

FINAL

Evaluation of the Texas Vehicle Emissions Inspection and Maintenance Program in the Dallas-Fort Worth and Houston-Galveston- Brazoria Nonattainment Areas

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Prepared by:

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**EVALUATION OF THE TEXAS VEHICLE EMISSIONS INSPECTION AND
MAINTENANCE PROGRAM IN THE DALLAS-FORT WORTH AND HOUSTON-
GALVESTON-BRAZORIA NONATTAINMENT AREAS**

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OVERVIEW

Eastern Research Group, Inc. (ERG) performed this biennial evaluation for the Texas Commission on Environmental Quality to assess the effectiveness of the vehicle inspection and maintenance program in the Dallas-Fort Worth and Houston-Galveston-Brazoria nonattainment areas. The program evaluation methodology followed the recommended U.S. Environmental Protection Agency guidance procedures. Results of the assessment and specific recommendations for the program have been provided for future consideration.

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EXECUTIVE SUMMARY

This report documents the evaluation of the Texas Vehicle Emissions Inspection and Maintenance (I/M) program for the 2024 and 2025 biennial period. Eastern Research Group, Inc. (ERG) performed this evaluation for the Texas Commission on Environmental Quality (TCEQ) using the Texas Information Management System (the TIMS) database and Remote Sensing (RS) data from January 1, 2024, through December 31, 2025.

This evaluation generally follows the U.S. Environmental Protection Agency (EPA) draft guidance on using in-program data for the evaluation of the Texas I/M program performance [EPA, 2001]¹ and EPA guidance on the use of RS for the evaluation of I/M program performance [EPA, 2004]. This study focuses on program coverage, the inspection process, and the repair process.

Overall, the program was found to meet evaluation requirements. However, ERG found that improvements could be made in a few areas, and a list of specific recommendations for improvements to the program is provided in the Recommendations section of this Executive Summary, including recommendations intended to make the results more reflective of overall program performance in future biennial evaluations.

Coverage

Participation Rates (Section II) – The results of the coverage analysis using out-of-program RS data revealed a consistent, high rate of participation in the Texas I/M program. Program participation rates were estimated by determining the fraction of vehicles seen on the road in I/M regions during RS studies that had recent records in the TIMS. This analysis found that in the Dallas-Fort Worth (DFW) program area, the participation rate was 89.95% in 2024 and 92.87% in 2025. In the Houston-Galveston-Brazoria (HGB) program area, the 2024 and 2025 participation rates were 90.43% and 93.18%, respectively. The overall program participation rates were 90.24% in 2024 and 93.08% in 2025.

Inspection

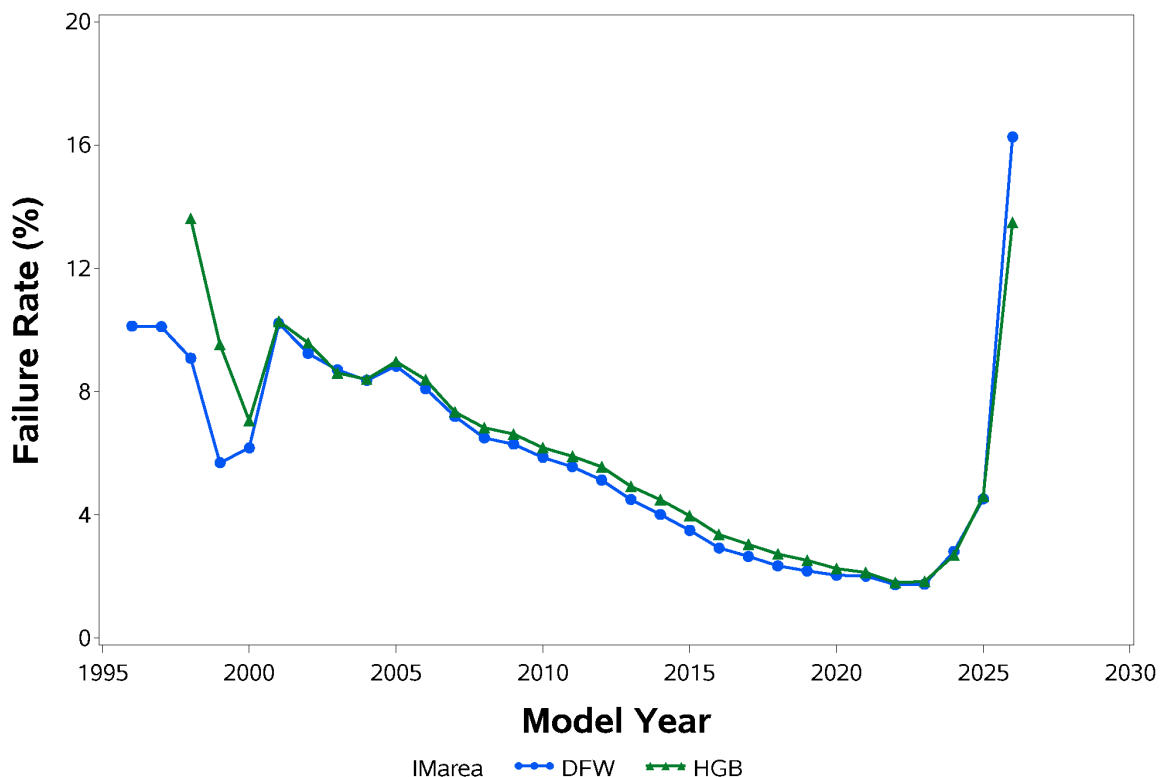
Appropriateness of Major Fields in the TIMS database (Section III.A) – The TIMS data were used to evaluate the Texas I/M program inspection process. As part of this evaluation, ERG assessed the major fields in the TIMS using a series of basic data quality checks to assess the accuracy and completeness of the dataset. ERG produced frequency distributions for nearly all database variables to identify in-range values,

¹ Citations for references are given in Section VII.

out-of-range values, and missing values. The major findings from this analysis are summarized below.

Inspection Statistics (Section III.B) – Analysis of the TIMS data indicates that during the biennial evaluation period, over 19.9 million On Board Diagnostic (OBD) tests were performed on model year 1996 and newer light-duty passenger cars and trucks, resulting in over 8.5 million unique vehicle OBD tests. The DFW and HGB program areas initial inspection failure rates were similar and are illustrated in the figure below. Vehicles with model years older than 2000 and newer than 2023 were not subject to the program during the inspection period, as such they are primarily volunteer tests. In calendar year 2024, vehicles 2000-2022 were subject to the program, and in calendar year 2025, vehicles 2001-2023 were subject to the program, so vehicles of model years 2000-2023 were subject to inspections during the reporting period, along with vehicles less than two years old but with more than 50,000 miles undergoing resale in the program areas.

Figure ES-1. Initial Inspection Failure Rates by Model Year and I/M Program Area



Repeat I/M Failure Patterns (Section III.C) – ERG examined the TIMS data to determine the relative frequencies of the I/M pass/fail patterns during each vehicle’s inspection cycle.

In 99.5% of test sequences, either a verified initial test or an initial test that could reasonably be assumed to be a true initial test was confirmed, with an associated final test identified.

OBD Inspection Analyzer Communication Performance (Section III.D) – Overall, OBD communication rates between vehicle control modules and program analyzers were 99.55%. During this biennial period, however, a notable shift was observed in tests in which the data link connector (DLC) was reported as damaged, inaccessible, or not found: the proportion attributed to the “Other” manufacturer category increased substantially compared to the previous biennial period, rising from 0.04% to 18.63%. Investigation of the records suggest these were light-duty vehicles (LDVs) tested as heavy-duty vehicles (HDVs) to avoid OBD testing requirements. Although this is a small overall change (18.63% of 0.45% of tests), we recommend TCEQ and the Texas Department of Public Safety (DPS) implement additional safeguards to minimize this potential test fraud.

The TIMS’ Handling of OBD Codes (Section III.E) – The OBD inspection logic used in Texas for gasoline-powered LDVs appears to align with EPA policies. In the limited cases where inconsistencies were identified, it’s possible they resulted from minor oversights, such as operator error or analyzers temporarily operating without the latest software update, affecting only a small percentage of inspections.

Repair

Number and Types of Repairs (Section IV.A) – During the evaluation period, analysis of the TIMS data indicated that 72,624 repairs were made to vehicles to bring them into compliance with the Texas I/M program. The program requires reporting repair types according to five categories: fuel system, ignition electrical system, emissions system, engine mechanical, and miscellaneous. The fractions of total repairs in these five categories were approximately 36%, 7%, 15%, 2%, and 40%, respectively.

OBD Repair Effectiveness (Section IV.B) – ERG’s analyses indicate that approximately 75% of OBD tests that initially fail due to an illuminated malfunction indicator light (MIL) with stored diagnostic trouble codes (DTCs) eventually receive a passing inspection. Within that cohort, approximately 64% of the MIL-On failures passed with confirmed repairs and their monitors reset, and approximately 11% passed after being repaired but without monitors being reset. As seen in the earlier studies, when evaluating repairs by failure category (i.e., evaporative emissions control system, oxygen (O₂) sensor, exhaust gas recirculation (EGR) system, air injection system, and catalytic converter), unset readiness monitors were seen to potentially “hide” malfunctions in 1.5% to 25% of “repaired” vehicles. This large range is consistent with findings from previous program evaluations and reflects the uncertainty in identifying cases where unset readiness monitors are masking MIL illumination in repaired vehicles.

Average Repair Costs (Section IV.C) – After excluding records with zero-cost entries and those exceeding \$2,000, analysis of the TIMS’ repair cost data indicates that Texas motorists spent approximately \$3.7 million on 21,000 repairs during the evaluation period to meet Texas I/M program requirements. It is important to note that repair cost data are manually entered by vehicle emissions inspectors, which may introduce transcription errors.

Consistent with prior studies, a substantial share of the TIMS’ repair records (68.1%) report zero cost. Excluding zero-cost entries and costs exceeding \$2,000, the remaining data indicate median repair costs ranging from \$25 to \$299, and mean costs ranging from \$82 to \$415.

I/M Emissions Benefits

The annual emissions benefit of an I/M program (I/M benefit) is typically measured as the reduction in emissions achieved when high-emitting vehicles are identified and repaired through the program. In this analysis, the annual I/M benefit was estimated by comparing RS emissions measured before and after the I/M test (comprehensive method) and by comparing RS emission levels between “in-program” vehicles and “out-of-program” vehicles (reference method).

Calculation of the Annual I/M Benefit using the Comprehensive Method (Section V.B) – Program benefits were estimated by comparing average RS emissions measured 30 to 90 days prior to I/M inspections with those measured one to 90 days following inspection. Approximately 96% of vehicles with RS measurements passed their initial inspection, while 3.8% exhibited a Fail-Pass I/M test sequence. Vehicles that passed the initial inspection showed a slight RS increase in hydrocarbon (HC), carbon monoxide (CO), and nitrogen oxides (NO_x) emissions from the pre- to post-inspection period. In contrast, vehicles with a Fail-Pass sequence generally exhibited declining emissions for HC, CO, and NO_x at or immediately following the I/M inspection, although some model year groups showed little to no change across the same period.

Calculation of the Program Benefit using the Reference Method (Section V.C) – Vehicles observed by RS were divided into two groups: vehicles that have never been in the I/M program prior to the RS observation (non-I/M vehicles), and vehicles that have been in the I/M program prior to the RS observation (I/M vehicles). Data from the four-year period preceding the 2024/2025 analysis years were used to ensure a sufficiently large sample size for comparison between the I/M fleet and non-I/M fleet. Fleet average emissions for the two groups were then plotted by vehicle model year, showing that emission averages for each pollutant were strongly dependent on model year. HC emissions in the non-I/M fleet were generally similar to those in the I/M fleet, with minor variations by model year, while the non-I/M fleet had substantially higher NO_x emissions than the I/M fleet, indicating that the program’s strongest impact during the biennial period was in reducing NO_x.

Measures for Evaluating Station Performance

(Section VI) – This section strives to consolidate the analyses performed that pertain to the evaluation of station performance. Non-compliance with program criteria is broken into two categories: non-compliance in the conduct of the OBD inspection, and non-compliance with the overall inspection process. Non-compliant OBD inspection processes might be observed through a mismatch between the Vehicle Identification Number (VIN) and the electronic VIN (eVIN), a missing eVIN, an electronic profile mismatch from between an initial inspection and a retest inspection, or a downloaded communications protocol that does not match that expected for the vehicle. Non-compliance with the overall inspection process could be identified by retest inspections that occur in a very short time following a failed initial test, retest inspections for a vehicle that was initially tested as a LDV is retested as a HDV, or identifying stations with exceptionally high or low failure rates.

In the benign case, any of these types of discrepancies are basically random and could be due to wide variety of inspection issues. In a highly suspicious case, when the same type of discrepancy is repeatedly found at a given station, factors other than random chance may be suspected.

For each type of potential inspection non-compliance, stations were evaluated against the associated list of indicators, and a percentage rank was assigned based on their performance. Ranking stations for each indicator enables comparisons across indicators, even when those indicators yield different types of results. The final results consist of a compilation of each station's rankings across all indicators of potential inspection fraud.

It was observed during the period of evaluation that the key on, engine off (KOEO) MIL bulb check now appears to be 100% enforced (i.e., no tests were found with an inspector-entered MIL bulb check disposition of "F"), and it was also observed that the number of OBD "pass" results issued with the MIL commanded on and stored emissions-related DTCs has decreased since the prior evaluation period. Additional details are presented in Section III.E.

In the current evaluation period, it was notable that the rates of OBD-related inspection fraud were much lower than the corresponding rates in the 2024 I/M Evaluation [ERG, 2024]. While some stations still exhibited high rates of performing potentially fraudulent inspections, there were far fewer stations doing so, as compared to the previous evaluation period. This was particularly evident in the rates of missing eVINs, and the mismatches in communication protocols. This improvement may be related to the program improvements that were made during the period of evaluation, as noted in Section F, below.

Program Improvements

Several improvements were made to the I/M program over the period of evaluation in order to improve program compliance, efficiency, and effectiveness.

On January 1, 2025, the safety inspection component of the program was discontinued across the state for all non-commercial vehicles. Vehicles not subject to an emissions inspection are no longer required to receive a state vehicle inspection. This cessation eliminated the opportunity for an inspector to convert from an emissions inspection to a safety inspection for vehicles that have failed the emissions (OBD) component of their test.

From March through October 2025, an enhanced enforcement effort was implemented sequentially through all I/M counties that allows for a vehicle emissions inspection to fail in real-time if specific OBD characteristics suggest fraud may be occurring.

During the period of evaluation, Texas also implemented another enhanced enforcement effort that can be applied when data patterns suggest non-compliant inspector test procedures. The root cause of the test data issue(s) can then be investigated.

Beginning on July 1, 2025, Texas eliminated most dealer-issued temporary vehicle tags to eliminate counterfeit paper tags. With few exceptions, dealers are now required to issue metal tags at the point of sale, and electronic title and registration processing must now be performed by the dealer through an online portal established by the state. These moves target both registration and inspection fraud.

Forward-Looking Recommendations

As part of this biennial evaluation of the Texas I/M program, ERG developed a list of forward-looking recommendations for TCEQ's consideration. Consistent with previous biennial evaluation reports, most of these recommendations are intended to improve the program, while some are intended to enhance future biennial I/M program evaluations. For each recommendation, ERG assigned an importance rating of High (***), Medium (**), or Low (*). These ratings are intended to assist TCEQ in prioritizing efforts to improve and enhance the Texas I/M program and future biennial evaluations.

OBD Recommendations

OBD Recommendation 1 (*): Investigate requiring a “set” status for certain monitors to prevent hiding malfunctions.** Our analysis found that in 1.5% to 25% of instances when a vehicle received an initial fail for a certain monitored component, the retest OBD result, which follows a repair, could be hidden by an “unset” readiness status for that monitor. This opens the possibility that malfunctioning emissions control components could remain unrepaired even though the follow-up OBD test

received a “pass.” ERG recommends that TCEQ consider implementing a software change that would require certain monitors to have a “set” readiness status on an OBD retest that follows certain types of initial failures. For example, if the prior failure was a catalyst failure, then the catalyst monitor could be required to be “ready” upon retest for a pass (along with the overall “not ready” limits). Similar readiness requirements for the other monitors that are typically slow to complete, including the evaporative emissions control system monitor, the exhaust gas recirculation monitor, and the O₂ monitor, could also be added. This would help ensure that effective repairs were implemented and emission faults are not masked by readiness.

OBD Recommendation 2 (): Monitor Switching Failed Light-Duty Vehicle OBD test to Heavy-Duty Vehicle.** ERG investigated whether switching a vehicle from having a light-duty gross vehicle weight rating (GVWR) less than or equal to 8,500 pounds (lbs.) to a heavy-duty GVWR was ever used to manipulate emissions inspection results. The vehicle GVWR is an inspector-entered field in the inspection record. Overall, it was found that only 1.3% of inspections (about 8,000 inspections) that were initially failed as an LDV were followed by a passing retest as a heavy-duty vehicle (HDV). However, these inspections were clustered at a handful of stations, and at the 10 highest ranking stations this was done for 12% – 100% of retests. ERG suggests adding a software check in the system that requires the inspector to verify the change in GVWR if it is greater than 10% of the value entered for the original test, or some other suitable flag to discourage this behavior. ERG also notes that switching from LDV to HDV on retest happened 1,600 times in 2024, and 8,000 times in the current evaluation period. It may be useful to monitor non-OBD forms of inspection fraud, following the software improvements that now prevent much of the I/M test fraud. Ensuring the test being performed is appropriate for the vehicle will improve program compliance and emissions reductions.

OBD Recommendation 3 (*): Consider Diesel and Heavy-Duty Gasoline OBD Testing. Per EPA guidance, Texas does not perform testing on OBD-equipped HDVs. Furthermore, legislative action would be required to grant TCEQ the authority to test these vehicles. However, this topic continues to be discussed in the I/M community and California implemented an HDV diesel I/M program in 2023. Other states are also exploring the possibility of adding an HDV component to their I/M program; therefore, ERG suggests TCEQ stay abreast of any developments in this area. Including these vehicles in the program would help reduce excessive emissions from heavy-duty gasoline-powered vehicles.

OBD Recommendation 4 (*): Resolve Key-On-Engine-Running Discrepancies. The MIL Illumination Status appears to be well enforced as a condition for OBD failure as no inspections were recorded with a MIL Illumination Status of “N” and an overall OBD result of “P.” However, the Key-On-Engine-Running (KOER) MIL Illumination Status is manually entered by the inspector, and the accuracy of this entry is not automatically enforced by the analyzer. In this analysis there were 178,219 inspections with a “pass”

result that was manually entered when the downloaded MIL status indicated a “fail” result, and a “fail” result was entered 7,746 times when the MIL status indicated a “pass” result. Therefore, TCEQ may want to consider a specification change where passing MIL Status (downloaded MIL command status with no emissions-related DTCs) would result in a passing OBD result despite a KOER result of fail. This could improve customer satisfaction through the reduction of false failures.

OBD Recommendation 5 (*): Collect Additional OBD Data. TCEQ may want to explore collecting additional OBD data that may now be available such as permanent DTCs, in-use performance ratios, pending DTCs, fuel consumption, run time, and traveled distance. These updates could be rolled into software updates that will be required for the upcoming OBDOnUDS (SAE J1979-2) OBD protocol. Collecting these additional data could help ensure no emissions-related malfunctions are hidden in tested vehicles.

RS Recommendations

RS Recommendation 1 (): Collect RS data in Bexar County.** In the 2009 Report [ERG, 2009], ERG was able to use RS data from Bexar County to analyze the DFW/HGB RS fleet data using the Reference Method. The Reference Method for evaluating I/M programs compares RS readings from a non-I/M area like Bexar County to the RS readings from an I/M area to identify trends and calculate effectiveness of implementing an I/M program. If possible, efforts should continue to obtain RS data from a non-I/M area for future evaluations, in particular since Bexar County will soon become an I/M area. Collecting this data can help improve future program emissions benefit analysis.

I. INTRODUCTION

The purpose of this report is to fulfill a federal requirement to evaluate the effectiveness of the Texas I/M program operating in the DFW and HGB areas. Title 40 of the Code of Federal Regulations (CFR) §51.353(c), Network Type and Program Evaluation, requires all states subject to an enhanced I/M program to evaluate the effectiveness of their program and submit a program evaluation report to EPA every two years. The last program evaluation report for TCEQ was issued on June 21, 2024, for the DFW and HGB areas. These two areas are subject to biennial evaluations since they are within the enhanced program region, and this report will cover these program areas. The Austin-Round Rock Area and El Paso County areas of the program are not enhanced and therefore, are not included in this evaluation.

The DFW and HGB enhanced I/M program was implemented on May 1, 2002, by TCEQ and DPS. This program incorporated vehicle emissions inspections using OBD computer testing and Acceleration Simulation Mode (ASM) dynamometer testing in Collin, Dallas, Denton, and Tarrant Counties of the DFW area and Harris County of the HGB area. In May 2003, the enhanced I/M program was expanded to include Ellis, Johnson, Kaufman, Parker, and Rockwall Counties of the DFW area, and Brazoria, Fort Bend, Galveston, and Montgomery Counties of the HGB area. On January 1, 2020, the ASM test was eliminated from the program and now only OBD testing is performed on model year 1996 and newer vehicles, although 1996-1999 vehicles were aged out of I/M testing during the period of evaluation.

Beginning in 2004, TCEQ contracted with ERG to research options for evaluating the DFW and HGB I/M program, and as a result, ERG developed the Texas I/M Program Evaluation Plan [ERG, 2004]. The Plan detailed numerous potential methods and metrics for evaluating the Texas I/M program. In coordination with ERG, TCEQ selected a set of metrics that provide qualitative and quantitative assessments of the four major evaluation elements as described in EPA's "*Guidance on Use of In-Program Data for Evaluation of I/M Program Performance*", along with several metrics that assess actual emissions benefits, as described in the Texas I/M Program Evaluation Plan and EPA's "*Guidance on Use of Remote Sensing for Evaluation of I/M Program Performance*". This evaluation is required to be conducted in accordance with TCEQ-selected metrics.

I.A. Evaluation Analysis Approach

The federal Clean Air Act requires that states evaluate their I/M programs every two years. The Sierra Method was initially used to evaluate the Texas I/M program in 2000 [ERG, 2003], and later ERG used the updated EPA guidance [EPA, 2001, EPA, 2004] as a framework for the evaluation performed in 2006 [ERG, 2006]. Since then, ERG performed evaluations in 2009 [ERG, 2009], 2012 [ERG, 2012], 2014 [ERG, 2014], 2016

[ERG, 2016], 2018 [ERG, 2018], 2020 [ERG, 2020], 2022 [ERG, 2022] and 2024 [ERG, 2024], all building upon the original approach as used in the 2006 Report.

This 2026 report follows the same general methodology, analyzing and evaluating data to assess program coverage, the vehicle inspection process, the vehicle repair process, program air quality benefits, and station performance. These focus areas were selected to provide the most useful information at a reasonable cost, while also offering an objective assessment of the overall status of the Texas I/M program, with the intent of identifying both areas for improvement and areas that are performing well.

I.B. Structure of the Report

This report follows the same outline as the Texas I/M program's previous biennial evaluation reports.

Section II provides an assessment of program coverage by comparing vehicle license plates collected during RS measurements with vehicles recorded in the TIMS database.

Section III presents the results of an evaluation of the inspection process using the TIMS data from the evaluation period. This includes reviewing data fields for appropriateness, counting and analyzing failure patterns, and examining OBD communication rates and test outcomes.

Section IV analyzes the TIMS data with a focus on the repair activity, examining the types, costs, and success rates of repairs, using OBD readiness and diagnostic data.

Section V provides emissions benefit estimates based on RS data.

Section VI presents a detailed analysis of station performance based on the TIMS data. This section covers a variety of inspection details that could indicate that fraudulent inspections are being performed, such as “clean-scanning” with the eVIN missing or not matching the VIN of record, and other anomalous test results.

II. COVERAGE

An important component of an I/M program is the level of fleet coverage, or the vehicle compliance rate. In this section, coverage is evaluated by estimating the fraction of vehicles observed on the road using RS data that also have a current and valid Texas record in the TIMS data.

Estimates of the participation rate of vehicles subject to I/M in the DFW program area and in the HGB program area were made through a comparison of RS data and the TIMS data. The RS data provide a sample of vehicles that were driven on the road, and if these vehicles were eligible for I/M, they should have an I/M test record in the TIMS database.

To perform this analysis, ERG first created a dataset of I/M-eligible vehicles captured on the road by RS at least once during the biennial period. To create this dataset, RS data were merged with Texas registration records by license plate. This dataset excludes out-of-state vehicles and those registered in non-I/M counties and includes I/M-eligible model years. Therefore, vehicles newer than two years and older than 24 years, at the time of the RS measurement, were excluded from the analysis. Table II-1 shows the counts of unique I/M-eligible vehicles from the DFW or HGB program areas that were measured by RS between January 1, 2024, and December 31, 2025.

Table II-1. Count of Unique I/M-Eligible RS Vehicles Registered in Texas I/M Program Areas by Calendar Year

I/M Registered Area at Time of RS	Unique RS-Captured Vehicles by Calendar Year		
	2024	2025	Total
DFW	148,743	126,306	275,049
HGB	220,749	287,747	508,496
Total	369,492	414,053	783,545

Next, the number of unique I/M-compliant vehicles (i.e., vehicles that were tested and ultimately passed or received a waiver) in each of the Texas I/M program areas during that same time frame was determined. Table II-2 shows the overall counts for the I/M tests in the DFW and HGB program areas.

Table II-2. Count of Unique I/M-Compliant Vehicles in Texas I/M Program Areas

I/M Area where Test Performed	Unique I/M-Tested Vehicles	
	2024	2025
DFW	4,690,649	4,724,948
HGB	4,082,290	4,291,024
Total	8,772,939	9,015,972

The I/M tests were then matched to the RS/registration dataset by VIN. If an I/M test occurred any time between January 1, 2024, and December 31, 2025, and was found to have a corresponding VIN with a RS measurement taken any time during the same period, this was a matched pair. Table II-3 summarizes these results for the DFW and HGB program areas. These I/M tested matched pair values were then divided by their respective I/M eligible values for each program area in Table II-1 to obtain an estimate for the Texas I/M program participation rate (e.g., in 2024, the DFW program area participation rate was calculated as 92.8% (117,296/126,306 x 100)). Table II-3 shows that the participation rate did increase slightly overall from 2024 to 2025.

Table II-3. Count of Unique I/M Eligible RS Vehicles Paired with Unique I/M-Compliant Vehicles in Texas I/M Program Areas by Calendar Year

I/M Program Area where Test Performed	Paired RS and the TIMS' VIN Matches		Participation Rate	
	2024	2025	2024	2025
DFW	133,796	117,296	89.95%	92.87%
HGB	199,633	268,117	90.43%	93.18%
Total	333,429	385,413	90.24%	93.08%

III. INSPECTION

III.A. Check Major Data Fields for Appropriateness

The goal of this section was to analyze the ranges and values of the primary variables that make up the TIMS database. This analysis provides an indication of the ability of the Texas I/M program's analyzers and database system to accurately record the activities of the Texas I/M program. Any variables with missing or out-of-range values for unexplained reasons may be indications that the Texas I/M program activities are not being conducted properly or monitored adequately.

An iterative series of steps was used to evaluate the accuracy and completeness of the data in the database. Within the database, each record or row was a test entry that contained columns of variables or data fields. The first set of basic filters applied was to remove unusual or incomplete inspections from the dataset (e.g., aborted inspections, covert audits, etc.). Then, a frequency distribution was performed on nearly all database variables to evaluate the accuracy and completeness of data fields (excluding variables with unique information for each record, such as those for VIN, license plate, or test date, and excluding variables not relevant to this analysis such as TX96_STIK_COND, TX96_INSUR_CONFIRM, or TX96_SOFTWARE_VERSION). Additional records with obvious problems were tallied and removed from the dataset, such as invalid/undefined characters stored for a coded categorical variable. Finally, combinations of variables were evaluated for consistency. These steps are described in detail below.

III.A.1 Initial filters and frequency distributions

The following criteria were used to delete records from the full database containing approximately 26.8 million inspection records to get a set of successful inspections. This deletion covered:

- Out-of-area inspections (not from DFW or HGB areas);
- Aborted inspections (TX96_ABORT = "J", "A");
- Safety-only or visual-only inspections (TX96_TEST_TYPE="H", "P");
- Inspections that were covert audits (TX96_covert_FL not "N");
- Out-of-program model years, older than 2002 or newer than 2024;
- Inspections with invalid VINs, either fewer than 17 characters, including invalid characters (such as "!", "@", etc.), or flagged (TX96_VIN_FL= "B"); and
- Any remaining inspections with TX96_TEST_SEQUENCE less than 1.

In total, these deletions removed about 6.9 million records from the dataset (mostly for safety-only inspections and out-of-area inspections), leaving about 19.9 million potentially valid emissions inspections in the dataset.

Almost every database variable that stores a categorical result was checked for completeness and appropriateness of information. As mentioned above, variables such as TX96_STIK_COND, TX96_INSUR_CONFIRM, or TX96_SOFTWARE_VERSION that have little relevance to emissions inspection impacts are examples of those that were ignored. Most of the variables in the dataset contained the expected information, but after the record deletions described above, a few variables that still contained anomalous information included:

- 4,161 records with an overall inspection cost greater than \$100 (TX96_OVERALL_COST>100);
- 231 records with a repair cost greater than \$2,000 (TX96_REP_OVERALL_COST>2000); and
- Various other variables that had a small number of missing value results or otherwise odd results that did not appear to be significant.

The anomalous records described in the list above were counted and listed but were not deleted from the dataset. Most of the anomalies were investigated, and the results of those investigations are discussed in further detail in other areas of the report.

III.B. Inspection Statistics: Number of Vehicles Inspected

To provide a basic overview of emissions inspections under the Texas I/M program, several inspection statistics were calculated. Because the Texas I/M program now relies exclusively on OBD inspections, only this inspection type is reported; the ASM and two-speed idle (TSI) tailpipe inspections have been phased out. Guidance from EPA's Office of Transportation and Air Quality (OTAQ) requires detailed reporting of inspection results by model year, vehicle type, and final inspection result; consequently, the following tables are substantially larger than those presented in I/M evaluation reports from 2020 and earlier.²

Table III-1 presents the inspection statistics for passenger cars in the DFW area. The table includes results for all vehicles tested, beginning with the initial inspection, and continuing through the final disposition of those initial inspections, categorized as either a pass, a waiver, or a vehicle with no known final outcome. The first column on the left counts every inspection in the dataset for the two-year period. This includes two annual inspections for most of the vehicles, as well as any retests needed to pass the inspection after initially failing it. The total number of initial inspections is provided in the second column. A vehicle may appear twice in this column (once for an initial inspection in 2024, and once for an initial inspection in 2025), but no more than twice, as retests are not included. The first two columns are provided for use by TCEQ; they are not required by OTAQ guidance. The information requested by OTAQ begins

² "Guidance on Vehicle Inspection and Maintenance (I/M) Test Data Statistics as Part of Annual I/M Reporting Requirements", EPA OTAQ Transportation and Climate Division, May 2020, EPA-420-B-20-033.

at the third column, the number of inspections of unique vehicles. This includes only one count per VIN, i.e., one count for every unique vehicle in the Texas I/M fleet. The columns to the right of that third column continue to subdivide the count of unique vehicles according to their test disposition.

Table III-2 shows the same information for light trucks in DFW. Table III-3 and Table III-4 show the same information for the HGB area. Overall, there were 19.9 million total inspections performed with over 8.5 million total unique inspections.

Table III-1. Number of Inspections for DFW Passenger Cars

Model Year	Total Tests	Total Initial Tests	Total Tested Unique Veh.	Divide Total Tested Vehicles into:		Divide Initially Failing Unique Vehicles into:					
				Initial Pass	Initial Fail	Initial Fail / Ultimate Pass		Initial Fail / Waiver		Initial Fail / No Final Outcome	
						Num.	Pct.	Num.	Pct.	Num.	Pct.
1996*	129	126	104	91	13	1	7.7%	0	0.0%	12	92.3%
1997*	187	183	156	137	19	1	5.3%	0	0.0%	45	75.0%
1998*	385	380	269	247	22	3	13.6%	0	0.0%	119	26.7%
1999*	829	815	538	492	46	6	13.0%	0	0.0%	153	16.3%
2000	14,144	13,144	7,454	6,435	1,019	750	73.6%	3	0.3%	194	13.8%
2001	29,556	26,293	11,687	9,696	1,991	1,583	79.5%	10	0.5%	346	15.5%
2002	38,238	34,155	14,914	12,524	2,390	1,958	81.9%	11	0.5%	348	14.0%
2003	48,662	43,721	19,074	16,242	2,832	2,375	83.9%	10	0.4%	399	14.0%
2004	57,938	52,406	22,368	19,208	3,160	2,672	84.6%	14	0.4%	415	13.1%
2005	77,010	69,967	29,593	25,679	3,914	3,315	84.7%	8	0.2%	512	13.0%
2006	96,514	88,345	37,474	32,878	4,596	3,858	83.9%	25	0.5%	571	12.4%
2007	127,788	118,085	49,194	43,761	5,433	4,713	86.7%	17	0.3%	599	11.8%
2008	138,408	128,803	53,629	48,168	5,461	4,768	87.3%	11	0.2%	532	10.4%
2009	126,251	117,961	48,565	43,897	4,668	4,042	86.6%	12	0.3%	408	9.6%
2010	156,792	146,804	60,753	55,228	5,525	4,827	87.4%	9	0.2%	521	10.9%
2011	168,394	157,917	64,830	59,049	5,781	5,117	88.5%	11	0.2%	548	10.9%
2012	240,922	226,606	92,703	84,931	7,772	6,845	88.1%	11	0.1%	657	10.0%
2013	290,196	274,792	112,705	104,280	8,425	7,501	89.0%	13	0.2%	697	9.9%
2014	310,656	296,474	120,661	112,772	7,889	7,016	88.9%	10	0.1%	646	9.7%
2015	343,211	327,943	133,945	125,573	8,372	7,538	90.0%	2	0.0%	693	10.1%
2016	331,736	318,679	130,463	123,387	7,076	6,292	88.9%	12	0.2%	559	9.6%
2017	326,503	314,747	129,666	123,124	6,542	5,850	89.4%	5	0.1%	576	10.8%
2018	298,065	288,648	118,742	113,387	5,355	4,760	88.9%	6	0.1%	508	11.1%
2019	279,310	270,970	112,005	107,245	4,760	4,207	88.4%	1	0.0%	500	11.4%
2020	239,719	233,111	96,644	92,858	3,786	3,357	88.7%	0	0.0%	499	12.1%

Model Year	Total Tests	Total Initial Tests	Total Tested Unique Veh.	Divide Total Tested Vehicles into:		Divide Initially Failing Unique Vehicles into:					
				Initial Pass	Initial Fail	Initial Fail / Ultimate Pass		Initial Fail / Waiver		Initial Fail / No Final Outcome	
						Num.	Pct.	Num.	Pct.	Num.	Pct.
2021	217,863	212,545	86,817	83,547	3,270	2,880	88.1%	0	0.0%	486	17.2%
2022	213,161	208,833	100,990	97,889	3,101	2,612	84.2%	2	0.1%	123	34.4%
2023	136,110	134,063	115,069	112,811	2,258	1,747	77.4%	0	0.0%	54	47.4%
2024	35,108	34,574	32,431	31,663	768	476	62.0%	0	0.0%	1	9.1%
2025**	9,690	9,529	9,172	8,892	280	140	50.0%	0	0.0%	1	9.1%
2026**	214	204	184	173	11	9	81.8%	0	0.0%	1	9.1%
Total	4,353,689	4,150,823	1,812,799	1,696,264	116,535	101,219	86.9%	203	0.2%	11,723	10.1%

* Vehicles older than model year 2000 are not subject to the program. These are voluntary tests.

** Inspections are required for resale of vehicles less than 2 years old with more than 50,000 miles.

Table III-2. Number of Inspections for DFW Light Trucks

Model Year	Total Tests	Total Initial Tests	Total Tested Unique Veh.	Divide Total Tested Vehicles into:		Divide Initially Failing Unique Vehicles into:					
				Initial Pass	Initial Fail	Initial Fail / Ultimate Pass		Initial Fail / Waiver		Initial Fail / No Final Outcome	
						Num.	Pct.	Num.	Pct.	Num.	Pct.
1996*	171	169	146	137	9	1	11.1%	0	0.0%	8	88.9%
1997*	357	351	293	273	20	2	10.0%	0	0.0%	18	90.0%
1998*	452	443	358	334	24	5	20.8%	0	0.0%	19	79.2%
1999*	1,615	1,578	1,104	1,056	48	18	37.5%	0	0.0%	30	62.5%
2000	28,874	27,021	15,347	13,799	1,548	1,229	79.4%	1	0.1%	318	20.5%
2001	71,055	63,708	26,711	23,134	3,577	3,085	86.2%	13	0.4%	479	13.4%
2002	86,216	78,071	32,051	28,157	3,894	3,413	87.6%	10	0.3%	471	12.1%
2003	98,834	90,104	37,126	32,901	4,225	3,724	88.1%	11	0.3%	490	11.6%
2004	117,745	107,529	43,843	38,828	5,015	4,418	88.1%	19	0.4%	578	11.5%
2005	117,715	106,668	43,556	38,563	4,993	4,450	89.1%	14	0.3%	529	10.6%
2006	127,465	116,449	47,287	42,280	5,007	4,468	89.2%	13	0.3%	526	10.5%
2007	172,446	158,525	64,038	57,603	6,435	5,794	90.0%	12	0.2%	629	9.8%
2008	177,737	164,426	65,128	58,879	6,249	5,594	89.5%	11	0.2%	644	10.3%
2009	107,541	99,470	39,635	35,811	3,824	3,400	88.9%	4	0.1%	420	11.0%
2010	152,821	142,042	56,222	51,158	5,064	4,576	90.4%	14	0.3%	474	9.4%
2011	194,746	182,020	71,707	65,815	5,892	5,319	90.3%	8	0.1%	565	9.6%
2012	209,893	197,295	77,084	71,196	5,888	5,330	90.5%	7	0.1%	551	9.4%
2013	267,225	252,553	97,903	91,132	6,771	6,178	91.2%	10	0.1%	583	8.6%
2014	305,559	289,647	111,854	104,472	7,382	6,756	91.5%	3	0.0%	623	8.4%
2015	371,345	355,340	137,454	129,981	7,473	6,875	92.0%	2	0.0%	596	8.0%
2016	392,780	378,501	145,429	138,727	6,702	6,180	92.2%	11	0.2%	511	7.6%

Model Year	Total Tests	Total Initial Tests	Total Tested Unique Veh.	Divide Total Tested Vehicles into:		Divide Initially Failing Unique Vehicles into:					
				Initial Pass	Initial Fail	Initial Fail / Ultimate Pass		Initial Fail / Waiver		Initial Fail / No Final Outcome	
						Num.	Pct.	Num.	Pct.	Num.	Pct.
2017	447,020	432,294	166,636	159,696	6,940	6,351	91.5%	4	0.1%	585	8.4%
2018	472,259	458,155	174,669	168,062	6,607	6,023	91.2%	3	0.0%	581	8.8%
2019	511,261	497,028	191,515	184,709	6,806	6,196	91.0%	4	0.1%	606	8.9%
2020	466,930	455,198	173,477	167,731	5,746	5,180	90.1%	2	0.0%	564	9.8%
2021	492,146	479,592	178,404	172,375	6,029	5,398	89.5%	0	0.0%	632	10.5%
2022	423,396	414,464	172,704	167,977	4,727	4,138	87.5%	0	0.0%	589	12.5%
2023	244,394	240,355	196,791	193,130	3,661	2,896	79.1%	0	0.0%	765	20.9%
2024	52,665	51,692	47,311	46,176	1,135	772	68.0%	0	0.0%	363	32.0%
2025**	13,853	13,457	12,867	12,366	501	300	59.9%	0	0.0%	201	40.1%
2026**	473	448	376	354	22	19	86.4%	0	0.0%	3	13.6%
Total	6,126,989	5,854,593	2,429,026	2,296,812	132,214	118,088	89.3%	176	0.1%	13,951	10.6%

* Vehicles older than model year 2000 are not subject to the program. These are voluntary tests.

** Inspections are required for resale of vehicles less than 2 years old with more than 50,000 miles.

Table III-3. Number of Inspections for HGB Passenger Cars

Model Year	Total Tests	Total Initial Tests	Total Tested Unique Veh.	Divide Total Tested Vehicles into:		Divide Initially Failing Unique Vehicles into:					
				Initial Pass	Initial Fail	Initial Fail / Ultimate Pass		Initial Fail / Waiver		Initial Fail / No Final Outcome	
						Num.	Pct.	Num.	Pct.	Num.	Pct.
1996*	57	56	39	28	11	1	9.1%	0	0.0%	10	90.9%
1997*	128	121	89	65	24	3	12.5%	0	0.0%	21	87.5%
1998*	253	247	174	156	18	3	16.7%	0	0.0%	15	83.3%
1999*	684	664	476	425	51	15	29.4%	0	0.0%	36	70.6%
2000	11,067	10,272	6,102	5,426	676	437	64.6%	1	0.1%	238	35.2%
2001	26,602	23,526	11,294	9,573	1,721	1,360	79.0%	3	0.2%	358	20.8%
2002	34,344	30,538	14,285	12,222	2,063	1,729	83.8%	9	0.4%	325	15.8%
2003	43,494	38,978	18,000	15,619	2,381	1,955	82.1%	4	0.2%	422	17.7%
2004	50,469	45,420	20,745	18,055	2,690	2,212	82.2%	4	0.1%	475	17.7%
2005	68,092	61,527	27,626	24,198	3,428	2,900	84.6%	11	0.3%	518	15.1%
2006	86,031	78,244	34,934	30,810	4,124	3,430	83.2%	6	0.1%	688	16.7%
2007	112,679	103,463	45,619	40,843	4,776	4,121	86.3%	10	0.2%	645	13.5%
2008	121,918	112,294	49,082	44,165	4,917	4,261	86.7%	7	0.1%	649	13.2%
2009	112,587	104,156	44,725	40,557	4,168	3,684	88.4%	3	0.1%	482	11.6%
2010	136,492	126,929	54,099	49,238	4,861	4,252	87.5%	6	0.1%	603	12.4%
2011	145,054	135,008	57,342	52,199	5,143	4,506	87.6%	9	0.2%	629	12.2%

Model Year	Total Tests	Total Initial Tests	Total Tested Unique Veh.	Divide Total Tested Vehicles into:		Divide Initially Failing Unique Vehicles into:					
				Initial Pass	Initial Fail	Initial Fail / Ultimate Pass		Initial Fail / Waiver		Initial Fail / No Final Outcome	
						Num.	Pct.	Num.	Pct.	Num.	Pct.
2012	200,623	186,997	78,727	71,803	6,924	6,093	88.0%	13	0.2%	818	11.8%
2013	241,147	226,336	94,957	87,567	7,390	6,566	88.8%	5	0.1%	819	11.1%
2014	262,644	248,575	102,863	95,739	7,124	6,308	88.5%	9	0.1%	807	11.3%
2015	289,900	275,037	113,892	106,430	7,462	6,699	89.8%	8	0.1%	755	10.1%
2016	269,254	257,101	106,538	100,332	6,206	5,527	89.1%	2	0.0%	677	10.9%
2017	272,245	260,684	108,524	102,549	5,975	5,380	90.0%	6	0.1%	589	9.9%
2018	248,232	239,278	98,306	93,600	4,706	4,193	89.1%	1	0.0%	512	10.9%
2019	226,410	218,263	90,118	85,920	4,198	3,774	89.9%	7	0.2%	417	9.9%
2020	193,513	187,471	78,018	74,785	3,233	2,898	89.6%	4	0.1%	331	10.2%
2021	174,790	170,230	69,292	66,717	2,575	2,294	89.1%	1	0.0%	280	10.9%
2022	175,041	171,237	80,340	77,852	2,488	2,210	88.8%	0	0.0%	278	11.2%
2023	117,131	115,063	95,489	93,491	1,998	1,645	82.3%	0	0.0%	354	17.7%
2024	33,345	32,781	30,042	29,336	706	504	71.4%	0	0.0%	202	28.6%
2025**	8,229	8,026	7,716	7,465	251	171	68.1%	0	0.0%	80	31.9%
2026**	190	182	161	156	5	5	100.0%	0	0.0%	0	0.0%
Total	3,662,645	3,468,704	1,539,614	1,437,321	102,293	89,136	87.1%	129	0.1%	13,033	12.7%

* Vehicles older than model year 2000 are not subject to the program. These are voluntary tests.

** Inspections are required for resale of vehicles less than 2 years old with more than 50,000 miles.

Table III-4. Number of Inspections for HGB Light Trucks

Model Year	Total Tests	Total Initial Tests	Total Tested Unique Veh.	Divide Total Tested Vehicles into:		Divide Initially Failing Unique Vehicles into:					
				Initial Pass	Initial Fail	Initial Fail / Ultimate Pass		Initial Fail / Waiver		Initial Fail / No Final Outcome	
						Num.	Pct.	Num.	Pct.	Num.	Pct.
1996*	92	88	61	42	19	0	0.0%	0	0.0%	19	100.0%
1997*	199	193	140	118	22	6	27.3%	0	0.0%	16	72.7%
1998*	361	354	257	224	33	3	9.1%	0	0.0%	30	90.9%
1999*	1,188	1,144	823	761	62	19	30.6%	0	0.0%	43	69.4%
2000	24,236	22,624	13,646	12,471	1,175	844	71.8%	0	0.0%	331	28.2%
2001	66,375	59,800	26,421	23,274	3,147	2,615	83.1%	7	0.2%	525	16.7%
2002	82,440	74,614	31,983	28,406	3,577	3,086	86.3%	6	0.2%	485	13.6%
2003	93,419	85,409	36,729	33,053	3,676	3,177	86.4%	8	0.2%	491	13.4%
2004	110,581	101,023	43,369	39,067	4,302	3,740	86.9%	10	0.2%	552	12.8%
2005	115,304	104,197	44,044	39,553	4,491	3,888	86.6%	10	0.2%	593	13.2%
2006	131,887	120,017	49,983	45,191	4,792	4,213	87.9%	14	0.3%	565	11.8%
2007	172,554	158,695	66,697	60,789	5,908	5,212	88.2%	3	0.1%	693	11.7%

Model Year	Total Tests	Total Initial Tests	Total Tested Unique Veh.	Divide Total Tested Vehicles into:		Divide Initially Failing Unique Vehicles into:					
				Initial Pass	Initial Fail	Initial Fail / Ultimate Pass		Initial Fail / Waiver		Initial Fail / No Final Outcome	
						Num.	Pct.	Num.	Pct.	Num.	Pct.
2008	178,240	164,932	67,530	61,632	5,898	5,206	88.3%	13	0.2%	679	11.5%
2009	110,256	101,753	41,343	37,743	3,600	3,224	89.5%	3	0.1%	374	10.4%
2010	146,978	136,312	54,653	50,111	4,542	4,081	89.9%	5	0.1%	456	10.0%
2011	191,021	178,025	70,785	65,232	5,553	4,972	89.5%	12	0.2%	569	10.2%
2012	202,988	189,950	74,591	69,023	5,568	5,045	90.6%	7	0.1%	516	9.3%
2013	256,955	242,186	94,090	87,532	6,558	5,945	90.7%	6	0.1%	607	9.3%
2014	294,969	278,586	108,240	101,193	7,047	6,371	90.4%	7	0.1%	670	9.5%
2015	358,941	341,544	131,727	124,347	7,380	6,768	91.7%	4	0.1%	608	8.2%
2016	352,522	337,781	129,720	123,264	6,456	5,917	91.7%	2	0.0%	537	8.3%
2017	410,118	394,757	152,138	145,506	6,632	6,104	92.0%	7	0.1%	522	7.9%
2018	439,112	423,801	160,343	153,629	6,714	6,147	91.6%	3	0.0%	564	8.4%
2019	455,192	440,987	168,326	161,965	6,361	5,814	91.4%	4	0.1%	543	8.5%
2020	410,638	398,887	150,464	145,214	5,250	4,823	91.9%	2	0.0%	425	8.1%
2021	423,830	412,236	151,716	146,605	5,111	4,638	90.7%	3	0.1%	470	9.2%
2022	371,041	362,777	146,405	142,312	4,093	3,658	89.4%	1	0.0%	434	10.6%
2023	220,671	216,666	171,749	168,423	3,326	2,755	82.8%	0	0.0%	571	17.2%
2024	54,735	53,704	48,110	46,945	1,165	815	70.0%	0	0.0%	350	30.0%
2025**	12,690	12,344	11,713	11,269	444	256	57.4%	0	0.0%	190	42.6%
2026**	347	328	287	276	11	8	72.7%	0	0.0%	3	27.3%
Total	5,676,843	5,403,042	2,236,083	2,113,625	122,458	109,086	89.1%	137	0.1%	13,238	10.8%

* Vehicles older than model year 2000 are not subject to the program. These are voluntary tests.

** Inspections are required for resale of vehicles less than 2 years old with more than 50,000 miles.

Inspection counts by model year are presented in the figures below. Figure III-1 shows the number of inspections by model year for the DFW and HGB program areas. The dip in the number of inspections for the 2009 and 2010 model years is due to the recession and has been observed in previous reports. The number of inspections by month of inspection is shown in Figure III-2. Finally, the failure rate by model year is shown in Figure III-3 for the DFW and HGB program areas. Only initial inspections are included, and retests are excluded. As stated in the table footnotes, vehicles older than model year 2000 are exempt from testing, so these results are for voluntary tests. In general, the trends shown are as expected: more vehicles of newer model years are inspected than vehicles of older model years, and failure rates are considerably higher for older vehicles. The pass-fail rate increases for the 2024 and 2025 model years, with most of the failures for these vehicles attributable to readiness issues. This occurs because newer vehicles often have one or more non-continuous monitors reporting a status of “not ready.”

Figure III-1. Number of Inspections by Model Year and I/M Program Area

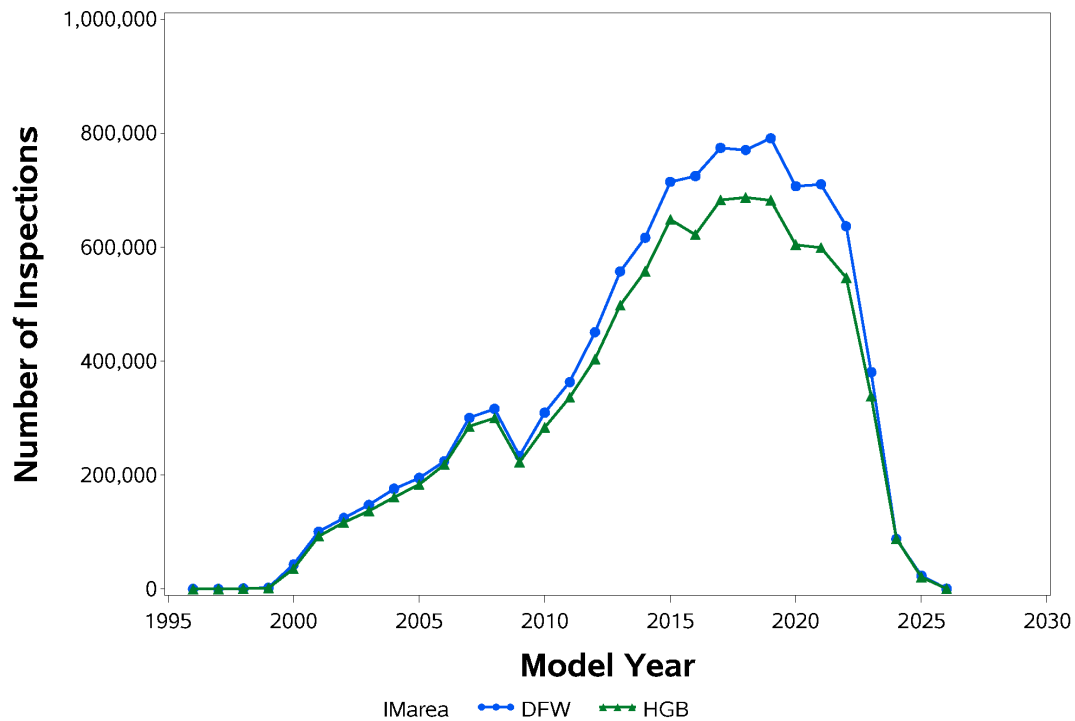


Figure III-2. Number of Inspections by Year and Month of Inspection

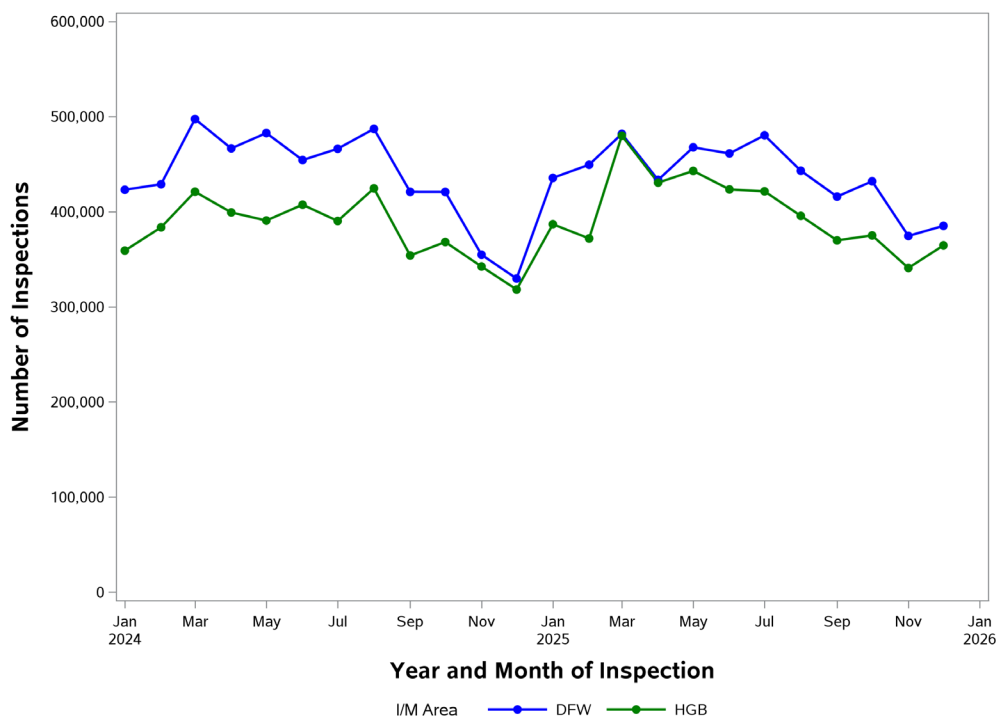
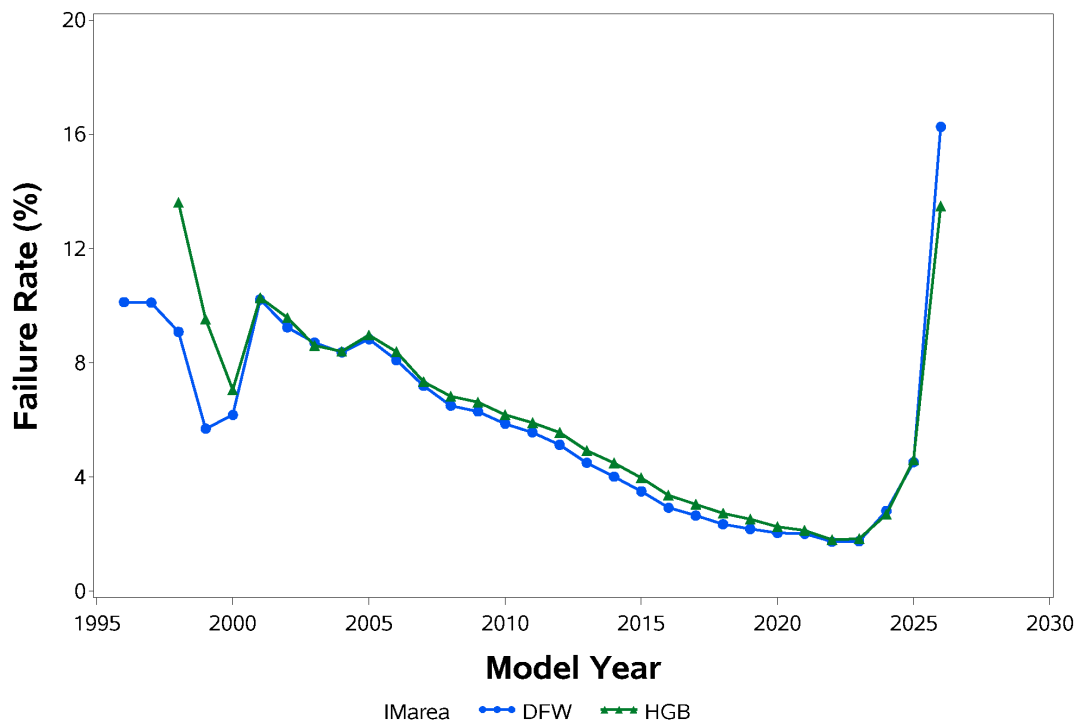


Figure III-3. Initial Inspection Failure Rate by Model Year and I/M Program Area



III.C. Repeat I/M Failure Patterns

Understanding repeat I/M failures provides insight into the effectiveness of repairs and recurring compliance challenges within the Texas I/M program. To identify patterns of repeat I/M failures, ERG analyzed the TIMS data. The analysis characterizes the scope and nature of repairs associated with the Texas I/M program and is based on the two-year evaluation period, covering all of 2024 and 2025.

Initial and retest inspections were not determined using the TX96_TEST_SEQUENCE or TX96_TEST_TYPE variables. These database variables are intended to store the number of inspections in an inspection sequence and indicate whether an inspection is an initial or a retest inspection. However, many factors can affect the information stored in these variables, such as the time span between an initial and a retest inspection, whether the motorist chose a different inspection station for the retest, or whether a safety-only inspection was performed at some point. For the purposes of this analysis, ERG made new initial/retest assignments. The first inspection for a VIN under the evaluation period was labeled an initial inspection, and additional inspections to that VIN were labeled as retests until an inspection was passed or a waiver was granted. The next inspection following a passed inspection or a waiver was labeled an initial inspection. For identifying initial inspections, inspection cycles that appeared to begin in the first four months of 2024 were excluded from the counts as they could have

been preceded by additional inspections in 2023.³ Also, for the purpose of identifying final inspections, any inspection cycles that appeared to end in the last four months of 2025 were excluded as there could be additional inspections in early 2026.

An “inspection sequence” is the series of inspections a vehicle receives as it moves through the Texas I/M program requirements. By far, the most common sequence is a single inspection that results in a pass. The second most common sequence is a failed inspection followed by repair and a passed retest. Other sequences may include multiple failed inspections before the vehicle ultimately passes.

However, sequences in which additional retests occur after a passed inspection generally do not appear. Such patterns may indicate issues with the measurement process or with the effectiveness of repairs performed under the program. For example, a sequence such as fail, fail, fail, fail, pass may suggest that the motorist is “shopping around” for a passing result, that no repairs were performed, that the repairs made were inadequate, or that the test results themselves were inaccurate.

All vehicles included in this analysis underwent testing at an I/M inspection station on at least one occasion within the biennial evaluation cycle. The dataset contains a variable identifying the type of test (Initial or Retest) and another indicating the result of the emissions test (Pass or Fail). Failed inspections were coded as “F,” passed inspections as “P,” and inspections that resulted in a waiver as “W.” For each unique VIN in the dataset, the designators were concatenated in chronological order to create a sequence representing the tests a vehicle underwent during an I/M testing cycle. For example, for a vehicle that initially failed and then passed on a retest, the test sequence would be “FP.” The frequency distribution of the resulting test sequences is shown in Table III-5, with results for the DFW and HGB program areas shown separately. The infrequent waiver inspections are included in the “Other” category. In 99.5% of the test sequences, a verified initial test or an initial test that could reasonably be assumed to be a true initial test was confirmed, and a final test certified.

Table III-5. Frequency Distribution of Test Sequences

DFW			HGB		
Inspection Sequence	Number of Vehicles	Percent of Vehicles	Inspection Sequence	Number of Vehicles	Percent of Vehicles
P	7,869,569	95.30%	P	7,036,654	94.87%
FP	306,695	3.71%	FP	301,297	4.06%
F	42,936	0.52%	F	38,123	0.51%
FFP	26,320	0.32%	FFP	28,555	0.38%
FFFP	4,702	0.06%	FFFP	5,103	0.07%

³ In previous years, ERG used a three-month period instead of four. However, the 2020 OTAQ guidance referred to in footnote 2 suggested a change to a four-month period, and ERG has made that change for this document.

DFW			HGB		
Inspection Sequence	Number of Vehicles	Percent of Vehicles	Inspection Sequence	Number of Vehicles	Percent of Vehicles
FF	4,088	0.05%	FF	3,965	0.05%
FFFFP	1159	0.01%	FFFFP	1210	0.02%
FFF	934	0.01%	FFF	824	0.01%
Other	1,504	0.02%	Other	1,312	0.02%

In Table III-5, the top two rows, which represent the two “ideal” inspection sequences—P and FP—comprise about 99% of the total distribution, both in the DFW and HGB program areas. Some of the other sequences, however, raise questions about vehicle outcomes, particularly those that fail an inspection and do not receive a passing retest.

One concern is whether these cases might be affected by sequences that start near the end of the dataset and might have later retests at the beginning of the next dataset. A check of these vehicles shows that sequences ending with a failed inspection are distributed fairly uniformly across all months of 2024 and 2025, although a modest increase is observed in the later months of the dataset. The vehicles that did not complete their inspection sequences and ended with no final passed inspection (NFP) may have moved (or have been re-registered) out of the I/M program area, and therefore may no longer be required to participate in the I/M program. However, some of the NFP vehicles were observed in the I/M program area by RS after their incomplete inspection cycle. These non-compliant vehicles were observed at approximately half the frequency as compliant vehicles. Of the non-compliant vehicles (NFP), there were 42,936 in the DFW area, accounting for 11.1% of all failing vehicles, and 38,123 in the HGB area, accounting for 10.0% of all failing vehicles.

Several hundred less common sequences accounted for the remaining 0.01 – 0.02% of the tested fleets. Many of these remaining sequences seem to be unlikely, involving numerous failed inspections and/or multiple passed inspections. Some of these could be the result of resale vehicles or possibly test classification errors rather than real situations. Covert vehicles are flagged in the TIMS and removed from this evaluation, and so are not believed to contribute to this count. These unlikely test sequences are relatively uncommon.

III.D. OBD Inspection Analyzer Communication Performance

ERG analyzed the TIMS OBD data to evaluate analyzer communication performance, recognizing that certain inspection analyzer models may be unable to communicate with certain vehicle makes, models, and model years when connected through the vehicle’s Diagnostic Link Connector (DLC). The objective of this task was to analyze the TIMS data to determine whether certain manufacturers of OBD inspection analyzers exhibit elevated communication failure rates with certain vehicle groups, which would

suggest compatibility issues between specific analyzer models and vehicle makes, models, or model years.

For this task, ERG reviewed OBD inspection records to identify all tests with a result other than “P” in the “OBD2_DLC_RES” field of the test record. For these records, analysis was performed to identify rates of failure to communicate by:

- vehicle model year;
- analyzer manufacturer;
- vehicle make; and
- vehicle model.

Results are presented below for each of these four communication failure categories.

Only one of the 19,854,990 OBD test records had no information stored in the OBD communication result field. This record had null values for ready result, fault code result, downloaded MIL status, and OBD pass/fail result, and had an overall passing result (a “P” in the “OVERALL_RESULTS” field). There were also 561,857 records for vehicles of unknown GVWR or HDVs (i.e., >8,500 lbs. GVWR). All of these records were excluded from the results, leaving 19,293,132 OBD records in the dataset.

Communication Rates by Vehicle Model Year –Table III-6 provides a summary of communication rates by model year of vehicles tested in the program.

The “MODEL_YEAR” field from the vehicle test result tables was used to determine model year. Values and percentages shown in the table are listed by model year. For example, 180,226 OBD tests were conducted on model year 2001 vehicles, and only 381 of these had an OBD fail to communicate status. Overall, very low numbers were seen for “failure to communicate” test results, and the overall “failure to communicate” rates were very low. In addition, most tests with a “failure to communicate” result were followed by a subsequent test of the same vehicle in which OBD communication was successfully established. The overall program-wide communication rate between vehicles and analyzers, excluding the inspections that were removed from the dataset as described in Section III.A, is 99.5%.

Table III-6. OBD Communication Rates by Vehicle Model Year

Model Year	DLC is Damaged, Inaccessible, or Cannot be Found		Vehicle will not Communicate with Analyzer		Vehicle Successfully Communicates with Analyzer		Total Count of Tests by Model Year
	Count	Percent	Count	Percent	Count	Percent	
1996*	2	0.45%	2	0.45%	436	99.09%	440
1997*	4	0.48%	3	0.36%	827	99.16%	834
1998*	7	0.50%	10	0.71%	1,388	98.79%	1,405
1999*	9	0.22%	17	0.41%	4,112	99.37%	4,138
2000	147	0.20%	174	0.24%	72,851	99.56%	73,172
2001	1548	0.86%	381	0.21%	178,297	98.93%	180,226
2002	1810	0.80%	476	0.21%	225,313	99.00%	227,599
2003	2171	0.81%	637	0.24%	264,923	98.95%	267,731
2004	2490	0.78%	581	0.18%	316,606	99.04%	319,677
2005	3278	0.91%	661	0.18%	357,472	98.91%	361,411
2006	3490	0.83%	680	0.16%	418,418	99.01%	422,588
2007	3853	0.68%	703	0.12%	559,881	99.19%	564,437
2008	3112	0.52%	588	0.10%	589,680	99.38%	593,380
2009	1940	0.44%	409	0.09%	440,407	99.47%	442,756
2010	2118	0.36%	586	0.10%	578,036	99.53%	580,740
2011	2733	0.40%	779	0.11%	676,569	99.48%	680,081
2012	2922	0.35%	915	0.11%	828,950	99.54%	832,787
2013	2888	0.28%	949	0.09%	1,029,690	99.63%	1,033,527
2014	2848	0.25%	931	0.08%	1,148,358	99.67%	1,152,137
2015	3345	0.25%	1219	0.09%	1,325,590	99.66%	1,330,154
2016	2822	0.21%	1285	0.10%	1,311,617	99.69%	1,315,724
2017	2815	0.20%	1446	0.10%	1,418,229	99.70%	1,422,490
2018	2376	0.17%	1653	0.12%	1,424,424	99.72%	1,428,453
2019	2951	0.21%	1719	0.12%	1,428,501	99.67%	1,433,171
2020	2067	0.16%	2430	0.19%	1,274,025	99.65%	1,278,522
2021	2044	0.16%	4432	0.35%	1,272,230	99.49%	1,278,706
2022	2045	0.18%	1824	0.16%	1,149,014	99.66%	1,152,883
2023	1499	0.21%	1014	0.14%	696,953	99.64%	699,466
2024	489	0.29%	217	0.13%	169,222	99.58%	169,928
2025**	73	0.17%	162	0.37%	43,149	99.46%	43,384
2026**	12	1.01%	81	6.84%	1,092	92.15%	1,185
Total	59,908	0.31%	26,964	0.14%	19,206,260	99.55%	19,293,132

* Vehicles older than model year 2000 are not subject to the program. These are voluntary tests.

** Inspections are required for resale of vehicles less than 2 years old with more than 50,000 miles.

Communication Rates by Equipment Manufacturer – Table III-7 provides results of communication rates among the various analyzer manufacturers. Opus Inspection makes Environmental Systems Products (ESP)-branded analyzers. Records in the TIMS data from ESP analyzers are identified by their two-letter designation, ES. Similarly, Worldwide Environmental Products makes self-branded analyzers whose records use WW as their two-letter designation.

The percentages shown for the “DLC is Damaged, Inaccessible, or Cannot be Found,” the “Vehicle Will Not Communicate with Analyzer,” and the “Vehicle Successfully Communicates with Analyzer” columns below pertain to all tests conducted by each analyzer manufacturer (not percentage of all tests). The two rightmost columns provide counts and percentages of tests by each analyzer manufacturer relative to the total number of tests. For the most part, the rate of communication problems was consistently low for each manufacturer.

Table III-7. OBD Communication Rates by Equipment Manufacturer

Equipment Manufacturer (EM)	DLC is Damaged, Inaccessible, or Cannot be Found		Vehicle will not Communicate with Analyzer		Vehicle Successfully Communicates with Analyzer		Total Count of Tests by EM	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
ESP	3,210	0.02%	21,219	0.14%	14,805,771	99.84%	14,830,200	76.87%
WW	56,698	1.27%	5,745	0.13%	4,400,489	98.60%	4,462,932	23.13%
Total	59,908	0.31%	26,964	0.14%	19,206,260	99.55%	19,293,132	100.00%

Communication Rates by Vehicle Make - To assess communication rates by vehicle make, vehicle registration records were merged with vehicle test records by VIN. Makes that were represented by 100 or fewer vehicles were removed from the table since sample sizes would be too small to provide meaningful results.

Table III-8 provides a summary of communication rates among the various vehicle makes. The incident rates for “damaged, inaccessible, or cannot be found” or “no communication” were very low. However, it is notable that 67,000 inspections were found with a make of “OTHR”, and that 18% of these had a DLC that was damaged, inaccessible, or not found. A brief investigation into the content of these records revealed that most of them were tested as HDVs (TX96_GVW_TYPE=2), and therefore not required to pass an OBD inspection, even though they are predominantly LDV. This combination of data entries was not seen in previous evaluation periods, and it seems possible that it might be an indicator of a new form of inspection fraud (conversion to HD test to avoid the OBD test component).

Table III-8. OBD Communication Rates by Vehicle Make

Vehicle Make	DLC is Damaged, Inaccessible, or Cannot be Found		Vehicle will not Communicate with Analyzer		Vehicle Successfully Communicates with Analyzer		Total Count of Tests by Make	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
ACURA	37	0.01%	300	0.11%	267,127	99.87%	267,464	1.39%
ALFA ROMEO	5	0.04%	17	0.14%	11,757	99.81%	11,779	0.06%
AUDI	31	0.01%	289	0.13%	221,762	99.86%	222,082	1.15%
BMW	75	0.02%	683	0.16%	417,027	99.82%	417,785	2.17%
BUICK	26	0.01%	183	0.10%	179,787	99.88%	179,996	0.93%
CADILLAC	569	0.18%	337	0.11%	317,766	99.72%	318,672	1.65%

Vehicle Make	DLC is Damaged, Inaccessible, or Cannot be Found		Vehicle will not Communicate with Analyzer		Vehicle Successfully Communicates with Analyzer		Total Count of Tests by Make	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
CHEVROLET	14,854	0.64%	3,005	0.13%	2,301,398	99.23%	2,319,257	12.04%
CHRYSLER	34	0.02%	165	0.09%	177,942	99.89%	178,141	0.92%
DODGE	4,365	0.73%	626	0.10%	595,491	99.17%	600,482	3.12%
FIAT	3	0.02%	18	0.10%	17,552	99.88%	17,573	0.09%
FORD	15,636	0.65%	7,039	0.29%	2,392,229	99.06%	2,414,904	12.53%
GENESIS	1	0.01%	17	0.09%	19,498	99.91%	19,516	0.10%
GMC	3,232	0.52%	720	0.12%	620,803	99.37%	624,755	3.24%
HONDA	244	0.01%	1,748	0.10%	1,739,274	99.89%	1,741,266	9.04%
HUMMER	2	0.02%	19	0.22%	8,603	99.76%	8,624	0.04%
HYUNDAI	74	0.01%	701	0.10%	706,290	99.89%	707,065	3.67%
INFINITI	25	0.01%	263	0.10%	258,590	99.89%	258,878	1.34%
ISUZU	444	11.37%	14	0.36%	3,448	88.27%	3,906	0.02%
JAGUAR	4	0.01%	48	0.14%	34,117	99.85%	34,169	0.18%
JEEP	957	0.14%	783	0.12%	672,870	99.74%	674,610	3.50%
KIA	74	0.01%	615	0.10%	598,738	99.89%	599,427	3.11%
LEXUS	52	0.01%	567	0.08%	698,807	99.91%	699,426	3.63%
LINCOLN	175	0.12%	419	0.29%	143,791	99.59%	144,385	0.75%
LAND ROVER	12	0.01%	119	0.12%	97,036	99.87%	97,167	0.50%
MASERATI	2	0.02%	20	0.17%	11,527	99.81%	11,549	0.06%
MAZDA	59	0.02%	767	0.22%	343,794	99.76%	344,620	1.79%
MERCEDES	5	0.02%	36	0.13%	26,775	99.85%	26,816	0.14%
MERCURY	78	0.02%	982	0.20%	484,353	99.78%	485,413	2.52%
MITSUBISHI	20	0.02%	235	0.21%	109,259	99.77%	109,514	0.57%
MINI	5	0.01%	73	0.16%	44,492	99.82%	44,570	0.23%
NISSAN	281	0.02%	1,540	0.10%	1,534,846	99.88%	1,536,667	7.98%
PONTIAC	6	0.02%	61	0.21%	28,600	99.77%	28,667	0.15%
PORSCHE	24	0.03%	199	0.23%	86,959	99.74%	87,182	0.45%
RAM	63	0.02%	372	0.12%	308,897	99.86%	309,332	1.61%
SATURN	8	0.04%	26	0.14%	17,962	99.81%	17,996	0.09%
SCION	9	0.02%	73	0.14%	52,307	99.84%	52,389	0.27%
SUBARU	22	0.01%	292	0.11%	260,376	99.88%	260,690	1.35%
SUZUKI	10	0.16%	23	0.36%	6,347	99.48%	6,380	0.03%
TOYOTA	3,180	0.11%	2,727	0.09%	2,896,447	99.80%	2,902,354	15.06%
VOLKSWAGEN	60	0.02%	520	0.16%	316,840	99.82%	317,420	1.65%
VOLVO	16	0.02%	108	0.11%	95,380	99.87%	95,504	0.50%
OTHER	12,518	18.63%	125	0.19%	54,553	81.18%	67,196	0.35%
Total	57,297	0.30%	26,874	0.14%	19,181,417	99.56%	19,265,588	100%

Communication Rates by Vehicle Model – To assess communication rates by vehicle model, the model codes and model names (series) as reported in the vehicle test results tables were used. Table III-9 lists communication rates for each vehicle model code. Records for the more uncommon series, (i.e., less than 100 inspection records), were excluded. Given the length of Table III-9, the text below presents only vehicle makes through Alfa when models are ordered alphabetically. The full table is provided in Appendix A.

It can be seen from the table that no model codes/vehicle series had “damaged, inaccessible, or cannot be found” or “no communication” rates that were greater than 1%, and all were below 0.5% except for Lotus.

Table III-9. OBD Communication Rates by Vehicle Model Code for Elevated Miscommunications

Make/Model	DLC is Damaged, Inaccessible, or Cannot be Found		Vehicle will not Communicate with Analyzer		Vehicle Successfully Communicates with Analyzer		Total Count of Tests by Make	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
ACUR								
ILX	1	0.01%	11	0.07%	16,570	99.93%	16,582	0.09%
MDX	12	0.01%	100	0.11%	89,488	99.88%	89,600	0.49%
RDX	8	0.01%	62	0.09%	66,817	99.90%	66,887	0.36%
TL	8	0.03%	35	0.11%	30,623	99.86%	30,666	0.17%
TLX	4	0.01%	29	0.10%	30,285	99.89%	30,318	0.16%
TSX	3	0.02%	25	0.13%	19,422	99.86%	19,450	0.11%
ALFA								
Giulia (952)	2	0.03%	13	0.22%	5,789	99.74%	5,804	0.03%
Stelvio	3	0.05%	4	0.07%	5,700	99.88%	5,707	0.03%

III.E. Handling of OBD Codes by the TIMS

ERG analyzed the TIMS OBD data to evaluate the accuracy of OBD data collected in the Texas I/M program. This is a process-based measure for inspection effectiveness. The handling of OBD readiness, diagnostic trouble codes, and communication failures varies among I/M programs. The objective of this task was to analyze OBD inspection records to ensure OBD test results are appropriate for various OBD test dispositions, such as a vehicle with too many OBD monitors “not ready,” a vehicle with “pending” DTCs, or a vehicle that fails to communicate with the analyzer.

III.E.1 Program Description and Results of Analysis

Proper handling of various OBD test scenarios is defined in sections 85.2207 and 85.2222 of Title 40 of the CFR and also in various OBD implementation guidance documents issued by EPA. Appropriate responses to the various test scenarios are summarized here and serve as the basis for analysis in this task. The dataset for this analysis included records for OBD inspections between January 1, 2024, and December 31, 2025. Records for inspections that were aborted were excluded from the dataset, as were records for which either the OBD result, or the overall result was not “P” (pass) or “F” (fail). Because this analysis was performed with the goal of determining whether OBD inspection guidelines are enforced, only records for LDVs were used. Downloaded OBD test pass/fail results are not enforced for HDVs (i.e., vehicles with a GVWR greater than 8,500 pounds); therefore, these vehicles were removed from the dataset. HDVs were identified as those with the TX96_TYPE field

equal to one and the TX96_GVW_ACTUAL field between zero and 8,501. Vehicles with no GVWR given were also removed since these might be HDVs. Following these removals, 19,185,995 records remained in the dataset.

Diagnostic Link Connector Communication Status – According to federal guidelines, a diagnostic link connector (DLC) that is missing, tampered, or otherwise inoperable is a basis for failure, but the vehicle may be “rejected” for a DLC that is inaccessible or cannot be located. Failure to communicate with an OBD analyzer is also a basis for failure. To perform this analysis, the result stored in the “OBD2_DLC_RES” field was compared with that in the “OBD2_PF_FLAG” field. No test results with a “D” (damaged), “N” (connected but will not communicate), “L” (inspector cannot find DLC), or “I” (DLC is inaccessible) in the “OBD2_DLC_RES” should have a “P” in the “OBD2_PF_FLAG”. Results of this analysis are shown in Table III-10.

Table III-10 shows that 1,697 test records have a DLC communication status of “D,” “I,” “L,” or “N,” yet have an OBD test result of “pass.” For these records, it was noted that no result was given for monitor readiness (since presumably no communication occurred). It is not clear what led to the passing result for those records. In conclusion, the DLC failure to communicate was enforced on the vast majority of OBD tests conducted on LDVs during the period of evaluation. For this iteration of the evaluation cycle, the majority of DLC communication status issues were due to “L” (inspector cannot find DLC), an inspector-entered value rather than a true failure to communicate.

**Table III-10. Comparison of DLC Communication Status
with Overall OBD Test Results**

DLC Communication Status	Overall OBD Test Results	
	Fail	Pass
“D” (damaged)	865	1
“I” (DLC is inaccessible)	429	0
“L” (inspector cannot find DLC)	735	1,618
“N” (connected but will not communicate)	26,383	78
Sub-Total count of “D,” “I,” “L,” and “N” Tests	28,412	1,697
“P” (communication successful)	848,801	18,307,085
Total	877,213	18,308,782

Because successful communication with the inspection analyzer is critical for all other OBD results, the OBD records with OBD2_DLC_RES results other than “P” were removed from the dataset for the other analyses that comprise the remainder of this section. This left 19,155,886 records in the dataset.

Agreement between OBD test result and overall test result – A vehicle that fails the OBD inspection should fail the overall inspection. To determine if OBD failures were properly recorded in the overall inspection disposition, a query was performed to

quantify the number of vehicles that failed the OBD portion of the test (“F” in the “OBD2_PF_FLAG” field) but passed the overall OBD test (“P” in the “OVERALL_RESULTS” field). Table III-11 shows that no tests were recorded with a “fail” in the OBD portion of the test and a “pass” for the overall test.

Table III-11. Comparison of OBD Test Result with Overall Test Result

Result of OBD Test	Overall Test Result				Total	
	Fail		Pass			
Fail	848,801	100.00%	0	0.00%	848,801	4.43%
Pass	195,257	1.07%	18,111,828	98.93%	18,307,085	95.57%
Total	1,044,058	5.45%	18,111,828	94.55%	19,155,886	100.00%

Inspector-Entered MIL bulb check – This is also referred to as the Key On / Engine Off (KOEO) check. The inspector is instructed to turn the vehicle’s ignition key to the “on” position, but not start the vehicle, to illuminate the MIL. Results are manually entered into the analyzer (via keyboard) by the inspector. If the MIL does not illuminate, the vehicle should fail the OBD portion of the inspection.

To perform this analysis, the results for the inspector keyboard-entered MIL bulb check (“OBD2_MIL_CHECK” field of the test record) were compared with results of the overall OBD test result (“OBD2_PF_FLAG” field), to ensure that a MIL bulb check failure always results in an OBD test failure. The “OBD2_MIL_CHECK” results are “Y” or “K,” which is a pass (yes, the MIL did illuminate or keyless ignition), and “N,” which is a fail (no, the MIL did not illuminate). All records with a KOEO MIL result of “N” (fail) received a failing OBD result. This is a new and positive result as prior I/M evaluation reports had observed at least a few dozen records where the “N” result did not receive a failing OBD result. The one inspection for which no KOEO result was available also received a failing result. The results are presented in Table III-12 below.

Table III-12. Comparison of KOEO MIL Bulb Check Result with Overall OBD Test Result

Result of KOEO MIL Bulb Check	Overall OBD Test Result		Total
	Fail	Pass	
Missing result*	1	0	1
N (fail)	13,610	0	13,610
K (pass)	128,976	4,767,654	4,896,630
Y (pass)	706,214	13,539,431	14,245,645
Total	848,801	18,307,085	19,155,886

*This record was missing all inspector-entered and downloaded OBD data.

Inspector-Entered Engine-Running MIL Illumination Status – The KOER result manually entered by the inspector is a basis for failure. No vehicle with an “F” in the “OBD2_MIL_ON_RUN” field should have a “P” in the “OBD2_PF_FLAG” field of the OBD test record. The “OBD2_MIL_ON_RUN” results are “Y,” which is a pass (Y = MIL turned

off after the vehicle was started) or “N,” which is a fail (N = MIL stayed illuminated after the vehicle was started). Table III-13 shows that the MIL Illumination Status appears to be enforced as a condition for OBD failure: no inspections were recorded with a MIL Illumination status of “N” and an overall OBD result of “P.” However, since the KOER MIL Illumination Status is manually entered by the inspector, accuracy of this entry is not automatically enforced by the analyzer. As shown in Table III-14, in 178,219 inspections a “pass” result was manually entered when the downloaded MIL status indicated a “fail” result, and a “fail” result was entered 7,746 times when the MIL status indicated a “pass” result. These latter cases are possible false failures.

Table III-13. Comparison of Inspector-Entered MIL Illumination Status (Engine Running, KOER) with Overall OBD Test Result

Result of MIL Illumination Status	Overall OBD Test Result		Total
	Fail	Pass	
Missing result*	1	0	1
N (Fail)	31,068	0	31,068
Y (Pass)	817,732	18,307,085	19,124,817
Total	848,801	18,307,085	19,155,886

*This record was missing all inspector-entered and downloaded OBD data.

Table III-14. Comparison of Downloaded MIL Command Status with Inspector-Entered MIL Illumination Status (Engine Running, KOER)

Result of Downloaded MIL Status	Result of MIL Illumination Status			Total
	(missing result)	Fail	Pass	
Missing result*	1	0	0	1
Fail	0	23,322	178,219	201,541
Pass	0	7,746	18,946,598	18,954,344
Total	1	31,068	19,124,817	19,155,886

*This record was missing all inspector-entered and downloaded OBD data.

MIL Commanded On – A vehicle with the MIL commanded on and with stored emissions-related DTCs should fail the OBD inspection, regardless of readiness status. The TIMS software ignores manufacturer-specific (non-generic) DTCs in this pass/fail determination. To perform this analysis, all OBD test records were reviewed to determine the overall OBD pass/fail status in comparison with the downloaded MIL command status results. Specifically, any vehicle with “F” in the “OBD2_MIL_STATUS” should also have “F” in the “OBD2_PF_FLAG” field (if DTCs are present). Table III-15 provides the results of this review.

Table III-15. Comparison of Downloaded MIL Command Status with Overall OBD Test Result

Result of Downloaded MIL Status	Overall OBD Test Result				Total	
	Fail		Pass			
Missing result	1	0.0%	0	0.0%	1	0.0%
Fail	167,410	19.7%	34,131	0.2%	201,541	1.1%
Pass	681,390	80.3%	18,272,954	99.8%	18,954,344	98.9%
Total	848,801	100.0%	18,307,085	100.0%	19,155,886	100.0%

The results in Table III-15 show that 34,131 test records (0.2%) of all OBD “pass” test records) have a MIL commanded on status yet receive an overall OBD pass result. However, 32,892 of the 34,141 tests had no stored DTCs, in which case it is appropriate to pass the test. The 1,240 remaining inspections had one or more DTCs stored, and should have resulted in a failed OBD result, since the MIL was commanded on. In conclusion, the downloaded OBD MIL command status was enforced for almost all OBD tests conducted on LDVs ($\leq 8,500$ lbs. GVWR) with stored DTCs during the period of evaluation.

Readiness Evaluation – Federal guidelines recommend two or fewer unset non-continuous monitors be allowed for model year 1996 through 2000 vehicles and only one (or none) unset non-continuous monitors be allowed for model year 2001 and newer vehicles. Vehicles with higher counts of unset non-continuous monitors should not receive a pass result. They should be failed or rejected based on the OBD system’s readiness status.

To perform this analysis, the OBD readiness status of test records was compared on a model-year basis to evaluate conformance with the readiness guidelines. Vehicles of model years 1996 through 2000 with three or more “not ready” non-continuous monitors should have an OBD readiness failure (“F” in the “OBD2_READY_RES” field of the test record) and an OBD test result of fail (“F” in the “OBD2_PF_FLAG” field of the test record). Vehicles with two or fewer “not ready” non-continuous monitors should have an OBD readiness result of pass (“P” in the “OBD2_READY_RES” of the test record). The 2001 and newer vehicles with two or more “not ready” non-continuous monitors should have an OBD readiness failure (“F” in the “OBD2_READY_RES” of the test record) and an OBD test record result of fail (“F” in the “OBD2_PF_FLAG” field of the test record), while 2001 and newer vehicles with one or fewer “not ready” non-continuous monitors should have an OBD readiness result of pass (“P” in the “OBD2_READY_RES” field of the test record).

Table III-16 compares OBD readiness status with the number of unset monitors for all OBD tests. Only non-continuous and “enabled” monitors are presented in this comparison. The MY 1998 through 2000 vehicles are mostly outside the subject vehicle

age range for this program (model year 2000 vehicles would have been tested one last time during calendar year 2024, but none should have been tested in 2025).

Table III-16. Unset Monitors vs. Test Readiness Status for Inspections

Count of Unset Non-Continuous Monitors	Counts of Tests of Vehicles Model Year 1998 through 2000		Counts of Tests of Vehicles Model Year 2001 and newer	
	OBD “Not Ready”	OBD “Ready”	OBD “Not Ready”	OBD “Ready”
0	0	48,007	6	16,786,791
1	0	13,533	1	1,595,672
2	14	7,576	286,772	1410
3	1,729	0	195,296	2
4	1,113	0	154,882	1
5	754	0	59,682	0
6	23	0	2,137	0
8	0	0	2	0
Total	3,633	69,116	698,778	18,383,876

Results in Table III-16 show that a small number of tests (a total of six) appear to have received an OBD “not ready” status despite having no unset monitors and another 15 not ready (14 for model year 1998-2000 and one for model year 2001 and newer) despite fewer monitors below the limit. Also, 1,413 vehicles of model year 2001 or newer with two or more unset readiness monitors still received a readiness result of “pass.” The majority of these were tested using ESP equipment.

Table III-17 shows these data in greater detail, separated by model year.

Table III-17. Unset Monitors vs. Test Readiness Status for Inspections by Model Year

Model Year	Count of Unset Non-Continuous Monitors							
	0		1		2		3 or more	
	OBD Not Ready	OBD Ready	OBD Not Ready	OBD Ready	OBD Not Ready	OBD Ready	OBD Not Ready	OBD Ready
2000	0	48,007	0	13,533	14	7,576	3,619	0
2001	0	122,201	0	37,262	8817	53	9,069	0
2002	0	158,515	0	45,563	9628	56	10,608	0
2003	0	185,234	0	56,398	10690	83	11,338	0
2004	0	227,353	0	62,487	12188	101	13,360	2
2005	0	267,588	0	60,308	12560	108	15,449	1
2006	0	318,000	0	68,632	12971	78	17,097	0
2007	0	440,793	0	81,599	14323	132	21,461	0
2008	1	476,206	0	75,746	15251	101	20,777	0
2009	1	363,203	0	50,060	10899	75	15,168	0
2010	0	485,868	0	59,317	12465	78	19,327	0

Model Year	Count of Unset Non-Continuous Monitors							
	0		1		2		3 or more	
	OBD Not Ready	OBD Ready	OBD Not Ready	OBD Ready	OBD Not Ready	OBD Ready	OBD Not Ready	OBD Ready
2011	0	571,943	0	67,756	14032	76	21,385	0
2012	0	710,068	0	76,403	15830	69	24,953	0
2013	0	900,576	1	82,608	16439	85	28,323	0
2014	1	1,013,788	0	87,960	15899	77	28,836	0
2015	1	1,186,193	0	92,381	16596	69	27,761	0
2016	0	1,192,280	0	80,572	13488	47	22,772	0
2017	0	1,296,424	0	83,664	14458	39	20,824	0
2018	0	1,313,696	0	76,904	12928	22	18,524	0
2019	1	1,294,566	0	100,704	13030	27	17,066	0
2020	0	1,161,288	0	85,916	10411	19	13,704	0
2021	0	1,183,236	0	64,611	9186	6	12,776	0
2022	0	1,072,145	0	56,333	7525	7	10,627	0
2023	1	652,871	0	30,332	4742	2	6,645	0
2024	0	154,913	0	8,977	1710	.	2,880	0
2025	0	37,843	0	3,179	706	.	1,267	0
Total	6	16,834,798	1	1,609,205	286,786	8,986	415,616	3

Comparison of readiness result with overall pass/fail result – The pass/fail disposition of the readiness result field of the test record was compared with the overall OBD test disposition to see if any vehicles with a “not ready” status (as determined automatically by the analyzer) received an overall OBD test result of “pass.” To perform this analysis, the “OBD2_READY_RES” field was compared to the “OBD2_PF_FLAG” fields in the analyzer OBD test records. These records with transitional vehicles were excluded from this analysis of readiness to prevent any confusion in the results, leaving 19,155,886 records in the dataset for this analysis. The results are shown in Table III-18.

Table III-18. Comparison of Readiness Status Field with Overall OBD Test Result

Readiness Status Check	Overall OBD Test Result				Total	
	Fail		Pass			
Missing result	14	0.00%	468	0.00%	482	0.00%
Fail (Not Ready)	683,489	80.52%	18,923	0.10%	702,412	3.67%
Pass (Ready)	165,298	19.47%	18,287,694	99.89%	18,452,992	96.33%
Total	848,801	100.00%	18,307,085	100.00%	19,155,886	100.00%

Table III-18 indicates that 468 of the vehicles with a “not ready” status received an overall “pass” result for the OBD portion of the test. This represents less than 0.001%; therefore, the value in Table III-18 is shown as 0.0%. This indicates that the OBD

readiness status (as determined by the analyzer and stored in the OBD2_READY_RES” field of the test record) was almost always enforced for OBD tests formed during the period of evaluation. Note that the first row of the table, for 482 records with a missing result for the readiness status check, is a new addition that began with the 2022 report [ERG, 2022] per EPA guidance. However, it is not clear why the few hundred records with the missing readiness result were able to receive mostly passing inspections.

IV. REPAIR

ERG analyzed the TIMS data from January 1, 2024, through December 31, 2025, to determine the extent and effectiveness of repairs directed by the Texas I/M program. This task covers process-based measures for repair effectiveness.

There are several issues with the repair data contained in the TIMS dataset that make analysis difficult. Future improvements in data collection and storage practices may address many of these limitations. These issues are described below and are very similar to those listed in previous reports.

Repair information in the TIMS is entered by the inspector performing the inspection; however, motorists frequently do not bring repair documentation to the re-inspection. As a result, inspectors often leave the repair fields blank. Consequently, most repair entries in the TIMS are provided by inspectors who either work in the same facility where the re-inspection is performed or who performed the repairs themselves.

The TIMS repair data includes five repair categories, which is a relatively broad repair characterization. The categories consist of fuel system, ignition/electrical system, emissions system, engine mechanical, and miscellaneous. As listed in Table IV-2, “miscellaneous” repairs account for nearly 40% of reported repairs. Although utilizing more detailed repair categories could allow for greater analytical specificity, TCEQ has previously determined that inspectors did not frequently populate more extensive repair lists accurately, so TCEQ adopted the simpler set of repair categories currently in place. Challenges related to the accuracy and completeness of repair data are common across I/M programs that attempt to collect detailed repair data.

Another limitation, described in the costs section below, exists in the reported values of repair costs. Many repairs with a cost of zero exist in the dataset, along with some extremely high costs as well as shown in the subsequent Figure IV-1. The source of these zero cost entries is not clear, but their presence makes it difficult to comprehensively assess costs across the entire dataset because they skew the results downward, just as inflated repair costs would tend to bias the overall repair costs high.

IV.A. Number and Types of Repairs

ERG analyzed the number and types of repairs reported in the TIMS for the two years covered by this biennial report. The inspectors at Texas I/M stations have an opportunity to enter vehicle repair information into the inspection analyzer prior to conducting an emissions retest. A simple count of the number of repairs entered and stored in the TIMS and a distribution of the repair categories suggests the Texas I/M program is resulting in vehicles being repaired.

IV.A.1 General I/M Repairs

As noted above, the TIMS database, provided by TCEQ for this analysis, contained many repair entries but relatively little detail on the nature of repairs performed. The five repair categories listed in the TIMS, along with the corresponding number of performed repairs, are presented in Table IV-1 by model year group. Although earlier results have been presented for voluntary tests (vehicles of model year 1999 and older), results here are limited to model year 2000 and newer vehicles to avoid biasing the repair analysis with any potential voluntary repairs.

Table IV-1. Repairs Listed in the TIMS

Repair Category	Model Year	Number of Repairs	% of Repair Category	% of Total
Fuel System	2000-2006	6,526	24.97%	8.99%
	2007-2012	8,430	32.25%	11.61%
	post-2013	11,181	42.78%	15.40%
	<i>Total</i>	<i>26,137</i>	<i>100.00%</i>	<i>35.99%</i>
Ignition / Electrical System	2000-2006	1,154	24.26%	1.59%
	2007-2012	1,495	31.43%	2.06%
	post-2013	2,107	44.30%	2.90%
	<i>Total</i>	<i>4,756</i>	<i>100.00%</i>	<i>6.55%</i>
Emissions System	2000-2006	2,569	23.15%	3.54%
	2007-2012	3,460	31.18%	4.76%
	post-2013	4,253	38.33%	5.86%
	<i>Total</i>	<i>11,097</i>	<i>100.00%</i>	<i>15.28%</i>
Engine Mechanical	2000-2006	178	35.20%	0.25%
	2007-2012	235	34.10%	0.32%
	post-2013	332	30.60%	0.46%
	<i>Total</i>	<i>1,691</i>	<i>100.00%</i>	<i>2.33%</i>
Miscellaneous	2000-2006	7,074	24.44%	9.74%
	2007-2012	9,113	31.49%	12.55%
	post-2013	12,756	44.07%	17.56%
	<i>Total</i>	<i>28,943</i>	<i>100.00%</i>	<i>39.85%</i>
Grand Total		72,624		100.00%

IV.B. Success of Repairs to Vehicles Failing OBD

The objective of this task was to determine whether vehicles failing the OBD inspection were being properly repaired. ERG performed an analysis of the TIMS data for OBD failures and the presence of an illuminated MIL and DTCs followed by an OBD pass (readiness criteria met, MIL commanded off and no DTCs) as an indicator that the I/M program is resulting in OBD repairs. In this analysis, it is assumed that an OBD fail result followed by an OBD pass result is due to vehicle repairs, although it is possible that some of the OBD fails followed by an OBD pass could result from intermittent problems, self-correcting problems (such as a loose gas cap that is tightened upon a vehicle refuel) or an OBD problem that is masked by unset readiness monitors (e.g., through a battery disconnect) on a subsequent passing retest. For example, after DTCs

are cleared, it might be possible to pass a retest if the monitor associated with the DTC has not reset to ready. This “masking” issue is analyzed later in this section.

Since the electronic OBD information is not used to determine the pass or fail status of HDVs during OBD inspections, the records from their inspections were excluded from this analysis. This left a dataset of 19,156,562 OBD inspection records available for the analysis.

IV.B.1 Overall Success of Repairs to Vehicles Failing OBD

For this task, ERG analyzed vehicle inspection records to identify tests with OBD failures and then determined how many of those failures were subsequently corrected. In addition, ERG created very specific definitions of OBD “fail” and “pass” to exclude initial test failures associated with readiness, failures due to OBD/analyzer communication problems, OBD test failures associated with inspector-entry, and bulb-illumination checks. An OBD test failure was defined to be any test record with one or more stored DTCs, coinciding with the OBD MIL command status of “on.” A passing result for an OBD test was defined as a downloaded OBD MIL commanded status of “off.” These definitions were necessary to fully control the analysis of MIL status, but they did leave some inspections that did not qualify as either a full “fail” or a full “pass” (i.e., OBD test was passed but overall, I/M test was failed, etc.).

Next, all individual vehicle I/M cycles that contained at least one failed OBD test were identified. I/M cycles were defined to be a single test, or a series of tests, performed on a vehicle until the vehicle either passed the overall inspection or received a waiver. Thus, if a vehicle failed its initial OBD test, the associated I/M cycle consisted of the initial failure and any subsequent tests conducted until the vehicle passed its inspection, received a waiver, or the evaluation period ended. Once the vehicle passed its inspection, its next test (most likely for the following year’s I/M inspection) would be considered a new I/M cycle. Any I/M cycles that began on or after September 1, 2025, were excluded from the analysis, since it would be possible that cycles starting so near the end of the date range of the dataset could have included additional re-inspections after December 31, 2025, and there would be no information for those inspections. Using these criteria, the dataset contained 15,516,012 OBD I/M cycles (including single-OBD-test passes) that started before September 1, 2025.

After grouping by I/M cycle for vehicles with OBD failures (as previously defined), 602,165 I/M cycles were seen to include at least one failed OBD test. Of these cycles, 496,006 (82%) had a final OBD test disposition of “pass,” which for purposes of this analysis was defined as a test with a commanded MIL status of “pass” (MIL commanded off) and an OBD test disposition of “pass.” Of the remaining vehicles that never passed a subsequent OBD test, 1,214 received waivers, but the majority simply failed to report for additional inspections to complete the program requirements, although additional re-inspections may have occurred after December 31, 2025, which would increase the overall “repaired” numbers. Note that this indicates a higher “no-

final-pass” rate than that reported above in Section III. The results here use stricter criteria for passing the test and are therefore different than the results in Section III that were simply based on the recorded pass/fail result.

It should be noted that the two allowed unset monitors could mask existing malfunctions in some of these repaired outcomes. The influence of this masking is explored later in this section.

IV.B.2 Success of Repairs to Specific Emission Control Systems Failing OBD

For this analysis, DTCs were categorized by monitored system type. ERG then analyzed repair activity by component category to assess whether the program was resulting in effective emissions control system repairs. This task was performed as a continuation of the analysis in Section III.C. It uses combinations of vehicles and I/M cycles defined in that section. However, for this task, failure modes were assigned based on the DTCs contained in the failed test records.

Specifically, the analysis was performed on vehicles with DTC failures associated with oxygen sensors (O₂ Sensor), exhaust gas recirculation systems (EGR System), secondary air injection systems (AI System), catalytic converter efficiency (Catalyst), and evaporative emissions control system (Evap System) components.⁴ The O₂ Sensor, EGR System, AI System, and Catalyst were included with this analysis because the readiness status of these systems, as well as the evaporative system, are specifically monitored by non-continuous monitors, and therefore the extent to which malfunctions may be masked by unset readiness monitors during a retest (which could result in a false pass) can be quantified. In this analysis, the extent of this potential masking is quantified along with the overall repair rates as indicated by a “fail” test followed by a “pass” test.

For each of the failure categories, a failed inspection is defined as any inspection that contains at least one test record with stored DTCs, a downloaded OBD MIL commanded status of “on,” an OBD test disposition of “fail,” and an overall test disposition of “fail.” Passed inspections were those that had a final test in that I/M cycle with a downloaded MIL status of “pass” (not commanded on) and an OBD test disposition of “pass.”

To quantify the upper limit to which readiness may be masking unrepaired malfunctions during OBD retests, the following distinctions of “repaired” vehicles were made:

- **Total Repaired** – This is the count of all vehicles that had at least one “fail” test with the final test classified as “repaired.” No regard is given to which (if any) monitors remain unset.

⁴ A list of DTCs that were included in each of these groups is given in Appendix B.

- **Repaired with Unset Monitors** – This is the count of all “repaired” vehicles that have an unset monitor that may be masking the failure mode seen in the initial “fail” test. For example, if a vehicle fails for an evaporative system malfunction, then the evaporative system monitor is unset on the final “pass” test for this vehicle, thereby possibly masking an unrepaired evaporative system malfunction. Once this monitor becomes “ready,” any unrepaired malfunction would result in a stored evaporative system DTC and MIL re-illumination.
- **Confirmed Repaired** – These are the vehicles whose monitors for which the initial failure occurred are “ready” in the final test, indicating that specific type of failure is not being masked by a “not-ready” monitor. Therefore, there is much higher confidence that these “confirmed repaired” vehicles are indeed properly repaired.

During this analysis of readiness status, some vehicles that failed for a certain system (e.g., EGR) were found to have a “not monitored” status for that monitored system (e.g., EGR not monitored). This might have been due to DTCs being generated by a continuous monitor; however, by definition, this should not be possible since a system with a stored code must be monitored. Therefore, this subset of results was classified as “ready.” Because this subset of inspections was failed, it seems that incorrect reporting of monitor status is truly the cause as opposed to potential inspection fraud through “clean-scanning.”

Regarding criteria used for categorizing “pass” and “fail” tests, it should also be noted that historical or permanent DTCs without MIL illumination are trouble codes for previous malfunctions that do not necessarily indicate a current malfunction. In accordance with EPA guidance, vehicles are not failed for historical or non-MIL permanent DTCs, that is, stored DTCs but no MIL. Pending DTCs or permanent DTCs are not collected in the Texas I/M program. Results from this repair analysis, therefore, only defines tests with MIL illumination and stored DTCs as “fail” tests, and only considers MIL illumination (without regard to stored DTCs) in determining whether a vehicle is successfully repaired.

Finally, it is worthwhile to note that a failed OBD test record could contain more than one DTC. In the Texas I/M program, up to 10 DTCs may be stored in the test record, and all stored DTCs were referenced for this analysis. Therefore, some vehicles were included in more than one set of results. For example, repair results for vehicles with both oxygen sensor DTCs and catalytic converter DTCs were included in both the oxygen sensor repair analysis and the catalytic converter repair analysis. Because of the inter-dependence of the various systems (e.g., an oxygen sensor failure may lead to a future catalytic converter failure), distinctions were not made regarding the number or types of DTCs in the original OBD-fail records. Rather, vehicles were categorized as “repaired” when the MIL was extinguished and the analyzer assigned an overall OBD “pass” result, regardless of the number or type of DTCs seen in the initial test failure.

Table IV-2 provides a summary of vehicle repairs (as indicated by OBD-fails followed by OBD-passes) performed over the period of evaluation. Since this analysis was performed on I/M data collected from January 1, 2024, through December 31, 2025, it is possible that some of the unrepaired vehicles were repaired in 2026. This would increase the “repaired” counts from the numbers shown in this table.

These data show that roughly 75% of vehicles that failed an OBD test received a passing OBD test. As previously indicated, many vehicles failed with more than one DTC. Therefore, Table IV-2 may contain vehicles included in more than one DTC category. Also, only categories directly monitored with non-continuous monitors are tabulated in Table IV-2. Other failure categories for which readiness status would be more difficult to assess are excluded from the table. Table IV-2 indicates that readiness status may be masking malfunctions of 1.5% to 25% of vehicles that pass OBD retests based on MIL status with these types of failures. I/M program modifications that would require confirmation of specific failure-mode monitors being set to “ready” would likely reduce the extent of potential false passes but at the expense of a potential increase in motorist inconvenience, especially for difficult to set monitors.

A comparison was also made between OBD evaporative system results and gas cap test results, on a by-test basis, for all OBD tests conducted during the period of evaluation. Table IV-3 presents a summary of these results.

Table IV-2. System Specific Repair Analysis for Vehicles

Type of Failure (DTC Category)	Total Vehicles Failed (with Indicated Failure Mode DTCs)	Total Repaired Vehicles (MIL Off)		Repaired Vehicles with Failure Mode Monitors Not Yet Set		Confirmed Repairs (Failure Mode Monitors Set)	
Evap System	36,297	27,590	76.01%	8,832	24.33%	18,758	51.68%
O ₂ Sensor	19,583	14,281	72.93%	312	1.59%	13,969	71.33%
EGR System	3,005	2,065	68.72%	45	1.50%	2,020	67.22%
AI System	1014	659	64.99%	58	5.72%	601	59.27%
Catalyst	36,403	27,512	75.58%	1,042	2.86%	26,470	72.71%
Totals	96,302	72,107	74.88%	10,289	10.68%	61,818	64.19%

Table IV-3. Comparison of OBD Evaporative Emission Control System Test Results with Gas Cap Test Results

OBD Evap System Test Results	Gas Cap Test Result				Total
	Pass		Fail		
Pass	15,887,782	98.59%	65,103	0.40%	15,952,885
Fail	159,751	0.99%	1,645	0.01%	161,396
Total	16,047,533	99.59%	66,748	0.41%	16,114,281

Table IV-3 shows that approximately 0.99% of the tests had failed the OBD portion of the test with evaporative system DTCs, and approximately 0.41% of the tests failed the gas cap portion of the test. The OBD evaporative system monitoring is designed to be a more comprehensive test since it assesses the integrity of the entire evaporative control system, but the OBD evaporative emissions control system fail rate may be lowered in part by unset evaporative system readiness monitors. Evaporative emissions control systems generally require a complex series of vehicle operating conditions before this monitor is set. Although most vehicles passed both tests, very few vehicles, less than 1%, failed both tests. Allowable pressure decay limits and enhanced OBD evaporative emissions control system test criteria may contribute to differences in fail rates of the two tests and the slight discrepancy in overlap between the two tests.

IV.B.3 Overall OBD Repair Slates

The most common repair slates for vehicles receiving OBD inspections were also identified. The process for performing this analysis is provided in the following paragraph. The top 10 slates are listed in Table IV-4. The table also gives the total number of vehicles that received repairs, i.e., received one of the top 10 repairs or some other repair.

Table IV-4. 10 Most Common Repair Slates

Repair Description	OBD	
	Count	Percent
Miscellaneous	22,767	40.06%
Fuel System	21,097	37.12%
Emissions System	8,107	14.26%
Ignition/Electrical System	3,729	6.56%
Engine/Mechanical	560	0.99%
Fuel System & Miscellaneous	246	0.43%
Emissions & Fuel Systems	102	0.18%
Emissions System & Miscellaneous	63	0.11%
Fuel System & Ignition/Electrical	35	0.06%
Ignition/Electrical & Emissions Systems	41	0.07%
Other	92	0.16%
Total	56,839	100.00%

For OBD inspections, a failed inspection occurs when one or more DTCs are set; these DTCs identify the types of problems present that may require repair. In contrast, a passing OBD inspection indicates that no DTCs are set. Therefore, the DTCs that are initially set and then finally unset (turned off) were compared to the repairs for OBD vehicles. Since there are too many possible combinations of DTCs to create “DTC slates” analogous to the repair slates—where all DTCs set during an inspection sequence would be grouped and analyzed together—repairs in the OBD analysis were correlated with individual DTCs rather than with DTC slates.

In Table IV-5, the five repair categories are listed horizontally across the header row and each row of the table represents one DTC. The number of times that each DTC was “turned off” in the same inspection cycle as each repair is given in the cells of the table. For example, in row one of the table, DTC P0420 (a catalyst system DTC) was turned off most frequently by “Fuel System” repairs (597 times), followed by “Miscellaneous” repairs (479 times), and then by “Emissions System” repairs (452 times). Rows with DTCs that relate to similar components or problems are grouped together in the table. The DTCs listed in Table IV-5 are the most commonly recorded DTCs, representing about two-thirds of the total DTC repair counts. In some cases, the inspectors are not choosing the correct repair category. For example, most misfire DTCs should involve ignition system repairs.

Table IV-5. Most Common OBD DTCs and Associated Repairs

DTC Name	DTC Description	Repair Type										Total
		Fuel System		Ignition/ Electrical System		Emissions System		Engine Mechanical		Miscellaneous		
		Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count
Catalyst Efficiency Faults												
P0420	Catalyst System Efficiency Below Threshold (Bank 1)	597	38%	38	2%	452	28%	22	1%	479	30%	1,588
P0430	Catalyst System Efficiency Below Threshold (Bank 2)	241	37%	27	4%	190	29%	6	1%	191	29%	655
Cylinder Misfire Detection Faults												
P0300	Random/Multiple Cylinder Misfire Detected	186	36%	78	15%	80	16%	14	3%	152	30%	510
P0301	Cylinder 1 Misfire Detected	94	35%	47	18%	40	15%	8	3%	78	29%	267
P0302	Cylinder 2 Misfire Detected	88	35%	43	17%	37	15%	8	3%	72	29%	248
P0303	Cylinder 3 Misfire Detected	85	35%	48	20%	33	13%	8	3%	71	29%	245
P0304	Cylinder 4 Misfire Detected	88	38%	45	19%	30	13%	4	2%	67	29%	234
P0305	Cylinder 5 Misfire Detected	38	32%	22	18%	13	11%	7	6%	40	33%	120
P0306	Cylinder 6 Misfire Detected	41	33%	20	16%	15	12%	8	7%	39	32%	123

DTC Name	DTC Description	Repair Type										Total
		Fuel System		Ignition/ Electrical System		Emissions System		Engine Mechanical		Miscellaneous		
		Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count
Evaporative Emission Control System Faults												
P0441	Evaporative Emission Control System Incorrect Purge Flow	89	31%	12	4%	81	28%	6	2%	99	34%	287
P0442	Evaporative Emission Control System Leak Detected (small leak)	179	35%	26	5%	119	23%	6	1%	179	35%	509
P0446	Evaporative Emission Control System Vent Control Circuit Malfunction	87	37%	7	3%	57	24%	5	2%	78	33%	234
P0455	Evaporative Emission Control System Leak Detected (gross leak)	211	32%	30	5%	186	29%	9	1%	216	33%	652
P0456	Evaporative Emission Control System Leak Detected (very small leak)	221	33%	27	4%	206	31%	11	2%	205	31%	670
P0457	Evaporative Emission Control System Leak Detected (fuel cap loose/off)	53	32%	5	3%	44	27%	5	3%	57	35%	164
Fuel Control System Faults												
P0171	Fuel System too Lean (Bank 1)	314	41%	49	6%	159	21%	18	2%	227	30%	767
P0172	Fuel System too Rich (Bank 1)	46	37%	13	10%	31	25%	2	2%	33	26%	125
P0174	Fuel System too Lean (Bank 2)	167	43%	22	6%	69	18%	14	4%	112	29%	384

DTC Name	DTC Description	Repair Type										Total
		Fuel System		Ignition/ Electrical System		Emissions System		Engine Mechanical		Miscellaneous		
		Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count
Mass Air Flow Measurement System Faults												
P0101	Mass Air Flow (MAF) Circuit Range/Performance	100	38%	10	4%	42	16%	4	2%	110	41%	266
O ₂ Sensor Circuit System Faults												
P0137	O ₂ Sensor Circuit Low Voltage (Bank 2 Sensor 2)	48	40%	5	4%	38	32%	2	2%	27	23%	120
P0138	O ₂ Sensor Circuit High Voltage (Bank 2 Sensor2)	53	46%	6	5%	23	20%	1	1%	31	27%	114
Miscellaneous Faults												
P0011	Camshaft Position Timing Over-Advanced (Bank 1)	24	24%	3	3%	19	19%	8	8%	46	46%	100
P0014	Exhaust Camshaft Timing Over-Advanced (Bank 1)	26	27%	7	7%	20	21%	10	10%	34	35%	97
P0106	Manifold Absolute Pressure/Barometric Sensor Range/Performance	23	41%	3	5%	11	20%	0	0%	19	34%	56
P0113	Intake Air Temperature Sensor 1 Circuit High Input	54	40%	11	8%	27	20%	3	2%	41	30%	136
P0121	Throttle Position Sensor/Switch A Circuit Malfunction	26	33%	4	5%	17	22%	3	4%	28	36%	78

DTC Name	DTC Description	Repair Type										Total
		Fuel System		Ignition/ Electrical System		Emissions System		Engine Mechanical		Miscellaneous		
		Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count
P0128	Coolant Temperature Below Thermostat Regulating Temp.	182	30%	30	5%	95	16%	18	3%	286	47%	611
P0497	Evaporative Emission System Low Purge Flow	20	28%	2	3%	21	30%	4	6%	24	34%	71
P0562	System Voltage Low	21	47%	7	16%	7	16%	0	0%	10	22%	45
P0700	Transmission Control System Malfunction	35	27%	9	7%	19	14%	6	5%	63	48%	132

IV.C. Average Repair Costs

The TIMS dataset contains manually entered costs for I/M program repairs. This information was analyzed to provide a rough estimate of the cost of vehicle repairs resulting from Texas I/M program-related repairs.

To estimate repair costs based on type of repair, repair category combinations were developed for each vehicle for a given I/M cycle. A repair combination is a combination of repairs performed in a repair event. The five repair categories listed in Table IV-1 were combined to produce the seven most common repair combinations, which account for approximately 98.5% of all vehicle and I/M sequences. These combinations are presented in Table IV-6.

Table IV-6. Records in the TIMS with a Repair Cost of Zero by Repair Combination

Repair Combinations	Cost > \$0	Cost = \$0	Total	% of Cost = \$0
Fuel System and Emissions System	71	58	129	45.0%
Emissions System & Miscellaneous	55	27	82	32.9%
Engine Mechanical	473	208	681	30.5%
Ignition / Electrical System	2,491	1,932	4,423	43.7%
Fuel System	5,740	19,160	24,900	76.9%
Miscellaneous	8,307	18,700	27,007	69.2%
Emissions System	4,210	5,463	9,673	56.5%
Total	21,347	45,548	66,895	68.1%

About two-thirds (68.1%) of the repair costs in the TIMS were recorded as zero. There are several possible reasons for this, including repairs under warranty, inaccurate repair data entry during a vehicle re-inspection; motorists performing their own repairs; lack of repair data available during a vehicle re-inspection; or vehicles receiving a retest without receiving repairs, such as vehicles that fail due to a readiness monitor and need to simply be driven until the monitors achieve readiness. Because of the large number of repair records affected, no attempt was made to correct the costs as part of this analysis. Nonetheless, the existence of so many repair costs with a value of zero significantly affected the average and median repair values calculated. Table IV-6 presents the number of records with a cost of zero by repair category. It was observed that some repair categories listed contained about 20 – 40% with zero repair costs, but the most common repair categories of emissions system, fuel system, and miscellaneous repairs contained a much higher percentage, at 50% or more. However, all these percentages are comparable to those in the 2014, 2016, 2018, 2020, 2022, and 2024 reports.

The repair cost range was large, with costs ranging from \$0 to over \$98,000. Sixty-eight percent of the repair costs were entered as zero, and 99% of the repair costs were under \$1,000. Due to the high number of “zero” repair costs, the median repair cost is zero. With the zeros removed, the median repair cost is \$100. Some of these costs are

believed to reflect data entry errors by inspectors during vehicle re-inspections, rather than actual repair expenses incurred by vehicle owners. Figure IV-1 presents two histograms of entered repair costs, those with costs less than or equal to \$4,000 (left), and those with costs greater than \$4,000 (right). The zero repair costs have not been removed from these figures.

Figure IV-1. Repairs with Costs Less than or Equal to \$4,000 and Greater than \$4,000

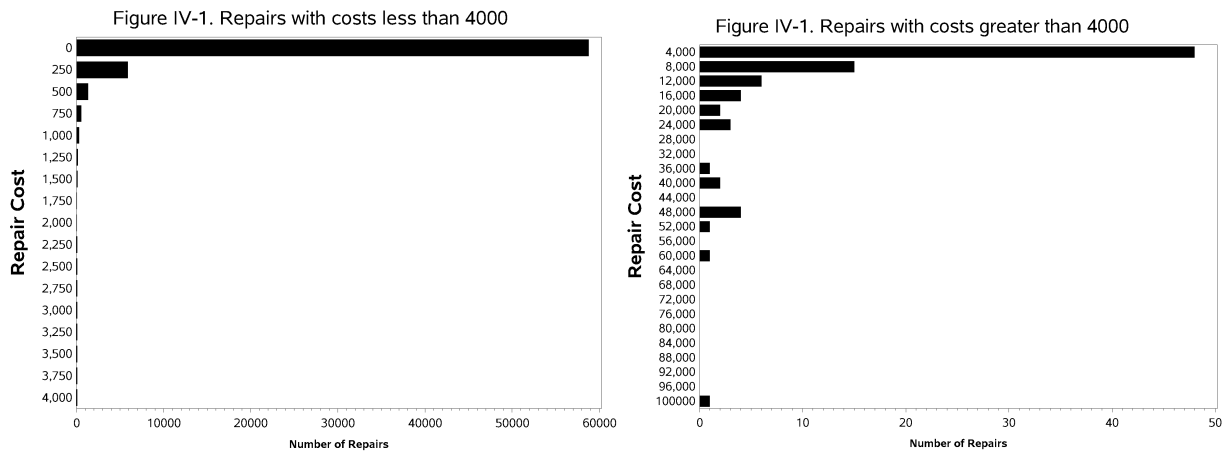


Table IV-7 presents median and mean repair costs for each of the repair categories specified in the TIMS. Mean and median repair costs are calculated twice: once using the full, unedited dataset, which includes zero-dollar repairs and repair costs greater than \$2,000, and once using an edited dataset that excludes those values. According to the unedited dataset, vehicle owners performed 67,000 repairs while spending approximately \$5.2 million. According to the edited dataset, vehicle owners performed 21,000 repairs while spending approximately \$3.7 million. These numbers are roughly 25% lower than the numbers for 2024 I/M evaluations, both for the numbers of repairs and the total costs.

Table IV-7. Average Repair Costs

Year of Inspection	Repair Combination	Original Dataset			Costs Between \$0 and \$2,000		
		Number of Repairs	Median Repair Cost	Mean Repair Cost	Number of Repairs	Median Repair Cost	Mean Repair Cost
2024	Fuel System and Emissions System	68	\$25	\$208	35	\$280	\$382
2024	Emissions System & Miscellaneous	44	\$85	\$322	28	\$151	\$327
2024	Engine Mechanical	345	\$93	\$381	214	\$225	\$328
2024	Ignition / Electrical System	2,393	\$75	\$122	1,356	\$180	\$206
2024	Fuel System	15,029	\$0	\$37	3,310	\$75	\$140
2024	Emissions System	4,668	\$0	\$190	2,055	\$200	\$310
2024	Miscellaneous	13,348	\$0	\$43	3,858	\$35	\$99
2025	Fuel System and Emissions System	61	\$38	\$245	32	\$165	\$338
2025	Emissions System & Miscellaneous	38	\$185	\$407	26	\$265	\$415
2025	Engine Mechanical	336	\$193	\$440	240	\$299	\$360
2025	Ignition / Electrical System	2,030	\$56	\$163	1,124	\$185	\$225
2025	Fuel System	9,871	\$0	\$74	2,372	\$50	\$144
2025	Emissions System	5,005	\$0	\$173	2,065	\$200	\$332
2025	Miscellaneous	13,659	\$0	\$33	4,403	\$25	\$82

Figure IV-2 and Figure IV-3 present mean repair costs by inspection year and model year, for both the unedited and edited datasets from the TIMS. There is significant variability in the unedited data compared to the edited data. As shown by these plots, in general, entered repair costs have decreased year-over-year. Due to the limited control in repair data entry and the large number of suspect values in the TIMS repair data, these results may be significantly different from true repair costs resulting from the Texas I/M program.

Figure IV-2. Mean Repair Costs by Model Year and Inspection Year (Unedited Dataset)

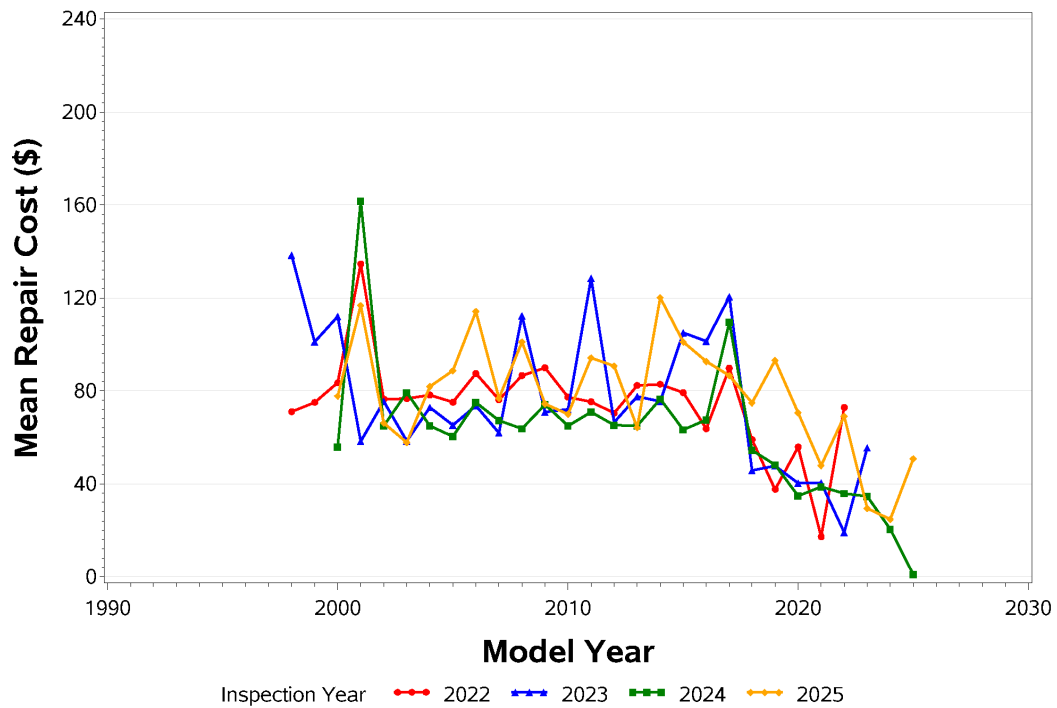


Figure IV-3. Mean Repair Costs by Model Year and Inspection Year (Edited Dataset)

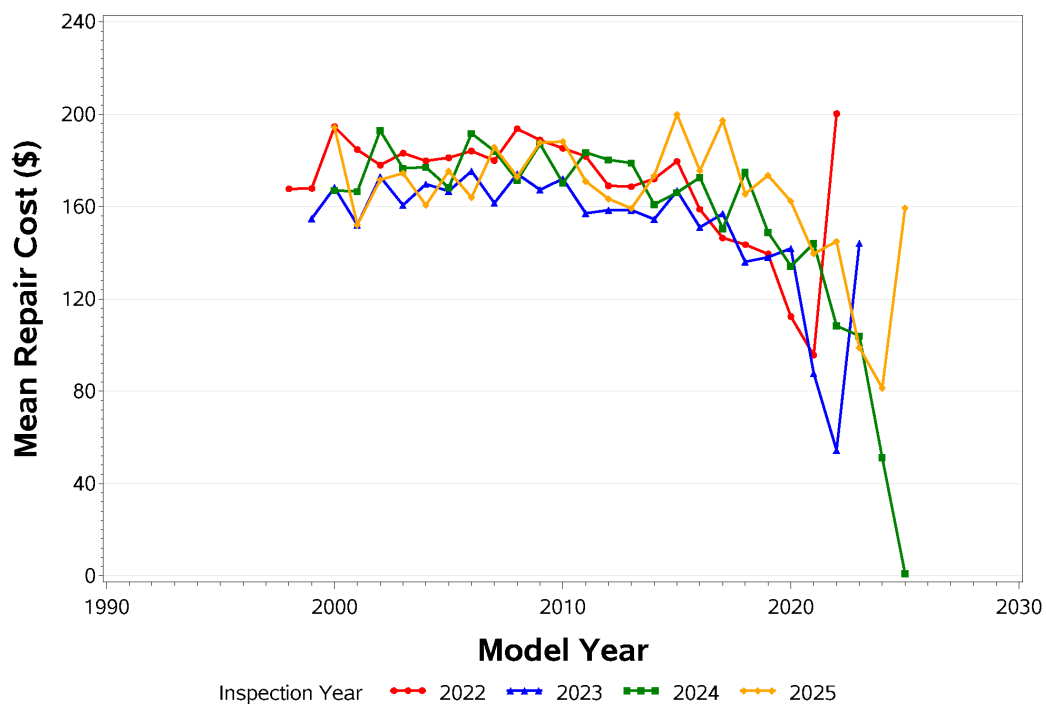


Figure IV-4 and Figure IV-5 present the percentile distribution of repair costs for the most common repair categories in the TIMS, for both the unedited and edited datasets. The unedited dataset contains repairs with an average cost of zero for all repair slates, but miscellaneous repairs costing zero extend close to the 70th percentile, which is considerably more than the other categories.

Figure IV-4. Distribution of Repair Costs by Category (Unedited Dataset)

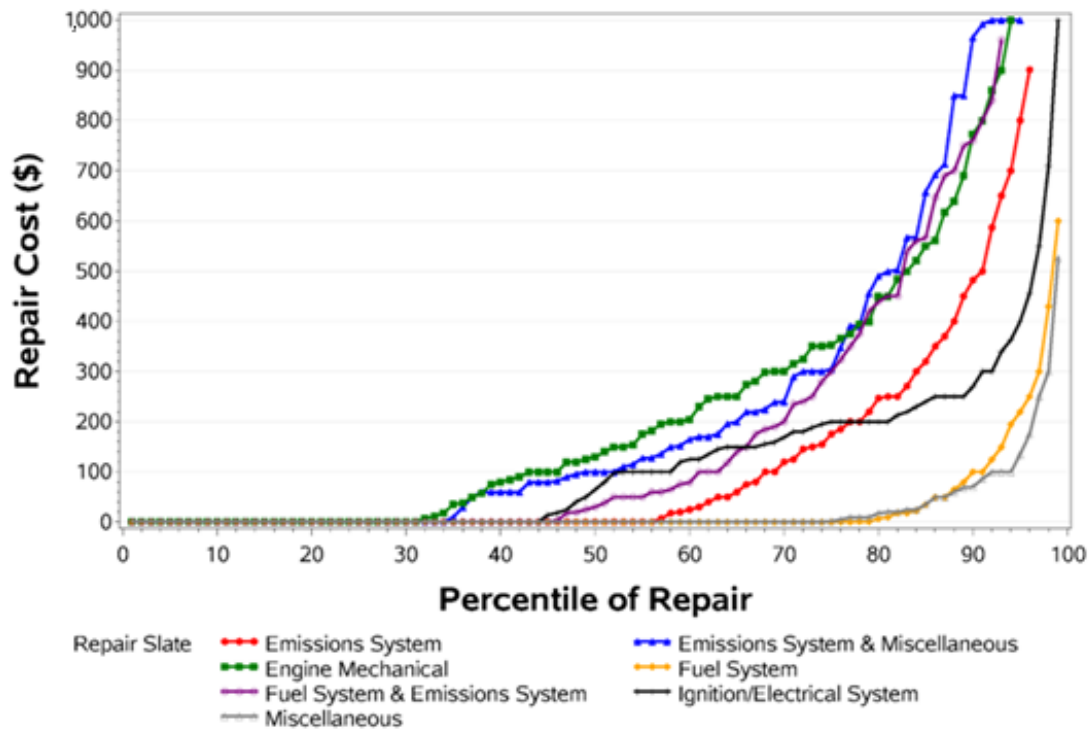
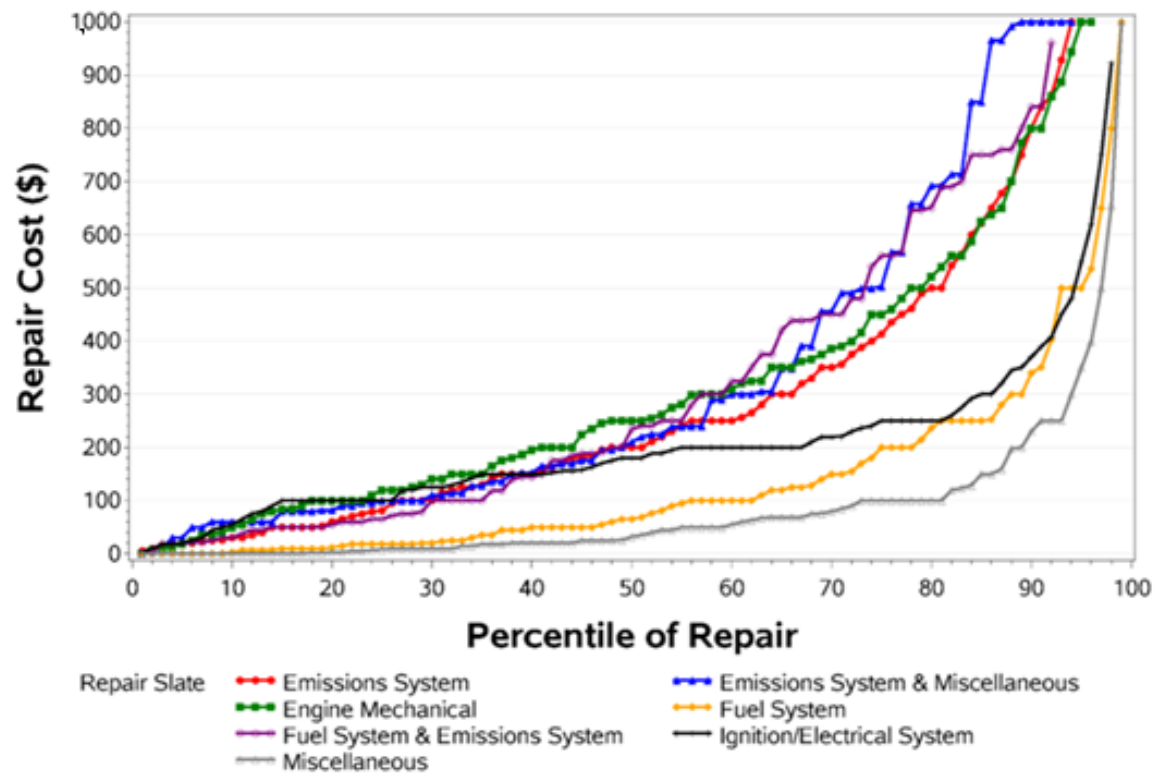


Figure IV-5. Distribution of Repair Costs by Category (Edited Dataset)



For both datasets, average costs showed the least variation for miscellaneous repairs, while repairs to the fuel and emissions systems generally exhibited the greatest variation in average costs.

V. ESTIMATES OF I/M PROGRAM BENEFITS

Several methods exist for evaluating the benefit of an I/M program. In previous biennial Texas I/M program evaluation reports, ERG used tailpipe inspection data from ASM and TSI tests to calculate emissions reductions for vehicles inspected under the program. However, the tailpipe testing program ended on December 31, 2019, and all inspections are now performed via OBD testing. Since tailpipe emissions results are no longer available for evaluation, ERG expanded its analysis of paired RS and the TIMS data. Using these paired data, ERG quantified the program's emissions benefits through the "Comprehensive Method" [EPA, 2004], which pairs RS measurements with the TIMS inspection records to compare emissions levels before-I/M and after-I/M RS. This approach and its results are described and presented in Section A below. ERG also used the "Reference Method" [EPA, 2004] to evaluate program benefits. As an additional measurement of program effectiveness, the Reference Method compares in-program RS data with RS data measured on vehicles that have never been covered by the I/M program. This methodology and its results are provided in Section B below.

V.A. Preparation of RS Data

In this task, the RS data were collected in the DFW and HGB program areas to evaluate the annual I/M benefit. The goal was to use the RS data already being collected by DPS as an independent means of measuring program benefits. The RS data provided by DPS started with approximately 1.9 million records, collected between July 1, 2023, and February 28, 2026, with about 0.6 million records coming from the DFW area and about 1.3 million records coming from the HGB area. It should be noted that these numbers are lower than the counts for the 2024 I/M evaluation. The dataset appears to have undergone some level of quality control prior to being provided to ERG, as records associated with very high and very low vehicle specific power (VSP) were removed.

The RS contractor matched the RS records to registration records shortly after data collection; therefore, no additional matching was required for this analysis. Matching RS records to registration records enabled subsequent linkage to corresponding I/M test records in the TIMS dataset when a successful match was identified. The RS records provided to ERG included vehicle information obtained through matching with the registration dataset, including model year, make, and model. This information, in addition to the vehicle information in the TIMS dataset, can be used to characterize the on-road fleet for the Comprehensive Method [EPA, 2004] calculations.

The RS records provided to ERG by DPS had already been validated by the RS data collection contractor; therefore, no additional validation of individual data fields was performed in this analysis. However, a filter based on VSP was applied to exclude vehicles observed under very high or very low load conditions. Records with VSP values outside the range of 0 to 35 kilowatts per ton (kW/ton) were removed from the dataset.

Because records with VSP values outside the range of 0 to 60 kW/ton had already been excluded prior to the dataset being provided to ERG, this additional screening step removed only records with VSP values between 36 kW/ton and 60 kW/ton. After applying this criterion, approximately 1.7 million records remained in the dataset, including 600,000 records from the DFW program area and 1.1 million records from the HGB program area.

The counts of available RS records vary every year. For this evaluation, the dataset is very similar in size to that of the previous I/M biennial evaluation in 2024.

V.B. Calculation of the Annual I/M Benefit using the Comprehensive Method

ERG calculated the annual benefit of the Texas I/M program using EPA's Comprehensive Method [EPA, 2004], which pairs RS data collected in the I/M program area with I/M inspections, by vehicle.

ERG calculated the time interval between the RS reading and the I/M test and assigned each observation to a corresponding monthly bin (e.g., one month prior to the initial test, two months prior to the initial test, three months prior to the initial test, one month after the final test, two months after the final test). Any RS readings that occurred within the I/M cycle—that is, between the initial and final inspection—were excluded from the analysis because it was not possible to assume the vehicle's state of repair at the time of the mid-cycle RS measurement.

Four inspection sequence categories were considered in this analysis. Each of the I/M sequences described in Section III.C were combined into these four categories for the purpose of calculating the annual I/M program benefit. The inspection sequence categories are as follows.

- **Single Pass (1P)** – A vehicle completed its annual I/M requirement with a pass on the first inspection.
- **Single Fail (1F)** – A vehicle received a single inspection, which it failed. The dataset does not contain any evidence that the vehicle returned for a re-inspection or that it received a waiver.
- **Initial Fail, then Final Fail (FF)** – A vehicle failed its first annual emissions inspection and then, perhaps after a series of repairs and re-inspections, failed its last annual inspection. Waivers are flagged separately but are not removed from these calculations.
- **Initial Fail, then Final Pass (FP)** – A vehicle failed its first annual emissions inspection and then ultimately passed its last annual inspection to meet the I/M requirements.

The most common sequence category in an evaluation period is always 1P since most vehicles pass their initial OBD inspection each year. This sequence category accounts for more than 90% of the fleet in any evaluation period. The FP sequence category is the next most common and accounts for the majority of remaining sequences. The 1F and FF sequence categories make up the remaining small percentage of sequences, but because they are infrequent and do not result in a passed inspection, they do not contribute to the calculated annual I/M benefit.

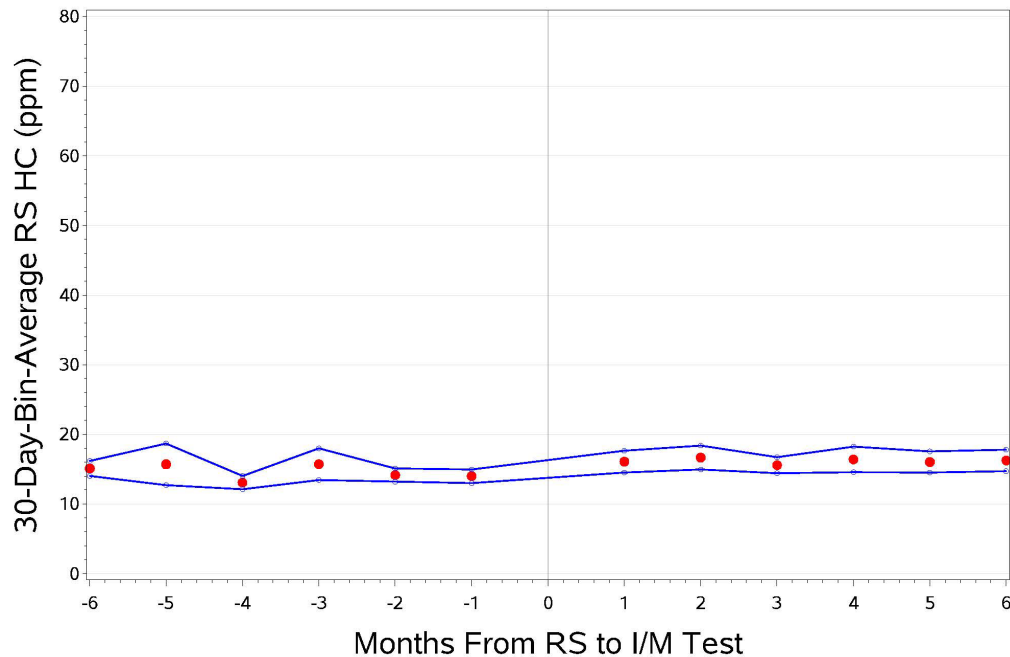
While the Texas I/M program reduces emissions by repairing vehicles that fail an emissions test, emissions from these vehicles are likely to increase again over time until their next I/M inspection, leading to a fleet's "saw tooth" emissions profile that occurs during each inspection cycle as vehicles in the fleet are repeatedly inspected and repaired. This pattern also applies to vehicles that initially pass an inspection. RS data make it possible to observe this gradual increase in emissions, often called emission creep or deterioration, as vehicles that pass their initial inspection (which make up the vast majority of the fleet) progress through the Texas I/M program and experience incremental increases in emissions each year. Over time, as emissions continue to rise and reach sufficiently high levels, a vehicle eventually fails an I/M inspection, undergoes repairs, and experiences a corresponding reduction in emissions. In the years preceding that failure, however, emissions from vehicles that initially passed inspection steadily increased.

A vehicle can be measured by RS at any time before or after its annual I/M inspection. By aligning all RS measurements relative to the timing of the I/M test, and assuming that vehicles failing inspection receive the necessary repairs, the averaged RS measurements can be used to characterize both the emissions reductions attributable to the Texas I/M program and the rate of emissions deterioration between successive I/M inspections. However, it is important to understand that the vehicles with RS measurements taken before the I/M inspection are not the same individual vehicles as those with RS measurements taken after the inspection; therefore, the comparison reflects differences between two separate vehicle groups rather than changes in the same vehicles over time. Because of the large emissions variability of RS emissions measurements, the average RS emissions over time before and after I/M inspection will have a considerable amount of variability even when millions of RS measurements are analyzed. Nevertheless, the calculation provides an estimate of the benefits of the Texas I/M program that is independent of the program itself.

The average RS concentrations of HC, CO, and NO_x by month bin, by I/M sequence category, and by model year group were examined. Because the Texas I/M program is an annual program, the plots were limited to only the RS matches that occurred up to six months before and six months after the I/M test. The HC, CO, and NO_x plots for the entire dataset are shown in Figure V-1 through Figure V-3 for the DFW program area and in Figure V-4 through Figure V-6 for the HGB program area. These figures present

the RS averages (indicated by dots) and the uncertainties associated with these averages at a 95% confidence level (indicated by lines).

**Figure V-1. Average RS HC vs. Month from the I/M Test
RS Readings from the DFW Program Area**



**Figure V-2. Average RS CO vs. Month from the I/M Test
RS Readings from the DFW Program Area**

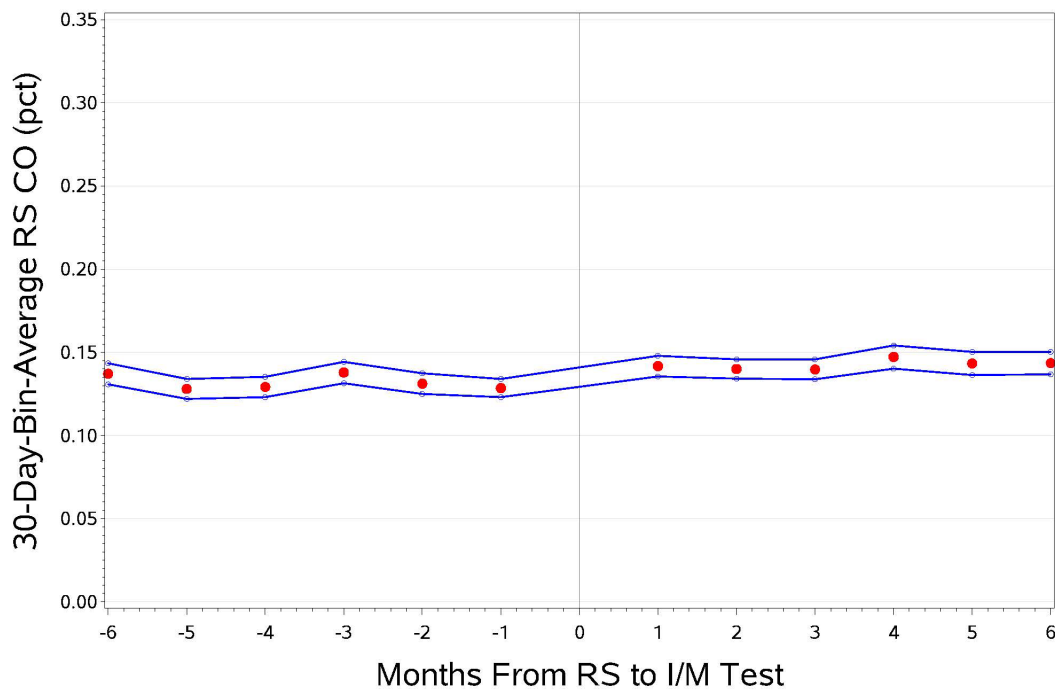


Figure V-3. Average RS NO_x vs. Month from the I/M Test
RS Readings from the DFW Program Area

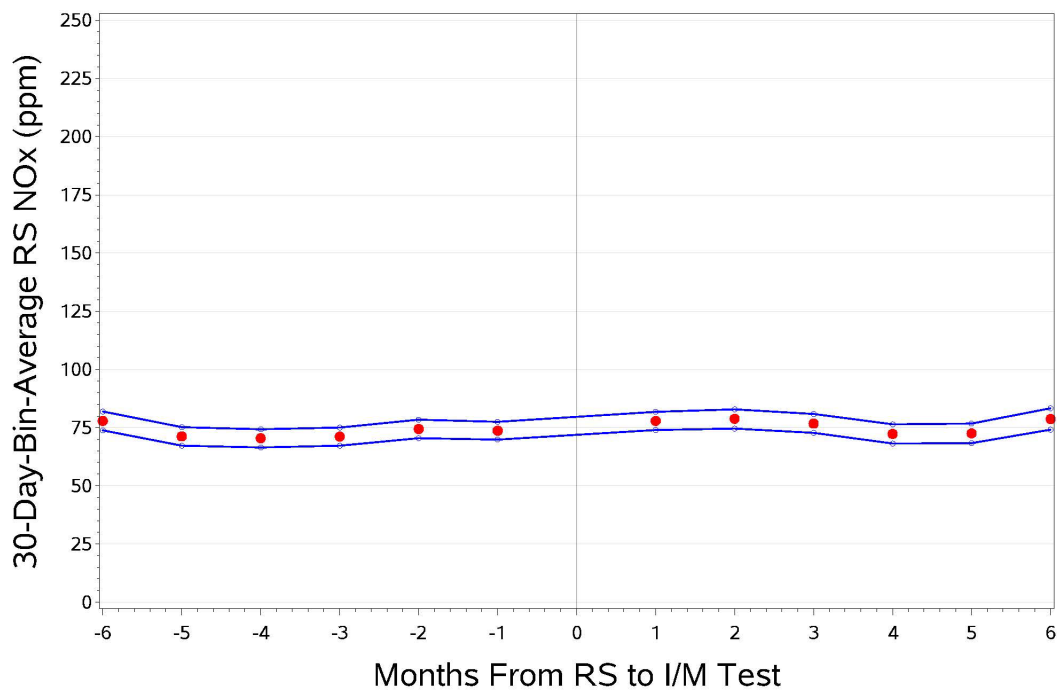


Figure V-4. Average RS HC vs. Month from the I/M Test
RS Readings from the HGB Program Area

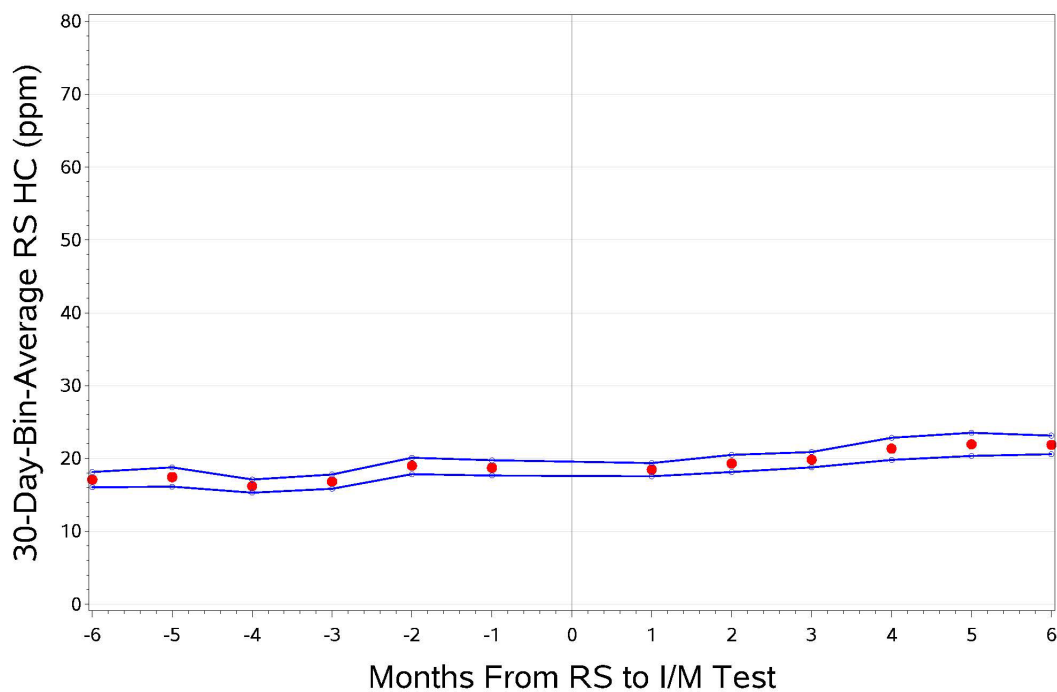


Figure V-5. Average RS CO vs. Month from the I/M Test
RS Readings from the HGB Program Area

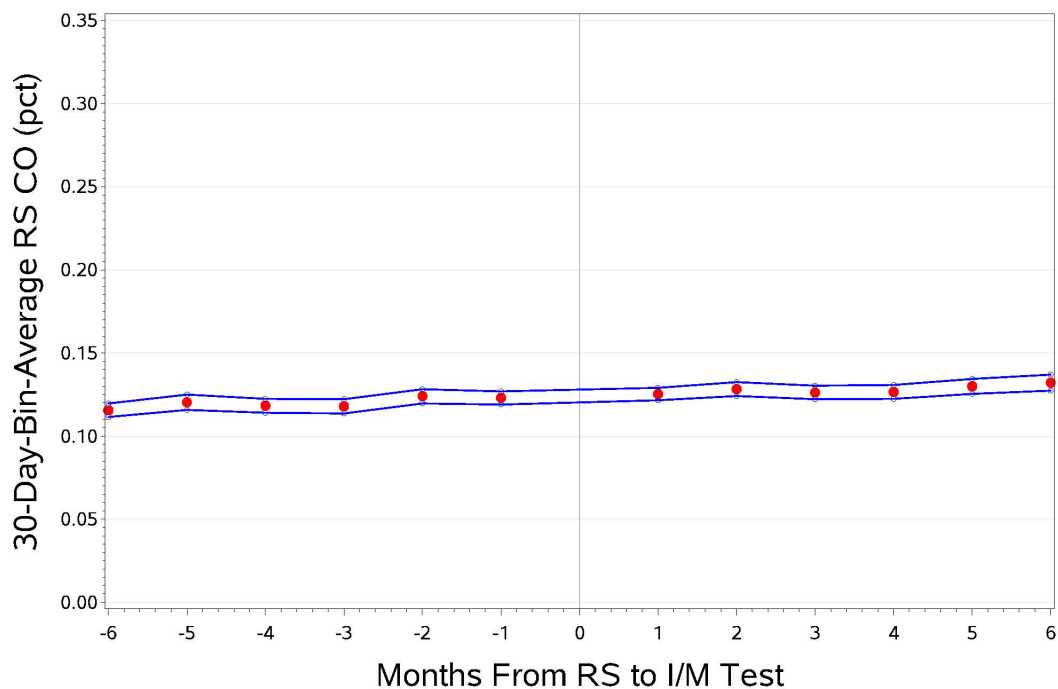
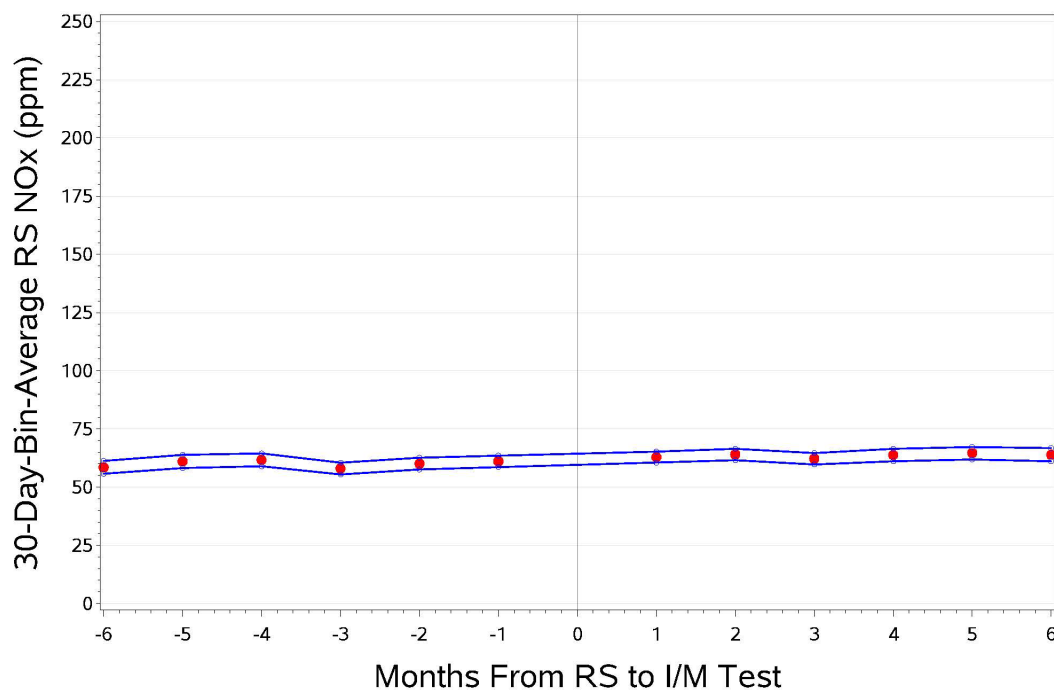


Figure V-6. Average RS NO_x vs. Month from the I/M Test
RS Readings from the HGB Program Area



It is difficult to assess the impact of I/M testing from these figures, as the RS measurements do not show strong trends relative to the timing of I/M inspections. HC readings are relatively constant at approximately 15 parts per million (ppm) in both program areas. For CO, average values in the DFW program area are slightly higher—averaging around 0.15%—than those observed in the HGB program area, which are closer to 0.13%. Similarly, NO_x values are higher in the DFW program area than in the HGB program area, at 75 ppm and 60 ppm, respectively. This pattern of higher RS measurements in the DFW program area compared to the HGB program area was also observed in the 2022 and 2024 I/M evaluations, although the differences shown in the 2026 evaluation are smaller than those reported in the 2024 evaluation.

Figure V-1 through Figure V-6 show that differences between the DFW and HGB program areas are substantially larger than any differences observed in RS measurements with respect to the timing of the I/M inspection. However, when the data are stratified by I/M sequence category, patterns consistent with potential I/M-related emission benefits begin to emerge.

Table V-1 shows the number of records in the RS-matched dataset with the TIMS dataset for both the DFW and HGB program areas that fall into each I/M sequence category. The sample sizes represent the total number of I/M vehicles matched to RS records; however, they do not necessarily include the same individual vehicles before and after the I/M test. The table clearly demonstrates that 1P and FP I/M sequence categories account for the majority of Texas I/M program vehicles observed on the road. Few vehicles that fail and never pass (1F and FF) are observed by remote sensing.

Table V-1. Number of Vehicles in Each I/M Sequence Category for the Dataset of RS Events Matched with I/M Tests

I/M Sequence Category	DFW		HGB	
	Number of Vehicles	Percent	Number of Vehicles	Percent
Pass Initial (1P)	183,336	95.8	383,783	95.8
Fail Initial (1F)	815	0.4	1,520	0.4
Fail Initial, Fail Final (FF)	86	0.0	175	0.0
Fail Initial, Pass Final (FP)	7,200	3.8	15,195	3.8
Other Misc. Sequences	23	0.0	31	0.0
Total	191,460	100.0	400,704	100.0

The plots of mean RS concentrations relative to the timing of I/M inspections were repeated, this time separately for the 1P and FP sequence categories. Figure V-7, Figure V-9, and Figure V-11 show the monthly average RS measurements of HC, CO, and NO_x in the DFW program area relative to the timing of I/M inspections for vehicles that passed initially (1P). Figure V-8, Figure V-10, and Figure V-12 present the results of

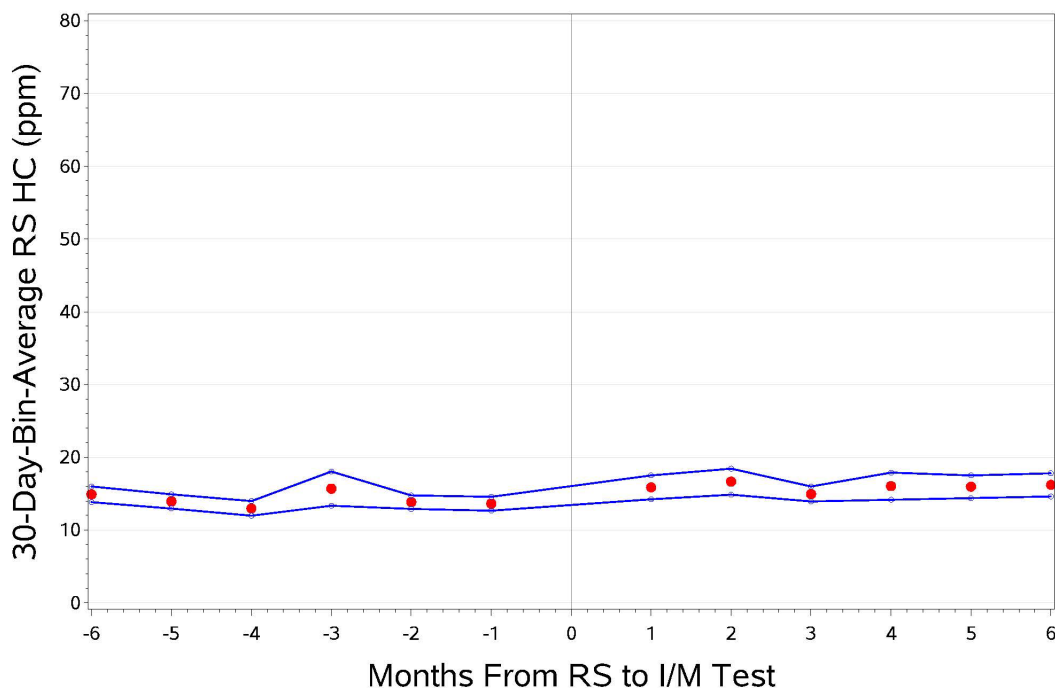
the same monthly average RS tests over time for vehicles that failed initially and then ultimately passed (FP).

The 1P plots, which describe 95.8% of the vehicles in the DFW program area, show small emission increases from the month prior to and the month after the I/M inspection. There is no evidence of a decrease in emissions in the two months preceding the I/M inspection that could be attributed to pre-inspection repairs. Instead, the long-term trend appears to be generally upward, which may be attributed to the gradual emissions deterioration of these vehicles over time.

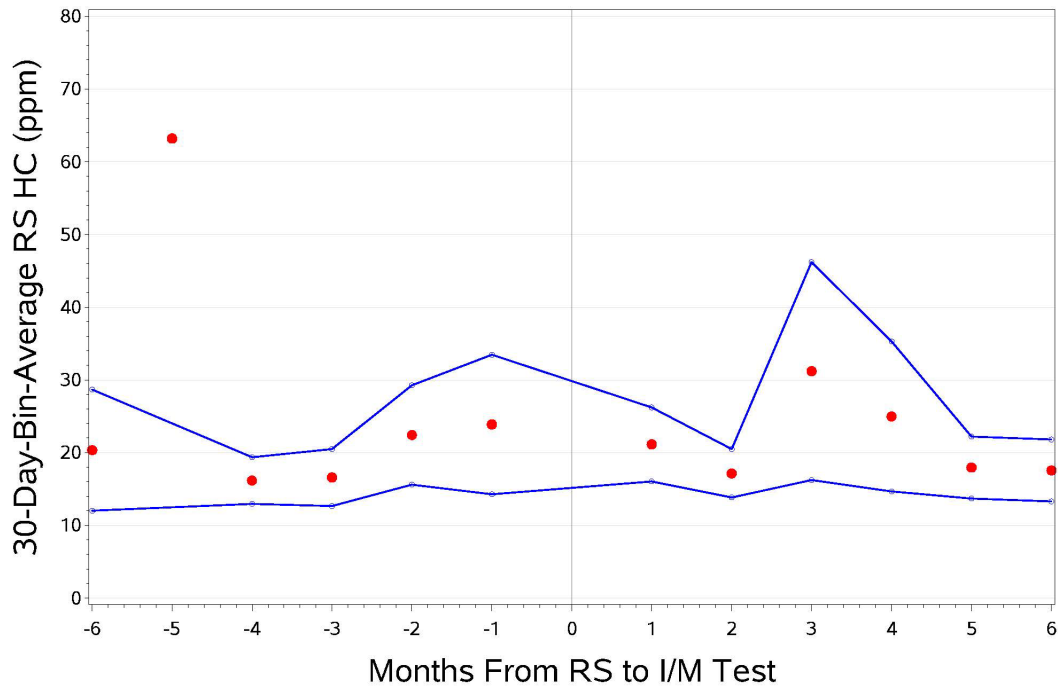
The FP plots, which describe 3.8% of the vehicles in the DFW program area, show downward trends in the emissions at the time of the I/M inspection, or immediately following the inspection. Examining the overall trend of each plot shows that downward jogs at the I/M inspection interrupts the generally upward trend of emissions creep, which is what the Texas I/M program is designed to do.

Grouping vehicles of all I/M sequence categories results in a slightly increasing trend from before to after I/M as seen in Figure V-2 and Figure V-3. This is because although the FP vehicles show substantial emissions decreases, they make up only 3.8% of the DFW fleet. An additional 95.8% of the fleet is made up of 1P vehicles that have slight emissions increases, as an expected result of general long-term emission creep. There was no discernible difference in the plots for the emissions in the HGB program area; therefore, they were not included here to conserve space.

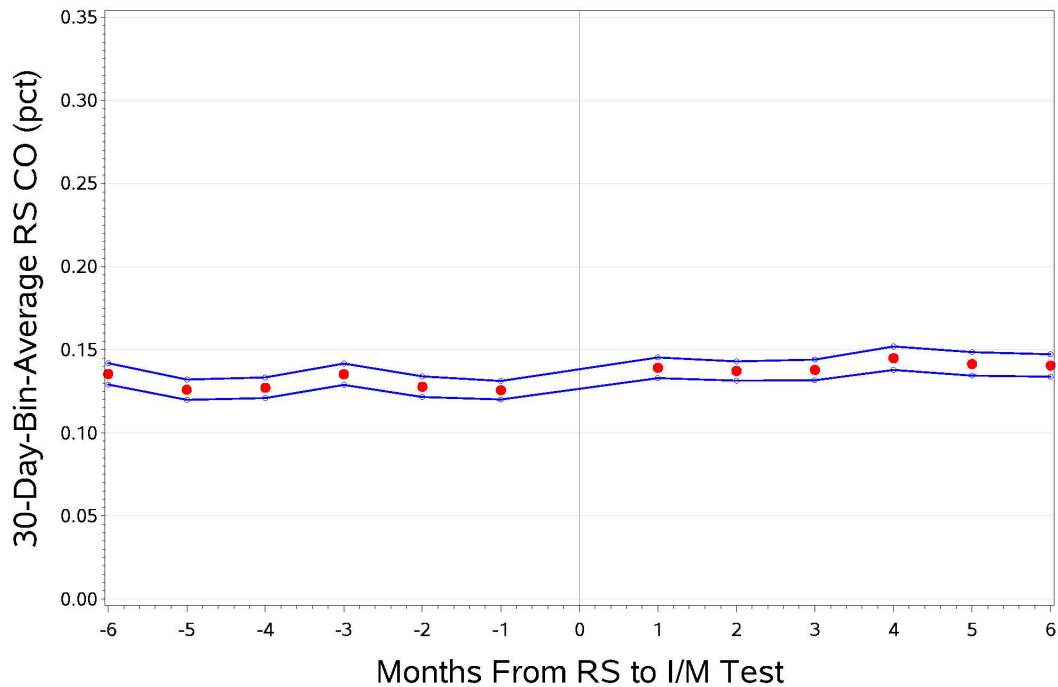
**Figure V-7. Average RS HC vs. Month After the I/M Test for DFW
Vehicles with I/M Sequence Category = 1P**



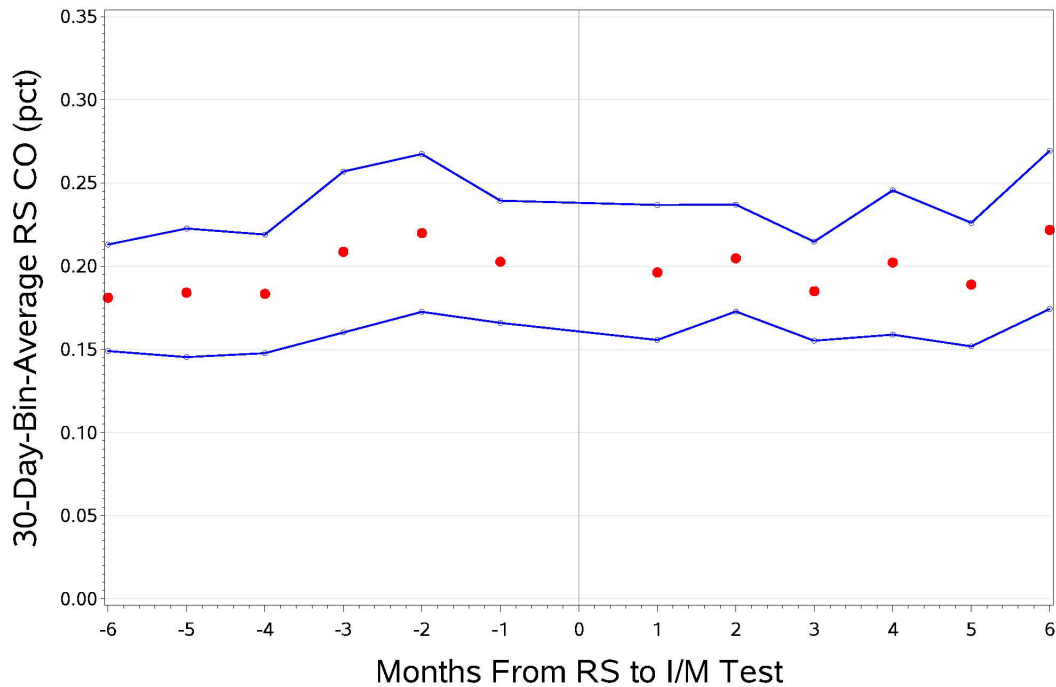
**Figure V-8. Average RS HC vs. Month After the I/M Test for DFW
Vehicles with I/M Sequence Category = FP**



**Figure V-9. Average RS CO vs. Month After the I/M Test for DFW
Vehicles with I/M Sequence Category = 1P**



**Figure V-10. Average RS CO vs. Month After the I/M Test for DFW
Vehicles with I/M Sequence Category = FP**



**Figure V-11. Average RS NO_x vs. Month After the I/M Test for DFW
Vehicles with I/M Sequence Category = 1P**

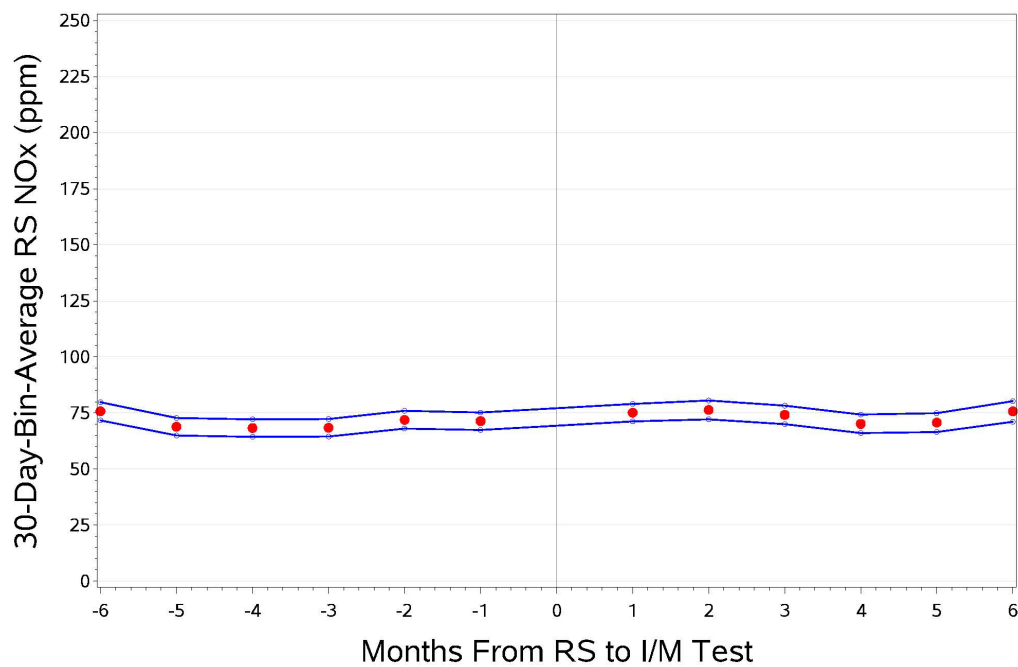
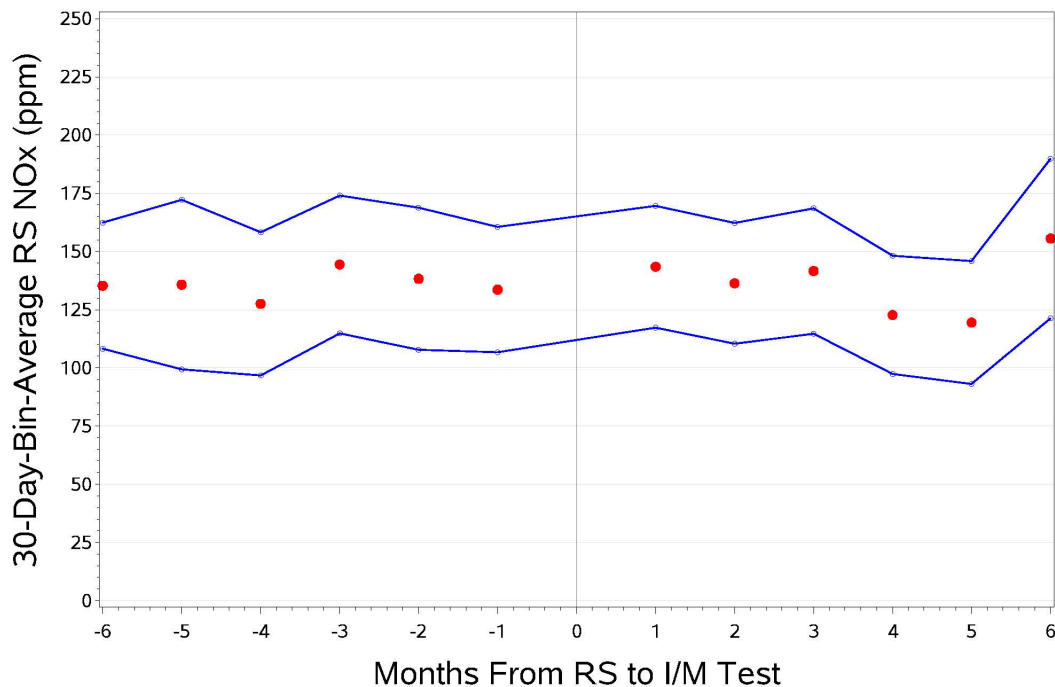


Figure V-12. Average RS NO_x vs. Month After the I/M Test for DFW Vehicles with I/M Sequence Category = FP



To quantify the annual I/M program benefit, monthly bins were combined to obtain a single average RS concentration prior to the I/M test and another average RS concentration after the I/M test. The “before” bin includes all RS measurements collected between 31 and 120 days prior to the initial I/M test. RS measurements collected within one to 30 days before the I/M test were excluded to minimize the influence of pre-inspection repairs on the calculated pre-inspection average. This binning methodology was suggested by EPA in the documentation for the Comprehensive Method. The “after” bin contains all RS measurements collected between one and 120 days following the final I/M test.

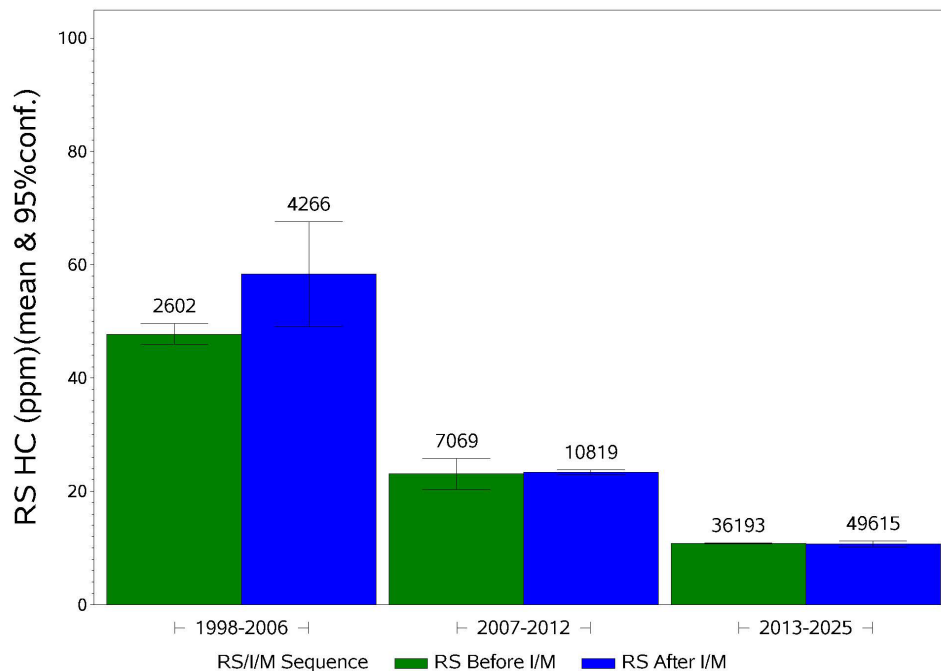
Calculations for the “before” and “after” I/M RS averages were completed for the entire dataset matched between RS and the TIMS for each of the two major I/M sequence categories: FP and 1P. Averages were calculated separately by model year group. At the beginning of this analysis, a comparison of the fleet characteristics between the full I/M fleet and the subset of vehicles matched to RS data showed that the RS-matched fleet included a higher percentage of new vehicles. Accordingly, each I/M sequence category bin was further stratified by model year group. The benefits estimated for each model year group could be weighted by that group’s share of the overall I/M fleet, allowing the benefits observed in the RS-matched fleet to be translated to the full I/M fleet.

These “before” and “after” I/M average RS measurements for FP and 1P vehicles were plotted for both the DFW and HGB program areas in Figure V-13 through Figure V-24.

The graphs show the mean emissions levels, and the error bars show the 95% confidence level uncertainties for the respective averages, including the number of observations. There are two groups of vehicles shown on each plot. The first, labeled “RS Before I/M,” contains vehicles observed by RS prior to their I/M inspection. The second, labeled “RS After I/M,” contains vehicles observed by RS after their I/M inspection.

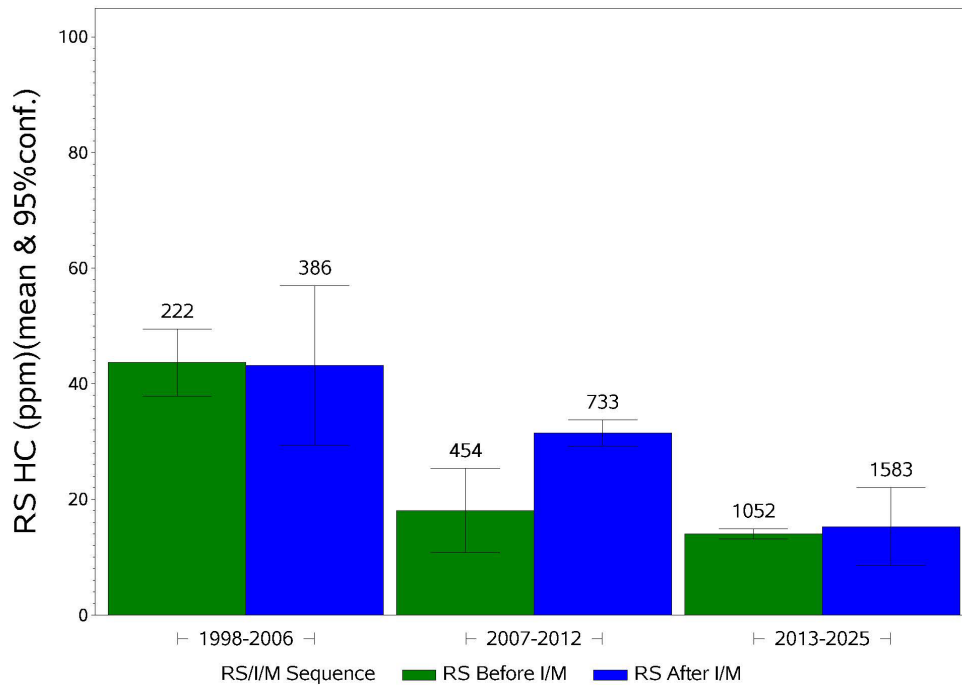
The plots for FP vehicles show that emissions generally decline, particularly among older model year groups; however, in many cases these decreases are not statistically significant, even with thousands of RS observations in the FP category. The plots for 1P vehicles show that in some cases, emissions increase across I/M inspections; however, in many cases these increases are not statistically significant, even with tens of thousands of RS observations in the 1P category.

Figure V-13. Average 1P RS HC by Model Year Group Before and After I/M Test for DFW Vehicles*



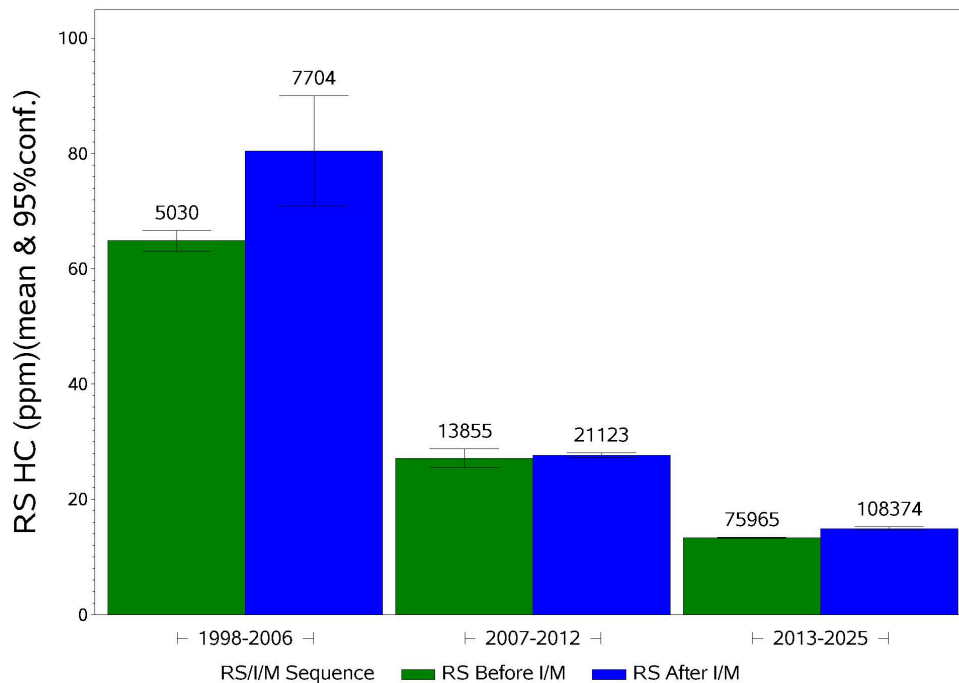
*Note: Vehicles older than model year 2000 are not subject to the program.

Figure V-14. Average FP RS HC by Model Year Group Before and After I/M Test for DFW Vehicles*



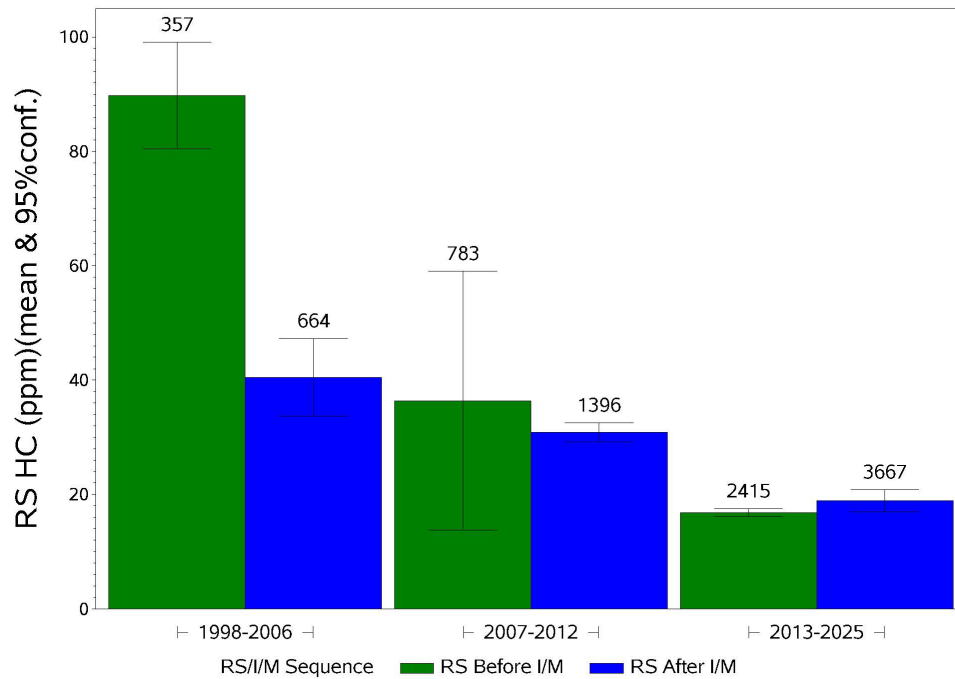
*Note: Vehicles older than model year 2000 are not subject to the program.

Figure V-15. Average 1P RS HC by Model Year Group Before and After I/M Test for HGB Vehicles*



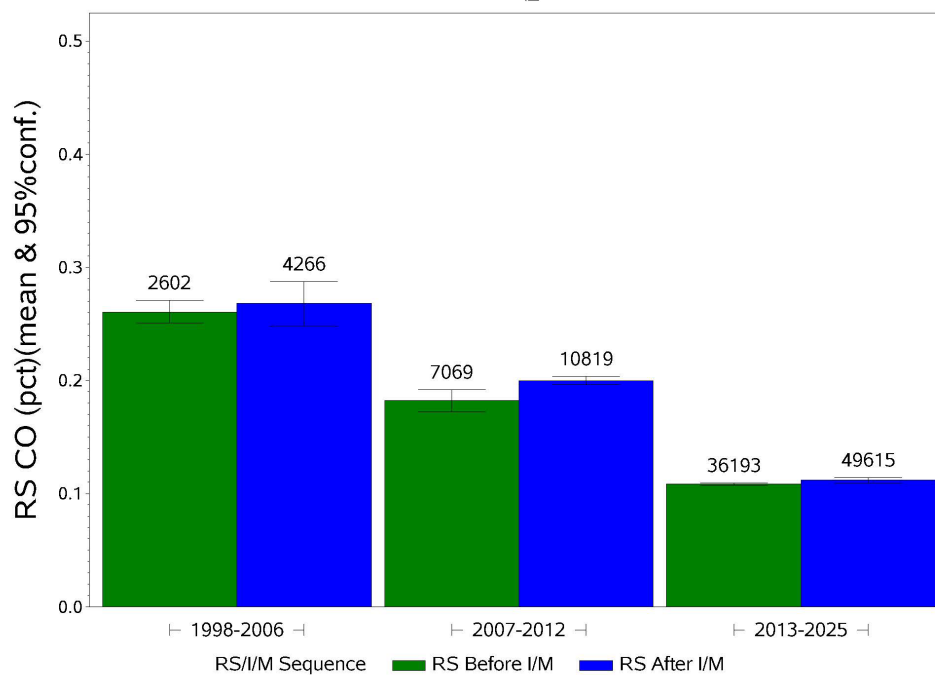
*Note: Vehicles older than model year 2000 are not subject to the program.

Figure V-16. Average FP RS HC by Model Year Group Before and After I/M Test for HGB Vehicles*



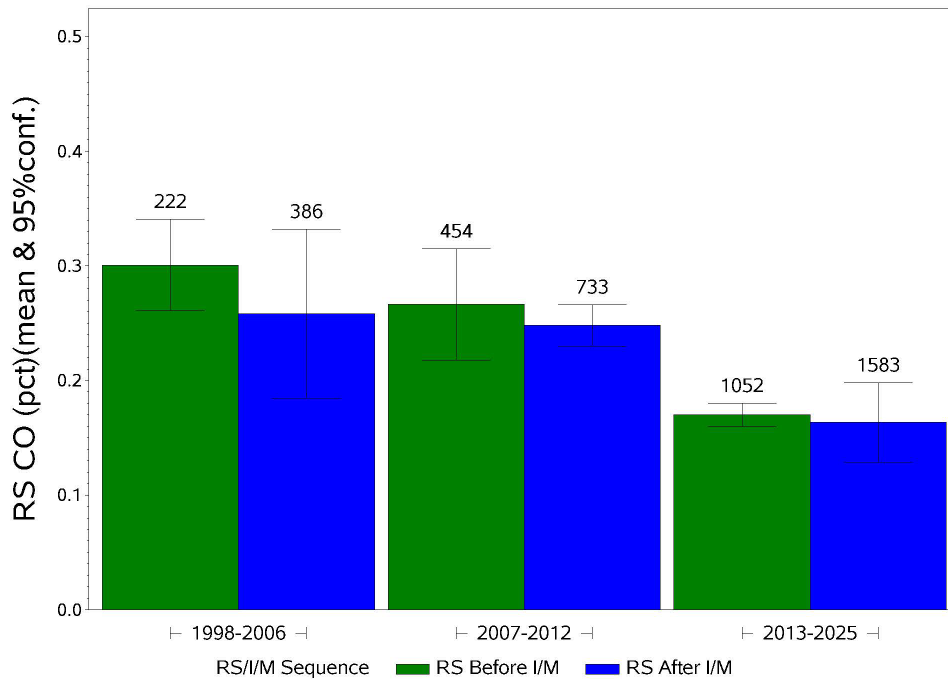
* Note: Vehicles older than model year 2000 are not subject to the program.

Figure V-17. Average 1P RS CO by Model Year Group Before and After I/M Test for DFW Vehicles*



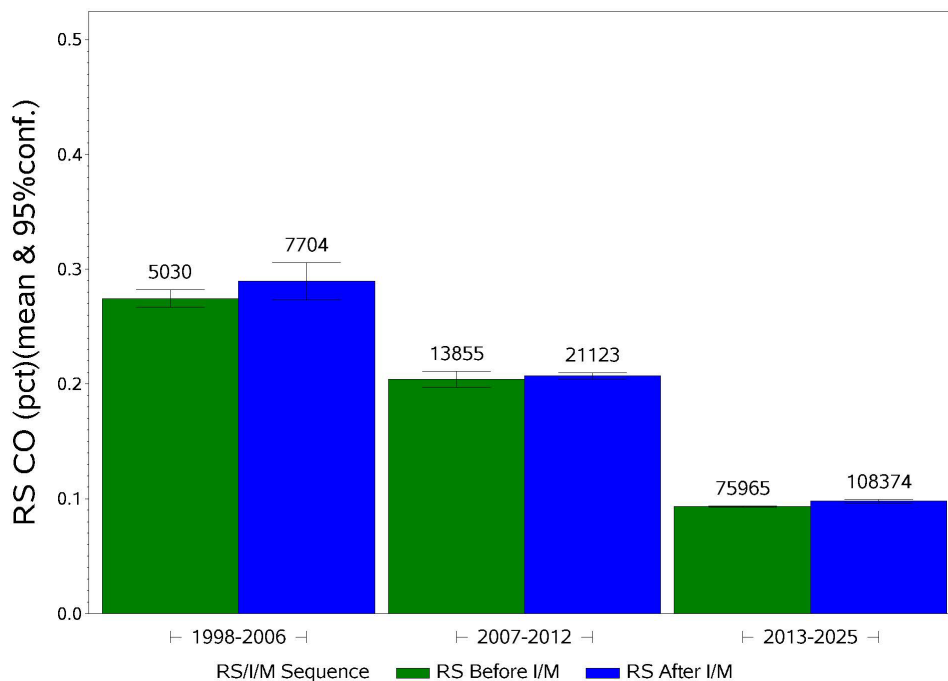
*Note: Vehicles older than model year 2000 are not subject to the program.

Figure V-18. Average FP RS CO by Model Year Group Before and After I/M Test for DFW Vehicles*



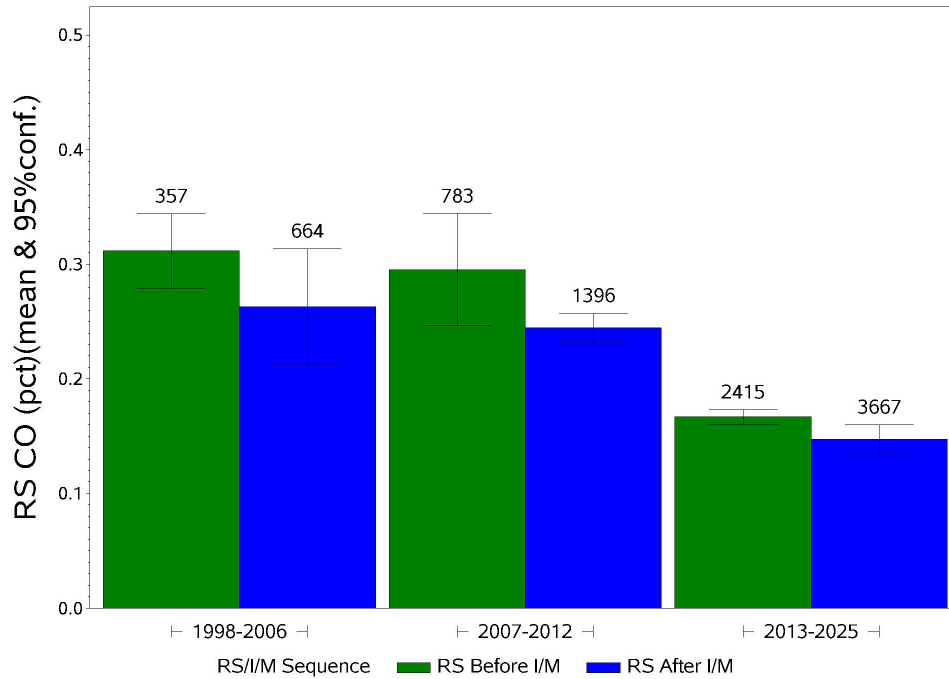
*Note: Vehicles older than model year 2000 are not subject to the program.

Figure V-19. Average 1P RS CO by Model Year Group Before and After I/M Test for HGB Vehicles*



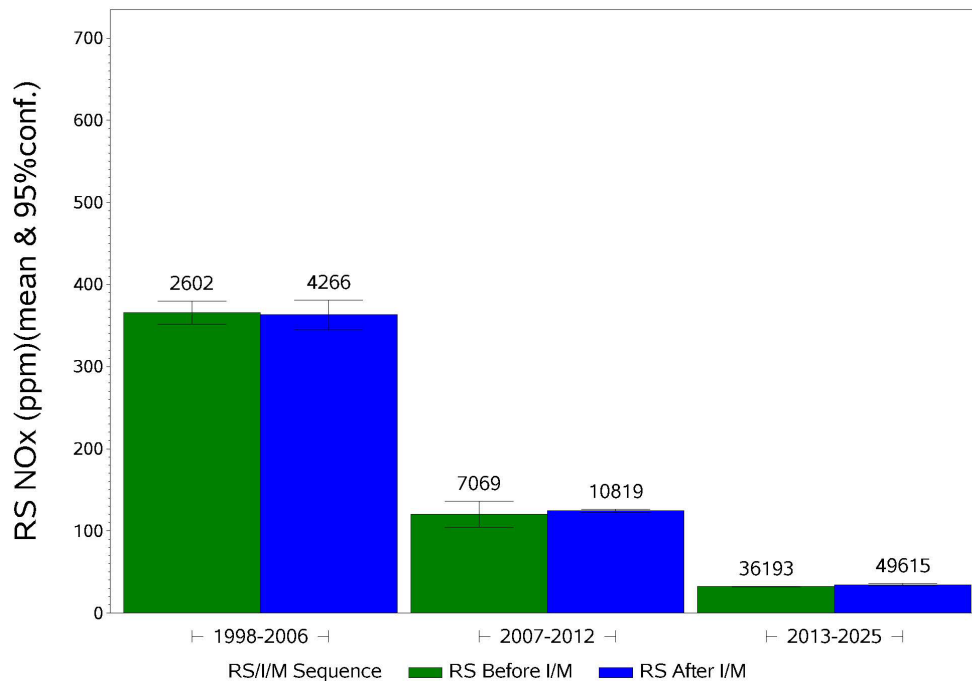
*Note: Vehicles older than model year 2000 are not subject to the program.

Figure V-20. Average FP RS CO by Model Year Group Before and After I/M Test for HGB Vehicles*



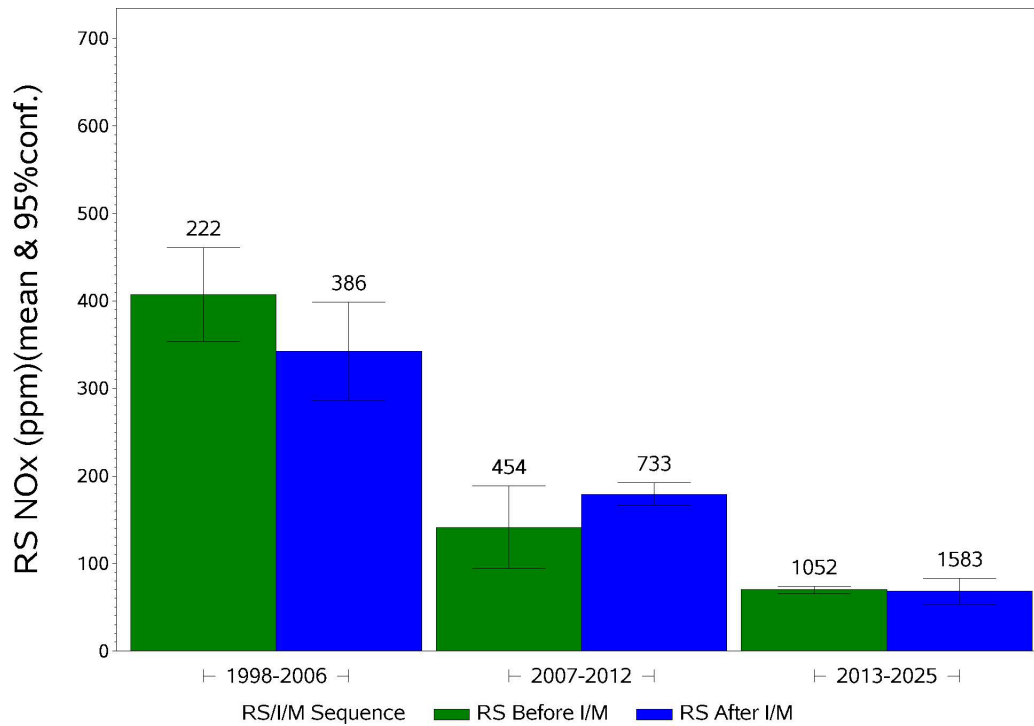
*Note: Vehicles older than model year 2000 are not subject to the program.

Figure V-21. Average 1P RS NO_x by Model Year Group Before and After I/M Test for DFW Vehicles*



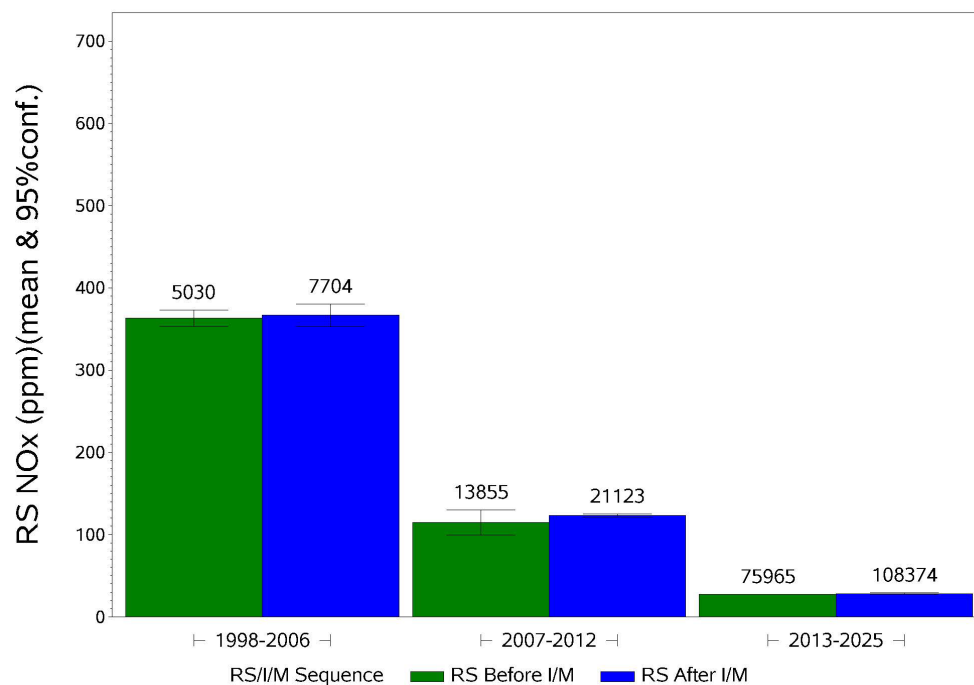
*Note: Vehicles older than model year 2000 are not subject to the program.

Figure V-22. Average FP RS NO_x by Model Year Group Before and After I/M Test for DFW Vehicles*



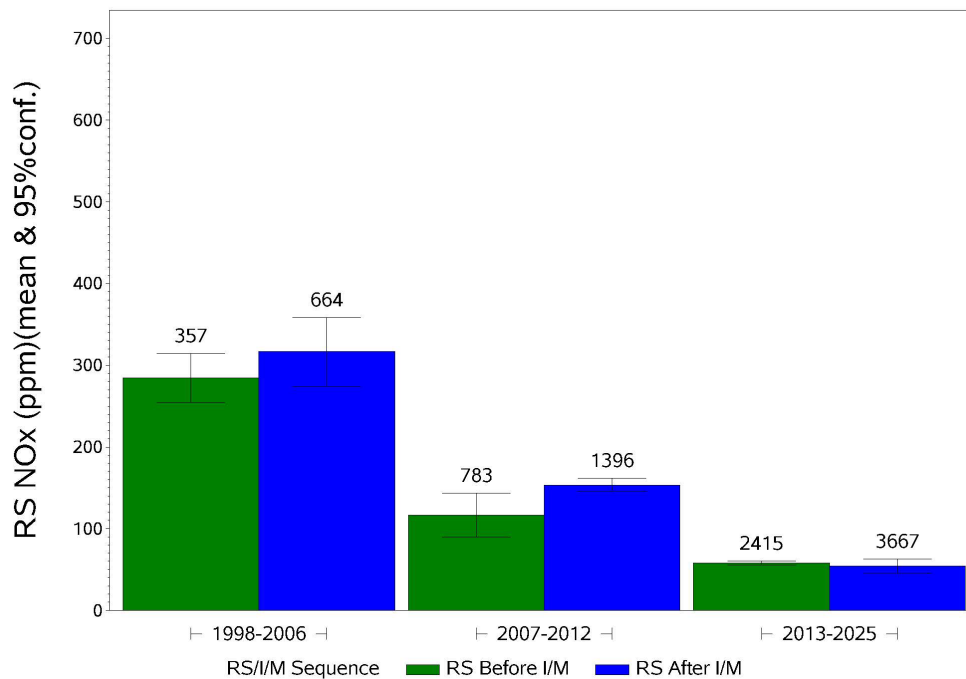
*Note: Vehicles older than model year 2000 are not subject to the program.

Figure V-23. Average 1P RS NO_x by Model Year Group Before and After I/M Test for HGB Vehicles*



*Note: Vehicles older than model year 2000 are not subject to the program.

Figure V-24. Average FP RS NO_x by Model Year Group Before and After I/M Test for HGB Vehicles*



*Note: Vehicles older than model year 2000 are not subject to the program.

The RS average concentrations shown in the figures above are summarized in Table V-2 and Table V-3. The values in Table V-2 show that for vehicles that failed and then passed, HC, CO, and NO_x emissions were substantially reduced for some model year groups, while other model year groups remained constant from before to after the I/M inspection. Table V-3 shows that for 1P vehicles, there was some variability of increases or decreases in RS average concentrations. However, looking back at Figure V-13 through Figure V-18, the changes are almost always within the error bars, and therefore, not statistically significant.

Table V-2. RS Averages Before and After an I/M Test for DFW and HGB for I/M Sequence Category = FP

Model Year Group	RS HC (ppm)		RS CO (%)		RS NO _x (ppm)	
	Before I/M	After I/M	Before I/M	After I/M	Before I/M	After I/M
DFW Program Area						
1998–2006*	43.7	43.2	0.30	0.26	407	343
2007–2012	18.1	31.5	0.27	0.25	141	181
2013–2025	14.0	15.5	0.17	0.16	70	69
HGB Program Area						
1998–2006*	89.8	42.6	0.31	0.26	285	324
2007–2012	36.4	30.7	0.30	0.24	117	154
2013–2025	16.8	19.1	0.17	0.15	58	55

*Note: Vehicles older than model year 2000 are not subject to the program. These are voluntary tests.

Table V-3. RS Averages Before and After an I/M Test for DFW and HGB for I/M Sequence Category = 1P

DFW Program Area						
Model Year Group	RS HC (ppm)		RS CO (%)		RS NO _x (ppm)	
	Before I/M	After I/M	Before I/M	After I/M	Before I/M	After I/M
1998–2006*	47.8	58.5	0.26	0.27	366	363
2007–2012	23.1	23.3	0.18	0.20	120	124
2013–2025	10.8	10.7	0.11	0.11	32	34
HGB Program Area						
Model Year Group	RS HC (ppm)		RS CO (%)		RS NO _x (ppm)	
	Before I/M	After I/M	Before I/M	After I/M	Before I/M	After I/M
1998–2006*	64.9	79.4	0.27	0.29	363	371
2007–2012	27.2	27.7	0.20	0.21	115	124
2013–2025	13.3	14.8	0.09	0.10	27	28

*Note: Vehicles older than model year 2000 are not subject to the program. These are voluntary tests.

The results in Table V-2 and Table V-3 show, for each model year group, the difference in average RS concentrations between measurements taken before and after the I/M inspection, with Table V-2 showing results for FP vehicles and Table V-3 showing results for 1P vehicles. These results are then combined to calculate the overall net effect of the I/M program on emissions. Because RS measurements are primarily collected on freeway on-ramps, newer vehicles are more likely to be observed; as a result, the average vehicle captured in the RS dataset tends to be newer than the average vehicle in the I/M fleet. This difference is shown in Table V-4, which contains the distribution of vehicles among the model year groups for the RS measurements-matched-to-I/M fleet, and for the I/M fleet. The fact that this difference exists (i.e., that the RS measurements-matched-to-I/M fleet is generally newer than the I/M fleet) should be considered when evaluating the overall fleet results. The overall fleet results for the annual I/M benefit are shown in Table V-5. It should be noted that in the absence of an I/M program, fleet emissions are expected to increase as motorists are less likely to make emissions repairs to pass an upcoming I/M test; therefore, the actual emission reductions are likely to be greater than those reported below.

Table V-4. Model Year Distributions for RS-Matched-to-I/M Fleet and I/M Tested Fleet

Model Year Group	DFW				HGB			
	RS-Matched-to-I/M Fleet		I/M Tested Fleet		RS-Matched-to-I/M Fleet		I/M Tested Fleet	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
1998-2006*	12,393	6.5	801,891	9.3	22,634	5.7	778,175	10.0
2007–2012	31,448	16.4	1,594,797	18.4	61,168	15.3	1,508,722	19.4
2013–2025	147,619	77.1	6,266,595	72.3	316,902	79.0	5,501,208	70.6
Total	191,460	100.0	8,663,283	100.0	400,704	100.0	7,788,105	100.0

*Note: Vehicles older than model year 2000 are not subject to the program. These are voluntary tests.

Table V-5. RS Average Concentrations to Evaluate the Annual I/M Benefit

I/M Program Area	I/M Sequence	RS with respect to I/M	Number of Observations	RS HC (ppm)				RS CO (%)				RS NOx (ppm)			
				Mean	UCLM*	LCLM*	Change (%)	Mean	UCLM*	LCLM*	Change (%)	Mean	UCLM*	LCLM*	Change (%)
DFW+HGB	1P+FP	Before	145,997	17.3	17.8	16.8		0.13	0.13	0.12		62	63	60	
	1P+FP	After	219,837	19.2	19.7	18.7	10.9	0.13	0.13	0.13	5.1	67	68	66	8.6
	1P	Before	140,714	17.0	17.5	16.5		0.12	0.12	0.12		60	61	59	
	1P	After	211,027	19.0	19.5	18.5	11.6	0.13	0.13	0.13	5.9	65	66	64	8.0
	FP	Before	5,283	25.3	29.7	20.9		0.21	0.23	0.19		106	115	97	
	FP	After	8,810	24.4	26.4	22.3	-3.7	0.19	0.20	0.18	-10.0	119	126	112	12.3
DFW	1P+FP	Before	47,592	14.9	15.9	13.9		0.13	0.14	0.13		67	69	65	
	1P+FP	After	67,491	16.3	17.1	15.4	9.2	0.14	0.14	0.14	6.4	74	76	72	10.2
HGB	1P+FP	Before	98,405	18.5	19.1	17.8		0.12	0.12	0.12		59	61	58	
	1P+FP	After	152,346	20.5	21.1	19.9	10.9	0.13	0.13	0.13	4.8	64	65	63	8.2
DFW	1P	Before	45,864	14.8	15.8	13.7		0.13	0.13	0.12		64	67	62	
	1P	After	64,784	16.0	16.8	15.1	8.2	0.14	0.14	0.13	6.9	71	73	69	10.2
	FP	Before	1,728	18.9	22.0	15.8		0.21	0.24	0.18		132	150	114	
	FP	After	2,707	23.8	28.7	18.9	25.9	0.20	0.22	0.18	-5.4	139	153	124	5.1
HGB	1P	Before	94,850	18.1	18.7	17.5		0.12	0.12	0.12		58	59	56	
	1P	After	146,243	20.3	20.9	19.7	12.2	0.13	0.13	0.12	5.7	62	63	61	7.2
	FP	Before	3,555	28.4	34.8	22.1		0.21	0.23	0.19		94	104	83	
	FP	After	6,103	24.6	26.6	22.7	-13.4	0.18	0.20	0.17	-12.0	111	119	102	18.1

* - UCLM/LCLM-upper/lower confidence limit

V.C. Calculation of the Annual I/M Benefit- Reference Method

The RS data used in this analysis were collected in the DFW and HGB program areas, where most vehicles are subject to the I/M program. However, some vehicles operating in these areas may not be required to participate in the program, including commuter vehicles registered outside the I/M area, very new vehicles within their two-year exemption period, and vehicles that may otherwise be avoiding program compliance. Unregistered vehicles cannot be included in the RS dataset, because if the observed license plate is not linked to a registered vehicle, then the RS record does not contain any vehicle information and is not used for any analysis.

For this analysis, vehicles observed by RS were divided into two groups: vehicles with no prior participation in the I/M program before the RS observation, and vehicles that had participated in the I/M program prior to the RS observation. The lookback period cutoff for identifying prior I/M inspections was January 1, 2020. This provides a four-year period preceding the 2024-2025 analysis period and is considered sufficient to identify vehicles that were effectively operating under no-I/M conditions at the beginning of 2024.

The sample size of vehicles available for the analysis is shown in Figure V-25, and again in Figure V-26. The first figure uses a linear scale for the vertical axis, while the second figure uses a logarithmic scale, to allow smaller counts to be seen. The figures show that the group of no-I/M vehicles (red) is dominated by vehicles in their new-vehicle exemption period. However, for all model years 2001 and newer, there are at least 1,000 no-I/M vehicles, and that will provide a large enough sample for this analysis.

Figure V-25. Number of RS Vehicles (linear scale) by Model Year and I/M Area

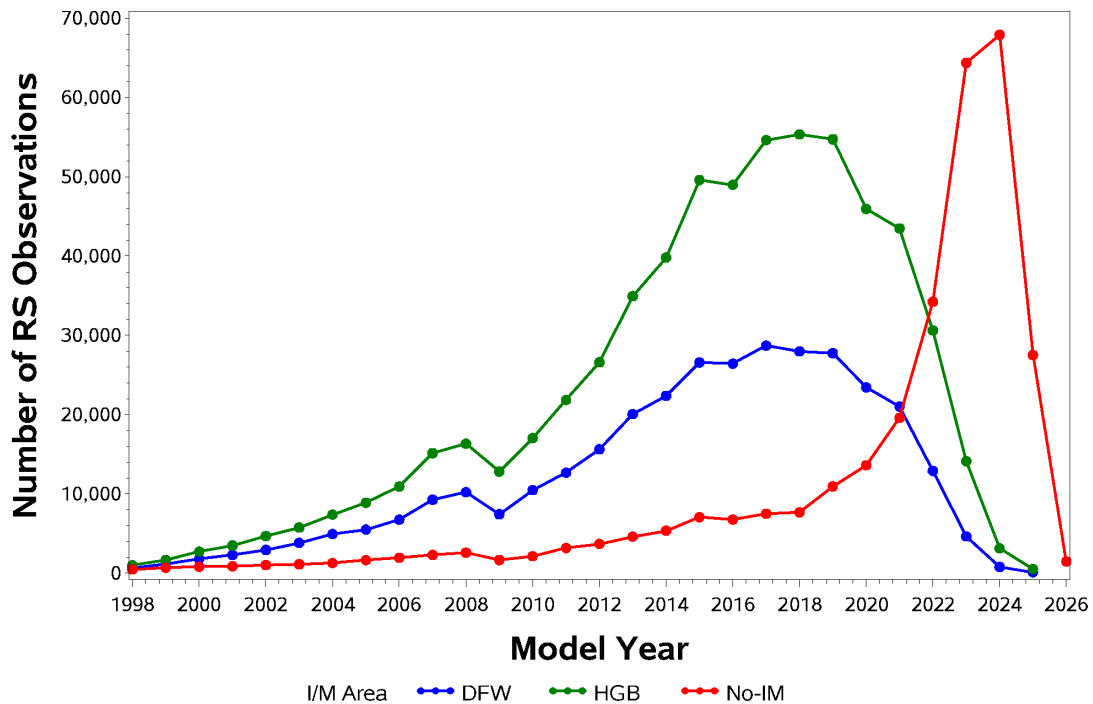


Figure V-26. Number of RS Vehicles (log scale) by Model Year and I/M Area

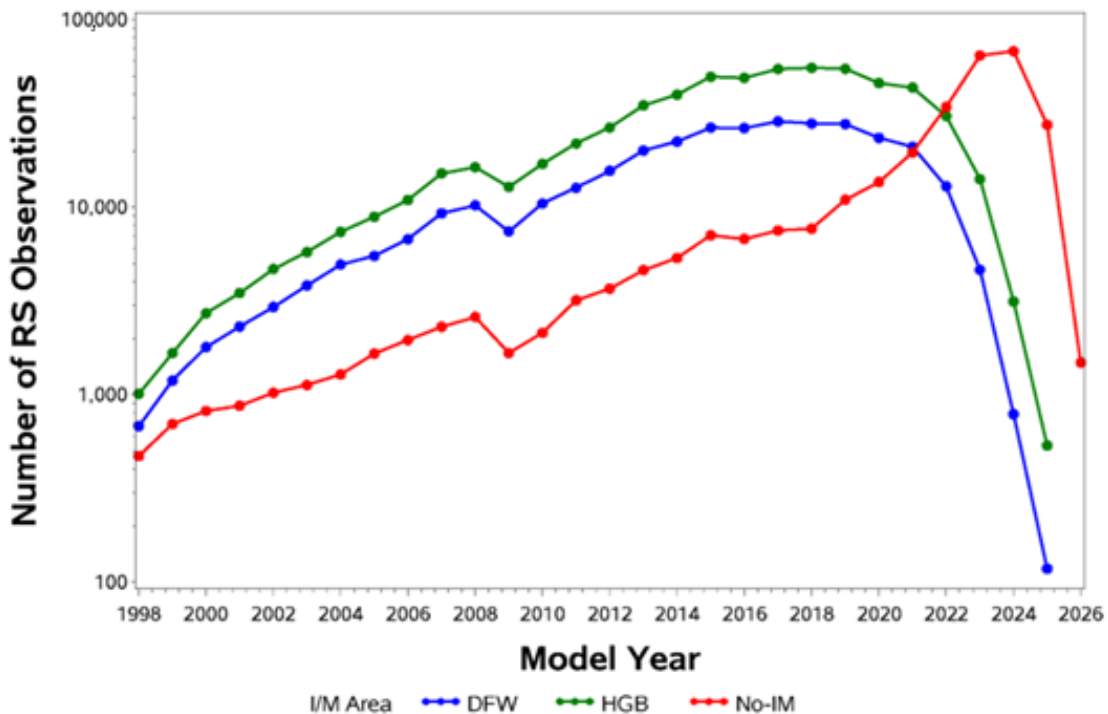
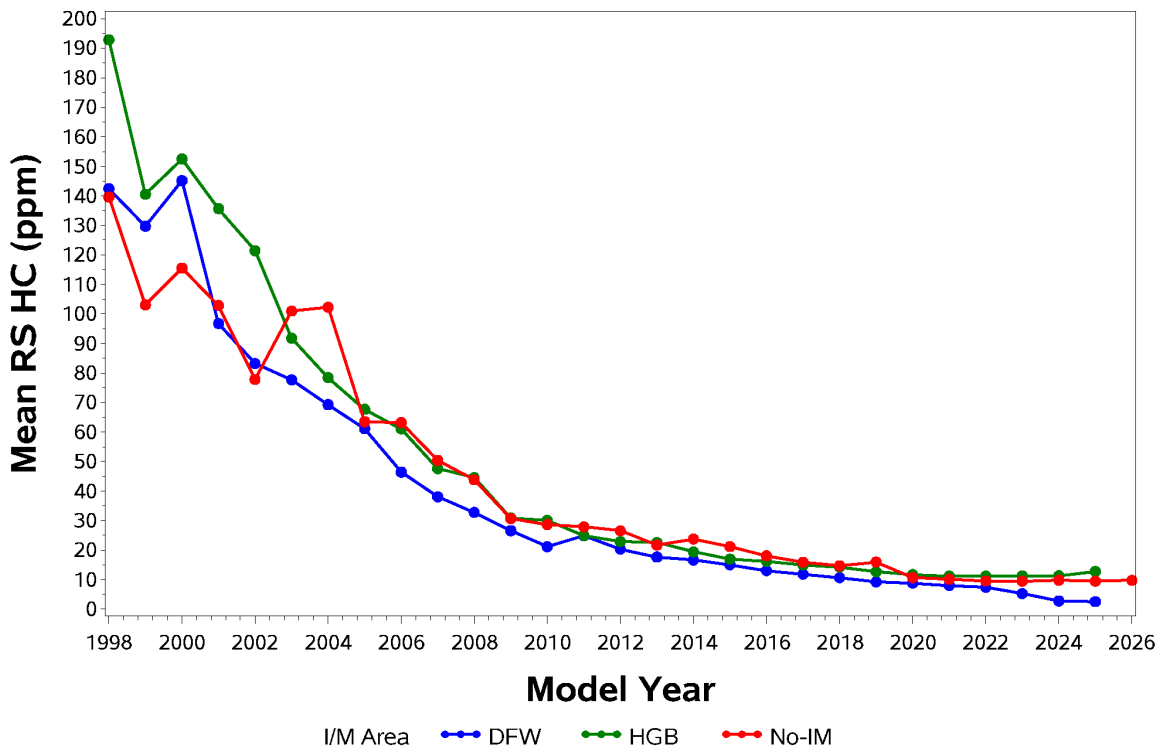


Figure V-27, Figure V-28, and Figure V-29 show the average RS HC, CO, and NO_x, for the DFW, HGB, and no-I/M program areas.⁵ In Figure V-27, the no-I/M program area HC averages are slightly higher than the DFW or HGB program area HC averages for model years in the 2010's. For model years older and newer than that range, the no-I/M program area HC averages are very similar to the DFW and HGB program area averages. The no-I/M program area CO averages shown in the Figure V-28 are lower than the DFW and HGB program area averages for model years 2014 and older. The no-I/M program area CO averages are similar to those of the DFW and HGB program areas for model years newer than 2014. Finally, Figure V-29 shows that the NO_x averages for the no-I/M program area fleet are substantially higher than the averages for the DFW and HGB program areas. This figure indicates that the I/M program's most significant impact is on NO_x emissions. This is important since NO_x plays a major role in ozone formation.

Figure V-27. Average RS HC by Model Year and I/M Area



⁵ These figures were also examined as bar charts with confidence intervals. Due to the large sample sizes in the dataset, the confidence intervals were very small. Therefore, since the overall trends are much easier to see in the line plots, the bar charts are not used here.

Figure V-28. Average RS CO by Model Year and I/M Area

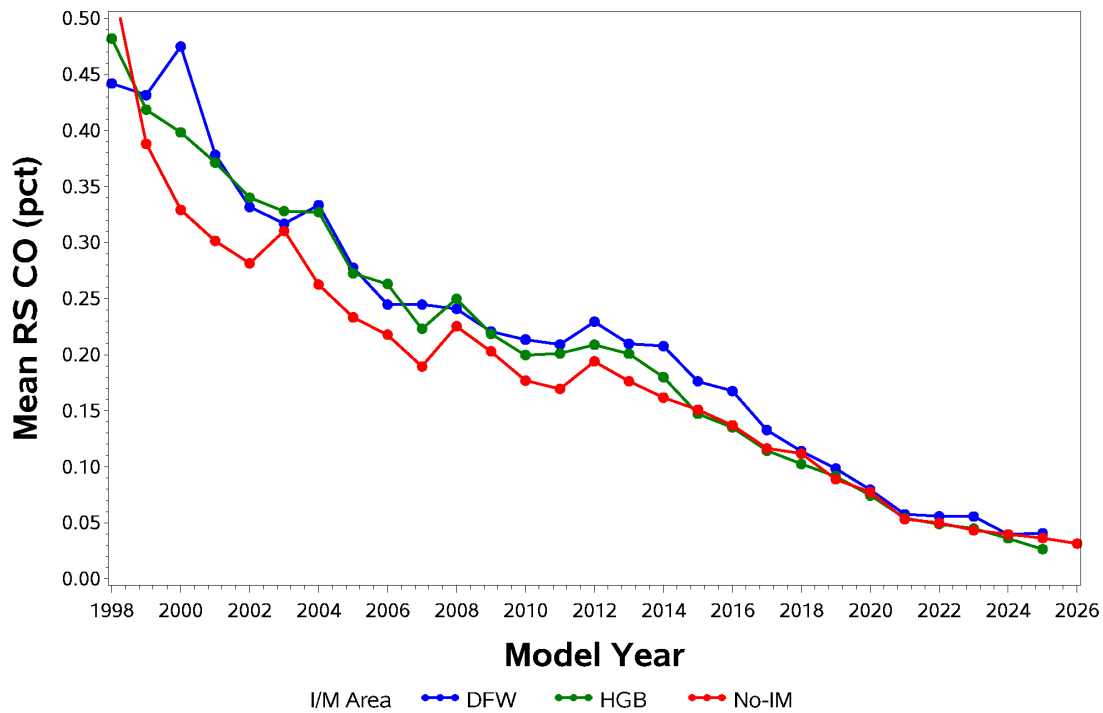
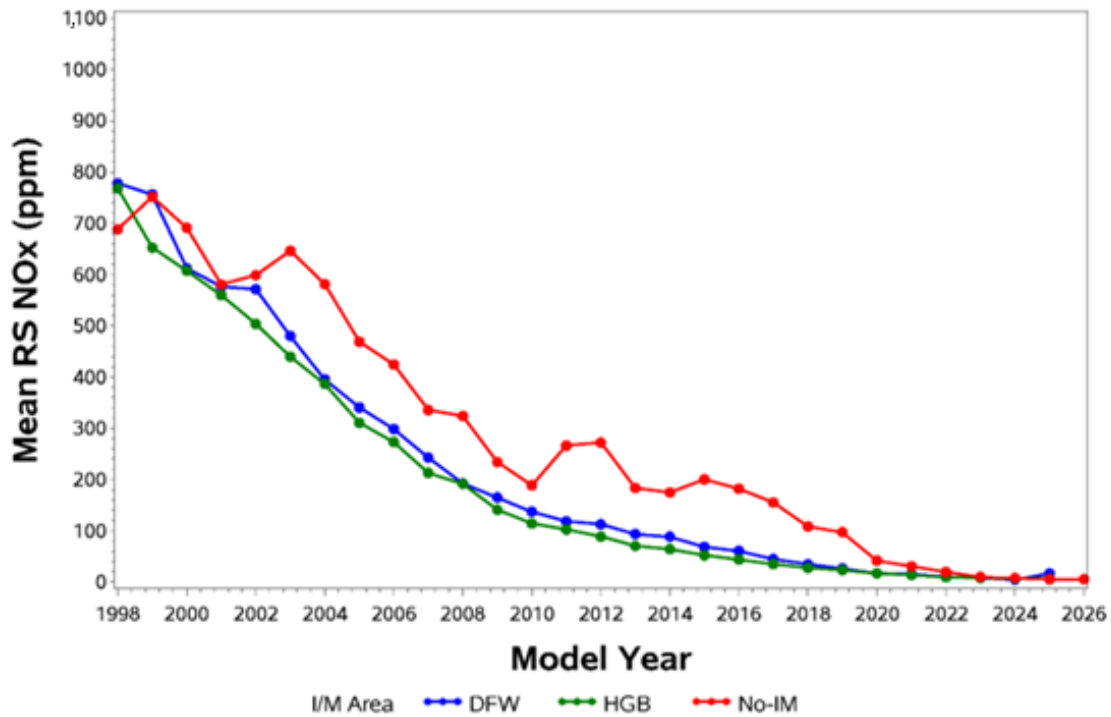


Figure V-29. Average RS NO_x by Model Year and I/M Area



VI. MEASURES FOR EVALUATING STATION PERFORMANCE

For an I/M program to function as designed, it is critical that each I/M inspection station follow the procedures and regulations that have been created to ensure that inspections are consistently performed properly. In this section, the TIMS database records were used to explore a range of ways in which individual I/M stations and inspectors may be circumventing procedures or regulations. These offenses are broken into two categories: tampering with the conduct of the OBD inspection (Section VI.A), and tampering with the overall inspection process (Section VI.B). Subcategories for the two types of indicators are listed below.

- **Tampering with the OBD Inspection: Fraud Checks for Potential Clean-Scanning (Section VI.A)**
 - VIN from vehicle does not match eVIN (VI.A.1)
 - eVIN is missing (VI.A.2)
 - Powertrain Control Module (PCM), Parameter ID (PID), VIN, and/or not ready status changes between inspections (VI.A.3)
 - Communications Protocol differs from expected (VI.A.4)
- **Tampering with the Overall Inspection: Additional Inspection Manipulation (Section VI.B)**
 - Retest too soon to have performed repairs: a passing retest follows a failed inspection within only a few minutes (VI.B.1)
 - Stations with very high safety-only inspection rates (VI.B.2)
 - Switching from LDV (<8,500 GVWR) to HDV (≥8,500 GVWR) to pass inspection (VI.B.3)
 - Stations with an average very high or very low fail rates relative to peers (VI.B.4)

Many stations will have an occasional inspection where the VIN was accidentally entered incorrectly and therefore did not match the eVIN, or the communications protocol is not as expected, or other anomalies. The objective of this section, however, is to identify stations where these events occur more often than expected—that is, to identify statistical outliers. Elevated frequencies at a given station suggest that these occurrences are unlikely to be accidental and instead represent patterns that are substantially more common than at other stations.

For each subcategory, stations were evaluated against the associated list of indicators, and a percentage rank was assigned based on their performance. Ranking stations for each indicator enables comparisons across indicators, even when those indicators yield different types of results. The final results consist of a compilation of each station's rankings across all indicators of potential inspection fraud. These compiled rankings are discussed in Section VI.C.

Government-operated inspection stations tend to exhibit a substantially different range of results than the majority of privately operated stations, skewing the distribution of the results. These stations may be identified by the “G” within the station identification number and were excluded from the following analysis. Fleet inspection stations may also exhibit a different range of results than public stations; however, since it is possible that a fleet might have incentive to perform clean-scanned inspections, fleet inspection stations were included in the analysis.

VI.A. OBD Data Checks for Evidence of Station Fraud

For a vehicle undergoing an OBD inspection, “clean-scanning” refers to the practice of substituting a vehicle with no MIL illumination in place of a vehicle with an illuminated MIL in an attempt to receive a passing test result. Data downloaded from the OBD system during an inspection may be used to identify potential clean-scanning activity. The parameters collected during an OBD inspection establish an electronic signature; if the observed test parameters do not match those expected for the vehicle under inspection, this may indicate that clean-scanning has occurred.

VI.A.1 Mismatch Between Inspector-Entered VIN and Vehicle-Downloaded eVIN

Most of the vehicles undergoing OBD testing report the VIN electronically. VINs downloaded with a Mode \$09 request from the engine control module are referred to as “eVINs.” All model year 2005 and newer LDVs are required to report eVINs. Most vehicles from model year 2002 to 2004 also report eVINs, and a smaller subset of model year 1996 to 2001 do as well. Comparing the inspector-entered VIN against the eVIN via the OBD connection can help verify that OBD inspections are performed on the correct vehicle. Both the inspector-entered VIN and the eVIN are recorded in the TIMS vehicle inspection records.

For this analysis, only OBD inspection records containing a valid eVIN were used; eVINs were validated using the check digit method. Approximately 17.9 million eVIN records were validated within the dataset. For each validated record, the eVIN was compared with the VIN entered during the vehicle inspection, either via keyboard or barcode scan. Of these records, approximately 1.7% (300,109 records) were found to have VIN-to-eVIN discrepancies.

Further examination of these discrepancies, summarized in Table VI-1, revealed that vehicles from the early years of OBD implementation (model years 2000 to 2003) had fairly high discrepancy rates, with 11 to 30% of records showing a mismatch. In contrast, discrepancy rates were very low for later model years, largely reflecting federal requirements that model year 2005 and newer vehicles provide the eVIN through the OBD system. This pattern suggests that VIN-to-eVIN discrepancies may be more prevalent among older vehicles, which are also more likely to fail inspections and therefore could disproportionately benefit from clean scanning. However, Table VI-1 also shows eVIN discrepancy rates separately for inspections that passed and those

that failed, allowing this hypothesis to be evaluated directly. The discrepancy rates were much higher for passing vehicles, especially in the older model years. This result may indicate that these mismatches were primarily the result of clean-scanning. Note that pre-2000 tests are voluntary and are excluded from Table VI-1 results.

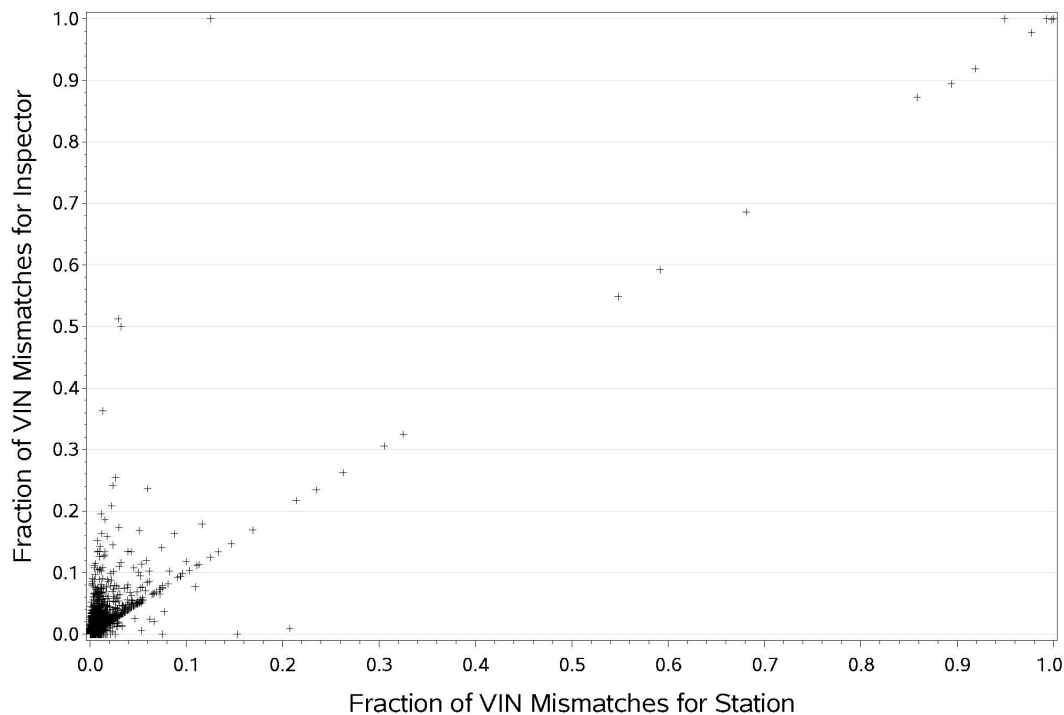
Table VI-1. Rates of OBD-Downloaded and Inspector-Entered VIN Discrepancies by Model Year

Model Year	Total Inspections with Valid eVINs	Number of OBD Inspections with Valid eVIN but VIN Mismatch	Percent of All OBD Inspections with VIN Mismatch	Percent of Passed OBD Inspections with VIN Mismatch	Percent of Failed OBD Inspections with VIN Mismatch
2000	10,930	3,281	30.0	31.7	5.1
2001	75,978	9,166	12.1	13.4	2.3
2002	100,283	11,124	11.1	12.2	2.3
2003	120,901	13,393	11.1	12.1	2.4
2004	157,705	15,016	9.5	10.4	2.3
2005	294,422	18,009	6.1	6.3	4.6
2006	350,596	19,918	5.7	5.9	4.1
2007	475,299	22,993	4.8	5.0	3.1
2008	515,265	20,639	4.0	4.2	1.9
2009	390,177	13,822	3.5	3.7	1.9
2010	519,405	15,220	2.9	3.0	1.5
2011	618,050	16,222	2.6	2.7	1.6
2012	770,230	17,270	2.2	2.3	1.4
2013	968,541	17,079	1.8	1.8	1.0
2014	1,087,747	16,479	1.5	1.5	0.9
2015	1,279,016	15,502	1.2	1.2	0.9
2016	1,277,798	12,463	1.0	1.0	0.8
2017	1,395,214	11,178	0.8	0.8	0.8
2018	1,407,643	8,902	0.6	0.6	0.7
2019	1,424,268	7,287	0.5	0.5	0.7
2020	1,274,043	5,558	0.4	0.4	0.7
2021	1,276,675	4,439	0.3	0.3	0.9
2022	1,158,510	3,111	0.3	0.3	0.9
2023	705,061	1,361	0.2	0.2	1.0
2024	172,607	377	0.2	0.2	0.9
2025	43,862	104	0.2	0.2	0.8
Total	17,870,226	299,913	1.7	1.7	1.6

The rate at which VIN-to-eVIN discrepancies were recorded was also calculated for each station that performed OBD inspections, and for each inspector. These rates are compared graphically in Figure VI-1. The horizontal axis shows the fraction of OBD inspections that contained a VIN-to-eVIN discrepancy for each station, while the vertical axis shows the fraction of OBD inspections with a VIN-to-eVIN discrepancy for each inspector. To reduce errors due to small sample size, stations or inspectors that

performed fewer than 100 inspections were excluded from the plot. The large cluster of points at the bottom left corner of the plot includes most stations and inspections: this majority had a near-zero rate of VIN-to-eVIN discrepancies. The points plotted closer to 1.0 on the horizontal or vertical axis indicate stations or inspectors that almost always produced OBD records with a VIN-to-eVIN discrepancy. These very-high rates could in part result from practices other than clean-scanning, such as manual data entry errors when the VIN is entered, or issues with invalid or unavailable eVINs (e.g., earlier model year vehicles or those with PCM replacements).

Figure VI-1. Rates of OBD-Downloaded and Inspector-Entered VIN Discrepancies by Station and Inspector



One additional factor that was calculated for each station was the number of times the same eVIN was downloaded in different OBD inspections. If clean-scanning is taking place, there is a good chance that the “clean” vehicle would be used repeatedly, and its eVIN would be downloaded numerous times, whereas VIN typos would vary with each inspection. This analysis identified that some stations were downloading the same eVIN during different OBD inspections and revealed a single station had downloaded the same eVIN in over 49,000 inspections. The next most common eVINs were downloaded 33,000 times, and 13,000 times.

These VIN-to-eVIN mismatch findings were condensed into a rank for each station, based on the fraction of inspections that revealed a VIN-to-eVIN discrepancy. Stations that performed fewer than 100 OBD inspections over the two-year period were excluded from the analysis due to the possibility of spurious results from the small

sample size. The ten stations with the highest VIN-to-eVIN mismatch rates are listed below in Table VI-2. The table shows the rate at which there was a discrepancy between the entered VIN and the eVIN, out of all inspections at that station that included a 17-digit VIN in both fields. The table also shows the maximum number of times a single VIN was tested at each station.

Table VI-2. Ten Stations with Highest Rates of OBD and Entered VIN Mismatches

Station Rank	Percent of Inspections Where VIN Did Not Match	Total Number of Inspections Performed at Station	Maximum Number of Tests on a Single VIN	Percentile Rank for Station
1	100.0	84,675	48,926	100.0
2	100.0	9,766	6,284	100.0
3	100.0	668	668	100.0
4	100.0	14,420	8,793	99.9
5	100.0	13,125	13,125	99.9
6	100.0	4,295	4,223	99.9
7	99.8	75,746	33,481	99.9
8	99.3	6,512	4,511	99.9
9	97.7	442	164	99.9
10	94.9	1,067	1,009	99.8

VI.A.2 eVIN is Missing

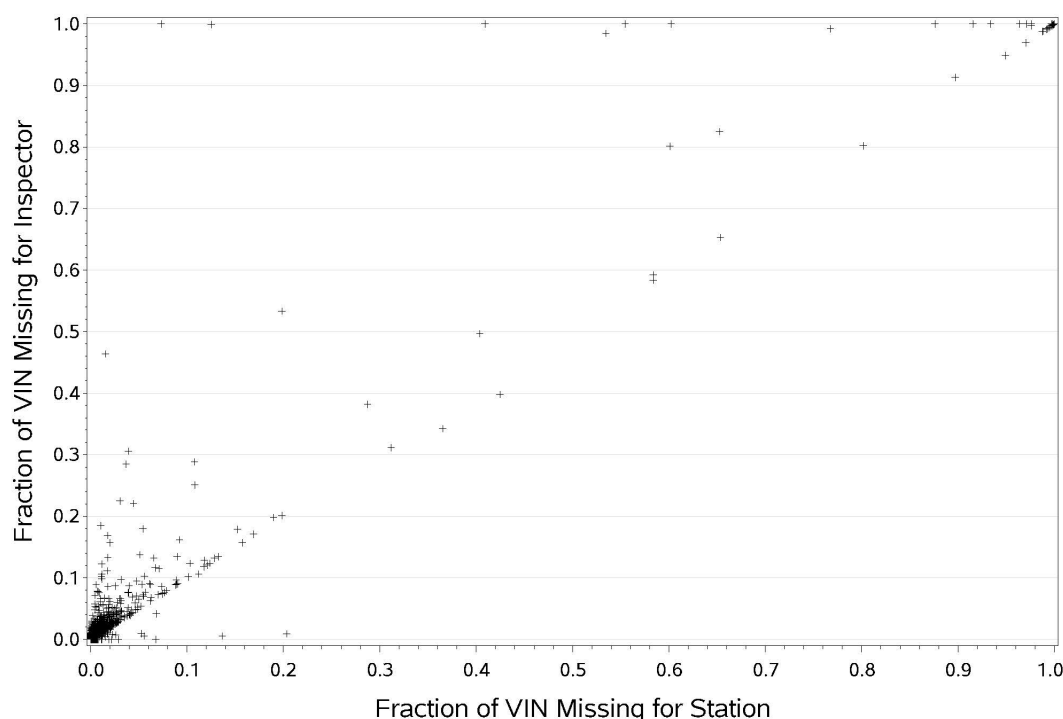
Model year 2005 and newer vehicles are required to provide an eVIN that is downloaded during OBD inspection. For this analysis, approximately 18.4 million OBD inspection records for model year 2005 and newer vehicles from the two-year evaluation period were evaluated for missing eVINs. For each of these records, the eVIN was checked and the record flagged if the eVIN was missing. Of the OBD inspections for model year 2005 and newer vehicles, approximately 0.9 million inspections had a missing eVIN (i.e., entirely blank or entered as “N/A”). The counts by model year are given in Table VI-3. Rates are low for the newest model years, and much higher for the older model years, indicating that clean-scanning may be occurring. The table also shows the rates of missing eVINs separately for passed and failed inspections. It can be seen that the rates of missing eVINs are far higher for passed inspections than for failed inspections, which is another indication that clean-scanning or some type of program fraud may be occurring.

Table VI-3. Rates of OBD Inspections without eVIN by Model Year

Model Year	Total OBD Inspections	Number of OBD Inspections with Missing eVIN	Percent of All OBD Inspections with Missing eVIN	Percent of Passed OBD Inspections with Missing eVIN	Percent of Failed OBD Inspections with Missing eVIN
2005	366,726	67,931	18.5	19.7	7.1
2006	429,214	75,070	17.5	18.5	6.9
2007	571,320	93,205	16.3	17.3	5.4
2008	602,354	84,743	14.1	15.0	1.8
2009	447,388	55,621	12.4	13.3	1.4
2010	584,159	62,873	10.8	11.4	1.6
2011	687,483	67,489	9.8	10.4	1.6
2012	841,576	69,635	8.3	8.7	1.1
2013	1,041,969	71,571	6.9	7.2	1.1
2014	1,160,226	70,840	6.1	6.3	1.1
2015	1,346,011	65,667	4.9	5.0	1.3
2016	1,329,112	50,566	3.8	3.9	1.1
2017	1,439,336	43,592	3.0	3.1	1.0
2018	1,441,379	33,523	2.3	2.4	0.9
2019	1,451,892	27,850	1.9	1.9	1.0
2020	1,292,961	19,079	1.5	1.5	0.9
2021	1,290,507	14,121	1.1	1.1	1.1
2022	1,167,856	9,737	0.8	0.8	1.0
2023	709,789	5,091	0.7	0.7	1.0
2024	173,725	1,223	0.7	0.7	0.6
2025	44,138	284	0.6	0.7	0.2
Total	18,419,121	989,711	5.4	5.5	2.0

The rate at which eVINs were missing was calculated for each station that performed OBD inspections, and for each inspector. These are compared graphically in Figure VI-1. The horizontal axis shows the fraction of OBD inspections that contained no eVIN for each station, while the vertical axis shows the fraction of OBD inspections that contained no eVIN for each inspector. To reduce errors due to small sample size, stations or inspectors that performed fewer than 100 inspections were excluded from the plot. The large cluster of points at the bottom left corner of the plot includes most stations and inspections: these OBD inspections almost always included an eVIN. The points closer to one on the horizontal or vertical axis indicate stations or inspectors that almost never performed OBD inspections that contained an eVIN.

Figure VI-2. Rates of OBD Inspections without eVIN by Station and Inspector



These findings of missing eVINs were condensed into a rank for each station based on the fraction of inspections that did not include an eVIN. Stations that performed fewer than 100 OBD inspections over the two-year period were again excluded from the results, due to the possibility of spurious results from the small sample size. As an example of the findings, the 10 stations with the highest rates of missing-eVINs are listed below in Table VI-4. The table shows the rate at which the eVIN was missing from OBD inspections performed on model year 2005 and newer vehicles at the station.

Table VI-4. 10 Stations with Highest Rates of Inspections without Downloaded eVINs

Station Rank	Percent of Inspections Without eVIN	Total Number of Inspections Performed at Station	Percentile Rank for Station
1	100.0	1,097	100.0
2	100.0	10,044	100.0
3	100.0	33,548	100.0
4	100.0	25,097	99.9
5	100.0	14,353	99.9
6	100.0	218	99.9
7	100.0	82,561	99.9
8	100.0	58,631	99.9
9	100.0	534	99.9
10	100.0	818	99.8

VI.A.3 Comparison of Vehicle-Specific Information between the First Test and Subsequent Tests

The purpose of this analysis was to compare OBD-downloaded information from each vehicle's initial inspection with the OBD-downloaded information from subsequent retests of the same vehicle. Certain OBD data elements may be combined to create a unique "electronic profile" for each vehicle, and that profile should remain consistent between the initial inspection and subsequent re-inspections. If the electronic profile changes from one inspection to the next, inspection fraud may be suspected. For this analysis, only vehicle inspection cycles that included an initial test and at least one retest were used, and only records with available readiness monitor values were included. These criteria reduced the dataset from approximately 20 million OBD inspections to about 1.7 million inspections, including 801,000 initial inspections and 900,000 retests.

Two separate OBD-based profile types were developed for each vehicle and compared between the initial inspection and subsequent re-tests:

1. **Electronic Identification Profile:** Based on static OBD parameters expected to remain constant for a given vehicle; and
2. **OBD Monitor Configuration Profile:** Based on the monitored/not-monitored status (supported/not supported status) of selected readiness monitors that vary meaningfully across vehicle configurations.

Electronic Identification Profile

In earlier I/M program evaluations (i.e., 2016 and earlier), three variables were used to create the first "electronic identification profile" for each vehicle: the eVIN, the PCM ID, and the PID count. Beginning with the 2018 analysis, three additional variables were added: the communications protocol (COMM_PROT), the calibration ID (CAL_ID), and the CVN (calibration verification number). A summary of the downloaded values for these six variables from OBD tests conducted during the biennial evaluation period is provided below.

- **eVIN:** eVINs (valid or invalid) were only available in 90% of the test records. The eVIN or the manually entered VIN was missing in the remaining 10% of the OBD test records. The 10% of records that did not download correctly could be attributed to factors other than inspection fraud, such as vehicle age, ECM replacement, or other factors. As a result, use of the eVIN alone would not be sufficient to positively identify clean-scanning.
- **PCM ID:** The PCM ID was available in all but 1,535 of the test records. There were 62 unique PCM ID values, but 70% of all PCM IDs had a value of "E8" and 16% had a value of "10." Two other PCM IDs each represented another 4% of records, three other PCM IDs each comprised an additional 1% of the test records, and the

remaining test records were distributed among the other PCM IDs. Because of this, as with the eVIN, use of PCM ID alone would not be sufficient to positively identify clean-scanning (a substituted vehicle could easily have a value of “E8” or one of the other most common PCM IDs).

- **PID Count:** There were 99 unique PID count values and all but 80,000 OBD test records contained a value for PID Count. Nine PID Count values were seen in 50% of all OBD test records, while the remaining test records contained one of the remaining PID Count values. Therefore, the use of the PID Count alone would not be sufficient to positively identify clean-scanning.
- **COMM_PROT:** There were seven unique values and all OBD test records contained a value for the COMM_PROT. Two COMM_PROT values were used for 84% of records, so the use of COMM_PROT alone would not be sufficient to positively identify clean-scanning.
- **CVN and CAL_ID:** CVN and CAL_ID each contain hundreds of unique values. These variables could be quite specific for identifying changes from one inspection to the next, except that they are only populated for about 92% of the OBD records, meaning that the other 8% of OBD records have the same values (missing) for these variables, and the CVN and CAL_ID combination alone would not be sufficient to positively identify clean-scanning.
- When considered together, the PCM ID, PID Count, COMM_PROT, CAL_ID, and CVN variables exhibit substantial variability, with the five most common combinations accounting for just 0.25% to 2.8% of inspections, and many hundreds of other combinations each accounting for less than 1% of the remaining inspections. Thus, the combination of these five variables is highly variable and may be a good indicator for identifying when a different vehicle is being substituted for the test.

OBD Monitor Configuration Profile

A second electronic profile was developed based on the monitored (supported) status of selected OBD readiness monitors. For this analysis, OBD readiness monitors were identified that frequently appear as either “monitored” and “not monitored,” depending on the make/model/model year of the vehicle being inspected.

Readiness monitors that are almost always either monitored or not monitored across the fleet were excluded because they provide little discriminatory value. For example, positive crankcase ventilation and air conditioning system monitors are rarely monitored, while catalyst and oxygen sensor monitors are almost always monitored. Because these monitors typically have the same status across most vehicles, they are not useful indicators of potential clean-scanning. Instead, the four readiness monitors shown below—EGR systems, evaporative emission control systems, and to a lesser extent heated oxygen sensors and secondary air injection systems—were identified as having significant variation in monitored status across the fleet and were therefore selected for this analysis.

- **EGR systems:** 19% not monitored, 81% monitored;
- **Evaporative systems:** 1% not monitored, 99% monitored;
- **Heated O₂ systems:** 2% not monitored, 98% monitored; and
- **Secondary air systems:** 91% not monitored, 9% monitored.

The combined status of these four monitors produced distinct monitored-status patterns across the fleet. Two monitor-status combinations dominated the dataset, accounting for 73% and 16% of vehicles, respectively, while the remaining 14 combinations represented the other 11% of vehicles. Since the combined status of these four monitors could provide a characteristic profile for many vehicles, these four monitors were used to develop the OBD monitor configuration profile for this analysis.

An electronic identification profile and an OBD monitor configuration profile were created for each vehicle using data from the initial inspection and all subsequent re-inspections. Any tests where either profile differed from inspection to inspection were flagged. Tests where both the electronic identification profile and the OBD monitor configuration profile changed would be an indicator that a different vehicle was being substituted for the test. Note that for any individual vehicle, these downloaded values may vary among analyzer manufacturers (in particular the PID count), so the analysis was based on vehicle/analyzer combinations. All inspections where the initial inspection took place on a different type of analyzer than that used for the retest inspection were excluded from the analysis to avoid false positives resulting from potential analyzer data conversion differences.

Occasionally, analyzer hardware upgrades or software updates could result in OBD system PID count mismatches between multiple tests on the same vehicle. In addition, the eVIN could be mismatched on multiple tests from the same vehicle in extremely rare instances where the PCM on the vehicle was improperly reprogrammed in an attempt to repair the vehicle. An assessment of the likelihood of fraud is provided for each of the scenarios listed below. It is also worthwhile to note that since each vehicle's OBD electronic identification "profile" was assigned based on the information collected during the vehicle's first test, this analysis would not identify any tests where a vehicle was substituted (i.e., clean-scanned) during the initial inspection.

As described above, the dataset included approximately 801,000 initial inspections and 900,000 retests. Retests that took place on an analyzer from a different manufacturer than the initial test were excluded from the results, leaving approximately 787,000 retests for analysis. The results of the analysis were as follows.

- 712,315 (90.4%) retests had matches for both the electronic profile and the readiness profile between initial test and subsequent retests on the same analyzer. These tests very likely indicate compliant testing.

- 28,221 (4.6%) retests had a mismatch for both the electronic profile info and the readiness profile, between the initial test and at least one retest on the same analyzer. Test pairs where both PCM ID information and readiness profile differ are likely to be performed on two different vehicles (i.e., an indication of clean-scanning).
- 302 (<0.1%) retests had a “readiness profile” mismatch between the initial test and at least one retest on the same analyzer, but the electronic profile matched between the initial test and all subsequent retests on the same analyzer. This scenario is difficult to interpret, since the readiness profile is based on “monitored versus unmonitored” status of various systems, as opposed to ready/not ready status, and therefore should never change for a vehicle despite the vehicle’s state of readiness. Similarly, the computer ID information should be static for any one vehicle except for the case when PCM reprogramming is part of the repair process. Because of these difficulties in interpreting these results, the scenario of a readiness profile mismatch with a computer identification (ID) match is not considered to be a strong indicator of non-compliant testing.
- 47,076 (6.0%) retests had an electronic profile mismatch info between the initial test and at least one retest on the same analyzer, but the “readiness profile” matched between the initial test and all subsequent retests on the same analyzer. Since the computer ID serves as a unique identifier for any vehicle, this information should always match for retests on the same vehicle. A mismatch could occur only if another vehicle was substituted for a retest (clean-scanning), if an anomaly in the analyzer software interpreted the computer ID information two different ways on subsequent retests for the same vehicle, or if a vehicle repair was performed in which the vehicle’s PCM was re-programmed with new ID information as a part of a repair. Although the last two scenarios are unlikely, it was not possible to quantify the likelihood of this occurring in this analysis. It is possible for two different vehicles to have common readiness profiles, so a readiness profile match does not confirm that clean-scanning did not occur. Therefore, this scenario (computer ID mismatch) is thought to be a good indicator of clean-scanning.

A summary of this information is provided in Table VI-5.

**Table VI-5. Percentages of Tests with Various
OBD Fraud Indicators**

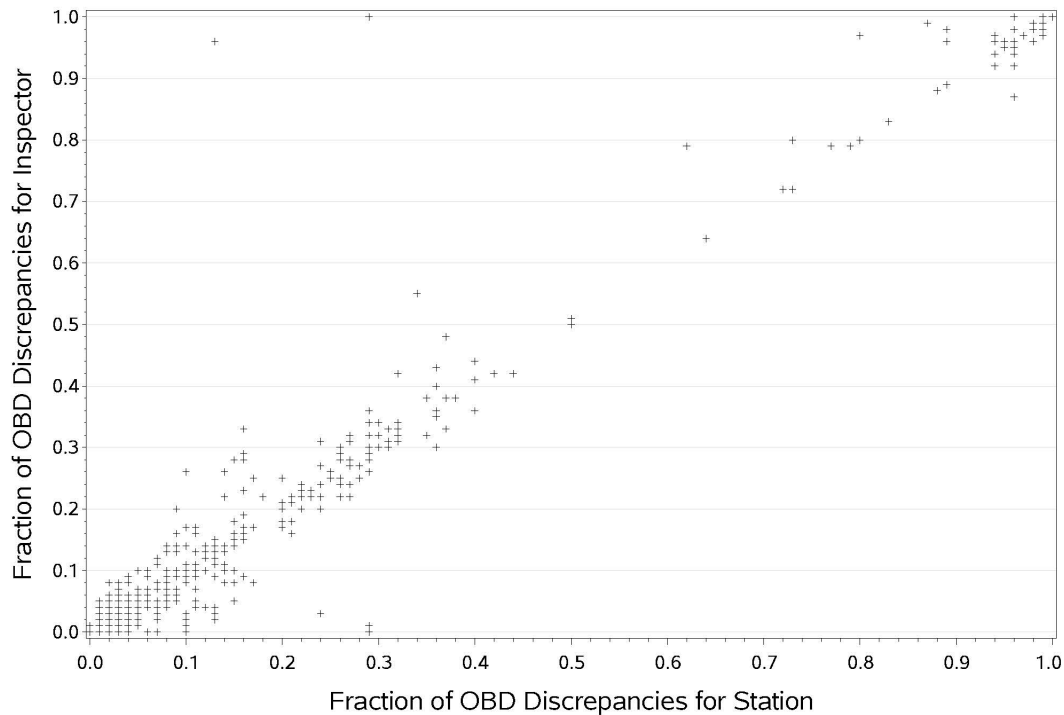
Retest Match Scenario	Retest-only Dataset
All match (compliant)	90.4%
Readiness mismatch (ambiguous)	<0.1%
PCM ID info mismatch (fraud likely)	6.0%
Both mismatch (fraud very likely)	4.6%
Estimated % of clean-scanning	4% to 10%

Next, using the complete dataset, which includes tests classified as initial tests, the following general statistics were seen for stations and inspectors with computer ID information or “readiness profile” mismatches.

- From January 1, 2024, through December 31, 2025, 61% of the 6,845 inspection stations had at least one test record with either a readiness profile or computer ID information mismatch between an initial test and a subsequent test for the same vehicle (tested using the same analyzer as the initial test). The maximum number of mismatch retest records for any one station was 6,402 records over the two-year period, and another 40 stations had more than 200 records with a mismatch. Some stations had mismatch rates close to 100%, almost all of the retest inspections performed at the station showed a mismatch in the readiness profile or computer ID information. These stations are almost certainly using clean-scanning to help failing vehicles to pass the retest.
- From January 1, 2024, through December 31, 2025, 334 of the 30,956 inspectors had at least one test record with either a readiness profile or computer ID information mismatch between an initial test and a subsequent test on the same vehicle using the same analyzer. The maximum number of mismatch retest records for any one inspector was 5,836 records over the two-year period, while an additional 40 inspectors had more than 200 mismatch retest records. Inspector mismatch rates close to 100% were identified.

The distribution of station and inspector mismatch rates is shown in Figure VI-3. The horizontal axis shows the fraction of retest records that contained an electronic profile or readiness profile mismatch for each station. The vertical axis shows the fraction for each inspector. The large concentration of data points in the lower left corner are stations and inspectors that produced retest records that rarely had a mismatch when compared to the information from the initial inspection. In contrast, the stations/inspectors in the upper right-hand portion of the chart are those that are most likely to be clean-scanning.

Figure VI-3. Rates of Retest Discrepancies in OBD Computer and Readiness Information, by Station and Inspector



These results were condensed into a rank for each station, based on the fraction of retest inspections performed at that station that included both an electronic profile mismatch and a readiness profile mismatch. Stations with fewer than 100 OBD retest inspections over the two-year period were excluded from the results, due to the possibility of spurious results from the small sample size. The 10 stations with the highest rates of profile mismatches are listed in Table VI-6. Some electronic profile and/or readiness mismatches are to be expected, and as shown above, 61% of stations had at least one case of a mismatch. However, most of those stations had only one or a few mismatches. Overall, about 4.6% of retest inspections resulted in a readiness profile and electronic profile mismatch. When stations with a mismatch in more than 90% of their inspections are seen, it suggests fraudulent testing is being performed.

Table VI-6. 10 Stations with Highest Percent of Electronic Profile and Readiness Profile Mismatches

Station Rank	Percent of Re-inspections with both Electronic & Readiness Mismatch	Number of Re-inspections at Station	Percentile Rank for Station
1	95.0	160	100.0
2	94.2	961	100.0
3	93.5	200	99.9
4	92.7	315	99.9
5	92.1	800	99.8

Station Rank	Percent of Re-inspections with both Electronic & Readiness Mismatch	Number of Re-inspections at Station	Percentile Rank for Station
6	91.6	358	99.8
7	89.3	373	99.7
8	89.0	299	99.7
9	88.2	1,842	99.6
10	86.8	3,155	99.6

VI.A.4 Comparison of Downloaded and Expected Communication Protocol

Consistent with the previous program evaluation, the OBD communications protocol indicator (TX96_COMM_PROT) was also evaluated. This variable will assume one of seven values, each corresponding to either one of six California Air Resources Board (CARB)/EPA approved communication protocols for vehicles sold in the U.S. or “none” as shown in Table VI-7.

Table VI-7. OBD Communications Protocol Codes

Code	Protocol
C	Controller Area Network (CAN)
D	CAN
P	PWM (Pulse Width Modulation)
I	ISO (International Organization for Standardization)
V	VPW (Variable Pulse Width)
K	KWP (Key Word Protocol)
N	(none found)

In theory, each type of vehicle that is manufactured uses one of these communications protocols, and all vehicles of the same make/model/model year use the same protocol.⁶ US-certified vehicles of model year 2008 and newer should all conform to CAN, while older vehicles may utilize the other (legacy) protocols.

ERG’s previous subcontractor, de la Torre Klausmeier Consulting, Inc. (dKC), worked extensively with comparisons of expected communication protocols with the communication protocols recorded during the OBD test, for various I/M areas. For such comparisons, dKC constructed a look-up table of communication protocols by VIN stem (comprised of VIN digits in positions 1–8, 10, and 11), using reliable data from a highly controlled, centralized I/M program.

ERG was able to match approximately 66% of model year 2000 through 2009 vehicles in the dataset using the dKC look-up table. Because almost all vehicles after model year

⁶ It is known that Chrysler vehicles from model years 1999–2005 have exhibited unreliable communications protocol values, so 1999–2005 Dodge, Jeep, and Chrysler makes were excluded from analysis in this section.

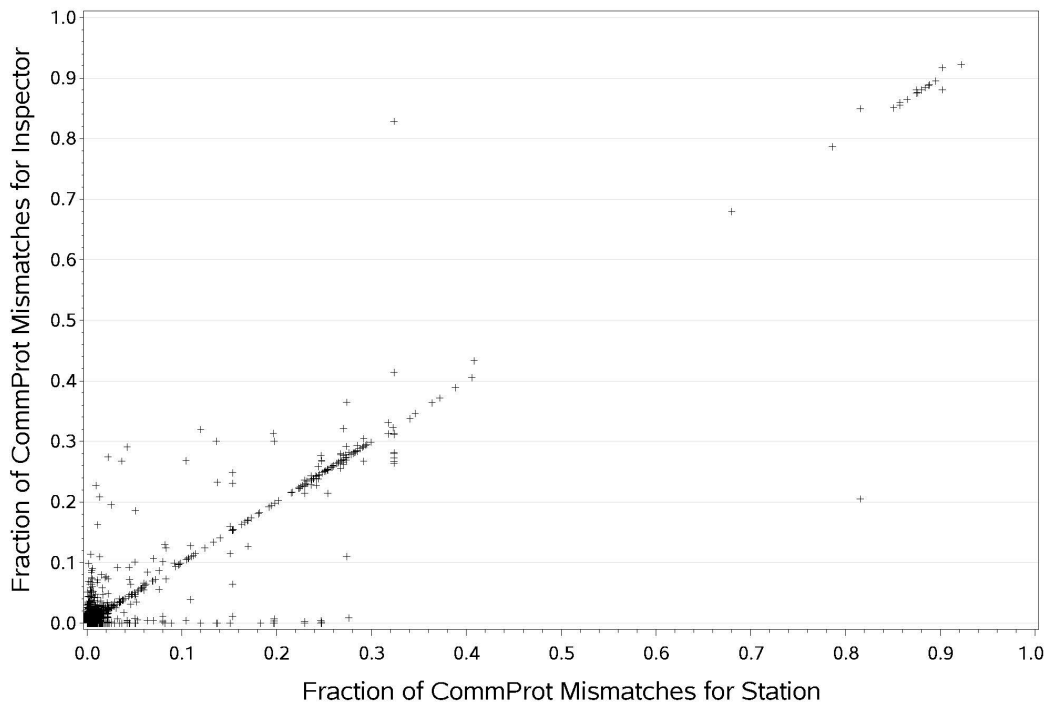
2008 use the CAN protocol, the dKC look-up table stops with the 2009 model year. Results by model year are shown in Table VI-8. The overall mismatch rate was much higher for passing tests than failing tests: 26% versus 1%. The mismatch rate is very high for vehicles of older model years where inspection fraud might be used to help the vehicle pass the inspection. Note that pre-2000 tests are voluntary and are excluded from Table VI-8 results.

**Table VI-8. Rates of Communication Protocol Mismatches
by Model Year**

Model Year	Mismatches: Failed Inspections		Mismatches: Passed Inspections	
	Number of Fails with Mismatch	Percent of Fails that had Mismatch	Number of Passes with Mismatch	Percent of Passes that had Mismatch
2000	11	0.3	11,552	35.9
2001	44	0.3	28,330	38.3
2002	48	0.3	30,211	34.2
2003	52	0.3	38,077	33.2
2004	88	0.5	37,967	26.1
2005	1,831	9.1	33,975	20.8
2006	2,236	9.2	33,146	15.0
2007	1,729	6.6	21,176	7.2
2008	235	0.8	4,317	1.3
2009	97	0.5	2,563	1.0
Total	6,374	3.4	241,314	13.8

The rate at which communication protocol mismatches were recorded was calculated for each station that performed OBD inspections and for each inspector. These are compared graphically in Figure VI-4. The horizontal axis shows the fraction of OBD inspections that contained a communication protocol mismatch for each station, while the vertical axis shows the fraction of OBD inspections with a mismatch for each inspector. To reduce errors due to small sample size, stations or inspectors that performed fewer than 100 inspections were excluded from the plot. The large cluster of points at the bottom left corner of the plot includes most stations and inspections: these had a very low rate of communication protocol discrepancies. The points closer to one on the horizontal or vertical axis indicate stations or inspectors that almost always produced OBD records with a communication protocol discrepancy.

Figure VI-4. Rates of Communication Protocol Mismatches by Station and Inspector



These results were condensed into a rank for each station, based on the fraction of inspections at that station that included a communication protocol mismatch. Stations with fewer than 100 OBD test inspections over the two-year period were excluded from the results due to the possibility of spurious results from the small sample size. The 10 stations with the highest rates of mismatches are listed in Table VI-9. Some mismatches are to be expected, and most stations had at least one case of a mismatch. However, most of those stations had only one or a few mismatches. Overall, about 17% of inspections resulted in a communication protocol mismatch. As stated earlier, when stations have this high a level of mismatch it suggests fraudulent testing.

Table VI-9. 10 Stations with Highest Percent of Communication Protocol Mismatches

Station Rank	Percent of Inspections with Communication Protocol Mismatch	Number of Inspections at Station	Percentile Rank for Station
1	92.2	1,714	100.0
2	90.2	593	100.0
3	89.5	764	100.0
4	88.9	871	99.9
5	88.8	4,816	99.9
6	88.4	553	99.9
7	88.4	2,182	99.9
8	88.0	100	99.9
9	87.6	1,413	99.9
10	87.5	13,812	99.8

VI.B. Additional Inspection Manipulation

Several types of inspection results have been identified that do not use OBD-downloaded information, but may serve as useful indicators of potential emissions inspection fraud at a given station. Although these occurrences are rare in the overall TIMS dataset, they appear with a relatively high frequency at a small number of stations. A list of potential non-OBD-related indicators of emissions inspection fraud at the station level is provided below:

- **Short Time Interval Between Inspections:** Sometimes a failing inspection is followed by a passing inspection only a few minutes later. This could indicate the occasional warm-up or easy repair when it happens once or twice for each station, but when it occurs many times at only a few stations it is more likely to indicate clean-scanning.
- **Safety-Only Inspection Rate:** Vehicles that are between two and 24 years old are required to participate in the emissions inspection program by receiving OBD inspections. Vehicles older than 24 years are only required to receive a safety inspection, so it can be easier for them to pass their inspection. This can sometimes result for misclassification at the time of the inspection, but it happens more frequently at some stations than at others.
- **Changing from LDV to HDV to Pass:** Similarly, an initial failed inspection of an LDV (GVWR <8,500 lbs.) is sometimes followed by a passed inspection of that vehicle as an HDV. OBD pass/fail stringency is lower for HDVs, making the inspection easier to pass. This happens very infrequently in the dataset, but much more frequently at some stations.
- **Pass/Fail Outliers:** The overall failure rate at a station can be used as an indicator of whether fraud is occurring. Unusually high or unusually low failure rates may both be a cause for concern. This factor can be difficult to analyze since it is known that different areas with a different type of fleet (or a different socio-economic status) often have real differences in failure rates.

Each of these potential indicators is discussed in more detail in the following sections, and a ranking is assigned to each station for each potential indicator.

VI.B.1 Short Time Interval Between Inspections

For inspection cycles that begin with a failing inspection, a retest (or retests) usually follows a day or several days after the initial failed inspection. Presumably, repairs are performed during that interval between inspections. However, some failing inspections are followed by a passing inspection within minutes, raising concern as to how the vehicle was successfully repaired so quickly, or if instead clean-scanning occurred for the passing retest. The dataset shows that many stations have one or a few cases of a passing retest following a failing initial test within a short time. These occasional cases may be the real result of a simple fix: a reconnection of a loose line or wire or other

simple repair. However, some stations show a disproportionately high rate of initial inspections that are followed in a short period of time by passing inspections. This pattern deviates from the norm observed across most stations and could indicate potential inspection fraud.

For this analysis, the dataset contained approximately 19.8 million records. Because the focus was on identifying unusually short time intervals between an initial inspection and subsequent retests as a potential indicator of inspection station fraud, only time differences for retest inspections conducted at the same station as the initial inspection were considered. This resulted in a dataset of approximately 642,000 retest observations.

The distribution of the number of instances in which a failed initial inspection was followed by a passing retest within 15 minutes at a given station over a two-year period is listed in Table VI-10. The table indicates that this pattern occurred rarely or not at all for most stations. However, for 147 stations, it occurred 20 or more times, with the highest station reaching up to 460 times (not shown in the table).

Table VI-10. Number of Short-Interval Retests per Station

Number of Short-Interval Retests	Number of Stations	Percent of Stations
0	3,263	49.9
1	959	14.7
2	580	8.9
3	393	6.0
4	271	4.1
5	196	3.0
6	137	2.1
7	115	1.8
8	88	1.3
9	83	1.3
10	60	0.9
11	51	0.8
12	47	0.7
13	29	0.4
14	31	0.5
15	32	0.5
16	20	0.3
17	21	0.3
18	11	0.2
19	11	0.2
20 or more	147	2.3
Total	6,545	100.0

The 10 stations with the highest rates of short-interval retests are listed in Table VI-11. The percentage was calculated as the number of inspections with short time intervals

between inspections divided by the total number of retests at each station. Stations that performed fewer than 100 retest inspections over the two-year period are excluded from the results. As shown in Table VI-11, the highest ranked stations for this potential emissions inspection fraud indicator performed more than half of their retest inspections within the short interval of 15 minutes or less after the initial passed inspection.

Table VI-11. Percent of Short-Interval Retests for 10 Highest Ranking Stations

Station Rank	Percent of Short-Interval Retests	Number of Short-Interval Retests	Total Number of Retest Inspections	Percentile Rank for Station
1	90.2	111	123	100.0
2	54.0	68	126	99.9
3	50.8	460	906	99.9
4	42.1	64	152	99.8
5	37.3	84	225	99.8
6	34.0	54	159	99.7
7	26.0	151	581	99.7
8	20.8	90	432	99.6
9	19.6	282	1,442	99.5
10	18.7	23	123	99.5

VI.B.2 Safety-Only Inspection Rate

On January 1, 2025, the annual safety inspection requirement was eliminated in all counties in Texas. That means that potentially clean-scanning by entering an inspection as safety-only is no longer an option. Therefore, this analysis of safety-only inspection rates is no longer applicable and will no longer be provided as part of the Evaluation.

VI.B.3 Changing Vehicle Type from LDV to HDV to Pass Vehicle

ERG then investigated whether vehicle tests were converted from a light-duty test GVWR (less than or equal to 8,500 lbs.) to a heavy-duty test (greater than 8,500 lbs.) to determine if this is ever attempted, possibly in an effort to manipulate emissions inspection results. The vehicle GVWR is an inspector-modifiable field in the inspection record.

For this analysis, aborted inspections were excluded from the dataset. This resulted in a dataset of approximately 19.8 million inspection records. Only inspection cycles where the initial inspection and the retest inspection were conducted at the same station were used. This left about 642,000 retest inspections in the dataset.

Overall, it was found that only 1.3% of inspections (about 8,000 inspections) that were initially failed as an LDV were followed by a passing retest as an HDV. However, these inspections were clustered at a handful of stations, shown below in Table VI-12. The

table presents the 10 inspection stations with the highest frequency of retests in which a vehicle failed as an LDV on the initial inspection and subsequently passed in a retest as an HDV. At the top stations on the list, almost all of vehicles that failed as an LDV passed the retest when the inspector entered the vehicle as an HDV.

Table VI-12. Percent of Retest Inspections Switched from LDV to HDV for 10 Highest Ranking Stations

Station ID	Percent of Retests Switched from LDV to HDV	Number of Switched Retests	Total Number of Retest Inspections	Percentile Rank for Station
1	97.6	120	123	100.0
2	95.7	1,935	2,023	99.9
3	93.6	2,491	2,661	99.9
4	83.7	1,207	1,442	99.8
5	76.9	123	160	99.8
6	44.5	94	211	99.7
7	29.6	45	152	99.7
8	17.2	46	267	99.6
9	12.9	32	248	99.5
10	12.4	31	249	99.5

VI.B.4 PASS/FAIL OUTLIERS

Stations can also be evaluated based on the percentage of vehicles they pass or fail. Extremely high rates of either passing or failing vehicles may warrant further scrutiny by DPS.

It is recognized that differences in inspection failure rates among stations are often due to factors other than fraud. For instance, the age and maintenance level of the fleet tested at each station may vary widely. However, evaluation of the fleet quality and/or socio-economic status of the area surrounding each station is beyond the scope of this evaluation, so only overall pass/fail rates for each station are considered here.

To identify both unusually low and unusually high failure rates, stations were grouped into two categories based on their relative performance: those with failure rates above the overall mean across all stations and those with failure rates below the mean. For stations with failure rates above the mean, rankings were assigned such that the station at the mean received a rank of 0% and the station with the highest failure rate received a rank of 100%. For stations with failure rates below the mean, rankings were similarly assigned, with the station at the mean receiving a rank of 0% and the station with the lowest failure rate receiving a rank of 100%. As a result, each station is assigned a single rank, reflecting either relatively high or relatively low failure rates. The stations with the highest OBD failure rates are listed in Table VI-13, and those with the lowest failure rates are listed in Table VI-14. Stations with fewer than 100 inspections were excluded from the analysis.

Table VI-13. Stations with Highest OBD Failure Rates

Station ID	Failure Rate (%)	Number of Failed Inspections	Total Number of Inspections	Percentile Rank for Station
1	33.5	57	170	100.0
2	32.7	37	113	100.0
3	30.7	206	672	99.9
4	28.9	394	1,364	99.9
5	26.9	29	108	99.8
6	26.3	85	323	99.8
7	25.2	34	135	99.8
8	24.2	50	207	99.7
9	24.0	91	379	99.7
10	23.7	28	118	99.6

Table VI-14. Stations with Lowest OBD Failure Rates

Station ID	Failure Rate (%)	Number of Failed Inspections	Total Number of Inspections	Percentile Rank for Station
1	0.0	0	225	100.0
2	0.0	0	323	100.0
3	0.0	0	162	99.9
4	0.0	0	214	99.9
5	0.0	0	176	99.9
6	0.0	0	281	99.9
7	0.0	0	636	99.8
8	0.0	0	120	99.8
9	0.0	0	1,047	99.8
10	0.0	0	307	99.7

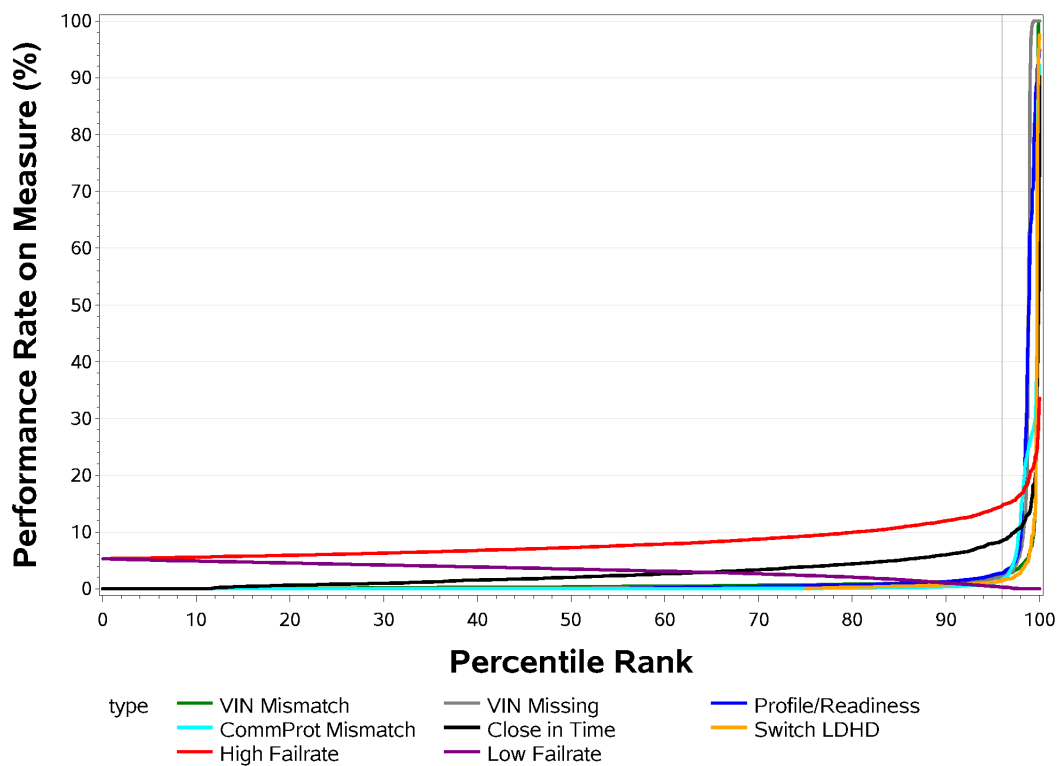
VI.C. Compilation of Percentile Rankings

After a separate ranking was assigned for each of the measures of potential inspection fraud, the ranks were used to score the stations and identify the stations with the highest likelihood of inspection fraud.

Some of the details of the ranking procedure and the resulting ranks make it challenging to combine the ranks for an overall score. First, many stations did not perform enough inspections to receive a rank for all measures. Second, there was a large range of performance on the various measures of potential inspection fraud from sub-sections VI.A and VI.B. Some sort of designation to determine whether or not a station's performance on each measure was within an expected reasonable range. Figure VI-5 shows the distribution of the results and the rankings that were created from those results for each of the measures of potential inspection fraud. In the figure,

it can be seen that for all measures of potential inspection fraud, most stations had a very low incidence of occurrences. Looking at the figure starting at the left and moving toward the right shows there is a very slow increase in the rates of potential inspection fraud for any given station. However, moving toward the right-hand-side of the graph, there is a steep increase in the rate for each given measure (at around the 96th percentile). It is at the point of steep increase that we suspect a transition from a normal range of inspection anomalies to a potential for systematic inspection fraud. From the figure, it looks like the 96th percentile would be a suitable cutoff for acceptable vs. non-acceptable performance.

**Figure VI-5. Distribution of Results and Percentiles
for Errors of Commission**



At values below the 96th percentile (above which the results rapidly worsen) in each line on Figure VI-5, it is probably not likely that the station is performing the type of fraudulent activity that can be detected through this analysis. At percentiles above the 96th percentile, there is evidence for suspicion of fraud. Thus, the visual results of the location of the rapid increase in rates of potentially fraudulent inspections were used to create an indicator flag for each of the measures. Stations above the 96th percentile cutoff for the given measure were flagged. Then, the total number of flags that each station received was determined. The stations were then sorted in descending order according to the number of flags received to create a final list ordered from most suspicious to least suspicious. The results for the top 50 most suspicious stations are

given in Table VI-15. It should be noted the “Last Month of Testing at Station” column in this table shows 41 of these 50 stations ceased testing before December 2025, likely due to DPS anti-fraud enforcement efforts. Table VI-16 gives the results for an additional 50 stations from near the middle of the range of results for comparison purposes, and it can be seen that 15 of these stations ceased testing before December 2025, also possibly due to DPS anti-fraud enforcement efforts.

Some of the first lines in the table show stations that should be investigated (if they have not already been, as a result of other analysis tools or audits). For example, the first station in the first row of the table had a very high rate of eVIN mismatches, high rates of OBD readiness and electronic profile mismatches, and a high rate of OBD communication protocol mismatches. This indicates a high possibility of OBD inspection fraud. This station also had a high rate of close-in-time retests, as well as a very low OBD inspection failure rate. This station is likely clean-scanning and would be a good candidate for an investigation.

If this table were to be used for identifying stations for investigations, audits, etc., it would be informative to review the tables to identify the stations with the clearest combination of factors for the type of fraud being considered. The entire table with all stations is available in electronic format and has been provided directly to TCEQ.

Table VI-15. Top 50 Most Suspicious Stations for Potentially Fraudulent Inspections

Station Rank	Last Month of Testing at Station	Sum of Rank Flags	Max Rank for Station	Individual Ranks (percentiles)							
				eVIN Mismatch	OBD eVIN Missing	OBD Profile/Readiness	OBD Communication Protocol Mismatch	Close-In-Time	Switch LDV to HDV	OBD High Fail Rate	OBD Low Fail Rate
1	2025_12	6	99.9	99.9	98.7	98.9	99.7	99.5	99.8	69.3	.
2	2025_02	6	99.8	99.5	99.1	99.6	99.6	99.8	35.9	.	97.6
3	2025_12	5	100.0	99.6	28.6	98.5	99.6	100.0	100.0	.	17.4
4	2025_07	5	100.0	.	100.0	99.4	98.6	98.7	74.9	.	97.2
5	2025_12	5	99.9	99.9	98.4	98.2	99.3	63.1	99.9	88.5	.
6	2025_04	5	99.9	.	99.9	99.5	98.8	99.7	74.6	.	97.3
7	2025_12	5	99.9	.	99.2	98.4	99.5	82.4	99.9	97.9	.
8	2025_12	5	99.8	96.3	99.0	98.1	98.1	99.8	74.9	95.7	.
9	2024_04	5	99.7	99.7	99.1	99.7	99.3	.	.	.	98.1
10	2025_06	5	99.2	38.4	99.1	99.2	98.6	97.7	74.6	.	96.8
11	2025_12	5	98.9	90.5	98.9	98.2	97.7	97.0	98.2	61.1	.
12	2025_08	4	100.0	100.0	25.1	99.3	98.9	.	.	.	98.0
13	2025_08	4	100.0	.	100.0	100.0	98.5	.	.	.	98.1
14	2024_08	4	100.0	100.0	24.6	99.3	99.4	.	.	.	98.1
15	2025_10	4	100.0	96.6	96.8	.	99.3	.	.	100.0	.
16	2024_08	4	100.0	.	99.4	100.0	99.1	.	.	.	97.7
17	2025_06	4	99.9	.	99.9	99.9	98.7	.	.	.	97.6
18	2024_03	4	99.9	99.9	23.4	99.0	99.6	.	.	.	99.6
19	2025_04	4	99.9	.	99.9	99.9	98.6	.	.	.	97.7
20	2024_10	4	99.9	99.9	23.6	99.1	99.5	.	.	.	97.8
21	2025_12	4	99.9	.	99.3	97.9	98.2	99.9	75.8	53.0	.
22	2024_12	4	99.9	.	99.9	99.8	99.0	.	.	.	97.9
23	2024_12	4	99.9	99.9	19.4	99.4	98.7	.	.	.	97.9
24	2024_07	4	99.8	.	99.8	99.6	99.1	.	.	.	97.7
25	2025_07	4	99.8	.	99.4	98.8	99.8	.	.	.	97.3
26	2024_10	4	99.8	.	99.3	99.8	99.0	.	.	.	97.7
27	2025_02	4	99.7	.	99.7	99.7	99.0	.	.	.	98.0
28	2025_08	4	99.7	.	99.7	99.0	98.7	.	.	.	98.0
29	2024_05	4	99.6	.	99.6	99.5	99.5	.	.	.	97.8

Station Rank	Last Month of Testing at Station	Sum of Rank Flags	Max Rank for Station	Individual Ranks (percentiles)							
				eVIN Mismatch	OBD eVIN Missing	OBD Profile/ Readiness	OBD Communication Protocol Mismatch	Close-In-Time	Switch LDV to HDV	OBD High Fail Rate	OBD Low Fail Rate
30	2025_01	4	99.6	99.6	99.1	99.2	99.2	.	.	.	93.8
31	2025_12	4	99.0	81.6	99.0	98.8	98.8	98.1	69.5	.	92.8
32	2025_03	3	100.0	.	99.7	.	100.0	.	.	.	97.6
33	2025_11	3	100.0	.	100.0	.	99.1	35.4	99.8	.	76.3
34	2024_06	3	100.0	.	99.9	.	100.0	.	.	.	99.8
35	2024_09	3	100.0	.	99.2	.	100.0	.	.	.	99.0
36	2024_02	3	100.0	100.0	24.0	.	99.0	.	.	.	96.0
37	2024_08	3	99.9	.	99.3	.	99.9	.	.	.	98.9
38	2025_08	3	99.9	96.1	25.8	.	98.5	.	.	.	99.9
39	2024_01	3	99.9	.	99.5	.	99.9	.	.	.	98.7
40	2025_01	3	99.9	.	99.9	.	99.3	.	.	.	99.9
41	2024_08	3	99.9	.	99.7	.	99.9	.	.	.	99.0
42	2025_07	3	99.9	.	99.0	.	98.3	.	.	.	99.9
43	2025_12	3	99.9	92.1	96.5	95.3	95.6	56.9	96.4	99.9	.
44	2024_01	3	99.9	.	99.4	.	99.9	.	.	.	97.5
45	2024_10	3	99.8	.	99.5	.	99.8	.	.	.	97.9
46	2024_04	3	99.8	.	99.8	.	99.8	.	.	.	99.8
47	2024_10	3	99.8	99.8	12.0	.	98.8	.	.	.	99.0
48	2024_03	3	99.8	.	99.3	.	99.8	.	.	.	97.3
49	2025_02	3	99.8	.	99.8	.	98.6	.	.	.	99.7
50	2024_06	3	99.8	83.1	97.9	.	99.6	.	.	.	99.8

* Note that 41 of these 50 stations ceased testing operations prior to December 2025, likely due to DPS anti-fraud enforcement efforts.

Table VI-16. 50 Mid-Range Stations for Potentially Fraudulent Inspections

Station Rank	Last Month of Testing at Station	Sum of Rank Flags	Max Rank for Station	Individual Ranks (percentiles)							
				eVIN Mismatch	OBD eVIN Missing	OBD Profile/Readiness	OBD Communication Protocol Mismatch	Close-In-Time	Switch LDV to HDV	OBD High Fail Rate	OBD Low Fail Rate
3285	2025_12	0	81.2	48.5	70.8	81.2	77.7	0.0	33.3	74.1	.
3286	2025_12	0	81.2	25.2	81.2	.	81.0	.	.	46.9	.
3287	2025_12	0	81.2	25.7	73.4	.	81.2	.	.	.	67.8
3288	2025_12	0	81.2	49.0	43.4	75.5	65.3	48.2	81.2	.	59.2
3289	2025_12	0	81.2	25.0	64.3	56.6	62.7	81.2	48.1	.	1.1
3290	2025_12	0	81.2	81.2	79.3	.	39.0	.	.	22.2	.
3291	2025_01	0	81.2	62.3	10.0	.	18.6	.	.	81.2	.
3292	2025_12	0	81.2	81.2	74.9	.	39.9	.	.	47.9	.
3293	2025_12	0	81.2	27.2	11.9	.	23.6	.	.	.	81.2
3294	2025_12	0	81.2	59.2	77.7	.	81.2	.	.	.	19.9
3295	2024_12	0	81.1	40.8	81.1	.	73.9	.	.	.	77.3
3296	2025_12	0	81.1	64.4	67.0	63.4	70.4	27.4	60.4	81.1	.
3297	2025_12	0	81.1	35.1	63.5	74.9	58.9	72.2	81.1	49.4	.
3298	2025_09	0	81.1	29.0	64.9	79.2	61.1	81.1	33.9	.	55.3
3299	2024_12	0	81.1	9.8	16.1	.	30.2	.	.	.	81.1
3300	2024_09	0	81.1	58.7	81.1	.	13.3	.	.	.	56.4
3301	2025_12	0	81.1	64.6	81.1	21.1	63.3	27.6	75.9	13.7	.
3302	2025_12	0	81.1	20.8	78.4	4.5	81.1	42.6	5.4	.	72.2
3303	2025_12	0	81.1	40.5	38.9	70.3	59.8	44.8	7.2	.	81.1
3304	2024_12	0	81.1	43.9	81.1	.	27.3	.	.	12.8	.
3305	2024_12	0	81.1	11.8	18.7	.	33.8	.	.	81.1	.
3306	2025_12	0	81.1	68.4	50.6	.	81.1	.	.	.	58.4
3307	2025_12	0	81.1	23.6	51.4	17.4	60.6	74.7	81.1	40.7	.
3308	2025_12	0	81.1	38.6	11.2	24.4	73.2	81.1	32.9	.	1.5
3309	2025_12	0	81.1	18.7	36.8	5.6	11.6	20.1	6.6	.	81.1
3310	2025_12	0	81.1	62.7	78.5	32.0	81.1	0.0	42.5	58.6	.
3311	2025_12	0	81.0	20.6	61.8	.	20.3	.	.	.	81.0
3312	2025_12	0	81.0	34.2	81.0	.	37.1	.	.	.	51.6
3313	2024_12	0	81.0	81.0	16.4	.	30.6	.	.	75.4	.
3314	2025_12	0	81.0	64.3	47.6	77.3	81.0	69.3	30.3	.	15.4

Station Rank	Last Month of Testing at Station	Sum of Rank Flags	Max Rank for Station	Individual Ranks (percentiles)							
				eVIN Mismatch	OBD eVIN Missing	OBD Profile/Readiness	OBD Communication Protocol Mismatch	Close-In-Time	Switch LDV to HDV	OBD High Fail Rate	OBD Low Fail Rate
3315	2024_12	0	81.0	81.0	6.5	.	8.9	.	.	.	23.2
3316	2025_12	0	81.0	17.9	37.4	17.8	17.7	81.0	23.1	.	55.7
3317	2025_12	0	81.0	57.0	73.3	64.2	67.3	73.6	81.0	51.9	.
3318	2025_12	0	81.0	71.1	63.1	81.0	53.8	0.0	13.3	.	35.5
3319	2024_12	0	81.0	81.0	6.0	.	8.2	.	.	.	1.8
3320	2025_12	0	81.0	44.5	34.6	.	81.0	.	.	.	38.3
3321	2025_12	0	81.0	43.5	20.6	.	81.0	.	.	.	63.2
3322	2025_12	0	81.0	59.3	44.6	8.3	62.1	55.6	10.4	81.0	.
3323	2025_12	0	81.0	19.3	27.6	81.0	56.4	73.3	40.4	.	79.2
3324	2025_12	0	80.9	80.9	19.5	.	76.5	.	.	.	54.6
3325	2025_12	0	80.9	47.6	46.9	.	80.9	.	.	.	72.8
3326	2025_12	0	80.9	14.2	60.4	.	49.3	.	.	80.9	.
3327	2024_11	0	80.9	13.8	80.9	.	46.3	.	.	22.2	.
3328	2024_03	0	80.9	74.0	71.4	44.7	80.9	0.0	58.6	18.4	.
3329	2024_12	0	80.9	6.8	80.9	.	21.9	.	.	.	9.8
3330	2025_12	0	80.9	58.1	76.3	62.9	68.0	79.8	80.9	28.9	.
3331	2025_12	0	80.9	79.4	36.2	48.1	43.7	80.9	63.7	57.9	.
3332	2024_12	0	80.9	2.3	80.9	.	4.4	.	.	.	19.5
3333	2025_12	0	80.9	80.9	74.0	33.6	68.8	54.4	44.2	80.1	.
3334	2024_12	0	80.9	60.5	2.8	.	3.9	.	.	80.9	.

* Note that 15 of these 50 stations ceased testing operations prior to December 2025, some possibly due to DPS anti-fraud enforcement efforts.

VII. REFERENCES

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Appendix A-
OBD Communication Rates by Vehicle
Model Code for Elevated Miscommunications

Table A-1. OBD Communication Rates by Vehicle Model Code for Elevated Miscommunications

Make/Model	DLC is Damaged, Inaccessible, or Cannot be Found		Vehicle will not Communicate with Analyzer		Vehicle Successfully Communicates with Analyzer		Total Count of Tests by Make	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
ACUR								
ILX	1	0.01%	11	0.07%	16,570	99.93%	16,582	0.09%
MDX	12	0.01%	100	0.11%	89,488	99.88%	89,600	0.49%
RDX	8	0.01%	62	0.09%	66,817	99.90%	66,887	0.36%
TL	8	0.03%	35	0.11%	30,623	99.86%	30,666	0.17%
TLX	4	0.01%	29	0.10%	30,285	99.89%	30,318	0.16%
TSX	3	0.02%	25	0.13%	19,422	99.86%	19,450	0.11%
ALFA								
Giulia (952)	2	0.03%	13	0.22%	5,789	99.74%	5,804	0.03%
Stelvio	3	0.05%	4	0.07%	5,700	99.88%	5,707	0.03%
ASTO								
Vanquish	3	2.16%	5	3.60%	131	94.24%	139	0.00%
AUDI								
A3	6	0.05%	15	0.12%	12,481	99.83%	12,502	0.07%
A4	7	0.02%	39	0.14%	28,574	99.84%	28,620	0.16%
A5	3	0.02%	19	0.13%	15,049	99.85%	15,071	0.08%
A6	3	0.02%	34	0.22%	15,667	99.76%	15,704	0.09%
Q5	4	0.01%	42	0.08%	53,719	99.91%	53,765	0.29%
Q7	3	0.01%	55	0.17%	32,246	99.82%	32,304	0.18%
Q8	2	0.03%	8	0.11%	7,358	99.86%	7,368	0.04%
S5	1	0.02%	5	0.09%	5,463	99.89%	5,469	0.03%
S6	1	0.11%	1	0.11%	880	99.77%	882	0.00%
BMW								
128i	1	0.04%	6	0.26%	2,275	99.69%	2,282	0.01%

Make/Model	DLC is Damaged, Inaccessible, or Cannot be Found		Vehicle will not Communicate with Analyzer		Vehicle Successfully Communicates with Analyzer		Total Count of Tests by Make	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
228i	1	0.02%	7	0.16%	4,493	99.82%	4,501	0.02%
320i	2	0.02%	15	0.15%	10,151	99.83%	10,168	0.06%
325Ci	1	0.06%	5	0.31%	1,588	99.62%	1,594	0.01%
325i	3	0.07%	13	0.32%	4,030	99.60%	4,046	0.02%
328i	4	0.01%	64	0.17%	36,821	99.82%	36,889	0.20%
330Ci	1	0.06%	6	0.38%	1,555	99.55%	1,562	0.01%
330e	1	0.06%	9	0.52%	1,710	99.42%	1,720	0.01%
330i	5	0.02%	33	0.16%	20,696	99.82%	20,734	0.11%
335i	1	0.01%	17	0.22%	7,676	99.77%	7,694	0.04%
428i	1	0.02%	8	0.13%	6,145	99.85%	6,154	0.03%
430i	1	0.01%	12	0.10%	11,633	99.89%	11,646	0.06%
435i	3	0.12%	8	0.32%	2,515	99.56%	2,526	0.01%
528i	1	0.01%	21	0.16%	13,179	99.83%	13,201	0.07%
530e	1	0.05%	13	0.59%	2,188	99.36%	2,202	0.01%
530i	3	0.02%	19	0.15%	12,423	99.82%	12,445	0.07%
535i	2	0.02%	20	0.15%	13,065	99.83%	13,087	0.07%
650i	1	0.03%	5	0.17%	2,954	99.80%	2,960	0.02%
750Li Alpina B7	1	0.05%	3	0.16%	1,903	99.79%	1,907	0.01%
840i	1	0.07%	2	0.14%	1,456	99.79%	1,459	0.01%
M235i	1	0.08%	1	0.08%	1,203	99.83%	1,205	0.01%
M3	1	0.02%	10	0.21%	4,725	99.77%	4,736	0.03%
M5	1	0.04%	1	0.04%	2,640	99.92%	2,642	0.01%
M850i	1	0.09%	1	0.09%	1,126	99.82%	1,128	0.01%
X1	3	0.02%	15	0.08%	18,460	99.90%	18,478	0.10%
X2	1	0.02%	4	0.09%	4,420	99.89%	4,425	0.02%

Make/Model	DLC is Damaged, Inaccessible, or Cannot be Found		Vehicle will not Communicate with Analyzer		Vehicle Successfully Communicates with Analyzer		Total Count of Tests by Make	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
X3	11	0.02%	84	0.14%	61,371	99.85%	61,466	0.33%
X5	14	0.02%	110	0.16%	67,475	99.82%	67,599	0.37%
X6	3	0.03%	24	0.24%	10,020	99.73%	10,047	0.05%
i3	2	0.25%	4	0.49%	806	99.26%	812	0.00%
BUIC								
Enclave	11	0.02%	32	0.06%	50,630	99.92%	50,673	0.27%
Encore	5	0.01%	22	0.06%	36,371	99.93%	36,398	0.20%
Encore GX	2	0.02%	21	0.21%	9,867	99.77%	9,890	0.05%
LeSabre	1	0.02%	23	0.39%	5,822	99.59%	5,846	0.03%
Lucerne	2	0.03%	11	0.17%	6,597	99.80%	6,610	0.04%
Regal	2	0.02%	9	0.11%	8,175	99.87%	8,186	0.04%
Rendezvous	3	0.14%	14	0.65%	2,135	99.21%	2,152	0.01%
CADI								
ATS	30	0.17%	13	0.07%	17,763	99.76%	17,806	0.10%
CT4	2	0.04%	9	0.18%	5,083	99.78%	5,094	0.03%
CT5	9	0.09%	31	0.32%	9,603	99.59%	9,643	0.05%
CT6	2	0.03%	7	0.12%	5,860	99.85%	5,869	0.03%
CTS	96	0.25%	32	0.08%	38,604	99.67%	38,732	0.21%
DTS	16	0.27%	3	0.05%	5,828	99.68%	5,847	0.03%
Deville	17	0.50%	13	0.38%	3,376	99.12%	3,406	0.02%
Escalade	239	0.33%	92	0.13%	73,177	99.55%	73,508	0.40%
Escalade ESV	10	0.07%	21	0.15%	13,905	99.78%	13,936	0.08%
SRX	88	0.20%	29	0.07%	43,969	99.73%	44,086	0.24%
STS	5	0.20%	1	0.04%	2,456	99.76%	2,462	0.01%
XLR	1	0.14%	5	0.71%	701	99.15%	707	0.00%

Make/Model	DLC is Damaged, Inaccessible, or Cannot be Found		Vehicle will not Communicate with Analyzer		Vehicle Successfully Communicates with Analyzer		Total Count of Tests by Make	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
XT4	5	0.03%	20	0.10%	19,271	99.87%	19,296	0.10%
XT5	17	0.04%	30	0.07%	44,921	99.90%	44,968	0.24%
XT6	3	0.02%	16	0.12%	13,636	99.86%	13,655	0.07%
XTS	20	0.12%	12	0.07%	17,347	99.82%	17,379	0.09%
CHEV								
Astro Van	43	1.36%	8	0.25%	3,119	98.39%	3,170	0.02%
Avalanche	229	0.70%	44	0.13%	32,389	99.16%	32,662	0.18%
Aveo	43	0.72%	5	0.08%	5,896	99.19%	5,944	0.03%
Blazer	23	0.08%	29	0.10%	28,205	99.82%	28,257	0.15%
Camaro	189	0.21%	92	0.10%	88,196	99.68%	88,477	0.48%
Caprice Police Vehicle	3	0.48%	1	0.16%	620	99.36%	624	0.00%
Captiva Sport	5	0.10%	1	0.02%	5,059	99.88%	5,065	0.03%
Cavalier	5	0.15%	5	0.15%	3,303	99.70%	3,313	0.02%
City Express	6	0.31%	2	0.10%	1,935	99.59%	1,943	0.01%
Cobalt	54	0.37%	6	0.04%	14,573	99.59%	14,633	0.08%
Colorado	188	0.23%	145	0.17%	83,000	99.60%	83,333	0.45%
Corvette	75	0.14%	121	0.22%	53,712	99.64%	53,908	0.29%
Cruze	260	0.32%	58	0.07%	79,752	99.60%	80,070	0.43%
Cruze Limited	16	0.27%	7	0.12%	5,978	99.62%	6,001	0.03%
Equinox	346	0.18%	176	0.09%	191,592	99.73%	192,114	1.04%
Express	3205	9.86%	84	0.26%	29,208	89.88%	32,497	0.18%
F-150	2	0.97%	1	0.48%	204	98.55%	207	0.00%
GMT-400	10	2.22%	1	0.22%	440	97.56%	451	0.00%
HHR	38	0.32%	14	0.12%	11,802	99.56%	11,854	0.06%
Impala	202	0.24%	82	0.10%	83,757	99.66%	84,041	0.46%

Make/Model	DLC is Damaged, Inaccessible, or Cannot be Found		Vehicle will not Communicate with Analyzer		Vehicle Successfully Communicates with Analyzer		Total Count of Tests by Make	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Impala Limited	20	0.33%	6	0.10%	6,061	99.57%	6,087	0.03%
Malibu	439	0.26%	209	0.13%	166,173	99.61%	166,821	0.90%
Malibu Limited	13	0.24%	3	0.06%	5,431	99.71%	5,447	0.03%
Monte Carlo	17	0.69%	1	0.04%	2,437	99.27%	2,455	0.01%
S-10 Pickup	94	0.91%	20	0.19%	10,179	98.89%	10,293	0.06%
SS	3	0.19%	3	0.19%	1,554	99.62%	1,560	0.01%
SSR	2	0.19%	1	0.09%	1,073	99.72%	1,076	0.01%
Sierra	55	0.81%	12	0.18%	6,723	99.01%	6,790	0.04%
Silverado	6231	0.86%	993	0.14%	717,151	99.00%	724,375	3.93%
Silverado HD	629	21.27%	5	0.17%	2,323	78.56%	2,957	0.02%
Silverado LD	4	0.10%	2	0.05%	4,187	99.86%	4,193	0.02%
Silverado LTD	10	0.06%	30	0.18%	16,991	99.77%	17,031	0.09%
Sonic	64	0.24%	19	0.07%	26,171	99.68%	26,254	0.14%
Spark	14	0.07%	19	0.09%	21,323	99.85%	21,356	0.12%
Suburban	489	0.41%	183	0.15%	117,551	99.43%	118,223	0.64%
Tahoe	1126	0.43%	367	0.14%	263,127	99.44%	264,620	1.43%
Tracker	3	0.31%	1	0.10%	979	99.59%	983	0.01%
Trailblazer	214	0.52%	75	0.18%	41,019	99.30%	41,308	0.22%
Traverse	249	0.21%	108	0.09%	115,754	99.69%	116,111	0.63%
Trax	38	0.10%	38	0.10%	38,352	99.80%	38,428	0.21%
Uplander	20	0.80%	6	0.24%	2,476	98.96%	2,502	0.01%
Venture	13	1.27%	2	0.20%	1,006	98.53%	1,021	0.01%
Volt	3	0.07%	8	0.19%	4,305	99.75%	4,316	0.02%
Yukon	2	0.30%	2	0.30%	659	99.40%	663	0.00%
CHRY								

Make/Model	DLC is Damaged, Inaccessible, or Cannot be Found		Vehicle will not Communicate with Analyzer		Vehicle Successfully Communicates with Analyzer		Total Count of Tests by Make	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
200	5	0.02%	22	0.07%	29,768	99.91%	29,795	0.16%
300	10	0.02%	47	0.08%	56,771	99.90%	56,828	0.31%
Crossfire	1	0.06%	6	0.36%	1,643	99.58%	1,650	0.01%
PT Cruiser	1	0.01%	16	0.20%	7,799	99.78%	7,816	0.04%
Pacifica	6	0.02%	38	0.11%	34,608	99.87%	34,652	0.19%
Sebring	2	0.04%	3	0.07%	4,563	99.89%	4,568	0.02%
Town and Country	9	0.03%	25	0.08%	29,505	99.88%	29,539	0.16%
DODG								
1500	383	0.95%	38	0.09%	39,770	98.95%	40,191	0.22%
2500	772	24.67%	10	0.32%	2,347	75.01%	3,129	0.02%
Avenger	49	0.30%	8	0.05%	16,092	99.65%	16,149	0.09%
Caliber	20	0.28%	3	0.04%	7,066	99.68%	7,089	0.04%
Caravan	3	0.82%	1	0.27%	363	98.91%	367	0.00%
Caravan/Grand Caravan	103	0.81%	22	0.17%	12,611	99.02%	12,736	0.07%
Challenger	133	0.18%	85	0.12%	72,074	99.70%	72,292	0.39%
Charger	304	0.25%	123	0.10%	120,723	99.65%	121,150	0.66%
Dakota	60	0.42%	22	0.15%	14,223	99.43%	14,305	0.08%
Dart	63	0.44%	13	0.09%	14,212	99.47%	14,288	0.08%
Durango	200	0.33%	48	0.08%	60,749	99.59%	60,997	0.33%
Grand Caravan	141	0.30%	37	0.08%	46,102	99.62%	46,280	0.25%
Journey	155	0.29%	45	0.08%	53,021	99.62%	53,221	0.29%
Magnum	12	0.58%	2	0.10%	2,068	99.33%	2,082	0.01%
Neon	5	0.31%	2	0.12%	1,628	99.57%	1,635	0.01%
Nitro	37	0.51%	4	0.06%	7,194	99.43%	7,235	0.04%

Make/Model	DLC is Damaged, Inaccessible, or Cannot be Found		Vehicle will not Communicate with Analyzer		Vehicle Successfully Communicates with Analyzer		Total Count of Tests by Make	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
ProMaster 1500	165	20.70%	1	0.13%	631	79.17%	797	0.00%
ProMaster 2500	238	19.02%	4	0.32%	1,009	80.66%	1,251	0.01%
ProMaster 3500	181	27.89%	4	0.62%	464	71.49%	649	0.00%
Promaster City	27	1.65%	3	0.18%	1,602	98.16%	1,632	0.01%
Ram	1140	0.97%	139	0.12%	116,352	98.91%	117,631	0.64%
Ram Van	14	1.95%	1	0.14%	702	97.91%	717	0.00%
Stratus	3	0.31%	2	0.21%	951	99.48%	956	0.01%
FERR								
360	2	1.27%	1	0.64%	154	98.09%	157	0.00%
FIAT								
500	1	0.01%	11	0.11%	10,099	99.88%	10,111	0.05%
500L	2	0.09%	2	0.09%	2,319	99.83%	2,323	0.01%
FORD								
Bronco	5	0.02%	29	0.13%	22,598	99.85%	22,632	0.12%
Bronco Sport	32	0.13%	646	2.67%	23,488	97.19%	24,166	0.13%
Commercial Chassis	930	79.22%	39	3.32%	205	17.46%	1,174	0.01%
Crown Victoria	23	0.30%	14	0.18%	7,710	99.52%	7,747	0.04%
E-150	309	4.17%	9	0.12%	7,091	95.71%	7,409	0.04%
E-250	846	14.59%	10	0.17%	4,943	85.24%	5,799	0.03%
E-350	1356	21.40%	29	0.46%	4,951	78.14%	6,336	0.03%
E-450	506	35.61%	8	0.56%	907	63.83%	1,421	0.01%
Ecosport	11	0.07%	37	0.24%	15,325	99.69%	15,373	0.08%
Edge	152	0.13%	152	0.13%	120,494	99.75%	120,798	0.65%
Escape	277	0.14%	1190	0.59%	199,337	99.27%	200,804	1.09%
Excursion	76	11.16%	2	0.29%	603	88.55%	681	0.00%

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Expedition	361	0.31%	144	0.12%	114,900	99.56%	115,405	0.63%
Expedition EL	3	0.09%	5	0.15%	3,437	99.77%	3,445	0.02%
Expedition MAX	24	0.08%	50	0.17%	28,662	99.74%	28,736	0.16%
Explorer	454	0.19%	464	0.19%	240,977	99.62%	241,895	1.31%
Explorer Sport	1	0.24%	1	0.24%	419	99.52%	421	0.00%
Explorer Sport Trac	53	0.40%	22	0.17%	13,232	99.44%	13,307	0.07%
F-150	2511	0.26%	2898	0.30%	953,473	99.44%	958,882	5.20%
F-150 Heritage	25	0.63%	8	0.20%	3,905	99.16%	3,938	0.02%
F-250	3212	17.55%	80	0.44%	15,011	82.01%	18,303	0.10%
F-350	800	20.89%	24	0.63%	3,005	78.48%	3,829	0.02%
F-450	252	36.15%	5	0.72%	440	63.13%	697	0.00%
F-550	156	31.20%	3	0.60%	341	68.20%	500	0.00%
F-650	212	64.44%	16	4.86%	101	30.70%	329	0.00%
Fiesta	39	0.14%	26	0.09%	28,693	99.77%	28,758	0.16%
Five Hundred	9	0.28%	4	0.13%	3,182	99.59%	3,195	0.02%
Flex	29	0.19%	6	0.04%	15,275	99.77%	15,310	0.08%
Focus	171	0.17%	91	0.09%	98,610	99.74%	98,872	0.54%
Freestar	3	0.20%	2	0.13%	1,494	99.67%	1,499	0.01%
Freestyle	3	0.20%	3	0.20%	1,475	99.59%	1,481	0.01%
Fusion	172	0.11%	385	0.25%	152,221	99.64%	152,778	0.83%
GT	2	1.16%	2	1.16%	169	97.69%	173	0.00%
Maverick	10	0.09%	71	0.64%	10,976	99.27%	11,057	0.06%
Mustang	317	0.23%	228	0.16%	139,918	99.61%	140,463	0.76%
Ranger	172	0.25%	127	0.19%	68,324	99.56%	68,623	0.37%
Taurus	73	0.20%	43	0.12%	37,168	99.69%	37,284	0.20%

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Transit	1874	15.69%	52	0.44%	10,015	83.87%	11,941	0.06%
Transit Connect	60	0.23%	91	0.34%	26,265	99.43%	26,416	0.14%
Windstar	6	0.53%	2	0.18%	1,122	99.29%	1,130	0.01%
GENS								
GV80	1	0.02%	6	0.14%	4,382	99.84%	4,389	0.02%
GMC								
Acadia	178	0.23%	62	0.08%	75,709	99.68%	75,949	0.41%
Canyon	45	0.18%	25	0.10%	24,633	99.72%	24,703	0.13%
Envoy	71	0.68%	17	0.16%	10,354	99.16%	10,442	0.06%
Jimmy Utility	3	0.97%	1	0.32%	305	98.71%	309	0.00%
Safari	7	1.22%	2	0.35%	564	98.43%	573	0.00%
Savana	638	12.20%	13	0.25%	4,578	87.55%	5,229	0.03%
Sierra	1413	0.53%	317	0.12%	265,107	99.35%	266,837	1.45%
Sierra Limited	7	0.10%	12	0.16%	7,305	99.74%	7,324	0.04%
Silverado	16	2.97%	1	0.19%	521	96.84%	538	0.00%
Sonoma	6	0.45%	4	0.30%	1,328	99.25%	1,338	0.01%
Terrain	143	0.20%	49	0.07%	69,955	99.73%	70,147	0.38%
Yukon	323	0.30%	142	0.13%	106,763	99.57%	107,228	0.58%
Yukon XL	168	0.32%	71	0.14%	51,977	99.54%	52,216	0.28%
HOND								
Accord	73	0.01%	512	0.10%	504,703	99.88%	505,288	2.74%
CR-V	30	0.01%	345	0.10%	330,743	99.89%	331,118	1.80%
Civic	48	0.01%	357	0.09%	398,287	99.90%	398,692	2.16%
Element	1	0.01%	22	0.21%	10,345	99.78%	10,368	0.06%
Fit	2	0.01%	33	0.08%	39,667	99.91%	39,702	0.22%

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HR-V	6	0.01%	73	0.14%	52,067	99.85%	52,146	0.28%
Insight	1	0.01%	13	0.14%	9,068	99.85%	9,082	0.05%
Odyssey	40	0.03%	143	0.09%	153,207	99.88%	153,390	0.83%
Passport	3	0.02%	18	0.13%	14,185	99.85%	14,206	0.08%
Pilot	34	0.02%	176	0.10%	176,636	99.88%	176,846	0.96%
Ridgeline	4	0.01%	27	0.09%	29,825	99.90%	29,856	0.16%
HUMM								
H3	2	0.03%	16	0.20%	7,802	99.77%	7,820	0.04%
HYUN								
Accent	4	0.01%	36	0.08%	42,331	99.91%	42,371	0.23%
Elantra	14	0.01%	140	0.08%	167,497	99.91%	167,651	0.91%
Genesis	1	0.01%	8	0.06%	12,351	99.93%	12,360	0.07%
Palisade	7	0.02%	46	0.14%	32,508	99.84%	32,561	0.18%
Santa Cruz	1	0.02%	6	0.13%	4,715	99.85%	4,722	0.03%
Santa Fe	17	0.02%	117	0.12%	95,270	99.86%	95,404	0.52%
Santa Fe Sport	5	0.02%	25	0.08%	31,409	99.90%	31,439	0.17%
Sonata	13	0.01%	129	0.09%	147,681	99.90%	147,823	0.80%
Tucson	10	0.01%	116	0.12%	96,102	99.87%	96,228	0.52%
Venue	1	0.01%	10	0.13%	7,586	99.86%	7,597	0.04%
Veracruz	1	0.03%	4	0.14%	2,955	99.83%	2,960	0.02%
INFI								
FX35	2	0.03%	6	0.09%	6,392	99.88%	6,400	0.03%
JX35	5	0.09%	7	0.12%	5,696	99.79%	5,708	0.03%
Q50	1	0.00%	37	0.10%	36,062	99.89%	36,100	0.20%
QX4	1	0.15%	1	0.15%	668	99.70%	670	0.00%

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QX50	1	0.00%	38	0.15%	25,518	99.85%	25,557	0.14%
QX55	1	0.04%	1	0.04%	2,406	99.92%	2,408	0.01%
QX56	5	0.05%	6	0.06%	10,199	99.89%	10,210	0.06%
QX60	7	0.01%	44	0.08%	55,239	99.91%	55,290	0.30%
QX70	1	0.02%	4	0.09%	4,228	99.88%	4,233	0.02%
QX80	1	0.00%	32	0.09%	35,265	99.91%	35,298	0.19%
ISU								
Ascender	5	0.77%	2	0.31%	640	98.92%	647	0.00%
NPR/NPR-HD	294	48.68%	1	0.17%	309	51.16%	604	0.00%
Rodeo	7	0.50%	3	0.22%	1,379	99.28%	1,389	0.01%
i-290	1	0.34%	2	0.67%	295	98.99%	298	0.00%
JAGU								
F-PACE	1	0.01%	9	0.09%	9,487	99.89%	9,497	0.05%
S-Type	1	0.06%	2	0.13%	1,542	99.81%	1,545	0.01%
XE	2	0.07%	3	0.11%	2,821	99.82%	2,826	0.02%
JEEP								
Cherokee	158	0.18%	104	0.12%	88,425	99.70%	88,687	0.48%
Commander	27	0.48%	3	0.05%	5,637	99.47%	5,667	0.03%
Compass	60	0.11%	69	0.12%	55,739	99.77%	55,868	0.30%
Gladiator	16	0.06%	28	0.11%	26,141	99.83%	26,185	0.14%
Grand Cherokee	245	0.14%	169	0.10%	169,781	99.76%	170,195	0.92%
Grand Cherokee L	2	0.01%	28	0.16%	17,093	99.82%	17,123	0.09%
Liberty	101	0.42%	28	0.12%	23,789	99.46%	23,918	0.13%
Patriot	80	0.26%	39	0.13%	30,626	99.61%	30,745	0.17%
Renegade	30	0.09%	43	0.13%	34,217	99.79%	34,290	0.19%

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Wagoneer	1	0.02%	8	0.14%	5,841	99.85%	5,850	0.03%
Wrangler	232	0.11%	257	0.13%	204,730	99.76%	205,219	1.11%
Wrangler JK	3	0.04%	4	0.05%	7,865	99.91%	7,872	0.04%
KIA								
Borrego	2	0.18%	1	0.09%	1,086	99.72%	1,089	0.01%
Cadenza	1	0.03%	2	0.05%	3,736	99.92%	3,739	0.02%
Forte	11	0.01%	100	0.11%	89,393	99.88%	89,504	0.49%
K5	2	0.01%	28	0.14%	20,140	99.85%	20,170	0.11%
Optima	11	0.01%	89	0.10%	85,519	99.88%	85,619	0.46%
Rio	1	0.00%	45	0.14%	31,831	99.86%	31,877	0.17%
Sedona	7	0.04%	8	0.05%	17,213	99.91%	17,228	0.09%
Seltos	1	0.01%	7	0.07%	9,765	99.92%	9,773	0.05%
Sorento	9	0.01%	105	0.10%	101,249	99.89%	101,363	0.55%
Soul	15	0.01%	92	0.09%	104,887	99.90%	104,994	0.57%
Spectra	4	0.04%	12	0.12%	10,063	99.84%	10,079	0.05%
Sportage	6	0.01%	69	0.11%	62,986	99.88%	63,061	0.34%
Telluride	4	0.01%	34	0.09%	37,913	99.90%	37,951	0.21%
LEXS								
CT	1	0.02%	5	0.09%	5,774	99.90%	5,780	0.03%
ES	8	0.01%	121	0.09%	137,671	99.91%	137,800	0.75%
GS	1	0.00%	31	0.10%	30,113	99.89%	30,145	0.16%
GX	5	0.01%	45	0.06%	70,255	99.93%	70,305	0.38%
IS	6	0.01%	64	0.09%	73,201	99.90%	73,271	0.40%
LS	2	0.01%	29	0.10%	28,565	99.89%	28,596	0.16%
LX	1	0.01%	15	0.13%	11,636	99.86%	11,652	0.06%

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NX	3	0.00%	54	0.08%	66,410	99.91%	66,467	0.36%
RX	25	0.01%	175	0.07%	246,879	99.92%	247,079	1.34%
LINC								
Aviator	4	0.04%	14	0.12%	11,196	99.84%	11,214	0.06%
Continental	1	0.02%	11	0.26%	4,274	99.72%	4,286	0.02%
Corsair	8	0.10%	217	2.75%	7,680	97.15%	7,905	0.04%
LS	3	0.29%	4	0.38%	1,036	99.33%	1,043	0.01%
MKC	7	0.06%	21	0.18%	11,713	99.76%	11,741	0.06%
MKS	7	0.12%	1	0.02%	5,913	99.86%	5,921	0.03%
MKT	4	0.15%	7	0.26%	2,694	99.59%	2,705	0.01%
MKX	16	0.08%	15	0.07%	20,661	99.85%	20,692	0.11%
MKZ	16	0.08%	49	0.24%	20,210	99.68%	20,275	0.11%
Mark LT	9	0.31%	1	0.03%	2,876	99.65%	2,886	0.02%
Nautilus	1	0.01%	20	0.18%	10,817	99.81%	10,838	0.06%
Navigator	71	0.27%	34	0.13%	26,327	99.60%	26,432	0.14%
Navigator L	4	0.08%	9	0.18%	5,047	99.74%	5,060	0.03%
Town Car	22	0.17%	15	0.12%	12,549	99.71%	12,586	0.07%
LNDR								
Defender	2	0.03%	10	0.15%	6,714	99.82%	6,726	0.04%
Discovery	1	0.02%	6	0.13%	4,683	99.85%	4,690	0.03%
LR3	1	0.08%	3	0.23%	1,300	99.69%	1,304	0.01%
Range Rover	5	0.02%	28	0.12%	23,175	99.86%	23,208	0.13%
Range Rover Evoque	1	0.01%	6	0.06%	10,214	99.93%	10,221	0.06%
Range Rover Sport	2	0.01%	37	0.14%	27,183	99.86%	27,222	0.15%
MASE								

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Ghibli	2	0.04%	6	0.13%	4,783	99.83%	4,791	0.03%
MAZD								
CX-30	1	0.01%	23	0.13%	17,038	99.86%	17,062	0.09%
CX-5	3	0.00%	78	0.07%	114,187	99.93%	114,268	0.62%
CX-7	9	0.11%	93	1.16%	7,915	98.73%	8,017	0.04%
CX-9	1	0.00%	23	0.07%	34,059	99.93%	34,083	0.18%
MPV	3	0.24%	12	0.98%	1,211	98.78%	1,226	0.01%
MX-5	4	0.03%	46	0.31%	14,719	99.66%	14,769	0.08%
Mazda2	3	0.10%	26	0.83%	3,089	99.07%	3,118	0.02%
Mazda3	19	0.02%	274	0.33%	83,632	99.65%	83,925	0.46%
Mazda5	2	0.03%	19	0.33%	5,779	99.64%	5,800	0.03%
Mazda6	10	0.03%	126	0.32%	39,351	99.66%	39,487	0.21%
Protege	3	0.19%	12	0.77%	1,540	99.04%	1,555	0.01%
Tribute	1	0.02%	5	0.09%	5,482	99.89%	5,488	0.03%
MERC								
Grand Marquis	1	0.01%	26	0.18%	14,382	99.81%	14,409	0.08%
Monterey	1	0.45%	1	0.45%	220	99.10%	222	0.00%
Mountaineer	3	0.09%	4	0.12%	3,234	99.78%	3,241	0.02%
MERZ								
A-Class	4	0.06%	20	0.32%	6,169	99.61%	6,193	0.03%
AMG GT	2	0.07%	11	0.36%	3,059	99.58%	3,072	0.02%
C-Class	10	0.01%	138	0.16%	88,206	99.83%	88,354	0.48%
CLA-Class	1	0.01%	32	0.17%	18,520	99.82%	18,553	0.10%
CLS-Class	2	0.02%	16	0.18%	8,837	99.80%	8,855	0.05%
E-Class	11	0.01%	130	0.17%	74,531	99.81%	74,672	0.40%

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G-Class	1	0.01%	24	0.26%	9,222	99.73%	9,247	0.05%
GL-Class	1	0.01%	16	0.13%	12,075	99.86%	12,092	0.07%
GLA-Class	3	0.01%	45	0.22%	20,259	99.76%	20,307	0.11%
GLB-Class	1	0.01%	48	0.41%	11,538	99.58%	11,587	0.06%
GLC-Class	13	0.02%	119	0.21%	57,282	99.77%	57,414	0.31%
GLE-Class	9	0.01%	181	0.29%	61,966	99.69%	62,156	0.34%
GLK-Class	4	0.03%	8	0.05%	15,503	99.92%	15,515	0.08%
GLS-Class	2	0.01%	85	0.47%	17,970	99.52%	18,057	0.10%
M-Class	4	0.04%	4	0.04%	9,244	99.91%	9,252	0.05%
ML-Class	2	0.01%	9	0.06%	15,066	99.93%	15,077	0.08%
Metris	1	0.05%	3	0.16%	1,870	99.79%	1,874	0.01%
R-Class	2	0.20%	2	0.20%	1,020	99.61%	1,024	0.01%
S-Class	3	0.01%	45	0.15%	29,324	99.84%	29,372	0.16%
SL-Class	1	0.01%	10	0.12%	8,099	99.86%	8,110	0.04%
SLK-Class	1	0.02%	13	0.22%	6,029	99.77%	6,043	0.03%
MITS								
Eclipse	2	0.05%	32	0.79%	4,040	99.17%	4,074	0.02%
Endeavor	2	0.07%	12	0.42%	2,843	99.51%	2,857	0.02%
Galant	1	0.02%	47	0.73%	6,432	99.26%	6,480	0.04%
Lancer Evolution	1	0.09%	1	0.09%	1,127	99.82%	1,129	0.01%
Mirage	1	0.01%	23	0.23%	10,133	99.76%	10,157	0.06%
Mirage G4	1	0.02%	10	0.15%	6,525	99.83%	6,536	0.04%
Montero	1	0.15%	9	1.37%	647	98.48%	657	0.00%
Montero Sport	1	0.08%	2	0.17%	1,199	99.75%	1,202	0.01%
Outlander	7	0.02%	57	0.19%	29,964	99.79%	30,028	0.16%

Make/Model	DLC is Damaged, Inaccessible, or Cannot be Found		Vehicle will not Communicate with Analyzer		Vehicle Successfully Communicates with Analyzer		Total Count of Tests by Make	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Outlander Sport	2	0.01%	31	0.11%	27,587	99.88%	27,620	0.15%
MNNI								
Clubman	1	0.02%	11	0.27%	4,030	99.70%	4,042	0.02%
Cooper	1	0.02%	11	0.21%	5,149	99.77%	5,161	0.03%
Cooper Convertible	1	0.03%	3	0.08%	3,627	99.89%	3,631	0.02%
Countryman	1	0.01%	14	0.11%	12,712	99.88%	12,727	0.07%
Hardtop	1	0.01%	34	0.20%	17,370	99.80%	17,405	0.09%
NISS								
370Z	2	0.03%	6	0.08%	7,725	99.90%	7,733	0.04%
Altima	43	0.01%	340	0.10%	342,259	99.89%	342,642	1.86%
Armada	12	0.02%	62	0.13%	49,138	99.85%	49,212	0.27%
Frontier	29	0.03%	120	0.12%	102,332	99.85%	102,481	0.56%
Juke	3	0.02%	5	0.03%	18,073	99.96%	18,081	0.10%
Kicks	6	0.02%	56	0.15%	38,192	99.84%	38,254	0.21%
Maxima	7	0.01%	51	0.08%	62,889	99.91%	62,947	0.34%
Murano	28	0.03%	80	0.08%	99,057	99.89%	99,165	0.54%
NV	3	0.23%	1	0.08%	1,296	99.69%	1,300	0.01%
NV200	3	0.03%	16	0.15%	10,596	99.82%	10,615	0.06%
Pathfinder	21	0.02%	108	0.12%	93,457	99.86%	93,586	0.51%
Quest	3	0.04%	6	0.08%	7,210	99.88%	7,219	0.04%
Rogue	42	0.02%	270	0.10%	275,467	99.89%	275,779	1.50%
Rogue Sport	4	0.01%	44	0.11%	40,516	99.88%	40,564	0.22%
Sentra	23	0.01%	171	0.09%	194,945	99.90%	195,139	1.06%
Titan	28	0.05%	49	0.09%	54,580	99.86%	54,657	0.30%
Versa	11	0.01%	90	0.11%	79,671	99.87%	79,772	0.43%

Make/Model	DLC is Damaged, Inaccessible, or Cannot be Found		Vehicle will not Communicate with Analyzer		Vehicle Successfully Communicates with Analyzer		Total Count of Tests by Make	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Versa Note	1	0.01%	12	0.07%	16,304	99.92%	16,317	0.09%
Xterra	11	0.05%	28	0.12%	22,513	99.83%	22,552	0.12%
OTHR								
Acadia	6	4.41%	1	0.74%	129	94.85%	136	0.00%
CR-V	257	34.45%	1	0.13%	488	65.42%	746	0.00%
Camry	19	8.05%	1	0.42%	216	91.53%	236	0.00%
Carnival	1	0.27%	1	0.27%	368	99.46%	370	0.00%
Compass	7	4.24%	1	0.61%	157	95.15%	165	0.00%
Continental	11	5.21%	1	0.47%	199	94.31%	211	0.00%
E-450	228	60.64%	1	0.27%	147	39.10%	376	0.00%
Escape	7	4.38%	2	1.25%	151	94.38%	160	0.00%
F-150	22	4.25%	3	0.58%	493	95.17%	518	0.00%
Forester	8	6.50%	1	0.81%	114	92.68%	123	0.00%
G70	1	0.11%	2	0.22%	904	99.67%	907	0.00%
G80	1	0.14%	1	0.14%	689	99.71%	691	0.00%
GLC-Class	21	11.86%	1	0.56%	155	87.57%	177	0.00%
GLE-Class	17	8.72%	1	0.51%	177	90.77%	195	0.00%
Genesis	9	4.15%	1	0.46%	207	95.39%	217	0.00%
Grand Caravan	2	0.18%	3	0.26%	1,133	99.56%	1,138	0.01%
Grand Cherokee	7	1.36%	1	0.19%	506	98.44%	514	0.00%
H2	89	7.82%	4	0.35%	1,045	91.83%	1,138	0.01%
Highlander	4	1.14%	1	0.28%	346	98.58%	351	0.00%
Motorhome Chassis	239	73.54%	6	1.85%	80	24.62%	325	0.00%
NPR/NPR-HD	13	8.33%	1	0.64%	142	91.03%	156	0.00%
NV	370	33.98%	2	0.18%	717	65.84%	1,089	0.01%

Make/Model	DLC is Damaged, Inaccessible, or Cannot be Found		Vehicle will not Communicate with Analyzer		Vehicle Successfully Communicates with Analyzer		Total Count of Tests by Make	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Odyssey	340	5.54%	11	0.18%	5,782	94.28%	6,133	0.03%
Pacifica	32	3.25%	3	0.30%	949	96.44%	984	0.01%
ProMaster 1500	83	28.82%	1	0.35%	204	70.83%	288	0.00%
ProMaster 2500	92	25.41%	2	0.55%	268	74.03%	362	0.00%
ProMaster 3500	52	23.32%	2	0.90%	169	75.78%	223	0.00%
Promaster City	11	2.52%	1	0.23%	424	97.25%	436	0.00%
RAV4	2	0.35%	2	0.35%	572	99.31%	576	0.00%
RDX	24	20.17%	2	1.68%	93	78.15%	119	0.00%
RX	95	15.32%	1	0.16%	524	84.52%	620	0.00%
Ram	26	3.00%	2	0.23%	838	96.77%	866	0.00%
Range Rover	17	7.39%	2	0.87%	211	91.74%	230	0.00%
Rogue	181	46.53%	1	0.26%	207	53.21%	389	0.00%
Santa Fe	95	48.72%	1	0.51%	99	50.77%	195	0.00%
Sienna	11	0.30%	8	0.22%	3,608	99.48%	3,627	0.02%
Sierra	30	1.70%	2	0.11%	1,734	98.19%	1,766	0.01%
Sorento	91	28.98%	1	0.32%	222	70.70%	314	0.00%
Soul	74	8.90%	1	0.12%	756	90.97%	831	0.00%
Sportage	31	17.32%	1	0.56%	147	82.12%	179	0.00%
Sprinter	52	21.31%	2	0.82%	190	77.87%	244	0.00%
Terrain	5	3.50%	1	0.70%	137	95.80%	143	0.00%
Wrangler	3	0.48%	1	0.16%	622	99.36%	626	0.00%
PONT								
Grand Prix	1	0.03%	6	0.18%	3,416	99.80%	3,423	0.02%
Montana SV6	1	0.40%	1	0.40%	246	99.19%	248	0.00%
Torrent	3	0.28%	1	0.09%	1,083	99.63%	1,087	0.01%

Make/Model	DLC is Damaged, Inaccessible, or Cannot be Found		Vehicle will not Communicate with Analyzer		Vehicle Successfully Communicates with Analyzer		Total Count of Tests by Make	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Vibe	1	0.02%	6	0.11%	5,612	99.88%	5,619	0.03%
PORS								
911	6	0.03%	57	0.30%	19,202	99.67%	19,265	0.10%
Boxster	3	0.07%	33	0.80%	4,075	99.12%	4,111	0.02%
Cayenne	7	0.03%	31	0.12%	25,232	99.85%	25,270	0.14%
Cayman	2	0.07%	12	0.40%	2,961	99.53%	2,975	0.02%
Macan	2	0.01%	36	0.17%	21,628	99.82%	21,666	0.12%
Panamera	3	0.03%	26	0.26%	10,048	99.71%	10,077	0.05%
RAM								
1500	51	0.02%	319	0.12%	271,581	99.86%	271,951	1.47%
ProMaster 1500	1	0.15%	2	0.30%	653	99.54%	656	0.00%
ProMaster 2500	2	0.32%	2	0.32%	614	99.35%	618	0.00%
Promaster City	1	0.02%	22	0.39%	5,678	99.60%	5,701	0.03%
Ram	8	0.03%	15	0.06%	26,602	99.91%	26,625	0.14%
SCIO								
Scion FR-S	3	0.07%	44	0.98%	4,441	98.95%	4,488	0.02%
Scion tC	2	0.01%	12	0.06%	19,151	99.93%	19,165	0.10%
Scion xA	1	0.04%	5	0.19%	2,614	99.77%	2,620	0.01%
Scion xB	2	0.01%	8	0.05%	16,190	99.94%	16,200	0.09%
Scion xD	1	0.02%	3	0.06%	5,137	99.92%	5,141	0.03%
SMRT								
Fortwo	1	0.03%	1	0.03%	3,356	99.94%	3,358	0.02%
STRN								
SC2	1	0.71%	1	0.71%	138	98.57%	140	0.00%
Vue	5	0.06%	13	0.17%	7,705	99.77%	7,723	0.04%

Make/Model	DLC is Damaged, Inaccessible, or Cannot be Found		Vehicle will not Communicate with Analyzer		Vehicle Successfully Communicates with Analyzer		Total Count of Tests by Make	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
SUBA								
Ascent	6	0.03%	21	0.09%	22,837	99.88%	22,864	0.12%
B9 Tribeca	1	0.09%	7	0.66%	1,046	99.24%	1,054	0.01%
BRZ	1	0.02%	23	0.53%	4,327	99.45%	4,351	0.02%
Forester	5	0.01%	93	0.13%	70,091	99.86%	70,189	0.38%
Impreza	2	0.01%	34	0.18%	19,165	99.81%	19,201	0.10%
Legacy	2	0.01%	11	0.07%	14,756	99.91%	14,769	0.08%
Outback	5	0.01%	63	0.08%	74,086	99.91%	74,154	0.40%
SUZI								
Grand Vitara	6	0.35%	16	0.92%	1,708	98.73%	1,730	0.01%
XL7	2	0.23%	2	0.23%	857	99.54%	861	0.00%
TOYT								
4Runner	186	0.10%	193	0.11%	182,493	99.79%	182,872	0.99%
86	2	0.11%	11	0.58%	1,871	99.31%	1,884	0.01%
Avalon	55	0.08%	69	0.10%	68,296	99.82%	68,420	0.37%
C-HR	8	0.04%	24	0.11%	22,452	99.86%	22,484	0.12%
COROLLA iM	1	0.04%	3	0.11%	2,693	99.85%	2,697	0.01%
Camry	575	0.09%	531	0.09%	617,882	99.82%	618,988	3.36%
Camry Solara	12	0.13%	9	0.10%	9,252	99.77%	9,273	0.05%
Celica	6	0.30%	2	0.10%	1,997	99.60%	2,005	0.01%
Corolla	666	0.14%	426	0.09%	464,985	99.77%	466,077	2.53%
Corolla Matrix	66	0.51%	14	0.11%	12,897	99.38%	12,977	0.07%
Echo	3	0.20%	5	0.34%	1,465	99.46%	1,473	0.01%
FJ Cruiser	17	0.11%	13	0.08%	16,052	99.81%	16,082	0.09%
GR86	2	0.10%	2	0.10%	2,058	99.81%	2,062	0.01%

Make/Model	DLC is Damaged, Inaccessible, or Cannot be Found		Vehicle will not Communicate with Analyzer		Vehicle Successfully Communicates with Analyzer		Total Count of Tests by Make	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Highlander	160	0.07%	243	0.10%	242,868	99.83%	243,271	1.32%
Land Cruiser	4	0.05%	9	0.12%	7,502	99.83%	7,515	0.04%
Prius	29	0.05%	52	0.09%	57,911	99.86%	57,992	0.31%
Prius C	3	0.04%	6	0.09%	6,679	99.87%	6,688	0.04%
Prius V	2	0.03%	6	0.10%	6,127	99.87%	6,135	0.03%
RAV4	135	0.04%	314	0.08%	372,462	99.88%	372,911	2.02%
Scion tC	4	2.03%	2	1.02%	191	96.95%	197	0.00%
Sequoia	124	0.30%	36	0.09%	41,594	99.62%	41,754	0.23%
Sienna	253	0.19%	111	0.08%	135,904	99.73%	136,268	0.74%
Supra	4	0.14%	7	0.24%	2,883	99.62%	2,894	0.02%
Tacoma	274	0.10%	303	0.11%	275,795	99.79%	276,372	1.50%
Tundra	531	0.20%	260	0.10%	267,137	99.70%	267,928	1.45%
Venza	11	0.04%	19	0.08%	24,998	99.88%	25,028	0.14%
Yaris	26	0.11%	20	0.08%	23,521	99.80%	23,567	0.13%
Yaris iA	3	0.06%	2	0.04%	5,008	99.90%	5,013	0.03%
VOLK								
Atlas	7	0.02%	64	0.16%	40,533	99.83%	40,604	0.22%
Beetle	8	0.04%	32	0.17%	19,095	99.79%	19,135	0.10%
CC	1	0.04%	2	0.07%	2,707	99.89%	2,710	0.01%
Golf	1	0.02%	11	0.20%	5,531	99.78%	5,543	0.03%
Jetta	26	0.03%	151	0.17%	89,016	99.80%	89,193	0.48%
Passat	9	0.02%	73	0.17%	43,017	99.81%	43,099	0.23%
Taos	1	0.01%	16	0.13%	12,607	99.87%	12,624	0.07%
Tiguan	7	0.01%	105	0.17%	62,803	99.82%	62,915	0.34%
VOLV								

Make/Model	DLC is Damaged, Inaccessible, or Cannot be Found		Vehicle will not Communicate with Analyzer		Vehicle Successfully Communicates with Analyzer		Total Count of Tests by Make	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent
S60	2	0.01%	16	0.10%	15,695	99.89%	15,713	0.09%
XC40	1	0.01%	10	0.13%	7,939	99.86%	7,950	0.04%
XC60	4	0.01%	25	0.09%	27,350	99.89%	27,379	0.15%
XC70	2	0.14%	1	0.07%	1,417	99.79%	1,420	0.01%
XC90	4	0.01%	44	0.14%	30,592	99.84%	30,640	0.17%
Grand Total	46,647	0.25%	25,818	0.14%	18,370,294	99.61%	18,442,759	100.00%

Appendix B- DTC Groups

Table B-1. Evap DTCs

DTC	DTC Description	DTC	DTC Description
P0093	Fuel System Leak Detected - Large Leak	P0496	Evap High Purge Flow
P0094	Fuel System Leak Detected - Small Leak	P0497	Evap Low Purge Flow
P0440	Evap Malfunction	P0498	Evap Vent Valve Control Circuit Low
P0441	Evap Incorrect Purge Flow	P0499	Evap Vent Valve Control Circuit High
P0442	Evap Leak Detected (small leak)	P2024	Evap Fuel Vapor Temperature Sensor Circuit
P0443	Evap Purge Control Valve Circuit	P2025	Evap Fuel Vapor Temperature Sensor Performance
P0444	Evap Purge Control Valve Circuit Open	P2026	Evap Fuel Vapor Temperature Sensor Circuit Low Voltage
P0445	Evap Purge Control Valve Circuit Shorted	P2027	Evap Fuel Vapor Temperature Sensor Circuit High Voltage
P0446	Evap Vent Control Circuit Malfunction	P2028	Evap Fuel Vapor Temperature Sensor Circuit Intermittent
P0447	Evap Vent Control Circuit Open	P2400	Evap Leak Detection Pump Control Circuit/Open
P0448	Evap Vent Control Circuit Shorted	P2401	Evap Leak Detection Pump Control Circuit Low
P0449	Evap Vent Valve/Solenoid Circuit Malfunction	P2402	Evap Leak Detection Pump Control Circuit High
P0450	Evap Pressure Sensor Malfunction	P2403	Evap Leak Detection Pump Sense Circuit/Open
P0451	Evap Pressure Sensor Range/Performance	P2404	Evap Leak Detection Pump Sense Circuit Range/Performance
P0452	Evap Pressure Sensor Low Input	P2405	Evap Leak Detection Pump Sense Circuit Low
P0453	Evap Pressure Sensor High Input	P2406	Evap Leak Detection Pump Sense Circuit High
P0454	Evap Pressure Sensor Intermittent	P2407	Evap Leak Detection Pump Sense Circuit Intermittent/Erratic
P0455	Evap Leak Detected (gross leak)	P2408	Fuel Cap Sensor/Switch Circuit
P0456	Evap Leak Detected (very small leak)	P2409	Fuel Cap Sensor/Switch Circuit Range/Performance
P0457	Evap Leak Detected (fuel cap loose/off)	P2410	Fuel Cap Sensor/Switch Circuit Low
P0458	Evap Purge Control Valve Circuit Low	P2411	Fuel Cap Sensor/Switch Circuit High
P0459	Evap Purge Control Valve Circuit High	P2412	Fuel Cap Sensor/Switch Circuit Intermittent/Erratic
P0465	Purge Flow Sensor Circuit Malfunction	P2418	Evap Switching Valve Control Circuit / Open
P0466	Purge Flow Sensor Circuit Range/Performance	P2419	Evap Switching Valve Control Circuit Low
P0467	Purge Flow Sensor Circuit Low Input	P2420	Evap Switching Valve Control Circuit High
P0468	Purge Flow Sensor Circuit High Input	P2421	Evap Vent Valve Stuck Open
P0469	Purge Flow Sensor Circuit Intermittent	P2422	Evap Vent Valve Stuck Closed

Table B-2. Catalyst DTCs⁷

DTC	DTC Description	DTC	DTC Description
P0420	Catalyst System Efficiency Below Threshold	P0431	Warm Up Catalyst Efficiency Below Threshold
P0421	Warm Up Catalyst Efficiency Below Threshold	P0432	Main Catalyst Efficiency Below Threshold
P0422	Main Catalyst Efficiency Below Threshold	P0433	Heated Catalyst Efficiency Below Threshold
P0423	Heated Catalyst Efficiency Below Threshold	P0434	Heated Catalyst Temperature Below Threshold
P0424	Heated Catalyst Temperature Below Threshold	P0435	Catalyst Temperature Sensor
P0425	Catalyst Temperature Sensor	P0436	Catalyst Temperature Sensor Range/Performance
P0426	Catalyst Temperature Sensor Range/Performance	P0437	Catalyst Temperature Sensor Low
P0427	Catalyst Temperature Sensor Low	P0438	Catalyst Temperature Sensor High
P0428	Catalyst Temperature Sensor High	P0439	Catalyst Heater Control Circuit
P0429	Catalyst Heater Control Circuit	P2423	HC Adsorption Catalyst Efficiency Below Threshold
P0430	Catalyst System Efficiency Below Threshold	P2424	HC Adsorption Catalyst Efficiency Below Threshold

Table B-3. EGR DTCs

DTC	DTC Description	DTC	DTC Description
P0400	EGR Flow	P0489	EGR Control Circuit Low
P0401	EGR Flow Insufficient Detected	P0490	EGR Control Circuit High
P0402	EGR Flow Excessive Detected	P2141	EGR Throttle Control Circuit Low
P0403	EGR Control Circuit	P2142	EGR Throttle Control Circuit High
P0404	EGR Control Circuit Range/Performance	P2143	EGR Vent Control Circuit/Open
P0405	EGR Sensor "A" Circuit Low	P2144	EGR Vent Control Circuit Low
P0406	EGR Sensor "A" Circuit High	P2145	EGR Vent Control Circuit High
P0407	EGR Sensor "B" Circuit Low	P2413	EGR System Performance
P0408	EGR Sensor "B" Circuit High	P2425	EGR Cooling Valve Control Circuit/Open
P0409	EGR Sensor "A" Circuit	P2426	EGR Cooling Valve Control Circuit Low
P0486	EGR Sensor "B" Circuit	P2427	EGR Cooling Valve Control Circuit High
P0487	EGR Throttle Position Control Circuit	P2428	Exhaust Gas Temperature Too High
P0488	EGR Throttle Position Control Range/Perf	P2429	Exhaust Gas Temperature Too High

⁷ Includes heated catalyst DTCs, although none were present in the data analyzed for this study.

Table B-4. O₂ System DTCs⁸

DTC	DTC Description	DTC	DTC Description
P0030	HO2S Heater Control Circuit	P0166	O2 Sensor Circuit No Activity Detected
P0031	HO2S Heater Control Circuit Low	P0167	O2 Sensor Heater Circuit
P0032	HO2S Heater Control Circuit High	P2195	O2 Sensor Signal Stuck Lean
P0036	HO2S Heater Control Circuit	P2196	O2 Sensor Signal Stuck Rich
P0037	HO2S Heater Control Circuit Low	P2197	O2 Sensor Signal Stuck Lean
P0038	HO2S Heater Control Circuit High	P2198	O2 Sensor Signal Stuck Rich
P0040	O2 Sensor Signals Swapped B1 S1/ B2 S1	P2231	O2 Sensor Signal Circuit Shorted to Heater Circuit
P0041	O2 Sensor Signals Swapped B1 S2/ B2 S2	P2232	O2 Sensor Signal Circuit Shorted to Heater Circuit
P0042	HO2S Heater Control Circuit	P2233	O2 Sensor Signal Circuit Shorted to Heater Circuit
P0043	HO2S Heater Control Circuit Low	P2234	O2 Sensor Signal Circuit Shorted to Heater Circuit
P0044	HO2S Heater Control Circuit High	P2235	O2 Sensor Signal Circuit Shorted to Heater Circuit
P0050	HO2S Heater Control Circuit	P2236	O2 Sensor Signal Circuit Shorted to Heater Circuit
P0051	HO2S Heater Control Circuit Low	P2237	O2 Sensor Positive Current Control Circuit/Open
P0052	HO2S Heater Control Circuit High	P2238	O2 Sensor Positive Current Control Circuit Low
P0053	HO2S Heater Resistance	P2239	O2 Sensor Positive Current Control Circuit High
P0054	HO2S Heater Resistance	P2240	O2 Sensor Positive Current Control Circuit/Open
P0055	HO2S Heater Resistance	P2241	O2 Sensor Positive Current Control Circuit Low
P0056	HO2S Heater Control Circuit	P2242	O2 Sensor Positive Current Control Circuit High
P0057	HO2S Heater Control Circuit Low	P2243	O2 Sensor Reference Voltage Circuit/Open
P0058	HO2S Heater Control Circuit High	P2244	O2 Sensor Reference Voltage Performance
P0059	HO2S Heater Resistance	P2245	O2 Sensor Reference Voltage Circuit Low
P0060	HO2S Heater Resistance	P2246	O2 Sensor Reference Voltage Circuit High
P0061	HO2S Heater Resistance	P2247	O2 Sensor Reference Voltage Circuit/Open
P0062	HO2S Heater Control Circuit	P2248	O2 Sensor Reference Voltage Performance
P0063	HO2S Heater Control Circuit Low	P2249	O2 Sensor Reference Voltage Circuit Low
P0064	HO2S Heater Control Circuit High	P2250	O2 Sensor Reference Voltage Circuit High
P0130	O2 Sensor Circuit	P2251	O2 Sensor Negative Current Control Circuit/Open
P0131	O2 Sensor Circuit Low Voltage	P2252	O2 Sensor Negative Current Control Circuit Low
P0132	O2 Sensor Circuit High Voltage	P2253	O2 Sensor Negative Current Control Circuit High
P0133	O2 Sensor Circuit Slow Response	P2254	O2 Sensor Negative Current Control Circuit/Open
P0134	O2 Sensor Circuit No Activity Detected	P2255	O2 Sensor Negative Current Control Circuit Low
P0135	O2 Sensor Heater Circuit	P2256	O2 Sensor Negative Current Control Circuit High
P0136	O2 Sensor Circuit	P2270	O2 Sensor Signal Stuck Lean
P0137	O2 Sensor Circuit Low Voltage	P2271	O2 Sensor Signal Stuck Rich
P0138	O2 Sensor Circuit High Voltage	P2272	O2 Sensor Signal Stuck Lean
P0139	O2 Sensor Circuit Slow Response	P2273	O2 Sensor Signal Stuck Rich
P0140	O2 Sensor Circuit No Activity Detected	P2274	O2 Sensor Signal Stuck Lean
P0141	O2 Sensor Heater Circuit	P2275	O2 Sensor Signal Stuck Rich
P0142	O2 Sensor Circuit	P2276	O2 Sensor Signal Stuck Lean
P0143	O2 Sensor Circuit Low Voltage	P2277	O2 Sensor Signal Stuck Rich
P0144	O2 Sensor Circuit High Voltage	P2278	O2 Sensor Signals Swapped B1 S3 / B2 S3
P0145	O2 Sensor Circuit Slow Response	P2297	O2 Sensor Out of Range During Deceleration
P0146	O2 Sensor Circuit No Activity Detected	P2298	O2 Sensor Out of Range During Deceleration
P0147	O2 Sensor Heater Circuit	P2414	O2 Sensor Exhaust Sample Error
P0150	O2 Sensor Circuit	P2415	O2 Sensor Exhaust Sample Error
P0151	O2 Sensor Circuit Low Voltage	P2416	O2 Sensor Signals Swapped B1 S2 / B1 S3

⁸ Includes oxygen sensor and oxygen sensor heater.

DTC	DTC Description	DTC	DTC Description
P0152	O2 Sensor Circuit High Voltage	P2417	O2 Sensor Signals Swapped B2 S2 / B2 S3
P0153	O2 Sensor Circuit Slow Response	P2626	O2 Sensor Pumping Current Trim Circuit/Open
P0154	O2 Sensor Circuit No Activity Detected	P2627	O2 Sensor Pumping Current Trim Circuit Low
P0155	O2 Sensor Heater Circuit	P2628	O2 Sensor Pumping Current Trim Circuit High
P0156	O2 Sensor Circuit	P2629	O2 Sensor Pumping Current Trim Circuit/Open
P0157	O2 Sensor Circuit Low Voltage	P2630	O2 Sensor Pumping Current Trim Circuit Low
P0158	O2 Sensor Circuit High Voltage	P2631	O2 Sensor Pumping Current Trim Circuit High
P0159	O2 Sensor Circuit Slow Response	P2A00	O2 Sensor Circuit Range/Performance
P0160	O2 Sensor Circuit No Activity Detected	P2A01	O2 Sensor Circuit Range/Performance
P0161	O2 Sensor Heater Circuit	P2A02	O2 Sensor Circuit Range/Performance
P0162	O2 Sensor Circuit	P2A03	O2 Sensor Circuit Range/Performance
P0163	O2 Sensor Circuit Low Voltage	P2A04	O2 Sensor Circuit Range/Performance
P0164	O2 Sensor Circuit High Voltage	P2A05	O2 Sensor Circuit Range/Performance
P0165	O2 Sensor Circuit Slow Response		

Table B-5. Secondary Air Intake System DTCs

DTC	DTC Description	DTC	DTC Description
P0410	Secondary Air Injection System	P2431	Secondary Air Injection System Air Flow/Pressure Sensor Circuit Range/Performance
P0411	Secondary Air Injection System Incorrect Flow Detected	P2432	Secondary Air Injection System Air Flow/Pressure Sensor Circuit Low
P0412	Secondary Air Injection System Switching Valve "A" Circuit	P2433	Secondary Air Injection System Air Flow/Pressure Sensor Circuit High
P0413	Secondary Air Injection System Switching Valve "A" Circuit Open	P2434	Secondary Air Injection System Air Flow/Pressure Sensor Circuit Intermittent/Erratic
P0414	Secondary Air Injection System Switching Valve "A" Circuit Shorted	P2435	Secondary Air Injection System Air Flow/Pressure Sensor Circuit
P0415	Secondary Air Injection System Switching Valve "B" Circuit	P2436	Secondary Air Injection System Air Flow/Pressure Sensor Circuit Range/Performance
P0416	Secondary Air Injection System Switching Valve "B" Circuit Open	P2437	Secondary Air Injection System Air Flow/Pressure Sensor Circuit Low
P0417	Secondary Air Injection System Switching Valve "B" Circuit Shorted	P2438	Secondary Air Injection System Air Flow/Pressure Sensor Circuit High
P0418	Secondary Air Injection System Control "A" Circuit	P2439	Secondary Air Injection System Air Flow/Pressure Sensor Circuit Intermittent/Erratic
P0419	Secondary Air Injection System Control "B" Circuit	P2440	Secondary Air Injection System Switching Valve Stuck Open
P0491	Secondary Air Injection System Insufficient Flow	P2441	Secondary Air Injection System Switching Valve Stuck Closed
P0492	Secondary Air Injection System Insufficient Flow	P2442	Secondary Air Injection System Switching Valve Stuck Open
P2257	Secondary Air Injection System Control "A" Circuit Low	P2443	Secondary Air Injection System Switching Valve Stuck Closed
P2258	Secondary Air Injection System Control "A" Circuit High	P2444	Secondary Air Injection System Pump Stuck On
P2259	Secondary Air Injection System Control "B" Circuit Low	P2445	Secondary Air Injection System Pump Stuck Off
P2260	Secondary Air Injection System Control "B" Circuit High	P2446	Secondary Air Injection System Pump Stuck On
P2430	Secondary Air Injection System Air Flow/Pressure Sensor Circuit	P2447	Secondary Air Injection System Pump Stuck Off