2016

# Smog Check Performance Report

## (An Analysis of Roadside Inspection Data)

DEPARTMENT OF CONSUMER AFFAIRS

BAR

Bureau of Automotive Repair

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# 2016 Smog Check Performance Report

Assembly Bill (AB) 2289 (Eng, Chapter 258, Statutes of 2010) marked the first major update to the Smog Check Program since the mid-1990s. The law is a comprehensive effort to modernize California's vehicle emissions inspection and maintenance program (Smog Check). The legislation required the Bureau of Automotive Repair (BAR) to implement both inspection-based performance standards[1] for stations inspecting directed vehicles[2] and improved On-Board Diagnostics (OBD II) inspections for newer vehicles.[3] It also enhances BAR's ability to identify and discipline stations performing improper inspections.[4] Lastly, the law requires BAR, in cooperation with the Air Resources Board (ARB), to perform annual evaluations of the Smog Check Program using Roadside inspection data. This report is an analysis of tailpipe emissions from Roadside inspected vehicles and satisfies this requirement for 2016.

**Background**

In March 2009, Sierra Research[5] (Sierra) released a report entitled "Evaluation of the California Smog Check Program Using Random Roadside Data." The report analyzed the effectiveness of the California Smog Check Program. Sierra's primary finding was that many vehicles "either were not actually repaired or were repaired only temporarily."[6] Sierra reached this finding by studying the rate at which vehicles that were previously certified by a Smog Check station failed a subsequent Roadside inspection. BAR's Roadside Inspection Program randomly pulls over vehicles and performs an Acceleration Simulation Mode (ASM) inspection of tailpipe emissions.

[1] BAR implemented the STAR Program in January 2013. The STAR Program requires stations interested in inspecting directed vehicles to apply for STAR certification. BAR will grant certification upon finding that the station meets various inspection-based performance standards based on each calendar quarter's performance. In addition to the performance measures, stations must also be in compliance with the enforcement-related standards of the STAR Program. This includes a review of citations and/or administrative actions associated with the station and its technicians.

[2] A directed vehicle must have its Smog Check performed at a STAR certified station. These vehicles are 1999 model-year and older vehicles and newer vehicles with the greatest likelihood of failing their next inspection.

[3] BAR implemented statewide OBD II testing on March 9, 2015 for 2000 and newer gasoline-powered vehicles and 1998 and newer diesel-powered vehicles. The tests on these vehicles do not require a tailpipe emissions inspection.

[4] As part of the OBD II implementation, BAR developed Smog Check database software to provide significantly better detection of improper inspections on newer model-year vehicles. This includes the illegal act of using a surrogate vehicle to get an otherwise failing vehicle to pass the Smog Check inspection.

[5] The Air Resources Board (ARB), in cooperation with BAR, hired Sierra Research, Inc. to conduct an independent research and analysis of the Smog Check Program using data collected from Roadside inspections conducted in 2003-2006.

[6] "Evaluation of the California Smog Check Program Using Random Roadside Data," page 1-1.

The vehicle is put on a dynamometer and tested using a BAR-97 Emissions Inspection System, the same test performed by Smog Check stations on enhanced area[7] vehicles.

Sierra found that for 1976-1995 model-year vehicles, that initially failed the ASM tailpipe portion of the Smog Check, then subsequently passed a retest and were issued a certificate of compliance by a Smog Check station, 49% failed an ASM Roadside tailpipe inspection within one year of certification (i.e., Fail-Pass-Roadside Fail vehicles). The Roadside inspection occurred, on average, about six months after the vehicle had been certified. For 1976-1995 model-year vehicles that passed their initial ASM inspection and were issued a certificate by a Smog Check station, 19% failed an ASM Roadside test within one year of certification (i.e., Pass-Roadside Fail vehicles). In 2015, BAR published its first comparison to the findings of the Sierra report, using 2013-2014 Roadside data. This year's report performs that same analysis with 2014-2015 Roadside data.

[7] Enhanced areas are California Smog Check Program areas within any part of an urbanized area of the state that is classified by the U.S. Environmental Protection Agency as not meeting air quality standards. Pre-2000 model-year gasoline-powered vehicles registered in enhanced areas require an ASM inspection.

**Post-AB 2289 Implementation Findings**

BAR analyzed recent Roadside data collected between January 2014 and December 2015. This 2014-2015 study illustrates a significant improvement for vehicles that failed their initial Smog Check inspection since the implementation of the STAR Program in January 2013.

*Re-fail Analysis: 1976-1995 Model-Year Vehicles*

Table 1 compares the Roadside failure rates between the Sierra and BAR studies. Details from BAR's 2014-2015 study are further broken down between STAR and non-STAR stations. As of December 31, 2015, there were 7,137 licensed Smog Check stations, of which 4,332 were STAR certified. As these outcomes indicate, STAR stations outperformed non-STAR stations across the board. The 49% Fail-Pass-Roadside Fail rate for vehicles from the 2009 Sierra study dropped to 34%. In particular, the study shows that the Fail-Pass-Roadside Fail rate was 33% for vehicles that had been inspected at STAR stations compared to 44% for non-STAR stations. In addition, the overall Roadside failure rate for 1976-1995 model-year vehicles within one year of certification was 24% for STAR stations as compared to 30% for non-STAR stations.

**Table 1: Roadside ASM Failure Rates for 1976 – 1995 Model-Year Vehicles Tested at the Roadside within One Year after Passing a Smog Check**

| Initial Smog Check Result | Sierra Study (2003-2006 Roadside Data) | BAR Study* (2014-2015 Roadside Data) | | |
|---|---|---|---|---|
| | | All Station Types | Non-STAR | STAR |
| Fail** | 49% (576) | 34% (716) | 44% (25) | 33% (691) |
| Pass*** | 19% (2327) | 21% (2324) | 27% (113) | 21% (2211) |
| **Overall Re-fail Rate** | 24% (2903) | 24% (3040) | 30% (138) | 24% (2902) |

*Note: Roadside sample sizes are shown in parentheses beneath the re-fail rate percentages.

**Note: Although these vehicles failed their initial Smog Check, they eventually were certified as passing the inspection, but subsequently (within 1 year) failed a Roadside inspection.

***Note: Although these vehicles passed their initial Smog Check, they subsequently (within 1 year) failed a Roadside inspection.

As measured by the Fail-Pass-Roadside Failure rate, the quality of the Smog Check Program has improved substantially since Sierra's 2003-2006 study. With regard to the overall re-fail rate, however, the percentage is unchanged from the 24% in the original report and marginally higher than the 23% in last year's report.

There are several factors that may influence the re-fail rates reported in Table 1. While some factors would be expected to increase the re-fail rate, others would be expected to decrease it. First, the fleet studied is approximately eleven years older than it was during the original 2003-2006 Sierra study. As such, these vehicles are more prone to fail a Smog Check inspection[8] than they were in the Sierra study. This factor by itself would be expected to increase the re-fail rate. Still, the Roadside failure rate for Fail-Pass-Roadside Fail vehicles is decreasing and the overall re-fail rate has remained relatively constant in spite of the aging fleet.

Second, the percentage of vehicles inspected prior to implementation of the STAR Program in January is significantly smaller in this year's report of 2014-2015 Roadside data compared to last year's report of 2013-2014 Roadside data. In particular, Table 1 analyzes a smaller group of vehicles that were tested at the Roadside one year after passing a Smog Check inspection. In last year's report, 19% of the 1976-1995 model-year vehicles used to determine the re-fail rate were certified at a Smog Check station prior to implementation of the STAR Program. In this year's report, the results from STAR and non-STAR stations, detailed in Table 1, were calculated exclusively from vehicles certified after implementation of the STAR Program. This factor by itself would be expected to lower the re-fail rate, as long as the level of performance across all STAR stations is similar.

A likely contributor to the relatively constant overall re-fail rate is the continued participation of low-performing stations in the STAR Program. There are two ways in which this result commonly occurs. First, removing directed vehicle inspection privileges for existing STAR stations failing to meet the performance standards can be a long and drawn out process, if stations choose to exercise their right to fully appeal any action taken against the station's certification. While the appeal is pending, these stations may continue inspecting directed vehicles and, in turn, can impair the overall performance of the Smog Check Program.

A second way that the quality of STAR stations can be diminished is through new stations coming in with brand new inspectors. A loophole in the existing STAR regulations allows stations entry into the program provided they have one calendar quarter's worth of passing data for the STAR Program's short-term performance measures. This means that they can enter the program without consideration of any long-term inspection data. Some of these new stations may perform low-quality inspections until their STAR privileges are invalidated.

Note that STAR regulatory changes are currently under development at BAR that would address both of these issues. These proposals include removing loopholes that allow low-performing stations to maintain STAR Program eligibility and providing incentives for better program compliance.

[8] The Smog Check failure rate for 1976-1995 model-year vehicles was 19.3% in 2005, compared to 27.3% in 2015.

*Re-fail Analysis: 1976-1999 Model-Year Vehicles*

Table 2 provides the same analysis as Table 1, while opening up the analysis to include 1996-1999 model-year vehicles. The fleet of pre-1996 model-year vehicles is diminishing in number. Therefore, the original 1976-1995 model-year range will be replaced with the expanded 1976-1999 model-year range in future analyses. The table below provides a bridge from which to compare this year's report to next year's report. As shown, the Fail-Pass-Roadside Fail rate for 1976-1999 model-year vehicles was 29%, and 13% for Pass-Roadside Fail vehicles of the same model-years.

**Table 2: Roadside ASM Failure Rates for 1976 – 1999 Model-Year Vehicles Tested at the Roadside within One Year after Passing a Smog Check**

| Initial Smog Check Result | BAR Study* (2014-2015 Roadside Data) | | |
|---|---|---|---|
| | All Station Types | Non-STAR | STAR |
| Fail** | 29% (984) | 45% (36) | 28% (948) |
| Pass*** | 13% (4976) | 17% (270) | 13% (4706) |
| **Overall Re-fail Rate** | 15% (5960) | 20% (306) | 15% (5654) |

*Note: Roadside sample sizes are shown in parentheses beneath the re-fail rate percentages.
**Note: Although these vehicles failed their initial Smog Check, they eventually were certified as passing the inspection, but subsequently (within 1 year) failed a Roadside inspection.
***Note: Although these vehicles passed their initial Smog Check, they subsequently (within 1 year) failed a Roadside inspection.

*Station Performance Analysis*

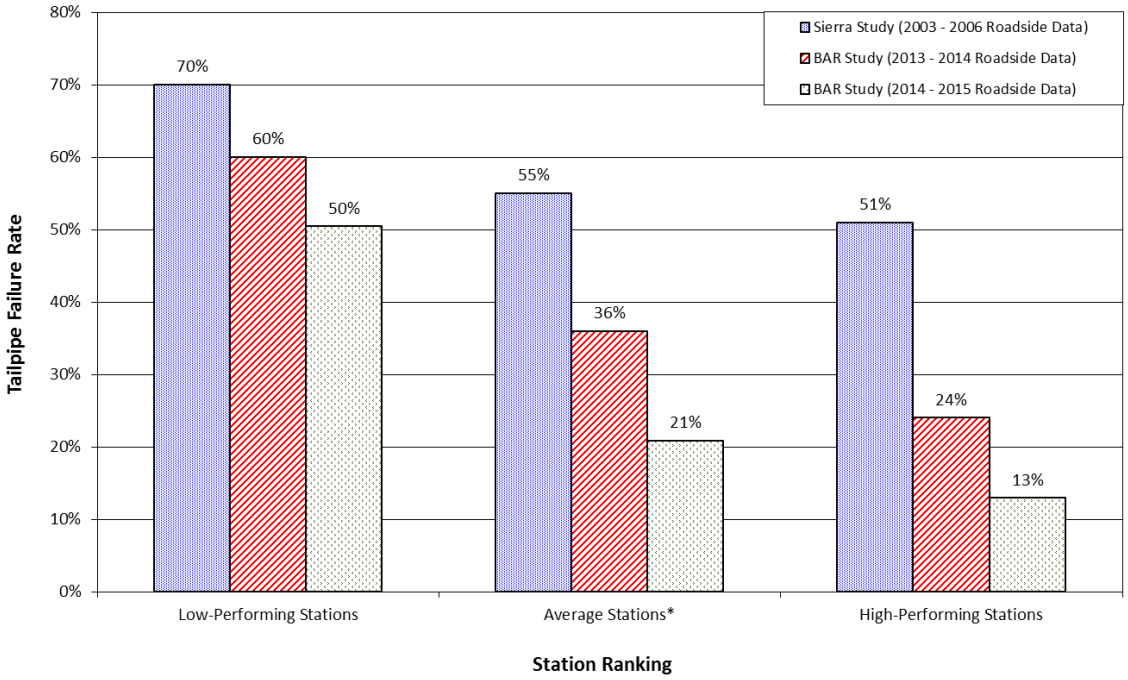
To better understand the performance of the Smog Check Program, Sierra's 2009 report grouped Roadside results using a Station Performance Algorithm. BAR further enhanced this algorithm to evaluate station performance under the STAR Program. The new algorithm is called the Follow-up Pass Rate (FPR). The FPR evaluates Smog Check stations and technicians based upon the rate at which the vehicles they certified in the previous inspection cycle are passing their Smog Check in the current cycle, regardless of where that next inspection occurs, and as compared to similar vehicles. FPR scores range from a low of zero (0) to a high of one (1).

The 2009 Sierra report grouped stations by high-, medium-, and low-performing. The report further analyzed the performance of these station groups using two scenario criteria. In Scenario 1, high-performing stations had a 0.90 or greater FPR; low-performing stations had a

0.10 or lower FPR. In Scenario 2, which was more stringent, the thresholds were a 0.975 or higher FPR for high-performing stations and a 0.025 or lower FPR for low-performing stations. Figure 1 compares the Roadside failure rates from BAR's 2015 and 2016 reports to those from Sierra's 2009 report. The Roadside failure rates are lower across the board for all station performance groups using the Scenario 1 criteria, with the percentage of improvement greatest among high-performing stations. Not coincidentally, these stations are most likely to participate in the STAR Program. This year's report on 2014-2015 Roadside data shows the failure rate at high-performing stations decreased by 75% since the original Sierra study. By comparison, the same failure rate for low-performing stations decreased by only 29%.

It is important to note that data from new stations are not represented; only stations that have earned an FPR score appear in this chart.

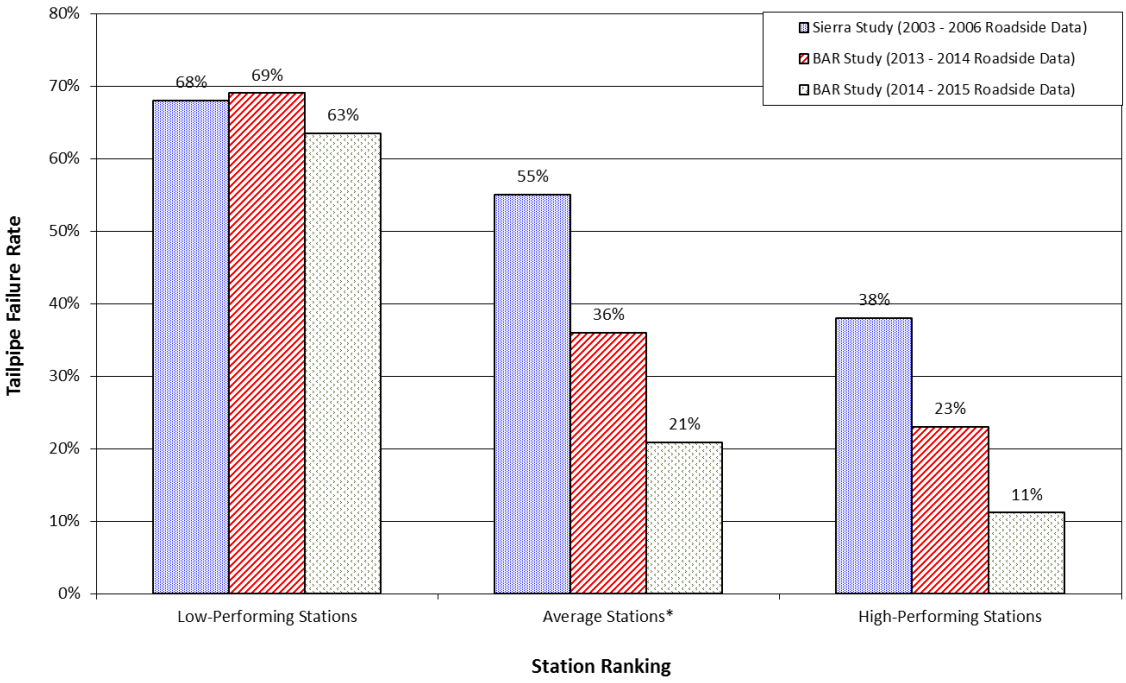
**Figure 1: Scenario 1 Criteria**
**Roadside ASM Tailpipe Failure Rates for Vehicles**
**Within One Year of Failing Initial Smog Inspection Prior to Certification**
**(1976-1995 Model-Year Vehicles)**




*Note: "Average Stations" includes High-, Medium-, and Low- Performing Stations.

Figure 2 shows the results among the three station groups using the more stringent Scenario 2 criteria. The Roadside failure rates in Figure 2 dropped significantly for high-performing and average stations across the three studies; however, the failure rate for low-performing stations decreased only marginally. This draws attention to the fact that the performance of the worst performing stations has changed very little since implementation of the STAR Program. Note that some of the low-performing stations in the two BAR studies may be STAR stations that entered the program with acceptable scores, but are now in the process of losing their STAR certification. As previously noted, these stations can maintain their directed vehicle inspection privileges as they appeal their proposed removal from the program.

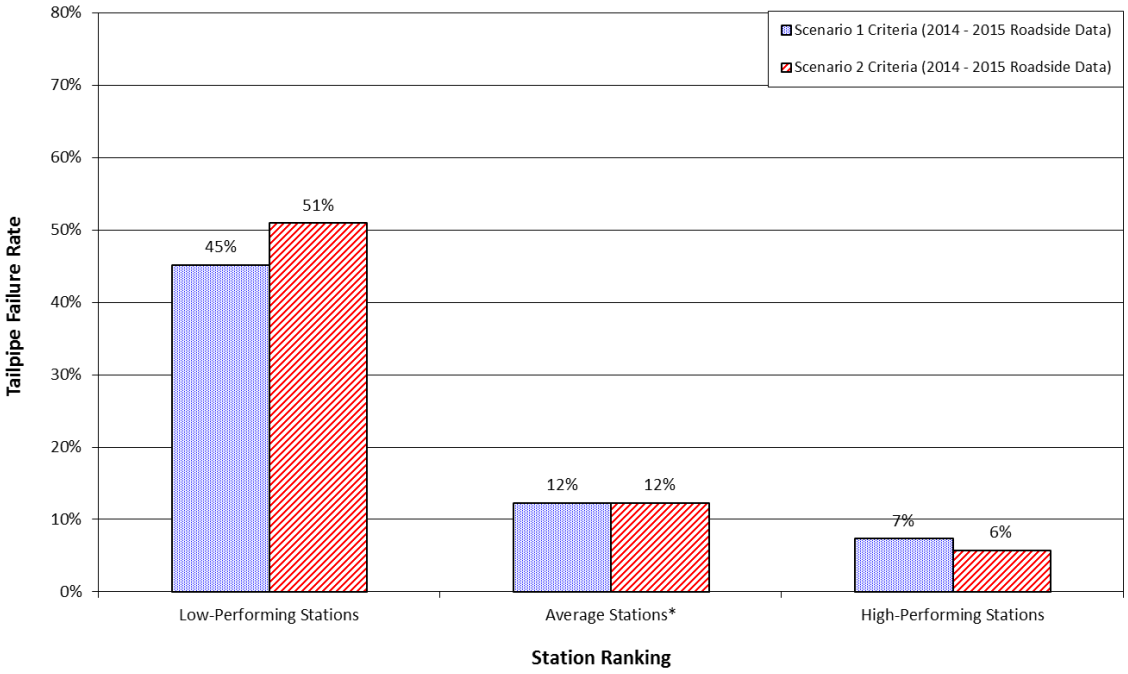
**Figure 2: Scenario 2 Criteria**
**Roadside ASM Tailpipe Failure Rates for Vehicles**
**Within One Year of Failing Initial Smog Inspection Prior to Certification**
**(1976-1995 Model-Year Vehicles)**




*Note: "Average Stations" includes High-, Medium-, and Low- Performing Stations.

Figure 3 shows the results of the 2014-2015 data under both scenarios using the expanded range of 1976-1999 model-year vehicles. These data are a baseline that will be used to compare to 2015-2016 data in next year's report and future Smog Check Performance Reports.

**Figure 3: Scenario 1 and Scenario 2 Criteria**
**Roadside ASM Tailpipe Failure Rates for Vehicles**
**Within One Year of Failing Initial Smog Inspection Prior to Certification**
**(1976-1999 Model-Year Vehicles)**




*Note: "Average Stations" includes High-, Medium-, and Low- Performing Stations.

*Current Excess Emissions: 1976-1995 Model-Year Vehicles*

The 2009 Sierra report also included an analysis of emissions reductions lost due to poor Smog Check inspection performance. Using Scenario 2 criteria, the 2009 Sierra report indicated that an additional 70 tons per day (tpd) of reactive organic gases (ROG) and oxides of nitrogen (NOx) could have been eliminated from the air, provided all Smog Check stations performed on par with high-performing stations when testing 1976-1995 model-year vehicles. This was based on the California Air Resources Board (ARB) EMFAC 2002 emissions model run for calendar year 2005. A recalculation using ARB's more recent EMFAC 2011 model for calendar year 2005 revised that lost emissions benefit from 70 tpd to 50 tpd.

For this report, the EMFAC 2011 model was used to estimate the lost benefit for calendar year 2015 based on 2014-2015 Roadside data. It estimates the lost benefit to have dropped to 23 tpd.

**Conclusion**

This most recent BAR study of 2014-2015 Roadside data shows that the Smog Check Program has improved since implementation of AB 2289. STAR stations tend to outperform non-STAR stations, and stations having FPR scores that were at the mid to upper end of the spectrum improved dramatically.

Among stations with the lowest FPR scores, however, there appears to have been little improvement in quality. While stations applying for STAR certification are denied program entry if they do not meet certain performance measures, existing STAR stations that no longer meet these standards are protected from removal from the program until their appeals have been exhausted.

BAR is addressing the limitations of the STAR Program with forthcoming regulatory changes. It will likely take at least a year to adopt any regulations. As such, the effects of any changes will not be evident for at least a year after the adoption of the regulations.

However, next year's report will reflect significant developments. For example, BAR is in the process of contracting for an independent validation of the findings of this year's report, as required by AB 2289. BAR will present these findings in next year's report. Next year's report may also include Roadside inspection data from newer vehicles into the re-fail calculation. If a sufficient sample of vehicles can be collected from the Roadside program, next year's re-fail analysis will be the first to include OBD inspections.