

Monitoring and Laboratory Division

Summary Document:

Small Off-Road Engine Evaporative Emission Compliance Testing

October 12, 2018

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I. INTRODUCTION

The California Air Resources Board (CARB) conducts compliance testing of spark-ignited small off-road engines (SORE) to ensure engines used by California consumers meet diurnal evaporative emission standards. CARB staff increased the frequency with which this compliance testing is conducted in 2016 in response to the results of the model year 2013-2015 phase of the evaporative emission validation studies,¹ in which 50 percent of engines failed to meet the existing diurnal emission standards. Through increased compliance testing CARB staff aims to identify and remedy non-compliant engines sold in California. The purpose of this summary is to provide an update to all interested parties regarding the testing activities and results to date.

Since 2016, CARB staff has completed testing on 14 SORE evaporative families that represent a cross section of equipment introduced into California commerce. Each evaporative compliance test consists of diurnal emissions testing of five equipment units from an evaporative family purchased from retailers in California. Compliance with the diurnal emission standards in Title 13, California Code of Regulations, Section 2754 is determined in accordance with Section 2765 and is based on whether the “U-factor,” the upper limit of the 95 percent confidence interval of the test results, exceeds a threshold of 10 to 50 percent above the diurnal emission standard. Testing is conducted at the Haagen-Smit Laboratory in El Monte, California, and the SHED laboratory in Sacramento, California.

II. TEST METHODOLOGY

SORE evaporative compliance testing is conducted according to CARB test procedure TP-902, *Test Procedure for Determining Diurnal Evaporative Emissions from Small Off-Road Engines and Equipment* (TP-902), adopted July 26, 2004. The durability demonstration in section 3 of TP-902 has been abbreviated or omitted to allow for more testing to be completed with the available CARB staff and facility resources. Emissions may be lower in this testing than in testing that includes the full durability demonstration.

III. TEST RESULTS

Of the 14 completed SORE evaporative compliance tests to date, 8 have passed and 6 have failed. Testing was conducted on equipment units from model years 2015, 2016, and 2017. Two model year 2016 engines included in these results had fuel leaks. Results from completed testing are shown in Figure 1, below.

¹ <https://www.arb.ca.gov/regact/2016/sore2016/soreisor.pdf>

The results are presented as diurnal emissions divided by the diurnal emission standard, so a value of one represents emissions equal to the diurnal emission standard. A value less than one indicates an individual engine met the diurnal emission standard and a value greater than one indicates an individual engine failed to meet the diurnal emission standard. The actual standards for each evaporative family (with the exception of walk-behind lawn mowers) vary with the fuel tank nominal capacity as shown in Table 1.

Table 1. Diurnal Emission Standards

Category	Diurnal Emission Standard (g·day ⁻¹)
Walk-behind lawn mower (80 cc < displacement ≤ 225 cc)	1.0
Other 80 cc < displacement ≤ 225 cc	0.95 + 0.056 × nominal capacity (L)
≥ 225 cc	1.20 + 0.056 × nominal capacity (L)

On average, the diurnal emissions for all samples tested were 73 percent higher than the diurnal emission standards. All evaporative families included in this testing were performance-certified. For comparison, in the model year 2013-2015 phase of the evaporative emission validation studies,¹ 60 percent of performance-certified evaporative families failed and emissions were 8 percent higher than the diurnal emission standards on average. For design-certified evaporative families in the validation studies, 48 percent of families failed and emissions were 117 percent higher than the diurnal emission standards on average. The emissions for individual engines from model year 2017 evaporative families tested by CARB have generally been lower than those for individual engines from model year 2016 evaporative families tested by CARB, relative to the diurnal emission standards. However, there is no statistically significant difference in the average results for model year 2017 versus those for model year 2016 or versus the entire population of results for model years 2015-2017.

IV. NEXT STEPS

For evaporative families that failed to meet the diurnal emission standards, the Executive Order holder has the opportunity to provide additional information and independent test results that document compliance. This information, along with any emission credits and corrective actions applied by the Executive Order holder, is considered by the Executive Officer in determining if an evaporative family complies with the standards in Section 2754.

The Executive Order holders for the six evaporative families that failed to meet the diurnal emission standards in CARB's testing all elected to conduct some testing to confirm or dispute CARB's findings. To date, two of these Executive Order holders have observed emissions above the diurnal emission standards and have begun investigating the cause of the failures and possible remedies. The other four

Executive Order holders have notified the Executive Officer of their intent to provide independent test results for five units.

Six additional evaporative families are undergoing CARB testing at this time, and CARB staff will continue testing additional evaporative families on an ongoing basis. To date, SORE compliance testing has been conducted on performance-certified evaporative families only. Beginning with model year 2020, design-certified families will also be required to meet the diurnal emission standards and will be included in CARB's evaporative compliance testing. CARB staff will work with holders of Executive Orders for evaporative families that have failed compliance testing to understand the causes of the failures and determine the appropriate remedies, and will monitor compliance with the diurnal emission standards and the trend in compliance as the recently-adopted amendments to the evaporative emission regulations are fully implemented. If significant non-compliance with the standards remains, CARB staff will develop further proposals to resolve the non-compliance as part of a future rulemaking.