

California Environmental Protection Agency



Spark-Ignition Marine Engine Evaporative Emissions Test Procedure

TP - 1502

Test Procedure for Determining Hot Soak Evaporative Emissions from Spark-Ignition Marine Engines

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**TP-1502
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**California Environmental Protection Agency
Air Resources Board**

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Spark-Ignition Marine Engines**

A set of definitions common to all Certification and Test Procedures is in Title 13, California Code of Regulations (CCR), section 2752 et seq. These definitions apply to all applicable instances in this test procedure.

For the purpose of this procedure, the term "CARB" refers to the California Air Resources Board, and the term "Executive Officer" refers to the CARB Executive Officer, or his or her authorized representative or designate.

1. APPLICABILITY

This Test Procedure, TP-1502, is used to determine the hot soak emissions of spark-ignition marine engines. Spark-ignition marine engines are defined in Title 13, California Code of Regulations (CCR), section 2853 et seq. This Test Procedure is proposed pursuant to section 43013 and 43018 of the California Health and Safety Code (CH&SC), and the references cited in section (9) of this document, and is applicable in all cases where equipment subject to fuel injection performance standards are sold, supplied, offered for sale, or manufactured for use in the State of California.

1.1 Requirement to Comply with All Other Applicable Codes and Regulations

Certification or approval of a certified spark-ignition marine engine by the Executive Officer does not exempt any part of the fuel systems from compliance with other applicable codes and regulations such as state and federal safety codes and regulations.

1.2 Safety

This test procedure involves the use of flammable materials and possibly hazardous operations and should only be conducted by or under the supervision of those familiar and experienced in the safe use of such materials and operations. Appropriate safety precautions should be observed at all times while performing the test sequences in this test procedure.

2. PERFORMANCE STANDARDS

The minimum performance standard for certification of a spark-ignition marine engine is defined in CCR Title 13, Chapter 15, Article 4, Section 2855.

3. GENERAL SUMMARY OF TEST PROCEDURE

A Sealed Housing for Evaporative Determination (SHED) is used to measure diurnal emissions. This method subjects spark-ignition marine engines to a temperature profile while maintaining a constant pressure and continuously sampling for hydrocarbons with a flame ionization detector (FID). The volume of a SHED enclosure can be accurately determined. The calculation of the mass of the diurnal evaporative emissions is as specified in Part III of the "California Evaporative Emission Standards and Test Procedures for 2001 and Subsequent Model Motor Vehicles."

This test procedure measures hot soak emissions from spark-ignition marine engines with complete evaporative emission control systems as defined in 13 CCR 2752 (a)(8) by subjecting them to a hot soak test. E10 CERT fuel must be used. The basic process is as follows:

- Fill a portable fuel tank with attached fuel line and quick connect (fuel delivery system) with fuel and attach it to the engine.
- Precondition the engine and fuel delivery system.
- Drain and refill fuel delivery system.
- Operate engine at 50% maximum governed speed for fifteen minutes.
- Soak the engine for 6-36 hours at 65-86°F (18.3-30°C) with the last 6 hours being at 65°F (18.3°C).
- Operate engine at 50% maximum governed speed for fifteen minutes to allow the engine to reach normal operating temperature.
- Disconnect the fuel delivery system and place only the engine inside SHED.
- Subject the engine to a three-hour constant 105°F (40.6°C) hot soak.

The mass of total hydrocarbons measured by the SHED over the 3-hour constant temperature profile is compared with the performance standards in CCR Title 13, Chapter 15, Article 4, section 2855. Spark-ignition marine engines that meet the appropriate performance standard shall be considered compliant.

4. INSTRUMENTATION

The instrumentation necessary to perform evaporative emission testing for spark-ignition marine engines is the same instrumentation used for passenger cars and light duty vehicles, and is described in 40 CFR 86.107-96.

4.1 Calibrations

Evaporative emission enclosure calibrations are specified in 40 CFR section 86.117-90, as incorporated by reference amended with the following subsection:

The evaporative emission measurement enclosure calibration consists of the following parts: initial and periodic determination of enclosure background emissions, initial determination of enclosure volume, and periodic hydrocarbon (HC) and ethanol retention check and calibration. Calibration for HC and ethanol may be conducted in the same test run or in sequential test runs.

- All test fuels must be tested to ensure they meet ARB specification for E10 CERT fuel. Fuel analysis certification results from a fuel supplier are sufficient to meet this requirement.

- The SHED must be capable of controlling temperature to within the specification of this test procedure while keeping pressure constant.

5. PRE-SOAK

The spark-ignition marine engine fuel system must be sufficiently soaked at the test temperature to ensure that the entire fuel system temperature has reached equilibrium.

- Fill the fuel delivery system with California E10 CERT Fuel.
- Operate the engine at 50% maximum governed speed for fifteen minutes to allow the engine to reach normal operating temperature.
- Soak the engine and fuel delivery system for no less than 30 days at 68-86°F (18.3-30°C).

6. TEST PROCEDURE

- Drain and refill the fuel delivery system with E10 CERT fuel and attach it to the engine.
- Operate the engine at 50% maximum governed speed for fifteen minutes to allow the engine to reach normal operating temperature.
- Soak the engine and fuel delivery system at 65-86°F (18.3-30°C) for 6-36 hours with the last six hours at 65°F \pm 2°F (18.3°C \pm 1.1°C).
- Purge the SHED of hydrocarbons.
- Keep the SHED wall temperature at 105°F \pm 2°F (40.6°C \pm 1.1°C).
- Zero and span the FID (or HFID) hydrocarbon analyzer immediately prior to beginning the test.
- Operate the engine at 50% maximum governed speed for fifteen minutes to allow the engine to reach normal operating temperature.
- Shut off the engine.
- Disconnect and remove the fuel delivery system.
- Place the engine only inside the SHED enclosure within 2 minutes.
- Turn on the enclosed mixing fan.
- Conduct a 3-hour hot soak at a constant 105°F (40.6°C).

7. TEST FUEL

E10 CERT Fuel is California certification gasoline as specified in “California 2015 and Subsequent Model Criteria Pollutant Exhaust Emission Standards and Test Procedures and 2017 and Subsequent Model Greenhouse Gas Exhaust Emission Standards and Test Procedures for Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles” Section II.A.100.3.1.2 as adopted March 22, 2012, as incorporated by reference herein.

8. CALCULATING EMISSIONS

The procedure for calculating of non-methane hydrocarbon emissions in grams can be found in Part III of the *California Evaporative Emission Standards and Test Procedures for 2001 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles*.

Permeation emissions from permeating materials (such as fuel hose, fuel tank, etc.) must be calculated separately and subtracted from the overall hydrocarbon emissions calculation.

9. ALTERNATIVE TEST PROCEDURES

Test procedures, other than specified above, shall only be used if prior written approval is obtained from the Executive Officer. In order to secure the CARB Executive Officer's approval of an alternative test procedure, the applicant is responsible for demonstrating to the CARB Executive Officer's satisfaction that the alternative test procedure is equivalent to this test procedure.

- Documentation of any such approvals and demonstrations shall be maintained by the CARB Executive Officer and shall be made available upon request.
- Demonstration for equivalency must include a minimum of three (3) test results each from the CARB test procedure and from the submitted alternative test procedure. The application must also include a comparison of the results demonstrating that the submitted alternative test procedure meets or exceeds the standard. The applicant must also submit the test procedure in detail for an engineering review and clearly identify any modifications to the CARB test procedure.
- Once approved for use, an alternative test procedure may be used and referenced by any manufacturer subject to the limitations and constraints in the Executive Order approving the alternative test procedure.

10. REFERENCES

1. *California Evaporative Emission Standards and Test Procedures for 2001 and Subsequent Model Motor Vehicles*, California Environmental Protection Agency, Air Resources Board, El Monte, CA, March 2012.
2. *Control of Emissions from New and In-use Highway Vehicles and Engines*, Code of Federal Regulations, Title 40, Part 86, June 1995.