

California Environmental Protection Agency



Air Resources Board

PROCEDURE FOR THE DETERMINATION OF THE REID VAPOR PRESSURE EQUIVALENT OF GASOLINE

Standard Operating Procedure MV-FUEL-125

Revision No. 2.3

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Fuel Analysis and Methods Evaluation Section
Chemical Analysis & Emissions Research Branch
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SOP MV-FUEL-154 PROCEDURE FOR THE DETERMINATION OF THE REID VAPOR PRESSURE EQUIVALENT OF GASOLINE

1 Introduction

1.1 This test method covers the determination of the total pressure, exerted in vacuum, by air-containing, volatile petroleum products. The test method is suitable for testing samples with boiling points above 32 °F that exert a vapor pressure between 7 and 130 kPa (1.0 and 19 psi) at 100 °F and a vapor to liquid ratio of 4:1. The test method is suitable for testing gasoline samples which contain oxygenates. No account is made of dissolved water in the sample.

1.2 This method covers the use of automated vapor pressure instruments that perform measurements on liquid specimen sizes in the range of 1-10 mL.

1.3 This test method is based on the California Code of Regulations, Title 13, section 2297. It is similar, but not identical, to ASTM D5191-01.

2 Test Method

2.1 A known volume of chilled, air-saturated sample is introduced into a thermostatically controlled test chamber, the internal volume of which is five times that of the specimen. A vacuum is applied to the chamber. The test specimen is allowed to reach thermal equilibrium at the test temperature (100 °F). The resulting rise in pressure in the chamber is measured using a pressure transducer sensor and indicator.

2.2 Only the sum of the partial pressures of the sample and the dissolved are (referred to as the total pressure) is used in this test method (except for the quality control check; see section 10.1).

2.3 The measured total vapor pressure is converted to a Reid vapor pressure equivalent (RVPE) by the use of a calibration equation (see section 9.2). This equation converts the total pressure to the Reid vapor pressure (RVP) expected from ASTM D323-58.

3 Instrument

3.1 The instruments used in this analysis are the Grabner Instruments Minivap VPS and the Eralytics Eravap.

3.2 An ice-water bath is required for chilling the samples to temperatures between 32 and 34 °F.

4 Reagents

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- 4.1 A pure material of known absolute vapor pressure is used for quality control checks. The material used must be of the highest available purity (reagent grade, if available).
- 4.2 The reagent currently in use is 2,3-dimethylbutane.

5 Sampling

- 5.1 Samples should be obtained in accordance with Section 2261 of Title 13 of the California Code of Regulations or ASTM D4057 in order to obtain accurate results.
- 5.2 Vapor pressure measurements can be very sensitive to the loss of volatile components through evaporation. Samples should be opened only when chilled and for the minimum amount of time possible.
- 5.3 Samples which have been stored in leaky containers should not be analyzed unless no replacement of the sample is possible. If a sample in a leaky container must be analyzed, the condition of the container must be noted in the report of results.

6 Calibration

- 6.1 Calibration is performed annually by the instrument manufacturer or an authorized service provider as part of the instrument's regular maintenance.

7 Procedure

- 7.1 Cool the sample container and contents in an ice water bath or refrigerator to 32 to 34 °F. Allow 30 minutes to reach this temperature range if the samples begin at room temperature.
- 7.2 Wipe the top portion of the sample container dry and open the container to verify that the liquid content in the sample container is between 70% and 80% of the container's capacity.
 - 7.2.1 If the sample content is greater than 80%, discard enough sample to bring the liquid content into the 70% to 80% range.
 - 7.2.2 If the sample content is lower than 70%, obtain a new sample if possible. Otherwise, note the insufficient sample quantity on the results report.
- 7.3 Reseal the container and shake vigorously. Return the container to the ice water bath for at least two minutes.

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- 7.4 Enter the sample number into the instrument.
- 7.5 Remove the container from the ice water bath and wipe the top portion dry. Open the container, insert the instrument's sample tube, and start the analysis according to the manufacturer's instructions.
- 7.6 The sample container must be resealed as soon as the instrument has finished drawing the sample.
- 7.7 The vapor pressure determination must be performed on the first test specimen withdrawn from the sample container. Successive vapor pressure determinations may be made on the remaining material if the container was tightly sealed after the previous vapor pressure measurement.
- 7.8 The RVPE reported by the instrument is recorded to the nearest 0.01 psi.

8 Safety

- 8.1 Gasoline and many of its various components are toxic. All volatile hydrocarbons are flammable. Persons using this method must wear protective gloves and eyewear when working with reagents and samples. Reagents and samples are kept in a fume hood with adequate ventilation.

9 Calculation

- 9.1 Different equations for converting the total vapor pressure to the RVPE have been proposed by different agencies.
- 9.2 The California Air Resources Board has adopted the following equation:

$$\text{RVPE} = 0.972^*(\text{total vapor pressure}) - 0.715 \text{ psi}$$

10 Quality Control

- 10.1 At the beginning of each analysis day, a quality control sample is analyzed. The measured absolute vapor pressure must agree with the literature value within 0.15 psi. If the difference is greater, then corrective action must be taken before the instrument can be used.
- 10.2 A list of possible quality control materials, with their absolute vapor pressures² at 100 °F, follows:

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cyclohexane	3.27 psi
cyclopentane	9.92 psi
2,2-dimethylbutane	9.86 psi
2,3-dimethylbutane	7.50 psi
2-methylpentane	6.77 psi
toluene	1.03 psi

11 Precision

11.1 The reproducibility of this test method has been determined to be 0.21 psi (see CCR 13, section 2297).

12 References

1. "Minivap VPS Operation Manual," Grabner Instruments, Vienna, Austria, 1996.
2. Absolute vapor pressures were obtained from Phillips Petroleum Co., Bartlesville, OK or the "Table of Physical Constants", National Gas Producer Association, or from discussions at meetings of Subcommittee 8 of Committee D02 on Petroleum products of ASTM International.

12 Revision History

Version 1.0 April 1, 1996

Version 2.0 April 1, 2003

Numerous statements not directly related to the operation of the method have been removed.

Generic instrument specifications have been replaced by the specific instrument used.

All references to mercury barometers and McLeod vacuum gauges have been removed. The checks requiring these items (such as calibration) are performed by the manufacturer as part of annual maintenance.

Verification of single phase has been removed. Enforcement Division, the client which had previously requested the identification of cloudy samples, is no longer interested in this information.

The precision section has been updated to reflect recent ASTM round robins.

Version 2.1 October 1, 2004

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The quality control section has been updated to reflect a recent ASTM round robin. The absolute vapor pressure of 2,3-dimethylbutane has been redetermined as 7.44 psi.

Version 2.2 January 1, 2005

The quality control section has been updated to reflect a recent ASTM round robin. The absolute vapor pressure of 2,3-dimethylbutane has been redetermined as 7.50 psi.

Version 2.3 June 1, 2009

The instrument section has been expanded to reflect the use of the Eralytics Eravap in addition to the Grabner Minivap.