California Environmental Protection Agency

Air Resources Board

Small Off-Road Engine~~ and Equipment~~ Evaporative Emissions Test Procedure

TP~~--~~901

Test Procedure for Determining Permeation Emissions from Small Off-Road Engines~~ and Equipment~~ Fuel Tanks

Adopted: July 26, 2004
Amended: September 18, 2017

(Note: Set forth are the amendments to the existing regulatory language. The amendments are shown in underline to indicate additions and ~~strikeout~~ to indicate deletions from the existing regulatory text.)

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A set of definitions common to all Certification and Test Procedures ~~are~~is in ~~T~~title 13, California Code of Regulations~~ (CCR)~~, ~~S~~section 2752 et seq.

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

1. APPLICABILITY

This Test Procedure, TP-901, is used by the Air Resources Board to determine the permeation rate from fuel tanks of ~~equipment that use~~ spark-~~-~~ignited small off-road engines and equipment. Small off-road engines (SORE) are defined in ~~T~~title 13, California Code of Regulations (CCR), section 2401 et seq. This Test Procedure is proposed pursuant to Section 43824 of the California Health and Safety Code (CH&SC) and is applicable in all cases where engines or equipment with fuel tanks subject to the ~~maximum allowable~~ permeation ~~performance~~emission standard in title 13, Cal. Code Regs., section 2754, 2755 or 2757 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~~n~~ ~~equipment~~ fuel tank or evaporative emission control system by the Executive Officer does not exempt the fuel tank or evaporative emission control system 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 operations~~ and ~~should~~shall only be used by or under the supervision of those familiar and experienced in the use of such materials~~ and operations~~. Appropriate safety precautions ~~should~~shall be observed at all times while performing this test procedure.

~~2. PERFORMANCE STANDARDS~~

~~The minimum performance standards for certification of evaporative emission control systems on small off-road engines or equipment that use small off-road engines are defined in CCR Title 13, Chapter 15, Article 1, Section 2755 and Section 2754.~~

~~3~~2. PRINCIPLE AND SUMMARY OF TEST PROCEDURE

This test procedure uses the corrected daily mass change or reactive organic gas (ROG) emissions measured by a flame ionization detector (FID) of five identical fuel tanks to calculate the permeation rate of each fuel tank. Prior to permeation testing of the fuel tanks, durability testing ~~is~~and preconditioning are performed. Durability testing exposes the fuel tanks to pressure and vacuum extremes, ultraviolet radiation, ~~and~~ fuel sloshing, and fuel cap installation cycles. After durability testing, the fuel tanks ~~outlet(s)~~ are ~~sealed and the tank is then~~ filled with ~~Phase II California Reformulated Certification (CERT)~~ fuel ~~or Indolene. Once filled, the tank is~~and allowed to precondition to maximize the permeation emissions. ~~at ambient temperature and pressure for a minimum of 20 weeks or until equilibrium is reached. Once preconditioning is complete, the tank is emptied, immediately refilled with CERT fuel, and allowed to equilibrate at 40 °C.~~

~~After the fuel temperature reaches 40 °C +/- 2 °C, an additional coupon of the same material as the tank is used to seal the tank inlet in place of the fuel cap. The tank is then leak tested, weighed, and subjected to a constant (40 °C) temperature. At the end of each 24-hour period, the tank is re-weighed and the weight loss in grams is calculated. The permeation rate is defined as the average steady state weight loss over time divided by the tank's internal surface area.~~After preconditioning, the fuel tanks are placed in a temperature-controlled enclosure and exposed to a constant temperature of 40 ± 2 °C. The permeation rate is determined by one of two methods. In the first, described in section 11 of this test procedure, the mass change of each fuel tank is measured daily and corrected using an identical reference tank that does not contain fuel to calculate the permeation rate. In the second, described in section 12 of this test procedure, the ROG emissions from each tank are measured by a FID.

~~4~~3. BIASES AND INTERFERENCES

~~To accurately quantify the losses attributable solely to permeation, each tank tested must be completely sealed. Tanks incorrectly sealed will emit evaporative emissions, which can affect the final weight loss calculations.~~

To ensure the losses attributed to permeation are accurately quantified during this test procedure, the tanks must remain exposed to the constant 40 ±2 °C temperature for each 24-hour~~s~~ (± 30 minutes) period.

CERTCertification test fuel as specified in section 6 of this procedure is required for both preconditioning and testing. CERT fuel does not contain alcohol. Fuels containing alcohol can significantly bias permeation results.

Relative humidity greater than 20% can bias the permeation results for certain plastics such as nylon. To identify bias due to humidity, relative humidity must be recorded daily.

54. SENSITIVITY AND RANGE

The Rrange of mass measurement of filled tanks is approximately 100 grams to 32,000 grams, depending on tank volume. For mass measurements more thenthan 6200 grams, the minimum sensitivity of the balance must be 0.1 grams. For mass measurement between 1000 and 6200 grams, the minimum sensitivity of the balance must be 0.01 grams. For mass measurements less than 1000 grams, the minimum sensitivity of the balance must be 0.001 grams.

65. EQUIPMENT

6.1(a) A hand-held, thermostatically--controlled, tTeflon--coated aluminum hot plate (hand-held fusion welder) and coupons of the same material as the tank. Both the hand held fusion welder and coupons must be of sufficient diameter to completely cover the opening(s) of the tank (optional). An alternative method to seal the tank may be used.

6.2(b) A top loading balance that meets the requirements of section 4-5 above.

6.3(c) A vented enclosure with a temperature conditioning system capable of controlling the internal enclosure air temperature to an average tolerance of +/-within ± 2.0 °ºC over the duration of the test. Additionally, the instantaneous temperature shall not exceed +/- 3.0ºC for more than 15 minutes each day of the test. Data confirming this performance shall be recorded at a rate no slower than once every 5 minutes.

6.4(d) A barometric pressure transducer capable of measuring atmospheric pressure to within ± 2.0 millimeters of mercury.

6.5(e) A temperature instrument capable of measuring ambient temperature to within +/-± 0.2°C.

(f) A relative humidity measuring instrument capable of measuring the relative humidity (RH) accurately to within ± 2 percent RH (optional).

(g) Instrumentation meeting the requirements of section 4 of TP-902, adopted July 26, 2004, and amended September 18, 2017 (if permeation testing will be performed according to section 12 of this test procedure).

6. CERTIFICATION TEST FUEL

Testing according to this procedure shall be conducted using 1) LEV III Certification Gasoline as defined in part II, section A.100.3.1.2 of the *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*, as last amended September 2, 2015, or 2) the fuel defined in 40 CFR Part 1065.710(b) for general testing.

The fuel specified in part II, section A.100.3.1.1 of the *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*, as last amended September 2, 2015, may be used as an alternative test fuel to certify fuel tanks for use on engines and equipment through model year 2019.

7. CALIBRATION PROCEDURE

All instruments and equipment used ~~to measure permeation~~in this procedure shall be calibrated ~~prior to use per~~at the interval specified by the manufacturer~~'s specifications~~.

The balance listed in section 5(b) shall be calibrated annually per the balance manufacturer's instructions using National Institute of Standards and Technology (NIST)-traceable mass standards. The NIST-traceable mass standards shall be calibrated annually by an independent organization.

The instrumentation for measuring permeation emissions according to section 12 of this test procedure must be calibrated as specified in section 4 of TP-902.

8. DURABILITY DEMONSTRATION

A durability demonstration is required prior to ~~any~~permeation testing~~ to determine the performance of a fuel tank~~. These durability tests are designed to ensure ~~that~~ the fuel tank assembly ~~remains effective~~meets the permeation emission standard throughout the useful life of the equipment. A durability demonstration consists of the following tests:

8.1 Pressure~~/Vacuum~~ Test

The Pressure~~/Vacuum~~ test ~~is~~shall be performed prior to any preconditioning of the fuel tank. Determine the fuel tank system's design pressure and vacuum limits under normal operating and storage conditions considering the influence of any associated pressure/vacuum relief components. A pressure test shall be performed by sealing each fuel tank and cycling the pressure between + 13.8 and − 3.4 kPa (+ 2.0 and − 0.5 psig) for 10,000 cycles at a rate of 60 seconds per cycle. If normal operating or storage conditions cause pressure changes greater than + 13.8 or – 3.4 kPa to accumulate in the fuel tanks, cycle the pressure in the fuel tanks between the actual high and low pressure limits experienced during normal operation or storage.~~Pressurize the empty tank, sealed with the OEM fuel cap, or a modified OEM fuel cap as required, to within 10% of the system's normal high pressure operating limit and then evacuate to within 10% of the system's normal vacuum operating limit.~~ If the fuel tanks ~~has~~have no features that would cause positive or negative pressure~~s~~ to accumulate during normal operation or storage, then a pressure~~/vacuum cycling~~ test is not required. The tank pressure~~/vacuum cycling~~ test shall be performed in a 49º~~C +/-~~ ± 3 °~~º~~C ~~ambient~~environment with compressed air of no less than 21 °~~º~~C.~~ Repeat the pressure/vacuum process until the tank has been subjected to not less than 1000 cycles in 8 hours +/- 1 hour.~~

Tanks that have a secondary operation for drilling holes for insertion of fuel line and grommet system may have these eliminated for purposes of durability and permeation testing.

8.2 Slosh Test

~~The Slosh test can be performed during the preconditioning period. Perform a slosh test by filling the tank to 50 percent capacity with CERT fuel. Seal the tank using the OEM fuel cap or modified fuel cap and metal plugs for the fuel tank outlet(s). Use a laboratory sample orbital shaker table or similar device to subject the tank to a centripetal acceleration of at least 2.4 meter/second^2 at a frequency of 2 cycles per second +/- 0.25 for one million cycles. As an alternative, slosh testing may be performed using the method specified in 40 CFR Part 1051 §1051.515 (c).~~

~~Following these durability tests, each tank must be preconditioned to ensure a stable permeation rate. The period of slosh testing may be considered part of the preconditioning period provided each tank tested remains at least half filled with fuel and is never empty for more than one hour over the entire preconditioning period.~~

A slosh test shall be performed by filling each fuel tank to 50 percent of its nominal capacity with the fuel specified in section 6 of this procedure and rocking it from an angle deviation of + 15° to −15° from level at a rate of 15 cycles per minute for a total of one million total cycles. As an alternative to rocking the fuel tank, use a laboratory sample orbital shaker table or similar device to subject the tank to a centripetal acceleration of at least 2.4 meter·second^{-2} at a frequency of 2 ± 0.25 cycles per second for one million cycles. Seal all openings in each fuel tank as they would be sealed when installed on a production engine during slosh testing. A plug, cap, or coupon may be used to seal any openings to which a hose or tube is normally attached.

8.3 Ultraviolet Radiation Exposure

A sunlight-exposure test shall be performed by exposing each fuel tank to an ultraviolet light of at least 24 $W \cdot m^{-2}$ (0.40 $W \cdot hr \cdot m^{-2} \cdot min^{-1}$) on the tank surface for at least 450 hours. Alternatively, each fuel tank may be exposed to direct natural sunlight for at least 450 daylight hours. The ultraviolet radiation exposure test may be omitted if no part of the fuel tank, including the filler neck and fuel cap, will be exposed to light when installed on an engine.

8.4 Fuel Cap Installation Cycles

The following test is optional: Installation cycles shall be performed with fuel caps intended for use with the fuel tanks by putting each fuel cap on and taking it off 300 times. Tighten the fuel cap each time in a way that represents typical usage.

9. PRECONDITIONING PROCEDURE

After performing the durability tests, ~~ensure that the fuel tank and any vent outlets are sealed and leak tight. This can be accomplished by fusion welding a coupon over the fuel outlet(s) or by inserting and clamping metal plugs into each outlet. Once sealed,~~ fill ~~the~~each tank to its nominal capacity with ~~CERT~~the fuel specified in section 6 of this procedure and ~~attach the OEM fuel cap~~install a production fuel cap expected to have permeation emissions at least as high as the highest-emitting fuel cap that will be used with fuel tanks from the evaporative family. Place the tanks in a suitable vented enclosure. Record the preconditioning start date on the ~~field~~ data sheet. Soak the tanks at ~~30º C ± 10º~~a temperature that never falls below 38 °C for not less than 140 days. Accelerated preconditioning of the tanks can be accomplished by soaking the tanks at an elevated temperature. Data documenting that permeation emissions from the fuel tanks will not increase with further preconditioning ~~has reached equilibrium~~ must be provided for tanks soaked less than 140 days. The time of the durability demonstration in section 8 of this procedure may be counted as part of the preconditioning procedure if the ambient temperature remains within the specified temperature range, the same fuel cap is used throughout the durability demonstration and preconditioning period, and each fuel tank is at least 50 percent full; fuel may be added or replaced as needed to conduct the specified durability tests.

10. SEALING PROCEDURE

~~10.1~~(a)After preconditioning, remove the tanks from the enclosure to a well-ventilated area. Record the preconditioning end date on the ~~field~~ data sheet. Remove the cap and empty the tanks. The tanks must not remain empty for more than fifteen minutes. Immediately refill theeach tank to its nominal capacity with CERTthe fuel specified in section 6 of this procedure. Place theeach unsealed tank in a heated enclosure and allow it to equilibrate to 40º C ± 2º °C for a minimum of two hours. After the fuel temperature has equilibrated to 40º C ± 2º °C, seal theeach tank with the same fuel cap used for the durability demonstration and preconditioning procedure or by fusion welding a coupon over the fuel fill neck opening to make a seal. Perform a leak check by submerging each tank in a water bath large enough to completely cover the tank plus six inches. Observe the tank for any leaks. Leak points will be visible as a bubble or stream of bubbles while immersed in the water bath. Alternative methods may be used to verify that the tank is sealed other than water submersion. If leaks are observed, remove and dry the tank and repair all leaks. Continue this process until no leaks are observed.

10.2 For materials that cannot beIf the fuel tank is not sealed using the fuel cap or fusion welding, good engineering practices should be used to seal the tank. As an alternative, tThe technique used to seal tanks described in SAE 920164 "Permeation of Gasoline-Alcohol Fuel Blends Through High-Density Polyethylene Fuel Tanks with Different Barrier Technologies" may be used.

(b) A reference tank is required to correct for buoyancy effects that may occur during testing only if the fuel tanks will be tested using the gravimetric permeation test in section 11 of this test procedure. Prepare the reference tank as follows:

(1) Obtain a sixth identical fuel tank that has not previously contained fuel or any other contents that might affect its mass stability.

(2) Fill the reference tank with enough glass beads (or other inert material) so the mass of the reference tank is approximately the same as the test fuel tanks when filled with fuel. Considering the performance characteristics of the balance to be used, use good engineering judgment as defined in 40 CFR Part 1060.801 to determine how similar the mass of the reference tank needs to be to the mass of the test tank.

(3) Ensure that the inert material is dry.

(4) Seal the reference tank in the same manner as the test fuel tanks were sealed.

11. TEST PROCEDURE WITH TRIP BLANK CORRECTIONGRAVIMETRIC PERMEATION TEST

11.1 Two identical sealed tanks, one containing fuel and one remaining empty, are weighed concurrently. The mass changes documented by the empty tank are used to correct the tank containing fuel. Ensure that the exterior surface of each tank is clean, dry, and free of dirt and debris. Carefully place the full tank on the high capacity balance. Record the initial weight (W_{if}), date, relative humidity, barometric pressure, and start time on the field data sheet (Figure 1). Next, carefully place the empty tank on the high capacity balance. Record the initial weight (W_{ie}), date, and start time on the field data sheet.

11.2 Immediately place the two sealed tanks in the enclosure. Begin the 24-soak at 40º C ± 2º C. If more than thirty minutes elapses between the time the sealed tank was weighed and the initiation of the 24-hour soak, then both tanks must be re-weighed.

11.3 At the conclusion of the 24-hour soak period, immediately remove the tanks from the enclosure and ensure that the exterior surface is clean, dry, and free of dirt and debris. Carefully weigh each tank on the high capacity balance. Record the final weights (W_{ff}), (W_{fe}), date, relative humidity, barometric pressure, and end time on the field data sheet. If more than thirty minutes elapses between the conclusion of the 24-hour soak period and the final weighing of the sealed tank, the final weight is invalid and should not be used in future calculations. If this occurs, the test procedure must be reinitiated.

11.4 Calculate the difference between the initial weight (Wi) and the final weight (Wf) for each tank. Record the difference on the field data sheet. Refer to Section 14 for calculation.

11.5 Repeat this process until the correlation coefficient (R^2), from a plot of the cumulative daily weight loss versus time for ten consecutive 24-hour cycles, is 95% or greater.

(a) Perform the following steps to test the fuel tanks for permeation emissions:

(1) Determine the fuel tank's internal surface area in square-meters, accurate to at least three significant figures. The tank internal surfaces are those surfaces that are subjected to liquid fuel or fuel vapor under normal operating conditions and have an opposing surface through the wall section that is exposed to the atmosphere. Internal webs and strengthening structures not in communication with the atmosphere are not considered internal surfaces for the purposes of this testing.

(2) Weigh each sealed test fuel tank and record the mass, date,

relative humidity (optional), barometric pressure, and time on the data sheet (Figure 1) or a similar data sheet. Place the reference tank on the balance and tare it so it reads zero. Place each sealed test fuel tank on the balance and record the difference between the test fuel tank and the reference tank. This value is M_0 for each fuel tank. Take this measurement directly after sealing each test fuel tank as specified in section 10 of this procedure.

(3) Carefully place each fuel tank within a temperature-controlled room or enclosure within 30 minutes of weighing it. Do not spill or add any fuel.

(4) Close the room or enclosure as needed to control temperatures and record the time. Steps may be taken to prevent an accumulation of hydrocarbon vapors in the room or enclosure that might affect the degree to which fuel permeates through the fuel tanks. This might simply involve passive ventilation to allow fresh air exchanges.

(5) Ensure that the measured temperature in the room or enclosure stays within the temperature range specified in paragraph (a)(7) of this section.

(6) Leave the tank in the room or enclosure for the duration of the test run.

(7) Hold the temperature of the room or enclosure at 40 ± 2 °C; measure and record the temperature at least every five minutes. Record the time when each fuel tank is removed from the room or enclosure.

(8) Measure mass loss daily by retaring the balance using the reference tank and weighing each sealed test fuel tank. Record the mass, date, relative humidity (optional), barometric pressure, and time on the data sheet. Calculate the cumulative mass loss in grams for each measurement using the equation in section 14(a) of this procedure. Calculate the coefficient of determination, r^2, based on a linear plot of cumulative weight loss vs. test days. Use the equation in 40 CFR 1065.602(k), with cumulative weight loss represented by y_i and cumulative time represented by y_{ref}. The daily measurements must be at approximately the same time each day. Return each fuel tank to the temperature-controlled room or enclosure within 30 minutes of removing it for weighing. Up to two daily measurements may be omitted in any seven-day period. Test for ten full days, then determine when to stop testing as follows:

(i) Testing of a fuel tank may be stopped after the measurement on the tenth day if r^2 is at or above 0.95 or if the measured permeation rate is less than 50 percent of the applicable standard and the upper limit of the 95 percent confidence interval, as calculated in section 14(d) of this procedure, of the mean permeation rate for the fuel tank is below the applicable standard.

(ii) If, after ten days of testing, r^2 is below 0.95 and the measured permeation rate is more than 50 percent of the applicable standard or the upper limit of the 95 percent confidence interval of the mean permeation rate for the fuel tank is above the applicable standard, continue testing for a total of 20 days or until r^2 is at or above 0.95. If r^2 is not at or above 0.95 within 20 days of testing, discontinue the test and precondition the fuel tank further until it has stabilized permeation emission levels, then repeat the testing.

(9) Record the difference in mass between the reference tank and each test fuel tank for each daily measurement. This value is M_i, where i is a counter representing the number of days elapsed.

(10) Determine the final permeation rate based on the cumulative mass loss measured on the final day of testing using the equation in section 14(e). Round this result to the same number of decimal places as the emission standard.

12. ~~QUALITY ASSURANCE / QUALITY CONTROL (QA/QC)~~PERMEATION TEST WITH FLAME IONIZATION DETECTOR

~~This section is reserved for future specification.~~

(a) Perform the following steps to test each fuel tank for permeation emissions:

(1) Determine the fuel tank's internal surface area in square-meters, accurate to at least three significant figures. The tank internal surfaces are those surfaces that are subjected to liquid fuel or fuel vapor under normal operating conditions and have an opposing surface through the wall section that is exposed to the atmosphere. Internal webs and strengthening structures not in communication with the atmosphere are not considered internal surfaces for the purposes of this testing.

(2) Place the fuel tank in an enclosure meeting the requirements of section 4 of TP-902 that is equilibrated to 40 ± 2 °C, and close the

enclosure.

(3) Purge the enclosure to reduce the reactive organic gas concentration and perform a 24-hour permeation test at a constant temperature of 40 ± 2 °C. Measure the reactive organic gas emissions from the fuel tank using a flame ionization detector meeting the requirements of section 4 of TP-902.

13. RECORDING DATA

Record data on ~~field~~ data sheet shown in figure 1 or a similar data sheet.

14. ~~CALCULATING PERMEATION RATE USING TRIP BLANK CORRECTION~~CALCULATIONS

(a) The cumulative daily ~~weight~~mass loss in grams for each test fuel tank is calculated for each 24-hour cycle as follows:

~~$Wl = W_{if} - D_f$~~

~~Where:~~

~~Wl = The weight loss in grams~~
~~W_{if} = The initial weight of the full tank in grams~~
~~W_{ff} = The final weight of the full tank in grams~~
~~D_f = $W_{ff} + D_e$~~
~~D_e = $W_{ie} - W_{fe}$~~
~~W_{ie} = The initial weight of the empty tank in grams~~
~~W_{fe} = The final weight of the empty tank in grams~~

cumulative mass loss = $M_0 - M_i$

Where
M_0 = initial difference in mass between a test fuel tank and the reference tank;
M_i = difference in mass between a test fuel tank and the reference tank after permeation testing for i days.

(b) Calculate the daily mass loss as follows:

daily mass loss = $M_i - M_{i-1}$

Where
M_{i-1} = difference in mass between a test fuel tank and the reference tank after permeation testing for (i – 1) days.

(c) Calculate the daily permeation rate, P_i, for a test fuel tank as follows:

$$P_i = \frac{\text{daily mass loss}}{SA \cdot 1 \text{ day}}$$

Where

SA = the internal surface area of the fuel tank

(d) Calculate the upper limit of the 95 percent confidence interval for the mean permeation rate of each test fuel tank as follows:

$$\text{Upper limit of 95 percent CI} = \bar{P} + \frac{ts}{\sqrt{N}}$$

Where

$\bar{P}$ = mean daily permeation rate for a test fuel tank;

t = Student's critical t value for 95 percent confidence (e.g., 2.262 for 10 measurements);

s = sample standard deviation of the mean,

$$\sqrt{\frac{\sum_{i=1}^{N} (P_i - \bar{P})^2}{N-1}};$$

N = number of measurements.

(e) Calculate the final permeation rate, P, for a test fuel tank tested according to section 11 of this test procedure as follows:

$$P = \frac{\text{cumulative mass loss}}{SA \cdot i}$$

Where

i = number of days of permeation testing for a test fuel tank.

(f) Calculate the permeation rate for a fuel tank tested according to section 12 of this test procedure as described in section 5.5 of TP-902 for diurnal emissions, using the actual test volume of the fuel tank assembly as tested instead of the volume of an engine or equipment unit.

~~Plot the cumulative daily weight loss (in grams) against the sampling time (days). Perform a linear regression on ten consecutive data points.~~

~~If the correlation coefficient is at least 95%, the permeation rate in grams per square meter per day is calculated by dividing the slope of the regression line (grams/day) by the tanks internal surface area (obtained from the tank~~

manufacturer).

$P_{rate} = Slope / A_{tank}$

Where:

P_{rate} = The permeation rate in grams/meter^2/day

$Slope$ = The slope of the regression line in grams/day

A_{tank}[1] = The tank's internal surface area in meter^2

[1] Report the tank's internal surface area in square-meters to at least three significant figures. The tank internal surfaces are those surfaces that are subjected to fuel liquid or vapor under normal operating conditions and have an opposing surface through the wall section that is in communication with the atmosphere. Internal webs and strengthening structures not in communication with the atmosphere are not considered internal surfaces for the purposes of this testing.

15. ALTERNATIVE TEST PROCEDURES

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

(1) Documentation of any such approvals, demonstrations, and approvals shall be maintained by the ARB Executive Officer and shall be made available upon request.

(2) 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.

16. REFERENCES

Permeation of Gasoline-Alcohol Fuel Blends Through High-Density Polyethylene Fuel Tanks with Different Barrier Technologies, SAE Technical Paper Series 920124, International Congress & Exposition, Detroit Michigan, February 1992

17. FIGURES

Figure 1. Field Data Sheet (Trip Blank Correction)

Figure 1. ~~Field~~ Data Sheet ~~(Trip Blank Correction)~~

Tank Manufacturer:____

Tank I.D:____

Tested By:____

Water Bath Test (pass/fail):____

Tank Internal Surface Area (meter^2):____

Full Tank Data

Date/Time Start		Date/Time End		Initial Weight W_{if} (grams)	Final Weight W_{ff} (grams)	Difference D_f (grams)	Weight Loss Wl (grams)

$Wl = (W_{if} - D_f)$, $D_f = (W_{ff} + D_e)$, $D_e = (W_{ie} - W_{fe})$

~~Empty~~Reference Tank Data

Date/Time Start		Date/Time End		Initial Weight W_{ie} (grams)	Final Weight W_{fe} (grams)	Difference D_e (grams)	%RH	Baro. Pres.