

California Environmental Protection Agency



Vapor Recovery Test Procedure

TP-201.6C

Compliance Determination of Liquid Removal Rate

Adopted: July 3, 2002

**California Environmental Protection Agency
Air Resources Board**

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A set of definitions common to all certification and test procedures is in:

D-200 Definitions for Vapor Recovery Procedures

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. PURPOSE AND APPLICABILITY

- 1.1** This procedure is used to quantify the removal rate of liquid from the vapor passage of a Phase II balance system hose equipped with a liquid removal device. This procedure determines compliance with the performance standard defined in the Certification Procedure CP-201 for the purposes of certification and for determining gasoline dispensing facilities compliance.

2. PRINCIPLE AND SUMMARY OF TEST PROCEDURE

- 2.1** This test procedure provides two options to determine the compliance of liquid removal devices. Under option 1 (short version), liquid in the vapor path of a coaxial hose is drained and measured. If the volume of liquid drained equals or exceeds 25 ml, a liquid removal test is conducted. For those hoses with less than 25 ml drained, no further testing is required. Under option 2 (long version), all hoses are evaluated regardless of the volume of liquid drained. Option 2 includes a prewetting and wall adhesion step. Both options test the liquid removal device by introducing gasoline into the vapor path of the coaxial hose through the nozzle bellows. After 7.5 gallons of gasoline is dispensed, the amount of gasoline remaining in the hose is measured and the liquid removal rate is determined. The district shall specify which testing option to be used.

3. BIASES AND INTERFERENCES

- 3.1.** Slits or tears in the hose or nozzle vapor path may bias the results towards compliance.
- 3.2.** Any spillage of liquid when draining or introducing gasoline invalidates the test.
- 3.3.** A breach of the inner product hose may introduce additional gasoline into the outer vapor

path resulting in a larger volume drained than introduced.

3.4. Incorrect nozzle and/or hose orientation while dispensing invalidates the test.

4. SENSITIVITY, RANGE, AND PRECISION

4.1 The range of measurement of the liquid removal rate is dependent upon the range of the graduated cylinder used for testing.

4.2 To ensure precision, graduated cylinder readings shall be measured at the liquid level meniscus.

5. EQUIPMENT

5.1. Stopwatch. Use a stopwatch accurate to within 0.2 seconds.

5.2. Funnels. Large and small gasoline compatible, non-breakable, funnels with dimensions similar to those as shown in Figure 1, or equivalent.

5.3. Tape Measure. Use a standard tape measure with a minimum length of 5 feet.

5.4. Graduated Cylinders. Gasoline compatible, non-breakable 0-25ml, 0-100ml, 0-250 ml, and 0-500 ml graduated cylinders with stable base plates. The 25ml cylinder may be necessary to quantify volumes of liquid less than 20 ml.

5.5. Gasoline Test Tank. (Optional) A portable tank, meeting fire safety requirements for use with gasoline, may be used to receive the gasoline dispensed during testing. The tank shall have sufficient volume so that at least 10.0 gallons may be dispensed prior to activating the primary shutoff mechanism of the nozzle. The tank shall be constructed with a fill pipe opening meeting the specifications listed in Sections 6.12 and 6.13 of this procedure. To minimize testing-related emissions, vehicle refueling events should be used for this procedure whenever feasible.

5.6. Traffic Cones. Use traffic cones to encircle the area where testing is conducted.

5.7. Spout Measurement Angle Device. Use an angle measurement device to ensure the nozzle spout is resting in the vehicle or test tank fill pipe at an angle of $30^{\circ} (\pm 5^{\circ})$ degrees from horizontal during dispensing. A typical way to do this is to use a spout angle measurement device, as shown in Figure 2.

5.8. Field Data Sheet. Use the appropriate data sheet to record liquid removal test information. Form 1 and 2 serves as examples; districts may require a modified version.

5.9. Gasoline Container. Use a portable fuel container equipped with a tight fitting cap, of at least 1.0 gallon capacity.

NOTE: THIS TEST PROCEDURE PROVIDES TWO OPTIONS TO DETERMINE COMPLIANCE OF LIQUID REMOVAL DEVICES. THE DISTRICT SHALL SPECIFY WHICH TESTING OPTION TO BE

USED

6. OPTION 1 (SHORT VERSION)

PRE-TEST PROCEDURE

- 6.1 Verify that the 500 ml graduated cylinder is empty. Position the large funnel into the graduated cylinder.
- 6.2 Remove the nozzle from the dispenser and carefully tilt the spout into the funnel/graduated cylinder assembly.
- 6.3 Lower the nozzle and funnel/graduated cylinder assembly as close to the ground as possible. "Walk out" the hose while keeping the nozzle lowered and hose fully extended. The hose shall slope downward from the dispenser toward the nozzle.
- 6.4 Open the nozzle's vapor check valve by compressing the bellows. Allow 60 seconds for all liquid to drain. Use caution to avoid spillage.
- 6.5 Return the nozzle to the dispenser and measure the volume of liquid drained. If the volume drained is less than 200 ml, transfer the liquid into an appropriately sized graduated cylinder. For example, if 40 ml of liquid was drained, use the 100 ml graduated cylinder to take the measurement.
- 6.6 Record the amount of liquid drained on Form 1.
- 6.7 If the volume drained is greater than or equal to 25 ml, proceed to Section 6.8 of the procedure. Hoses with greater than 25 ml drained are considered to be pre-wetted. If the amount drained is less than 25 ml, proceed to the next nozzle/hose to be evaluated and repeat Section 6.1-6.6

TEST PROCEDURE (FOR HOSES WITH GREATER THAN 25 ML DRAINED)

- 6.8 Pour 150 ml to 175 ml of gasoline into the 250 ml graduated cylinder. Measure and record this volume on Form 1.
- 6.9 Remove the nozzle from the dispenser and position the nozzle upright so that the spout is in a vertical position.
- 6.10 Open the nozzle's vapor check valve by compressing the bellows and carefully insert the stem of the small funnel between the bellows and nozzle spout.
- 6.11 Pour the measured volume into the vapor path of the hose. Use caution not to spill the gasoline (see Section 3.2). Remove the small funnel after the gasoline has been introduced.
- 6.12 Position a vehicle or test tank fill pipe opening 48 (± 6) inches from the dispenser measured perpendicular to the nozzle hanger and 30 (± 6) inches above grade. Use the tape

measure to verify these distances. See Figure 3.

- 6.13** Insert the nozzle into the fill pipe. Use the angle measuring device to ensure the spout shall rest in the vehicle or test tank fill pipe at an angle of +30° (±5°) measured from horizontal. See Figure 3.
- 6.14** Dispense 7.5 (±0.5) gallons at the highest possible flow rate by holding the nozzle lever in the fully open position. Use a stopwatch to measure the time elapsed while dispensing. Record the volume of fuel dispensed and the elapsed time on a Form 1.
- 6.15** Calculate the dispensing rate using the equation below. If the dispensing rate is less than 5.0 gallons per minute (GPM), or a minimum rate approved by the Executive Officer as being consistent with normal operation, the test results are invalid. If the dispensing rate is greater than 10.0 GPM the test results are invalid.

$$\text{GPM} = 60 \times \left(\frac{\text{G}}{\text{T}} \right)$$

Where:

GPM = dispensing rate (in gallons per minute)
G = gallons of fuel dispensed
T = number of seconds required to dispense

- 6.16** Using the 250 ml graduated cylinder and large funnel, carefully drain the remaining liquid from the vapor path of the hose as described in Section 6.1 through 6.5. Record this quantity on Form 1.
- 6.17** If the liquid removal rate is less than 5.0 ml/gallon, but greater than or equal to 4.5 ml/gallon, repeat the test two additional times and average the three results.

7. OPTION 2 (LONG VERSION)

PRETEST PROCEDURE

- 7.1** Carefully pour 150 ml of gasoline into the 250 ml graduated cylinder.
- 7.2** Remove the nozzle from the dispenser and position the nozzle upright so that the spout is in a vertical position.
- 7.3** Open the nozzle's vapor check valve by compressing the bellows and insert the small funnel between the bellows and nozzle spout.
- 7.4** Pour the gasoline from the 250 ml graduated cylinder into the vapor path of the hose. Use caution not to spill the gasoline (see Section 3.2). Remove the small funnel after the gasoline has been introduced.
- 7.5** Verify that the 500 ml graduated cylinder is empty. Position the large funnel into the graduated cylinder.

- 7.6 Remove the nozzle from the dispenser and carefully tilt the spout into the funnel/graduated cylinder assembly.
- 7.7 Lower the nozzle and funnel/graduated cylinder assembly as close to the ground as possible. "Walk out" the hose while keeping the nozzle lowered and hose fully extended. The hose shall slope downward from the dispenser toward the nozzle.
- 7.8 Open the nozzle's vapor check valve by compressing the bellows. Allow 60 seconds for all liquid to drain. Use caution to avoid spillage (see Section 3.2). If necessary, drain full graduated cylinders into a portable gas can until the hose is empty.
- 7.9 Return the nozzle to the dispenser.

TEST PROCEDURE

- 7.10 Pour 150 ml to 175 ml of gasoline into the 250 ml graduated cylinder. Measure and record this volume on Form 2.
- 7.11 Remove the nozzle from the dispenser and position the nozzle upright so that the spout is in a vertical position.
- 7.12 Open the nozzle's vapor check valve by compressing the bellows and carefully insert the stem of the small funnel between the bellows and nozzle spout.
- 7.13 Pour the measured volume into the vapor path of the hose. Use caution not to spill the gasoline (see Section 3.2). Remove the small funnel after the gasoline has been introduced.
- 7.14 Position a vehicle or test tank fill pipe opening 48 (±6) inches from the dispenser measured perpendicular to the nozzle hanger and 30 (±6) inches above grade. Use the tape measure to verify these distances. See Figure 3.
- 7.15 Insert the nozzle into the fill pipe. Use the spout angle measurement device to ensure the spout shall rest in the vehicle or test tank fill pipe at an angle of +30° (±5°) measured from horizontal. See Figure 3.
- 7.16 Dispense 7.5 (±0.5) gallons at the highest possible flow rate by holding the nozzle lever in the fully open position. Use a stopwatch to measure the time elapsed while dispensing. Record the volume of fuel dispensed and the elapsed time on a form similar to that as shown in Form 2.
- 7.17 Calculate the dispensing rate using the equation below. If the dispensing rate is less than 5.0 gallons per minute (GPM), or a minimum rate approved by the Executive Officer as being consistent with normal operation, the test results are invalid. If the dispensing rate is greater than 10.0 GPM the test results are invalid.

$$\text{GPM} = 60 \times \left(\frac{\text{G}}{\text{T}} \right)$$

Where:

GPM = dispensing rate (in gallons per minute)
G = gallons of fuel dispensed
T = number of seconds required to dispense

- 7.18** Using the 250 ml graduated cylinder and large funnel, carefully drain the remaining liquid from the vapor path of the hose as described in Section 7.5 through 7.8. Record this quantity on Form 2.
- 7.19** Use the 250 ml graduated cylinder and small funnel to pour 150 ml of gasoline into the vapor passage of the hose. Dispense no gasoline.
- 7.20** Using the 250 ml graduated cylinder and large funnel, completely drain the gasoline from the vapor passage back into the graduated cylinder as described in Section 7.5 through 7.9.
- 7.21** Subtract the volume drained (value from Section 9.11) from the volume added (value from Section 9.4). This value represents the volume of gasoline lost due to wall adhesion. The purpose of the wall adhesion value is to quantify the amount of gasoline lost to evaporation from transfer to and from the graduated cylinders and adhesion of liquid to vapor passage surfaces in previous measurements.
- 7.22** If the liquid removal rate is less than 5.0 ml/gallon, but greater than or equal to 4.5 ml/gallon, repeat the test two additional times and average the three results.

8. POST TEST PROCEDURES

- 8.1.** Empty all containers and return any excess gasoline to the underground storage tank.
- 8.2.** Remove the traffic cones from the testing area.
- 8.3.** Use Equation 9.1 or 9.2 to calculate the liquid removal rate for all the applicable hoses tested.

9. CALCULATING RESULTS

- 9.1** If using OPTION 1(short version), the liquid removal rate shall be calculated as follows:

$$VR = \frac{VI - VF}{G}$$

Where:

VR = Gasoline removed per gallon dispensed, milliliters/gallon
VI = Total initial volume poured into hose vapor passage, milliliters
VF = Volume of gasoline remaining in the hose vapor passage after dispensing, milliliters
G = Total dispensed, gallons

9.2 If using OPTION 2 (long version), the liquid removal rate shall be calculated as follows:

$$VR = \frac{(VI - VW) - VF}{G}$$

Where:

VR	=	Gasoline removed per gallon dispensed, milliliters/gallon
VI	=	Total initial volume poured into hose vapor passage, milliliters
VW	=	Volume of liquid lost due to wall adhesion, milliliters
VF	=	Volume of gasoline remaining in the hose vapor passage after dispensing, milliliters
G	=	Total dispensed, gallons

10. REPORTING RESULTS

- 10.1.** Record all applicable liquid removal rate information on the appropriate form as shown in form 1 and 2.
- 10.2.** If the calculated liquid removal rate is greater than or equal to the minimum removal rate as specified in CP-201, the liquid removal device has demonstrated compliance.
- 10.3.** If the calculated liquid removal rate is less than the minimum required, the liquid removal device is not in compliance.

11. ALTERNATIVE TEST PROCEDURES

- 11.1.** This procedure shall be conducted as specified. Modifications to this test procedure shall not be used to determine compliance unless prior written approval has been obtained from the Executive Officer, pursuant to Section 14 of Certification Procedure CP-201.

FIGURE 1: FUNNEL SPECIFICATIONS

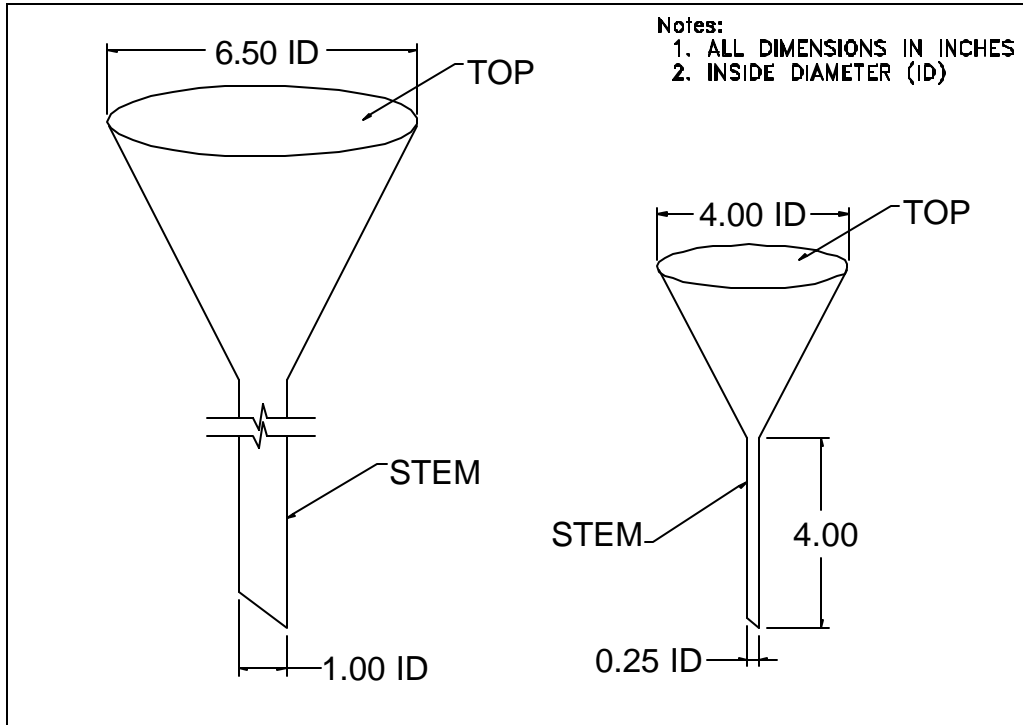


FIGURE 2: SPOUT ANGLE MEASUREMENT DEVICE

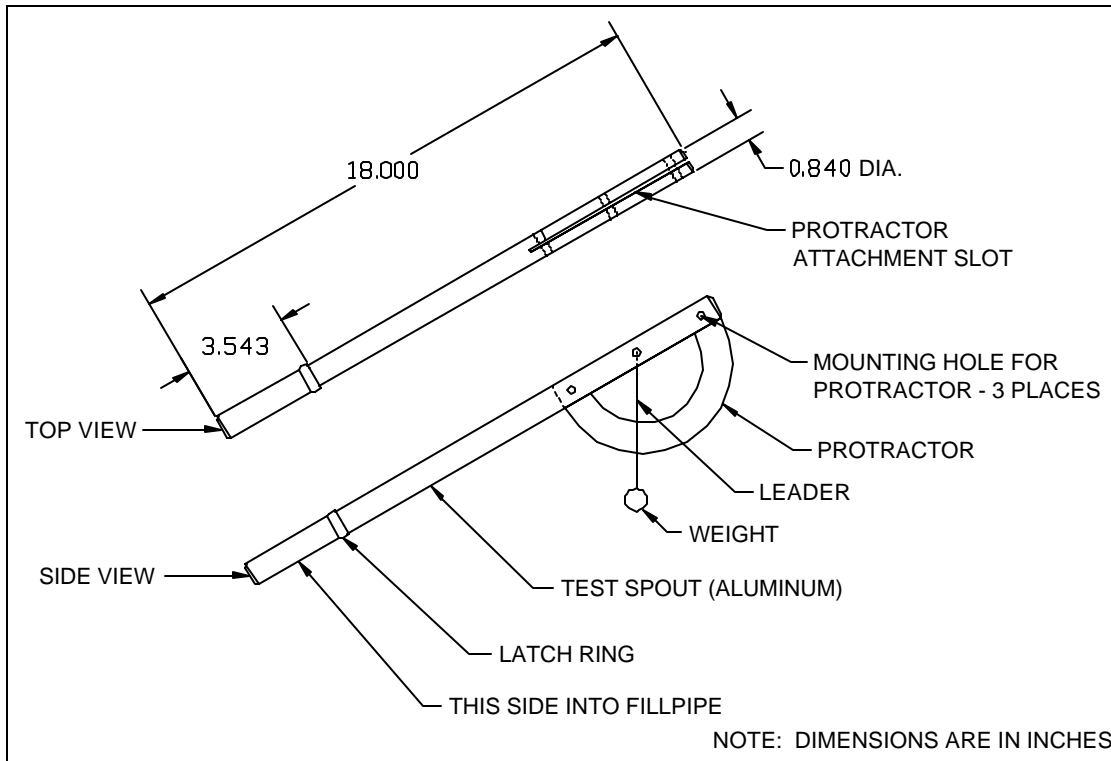


FIGURE 3: NOZZLE AND HOSE POSITIONING FOR LIQUID REMOVAL TESTING

