California Environmental Protection Agency

Air Resources Board

Vapor Recovery Test Procedure

PROPOSED: TP- 201.5

Determination (by Volume Meter) of Air to Liquid Volume Ratio of Vapor Recovery Systems of Dispensing Facilities

Adopted: April 12, 1996
Amended: _____

This procedure is being amended. For ease of viewing, the method is shown as repealed text and proposed text.

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Definitions common to all certification and test procedures are in:

D-200 Definitions for Vapor Recovery Procedures

For the purpose of this procedure, the term "CARB" refers to the State of 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 test procedure is used to quantify the Air to Liquid (A/L) Volumetric Ratio of Phase II vapor recovery systems installed at gasoline dispensing facilities (GDF), provided the nozzles use a coaxial spout design, or equivalent. This procedure provides a method to determine compliance with the A/L requirements specified in the applicable California Air Resources Board (CARB) Executive Order (EO) for the specified Phase II vapor recovery system.

2. PRINCIPLE AND SUMMARY OF TEST PROCEDURE

2.1 A tight fitting adaptor is placed on the spout of a dispensing nozzle. The adaptor, which isolates air flow to the nozzle vapor collection ports, is connected to a rotary gas meter, or equivalent. Gasoline is dispensed through the nozzle and the volume of air and vapors drawn through the vapor collection ports by the Phase II system vacuum pump is measured. The volume of the air mixture is recorded and compared with the volume of gasoline dispensed to determine the A/L Volumetric Ratio.

2.2 The test is conducted with the pressure/vacuum (P/V) relief valve(s) on the storage tank vent pipes installed, **unless** the applicable CARB EO specifies that, due to the design of the system, the P/V valve is to be removed during the test.

2.2.1 If the P/V valve is required to be removed during the test, the pressure integrity of the P/V valve connection shall be verified upon completion of the test, using either liquid leak solution or a bagging technique, as applicable.

3. BIASES AND INTERFERENCES

3.1 Nozzle spouts which are damaged such that the A/L adaptor cannot fit over the nozzle spout preclude the use of this test.

3.2 Refueling points not capable of achieving dispensing rates required for conducting the A/L test, as specified in the applicable CARB EO, preclude the use of this test.

3.3 Location or configuration of the vapor collection ports on the nozzle spout which are not compatible with the A/L adaptor specified in this procedure preclude the use of this test.

3.4 Bagging, or otherwise sealing any nozzle associated with the vacuum pump serving the nozzle being tested, may bias the test results towards compliance. **The A/L test to verify compliance shall be conducted without "bagging" any of the nozzles served by a common vacuum device.**

3.5 If the nozzle being tested introduces liquid into the test equipment, the A/L of that nozzle shall be deemed a failure and the nozzle shall immediately be removed from service pursuant to CH&SC Section 41960.2(d).

3.6 Do not drain or remove liquid in either the vapor passage of the hoses or the dispenser vapor piping prior to performing the test. Draining of this liquid gasoline will bias the test toward compliance.

3.7 Pressure in the headspace of the storage tank, created by draining the gasoline from the portable test tank to the storage tank, may bias the results of the test for systems certified to operate at, or near, atmospheric gauge pressure in the UST headspace. The test shall be conducted with the P/V valve installed, unless the applicable CARB Executive Order (EO) requires the P/V valve be removed during the test.

4. SENSITIVITY, RANGE, AND PRECISION

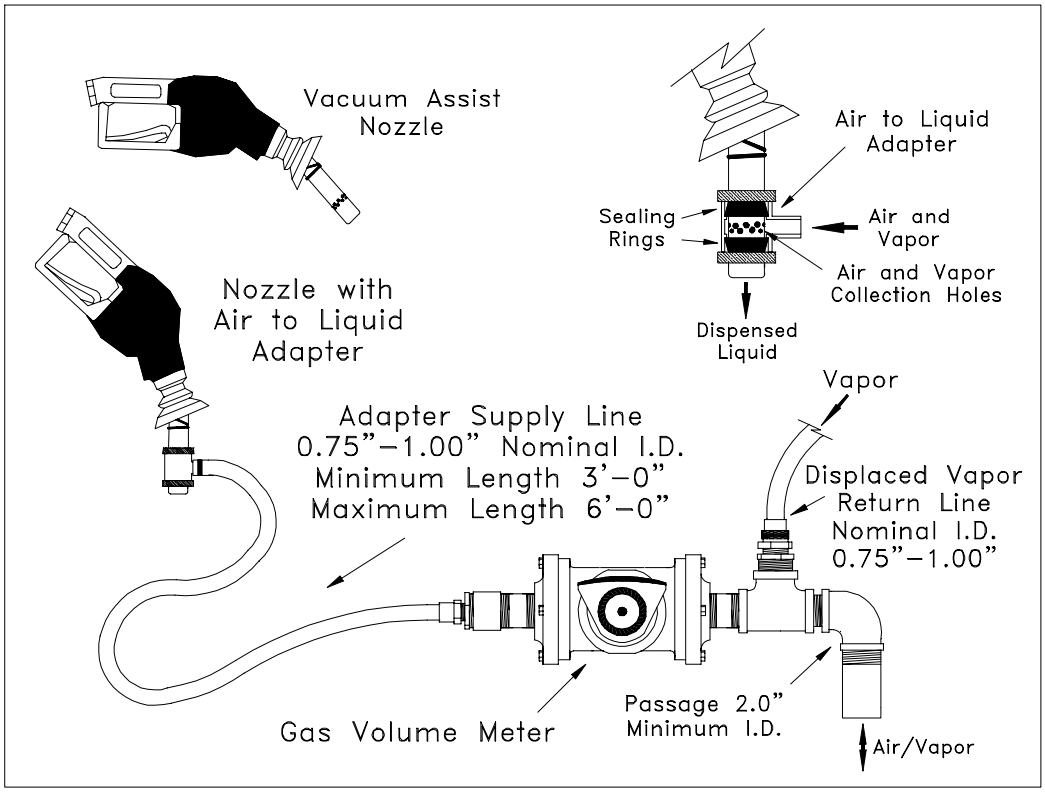
4.1 The maximum rated capacity of the gas volume meter shall be at least 250 CFH and not greater than 3,000 CFH.

4.2 The minimum rated capacity of the gas volume meter shall be 25 CFH.

4.3 The minimum readability of the gas volume meter shall be 0.01 cubic feet.

4.4 Precision is $\pm$ 5 percent of the gas volume meter reading.

Figure 1
Gas Volume Meter and Air To Liquid Adaptor



5. EQUIPMENT

5.1 Air to Liquid Adaptor. Use an Air to Liquid (A/L) adaptor compatible with the nozzle(s) employed at the GDF. The adaptor shall be capable of isolating the vapor holes in the nozzle and be connected to the gas volume meter with gasoline-resistant flexible tubing. The nominal inside diameter of the flexible tubing shall be between 0.75 and 1.00 inches, and the maximum length of the tubing shall be 8 feet. Figure 1 illustrates an A/L adaptor assembled on a nozzle. If CARB specifies certain adaptors in the applicable CARB EO, only those adaptors shall be used.

5.2 Gas Volume Meter. Use a Dresser Measurement Roots Meter, or equivalent, to measure the volumetric flowrate through the A/L adaptor. The meter shall be equipped as shown in Figure 1 and the maximum allowable pressure drop(s) across the meter shall be as follows:

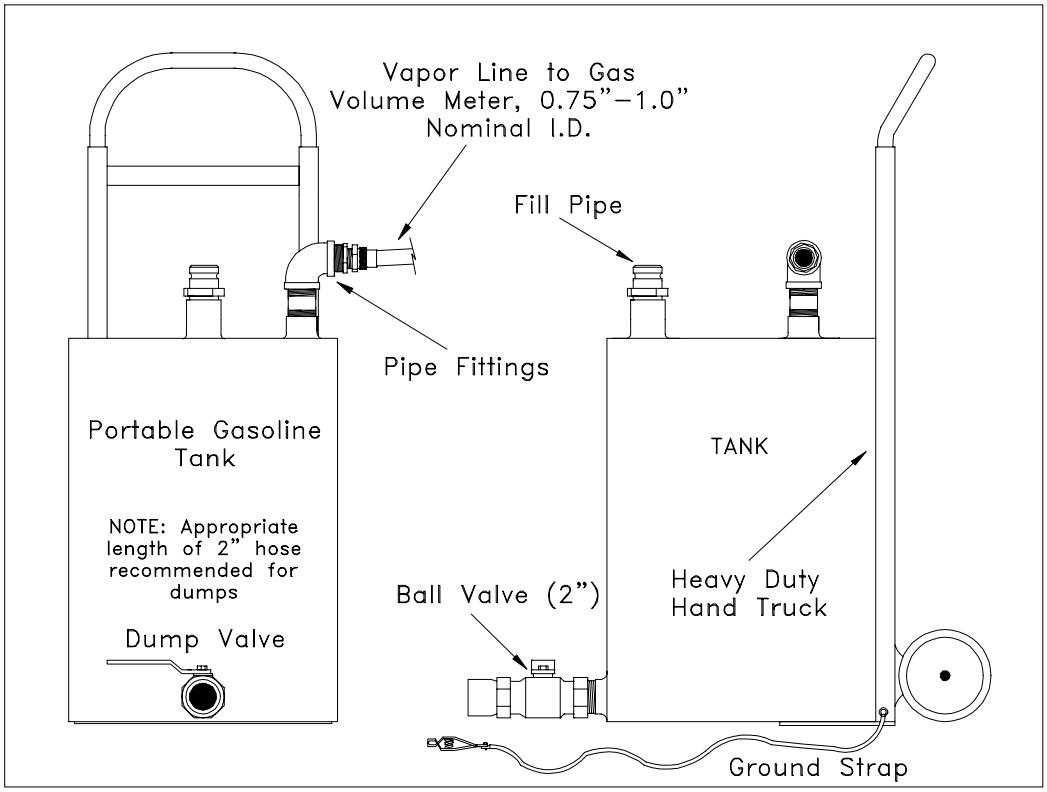
For a meter with a maximum rated capacity of 1000 CFH through 3,000 CFH:

1.10 inches H_2O at a flowrate of 3,000 CFH
0.05 inches H_2O at a flowrate of 30 SCFH.

For a meter with a maximum rated capacity of 800 to 1,000 CFH:

0.70 inches H_2O at a flowrate of 800 CFH
0.04 inches H_2O at a flowrate of 16 CFH

Figure 2
Portable Tank Assembly



5.3 Volume Gas Meter Inlet Manifold. This manifold is designed to return the vapors displaced from the portable gasoline tank assembly, at atmospheric pressure, to the inlet of the gas volume meter. This manifold shall be two (2.0) inches nominal inside diameter pipe.

5.4 Liquid Volume Meter. Use the totalizer on the gasoline dispenser to measure the volume of gasoline dispensed during the test.

5.5 Portable Gasoline Tank Assembly. A portable tank, acceptable for use with gasoline, shall be used to receive the gasoline dispensed during this test. The tank shall have sufficient volume so that at least 4.5 gallons may be dispensed prior to activating the primary shutoff mechanism of the dispensing nozzle. Tank material, likely to provide contact with the nozzle spout, or A/L adaptor, during the entire dispensing event, shall be constructed of aluminum or brass or other materials approved by the local fire codes for such application. The tank and recommended plumbing configuration is shown in Figure 2 and Figure 3. This configuration permits a portion of the vapors displaced during testing to be returned to the gasoline storage tank. The minimum and maximum dimensions shown in Figure 2 and Figure 3 shall be adhered to in all cases.

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

5.7 Lubricant. Appropriate lubricant, either grease or spray lubricant, shall be used to ensure a leak-tight seal between the O-rings in the A/L adaptor and the nozzle spout.

5.8 CARB Executive Order (EO). The applicable CARB Executive Order should be reviewed **prior** to conducting the test. This review shall include the status of the P/V valve (installed or removed) during the test and whether the processor should remain in operation during the test.

6. PRE-TEST PROCEDURES

6.1 Assemble the portable tank assembly and gas volume meter as shown in Figure 3. The minimum and maximum dimensions shown in Figure 3 shall be adhered to in all cases. **Ensure that the ground strap is properly connected to an acceptable ground**.

6.2 If more than one nozzle share vacuum plumbing with the test nozzle, one troubleshooting method for a low A/L ratio is to seal all nozzles other than the nozzle being tested, e.g., plastic bags and tape or rubber bands. If leaks in the nozzles/check valves served by common vacuum pump cause the bags to deflate, the low A/L ratio may have been caused by a leak through an idle nozzle during the test. **The A/L test to verify compliance, however, shall be conducted without "bagging" any of the nozzles.**

6.3 The gas volume meter shall be calibrated, within 180 days prior to conducting this procedure. In addition, calibration shall be conducted after any repairs or alterations to the meter. Calibrations, at a minimum, shall be conducted at flowrates of 30, 60, and 90 CFH (3.7, 7.5, and 11.2 gallons/minute) in accordance with one of the following:

(a) ARB Air Monitoring Quality Assurance, Volume VI, Standard Operating Procedures for Stationary Source Emission Monitoring, or
(b) US EPA quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods, or
(c) EPA Method 2A, Measurement of Gas Volume Through Pipes and Small Ducts
(d) Appropriate calibration procedures in accordance with California Department of Food and Agriculture, Division of Measurement Standards and County Department of Weights and Measures

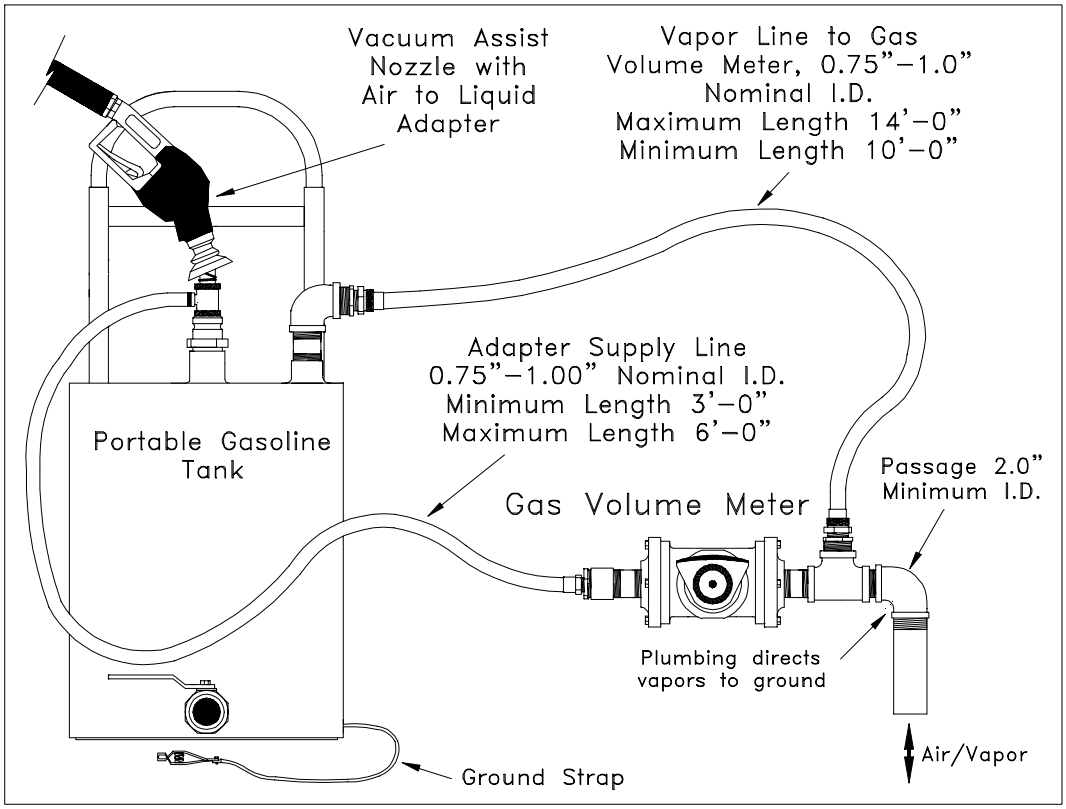
A copy of the most current calibration shall be kept with the meter.

6.4 A one-time test to verify proper design of the tee connection at the gas volume meter shall be conducted. Disconnect the A/L adaptor from the nozzle and dispense between four and one-half and five (4.5 - 5.0) gallons into the portable test can, insuring a tight fit at the nozzle spout/portable tank fill pipe. The design is

acceptable if the displacement on the gas volume meter is less than 0.01 cubic feet.

6.5 Verify that the O-rings in the A/L adaptor, if applicable, are present and in good condition. O-rings with nicks, tears, or other deformations shall be replaced prior to the test. The O-rings shall be properly greased to ensure a vapor tight connection.

Figure 3
Assembled Air To Liquid Volume Ratio Test Equipment



6.6 Conduct a pre-test leak check of the A/L adaptor by connecting the A/L adaptor to a surrogate spout as shown in Figure 4. Raise the test pressure to five inches H_2O, gauge (5.00"WCg). Squirt liquid leak detector solution on interfaces and other potential leak sources while watching for the formation of bubbles. There shall be no formation of bubbles, or a drop in pressure below 4.95 "WCg for three minutes from the start of the test. Any A/L adaptor which fails this pre-test leak check shall not be used to conduct A/L testing for the purpose of determining compliance. Other leak check protocols are acceptable, provided they have been approved, in writing, by the Executive Officer.

6.7 This test procedure shall be conducted with the storage tank pressure/vacuum (P/V) valve(s) installed and the Phase I poppetted vapor coupler(s) in the closed position, **unless** otherwise specified in the applicable CARB EO. If the CARB EO specifies

the removal of the P/V valve during the test, use care to remove and store the valve until the test is completed and the valve is to be reinstalled.

6.8 Review the applicable CARB EO to determine whether the processor, if applicable, should remain in operation during the test or be turned off.

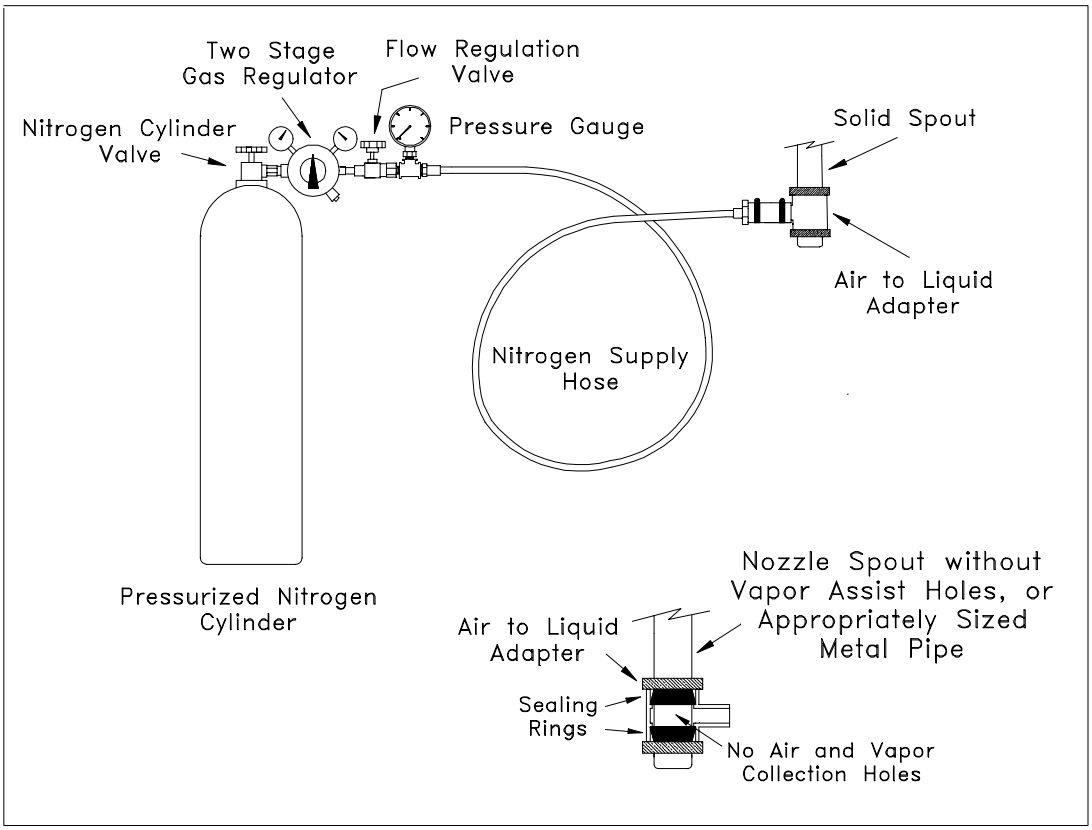
6.9 With the portable tank and A/L test equipment assembled, dispense between four and one-half and five (4.5 - 5.0) gallons into the portable tank. This provides to initially condition the portable tank with gasoline vapors. This initial conditioning shall be conducted once per facility, prior to beginning testing at each facility.

7. TEST PROCEDURES

7.1 Carefully connect the A/L adaptor to the nozzle spout as shown in Figure 1, isolating the vapor ports of the nozzle and insuring a tight connection.

7.2 Record the initial reading from the index of the gas volume meter on the A/L Field Data Summary, as shown in Form 1. This initial reading shall be taken before each test. Do not use the final reading from the preceding test as the initial reading for the current test, unless it has been verified. This is necessary since the meter index may have moved due to the low pressure drop through the meter.

Figure 4
Air To Liquid Adapter Leak Test Assembly



7.3 Reset the stopwatch and, if appropriate, reset the totalizer on the dispenser.

7.4 Fully engage the nozzle trigger and begin dispensing into the portable gasoline tank. **Ensure that the nozzle spout is in contact with the grounded tank assembly during dispensing**. Start the stopwatch when the totalizer indicates dispensing has started.

7.5 Dispense between four and one-half (4.5) and five (5.0) gallons of gasoline. If the applicable CARB Executive Order specifies an amount different than this range, the CARB required quantity shall be used.

If the nozzle being tested introduces liquid into the test equipment, the A/L of that nozzle shall be deemed a failure and the nozzle shall immediately be removed from service.

7.6 Simultaneously stop both the stopwatch and gasoline dispensing.

7.7 The following data for each test shall be recorded on the A/L Field Data Summary as shown in Form 1:

7.7.1 Dispenser (pump) number
7.7.2 Gas grade
7.7.3 Nozzle model and serial number

7.7.4 Initial gas volume meter reading, in cubic feet
7.7.5 Initial totalizer reading from the dispenser, in gallons
7.7.6 Final gas volume meter reading, in cubic feet
7.7.7 Final totalizer reading from the dispenser, in gallons
7.7.8 Elapsed time during dispensing, in seconds

Note: Units other than cubic feet, gallons, and seconds may be used, provided that Equation 9-1 is appropriately modified.

7.8 If the A/L Volumetric Ratio, as determined by Equation 9-1 is within the limits specified in the applicable CARB EO, the refueling point complies with the specifications of the applicable EO.

7.9 If the A/L Volumetric Ratio is outside the range specified in the applicable CARB EO by less than or equal to 0.10, conduct the test two additional times. Do not make adjustments to the gasoline dispensing or vapor recovery lines until all three test runs have been completed. Adjustments of the A/L test equipment, including the A/L adaptor and nozzle, is allowed as may be necessary to insure measurement accuracy. Calculate the numerical average of the three test runs. If the average A/L value of these three test runs is within the allowable limits, compliance has been verified. If the resulting average is outside of the specified limits, the refueling point does not comply with the specifications of the applicable CARB EO.

If the A/L Volumetric Ratio is outside the range specified in the applicable CARB EO by greater than 0.10, the refueling point does not comply with the specifications of the applicable CARB EO.

7.10 If more than one nozzle share vacuum plumbing with the test nozzle, one troubleshooting method for a low A/L ratio is to seal all nozzles other than the nozzle being tested, e.g., plastic bags and tape or rubber bands. If leaks in the nozzles/check valves served by common vacuum pump cause the bags to deflate, the low A/L ratio may have been caused by a leak through an idle nozzle during the test. **The A/L test to verify compliance, however, shall be conducted without "bagging" any of the nozzles.**

7.11 Conduct the A/L Volumetric Ratio test on each nozzle at the facility, unless otherwise specified in the applicable CARB Executive Order.

7.12 Periodically, or as necessary to avoid a build-up of gasoline, drain any condensed gasoline from the hoses between:
(a) the gas volume meter and portable tank assembly, and
(b) the A/L adaptor and gas volume meter.

8. POST-TEST PROCEDURES

8.1 Remove the A/L adaptor from the nozzle.

8.2 Drain the dispensed product into the appropriate gasoline storage tank at the facility. **Ground the portable tank assembly to the storage tank before draining**. Do not mix product grades in the portable tank assembly and use caution to drain the portable tank into the correct facility storage tank. If blending valves are utilized to produce product grades which do not have a dedicated storage tank, product from the blended grade shall be returned to the lower octane tank.

8.2.1 If the P/V valve was removed during the test, as specified in the applicable CARB EO, replace the valve prior to draining the product from the portable tank assembly to the storage tank. Use liquid leak detector or a bagging technique to verify the absence of leaks at the interface between the P/V valve(s) and vent pipe(s). As an alternative, nitrogen may be used to impose a pressure in the storage tank headspace of between 1.5 and 2.5 inches H_2O prior to using the liquid leak detection solution or bagging technique.

8.3 At the conclusion of testing at the facility, conduct a post-test leak check of the A/L adaptor by connecting the A/L adaptor to a surrogate spout as shown in Figure 4. Raise the test pressure to five inches H_2O, gauge (5.00"WCg). Squirt liquid leak detector solution on interfaces and other potential leak sources while watching for the formation of bubbles. There shall be no formation of bubbles, or a drop in pressure below 4.95 "WCg for three minutes from the start of the test. The data collected during the A/L testing is invalid if the A/L adaptor fails this post-test leak check.

8.4 Prior to transportation, the inlet and outlet of the gas volume meter shall be carefully sealed to prevent foreign matter from entering the meter.

8.5 At the conclusion of testing, the portable tank shall be transported in accordance with all applicable safety requirements.

9. CALCULATING RESULTS

9.1 The A/L Volumetric Ratio shall be calculated as shown in Equation 9-1.

$$A/L = \left[\frac{y(Vf - Vi)}{G_f - G_i}\right] \times 7.481 \qquad \textbf{[Equation 9-1]}$$

Where:

A/L = Air to Liquid Volumetric Ratio, dimensionless
y = Correction factor for gas volume meter. See Equation 9-3.
V_i = Initial gas volume meter reading, cubic feet
V_f = Final gas volume meter reading, cubic feet
G_i = Initial totalizer reading from the dispenser, gallons
G_f = Final totalizer reading from the dispenser, gallons
7.481 = Conversion factor from gallons to cubic feet, gallons per cubic foot

9.2 The gasoline dispensing rate during the A/L test shall be calculated as shown in Equation 9-2.

$$Q_g = \left[\frac{G_f - G_i}{t} \right] \times 60 \qquad \textbf{[Equation 9-2]}$$

Where:

Q_g = Gasoline dispensing rate, gallons per minute
G_i = Initial totalizer reading from the dispenser, gallons
G_f = Final totalizer reading from the dispenser, gallons
t = Elapsed time during dispensing event, seconds
60 = Conversion factor, seconds per minute

9.3 The correction factor for correcting observed values of the gas volume meter shall be calculated as shown in Equation 9-3.

$$y = \left[\frac{V_r}{V_m} \right] \qquad \textbf{[Equation 9-3]}$$

Where:

y = Correction factor for the gas volume meter's observed reading, dimensionless
V_r = True volume from current calibration of gas volume meter, cubic feet
V_m = Corresponding observed reading from gas volume meter, cubic feet

10. REPORTING RESULTS

10.1 Results submitted to a local air district for approval shall include the A/L Field Data Sheet as shown in Form 1, or other format specified by the local air district.

FORM 1

GDF Name and Address _____ _____ _____	**A/L Field Data Sheet**	Testing Firm Name and Address: _____ _____ _____ Phone No. ( )
Test Date/Time:		Test Performed by:
Pre-Test Leak Check: Initial/Final Pressures, in. H_2O _____ / _____ **Post-Test Leak Check:** Initial/Final Pressures, in. H_2O _____ / _____	Source: **GDF Phase II Vapor Recovery** **GDF #** _____ **Permit #** _____	VN Recommendation: Y/N _____ Applicable CARB EO # _____ Allowable A/L Range _____

Pump #	Gas Grade	Nozzle Model & Serial #	Initial Totalizer, gal	Final Totalizer, gal	Gasoline Pumped, gal.	Time sec.	Disp. Rate, gpm	Starting Meter Reading	Ending Meter Reading	Total Flow, acf	A/L