Source Test Procedure **ST-39**

GASOLINE DISPENSING FACILITIES
AIR TO LIQUID VOLUMETRIC RATIO

REF: Regulation 8-7-302

1. 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

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 Executive Officer determines 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 absence of leaks at the P/V valve connection shall be verified upon completion.

3. RANGE AND SENSITIVITY

3.1 The maximum rated capacity of the rotary gas meter shall be at least ~~800~~ 250 CFH and not greater than 3,000 CFH.

3.2 The minimum readability of the rotary gas meter shall be 0.01 cubic feet.

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

3.4 Precision is $\pm$ 2 percent of the gas volume meter reading.

4. INTERFERENCES

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

4.2 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.

4.3 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.

4.4 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.**

4.5 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.

4.6 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.

4.7 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 Executive Officer or the applicable CARB Executive Order (EO) requires the P/V valve be removed during the test.

4.8 O-rings in the A/L adaptor that are not properly greased may bias the results toward noncompliance. This bias may be eliminated if the O-rings are lubricated immediately prior to each A/L test run.

5. APPARATUS

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 rotary gas 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~~ 6 feet. Figure 39-1 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 Rotary Gas 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 39-1 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

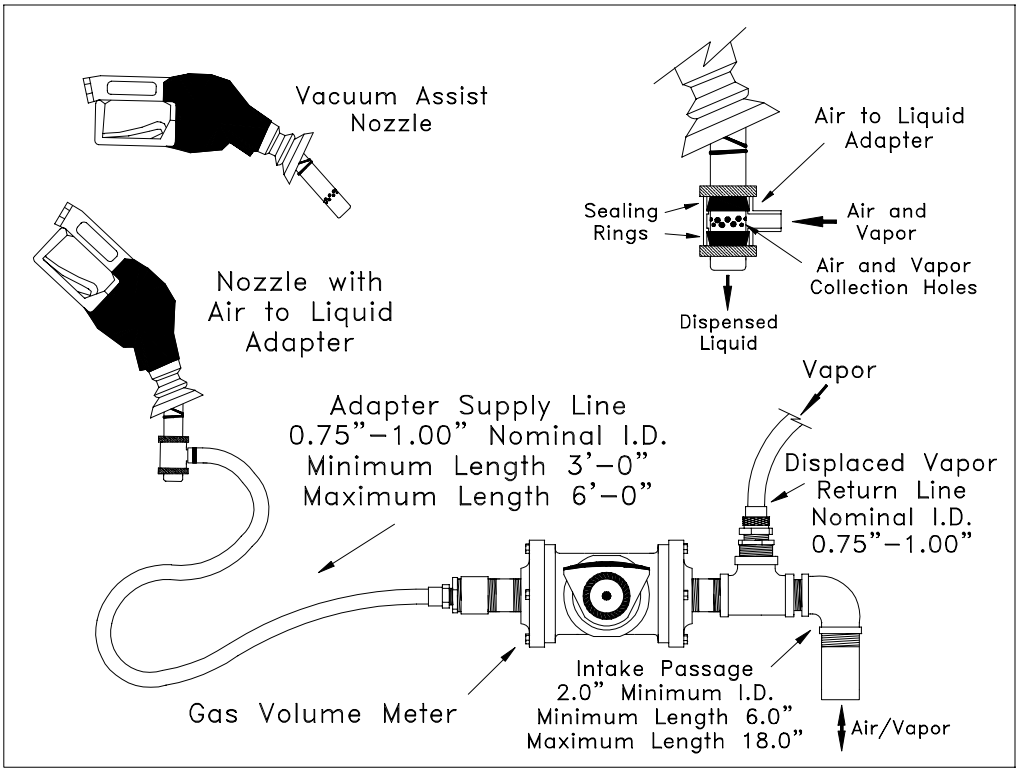
0.05 inches H_2O at a flowrate of 30 SCFH.

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 39-1

Rotary Gas Meter and Air To Liquid Adaptor



5.3 Rotary 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 rotary gas meter. This manifold shall be not less than two (2.0) inches nominal inside diameter. The intake passage of the manifold shall be no shorter than 6.0 inches and no longer than 18.0 inches. See Figure 39-1 for example.

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

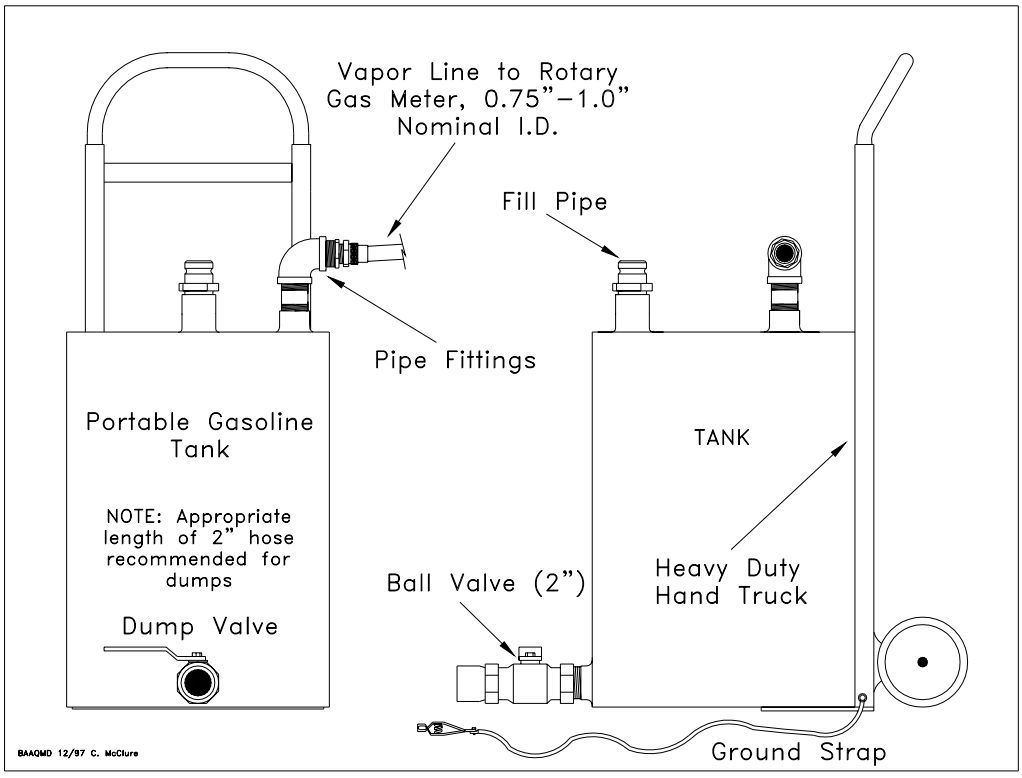
5.5 Portable Gasoline Tank Assembly. A portable tank, acceptable for use with gasoline, shall be used to receive the gasoline dispensed during this test. The tank shall have sufficient volume so that at least 4.5 gallons may be dispensed prior to activating the primary shutoff mechanism of the dispensing nozzle. Tank material, likely to provide contact with the nozzle spout 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 Figures 39-2 and Figure 39-3. 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 39-2 and Figure 39-3 shall be adhered to in all cases.

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

Figure 39-2

Portable Tank Assembly



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), When this procedure is used to determine the compliance of an installed system, 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.

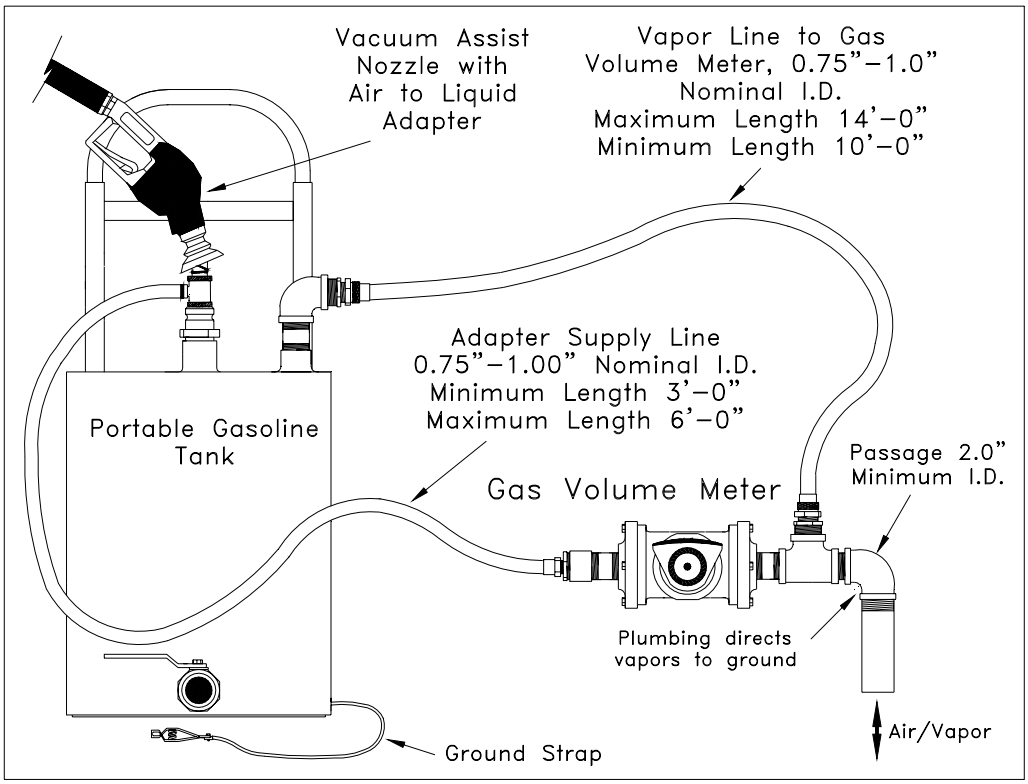
6. PRE-TEST PROCEDURES

6.1 Assemble the portable tank assembly and rotary gas meter as shown in Figure 39-3. The minimum and maximum dimensions shown in Figure 39-3 shall be

adhered to in all cases. **Ensure that the ground strap is properly connected to an acceptable ground**. The tank shall only be used when it is on the ground, not in the back of a pickup or trailer.

Figure 39-3

Assembled Air To Liquid Volume Ratio Test Equipment



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 rotary gas meter shall be calibrated, within 180 days prior to conducting this procedure, 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, January 1979, or

(b) US EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods, or

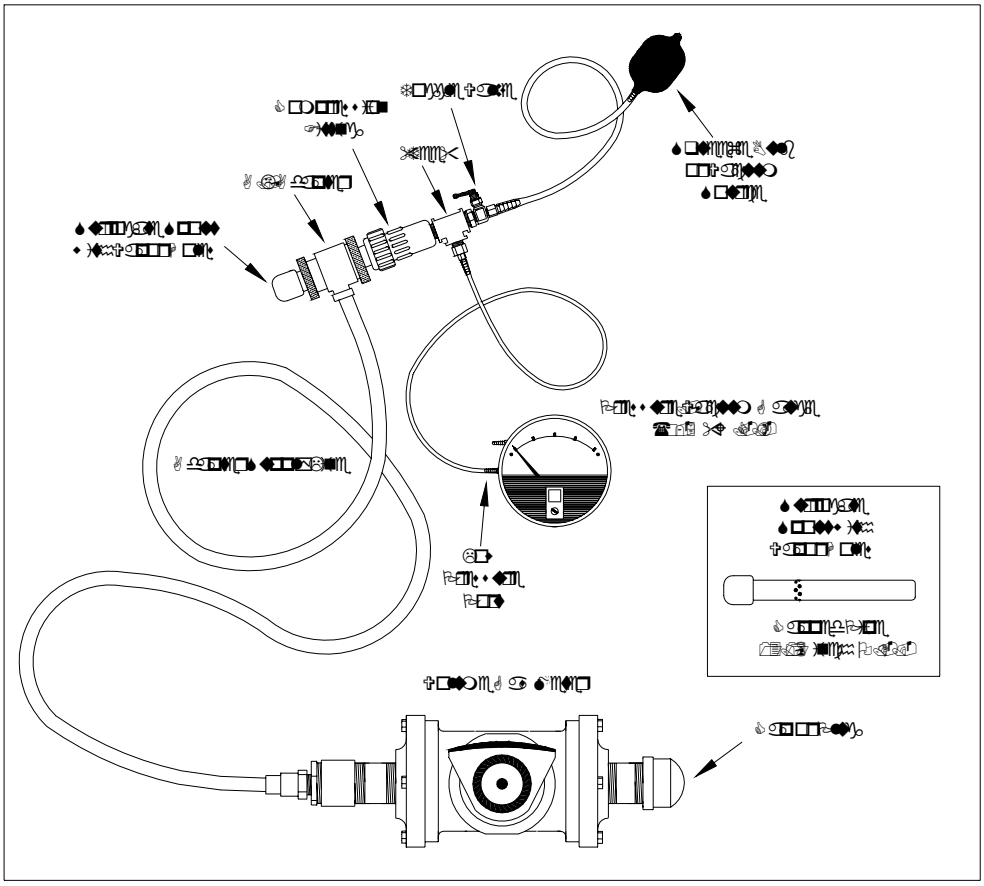
(c) EPA Method 2A, Measurement of Gas Volume Through Pipes and Small Ducts (40 CFR Part 60, Appendix A), or

(d) Appropriate calibration procedures in accordance with California Department of Food and Agriculture, Division of Measurement Standards and County Department of Weights and Measures (title 4, CCR, section 3.33).

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

Figure 39-4

Air To Liquid Adapter Leak Test Assembly



6.4 A one-time test to verify proper design of the tee connection at the rotary gas meter shall be conducted. Disconnect the A/L adaptor from the nozzle and dispense four and one half (4.5 ± 0.3) 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 rotary gas 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. Refer to the A/L adaptor manufacturer's instructions for

recommendations. If the O-rings are lubricated before each test, the chance of an improper seal between the nozzle spout and the A/L adaptor is reduced.

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 39-4. 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.

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

6.8 Determine whether the processor, if applicable, should remain in operation during the test or be turned off by reviewing the applicable certification EO.

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. TESTING

7.1 Carefully connect the A/L adaptor to the nozzle spout as shown in Figure 39-1, isolating the vapor ports of the nozzle and insuring a tight connection.

7.2 Record the initial reading from the index of the rotary gas meter on the A/L Field Data Summary, as shown in Form 39-1. 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.

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 39-1:

7.7.1 Dispenser (pump) number
7.7.2 Gas grade
7.7.3 Nozzle model and serial number
7.7.4 Initial rotary gas meter reading, in cubic feet
7.7.5 Initial totalizer reading from the dispenser, in gallons
7.7.6 Final rotary gas 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 difference between the **minimum or maximum allowable** A/L Volumetric Ratio specified in the CARB EO and the A/L Volumetric Ratio, as determined by Equation 9-1, is **greater than 0.10**, the refueling point does not comply with the specifications of the applicable CARB EO.

If the difference between the minimum or maximum allowable A/L Volumetric Ratio specified in the CARB EO and the A/L Volumetric Ratio, as determined by Equation 9-1, is 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. If the A/L test equipment is adjusted, then the prior test run results for that nozzle should not be used. 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.

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 rotary gas meter and portable tank assembly, and
(b) the A/L adaptor and rotary gas 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. **Ensure that the ground strap is properly connected to an acceptable ground.** 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 an underground tank, product from the blended grade shall be returned to the lower octane tank.

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 39-4. 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 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 after the last A/L test run is completed. 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.

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

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

9. CALCULATION

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

$$A/L = \left[\frac{V_f - V_i}{G_f - G_i}\right] \times 7.481 \quad \text{[Equation 9-1]}$$

Where:

A/L = Air to Liquid Volumetric Ratio, dimensionless
V_i = Initial rotary gas meter reading, cubic feet
V_f = Final rotary gas 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.

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

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

10. REPORTING

10.1 The results of the A/L Volumetric Ratio test shall be reported as shown in Form 39-2. Results submitted for District approval shall also include the A/L Field Data Summary as shown in Form 39-1.

Form 39-1

GDF Name and Address	**A/L Field Data Sheet**	Testing Firm Name and Address:
_____ _____ _____	**BAY AREA** **AIR QUALITY MANAGEMENT DISTRICT** *939 Ellis Street* *San Francisco, California 94109* *(415) 771-6000*	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 #** _____ **A/C #** _____	VN Recommendation:

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

Form 39-2

Distribution:	**BAY AREA AIR QUALITY MANAGEMENT DISTRICT**	**Report No.:**
Firm Permit Services Enforcement Services Technical Services Planning Requester DAPCO	*939 Ellis Street* *San Francisco, California 94109* *(415) 771-6000* **Summary of Source Test Results**	**Test Date:** **Test Times:** **Run A:** **Run B:** **Run C:**

Source Information		**BAAQMD Representatives**
Firm Name and Address	Firm Representative and Title Phone No. ( )	Source Test Engineers
Permit Conditions:	Source: Plant No. Permit No. Operates	Permit Services Division/Enforcement Division Test Requested By:
Operating Parameters:		
Applicable Regulations:		**VN Recommended:**

Source Test Procedure ST-39, Air to Liquid Volumetric Ratio, Test Results and Comments:

Nozzle #	Gas Grade	Nozzle Model	Gallons Dispensed	Dispensing Rate, gpm	Metered Volume, cf	A/L	Pass/ Fail
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

Comments:

Air Quality Engineer II Date	Supervising Air Quality Engineer Date	Approved by Air Quality Engineering Manager