California Environmental Protection Agency

Air Resources Board

Vapor Recovery Test Procedures

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: _____

Note: This document consists of the text of the proposed amendment to TP-201.5. All text is new text. The current TP-201.5 will be replaced with this procedure.

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DETERMINATION (BY VOLUME METER) OF AIR TO LIQUID VOLUME RATIO OF VAPOR RECOVERY SYSTEMS OF DISPENSING FACILITIES

1 APPLICABILITY

This 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

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.

3 DEFINITIONS

Definitions common to all certification and test procedures are in ARB vapor recovery test method:

D-200: Definitions for Certification Procedures and Test Procedures for Vapor Recovery Systems

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

4 BIASES AND INTERFERENCES

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

4.2 Dispensing rates below the minimum rates 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 vapor portion of the test equipment, the A/L of that nozzle shall be deemed a failure.

5 SAFETY

Gasoline is a flammable liquid. Gasoline and other petroleum products are known to the State of California to contain hazardous chemicals, such as benzene, that can cause immediate (acute) and delayed (chronic) injury, including cancer. Gasoline as a liquid, vapor, fume, or spray mist can be injurious to eyes, skin, nervous system, and lungs.

Testers at gasoline dispensing facilities should remain alert for traffic hazards. Traffic cones are recommended around the perimeter of the work area.

6 SENSITIVITY, RANGE, AND PRECISION

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

6.2 The minimum rated capacity of the gas volume meter shall be 25 CFH or less.

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

6.4 Precision is +/- 5 percent of the volume meter reading.

7 EQUIPMENT

(Use of trade or manufacturer's names is neither a recommendation nor endorsement by the ARB. The use of such names are examples of equipment that should meet or exceed the required specifications.)

7.1 Air to Liquid Adaptor

Figure 1 illustrates an A/L adaptor assembled on a nozzle.

a) Use an Air to Liquid (A/L) adaptor compatible with the nozzle(s) to be tested. If CARB specifies certain adaptors in the applicable CARB EO, only those adaptors shall be used.

b) The adaptor shall be capable of isolating the vapor holes in the nozzle and be connected to the gas volume meter with flexible tubing.

7.2 Adaptor Supply Line (connecting A/L adaptor to volume meter)

a) Minimum inside diameter of supply line tubing or hose shall be 1 inch.

b) Minimum inside diameter of any connector shall be 3/4 inch.

c) Maximum length of supply line including connectors shall be 5 feet.

d) Tubing or hose shall be of a flexible material not affected by gasoline vapors. Connectors may be rigid but must also be of a material not affected by gasoline vapors.

7.3 Gas Volume Meter

Use a Dresser Measurement Roots Meter, or equivalent, to measure the volumetric flow rate through the A/L adaptor. The meter shall be equipped as shown in Figure 1.

7.3.1 The meter shall be accurate to within 5% and readable to 0.01 cubic feet over the range of 25 CFH through 250 CFH.

7.3.2 The maximum allowable pressure drop(s) across the meter shall be as follows:

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

1.10 inches H_2O at a flow rate of 3,000 CFH

0.05 inches H_2O at a flow rate of 30 CFH.

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

0.70 inches H_2O at a flow rate of 800 CFH
0.04 inches H_2O at a flow rate of 16 CFH

7.4 Volume Meter Supply Piping

Supplies makeup air for volume meter inlet and allows excess vapors from portable gasoline tank to vent. See Figure 1 or 3 for piping configuration.

a) Use 2 inch pipe.

b) "Inlet" end should point down unless inlet is within 18" of ground.

c) This section does not pertain to vapor return line from portable gasoline tank to upstream of volume meter.

7.5 Vapor Return Line (from portable gasoline tank to volume meter supply piping)

See Figure 1 and 3 for configuration.

a) 1 inch internal diameter flexible hose or tubing.

b) 14 foot maximum length and 10 foot minimum length.

c) 3/4 inch internal diameter for any connections associated with vapor return line.

d) Line material shall be of a flexible material not affected by gasoline vapors.

7.6 Portable Gasoline Tank Assembly

A portable tank, acceptable for use with gasoline, shall be used to receive the gasoline dispensed during this test. See Figure 2 or 3 for an example of the tank configuration.

a) Tank volume shall be sufficient to dispense at least 4.5 gallons without activating the nozzle shutoff mechanism.

b) Tank shall have vent that can be plumbed to volume meter supply piping.

7.6.1 Tank fill pipe portion in contact with nozzle or A/L adaptor shall be constructed of aluminum, brass, or other materials approved by local fire codes for gasoline fill pipes.

7.6.2 2 inch drain valve is recommended. A plug for the drain valve is also recommended in

case the valve leaks or fails.

7.7 Liquid Volume Meter

Use the totalizer on the gasoline dispenser to measure the volume of gasoline dispensed during the test.

7.8 Stopwatch

Use a stopwatch accurate to within 0.2 seconds.

7.9 Lubricant

a) Appropriate grease lubricant for A/L adaptor and compression fitting gasket. Or

b) Spray lubricant applied to the nozzle spout tip.

7.10 Leak Check Equipment for A/L Adaptor and Volume Meter Assembly

See Figure 4 for an example of leak check equipment and A/L adaptor and volume meter assembly.

a) Use a compression fitting (fits ½" pipe).

b) ½ inch "T" fitting.

c) Squeeze bulb or hand pump.

d) Check valve (toggle valve) to isolate pump from leak check.

e) Flexible tubing.

f) Pressure/vacuum meter capable of measuring 0-5.0" water column or higher in 0.1 increments to measure vacuum, pressure, and leak rate.

g) Surrogate Vapor Spout with vapor holes for A/L adaptor.

Use a capped piece of 13/16 (±1/16) inch outside diameter (O. D.) rigid tubing (½ inch pipe) **with** vapor hole(s) to simulate a vacuum assist nozzle spout. A/L adaptor must be able to cover "vapor holes".

h) Surrogate Blank Spout without vapor holes.

Use a capped piece of 13/16 (±1/16) inch outside diameter (O. D.) rigid tubing (½ inch pipe) **without** vapor hole(s) to simulate a vacuum assist nozzle spout. This spout

is used to verify there are no leaks in the Leak Check Assembly.

8 CALIBRATIONS

8.1 Gas Volume Meter

Gas volume meters shall be calibrated in accordance with "ARB Air Monitoring Quality Assurance, Volume VI, Standard Operating Procedures for Stationary Source Emission Monitoring" or "US EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods." See Section 15 of this method for using alternate methods, subject to approval by the ARB Executive Officer.

8.1.1 Calibrations should be performed by people experienced in NIST-traceable calibrations of volume meters against NIST-traceable wet test meters or Bell-type spirometers.

8.1.2 All calibrations shall include 5 flowrates over the range between 25 CFH and 250 CFH; such as 25, 60, 100, 150, and 250 CFH.

8.1.3 A copy of the current NIST-traceable calibration shall be kept with the volume meter or with nearby support equipment (within 5 minutes of the meter) such as the volume meter carrying case or support vehicle.

8.1.4 Initial Calibration

Initial NIST-traceable volume meter calibrations shall be performed prior to service and after any repairs or alterations to the volume meter.

8.1.5 Annual Calibrations

After any initial calibration, NIST-traceable volume meter calibrations shall be performed within 1 year and may be conducted more frequently.

9 PRE-TEST PROCEDURES

9.1 Assemble A/L Adaptor and Volume Gas Meter Assembly including A/L adaptor, gas volume meter, connections between gas volume meter, and A/L adaptor. See Figures 1, 3, or 4.

9.2 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 or nozzle spout shall be properly lubricated to ensure a vapor

tight connection.

9.3 Pre-Test Leak Check

See Figure 4 for configuration. Repeat whenever A/L adaptor is disconnected from gas volume meter.

9.3.1 Assemble Leak Check Assembly including handpump, valve, compression fitting, pressure/vacuum meter, and connecting tubing.

9.3.2 Close off inlet to volume meter with plug, cap or other device needed to make the A/L Adaptor and Volume Gas Meter Assembly leak tight. (A/L adaptor is connected to the outlet or downstream side of the gas volume meter.).

9.3.3 Place A/L adaptor on Surrogate Vapor Spout and place the Surrogate Vapor Spout in the Leak Check Assembly compression fitting.

9.3.4 Evacuate Leak Check Assembly and A/L Adaptor and Volume Gas Meter Assembly until vacuum meter reads 4.5 inches or more.

9.3.5 Hold for 1 minute and observe vacuum meter.

9.3.6 If vacuum degrades 0.1 inch or more in 1 minute, equipment leaks. Reposition or replace equipment and repeat leak check until equipment passes. Reverse pump, pressurize equipment, and use soap solution as necessary to locate leaks.

9.3.7 Record the leak check results on the A/L Field Data Sheet. See Figure 5 for an example.

9.4 Assemble the portable tank assembly and gas volume meter. See Figure 3. **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 unless the pickup or trailer is properly grounded.

9.5 Check for forced movement of volume gas meter by portable tank vapor return. This is once-per-assembly test to verify proper design of the tee connection at the gas volume meter.

9.5.1 Disconnect the A/L adaptor from the nozzle.

9.5.2 Dispense four and one half (4.5 ± 0.3) gallons into the portable gasoline tank.

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

9.6 Condition A/L Tank and Equipment Assembly

9.6.1 Assemble portable tank and A/L test equipment as if conducting actual test. See Figure 3.

9.6.2 Dispense 4.5 gallons into portable tank.

9.6.3 This is required once per assembly. Fresh air drawn into portable gasoline tank when emptying tank will be saturated by the wetted surface of tank.

9.7 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.

10 TEST PROCEDURE

Always ground equipment before starting this procedure.

10.1 Carefully connect the A/L adaptor to the nozzle spout as shown in Figure 1 or 3, isolating the vapor ports of the nozzle and insuring a tight connection.

10.2 Record the initial reading from the gas volume meter on the A/L Field Data Sheet, as shown in Figure 5. 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.

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

10.4 Begin dispensing gasoline 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.

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

If the nozzle being tested introduces liquid into the vapor side of the test equipment during dispensing, that nozzle shall be deemed a failure.

10.6 Simultaneously stop both the stopwatch and gasoline dispensing.

10.7 The following data for each nozzle test shall be recorded on the A/L Field Data Sheet as

shown in Figure 5:

10.7.1 Dispenser (pump) number

10.7.2 Gas grade

10.7.3 Nozzle model and serial number

10.7.4 Initial gas volume meter reading, in cubic feet

10.7.5 Initial totalizer reading from the dispenser, in gallons

10.7.6 Final gas volume meter reading, in cubic feet

10.7.7 Final totalizer reading from the dispenser, in gallons

10.7.8 Elapsed time during dispensing, in seconds

Note: Units other than cubic feet, gallons, and seconds may be used, provided that Equation 13-1 is appropriately modified.

10.8 If the A/L Volumetric Ratio, as determined by Equation 13-1 is within the limits specified in the applicable ARB EO, the refueling point complies with the specifications of the applicable EO.

10.8.1 If the A/L Volumetric Ratio, as determined Equation 13-1, is outside the range between the **minimum and maximum allowable** A/L Volumetric Ratio specified in the ARB EO **by more than 0.10**, the refueling point does not comply with the specifications of the applicable ARB EO.

10.8.2 If the A/L volumetric ratio (Eq. 13-1), is outside the range between the minimum and maximum allowable A/L volumetric ratio specified in the ARB EO by less than or equal to 0.10, conduct the test two additional times.

a) Calculate the numerical average of the three test runs.

b) If the average A/L value of these three test runs is within the allowable limits, compliance has been verified.

c) If the resulting average is outside of the specified limits, the refueling point does not comply with the specifications of the applicable ARB EO.

10.9 Troubleshooting Low A/L Ratio (optional)

If more than one nozzle shares 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.**

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

10.11 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.

10.13 Post-Test Procedures

10.13.1 Remove the A/L adaptor from the nozzle.

10.13.2 Drain the dispensed product into the appropriate gasoline storage tank at the facility. 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. **Ground tank to storage tank before draining.**

10.13.4 Prior to disassembling test equipment, perform post-test leak check by repeating pre-test leak check procedures (Section 9.3). If equipment fails post-test leak check, all data collected since the last acceptable leak check is null and void.

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

10.13.6 The portable tank shall be transported in accordance with all applicable safety requirements.

11 QUALITY ASSURANCE / QUALITY CONTROL (QA/QC)

11.1 Calibrate volume meters in accordance with Chapter 8 of this method.

11.2 Perform pre-test leak check and other procedures in accordance with Chapter 9 of this method.

11.3 Perform post-test leak check in accordance with Section 10.13 of this method.

12 RECORDING DATA

Record the following data. See Figure 5 for an example of an A/L Field Data Sheet.

12.1 Gas Station name and address.

12.2 Testing Firm name, address, phone number and tester's name(s).

12.3 Test date and times.

12.4 Applicable ARB Executive Order Number(s) and acceptable A/L range.

12.5 Dispenser (pump) number.

12.6 Gas grade.

12.7 Nozzle model and serial number.

12.8 Initial gas volume meter reading, in cubic feet.

12.9 Initial totalizer reading from the dispenser, in gallons

12.10 Final gas volume meter reading, in cubic feet

12.12 Final totalizer reading from the dispenser, in gallons

12.13 Elapsed time during dispensing, in seconds

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12.14 Any violations.

13 CALCULATING RESULTS

13.1 The A/L Volumetric Ratio shall be calculated as shown in Equation 13-1.

$$A/L = \frac{y(V_f - V_i)\,7.481}{(G_f - G_i)} \qquad \text{Equation 13-1}$$

Where:

A/L	=	Air to Liquid Volumetric Ratio, dimensionless or gallons/gallons
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

y = Correction factor for volume gas meter. See Equation 13-3.

13.2 The gasoline dispensing rate during the A/L test shall be calculated as shown in Equation 13-2.

$$Q_g = \frac{(G_f - G_i)\,60}{t} \quad 2 \qquad \text{Equation 13-}$$

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

13.3 The correction factor for correcting observed values of the volume meter shall be calculated as shown in Equation 13-3.

$$y = \frac{V_r}{V_m} \qquad \text{Equation 13-3}$$

Where:

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

14 REPORTING

14.1 The results of the A/L Volumetric Ratio test submitted to the local District, or their designated representative, as shown in Figure 5 or other format acceptable.

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.

15.1 Such approval may be granted on a case-by-case basis only. Because of the evolving nature of technology and procedures for vapor recovery systems, such approval may or may not be granted in subsequent cases without a new request for approval and a new demonstration of equivalency. Approvals may also require acceptance by local jurisdictions (local APCD or AQMD).

15.2 Documentation of any such approvals and demonstrations may be maintained in the ARB Executive Officer's files and available upon request. The tester should also maintain a file of any such approvals and acceptances, and make them available, as necessary, in any affected test report.

15.3 The tester shall maintain a file of any such approvals and acceptances, and make them available, as necessary, in any affected test report and upon request.

16 REFERENCES

This method was developed from Bay Area Air Quality Management District method ST-39 with the help of testing staffs with Bay Area Air Quality Management District, San Diego County Air Pollution Control District, and Air Resource Board Compliance and Monitoring and Laboratory Divisions.

17 FIGURES

17.1 Figure 1 - Volume Gas Meter and Air to Liquid Adaptor

17.2 Figure 2 - Portable Tank Assembly

17.3 Figure 3 - Assembled Air to Liquid Volume Ratio Test Equipment

17.4 Figure 4 - A/L Adaptor and Volume Meter Leak Check Assembly

17.5 Figure 5 - A/L Field Data Sheet

Figure 1
Volume Gas Meter and Air To Liquid Adapter

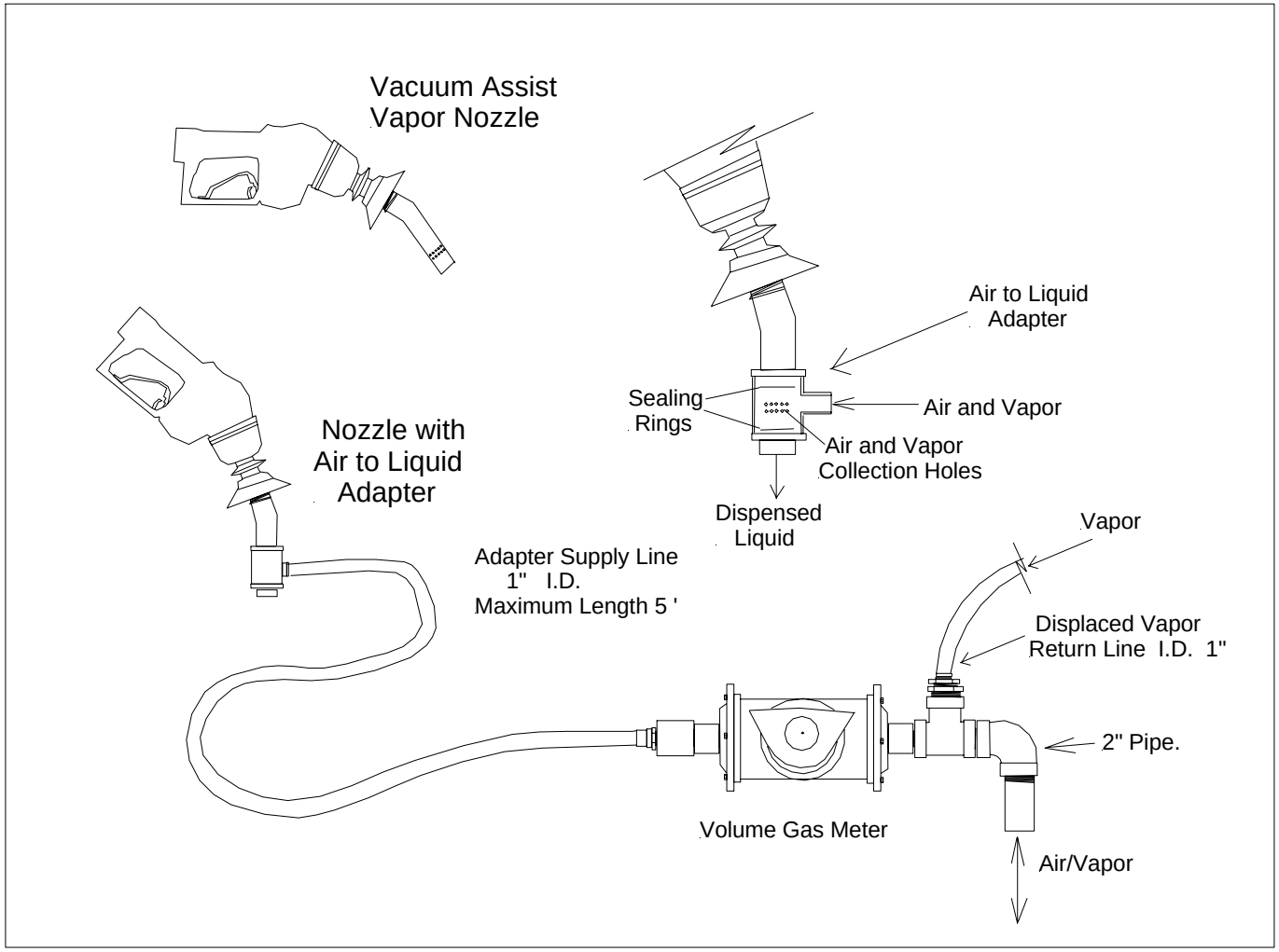

Figure 2
Portable Tank Assembly

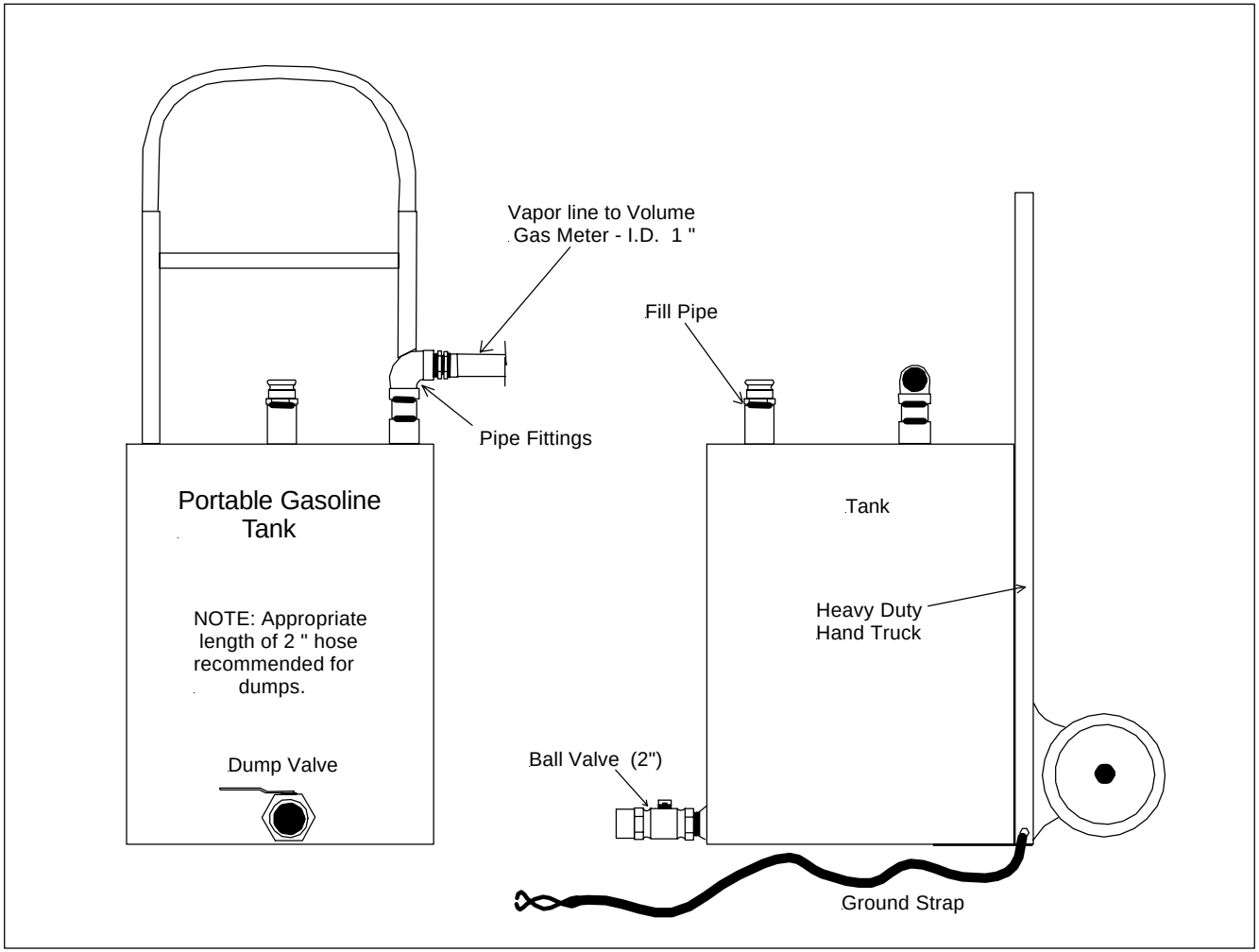

Figure 3

Assembled Air To Liquid Volume Ratio Test Equipment

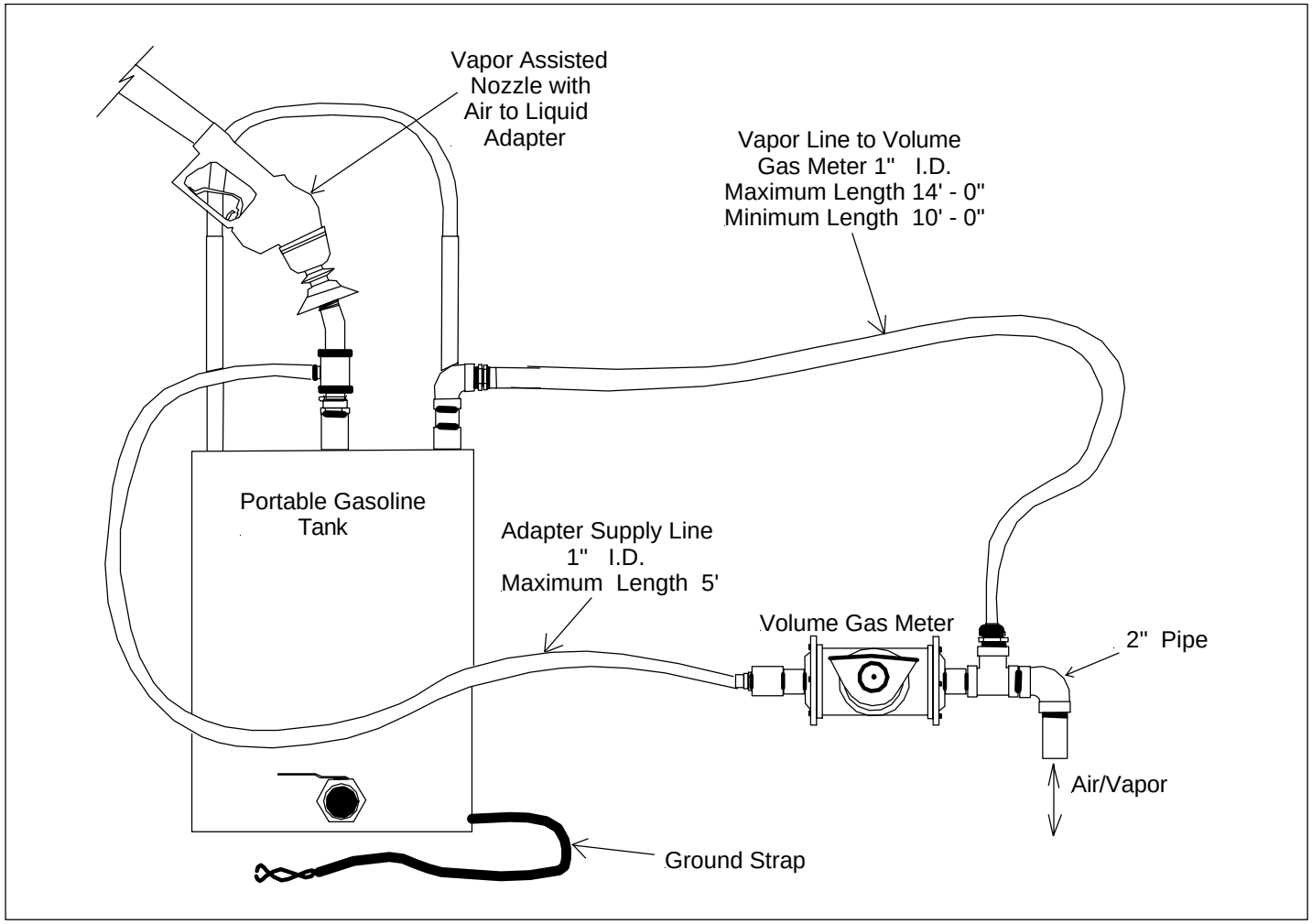

Figure 4

Example of A/L and Volume Gas Meter Assembly Leak Check

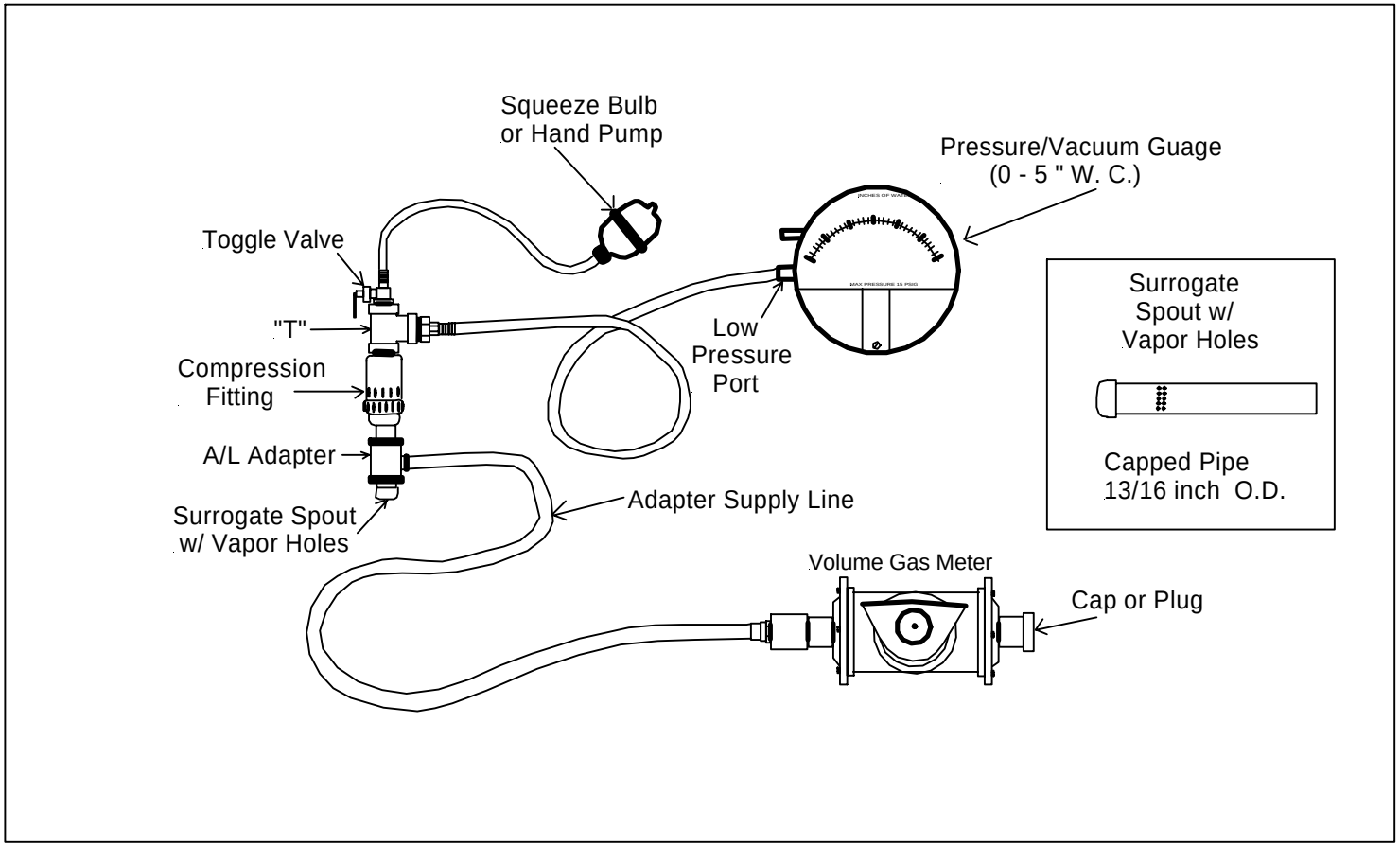

Figure 5

Station 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** **Station #** ______________ **Permit #** ______________	Violation? Y/N Applicable CARB EO#: __________ A/L Range: __________________

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