Division 244
Approved Test Methods

California Environmental Protection Agency

Air Resources Board

Vapor Recovery Test Procedure

TP- 201.5

Air to Liquid Volume Ratio

Adopted: April 12, 1996
Amended: February 1, 2001

California Environmental Protection Agency
Air Resources Board

Vapor Recovery Test Procedure

TP-201.5

Air to Liquid Volume Ratio

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 are compatible with the procedure. 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 volume gas meter. 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 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 Executive Order, preclude the use of this test for determining in-use compliance of certified systems.

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 of the A/L standard.

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

3.8 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.

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.

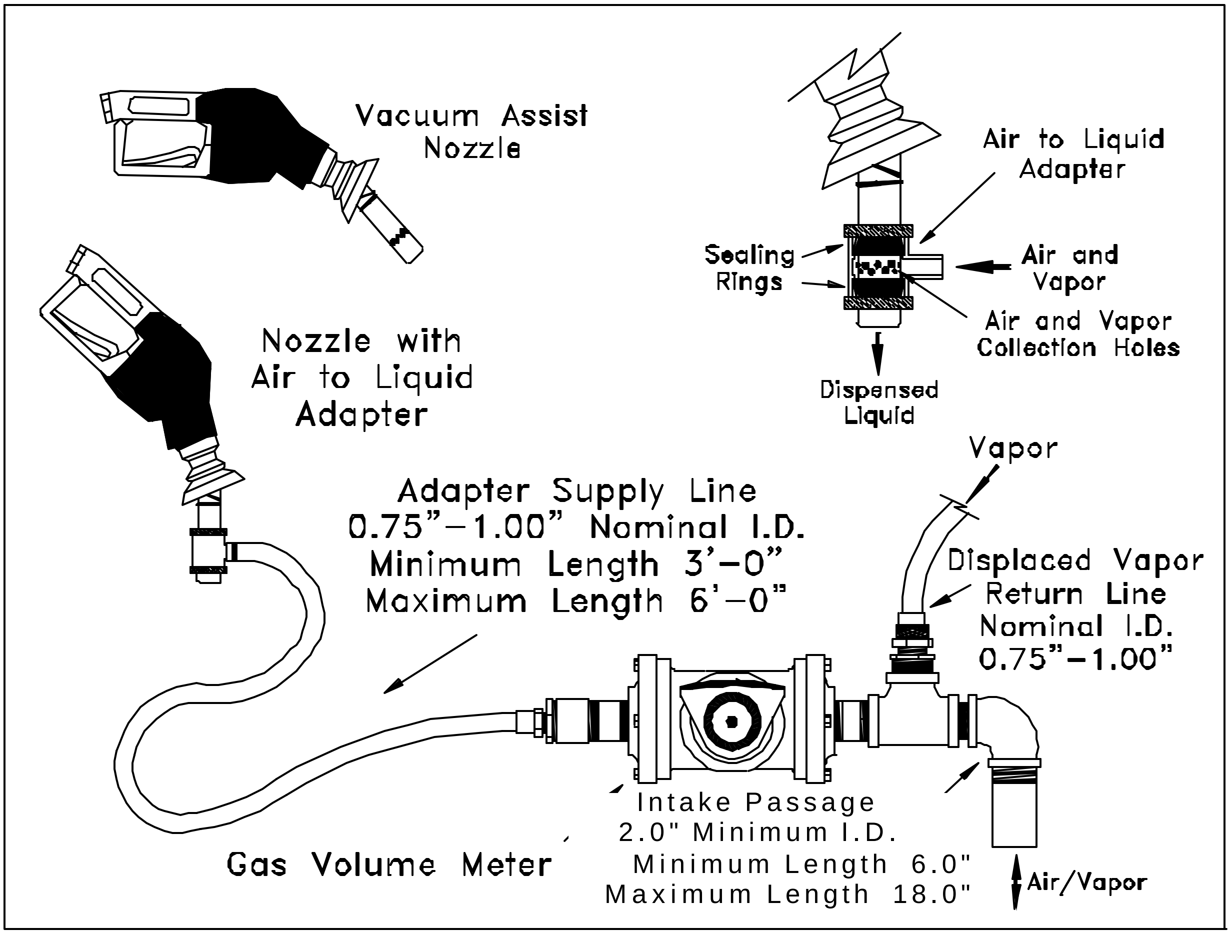
4.3 The minimum readability of the gas volume meter shall be 0.01 cubic feet.

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

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 6 feet. Figure 1 illustrates an A/L adaptor assembled on a nozzle. If the Executive Officer or the applicable CARB Executive Order specifies certain adaptors, only those adaptors shall be used.

Figure 1
Gas Volume Meter and Air To Liquid Adaptor

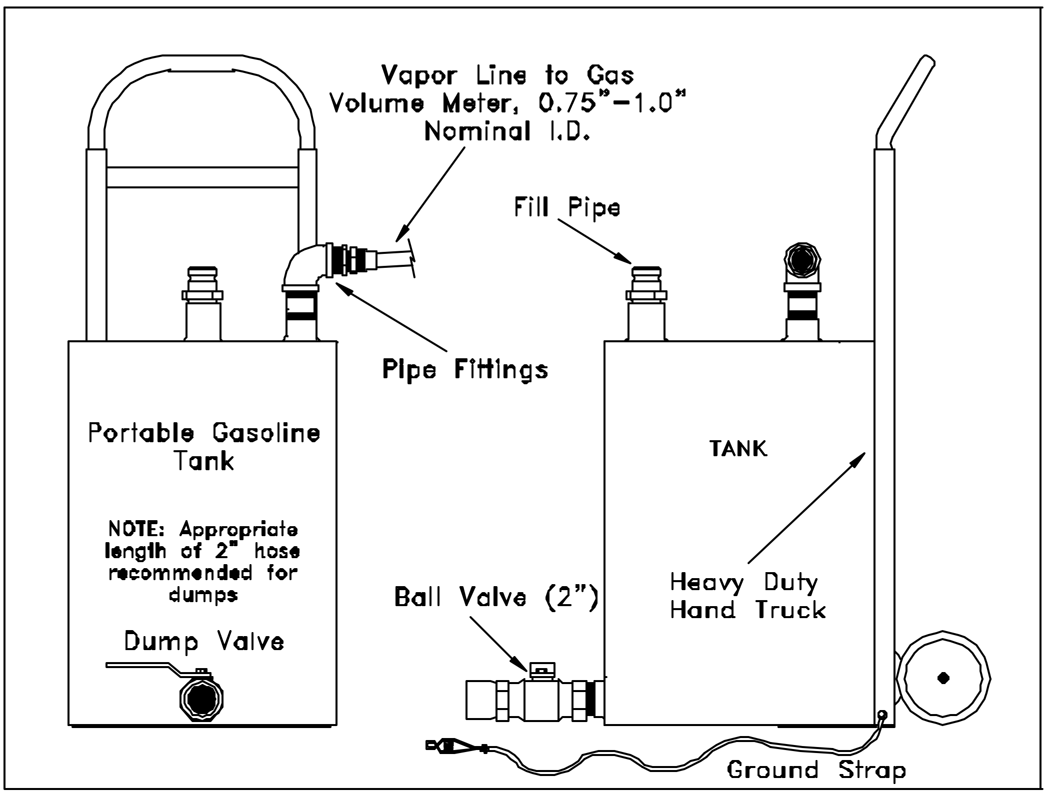


5.2 Gas Volume Meter. Use a Dresser Measurement Roots Meter®, or equivalent, to measure the volumetric flowrate through the A/L adaptor. The meter shall be equipped as shown in Figure 1 and the maximum allowable pressure drop(s) across the meter shall be as follows:

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 minimum inside diameter pipe. The intake passage of the manifold shall be no shorter than 6.0 inches and no longer than 18.0 inches. See Figures 1 and 3 for examples.

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, meeting fire safety requirements 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 required 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). 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 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, January 1979, or

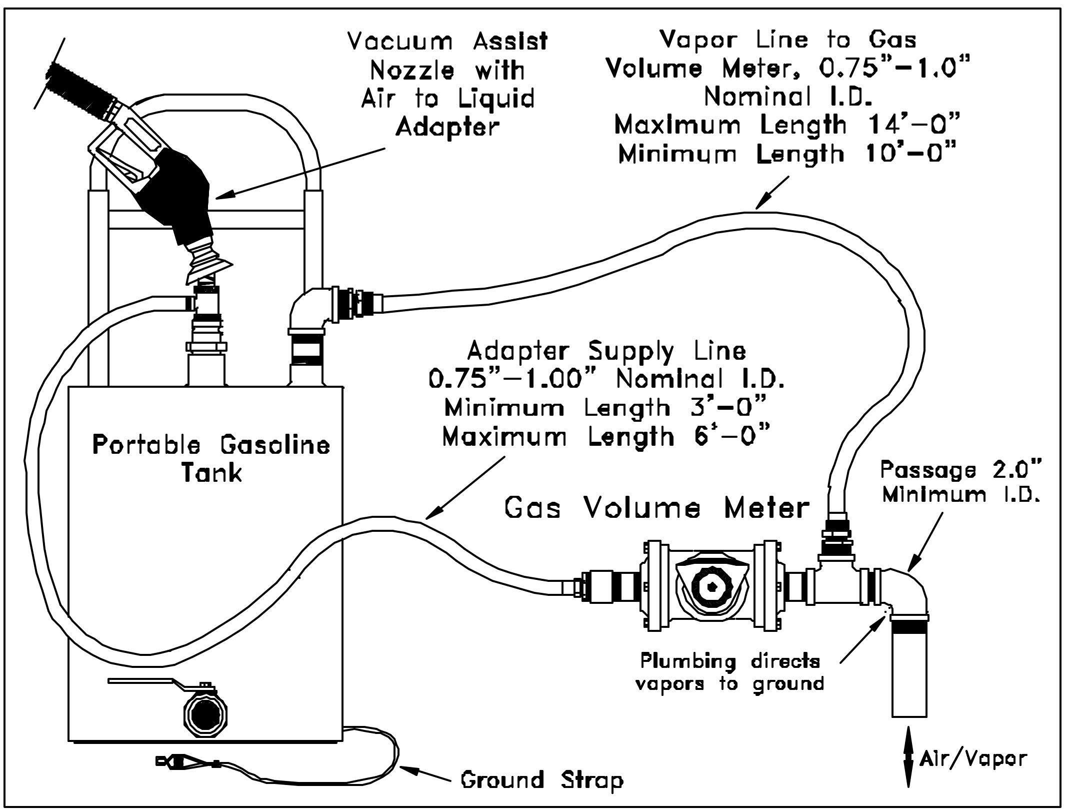
(b) US EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods, or

(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).

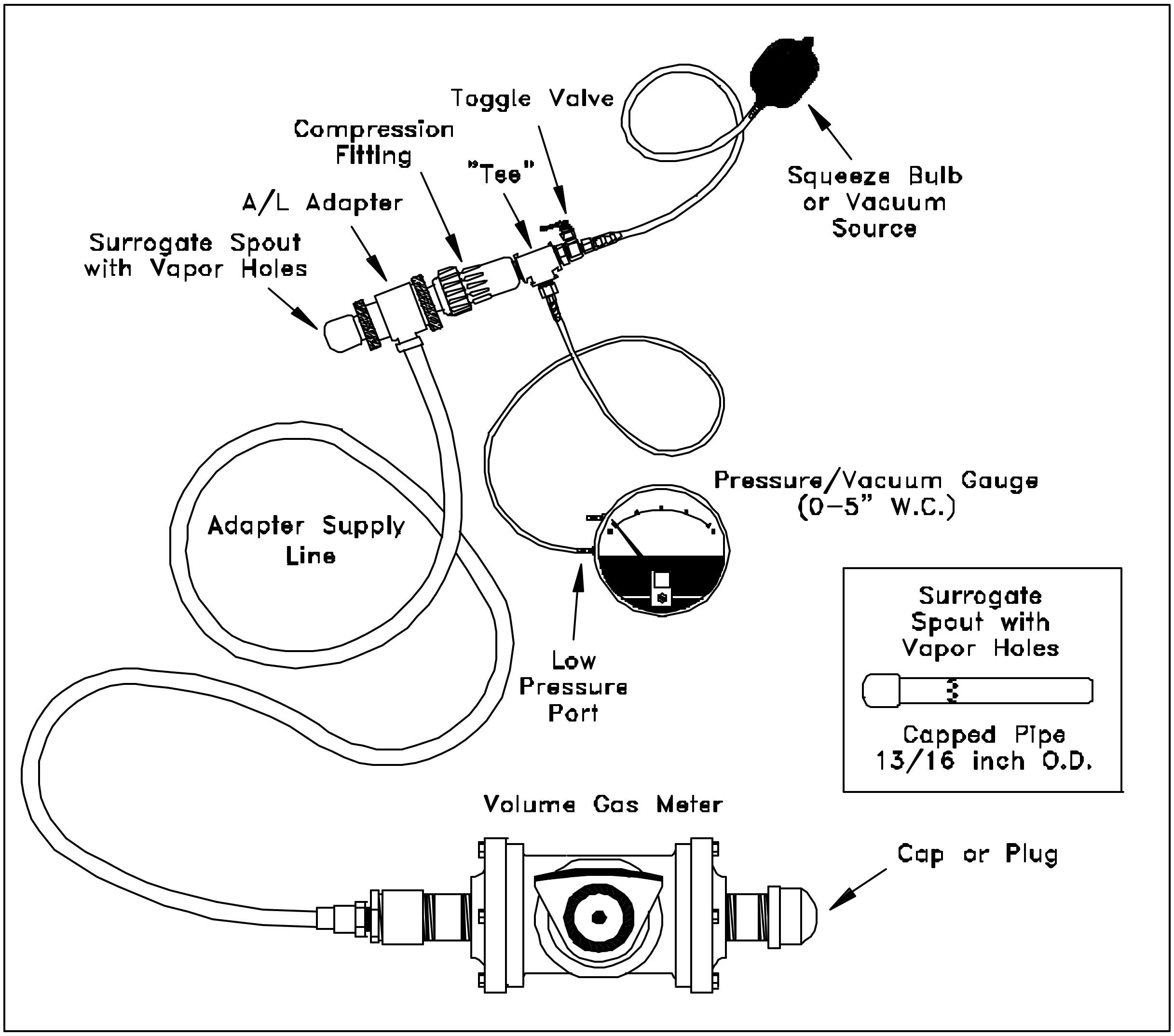
A copy of the most current calibration shall be kept with the meter.

Figure 3
Assembled Air To Liquid Volume Ratio Test Equipment



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.

Figure 4
Air To Liquid Adapter Leak Test Assembly



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 4. Induce a vacuum of five inches H_2O, gauge (5.00”WCg). Start the stopwatch. The vacuum shall be at least 4.95 “WCg after three minutes from the start of the leak check. Any test equipment 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 by the Executive Officer or 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. For compliance testing review 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. 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.

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.

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
7.72 Gas grade
7.73 Nozzle model and serial number
7.74 Initial gas volume meter reading, in cubic feet
7.75 Initial totalizer reading from the dispenser, in gallons
7.76 Final gas volume meter reading, in cubic feet
7.77 Final totalizer reading from the dispenser, in gallons
7.78 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.

For certification testing, the test data are used to determine the A/L Volumetric Ratio that will be specified in the CARB EO. For compliance testing, continue as described below.

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 an A/L value of 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.

If the A/L Volumetric Ratio is outside the range specified in the applicable CARB EO by an A/L value of 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 To avoid a build-up of gasoline, drain any condensed gasoline, periodically or after each test run, 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 without approval of the facility owner 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 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.

8.3 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 test equipment 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.

$$A/L = \left[\frac{y(Vf - Vi)}{G_f - G_i}\right] \times 7. \qquad \textbf{[Equation 9-1]}$$

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.

11. ALTERNATE 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 ARB Executive Officer, pursuant to Section 14 of Certification Procedure CP-201.

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, Gallons	Final Totalizer, Gallons	Gas Pumped, Gallons	Time, Seconds	Dispensing Rate, Gpm	Starting Meter Reading	Ending Meter Reading	A/L

California Environmental Protection Agency

Air Resources Board

Vapor Recovery Test Procedure

TP-201.1B

Static Torque of Rotatable Phase I Adaptors

Adopted: July 3, 2002
Amended: October 8, 2003

California Environmental Protection Agency
Air Resources Board

Vapor Recovery Test Procedure

TP-201.1B

Static Torque of Rotatable Phase I Adaptors

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 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

The purpose of this procedure is to quantify the amount of static torque required to start the movement of a rotatable Phase I adaptor and to ensure 360-degree rotation. This procedure determines compliance with the performance specifications set forth in Section 3 of CP-201 Vapor Recovery Certification Procedure.

2. PRINCIPLE AND SUMMARY OF TEST PROCEDURE

A compatible dust cap is installed on a rotatable Phase I adaptor. A Torque Test Tool is installed on the dust cap. A socket wrench is installed on the Torque Test Tool and 360-degree rotation is verified. Following the rotation test, a torque wrench is installed on the Torque Test Tool and three static torque measurements are taken. If the resulting, average static torque is less than, or equal to, the maximum allowable value specified in Certification Procedure 201 (CP-201), the adaptor is verified to be in compliance.

3. BIASES AND INTERFERENCES

3.1 Missing or defective gaskets in the dust cap may bias the results towards compliance as a dust cap may slip on the rotatable adaptor prior to the adaptor rotating. This bias is eliminated by ensuring that the dust cap seal is securely in place and does not show signs of excessive wear or damage.

3.2 Gasoline or other lubricants on the sealing surface of the rotatable adaptor or the dust cap seal can cause the dust cap to slip and may bias the results towards compliance. This bias is eliminated by ensuring that the sealing surface of the rotatable adaptor and dust cap is clean, dry and free of lubricants.

4. SENSITIVITY, RANGE, AND PRECISION

4.1 Torque Wrench. The maximum full-scale range shall be 250 pound-inches with minimum accuracy of 3.0 percent full-scale and minimum readability of 5 pound-inch increments. The torque wrench shall incorporate a mechanism, such as a tell-tale needle that identifies the maximum applied torque during each measurement.

5. EQUIPMENT

5.1 Torque Wrench. Use a Snap-On® Model TER12FUA Torque Wrench, or equivalent, to measure the static torque of the rotatable adaptor.

5.2 Static Torque Test Assembly. Use a compatible dust cap and rotatable adaptor Torque Test Tool, Phil-Tite® Part Number 6004, or equivalent. A depiction of a Torque Test Tool is shown in Figure 1. An example of a Static Torque Test Assembly is shown in Figure 2.

5.3 Socket wrench and socket extension. Use a $^3/_8$ inch or ½ inch socket wrench, adaptors and socket extension (if needed) to verify 360-degree rotation or to conduct static torque testing. The socket extension shall not exceed 12 inches in length.

Figure 1
Phil-Tite® Torque Test Tool

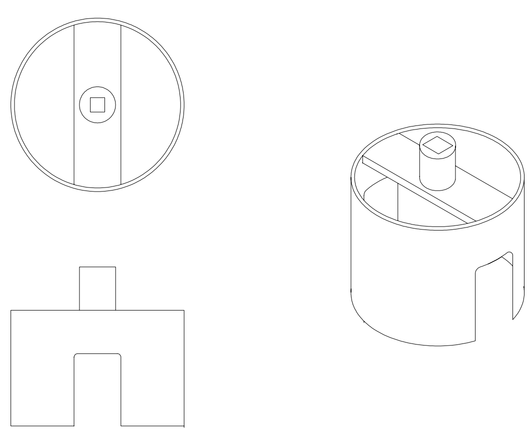
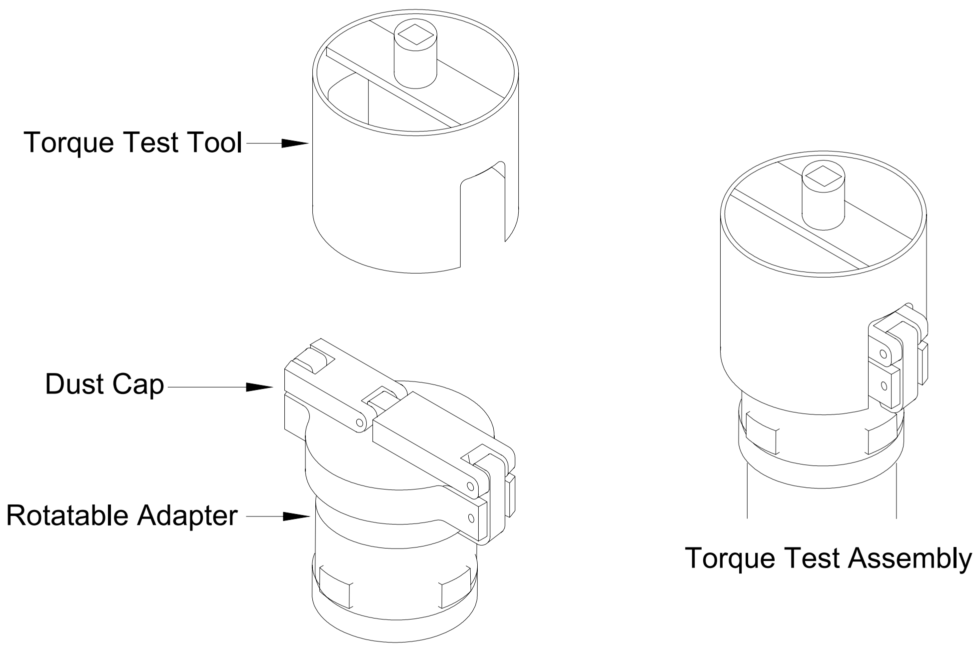


Figure 2
Static Torque Test Assembly



6. PRE-TEST PROCEDURES

6.1 Remove the lids of the Phase I spill containers. Visually determine that the adaptors are of the rotatable design.

6.2 Inspect the dust caps to ensure that the caps and that the gaskets are intact and do not show signs of excessive wear or damage.

6.3 Inspect the rotatable adaptors. If the adaptors are wet or covered with a lubricant, wipe the adaptors clean to ensure maximum friction between the dust cap and the adaptor seal surface.

7. TEST PROCEDURE

7.1 Install the dust cap on the Phase I rotatable adaptor.

7.2 Install the Torque Test Tool on the dust cap as shown in Figure 2.

7.3 Verification of rotation, conducted prior to the Static Torque Test. Place a socket wrench with socket extension (if required) into the Torque Test Tool, or equivalent. Rotate the adaptor a minimum of 360 degrees. Do not continue with static torque measurements if the adaptor does not rotate 360 degrees. Record the result on the data sheet where provided.

7.4 Install the Torque Wrench into the Torque Test Tool. If the spill container is too deep to allow connection of the Torque Wrench, use a compatible socket extension to reach into the bucket to the Torque Test Tool. The socket extension shall not exceed 12 inches in length.

7.5 Place one hand on top of the Torque Wrench, directly above the center of the Torque Test Tool to keep the wrench level while applying pressure. Gently apply an even, steady pressure just until the adaptor begins to rotate. Record the maximum applied static torque value shown on the torque wrench and proceed to 7.6.

7.6 After the first measurement, slowly rotate the adaptor one third of full rotation (120 degrees) from the point that the first measurement was taken. Using the same technique described in 7.5, measure and record the second torque measurement.

7.7 Following the first two measurements, slowly rotate the adaptor another, one third of full rotation (120 degrees) from the second measurement location. Using the same technique as described in 7.5, measure and record the third torque measurement. Rotating the adaptor in one-third increments ensures that the average static torque is representative of the entire adaptor rotation.

8. POST-TEST PROCEDURES

8.1 Remove the Torque Test Assembly and replace the appropriate lids on each of the spill containers. Store all test equipment in a protected location to prevent damage to the equipment.

9. CALCULATING RESULTS

9.1 Calculate the arithmetic average of the three tests for each adaptor tested and record the value on the data sheet where provided.

10. REPORTING RESULTS

10.1 Report the results of the static torque measurements on the data sheet where provided. Alternate data sheets may be used provided they include the same parameters identified on Form 1.

11. ALTERNATE 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.

Form 1
Static Torque of Rotatable Phase I Adaptors

Test Company:	**Conducted By**:
Test Date:	**Facility Name:**
Facility Address:	**City:**

Measurement Units: (circle one): pound-inches pound-feet

Vapor Adaptor 1	**Vapor Adaptor 2**	**Vapor Adaptor 3**	**Vapor Adaptor 4**
Brand:	**Brand:**	**Brand:**	**Brand:**
Model:	**Model:**	**Model:**	**Model:**
Grade:	**Grade:**	**Grade:**	**Grade:**
Torque 1:	Torque 1:	Torque 1:	Torque 1:
Torque 2:	Torque 2:	Torque 2:	Torque 2:
Torque 3:	Torque 3:	Torque 3:	Torque 3:
Average:	**Average:**	**Average:**	**Average:**
360 Rotation: Yes / No	**360 Rotation: Yes / No**	**360 Rotation: Yes / No**	**360 Rotation: Yes / No**

Product Adaptor 1	**Product Adaptor 2**	**Product Adaptor 3**	**Product Adaptor 4**
Brand:	**Brand:**	**Brand:**	**Brand:**
Model:	**Model:**	**Model:**	**Model:**
Grade:	**Grade:**	**Grade:**	**Grade:**
Torque 1:	Torque 1:	Torque 1:	Torque 1:
Torque 2:	Torque 2:	Torque 2:	Torque 2:
Torque 3:	Torque 3:	Torque 3:	Torque 3:
Average:	**Average:**	**Average:**	**Average:**
360 Rotation: Yes / No	**360 Rotation: Yes / No**	**360 Rotation: Yes / No**	**360 Rotation: Yes / No**

Comments: ____

CALIFORNIA
AIR RESOURCES BOARD

Vapor Recovery Test Procedure

TP-201.1C

Leak Rate of
Drop Tube/Drain Valve Assembly

Adopted: July 3, 2002
Amended: October 8, 2003
Amended: July 12, 2021

California Environmental Protection Agency
California Air Resources Board

Vapor Recovery Test Procedure

TP-201.1C

Leak Rate of Drop Tube/Drain Valve Assembly

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 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

The purpose of this procedure is to quantify the leak rate of drop tube/drain valve assembly when the spill container drain valve is configured to pass liquid into the drop tube as shown in Figure 1. It is used to certify and to determine the compliance of components with the performance specification for the maximum allowable leak rate as defined in CP-201 Vapor Recovery Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities Using Underground Storage Tanks.

2. PRINCIPLE AND SUMMARY OF TEST PROCEDURE

A compatible dust cap for a Phase I product adaptor is modified to allow the introduction of nitrogen into the Phase I drop tube. A pressure gauge is connected to the modified cap and nitrogen is flowed into the drop tube. If the resulting nitrogen flow rate necessary to maintain a steady-state pressure is less than or equal to the specifications described in CP-201, the drop tube/drain valve assembly is verified to be in compliance. An inflatable bladder is installed in the Phase I drop tube below the spill container drain valve path to eliminate potential biases resulting from the level of fuel in the storage tank.

For gasoline dispensing facilities equipped with remote fill Phase I configurations, an inflatable bladder is installed below the drain valve path at the remote fill spill container rather than below the drop tube.

3. BIASES AND INTERFERENCES

3.1 Missing or defective gaskets on the Phase I product adaptor or a loose adaptor may bias the results towards noncompliance. Prior to a final determination of noncompliance of the component(s), use leak detection solution on all visible components to verify the absence of leaks.

3.2 Leaks in the test equipment will bias the results toward noncompliance. Prior to conducting the test, this bias is eliminated by conducting a leak check of the test equipment. Leak detection solution may also be used during the test to verify the absence of leaks in the test equipment.

4. SENSITIVITY, RANGE, AND PRECISION

4.1 Flow Meter. The measurable leak rate is dependent upon the sensitivity, range and precision of the flow meter used for testing. The flow meter minimum sensitivity shall be 12.5 ml/min (.026 CFH) with minimum accuracy of ± 5 percent full-scale. The device scale shall be 150mm (5.91 inches) tall to provide a sufficient number of graduations for readability. For electronic flow metering devices, the minimum sensitivity shall be 1.0 ml/min (0.0021 CFH) with a minimum full-scale accuracy of ±1.0 percent.

4.2 Pressure Gauge. The measurable pressure is dependent upon the sensitivity, range and precision of the pressure gauge used for testing. For mechanical pressure gauges, the maximum pressure range shall be 0-4 inches H_2O. The minimum full-scale accuracy shall be ± 3.0 percent and the gauge shall be readable to the nearest 0.10 inches H_2O. For electronic pressure gauges, the maximum pressure range of the device shall be –10 to 10 inches H_2O. The minimum full accuracy shall be ± 1.5 percent of full-scale range and the pressure gauge shall be readable to the nearest 0.01 inches H_2O.

5. EQUIPMENT

5.1 Pressure Gauge. Use a pressure gauge with minimum specifications listed in Section 4 to monitor the pressure in the drop tube.

5.2 Flow Meter. Use a flow meter with minimum specifications listed in Section 4 to set the required nitrogen flow rate(s).

5.3 Nitrogen. Use commercial grade gaseous nitrogen in a high-pressure cylinder, equipped with a pressure regulator and a one psig pressure relief valve.

5.4 Stopwatch. Use a stopwatch accurate to within 0.10 seconds to time the pressurization of the drop tube and pressure stabilization period.

5.5 Leak Detection Solution. Any non-flammable commercial liquid solution designed to detect vapor leaks may be used.

5.6 Inflatable Bladder. Use an inflatable bladder and extension hose, as shown in Figure 1, to isolate the drain valve. Unless otherwise specified in the certification Executive Order for the system, a “3-4 model” inflatable plumber’s bladder may be used.

5.7 Product Adaptor Test Cap. Use a modified product dust cap compatible with the Phase I product adaptor. The cap shall be equipped with connections for a pressure gauge and flow meter. An optional metering valve may be installed to relieve excess pressure. An example of a Product Adaptor Test Cap is shown in Figure 3.

6. PRE-TEST PROCEDURES

6.1 The flow meter and pressure gauge shall be calibrated within six (6) months prior to conducting the testing. The flow meter(s) shall be calibrated for use with nitrogen. Calibrations shall be conducted in accordance with EPA or CARB protocols. CARB calibration methodology for flow meters and pressure gauges is contained in Appendix D of Air Monitoring Quality Assurance, Volume VI, Standard Operating Procedures for Stationary Source Emission Monitoring and Testing, January 1979.

6.2 Remove the lids from the spill containers and inspect the drain valve configuration. Verify that the drain valve passes liquid directly into the drop tube, as shown in Figure 1, rather than into the storage tank ullage space.

6.2.1 For gasoline dispensing facilities equipped with remote fill Phase I configurations, inspect the drain valve configuration within the remote fill spill container. Verify that the drain valve passes liquid directly into the product pipe. With remote fill configurations, the spill container is offset (distance will vary from site to site) from the vertical product riser that houses the drop tube, installed directly above the underground storage tank as shown in Figure 4.

6.3 Inspect the Phase I product adaptor to ensure that the gasket is installed and that the adaptor is securely attached to the Phase I product riser.

7. TEST PROCEDURE (DIRECT FILL CONFIGURATION)

For gasoline dispensing facilities equipped with a remote fill configuration, proceed directly to Section 8.

7.1 Carefully install the inflatable bladder into the drop tube as shown in Figure 1 and inflate.

7.2 Connect the Product Adaptor Test Cap to the Phase I product adaptor and connect the flow meter and pressure gauge to the test cap as shown in Figure 2.

7.3 Open the nitrogen supply, adjust the nitrogen flow to a rate no greater than the maximum allowable leak rate specified for the drain valve in CP-201, and start the stopwatch for a maximum of 5 minutes.

7.4 Wait until the pressure gauge indicates a pressure equal to the performance specification pressure for the drain valve as defined in CP-201.

7.4.1 If the pressure gauge does not indicate the specified pressure within 5 minutes, the drain valve does not comply with the maximum allowable leak rate specification.

7.4.2 If the pressure gauge indicates the specified pressure within 5 minutes, immediately reduce the nitrogen flow in order to stabilize at the specified pressure (±0.05 inches H_2O) for 30 seconds.

7.5 Record the flow rate required to stabilize at the pressure specified in CP-201.

7.5.1 If the final flow rate is below the detectable limit of the flow meter, record the lowest measurable flow rate and final pressure on the data sheet.

7.5.2 If the final flow rate is greater than the capacity of the flow meter, record the highest measurable flow rate and final pressure. Proceed to Section 9.

8. TEST PROCEDURE (REMOTE FILL CONFIGURATION)

8.1 Carefully install the inflatable bladder into the remote fill spill container as shown in Figure 4 and inflate.

8.2 Connect the Product Adaptor Test Cap to the product adaptor within the remote fill spill container. Connect the flow meter and pressure gauge to the test cap as shown in Figure 2.

8.3 Open the nitrogen supply, adjust the nitrogen flow rate to no greater than the maximum allowable leak rate specified for the drain valve in CP-201, and start the stopwatch for a maximum of 5 minutes.

8.4 Wait until the pressure gauge indicates a pressure equal to the performance specification pressure for the drain valve as defined in CP-201.

8.4.1 If the pressure gauge does not indicate the specified pressure within 5 minutes, the drain valve does not comply with the maximum allowable leak rate specification.

8.4.2 If the pressure gauge indicates the specified pressure within 5 minutes, immediately reduce the nitrogen flow in order to stabilize at the specified pressure (±0.05 inches H_2O) for 30 seconds.

8.5 Record the flow rate required to stabilize at the pressure specified in CP-201.

8.5.1 If the final flow rate is below the detectable limit of the flow meter, record the lowest measurable flow rate and final pressure on the data sheet.

8.5.2 If the final flow rate is greater than the capacity of the flow meter, record the highest measurable flow rate and final pressure.

9. POST-TEST PROCEDURES

9.1 Carefully remove the Product Adaptor Test Assembly and the inflatable bladder from the Phase I drop tube.

9.1.1 If the gasoline dispensing facility is equipped with a remote fill Phase I configuration, carefully remove the Product Adaptor Test Assembly and the inflatable bladder from the remote fill spill container.

9.2 Replace the caps on the appropriate Phase I adaptors, and the appropriate lids on the spill containers.

10. CALCULATING RESULTS

10.1 If the flow rate of nitrogen was at the upper limit of the flow meter and the measured pressure never reached the specified pressure, but was greater than 0.0 inches H_2O, the actual leak rate at a specified pressure shall be calculated as follows:

$$Q_{SP} = (SP)^{1/2}\left[\frac{Q_{actual}}{(P_{actual})^{1/2}}\right] \qquad \text{Equation 10 – 1}$$

Where:

Q_{SP}	=	The leak rate of the component at the specified pressure, cubic feet per hour
Q_{actual}	=	The actual flow rate of nitrogen, cubic feet per hour
P_{actual}	=	The actual measured steady-state pressure at Q_{actual}, inches H_2O
SP	=	Specified Pressure, defined in CP-201, inches H_2O

10.2 Commonly used flow rate conversions:

1 CFH = 471.95 ml/min

Example: Convert 0.17 CFH to ml/min: 0.17 CFH x 471.95 = 80 ml/min

1 ml/min = 0.00212 CFH

Example: Convert 100 ml/min to CFH: 100 ml/min x 0.00212 = 0.21 CFH

Commonly Used Flow Rate Conversions	
0.05 CFH = 24 ml/min	0.21 CFH = 100 ml/min
0.17 CFH = 80 ml/min	0.34 FH = 160 ml/min

11. REPORTING RESULTS

Report the results of the quantification of the leak rate through the drop tube/drain valve assembly as indicated on Form 1. Districts may require the use of alternate forms, provided they include the same minimum parameters as identified on Form 1.

12. ALTERNATE PROCEDURES

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 CP-201 (Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities Using Underground Storage Tanks).

Figure 1
Typical Inflatable Bladder Installation for Direct Fill Configuration

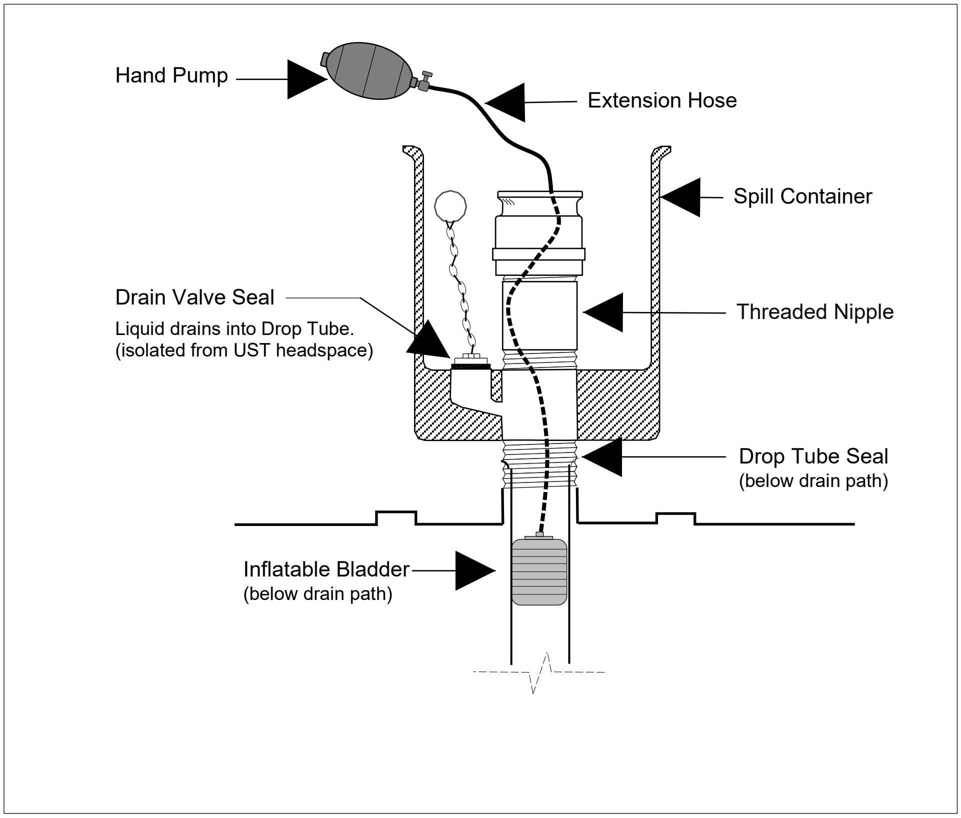


Figure 2
Leak Rate Test Assembly

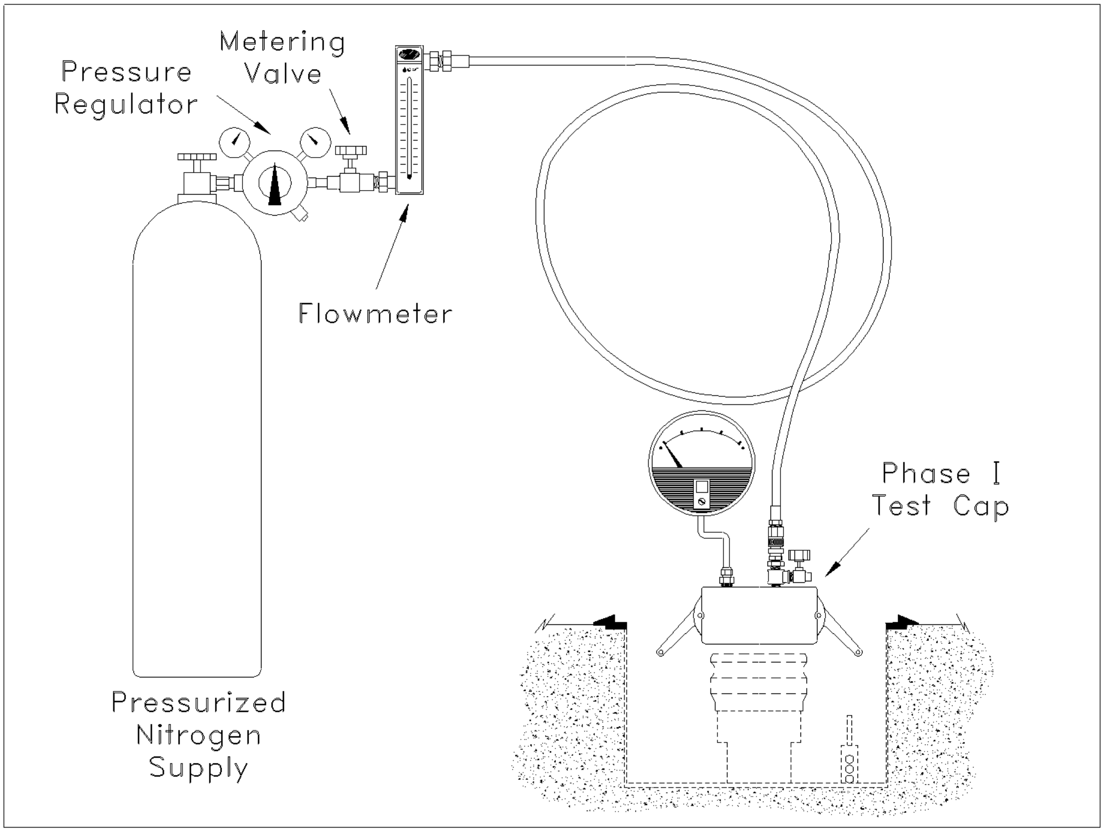


Figure 3
Product Adaptor Test Cap

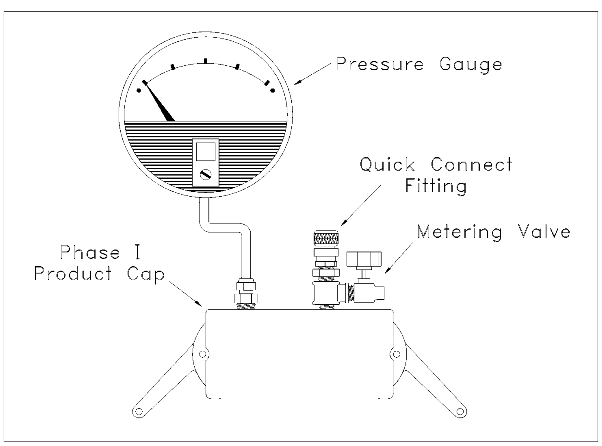
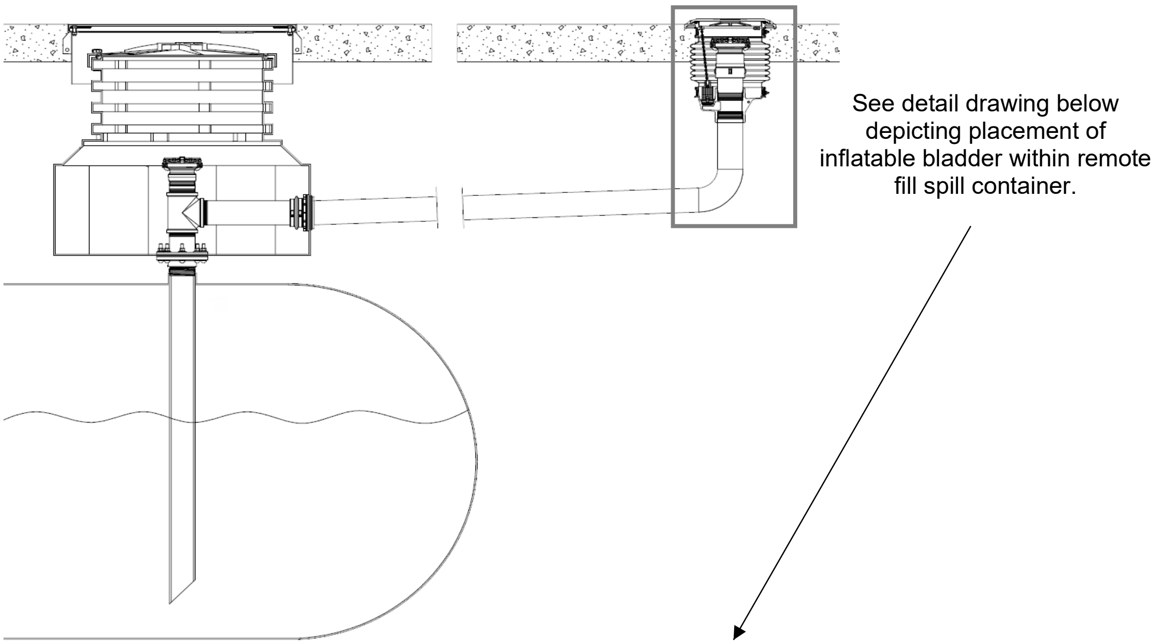
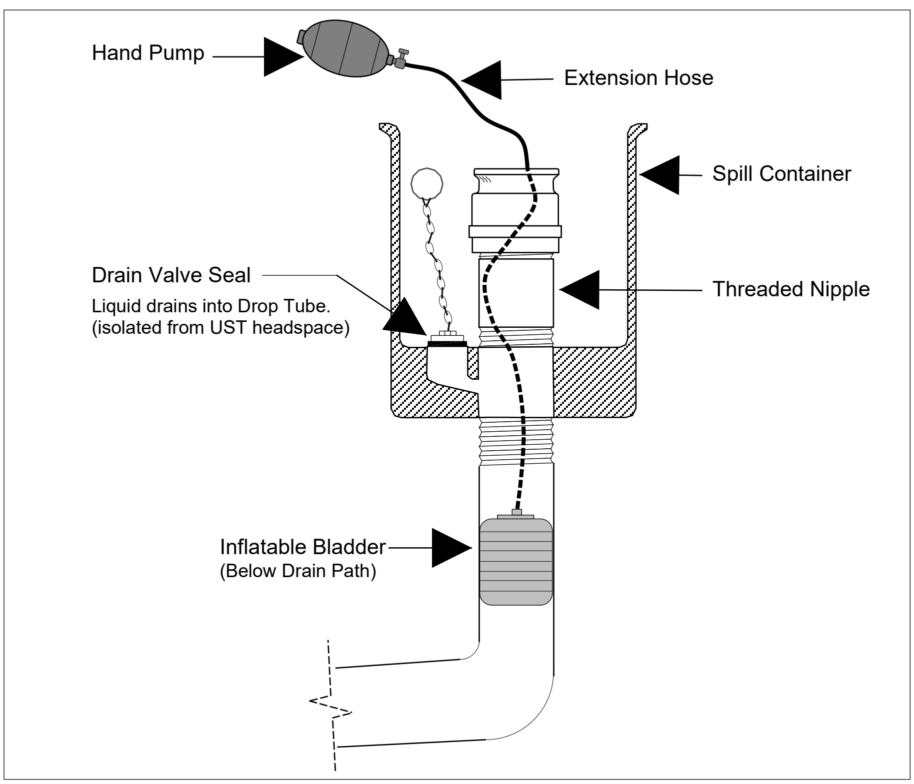


Figure 4
Typical Inflatable Bladder Installation for Remote Fill Configuration





TP-201.1C Form 1
Drop Tube/Drain Valve Assembly Data Sheet

Facility:	Test Company:	Test Date:
Address:	Test Personnel:	
City:	State, Zip Code	
Overfill Prevention Make & Model:	Spill Container Make & Model:	
Date of Last Flow Meter Calibration:	Date of Last Pressure Gauge Calibration:	

Test Results

Device Type & Product Grade	Time to Pressurize	30-Second Flow rate (CFH)	30-Second Pressure (in. H_2O)

Comments:

CALIFORNIA
AIR RESOURCES BOARD

Vapor Recovery Test Procedure

TP-201.1D

Leak Rate of
Drop Tube Overfill Prevention Devices
and Spill Container Drain Valves

Adopted: February 1, 2001
Amended: July 3, 2002
Amended: October 8, 2003
Amended: July 12, 2021

California Environmental Protection Agency
California Air Resources Board

Vapor Recovery Test Procedure

TP-201.1D

Leak Rate of Drop Tube Overfill Prevention Devices and Spill Container Drain Valves

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 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

The purpose of this procedure is to quantify the leak rate of overfill prevention devices located in the Phase I product drop tube on two-point Phase I systems. When applicable, this procedure is also used to quantify the leak rate of a spill container drain valve which passes liquid directly into the Phase I drop tube.

This procedure is applicable only to those Gasoline Dispensing Facilities (GDF) equipped with an overfill prevention device located in the Phase I product drop tube. It is used to determine the compliance of components with the performance specification for the maximum allowable leak rate as defined in CP-201 Vapor Recovery Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities Using Underground Storage Tanks.

2. PRINCIPLE AND SUMMARY OF TEST PROCEDURE

A compatible cap for a Phase I product adaptor is modified to allow the introduction of nitrogen into the Phase I drop tube. A pressure gauge is connected to the modified cap and nitrogen is flowed into the drop tube. If the resulting nitrogen flow rate necessary to maintain a steady-state pressure is less than or equal to the specifications described in CP-201, the overfill prevention device is verified to be in compliance. In the case where a spill container drain valve that passes liquid directly into the Phase I drop tube is installed, the components are isolated from each other with use of an inflatable bladder in order to determine the leak rate of each component. If the leak rate of the drain valve cannot be quantified, the overfill prevention device cannot be tested.

3. BIASES AND INTERFERENCES

3.1 Missing or defective gaskets on the Phase I product adaptor, or a loose adaptor, may bias the results towards noncompliance. Prior to a final determination of noncompliance of the component(s), use leak detection solution on all visible components to verify the absence of leaks.

3.2 Refueling during the test may bias the results. No vehicle refueling or bulk deliveries to any of the tanks at the facility shall occur during testing.

3.3 Product levels less than four (4) inches above the highest opening at the bottom of the submerged drop tube may bias the results toward noncompliance.

3.4 Pressure or vacuum in the storage tank headspace may bias the results. Use the Pressure Relief Adaptor in Section 5 to eliminate this potential bias.

3.5 Liquid levels in the drop tube that are above the location of the overfill prevention device will bias the results toward compliance.

3.6 Leaks in the test equipment will bias the results toward noncompliance. Prior to conducting the test, this bias is eliminated by conducting a leak check of the test equipment. Leak detection solution may also be used during the test to verify the absence of leaks in the test equipment.

3.7 Use of this procedure to quantify the leak rate of spill container drain valves that drain liquid into the ullage of the storage tank rather than into the drop tube will yield invalid results.

3.8 For remote fill Phase I configurations, the internal diameter of the product pipe assembly is assumed to be four inches in diameter. Product pipe assemblies with a diameter smaller than four inches will shorten pressure up times.

3.9 For remote fill Phase I configurations, a measurement of the length of pipe within the entire remote fill product pipe assembly is needed. The product pipe assembly consists of horizontal and vertical segments. The horizontal segment is the length of pipe that connects the remote fill spill container to the direct fill product riser above the underground storage tank (UST), which is sloped a minimum of 1/8 inch per foot toward the UST. The vertical segment is the length of pipe associated with the direct fill product riser, from the top of the product adaptor to the bottom of the UST. A cross sectional view of a typical remote fill product pipe assembly is depicted in Figure 6A. A two-step process is required to correctly measure the entire remote fill product pipe assembly length, as depicted in Figure 6A and described in Section 6 of this test procedure.

4. SENSITIVITY, RANGE, AND PRECISION

4.1 Flow Meter. The measurable leak rate is dependent upon the sensitivity, range and precision of the flow meter used for testing. The flow meter minimum sensitivity shall be 12.5 ml/min (0.026 CFH) with a minimum accuracy of ±5 percent full-scale. The device scale shall be 150 mm (5.91 inches) tall to provide a sufficient number of graduations for readability. For electronic flow metering devices, the minimum sensitivity shall be 1.0 ml/min (0.0021 CFH) with a minimum full-scale accuracy of ±1.0 percent.

4.2 Pressure Gauge. The measurable pressure is dependent upon the sensitivity, range and precision of the pressure gauge used for testing. For mechanical pressure gauges, the maximum pressure range shall be 0-4 inches H_2O. The minimum full-scale accuracy shall be ±3.0 percent and the gauge shall be readable to the nearest 0.10 inches H_2O. For electronic pressure gauges, the maximum pressure range of the device shall be –10 to 10 inches H_2O. The minimum accuracy shall be ±1.5 percent full-scale range and the pressure gauge shall be readable to the nearest 0.01 inches H_2O.

5. EQUIPMENT

5.1 Pressure Gauge. Use a pressure gauge with minimum specifications listed in Section 4 to monitor the pressure in the drop tube.

5.2 Flow Meter. Use a flow meter with minimum specifications listed in Section 4 to set the required nitrogen flow rate(s).

5.3 Nitrogen. Use commercial grade gaseous nitrogen in a high-pressure cylinder, equipped with a two-stage pressure regulator and a one psig pressure relief valve.

5.4 Stopwatch. Use a stopwatch accurate to within 0.10 seconds to time the pressurization of the drop tube and pressure stabilization period.

5.5 Leak Detection Solution. Any commercial liquid solution designed to detect vapor leaks may be used to verify the pressure integrity of the Phase I product adaptor during this test.

5.6 Vapor Adaptor Pressure Relief Assembly. Use a modified dust cap or a compatible vapor recovery elbow to open the Phase I vapor adaptor during the test. An example of a Vapor Adaptor Pressure Relief Assembly is shown in Figure 1. Screwdrivers or other devices that may damage the vapor adaptor or gasket seal shall not be used to open the Phase I vapor adaptor.

5.7 Inflatable Bladder. Use an inflatable bladder and extension hose, as shown in Figure 2, to isolate the drain valve from the overfill prevention device when applicable. Unless otherwise specified in the certification Executive Order for the system, a “3-4 model” inflatable plumber’s bladder may be used.

5.8 Product Adaptor Test Cap. Use a modified product dust cap compatible with the Phase I product adaptor. The cap shall be equipped with connections for a pressure gauge and flow meter. An example of a Product Adaptor Test Cap is shown in Figure 3.

5.8.1 For GDF equipped with remote fill configurations, a second product adaptor test cap will be needed to occupy both the direct fill product adaptor and remote fill product adaptor. See Figure 4 and Figure 6A for a typical remote fill Phase I configuration.

5.9 Tank Gauging Stick. Use a tank gauging stick, if required, of sufficient length to verify that the UST liquid level is at least four (4) inches above the highest opening at the bottom of the submerged drop tube. The tank gauging stick shall be equipped with a non-sparking "L" bracket at the end.

5.10 Length Measuring Device. For GDF equipped with remote fill configurations, a measuring device such as a tape measure or measuring wheel can be used to determine the length of the remote fill product pipe assembly. In addition, a tank gauging stick can be used for the vertical segment if the GDF has a restrictor plate and/or a trap door below the adaptor within the direct fill product riser.

6. PRE-TEST PROCEDURES

6.1 The flow meter(s) and pressure gauge shall be calibrated within the 180 days prior to conducting the test. The flow meter(s) shall be calibrated for use with nitrogen. Calibrations shall be conducted in accordance with EPA or CARB protocols. CARB calibration methodology for flow meters and pressure gauges are contained in Appendix D of Air Monitoring Quality Assurance, Volume VI, Standard Operating Procedures for Stationary Source Emission Monitoring and Testing, January 1979.

6.2 Remove the lids of the Phase I spill containers and product adaptor dust caps. Visually determine that the drop tube is equipped with an overfill prevention device.

6.3 Inspect the Phase I product adaptor to ensure that the gasket is installed and that the adaptor is securely attached to the Phase I product riser.

6.4 Verify that the liquid level in the storage tank is at least four (4) inches above the highest opening at the bottom of the submerged drop tube using the tank gauging stick.

6.5 Inspect the drain valve configuration. Verify that the drain valve passes liquid directly into the drop tube, as shown in Figure 2, rather than into the storage tank ullage space.

6.6 If the GDF is equipped with a remote fill configuration (i.e. not a conventional direct fill), measure and record the length of the entire product pipe assembly, including both horizontal and vertical segments as depicted in Figure 6A, on the field data sheet. It is important to note that the horizontal segment of pipe length from the direct fill product riser may not take a direct route to the remote fill spill container. A two-step process is required to correctly measure the entire remote fill product pipe assembly length as follows:

6.6.1 Measure and record the horizontal segment from the remote fill product adaptor to the fixed product adaptor installed on the direct fill product riser. Include an additional 25% to account for slope, underground pipe bends that are not visible on the surface, and the vertical section at the remote fill spill container. There are three ways to determine the horizontal length: direct field measurement at the ground surface, measurement from as-built drawings, or measurement obtained from the local Air Pollution Control District.

6.6.2 Measure and record the vertical segment from the top of the fixed product adaptor installed on the direct fill product riser to the bottom of the UST.

6.6.3 Sum the lengths of the horizontal segment (including the additional 25% mentioned in Section 6.6.1) and vertical segment to obtain the total length of pipe within the remote fill product pipe assembly and record the sum on the field data sheet. An example equation is provided below.

$$TL = (HL \times 1.25) + VL \qquad \text{Equation 6-1}$$

Where:

TL = total length of remote fill product pipe assembly (feet)
HL = length of horizontal pipe segment (feet)
VL = length of vertical pipe segment (feet)

6.6.4 Compare the total length of pipe to the values listed in Table 1 (in Section 8) to determine the maximum amount of time to reach 2.0 inches H_2O upon introducing nitrogen.

6.7 Remove the Phase I vapor adaptor dust cap for the tank to be tested. Connect the Vapor Adaptor Pressure Relief Assembly, or equivalent, to the Phase I vapor adaptor. Allow the UST ullage space to reach zero gauge pressure.

7. TEST PROCEDURE (DIRECT FILL CONFIGURATION)

7.1 For GDF's equipped with a remote fill configuration, proceed directly to Section 8.

7.2 Testing options for overfill prevention device and drain valve, if equipped.

7.2.1 If a drain valve is not present, or does not pass liquid directly into the drop tube, proceed directly to Section 7.9.

7.2.2 If a drain valve is present, a tester has either of the following testing options:

7.2.2.1 Proceed directly to Section 7.9 and test the entire drop tube assembly.

Note: If the drop tube assembly leak rate is ≥ 0.15 CFH (71 ml/min) at +2.0 inches H_2O, tester shall conduct testing per Section 7.3.

7.2.2.2 Proceed to Section 7.3.

7.3 Carefully install the inflatable bladder into the drop tube as shown in Figure 2 and inflate.

7.4 Connect the Product Adaptor Test Cap to the Phase I product adaptor and connect the flow meter and pressure gauge to the test cap as shown in Figure 5.

7.5 Open the nitrogen supply and adjust the flow to a rate no greater than the maximum allowable leak rate specified for the drain valve only in CP-201 and start the stopwatch for a maximum of 5 minutes.

7.6 Wait until the pressure gauge indicates a pressure equal to the performance specification pressure for the drain valve as defined in CP-201.

7.6.1 If the pressure gauge does not indicate the specified pressure within 5 minutes, the drain valve does not comply with the maximum allowable leak rate specification.

7.6.2 If the pressure gauge indicates the specified pressure within 5 minutes, immediately reduce the nitrogen flow in order to stabilize at the specified pressure (±0.05 inches H_2O) for 30 seconds.

7.7 Record the flow rate required to stabilize the pressure specified in CP-201.

7.7.1 If the final flow rate is below the detectable limit of the flow meter, record the lowest measurable flow rate and final pressure on the data sheet.

7.7.2 If the final flow rate is greater than the capacity of the flow meter, record the highest measurable flow rate and final pressure. No further testing shall be conducted until the leak rate of the drain valve can be determined.

7.8 Remove the Product Adaptor Test Cap. Deflate the inflatable bladder and carefully remove it from the drop tube.

7.9 Test the entire drop tube assembly, which includes the overfill prevention device and the spill container drain valve, if equipped. Connect the Product Adaptor Test Cap to the Phase I product adaptor and connect the flow meter and pressure gauge to the test cap as shown in Figure 5.

7.10 Open the nitrogen supply and adjust the nitrogen flow rate to 200 ml/min (0.42 CFH) and start the stopwatch for a maximum of 5 minutes.

7.11 Wait until the pressure gauge indicates a pressure equal to the performance specification pressure for the overfill prevention device as defined in CP-201.

7.11.1 Testing conducted per Section 7.2.2.1 (the option that allows testing the entire drop tube assembly)

7.11.1.1 If the pressure gauge does not indicate the specified pressure within 5 minutes, the overfill prevention device, drain valve, or both does not comply with maximum allowable leak rate specification. Proceed to Section 7.3.

7.11.1.2 If the pressure gauge indicates the specified pressure within 5 minutes immediately reduce the nitrogen flow in order to stabilize at the specified pressure (±0.05 inches H_2O) for 30 seconds. Proceed to 7.12.

Note: If the drop tube assembly leak rate is ≥ 0.15 CFH (71 ml/min) at +2.0 inches H_2O, tester shall conduct testing per Section 7.3.

7.11.2 Testing conducted per Section 7.2.2.2 (the option that allows testing the drain valve, followed by the entire drop tube assembly)

7.11.2.1 If the pressure gauge does not indicate the specified pressure within 5 minutes, the overfill prevention device does not comply with the maximum allowable leak rate specification.

7.11.2.2 If the pressure gauge indicates the specified pressure within 5 minutes immediately reduce the nitrogen flow in order to stabilize at the specified pressure (±0.05 inches H_2O) for 30 seconds. Proceed to 7.12.

7.12 Record the flow rate required to stabilize at the pressure specified in CP-201.

7.12.1 If the final flow rate is below the detectable limit of the flow meter, record the lowest measurable flow rate and final pressure on the data sheet.

7.12.2 If the final flow rate is greater than the capacity of the flow meter, record the highest measurable flow rate and final pressure. No further testing shall be conducted until the leak rate of the drain valve, if equipped, can be determined.

8. TEST PROCEDURE (REMOTE FILL CONFIGURATION)

8.1 Testing options for overfill prevention device and drain valve, if equipped.

8.1.1 If a drain valve is not present, or does not pass liquid directly into the drop tube, proceed directly to Section 8.10.

8.1.2 If a drain valve is present, a tester has either of the following testing options:

8.1.2.1 Proceed directly to Section 8.10 and test the entire remote fill product pipe assembly.

Note: If the product pipe assembly leak rate is ≥ 0.15 CFH (71 ml/min) at +2.0 inches H_2O, tester shall conduct testing per Section 8.2.

8.1.2.2 Proceed to Section 8.2.

8.2 Carefully install the inflatable bladder below the drain valve within the remote fill spill container as shown in Figure 6B and inflate.

8.3 Connect the Product Adaptor Test Caps to both the remote fill product adaptor and the direct fill product adaptor. Connect the flow meter and pressure gauge to the test cap installed on the remote fill product adaptor as shown in Figure 5.

8.4 Open the nitrogen supply, adjust the nitrogen flow rate to a rate no greater than the maximum allowable leak rate specified for the drain valve in CP-201 and start the stopwatch for a maximum of 5 minutes.

8.5 Wait until the pressure gauge indicates a pressure equal to the performance specification pressure for the drain valve as defined in CP-201.

8.5.1 If the pressure gauge does not indicate the specified pressure within 5 minutes, the drain valve does not comply with the maximum allowable leak rate specification.

8.5.2 If the pressure gauge indicates the specified pressure within 5 minutes, immediately reduce the nitrogen flow in order to stabilize at the specified pressure (±0.05 inches H_2O) for 30 seconds.

8.6 Record the flow rate required to stabilize at the pressure specified in CP-201.

8.6.1 If the final flow rate is below the detectable limit of the flow meter, record the lowest measurable flow rate and final pressure on the data sheet.

8.6.2 If the final flow rate is greater than the capacity of the flow meter, record the highest measurable flow rate and final pressure. No further testing shall be conducted until the leak rate of the drain valve can be determined.

8.7 Remove the Product Adaptor Test Cap from the remote fill spill container. Deflate the inflatable bladder and carefully remove it from the remote fill spill container.

8.8 Test the entire remote fill product pipe assembly, which includes the overfill prevention device and the spill container drain valve, if equipped. Connect the Product Adaptor Test Caps to the direct fill product adaptor and remote fill product adaptor. Connect the flow meter and pressure gauge to the test cap at the remote fill product adaptor as shown in Figure 5.

8.9 Open the nitrogen supply, adjust the nitrogen flow rate to 200 ml/min (0.42 CFH), and start the stopwatch for the maximum amount of time as specified in Table 1, based on the length of the remote fill product-piping run.

8.10 Wait until the pressure gauge indicates a pressure equal to the performance specification pressure for the overfill prevention device as defined in CP-201.

8.10.1 Testing conducted per Section 8.1.2.1 (the option that allows testing the entire remote fill product pipe assembly)

8.10.1.1 If the pressure gauge does not indicate the specified pressure within the maximum pressure up time specified in Table 1, the overfill prevention device, drain valve, or both does not comply with the maximum allowable leak rate specification. Proceed to Section 8.2.

8.10.1.2 If the pressure gauge indicates the specified pressure within the maximum pressure up time specified in Table 1, reduce the nitrogen flow in order to stabilize at the specified pressure (±0.05 inches H_2O) for 30 seconds. Proceed to Section 8.13.

Note: If the remote fill product pipe assembly leak rate is ≥ 0.15 CFH (71 ml/min) at +2.0 inches H_2O, tester shall conduct testing per Section 8.2.

8.10.2 Testing conducted per Section 8.1.2.2 (the option that allows testing the drain valve followed by the entire drop tube assembly)

8.10.2.1 If the pressure gauge does not indicate the specified pressure within the maximum pressure up time specified in Table 1, the overfill prevention device does not comply with the maximum allowable leak rate specification.

8.10.2.2 If the pressure gauge indicates the specified pressure within the maximum pressure up time specified in Table 1, reduce the nitrogen flow in order to stabilize at the specified pressure (±0.05 inches H_2O) for 30 seconds. Proceed to 8.11.

8.11 Record the flow rate required to stabilize at the pressure specified in CP-201.

8.11.1 If the final flow rate is below the detectable limit of the flow meter, record the lowest measurable flow rate and final pressure on the data sheet.

8.11.2 If the final flow rate is greater than the capacity of the flow meter, record the highest measurable flow rate and final pressure. No further testing shall be conducted until the leak rate of the drain valve, if equipped, can be determined.

Table 1
Time to Pressurize GDF Equipped with Remote Fill Configuration by Product Pipe Assembly Length

Total Length of Remote Fill Product Pipe Assembly (feet)	Time to Pressurize (minutes)
≤50	5
>50, ≤100	10
>100, ≤150	15
>150, ≤200	20
>200, ≤250	25

9. POST-TEST PROCEDURES

9.1 Carefully remove the Product Adaptor Test Cap and the Vapor Adaptor Pressure Relief Assembly from the Phase I connections.

9.2 Replace the appropriate caps on the Phase I adaptors, and the appropriate lids on the spill containers.

10. CALCULATING RESULTS

10.1 If the flow rate of Nitrogen was at the upper limit of the flow meter and the measured pressure never reached the specified pressure, but was greater than 0.00 inches H_2O, the actual leak rate at a specified pressure shall be calculated as follows:

$$Q_{SP} = (SP)^{1/2}\left[\frac{Q_{actual}}{(P_{actual})^{1/2}}\right] \qquad \text{Equation 10-1}$$

Where:

Q_{SP} = The leak rate of the component at the specified pressure, cubic feet per hour
Q_{actual} = The actual flow rate of nitrogen, cubic feet per hour
P_{actual} = The actual measured steady-state pressure at Q_{actual}, inches H_2O
SP = Specified Pressure, defined in CP-201, inches H_2O

10.2 If both a drain valve and a drop tube overfill prevention device were tested, and if a leak rate could be quantified for both components, the leak rate of the overfill prevention device shall be calculated as follows:

$$Q_{OPD} = Q_{Assembly} - Q_{Drain} \qquad \text{Equation 10-2}$$

Where:

Q_{OPD} = The leak rate of the overfill prevention device, cubic feet per hour
$Q_{Assembly}$ = The leak rate of the drop tube assembly, cubic feet per hour
Q_{Drain} = The leak rate of the drain valve, cubic feet per hour

10.3 Commonly used flow rate conversions:

1 CFH = 471.95 ml/min

Example: Convert 0.17 CFH to ml/min: 0.17 CFH x 471.95 = 80 ml/min

1 ml/min = 0.00212 CFH

Example: Convert 100 ml/min to CFH: 100 ml/min x 0.00212 = 0.21 CFH

Commonly Used Flow Rate Conversions	
0.05 CFH = 24 ml/min	0.21 CFH = 100 ml/min
0.17 CFH = 80 ml/min	0.34 CFH = 160 ml/min

11. REPORTING RESULTS

Report the results of the quantification of the leak rate through the drain valve and the drop tube overfill prevention device as indicated on Form 1. Districts may require the use of alternate forms, provided they include the same minimum parameters identified on Form 1.

12. ALTERNATE PROCEDURES

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 CP-201 Vapor Recovery Certification Procedure for Gasoline Dispensing Facilities Using Underground Storage Tanks.

Figure 1
Vapor Adaptor Pressure Relief Assembly

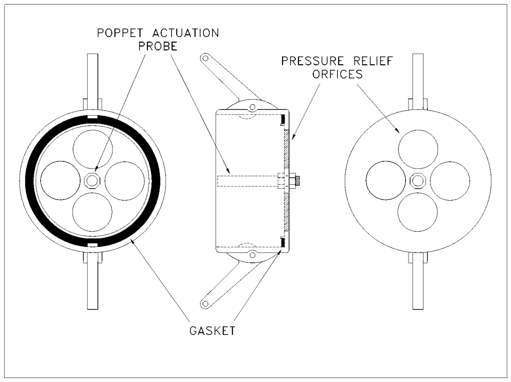


Figure 2
Typical Inflatable Bladder Installation for Direct Fill Configuration

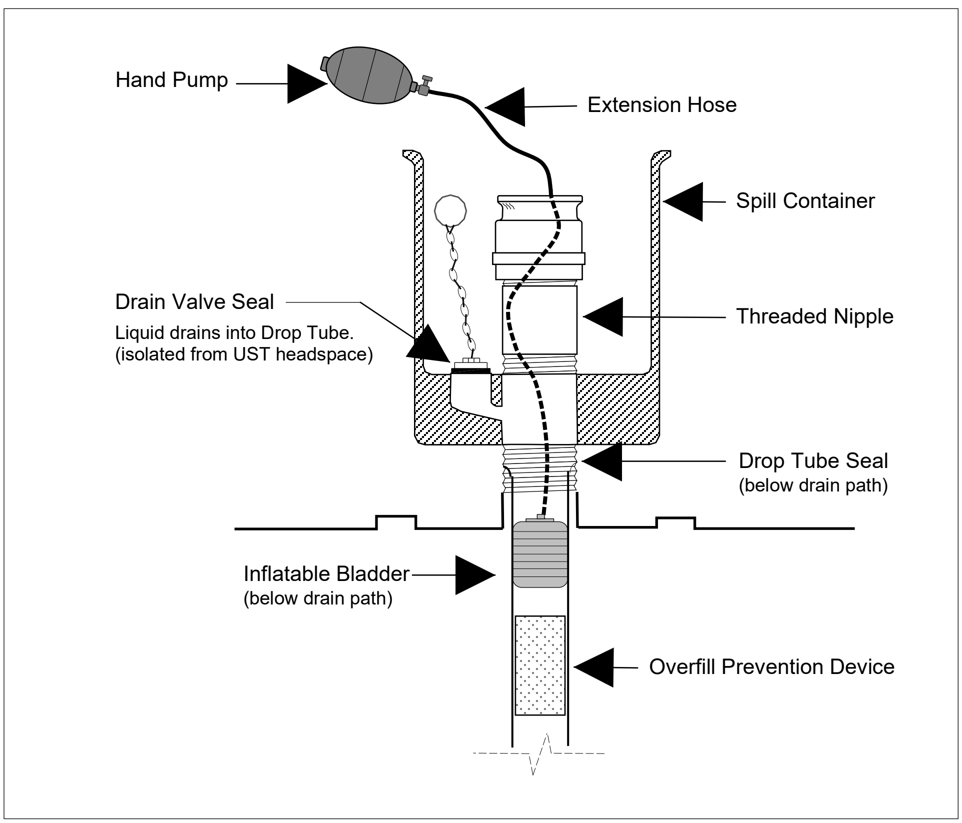


Figure 3
Product Cap Test Assembly

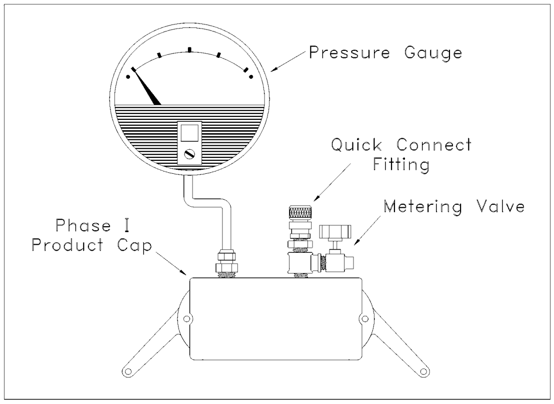


Figure 4
Remote Fill Phase I Configuration

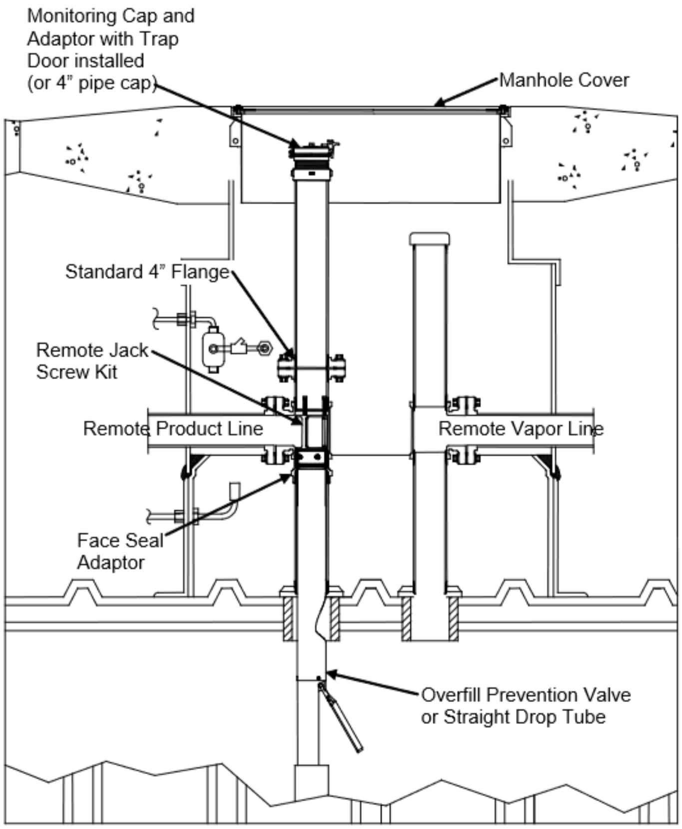


Figure 5
Leak Rate Test Assembly

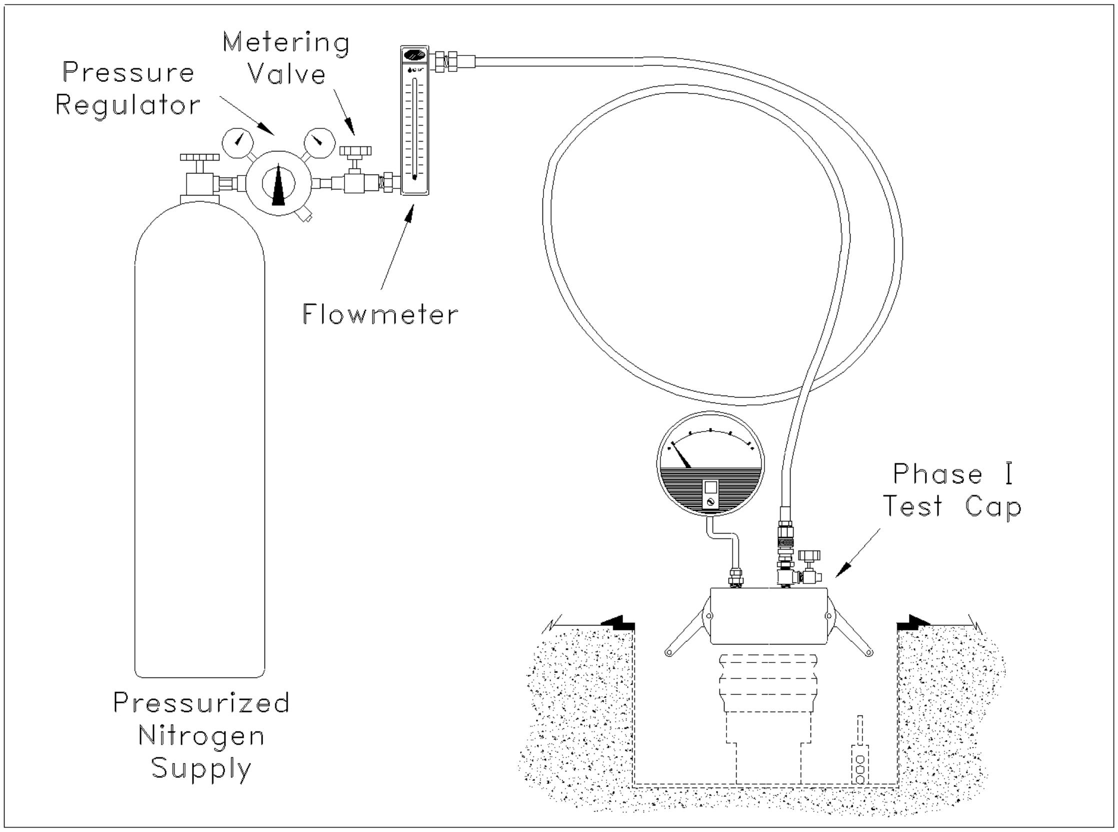


Figure 6A: Remote Fill Product Pipe Assembly Consisting of Two Segments

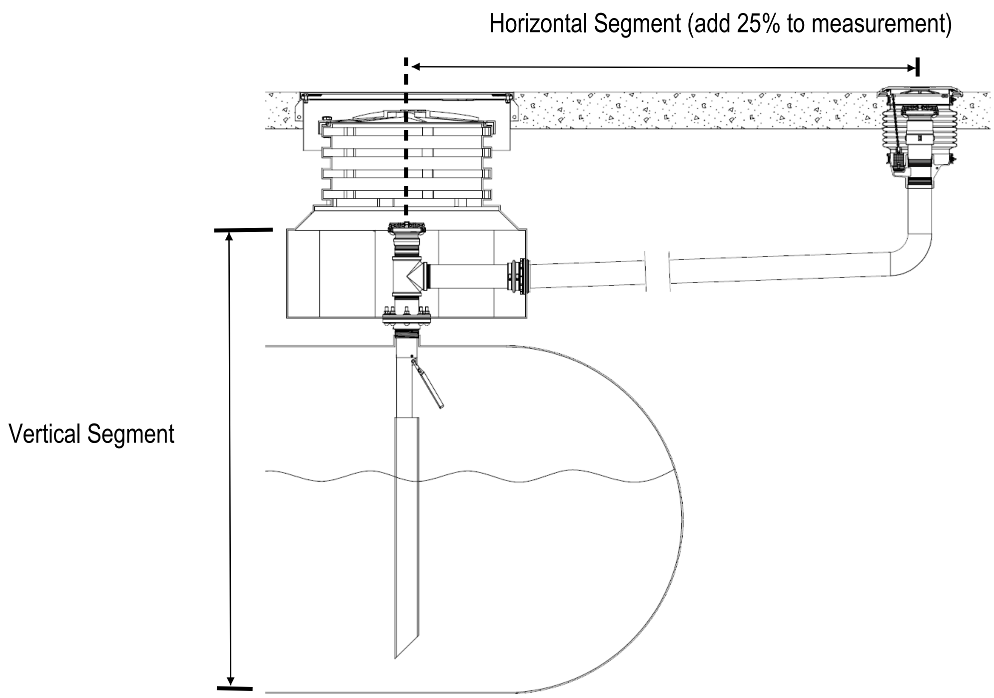
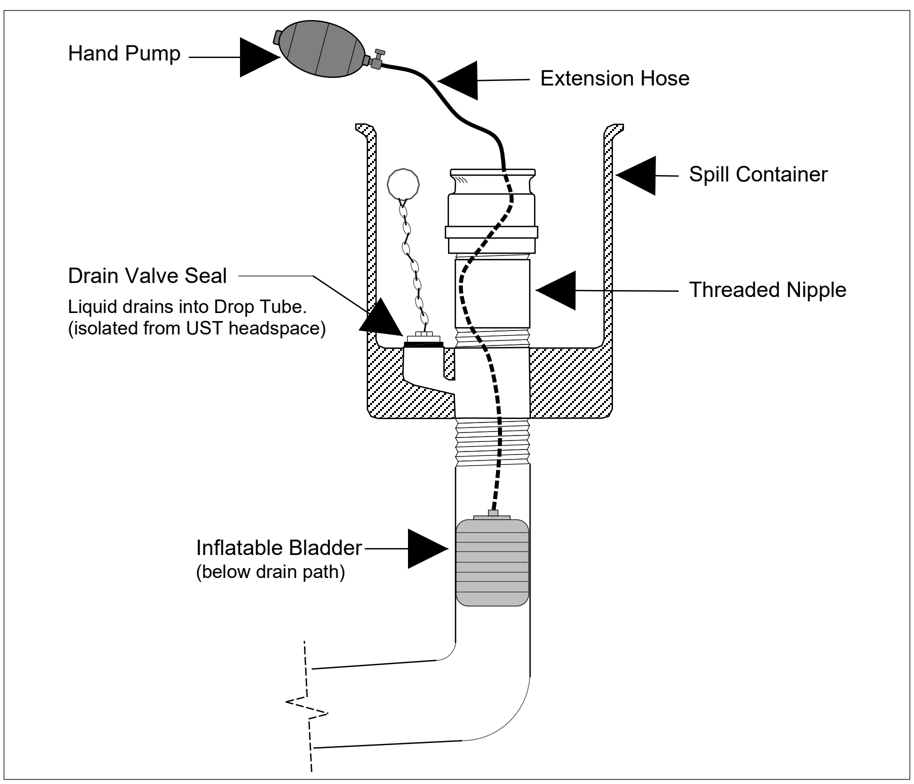


Figure 6B: Typical Inflatable Bladder Installation for Remote Fill Configuration



TP-201.1D Form 1

Drop Tube Overfill Prevention Device and Spill Container Drain Valve Test Procedure

Facility:	Test Company:	Test Date:
Address:	Test Personnel:	
City:	State, Zip Code	
Overfill Prevention Make & Model:	Spill Container Make & Model:	
Date of Last Flow Meter Calibration:	Date of Last Pressure Gauge Calibration:	

Is GDF equipped with Remote Fill Configuration? ☐ YES ☐ NO

If "YES", record length of remote fill product pipe assembly.

Note: The assembly consists of two measurements as described in Section 6.6 and depicted in Figure 6.

Horizontal Length (HL, feet):	Vertical Length (VL, feet):	**Total Length** (TL = HL x 1.25 + VL, feet):

Test Results

Device Type & Product Grade	**Time to Pressurize**	**30-Second Flow Rate (CFH)**	**30-Second Pressure (in. H_2O)**	**Corrected Flow Rate For Overfill Device Only** ***(See Section 10.2)***

Comments:

Source Test Procedure ST-30

STATIC PRESSURE INTEGRITY TEST UNDERGROUND STORAGE TANKS

(Adopted November 30, 1983)

REF: Regulation 8-7-301, 302

1. APPLICABILITY

1.1 This test procedure is used to quantify the vapor tightness of vapor recovery systems installed at gasoline dispensing facilities (GDF) equipped with pressure/vacuum (P/V) valves, provided that the designed pressure setting of the P/V valves is a minimum of 2.5 inches of water column (inches H_2O). Excessive leaks in the vapor recovery system will increase the quantity of fugitive hydrocarbon emissions and lower the overall efficiencies of both the Phase I and Phase II vapor recovery systems.

1.2 Systems equipped with a P/V valve(s) allowed to have a designed cracking pressure less than 2.5 inches H_2O shall be bagged to eliminate any flow contribution through the valve assembly from the test results. The valve/vent pipe connection, however, shall remain unobstructed during this test.

1.3 At facilities not required to be equipped with a P/V valve(s), the vent pipe(s) shall be capped. For those installations, the test may be conducted at the vent pipe(s).

2. PRINCIPLE

2.1 The entire vapor recovery system is pressurized with nitrogen to two (2.0) inches H_2O. The system pressure is then allowed to decay and the pressure after five (5) minutes is compared with an allowable value. The minimum allowable five-minute final pressure is based on the system ullage and pressure decay equations. For the purpose of compliance determination, this test shall be conducted after all back-filling, paving, and installation of all Phase I and Phase II components, including P/V valves, has been completed.

2.2 For GDF equipped with a coaxial Phase I system, this test shall be conducted at a Phase II vapor riser. For GDF which utilize a two-point Phase I system, this test may be conducted at either a Phase II riser or a Phase I vapor coupler provided that the criteria set forth in Section 6.7 have been met. If the integrity criteria for two-point systems specified in Section 6.7 are met, it is recommended that this test be conducted at the Phase I vapor coupler.

3. RANGE

3.1 If mechanical pressure gauges are employed, the full-scale range of the pressure gauges shall be 0-2.0, 0-1.0, and 0-0.50 inches H_2O column. Maximum incremental graduations of the pressure gauge shall be 0.05 inches H_2O and the minimum accuracy of the gauge shall be three percent of full scale. The minimum diameter of the pressure gauge face shall be 4 inches.

3.2 If an electronic pressure measuring device is used, the full-scale range of the device shall not exceed 0-10 inches H_2O with a minimum accuracy of 0.5 percent of full-scale. A 0-20 inches H_2O device may be used, provided the equivalent accuracy is not less than 0.25 percent of full scale.

3.3 The minimum and maximum total ullages shall be 500 and 25,000 gallons, respectively. These values are exclusive of all vapor piping volumes.

3.4 The minimum and maximum nitrogen feed-rates, into the system, shall be one (1) and five (5) CFM, respectively.

4. INTERFERENCES

4.1 Introduction of nitrogen into the system at flowrates exceeding five (5) CFM may bias the results of the test toward non-compliance.

4.2 For vacuum-assist Phase II systems which utilize an incinerator, power to the collection unit shall be turned off during testing.

4.3 For vacuum-assist systems which locate the vacuum producing device in-line between the Phase II vapor riser and the storage tank, the following requirements shall apply:

4.3.1 A valve shall be installed at the vacuum producing device. When closed, this valve shall isolate the vapor passage downstream of the vacuum producing device.

4.3.2 The storage tank side of the vacuum producing device shall be tested in accordance with the procedures outlined in Section 7 of this method. Compliance shall be determined by comparing the final five-minute pressure with the allowable minimum five-minute final pressure from the first column (1-6 affected nozzles) in Table 30-IB or use the corresponding equation in Section 9.2.

4.3.3 The upstream vapor passage (nozzle to vacuum producing device) shall also be tested. Methodology for this test shall be submitted to the Source Test Section of the BAAQMD for approval prior to submission of test results or shall be conducted in accordance with the procedures set forth in the applicable California Air Resources Board (CARB) Executive Order.

5. APPARATUS

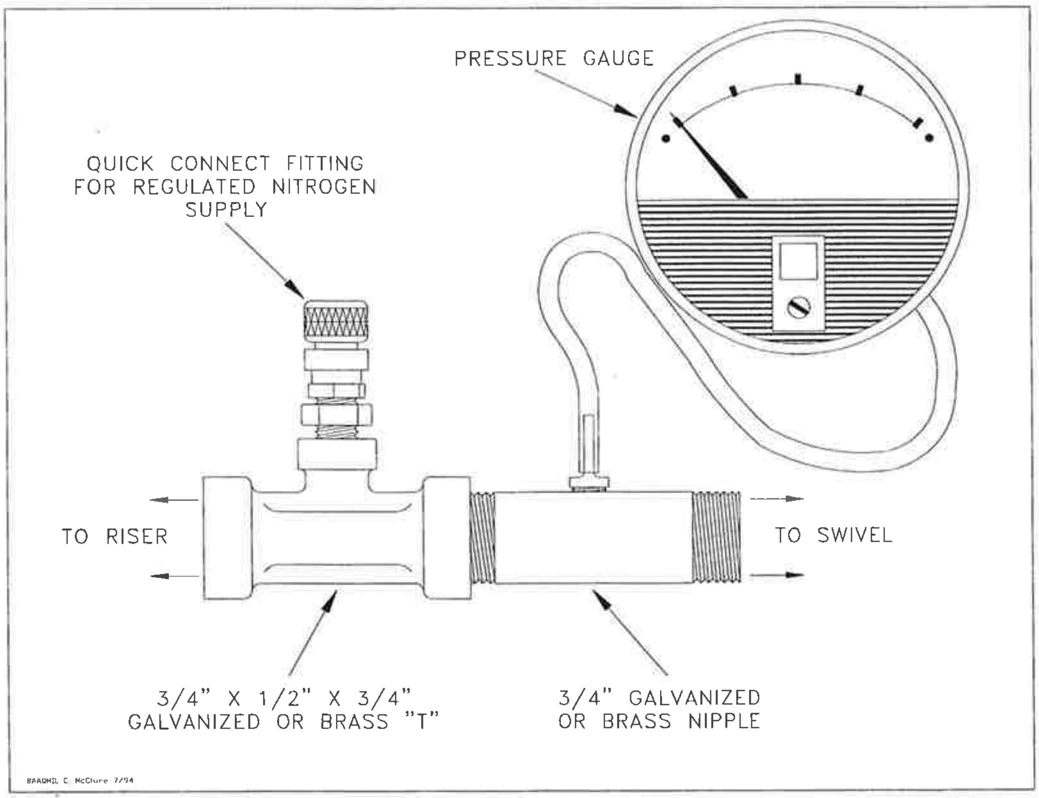
5.1 Nitrogen. Use commercial grade nitrogen in a high pressure cylinder, equipped with a two-stage pressure regulator and a one psig pressure relief valve.

5.2 Pressure Measuring Device. Use 0-2.0, 0-1.0, and 0-0.50 inches H_2O pressure gauges connected in parallel, a 0-2 inches H_2O manometer, or an electronic pressure measuring device to monitor the pressure decay in the vapor recovery system. The pressure measuring device shall, at a minimum, be readable to the nearest 0.05 inches H_2O.

5.3 "T" Connector Assembly. See Figure 30-1 for example.

Figure 30-1

"T" Connector Assembly



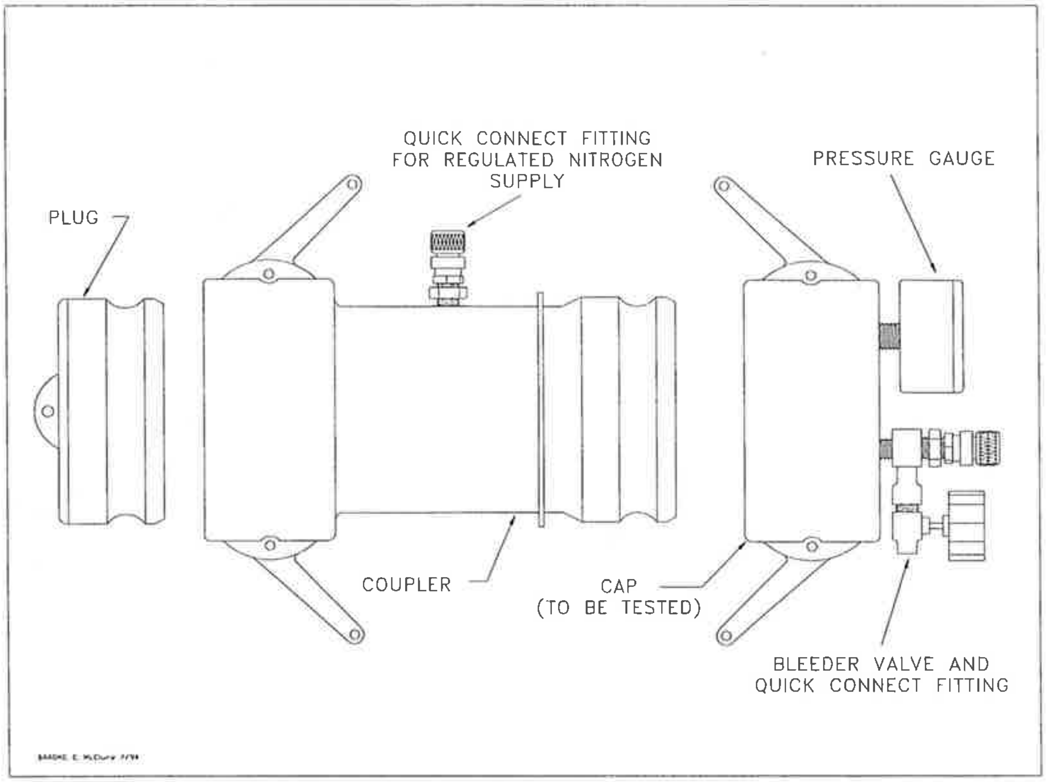
5.4 Vapor Coupler Integrity Assembly. Assemble OPW 633-A, 633-B, and 634-A adapters, or equivalent, as shown in Figure 30-2. If the test is to be conducted at the storage tank Phase I vapor coupler, this assembly shall be used prior to conducting the static leak test in order to verify the pressure integrity of the vapor poppet. The internal volume of this assembly shall not exceed 0.1 cubic feet.

5.5 Vapor Coupler Test Assembly. Use a compatible OPW 634-B cap, or equivalent, equipped with a center probe to open the poppet, a pressure measuring device to monitor the pressure decay, and a connection for the introduction of nitrogen into the system. See Figure 30-3 for an example.

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

Figure 30-2

Vapor Coupler Integrity Assembly



5.7 Flowmeter. Use a Dwyer flowmeter, Model RMC-104, or equivalent, to determine the required pressure setting of the delivery pressure gauge on the nitrogen supply pressure regulator. This pressure shall be set such that the nitrogen flowrate is between 1.0 and 5.0 CFM.

5.8 Combustible Gas Detector. A Bacharach Instrument Company, Model 0023-7356, or equivalent, may be used to verify the pressure integrity of system components during this test.

5.9 Leak Detection Solution. Any liquid solution designed to detect vapor leaks may be used to verify the pressure integrity of system components during this test.

6. PRE-TEST PROCEDURES

6.1 The following safety precautions shall be followed:

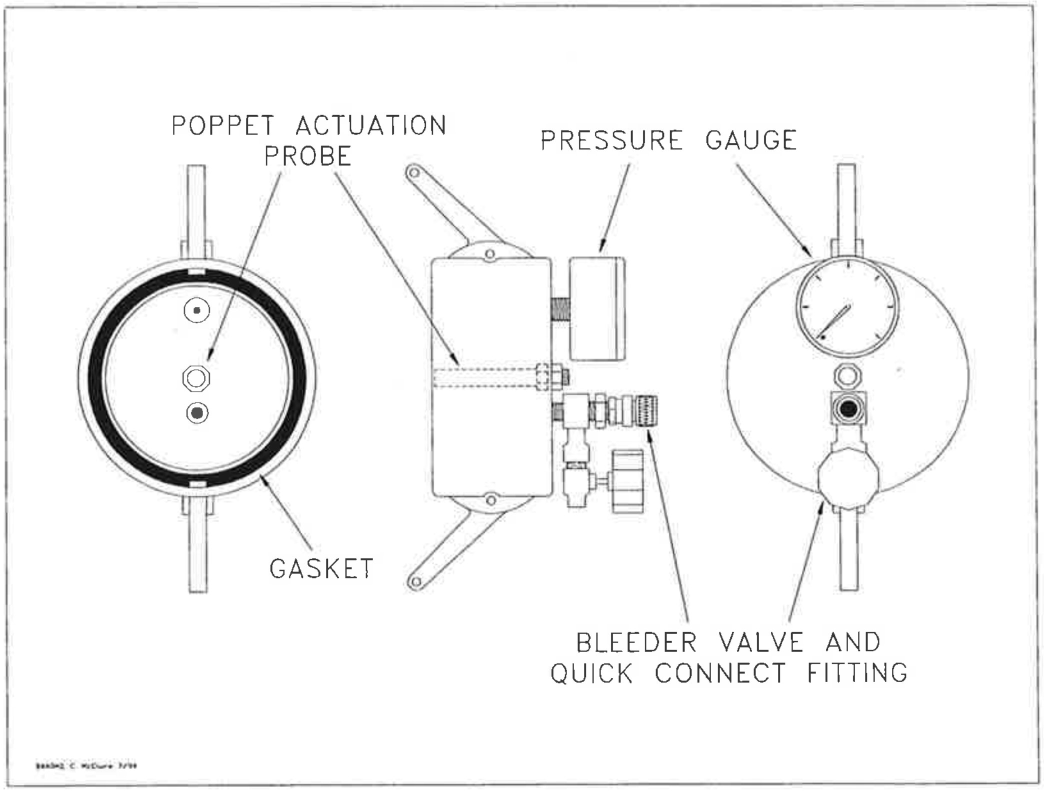
6.1.1 Only nitrogen shall be used to pressurize the system.

6.1.2 A one psig relief valve shall be installed to prevent the possible over-pressurizing of the storage tank.

6.1.3 A ground strap should be employed during the introduction of nitrogen into the system.

Figure 30-3

Vapor Coupler Test Assembly



6.2 Product dispensing shall not occur during the test. There shall have been no Phase I deliveries into or out of the storage tanks within the three hours prior to the test. For vacuum-assist Phase II systems, product dispensing shall not occur during the thirty minutes immediately prior to the test.

6.3 Measure the gallons of gasoline present in each underground storage tank and determine the actual capacity of each storage tank from facility records. Calculate the ullage space for each tank by subtracting the gasoline gallonage present from the actual tank capacity. The minimum ullage during the test shall be 25 percent of the tank capacity or 500 gallons, whichever is greater. The total ullage shall not exceed 25,000 gallons.

6.4 For two-point Phase I systems, this test shall be conducted with the dust cap removed from the vapor coupler. This is necessary to determine the vapor tightness of the Phase I vapor poppet. See Section 6.7 if this test is to be conducted at the Phase I vapor coupler.

6.4.1 For coaxial Phase I systems, this test shall be conducted with the dust cap removed from the Phase I coupler. This is necessary to insure the vapor tightness of the Phase I vapor poppet.

6.4.2 Verify that the liquid level in the storage tank is at least four (4) inches above the highest opening at the bottom of the submerged drop tube.

6.5 If the Phase I containment box is equipped with a drain valve, the valve assembly may be cleaned and lubricated prior to the test. This test shall, however, be conducted with the drain valve installed and the manhole cover removed. See subsection 7.4.1 for further details regarding containment box drain valves.

6.6 If the test is to be conducted at a Phase II vapor riser, disconnect the dispenser end of one vapor recovery hose and install the "T" connector assembly (see Figure 30-1). Connect the nitrogen gas supply (do not use air) and the pressure measuring device to the "T" connector.

6.6.1 For those Phase II systems utilizing a dispenser mounted remote vapor check valve, the "T" connector assembly shall be installed on the vapor riser side of the check valve.

6.7 If this test is to be conducted at the Phase I vapor coupler on a two-point Phase I system, the procedures set forth in subsections 6.7.1 and 6.7.2 shall be successfully completed prior to testing. The static pressure integrity test shall not be conducted at the Phase I coupler at facilities equipped with coaxial Phase I systems.

6.7.1 Connect the Vapor Coupler Integrity Assembly to the Phase I vapor coupler. Connect the Vapor Coupler Test Assembly. Connect the nitrogen supply to the assembly and carefully pressurize the internal volume of the assembly to two (2.0) inches H_2O. Start the stopwatch. Record the final pressure after one minute.

6.7.2 If the pressure after one minute is less than 0.25 inches H_2O, the leak rate through the Phase I vapor poppet precludes conducting the static leak test at this location. If the pressure after one minute is greater than or equal to 0.25 inches H_2O, the static leak test may be conducted at this location. This criteria assures a maximum leak rate through the Phase I vapor poppet of less than 0.0004 cubic feet per minute.

6.7.3 Disconnect the Vapor Coupler Integrity Assembly from the Phase I vapor coupler. If the requirements of subsection 6.7.2 were met, connect the Vapor Coupler Test Assembly to the Phase I vapor coupler.

6.8 All pressure measuring device(s) shall be bench calibrated using either a reference gauge or incline manometer. Calibration shall be performed at 20, 50, and 80 percent of full scale. Accuracy shall be within two percent at each of these calibration points. Calibrations shall be conducted on a frequency not to exceed 90 days.

6.9 Use the flowmeter to determine the nitrogen regulator delivery pressures which correspond to nitrogen flowrates of 1.0 and 5.0 CFM. These pressures define the allowable range of delivery pressures acceptable for this test procedure. Also record the regulator delivery pressure setting, and the corresponding nitrogen flowrate that will be used during the test. As an alternative, the flowmeter may be connected, in-line between the nitrogen supply regulator and Vapor Coupler Test Assembly, during the test.

6.10 Use Equation 9.3 to calculate the approximate time required to pressurize the system ullage to the initial starting pressure of two (2.0) inches H_2O. This will allow the tester to minimize the quantity of nitrogen introduced into those systems which cannot comply with the static leak standards.

6.11 Attach the Vapor Coupler Test assembly to the Phase I poppet or the "T" connector assembly to the Phase II vapor riser. Read the initial pressure of the storage tank and underground piping. If the initial pressure is greater than 0.5 inches H_2O, carefully bleed off the pressure, in accordance with all applicable safety procedures, in the storage tank and underground piping to less than 0.5 inches H_2O column.

7. TESTING

7.1 Open the nitrogen gas supply valve and set the regulator delivery pressure within the allowable range determined in Section 6.9, and start the stopwatch. Pressurize the vapor system (or subsystem for individual vapor return line systems) to **at least 2.2 inches H_2O** initial pressure. It is critical to maintain the nitrogen flow until the pressure stabilizes, indicating temperature and vapor pressure stabilization in the tanks. Check the test equipment using leak detecting solution or a combustible gas detector to verify that all test equipment is leak tight.

7.1.1 If the time required to achieve the initial pressure of two (2.0) inches H_2O exceeds twice the time derived from Equation 9.3, stop the test and use liquid leak detector, or a combustible gas detector, to find the leak(s) in the system. Failure to achieve the initial starting pressure within twice the time derived from Equation 9.3 demonstrates the inability of the system to meet the performance criteria. Repair or replace the faulty component(s) and restart the test pursuant to Section 7.1.

7.2 Close and disconnect the nitrogen supply. Start the stopwatch when the pressure has decreased to the initial starting pressure of two (2.0) inches H_2O.

7.3 At one-minute intervals during the test, record the system pressure. After five minutes, record the final system pressure. See the applicable of Tables 30-IA (or Equation 9.1) or 30-IB (or Equation 9.2) to determine the acceptability of the final system static pressure results. For intermediate values of ullage in Tables 30-IA and 30-IB, linear interpolation may be employed.

7.4 If the system failed to meet the criteria set forth in Table 30-I (or the appropriate equation in Section 9), repressurize the system and check all accessible vapor connections using leak detector solution or a combustible gas detector. If vapor leaks in the system are encountered, repair or replace the defective component and repeat the test. Potential sources of leaks include nozzle check valves, pressure/vacuum relief valves, containment box drain valve assemblies, and plumbing connections at the risers.

7.4.1 If the facility fails to comply with the static leak test standards and the Phase I system utilizes a non-CARB-certified drain valve equipped containment box, which was installed prior to July 1, 1992, for which a CARB-certified replacement drain valve assembly is not marketed, the following two subsections shall apply:

7.4.1.1 The drain valve may be removed and the port plugged. Reset the system. If the facility complies with the static leak test standards under these conditions, the facility shall be considered complying with the requirements, provided that the manufacturer and model number of the containment box and the date of installation are submitted with the test results.

7.4.1.2 The criteria set forth in subsection 7.4.1.1 shall not apply after July 1, 1996.

7.5 After the remaining system pressure has been relieved, remove the "T" connector assembly and reconnect the vapor recovery hose, if applicable.

7.6 If the vapor recovery system utilizes individual vapor return lines, repeat the leak test for each gasoline grade. Avoid leaving any vapor return line open longer than is necessary to install or remove the "T" connector assembly.

7.7 If the applicable CARB Executive requires the test to be conducted with and without the containment box cover in place, repeat the test with the cover in place. In these cases clearly specify, on Form 30-1, which results represent the pressure integrity with and without the cover in place.

8. POST-TEST PROCEDURES

8.1 Use the applicable of Table 30-IA or 30-IB, or the applicable of Equations 9.1 or 9.2, to determine the compliance status of the facility by comparing the final five-minute pressure with the minimum allowable final pressure.

8.1.1 For balance Phase II systems use Table 30-IA or the applicable of Equation 9.1 to determine compliance.

8.1.2 For vacuum-assist Phase II systems use Table 30-IB or the applicable of Equation 9.2 to determine compliance.

9. CALCULATIONS

9.1 For Phase II Balance Systems, the minimum allowable five-minute final pressure, with an initial pressure of two (2.0) inches H_2O, shall be calculated as follows:

[Equation 9-1]

$$P_f = 2e^{\frac{-760.490}{V}} \quad \text{if } N = 1\text{-}6$$

$$P_f = 2e^{\frac{-792.196}{V}} \quad \text{if } N = 7\text{-}12$$

$$P_f = 2e^{\frac{-824.023}{V}} \quad \text{if } N = 13\text{-}18$$

$$P_f = 2e^{\frac{-855.974}{V}} \quad \text{if } N = 19\text{-}24$$

$$P_f = 2e^{\frac{-888.047}{V}} \quad \text{if } N > 24$$

Where:

N = The number of affected nozzles. For manifolded systems, N equals the total number of nozzles. For dedicated plumbing configurations, N equals the number of nozzles serviced by the tank being tested.

P_f = The minimum allowable five-minute final pressure, inches H_2O

V = The total ullage affected by the test, gallons

e = A dimensionless constant approximately equal to 2.718

2 = The initial starting pressure, inches H_2O

9.2 For Phase II Vacuum Assist Systems, the minimum allowable five-minute final pressure, with an initial pressure of two (2.0) inches H_2O, shall be calculated as follows:

[Equation 9-2]

$$P_f = 2e^{\frac{-500.887}{V}} \quad \text{if } N = 1\text{-}6$$

$$P_f = 2e^{\frac{-531.614}{V}} \quad \text{if } N = 7\text{-}12$$

$$P_f = 2e^{\frac{-562.455}{V}} \quad \text{if } N = 13\text{-}18$$

$$P_f = 2e^{\frac{-593.412}{V}} \quad \text{if } N = 19\text{-}24$$

$$P_f = 2e^{\frac{-624.483}{V}} \quad \text{if } N > 24$$

Where:

N = The number of affected nozzles. For manifolded systems, N equals the total number of nozzles. For dedicated plumbing configurations, N equals the number of nozzles serviced by the tank being tested.
P_f = The minimum allowable five-minute final pressure, inches H_2O
V = The total ullage affected by the test, gallons
e = A dimensionless constant approximately equal to 2.718
2 = The initial starting pressure, inches H_2O

9.3 The minimum time required to pressurize the system ullage from zero (0) to two (2.0) inches H_2O gauge pressure shall be calculated as follows:

$$t_2 = \frac{V}{[1522]\,F} \qquad \text{[Equation 9-3]}$$

Where:

t_2 = The minimum time to pressurize the ullage to two inches H_2O, minutes
V = The total ullage affected by the test, gallons
F = The nitrogen flowrate into the system, CFM
1522 = The conversion factor for pressure and gallons

9.4 If the policy of the local District requires an allowable tolerance for testing error, the minimum allowable five-minute final pressure, including testing error, shall be calculated as follows:

$$P_{f-E} = 2 - \left[1 + \left(\frac{E}{100}\right)\right]\left[408.9 - \left(P_f + 406.9\right)\right] \qquad \text{[Equation 9-4]}$$

Where:

$P_{f\text{-}E}$ = The minimum allowable five-minute final pressure including allowable testing error, inches H_2O
E = The allowable testing error, percent
P_f = The minimum allowable five-minute final pressure calculated in Equations 9-1 or 9-2, inches H_2O
2 = The initial starting pressure, inches H_2O
408.9 = Atmospheric pressure plus the initial starting pressure, inches H_2O
406.9 = Atmospheric pressure, inches H_2O

10. REPORTING

10.1 The calculated ullage and system pressures for each five-minute vapor recovery system test shall be reported as shown in Form 30-1. Be sure to include the Phase I system type (two-point or coaxial), the Phase II system type, whether the system is manifolded, and the one-minute pressures during the test.

TABLE 30-1A

PHASE II BALANCE SYSTEMS

PRESSURE DECAY LEAK RATE CRITERIA

INITIAL PRESSURE OF 2 INCHES OF H_2O

MINIMUM PRESSURE AFTER 5 MINUTES, INCHES OF H_2O

ULLAGE, GALLONS	NUMBER OF AFFECTED NOZZLES				
	01-06	07-12	13-18	19-24	> 24
500	**0.44**	**0.41**	**0.38**	**0.36**	**0.34**
550	0.50	0.47	0.45	0.42	0.40
600	**0.56**	**0.53**	**0.51**	**0.48**	**0.46**
650	0.62	0.59	0.56	0.54	0.51
700	**0.67**	**0.64**	**0.62**	**0.59**	**0.56**
750	0.73	0.70	0.67	0.64	0.61
800	**0.77**	**0.74**	**0.71**	**0.69**	**0.66**
850	0.82	0.79	0.76	0.73	0.70
900	**0.86**	**0.83**	**0.80**	**0.77**	**0.75**
950	0.90	0.87	0.84	0.81	0.79
1,000	**0.93**	**0.91**	**0.88**	**0.85**	**0.82**
1,200	1.06	1.03	1.01	0.98	0.95
1,400	**1.16**	**1.14**	**1.11**	**1.09**	**1.06**
1,600	1.24	1.22	1.19	1.17	1.15
1,800	**1.31**	**1.29**	**1.27**	**1.24**	**1.22**
2,000	1.37	1.35	1.32	1.30	1.28
2,200	**1.42**	**1.40**	**1.38**	**1.36**	**1.34**
2,400	1.46	1.44	1.42	1.40	1.38
2,600	**1.49**	**1.47**	**1.46**	**1.44**	**1.42**
2,800	1.52	1.51	1.49	1.47	1.46
3,000	**1.55**	**1.54**	**1.52**	**1.50**	**1.49**
3,500	1.61	1.59	1.58	1.57	1.55
4,000	**1.65**	**1.64**	**1.63**	**1.61**	**1.60**
4,500	1.69	1.68	1.67	1.65	1.64
5,000	**1.72**	**1.71**	**1.70**	**1.69**	**1.67**
6,000	1.76	1.75	1.74	1.73	1.72
7,000	**1.79**	**1.79**	**1.78**	**1.77**	**1.76**
8,000	1.82	1.81	1.80	1.80	1.79
9,000	**1.84**	**1.83**	**1.83**	**1.82**	**1.81**
10,000	1.85	1.85	1.84	1.84	1.83
15,000	**1.90**	**1.90**	**1.89**	**1.89**	**1.89**
20,000	1.93	1.92	1.92	1.92	1.91
25,000	**1.94**	**1.94**	**1.94**	**1.93**	**1.93**

Note: For manifolded Phase II Balance Systems, the **"Number of Affected Nozzles"** shall be the total of all gasoline nozzles. For dedicated return configurations, the **"Number of Affected Nozzles"** shall be the total of those nozzles served by the tank being tested.

TABLE 30-1B

PHASE II ASSIST SYSTEMS

PRESSURE DECAY LEAK RATE CRITERIA

INITIAL PRESSURE OF 2 INCHES OF H_2O

MINIMUM PRESSURE AFTER 5 MINUTES, INCHES OF H_2O

ULLAGE, GALLONS	NUMBER OF AFFECTED NOZZLES				
	01-06	07-12	13-18	19-24	≥ 24
500	**0.73**	**0.69**	**0.65**	**0.61**	**0.57**
550	0.80	0.76	0.72	0.68	0.64
600	**0.87**	**0.82**	**0.78**	**0.74**	**0.71**
650	0.93	0.88	0.84	0.80	0.77
700	**0.98**	**0.94**	**0.90**	**0.86**	**0.82**
750	1.03	0.98	0.94	0.91	0.87
800	**1.07**	**1.03**	**0.99**	**0.95**	**0.92**
850	1.11	1.07	1.03	1.00	0.96
900	**1.15**	**1.11**	**1.07**	**1.03**	**1.00**
950	1.18	1.14	1.11	1.07	1.04
1,000	**1.21**	**1.18**	**1.14**	**1.10**	**1.07**
1,200	1.32	1.28	1.25	1.22	1.19
1,400	**1.40**	**1.37**	**1.34**	**1.31**	**1.28**
1,600	1.46	1.43	1.41	1.38	1.35
1,800	**1.51**	**1.49**	**1.46**	**1.44**	**1.41**
2,000	1.56	1.53	1.51	1.49	1.46
2,200	**1.59**	**1.57**	**1.55**	**1.53**	**1.51**
2,400	1.62	1.60	1.58	1.56	1.54
2,600	**1.65**	**1.63**	**1.61**	**1.59**	**1.57**
2,800	1.67	1.65	1.64	1.62	1.60
3,000	**1.69**	**1.68**	**1.66**	**1.64**	**1.62**
3,500	1.73	1.72	1.70	1.69	1.67
4,000	**1.76**	**1.75**	**1.74**	**1.72**	**1.71**
4,500	1.79	1.78	1.77	1.75	1.74
5,000	**1.81**	**1.80**	**1.79**	**1.78**	**1.77**
6,000	1.84	1.83	1.82	1.81	1.80
7,000	**1.86**	**1.85**	**1.85**	**1.84**	**1.83**
8,000	1.88	1.87	1.86	1.86	1.85
9,000	**1.89**	**1.89**	**1.88**	**1.87**	**1.87**
10,000	1.90	1.90	1.89	1.88	1.88
15,000	**1.93**	**1.93**	**1.93**	**1.92**	**1.92**
20,000	1.95	1.95	1.94	1.94	1.94
25,000	**1.96**	**1.96**	**1.96**	**1.95**	**1.95**

Note: For manifolded Phase II Assist Systems, the "**Number of Affected Nozzles**" shall be the total of all gasoline nozzles. For dedicated return configurations, the "**Number of Affected Nozzles**" shall be the total of those nozzles served by the tank being tested.

Form 30-1

Distribution:	BAY AREA AIR QUALITY MANAGEMENT DISTRICT	
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**	Report No.: ____________ Test Date: ____________ Test Times: Run A: ____________ Run B: ____________ Run C: ____________

Source Information		Facility Parameters
GDF Name and Address	**GDF Representative and Title**	**PHASE II SYSTEM TYPE** (Check One)
		Balance ☐
		Vapor Assist ☐
	GDF Phone No. ( )	**Type:**
	Source: GDF Vapor Recovery System	**Other** ☐
Permit Conditions	**BAAQMD GDF #** ____________	**Identify:**
	BAAQMD A/C # ____________	**Manifolded?** **Y or N**

Operating Parameters:

Number of Nozzles Served by Tank #1	______	Number of Nozzles Served by Tank #3	______
Number of Nozzles Served by Tank #2	______	Total Number of Gas Nozzles at Facility	______

Applicable Regulations: BAAQMD REGULATION 8, RULE 7 | FOR OFFICE USE ONLY:

Source Test Results and Comments:

TANK #:	1	2	3	TOTAL
1. Product Grade				
2. Actual Tank Capacity, gallons				
3. Gasoline Volume, Gallons				
4. Ullage, gallons (#2 -#3)				
5. Phase I System Type				
6. Initial Test Pressure, Inches H_2O **(2.0)**				
7. Pressure After 1 Minute, Inches H_2O				
8. Pressure After 2 Minutes, Inches H_2O				
9. Pressure After 3 Minutes, Inches H_2O				
10. Pressure After 4 Minutes, Inches H_2O				
11. **Final Pressure After 5 Minutes, Inches H_2O**				
12. Allowable Final Pressure from Table 30-I				
13. Test Status [**Pass** or **Fail**]				

Test Conducted by:	Test Company Name ____________ Address City ____________	Date and Time of Test:

California Environmental Protection Agency

Air Resources Board

Vapor Recovery Test Procedure

TP-201.3

Determination of 2 Inch WC
Static Pressure Performance of Vapor Recovery
Systems of Dispensing Facilities

Adopted: April 12, 1996
Amended: March 17, 1999
Amended: July 26, 2012

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California Environmental Protection Agency
Air Resources Board
Vapor Recovery Test Procedure

TP-201.3

Determination of 2 Inch WC Static Pressure Performance of Vapor Recovery Systems of Dispensing Facilities

1 APPLICABILITY

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 "ARB" or "CARB" refers to the California Air Resources Board, and the term "Executive Officer" refers to the ARB Executive Officer or his or her authorized representative or designate.

1.1 This test procedure is used to quantify the vapor tightness of vapor recovery systems installed at gasoline dispensing facilities (GDF) equipped with pressure/vacuum (P/V) valves, provided that the designed pressure setting of the P/V valves is a minimum of 2.5 inches of water column (inches H_2O).

1.2 Systems equipped with a P/V valve(s) allowed to have a designed cracking pressure less than 2.5 inches H_2O shall be bagged to eliminate any flow contribution through the valve assembly from the test results. The valve/vent pipe connection, however, shall remain unobstructed during this test.

1.3 At facilities not required to be equipped with a P/V valve(s), the vent pipe(s) shall be capped. For those installations, the test may be conducted at the vent pipe(s).

2 PRINCIPLE AND SUMMARY OF TEST PROCEDURE

2.1 The entire vapor recovery system is pressurized with nitrogen to two (2.0) inches H_2O. The system pressure is then allowed to decay and the pressure after five (5) minutes is compared with an allowable value. The minimum allowable five-minute final pressure is based on the system ullage and pressure decay equations. For the purpose of compliance determination, this test shall be conducted after all back-filling, paving, and installation of all Phase I and Phase II components, including P/V valves, has been completed.

2.2 For GDF equipped with a coaxial Phase I system, this test shall be conducted at a Phase II vapor riser. For GDF which utilize a two-point Phase I system, this test may be conducted at either a Phase II riser or a Phase I vapor coupler provided that the criteria set forth in Section 6.7 have been met. If the integrity criteria for two-point systems specified in Section 6.7 are met, it is recommended that this test be conducted at the Phase I vapor coupler.

3 RANGE

3.1 If mechanical pressure gauges are employed, the full-scale range of pressure gauges shall be 0-2.0, 0-1.0, and 0-0.50 inches H_2O column. Maximum incremental graduations of the pressure gauge shall be 0.05 inches H_2O and the minimum accuracy of the gauge shall be three percent of full scale. The minimum diameter of the pressure gauge face shall be 4 inches.

3.2 If an electronic pressure measuring device is used, the full-scale range of the device shall not exceed 0-10 inches H_2O with a minimum accuracy of 0.5 percent of full-scale. A 0-20 inches H_2O device may be used, provided the equivalent accuracy is not less than 0.25 percent of full-scale.

3.3 The minimum total ullage, for each individual tank, shall be 1,000 gallons or 25% of the tank capacity, whichever is less. The maximum total ullage, for all manifolded tanks, shall not exceed 25,000 gallons. These values are exclusive of all vapor piping volumes.

3.4 The minimum and maximum nitrogen feed-rates, into the system, shall be one (1) and five (5) CFM, respectively.

4 INTERFERENCES

4.1 Introduction of nitrogen into the system at flowrates exceeding five (5) CFM may bias the results of the test toward non-compliance. Only gaseous nitrogen shall be used to conduct this test. Air, liquefied nitrogen, helium, or any gas other than nitrogen shall not be used for this test procedure.

4.2 For vacuum-assist Phase II systems which utilize an incinerator, power to the collection unit and the processor shall be turned off during testing.

4.3 For vacuum-assist systems, with positive displacement vacuum pumps, which locate the vacuum producing device in-line between the Phase II vapor riser and the storage tank, the following requirements shall apply:

4.3.1 A valve shall be installed at the vacuum producing device. When closed, this valve shall isolate the vapor passage downstream of the vacuum producing device.

4.3.2 The storage tank side of the vacuum producing device shall be tested in accordance with the procedures outlined in Section 7 of this method. Compliance shall be determined by comparing the final five-minute pressure with the allowable minimum five-minute final pressure from the first column (1-6 affected nozzles) in Table IB or use the corresponding equation in Section 9.2.

4.3.3 The upstream vapor passage (nozzle to vacuum producing device) shall also be tested. Methodology for this test shall be submitted to the California Air Resources Board (CARB) for approval prior to submission of test results or shall be conducted in accordance with the procedures set forth in the applicable CARB Executive Order.

4.4 The results of this static pressure integrity test shall not be used to verify compliance if an Air to Liquid Volumetric Ratio Test (TP-201.5 or equivalent) was conducted within 24 hours prior to this test.

4.5 Thermal Bias for Electronic Manometers

Electronic manometers shall have a warm-up period of at least 15 minutes followed by a five minute drift check. If the drift exceeds 0.01 inches water column, the instrument should not be used.

5 APPARATUS

5.1 Nitrogen

Use commercial grade nitrogen in a high pressure cylinder, equipped with a two-stage pressure regulator and a one psig pressure relief valve.

5.2 Pressure Measuring Device

Use 0-2.0, 0-1.0, and 0-0.50 inches H_2O pressure gauges connected in parallel, a 0-2 inches H_2O manometer, or an electronic pressure measuring device to monitor the pressure decay in the vapor recovery system. The pressure measuring device shall, at a minimum, be readable to the nearest 0.05 inches H_2O.

5.3 “T” Connector Assembly

See Figure 1 for example.

5.4 Vapor Coupler Integrity Assembly

Assemble OPW 633-A, 633-B, and 634-A adapters, or equivalent, as shown in Figure 2. If the test is to be conducted at the storage tank Phase I vapor coupler, this assembly shall be used prior to conducting the static leak test in order to verify the pressure integrity of the vapor poppet. The internal volume of this assembly shall not exceed 0.1 cubic feet.

5.5 Vapor Coupler Test Assembly

Use a compatible OPW 634-B cap, or equivalent, equipped with a center probe to open the poppet, a pressure measuring device to monitor the pressure decay, and a connection for the introduction of nitrogen into the system. See Figure 3 for an example.

5.6 Stopwatch

Use a stopwatch accurate to within 0.2 seconds.

5.7 Flow Meter

Use a Dwyer flowmeter, Model RMC-104, or equivalent, to determine the required pressure setting of the delivery pressure gauge on the nitrogen supply pressure regulator. This pressure shall be set such that the nitrogen flowrate is between 1.0 and 5.0 CFM.

5.8 Combustible Gas Detector

A Bacharach Instrument Company, Model 0023-7356, or equivalent, may be used to verify the pressure integrity of system components during this test.

5.9 Leak Detection Solution

Any liquid solution designed to detect vapor leaks may be used to verify the pressure integrity of system components during this test.

6 PRE-TEST PROCEDURES

6.1 The following safety precautions shall be followed:

6.1.1 Only nitrogen shall be used to pressurize the system.

6.1.2 A one psig relief valve shall be installed to prevent the possible over-pressurizing of the storage tank.

6.1.3 A ground strap should be employed during the introduction of nitrogen into the system.

6.2 Failure to adhere to any or all of the following time and activity restrictions shall invalidate the test results:

6.2.1 There shall be no Phase I bulk product deliveries into or out of the storage tank(s) within the three (3) hours prior to the test or during performance of this test procedure.

6.2.2 There shall be no product dispensing within thirty (30) minutes prior to the test or during performance of this test procedure.

6.2.3 Upon commencement of the thirty minute “no dispensing” portion of this procedure, the headspace pressure in the tank shall be measured. If the pressure exceeds 0.50 inches H_2O, the pressure shall be carefully relieved in accordance with all applicable safety requirements. After the thirty minute “no dispensing” portion of this procedure, and prior to introduction of nitrogen, the headspace pressure shall again be lowered, if necessary, to less than 0.50 inches H_2O.

6.2.4 There shall be no Air to Liquid Volumetric Ratio Test (TP-201.5 or equivalent) conducted within the twenty-four (24) hour period immediately prior to this test.

6.2.5 The test shall be conducted with the station in normal operating mode. This includes all nozzles properly hung up in the dispenser boots and all dispenser cabinet covers in place. The exception to normal operating mode is that dispensing is disallowed as specified.

6.3 Measure the gallons of gasoline present in each underground storage tank and determine the actual capacity of each storage tank from facility records. Calculate the ullage space for each tank by subtracting the gasoline gallonage present from the actual tank capacity. The minimum ullage during the test, for all manifolded tanks, shall be 1,000 gallons or 25 percent of the tank capacity, whichever is less. The total ullage, for all manifolded tanks, shall not exceed 25,000 gallons.

6.4 For two-point Phase I systems, this test shall be conducted with the dust cap removed from both the product and the vapor coupler. This is necessary to determine the vapor tightness of the Phase I vapor poppet. See Section 6.7 if this test is to be conducted at the Phase I vapor coupler.

6.4.1 For coaxial Phase I systems, this test shall be conducted with the dust cap removed from the Phase I coupler. This is necessary to insure the vapor tightness of the Phase I vapor poppet.

6.4.2 Verify that the liquid level in the storage tank is at least four (4) inches above the highest opening at the bottom of the submerged drop tube.

6.5 If the Phase I containment box is equipped with a drain valve, this test shall be conducted with the drain valve installed and the manhole cover removed. If the drain valve is cover-actuated, the test shall be done once with the cover removed and repeated with the cover installed.

6.6 If the test is to conducted at a Phase II vapor riser, disconnect the dispenser end of one vapor recovery hose and install the “T” connector assembly (see Figure 1). Connect the nitrogen gas supply (do not use air) and the pressure measuring device to the “T” connector.

6.6.1 For those Phase II vapor systems utilizing a dispenser mounted remote vapor check valve, the “T” connector assembly shall be installed on the vapor riser side of the check valve.

6.7 If this test is to be conducted at the Phase I vapor coupler on a two-point Phase I system, the procedures set forth in subsections 6.7.1 and 6.7.2 shall be successfully completed prior to testing. The static pressure integrity test shall not be conducted at the Phase I coupler at facilities equipped with coaxial Phase I systems.

6.7.1 Connect the Vapor Coupler Integrity Assembly to the Phase I vapor coupler. Connect the Vapor Coupler Test Assembly. Connect the nitrogen supply to the assembly and carefully pressurize the internal volume of the assembly to two (2.0) inches H_2O. Start the stopwatch. Record the final pressure after one minute.

6.7.2 If the pressure after one minute is less than 0.25 inches H_2O, the leak rate through the Phase I vapor poppet precludes conducting the static leak test at this location. If the pressure after one minute is greater than or equal to 0.25 inches H_2O, the static leak test may be conducted at this location. This criteria assures a maximum leak rate through the Phase I vapor poppet of less than 0.0004 cubic feet per minute.

6.7.3 Disconnect the Vapor Coupler Integrity Assembly to the Phase I vapor coupler. If the requirements of subsection 6.7.2 were met, connect the Vapor Coupler Test Assembly to the Phase I vapor coupler.

6.7.4 Product may be poured onto the Phase I vapor coupler to check for leaks. This diagnostic procedure shall not be substituted for the procedures set forth in subsections 6.7.1 and 6.7.2.

6.8 All pressure measuring device(s) shall be bench calibrated using either a reference gauge or incline manometer. Calibration shall be performed at 20, 50, and 80 percent of full scale. Accuracy shall be within two percent at each of these calibration points. Calibrations shall be conducted on a frequency not to exceed 90 days.

6.9 Use the flowmeter to determine the nitrogen regulator delivery pressures which correspond to nitrogen flowrates of 1.0 and 5.0 CFM. These pressures define the allowable range of delivery pressures acceptable for this test procedure. Also record the regulator delivery pressure setting, and the corresponding nitrogen flowrate that will be used during the test. As an alternative, the flowmeter may be connected, in-line between the nitrogen supply regulator and Vapor Coupler Test Assembly, during the test.

6.10 Use Equation 9.3 to calculate the approximate time required to pressurize the system ullage to the initial starting pressure of two (2.0) inches H_2O. This will allow the tester to minimize the quantity of nitrogen introduced into those systems which cannot comply with the static leak standards.

6.11 Attach the Vapor Coupler Test assembly to the Phase I poppet or the "T" connector assembly to the Phase II vapor riser. Read the initial pressure of the storage tank and underground piping. If the initial pressure is greater than 0.5 inches H_2O, carefully bleed off the pressure, in accordance with all applicable safety procedures, in the storage tank and underground piping to less than 0.5 inches H_2O column.

6.12 Any electronic manometers shall be subject to warm-up and drift check before use; see Section 4.5.

7 TESTING

7.1 Open the nitrogen gas supply valve and set the regulator delivery pressure within the allowable range determined in Section 6.9, and start the stopwatch. Pressurize the vapor system (or subsystem for individual vapor return line systems) to **at least 2.2 inches H_2O** initial pressure. It is critical to maintain the nitrogen flow until the pressure stabilizes, indicating temperature and vapor pressure stabilization in the tanks. Check the test equipment using leak detecting solution or a combustible gas detector to verify that all test equipment is leak tight. Note: if a combustible gas detector is used to search for leaks, components which were certified with an allowable leak rate, such as 0.38 CFH at a pressure of two (2) inches, cannot be determined to be faulty solely on the basis of the concentration registered on the instrument.

7.1.1 If the time required to achieve the initial pressure of two (2.0) inches H_2O exceeds twice the time derived from Equation 9.3, stop the test and use liquid leak detector, or a combustible gas detector, to find leak(s) in the system. Failure to achieve the initial starting pressure within twice the time derived from Equation 9.3 demonstrates the inability of the system to meet the performance criteria. Repair or replace the faulty component(s) and restart the test pursuant to Section 7.1.

7.2 Close and disconnect the nitrogen supply. Start the stopwatch when the pressure has decreased to the initial starting pressure of two (2.0) inches H_2O.

7.3 At one-minute intervals during the test, record the system pressure. After five minutes, record the final system pressure. See the applicable of Tables 1A (or Equation 9.1) or 1B (or equation 9.2) to determine the acceptability of the final system static pressure results. For intermediate values of ullage in Tables 1A and 1B, linear interpolation may be employed.

7.4 If the system failed to meet the criteria set forth in Table 1A or 1B (or the appropriate equation in Section 9), repressurize the system and check all accessible vapor connections using leak detector solution or a combustible gas detector. If vapor leaks in the system are encountered, repair or replace the defective component and repeat the test. Potential sources of leaks include nozzle check valves, nozzle vapor paths, pressure/vacuum relief valves, containment box drain valve assemblies, and plumbing connections at the risers.

7.4.1 If the facility fails to comply with the static leak test standards and the two point Phase I system utilizes overfill prevention devices in the drop tubes which were installed before July 1, 1993, and which are unable to pass the test with the dust caps removed from the product and vapor couplers (see Sec. 6.4), the test may be conducted with the caps on the couplers, as an exception.

This exception is not intended to allow bleed holes in drop tubes.

This exception expires on January 1, 2002, after which date all testing shall be conducted with the fill and vapor caps removed from two point systems. Under no circumstances may the test be conducted with the caps on coaxial Phase I couplers.

7.5 After the remaining system pressure has been relieved, remove the “T” connector assembly and reconnect the vapor recovery hose, if applicable.

7.6 If the vapor recovery system utilizes individual vapor return lines, repeat the leak test for each gasoline grade. Avoid leaving any vapor return line open longer than is necessary to install or remove the “T” connector assembly.

7.7 If the applicable CARB Executive Order requires the test to be conducted with and without the containment box cover in place, repeat the test with the cover in place. In these cases clearly specify, on Form 1, which results represent the pressure integrity with and without the cover in place.

8 POST-TEST PROCEDURES

8.1 Use the applicable of Table 1A or 1B, or the applicable of Equations 9.1 or 9.2, to determine the compliance status of the facility by comparing the final five-minute pressure with the minimum allowable final pressure.

8.1.1 For balance Phase II systems use Table 1A or the applicable of Equation 9.1 to determine compliance.

8.1.2 For vacuum-assist Phase II systems use Table 1B or the applicable of Equation 9.2 to determine compliance.

9 CALCULATIONS

9.1 For Phase II Balance Systems, the minimum allowable five-minute final pressure, with an initial pressure of two (2.0) inches H_2O, shall be calculated as follows:

$$P_f = 2e^{\left(\frac{-760.490}{V}\right)} \quad \text{if } N = 1\text{-}6$$ [Equation 9-1]

$$P_f = 2e^{\left(\frac{-792.196}{V}\right)} \quad \text{if } N = 7\text{-}12$$

$$P_f = 2e^{\left(\frac{-824.023}{V}\right)} \quad \text{if } N = 13\text{-}18$$

$$P_f = 2e^{\left(\frac{-855.974}{V}\right)} \quad \text{if } N = 19\text{-}24$$

$$P_f = 2e^{\left(\frac{-888.047}{V}\right)} \quad \text{if } N > 24$$

where:

N = The number of affected nozzles. For manifolded systems, N equals the total number of nozzles. For dedicated plumbing configurations, N equals the number of nozzles serviced by the tank being tested.

P_f = The minimum allowable five-minute pressure, inches H_2O

V = The total ullage affected by the test, gallons

e = A dimensionless constant approximately equal to 2.718

2 = The initial starting pressure, inches H_2O

9.2 For Phase II Vacuum Assist Systems, the minimum allowable five-minute final pressure, with an initial pressure of two (2.0) inches H_2O, shall be calculated as follows:

$$P_f = 2e^{\left(\frac{-500.887}{V}\right)} \quad \text{if } N = 1\text{-}6$$ [Equation 9-2]

$$P_f = 2e^{\left(\frac{-531.614}{V}\right)} \quad \text{if } N = 7\text{-}12$$

$$P_f = 2e^{\left(\frac{-562.455}{V}\right)} \quad \text{if } N = 13\text{-}18$$

$$P_f = 2e^{\left(\frac{-593.412}{V}\right)} \quad \text{if } N = 19\text{-}24$$

$$P_f = 2e^{\left(\frac{-624.483}{V}\right)} \quad \text{if } N > 24$$

where:

N = The number of affected nozzles. For manifolded systems, N equals the number of nozzles. For dedicated plumbing configurations, N equals the number of nozzles serviced by the tank being tested.

P_f = The minimum allowable five-minute final pressure, inches H_2O

V = The total ullage affected by the test, gallons

e = A dimensionless constant approximately equal to 2.718

2 = The initial starting pressure, inches H_2O

9.3 The minimum time required to pressurize the system ullage from zero (0) to two (2.0) inches H_2O gauge pressure shall be calculated as follows:

$$t_2 = \frac{V}{(1522)F}$$ [Equation 9-3]

where:

t_2 = The minimum time to pressurize the ullage to two inches H_2O, minutes

V = The total ullage affected by the test, gallons

F = The nitrogen flowrate into the system, CFM

1522 = The conversion factor for pressure and gallons

9.4 If the policy of the local District requires an allowable tolerance for testing error, the minimum allowable five-minute final pressure, including testing error, shall be calculated as follows:

$$P_{f\text{-}E} = 2 - \left[1 + \left(\frac{E}{100}\right)\right]\left[408.9 - \left(P_f + 406.9\right)\right] \qquad \text{[Equation 9-4]}$$

where:

$P_{f\text{-}E}$ = The minimum allowable five-minute final pressure including allowable testing error, inches H_2O

E = The allowable testing error, percent

P_f = The minimum allowable five-minute final pressure calculated in Equations 9-1 or 9-2, inches H_2O

2 = The initial starting pressure, inches H_2O

408.9 = Atmospheric pressure plus the initial starting pressure, inches H_2O

406.9 = Atmospheric pressure, inches H_2O

10 REPORTING

10.1 The calculated ullage and system pressures for each five-minute vapor recovery system test shall be reported as shown in Form 1. District may require the use of alternate forms, provided they include the same minimum parameters identified in Form 1. Be sure to include the Phase I system type (two-point or coaxial), the Phase II system type, whether the system is manifolded, and the one-minute pressures during the test.

TABLE 1A

PHASE II **BALANCE** SYSTEMS

PRESSURE DECAY CRITERIA

INITIAL PRESSURE OF 2 INCHES WATER COLUMN (WC)

MINIMUM PRESSURE AFTER 5 MINUTES, INCHES WC

ULLAGE, GALLONS	NUMBER OF AFFECTED NOZZLES 01-06	07-12	13-18	19-24	>24
500	**0.44**	**0.41**	**0.38**	**0.36**	**0.34**
550	0.50	0.47	0.45	0.42	0.40
600	**0.56**	**0.53**	**0.51**	**0.48**	**0.46**
650	0.62	0.59	0.56	0.54	0.51
700	**0.67**	**0.64**	**0.62**	**0.59**	**0.56**
750	0.73	0.70	0.67	0.64	0.61
800	**0.77**	**0.74**	**0.71**	**0.69**	**0.66**
850	0.82	0.79	0.76	0.73	0.70
900	**0.86**	**0.83**	**0.80**	**0.77**	**0.75**
950	0.90	0.87	0.84	0.81	0.79
1,000	**0.93**	**0.91**	**0.88**	**0.85**	**0.82**
1,200	1.06	1.03	1.01	0.98	0.95
1,400	**1.16**	**1.14**	**1.11**	**1.09**	**1.06**
1,600	1.24	1.22	1.19	1.17	1.15
1,800	**1.31**	**1.29**	**1.27**	**1.24**	**1.22**
2,000	1.37	1.35	1.32	1.30	1.28
2,200	**1.42**	**1.40**	**1.38**	**1.36**	**1.34**
2,400	1.46	1.44	1.42	1.40	1.38
2,600	**1.49**	**1.47**	**1.46**	**1.44**	**1.42**
2,800	1.52	1.51	1.49	1.47	1.46
3,000	**1.55**	**1.54**	**1.52**	**1.50**	**1.49**
3,500	1.61	1.59	1.58	1.57	1.55
4,000	**1.65**	**1.64**	**1.63**	**1.61**	**1.60**
4,500	1.69	1.68	1.67	1.65	1.64
5,000	**1.72**	**1.71**	**1.70**	**1.69**	**1.67**
6,000	1.76	1.75	1.74	1.73	1.72
7,000	**1.79**	**1.79**	**1.78**	**1.77**	**1.76**
8,000	1.82	1.81	1.80	1.80	1.79
9,000	**1.84**	**1.83**	**1.83**	**1.82**	**1.81**
10,000	1.85	1.85	1.84	1.84	1.83
15,000	**1.90**	**1.90**	**1.89**	**1.89**	**1.89**
20,000	1.93	1.91	1.92	1.92	1.91
25,000	**1.94**	**1.94**	**1.94**	**1.93**	**1.93**

Note: For manifolded Phase II Balance Systems, the **"Number of Affected Nozzles"** shall be the total of all gasoline nozzles. For dedicated return configurations, the **"Number of Affected Nozzles"** shall be the total of those nozzles served by the tank being tested.

TABLE 1B

PHASE II **ASSIST** SYSTEMS

PRESSURE DECAY CRITERIA

INITIAL PRESSURE OF 2 INCHES WATER COLUMN (WC)

MINIMUM PRESSURE AFTER 5 MINUTES, INCHES WC

NUMBER OF AFFECTED NOZZLES

ULLAGE, GALLONS	**01-06**	**07-12**	**13-18**	**19-24**	**>24**
500	**0.73**	**0.69**	**0.65**	**0.61**	**0.57**
550	0.80	0.76	0.72	0.68	0.64
600	**0.87**	**0.82**	**0.78**	**0.74**	**0.71**
650	0.93	0.88	0.84	0.80	0.77
700	**0.98**	**0.94**	**0.90**	**0.86**	**0.82**
750	1.03	0.98	0.94	0.91	0.87
800	**1.07**	**1.03**	**0.99**	**0.95**	**0.92**
850	1.11	1.07	1.03	1.00	0.96
900	**1.15**	**1.11**	**1.07**	**1.03**	**1.00**
950	1.18	1.14	1.11	1.07	1.04
1,000	**1.21**	**1.18**	**1.14**	**1.10**	**1.07**
1,200	1.32	1.28	1.25	1.22	1.19
1,400	**1.40**	**1.37**	**1.34**	**1.31**	**1.28**
1,600	1.46	1.43	1.41	1.38	1.35
1,800	**1.51**	**1.49**	**1.46**	**1.44**	**1.41**
2,000	1.56	1.53	1.51	1.49	1.46
2,200	**1.59**	**1.57**	**1.55**	**1.53**	**1.51**
2,400	1.62	1.60	1.58	1.56	1.54
2,600	**1.65**	**1.63**	**1.61**	**1.59**	**1.57**
2,800	1.67	1.65	1.64	1.62	1.60
3,000	**1.69**	**1.68**	**1.66**	**1.64**	**1.62**
3,500	1.73	1.72	1.70	1.69	1.67
4,000	**1.76**	**1.75**	**1.74**	**1.72**	**1.71**
4,500	1.79	1.78	1.77	1.75	1.74
5,000	**1.81**	**1.80**	**1.79**	**1.78**	**1.77**
6,000	1.84	1.83	1.82	1.81	1.80
7,000	**1.86**	**1.85**	**1.85**	**1.84**	**1.83**
8,000	1.88	1.87	1.86	1.86	1.85
9,000	**1.89**	**1.89**	**1.88**	**1.87**	**1.87**
10,000	1.90	1.90	1.89	1.88	1.88
15,000	**1.93**	**1.93**	**1.93**	**1.92**	**1.92**
20,000	1.95	1.95	1.94	1.94	1.94
25,000	**1.96**	**1.96**	**1.96**	**1.95**	**1.95**

Note: For manifolded Phase II Assist Systems, the **"Number of Affected Nozzles"** shall be the total of all gasoline nozzles. For dedicated return configurations, the **"Number of Affected Nozzles"** shall be t he total of those nozzles served by the tank being tested.

FORM 1

SUMMARY OF SOURCE TEST DATA

SOURCE INFORMATION		FACILITY PARAMETERS
GDF Name and addresss ________________ ________________ ________________	GDF Representative and Title ________________ GDF Phone No. ( ) ________	PHASE II SYSTEM TYPE (Check One) Balance ____ Hirt ____ Red Jacket ____ Hasstech ____ Healy ____ Other ____
Permit Conditions	Source: GDF Vapor Recovery System GDF # ________ A/C # ________	Manifolded? Y or N

Operating Parameters

Number of Nozzles Served by Tank #1 ______ Number of Nozzles Served by Tank #3 ______

Number of Nozzles Served by Tank #2 ______ Number of Nozzles Served by Tank #4 ______

Applicable Regulations:	VN Recommended

Source Test Results and Comments

Tank #:	1	2	3	4
1. Product Grade				
2. Actual Tank Capacity, gallons				
3. Gasoline Volume				
4. Ullage, gallons (#2-#3)				
5. Initial Pressure, inches H_2O				
6. Pressure After 1 Minute, inches H_2O				
7. Pressure After 2 Minutes, inches H_2O				
8. Pressure After 3 Minutes, inches H_2O				
9. Pressure After 4 Minutes, inches H_2O				
10. Final Pressure After 5 Minutes, inches H_2O				
11. Allowable Final Pressure				

Test Conducted by:	Test Company:	Date of Test:

Figure 1
"T" Connector Assembly

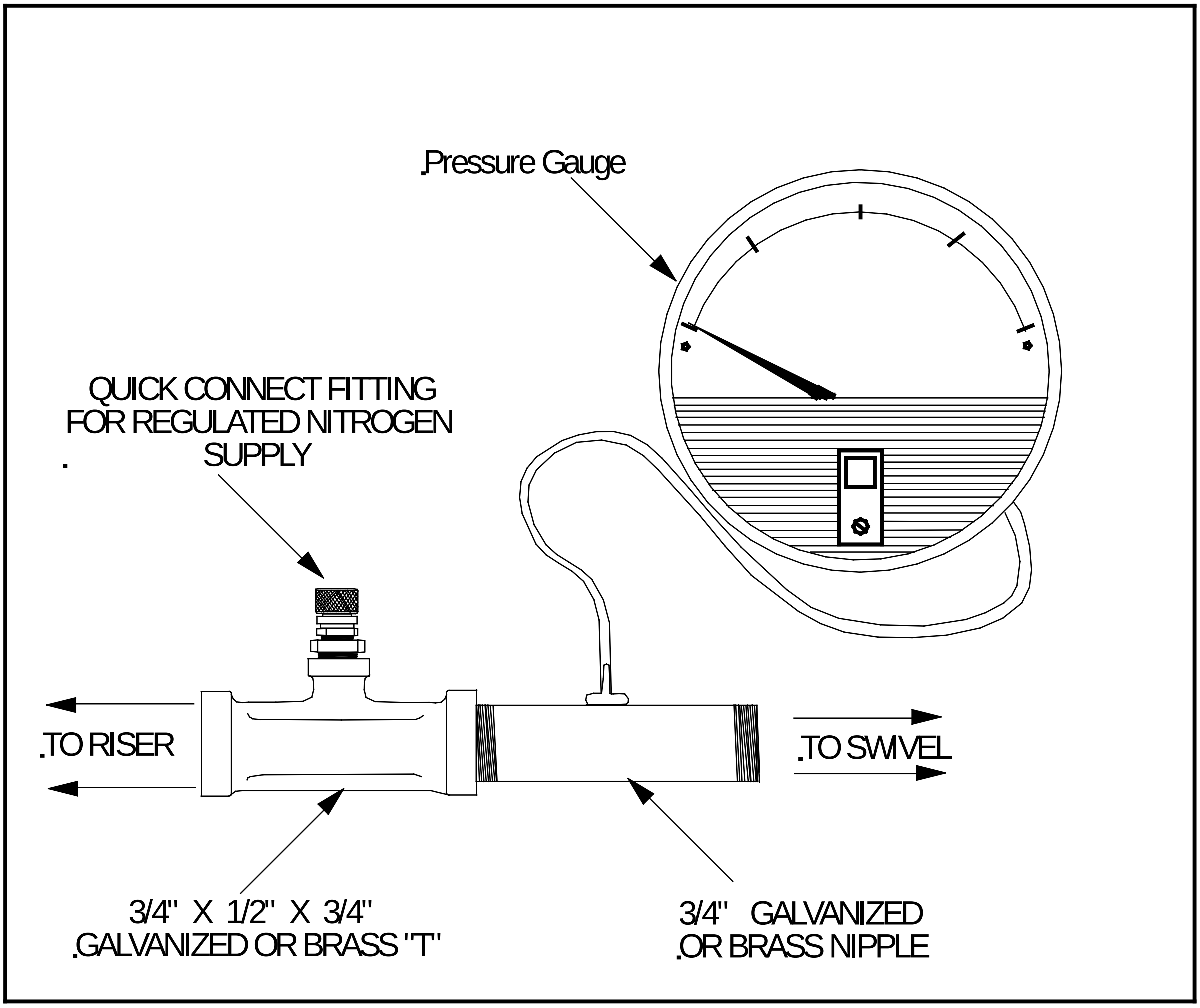


Figure 2

Vapor Coupler Integrity Assembly

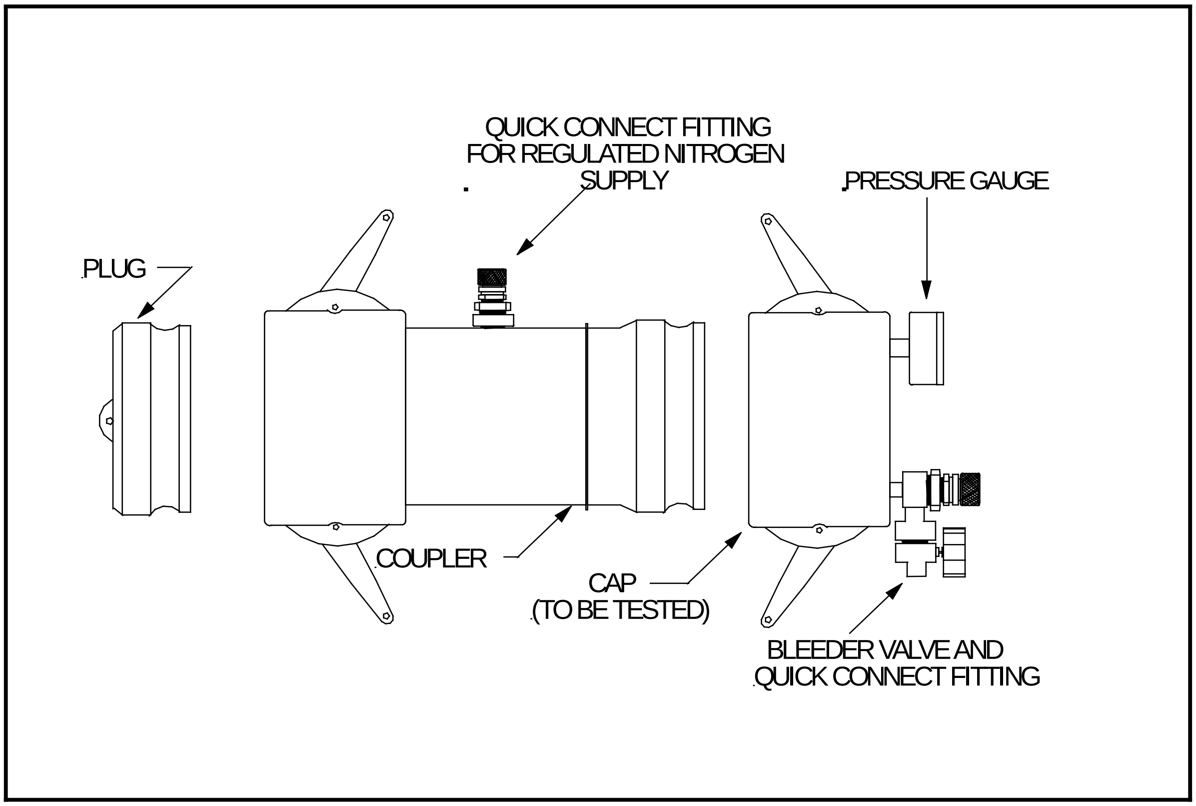
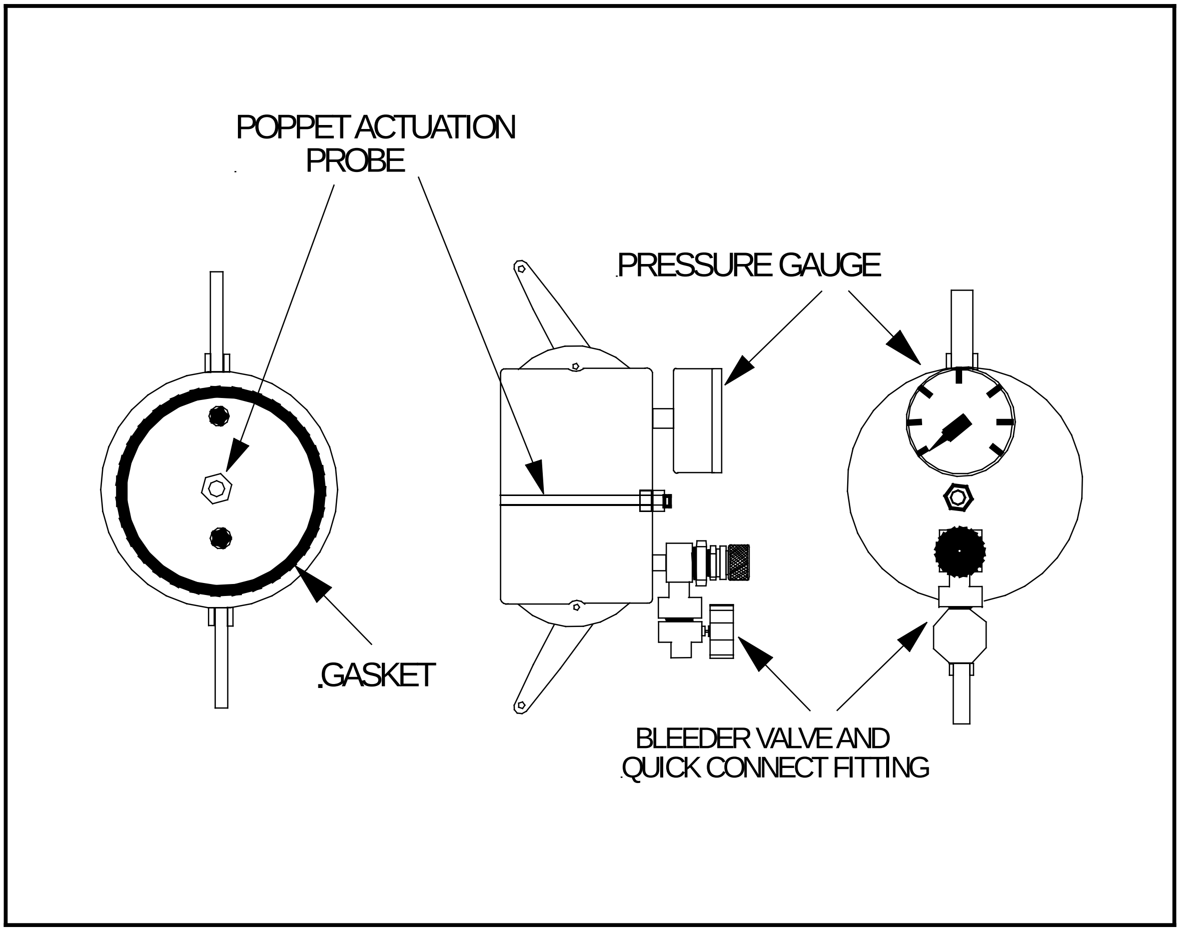


Figure 3

.Vapor Coupler Test Assembly



California Environmental Protection Agency

Air Resources Board

Vapor Recovery Test Procedure

TP-201.1E

Leak Rate and Cracking Pressure of Pressure/Vacuum Vent Valves

Adopted: October 8, 2003

California Environmental Protection Agency
Air Resources Board

Vapor Recovery Test Procedure

TP-201.1E

Leak Rate and Cracking Pressure of Pressure/Vacuum Vent Valves

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 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

The purpose of this procedure is to determine the pressure and vacuum at which a Pressure-/Vacuum Vent Valve (P/V Valve) actuates, and to determine the volumetric leak rate at a given pressure as specified in CP-201, Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities. This procedure is applicable for certification and compliance testing of P/V Valves.

2. PRINCIPLE AND SUMMARY OF TEST PROCEDURE

The volumetric leak rate of a P/V Valve is determined by measuring the positive and negative flow rates at corresponding pressures. The positive and negative cracking pressures of the valve are determined by measuring the pressure at which the P/V Valve opens to atmospheric pressure. With the exception of certification testing performed by the Executive Officer, these measurements are determined by removing the P/V Valve and conducting the test on a test stand. A flow metering device is used to introduce flow while measuring pressure.

3. BIASES AND INTERFERENCES

3.1 Installing a P/V Valve onto the test stand in a manner that is not in accordance with the manufacturer's recommended installation instructions can produce erroneous results.

3.2 Leaks in the test stand or test equipment can produce erroneous results.

4. SENSITIVITY, RANGE, AND PRECISION

4.1 Electronic Pressure Measuring Device. Minimum sensitivity shall be 0.01 inches H_2O with a maximum full-scale range of 20 inches H_2O and minimum accuracy of plus or minus 0.50 percent full-scale range.

4.2 Flow Meter. The measurable leak rate is dependent upon the sensitivity, range and precision of the flow meter used for testing. For electronic flow metering devices, the minimum sensitivity shall be 1.0 ml/min (0.0021 CFH) with a minimum full-scale accuracy of ±1.0 percent. For rotameters, the flow meter minimum sensitivity shall be 12.5 ml/min (.026 CFH) with minimum accuracy of ± 5 percent full-scale. The device scale shall be 150mm (5.91 inches) tall to provide a sufficient number of graduations for readability.

5. EQUIPMENT

5.1 Nitrogen. Use commercial grade gaseous nitrogen in a high-pressure cylinder equipped with a pressure regulator and one (1.00) psig pressure relief valve. As an alternative, compressed air may be used to pressurize to the minimum working pressure required by the Flow Metering device.

5.2 Ballast Tank. If required, use a commercially available tank (2 gallon minimum), capable of being pressurized or evacuated (placed under vacuum) to the minimum working pressure required by the flow-metering device(s).

5.3 Vacuum Pump or Vacuum Generating Device. Use a commercially available vacuum pump or equivalent, capable of evacuating the ballast tank or test stand to the minimum working pressure required by the flow-metering device.

5.4 Electronic Pressure Gauge. Use an electronic pressure gauge or digital manometer that conforms to the minimum requirements listed in section 4 to measure the pressure inside of the test stand.

5.5 Flow Metering Device(s). Use either an electronic flow-metering device or Rotameter as described below to measure or introduce a volumetric flow rate. Although the use of either type of instrument is allowed, electronic flow metering devices provide higher accuracy and precision. For the purpose of certification testing, only electronic flow metering devices shall be used.

5.5.1 Electronic Flow Metering Device. Use a Mass Flow Meter that conforms to the minimum requirements listed in section 4 to introduce nitrogen or compressed air into the test stand. The Mass Flow Meter shall be equipped with a high precision needle valve to accurately adjust the flow settings. The meter may be used for both positive and negative flow rates by reconfiguring the pressure or vacuum lines.

5.5.2 Rotameters. Two (2) devices required. Use two Flow Meters with minimum specifications described in Section 4 to measure or introduce flow rates. One meter shall use a needle valve oriented for introducing positive flow and the other using an inverted needle valve for introducing vacuum.

5.6 Test Stand. If a bench test arrangement is used, use a test stand as shown in Figure 1, or equivalent, equipped with a 2-inch NPT threaded pipe on at least one end for attaching the P/V Valve in an upright position. If other than 2-inch NPT is required, use an adaptor to reduce or enlarge the 2 inch pipe. The test stand shall be equipped with at least two (2) ports used for introducing flow and measuring pressure. Use a bypass valve to enable the tester to set the required flow without pressurizing the P/V Valve. Once the required flow rate is set, the bypass valve shall be closed to route the flow into the stand and pressurize the P/V Valve to check cracking pressure. Test stands may be constructed of various materials or dimensions. For certification testing conducted by Executive Officer only, the P/V valve may be isolated and tested in place at the facility.

6. PRE-TEST PROCEDURES

6.1 All pressure measuring device(s) shall be bench calibrated using a reference gauge, incline manometer or NIST traceable standard at least once every six (6) months. Calibration shall be performed at 20, 50, and 80 percent of full scale. Accuracy shall be within five (5) percent at each of these calibration points.

6.2 Electronic pressure measuring devices shall be calibrated immediately prior to testing using the zero gauge pressure adjustment knob located on the instrument.

6.3 The Flow Metering device(s) shall be calibrated using a reference meter or NIST traceable standard. Calibrations shall be performed at 20, 50, and 80 percent of full-scale range and shall take place at a minimum of once every six (6) months.

6.4 Leak check the test stand or test assembly prior to installing the P/V Valve.

(a) Install a 2-inch cap onto the NPT threads in place of the P/V Valve using pipe sealant or Teflon tape.

(b) Check all fittings for tightness and proper assembly.

(c) Slowly establish a stable gauge pressure in the test stand between 18.00 and 20.00 inches water column and allow pressure to stabilize.

(d) Check for leaks by applying a leak detection solution around all fittings and joints and by observing the pressure for pressure changes that may identify a leak. If no bubbles form, the test stand is leak tight.

(e) If soap bubbles form or the test stand pressure will not stabilize, repeat (a) through (d); it may be necessary to place the test apparatus in an environment that is free from the effects of wind or sunlight.

7. TEST PROCEDURE

7.1 Install the P/V Valve in an upright position following the installation instructions provided by the manufacturer. Incorrectly installing the valve will invalidate any pressure versus flow rate measurement.

7.2 Positive Leak Rate. Slowly open the control valve on the Positive Flow Metering device until the pressure stabilizes at the positive leak rate pressure described in CP-201 section 3. Maintain steady state pressure by using the control valve for at least ten (10) seconds. Steady state flow is indicated by a pressure change of no more than 0.05 inches H_2O on the pressure gauge. Record the final flow rate on the data sheet and close the control valve.

7.3 Positive Cracking Pressure. Open the bypass valve to route the flow outside of the test assembly. Open the control valve on the Positive Flow Metering device to establish a flow rate of 120 ml/min. Once flow is stabilized, close the bypass valve to route the flow into the test assembly. Observe the pressure. The P/V Valve should "crack" at a pressure within the range of positive cracking pressure as described in CP-201 section 3. This is marked by a sudden drop in pressure. Record the cracking pressure (highest pressure achieved***)*** on the data sheet and close the control valve.

7.4 Negative Leak Rate. Open the control valve on the Negative Flow Metering device until the pressure stabilizes at the negative leak rate pressure described in CP-201 section. Maintain steady state pressure by using the control valve for at least ten (10) seconds. Steady state flow is indicated by a pressure change of no more than 0.05 inches H_2O on the pressure gauge. Record the final flow rate on the data sheet and close the control valve.

7.5 Negative Cracking Pressure. Open the bypass valve to route the flow outside of the test assembly. Open the control valve on the Negative Flow Metering device to establish a negative flow rate of 200 ml/min. Once flow is stabilized, close the bypass valve to route the flow into the test assembly. Observe the pressure. The P/V Valve should "crack" at a pressure within the range of negative cracking pressure as described in CP-201 section 3. This is marked by a sudden drop in vacuum. Record the cracking pressure (highest vacuum achieved) on the data sheet and close the control valve.

8. POST-TEST PROCEDURES

8.1 Remove the P/V Valve from the test assembly.

8.2 Disassemble the pressure regulator from the compressed nitrogen cylinder (if used) and place the safety cap back on the cylinder.

8.3 Disassemble all remaining test equipment and store in a protected location.

9. CALCULATING RESULTS

9.1 Commonly used flow rate conversions:

1 CFH = 471.95 ml/min

Example: Convert 0.17 CFH to ml/min***:***

0.17 CFH (471.95) = 80 ml/min

1 ml/min = 0.00212 CFH

Example: Convert 100 ml/min to CFH:

100 ml/min (0.00212) = 0.21 CFH

10. REPORTING RESULTS

10.1 Record the station or location name, address and tester information on Form 1.

10.2 Record the P/V Valve manufacturer's name and model number on Form 1.

10.3 Record the results of the test(s) on Form 1. Use additional copies of Form 1 if needed to record additional P/V Valve tests.

10.4 Alternate data sheets or Forms may be used provided they contain the same parameters as identified on Form 1.

10.5 Use the formulas and example equation provided in Section 9 to convert the flow measurements into units of cubic feet per hour (CFH).

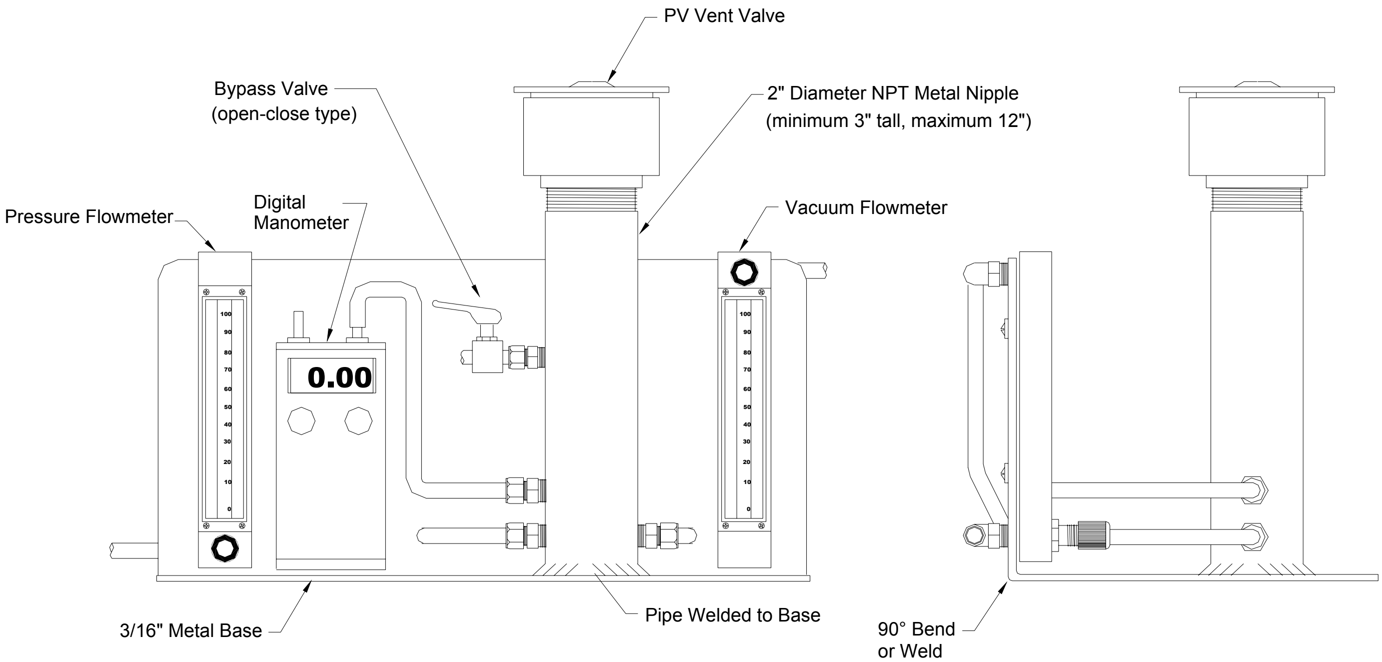
10.6 For certification testing, compare results to the performance standards listed in Table 3-1 of CP-201. For compliance testing, compare the results to the manufacturer's specifications listed on the P/V Valve for both leak rate and cracking pressure. For volumetric leak rates less than the manufacturers specified leakrate and cracking pressures within the manufacturers specified range, circle Pass on the data sheet where provided. If either the volumetric leak rate or cracking pressure exceeds the manufacturers specifications, circle Fail on the data sheet where provided.

11. ALTERNATIVE TEST PROCEDURES

This procedure shall be conducted as specified. Any modifications to this test procedure shall not be used unless prior written approval has been obtained from the Executive Officer pursuant to section 14 of CP-201.

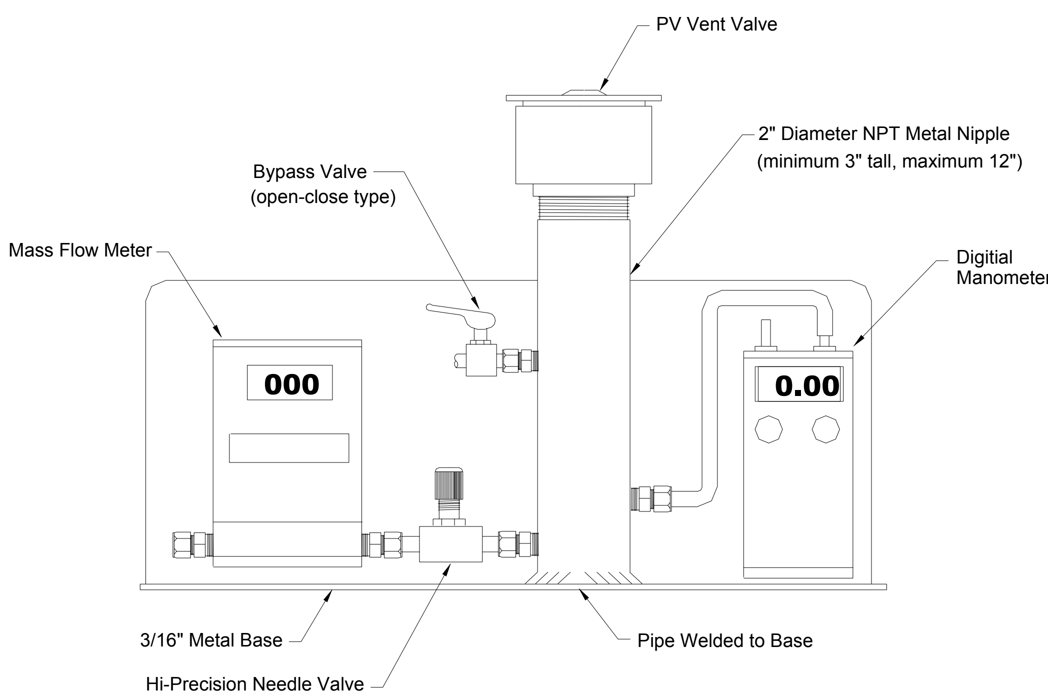
Figure 1

Example of Test Stand



FLOW METER CONFIGURATION

SIDE VIEW



MASS FLOW METER CONFIGURATION

Form 1

Pressure/Vacuum (P/V) Vent Valve Data Sheet

Facility Name:	Test Date:
Address:	Test Company:
City :	Tester Name:

P/V Valve Manufacturer:	**Model Number:** **Pass Fail**
Manufacturers Specified Positive Leak Rate (CFH):	**Manufacturers Specified Negative Leak Rate (CFH):**
Measured Positive Leak Rate (CFH):	Measured Negative Leak Rate (CFH):
Positive Cracking Pressure (in. H_2O):	Negative Cracking Pressure (in. H_2O):

P/V Valve Manufacturer:	**Model Number:** **Pass Fail**
Manufacturers Specified Positive Leak Rate (CFH):	**Manufacturers Specified Negative Leak Rate (CFH):**
Measured Positive Leak Rate (CFH):	Measured Negative Leak Rate (CFH):
Positive Cracking Pressure (in. H_2O):	Negative Cracking Pressure (in. H_2O):

P/V Valve Manufacturer:	**Model Number:** **Pass Fail**
Manufacturers Specified Positive Leak Rate (CFH):	**Manufacturers Specified Negative Leak Rate (CFH):**
Measured Positive Leak Rate (CFH):	Measured Negative Leak Rate (CFH):
Positive Cracking Pressure (in. H_2O):	Negative Cracking Pressure (in. H_2O):

P/V Valve Manufacturer:	**Model Number:** **Pass Fail**
Manufacturers Specified Positive Leak Rate (CFH):	**Manufacturers Specified Negative Leak Rate (CFH):**
Measured Positive Leak Rate (CFH):	Measured Negative Leak Rate (CFH):
Positive Cracking Pressure (in. H_2O):	Negative Cracking Pressure (in. H_2O):

California Environmental Protection Agency

Air Resources Board

Vapor Recovery Test Procedure

ALTERNATE
TP-201.1E

Leak Rate and Cracking Pressure of Pressure/Vacuum Vent Valves

Adopted: October 8, 2003
Approved: August 5, 2005

California Environmental Protection Agency
Air Resources Board

Vapor Recovery Test Procedure

Alternate TP-201.1E (Approved August 2005)

Leak Rate and Cracking Pressure of Pressure/Vacuum Vent Valves

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 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

The purpose of this procedure is to determine the pressure and vacuum at which a Pressure/Vacuum vent valve (P/V valve) actuates, and to determine the volumetric leak rate at a given pressure as specified in CP-201, Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities. This procedure is applicable for certification and compliance testing of P/V valves.

2. PRINCIPLE AND SUMMARY OF TEST PROCEDURE

The volumetric leak rate of a P/V valve is determined by measuring the positive and negative flow rates at corresponding pressures. The positive and negative cracking pressures of the valve are determined by measuring the pressure at which the P/V valve ”cracks” as defined by this test procedure. With the exception of certification testing performed by the Executive Officer, these measurements are determined by removing the P/V valve and conducting the test on a test stand. A flow metering device is used to introduce flow while measuring pressure.

For the positive and negative cracking pressure tests, three replicate test runs shall be conducted sequentially and the average of the three runs used for the result of the test.

The P/V valve shall not be cracked (i.e., by test or vapor recovery system personnel) prior to the first pressure/vacuum cracking test each day (i.e., each certification or compliance test day). The “1st crack” per test day should be included in the average result reported. While P/V valve operation as associated with the GDF will not be monitored, there must be no maintenance or testing of the P/V valve for at least twenty-four hours prior to the pressure/vacuum cracking tests.

3. BIASES AND INTERFERENCES

3.1 Installing a P/V valve onto the test stand in a manner that is not in accordance with the manufacturer's recommended installation instructions can produce erroneous results.

3.2 Leaks in the test stand or test equipment can produce erroneous results.

3.3 For certification testing, ball valves used to isolate P/V valves on vent stacks may leak if not functioning correctly or if not closed completely. Such conditions may lead to erroneous results in the leak rate determinations. Leak rate test results not meeting the CP-201 standards should not be considered as due solely to the P/V valve unless the ball valve is demonstrated to be leak free. (Note: installation of ball valves is prohibited except for at certification sites)

4. METHOD SENSITIVITY, RANGE, AND PRECISION

4.1 Positive and Negative Cracking Pressures: The sensitivity and range of the tests are dependent on the minimum readability and measurement range of the manometer (see Section 5.4). The method precision has been estimated to be $\pm$ 9.3% and $\pm$ 4.0% for the positive and negative cracking pressure tests, respectively. Note though that this precision was based on a limited data set and may be reviewed/updated by the Executive Officer as additional information becomes available.

4.2 Positive and Negative Leak Flow Rates: The sensitivity and range of the tests are dependent on the minimum readability and measurement range of the mass flow meters (see Section 5.5). The method precision for leak flow rates has not been estimated and may be added by the Executive Officer as additional information becomes available.

5. EQUIPMENT

5.1 Nitrogen. Use commercial grade gaseous nitrogen in a high-pressure cylinder equipped with a pressure regulator. As an alternative, compressed air may be used to pressurize to the minimum working pressure required by the mass flow meter (note; in this case the MFM must be calibrated with compressed air).

5.2 Ballast Tank. If required, use a commercially available tank (2 gallon minimum), capable of being pressurized or evacuated (placed under vacuum) to the minimum working pressure required by the flow-metering device(s).

5.3 Vacuum Pump or Vacuum Generating Device. Use a commercially available vacuum pump or equivalent, capable of evacuating the ballast tank or test stand to the minimum working pressure required by the flow-metering device.

5.4 Electronic Pressure Measuring Device (manometer(s)). Minimum readability shall be 0.01 inches H_2O with measurement range(s) to include at least up to +10 and –20 inches H_2O with a minimum accuracy of plus or minus 0.05 inches H_2O. For certification purposes, it is recommended that the electronic manometer have the capability to log the maximum/minimum pressures achieved during the test runs.

5.5 Flow Metering Device(s). Use a mass flow meter (MFM) as described below to measure or introduce a flow rate.

5.5.1 Mass Flow Meter. The minimum readability shall be 1.0 ml/min (0.0021 CFH) with a minimum full-scale accuracy of ±1.0 percent. The meter may be used for both positive and negative flow rates by reconfiguring the pressure or vacuum lines. A MFM with a full scale reading of 20 milliliters per minute (ml/min) will be used to measure flow rates of less than 20 ml/min and a MFM with a full scale reading of 200 ml/min will be used to measure flow rates from 20 ml/min to 200 ml/min.

5.5.2 Needle Valves. The test assembly shall be equipped with a high precision needle valve to accurately adjust the flow settings for the leak rate and cracking tests.

5.6 Test Assembly (or Test Stand). Use a test assembly as shown in Figure 1, or equivalent. The test assembly shall be equipped with at least two (2) ports used for introducing flow and measuring pressure. Use a bypass valve to enable setting the required flow without pressurizing the P/V valve. Once the required flow rate is set, the bypass valve shall be closed to route the flow into the assembly and pressurize the P/V valve to check cracking pressure.

A 6-liter surge tank (such as shown in Figure 1) will be placed in the test line between the bypass valve and the P/V valve for positive and negative cracking pressure tests. The surge tank is not used in the test assembly for the leak rate tests.

5.7 For certification testing, the P/V valve will normally be isolated on the vent stack with a ball valve and tested in place at the facility. However, “bench” testing of P/V valves may also be conducted for certification purposes.

6. PRE-TEST PROCEDURES

6.1 All manometer(s) shall be bench tested for accuracy using a reference gauge, incline manometer or National Institute of Standards and Technology (NIST) traceable standard at least once every six (6) months. Accuracy checks shall be performed at a minimum of 5 points (e.g., 10, 25, 50, 75 and 90 percent of full scale) each for both positive and negative pressure readings. Accuracy shall meet the requirements of Section 5.4.

6.2 Electronic manometers shall be allowed to ‘warm-up’ for a minimum of 10 minutes and zeroed to atmosphere immediately prior to each test. The manometer must not be zeroed while connected to the test equipment.

6.3 The MFMs shall be tested for accuracy using a reference meter or NIST traceable standard. Accuracy checks shall be performed at a minimum of five points (e.g., at 10, 20, 50, 80 and 100 percent of full-scale range) and shall take place at a minimum of once every six (6) months. Accuracy shall meet the requirements of Section 5.5.

The accuracy checks should be conducted at 1) 10 psig inlet pressure and 2) -25 inches mercury outlet vacuum (as used for the negative leak and cracking tests).

6.4 Perform an equipment leak check.

6.4.1 If testing a P/V valve on a test stand, install a 2-inch cap onto the NPT threads in place of the P/V Valve using pipe sealant or Teflon tape. If the site is equipped with ball valves and test ports (i.e., for certification sites), connect the two test lines (that would normally be connected to the test ports on the vent stack) to each other using a quick connect coupler (see Figure 2).

6.4.2 Check all fittings for tightness and proper assembly.

6.4.3 Conduct the positive and negative leak rate tests as specified in Sections 7.2 and 7.4, respectively.

6.4.4 If the measured leak rate is $\leq$ 2 ml/min then proceed to Section 7.

6.4.5 If the measured leak rate is > 2 ml/min then troubleshoot and resolve the leak problem before proceeding to Section 7.

7. TEST PROCEDURE

7.1 If using a test stand, Install the P/V valve in an upright position following the installation instructions provided by the manufacturer. Incorrectly installing the valve will invalidate any pressure versus flow rate measurement. If conducting a certification test with the P/V valve installed on the vent pipe, configure the test assembly per Figure 1.

7.2 Positive Leak Rate. Slowly open the needle valve on the test assembly until the pressure stabilizes at the positive leak rate pressure described in Section 3 of CP-201, system application, or value listed in the Executive Order. Maintain steady state pressure for at least ten (10) seconds by using the control valve. Steady state is indicated by a pressure change of no more than 0.05 inches H_2O on the electronic manometer. Record the final leak flow rate on the data sheet and close the control valve.

If the leak rate is greater than 75% of the required specification (e.g., > 60 ml/min for valves rated to 0.17 CFH or > 17 ml/min for valves rated to 0.05 CFH) then run the leak rate test two more times. Record the results of all runs on the data sheet and use the average to report the result of the test.

If the leak rate test result is greater than the specification stated in CP-201 then proceed to Section 7.6.

7.3 Positive Cracking Pressure. Open the bypass valve to route the flow outside of the test assembly (to avoid prematurely pressurizing the P/V valve). Open the needle valve on the test assembly to establish a flow rate of 120 ml/min. Once the flow rate is established, close the bypass valve to route the flow into the test assembly. Observe the pressure on the electronic manometer. The P/V valve should “crack” at a pressure within the range of positive cracking pressure as described in Section 3 of

CP-201, system application, or value listed in the Executive Order. This is marked by a brief peak then a slight drop in pressure. Record the cracking pressure (highest pressure achieved) on the data sheet and open the bypass valve.

Run the cracking test two more times (i.e., total of three replicates). Re-adjust the flow rate to 120 ml/min, if necessary, prior to each test replicate. Record all values on the data sheet and report the average of the three runs. For certification tests, the value recorded by the digital manometer as the maximum pressure achieved ("max hold") during the test run will be used for reporting purposes (i.e., as opposed to a visually determined value).

Note that the manometer "max hold" reading must be zeroed between each run. The maximum value logged must be checked/re-zeroed after any disconnecting/connecting of test assembly line quick connect fittings (as this may cause the maximum reading to change from zero). If it is known that the maximum reading was not zeroed (i.e., by mistake) between a previous test run and the current test run then make a note on the data sheet and re-run the replicate.

Note that care must be taken not to zero the manometer unless the manometer is disconnected from the test assembly and is open to atmosphere. Zeroing the manometer while it is connected to the test assembly may cause an erroneous instrument zero which could impact (invalidate) the test results.

Open the bypass valve and close the valve on the compressed nitrogen cylinder.

7.4 Negative Leak Rate. Open the needle valve on the test assembly until the pressure stabilizes at the negative leak rate pressure described in Section 3 of CP-201, system application, or value listed in the Executive Order. Maintain steady state pressure for at least ten (10) seconds by using the control valve. Steady state flow is indicated by a pressure change of no more than 0.05 inches H_2O on the electronic manometer. Record the final flow rate on the data sheet and close the control valve.

If the leak rate is greater than 75% of the required specification (e.g., > 75 ml/min for valves rated to 0.21 CFH) then run the leak rate test two more times. Record the results of all runs on the data sheet and use the average to report the result of the test.

If the leak rate test result is greater than the specification stated in CP-201 then proceed to Section 7.6.

7.5 Negative Cracking Pressure. Open the bypass valve to route the flow outside of the test assembly. Open the control valve on the test assembly to establish a negative flow rate of 200 ml/min. Once the correct flow rate is established, close the bypass valve to route the flow into the test assembly. Observe the pressure. The P/V valve should "crack" at a pressure within the range of negative cracking pressure as described in Section 3 of CP-201, system application, or value listed in the Executive Order. This is marked by a brief leveling off then a slight drop in vacuum. Record the cracking pressure (highest vacuum achieved) on the data sheet and open the bypass valve.

Run the cracking test two more times (i.e., total of three replicates). Record all values on the data sheet and report the average of the three runs. For certification test purposes, the value recorded by the digital manometer as the maximum pressure achieved ("max hold") during the test run will be used for reporting purposes (i.e., as opposed to a visually determined value). Also see the "note" in Section 7.3 for cautions on the use of the digital manometer.

7.6 Leak Rate Failure. If the P/V valve fails the positive or negative leak rate test, then disconnect the lines from the quick connect fittings on the P/V valve vent pipe (or test stand). Connect the two lines to each other using a female/female quick connect coupler (see Figure 2). Run the leak rate procedure (as specified in Section 7.2) to verify that there is no leak in the test assembly (i.e., exactly as used during the test that failed). This will be using the 0-200 ml/min MFM. If the result of the check on this configuration of the test assembly shows a leak (i.e., > 10 ml/min; i.e., > 5% of full scale) then troubleshoot and resolve the leak point and re-run the P/V valve leak rate test.

If the result of the above leak rate test is ≤ 10 ml/min, then reconfigure the test assembly to use the 0-20 ml/min MFM and re-conduct the leak rate test. If the result of the check on the test assembly shows a leak problem (i.e., ≥ 2 ml/min) then troubleshoot and resolve the problem and re-run the P/V valve leak rate test.

If no leak rate greater than 2 ml/min is observed in the test assembly, then remove the P/V valve (refer to Figure 1), cap the 2" vent pipe and conduct the leak rate procedure (as specified in Section 7.2) to verify that there is no leak (i.e., ≥ 2 ml/min) in the ball valve.

If the results of the checks on the test assembly and P/V vent ball valve show no leaks then report the average of results of the three P/V valve test replicates.

As noted in Section 3.2 and 3.3, leak rate test results not meeting the CP-201 specifications should not be considered as due solely to the P/V valve unless the test equipment and ball valve are demonstrated to be leak free.

8. CALCULATING RESULTS

8.1 Commonly used flow rate conversions:

1 CFH = 471.95 ml/min

Examples:
0.21 CFH * 471.95 ml/min/CFH = 99 ml/min
0.17 CFH *471.95 ml/min/CFH = 80 ml/min
0.05 CFH * 471.95 ml/min/CFH = 24 ml/min

8.2 The individual replicate runs will be reported to three significant figures and the average of the three runs will be reported to two significant figures.

8.3 Reporting Results with Tolerance for Testing Error

If the reporting policy allows a tolerance for testing error, the range of cracking pressures represented by the test result, including testing error, shall be calculated as follows:

$TR_{el} = TR - E\ (TR)$

$TR_{eu} = TR + E\ (TR)$

Where: TR_{el} = lower limit of the test result including allowable test error

TR_{eu} = upper limit of the test result including allowable test error

TR = the result from Section 9.2

E = the allowable testing error, percent

9. REPORTING RESULTS

9.1 Record the station or location name, address and tester information on Form 1.

9.2 Record the P/V valve manufacturer's name, model number and manufacture date (date stamp) on Form 1.

9.3 Record the results of the test(s) on Form 1. Use additional copies of Form 1 if needed to record additional P/V Valve tests.

9.4 Alternate data sheets or Forms may be used provided they contain the same parameters as identified on Form 1.

9.5 Use the formulas and example equation provided in Section 9 to convert the flow measurements into units of ml/min.

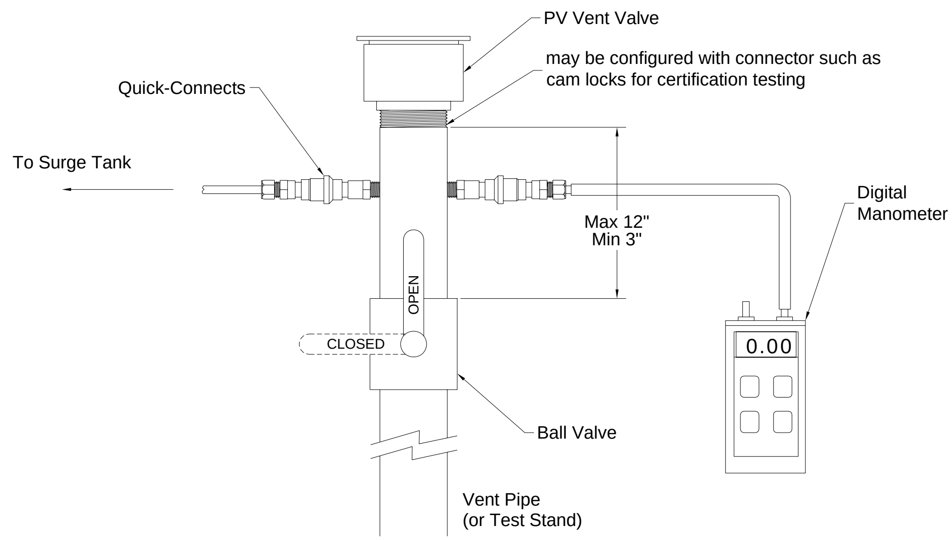
9.6 For certification testing, compare results to the performance specifications listed in Table 3-1 of CP-201 or as listed in the System Certification Application, applying any allowable tolerance for testing error (as specified in Section 9.3), if applicable. For compliance testing, compare the results to the performance specifications listed in the Executive Order. Circle "Pass" on the data sheet if the leak rate and cracking pressure meet the specifications. If either the volumetric leak rate or cracking pressure exceeds the manufacturer's specifications, circle "Fail" on the data sheet.

10. ALTERNATIVE TEST PROCEDURES

This procedure shall be conducted as specified. Any modifications to this test procedure shall not be used unless prior written approval has been obtained from the Executive Officer pursuant to section 14 of CP-201.

Figure 1

Example of Test Assembly



*The mass flow meter must be oriented in the correct direction of flow.

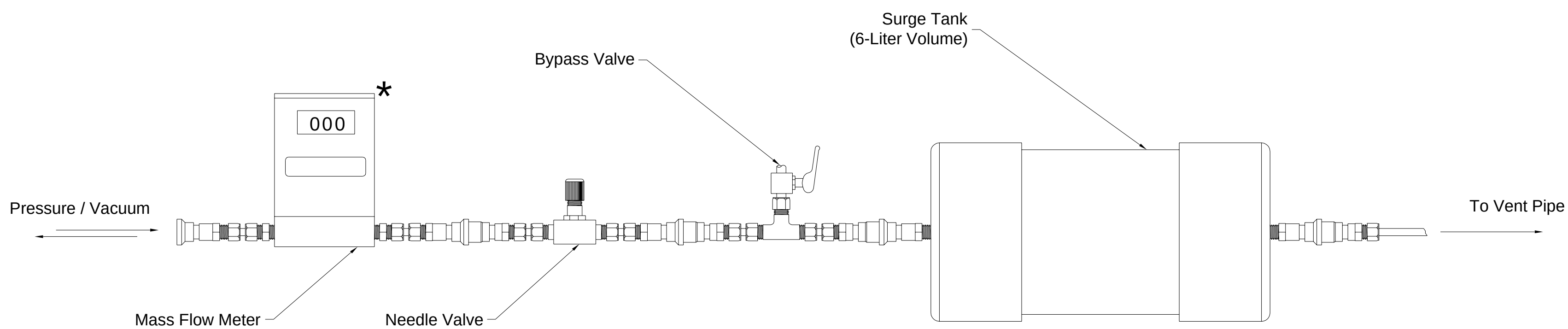
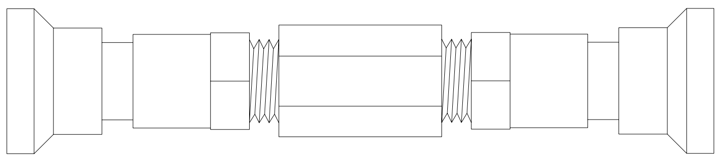


Figure 2
¼ Inch Quick Connect Union



Form 1

Pressure/Vacuum (P/V) Vent Valve Data Sheet

Facility Name:	Test Date:
Address:	Test Company:
City :	Tester(s) Name:

P/V Valve Manufacturer: **Model Number:** **Stamped Date:**

Required Positive Leak Rate Specification (CFH and ml/min):	**Required Negative Leak Rate Specification (CFH and ml/min):**
Measured Positive Leak Rate (ml/min), Run #1:	Measured Negative Leak Rate (ml/min): Run #1:
(if applicable) Run #2:	(if applicable) Run #2:
(if applicable) Run #3:	(if applicable) Run #3:
Average:	Average:
Pass/Fail	**Pass/Fail**
If Fail: 0-200 Assembly Leak Rate < 10 ml/min?:	**If Fail**: 0-200 Assembly Leak Rate < 10 ml/min?:
0-20 Assembly Leak Rate < 2 ml/min?:	0-20 Assembly Leak Rate < 2 ml/min?:
If Fail: Ball Valve Leak Rate < 2 ml/min?:	**If Fail**: Ball Valve Leak Rate < 2 ml/min?:
Positive Cracking Pressure (in. H_2O): Run #1:	Negative Cracking Pressure (in. H_2O): Run #1:
Run #2:	Run #2:
Run #3:	Run #3:
Average:	Average:
Comments:	Comments:
(If Applicable) Allowable Testing Tolerance (%):	(If Applicable) Allowable Testing Tolerance (%):
Test Result Range:	Test Result Range:
Pass/Fail	**Pass/Fail**

Was the "1st Crack" of the P/V valve for this test day included in the result? **Y / N**
If no, provide explanation:

Was there any maintenance or testing performed on the P/V valve within the last 24 hours? **Y / N**
If yes, provide explanation:

MFM accuracy check date: Manometer accuracy check date:

Comments: