California Environmental Protection Agency

Air Resources Board

PROPOSED

Vapor Recovery Test Procedure

TP-201.1E CERT

Leak Rate and Cracking Pressure of Pressure/Vacuum Vent Valves

Adopted:_____

[Note: All text is proposed for adoption. As permitted by title 2, California Code of Regulations, section 8, for ease of review underline to indicate adoption has been omitted.]

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Definitions common to all certification and test procedures are in:

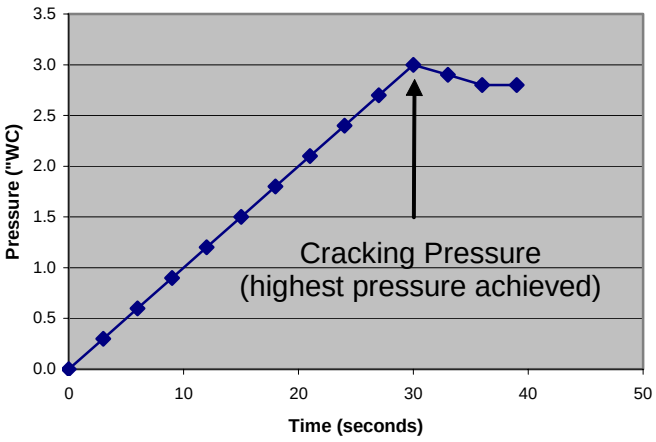
D-200 Definitions for Vapor Recovery Procedures

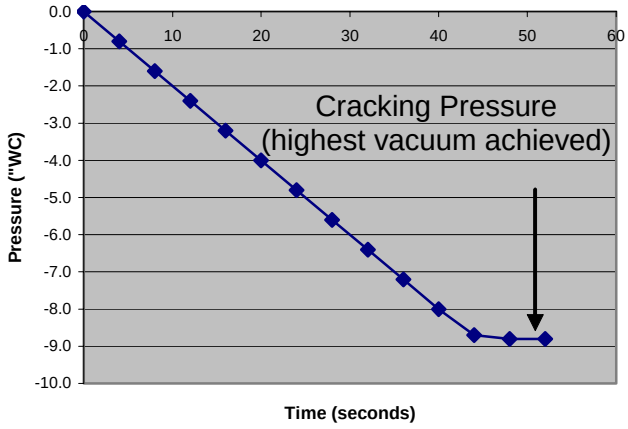
For the purpose of this procedure, the term "ARB" refers to the California Air Resources Board, and the term "Executive Officer" refers to the ARB Executive Officer or his or her authorized representative or designate.

1. PURPOSE AND APPLICABILITY

The purpose of this procedure is to determine whether a pressure/vacuum vent valve (P/V valve) meets the specifications in CP-201, *Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities*. This procedure is applicable for certification testing of P/V vent valves and is not applicable for compliance testing of in-use P/V valves.

For the purpose of this test procedure, the cracking pressure of the P/V valve is defined as the maximum pressure achieved during the application of this test procedure. Typical positive (left) and negative (right) pressure/time curves are provided below.





2. PRINCIPLE AND SUMMARY OF TEST PROCEDURE

2.1 The positive and negative gauge cracking pressures are determined by measuring the pressure at which the P/V valve cracking pressures occur, as defined by this test procedure. A flow metering device is used to introduce flow while measuring pressure.

2.2 The volumetric leak rates through the P/V valve under positive and negative pressures are determined by measuring the leak flow rate for compliance with the requirements of Section 3 of CP-201.

2.3 For the positive and negative cracking pressure tests, three (3) replicate test runs shall be conducted sequentially, and the average of the three runs shall be reported for the test results.

2.4 The valves are tested while connected to the vent pipe(s) using a ball valve, or other valves, as shown in Figure 1. Note that the ball valve is installed for certification testing purposes only and must be removed after the certification testing is completed. However, "bench" testing of P/V valves may also be conducted for certification purposes.

2.5 The P/V valve shall not be cracked by anyone prior to the first pressure/vacuum cracking test each day of certification testing. The first valve crack per test day should be included in the average result reported. No maintenance or testing of the P/V valve shall have occurred for at least twenty-four hours prior to the pressure/vacuum cracking tests.

3. BIASES AND INTERFERENCES

3.1 P/V valve installation that does not follow the manufacturer's recommended installation instructions can produce erroneous results.

3.2 Leaks in 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 specifications should not be considered as due solely to the P/V valve unless the ball valve is demonstrated to be leak free.

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 plus/minus 9.3 percent ($\pm$ 9.3 %) and plus/minus 4.0 percent ($\pm$ 4.0 %) for the positive and negative cracking pressure tests, respectively.

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 flow metering devices (see Section 5.5).

5. EQUIPMENT

5.1 Compressed Air or Nitrogen. Use air or nitrogen in a high-pressure cylinder equipped with a pressure regulator.

5.2 Surge Tank. If required, use a tank (10 liter minimum), capable of being pressurized or evacuated (placed under vacuum) to the minimum working pressure required by the control valve and/or flow-metering device(s).

5.3 Vacuum Pump or Vacuum Generating Device. Use a vacuum pump capable of evacuating the ballast tank or test stand to the minimum working pressure required by the control valve and/or flow-metering device.

5.4 Electronic Pressure Measuring Device (manometer). Minimum readability shall be 0.01 inches H_2O with measurement range(s) to include at least up to positive 10 (+10) and negative 20 (–20) inches H_2O with a minimum accuracy of plus or minus 0.05 inches H_2O. The electronic manometer shall 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 introduced flow rates.

5.5.1 Mass Flow Meter. The minimum readability shall be 1.0 milliliters per minute (ml/min) with a minimum full-scale accuracy of plus/minus 1.0 percent (± 1.0 %). 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 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 high precision needle valves of the appropriate control ranges to accurately adjust the flow settings for the leak rate and cracking tests.

5.6 Test Assembly. 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. The P/V valve will be isolated on the vent stack with a ball valve and tested in place at the facility. 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 six-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.

6. PRE-TEST PROCEDURES

6.1 All pressure measuring devices(s) shall be tested for accuracy using a reference gauge, incline manometer, or National Institute of Standards and Technology (NIST) traceable standard at least within six (6) months prior to the test. Accuracy checks shall be performed at a minimum of five 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 the manufacturer's required warm-up time and shall be 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 within six (6) months prior to testing. The accuracy checks should be conducted first at 10 pounds per square inch gauge (psig) inlet pressure and second at -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 two-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 leak rate tests as specified in Section 7.2.

6.4.4 If the measured leak rate is less than or equal to two milliliters per minute ($\leq$ 2 ml/min) then proceed to Section 7.

6.4.5 If the measured leak rate is greater than two milliliters per minute (> 2 ml/min) then troubleshoot and resolve the leak problem before proceeding to Section 7.

7. TEST PROCEDURE

7.1 Configure the test assembly per Figure 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 using a test stand, the ball valve, which would be used for isolating the P/V valve on a GDF vent stack, is not required.

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 or in the system application. 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 seventy five percent (75%) of the required specification (e.g., greater than 60 milliliters per minute (> 60 ml/min)) for valves rated to 0.17 CFH or greater than 17 milliliters per minute (> 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 pressures as described in Section 3 of CP-201. 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. The value recorded by the digital manometer as the maximum pressure achieved (max hold) during the test run will be used for reporting purposes.

Note that the manometer max hold reading must be zeroed between each run. The maximum value logged must be checked and 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 it 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 air 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 or in the system application. 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 or in the system application. 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. The value recorded by the digital manometer as the maximum pressure achieved (max hold) during the test run shall be used for reporting purposes. Also see 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 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). Use the MFM with a full scale reading of 0 to 200 ml/min. 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 $\leq$ 10 ml/min, then reconfigure the test assembly to use the MFM with a full scale reading of 0 to 20 ml/min and re-conduct the leak rate test. If the result of the check on the test assembly shows a leak problem (i.e., $\geq$ 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 two-inch vent pipe and conduct the leak rate procedure (as specified in Section 7.2) to verify that there is no leak (i.e., $\geq$ 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. POST TEST PROCEDURES

After all tests are completed and before leaving the test site, switch the ball valve to the open position.

9. CALCULATING RESULTS

9.1 Commonly used flow rate conversions:

1 CFH = 472 ml/min

Examples:
0.21 CFH * 472 ml/min/CFH = 99 ml/min
0.17 CFH *472 ml/min/CFH = 80 ml/min
0.05 CFH * 472 ml/min/CFH = 24 ml/min

9.2 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.

9.3 Reporting Results with 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 8.2

E = the allowable testing error, percent, i.e. precision from Section 4.1

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, model number, and manufacture date (date stamp) 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 8 to convert the flow measurements into units of ml/min.

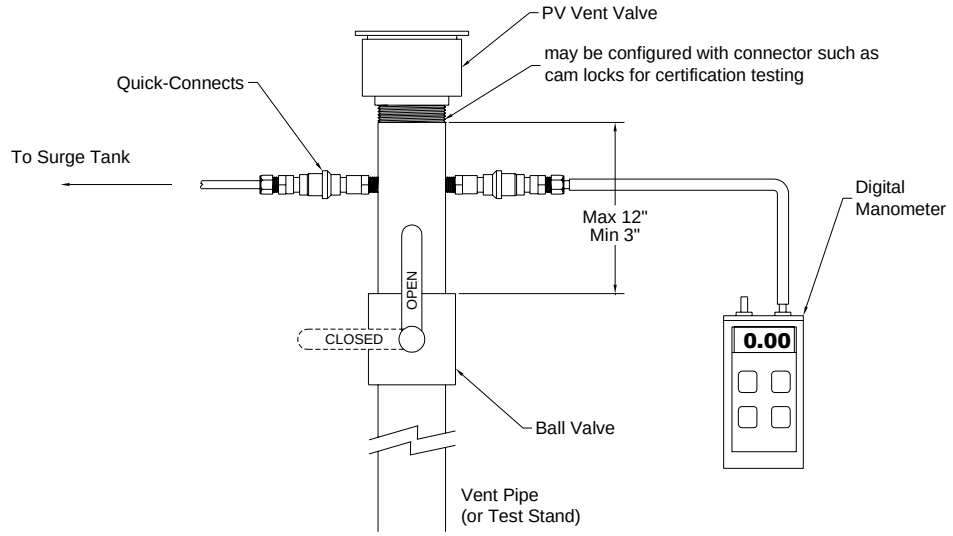
10.6 Compare the results to the performance specifications listed in Table 3-1 of CP-201 or as specified in Section 3 of CP-201, applying any allowable tolerance for testing error (as specified in Section 8.3). Circle "Pass" on the data sheet if the leak rate and cracking pressures meet the specifications. If either the volumetric leak rate or cracking pressure exceeds the specifications, circle "Fail" on the data sheet.

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 Assembly



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

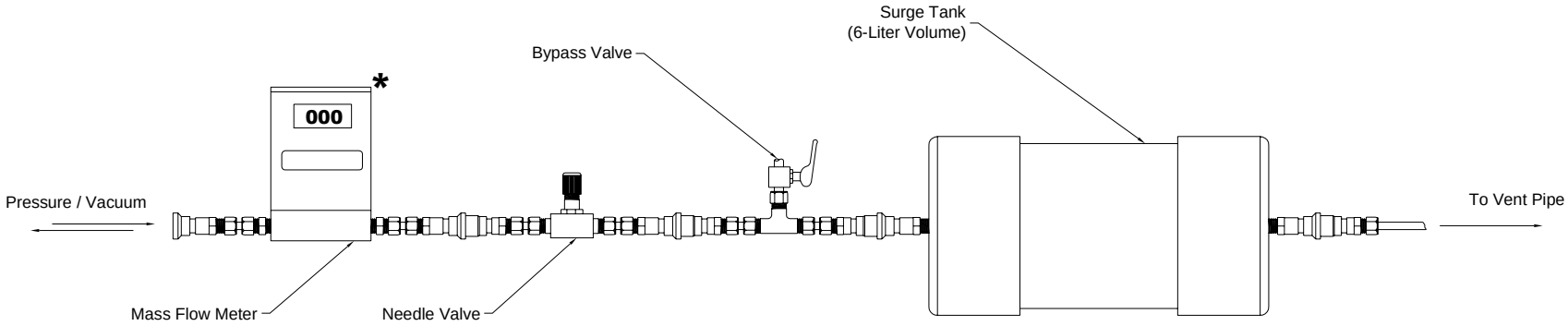
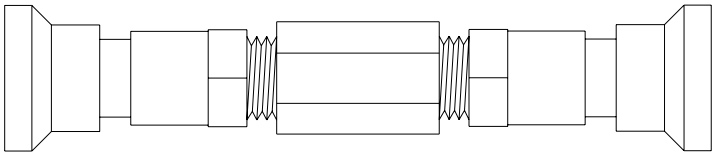


Figure 2
¼ Inch Quick Connect Union



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

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: