California Environmental Protection Agency

Air Resources Board

Spark Ignition Marine Watercraft Evaporative Emissions Test Procedure

TP-1505-A

Test Procedure for Determining Pressure Relief Valve Performance: Durability Demonstration and Leak Test

Alternative Procedure Adoption Date: August 28, 2017

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A set of definitions common to all certification and test procedures are in Cal. Code Regs, tit. 13, §2752 et seq. 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. APPLICABILITY

This test procedure is used by CARB to determine the performance of Pressure Relief Valves used to control evaporative emissions from Spark Ignition Marine Watercraft (SIMW). SIMW are defined in Cal. Code Regs, tit. 13, §2850 et seq. This test procedure is proposed pursuant to Section 43824 of the California Health and Safety Code and applies to fuel tank or equipment manufacturers seeking an Executive Order for an evaporative emissions control system utilizing a pressure relief valve. TP-1505a is used for design-based certification as defined in Cal. Code Regs, tit. 13, §2855.

1.1 Requirement to Comply with All Other Applicable Codes and Regulations

Approval of an evaporative emissions control system component, technology, or system by the Executive Officer does not exempt the manufacturer from compliance with other applicable codes and regulations such as state and federal safety codes and regulations.

1.2 Safety

This test procedure involves the use of potentially hazardous operations and should only be used by, or under the supervision of, those familiar and experienced in the use of such operations. Appropriate safety precautions should be observed at all times while performing this test procedure.

2. PERFORMANCE STANDARDS

The minimum performance standard for certification of a SIMW component is defined in Cal. Code Regs, tit. 13, §2855.

3. DURABILITY REQUIREMENT

A durability demonstration is required prior to any testing to determine the performance of a pressure relief valve. Durability demonstration tests are designed to ensure that the pressure relief valve remains effective throughout the useful life of the SIMW.

Prior to the commencement of a durability demonstration, if the applicant chooses to follow an alternative durability procedure, the applicant is required to submit and obtain approval of an alternative pressure relief valve durability test procedure according to Section 11 of this test procedure. Once approved, a manufacturer is not required to obtain a new approval for a durability demonstration unless changes result in new testing requirements.

Pressure relief valves shall be deemed acceptable if they remain functional after the durability demonstration prescribed below. Unless otherwise specified, all testing may be performed at ambient temperature. All testing temperatures must be within ± 5°F (± 3°C) of the required temperature.

The Executive Officer shall review the method for demonstrating durability based on the following requirements:

The pressure relief valve durability and reliability requirements may be performed on a sealed fuel tank, sealed test rig, or a representative sealed fuel system (manufacturer tank not required). Unless otherwise specified, all testing may be performed at ambient temperature. All testing temperatures must be within ± 5°F (± 3°C) of the required temperature.

3.1 Thermal Cycle

The pressure relief valve is placed in an environment where they are subjected to temperature changes for one cycle in the sequence below:

- 86°F (30ºC) for 15.5 hours,
- 77°F (25 ºC) for 0.5 hours,
- 68ºF (20ºC) for 7.5 hours,
- 77°F (25ºC) for 0.5 hours,
- 86°F (30ºC) for 15.5 hours,
- 77°F (25ºC) for 0.5 hours,
- 68ºF (20ºC) for 7.5 hours, and
- 77°F (25ºC) for 0.5 hours.

Up to 5 minutes is allowed for the temperature to rise/descend and then stabilize. A total of ten (10) cycles are required.

3.2 Pressure/Vacuum

The Pressure/Vacuum test is performed under both high 86°F (30ºC) and low - 68°F (20ºC) temperature. Determine the pressure relief valve's design pressure limit under normal operating conditions. Connect the pressure relief valve to a sealed empty tank. Pressurize the empty tank until the valve opens and then evacuate to at least 0 kPa. Flow rates must be no less than 1 L/min. The pressure/vacuum cycling shall be performed at 86ºF +/- 5ºF (30ºC +/- 3ºC) and at 68ºF+/- 5ºF (20ºC +/- 3ºC) ambient. Repeat the pressure/vacuum process until the valve has been subjected to not less than 8,300 cycles in each temperature condition.

3.3 Vibration

The vibration test is performed with a vibration frequency of 11 Hz at an acceleration of 29.4 m/s^2. The valve must be subjected to continuous sinusoidal vibration in its vertical and horizontal (radial and axial) direction for 2.5×10^4 times each.

3.4 Dust

The dust test is performed in a test room filled by dust indicated by JIS (Japanese Industrial Standards) Z8901 type 15 with a concentration of 100 $\mu g/m^3$. The valve is pressurized to open and then allowed to close when the tank is evacuated to a maximum of -2.94 kPa +/- 0.1kPa. For dual-acting valves that open under both pressure and vacuum, the evacuation pressure shall be at least the valve vacuum actuation point. Three hundred (300) pressure/vacuum cycles in the dust test room are required.

3.5 Ozone

The ozone test is a static test performed in an environment that can produce ozone to the specified level and temperature. The pressure relief valve must be subjected to a continuous exposure of 150 ppb +/- 5 ppb (parts per billion) of ozone at 86°F (30°C) for 120 hours.

4. GENERAL SUMMARY OF TEST PROCEDURE

This test procedure is designed to evaluate the durability and level of evaporative emissions control provided by SIMW pressure relief valves, including the effects of valve leakage and diurnal venting. The procedure quantifies the leak rate from the valve over the range of pressures experienced in a sealed fuel tank over the course of typical daily temperature fluctuations. It also estimates venting emissions during a typical diurnal temperature cycle based on the positive pressure at which the valve opens. The leak rate must be low enough that the combined emissions from the valve leaking and venting during the diurnal cycle does not exceed the degree of control required by the regulation.

The test procedure may be summarized as follows

- Five clearly and identifiably marked valves, which have been subjected to the durability procedures described in Section 3, are required for testing.
- Connect the valve to a sealed tank filled to at least 40% of its rated volume with E-10 fuel, per Cal. Code Regs, tit. 13, §2853(a)(1), and heat the gasoline to at least 6.7 °C (12 °F) above the ambient temperature for at least 12 hours.
- Within 72 hours after heating is completed, remove valve from tank and connect to leak measurement assembly.
- Pressurize and leak-check assembly.

- Determine Venting and Cracking pressures as defined in Section 9.
- Record “leak curve” of data point pressures and flow rates into system required to maintain data point pressure, from 0 inches of water column (inWC) (0 PSIG) until the valve vents.
- When leak curves for all five valves are recorded, enter data points from 2.0inWC (0.07PSIG) to the Cracking Pressure (as defined in Section 9) into the Diurnal Cycle Cert Tool spreadsheet.

5. INSTRUMENTATION, SENSITIVITY AND RANGE

- A sealable fuel tank of not less than one gallon capacity.
- A temperature measurement device, selected according to good engineering judgment, fitted to the tank so as to accurately read the temperature of fuel within the tank when filled to 40% of capacity.
- An appropriate mechanism for safely heating the fuel tank and its contents, consistent with good engineering judgment.
- A pressurized source of commercially pure nitrogen gas, with an appropriate pressure regulator to provide a pressure of 5-10 PSI upstream of the fine adjustment valve.
- A needle valve or other finely adjustable valve, suitable according to good engineering judgment for precise flow adjustment within the range of 0-20 ml/min.
- A purge valve which does not leak when closed.
- A gas flowmeter with a flow range of 0-20 ml/min, with rated accuracy of not less than ±0.05 ml/min at a flow rate of 1.0 ml/min and resolution of not less than 0.01 ml/min. If the flowmeter reports units in Standard Cubic Centimeters per Minute, 1.0 SCCM shall be considered as equivalent to 1.0 ml/min for the purposes of this test procedure.
- A pressure measurement device, such as a gauge, manometer, or transducer, with a range of at least 0 to 42 inWC (0-1.5 PSIG) and accuracy of at least ± 0.05 inWC (0.002 PSI) and readability of at least 0.01 inWC.

6. EQUIPMENT CALIBRATIONS

Mass flow controllers and meters, and pressure measurement instruments, must undergo an annual multiple point calibration with a primary standard and have a R^2 coefficient of 0.99 or greater.

7. FUEL VAPOR EXPOSURE PROCEDURE

Prior to conducting the leak test procedure described in Section 7, the valve must be exposed to fuel vapors so that its performance is consistent with what would be expected under real world operating conditions. The valve shall be exposed to fuel vapors in accordance with the following procedure:

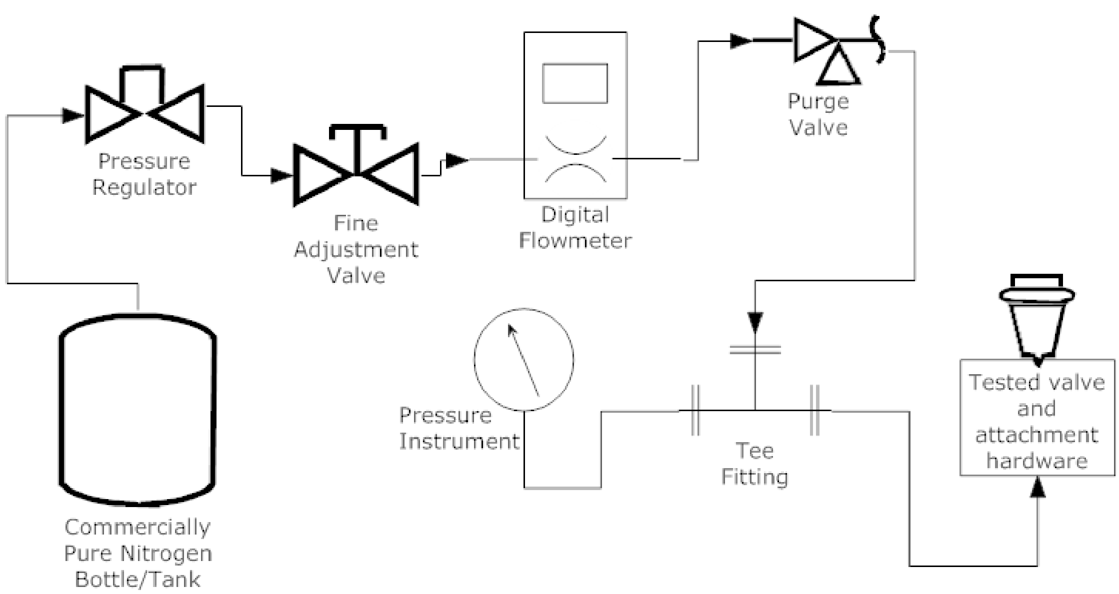
1. Connect the pressure relief valve to a sealable fuel tank or container of not less than one gallon rated capacity, fitted with appropriate temperature instrumentation. Multiple valve samples may be connected to the same tank for this part of the procedure, if desired.
2. Fill the tank to 40% of rated capacity with E-10 gasoline, per Cal. Code Regs, tit. 13, §2853(a)(1), and seal the tank. Record the ambient temperature at this point.
3. Safely raise the temperature of the tank such that the fuel reaches at least 6.7 °C (12 °F) above the ambient temperature at time of fueling and sealing.
4. Maintain fuel at this temperature or higher for at least 12 hours.

5. Upon completion of step 4, the valve may remain connected to the tank and exposed to fuel vapors for additional time as needed to facilitate testing, at either elevated or ambient temperature.
6. Remove valve from tank and take leak curve as instructed in Sections 8-10. Leak curve data must be collected within 72 hours of removing the valve from the fuel tank.

8. LEAK CURVE ASSEMBLY SETUP AND LEAK TESTING PROCEDURE

1. Connect the gas flowmeter, nitrogen source, pressure measurement device, fine-adjustment valve, and purge valve with suitable nitrogen-impermeable tubing and fittings as shown in figure 8.1. Select components to minimizing the system's internal volume, according to good engineering judgment.
2. Connect the pressure relief valve to the above assembly as shown in figure 8.1. Hardware and fittings to attach the pressure relief valve to the system should be consistent with the geometry of the valve and good engineering judgment, and should provide a leak-tight connection.
3. Start the flow of nitrogen and adjust the pressure regulator so that a pressure of 5-10 PSI is reached upstream of the fine adjustment valve.
4. Open the fine adjustment valve and allow nitrogen to flow into the assembly until its internal pressure reaches at least 28 inWC (1 PSI). Reduce nitrogen flow and apply bubble-producing leak detector solution to all joints downstream of the flowmeter and upstream of the valve to be tested. Rectify any leaks detected by this procedure.
5. Shut off flow of nitrogen using the fine adjustment valve. You may release pressure downstream of the fine adjustment valve using the purge valve, or begin the cracking point test described in Section 9.

Figure 8.1: Sketch of pressure relief valve leak testing system



9. VENTING PRESSURE AND CRACKING PRESSURE PROCEDURE

At pressures insufficient to actuate the valve mechanism, a real pressure relief valve will leak at a low, pressure-dependent rate. The mathematical nature of this dependence varies with the geometry and material characteristics of the valve. As pressure increases, a point is reached where the valve mechanism begins to actuate and a large increase in flow is observed with a small increase in pressure, representing the transition from leaking to venting. This point is designated as the “Cracking Pressure” for the valve. Over a small range of pressure increase (less than 2 inWC for most valves tested) the flow rate increases rapidly until the valve mechanism fully actuates and the valve offers minimal flow restriction, which results in the pressure across the valve either remaining steady, or dropping, even at relatively high flow rates, until a pressure is reached at which the valve re-seats. The pressure at which the valve fully actuates is designated as the “Venting Pressure” for the valve. These pressures must be determined in order to predict the total emissions from the valve by the mechanisms of leakage and venting. To ensure consistency between tests, the following procedure shall be used to determine the venting and cracking pressures for each valve sample.

1. Open the purge valve and adjust the fine adjustment valve until nitrogen flow rate is equal to 20 ml/min.
2. Close the purge valve and allow nitrogen to flow into the assembly at a rate of 20 ml/min.
3. Maintain this flow rate until a point is reached where pressure either remains constant or begins to decrease at this flow rate. Note and record the maximum pressure reached. This pressure is the Venting Pressure for the individual valve sample.
4. Subtract 1.0 inWC from the Venting Pressure, then round down to the next inWC. This is the Nominal Cracking Pressure. For example, if the Venting Pressure is 35.64 inWC, then the Nominal Cracking Pressure is 34inWC.
5. Record the Venting Pressure and Nominal Cracking Pressure on the valve sample data sheet in the appropriate spaces.

10. LEAK CURVE PROCEDURE

Data points for the leak curve shall be collected at intervals of no greater than 2 inWC (+/- 0.1 inWC at each nominal value) beginning with 2.0 +/- 0.1 inWC, until the pressure is within 5.0inWC of the Nominal Cracking Pressure as determined in Section 9, and thereafter at intervals of no greater than 1.0 +/- 0.1 inWC until the Nominal Cracking Pressure, +/- 0.1inWC, is reached. The actual pressure and flowmeter reading (leak rate) for each data point must be recorded; pre-filling the data sheet with the nominal pressure for each data point may be useful.

Data may be taken at more frequent intervals if desired; the Diurnal Cycle Cert Tool spreadsheet can accept up to 100 data points. However, the last data point entered into the tool must correspond to the Nominal Cracking Pressure as determined in Section 9.

1. Begin with the flow of nitrogen shut off using the fine adjustment valve. Release any built-up pressure downstream of the fine adjustment valve by opening the purge valve to atmosphere.
2. Open the fine-adjustment valve to allow nitrogen to flow into the system at a rate of

between 2 and 5 ml/min. Closely monitor the pressure rise.

3. Take each leak curve data point as follows:
    a. When the system pressure reaches the desired nominal pressure for the data point, +/- 0.1 inWC, reduce nitrogen flow until the flowmeter reading is no higher than the flow reading for the previous data point (0 ml/min for the first data point).
    b. Using the fine adjustment valve, adjust the flow rate until the pressure stabilizes and remains within ± 0.1 inWC of the desired nominal pressure. If pressure and/or flow are not stable for a period of at least 15 seconds, continue adjusting the valve until stability is achieved
    c. The data point is considered valid only when pressure remains stable within ± 0.1 inWC and flow rate does not vary by more than the rated accuracy of the flowmeter within a 15 second window. Record the actual pressure and flow rate for this data point.
4. Continue generating data points at increasing pressures until you reach the Nominal Cracking Pressure determined in Section 9. This will serve as the final data point for the leak curve. The actual pressure for this data point must be within ± 0.1 inWC of the Nominal Cracking Pressure. Record this in the “Cracking Pressure: Actual” box on the data sheet. This pressure will be designated as the Cracking Pressure for all subsequent calculations.
5. Confirm that each valve tested is clearly and identifiably marked and that the identifying mark is clearly noted on the corresponding data sheet.
6. Enter leak curve data points into the Diurnal Cycle Cert Tool spreadsheet as described in Appendix A.

Valves whose predicted emissions according to the Diurnal Cycle Cert Tool model do not meet the control standard cannot be certified by this procedure. Valves which do not pass according to this procedure may be redesigned to reduce leakage and/or raise the Cracking Pressure to reduce venting, or may be certified by another approved procedure if a passing result can be shown.

11. ALTERNATIVE TEST PROCEDURES

Test procedures, other than specified above, shall only be used if prior written approval is obtained from the Executive Officer. In order to obtain approval of an alternative test procedure, the applicant is responsible for demonstrating to the Executive Officer that the alternative test procedure is equivalent to this test procedure.

- Documentation of any such approvals and demonstrations shall be maintained by the Executive Officer and shall be made available upon request.
- Demonstration of equivalency must include a minimum of three (3) test results each from TP-1505A and from the submitted alternative test procedure. The application must also include a comparison of the results demonstrating that the submitted alternative test procedure yields results equivalent to this test procedure. The applicant must submit the test procedure in detail for an engineering review and clearly identify any modifications to TP-1505A.
- Once approved for use, an alternative test procedure may be used and referenced by any manufacturer subject to the limitations and constraints in the Executive Order approving the alternative test procedure.

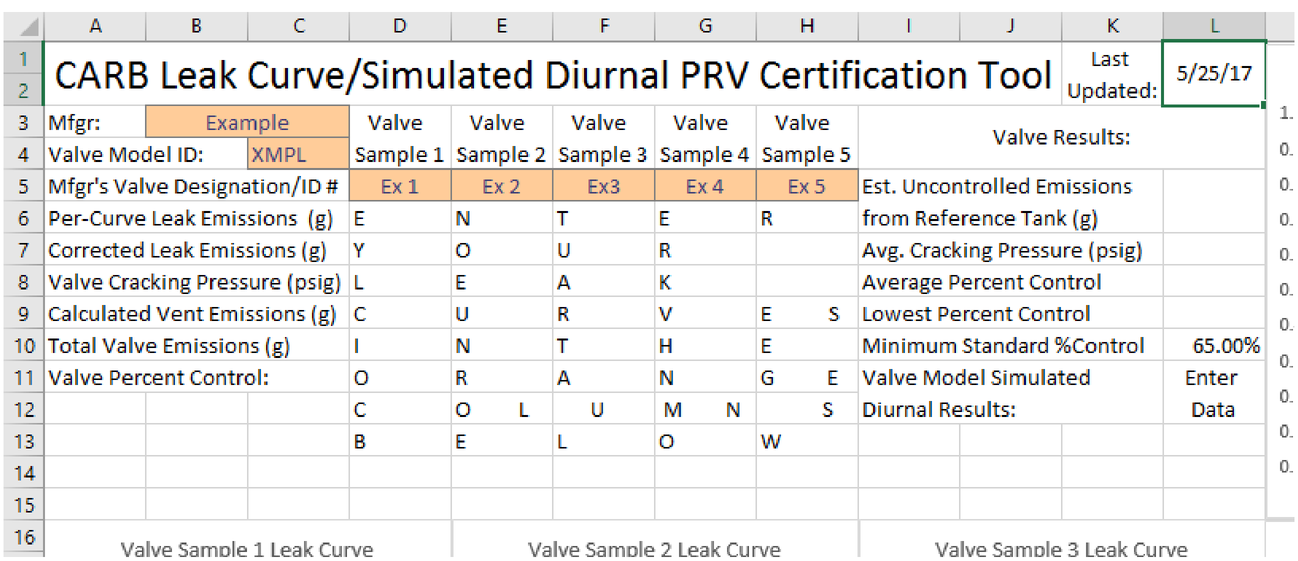
Appendix A: Simulated Diurnal Cycle Model Implementation Tool

A spreadsheet implementation tool of the simulated diurnal cycle model that was developed by ARB staff is available for download from ARB's SIMW component certification website. This tool calculates expected total hydrocarbon emissions from a reference tank when fitted with each of the five valve samples tested and subjected to a typical diurnal temperature cycle for trailerable watercraft.

Within the spreadsheet, orange cells require entry of data or labeling information and can accept input. The rest of the spreadsheet is protected and will not accept input. The non-input cells in the upper left region of the spreadsheet, and the graphs, will automatically populate when data is entered correctly. The procedure for filling out the spreadsheet is as follows:

1. Download the most recent version of the spreadsheet document from the ARB SIMW component certification website. Open the spreadsheet file using Microsoft Excel 2010 or later, or compatible spreadsheet software. Note: formatting may not display correctly in software other than Microsoft Excel 2010 or later. Select Save As and save a new copy with a distinguishing filename, to avoid overwriting data.

2. Enter the valve manufacturer's name and model designation of the valve model being tested in the "Mfgr" and "valve model ID" spaces, as shown in figure A.1 below. For each valve tested, enter the number or other identifier used to mark the valve sample in the "Mfgr's Valve Designation/ID #" box in the column which corresponds to the order in which the valves were tested; e.g. values corresponding to the first valve tested will be entered in the "Sample 1" column, as shown in figure A.1 below.



	A	B	C	D	E	F	G	H	I	J	K	L	
1	CARB Leak Curve/Simulated Diurnal PRV Certification Tool										Last	5/25/17	
2											Updated:		
3	Mfgr:	Example		Valve	Valve	Valve	Valve	Valve	Valve Results:				1.
4	Valve Model ID:		XMPL	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5					0.
5	Mfgr's Valve Designation/ID #			Ex 1	Ex 2	Ex3	Ex 4	Ex 5	Est. Uncontrolled Emissions				0.
6	Per-Curve Leak Emissions (g)			E	N	T	E	R	from Reference Tank (g)				0.
7	Corrected Leak Emissions (g)			Y	O	U	R		Avg. Cracking Pressure (psig)				0.
8	Valve Cracking Pressure (psig)			L	E	A	K		Average Percent Control				0.
9	Calculated Vent Emissions (g)			C	U	R	V	E S	Lowest Percent Control				0.
10	Total Valve Emissions (g)			I	N	T	H	E	Minimum Standard %Control			65.00%	0.
11	Valve Percent Control:			O	R	A	N	G E	Valve Model Simulated			Enter	0.
12				C	O L	U	M N	S	Diurnal Results:			Data	0.
13				B	E	L	O	W					0.
14													0.
15													
16	Valve Sample 1 Leak Curve				Valve Sample 2 Leak Curve				Valve Sample 3 Leak Curve				

Figure A.1: Screen capture showing upper cell data entry

3. For each valve tested, enter the actual pressure (in inWC) and flow rate (in ml/min) for each data point in the leak curve for the valve tested in the corresponding column, as shown in figure A.2 below. Data points must be entered as follows:
   a. Beginning with the first data point at which measured gauge pressure is greater than 0.0 inWC and ending with the data point corresponding to the Cracking Pressure as defined in Section 10.
   b. Data for the first data point must be entered on the first line of orange cells in the leak curve column.
   c. The data points must be in order of increasing pressure.
   d. Do not skip lines between data points.
   e. A maximum of 100 data points can be accepted by this tool.

0.0 10.0 20.0 30.0 40.0 50.0 | 0.0 10.0 20.0 30.0 40.0 5

Valve Sample 1 Leak Curve			Valve Sample 2 Leak Curve		
Data Point	Pressure (inWC)	Leak Rate (ml/min)	Data Point	Pressure (inWC)	Leak Rate (ml/min)
0	0.0	0.00	0	0.0	0.00
1	2.0	0.00	1	2.0	0.00
2	4.0	0.00	2	4.0	0.12
3	6.0	0.00	3	6.0	0.17
4	8.0	0.39	4	8.0	0.25
5	10.0	0.39	5	9.9	0.33
6	12.0	0.41	6	11.9	0.39
7	14.0	0.50	7	13.9	0.43
8	16.0	0.51	8	15.9	0.47
9	18.0	0.51	9	17.9	0.56
10	20.0	0.80	10	20.0	0.64
11	22.0	0.81	11	22.0	0.70
12	24.0	0.85	12	24.0	0.75
13	26.0	0.99	13	26.0	0.80
14	28.0	1.04	14	28.0	0.88
15	30.0	1.16	15	30.0	0.95
16	32.0	1.18	16	32.0	1.13
17	34.0	1.23	17	34.0	1.21
18	36.0	1.29	18	36.0	1.35
19	38.0	1.42	19	38.0	1.42
20	40.0	1.51	20	40.0	1.53

Figure A.2: Screen capture showing upper cell data entry
(Artificially generated data for illustrative purposes only)

4. When all five leak curves are entered, the tool will determine the average and minimum percent control achieved by the valve sample tested and compare it against the 65% diurnal emissions control standard required by Cal. Code Regs, tit. 13, §2855, as shown in figures A.3 through A.5. All five valve samples must meet the control standard for the valve model to pass and be accepted for certification via this procedure.

CARB Leak Curve/Simulated Diurnal PRV Certification Tool						Last Updated:	5/25/17
Mfgr: Example	Valve Sample 1	Valve Sample 2	Valve Sample 3	Valve Sample 4	Valve Sample 5	Valve Results:	
Valve Model ID: XMPL							
Mfgr's Valve Designation/ID #	Ex 1	Ex 2	Ex3	Ex 4	Ex 5	Est. Uncontrolled Emissions	
Per-Curve Leak Emissions (g)	0.973	0.959	0.969	0.976	0.975	from Reference Tank (g)	3.244
Corrected Leak Emissions (g)	0.389	0.384	0.387	0.390	0.390	Avg. Cracking Pressure (psig)	1.44
Valve Cracking Pressure (psig)	1.44	1.44	1.44	1.44	1.44	Average Percent Control	87.56%
Calculated Vent Emissions (g)	0.02	0.02	0.02	0.02	0.02	Lowest Percent Control	87.49%
Total Valve Emissions (g)	0.40	0.40	0.40	0.41	0.41	Minimum Standard %Control	65.00%
Valve Percent Control:	87.52%	87.70%	87.58%	87.49%	87.50%	Valve Model Simulated Diurnal Results:	Eligible

Valve Sample 1 Leak Curve | Valve Sample 2 Leak Curve | Valve Sample 3 Leak Curve

Figure A.3: Screen capture showing passing valve model
(Artificially generated data for illustrative purposes only)

CARB Leak Curve/Simulated Diurnal PRV Certification Tool						Last Updated:	5/25/17
Mfgr: Example	Valve Sample 1	Valve Sample 2	Valve Sample 3	Valve Sample 4	Valve Sample 5	Valve Results:	
Valve Model ID: XMPL							
Mfgr's Valve Designation/ID #	Ex 1	Ex 2	Ex3	Ex 4	Ex 5	Est. Uncontrolled Emissions	
Per-Curve Leak Emissions (g)	2.920	0.959	0.969	0.976	0.975	from Reference Tank (g)	3.244
Corrected Leak Emissions (g)	1.168	0.384	0.387	0.390	0.390	Avg. Cracking Pressure (psig)	1.44
Valve Cracking Pressure (psig)	1.44	1.44	1.44	1.44	1.44	Average Percent Control	82.76%
Calculated Vent Emissions (g)	0.02	0.02	0.02	0.02	0.02	Lowest Percent Control	63.52%
Total Valve Emissions (g)	1.18	0.40	0.40	0.41	0.41	Minimum Standard %Control	65.00%
Valve Percent Control:	63.52%	87.70%	87.58%	87.49%	87.50%	Valve Model Simulated Diurnal Results:	Ineligible

Valve Sample 1 Leak Curve | Valve Sample 2 Leak Curve | Valve Sample 3 Leak Curve

Figure A.4: Screen capture showing valve model with 1 failing sample (model fail)
(Artificially generated data for illustrative purposes only)

CARB Leak Curve/Simulated Diurnal PRV Certification Tool						Last Updated:	5/25/17
Mfgr: Example	Valve Sample 1	Valve Sample 2	Valve Sample 3	Valve Sample 4	Valve Sample 5	Valve Results:	
Valve Model ID: XMPL							
Mfgr's Valve Designation/ID #	Ex 1	Ex 2	Ex3	Ex 4	Ex 5	Est. Uncontrolled Emissions	
Per-Curve Leak Emissions (g)	2.920	2.877	2.906	2.927	2.925	from Reference Tank (g)	3.244
Corrected Leak Emissions (g)	1.168	1.151	1.162	1.171	1.170	Avg. Cracking Pressure (psig)	1.44
Valve Cracking Pressure (psig)	1.44	1.44	1.44	1.44	1.44	Average Percent Control	63.63%
Calculated Vent Emissions (g)	0.02	0.02	0.02	0.02	0.02	Lowest Percent Control	63.43%
Total Valve Emissions (g)	1.18	1.17	1.18	1.19	1.19	Minimum Standard %Control	65.00%
Valve Percent Control:	63.52%	64.05%	63.69%	63.43%	63.47%	Valve Model Simulated Diurnal Results:	Ineligible

Valve Sample 1 Leak Curve | Valve Sample 2 Leak Curve | Valve Sample 3 Leak Curve

Figure A.5: Screen capture showing valve model with 5 failing samples (model fail)
(Artificially generated data for illustrative purposes only)

Appendix B: Sample Data Sheet

CARB Data Sheet for TP-1505A Leak Curve Data

Name of Third Party Testing Organization:		
Valve Manufacturer:	Curve Taken By:	
Valve Model:	Date:	Time:
Valve Sample #/ID:	Signature:	
Venting Pressure: (inWC)	Cracking Pressure: Nominal: (inWC)	Actual: (inWC)
Comments:		

Take data points per TP-1505A. Conversion factor, if needed: 1 inWC = 0.0361 PSI.

Begin leak curve here. | Extra space if needed (model tool accepts up to 100 data points):

Nominal Pressure (inWC)	Actual Pressure (inWC)	Leak Rate (ml/min)	Nominal Pressure (inWC)	Actual Pressure (inWC)	Leak Rate (ml/min)
0	0.00	0.00			