California Environmental Protection Agency

Air Resources Board

Vapor Recovery Test Procedures

TP-204.2

Determination of One Minute Static Pressure Performance of Vapor Recovery Systems of Cargo Tanks

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Note: The text is shown in ~~strikeout~~ indicates deletions and underline indicates additions.

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Vapor Recovery Systems of Cargo Tanks

1 APPLICABILITY

Definitions common to all certification and test procedures are in:

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

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

1.1 General Applicability

This procedure is used to determine compliance with ~~applies to the determination of~~ the ~~one minute~~daily static pressure performance standard or one minute standard referenced in Vapor Recovery Certification Procedure 204 (CP-204), “Certification Procedure for Vapor Recovery Systems of Cargo Tanks,” ~~of a vapor recovery system of a cargo tank by fluid mechanical principles.~~ This procedure may be used to determine ~~applies to any vapor emissions~~daily static pressure associated with the dispensing of any fluid, although it is written to reflect application to the hydrocarbon vapors associated with the dispensing of gasoline.

~~1.2 Determinations of Compliance and Violation~~

~~Determinations of certain modes of compliance with and violation of certification specifications is outlined in § 9.~~

~~1.3 Modifications~~

~~Modification of this procedure may be necessary for vapors and fluids other than the hydrocarbon vapors associated with the dispensing of gasoline.~~

~~Any modification of this method shall be subject to approval by the ARB Executive Officer.~~

2 PRINCIPLE AND SUMMARY OF TEST PROCEDURE

Upon completion of loading operations at the bulk plant ~~gasoline distribution facility~~ or terminal, the gasoline cargo tank is pressurized~~,~~ with nitrogen~~,~~ to 18 inches water column (WC). By using the total cargo tank shell capacity, post-loading headspace volume, and the Ideal Gas Law, a one-minute maximum allowable pressure decay is calculated. The pressure decay is monitored for one minute and compliance is determined by comparison with the maximum allowable calculated value. The leak rate through the cargo tank internal vapor vent valve is similarly ~~obtained~~ determined.

3 BIASES AND INTERFERENCES

Thermal expansion due to direct sunlight on an exposed cargo tank can bias the results of this test procedure. Keep at least 75% of the length of the vapor space of a cargo tank in the shade during testing.

Cargo tank leakage exceeding the nitrogen feed rate precludes the use of this method. Such leakage demonstrates the inability of the cargo tank to meet its performance standard. The minimum nitrogen flowrate shall be calculated as shown in § ~~12~~9.2, or obtained from Table 5.

Pressure stability may not be achievable, within a reasonable time period, if the tank has been purged with air prior to loading gasoline. This tends to bias this test procedure toward determination of compliance. In such a case, the cargo tank shall be moved to disturb the liquid and saturate the vapor space.

Vapor leaks due to a faulty cargo tank vapor coupler or facility vapor hose coupler inherently shall constitute the violation of the one minute ~~performance~~ standard for any tank subject to this test procedure.

If the load prior to testing is diesel over gasoline, this tends to bias this test procedure toward determination of non-compliance. In such a case, the following steps shall be taken to eliminate this bias:

(1) The pressure decay portion of the test shall be conducted three times to compensate for the absorption of gasoline vapors into the diesel. For the purpose of this interference, diesel shall be defined as any petroleum distillate with a vapor pressure under 4.0 pounds Reid.

(2) The first two tests will promote absorption of the gasoline vapors into the diesel to eliminate this bias.

4 SENSITIVITY, RANGE, AND PRECISION

4.1 Mechanical Pressure Gauges

Mechanical gauges shall be a minimum of two inches in diameter.

The readability of a mechanical pressure gauge shall be:

0.20 inches WC ~~water column~~ on a full scale not to exceed thirty (30) inches

WC~~water column~~ for cargo tank tests and

0.10 inches WC~~water column~~ on a full scale not to exceed ten (10) inches WC ~~water column~~ for internal vapor valve tests.

The accuracy of a mechanical pressure gauge shall be one (1.0) percent of full scale.

4.2 Other Pressure Gauges

The full scale range of other pressure gauges shall not exceed twenty (20) inches WC ~~water column~~ for cargo tank tests and for internal vapor valve tests.

The accuracy of other pressure gauges shall be ~~one-half of one~~ 0.5 percent of full scale for cargo tank tests and for internal vapor valve tests.

5 EQUIPMENT

5.1 Nitrogen High Pressure Cylinder

Use a high pressure cylinder capable of maintaining a pressure of 2000 pounds per square inch gauge (psig). The cylinder shall be equipped with a compatible two-stage regulator with a one (1) psig relief valve and a flow control metering valve. The outlet of the metering valve shall be equipped with flexible tubing, a quick-connect fitting, and a one psi relief valve.

5.2 Vapor System Pressure Assembly

Use an OPW 634-B, or equivalent, cap (or OPW 634-A plug if applicable). The assembly shall be equipped with a 0-30 inch WC~~water column~~ pressure gauge, a metering valve, and a quick connect fitting (see Figure 1).

5.3 Vapor Valve Pressure Gauge

Use a pressure measuring device ~~(transducer, inclined manometer, or Magnahelic gauge)~~ with a design range suitable for the pressure being measured. The tap for the pressure measurement shall be located on the sample coupling attached to the inlet of the volume meter.

~~Use a Dwyer Model 2010 Magnahelic gauge (0-10 inches water column), or equivalent, equipped with a quick connect fitting.~~

5.4 Leak Test Assembly

Use OPW 633-D, 633-F, and 633-A (or 633-B if applicable) couplers, or equivalent as shown in Figure 2 ~~(attached)~~ to leak test the vapor system pressure assembly.

5.5 Flexible Tubing

Use high-pressure tubing equipped with a quick-connect fitting at each end to connect the nitrogen supply to the pressure assembly.

5.6 Nitrogen

Use a commercial grade nitrogen.

5.7 Stopwatch

Use a stopwatch accurate and precise to within 0.2 second.

5.8 Liquid Leak Detector

Use ~~Snoop liquid~~ leak detection solution ~~detector~~, or equivalent, to detect ~~gas~~vapor leaks in the vapor system pressure assembly.

5.9 Combustible Gas Detector

Use a Bacharach Instrument Company Model 0023-7356, or equivalent, to quantify any vapor leaks at the cargo tank vapor coupler during loading operations.

~~6 CALIBRATION PROCEDURE~~

~~This section is reserved for future specification.~~

6~~7~~ PRE-TEST PROTOCOL

The cargo tank shall adhere to all ~~of the other~~applicable certification conditions referenced in CP-204~~ (in addition to those requirements of CP-204 to which this test procedure applies)~~.

6~~7~~.1 Leak Check of Test Equipment

Assemble the vapor system pressure assembly as shown in Figure 1~~ (attached)~~.

Leak test the vapor system pressure assembly by connecting it to the leak test assembly and pressurizing, with nitrogen, to 20 inches WC~~water column~~. The decay rate shall not exceed 2 inches WC in five minutes.

6~~7~~.2 Cargo Tank Location

Locate any cargo tank to be tested where at least 75% of its length will be in shade for the duration of the test.

6~~7~~.3 Cargo Tank Preparation

6~~7~~.3.1 In general, this test procedure shall be performed on cargo tanks in conditions of routine operation, maintenance, and repair. Other conditions shall be documented in the test report.

6~~7~~.3.2 If performance of this test procedure is required due to demonstrated non-compliance with the leak performance standards, the test report shall document compliance with the following conditions:

6~~7~~.3.2.1 No repairs or maintenance of the cargo tank shall be allowed from the time of such demonstration until after the performance of this test procedure.

6~~7~~.3.2.2 Any movement or disturbance of the cargo tank or its contents shall be kept to a reasonable and practical minimum. For example:

(1) The cargo tank may be moved for business reasons if it occupies a position needed by another cargo tank.
(2) The cargo tank may be moved to meet the environmental requirements for cargo tank location.
(3) The cargo tank shall be moved to saturate the vapor space before testing if it was purged with air before gasoline loading.

7~~8~~ TEST PROCEDURE

For those cargo tanks with ~~manifolded~~ product lines that are manifolded, this test procedure ~~must~~shall be conducted on a per compartment basis.

7~~8~~.1 Initial Data Collection and Pressurization

7~~8~~.1.1 From ~~the cargo tank calibration sheet or~~ the identification plate on the cargo tank, determine and record the cargo tank shell capacity ~~on Line 1 of the data sheet shown in Figure 3 (attached). Record, in the upper right hand corner of the data sheet, whether the cargo tank's vapor coupler is equipped with a poppet and/or cap~~.

7~~8~~.1.2 Upon completion of the loading operations, record the total volume loaded ~~on Line 2 of the data sheet (Figure 3~~.

7~~8~~.1.3 If the system back pressure during loading was measured, enter the maximum observed pressure and number of arms loading ~~simultaneously on Line 4 of the data sheet (Figure 3)~~.

7~~8~~.1.4 If required by the safety procedures of the loading facility, ensure that a ground cable is connected to the cargo tank. If the cargo tank is remote from the loading rack so that the ground cable is not attached to the loading rack, then attach the ground cable to the nitrogen supply bottle. Connect the vapor system pressure assembly to the vapor coupler of the cargo tank. Open the internal vapor valve(s) of the cargo tank and record the initial headspace. ~~pressure on Line 5 of the data sheet (Figure 3).~~

7~~8~~.1.5 If the initial headspace pressure exceeds 18 inches water column, use the metering valve on the vapor system pressure assembly to reduce the pressure to 18.0 inches WC ~~water column~~.

7~~8~~.1.6 If the initial headspace pressure is less than 18 inches WC~~water column~~, adjust the delivery pressure on the nitrogen cylinder regulator such that the nitrogen feed rate exceeds the minimum allowable flow rate for an

empty cargo tank. See equation in § ~~12~~9.2, or Table 5. Connect the nitrogen supply to the pressure assembly and increase the cargo tank headspace pressure to 18 inches WC~~water column~~.

7~~8~~.1.7 For the next 30 ± 5 seconds, carefully adjust the headspace pressure to 18.0 inches WC~~water column~~.

7~~8~~.2 Static Pressure Performance Measurement

7~~8~~.2.1 Zero and re-start the stopwatch with the headspace pressure at 18.0 inches WC~~water column~~. After 60 ± 5 seconds record the headspace pressure as the "one-minute final pressure" ~~on Line 7 of the data sheet (Figure 3)~~.

7~~8~~.2.2 If the one-minute final pressure is less than 10 inches water column, the internal vapor valve portion of the test, as specified next, cannot be conducted.

7~~8~~.3 Re-pressurization

7~~8~~.3.1 Re-pressurize the cargo tank headspace to 18 inches WC~~water column~~. Close the internal vapor vent valve(s), wait for 30 ± 5 seconds, then, remove the pressure assembly cap to relieve the pressure, to atmospheric, downstream of the vapor vent valve. Wait for 15 ± 5 seconds. Replace the pressure assembly cap.

7~~8~~.3.2 Connect the 0-10 inches WC~~water column~~ pressure gauge to the quick connect fitting on the vapor system pressure assembly.

7~~8~~.4 Internal Vapor Valve Performance Measurement

7~~8~~.4.1 Interval Headspace Pressures

Zero and start the stopwatch as the pressure assembly cap is replaced. Repeat the following steps for up to five continuous intervals (each interval = 60 ± 5 seconds):

(1) record the total headspace pressure increase as the "interval pressure" ~~(on Lines 11 through 15 of the data sheet (Figure 3)~~ in sequence, depending on the next step~~)~~; and

(2) if the total headspace pressure increase is equal to or less than the corresponding allowable value specified in section 3.2.2 of CP-204, proceed to measure the "final pressure" as specified below; otherwise return to step (1)~~ above~~.

7~~8~~.4.2 Final Headspace Pressure

Within five seconds of the end of the last continuous interval above, open the vapor valve and record the headspace pressure as the "final pressure."~~ on Line 16 of the data sheet (Figure 3).~~

Remove the vapor system pressure assembly from the cargo tank.

8.0 REQUIREMENTS AT THE CONCLUSION OF PRESSURE TESTING

At the conclusion of pressure testing, the cargo tank owner or operator shall inspect the entire cargo tank and compartments, including tank, domes, dome vents, piping hose connections, adaptors, couplings, hoses and delivery elbows for evidence of wear, damage, or maladjustment that may be a potential leak source. Any part found to be defective shall be adjusted, repaired or replaced as necessary.

~~9 DETERMINATIONS OF COMPLIANCE AND VIOLATION~~

~~Determinations of certain modes of compliance with and violation of certification specifications are outlined below.~~

~~9.1 Static Pressure Performance Standard~~

~~9.1.1 Determination of Static Pressure Performance Standard~~

~~Determine the appropriate static pressure performance standard using § 1211.1 or Tables 1 through 4 (attached) and information from the data sheet (Figure 3).~~

~~9.1.2 Determination of Compliance~~

~~Compliance is determined if the one-minute final pressure on Line 7 of the data sheet (Figure 3) is equal to or greater than the appropriate static pressure performance standard.~~

~~9.1.3 Determination of Violation~~

~~Violation is determined if the one-minute final pressure on Line 7 of the data sheet (Figure 3) is less than the appropriate static pressure performance standard.~~

~~9.2 Internal Vapor Valve Performance Standard~~

~~9.2.1 Determination of Compliance~~

~~Compliance is determined if:~~

~~(1) the one-minute final pressure on Line 7 of the data sheet (Figure 3) was less than 10 inches water column; or~~

~~(2) a) any interval pressure across the internal vapor valve(s) on Lines 11-15 of the data sheet (Figure 3) is equal to or less than any of the five performance standards, as shown on the data sheet and in § 1211.3; and~~

~~b) the final pressure on Line 16 of the data sheet is equal to or greater than one-fifth (20%) of the one-minute final headspace pressure on Line 7 of the data sheet (Figure 3).~~

~~9.2.2 Determination of Violation~~

~~Violation is determined if:~~

~~(1) the one-minute final pressure on Line 7 of the data sheet (Figure 3) was equal to or greater than 10 inches water column; and~~

~~(2) a) no interval pressure across the internal vapor valve(s) on Lines 11-15 of the data sheet (Figure 3) is equal to or less than any of the five performance standards, as shown on the data sheet and in § 1211.3; or~~

~~b) the final pressure on Line 16 of the data sheet is less than one-fifth (20%) of the one-minute final headspace pressure on Line 7 of the data sheet (Figure 3).~~

~~10 QUALITY ASSURANCE / QUALITY CONTROL (QA/QC)~~

~~This section is reserved for future specification.~~

~~11 RECORDING DATA~~

~~The data shall be recorded as shown in Figure~~

9~~12~~ CALCULATING RESULTS

9~~12~~.1 One Minute Static Pressure Performance Standard

The minimum allowable one-minute final headspace pressure of a complying loaded cargo tank shall be obtained from the application of Tables 1 through 4, or shall be calculated as follows:

$$P_F = 18\left(\frac{N}{18}\right)^{\left(\frac{V_s}{5\,V_h}\right)}$$

Where:

P_F	=	minimum allowable one-minute final pressure, inches water column
V_s	=	total cargo tank shell capacity, gallons
V_h	=	cargo tank headspace volume after loading, gallons
18	=	initial pressure at start of test, inches water column
N	=	five minute performance standard, inches water column

Where:

If (Vs) is:			Then (N) equals:
≥		2,500	15.5
1,500	to	2,499	15.0

1,000	to	1,499	14.5
0	to	999	14.0

Important: If individual compartments are to be tested, both V_s and V_h must be the volumes relating to that compartment alone, not all compartments.

Note: Tables 1 through ~~4~~5 are convenient results of the calculation described above.

In these tables, the columns are headed by values of V_h and the rows are preceded by values of V_s.

Obtain the calculated result for P_F by finding the value of P_F at the intersection of the appropriate column and row for V_h and V_s.

9~~12~~.2 Minimum Nitrogen Flowrate

The minimum nitrogen flowrate required to test a cargo tank shall exceed the following calculated value by at least ten percent, or obtained from Table ~~5~~6:

$$Fn = \frac{V_s\,(18.0 - N)}{(7.481 \times 5 \times 406.9)}$$

Where:

Fn	=	minimum required nitrogen flowrate, CFM
Vs	=	total cargo tank shell capacity, gallons
18	=	initial pressure at start of test, inches water column
N	=	five minute performance standard, inches water column
5	=	5 minutes
406.9	=	atmospheric pressure, inches water column
7.481	=	number of gallons per cubic foot

9~~12~~.3 Internal Vapor Valve Performance Standard

The internal vapor valve performance standard is found in section 3.2.2 of CP-204. ~~compliance status of the cargo tank internal vapor vent valve(s) shall be determined as follows:~~

~~Test Time, Minutes~~	~~Maximum Allowable One-Minute Pressure Increase, inches H_2O~~
~~1.0~~	~~1.1~~
~~2.0~~	~~2.2~~
~~3.0~~	~~3.3~~
~~4.0~~	~~4.4~~
~~5.0~~	~~5.5~~

~~The values in the right hand column are adjusted upward to account for a systematic bias caused by expansion in the headspace of the cargo tank subsequent to thermal conduction from the shell. The value of 5.5 at the bottom of the column corresponds equivalently to the 5.0 inches H_2O pressure increase allowed by the five minute performance standard.~~

9~~12~~.4 Conversion from One Minute to Five Minute Pressure

The conversion of the one-minute final pressure to the equivalent five-minute final pressure of an empty cargo tank shall be calculated as follows:

$$P_{f5} = 18\, e^{-\left[5\left(\frac{V_h}{V_s}\right)\ln\left(\frac{18}{P_{f1}}\right)\right]}$$

Where:

Pf	=	equivalent five-minute final pressure for an empty cargo tank, ~~CFM~~ inches water column
V_s	=	total cargo tank shell capacity, gallons
V_h	=	cargo tank headspace volume after loading, gallons
P_{f1}	=	one-minute final pressure from Line 7 of the data sheet (Figure 3), inches water column
18	=	initial pressure at start of test, inches water column
5	=	5 minutes
ln	=	natural logarithm
e	=	constant equal to 2.71828

~~13 REPORTING RESULTS~~

~~The results shall be reported as shown in Figure 3.~~

10~~14~~ ALTERNATE~~IVE TEST~~ PROCEDURES

This test 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 5 of Certification Procedure 204 (CP-204).~~Test procedures, other than specified above, shall only be used if prior written approval is obtained from the ARB Executive Officer. In order to secure the ARB Executive Officer's approval of an alternative test procedure, the applicant is responsible for demonstrating to the ARB Executive Officer's satisfaction that the alternative test procedure is equivalent to this test procedure.~~

~~(1) Such approval shall be granted on a case-by-case basis only. Because of the evolving nature of technology and procedures for vapor recovery systems, such approval shall not be granted in subsequent cases without a new request for approval and a new demonstration of equivalency.~~

~~(2) Documentation of any such approvals, demonstrations, and approvals shall be maintained in the ARB Executive Officer's files and shall be made available upon request.~~

~~15 REFERENCES~~

~~This section is reserved for future specification.~~

11~~16~~ EXAMPLE FIGURES, ~~FORMS,~~ AND TABLES

Each figure ~~, form,~~ or table provides an illustration of an implementation which conforms to the requirements of this test procedure; other implementations which so conform are acceptable, too. Any specifications or dimensions provided in the figures~~, forms,~~ or tables are for example only, unless such specifications or dimensions are provided as requirements in the text of this or some other required test procedure.

Figure 1
Vapor System Pressure Assembly

Figure 2
Leak Test Assembly

~~**Figure 3**~~
~~**Data Form**~~

Table 1
One-Minute Static Performance Standard (4,000 to 9,900 gallons ullage)

Table 2
One-Minute Static Performance Standard (2,500 to 3,999 gallons ullage)

Table ~~2~~3
One-Minute Static Performance Standard (1,500 to 2,499 gallons ullage)

Table ~~3~~4
One-Minute Static Performance Standard (1,000 to 1,499 gallons ullage)

Table 4~~5~~5
One-Minute Static Performance Standard (300 to 999 gallons ullage)

Table ~~5~~6
Minimum Nitrogen Feed Rate

FIGURE 1

Vapor System Pressure Assembly

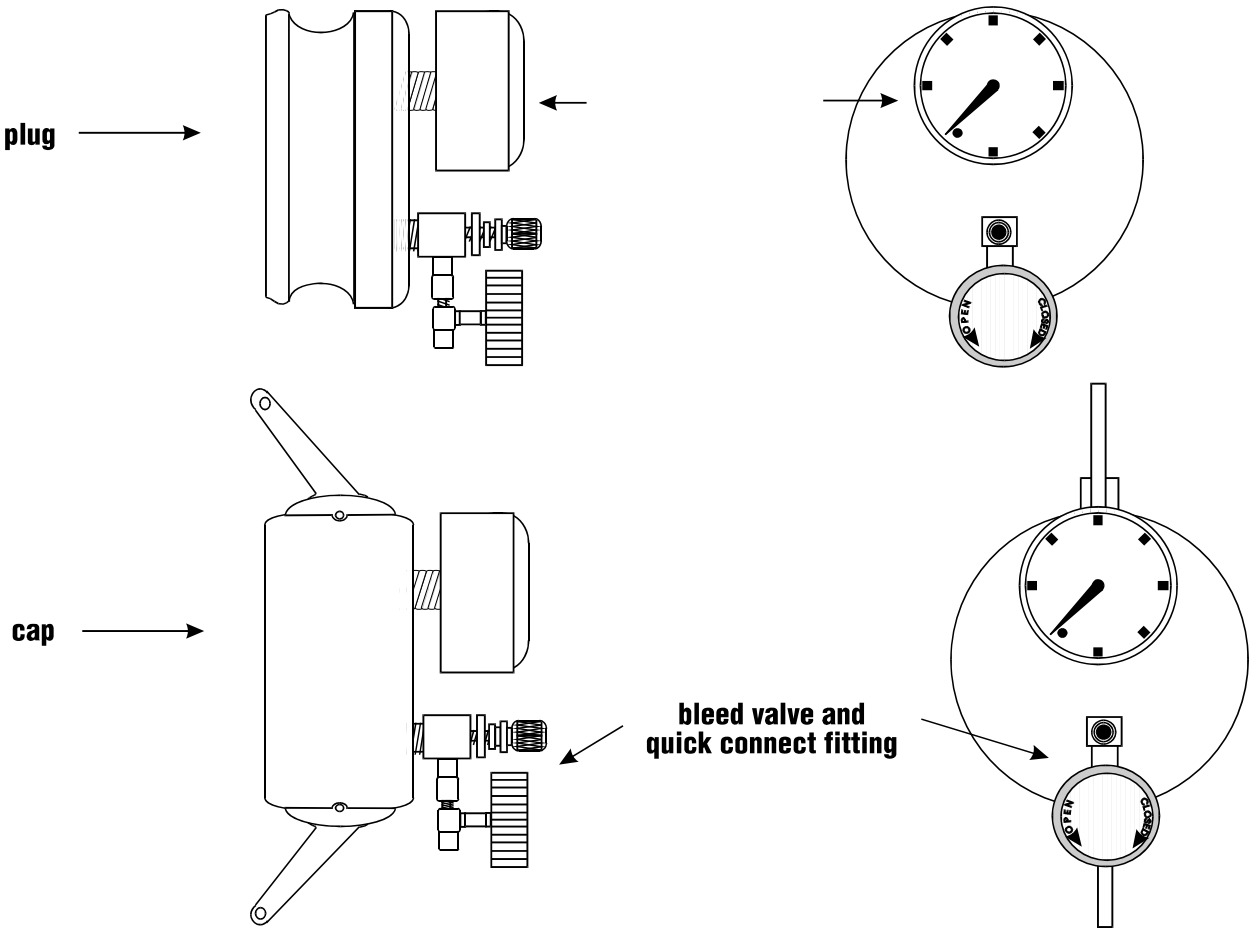

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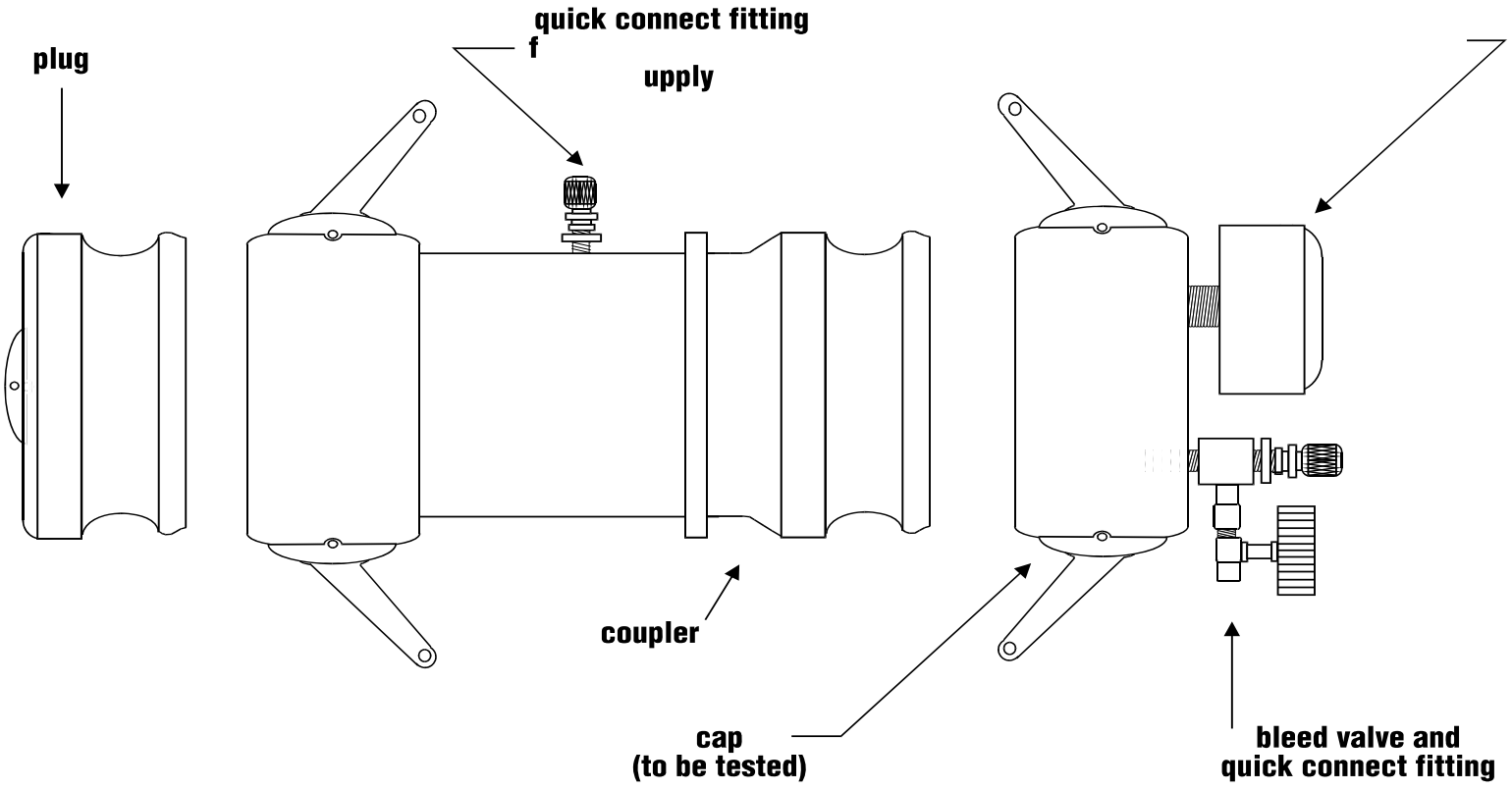
FIGURE 2
Leak Test Assembly



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~~FIGURE 3~~

~~Data Sheet~~

~~Company:~~ ~~Pit # or N #:~~	~~POPPETS - TRUCK~~
~~Address:~~ ~~City:~~ ~~Zip:~~	~~POPPETS - TRAILER~~
~~Driver:~~ ~~Tel. No. ( )~~	~~VAPOR CAP - TRUCK~~
~~Terminal:~~ ~~Pit #:~~	~~VAPOR CAP - TRAILER~~

~~Attention:~~

~~CARGO TANK TEST PROCEDURE~~

~~TP-204.2~~

		~~TRUCK~~	~~TRAILER~~
	~~CT #~~		
	~~ARB DECAL #~~		
	~~EXP. DATE~~		
~~**INITIAL DATA**~~			
~~1) CARGO TANK CAPACITY, GALLONS~~			
~~2) TOTAL VOLUME LOADED INTO CARGO TANK, GALLONS~~			
~~3) HEADSPACE VOLUME AFTER LOADING (#1-#2), GALLONS~~			
~~4) SYSTEM BACK PRESSURE, IN. H_2O~~			
~~**STATIC PRESSURE PERFORMANCE**~~			
~~5) INITIAL PRESSURE BEFORE NITROGEN FEED, IN. H_2O~~			
~~6) INITIAL PRESSURE FOR LEAK-RATE (18.0), IN. H_2O~~		~~18.0~~	~~18.0~~
~~7) ONE-MINUTE FINAL PRESSURE, IN. H_2O~~			
~~8) ALLOWABLE ONE-MINUTE FINAL PRESSURE, IN. H_2O~~			
~~9) COMPARABLE 5-MINUTE PRESSURE CHANGE, IN. H_2O~~			
~~**INTERNAL VAPOR VALVE PERFORMANCE**~~			
~~10) INITIAL PRESSURE (0.0), IN. H_2O~~		~~0.0~~	~~0.0~~
~~11) INTERVAL PRESSURE AFTER (1) MINUTE, IN. H_2O - ALLOWABLE = 1.1 IN. H_2O~~			
~~12) INTERVAL PRESSURE AFTER (2) MINUTES, IN. H_2O - ALLOWABLE = 2.2 IN. H_2O~~			
~~13) INTERVAL PRESSURE AFTER (3) MINUTES, IN. H_2O - ALLOWABLE = 3.3 IN. H_2O~~			
~~14) INTERVAL PRESSURE AFTER (4) MINUTES, IN. H_2O - ALLOWABLE = 4.4 IN. H_2O~~			
~~15) INTERVAL PRESSURE AFTER (5) MINUTES, IN. H_2O - ALLOWABLE = 5.5 IN. H_2O~~			
~~16) FINAL PRESSURE AFTER LAST INTERVAL AND VALVE OPENING~~			

~~TRUCK:~~	~~Comp't.~~	~~#1~~ _____	~~TRAILER:~~	~~Comp't.~~	~~#1~~
		~~#2~~ _____			~~#2~~
		~~#3~~ _____			~~#3~~
		~~#4~~ _____			~~#4~~
	~~TOTAL~~	_____		~~TOTAL~~	
	~~LOAD TYPE~~	_____		~~LOAD TYPE~~	

~~COMMENTS:~~

Table 1
One-Minute Static Performance Standard
(4,000 to 9,900 gallons ullage)
(See § 9~~12~~.1)

	100	150	200	250	300	350	400	450	500	550	600	650	700
	---	---	---	---	---	---	---	---	---	---	---	---	---
4,000	**5.4**	**8.1**	**9.9**	**11.2**	**12.1**	**12.8**	**13.3**	**13.8**	**14.2**	**14.5**	**14.7**	**15.0**	**15.2**
4,100	5.3	7.9	9.8	11.0	12.0	12.7	13.2	13.7	14.1	14.4	14.7	14.9	15.1
4,200	**5.1**	**7.8**	**9.6**	**10.9**	**11.8**	**12.6**	**13.1**	**13.6**	**14.0**	**14.3**	**14.6**	**14.8**	**15.0**
4,300	5.0	7.6	9.5	10.8	11.7	12.5	13.1	13.5	13.9	14.2	14.5	14.8	15.0
4,400	**4.8**	**7.5**	**9.3**	**10.6**	**11.6**	**12.4**	**13.0**	**13.4**	**13.8**	**14.2**	**14.5**	**14.7**	**14.9**
4,500	4.7	7.3	9.2	10.5	11.5	12.3	12.9	13.3	13.8	14.1	14.4	14.6	14.9
4,600	**4.5**	**7.2**	**9.0**	**10.4**	**11.4**	**12.1**	**12.8**	**13.3**	**13.7**	**14.0**	**14.3**	**14.6**	**14.8**
4,700	4.4	7.1	8.9	10.3	11.3	12.0	12.7	13.2	13.6	13.9	14.2	14.5	14.7
4,800	**4.3**	**6.9**	**8.8**	**10.1**	**11.2**	**11.9**	**12.6**	**13.1**	**13.5**	**13.9**	**14.2**	**14.4**	**14.6**
4,900	4.2	6.8	8.7	10.0	11.0	11.8	12.5	13.0	13.4	13.8	14.1	14.4	14.6
5,000	**4.0**	**6.6**	**8.5**	**9.9**	**10.9**	**11.7**	**12.4**	**12.9**	**13.3**	**13.7**	**14.0**	**14.3**	**14.5**
5,100	3.9	6.5	8.4	9.8	10.8	11.6	12.3	12.8	13.3	13.6	14.0	14.2	14.5
5,200	**3.8**	**6.4**	**8.3**	**9.7**	**10.7**	**11.5**	**12.2**	**12.7**	**13.2**	**13.6**	**13.9**	**14.2**	**14.4**
5,300	3.7	6.3	8.1	9.5	10.6	11.4	12.1	12.7	13.1	13.5	13.8	14.1	14.4
5,400	**3.6**	**6.1**	**8.0**	**9.4**	**10.5**	**11.3**	**12.0**	**12.6**	**13.0**	**13.4**	**13.8**	**14.0**	**14.3**
5,500	3.5	6.0	7.9	9.3	10.4	11.3	11.9	12.5	13.0	13.3	13.7	14.0	14.2
5,600	**3.4**	**5.9**	**7.8**	**9.2**	**10.3**	**11.2**	**11.8**	**12.4**	**12.9**	**13.3**	**13.6**	**13.9**	**14.2**
5,700	3.3	5.8	7.7	9.1	10.2	11.1	11.8	12.3	12.8	13.2	13.5	13.8	14.1

	300	350	400	450	500	550	600	650	700	750	800	850	900
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9,200	**7.2**	**8.2**	**9.0**	**9.8**	**10.4**	**10.9**	**11.4**	**11.8**	**12.1**	**12.5**	**12.8**	**13.0**	**13.3**
9,300	7.1	8.1	8.9	9.6	10.3	10.9	11.3	11.7	12.1	12.4	12.7	13.0	13.2
9,400	**7.1**	**8.1**	**8.9**	**9.6**	**10.3**	**10.8**	**11.3**	**11.7**	**12.0**	**12.4**	**12.7**	**12.9**	**13.2**
9,500	7.0	8.0	8.8	9.6	10.2	10.7	11.2	11.6	12.0	12.3	12.6	12.9	13.1
9,600	**6.9**	**7.9**	**8.8**	**9.5**	**10.1**	**10.7**	**11.2**	**11.2**	**11.9**	**12.3**	**12.6**	**12.8**	**13.1**
9,700	6.8	7.9	8.7	9.4	10.1	10.6	11.1	11.5	11.9	12.2	12.5	12.8	13.0
9,800	**6.8**	**7.8**	**8.7**	**9.4**	**10.0**	**10.6**	**11.0**	**11.5**	**11.8**	**12.2**	**12.5**	**12.8**	**13.0**
9,900	6.7	7.7	8.6	9.3	10.0	10.5	11.0	11.4	11.8	12.1	12.4	12.7	12.9

Table 2
One-Minute Static Performance Standard
(2,500 to 3,999 gallons ullage)
(See § 9.1)

	100	150	200	250	300	350	400	450	500	550	600	650	700
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2500	**8.5**	**10.9**	**12.4**	**13.3**	**14.0**	**14.5**	**14.9**	**15.2**	**15.5**	**15.7**	**15.9**	**16.0**	**16.2**
2600	8.3	10.7	12.2	13.2	13.9	14.4	14.8	15.1	15.4	15.6	15.8	16.0	16.1
2700	**8.0**	**10.5**	**12.0**	**13.0**	**13.8**	**14.3**	**14.7**	**15.0**	**15.3**	**15.5**	**15.7**	**15.9**	**16.0**
2800	7.8	10.3	11.8	12.9	13.6	14.2	14.6	14.9	15.2	15.5	15.7	15.8	16.0
2900	**7.6**	**10.1**	**11.7**	**12.7**	**13.5**	**14.0**	**14.5**	**14.8**	**15.1**	**15.4**	**15.6**	**15.8**	**15.9**
3000	7.3	9.9	11.5	12.6	13.3	13.9	14.4	14.7	15.0	15.3	15.5	15.7	15.8
3100	**7.1**	**9.7**	**11.3**	**12.4**	**13.2**	**13.8**	**14.3**	**14.6**	**15.0**	**15.2**	**15.4**	**15.6**	**15.8**
3200	6.9	9.5	11.2	12.1	13.1	13.7	14.2	14.6	14.9	15.1	15.3	15.5	15.7
3300	**6.7**	**9.3**	**11.0**	**12.1**	**13.0**	**13.6**	**14.1**	**14.5**	**14.8**	**15.0**	**15.2**	**15.5**	**15.6**
3400	6.5	9.1	10.8	12.0	12.8	13.5	14.0	14.4	14.7	15.0	15.2	15.4	15.6
3500	**6.3**	**9.0**	**10.7**	**11.8**	**12.7**	**13.5**	**13.9**	**14.3**	**14.6**	**14.9**	**15.1**	**15.3**	**15.5**
3600	6.1	8.8	10.5	11.7	12.6	13.2	13.8	14.2	14.5	14.8	15.0	15.3	15.4
3700	**6.0**	**8.6**	**10.4**	**11.6**	**12.4**	**13.3**	**13.6**	**14.1**	**14.4**	**14.7**	**15.0**	**15.2**	**15.4**
3800	5.8	8.4	10.2	11.4	12.3	13.0	13.5	14.0	14.3	14.6	14.9	15.1	15.3
3900	**5.6**	**8.3**	**10.0**	**11.3**	**12.2**	**12.9**	**13.4**	**13.9**	**14.3**	**14.6**	**14.8**	**15.0**	**15.2**
3999	**5.4**	**8.1**	**9.9**	**11.2**	**12.1**	**12.8**	**13.3**	**13.8**	**14.2**	**14.5**	**14.7**	**15.0**	**15.2**

TABLE ~~2~~3

One-Minute Static Performance Standard
(1,500 to 2,499 gallons ullage)

(See § 9~~12~~.1)

	50	100	150	200	250	300	350	400	450	500	550	600
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1,500	**6.0**	**10.4**	**12.5**	**13.7**	**14.5**	**15.0**	**15.4**	**15.7**	**15.9**	**16.1**	**16.3**	**16.4**
1,550	5.8	10.2	12.3	13.6	14.4	14.9	15.3	15.6	15.9	16.1	16.2	16.4
1,600	**5.6**	**10.0**	**12.2**	**13.4**	**14.3**	**14.8**	**15.2**	**15.6**	**15.8**	**16.0**	**16.2**	**16.3**
1,650	5.4	9.9	12.1	13.3	14.1	14.7	15.2	15.5	15.7	16.0	16.1	16.3
1,700	**5.2**	**9.7**	**11.9**	**13.2**	**14.0**	**14.6**	**15.1**	**15.4**	**15.7**	**15.9**	**16.1**	**16.2**
1,750	5.0	9.5	11.8	13.1	13.9	14.6	15.0	15.3	15.6	15.8	16.0	16.2
1,800	**4.8**	**9.3**	**11.6**	**13.0**	**13.8**	**14.5**	**14.9**	**15.3**	**15.6**	**15.8**	**16.0**	**16.1**
1,850	4.7	9.2	11.5	12.8	13.7	14.4	14.8	15.2	15.5	15.7	15.9	16.1
1,900	**4.5**	**9.0**	**11.3**	**12.7**	**13.6**	**14.3**	**14.8**	**15.1**	**15.4**	**15.7**	**15.9**	**16.0**
1,950	4.3	8.8	11.2	12.6	13.5	14.2	14.7	15.1	15.4	15.6	15.8	16.0
2,000	**4.2**	**8.7**	**11.1**	**12.5**	**13.4**	**14.1**	**14.6**	**15.0**	**15.3**	**15.6**	**15.8**	**15.9**
2,050	4.0	8.5	10.9	12.4	13.3	14.0	14.5	14.9	15.2	15.5	15.7	15.9
2,100	**3.9**	**8.4**	**10.8**	**12.3**	**13.3**	**13.9**	**14.5**	**14.9**	**15.2**	**15.4**	**15.7**	**15.8**
2,150	3.8	8.2	10.7	12.2	13.2	13.9	14.4	14.8	15.1	15.4	15.6	15.8
2,200	**3.6**	**8.1**	**10.5**	**12.1**	**13.1**	**13.8**	**14.3**	**14.7**	**15.1**	**15.3**	**15.6**	**15.7**
2,250	3.5	7.9	10.4	11.9	13.0	13.7	14.2	14.7	15.0	15.3	15.5	15.7
2,300	**3.4**	**7.8**	**10.3**	**11.8**	**12.9**	**13.6**	**14.2**	**14.6**	**14.9**	**15.2**	**15.5**	**15.7**
2,350	3.2	7.6	10.2	11.7	12.8	13.5	14.1	14.5	14.9	15.2	15.4	15.6
2,400	**3.1**	**7.5**	**10.0**	**11.6**	**12.7**	**13.4**	**14.0**	**14.5**	**14.8**	**15.1**	**15.4**	**15.6**
2,450	3.0	7.4	9.9	11.5	12.6	13.4	13.9	14.4	14.8	15.1	15.3	15.5
2,499	**2.9**	**7.2**	**9.8**	**11.4**	**12.5**	**13.3**	**13.9**	**14.3**	**14.7**	**15.0**	**15.3**	**15.5**

TABLE ~~3~~4

One-Minute Static Performance Standard
(1,000 to 1,499 gallons ullage)

(See § 9~~12~~.1)

	25	50	75	100	125	150	175	200	225	250
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1,000	**3.2**	**7.6**	**10.1**	**11.7**	**12.7**	**13.5**	**14.1**	**14.5**	**14.9**	**15.1**
1,050	2.9	7.3	9.8	11.4	12.5	13.3	13.9	14.3	14.7	15.0
1,100	**2.7**	**7.0**	**9.5**	**11.2**	**12.3**	**13.1**	**13.7**	**14.2**	**14.6**	**14.9**
1,150	2.5	6.7	9.3	10.9	12.1	12.9	13.5	14.0	14.4	14.8
1,200	**2.3**	**6.4**	**9.0**	**10.7**	**11.9**	**12.7**	**13.4**	**13.9**	**14.3**	**14.6**
1,250	2.1	6.1	8.8	10.5	11.7	12.6	13.2	13.7	14.2	14.5
1,300	**1.9**	**5.8**	**8.5**	**10.3**	**11.5**	**12.4**	**13.1**	**13.6**	**14.0**	**14.4**
1,350	1.7	5.6	8.3	10.0	11.3	12.2	12.9	13.4	13.9	14.3
1,400	**1.6**	**5.4**	**8.0**	**9.8**	**11.1**	**12.0**	**12.7**	**13.3**	**13.8**	**14.1**
1,450	1.5	5.1	7.8	9.6	10.9	11.8	12.6	13.2	13.6	14.0
1,499	**1.3**	**4.9**	**7.6**	**9.4**	**10.7**	**11.7**	**12.4**	**13.0**	**13.5**	**13.9**

TABLE 4~~4~~5

One-Minute Static Performance Standard
(300 to 999 gallons ullage)

(See § 9~~12~~.1)

	25	50	75	100	125	150	175	200	225	250
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300	**9.8**	**13.3**	**14.7**	**15.5**	**16.0**	**16.3**	**16.5**	**16.7**	**16.8**	**17.0**
350	8.9	12.7	14.2	15.1	15.6	16.0	16.3	16.5	16.6	16.8
400	**8.1**	**12.0**	**13.8**	**14.7**	**15.3**	**15.7**	**16.0**	**16.3**	**16.5**	**16.6**
450	7.3	11.4	13.3	14.4	15.0	15.5	15.8	16.1	16.3	16.4
500	**6.6**	**10.9**	**12.9**	**14.0**	**14.7**	**15.2**	**15.6**	**15.9**	**16.1**	**16.3**
550	6.0	10.4	12.5	13.7	14.4	15.0	15.4	15.7	15.9	16.1
600	**5.4**	**9.8**	**12.0**	**13.3**	**14.1**	**14.7**	**15.2**	**15.5**	**15.7**	**16.0**
650	4.9	9.4	11.6	13.0	13.9	14.5	14.9	15.3	15.6	15.8
700	**4.4**	**8.9**	**11.3**	**12.7**	**13.6**	**14.2**	**14.7**	**15.1**	**15.4**	**15.6**
750	4.0	8.5	10.9	12.3	13.3	14.0	14.5	14.9	15.2	15.5
800	**3.6**	**8.1**	**10.5**	**12.0**	**13.0**	**13.8**	**14.3**	**14.7**	**15.1**	**15.3**
850	3.3	7.7	10.2	11.7	12.8	13.5	14.1	14.5	14.9	15.2
900	**2.9**	**7.3**	**9.8**	**11.4**	**12.5**	**13.3**	**13.9**	**14.4**	**14.7**	**15.0**
950	2.7	6.9	9.5	11.2	12.3	13.1	13.7	14.2	14.6	14.9
999	**2.4**	**6.6**	**9.2**	**10.9**	**12.0**	**12.9**	**13.5**	**14.0**	**14.4**	**14.7**

TABLE ~~5~~6

Minimum Nitrogen Feed Rate
(See §9.2)

~~CARGO TANK CAPACITY~~
~~MINIMUM NITROGEN~~

CARGO TANK CAPACITY (GALLONS)	MINIMUM NITROGEN FEED-RATE, CFM
2,500	**0.41**
2,700	0.49
2,900	**0.52**
3,100	0.56
3,300	**0.60**
3,500	0.63
3,700	**0.69**
3,900	0.71
4,100	**0.74**
4,300	0.78
4,500	**0.81**
4,700	0.85
4,900	**0.89**
5,100	0.92
5,300	**0.96**
5,500	0.99
5,700	**1.03**
5,900	1.07
9,000	**1.63**
9,200	1.66
9,400	**1.70**
9,600	1.74
9,800	**1.77**