State of California
AIR RESOURCES BOARD

Executive Order G-70-106

Relating to the Adoption of "Test Procedure Gasoline Cargo Tanks" as an Equivalent Method for the Year-round Performance Standards for Gasoline Cargo Tanks.

WHEREAS, the Air Resources Board (the "Board") has established, pursuant to Section 41962 of the Health and Safety Code procedures to determine compliance of vapor recovery systems of cargo tanks used to transport gasoline.

WHEREAS, the Board has adopted "Certification and Test Procedures for Vapor Recovery Systems of Gasoline Delivery Tanks" (the certification procedures) and "Test Procedure for Gasoline Vapor Leak Detection Using Combustible Gas Detector."

WHEREAS, the Board's certification procedures require that year-round gasoline delivery tank testing be conducted by test procedures specified in Section IX or by the Board's "Test Procedure for Gasoline Vapor Leak Detection Using Combustion Gas Detector".

WHEREAS, both adopted Board procedures include provisions for use of alternative methods provided prior approval of the Executive Officer is obtained and it is demonstrated to the Executive Officer's satisfaction that the alternative method is equivalent to the adopted method.

WHEREAS, the Bay Area Quality Management District (BAAQMD) has submitted a test method entitled "Test Procedure Gasoline Cargo Tanks" to the Board for approval as an equivalent method to the Board's test procedures in Section IX of the certification procedures and "Test Procedure for Gasoline Vapor Leak Detection Using Combustible Gas Detector."

WHEREAS, The BAAQMD's "Test Procedure Gasoline Cargo Tanks" has been found to yield equivalent results to the Board's certification procedures and the "Test Procedure for Gasoline Vapor Leak Detection Using Combustible Gas Detector."

NOW THEREFORE, IT IS ORDERED that "Test Procedure Gasoline Cargo Tanks" (attached) is hereby approved as an equivalent method to the method specified in Section IX of the certification procedures and the ARB procedure "Test Procedure for Gasoline Vapor Leak Detection" for determining compliance with the year-round performance standard given in Sections B, C, D and E of the Certification Procedures.

Executed in Sacramento, California this 27th day of January, 1986.

James D. Boyd
Executive Officer

TEST PROCEDURE
GASOLINE CARGO TANKS

1. Applicability

1.1 This test procedure is used to quantify the leak rate from gasoline cargo tanks after loading at a bulk gasoline distribution facility. It is applicable for determining compliance with the year-round leak-rate criteria adopted by the California Air Resources Board pursuant to Section 41962 of the California Health and Safety Code.

2. Principle

2.1 By using the total cargo tank capacity and total headspace volume, a one minute pressure decay is calculated which will correspond to the allowable year-round criteria for an empty cargo tank. Upon completion of loading operations at the bulk gasoline distribution facility the gasoline cargo tank is allowed to reach pressure stability. The tank is then pressurized, with nitrogen, to 18 inches water column. The pressure decay is monitored for one minute and compared with the maximum allowable calculated value. The leak rate through the cargo tank vapor valve is similarly obtained.

3. Range and Sensitivity

3.1 The readability of the pressure gauge is 0.25 inches water column.

3.2 The accuracy of the pressure gauge is 2% of full scale.

4. Interferences

4.1 Thermal expansion due to direct sunlight on an exposed cargo tank precludes the use of this method if the internal pressure cannot be stabilized at 18 inches water column.

4.2 Cargo tank leakage exceeding the nitrogen feed rate precludes the use of this method. Such leakage shows the inability of the cargo tank to meet the year-round leak-rate criteria.

4.3 Pressure stability will not be reached in a reasonable time period if the tank has been purged with air prior to loading gasoline.

4.4 Leaks due to faulty cargo tank vapor couplers preclude the use of this method.

5. Apparatus

5.1 Nitrogen High Pressure Cylinder. Use a high pressure cylinder capable of maintaining a pressure of 2000 psig. The cylinder shall be equipped with a compatible two-stage regulator and a flow control metering valve. The outlet of the metering valve shall be equipped with a quick-connect fitting.

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 water column pressure gauge, a metering valve, and a quick connect fitting (see Figure I).

5.3 Vapor Valve Pressure Gauge. Use a Dwyer Model 2-5010 Minihelic gauge, 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 as shown in Figure II to leak test the vapor system pressure assembly.

5.5 Flexible Tubing. Use 3/16 inch I.D. 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 to within 0.1 second.

5.8 Liquid Leak Detector. Use Snoop liquid leak detector, or equivalent, to detect gas leaks in the vapor system pressure assembly.

6. Pre-Test Procedures

6.1 Assemble the vapor system pressure assembly as shown in Figure 1.

6.2 Leak test the vapor system pressure assembly by connecting it to the leak test assembly and pressurize, with nitrogen, to 20 inches water column. The decay rate shall not exceed 0.25 inches in five minutes.

7. Testing

7.1 From the identification plate on the cargo tank, determine and record the cargo tank shell capacity on the data sheet shown in Figure III.

7.2 Upon completion of the loading operations record, on the data sheet, the total gallonage loaded.

7.3 Connect the vapor system pressure assembly to the vapor coupler of the cargo tank. Open the internal valve(s) and vapor valve(s) of the cargo tank and record the initial pressure.

7.4 If the initial pressure exceeds 18 inches water column use the metering valve on the vapor system pressure assembly to reduce the pressure to 18.0 inches water column.

7.4.1 If the initial pressure is less than 18 inches water column, connect the nitrogen supply the pressure assembly and increase the pressure to 18 inches water column.

7.4.2 Adjust the pressure on the nitrogen cylinder regulator such that the nitrogen feed rate exceeds the maximum allowable flowrate for an empty cargo tank. See equation 9.7, 9.8, or Table IV.

7.5 Allow 60 seconds for the pressure to stablilize. Start the stopwatch with the pressure at 18.0 inches water column. After 60 seconds record the final pressure on the data sheet.

7.6 Pressurize the cargo tank to 18 inches water column. Close the internal and vapor valve(s) and remove the pressure assembly cap to relieve the pressure, to atmospheric, downstream of the vapor valve. Wait for 30 seconds. Replace the pressure assembly cap.

7.6.1 Connect the minihelic gauge to the quick connect fitting on the vapor system pressure assembly.

7.6.2 Start the stopwatch. After 60 seconds record the pressure increase on the data sheet.

7.7 Remove the pressure assembly from the cargo tank.

7.8 For those cargo tanks with manifolded product lines the test must be conducted on a per compartment basis.

8. Post-Test Procedures

8.1 Determine compliance with the year-round leak rate criteria by comparing the actual one minute decay rate with the maximum allowable one minute decay rate from Table I, Table II, or III, or equation 9.9.

8.2 Determine compliance of the vapor valve(s). The allowable pressure increase caused by leakage past the vapor valve(s) is one inch water column in one minute.

9. Calculations

9.1 The headspace volume after loading:

$$V_h = (V_s - G)/(7.481)$$

where:

V_s = cargo tank shell capacity, gallons

G = gallons of product loaded, gallons

7.481 = conversion from gallons to cubic feet

9.2 The volume of the empty cargo tank shell at 18 inches water column (gauge) pressure:

$$V_{18} = (V_s)((406.9 + 18)/406.9)/(7.481)$$

where:

V_s = cargo tank shell capacity, gallons

406.9 = atmospheric pressure, inches water column

7.481 = conversion from gallons to cubic feet

18 = gauge pressure, inches water column

9.3 The volume of the empty cargo tank shell at 15.5 inches water column:

$$V_{15.5} = (V_s)((406.9 + 15.5)/406.9)/(7.481)$$

where:

V_s = cargo tank shell capacity, gallons

406.9 = atmospheric pressure, inches water column

7.481 = conversion from gallons to cubic feet

15.5 = gauge pressure, inches water column

9.4 The volume of the empty cargo tank shell at 15.0 inches water column:

$$V_{15.0} = (V_s)((406.9 + 15.0)/406.9)/(7.481)$$

where:

V_s = cargo tank shell capacity, gallons

406.9 = atmosepheric pressure, inches water column

7.481 = conversion from gallons to cubic feet

15.0 = gauge pressure, inches water column

9.5 The volume of the empty cargo tank shell at 14.5 inches water column:

$$V_{14.5} = (V_s)((406.9 + 14.5)/406.9)/(7.481)$$

where:

V_s = cargo tank shell capacity, gallons

406.9 = atmospheric pressure, inches water column

7.481 = conversion from gallons to cubic feet

14.5 = gauge pressure, inches water column

9.6 The volume of the empty cargo tank shell at 14.0 inches water column:

$$V_{14.0} = (V_s)((406.9 + 14.0)/406.9)/(7.481)$$

where:

V_s = cargo tank shell capacity, gallons

406.9 = atmospheric pressure, inches water column

7.481 = conversion from gallons to cubic feet

14.0 = gauge pressure, inches water column

9.7 The maximum allowable flowrate for an empty cargo tank to meet the year-round criteria of 2.5 inches water column:

$$F = (V_{18} - V_{15.5})/5$$

where:

V_{18} = volume of the empty cargo tank at a gauge pressure of 18 inches water column

$V_{15.5}$ = volume of the empty cargo tank at a gauge-pressure of 15.5 inches water column

5 = time in which a 2.5 inch water column decay may occur, minutes

9.8 The maximum allowable flowrate for an empty cargo tank or compartment to meet the year-round criteria of 3.0, 3.5, or 4.0 inches water column may be obtained by substituting V_{15}, $V_{14.5}$, or $V_{14.0}$ for $V_{15.5}$ in equation 9.7.

9.9 The approximate minimum pressure of a complying loaded cargo tank, after one minute, when the initial gauge pressure is 18 inches water column:

$$P = (((424.9)/(406.9))(V_h/7.481))- F)((7.481)(406.9)/V_h)- 406.9$$

where:

V_h = the headspace volume after loading, gallons

F = the allowable flowrate for the empty cargo tank shell to meet the year-round criteria, CFM

406.9 = atmospheric pressure, inches water column

424.9 = 18 inch water column gauge pressure, inches water column absolute

7.481 = conversion from gallons to cubic feet

9.9.1 Equation 9.9 may be arithmetically reduced to the following form:

$$P = 18 - N(V_s/V_h)$$

where:

V_s = total cargo tank shell capacity, gallons

V_h = total headspace volume after loading, gallons

N = constant to adjust for volume related pressure changes.

If (V_s) is:	Then (N) is:
2500 +	0.50
1500-2499	0.60
1000-1499	0.70
0-999	0.80

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.

10. Reporting

10.1 The results shall be reported as shown in Figure III.

TABLE I

HEADSPACE VOLUME AFTER LOADING, GALLONS

Total Cargo Tank Shell Capacity, Gallons	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200
4000	11.3	12.3	13.0	13.6	14.0	14.4	14.7	14.9	15.1	15.3	15.5	15.6	15.8	15.9	16.0	16.1	16.2	16.3	16.3
4100	11.2	12.1	12.9	13.4	13.9	14.3	14.6	14.8	15.1	15.3	15.4	15.6	15.7	15.8	15.9	16.0	16.1	16.2	16.3
4200	11.0	12.0	12.7	13.3	13.8	14.2	14.5	14.8	15.0	15.2	15.4	15.5	15.7	15.8	15.9	16.0	16.1	16.2	16.2
4300	10.8	11.9	12.6	13.2	13.7	14.1	14.4	14.7	14.9	15.1	15.3	15.5	15.6	15.7	15.8	16.0	16.0	16.1	16.2
4400	10.7	11.7	12.5	13.1	13.6	14.0	14.3	14.6	14.9	15.1	15.2	15.4	15.6	15.7	15.8	15.9	16.0	16.1	16.2
4500	10.5	11.6	12.4	13.0	13.5	13.9	14.2	14.5	14.8	15.0	15.2	15.4	15.5	15.6	15.7	15.9	16.0	16.0	16.1
4600	10.3	11.4	12.2	12.9	13.4	13.8	14.2	14.5	14.7	14.9	15.1	15.3	15.4	15.6	15.7	15.8	15.9	16.0	16.1
4700	10.2	11.3	12.1	12.8	13.3	13.7	14.1	14.4	14.6	14.9	15.1	15.2	15.4	15.5	15.6	15.8	15.9	16.0	16.0
4800	10.0	11.1	12.0	12.7	13.2	13.6	14.0	14.3	14.6	14.8	15.0	15.2	15.3	15.5	15.6	15.7	15.8	15.9	16.0
4900	9.8	11.0	11.9	12.6	13.1	13.5	13.9	14.2	14.5	14.7	14.9	15.1	15.3	15.4	15.5	15.7	15.8	15.9	16.0
5000	9.7	10.9	11.7	12.4	13.0	13.5	13.8	14.2	14.4	14.7	14.9	15.1	15.2	15.4	15.5	15.6	15.7	15.8	15.9
5100	9.5	10.7	11.6	12.3	12.9	13.4	13.7	14.1	14.4	14.6	14.8	15.0	15.2	15.3	15.4	15.6	15.7	15.8	15.9
5200	9.3	10.6	11.5	12.2	12.8	13.3	13.7	14.0	14.3	14.5	14.7	14.9	15.1	15.3	15.4	15.5	15.6	15.7	15.8
5300	9.2	10.4	11.4	12.1	12.7	13.2	13.6	13.9	14.2	14.5	14.7	14.9	15.1	15.2	15.3	15.5	15.6	15.7	15.8
5400	9.0	10.3	11.2	12.0	12.6	13.1	13.5	13.8	14.1	14.4	14.6	14.8	15.0	15.2	15.3	15.4	15.5	15.6	15.7
5500	8.8	10.1	11.1	11.9	12.5	13.0	13.4	13.8	14.1	14.3	14.6	14.8	14.9	15.1	15.2	15.4	15.5	15.6	15.7
5600	8.7	10.0	11.0	11.8	12.4	12.9	13.3	13.7	14.0	14.3	14.5	14.7	14.9	15.0	15.2	15.3	15.5	15.6	15.7
5700	8.5	9.8	10.9	11.7	12.3	12.8	13.2	13.6	13.9	14.2	14.4	14.6	14.8	15.0	15.1	15.3	15.4	15.5	15.6
9200				7.8	8.8	9.6	10.3	10.9	11.4	11.9	12.2	12.6	12.9	13.2	13.4	13.6	13.8	14.0	14.2
9300				7.7	8.7	9.5	10.2	10.8	11.4	11.8	12.2	12.5	12.8	13.1	13.3	13.6	13.8	14.0	14.1
9400				7.5	8.6	9.4	10.2	10.8	11.3	11.7	12.1	12.5	12.8	13.0	13.3	13.5	13.7	13.9	14.1

Minimum pressure allowed after one minute for a year-round criteria of 2.5 inches water column.

HEADSPACE VOLUME AFTER LOADING, GALLONS

TOTAL CARGO TANK SHELL CAPACITY, GALLONS	150	200	250	300	350	400	450	500	550	600
1500	12.0	13.5	14.4	15.0	15.4	15.8	16.0	16.2	16.4	16.5
1550	11.8	13.4	14.3	14.9	15.3	15.7	15.9	16.1	16.3	16.5
1600	11.6	13.2	14.2	14.8	15.3	15.6	15.9	16.1	16.3	16.4
1650	11.4	13.1	14.0	14.7	15.2	15.5	15.8	16.0	16.2	16.4
1700	11.2	12.9	13.9	14.6	15.1	15.5	15.7	16.0	16.1	16.3
1750	11.0	12.7	13.8	14.5	15.0	15.4	15.7	15.9	16.1	16.2
1800	10.8	12.6	13.7	14.4	14.9	15.3	15.6	15.8	16.0	16.2
1850	10.6	12.4	13.6	14.3	14.8	15.2	15.5	15.8	16.0	16.1
1900	10.4	12.3	13.4	14.2	14.7	15.2	15.5	15.7	15.9	16.1
1950	10.2	12.1	13.3	14.1	14.7	15.1	15.4	15.7	15.9	16.0
2000	10.0	12.0	13.2	14.0	14.6	15.0	15.3	15.6	15.8	16.0
2050	9.8	11.8	13.1	13.9	14.5	14.9	15.3	15.5	15.8	15.9
2100	9.6	11.7	13.0	13.8	14.4	14.9	15.2	15.5	15.7	15.9
2150	9.4	11.5	12.8	13.7	14.3	14.8	15.1	15.4	15.7	15.8
2200	9.2	11.4	12.7	13.6	14.2	14.7	15.1	15.4	15.6	15.8
2250	9.0	11.3	12.6	13.5	14.1	14.6	15.0	15.3	15.5	15.8
2300	8.8	11.1	12.5	13.4	14.1	14.5	14.9	15.2	15.5	15.7
2350	8.6	10.9	12.4	13.3	14.0	14.5	14.9	15.2	15.4	15.6
2400	8.4	10.8	12.2	13.2	13.9	14.4	14.8	15.1	15.4	15.6
2450	8.2	10.6	12.1	13.1	13.8	14.3	14.7	15.1	15.3	15.5
2500	8.0	10.5	12.0	13.0	13.7	14.2	14.7	15.0	15.3	15.5

Minimum pressure allowed after one minute for a year-round criteria of 3.0 inches of water column.

TABLE III

HEADSPACE VOLUME AFTER LOADING, GALLONS

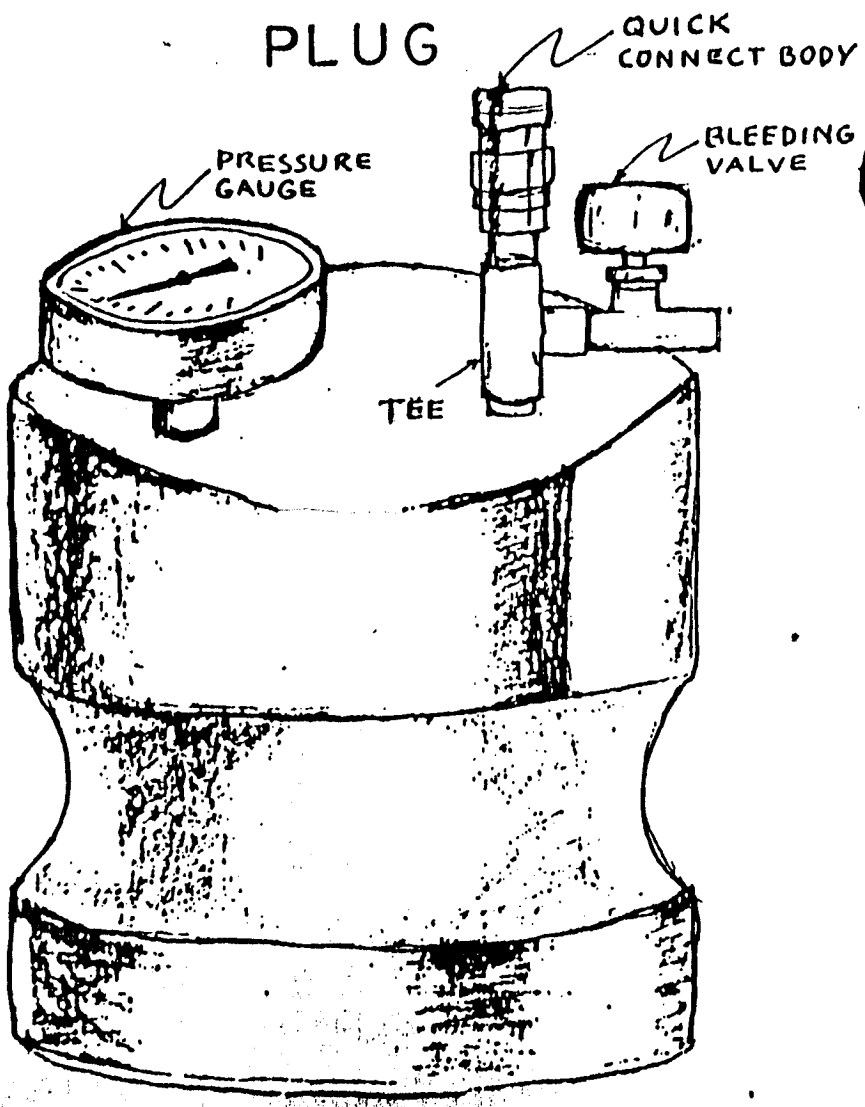
Total Cargo Tank Shell Capacity, Gallons	100	150	200	250	300	350	400	450	500	550
1000	11.0	13.3	14.5	15.2	15.7	16.0	16.2	16.4	16.6	16.7
1050	10.6	13.1	14.3	15.1	15.5	15.9	16.2	16.4	16.5	16.7
1100	10.3	12.9	14.1	14.9	15.4	15.8	16.1	16.3	16.5	16.6
1150	9.9	12.6	14.0	14.8	15.3	15.7	16.0	16.2	16.4	16.5
1200	9.6	12.4	13.8	14.6	15.2	15.6	15.9	16.1	16.3	16.5
1250	9.2	12.2	13.6	14.5	15.1	15.5	15.8	16.1	16.2	16.4
1300	8.9	11.9	13.4	14.4	15.0	15.4	15.7	16.0	16.2	16.3
1350	8.5	11.7	13.3	14.2	14.8	15.3	15.6	15.9	16.1	16.3
1400	8.2	11.5	13.1	14.1	14.7	15.2	15.5	15.8	16.0	16.2
1450	7.8	11.2	12.9	13.9	14.6	15.1	15.5	15.7	16.0	16.2
1500	7.5	11.0	12.7	13.8	14.5	15.0	15.4	15.7	15.9	16.1

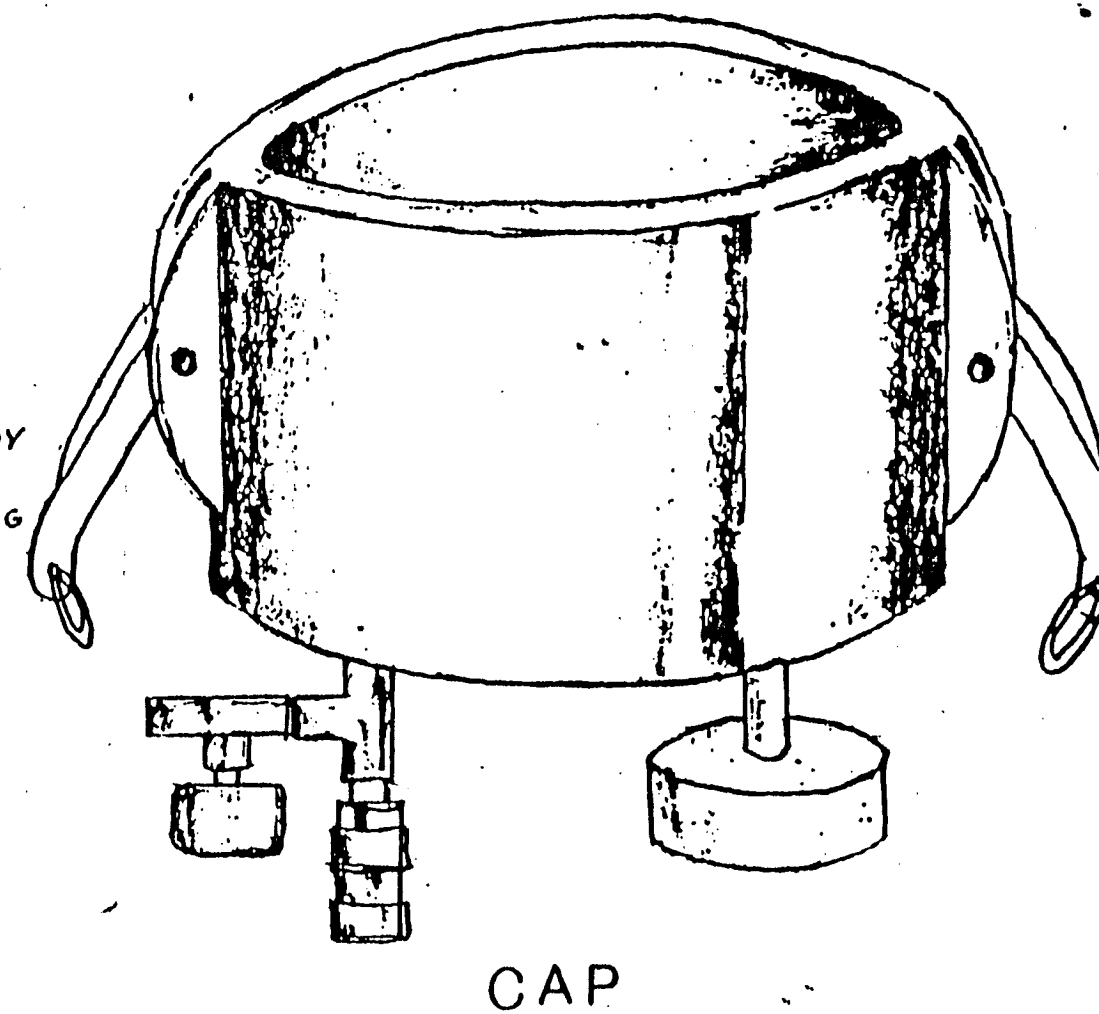
Minimum pressure allowed after one minute for a year-round criteria of 3.5 inches water column.

SHELL CAPACITY,GALLONS	ALLOWABLE LEAKRATE,CFM
2500	.411
2600	.427
2700	.444
2800	.460
2900	.477
3000	.493
3100	.510
3200	.526
3300	.543
3400	.559
3500	.575
3600	.592
3700	.608
3800	.625
3900	.641
4000	.658
4100	.674
4200	.691
4300	.707
4400	.723
4500	.740
4600	.756
4700	.773
4800	.789
4900	.806
5000	.822
5100	.839
5200	.855
5300	.871
5400	.888
5500	.904
5600	.921
5700	.937
9000	1.480
9100	1.496
9200	1.513
9300	1.529
9400	1.545
9500	1.562
9600	1.578

Minimum nitrogen feed rate for a given size cargo tank shell.

FIGURE I





VAPOR SYSTEM
PRESSURE ASSEMBLY

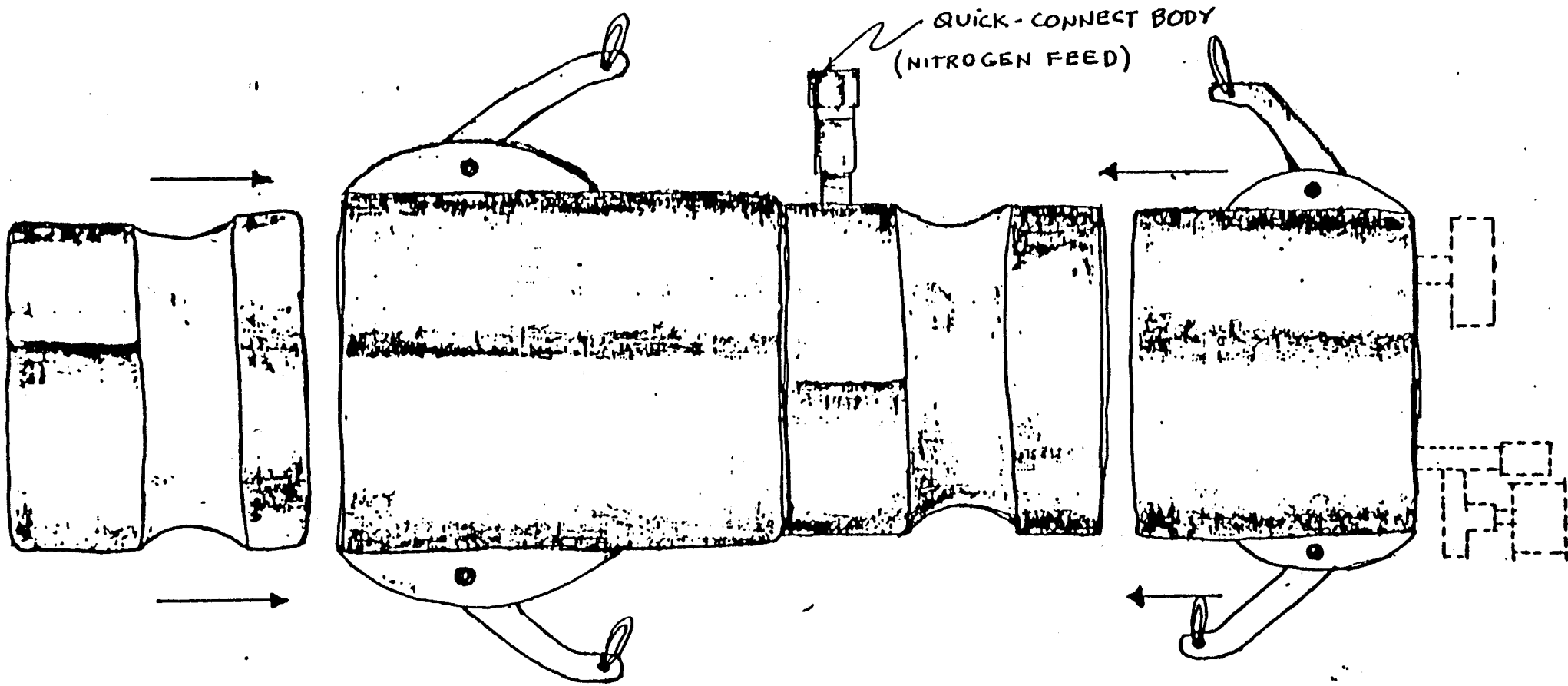


FIGURE II LEAK TEST ASSEMBLY

GASOLINE CARGO TANKS

TERMINAL: _____

ADDRESS: _____

CITY: _____ ZIP: _____

CONTACT: _____ PHONE: ( ) _____

TITLE: _____

REGISTERED OWNER

NAME: _____ PHONE: ( ) _____

ADDRESS: _____

CITY: _____ ZIP _____

	CT NUMBER	ARB STICKER NUMBER	EXPIRATION DATE MONTH/YEAR
TRUCK			
TRAILER			

		TRUCK	TRAILER
1)	CARGO TANK CAPACITY FROM I.D. PLATE, GALLONS	_____	_____
2)	TOTAL GALLONAGE LOADED INTO CARGO TANK	_____	_____
3)	HEADSPACE VOLUME AFTER LOADING (#3 - #4), GALLONS	_____	_____
	LEAK-RATE TEST		
4)	INITIAL PRESSURE BEFORE NITROGEN FEED, IN. H_2O	_____	_____
5)	INITIAL PRESSURE FOR LEAK-RATE (18.0), IN. H_2O	_____	_____
6)	FINAL PRESSURE AFTER ONE (1) MINUTE, IN. H_2O	_____	_____
*7)	ALLOWABLE PRESSURE FROM EQUATION 9.9 IN. H_2O	_____	_____
	VAPOR VALVE TEST		
8)	INITIAL PRESSURE (0), IN. H_2O	_____	_____
9)	FINAL PRESSURE AFTER ONE (1) MINUTE, IN. H_2O	_____	_____
10)	ALLOWABLE PRESSURE INCREASE, IN. H_2O	1.0	1.0

IF #7 ABOVE IS LESS THAN #6 ABOVE AND #9 ABOVE IS LESS THAN #10 ABOVE, THE CARGO TANK IS IN COMPLIANCE.

FIGURE III