APPENDIX J
STAGE II INSTALLATION TEST METHODS

While efficiency testing is not practical for each service station, there are tests that indicate improper installation of underground Stage II vapor piping. These tests are the pressure decay/leak test, the dynamic back-pressure test, and the liquid blockage test. Testing requirements are usually included as a permit condition. After a brief description of the test methods, various test methods from San Diego and Bay Area Districts of California are contained in this appendix. There are five tests discussed in Chapter 6.

1. Pressure Decay/Leak Test. This test procedure is also sometimes called simply the leak test. Example test procedures are contained in sections J.1 and J.5 of this appendix.

2. Dynamic Pressure Drop Test. This test method is also referred to as the pressure vs. flow test, and sometimes the "dry" pressure drop test. Copies of this test method are contained in section J.2 and J.4 of this appendix.

3. Liquid Blockage Test. The test methods for the dynamic pressure drop test are used to test for liquid blockage. This is also sometimes referred to as the "wet" pressure drop test. The methods in J.2 and J.4 discuss this variation of the test method.

4. Liquid Removal Device Test. This test method is contained in section J.3.

5. Flow rate determination. This test procedure is discussed in Chapter 6. However, since this only involves timing as gasoline is being dispensed, no test method is

included in this appendix.

Specifically, this appendix contains:

Section J.1	Bay Area ST-30 Leak Test Procedure
Section J.2	Bay Area ST-27 Dynamic Back Pressure
Section J.3	Bay Area Liquid Removal Devices (Draft Method)
Section J.4	San Diego Test Procedure TP-91-2 Pressure Drop vs Flow/Liquid Blockage Test Procedure
Section J.5	San Diego Test Procedure TP-92-1 Pressure Decay/Leak Test Procedure

APPENDIX J.1

BAY AREA ST-30 LEAK TEST PROCEDURE

Source Test Procedure ST-30

GASOLINE DISPENSING FACILITY

LEAK TEST PROCEDURE

REF: Regulation 8-7-301, 302

1. Applicability

1.1 This Test Procedure is used to quantify the vapor tightness of any vapor recovery system installed at a gasoline dispensing facility (GDF). Leaks in a balance system may cause excessive vapor emissions. Leaks in a vacuum assist system may decrease the efficiency of the vapor collection or processing system.

2. Principle

2.1 The entire vapor recovery system is pressurized to ten (10) inches of water column and then allowed to decay for five (5) minutes. The acceptability of the final pressure is based upon the vapor system volume or ullage space.

3. Range

3.1 The minimum and maximum full-scale ranges of the pressure gauge are 0-10 and 0-20 inches of water column, respectively. Maximum incremental graduations of the pressure gauge shall be one-tenth of an inch water column.

4. Interferences

4.1 On vacuum assist systems the processor must be isolated and the vapor system capped. On a balance system the vent pipes must be capped or plugged. Any leakage at these points will show up as a system component leak.

5. Apparatus

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

5.2 Pressure Gauge or Water Manometer. Use a 0-10 inch water column pressure gauge, or water manometer, to measure the pressure decay in the vapor recovery system. The pressure gauge shall be readable to the nearest tenth of an inch (0.1) water column.

5.3 Vent Cap Assembly. See Figure 30-1 for example.

5.4 "T" Connector Assembly. See Figure 30-2 for example.

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

6. Pre-Test Procedures

6.1 Dispensing shall not take place during the test. There shall have been no bulk drops into the storage tanks within the three hours prior to the test.

6.2 Measure the gasoline gallonage in each underground storage tank. Determine the actual capacity of each storage tank. Calculate the ullage space for each tank by subtracting the gasoline gallonage present from the actual tank capacity. The minimum ullage during the test shall be 30 percent of the tank capacity or 500 gallons, whichever is greater. The vent pipes may be manifolded during the test to achieve the required ullage.

6.3 Insure that all Phase I couplers are equipped with a locking dust cap. Replace the manhole covers as a safety precaution.

6.4 Disconnect the dispenser end of one vapor recovery hose and install the "T" connector assembly (see Figure 30-2). Connect the nitrogen gas supply (do not use air), and the pressure gauge to "T" connector.

6.4.1 For those Phase II systems utilizing a remote vapor check valve, the "T" connector assembly shall be installed on the vapor riser side of the check valve unless the remote check valve is disabled by removing the poppet on the fuel side.

6.5 Install the vent cap assembly(s) (see Figure 30-1). For manifolded systems all storage tank vent pipes shall be capped during the test.

6.6 If the storage tank vent pipe is open, and easily accessible, a modified version of the "T" connector may be installed at the vent pipe (see Figure 30-3). This will allow the test to be conducted without any dispenser modifications. This is advantageous at certain facilities using coaxial Phase II systems.

7. Testing

7.1 Open the nitrogen gas supply valve, regulate the delivery pressure to 5 psig, and pressurize the vapor system (or subsystem for individual vapor return line systems) to or slightly above 10 inches H_2O initial pressure. It is critical to maintain the nitrogen flow until both flow and pressure stabilize, indicating temperature and vapor pressure stabilization in the tanks. Check the vent cap assembly(s) and "T" connector assembly using leak detecting solution to verify that the test equipment is leak tight.

7.2 Close the nitrogen supply valve and start the stopwatch when the pressure decreases to the initial starting pressure of 10 inches of water column.

7.3 After each minute record the system pressure. After five minutes, record the final system pressure. See Table 30-I to determine the acceptability of the final system pressure results.

7.4 If the system failed to meet the criteria set forth in Table I repressurize the system and check all accessible vapor connections using leak detector solution or a combustible gas detector. If vapor leaks in the system are encountered, repair or replace the defective component and repeat the test.

7.5 Carefully remove the vent cap assembly(s). Allow any remaining pressure to be relieved through vent pipe(s). Keep all potential ignition sources away from the vent pipe(s).

7.6 After the pressure is relieved, remove the "T" connector assembly and reconnect the vapor recovery hose. If the fuel poppet was removed from a remote vapor check valve to conduct this test, carefully replace the poppet and reconnect the vapor hose.

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

8. Reporting

8.1 The calculated ullage and system pressures for each five minute vapor recovery system test shall be reported as shown in Figure 30-4.

TABLE 30-I

GASOLINE DISPENSING FACILITY
LEAK RATE CRITERIA
INITIAL PRESSURE - 10 INCHES WATER COLUMN

ULLAGE SPACE (GALLONS)	MINIMUM PRESSURE AFTER FIVE MINUTES (Inches of Water)
500	3.7
600	4.5
700	5.2
800	5.8
900	6.2
1,000	6.5
1,500	7.6
2,000	8.2
2,500	8.5
3,000	8.7
3,500	8.9
4,000	9.1
4,500	9.2
5,000	9.3
7,500	9.5
10,000	9.6
15,000	9.7
30,000	9.8

Use linear interpolation for intermediate values of ullage space.

FIGURE 30 - 1

VENT CAP ASSEMBLY

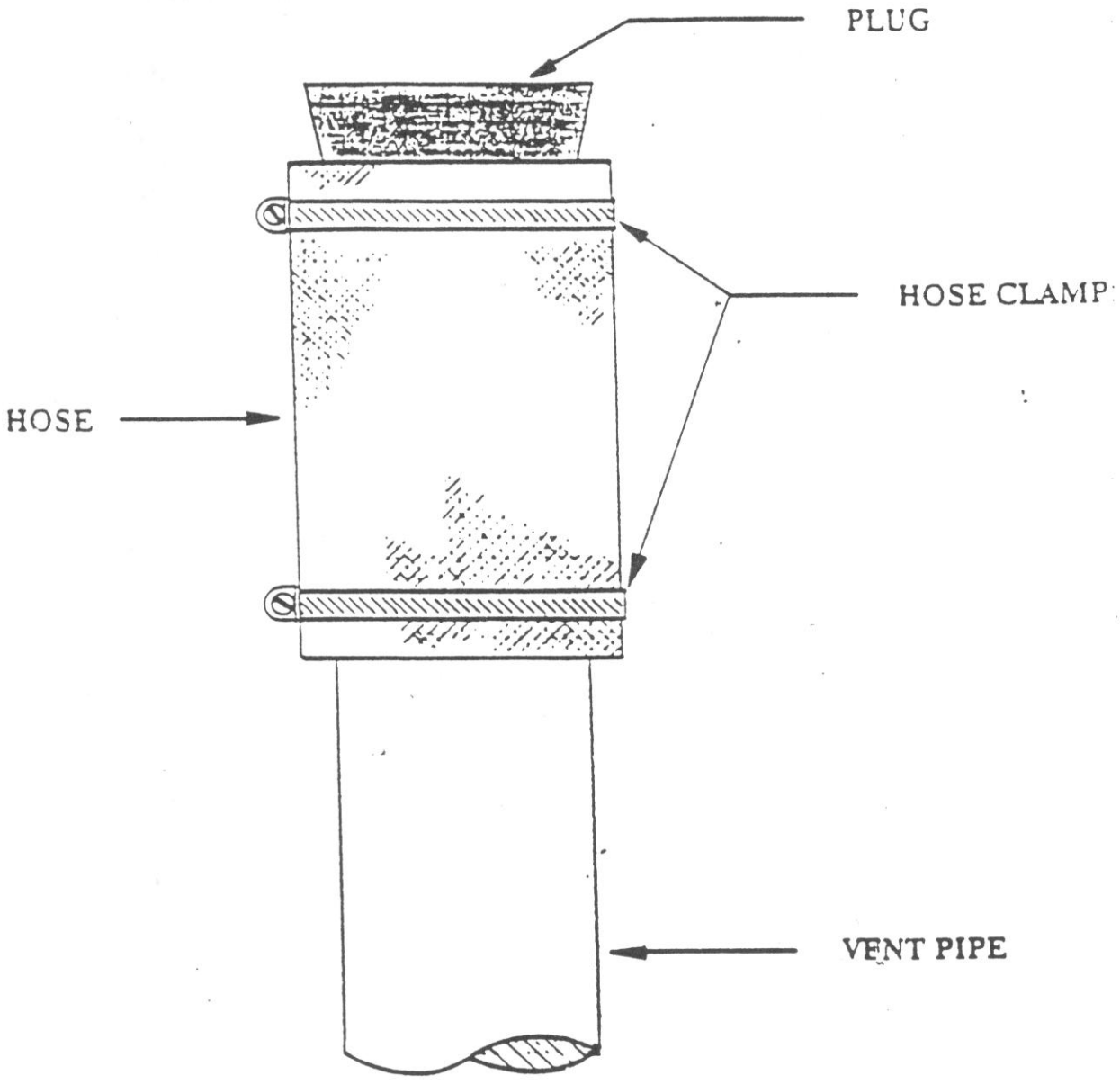


FIGURE 30 - 2

"T" CONNECTOR ASSEMBLY

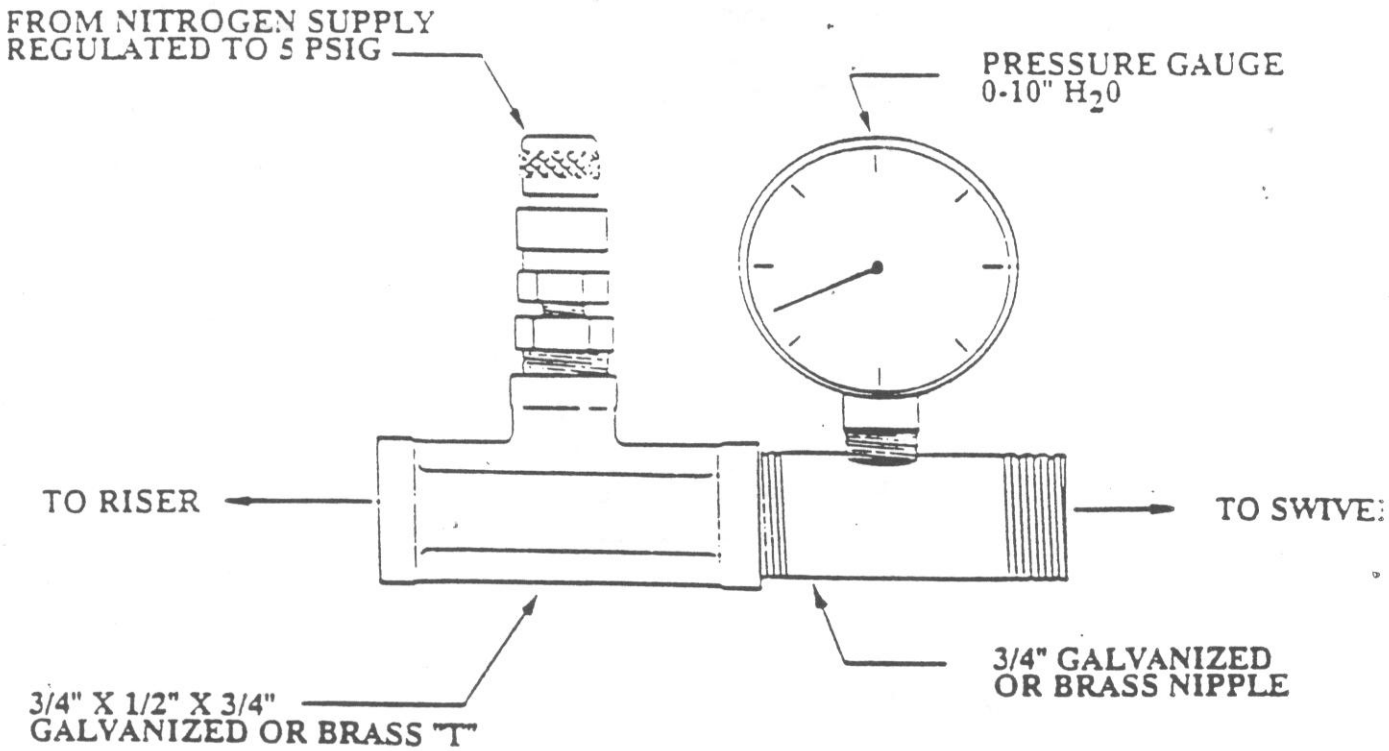


FIGURE 30 - 3

ALTERNATE VENT CAP ASSEMBLY

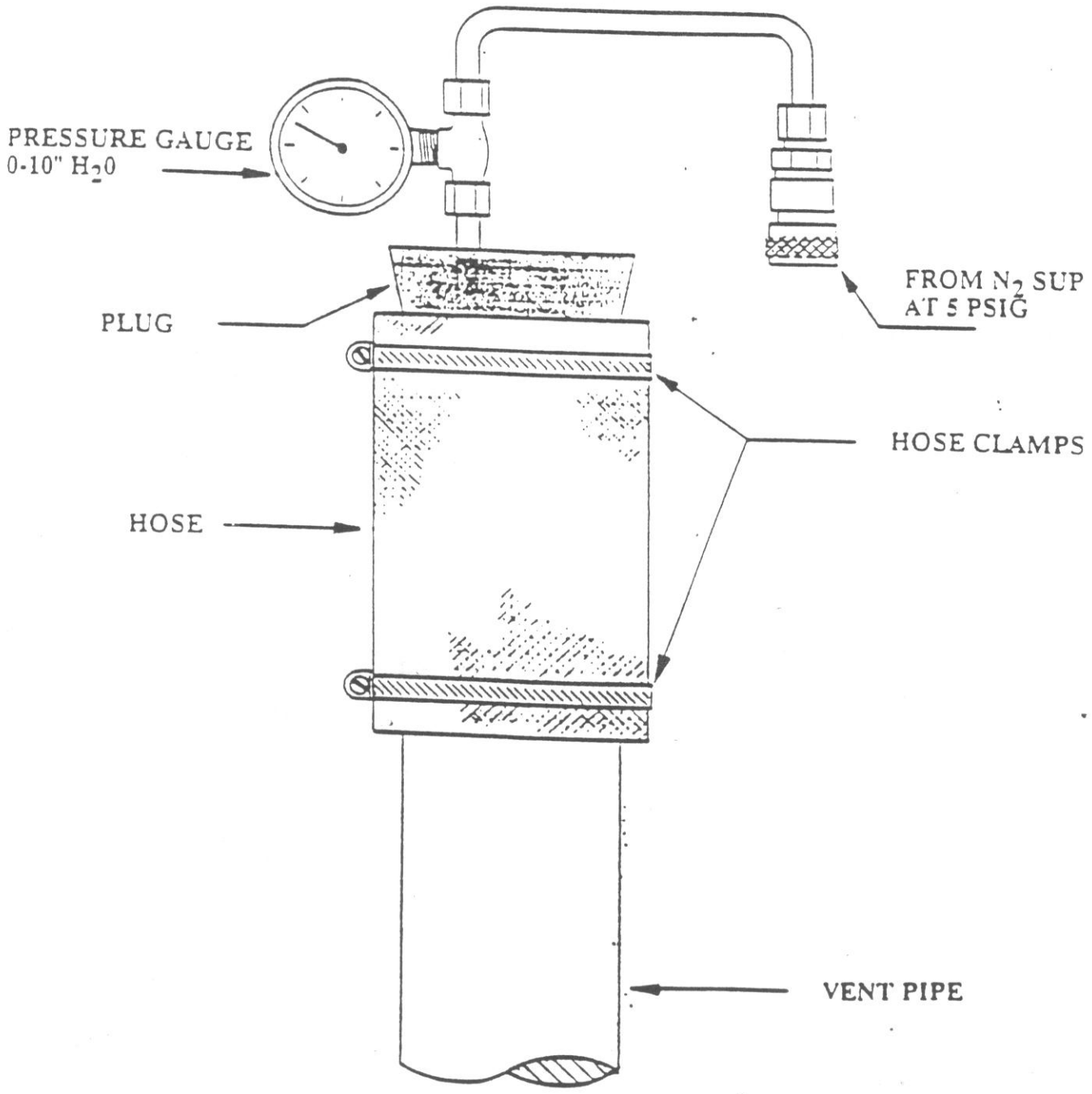


FIGURE 30 - 4

SUMMARY OF SOURCE TEST RESULTS

Report No. _____

Test Date: _____

Test Times:

Run A: _____

Run B: _____

Run C: _____

SOURCE INFORMATION

Firm Name and Address

Firm Representative and Title

Phone No.

Source:

Vapor Recovery System

Plant No. Permit No.

Operates hr/day & 365 days/yr

Permit Conditions

FACILITY PARAMETERS

PHASE II SYSTEM TYPE
(Check One)

Balance _____
Hirt _____
Red Jacket _____
Hasstech _____
Healy _____

Manifolded? (Y or N) _____

Operating Parameters:

Tank #	Capacity	Gallons Present
1	_____	_____
2	_____	_____
3	_____	_____

Applicable Regulations:

VN Recommended:

Source Test Results and Comments:

Tank #:	1	2	3
Product Grade:	_____	_____	_____
Actual Tank Capacity, gallons	_____	_____	_____
Gasoline Volume, gallons	_____	_____	_____
Ullage, gallons	_____	_____	_____
Initial Pressure, inches H_2O	_____	_____	_____
Pressure After 1 Minute, inches H_2O	_____	_____	_____
Pressure After 2 Minutes, inches H_2O	_____	_____	_____
Pressure After 3 Minutes, inches H_20	_____	_____	_____
Pressure After 4 Minutes, inches H_20	_____	_____	_____
Final Pressure After 5 Minutes, inches H_20	_____	_____	_____

NO COMMERCIAL USE OF THESE RESULTS IS AUTHORIZED

Test Conducted by	Test Company	Date of Test

Forms Summary of Source Test Results

PSETB: rev 16 July 8

APPENDIX J.2

BAY AREA ST-27 DYNAMIC BACK PRESSURE

SOURCE TEST PROCEDURE ST-27

GASOLINE DISPENSING FACILITY

DYNAMIC BACK PRESSURE

REF: Regulation 8-7-302

1. Applicability

1.1 This procedure is used to quantify the dynamic back pressure in the vapor path leading from the dispensing nozzle to the underground tank, inclusively. It is applicable in all cases where vapor balance or Hirt vacuum assist Phase II systems are utilized.

2. Principle

2.1 The dynamic back pressure during refueling is simulated by passing nitrogen through the Phase II recovery system at a constant rate. The resultant dynamic back pressure is measured using a pressure gauge. Alternate Methods 1 and 2 are also included for those Phase II systems which utilize a remote vapor check valve.

3. Range

3.1 The minimum and maximum dynamic back pressures that can be measured are dependent upon available pressure gauges. Recommended gauge ranges are 0-.5 inches H_2O and 0-2 inches H_2O for Alternate Methods 1 and 3. Recommended ranges for Alternate Method 2 are 0-.50 inches H_20 and 0-1 inch H_20.

4. Interferences

4.1 Any leaks in the nozzle vapor path, vapor hose, or underground vapor return piping will result in erroneously low dynamic back pressure measurements.

5. Apparatus

5.1 Nitrogen High Pressure Cylinder with Pressure Regulator. Use a high pressure nitrogen cylinder capable of maintaining a pressure of 2000 psig and equipped with a compatible two-stage pressure regulator.

5.2 Rotameter. Use a calibrated rotameter capable of accurately measuring nitrogen flowrates of 20, 60, and 100 CFH and equipped with a flow control valve.

5.3 Pressure gauges. Use two Magnehelic differential pressure gauges, or equivalent, with appropriate ranges , and equipped with toggle valves connected to the high pressure inlets.

5.4 Automobile fill pipe. Use a fill neck known to be compatible with all vapor recovery nozzles and equipped with a pressure tap.

5.5 Nitrogen. Use commercial grade nitrogen.

5.6 Hand Pump. Use a gasoline compatible hand pump to drain condensate pots.

6. Pre-Test Procedures

6.1 For those Phase II systems which **do not** utilize a remote vapor check valve, assemble the apparatus as shown in Figure 27-1, ensuring that the riser shut-off valve on the test equipment is closed. If a Hirt Phase II system is used, the vacuum producing device should be turned off during this test.

6.2 The test equipment must be leak-checked prior to use. Plug the nozzle end of the auto fill pipe, open the nitrogen cylinder and the toggle valves on the magnehelic gauges. Adjust the flow meter control valve until a pressure of 50 percent of full scale is indicated on the high range pressure gauge. Close the nitrogen cylinder valve and toggle valves. A pressure decay of 0.2 inches H_2O, in five minutes, is considered acceptable.

6.3 Perform an initial visual examination for vapor leaks at the nozzle and hose of the Phase II system to be tested.

6.4 Disconnect and drain the vapor hose for all dispensers to be tested. Pour two (2) gallons of gasoline into each vapor return riser. Reconnect vapor hose. Allow fifteen (15) minutes for liquid in the vapor return piping to drain. For Phase II systems which do not employ a remote vapor check valve, the 2 gallons of gasoline may be introduced through the vapor passage in the nozzle.

6.5 Completely drain all gasoline from the spout and bellows.

6.6 For those vapor piping configurations which utilize a condensate pot, drain the pot prior to testing.

6.7 For Alternate Methods 1, 2, and 3 the Phase I vapor poppet shall be propped open in such a manner that the valve is not damaged.

7. Testing

7.1 **Alternate Method 1.** Phase II systems which **do not** utilize a remote vapor check valve may be tested using the following methodology. Insert the nozzle into the fill pipe of the pressure drop test unit, ensuring that a tight seal at the fillpipe/nozzle interface is achieved. Ensure that the riser shut-off valve on the test equipment is closed.

7.2 Close both toggle valves and connect the nitrogen supply.

7.3 Open the nitrogen supply, set the delivery pressure to 10 psig, and use the flowmeter control valve to adjust the flowrate to 20 CFH.

7.4 Open the toggle valve on the 0-.5 inches H_2O gauge. If the pressure is greater than 0.5 inches H_2O, close this valve and use the 0-2 inches H_2O gauge.

7.5 A pulsating gauge needle indicates nitrogen passing through a liquid obstruction in the vapor return system. If this occurs, close the flowmeter control valve, disengage the nozzle and redrain the nozzle and hose assembly. Re-engage the nozzle, open the flowmeter control valve and repeat the test.

7.6 Repeat Sections 7.3 through 7.5 for nitrogen flowrates of 60 and 100 CFH.

7.7 The following information should be recorded on the field data sheet shown in Figure 27-2:

Pump Number and Product Grade
Nozzle make and model
Nitrogen flowrate, CFH
Dynamic back pressure, inches H_2O

7.8 Close and replace the dust cover on the Phase I poppet.

7.9 Alternate Method 2. Phase II systems which utilize a remote vapor check valve may be tested using the following methodology.

7.9.1 Disconnect the vapor recovery hose from the remote vapor valve. Test the nozzle/hose assembly pursuant to Sections 7.1 through 7.8 and record the results.

7.9.2 Disconnect the vapor check valve from the riser and connect a compatible pipe fitting to the riser as shown in Figure 27-1.

7.9.3 Plug the nozzle end of the fill pipe on the pressure drop test unit and open the riser shut-off valve on the test equipment.

7.9.4 Repeat Sections 7.2 through 7.8. In addition to the information required in Section 7.7, record the make and model of the remote vapor check valve.

7.9.5 Record on the field data sheet the pressure drop across the remote vapor check valve. This data is available from the manufacturer.

7.9.6 Add the dynamic back pressures, for each nitrogen flowrate, obtained from Sections 7.9.1, 7.9.4 and 7.9.5.

7.10 Alternate Method 3. Phase II balance and Hirt systems which use those models of remote vapor check valves which can be disabled by removing the poppet on the fuel side may be tested using the following methodology. The Emco-Wheaton A-228 remote vapor check valve <u>cannot</u> be tested using this method.

7.10.1 Carefully open the fuel side of the remote vapor check valve and remove the fuel poppet. Carefully replace the threaded plug on the fuel side of the valve.

7.10.2 Test the Phase II system pursuant to Sections 7.1 through 7.8, recording the data on the field data sheet shown in Figure 27-2.

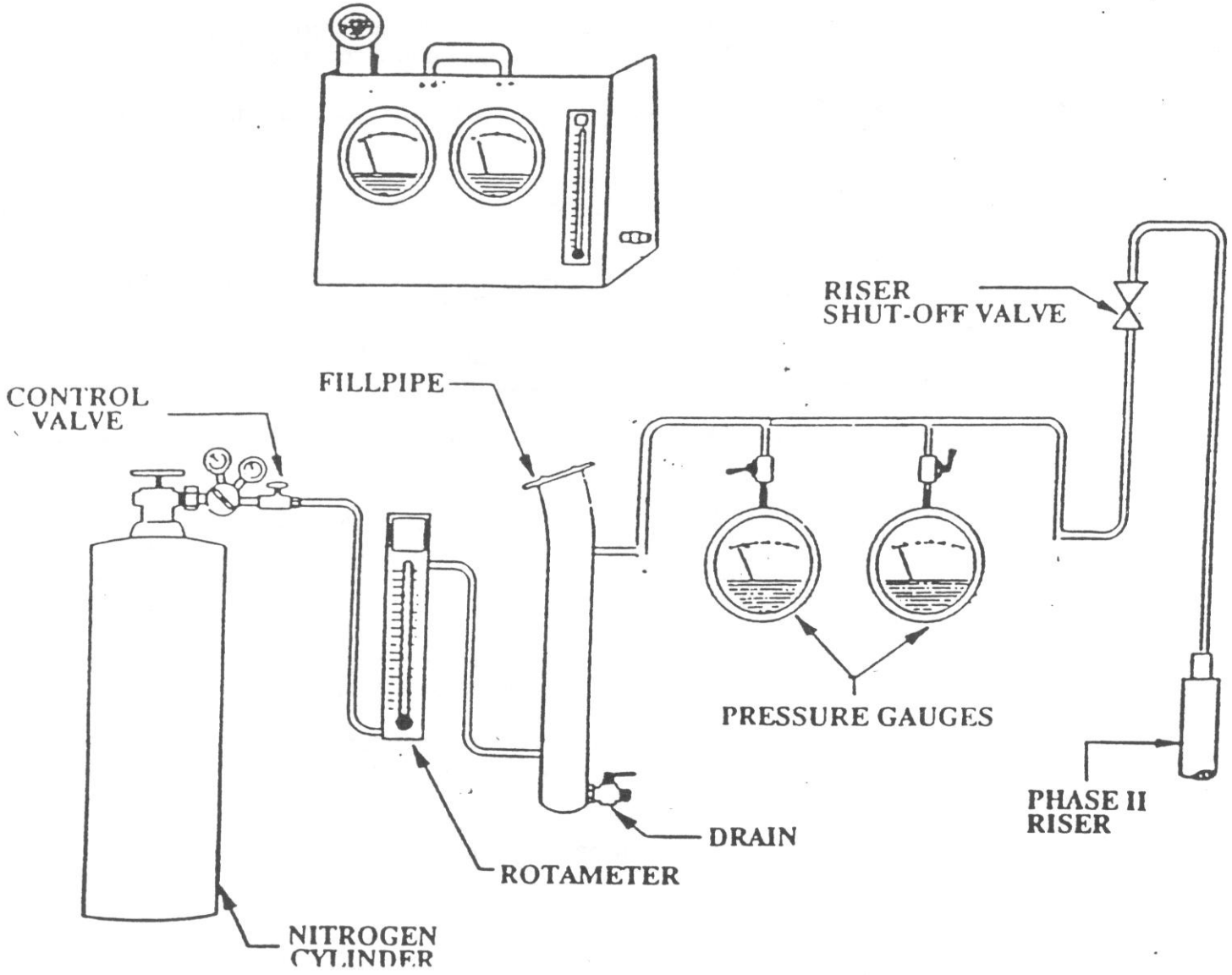
7.10.3 Carefully reassemble the remote vapor check valve by removing the plug on the fuel side and reinserting the fuel poppet. Replace the threaded fuel plug.

8. Reporting

8.1 Results from Alternate Methods 1 or 3 shall be reported as shown in Figure 27-2. Results from Alternate Method 2 shall be reported as shown in Figure 27-3. The maximum allowable system dynamic back pressures, with the dry brakes open, are as follows:

NITROGEN FLOWRATE, CFH	DYNAMIC BACK PRESSURE, INCHES H_2O
20	0.15
60	0.45
100	0.95

Figure 27 - 1
PRESSURE DROP TEST UNIT



SUMMARY OF SOURCE TEST RESULTS

Firm Name and Address

Testing Company Name and Address

PUMP #	GASOLINE GRADE	NOZZLE MFG.& MODEL NUMBER	DYNAMIC BACK PRESSURE, INS. W.C. 20 CFH	60 CFH	100 CFH	COMMENTS

Test Conducted By

Date

Company Name _____ Address _____ City _____ Phone _____

Test Date _____ Test Company _____ Address _____ City _____

SUMMARY OF SOURCE TEST RESULTS

PUMP #	GAS GRADE	NOZZLE MODEL	NITROGEN FLOW,CFH	VAPOR VALVE MODEL	DYNAMIC BACK PRESSURE, INCHES OF WATER COLUMN			
					NOZZLE/HOSE ASSEMBLE	RISER TO U.G. TANK	VAPOR VALVE	TOTAL ΔP,IN H2O

J.2-7

Figure 27 - 3

APPENDIX J.3

BAY AREA LIQUID REMOVAL DEVICES (DRAFT METHOD)

SOURCE TEST PROCEDURE ST-37

GASOLINE DISPENSING FACILITY

LIQUID REMOVAL DEVICES

REF: 8-7-302

1. Applicability

1.1 This procedure is used to quantify the removal of liquid gasoline from the vapor passage of coaxial hoses equipped with a liquid removal device. It is applicable in all cases where a liquid removal system is installed in conjunction with a Phase II balance system.

2. Principle

2.1 A dynamic back pressure baseline is established pursuant to Source Test Procedure ST-27. Sufficient liquid gasoline is introduced into the vapor passage of the coaxial hose to produce a dynamic back pressure between 2.0 and 6.0 inches water column at a nitrogen flowrate of 60 CFH. After ten gallons of gasoline are dispensed the dynamic back pressure is measured and compared to the baseline value. The total liquid volume removed is also considered.

3. Range

3.1 The minimum and maximum dynamic back pressures that can be measured are dependent upon available pressure gauges. Recommended gauge ranges are 0-.5 inches H_2O and 0-10 inches H_2O.

4. Interferences

4.1 Any leaks in the nozzle vapor path or hose vapor path will result in erroneous results.

4.2 Alteration of the hose and loop configuration between the prefueling test and the post refueling test can result in erroneous results.

4.3 If the hose connection, at the dispenser, is sufficiently low to allow the 100 CFH nitrogen flow to displace liquid gasoline into the underground Phase II piping, this test procedure shall not be used.

5. Apparatus

5.1 Delta P Test Unit. Use a test unit, as shown in Figure 37-1. This test assembly shall be equipped with two pressure gauges of appropriate ranges, a compatible automobile fillpipe, and a 0-100 CFH flowmeter equipped with a flow control valve. The test unit shall be securely mounted on a stand such that the height, above grade, to the fillpipe opening is 30 inches.

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

5.3 Nitrogen High Pressure Cylinder with Regulator. Use a high pressure supply of commercial grade nitrogen in a cylinder capable of withstanding a pressure of 2,500 psig. The cylinder shall be equipped with a compatible two-stage regulator and a high pressure delivery hose.

5.4 Graduated Cylinder. Use a shatterproof 0-300 milliliter cylinder which is compatible for use with gasoline.

5.5 Pressure Gauge. Use a 0-30 psig pressure gauge to measure the gasoline delivery pressure.

6. Pre-Test Procedures

6.1 Use a stopwatch to accurately measure the gasoline dispensing rates at high, medium, and low nozzle hold-open clip settings. For those nozzles without hold-open latches, use wedges to simulate the three latch positions. Record this data on the Liquid Removal Field Data Sheet shown in Figure 37-2.

6.2 Use the 0-30 psig pressure gauge to quantify the gasoline delivery pressure. If possible, this pressure shall be measured with only one nozzle is dispensing the given gasoline grade. Record this pressure on the Liquid Removal Field Data Sheet.

6.3 Position the Delta P Test Unit 48 inches from the face of the dispenser in order to represent a typical refueling configurations.

6.4 Completely drain all liquid from the vapor passage of the coaxial hose. Sufficient time shall be allocated for this pre-test procedure, especially if the hose has internal convolutions.

6.5 Use the graduated cylinder to pour 150 milliliters of gasoline into the vapor passage of the hose.

6.6 Completely drain the gasoline from the vapor passage back into the graduated cylinder. Subtract this quantity from the original 150 milliliters. This value represents the volume of gasoline lost due to surface adhesion to the hose wall.

6.7 With no dispensing activity occurring at the gasoline dispensing facility, conduct the dynamic back pressure tests at nitrogen flowrates of 20, 60, and 100 CFH, in accordance with Source Test Procedure ST-27. Record the results on the Liquid Removal Field Data Sheet. This establishes the dry baseline values for dynamic back pressures.

7. Testing

7.1 Use the graduated cylinder to pour 150 milliliters of gasoline into the vapor passage of the hose.

7.2 With no dispensing activity occurring at the gasoline dispensing facility, conduct the dynamic back pressure test, in accordance with Source Test Procedure ST-27, at nitrogen flowrates of 20, 60, and 100 CFH. Record this data on the Liquid Removal Field Data Sheet. This establishes the wet baseline values for dynamic back pressures. Ensure that the dynamic back pressure, at 60 CFH, does not exceed six (6) inches H_2O. This will preclude the possibility of premature nozzle shutoff while dispensing fuel. If the wet baseline value is less than two (2) inches H_2O, use the graduated cylinder to add sufficient gasoline to raise the dynamic back pressure to a minimum of two (2) inches H_2O.

7.3 Move the Delta P Test Unit and position a vehicle such that the fillpipe inlet is in approximately (+/- six inches) the same location previously occupied by the Delta P Test Unit fillpipe.

7.4 Using the low hold-open clip setting, dispense 10.0 gallons into the vehicle gas tank. Record the exact gallonage on the Liquid Removal Field Data Sheet.

7.5 Move the vehicle and return the Delta P Test Unit to it's original position, using the traced outline of the base to verify it's position.

7.6 Conduct the dynamic back pressure test, in accordance with Source Test Procedure ST-27, at nitrogen flowrates of 20, 60, and 100 CFH. Record this data on the Liquid Removal Field Data Sheet. These values represent the post-refueling dynamic back pressures.

7.7 Carefully drain any gasoline present in the vapor passage of the hose into the graduated cylinder. Record this data on the Liquid Removal Field Data Sheet.

7.8 Repeat Sections 6.3 through 6.7 and Sections 7.1 through 7.7 with the hold-open clip in both the medium and high positions. Record this data on the Liquid Removal Field Data Sheet.

8. Calculations

8.1 The volume of liquid gasoline removed from the hose vapor passage per gallon of gasoline dispensed is calculated as follows:

$$V_R = \frac{(V_I - V_W) - V_F}{G}$$

Where:

V_R = Gasoline removed per gallon dispensed, milliliters/gallon
V_I = Total initial volume poured into hose vapor passage, milliliters
V_W = The liquid lost due to wall adhesion, from Section 6.6, milliliters
V_F = The volume of gasoline remaining in the hose vapor passage after dispensing, from Section 7.7, milliliters
G = The total gallons dispensed, from Section 7.3, gallons

8.2 The percent increase in dynamic back pressure, from dry baseline to post refueling conditions, is calculated as follows:

$$P_I = \frac{P_{PR} - P_{DB}}{P_{DB}} \times 100$$

Where:

P_I = The percent increase in dynamic back pressure from dry baseline to post refueling conditions, percent
P_{PR} = The post refueling dynamic back pressure, inches H_2O
P_{DB} = The dry baseline dynamic back pressure, inches H_2O
100 = Conversion factor from decimal fraction to percent

9. Reporting

9.1 The results shall be reported as shown in Figure 37.3.

APPENDIX J.4

SAN DIEGO TEST PROCEDURE TP-91-2 PRESSURE DROP VS FLOW/LIQUID BLOCKAGE TEST PROCEDURE

SAN DIEGO COUNTY AIR POLLUTION CONTROL DISTRICT
TEST PROCEDURE TP-91-2*

PRESSURE DROP VS FLOW/LIQUID BLOCKAGE TEST PROCEDURE PHASE II BALANCE SYSTEM INSTALLATIONS

1.0 INTRODUCTION

This procedure is used to determine compliance with District Rules 61.4 and 61.8; Chapter 3, Article 5, California State Health & Safety Code (H&SC); and Title 17, Section 94006, California Code of Regulations (CCR). Back pressures due to flow resistances in the vapor return nozzles, hoses, dispensers, and piping was found, over years of testing, to be the primary cause of vapor losses from the balance vapor recovery systems. Therefore, various sections of Rule 61.4, the State Health & Safety Code, and Section 94006 of the CCR deal directly or indirectly with this potentially serious problem. All the applicable California State Air Resources Board (ARB) Executives Orders specify specific flow resistance limitations that are included in this procedure. Failure to meet this criteria is a violation of District Rule 61.4 and State law. New and modified installations that do not meet the criteria are not, according to State law, certified vapor recovery systems. Rule 61.8 and State law require that only certified systems be installed. Furthermore, this procedure is used to detect prohibited equipment defects listed pursuant to District Rule 61.4 and CCR Section 94006, and to determine if the underground vapor piping configuration complies with the applicable ARB Executive Orders as required by District Rules 61.4 and 61.8 and State law.

This procedure consists of two separate tests which must be conducted sequentially in the order indicated below:

1.1 Pressure vs Flow Test (Dry Test): This test is used to determine the pressure drop (flow resistance) through balance Phase II vapor recovery systems (including nozzles, vapor hose, swivels, dispenser piping and underground piping) at prescribed flow rates. The test method consists of flowing gaseous nitrogen through a calibrated test panel into the vapor recovery system at various flow rates to simulate the back pressure created during vehicle refueling. The resulting back pressures are measured near the nozzle faceplate using a pressure gauge and compared with ARB certification criteria.

1.2 Liquid Blockage Test (Wet Test): This test is used to determine if the piping configuration is correct and to detect low points in the piping where the accumulation of liquid condensate may cause blockages which restrict the flow of vapors and thus decrease the system's vapor collection efficiency. The test method consists of introducing gasoline into the vapor piping at the dispenser. When the gasoline can be heard dropping into the appropriate tank, enough gasoline is

This Test Procedure supercedes TP-79-2-A & TP-79-3-B. The Liquid Blockage Test described in this test procedure is also applicable for aspirator-assist Phase II installations.

deemed to have been added to create a blockage should a low point or other restiriction be present. Gaseous nitrogen is introduced into the vapor piping at a rate of 60 standard cubic feet per hour (SCFH). A liquid blockage is indicated either by the needle pegging on the pressure gauge and/or wild pulsing of the needle, or a reading in excess 0.45 inches of water gauge (wcg) back pressure at a flow of 60 SCFH of nitrogen.

Where there is underground piping, the San Diego Air Pollution Control District only requires that the test be performed after all vapor piping is in place and covered. Nevertheless, it is recommended for new construction that the contractor conduct this blockage test both before and after the vapor recovery piping is covered to minimize the extensive effort and cost associated with repairing the piping system should the vapor recovery system fail the test.

2.0 PREREQUISITES TO TESTING

The following requirements must be met before a valid test can be performed:

2.1 The District Must Be Notified - The appropriate person specified in the Air Pollution Control District Authority to Construct letter must be contacted within 10 working days of completion of construction to establish a mutually agreeable test date. Normally, the tests will be witnessed by a District representative; however, a District engineer may, under certain circumstances, authorize testing without a District observer being present. If the District is not notified of this test or any other required tests, then this test or other required tests may be declared invalid. If found invalid, testing may have to be repeated with a District observer present.

2.2 Condition of the Vapor Recovery System - The vapor recovery system must be proven leak tight with the District's pressure decay/leak test (see TP-91-1), or other method approved by the District, prior to conducting this test. There can be no alteration of the vapor recovery system between the time the pressure decay/leak test is conducted and this pressure drop test is run.

2.3 Restriction of Gasoline Dispensing Operations - During testing of a given product, no dispensing of that product will be allowed. If the vapor spaces of the underground storage tanks are manifolded, dispensing of gasoline from the entire station shall be prohibited during testing.

3.0 EQUIPMENT

The following equipment will be needed to perform the pressure vs flow and the liquid blockage tests :

3.1 A bottle of gaseous nitrogen and pressure regulators capable of regulating final downstream pressure to 5.0 pounds per square inch gauge (psig) are required. Use assorted valves, fittings, and pressure tubing as necessary. A means of providing a grounding path from the bottle of compressed nitrogen must be employed. The bottle shall be grounded for safety. It is recommended that the tubing be flexible metal tubing or non-metallic tubing that incorporates a grounding path throughout its length.

A pressure relief valve must be installed prior to testing. Attached it to the vapor piping or a storage tank vent within the piping system. The pressure relief valve must be adjusted to release at one psig (27.7 inches of water column gauge.) (The diaphragms in balance system nozzles are not designed to withstand pressures exceeding one psig and may be accidently ruptured if this procedure is not followed.)

WARNING - The nitrogen bottle must be securely fastened to a large, stationary object at all times. A compressed gas cylinder which falls and is damaged can easily become a lethal projectile.

3.2 A flow regulator is required that is capable of delivering nitrogen at very low pressure and at measured flow rates of 20, 60 and 100 SCFH.

3.3 A test panel as shown in Figure 1 must be used for testing balance system vapor flow restrictions. The panel consists of a section of vehicle fill pipe, attached pressure gauges, a drain to drain off gasoline liquid that spills into fillpipe from the nozzle fill spout, a plug in the back through which nitrogen enters the fill neck, a flow gauge to adjust nitrogen flow, control valves and attachments to connect the nitrogen bottle. The pressure drop through the Phase II system is determined using a gauge capable of accurately measuring pressures from 0 to 1 inch of water column gauge ("wcg) and readable in increments of 0.01" wcg. The gauge is used to measure back pressure before and after the gasoline is introduced. Pressure is to be sensed through a port, perpendicular to the direction of flow, located as close as possible to the vapor piping. An additional simultaneous-reading gauge with a 0 to 10" wcg range is desirable to quantify excessive flow resistance.

4.0 TEST PROCEDURES

4.1 Pressure vs Flow Test (Dry Test):

The farthest dispensing nozzle from the underground tanks for each product grade shall be tested using the following procedure unless otherwise required in the Authority to Construct letter.

4.1.1 Prop open only the Phase I drybreak valve at the tank with the same

product as the nozzle being tested. (The pressure drop is measured through the nozzle, vapor hoses, dispenser, vapor piping and through the tank to the Phase I drybreak. This comes close to duplicating the actual flow resistances that occur during normal opeations.) Set up traffic barriers in the vicinity of the drybreak valve to preclude the approach of potential ignition sources.

4.1.2 For manifolded systems, install the pressure relief safety valve, set at one psig (27.7 inches of water), over the opening of one of the storage tank vents and cap the remaining storage tank vents. (Manifolding the tank vent lines is prohibited.) For non-manifolded systems, test each product vapor recovery system separately with the pressure relief safety valve installed on the vent of the storage tank being tested. (Alternative setups may be used as long as they do not interfer with the objectives of the test and have prior District approval.) (Note: The tank vents are closed because it was discovered that wind flowing over open vents 12 feet high can interfere with the pressure measurements, even with the drybreaks open. Since the pressure decay/leak test must be conducted first, the caps and relief valve are usually already in place.)

4.1.3 If there is no remote check valve in the dispenser, proceed to Step 4.1.4. If the Phase II balance system employs a remote vapor check valve that can be disabled by removing the poppet on the fuel side, carefully open the fuel side of the remote vapor check valve and remove the fuel poppet. Replace the threaded plug on the fuel side of the valve.

4.1.4 Connect the pressure drop test device to the vapor return piping and the regulated nitrogen source. If the nitrogen is introduced through the vapor recovery nozzle, apply a film of lubricant to the faceplate of the nozzle to be tested and insert the nozzle into the fillpipe simulator of the test device. The nozzle must fit tightly.

4.1.5 Zero the pressure gauges.

4.1.6 Adjust the pressure regulators and the pressure drop panel flow control valve to produce a nitrogen flow rate of 20 SCFH. Record the back pressure (balance system pressure drop) measured immediately upstream of the vapor piping, i.e., at the entrance to the nozzle, in the appropriate space of the data log (attached).

4.1.7 Repeat steps 4.1.6 above with flow rates of 60 SCFH and 100 SCFH.

4.1.8 If the system failed to meet the criteria for passage set forth in Section 5.1, make necessary replacements of or adjustment to the nozzles, vapor hoses, swivels, dispenser piping, or underground piping to bring

the measured pressure drops within the appropriate standard.

4.1.9 After completion of the pressure vs flow test, close and cap the underground storage tank vapor dry break valves and remove the closures from the tank vent pipes.

4.1.10 For Phase II balance systems with remote vapor check valves, carefully reassemble the remote vapor check valve by removing the plug on the fuel side and reinserting the fuel poppet. Replace the threaded fuel plug.

4.2 Liquid Blockage Test (Wet Test):

Each dispensing nozzle/vapor return piping inlet shall be tested using the following procedure unless otherwise stated in the Authority to Construct letter. Testing shall be done starting with the farthest dispensing nozzle from the underground storage tanks for each product.

4.2.1 Prop open only the vapor dry break valve at the tank with the same product as the nozzle being tested. Set up traffic barriers in the vicinity of the dry break valve to preclude the approach of potential ignition sources.

4.2.2 Install a pressure relief safety valve set at a maximum cracking pressure of one pound per square inch gauge (27.7' wcg) at the vent of one of the storage tanks. If the system has manifolded vapor piping, cap the vents of the other storage tanks. If the system has non-manifolded piping, be sure the pressure relief valve is on the tank that has the same product as that which is dispensed at the location where liquid is introduced to the vapor piping.

4.2.3 For each nozzle, introduce gasoline into the vapor piping inlet located at or in each dispenser. (Don't introduce gasoline through the vapor return nozzle and vapor hose.) Have someone listening at the open Phase I drybreaks to identify the tank where liquid splashing is heard For systems with manifolded underground vapor piping, the liquid must drop into the leaded product tank, or the lowest octane unleaded tank if there is no leaded product. For non-manifolded systems with separate underground vapor piping, the liquid shall return to the tank that has the same product as is dispensed at the nozzle where the liquid was introduced into the vapor piping. If the product at the nozzle does not match the product in the tank, the underground piping is crossed and the system fails the test. For both manifolded and non-manifolded systems the piping must be the same as the configuration approved in the District's Authority to Construct letter or the facility fails the test.

4.2.4 Restore the dispensing/vapor return system to its normal balance system configuration.

4.2.5 If there is no remote check valve in the dispenser, proceed to Step 4.2.6. If the Phase II balance system employs a remote vapor check valve, that can be disabled by removing the poppet on the fuel side, carefully open the fuel side of the remote vapor check valve and remove the fuel poppet. Replace the threaded plug on the fuel side of the valve.

4.2.6 Connect the pressure drop test device to the vapor return piping and the regulated nitrogen source. If the nitrogen is introduced through the vapor recovery nozzle, apply a film of lubricant to the faceplate of the nozzle to be tested and insert the nozzle into the fillpipe simulator of the test device. The nozzle must fit tightly.

4.2.7 Zero the pressure gauges.

4.2.8 Adjust the pressure regulators and the pressure drop panel flow control valve to produce a nitrogen flow rate of 60 SCFH. Note the response and reading of the pressure gauge immediately upstream of the vapor piping, i.e., at the entrance to the nozzle. Record the back pressure reading on the attached data log under "wet test".

4.2.9 If during the "wet test" the back pressure gauge pegs at full scale or continously fluctuates, note this in the "Comments" section for the nozzle being tested.

4.2.10 If the system failed to meet the criteria for passage set forth in Section 5.2, make necessary repairs or adjustments to the tested piping to eliminate the blockage.

4.2.11 For Phase II balance systems with remote vapor check valves, carefully reassemble the remote vapor chech valve by removing the plug on the fuel side and reinserting the fuel poppet. Replace the threaded fuel plug.

4.2.12 Repeat steps 4.2.1 through 4.2.11 for each nozzle/vapor return piping inlet associated with the vapor return line being tested.

4.2.13 After completion of the liquid blockage test for all nozzles connected to the vapor return line, close and cap the underground storage tank vapor dry break valves and remove the closures from the tank vent pipes.

5.0 TEST STANDARDS

5.1 Pressure vs Flow Test (Dry Test):

In accordance with the California Air Resources Board (ARB) Executive Orders for balance systems, the system passes the pressure vs flow test if at the nitrogen flow rates of 20, 60 and 100 SCFH the flow resistance measured does not exceed the following pressure limits:

(a) 0.15 inches of water gauge at 20 SCFH
(b) 0.45 inches of water gauge at 60 SCFH
(c) 0.95 inches of water gauge at 100 SCFH

5.2 Liquid Blockage Test (Wet Test):

The system fails if the back pressure gauge pegs at full scale or continuously fluctuates during the "wet test", or if the "wet test" back pressure reading at 60 SCFH flow rate exceeds the maximum standard of 0.45 inches of water gauge prescribed in the applicable ARB Executive Orders.

6.0 REPORTING REQUIREMENTS

For those sites having Authorities to Construct requiring this or any other District tests, documentation of the required testings must be submitted to the District before a Permit to Operate will be issued. It is the ultimate responsibility of the applicant to make sure that the necessary documentation is submitted to the District; however, the District will accept test documentation directly from the contractor performing the tests. When a District observer is present and NCR forms are used, the observer will take the original of the form with him/her back to the office.

TEST PANEL

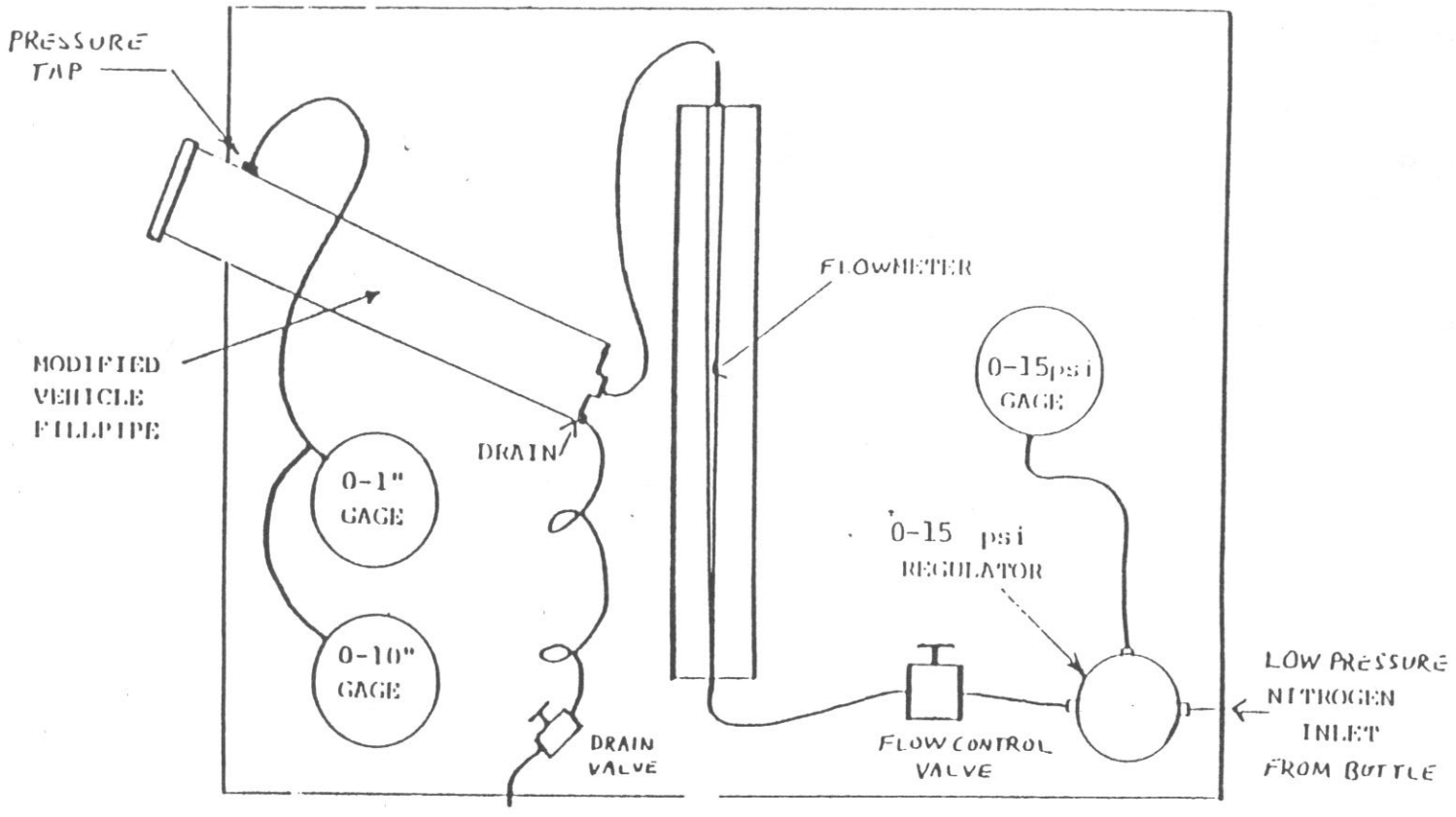


Figure 1

PHASE II BALANCE SYSTEMS PRESSURE DROP DURING FLOW TEST & LIQUID BLOCKAGE TEST

Site DBA:_____ Test Date:_____

Address:_____ APCD Observer:_____

_____ Test Conductor:_____

Test Contractor:_____ Office Phone No:_____

Site Plan:

NOZ. NO.	PROD.	Flowmeter, CFH				COMMENTS
		ΔP TEST			WET TEST	
		20	60	100	60	

White - APCD Yellow - Contractor Pink - Applicant APCD081286

APPENDIX J.5

SAN DIEGO TEST PROCEDURE TP-92-1 PRESSURE DECAY/LEAK TEST PROCEDURE

SAN DIEGO COUNTY AIR POLLUTION CONTROL DISTRICT
TEST PROCEDURE TP-91 -1*

PRESSURE DECAY/LEAK TEST PROCEDURE PHASE I & PHASE II VAPOR RECOVERY INSTALLATIONS

1.0 INTRODUCTION

This procedure is applicable to facilities that recover vapors from vehicle fueling operations (Phase II vapor recovery). It is used to determine compliance with District Rules 61.3, 61.4, and 61.8; Chapter 3, Article 5 of the State Health & Safety Code (HS&C); and Section 94006, Title 17, California Code of Regulations (CCR). Rule 63.1 requires 95% vapor recovery during the truck delivery of fuel to bulk storage tanks (Phase I vapor control). Air aspirated into the fuel during Phase I deliveries prevents compliance. Vapor leakage from adjacent tanks with a vapor manifold to the tank receiving fuel also precludes compliance. This will not happen if the system is leak tight. Rule 61.4 and State law require that the vapor recovery nozzle backpressure shut-off mechanisms not malfunction in any way. This procedure is used to check the shutoff mechanisms. Rule 61.4 and State law also require that all Phase I and Phase II vapor recovery systems perform with the same effectiveness as the State Air Resources Board (ARB) certification test systems associated with the applicable State Executive Orders defining the systems. All ARB test systems passed the pressure decay/leak criteria of the procedure that follows. It is impossible for any vapor recovery system failing the criteria to be as effective as the corresponding ARB certification test system. Rule 61.8 and State law require that all vapor recovery systems be ARB certified. To be certified, all bulk storage tanks must be connected to the Phase II vapor recovery system. This procedure is used to check vapor manifolds. The following procedure may also be used to identify equipment defects prohibited by Rule 61.4 and Section 94006 of the CCR.

2.0 PREREQUISITES TO TESTING

The following requirements must be met before a valid test may be performed:

2.1 The District Must Be Notified - The appropriate person specified in the Air Pollution Control District Authority to Construct letter must be contacted within ten working days of completion of construction to establish a mutually agreeable test date. Normally, the tests will be witnessed by a District representative; however, the District engineer may, under certain circumstances, authorize testing without a District observer being present. If the District is not notified of this test or any of the other required tests, then this test or any other required test may be declared invalid, in which case a retest will be required.

2.2 Minimum Tank Ullage - The ullage (vapor space) in each tank being tested must be at least 10% of the tank's capacity, but in no case less than 300 gallons

*This Test Procedure supercedes TP-88-1 & TP-79-4.

per tank. If the tanks are manifolded, each tank must meet the minimum ullage requirement described above.

2.3 Maximum Tank Ullage - There is no maximum tank ullage requirement. However, since the required test duration is directly proportional to the amount of tank ullage, it is recommended that the total tank ullage be kept as close as possible to the minimum tank ullage requirement to preclude excessively long tests.

2.4 Condition of the Vapor Recovery System - The complete vapor recovery system must be installed and intact during the test. If the installation includes a Phase II vapor recovery system, all hoses, nozzles, fittings, valves, and other system components must be installed as if the system were to be placed into service. All system components must be free of all visible defects such as torn or punctured bellows, loose or torn faceplates, or defective check valves. Plugging the vapor return plumbing where a leaking vapor recovery nozzle or remote check valve has been discovered is not allowed.

2.5 Restrictions on Gasoline Transfer Operations - Bulk transfers of gasoline into the storage tanks within one hour prior to the test is prohibited. In addition, dispensing of gasoline is not allowed during the test.

3.0 EQUIPMENT

The following equipment will be needed to perform this test. (Refer to the schematic presented in attached Figure 1 for a typical set-up.)

3.1 A bottle of compressed gaseous nitrogen and pressure regulators capable of regulating final downstream pressure to 1.0 pound per square inch gauge (psig) is required. Use assorted valves, fittings, and pressure tubing as necessary. A means of providing a grounding path from the bottle of compressed nitrogen is required. The bottle shall be grounded for safety. It is recommended that the tubing be flexible metal tubing or non-metal tubing that incorporates a grounding path throughout its length. A pressure relief device must also be installed prior to testing. The pressure relief device is installed to prevent accidental over pressurization. The pressure relief device must be adjusted to vent at one pound per square inch gauge (27.7 inches water column gauge).

WARNINGS:

a. Attempting the pressure decay test without a pressure relief device may result in over-pressurizing the system, which may create a hazardous condition and may cause damage to the

underground storage tanks, associated piping, and other system components.

b. The nitrogen bottle must be securely fastened to a large, stationary object at all times. A compressed gas cylinder which falls and is damaged can easily become a lethal projectile.

3.2 An accurate device for measuring pressure, such as a water manometer (preferable) or a Magnehelic gauge (or equivalent), is required to measure the system pressure. This device must be graduated in increments of one tenth (0.1) of an inch of water column pressure.

3.3 A stopwatch accurate to within 1 second.

4.0 TEST PROCEDURE

4.1 Determine the ullage of the underground storage tank (or tanks, if manifolded). Measure the gasoline gallonage in the underground storage tank(s). Calculate the ullage space for the storage tank(s) by subtracting the gasoline gallonage present from the tank capacity(ies). Note the ullage and total tank capacity in the appropriate space of the data log (attached). The actual tank ullage must meet the minimum tank ullage criteria specified in Section 2.2.

4.2 Calculate the required test duration by multiplying the total ullage (in thousand gallons) by 5.0. Note the resulting required test time (in minutes) in the appropriate space on the data log.

4.3 Install the pressure relief device, grounding wire, fittings, tubing, and equipment needed to pressurize and to monitor the system vapor space (see Figure 1). Nitrogen can be introduced into the system through the storage tank vent pipe or through the vapor return piping.

4.4 For manifolded systems, install the pressure relief safety valve, set at one psig (27.7 inches of water), over the opening of one of the storage tank vents and cap the remaining storage tank vents. (Manifolding the vent line is prohibited since this infers with the check of underground vapor manifolds.) For non-manifolded systems, test each product vapor recovery system separately with the pressure relief safety valve installed on the vent of the storage tank being tested. (Alternative setups may be used as long as they do not interfere with the objectives of the test and have prior District approval.)

4.5 Remove the Phase I adapter cap(s) on the vapor return drybreak valve(s) of the underground storage tank(s). The system must pass the pressure

decay/leak test with the drybreak cap(s) removed. It is permissible for the tank fill cap(s) to be in place on the fill adapter(s) during the test.

4.6 With no dispensing taking place, begin pressurizing the vapor system (or subsystem for individual vapor return line systems) to 11 inches water column gauge (wcg). Let the system sit for fifteen minutes to allow vapor pressure stabilization in the tank(s). Check the vent cap assembly(ies), nitrogen connector assembly, nozzles, vapor return adapter(s) and all accessible vapor connections using leak detecting solution to verify that the test equipment is leak tight. If after fifteen minutes, the ullage pressure is still above 10 inches wcg, reduce the system pressure to 10.0 inches wcg. If the ullage pressure is below 10 inches wcg, then again pressurize the vapor system to 10.0 inches wcg.

4.7 With the system pressurized to 10.0 inches wcg, begin the test. Start the stopwatch and note the time at which the test was begun in the appropriate space on the data log.

4.8 Intermediate readings may be taken to monitor the performance of the system, but the final system pressure reading must be taken at the end of the required test duration calculated in step 4.2 and recorded in the appropriate space on the data log. Refer to the test standards specified in Section 5.0 below to determine the acceptability of the final system pressure result.

4.9 While the system is still pressurized, check the integrity of the automatic back pressure relief device on each nozzle connected to the vapor recovery system being tested by pulling on the nozzle's trigger. The back pressure relief device is acceptable if there is no resistance when the nozzle's trigger is pulled. Nozzles with defective back pressure relief devices shall be replaced.

4.10 At the end of the pressure decay test, with the tank(s) still pressurized, complete the following checks:

(a) For systems with vapor manifolded tanks, depress the Phase I vapor drybreak valve of each tank to see if gases are released under pressure. (A tank where gases are not released under pressure is not manifolded to the Phase II vapor piping as required by District rules and State law.)

(b) For non-manifolded systems, depress the drybreak valve of each tank to see if the product in the storage tank matches the product dispensed by the nozzles where checks were made of the back pressure shut-off mechanisms. (This is a check to see if the underground vapor piping is crossed and goes to the wrong storage tanks. If crossed piping is indicated, verify by sending five gallons of liquid down the Phase II piping while a second person listens for

splashing at the tank with the drybreak open. See test procedure TP-91-2-Liquid Blockage Test/)

(c) Remove the caps of the fill risers of the storage tanks. If it appears that any gasket is damaged or missing, it must be replaced and the fill adapter tightened.

4.11 If the system failed to meet the criteria for passage set forth in Section 5.0, repressurize the system and check all accessible vapor connections using leak detecting solution. If vapor leaks in the system are encountered, repair or replace the defective component(s) and repeat the pressure decay test (steps 4.6 through 4.8). (Note: **applicants and contractors are advised to do a pre-test before the District witnesses compliance tests. Repairs that keep the District inspector waiting or that result in scheduling a re-test may result in substantial reinspection fees.**)

4.12 Depressurize the system by carefully removing the vent cap assembly(ies). Allow any remaining pressure to be relieved through the vent pipe(s).

4.13 If the vapor recovery system utilizes individual vapor return lines for each gasoline product or each underground storage tank, repeat the entire pressure decay/leak test for each vapor return system (steps 4.1 through 4.12).

5.0 TEST STANDARDS

The minimum allowable pressure decay time from 10.0 to 9.0 inches wcg shall be 5.0 minutes per 1000 gallons ullage.

This means that from an initial pressure of 10.0 inches wcg, if the system pressure reading at the end of the required test duration, as calculated using the methodology specified in Section 4.2, is less than 9.0 inches wcg, the system fails.

6.0 REPORTING REQUIREMENTS

For those sites having Authorities to Construct requiring this or any other District tests, documentation of the required testings must be submitted to the District before a Permit to Operate will be issued. It is the ultimate responsibility of the applicant to make sure that the necessary documentation is submitted to the District; however, the District will accept test documentation directly from the contractor performing the tests. When a District observer is present and NCR forms are used, the observer will take the original of the form with him/her back to the office.

PRESSURIZATION APPARATUS

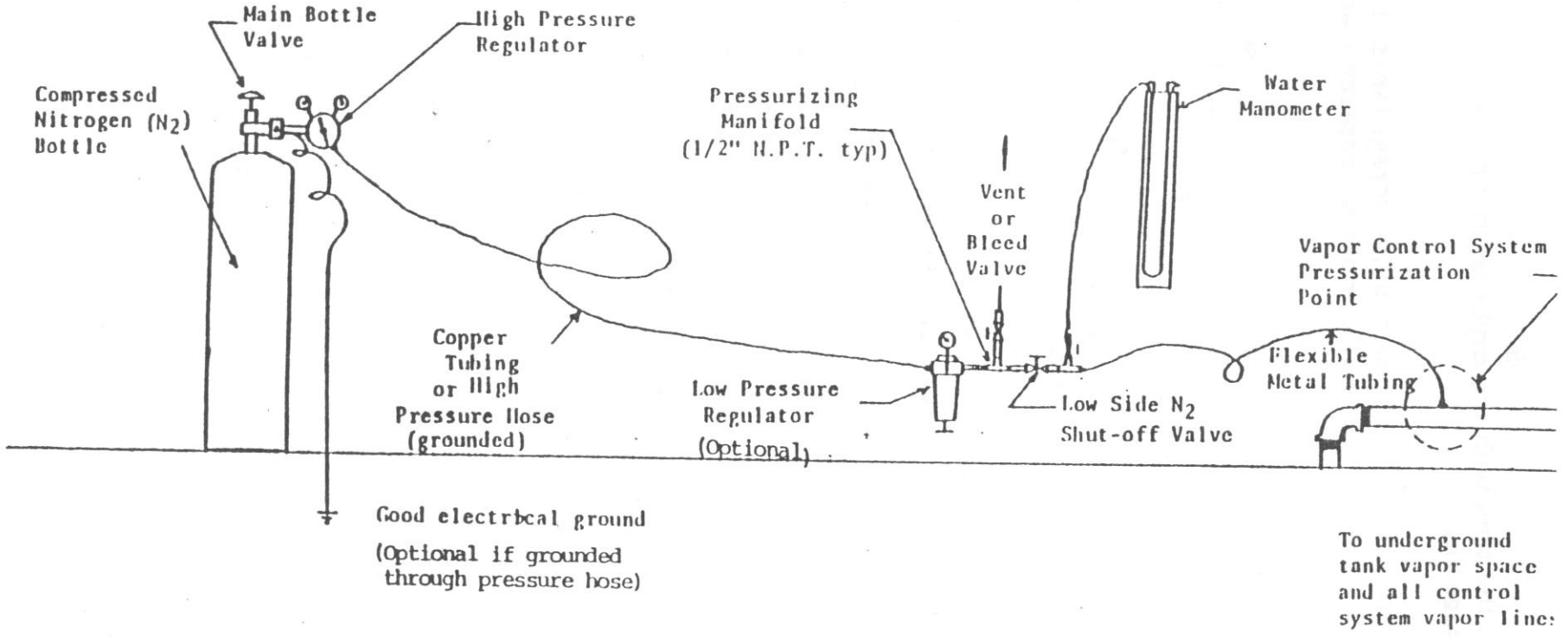


Figure 1

PRESSURE DECAY LOG

Site DBA: _____ Test Date: _____

Address: _____ APCD Observer: _____

_____ Test Conductor: _____

Test Contractor: _____ Office Phone No: _____

Tank Capacity (total, if manifolded): _____ gallons

Product(s): _____

Tank Ullage (total, if manifolded): _____ gallons

$\frac{\text{Ullage Volume*}}{\text{Total Volume}}$ _____ X 100 = _____ %

*The ullage (vapor space) in each tank being tested must be at least 10% of the tank's capacity, but in no case less than 300 gallons per tank.

Pressure Decay Test Criteria:

Test Duration = (5.0 minutes/1000 gallons ullage) x _____ thousand gallon ullage

= _____ minutes**

**The pressure decay test is failed if the final pressure at the end of the test duration, as calculated above, is less than 9.0" wcg.

Time of Day	Elapsed Time From Start of Test	System Pressure ("wcg)
	0 minute	10.0
	_____ minutes**	

White - APCD Yellow - Contractor Pink - Applicant