California Environmental Protection Agency

Air Resources Board

Vapor Recovery Test Procedure

TP - 201.2B

Flow and Pressure Measurement of Vapor Recovery Equipment

Adopted: April 12, 1996
Amended: February 1, 2001
Amended: October 8, 2003

California Environmental Protection Agency
Air Resources Board

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TP-201.2B

Flow and Pressure Measurement of Vapor Recovery Equipment

A set of definitions common to all certification and test procedures is in:

D-200 Definitions for Vapor Recovery Procedures

For the purpose of this procedure, the term "ARB" or “CARB” refers to the 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.

1. APPLICABILITY AND PURPOSE

This procedure applies to the determination of flow and pressure measurements for vapor recovery equipment installed at dispensing facilities. The purpose of the measurements is to determine compliance with performance standards specified in CP-201 and Executive Order.

2. PRINCIPLE AND SUMMARY OF TEST PROCEDURE

Flow and pressure measurements are based upon simultaneously collected data for flow, pressure, and time.

The data are collected from representative equipment used in vapor recovery systems at dispensing facilities. The data are reduced to yield the correlations.

For vapor recovery equipment used in dispensing facilities, the measurements can be used:

(1) to establish performance specifications during certification,

(2) to determine compliance with performance standards of CP-201,

(3) to determine compliance with performance standards and performance specifications listed in the Executive Order,

(4) for quality assurance and quality control of manufactured equipment.

Figures 1 through 3 are provided to illustrate some aspects of the principle and summary provided below. Figures are at the end of this document.

3. BIASES AND INTERFERENCES

Equipment tested for certification must be representative of the equipment used in actual installations of systems.

4. SENSITIVITY, RANGE, AND PRECISION

4.1 Sensitivity

4.1.1 Inclined Liquid Manometers and Electronic Pressure Meters

Maximum incremental graduations at, above, and below a pressure observation shall be 0.01 inches water column ("WC).

Each such graduation shall be defined as the resolution, P_{Res}, of a pressure observation.

The maximum bias shall be plus-or-minus one-half percent (0.5%) of full-scale.

4.1.2 Mechanical Spring Diaphragm Pressure Gauges

The minimum diameter of the pressure gauge face shall be 4 inches.

Maximum incremental graduations at, above, and below a pressure observation shall be 0.05 "WC.

Each such graduation shall be defined as the resolution, P_{Res}, of a pressure observation.

The maximum bias shall be plus-or-minus two percent (2%) of full-scale.

4.1.3 Volume Flow Meters

Maximum incremental graduations at, above, and below a volume flow observation shall be:

(1) 0.01 mL/min for 0.10 to 9.99 mL/min,
(2) 0.1 mL/min for 10.0 to 99.9 mL/min, and
(3) 1 mL/min for 100 to 999 mL/min.

Each such graduation shall be defined as the resolution, Q_{Res}, of a volume flow observation.

The maximum bias shall be plus-or-minus two percent (±2%) of full-scale.

4.2 Range

4.2.1 Pressure

The pressure specifications referenced in CP-201 are for +2.00 "WC to -8.00 "WC inches water column.

The range for the pressure meter shall be the range which includes the pressure specification, e.g.:

(1) for +2.00 "WC, the range shall be 0.00 to +10.00 "WC; and

(2) for -8.00 "WC, the range shall be 0.00 to -10.00 "WC.

4.2.2 Volume Flow

The volume flow specifications referenced in CP-201 are between 0.035 and 0.17 cubic feet per hour (CFH). These specifications correspond to 17.9 and 80.2 milliliters per minute (mL/min).

The range for the volume flow meter shall be the range which includes the volume flow specification.

4.3 Precision

4.3.1 Pressure

The precision of a pressure observation shall affect the compliance status of a system as described below, where:

$P_{req@Q}$ = pressure requirement, at a specified volume flow, per the appropriate certification procedure, rounded to the nearest integral multiple of P_{Res},

and

$P_{Obs@Q}$ = pressure observation, at the specified volume flow.

The precision for a pressure observation shall be one-half of P_{Res}.

$P_{obs@Q}$ shall be an integral multiple of P_{Res}.

Non-Compliance with a pressure requirement shall be determined when, at a specified volume flow:

$$P_{Req@Q} - P_{Obs@Q} \geq P_{Res}.$$

4.3.2 Volume Flow

The precision of a volume flow observation shall affect the compliance status of a system as described below, where:

$Q_{Req@P}$ = volume flow requirement, at a specified pressure, per the appropriate certification procedure, rounded to the nearest integral multiple of the resolution of Q_{Res},

and

$Q_{Obs@P}$ = volume flow observation, at the specified pressure.

The precision for a volume flow observation shall be one-half of Q_{Res}.

$Q_{obs@P}$ shall be an integral multiple of Q_{Res}.

Non-Compliance with a volume flow requirement shall be determined when, at a specified pressure:

$$Q_{Req@P} - Q_{Obs@P} \geq Q_{Res}.$$

5. EQUIPMENT

5.1 Pressure Meters

At least two types of pressure meters can meet the specifications of section 4:

(1) inclined liquid manometers and

(2) electronic pressure meters using pressure transducers.

5.2 Volume Meters

At least four types of volume flow meters can meet the specifications of section 4:

(1) meters using soap bubbles,

(2) meters using small calibrated pistons,

(3) meters using hot wire sensors, and

(4) meters using acoustic displacement techniques.

5.3 Nitrogen

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

5.4 Pressurized Ballast Tank

A large pressurized ballast tank is required to smooth out any pressure surges from the nitrogen tank and regulator.

6. CALIBRATION PROCEDURE

Follow manufacturers instructions.

7. PRE-TEST PROTOCOL

Establish that equipment tested for certification is representative of the equipment used in actual installations of systems.

8. TEST PROCEDURE

Figure 1 shows examples of locations within the system of equipment to be tested.

Figure 2 shows examples of equipment to be tested, depending upon the application of the certification procedure.

Figure 3 shows an example of a test bench prepared for testing a vapor return valve in a nozzle.

8.1 Steady Flow versus Pressure

(1) Assemble the test equipment as shown in Figure 3, but without connecting the test item yet.

(a) Use volumetric flow and pressure meter ranges as required in the procedure which applies to the test item.

(b) Cap the connection for the test item with a leak-tight seal.

(2) Leak-check the test equipment.

(a) Visually and manually check all fittings for proper assembly.

(b) Slowly establish a stable gauge pressure at twice the maximum required in the procedure which applies to the test item.

(c) Check for leaks by applying soap solution around all fittings and by observing the pressure meter.

(d) If soap bubbles grow around fittings or if the pressure changes by more than 0.1 "WC after stabilizing, then repeat (a) through (d); it may be necessary to provide an isothermal environment for the pressurized ballast tank, too.

(3) Connect the test item with a leak-tight connector as shown in Figure 3.

(4) Slowly establish a stable gauge pressure at the gauge pressure level required in the procedure which applies to the test item.

(5) Measure the flow with the flow meter.

8.2 Transition Flow versus Pressure

Transition flow refers to the flow rate at which a transition occurs in the slope of the plot of flow rate versus pressure for a valve tested. Compliance with a performance specification for transition flow versus pressure must be demonstrated both for opening and closing, as follows:

8.2.1 Opening Transition Pressure

(1) Assemble the test equipment as shown in Figure 3, but without connecting the test item yet.

(a) Use volumetric flow and pressure meter ranges as required in the procedure which applies to the test item.

(b) Cap the connection for the test item with a leak-tight seal.

(2) Leak-check the test equipment.

(a) Visually and manually check all fittings for proper assembly.

(b) Slowly establish a stable gauge pressure at twice the maximum required in the procedure which applies to the test item.

(c) Check for leaks by applying soap solution around all fittings and by observing the pressure meter.

(d) If soap bubbles grow around fittings or if the pressure changes by more than 0.1 "WC after stabilizing, then repeat (a) through (d); it may be necessary to provide an isothermal environment for the pressurized ballast tank, too.

(3) Connect the test item with a leak-tight connector as shown in Figure 3.

(4) Slowly establish a stable gauge pressure at 75% of the gauge pressure level required in the procedure which applies to the test item.

(5) Slowly raise the gauge pressure to 125% of the gauge pressure level required in the procedure which applies to the test item.

(6) At 5% intervals of gauge pressure, measure and record the gauge pressure in and the flow rate through the test item.

(7) Plot the flow versus pressure and determine the opening transition flow rate.

8.2.2 Closing Transition Pressure

(1) Assemble the test equipment as shown in Figure 3, but without connecting the test item yet.

(a) Use volumetric flow and pressure meter ranges as required in the procedure which applies to the test item.

(b) Cap the connection for the test item with a leak-tight seal.

(2) Leak-check the test equipment.

(a) Visually and manually check all fittings for proper assembly.

(b) Slowly establish a stable gauge pressure at twice the maximum required in the procedure which applies to the test item.

(c) Check for leaks by applying soap solution around all fittings and by observing the pressure meter.

(d) If soap bubbles grow around fittings or if the pressure changes by more than 0.1 "WC after stabilizing, then repeat (a) through (d); it may be necessary to provide an isothermal environment for the pressurized ballast tank, too.

(3) Connect the test item with a leak-tight connector as shown in Figure 3.

(4) Slowly establish a stable gauge pressure at 125% of the gauge pressure level required in the procedure which applies to the test item.

(5) Slowly lower the gauge pressure to 75% of the gauge pressure level required in the procedure which applies to the test item.

(6) At 5% intervals of gauge pressure, measure and record the gauge pressure in and the flow rate through the test item.

(7) Plot the flow versus pressure and determine the closing transition flow rate.

9. QUALITY ASSURANCE / QUALITY CONTROL (QA/QC)

This section is reserved for future specification.

10. RECORDING DATA

This section is reserved for future specification.

11. CALCULATING RESULTS

12. REPORTING RESULTS

This section is reserved for future specification.

13. ALTERNATIVE TEST PROCEDURES

This procedure shall be conducted as specified. Any modifications to this test procedure shall not be used unless prior written approval has been obtained from the ARB Executive Officer pursuant to section 14 of Certification Procedure CP-201.

14. REFERENCES

This section is reserved for future specification.

15. EXAMPLE FIGURES AND FORMS

15.1 Figures

Each figure 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 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
Examples of Locations of Equipment to Be Tested

Figure 2
Examples of Equipment to Be Tested

Figure 3
Example of a Bench Test

15.2 Forms

This section is reserved for future specification.

Figure 1

Examples of Locations of Equipment to be Tested

1F "closed" idle nozzle check valves
2F "closed" overfill drain valves
3F "closed" vent valves

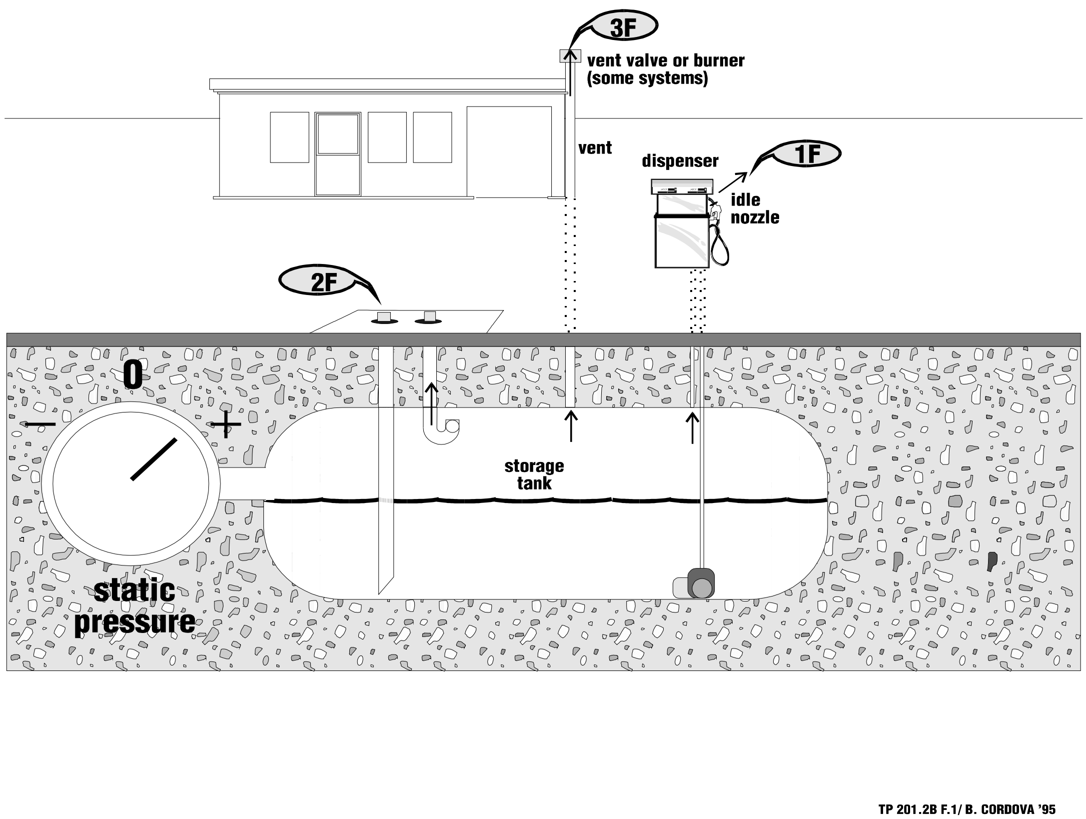


FIGURE 2

Examples of Equipment to be Tested

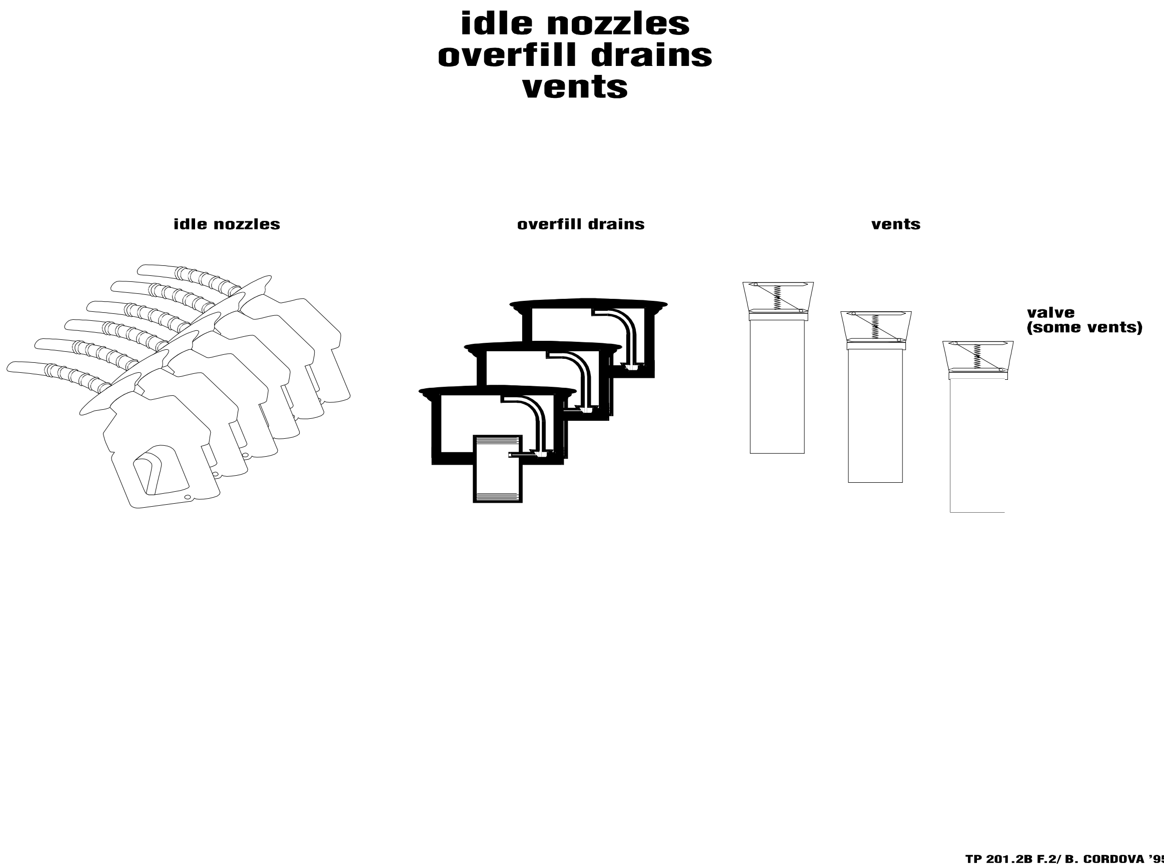
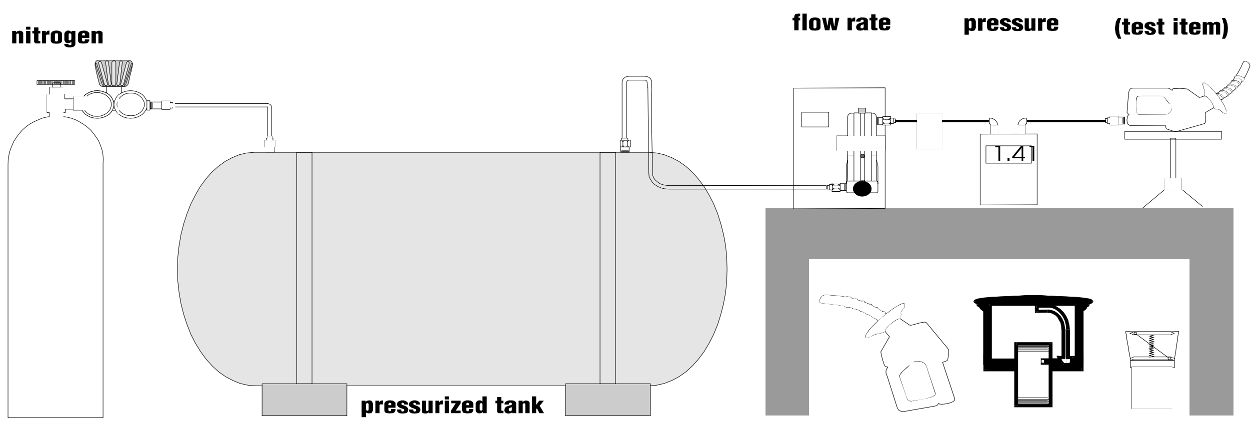


FIGURE 3

Example of a Bench Test



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California Environmental Protection Agency

Air Resources Board

Vapor Recovery Test Procedure

TP-201.3

Determination of 2 Inch WC Static Pressure Performance of Vapor Recovery Systems of Dispensing Facilities

Adopted: April 12, 1996
Amended: March 17, 1999

California Environmental Protection Agency
Air Resources Board
Vapor Recovery Test Procedure

TP-201.3

Determination of 2 Inch WC Static Pressure Performance of Vapor Recovery Systems of Dispensing Facilities

1 APPLICABILITY

Definitions common to all certification and test procedures are in:

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

For the purpose of this procedure, the term "ARB" 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.

1.1 This test procedure is used to quantify the vapor tightness of vapor recovery systems installed at gasoline dispensing facilities (GDF) equipped with pressure/vacuum (P/V) valves, provided that the designed pressure setting of the P/V valves is a minimum of 2.5 inches of water column (inches H_2O).

1.2 Systems equipped with a P/V valve(s) allowed to have a designed cracking pressure less than 2.5 inches H_2O shall be bagged to eliminate any flow contribution through the valve assembly from the test results. The valve/vent pipe connection, however, shall remain unobstructed during this test.

1.3 At facilities not required to be equipped with a P/V valve(s), the vent pipe(s) shall be capped. For those installations, the test may be conducted at the vent pipe(s).

2 PRINCIPLE AND SUMMARY OF TEST PROCEDURE

2.1 The entire vapor recovery system is pressurized with nitrogen to two (2.0) inches H_2O. The system pressure is then allowed to decay and the pressure after five (5) minutes is compared with an allowable value. The minimum allowable five-minute final pressure is based on the system ullage and pressure decay equations. For the purpose of compliance determination, this test shall be conducted after all back-filling, paving, and installation of all Phase I and Phase II components, including P/V valves, has been completed.

2.2 For GDF equipped with a coaxial Phase I system, this test shall be conducted at a Phase II vapor riser. For GDF which utilize a two-point Phase I system, this test may be conducted at either a Phase II riser or a Phase I vapor coupler provided that the criteria set forth in Section 6.7 have been met. If the integrity criteria for two-point systems specified in Section 6.7 are met, it is recommended that this test be conducted at the Phase I vapor coupler.

3 RANGE

3.1 If mechanical pressure gauges are employed, the full-scale range of pressure gauges shall be 0-2.0, 0-1.0, and 0-0.50 inches H_2O column. Maximum incremental graduations of the pressure gauge shall be 0.05 inches H_2O and the minimum accuracy of the gauge shall be three percent of full scale. The minimum diameter of the pressure gauge face shall be 4 inches.

3.2 If an electronic pressure measuring device is used, the full-scale range of the device shall not exceed 0-10 inches H_2O with a minimum accuracy of 0.5 percent of full-scale. A 0-20 inches H_2O device may be used, provided the equivalent accuracy is not less than 0.25 percent of full-scale.

3.3 The minimum total ullage, for each individual tank, shall be 1,000 gallons or 25% of the tank capacity, whichever is less. The maximum total ullage, for all manifolded tanks, shall not exceed 25,000 gallons. These values are exclusive of all vapor piping volumes.

3.4 The minimum and maximum nitrogen feed-rates, into the system, shall be one (1) and five (5) CFM, respectively.

4 INTERFERENCES

4.1 Introduction of nitrogen into the system at flowrates exceeding five (5) CFM may bias the results of the test toward non-compliance. Only gaseous nitrogen shall be used to conduct this test. Air, liquefied nitrogen, helium, or any gas other than nitrogen shall not be used for this test procedure.

4.2 For vacuum-assist Phase II systems which utilize an incinerator, power to the collection unit and the processor shall be turned off during testing.

4.3 For vacuum-assist systems, with positive displacement vacuum pumps, which locate the vacuum producing device in-line between the Phase II vapor riser and the storage tank, the following requirements shall apply:

4.3.1 A valve shall be installed at the vacuum producing device. When closed, this valve shall isolate the vapor passage downstream of the vacuum producing device.

4.3.2 The storage tank side of the vacuum producing device shall be tested in accordance with the procedures outlined in Section 7 of this method. Compliance shall be determined by comparing the final five-minute pressure with the allowable minimum five-minute final pressure from the first column (1-6 affected nozzles) in Table IB or use the corresponding equation in Section 9.2.

4.3.3 The upstream vapor passage (nozzle to vacuum producing device) shall also be tested. Methodology for this test shall be submitted to the California Air Resources Board (CARB) for approval prior to submission of test results or shall be conducted in accordance with the procedures set forth in the applicable CARB Executive Order.

4.4 The results of this static pressure integrity test shall not be used to verify compliance if an Air to Liquid Volumetric Ratio Test (TP-201.5 or equivalent) was conducted within 24 hours prior to this test.

4.5 Thermal Bias for Electronic Manometers

Electronic manometers shall have a warm-up period of at least 15 minutes followed by a five minute drift check. If the drift exceeds 0.01 inches water column, the instrument should not be used.

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 Measuring Device

Use 0-2.0, 0-1.0, and 0-0.50 inches H_2O pressure gauges connected in parallel, a 0-2 inches H_2O manometer, or an electronic pressure measuring device to monitor the pressure decay in the vapor recovery system. The pressure measuring device shall, at a minimum, be readable to the nearest 0.05 inches H_2O.

5.3 “T” Connector Assembly

See Figure 1 for example.

5.4 Vapor Coupler Integrity Assembly

Assemble OPW 633-A, 633-B, and 634-A adapters, or equivalent, as shown in Figure 2. If the test is to be conducted at the storage tank Phase I vapor coupler, this assembly shall be used prior to conducting the static leak test in order to verify the pressure integrity of the vapor poppet. The internal volume of this assembly shall not exceed 0.1 cubic feet.

5.5 Vapor Coupler Test Assembly

Use a compatible OPW 634-B cap, or equivalent, equipped with a center probe to open the poppet, a pressure measuring device to monitor the pressure decay, and a connection for the introduction of nitrogen into the system. See Figure 3 for an example.

5.6 Stopwatch

Use a stopwatch accurate to within 0.2 seconds.

5.7 Flow Meter

Use a Dwyer flowmeter, Model RMC-104, or equivalent, to determine the required pressure setting of the delivery pressure gauge on the nitrogen supply pressure regulator. This pressure shall be set such that the nitrogen flowrate is between 1.0 and 5.0 CFM.

5.8 Combustible Gas Detector

A Bacharach Instrument Company, Model 0023-7356, or equivalent, may be used to verify the pressure integrity of system components during this test.

5.9 Leak Detection Solution

Any liquid solution designed to detect vapor leaks may be used to verify the pressure integrity of system components during this test.

6 PRE-TEST PROCEDURES

6.1 The following safety precautions shall be followed:

6.1.1 Only nitrogen shall be used to pressurize the system.

6.1.2 A one psig relief valve shall be installed to prevent the possible over-pressurizing of the storage tank.

6.1.3 A ground strap should be employed during the introduction of nitrogen into the system.

6.2 Failure to adhere to any or all of the following time and activity restrictions shall invalidate the test results:

6.2.1 There shall be no Phase I bulk product deliveries into or out of the storage tank(s) within the three (3) hours prior to the test or during performance of this test procedure.

6.2.2 There shall be no product dispensing within thirty (30) minutes prior to the test or during performance of this test procedure.

6.2.3 Upon commencement of the thirty minute “no dispensing” portion of this procedure, the headspace pressure in the tank shall be measured. If the pressure exceeds 0.50 inches H_2O, the pressure shall be carefully relieved in accordance with all applicable safety requirements. After the thirty minute “no dispensing” portion of this procedure, and prior to introduction of nitrogen, the headspace pressure shall again be lowered, if necessary, to less than 0.50 inches H_2O.

6.2.4 There shall be no Air to Liquid Volumetric Ratio Test (TP-201.5 or equivalent) conducted within the twenty-four (24) hour period immediately prior to this test.

6.2.5 The test shall be conducted with the station in normal operating mode. This includes all nozzles properly hung up in the dispenser boots and all dispenser cabinet covers in place. The exception to normal operating mode is that dispensing is disallowed as specified.

6.3 Measure the gallons of gasoline present in each underground storage tank and determine the actual capacity of each storage tank from facility records. Calculate the ullage space for each tank by subtracting the gasoline gallonage present from the actual tank capacity. The minimum ullage during the test, for all manifolded tanks, shall be 1,000 gallons or 25 percent of the tank capacity, whichever is less. The total ullage, for all manifolded tanks, shall not exceed 25,000 gallons.

6.4 For two-point Phase I systems, this test shall be conducted with the dust cap removed from both the product and the vapor coupler. This is necessary to determine the vapor tightness of the Phase I vapor poppet. See Section 6.7 if this test is to be conducted at the Phase I vapor coupler.

6.4.1 For coaxial Phase I systems, this test shall be conducted with the dust cap removed from the Phase I coupler. This is necessary to insure the vapor tightness of the Phase I vapor poppet.

6.4.2 Verify that the liquid level in the storage tank is at least four (4) inches above the highest opening at the bottom of the submerged drop tube.

6.5 If the Phase I containment box is equipped with a drain valve, this test shall be conducted with the drain valve installed and the manhole cover removed. If the drain valve is cover-actuated, the test shall be done once with the cover removed and repeated with the cover installed.

6.6 If the test is to conducted at a Phase II vapor riser, disconnect the dispenser end of one vapor recovery hose and install the "T" connector assembly (see Figure 1). Connect the nitrogen gas supply (do not use air) and the pressure measuring device to the "T" connector.

6.6.1 For those Phase II vapor systems utilizing a dispenser mounted remote vapor check valve, the "T" connector assembly shall be installed on the vapor riser side of the check valve.

6.7 If this test is to be conducted at the Phase I vapor coupler on a two-point Phase I system, the procedures set forth in subsections 6.7.1 and 6.7.2 shall be successfully completed prior to testing. The static pressure integrity test shall not be conducted at the Phase I coupler at facilities equipped with coaxial Phase I systems.

6.7.1 Connect the Vapor Coupler Integrity Assembly to the Phase I vapor coupler. Connect the Vapor Coupler Test Assembly. Connect the nitrogen supply to the assembly and carefully pressurize the internal volume of the assembly to two (2.0) inches H_2O. Start the stopwatch. Record the final pressure after one minute.

6.7.2 If the pressure after one minute is less than 0.25 inches H_2O, the leak rate through the Phase I vapor poppet precludes conducting the static leak test at this location. If the pressure after one minute is greater than or equal to 0.25 inches H_2O, the static leak test may be conducted at this location. This criteria assures a maximum leak rate through the Phase I vapor poppet of less than 0.0004 cubic feet per minute.

6.7.3 Disconnect the Vapor Coupler Integrity Assembly to the Phase I vapor coupler. If the requirements of subsection 6.7.2 were met, connect the Vapor Coupler Test Assembly to the Phase I vapor coupler.

6.7.4 Product may be poured onto the Phase I vapor coupler to check for leaks. This diagnostic procedure shall not be substituted for the procedures set forth in subsections 6.7.1 and 6.7.2.

6.8 All pressure measuring device(s) shall be bench calibrated using either a reference gauge or incline manometer. Calibration shall be performed at 20, 50, and 80 percent of full scale. Accuracy shall be within two percent at each of these calibration points. Calibrations shall be conducted on a frequency not to exceed 90 days.

6.9 Use the flowmeter to determine the nitrogen regulator delivery pressures which correspond to nitrogen flowrates of 1.0 and 5.0 CFM. These pressures define the allowable range of delivery pressures acceptable for this test procedure. Also record the regulator delivery pressure setting, and the corresponding nitrogen flowrate that will be used during the test. As an alternative, the flowmeter may be connected, in-line between the nitrogen supply regulator and Vapor Coupler Test Assembly, during the test.

6.10 Use Equation 9.3 to calculate the approximate time required to pressurize the system ullage to the initial starting pressure of two (2.0) inches H_2O. This will allow the tester to minimize the quantity of nitrogen introduced into those systems which cannot comply with the static leak standards.

6.11 Attach the Vapor Coupler Test assembly to the Phase I poppet or the “T” connector assembly to the Phase II vapor riser. Read the initial pressure of the storage tank and underground piping. If the initial pressure is greater than 0.5 inches H_2O, carefully bleed off the pressure, in accordance with all applicable safety procedures, in the storage tank and underground piping to less than 0.5 inches H_2O column.

6.12 Any electronic manometers shall be subject to warm-up and drift check before use; see Section 4.5.

7 TESTING

7.1 Open the nitrogen gas supply valve and set the regulator delivery pressure within the allowable range determined in Section 6.9, and start the stopwatch. Pressurize the vapor system (or subsystem for individual vapor return line systems) to **at least 2.2 inches H_2O** initial pressure. It is critical to maintain the nitrogen flow until the pressure stabilizes, indicating temperature and vapor pressure stabilization in the tanks. Check the test equipment using leak detecting solution or a combustible gas detector to verify that all test equipment is leak tight. Note: if a combustible gas detector is used to search for leaks, components which were certified with an allowable leak rate, such as 0.38 CFH at a pressure of two (2) inches, cannot be determined to be faulty solely on the basis of the concentration registered on the instrument.

7.1.1 If the time required to achieve the initial pressure of two (2.0) inches H_2O exceeds twice the time derived from Equation 9.3, stop the test and use liquid leak detector, or a combustible gas detector, to find leak(s) in the system. Failure to achieve the initial starting pressure within twice the time derived from Equation 9.3 demonstrates the inability of the system to meet the performance criteria. Repair or replace the faulty component(s) and restart the test pursuant to Section 7.1.

7.2 Close and disconnect the nitrogen supply. Start the stopwatch when the pressure has decreased to the initial starting pressure of two (2.0) inches H_2O.

7.3 At one-minute intervals during the test, record the system pressure. After five minutes, record the final system pressure. See the applicable of Tables 1A (or Equation 9.1) or 1B (or equation 9.2) to determine the acceptability of the final system static pressure results. For intermediate values of ullage in Tables 1A and 1B, linear interpolation may be employed.

7.4 If the system failed to meet the criteria set forth in Table 1A or 1B (or the appropriate equation in Section 9), 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. Potential sources of leaks include nozzle check valves, nozzle vapor paths, pressure/vacuum relief valves, containment box drain valve assemblies, and plumbing connections at the risers.

7.4.1 If the facility fails to comply with the static leak test standards and the two point Phase I system utilizes overfill prevention devices in the drop tubes which were installed before July 1, 1993, and which are unable to pass the test with the dust caps removed from the product and vapor couplers (see Sec. 6.4), the test may be conducted with the caps on the couplers, as an exception.

This exception is not intended to allow bleed holes in drop tubes.

This exception expires on January 1, 2002, after which date all testing shall be conducted with the fill and vapor caps removed from two point systems. Under no circumstances may the test be conducted with the caps on coaxial Phase I couplers.

7.5 After the remaining system pressure has been relieved, remove the “T” connector assembly and reconnect the vapor recovery hose, if applicable.

7.6 If the vapor recovery system utilizes individual vapor return lines, repeat the leak test for each gasoline grade. Avoid leaving any vapor return line open longer than is necessary to install or remove the “T” connector assembly.

7.7 If the applicable CARB Executive Order requires the test to be conducted with and without the containment box cover in place, repeat the test with the cover in place. In these cases clearly specify, on Form 1, which results represent the pressure integrity with and without the cover in place.

8 POST-TEST PROCEDURES

8.1 Use the applicable of Table 1A or 1B, or the applicable of Equations 9.1 or 9.2, to determine the compliance status of the facility by comparing the final five-minute pressure with the minimum allowable final pressure.

8.1.1 For balance Phase II systems use Table 1A or the applicable of Equation 9.1 to determine compliance.

8.1.2 For vacuum-assist Phase II systems use Table 1B or the applicable of Equation 9.2 to determine compliance.

9 CALCULATIONS

9.1 For Phase II Balance Systems, the minimum allowable five-minute final pressure, with an initial pressure of two (2.0) inches H_2O, shall be calculated as follows:

$$P_f = 2e^{\left(\frac{-760.490}{V}\right)} \quad \text{if } N = 1\text{-}6 \qquad \text{[Equation 9-1]}$$

$$P_f = 2e^{\left(\frac{-792.196}{V}\right)} \quad \text{if } N = 7\text{-}12$$

$$P_f = 2e^{\left(\frac{-824.023}{V}\right)} \quad \text{if } N = 13\text{-}18$$

$$P_f = 2e^{\left(\frac{-855.974}{V}\right)} \quad \text{if } N = 19\text{-}24$$

$$P_f = 2e^{\left(\frac{-888.047}{V}\right)} \quad \text{if } N > 24$$

where:

N = The number of affected nozzles. For manifolded systems, N equals the total number of nozzles. For dedicated plumbing configurations, N equals the number of nozzles serviced by the tank being tested.

P_f = The minimum allowable five-minute pressure, inches H_2O

V = The total ullage affected by the test, gallons

e = A dimensionless constant approximately equal to 2.718

2 = The initial starting pressure, inches H_2O

9.2 For Phase II Vacuum Assist Systems, the minimum allowable five-minute final pressure, with an initial pressure of two (2.0) inches H_2O, shall be calculated as follows:

$$P_f = 2e^{\left(\frac{-500.887}{V}\right)} \quad \text{if } N = 1\text{-}6$$ [Equation 9-2]

$$P_f = 2e^{\left(\frac{-531.614}{V}\right)} \quad \text{if } N = 7\text{-}12$$

$$P_f = 2e^{\left(\frac{-562.455}{V}\right)} \quad \text{if } N = 13\text{-}18$$

$$P_f = 2e^{\left(\frac{-593.412}{V}\right)} \quad \text{if } N = 19\text{-}24$$

$$P_f = 2e^{\left(\frac{-624.483}{V}\right)} \quad \text{if } N > 24$$

where:

N = The number of affected nozzles. For manifolded systems, N equals the number of nozzles. For dedicated plumbing configurations, N equals the number of nozzles serviced by the tank being tested.

P_f = The minimum allowable five-minute final pressure, inches H_2O

V = The total ullage affected by the test, gallons

e = A dimensionless constant approximately equal to 2.718

2 = The initial starting pressure, inches H_2O

9.3 The minimum time required to pressurize the system ullage from zero (0) to two (2.0) inches H_2O gauge pressure shall be calculated as follows:

$$t_2 = \frac{V}{(1980)F}$$ [Equation 9-3]

where:

t_2 = The minimum time to pressurize the ullage to two inches H_2O, minutes

V = The total ullage affected by the test, gallons

F = The nitrogen flowrate into the system, CFM

1980 = The conversion factor for pressure and gallons

9.4 If the policy of the local District requires an allowable tolerance for testing error, the minimum allowable five-minute final pressure, including testing error, shall be calculated as follows:

$$P_{f\text{-}E} = 2 - \left[1 + \left(\frac{E}{100}\right)\right]\left[408.9 - \left(P_f + 406.9\right)\right] \qquad \text{[Equation 9-4]}$$

where:

$P_{f\text{-}E}$ = The minimum allowable five-minute final pressure including allowable testing error, inches H_2O

E = The allowable testing error, percent

P_f = The minimum allowable five-minute final pressure calculated in Equations 9-1 or 9-2, inches H_2O

2 = The initial starting pressure, inches H_2O

408.9 = Atmospheric pressure plus the initial starting pressure, inches H_2O

406.9 = Atmospheric pressure, inches H_2O

10 REPORTING

10.1 The calculated ullage and system pressures for each five-minute vapor recovery system test shall be reported as shown in Form 1. Be sure to include the Phase I system type (two-point or coaxial), the Phase II system type, whether the system is manifolded, and the one-minute pressures during the test.

TABLE 1A

PHASE II **BALANCE** SYSTEMS

PRESSURE DECAY CRITERIA

INITIAL PRESSURE OF 2 INCHES WATER COLUMN (WC)

MINIMUM PRESSURE AFTER 5 MINUTES, INCHES WC

ULLAGE, GALLONS	**NUMBER OF AFFECTED NOZZLES**				
	01-06	**07-12**	**13-18**	**19-24**	**>24**
500	**0.44**	**0.41**	**0.38**	**0.36**	**0.34**
550	0.50	0.47	0.45	0.42	0.40
600	**0.56**	**0.53**	**0.51**	**0.48**	**0.46**
650	0.62	0.59	0.56	0.54	0.51
700	**0.67**	**0.64**	**0.62**	**0.59**	**0.56**
750	0.73	0.70	0.67	0.64	0.61
800	**0.77**	**0.74**	**0.71**	**0.69**	**0.66**
850	0.82	0.79	0.76	0.73	0.70
900	**0.86**	**0.83**	**0.80**	**0.77**	**0.75**
950	0.90	0.87	0.84	0.81	0.79
1,000	**0.93**	**0.91**	**0.88**	**0.85**	**0.82**
1,200	1.06	1.03	1.01	0.98	0.95
1,400	**1.16**	**1.14**	**1.11**	**1.09**	**1.06**
1,600	1.24	1.22	1.19	1.17	1.15
1,800	**1.31**	**1.29**	**1.27**	**1.24**	**1.22**
2,000	1.37	1.35	1.32	1.30	1.28
2,200	**1.42**	**1.40**	**1.38**	**1.36**	**1.34**
2,400	1.46	1.44	1.42	1.40	1.38
2,600	**1.49**	**1.47**	**1.46**	**1.44**	**1.42**
2,800	1.52	1.51	1.49	1.47	1.46
3,000	**1.55**	**1.54**	**1.52**	**1.50**	**1.49**
3,500	1.61	1.59	1.58	1.57	1.55
4,000	**1.65**	**1.64**	**1.63**	**1.61**	**1.60**
4,500	1.69	1.68	1.67	1.65	1.64
5,000	**1.72**	**1.71**	**1.70**	**1.69**	**1.67**
6,000	1.76	1.75	1.74	1.73	1.72
7,000	**1.79**	**1.79**	**1.78**	**1.77**	**1.76**
8,000	1.82	1.81	1.80	1.80	1.79
9,000	**1.84**	**1.83**	**1.83**	**1.82**	**1.81**
10,000	1.85	1.85	1.84	1.84	1.83
15,000	**1.90**	**1.90**	**1.89**	**1.89**	**1.89**
20,000	1.93	1.91	1.92	1.92	1.91
25,000	**1.94**	**1.94**	**1.94**	**1.93**	**1.93**

Note: For manifolded Phase II Balance Systems, the **"Number of Affected Nozzles"** shall be the total of all gasoline nozzles. For dedicated return configurations, the **"Number of Affected Nozzles"** shall be the total of those nozzles served by the tank being tested.

TABLE 1B

PHASE II **ASSIST** SYSTEMS

PRESSURE DECAY CRITERIA

INITIAL PRESSURE OF 2 INCHES WATER COLUMN (WC)

MINIMUM PRESSURE AFTER 5 MINUTES, INCHES WC

ULLAGE, GALLONS	NUMBER OF AFFECTED NOZZLES				
	01-06	07-12	13-18	19-24	>24
500	**0.73**	**0.69**	**0.65**	**0.61**	**0.57**
550	0.80	0.76	0.72	0.68	0.64
600	**0.87**	**0.82**	**0.78**	**0.74**	**0.71**
650	0.93	0.88	0.84	0.80	0.77
700	**0.98**	**0.94**	**0.90**	**0.86**	**0.82**
750	1.03	0.98	0.94	0.91	0.87
800	**1.07**	**1.03**	**0.99**	**0.95**	**0.92**
850	1.11	1.07	1.03	1.00	0.96
900	**1.15**	**1.11**	**1.07**	**1.03**	**1.00**
950	1.18	1.14	1.11	1.07	1.04
1,000	**1.21**	**1.18**	**1.14**	**1.10**	**1.07**
1,200	1.32	1.28	1.25	1.22	1.19
1,400	**1.40**	**1.37**	**1.34**	**1.31**	**1.28**
1,600	1.46	1.43	1.41	1.38	1.35
1,800	**1.51**	**1.49**	**1.46**	**1.44**	**1.41**
2,000	1.56	1.53	1.51	1.49	1.46
2,200	**1.59**	**1.57**	**1.55**	**1.53**	**1.51**
2,400	1.62	1.60	1.58	1.56	1.54
2,600	**1.65**	**1.63**	**1.61**	**1.59**	**1.57**
2,800	1.67	1.65	1.64	1.62	1.60
3,000	**1.69**	**1.68**	**1.66**	**1.64**	**1.62**
3,500	1.73	1.72	1.70	1.69	1.67
4,000	**1.76**	**1.75**	**1.74**	**1.72**	**1.71**
4,500	1.79	1.78	1.77	1.75	1.74
5,000	**1.81**	**1.80**	**1.79**	**1.78**	**1.77**
6,000	1.84	1.83	1.82	1.81	1.80
7,000	**1.86**	**1.85**	**1.85**	**1.84**	**1.83**
8,000	1.88	1.87	1.86	1.86	1.85
9,000	**1.89**	**1.89**	**1.88**	**1.87**	**1.87**
10,000	1.90	1.90	1.89	1.88	1.88
15,000	**1.93**	**1.93**	**1.93**	**1.92**	**1.92**
20,000	1.95	1.95	1.94	1.94	1.94
25,000	**1.96**	**1.96**	**1.96**	**1.95**	**1.95**

Note: For manifolded Phase II Assist Systems, the **"Number of Affected Nozzles"** shall be the total of all gasoline nozzles. For dedicated return configurations, the **"Number of Affected Nozzles"** shall be t he total of those nozzles served by the tank being tested.

FORM 1

SUMMARY OF SOURCE TEST DATA

SOURCE INFORMATION		FACILITY PARAMETERS
GDF Name and addresss __________ __________ __________	GDF Representative and Title GDF Phone No. ( )	PHASE II SYSTEM TYPE (Check One) Balance Hirt Red Jacket Hasstech Healy Other ____
Permit Conditions	Source: GDF Vapor Recovery System GDF # __________ A/C # __________	Manifolded? Y or N

Operating Parameters
Number of Nozzles Served by Tank #1
Number of Nozzles Served by Tank #2
Number of Nozzles Served by Tank #3
Number of Nozzles Served by Tank #4

Applicable Regulations:	VN Recommended

Source Test Results and Comments

Tank #:	1	2	3	4
1. Product Grade				
2. Actual Tank Capacity, gallons				
3. Gasoline Volume				
4. Ullage, gallons (#2-#3)				
5. Initial Pressure, inches H_2O				
6. Pressure After 1 Minute, inches H_2O				
7. Pressure After 2 Minutes, inches H_2O				
8. Pressure After 3 Minutes, inches H_2O				
9. Pressure After 4 Minutes, inches H_2O				
10. Final Pressure After 5 Minutes, inches H_2O				
11. Allowable Final Pressure				

Test Conducted by:	Test Company:	Date of Test:

Figure 1
"T" Connector Assembly

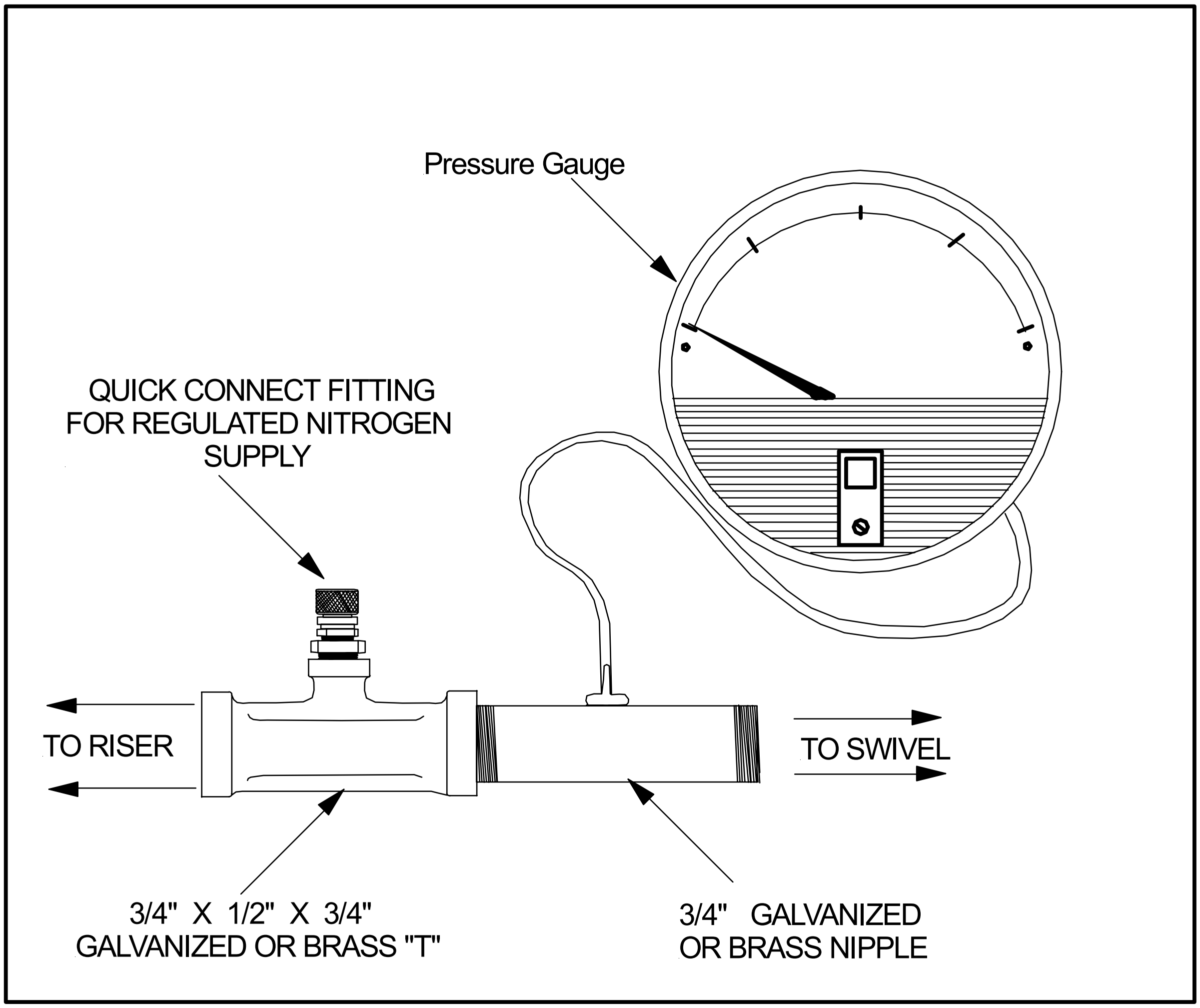


Figure 2

Vapor Coupler Integrity Assembly

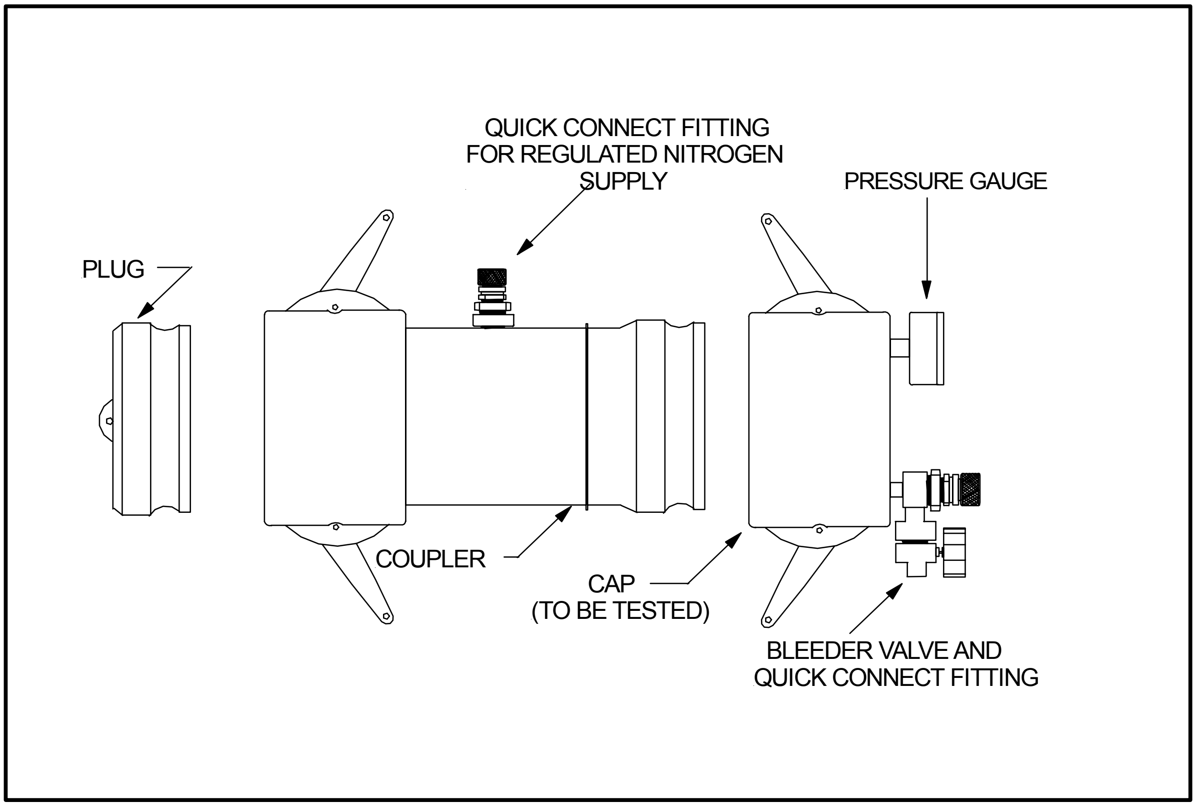
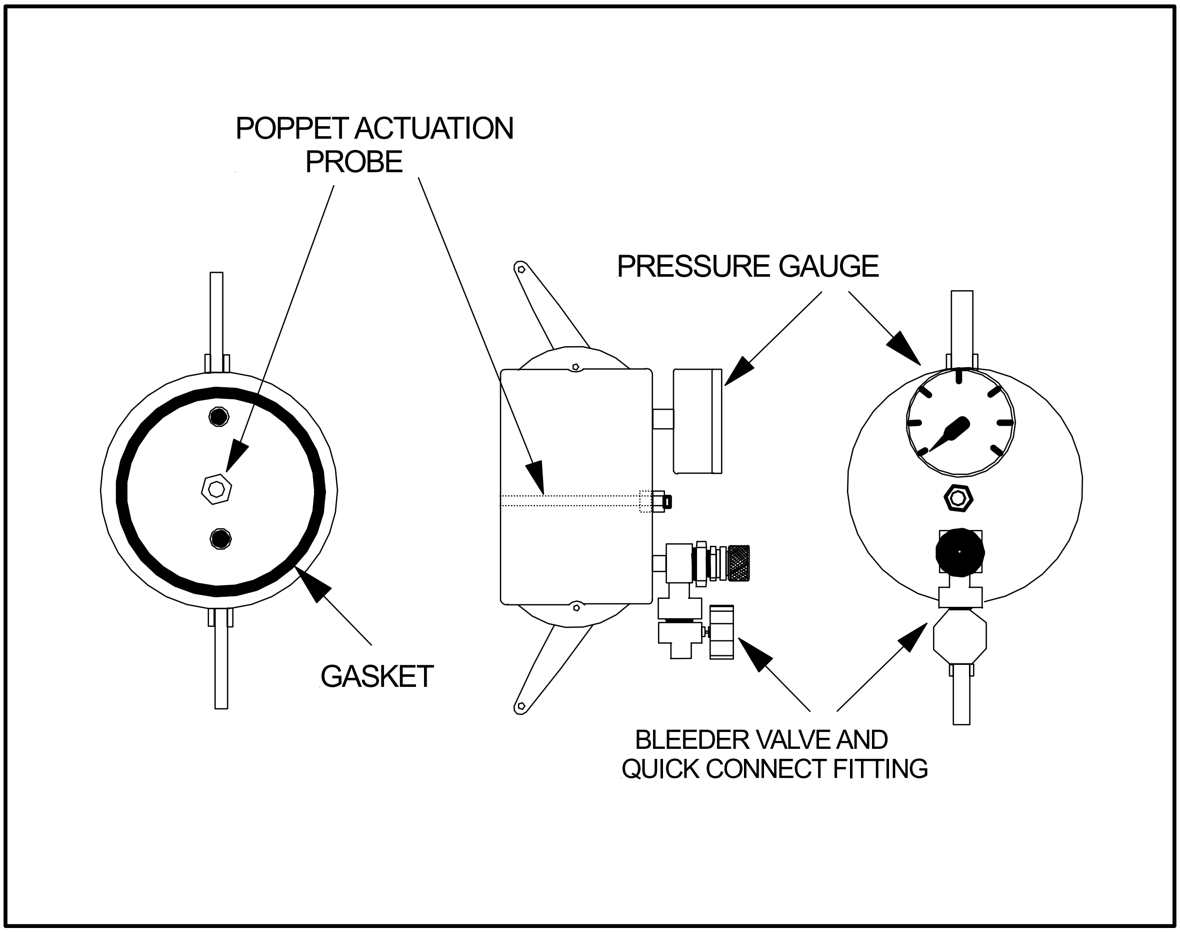


Figure 3

Vapor Coupler Test Assembly



California Environmental Protection Agency

Air Resources Board

Vapor Recovery Test Procedure

TP- 201.4

Dynamic Back Pressure

Adopted: April 12, 1996
Amended: April 28, 2000
Amended: July 3, 2002

California Environmental Protection Agency
Air Resources Board

Vapor Recovery Test Procedure

TP-201.4

Dynamic Back Pressure

Definitions common to all certification and test procedures are in:

D-200 Definitions for Vapor Recovery Procedures

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

1. PURPOSE AND APPLICABILITY

1.1 This procedure is used to verify the applicable dynamic back pressure limits imposed on any gasoline vapor recovery system. The methodologies in this procedure are applicable for certification and compliance testing.

1.1.1 **Methodology 1**. This procedure is applicable if the dynamic back pressure standards are imposed from the nozzle to the gasoline storage tank, provided remote vapor check valves are not part of the Phase II system.

1.1.2 **Methodology 2**. This procedure is applicable if the dynamic back pressure standards are imposed from the nozzle to the gasoline storage tank and a remote vapor check valve is installed.

1.1.3 **Methodology 3**. This procedure is applicable if the dynamic back pressure standards are imposed from the nozzle to the gasoline storage tank and a remote vapor check valve that can be disabled by removing the poppet on the fuel side is installed.

1.1.4 **Methodology 4**. This procedure is applicable if the dynamic back pressure standards are imposed from the Phase II riser to the gasoline storage tank provided there is no vacuum-producing device located between the riser and tank.

1.1.5 **Methodology 5**. This procedure is applicable if the dynamic back pressure standards are imposed at the nozzle/vehicle interface during vehicle fueling.

1.1.6 **Methodology 6**. This procedure shall be conducted in conjunction with the applicable of Methodologies 1, 2, 3 or 4.

1.2 Unless the certification Executive Order specifies otherwise, compliance testing using Methodologies 1, 2, 3, 4 and 6 shall be conducted with the Phase I vapor poppet open, while Methodology 5 shall be conducted with the poppet closed.

1.3 For those systems possessing a design incompatible with this test procedure, compliance testing shall be conducted in accordance with the procedures specified in the applicable certification Executive Order. Appropriate certification testing shall be determined and conducted in accord with sound engineering principles and accepted engineering evaluation criteria.

2. PRINCIPLE AND SUMMARY OF TEST PROCEDURE

2.1 Using Methodologies 1, 2, 3, 4 or 6, the dynamic back pressure during vehicle fueling is simulated by passing nitrogen through the vapor recovery system at specified rates. The resultant dynamic back pressure is measured using a pressure gauge, or equivalent device. Methodologies 2 and 3 are included for those systems that utilize both bellows-equipped nozzles and a remote vapor check valve. Methodology 5 is a direct measurement of the pressure at the nozzle/fillpipe interface during gasoline dispensing.

3. BIASES AND INTERFERENCES

3.1 Any leaks in the nozzle vapor path, fillpipe interface, vapor hose, or underground vapor return piping may result in erroneously low dynamic back pressure measurements.

3.2 Testing of systems that have liquid condensate traps in the underground vapor return piping that contain liquid at the time of the test may result in erroneously high dynamic back pressure measurements.

3.3 Measuring dynamic back pressure without waiting a minimum of 30 seconds for the flow of nitrogen to stabilize may result in erroneous back pressure measurements.

4. SENSITIVITY, RANGE AND PRECISION

4.1 The minimum and maximum dynamic back pressures that can be measured are dependent upon available pressure gauges. The recommended mechanical or electronic pressure gauge ranges are described in Sections 4.2 and 4.3.

4.2 If mechanical pressure gauges are used, the minimum diameter of the gauge face shall be four inches; the minimum accuracy shall be 3.0 percent of full scale and the minimum readability shall be 5.0 percent of full scale.

4.2.1 **Methodology 1**. 0-0.5 and 0-1 inches H_2O.
4.2.2 **Methodology 2**. 0-0.5 and 0-1 inches H_2O.
4.2.3 **Methodology 3**. 0-0.5 and 0-1 inches H_2O.
4.2.4 **Methodology 4**. 0-0.25 inches H_2O.
4.2.5 **Methodology 5**. -1-0-+1 inches H_2O.
4.2.6 **Methodology 6.** 0-0.5 and 0-1 inches H_2O.

4.3 If an electronic pressure measuring device is used, the full-scale range of the device shall not exceed 0-10 inches H_2O with a minimum accuracy of 0.5 percent of full scale. A 0-20 inches H_2O device may be used provided the equivalent accuracy is not less than 0.25 percent of full-scale.

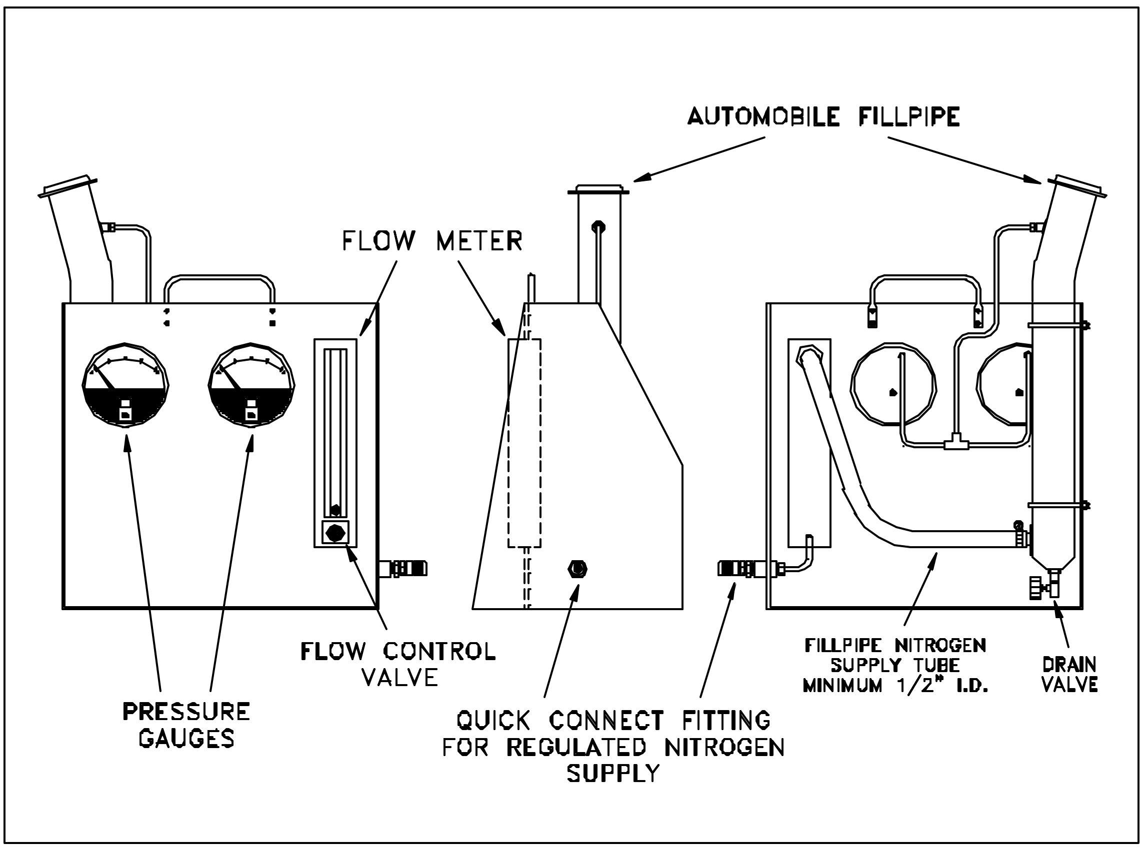
5. EQUIPMENT

5.1 Nitrogen High Pressure Cylinder with Pressure Regulator. Use a high pressure nitrogen cylinder capable of maintaining a pressure of at least 2000 psig and equipped with a compatible two-stage pressure regulator and a one psig relief valve. A ground strap is recommended during introduction of nitrogen into the system.

5.2 Rotameter. Use a calibrated rotameter capable of accurately measuring nitrogen flowrate(s) applicable for the imposed dynamic back pressure limits.

5.3 Pressure Gauges. Use differential pressure gauges as described in Sections 4.2 and 4.3.

Figure 1
Dynamic Back Pressure Test Assembly



5.4 Fillpipe. Use an automobile fillpipe, or equivalent, known to be compatible with all bellows-equipped vapor recovery nozzles, and equipped with a pressure tap. See Figure 1.

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

5.6 Hand Pump. Use a gasoline compatible hand pump, if applicable, to drain any gasoline from condensate pots.

5.7 Stopwatch. Use a stopwatch accurate to within 0.2 seconds to time the duration of the test.

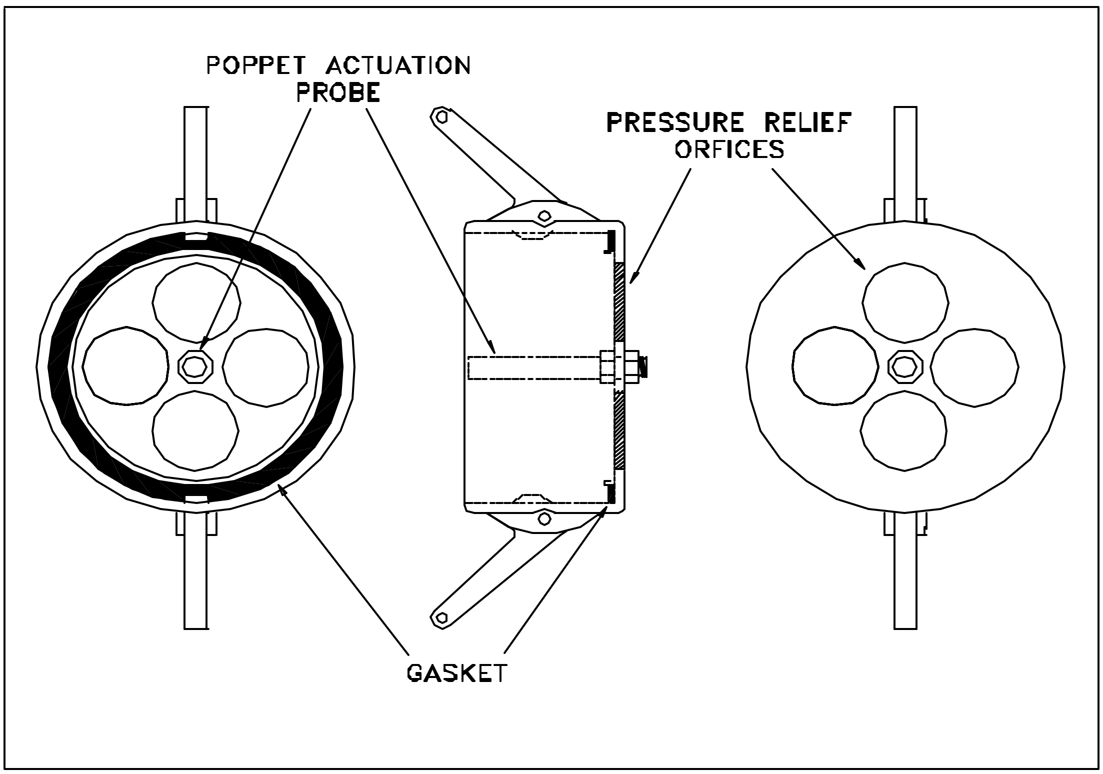
5.8 Gasket. Use a flat gasket made of a gasoline compatible material with dimensions similar to the donut shown in Figure 4, to ensure proper seal between the nozzle and the Dynamic Back Pressure Assembly.

6. PRE-TEST PROCEDURES

6.1 **Methodologies 1, 2 & 3**. The following subsections are applicable for those Phase II systems where a limitation is imposed on the dynamic back pressure between the nozzle and the gasoline storage tank. If a central vacuum system is used, this device shall be turned off during this test.

6.1.1 Assemble a Dynamic Back Pressure Test Assembly as shown in Figure 1, ensuring that the rotameter control valve is closed.

Figure 2
Dynamic Pressure Release Assembly

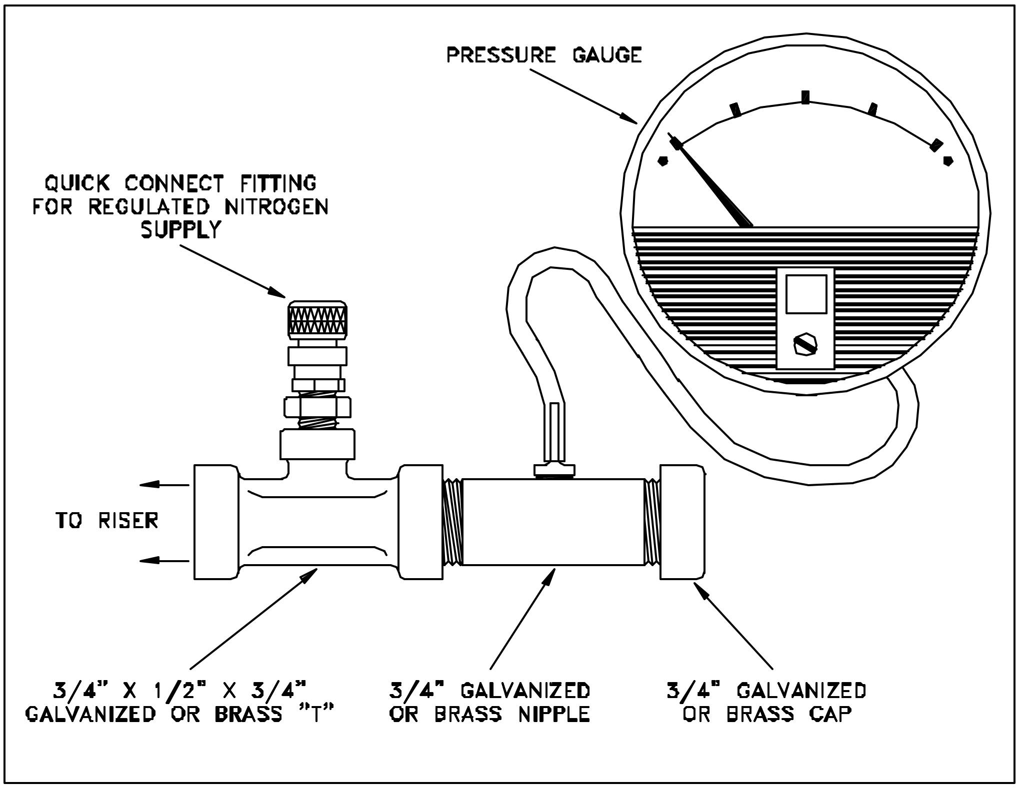


6.1.2 The test equipment must be leak-checked prior to use. Plug the nozzle end of the auto fillpipe on the Dynamic Back Pressure Assembly and open the nitrogen cylinder. Adjust the rotameter control valve until a pressure of 50 percent of full scale is indicated on the high range pressure gauge. Close the nitrogen cylinder valve and any toggle valves. A pressure decay of less than 0.2 inches H_2O, in five minutes, is considered acceptable.

6.1.3 With the Dynamic Back Pressure Assembly open to atmosphere, flow nitrogen through the assembly at each specified flowrate. Record any back pressure on the appropriate data sheet. Allow a minimum of 30 seconds for the nitrogen flow to stabilize before taking back pressure measurement.

6.1.4 Perform an initial visual examination for vapor leaks at the nozzle and hose of the Phase II system to be tested. All leak sources shall be repaired or the component(s) removed and replaced prior to testing.

Figure 3
Capped "T" Assembly



6.1.5 Pour a minimum of two (2) gallons of gasoline into each Phase II vapor return riser. This gasoline may be introduced into the Phase II riser in any appropriate manner. Alternatively, a minimum of twenty gallons of gasoline may be introduced into the Phase II riser furthest from the gasoline storage tank, provided that the riser is common to all products available at that dispenser. If product-specific risers are employed, a minimum of seven gallons, per product grade, may be introduced into the riser of each product that is furthest from the gasoline storage tank. The Districts may waive this requirement in facilities that have been in operation prior to the test. Allow at least fifteen (15) minutes for the liquid in the vapor return piping to drain.

6.1.6 Completely drain any gasoline from the spout and bellows.

6.1.7 For vapor piping configurations that utilize a liquid condensate pot, drain the pot prior to testing.

6.1.8 The Phase I vapor poppet shall be opened in such a manner that the valve is not damaged. This may be accomplished by using either a vapor recovery elbow or a Dynamic Pressure Release Assembly, as shown in Figure 2.

6.2 Methodology 4.

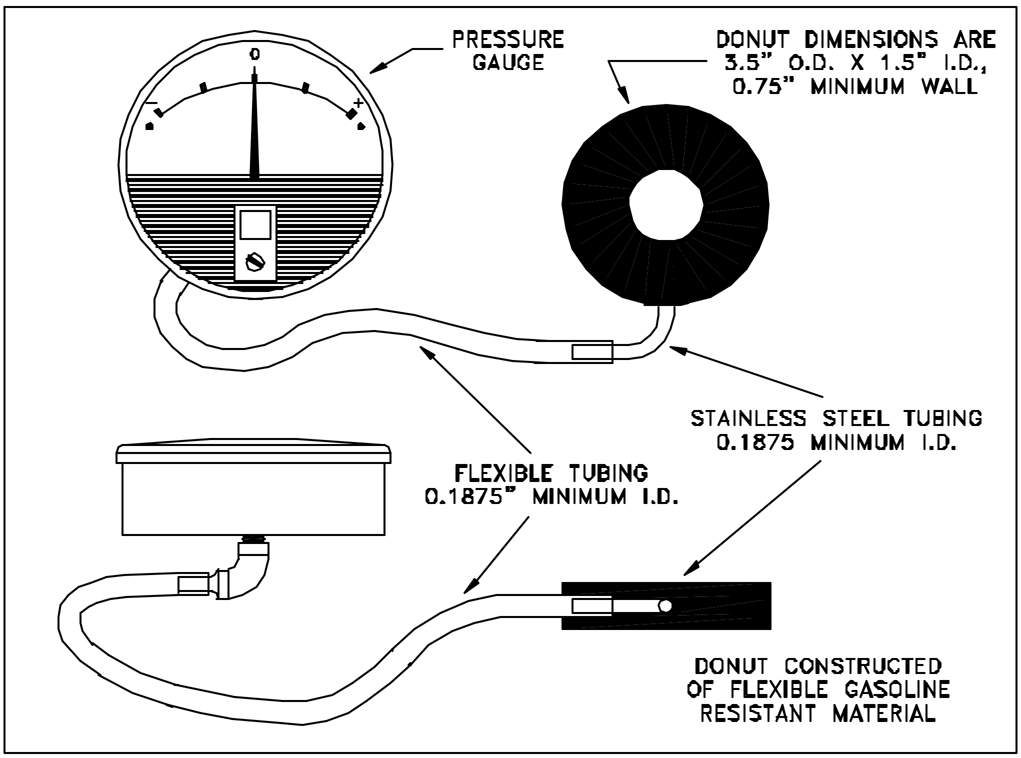
6.2.1 Assemble the Capped "T" Assembly as shown in Figure 3.

6.2.2 With the Capped "T" Assembly open to atmosphere, flow nitrogen through the assembly at each specified flowrate. Record any back pressure on the appropriate data sheet. Allow a minimum of 30 seconds for the nitrogen flow to stabilize before taking back pressure measurement.

6.2.3 Open the Phase I vapor poppet for the affected tank(s), using either methodology described in 6.1.8.

Figure 4

Donut Pressure Test Assembly



6.2.4 Pour a minimum of two (2) gallons of gasoline into each Phase II vapor return riser. This gasoline may be introduced into the riser in any appropriate manner.

6.5 Methodology 5.

6.5.1 Assemble the Donut Pressure Test Assembly as shown in Figure 4.

6.5.2 The Phase I vapor poppet shall remain closed during this test.

6.6 Methodology 6.

6.6.1 Assemble the Vent Pipe Pressure Assembly as shown in Figure 5.

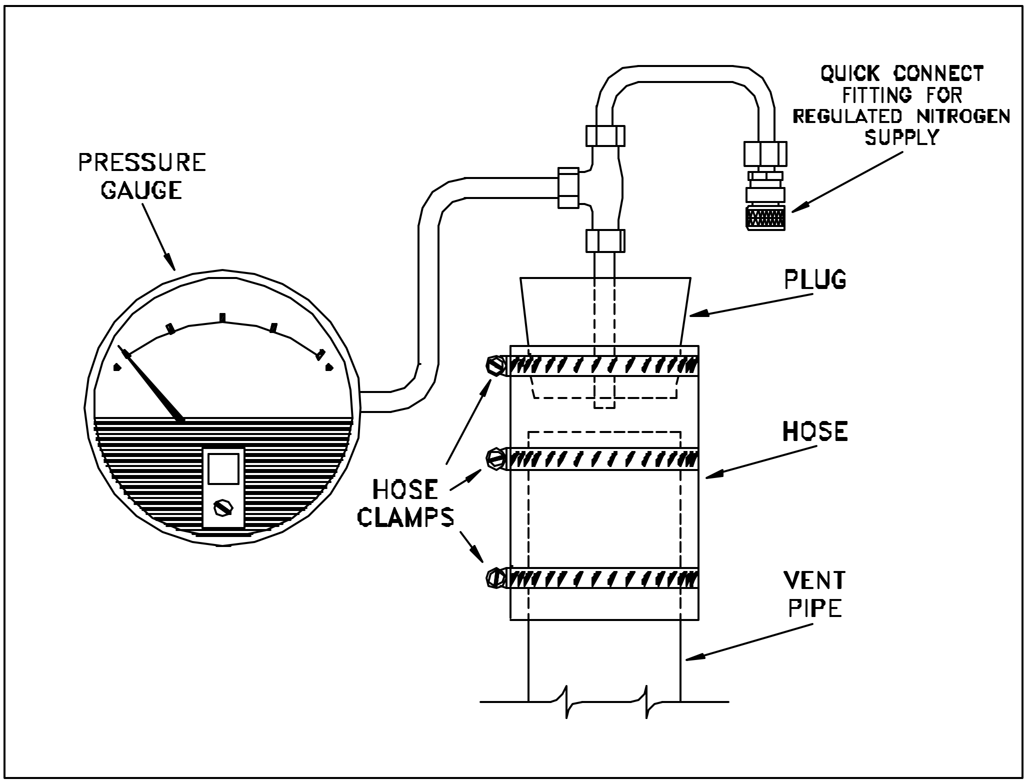
6.6.2 With the Vent Pipe Pressure Assembly open to atmosphere, flow nitrogen through the assembly at each specified flowrate. Record any back pressure on the appropriate data sheet. Allow a minimum of 30 seconds for the nitrogen flow to stabilize before taking back pressure measurement.

6.6.3 Carefully remove the vent pipe pressure/vacuum (P/V) valve.

6.6.4 Open the Phase I vapor poppet for the affected tank(s), using either methodology described in 6.1.8.

6.6.5 Insure that the collection unit of the Phase II system is turned off.

Figure 5
Vent Pipe Pressure Assembly



7. TEST PROCEDURE

7.1 Methodology 1. Insert the nozzle into the fillpipe of the Dynamic Back Pressure Test Unit. Ensure that a tight seal is achieved at the fillpipe/nozzle interface. This may be accomplished with the use of a “donut” shaped gasket, as described in Section 5.8

7.1.1 Connect the nitrogen supply to the test assembly.

7.1.2 Open the nitrogen cylinder, set the delivery pressure to 5 psig. Use the rotameter control valve to adjust the flowrate to lowest of the required nitrogen flowrates. Care must be taken to ensure that the initial flowrate through the rotameter does not exceed the lowest specified in the certification Executive Order. If nitrogen has been introduced in excess of the minimum flowrate, then liquid must be introduced, pursuant to section 6.1.5, to conduct a valid test. Allow a minimum of 30 seconds for the nitrogen flow to stabilize before taking back pressure measurement.

7.1.3 A pulsating gauge needle indicates nitrogen passing through a liquid obstruction in the vapor return system. If this occurs, close the rotameter control valve, disengage the nozzle, and redrain the nozzle and hose assembly. Re-engage the nozzle, open the rotameter control valve and repeat Section 7.1.2.

7.1.4 The following information shall be recorded on the field data sheet, as shown on Form 1:
(a) Dispenser Number and Product Grade
(b) Nozzle manufacturer and model
(c) Nitrogen flowrate, CFH
(d) Dynamic back pressure, inches H_2O

7.1.5 Repeat Sections 7.1.1 through 7.1.4 for each additional nitrogen flowrate specified in the certification Executive Order, from the lowest remaining flowrate to the highest.

7.1.6 Remove the vapor recovery elbow or Dynamic Pressure Release Assembly from the Phase I poppet and replace the dust cap.

7.2 Methodology 2. Phase II balance and Hirt systems, which utilize both bellows-equipped nozzles and a fuel-activated remote vapor check valve, may be tested using the following methodology.

7.2.1 Disconnect the vapor recovery hose from the remote vapor check valve. Test the nozzle/hose assembly pursuant to Section 7.1.1 through 7.1.4, and record the results on the field data sheet as shown in Form 2.

7.2.2 Disconnect the vapor check valve and connect a compatible "T" fitting, as shown in Figure 3, to the dispenser at that location.

7.2.3 Connect the nitrogen supply to the "T" assembly.

7.2.4 Repeat Sections 7.1.2 through 7.1.5. In addition to the information required in Section 7.1.4, record both the make and model of the remote vapor check valve.

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

7.2.6 Add the dynamic back pressures, for each required nitrogen flowrate, obtained from Sections 7.2.1, 7.2.4 and 7.2.5 as shown in Form 2.

7.2.7 Disconnect the “T” fitting from the dispenser and re-connect the vapor check valve.

7.2.8 Remove the vapor recovery elbow or Dynamic Pressure Release Assembly from the Phase I poppet and replace the dust cap.

7.3 Methodology 3. Phase II balance and Hirt systems which use both bellows-equipped nozzles and those models of fuel-activated remote vapor check valves which can be disabled by removing the poppet on the fuel side may be tested using the following methodology. Phase II systems using an Emco-Wheaton A-228 remote vapor check valve cannot be tested using this methodology.

7.3.1 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.

7.3.2 Test the Phase II system pursuant to Sections 7.1.1 through 7.1.5, recording the data on the field data sheet shown in Form 1.

7.3.3 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, taking care not to strip the threads.

7.3.4 Remove the vapor recovery elbow or Dynamic Pressure Release Assembly from Phase I poppet and replace dust cap.

7.4 Methodology 4 Those Phase II systems subject to regulatory limitations on the dynamic back pressure between the Phase II riser and gasoline storage tank may be tested using this methodology.

7.4.1 Disconnect the Phase II vapor riser and install the "T" assembly as shown in Figure 3.

7.4.2 Connect the nitrogen supply to the "T" assembly.

7.4.3 Open the nitrogen cylinder, set the delivery pressure to 5 psig. Use the rotameter control valve to adjust the flowrate to lowest of the required nitrogen flowrates. Care must be taken to ensure that the initial flowrate through the rotameter does not exceed the lowest specified in the Executive Order. If nitrogen has been introduced in excess of the minimum flowrate, then liquid must be introduced, pursuant to section 6.1.5, to conduct a valid test. Allow a minimum of 30 seconds for the nitrogen flow to stabilize before taking back pressure measurement.

7.4.4 A pulsating gauge needle indicates nitrogen passing through a liquid obstruction in the vapor return system. If this occurs, close the rotameter control valve, disengage the nozzle, and redrain the nozzle and hose assembly. Re-engage the nozzle, open the rotameter control valve and repeat Section 7.4.3.

7.4.5 The following information shall be recorded on the field data sheet, as shown in Form 3:

(a) Dispenser Number and Product Grade
(b) Nitrogen flowrate, CFH
(c) Dynamic back pressure, inches H_2O

7.4.6 Repeat subsections 7.4.3 through 7.4.5 for all required nitrogen flowrates, as specified in CP-201.

7.4.7 Remove the “T” assembly and re-connect the Phase II vapor riser.

7.4.8 Remove the vapor recovery elbow or Dynamic Pressure Release Assembly from the Phase I poppet and replace the dust cap.

7.5 Methodology 5. Those bellows-equipped Phase II systems subject to regulatory limitations on the dynamic back pressure at the nozzle/fillpipe interface during gasoline dispensing shall use the following methodology.

7.5.1 Assemble the Donut Pressure Test Assembly, shown in Figure 4.

7.5.2 Insert the nozzle spout through the inner hole of the donut.

7.5.3 Insert and latch the nozzle in the vehicle fillpipe. Visually ensure that a tight connection is made between the donut and fillpipe.

7.5.4 Activate the dispenser and set the nozzle hold-open latch on low. After at least one gallon has been dispensed start the stopwatch. Dispense a minimum of four gallons of gasoline. The following data shall be recorded on the field data sheet as shown in Form 4:

(a) Dispenser Number and gasoline grade
(b) Gallons dispensed during test
(c) Maximum dynamic back pressure, inches H_2O
(d) Minimum dynamic back pressure, inches H_2O
(e) The average dispensing rate, gallons per minute

7.5.5 This Methodology shall only be conducted with the Phase I vapor poppet closed, since gasoline is being dispensed during the test.

7.6 Methodology 6. This procedure verifies proper drainage of gasoline from the base of the vent pipe to the gasoline storage tank.

7.6.1 After verifying certification or compliance with the dynamic back pressure standards, pursuant to the applicable of Methodologies 1, 2, 3, or 4, close the Phase I vapor poppet.

7.6.2 Remove the pressure/vacuum (P/V) valve(s) from each vent pipe.

7.6.3 Carefully pour a minimum of 5 gallons of gasoline down each vent pipe.

7.6.4 Wait at least 15 minutes.

7.6.5 Open the Phase I poppet(s) on all affected tanks, per section 6.1.8.

7.6.6 Install the Vent Pipe Pressure Assembly as shown in Figure 5.

7.6.7 Connect the nitrogen supply to the Vent Pipe Pressure Assembly.

7.6.8 Open the nitrogen cylinder and adjust the flowrate to 60 CFH.

7.6.9 After a minimum of 30 seconds, record the dynamic back pressure.

7.6.10 A dynamic back pressure, from the top of the vent pipe to the storage tank, of less than 0.5 inches H_2O shall be considered acceptable.

7.6.11 Repeat steps 7.6.6 through 7.6.10 for each vent stack that has a P/V valve.

7.6.12 Remove the Vent Pipe Pressure Assembly from the vent pipe and replace the pressure/vacuum (P/V) valve(s).

7.6.13 Remove the vapor recovery elbow or Dynamic Pressure Release Assembly from the Phase I poppet and replace the dust cap.

8. POST-TEST PROCEDURES

Refer to each methodology for the appropriate post-test procedure.

9. REPORTING RESULTS

9.1 Report the results of the dynamic back pressure test as shown below:

9.1.1	Methodology 1	Form 1
9.1.2	Methodology 2	Form 2
9.1.3	Methodology 3	Form 1
9.1.4	Methodology 4	Form 3
9.1.5	Methodology 5	Form 4
9.1.6	Methodology 6	Forms 1, 2, 3, or 4, as appropriate

10. ALTERNATE PROCEDURES

10.1 This 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 ARB Executive Officer, pursuant to Section 14 of Certification Procedure CP-201.

Form 1

	Dynamic Back Pressure Source Test Results	Report No.: ______ Test Date: ______ Test Times: Run A: ______

Source Information		Representatives
Station Name and Address	Station Representative and Title Phone No. ( )	Source Test Engineers
Permit Conditions:	Source: **GDF Vapor Recovery** **GDF #** ______ **A/C #** ______	Permit Services Division/Enforcement Division Test Requested By:
Operating Parameters:		
Applicable Regulations:		VN Recommended:

Sources Test Results and Comments:

Nozzle #	Gas Grade	Nozzle Model	Dynamic Back Pressure, Inches H_2O CFH	CFH	CFH

Results Received by Date	Results Reviewed by Date	Results Approved/Disapproved

Form 2

Station Name and Address	**Dynamic Back Pressure Source Test Results**	Station Representative and Title Phone No. ( )
Permit Services/Enforcement:		Test Performed by:
Permit Conditions:		Test Date/Time:
Applicable Regulations:	Source: **GDF Vapor Recovery GDF # A/C #**	VN Recommendation:

Source Test Results and Comments:

Pump #	Gas Grade	Nozzle Model	Vapor Valve Make/Model	Nitrogen Flow, CFH	Dynamic Back Pressure, Inches of Water Column: Nozzle/Hose Assembly	Riser to U.G. Tank	Vapor Valve	Total Δ P, Inches H_20

Test Received by: Date:	Test Reviewed by: Date:	Test Approved/Disapproved: Date:

Form 3

	Dynamic Back Pressure Source Test Results	Report No.: ________ Test Date: ________ Test Times: Run A: ________

Source Information		Representatives
Station Name and Address	Station Representative and Title Phone No. ( )	Source Test Engineers
Permit Conditions:	Source: **GDF Vapor Recovery** **GDF #** ________ **A/C #** ________	Permit Services Division/Enforcement Division Test Requested By:
Operating Parameters:		
Applicable Regulations:		VN Recommended:

Sources Test Results and Comments:

Riser #	Gas Grade	Dynamic Back Pressure, Inches H_20 CFH	CFH	CFH

Results Received by	Date	Results Reviewed by	Date	Results Approved/Disapproved

Form 4

	Dynamic Back Pressure Source Test Results	Report No.: ____________ Test Date: ____________ Test Times: Run A: ____________

Source Information		Representatives
Station Name and Address	Station Representative and Title Phone No. ( )	Source Test Engineers
Permit Conditions:	Source: **GDF Vapor Recovery** **GDF #** ____________ **A/C #** ____________	Permit Services Division/Enforcement Division Test Requested By:
Operating Parameters:		
Applicable Regulations:		VN Recommended:

Sources Test Results and Comments:

Nozzle #	Gas Grade	Gallons Dispensed	Dynamic Back Pressure, In. H_2O		
			Max. B.P.	Min. B.P.	Rate, GPM

Results Received by Date	Results Reviewed by Date	Results Approved/Disapproved

California Environmental Protection Agency

Air Resources Board

Vapor Recovery Test Procedure

TP- 201.5

Air to Liquid Volume Ratio

Adopted: April 12, 1996
Amended: February 1, 2001

California Environmental Protection Agency
Air Resources Board

Vapor Recovery Test Procedure

TP-201.5

Air to Liquid Volume Ratio

Definitions common to all certification and test procedures are in:

D-200 Definitions for Vapor Recovery Procedures

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

1. PURPOSE AND APPLICABILITY

1.1 This test procedure is used to quantify the Air to Liquid (A/L) Volumetric Ratio of Phase II vapor recovery systems installed at gasoline dispensing facilities (GDF), provided the nozzles are compatible with the procedure. This procedure provides a method to determine compliance with the A/L requirements specified in the applicable California Air Resources Board (CARB) Executive Order (EO) for the specified Phase II vapor recovery system.

2. PRINCIPLE AND SUMMARY OF TEST PROCEDURE

2.1 A tight fitting adaptor is placed on the spout of a dispensing nozzle. The adaptor, which isolates air flow to the nozzle vapor collection ports, is connected to a volume gas meter. Gasoline is dispensed through the nozzle and the volume of air and vapors drawn through the vapor collection ports by the Phase II system vacuum pump is measured. The volume of the air mixture is recorded and compared with the volume of gasoline dispensed to determine the A/L Volumetric Ratio.

2.2 The test is conducted with the pressure/vacuum (P/V) relief valve(s) on the storage tank vent pipes installed, **unless** the Executive Officer determines that, due to the design of the system, the P/V valve is to be removed during the test.

2.2.1 If the P/V valve is required to be removed during the test, the absence of leaks at the P/V valve connection shall be verified upon completion of the test, using either liquid leak solution or a bagging technique, as applicable.

3. BIASES AND INTERFERENCES

3.1 Nozzle spouts which are damaged such that the A/L adaptor cannot fit over the nozzle spout preclude the use of this test.

3.2 Refueling points not capable of achieving dispensing rates required for conducting the A/L test, as specified in the applicable CARB Executive Order, preclude the use of this test for determining in-use compliance of certified systems.

3.3 Location or configuration of the vapor collection ports on the nozzle spout which are not compatible with the A/L adaptor specified in this procedure preclude the use of this test.

3.4 Bagging, or otherwise sealing any nozzle associated with the vacuum pump serving the nozzle being tested, may bias the test results towards compliance. **The A/L test to verify compliance shall be conducted without "bagging" any of the nozzles served by a common vacuum device.**

3.5 If the nozzle being tested introduces liquid into the test equipment, the A/L of that nozzle shall be deemed a failure of the A/L standard.

3.6 Do not drain or remove liquid in either the vapor passage of the hoses or the dispenser vapor piping prior to performing the test. Draining of this liquid gasoline will bias the test toward compliance.

3.7 Pressure in the headspace of the storage tank, created by draining the gasoline from the portable test tank to the storage tank, may bias the results of the test for systems certified to operate at, or near, atmospheric gauge pressure in the UST headspace. The test shall be conducted with the P/V valve installed, unless the Executive Officer or the applicable CARB Executive Order (EO) requires the P/V valve be removed during the test.

3.8 O-rings in the A/L adaptor that are not properly greased may bias the results toward noncompliance. This bias may be eliminated if the O-rings are lubricated immediately prior to each A/L test run.

4. SENSITIVITY, RANGE, AND PRECISION

4.1 The maximum rated capacity of the gas volume meter shall be at least 250 CFH and not greater than 3,000 CFH.

4.2 The minimum rated capacity of the gas volume meter shall be 25 CFH.

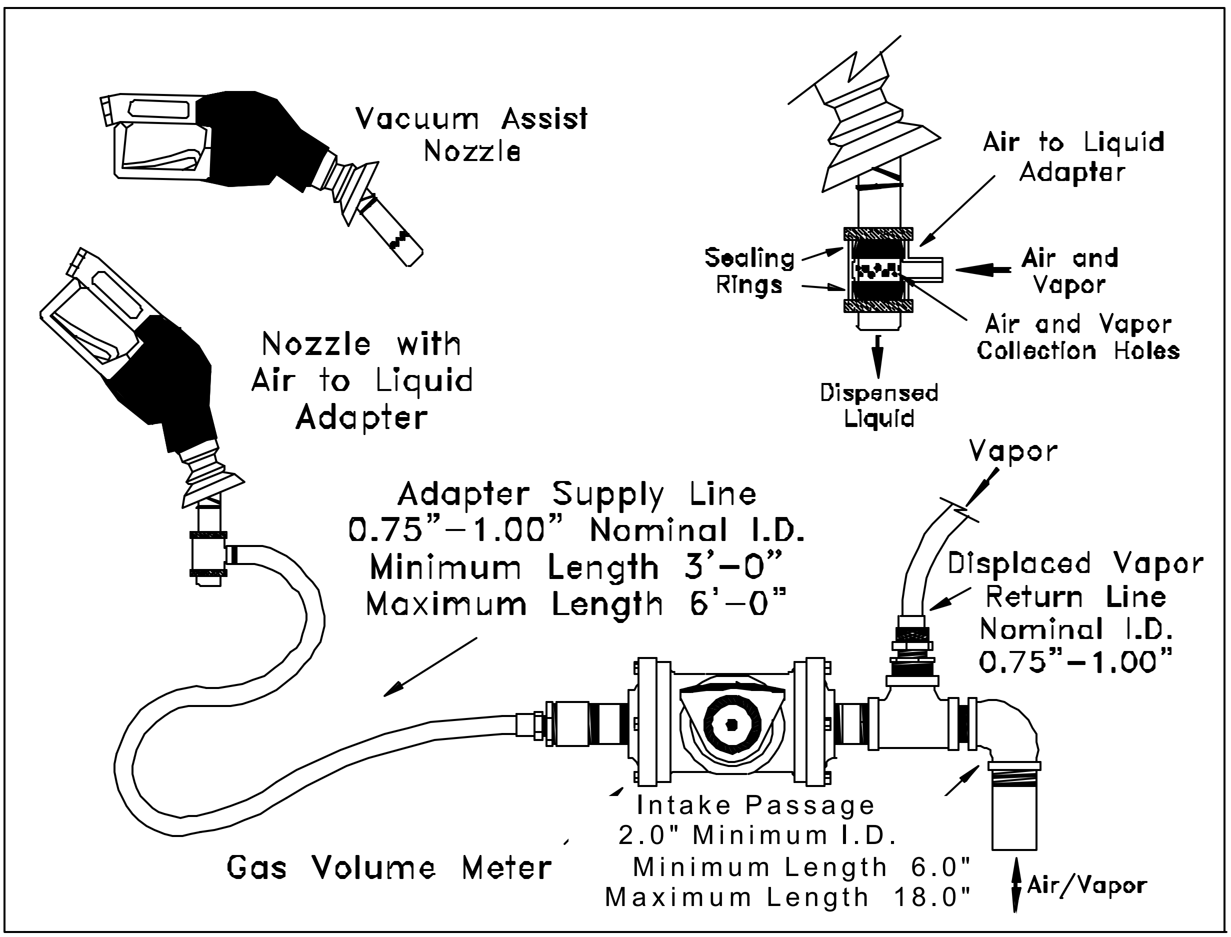
4.3 The minimum readability of the gas volume meter shall be 0.01 cubic feet.

4.4 Precision is $\pm$ 5 percent of the gas volume meter reading.

5. EQUIPMENT

5.1 Air to Liquid Adaptor. Use an Air to Liquid (A/L) adaptor compatible with the nozzle(s) employed at the GDF. The adaptor shall be capable of isolating the vapor holes in the nozzle and be connected to the gas volume meter with gasoline-resistant flexible tubing. The nominal inside diameter of the flexible tubing shall be between 0.75 and 1.00 inches, and the maximum length of the tubing shall be 6 feet. Figure 1 illustrates an A/L adaptor assembled on a nozzle. If the Executive Officer or the applicable CARB Executive Order specifies certain adaptors, only those adaptors shall be used.

Figure 1
Gas Volume Meter and Air To Liquid Adaptor

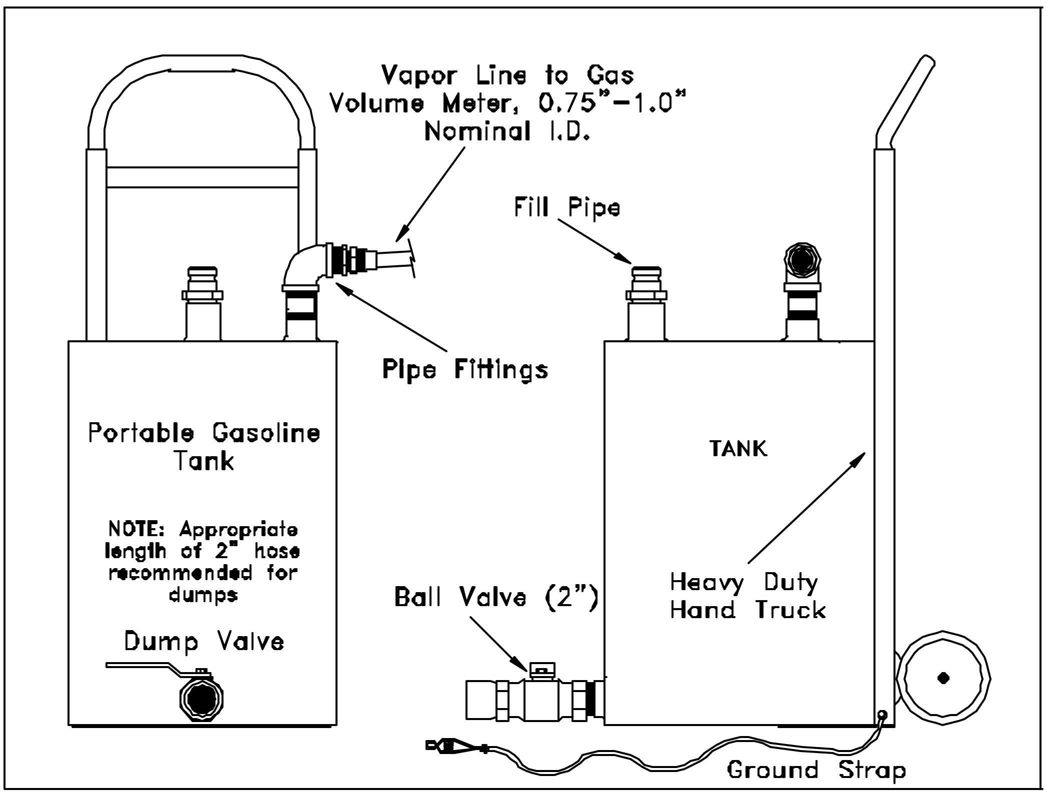


5.2 Gas Volume Meter. Use a Dresser Measurement Roots Meter®, or equivalent, to measure the volumetric flowrate through the A/L adaptor. The meter shall be equipped as shown in Figure 1 and the maximum allowable pressure drop(s) across the meter shall be as follows:

For a meter with a maximum rated capacity of 1000 CFH through 3,000 CFH:
1.10 inches H_2O at a flowrate of 3,000 CFH
0.05 inches H_2O at a flowrate of 30 SCFH.

For a meter with a maximum rated capacity of 800 to 1,000 CFH:
0.70 inches H_2O at a flowrate of 800 CFH
0.04 inches H_2O at a flowrate of 16 CFH

Figure 2
Portable Tank Assembly



5.3 Volume Gas Meter Inlet Manifold. This manifold is designed to return the vapors displaced from the portable gasoline tank assembly, at atmospheric pressure, to the inlet of the gas volume meter. This manifold shall be two (2.0) inches minimum inside diameter pipe. The intake passage of the manifold shall be no shorter than 6.0 inches and no longer than 18.0 inches. See Figures 1 and 3 for examples.

5.4 Liquid Volume Meter. Use the totalizer on the gasoline dispenser to measure the volume of gasoline dispensed during the test.

5.5 Portable Gasoline Tank Assembly. A portable tank, meeting fire safety requirements for use with gasoline, shall be used to receive the gasoline dispensed during this test. The tank shall have sufficient volume so that at least 4.5 gallons may be dispensed prior to activating the primary shutoff mechanism of the dispensing nozzle. Tank material, likely to provide contact with the nozzle spout, or A/L adaptor, during the entire dispensing event, shall be constructed of aluminum or brass or other materials approved by the local fire codes for such application. The tank and required plumbing configuration is shown in Figure 2 and Figure 3. This configuration permits a portion of the vapors displaced during testing to be returned to the gasoline storage tank. The minimum and maximum dimensions shown in Figure 2 and Figure 3 shall be adhered to in all cases.

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

5.7 Lubricant. Appropriate lubricant, either grease or spray lubricant, shall be used to ensure a leak-tight seal between the O-rings in the A/L adaptor and the nozzle spout.

5.8 CARB Executive Order (EO). When this procedure is used to determine the compliance of an installed system, the applicable CARB Executive Order should be reviewed **prior** to conducting the test. This review shall include the status of the P/V valve (installed or removed) during the test and whether the processor should remain in operation during the test.

6. PRE-TEST PROCEDURES

6.1 Assemble the portable tank assembly and gas volume meter as shown in Figure 3. The minimum and maximum dimensions shown in Figure 3 shall be adhered to in all cases. **Ensure that the ground strap is properly connected to an acceptable ground**.

6.2 If more than one nozzle share vacuum plumbing with the test nozzle, one troubleshooting method for a low A/L ratio is to seal all nozzles other than the nozzle being tested, e.g., plastic bags and tape or rubber bands. If leaks in the nozzles/check valves served by common vacuum pump cause the bags to deflate, the low A/L ratio may have been caused by a leak through an idle nozzle during the test. **The A/L test to verify compliance, however, shall be conducted without "bagging" any of the nozzles.**

6.3 The gas volume meter shall be calibrated, within 180 days prior to conducting this procedure. In addition, calibration shall be conducted after any repairs or alterations to the meter. Calibrations, at a minimum, shall be conducted at flowrates of 30, 60, and 90 CFH (3.7, 7.5, and 11.2 gallons/minute) in accordance with one of the following:

(a) ARB Air Monitoring Quality Assurance, Volume VI, Standard Operating Procedures for Stationary Source Emission Monitoring, January 1979, or

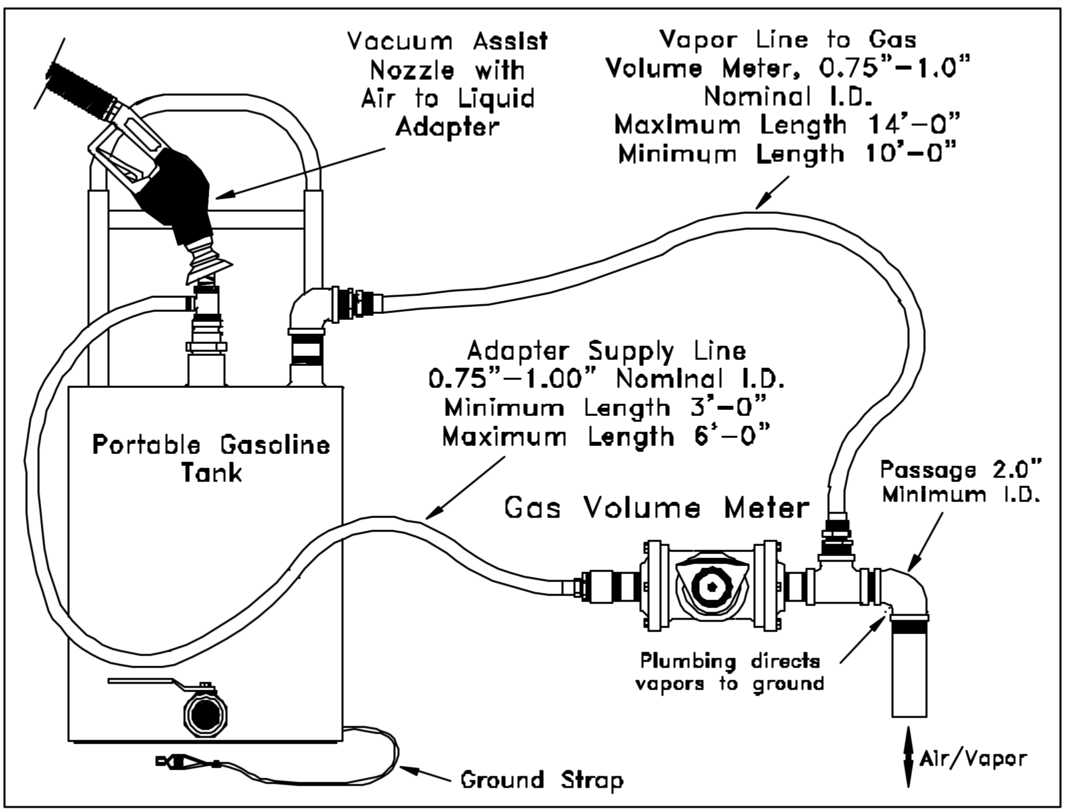
(b) US EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods, or

(c) EPA Method 2A, Measurement of Gas Volume Through Pipes and Small Ducts (40 CFR Part 60, Appendix A), or

(d) Appropriate calibration procedures in accordance with California Department of Food and Agriculture, Division of Measurement Standards and County Department of Weights and Measures (title 4, CCR, section 3.33).

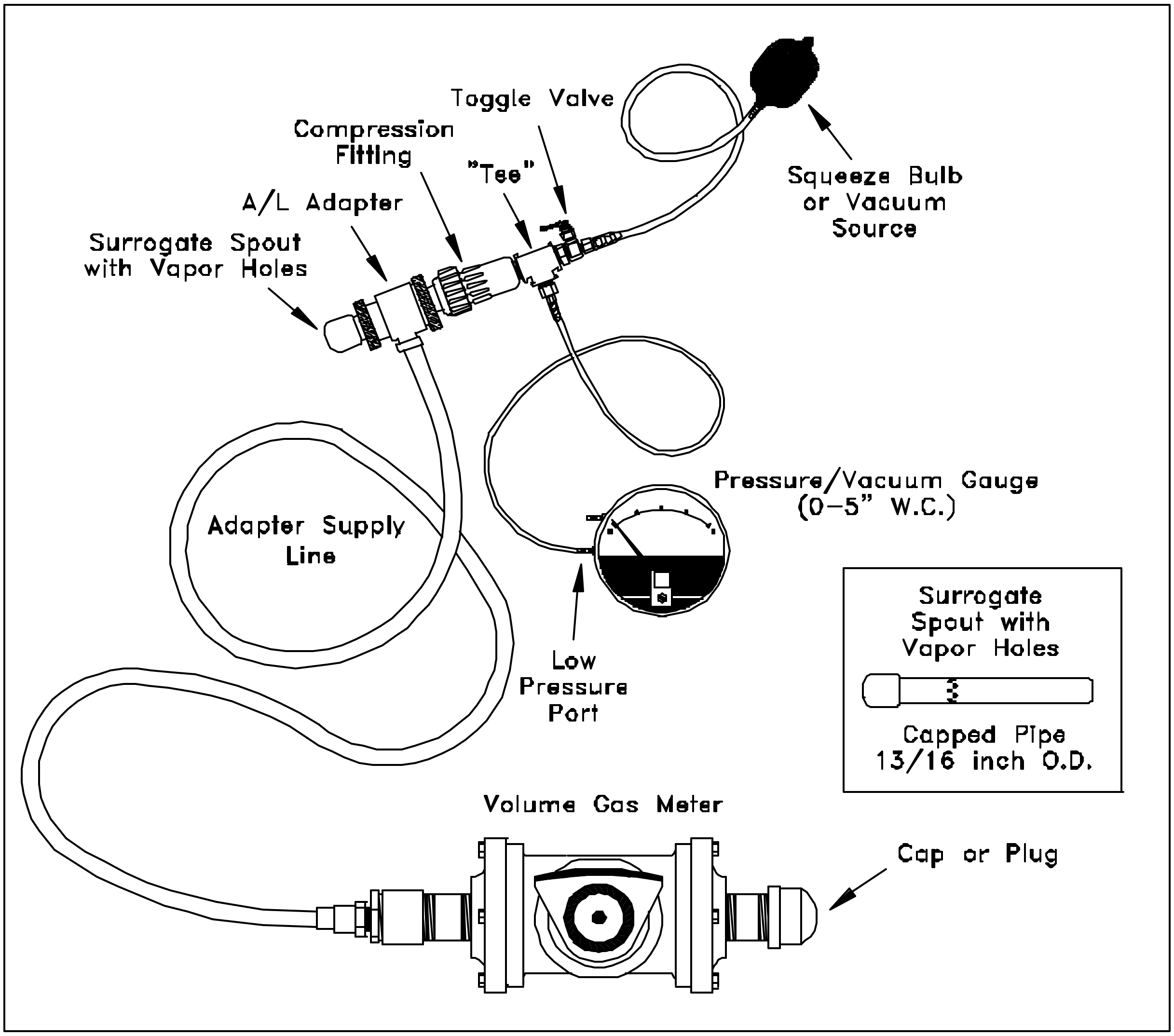
A copy of the most current calibration shall be kept with the meter.

Figure 3
Assembled Air To Liquid Volume Ratio Test Equipment



6.4 A one-time test to verify proper design of the tee connection at the gas volume meter shall be conducted. Disconnect the A/L adaptor from the nozzle and dispense between four and one-half and five (4.5 - 5.0) gallons into the portable test can, insuring a tight fit at the nozzle spout/portable tank fill pipe. The design is acceptable if the displacement on the gas volume meter is less than 0.01 cubic feet.

Figure 4
Air To Liquid Adapter Leak Test Assembly



6.5 Verify that the O-rings in the A/L adaptor, if applicable, are present and in good condition. O-rings with nicks, tears, or other deformations shall be replaced prior to the test. The O-rings shall be properly greased to ensure a vapor tight connection. Refer to the A/L adaptor manufacturer's instructions for recommendations. If the O-rings are lubricated before each test, the chance of an improper seal between the nozzle spout and the A/L adaptor is reduced.

6.6 Conduct a pre-test leak check of the A/L adaptor by connecting the A/L adaptor to a surrogate spout as shown in Figure 4. Induce a vacuum of five inches H_2O, gauge (5.00"WCg). Start the stopwatch. The vacuum shall be at least 4.95 "WCg after three minutes from the start of the leak check. Any test equipment which fails this pre-test leak check shall not be used to conduct A/L testing for the purpose of determining compliance. Other leak check protocols are acceptable, provided they have been approved, in writing, by the Executive Officer.

6.7 This test procedure shall be conducted with the storage tank pressure/vacuum (P/V) valve(s) installed and the Phase I poppetted vapor coupler(s) in the closed position, **unless** otherwise specified by the Executive Officer or in the applicable CARB EO. If removal of the P/V valve during the test is required, use care to remove and store the valve until the test is completed and the valve is to be reinstalled.

6.8 Determine whether the processor, if applicable, should remain in operation during the test or be turned off. For compliance testing review the applicable certification EO.

6.9 With the portable tank and A/L test equipment assembled, dispense between four and one-half and five (4.5 - 5.0) gallons into the portable tank. This provides to initially condition the portable tank with gasoline vapors. This initial conditioning shall be conducted once per facility, prior to beginning testing at each facility.

7. TEST PROCEDURES

7.1 Carefully connect the A/L adaptor to the nozzle spout as shown in Figure 1, isolating the vapor ports of the nozzle and insuring a tight connection.

7.2 Record the initial reading from the index of the gas volume meter on the A/L Field Data Summary, as shown in Form 1. This initial reading shall be taken before each test. Do not use the final reading from the preceding test as the initial reading for the current test, unless it has been verified. This is necessary since the meter index may have moved due to the low pressure drop through the meter.

7.3 Reset the stopwatch and, if appropriate, reset the totalizer on the dispenser.

7.4 Fully engage the nozzle trigger and begin dispensing into the portable gasoline tank. **Ensure that the nozzle spout is in contact with the grounded tank assembly during dispensing**. Start the stopwatch when the totalizer indicates dispensing has started.

7.5 Dispense between four and one-half (4.5) and five (5.0) gallons of gasoline. If the applicable CARB Executive Order specifies an amount different than this range, the CARB required quantity shall be used.

If the nozzle being tested introduces liquid into the test equipment, the A/L of that nozzle shall be deemed a failure.

7.6 Simultaneously stop both the stopwatch and gasoline dispensing.

7.7 The following data for each test shall be recorded on the A/L Field Data Summary as shown in Form 1:

7.7.1 Dispenser (pump) number
7.72 Gas grade
7.73 Nozzle model and serial number
7.74 Initial gas volume meter reading, in cubic feet
7.75 Initial totalizer reading from the dispenser, in gallons
7.76 Final gas volume meter reading, in cubic feet
7.77 Final totalizer reading from the dispenser, in gallons
7.78 Elapsed time during dispensing, in seconds

Note: Units other than cubic feet, gallons, and seconds may be used, provided that Equation 9-1 is appropriately modified.

For certification testing, the test data are used to determine the A/L Volumetric Ratio that will be specified in the CARB EO. For compliance testing, continue as described below.

7.8 If the A/L Volumetric Ratio, as determined by Equation 9-1 is within the limits specified in the applicable CARB EO, the refueling point complies with the specifications of the applicable EO.

7.9 If the A/L Volumetric Ratio is outside the range specified in the applicable CARB EO by an A/L value of less than or equal to 0.10, conduct the test two additional times. Do not make adjustments to the gasoline dispensing or vapor recovery lines until all three test runs have been completed. Adjustments of the A/L test equipment, including the A/L adaptor and nozzle, is allowed as may be necessary to insure measurement accuracy. If the A/L test equipment is adjusted, then the prior test run results for that nozzle should not be used. Calculate the numerical average of the three test runs. If the average A/L value of these three test runs is within the allowable limits, compliance has been verified. If the resulting average is outside of the specified limits, the refueling point does not comply with the specifications of the applicable CARB EO.

If the A/L Volumetric Ratio is outside the range specified in the applicable CARB EO by an A/L value of greater than 0.10, the refueling point does not comply with the specifications of the applicable CARB EO.

7.10 If more than one nozzle share vacuum plumbing with the test nozzle, one troubleshooting method for a low A/L ratio is to seal all nozzles other than the nozzle being tested, e.g., plastic bags and tape or rubber bands. If leaks in the nozzles/check valves served by common vacuum pump cause the bags to deflate, the low A/L ratio may have been caused by a leak through an idle nozzle during the test. **The A/L test to verify compliance, however, shall be conducted without "bagging" any of the nozzles.**

7.11 To avoid a build-up of gasoline, drain any condensed gasoline, periodically or after each test run, from the hoses between:
(a) the gas volume meter and portable tank assembly, and
(b) the A/L adaptor and gas volume meter.

8. POST-TEST PROCEDURES

8.1 Remove the A/L adaptor from the nozzle.

8.2 Drain the dispensed product into the appropriate gasoline storage tank at the facility. **Ground the portable tank assembly to the storage tank before draining**. Do not mix product grades in the portable tank assembly without approval of the facility owner and use caution to drain the portable tank into the correct facility storage tank. If blending valves are utilized to produce product grades which do not have a dedicated storage tank, product from the blended grade shall be returned to the lower octane tank.

8.2.1 If the P/V valve was removed during the test, as specified in the applicable CARB EO, replace the valve prior to draining the product from the portable tank assembly to the storage tank after the last A/L test run is completed. Use liquid leak detector or a bagging technique to verify the absence of leaks at the interface between the P/V valve(s) and vent pipe(s). As an alternative, nitrogen may be used to impose a pressure in the storage tank headspace of between 1.5 and 2.5 inches H_2O prior to using the liquid leak detection solution or bagging technique.

8.3 At the conclusion of testing at the facility, conduct a post-test leak check of the A/L adaptor by connecting the A/L adaptor to a surrogate spout as shown in Figure 4. Raise the test pressure to five inches H_2O, gauge (5.00"WCg). Squirt liquid leak detector solution on interfaces and other potential leak sources while watching for the formation of bubbles. There shall be no formation of bubbles, or a drop in pressure below 4.95 "WCg for three minutes from the start of the test. The data collected during the A/L testing is invalid if the test equipment fails this post-test leak check.

8.4 Prior to transportation, the inlet and outlet of the gas volume meter shall be carefully sealed to prevent foreign matter from entering the meter.

8.5 At the conclusion of testing, the portable tank shall be transported in accordance with all applicable safety requirements.

9. CALCULATING RESULTS

9.1 The A/L Volumetric Ratio shall be calculated as shown in Equation 9-1.

$$A/L = \left[\frac{y(Vf - Vi)}{G_f - G_i}\right] \times 7.481 \qquad \textbf{[Equation 9-1]}$$

Where:

A/L = Air to Liquid Volumetric Ratio, dimensionless
y = Correction factor for gas volume meter. See Equation 9-3.
V_i = Initial gas volume meter reading, cubic feet
V_f = Final gas volume meter reading, cubic feet
G_i = Initial totalizer reading from the dispenser, gallons
G_f = Final totalizer reading from the dispenser, gallons
7.481 = Conversion factor from gallons to cubic feet, gallons per cubic foot

9.2 The gasoline dispensing rate during the A/L test shall be calculated as shown in Equation 9-2.

$$Q_g = \left[\frac{G_f - G_i}{t}\right] \times 60 \qquad \textbf{[Equation 9-2]}$$

Where:

Q_g = Gasoline dispensing rate, gallons per minute
G_i = Initial totalizer reading from the dispenser, gallons
G_f = Final totalizer reading from the dispenser, gallons
t = Elapsed time during dispensing event, seconds
60 = Conversion factor, seconds per minute

9.3 The correction factor for correcting observed values of the gas volume meter shall be calculated as shown in Equation 9-3.

$$y = \left[\frac{V_r}{V_m}\right] \qquad \textbf{[Equation 9-3]}$$

Where:

y = Correction factor for the gas volume meter's observed reading, dimensionless
V_r = True volume from current calibration of gas volume meter, cubic feet
V_m = Corresponding observed reading from gas volume meter, cubic feet

10. REPORTING RESULTS

10.1 Results submitted to a local air district for approval shall include the A/L Field Data Sheet as shown in Form 1, or other format specified by the local air district.

11. ALTERNATE PROCEDURES

11.1 This 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 ARB Executive Officer, pursuant to Section 14 of Certification Procedure CP-201.

A/L Field Data Sheet

GDF Name and Address _______________ _______________ _______________	**A/L Field Data Sheet**	Testing Firm Name and Address: _______________ _______________ _______________ Phone No. ( )
Test Date/Time:		Test Performed by:
Pre-Test Leak Check: Initial/Final Pressures, in. H_2O _____ / _____ **Post-Test Leak Check:** Initial/Final Pressures, in. H_2O ___ _ / _____	Source: **GDF Phase II Vapor Recovery** **GDF #** ____________ **Permit #** ____________	VN Recommendation: Y/N ________ Applicable CARB EO # ________ Allowable A/L Range ________

Pump #	Gas Grade	Nozzle Model & Serial #	Initial Totalizer, Gallons	Final Totalizer, Gallons	Gas Pumped, Gallons	Time, Seconds	Dispensing Rate, Gpm	Starting Meter Reading	Ending Meter Reading	A/L

Inspection Procedure **GDF-01**

Gasoline Dispensing Facilities

BAG TEST FOR MULTI-NOZZLE VACUUM ASSIST SYSTEMS

1. PURPOSE

1.1 This inspection procedure provides a method to determine if "bootless" vacuum assist vapor recovery nozzles allow air ingestion into the vapor recovery system which degrades its performance during vehicle refueling. The procedure can also isolate the source of air leakage. It can be used on dispensers that have three nozzles on each side with built-in integral check valves.

2. PRINCIPLE

2.1 A plastic bag is placed over the nozzle and sealed around the hose at the base of the nozzle. The bag is observed while another nozzle on the same side of the dispenser dispenses at least 2.5 gallons of fuel into a vehicle. If the bag shows a definite collapsing during the dispensing event, there is a leak in the bagged nozzle causing ingestion of air into the vapor recovery system. Ingestion of air will reduce nozzle vapor recovery effectiveness and increase gasoline evaporation in the system.

3. INTERFERENCES

3.1 If the vapor recovery vacuum pump is not operational, this procedure will not detect a leaking nozzle.

3.2 If the vapor passage of the hose has a column of gasoline larger than the vacuum capabilities of the vacuum pump, a leaking nozzle may not be detected.

3.3 Some models of dispensers cannot set the price-per-gallon if more than one nozzle is removed from the dispenser holster. Wait until the price has been set before removing the nozzle to be tested.

3.4 The nozzle being tested and the nozzle dispensing fuel must be connected to the same common vapor piping and vacuum pump.

3.5 This procedure cannot be used on single nozzle dispensers or passive systems such as a balance system.

3.6 Any holes in the bag will bias the test procedure to indicate compliance.

4. EQUIPMENT

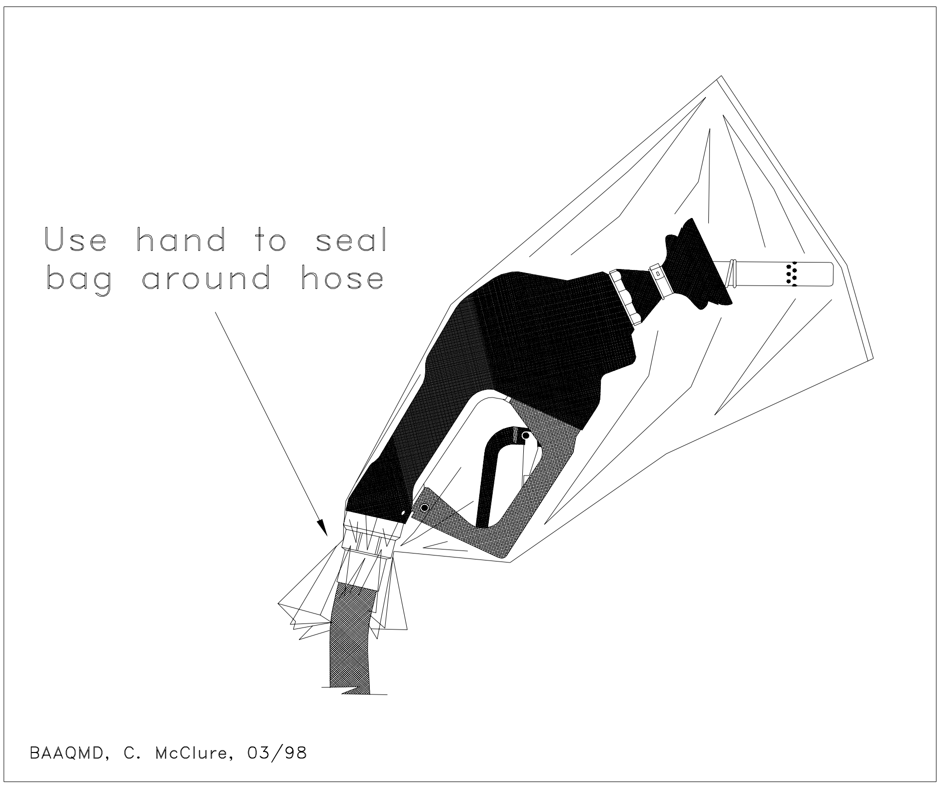
4.1 **Bag**. Use a polyethylene plastic bag large enough to enclose the entire vapor recovery nozzle. Recommended sizes for a polyethylene bag are 10 to 12 inches in width and 18 to 20 inches in length. The bag should be at least 1.5 mils thick, but not greater than 4 mils thick. Bags that are too thin will tend to break while bags that are too thick may tend to mask a leak in the nozzle.

4.2 **Data Sheet**. Use a data sheet to keep track of which nozzles have been tested. This data sheet will help ensure and verify that all nozzles have been checked on a routine basis. An example of a data sheet is shown in Figure 3.

5. INSPECTION PROCEDURE

5.1 Visually inspect the polyethylene plastic test bag to verify it has no holes. After product flow from one of the nozzles into a vehicle has been initiated, pick up one of two nozzles not being used and carefully place the entire nozzle into the plastic bag. Avoid tipping the nozzle spout downward, which may cause spillage of gasoline. Once again, visually inspect the test bag to ensure no holes were caused by inserting the nozzle. Ensure that some air is in the bag and use your hand to provide a tight seal between the bag and the nozzle/hose connection. See Figure 1. Watch the bag for signs of collapse. If the bag does not show a definite collapse due to air being removed after 2.5 gallons, remove the nozzle from the bag, hang it back up on the dispenser, and check the other idle nozzle.

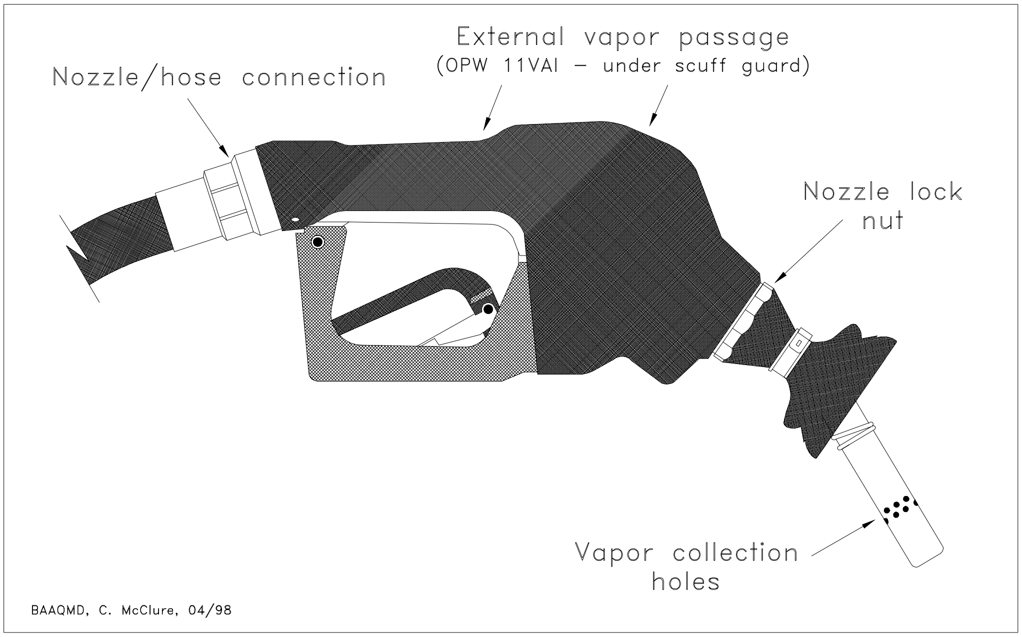
FIGURE 1
Bag and Nozzle



5.2 If the bag collapses, it verifies that there is air leaking into the nozzle. The following additional tests may be done to determine where the leak is occurring:

5.2.1 Use your hand to seal the bag on the nozzle body just below the nozzle lock nut. Make sure some air is in the bag to start. If no collapse of the bag is observed, the leak is probably through the nozzle vapor passage. If the bag does collapse, use your hand to seal the bag just below the spout's vapor collection holes. Again make sure that some air is in the bag. If the bag collapses when sealed below the vapor collection holes, the leak is probably at the nozzle's vapor check valve. If the bag fails to collapse after being sealed just below the spout vapor collection holes, the leak was probably at the nozzle lock nut. See Figure 2 for illustration of nozzle components.

FIGURE 2
Typical Nozzle Components



5.3 Record the presence or absence of leaks on the data sheet. Retain this data sheet as a record of which nozzles have been tested for leaks, corrective actions taken and re-tests performed.

5.4 Replace the nozzle component that caused the leak or, If the leak was caused by the nozzle vapor check valve, replace the nozzle. After replacing defective components or the nozzle, retest the new or repaired nozzle as outlined in this procedure.

5.5 To check all three nozzles on the side of a dispenser will require at least two vehicles refueling with different product grades.

6. RECORDING DATA

6.1 Results of the bag test should be tabulated on a data sheet to provide a record of nozzles checked and a reminder to take corrective action to fix leaks found.

6.2 Routine bag testing will help minimize the emissions of gasoline vapors and reduce evaporation of liquid gasoline.

This Inspection Procedure developed by the Source Test Section of the
Bay Area Air Quality Management District

FIGURE 3
BAG TEST DATA SHEET-INSPECTION PROCEDURE GDF-01

STATION NAME ______________________ ADDRESS ______________________

CITY ______________________ PHONE ______________________

DISPENSER MODEL # ______________________ NUMBER OF NOZZLES ______________________

PUMP #	GAS GRADE	NOZZLE BRAND	NOZZLE SERIAL #	NOZZLE LEAKS [Y/N]	LOCATION OF LEAK	CORRECTIVE ACTION	DATE REPAIRED
1	87						
1	89						
1	92						
2	87						
2	89						
2	92						
3	87						
3	89						
3	92						
4	87						
4	89						
4	92						
5	87						
5	89						
5	92						
6	87						
6	89						
6	92						
7	87						
7	89						
7	92						
8	87						
8	89						
8	92						
9	87						
9	89						
9	92						
10	87						
10	89						
10	92						

TEST CONDUCTED BY ______________________ DATE ______________________

Inspection Procedure **GDF-02**

Gasoline Dispensing Facilities

BAG TEST FOR SINGLE-NOZZLE VACUUM ASSIST SYSTEMS

1. PURPOSE

1.1 Air ingestion caused by a leaking nozzle degrades vapor collection during vehicle refueling and increases pressure-related fugitive emissions by promoting gasoline evaporation in the vapor recovery system. This inspection procedure provides a method to determine if “bootless” Phase II vacuum assist vapor recovery nozzles allow air ingestion into the vapor recovery system. It can be used on dispensers that have one nozzle on each side.

2. PRINCIPLE

2.1 A plastic bag is placed over the nozzle, with the nozzle spout extending through a small hole in the sealed end of the bag. The bag is secured to the nozzle, both at the spout and at the base of the nozzle. After dispensing has started, the nozzle is latched in the high-clip mode and the bag is observed while the nozzle dispenses at least 2.5 gallons of fuel into a vehicle. If the bag shows a definite collapsing during the dispensing event, there is a leak in the nozzle, causing ingestion of air into the vapor recovery system.

3. INTERFERENCES

3.1 If the vapor recovery vacuum pump is not operational, this procedure will not detect a leaking nozzle.

3.2 If the vapor passage of the hose has a column of gasoline larger than the vacuum capabilities of the vacuum pump, a leaking nozzle may not be detected.

4. EQUIPMENT

4.1 **Bag**. Use a bag large enough to enclose the entire vapor recovery nozzle. Recommended sizes for a polyethylene bag are 10 to 12 inches in width and 18 to 20 inches in length. The bag should be at least 1.5 mils thick, but not greater than 4 mils thick. Bags that are too thin will tend to break while bags that are too thick may tend to mask a leak in the nozzle. A small hole, approximately 0.75 inches in diameter, must be cut into the sealed end of the bag. The nozzle spout will be inserted through this hole.

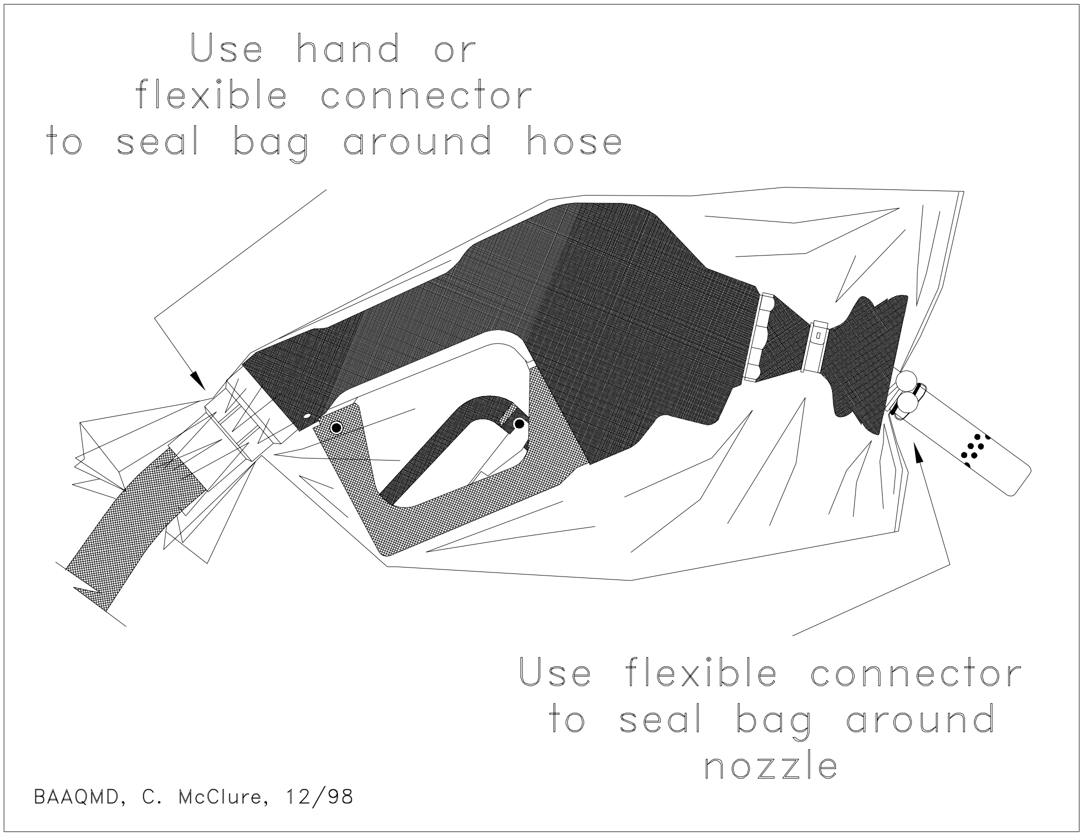
4.2 **Data Sheet**. Use a data sheet to keep track of which nozzles have been tested. This data sheet will help ensure and verify that all nozzles have been checked on a routine basis. Example of a data sheet is shown in Figure 3.

4.3 **Flexible Connector.** Use a flexible connector, such as a tie-wrap or twin bead hair fastener to secure the bag to the nozzle spout and, if desired, to the nozzle/hose connection. See Figure 2 for nozzle component identification.

4.4 **Approved Gas Can.** Use an approved gas can to hold any gasoline that can be drained from the nozzle/hose assembly prior to connecting the bag.

FIGURE 1

Bag and Nozzle



5. INSPECTION PROCEDURE

5.1 Remove the nozzle to be tested from the dispenser holster. Carefully drain any liquid retain from the nozzle/hose assembly into the approved gas can. Slip the bag over the nozzle, inserting the spout through the small hole in the end of the bag. Use a flexible connector to secure the bag to the nozzle spout, ensuring that at least three (3.0) inches of spout length is exposed. Insert the spout into the vehicle tank and begin dispensing. Ensure that some air is in the bag and use your hand, or a flexible connector, to provide a tight seal between the bag and the nozzle/hose connection. See Figure 1. Watch the bag for any signs of collapse. If the bag does not show a definite collapse due to air being removed after 2.5 gallons, the nozzle is probably vapor tight and the test is over.

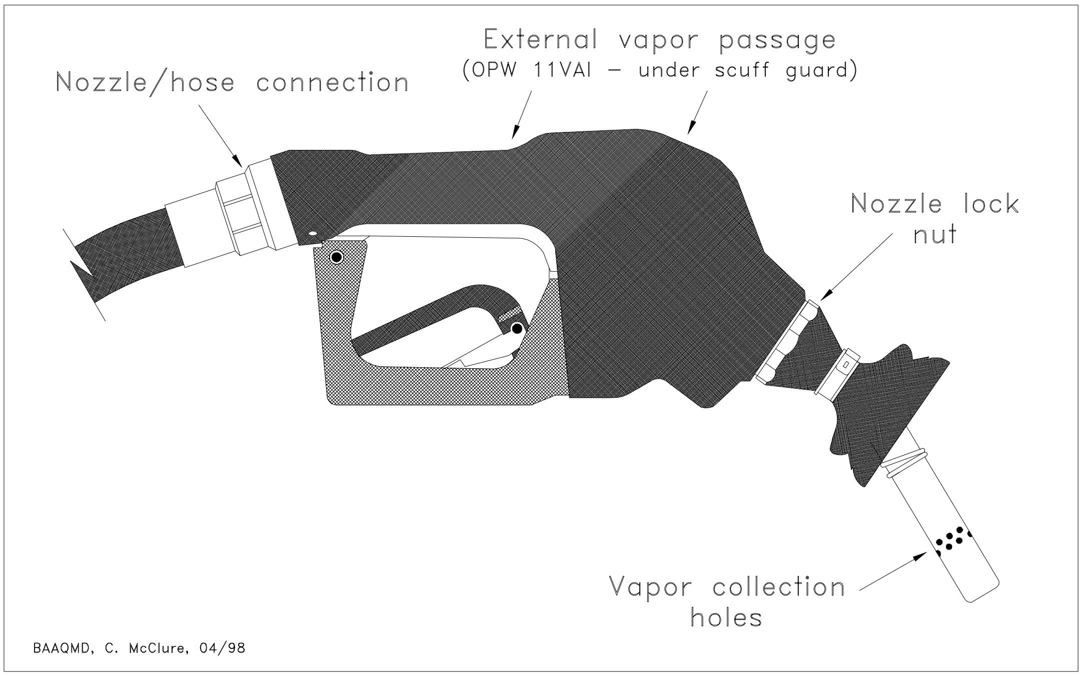
5.2 If the bag collapses, it verifies that there is air leaking into the nozzle and the nozzle must be repaired or replaced.

5.3 Record the presence or absence of leaks on the data sheet. Retain this data sheet as a record of which nozzles have been tested for leaks, corrective actions taken and re-tests performed.

5.4 Replace the nozzle component that caused the leak, or replace the nozzle. After replacing defective components or the nozzle, retest the new or repaired nozzle as outlined in this procedure.

FIGURE 2

Typical Nozzle Components



6. RECORDING DATA

6.1 Results of the bag test should be tabulated on a data sheet to provide a record of nozzles checked and a reminder to take corrective action to fix leaks found.

6.2 Routine bag testing will help minimize the emissions of gasoline vapors and reduce evaporation of liquid gasoline.

This Inspection Procedure developed by the Source Test Section of the
Bay Area Air Quality Management District

FIGURE 3
BAG TEST DATA SHEET-INSPECTION PROCEDURE GDF-02

STATION NAME ______________________________ **ADDRESS** ____________________________________

CITY ______________________________________ **PHONE** ____________________________________

DISPENSER MODEL # _________________________ **NUMBER OF NOZZLES** _________________________

PUMP #	NOZZLE BRAND	NOZZLE SERIAL #	NOZZLE LEAKS [Y/N]	LOCATION OF LEAK	CORRECTIVE ACTION	DATE REPAIRED

TEST CONDUCTED BY:____ DATE:________________________

Inspection Procedure **GDF-09**

Gasoline Dispensing Facilities

PHASE II BALANCE SYSTEM
NOZZLE INSERTION INTERLOCK OPERATION DETERMINATION

1. PURPOSE

1.1 The purpose of this inspection procedure is to provide a methodology to determine the compliance status of the insertion interlock mechanism of Phase II balance system nozzles.

2. PRINCIPLE AND SUMMARY

2.1 The insertion interlock mechanism of the nozzle is checked to ensure that fuel cannot be dispensed without activating the dispenser and compressing the nozzle bellows.

3. BIASES AND INTERFERENCES

3.1 If the bellows of the balance system nozzle is not fully compressed during the procedure specified in Section 5.2, results may be biased toward noncompliance.

3.2 If the proper methodology for the specific nozzle type is not employed the results may be biased toward noncompliance.

4. EQUIPMENT

4.1 **Approved Gas Can**. Use an approved gas can to hold any gasoline that may be dispensed during testing.

4.2 **Stopwatch.** Use a stopwatch accurate to ± 0.2 seconds.

4.3 **Field Data Sheet.** Use a data sheet to record which nozzles have been tested and their respective compliance status. This field data sheet will help ensure, and verify, that all nozzles have been checked on a routine basis. An example of a Field Data Sheet is shown in Form 1.

5. INSPECTION PROCEDURE

5.1 The following nozzles may be tested for proper operation of the insertion interlock **WITHOUT** activating the dispenser:

Emco Wheaton A4000	Emco Wheaton A4003
Rainbow RA4000	Emco Wheaton A4005
Emco Wheaton A4001	Rainbow RA4005
Rainbow RA4001	EZ-flo Rebuilt A4000
Emco Wheaton A4002	EZ-flo Rebuilt A4001
OPW-111V	Husky Model V

5.2 If the nozzle to be tested is listed in Section 5.1, remove the nozzle from the dispenser holster. **DO NOT ACTIVATE THE DISPENSER**. Carefully tip the nozzle spout into the gas can to collect any retained gasoline. **WITHOUT COMPRESSING THE BELLOWS,** pull the nozzle trigger.

5.3 Note if the trigger had, or did not have, tension on the Field Data Sheet, as shown in Form 1. Tension on the trigger without the bellows being depressed indicates that the interlock is not working properly and that the nozzle must be repaired or replaced.

5.4 If the nozzle is not on the list in Section 5.1, activate the dispenser and place the nozzle spout tip so that any dispensed gas would flow into the approved gas can but so that the **BELLOWS ARE NOT COMPRESSED**. (In addition, any bellows-equipped balance nozzle may be tested using this method. However, testing nozzles listed in Section 5.1 using this method may create unnecessary emissions caused by the "spitting" or spilling of retained gasoline.)

5.5 Simultaneously pull the nozzle trigger and start the stopwatch. Observe whether gasoline continues to flow after 2 seconds. Release the trigger. If fuel continues to be dispensed after 2 seconds, the insertion interlock is not working properly and the nozzle must be repaired or replaced.

5.6 Carefully empty the gasoline from the gas can into the LOWEST OCTANE Phase I product riser, as necessary.

6. RECORDING DATA

6.1 Complete the station information at the top of Form 1 and record the following information:

a) Dispenser Number
b) Gasoline Octane or Grade
c) Nozzle Make and Model Number
d) Was Trigger Tension Noted or
e) Was Fuel Dispensed After Two Seconds
f) Name of Person Conducting the Test and Test Date

FORM 1

BALANCE NOZZLE INSERTION INTERLOCK OPERATION

INSPECTION PROCEDURE GDF-09

STATION NAME: ______________________________ **ADDRESS:** ______________________________

CITY: ______________________________ **PHONE:** ______________________________

PHASE II SYSTEM TYPE: ______________________________ **NUMBER OF NOZZLES:** ______________________________

DISPENSER #	GAS GRADE [87,89,92]	NOZZLE MAKE	NOZZLE MODEL #	TRIGGER TENSION OR FUEL DISPENSED AFTER 2 SECONDS [YES OR NO]	PASS/ FAIL	DATE REPAIRED

TEST CONDUCTED BY: ______________________________ DATE: ______________________________

United States
Environmental Protection
Agency

Environmental Monitoring Systems
Laboratory
Research Triangle Park NC 27711

Research and Development

EPA-600/4-77-027b Feb. 1984

EPA

Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III. Stationary Source Specific Methods

Addition Section 3.12

Volume III
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Environmental Protection
Agency

Environmental Monitoring Systems
Laboratory
Research Triangle Park NC 27711

Research and Development

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EPA

Section 3.12
Method 9—Visible Determination of the Opacity of Emissions from Stationary Sources

Outline

Summary

Many stationary sources discharge plume-shaped visible emissions into the atmosphere. Method 9 (EPA Reference Method) is used to determine the opacity of this plume by qualified observers. The method includes procedures for the training and certification of observers and procedures to be used by these observers in the field to determine plume opacity. This section of the Quality Assurance (QA) Handbook primarily concerns procedures used by the observers. Only Section 3.12.1 reviews the training and certification procedures, which are described in Reference 1.

The appearance of a plume as viewed by an observer depends upon a number of variables, some of which may be controllable and some of which may not be controllable in the field. Variables which can be controlled to an extent to which they no longer exert a significant influence upon plume appearance include: angle of the observer with respect to the plume; angle of the observer with respect to the sun; point of observation of attached and detached steam plumes and angle of the observer with respect to a plume emitted from a rectangular stack with a large length to width ratio. The

method includes specific criteria applicable to these variables.

Other variables which may not be controllable in the field are luminescence and color contrast between the plume and the background against which the plume is viewed. These variables exert an influence upon the appearance of a plume as viewed by an observer, and can affect the ability of the observer to accurately assign opacity values to the observed plume. Research studies of plume opacity have demonstrated that a plume is most visible and presents the greatest apparent opacity when viewed against a contrasting background. It follows from this, and is confirmed by field trials, that the opacity of a plume, viewed under conditions where a contrasting background is present can be assigned with the greatest degree of accuracy. However, the potential for a positive error is also the greatest when a plume is viewed under such contrasting conditions. Under conditions presenting a less contrasting background, the apparent opacity of a plume is less and approaches zero as the color and luminescence contrast decrease toward zero. As a result, significant negative bias and negative errors can be made when a plume is viewed under less contrasting conditions. A negative bias decreases rather than increases the possibility that a plant operator will be cited for a violation of opacity standards due to observer error.

Method 9 is applicable for the determination of the opacity of emissions from stationary sources pursuant to 60.11(b). Studies have been undertaken to determine the magnitude of positive errors that qualified observers can make while reading plumes under contrasting conditions and using the procedures specified in Method 9. The results of these studies, which involve a total of 769 sets of 25 readings each, are as follows:

1. In the case of black plumes, 100 percent of the sets were read with positive error of less than 7.5 percent opacity; 99 percent were read with a positive error of less than 5 percent opacity.
2. In the case of white plumes, 99 percent of the sets were read with a positive error (higher values) of less than 7.5 percent opacity; 95 percent were read with a positive error of less than 5 percent opacity.

The positive observational error associated with an average of twenty-five readings is therefore established. The accuracy of the method must be taken into account when determining possible violations of applicable opacity standards.

Note: Proper application of Method 9 by control agency personnel in determining the compliance status of sources subject to opacity standards often involves a number of administrative and technical procedural steps not specifically addressed in the *Federal Register* method. Experience has shown these steps are necessary to lay a proper foundation for any subsequent enforcement action. To clearly delineate items that are EPA procedural policy and requirements of the Method 9 from additional quality assurance procedures, a wording scheme was developed. All of Sections 3.12.1, 3.12.2, 3.12.3, 3.12.6, and 3.12.7 are suggested quality assurance procedures except where noted as EPA policy or *Federal Register* citings. Section 3.12.4 notes EPA requirements with directive statements using words such as shall, should, and must. QA procedures are noted either with suggestive statements using words such as recommended, suggested, and beneficial or by stating that the entire subsection is recommended. The use of these QA procedures should provide a more consistent program, improved observer effectiveness and efficiency, and improved data documentation.

Method Highlights

Section 3.12 primarily describes Method 9 procedures for the determination of plume opacity. Section 3.12.1 briefly reviews the quality assurance procedures to be used in the observer training and certification procedures described in detail in Reference 1. The remaining sections describe the field procedures.

Section 3.12.10 provides blank data forms recommended for use by the observer and other personnel, as required. Partially completed forms are included in Sections 3.12.1 through 3.12.7 of the Method Description. Each form in Section 3.12.10 has a subtitle (e.g., Method 9, Figure 2.1) to allow easy reference to the corresponding completed form.

The following paragraphs present a brief discussion of the contents of this section of the QA Handbook.

1. *Certification and Training of Observers* The primary purpose of this section is to provide a brief summary of the certification and training procedures described in Reference 1. It includes a definition and a brief history of opacity, and it discusses observer training procedures and certification and recertification of observers.

2. *Procurement of Apparatus and Supplies* Section 3.12.2 presents specifications criteria and design features to aid the procurement of useful equipment that would provide good quality visible emissions data. The following are some recommended equipment items not specifically required by Method 9: watch, compass, range finder, Abney level or clinometer, sling psychrometer, binoculars, camera, safety equipment, clipboard, and accessories. Table 2.1 summarizes the quality assurance aspects of equipment procurement.

3. *Preobservation Operations* Section 3.12.3 summarizes the preobservation activities: gathering facility information, providing prior notification, establishing protocol, and performing equipment checks. Table 3.1 summarizes these procedures.

4. *On-Site Field Observations* Section 3.12.4 contains detailed procedures for determining the visible emissions (VE). This section not only includes the recommended procedures for performing the perimeter survey, plant entry, and VE determination; it also contains a subsection on special observation problems. This subsection explains how to take VE readings under less than ideal conditions (e.g., when the observer position is restricted). The main feature of this section is the presentation of detailed instructions on how to complete the recommended VE data form, and examples of completed forms.

5. *Postobservation Operations* Section 3.12.5 presents a brief discussion concerning the data reporting procedures, data summary, data validation, and equipment check. Section 3.12.6 contains a discussion of the calculations required for completing the data forms and reports. It also includes procedures for calculating the path length through the plume and for predicting steam plume formation by use of a psychrometric chart and pertinent measurements.

6. *Auditing Procedures* Section 3.12.7 recommends performance and system audits for use with field VE determinations. The two performance audits are an audit by senior observer/supervisor and a data calculation audit. A system audit is suggested, along with a Method 9 checklist, as shown in Figure 7.1. Table 7.1 summarizes the quality assurance activities for audits.

7. *References and Bibliography* Sections 3.12.8 and 3.12.9 contain the Method 9 and suggested references and bibliography.

8. *Data Forms* Section 3.12.10 provides blank data forms which can be taken from the QA Handbook for field use or serve as the basis of a revised form to be used by the Agency. Partially completed forms are included in the corresponding section of the QA Handbook.

1.0 Certification and Training of Observers

The purpose of this section is to summarize the content of the QA manual for VE training programs.[1] Since the observer must be properly certified or a qualified VE reader in order to have his/her opacity reading accepted, it is important that he/she fully understand this phase of his/her training.

1.1 Definition and Brief History of Opacity

The VE evaluation system evolved from the concept developed by Maximillian Ringelmann in the late 1800's, in which a chart with calibrated black grids on a white background was used to measure black smoke emissions from coal-fired boilers. The Ringelmann Chart was adopted by the U.S. Bureau of Mines in the early 1900's and was used extensively in efforts to assess and control emissions. In the early 1950's, the Ringelmann concept was expanded to other colors of smoke by the introduction of the concept of "equivalent opacity."

The Federal government has discontinued the use of Ringelmann numbers in EPA Method 9 procedures for New Source Performance Standards (NSPS). Current procedures are based solely on opacity. Although some State regulations still specify the use of the Ringelmann Chart to evaluate black and gray plumes, the general trend is toward reading all emissions in percent opacity.

In practice, the evaluation of opacity by the human eye is a complex phenomenon and is not completely understood. However, it is well documented that visible emissions can be assessed accurately and with good reproducibility by properly trained/certified observers.

The relationships between light transmittance, plume opacity, Ringlemann number, and optical density are presented in Table 1.1. A literal definition of plume opacity is the degree to which the transmission of light is reduced or the degree to which visibility of a background as viewed through the diameter of a plume is reduced. In terms of physical optics, opacity is dependent upon transmittance (I/I_o) through the plume, where I_o is the incident light flux and I is the light flux leaving the plume along the same light path. Percent opacity is defined as follows:

Percent opacity = $(1 - I/I_o) \times 100$.

Many factors influence plume opacity readings: particle density, particle refractive index, particle size distribution, particle color, plume background, path length, distance and relative elevation to stack exit, sun angle, and lighting conditions. Particle size is particularly significant; particles decrease light transmission by both scattering and direct absorption. Thus, particles with diameters approximately equal to the wavelength of visible light (0.4 to 0.7 μm) have the greatest scattering effect and cause the highest opacity.

1.2 Training of Observer

Field inspectors and observers are required to maintain their opacity evaluation skills by periodically participating in a rigorous VE certification program. Accordingly, EPA's Stationary Source Compliance Division (SSCD) and Environmental Monitoring Systems Laboratory (EMSL) have provided the QA training document[1] to individuals who conduct VE training and certification programs. This section summarizes the training program.

1.2.1 Frequency of Training Sessions — Certification schools should be scheduled at least twice per year since Method 9 requires a semiannual recertification. It is highly recommended that training be an integral part of the certification program. A spring/fall schedule is preferable because of weather considerations. Certifying previous graduates while the smoke school is in session is more efficient and less costly than scheduling a separate session.

1.2.2 Classroom Training — The training is accomplished most effectively by holding an intensive 1- or 2-day classroom lecture/discussion session. Although this training is not required, it is highly recommended for the following reasons:

1. Increases the VE observer's knowledge and confidence for the day-to-day field practice and application.
2. Reduces training time required to achieve certification.
3. Trains the smoke reader in the proper recording and presentation of data that will withstand the rigors of litigation and strengthens an agency's compliance and enforcement program.
4. Provides a forum for the periodic exchange of technical ideas and information.

Some states require classroom training for initial certification only. It is recommended, however, that observers attend the classroom training at 3-year intervals to review proper field observation techniques and method changes and to participate in the exchange of ideas and new information.

1.2.3 Lecture Material — Example lecture material for a thorough training program is presented in Section 3.1 and Appendix A of Reference 1. A typical six-lecture classroom training program consists of the following:

Lecture 1—Background, principles, and theory of opacity.

Lecture 2—Sources of VE's, presented by someone thoroughly familiar with source conditions, related particle characteristics, and opacity reading procedures and problems.

Lecture 3—Proper procedures for conducting field observations under a variety of conditions.

Table 1.1. *Comparison of Light, Extinction Terms*

Light transmission, %	*Optical density units*	*Plume opacity, %*	*Ringelmann number*
0	N/A[a]	100	5
20	0.70	80	4
40	0.40	60	3
60	0.22	40	2
80	0.10	20	1
100	0.00	0	0

[a]*N/A = not applicable.*

Lecture 4—Influence and impact of meteorology on plume behavior.
Lecture 5—Legal aspects of VE and opacity measurements.
Lecture 6—Actual observation/testing procedures.

1.2.4 Training Equipment — An integral part of the training program is the design and operation of the smoke generator and its associated transmissometer, as specified in Method 9 (reproduced in Section 3.12.8). Such a program is essential because proper observer certification cannot take place without the proper equipment. Section 4 of Reference 1 presents performance specifications and operating procedures for smoke generators which, if followed under a good QA program, will ensure nationwide uniformity and consistency with Method 9 criteria.

The design and operation of the smoke generator has evolved significantly since the mid-1960's. The basic components of the smoke generator now include:

1. Black and white smoke generating units,
2. Fan and stack,
3. Transmissometer system, and
4. Control panel and strip chart recorder.

Table 1.2 lists the design and performance specifications for the smoke generator. It must generate smoke with an opacity range of 0 to 100 percent and be sufficiently accurate to allow the operator to control and stabilize the opacity of the smoke. It is recommended that the generator also achieve and hold opacities in 5 percent increments at ±2 percent for a minimum of 5 s.

White smoke is produced by dispensing, at regulated rates, No. 2 fuel oil into the propane-heated vaporization chamber. The opacity varies in proportion to the volume of fuel oil vaporized and is regulated by adjusting the flow of fuel oil.

Black smoke is produced by the incomplete combustion of toluene in the double-wall combustion chamber. The toluene flowrate is also controlled by valves and flowmeters.

1.2.5 Equipment Calibration Procedures — Detailed calibration procedures are included in a QA procedures manual for VE training programs.[1] The generator transmissometers must be calibrated every six months or after each repair. The National Bureau of Standards (NBS) traceable standards (optical filters) for linearity response are available from Quality Assurance Division, Environmental Monitoring Systems Laboratory, U.S. EPA, Research Triangle Park, North Carolina 27711. It is strongly recommended that the calibration be performed before and after each certification course to ascertain whether any significant drift or deviation has occurred during the training period. The "zero and span" check must be repeated before and after each test run. If the drift exceeds 1 percent opacity after a typical 30-min test run, the instrument must be corrected to 0 and 100 percent of scale before resuming the testing.

All of the smoke generator performance verification procedures (e.g., repair and maintenance work, spectral response checks, calibration check, and response time checks) should be documented in writing and dated; a bound logbook is highly recommended. These records become part of the permanent files on the VE training program.

1.2.6 Setup, Operating, and Shutdown Procedures — Detailed procedures and a parts list are given in Section 4.4 of Reference 1.

1.2.7 Storage and Maintenance of the Smoke Generator — Proper storage and maintenance procedures are essential for smoke generators to increase their useful operating life and to provide reliability.

1.2.8 Common Problems, Hazards, and Corrective Actions — The generator has hot surfaces that can cause serious burns. It is recommended that attendees be advised to stay away from the generator during training and test runs. It is also recommended that gas and fuel lines be correctly checked for leaks prior to each use of the generator to prevent fire and explosive hazards to the operator and nearby attendees.

Occasional breakdowns or malfunctions of the generator usually occur at the most inopportune times. The problem must be diagnosed and repairs made expeditiously to provide the proper training and maintain the interest of the course attendees. Some common malfunctions are listed in Section 4 of the QA training manual.[1]

1.3 Certification of Observer

This section summarizes the certification part of the training program. The first part of the certification program is to acclimate the smoke readers. The following procedure is recommended. Both black and white plumes are produced at certain levels, and during this production, the opacity values are announced. After some standards exposure, four plumes are presented to the trainee for evaluation. The correct values of the four plumes are announced to provide the trainee with immediate feedback. The majority of the trainees should be ready to take the test after a few sets. Certification runs are made in blocks of 50 readings (25 black smoke and 25 white smoke). The trainees who successfully meet the criteria receive a letter of certification and a copy of their qualification form. The school retains the original of the qualification form for a minimum of three years, to be available for any legal proceedings that might occur. According to Method 9, certification is valid for a period of *only six months*. Neither certification or recertification procedures require the observer to attend the lecture program; however, it is recommended that the observer attend the series during initial certification and thereafter every three years. It is also recommended that all persons unable to pass after 10 qualification runs, be provided additional training before allowing qualification runs to be made.

Test forms vary greatly because of the specific needs and experiences of each agency. Figure 1.1 illustrates one suggested form. The form should be printed on two-copy paper, the original for the official file and the carbon copy for the trainee to grade after each certification run. The test

Table 1.2. *Smoke Generator Design and Performance Specifications*

Parameter	*Performance*
Light source	*Incandescent lamp operated at ±5% of nominal rated voltage*
Photocell spectral response	*Photopic (daylight spectral response of the human eye)*
Angle of view	*15° maximum total angle*
Angle of projection	*15° maximum total angle*
Calibration error	*±3% opacity, maximum*
Zero and span drift	*±1% opacity, 30 min*
Response time	*5 s, maximum*

Affiliation STATE OF VIRGINIA *Name* TOM ROSE *Run Number* 1-8
Course location RICHMOND *Sunglasses* NO
Date 4-15-82 *Sky* CLEAR *Wind* 3-5 MPH
Distance and direction to stack 150 FT. NNE

Reading number																						Error
1	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
2	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
3	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
4	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
5	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
6	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
7	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
8	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
9	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
10	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
11	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
12	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
13	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
14	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
15	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
16	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
17	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
18	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
19	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
20	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
21	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
22	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
23	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
24	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
25	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	

Deviation ______

Reading number																						Error
1	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
2	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
3	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
4	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
5	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
6	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
7	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
8	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
9	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
10	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
11	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
12	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
13	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
14	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
15	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
16	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
17	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
18	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
19	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
20	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
21	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
22	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
23	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
24	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	
25	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	

Deviation ______

Figure 1.1. *Sample certification test form.*

form must be filled in completely. Certification requires that *both* of the following criteria be satisfied:

1. No reading may be in error by more than 15 percent opacity.
2. The average [absolute] error must not exceed 7.5 percent for either set of 25 white or 25 black smoke readings. The certification runs may be repeated as often as necessary. However, it is recommended that all persons who have not passed after ten certification runs be given additional training prior to conducting additional certification runs.

The detailed testing and grading procedures required to ensure a valid test are outlined in Section 5 of the QA training manual.[1] The Agency should maintain a bound logbook, arranged by training session, for at least three years, as evidence that the observer has been certified as a qualified VE evaluator by a recognized smoke training and certification group. Each trainee who successfully meets the Method 9 criteria receives a letter of certification and a copy of his/her qualification form. This letter includes the date of expiration.

1.4 Recertification

Method 9 requires an individual to be recertified every six months.

1.5 In-the-Field Training

After the observer's initial certification, it is recommended that a senior observer accompany the new observer on a field observation trip and that both individuals simultaneously record (using the same time piece) their opacity readings as a QA check (see Section 3.12.7). A comparison of these readings will indicate any problems the new observer might have in conducting observations under field conditions. A significant discrepancy between the readings of the two observers, in individual or average values, indicates the need for further in-field training and continuance of the senior observer (not necessarily the same one) QA check. After satisfactory checks have been made on two consecutive field observations, the new observer can confidently conduct inspections without a senior observer. The suggested standard for a satisfactory check for 6-min (minimum) of consecutive readings is:

1. No difference in individual readings should exceed 20 percent.
2. The difference of the average value between observers should not exceed 10 percent.

1.6 Smoke School Certification Quality Assurance Program

It is recommended that any government agency planning to develop a smoke school certification program obtain a copy of the "Recommended Quality Assurance Techniques and Procedures for Visible Emission Training Programs."[1] Table 1.3 contains an activity matrix for certification and training of observers.

Table 1.3. Activity Matrix for Certification and Training of Observers

Activity	Acceptance limits	Frequency and method of measurement	Action if requirements are not met
Classroom training of observer	*Classroom training per Ref. 1 (suggested)*	*Initially and every 3 years*	*Review training procedures per Ref. 1*
Smoke generator	*Should be able to generate smoke with an opacity range of 0 to 100%; hold opacities ±2% for at least 5 s*	*Before each certification test run; use method in Ref. 1*	*Adjust and make repeat check of operation*
Setup, operating, and shutdown procedures	*Adherence to procedures in Ref. 1*	*Each test run*	*Review procedures*
Storage and maintenance	*As above*	*As above*	*As above*
Transmissometer			
Design and performance specifications	*Specifications in Table 1.2*	*Upon receipt, repair, and at 6-mo intervals use method in Ref. 1*	*Adjust and repeat specification check until specifications are met*
Calibration	*±3% opacity maximum*	*Every 6 mo or after repair, before and after each certification course is recommended; use method in Ref. 1*	*Adjust and recalibrate until acceptance limits are met*
Zero and span	*Opacity drift <1% after a typical 30-min test run*	*As above*	*Instruments must be corrected to 0 and 100% before testing is resumed*
Certification of observer	*No reading must be in error by more than 15%* ***and*** *average absolute error must not exceed 7.5% for either white or black smoke readings*	*Take smoke reading test until a successful test has been completed*	*Retake test until successful completion*
Recertification	*As above*	*Every 6 mo take a smoke reading test until a successful test has been completed*	*As above*
In-the-field training	*No reading in error by more than 20% difference* ***and*** *average absolute error should not exceed 10% difference during the field observation*	*Checks are made on the first two field observations subsequent to the initial certification; comparison is made between new certified observer and an experienced observer*	*Continue comparisons until acceptance limits are met during two field observations*

2.0 Procurement of Apparatus and Supplies

Method 9 does not specifically require any equipment or supplies. Therefore, this entire section includes quality assurance procedures that are recommended to assist the observer in documenting data. Nevertheless, this section provides specifications criteria or design features, as applicable, to aid in the selection of equipment that may be useful in collecting VE data. Procedures and limits for acceptance checks are also provided. During the procurement of equipment and supplies, it is suggested that a procurement log (Figure 2.1) be used to record the descriptive title of the equipment, the identification number (if applicable), and results of any acceptance checks. Table 2.1 at the end of this section contains a summary of the quality assurance activities for procurement and acceptance of apparatus and supplies.

2.1 Stopwatch

A watch is used to time the 15-second intervals between opacity readings. The watch should provide a continuous display of time to the nearest second.

2.2 Compass

A compass is useful for determining the direction of the emission point from the spot where the VE observer stands and for determining the wind direction at the source. For accurate readings, the compass should be magnetic with resolution better than 10°. It is suggested that the compass be jewel-mounted and liquid-filled to dampen the needle swing; map reading compasses are excellent for this purpose.

2.3 Range Finder

A range finder is used to measure the observer's distance from the emission point and should be capable of determining distances to 1000 meters with an accuracy of ±10 percent. The accuracy of the range finder should be checked upon receipt and periodically thereafter with targets at known distances of approximately 500 meters and 1000 meters.

Item description	*Quantity*	*Purchase order number*	*Vendor*	*Date*		*Cost*	*Disposition*	*Comments*
				Ordered	*Received*			
Stopwatch	2	Z 5096	Fisher Scientific	5/1/82	5/14/82	$52.94	checked - ready to use.	

Figure 2.1. *Example of a procurement log.*

2.4 Abney Level or Clineometer

An Abney level is a device for determining the vertical viewing angle. For visible emission observation purposes, it should measure within 5 degrees. The accuracy should be tested by placing the level flat on a table that has been previously leveled with a referring level and checking it at a 45° angle by placing it on a 45° inclined plane constructed with the plane as the hypotenuse of a right triangle with equal base and height.

2.5 Sling Psychrometer

The sling psychrometer is used in cases where it is suspected that the atmospheric conditions will promote the formation of a steam plume (see Subsection 6.3). The psychrometer should consist of two thermometers, accurate to 1/2°C, mounted on a sturdy assembly whereby the thermometers may be swung rapidly in the air. One thermometer should be fitted with a wettable cotton wick tube on the bulb. Thermometer accuracy should be checked by placing the bulbs in a fresh ice water bath at 0°C.

2.6 Binoculars

It is recommended that the observer obtain binoculars preferably with a magnification of at least 8 x 50 or 10 x 50. The binoculars should have color-corrected coated lenses and a rectilinear field of view. Color correction can be checked by viewing a black and white pattern such as a Ringelmann card at a distance greater than 50 ft; no color rings or bands should be evident, only black and white. The rectilinear field of view can be tested by viewing a brick wall at a distance greater than 50 ft. There should be no distortion of the brick pattern as the field of view is changed. The binoculars are helpful for identifying stacks, searching the area for emissions and aid in characterizing behavior and composition of plume.

2.7 Camera and Accessories

A camera is often used in VE observations to document the emissions before and after the actual opacity determination. A 35-mm camera with through-the-lens light metering is recommended for this purpose. Useful accessories include a "macro" lens or a 250-mm to 350-mm telephoto lens, and a 6-diopter closeup lens (for photographing logbook and evidence of particulate deposition). A photo logbook is necessary for proper documentation, and the observer should always be sure to purchase enough fresh color negative film (ASA 100 recommended) for his/her purposes.

2.8 Clipboard and Accessories

For documenting the visible emission observation, the observer should have a 10 in. x 12 in. masonite or metal clipboard, several black ball-point pens (medium point), a large rubber band, and a sufficient number of visible emission observation forms.

2.9 Safety Equipment

The following safety equipment, which should be approved by the Occupational Safety and Health Association (OSHA), is recommended for the VE observer:

- Hard hat in high-visibility yellow or orange
- Safety glasses, goggles, or eye shields
- Ear protectors
- Safety shoes (steel-toed for general industrial use).

Specially insulated safety shoes are necessary in certain areas, such as the top of coke ovens.

Table 2.1. *Activity Matrix for Procurement of Recommended Equipment and Supplies*

Equipment	*Acceptance limits*	*Frequency and method of measurement*	*Action if requirements are not met*
Watch	*Continuous display*	*Check upon receipt*	*Return to supplier*
Compass	*Magnetic with 10° resolution*	*Check upon receipt*	*Return to supplier*
Range finder	*Accuracy of ±10% over distances to 1000 m*	*Check upon receipt and quarterly with targets at known distances of about 500 m and 1000 m*	*Adjust or return to supplier*
Abney level	*Accurate within ±5°*	*Check at 0° and 45°*	*Same as above*
Sling psychrometer	*Each thermometer accurate to 1/2°C (1°F)*	*Check thermometer accuracy with ice water bath at 0°C*	*Repair or return to supplier*
Binoculars	*Magnification of 8 x 50 or 10 x 50, color-corrected coated lenses and a rectilinear field of view*	*Check upon receipt by viewing selected objects*	*Return to supplier*
Camera	*35-mm camera with through-the-lens light metering*	*Check quality of photos on receipt and after processing film*	*Return to supplier for repair*
Clipboard/ accessories/forms	*10 in. by 12 in. clipboard; black ball-point pens; VE observation forms*	*Check supplies periodically*	*Replenish supplies*
Safety equipment	*Hardhat—yellow or orange, safety glasses and shoes, ear protectors*	*Check supply of safety equipment periodically*	*Maintain equipment availability*

3.0 Preobservation Operations

The following procedures are not required by Method 9 but are recommended in order to provide more consistent data collection and better data documentation and verification of representative plume viewing conditions. Not all procedures are needed for every observation.

Before making on-site VE determinations, the observer should gather the necessary facility data, provide prior notifications when applicable, establish an observation protocol, and check for availability of supplies and properly maintained equipment. Table 3.1 at the end of this section summarizes the quality assurance activities for preobservation operations.

3.1 Gather Facility Information

The observer should be thoroughly familiar with the source facility, operation, emissions, and applicable regulations. In preparation for the on-site visit, the observer should review the Agency's information (in the official source file) on the source in question. The observer should:

1. Determine the pertinent people to be contacted.
2. Become familiar with the processes and operations at the facility and identify those facilities to be observed.
3. Review the permit conditions, requirements, and recent applications.
4. Determine applicable emission regulations.
5. Identify all operating air pollution control equipment, emission points, and types and quantities of emissions.
6. Review history of previous inspections, source test results, and complaints.
7. Check the file to become familiar with (or review) plant layout and possible observation sites.
8. Determine normal production and operation rates.
9. Identify unique problems and conditions that may be encountered (e.g., steam plume).
10. Discuss with attorney if case development is expected.
11. Obtain a copy of the facility map with labeled emission points, profile drawings, and photographs, if available. A facility map is very helpful during inspection and should be a required item for every Agency source file. The map makes it easier for the observer to identify point sources and activities, and it may be used to mark any emission points that have been added or modified.
12. If an operating permit exists, obtain a copy because it may contain the VE limits for each point source and any special operating requirements.
13. Determine the status of the source with respect to any variance or exemption from the Agency's rules and regulations. Observation may not be required if the source has a variance or is exempt from the regulations.
14. Review plant terminology.
15. Use references such as facility maps and previous inspection reports to determine if the viewing position is restricted because of buildings or natural barriers. If the viewing position requires observations to be taken at a particular time of day (morning or evening) because of sun angle, consider this when planning the inspection.
16. Determine the possibility of water vapor in the plume condensing (see Section 3.12.6). This determination may prevent a wasted trip to the facility on days when a persistent water droplet plume is anticipated because of adverse ambient conditions.

Note: If the observer is not familiar with the type of facility or operation, he/she should consult available reference material and inspection manuals on the source category.

3.2 Prior Notification

The-usual procedure is to make the VE determination without prior notification unless the plant must be entered first to obtain a good view of the emission point of interest. However, this procedure is not always possible, especially in remote locations, when operations are intermittent, or when specific personnel must be present or contacted. Determining VE for compliance with State Implementation Plan (SIP) or NSPS opacity regulations requires on-site observations during conditions of typical or normal maximum operations. If the facility is notified of the time of this evaluation, some operating conditions may be altered. If this situation appears likely, it is EPA's policy not to give prior notification. EPA is obligated to notify State/local agencies of inspections and generally prefers to invite the applicable agency to participate. The observer should notify the affected facility and control agencies as soon as practical following any official opacity readings.

3.3 Establish Observation Protocol

Based on information collected under Section 3.1 and any prior experience with the source, an observation protocol should be established. First, the observer should determine whether one, two, or more observers will be required. For example, two observers may be required to simultaneously make the VE determination and gather other on-site data (e.g., take photographs, draw a new modified facility map if one is not available from the plant or gather other needed plant information). In certain situations where the VE observations must be correlated to process operation, the second person will closely monitor the process activity and record the exact time of the operating modes of interest. Only one observer will make the VE determination unless an observer audit is being conducted. In this case, the designated observer is the one being audited.

The applicability of Method 9 (and hence the method of observation) should be determined. If Method 9 is not applicable, see Section 3.12.4, Special Problems.

A written checklist regarding an expected walk-through of the plant including questions to ask plant officials may be helpful.

3.4 Perform Equipment Checks for On-Site Use

Be sure that the necessary equipment and supplies are available for making the VE determination and documenting the results. All equipment should be visually checked for damage and satisfactory operation before each VE determination field trip.

Table 3.1. Activity Matrix for Preobservation Operations

Activity	Acceptance limits	Frequency and method of measurement	Action if requirements are not met
Gather facility information	Obtain necessary facility data, Subsec 3.1	Check for completeness of data	Obtain missing data before on-site visit, if possible
Make prior notification	Make VE determination without prior notification except as stated in Subsec 3.2; EPA should notify State/local agencies and invite participation	Check the protocol for notification before each on-site visit and revise the protocol as necessary	Make required notifications
Establish protocol	Prepare observation protocol, Subsec 3.3	Check before on-site visit	Complete or prepare protocol as required
Perform equipment check	All equipment/supplies available and in satisfactory working order	Same as above	Replace or adjust equipment

4.0 On-Site Field Observations

This section describes field observation procedures, including perimeter survey, plant entry, VE determination, and special observation problems. The latter subsection supplements the subsection on VE determination by providing some information on how to take VE readings when unfavorable field conditions prevent the use of the procedure described in Subsection 4.3 (e.g., when the emissions are intermittent or the observer position is restricted). The QA activities are summarized in Table 4.2 at the end of this section.

4.1 Perimeter Survey

Before and after the VE determination, it is strongly recommended that the observer make a perimeter survey of the area surrounding (1) the point of observation and (2) the emission point on which the determination is being made. Such a survey also may be made during the VE determination, if warranted.

A perimeter survey can be useful in determining the presence of other factors that could affect the opacity readings. For example, the representativeness of the VE readings for a given emission point could be questioned unless data is available to show that the observer excluded emissions related to material stockpiling, open burning, and ambient condensed water vapor in adjoining areas of the plant. It is vital that the observer be as aware as much as possible of extenuating conditions. The perimeter survey is made to document these conditions. Common sense should be used in determining the need and extent of the survey; in some cases (e.g., a single 350-foot stack) a perimeter survey is not vital.

Perimeter surveys can be made from either outside or inside the plant property, or both. This decision would depend on whether the VE observations are made from inside or outside of the plant, whether the observer actually gains entry to the plant premises, and whether the plant is sufficiently visible from outside the premises to make a reasonable survey. It is suggested that during the survey the observer should note such factors as:

1. Other stacks and emission points whose visible emissions might interfere with opacity readings.
2. Fugitive emissions that result from product or waste storage piles and material handling and may interfere with observations.
3. Fugitive emissions that result from unpaved road travel and may interfere with observations.
4. Water vapor emissions from sludge or cooling ponds.
5. Open burning.
6. Any unusual activities on or around plant premises that could result in nonrepresentative emissions or interfere with opacity readings.

If deemed useful by the observer, photographs may be taken to document extenuating conditions (see discussion of confidentiality and the use of cameras in Subsection 4.2.7).

4.2 Plant Entry

The following discussion presents the recommended plant entry procedures. The VE readings themselves should not be affected by a change in these procedures. However, the usefulness of the readings in showing a possible violation of the applicable standards may be compromised by not following agency procedures for entering plants. Depending on the location of emission points at the plant and the availability of observation points in the area surrounding a facility, the VE observer may not have to gain entry to the plant premises *prior* to making VE observations. It may be preferable to gain access after taking readings to check on plant process control equipment operating conditions or to complete a perimeter survey. Figure 4.1 is an example entry checklist that can be used to assist the observer in organizing the information that could be used at the time of plant entry.

To maintain a good working relationship with plant officials and, most importantly, to comply with the Clean Air Act and avoid any legal conflict with trespass laws or the company's right to privacy and due process of law under the U.S. Constitution, the observer must follow certain procedures in gaining entry to the plant's private premises. In most cases, consent to enter (or the absence of express denial to enter) is granted by the owner or company official. Figure 4.1 lists the pertinent section of the Clean Air Act on facility entry as well as information on confidentiality of process information. It is recommended that the inspector have a copy of this information available in case questions are raised by source representatives.

4.2.1 Entry Point — It is recommended that the plant premises be entered through the main gate or through the entrance designated by the company officials in response to prior notification. The observer's arrival will usually occur during normal working hours unless conditions contributing to excess opacity levels are noted at certain times other than normal working hours. If only a guard is present at the entrance, it is desirable for the observer to present the appropriate credentials and to suggest that the guard's supervisor be contacted for the name of a responsible company official. The observer would then ask to speak with this official, who may be the owner, operator, or agent in charge (including the environmental engineer).

4.2.2 Credentials — After courteously introducing himself/herself to the company official, the observer should briefly describe the purpose of the visit and present the appropriate credentials confirming that he/she is a lawful representative of the agency. Such credentials will naturally differ depending upon the agency represented, but it is recommended that they include at least the observer's photograph, signature, physical description (age, height, weight, color of hair and eyes), and the authority for plant entry. Agencies issue credentials in several forms, including letters, badges, ID cards, or folding wallets.

4.2.3 Purpose of Visit — When first meeting with a company official, the observer needs to be prepared to state succinctly the purpose of the visit, including the reason for the VE determination. Space is provided in the recommended form (Figure 4.1) to specify the exact purpose of the visit, and the observer can refer to this when talking with the company official.

Source name and address DRI-HARD PORTLAND CEMENT 2 MILES E. OF RT. 1 ON STATE RD. 1836 ROCKY HILLS, NJ 08916	*Observer* JUDY A. SMITH *Agency* U.S. EPA REGION II *Date of VE observation* 5/5/82

Previous company contact (if applicable) GEORGE C. MEARS

Title OWNER

Purpose of visit EPA AUDIT INSPECTION AND VE OBSERVATION; REGIONAL OFFICE INSPECTS 10% OF MAJOR SOURCES IN NJ EVERY YEAR.

Emission points at which VE observations to be conducted
01 GRINDER 3-05-007-02 03 COAL-FIRED KILN 3-05-007-05
02 DRYERS #1 AND #2 3-05-007-02

Authority for entry (see reverse side)

Plant safety requirements

- ☒ Hardhat
- ☒ Safety glasses
- ☒ Side shields (on glasses)
- ☐ Goggles
- ☐ Hearing protection Specify EARMUFFS IN MARKED AREAS; PROVIDED BY PLANT
- ☒ Safety shoes (steel-toed)
- ☐ Insulated shoes
- ☐ Gloves
- ☐ Coveralls
- ☒ Dust mask suggested
- ☐ Respirator(s) Specify ______
- ☐ Other Specify ______

Company official contacted (on this visit) STANLEY O. GRAY

Title ENVIRONMENTAL ENGINEER

Figure 4.1. *Visible emission observer's plant entry checklist.*

Authority for Plant Entry: Clean Air Act, Section 114

(a)(2) the Administrator or his authorized representative upon presentation of his credentials -

(A) shall have a right of entry to, upon or through any premises of such person or in which any records required to be maintained under paragraph (1) of this section are located, and

(B) may at reasonable times have access to, and copy of any records, inspect any monitoring equipment or methods required under paragraph (1), and sample any emissions which such person is required to sample under paragraph (1).

(b) (1) Each State may develop and submit to the Administrator a procedure for carrying out this section in such State. If the Administrator finds the State procedure is adequate, he may delegate to such State any authority he has to carry out this section.

(2) Nothing in this subsection shall prohibit the Administrator from carrying out this section in a State.

(c) Any records, reports or information obtained under subsection (a) shall be available to the public except that upon a showing satisfactory to the Administrator by any person that records, reports, or information, or particular part thereof, (other than emission data) to which the Administrator has access under this section if made public would divulge methods or processes entitled to protection as trade secrets of such person, the Administrator shall consider such record, report, or information or particular portion thereof confidential in accordance with the purposes of Section 1905 of Title 18 of the United States concerned with carrying out this Act or when relevant in any proceeding under this Act."

Confidential Information: Clean Air Act, Section 114 (see above) 41 ***Federal Register*** *36902, September 1, 1976*

If you believe that any of the information required to be submitted pursuant to this request is entitled to be treated as confidential, you may assert a claim of business confidentiality, covering all or any part of the information, by placing on (or attaching to) the information a cover sheet, stamped or typed legend, or other suitable notice, employing language such as "trade secret," "proprietary," or "company confidential." Allegedly confidential portions of otherwise nonconfidential information should be clearly identified. If you desire confidential treatment only until the occurrence of a certain event; the notice should so state. Information so covered by a claim will be disclosed by EPA only to the extent, and through the procedures, set forth at 40 CFR, Part 2, Subpart B (41 ***Federal Register*** *36902, September 1, 1976.)*

If no confidentiality claim accompanies this information when it is received by EPA, it may be made available to the public by EPA without further notice to you.

Figure 4.1. *Reverse side of form. (Continued)*

The principal purpose for an observer's visit to a plant will probably fall into one of three categories: (1) a VE determination is being made pursuant to a neutral administrative scheme* to verify compliance with an applicable SIP or NSPS, (2) a VE determination is being made because some evidence of an opacity violation already exists, or (3) an unscheduled VE determination has just been made from an area off the plant property. The statement of purpose should state clearly what has prompted the visit.

At this time, the observer also should provide the company official with a copy of the opacity readings and ask that person to sign an acknowledgment of receipt of any VE readings made previous to entry. In lieu of the above, the agency should provide a copy within a reasonable time.

4.2.4 Visitor's Agreements, Release of Liability (Waivers) — The observer should not sign a visitor's agreement, release of liability (waiver), hold-harmless agreement, or any other agreement that purports to release the company from tort liability. Signing this type of release form may waive the rights of the observer and his/her employer compensation in event of personal injury or damages; the precise effect of signing an advance release of liability for negligence depends upon the laws of the state in which it is signed. If the plant official denies entry for refusal to sign a release form, the observer should proceed as described in the section on entry refusal.

4.2.5 Section 114 — Section 114 of the Clean Air Act addresses both the authority for plant entry and the protection of trade secrets and confidential information. For the observer's reference, the applicable paragraphs are included on the reverse side of the entry checklist in Figure 4.1.

4.2.6 Entry Refusal — In the event that an observer is refused entry by a plant official or that consent is withdrawn before the agreed-upon activities have been completed, the following procedural steps should be followed:

1. *Tactfully* discuss the reason(s) for denial with the plant official; this is to insure that the denial has not been based on some sort of misunderstanding. Discussion might lead to resolution of the problem and the observer may be given consent to enter the premises. If resolution is beyond his/her authority, the observer should withdraw from the premises and contact his/her supervisor to decide on a subsequent course of action.
2. Note the facility name and exact address, the name and title of the plant officials approached, the authority of the person issuing the denial, the date and time of denial, the reason for denial, the appearance of the facility, and any reasonable suspicions as to why entry was refused.
3. The observer should be very careful to avoid any situations that might be construed as threatening or inflammatory. Under no circumstances should the potential penalties of entry denial be cited.

All evidence obtained prior to the withdrawal of consent is considered admissible in court.

*Any routine of selecting sites for observation that is not directed toward any company.

When denied access only to certain parts of the plant, the observer should make note of the area(s) and the official's reason for denial. After completing normal activities to the extent possible and leaving the facility, the observer should contact his/her supervisor for further instructions.

4.2.7 Confidentiality of Data — In conducting the VE investigation, the observer may occasionally obtain proprietary or confidential business data. It is essential that this information be handled properly.

The subject of confidential business information known as "a trade secret" is addressed in Section 114 of the Clean Air Act (see Subsection 4.2.5) and in the Code of Federal Regulations (40 CFR 2; 41 *Federal Register* 36902, September 1, 1976, as amended). The Code of Federal Regulations (40 CFR 2, Subpart B, 2.203) embodies a notice to be included in EPA information requests. This notice is paraphrased on the reverse side of the entry checklist (Figure 4.1) for the observer's and plant official's reference. The Code of Federal Regulations (40 CFR 2, Subpart B, 2.211) also includes the penalties for wrongful disclosure of confidential information by Federal employees, in addition to the penalties set forth in the United States Code, Title 18, Section 1905. Employees of other agencies should check with agency attorneys to determine their exact personal liability.

From the observer's standpoint, confidential information may be defined as information received under a request of confidentiality which may concern or relate to trade secrets. A trade secret is interpreted as an unpatented secret, commercially valuable plan, appliance, formula, or process used in production. This information can be in written form, in photographs, or in the observer's memory. *Emissions data* are not considered confidential information. Also the Agency reserves the right to determine if information submitted to it under an official request should be treated as confidential.

A good rule of thumb for the observer to follow is to collect only that process and operational information and to take only those photographs that are pertinent to the purpose of the plant visit. The plant official should be advised that he must *request* confidential treatment of specific information provided (see paragraph on claims of confidentiality on reverse side of entry checklist) before it will be treated as confidential pending legal determination. The plant official should inform the observer of any sensitive areas of the facility or processes where proprietary or trade secret information is indicated.

Photographs are often used to document visible emissions observations (see Subsection 4.3.4). Before taking photographs from inside the plant premises, the observer must have the consent of the plant official. Most of an observer's photographs will be of emission points only; presumably, these should not include confidential areas of the plant. If any opposition is encountered regarding the use of a camera on the plant premises, the observer should explain that the plant official should request confidential treatment of any photographs taken. The observer must properly document each photograph and handle those for which confidential treatment has been requested in the same manner as other confidential data. Photographic documentation of VE observations from an area of public access outside of the plant premises does not require approval from a plant official, provided the documentation is accomplished without the use of highly sophisticated equipment or techniques. For example, use of a high-power telephoto lens (over 100 mm on a 35 mm camera) that yields extensive details (e.g., construction layout) might be construed as surreptitiously taking confidential business information. Thus, a good rule of thumb is to be sure that any pictures taken show only the details that could be seen with the naked eye from an area accessible to the public.

When preparing to leave the plant, the observer should allow the plant official to examine the data collected and make claims of confidentiality. All potentially confidential information should be so marked, and while on the road, the observer should keep it in a locked briefcase or file container. It should be noted that emission data are not considered confidential.

When the observer returns to the agency office, the potentially confidential information should be placed in a secure, lockable file cabinet designated especially for that purpose. The observer's agency should have an established secure filing system and procedures for safeguarding confidential documents. In all cases, the observer should make no disclosure of potentially confidential information until a company has had full opportunity to declare its intentions regarding the information and the Agency has ruled that the information is not legally confidential.

4.2.8 Determination of Safety Requirements — The violation of a safety rule does not invalidate VE readings; however, the observer should always anticipate safety requirements by arriving at the plant with a hardhat, steel-toed safety shoes, safety glasses with side shields, and ear protectors. Safety equipment also should include any other equipment that is specified in the agency files and noted on the entry checklist form.

Some companies require unusual safety equipment, such as specific respirators for a particular kind of toxic gas. In many cases, these companies will provide the observer with the necessary equipment. In any event, the observer must be aware of and adhere to *all* safety requirements before entering the plant. Information on plant alarms and availability of first aid and medical help may be needed.

4.2.9 Observer Behavior — Observers must perform their duties in a professional, businesslike, and responsible manner. They should always consider the public relations liaison part of their role by seeking to develop or improve a good working relationship with plant officials through use of diplomacy, tact, and if necessary, gentle persuasion in all dealings with plant personnel.

Specifically, observers should *be objective and impartial* in conducting observations and interviews with plant officials. All information acquired during a plant visit is intended for official use only and should never be used for private gain. Observers must be careful never to speak of any person, agency, or facility in any manner that could be construed as derogatory. Lastly, observers should use discretion when asked to give a professional opinion on specific products or projects and should *never* make judgments or draw conclusions concerning a company's compliance with applicable regulations. Upon giving the data to the plant the observer can tell the source these are the data that were obtained and no judgment as to compliance can be made until all the data and the regulations are closely reviewed.

4.3 Visible Emission Determination

This subsection describes the preferred approach to VE determination. Because practical considerations do not always permit the observer to follow this procedure, however, special observation problems are discussed in Subsection 4.4.

4.3.1 Opacity Readings — The observer must be certified in accordance with Section 3.12.1, Subsection 1.3, and should use the following procedure for visually determining the opacity of emissions.

Observer Position

1. The observer must stand at a distance that provides a clear view of the emissions with the sun oriented in the 140° sector to his/her back. If the observer faces the emission/viewing point and places the point of a pencil on the sun location line such that the shadow crosses the observers position, the sun location (pencil) must be within the 140° sector of the line. During overcast weather conditions, the position of the sun is less important.
2. Consistent with number 1 above, when possible, the observer should, make observations from a position in which the line of vision is approximately perpendicular to the plume direction; when observing opacity of emissions from rectangular outlets (e.g., roof monitors, open baghouses, and noncircular stacks), the observer's position should be approximately perpendicular to the longer axis of the outlet.
3. When multiple stacks are involved, the observer's line of sight should not include more than one plume at a time, and in any case, during observations, the observer's line of sight should be perpendicular to the longer axis of a set of multiple stacks (e.g., stub stacks on baghouses).
4. The observer must stand at a distance that provides total perspective and a good view.
5. In order to comply with the sun angle requirements (see item 1) it is recommended that the observer should try to avoid the noon hours (11:00 a.m. to 1:00 p.m.) in the summertime (when the sun is almost overhead). This is more critical in the southern continental United States. The preferred reading distance is between 3 stack heights and 1/4 mile from the base of the stack.
6. The reading location should be safe for the observer.

Opacity Observations

1. Opacity observations must be made at the point of greatest opacity in that portion of the plume where condensed water vapor is not present.
2. The observer must not look continuously at the plume (this causes eye fatigue), but should observe the plume momentarily at 15-s intervals. A 15-s beeper is recommended to aid in performing the VE readings.
3. When steam plumes are attached, i.e., when condensed water vapor is present within the plume as it emerges from the emission outlet, the opacity must be evaluated beyond the point in the plume at which condensed water vapor is no longer visible. The observer must record the approximate distance from the emission outlet to the point in the plume at which the observations are made.
4. When steam plumes are detached, i.e., when water vapor in the plume condenses and becomes visible at a distinct distance from the emission outlet, the opacity of emissions should be evaluated near the outlet, prior to the condensation of water vapor and the formation of the steam plume, unless the opacity is higher after dissipation.
5. Readings must be made to the nearest 5 percent opacity. A minimum of 24 observations must be recorded. It is advisable to read the plume for a reasonable period in excess of the time stipulated in the regulations (i.e., at least 10 readings more than the minimum required).
6. A clearly visible background of contrasting color is best for greatest reading accuracy. However, the probability of positive error (higher values) is greater under these conditions. Generally, the apparent plume opacity diminishes and tends to assume a negative bias as the background becomes less contrasting.
7. It is recommended the observer wear the same corrective lenses that were worn for certification. If sunglasses were not worn during certification, the observer should remove them and allow time for the eyes to adjust to the daylight before making VE determinations. It is recommended that the observer not wear photo compensating sunglasses.
8. The best viewing spot is usually within one stack diameter above the stack exit, where the plume is densest and the plume width is approximately equal to the stack's diameter.

4.3.2 Field Data: The "Visible Emission Observation Form" — The 1977 revision of EPA Method 9 specifies the recording of certain information in the field documentation of a visible emission observation. The required information includes the name of the plant, the emission location, the type of facility, the observer's name and affiliation, the date, the time, the estimated distance to the emission location, the approximate wind direction, the estimated windspeed, a description of the sky conditions (presence and color of clouds), and the plume background.

Experience gained from past enforcement litigation involving opacity readings as primary evidence of emission standards violations has demonstrated a need for additional documentation when making visual determinations of plume opacity. The Visible Emission Observation Form presented in Figure 4.2 is recommended. This form was developed after reviewing the opacity forms used in EPA Regional Offices and State and local air quality control agencies. The form includes not only the data required by Method 9, but also the information necessary for maximum legal acceptability. Valid data can be collected on any form; however, the recommended form may enhance observer efficiency and data documentation. A detailed description of the use of the recommended form is given in the following paragraphs.

The Visible Emission Observation Form can be functionally divided into 11 major sections, as shown in Figure 4.3. Each section documents one or two aspects of the opacity determination. The form endeavors to cover all the required and recommended areas of documentation in a typical opacity observation. A "comments" section is included for notation of any relevant information that is not listed on the form.

VISIBLE EMISSION OBSERVATION FORM

SOURCE NAME
ADMIRAL POWER PLANT

ADDRESS
112 OCEAN ROAD

CITY ADMIRAL CITY | STATE VA | ZIP 23451

PHONE 804-425-5101 | SOURCE ID NUMBER NEDS 45721

PROCESS EQUIPMENT OIL FIRED BOILER | OPERATING MODE BASE LOAD

CONTROL EQUIPMENT ELECTROSTATIC PRECIPITATOR | OPERATING MODE RAPPING

DESCRIBE EMISSION POINT
START BRICK STACK 25' DIA. STOP ✓

HEIGHT ABOVE GROUND LEVEL START 100' STOP ✓ | HEIGHT RELATIVE TO OBSERVER START 100' STOP ✓

DISTANCE FROM OBSERVER START 400' STOP ✓ | DIRECTION FROM OBSERVER START NNE STOP ✓

DESCRIBE EMISSIONS
START LOFTING PLUME STOP ✓

EMISSION COLOR START GREY/WHITE STOP ✓ | PLUME TYPE: CONTINUOUS ☑ FUGITIVE ☐ INTERMITTENT ☐

WATER DROPLETS PRESENT: NO ☑ YES ☐ | IF WATER DROPLET PLUME: ATTACHED ☐ DETACHED ☐

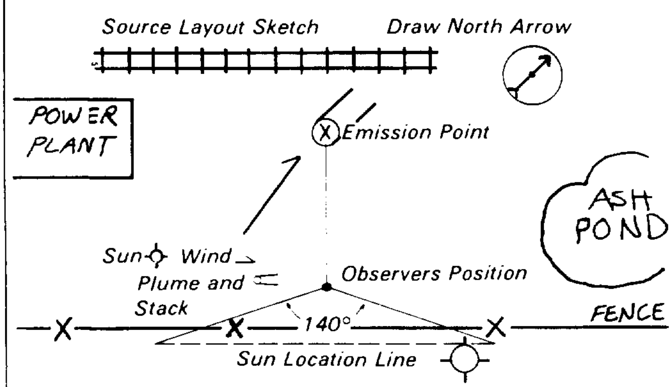
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED
START 10' ABOVE STACK EXIT STOP ✓

DESCRIBE BACKGROUND
START SKY STOP W/BROKEN CLOUDS

BACKGROUND COLOR START BLUE STOP BLUE/WHITE | SKY CONDITIONS START CLEAR STOP PARTLY CLOUDY

WIND SPEED START 15 MPH STOP 20 MPH | WIND DIRECTION START SW STOP ✓

AMBIENT TEMP. START 85°F STOP ✓ | WET BULB TEMP. 54°F | RH, percent 8.5%



COMMENTS
USES #6 OIL

I HAVE RECEIVED A COPY OF THESE OPACITY OBSERVATIONS
SIGNATURE William P. Jance

TITLE SHIFT MANAGER | DATE 7-15-82

OBSERVATION DATE 15 JULY 1982 | START TIME 1330 | STOP TIME 1342

MIN \ SEC	0	15	30	45	MIN \ SEC	0	15	30	45
1	30	35	55	55	31				
2	55	50	40	30	32				
3	35	35	35	35	33				
4	30	35	35	35	34				
5	30	30	30	30	35				
6	35	35	35	35	36				
7	30	30	35	35	37				
8	35	40	60	55	38				
9	60	40	55	60	39				
10	50	45	35	30	40				
11	30	30	30	30	41				
12	30	30	30	30	42				
13					43				
14					44				
15					45				
16					46				
17					47				
18					48				
19					49				
20					50				
21					51				
22					52				
23					53				
24					54				
25					55				
26					56				
27					57				
28					58				
29					59				
30					60				

AVERAGE OPACITY FOR HIGHEST PERIOD 40% | NUMBER OF READINGS ABOVE 40 % WERE 11

RANGE OF OPACITY READINGS
MINIMUM 30% MAXIMUM 60%

OBSERVER'S NAME (PRINT)
V.E. PROFFIT

OBSERVER'S SIGNATURE V. E. Proffit | DATE 15 JULY 1982

ORGANIZATION
STATE AIR POLLUTION CONTROL BOARD

CERTIFIED BY EASTERN TECHNICAL ASSOC. | DATE 18 MAY 1982

VERIFIED BY RDA | DATE 15 AUG 1982

Figure 4.2. *Visible emission observation form.*

VISIBLE EMISSION OBSERVATION FORM

This form is designed to be used in conjunction with EPA Method 9, "Visual Determination of the Opacity of Emissions from Stationary Sources." Any deviations, unusual conditions, circumstances, difficulties, etc., not dealt with elsewhere on the form should be fully noted in the section provided for comments. Following are brief descriptions of the type of information that needs to be entered on the form; for a more detailed discussion of each part of the form, refer to the "User's Guide to the Visible Emission Observation Form."

**Source Name - full company name, parent company or division information, if necessary.*

**Address - street (not mailing) address or physical location of facility where VE observation is being made.*

Phone - self-explanatory.

Source ID Number - number from NEDS, CDS, agency file, etc.

**Process Equipment, Operating Mode - brief description of process equipment (include ID no.) and operating rate, % capacity utilization, and/or mode (e.g., charging, tapping).*

**Control Equipment, Operating Mode - specify control device type(s) and % utilization, control efficiency.*

**Describe Emission Point - stack or emission point location, geometry, diameter, color; for identification purposes.*

**Height Above Ground Level - stack or emission point height, from files or engineering drawings.*

**Height Relative to Observer - indicate vertical position of observation point relative to stack top.*

**Distance From Observer - distance to stack ±10%; to determine, use rangefinder or map.*

**Direction From Observer - direction to stack; use compass or map; be accurate to eight points of compass.*

**Describe Emissions - include plume behavior and other physical characteristics (e.g., looping, lacy, condensing, fumigating, secondary particle formation, distance plume visible, etc.).*

**Emission Color - gray, brown, white, red, black, etc.*

Plume Type:
Continuous - opacity cycle >6 minutes
Fugitive - no specifically designed outlet
Intermittent - opacity cycle <6 minutes

***Water Droplets Present - determine by observation or use wet sling psychrometer; water droplet plumes are very white, opaque, and billowy in appearance, and usually dissipate rapidly.*

***If Water Droplet Plume:*
Attached - forms prior to exiting stack
Detached - forms after exiting stack

***Point in the Plume at Which Opacity was Determined - describe physical location in plume where readings were made (e.g., 4 in. above stack exit or 10 ft after dissipation of water plume).*

**Describe Background - object plume is read against, include atmospheric conditions (e.g., hazy).*

**Background Color - blue, white, new leaf green, etc.*

**Sky Conditions - indicate cloud cover by percentage or by description (clear, scattered, broken, overcast, and color of clouds).*

**Windspeed - use Beaufort wind scale or hand-held anomometer; be accurate to ±5 mph.*

**Wind Direction - direction wind is from; use compass; be accurate to eight points.*

**Ambient Temperature - in °F or °C.*

***Wet Bulb Temperature - the wet bulb temperature from the sling psychrometer.*

***Relative Humidity - use sling psychrometer; use local U.S. Weather Bureau only if nearby.*

**Source Layout Sketch - include wind direction, associated stacks, roads, and other landmarks to fully identify location of emission point and observer position.*

Draw North Arrow - point line of sight in direction of emission point, place compass beside circle, and draw in arrow parallel to compass needle.

Sun Location Line - point line of sight in direction of emission point, place pen upright on sun location line, and mark location of sun when pen's shadow crosses the observers position.

***Comments - factual implications, deviations, altercations, and/or problems not addressed elsewhere.*

Acknowledgment - signature, title, and date of company official acknowledging receipt of a copy of VE observation form.

**Observation Date - date observations conducted.*

**Start Time, Stop Time - beginning and end times of observation period (e.g., 1635 or 4:35 p.m.).*

**Data Set - percent opacity to nearest 5%; enter from left to right starting in left column.*

**Average Opacity for Highest Period - average of highest 24 consecutive opacity readings.*

Number of Readings Above (Frequency Count) - count of total number of readings above a designated opacity.

**Range of Opacity Readings:*
Minimum - lowest reading
Maximum - highest reading

**Observer's Name - print in full.*

Observer's Signature, Date - sign and date after performing final calculations.

**Organization - observer's employer.*

**Certifier, Date - name of "smoke school" certifying observer and date of most recent certification.*

Verifier, Date - signature of person responsible for verifying observer's calculations and date of verification.

*Required by Reference Method 9; other items suggested.
**Required by Method 9 only when particular factor could affect the reading.

Figure 4.2. Reverse side of form. (Continued)

VISIBLE EMISSION OBSERVATION FORM

SOURCE NAME

ADDRESS

CITY STATE ZIP

A

PHONE SOURCE ID NUMBER

B

PROCESS EQUIPMENT OPERATING MODE

CONTROL EQUIPMENT OPERATING MODE

DESCRIBE EMISSION POINT
START STOP

C

HEIGHT ABOVE GROUND LEVEL START STOP
HEIGHT RELATIVE TO OBSERVER START STOP

DISTANCE FROM OBSERVER START STOP
DIRECTION FROM OBSERVER START STOP

DESCRIBE EMISSIONS
START STOP

D

EMISSION COLOR START STOP
PLUME TYPE: CONTINUOUS □ FUGITIVE □ INTERMITTENT □

WATER DROPLETS PRESENT: NO □ YES□
IF WATER DROPLET PLUME: ATTACHED □ DETACHED □

POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED
START STOP

DESCRIBE BACKGROUND
START STOP

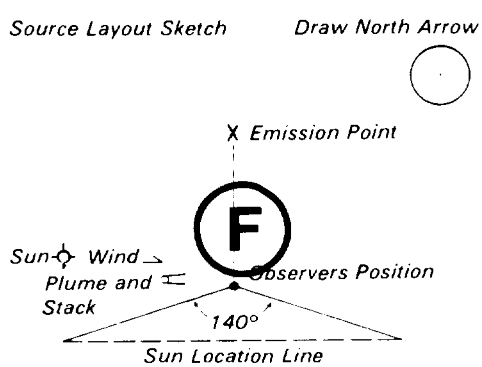
E

BACKGROUND COLOR START STOP
SKY CONDITIONS START STOP

WIND SPEED START STOP
WIND DIRECTION START STOP

AMBIENT TEMP. START STOP
WET BULB TEMP.
RH, percent

F



G

COMMENTS

H

I HAVE RECEIVED A COPY OF THESE OPACITY OBSERVATIONS
SIGNATURE
TITLE DATE

OBSERVATION DATE | START TIME | STOP TIME

I

MIN \ SEC	0	15	30	45	MIN \ SEC	0	15	30	45
1					31				
2					32				
3					33				
4					34				
5					35				
6					36				
7					37				
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27					57				
28					58				
29					59				
30					60				

J

AVERAGE OPACITY FOR HIGHEST PERIOD
NUMBER OF READINGS ABOVE % WERE

RANGE OF OPACITY READINGS
MINIMUM MAXIMUM

OBSERVER'S NAME (PRINT)

K

OBSERVER'S SIGNATURE DATE

ORGANIZATION

CERTIFIED BY DATE

VERIFIED BY DATE

Figure 4.3. Functional sections of visible emission observation form.

Each major section of the form is discussed in the following text. A short explanation of each section's purpose, a background explanation of each data element, a description of the type of information being sought, and in some cases, appropriate entries are included. These discussions are keyed to Figure 4.3 by corresponding capital letters, and it is clearly indicated whether information is required or recommended.

A. SOURCE IDENTIFICATION. Provides information that uniquely identifies the source and permits the observer to locate or make contact with the source.

Source name		
Address		
City	*State*	*Zip*
Phone	*Source ID number*	

Source Name (Required) - include the source's complete name. If necessary for complete identification of the facility, the parent company name, division, or subsidiary name should be included.

Address (Required) - Indicate the street address of the source (not the mailing address or the home office address) so that the exact physical location of the source is known. If necessary, the mailing address or home office address may be listed elsewhere.

City, State, Zip, Phone (Recommended) - Self-explanatory.

Source ID Number (Recommended) - This space is provided for the use of agency personnel and should be used to enter the number the agency uses to identify that particular source, such as the State file number, Compliance Data System number, or National Emission Data System number.

B. PROCESS AND CONTROL DEVICE TYPE. Includes a several word descriptor of the process and control device, indication of current process operating capacity or mode, and operational status of control equipment.

Process equipment	*Operating mode*
Control equipment	*Operating mode*

Process Equipment (Required) - Enter a description of the process equipment that emits the plume or emissions to be read. The description should be brief but should include as much information as possible, as indicated in the following examples:

Coal-Fired Boiler
#2 Oil-Fired Boiler
Wood Waste Conical Incinerator
Paint Spray Booth
Primary Crusher
Fiberglass Curing Oven
Reverberatory Smelting Furnace
Basic Oxygen Furnace

Operating Mode (Recommended) - Depending on the type of process equipment, this information may vary from a quantification of the current operating rate to a description of the portion of a batch-type process for which the emission opacity is being read. For example, entries could include "90 percent capacity" for a boiler or "85 percent production rate" for the shakeout area of a grey iron foundry. For a steel making furnace, entries would include the exact part of the process for which readings are being made, such as "charging" or "tapping." In some cases, the observer may have to obtain this information from a plant official.

Control Equipment (Required) - Specify the type(s) of control equipment being used in the system after the process equipment in question (e.g., "hot-side electrostatic precipitator").

Operating Mode (Recommended) - Indicate the degree to which the control equipment is being utilized at the time of the opacity observations (e.g., 75% capacity, full capacity, shut down, off line) and the operating mode (e.g., automatic). The observer will probably have to obtain this information from a plant official.

C. EMISSION POINT IDENTIFICATION. Contains information uniquely identifying the emission point and its spatial relationship with the observer's position.

Describe emission point *Start* *Stop*	
Height above ground level *Start* *Stop*	*Height relative to observer* *Start* *Stop*
Distance from observer *Start* *Stop*	*Direction from observer* *Start* *Stop*

Describe Emission Point (Required) - Include the identifying physical characteristics of the point of release of emissions from the source. The description must be specific enough so that the emission outlet can be distinguished from all others at the source. In subsequent enforcement proceedings, the observer must be certain of the origin of the emissions that were being read.

Typical descriptions of the emission outlet include the color, geometry of the stack or other outlet, and the location in relation to other recognizable facility landmarks. Any special identification codes the agency or source uses to identify a particular stack or outlet should be noted along with the source code used by the observer. The source of this information should be recorded (e.g., plant layout map or engineering drawing).

Height Above Ground Level (Required) - Indicate the height of the stack or other emission outlet from its foundation base. This information is usually available from agency files, engineering drawings, or computer printouts (such as NEDS printouts). The information also may be obtained by using a combination of a rangefinder and an Abney level or clineometer. The height may also be estimated.

Height Relative to Observer (Required) - Indicate an estimate of the height of the stack outlet (or of any other type of emission outlet) above the position of the observer. This measurement indicates the observer's position in relation to the stack base (i.e., higher or lower than the base) and may later be used in slant angle calculations (see Section 3.12.6 and Subsection 4.4.6) if such calculations become necessary.

Distance From Observer (Required) - Record the distance from the point of observation to the emission outlet. This measurement may be made by using a rangefinder. If necessary, a map also may be used to estimate the distance.

It is important that this measurement be reasonably accurate if the observer is close to the stack (within 3 stack heights) because it is coupled with the outlet height relative to the observer to determine the slant angle at which the observations were made (see Figure 4.4). A precise determination of the slant angle may become important in calculating any positive bias inherent in the opacity readings.

Direction From Observer (Required) - Specify the direction of the emission point from the observer to the closest of the eight points of the compass (e.g., S, SE, NW, NE) or 45°. Use of a compass to make this determination in the following manner is suggested: hold the compass while facing the emission *point*; rotate the compass until the North compass *point* lies directly beneath the needle (which will be pointing towards magnetic North); then the point of the compass closest to the emission outlet will indicate the direction (Figure 4.5). A map (plant layout) also may be used to make this determination.

Describe Emissions (Required) - Include both the physical characteristics of the emissions not recorded elsewhere on the form and the behavior of the resultant plume. The description of the physical characteristics might include terms such as lacy, fluffy, and detached nonwater vapor condensibles.

The terminology illustrated in Figure 4.6 can be used to describe plume behavior. The behavior can be used to determine the atmospheric stability on the day of the opacity observations.

Emission Color (Required) - Note the color of the emissions. The plume color can sometimes be useful in determining the composition of the emissions and will also serve to document the total contrast between the plume and its background as seen by the opacity observer during the observation period.

Plume Type (Recommended) - Check "continuous" if the duration of the emissions being observed is greater than 6 minutes. Check "intermittent" if the opacity cycle is less than 6 minutes. Check "fugitive" if the emissions have no specifically designated outlet.

Water Droplets Present (May be required) - Check "yes" or "no" as appropriate. In some cases, the presence of condensed water vapor in the plume can be easily observed.

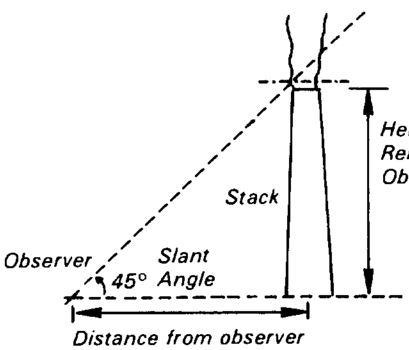
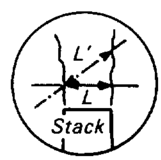


Figure 4.4. *Slant angle relationships.*



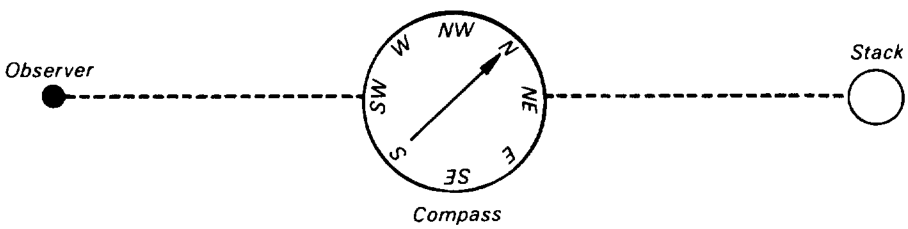


Figure 4.5. *Direction from observer is NE.*

D. EMISSIONS DESCRIPTION. Includes information that definitely establishes what was observed while making the visible emissions determination.

Describe emissions *Start* *Stop*	
Emission color *Start* *Stop*	*Plume type: Continuous* ☐ *Fugitive* ☐ *Intermittent* ☐
Water droplets present *No* ☐ *Yes*☐	*If water droplet plume* *Attached* ☐ *Detached* ☐
Point in the plume at which opacity was determined *Start* *Stop*	

Plumes containing condensed water vapor (or "steam plumes") are usually very white, billowy, and wispy at the point of dissipation, where the opacity decreases rapidly from a high value (usually 100%) to 0 percent if there is no residual opacity plume contributed by contaminate in the effluent.

To document the presence or absence of condensed water vapor in the plume, the observer must address two points. First, is sufficient moisture present (condensed or uncondensed) in the plume initially? Second, if enough moisture is present, are the in-stack and ambient conditions such that it will condense either before exiting the stack or after exiting (when it meets with the ambient air)? The first question can be answered by examining the process type and/or the treatment of the effluent gas after the process. Some common sources of moisture in the plume are:

- Water produced by combustion of fuels,
- Water from dryers,
- Water introduced by wet scrubbers,
- Water introduced for gas cooling prior to an electrostatic precipitator, or other control device, and
- Water used to control the temperature of chemical reactions.

If water is present in the plume, data from a sling psychrometer, which measures relative humidity, in combination with the moisture content and temperature of the effluent gas can be used to predict whether the formation of a steam plume is a possibility (see Section 3.12.6).

If Water Droplet Plume: (May be required) - Check "attached" if condensation of the moisture contained in the plume occurs within the stack and the steam plume is visible at the stack exit. Check "detached" if condensation occurs some distance downwind from the stack exit and the steam plume and the stack appear to be unconnected.

Point in the Plume at Which Opacity was Determined (May be required) - Describe as succinctly as possible the physical location in the plume where the observations were made. This description is especially important in the case where condensed water vapor and/or secondary plume is present. For example, were the readings made prior to formation of the steam plume? If the readings were made subsequent to dissipation (e.g., in the case of an attached steam

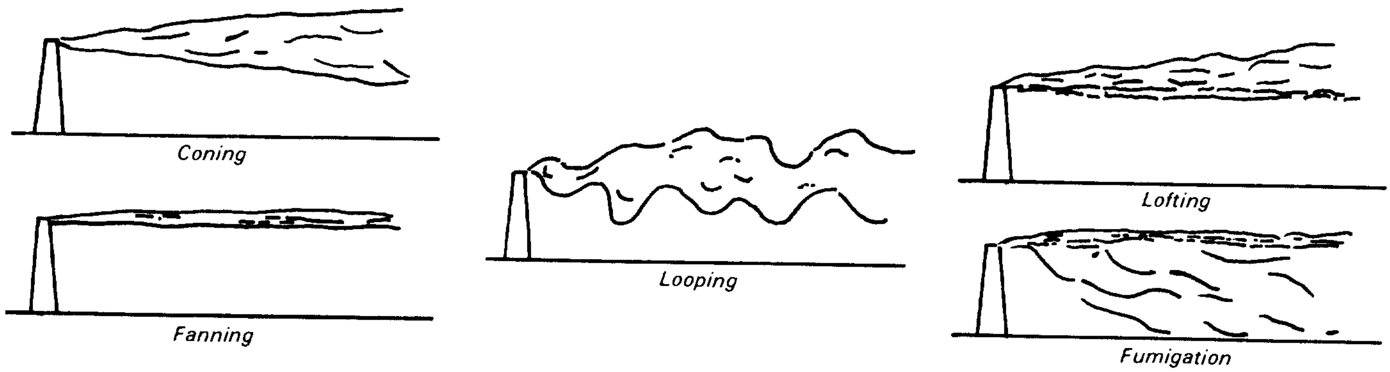


Figure 4.6. *Plume behavior descriptors.*

plume), then specify how far downwind of the dissipation point and how far downwind of the stack exit the reading was made. This information can be used to estimate the amount of dilution that occurred prior to the point of opacity readings. Descriptions such as 4 feet above outlet and 80 feet downstream from outlet, 10 feet after steam dissipation are appropriate.

Figure 4.7 shows some examples of the correct location for making opacity readings in various steam plume and secondary plume situations.

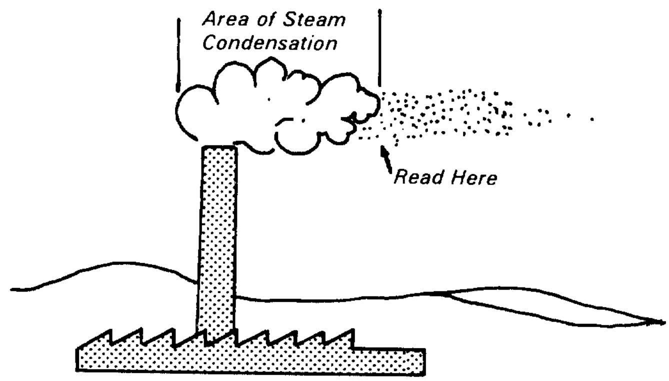
Describe Background (Required) - Describe the background that the plume is obscuring and against which the opacity is being read. While describing the background, note any imperfections or conditions, such as texture, that might affect the ease of making readings. Examples of background descriptions are roof of roof monitor, stand of pine trees, edge of jagged stony hillside, clear blue sky, stack scaffolding, and building obscured by haze.

Background Color (Required) - Accurately note the background color (e.g., new leaf green, conifer green, brick red, sky blue, and gray stone).

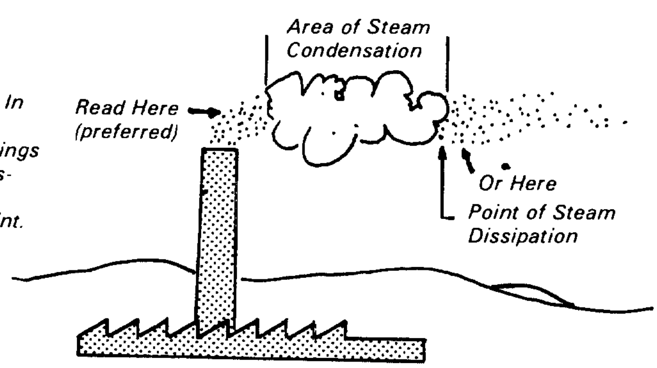
E. OBSERVATION CONDITIONS.
Covers the background and ambient weather conditions that occur during the observation period and could affect observed opacity.

Describe background Start Stop			
Background color Start Stop		*Sky conditions* Start Stop	
Windspeed Start Stop		*Wind direction* Start Stop	
Ambient temp. Start Stop	*Wet bulb temp.*	*Relative humidity*	

Attached steam plume.



Detached steam plume. In rare cases, it may be necessary to make readings at the point of steam dissipation if the plume is more opaque at that point.



Plume from a sulfuric acid plant with detached steam plume. Plume is clear at stack exit. Secondary acid mist is formed in area of steam condensation.

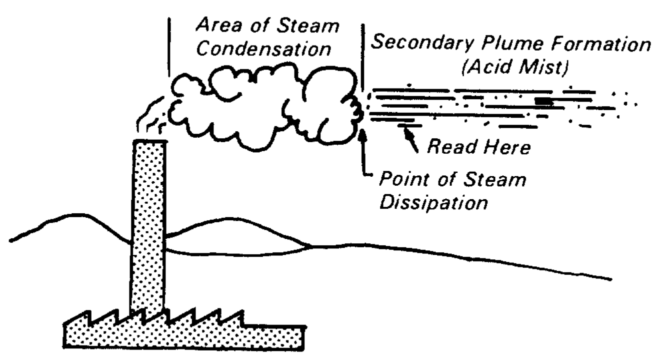


Figure 4.7. *Location for reading opacity under various conditions.*

Sky Conditions (Required) - Indicate the percent cloud cover of the sky. This information can be indicated by using straight percentages (e.g., 10% overcast, 100% overcast) or by description, as shown below.

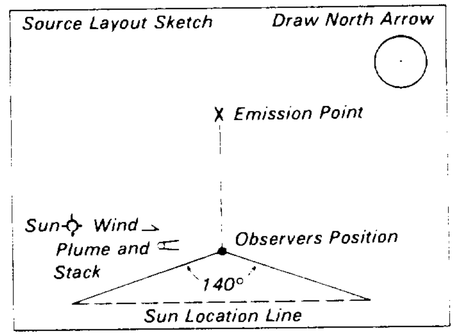
Term	*Amount of cloud cover*
Clear	*<10%*
Scattered	*10% to 50%*
Broken	*50% to 90%*
Overcast	*>90%*

Windspeed (Required) - Give the windspeed accurately to ±5 miles per hour. The windspeed can be determined using a hand-held anemometer (if available), or it can be estimated by using the Beaufort Scale of Windspeed Equivalents in Table 4.1.
Wind Direction (Required) - Indicate the direction *from which* the wind is blowing. The direction should be estimated to eight points of the compass by observing which way the plume is blowing. If this type of estimation is not possible, the direction may be determined by observing a blowing flag or by noting the direction a few blades of grass or handfull of dust are blown when tossed into the air. Keep in mind that the wind direction at the observation point may be different from that at the emission point; the wind direction at the emission point is the one of interest.
Ambient Temperature (Required) - The outdoor temperature at the plant site is measured by a thermometer (in degrees Fahrenheit or centigrade) obtained from a local weather bureau or estimated. Be certain to note which temperature scale is used. This is done in conjunction with the wet bulb temperature and is only needed when there are indications of a condensing water droplet plume.
Wet Bulb Temperature (May be required) - Record the wet bulb temperature from the sling psychrometer. This is to be done only when there are indications of a condensing water droplet plume.
Relative Humidity (May be required) - Enter the relative humidity measured by using a sling psychrometer in conjunction with a psychrometric chart. This information can be used to determine if water vapor in the plume will condense to form a steam plume (see Section 3.12.6). If a sling psychrometer is not available, data from a *nearby* U.S. Weather Bureau can be substituted.

Table 4.1. *The Beaufort Scale of Windspeed Equivalents*

General description	*Specifications*	*Limits of velocity 33 ft (10 m) above level ground, mph*
Calm	*Smoke rises vertically*	*Under 1*
	Direction of wind shown by smoke drift but not by wind vanes	*1 to 3*
Light	*Wind felt on face; leaves rustle; ordinary vane moved by wind*	*4 to 7*
Gentle	*Leaves and small twigs in constant motion; wind extends light flag*	*8 to 12*
Moderate	*Raises dust and loose paper; small branches are moved*	*13 to 18*
Fresh	*Small trees in leaf begin to sway; crested wavelets form on inland waters*	*19 to 24*
	Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty	*25 to 31*
Strong	*Whole trees in motion; inconvenience felt in walking against the wind*	*32 to 38*
	Twigs broken off trees; progress generally impeded	*39 to 46*
Gale	*Slight structural damage occurs (chimney pots and slate removed)*	*47 to 54*
	Trees uprooted; considerable structural damage occurs	*55 to 63*
Whole gale	*Rarely experienced; accompanied by widespread damage*	*64 to 75*
Hurricane		*Above 75*

F. OBSERVER POSITION AND SOURCE LAYOUT. Clearly identifies the observer's position in relation to the emission point, plant landmarks, topographic features, sun position, and wind direction.



Source Layout Sketch (Required) - This sketch should include as many landmarks as possible. At the very least, the sketch should locate the relative position of the observed outlet in such a way that it will not be confused with others at a later date, and clearly locate the position of the observer while making the VE readings. The exact landmarks will depend on the specific source, but they might include:

- Other stacks
- Hills
- Roads
- Fences
- Buildings
- Stockpiles
- Rail heads
- Tree lines
- Background for readings

To assist in subsequent analysis of the reading conditions, sketch in the plume (indicate the direction of wind travel). The wind direction also must be indicated in the previous section.

Draw North Arrow (Recommended) - To determine the direction of north, point the line of sight in the source layout sketch in the direction of the actual emission point, place the compass next to the circle and draw an arrow in the circle parallel to the compass needle. A map (plant layout) may also be used to determine direction north.
Sun's Location (Recommended) - It is important to verify this parameter before making any opacity readings. The sun's location should be within the 140° sector indicated in the layout sketch; this confirms that the sun is within the 140° sector to the observer's back.

To draw the sun's location, point the line of sight in the source layout sketch in the direction of the actual emission point, place a pen upright along the "sun location line" until the shadow of the pen falls across the observer's position. Then draw the sun at the point where the pen touches the "sun location line."

G. COMMENTS. Includes all implications, deviations, disagreement with plant personnel and/or problems of a factual nature that have bearing on the opacity observations and that cannot be or have not been addressed elsewhere on the form.

Comments

Comments (May be required) - Note all implications, deviations, disagreements with plant personnel, or problems of a factual nature that cannot be or have not been addressed elsewhere on the form. Examples of points to be included in this section are:

- Changes in ambient conditions from the time of the start of readings.
- Changes in plume color, behavior, or other characteristics.
- Changes in observer position and reasons for the change; a new form should also be initiated in this case so that a new source layout sketch may be drawn.
- Difficulties encountered in plant entry.
- Conditions that might interfere with readings or cause them to be biased.
- Drawing of unusual stack configuration (to show multiple stacks or stack in relation to roof line).
- Suspected changes to the emissions or process during observation.
- Unusual process conditions.
- Additional source identification information.
- Type of plant (if not specified elsewhere).
- Reasons for missed readings.
- Other observers present.

H. COMPANY ACKNOWLEDGEMENT. Company acknowledgement of, but not necessarily agreement with, the opacity observations stated on the form.

I have received a copy of these opacity observations *Signature*	
Title	*Date*

Signature (Recommended) - This space is provided for the signature of a plant official who acknowledges that he/she has received a copy of the observer's opacity readings. His/her signature does not in any way indicate that he/she or the company concurs with those readings.

Title (Recommended) - Include the acknowledging official's company title.

Date (Recommended) - The company official should enter the date of acknowledgment.

I. DATA SET. Opacity readings for the observation period, organized by minute and second. This section also includes the actual date and start and stop times for the observation period.

Observation date					*Start time*			*Stop time*	
M \ S	*0*	*15*	*30*	*45*	*M \ S*	*0*	*15*	*30*	*45*
1					*31*				
2					*32*				
29					*59*				
30					*60*				

Observation Date (Required) - Enter the date on which the opacity observations were made.

Start Time, Stop Time (Required) - Indicate the times at the beginning and the end of the actual observation period. The times may be expressed in 12-hour or 24-hour time (i.e., 8:35 a.m. or 0835); however, 24-hour time tends to be less confusing.

Data Set (Required) - Spaces are provided for entering an opacity reading every 15 s for up to a 1-hour observation period. The readings should be in percent opacity and made to the nearest 5 percent. The readings are entered from left to right for each numbered minute, beginning at the upper left corner of the left-hand column, labeled row "M 1" (minute 1) and column "s 0" (0 seconds). The next readings are entered consecutively in the spaces labeled M 1, s 15; M 1, s 30; M 1, s 45; M 2, s 0, M 2, s 15, etc.

If, for any reason, a reading is not made for a particular 15-second period, that space should be skipped and an explanation should be provided in the comments section. Also a dash (-) should be placed in the space which denotes that the space is not just an oversight.

J. DATA REDUCTION. Basic analysis of the opacity readings to allow preliminary compliance appraisal in accordance with EPA Reference Method 9.

Average opacity for highest period	*Number of readings above* *% were*
Range of opacity readings *Minimum* *Maximum*	

Average Opacity for the Highest Period (Required) - Enter the average of the sum of the highest 24 consecutive readings (6-minute set). In other words, identify the 24 consecutive readings that would sum to the greatest value and then divide this value by 24 to get the average opacity for that set of readings. *Note:* The average should not include a time lapse for which a valid reading could have been taken but was not (see Section 3.12.6).

Number of Readings Above ...% Were ... (Recommended) - Indicate an optional frequency count of the opacity readings above a particular value. The value is chosen according to the opacity standard for the emission point and is generally the actual value of the standard.

Method 9 does *not* specify the use of frequency counting to reduce data, but many States use it to determine compliance with their time exemption opacity standards. For example, a State regulation might specify that opacity of a specific type of emission source is not to exceed 20 percent for more than 3 minutes in an hour. If more than 12 readings out of 240 exceed 20 percent in an hour-long observation period, that State may consider that source out of compliance. For example,

14 readings out of 240 readings (1 hour) are above 20 percent opacity
14 x 15 s per reading = 210 s
= 3.5 minutes of readings above the standard.

Range of Opacity Readings (Required) - Enter the highest and lowest opacity readings taken during the specified observation period.

K. OBSERVER DATA. Information required to validate the opacity data.

Observer's name (print)	
Observer's signature	*Date*
Organization	
Certified by	*Date*
Verified by	*Date*

Observer's Name (Required) - Print observer's entire name.
Observer's Signature/Date (Recommended) - Self-explanatory.
Organization (Required) - Provide the name of the agency or company that employs the observer.

Certified By (Recommended) - Identify the agency, company, or other organization that conducted the "smoke school" or VE training and certification course where the observer obtained his/her most current certification.
Date (Required) - Provide the date of the most current certification.
Verified By (Recommended) - The actual signature of someone who has verified the opacity readings and calculations, usually the observer's supervisor, or the individual who is responsible for his/her work.
Date (Recommended) - Provide the date of verification.

4.3.3 Facility Operating Data - It is strongly recommended that a VE inspection/observation conclude with a source inspection if opacity values are in excess of the standard. The observer would first follow the plant entry procedure in Subsection 4.1 and then follow the indicated procedure to obtain facility operating data.

After the VE determination, it is recommended that the following source information be determined:

1. Were the plant and the source of interest operating normally at the time of the VE evaluation?
2. Are there any control devices associated with the source?
3. Were the control devices operating properly?
4. Have there been any recent changes in the operation of the process or control devices?
5. Have any malfunctions or frequent upsets in the process or control devices been noted and reported (if required by the agency)?
6. Is the plant operator aware of excessive visible emissions and have any corrective steps been taken to alleviate the problems?
7. Are there any other sources of visible emissions in close proximity to the source in question that may interfere with reading the plume opacity or contribute to the appearance of the plume?

4.3.4 Photographs - It is suggested that photographs be taken before and after the observation is made, not during the observation period. Conditions should be recorded as they existed at the time of the observation. The use of a 35-mm camera is recommended to ensure good photographs.

Each photograph should be identified with the date and time, the source, and the position from which the photograph was taken.

4.4 *Special Observation Problems*

The VE observer constantly should be aware that his/her observations may be used as the basis of a violation action and subject to questioning as to the reliability of the observations. Therefore, he/she must also be aware that under some conditions or situations it may be difficult or impossible to conduct a technically defensible visible emissions observation.

This section discusses some of the most prevalent difficult conditions or special problems associated with the visible emission observation. Each discussion is directed toward defining the problem, indicating how it might invalidate readings taken, and addressing possible solutions and/or ways to minimize the invalidating effects.

Not all of these discussions offer a complete solution for a particular problem; thus, it is important for the individual observer to keep in mind the purpose of the visible emission observation when considering exactly what action to take when faced with a special problem.

4.4.1 Positional Requirements - Valid VE evaluations can be conducted only when the sun is properly positioned at the observer's back. Failure to adhere to this positioning can result in significant positive bias caused by forward light scatter in opacity readings. Because of this overriding constraint, some times and locations make it difficult for the observer to meet other opacity reading criteria, e.g., reading the narrow axis of a rectangular stack, reading a series of stacks across a short axis to prevent multiple plume effects, and obtaining a contrasting background. Plant topography also may generate constraints that restrict viewing positions to one or more locations. The observer will be aided in determining the best observation location by following the criteria listed below.

1. Make sure that the emission point is north of the observation point.
2. Obtain a clear view of the emission point with no interfering plumes.
3. Be sure that rectangular stacks are read across the narrow axis and multiple stacks are read perpendicular to the line of stacks.
4. Minimize the slant angle by moving a sufficient distance from the stack or to an elevated position (see Subsection 4.4.4).
5. Find a contrasting background or a clear sky background.
6. Finally, determine the best time of day for observations based on the daily sun tracks at that location.

Collaborative studies of the performances of trained observers have indicated that, with the exception of the positive bias caused by having the improper sun angle, visible emission observation biases tend to be negative. Thus, if viewing conditions are not ideal and a negative bias (lower value) results, opacity readings may not provide the true measure of plume opacity required to correlate to mass emissions or control equipment efficiency. However, readings that indicate a violation can be regarded as the minimum opacity; therefore, documentation of the violation is valid.

In situations where the observer must make plume opacity readings when all the criteria for correct viewing cannot be met, all extenuating circumstances must be documented on the VE evaluation form.

4.4.2 Multiple Sources/Multiple Stacks - An observer is sometimes compelled to evaluate a stack that discharges emissions from more than one source or to evaluate a single source that has more than one emission point.

In the case where one stack serves more than one emission source, the observer may be able to isolate the emissions from one source as a result of intervals of operation, or by requesting the facility's cooperation in temporarily shutting down the other source(s). Otherwise, the observer should proceed with the VE observation and document the situation completely on the VE evaluation form.

In the case of multiple emission points for a single source (e.g., in positive-pressure baghouses and multiple vents in roof monitors), Section 2.1 of Method 9 directs the observer to read multiple stacks independently if it is possible to do so while meeting sun position requirements. If it is necessary to get an overall reading for the group of stacks, the following set of formulas can be used to calculate this reading from the individual opacity values.

$$1 - \frac{O_1}{100} = T_1$$

$$1 - \frac{O_2}{100} = T_2$$

$$1 - \frac{O_N}{100} = T_N$$

$$T_1 \times T_2 \times \ldots .\ T_N = T_T$$

$$100 \times (1 - T_T) = O_T$$

where
O_1 = % opacity of 1st plume
O_2 = % opacity of 2nd plume
O_N = % opacity of nth plume
T_1 = Transmittance of 1st plume
T_2 = Transmittance of 2nd plume
T_N = Transmittance of nth plume
T_T = Total transmittance
O_T = % total opacity

4.4.3 High Winds - Occasionally the crosswind conditions are unfavorable during field observations of plume opacity. When the winds are strong enough to shear the emissions at the stack outlet, it is difficult for the observer to make an accurate and fair VE observation. Strong crosswinds can have several effects on the plume:

1. The plume becomes essentially flattened and is no longer conical in shape thus the path length and apparent opacity increases.
2. The plume is torn into fragments and becomes difficult to obtain a representative reading.
3. The plume becomes diluted, and the apparent opacity is lowered.

The observer can compensate somewhat for the effect of flattening by reading the plume downwind of the stack, after it has reformed into a cone. The dilution effect of high winds, which lowers the apparent opacity, presents more of a problem. Because of the negative bias introduced, the effectiveness of Method 9 as a control tool under these conditions is diminished. If a violation is still observed under these conditions, it should be considered valid. It is recommended that whenever feasible, VE observations be suspended until the wind-caused interferences have abated.

4.4.4 Poor Lighting - Poor lighting conditions for VE observations usually involve one or more of the following: (1) a totally overcast sky, (2) early morning or late afternoon hours, or (3) nighttime. Each of these three lighting conditions has the same net effect on the plume; they differ slightly only in the cause of the poor illumination. When the amount of available sunlight is below a certain level, the contrast between a white plume and the background decreases. Therefore, readings are not recommended in either the early morning hours (at or approaching dawn) or late afternoon hours (at or approaching dusk).

Nighttime viewing obviously represents the most severe of poor lighting conditions. Some agencies have attempted, with mixed results, to use night vision devices (light intensification scopes) for plume viewing and testing in the dark. Others have achieved better results by placing a light behind the emissions, which provides a very high contrast background. For this method, it is important to select a source of light of moderate strength that does not cause the iris of the eye to close.

4.4.5 Poor Background - The color contrast between the plume and the background against which it is viewed can affect the appearance of the plume as viewed by an observer. Field studies have corroborated predictions of the plume opacity theory by demonstrating that a plume is most visible and has the greatest apparent opacity when viewed against a contrasting background.

Consistent with these findings is the fact that with a high contrast background, the potential for positive observer bias is the greatest. However, field trials consisting of 769 sets of 25 opacity readings each have shown that for more than 99 percent of the sets, the positive observer error was no greater than 7.5 percent opacity.[2]

Also consistent with these findings is the fact that as the contrast between the plume and its background *decreases,* the apparent opacity decreases; this greatly increases the chance for a negative observer bias. Under these conditions, the likelihood lessens of a facility being cited for a violation of an opacity standard because of observer error.

When faced with a situation where there is a choice of backgrounds, the observer should always choose the one providing the highest contrast with the plume because it will permit the most accurate opacity reading. However, if a situation arises where other constraints make it impossible to locate an observation point that provides a high contrast background, the observer may read against a less contrasting one with confidence that a documented violation should be legally defensible.

4.4.6 Reduced Visibility - Environmental factors at the time of observation also are of concern to the visible emissions observer. Environmental considerations include rain, snow, or other forms of precipitation, and photochemical smog buildup, fog, sea spray, high humidity levels, or any other cause of haze. These environmental factors create a visual obscuration that can increase the apparent opacity of the plume, but more commonly reduce the background contrast and thus decrease the apparent opacity.

In recognition of the problems that could result from reduced visibility caused by environmental factors, the amended Method 9 (November 12, 1974) states, in paragraph 2.1 of the Procedures Section: "The qualified observer shall stand at a distance sufficient to provide a clear view of the emissions ..." A "clear view" must be interpreted as a view free from obstacles or interferences. Most problems caused by reduced visibility can be alleviated simply by making the observations on another day.

4.4.7 Tall Stacks/Slant Angle - When an observer's distance from the stack approaches 1/4 mile (approximately 1300 feet, or a little over four football fields), the ambient light scattering may begin to have an adverse effect on the contrast between the plume and the background. Also, if the sky is overcast or hazy on the day of observation, the farther the observer is from the emission point, the more the haze interferes with the view of the plume and hence, the less reliable the readings.

On the other hand, the recommendation that the observer stand at least three stack heights from the stack being observed is intended to ensure that the width of the plume as it is viewed is approximately the same as it is at the stack outlet. As the observer gets closer to the stack and the viewing (slant) angle increases, the observed path length also increases; this causes the observed opacity to increase because the observer is reading through more emissions. These relationships are shown in Figure 4.8. At an observer distance of three stack heights, which corresponds to a slant angle of 18°, the deviation of observed opacity from actual opacity decreases to 1 percent opacity, which is considered acceptable (see Section 3.12.6).

The three-stack-heights relationship only occurs if the observer and the base of the stack are in the same horizontal plane. If the observer is on a higher plane than the base of the stack, then the minimum distance for proper viewing can be reduced to *less* than three stack heights; conversely, if the observer's plane is lower than that of the stack base, then the minimum suggested distance will be *greater* than three stack heights (see Figure 4.8). The real determining factor is the slant angle. To assure no more than a 1 percent opacity deviation of observed opacity from actual opacity, the observer must have a visual slant angle of 18° or less.

4.4.8 Steam Plumes - Under certain conditions, water vapor present in an effluent gas stream will condense to form a visible water droplet or "steam" plume. Because the NSPS (specifically Method 9) and almost all SIP's exclude condensed, uncombined water vapor from opacity regulations, the VE observer must be careful that he/she does not knowingly read a plume at a point where condensed water vapor is present and record the value as representative of stack emissions.

Knowledge of the kind of process that generates the emissions being read and simple observation of the resultant plume almost always allows the observer to determine if a steam plume is present. Steam plumes are commonly associated with processes or control equipment that introduce water vapor into the gas stream. These sources include:

- Fuel combustion,
- Drying operations,
- Wet scrubbers,
- Water-induced gas cooling prior to an emissions control device, and
- Water-induced chemical reaction cooling.

Also, observation of steam plumes will reveal that they are usually very white, billowy, and have an abrupt point of dissipation. At the point of dissipation, the opacity generally decreases *rapidly* from a high value (usually 100%) to a low value. Depending on the moisture and temperature conditions in the stack and in the ambient air, steam plumes may be either "attached" or "detached." An attached steam plume forms within the stack and is visible at the exit; a detached steam plume forms downwind of the stack exit and does not appear to be connected to the stack. In cases when it is not clear whether a steam plume is present or when an observer would like to predict the formation of a steam plume, the stack gas conditions may be used in conjunction with the ambient relative humidity to make the prediction (see Section 3.12.6).

When a steam plume *is* present, the particulate plume is read at a point where 1) no condensed water vapor exists, and 2) the opacity is the greatest. In the case of a detached steam plume, this point is usually at the stack exit, prior to the water vapor condensation; in the case of an attached steam plume, it is usually slightly downwind of the point of steam plume dissipation (for examples, see Figure 4.7). The observer should always carefully document the point chosen.

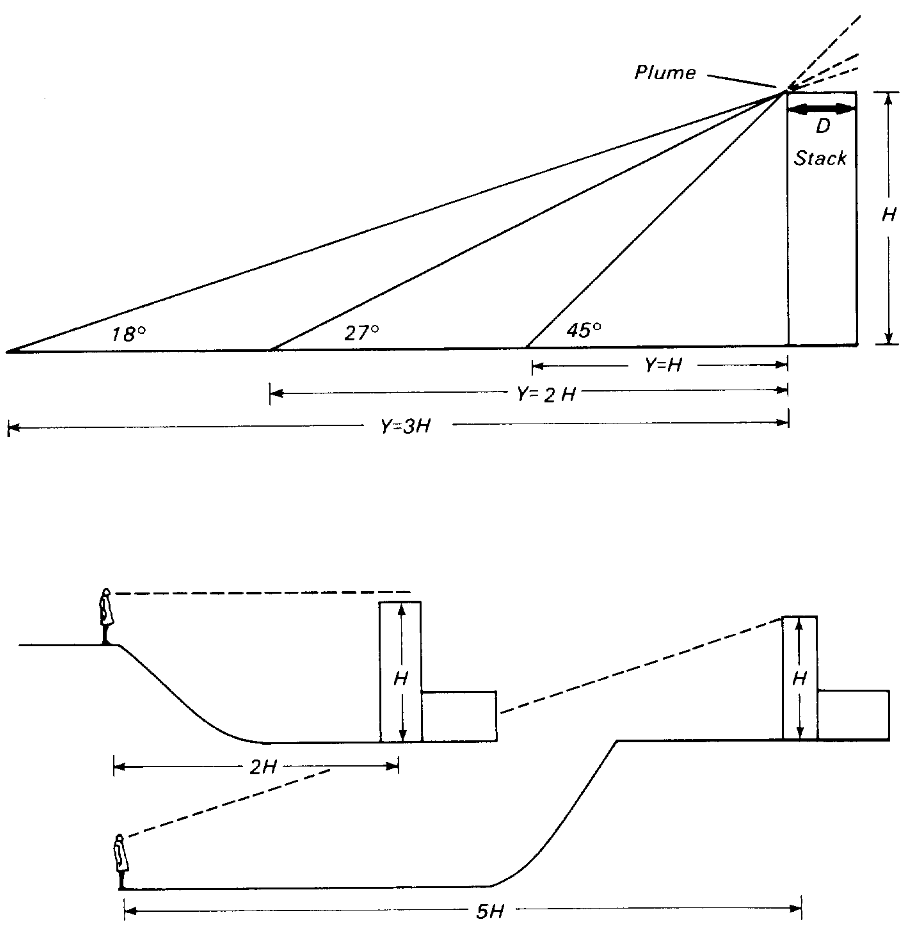


Figure 4.8. *Observer distance, observed path length relationships.*

4.4.9 Secondary Plume Formation - Some effluent gas streams contain species that form visible mists or plumes by a physical and/or chemical reaction that occurs either at some point in the stack or after the emissions come in contact with the atmosphere. This situation is known as secondary plume formation. Examples of such secondary plume formation include:

- A change in the physical state of a compound condensing from a gas into a liquid, such as vaporized hydrocarbon condensing into an aerosol or a solid.
- A physiocochemical reaction between two or more gaseous (or in some cases, liquid) species in a plume, such as the condensation of ammonia, sulfur dioxide, and water vapor to form

particulate ammonium sulfite or the condensation of sulfur trioxide and water vapor to form sulfuric acid mist.

- A physiocochemical reaction between species in a plume and species in the atmosphere, such as the formation of N_2O_3.

Secondary plumes are sometimes found in the following processes (with these suspected secondary reactions):

- Coal- and oil-fired cement kilns ($SO_3 + H_2O \rightarrow H_2SO_4$ mist) or [$NH_3 + SO_2 + H_2O \rightarrow (NH_4)_2 SO_3$]
- Fossil-fuel-fired steam generators ($SO_2 + H_2O \rightarrow H_2SO_4$ mist)
- Sulfuric acid manufacturing ($SO_3 + H_2O \rightarrow H_2SO_4$ mist)
- Plywood and particleboard wood heating (organic vapor $\rightarrow$ organic mist)
- Glass manufacturing (inorganic vapor $\rightarrow$ organic aerosol).

As in the case of steam plumes, secondary plumes can be attached or detached, depending on the specific condensation reaction and the ambient conditions. For example, a secondary plume will be attached if a reaction between plume species occurs in the stack and the stack temperature is sufficiently low to cause condensation of the reaction products to a visible liquid or solid phase. A detached secondary plume will be evident when the reaction does not occur until the gas stream comes in contact with the atmosphere. The degree of detachment depends on the ambient conditions, the degree of mixing between the effluent and the atmosphere, and the specific reaction(s) involved.

Secondary plumes may occur with or without an accompanying steam plume, and it is important that the observer be able to distinguish between the two. Unlike steam plumes, secondary plumes are often persistent (they do not dissipate rapidly), are usually bluish white (due to the fine particles present), and are grainy rather than billowy.

To read a secondary plume, the observer must locate the densest point of the plume where water vapor is not evident and make the readings at that point. This point may occur in several different areas, depending on the type of secondary plume. An attached secondary plume will usually be read at the stack exit if an attached *steam* plume is not present; if an attached steam plume *is* present, the secondary plume must be read at the point of steam dissipation. A detached secondary plume will usually be read slightly downwind of the area of formation, assuming there is no interfering condensed water vapor. Under some conditions, a secondary plume may not fully condense until some distance downstream of the point of formation; in this case, the observer simply looks for the densest area of the plume and makes the reading at that point. It is especially important in reading a secondary formation plume to describe fully the point at which the reading was taken and the exact appearance of the plume. (Refer to Figure 4.7 for one example of where to read a secondary plume.)

4.4.10 Fugitive Emissions - Fugitive emissions are those emissions that do not emanate from a conventional smoke stack or vent. Examples of these nonconventional emissions include:

- Dusty or unpaved roads
- Stock or raw material piles under windy conditions or when moved by machinery
- Conveyor belts, pneumatic lifts, clamshells, and draglines
- Cutting, crushing, grinding, and sizing of minerals or other materials
- Plowing, tilling, and bulldozing
- Open incineration
- Demolition activities
- Roof monitors or building vents, especially in foundries, iron and steel facilities, and related industries.

Because of the irregular shape of their emission point or area, conducting a conventional Method 9 test on fugitive emissions may appear difficult; however, it usually involves only relatively minor adjustments. Commonly used procedures for observation of fugitive emissions are listed below:

1. If possible, isolate the particular emission from other emissions by choosing an appropriate position for observation.
2. Adhere to the lighting requirements of Method 9 by keeping the sun in the 140° sector to the observer's back.
3. Also adhere to Method 9 in selecting a position with regard to wind direction and a contrasting background.
4. Whenever possible, select the shortest path length through the plume.
5. Before taking readings, view the emission for several minutes to determine its characteristics. Changes that may occur in the airborne particulate pattern over time are important to note and to consider in selecting a viewing point.
6. Select the line of sight and the viewing point in the emissions so that, on the average, the densest part of the emissions will be observed. It is recommended that all subsequent readings in a data set be taken at the same relative position to the emission source.
7. The configuration of the emission point or area may necessitate taking readings at a point downwind where the emissions have assumed a more conventional plume shape.
8. If the plume cannot be viewed through a nearly perpendicular angle, corrections may be necessary.

4.4.11 Intermittent Sources - Some sources release visible emissions intermittently rather than continuously; e.g., coke ovens, batch operations, single chamber incinerators, malfunctioning control equipment (in rapping, bag shaking, etc.), boilers during soot blowing, and process equipment during startup.

Intermittent emissions may have a high opacity for a short time and a low or negligible opacity at other times. This high-low cycle may be repeated at fairly regular intervals. If a source is in violation (or in continuous compliance) of the applicable standard over the 6-minute averaging time required by Method 9, it does not pose a problem to the visible emissions observer. If the pollutant-emitting operational cycle of a source is less than 6 minutes in duration, however, that source may be out of compliance only for a portion of each 6-minute averaging period, which will make it difficult or impossible to document a violation if the data is to be reduced to a 6-minute average.

If the source is not covered by a NSPS or a State Implementation Plan that specifies the explicit use of Method 9 or another specified modification to Method 9, another technique for reading intermittent emissions of less than a 6-minute duration is to use Method 9 procedures but reduce the averaging time to about 3 minutes. This reduction will allow the observer to tally the number of 3-minute violations that occur. Analysis of many data sets has confirmed that using this method sacrifices little or no accuracy.

In all cases where sources are not subject to NSPS or other federally promulgated standard, the existing State regulations and specified opacity observation methods (if any) must be used. Two other techniques that have been used to document intermittent emissions are the "stopwatch" technique (measuring the total accumulated time that the opacity exceeds the applicable standard) and the time-aggregate data reporting technique (taking readings every 15 seconds, tallying the number of readings exceeding the standard, and multiplying this number by 15 seconds to determine the amount of time the source is out of compliance during the observation period). Many State agencies use these latter techniques, and have adopted their methods in their SIP rules and regulations. EPA currently has studies underway to evaluate the accuracy and reliability of these nonaveraging techniques.

Table 4.2. *Activity Matrix for Visible Emission Determination*

Activity	*Acceptance limits*	*Frequency and method of measurement*	*Action if requirements are not met*
Perimeter survey	*Completed perimeter survey*	*Prior to, following, and during (if warranted) the VE determination*	*N/A*
Plant entry	*Observer should follow protocol as suggested in Subsec 4.2 and adhere to confidentiality of data*	*Entry prior to taking VE readings only if necessary; entry after VE readings to provide plant representative with data and/or to obtain necessary plant process data*	*N/A*
VE Determination			
1. Position	*In accordance with Subsec 4.3.1*	*Take a position for observation as described in Subsec 4.3.1 and document on data form*	*Follow instructions under special problems (Subsec 4.4) when a proper position cannot be assumed*
2. Observations	*Taken in accordance with Subsec 4.3.1*	*Make VE determination as described in Subsec 4.3.1*	*As above*
3. Field data: VE observation form	*Completed data form*	*Complete data form as per instructions and examples in Subsec 4.3.2*	*Complete missing data (if possible) or give rationale for incomplete data*
4. Facility operating data	*Pertinent process data obtained*	*After VE observations, obtain facility data per Subsec 4.3.3*	*Data must be obtained as soon as possible after VE observation*
Special observation problems	*N/A*	*Refer to Subsec 4.4 when conditions do not permit VE observation under proper position, etc.*	*N/A*

N/A = not applicable.

5.0 Postobservation Operations

Table 5.1 at the end of this section summarizes the quality assurance activities for postobservation operations. These activities include preparation of reports and data summaries and validation.

5.1 Data Summary

The opacity observations are recorded on data forms such as those shown in Figures 4.1 and 4.2. Figure 5.1 is a summary data form for manual calculations. This form and the calculation procedures are discussed in detail in Section 3.12.6. It is recommended, however, that a computer be used when reducing large quantities of data and to avoid calculation errors.

5.2 Reporting Procedures

Recording opacity observation data on a three-part form is most convenient. One part can be given to the appropriate facility personnel immediately following the on-site field observation if this is the agency policy or procedure, one part should be given to the Agency, and one part should be maintained in the observer's file. The data form should be completed on-site, and it should be signed by the observer, the facility representative (if applicable), and the data validator. All corrections must be initialed. The file copy should be signed by the data validator.

Inspection forms alone may not be adequate for documenting an enforceable violation and can be supplemented by a narrative report. It is recommended that a summary report be made containing the following information:

1. Name and location of facility, date and time of inspection, name of inspector, and name of company official(s) contacted.
2. Brief description of the specific process information gathered,

Company Admiral Power Plant Date 15 July 1982 Location 112 Ocean Rd., Admiral City, Va.
Start time 1330 Emission point Oil Fired Boiler

Start no.	Total opacity	Average opacity	Start no.	Total opacity	Average opacity	Start no.	Total opacity	Average opacity	Start no.	Total opacity	Average opacity	Start no.	Total opacity	Average opacity	Start no.	Total opacity	Average opacity
1	885	36.8	37			73			109			145			181		
2	885	36.8	38			74			110			146			182		
3	880	36.6	39			75			111			147			183		
4	860	35.8	40			76			112			148			184		
5	840	35.0	41			77			113			149			185		
6	845	35.2	42			78			114			150			186		
7			43			79			115			151			187		
8			44			80			116			152			188		
9			45			81			117			153			189		
10			46			82			118			154			190		
11			47			83			119			155			191		
12			48			84			120			156			192		
13			49			85			121			157			193		
14			50			86			122			158			194		
15			51			87			123			159			195		
16			52			88			124			160			196		
17			53			89			125			161			197		
18			54			90			126			162			198		
19			55			91			127			163			199		
20			56			92			128			164			200		
21			57			93			129			165			201		
22			58			94			130			166			202		
23			59			95			131			167			203		
24			60			96			132			168			204		
25			61			97			133			169			205		
26			62			98			134			170			206		
27			63			99			135			171			207		
28			64			100			136			172			208		
29			65			101			137			173			209		
30			66			102			138			174			210		
31			67			103			139			175			211		
32			68			104			140			176			212		
33			69			105			141			177			213		
34			70			106			142			178			214		
35			71			107			143			179			215		
36			72			108			144			180			216		

Maximum average 36.8 % Start number of six minute average 1
Number of nonoverlapping averages in excess of standard 3 Listing start number of these averages 1, 12, 80, 175
Calculated by V.E. Proffit Date 16 JULY 1982 Reviewed by I.M. REVIEWER Date 17 JULY 1982

Figure 5.1 Visible emission summary data sheet.

particularly any unusual occurrences.

3. Description of the equipment that was inspected and its operating mode at the time of inspection.
4. Notation of any excessive emissions seen and corresponding data from opacity continuous emissions monitor if available.
5. Explanation of excessive emissions, if available, and corrective actions being taken.
6. Summary of emission points *not* in compliance.
7. Recommendations for followup action.

One copy of the report, an updated plot plan, photographs, and other pertinent data should be placed in the Agency file. Whenever a violation is noted, it is EPA policy to notify the facility of the alleged violation and to permit them to review the evidence against them in a meaningful way. The importance of a good file cannot be overstated. This file represents the official Agency documentation of compliance history, the latest information on the source's operation and compliance status. The file also provides the means of communicating source conditions to other staff members. A thorough and accurate historical record on source inspections and opacity readings is essential to good operation and any necessary compliance/enforcement actions.

5.3 Data Validation

All opacity observation data obtained for compliance determination should be validated by senior staff assigned this responsibility. Data validation procedures are described in References 16 and 17. These data should be checked to the extent possible for their completeness, the correctness of source, the emission point and description, the background, and the process and control equipment in use. The calculation of the average opacities and highest average opacity also should be checked. All calculation checks should agree within acceptable roundoff errors. If possible, any questionable data should be reviewed with the observer. Ideally the data validation should occur as soon as possible after the observations are recorded so that questions may be resolved. Any other calculations made for the purpose of supporting the data (e.g., the effect of angle of observation on the observed opacity) should also be verified. *Note:* Any corrections in the data must be forwarded to all interested parties so that they may correct their records (a data form should have been given to them after the opacity observations were completed).

5.4 Equipment Check

A check of the equipment following the opacity observations helps to ensure the quality of the data. Any indication of equipment damage/malfunction should be recorded on an equipment log and noted for purposes of data validation. The malfunctioning equipment should be repaired, adjusted, or replaced so that the equipment will be available for subsequent on-site field observations.

Table 5.1. *Activity Matrix for Postobservation Operations*

Activity	*Acceptance limits*	*Frequency and method of measurement*	*Action if requirements are not met*
Data summary	*Completed data form*	*See Subsec 3.12.6 for instructions for calculations*	*Complete the data summary*
Reporting procedures	*Completed report and data forms*	*Use 3-part form as suggested in Subsec 5.2*	*Complete the necessary data forms and reporting procedure*
Data validation	*All checks should agree within acceptable roundoff error*	*Make data validation check as soon as possible after VE observation*	*Forward all corrections of the data/calculations to the interested parties*
Equipment check	*All equipment/apparatus should be checked for satisfactory operation after each VE observation day*	*Check equipment for damage/malfunctions*	*Note on equipment log and repair, adjust or replace the equipment*

6.0 Calculations

Three types of calculations are described in this section: (1) the calculation of the average opacity for the specified time period (usually 6 min, or 24 observations recorded at 15-s intervals), (2) the calculation of the path length through the plume (seldom needed), and (3) the prediction of steam plume formation (seldom needed). In the first calculation, the 6-min running (or rolling) averages may be required. To minimize errors in the calculations, another individual should check all calculations for each VE determination for compliance. If a difference greater than a typical roundoff error is detected, the corrections should be made and initialed by the one making the correction. Table 6.3 at the end of this section summarizes the quality assurance activities for these calculations.

6.1 Calculation of Average Opacity

Figure 6.1 shows actual opacity data taken at one company (unspecified) for two 6-min periods. *Note:* Any corrections made by an observer must be initialed and the corrected value used in the computation of an average. The calculations can be checked by obtaining the row and column subtotals; the totals of these subtotals must be identical.

Running 6-min averages are calculated from data on Figure 6.2 and reported as described below. Running averages can include a time-lapse break in opacity readings when caused by an element that makes taking a valid reading difficult (e.g., fugitive emissions, improper background, or process shutdown). Running averages should not contain time-lapse breaks in the readings as a result of the observer's desire not to take visible emission data for personnel reasons when conditions exist that would allow the observer to take valid opacity data (e.g., eye strain or no desire to continue readings). Figure 6.3 is included to provide an easy reference between the VE reading time on Figure 6.1 and the start number on Figure 6.2. The start numbers are used to find the corresponding observation time for the beginning of the calculated six minute average.

Determination of the running average is generally performed by computer or by a hand calculator. The main purpose of the calculations is to determine the number of 6-min periods in excess of the standard and the greatest value for any 6-min period. It is also suggested, but not required, that the opacity readings be plotted on a graph showing percent opacity versus time, with a straight line connecting each subsequent reading.

6.1.1 Use of Computer for Calculations - It is highly recommended that a computer be used to calculate and plot data. Programming will vary with the language used by the particular computer, but the basic principle is as follows:

Input:

1. Enter all VE readings with their corresponding start number or identifying start time.

Computation:

1. The first average opacity reading is obtained by averaging the first 24 opacity readings.
2. Each succeeding running average is obtained from the previous one by adding the next observation reading and subtracting the first observation in the series and then dividing by 24 (assuming 6-min running average).

Printout

1. The computer should print all VE readings with their corresponding number or time. This printing will ensure that all readings have been entered properly.
2. The computer should search all averages and print the highest average opacity and its corresponding number or time interval.
3. Starting at the first interval, the computer should search for all nonoverlapping 6-minute periods in excess of the standard. Each interval's average opacity value and corresponding number or time should be printed out.
4. Finally the computer should plot VE readings versus time intervals. If the computer has a plotter, it should be used. If not, the values can be plotted without connecting lines. If desired, the computer can bracket intervals in excess of the standard.

6.1.2 Use of Hand Calculator for Calculations - When a hand calculator is used, the calculation procedures are the same as those for the computer, except that they must be performed manually. All data should be recorded on the VE Summary Data Sheet (see Figure 6.2) if desired. To avoid calculating average opacity values that are less than the standard, the following procedure can be used. The total value for the 24 readings should be calculated first, and the total opacity should be entered at Start no. 1.

Each succeeding total value can be obtained and recorded by adding the difference between the value dropped and the one added. These calculations can be performed easily without a calculator. If desired, the average opacity reading could then be calculated only for those totals that exceed the total allowable opacity limit (e.g., 20% x 24 = 480). Therefore, a total opacity of 480 or greater would be an exceedance of a 20 percent opacity standard. Method 9 does, however, require that the accuracy of the method be taken into account when determining possible violations of applicable opacity standard.

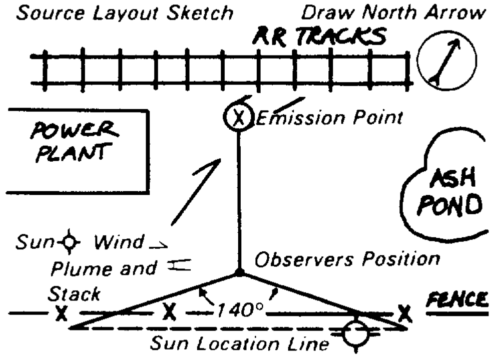
It is suggested that when the opacity standard has been exceeded for any 24 consecutive readings, the data be hand-plotted with each VE reading versus its time interval. These plots fit best on graph paper scaled 10 lines to the inch. Each 15-second reading can be plotted at 1/2 spacing, thereby allowing 20 readings per inch. If desired, intervals of opacity in excess of the standards can be marked on this plot. It is much easier to visualize a trend in opacity with time with such a graphical presentation than with tabulated numerical readings as shown in Figure 6.4.

6.2 Calculation of Path Length Through the Plume

The observer should be located so that only one plume diameter is being sighted through. In rare cases, the observer has no choice but to be relatively close to the stack so that the view is up through the plume rather than across it. In these cases, this extra width of plume should be

SOURCE NAME	ADMIRAL POWER PLANT
ADDRESS	112 OCEAN ROAD
CITY	ADMIRAL CITY
STATE	VA
ZIP	23451
PHONE	804-425-5101
SOURCE ID NUMBER	NEDS 45721
PROCESS EQUIPMENT	OIL FIRED BOILER
OPERATING MODE	BASE LOAD
CONTROL EQUIPMENT	ELECTROSTATIC PRECIPITATOR
OPERATING MODE	RAPPING
DESCRIBE EMISSION POINT	START BRICK STACK 25' DIA. STOP ✓
HEIGHT ABOVE GROUND LEVEL	START 100' STOP ✓
HEIGHT RELATIVE TO OBSERVER	START 100' STOP ✓
DISTANCE FROM OBSERVER	START 400' STOP ✓
DIRECTION FROM OBSERVER	START NNE STOP ✓
DESCRIBE EMISSIONS	START LOFTING PLUME STOP ✓
EMISSION COLOR	START GREY/WHITE STOP ✓
PLUME TYPE	CONTINUOUS ☑ FUGITIVE ☐ INTERMITTENT ☐
WATER DROPLETS PRESENT	NO ☑ YES ☐
IF WATER DROPLET PLUME	ATTACHED ☐ DETACHED ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED	START 10' ABOVE STACK EXIT STOP ✓
DESCRIBE BACKGROUND	START SKY STOP W/BROKEN CLOUDS
BACKGROUND COLOR	START BLUE STOP BLUE/WHITE
SKY CONDITIONS	START CLEAR STOP PARTLY CLOUDY
WIND SPEED	START 15mph STOP 20mph
WIND DIRECTION	START SW STOP ✓
AMBIENT TEMP.	START 85°F STOP ✓
WET BULB TEMP.	54°F
RH, percent	8.5%

Source Layout Sketch Draw North Arrow



COMMENTS	USES #6 OIL
I HAVE RECEIVED A COPY OF THESE OPACITY OBSERVATIONS SIGNATURE	William P. Jance
TITLE	SHIFT MANAGER
DATE	7-15-82

OBSERVATION DATE	15 JULY 1982
START TIME	1330
STOP TIME	1342

MIN \ SEC	0	15	30	45	MIN \ SEC	0	15	30	45
1	30	35	55	55	31				
2	55	50	40	30	32				
3	35	35	35	35	33				
4	30	35	35	35	34				
5	30	30	30	30	35				
6	35	35	35	35	36				
7	30	30	35	35	37				
8	35	40	60	55	38				
9	60	40	55	60	39				
10	50	45	35	30	40				
11	30	30	30	30	41				
12	30	30	30	30	42				
13					43				
14					44				
15					45				
16					46				
17					47				
18					48				
19					49				
20					50				
21					51				
22					52				
23					53				
24					54				
25					55				
26					56				
27					57				
28					58				
29					59				
30					60				

AVERAGE OPACITY FOR HIGHEST PERIOD	40%
NUMBER OF READINGS ABOVE 40 % WERE	11
RANGE OF OPACITY READINGS	MINIMUM 30% MAXIMUM 60%
OBSERVER'S NAME (PRINT)	V.E. PROFFIT
OBSERVER'S SIGNATURE	V. E. Proffit
DATE	15 JULY 82
ORGANIZATION	STATE AIR POLLUTION CONTROL BOARD
CERTIFIED BY	EASTERN TECHNICAL ASSOC.
DATE	18 MAY 1982
VERIFIED BY	RDA
DATE	15 AUG 1982

Figure 6.1. Visible emission observation form.

Visible Emission Summary Data Sheet

Company ADMIRL POWER PLANT Date 15 JULY 1982 Location 112 OCEAN RD., ADMIRAL CITY
Start time 1330 Emission point OIL FIRED BOILER

Start no.	Total opacity	Average opacity	Start no.	Total opacity	Average opacity	Start no.	Total opacity	Average opacity	Start no.	Total opacity	Average opacity	Start no.	Total opacity	Average opacity	Start no.	Total opacity	Average opacity
1	885	36.8	37			73			109			145			181		
2	885	36.8	38			74			110			146			182		
3	880	36.6	39			75			111			147			183		
4	860	35.8	40			76			112			148			184		
5	840	35.0	41			77			113			149			185		
6	845	35.2	42			78			114			150			186		
7			43			79			115			151			187		
8			44			80			116			152			188		
9			45			81			117			153			189		
10			46			82			118			154			190		
11			47			83			119			155			191		
12			48			84			120			156			192		
13			49			85			121			157			193		
14			50			86			122			158			194		
15			51			87			123			159			195		
16			52			88			124			160			196		
17			53			89			125			161			197		
18			54			90			126			162			198		
19			55			91			127			163			199		
20			56			92			128			164			200		
21			57			93			129			165			201		
22			58			94			130			166			202		
23			59			95			131			167			203		
24			60			96			132			168			204		
25			61			97			133			169			205		
26			62			98			134			170			206		
27			63			99			135			171			207		
28			64			100			136			172			208		
29			65			101			137			173			209		
30			66			102			138			174			210		
31			67			103			139			175			211		
32			68			104			140			176			212		
33			69			105			141			177			213		
34			70			106			142			178			214		
35			71			107			143			179			215		
36			72			108			144			180			216		

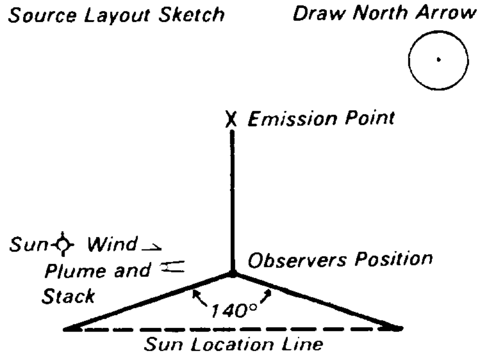
Maximum average 36.8 % Start number of six minute average 1
Number of nonoverlapping averages in excess of standard 3 Listing start number of these averages 1, 12, 80, 175
Calculated by V.E. PROFFET Date 16 JULY 83 Reviewed by ____ Date 17 JULY 1982

Figure 6.2. Visible emission summary data sheet.

VISIBLE EMISSION OBSERVATION FORM

SOURCE NAME	
ADDRESS	
CITY	STATE / ZIP
PHONE	SOURCE ID NUMBER
PROCESS EQUIPMENT	OPERATING MODE
CONTROL EQUIPMENT	OPERATING MODE
DESCRIBE EMISSION POINT START STOP	
HEIGHT ABOVE GROUND LEVEL START STOP	HEIGHT RELATIVE TO OBSERVER START STOP
DISTANCE FROM OBSERVER START STOP	DIRECTION FROM OBSERVER START STOP
DESCRIBE EMISSIONS START STOP	
EMISSION COLOR START STOP	PLUME TYPE: CONTINUOUS ☐ FUGITIVE ☐ INTERMITTENT ☐
WATER DROPLETS PRESENT: NO ☐ YES☐	IF WATER DROPLET PLUME: ATTACHED ☐ DETACHED ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED START STOP	
DESCRIBE BACKGROUND START STOP	
BACKGROUND COLOR START STOP	SKY CONDITIONS START STOP
WIND SPEED START STOP	WIND DIRECTION START STOP
AMBIENT TEMP. START STOP	WET BULB TEMP. / RH,percent

Source Layout Sketch Draw North Arrow



COMMENTS	
I HAVE RECEIVED A COPY OF THESE OPACITY OBSERVATIONS SIGNATURE	
TITLE	DATE

OBSERVATION DATE	START TIME	STOP TIME

SEC / MIN	0	15	30	45	SEC / MIN	0	15	30	45
1	1	2	3	4	31	121	122	123	124
2	5	6	7	8	32	125	126	127	128
3	9	10	11	12	33	129	130	131	132
4	13	14	15	16	34	133	134	135	136
5	17	18	19	20	35	137	138	139	140
6	21	22	23	24	36	141	142	143	144
7	25	26	27	28	37	145	146	147	148
8	29	30	31	32	38	149	150	151	152
9	33	34	35	36	39	153	154	155	156
10	37	38	39	40	40	157	158	159	160
11	41	42	43	44	41	161	162	163	164
12	45	46	47	48	42	165	166	167	168
13	49	50	51	52	43	169	170	171	172
14	53	54	55	56	44	173	174	175	176
15	57	58	59	60	45	177	178	179	180
16	61	62	63	64	46	181	182	183	184
17	65	66	67	68	47	185	186	187	188
18	69	70	71	72	48	189	190	191	192
19	73	74	75	76	49	193	194	195	196
20	77	78	79	80	50	197	198	199	200
21	81	82	83	84	51	201	202	203	204
22	85	86	87	88	52	205	206	207	208
23	89	90	91	92	53	209	210	211	212
24	93	94	95	96	54	213	214	215	216
25	97	98	99	100	55	217	218	219	220
26	101	102	103	104	56	221	222	223	224
27	105	106	107	108	57	225	226	227	228
28	109	110	111	112	58	229	230	231	232
29	113	114	115	116	59	233	234	235	236
30	117	118	119	120	60	237	238	239	240

AVERAGE OPACITY FOR HIGHEST PERIOD	NUMBER OF READINGS ABOVE % WERE
RANGE OF OPACITY READINGS MINIMUM MAXIMUM	
OBSERVER'S NAME (PRINT)	
OBSERVER'S SIGNATURE	DATE
ORGANIZATION	
CERTIFIED BY	DATE
VERIFIED BY	DATE

Figure 6.3. Opacity data form with start numbers shown.

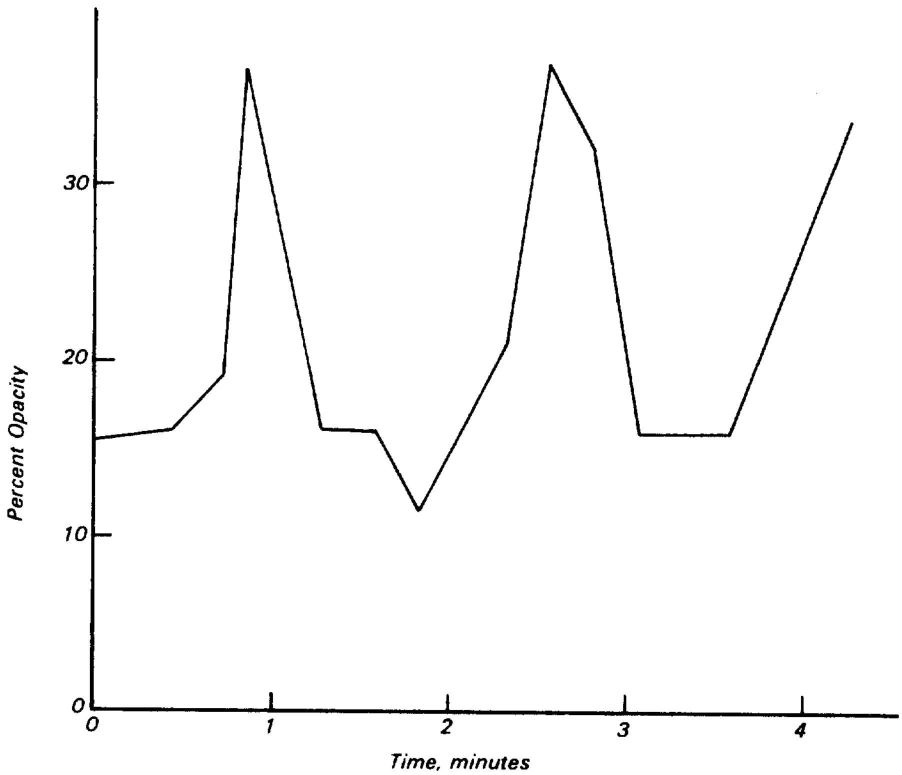


Figure 6.4. *Plot opacity versus time.*

acknowledged and the individual data values may be adjusted mathematically in the final data report to show the increase in opacity reading due to the added path length. These adjusted opacity readings should be used in determining averages in excess of the standard.

The calculation of observed path length is shown in Appendix A of Reference 1 and is included here for the observer's convenience. Figure 6.5 shows how the slant angle varies with distance from an elevated source. As an observer moves closer to the base of the stack, the angle of sight and the path length through the plume both increase; this causes the observed opacity to increase even though the cross-plume opacity remains constant. This situation only applies when the opacity is read through a vertically rising plume and the observer is on the same plane as the base of the stack.

The actual opacity may be calculated from the observed opacity, if the slant angle θ is known, or from the known height of the stack and the distance from the observer to the base of the stack.

Method 1 (when slant angle θ is known)

$$1 - \left(\frac{O_o}{100}\right) = T_o \qquad \text{Equation 6-1}$$

$$(1 - T_o^F) \times 100 = O_c$$

where

O_o = observed opacity in %
T_o = observed transmittance
F = cosine of θ
O_c = corrected opacity in %.

Method 2 (where distances are known)

$$F = \frac{Y}{\sqrt{H^2 + Y^2}} \qquad \text{Equation 6-2}$$

$$1 - \left(\frac{O_o}{100}\right) = T_o$$

$$(1 - T_o^F) \times 100 = O_c$$

where

O_o = observed opacity in %
T_o = observed transmittance
F = cosine of θ
O_c = corrected opacity in %
H = height of stack
Y = distance of observer from stack.

Note: Since the correction is a power function, the correction must be made on each opacity reading and the corrected values used for calculations, in lieu of the correction being conducted on the reduced (averaged) data.

Table 6.1 presents the opacity corrected for slant angle or viewing angle θ versus the full range of opacity readings. For angles less than approximately 18° the adjustment is relatively insignificant.

6.3 Predicting Steam Plume Formation

The psychrometric chart can be used in conjunction with a simple

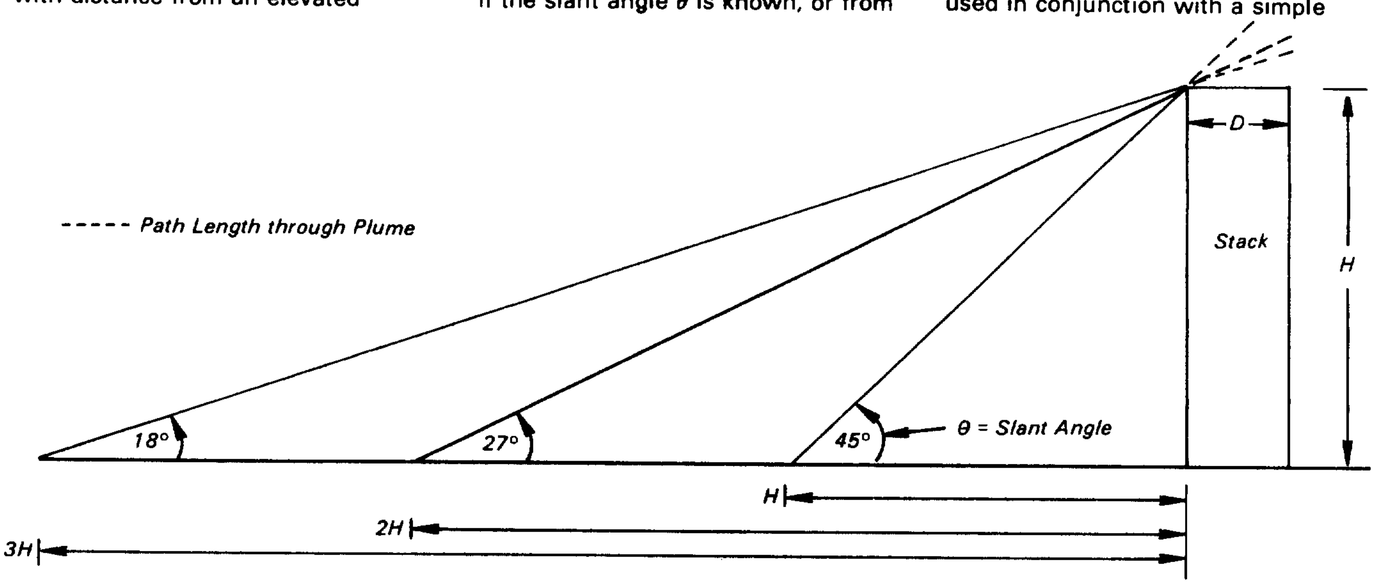


Figure 6.5. *Variation of observation angle and pathlength with distance from an elevated source.*

Table 6.1. Opacity Correction for Slant Angle

Measured opacity, %	Slant angle θ, degrees 0	10	20	30	40	50	60
95	95	95	94	93	90	85	78
90	90	90	89	86	83	77	68
85	85	85	83	81	77	71	62
80	80	80	78	75	71	65	55
75	75	75	73	70	65	59	50
70	70	70	68	65	60	54	45
65	65	64	63	60	55	49	41
60	60	59	58	55	50	45	37
55	55	55	53	50	46	40	33
50	50	50	48	45	41	36	29
45	45	45	43	40	37	32	26
40	40	40	38	36	32	28	23
35	35	35	33	31	28	24	19
30	30	30	29	27	24	21	16
25	25	25	24	22	20	17	13
20	20	20	19	18	16	13	11
15	15	15	14	13	12	10	8
10	10	10	9	9	8	7	5
5	5	5	4	4	3	3	3
0	0	0	0	0	0	0	0

equation to predict the formation of a visible water vapor (steam) plume. The psychrometric chart is a graphical representation of the solutions of various equations of the state of air and water vapor mixtures (see Figure 6.6). Both the ambient and stack emission data points on the chart are referred to as their "state point" and represent one unique combination of the following five atmospheric properties.

Dry bulb temperature - The actual ambient temperature; represented by the horizontal axis.

Wet bulb temperature - The temperature indicated by a "wet bulb" thermometer (a regular thermometer that has its bulb covered with a wet wick and exposed to a moving air stream); represented by the curved axis on the left side of the chart (saturation temperature).

Relative humidity - The ratio of the partial pressure of the water vapor to the vapor pressure of water at the same temperature; values are represented by the set of curved lines originating in the lower left portion of the chart.

Absolute humidity (humidity ratio) - The mass of water vapor per unit mass of air; expressed as grains per pound or pound per pound; represented by the vertical axes.

Specific volume - The volume occupied by a unit mass of air, expressed as cubic feet per pound; represented by the diagonal lines running from lower right to upper left. The relationships shown in the chart differ with changes in barometric pressure. The chart included in this section is for a barometric pressure of 29.92 inches of mercury. Therefore, with use of wet bulb dry bulb technique, if the actual pressure is less than about 29.5 inches of mercury, the humidity ratio should be calculated from the equation and not the chart.

Plotting the values for any two of the five atmospheric properties determines the values for the remaining three properties. For example, by using a sling psychrometer to measure the wet and dry bulb temperatures, one can determine the relative humidity, the absolute humidity, and the specific volume of the air.

To predict the occurrence of a visible steam plume, both the ambient air conditions and the stack gas conditions must be known or calculated and located on the psychrometric chart. If any portion of the line connecting the two points lies to the left of the 100 percent relative humidity line, it is an indication that the change of the exhaust gas from the stack state conditions to the ambient air state will be accompanied by the condensation of the water vapor present in the exhaust stream and a resultant visible steam plume.

Obtaining the state point for the ambient air conditions is relatively simple; as previously indicated, the wet and dry bulb temperatures, which will determine a unique state point, can be measured by using a sling psychrometer. Often the only data available for determining the state point of the stack gas are the dry bulb temperature of the exhaust gas stream and its moisture content.* However, a relationship exists between the moisture content and the humidity ratio (or absolute humidity), as shown in the following equation:

$$HR = \frac{0.62\,(MC)}{1 - MC} \quad \text{Equation 6-3}$$

where

HR = humidity ratio, in pound of water vapor per pound of dry air

MC = $\frac{\%}{100}$ moisture content, expressed as a decimal.

The following sample problem demonstrates the use of this equation.

Given:

Ambient conditions
- Dry bulb temperature = 70°F
- Wet bulb temperature = 60°F
- Barometric pressure = 29.92 in. Hg

Effluent gas conditions
- Dry bulb temperature = 160°F
- Moisture content = $\frac{16.8\%}{100}$ = 0.168

Find:

Ambient relative humidity

Exhaust gas humidity ratio

Determine whether or not condensed water (steam plume) will form

*These are usually obtained from plant records or are estimated from recent source test data.

Table 6.2. Vapor Pressures of Water at Saturation

Temp., °F	Water vapor pressure, in. Hg 0	1	2	3	4	5	6	7	8	9
30	0.1647	0.1716	0.1803	0.1878	0.1955	0.2035	0.2118	0.2203	0.2292	0.2383
40	0.2478	0.2576	0.2677	0.2783	0.2891	0.3004	0.3120	0.3240	0.3364	0.3493
50	0.3626	0.3764	0.3906	0.4052	0.4203	0.4359	0.4520	0.4586	0.4858	0.5035
60	0.5218	0.5407	0.5601	0.5802	0.6009	0.6222	0.6442	0.6669	0.6903	0.7144
70	0.7392	0.7648	0.7912	0.8183	0.8462	0.8750	0.9046	0.9352	0.9666	0.9989
80	1.032	1.066	1.102	1.138	1.175	1.213	1.253	1.293	1.335	1.378
90	1.422	1.467	1.513	1.561	1.610	1.660	1.712	1.765	1.819	1.875
100	1.932	1.992	2.052	2.114	2.178	2.243	2.310	2.379	2.449	2.521
110	2.596	2.672	2.749	2.829	2.911	2.995	3.081	3.169	3.259	3.351
120	3.446	3.543	3.642	3.744	3.848	3.954	4.063	4.174	4.289	4.406
130	4.525	4.647	4.772	4.900	5.031	5.165	5.302	5.442	5.585	5.732

Solution:

Plot ambient wet bulb and dry bulb temperatures (see Figure 6.5).

Ambient relative humidity = 55%.

Exhaust gas humidity ratio = HR

$$HR = \frac{0.62\ (MC)}{1 - MC} = \frac{0.62\ (0.168)}{1 - 0.168} = 0.125 \text{ lb/lb dry air}$$

Plot humidity ratio and stack dry bulb temperature (see Figure 6.6). Connect the ambient state point and stack gas state point with a straight line (see Figure 6.5). The line crosses the 100 percent relative humidity line; thus, formation of a visible water vapor plume is probable.

When the wet bulb/dry bulb technique is used and the barometric pressure is less than 29.5 in. Hg, it is suggested that Equation 6-5 be used to calculate the moisture content (MC).

$$MC = \frac{V.P.}{P_{abs}} \qquad \text{Equation 6-5}$$

where

VP = Vapor pressure of H_2O using Equation 6-6

P_{abs} = Barometric pressure

$$VP = SVP - \frac{(3.57 \times 10^{-4})\ (P_{abs})\ (T_d - T_w)\ (1 + T_w - 32)}{1571} \qquad \text{Equation 6-6}$$

where

SVP = Saturated vapor pressure in in. Hg at wet bulb temperature (taken from Table 6.2)

T_d = Temperature of dry bulb thermometer, °F

T_w = Temperature of wet bulb thermometer, °F.

Table 6.3 *Activity Matrix for Calculations*

Calculation	*Acceptance limits*	*Frequency and method of measurement*	*Action if requirements are not met*
Average opacity	*Data in Fig 6.1 completed and checked to within roundoff error*	*For each compliance test, perform independent check of data form and calculations*	*Complete the data and initial any changes in calculations*
Running average opacity	*Data in Fig 6.2 completed and checked*	*As above*	*As above*
Path length through the plume	*No limits have been set*	*For each compliance test with the slant angle >18°, calculate using Eq. 6-1*	*Perform calculations*
Predicting steam plume	*No limits have been set*	*Use psychrometric chart and Equation 6-3*	*Perform calculations*

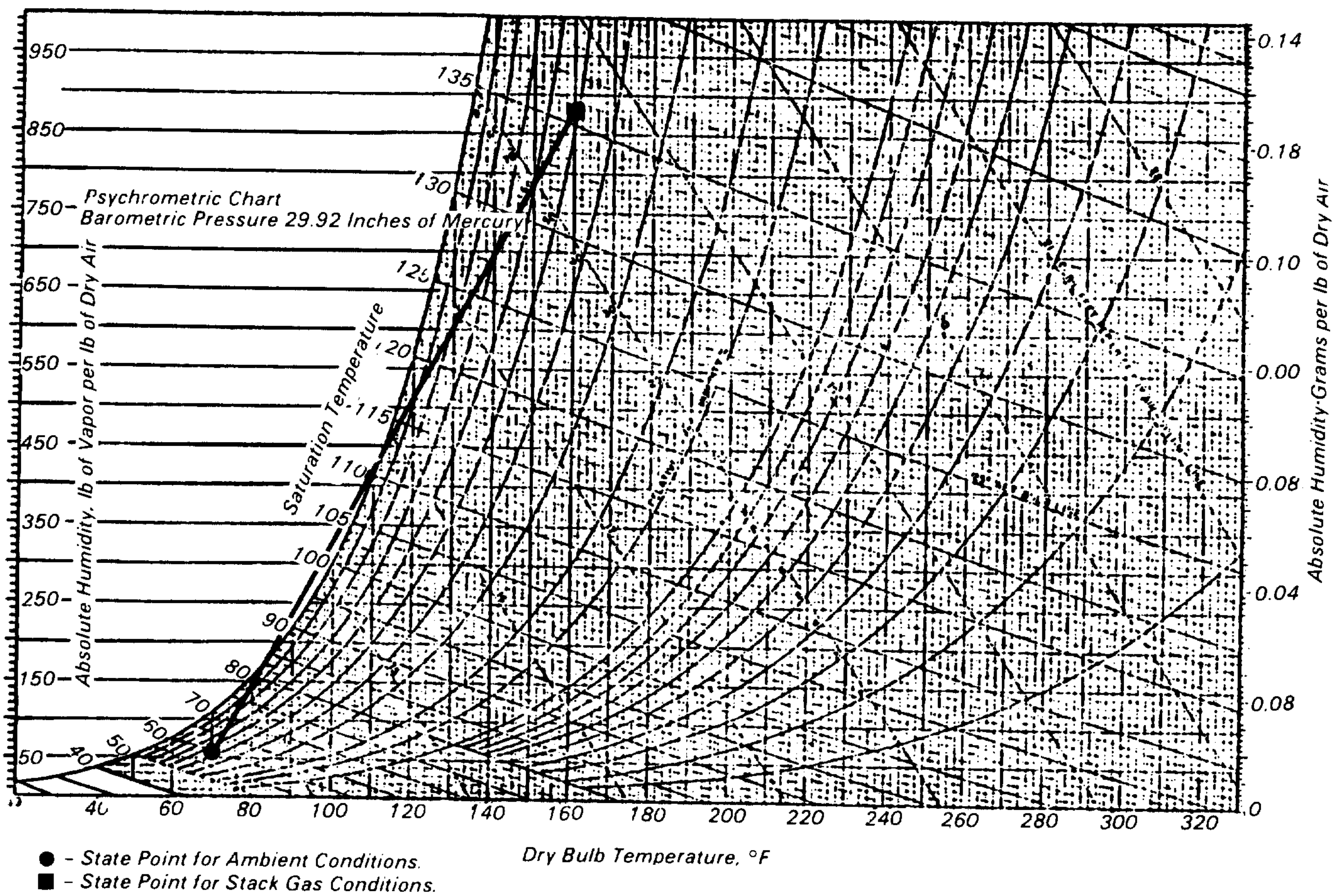


Figure 6.6. *Psychrometric chart for problem solution.*

7.0 Auditing Procedures

An audit is an independent assessment of data quality. Independence is achieved by using observers and data analysts other than the original observer/analyst. Routine QA checks for proper observer positioning and documentation are necessary to obtain good quality data. Table 7.1 at the end of this section summarizes the QA activities for auditing.

Two performance audits are recommended for VE readings:

1. Audit of observer by having an experienced observer make independent readings.
2. Audit of data forms and calculations.

In addition, it is recommended that a systems audit be conducted by an experienced observer at the same time the performance audit of visible emissions is conducted. The two performance audits are described in Subsection 7.1 and the systems audit is described in Subsection 7.2.

7.1 Performance Audits

Performance audits are quantitative evaluations of the quality of visible emission data.

7.1.1 Performance Audit of Visible Emissions - In this audit, an experienced observer goes with the observer being audited and both observers take the readings simulataneously (using the same time piece) and complete the data forms as independently as is practical. The audit is intended for observers in their first year and observers who have not made opacity observation in the field in over a year. The differences between the two readings serve as a measure of accuracy assuming the experienced observer reads the "true opacity." Because this assumption is not necessarily correct, the difference between the two readings is a combined measure of accuracy of both observers. For a minimum of six minutes (24 readings), the average of the absolute differences should be less than 10 percent, and no individual differences should exceed 20 percent. (The values of 10% and 20% suggested for the limits are the approximate results of combining the allowable errors of the two observers; e.g., $\sqrt{(7.5)^2 + (7.5)^2} = 10.6\%$, and $\sqrt{15^2 + 15^2} = 21.2\%$. This audit should be performed twice in a year for the first year of an observer and whenever conditions tend to warrant them thereafter. Calculate %A using Equation 7-1.

$$\%A = |VE\ (\text{observer}) - VE\ (\text{auditor})| \qquad \text{Equation 7-1}$$

where

VE (observer) = average and individual VE reading(s) of the observer being audited

VE (auditor) = average and individual VE reading(s) of the auditor.

7.1.2 Performance Audit of Data Calculations - This audit is an independent check of all calculations performed for the summary VE report. Every calculation should be checked within round-off error. This audit should be conducted on at least 7 percent of the annual numbers of VE summary reports.

7.2 System Audit

A system audit provides an on-site qualitative inspection and review of the total inspection. This audit includes a check of the "Record of Visual Determination of Opacity," Figure 9.1 of Section 3.12.8, and the top portion of the "Observation Record," Figure 9.2 of Section 3.12.8. In addition, the auditor should assess the visible emission inspection technique used by the auditee. This portion of the system audit is best handled in conjunction with the performance audit described in the previous Subsection 7.1.1. Therefore, the frequency of the system audit should coincide with the frequency of the performance audits of visible emissions. Some observations to be made by the auditor are listed in Figure 7.1.

Table 7.1. *Activity Matrix for Auditing Procedures*

Audit	*Acceptance limits*	*Frequency and method of measurement*	*Action if requirements are not met*
Performance audit of visible emissions	*Individual observations within ±20%; average (absolute) deviation within ±10%*	*At least two times during the first year; simultaneous observation and data recording*	*Review observation techniques*
Performance audit of data calculations	*Original and check calculations agree within round-off error*	*Seven percent of tests for compliance, perform independent check on all calculations*	*Check and correct all calculated results (averages)*
System audit	*Conduct observations as described in this section of the Handbook*	*At least two times during the first year; use audit checklist (Fig 7.1)*	*Explain to observer the deviations from recommended procedures; note the deviations on Fig 7.1*

Name of individual(s) audited Buff A. Low

Affiliation New York State Agency

Auditor name N. Jersey Affiliation Region II EPA

Date of audit 12·25·82 Auditor signature New Jersey

Yes	No	Comment	Operation
✓			1. Equipment satisfactory
✓			2. Data forms completed
✓			3. Post-notification (courtesy obligation) performed
✓			4. Correct identification of point of emissions
✓			5. Plume associated with process generation point
✓			6. Credentials okay
✓			7. Observer acted in professional and courteous manner
✓			8. Proper observer position
✓			9. Opacity readings complete
✓			10. Ancillary measurements available
✓		confidentially required	11. Camera used to validate sightings/source identification
✓			12. Facility personnel given a copy of raw data
		N/A	13. Mutiple sources/plumes/outlets
✓			14. Lighting conditions satisfactory
			15. Background conditions (raining, etc.) satisfactory
✓			16. Slant angle recorded
		N/A	17. Fugitive emissions
✓			18. Time of day recorded
✓			19. Recertified within last 6 months

General comments:

Performance Audit of VE Readings Were Acceptable. However, All of the VE Readings were less than 20% in Opacity from the source.

Figure 7.1. *Method 9 checklist for auditors.*

8.0 Reference Method[a]

Method 9—Visual Determination of the Opacity of Emissions from Stationary Sources

Many stationary sources discharge visible emissions into the atmosphere; these emissions are usually in the shape of a plume. This method involves the determination of plume opacity by qualified observers. The method includes procedures for the training and certification of observers, and procedures to be used in the field for determination of plume opacity. The appearance of a plume as viewed by an observer depends upon a number of variables, some of which may be controllable and some of which may not be controllable in the field. Variables which can be controlled to an extent to which they no longer exert a significant influence upon plume appearance include: Angle of the observer with respect to the plume; angle of the observer with respect to the sun; point of observation of attached and detached steam plume; and angle of the observer with respect to a plume emitted from a rectangular stack with a large length to width ratio. The method includes specific criteria applicable to these variables.

Other variables which may not be controllable in the field are luminescence and color contrast between the plume and the background against which the plume is viewed. These variables exert an influence upon the appearance of a plume as viewed by an observer, and can affect the ability of the observer to accurately assign opacity values to the observed plume. Studies of the theory of plume opacity and field studies have demonstrated that a plume is most visible and presents the greatest apparent opacity when viewed against a contrasting background. It follows from this, and is confirmed by field trials, that the opacity of a plume, viewed under conditions where a contrasting background is present can be assigned with the greatest degree of accuracy. However, the potential for a positive error is also the greatest when a plume is viewed under such contrasting conditions. Under conditions presenting a less contrasting background, the apparent opacity of a plume is less and approaches zero as the color and luminescence contrast decrease toward zero. As a result, significant negative bias and negative errors can be made when a plume is viewed under less contrasting conditions. A negative bias decreases rather than increases the possibility that a plant operator will be cited for a violation of opacity standards due to observer error.

Studies have been undertaken to determine the magnitude of positive errors which can be made by qualified observers while reading plumes under contrasting conditions and using the procedures set forth in this method. The results of these studies (field trials) which involve a total of 769 sets of 25 readings each are as follows:

(1) For black plumes (133 sets at a smoke generator). 100 percent of the sets were read with a positive error[1] of less than 7.5 percent opacity; 99 percent were read with a positive error of less than 5 percent opacity.

(2) For white plumes (170 sets at a smoke generator, 168 sets at a coal-fired power plant, 298 sets at a sulfuric acid plant), 99 percent of the sets were read with a positive error of less than 7.5 percent opacity; 95 percent were read with a positive error of less than 5 percent opacity.

The positive observational error associated with an average of twenty-five readings is therefore established. The accuracy of the method must be taken into account when determining possible violations of applicable opacity standards.

1. Principle and applicability.

1.1 Principle. The opacity of emissions from stationary sources is determined visually by a qualified observer.

1.2 Applicability. This method is applicable for the determination of the opacity of emissions from stationary sources pursuant to § 60.11(b) and for qualifying observers for visually determining opacity of emissions.

[1]For a set, positive error = average opacity determined by observers' 25 observations — average opacity determined from transmissometer's 25 recordings.

2. Procedures.

The observer qualified in accordance with paragraph 3 of this method shall use the following procedures for visually determining the opacity of emissions:

2.1 Position. The qualified observer shall stand at a distance sufficient to provide a clear view of the emissions with the sun oriented in the 140° sector to his back. Consistent with maintaining the above requirement, the observer shall, as much as possible, make his observations from a position such that his line of vision is approximately perpendicular to the plume direction, and when observing opacity of emissions from rectangular outlets (e.g. roof monitors, open baghouses, noncircular stacks), approximately perpendicular to the longer axis of the outlet. The observer's line of sight should not include more than one plume at a time when multiple stacks are involved, and in any case the observer should make his observations with his line of sight perpendicular to the longer axis of such a set of multiple stacks (e.g. stub-stacks on baghouses).

2.2 Field records. The observer shall record the name of the plant, emission location, type facility, observer's name and affiliation, and the date on a field data sheet (Figure 9-1). The time, estimated distance to the emission location, approximate wind direction, estimated wind speed, description of the sky condition (presence and color of clouds), and plume background are recorded on a field data sheet at the time opacity readings are initiated and completed.

2.3 Observations. Opacity observations shall be made at the point of greatest opacity in that portion of the plume where condensed water vapor is not present. The observer shall not look continuously at the plume, but instead shall observe the plume momentarily at 15-second intervals.

2.3.1. Attached steam plumes. When condensed water vapor is present within the plume as it emerges from the emission outlet, opacity observations shall be made beyond the point in the plume at which

Company ______
Location ______
Test Number ______
Date ______
Type Facility ______
Control Device ______

Hours of Observation ______
Observer ______
Observer Certification Date ______
Observer Affiliation ______
Point of Emissions ______
Height of Discharge Point ______

	Initial			*Final*
Clock Time				
Observer Location *Distance to Discharge*				
Direction from Discharge				
Height of Observation Point				
Background Description				
Weather Conditions *Wind Direction*				
Wind Speed				
Ambient Temperature				
Sky Conditions (clear, overcast, % clouds, etc.)				
Plume Description *Color*				
Distance Visible				
Other Information				

Summary of Average Opacity

Set Number	*Time*	*Opacity*	
	Start—End	*Sum*	*Average*

Readings ranged from ____ to ____ % opacity

The source was/was not in compliance with ____ at the time evaluation was made.

Figure 9.1 *Record of Visual Determination of Opacity*

Page ____ of ____

condensed water vapor is no longer visible. The observer shall record the approximate distance from the emission outlet to the point in the plume at which the observations are made.

2.3.2 Detached steam plume. When water vapor in the plume condenses and becomes visible at a distinct distance from the emission outlet, the opacity of emissions should be evaluated at the emission outlet prior to the condensation of water vapor and the formation of the steam plume.

2.4 Recording observations. Opacity observations shall be recorded to the nearest 5 percent at 15-second intervals on an observational record sheet. (See Figure 9-2 for an example.) A minimum of 24 observations shall be recorded. Each momentary observation recorded shall be deemed to represent the average opacity of emissions for a 15-second period.

2.5 Data Reduction. Opacity shall be determined as an average of 24 consecutive observations recorded at 15-second intervals. Divide the observations recorded on the record sheet into sets of 24 consecutive observations. A set is composed of any 24 consecutive observations. Sets need not be consecutive in time and in no case shall two sets overlap. For each set of 24 observations, calculate the average by summing the opacity of the 24 observations and dividing this sum by 24. If an applicable

Company ______________________ *Observer* ______________________
Location ______________________ *Type Facility* ______________________
Test Number ______________________ *Point of Emissions* ______________________
Date ______________________

Hr.	*Min.*	*Seconds*				*Steam Plume (check if applicable)*		*Comments*
		0	*15*	*30*	*45*	*Attached*	*Detached*	
	0							
	1							
	2							
	3							
	4							
	5							
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Figure 9.2 *Observation Record*

Page _____ *of* _____

standard specifies an averaging time requiring more than 24 observations, calculate the average for all observations made during the specified time period. Record the average opacity on a record sheet. (See Figure 9-1 for an example.)

3. Qualifications and testing.

3.1 Certification requirements. To receive certification as a qualified observer, a candidate must be tested and demonstrate the ability to assign opacity readings in 5 percent increments to 25 different black plumes and 25 different white plumes, with an error not to exceed 15 percent opacity on any one reading and an average error not to exceed 7.5 percent opacity in each category. Candidates shall be tested according to the procedures described in paragraph 3.2. Smoke generators used pursuant to paragraph 3.2 shall be equipped with a smoke meter which meets the requirements of paragraph 3.3.

The certification shall be valid for a period of 6 months, at which time the qualification procedure must be repeated by any observer in order to retain certification.

3.2 Certification procedure.

The certification test consists of showing the candidate a complete run of 50 plumes—25 black plumes and 25 white plumes—generated by a smoke generator. Plumes within each set of 25 black and 25 white runs shall be presented in random order. The candidate assigns an opacity value to each plume and records his observation on a suitable form. At the completion of each run of 50 readings, the score of the candidate is determined. If a candidate fails to qualify, the complete run of 50 readings must be repeated in any retest. The smoke test may be administered as part of a smoke school or training program, and may be preceded by training or familiarization runs of the smoke generator during which candidates are shown black and white plumes of known opacity.

3.3 Smoke generator specifications.

Any smoke generator used for the purposes of paragraph 3.2 shall be equipped with a smoke meter installed to measure opacity across the diameter of the smoke generator stack. The smoke meter output shall display instack opacity based upon a path length equal to the stack exit diameter, on a full 0 to 100 percent chart recorder scale. The smoke meter optical design and performance shall meet the specifications shown in Table 9-1. The smoke meter shall be calibrated as prescribed in paragraph 3.3.1 prior to the conduct of each smoke reading test. At the completion of each test, the zero and span drift shall be checked and if the drift exceeds ±1 percent opacity, the conditions shall be corrected prior to conducting any subsequent test runs. The smoke meter shall be demonstrated, at the time of installation, to meet the specifications listed in Table 9-1. This demonstration shall be repeated following any subsequent repair or replacement of the photocell or associated electronic circuitry including the chart recorder or output meter, or every 6 months, whichever occurs first.

Table 9-1. *Smoke Meter Design and Performance Specifications*

Parameter:	*Specification*
a. Light source	*Incandescent lamp operated at nominal rated voltage.*
b. Spectral response of photocell.	*Photopic (daylight spectral response of the human eye—reference 4.3).*
c. Angle of view	*15° maximum total angle.*
d. Angle of projection	*15° maximum total angle.*
e. Calibration error	*±3% opacity, maximum*
f. Zero and span drift.	*±1% opacity, 30 minutes.*
g. Response time	*≤5 seconds.*

3.3.1 Calibration. The smoke meter is calibrated after allowing a minimum of 30 minutes warmup by alternately producing simulated opacity of 0 percent and 100 percent. When stable response at 0 percent or 100 percent is noted, the smoke meter is adjusted to produce an output of 0 percent or 100 percent, as appropriate. This calibration shall be repeated until stable 0 percent and 100 percent readings are produced without adjustment. Simulated 0 percent and 100 percent opacity values may be produced by alternately switching the power to the light source on and off while the smoke generator is not producing smoke.

3.3.2 Smoke meter evaluation. The smoke meter design and performance are to be evaluated as follows:

3.3.2.1 Light source. Verify from manufacturer's data and from voltage measurements made at the lamp, as installed, that the lamp is operated within ±5 percent of the nominal rated voltage.

3.3.2.2 Spectral response of photocell. Verify from manufacturer's data that the photocell has a photopic response; i.e., the spectral sensitivity of the cell shall closely approximate the standard spectral-luminosity curve for photopic vision which is referenced in (b) of Table 9-1.

3.3.2.3 Angle of view. Check construction geometry to ensure that the total angle of view of the smoke plume, as seen by the photocell, does not exceed 15°. The total angle of view may be calculated from: $\theta = 2 \tan^{-1} d/2L$, where θ = total angle of view; d = the sum of the photocell diameter + the diameter of the limiting aperture; and L = the distance from the photocell to the limiting aperture. The limiting aperture is the point in the path between the photocell and the smoke plume where the angle of view is most restricted. In smoke generator smoke meters this is normally an orifice plate.

3.3.2.4 Angle of projection. Check construction geometry to ensure that the total angle of projection of the lamp on the smoke plume does not exceed 15°. The total angle of projection may be calculated from: $\theta = 2 \tan^{-1} d/2L$, where θ = total angle of projection; d = the sum of the length of the lamp filament + the diameter of the limiting aperture; and L = the distance from the lamp to the limiting aperture.

3.3.2.5 Calibration error. Using neutral-density filters of known opacity, check the error between the actual response and the theoretical linear response of the smoke meter. This check is accomplished by first calibrating the smoke meter according to 3.3.1 and then inserting a series of three neutral-density filters of nominal opacity of 20, 50, and 75 percent in the smoke meter pathlength. Filters calibrated within ±2 percent shall be used. Care should be taken when inserting the filters to prevent stray light from affecting the meter. Make a total of five nonconsecutive readings for each filter. The maximum error on any one reading shall be 3 percent opacity.

3.3.2.6 Zero and span drift. Determine the zero and span drift by calibrating and operating the smoke generator in a normal manner over a 1-hour period. The drift is measured by checking the zero and span at the end of this period.

3.3.2.7 Response time. Determine the response time by producing the series of five simulated 0 percent and 100 percent opacity values and observing the time required to reach stable response. Opacity values of 0 percent and 100 percent may be simulated by alternately switching the power to the light source off and on while the smoke generator is not operating.

4. References.

4.1 Air Pollution Control District Rules and Regulations, Los Angeles County Air Pollution Control District, Regulation IV, Prohibitions, Rule 50.

4.2 Weisburd, Melvin L. Field Operations and Enforcement Manual for Air, U.S. Environmental·Protection Agency, Research Triangle Park, N.C., APTD-1100, August 1972, pp. 4.1-4.36.

4.3 Condon, E.U., and Odishaw, H., Handbook of Physics, McGraw-Hill Co., N.Y., N.Y., 1958, Table 3.1, p. 6-52.

9.0 References and Bibliography

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2. *Federal Register,* Volume 39, No. 219, November 12, 1974. Method 9 - Visual Determination of the Opacity of Emissions from Stationary Sources (Appendix A).
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11. Ringelmann, M. Method of Estimating Smoke Produced by Industrial Installations. Rev. Technique, 268, June 1898.
12. Weir, A., Jr., D.G. Jones, and L.T. Paypay. Measurement of Particle Size and Other Factors Influencing Plume Opacity. Paper presented at the International Conference on Environmental Sensing and Assessment, Las Vegas, Nevada, September 14-19, 1975.
13. U.S. Environmental Protection Agency. APTI Course 439 Visible Emissions Evaluation. Student Manual. EPA-450/3-78-106, 1978.
14. U.S. Environmental Protection Agency. APTI Course 439 Visible Emissions Evaluation. Instructor Manual. EPA-450/3-78-105, 1978.
15. U.S. Environmental Protection Agency. Guidelines for Evaluation of Visible Emissions. EPA-340/1-75-007, 1975.
16. U.S. Environmental Protection Agency. Screening Procedures for Ambient Air Quality Data. EPA-450/2-78-037, July 1978.
17. Validation of Air Monitoring Data. EPA-600/4-80-030, June 1980.

10.0 Data Forms

Blank data forms are provided on the following pages for the convenience of the QA Handbook user. No documentation is given on these forms because it would detract from their usefulness. Also, the titles are placed at the top of the figures, as is customary for a data form. These forms are not required format, but are intended as guides for the development of an organizations' own program. To relate the form to the text, a form number is also indicated in the lower right-hand corner (e.g., Form M9-1.1, which implies that the form is Figure 1.1. in Section 3.12.1 of the Method 9 Handbook). Any future revisions of this form can be documented by adding A, B, C (e.g., 1.1A, 1.1B). The data forms included in this section are listed below.

Form	*Title*
1.2	Sample Certification Test Form
2.1	Procurement Log
4.1	Visible Emission Observer's Plant Entry Checklist
4.1	Visible Emission Observer's Plant Entry Checklist (Reverse Side)
4.2	Visible Emission Observation Form
4.2	Visible Emission Observation Form (Reverse Side)
5.1	Visible Emission Summary Data Sheet
6.2	Visible Emission Summary Data Sheet (same as Figure 5.1)
7.1	Method 9 Checklist for Auditors

Sample Certification Test Form

Affiliation ______________ *Name* ______________ *Run Number* ______________

Course location ______________ *Sunglasses* ______________

Date ______________ *Sky* ______________ *Wind* ______________

Distance and direction to stack ________

Reading number																						Error
1	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
2	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
3	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
4	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
5	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
6	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
7	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
8	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
9	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
10	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
11	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
12	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
13	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
14	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
15	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
16	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
17	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
18	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
19	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
20	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
21	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
22	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
23	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
24	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
25	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____

Deviation ________

Reading number																						Error
1	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
2	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
3	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
4	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
5	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
6	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
7	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
8	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
9	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
10	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
11	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
12	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
13	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
14	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
15	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
16	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
17	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
18	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
19	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
20	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
21	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
22	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
23	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
24	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____
25	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	____

Deviation ________

Procurement Log

Item description	Quantity	Purchase order number	Vendor	Date		Cost	Disposition	Comments
				Ordered	Received			

Visible Emission Observer's Plant Entry Checklist

Source name and address	*Observer* *Agency* *Date of VE observation*

Previous company contact (if applicable)

Title

Purpose of visit

Emission points at which VE observations to be conducted

Authority for entry (see reverse side)

Plant safety requirements

- ☐ *Hardhat*
- ☐ *Safety glasses*
- ☐ *Side shields (on glasses)*
- ☐ *Goggles*
- ☐ *Hearing protection*
  Specify ______
- ☐ *Safety shoes (steel-toed)*
- ☐ *Insulated shoes*
- ☐ *Gloves*
- ☐ *Coveralls*
- ☐ *Dust mask suggested*
- ☐ *Respirator(s)*
  Specify ______
- ☐ *Other*
- ☐ *Specify* ______

Company official contacted (on this visit)

Title

Visible Emission Observer's Plant Checklist (Continued)

Authority for Plant Entry: Clean Air Act, Section 114

(a)(2) the Administrator or his authorized representative upon presentation of his credentials -

(A) shall have a right of entry to, upon or through any premises of such person or in which any records required to be maintained under paragraph (1) of this section are located, and

(B) may at reasonable times have access to, and copy of any records, inspect any monitoring equipment or methods required under paragraph (1), and sample any emissions which such person is required to sample under paragraph (1).

(b) (1) Each State may develop and submit to the Administrator a procedure for carrying out this section in such State. If the Administrator finds the State procedure is adequate, he may delegate to such State any authority he has to carry out this section.

(2) Nothing in this subsection shall prohibit the Administrator from carrying out this section in a State.
(c) Any records, reports or information obtained under subsection (a) shall be available to the public except that upon a showing satisfactory to the Administrator by any person that records, reports, or information, or particular part thereof, (other than emission data) to which the Administrator has access under this section if made public would divulge methods or processes entitled to protection as trade secrets of such person, the Administrator shall consider such record, report, or information or particular portion thereof confidential in accordance with the purposes of Section 1905 of Title 18 of the United States concerned with carrying out this Act or when relevant in any proceeding under this Act."

Confidential Information: Clean Air Act, Section 114 (see above) 41 ***Federal Register*** *36902, September 1, 1976*

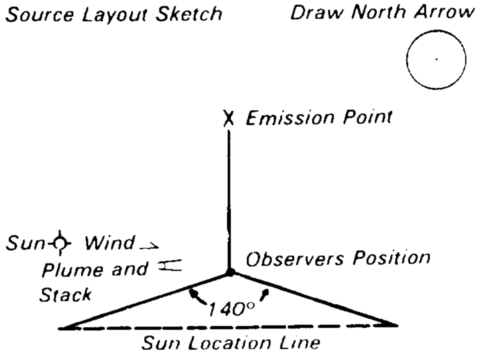
If you believe that any of the information required to be submitted pursuant to this request is entitled to be treated as confidential, you may assert a claim of business confidentiality, covering all or any part of the information, by placing on (or attaching to) the information a cover sheet, stamped or typed legend, or other suitable notice, employing language such as "trade secret," "proprietary," or "company confidential." Allegedly confidential portions of otherwise nonconfidential information should be clearly identified. If you desire confidential treatment only until the occurrence of a certain event; the notice should so state. Information so covered by a claim will be disclosed by EPA only to the extent, and through the procedures, set forth at 40 CFR, Part 2, Subpart B (41 ***Federal Register*** *36902, September 1, 1976.)*

If no confidentiality claim accompanies this information when it is received by EPA, it may be made available to the public by EPA without further notice to you.

Visible Emission Observation Form

SOURCE NAME	
ADDRESS	
CITY	STATE / ZIP
PHONE	SOURCE ID NUMBER
PROCESS EQUIPMENT	OPERATING MODE
CONTROL EQUIPMENT	OPERATING MODE
DESCRIBE EMISSION POINT START STOP	
HEIGHT ABOVE GROUND LEVEL START STOP	HEIGHT RELATIVE TO OBSERVER START STOP
DISTANCE FROM OBSERVER START STOP	DIRECTION FROM OBSERVER START STOP
DESCRIBE EMISSIONS START STOP	
EMISSION COLOR START STOP	PLUME TYPE: CONTINUOUS ☐ FUGITIVE ☐ INTERMITTENT ☐
WATER DROPLETS PRESENT: NO ☐ YES ☐	IF WATER DROPLET PLUME: ATTACHED ☐ DETACHED ☐
POINT IN THE PLUME AT WHICH OPACITY WAS DETERMINED START STOP	
DESCRIBE BACKGROUND START STOP	
BACKGROUND COLOR START STOP	SKY CONDITIONS START STOP
WIND SPEED START STOP	WIND DIRECTION START STOP
AMBIENT TEMP. START STOP	WET BULB TEMP. / RH, percent

Source Layout Sketch Draw North Arrow



COMMENTS	
I HAVE RECEIVED A COPY OF THESE OPACITY OBSERVATIONS SIGNATURE	
TITLE	DATE

OBSERVATION DATE	START TIME	STOP TIME

SEC / MIN	0	15	30	45	SEC / MIN	0	15	30	45
1					31				
2					32				
3					33				
4					34				
5					35				
6					36				
7					37				
8					38				
9					39				
10					40				
11					41				
12					42				
13					43				
14					44				
15					45				
16					46				
17					47				
18					48				
19					49				
20					50				
21					51				
22					52				
23					53				
24					54				
25					55				
26					56				
27					57				
28					58				
29					59				
30					60				

AVERAGE OPACITY FOR HIGHEST PERIOD	NUMBER OF READINGS ABOVE % WERE
RANGE OF OPACITY READINGS MINIMUM MAXIMUM	
OBSERVER'S NAME (PRINT)	
OBSERVER'S SIGNATURE	DATE
ORGANIZATION	
CERTIFIED BY	DATE
VERIFIED BY	DATE

Visible Emission Observation Form

This form is designed to be used in conjunction with EPA Method 9, "Visual Determination of the Opacity of Emissions from Stationary Sources." Any deviations, unusual conditions, circumstances, difficulties, etc., not dealt with elsewhere on the form should be fully noted in the section provided for comments. Following are brief descriptions of the type of information that needs to be entered on the form; for a more detailed discussion of each part of the form, refer to the "User's Guide to the Visible Emission Observation Form."

***Source Name** - full company name, parent company or division information, if necessary.*

***Address** - street (not mailing) address or physical location of facility where VE observation is being made.*

***Phone** - self-explanatory.*

***Source ID Number** - number from NEDS, CDS, agency file, etc.*

***Process Equipment, Operating Mode** - brief description of process equipment (include ID no.) and operating rate, % capacity utilization, and/or mode (e.g., charging, tapping).*

***Control Equipment, Operating Mode** - specify control device type(s) and % utilization, control efficiency.*

***Describe Emission Point** - stack or emission point location, geometry, diameter, color; for identification purposes.*

***Height Above Ground Level** - stack or emission point height, from files or engineering drawings.*

***Height Relative to Observer** - indicate vertical position of observation point relative to stack top.*

***Distance From Observer** - distance to stack ±10%; to determine, use rangefinder or map.*

***Direction From Observer** - direction to stack; use compass or map; be accurate to eight points of compass.*

***Describe Emissions** - include plume behavior and other physical characteristics (e.g., looping, lacy, condensing, fumigating, secondary particle formation, distance plume visible, etc.).*

***Emission Color** - gray, brown, white, red, black, etc.*

Plume Type:
Continuous - opacity cycle >6 minutes
Fugitive - no specifically designed outlet
Intermittent - opacity cycle <6 minutes

***Water Droplets Present** - determine by observation or use wet sling psychrometer; water droplet plumes are very white, opaque, and billowy in appearance, and usually dissipate rapidly.*

If Water Droplet Plume:
Attached - forms prior to exiting stack
Detached - forms after exiting stack

***Point in the Plume at Which Opacity was Determined** - describe physical location in plume where readings were made (e.g., 4 in. above stack exit or 10 ft after dissipation of water plume).*

***Describe Background** - object plume is read against, include atmospheric conditions (e.g., hazy).*

***Background Color** - blue, white, new leaf green, etc.*

***Sky Conditions** - indicate cloud cover by percentage or by description (clear, scattered, broken, overcast, and color of clouds).*

***Windspeed** - use Beaufort wind scale or hand-held anomometer; be accurate to ±5 mph.*

***Wind Direction** - direction wind is **from**; use compass; be accurate to eight points.*

***Ambient Temperature** - in °F or °C.*

***Wet Bulb Temperature** - the wet bulb temperature from the sling psychrometer.*

***Relative Humidity** - use sling psychrometer; use local U.S. Weather Bureau only if nearby.*

***Source Layout Sketch** - include wind direction, associated stacks, roads, and other landmarks to fully identify location of emission point and observer position.*

***Draw North Arrow** - point line of sight in direction of emission point, place compass beside circle, and draw in arrow parallel to compass needle.*

***Sun Location Line** - point line of sight in direction of emission point, place pen upright on sun location line, and mark location of sun when pen's shadow crosses the observers position.*

***Comments** - factual implications, deviations, altercations, and/or problems not addressed elsewhere.*

***Acknowledgment** - signature, title, and date of company official acknowledging receipt of a copy of VE observation form.*

***Observation Date** - date observations conducted.*

***Start Time, Stop Time** - beginning and end times of observation period (e.g., 1635 or 4:35 p.m.).*

***Data Set** - percent opacity to nearest 5%; enter from left to right starting in left column.*

***Average Opacity for Highest Period** - average of highest 24 consecutive opacity readings.*

***Number of Readings Above (Frequency Count)** - count of total number of readings above a designated opacity.*

Range of Opacity Readings:
Minimum - lowest reading
Maximum - highest reading

***Observer's Name** - print in full.*

***Observer's Signature, Date** - sign and date after performing final calculations.*

***Organization** - observer's employer.*

***Certifier, Date** - name of "smoke school" certifying observer and date of most recent certification.*

***Verifier, Date** - signature of person responsible for verifying observer's calculations and date of verification.*

*Required by Reference Method 9; other items suggested.
**Required by Method 9 only when particular factor could affect the reading.

Visible Emission Summary Data Sheet

Company ______________________ *Date* ______________________ *Location* ______________________

Start time ______________ *Emission point* ______________________________________

Start no.	Total opacity	Average opacity	Start no.	Total opacity	Average opacity	Start no.	Total opacity	Average opacity	Start no.	Total opacity	Average opacity	Start no.	Total opacity	Average opacity	Start no.	Total opacity	Average opacity
1			37			73			109			145			181		
2			38			74			110			146			182		
3			39			75			111			147			183		
4			40			76			112			148			184		
5			41			77			113			149			185		
6			42			78			114			150			186		
7			43			79			115			151			187		
8			44			80			116			152			188		
9			45			81			117			153			189		
10			46			82			118			154			190		
11			47			83			119			155			191		
12			48			84			120			156			192		
13			49			85			121			157			193		
14			50			86			122			158			194		
15			51			87			123			159			195		
16			52			88			124			160			196		
17			53			89			125			161			197		
18			54			90			126			162			198		
19			55			91			127			163			199		
20			56			92			128			164			200		
21			57			93			129			165			201		
22			58			94			130			166			202		
23			59			95			131			167			203		
24			60			96			132			168			204		
25			61			97			133			169			205		
26			62			98			134			170			206		
27			63			99			135			171			207		
28			64			100			136			172			208		
29			65			101			137			173			209		
30			66			102			138			174			210		
31			67			103			139			175			211		
32			68			104			140			176			212		
33			69			105			141			177			213		
34			70			106			142			178			214		
35			71			107			143			179			215		
36			72			108			144			180			216		

Maximum average ______________ *% Start number of six minute average* ____/ __
Number of nonoverlapping averages in excess of standard ______ *Listing start number of these averages* ______________
Calculated by ______________________ *Date* ______ *Reviewed by* ______ *Date* ______

Quality Assurance Handbook M9-5.1 and M9-6.2

Method 9 Checklist for Auditors

Name of individual(s) audited ______________________

Affiliation ______________________

Auditor name ______________________ *Affiliation* ______________________

Date of audit ______________________ *Auditor signature* ______________________

Yes	No	Comment	Operation
___	___	___	1. Equipment satisfactory
___	___	___	2. Data forms completed
___	___	___	3. Post-notification (courtesy obligation) performed
___	___	___	4. Correct identification of point of emissions
___	___	___	5. Plume associated with process generation point
___	___	___	6. Credentials okay
___	___	___	7. Observer acted in professional and courteous manner
___	___	___	8. Proper observer position
___	___	___	9. Opacity readings complete
___	___	___	10. Ancillary measurements available
___	___	___	11. Camera used to validate sightings/source identification
___	___	___	12. Facility personnel given a copy of raw data
___	___	___	13. Mutiple sources/plumes/outlets
___	___	___	14. Lighting conditions satisfactory
___	___	___	15. Background conditions (raining, etc.) satisfactory
___	___	___	16. Slant angle recorded
___	___	___	17. Fugitive emissions
___	___	___	18. Time of day recorded
___	___	___	19. Recertified within last 6 months

General comments:

☆U. S. GOVERNMENT PRINTING OFFICE: 1984/759-102/0899

VAPOR RECOVERY SYSTEMS
FIELD COMPLIANCE TESTING

Discussion

This Examination Procedures Outline is directed primarily at those systems/nozzles requiring an "intended tight seal" and use of the "Field Compliance Test Unit".

Systems

Stage II vapor recovery systems are designed to control motor vehicle fuel vapors. The principle types of systems include:

1. Balance System - Where the fuel nozzles include a bellows and face plate designed to make an "intended tight seal" with the vehicle fill opening. Liquid entering a fuel tank displaces vapor which returns to storage.

1. Assist System - These systems may include more than one type of fuel delivery nozzle. One includes a bellows and face plate, but does not require a "tight seal". The other system includes a coaxial fill spout with perforations in the outer tube near its tip. Both systems allow visual observation of vehicle fill opening while filling, if desired, and both rely on some external mechanism to create a vacuum to remove fuel vapors.
   4054, A1.1, A1.2

Nozzles

All the systems utilizing vapor recovery type nozzles shall contain in each nozzle adequate and automatic means to prevent measured liquid from either recirculating, entering the vapor return line, or overflowing a vehicle fill opening. **4054.1, S.1**

All nozzle types shall have a primary shut-off device which automatically activates when liquid covers the primary shut-off sensing mechanism. **4054.1, S.1.1(a)**

Balance Type

These nozzles shall have a secondary shut-off device or other effective means to prevent liquid recirculation. These automatically activate after liquid has entered the vapor return line upon primary shut-off failure.
4054.1, S.1.1(b)

<u>Assist Type</u>

These nozzles may have a secondary shut-off or some other effective means to avoid liquid overflowing a vehicle fuel tank because of primary shut-off failure. "Other effective means" include, but are not limited to, permitting liquid to be seen either by observing the vehicle pipe opening or hearing and seeing liquid overflow spillage.
4054.1, S.1.1(c)

<u>Pre-Test Inspection</u>

1. Identification.

   1.1. Manufacturer's or distributor's name or trademark, model number and serial number.
   Health & Safety Code 41958

   (a) Systems may have an I.D. plate.

   (b) Nozzles may have this information cast in the nozzle body or on a metal I.D. tag depending on manufacturer.

2. Type approval. **B&P 12500.5**

   (a) Systems. **DMS Notice D-86-2**

   (b) Nozzles (new or rebuilt). **DMS Notice D-94-1**

<u>Pre-Test Determinations</u>

1. Equipment.

   1.1. Field Compliance Test Unit built as specified in California Code of Regulations, Section 4054.1, S.2.2. Design. **4055, N.1**

   NOTE: These units should be tested against Division of Measurement Standards area specialist Field Compliance Units for uniformity of performance.

2. Tolerances. **4005, N.2.1**

   2.1. Performance accuracy - primary shut-off devices.

   Primary shut-off device overrides. The required, additional attempts, in total, to override any nozzle primary shut-off device shall not increase the dispenser volume indication by more than 1/10 gallon.
   4054.3

Tests

SAFETY NOTE: Use grounding wires between Field Compliance Unit, nozzle, and dispenser prior to testing.
4055, N.2

1. Initial test - primary shut-off.

    1.1. Dispense fuel into the Field Compliance Test Unit in accordance with common public usage. The nozzle shall shut-off automatically when the primary shut-off sensing mechanism is covered by liquid. After the initial primary shut-off device activates, dispense enough additional fuel into the test unit to immerse the nozzle primary shut-off sensing mechanism in liquid.

    1.2. Record the dispenser indicator gallons.

    1.3. Make 6 additional, consecutive override attempts duplicating a full range of potential customer usage and record the new indicated gallons. All 6 attempts shall result in automatic nozzle shut-off before the dispenser volume indicator increases more than the 1/10 gallon limit.

    NOTE: A test unit must be used for this procedure so the primary shut-off device sensing mechanism can be immersed in liquid.

2. Secondary shut-off device.

    2.1. Introduce sufficient fuel into the vapor return line (approximately 1/10 gallon) to block the return of vapors through the line.

    2.2. Hold in place a "U-shaped" configuration of the fuel discharge hose at a level lower than the nozzle to concentrate the liquid. Make one or more attempts to dispense fuel into an empty Field Compliance Test Unit (balance-type nozzles must make their intended tight seal at the fill pipe opening).

    2.3. The nozzles shall shut-off automatically before the dispenser volume indicator increases more than 3/10 gallon limit for each attempt as specified.

    NOTE: This test is not usually performed except for customer complaints regarding nozzle performance.

FIELD COMPLIANCE TEST UNIT

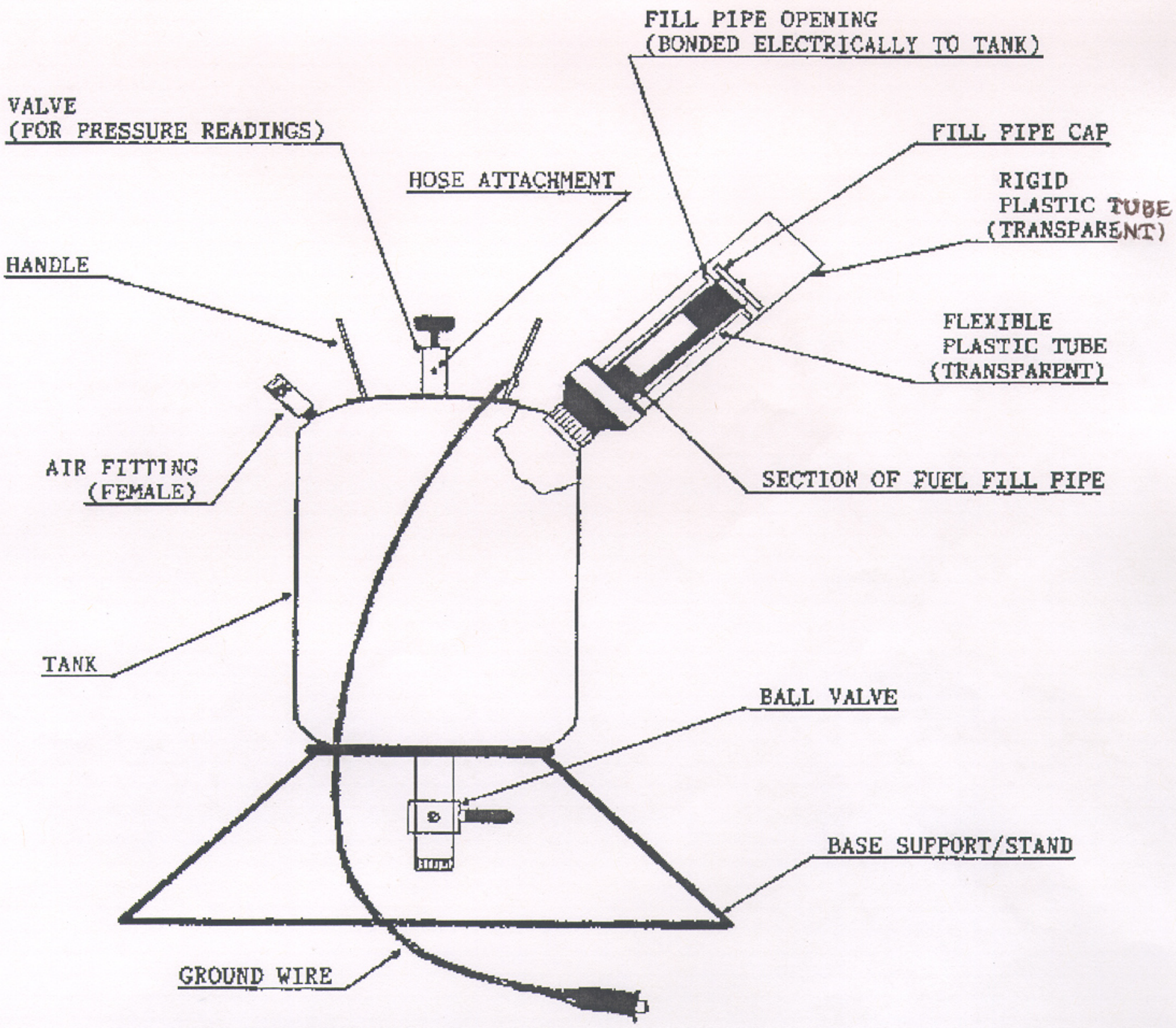


FIGURE 1

Executive Order G-70-187

Exhibit 5

Fillneck Vapor Pressure Regulation Fueling Test

1 Applicability

This test procedure is used to verify proper operation of the nozzle boot pressure regulation unique to the Healy Model 400 ORVR nozzle.

2 Principle

The nozzle vapor pressure regulation is verified during refueling into a tight simulated vehicle fuel tank with saturated vapors (Procedure 1) or into an actual non-ORVR equipped vehicle (Procedure 2). Pressure readings are taken with a mechanical gauge during a fueling of at least 5 gallons, excluding the first two gallons and last one gallon dispensed in order to eliminate the interferences due to vapor growth or contraction. A vacuum which exceeds ½ inches wc, or a pressure which exceeds ¼ inches wc, except during the excluded beginning and ending gallons, indicates a defective nozzle.

3 Interferences

Vacuum or pressure levels outside of the specified range may occur during the beginning or end of the refueling operation when properly functioning equipment is affected by the following conditions: (1) gasoline dispensed into a vehicle fuel tank which is significantly warmer than the dispensed fuel may cause a vacuum of several inches water column; and, conversely, (2) gasoline dispensed into a vehicle tank which is significantly cooler than the dispensed fuel may temporarily cause a pressure greater than ¼ inches water column. The effect of the temperature differential will be most pronounced at the beginning of the fueling operation and tends to gradually disappear toward the end of the fueling operation as fuel and vapor temperatures in the vehicle fuel tank equalize.

4 Apparatus

Mechanical Pressure Gauge - the full scale range of the gauge shall be 1 inch water column pressure to 1 inch water column vacuum (-1.0” wc – +1.0” wc). Maximum incremental graduations of the pressure gauge shall be 0.25 inches wc and the minimum accuracy of the gauge shall be three percent (3%) of full scale. The minimum diameter of the pressure gauge shall be four inches.

4.1 **Procedure 1**. Use a gauge mounted on the test tank fillneck to measure vapor pressure during fueling of a simulated fuel tank (see Figure 1). Any test tank as approved in Air Resources Board, Source Test Methods, Volume 2, TP-201.5, “Determination (by Volume Meter) of Air to Liquid Volume Ratio of Vapor Recovery Systems of Dispensing Facilities” may be used in lieu of the setup shown in Figure 1.

4.2 **Procedure 2.** Use a gauge mounted on a stand and placed level on the vehicle during fueling of actual vehicles (see Figure 2).

4.3 All pressure measuring device(s) shall be bench calibrated using either a reference gauge or an inclined manometer. Calibration shall be performed at 20, 50 and 80 percent of full scale. Accuracy shall be within two percent (2%) at each calibration point. Instrument Calibrations shall be conducted and a certification report filed periodically every 90 days (or less).

5 Pre-Test Procedures

Verify that the system vacuum source is operating in the 65” to 85” WC operating range. No tears or holes are allowed in or on the nozzle boot or face seal.

Ensure that the high vacuum vapor return lines are tight (see Exhibit 4).

5.1 Procedure 1 – simulated vehicle fuel tank (Figure 1).

a. Position test tank next to dispenser nozzle being tested.

b. Dispense 1-2 gallons of gasoline into test tank.

c. Remove nozzle and replace fill cap.

d. Roll tank back and forth vigorously for thirty seconds to splash saturate the vapor head space in the tank.

5.2 Procedure 2 – Torus Pressure Test with actual vehicle (Figure 2).

a. Place the gauge assembly on the vehicle in a level position.

6 Testing

6.1 Procedure 1

a. Remove the fillpipe cap and insert nozzle, making a seal between the nozzle boot and the test tank fillpipe opening. Dispense gasoline (minimum 5 gallons).

b. Observe pressure gauge during fueling.

c. Repeat test for additional nozzles. Drain test tank as necessary.

6.2 Procedure 2

a. Remove the fillpipe cap and position the torus centered over the vehicle fillpipe. Insert nozzle, making a seal between the nozzle boot and the torus and between the torus and fillpipe. Dispense gasoline (minimum 5 gallons).

b. Observe pressure gauge during fueling.

c. Repeat test for additional nozzles.

7 Reporting

Record observed operating levels measured for each nozzle tested along with type and model of pressure measuring device used including: range, accuracy and date of last calibration.

Exhibit 5
Figure 1

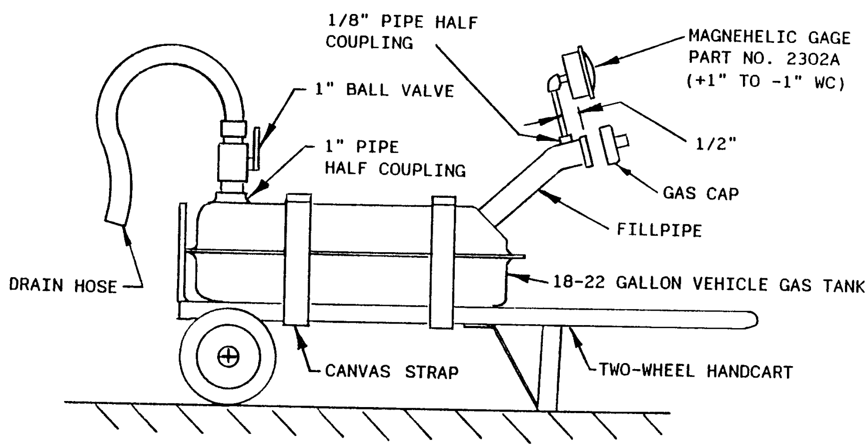
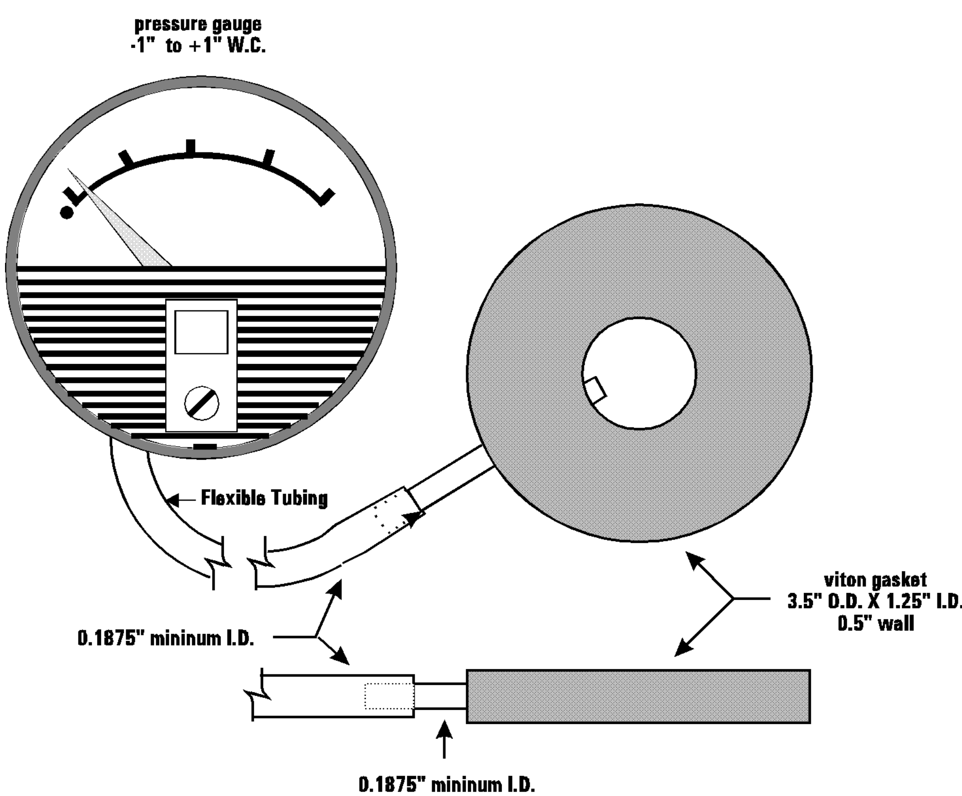


Exhibit 5
Figure 2



EXECUTIVE ORDER G-70-191-AA

EXHIBIT 2

SPECIFICATIONS FOR THE HEALY ORVR PHASE II VAPOR RECOVERY SYSTEM

Nozzle

1. A vapor collection boot shall be installed on the nozzle at the base of the spout, as shown in Exhibit 2, Figure 2B-1. Any nozzle with a vapor collection boot which is missing, or which has one half of the mini-boot faceplate or greater missing is defective and shall be immediately removed from service.

2. The Healy Model 600 ORVR / 800 nozzle has an integral vapor valve which prevents the loss of vapor from the underground storage tanks, ensures proper operation of the system and prevents the ingestion of air into the system. Any nozzle with a defective vapor valve shall be immediately removed from service. The integrity of the system shall be restored by replacing the nozzle or otherwise closing the vapor path as soon as practicable.

3. Nozzles shall be 100 percent performance checked at the factory, including checks of all shutoff mechanisms and of the integrity of the vapor path. The maximum allowable leak rate for the nozzle vapor path shall not exceed the following:

   0.038 CFH at a pressure of two inches water column (2" WC), and
   CFH at a vacuum of eighty-three inches water column (approx. 3 psi).

4. Verification of the integrity of the vapor valve can be performed on installed nozzles by use of the following test.

   a. Seal all nozzles on a dispenser in plastic bags, using tape or other means to secure the bag around the base of the nozzle. Any plastic bag large enough to enclose the nozzles and having a thickness of no greater than 2 mils can be used. 12 " X 20" X 2mil. thick bags are available in California from the California Air Resources Board by calling (800) 952-5588.

   b. Initialize the dispenser for fueling. **Do not dispense any fuel.** The Healy/Franklin VP-1000 vane pump engages upon dispenser activation and provides approximately 3 psi vacuum to all nozzle points on the dispenser simultaneously.

   c. With the dispenser initialized, observe all bagged nozzles for approximately 30 seconds. Any nozzle where the bag can be seen visually collapsing has a defective vapor valve and shall be removed from service immediately.

   d. Disengage the dispenser, remove the bags from all of the nozzles and re-hang the nozzles.

Dispensing Rate

The dispensing rate for installations of this system shall not exceed 10.0 gallons per minute at any time. This shall be determined as specified in Exhibit 3 or as specified in TP-201.5 or any alternative test method approved in writing by the Executive Officer.

Inverted Coaxial Hoses

1. The maximum length of the hose assembly shall be 15 feet measured from the dispenser outlet casting to the base of the nozzle.

2. The length of hose, which may be in contact with the island and/or ground when the nozzle is properly mounted on the dispenser, is limited to six inches (6") per loop.

Breakaway Couplings

Breakaway couplings are optional but, if installed, only CARB-certified breakaways with a valve, which closes the vapor path when separated, may be used.

Healy ORVR Phase II Vapor Recovery System

1. The Healy ORVR Phase II Vapor Recovery System shall consist of an integrated vapor recovery unit made up of an electronic (computerized) control unit and a one-eighth (1/8) hp alternating current electric motor that drives a variable speed rotary vane pump. The VP-1000 Vapor Recovery Vane Pump has been sized to satisfy the recovery needs of one dispenser, with two hoses, pumping either individually or simultaneously. Healy Systems supplies a unique regulation valve, built into the faceplate of the pump assembly, to assure that proper levels of vacuum are maintained. The actual vapor recovery rate is determined by a valve in the nozzle which senses product flow.

   The A/L ratio of the system shall be 1.10 plus or minus 0.10 (1.00 to 1.20). Any fueling point not capable of demonstrating compliance with this performance standard shall be deemed defective and removed from service. The A/L ratio shall be determined by using the CARB-approved procedure TP-201.5. Note: A CARB certified spout adapter / sleeve unique to the Healy 600 ORVR / 800 nozzle must be used in order to obtain accurate results. See Exhibit 2 Figure 2C-1. Alternative test procedures may be used if they are determined by the Executive Officer, in writing, to yield comparable results.

   NOTE: Test Procedure TP-201.5 returns air rather than vapor to the storage tank, and normally causes an increase in storage tank pressure which may result in vent emissions. This is a temporary condition due to the test and should not be considered an indication of malfunction or noncompliance.

2. The Healy ORVR Phase II Vapor Recovery System with the Healy/Franklin Electric VP 1000 Vapor Pump, (Exhibit 2 Figure 2B-2) shall have the following electronic protective features:

- High Power Level Control. The system shall automatically sense conditions that cause high power levels and shall shut down. Conditions causing high power levels include the following: locked rotor condition of the motor, shorted motor windings, fluid in pump cavity for more time than required to clear a blockage and pump overload conditions. If any of these conditions exist, a signal shall be sent to the VP1000 vane pump interface module located inside the dispenser. The system shall then restart automatically. This “shut down send signal wait-restart” cycle will occur three times. After the third cycle failure, it shall not restart automatically. Instead, an error signal is sent to the interface module, (High Power Level Failure), which will then disable the entire dispenser from dispensing product.

- Low Power Level Control. The system shall automatically sense conditions that cause low power levels and shall shut down. Conditions causing low power levels include the following: broken rotor, free running motor shaft-no load conditions. If any of these conditions exist, a signal shall be sent to the VP1000 vane pump interface module located inside the dispenser. The system shall then restart automatically. This “shut down send signal wait-restart” cycle will occur three times. After the third cycle failure it shall not restart automatically. Instead, an error signal is sent to the interface module, (Low Power Level Failure), which will then disable the entire dispenser from dispensing product.

- Verification that the Healy/Franklin VP1000 vane pump is operating correctly can be determined by conducting A/L testing as specified in TP-201.5 or an alternative test method approved in writing by the Executive Officer. Any dispenser where a 0.0 A/L is measured on all fueling points on both sides of the dispenser indicates a failure of the electronic shut-down features of the VP-1000 vane pump. A measured A/L of 0.0 on only one fueling point on one side of a dispenser may be due to hanging hardware problems and may not be indicative of a vane pump problem.

Dispenser Specifications

1. The Healy ORVR Phase II Vapor Recovery System can be installed on any CARB-certified balance vapor ready dispenser. Conversion kits as specified in Exhibit 1 can be used to retrofit non-vapor-ready dispensers. All dispensers must also comply with the following:

    a) Electronically compatible with the Healy ORVR Phase II Vapor Recovery System with the Healy/Franklin Electric VP 1000 Vapor Pump, which must be capable of displaying the electronic protective features as specified in this Exhibit.

b) Tested for compliance with air to liquid ratio limits contained in this Exhibit. The test shall be conducted in accordance with TP 201.5, or an alternative test method approved in writing by the Executive Officer.

Pressure/Vacuum Valves for Storage Tank Vents

1. At least one pressure/vacuum (P/V) valve shall be installed on tank vents. Manifolding of vent lines to minimize the number of P/V valves and potential leak sources is recommended, provided the manifold is installed at a height not less than 12 feet above the driveway surface used for Phase I tank truck filling operations. At least one P/V valve shall be installed on manifolded vents. The P/V valve shall be a CARB-certified valve as specified in Exhibit 1. The outlets shall vent upward and be located to eliminate the possibility of vapor accumulating or traveling to a source of ignition or entering adjacent buildings.

2. The P/V valve is designed to open at a pressure of approximately three inches water column (3" WC). Storage tank pressures which exceed 3" WC for more than a short time may indicate a malfunctioning pressure/vacuum vent valve.

Vapor Recovery Piping Configurations, (Figures 2A-1 - 2A-5)

Note: Figures 2A-1-2A-5 show general vapor plumbing piping layouts and are not to be used as specifications.

1. All vapor return and vent lines shall be a minimum 2" diameter from the dispensers to the first main manifold. All lines after the first manifold and back to the underground storage tanks shall be a minimum 3" diameter.

   Exception: Smaller vapor lines are not recommended but if pre-existing, may be used providing the pressure drop criteria specified below are met.

2. The maximum allowable pressure drop through the system shall never exceed one/half inch (0.5") water column at 60 SCFH. The pressure drop shall be measured from the dispenser riser to the UST with pressure/vacuum valves installed and with the poppeted Phase I vapor connection open.

3. All vapor return and vent lines shall slope a minimum of 1/8" per linear foot. A slope of 1/4" per linear foot or more is recommended whenever feasible.

   Exception: When it is not possible to achieve the necessary minimum slope from the dispenser risers back to the under ground storage tanks due to the topography of a new site or due to upgrading of an existing site, low-point condensate traps or knock-out pots can be utilized as long as the following conditions are met:

   a. The condensate traps must be self-evacuating.
   b. The entire system must remain vapor tight.
   c. Access must be provided for inspection purposes. The condensate traps must be maintained in good working order.
   d. The maximum pressure drop through the system with the condensate traps in place shall not exceed 0.5" WC at 60 SCFH.

4. All vapor return and vent piping shall be installed in accordance with the manufacturer's instructions and all applicable regulations.

5. No product shall be dispensed from any fueling point associated with a vapor line which is disconnected and open to the atmosphere. If vapor lines are manifolded, this includes all fueling points in the facility.

6. All vapor return and vent lines shall be installed in accordance with the manufacturer's instructions and all applicable regulations. The vapor return lines shall be manifolded below grade at the tanks using a minimum 3" diameter line.

   Exception: For installations with a vapor return line directly to only one tank, and for which a manifold on the tank vents will be used to provide part of the vapor return path to other tanks, the vent manifold may be used as an alternative to the underground manifold only in existing installations where the vapor piping is already installed, and shall not be used in "new" installations where vapor piping is being installed. For installations with dedicated vapor piping directly to each tank, the vent manifold is approved for both new and existing installations and an additional tank manifold below grade is optional but not required.

7. The dispenser shall be connected to the riser with either flexible or rigid material which is listed for use with gasoline. The dispenser-to-riser connection shall be installed so that any liquid in the lines will drain toward the storage tank. The internal diameter of the connector, including all fittings, shall not be less than one-half inch (1/2”).

Inverted Coaxial Hose Adapters

1. Inverted coaxial hose adapters shall be 100 percent performance checked at the factory to verify the integrity of the vapor path.

Underground Storage Tank (UST) Pressure

WARNING: Phase I fill caps should be opened with caution because the storage tank may be under pressure.

Phase I System

1. The Phase I system shall be a CARB-certified system which is in good working order and which demonstrates compliance with the static pressure decay test criteria as specified in the most current version of TP-201.3. Coaxial Phase I systems shall not be used with new installations of the Healy ORVR Phase II Vapor Recovery System. Replacement of storage tanks at existing facilities, or modifications which cause the installation of new or replacement Phase I vapor recovery equipment, are considered new installations with regard to this prohibition. An exception to this prohibition may be made for coaxial Phase I systems CARB-certified after January 1, 1994, as compatible for use with Phase II systems which require pressure/vacuum vent valves.

   Where installation of the Healy ORVR Phase II Vapor Recovery System is made by retrofitting previously installed equipment, local districts may elect to allow existing coaxial Phase I systems to remain in use for a specifically identified period of time provided the following conditions are met:

- the existing coaxial Phase I system is a poppeted, CARB-certified system capable of demonstrating compliance with the static pressure decay test as specified above; and

- installation of the Phase II system requires no modification of the UST(s) and/or connections.

2. Spill containment manholes which have drain valves shall demonstrate compliance with the static pressure decay criteria with the drain valves installed as in normal operation. Manholes with cover-actuated drain valves shall not be used. The local district may require the removal of drain valves provided an alternate method of draining the spill container is specified (i.e., a hand pump maintained at the facility and/or on the product delivery trucks).

3. Phase I deliveries shall be accomplished so as to ensure that there is at least one vapor connection between the cargo tank compartment headspace and the storage tank associated with the product delivery. There shall be no more than two product hoses used with one vapor hose connected, and no more than three product hoses used with two vapor hoses connected.

   - the Phase I vapor return hose is connected to the delivery tank and to the delivery elbow before the elbow is connected to the facility storage tank;

   - the delivery tank is opened only after all vapor connections have been made, and is closed before connection of any vapor return hoses;

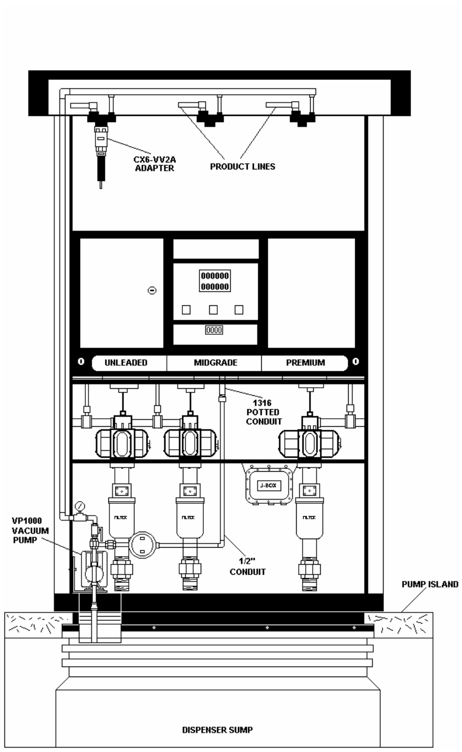
   - the existing coaxial Phase I equipment is in good working order and has demonstrated compliance with static pressure decay test criteria when tested with all fill caps removed; and

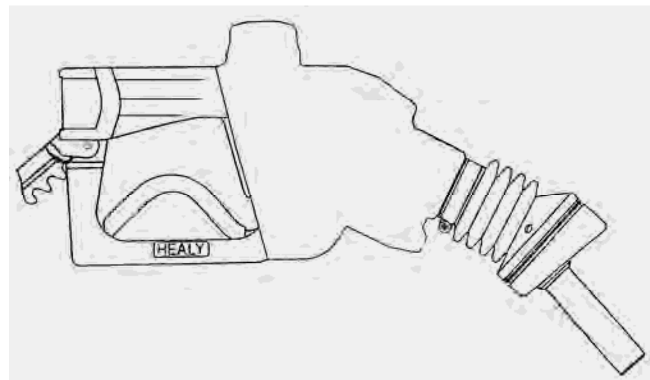
   - the vapor return hose is disconnected from the facility storage tank before it is disconnected from the delivery tank.

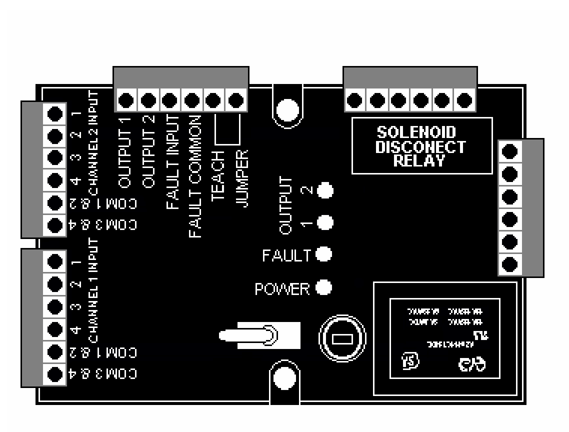
4. Storage tank vent pipes, manhole covers and spill containment bucket covers shall be maintained any color which minimizes solar gain and has a reflective effectiveness of 55% or greater. Reflectivity can be determined by visual comparison of the paint with paint color cards obtained from a paint manufacturer who uses the “Master Pallet Notation” to specify the paint color (i.e., 58YY *88*/180 where the number in italics is the paint reflectivity). Example colors having a reflective ness of 55% or greater include yellow, light gray, aluminum, tan, red iron oxide, cream or pale blue, light green, glossy gray, light blue, light pink, light cream, white, silver, beige, tin plate or mirrored finish. Spill containment bucket covers that are color coded for product identification are exempted from this requirement.

   Exception: Insulated manhole covers such as those manufactured out of a composite material and injected with foam insulation are exempt from the color requirement.

HEALY SYSTEMS VP1000
DISPENSER MOUNTED VACUUM PUMP
INSTALLATION & SERVICE
GUIDE FOR
MULTIPRODUCT DISPENSERS







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Rev. 07-19-03 CWG

INDEX

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(Rev 7-19-03 CWG)

Healy System Scheduled Maintenance Instructions For 600 & 800 Series Nozzle System with VP1000 Dispenser Mounted Vacuum Pump

The Healy System by design requires very limited maintenance. Initial problems are usually created by installation anomalies and are easily detected and repaired when the “ Vapor Return Line Test “ is performed. Periodic maintenance described here will eliminate problems, poor customer performance and maintain peak operation of the system. OPERATING NOTE: In parts of the country where the outside temperature drops below 35° F, the VP1000 vacuum pump motor will automatically run at a very low RPM to prevent freezing. This is normal operation.

Weekly Inspection to Be Performed By Station Manager

- Inspect each nozzle, hose, and breakaway for damage, loose connections or leaks.
- Inspect hoses for wear, severe kinks, cracks and splitting. Replace if wire braid is visible.
- Inspect nozzles for damaged vapor boots or spouts. Any nozzle with a vapor collection boot which is missing, or which has one half of the mini-boot faceplate or greater missing is defective and should immediately removed from service until replaced or repaired. Spouts with visible damage must also be replaced.
- Test the VP1000 Vacuum Pump for normal operation using the following test procedure:

Normal operation will have the VP1000 Vacuum Pump running at low speed if only one side of a dispenser is activated and will run at full speed if both sides of the dispenser are activated. *NOTE: The VP1000 vacuum pump may continue to run for a few seconds after a nozzle is re-holstered.*

1. Activate one side of the dispenser and the vacuum pump should come on. The VP1000 should come on immediately when the nozzle is lifted and the dispenser has reset from 8’s to 0’s.
2. Lift each nozzle one at a time on both sides to verify the vacuum pump is activated after the dispenser display resets from 8’s to 0’s. On some dispensers, activation comes on only after a product is selected.
3. Leaving one nozzle activated on the first side and with the pump now running, lift a nozzle on the other side of the dispenser and listen for a change of speed (increase) in the pump motor.
4. Leaving one side still activated verify the speed change by activating the remaining nozzles on the opposite side one at a time.

If the above procedures can be confirmed by starting with the ‘other’ side, then the unit is correctly installed. Note that after the unit gets to second speed, it will not drop back to single speed until one nozzle is re-holstered.

Quarterly Inspection to Be Performed By Qualified Service Personnel

- Perform Weekly Inspection prior to Quarterly inspection
- Inspect the VP1000 for loose or damaged vapor line connections as well as electrical connections. Repair or replace if damaged.
- Verify proper operating range of the VP1000 (60 " or greater of water column) with a 0-100 inch water column gage, utilizing the "VP1000 Vacuum Performance Test Procedure".
- Inspect submersible and dispenser containment sumps for any leaks and repair as needed.
- Check product flow rate. Replace dispenser filters when flow rate is below 7 GPM / 26.5 LPM. If flow rates exceed 10 GPM / 37.8 LPM, install Healy Flow Limiters.

Annual Inspection to Be Performed By Qualified Service Personnel

- Perform weekly and quarterly inspection prior to Annual Inspection.
- Perform vapor return line tightness test. Repair all leaks.
- Perform pressure decay test. Repair all leaks.
- Perform A / L test on all nozzles. Adjust and replace as necessary.
- Inspect Pressure / Vacuum Vent Valves for proper operation and loose or broken seals.

For more information on Healy Systems maintenance & testing procedures please call our Technical Services Department at: **(603) 882-2472**

Executive Order G-70-204-A
Gilbarco VaporVac/OPW Vaporsaver
ORVR-Compatible Phase II Vapor Recovery System

Exhibit 2
System Specifications

Figures 2A-1 through 2A-10 contain drawings of a typical installation of the VaporVac/Vaporsaver system. Figure 2B-1 depicts the location of component parts of the VaporVac system. Figure 2C-1 includes an illustration and instructions for conducting A/L testing with the Husky 6250 nozzle. Figures 2D-1 through 2D-3 contain drawings of typical manifold installation of one, two and three P/V Vent Valve configurations. Figure 2E-1 contains an example of a GDF Maintenance Record.

Vaporsaver[1]

The Vaporsaver tank pressure management system processes vapor to reduce pressure in the underground storage tank. Detection of a positive pressure of +0.10 ± 0.04 inches water column (" wc), causes the processor to actuate. A maximum of ten minutes of run time is alternated with a minimum of a two-minute rest period during a typical run cycle. The processor stops running when a negative pressure of -0.50 ± 0.20" wc is reached or when the ten minute cycle ends.

1. The processor automatically runs diagnostics each time the high pressure set point (0.10 ± 0.04) is triggered to verify proper pressure and vacuum levels or detect various potential equipment failures, listed below in sections A, B, C and D. In the event of a failure, an audible and visual alarm sounds and an error message is displayed on the User Interface indicating the detected condition and the error is posted to the alarm history. Pressure-related fugitive emissions, including vent emissions, significantly impair the effectiveness of the vapor recovery system when the processor is not operative for more than 24 consecutive hours (including time when the GDF is closed for business). A processor that is inoperative for more than 24 consecutive hours is considered a vapor recovery equipment defect and the system shall be removed from service. The Control Panel displays SYSTEM NORMAL during normal operation. **Failure conditions are indicated by the following error codes**, which are also displayed on the Control Panel.

    A. ALARM COMP (Compressor/Feed Pump Alarm)
    The Control System Feed Pump (Compressor) has not achieved minimum operating pressure (15 psi) within the required time (30 seconds of the motor

[1] Executive Order G-70-204 requires that the system be removed from service when the Vaporsaver is inoperative. This requirement is hereby repealed for any system subject to Executive Order G-70-204. The requirement for removal from service is as stated in this Exhibit for any system subject to Executive Order G-70-204.

starting). The system shall be removed from service if the processor is inoperative for more than 24 consecutive hours.

B. ALARM VAC (Vacuum Pump Alarm)
The Control System Vacuum Pump has not achieved minimum operating vacuum (15 in Hg) within the required time (30 seconds of the motor starting). The system shall be removed from service if the processor is inoperative for more than 24 consecutive hours.

C. ALARM PR (General Processor Alarm)
This is a general alarm that could be caused by one or more of the errors listed below. The system shall be removed from service if the processor is inoperative for more than 24 consecutive hours.

The motor relay has failed in the closed position, leaving the Control System cycling continuously when it is not required.

Compressor pressure switch has failed in the closed position.

Vacuum pump pressure switch has failed in the closed position.

D. ALARM HC (Hydrocarbon Sensor Alarm)
This alarm indicates that the hydrocarbon concentration of the exhaust air exceeds the 4% by volume limit. The system shall be removed from service if the processor is inoperative for more than 24 consecutive hours.

The hydrocarbon concentration in the exhaust air may be determined by ARB Method 100, ***Procedures for Continuous Gaseous Emission Stack Sampling***. This determination is not required by OPW or ARB, but may be used to verify that sensor alarm is operating properly.

2. The following error message indicates a warning condition for the processor that should be investigated by a trained service technician. The station operator is required to call for service within 24 hours of the posted error code warning. This does not indicate that the processor is inoperative and should be removed from service.

A. WARNING RT (Run Time Warning)
This warning indicates that the Control System daily run time is either too long or not long enough. This alarm is displayed when one of the following conditions exists:

Excessive Run Time. This displays when the processor run time is greater than 1140 minutes per day for three consecutive days.

Minimal Run Time. This is displayed when the system runs for no more than five minutes per day for three consecutive days.

3. In addition to the automatic diagnostic tests, the processor has a RESET procedure that manually forces a Self Test for up to 180 seconds. The procedure is as follows:

   On the Control Panel, press MENU button
   Press the RESET button
   Press the YES button to confirm RESET

   During the Self Test, the Control System will run and verify proper operation of all the components. If there is a problem, the Control System will shut down, the User Interface will sound an alarm and display the alarm condition. Note that if more than one alarm occurs at the same time, the most recent will appear first, then the previous one, until all the current alarms are shown.

4. VaporVac/Vaporsaver installations shall not exceed a maximum of 16 fueling points.

5. The processor shall activate when the pressure of the underground storage tank exceeds 0.14 inches WC as determined by Exhibit 4, ***Determination of Pressure of Underground Gasoline Storage Tanks.*** Districts shall specify the frequency of testing.

6. A processor that is inoperative for more than 24 consecutive hours is considered a vapor recovery equipment defect which substantially impairs the effectiveness of the vapor recovery system.

7. Except for testing, repairs or maintenance activities, the processor shall be operating at all times.

8. Maintenance requirements for the Vaporsaver system are provided in the Vaporsaver Start-up and Troubleshooting manual and are summarized in the table below:

Maintenance Interval	Maintenance
12 months	Visually check system for leaks, inspect belts, and verify operating pressure and vacuum readings. Verify total run time and replace pumps if greater than recommended maximum hours
36 months	Replace hydrocarbon sensor

<u>Nozzles</u>

1. The VaporVac/Vaporsaver system has one vapor pump per fueling point (dispenser side). Different brands of nozzles may be used on the same fueling point.

2. The nozzles shall have an integral vapor valve which prevents the loss of vapor from the underground storage tanks, ensures proper operation of the system and prevents the ingestion of air into the system when another nozzle which is connected to the same vapor pump is used. Any nozzle with a defective vapor valve will substantially impair the effectiveness of the other nozzles associated with the same vapor pump. Therefore, any nozzle with a defective vapor valve, and all nozzles at the same fueling point (dispenser side), shall be immediately removed from service and the vapor path shall be closed as soon as practicable.

3. Nozzles shall be performance checked at the factory, including checks of the integrity of the vapor path. The maximum allowable leak rate for the nozzle, as determined by TP-201.2B, Flow and Pressure Measurement of Vapor Recovery Equipment, shall not exceed the following:

   0.038 CFH at a pressure of two inches water column (2" w.c.), and
   0.005 CFH at a vacuum of twenty-seven inches water column (approx. 1 psi).

4. Failure mode testing demonstrated that blockage of some of the vapor collection holes in the spout of the nozzle has negligible effect on the operation of the system until the number of unblocked holes is less than required below. Any nozzle that is found to have fewer than the required number of unobstructed vapor collection holes is defective and shall be immediately removed from service.

Nozzle	Minimum Number of Unblocked Vapor Holes Required
Catlow ICVN (Richards AstroVac)	3
Emco Wheaton A4505	3
Husky V34 6250	N/A*****
OPW 12VW	1

* The Husky V34 6250 nozzle uses a solid spout design and does not have any vapor collection holes on the tip of the spout. Gasoline vapors are directed to the base of the spout by the VSG to be collected by the VaporVac/Vaporsaver System.

5. **Catlow ICVN Nozzle (Richards AstroVac).** An Efficiency Compliance Device (ECD) shall be installed on the Catlow ICVN (Richards AstroVac) nozzle at the base of the spout, as shown in **Figure 1A-1**. Any Catlow ICVN (Richards AstroVac) nozzle with an ECD which is missing, or which is damaged with a slit from the base to the rim is defective and shall be immediately removed from service.

6. **Emco Wheaton A4505 Nozzle.** A Vapor Guard (VG) shall be installed on the Emco Wheaton A4505 nozzle at the base of the spout, as shown in **Figure 1A-2**.

Any Emco Wheaton A4505 nozzle with a VG which is missing, or which is damaged such that at least one-eighth (1/8) of the circumference is missing, or which has cumulative damage equivalent to at least 1/8 of the circumference missing, is defective and shall be immediately removed from service.

7. **Husky V34 6250 Nozzle.** A Vapor Splash Guard (VSG) shall be installed on the Husky V34 6250 nozzle at the base of the spout, as shown in **Figure 1A-3**. Any Husky V34 6250 nozzle with a VSG which is missing, or which is damaged such that at least a one and one-half (1.5) inch slit has developed, or which has cumulative damage equivalent to at least a 1.5 inch slit, is defective and shall be immediately removed from service. Any Husky V34 6250 nozzle with a VSG which is damaged such that greater than a three-eighths (3/8) inch hole has developed, or which has cumulative damage greater than a 3/8 inch hole, is defective and shall be immediately removed from service.

8. **OPW 12VW Nozzle.** A Vapor Escape Guard (VEG) shall be installed on the OPW 12VW nozzle at the base of the spout, as shown in **Figure 1A-4**. Any OPW 12VW nozzle with a VEG which is missing, or which is damaged such that at least three-quarters (3/4) of the circumference is missing, or which has cumulative damage equivalent to at least 3/4 of the circumference missing, is defective and shall be immediately removed from service.

<u>Solenoid Vapor Valves</u>

1. The VaporVac system was originally certified with solenoid vapor valves. These valves are no longer required but, if present, may remain in place.

<u>Air To Liquid Ratio</u>

1. The A/L ratio of the system, measured at a flow rate between six and ten gallons per minute (6.0 – 10.0 gpm), shall be **0.90** to **1.10**. Any fueling point not capable of demonstrating compliance with this performance standard shall be deemed defective and removed from service. The A/L ratio shall be determined by using Exhibit 5, with the shut-off port excluded. Alternative test procedures may be used if they are determined by the Executive Officer, in writing, to yield comparable results. **Figure 2C-1** includes an illustration and instructions for conducting A/L testing with the Husky V34 6250 nozzle.

<u>Inverted Coaxial Hoses</u>

1. The length of hose which may be in contact with the island and/or ground when the nozzle is properly mounted on the dispenser is limited to six inches (6").

2. The maximum length of the hose shall be fifteen feet (15').

VaporVac System

1. The VaporVac shall be equipped with electronic safeguards designed to ensure that no fuel is dispensed unless the VaporVac system is operating properly. An error code is indicated on the sales display of the dispenser, which identifies the problem as being related to the VaporVac system.

2. The following conditions shall halt or inhibit the operation of the one side of the dispenser, with an error code indicated, while allowing the other side to operate.

   <u>Excessive vapor pump motor current</u>; possible causes include bearing failure, locked rotor, motor winding shorts or fluid in pump cavity for more time than required to clear a blockage.

   <u>Failure of the vapor pump to start</u> while fuel is being dispensed (possible causes include control electronics failure, disconnected or severed motor wiring, or locked rotor).

   <u>Vapor pump activity during idle periods</u> when no fuel is being dispensed.

   <u>Maximum permissible pump speed exceeded</u> (possible causes include loose connections in vapor path or pump malfunction).

   <u>Disconnection or accidental swapping of Side A/B vapor pumps</u>. The VaporVac control system is designed to verify that side A is connected to pump A and side B is connected to pump B. This is done by a crossover check that the system conducts when either side of the dispenser is activated. If the sides are crossed, an error code will be triggered for both sides of the dispenser.

   The following conditions shall shut down the entire dispenser in a manner similar to a "dead-man switch", in that the VaporVac system must actively prevent its activation. This is achieved by requiring the VaporVac system to maintain a normally-closed switch, which will open should the VaporVac system be taken "off-line" via various mechanisms.

   A. Failure or loss of the VaporVac power supply.

   B. A.C. line fuse opens.

   C. Cabling/wiring missing or disconnected (tampering).

Pressure/Vacuum Vent Valves for Storage Tank Vents

1. The P/V vent valve shall be an ARB-certified valve as specified in Exhibit 1.

2. At least one pressure/vacuum (P/V) vent valve shall be installed on each tank vent. Vent lines may be manifold to minimize the number of P/V vent valves and potential leak sources, provided the manifold conforms to all applicable fire regulations. At least one P/V vent valve shall be installed on manifold vents. Figure 2D-1 shows a typical manifold configuration for a single P/V vent valve. If two P/V vent valves are desired, they shall be installed <u>in parallel</u>, so that each can serve as a backup to the other if one should fail to open properly. Figure 2D-2 shows a typical manifold configuration for two P/V vent valves installed in parallel. Figure 2D-3 shows a typical manifold configuration for three P/V vent valves installed in parallel.

Vapor Recovery Piping Configurations

1. The recommended maximum pressure drop through the system, measured at a flow rate of 60 SCFH with dry Nitrogen gas, is 0.02 inches water column (0.03 inches wc at 60 SCFH if the measurement includes an impact valve). The maximum allowable pressure drop through the system shall never exceed one/half inch (0.5") water column at 60 SCFH. The pressure drop shall be measured from the dispenser riser to the UST with the P/V vent valves installed and with the poppeted Phase I vapor connection open, as specified in TP-201.4 (July 3, 2002).

   Note: The A/L test may be used to verify proper operation of the system, in lieu of measuring the pressure drop through the lines, provided that at least two gallons of product are introduced into the system through each dispenser riser.

2. All vapor return lines shall slope a minimum of 1/8 inch per foot. A slope of 1/4 inch or more per foot is recommended wherever feasible.

3. The dispenser shall be connected to the riser with either flexible or rigid materials specified by the manufacturer as acceptable for use with gasoline. The dispenser-to-riser connection shall be installed so that any liquid in the lines will drain toward the storage tank. The internal diameter of the connector, including all fittings, shall not be less than three-fourths inch (3/4").

4. All vapor return and vent piping shall be installed in accordance with the manufacturer's instructions and all applicable regulations.

5. No product shall be dispensed from any fueling point associated with a vapor line that is disconnected and open to the atmosphere. If vapor lines are manifold, this includes all fueling points in the facility.

6. The recommended nominal inside diameter of the underground Phase II plumbing is as indicated in **Figures 2A-1** through **Figures 2A-10**. Smaller vapor lines are not recommended but may be used provided the pressure drop criteria specified above are met. The vapor return lines shall be manifold below grade at the tanks as indicated in the figures.

   Exception: For installations with a vapor return line directly to only one tank, and for which a manifold on the tank vents will be used to provide part of the vapor return path to other tanks, the vent manifold may be used as an alternative to the underground manifold only in existing installations where the vapor piping is already installed, and shall not be used in "new" installations where vapor piping is being installed. For installations with dedicated vapor piping directly to each tank, the vent manifold is approved for both new and existing installations and an additional tank manifold below grade is optional but not required.

Phase I System

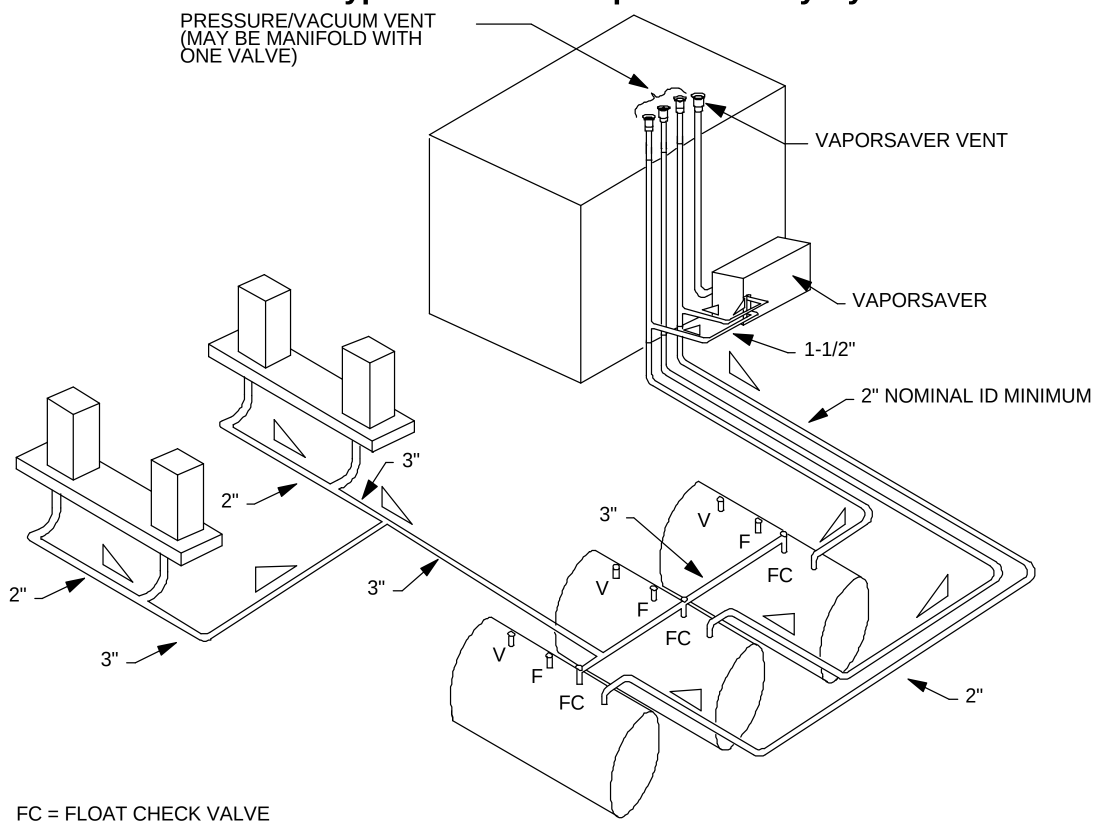
1. The Phase I system shall be an ARB-certified system which is in good working order and which demonstrates compliance with the static pressure decay test criteria contained in TP-201.3 (March 17, 1999).

Maintenance Records

1. Each GDF operator/owner shall keep records of maintenance performed at the facility. Such records shall be maintained on site in accordance with district requirements or policies. The records shall include the maintenance or test date, date and time of maintenance call, repair date to correct test failure, maintenance or test performed, affiliation, telephone number and name of individual conducting maintenance or test. An example of a Maintenance Record is shown in Figure 2E.

Executive Order G-70-204-A
Gilbarco VaporVac/OPW Vaporsaver
ORVR-Compatible Phase II Vapor Recovery System

Exhibit 2
Figure 2A-1
Typical Installation of the OPW Vaporsaver Phase II Tank Pressure Management System with Typical Phase II Vapor Recovery System



FC = FLOAT CHECK VALVE
F = FILL LINE
V = PHASE I VAPOR RECOVERY

NOTE:
1. ALL VAPOR/VENT LINES ARE 3" NOMINAL ID MINIMUM EXCEPT AS NOTED
2. SLOPE: 1/8" PER FOOT MINIMUM
1/4" PER FOOT PREFERED

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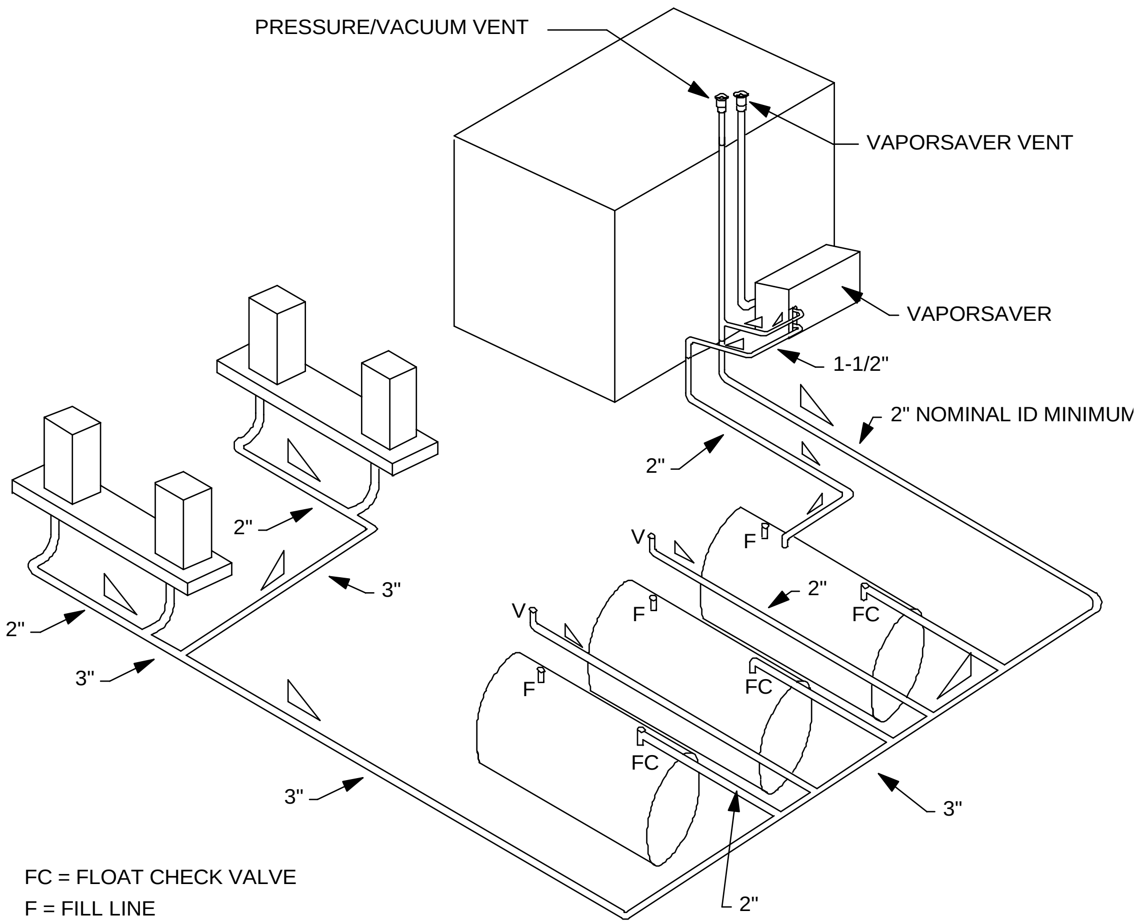
ORVR-Compatible Phase II Vapor Recovery System

Exhibit 2
Figure 2A-2
Typical Installation of the OPW Vaporsaver
Phase II Tank Pressure Management System
with Typical Phase II Vapor Recovery System



FC = FLOAT CHECK VALVE
F = FILL LINE
V = PHASE I VAPOR RECOVERY

NOTE:
1. ALL VAPOR/VENT LINES ARE 3" NOMINAL ID MINIMUM EXCEPT AS NOTED
2. SLOPE: 1/8" PER FOOT MINIMUM
1/4" PER FOOT PREFERED

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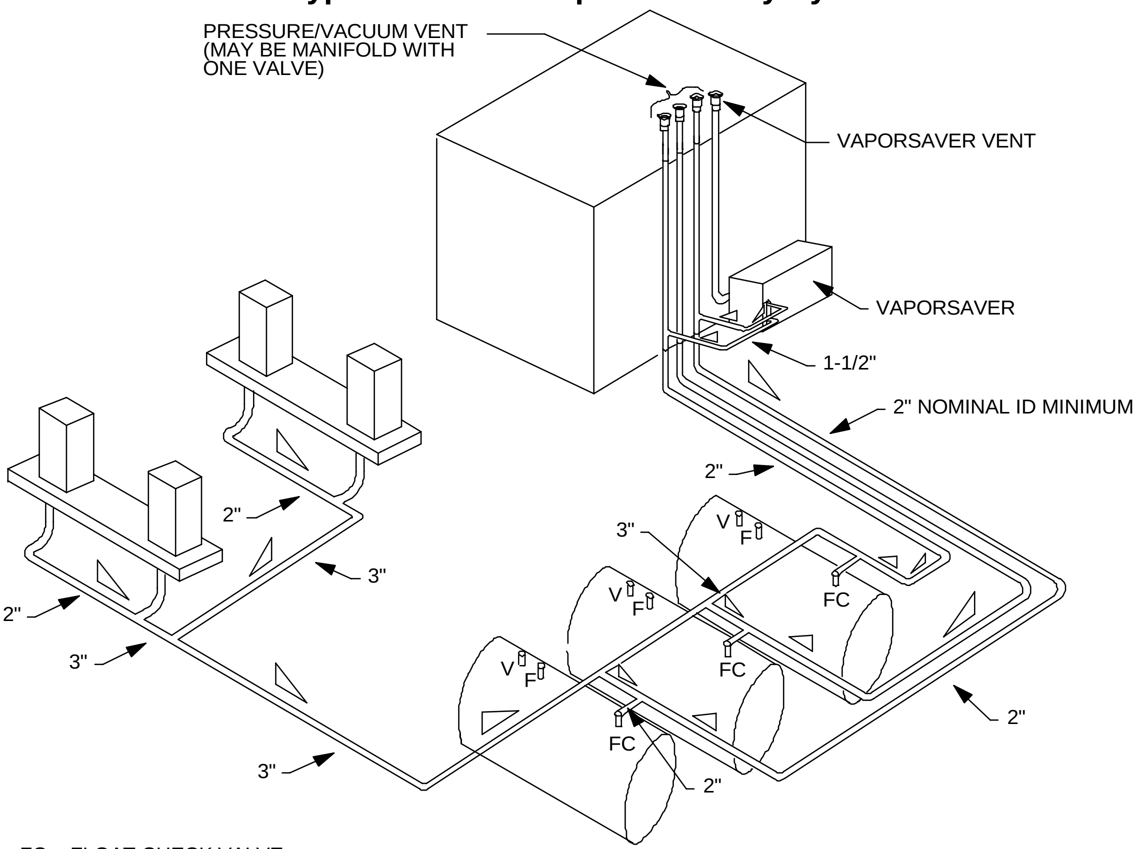
Exhibit 2
Figure 2A- 3
Typical Installation of the OPW Vaporsaver Phase II Tank Pressure Management System with Typical Phase II Vapor Recovery System



FC = FLOAT CHECK VALVE
F = FILL LINE
V = PHASE I VAPOR RECOVERY

NOTE:
1. ALL VAPOR/VENT LINES ARE 3" NOMINAL ID MINIMUM EXCEPT AS NOTED
2. SLOPE: 1/8" PER FOOT MINIMUM
1/4" PER FOOT PREFERED

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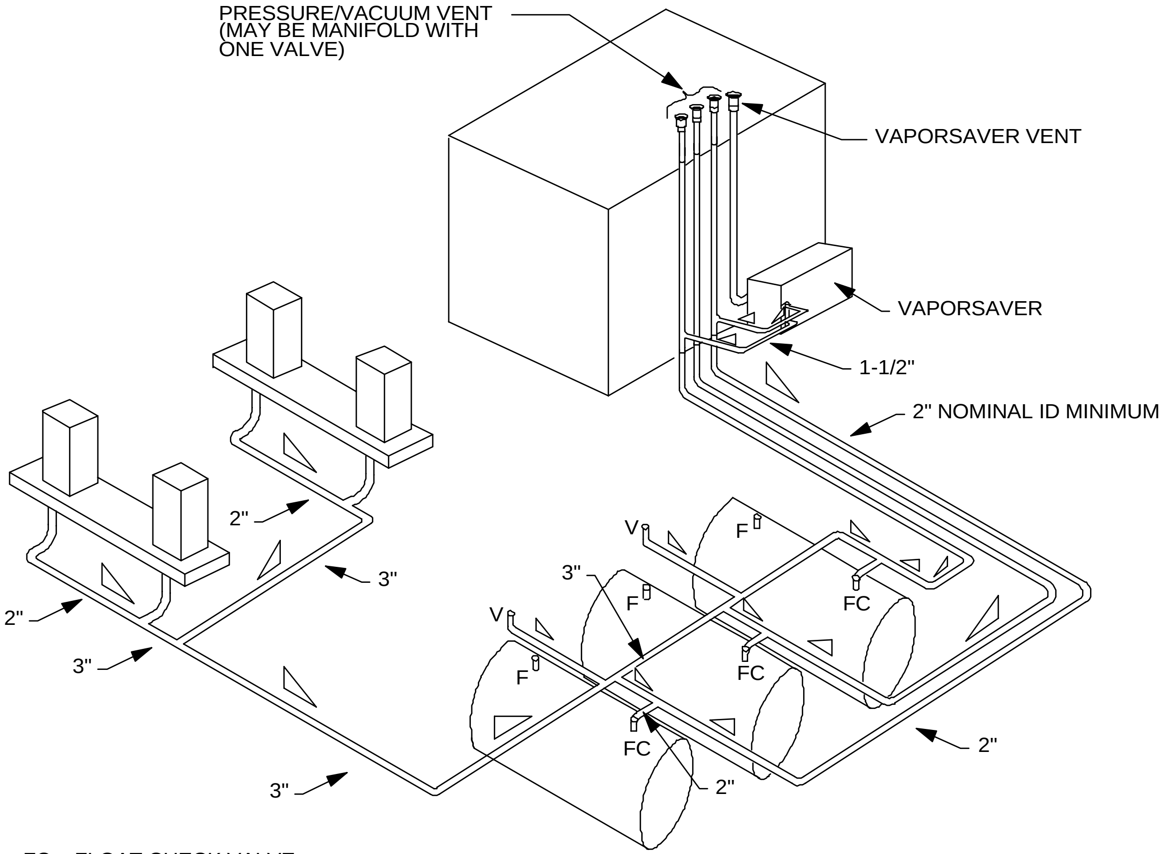
ORVR-Compatible Phase II Vapor Recovery System

Exhibit 2
Figure 2A- 4
Typical Installation of the OPW Vaporsaver Phase II Tank Pressure Management System with Typical Phase II Vapor Recovery System



FC = FLOAT CHECK VALVE

F = FILL LINE

V = PHASE I VAPOR RECOVERY

NOTE:

1. ALL VAPOR/VENT LINES ARE 3" NOMINAL ID MINIMUM EXCEPT AS NOTED
2. SLOPE: 1/8" PER FOOT MINIMUM
   1/4" PER FOOT PREFERED

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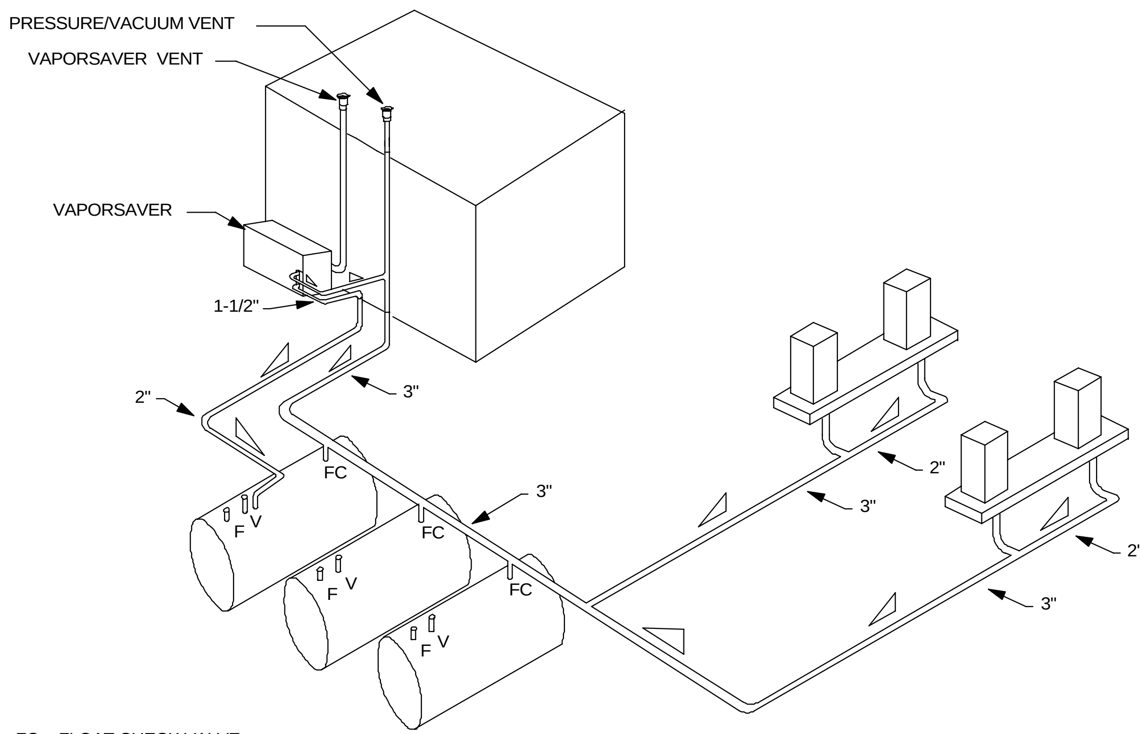
Exhibit 2
Figure 2A- 5
Typical Installation of the OPW Vaporsaver Phase II Tank Pressure Management System with Typical Phase II Vapor Recovery System



FC = FLOAT CHECK VALVE
F = FILL LINE
V = PHASE I VAPOR RECOVERY

NOTE:
1. ALL VAPOR/VENT LINES ARE 3" NOMINAL ID MINIMUM EXCEPT AS NOTED
2. SLOPE: 1/8" PER FOOT MINIMUM
1/4" PER FOOT PREFERED

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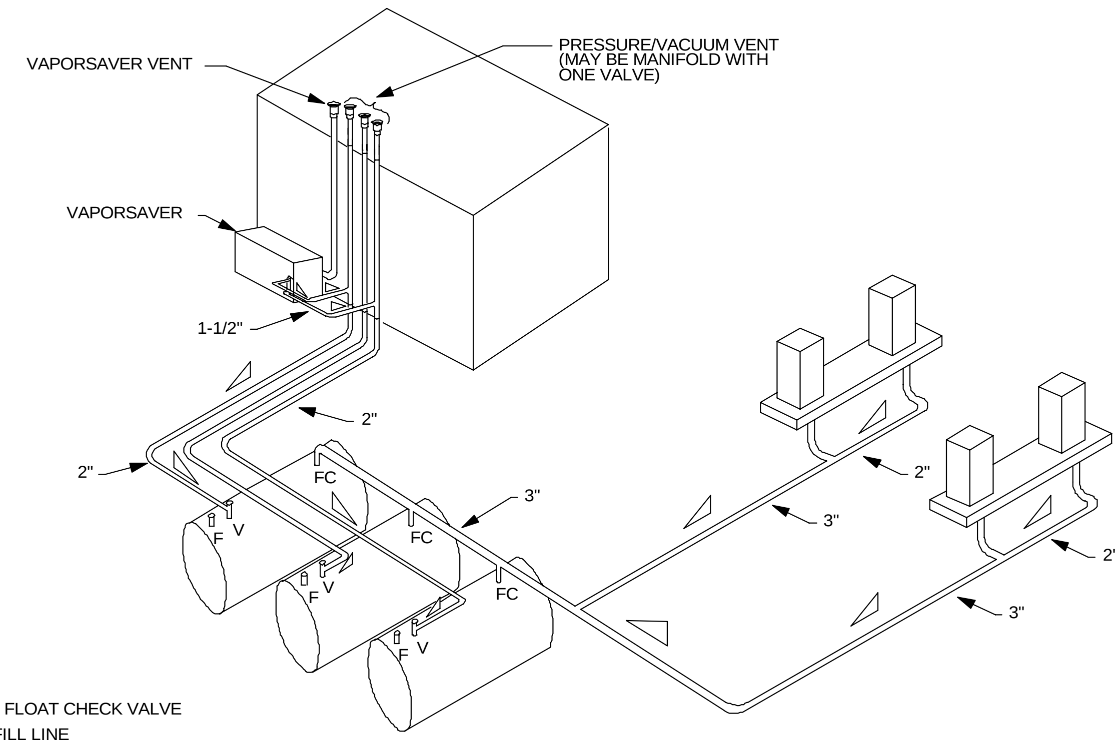
Exhibit 2
Figure 2A- 6
Typical Installation of the OPW Vaporsaver
Phase II Tank Pressure Management System
with Typical Phase II Vapor Recovery System



FC = FLOAT CHECK VALVE
F = FILL LINE
V = PHASE I VAPOR RECOVERY

NOTE:
1. ALL VAPOR/VENT LINES ARE 3" NOMINAL ID MINIMUM EXCEPT AS NOTED
2. SLOPE: 1/8" PER FOOT MINIMUM
1/4" PER FOOT PREFERED

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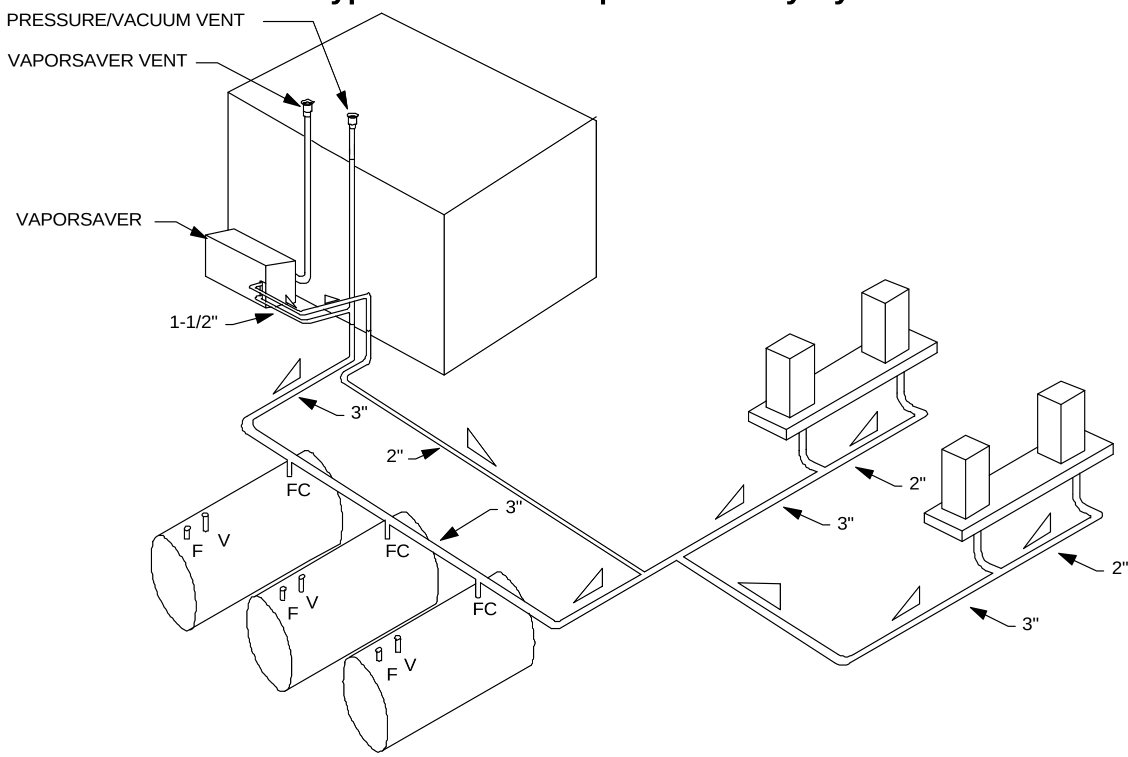
Exhibit 2
Figure 2A- 7
Typical Installation of the OPW Vaporsaver
Phase II Tank Pressure Management System
with Typical Phase II Vapor Recovery System



FC = FLOAT CHECK VALVE
F = FILL LINE
V = PHASE I VAPOR RECOVERY

NOTE:
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2. SLOPE: 1/8" PER FOOT MINIMUM
1/4" PER FOOT PREFERED

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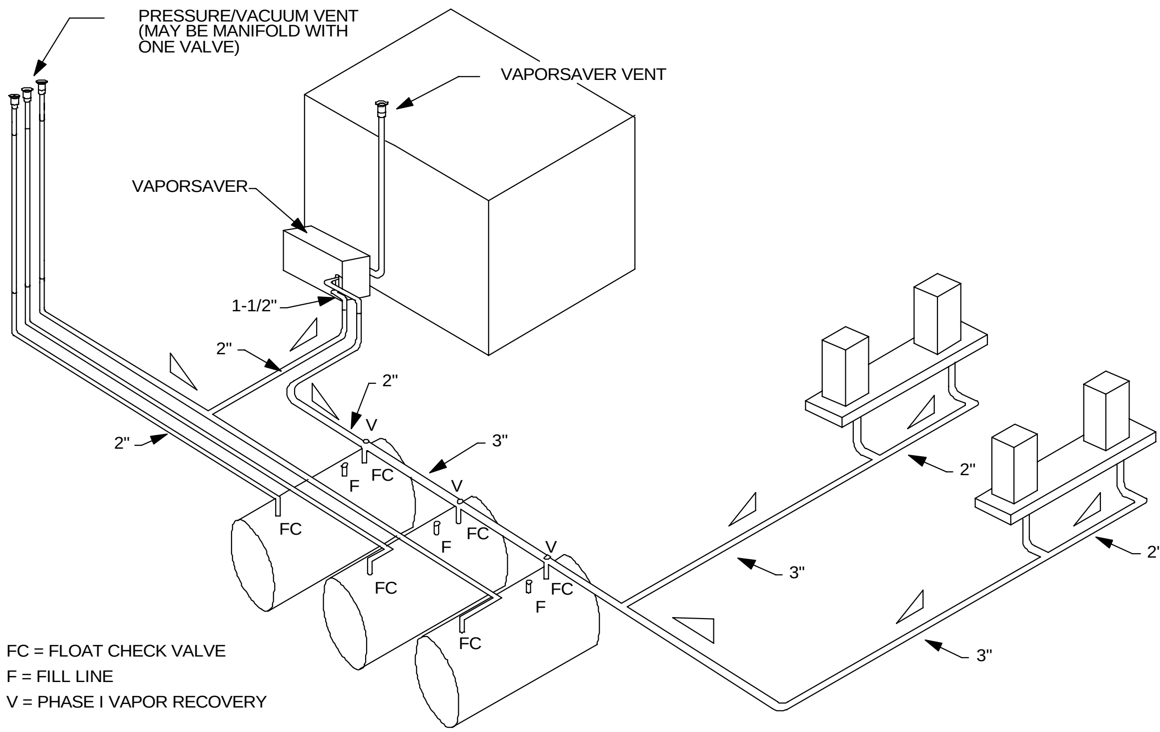
Exhibit 2
Figure 2A- 8
Typical Installation of the OPW Vaporsaver
Phase II Tank Pressure Management System
with Typical Phase II Vapor Recovery System



FC = FLOAT CHECK VALVE
F = FILL LINE
V = PHASE I VAPOR RECOVERY

NOTE:
1. ALL VAPOR/VENT LINES ARE 3" NOMINAL ID MINIMUM EXCEPT AS NOTED
2. SLOPE: 1/8" PER FOOT MINIMUM
1/4" PER FOOT PREFERED

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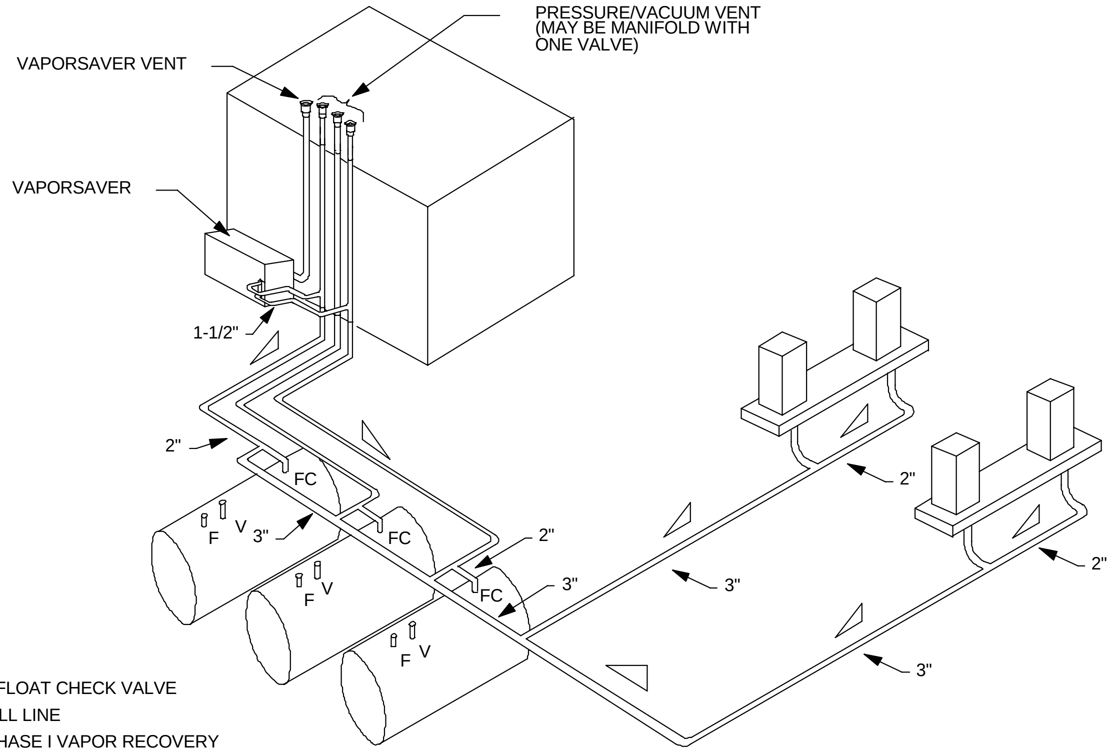
Exhibit 2
Figure 2A- 9
Typical Installation of the OPW Vaporsaver Phase II Tank Pressure Management System with Typical Phase II Vapor Recovery System



FC = FLOAT CHECK VALVE
F = FILL LINE
V = PHASE I VAPOR RECOVERY

NOTE:
1. ALL VAPOR/VENT LINES ARE 3" NOMINAL ID MINIMUM EXCEPT AS NOTED
2. SLOPE: 1/8" PER FOOT MINIMUM
1/4" PER FOOT PREFERED

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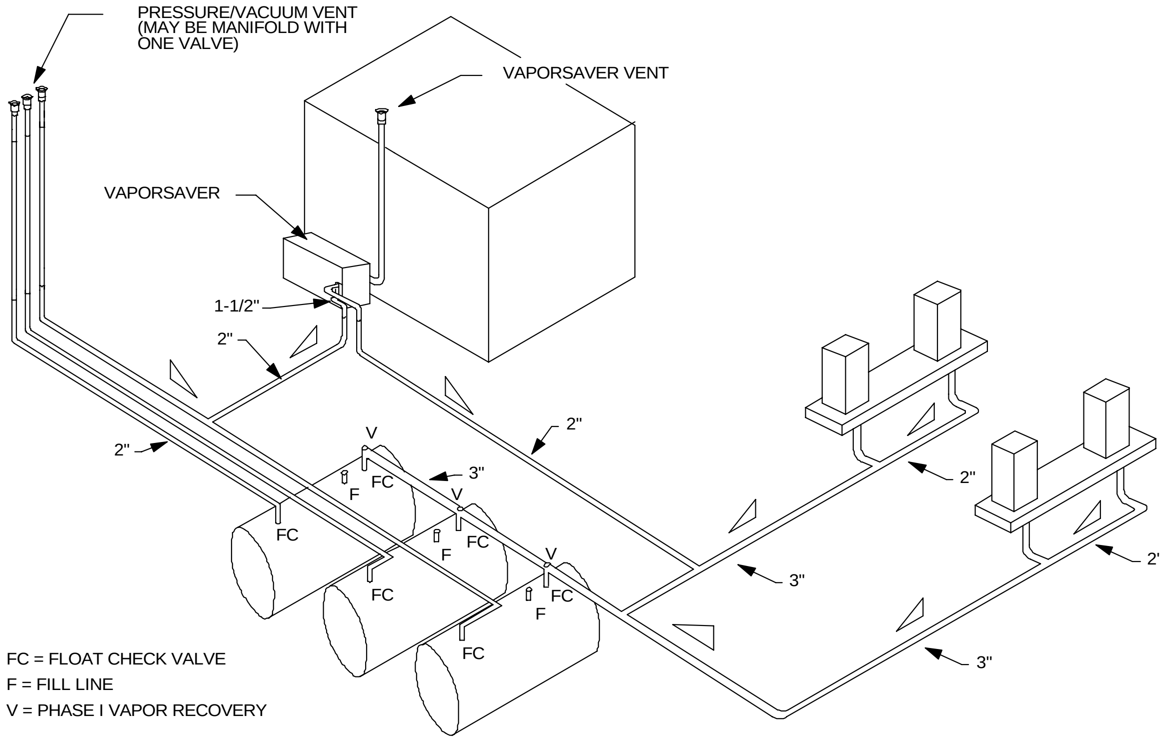
Exhibit 2
Figure 2A- 10
Typical Installation of the OPW Vaporsaver Phase II Tank Pressure Management System with Typical Phase II Vapor Recovery System



FC = FLOAT CHECK VALVE
F = FILL LINE
V = PHASE I VAPOR RECOVERY

NOTE:
1. ALL VAPOR/VENT LINES ARE 3" NOMINAL ID MINIMUM EXCEPT AS NOTED
2. SLOPE: 1/8" PER FOOT MINIMUM
1/4" PER FOOT PREFERED

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Gilbarco VaporVac/OPW Vaporsaver
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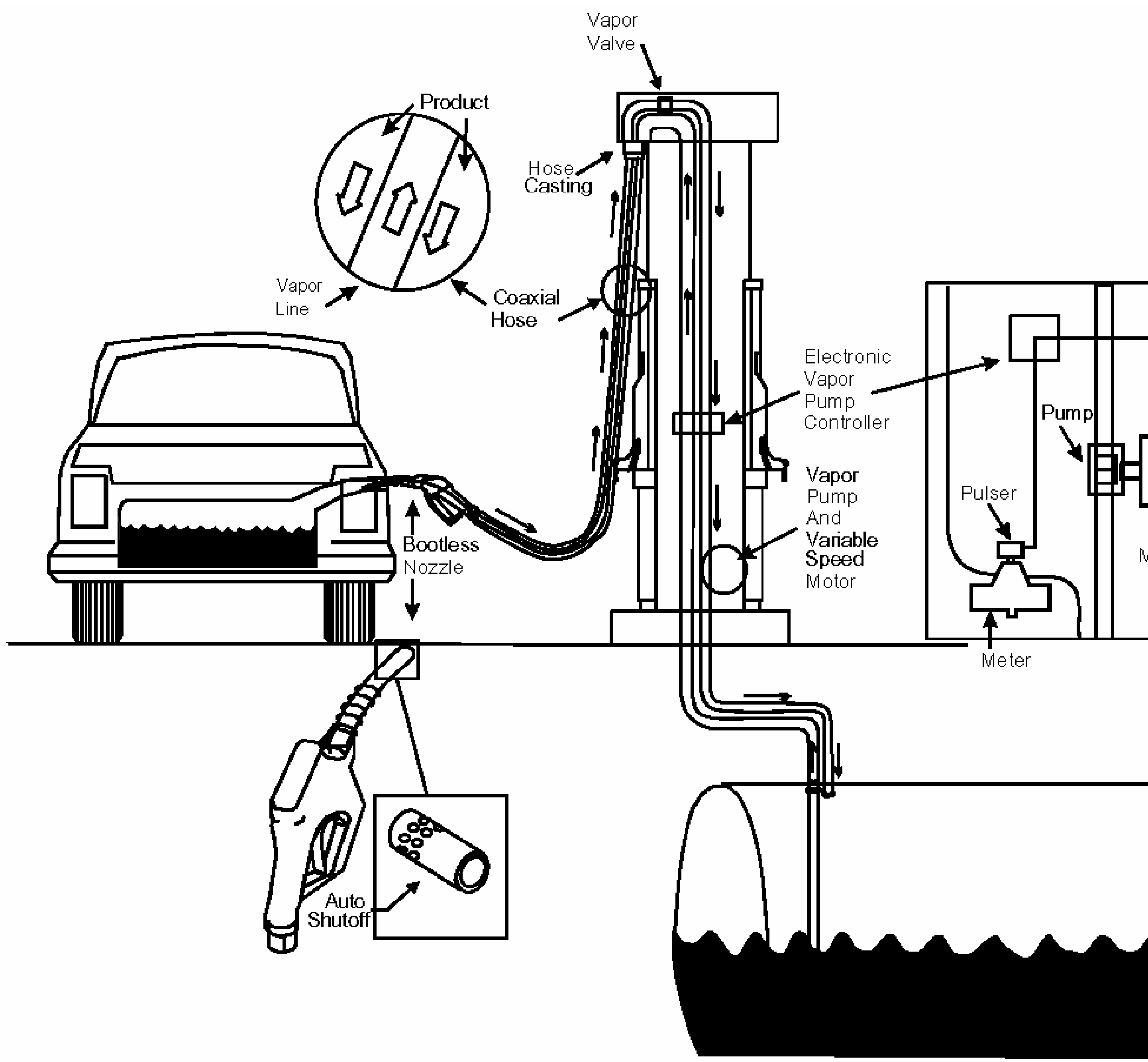
Exhibit 2
Figure 2B-1
Component Parts of the Gilbarco VaporVac System



Note: VaporVac system dispensers were originally certified with solenoid vapor valves. These vapor valves are no longer required but, if present, may remain in place.

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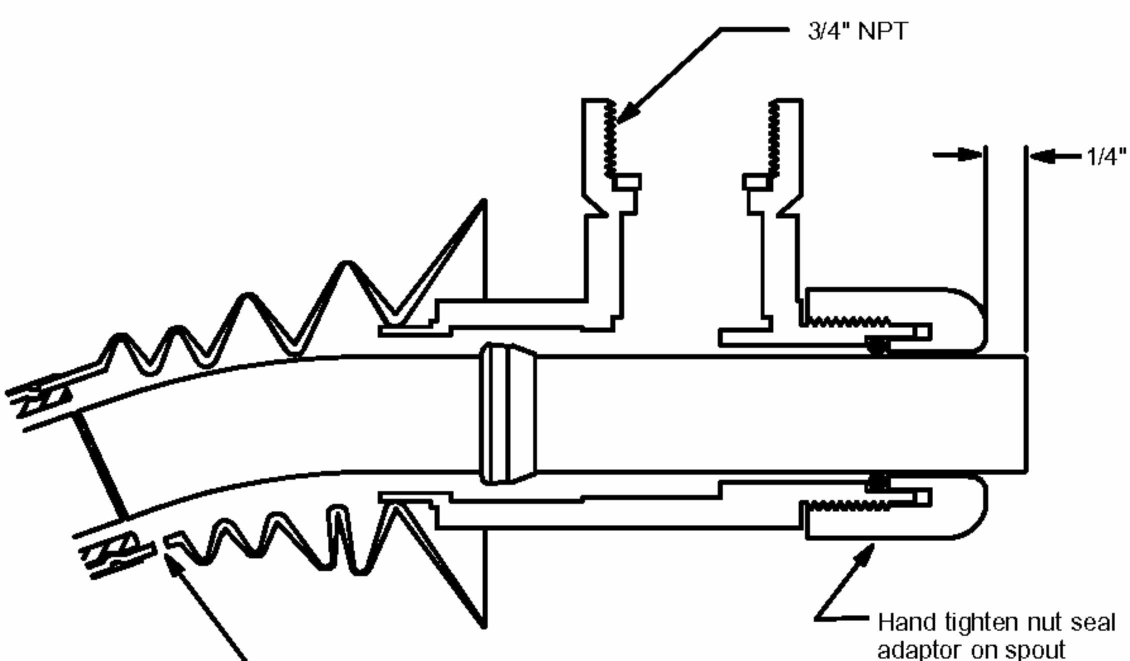
Exhibit 2
Figure 2C-1
Installation of the A/L Adaptor on Husky 6250 Nozzle



Instructions for use of the 6250 A/L Adaptor

1) Inspect the Vapor Splash Guard (VSG) and spout for damage. Any tears or extra holes in the VSG will reduce the accuracy of the test.

2) Slide the A/L adaptor over the spout such that 1/4" of the spout is exposed past the nut.

3) Hand tighten the nut. This will seal the A/L adaptor to the spout.

4) Pull the VSG up over the smallest step on the A/L adaptor. This will seal the VSG to the adaptor.

5) Using a piece of tape, seal the 1/8" hole in the cuff of the VSG.

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Exhibit 2
Figure 2D-1
Typical Installation of a Single P/V Vent Valve Manifold

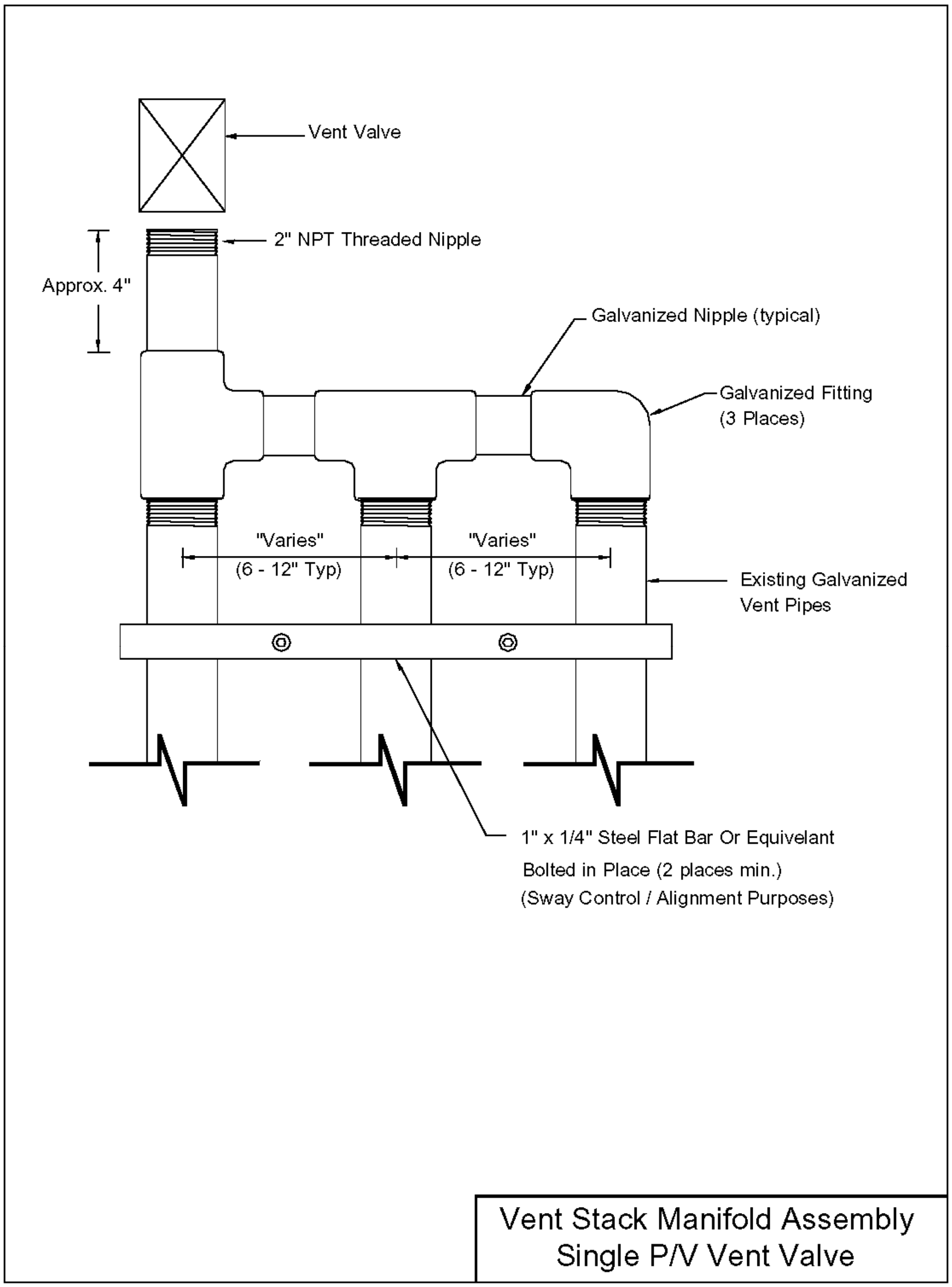

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Exhibit 2
Figure 2D-2
Typical Installation of a Two P/V Vent Valve Parallel Manifold

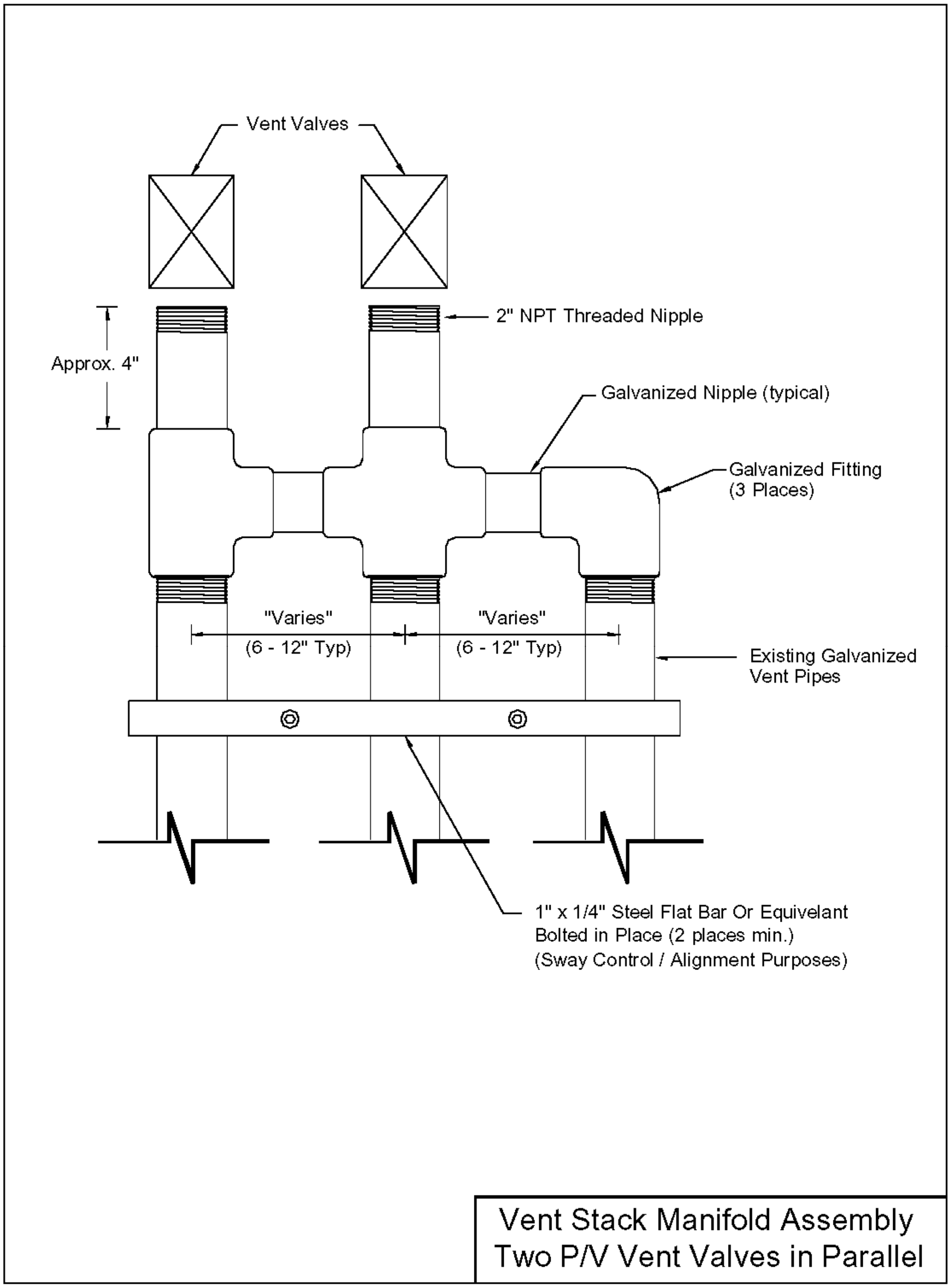

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Exhibit 2
Figure 2D-3
Typical Installation of a Three P/V Vent Valve Parallel Manifold

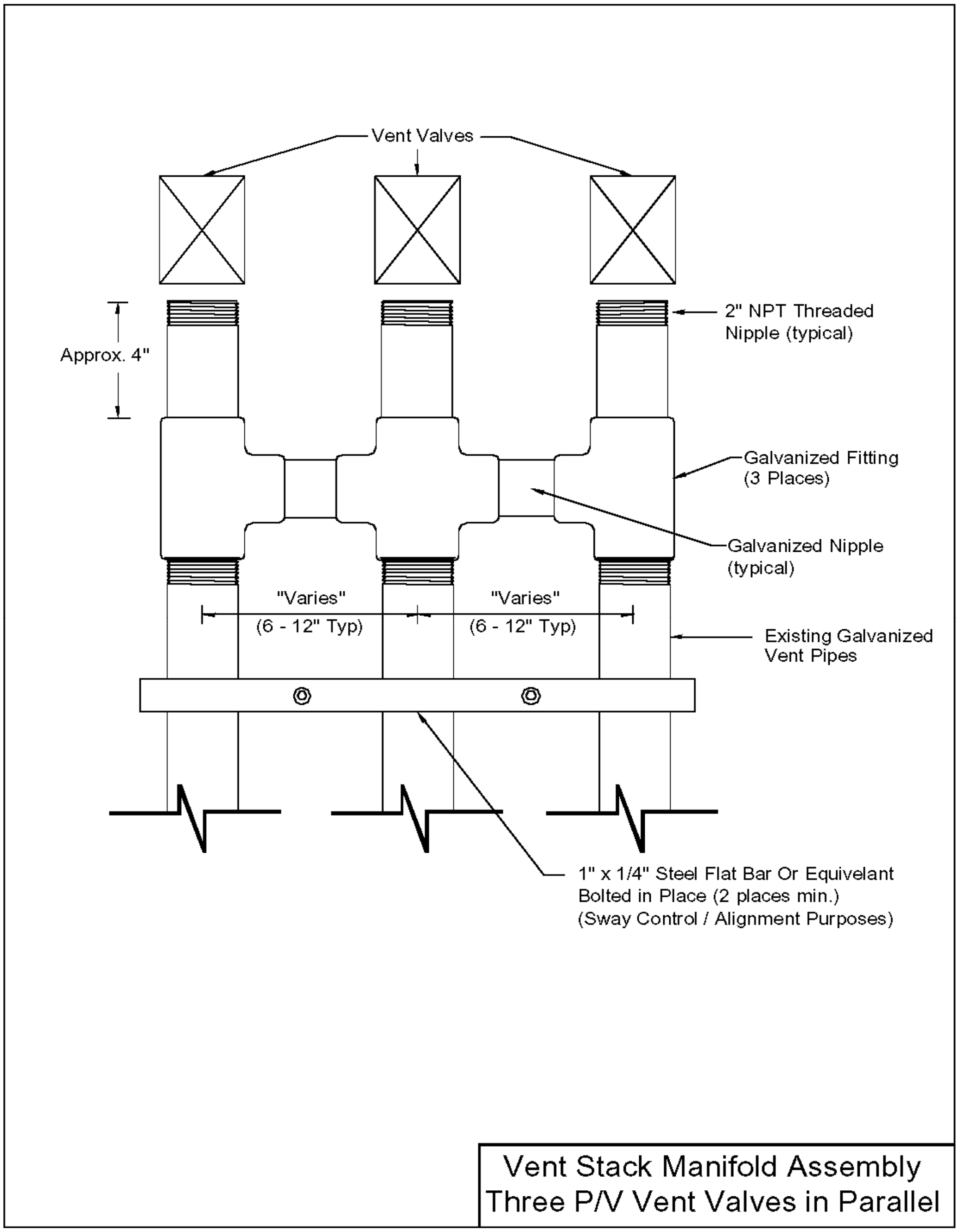


Figure 2E

Example of a GDF Maintenance Record

Date of Maintenance/ Test/Inspection/Failure (including date and time of maintenance call)	Repair Date To Correct Test Failure	Maintenance/Test/Inspection Performed and Outcome	Affiliation	Name of Individual Conducting Maintenance or Test	Telephone Number

California Environmental Protection Agency
Air Resources Board

Vapor Recovery Test Procedure

Exhibit 5

Determination (by Volume Meter) of Air to Liquid Volume Ratio of Vapor Recovery Systems of Dispensing Facilities

1 APPLICABILITY

Definitions common to all certification and test procedures are in:

D-200 Definitions for Vapor Recovery Procedures

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

This test procedure can be used to quantify the air to liquid volume ratio (A/L) of a vapor recovery system. This test procedure is particularly well suited to dispensing facility vapor recovery systems that use bootless nozzles with circumferential holes near the front of their spouts; but it may be adapted for other systems.

This test procedure can be used to determine the performance specification for air to liquid volume ratio of a vapor recovery system during the certification process and subsequently to determine compliance with that performance specification for any installations of such a system.

When this test procedure is used to set a performance specification for a system, any deviations from the use of the equipment and procedures specified below shall be written into the certification report for such system if it is certified. Any compliance testing of a system shall be done according to this procedure, with appropriate adjustments for such deviations.

2 PRINCIPLE AND SUMMARY OF TEST PROCEDURE

The air to liquid volume ratio (A/L) of a vapor recovery system is, for a given dispensing episode, the quotient of the volume of air collected by a nozzle and the volume of liquid dispensed by that nozzle. In principle, any equipment and procedure which provides for the simultaneous measurement of air volume collected and liquid volume dispensed, from the same system, is a basis for determination of A/L for that system.

EXHIBIT 3 measures A/L rather than the volume ratio of vapor (mixed with air) to liquid (V/L), because doing so is much more consistent, repeatable, and less expensive. A/L testing can be coordinated with efficiency testing to yield A/L performance specifications for compliance testing.

3 BIASES AND INTERFERENCES

There are no known biases or interferences inherent to the equipment and procedures specified; however several system parameters must be monitored and controlled so that this procedure can serve its intended purpose.

3.1 Non-Repeatable or Non-Representative Test Conditions

It is possible that system components could operate during testing in such a way that results are non-repeatable or are non-representative of subsequent installations of the system. To minimize such effects, the ARB test monitor shall note any relevant operating parameters for inclusion in the certification process as conditions on certification at a particular A/L ratio.

3.1.1 Non-Repeatable Test Conditions

For example, the liquid dispensing rate can introduce bias if it is non-repeatable; for many systems, the A/L performance varies with liquid flow rate.

In the procedures below, a maximum repeatable flow rate of liquid is required. If A/L performance varies with liquid flow rate for some system, it is necessary to place an upper limit on liquid flow rate in the ARB Executive Order.

(1) **(Liquid) Fuel Pumps**

To achieve repeatability, it is necessary to control the number of simultaneous dispensing episodes from a common liquid pump during certification testing. Such number shall be a performance specification in the ARB Executive Order so that subsequent installations of the system can be consistently tested.

(2) **(Air and Vapor) Assist Pumps**

To achieve repeatability, it is necessary to control the number of simultaneous dispensing episodes served by a common assist pump during certification testing. Such number shall be a performance specification in the ARB Executive Order so that subsequent installations of the system can be consistently tested.

3.1.2 Non-Representative Test Conditions

For example, nozzle quantities, qualities, and interactions can introduce bias if they are non-representative; for many systems, the A/L performance varies with such parameters.

In the procedures below, if more than one nozzle is served by the same assist pump, precautions are required to eliminate nozzle interactions that yield non-representative A/L performance. Within a system subject to certification testing, nozzle qualities must be representative of the nozzle qualities within subsequent installations.

To achieve representativeness, it may be necessary to control the nozzle quantities, qualities, and interactions during certification testing and subsequently by inclusion of specific requirements in the ARB Executive Order.

3.2 Condensation, Evaporation, and Other Factors

Different systems have different tendencies to condense and evaporate liquid in vapor lines. This and other factors can cause different A/L values in different modes of system operation. In consideration of such factors, the ARB Executive Officer may determine a different data collection protocol and a different data reduction protocol than the examples given in §§ 8 and 11.

4 SENSITIVITY, RANGE, AND PRECISION

The values of the determinations required by this test procedure are well within the limits of sensitivity, range, and precision of the specified equipment.

5 EQUIPMENT

Some of the equipment for testing a bootless nozzle is shown in:

Figure 1
A/L Volumetric Test Meter and

Figure 2
A/L Test Tank.

5.1 Air Volume Meter and Plumbing Hardware

The plumbing hardware shall connect the nozzle spout to a positive displacement air volume meter (e.g. Roots® meter) so that the air volume pulled into the collection holes in the spout can be measured with minimal pressure drop.

Use a calibrated positive displacement gas volume meter (e.g. a Roots meter) for measurement of volumetric flow rate through the sleeve.

Use rotary type positive displacement meter(s) with a back pressure limit (BPL) less than:

1.10 inches water column at a flow rate of 3,000 CFH down to 0.05 inches water column at a flow rate of 30 CFH for a meter with a rating over 1000 CFH and

0.70 inches water column at a flow rate of 800 CFH down to 0.04 inches water column at a flow rate of 16 CFH for a meter with a rating of or less than 1000 CFH.

Meter(s) shall be equipped with taps accommodating the following equipment:

(1) taps on the inlet side for

(a) a thermocouple with a range of 0 to 150 °F and

(b) a pressure gauge with a range providing absolute pressure readings within 10 to 90% of the range (more than one gauge shall be used, if necessary) and

(2) taps on the inlet and outlet sides for a differential pressure gauge with a range of 0 to < 2x BPL (i.e. full scale shall be less than twice the back pressure limit) or any other range appropriate to allow detection of a pressure drop greater than the BPL.

5.2 Liquid Volume Meter

Use the meter on the liquid dispenser.

5.3 Portable Liquid Tank

A portable tank shall be used to receive dispensed liquid. The tank shall have sufficient volume so that 7.5 gallons can be received without triggering a premature shutoff. In the development of this procedure, a 25-gallon tank was adequate for two dispensing episodes between emptyings. The tank shall be on a wheeled cart and plumbed so that liquid received by the tank can be returned to the appropriate storage tank.

Figure 2, for example, shows an optional carbon scrubber arrangement that provides personnel protection from hazardous vapors and reduces emissions due to the performance of this test procedure.

5.4 Stopwatch

Use a stopwatch accurate and precise to within 0.2 seconds.

6 CALIBRATION PROCEDURE

Follow the appropriate calibration procedures from TP-201.2.

7 PRE-TEST PROTOCOL

7.1 Location of Test Site

Prototype systems will be located within 100 miles of Sacramento for testing. Other locations may be accepted at the discretion of the ARB Executive Officer.

7.2 Specification of Test, Challenge, and Failure Modes

The specification of test, challenge, and failure modes such as the number of liquid transfer episodes, volume and volumetric rate of liquid transfer, storage tank volumes, etc. shall be done according to the principles of CP-201 § 5 for the testing and evaluation of vapor recovery equipment.

8 TEST PROCEDURE

The facility and system shall be prepared to operate according to any specified test, challenge and failure modes.

The procedures below are for testing a bootless nozzle; with appropriate changes, these procedures can be used on other equipment. The procedure below shall be performed by at least two people familiar with the safety and mechanical principles of liquid dispensing equipment, especially for dispensing gasoline and other hazardous liquids.

8.1 General A/L Test Instructions

(1) Assemble the equipment shown in Figures 1 and 2, for example, if more than one nozzle is served by the same assist pump, all nozzles other than

the test nozzle shall be sealed vapor tight with, e.g., plastic bags and tape or rubber bands.

(2) Read and record the initial value on the air volume meter. Do not depend on using the terminal reading from a prior dispensing episode. The pressure drop across an appropriate volume meter is so low that a light breeze can change this value.

(3) Set the liquid meter and stopwatch to zero.

(4) Fully engage the dispensing lever and hold for the maximum repeatable flow rate of liquid. For most systems, there will be a brief pause before the liquid flows and is registered by the liquid meter.

(5) Start the stopwatch when the liquid meter indicates liquid flow.

(6) Attempt to dispense 7.48 gallons (one cubic foot) of liquid and simultaneously:

(a) shut off liquid flow and

(b) stop the stopwatch.

Read and record the liquid volume dispensed and the elapsed time.

(7) Read and record the final value on the air volume meter.

8.2 **Certification Test Instructions**

Different systems have different tendencies to condense and evaporate liquid in vapor lines. This and other factors can cause different A/L values in different modes of system operation. In consideration of such factors, the ARB Executive Officer may determine a different data collection protocol and a different data reduction protocol than the examples below. However, instructions must be determined before collection of final certification test data.

(1) Collect three sets of A/L test data per nozzle:

(a) from any nozzle (or nozzles) on any dispenser (or dispensers) used by the applicant for certification efficiency testing and

(b) at three flow rates (e.g. repeatable minimum, average of repeatable minimum and repeatable maximum, and repeatable maximum.

(2) Calculate the performance specification as an allowed range of A/L values

according to one of the alternatives provided in § 11.

8.3 Compliance Test Instructions

Different systems have different tendencies to condense and evaporate liquid in vapor lines. This and other factors can cause different A/L values in different modes of system operation. In consideration of such factors, the ARB Executive Officer may determine a different data collection protocol and a different data reduction protocol than the examples below. However, instructions may not be changed after certification.

(1) Collect one set of A/L test data per nozzle:

(2) Compare the resulting A/L value with the allowed range of A/L values given as a performance specification in the ARB Executive Order G-70-204-A.

   (a) If the resulting value is in the allowed range of A/L values, the system complies.

   (b) If the resulting value is not in the allowed range of A/L values, collect two more sets of A/L test data and calculate the average A/L for all three sets.

      (i) If the resulting value is in the allowed range of A/L values, the system complies.

      (ii) If the resulting value is not in the allowed range of A/L values, the system does not comply.

9 QUALITY ASSURANCE / QUALITY CONTROL (QA/QC)

This section is reserved for future specification.

10 RECORDING DATA

This section is reserved for future specification.

11 CALCULATING RESULTS

Different systems have different tendencies to condense and evaporate liquid in vapor lines. This and other factors can cause different A/L values in different modes of system operation. In consideration of such factors, the ARB Executive Officer may determine a different data reduction protocol than the examples below. However, all calculation protocols must be determined before collection of final certification test data.

11.1 A/L Values

Calculate A/L for each test of a dispensing episode:

$$A/L = \frac{\text{(volume of air collected)}}{\text{(volume of liquid dispensed)}}$$

11.2 Performance Specification

The performance specification shall be expressed as an allowed range of A/L values. The performance specification range shall be the mean value of A/L ±10% of the mean.

11.3 Alternative Performance Specification

This performance specification may be used after an engineering evaluation by the ARB Executive Officer has determined that it is necessary to statistically account for the variance of A/L values for a system.

The performance specification shall be expressed as an allowed range of A/L values. The performance specification shall be the same as the 95% confidence interval for the expectation value of a single observation of A/L.

For example, assume that a nozzle was tested with the following results for A/L:

observation number	A/L
1	1.02
2	0.99
3	1.02

(1) Find the mean value of A/L.

$$\bar{x} = \frac{1.02 + 0.99 + 1.02}{3} = 1.01$$

(2) Find the sample standard deviation of the mean value of A/L.

$$s = \sqrt{\frac{(1.02 - \bar{x})^2 + (0.99 - \bar{x})^2 + (1.02 - \bar{x})^2}{(3 - 1)}} = 0.0173$$

(3) Find the 95% confidence interval for the expectation value of a single observation of A/L using Student's t Statistic and assuming a normal distribution of A/L values for all system nozzles.

Note that for three observations, there are two degrees of freedom and the Student's t Statistic is 4.303 for a 95% confidence interval.

$$95\%\ \text{c.i.} = \bar{x} \pm (t\,s) = 1.01 \pm 0.075$$

Other values of t are provided below for convenience:

number of observations	t
4	3.182
5	2.776
6	2.571
7	2.447
8	2.365
9	2.306
10	2.262
15	2.145
30	2.045

12 REPORTING RESULTS

12.1 Certification Report

12.1.1 Performance Specification

Report:

(1) the mean value of A/L,

(2) 10% of the mean value of A/L, and

(3) the mean value of A/L ± 10% of the mean.

Report (3) as the performance specification that is the allowed range of A/L values for subsequent installations of the system.

12.1.2 **Alternative Performance Specification**

Report:

(1) the mean value of A/L,

(2) the variance of the mean value of A/L, and

(3) the 95% confidence interval for the expectation value of a single observation of A/L using Student's t Statistic and assuming a normal distribution of A/L values for all system nozzles.

Report (3) as the performance specification that is the allowed range of A/L values for subsequent installations of the system.

12.2 **Compliance Test Report**

Report:

(1) the number of nozzles at the dispensing facility which do not meet the performance specification and

(2) the total number of nozzles at the dispensing facility.

Report any other system operating parameters technically pertinent to the A/L performance specification as required by the certification procedure.

13 ALTERNATIVE TEST PROCEDURES

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.

14 REFERENCES

This section is reserved for future specification.

15 EXAMPLE FIGURES

Each figure provides an illustration of an implementation that conforms to the requirements of this test procedure; other implementations that so conform are acceptable, too. Any specifications or dimensions provided in the figures 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
A/L Volumetric Test Equipment

Figure 2
A/L Test Tank

FIGURE 1

A/L Test Equipment for Bootless Nozzles

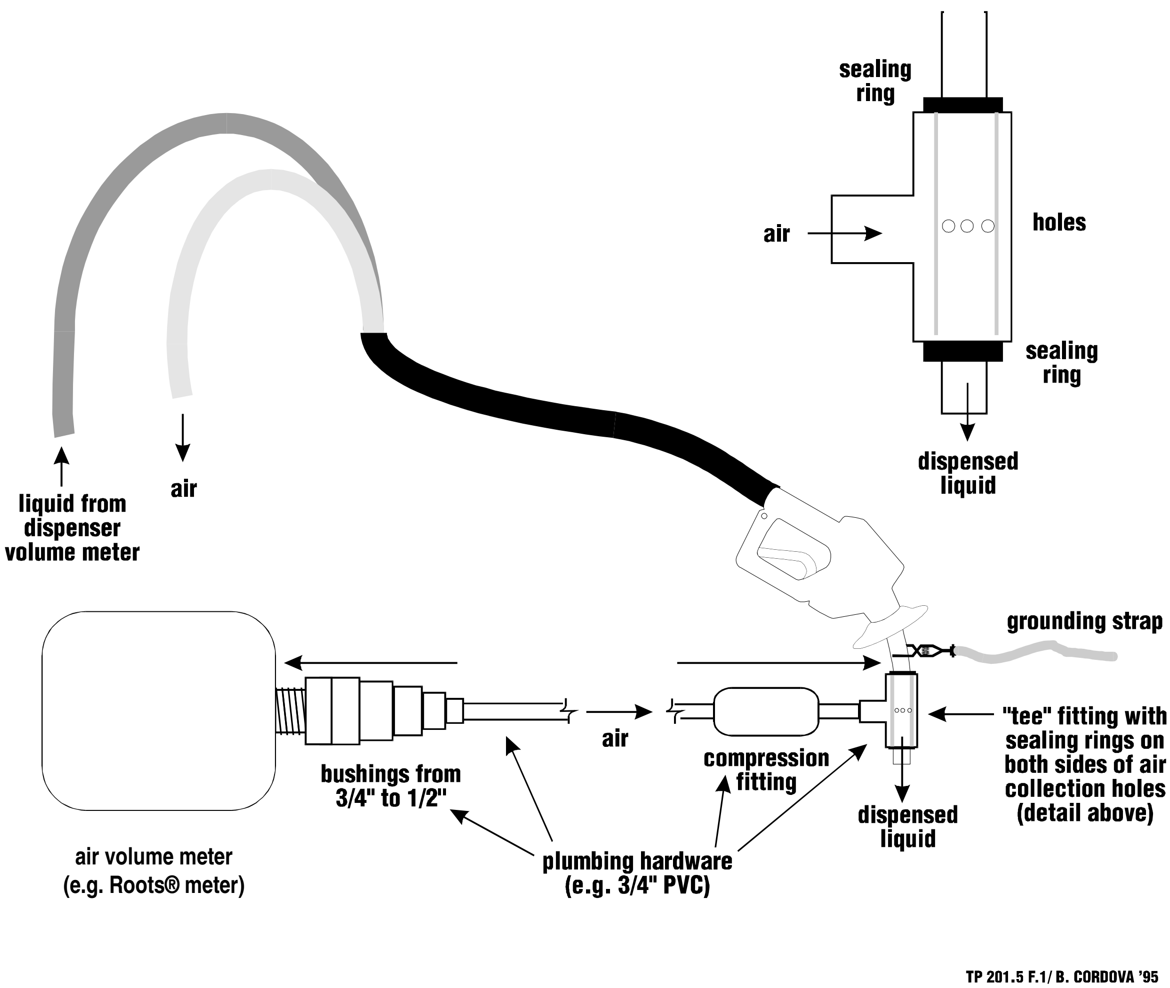
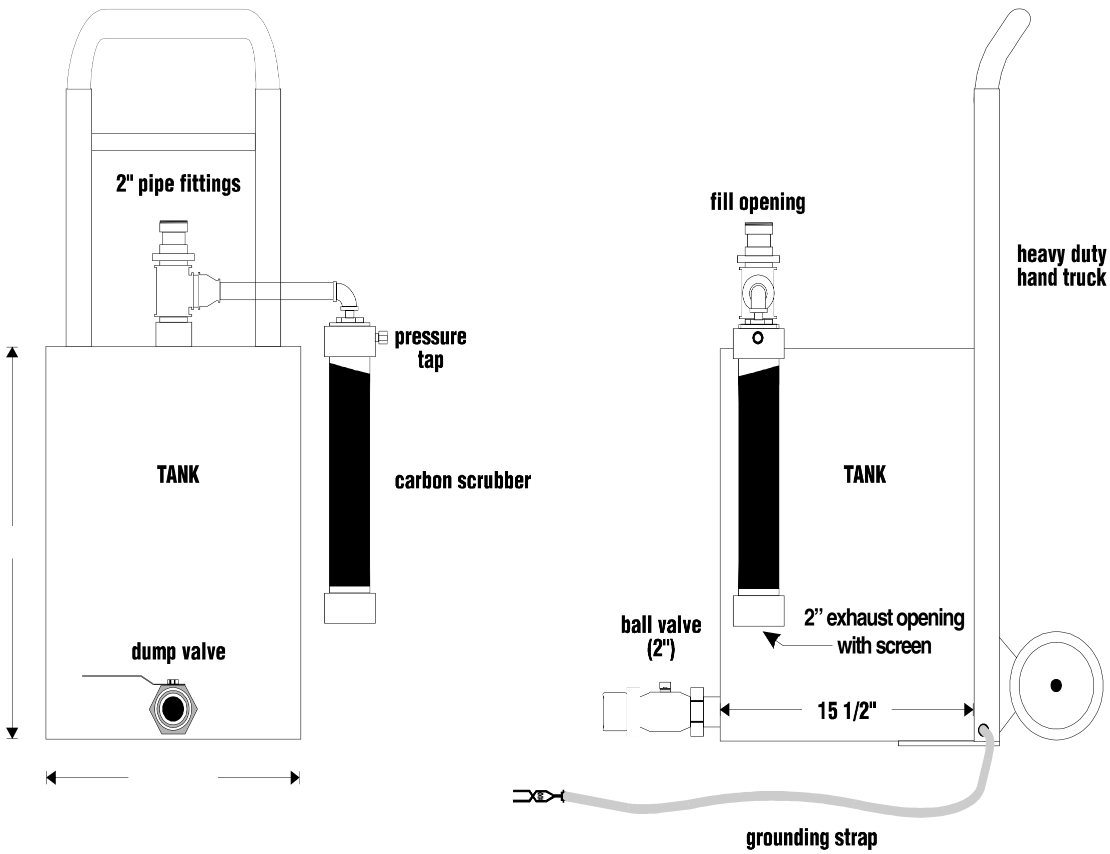


FIGURE 2
A/L Testing Tank



This design can meet the performance specifications of this procedure, any other design that meets such specifications is acceptable.

Healy Systems Scheduled Maintenance

1.0 Scheduled Maintenance Instructions for a Healy System with VP1000 Vacuum Source and 900 Series EVR Nozzle.

Initial problems are usually caused by installation irregularities that are easily detected and repaired by performing the “VP1000 Vacuum Performance Test Procedure” located in the dispenser installation manual. Periodic maintenance described here will eliminate problems and maintain peak operation of the system.

Note: Only a Healy Certified Technician can service any problems discovered while conducting the Weekly or Quarterly Inspection and Testing. Provided that there are no other local district requirements, a GDF Owner / Operator can remove and install nozzles, curb hoses, breakaways, flow limiters and whip hoses without a manufacturer certification. Additional certifications may be required in accordance with local district requirements.

1.1 Weekly Inspection and Testing

- Inspect each nozzle, hose, and breakaway for damage, loose connections, or leaks. Inspect nozzles for damaged vapor boots or spouts. Any nozzle with a vapor collection boot which is missing, or which has one half of the mini-boot faceplate or greater missing should be replaced or repaired as soon as practicable. Spouts with visible damage must be replaced.
- Inspect hoses for wear, severe kinks, cracks, and splitting. Replace if wire braid is visible.
- Test the VP1000 Vacuum Pump for normal operation using the following test procedure:
  - Normal operation will have the VP1000 Vacuum Pump running at low speed if only one side of a dispenser / pump is activated (ready to dispense fuel) and will run at full speed if both sides of the dispenser are activated (ready to dispense fuel). The VP1000 vacuum pump may continue to run for a few seconds after a nozzle is reholstered.

  NOTE: If any of the four bullets below cannot be achieved, tag out dispenser and call a Healy Certified Technician for service.

    - The VP1000 vacuum pump should come on immediately when a nozzle is lifted and the dispenser is activated and ready to dispense fuel.
    - Repeat for each nozzle on both sides of the dispenser being tested, one at a time, to verify the VP1000 vacuum pump is running after the dispenser is activated and ready to dispense fuel.

NOTE: For unihose dispensers, conduct individual tests for each product grade on each side of the dispenser to ensure that the VP1000 activates for all grades on the same side.

- Leave one nozzle activated on the first side and with the pump running, lift a nozzle on the other side of the dispenser (activated as above) and listen for a change of speed (increase) in the pump motor. Return both nozzles to the dispenser.

- Repeat the above procedures to activate both sides of the dispenser, but start with the opposite side of the dispenser. If the above procedures can be confirmed by starting with the opposite side of the dispenser, the VP1000 vacuum pump is correctly installed. After the VP1000 vacuum pump gets to second speed, it will not drop back to single speed until one nozzle is reholstered.

Note: In parts of the country where the outside temperature drops below 35° F, the VP1000 vacuum pump motor will automatically run at a very low RPM to prevent freezing. This is normal operation.

1.2 Quarterly Inspection and Testing

1.2.1 Perform Weekly Inspection prior to Quarterly inspection.

1.2.2 Inspect the VP1000 vacuum pump for loose or damaged vapor line connections. If copper tubing is kinked or loose remove the dispenser from service and call a Healy Certified Technician for service.

1.2.3 Check product dispensing flow rate at maximum (handheld) dispensing position. Verify flow rate is between 6.0 gpm and 10.0 gpm.

1.2.3.1 Replace dispenser filters when flow rate is below 6.5 gpm and check flow rate again. If the flow rate does not increase after filter change, remove the fueling point from service.

1.2.3.2 If flow rates exceed 10.0 gpm, install either Healy Model 1301 or 1302 Flow Limiter and check flow rate again. If flow rate still exceeds 10.0 gpm, remove the fueling point from service.

1.2.4 Check Clean Air Separator for proper operating configuration. See EO VR-201-N or VR-202-N, Exhibit 2, Figure 2B-2 or 2B-2H for guidance. Figure 2B-2 applies to vertical CAS installations. Figure 2B-2H applies to horizontal CAS installations.

1.3 Annual Inspection and Testing to Be Performed By a Healy Certified Technician.

The following procedures are recommended to be conducted in the order listed.

1.3.1 Perform weekly and quarterly inspection prior to Annual Inspection.

1.3.2 Conduct static pressure performance of the Healy Clean Air Separator (EO VR-201-N or VR-202-N, Exhibit 4).

1.3.3 Conduct pressure decay test (TP-201.3 and EO VR-201-N or VR-202-N, Exhibit 8).

1.3.4 Conduct dispenser vapor line tightness test found in the Healy dispenser manual under “testing the system” for each dispenser at GDF. Repair all leaks.

1.3.5 Conduct V/L test on all nozzles (EO VR-201-N or VR-202-N, Exhibit 5 or an ARB approved alternate test procedure). Adjust and replace as necessary.

1.4 Procedure for Reconnecting Breakaway and Testing Fueling Point after Drive-Off.

Note: The following procedure does not require a Healy Certified Technician. If any of the tests listed requires removing the fueling point or dispenser from service, contact a Healy Certified Technician. Breakaway reconnections and/or service by the GDF owner/operator or a Healy Certified Technician shall be logged in the GDF Maintenance Log.

1.4.1 After a Drive-Off, inspect the nozzle, hose and breakaway for damage. Spouts with visible damage must be replaced. Hoses with wire braid showing must be replaced.

1.4.2 Reconnect the breakaway assembly per the procedure in the appropriate Reconnectable Breakaway Coupling (P/N 8701VV or P/N 807) section of the *ARB Approved Installation, Operation and Maintenance Manual*. This procedure requires the use of the Healy reconnection clamp, P/N 795. Verify that the tip of the shear screw installed prior to the Drive-Off is removed from the dispenser end body (connected to the whip hose) of the breakaway.

Note: Do not remove the hose or nozzle from the bottom section of the breakaway, as the breakaway is holding the liquid gasoline in the hose/nozzle.

1.4.3 Authorize dispenser and inspect the hanging hardware for liquid leaks and meter creep (fueling position display is counting up without dispensing product). If no liquid leaks or meter creep are observed, proceed to section 1.4.4 of this procedure. If liquid leaks or meter creep are observed, remove the fueling point from service and conduct the following:

1.4.3.1 Use the breakaway reconnection procedure, referenced in section 1.4.2, in reverse order to disconnect the breakaway. Remove the nozzle and hose from the dispenser. (A towel can be placed into the upper portion of the nozzle holster of the dispenser to stop the dispenser beep associated with the nozzle being removed from the holster).

1.4.3.2 Install a plastic bag around the portion of the breakaway still connected to the dispenser whip hose. The plastic bag shall be large enough to enclose the breakaway and shall have a thickness of no greater than 2 mils. In California, 12” x 26” x 2 mil thick bags are available from the Air Resources Board by calling 800-952-5588.

1.4.3.3 Initialize the dispenser for fueling. **Do not dispense any fuel**.

1.4.3.4 With the dispenser initialized, observe the bagged breakaway for thirty (30) seconds.

1.4.3.5 If the bag collapses (indicating the breakaway is not maintaining vapor integrity), or liquid leaks or meter creep are observed, replace breakaway assembly per the procedure in the appropriate Reconnectable Breakaway Coupling (P/N 8701VV or P/N 907) section of ARB approved Installation, operation and Maintenance Manual, and return to section 1.4.3 of this procedure. If bag collapses or liquid leaks, or meter creep is observed after replacing breakaway assembly, remove the dispenser from service and contact a Healy Certified Technician. If the bag does not collapse (indicating the breakaway is maintaining vapor integrity) and no liquid leaks or meter creep are observed, the dispenser can remain in service.

1.4.4 Conduct the Nozzle Bag Test using the procedure from Exhibit 7 of Executive Order VR-201-N or VR-202-N. If the bag around the nozzle does not collapse, proceed to section 1.4.5 of this procedure. A nozzle where the bag is collapsing indicates a defective vapor valve. If the nozzle bag test indicates a defective vapor valve, replace nozzle assembly and return to section 1.4.3 of this procedure. If bag collapses or liquid leaks or meter creep is observed after replacing the nozzle assembly, remove the fueling point from service and conduct the following:

1.4.4.1 Use the breakaway reconnection procedure, referenced in section 1.4.2, in reverse order to disconnect the breakaway. Remove the nozzle and hose from the dispenser. (A towel can be placed into the upper portion of the nozzle holster of the dispenser to stop the dispenser beep associated with the nozzle being removed from the holster).

1.4.4.2 Install a plastic bag around the portion of the breakaway still connected to the dispenser whip hose. The plastic bag shall be large enough to enclose the breakaway and shall have a thickness of no greater than 2 mils. In California, 12” x 26” x 2 mil thick bags are available from the Air Resources Board by calling 800-952-5588.

1.4.4.3 Initialize the dispenser for fueling. **Do not dispense any fuel.**

1.4.4.4 With the dispenser initialized, observe the bagged breakaway for thirty (30) seconds.

1.4.4.5 If the bag collapses (indicating the breakaway is not maintaining vapor integrity), or liquid leaks or meter creep are observed, remove the dispenser from service and contact a Healy Certified Technician. If the bag does not collapse (indicating the breakaway is maintaining vapor integrity) and no liquid leaks or meter creep are observed, the dispenser can remain in service.

1.4.5 The following tests shall be performed after passing sections 1.4.3 and 1.4.4 of this procedure.

1.4.5.1 Test the insertion interlock feature of the nozzle using the procedures outlined in Sections 1.1.7 and 1.1.8 in the Healy Model 900 Nozzle section of the *ARB Approved Installation, Operation and Maintenance Manual*. If the nozzle fails either of these tests, replace nozzle assembly and return to section 1.4.3 of this procedure. If the nozzle fails any of the tests after replacing the nozzle, remove the fueling point from service and contact a Healy Certified Technician.

1.4.5.2 Test the automatic shutoff feature of the nozzle using the procedures outlined in Sections 1.2.8, 1.2.9 and 1.2.10 in the Healy Model 900 Nozzle section of the *ARB Approved Installation, Operation and Maintenance Manual*. If the nozzle fails any of the tests, replace nozzle assembly and return to section 1.4.3 of this procedure. If the nozzle fails any of the tests after replacing the nozzle, remove the fueling point from service and contact a Healy Certified Technician.

For more information about testing and/or maintenance of Healy products, contact Healy Technical Services @ 800-984-6266.

VR-201-N and VR-202-N - Weekly Inspection and Testing Checklist

Checklist results may be used to assist with filling out GDF maintenance log. | Date: _________ | Page ____ of ____

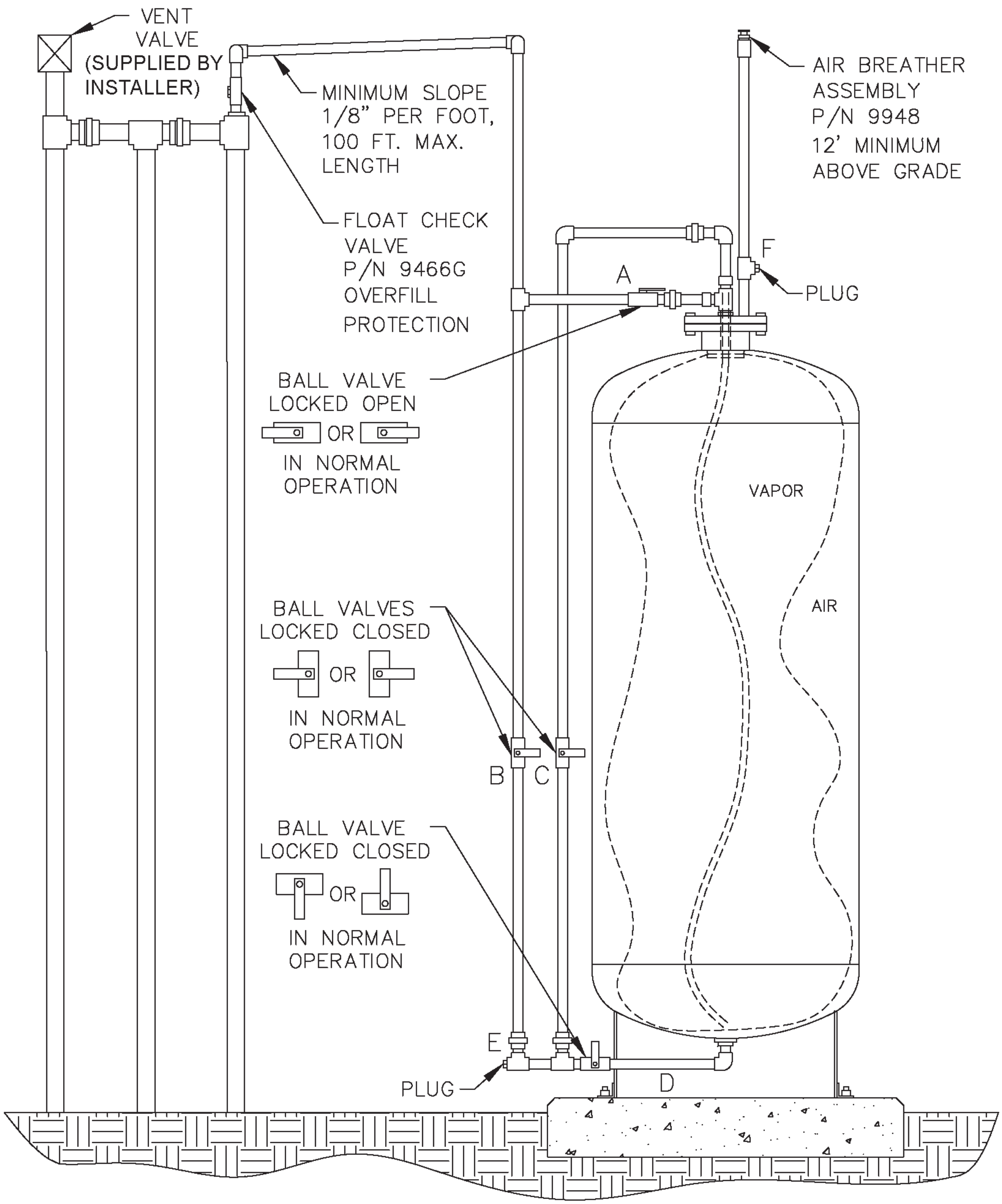
Dispenser Number	Unihose or Fuel Grade (circle one)	Nozzle Inspection (circle one)	Hose Inspection (circle one)	Breakaway Inspection (circle one)	VP1000 Vacuum Pump Normal Operation (circle one)
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No

VR-201-N and VR-202-N - Quarterly Inspection and Testing Checklist

Checklist results may be used to assist with filling out GDF maintenance log. Date: __________ Page ____ of ____

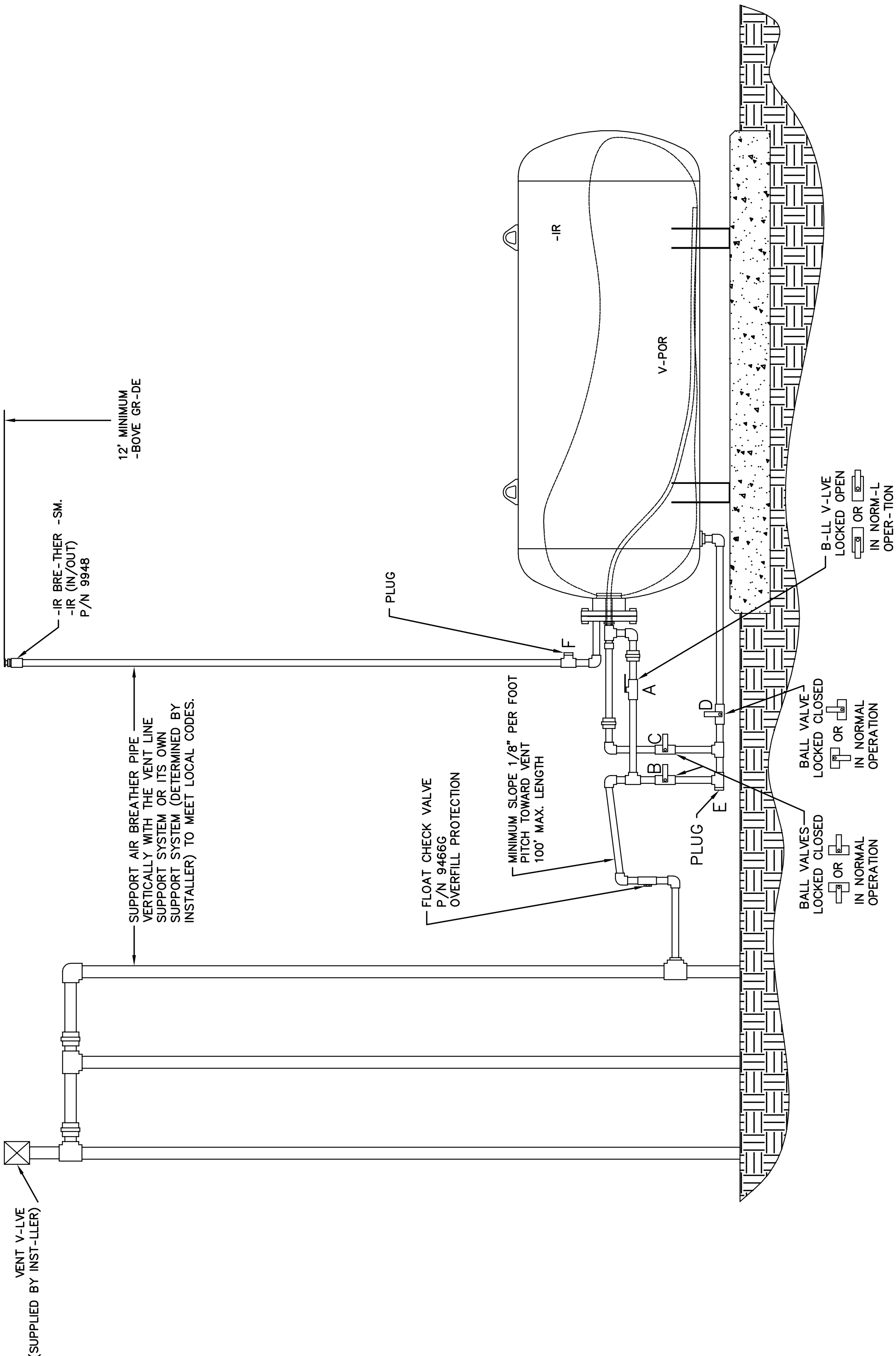
Dispenser Number	Unihose or Fuel Grade (circle one)	Weekly Inspection Complete (circle one)	VP1000 Inspection (circle one)	Product Dispensing Rate (gallons per minute)	Fuel Grade Tested (circle one)	Clean Air Separator Configuration (see Figures 1 and 1H)		
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___	Valve	Circle One	
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___	A	Open	Closed
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___	B	Open	Closed
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___	C	Open	Closed
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___	D	Open	Closed
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___			
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___	Plug	Circle One	
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___	E	Installed	Missing
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___	F	Installed	Missing
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___			
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___			
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___			
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___			
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___			
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___			
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___			

Figure 1
Normal Clean Air Separator Operating Configuration[1]



1 Vent stack configuration may be different than what is shown in this figure.

Figure 1H
Normal Horizontal Clean Air Separator Operating Configuration[1]



1 Vent stack configuration may be different than what is shown in this figure.

VR-201-N and VR-202-N - Annual Inspection and Testing Checklist

Checklist results may be used to assist with filling out GDF maintenance log. Date: ________ Page __ of __

Complete Weekly Inspection Checklist	Complete Quarterly Inspection Checklist	Clean Air Separator Test, Exhibit 4 (circle one)	Pressure Decay Test, TP-201.3 & Exhibit 8 (circle one)	Dispenser Number	Dispenser Vapor Line Tightness Test (circle one)	Dispenser Number	Fuel Grade Tested (circle one)	Nozzle V/L Test, Exhibit 5 (circle one)
		Pass	Pass		Pass Fail		87 89 91 Other___	Pass Fail
					Pass Fail		87 89 91 Other___	Pass Fail
					Pass Fail		87 89 91 Other___	Pass Fail
					Pass Fail		87 89 91 Other___	Pass Fail
					Pass Fail		87 89 91 Other___	Pass Fail
					Pass Fail		87 89 91 Other___	Pass Fail
					Pass Fail		87 89 91 Other___	Pass Fail
					Pass Fail		87 89 91 Other___	Pass Fail
		Fail	Fail		Pass Fail		87 89 91 Other___	Pass Fail
					Pass Fail		87 89 91 Other___	Pass Fail
					Pass Fail		87 89 91 Other___	Pass Fail
					Pass Fail		87 89 91 Other___	Pass Fail
					Pass Fail		87 89 91 Other___	Pass Fail
					Pass Fail		87 89 91 Other___	Pass Fail
					Pass Fail		87 89 91 Other___	Pass Fail
					Pass Fail		87 89 91 Other___	Pass Fail

Executive Order VR-201-N
Healy Phase II EVR System
Not Including ISD

Exhibit 2

System Specifications

This exhibit contains the installation, maintenance and compliance standards and specifications that apply to the Healy Phase II EVR System installed in a gasoline dispensing facility. All components must be installed in accordance with the specifications in the **ARB Approved Installation, Operation and Maintenance Manual**. Installation, maintenance and repair of system components, including removal and installation of such components in the course of any required tests, shall be performed by technicians certified by the appropriate manufacturer. Additional certifications may be required in accordance with local district requirements. Provided that there are no other local district requirements, a GDF Owner / Operator can remove and install nozzles, curb hoses, breakaways, flow limiters and whip hoses without a manufacturer certification

Nozzle

1. A vapor collection boot shall be installed on the nozzle at the base of the spout, as shown in **Figure 2B-1**.

2. The Healy Model 900 nozzle has an integral vapor valve which prevents the loss of vapor from the underground storage tanks, ensures proper operation of the system and prevents the ingestion of air into the system. Any dispenser that has a nozzle installed that is determined to have a defective vapor valve, as described in items 2.1 or 2.2 below, shall be immediately removed from service (including nozzle(s) on both sides of dispenser) and a call for repair made immediately.

   2.1. The maximum allowable leak rate for the nozzle vapor path, as determined by TP-201.2B, shall not exceed the following:

   0.038 cubic feet per hour (CFH) at a pressure of two inches water column (2.00” wc), and
   0.10 CFH at a vacuum of one hundred inches water column (-100.00” wc)

   2.2. Verification of the integrity of the vapor valve can be performed on installed nozzles using the nozzle bag test procedure in Exhibit 7.

Vapor Collection

1. The V/L ratio of the system shall be **1.05 plus or minus 0.10 (0.95 to 1.15)**, measured at a flow rate between six and ten gallons per minute (6.0 – 10.0 gpm). *Any fueling point whose V/L ratio is determined to be at or below 0.80 shall be deemed defective and removed from service.* The V/L ratio shall be determined by using the test procedure in Exhibit 5 with the shut-off port excluded, or with an ARB approved alternate test procedure. See Section 7 of Exhibit 5 for guidance on V/L adjustment.

2. Inoperative vapor pumps, as determined by the ***ARB Approved Installation, Operation and Maintenance Manual***, constitute a defect.

3. For unihose dispensers, any modifications or repairs to the nozzle, hanging hardware or vacuum pump done to bring one fuel grade V/L into compliance at a fueling point invalidates the results of any previous fuel grade(s) tested before the alteration. All fuel grades at that fueling point shall be tested again to verify compliance.

Inverted Coaxial Hoses

1. The maximum length of the hose assembly, including hose adaptor, whip hose, breakaway, flow limiter (optional) and inverted coaxial hose, measured at the base of the nozzle, shall be no more than twenty (20) feet.

2. Any hose configuration is allowed.

Breakaway Couplings

1. Testing is required after reconnecting the breakaway to ensure proper operation and no observed leaks. The procedure for reconnecting breakaway and fueling point testing after a drive-off, referenced in Section 1.4 of Healy Systems Scheduled Maintenance, shall be conducted to verify that breakaway, hose and nozzle are operating properly after a drive-off.

Flow Limiters

1. Flow limiter is mandatory when the flow rate is greater than 10.0 gallons per minute to comply with U.S. EPA requirement.

Clean Air Separator Pressure Management System

1. The Clean Air Separator (CAS) is a passive gasoline storage tank ullage pressure management system, with no electrical requirements. The Clean Air Separator vapor integrity shall be evaluated using the test procedure outlined in Exhibit 4 of this Executive Order.

    a. The system shall be removed from service when the Clean Air Separator fails the leak decay test outlined in Exhibit 4.

    b. Unless there is maintenance or testing being conducted on the Clean Air Separator, the system shall be removed from service when the four ball valves are not locked in the positions shown in **Figure 2B-2** or **2B-2H** for normal Clean Air Separator operation. Figure 2B-2 applies to vertical CAS installations and Figure 2B-2H applies to horizontal CAS installations.

2. The Clean Air Separator shall be installed within 100 feet from the vent line(s), and the associated piping shall be sloped 1/8” per foot minimum toward the vent line(s).

Pressure/Vacuum Vent Valves for Gasoline Storage Tank Vents

1. All P/V vent valves shall be an ARB-certified P/V vent valve for a Phase I system.

2. At least one pressure/vacuum (P/V) vent valve shall be installed on each gasoline storage tank vent. The maximum number of P/V vent valves allowed and P/V vent valve performance specifications are listed in the applicable Phase I EVR Executive Order. Vent lines may be manifold to minimize the number of P/V vent valves and potential leak sources, provided the manifold conforms to all applicable fire regulations. At least one P/V vent valve shall be installed on vents if a manifold is incorporated. **Figure 2B-3** or **2B-3H** shows a typical manifold configuration for a single P/V vent valve with the Clean Air Separator. If two or more P/V vent valves are desired, they shall be installed in parallel, so that each can serve as a backup to the other if one should fail to open properly. **Figure 2B-4** or **2B-4H** shows a typical manifold configuration for two P/V vent valves installed in parallel with the Clean Air Separator. **Figure 2B-5** or **2B-5H** shows a typical manifold configuration for three P/V vent valves installed in parallel with the Clean Air Separator. **Figure 2B-6** or **2B-6H** shows a typical configuration for a P/V vent valve mounted on a single 3” vent line with the Clean Air Separator. Figures 2B-3, 2B-4, 2B-5 and 2B-6 apply to vertical CAS installations. Figures 2B-3H, 2B-4H, 2B-5H and 2B-6H apply to horizontal CAS installations.

Vapor Recovery Piping Configurations

NOTE: Vapor Return Piping shall meet the requirements specified in section 4.11 of CP-201.

1. Vapor Return and Vent Lines

   a. For facilities installed on or after April 1, 2003, all vapor return and vent lines shall be a minimum nominal internal diameter of 2 inches from the dispensers or the vent stacks to the first manifold. All lines after the first manifold and back to the underground storage tank shall have a minimum nominal internal diameter of 3 inches.

      Note: Facilities permitted by a local district prior to April 1, 2003 shall be required to meet the three inch diameter standard only upon facility modification requiring exposing at least 50 percent of the underground vapor return piping.

After backfilling the vapor return and vent lines, the maximum pressure drop shall not exceed 0.5 inches WC at 60 cubic feet per hour as determined by TP-201.4, Dynamic Backpressure. The pressure drop shall be measured from the dispenser riser to the UST with pressure/vacuum vent valves installed and with the poppeted Phase I vapor connection open.

b. For existing installations, the maximum pressure drop through the system shall not exceed 0.5 inches WC at 60 cubic feet per hour as determined by TP-201.4, Dynamic Backpressure. The pressure drop shall be measured from the dispenser riser to the UST with the pressure/vacuum vent valves installed and with the poppeted Phase I vapor connection open.

Note: The V/L test from Exhibit 5 may be used to verify proper operation of the system, in lieu of measuring the pressure drop through the lines, provided that at least two gallons of product are introduced into the system through each dispenser riser, prior to the test.

2. All vapor return lines shall have a minimum slope of 1/8 inch per foot from the dispenser riser to the riser of the underground storage tank (UST). A slope of 1/4 inch or more per foot is recommended wherever feasible. The vapor return path from any dispenser riser to the UST shall be free of liquid or fixed blockage.

Exception: When it is not possible to achieve the necessary minimum slope from the dispenser back to the underground storage tanks, a low point Liquid Condensate Trap (i.e. knock out pot, thief port) can be utilized as long as the conditions under **Liquid Condensate Traps** in this Exhibit 2 are met.

3. The dispenser shall be connected to the riser with either flexible or rigid material that is listed for use with gasoline. The dispenser-to-riser connection shall be installed so that any liquid in the lines will drain toward the gasoline storage tank. The internal diameter of the connector, including all fittings, shall not be less than one-half inch (1/2”).

Note: The dispenser-to-riser connection is defined as the piping connection between the outlet of the vacuum pump and the inlet of the dispenser riser. A vapor shear valve may also be part of the riser connection.

4. There is no length restriction for the vapor return piping of the system as long as the system complies with the maximum pressure drop requirement of Item 1 (or the V/L option).

5. No product shall be dispensed from any fueling point at a GDF installed with the Healy Phase II EVR System if there is a vapor line that is disconnected and open to the atmosphere.

Dispenser Vapor Piping

1. Any dispenser with a dispenser piping test valve in the closed position shall be considered a defect.

2. The ball valve shall be installed between the test port and the vacuum pump. The ball valve and test port shall be located on the inlet side of the vacuum pump.

Liquid Condensate Traps

1. There shall be no vapor leaks when tested in accordance with the latest version of TP 201.3, **Determination of 2 Inch WC Static Pressure Performance of Vapor Recovery Systems of Dispensing Facilities**.

2. The Liquid Level Sensor shall alarm within five (5) minutes when tested in accordance with Exhibit 9, **Liquid Condensate Trap Compliance Test**.

3. The Liquid Level Sensor audible alarm shall be installed at a location that is most likely to be heard by the station attendant during normal station operation (e.g. cash register).

4. The Liquid Evacuation System shall automatically evacuate gasoline when tested in accordance with Exhibit 9, **Liquid Condensate Trap Compliance Test.**

5. A metal tag specifying the capacity of the Liquid Condensate Trap shall be installed and maintained as specified in the Installation, Operation, and Maintenance Manual.

Phase I System

1. The Phase I system shall be an ARB-certified system that demonstrates compliance with the static pressure decay test criteria contained in the latest version of TP-201.3.

Maintenance Records

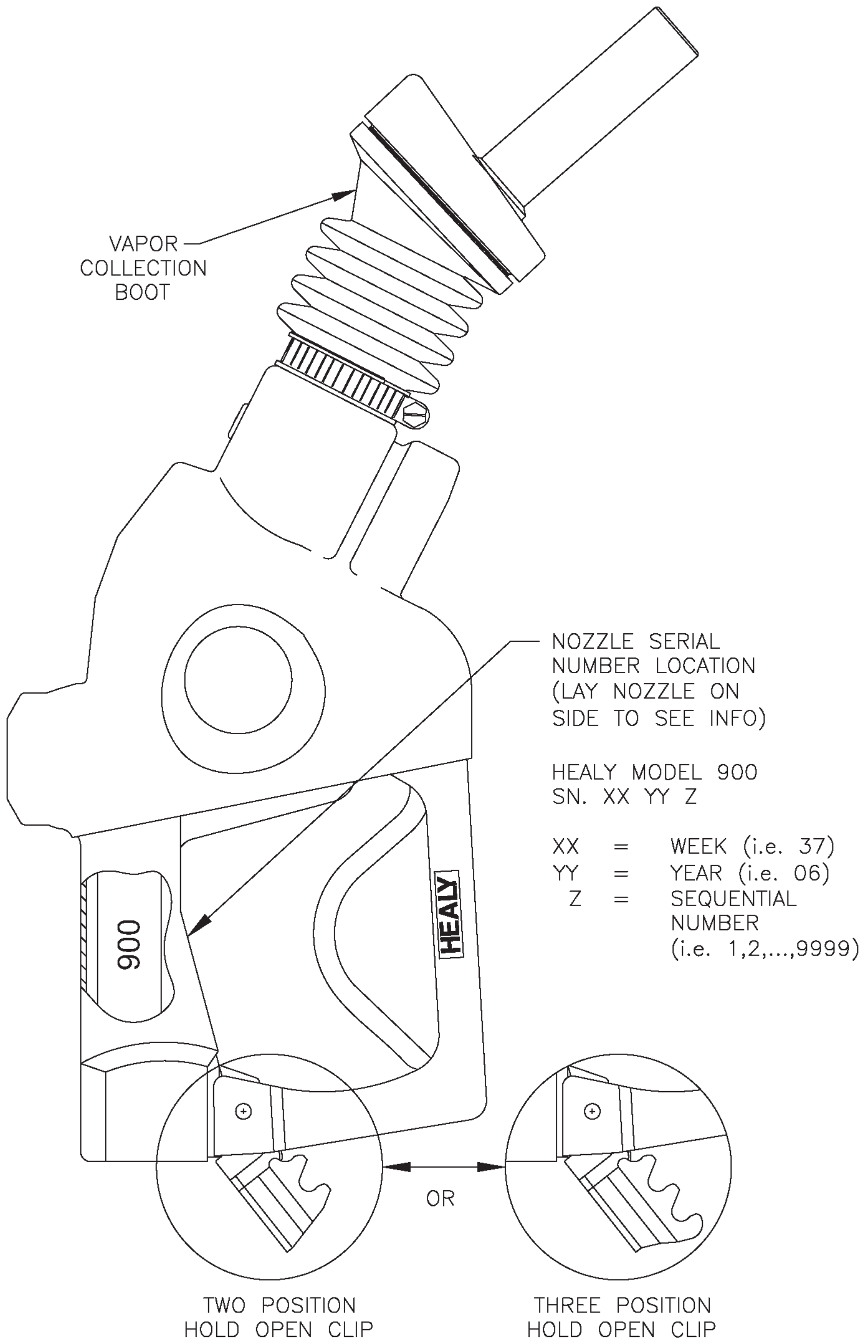
1. Each GDF operator/owner shall keep records of maintenance performed at the facility. Such records shall be maintained on site in accordance with district requirements or policies. The records shall include the maintenance or test date, repair date to correct test failure, maintenance or test performed, affiliation, telephone number, name and Certified Technician Identification Number of individual conducting maintenance or test. Additional information may be required in accordance with local district requirements. An example of a GDF Maintenance Record is shown in **Figure 2B-7**.

2. Maintenance shall be conducted in accordance with Healy Systems Scheduled Maintenance section of the ***ARB Approved Installation, Operation, and Maintenance Manual***.

3. Reconnection of breakaways shall be included in the maintenance records.

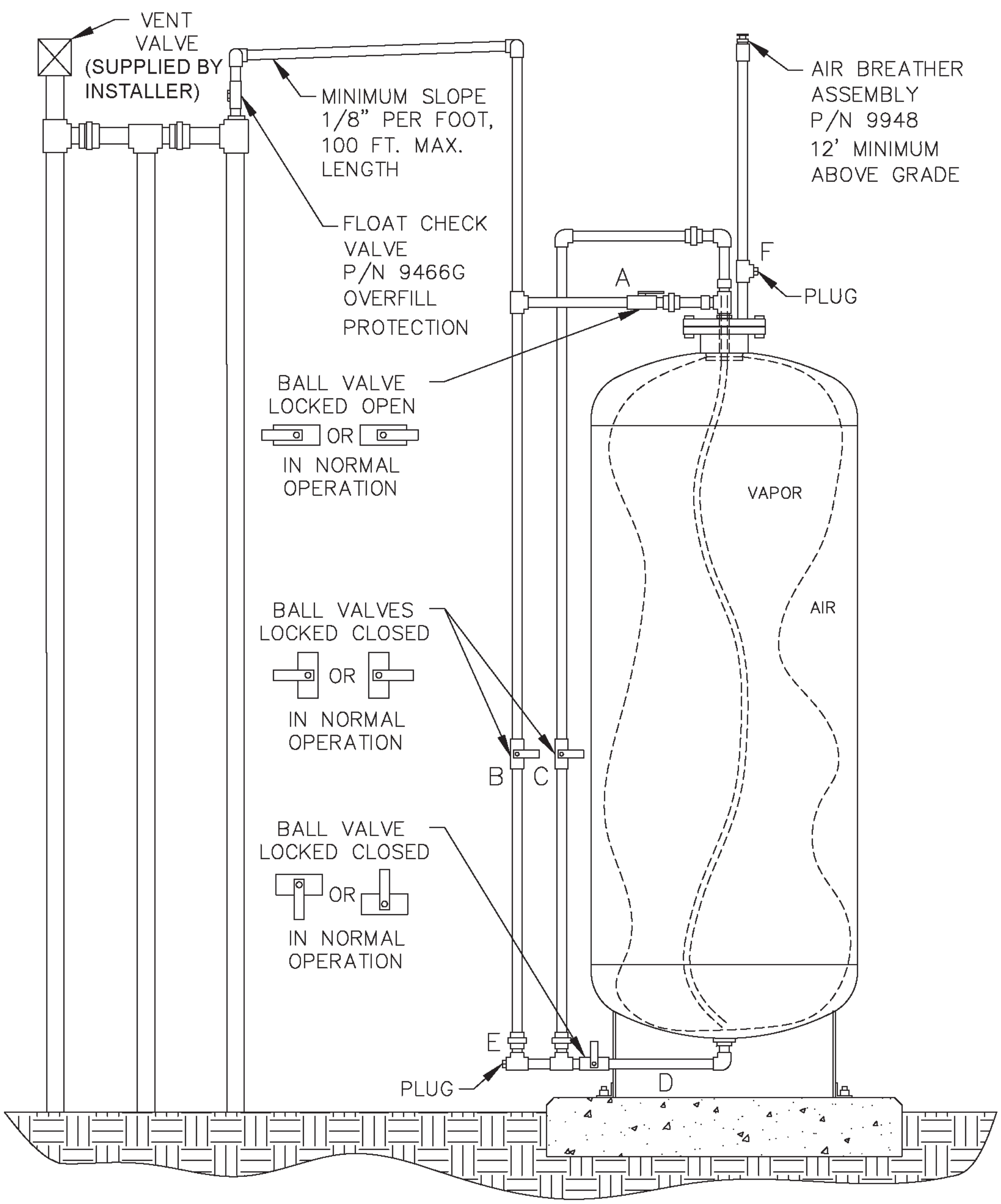
Executive Order VR-201-N
Healy Phase II EVR System
Not Including ISD

Exhibit 2
Figure 2B-1
Vapor Boot for Healy 900 Nozzle



Executive Order VR-201-N
Healy Phase II EVR System
Not Including ISD

Exhibit 2
Figure 2B-2
Clean Air Separator Normal Operation Configuration



Executive Order VR-201-N
Healy Phase II EVR System
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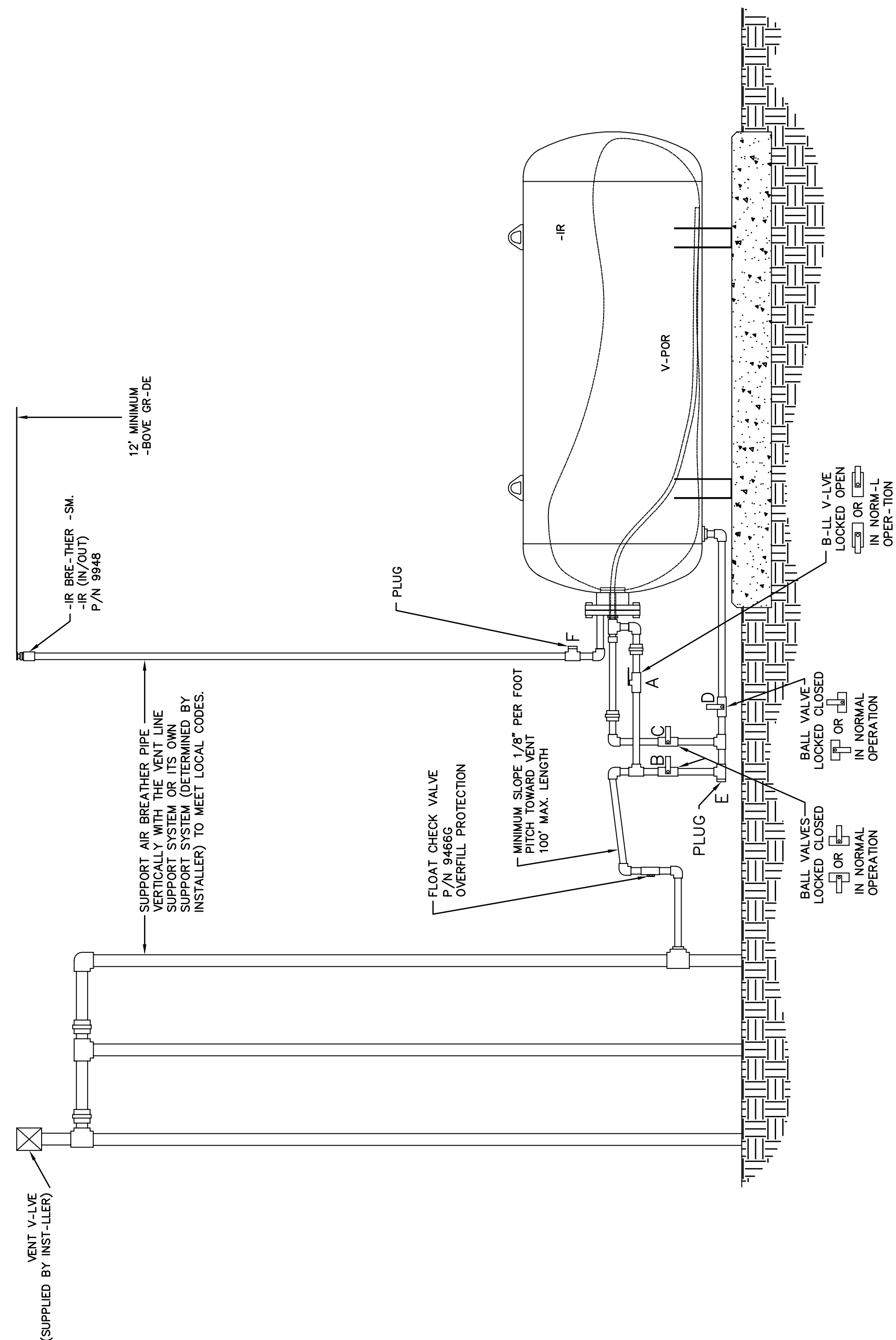
Exhibit 2
Figure 2B-2H
Clean Air Separator Normal Operation Configuration



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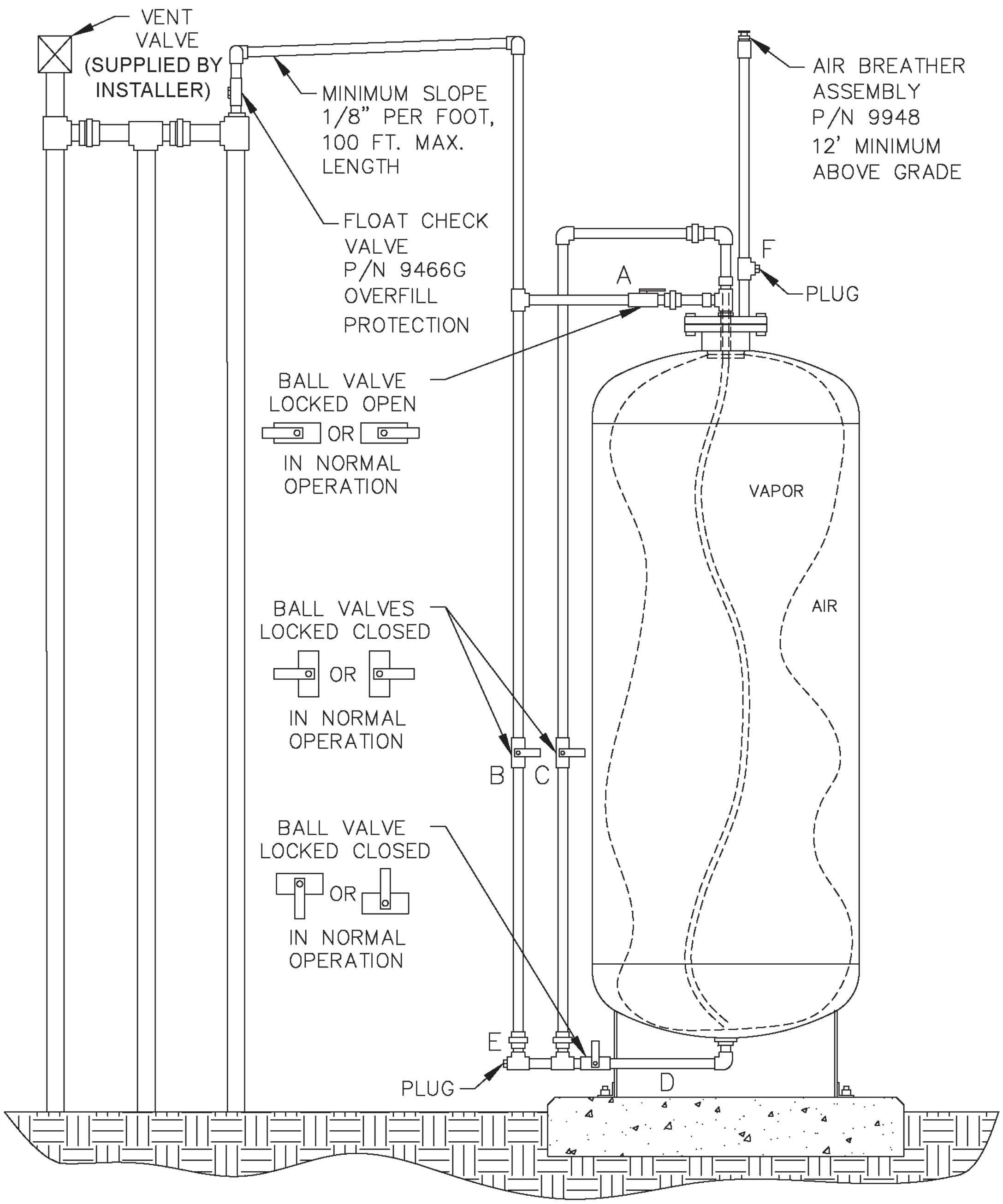
Healy Phase II EVR System
Not Including ISD

Exhibit 2
Figure 2B-3
Typical Installation of a Single P/V Vent Valve Manifold with Healy Clean Air Separator



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Healy Phase II EVR System
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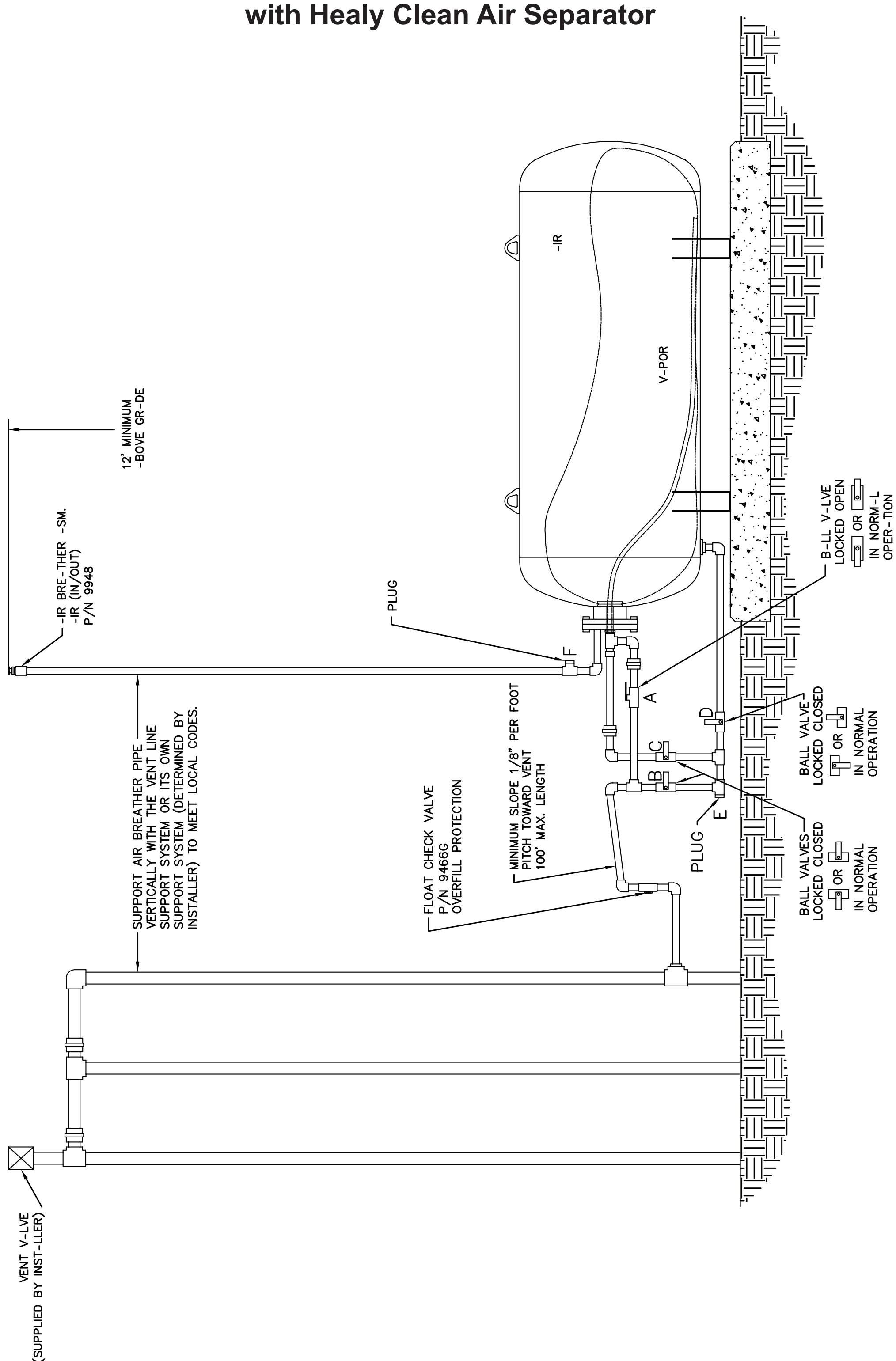
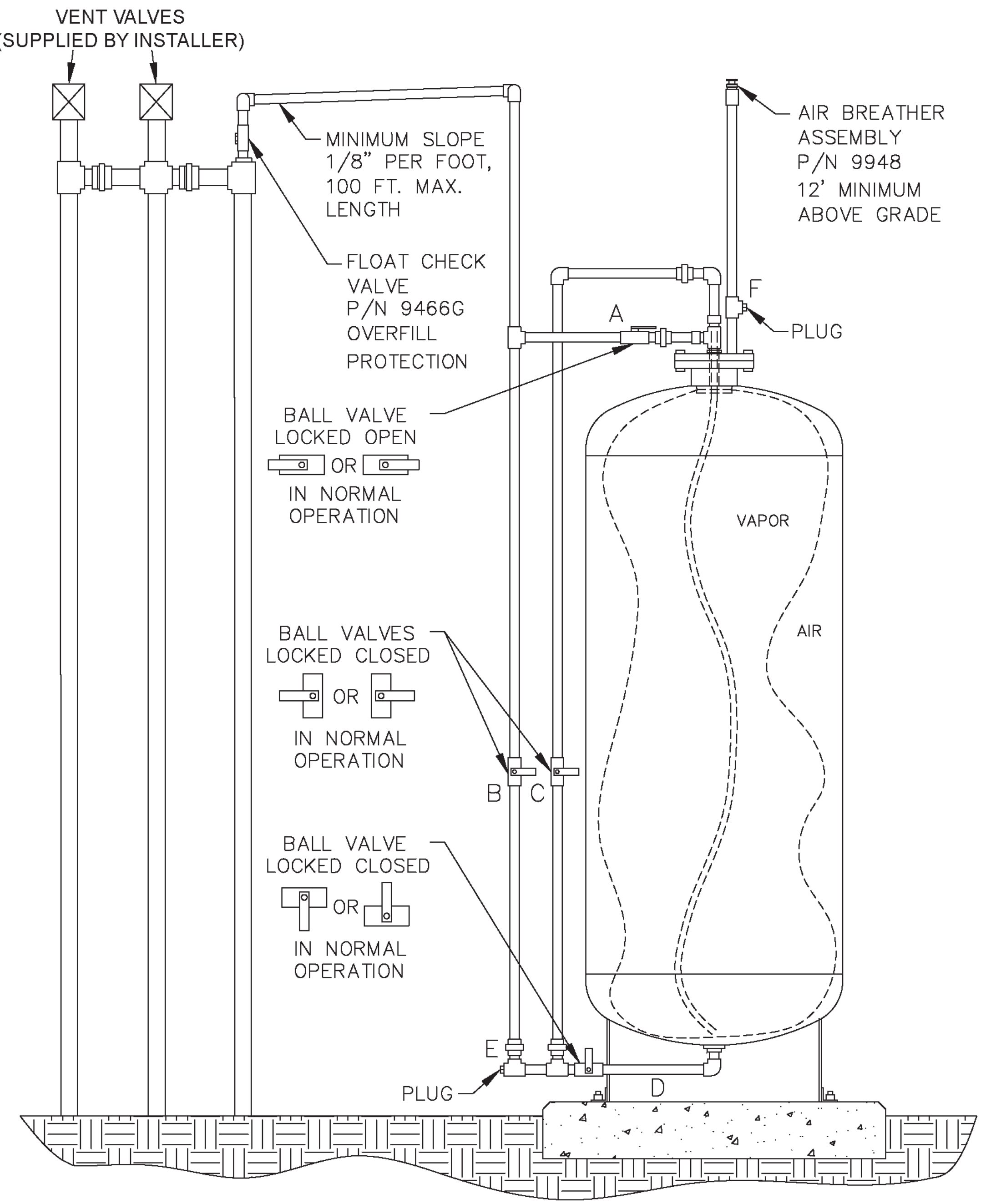
Exhibit 2
Figure 2B-3H
Typical Installation of a Single P/V Vent Valve Manifold with Healy Clean Air Separator



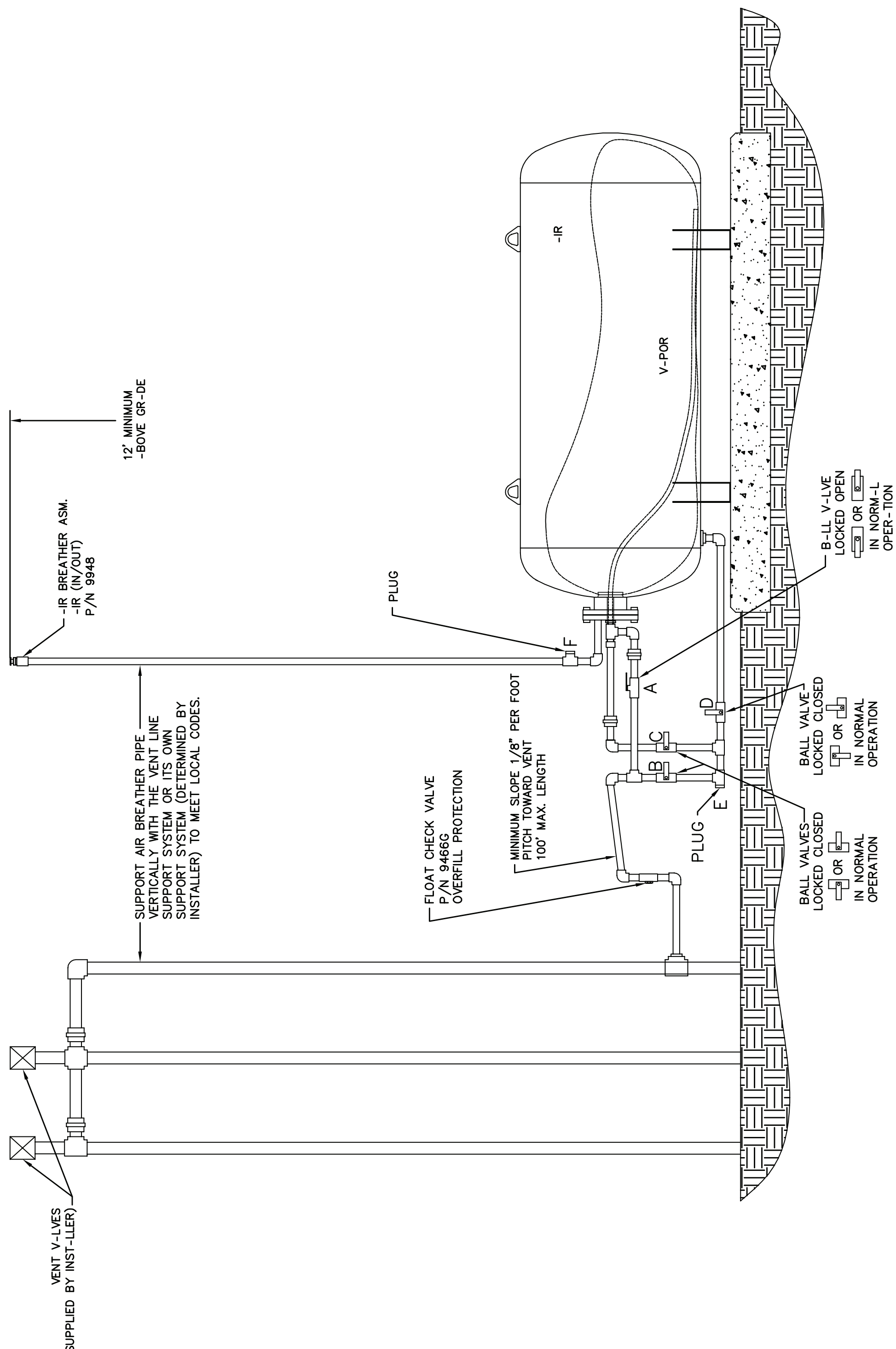
Executive Order VR-201-N
Healy Phase II EVR System
Not Including ISD

Exhibit 2
Figure 2B-4
Typical Installation of a Two P/V Vent Valve Parallel Manifold with Healy Clean Air Separator



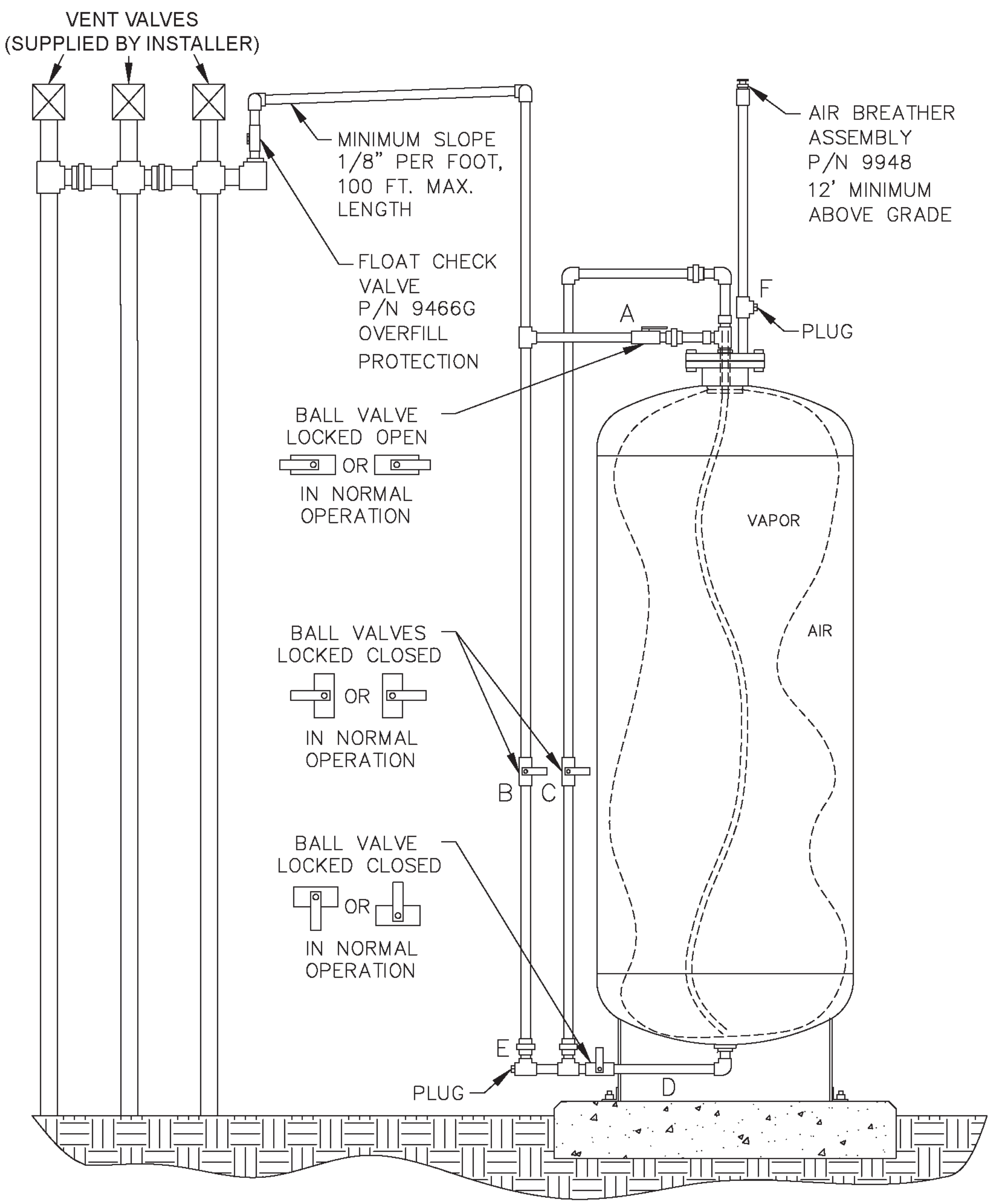
Executive Order VR-201-N
Healy Phase II EVR System
Not Including ISD

Exhibit 2
Figure 2B-4H
Typical Installation of a Two P/V Vent Valve Parallel Manifold with Healy Clean Air Separator



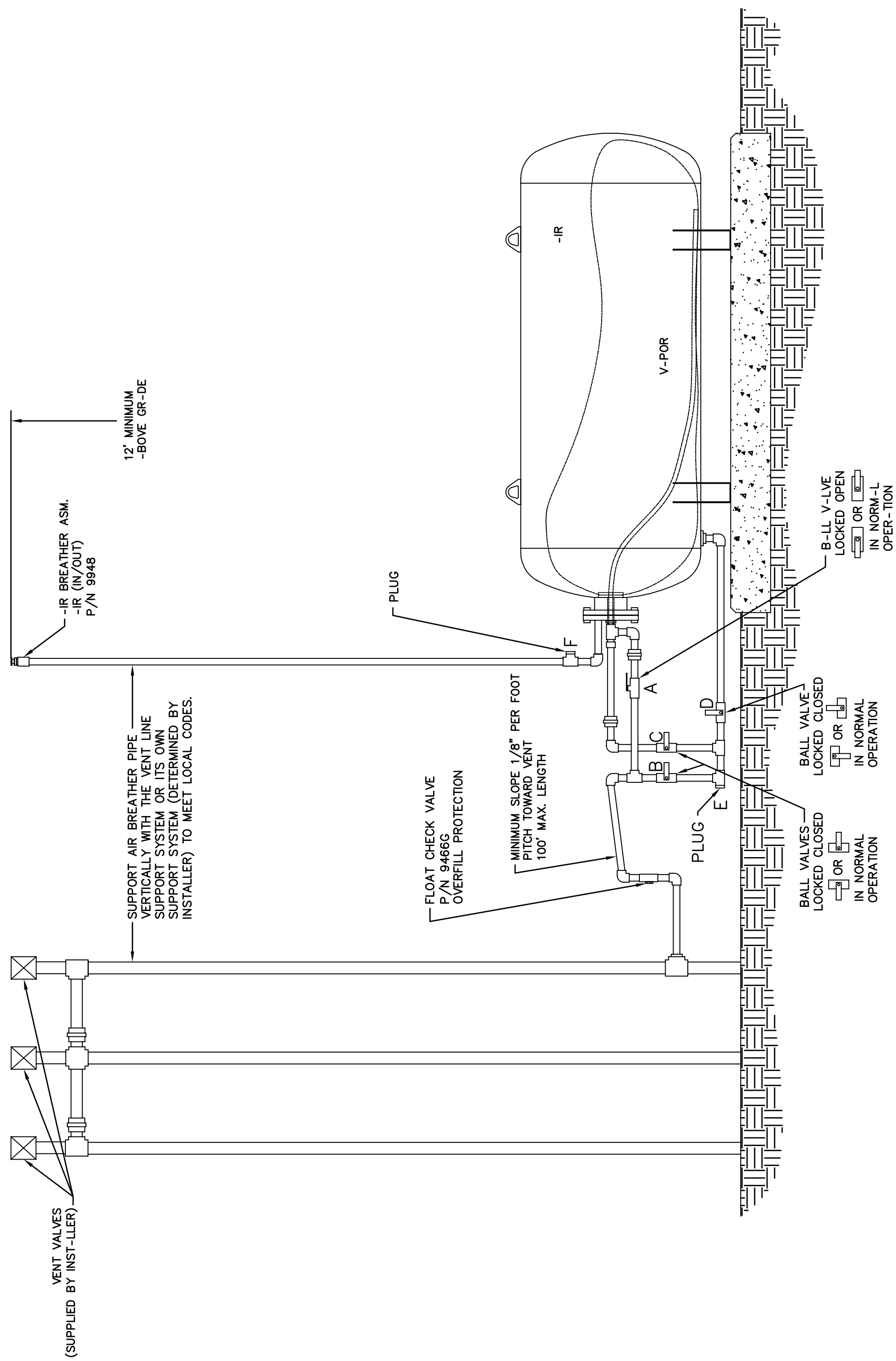
Executive Order VR-201-N
Healy Phase II EVR System
Not Including ISD

Exhibit 2
Figure 2B-5
Typical Installation of a Three P/V Vent Valve Parallel Manifold with Healy Clean Air Separator



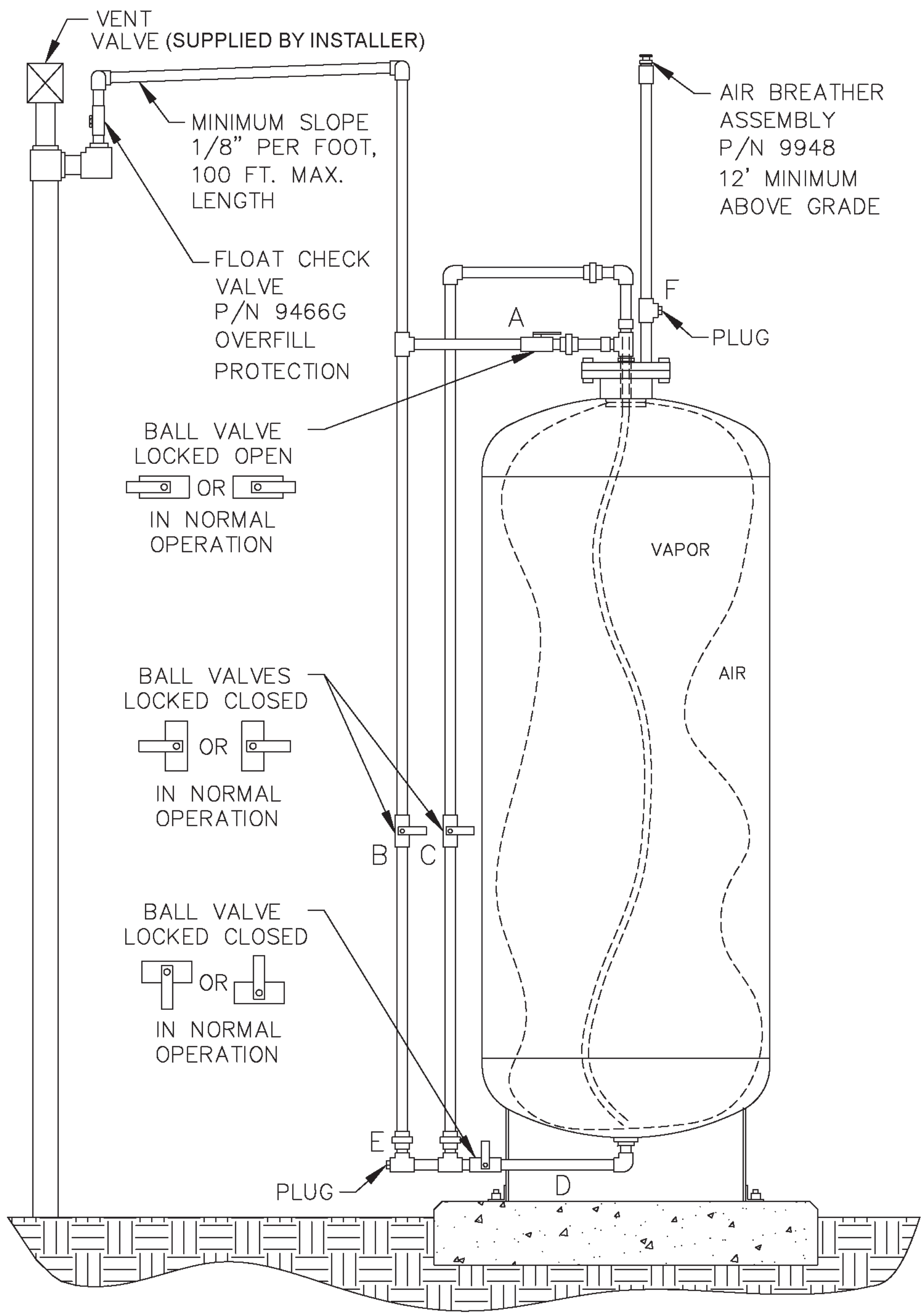
Executive Order VR-201-N
Healy Phase II EVR System
Not Including ISD

Exhibit 2
Figure 2B-5H
Typical Installation of a Three P/V Vent Valve Parallel Manifold with Healy Clean Air Separator



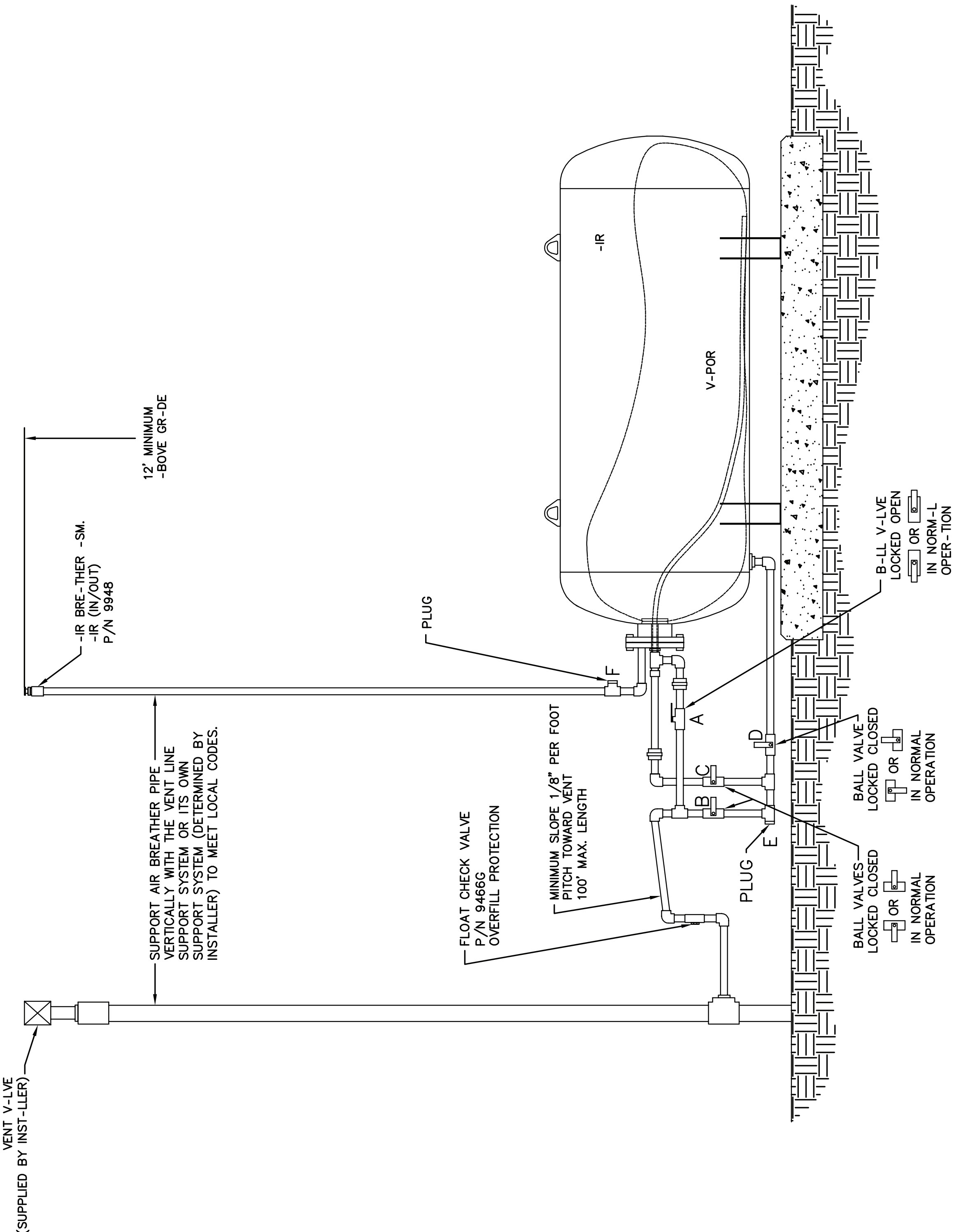
Executive Order VR-201-N
Healy Phase II EVR System
Not Including ISD

Exhibit 2
Figure 2B-6
Typical Configuration of a P/V Vent Valve Mounted on a Single 3" Vent Line with the Clean Air Separator



Executive Order VR-201-N
Healy Phase II EVR System
Not Including ISD

Exhibit 2
Figure 2B-6H
Typical Configuration of a P/V Vent Valve Mounted on a Single 3" Vent Line with the Clean Air Separator



Executive Order VR-201-N
Healy Phase II EVR System
Not Including ISD

Exhibit 2
Figure 2B-7
Example of a GDF Maintenance Record

Date of Maintenance/ Test/Inspection/Failure/y (including date and time of maintenance call)	Repair Date To Correct Test Failure	Maintenance/Test/Inspection Performed and Outcome	Affiliation	Name and Technician ID number of Individual Conducting Maintenance or Test	Telephone Number

Exhibit 4

Determination of Static Pressure Performance of the Healy Clean Air Separator
(Executive Orders VR-201-N and VR-202-N)

1 APPLICABILITY

Definitions common to all certification and test procedures are in:

D-200 Definitions for Vapor Recovery Procedures

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

1.1 This test procedure is used to quantify the vapor tightness of the Healy Clean Air Separator (CAS) pressure management system installed as part of a gasoline dispensing facility (GDF) under either Executive Order VR-201-N or VR-202-N.

2 PRINCIPLE AND SUMMARY OF TEST PROCEDURE

2.1 The Clean Air Separator, while isolated from the vapor recovery system, is evaluated for vapor integrity using a vacuum decay procedure. The vacuum decay after 5 minutes is compared with an allowable value. The allowable value is based upon the initial vacuum level when conducting the test using the table provided in this test procedure.

2.2 A positive pressure decay procedure is included that conducts the same evaluation as the vacuum decay but with positive pressure. This test is conducted if there is insufficient vacuum (not greater than – 2.00” wc) to conduct the vacuum decay. Districts have the authority to specify in the permit conditions that this positive pressure test is to be conducted even if the vacuum test has been conducted.

3 RANGE

3.1 The full-scale range of the electronic measuring device shall not exceed 0-20.00” wc with a minimum accuracy of not less than 0.25 percent of full-scale.

4 INTERFERENCES

4.1 Leaks in the piping for the Clean Air Separator could bias the test results toward non-compliance.

4.2 Introduction of gaseous nitrogen into the system at flow rates exceeding 4 CFM (240 CFH) may bias the results of the test toward non-compliance. Only gaseous nitrogen shall be used to conduct this test.

4.3 Pressurizing the Clean Air Separator bladder greater than 14.00" wc could damage the bladder, biasing the test toward non-compliance.

4.4 Thermal Bias for Electronic Manometers

Electronic manometers shall have a warm-up period of at least 15 minutes followed by a drift check of 5 minutes. If the drift exceeds 0.01" wc, the instrument should not be used.

5 APPARATUS

5.1 Nitrogen

Use commercial grade gaseous nitrogen in a high pressure cylinder, equipped with a two-stage pressure regulator.

5.2 Pressure Measurement Device

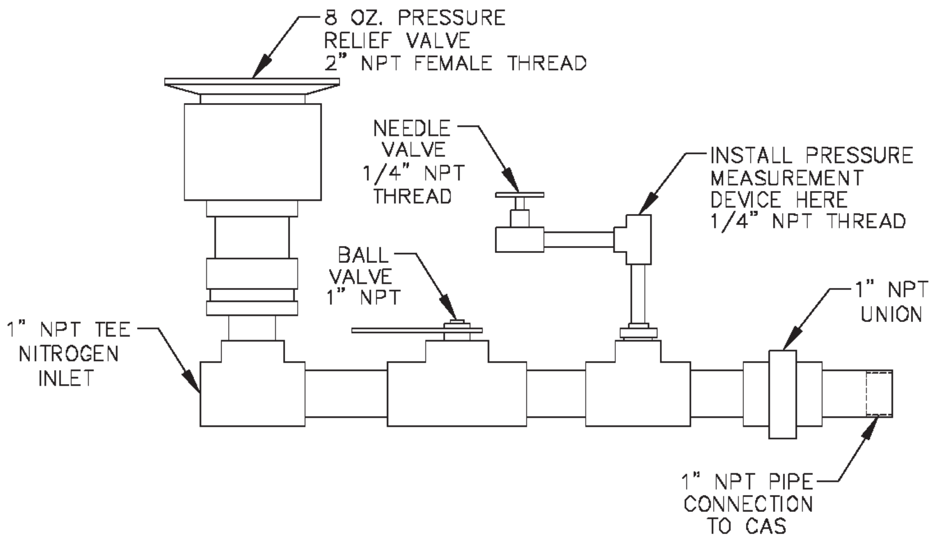
Use an electronic pressure measurement device to monitor the pressure decay in the Clean Air Separator. The pressure measurement device shall, at a minimum, be readable to the nearest 0.01" wc.

5.3 Test Port Assembly

Use a test port assembly constructed similar to the one in Figure A. The assembly should have an 8 oz. Pressure Relief valve, to ensure that the Clean Air Separator is not over pressurized. The Model 9968 Clean Air Separator Test Port Assembly can be purchased from Healy Systems, Inc.

Figure A

Clean Air Separator Test Port Assembly



5.4 Stopwatch

Use a stopwatch accurate to within 0.2 seconds.

5.5 Flow Meter

Use a flow meter to determine the required pressure setting of the delivery pressure gauge on the nitrogen supply pressure regulator. This pressure shall be set such that the nitrogen flow rate is between 2.0 CFM (120 CFH) and 4.0 CFM (240 CFH).

5.6 Leak Detection Solution

Any liquid solution designed to detect vapor leaks may be used to verify the pressure integrity of the test equipment prior to conducting the test.

5.7 Condensate Collection Vessel

A container approved for use with gasoline that can hold at least a half gallon of material.

5.8 Graduated Cylinder

A graduated cylinder suitable for use with gasoline capable of measuring to the nearest ounce or mL.

6 PRE-TEST PROCEDURES

6.1 The following safety precautions shall be followed:

6.1.1 Only gaseous nitrogen shall be used to pressurize the system.

6.1.2 An 8 oz. pressure relieve valve shall be installed on the Test Port Assembly to prevent the possible over-pressurizing of the Clean Air Separator.

6.1.3 A ground strap should be employed during the introduction of nitrogen into the system.

6.2 There shall be no Phase I bulk product deliveries into or out of the gasoline storage tank(s) within the three (3) hours prior to the test or during the performance of this test procedure.

6.3 All pressure measuring device(s) shall be bench calibrated using a reference standard. Calibration shall be performed at 20, 50, and 80 percent of full scale. Accuracy shall be within two percent at each of these calibration points.

Calibrations shall be conducted on a frequency not to exceed 180 days. Calibration documentation shall be maintained with the equipment at all times.

6.4 Use the flow meter to determine the nitrogen regulator delivery pressures that correspond to nitrogen flow rates of 2.0 CFM (120 CFH) and 4.0 CFM (240 CFH). These pressures define the allowable range of delivery pressures acceptable for this test procedure. The flow meter shall be connected in-line between the nitrogen supply regulator and the Test Port Assembly during pressurization. The flow meter may be connected in-line between the nitrogen supply regulator and the Test Port Assembly during the test.

6.5 The electronic pressure measurement device shall be subject to warm-up and drift check before use; see Section 4.5.

6.6 The four ball valves used in the installation of the Clean Air Separator are lockable and shall be locked in the position shown in Figure 2B-2 or 2B-2H of Exhibit 2 and in Figure 1 or Figure 1H of this Exhibit during normal operation. Figure 1 and 2B-2 apply to vertical CAS installations and Figure 1H and 2B-2H apply to horizontal CAS installations. The four padlocks provided by Healy Systems, Inc. in their installation kit are keyed the same. However, it is possible that one or more of the padlocks on the Clean Air Separator could have been replaced (seizing, damage, broken key, etc.). Conducting this test will require a set of keys necessary to unlock all padlocks.

6.7 Verify that the Clean Air Separator is in its normal operating configuration by confirming that all components are as indicated (See Figure 1 or Figure 1H):

Valve “A” - Open
Valve “B, C and D” - Closed
Pipe End “E” - Plugged
Tee Branch “F” - Plugged

Figure 1

Normal Clean Air Separator Operating Configuration

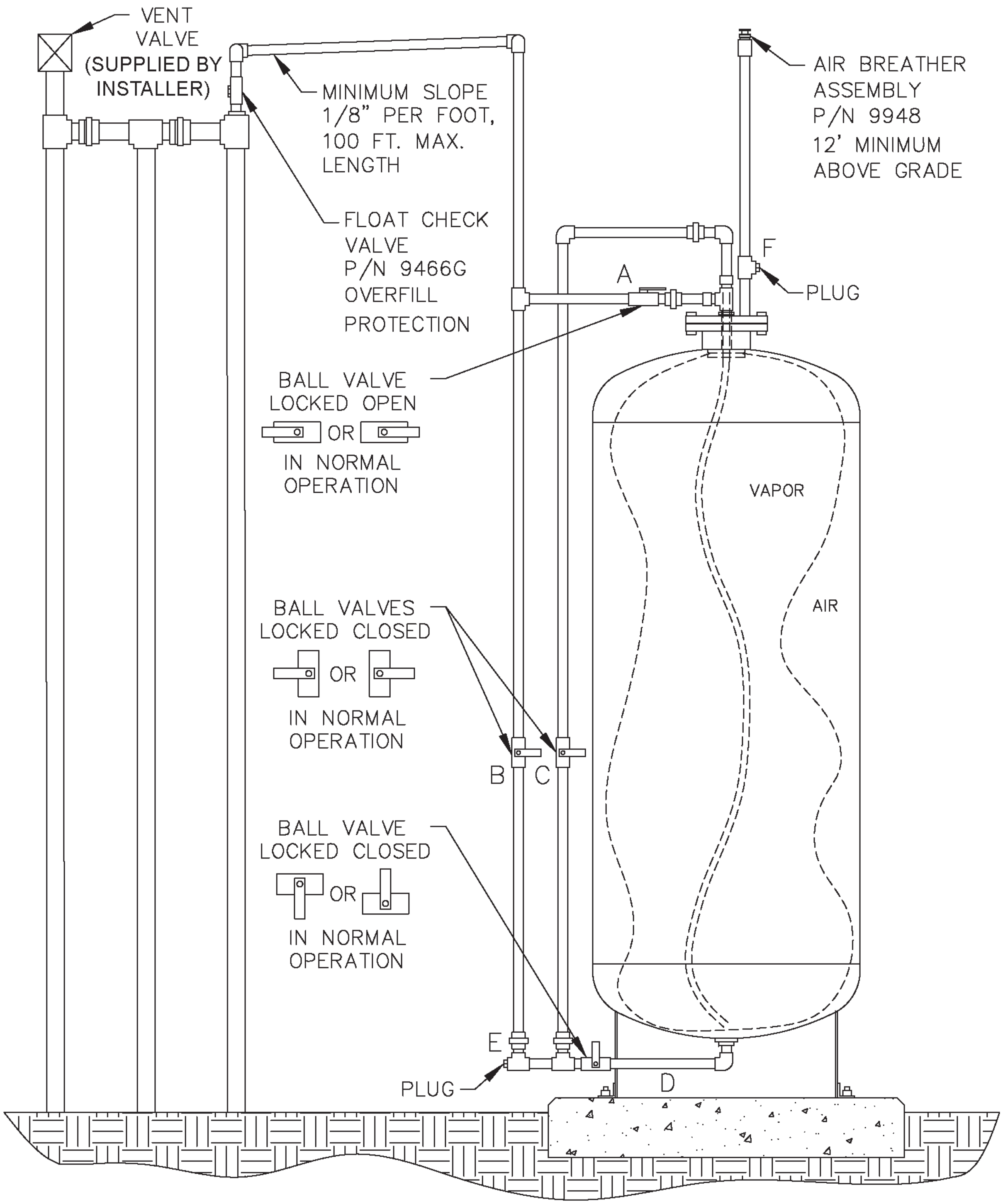
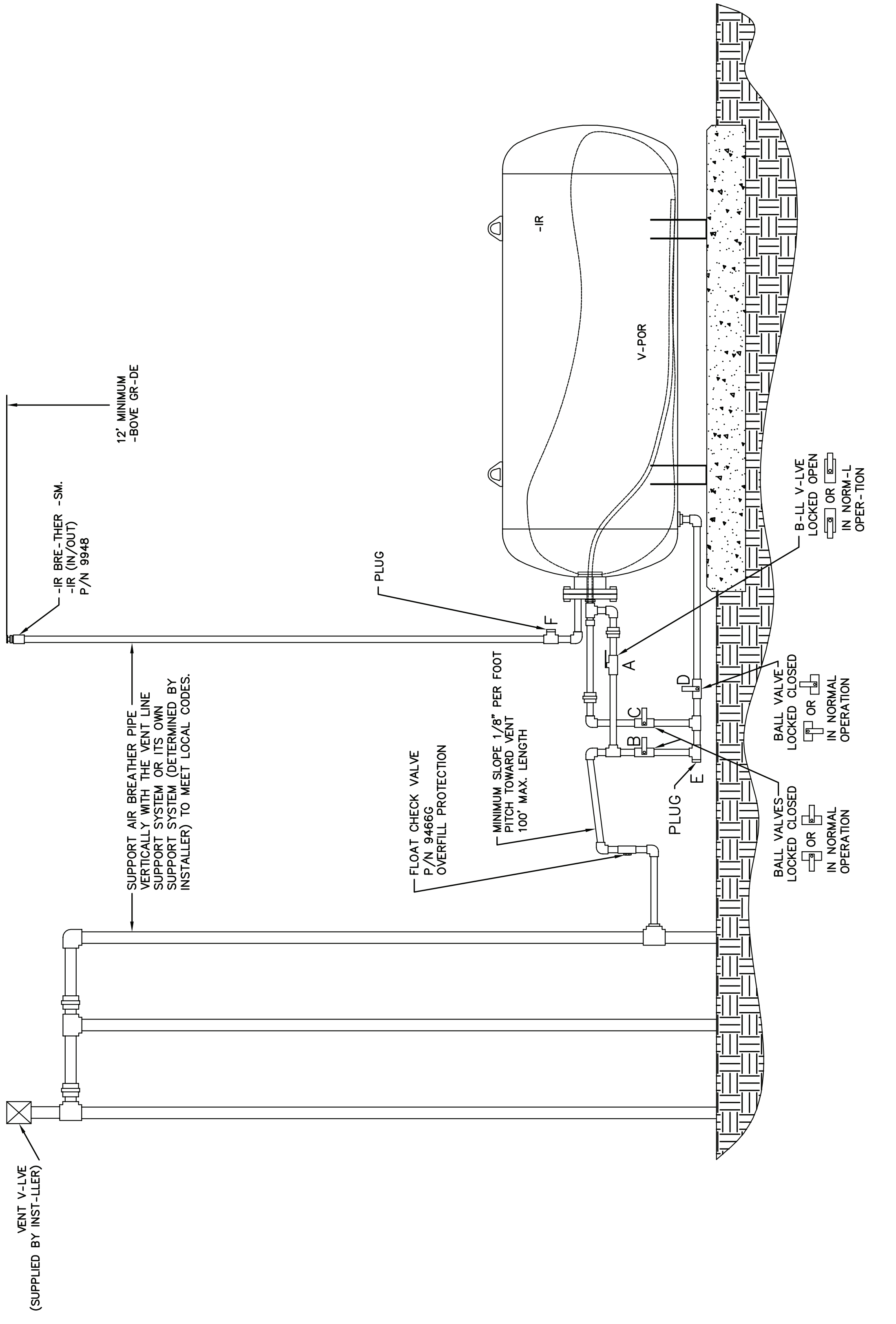


Figure 1H

Normal Clean Air Separator Operating Configuration



6.8 Installing the Test Port Assembly

6.8.1 Open the ball valve marked “B”, shown in Figure 1 or Figure 1H. This ensures that if there is any condensate in the primary connection line to the Clean Air Separator it will drop down into the lower section of the piping configuration, so that it can be measured. Close the valve after approximately 30 seconds.

6.8.2 Position the condensate collection vessel below plug “E” prior to removing it. Remove the 1” plugs from locations “E” and “F” from Figure 1 or Figure 1H. Transfer the collected condensate into the graduated cylinder. If there is more than 16 oz. (473 mL) of liquid condensate, the bladder and vapor processor vessel must be drained. Conduct the bladder and vessel draining procedures from the Clean Air Separator section of the ***ARB Approved Installation, Operation and Maintenance Manual***.

Note: Depending upon the size of the graduated cylinder and the amount of condensate, it may take multiple transfers from the condensate collection vessel to get the total condensate measurement.

6.8.3 Install the Test Port Assembly to the Clean Air Separator at location “E”. See Figure 2 or Figure 2H. Figure 2 applies to vertical CAS installations and Figure 2H applies to horizontal CAS installations.

6.8.4 Connect the gaseous nitrogen supply to the Test Port Assembly. See Figure 2 or Figure 2H.

6.8.5 Check the test equipment and piping isolated from normal Clean Air Separator operation by the ball valves “B, C and D” by pressurizing with nitrogen to a pressure of 4” wc ± 1” wc and closing the ball valve on the Test Port Assembly. Use leak detection solution. Tighten as necessary. The test equipment shall have no leaks.

6.8.6 Open the needle valve on the Test Port Assembly to bleed the pressure off the equipment. Keep ball valve on Test Port Assembly closed.

Figure 2

Clean Air Separator in Configuration to Conduct Test

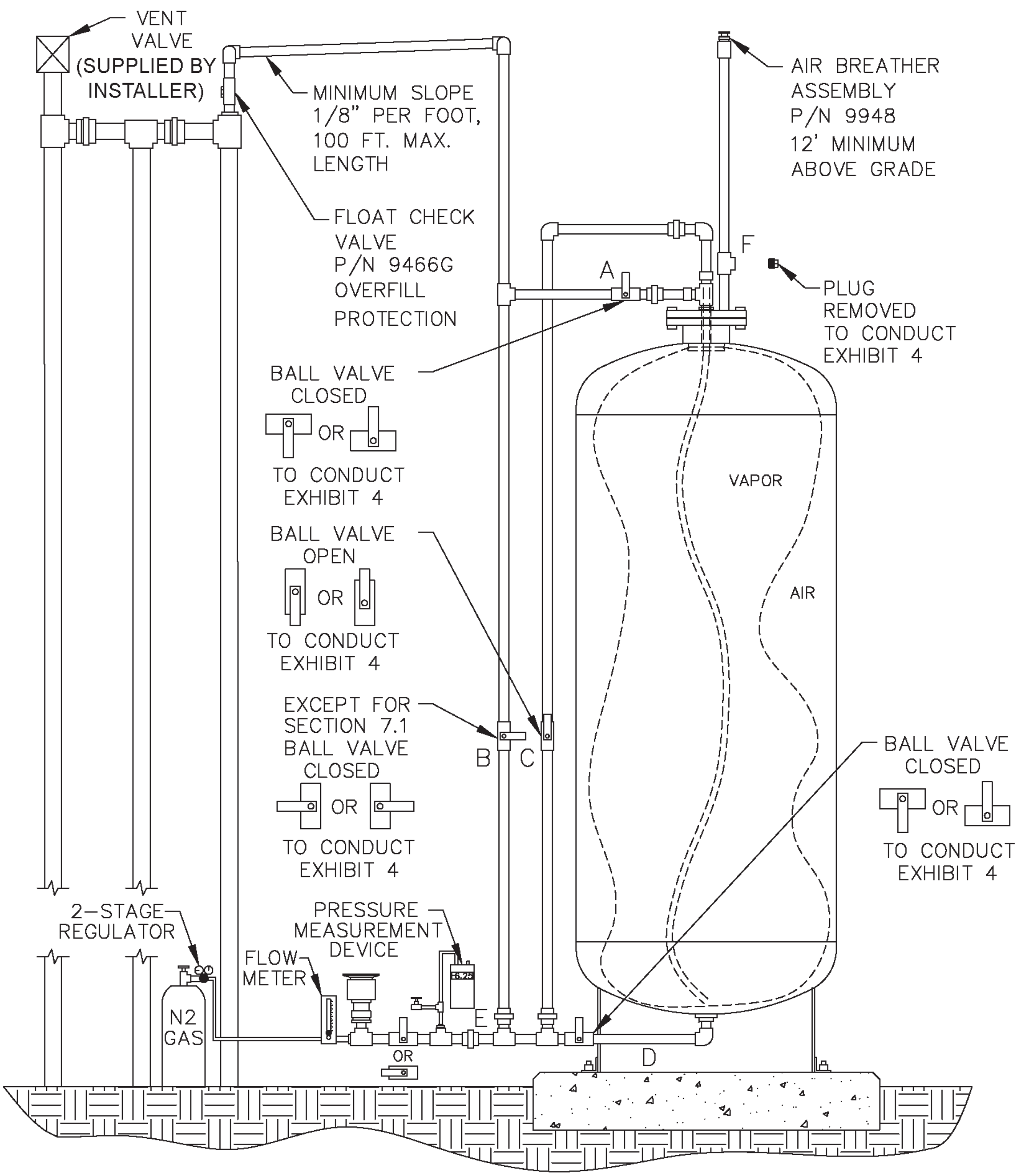
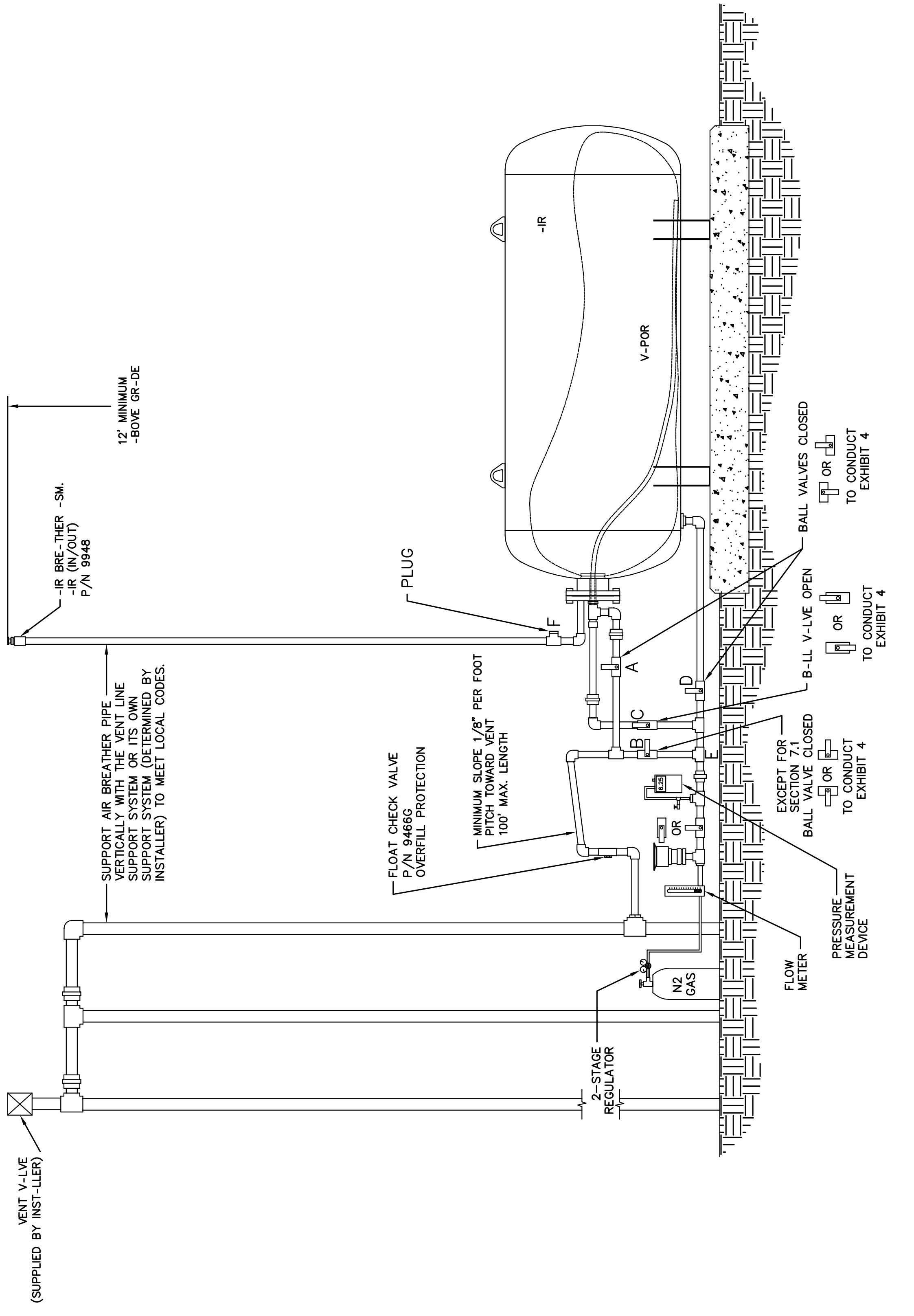


Figure 2H

Clean Air Separator in Configuration to Conduct Test



7 TESTING

7.1 Open the ball valve marked “B” from Figure 2 or Figure 2H. The pressure measurement device installed on the Test Port Assembly should now be reading UST and Clean Air Separator ullage pressure (or vacuum).

7.2 If the station vacuum is greater than (more negative) than -2.00” wc, then proceed to Section 7.2.1. If less than –2.00” wc, then proceed to Section 7.3:

7.2.1 Close the ball valves marked “A” and “B” from Figure 2.

7.2.2 Open the ball valve marked “C” from Figure 2 and wait one minute.

7.2.3 If necessary, use the needle valve on the Test Port Assembly to bleed air into the bladder until the vacuum level reaches as close to a whole number on the pressure measurement device as the accuracy of the device will provide (ie. -2.00, -3.00, -4.00, -5.00, -6.00, -7.00, -8.00). Make sure the needle valve is closed. Record this vacuum and start the stop watch to begin a 5 minute decay.

7.2.4 Record the vacuum at one-minute increments up to 5 minutes.

7.2.5 Using the information from Table 1, verify that the vacuum after 5 minutes is equal to or greater than the allowable minimum for the initial vacuum recorded from Section 7.2.3.

7.2.6 If the vacuum is greater than the allowable minimum, the Clean Air Separator passed the test.

7.2.7 If the vacuum is less than the allowable minimum, the Clean Air Separator failed the test.

TABLE 1
Allowable 5 Minute Vacuum Decay for Clean Air Separator

Vacuum at Start of Test (inches wc)	Allowable Minimum Vacuum after 5 min. (inches wc)
8.0	5.5
7.0	4.7
6.0	3.8
5.0	3.0
4.0	2.2
3.0	1.5
2.0	0.8

7.3 If the station vacuum is less than –2.00” wc (from Section 7.2), or at the direction of district (refer to Section 2.2), conduct the following:

7.3.1 Close the ball valves marked “A” and “B” from Figure 2.

7.3.2 Open the ball valve marked “C” from Figure 2.

7.3.3 Open the ball valve of the Test Port Assembly and flow nitrogen into the Clean Air Separator bladder at a flow rate between 2 and 4 CFM until the pressure in the bladder reaches 2.20” wc.

7.3.3.1 Depending upon the nitrogen flow rate used, the bladder could take up to 30 minutes to fill completely.

7.3.3.2 Because of the close proximity of the pressure measurement device to the nitrogen inlet of the Test Port Assembly, the pressure measurement device may read a higher pressure when nitrogen is flowing. The pressure measurement device is usually steady, but will start to increase rapidly when the bladder is getting full.

7.3.3.3 Periodically stopping nitrogen flow will provide an accurate reading of the pressure in the bladder.

7.3.4 Once the pressure reaches 2.20” wc, shut off the flow of nitrogen to the Clean Air Separator bladder and close the ball valve of the Test Port Assembly.

7.3.5 Wait 5 minutes or until pressure stabilizes above 2.00” wc. If the pressure does not stabilize, repeat steps 7.3.3 and 7.3.4.

7.3.6 Use the needle valve on the Test Port Assembly to bleed off the nitrogen until the pressure reaches 2.00” wc. Make sure the needle valve is closed. Record the pressure.

7.3.7 Start the stop watch to begin a 5 minute decay.

7.3.8 Record the pressure in one-minute increments up to 5 minutes.

7.3.9 If the pressure in the bladder is greater than 1.77” wc at the end of 5 minutes, then the Clean Air Separator passed the test.

7.3.10 If the pressure in the bladder is less than 1.77” wc at the end of 5 minutes, then the Clean Air Separator failed the test.

7.4 If the bladder was evaluated using the vacuum procedure (Section 7.2), close the ball valve “C” to keep it in a vacuum condition. If the bladder was evaluated using the pressure procedure (Section 7.3), open the needle valve on the Test Port Assembly to bleed off all pressure from the bladder.

7.5 Close the ball valve marked “C”, if not already done.

7.6 Remove the Test Port Assembly from location “E” and install the 1” pipe plug. Use a pipe sealant approved for use with gasoline on the threads and tighten to 60 ft-lbs.

7.7 Install the 1” pipe plug to location “F”. Use a pipe sealant approved for use with gasoline on the threads and tighten to 60 ft-lbs.

7.8 Open the ball valve marked “A”. Lock all ball valves using the padlocks.

7.9 The Clean Air Separator should now be in normal operation configuration. Verify this by using the outline from Section 6.7 and Figure 1 or Figure 1H.

8 REPORTING

8.1 Record test data on the form shown in Figure 3. Districts may require the use of an alternate form, provided that the alternate form includes the same minimum parameters as in Figure 3.

Figure 3

Data Form for Determination of Static Pressure Performance of the Healy Clean Air Separator for Executive Orders VR-201-N and VR-202-N

SOURCE INFORMATION	
GDF Name and address __________ __________ __________	GDF Represenative and title __________ __________ GDF Phone No. __________
Date and Time of Last Fuel Drop to GDF: __________ Date of Last Calibration of Pressure Measurement Device: __________	P/O #: __________ A/C#: __________ District Test Witness: __________

VACUUM TEST (Section 7.1 through 7.2.7)	
Vacuum at start of test, inches water column (7.2.3)	________
Vacuum at one minute, inches water column	________
Vacuum at two minutes, inches water column	________
Vacuum at three minutes, inches water column	________
Vacuum at four minutes, inches water column	________
Final vacuum at five minutes, inches water column	________
Allowable minimum vacuum, inches water column (from Table 1)	________

POSITIVE PRESSURE TEST (Section 7.3 through 7.3.9)	
Pressure at start of test, inches water column (7.3.6)	________
Pressure at one minute, inches water column	________
Pressure at two minutes, inches water column	________
Pressure at three minutes, inches water column	________
Pressure at four minutes, inches water column	________
Final pressure at five minutes, inches water column	________
Allowable final pressure, inches water column (7.3.9)	1.77

Healy Certified Technician Name, Certification Number and Expiration Date	Test Company	Date Test Conducted

Exhibit 5

Vapor to Liquid Volume Ratio
(Executive Orders VR-201-N and VR-202-N)
(Healy Model 900 EVR Nozzle)

Definitions common to all certification and test procedures are in:

D-200 Definitions for Vapor Recovery Procedures

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

1. PURPOSE AND APPLICABILITY

1.1 This test procedure is used to quantify the Vapor to Liquid (V/L) Volumetric Ratio of the Healy Model 900 EVR Nozzle installed at gasoline dispensing facilities (GDF). This procedure provides a method to determine compliance with the V/L requirements specified in ARB Executive Orders (EO) VR-201-N and VR-202-N.

2. PRINCIPLE AND SUMMARY OF TEST PROCEDURE

2.1 A tight fitting adaptor is placed on the spout of a dispensing nozzle. The adaptor, which isolates vapor flow to the nozzle vapor collection ports, is connected to a volume gas meter. Gasoline is dispensed through the nozzle and the volume of vapors drawn through the vapor collection boot by the Phase II system vacuum pump is measured. The volume of vapor is recorded and compared with the volume of gasoline dispensed to determine the V/L Volumetric Ratio.

2.2 The test is conducted with the pressure/vacuum (P/V) vent valve(s) installed on the storage tank vent pipes.

2.3 The test procedure requires no modifications to the GDF being evaluated.

2.4 The test procedure may be conducted on a fueling point on one side of the dispenser with the other side of the dispenser either authorized to dispense fuel (but not dispensing), or with the other side dispensing fuel into a vehicle or another portable test tank. Conducting the test this way will be evaluating the V/L of the fueling point with the VP1000 vacuum pump running on its high speed setting.

3. BIASES AND INTERFERENCES

3.1 Nozzle spouts that are damaged such that the V/L adaptor cannot fit over the nozzle spout preclude the use of this test.

3.2 Refueling points not capable of achieving dispensing rates (see Equation 9-2) required for conducting the V/L test, as specified in Exhibit 2 of ARB Executive Orders VR-201-N and VR-202-N, preclude the use of this test for determining in-use compliance of certified systems.

3.3 Bagging, or otherwise sealing any nozzle associated with the vacuum pump serving the nozzle being tested, may bias the test results towards compliance. **The V/L test to verify compliance shall be conducted without "bagging" any of the nozzles served by a common vacuum device.**

3.4 If the nozzle being tested introduces liquid into the V/L adaptor, gas volume meter or the adaptor supply hose, the V/L of that nozzle shall be deemed a failure of the V/L standard.

3.5 Do not drain or remove liquid in either the vapor passage of the hoses or the dispenser vapor piping prior to performing the test. Draining of this liquid gasoline will bias the test toward compliance.

3.6 The O-ring in the V/L adaptor that is not properly lubricated may bias the results toward noncompliance. See Section 5.7 for lubrication requirements. Motor oil (any weight) is acceptable for lubricating the O-ring. Contact Healy Technical Services with any questions about other lubricants that may be used in conducting this test.

3.7 Conducting V/L testing with an improperly conditioned portable test tank (not saturated with gasoline vapors) will bias the test results of the as found V/L of the fueling point. Refer to Section 6.6 for proper portable test tank conditioning.

4. SENSITIVITY, RANGE, AND ACCURACY

4.1 The maximum rated capacity of the gas volume meter shall be at least 800 CFH and not greater than 3,000 CFH.

4.2 The minimum rated capacity of the gas volume meter shall be 25 CFH.

4.3 The minimum readability of the gas volume meter shall be 0.01 cubic feet.

4.4 Accuracy, determined during calibration, will be $\pm$ 5 percent of the gas volume meter reading.

5. EQUIPMENT

5.1 Vapor to Liquid Adaptor and Surrogate Spout

A **Vapor to Liquid Adaptor**. Only the Healy Systems, Inc. V/L Test Sleeve (figures 1, 4 and 5), Part No. 8034-1, can be used to conduct V/L testing on the Healy Phase II EVR System (Executive Order VR-201 series or Executive Order VR-202 series). The nominal inside diameter of the flexible tubing shall be between 0.75 and 1.00 inches, and the length of the tubing shall be between 3.0 and 6.0 feet.

B **Surrogate Spout**. Only the Healy Systems, Inc. V/L Surrogate Spout (figures 1 and 5), Part No. 8175, can be used to conduct the pre-test and post-test leak check.

5.2 Gas Volume Meter. Use a gas volume meter to measure the volumetric flow rate through the V/L adaptor. The meter shall be equipped as shown in Figure 2 and the maximum allowable pressure drop(s) (determined by the manufacturer) across the meter shall be:

For a meter with a maximum rated capacity of 1000 CFH through 3,000 CFH:
1.10 inches H_2O at a flowrate of 3,000 CFH
0.05 inches H_2O at a flowrate of 30 CFH

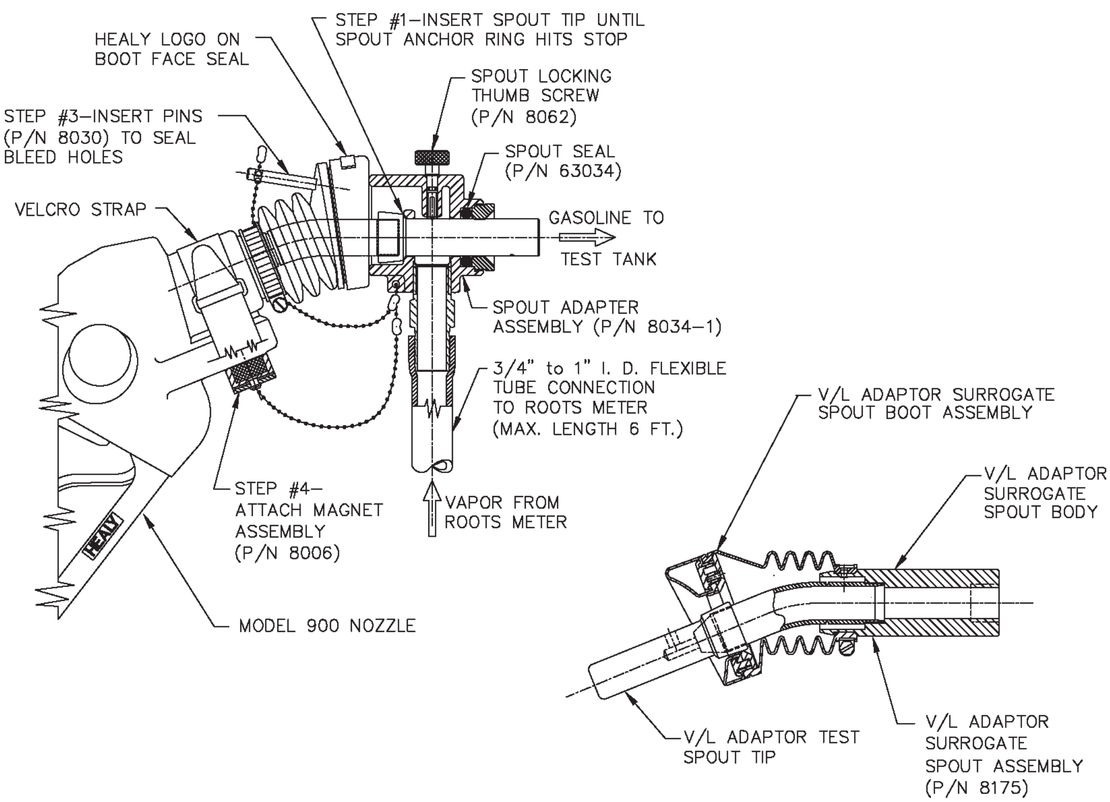
For a meter with a maximum rated capacity of 800 to 1,000 CFH:
0.70 inches H_2O at a flowrate of 800 CFH
0.04 inches H_2O at a flowrate of 16 CFH

See Section 6.2 for further gas volume meter specifications.

5.3 Volume Gas Meter Inlet Manifold. This manifold is designed to return the vapors displaced from the portable gasoline tank assembly, at atmospheric pressure, to the inlet of the gas volume meter. This manifold shall be two (2.0) inches minimum inside diameter pipe. The intake passage of the manifold shall be no shorter than 6.0 inches and no longer than 18.0 inches. See Figures 2 and 4.

Figure 1

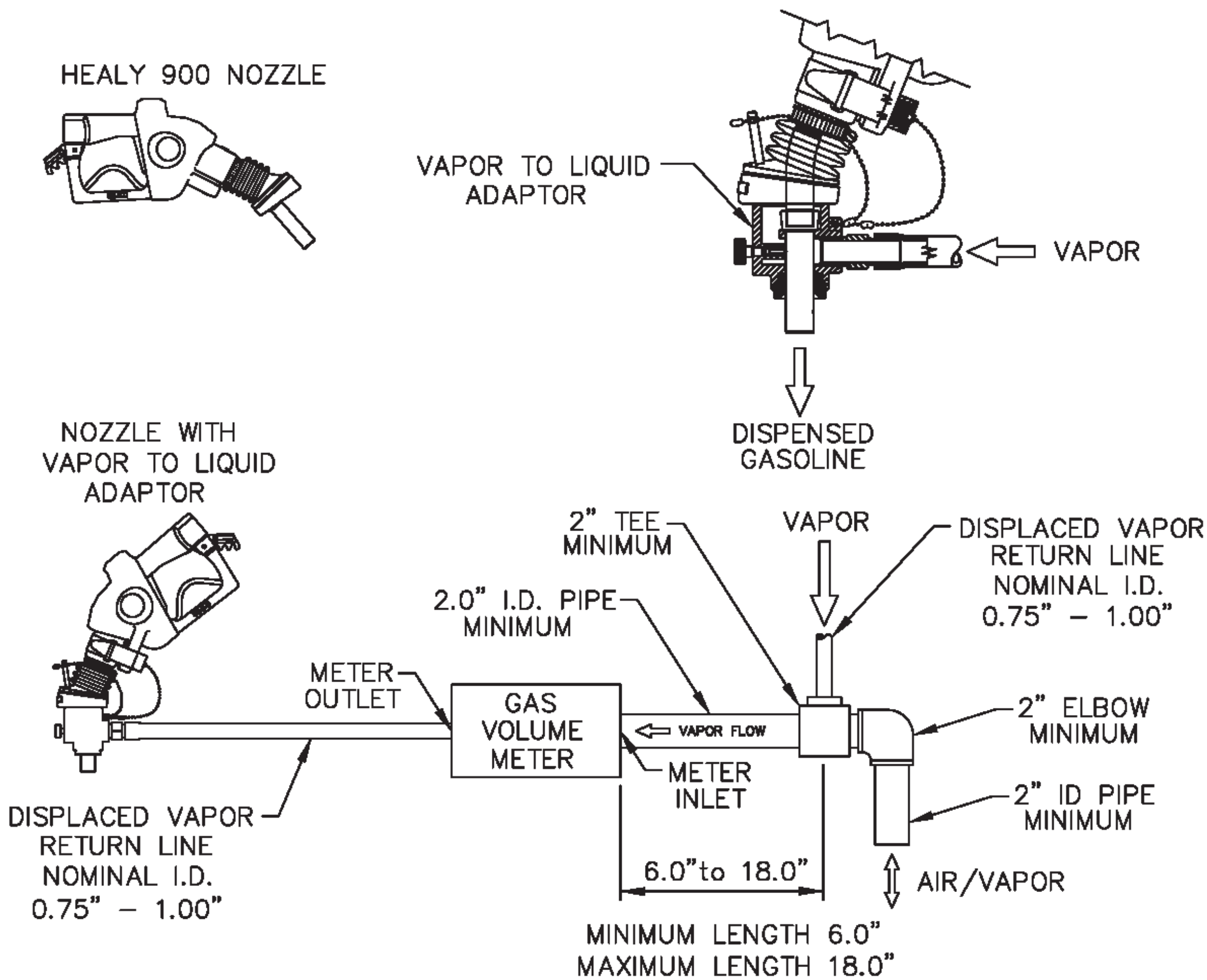
Healy Vapor To Liquid (V/L) Adaptor and Surrogate Spout Assembly



NOTE: The thumbscrew and Healy logo on top of the nozzle boot face seal must be in vertical alignment to imitate fueling an unleaded vehicle.

Figure 2

Gas Volume Meter and Vapor To Liquid Adaptor



5.4 Liquid Volume Meter. Use the totalizer on the gasoline dispenser to measure the volume of gasoline dispensed during the test.

5.5 Portable Gasoline Tank Assembly. A portable tank, meeting fire safety requirements for use with gasoline, shall be used to receive the gasoline dispensed during this test. The tank shall have sufficient volume so that at least 4.5 gallons may be dispensed prior to activating the primary shutoff mechanism of the dispensing nozzle. Portable tanks shall have a permanent label or mark indicating the total fuel capacity in gallons. Tank material, likely to provide contact with the nozzle spout, or V/L adaptor, during the entire dispensing event, shall be constructed of aluminum or brass or other materials approved by the local fire codes for such application. The tank and required plumbing configuration is shown in Figure 3 and Figure 4. This configuration permits a portion of the vapors displaced during testing to be returned to the underground storage tank (UST). The minimum and maximum dimensions shown in Figure 2 and Figure 4 shall be adhered to in all cases.

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

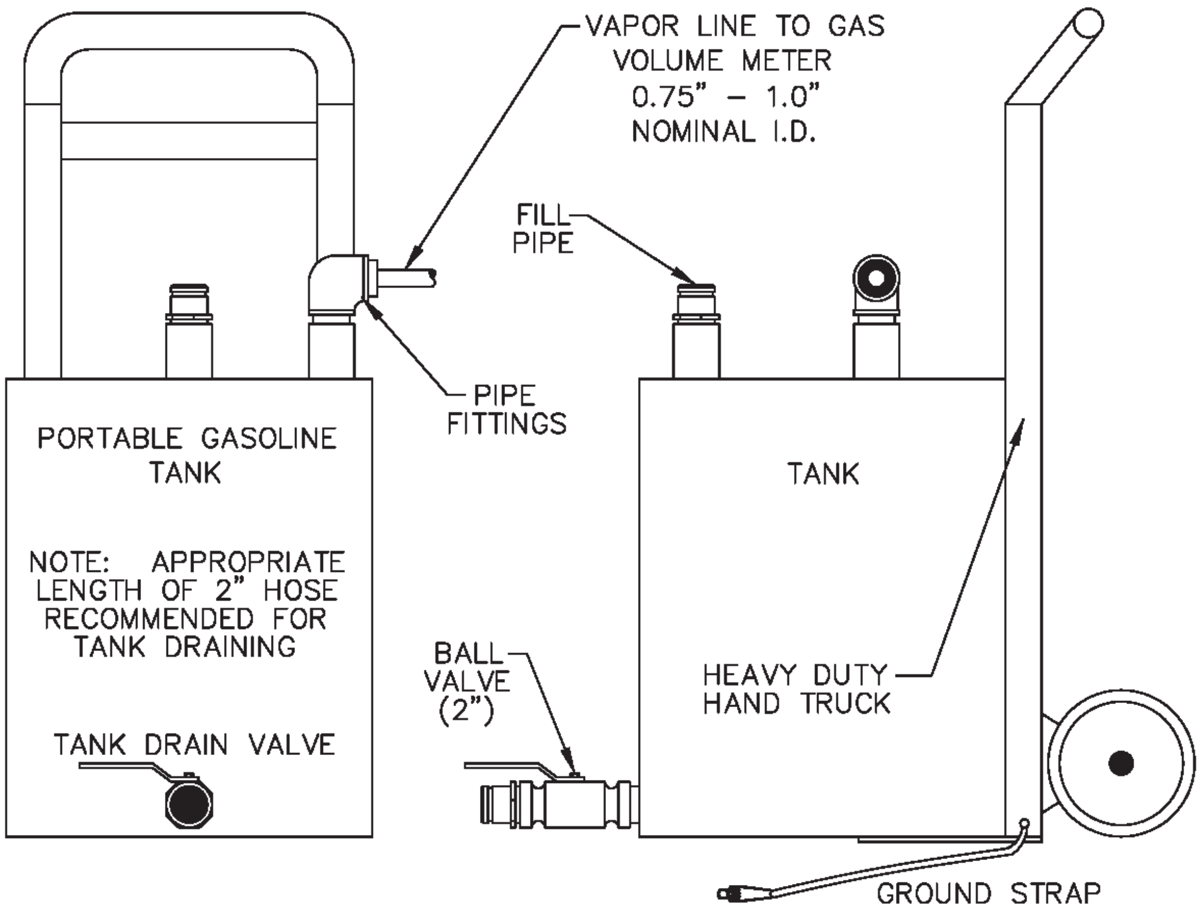
5.7 Lubricant. Appropriate lubricant shall be used to ensure a leak-tight seal between the O-ring in the V/L adaptor and the nozzle spout. Motor oil (any weight) is acceptable for lubricating the O-ring. Contact Healy Technical Services with any questions about other lubricants that may be used in conducting this test.

5.8 Leak Detection Solution. Any liquid solution designed to detect gaseous leaks may be used to verify the pressure integrity of test equipment during this test.

5.9 Pressure Measuring Device. An electronic pressure measuring device with a full scale range that shall not exceed 0-10 inches WC with a minimum accuracy of 0.5 percent of full scale. A 0-20 inches WC device may be used provided the minimum accuracy is 0.25 percent of full-scale.

Figure 3

Portable Tank Assembly



6. PRE-TEST PROCEDURES

6.1 Assemble the portable tank assembly and gas volume meter as shown in Figure 4. The minimum and maximum dimensions shown in Figure 4 shall be adhered to in all cases. **Ensure that the ground strap is properly connected to an acceptable ground**.

Note: A one-time test to verify proper design of the tee connection at the gas volume meter shall be conducted. Disconnect the V/L adaptor from the nozzle. Insert the nozzle into the portable test tank so that there is no visible gap between the nozzle boot/portable test tank fill pipe interface. Dispense between four and one-half and five (4.5 - 5.0) gallons into the portable test tank. The tee connection design passes the test if the displacement on the gas volume meter is less than 0.01 cubic feet. The result of this test shall be kept with the test equipment. If the tee connection is altered or changed, the above test must be repeated to ensure proper design.

6.2 The gas volume meter shall be calibrated, within 180 days prior to conducting this procedure. In addition, calibration shall be conducted after any repairs or alterations (changes to the operation or configuration of the meter) to the meter. Calibrations, at a minimum, shall be conducted at flowrates of 30, 60, and 90 CFH (3.7, 7.5, and 11.2 gallons/minute) in accordance with one of the following:

(a) ARB Air Monitoring Quality Assurance, Volume VI, Standard Operating Procedures for Stationary Source Emission Monitoring, January 1979, or

(b) US EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods, or

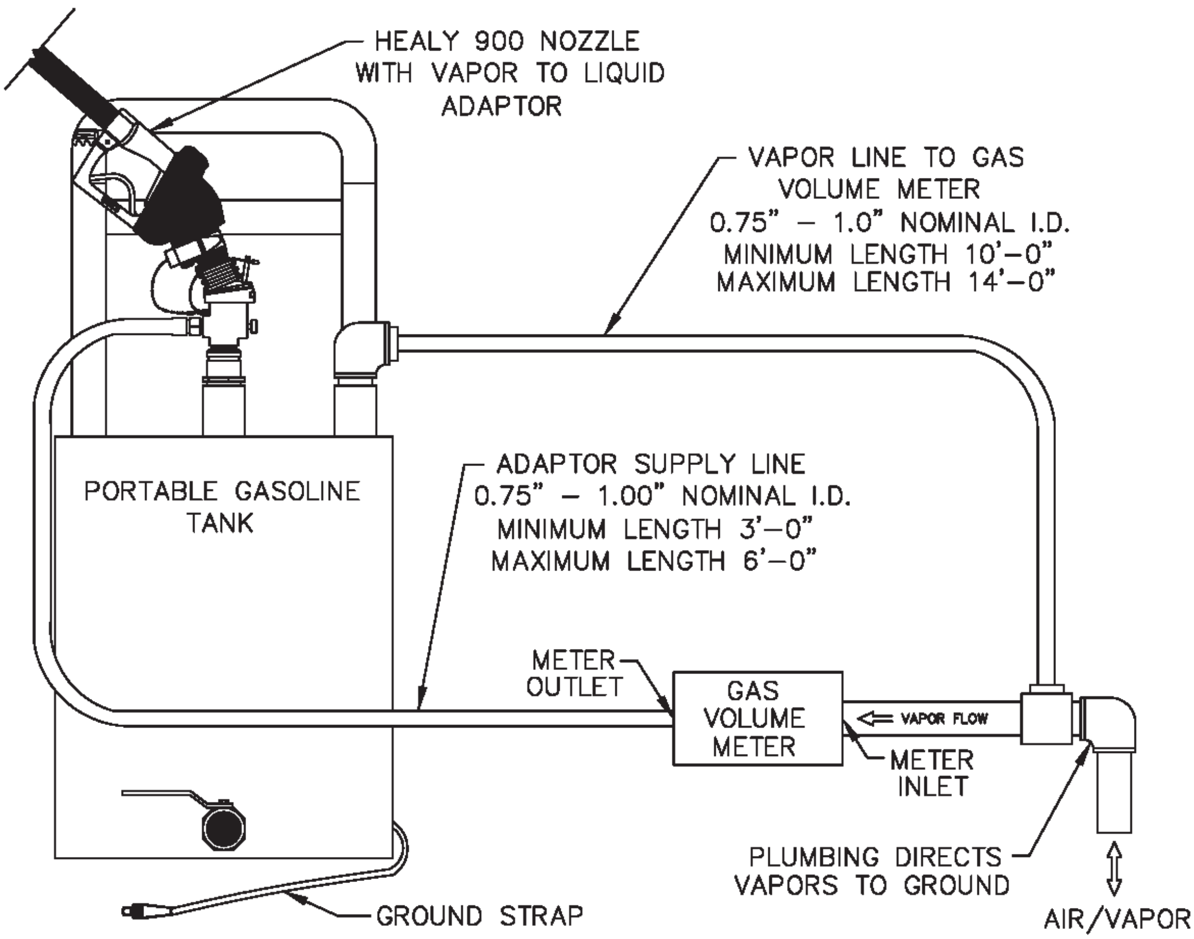
(c) EPA Method 2A, Measurement of Gas Volume Through Pipes and Small Ducts (40 CFR Part 60, Appendix A), or

(d) Appropriate calibration procedures in accordance with California Department of Food and Agriculture, Division of Measurement Standards and County Department of Weights and Measures (title 4, CCR, section 3.33).

A copy of the most current calibration shall be kept with the meter.

Figure 4

Assembled Vapor to Liquid Volume Ratio Test Equipment



6.3 Verify that the O-ring in the V/L adaptor is present and in good condition. An O-ring with nicks, tears, or other deformations shall be replaced prior to the test. The O-ring shall be properly lubricated (see Section 5.7) to ensure a vapor tight connection.

6.4 Conduct a pre-test leak check of the V/L adaptor, the gas volume meter and the adaptor supply hose by connecting the V/L adaptor to a surrogate spout as shown in Figure 5 and described in Section 5.1B. Raise the test pressure to 5.00” ± 0.50” WC. There shall not be a pressure drop of more than 1.00” WC from the above starting pressure for 30 seconds from the start of the test. If the leak test passes, proceed with the V/L testing. If the leak test fails, proceed to isolate the source of the leak by pressurizing the test equipment again. Squirt liquid leak detector solution on interfaces and other potential leak sources and watch for the formation of bubbles. Once leak(s) are repaired, repeat the leak test procedure.

Note: Leak checks shall be conducted in a shaded area or away from direct sunlight. Leak checks may be conducted during V/L testing to ensure leak integrity of test equipment.

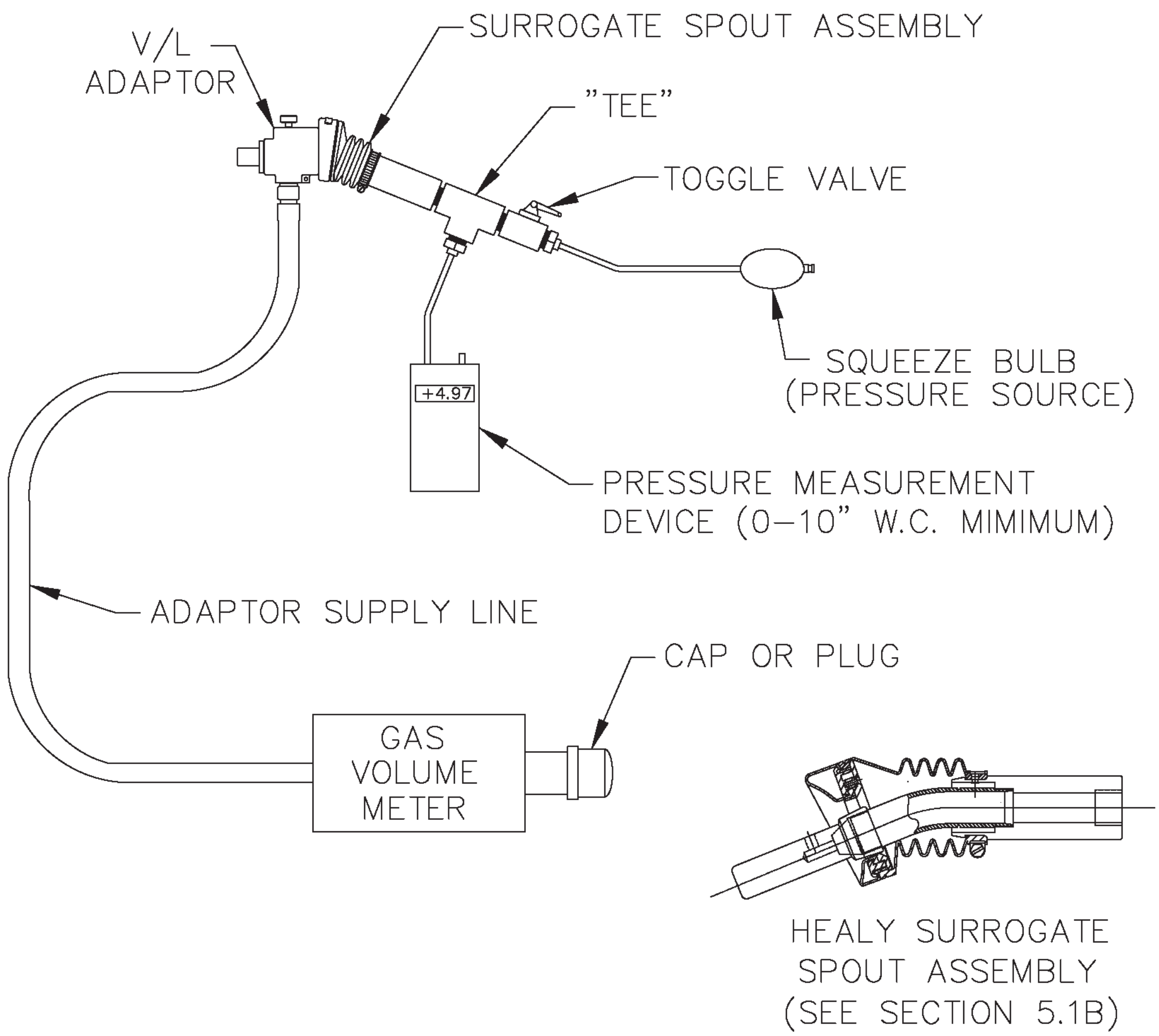
6.5 This test procedure shall be conducted with the storage tank pressure/vacuum (P/V) valve(s) installed and the Phase I vapor coupler(s) poppet(s) in the closed position with the adaptor dust cap(s) installed.

6.6 With the portable tank and V/L test equipment assembled, dispense gasoline into the portable test tank until at least 10% of the tanks total capacity has been reached. This will condition the portable tank with gasoline vapors. This conditioning shall be conducted each time the test tank is emptied prior to conducting testing at each facility.

6.7 All pressure measuring device(s) shall be bench calibrated using a reference gauge, incline manometer or NIST traceable standard at least once every six (6) months. Calibration shall be performed at 20, 50, and 80 percent of full scale. Accuracy shall be within five (5) percent at each of these calibration points.

Figure 5

Vapor To Liquid Adaptor and Gas Volume Meter Leak Test Assembly



7. TEST PROCEDURES

7.1 Carefully connect the V/L adaptor to the nozzle spout as shown in Figure 1, isolating the vapor path of the nozzle and ensuring a tight connection.

7.2 Record the initial reading from the index of the gas volume meter on the Healy V/L Field Data Sheet at the end of this document. This initial reading shall be taken before each test. Do not use the final reading from the preceding test as the initial reading for the current test, unless it has been verified. This is necessary since the meter index may have moved due to the low pressure drop through the meter.

7.3 Reset the stopwatch and, if appropriate, reset the totalizer on the dispenser.

7.4 Holding the nozzle lever in the maximum hand-held position in order to dispense at the highest possible flow rate and begin dispensing into the portable gasoline tank. **Ensure that the nozzle spout is in contact with the grounded tank assembly during dispensing**. Start the stopwatch when the totalizer indicates dispensing has started.

7.5 Dispense between four and one-half (4.5) and five (5.0) gallons of gasoline.

If the nozzle being tested introduces liquid into the V/L adaptor, the gas volume meter or the adaptor supply hose, the V/L of that nozzle shall be deemed a failure.

7.6 Simultaneously stop both the stopwatch and gasoline dispensing.

7.7 The following data for each test shall be recorded on the Healy V/L Field Data Sheet:

7.7.1 Dispenser (pump) number
7.7.2 Fuel grade
7.7.3 Nozzle serial number (found below nozzle handguard)
7.7.4 Initial gas volume meter reading, in cubic feet
7.7.5 Initial totalizer reading from the dispenser, in gallons
7.7.6 Final gas volume meter reading, in cubic feet
7.7.7 Final totalizer reading from the dispenser, in gallons
7.7.8 Elapsed time during dispensing, in seconds

Note: Units other than cubic feet, gallons, and seconds may be used, provided that Equation 9-1 is appropriately modified.

7.8 If the V/L Volumetric Ratio, as determined by Equation 9-1 is between 0.95 –1.15, the grade point complies with the specifications.

7.9 If the V/L Volumetric Ratio is between 0.76 – 0.94, or greater than or equal to 1.16, conduct the test two additional times. Do not make adjustments to the gasoline dispensing or vapor recovery lines until all three test runs have been completed. Only adjustments to the V/L test equipment and the connection between the V/L adaptor and the nozzle will be allowed in order to ensure measurement accuracy. All other adjustments to the vapor recovery equipment, including but not limited to the vapor collection pump and the nozzle, are not allowed. If the V/L test equipment is adjusted, then the prior test run results for that grade point tested should not be used. Calculate the numerical average of the three test runs. If the average V/L value of these three test runs is within the allowable limits, compliance has been verified. If the resulting average is outside of the specified limits, the grade point tested does not comply with the specifications of the EO.

Note: Section 1.10 of the Healy 900 Nozzle portion of the **ARB Approved Installation, Operation and Maintenance Manual** provides instructions on making nozzle V/L adjustments.

7.10 If the initial V/L Volumetric Ratio is less than or equal to 0.75, this indicates a V/L failure of the grade point tested.

7.11 To avoid a build-up of gasoline, drain any condensed gasoline from the hoses between the gas volume meter and portable tank assembly, and the V/L adaptor and gas volume meter whenever fuel is emptied from the portable tank.

8. POST-TEST PROCEDURES

8.1 Remove the V/L adaptor from the nozzle.

8.2 Drain the dispensed product into the appropriate gasoline storage tank at the facility. **Ground the portable tank assembly to the storage tank before draining**. Do not mix product grades in the portable tank assembly without approval of the facility owner and use caution to drain the portable tank into the correct facility storage tank. If blending valves are utilized to produce product grades that do not have a dedicated storage tank, product from the blended grade shall be returned to the lower octane tank.

8.3 After concluding testing at the facility, perform a post-test leak check of the V/L adaptor, the gas volume meter and the adaptor supply hose by connecting the V/L adaptor to a surrogate spout as shown in Figure 5 and described in Section 5.1B. Raise the test pressure to 5.00” ± 0.50” WC. There shall not be a pressure drop of more than 1.00” WC from the above starting pressure for 30 seconds from the start of the test. The data collected during the V/L testing between the last valid test equipment leak check (see Section 6.4) and the post-test leak check is invalid if the test equipment fails this post-test leak check.

Note: Leak checks shall be conducted in a shaded area or away from direct sunlight.

8.4 Prior to transportation, the inlet and outlet of the gas volume meter shall be carefully sealed to prevent foreign matter from entering the meter.

8.5 The Authority Having Jurisdiction (AHJ) may be contacted on the requirements for storage and transportation of the portable test tank. This would typically be the local fire department.

9. CALCULATING RESULTS

9.1 The V/L Volumetric Ratio shall be calculated as shown in Equation 9-1.

$$V/L = \left[\frac{y\,(Vf - Vi)}{G_f - G_i} \right] \text{x } 7.481 \qquad \textbf{[Equation 9-1]}$$

Where:

V/L	=	Vapor to Liquid Volumetric Ratio, dimensionless
y	=	Correction factor for gas volume meter. See Equation 9-3
V_i	=	Initial gas volume meter reading, cubic feet
V_f	=	Final gas volume meter reading, cubic feet
G_i	=	Initial totalizer reading from the dispenser, gallons
G_f	=	Final totalizer reading from the dispenser, gallons
7.481	=	Conversion factor from gallons to cubic feet, gallons per cubic foot

9.2 The gasoline dispensing rate during the V/L test shall be calculated as shown in Equation 9-2.

$$Q_g = \left[\frac{G_f - G_i}{t} \right] \text{x } 60 \qquad \textbf{[Equation 9-2]}$$

Where:

Q_g	=	Gasoline dispensing rate, gallons per minute
G_I	=	Initial totalizer reading from the dispenser, gallons
G_f	=	Final totalizer reading from the dispenser, gallons
t	=	Elapsed time during dispensing event, seconds
60	=	Conversion factor, seconds per minute

9.3 The correction factor (determined during gas volume meter calibration) for correcting observed values of the gas volume meter shall be calculated as shown in Equation 9-3.

$$y = \left[\frac{V_r}{V_m} \right] \qquad \textbf{[Equation 9-3]}$$

Where:

y	=	Correction factor for the gas volume meter's observed reading, dimensionless
V_r	=	True volume from current calibration of gas volume meter, cubic feet
V_m	=	Corresponding observed reading from gas volume meter, cubic feet

10. REPORTING RESULTS

10.1 Report V/L test data and other information as required in the Healy V/L Field Data Sheet at the end of this document. Districts may require the use of alternate forms, provided they include the same minimum parameters as identified in the Healy V/L Field Data Sheet.

11. ALTERNATE PROCEDURES

11.1 This 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 ARB Executive Officer, pursuant to Section 14 of Certification Procedure CP-201.

GDF Name and Address:	# Healy V/L Field Data Sheet	Testing Firm Name and Address:
________ ________ ________	Tee Connection Test Result (6.1) ______ ft^3 Date of Last Gas Volume Meter Calibration ______ Gas Volume Meter Correction Factor (9.3) ______ Pressure Measurement Device Calibration Date ______	________ ________ ________ Phone No. ( )
Test Date/Time:		Test Performed by:______ If Required by local district, provide Technician Certification Number:______ Certification Expiration Date:
Pre-Test Leak Check: Initial/Final Pressures, in. H_2O _____ / _____ **Post-Test Leak Check:** Initial/Final Pressures, in. H_2O _____ / _____	**A/C #** ________ **P/O #** ________	District Test Witness ______ Applicable ARB Executive Order (circle one) VR-201 or VR-202 Allowable V/L Range 0.95 – 1.15

7.7.1 Pump #	7.7.2 Fuel Grade	7.7.3 Nozzle Serial #	7.7.5 Initial Dispenser Totalizer, Gallons	7.7.7 Final Dispenser Totalizer, Gallons	Total Gas Pumped, Gallons	7.7.8 Time, Seconds	9.2 Dispensing Rate, gpm	7.7.4 Initial Meter Reading, ft3	7.7.6 Final Meter Reading, ft3	7.8, 9.1 V/L	7.9 V/L Average (if necessary)	7.8, 7.9 or 7.10 Pass or Fail

Exhibit 7

Nozzle Bag Test Procedure

(Executive Orders VR-201-N and VR-202-N)

Verification of the integrity of the vapor valve shall be performed on installed nozzles by use of the following test.

Note: The following procedure requires that all nozzles on a dispenser be bagged at the same time. Bagging only one nozzle on a dispenser during this procedure may bias the results toward compliance.

a. Seal all nozzles on a dispenser in plastic bags, using tape or other means to secure the bag around the base of the nozzle (see Figure 1). Any plastic bag large enough to enclose the nozzle and having a thickness of no greater than 2 mils can be used.

b. Initialize the dispenser for fueling as follows:

   1. Inform the station operator that you are running a test and ask the operator to initialize the dispenser; or

   2. Swipe a credit card in the dispenser card reader.

c. Activate the Healy vacuum pump by lifting one of the nozzles off the dispenser holster and selecting a grade of fuel. **Do not dispense any fuel**.

d. With the dispenser initialized and the vacuum pump activated, observe all bagged nozzles for 30 seconds. Any nozzle where the bag can be seen visually collapsing has a defective vapor valve and the dispenser shall be removed from service immediately.

e. Record the test results on the “Nozzle Bag Test Results” form provided in this Exhibit. Districts may require use of an alternate form, provided that the alternate form includes the same minimum parameters.

f. Remove the bags from all the nozzles tested and disengage the dispenser by returning the nozzles to the dispenser holsters.

g. Repeat steps a through f for each dispenser.

Figure 1

NOZZLE BAG TEST RESULTS

SOURCE INFORMATION		TEST COMPANY INFORMATION	
Facility (DBA)/Site Address:	Facility Representative/Title:	Test Company Name/Address	# of Nozzles:________________ # Nozzles Tested:_____________ # Nozzles Passed:_____________ # Nozzles Failed: _____________ # Nozzles not Tested: _________
Print Name	Print Name	Print Name	
Street Address	Title ( )	Street Address	
City Zip	Phone No.	City Zip	
District Inspector:	☐ P/O ☐ S/A ☐ A/C Number:	Date of Test:	Time of Test:

Dispenser	Gas Grade	Nozzle Type	Bag Collapse after 30 Seconds?
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No

Healy Systems Scheduled Maintenance

1.0 Scheduled Maintenance Instructions for a Healy System with VP1000 Vacuum Source and 900 Series EVR Nozzle.

Initial problems are usually caused by installation irregularities that are easily detected and repaired by performing the “VP1000 Vacuum Performance Test Procedure” located in the dispenser installation manual. Periodic maintenance described here will eliminate problems and maintain peak operation of the system.

Note: Only a Healy Certified Technician can service any problems discovered while conducting the Weekly or Quarterly Inspection and Testing. Provided that there are no other local district requirements, a GDF Owner / Operator can remove and install nozzles, curb hoses, breakaways, flow limiters and whip hoses without a manufacturer certification. Additional certifications may be required in accordance with local district requirements.

1.1 Weekly Inspection and Testing

- Inspect each nozzle, hose, and breakaway for damage, loose connections, or leaks. Inspect nozzles for damaged vapor boots or spouts. Any nozzle with a vapor collection boot which is missing, or which has one half of the mini-boot faceplate or greater missing should be replaced or repaired as soon as practicable. Spouts with visible damage must be replaced.
- Inspect hoses for wear, severe kinks, cracks, and splitting. Replace if wire braid is visible.
- Test the VP1000 Vacuum Pump for normal operation using the following test procedure:
  - Normal operation will have the VP1000 Vacuum Pump running at low speed if only one side of a dispenser / pump is activated (ready to dispense fuel) and will run at full speed if both sides of the dispenser are activated (ready to dispense fuel). The VP1000 vacuum pump may continue to run for a few seconds after a nozzle is reholstered.

  NOTE: If any of the four bullets below cannot be achieved, tag out dispenser and call a Healy Certified Technician for service.

    - The VP1000 vacuum pump should come on immediately when a nozzle is lifted and the dispenser is activated and ready to dispense fuel.
    - Repeat for each nozzle on both sides of the dispenser being tested, one at a time, to verify the VP1000 vacuum pump is running after the dispenser is activated and ready to dispense fuel.

NOTE: For unihose dispensers, conduct individual tests for each product grade on each side of the dispenser to ensure that the VP1000 activates for all grades on the same side.

- Leave one nozzle activated on the first side and with the pump running, lift a nozzle on the other side of the dispenser (activated as above) and listen for a change of speed (increase) in the pump motor. Return both nozzles to the dispenser.

- Repeat the above procedures to activate both sides of the dispenser, but start with the opposite side of the dispenser. If the above procedures can be confirmed by starting with the opposite side of the dispenser, the VP1000 vacuum pump is correctly installed. After the VP1000 vacuum pump gets to second speed, it will not drop back to single speed until one nozzle is reholstered.

Note: In parts of the country where the outside temperature drops below 35° F, the VP1000 vacuum pump motor will automatically run at a very low RPM to prevent freezing. This is normal operation.

1.2 Quarterly Inspection and Testing

1.2.1 Perform Weekly Inspection prior to Quarterly inspection.

1.2.2 Inspect the VP1000 vacuum pump for loose or damaged vapor line connections. If copper tubing is kinked or loose remove the dispenser from service and call a Healy Certified Technician for service.

1.2.3 Check product dispensing flow rate at maximum (handheld) dispensing position. Verify flow rate is between 6.0 gpm and 10.0 gpm.

1.2.3.1 Replace dispenser filters when flow rate is below 6.5 gpm and check flow rate again. If the flow rate does not increase after filter change, remove the fueling point from service.

1.2.3.2 If flow rates exceed 10.0 gpm, install either Healy Model 1301 or 1302 Flow Limiter and check flow rate again. If flow rate still exceeds 10.0 gpm, remove the fueling point from service.

1.2.4 Check Clean Air Separator for proper operating configuration. See EO VR-201-N or VR-202-N, Exhibit 2, Figure 2B-2 or 2B-2H for guidance. Figure 2B-2 applies to vertical CAS installations. Figure 2B-2H applies to horizontal CAS installations.

1.3 Annual Inspection and Testing to Be Performed By a Healy Certified Technician.

The following procedures are recommended to be conducted in the order listed.

1.3.1 Perform weekly and quarterly inspection prior to Annual Inspection.

1.3.2 Conduct static pressure performance of the Healy Clean Air Separator (EO VR-201-N or VR-202-N, Exhibit 4).

1.3.3 Conduct pressure decay test (TP-201.3 and EO VR-201-N or VR-202-N, Exhibit 8).

1.3.4 Conduct dispenser vapor line tightness test found in the Healy dispenser manual under "testing the system" for each dispenser at GDF. Repair all leaks.

1.3.5 Conduct V/L test on all nozzles (EO VR-201-N or VR-202-N, Exhibit 5 or an ARB approved alternate test procedure). Adjust and replace as necessary.

1.4 Procedure for Reconnecting Breakaway and Testing Fueling Point after Drive-Off.

Note: The following procedure does not require a Healy Certified Technician. If any of the tests listed requires removing the fueling point or dispenser from service, contact a Healy Certified Technician. Breakaway reconnections and/or service by the GDF owner/operator or a Healy Certified Technician shall be logged in the GDF Maintenance Log.

1.4.1 After a Drive-Off, inspect the nozzle, hose and breakaway for damage. Spouts with visible damage must be replaced. Hoses with wire braid showing must be replaced.

1.4.2 Reconnect the breakaway assembly per the procedure in the appropriate Reconnectable Breakaway Coupling (P/N 8701VV or P/N 807) section of the *ARB Approved Installation, Operation and Maintenance Manual*. This procedure requires the use of the Healy reconnection clamp, P/N 795. Verify that the tip of the shear screw installed prior to the Drive-Off is removed from the dispenser end body (connected to the whip hose) of the breakaway.

Note: Do not remove the hose or nozzle from the bottom section of the breakaway, as the breakaway is holding the liquid gasoline in the hose/nozzle.

1.4.3 Authorize dispenser and inspect the hanging hardware for liquid leaks and meter creep (fueling position display is counting up without dispensing product). If no liquid leaks or meter creep are observed, proceed to section 1.4.4 of this procedure. If liquid leaks or meter creep are observed, remove the fueling point from service and conduct the following:

1.4.3.1 Use the breakaway reconnection procedure, referenced in section 1.4.2, in reverse order to disconnect the breakaway. Remove the nozzle and hose from the dispenser. (A towel can be placed into the upper portion of the nozzle holster of the dispenser to stop the dispenser beep associated with the nozzle being removed from the holster).

1.4.3.2 Install a plastic bag around the portion of the breakaway still connected to the dispenser whip hose. The plastic bag shall be large enough to enclose the breakaway and shall have a thickness of no greater than 2 mils. In California, 12” x 26” x 2 mil thick bags are available from the Air Resources Board by calling 800-952-5588.

1.4.3.3 Initialize the dispenser for fueling. **Do not dispense any fuel**.

1.4.3.4 With the dispenser initialized, observe the bagged breakaway for thirty (30) seconds.

1.4.3.5 If the bag collapses (indicating the breakaway is not maintaining vapor integrity), or liquid leaks or meter creep are observed, replace breakaway assembly per the procedure in the appropriate Reconnectable Breakaway Coupling (P/N 8701VV or P/N 907) section of ARB approved Installation, operation and Maintenance Manual, and return to section 1.4.3 of this procedure. If bag collapses or liquid leaks, or meter creep is observed after replacing breakaway assembly, remove the dispenser from service and contact a Healy Certified Technician. If the bag does not collapse (indicating the breakaway is maintaining vapor integrity) and no liquid leaks or meter creep are observed, the dispenser can remain in service.

1.4.4 Conduct the Nozzle Bag Test using the procedure from Exhibit 7 of Executive Order VR-201-N or VR-202-N. If the bag around the nozzle does not collapse, proceed to section 1.4.5 of this procedure. A nozzle where the bag is collapsing indicates a defective vapor valve. If the nozzle bag test indicates a defective vapor valve, replace nozzle assembly and return to section 1.4.3 of this procedure. If bag collapses or liquid leaks or meter creep is observed after replacing the nozzle assembly, remove the fueling point from service and conduct the following:

1.4.4.1 Use the breakaway reconnection procedure, referenced in section 1.4.2, in reverse order to disconnect the breakaway. Remove the nozzle and hose from the dispenser. (A towel can be placed into the upper portion of the nozzle holster of the dispenser to stop the dispenser beep associated with the nozzle being removed from the holster).

1.4.4.2 Install a plastic bag around the portion of the breakaway still connected to the dispenser whip hose. The plastic bag shall be large enough to enclose the breakaway and shall have a thickness of no greater than 2 mils. In California, 12” x 26” x 2 mil thick bags are available from the Air Resources Board by calling 800-952-5588.

1.4.4.3 Initialize the dispenser for fueling. **Do not dispense any fuel.**

1.4.4.4 With the dispenser initialized, observe the bagged breakaway for thirty (30) seconds.

1.4.4.5 If the bag collapses (indicating the breakaway is not maintaining vapor integrity), or liquid leaks or meter creep are observed, remove the dispenser from service and contact a Healy Certified Technician. If the bag does not collapse (indicating the breakaway is maintaining vapor integrity) and no liquid leaks or meter creep are observed, the dispenser can remain in service.

1.4.5 The following tests shall be performed after passing sections 1.4.3 and 1.4.4 of this procedure.

1.4.5.1 Test the insertion interlock feature of the nozzle using the procedures outlined in Sections 1.1.7 and 1.1.8 in the Healy Model 900 Nozzle section of the *ARB Approved Installation, Operation and Maintenance Manual*. If the nozzle fails either of these tests, replace nozzle assembly and return to section 1.4.3 of this procedure. If the nozzle fails any of the tests after replacing the nozzle, remove the fueling point from service and contact a Healy Certified Technician.

1.4.5.2 Test the automatic shutoff feature of the nozzle using the procedures outlined in Sections 1.2.8, 1.2.9 and 1.2.10 in the Healy Model 900 Nozzle section of the *ARB Approved Installation, Operation and Maintenance Manual*. If the nozzle fails any of the tests, replace nozzle assembly and return to section 1.4.3 of this procedure. If the nozzle fails any of the tests after replacing the nozzle, remove the fueling point from service and contact a Healy Certified Technician.

For more information about testing and/or maintenance of Healy products, contact Healy Technical Services @ 800-984-6266.

VR-201-N and VR-202-N - Weekly Inspection and Testing Checklist

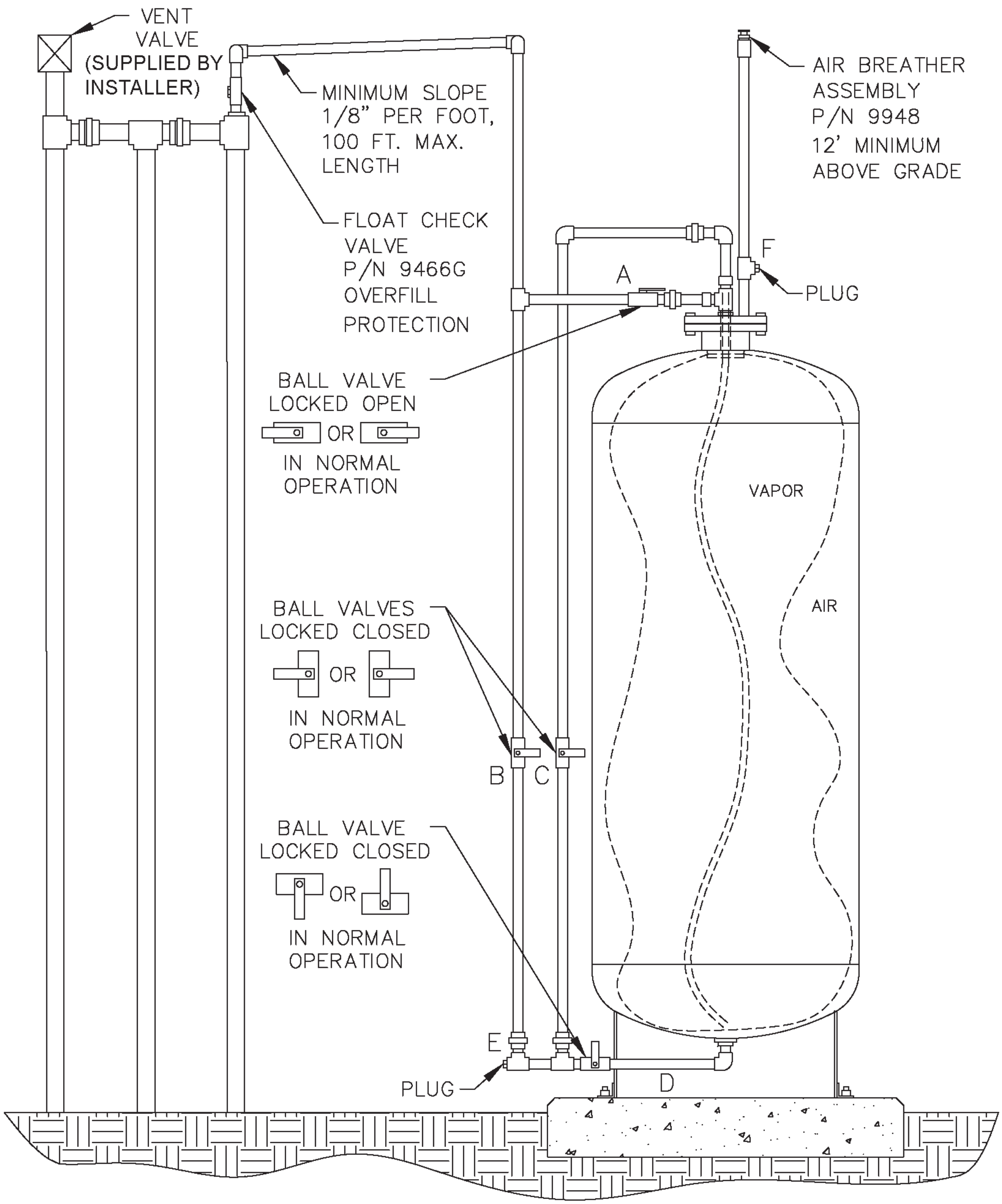
Checklist results may be used to assist with filling out GDF maintenance log. | Date: _________ | Page ____ of ____

Dispenser Number	Unihose or Fuel Grade (circle one)	Nozzle Inspection (circle one)	Hose Inspection (circle one)	Breakaway Inspection (circle one)	VP1000 Vacuum Pump Normal Operation (circle one)
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No
	Unihose 87 89 91 Other ___	Pass Fail	Pass Fail	Pass Fail	Yes No

VR-201-N and VR-202-N - Quarterly Inspection and Testing Checklist

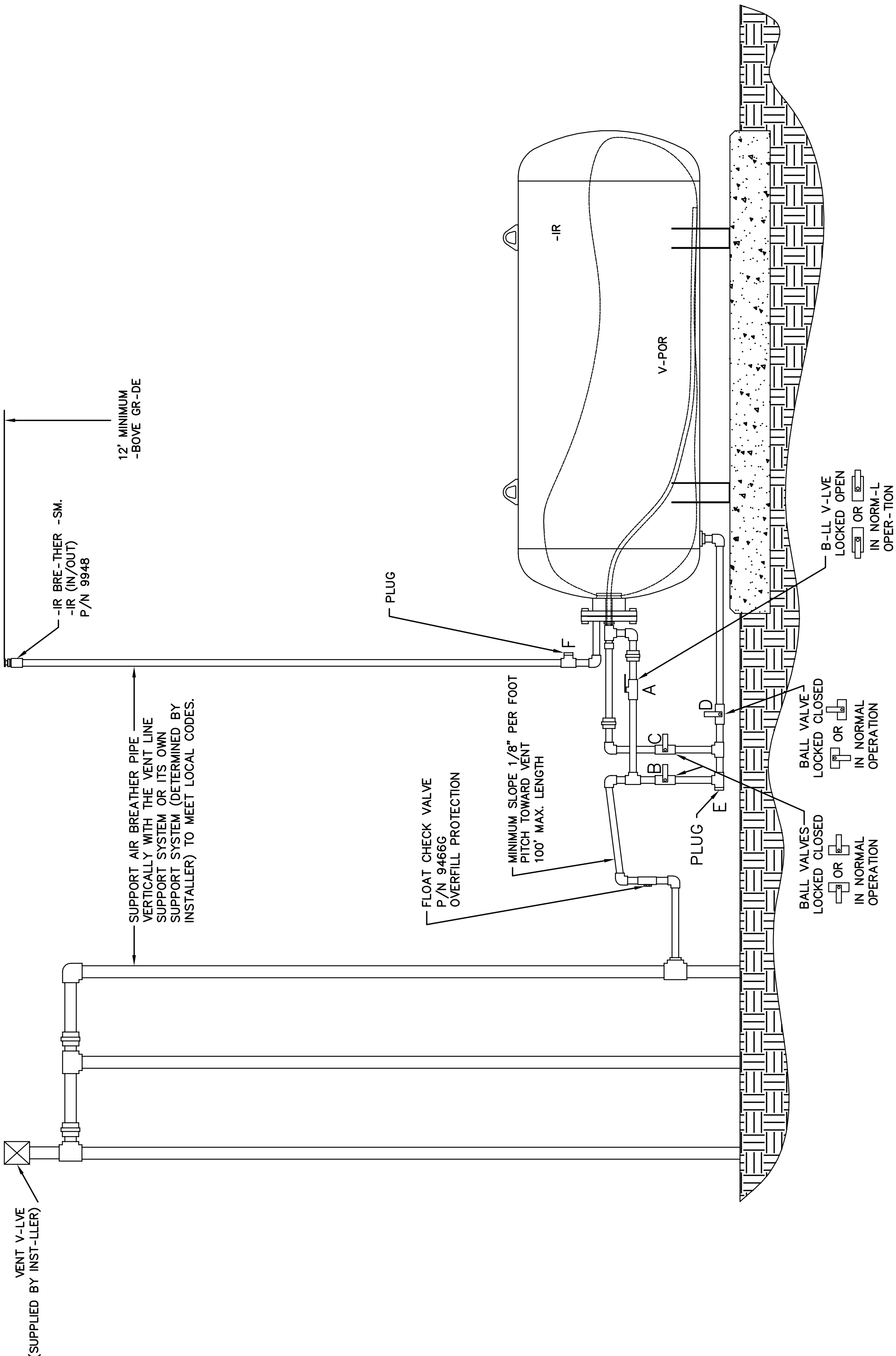
Checklist results may be used to assist with filling out GDF maintenance log.					Date: __________	Page ____ of ____		
Dispenser Number	Unihose or Fuel Grade (circle one)	Weekly Inspection Complete (circle one)	VP1000 Inspection (circle one)	Product Dispensing Rate (gallons per minute)	Fuel Grade Tested (circle one)	Clean Air Separator Configuration (see Figures 1 and 1H)		
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___	Valve	Circle One	
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___	A	Open	Closed
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___	B	Open	Closed
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___	C	Open	Closed
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___	D	Open	Closed
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___			
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___	Plug	Circle One	
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___	E	Installed	Missing
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___	F	Installed	Missing
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___			
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___			
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___			
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___			
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___			
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___			
	Unihose 87 89 91 Other ___	Yes No	Pass Fail	gpm	87 89 91 Other___			

Figure 1
Normal Clean Air Separator Operating Configuration[1]



1 Vent stack configuration may be different than what is shown in this figure.

Figure 1H
Normal Horizontal Clean Air Separator Operating Configuration[1]



1 Vent stack configuration may be different than what is shown in this figure.

VR-201-N and VR-202-N - Annual Inspection and Testing Checklist

Checklist results may be used to assist with filling out GDF maintenance log. Date: ________ Page __ of __

Complete Weekly Inspection Checklist	Complete Quarterly Inspection Checklist	Clean Air Separator Test, Exhibit 4 (circle one)	Pressure Decay Test, TP-201.3 & Exhibit 8 (circle one)	Dispenser Number	Dispenser Vapor Line Tightness Test (circle one)	Dispenser Number	Fuel Grade Tested (circle one)	Nozzle V/L Test, Exhibit 5 (circle one)
		Pass	Pass		Pass Fail		87 89 91 Other___	Pass Fail
					Pass Fail		87 89 91 Other___	Pass Fail
					Pass Fail		87 89 91 Other___	Pass Fail
					Pass Fail		87 89 91 Other___	Pass Fail
					Pass Fail		87 89 91 Other___	Pass Fail
					Pass Fail		87 89 91 Other___	Pass Fail
					Pass Fail		87 89 91 Other___	Pass Fail
					Pass Fail		87 89 91 Other___	Pass Fail
		Fail	Fail		Pass Fail		87 89 91 Other___	Pass Fail
					Pass Fail		87 89 91 Other___	Pass Fail
					Pass Fail		87 89 91 Other___	Pass Fail
					Pass Fail		87 89 91 Other___	Pass Fail
					Pass Fail		87 89 91 Other___	Pass Fail
					Pass Fail		87 89 91 Other___	Pass Fail
					Pass Fail		87 89 91 Other___	Pass Fail
					Pass Fail		87 89 91 Other___	Pass Fail

Executive Order VR-202-N
Healy Phase II EVR System
Including In-Station Diagnostics (ISD) Systems

Exhibit 2
Part I - Healy EVR System Specifications

This exhibit contains the installation, maintenance and compliance standards and specifications that apply to the Healy Phase II EVR System Including In-Station Diagnostics (ISD) Systems installed in a gasoline dispensing facility. All components must be installed in accordance with the specifications in the **ARB Approved Installation, Operation and Maintenance Manual**. Installation, maintenance and repair of system components, including removal and installation of such components in the course of any required tests, shall be performed by technicians certified by the appropriate manufacturer. Additional certifications may be required in accordance with local district requirements. Provided that there are no other local district requirements, a GDF Owner / Operator can remove and install nozzles, curb hoses, breakaways, flow limiters and whip hoses without a manufacturer certification.

Nozzle

1. A vapor collection boot shall be installed on the nozzle at the base of the spout, as shown in **Figure 2B-1**.

2. The Healy Model 900 nozzle has an integral vapor valve which prevents the loss of vapor from the underground storage tanks, ensures proper operation of the system and prevents the ingestion of air into the system. Any dispenser that has a nozzle installed that is determined to have a defective vapor valve, as described in items 2.1 or 2.2 below, shall be immediately removed from service (including nozzle(s) on both sides of dispenser) and a call for repair made immediately.

   2.1. The maximum allowable leak rate for the nozzle vapor path, as determined by TP-201.2B, shall not exceed the following:

   0.038 cubic feet per hour (CFH) at a pressure of two inches water column (2.00” wc), and
   0.10 CFH at a vacuum of one hundred inches water column (-100.00” wc)

   2.2. Verification of the integrity of the vapor valve can be performed on installed nozzles using the nozzle bag test procedure in Exhibit 7.

Vapor Collection

1. The V/L ratio of the system shall be **1.05 plus or minus 0.10 (0.95 to 1.15)**, measured at a flow rate between six and ten gallons per minute (6.0 – 10.0 gpm). *Any fueling point whose V/L ratio is determined to be at or below 0.80 shall be deemed defective and removed from service.* The V/L ratio shall be determined by using the test procedure in Exhibit 5 with the shut-off port excluded, or with an ARB approved alternate test procedure. See Section 7 of Exhibit 5 for guidance on V/L adjustment.

2. Inoperative vapor pumps, as determined by the ***ARB Approved Installation, Operation and Maintenance Manual***, constitute a defect.

3. For unihose dispensers, any modifications or repairs to the nozzle, hanging hardware or vacuum pump done to bring one fuel grade V/L into compliance at a fueling point invalidates the results of any previous fuel grade(s) tested before the alteration. All fuel grades at that fueling point shall be tested again to verify compliance.

Inverted Coaxial Hoses

1. The maximum length of the hose assembly, including hose adaptor, whip hose, breakaway, flow limiter (optional) and inverted coaxial hose, measured from the base of the nozzle to the end of dispenser adapter or dispenser, as appropriate, shall be no more than twenty (20) feet.

2. Any hose configuration is allowed.

Breakaway Couplings

1. Testing is required after reconnecting the breakaway to ensure proper operation and no observed leaks. The procedure for reconnecting breakaway and fueling point testing after a drive-off, referenced in Section 1.4 of Healy Systems Scheduled Maintenance, shall be conducted to verify that breakaway, hose and nozzle are operating properly after a drive-off.

Flow Limiters

1. Flow limiter is mandatory when the flow rate is greater than 10.0 gallons per minute to comply with U.S. EPA requirement.

Clean Air Separator Pressure Management System

1. The Clean Air Separator is a passive gasoline storage tank ullage pressure management system, with no electrical requirements. The Clean Air Separator vapor integrity shall be evaluated using the test procedure outlined in Exhibit 4 of this Executive Order.

   a. The system shall be removed from service when the Clean Air Separator fails the leak decay test outlined in Exhibit 4.

   b. Unless there is maintenance or testing being conducted on the Clean Air Separator, the system shall be removed from service when the four ball valves are not locked in the positions shown in **Figure 2B-2** or **2B-2H** for normal Clean Air Separator operation. Figure 2B-2 applies to vertical CAS installations and Figure 2B-2H applies to horizontal CAS installations.

2. The Clean Air Separator shall be installed within 100 feet from the vent line(s), and the associated piping shall be sloped 1/8" per foot minimum toward the vent line(s).

Pressure/Vacuum Vent Valves for Gasoline Storage Tank Vents

1. All P/V vent valves shall be an ARB-certified P/V vent valve for a Phase I system.

2. At least one pressure/vacuum (P/V) vent valve shall be installed on each gasoline storage tank vent. The maximum number of P/V vent valves allowed and P/V vent valve performance specifications are listed in the applicable Phase I EVR Executive Order. Vent lines may be manifold to minimize the number of P/V vent valves and potential leak sources, provided the manifold conforms to all applicable fire regulations. At least one P/V vent valve shall be installed on vents if a manifold is incorporated. **Figure 2B-3** or **2B-3H** shows a typical manifold configuration for a single P/V vent valve with the Clean Air Separator. If two or more P/V vent valves are desired, they shall be installed in parallel, so that each can serve as a backup to the other if one should fail to open properly. **Figure 2B-4** or **2B-4H** shows a typical manifold configuration for two P/V vent valves installed in parallel with the Clean Air Separator. **Figure 2B-5** or **2B-5H** shows a typical manifold configuration for three P/V vent valves installed in parallel with the Clean Air Separator. **Figure 2B-6** or **2B-6H** shows a typical configuration for a P/V vent valve mounted on a single 3" vent line with the Clean Air Separator. Figures 2B-3, 2B-4, 2B-5 and 2B-6 apply to vertical CAS installations. Figures 2B-3H, 2B-4H, 2B-5H and 2B-6H apply to horizontal CAS installations.

Vapor Recovery Piping Configurations

NOTE: Vapor return piping shall meet the piping requirements specified in section 4.11 of CP-201.

1. Vapor Return and Vent Lines

   a. For facilities installed on or after April 1, 2003, all vapor return and vent lines shall be a minimum nominal internal diameter of 2 inches from the dispensers or the vent stacks to the first manifold. All lines after the first manifold and back to the underground storage tank shall have a minimum nominal internal diameter of 3 inches.

   Note: Facilities permitted by a local district prior to April 1, 2003 shall be required to meet the three inch diameter standard only upon facility modification which involves the addition, replacement, or removal of 50 percent or more of the buried vapor piping.

After backfilling the vapor return and vent lines, the maximum pressure drop shall not exceed 0.5 inches WC at 60 cubic feet per hour as determined by TP-201.4, Dynamic Backpressure. The pressure drop shall be measured from the dispenser riser to the UST with pressure/vacuum vent valves installed and with the poppeted Phase I vapor connection open.

b. For existing installations, the maximum pressure drop through the system shall not exceed 0.5 inches WC at 60 cubic feet per hour as determined by TP-201.4, Dynamic Backpressure. The pressure drop shall be measured from the dispenser riser to the UST with the pressure/vacuum vent valves installed and with the poppeted Phase I vapor connection open.

Note: The V/L test from Exhibit 5 may be used to verify proper operation of the system, in lieu of measuring the pressure drop through the lines, provided that at least two gallons of product are introduced into the system through each dispenser riser, prior to the test.

2. All vapor return lines shall have a minimum slope of 1/8 inch per foot from the dispenser riser to the riser of the underground storage tank (UST). A slope of 1/4 inch or more per foot is recommended wherever feasible. The vapor return path from any dispenser riser to the UST shall be free of liquid or fixed blockage.

Exception: When it is not possible to achieve the necessary minimum slope from the dispenser back to the underground storage tanks, a low point Liquid Condensate Trap (i.e. knock out pot, thief port) can be utilized as long as the conditions under **Liquid Condensate Traps** in this Exhibit 2 are met.

3. The dispenser shall be connected to the riser with either flexible or rigid material that is listed for use with gasoline. The dispenser-to-riser connection shall be installed so that any liquid in the lines will drain toward the gasoline storage tank. The internal diameter of the connector, including all fittings, shall not be less than one-half inch (1/2”).

Note: The dispenser-to-riser connection is defined as the piping connection between the outlet of the vapor flow meter and the inlet of the dispenser riser. A vapor shear valve may also be part of the riser connection.

4. There is no length restriction for the vapor return piping of the system as long as the system complies with the maximum pressure drop requirement of Item 1 (or the V/L option).

5. No product shall be dispensed from any fueling point at a GDF installed with the Healy Phase II EVR System Including In-Station Diagnostics (ISD) Systems if there is a vapor line that is disconnected and open to the atmosphere.

<u>Dispenser Vapor Piping</u>

1. Any dispenser with a dispenser piping test valve in the closed position shall be considered a defect.

2. The ball valve shall be installed between the test port and the vacuum pump. The ball valve and test port shall be located on the inlet side of the vacuum pump.

3. If the vapor flow meter is installed below the vapor shear valve, then a "Y" fitting for introducing liquid shall be installed below the vapor flow meter.

4. The vapor flow meter shall be installed on the down stream side of the vacuum pump.

5. The Vapor Pressure Sensor shall be installed into one of the dispensers at the GDF located closest to the underground storage tanks (If a row of dispensers are equal distance from the gasoline tank pad and within 10' of each other, any dispenser can be used).

<u>Liquid Condensate Traps</u>

1. There shall be no vapor leaks when tested in accordance with the latest version of TP 201.3, **Determination of 2 Inch WC Static Pressure Performance of Vapor Recovery Systems of Dispensing Facilities**.

2. The Liquid Level Sensor shall alarm within five (5) minutes when tested in accordance with Exhibit 11, **Liquid Condensate Trap Compliance Test**.

3. The Liquid Level Sensor audible alarm shall be installed at a location that is most likely to be heard by the station attendant during normal station operation (e.g. cash register).

4. The Liquid Evacuation System shall automatically evacuate gasoline when tested in accordance with Exhibit 11, **Liquid Condensate Trap Compliance Test.**

5. A metal tag specifying the capacity of the Liquid Condensate Trap shall be installed and maintained as specified in the Installation, Operation, and Maintenance Manual.

<u>In-Station Diagnostics</u>

Veeder-Root In-Station Diagnostics

1. The gasoline dispensing facility operator/owner and contractor shall comply with local district requirements, if any, following a warning by the Veeder-Root In-Station Diagnostics (ISD) system.

2. Suggested Troubleshooting, found in Table 5-1 of the Veeder-Root In-Station Diagnostics ISD) Install, Setup, and Operation Manual (ARB Approved Installation, Operation, and Maintenance Manual), recommends that certain tests be conducted to verify the cause of the ISD warning or failure alarms. Districts may require that these tests or other tests specified by the districts be conducted in response to the ISD alarms.

INCON Vapor Recovery Monitoring

1. The gasoline dispensing facility operator/owner shall comply with local district requirements, if any, following a warning by the INCON Vapor Recovery Monitoring system and a shut down of individual dispensers for all gasoline products by the vapor recovery.

2. Suggested Troubleshooting, found in Appendix A of the INCON Vapor Recovery Monitoring Install, Setup, and Operation Manual (ARB Approved Installation, Operation, and Maintenance Manual), recommends that certain tests be conducted to verify the cause of the warning or failure alarms. Districts may require that these tests or other tests specified by the districts be conducted in response to the monitoring system alarms.

Phase I System

1. The Phase I system shall be an ARB-certified system that demonstrates compliance with the static pressure decay test criteria contained in the latest version of TP-201.3.

Maintenance and Alarm History Records

1. Each GDF operator/owner shall keep records of maintenance performed at the facility. Such records shall be maintained on site or in accordance with district requirements or policies. The records shall include the maintenance or test date, repair date to correct test failure, maintenance or test performed, affiliation, telephone number, name and Certified Technician Identification Number of individual conducting maintenance or test. Additional information may be required in accordance with local district requirements.

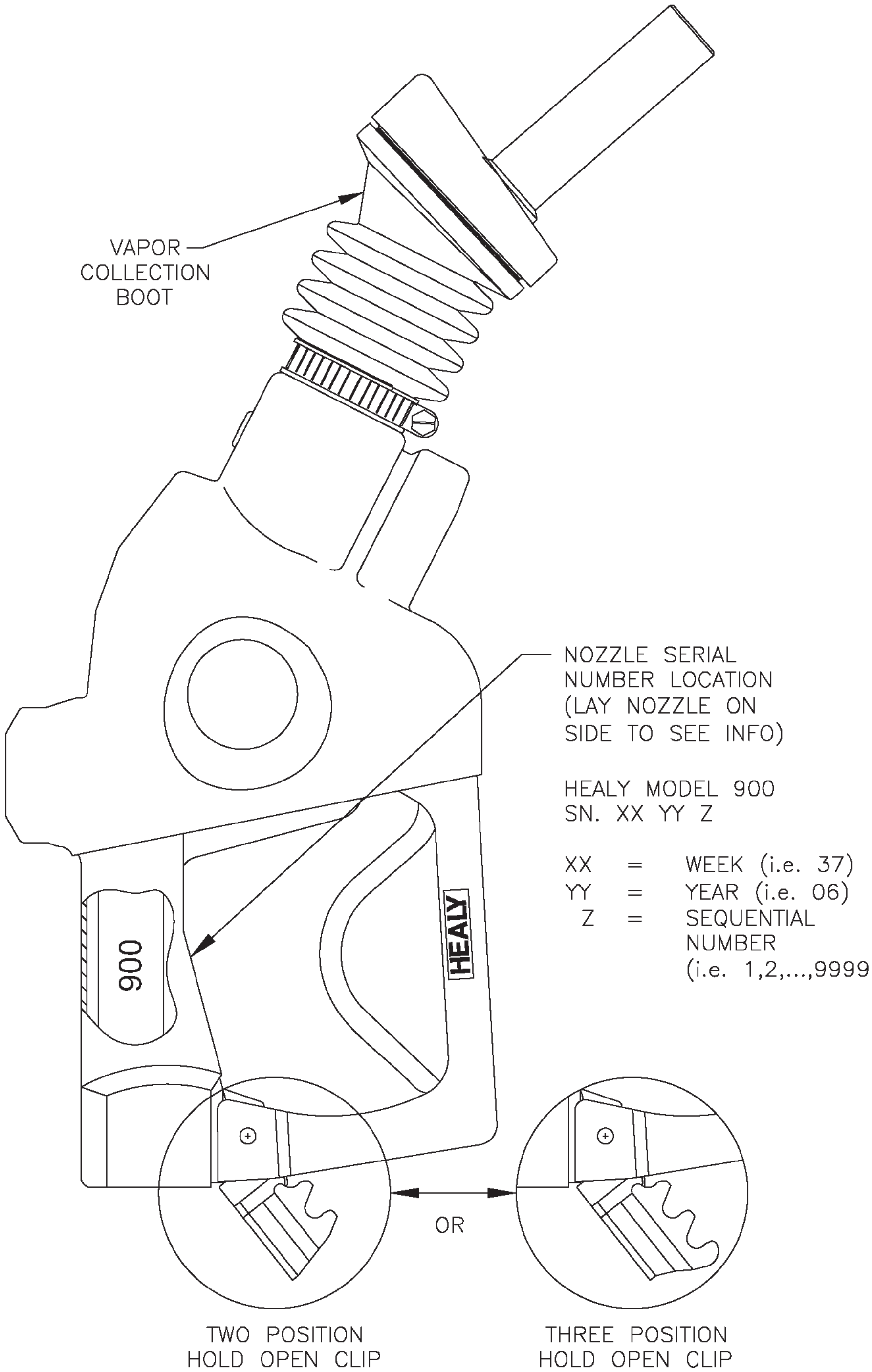
   Each GDF operator/owner shall keep records of all alarms detected by the ISD system. Alarm History records shall be maintained on site or in accordance with district requirements or policies. The records shall include the alarm date, the nature of the alarm, type of test and test date to verify the validity of ISD alarm, maintenance or repair date to correct the cause of the alarm, maintenance or repair performed to correct the cause of the alarm, affiliation, telephone number, name and Certified Technician Identification Number of individual conducting maintenance or test. Additional information may be required in accordance with local district requirements.

   An example of a GDF Maintenance and Alarm History Record is shown in **Figure 2B-15**.

2. Maintenance shall be conducted in accordance with Healy Systems Scheduled Maintenance document in ***ARB Approval Installation, Operation and Maintenance Manual***.

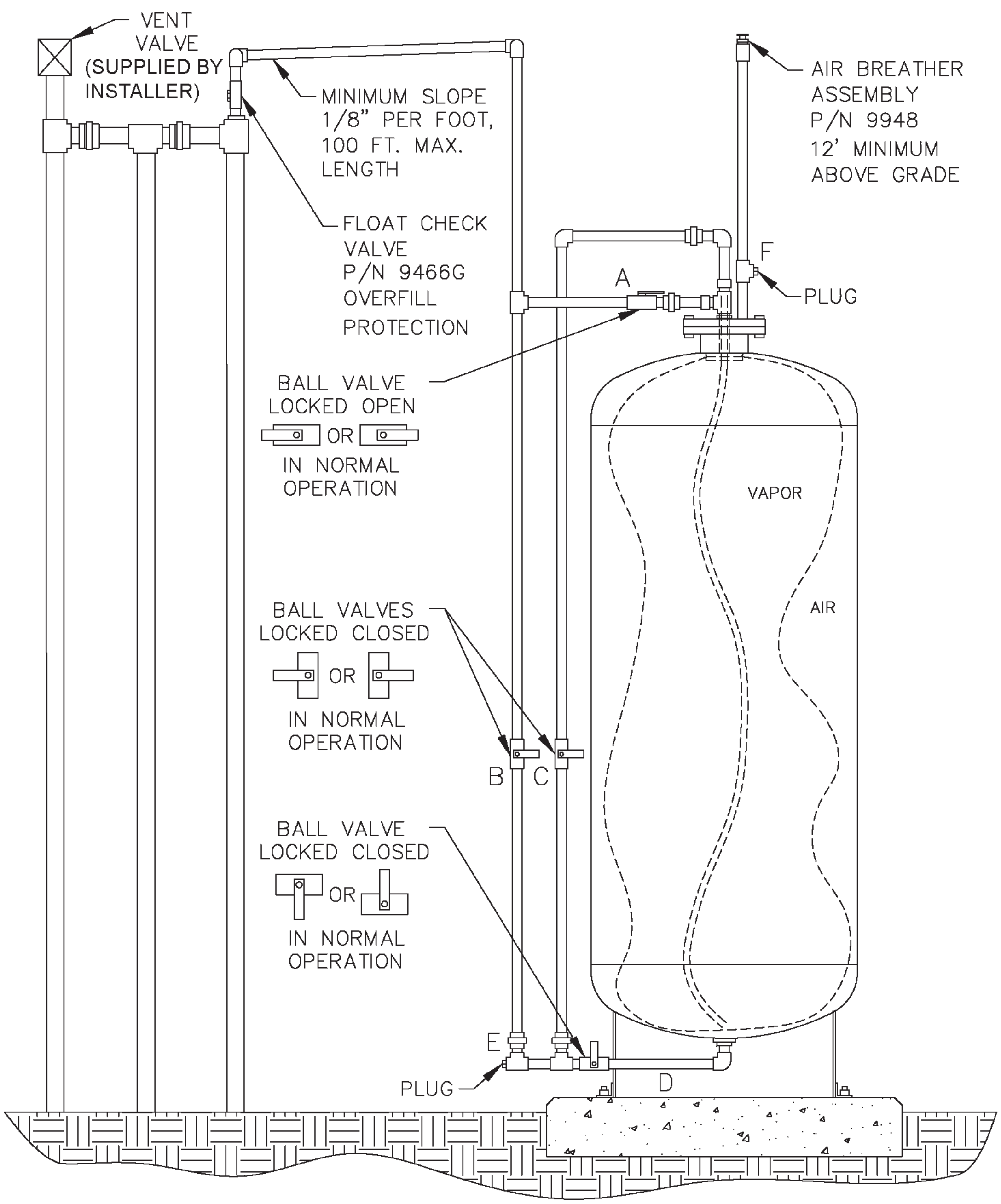
3. Reconnection of breakaways shall be included in the maintenance records.

Nozzle


VAPOR COLLECTION BOOT
NOZZLE SERIAL NUMBER LOCATION (LAY NOZZLE ON SIDE TO SEE INFO)
HEALY MODEL 900
SN. XX YY Z
XX = WEEK (i.e. 37)
YY = YEAR (i.e. 06)
Z = SEQUENTIAL NUMBER (i.e. 1,2,...,9999)
900
HEALY
OR
TWO POSITION HOLD OPEN CLIP
THREE POSITION HOLD OPEN CLIP

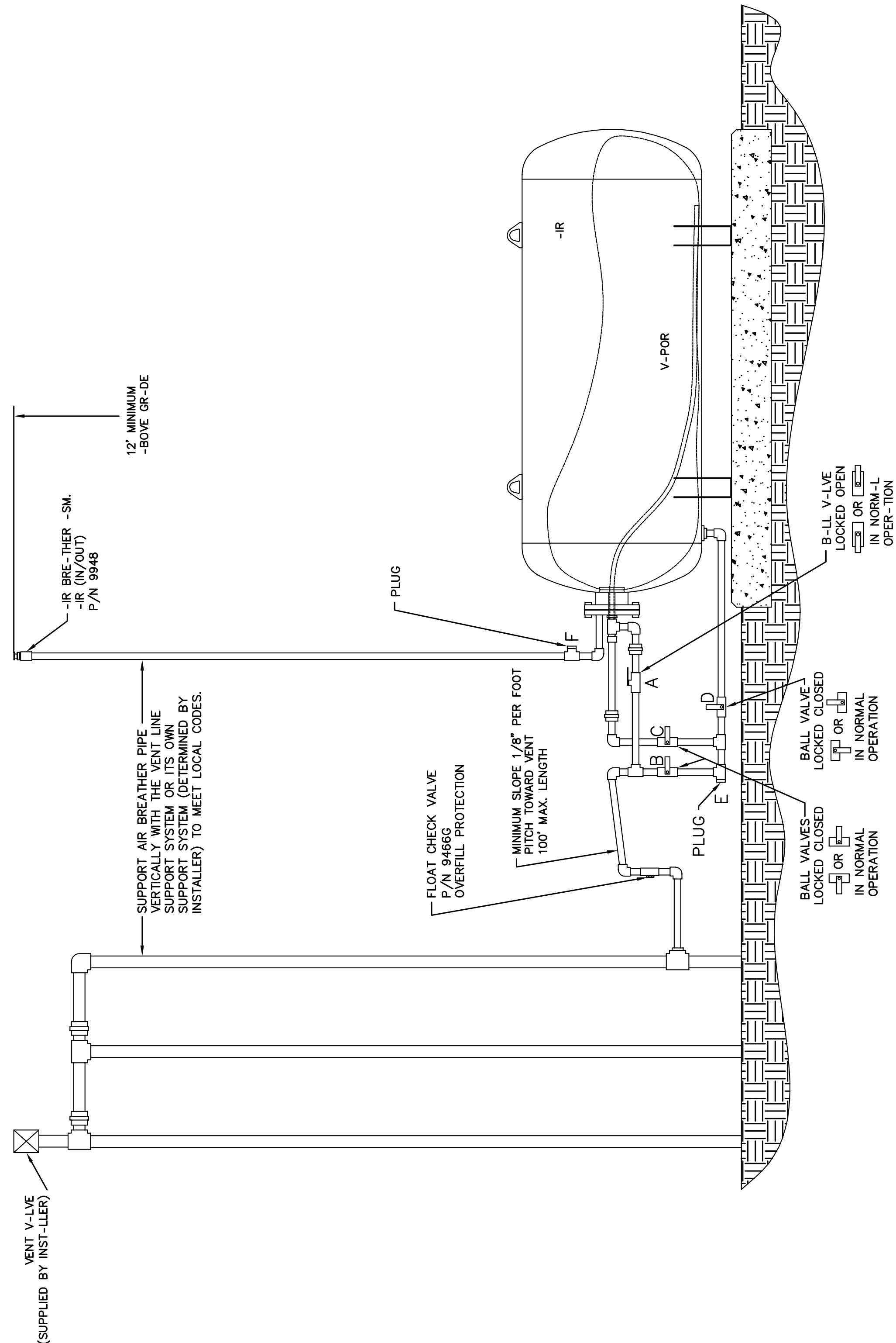
Executive Order VR-202-N
Healy Phase II EVR System
Including In-Station Diagnostics (ISD) Systems

Exhibit 2
Figure 2B-2
Clean Air Separator Normal Operation Configuration



Executive Order VR-202-N
Healy Phase II EVR System
Including In-Station Diagnostics (ISD) Systems

Exhibit 2
Figure 2B-2H
Clean Air Separator Normal Operation Configuration



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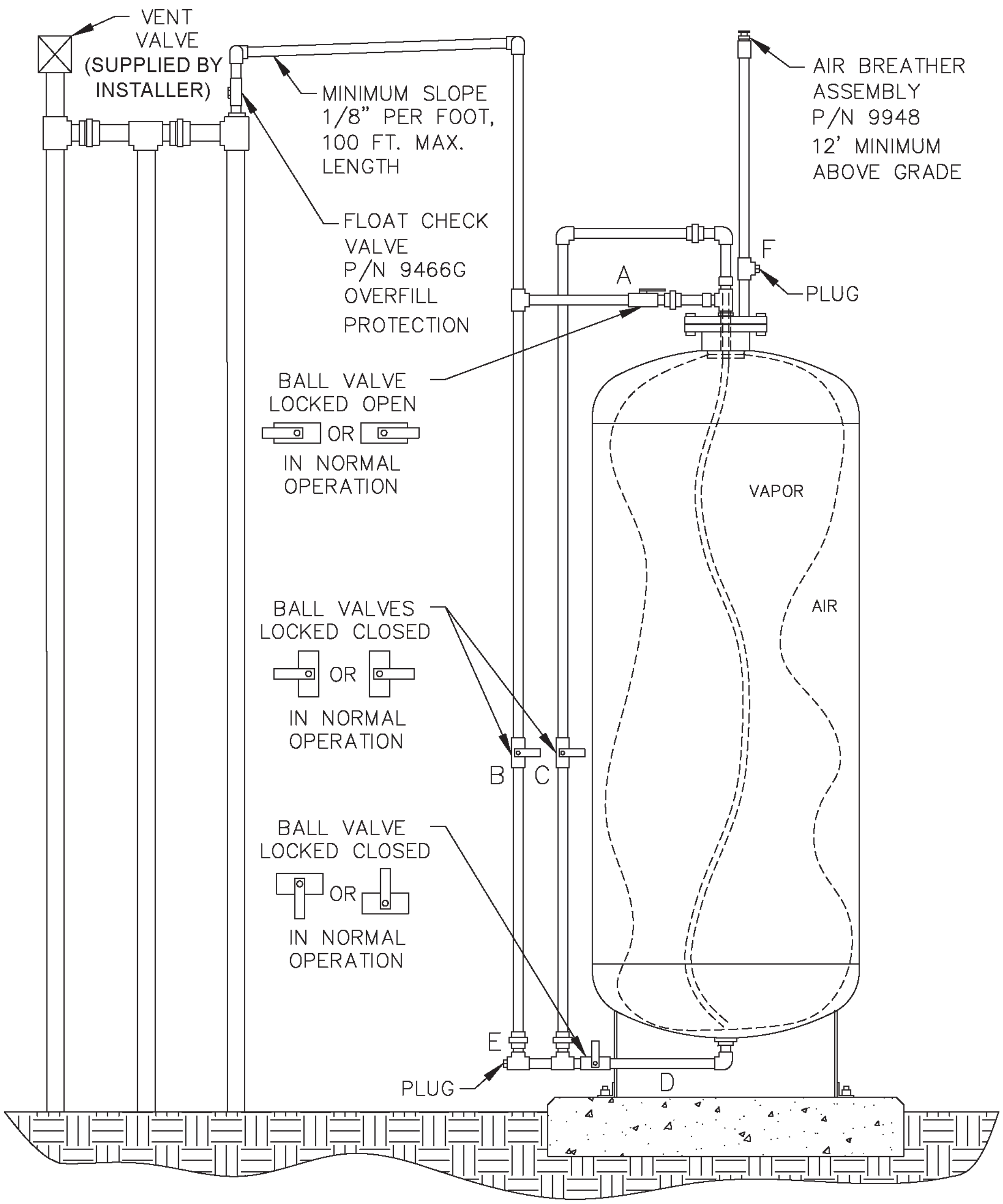
Healy Phase II EVR System
Including In-Station Diagnostics (ISD) Systems

Exhibit 2
Figure 2B-3
Typical Installation of a Single P/V Vent Valve Manifold with Healy Clean Air Separator



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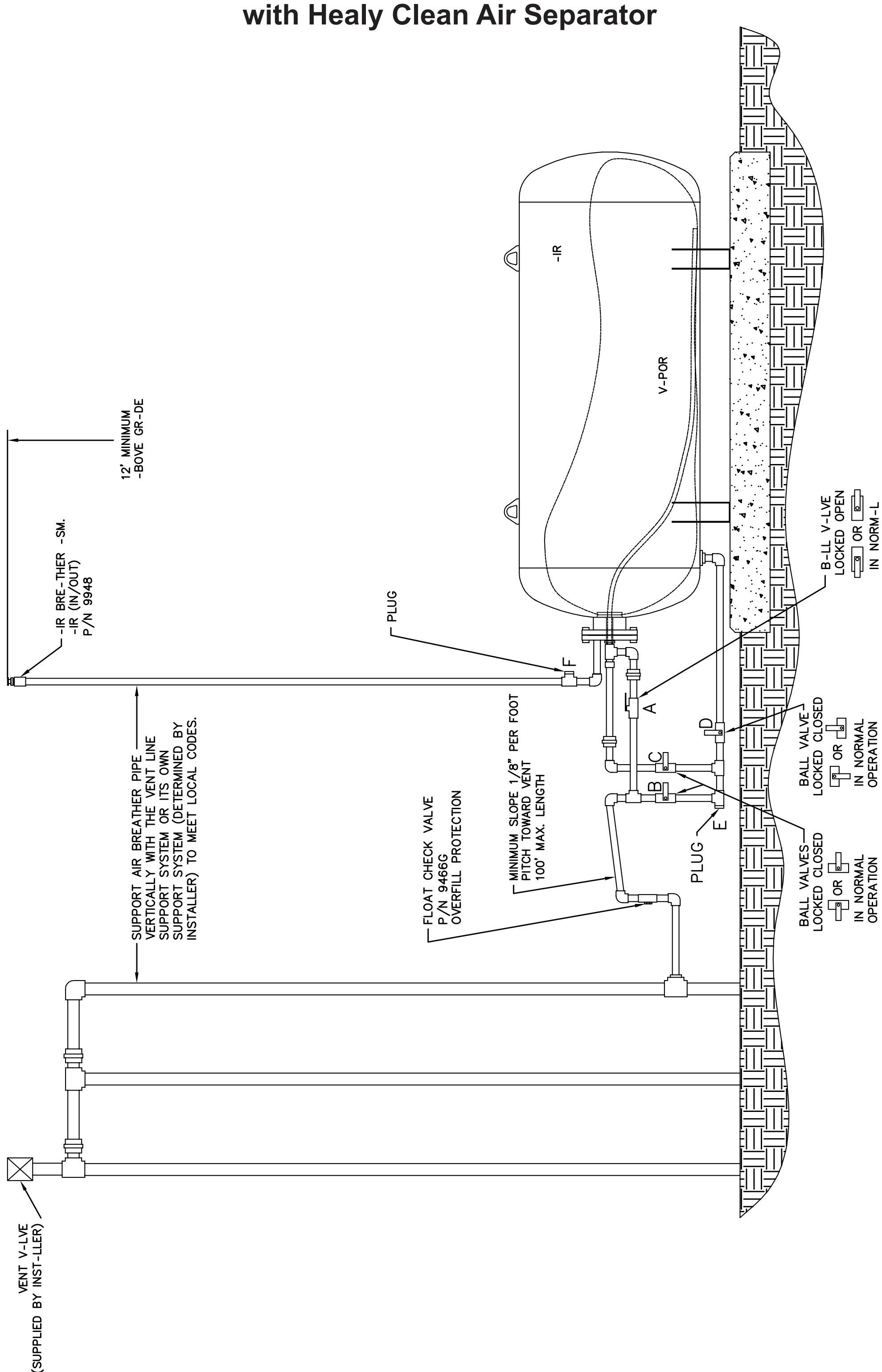
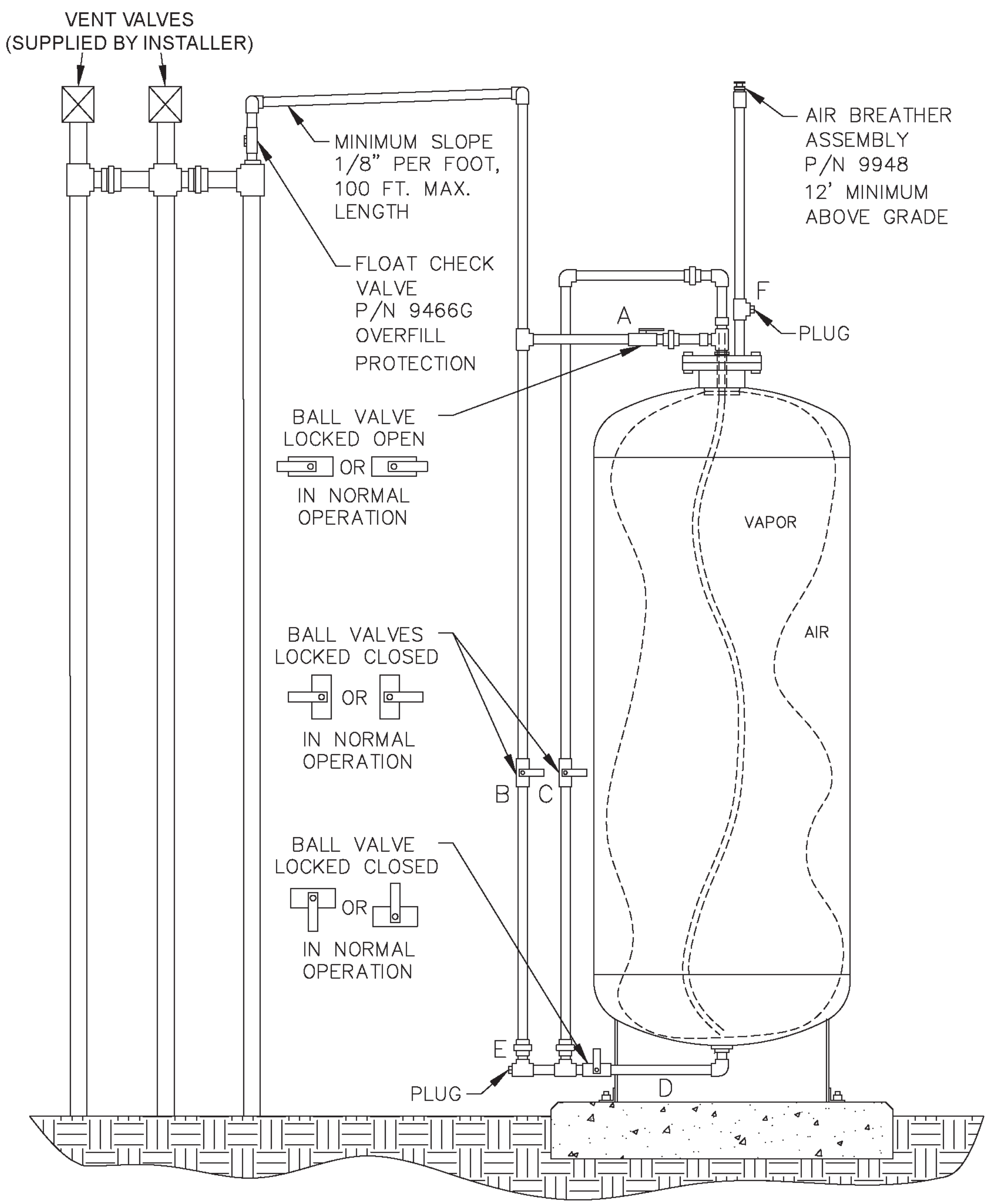
Healy Phase II EVR System
Including In-Station Diagnostics (ISD) Systems

Exhibit 2
Figure 2B-3H
Typical Installation of a Single P/V Vent Valve Manifold with Healy Clean Air Separator



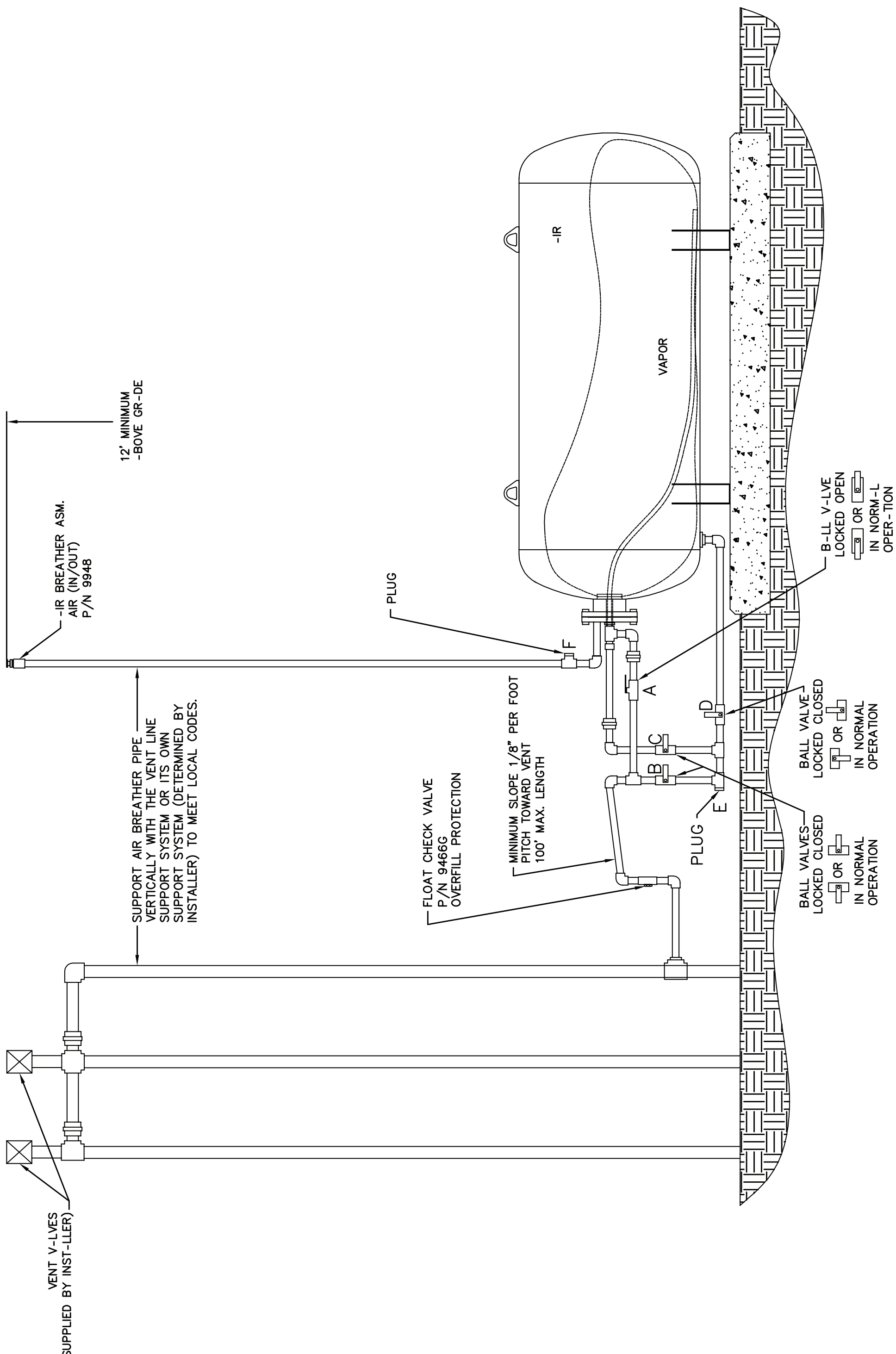
Executive Order VR-202-N
Healy Phase II EVR System
Including In-Station Diagnostics (ISD) Systems

Exhibit 2
Figure 2B-4
Typical Installation of a Two P/V Vent Valve Parallel Manifold with Healy Clean Air Separator



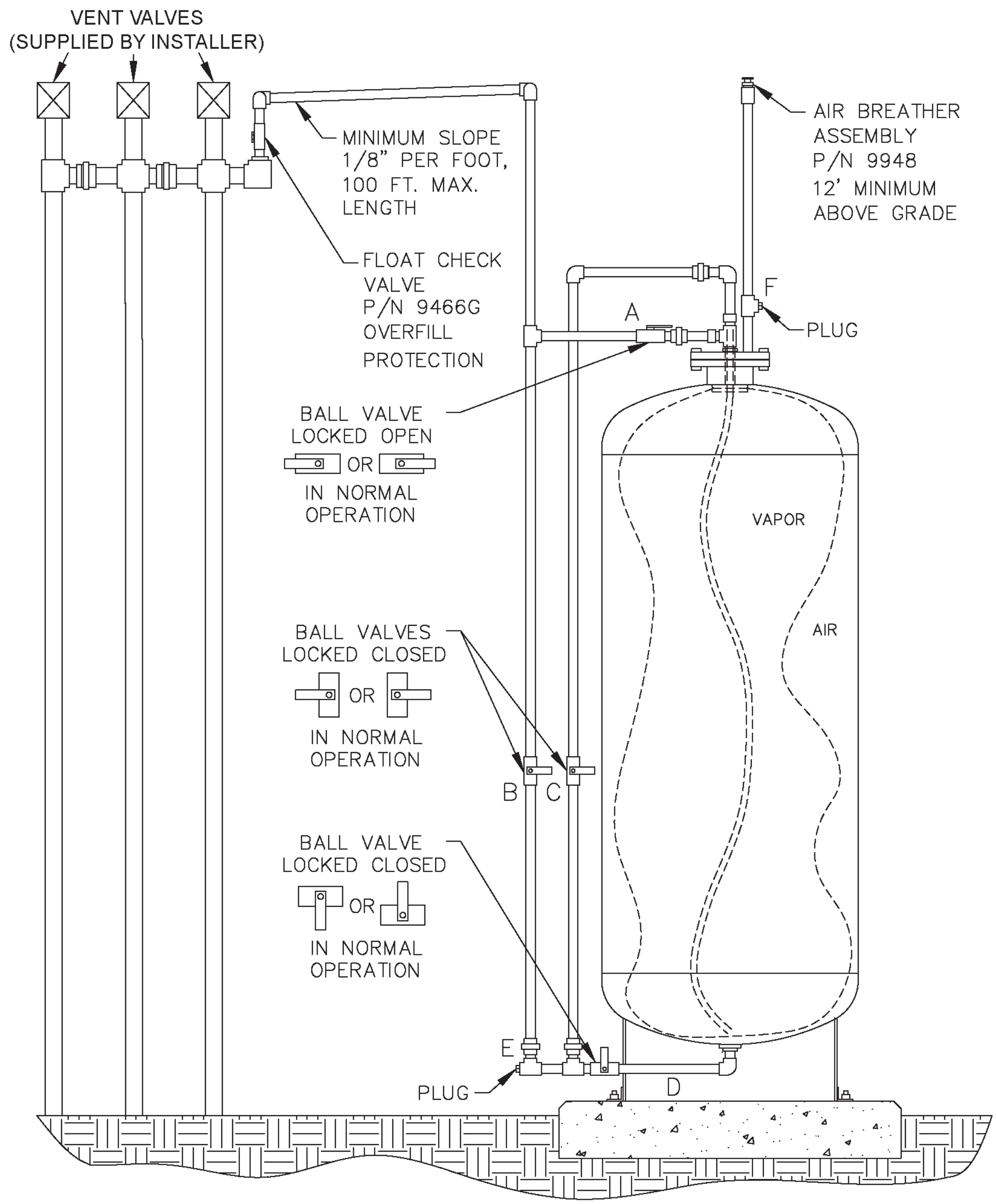
Executive Order VR-202-N
Healy Phase II EVR System
Including In-Station Diagnostics (ISD) Systems

Exhibit 2
Figure 2B-4H
Typical Installation of a Two P/V Vent Valve Parallel Manifold with Healy Clean Air Separator



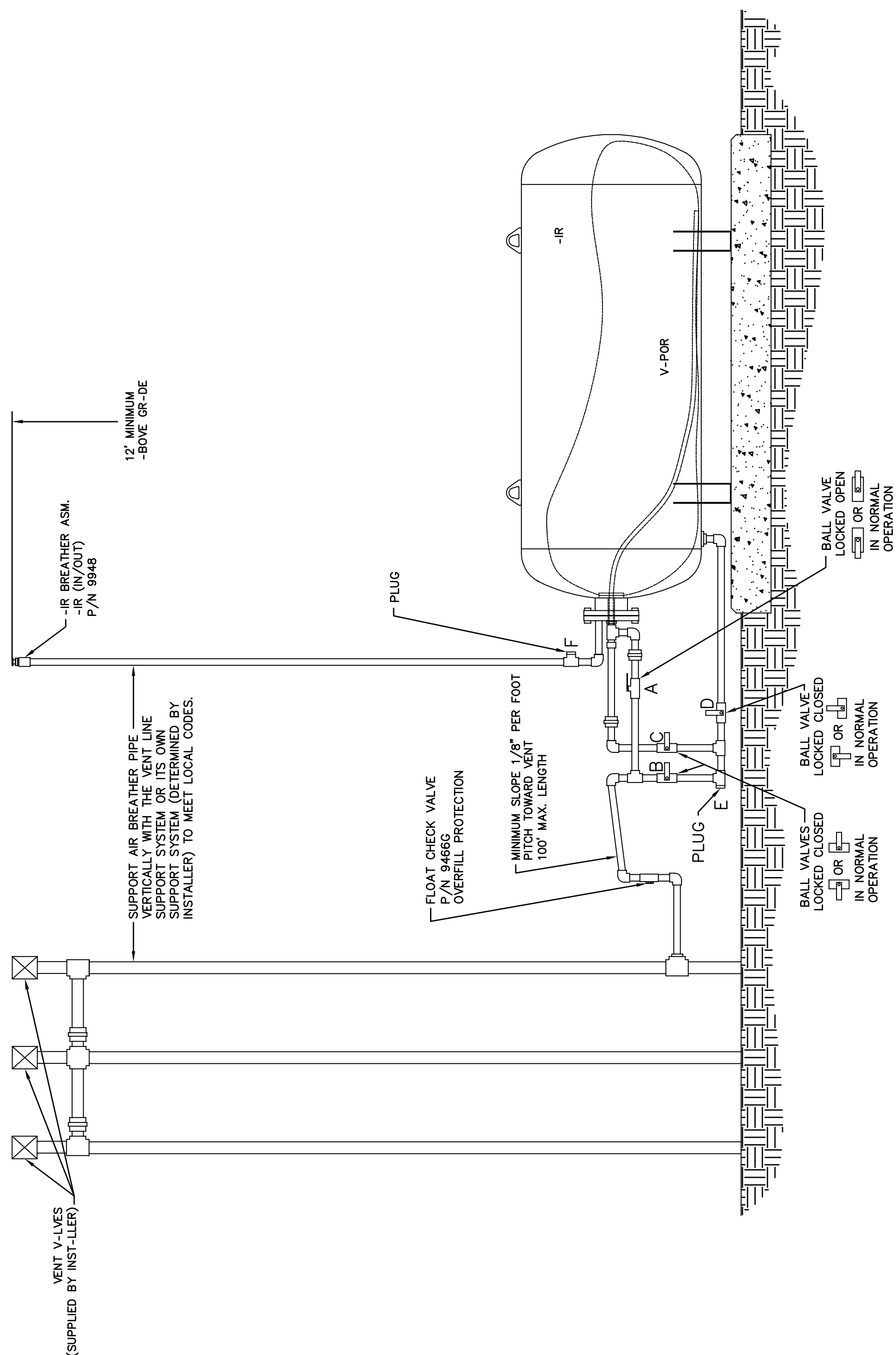
Executive Order VR-202-N
Healy Phase II EVR System
Including In-Station Diagnostics (ISD) Systems

Exhibit 2
Figure 2B-5
Typical Installation of a Three P/V Vent Valve Parallel Manifold with Healy Clean Air Separator



Executive Order VR-202-N
Healy Phase II EVR System
Including In-Station Diagnostics (ISD) Systems

Exhibit 2
Figure 2B-5H
Typical Installation of a Three P/V Vent Valve Parallel Manifold with Healy Clean Air Separator



Executive Order VR-202-N
Healy Phase II EVR System
Including In-Station Diagnostics (ISD) Systems

Exhibit 2
Figure 2B-6
Typical Configuration of a P/V Vent Valve Mounted on a Single 3” Vent Line with the Clean Air Separator

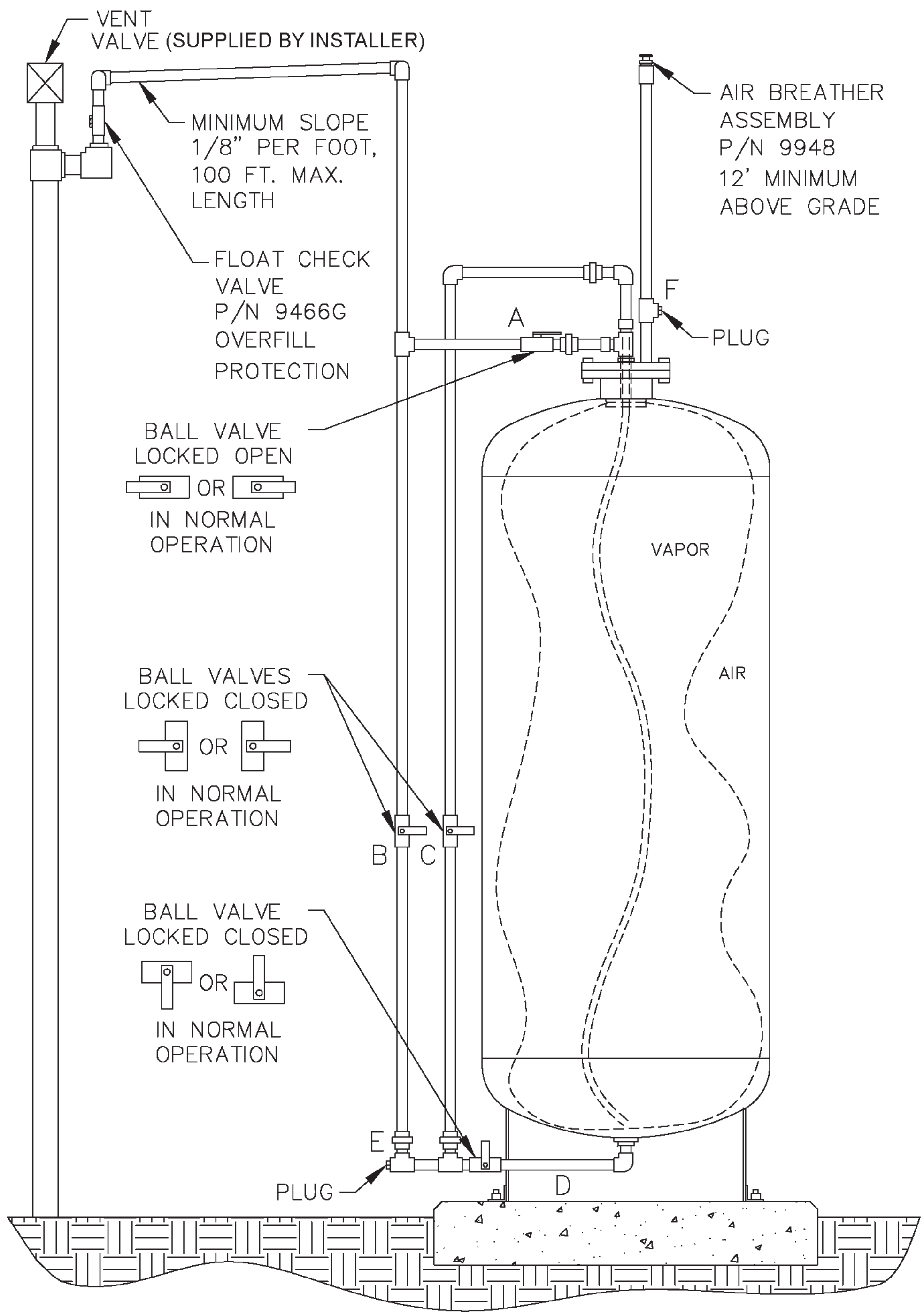


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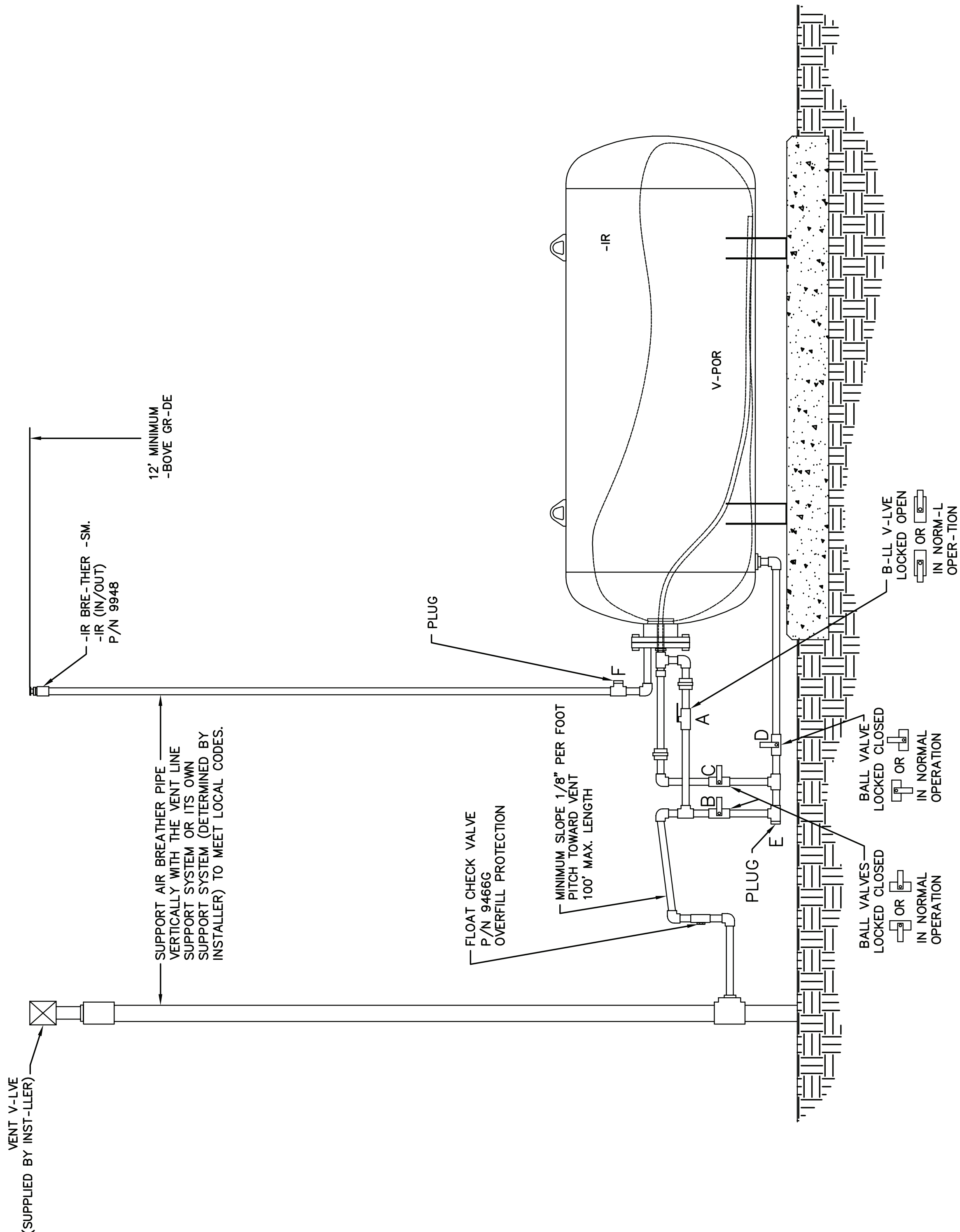
Exhibit 2
Figure 2B-6H
Typical Configuration of a P/V Vent Valve Mounted on a Single 3” Vent Line with the Clean Air Separator



Part II - In-Station Diagnostics Systems
Option I - Veeder-Root ISD System Specifications

TLS Console & ISD Software Version Number

The ISD audible alarms shall be installed at a location that is most likely to be heard by the station attendant during normal station operation (e.g., cash register). The TLS console shall be installed in a location that allows the RS232 port to be easily accessible, and if applicable, per district requirements, for use at anytime. A vacant RS232 serial port shall always be available to electronically download reports.

The presence of ISD and the ISD software version number can be verified on the TLS Console LCD screen by using the <STEP> key or by using the TLS Console <PRINT> key to print and review the latest ISD Daily Report. **See Figure 2B-7** and **2B-8** for TLS and ISD verification instructions.

The TLS Console must have a printer as well as an RS232 interface port.

If the TLS is equipped with security features which prohibit access to the TLS, instructions to override these security features shall be maintained on site in accordance with air district requirements and shall be available to the air district upon request.

The Table below provides a list of expiration dates for each ISD Software version.

Veeder-Root ISD System Software Version Expiration Dates

Phase II EVR System Description	Software Version	Last Date Software May Remain In Use	Notes
Healy (Assist) VR-202 Series	Version 1.00	12/15/2010	Subject GDFs must upgrade to the certified software version (1.01 or later)
	Version 1.01* for Multi-Product (six pack) Dispensers with Fuel Blending	07/01/2012	Only applies to GDFs equipped with multi-product dispensers with fuel blending. Does not apply to GDFs equipped with uni-hose dispensers with fuel blending. Subject GDFs must upgrade to the certified software version (1.02 or later)
	Version 1.02, 1.03	N/A	May Remain in Use at Existing Facilities
	Version 1.04	N/A	Required for New Installations and Major Modifications

*Existing sites equipped with Veeder-Root Software Version 1.01 may remain in use only if equipped with uni-hose or mulititi-product dispenser without fuel blending.

Operability Test Procedure

The Veeder-Root ISD operability test procedure provided in Exhibit 9, and in section 4 of the ***ARB Approved Installation, Operation and Maintenance Manual***, shall be used at GDF sites to determine the operability of the Veeder-Root ISD system to comply with applicable performance standards and performance specification in CP-201. Testing the ISD equipment in accordance with this procedure will verify the proper selection, setup and operation of the TLS Console sensors and interface modules.

The Vapor Flow Meter

The Veeder-Root ISD system requires one Vapor Flow Meter per dispenser installed via the ***ARB Approved ISD Vapor Flow Meter Manual 577013-796, Rev. E for the Veeder-Root ISD System***. The Vapor Flow Meter shall be installed into dispensers listed in Exhibit 1 of this Executive Order in accordance with the ***ARB Approved Installation, Operation and Maintenance Manual***. The Vapor Flow Meter is an intrinsically safe sensor that is wired to the TLS Console Smart Sensor Module via a conduit dedicated to TLS Console low-voltage sensors. **Figure 2B-9** shows the ISD Vapor Flow Meter. **Figures 2B-13** and **2B-14** show the installation configuration.

The Vapor Pressure Sensor

The Veeder-Root ISD system requires one Vapor Pressure Sensor per GDF installed into one of the dispensers located closest to the gasoline tanks (If a row of dispensers are equal distance from the gasoline tank pad and within 10’ of each other, any dispenser can be used) in accordance with the ***ARB Approved Installation, Operation and Maintenance Manual***. The Vapor Pressure sensor shall be installed into dispensers listed in Exhibit 1 of this Executive Order. For vapor vent stack installation, install the pressure sensor on the vent stack line closest to the tank being monitored, in accordance with Section 21 of the **ARB Approved IOM Manual**. The Vapor Pressure Sensor is an intrinsically safe sensor that is wired to the TLS Console Smart Sensor Module via a conduit dedicated to TLS Console low-voltage sensors. **Figure 2B-10** shows an ISD Vapor Pressure Sensor illustration. **Figures 2B-13** and **2B-14** show the installation configuration. **Figure 2B-14-I** shows the installation configuration of the Veeder-Root vapor pressure sensor on a vapor vent stack. **Figure 2B-22** shows the wireless vapor flow meter components.

Dispenser Interface Module (DIM)

Existing Dispenser Interface Modules or DIM communication cards are used to interface to the dispenser Point Of Sale (POS) or controller system to gather fuel transaction data. The ISD Operability Test Procedure provided in Exhibit 9 and in Section 4 of the Veeder-Root ISD Install, Setup and Operation Manual can be used to verify the proper selection and setup of the Dispenser Interface Module. See **Figure 2B-11** for a typical Dispenser Interface Module Illustration.

Tank Inventory Probe Sensor

Existing Tank Inventory Probe sensors (one per gasoline storage tank) are used to measure the amount of vapor space in the Underground Storage Tanks (USTs). The ISD Operability Test Procedure can be used to verify the proper selection and setup of the Tank Inventory Probes. See **Figure 2B-12** for a typical Tank Inventory Probe Sensor.

Shutdown Control

The TLS Console must be wired per the Veeder-Root ISD Install, Setup and Operation Manual 557013-800, Rev. E of the ARB Approved Installation, Operation and Maintenance Manual for the Healy Phase II EVR System Including the Veeder-Root ISD System such that it shall automatically prohibit the dispensing of individual dispensers or through shutdown of all the gasoline turbine pumps during a CP-201 ISD failure alarm. It shall also automatically prohibit the dispensing of all dispensers during TLS Console ISD system power loss.

TLS Console Modules

The ISD Operability Test Procedure in Exhibit 9 and in section 4 of the Veeder-Root ISD Install, Setup, and Operation Manual of the ***ARB Approved Installation, Operation, and Maintenance Manual*** shall be used to verify the proper selection and setup of the TLS Console Modules.

Training Program

All Veeder-Root contractors must successfully complete the applicable Veeder-Root training program before they can install, startup, and service TLS Console equipment. Contractors must have up-to-date Level 1 certification to install the TLS Console ISD system. Contractors must have an up-to-date Level 2, 3 or 4 certification and the ISD certification to startup and service the ISD system. The schedule, fee and registration information for the Authorized Service Contractor (ASC) training program can be found at http://www.veeder.com.

To confirm TLS or ISD training a regulator should send an email to technicaltraining@gilbarco.com with the name (and company) of the ASC to obtain verification of the ASC TLS/ISD training status or call 800-997-7725 and press “4” to get to the Veeder-Root menu and then “*” to speak to a representative or sign on to the Gilbarco Learning Suite at http://wise.gilbarco.com.

Maintenance

The TLS console, including interface modules, do not require scheduled maintenance. ISD System Self-Test Monitoring algorithms are designed to verify proper selection, setup and operation of the TLS console and sensors.

There is no recommended maintenance, inspection nor calibration for the Vapor Flow Meter or the Vapor Pressure Sensor. Servicing should be performed in response to warning or alarm conditions.

RF Wireless Components
The wireless system consists of the following devices (Figure 2B-22)

a. RF Receiver-2
b. RF Repeater-2
c. RF Transmitter-2
d. RF Battery Pack
e. TLS RF Console-2 Box

These devices convert data in smart-sensor-protocol format to RF format and back to smart-sensor format for TLS such that TLS software assumes it is directly connected to the sensor. The transmitter automatically identifies the Flow Meter connected to it and polls it periodically. The collected data is converted to radio format and transmitted through air to receiver. The receiver collects the radio packet and within 200ms sends the data to the TLS RF on RS485 bus. The TLS RF provides this data to TLS on next poll by TLS. To prevent adjacent GDF with wireless equipment from interfering with each others transmissions, dip switches on the Transmitter and Receiver are used to configure a site ID. The Repeater is not required, but may be installed as needed to provide a second path for the wireless signal traveling from Transmitter to Receiver.

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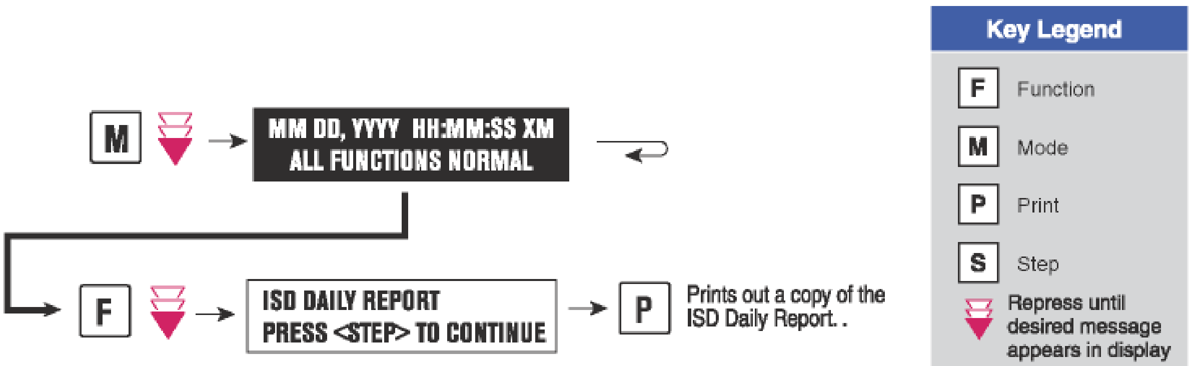
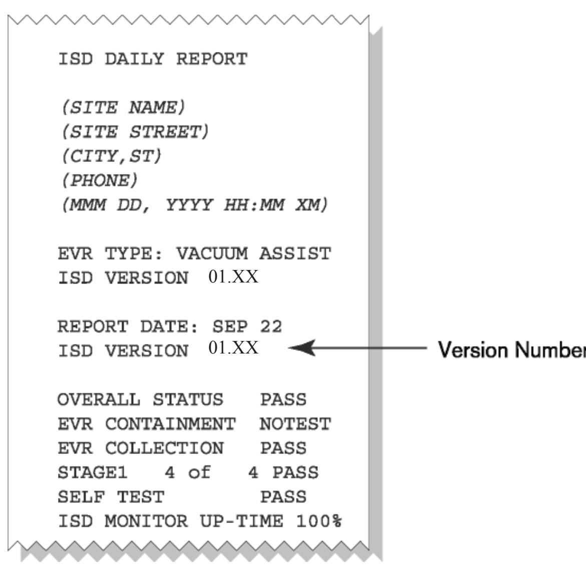
Exhibit 2
Figure 2B-7
Finding The Veeder-Root ISD Version Number

Use the TLS Console <FUNCTION> key to find the ISD Daily Report menu:



The ISD version number can be verified on the TLS Console LCD screen using the <STEP> key or by using the TLS Console <PRINT> key to print and review the latest ISD Daily Report:

Presence of the ISD Daily Report menu and correct ISD software version number is evidence that ISD is installed and activated in the TLS Console.



```
ISD DAILY REPORT

(SITE NAME)
(SITE STREET)
(CITY,ST)
(PHONE)
(MMM DD, YYYY HH:MM XM)

EVR TYPE: VACUUM ASSIST
ISD VERSION  01.XX

REPORT DATE: SEP 22
ISD VERSION  01.XX

OVERALL STATUS    PASS
EVR CONTAINMENT   NOTEST
EVR COLLECTION    PASS
STAGE1   4 of   4 PASS
SELF TEST         PASS
ISD MONITOR UP-TIME 100%
```

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Exhibit 2
Figure 2B-8
Standard TLS Console

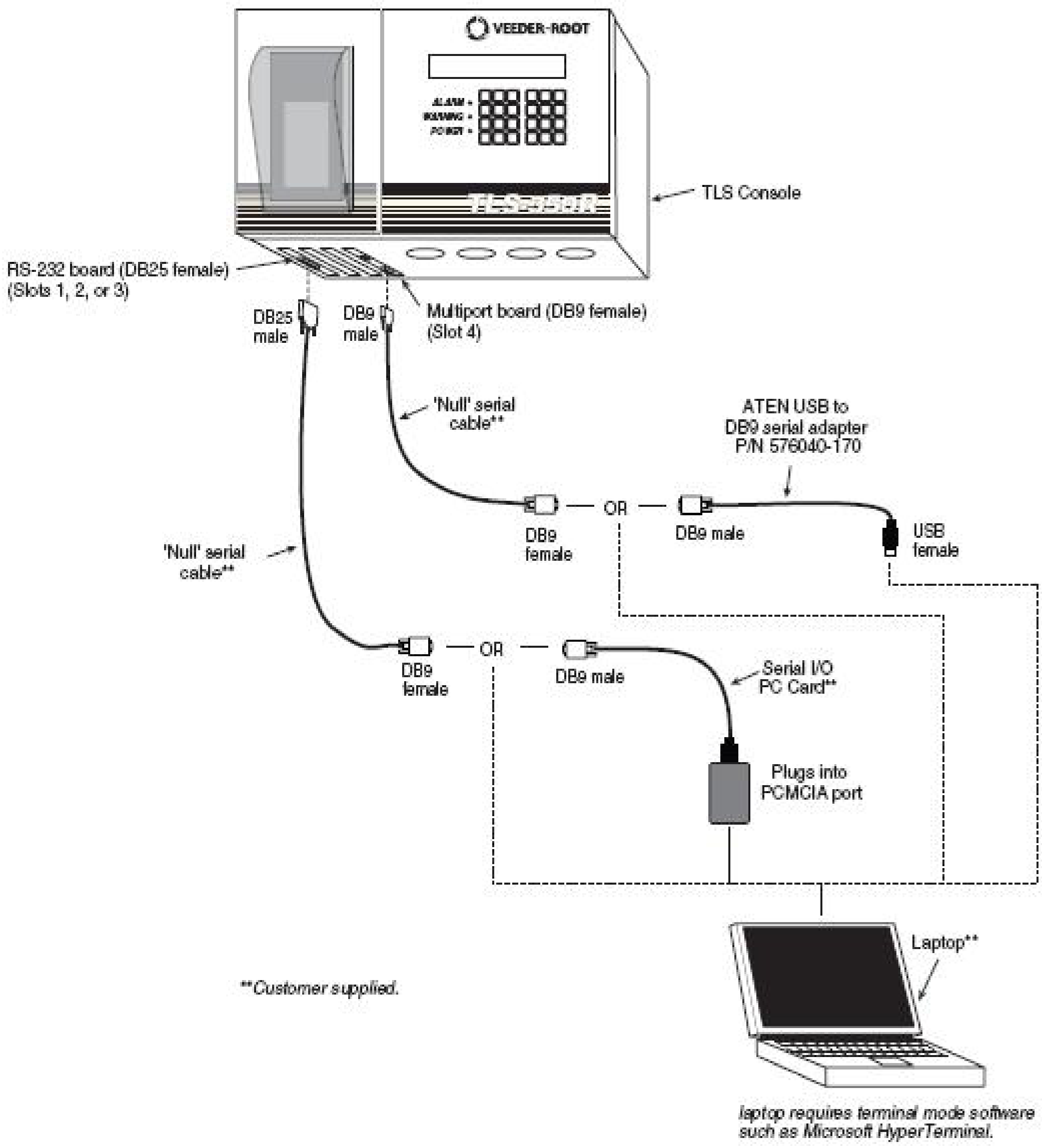

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Exhibit 2

Figure 2B-9
Veeder-Root 331847-XXX
Vapor Flow Meter

Figure 2B-10
Veeder-Root 331946-001
Vapor Pressure Sensor

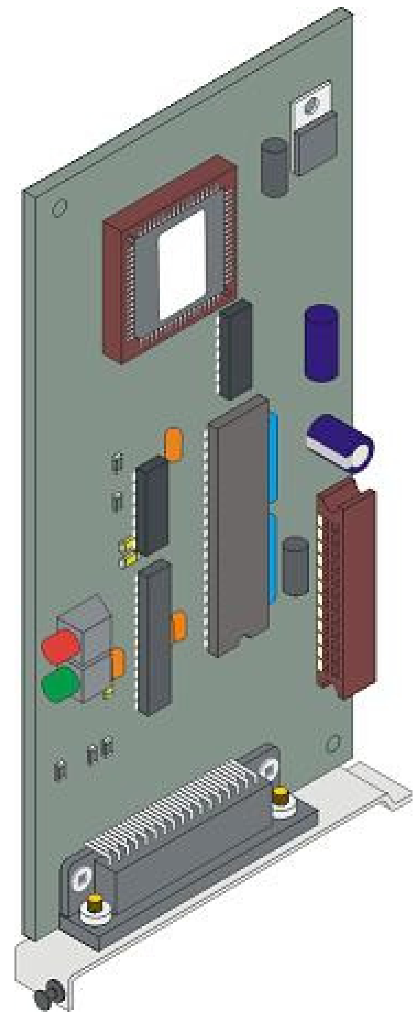

Figure 2B-11
Veeder-Root
Dispenser Interface Module
(DIM)

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Healy Phase II EVR System
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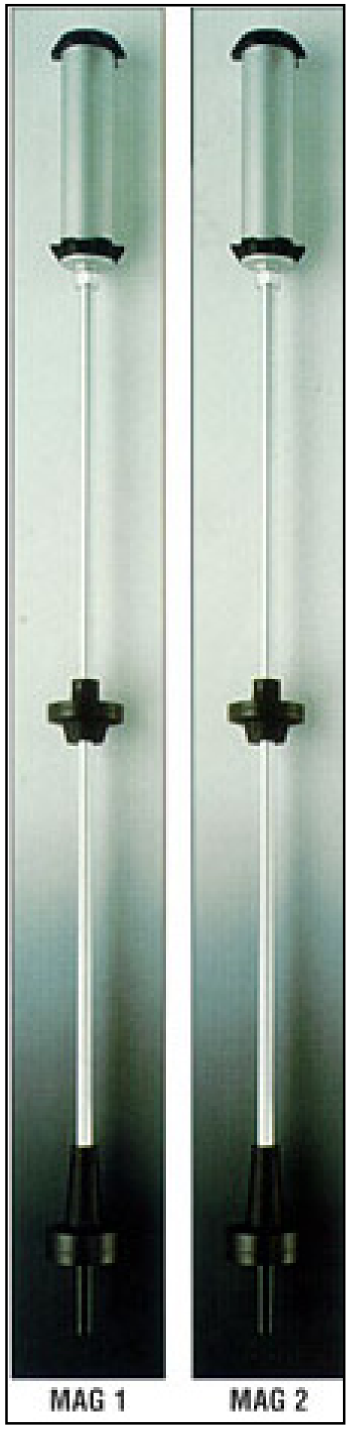
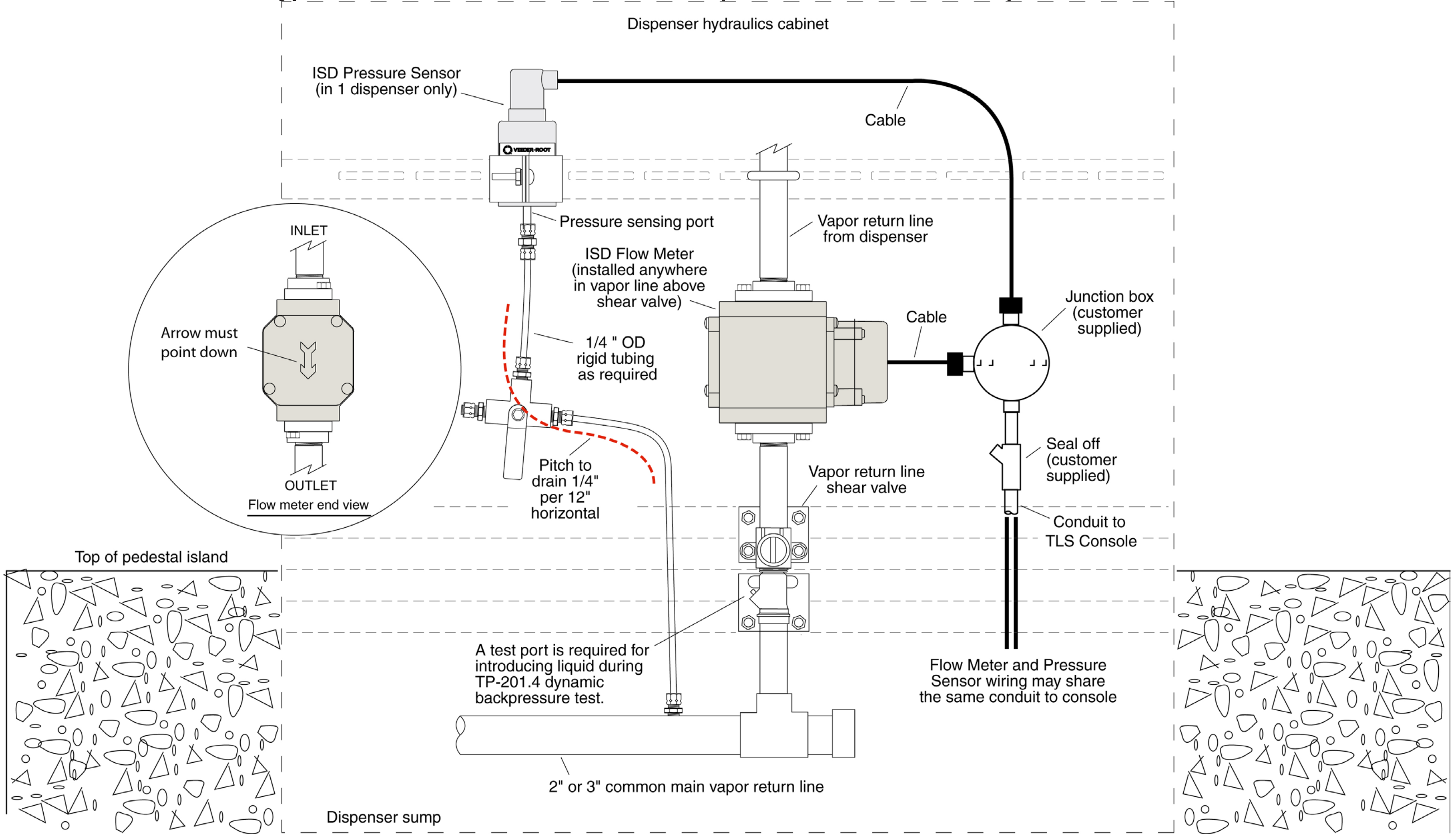
Exhibit 2
Figure 2B-12
Tank Inventory Probe Sensor



Executive Order VR-202-N
Healy Phase II EVR System
Including In-Station Diagnostics (ISD) Systems

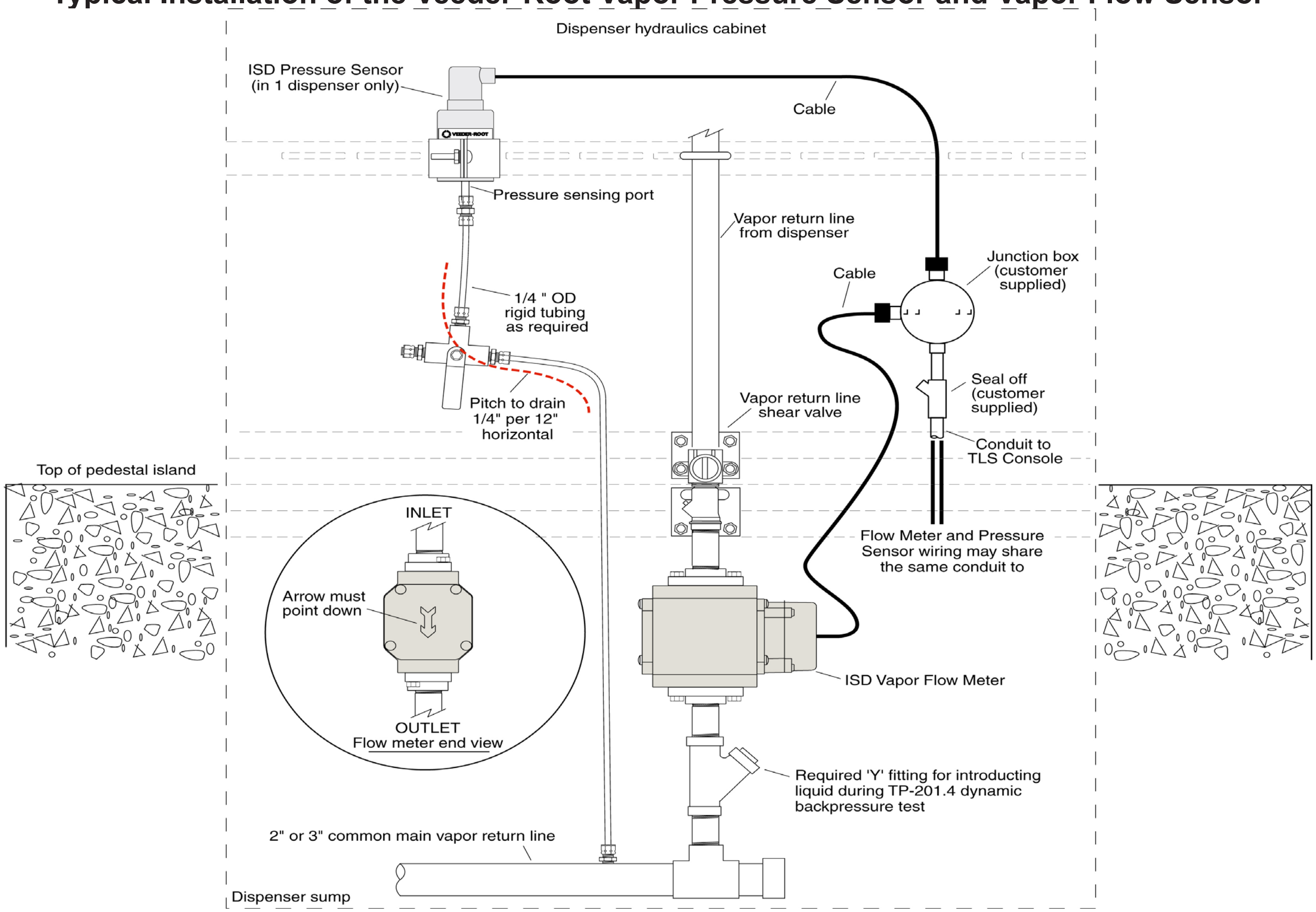
Exhibit 2
Figure 2B-13

Typical Installation of the Veeder-Root Vapor Pressure Sensor & Vapor Flow Sensor



Executive Order VR-202-N
Healy Phase II EVR System
Including In-Station Diagnostics (ISD) Systems

Exhibit 2
Figure 2B-14
Typical Installation of the Veeder-Root Vapor Pressure Sensor and Vapor Flow Sensor



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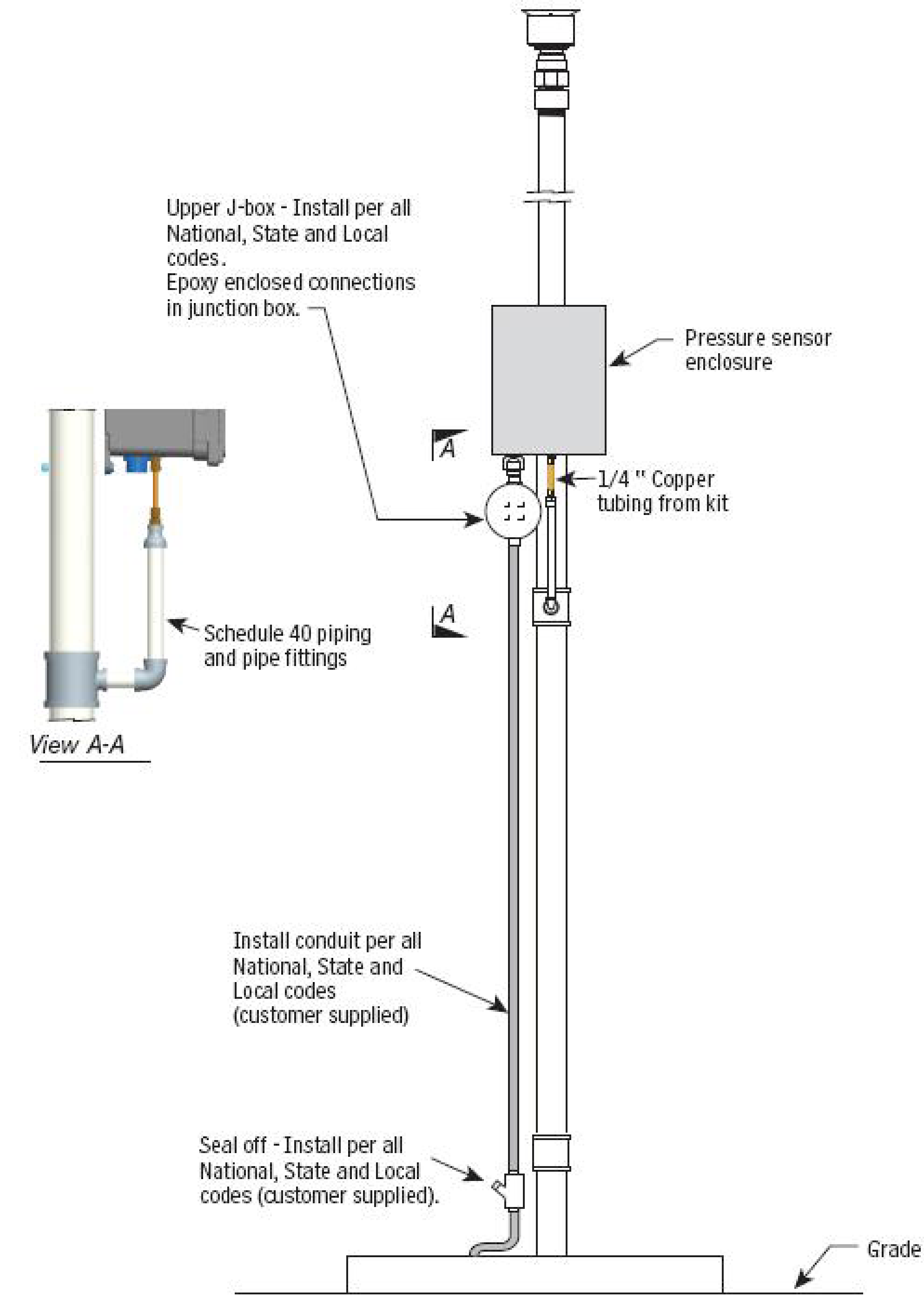
Healy Phase II EVR System
Including In-Station Diagnostic (ISD) Systems

Exhibit 2
Figure 2B-14-I
Typical Installation of the Veeder-Root Vapor Pressure Sensor on a vapor vent stack



Option II - INCON Vapor Recovery Monitoring (VRM) System Specifications

Console & VRM Software Version Number

The ISD audible alarms shall be installed at a location that is most likely to be heard by the station attendant during normal station operation (e.g., cash register). The console shall be installed in a location that allows the Ethernet or RS232 port (COMM 1) to be easily accessible, and if applicable, per district requirements, for use at anytime. A vacant RS232 serial port (COMM 1) shall always be available to electronically download reports.

The presence of VRM and the VRM software version number can be verified on the Console touchscreen screen by pressing the VRM Icon key or by printing a VRM Daily or Monthly Report. See **Figure 2B-15** for the verification instructions.

The Console must have a printer.

The Console is equipped with password security features which prohibit the ability to make changes to the system. Instructions and passwords shall be maintained on site in accordance with air district requirements and shall be available to the air district upon request.

The Table below provides a list of expiration dates for each ISD Software version.

INCON ISD System Software Version Expiration Dates

Phase II EVR System Description	Software Version	Last Date Software May Remain In Use	Notes
Healy (Assist) VR-202 Series	Version 1.0.0 and 1.1.0 for Multi-Product (six pack) Dispensers	01/01/2014	Does not apply to GDFs equipped with unihose dispensers. Subject GDFs must upgrade to the certified software version (1.2.0 or later)
	Version 1.2.0 for Multi-Product (six pack) Dispensers	N/A	May Remain in Use at Existing Facilities Required for New Installations and Major Modifications

Operability Test Procedure

The INCON VRM operability test procedure provided in Exhibit 10, and in the VRM Operability Testing section of the **ARB Approved Installation, Operation and Maintenance Manual**, shall be used at GDF sites to determine the operability of the INCON VRM system to comply with applicable performance standards and performance specification in CP- 201. Testing the VRM equipment in accordance with this procedure will verify the proper selection, setup and operation of the Console sensors and interface modules.

Vapor Flow Meter

The INCON VRM system requires one Vapor Flow Meter per dispenser installed via the ARB Approved Vapor Flow Meter Manual 000-2144, Rev. A. The Vapor Flow Meter shall be installed into dispensers listed in Exhibit 1 of this Executive Order in accordance with the **ARB Approved Installation, Operation and Maintenance Manual**. The Vapor Flow Meter is an intrinsically safe sensor that is wired to the Console Probe Module orTS-DTU Module via a conduit dedicated to low-voltage sensors. **Figure 2B-17** shows the Vapor Flow Meter. **Figure 2B-19** shows the installation configuration.

Vapor Pressure Sensor

The INCON VRM system requires one Vapor Pressure Sensor per GDF installed into one of the dispensers located with the shortest run to the underground storage tanks (If a row of dispensers are equal distance from the tank pad, any dispenser can be used) in accordance with the **ARB Approved Installation, Operation and Maintenance Manual**. The Vapor Pressure Sensor shall be installed into dispensers listed in Exhibit 1 of this Executive Order. The Vapor Pressure Sensor is an intrinsically safe sensor that is wired to the Console's 4-20mA Module or a TS-DTU Module via a conduit dedicated to low-voltage sensors. **Figure 2B-18** shows a Vapor Pressure Sensor illustration. **Figure 2B-20** shows the installation configuration.

Dispenser Interface Module (DIM)

Existing Dispenser Interface Modules or DIM communication cards are used to interface to the dispenser Point Of Sale (POS) or controller system to gather fuel transaction data. The ISD Operability Test Procedure provided in Exhibit 10 and in the **ARB Approved Install, Operators, and Maintenance Manual** can be used to verify the proper selection and setup of the Dispenser Interface Module.

Data Transfer Unit

The optional Data Transfer Unit can be installed as a replacement for underground wire and conduit for both the Vapor Flow Meter and Vapor Pressure Sensor. The TS-DTU must be wired per the INCON Data Transfer Unit Dispenser Retrofit Manual 000-2146, Rev. B of the **ARB Approved Installation, Operation and Maintenance Manual.** A minimum of two units are required when installing DTUs, one in the GDF and one in a dispenser. A single site can mix and match between dedicated cables and DTU installation methods. See Figure 2B-21.

Shutdown Control

The Console must be wired per the INCON VRM Install, Operators, and Maintenance Manual 000-2058, Rev. E of the **ARB Approved Installation, Operation and Maintenance Manual** such that it shall automatically prohibit the dispensing of fuel through shutdown of individual dispensers during a CP-201 ISD failure alarm.

Console Modules

The VRM Operability Test Procedure in Exhibit 10 and in the INCON VRM Install, Operators, and Maintenance Manual 000-2058, Rev E of the **ARB Approved Installation, Operation, and Maintenance Manual** shall be used to verify the proper selection and setup of the Console Modules.

Training Program

All INCON contractors must successfully complete the applicable Franklin Fueling Systems training program before they can install, startup, and service INCON Console equipment. Contractors must have up-to-date Level 1 & 2 certifications to install and startup the TS Console. Contractors must have an up-to-date Level 5 certification to install, startup and service the VRM system. The schedule, fee and registration information for the Authorized Service Contractor (ASC) training program can be found at http://techlab.franklinfueling.com.

A list of certified contractors with current console and VRM training will be available at the Franklin Fueling web page,
http://techlab.franklinfueling.com/mod/resource/view.php?id=64.

Maintenance

The console, including interface modules, do not require scheduled maintenance. The VRM System uses a Self-Test Monitoring feature that is designed to verify proper selection, setup and operation of the console and sensors. There is no recommended maintenance, inspection nor calibration for the Vapor Flow Meter or the Vapor Pressure Sensor. Servicing should be performed in response to warning or alarm conditions.

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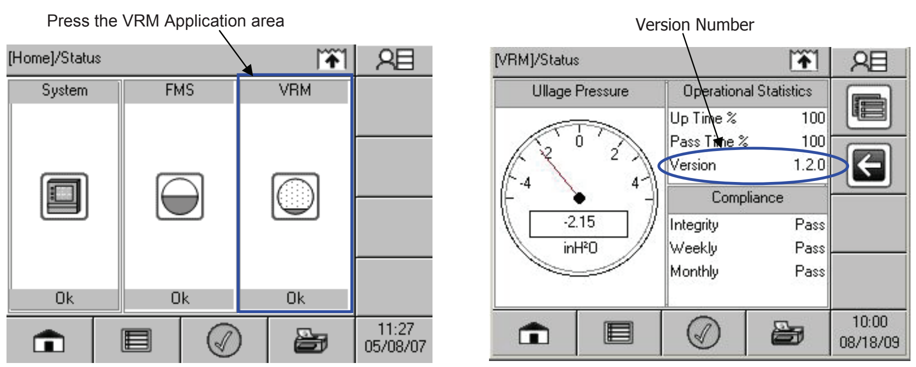
Exhibit 2
Figure 2B-15
Finding The INCON VRM Version Number

Version number on the LCD:



Version number on the VRM Daily Report or Monthly Report:

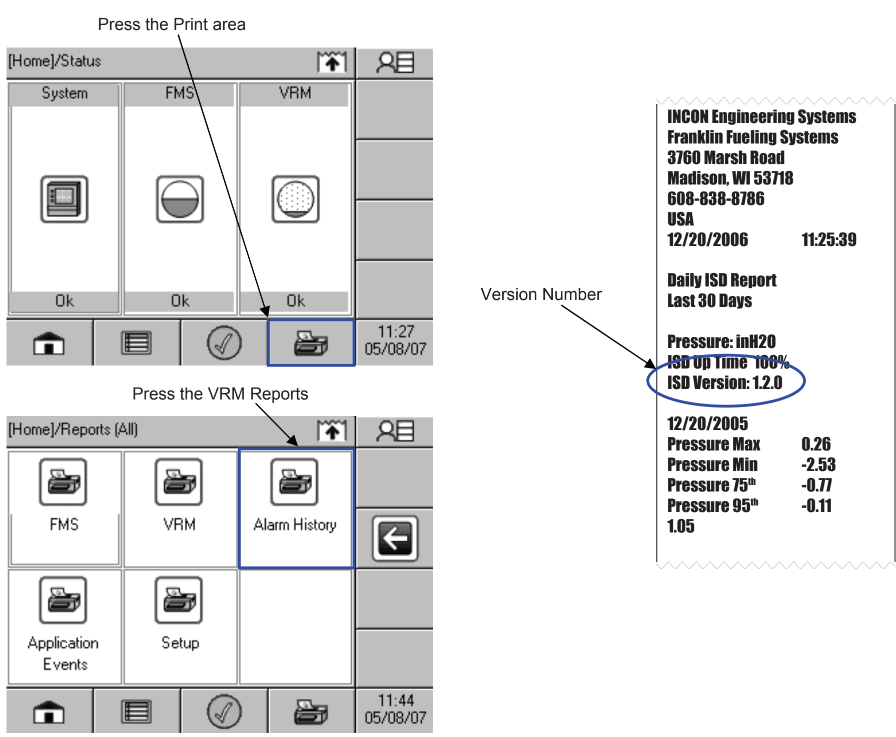


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Exhibit 2
Figure 2B-16
Standard Tank Sentinel Console

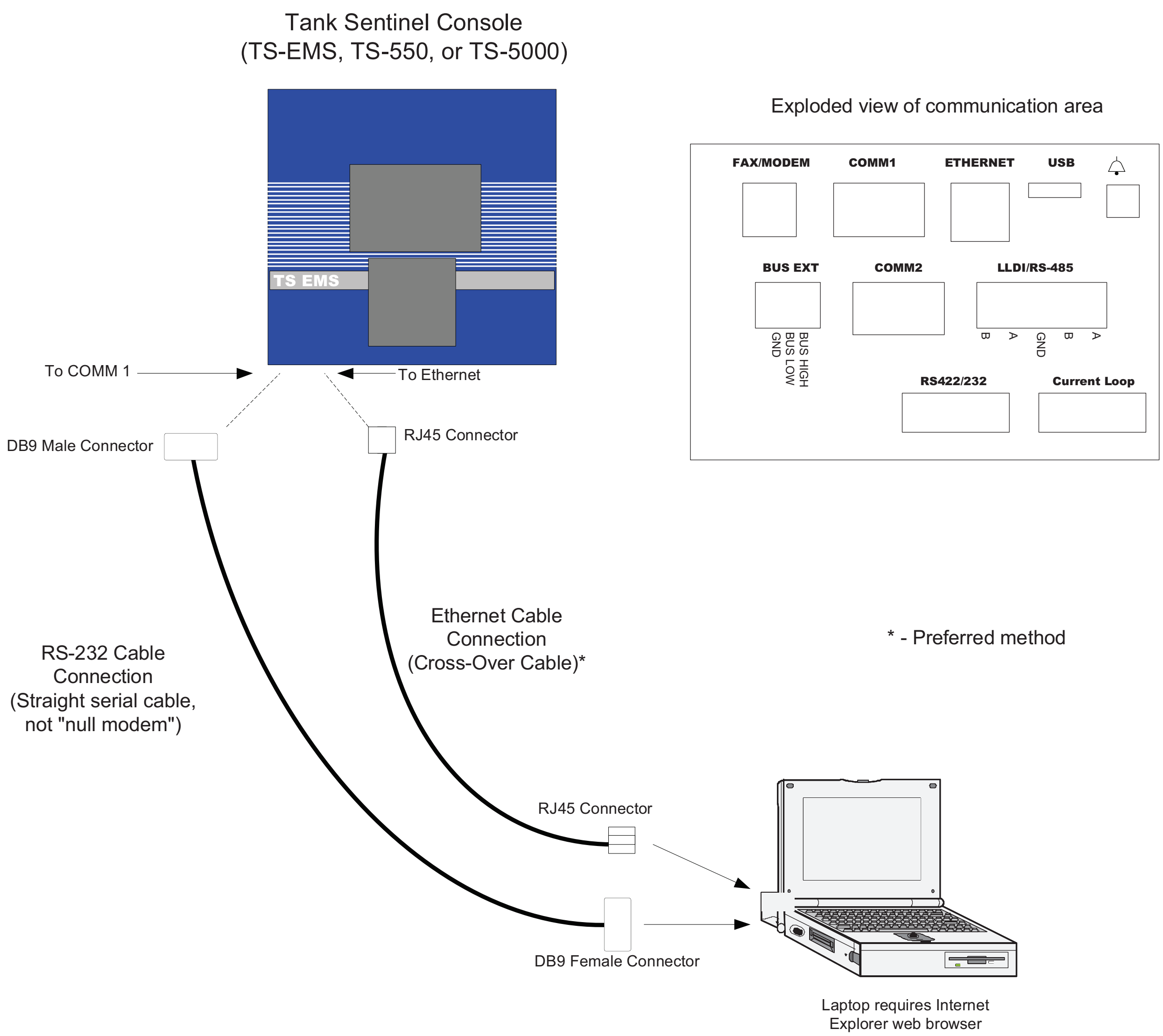

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Exhibit 2

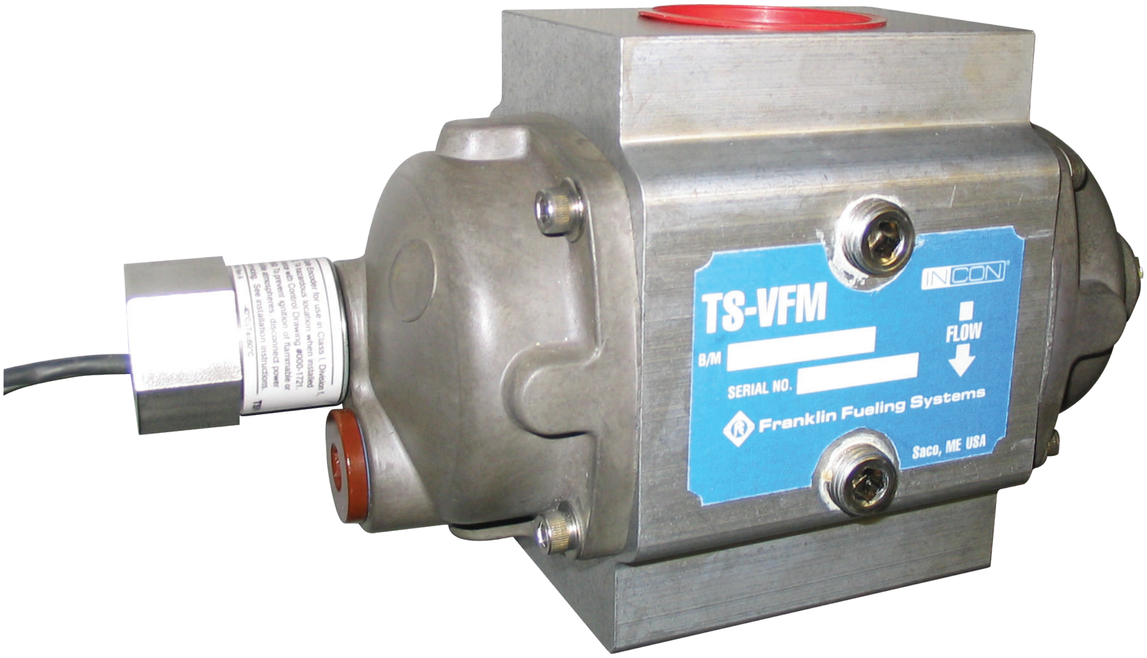

Figure 2B-17
INCON TS-VFM
Vapor Flow Meter

Figure 2B-18
INCON TS-VPS
Vapor Pressure Sensor

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Exhibit 2
Figure 2B-19
Typical Installation of the INCON Vapor Flow Meter

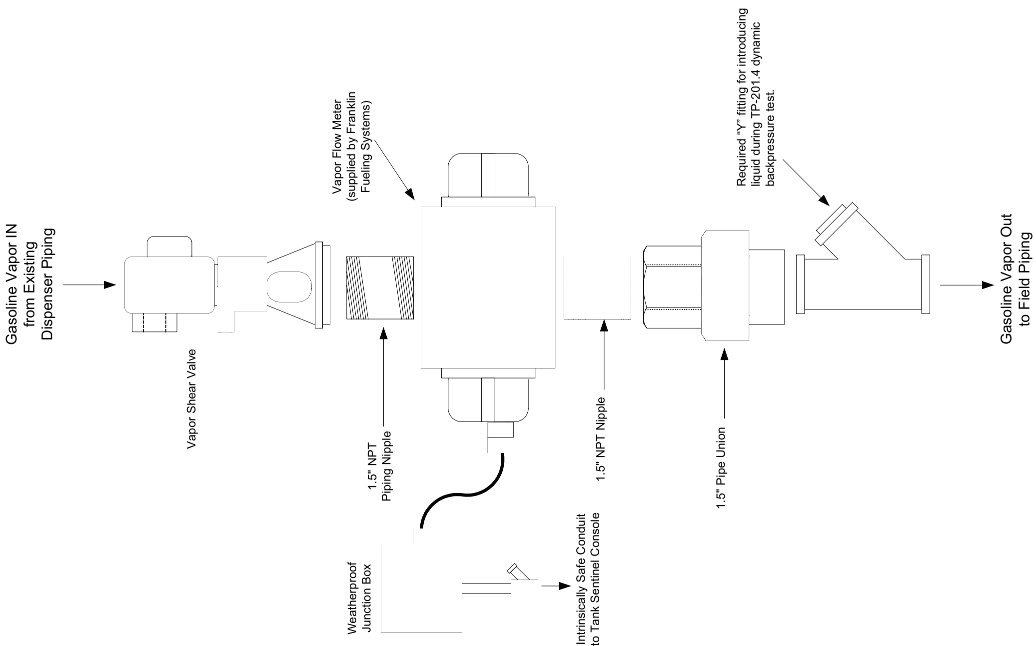

Figure 2
Flow Meter Below Shear Valve

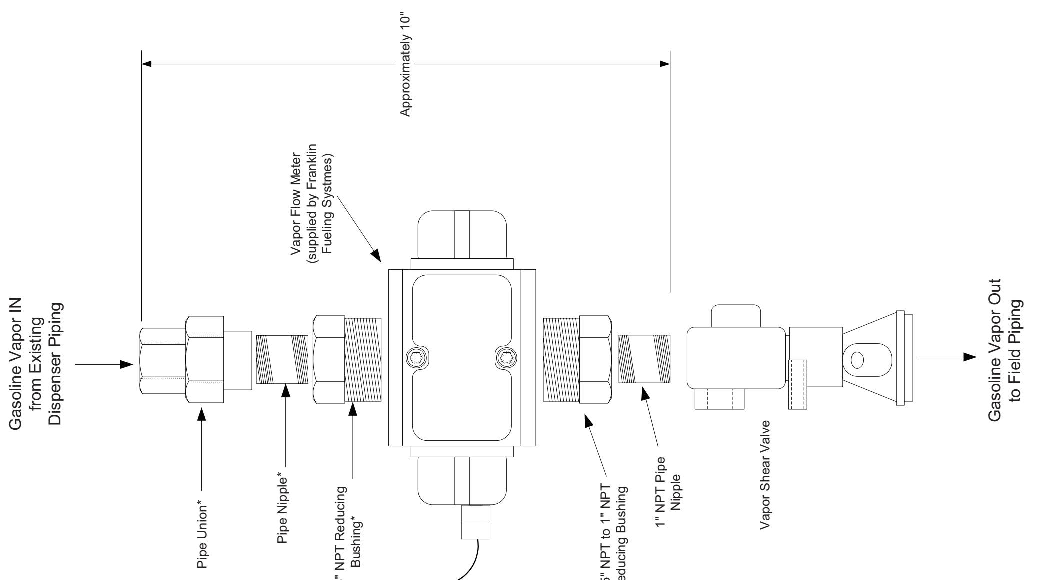

Figure 1
Flow Meter Above Shear Valve

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Exhibit 2
Figure 2B-20
Typical Installation of the INCON Vapor Pressure Sensor

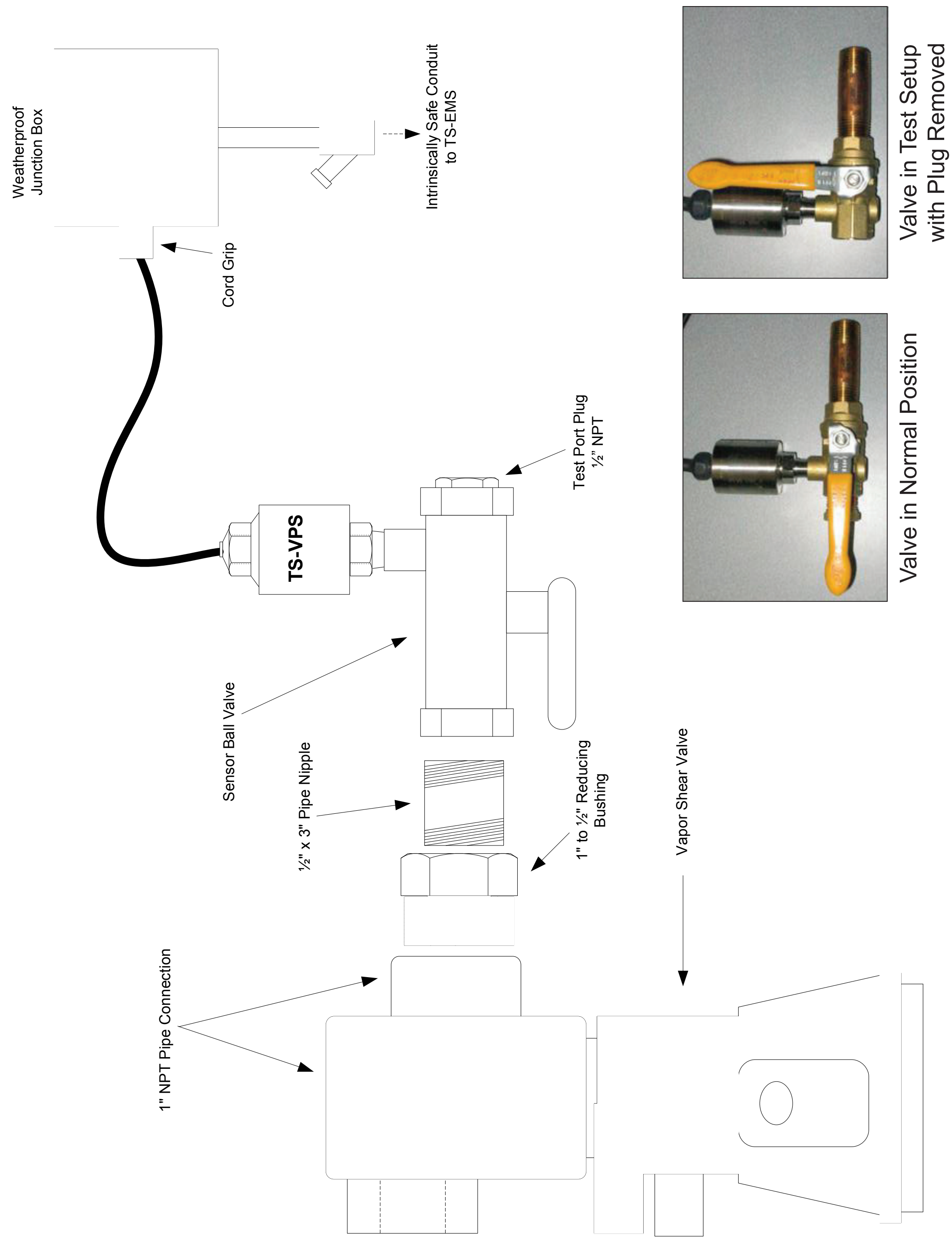

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Exhibit 2
Figure 2B-21
Data transfer Unit

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Healy Phase II EVR System
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Exhibit 2
Figure 2B-21
Example of a GDF Maintenance and Alarm History Record

Date of Maintenance/ Test/Inspection/Failure/ Alarm History (including date and time of maintenance call)	Repair Date To Correct Test Failure	Maintenance/Test/Inspection Performed and Outcome	Affiliation	Name and Technician ID number of Individual Conducting Maintenance or Test	Telephone Number

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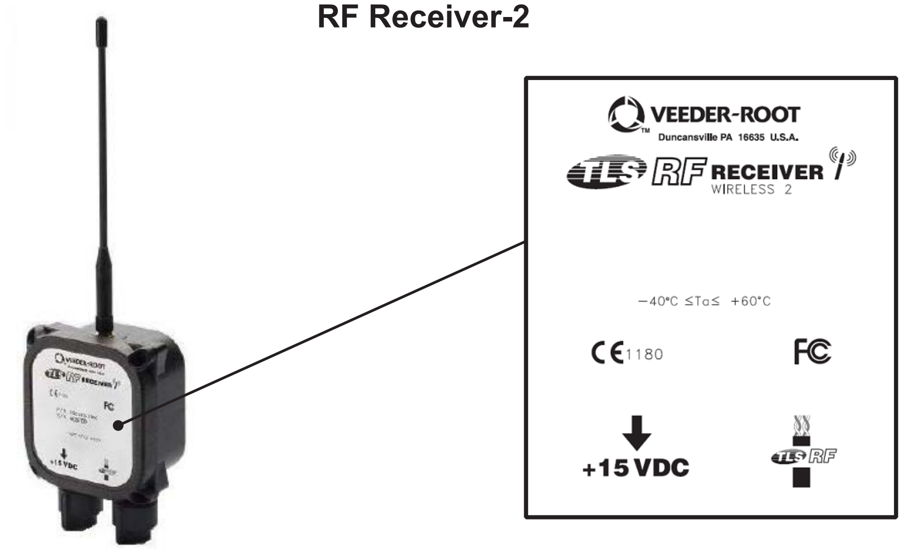
Including In-Station Diagnostic (ISD) Systems

Exhibit 2
Figure 2B-22
Wireless Components for Veeder-Root ISD Vapor Flow Meter

RF Receiver-2



RF Repeater-2

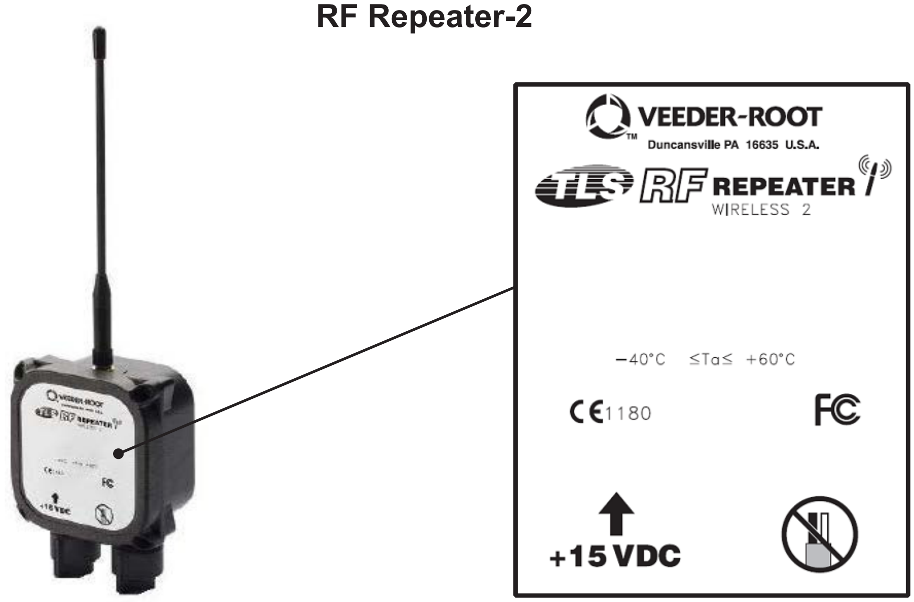


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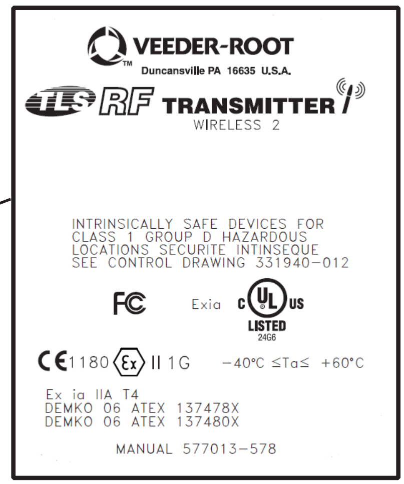
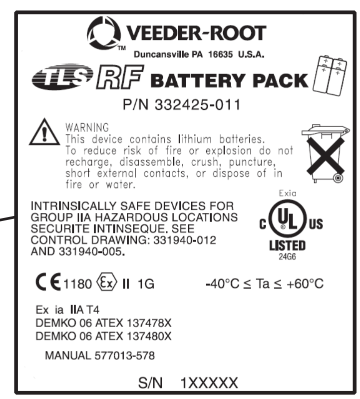
Exhibit 2
Figure 2B-22 (continue)
Wireless Components for Veeder-Root ISD Vapor Flow Meter

RF Transmitter-2



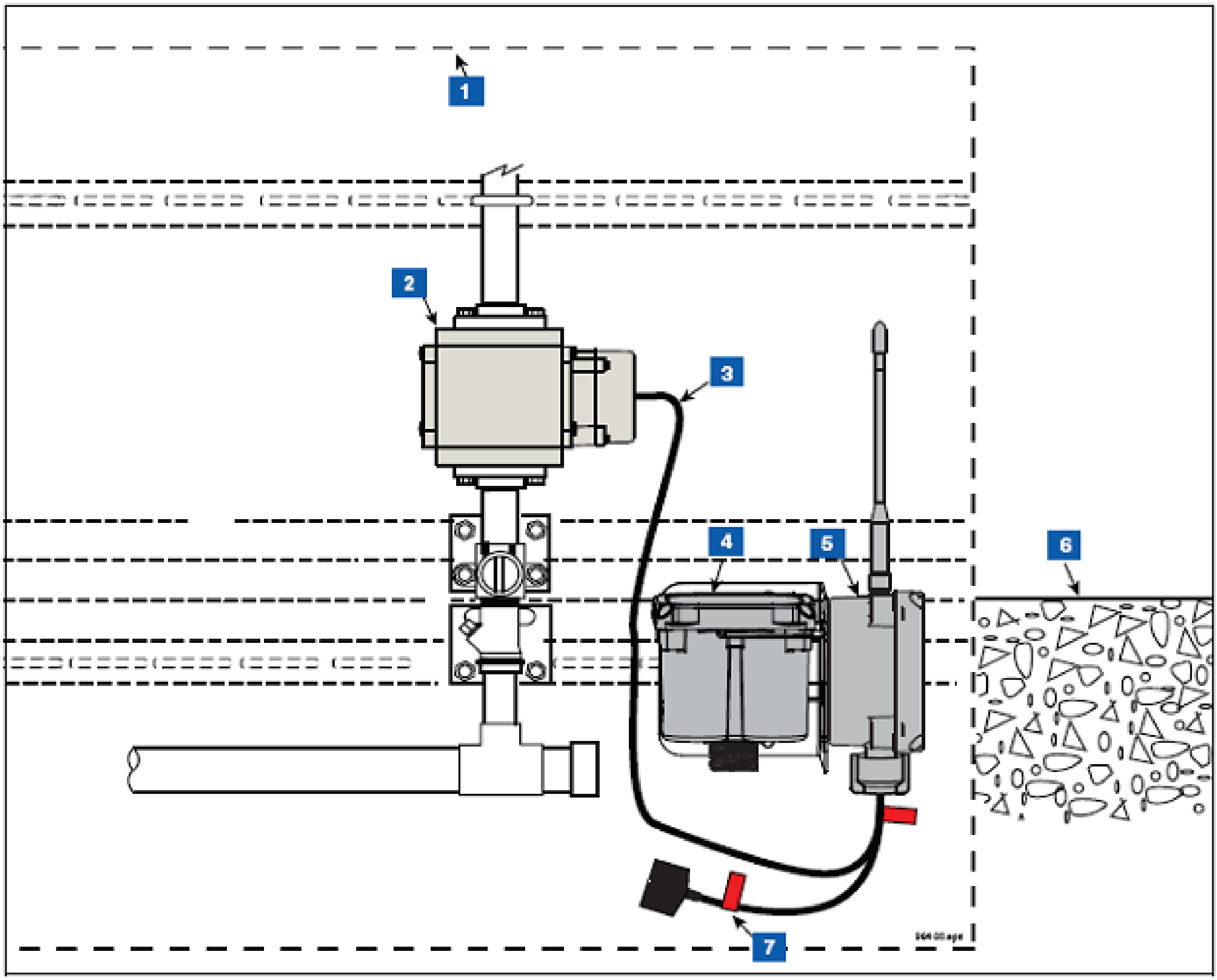
RF Battery Pack



TLS RF Console-2

Executive Order VR-202-N
Healy Phase II EVR System
Including In-Station Diagnostic (ISD) Systems

Exhibit 2
Figure 2B- 23
Typical Installation of the Veeder-Root Vapor Flow Meter with VFM Transmitter in Dispenser



	Legend for Numbers Boxes in Figure 2B -		
1.	Base of Dispenser cabinet VFM Transmitter	5.	Transmitter
2.	VFM	6.	Top of Dispenser Pedestal
3.	VFM cable	7.	Battery caution label attached to battery cable (2 places)
4.	Battery Pack		

Exhibit 4

Determination of Static Pressure Performance of the Healy Clean Air Separator
(Executive Orders VR-201-N and VR-202-N)

1 APPLICABILITY

Definitions common to all certification and test procedures are in:

D-200 Definitions for Vapor Recovery Procedures

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

1.1 This test procedure is used to quantify the vapor tightness of the Healy Clean Air Separator (CAS) pressure management system installed as part of a gasoline dispensing facility (GDF) under either Executive Order VR-201-N or VR-202-N.

2 PRINCIPLE AND SUMMARY OF TEST PROCEDURE

2.1 The Clean Air Separator, while isolated from the vapor recovery system, is evaluated for vapor integrity using a vacuum decay procedure. The vacuum decay after 5 minutes is compared with an allowable value. The allowable value is based upon the initial vacuum level when conducting the test using the table provided in this test procedure.

2.2 A positive pressure decay procedure is included that conducts the same evaluation as the vacuum decay but with positive pressure. This test is conducted if there is insufficient vacuum (not greater than – 2.00" wc) to conduct the vacuum decay. Districts have the authority to specify in the permit conditions that this positive pressure test is to be conducted even if the vacuum test has been conducted.

3 RANGE

3.1 The full-scale range of the electronic measuring device shall not exceed 0-20.00" wc with a minimum accuracy of not less than 0.25 percent of full-scale.

4 INTERFERENCES

4.1 Leaks in the piping for the Clean Air Separator could bias the test results toward non-compliance.

4.2 Introduction of gaseous nitrogen into the system at flow rates exceeding 4 CFM (240 CFH) may bias the results of the test toward non-compliance. Only gaseous nitrogen shall be used to conduct this test.

4.3 Pressurizing the Clean Air Separator bladder greater than 14.00” wc could damage the bladder, biasing the test toward non-compliance.

4.4 Thermal Bias for Electronic Manometers

Electronic manometers shall have a warm-up period of at least 15 minutes followed by a drift check of 5 minutes. If the drift exceeds 0.01” wc, the instrument should not be used.

5 APPARATUS

5.1 Nitrogen

Use commercial grade gaseous nitrogen in a high pressure cylinder, equipped with a two-stage pressure regulator.

5.2 Pressure Measurement Device

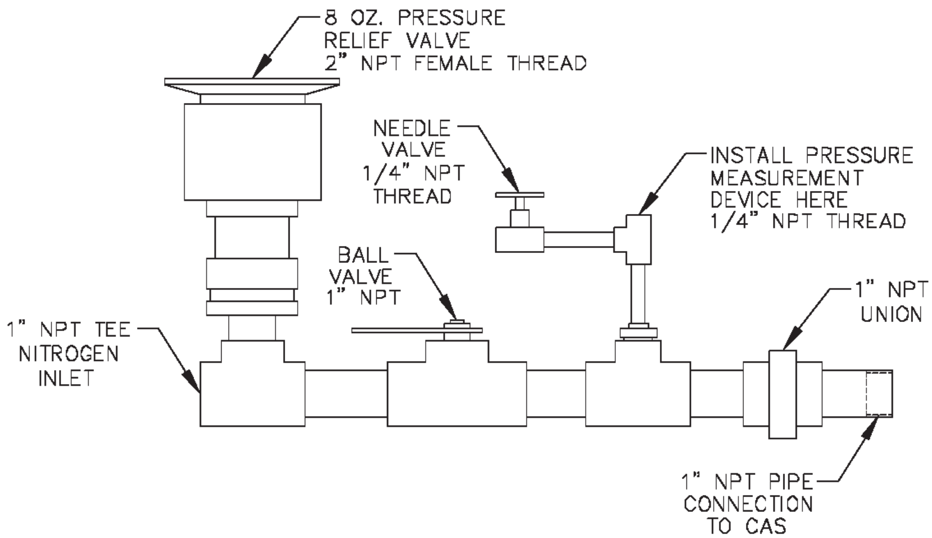
Use an electronic pressure measurement device to monitor the pressure decay in the Clean Air Separator. The pressure measurement device shall, at a minimum, be readable to the nearest 0.01” wc.

5.3 Test Port Assembly

Use a test port assembly constructed similar to the one in Figure A. The assembly should have an 8 oz. Pressure Relief valve, to ensure that the Clean Air Separator is not over pressurized. The Model 9968 Clean Air Separator Test Port Assembly can be purchased from Healy Systems, Inc.

Figure A

Clean Air Separator Test Port Assembly



5.4 Stopwatch

Use a stopwatch accurate to within 0.2 seconds.

5.5 Flow Meter

Use a flow meter to determine the required pressure setting of the delivery pressure gauge on the nitrogen supply pressure regulator. This pressure shall be set such that the nitrogen flow rate is between 2.0 CFM (120 CFH) and 4.0 CFM (240 CFH).

5.6 Leak Detection Solution

Any liquid solution designed to detect vapor leaks may be used to verify the pressure integrity of the test equipment prior to conducting the test.

5.7 Condensate Collection Vessel

A container approved for use with gasoline that can hold at least a half gallon of material.

5.8 Graduated Cylinder

A graduated cylinder suitable for use with gasoline capable of measuring to the nearest ounce or mL.

6 PRE-TEST PROCEDURES

6.1 The following safety precautions shall be followed:

6.1.1 Only gaseous nitrogen shall be used to pressurize the system.

6.1.2 An 8 oz. pressure relieve valve shall be installed on the Test Port Assembly to prevent the possible over-pressurizing of the Clean Air Separator.

6.1.3 A ground strap should be employed during the introduction of nitrogen into the system.

6.2 There shall be no Phase I bulk product deliveries into or out of the gasoline storage tank(s) within the three (3) hours prior to the test or during the performance of this test procedure.

6.3 All pressure measuring device(s) shall be bench calibrated using a reference standard. Calibration shall be performed at 20, 50, and 80 percent of full scale. Accuracy shall be within two percent at each of these calibration points.

Calibrations shall be conducted on a frequency not to exceed 180 days. Calibration documentation shall be maintained with the equipment at all times.

6.4 Use the flow meter to determine the nitrogen regulator delivery pressures that correspond to nitrogen flow rates of 2.0 CFM (120 CFH) and 4.0 CFM (240 CFH). These pressures define the allowable range of delivery pressures acceptable for this test procedure. The flow meter shall be connected in-line between the nitrogen supply regulator and the Test Port Assembly during pressurization. The flow meter may be connected in-line between the nitrogen supply regulator and the Test Port Assembly during the test.

6.5 The electronic pressure measurement device shall be subject to warm-up and drift check before use; see Section 4.5.

6.6 The four ball valves used in the installation of the Clean Air Separator are lockable and shall be locked in the position shown in Figure 2B-2 or 2B-2H of Exhibit 2 and in Figure 1 or Figure 1H of this Exhibit during normal operation. Figure 1 and 2B-2 apply to vertical CAS installations and Figure 1H and 2B-2H apply to horizontal CAS installations. The four padlocks provided by Healy Systems, Inc. in their installation kit are keyed the same. However, it is possible that one or more of the padlocks on the Clean Air Separator could have been replaced (seizing, damage, broken key, etc.). Conducting this test will require a set of keys necessary to unlock all padlocks.

6.7 Verify that the Clean Air Separator is in its normal operating configuration by confirming that all components are as indicated (See Figure 1 or Figure 1H):

Valve “A” - Open
Valve “B, C and D” - Closed
Pipe End “E” - Plugged
Tee Branch “F” - Plugged

Figure 1

Normal Clean Air Separator Operating Configuration

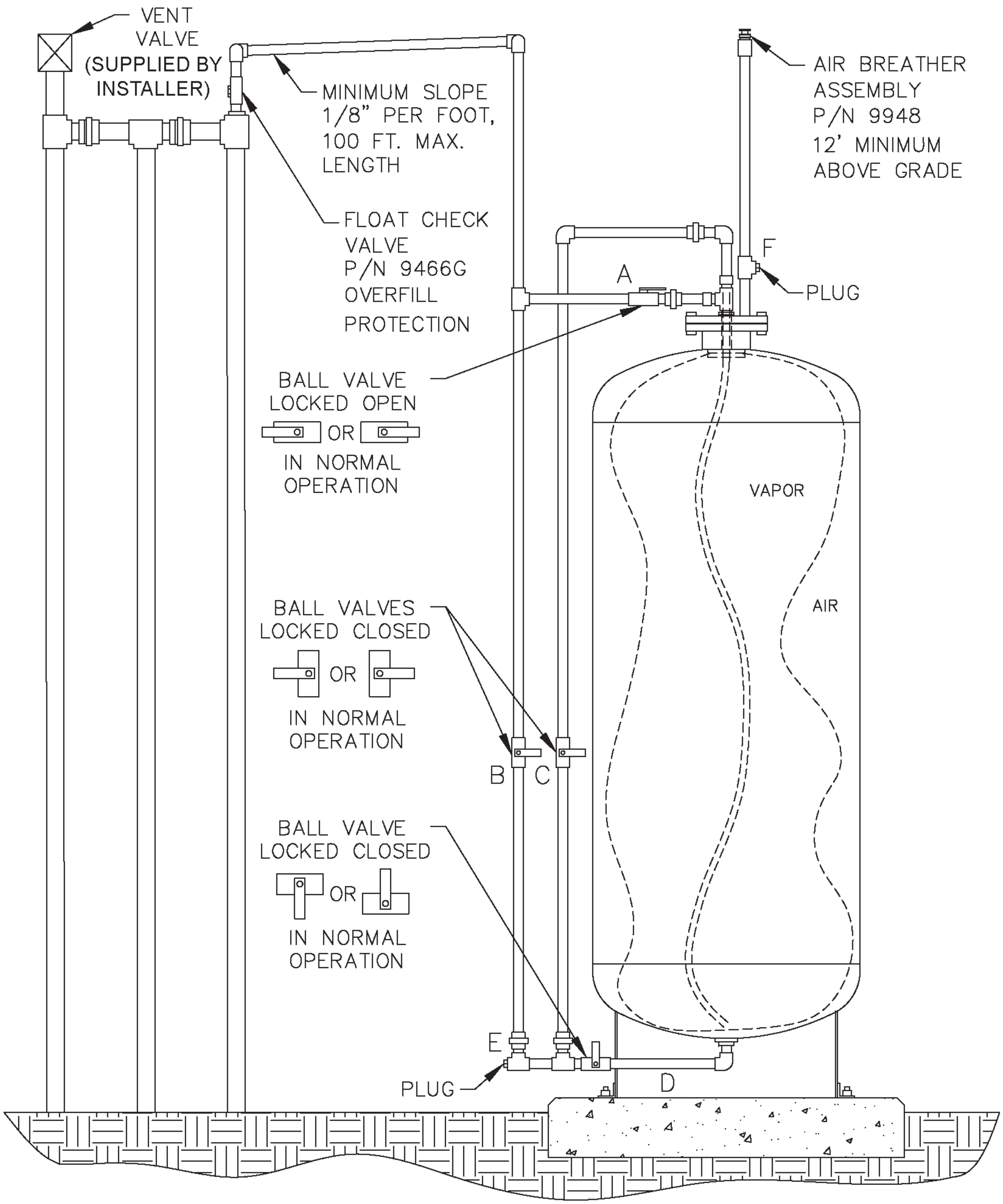
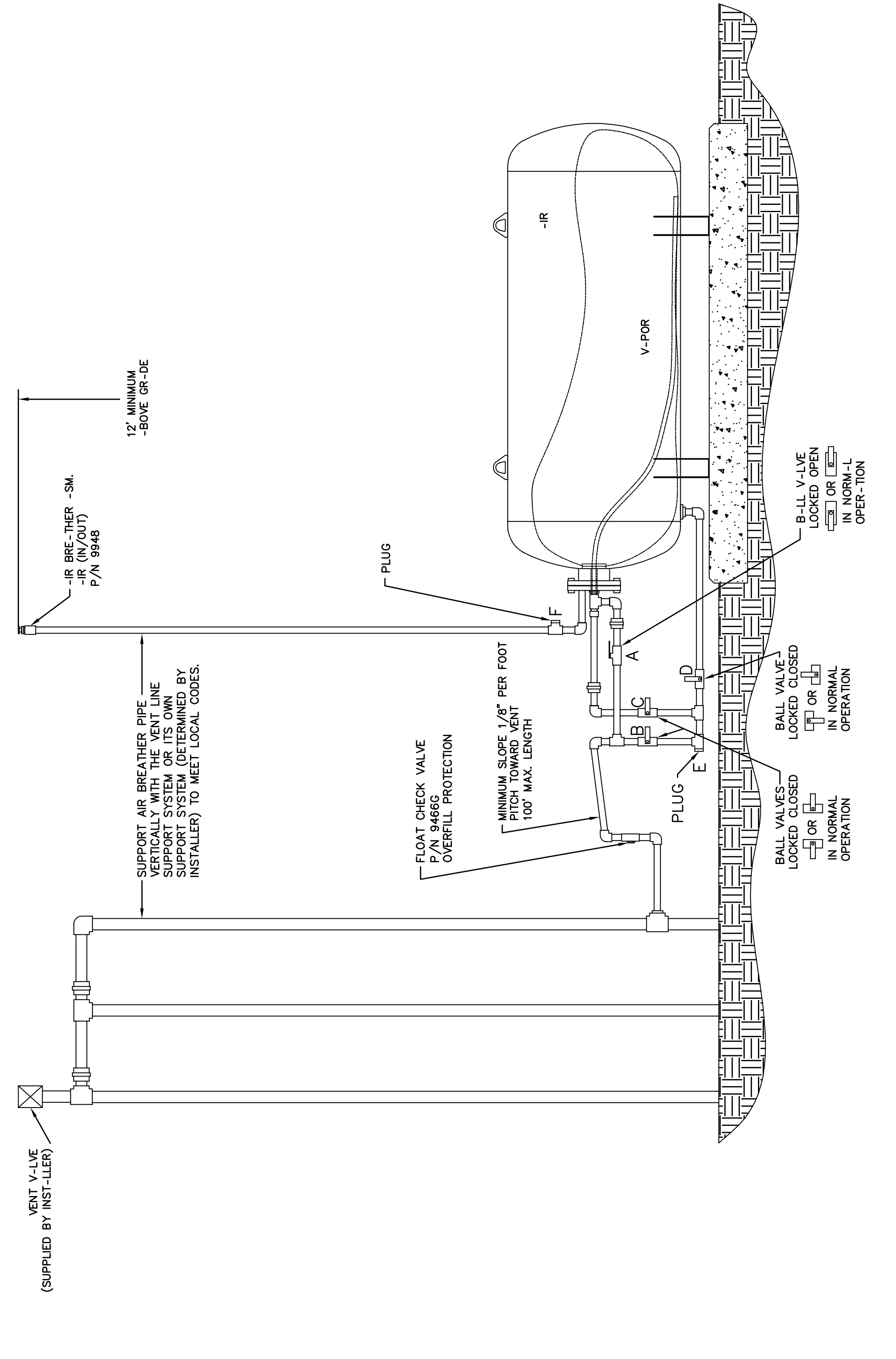


Figure 1H

Normal Clean Air Separator Operating Configuration



6.8 Installing the Test Port Assembly

6.8.1 Open the ball valve marked “B”, shown in Figure 1 or Figure 1H. This ensures that if there is any condensate in the primary connection line to the Clean Air Separator it will drop down into the lower section of the piping configuration, so that it can be measured. Close the valve after approximately 30 seconds.

6.8.2 Position the condensate collection vessel below plug “E” prior to removing it. Remove the 1” plugs from locations “E” and “F” from Figure 1 or Figure 1H. Transfer the collected condensate into the graduated cylinder. If there is more than 16 oz. (473 mL) of liquid condensate, the bladder and vapor processor vessel must be drained. Conduct the bladder and vessel draining procedures from the Clean Air Separator section of the ***ARB Approved Installation, Operation and Maintenance Manual***.

Note: Depending upon the size of the graduated cylinder and the amount of condensate, it may take multiple transfers from the condensate collection vessel to get the total condensate measurement.

6.8.3 Install the Test Port Assembly to the Clean Air Separator at location “E”. See Figure 2 or Figure 2H. Figure 2 applies to vertical CAS installations and Figure 2H applies to horizontal CAS installations.

6.8.4 Connect the gaseous nitrogen supply to the Test Port Assembly. See Figure 2 or Figure 2H.

6.8.5 Check the test equipment and piping isolated from normal Clean Air Separator operation by the ball valves “B, C and D” by pressurizing with nitrogen to a pressure of 4” wc ± 1” wc and closing the ball valve on the Test Port Assembly. Use leak detection solution. Tighten as necessary. The test equipment shall have no leaks.

6.8.6 Open the needle valve on the Test Port Assembly to bleed the pressure off the equipment. Keep ball valve on Test Port Assembly closed.

Figure 2

Clean Air Separator in Configuration to Conduct Test

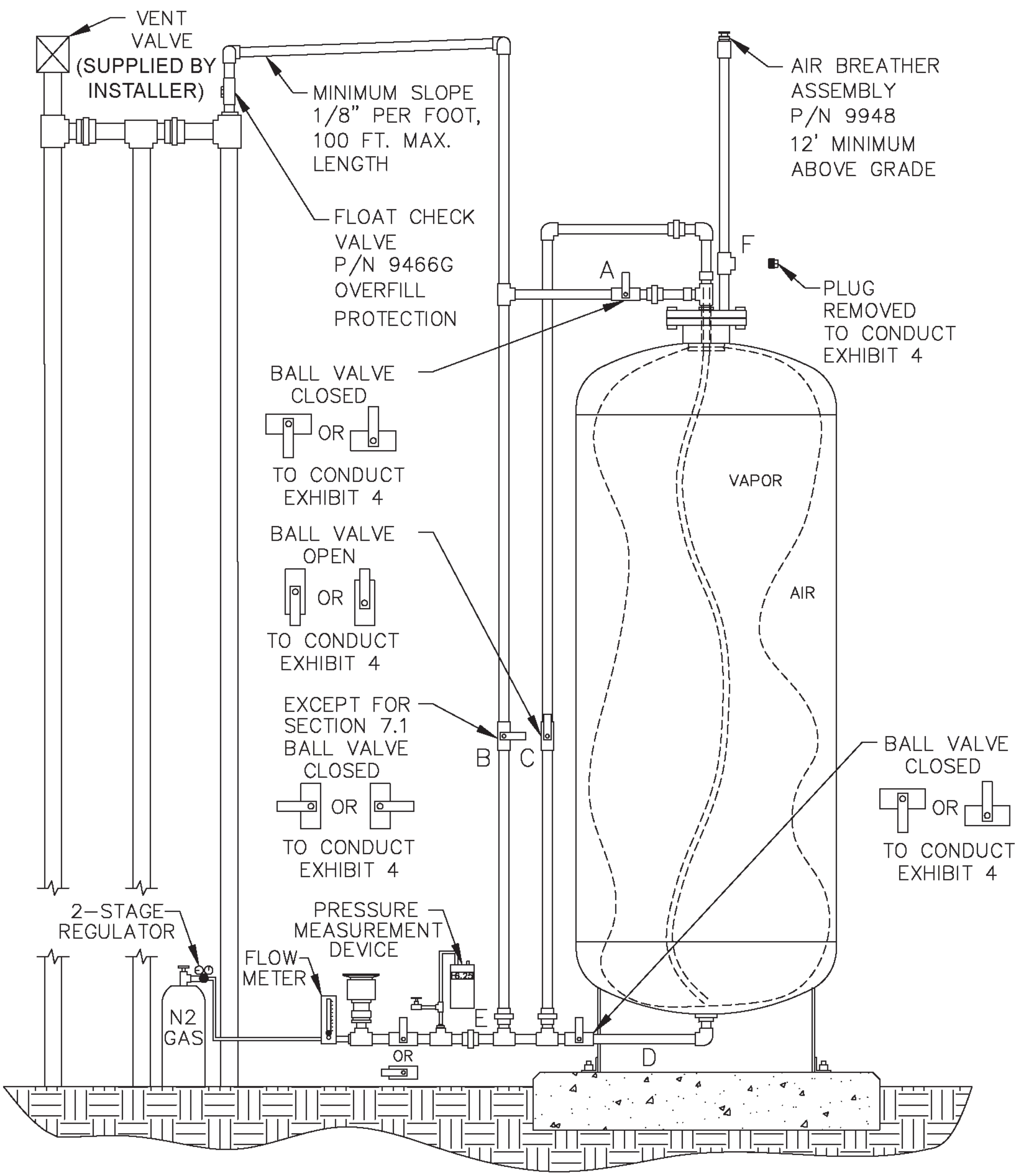
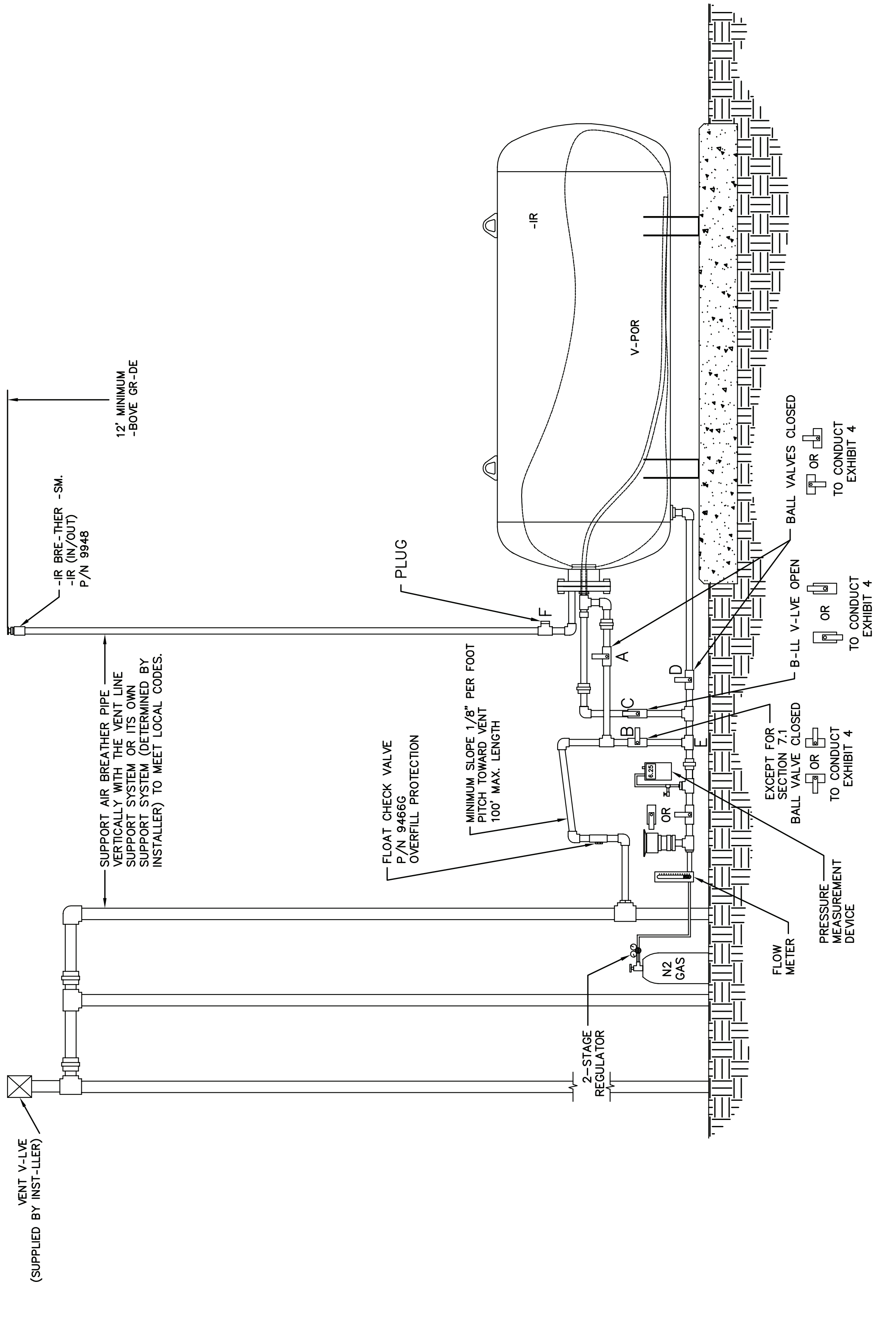


Figure 2H

Clean Air Separator in Configuration to Conduct Test



7 TESTING

7.1 Open the ball valve marked “B” from Figure 2 or Figure 2H. The pressure measurement device installed on the Test Port Assembly should now be reading UST and Clean Air Separator ullage pressure (or vacuum).

7.2 If the station vacuum is greater than (more negative) than -2.00” wc, then proceed to Section 7.2.1. If less than –2.00” wc, then proceed to Section 7.3:

7.2.1 Close the ball valves marked “A” and “B” from Figure 2.

7.2.2 Open the ball valve marked “C” from Figure 2 and wait one minute.

7.2.3 If necessary, use the needle valve on the Test Port Assembly to bleed air into the bladder until the vacuum level reaches as close to a whole number on the pressure measurement device as the accuracy of the device will provide (ie. -2.00, -3.00, -4.00, -5.00, -6.00, -7.00, -8.00). Make sure the needle valve is closed. Record this vacuum and start the stop watch to begin a 5 minute decay.

7.2.4 Record the vacuum at one-minute increments up to 5 minutes.

7.2.5 Using the information from Table 1, verify that the vacuum after 5 minutes is equal to or greater than the allowable minimum for the initial vacuum recorded from Section 7.2.3.

7.2.6 If the vacuum is greater than the allowable minimum, the Clean Air Separator passed the test.

7.2.7 If the vacuum is less than the allowable minimum, the Clean Air Separator failed the test.

TABLE 1
Allowable 5 Minute Vacuum Decay for Clean Air Separator

Vacuum at Start of Test (inches wc)	Allowable Minimum Vacuum after 5 min. (inches wc)
8.0	5.5
7.0	4.7
6.0	3.8
5.0	3.0
4.0	2.2
3.0	1.5
2.0	0.8

7.3 If the station vacuum is less than –2.00” wc (from Section 7.2), or at the direction of district (refer to Section 2.2), conduct the following:

7.3.1 Close the ball valves marked “A” and “B” from Figure 2.

7.3.2 Open the ball valve marked “C” from Figure 2.

7.3.3 Open the ball valve of the Test Port Assembly and flow nitrogen into the Clean Air Separator bladder at a flow rate between 2 and 4 CFM until the pressure in the bladder reaches 2.20” wc.

7.3.3.1 Depending upon the nitrogen flow rate used, the bladder could take up to 30 minutes to fill completely.

7.3.3.2 Because of the close proximity of the pressure measurement device to the nitrogen inlet of the Test Port Assembly, the pressure measurement device may read a higher pressure when nitrogen is flowing. The pressure measurement device is usually steady, but will start to increase rapidly when the bladder is getting full.

7.3.3.3 Periodically stopping nitrogen flow will provide an accurate reading of the pressure in the bladder.

7.3.4 Once the pressure reaches 2.20” wc, shut off the flow of nitrogen to the Clean Air Separator bladder and close the ball valve of the Test Port Assembly.

7.3.5 Wait 5 minutes or until pressure stabilizes above 2.00” wc. If the pressure does not stabilize, repeat steps 7.3.3 and 7.3.4.

7.3.6 Use the needle valve on the Test Port Assembly to bleed off the nitrogen until the pressure reaches 2.00” wc. Make sure the needle valve is closed. Record the pressure.

7.3.7 Start the stop watch to begin a 5 minute decay.

7.3.8 Record the pressure in one-minute increments up to 5 minutes.

7.3.9 If the pressure in the bladder is greater than 1.77” wc at the end of 5 minutes, then the Clean Air Separator passed the test.

7.3.10 If the pressure in the bladder is less than 1.77” wc at the end of 5 minutes, then the Clean Air Separator failed the test.

7.4 If the bladder was evaluated using the vacuum procedure (Section 7.2), close the ball valve “C” to keep it in a vacuum condition. If the bladder was evaluated using the pressure procedure (Section 7.3), open the needle valve on the Test Port Assembly to bleed off all pressure from the bladder.

7.5 Close the ball valve marked “C”, if not already done.

7.6 Remove the Test Port Assembly from location “E” and install the 1” pipe plug. Use a pipe sealant approved for use with gasoline on the threads and tighten to 60 ft-lbs.

7.7 Install the 1” pipe plug to location “F”. Use a pipe sealant approved for use with gasoline on the threads and tighten to 60 ft-lbs.

7.8 Open the ball valve marked “A”. Lock all ball valves using the padlocks.

7.9 The Clean Air Separator should now be in normal operation configuration. Verify this by using the outline from Section 6.7 and Figure 1 or Figure 1H.

8 REPORTING

8.1 Record test data on the form shown in Figure 3. Districts may require the use of an alternate form, provided that the alternate form includes the same minimum parameters as in Figure 3.

Figure 3

Data Form for Determination of Static Pressure Performance of the Healy Clean Air Separator for Executive Orders VR-201-N and VR-202-N

SOURCE INFORMATION	
GDF Name and address ________________ ________________ ________________	GDF Represenative and title ________________ ________________ GDF Phone No. ________________
Date and Time of Last Fuel Drop to GDF: ________________ Date of Last Calibration of Pressure Measurement Device: ________	P/O #: ____________ A/C#: ____________ District Test Witness: ________________

VACUUM TEST (Section 7.1 through 7.2.7)	
Vacuum at start of test, inches water column (7.2.3)	________
Vacuum at one minute, inches water column	________
Vacuum at two minutes, inches water column	________
Vacuum at three minutes, inches water column	________
Vacuum at four minutes, inches water column	________
Final vacuum at five minutes, inches water column	________
Allowable minimum vacuum, inches water column (from Table 1)	________

POSITIVE PRESSURE TEST (Section 7.3 through 7.3.9)	
Pressure at start of test, inches water column (7.3.6)	________
Pressure at one minute, inches water column	________
Pressure at two minutes, inches water column	________
Pressure at three minutes, inches water column	________
Pressure at four minutes, inches water column	________
Final pressure at five minutes, inches water column	________
Allowable final pressure, inches water column (7.3.9)	1.77

Healy Certified Technician Name, Certification Number and Expiration Date	Test Company	Date Test Conducted

Exhibit 5

Vapor to Liquid Volume Ratio
(Executive Orders VR-201-N and VR-202-N)
(Healy Model 900 EVR Nozzle)

Definitions common to all certification and test procedures are in:

D-200 Definitions for Vapor Recovery Procedures

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

1. PURPOSE AND APPLICABILITY

1.1 This test procedure is used to quantify the Vapor to Liquid (V/L) Volumetric Ratio of the Healy Model 900 EVR Nozzle installed at gasoline dispensing facilities (GDF). This procedure provides a method to determine compliance with the V/L requirements specified in ARB Executive Orders (EO) VR-201-N and VR-202-N.

2. PRINCIPLE AND SUMMARY OF TEST PROCEDURE

2.1 A tight fitting adaptor is placed on the spout of a dispensing nozzle. The adaptor, which isolates vapor flow to the nozzle vapor collection ports, is connected to a volume gas meter. Gasoline is dispensed through the nozzle and the volume of vapors drawn through the vapor collection boot by the Phase II system vacuum pump is measured. The volume of vapor is recorded and compared with the volume of gasoline dispensed to determine the V/L Volumetric Ratio.

2.2 The test is conducted with the pressure/vacuum (P/V) vent valve(s) installed on the storage tank vent pipes.

2.3 The test procedure requires no modifications to the GDF being evaluated.

2.4 The test procedure may be conducted on a fueling point on one side of the dispenser with the other side of the dispenser either authorized to dispense fuel (but not dispensing), or with the other side dispensing fuel into a vehicle or another portable test tank. Conducting the test this way will be evaluating the V/L of the fueling point with the VP1000 vacuum pump running on its high speed setting.

3. BIASES AND INTERFERENCES

3.1 Nozzle spouts that are damaged such that the V/L adaptor cannot fit over the nozzle spout preclude the use of this test.

3.2 Refueling points not capable of achieving dispensing rates (see Equation 9-2) required for conducting the V/L test, as specified in Exhibit 2 of ARB Executive Orders VR-201-N and VR-202-N, preclude the use of this test for determining in-use compliance of certified systems.

3.3 Bagging, or otherwise sealing any nozzle associated with the vacuum pump serving the nozzle being tested, may bias the test results towards compliance. **The V/L test to verify compliance shall be conducted without "bagging" any of the nozzles served by a common vacuum device.**

3.4 If the nozzle being tested introduces liquid into the V/L adaptor, gas volume meter or the adaptor supply hose, the V/L of that nozzle shall be deemed a failure of the V/L standard.

3.5 Do not drain or remove liquid in either the vapor passage of the hoses or the dispenser vapor piping prior to performing the test. Draining of this liquid gasoline will bias the test toward compliance.

3.6 The O-ring in the V/L adaptor that is not properly lubricated may bias the results toward noncompliance. See Section 5.7 for lubrication requirements. Motor oil (any weight) is acceptable for lubricating the O-ring. Contact Healy Technical Services with any questions about other lubricants that may be used in conducting this test.

3.7 Conducting V/L testing with an improperly conditioned portable test tank (not saturated with gasoline vapors) will bias the test results of the as found V/L of the fueling point. Refer to Section 6.6 for proper portable test tank conditioning.

4. SENSITIVITY, RANGE, AND ACCURACY

4.1 The maximum rated capacity of the gas volume meter shall be at least 800 CFH and not greater than 3,000 CFH.

4.2 The minimum rated capacity of the gas volume meter shall be 25 CFH.

4.3 The minimum readability of the gas volume meter shall be 0.01 cubic feet.

4.4 Accuracy, determined during calibration, will be ± 5 percent of the gas volume meter reading.

5. EQUIPMENT

5.1 Vapor to Liquid Adaptor and Surrogate Spout

A **Vapor to Liquid Adaptor**. Only the Healy Systems, Inc. V/L Test Sleeve (figures 1, 4 and 5), Part No. 8034-1, can be used to conduct V/L testing on the Healy Phase II EVR System (Executive Order VR-201 series or Executive Order VR-202 series). The nominal inside diameter of the flexible tubing shall be between 0.75 and 1.00 inches, and the length of the tubing shall be between 3.0 and 6.0 feet.

B **Surrogate Spout**. Only the Healy Systems, Inc. V/L Surrogate Spout (figures 1 and 5), Part No. 8175, can be used to conduct the pre-test and post-test leak check.

5.2 Gas Volume Meter. Use a gas volume meter to measure the volumetric flow rate through the V/L adaptor. The meter shall be equipped as shown in Figure 2 and the maximum allowable pressure drop(s) (determined by the manufacturer) across the meter shall be:

For a meter with a maximum rated capacity of 1000 CFH through 3,000 CFH:
1.10 inches H_2O at a flowrate of 3,000 CFH
0.05 inches H_2O at a flowrate of 30 CFH

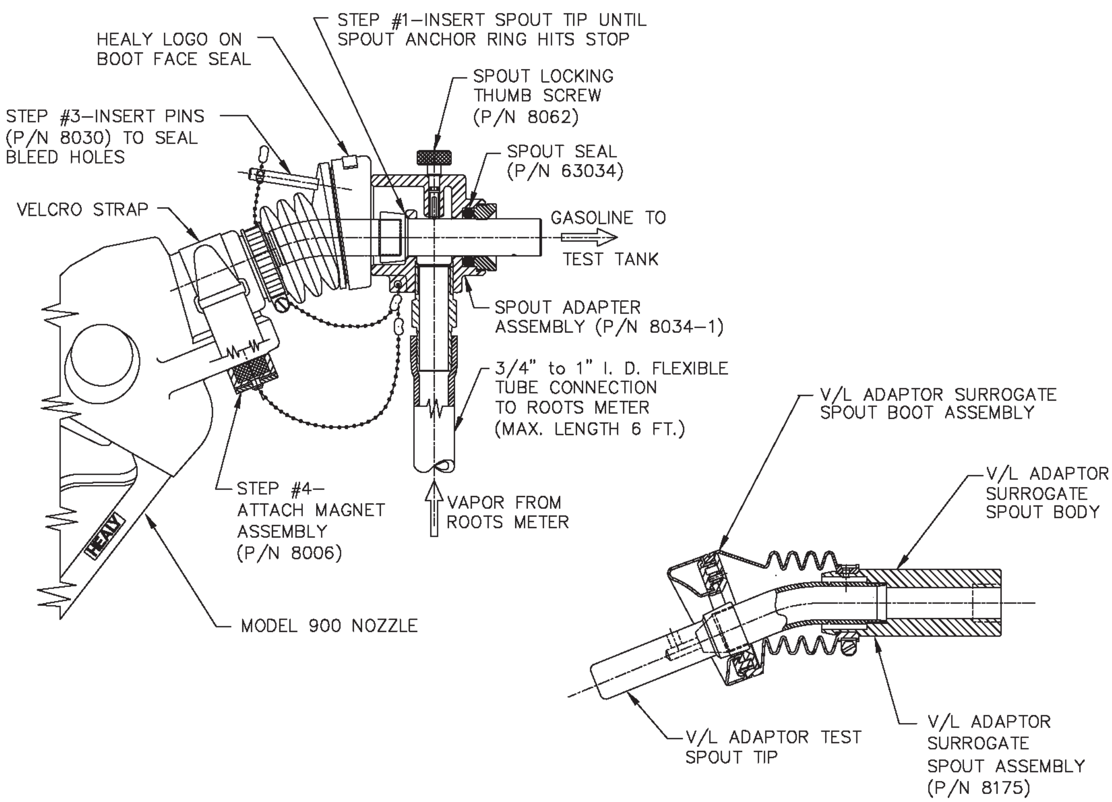
For a meter with a maximum rated capacity of 800 to 1,000 CFH:
0.70 inches H_2O at a flowrate of 800 CFH
0.04 inches H_2O at a flowrate of 16 CFH

See Section 6.2 for further gas volume meter specifications.

5.3 Volume Gas Meter Inlet Manifold. This manifold is designed to return the vapors displaced from the portable gasoline tank assembly, at atmospheric pressure, to the inlet of the gas volume meter. This manifold shall be two (2.0) inches minimum inside diameter pipe. The intake passage of the manifold shall be no shorter than 6.0 inches and no longer than 18.0 inches. See Figures 2 and 4.

Figure 1

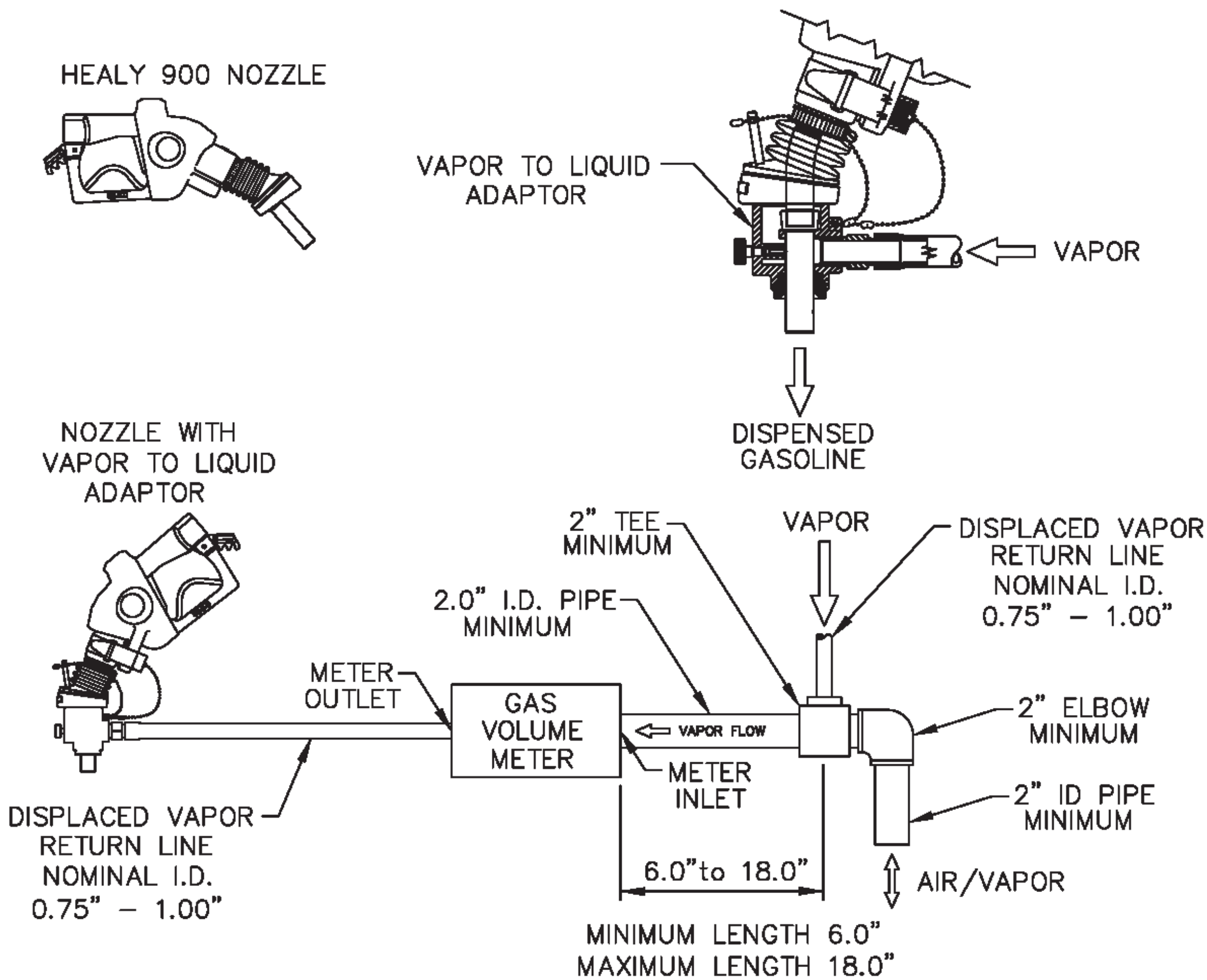
Healy Vapor To Liquid (V/L) Adaptor and Surrogate Spout Assembly



NOTE: The thumbscrew and Healy logo on top of the nozzle boot face seal must be in vertical alignment to imitate fueling an unleaded vehicle.

Figure 2

Gas Volume Meter and Vapor To Liquid Adaptor



5.4 Liquid Volume Meter. Use the totalizer on the gasoline dispenser to measure the volume of gasoline dispensed during the test.

5.5 Portable Gasoline Tank Assembly. A portable tank, meeting fire safety requirements for use with gasoline, shall be used to receive the gasoline dispensed during this test. The tank shall have sufficient volume so that at least 4.5 gallons may be dispensed prior to activating the primary shutoff mechanism of the dispensing nozzle. Portable tanks shall have a permanent label or mark indicating the total fuel capacity in gallons. Tank material, likely to provide contact with the nozzle spout, or V/L adaptor, during the entire dispensing event, shall be constructed of aluminum or brass or other materials approved by the local fire codes for such application. The tank and required plumbing configuration is shown in Figure 3 and Figure 4. This configuration permits a portion of the vapors displaced during testing to be returned to the underground storage tank (UST). The minimum and maximum dimensions shown in Figure 2 and Figure 4 shall be adhered to in all cases.

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

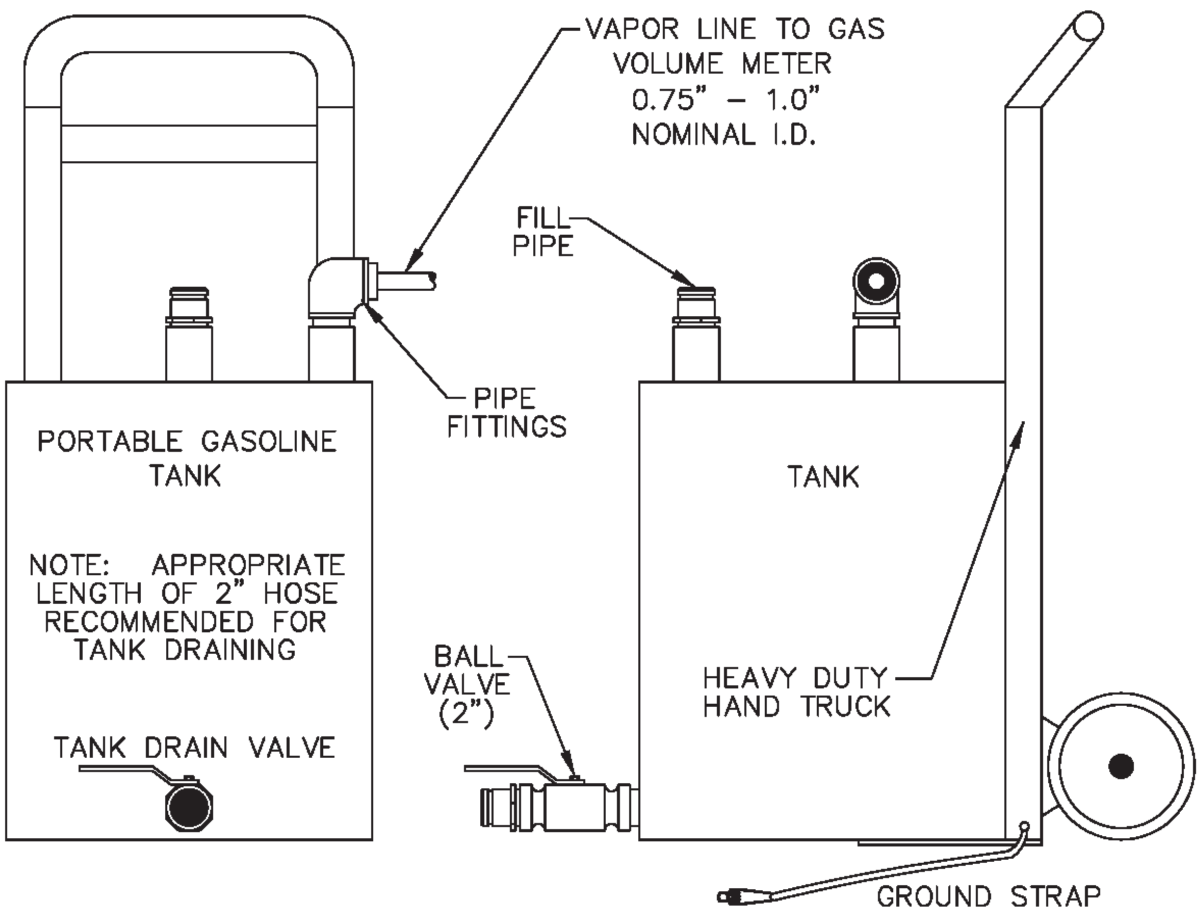
5.7 Lubricant. Appropriate lubricant shall be used to ensure a leak-tight seal between the O-ring in the V/L adaptor and the nozzle spout. Motor oil (any weight) is acceptable for lubricating the O-ring. Contact Healy Technical Services with any questions about other lubricants that may be used in conducting this test.

5.8 Leak Detection Solution. Any liquid solution designed to detect gaseous leaks may be used to verify the pressure integrity of test equipment during this test.

5.9 Pressure Measuring Device. An electronic pressure measuring device with a full scale range that shall not exceed 0-10 inches WC with a minimum accuracy of 0.5 percent of full scale. A 0-20 inches WC device may be used provided the minimum accuracy is 0.25 percent of full-scale.

Figure 3

Portable Tank Assembly



6. PRE-TEST PROCEDURES

6.1 Assemble the portable tank assembly and gas volume meter as shown in Figure 4. The minimum and maximum dimensions shown in Figure 4 shall be adhered to in all cases. **Ensure that the ground strap is properly connected to an acceptable ground**.

Note: A one-time test to verify proper design of the tee connection at the gas volume meter shall be conducted. Disconnect the V/L adaptor from the nozzle. Insert the nozzle into the portable test tank so that there is no visible gap between the nozzle boot/portable test tank fill pipe interface. Dispense between four and one-half and five (4.5 - 5.0) gallons into the portable test tank. The tee connection design passes the test if the displacement on the gas volume meter is less than 0.01 cubic feet. The result of this test shall be kept with the test equipment. If the tee connection is altered or changed, the above test must be repeated to ensure proper design.

6.2 The gas volume meter shall be calibrated, within 180 days prior to conducting this procedure. In addition, calibration shall be conducted after any repairs or alterations (changes to the operation or configuration of the meter) to the meter. Calibrations, at a minimum, shall be conducted at flowrates of 30, 60, and 90 CFH (3.7, 7.5, and 11.2 gallons/minute) in accordance with one of the following:

(a) ARB Air Monitoring Quality Assurance, Volume VI, Standard Operating Procedures for Stationary Source Emission Monitoring, January 1979, or

(b) US EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods, or

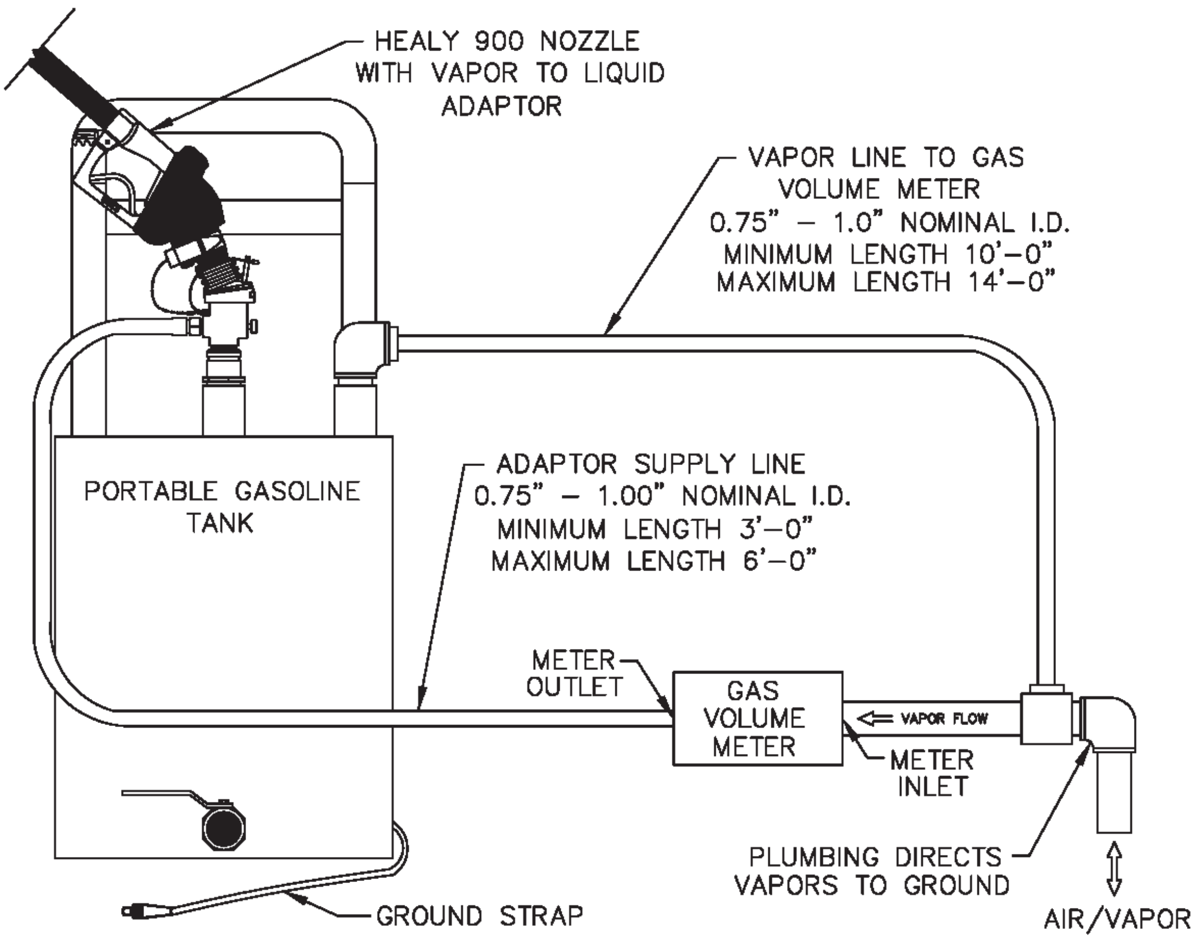
(c) EPA Method 2A, Measurement of Gas Volume Through Pipes and Small Ducts (40 CFR Part 60, Appendix A), or

(d) Appropriate calibration procedures in accordance with California Department of Food and Agriculture, Division of Measurement Standards and County Department of Weights and Measures (title 4, CCR, section 3.33).

A copy of the most current calibration shall be kept with the meter.

Figure 4

Assembled Vapor to Liquid Volume Ratio Test Equipment



6.3 Verify that the O-ring in the V/L adaptor is present and in good condition. An O-ring with nicks, tears, or other deformations shall be replaced prior to the test. The O-ring shall be properly lubricated (see Section 5.7) to ensure a vapor tight connection.

6.4 Conduct a pre-test leak check of the V/L adaptor, the gas volume meter and the adaptor supply hose by connecting the V/L adaptor to a surrogate spout as shown in Figure 5 and described in Section 5.1B. Raise the test pressure to 5.00” ± 0.50” WC. There shall not be a pressure drop of more than 1.00” WC from the above starting pressure for 30 seconds from the start of the test. If the leak test passes, proceed with the V/L testing. If the leak test fails, proceed to isolate the source of the leak by pressurizing the test equipment again. Squirt liquid leak detector solution on interfaces and other potential leak sources and watch for the formation of bubbles. Once leak(s) are repaired, repeat the leak test procedure.

Note: Leak checks shall be conducted in a shaded area or away from direct sunlight. Leak checks may be conducted during V/L testing to ensure leak integrity of test equipment.

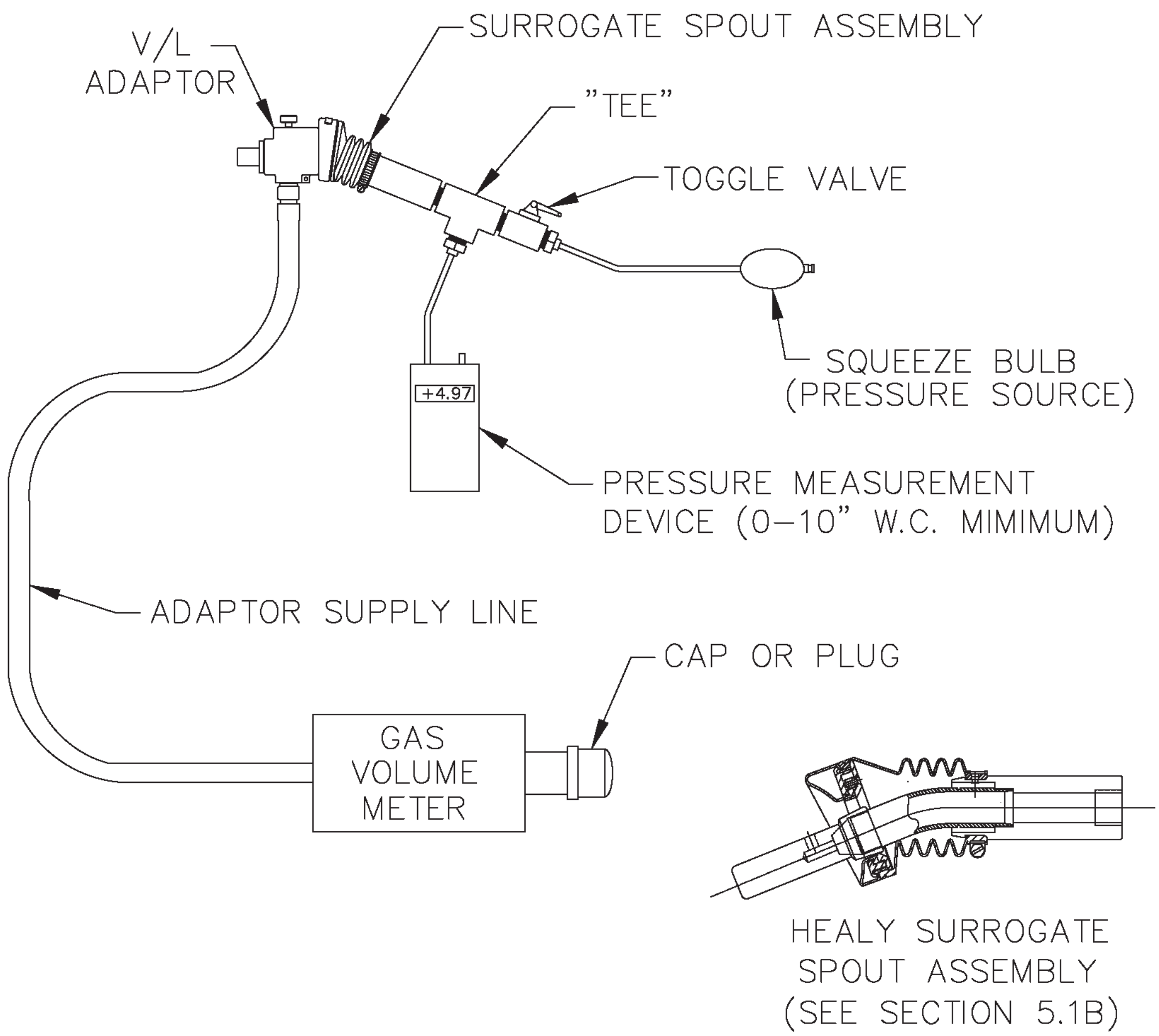
6.5 This test procedure shall be conducted with the storage tank pressure/vacuum (P/V) valve(s) installed and the Phase I vapor coupler(s) poppet(s) in the closed position with the adaptor dust cap(s) installed.

6.6 With the portable tank and V/L test equipment assembled, dispense gasoline into the portable test tank until at least 10% of the tanks total capacity has been reached. This will condition the portable tank with gasoline vapors. This conditioning shall be conducted each time the test tank is emptied prior to conducting testing at each facility.

6.7 All pressure measuring device(s) shall be bench calibrated using a reference gauge, incline manometer or NIST traceable standard at least once every six (6) months. Calibration shall be performed at 20, 50, and 80 percent of full scale. Accuracy shall be within five (5) percent at each of these calibration points.

Figure 5

Vapor To Liquid Adaptor and Gas Volume Meter Leak Test Assembly



7. TEST PROCEDURES

7.1 Carefully connect the V/L adaptor to the nozzle spout as shown in Figure 1, isolating the vapor path of the nozzle and ensuring a tight connection.

7.2 Record the initial reading from the index of the gas volume meter on the Healy V/L Field Data Sheet at the end of this document. This initial reading shall be taken before each test. Do not use the final reading from the preceding test as the initial reading for the current test, unless it has been verified. This is necessary since the meter index may have moved due to the low pressure drop through the meter.

7.3 Reset the stopwatch and, if appropriate, reset the totalizer on the dispenser.

7.4 Holding the nozzle lever in the maximum hand-held position in order to dispense at the highest possible flow rate and begin dispensing into the portable gasoline tank. **Ensure that the nozzle spout is in contact with the grounded tank assembly during dispensing**. Start the stopwatch when the totalizer indicates dispensing has started.

7.5 Dispense between four and one-half (4.5) and five (5.0) gallons of gasoline.

If the nozzle being tested introduces liquid into the V/L adaptor, the gas volume meter or the adaptor supply hose, the V/L of that nozzle shall be deemed a failure.

7.6 Simultaneously stop both the stopwatch and gasoline dispensing.

7.7 The following data for each test shall be recorded on the Healy V/L Field Data Sheet:

7.7.1 Dispenser (pump) number
7.7.2 Fuel grade
7.7.3 Nozzle serial number (found below nozzle handguard)
7.7.4 Initial gas volume meter reading, in cubic feet
7.7.5 Initial totalizer reading from the dispenser, in gallons
7.7.6 Final gas volume meter reading, in cubic feet
7.7.7 Final totalizer reading from the dispenser, in gallons
7.7.8 Elapsed time during dispensing, in seconds

Note: Units other than cubic feet, gallons, and seconds may be used, provided that Equation 9-1 is appropriately modified.

7.8 If the V/L Volumetric Ratio, as determined by Equation 9-1 is between 0.95 –1.15, the grade point complies with the specifications.

7.9 If the V/L Volumetric Ratio is between 0.76 – 0.94, or greater than or equal to 1.16, conduct the test two additional times. Do not make adjustments to the gasoline dispensing or vapor recovery lines until all three test runs have been completed. Only adjustments to the V/L test equipment and the connection between the V/L adaptor and the nozzle will be allowed in order to ensure measurement accuracy. All other adjustments to the vapor recovery equipment, including but not limited to the vapor collection pump and the nozzle, are not allowed. If the V/L test equipment is adjusted, then the prior test run results for that grade point tested should not be used. Calculate the numerical average of the three test runs. If the average V/L value of these three test runs is within the allowable limits, compliance has been verified. If the resulting average is outside of the specified limits, the grade point tested does not comply with the specifications of the EO.

Note: Section 1.10 of the Healy 900 Nozzle portion of the **ARB Approved Installation, Operation and Maintenance Manual** provides instructions on making nozzle V/L adjustments.

7.10 If the initial V/L Volumetric Ratio is less than or equal to 0.75, this indicates a V/L failure of the grade point tested.

7.11 To avoid a build-up of gasoline, drain any condensed gasoline from the hoses between the gas volume meter and portable tank assembly, and the V/L adaptor and gas volume meter whenever fuel is emptied from the portable tank.

8. POST-TEST PROCEDURES

8.1 Remove the V/L adaptor from the nozzle.

8.2 Drain the dispensed product into the appropriate gasoline storage tank at the facility. **Ground the portable tank assembly to the storage tank before draining**. Do not mix product grades in the portable tank assembly without approval of the facility owner and use caution to drain the portable tank into the correct facility storage tank. If blending valves are utilized to produce product grades that do not have a dedicated storage tank, product from the blended grade shall be returned to the lower octane tank.

8.3 After concluding testing at the facility, perform a post-test leak check of the V/L adaptor, the gas volume meter and the adaptor supply hose by connecting the V/L adaptor to a surrogate spout as shown in Figure 5 and described in Section 5.1B. Raise the test pressure to 5.00” ± 0.50” WC. There shall not be a pressure drop of more than 1.00” WC from the above starting pressure for 30 seconds from the start of the test. The data collected during the V/L testing between the last valid test equipment leak check (see Section 6.4) and the post-test leak check is invalid if the test equipment fails this post-test leak check.

Note: Leak checks shall be conducted in a shaded area or away from direct sunlight.

8.4 Prior to transportation, the inlet and outlet of the gas volume meter shall be carefully sealed to prevent foreign matter from entering the meter.

8.5 The Authority Having Jurisdiction (AHJ) may be contacted on the requirements for storage and transportation of the portable test tank. This would typically be the local fire department.

9. CALCULATING RESULTS

9.1 The V/L Volumetric Ratio shall be calculated as shown in Equation 9-1.

$$V/L = \left[\frac{y\,(Vf - Vi)}{G_f - G_i} \right] \text{x } 7.481 \qquad \textbf{[Equation 9-1]}$$

Where:

V/L	=	Vapor to Liquid Volumetric Ratio, dimensionless
y	=	Correction factor for gas volume meter. See Equation 9-3
V_i	=	Initial gas volume meter reading, cubic feet
V_f	=	Final gas volume meter reading, cubic feet
G_i	=	Initial totalizer reading from the dispenser, gallons
G_f	=	Final totalizer reading from the dispenser, gallons
7.481	=	Conversion factor from gallons to cubic feet, gallons per cubic foot

9.2 The gasoline dispensing rate during the V/L test shall be calculated as shown in Equation 9-2.

$$Q_g = \left[\frac{G_f - G_i}{t} \right] \text{x } 60 \qquad \textbf{[Equation 9-2]}$$

Where:

Q_g	=	Gasoline dispensing rate, gallons per minute
G_I	=	Initial totalizer reading from the dispenser, gallons
G_f	=	Final totalizer reading from the dispenser, gallons
t	=	Elapsed time during dispensing event, seconds
60	=	Conversion factor, seconds per minute

9.3 The correction factor (determined during gas volume meter calibration) for correcting observed values of the gas volume meter shall be calculated as shown in Equation 9-3.

$$y = \left[\frac{V_r}{V_m} \right] \qquad \textbf{[Equation 9-3]}$$

Where:

y	=	Correction factor for the gas volume meter's observed reading, dimensionless
V_r	=	True volume from current calibration of gas volume meter, cubic feet
V_m	=	Corresponding observed reading from gas volume meter, cubic feet

10. REPORTING RESULTS

10.1 Report V/L test data and other information as required in the Healy V/L Field Data Sheet at the end of this document. Districts may require the use of alternate forms, provided they include the same minimum parameters as identified in the Healy V/L Field Data Sheet.

11. ALTERNATE PROCEDURES

11.1 This 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 ARB Executive Officer, pursuant to Section 14 of Certification Procedure CP-201.

Healy V/L Field Data Sheet

GDF Name and Address:	Healy V/L Field Data Sheet	Testing Firm Name and Address:
____________ ____________ ____________	Tee Connection Test Result (6.1) ______ ft³ Date of Last Gas Volume Meter Calibration ______ Gas Volume Meter Correction Factor (9.3) ______ Pressure Measurement Device Calibration Date ______	____________ ____________ ____________ Phone No. ( )
Test Date/Time:		Test Performed by:__________ If Required by local district, provide Technician Certification Number:__________ Certification Expiration Date:
Pre-Test Leak Check: Initial/Final Pressures, in. H_2O _____ / _____ **Post-Test Leak Check:** Initial/Final Pressures, in. H_2O _____ / _____	**A/C #** __________ **P/O #** __________	District Test Witness __________ Applicable ARB Executive Order (circle one) VR-201 or VR-202 Allowable V/L Range 0.95 – 1.15

7.7.1 Pump #	7.7.2 Fuel Grade	7.7.3 Nozzle Serial #	7.7.5 Initial Dispenser Totalizer, Gallons	7.7.7 Final Dispenser Totalizer, Gallons	Total Gas Pumped, Gallons	7.7.8 Time, Seconds	9.2 Dispensing Rate, gpm	7.7.4 Initial Meter Reading, ft3	7.7.6 Final Meter Reading, ft3	7.8, 9.1 V/L	7.9 V/L Average (if necessary)	7.8, 7.9 or 7.10 Pass or Fail

Exhibit 7

Nozzle Bag Test Procedure

(Executive Orders VR-201-N and VR-202-N)

Verification of the integrity of the vapor valve shall be performed on installed nozzles by use of the following test.

Note: The following procedure requires that all nozzles on a dispenser be bagged at the same time. Bagging only one nozzle on a dispenser during this procedure may bias the results toward compliance.

a. Seal all nozzles on a dispenser in plastic bags, using tape or other means to secure the bag around the base of the nozzle (see Figure 1). Any plastic bag large enough to enclose the nozzle and having a thickness of no greater than 2 mils can be used.

b. Initialize the dispenser for fueling as follows:

    1. Inform the station operator that you are running a test and ask the operator to initialize the dispenser; or

    2. Swipe a credit card in the dispenser card reader.

c. Activate the Healy vacuum pump by lifting one of the nozzles off the dispenser holster and selecting a grade of fuel. **Do not dispense any fuel**.

d. With the dispenser initialized and the vacuum pump activated, observe all bagged nozzles for 30 seconds. Any nozzle where the bag can be seen visually collapsing has a defective vapor valve and the dispenser shall be removed from service immediately.

e. Record the test results on the “Nozzle Bag Test Results” form provided in this Exhibit. Districts may require use of an alternate form, provided that the alternate form includes the same minimum parameters.

f. Remove the bags from all the nozzles tested and disengage the dispenser by returning the nozzles to the dispenser holsters.

g. Repeat steps a through f for each dispenser.

Figure 1

NOZZLE BAG TEST RESULTS

SOURCE INFORMATION		TEST COMPANY INFORMATION	
Facility (DBA)/Site Address:	Facility Representative/Title:	Test Company Name/Address	# of Nozzles:________________ # Nozzles Tested:_____________ # Nozzles Passed:_____________ # Nozzles Failed: _____________ # Nozzles not Tested: _________
Print Name	Print Name	Print Name	
Street Address	Title ( )	Street Address	
City Zip	Phone No.	City Zip	
District Inspector:	☐ P/O ☐ S/A ☐ A/C Number:	Date of Test:	Time of Test:

Dispenser	Gas Grade	Nozzle Type	Bag Collapse after 30 Seconds?
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No

Executive Order VR-203-M
VST Phase II EVR System

EXHIBIT 2

System Specifications

This exhibit contains the installation, maintenance and compliance standards and specifications that apply to the VST Phase II EVR System installed at a gasoline dispensing facility (GDF). All components must be installed, maintained, and operated in accordance with the specifications in the **ARB Approved Installation, Operation and Maintenance Manual** (IOM). Installation, maintenance and repair of system components, including removal and installation of such components in the course of any required tests, shall be performed by technicians certified by the appropriate manufacturer. Additional certifications may be required in accordance with local district requirements. Provided that there are no other local district requirements, a GDF owner/operator can remove and install nozzles, curb hoses, breakaways, and whip hoses without a manufacturer certification.

Nozzle

1. A vapor collection sleeve shall be installed on the VST nozzle at the base of the spout, as shown in **Figure 2B-1**. A vapor collection bellows shall be installed on the EMCO nozzle at the base of the spout, as shown in **Figure 2B-2**.

2. The VST Model VST–EVR-NB and EMCO Model A4005EVR nozzles have an integral vapor valve which prevents the loss of vapor from the underground storage tanks, ensures proper operation of the system and prevents the ingestion of air into the system. The performance of the nozzle vapor valve can be determined by items 2.1 or 2.2.

   2.1. The maximum allowable leak rate for the nozzle vapor path, as determined by TP-201.2B, shall not exceed 0.07 cubic feet per hour (CFH) at a pressure of two inches water column (2.00” WC)

   2.2. Verification of the integrity of the vapor valve can be performed on installed nozzles using the nozzle bag test procedure in Exhibit 7.

3. The gasoline flow rate of the nozzle shall be between six (6.0) and ten (10.0) gallons per minute as determined by the applicable provisions of section 6 or 7 of Exhibit 5 or by direct observation for 30 seconds minimum at the maximum hand held position.

Vapor Collection

1. The system pressure drop from the nozzle to the UST, as determined by TP-201.4 (Methodology 1) and Exhibit 6, shall not exceed the following:

   0.35 inches WC at a flow rate of 60 CFH of Nitrogen; and
   0.62 inches WC at a flow rate of 80 CFH of Nitrogen.

Coaxial Hoses

1. The maximum length of the curb hose, breakaway, and whip hose combined shall not exceed fifteen feet as measured from the base of the nozzle to the end of dispenser adapter or dispenser, as appropriate (Reference Exhibit 1, Figure 1A-2).

2. The liquid removal rate shall not be less than five milliliters per gallon (5.0 ml/gal) as determined by Exhibit 5 when tested with a gasoline flow rate between six (6.0) and ten (10.0) gallons per minute. Liquid removal requirement is applicable to all grades of gasoline.

3, All hoses shall have a permanent marking indicating the liquid pick-up location.

4. Any hose configuration is allowed when installed in accordance with IOM section 8.

Breakaway Couplings

1. The VST breakaway and EMCO safe break couplings are non-reconnecting and shall be replaced following a drive-off.

Flow Limiter

1. No flow limiter is allowed for this system.

VST ECS Membrane Processor

1. The processor vapor integrity shall demonstrate compliance with the static pressure decay criteria of TP-201.3 and Exhibit 4.

2. Unless there is maintenance or testing being conducted on the processor, the processor shall be on and in the automatic vapor processor mode and the three ball valves shall be locked in the open positions shown in **Figure 2B-3** for normal processor operation. The handles of the ball valves shall not be removed.

3. Piping to and from the processor shall be sloped 1/8” per foot minimum toward the vent line(s).

4. The hydrocarbon concentration of the ECS membrane processor taken from the Hydrocarbon Diagnostic Report shall be between ± one percent (±1%) for the zero and mid-range gas and ± two percent (±2%) for the high-range gas, when tested in accordance with Exhibit 8.

5. The processor shall activate when the pressure of the underground storage tank is less than or equal to 0.4 inches WC (≤0.4 inches WC) as determined by Exhibit 9.

6. The Vapor Pressure Sensor shall be between +0.2 and –0.2 inches WC when tested in accordance with section 9 of Exhibit 10.

7. The pressure reading from the TLS console shall be within ±0.2 inches WC of the measured ullage UST pressure as determined by section 8 of Exhibit 10.

8. The TLS-350 audible alarm shall be installed at a location that is most likely to be occupied by the station attendant during normal station operation (e.g., cash register).

9. The TLS console controlling the membrane shall have an RS232 port which shall be installed in a location that allows the RS232 port to be easily accessible, and if applicable per district requirements, for use at anytime. A vacant RS232 serial port shall always be available to electronically download reports.

10. The hydrocarbon concentration of the VST ECS Processor shall not exceed twelve percent (12%) as determined by accessing the Vapor Processor Status Report.

Veeder-Root Vapor Polisher

1. The carbon type shall be BAX G1500 manufactured by MeadWestvaco.

2. Unless there is maintenance or testing being conducted on the processor, the vapor polisher shall be on and in the automatic vapor processor mode and the inlet ball valve shall be locked in the open position shown in **Figure 2B-4** for normal polisher operation. The handle of the ball valve shall not be removed.

3. The pressure reading from the TLS console shall be within ±0.2 inches WC of the measured ullage UST pressure as determined by section 8 of Exhibit 10.

4. The Vapor Pressure Sensor shall be between +0.2 and –0.2 inches WC when tested in accordance with section 9 of Exhibit 10.

5. The Vapor Polisher pressure decrease between starting and ending pressures shall be less than 0.5 inches WC loss when tested in accordance with Exhibit 11. The ending pressure must be greater than 7.0 inches WC. Pressure drop across the Vapor Polisher at 18.0 standard cubic feet per hour flow shall be between 1.69 inches WC and 2.25 inches WC when tested in accordance with Exhibit 11. Differences in temperature readings shall not exceed 10 ºF when tested in accordance with Exhibit 11. The atmospheric pressure sensor reading shall be within 10% of the atmospheric pressure obtained from a local independent source when tested in accordance with Exhibit 11.

6. The hydrocarbon concentration from the vapor polisher outlet shall not exceed 9000 ppm iso-butane (0.9% by volume iso-butane) when tested in accordance with Exhibit 12.

7. The TLS console controlling the vapor polisher shall have an RS232 port which shall be installed in a location that allows the RS232 port to be easily accessible, and if applicable

per district requirements, for use at anytime. A vacant RS232 serial port shall always be available to electronically download reports.

8. Security seal tags must be installed on the vapor polisher. If for any reason the seal tags are damaged or missing, the district may require that Exhibit 11 and Exhibit 12 be conducted and pass prior to installing new security seal tags.

Hirt VCS 100 Thermal Oxidizer

1. The processor vapor integrity shall demonstrate compliance with the static pressure decay criteria of TP-201.3 and Exhibit 4.

2. Unless there is maintenance or testing being conducted on the processor, the processor shall be on (power lamp is lit). The ball valve on the inlet of the processor shall be locked in the open position shown in **Figure 2B-5** and the 3-Way Valve handle shall be pointing down in the Normal Operating Position (Opened to UST Ullage) shown in **Figure 2B-6** during normal processor operation. The handles of the ball valves shall not be removed.

3. The processor shall be installed at least 20 feet from the pressure/vacuum vent valve(s) and the associated piping shall be sloped 1/8" per foot minimum toward the vent line(s) or tank fitting.

4. The VCS 100 Indicator Panel shall be installed at a location that is most likely to be occupied by the station attendant during normal station operation (e.g., cash register).

5. The processor shall activate when the processor is exposed to an atmospheric pressure input and the Processing lamp at the Indicator Panel shall light within three (3) minutes as determined by Exhibit 13.

6. When the processor is exposed to an atmospheric pressure input, the OVERPRESSURE lamp at the Indicator Panel shall light within sixty two (62) minutes as determined by Exhibit 13.

7. If the OVERPRESSURE lamp lights, the system is not in proper working order. The GDF owner/operator shall immediately take the following actions:

    a. record the date and time the OVERPRESSURE lamp lit in the station's maintenance and alarm records;
    b. investigate the cause of the OVERPRESSURE light as provided by section 16 of the Installation, Operations, and Maintenance Manual. Record results of inspections, maintenance, and/or testing conducted in the station's maintenance and alarm records; and if necessary,
    c. record the date and time when the GDF owner/operator called the maintenance contractor for service.

Franklin Fueling Systems Clean Air Separator Pressure Management System

1. The Clean Air Separator vapor integrity shall be evaluated using the test procedure outlined in Exhibit 14 of the Executive Order.

2. The Franklin Fueling Systems Clean Air Separator shall be installed within 100 feet from the vent line(s), and the associated piping shall be sloped 1/8" per foot minimum toward the vent line(s).

3. Unless there is maintenance or testing being conducted on the Franklin Fueling Systems Clean Air Separator, the four ball valves shall be locked in the positions shown in **Figure 2B-7** or **2B-7H** for normal Clean Air Separator operation. Figure 2B-7 applies to vertical CAS installations and Figure 2B-7H applies to horizontal CAS installations

Pressure/Vacuum Vent Valves for Storage Tank Vents

1. All P/V vent valves shall be an ARB certified P/V valve for a Phase I system.

2. At least one pressure/vacuum (P/V) vent valve shall be installed on each tank vent. The maximum number of P/V vent valves allowed and P/V vent valve performance specifications are listed in the applicable Phase I EVR Executive Order. Vent lines may be manifold to minimize the number of P/V vent valves and potential leak sources, provided the manifold conforms to all applicable fire regulations. However, the vents connecting the vapor inlet and vapor outlet to the VST ECS Membrane Processor cannot be manifold together.

Vapor Recovery Piping Configurations

NOTE: Vapor Return Piping shall meet the requirements specified in section 4.11 of CP-201.

1. Vapor Return and Vent Lines

   For facilities installed on or after April 1, 2003, all vapor return and vent lines shall be a minimum nominal internal diameter of 2 inches from the dispensers or the vent stacks to the first manifold. All lines after the first manifold and back to the underground storage tank shall have a minimum nominal internal diameter of 3 inches.

   Note: Facilities permitted by a local district prior to April 1, 2003 shall be required to meet the three inch diameter standard only upon facility modification which involves the addition, replacement, or removal of 50 percent or more of the buried vapor piping.

2. All vapor return lines shall have a minimum slope of 1/8 inch per foot from the dispenser riser to the riser of the UST. A slope of 1/4 inch or more per foot is recommended wherever feasible.

3. The dispenser shall be connected to the riser with either flexible or rigid material that is listed for use with gasoline. The dispenser-to-riser connection shall be installed so that any liquid in the lines will drain toward the storage tank. The internal diameter of the connector, including all fittings, shall not be less than one inch (1").

   Note: The dispenser-to-riser connection is defined as the piping connection between the dispenser piping and the inlet of the dispenser riser. A vapor shear valve may also be part of the riser connection.

4. There is no length restriction for the vapor return piping of the system as long as the system complies with the maximum pressure drop requirement, item 1 of the Vapor Collection section.

5. No product shall be dispensed from any fueling point at a GDF installed with the VST Phase II EVR System if there is a vapor line that is disconnected and open to the atmosphere.

6. Bulk Plant Operations are not allowed with this system.

Dispensers

1. The dispenser vapor piping must be sized adequately to meet the maximum pressure drop requirement, item 1 of the Vapor Collection section.

2. Dispenser vapor piping shall be installed so that any liquid in the lines will drain toward the dispenser riser.

Liquid Condensate Traps

1. Liquid condensate trap connections and fittings shall not leak. Compliance with this requirement shall be verified by the use of commercial liquid leak detection solution or by bagging, when the vapor containment space of the underground storage tanks is subjected to a non-zero pressure. (Note: Leak detection solution will detect leaks only when positive gauge pressure exists).

2. The Liquid Level Sensor shall alarm within five (5) minutes when tested in accordance with Exhibit 16, **Liquid Condensate Trap Compliance Test**.

3. The Liquid Level Sensor audible alarm shall be installed at a location that is most likely to be heard by the station attendant during normal station operation (e.g. cash register).

4. The Liquid Evacuation System shall automatically evacuate gasoline when tested in accordance with Exhibit 16, **Liquid Condensate Trap Compliance Test.**

5. A metal tag specifying the capacity of the Liquid Condensate Trap shall be installed and maintained as specified in the Installation, Operation, and Maintenance Manual.

Phase I System

1. The Phase I system shall be an ARB-certified system that demonstrates compliance with the static pressure decay test criteria contained in TP-201.3 and Exhibit 4.

Maintenance Records

1. Each GDF operator owner shall keep records of alarms and maintenance performed at the facility. Such records shall be maintained on site in accordance with district requirements or policies. The records shall include alarm date and time, nature of the alarm, troubleshooting, maintenance or repair performed to validate and/or correct alarms, component, or system failures, date when maintenance or repair was conducted, name and Certified Technician Identification Number of individual conducting maintenance or test, affiliation, and telephone number. Additional information may be required in accordance with local district requirements. An example of a GDF maintenance and alarm form is shown in **Figure 2B-8**.

2. Maintenance shall be conducted in accordance with the Scheduled Maintenance section of the ARB approved Installation, Operation, and Maintenance Manual.

Vapor Recovery Equipment Defects

The following is deemed a defect for the affected grade point(s) or system.

Grade Points – VST Nozzles

1. The grade point shall be removed from service when more than 30% of a nozzle face seal is missing (e.g., a triangular or similar shape in which greater than 2.5 inches of the faceplate circumference is missing (accumulated)).

2. The grade point shall be removed from service when more than 0.375 square inches of a nozzle vapor collection sleeve is missing (e.g., a rectangular shape of greater than nine/sixteenth (9/16) inches or more on each side, a circular shape of eleven/sixteenth (11/16) inches or more in diameter, or a triangular shape of seven/eighth (7/8) inches on the side.

3. The grade point shall be removed from service when the total slit length in the convolutions exceeds 18 inches as determined by direct measurements.

Grade Points – EMCO Nozzles

4. The grade point shall be removed from service when more than 0.38 square inches of a nozzle boot face material is missing (e.g., a triangular or similar shape in which greater than 7/16 inches of the boot face circumference is missing (accumulated)).

5. The grade point shall be removed from service when there is slit across seven (7) consecutive bellows convolutions as determined by direct measurements.

6. The grade point shall be removed from service when there is a 360 degree cut around the bellows convolution.

Grade Points – General

7. The grade point shall be removed from service when the dispensing rate is greater than ten (10.0) gallons per minute (gpm) or less than five (5.0) gpm as determined by the applicable provisions of section 6 or 7 of Exhibit 5 or by direct observation for 30 seconds minimum at the maximum hand held position.

8. The grade point shall be removed from service when a hose is found to have greater than 150 ml of gasoline in the vapor side as determined by sections 6.1 to 6.5 of Exhibit 5. Note: Prior to draining gasoline from the vapor side of the hose, use Emco tool P/N 494635EVR (for EMCO EVR nozzle) or VST tool P/N VST STP 100 (for VST EVR nozzle) and plug the fuel spout. **Do not activate dispenser when draining gasoline from the vapor side of the hose.**

9. The grade point shall be removed from service when any hose has a visible opening as determined by direct observation.

10. The grade point shall be removed from service when any nozzle lever has spring tension (live lever) when the vapor recovery sleeve or bellows is uncompressed as determined by direct observation.

11. The grade point shall be removed from service when the nozzle automatic liquid shut-off mechanisms malfunction in any manner as determined by EPO No. 26-F (See Vapor Recovery Equipment Defects List) or direct observation.

12. The grade point shall be removed from service when any nozzle has a defective vapor valve as determined by Exhibit 7 or when the vapor valve has a leak rate that exceeds 0.07 cubic feet per minute at a pressure of two (2) inches WC as determined by TP-201.2B.

13. The grade point or system shall be removed from service when any component required by this Executive Order is absent, installed improperly or disconnected as determined by direct observation.

System with VST ECS Processor

1. Unless there is maintenance or testing being conducted on the VST ECS processor, the system shall be removed from service when the three ball valves on the VST ECS processor are not locked in the proper operating configuration (**Figure 2B-3**) as determined by direct observation.

2. Unless there is maintenance or testing being conducted on the VST ECS processor, the system shall be removed from service when the ECS membrane processor is not on or in the automatic vapor processor mode as determined by the Diagnostic section of the Pressure Measurement Control (Section 12) of IOM.

System with Veeder-Root Vapor Polisher

1. Unless there is maintenance or testing being conducted on the Veeder-Root Vapor Polisher, the system shall be removed from service when the ball valve on the Vapor Polisher is not locked in the proper operating configuration (**Figure 2B-4**) as determined by direct observation.

2. Unless there is maintenance or testing being conducted on the Veeder-Root Vapor Polisher, the system shall be removed from service when the Vapor Polisher is not in the automatic mode as determined by the Diagnostic section of the Pressure Measurement Control (Section 15) of IOM.

System with Hirt Thermal Oxidizer

1. Unless there is maintenance or testing being conducted on the Hirt Thermal Oxidizer, the system shall be removed from service when the ball valve on the Thermal Oxidizer is not locked in the proper operating configuration (**Figure 2B-5**) as determined by direct observation.

2. Unless there is maintenance or testing being conducted on the Hirt Thermal Oxidizer, the system shall be removed from service when the Thermal Oxidizer Indicator Panel is not in the "power on" position (power lamp is lit).

System with Franklin Fueling Systems Clean Air Separator

1. The system shall be removed from service when the Franklin Fueling Systems Clean Air Separator fails the leak decay test outlined in Exhibit 14.

2. Unless there is maintenance or testing being conducted on the Franklin Fueling Systems Clean Air Separator, the system shall be removed from service when the four ball valves are not locked in the positions shown in **Figure 2B-7** or **2B-7H** for normal Clean Air Separator operation. Figure 2B-7 applies to vertical CAS installations and Figure 2B-7H applies to horizontal CAS installations.

Figure 2B-1
Model VST-EVR- NB Nozzle

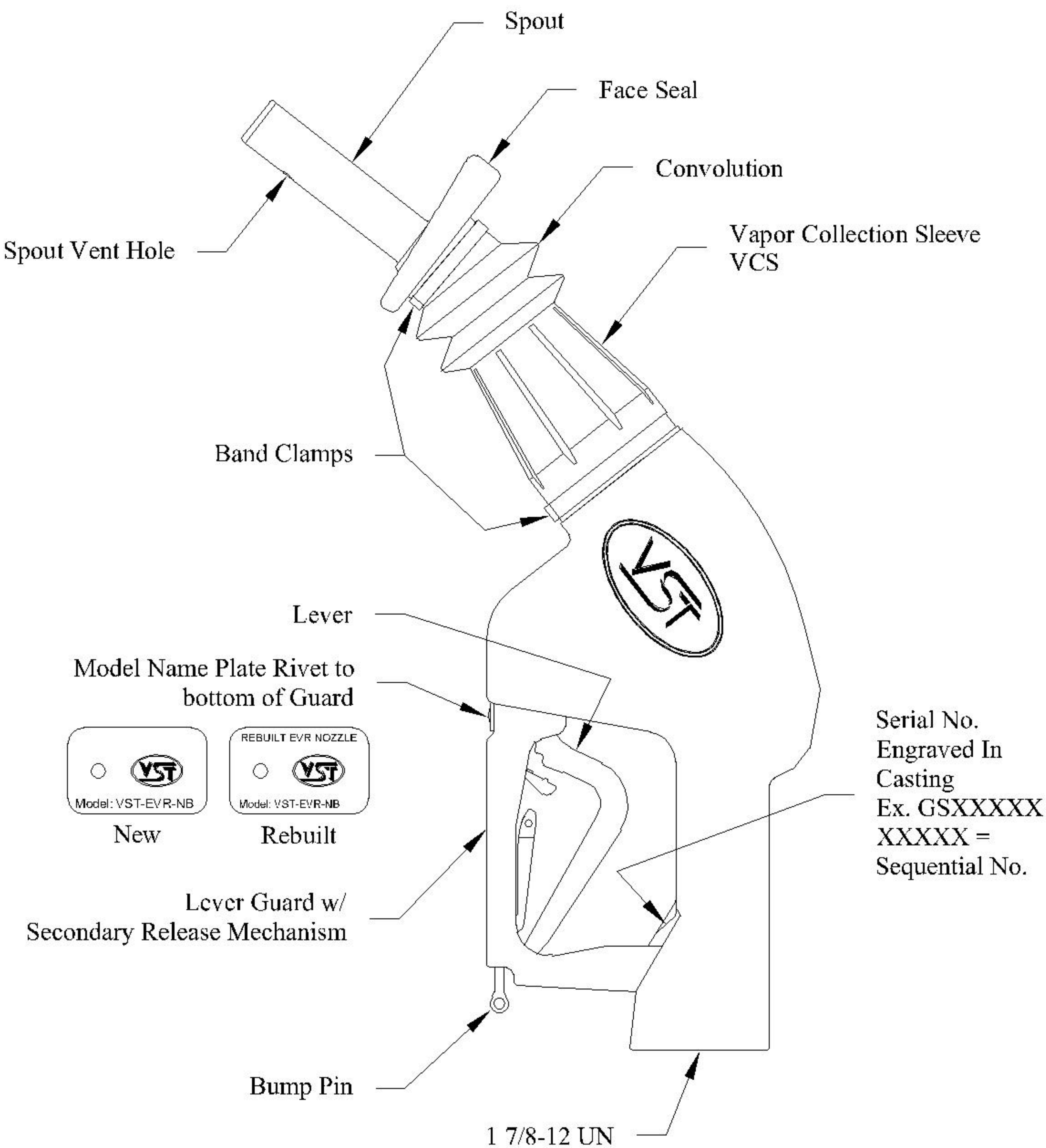


Figure 2B-2
EMCO Model A4005EVR Nozzle

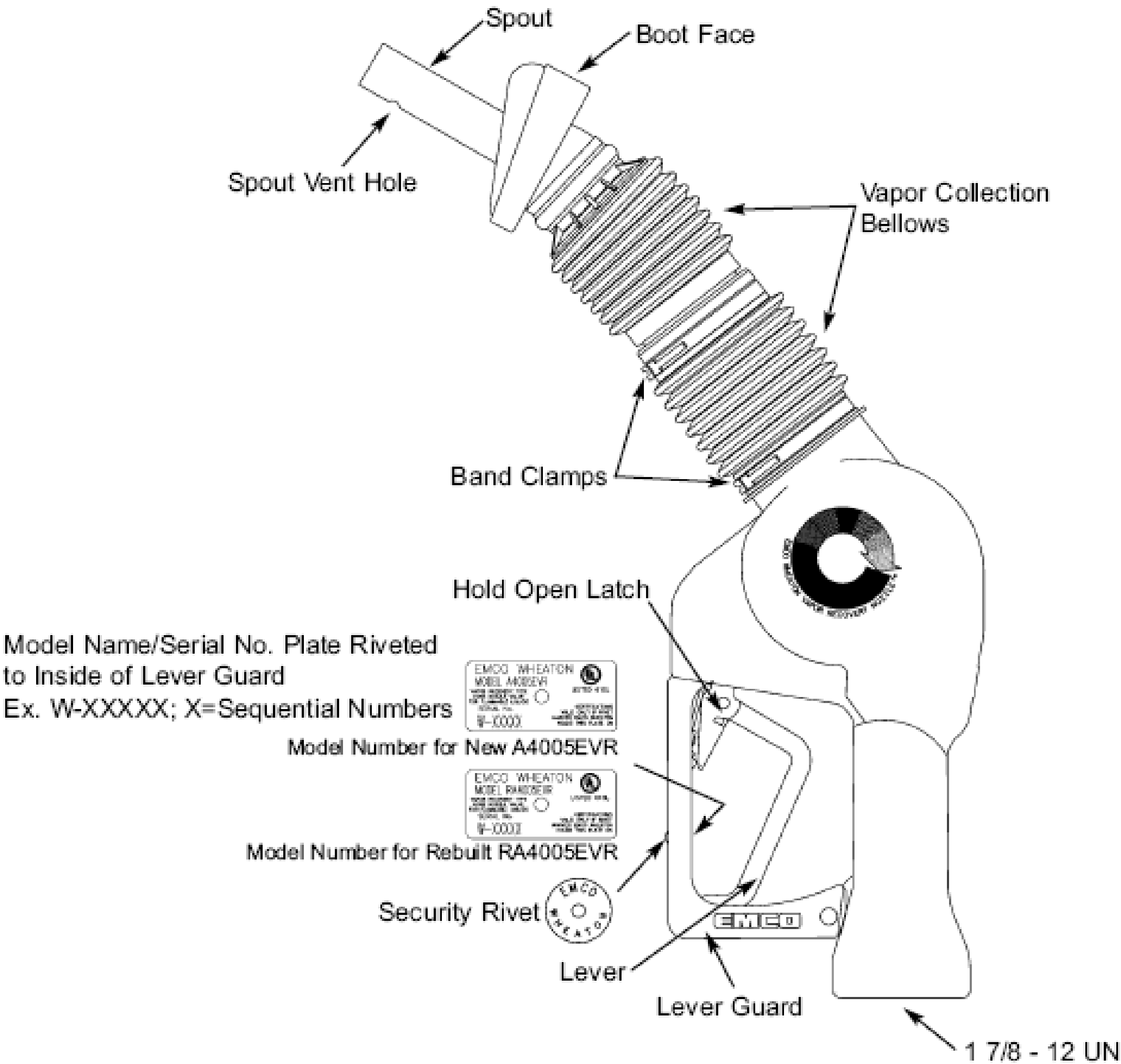


Figure 2B-3
Typical VST-ECS-CS3 Membrane Processor

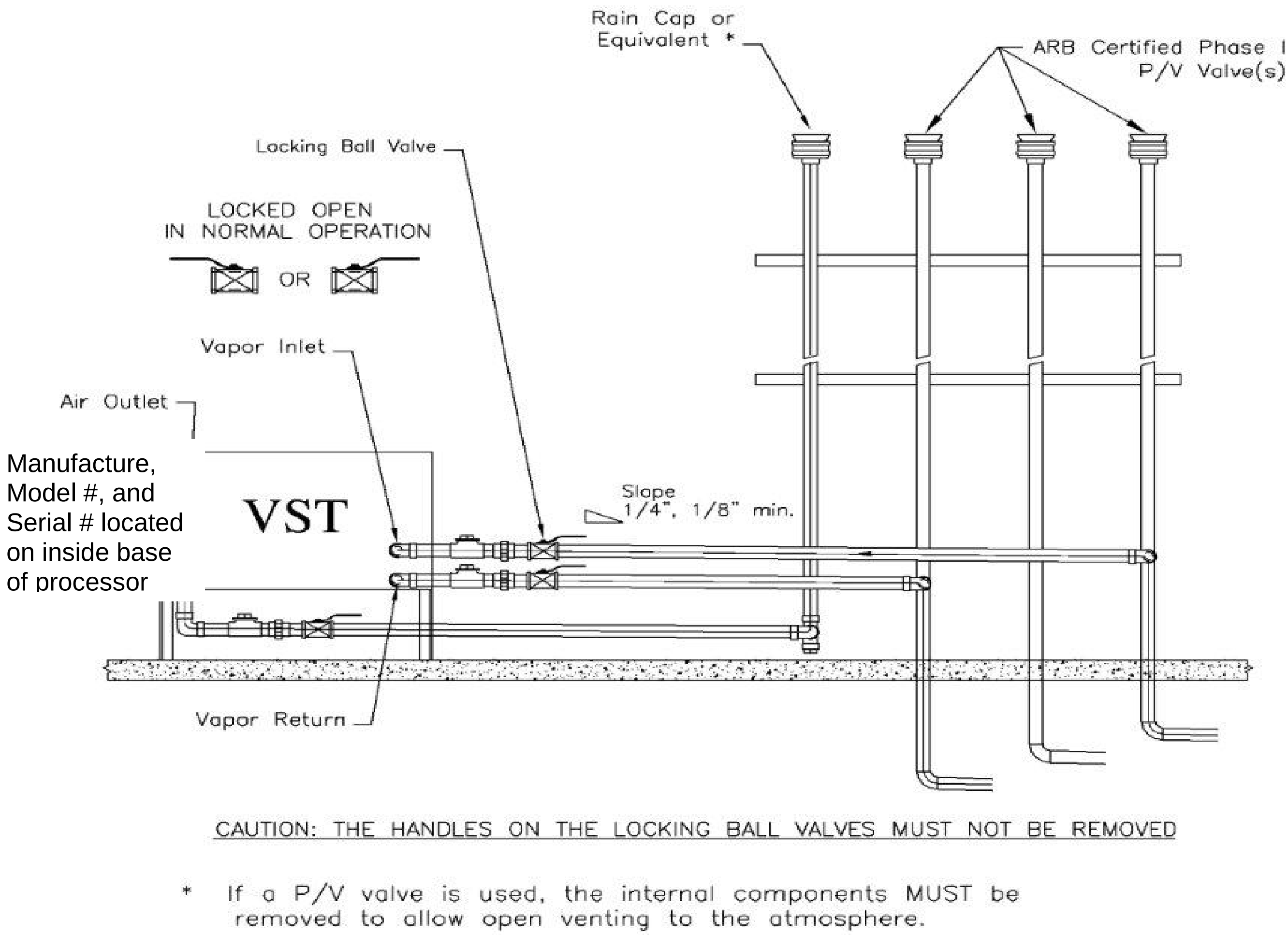


Figure 2B-4
Typical Veeder-Root Vapor Polisher

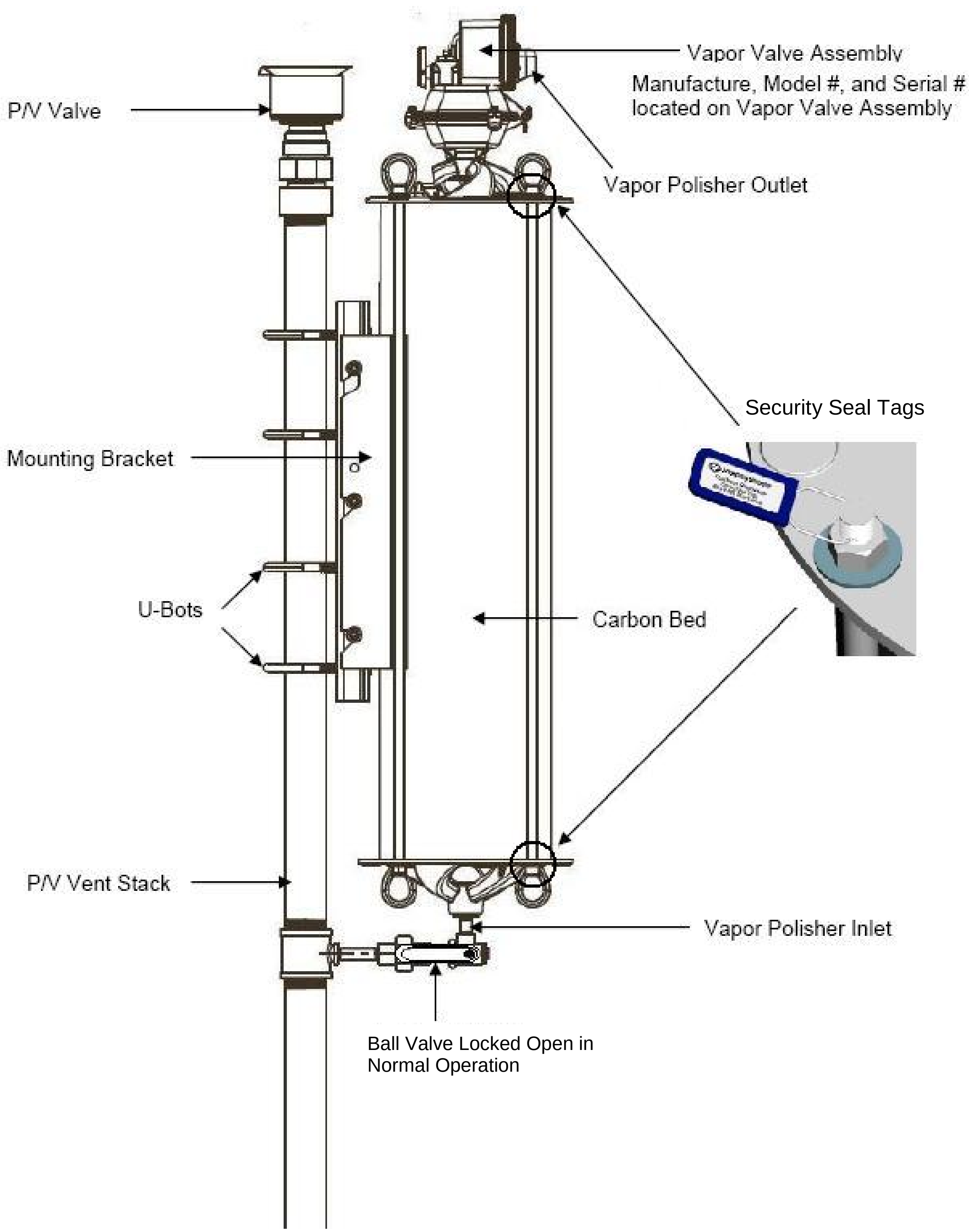


Figure 2B-5
Hirt VCS 100 Thermal Oxidizer
(shown in normal operation)

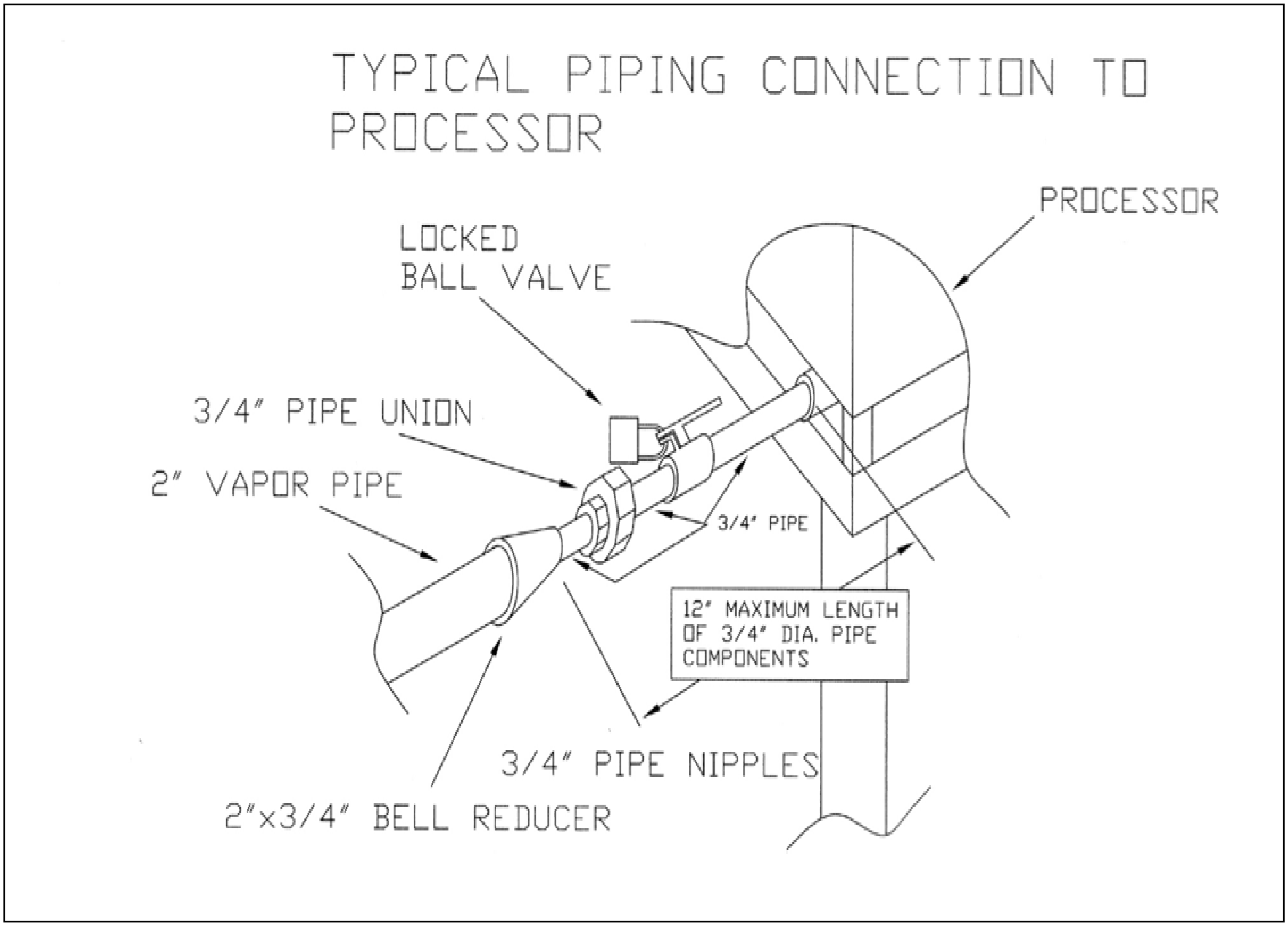


Figure 2B-6
Hirt VCS 100 Thermal Oxidizer
(3-Way Valve shown in normal operation)

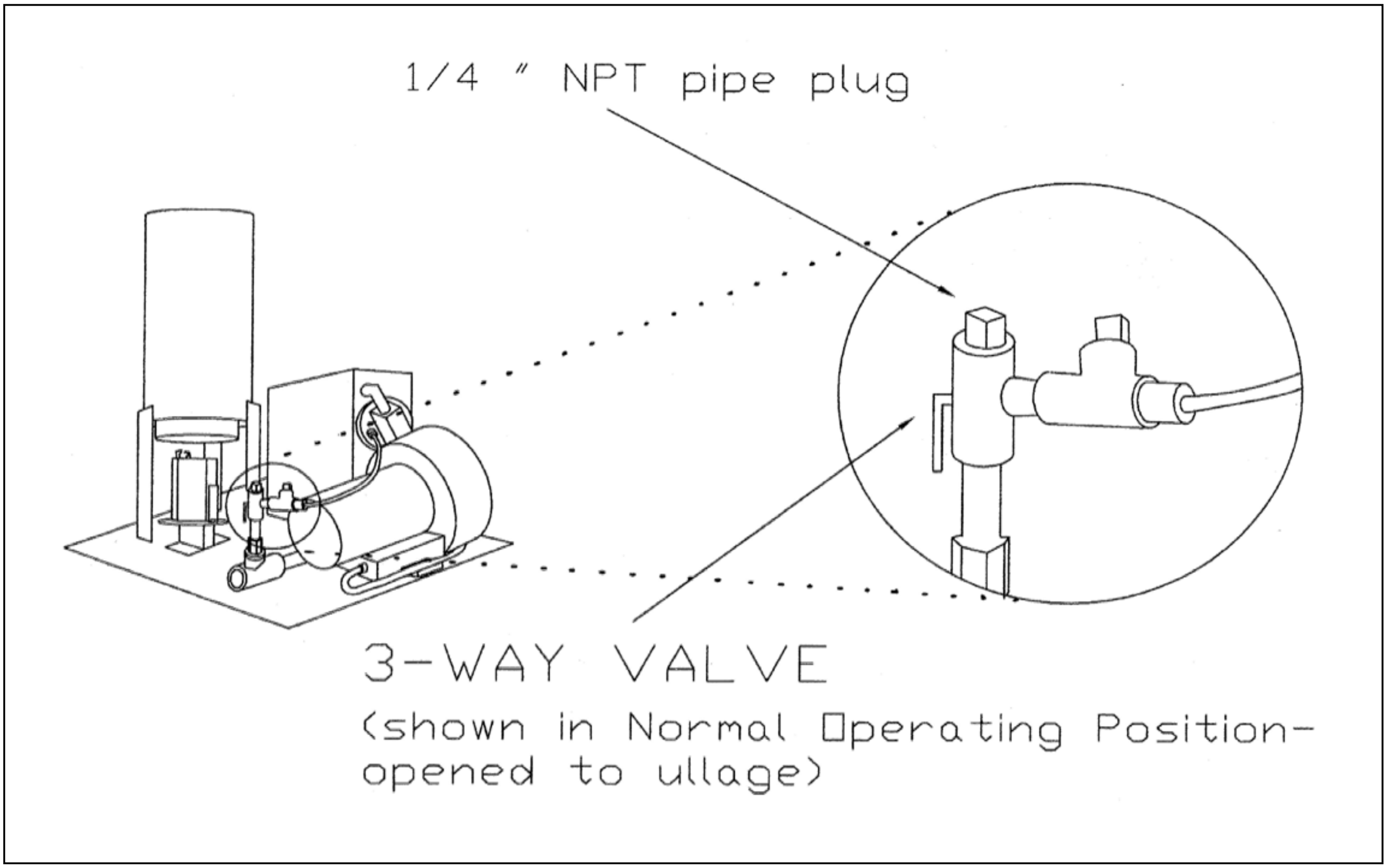


Figure 2B-7
Clean Air Separator Normal Operation Configuration

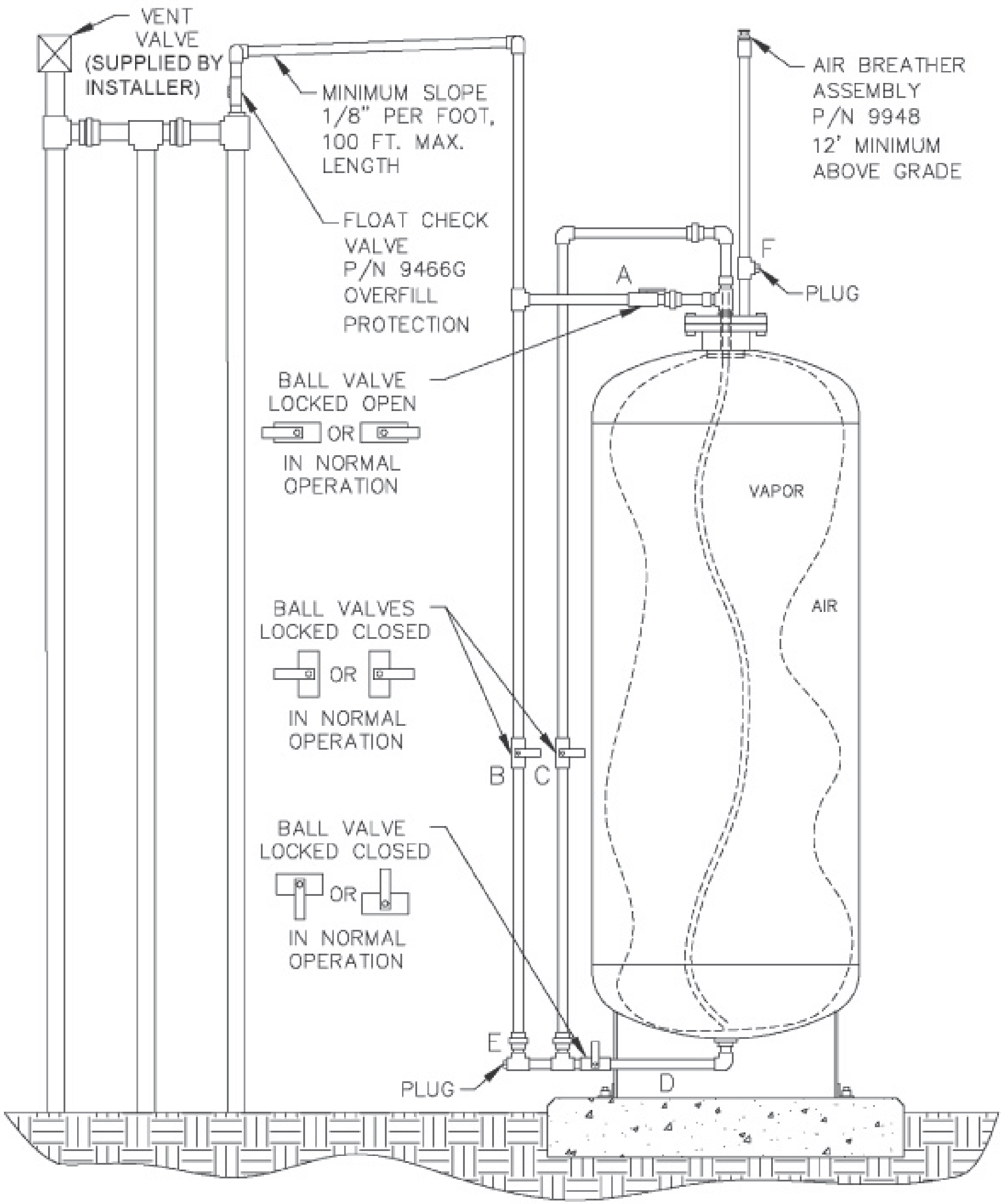


Figure 2B-7H
Clean Air Separator Normal Operation Configuration

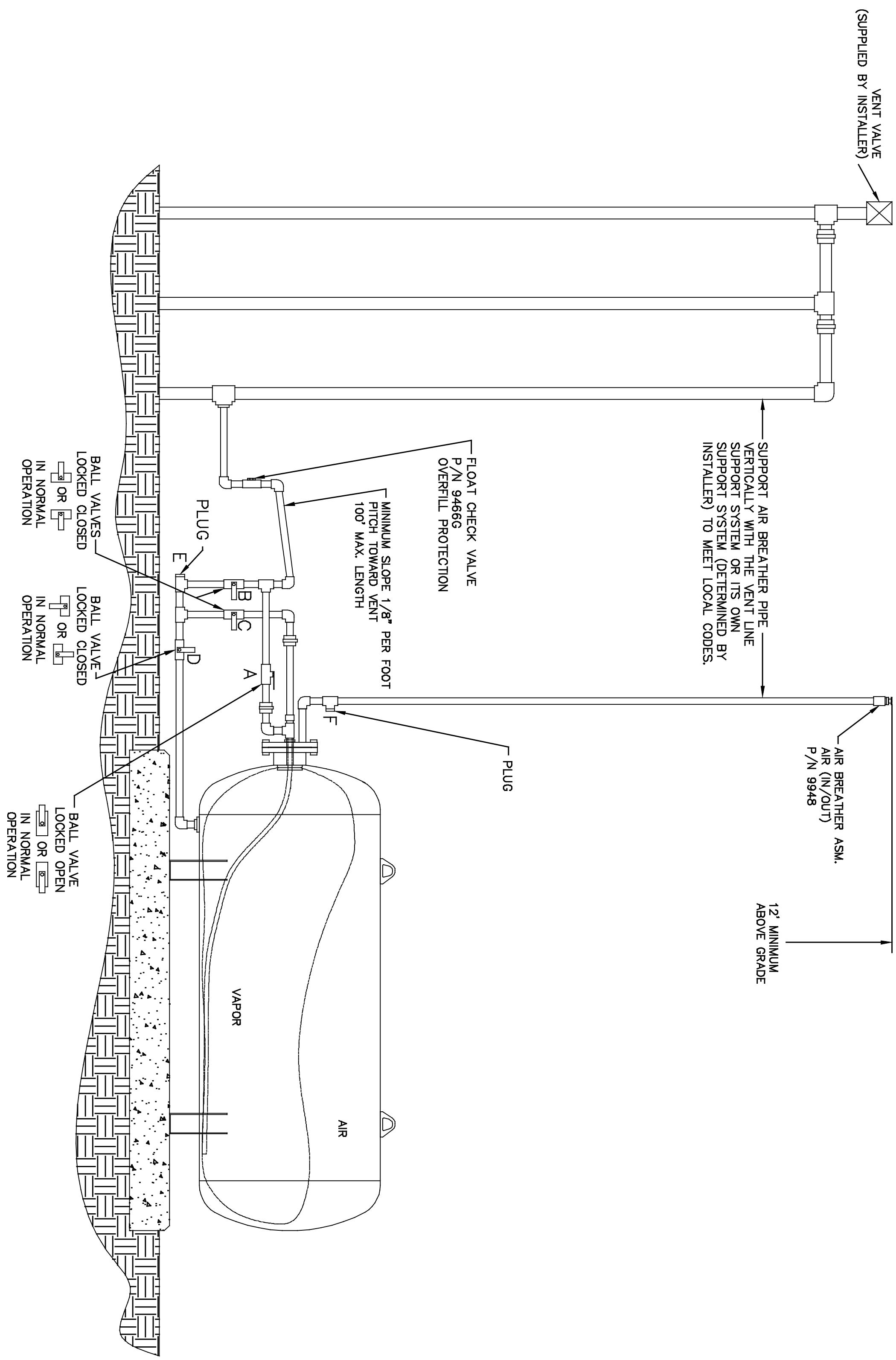


Figure 2B-8
Example of a GDF Maintenance Record and Alarm History Form

Date of Maintenance/ Test/Inspection/Failure /alarm history (including date and time of maintenance call)	Repair Date To Correct Test Failure	Maintenance/Test/Inspection Performed and Outcome/Action Taken in Response to Alarm	Affiliation	Name and Technician ID Number of Individual Conducting Maintenance or Test	Telephone Number

EXHIBIT 5

Liquid Removal Test Procedure

Definitions common to all certification and test procedures are in:

D-200 Definitions for Vapor Recovery Procedures

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

1. PURPOSE AND APPLICABILITY

1.1 This procedure is used to quantify the removal rate of liquid from the vapor passage of a Phase II balance system hose equipped with a liquid removal device. This procedure provides a method to determine compliance with the liquid removal requirements specified in ARB Executive Orders VR-203 and VR-204 and any subsequent amendments or revisions.

2. PRINCIPLE AND SUMMARY OF TEST PROCEDURE

2.1 This test procedure provides two options to determine the compliance of liquid removal devices. Under option 1 (short version), liquid in the vapor path of a coaxial hose is drained and measured. If the volume of liquid drained equals or exceeds 25 ml, a liquid removal test is conducted. For those hoses with less than 25 ml drained, no further testing is required. Under option 2 (long version), all hoses are evaluated regardless of the volume of liquid drained. Option 2 includes a prewetting and wall adhesion step. Both options test the liquid removal device by introducing gasoline into the vapor path of the coaxial hose through the nozzle bellows. After 7.5 gallons of gasoline is dispensed, the amount of gasoline remaining in the hose is measured and the liquid removal rate is determined. The district shall specify which testing option is to be used.

Caution: When draining gasoline from the vapor side of the hose, make sure the dispenser is not activated. Gasoline is drained from the vapor side of the hose by compressing the bellows and engaging the fuel lever (note the nozzle vapor valve is on the same stem as the fuel valve). If the dispenser is activated, gasoline in the fuel hose may be pressurized when engaging the fuel lever.

3. BIASES AND INTERFERENCES

3.1. Slits or tears in the hose or nozzle vapor path may bias the results towards compliance.

3.2. This test shall not be conducted on any fueling point where the hanging hardware is defective as identified in Exhibit 2.

3.3. Any spillage of gasoline invalidates the test for any volumes that are required to be measured or recorded.

3.4. A breach of the inner product hose may introduce additional gasoline into the outer vapor path resulting in a larger volume drained than introduced.

3.5. Not having the liquid extraction device (indicated by the mark on the outside of the house) at the bottom of the hose loop during liquid removal testing, as shown in Figure 1, will bias the results towards failure.

3.6. If testing a fueling point with a VST Model VST-EVR-NB nozzle, the test procedure requires the use of VST's nozzle spout plug, P/N VST-STP-100 as shown in Figure 2. If testing a fueling point with a EMCO Model A4005EVR nozzle, the test procedure requires the use of EMCO's nozzle spout plug, P/N 494635EVR as shown in Figure 3. This tool is used to plug the spout when draining liquid from the vapor side of the hose. Not plugging the spout may bias the results towards failure. Nicks, cuts, or tears in the plug o-rings will bias the results towards failure.

3.7. Dispensing rates not between 6.0 and 10.0 gallons per minute (GPM) invalidates the test.

4. SENSITIVITY, RANGE, AND PRECISION

4.1 The range of measurement of the liquid removal rate is dependent upon the range of the graduated cylinder used for testing.

4.2 To ensure precision, graduated cylinder readings shall be measured at the liquid level meniscus.

5. EQUIPMENT

5.1. Nozzle Spout Plug: If testing a fueling point with a VST Model VST-EVR-NB nozzle, use VST's spout plug, P/N VST-STP-100 (Figure 2). If testing a fueling point with a EMCO Model A4005EVR nozzle, use EMCO's nozzle spout plug, P/N 494635EVR as shown in Figure 3.

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

5.3. Funnels. Large and small gasoline compatible, non-breakable, funnels with dimensions similar to those as shown in Figure 4, or equivalent.

5.4. Graduated Cylinders. Gasoline compatible, non-breakable 0-25ml, 0-100ml, 0-250 ml, and 0-500 ml graduated cylinders with stable base plates. The 25ml cylinder may be necessary to quantify volumes of liquid less than 20 ml.

5.5. Gasoline Test Tank. (Optional) A portable tank, meeting fire safety requirements for use with gasoline, may be used to receive the gasoline dispensed during testing. The tank shall have sufficient volume so that at least 10.0 gallons may be dispensed prior to activating the primary shutoff mechanism of the nozzle. **When using a gasoline test tank, ensure that a ground strap is used and that it is properly connected to an acceptable ground.** To minimize testing-related emissions, vehicle refueling events should be used for this procedure whenever feasible.

5.6. Traffic Cones. Use traffic cones to encircle the area where testing is conducted.

5.7. Field Data Sheet. Use the appropriate data sheet to record liquid removal test information. Forms 1 and 2 serve as examples; districts may require modified versions.

5.8. Gasoline Container. Use a portable fuel container equipped with a tight fitting cap, of at least 1.0 gallon capacity.

NOTE: THIS TEST PROCEDURE PROVIDES TWO OPTIONS TO DETERMINE COMPLIANCE OF LIQUID REMOVAL DEVICES. THE DISTRICT SHALL SPECIFY WHICH TESTING OPTION IS TO BE USED

6. OPTION 1 (SHORT VERSION)

PRE-TEST PROCEDURE

6.1 Verify that the 500 ml graduated cylinder is empty. Position the large funnel into the graduated cylinder.

6.2 Remove the nozzle from the dispenser. <u>**Do not activate dispenser!**</u> If testing a fueling point with a VST Model VST-EVR-NB nozzle, install VST's spout plug, P/N VST-STP-100 in the tip of the spout (Figure 2). If testing a fueling point with an EMCO Model A4005EVR nozzle, install EMCO's nozzle spout plug, P/N 494635EVR in the tip of the spout (Figure 3). Carefully tilt the spout into the funnel/graduated cylinder assembly.

6.3 Lower the nozzle and funnel/graduated cylinder assembly as close to the ground as possible. "Walk out" the hose while keeping the nozzle lowered and hose fully extended. The hose shall slope downward from the dispenser toward the nozzle.

6.4 <u>**Do not activate dispenser!**</u> Open the nozzle's vapor check valve by compressing the bellows and engaging the fuel lever. Allow 20 seconds for all liquid to drain. Use caution to avoid spillage.

6.5 Remove VST's or EMCO's spout plug and return the nozzle to the dispenser and measure the volume of liquid drained. If the volume drained is less than 200 ml, transfer the liquid into an appropriately sized graduated cylinder. For example, if 40 ml of liquid was drained, use the 100 ml graduated cylinder to take the measurement.

6.6 Record the amount of liquid drained on Form 1 ("PRE-TEST").

6.7 If the volume drained is greater than or equal to 25 ml, proceed to Section 6.8 of the procedure. Hoses with greater than 25 ml drained are considered to be pre-wetted. If the amount drained is less than 25 ml, proceed to the next nozzle/hose to be evaluated and repeat Section 6.1-6.6

TEST PROCEDURE (FOR HOSES WITH GREATER THAN 25 ML DRAINED)

6.8 Pour 150 ml to 175 ml of gasoline into the 250 ml graduated cylinder. Measure and record this volume on Form 1 (VI).

6.9 Remove the nozzle from the dispenser and position the nozzle upright so that the spout is in a vertical position. **Do not activate dispenser!**

6.10 Open the nozzle's vapor check valve by compressing the bellows and engaging the fuel lever. Carefully insert the stem of the small funnel between the bellows and nozzle spout.

6.11 Pour the measured volume into the vapor path of the hose. Use caution not to spill the gasoline. Remove the small funnel after the gasoline has been introduced.

6.12 Insert the nozzle into a vehicle or test tank fill pipe.

6.13 Find the mark on the outside of the hose which indicates the location of the liquid pick-up device. Ensure the mark is at the bottom of the hose loop when dispensing as shown in Figure 1. This can be accomplished by lifting up the back of the hose, adjusting nozzle position, or adjusting the test tank position.

6.14 Dispense 7.5 (±0.5) gallons at the highest possible flow rate by holding the nozzle lever in the maximum handheld position. Use a stopwatch to measure the time elapsed while dispensing. Record the volume of fuel dispensed (G) and the elapsed time (T) on Form 1. Return nozzle to the dispenser.

6.15 Calculate the dispensing rate using the equation below. If the dispensing rate is not between 6.0 and 10.0 gallons per minute (GPM), the test results are invalid.

$$\text{GPM} = 60 \text{ x} \left(\frac{G}{T} \right)$$

Where:

GPM	=	dispensing rate (in gallons per minute)
G	=	gallons of fuel dispensed
T	=	number of seconds required to dispense

6.16 Using the 250 ml graduated cylinder and large funnel, carefully drain the remaining liquid from the vapor path of the hose as described in Section 6.1 through 6.5 **(make sure dispenser is not activated and spout plug is installed before draining liquid!)**. Record this quantity on Form 1 (VF).

6.17 Use Equation 9.1 to calculate the liquid removal rate for all the applicable hoses tested.

6.18 If the liquid removal rate is less than 5.0 ml/gallon, but greater than or equal to 4.5 ml/gallon, repeat the test two additional times and average the three results.

7. OPTION 2 (LONG VERSION)

PRETEST PROCEDURE

7.1 Carefully pour 150 ml of gasoline into the 250 ml graduated cylinder.

7.2 Remove the nozzle from the dispenser. **Do not activate dispenser!** If testing a fueling point with a VST Model VST-EVR-NB nozzle, Install VST's spout plug, P/N VST-STP-100 in the tip of the spout as shown in Figure 2. If testing a fueling point with an EMCO Model A4005EVR nozzle, install EMCO's nozzle spout plug, P/N 494635EVR in the tip of the spout (Figure 3). Position the nozzle upright so that the spout is in a vertical position.

7.3 Open the nozzle's vapor check valve by compressing the bellows and engaging the fuel lever. Carefully insert the stem of the small funnel between the bellows and nozzle spout.

7.4 Pour the gasoline from the 250 ml graduated cylinder into the vapor path of the hose. Use caution not to spill the gasoline. Remove the small funnel after the gasoline has been introduced.

7.5 Verify that the 500 ml graduated cylinder is empty. Position the large funnel into the graduated cylinder.

7.6 Carefully tilt the spout into the funnel/graduated cylinder assembly. **Make sure VST's or EMCO's spout plug is installed and the dispenser is deactivated.**

7.7 Lower the nozzle and funnel/graduated cylinder assembly as close to the ground as possible. "Walk out" the hose while keeping the nozzle lowered and hose fully extended. The hose shall slope downward from the dispenser toward the nozzle.

7.8 Open the nozzle's vapor check valve by compressing the bellows and engaging the fuel lever. Allow 20 seconds for all liquid to drain. Use caution to avoid spillage. If necessary, drain full graduated cylinders into a portable gas can until the hose is empty.

7.9 Remove VST's or EMCO's spout plug and return the nozzle to the dispenser.

TEST PROCEDURE

7.10 Pour 150 ml to 175 ml of gasoline into the 250 ml graduated cylinder. Measure and record this volume on Form 2 (VI).

7.11 Remove the nozzle from the dispenser. **<u>Do not activate dispenser!</u>** Position the nozzle upright so that the spout is in a vertical position.

7.12 Open the nozzle's vapor check valve by compressing the bellows and engaging the fuel lever. Carefully insert the stem of the small funnel between the bellows and nozzle spout.

7.13 Pour the measured volume into the vapor path of the hose. Use caution not to spill the gasoline. Remove the small funnel after the gasoline has been introduced.

7.14 Insert the nozzle into a vehicle or test tank fill pipe.

7.15 Find the mark on the outside of the hose which indicates the location of the liquid pick-up device. Ensure the mark is at the bottom of the hose loop when dispensing as shown in Figure 1. This can be accomplished by lifting up the back of the hose, adjusting nozzle position, or adjusting the test tank position.

7.16 Dispense 7.5 (±0.5) gallons at the highest possible flow rate by holding the nozzle lever in the maximum handheld position. Use a stopwatch to measure the time elapsed while dispensing. Record the volume of fuel dispensed (G) and the elapsed time (T) on Form 2. Return nozzle to the dispenser.

7.17 Calculate the dispensing rate using the equation below. If the dispensing rate is not between 6.0 and 10.0 gallons per minute (GPM), the test results are invalid.

$$\text{GPM} = 60 \times \left(\frac{G}{T}\right)$$

Where:

GPM	=	dispensing rate (in gallons per minute)
G	=	gallons of fuel dispensed
T	=	number of seconds required to dispense

7.18 Using the 250 ml graduated cylinder and large funnel, carefully drain the remaining liquid from the vapor path of the hose as described in Section 7.5 through 7.8 **<u>(make sure dispenser is deactivated and spout plug is installed before draining liquid!)</u>**. Record this quantity on Form 2 (VF).

7.19 Open the nozzle's vapor check valve by compressing the bellows and engaging the fuel lever. **<u>Do not activate dispenser!</u>** Carefully insert the stem of the small funnel between the bellows and nozzle spout

7.20 Use the 250 ml graduated cylinder and small funnel to pour 150 ml of gasoline into the vapor passage of the hose. Dispense no gasoline.

7.21 Using the 250 ml graduated cylinder and large funnel, completely drain the gasoline from the vapor passage back into the graduated cylinder as described in Section 7.5 through 7.9 **(make sure dispenser is deactivated and spout plug is installed before draining liquid!)**.

7.22 Subtract the volume drained (value from Section 7.21) from the volume added (value from Section 7.20). This value represents the volume of gasoline lost due to wall adhesion. The purpose of the wall adhesion value is to quantify the amount of gasoline lost to evaporation from transfer to and from the graduated cylinders and adhesion of liquid to vapor passage surfaces in previous measurements. Record this quantity on Form 2 (VW).

7.23 Use Equation 9.2 to calculate the liquid removal rate for all the applicable hoses tested.

7.24 If the liquid removal rate is less than 5.0 ml/gallon, but greater than or equal to 4.5 ml/gallon, repeat the test two additional times and average the three results.

8. POST TEST PROCEDURES

8.1. Ensure nozzle spout plug(s) is removed and nozzle is hung in dispenser cradle.

8.2. Empty all containers and return any excess gasoline to the underground storage tank.

8.3. Remove the traffic cones from the testing area.

9. CALCULATING RESULTS

9.1 If using OPTION 1(short version), the liquid removal rate shall be calculated as follows:

$$VR = \frac{VI - VF}{G}$$

Where:

VR	=	Gasoline removed per gallon dispensed, milliliters/gallon
VI	=	Total initial volume poured into hose vapor passage, milliliters
VF	=	Volume of gasoline remaining in the hose vapor passage after dispensing, milliliters
G	=	Total dispensed, gallons

9.2 If using OPTION 2 (long version), the liquid removal rate shall be calculated as follows:

$$VR = \frac{(VI - VW) - VF}{G}$$

Where:

VR	=	Gasoline removed per gallon dispensed, milliliters/gallon
VI	=	Total initial volume poured into hose vapor passage, milliliters
VW	=	Volume of liquid lost due to wall adhesion, milliliters
VF	=	Volume of gasoline remaining in the hose vapor passage after dispensing, milliliters
G	=	Total dispensed, gallons

10. REPORTING RESULTS

10.1. Record all applicable liquid removal rate information on the appropriate form as shown in Form 1 and 2. Districts may require the use of alternate forms provided that the alternate forms include the same parameters as identified in Forms 1 and 2.

10.2. If the calculated liquid removal rate is greater than or equal to 5 milliliters/gallon, the liquid removal device has demonstrated compliance.

10.3. If the calculated liquid removal rate is less than 5 milliliters/gallon, the liquid removal device is not in compliance.

11. ALTERNATIVE TEST PROCEDURES

This 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 14 of Certification Procedure CP-201.

Figure 1
Position of Liquid Removal Device
When Conducting Liquid Removal Testing

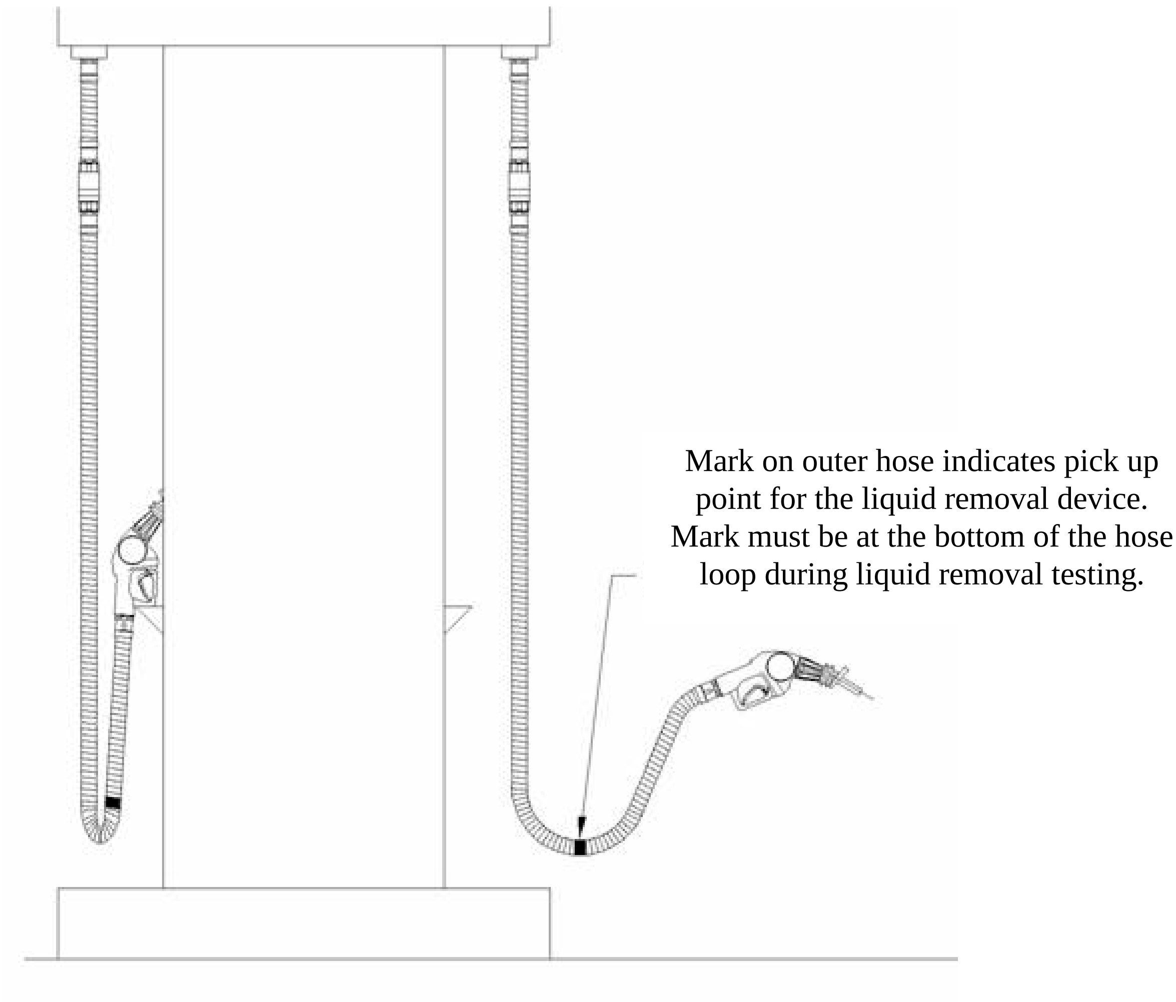
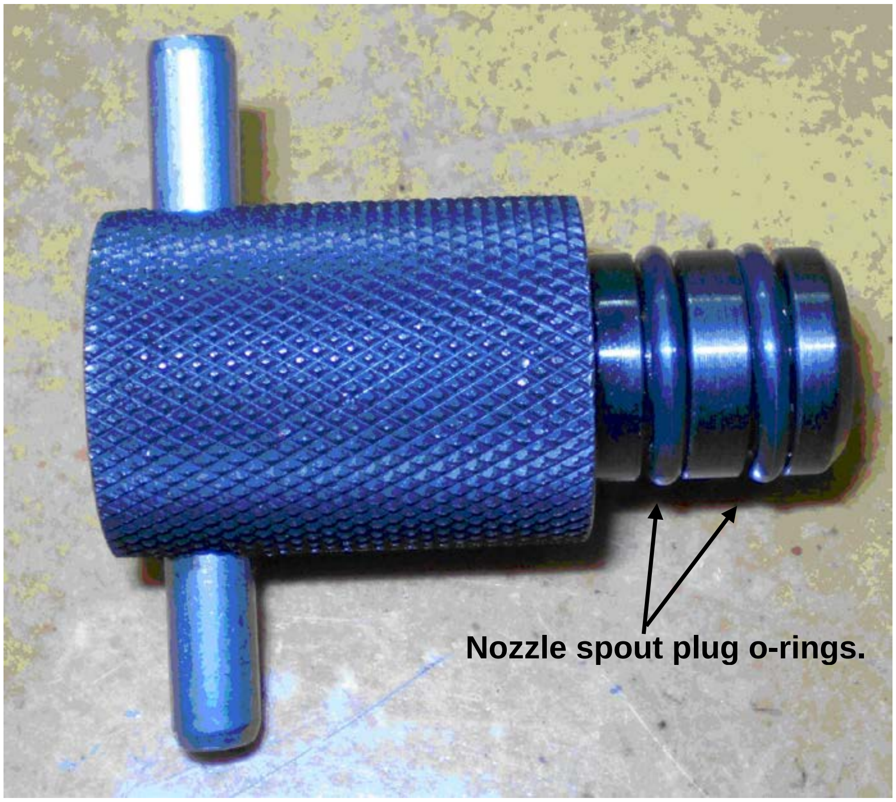
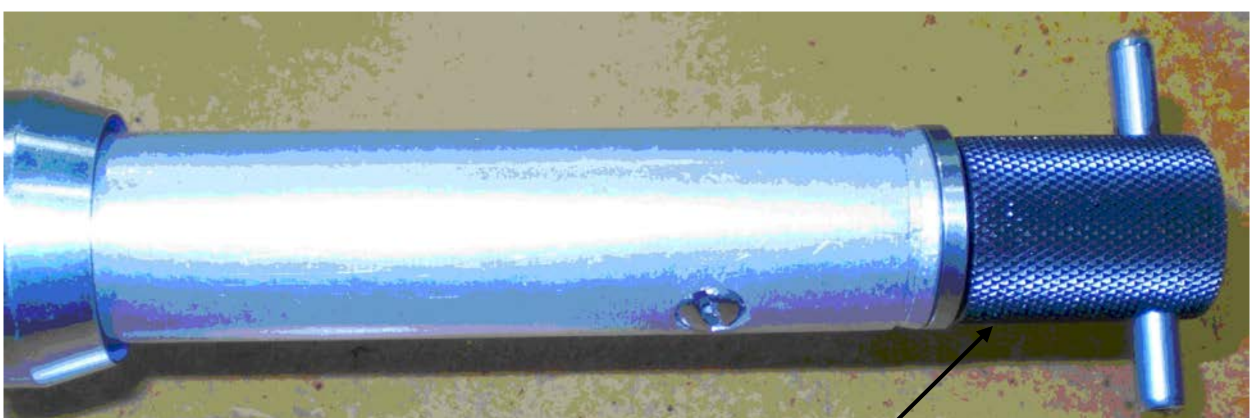


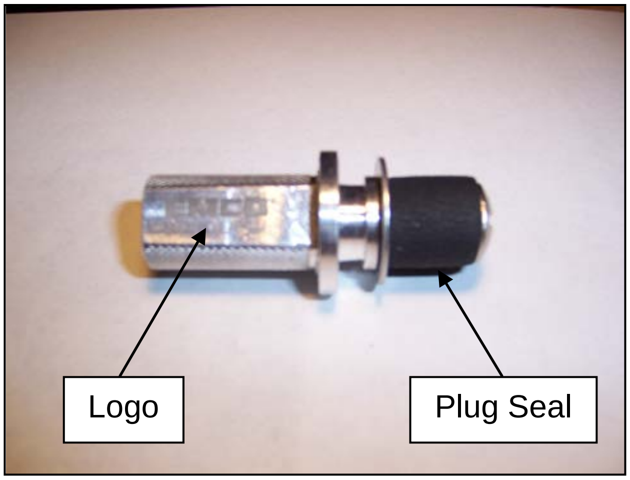
Figure 2
VST Nozzle Spout Plug P/N VST-STP-100





Plug properly inserted into nozzle spout.
Both plug o-rings seated into nozzle spout.

Figure 3
EMCO Nozzle Spout Plug P/N 494635EVR



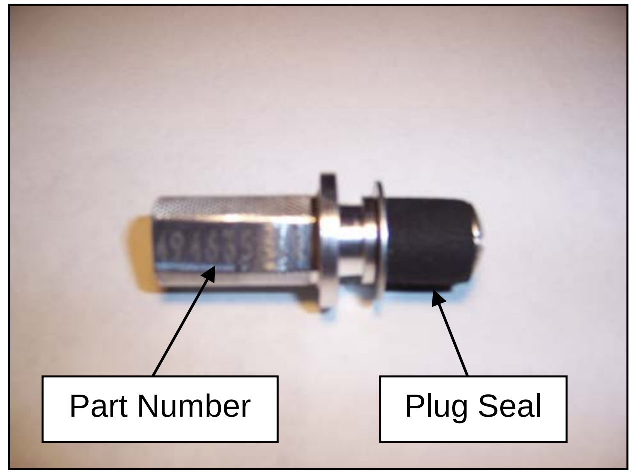
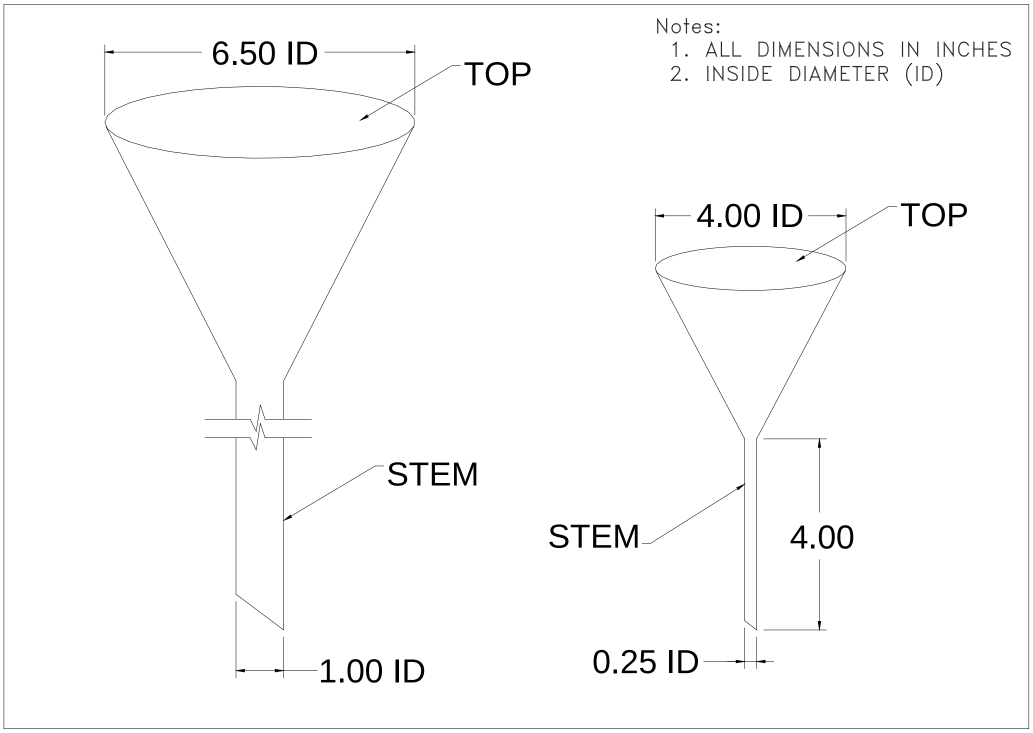


Figure 4
Recommended FUNNEL SPECIFICATIONS



FORM 1: LIQUID REMOVAL TEST DATA SHEET (OPTION 1)

Facility Name & Address	Facility Representative & Title		
		Test Date	
		A/C or Permit No.	
		Testing Company	
		Tester Name	
	Phone No.	VST Training Cert # (if applicable)	
		Inspector Name	

GENERAL INFORMATION				PRE-TEST	TEST RUN					VR=(VI-VF)/G
Dispenser Number	Product Grade	Make & Model of Hose	Serial Number of Hose	Volume Drained From Hose in mL	Volume Poured Into Hose in mL (VI)	Gallons Dispensed (G)	Seconds to Dispense (T)	Dispensing Rate (60*(G/T))	Volume Remaining in mL (VF)	Liquid Removal Rate (mL/gal)

FORM 2: LIQUID REMOVAL TEST DATA SHEET (OPTION 2)

Facility Name & Address	Facility Representative & Title		
		Test Date	
		A/C or Permit No.	
		Testing Company	
		Tester Name	
	Phone No.	VST Training Cert # (if applicable)	
		Inspector Name	

GENERAL INFORMATION				PRE-TEST	TEST RUN					VR=((VI-VW)-VF)/G
Dispenser Number	Product Grade	Make & Model of Hose	Serial Number of Hose	Volume Poured into Hose in mL (VI)	Gallons Dispensed (G)	Seconds to Dispense (T)	Dispensing Rate (60*(G/T))	Volume Remaining in mL (VF)	Volume Lost to Wall Adhension in mL (VW)	Liquid Removal Rate (mL/gal)

Executive Orders VR-203-M and VR-204-M
VST Phase II EVR System

EXHIBIT 7

Nozzle Bag Test Procedure

Verification of the integrity of the VST or EMCO EVR nozzle vapor valve shall be performed on installed nozzles by use of the following test.

1. Seal nozzle(s) at the gasoline dispensing facility (GDF) in a plastic bag, using tape or other means to secure the bag around the base of the nozzle (see Figure 1). Any plastic bag large enough to enclose the nozzle and having a thickness of no greater than 2 mils can be used.

2. Observe the bagged nozzle(s) for 30 seconds.

3. Any nozzle where the bag can be seen visually expanding or collapsing has a defective vapor valve and is not in compliance with Exhibit 2.

4. Record the test results on the "Nozzle Bag Test Results" form provided in this Exhibit. Districts may require use of an alternate form, provided that the alternate form includes the same minimum parameters.

5. Remove the bags from all the nozzles and return the nozzles to the dispenser holsters.

Figure 1
Example of Bagged Nozzle

NOZZLE BAG TEST RESULTS

<table>
<tr><th colspan="2">SOURCE INFORMATION</th><th colspan="2">TEST COMPANY INFORMATION</th></tr>
<tr><td>Facility (DBA)/Site Address:</td><td>Facility Representative/Title:</td><td>Test Company Name</td><td rowspan="4"># of Nozzles:________
Nozzles Tested:
____
Nozzles Passed:
____
Nozzles Failed:
____
Nozzles not Tested:
________________</td></tr>
<tr><td>Print Name</td><td>Print Name</td><td>Print Name of Tester</td></tr>
<tr><td>Street Address</td><td>Title
(   )</td><td>Street Address</td></tr>
<tr><td>City   Zip</td><td>Phone No.</td><td>City   Zip</td></tr>
<tr><td>District Inspector:</td><td>☐ P/O ☐ S/A ☐ A/C
Number:</td><td>Date of Test:</td><td>Time of Test:</td></tr>
</table>

Dispenser	Gas Grade	Nozzle Type	Bag Expanded or Collapsed after 30 Seconds
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No

Executive Orders VR-203-M and VR-204-M
VST Phase II EVR System with Hirt Thermal Oxidizer

EXHIBIT 13

Hirt VCS 100 Processor with Indicator Panel
Operability Test Procedure

Definitions common to all certification and test procedures are in:

D-200 Definitions for Vapor Recovery Procedures

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

1. PURPOSE AND APPLICABILITY

This test procedure verifies the operational status of the Hirt VCS 100 Processor and Indicator Panel.

The station may remain open (normal fuel dispensing) while conducting this procedure.

2. PRINCIPLE AND SUMMARY OF TEST PROCEDURE

The Hirt VCS 100 Processor is designed to activate (e.g. thermally oxidize vapors) when the underground storage tank (UST) ullage pressure exceeds a nominal -0.40 inches water column ("w.c.). Processor activation will be verified by exposing the processor's internal vacuum sensor/switch to an atmospheric pressure input. The processor should activate and the Indicator Panel Processing lamp should light.

3. BIASES AND INTERFERENCES

3.1 This test is only valid when total ullage is 70% or less than capacity of GDF storage tanks.

3.2 At least 24 hours must have elapsed after any tests that introduce air and/or nitrogen into the vapor spaces, such as, but not limited to TP-201.3 (including Exhibit 4), TP-201.4 (including Exhibit 6) and Exhibit 5.

3.3 There shall be no Phase I bulk product deliveries into or out of the storage tank(s) within the three (3) hours prior to the test or during performance of this test procedure.

3.4 Processor should be inactive (i.e. powered but not processing gasoline vapor).

4. EQUIPMENT

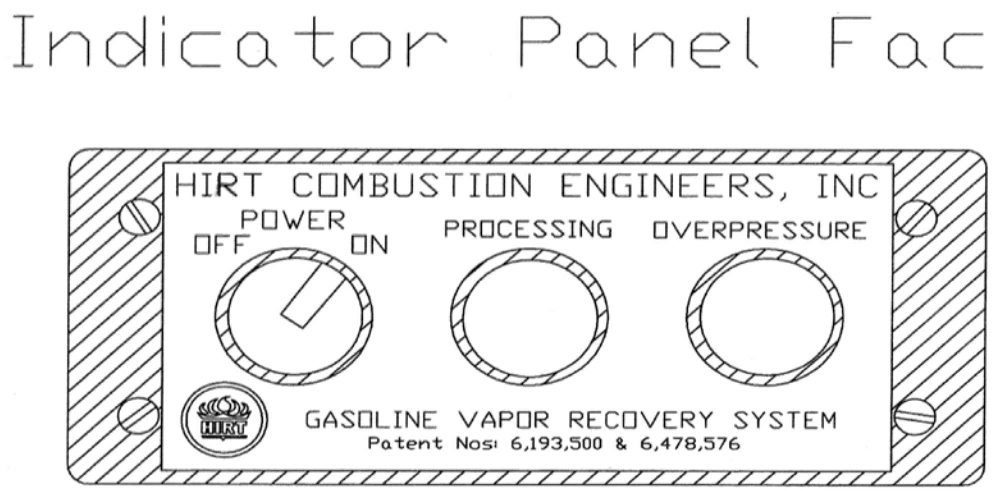
4.1 Hand tools: 5/16" nut driver or equivalent, 3/8" open end wrench.

4.2 Stopwatch: Use a stopwatch with an accuracy of ±0.2 seconds.

4.3 Teflon pipe tape.

5. TEST PROCEDURE

5.1 System Status Check: Locate Hirt Indicator Panel and verify that the green lamp on the POWER switch is lit, to be sure power is ON. Record on Form 1. If the Power switch is not lit, the processor does not meet the Exhibit 2 Hirt VCS 100 Thermal Oxidizer specifications and no testing shall be conducted.

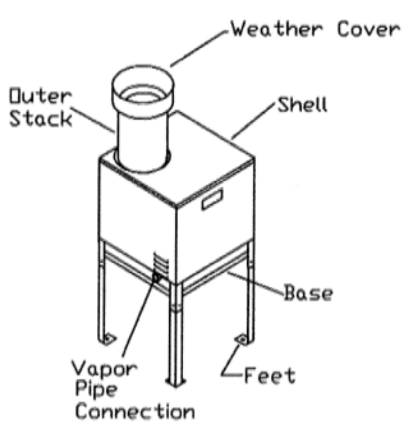


5.2 Check green PROCESSING lamp on Indicator Panel. Is the green PROCESSING lamp on? Record on Form 1. If so, then wait until PROCESSING lamp is extinguished before proceeding to step 5.3, to meet BIAS condition 3.4.

5.3 Forced Processor Operation: Turn POWER to processor OFF at Indicator Panel.

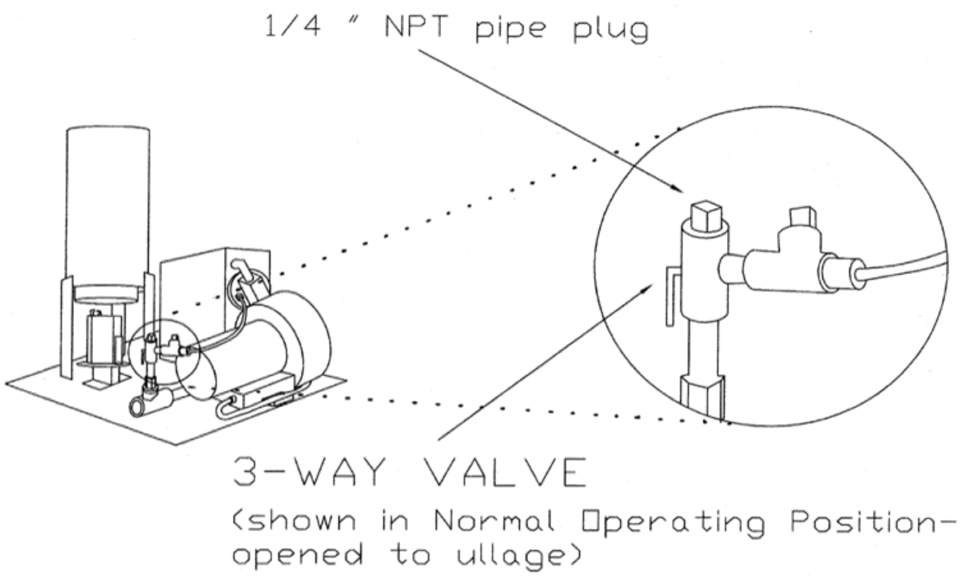
CAUTION: Processor components, such as Shell, Stack, Burner, and Weather Cover can be Hot! Use care when handling processor or removing its parts.

5.4. Remove screw from Weather Cover with 5/16” nut driver and remove Weather Cover from Outer Stack.

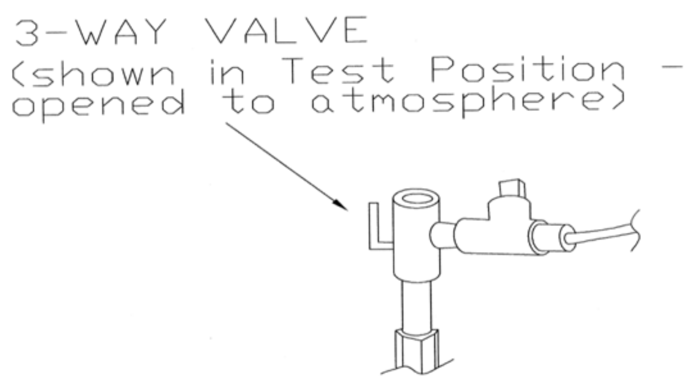


5.5 Remove (4) screws holding Shell to Base with 5/16" nut driver and then remove Shell.

5.6 Locate 3-Way Valve on tubing leading to Vacuum Sensor/Switch. The 3-Way Valve handle should be pointing down, in the Normal Operating Position – Opened to UST Ullage. Remove the 1/4" NPT pipe plug from 3-Way Valve with 3/8" wrench.



5.7 Turn 3-Way Valve handle to the up position.



5.8 Turn POWER to processor ON at Indicator Panel, and verify that green lamp on POWER switch is lit. Start the stopwatch.

5.9 Verify green PROCESSING lamp on the Indicator Panel lights within 3 minutes. Record on Form 1. If the Processing lamp is on, processor meets the Exhibit 2 Processor specifications. If the Processing lamp is not on within 3 minutes, the processor does not meet the Exhibit 2 Processor specifications and needs technical service.

5.10 Verify the OVERPRESSURE lamp on the Indicator Panel lights within sixty two (62) minutes. Record on Form 1. If the OVERPRESSURE lamp is on, processor meets the Exhibit 2 Processor specifications. If the OVERPRESSURE lamp is not on within sixty two (62) minutes, the processor does not meet the Exhibit 2 Processor specifications and needs technical service.

5.11 Turn POWER to processor OFF at Indicator Panel.

5.12 Turn 3-Way Valve handle back down to Normal Operating Position. Reinstall 1/4" NPT plug (with Teflon pipe tape) and tighten ¼ turn past snug. Reinstall Shell and Weather Cover.

5.13 Turn POWER to processor ON at Indicator Panel. Testing is completed.

6. REPORTING

Record all results on Form 1. Districts may require the use of an alternate Form, provided it includes the same minimum parameters as identified in Form 1.

FORM 1:
HIRT VCS 100 PROCESSOR OPERABILITY TEST

DATE OF TEST:

SERVICE COMPANY NAME	SERVICE COMPANY'S TELEPHONE
SERVICE TECHNICIAN	HIRT TECHNICIAN CERTIFICATION #(as applicable) CC or DISTRICT TRAINING CERTIFICATION (as applicable)
STATION NAME	DISTRICT PERMIT #

STATION ADDRESS	CITY	STATE ZIP

Was TP-201.3 (Including Exhibit 4) conducted in the last 24 hours? Yes ____ No ____

Was TP-201.4 (Including Exhibit 6) conducted in the last 24 hours? Yes ____ No ____

Was Exhibit 5 conducted in the last 24 hours? Yes ____ No ____

Was there a fuel delivery within the last 3 hours? Yes ____ No ____

The % ullage of GDF storage tank(s) is ___________ gallons.

STEP 5.1	**Is POWER switch lit?**	YES ☐ NO ☐
STEP 5.2	**Is PROCESSING lamp ON?** If "YES", test cannot be performed until lamp goes off.	YES ☐ NO ☐
STEP 5.9	**Time for PROCESSING Lamp to Light? _________ minutes** **Did PROCESSING Lamp light within three (3) minutes?**	YES ☐ NO ☐
STEP 5.10	**Time for OVERPRESSURE Lamp to Light? _________ minutes** **Did OVERPRESSURE Lamp light within sixty two (62) minutes?**	YES ☐ NO ☐

Executive Orders VR-203-M and VR-204-M
VST Phase II EVR System

EXHIBIT 14

Franklin Fueling Systems Healy Clean Air Separator Static Pressure Performance Test Procedure

1 APPLICABILITY

Definitions common to all certification and test procedures are in:

D-200 Definitions for Vapor Recovery Procedures

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

1.1 This test procedure is used to quantify the vapor tightness of the Healy Clean Air Separator (CAS) pressure management system installed as part of a gasoline dispensing facility (GDF) under Executive Order VR-203 and VR-204.

2 PRINCIPLE AND SUMMARY OF TEST PROCEDURE

2.1 The Clean Air Separator, while isolated from the vapor recovery system, is evaluated for vapor integrity using a vacuum decay procedure. The vacuum decay after 5 minutes is compared with an allowable value. The allowable value is based upon the initial vacuum level when conducting the test using the table provided in this test procedure.

2.2 A positive pressure decay procedure is included that conducts the same evaluation as the vacuum decay but with positive pressure. This test is conducted if there is insufficient vacuum (not greater than – 2.00” wc) to conduct the vacuum decay. Districts have the authority to specify in the permit conditions that this positive pressure test is to be conducted even if the vacuum test has been conducted.

3 RANGE

3.1 The full-scale range of the electronic measuring device shall not exceed 0-20.00” wc with a minimum accuracy of not less than 0.25 percent of full-scale.

4 INTERFERENCES

4.1 Leaks in the piping for the Clean Air Separator could bias the test results toward non-compliance.

4.2 Introduction of gaseous nitrogen into the system at flow rates exceeding 4 CFM (240 CFH) may bias the results of the test toward non-compliance. Only gaseous nitrogen shall be used to conduct this test.

4.3 Pressurizing the Clean Air Separator bladder greater than 14.00” wc could damage the bladder, biasing the test toward non-compliance.

4.4 Thermal Bias for Electronic Manometers

Electronic manometers shall have a warm-up period of at least 15 minutes followed by a drift check of 5 minutes. If the drift exceeds 0.01” wc, the instrument should not be used.

5 APPARATUS

5.1 Nitrogen

Use commercial grade gaseous nitrogen in a high pressure cylinder, equipped with a two-stage pressure regulator.

5.2 Pressure Measurement Device

Use an electronic pressure measurement device to monitor the pressure decay in the Clean Air Separator. The pressure measurement device shall, at a minimum, be readable to the nearest 0.01” wc.

5.3 Test Port Assembly

Use a test port assembly constructed similar to the one in Figure A. The assembly should have an 8 oz. Pressure Relief valve, to ensure that the Clean Air Separator is not over pressurized. The Model 9968 Clean Air Separator Test Port Assembly can be purchased from Healy Systems, Inc.

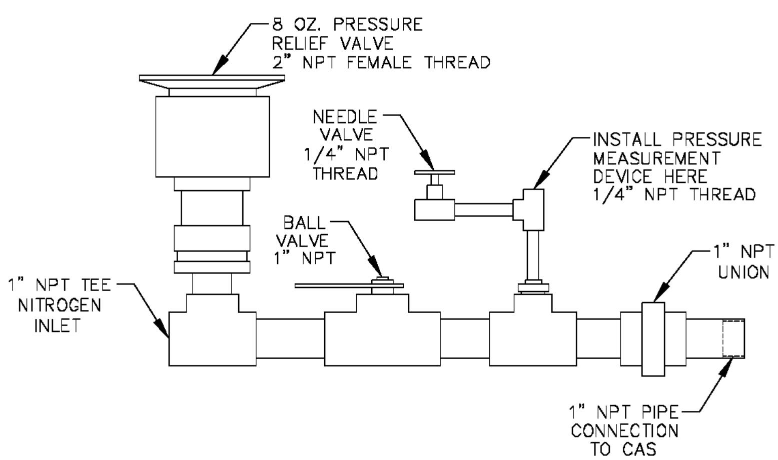


Figure A - Clean Air Separator Test Port Assembly

5.4 Stopwatch

Use a stopwatch accurate to within 0.2 seconds.

5.5 Flow Meter

Use a flow meter to determine the required pressure setting of the delivery pressure gauge on the nitrogen supply pressure regulator. This pressure shall be set such that the nitrogen flow rate is between 2.0 CFM (120 CFH) and 4.0 CFM (240 CFH).

5.6 Leak Detection Solution

Any liquid solution designed to detect vapor leaks may be used to verify the pressure integrity of the test equipment prior to conducting the test.

5.7 Condensate Collection Vessel

A container approved for use with gasoline that can hold at least a half gallon of material.

5.8 Graduated Cylinder

A graduated cylinder that is suitable for use with gasoline and capable of measuring to the nearest ounce or ml.

6 PRE-TEST PROCEDURES

6.1 The following safety precautions shall be followed:

6.1.1 Only gaseous nitrogen shall be used to pressurize the system.

6.1.2 An 8 oz. pressure relieve valve shall be installed on the Test Port Assembly to prevent the possible over-pressurizing of the Clean Air Separator.

6.1.3 A ground strap should be employed during the introduction of nitrogen into the system.

6.2 There shall be no Phase I bulk product deliveries into or out of the gasoline storage tank(s) within the three (3) hours prior to the test or during the performance of this test procedure.

6.3 All pressure measuring device(s) shall be bench calibrated using a reference standard. Calibration shall be performed at 20, 50, and 80 percent of full scale. Accuracy shall be within two percent at each of these calibration points. Calibrations shall be conducted on a frequency not to exceed 180 days. Calibration documentation shall be maintained with the equipment at all times.

6.4 Use the flow meter to determine the nitrogen regulator delivery pressures that correspond to nitrogen flow rates of 2.0 CFM (120 CFH) and 4.0 CFM (240 CFH). These pressures define the allowable range of delivery pressures acceptable for this test procedure. The flow meter shall be connected in-line between the nitrogen supply regulator and the Test Port Assembly during pressurization. The flow meter may be connected in-line between the nitrogen supply regulator and the Test Port Assembly during the test.

6.5 The electronic pressure measurement device shall be subject to warm-up and drift check before use; see Section 4.5.

6.6 The four ball valves used in the installation of the Clean Air Separator are lockable and shall be locked in the position shown in Figure 1 or Figure 1H of this Exhibit during normal operation. Figure 1 applies to vertical CAS installations and Figure 1H applies to horizontal CAS installations. The four padlocks provided by Healy Systems, Inc. in their installation kit are keyed the same. However, it is possible that one or more of the padlocks on the Clean Air Separator could have been replaced (seizing, damage, broken key, etc.). Conducting this test will require a set of keys necessary to unlock all padlocks.

6.7 Verify that the Clean Air Separator is in its normal operating configuration by confirming that all components are as indicated (See Figure 1 or Figure 1H):

Valve “A” - Open
Valve “B, C and D” - Closed
Pipe End “E” - Plugged
Tee Branch “F” – Plugged

Figure 1
Normal Clean Air Separator Operating Configuration

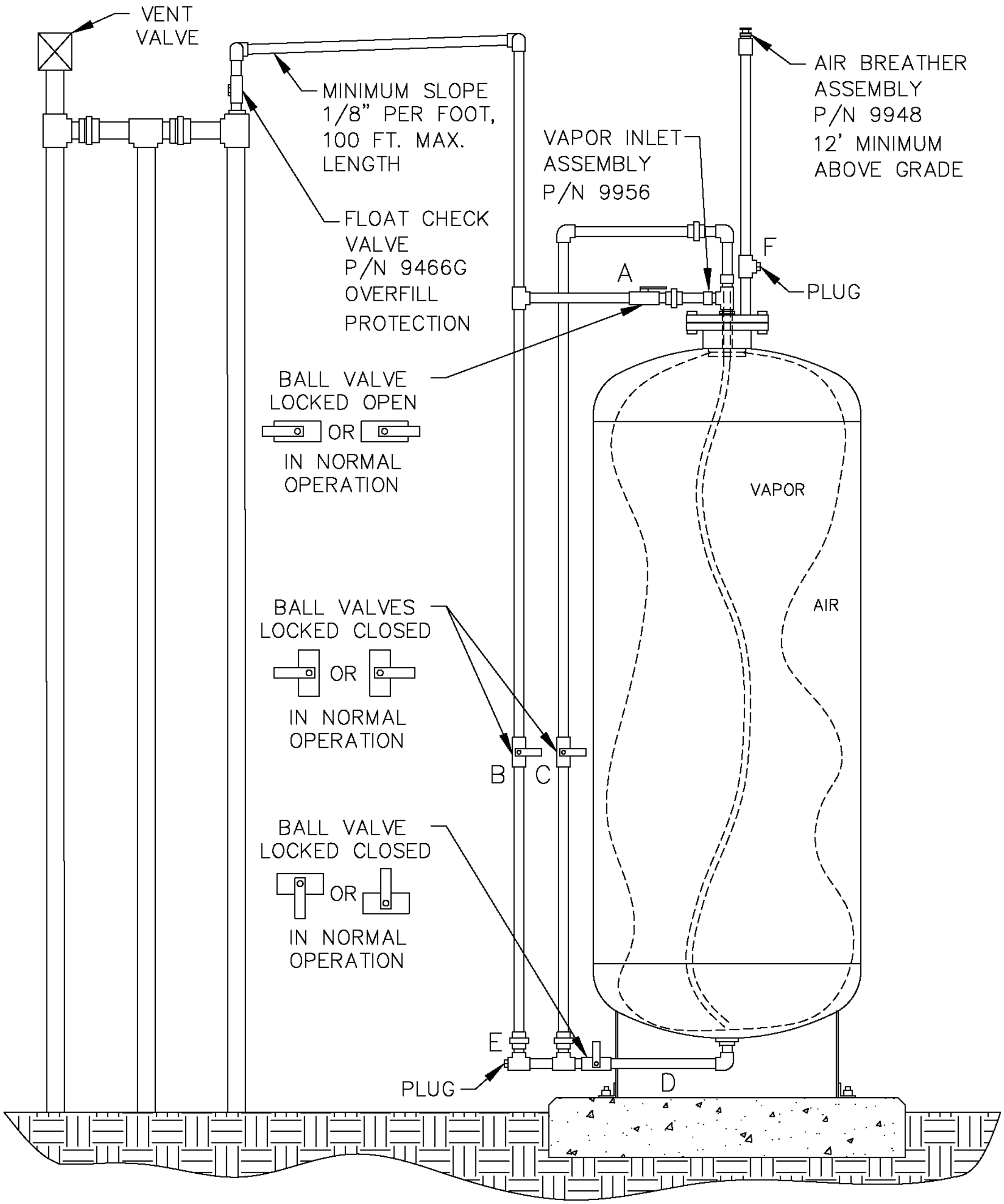
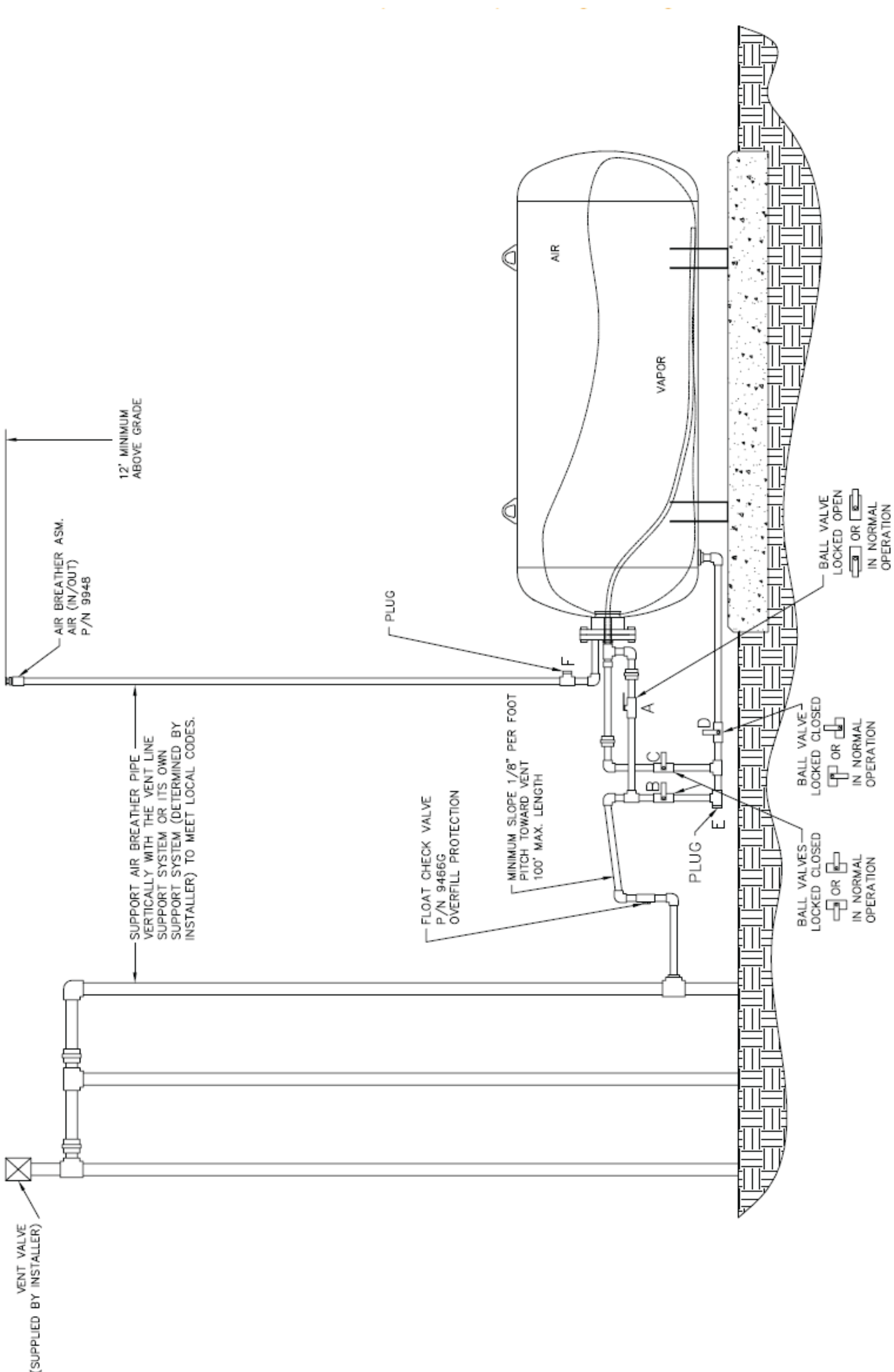


Figure 1H
Normal Clean Air Separator Operating Configuration



6.8 Installing the Test Port Assembly

6.8.1 Open the ball valve marked “B”, shown in Figure 1 or Figure 1H. This ensures that if there is any condensate in the primary connection line to the Clean Air Separator it will drop down into the lower section of the piping configuration, so that it can be measured. Close the valve after approximately 30 seconds.

6.8.2 Position the condensate collection vessel below plug “E” prior to removing it. Remove the 1” plugs from locations “E” and “F” from Figure 1 or Figure 1H. Transfer the collected condensate into the graduated cylinder. If there is more than 16 oz. (473 mL) of liquid condensate, the bladder and vapor processor vessel must be drained. Conduct the bladder and vessel draining procedures from the Clean Air Separator section of the ***ARB Approved Installation, Operation and Maintenance Manual***.

Note: Depending upon the size of the graduated cylinder and the amount of condensate, it may take multiple transfers from the condensate collection vessel to get the total condensate measurement.

6.8.3 Install the Test Port Assembly to the Clean Air Separator at location “E”. See Figure 2 or Figure 2H. Figure 2 applies to vertical CAS installations and Figure 2H applies to horizontal CAS installations.

6.8.4 Connect the gaseous nitrogen supply to the Test Port Assembly. See Figure 2 or Figure 2H.

6.8.5 Check the test equipment and piping isolated from normal Clean Air Separator operation by the ball valves “B, C and D” by pressurizing with nitrogen to a pressure of 4” wc ± 1” wc and closing the ball valve on the Test Port Assembly. Use leak detection solution. Tighten as necessary. The test equipment shall have no leaks.

6.8.6 Open the needle valve on the Test Port Assembly to bleed the pressure off the equipment. Keep ball valve on Test Port Assembly closed.

Figure 2
Clean Air Separator in Configuration to Conduct Test

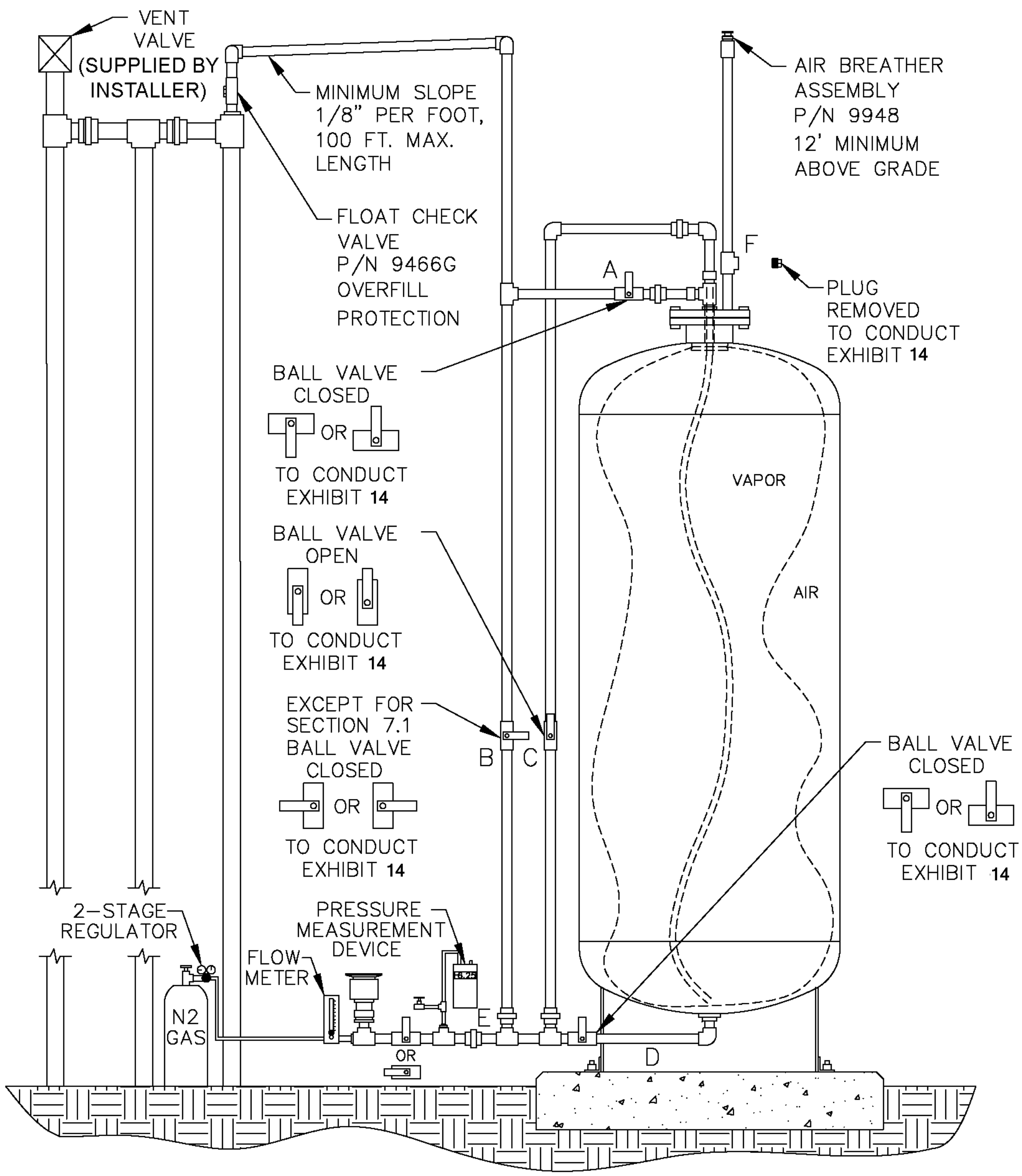
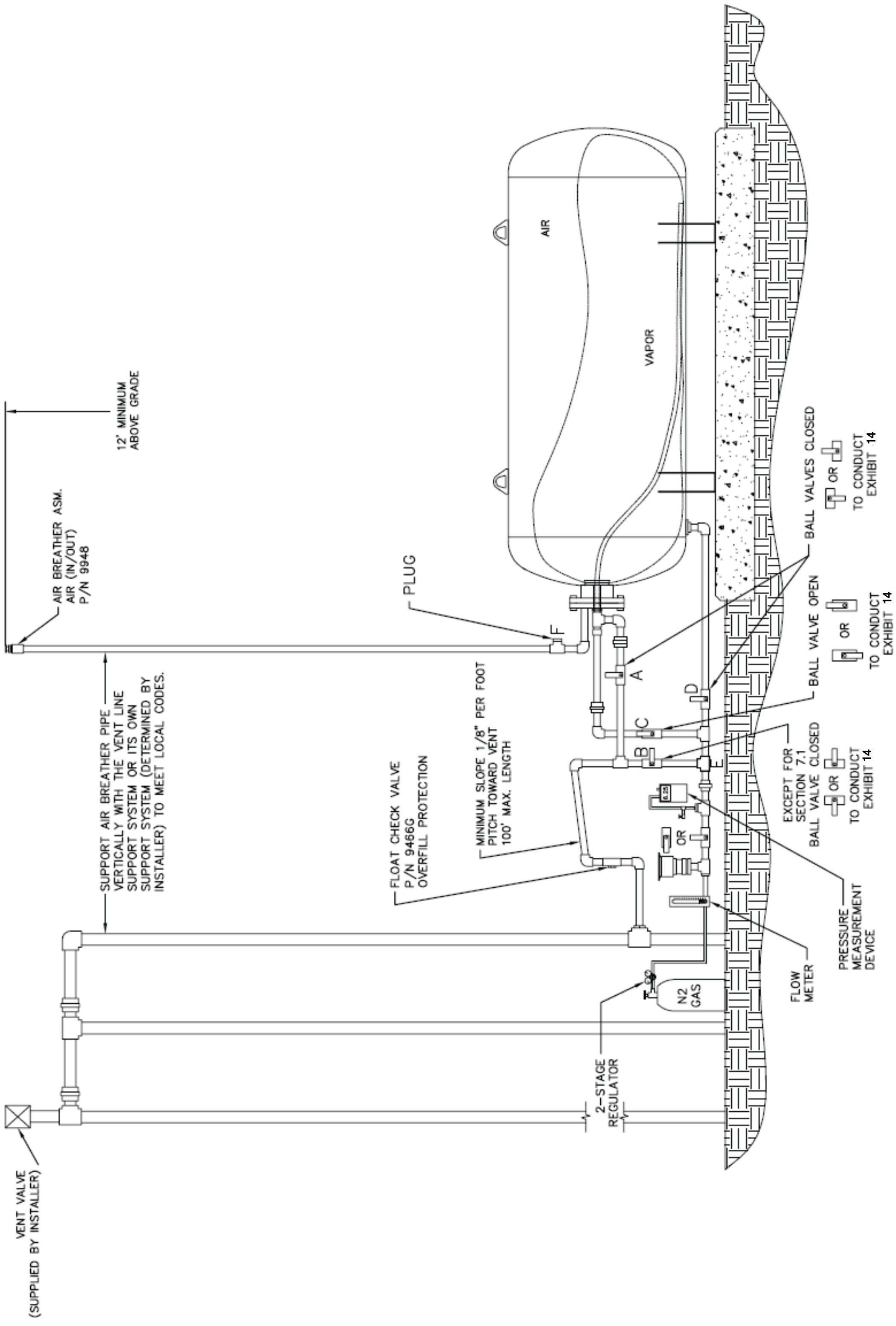


Figure 2H
Clean Air Separator in Configuration to Conduct Test



7 TESTING

7.1 Open the ball valve marked “B” from Figure 2 or Figure 2H. The pressure measurement device installed on the Test Port Assembly should now be reading UST and Clean Air Separator ullage pressure (or vacuum).

7.2 If the station vacuum is greater than (more negative) than -2.00” wc, then proceed to Section 7.2.1. If less than –2.00” wc, then proceed to Section 7.3:

7.2.1 Close the ball valves marked “A” and “B” from Figure 2.

7.2.2 Open the ball valve marked “C” from Figure 2 and wait one minute.

7.2.3 If necessary, use the needle valve on the Test Port Assembly to bleed air into the bladder until the vacuum level reaches as close to a whole number on the pressure measurement device as the accuracy of the device will provide (ie. -2.00, -3.00, -4.00, -5.00, -6.00, -7.00, -8.00). Make sure the needle valve is closed. Record this vacuum and start the stop watch to begin a 5 minute decay.

7.2.4 Record the vacuum at one-minute increments up to 5 minutes.

7.2.5 Using the information from Table 1, verify that the vacuum after 5 minutes is equal to or greater than the allowable minimum for the initial vacuum recorded from Section 7.2.3.

7.2.6 If the vacuum is greater than the allowable minimum, the Clean Air Separator passed the test.

7.2.7 If the vacuum is less than the allowable minimum, the Clean Air Separator failed the test.

TABLE 1
Allowable 5 Minute Vacuum Decay for Clean Air Separator

Vacuum at Start of Test (inches wc)	Allowable Minimum Vacuum after 5 min. (inches wc)
8.0	5.5
7.0	4.7
6.0	3.8
5.0	3.0
4.0	2.2
3.0	1.5
2.0	0.8

7.3 If the station vacuum is less than –2.00” wc (from Section 7.2), or at the direction of district (refer to Section 2.2), conduct the following:

7.3.1 Close the ball valves marked “A” and “B” from Figure 2.

7.3.2 Open the ball valve marked “C” from Figure 2.

7.3.3 Open the ball valve of the Test Port Assembly and flow nitrogen into the Clean Air Separator bladder at a flow rate between 2 and 4 CFM until the pressure in the bladder reaches 2.20” wc.

7.3.3.1 Depending upon the nitrogen flow rate used, the bladder could take up to 30 minutes to fill completely.

7.3.3.2 Because of the close proximity of the pressure measurement device to the nitrogen inlet of the Test Port Assembly, the pressure measurement device may read a higher pressure when nitrogen is flowing. The pressure measurement device is usually steady, but will start to increase rapidly when the bladder is getting full. Periodically stopping nitrogen flow will provide an accurate reading of the pressure in the bladder.

7.3.4 Once the pressure reaches 2.20” wc, shut off the flow of nitrogen to the Clean Air Separator bladder and close the ball valve of the Test Port Assembly.

7.3.5 Wait 5 minutes or until pressure stabilizes above 2.00” wc. If the pressure does not stabilize, repeat steps 7.3.3 and 7.3.4.

7.3.6 Use the needle valve on the Test Port Assembly to bleed off the nitrogen until the pressure reaches 2.00” wc. Make sure the needle valve is closed. Record the pressure.

7.3.7 Start the stop watch to begin a 5 minute decay.

7.3.8 Record the pressure in one-minute increments up to 5 minutes.

7.3.9 If the pressure in the bladder is greater than 1.77” wc at the end of 5 minutes, then the Clean Air Separator passed the test.

7.3.10 If the pressure in the bladder is less than 1.77” wc at the end of 5 minutes, then the Clean Air Separator failed the test.

7.4 If the bladder was evaluated using the vacuum procedure (Section 7.2), close the ball valve “C” to keep it in a vacuum condition. If the bladder was evaluated using the pressure procedure (Section 7.3), open the needle valve on the Test Port Assembly to bleed off all pressure from the bladder.

7.5 Close the ball valve marked “C”, if not already done.

7.6 Remove the Test Port Assembly from location “E” and install the 1” pipe plug. Use a pipe sealant approved for use with gasoline on the threads and tighten to 60 ft-lbs.

7.7 Install the 1” pipe plug to location “F”. Use a pipe sealant approved for use with gasoline on the threads and tightens to 60 ft-lbs.

7.8 Open the ball valve marked “A”. Lock all ball valves using the padlocks.

7.9 The Clean Air Separator should now be in normal operation configuration. Verify this by using the outline from Section 6.7 and Figure 1 or Figure 1H.

8 REPORTING

8.1 Record test data on the form shown in Figure 3. Districts may require the use of an alternate form, provided that the alternate form includes the same minimum parameters as in Form 1.

Form 1

Data Form for Determination of Static Pressure Performance of the
Healy Clean Air Separator for Executive Order VR-203 and VR-204

SOURCE INFORMATION	
GDF Name and Address ________________ ________________ ________________	GDF Representative and Title ________________ ________________ GDF Phone No. ________________
Date and Time of Last Fuel Drop to GDF: ________________ Date of Last Calibration of Pressure Measurement Device: ________	P/O #: ________________ A/C#: ________________ District Test Witness: ________________

VACUUM TEST (Section 7.1 through 7.2.7)	
Vacuum at start of test, inches water column (7.2.3)	________
Vacuum at one minute, inches water column	________
Vacuum at two minutes, inches water column	________
Vacuum at three minutes, inches water column	________
Vacuum at four minutes, inches water column	________
Final vacuum at five minutes, inches water column	________
Allowable minimum vacuum, inches water column (from Table 1)	________
POSITIVE PRESSURE TEST (Section 7.3 through 7.3.9)	
Pressure at start of test, inches water column (7.3.6)	________
Pressure at one minute, inches water column	________
Pressure at two minutes, inches water column	________
Pressure at three minutes, inches water column	________
Pressure at four minutes, inches water column	________
Final pressure at five minutes, inches water column	________
Allowable final pressure, inches water column (7.3.9)	**1.77**

Healy Certified Technician Name, Certification Number and Expiration Date	Test Company	Date Test Conducted

Pressure Management Control

Install, Setup, & Operation Manual

For VST Processors

Notice

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DAMAGE CLAIMS / LOST EQUIPMENT

Thoroughly examine all components and units as soon as they are received. If any cartons are damaged or missing, write a complete and detailed description of the damage or shortage on the face of the freight bill. The carrier's agent must verify the inspection and sign the description. Refuse only the damaged product, not the entire shipment.

Veeder-Root must be notified of any damages and/or shortages within 30 days of receipt of the shipment, as stated in our Terms and Conditions.

VEEDER-ROOT'S PREFERRED CARRIER

1. Contact Veeder-Root Customer Service at 800-873-3313 with the specific part numbers and quantities that were missing or received damaged.
2. Fax signed Bill of Lading (BOL) to Veeder-Root Customer Service at 800-234-5350.
3. Veeder-Root will file the claim with the carrier and replace the damaged/missing product at no charge to the customer. Customer Service will work with production facility to have the replacement product shipped as soon as possible.

CUSTOMER'S PREFERRED CARRIER

1. It is the customer's responsibility to file a claim with their carrier.
2. Customer may submit a replacement purchase order. Customer is responsible for all charges and freight associated with replacement order. Customer Service will work with production facility to have the replacement product shipped as soon as possible.
3. If "lost" equipment is delivered at a later date and is not needed, Veeder-Root will allow a Return to Stock without a restocking fee.
4. Veeder-Root will NOT be responsible for any compensation when a customer chooses their own carrier.

RETURN SHIPPING

For the parts return procedure, please follow the appropriate instructions in the "General Returned Goods Policy" pages in the "Policies and Literature" section of the Veeder-Root **North American Environmental Products** price list. Veeder-Root will not accept any return product without a Return Goods Authorization (RGA) number clearly printed on the outside of the package.

FCC INFORMATION

This equipment complies with the requirements in Part 15 of the FCC rules for a Class A computing device. Operation of this equipment in a residential area may cause unacceptable interference to radio and TV reception requiring the operator to take whatever steps are necessary to correct the interference.

WARRANTY - Please see next page, iii.

Warranty

This warranty applies only when the product is installed in accordance with Veeder-Root's specifications, and that a Warranty Registration and Checkout Form has been filed with Veeder-

Root by an authorized Veeder-Root Distributor. This warranty will not apply to any product which has been subjected to misuse, negligence, accidents, systems that are misapplied or are not installed per Veeder-Root specifications, modified or repaired by unauthorized persons, or damage related to acts of God. Veeder-Root is not liable for incidental, consequential, or indirect damages or loss, including, without limitation, personal injury, death, property damage, environmental damages, cost of labor, clean-up, downtime, installation and removal, product damages, loss of product, or loss of revenue or profits. **THE WARRANTY CONTAINED HEREIN IS EXCLUSIVE AND THERE ARE NO OTHER EXPRESS, IMPLIED, OR STATUTORY WARRANTIES. WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE EXPRESSLY EXCLUDED.**

TLS-350R, TLS-350 PLUS, TLS-350J AND TLS-300I/C, AND TLS2 MONITORING SYSTEMS

We warrant that this product shall be free from defects in material and workmanship for a period of one (1) year from the date of installation or twenty-four (24 months) from the date of invoice, whichever occurs first. During the warranty period, we or our representative will repair or replace the product, if determined by us to be defective, at the location where the product is in use and at no charge to the purchaser. LAMPS, FUSES, AND LITHIUM BATTERIES ARE NOT COVERED UNDER THIS WARRANTY.

If "Warranty" is purchased as part of the Fuel Management Service, Veeder-Root will maintain the equipment for the life of the contract in accordance with the written warranty provided with the equipment. A Veeder-Root Fuel Management Services Contractor shall have free site access during Customer's regular working hours to work on the equipment. Veeder-Root has no obligation to monitor federal, state or local laws, or modify the equipment based on developments or changes in such laws.

MODULES, KITS, OTHER COMPONENTS (PARTS PURCHASED SEPARATE OF A COMPLETE CONSOLE)

We warrant that this product shall be free from defects in material and workmanship for a period of one (1) year from the date of installation or fifteen (15) months from the date of invoice, whichever occurs first. We warrant that the lithium batteries (excluding EVR BATTERY PACK) shall be free from defects in material and workmanship for a period of three (3) months from date of invoice. We will repair or replace the product if the product is returned to us; transportation prepaid by user, within the warranty period, and is determined by us to be defective. **LAMPS AND FUSES ARE NOT COVERED UNDER THIS WARRANTY.**

Introduction

Installation

Setup

Operation

Diagnostics

Figures

Tables

Introduction

This manual provides instructions to install, setup, and operate the components of Veeder-Root Pressure Management Control (PMC) equipment. The PMC feature is an option for the TLS console platform, and as such, many of the installation/setup/operation instructions for non-PMC specific tasks are covered in TLS-3XX supplied literature. Do not use this manual when PMC is installed with ISD. Use the ISD Setup & Operation Manual, 577021-800.

Site Requirements

Below are the requirements for all PMC installations:

- V-R TLS-350R/EMC w/BIR, TLS-350 Plus/EMC Enhanced, TLS-350/EMC and ProMax consoles with ECPU2 - install as per TLS-3XX Site Prep manual, setup following instructions in TLS-3XX System Setup Manual.
- A flash memory board (NVMEM203) for PMC software storage - installed on the ECPU2 board in place of the console's 1/2 Meg RAM board - install as per TLS-350 Series Board and Software Replacement Manual, no setup required.
- Smart Sensor Module and Vapor Pressure Sensor. Install and connect following instructions in the Vapor Pressure Sensor installation Guide.
- Multiport card connected to a hydrocarbon sensor module installed according to processor manufacturers specifications.
- A 4-Relay or I/O Combination Module to control the vapor processor motor and setup as instructed in this manual.
- An RS-232 Port will be available for use by contractor or government inspectors.

Contractor Certification Requirements

Veeder-Root requires the following minimum training certifications for contractors who will install and setup the equipment discussed in this manual:

Installer (Level 1) Certification: Contractors holding valid Installer Certification are approved to perform wiring and conduit routing; equipment mounting; probe, sensor and carbon canister vapor polisher installation; wireless equipment installation; tank and line preparation; and line leak detector installation.

ATG Technician (Level 2/3 or 4) Certification: Contractors holding valid ATG Technician Certifications are approved to perform installation checkout, startup, programming and operations training, system tests, troubleshooting and servicing for all Veeder-Root Series Tank Monitoring Systems, including Line Leak Detection. In addition, Contractors with the following sub-certification designations are approved to perform installation checkout, startup, programming, system tests, troubleshooting, service techniques and operations training on the designated system.

- Wireless 2
- Tall Tank

VR Vapor Products Certification: Contractors holding a certification with the following designations are approved to perform installation checkout, startup, programming, system tests, troubleshooting, service techniques and operations training on the designated system.

- ISD – In Station Diagnostics
- PMC – Pressure Management Control
- CCVP - Veeder-Root Vapor Polisher
- Wireless – ISD/PMC Wireless
- A current Veeder-Root Technician Certification is a prerequisite for the VR Vapor Products course.

Warranty Registrations may only be submitted by selected Distributors.

Related Manuals

The manuals in Table 1 below are shipped with the equipment on the V-R Tech Docs CD-ROM and will be needed to install specific equipment.

Table 1. Related Manuals

V-R Manual	Part Number
TLS-3XX Site Prep Manual	576013-879
Vapor Pressure Sensor Installation Guide	VR203 Section 13
TLS-3XX Series Consoles System Setup Manual	576013-623
TLS-3XX Series Consoles Operator's Manual	576013-610
Serial Comm Modules Installation Guide	577013-528
TLS-350 Series Board and Software Replacement Manual	576013-637

Safety Precautions

The following symbols may be used throughout this manual to alert you to important safety hazards.

ELECTRICITY
High voltage exists in, and is supplied to, the device. A potential shock hazard exists.

TURN POWER OFF
Live power to a device creates a potential shock hazard. Turn Off power to the device and associated accessories when servicing the unit.

READ ALL RELATED MANUALS
Knowledge of all related procedures before you begin work is important. Read and understand all manuals thoroughly. If you do not understand a procedure, ask someone who does.

WARNING
Heed the adjacent instructions to avoid equipment damage or personal injury.

WARNING

The console contains high voltages which can be lethal. It is also connected to low power devices that must be kept intrinsically safe.

Turn power Off at the circuit breaker. Do not connect the console AC power supply until all devices are installed.

FAILURE TO COMPLY WITH THE FOLLOWING WARNINGS AND SAFETY PRECAUTIONS COULD CAUSE DAMAGE TO PROPERTY, ENVIRONMENT, RESULTING IN SERIOUS INJURY OR DEATH.

Installation

This section discusses the installation and wiring of the hardware required to enable the TLS console to perform pressure management of the site's gasoline vapor processor equipment:

- Vapor Pressure Sensor
- Smart Sensor Interface Module
- NVMEM203 board
- Multiport Card
- 4-Relay or I/O Combination Module

All field wiring, its type, its length, etc., used for TLS console sensors must conform to the requirements outlined in the Veeder-Root TLS-3XX Site Prep manual (P/N 576013-879).

Installing TLS Console Modules - General Notes

TLS consoles have three bays in which interface modules can be installed; Comm bay, Power bay and Intrinsically-Safe bay (ref. Figure 1). Probe Interface modules and Smart Sensor modules are installed in the Intrinsically-Safe bay and the Mod Bus module is installed in the Comm bay.

In all cases, the position of the modules, their respective connectors and the devices wired to the connectors must be recorded to prevent improper replacement during installation or service. A circuit directory for Power and I.S. bay Interface Modules is adhered to the back of the right-hand door for this purpose.

Switch off power to the TLS console before you install modules and connect sensor wiring.

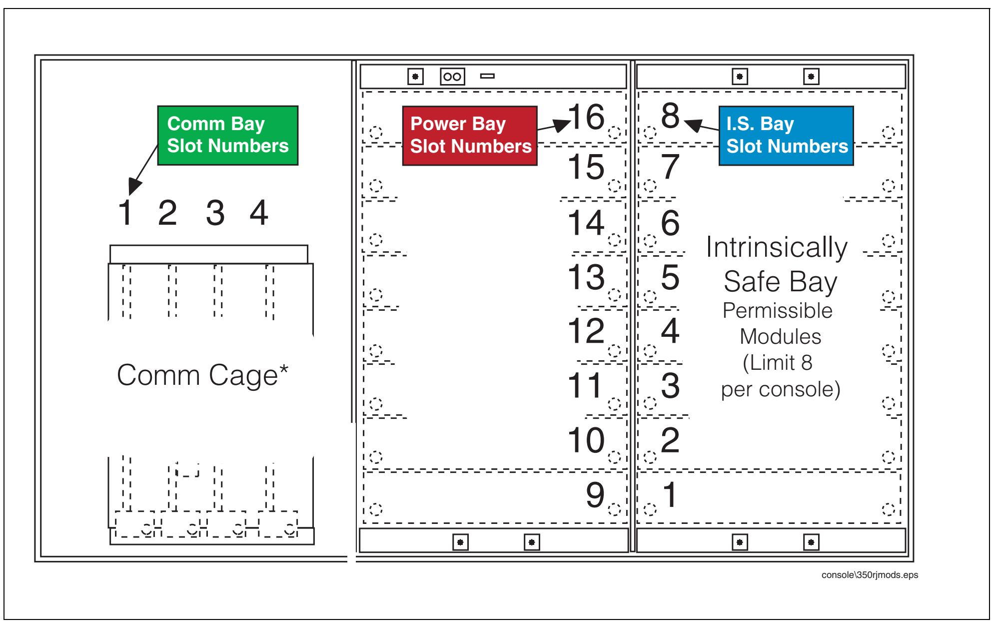


Figure 1. TLS console Interface Module Bays

CAUTION! During programming, module positions and the devices wired to each module are identified and stored in memory. If a connector is removed and reinstalled on a different module after programming, or if an entire module with its connector is removed and reinstalled in a different module slot, the TLS console will not identify correctly the data being received.

Module Position

1. Record on the circuit directory the type of module in each slot location.
2. If a system contains multiple modules of a single type (i.e., two Smart Sensor Modules), they may be swapped between their respective slot locations, **however, the connectors must remain with their original locations, not with the original modules**.

Connector Position

1. Identify all connectors according to their slot location using the self-adhesive numbering labels furnished with each module. Accurately record on the circuit directory the location of each device wired to the connector **as you attach wires** to the module.
2. Once a device has been wired to certain terminals on a connector and the system has been programmed, the wires from that device may not be relocated to other terminals without reprogramming the system.

Grounding Probe and Sensor Shields

Connect probe and sensor cable shields to ground at the console only. Do not ground both ends of the shield.

CIRCUIT DIRECTORY

A circuit directory is adhered to the inside of the right-hand door. It should be filled out by the installer as the module's connectors are being wired.

The following information should be recorded for each slot:

- Module Type: record what type of module has been installed in the slot, e.g., Smart Sensor Module.
- Position Record: record the physical location and/or type of device wired to each terminal of the module connector in the slot, e.g., VPS: FP1&2.

Vapor Pressure Sensor

Install one Vapor Pressure Sensor in the vapor return piping of the gasoline dispenser closest to the tanks following the instructions in the Pressure Sensor Installation guide (VR203 Section 13).

Smart Sensor Interface Module

The Smart Sensor Interface Module 8 input or 7 input w/embedded pressure versions monitor the Vapor Pressure Sensor (VPS) inputs.

Switch off power to the TLS console while you install modules and connect sensor wiring.

Open the right door of the console and slide the necessary Smart Sensor modules into empty I.S. Bay slots. Connect the field wiring from the sensor following instructions in the Vapor Pressure Sensor manual. Setup the Smart Sensor module(s) following instructions in this manual.

NVMEM203 Board

Verify that a NVMEM203 board is installed in the TLS console (ref. Figure 2-7 in the V-R TLS-3XX Series Consoles Troubleshooting Manual P/N 576013-818, Rev Q or later). This board contains flash EEPROM and RAM needed to run PMC software. No setup is required.

Probe Interface Module

Verify that a Probe Interface Module(s) is installed (Intrinsically-Safe bay) and that a Mag probe is in each gasoline tank and is connected to the module(s). Program the Mag probes following instructions in the TLS-3XX System Setup manual.

I/O Combination or 4-Relay Module

Connect the vapor processor motor control relay to two relays on either the 4-Relay or I/O Combination module as shown in Figure 2.

Multiport Card for Vapor Processor Communication

A Multiport card is needed for RS-485 communication with the TLS console and is required with VST ECS membrane processor installations. Verify that a Multiport card is installed in slot 4 of the card cage in the communications bay of the TLS console (ref. Figure 2). When installing this card, refer to the V-R Serial Comm Modules Installation Guide (577013-528) for instructions. Connect this card to the vapor processor as shown in Figure 2. Program the card as instructed in this manual.

TLS Console with VST ECS Membrane Processor

Figure 2 shows the interconnection wiring between a TLS console and a VST ECS Membrane Processor.

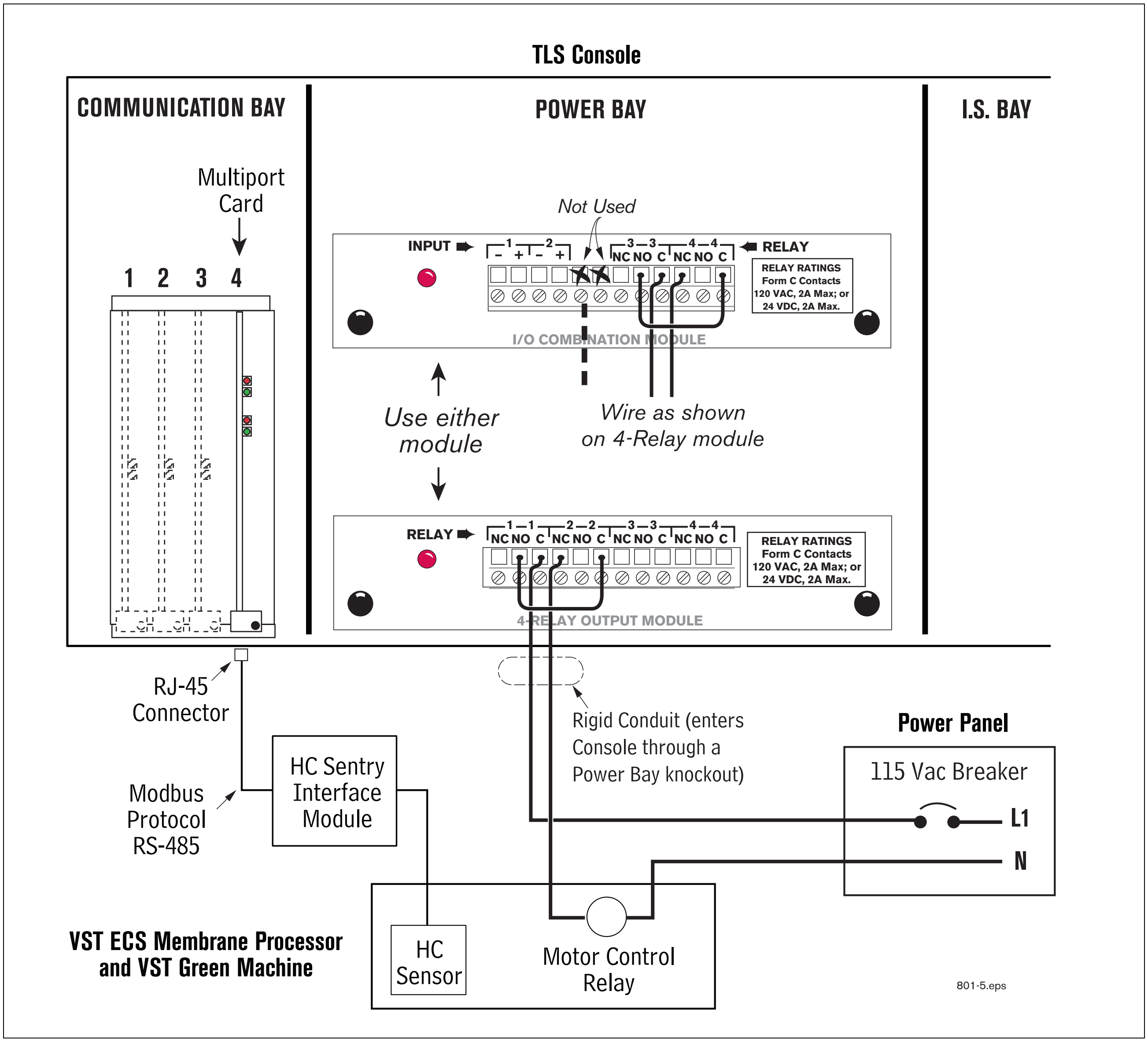


Figure 2. VST ECS Membrane Processor or VST Green Machine Connections to TLS Console

Setup

Introduction

This section describes how to perform PMC setup using the TLS console's front panel buttons and display. The procedures in this manual follow standard TLS console setup programming input, i.e., keypad/display interaction. If necessary, refer to Section 2 of the TLS-3XX System Setup manual (P/N 576013-623) to review entering data via the front panel keypads.

All PMC-related equipment must be installed in the site and connected to the TLS console prior to beginning the setups covered in this section. As with all TLS connections, you cannot change sensor wiring or module slots after programming or the console may not operate properly. Reference the section entitled "Connecting Probe/Sensor Wiring to Consoles" in the TLS-3XX Site Prep and Installation manual (P/N 576013-879) for rewiring precautions.

Smart Sensor Setup

The Smart Sensor Interface Module is installed in the Intrinsically-Safe bay of the TLS console. This module monitors the Vapor Pressure Sensor. Figure 3 diagrams the Smart Sensor setup procedure.

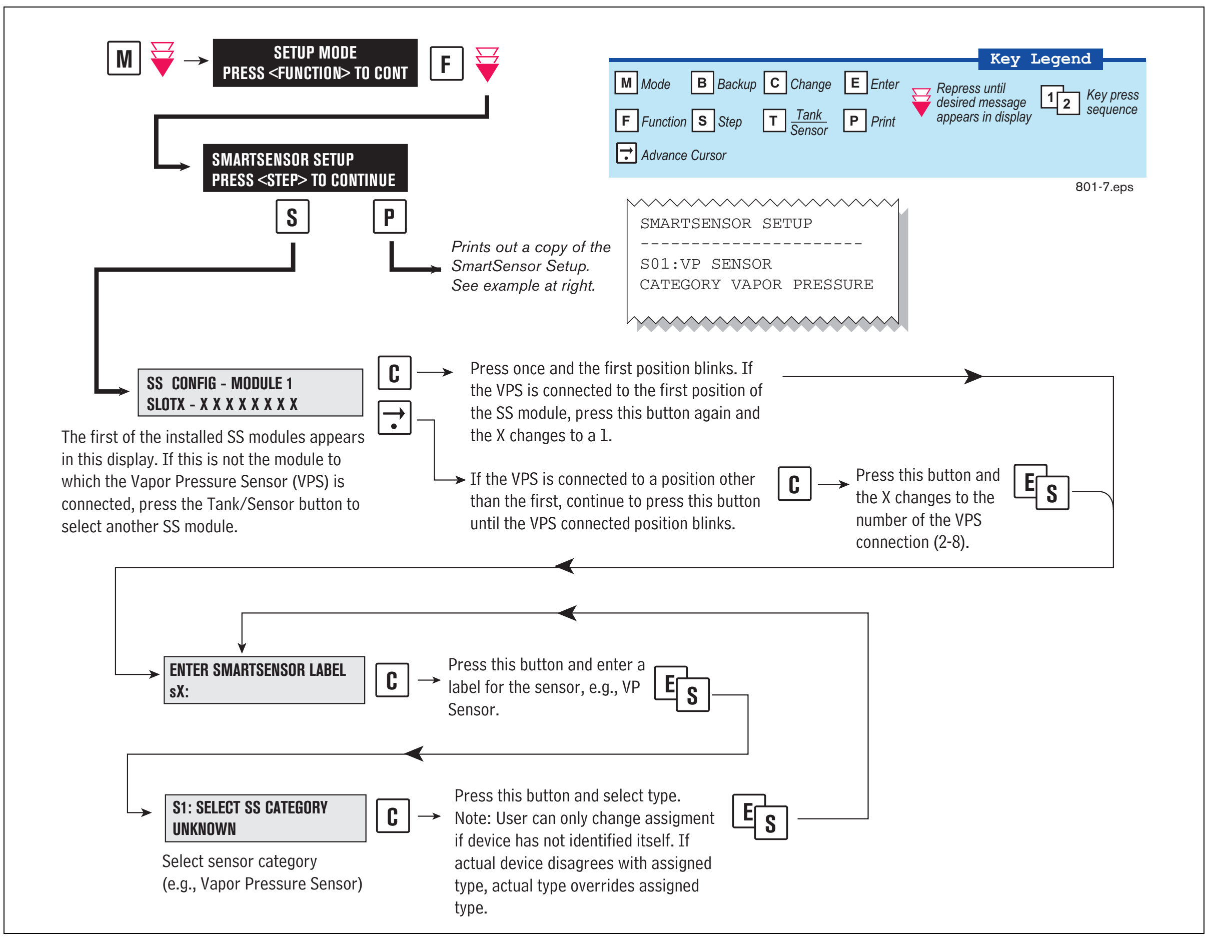


Figure 3. Smart Sensor Setup

Output Relay Setup - VST ECS Membrane Processor & VST Green Machine

The Output Relay setup programs an output relay so that the TLS console can switch a controlled vapor processor on and off as shown in Figure 4.

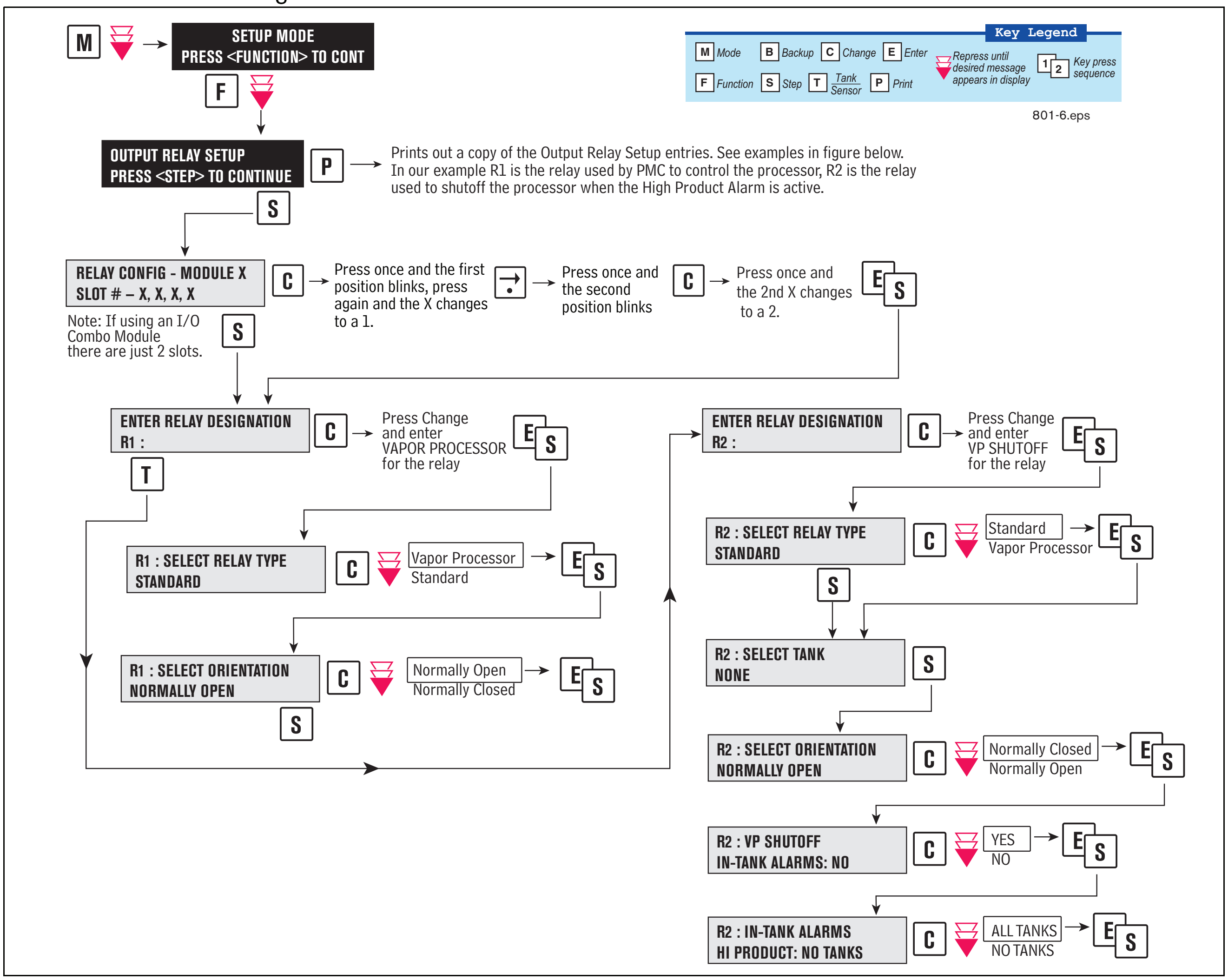
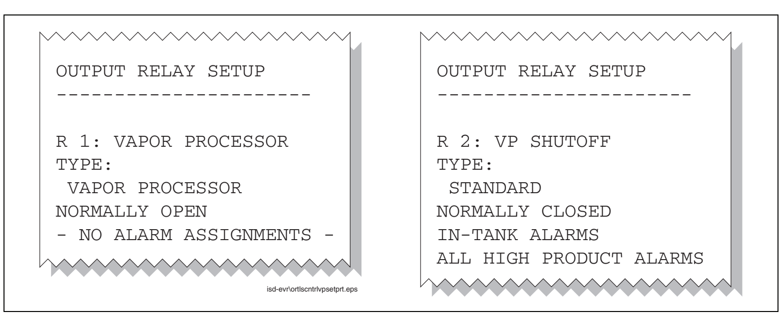


Figure 4. Output Relay Setup for VST ECS Membrane Processor

Figure 5 shows example setup printouts of the Output Relays setup.



```
OUTPUT RELAY SETUP
----------------------

R 1: VAPOR PROCESSOR
TYPE:
 VAPOR PROCESSOR
NORMALLY OPEN
- NO ALARM ASSIGNMENTS -
```

```
OUTPUT RELAY SETUP
----------------------

R 2: VP SHUTOFF
TYPE:
 STANDARD
NORMALLY CLOSED
IN-TANK ALARMS
ALL HIGH PRODUCT ALARMS
```


Figure 5. Output Relay Setup Printout Examples for TLS Console Controlled Processor

PMC Setup

Figure 6 diagrams the PMC setup programming.

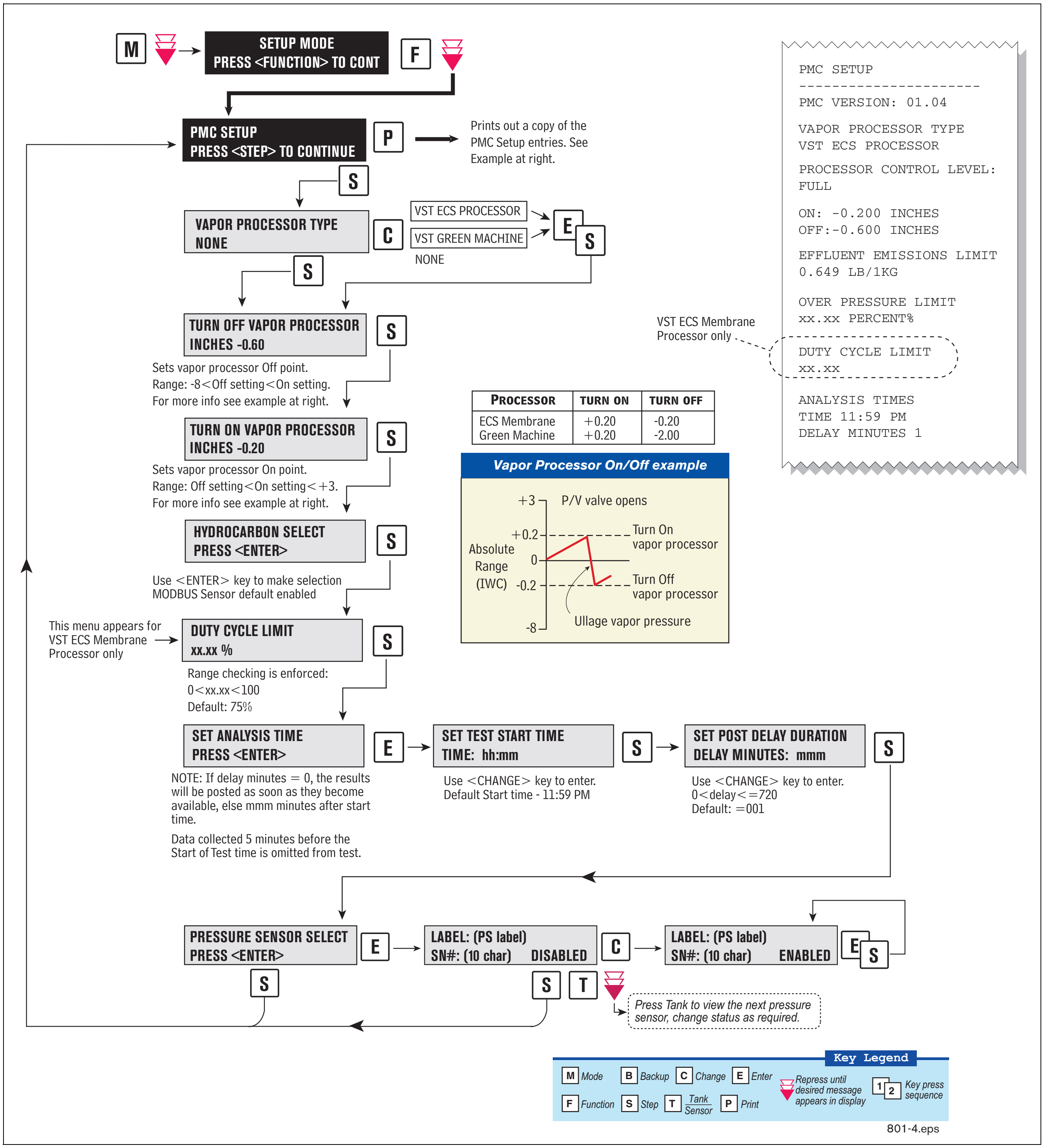


Figure 6. PMC Setup

Alarms

OVERVIEW OF TLS CONSOLE INTERFACE

The TLS console is continuously monitoring the vapor recovery system and PMC sensors for alarm conditions.

During normal operation when the TLS console and monitored PMC equipment is functioning properly and no alarm conditions exist, the "ALL FUNCTIONS NORMAL" message will appear in the system status (bottom) line of the console display, and the green Power light will be On (see Figure 7).

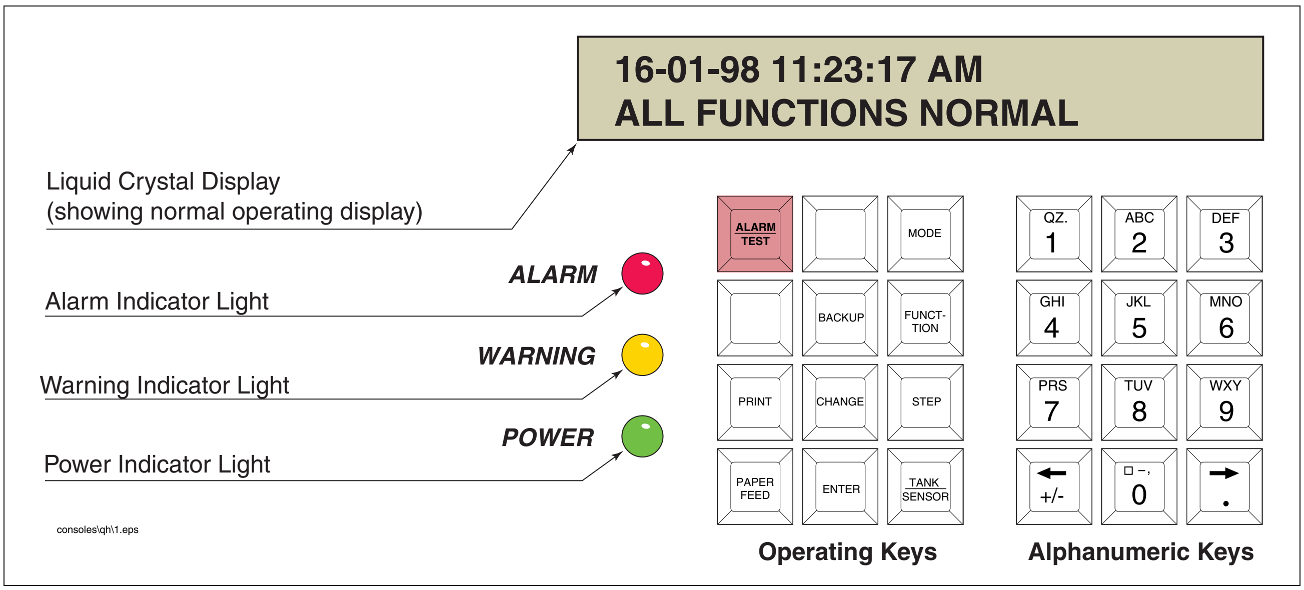


Figure 7. TLS console alarm interface

If an alarm condition occurs the system displays the condition type and its location. If more than one condition exists, the display will continuously cycle through the appropriate alarm messages. The system automatically prints an alarm report showing the alarm type, its location and the date and time the alarm condition occurred.

Warning and alarm posting causes the TLS console-based system to activate warning or failure indicator lights, an audible alarm, and an automatic strip paper printout documenting the warning or alarm.

WARNING POSTING

Displayed messages alert you to the type of warning. Printed messages show the type of warning and the time the warning was posted (see Figure 8). Warnings are logged into the Non-Priority Alarm History in the TLS.

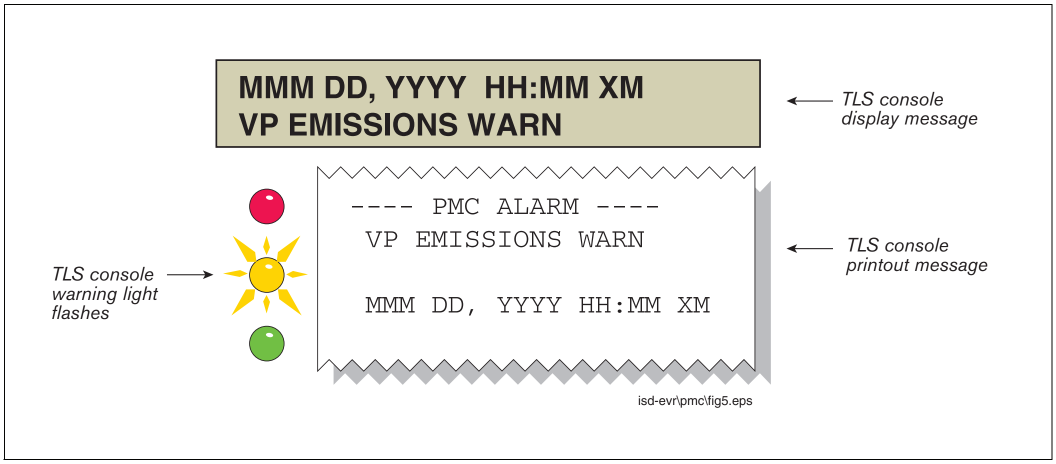


Figure 8. TLS console warning example

ALARM POSTING

Displayed Messages alert you to the type of alarm. Printed messages show the type of alarm and the time the alarm was posted. Alarm example in Figure 9. PMC Alarms are logged into the Priority Alarm History in the TLS.

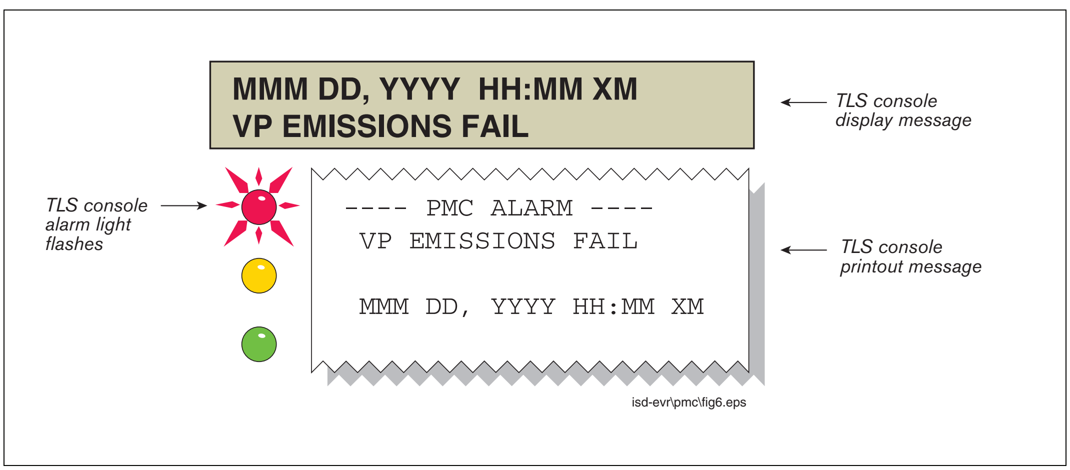


Figure 9. TLS console alarm example

PMC Alarm Summary

Table 2 contains a listing of the PMC generated alarms including their displayed message and cause. TLS Console PMC alarms may be interspersed amongst non-PMC alarms, please see TLS-350 Series manuals for more information.

Table 2. TLS-350 (PMC) Alarm Troubleshooting Summary

<table>
<tr><th>Displayed Message</th><th>Description</th><th>Light Indicator</th><th>Suggested Troubleshooting</th></tr>
<tr><td>VP EMISSION WARN</td><td>Mass emission exceeded the certified daily threshold</td><td>Yellow</td><td rowspan="2">• Troubleshooting Guide www.vsthose.com.
• Exhibit 8
• Exhibit 9</td></tr>
<tr><td>VP EMISSION FAIL</td><td>2nd Consecutive mass emission failure</td><td>Red</td></tr>
<tr><td>PMC SETUP FAIL</td><td>PMC is not configured or missing components.</td><td>Red</td><td>• Troubleshooting Guide www.vsthose.com
• See ISD Troubleshooting Guide, P/N 577013-819
• Exhibit 8
• Exhibit 9</td></tr>
<tr><td>VP DUTY CYCLE WARN[1]</td><td>Duty cycle exceeds 18 hours per day 0r 75% of 24 hours</td><td>Yellow</td><td rowspan="2">• Troubleshooting Guide www.vsthose.com.
• TLS-350 PMC Setup Procedure
• Exhibit 4
• Exhibit 9
• Exhibit 10</td></tr>
<tr><td>VP DUTY CYCLE FAIL[1]</td><td>2nd Consecutive Duty Cycle Failure</td><td>Red</td></tr>
<tr><td>PMC SENSOR FAULT</td><td>Component used by PMC has failed or reported an error condition. See Troubleshooting section for complete description of sensors and associated conditions that can cause a sensor fault.</td><td>Red</td><td>Check for Smart Sensor Device Alarm or Fault.</td></tr>
</table>

[1]VST ECS Membrane Processor Only

PMC Status Report

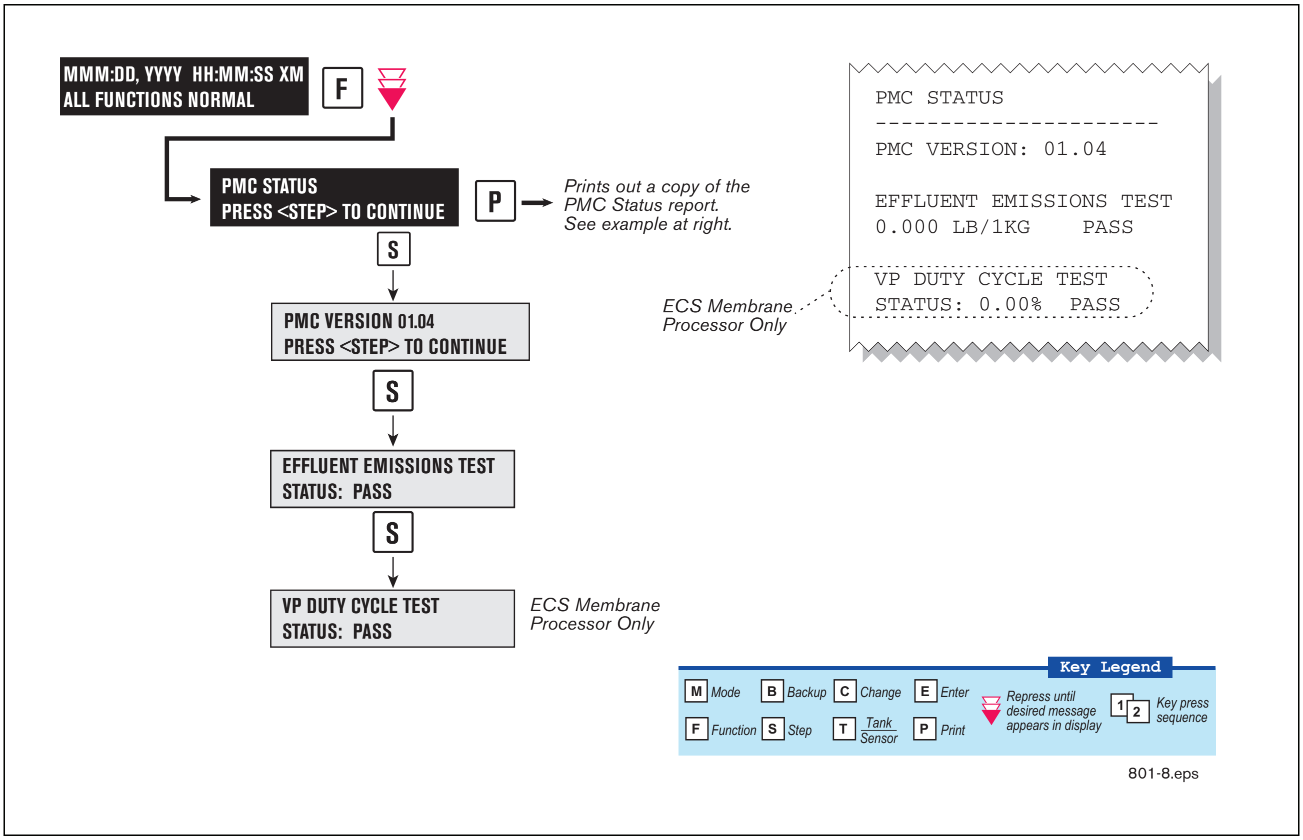
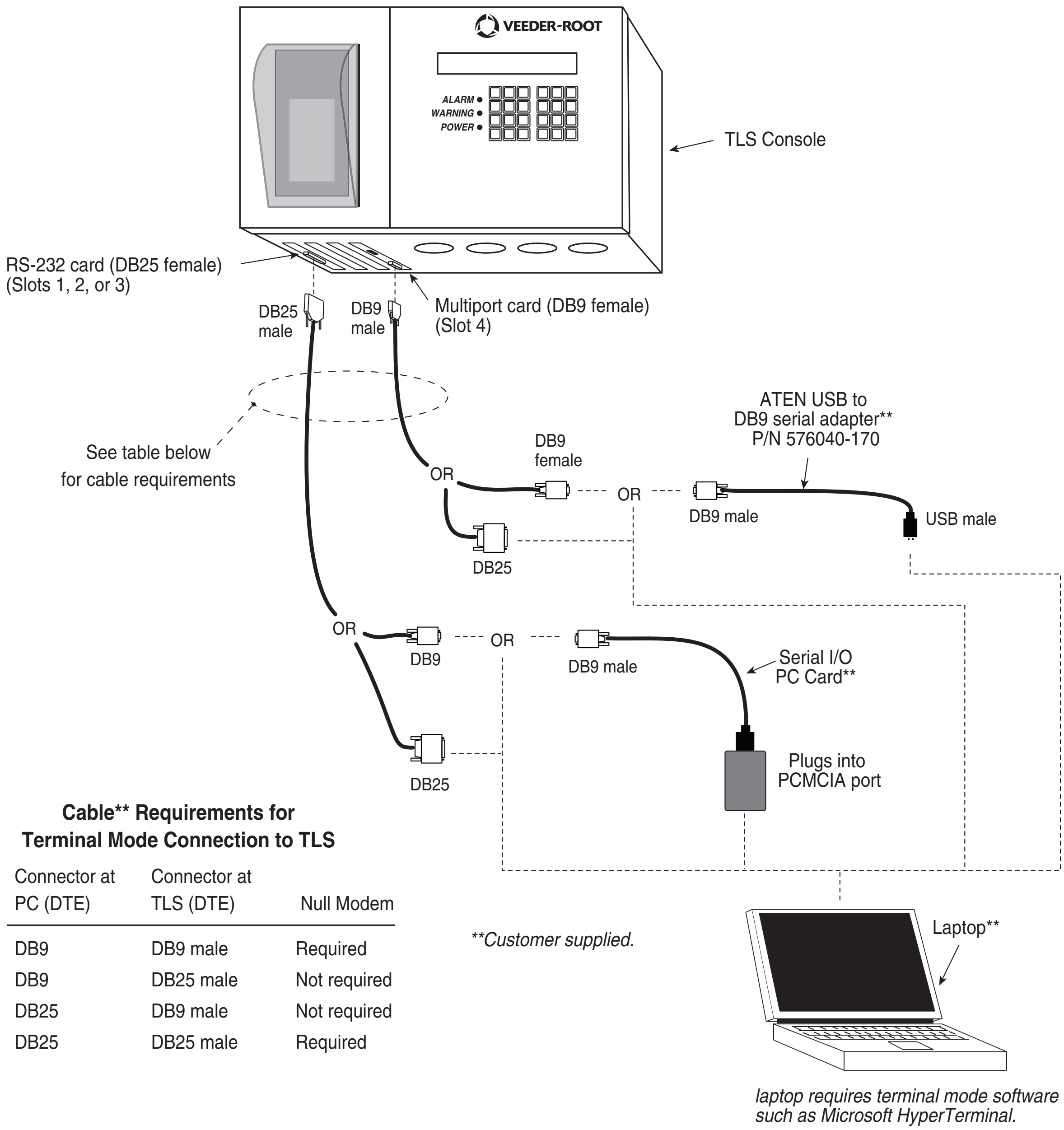


Figure 10. PMC Status Report

Viewing PMC Reports Via RS-232 Connection

CONNECTING LAPTOP TO CONSOLE

Connect your laptop to the TLS console's RS-232 or Multiport card using one of the methods shown in the examples in Figure 11 below.



Cable Requirements for Terminal Mode Connection to TLS**

Connector at PC (DTE)	Connector at TLS (DTE)	Null Modem
DB9	DB9 male	Required
DB9	DB25 male	Not required
DB25	DB9 male	Not required
DB25	DB25 male	Required

Figure 11. Connecting laptop to TLS console for serial communication

CONNECTING LAPTOP TO CONSOLE

1. Open your laptop's serial communication program, e.g., HyperTerminal. You can typically find HyperTerminal under: Start/Programs/Accessories/Communications.

2. After opening the terminal software program, ignore (cancel) any modem/dialing related request windows since you will be directly connecting to the console via serial communications. When the Connection Description window appears (Figure 12), enter a connection name, e.g., TLSDIRECT, and click the OK button.

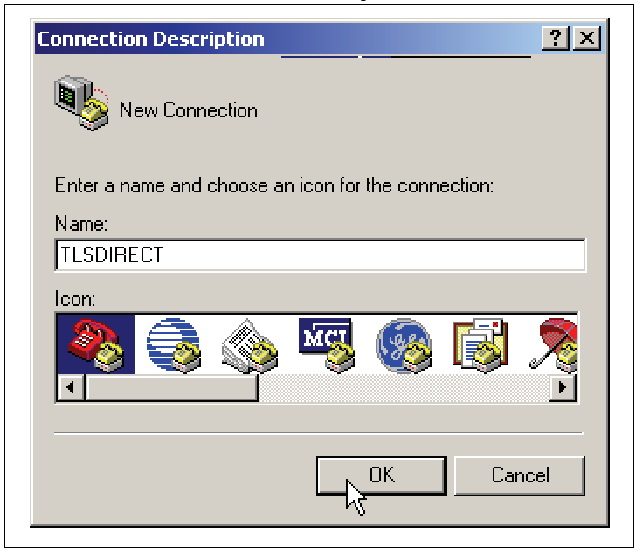


Figure 12. Connection Description window

3. After clicking the OK button, you may see a repeat of the modem/dialing windows, in which case ignore (cancel) them all.

4. When the Connect To window appears (Figure 13), depending on your connection method, select either COM1 (If RS-232 port on laptop), USB-Serial Controller (if using USB port on laptop), or Serial I/O PC Card (if using PCMCIA port on laptop) in the 'Connect using' drop down box, then click OK button.

.

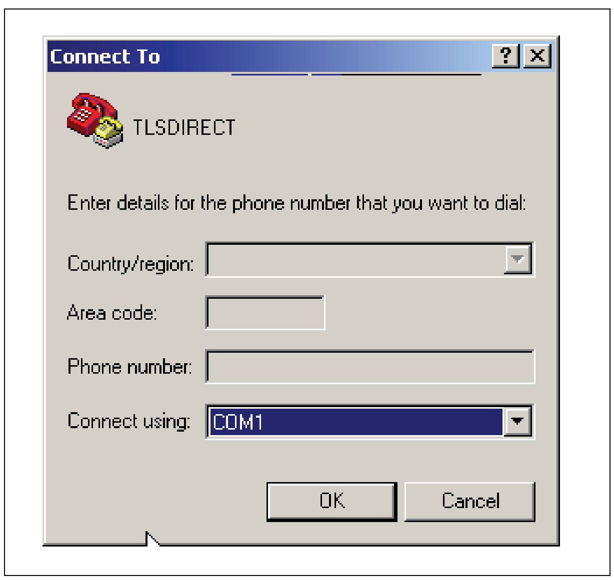


Figure 13. Connect To window

5. Next you should see the 'Port Settings' window.

IMPORTANT! The settings of the laptop's com port must match those of the console's com port to which you are connected.

a. Go to the console front panel press the MODE key until you see:

SETUP MODE
PRESS <FUNCTION> TO CONT

b. Press the FUNCTION key until you see the message:

COMMUNICATIONS SETUP
PRESS <STEP> TO CONTINUE

c. Press the STEP key until you see the message:

PORT SETTINGS
PRESS <ENTER>

d. Press the PRINT key to printout the port settings for all communication modules installed in the console. Figure 14 shows an example port settings printout with the RS-232 module installed. Using the console port settings in the example below, your HyperTerminal ‘Port Settings’ window entries would be Bits per second - 2400, Data bits - 7, Parity - Odd, Stop Bits - 1. For the ‘Flow Control’ entry select None. Click OK.

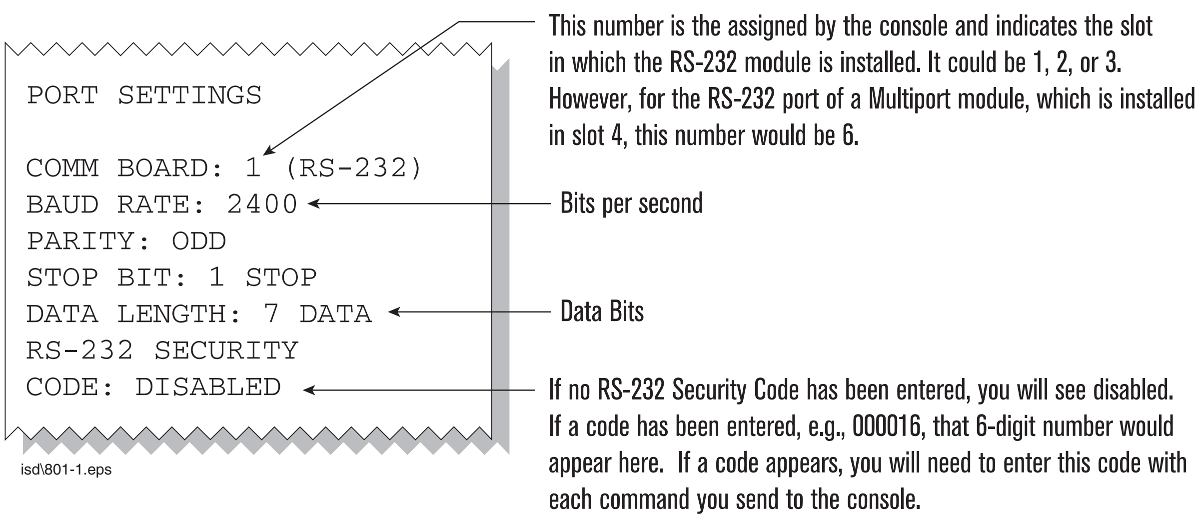


Figure 14. Console comm port settings printout example

In the example port settings printout above, the RS-232 Security Code is disabled. If the code was enabled you would see a 6-digit number which you will need to enter to access the console (refer to the ‘Sending Console Commands’ paragraph below for more information).

6. After entering your port settings, the program's main window appears (Figure 15).

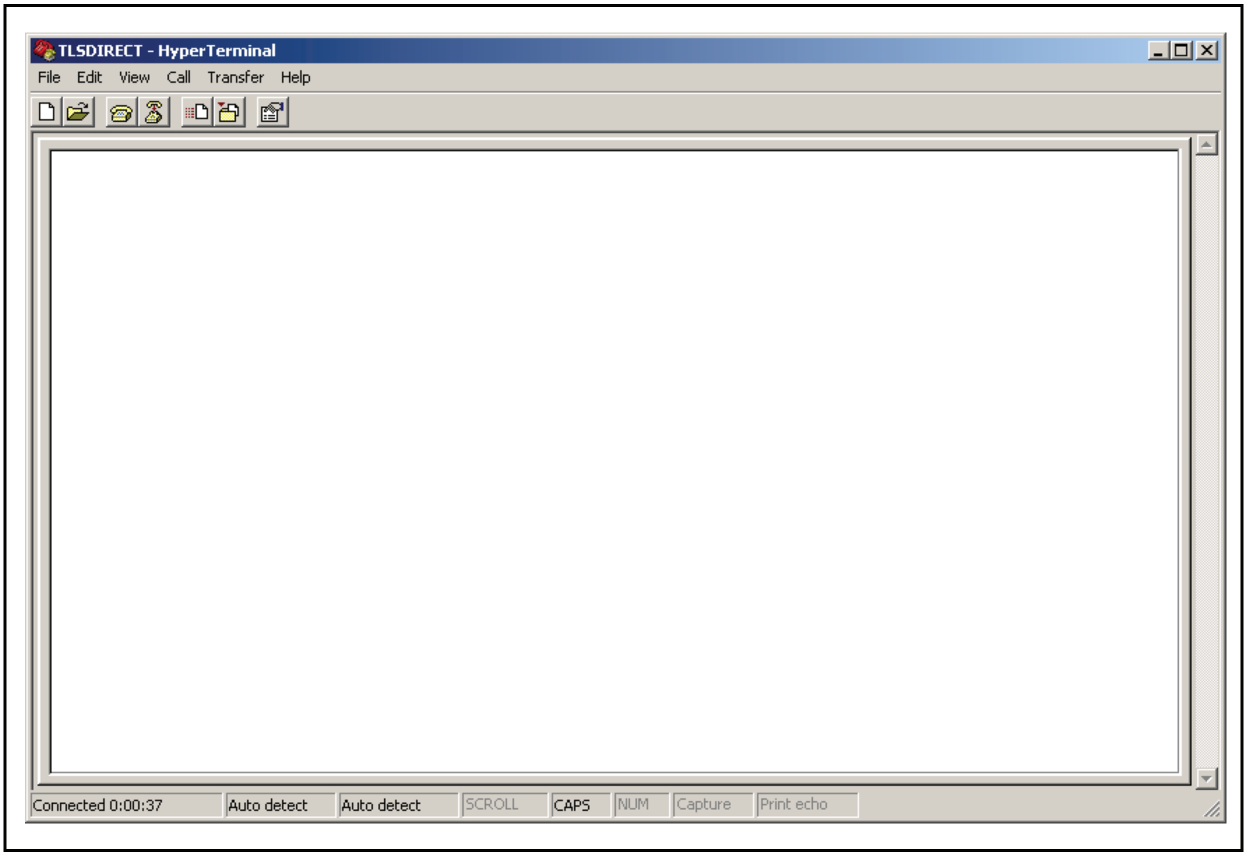


Figure 15. HyperTerminal main window

SENDING CONSOLE COMMANDS

Table 3 shows four important PMC console commands: IV8200, IV8000, IV8100 and I11100. The <SOH> shown in the table means that you must press and hold the **Ctrl** key while you press the **A** key.

For example, let's say you want to see the Vapor Processor Status Report.

Note: If you want to see the characters of the command as you type them in, click on File menu, then select Properties/Settings (tab)/ASCII Setup and click the check box for 'Echo typed characters locally', then click OK to close the window(s) and return to the main screen.

If the RS-232 Security Code is disabled - press and hold the Ctrl key while you press the A key, then type in IV8200. If the RS-232 Security Code is enabled (e.g., 000016) you must enter the security code before the command - press and hold the Ctrl key while you press the A key, then type in 000016IV8200.

You will see the typed command on the screen: `☺IV8200` followed by the response (report) from the console. The ☺ symbol indicates CrtlA and the ♥ symbol indicates the end of the response.

If the console recognizes the command the response displays as soon as the command is typed in.

If the console does not recognize the command you would see something like `☺IV8200☺9999FF1B♥` which indicates the console did not recognize the command.

All responses (Reports) can be printed or saved to a file. See the terminal program's help file for instructions.

Table 3. Serial Commands for PMC Diagnostic Reports

Report Type	Serial Command (PC to Console)*
Vapor Processor Status Report (See example Figure 16)	`<SOH>IV8200`
Vapor Processor Runtime Diagnostic Report (See example Figure 17)	`<SOH>IV8000`
Percent Hydrocarbon Diagnostic Report (See example Figure 18)	`<SOH>IV8100`
Priority Alarm History Report (See example Figure 19)	`<SOH>I11100`
Non-Priority Alarm History Report (See example Figure 20)	`<SOH>I11200`

*<SOH> = Control A. For more information on TLS console serial commands, refer to the V-R Serial Interface Manual.

```
<SOH>
   IV8200
   JUN  1, 2002  8:07 AM

   (SITE NAME)
   (SITE STREET)
   (CITY, STATE)
   (PHONE NUMBER)

VAPOR PROCESSOR STATUS REPORT

PMC VERSION: 01.04
VAPOR PROCESSOR TYPE: VST ECS PROCESSOR

PMC MONITORING TEST PASS/FAIL THRESHOLDS
                                              PERIOD    BELOW  ABOVE
H2O
VAPOR PROCESSOR MASS EMISSION FAIL             1DAYS     ----   0.32 LBS/1KG
VAPOR PROCESSOR DUTY CYCLE FAIL                1DAYS     ----  75.00 %
  (VST ECS Membrane Processor Only)

EFFLUENT EMISSIONS TEST : PASS     (0.15 LBS/1KG)
VP DUTY CYCLE TEST      : PASS     (17.54%)
  (VST ECS Membrane Processor Only)
VP INPUT STATUS         : NOTEST

RUN TIME HOURS    :    4.2
DAILY THROUGHPUT  :   8421 GALS
AVG HC PERCENT    :   8.85 %
```

Figure 16. Vapor Processor Status Report Details - Serial to PC Format

```
IV8000
AUG 30, 2007 11:52 AM

(SITE NAME)
(SITE STREET)
(CITY, STATE)
(PHONE NUMBER)

VAPOR PROCESSOR
                   ELAPSED    PRESSURE INCHES H2O    RUNTIME
DATE-TIME ON       MINUTES       ON        OFF        FAULT
 3-08-07  8:52PM    5.53        0.209    -0.211        NO
 3-08-07  8:58PM    0.98        0.303    -0.203        NO
 3-09-07  5:03AM   26.60        0.221    -0.205        NO
 3-09-07  1:15PM   17.92        0.278    -0.268        NO
 3-10-07  3:01AM    7.70        0.200    -0.223        NO
 3-10-07  4:30AM    4.02        0.202    -0.224        NO
 3-10-07  7:54PM   23.62        0.306    -0.245        NO
 3-11-07 11:24PM    6.55        0.256    -0.213        NO
 3-12-07 11:31PM   21.23        0.228    -0.203        NO
 3-13-07  3:44PM   23.95        0.926    -0.230        NO
 3-15-07  1:35AM   30.00        0.202     0.154        YES
 3-15-07  2:36AM    6.87        0.200    -0.205        NO
 3-15-07  3:24AM   30.00        0.201     0.442        YES
 3-16-07  3:10AM    4.33        0.202    -0.205        NO
 3-16-07  1:28PM   20.78        0.234    -0.264        NO
 3-16-07  2:38PM    1.30        0.220    -0.219        NO
 3-17-07 12:44AM    6.52        0.206    -0.200        NO
 3-17-07  2:00PM   27.47        0.254    -.210         NO
```

Figure 17. Vapor Processor Runtime Diagnostic Report - Serial to PC Format

```
IV800
SEP 21, 2010 8:52 AM
HYDROCARBON SENSOR DIAGNOSTIC
DATE/TIME       READING%
9-25-10 8:57 AM 1.174
9-25-10 8:57 AM 1.188
9-25-10 8:57 AM 1.168
9-25-10 8:57 AM 1.182
9-25-10 8:57 AM 1.182
9-25-10 8:57 AM 1.182
9-25-10 8:57 AM 1.174
9-25-10 8:57 AM 1.188
9-25-10 8:57 AM 1.182
9-25-10 8:57 AM 1.194
9-25-10 8:57 AM 1.188
9-25-10 8:57 AM 1.200
9-25-10 8:56 AM 1.188
```

Figure 18. Percent Hydrocarbon Diagnostic Report - Serial to PC Format

```
I11100
APR 17, 2008 12:30 AM

<Site Name>
<Site Address>
<Site Address>
<Site Address>

PRIORITY ALARM HISTORY
ID  CATEGORY  DESCRIPTION          ALARM TYPE           STATE    DATE    TIME
T 2 TANK      Premium 91           PROBE OUT            CLEAR   4-04-08 12:14PM
T 2 TANK      Premium 91           PROBE OUT            ALARM   4-04-08 12:14PM
T 2 TANK      Premium 91           LOW PRODUCT ALARM    CLEAR   4-04-08 12:04PM
T 2 TANK      Premium 91           PROBE OUT            CLEAR   4-04-08 12:04PM
T 1 TANK      Unlead 87            PROBE OUT            CLEAR   4-04-08 11:37AM
T 1 TANK      Unlead 87            PROBE OUT            ALARM   4-04-08 10:51AM
T 2 TANK      Premium 91           PROBE OUT            ALARM   4-04-08 10:42AM
T 2 TANK      Premium 91           LOW PRODUCT ALARM    ALARM   4-04-08 10:42AM
s 8 OTHER     PRES SEN 2 DISP 1-2  COMMUNICATION ALARM  CLEAR   3-26-08  1:39PM
s 8 OTHER     PRES SEN 2 DISP 1-2  COMMUNICATION ALARM  ALARM   3-26-08  1:37PM
    SYSTEM                         BATTERY IS OFF       CLEAR   3-10-08  8:00AM
    SYSTEM                         BATTERY IS OFF       ALARM   3-10-08  8:00AM
```

Figure 19. Priority Alarm History Report - Serial to PC Format

```
I11200
DEC  9, 2010  4:20 AM

<Site Name>
<Site Address>
<Site Address>
<Site Address>

NON-PRIORITY ALARM HISTORY
ID  CATEGORY  DESCRIPTION          ALARM TYPE          STATE    DATE    TIME
T 3 TANK      DIESEL               LOW TEMP WARNING    CLEAR  12-08-10  3:00PM
T 3 TANK      DIESEL               LOW TEMP WARNING    ALARM  12-08-10  3:00PM
T 3 TANK      DIESEL               HIGH PRODUCT ALARM  CLEAR  12-08-10  3:00PM
T 3 TANK      DIESEL               HIGH PRODUCT ALARM  ALARM  12-08-10  2:56PM
    SYSTEM                         PRINTER ERROR       CLEAR  11-17-10 10:51AM
    SYSTEM                         PAPER OUT           CLEAR  11-17-10 10:51AM
    SYSTEM                         PAPER OUT           ALARM  11-17-10 10:50AM
    SYSTEM                         PRINTER ERROR       ALARM  11-17-10 10:50AM
```

Figure 20. Non-Priority Alarm History Report - Serial to PC Format

Diagnostics

Automatic Control

Under Automatic control, vapor pressure readings are compared to user programmable thresholds to determine the appropriate Pressure Management Device (PMD) state. When the PMD is off and the TURN ON VAPOR PROCESSOR is exceeded, an internal relay is enabled and remains so until the pressure drops below the TURN OFF VAPOR PROCESSOR threshold. Automatic control is the default mode.

Manual control

If PMC mode is Manual, the diagnostic menu allows the PMD to be directly turned on/off through the relay. This feature is to support unit operational testing without waiting for the pressure to hit limits. The current UST ullage space vapor pressure will also be available through the diagnostic menu. The VC1 RS232 command allows for remote control of the PMD when the PMD control is manual. Note: If the PMD is on and the PMC mode is Automatic, changing the control mode to Manual mode will turn the PMD off.

When set to Manual mode, the system will revert to Automatic mode after 4 hours.

PMC Diagnostic Menu

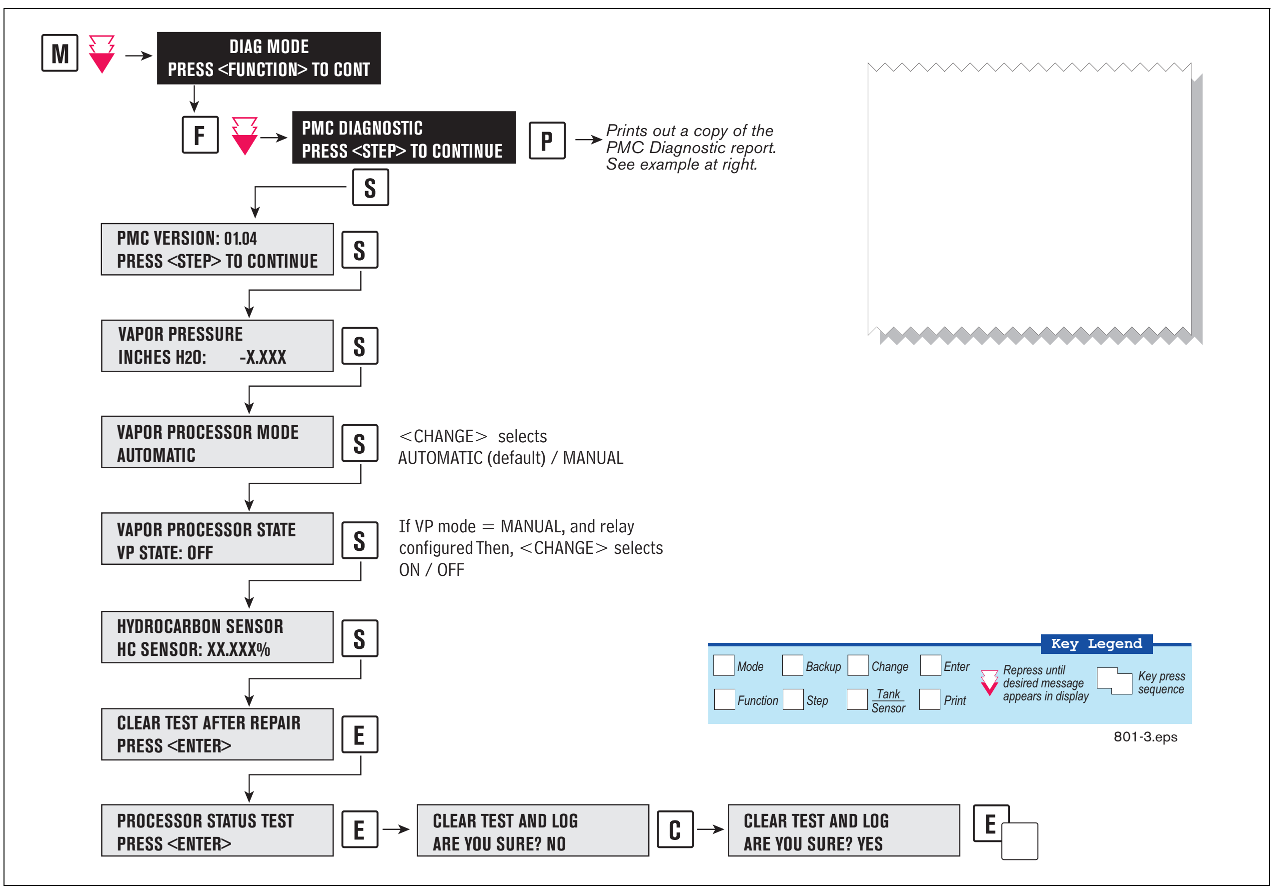


Figure 21. PMC Diagnostic Menus

For technical support, sales or other assistance, please visit:
www.veeder.com

Pressure Management Control

Install, Setup, & Operation Manual

For Veeder-Root Vapor Polishers

VEEDER-ROOT

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DAMAGE CLAIMS / LOST EQUIPMENT

Thoroughly examine all components and units as soon as they are received. If any cartons are damaged or missing, write a complete and detailed description of the damage or shortage on the face of the freight bill. The carrier's agent must verify the inspection and sign the description. Refuse only the damaged product, not the entire shipment.

Veeder-Root must be notified of any damages and/or shortages within 30 days of receipt of the shipment, as stated in our Terms and Conditions.

VEEDER-ROOT'S PREFERRED CARRIER

1. Contact Veeder-Root Customer Service at 800-873-3313 with the specific part numbers and quantities that were missing or received damaged.
2. Fax signed Bill of Lading (BOL) to Veeder-Root Customer Service at 800-234-5350.
3. Veeder-Root will file the claim with the carrier and replace the damaged/missing product at no charge to the customer. Customer Service will work with production facility to have the replacement product shipped as soon as possible.

CUSTOMER'S PREFERRED CARRIER

1. It is the customer's responsibility to file a claim with their carrier.
2. Customer may submit a replacement purchase order. Customer is responsible for all charges and freight associated with replacement order. Customer Service will work with production facility to have the replacement product shipped as soon as possible.
3. If "lost" equipment is delivered at a later date and is not needed, Veeder-Root will allow a Return to Stock without a restocking fee.
4. Veeder-Root will NOT be responsible for any compensation when a customer chooses their own carrier.

RETURN SHIPPING

For the parts return procedure, please follow the appropriate instructions in the "General Returned Goods Policy" pages in the "Policies and Literature" section of the Veeder-Root **North American Environmental Products** price list. Veeder-Root will not accept any return product without a Return Goods Authorization (RGA) number clearly printed on the outside of the package.

FOR INSTALLATION IN THE STATE OF CALIFORNIA

Please refer to the California Air Resources Board Vapor Recover Certification Phase II EVR Executive Order web site (*www.arb.ca.gov/vapor/eo-evrphaseII.htm*) for the latest manual revisions pertaining to Executive Order VR 203 (VST Phase II EVR System).

WARRANTY

Please see next page.

Warranty

This warranty applies only when the product is installed in accordance with Veeder-Root's specifications, and that a Warranty Registration and Checkout Form has been filed with Veeder-

Root by an authorized Veeder-Root Distributor. This warranty will not apply to any product which has been subjected to misuse, negligence, accidents, systems that are misapplied or are not installed per Veeder-Root specifications, modified or repaired by unauthorized persons, or damage related to acts of God. Veeder-Root is not liable for incidental, consequential, or indirect damages or loss, including, without limitation, personal injury, death, property damage, environmental damages, cost of labor, clean-up, downtime, installation and removal, product damages, loss of product, or loss of revenue or profits. **THE WARRANTY CONTAINED HEREIN IS EXCLUSIVE AND THERE ARE NO OTHER EXPRESS, IMPLIED, OR STATUTORY WARRANTIES. WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE EXPRESSLY EXCLUDED.**

TLS-350R, TLS-350 PLUS, TLS-350J AND TLS-300I/C, AND TLS2 MONITORING SYSTEMS

We warrant that this product shall be free from defects in material and workmanship for a period of one (1) year from the date of installation or twenty-four (24 months) from the date of invoice, whichever occurs first. During the warranty period, we or our representative will repair or replace the product, if determined by us to be defective, at the location where the product is in use and at no charge to the purchaser. LAMPS, FUSES, AND LITHIUM BATTERIES ARE NOT COVERED UNDER THIS WARRANTY.

If "Warranty" is purchased as part of the Fuel Management Service, Veeder-Root will maintain the equipment for the life of the contract in accordance with the written warranty provided with the equipment. A Veeder-Root Fuel Management Services Contractor shall have free site access during Customer's regular working hours to work on the equipment. Veeder-Root has no obligation to monitor federal, state or local laws, or modify the equipment based on developments or changes in such laws.

CARBON CANISTER VAPOR POLISHER

We warrant that this product shall be free from defects in material and workmanship for a period of one (1) year from the date of installation or twenty-four (24 months) from the date of invoice, whichever occurs first. We will repair or replace the product if the product is returned to us; transportation prepaid by user, within the warranty period, and is determined by us to be defective. The user must contact the Veeder-Root Customer Service for specific detailed information concerning the failed component return to ensure proper processing. **LAMPS, FUSES, AND LITHIUM BATTERIES ARE NOT COVERED UNDER THIS WARRANTY.**

MODULES, KITS, OTHER COMPONENTS (PARTS PURCHASED SEPARATE OF A COMPLETE CONSOLE)

We warrant that this product shall be free from defects in material and workmanship for a period of one (1) year from the date of installation or fifteen (15) months from the date of invoice, whichever occurs first. We warrant that the lithium batteries (excluding EVR BATTERY PACK) shall be free from defects in material and workmanship for a period of three (3) months from date of invoice. We will repair or replace the product if the product is returned to us; transportation prepaid by user, within the warranty period, and is determined by us to be defective. **LAMPS AND FUSES ARE NOT COVERED UNDER THIS WARRANTY.**

EVR BATTERY PACK

We warrant that this product shall be free from defects in material and workmanship for a period of one (1) year from the date of installation or fifteen (15) months from the date of invoice, whichever occurs first. **The replacement EVR Battery Pack warranty period will be the REMAINING warranty period of the original EVR Battery Pack. LAMPS, FUSES, AND LITHIUM BATTERIES OTHER THAN THE EVR BATTERY PACK, ARE NOT COVERED UNDER THIS WARRANTY.**

Figures

Tables

Introduction

This manual provides instructions to install, setup, and operate the components of Veeder-Root Pressure Management Control (PMC) equipment. The PMC feature is an option for the TLS console platform, and as such, many of the installation/setup/operation instructions for non-PMC specific tasks are covered in TLS-3XX supplied literature. Do not use this manual when PMC is installed with ISD. Use the ISD Setup & Operation Manual, VR204 Section 12.

Site Requirements

Below are the requirements for all PMC installations:

- V-R TLS-350R/EMC w/BIR, TLS-350 Plus/EMC Enhanced, TLS-350/EMC and ProMax consoles with ECPU2 - install as per TLS-3XX Site Prep manual, setup following instructions in TLS-3XX System Setup Manual.
- A flash memory board (NVMEM203) for PMC software storage - installed on the ECPU2 board in place of the console's 1/2 Meg RAM board - install as per TLS-350 Series Board and Software Replacement Manual, no setup required.
- Vapor Pressure Sensor and Smart Sensor Module- install and connect following instructions in the Vapor Pressure Sensor Installation Guide.
- Carbon Canister Vapor Polisher - install and connect following instructions in the Carbon Canister Vapor Polisher Installation and Maintenance Guide.
- An RS-232 Port will be available for use by contractor or government inspectors.

Contractor Certification Requirements

Veeder-Root requires the following minimum training certifications for contractors who will install and setup the equipment discussed in this manual:

Installer (Level 1) Certification: Contractors holding valid Installer Certification are approved to perform wiring and conduit routing; equipment mounting; probe, sensor and carbon canister vapor polisher installation; wireless equipment installation; tank and line preparation; and line leak detector installation.

ATG Technician (Level 2/3 or 4) Certification: Contractors holding valid ATG Technician Certifications are approved to perform installation checkout, startup, programming and operations training, system tests, troubleshooting and servicing for all Veeder-Root Series Tank Monitoring Systems, including Line Leak Detection. In addition, Contractors with the following sub-certification designations are approved to perform installation checkout, startup, programming, system tests, troubleshooting, service techniques and operations training on the designated system.

- Wireless 2
- Tall Tank

VR Vapor Products Certification: Contractors holding a certification with the following designations are approved to perform installation checkout, startup, programming, system tests, troubleshooting, service techniques and operations training on the designated system.

- ISD – In Station Diagnostics
- PMC – Pressure Management Control
- CCVP - Veeder-Root Vapor Polisher
- Wireless – ISD/PMC Wireless

A current Veeder-Root Technician Certification is a prerequisite for the VR Vapor Products course.

Warranty Registrations may only be submitted by selected Distributors.

Related Manuals

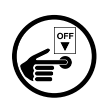
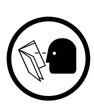
The manuals in Table 1 below are shipped with the equipment on the V-R Tech Docs CD-ROM and will be needed to install specific equipment.

Table 1. Related Manuals

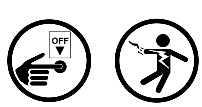
V-R Manual	Part Number
TLS-3XX Site Prep Manual	576013-879
Vapor Pressure Sensor Installation Guide	577013-797
TLS-3XX Series Consoles System Setup Manual	576013-623
TLS-3XX Series Consoles Operator's Manual	576013-610
Serial Comm Modules Installation Guide	577013-528
TLS-350 Series Board and Software Replacement Manual	576013-637
Carbon Canister Vapor Polisher Installation and Maintenance Guide	577013-920
In-Station Diagnostics and PMC Troubleshooting Guide	577013-819
TLS RF Wireless 2 System (W2) Installation and Maintenance Guide	577013-964

Safety Precautions

The following symbols may be used throughout this manual to alert you to important safety hazards.

	**ELECTRICITY** High voltage exists in, and is supplied to, the device. A potential shock hazard exists.		**TURN POWER OFF** Live power to a device creates a potential shock hazard. Turn Off power to the device and associated accessories when servicing the unit.
	**READ ALL RELATED MANUALS** Knowledge of all related procedures before you begin work is important. Read and understand all manuals thoroughly. If you do not understand a procedure, ask someone who does.		**WARNING** Heed the adjacent instructions to avoid equipment damage or personal injury.

⚠ WARNING



The console contains high voltages which can be lethal. It is also connected to low power devices that must be kept intrinsically safe.

Turn power Off at the circuit breaker. Do not connect the console AC power supply until all devices are installed.

FAILURE TO COMPLY WITH THE FOLLOWING WARNINGS AND SAFETY PRECAUTIONS COULD CAUSE DAMAGE TO PROPERTY, ENVIRONMENT, RESULTING IN SERIOUS INJURY OR DEATH.

Installation

This section discusses the installation and wiring of the hardware required to enable the TLS console to perform pressure management of the site's gasoline vapor polisher equipment:

- Vapor Pressure Sensor
- Carbon Canister Vapor Polisher
- Smart Sensor Interface Module
- NVMEM203 board
- Multiport Card - only required for sites with TLS console controlled vapor processor
- I/O Combination Module - only required for sites with non-TLS console controlled vapor processor

All field wiring, its type, its length, etc., used for TLS console sensors must conform to the requirements outlined in the Veeder-Root TLS-3XX Site Prep manual (P/N 576013-879).

Vapor Pressure Sensor

Install one Vapor Pressure Sensor in the vapor return piping of the gasoline dispenser closest to the tanks following the instructions in the Vapor Pressure Sensor Installation guide (P/N 577013-797).

Carbon Canister Vapor Polisher

Install one Carbon Canister Vapor Polisher following the instructions in the Carbon Canister Vapor Polisher Installation and Maintenance Guide (P/N 577013-920).

Installing TLS Console Modules - General Notes

TLS consoles have three bays in which interface modules can be installed; Comm bay, Power bay and Intrinsically-Safe bay (ref. Figure 1). Probe Interface modules and Smart Sensor modules are installed in the Intrinsically-Safe bay and the Mod Bus module is installed in the Comm bay.

In all cases, the position of the modules, their respective connectors and the devices wired to the connectors must be recorded to prevent improper replacement during installation or service. A circuit directory for Power and I.S. bay Interface Modules is adhered to the back of the right-hand door for this purpose.

Switch off power to the TLS console before you install modules and connect sensor wiring.

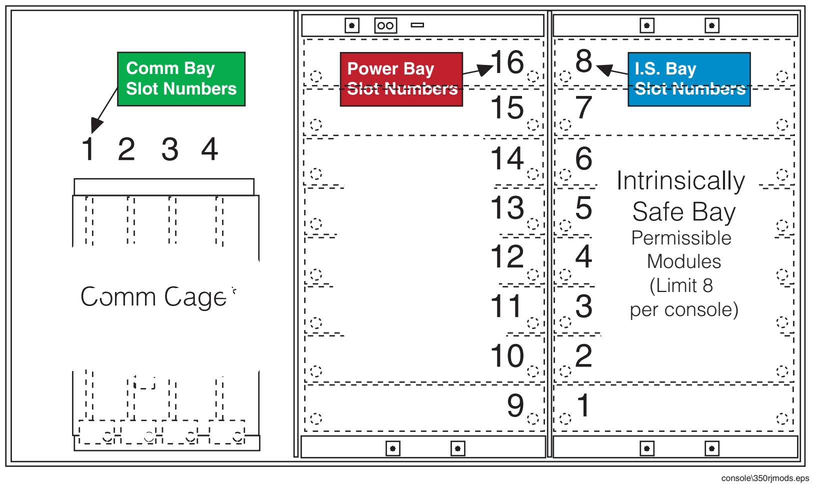


Figure 1. TLS console Interface Module Bays

CAUTION! During programming, module positions and the devices wired to each module are identified and stored in memory. If a connector is removed and reinstalled on a different module after programming, or if an entire module with its connector is removed and reinstalled in a different module slot, the TLS console will not identify correctly the data being received.

Module Position

1. Record on the circuit directory the type of module in each slot location.
2. If a system contains multiple modules of a single type (i.e., two Smart Sensor Modules), they may be swapped between their respective slot locations, **however, the connectors must remain with their original locations, not with the original modules.**

Connector Position

1. Identify all connectors according to their slot location using the self-adhesive numbering labels furnished with each module. Accurately record on the circuit directory the location of each device wired to the connector **as you attach wires** to the module.
2. Once a device has been wired to certain terminals on a connector and the system has been programmed, the wires from that device may not be relocated to other terminals without reprogramming the system.

Grounding Probe and Sensor Shields

Connect probe and sensor cable shields to ground at the console only. Do not ground both ends of the shield.

CIRCUIT DIRECTORY

A circuit directory is adhered to the inside of the right-hand door. It should be filled out by the installer as the module's connectors are being wired.

The following information should be recorded for each slot:

- Module Type: record what type of module has been installed in the slot, e.g., Smart Sensor Module.
- Position Record: record the physical location and/or type of device wired to each terminal of the module connector in the slot, e.g., VPS: FP1.

Smart Sensor Interface Module

Verify that a Smart Sensor Interface Module with Atmospheric Sensor (P/N 332250-001) is installed in the TLS console. Connect the field wiring from the Vapor Pressure Sensor (VPS) to the Smart Sensor Interface Module as instructed in the VPS installation manual. The Carbon Canister Vapor Polisher will also be connected to the Smart Sensor Interface Module.

NVMEM203 Board

Verify that a NVMEM203 board is installed in the TLS console (ref. Figure 2-14 in the V-R TLS-3XX Series Consoles Troubleshooting Manual P/N 576013-818, Rev J or later). This board contains flash EEPROM and RAM needed to run PMC software and store PMC reports. No setup is required.

Setup

Introduction

This section describes how to perform PMC setup using the TLS console's front panel buttons and display. The procedures in this manual follow standard TLS console setup programming input, i.e., keypad/display interaction. If necessary, refer to Section 2 of the TLS-3XX System Setup manual (P/N 576013-623) to review entering data via the front panel keypads.

All PMC-related equipment must be installed in the site and connected to the TLS console prior to beginning the setups covered in this section. As with all TLS connections, you cannot change sensor wiring or module slots after programming or the console may not operate properly. Reference the section entitled "Connecting Probe/Sensor Wiring to Consoles" in the TLS-3XX Site Prep and Installation manual (P/N 576013-879) for rewiring precautions.

Smart Sensor Setup - Vapor Pressure Sensor

The Smart Sensor Interface Module is installed in the Intrinsically-Safe bay of the TLS console. This module monitors the Vapor Pressure Sensor. Figure 2 diagrams the Smart Sensor setup procedure.

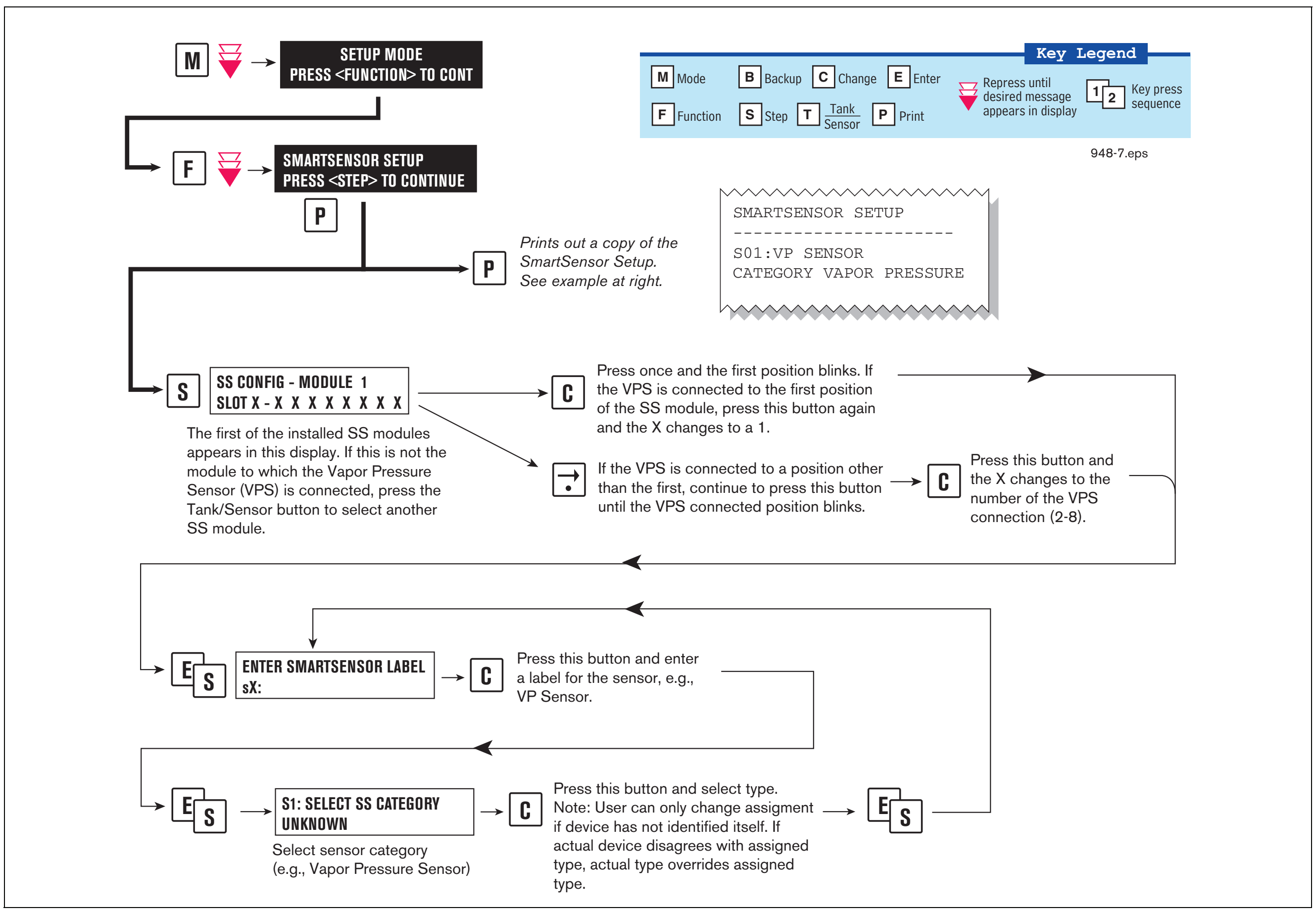


Figure 2. Smart Sensor Setup - Vapor Pressure Sensor

Smart Sensor Setup - Vapor Polisher

The Smart Sensor Interface Module is installed in the Intrinsically-Safe bay of the TLS console. This module monitors the Vapor Polisher. Figure 3 diagrams the Smart Sensor setup procedure.

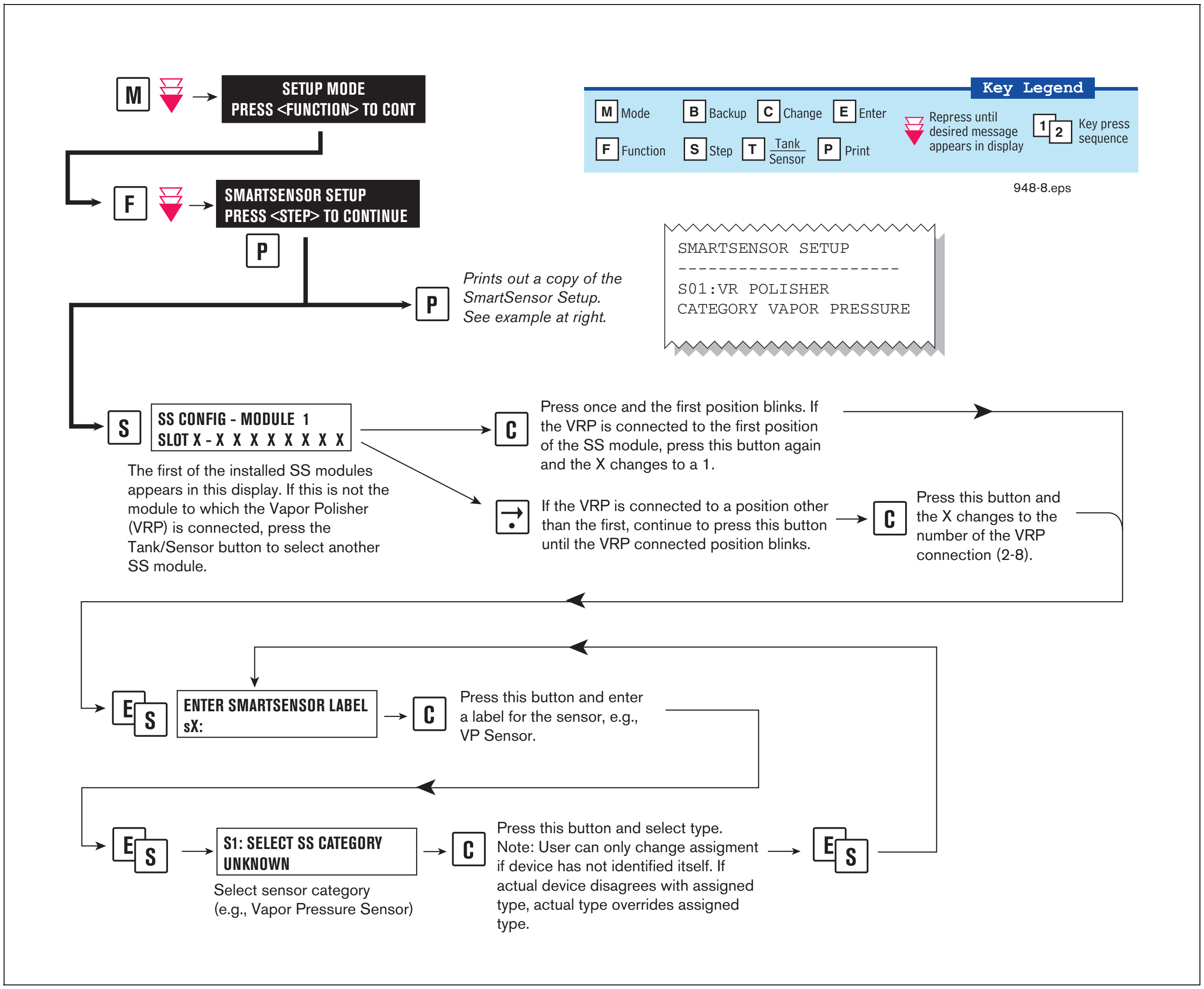


Figure 3. Smart Sensor Setup - Vapor Polisher

ATM Pressure Sensor Setup

The ATM Pressure Sensor is factory installed in the SmartSensor / Press module and preassigned to channel 8. At least one SmartSensor / Press module, which contains the ATM Pressure Sensor, must be installed in the console. You must configure at least one ATM Pressure Sensor for use by the Vapor Polisher or a PMC Set-up Fail will occur. NOTE: if more than one SmartSensor / Press module is installed, only one ATM Pressure Sensor needs to be configured.

Look in console and note the slot position of the SmartSensor / Press module. Enter the Setup Mode and press the FUNCTION key until you see the message:

SMARTSENSOR SETUP
PRESS <STEP> TO CONTINUE

Press STEP until you see the message:

SS CONFIG - MODULE *n*
SLOT *x* - X X X X X X X X

Where *x* is the slot number containing the SmartSensor / Press module. Press the → key to move the cursor to the last (8th) X. Press CHANGE and the message below should appear:

SLOT *x* - X X X X X X X 8
PRESS <STEP> TO CONTINUE

Press STEP:

ENTER SMARTSENSOR LABEL
s 8:

NOTE: In the example above, the ATM P sensor position is 8 but it could be16, 32, or 40 depending on the SmartSensor's module number.

Press CHANGE and enter a label:

ENTER SMARTSENSOR LABEL
s 8: (ATMP Sensor Label)

Press ENTER to accept your label:

s 8: (ATMP Sensor Label)
PRESS <STEP> TO CONTINUE

Press STEP:

s 8: SELECT SS CATEGORY
UKNOWN

Press CHANGE until you see the message:

s 8: SELECT SS CATEGORY
ATM P SENSOR

Press ENTER to accept the category. Press STEP, then BACKUP to return to the configuration display for Smart Sensor module 1:

SS CONFIG - MODULE 1
SLOT *x* - X X X X X X X X

This completes the ATM Pressure Sensor configuration.

PMC Setup

Figure 4 diagrams the PMC setup programming.

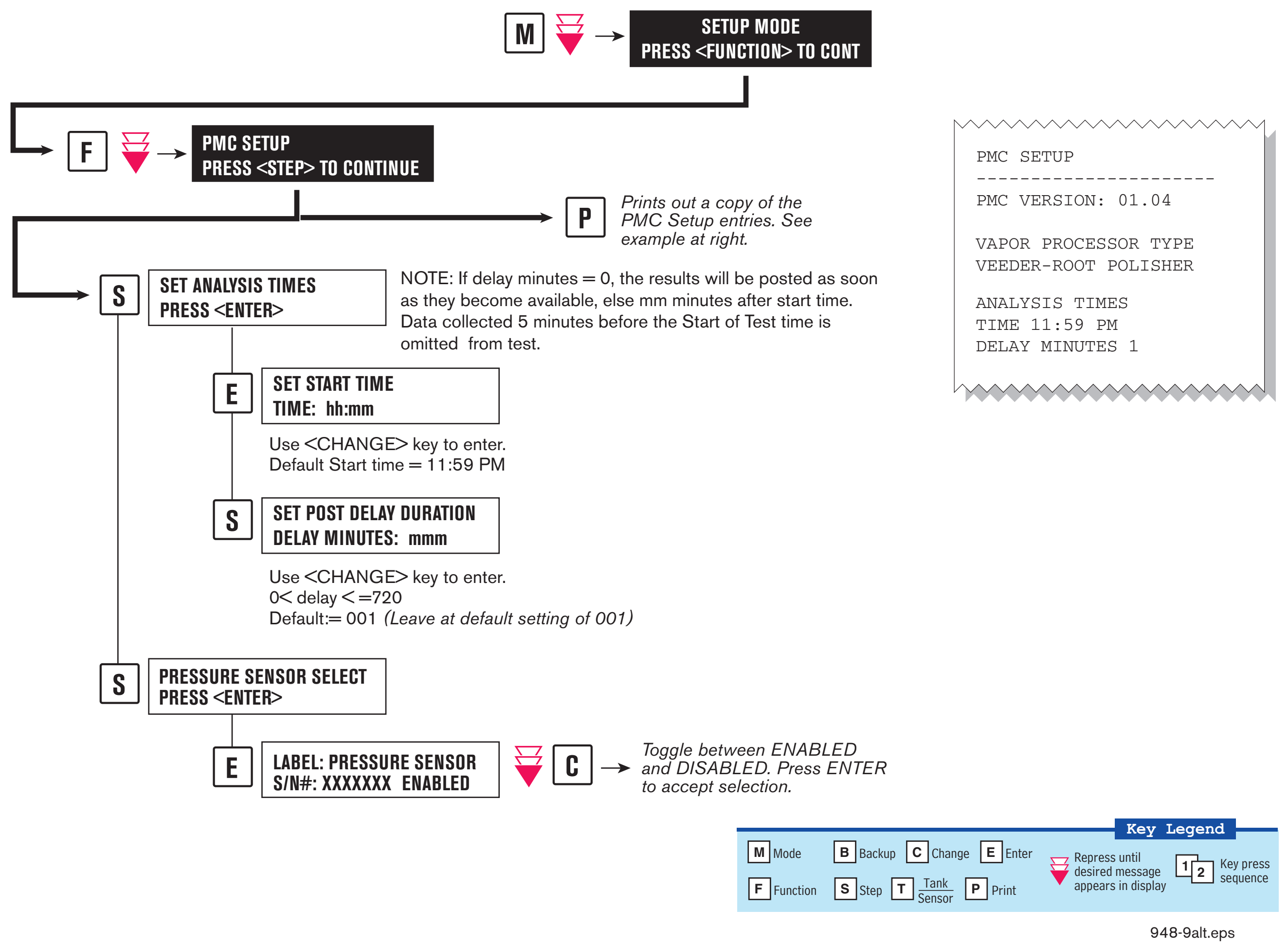


Figure 4. PMC Setup

Alarms

OVERVIEW OF TLS CONSOLE INTERFACE

The TLS console is continuously monitoring the vapor recovery system and PMC sensors for alarm conditions.

During normal operation when the TLS console and monitored PMC equipment is functioning properly and no alarm conditions exist, the "ALL FUNCTIONS NORMAL" message will appear in the system status (bottom) line of the console display, and the green Power light will be On (see Figure 5).

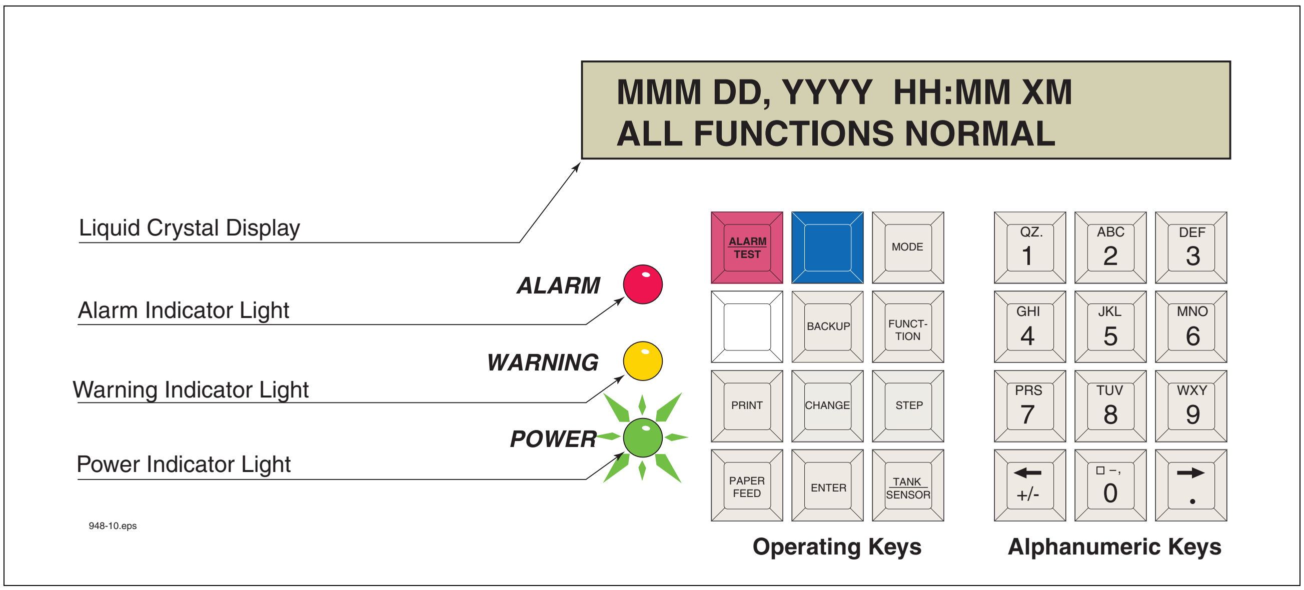


Figure 5. TLS console alarm interface

If an alarm condition occurs the system displays the condition type and its location. If more than one condition exists, the display will continuously cycle through the appropriate alarm messages. The system automatically prints an alarm report showing the alarm type, its location and the date and time the alarm condition occurred.

Alarm posting causes the TLS console-based system to activate indicator lights, an audible alarm, and an automatic strip paper printout documenting the alarm.

ALARM POSTING

Displayed messages alert you to the type of alarm. Printed messages show the type of alarm and the time it was was posted (see Figure 6). Alarms are logged into the Priority Alarm History and warnings are logged in the Non-Priority Alarm History in the TLS.

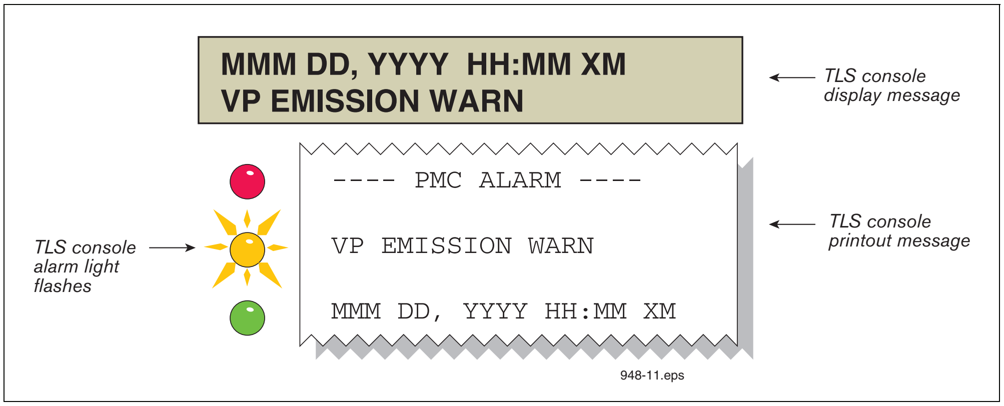


Figure 6. TLS console alarm example

PMC Alarm Summary

Table 2 contains a listing of the PMC generated alarms including a brief description of each and associated front panel indicator.

Table 2. PMC Alarm Summary

Displayed Message	Description	Light Indicator	Suggested Troubleshooting[1]
VP EMISSION WARN	Mass emission exceeded the certified daily threshold.	Yellow	Ensure Polisher is in Automatic Mode. Resolve any Vapor Valve Sensor Fault Alarms.
VP EMISSION FAIL	2nd consecutive mass emission failure	Red	
PMC SETUP FAIL	PMC is not configured or missing components.	Red	Ensure that all required components are installed and operational.
PMC SENSOR FAULT	Component used by PMC has failed or reported an error condition. See Troubleshooting section for complete description of sensors and associated conditions that can cause a sensor fault.	Red	Check for Smart Sensor Device Alarm or Fault.

[1]Refer to the Troubleshooting Section of this manual and the ISD/PMC Troubleshooting Guide 577013-819.

Wireless Related Sensor Alarms

The TLS RF Wireless 2 System (W2) features two-way communication utilizing a client/server architecture. When the Veeder-Root Polisher Vapor Valve uses this type of technology, the following alarm may occur:

Displayed Message	Description	Light Indicator	Suggested Troubleshooting
BATTERY WARNING	Vapor Valve transmitter reports battery status as ‘Replace’ for 24 hours.	Yellow	Remove and replace battery pack.

PMC Status Report

Figure 7 below shows the procedure to view the PMC Status Report.

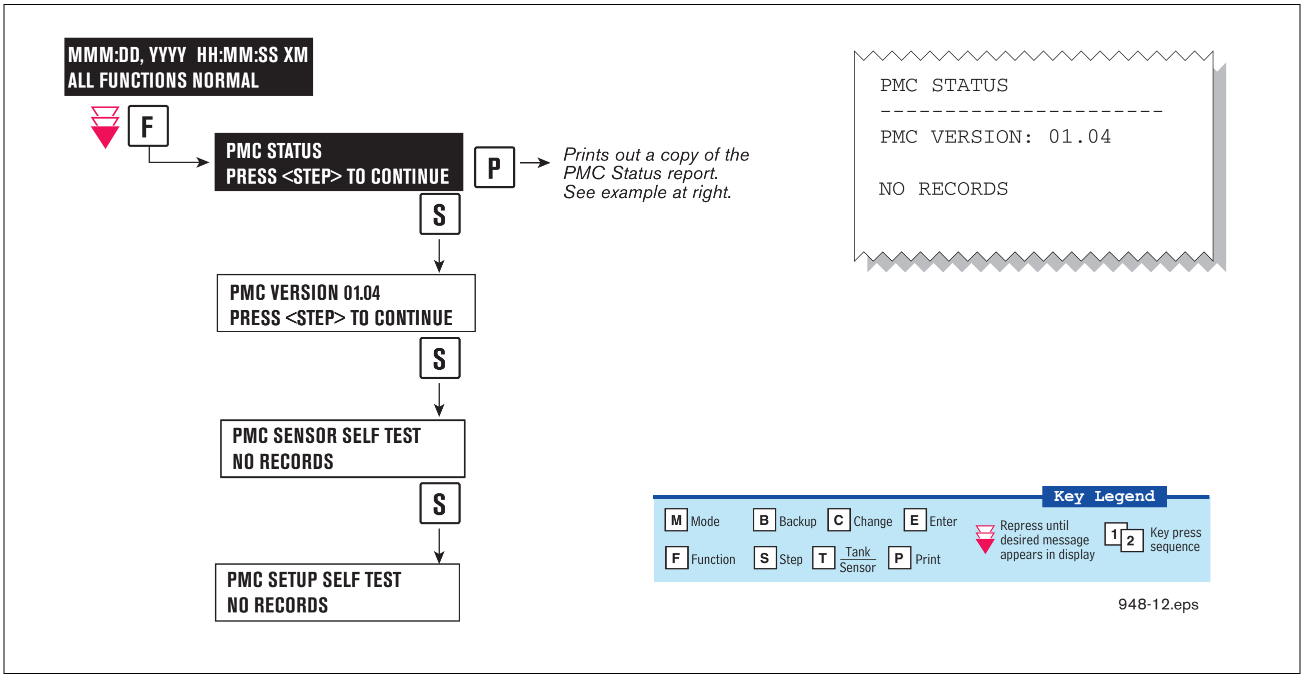
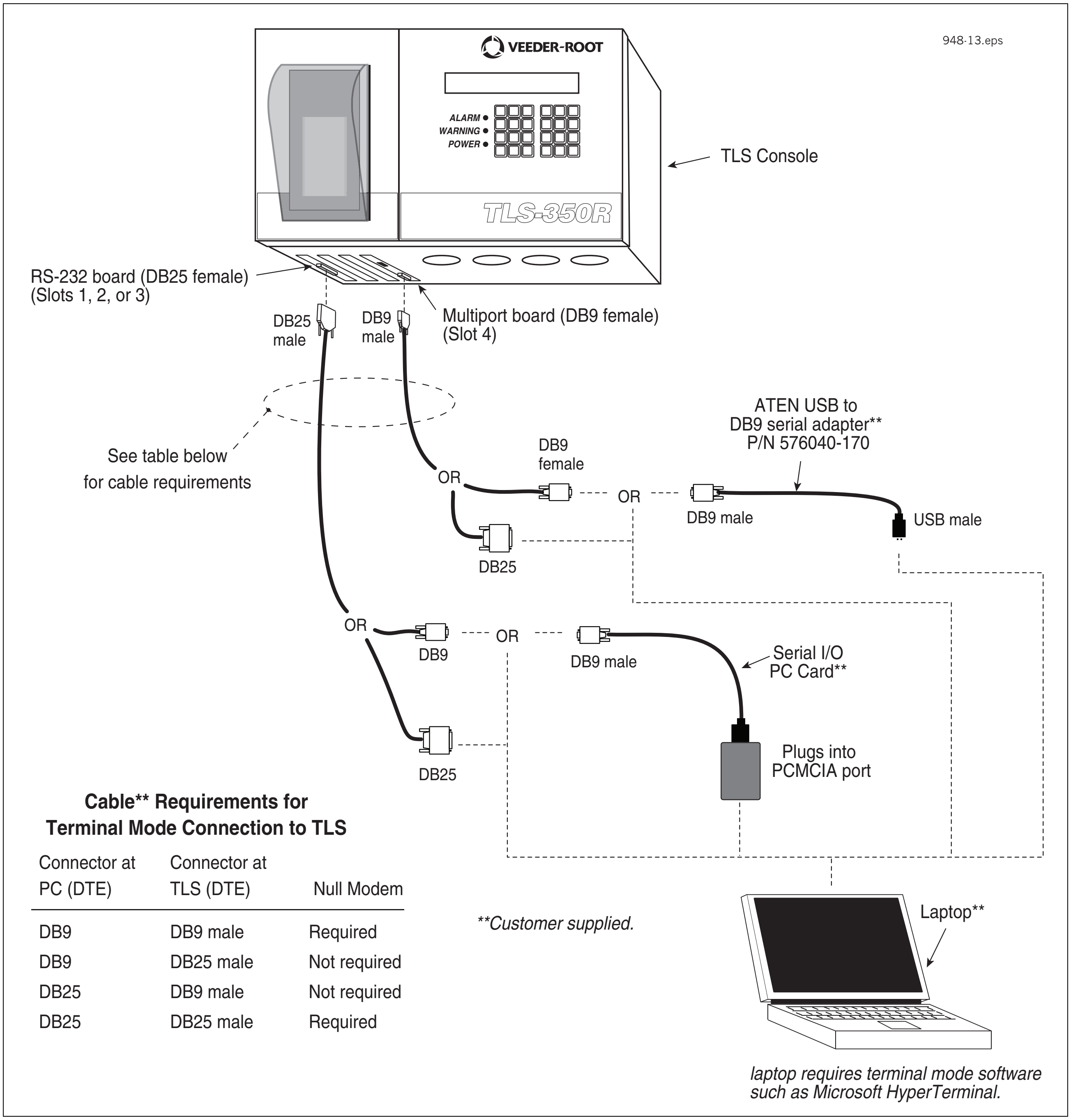


Figure 7. PMC Status Report

Viewing PMC Reports Via RS-232 Connection

CONNECTING LAPTOP TO CONSOLE

Connect your laptop to the TLS console's RS-232 or Multiport module using one of the methods shown in the examples in Figure 8 below.



Cable Requirements for Terminal Mode Connection to TLS**

Connector at PC (DTE)	Connector at TLS (DTE)	Null Modem
DB9	DB9 male	Required
DB9	DB25 male	Not required
DB25	DB9 male	Not required
DB25	DB25 male	Required

Figure 8. Connecting laptop to TLS console for serial communication

CONNECTING LAPTOP TO CONSOLE

1. Open your laptop's serial communication program, e.g., HyperTerminal. You can typically find HyperTerminal under: Start/Programs/Accessories/Communications.

2. After opening the terminal software program, ignore (cancel) any modem/dialing related request windows since you will be directly connecting to the console via serial communications. When the Connection Description window appears (Figure 9), enter a connection name, e.g., TLSDIRECT, and click the OK button.

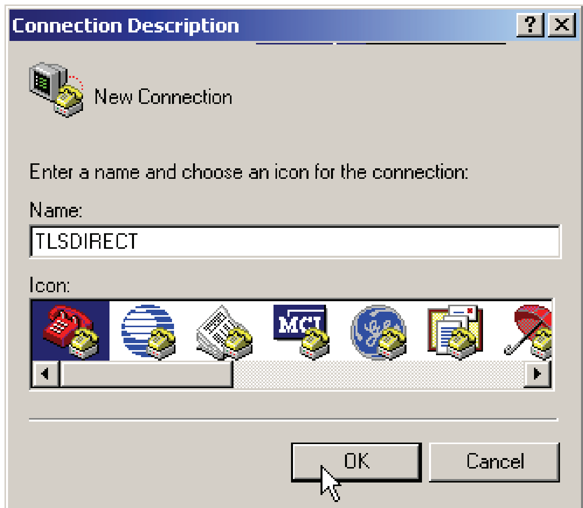


Figure 9. Connection Description window

3. After clicking the OK button, you may see a repeat of the modem/dialing windows, in which case ignore (cancel) them all.

4. When the Connect To window appears (Figure 10), depending on your connection method, select either COM1 (If RS-232 port on laptop), USB-Serial Controller (if using USB port on laptop), or Serial I/O PC Card (if using PCMCIA port on laptop) in the 'Connect using' drop down box, then click OK button.

.

Figure 10. Connect To window

5. Next you should see the 'Port Settings' window.

IMPORTANT! The settings of the laptop's com port must match those of the console's com port to which you are connected.

a. Go to the console front panel press the MODE key until you see:

SETUP MODE
PRESS <FUNCTION> TO CONT

b. Press the FUNCTION key until you see the message:

COMMUNICATIONS SETUP
PRESS <STEP> TO CONTINUE

c. Press the STEP key until you see the message:

PORT SETTINGS
PRESS <ENTER>

d. Press the PRINT key to printout the port settings for all communication modules installed in the console. Figure 11 shows an example port settings printout with the RS-232 module installed. Using the console port settings in the example below, your HyperTerminal ‘Port Settings’ window entries would be Bits per second - 2400, Data bits - 7, Parity - Odd, Stop Bits - 1. For the ‘Flow Control’ entry select None. Click OK.

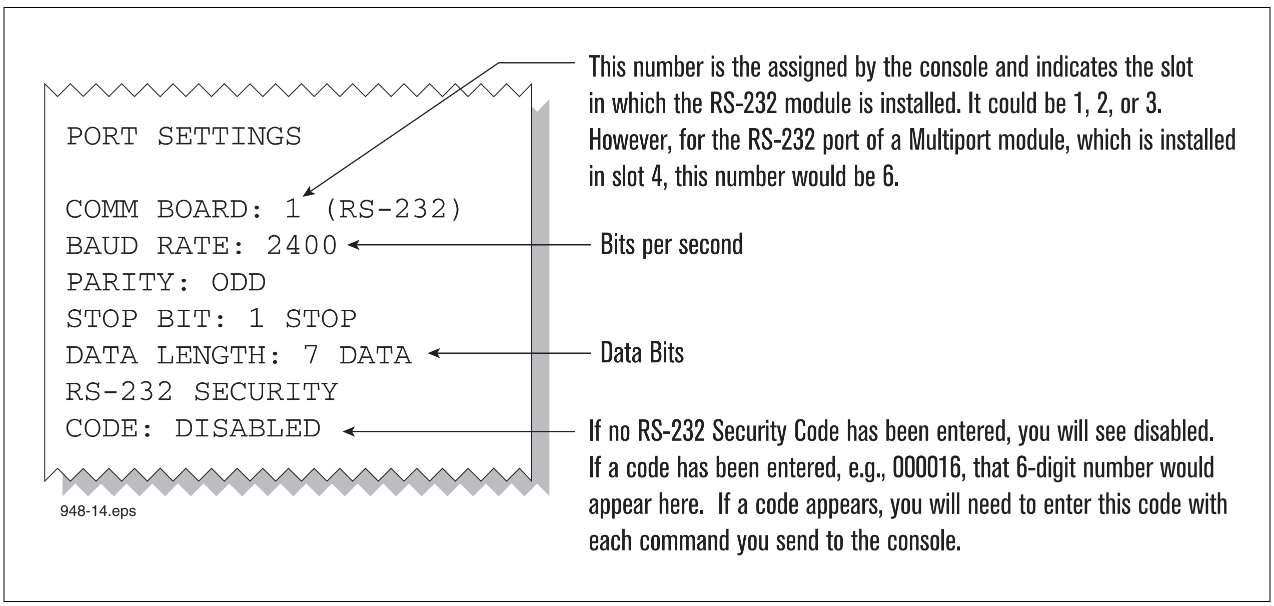


Figure 11. Console comm port settings printout example

In the example port settings printout above, the RS-232 Security Code is disabled. If the code was enabled you would see a 6-digit number which you will need to enter to access the console (refer to the ‘Sending Console Commands’ paragraph below for more information).

6. After entering your port settings, the program's main window appears (Figure 12).

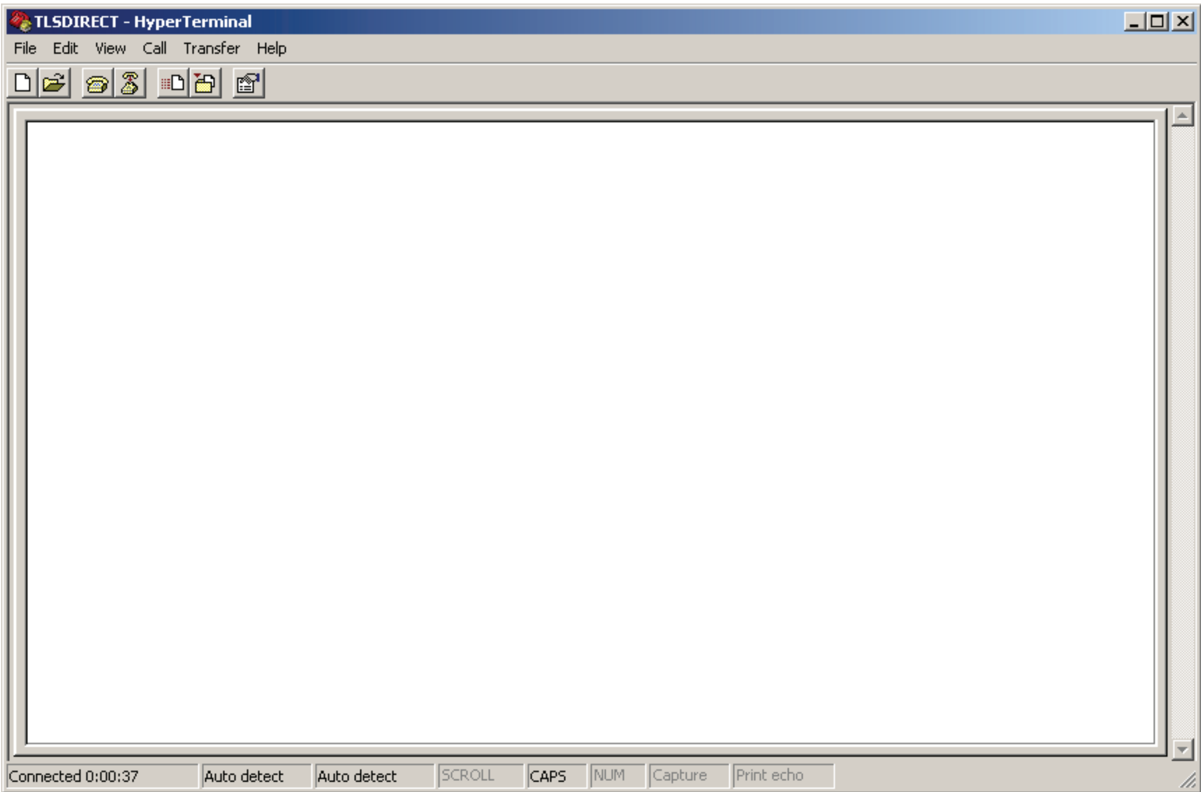


Figure 12. HyperTerminal main window

SENDING CONSOLE COMMANDS

Table 3 shows important PMC console commands. The <SOH> shown in the table means that you must press and hold the **Ctrl** key while you press the **A** key.

For example, let's say you want to see the Vapor Polisher Runtime Diagnostic Report.

Note: If you want to see the characters of the command as you type them in, click on File menu, then select Properties/Settings (tab)/ASCII Setup and click the check box for 'Echo typed characters locally', then click OK to close the window(s) and return to the main screen.

If the RS-232 Security Code is disabled - press and hold the Ctrl key while you press the A key, then type in IV8000. If the RS-232 Security Code is enabled (e.g., 000016) you must enter the security code before the command - press and hold the Ctrl key while you press the A key, then type in 000016IV8000.

You will see the typed command on the screen: `☺IV8000` followed by the response (report) from the console. The ☺ symbol indicates CrtlA and the ♥ symbol indicates the end of the response.

If the console recognizes the command the response displays as soon as the command is typed in.

If the console does not recognize the command you would see something like `☺IV80000☺9999FF1B♥` which indicates the console did not recognize the command.

All responses (Reports) can be printed or saved to a file. See the terminal program's help file for instructions.

Table 3. Serial Commands for PMC Diagnostic Reports

Report Type	Serial Command (PC to Console)*
Vapor Valve Status Report (See example Figure 13)	`<SOH>IB6100`
Smart Sensor Sub Alarm History Report (See example Figure 14)	`<SOH>IB6200`
Vapor Processor Status Report (See example Figure 15)	`<SOH>IV8200`
Priority Alarm History Report (See example Figure 16)	`<SOH>I11200`
Non-Priority Alarm History Report (See example Figure 17)	`<SOH>I11100`
Vapor Polisher Runtime Diagnostic Report (See example Figure 18)	`<SOH>IV8000`
Daily Vapor Polisher Diagnostic Report (See example Figure 19)	`<SOH>IV8800yyyymmddnnnn` Where yyyy=year number, mm=month number (01=January, 02=February, etc.), dd=day of the month; nnnn=number of records after the date entered (9999=all).

*<SOH> = Control A. For more information on TLS console serial commands, refer to the V-R Serial Interface Manual.

Figure 13 shows an example Vapor Valve Status report.

```
IB6100
FEB  4, 2008  1:09 PM
s 2:Vapor valve

VAPOR VALVE
SERIAL NUMBER     123456
VALVE POSITION:     OPEN
OPEN CAP:        CHARGED
CLOSE CAP:       CHARGED
AMBNT TEMP:      65.08 F
OUTLET TMP:      75.05 F
SENSOR FAULTS:
 NONE
```

Figure 13. Vapor Valve Status Report - Serial to PC Format

The IB6100 command reports the current state of the Vapor Valve Components. The current position of the valve is reported as Open or Closed. The Capacitors are used to move the valve and are reported as Charged or Discharged. Outlet Temperature is the Canister thermal probe temperature. Ambient Temperature is the temperature at the Vapor Valve ambient temperature sensor. Sensor Faults are the active faults reported by the Vapor Valve. The IB6100 (Figure 13) command only provides active Sensor Fault conditions. Use the IB6200 command to see archived fault conditions (Figure 14).

```
IB6200
SEP 19, 2008  1:05 PM

<Site Name>
<Site Address>
<Site Address>
<Site Address>

SMART SENSOR SUB ALARM HISTORY

ID  TYPE  ALARM TYPE           SUB ALARM                 STATE    DATE     TIME

 9   14   SENSOR FAULT ALARM   TEMPERATURE RANGE FAULT  CLEAR   9-19-08  11:50AM

 9   14   SENSOR FAULT ALARM   TEMPERATURE RANGE FAULT  ALARM   9-19-08  11:46AM
```

Figure 14. Smart Sensor Sub Alarm History Report - Serial to PC Format

Figure 15 shows an example Vapor Processor Status Report.

```
IV8200
DEC  8, 2010  4:29 AM

<Site Name>
<Site Address>
<Site Address>
<Site Address>

VAPOR PROCESSOR STATUS REPORT

PMC VERSION: 01.04

ASSESSMENT TIME: DEC  7, 2010 11:59 PM


VAPOR PROCESSOR TYPE: VEEDER-ROOT POLISHER

PMC MONITORING TEST PASS/FAIL THRESHOLDS
                                              PERIOD    BELOW  ABOVE
VAPOR PROCESSOR MASS EMISSION FAIL             1DAYS     ----   0.32 LBS/1KG

EFFLUENT EMISSIONS TEST : PASS     (0.00 LBS/1KG)

DAILY THROUGHPUT  :   6989 GALS
```

Figure 15. Vapor Processor Status Report - Serial to PC Format

Figure 16 shows an example Priority Alarm History Report.

```
I11100
DEC  9, 2010  4:20 AM

<Site Name>
<Site Address>
<Site Address>
<Site Address>

PRIORITY ALARM HISTORY
ID  CATEGORY  DESCRIPTION          ALARM TYPE           STATE    DATE    TIME
T 2 TANK      91 OCTANE            PROBE OUT            CLEAR  12-08-10  7:55PM
T 2 TANK      91 OCTANE            PROBE OUT            ALARM  12-08-10  7:07PM
T 2 TANK      91 OCTANE            OVERFILL ALARM       CLEAR  11-17-10 11:46AM
T 2 TANK      91 OCTANE            OVERFILL ALARM       ALARM  11-17-10 11:45AM
```

Figure 16. Priority Alarm History Report - Serial to PC Format

Figure 17 shows an example Non-Priority Alarm History Report.

```
I11200
DEC  9, 2010  4:20 AM

<Site Name>
<Site Address>
<Site Address>
<Site Address>

NON-PRIORITY ALARM HISTORY
ID  CATEGORY  DESCRIPTION          ALARM TYPE           STATE    DATE    TIME
T 3 TANK      DIESEL               LOW TEMP WARNING     CLEAR  12-08-10  3:00PM
T 3 TANK      DIESEL               LOW TEMP WARNING     ALARM  12-08-10  3:00PM
T 3 TANK      DIESEL               HIGH PRODUCT ALARM   CLEAR  12-08-10  3:00PM
T 3 TANK      DIESEL               HIGH PRODUCT ALARM   ALARM  12-08-10  2:56PM
    SYSTEM                         PRINTER ERROR        CLEAR  11-17-10 10:51AM
    SYSTEM                         PAPER OUT            CLEAR  11-17-10 10:51AM
    SYSTEM                         PAPER OUT            ALARM  11-17-10 10:50AM
    SYSTEM                         PRINTER ERROR        ALARM  11-17-10 10:50AM
```

Figure 17. Non-Priority Alarm History Report - Serial to PC Format

Figure 18 shows an example Vapor Polisher Runtime Diagnostic Report and Table 4 explains the `IV8000` report's event codes.

```
IV8000                                      948-16.eps
FEB  4, 2008  1:01 PM

TLS_350 UST
VEEDER-ROOT TEST LAB
125 POWDER FOREST DR
SIMSBURY, CT 06070

VAPOR POLISHER
VALVE EVENT          PRESSURE
DATE-TIME              "WC      EVENT CODE
 1-31-08  3:44PM      -0.700    OPEN PURGE
 1-31-08  3:47PM       0.038    CLOSE FORCE PURGE
 1-31-08  3:51PM      -0.255    OPEN PURGE
 1-31-08  8:08PM      -0.300    CLOSE PURGE Hi P
 2-01-08  1:59PM      -0.300    OPEN PURGE
 2-01-08  2:18PM      -0.263    OPEN PURGE
 2-01-08  2:33PM      -0.289    OPEN PURGE
 2-04-08 11:22AM      -0.560    NO EVENT
 2-04-08 11:28AM      -0.560    OPEN PURGE
 2-04-08 11:48AM      -0.300    OPEN PURGE
 2-04-08 12:28PM      -0.263    OPEN PURGE
 2-04-08 12:42PM      -0.299    OPEN PURGE
```

Figure 18. Vapor Polisher Runtime Diagnostic Report - Serial to PC Format

Table 4. Vapor Polisher Runtime Diagnostic Report Event Codes

Event Code	Cause	Event Code	Cause
NO EVENT	The valve changed state outside of the carbon canister algorithm.	CLOSE NEAR FULL	Canister load is between 80 and 100% and pressure is <1.05.
CLOSE TEST	Manual operation of the valve	CLOSE EMPTY	Excess purging is complete.
OPEN TEST	Manual operation of the valve	OPEN PURGE	Canister load is >0% and pressure <-0.25
CLOSE PURGE HI P	The canister state is in excess purge and the pressure is >-0.5.	OPEN EXCESS PURGE	Canister load is 0%, Excess purge is incomplete, pressure <-1.5, time is between 6AM and 4PM.
CLOSE PURGE TIME	The canister state is in excess purge and the time is outside 6AM to 4PM.	OPEN FILL	Canister valve is open for loading: • When pressure is greater than or equal to 0.75 IWC and Canister load is less than 80%. • Pressure is greater than or equal to 1.3 IWC and Canister load is greater than 80% and below emission limit.
CLOSE FORCE PURGE	Canister is in startup period. Loading with pressures <+1.05 is not allowed until startup period is complete.	CLOSE LIMIT	Valve closed because canister has reached allowable extended capacity loading limit.
CANISTER EMPTY	Canister load equals 0% after having loaded to more than 1%. No valve state change.	CLOSE CVLD TEST	Valve closed to collect data for ISD containment leak test.
CANISTER FULL	No valve state change. The canister load passed from below 95% to/thru the 100% point and not yet at day's emission limit.		

Figure 19 shows an example PMC Daily Vapor Polisher Diagnostic Report.

```
IV8800
OCT 2, 2008 2:53 PM

PMC DAILY VAPOR POLISHER DIAGNOSTIC

                     LOAD  PRGE  MIN%   MAX%   SELF  EMISSION
DATE/TIME            HRS   HRS   LOAD   LOAD   TEST  TEST
08-10-02 13:58:58    3.1   2.5    15     69    WARN  FAIL
```

Figure 19. PMC Daily Vapor Polisher Diagnostic Report - Serial to PC Format

Diagnostics

Automatic Control

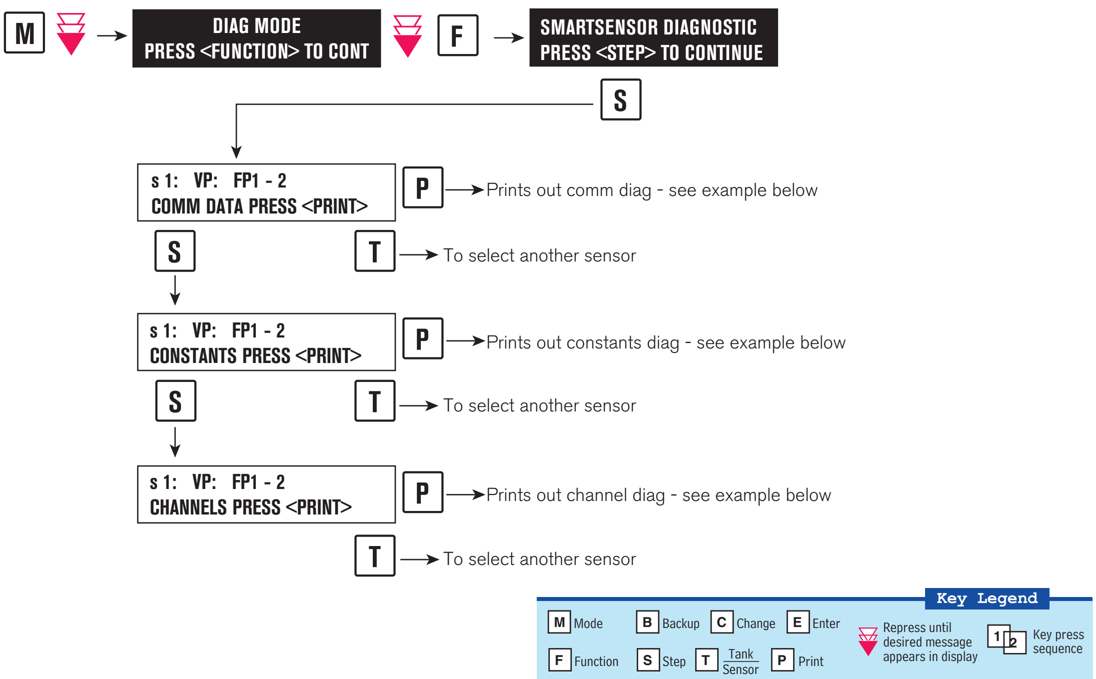
If PMC mode is in AUTOMATIC, PMC will control flow through the canister using a vapor control valve. The control algorithms will monitor tank pressure, atmospheric pressure, vapor temperature and carbon temperature to monitor carbon canister loading. When the pressure is positive, the valve is opened to relieve the pressure and begin loading the canister. Purging occurs when the valve is open and the UST pressure is negative. The valve will close when the canister has either reached capacity or the canister is empty after purging.

Manual control

If PMC mode is in MANUAL, the diagnostic menu allows the valve to be opened (ON) or closed (OFF) manually. This feature is to support testing operation (see Exhibit 11 of VR 203) of the valve without waiting for canister to reach loading or purging thresholds. When set to Manual mode, the system will reset to Automatic mode after 4 hours. The current UST ullage space vapor pressure will also be available through the diagnostic menu.

PMC Diagnostic Menus

The Smart Sensor (see Figure 20) and PMC (see Figure 21) diagnostic menus below are viewed from the TLS Console front panel.




```
SS COMM DIAG
-----------------------
s 1: AFM1    FP1-2
SAMPLES READ     58
SAMPLES USED     54
PARITY ERR        0
PARTIAL READ      0
COMM ERR          0
RESTARTS          0
```

```
SS CONSTANTS DIAG
-----------------------
s 1: AFM1    FP1-2

VAPOR PRESSURE
SERIAL NUMBER      1007
PROTOCOL VERSION      0
```

```
SS CHANNEL DIAG
-----------------------
s 1: AFM1    FP1-2
YY-MM-DD  HH:MM:SS
C00 B50B 3D68 00E0 0000
C04 0000 03EF 0000 0004
C08 0A3C 3D68 5693 0081
C12 80C4 80A4 0104 2579
C16 0000 0000 00A3 03D6
C20 0709 0032 04C9 880F
```

948-1.eps

Figure 20. SmartSensor Diagostic Menus

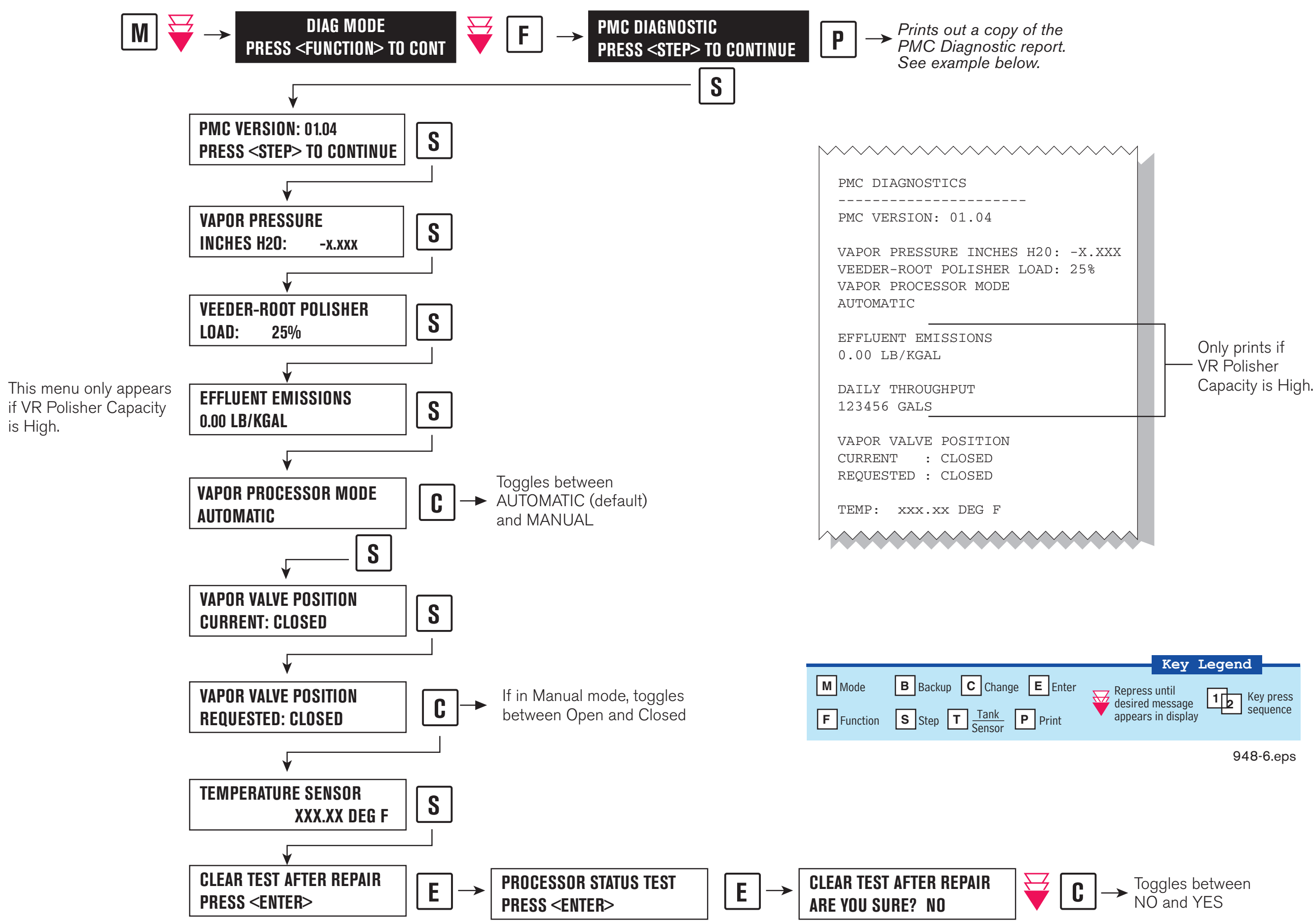


Figure 21. PMC Diagnostic Menus

Troubleshooting

PMC Setup

This warning occurs when the PMC setup is not complete.

DIAGNOSTIC CHECKLIST

Procedure		
STEP 1.	**Gasoline tanks configured?**	☐
STEP 2.	**ATM sensor configured and enabled?**	☐
STEP 3.	**Vapor valve installed and configured?**	☐
STEP 4.	**On the TLS press the MODE key until the DIAGNOSTIC MODE menu is displayed (this will cause a TLS console System Self-Test).**	☐
STEP 5.	**If alarm does not clear, contact Veeder-Root Technical Support at (800) 323-1799.**	

PMC Sensor Faults

Table 5 contains a listing of the Smart Sensor Device generated alarms including their cause and suggested troubleshooting. TLS Console PMC alarms may be interspersed amongst non-PMC alarms, please see TLS Series manuals for more information.

Table 5. Smart Sensor Device Fault Summary

Fault Message	Devices	Cause	Suggested Troubleshooting
Communication Alarm	Vapor Valve, Pressure Sensor, Tank Probe	Device not communicating with Smart Sensor Module	Check wiring and connections from the Smart Sensor board to the device in alarm.
Smart Sensor Fault Valve Command Fault	Vapor Valve	Valve will not move when commanded	Check installation of all Vapor Valve components including Thermal Probe and Vapor Sensor Assembly. Refer to manual 577013-920.
Smart Sensor Faullt Cap Not Holding		Capacitor not holding charge	
Smart Sensor Fault Cap Not Charging		Capacitor not charging	
Smart Sensor Fault Temperature Range		Temperature out of range	

Wireless Related Sensor Alarms

The TLS RF Wireless 2 System (W2) features two-way communication utilizing a client/server architecture. When the Veeder-Root Polisher Vapor Valve uses this type of technology, the following alarm may occur:

Displayed Message	Description	Light Indicator	Suggested Troubleshooting
BATTERY WARNING	Vapor Valve transmitter reports battery status as 'Replace' for 24 hours.	Yellow	Remove and replace battery pack.

VP Emission Alarm

In the even that a VP EMISSION WARNING is present when the valve is in Automatic mode for 24 hours and there are no PMC Sensor Fault alarms on the system, notify Veeder-Root Technical Support.

Example Smart Sensor reports

```
IB6100
FEB  4,  2008  1:09  PM
s 2:Vapor valve

VAPOR VALVE
SERIAL NUMBER       123456
VALVE POSITION:       OPEN
OPEN CAP:          CHARGED
CLOSE CAP:         CHARGED
AMBNT TMP:         65.08 F
OUTLET TMP:        75.05 F
SENSOR FAULTS:
VALVE COMMAND FAULT
```

```
IB6100
FEB  4,  2008  1:09  PM
s 2:Vapor valve

VAPOR VALVE
SERIAL NUMBER       123456
VALVE POSITION:       OPEN
OPEN CAP:          CHARGED
CLOSE CAP:         CHARGED
AMBNT TMP:         65.08 F
OUTLET TMP:        75.05 F
SENSOR FAULTS:
CAP NOT HOLDING
```

```
IB6100
FEB  4,  2008  1:09  PM
s 2:Vapor valve

VAPOR VALVE
SERIAL NUMBER       123456
VALVE POSITION:       OPEN
OPEN CAP:          CHARGED
CLOSE CAP:         CHARGED
AMBNT TMP:         65.08 F
OUTLET TMP:        75.05 F
SENSOR FAULTS:
CAP NOT CHARGING
```

```
IB6100
FEB  4,  2008  1:09  PM
s 2:Vapor valve

VAPOR VALVE
SERIAL NUMBER       123456
VALVE POSITION:       OPEN
OPEN CAP:          CHARGED
CLOSE CAP:         CHARGED
AMBNT TMP:         65.08 F
OUTLET TMP:        75.05 F
SENSOR FAULTS:
TEMPERATURE RANGE
```

```
IB6100
FEB  4,  2008  1:09  PM
s 2:Vapor valve

VAPOR VALVE
SERIAL NUMBER       123456
VALVE POSITION:       OPEN
BATTERY:              FULL
OPEN CAP:          CHARGED
CLOSE CAP:         CHARGED
AMBNT TMP:         65.08 F
OUTLET TMP:        75.05 F
SENSOR FAULTS:
TEMPERATURE RANGE
```

'Wireless' vapor valve example

Operability Test Procedures

Refer to Exhibit 11 and Exhibit 12 of VR 203 and VR 204 for applicable operability test requirements for the Vapor Polisher.

VEEDER-ROOT

For technical support, sales or
other assistance, please visit:
www.veeder.com

Executive Order VR-204-M
VST Phase II EVR System Including Veeder-Root ISD

EXHIBIT 2

System Specifications

This exhibit contains the installation, maintenance and compliance standards and specifications that apply to the VST Phase II EVR System Including Veeder-Root ISD installed at a gasoline dispensing facility (GDF). All components must be installed, maintained, and operated in accordance with the specifications in the **ARB Approved Installation, Operation and Maintenance Manual** (IOM). Installation, maintenance and repair of system components, including removal and installation of such components in the course of any required tests, shall be performed by technicians certified by the appropriate manufacturer. Additional certifications may be required in accordance with local district requirements. Provided that there are no other local district requirements, a GDF owner/operator can remove and install nozzles, curb hoses, breakaways, and whip hoses without a manufacturer certification.

Nozzle

1. A vapor collection sleeve shall be installed on the VST nozzle at the base of the spout, as shown in **Figure 2B-1**. A vapor collection bellows shall be installed on the EMCO nozzle at the base of the spout, as shown in **Figure 2B-2**.

2. The VST Model VST–EVR-NB and EMCO Model A4005EVR nozzles have an integral vapor valve which prevents the loss of vapor from the underground storage tanks, ensures proper operation of the system and prevents the ingestion of air into the system. The performance of the nozzle vapor valve can be determined by items 2.1 or 2.2.

    2.1. The maximum allowable leak rate for the nozzle vapor path, as determined by TP-201.2B, shall not exceed 0.07 cubic feet per hour (CFH) at a pressure of two inches water column (2.00” WC)

    2.2. Verification of the integrity of the vapor valve can be performed on installed nozzles using the nozzle bag test procedure in Exhibit 7.

3. The gasoline flow rate of the nozzle shall be between six (6.0) and ten (10.0) gallons per minute as determined by the applicable provisions of section 6 or 7 of Exhibit 5 or by direct observation for 30 seconds minimum at the maximum hand held position.

Vapor Collection

1. The system pressure drop from the nozzle to the UST, as determined by TP-201.4 (Methodology 1) and Exhibit 6, shall not exceed the following:

    0.35 inches WC at a flow rate of 60 CFH of Nitrogen; and
    0.62 inches WC at a flow rate of 80 CFH of Nitrogen.

Coaxial Hoses

1. The maximum length of the curb hose, breakaway, and whip hose combined shall not exceed fifteen feet as measured from the base of the nozzle to the end of dispenser adapter or dispenser, as appropriate (Reference Exhibit 1, Figure 1A-2).

2. The liquid removal rate shall not be less than five milliliters per gallon (5.0 ml/gal) as determined by Exhibit 5 when tested with a gasoline flow rate between six (6.0) and ten (10.0) gallons per minute. Liquid removal requirement is applicable to all grades of gasoline.

3. All hoses shall have a permanent marking indicating the liquid pick-up location.

4. Any hose configuration is allowed when installed in accordance with IOM section 8.

Breakaway Couplings

1. The VST breakaway and EMCO safe break couplings are non-reconnecting and shall be replaced following a drive-off.

Flow Limiter

1. No flow limiter is allowed for this system.

VST ECS Membrane Processor

1. The processor vapor integrity shall demonstrate compliance with the static pressure decay criteria of TP-201.3 and Exhibit 4.

2. Unless there is maintenance or testing being conducted on the processor, the processor shall be on and in the automatic vapor processor mode and the three ball valves shall be locked in the open positions shown in **Figure 2B-3** for normal processor operation. The handles of the ball valves shall not be removed.

3. Piping to and from the processor shall be sloped 1/8” per foot minimum toward the vent line(s).

4. The hydrocarbon concentration of the ECS membrane processor taken from the Hydrocarbon Diagnostic Report shall be between ± one percent (±1%) for the zero and mid-range gas and ± two percent (±2%) for the high-range gas, when tested in accordance with Exhibit 8.

5. The processor shall activate when the pressure of the underground storage tank is less than or equal to 0.4 inches WC (≤0.4 inches WC) as determined by Exhibit 9.

6. The Vapor Pressure Sensor shall be between +0.2 and –0.2 inches WC when tested in accordance with section 9 of Exhibit 10.

7. The pressure reading from the TLS console shall be within ±0.2 inches WC of the measured ullage UST pressure as determined by section 8 of Exhibit 10.

8. The TLS-350 audible alarm shall be installed at a location that is most likely to be occupied by the station attendant during normal station operation (e.g., cash register).

9. The TLS console controlling the membrane shall have an RS232 port which shall be installed in a location that allows the RS232 port to be easily accessible, and if applicable per district requirements, for use at anytime. A vacant RS232 serial port shall always be available to electronically download reports.

10. The hydrocarbon concentration of the VST ECS Processor shall not exceed twelve percent (12%) as determined by accessing the Vapor Processor Status Report.

Veeder-Root Vapor Polisher

1. The carbon type shall be BAX G1500 manufactured by MeadWestvaco.

2. Unless there is maintenance or testing being conducted on the processor, the vapor polisher shall be on and in the automatic vapor processor mode and the inlet ball valve shall be locked in the open position shown in **Figure 2B-4** for normal polisher operation. The handle of the ball valve shall not be removed.

3. The pressure reading from the TLS console shall be within ±0.2 inches WC of the measured ullage UST pressure as determined by section 8 of Exhibit 10.

4. The Vapor Pressure Sensor shall be between +0.2 and –0.2 inches WC when tested in accordance with section 9 of Exhibit 10.

5. The Vapor Polisher pressure decrease between starting and ending pressures shall be less than 0.5 inches WC loss when tested in accordance with Exhibit 11. The ending pressure must be greater than 7.0 inches WC. Pressure drop across the Vapor Polisher at 18.0 standard cubic feet per hour flow shall be between 1.69 inches WC and 2.25 inches WC when tested in accordance with Exhibit 11. Differences in temperature readings shall not exceed 10 ºF when tested in accordance with Exhibit 11. The atmospheric pressure sensor reading shall be within 10% of the atmospheric pressure obtained from a local independent source when tested in accordance with Exhibit 11.

6. The hydrocarbon concentration from the vapor polisher outlet shall not exceed 9000 ppm iso-butane (0.9% by volume iso-butane) when tested in accordance with Exhibit 12.

7. The TLS console controlling the vapor polisher shall have an RS232 port which shall be installed in a location that allows the RS232 port to be easily accessible, and if applicable

per district requirements, for use at anytime. A vacant RS232 serial port shall always be available to electronically download reports.

8. Security seal tags must be installed on the vapor polisher. If for any reason the seal tags are damaged or missing, the district may require that Exhibit 11 and Exhibit 12 be conducted and pass prior to installing new security seal tags.

Hirt VCS 100 Thermal Oxidizer

1. The processor vapor integrity shall demonstrate compliance with the static pressure decay criteria of TP-201.3 and Exhibit 4.

2. Unless there is maintenance or testing being conducted on the processor, the processor shall be on (power lamp is lit). The ball valve on the inlet of the processor shall be locked in the open position shown in **Figure 2B-17** and the 3-Way Valve handle shall be pointing down in the Normal Operating Position (Opened to UST Ullage) shown in **Figure 2B-18** during normal processor operation. The handles of the ball valves shall not be removed.

3. The processor shall be installed at least 20 feet from the pressure/vacuum vent valve(s) and the associated piping shall be sloped 1/8" per foot minimum toward the vent line(s) or tank fitting.

4. The VCS 100 Indicator Panel shall be installed at a location that is most likely to be occupied by the station attendant during normal station operation (e.g., cash register).

5. The processor shall activate when the processor is exposed to an atmospheric pressure input and the Processing lamp at the Indicator Panel shall light within three (3) minutes as determined by Exhibit 13.

6. When the processor is exposed to an atmospheric pressure input, the OVERPRESSURE lamp at the Indicator Panel shall light within sixty two (62) minutes as determined by Exhibit 13.

7. If the OVERPRESSURE lamp lights, the system is not in proper working order. The GDF owner/operator shall immediately take the following actions:

   a. record the date and time the OVERPRESSURE lamp lit in the station's maintenance and alarm records;
   b. investigate the cause of the OVERPRESSURE light as provided by section 16 of the Installation, Operations, and Maintenance Manual. Record results of inspections, maintenance, and/or testing conducted in the station's maintenance and alarm records; and if necessary,
   c. record the date and time when the GDF owner/operator called the maintenance contractor for service.

<u>Franklin Fueling Systems Clean Air Separator Pressure Management System</u>

1. The Clean Air Separator vapor integrity shall be evaluated using the test procedure outlined in Exhibit 14 of the Executive Order.

2. The Franklin Fueling Systems Clean Air Separator shall be installed within 100 feet from the vent line(s), and the associated piping shall be sloped 1/8" per foot minimum toward the vent line(s).

3. Unless there is maintenance or testing being conducted on the Franklin Fueling Systems Clean Air Separator, the four ball valves shall be locked in the positions shown in **Figure 2B-16** or **2B-16H** for normal Clean Air Separator operation. Figure 2B-16 applies to vertical CAS installations and Figure 2B-16H applies to horizontal CAS installations

<u>Pressure/Vacuum Vent Valves for Storage Tank Vents</u>

1. All P/V vent valves shall be an ARB certified P/V valve for a Phase I system.

2. At least one pressure/vacuum (P/V) vent valve shall be installed on each tank vent. The maximum number of P/V vent valves allowed and P/V vent valve performance specifications are listed in the applicable Phase I EVR Executive Order. Vent lines may be manifold to minimize the number of P/V vent valves and potential leak sources, provided the manifold conforms to all applicable fire regulations. However, the vents connecting the vapor inlet and vapor outlet to the VST ECS Membrane Processor cannot be manifold together.

<u>Vapor Recovery Piping Configurations</u>

<u>NOTE: Vapor Return Piping shall meet the requirements specified in section 4.11 of CP-201.</u>

1. Vapor Return and Vent Lines

   For facilities installed on or after April 1, 2003, all vapor return and vent lines shall be a minimum nominal internal diameter of 2 inches from the dispensers or the vent stacks to the first manifold. All lines after the first manifold and back to the underground storage tank shall have a minimum nominal internal diameter of 3 inches.

   Note: Facilities permitted by a local district prior to April 1, 2003 shall be required to meet the three inch diameter standard only upon facility modification which involves the addition, replacement, or removal of 50 percent or more of the buried vapor piping.

2. All vapor return lines shall have a minimum slope of 1/8 inch per foot from the dispenser riser to the riser of the UST. A slope of 1/4 inch or more per foot is recommended wherever feasible.

3. The dispenser shall be connected to the riser with either flexible or rigid material that is listed for use with gasoline. The dispenser-to-riser connection shall be installed so that any liquid in the lines will drain toward the storage tank. The internal diameter of the connector, including all fittings, shall not be less than one inch (1").

   Note: The dispenser-to-riser connection is defined as the piping connection between the dispenser piping and the inlet of the dispenser riser. A vapor shear valve may also be part of the riser connection.

4. There is no length restriction for the vapor return piping of the system as long as the system complies with the maximum pressure drop requirement, item 1 of the Vapor Collection section.

5. No product shall be dispensed from any fueling point at a GDF installed with the VST Phase II EVR System if there is a vapor line that is disconnected and open to the atmosphere.

6. Bulk Plant Operations are not allowed with this system.

Dispensers

1. The dispenser vapor piping must be sized adequately to meet the maximum pressure drop requirement, item 1 of the Vapor Collection section.

2. Dispenser vapor piping shall be installed so that any liquid in the lines will drain toward the dispenser riser.

Liquid Condensate Traps

1. Liquid condensate trap connections and fittings shall not leak. Compliance with this requirement shall be verified by the use of commercial liquid leak detection solution or by bagging, when the vapor containment space of the underground storage tanks is subjected to a non-zero pressure. (Note: Leak detection solution will detect leaks only when positive gauge pressure exists).

2. The Liquid Level Sensor shall alarm within five (5) minutes when tested in accordance with Exhibit 16, **Liquid Condensate Trap Compliance Test**.

3. The Liquid Level Sensor audible alarm shall be installed at a location that is most likely to be heard by the station attendant during normal station operation (e.g. cash register).

4. The Liquid Evacuation System shall automatically evacuate gasoline when tested in accordance with Exhibit 16, **Liquid Condensate Trap Compliance Test.**

5. A metal tag specifying the capacity of the Liquid Condensate Trap shall be installed and maintained as specified in the Installation, Operation, and Maintenance Manual.

In-Station Diagnostics (ISD)

1. The gasoline dispensing facility operator/owner and contractor shall comply with local district requirements, if any, following a warning by the Veeder-Root In-Station Diagnostics (ISD) system and shut down individual dispensers or submersible pumps to all gasoline tanks by the ISD systems.

2. Suggested Troubleshooting, found in Table 12-3 of the Veeder-Root In-Station Diagnostics (ISD) Install, Setup, and Operation Manual (ARB Approved Installation, Operation, and Maintenance Manual), recommends that certain tests be conducted to verify the cause of the ISD warning or failure alarms. Districts may require that these tests or other tests specified by the districts be conducted in response to the ISD alarms.

3. For this certification, the baseline vapor collection performance value used was 1.0. This value will not be used for enforcement purposes.

4. The table below provides a list of expiration dates for each ISD software version that has been revoked.

ISD System Software Version Expiration Dates

Phase II EVR System Description	ISD Manufacturer	Revoked Software Version	Last Date Software May Remain In Use	Notes
VST (Balance) VR-204 Series	Veeder-Root*	Version 1.01 for Multi-Product (six pack) Dispensers with Fuel Blending	07/01/2012	Only applies to GDFs equipped with multi-product dispensers with fuel blending. Does not apply to GDFs equipped with uni-hose dispensers with fuel blending. Subject GDFs must upgrade to the currently certified software version (1.03 or later)

* Existing GDFs equipped with Veeder Root ISD Software Version 1.02 may remain in use because it has not been revoked. Existing sites equipped with Veeder Root Software Version 1.01 may remain in use if not equipped with muliti-product dispenser with fuel blending.

<u>Phase I System</u>

1. The Phase I system shall be an ARB-certified system that demonstrates compliance with the static pressure decay test criteria contained in TP-201.3 and Exhibit 4.

<u>Maintenance Records</u>

1. Each GDF operator owner shall keep records of alarms and maintenance performed at the facility. Such records shall be maintained on site in accordance with district requirements or policies. The records shall include alarm date and time, nature of the alarm, troubleshooting, maintenance or repair performed to validate and/or correct alarms, component, or system failures, date when maintenance or repair was conducted, name and Certified Technician Identification Number of individual conducting maintenance or test, affiliation, and telephone number. Additional information may be required in accordance with local district requirements. An example of a GDF maintenance and alarm form is shown in **Figure 2B-19**.

2. Maintenance shall be conducted in accordance with the Scheduled Maintenance section of the ARB approved Installation, Operation, and Maintenance Manual.

Vapor Recovery Equipment Defects

The following is deemed a defect for the affected grade point(s) or system.

Grade Points – VST Nozzles

1. The grade point shall be removed from service when more than 30% of a nozzle face seal is missing (e.g., a triangular or similar shape in which greater than 2.5 inches of the faceplate circumference is missing (accumulated).

2. The grade point shall be removed from service when more than 0.375 square inches of a nozzle vapor collection sleeve is missing (e.g., a rectangular shape of greater than nine/sixteenth (9/16) inches or more on each side, a circular shape of eleven/sixteenth (11/16) inches or more in diameter, or a triangular shape of seven/eighth (7/8) inches on the side.

3. The grade point shall be removed from service when the total slit length in the convolutions exceeds 18 inches as determined by direct measurements.

Grade Points – EMCO Nozzles

4. The grade point shall be removed from service when more than 0.38 square inches of a nozzle boot face material is missing (e.g., a triangular or similar shape in which greater than 7/16 inches of the boot face circumference is missing (accumulated)).

5. The grade point shall be removed from service when there is slit across seven (7) consecutive bellows convolutions as determined by direct measurements.

6. The grade point shall be removed from service when there is a 360 degree cut around the bellows convolution.

Grade Points – General

7. The grade point shall be removed from service when the dispensing rate is greater than ten (10.0) gallons per minute (gpm) or less than five (5.0) gpm as determined by the applicable provisions of section 6 or 7 of Exhibit 5 or by direct observation for 30 seconds minimum at the maximum hand held position.

8. The grade point shall be removed from service when a hose is found to have greater than 150 ml of gasoline in the vapor side as determined by sections 6.1 to 6.5 of Exhibit 5. Note: Prior to draining gasoline from the vapor side of the hose, use EMCO tool P/N 494635EVR (for EMCO EVR nozzle) or VST tool P/N VST STP 100 (for VST EVR nozzle) and plug the fuel spout. **Do not activate dispenser when draining gasoline from the vapor side of the hose.**

9. The grade point shall be removed from service when any hose has a visible opening as determined by direct observation.

10. The grade point shall be removed from service when any nozzle lever has spring tension (live lever) when the vapor recovery sleeve or bellows is uncompressed as determined by direct observation.

11. The grade point shall be removed from service when the nozzle automatic liquid shut-off mechanisms malfunction in any manner as determined by EPO No. 26-F (See Vapor Recovery Equipment Defects List) or direct observation.

12. The grade point shall be removed from service when any nozzle has a defective vapor valve as determined by Exhibit 7 or when the vapor valve has a leak rate that exceeds 0.07 cubic feet per minute at a pressure of two (2) inches WC as determined by TP-201.2B.

13. The grade point or system shall be removed from service when any component required by this Executive Order is absent, installed improperly or disconnected as determined by direct observation.

System with VST ECS Processor

1. Unless there is maintenance or testing being conducted on the VST ECS processor, the system shall be removed from service when the three ball valves on the VST ECS processor are not locked in the proper operating configuration (**Figure 2B-3**) as determined by direct observation.

2. Unless there is maintenance or testing being conducted on the VST ECS processor, the system shall be removed from service when the ECS membrane processor is not on or in the automatic vapor processor mode as determined by the Diagnostic section of the Pressure Measurement Control (Section 12) of IOM.

System with Veeder-Root Vapor Polisher

1. Unless there is maintenance or testing being conducted on the Veeder-Root Vapor Polisher, the system shall be removed from service when the ball valve on the Vapor Polisher is not locked in the proper operating configuration (**Figure 2B-4**) as determined by direct observation.

2. Unless there is maintenance or testing being conducted on the Veeder-Root Vapor Polisher, the system shall be removed from service when the Vapor Polisher is not in the automatic mode as determined by the Diagnostic section of the Pressure Measurement Control (Section 12) of IOM.

System with Hirt Thermal Oxidizer

1. Unless there is maintenance or testing being conducted on the Hirt Thermal Oxidizer, the system shall be removed from service when the ball valve on the Thermal Oxidizer is not locked in the proper operating configuration (**Figure 2B-17**) as determined by direct observation.

2. Unless there is maintenance or testing being conducted on the Hirt Thermal Oxidizer, the system shall be removed from service when the Thermal Oxidizer Indicator Panel is not in the “power on” position (power lamp is lit).

System with Franklin Fueling Systems Clean Air Separator

1. The system shall be removed from service when the Franklin Fueling Systems Clean Air Separator fails the leak decay test outlined in Exhibit 14.

2. Unless there is maintenance or testing being conducted on the Franklin Fueling Systems Clean Air Separator, the system shall be removed from service when the four ball valves are not locked in the positions shown in **Figure 2B-16** or **2B-16H** for normal Clean Air Separator operation. Figure 2B-16 applies to vertical CAS installations and Figure 2B-16H applies to horizontal CAS installations.

Veeder-Root ISD System Specifications

TLS Console & ISD Software Version Number

The ISD audible alarm shall be installed at a location that is most likely to be occupied by the station attendant during normal station operation (e.g. cash register) to hear the alarm. The TLS console shall be installed in a location that allows the RS232 port to be easily accessible, and if applicable, per district requirements, for use at anytime. A vacant RS232 serial port shall always be available to electronically download reports.

The presence of ISD and the ISD software version number can be verified on the TLS Console LCD screen by using the <STEP> key or by using the TLS Console <PRINT> key to print and review the latest ISD Daily Report. **See Figures 2B-5** and **2B-6** for TLS and ISD verification instructions.

The TLS Console must have a printer as well as an RS232 interface port.

If the TLS is equipped with security features which prohibit access to the TLS, instructions to override these security features shall be maintained on site in accordance with air district requirements and shall be available to the air district upon request.

Operability Test Procedure

The Veeder-Root ISD operability test procedure provided in Exhibit 10 and Exhibit 17, and in section 12 of the ***ARB Approved Installation, Operation and Maintenance Manual*** (IOM), shall be used at GDF sites to determine the operability of the Veeder-Root ISD system to comply with applicable performance standards and performance specification in CP-201. Testing the ISD equipment in accordance with this procedure will verify the proper selection, setup and operation of the TLS Console sensors and interface modules.

The Vapor Flow Meter

The Veeder-Root ISD system requires one Vapor Flow Meter per dispenser installed in accordance with Section 15 **of *ARB Approved IOM* (*Veeder-Root ISD Balance Vapor Flow Meter Manual Installation Guide (577013-916, Rev. B)) for the Veeder-Root ISD System***. The Vapor Flow Meter is an intrinsically safe sensor that is wired to the TLS Console Smart Sensor Module via a conduit dedicated to TLS Console low-voltage sensors. **Figure 2B-7** shows the ISD Vapor Flow Meter. **Figures 2B-12, 2B-13, and 2B-14** show the installation configuration.

The Vapor Pressure Sensor

The Veeder-Root ISD system requires one Vapor Pressure Sensor per GDF installed into one of the dispensers located closest to the tanks (If a row of dispensers are equal distance from the tank pad and within 10' of each other, any dispenser can be used) in accordance with Section 13 of the ***ARB Approved IOM Manual***. For vapor vent stack installation, determine which vapor vent stack line is closest to the tank being monitored. Select this line for the addition of the pressure sensor. The connection must be BELOW the Veeder-Root Carbon Canister if equipped in accordance with Section 13 of the **ARB Approved IOM Manual**. **Caution:** Installation of the pressure sensor on the vapor vent stack is only allowed at facilities equipped with a Veeder-Root Vapor Polisher or Franklin Fueling/Healy Clean Air Separator. The Vapor Pressure Sensor is an intrinsically safe sensor that is wired to the TLS Console Smart Sensor Module via a conduit dedicated to TLS Console low-voltage sensors. **Figure 2B-8** shows an

ISD Vapor Pressure Sensor illustration. **Figures 2B-12** and **2B-13** show the dispenser installation configuration. **Figure 2B-15** shows the vapor vent stack installation configuration.

Dispenser Interface Module (DIM)

Existing Dispenser Interface Modules or DIM communication cards are used to interface to the dispenser Point of Sale (POS) or controller system to gather fuel transaction data. The ISD Operability Test Procedure provided in Exhibit 10 and Exhibit 17 and in Section 4 of the Veeder-Root ISD Install, Setup and Operation Manual for VST ECS Membrane Processors can be used to verify the proper selection and setup of the Dispenser Interface Module. See **Figure 2B-9** for a typical Dispenser Interface Module Illustration.

Tank Inventory Probe Sensor

Existing Tank Inventory Probe sensors (one per tank) are used to measure the amount of vapor space in the Underground Storage Tanks (USTs). The ISD Operability Test Procedure can be used to verify the proper selection and setup of the Tank Inventory Probes. See **Figure 2B-10** for a typical Tank Inventory Probe Sensor.

Shutdown Control

The TLS Console must be wired per the ***Veeder-Root ISD Install, Setup and Operation Manual 577013-937 Rev. D*** of the ***ARB Approved Installation, Operation and Maintenance Manual for the VST Phase II EVR System Including the Veeder-Root ISD System*** such that it shall automatically prohibit the dispensing of individual dispensers or through shutdown of all the gasoline turbine pumps during a CP-201 ISD failure alarm. It shall also automatically prohibit the dispensing of all dispensers during a TLS Console ISD system power loss.

TLS Console Modules

The ISD Operability Test Procedure in Exhibit 10 and Exhibit 17 and in section 12 of ***ARB Approved IOM Manual*** (Section 4 of the Veeder-Root ISD Install, Setup, and Operation Manual for VST ECS Membrane Processors) shall be used to verify the proper selection and setup of the TLS Console Modules.

RF Wireless Components

The wireless system consists of the following devices (**Figure 2B-11**):

a. TLS RF Console-2 Box
b. RF Transmitter-2
c. RF Transmitter Battery Pack
d. RF Repeater-2
e. RF Receiver-2

These devices convert data in smart-sensor-protocol format to RF format and back to smart-sensor format for TLS such that TLS software assumes it is directly connected to the sensor. The transmitter automatically identifies the type of sensor (e.g. Carbon Canister or Flow Meter) connected to it and polls it periodically. The collected data is converted to radio format and transmitted through air to receiver. The Receiver collects the radio packet and within 200ms sends the data to the TLS RF on RS485 bus. The TLS RF provides this data to TLS on next poll by TLS. To prevent adjacent GDF with wireless equipment from interfering with each others transmissions, dip switches on the Transmitter and Receiver are used to configure a site ID. The Repeater is not required, but may be installed as needed to provide a second path for the wireless signal traveling from Transmitter to Receiver.

Training Program

All Veeder-Root contractors must successfully complete the applicable Veeder-Root training program before they can install, startup, and service TLS Console equipment. Contractors must have up-to-date Level 1 certification to install the TLS Console ISD system. Contractors must have an up-to-date Level 2, 3 or 4 certification and the ISD certification to startup and service the ISD system. The schedule, fee and registration information for the Authorized Service Contractor (ASC) training program can be found at http://www.veeder.com.

To confirm TLS or ISD training a regulator should send an email to technicaltraining@gilbarco.com with the name (and company) of the ASC to obtain verification of the ASC TLS/ISD training status or call 800-997-7725 and press “4” to get to the Veeder-Root menu and then “*” to speak to a representative or sign on to the Gilbarco Learning Suite at http://wise.gilbarco.com.

Maintenance

The TLS console, including interface modules, does not require scheduled maintenance. ISD System Self-Test Monitoring algorithms are designed to verify proper selection, setup and operation of the TLS console and sensors.

There is no recommended maintenance, inspection nor calibration for the Vapor Flow Meter or the Vapor Pressure Sensor. Servicing should be performed in response to warning or alarm conditions.

Figure 2B-1
Model VST-EVR- NB Nozzle

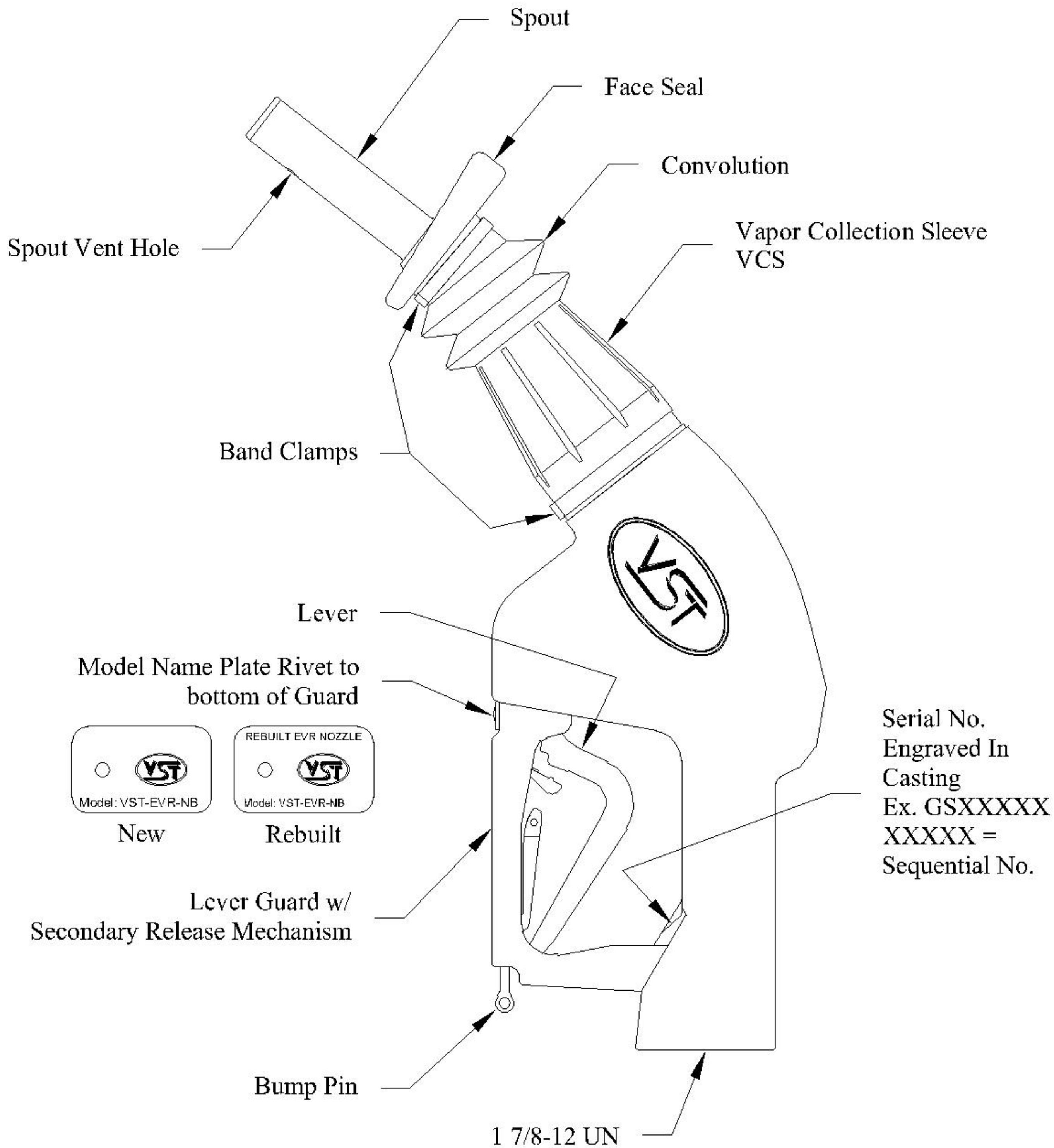


Figure 2B-2
EMCO Model A4005EVR Nozzle

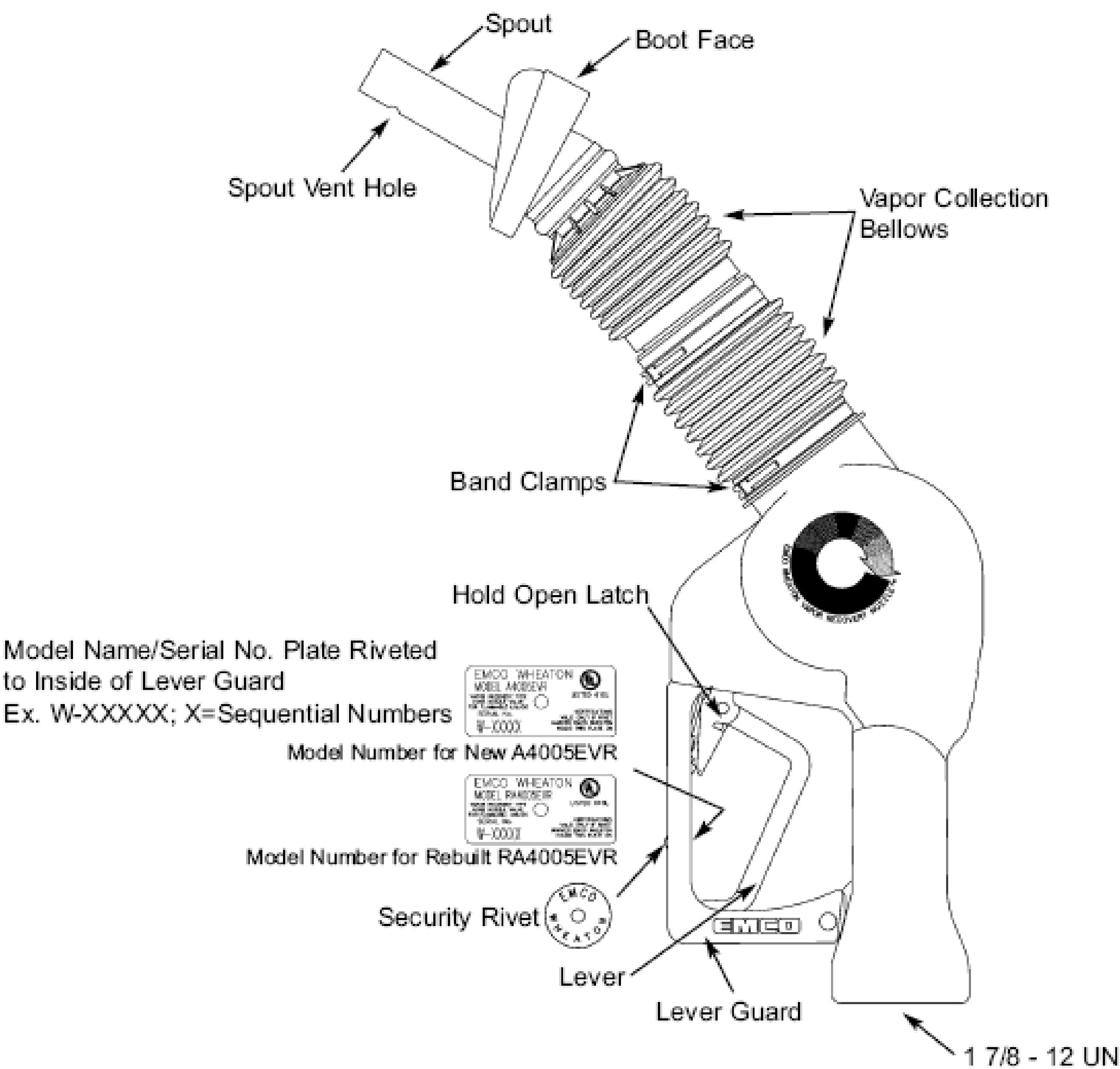


Figure 2B-3
Typical VST-ECS-CS3 Membrane Processor

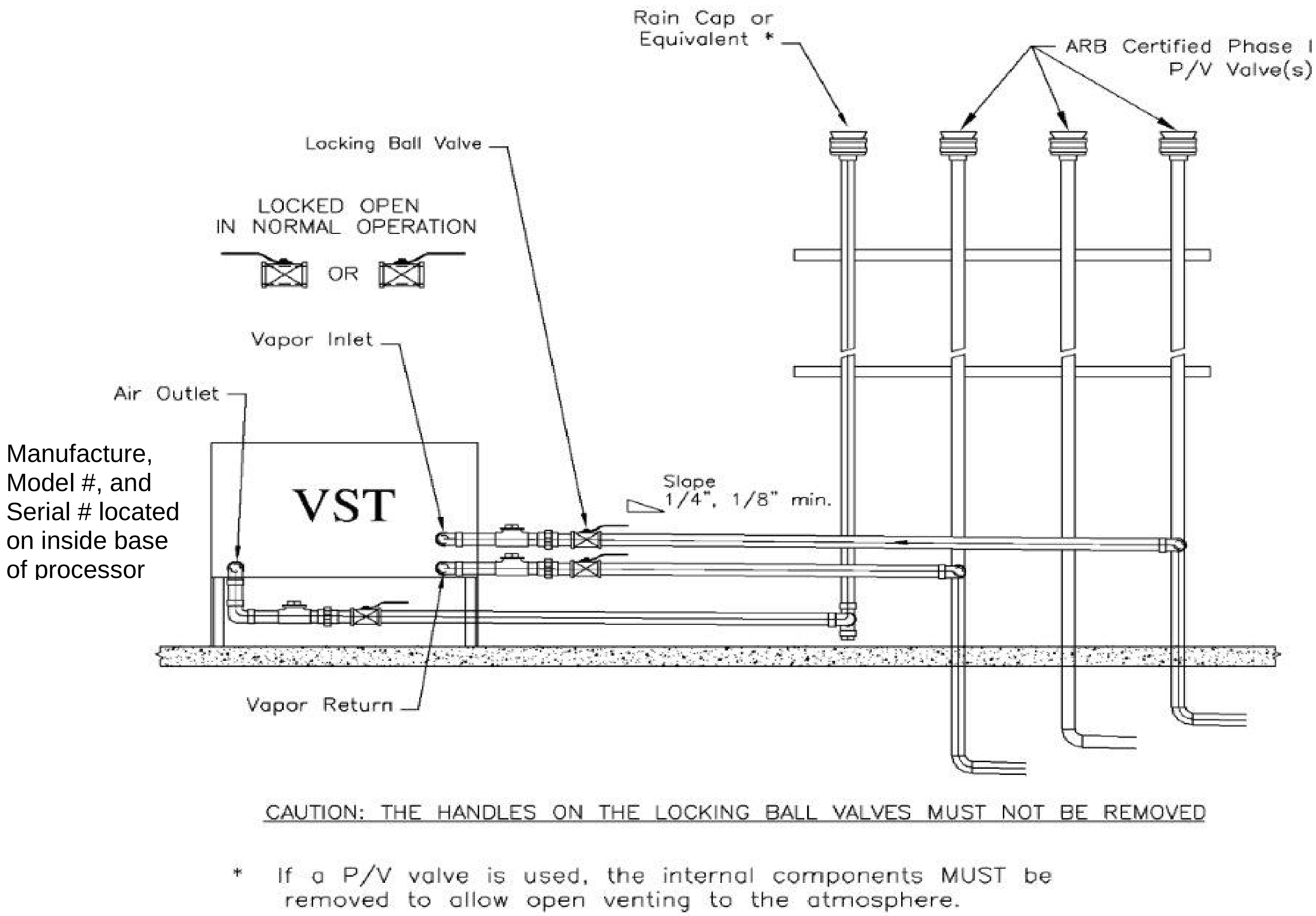


Figure 2B-4
Typical Veeder-Root Vapor Polisher

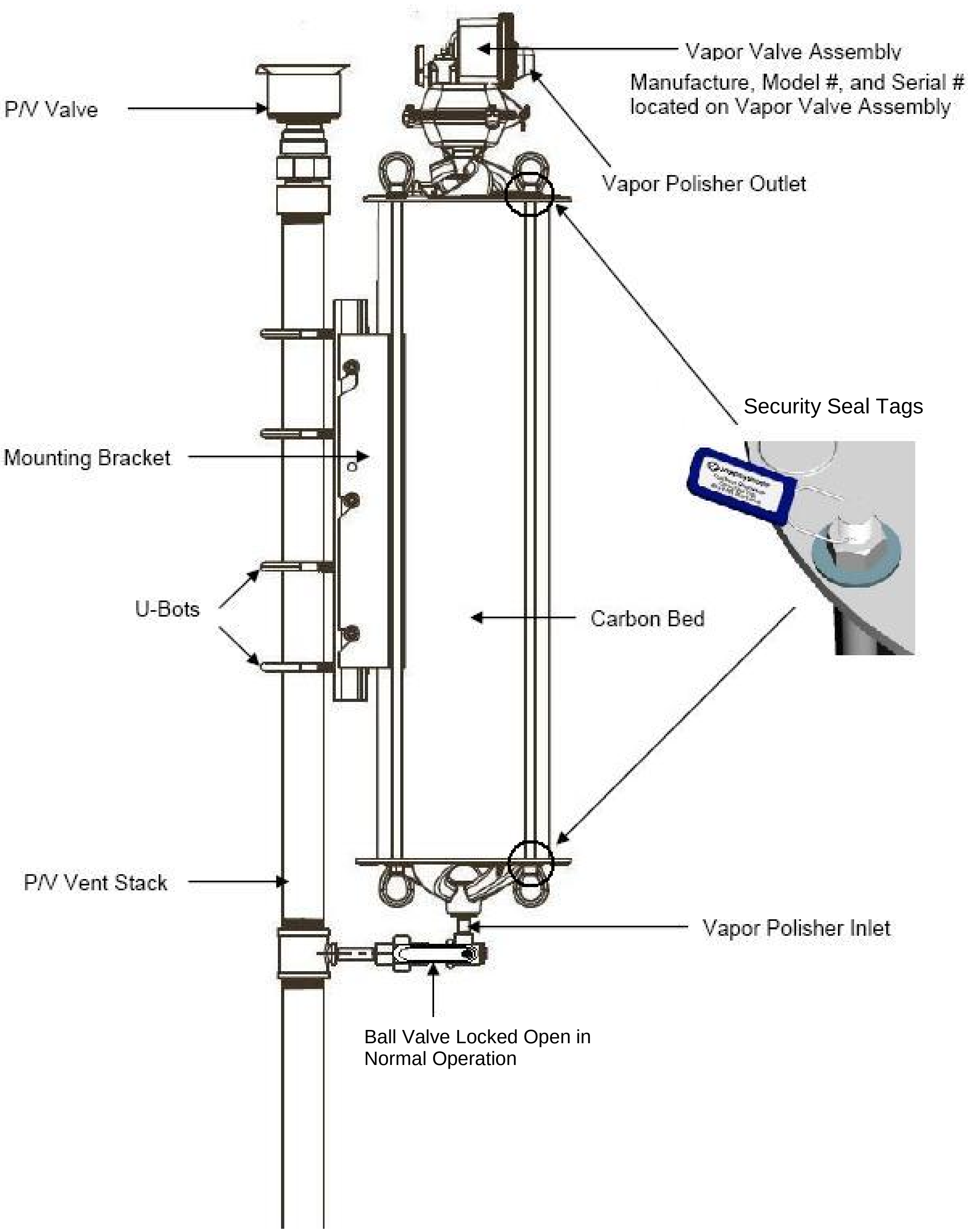
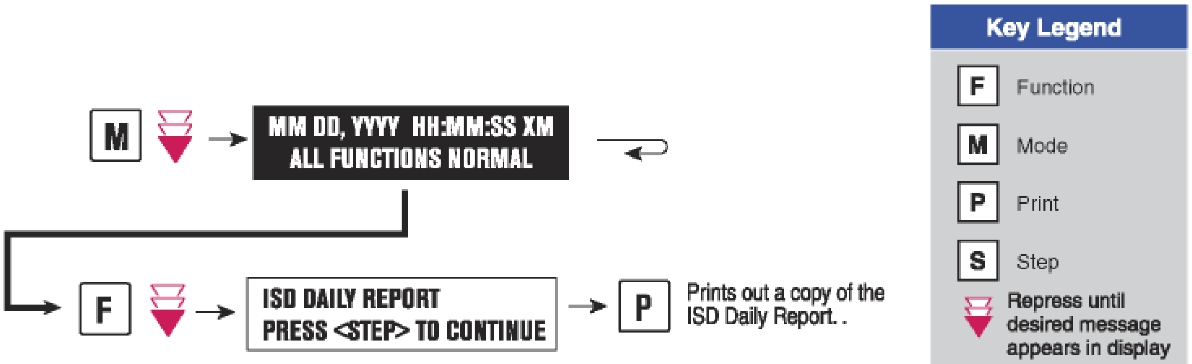
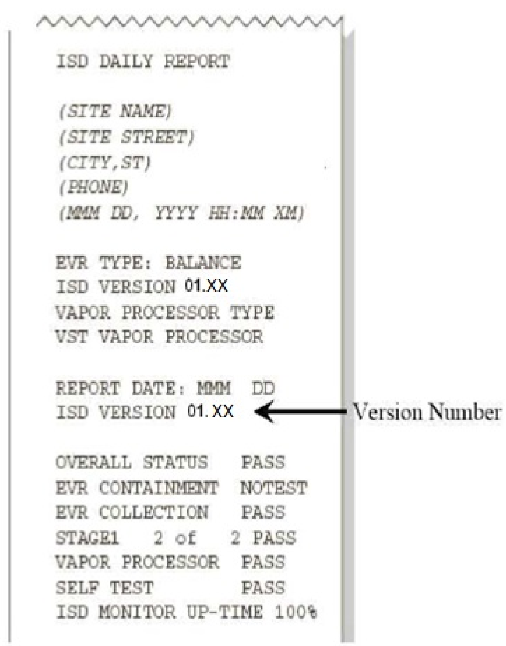


Figure 2B-5
Finding Veeder-Root ISD Version Number

Use the TLS Console <FUNCTION> key to find the ISD Daily Report menu:



The ISD version number can be verified on the TLS Console LCD screen using the <STEP> key or by using the TLS Console <PRINT> key to print and review the latest ISD Daily Report:



Presence of the ISD Daily Report menu and correct ISD software version number is evidence that ISD is installed and activated in the TLS Console.

Figure 2B-6
Standard TLS Console

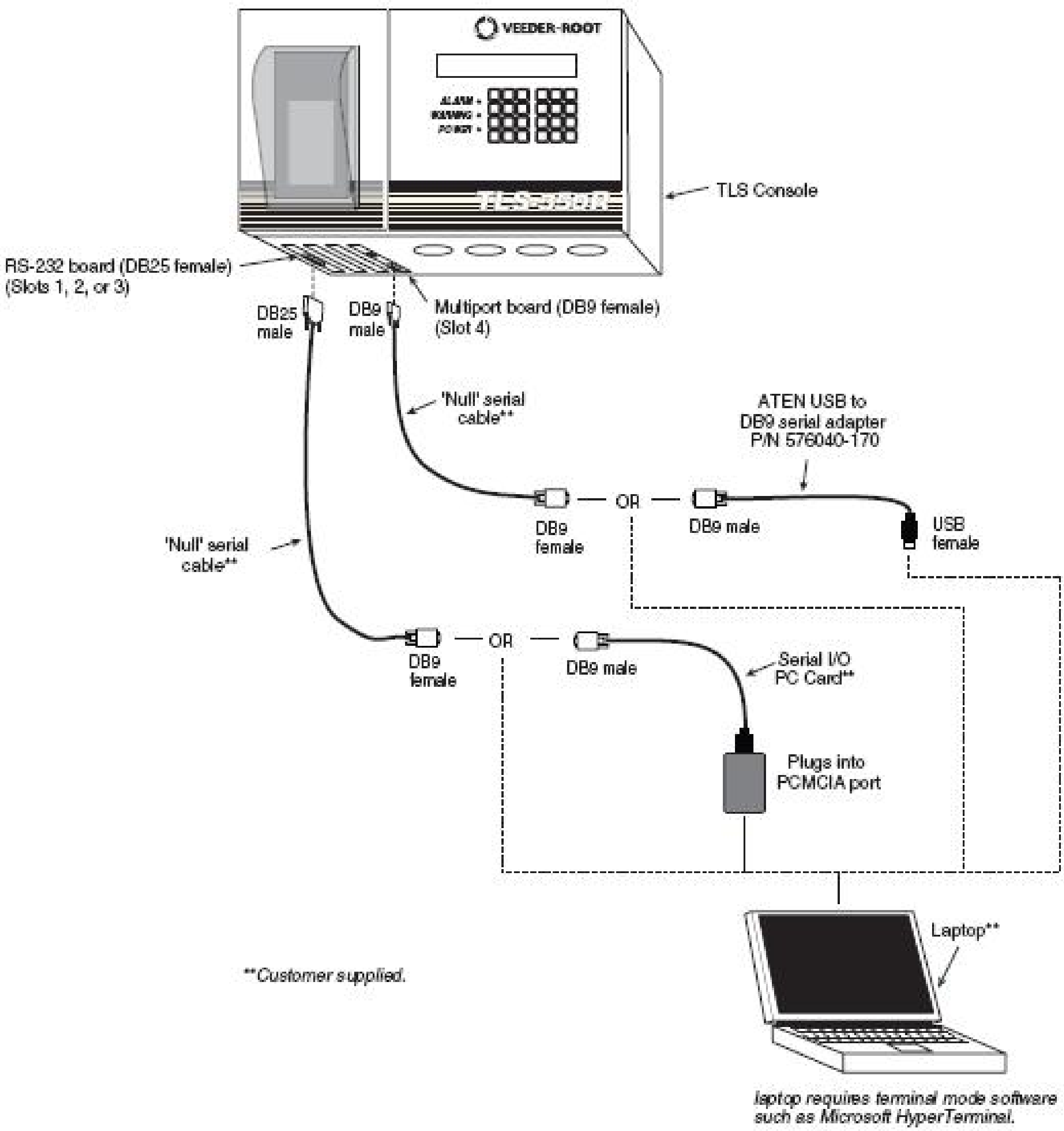


Figure 2B-7
Veeder-Root 332374-XXX
Vapor Flow Meter

Figure 2B-8
Veeder-Root 331946-001
Vapor Pressure Sensor

Figure 2B-9
Veeder-Root DIM Series
Dispenser Interface Module (DIM)

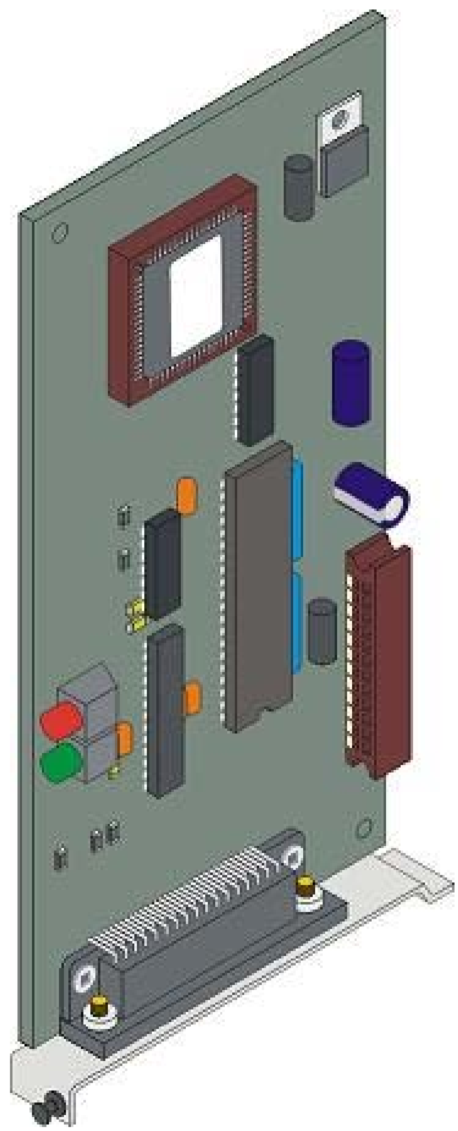


Figure 2B-10
Tank Inventory Probe Sensor

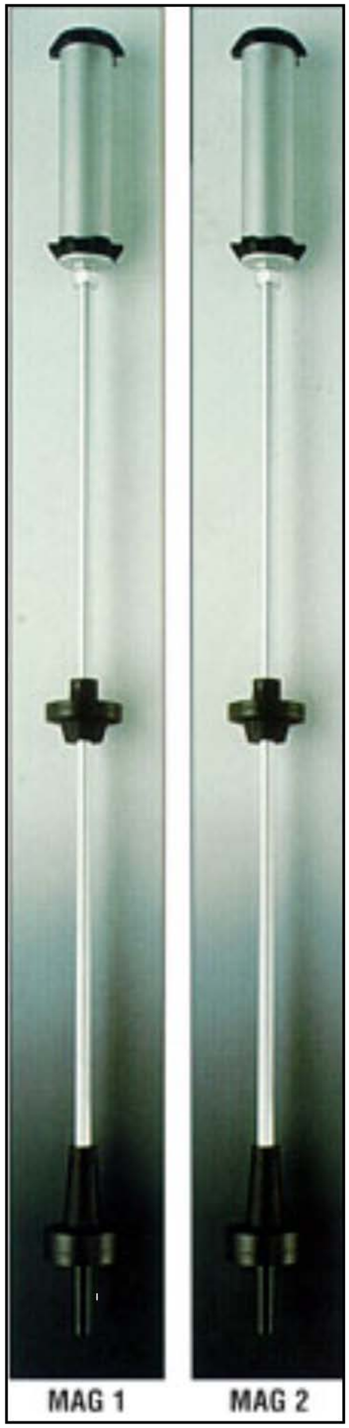


Figure 2B-11
Veeder Root's RF Wireless Components

Wireless TLS RF Console

Wireless Receiver

Wireless Repeater

Wireless Transmitter

Wireless Battery Pack

Wireless Enclosure

Figure 2B-12
Typical Installation of the Veeder-Root Vapor Pressure Sensor & Vapor Flow Sensor

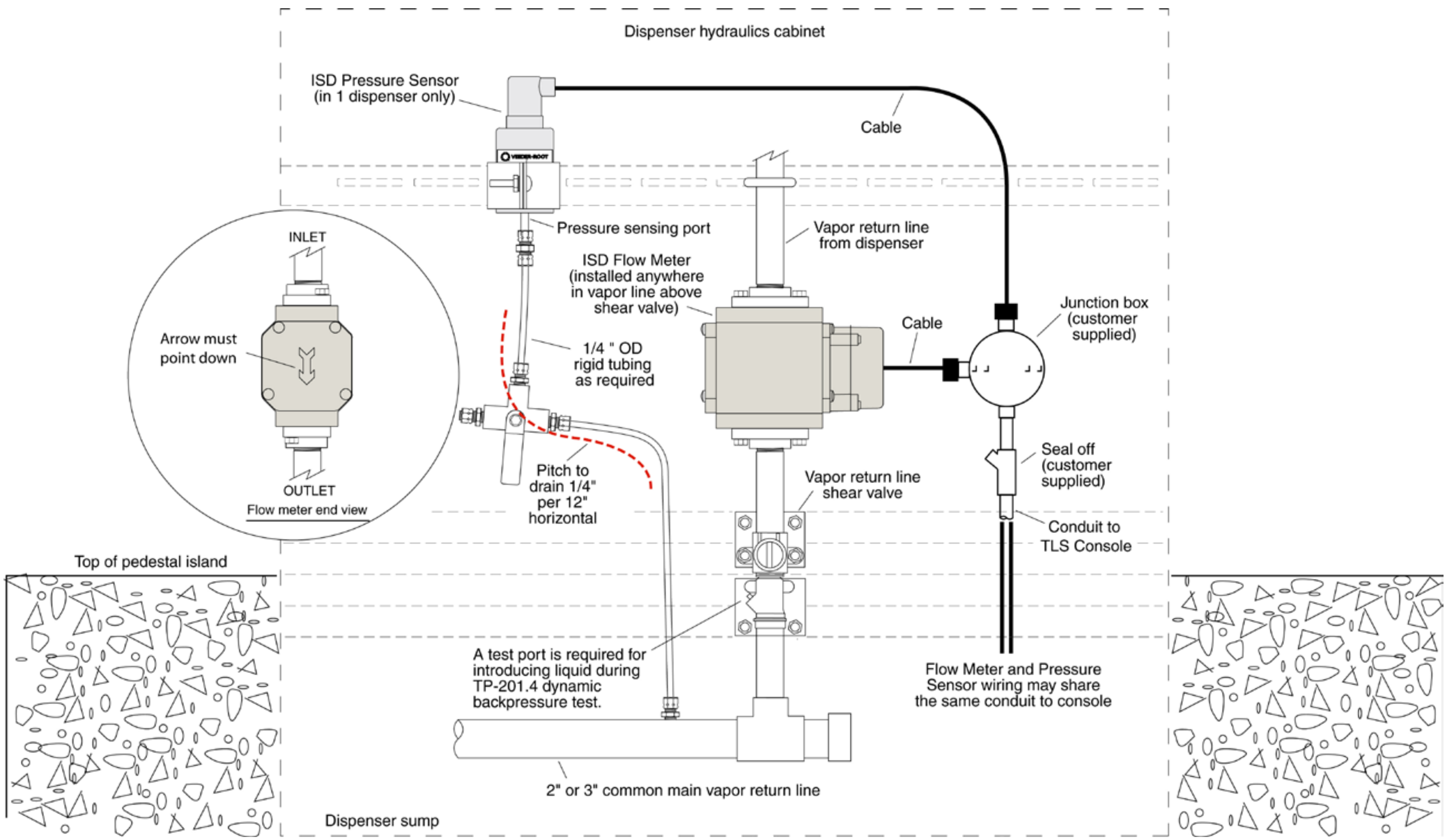


Figure 2B-13
Typical Installation of the Veeder-Root Vapor Pressure Sensor and Vapor Flow Sensor

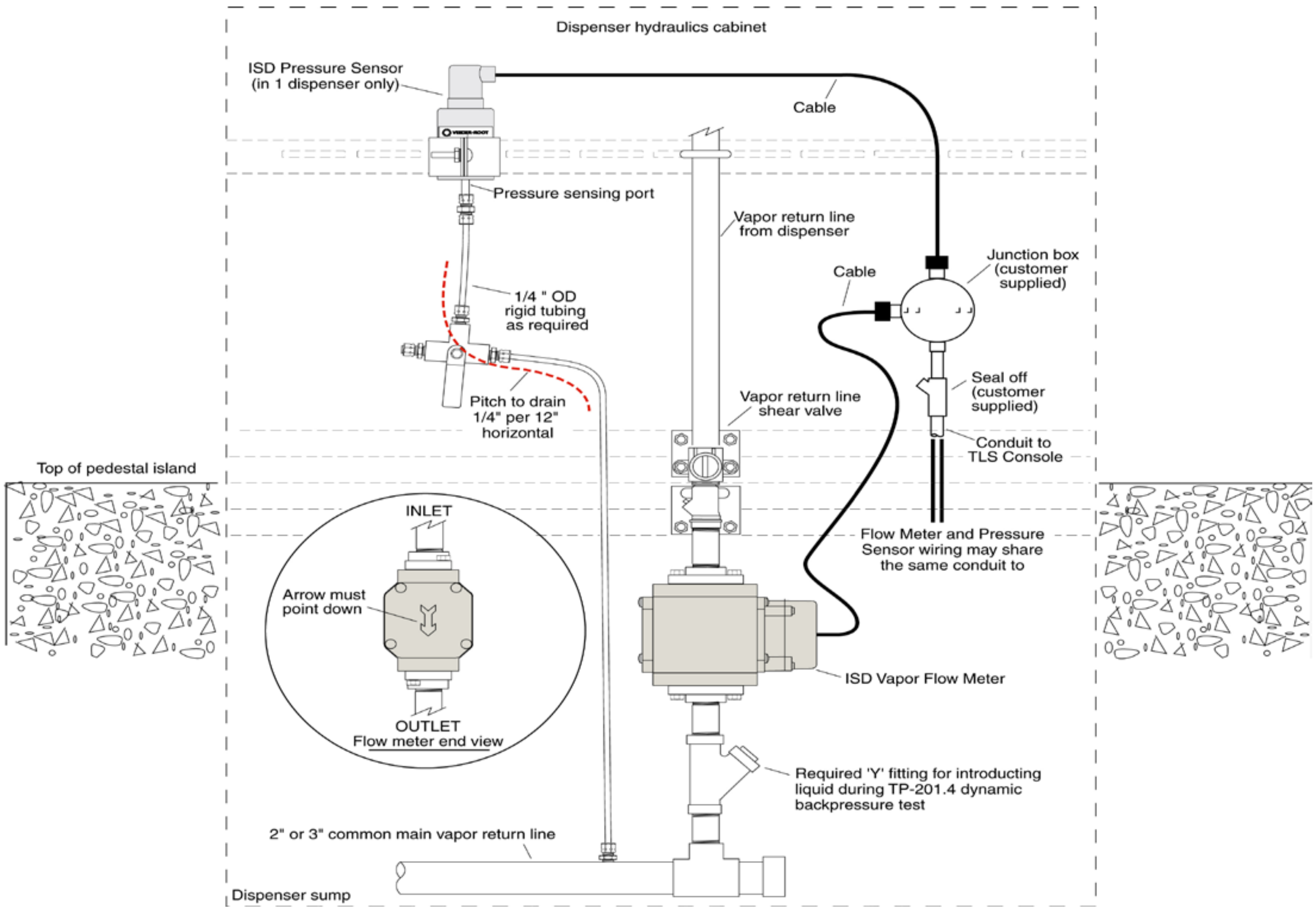
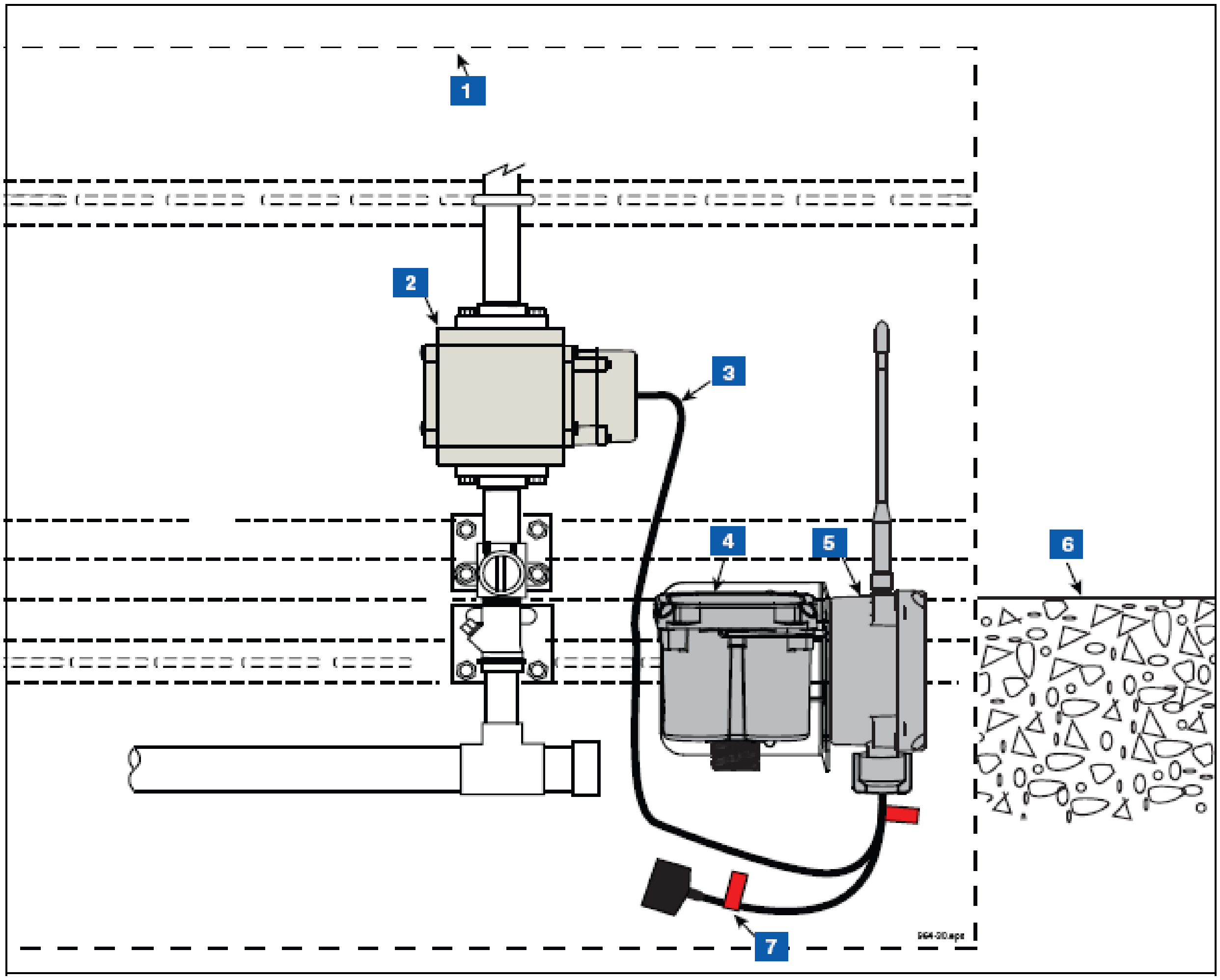


Figure 2B-14
Typical Installation of the Veeder-Root Vapor Flow Sensor with VFM Transmitter in Dispenser



LEGEND FOR NUMBERED BOXES IN Figure 14	
1. Base of dispenser cabinetVFMTransmitter	5. Transmitter
2. VFM	6. top of dispenser pedestal
3. VFM cable	7. Battery caution label attached to battery cable (2 places)
4. Battery pack	

Figure 2B-15
Typical Installation of the Veeder-Root Vapor Pressure Sensor on a vapor vent stack

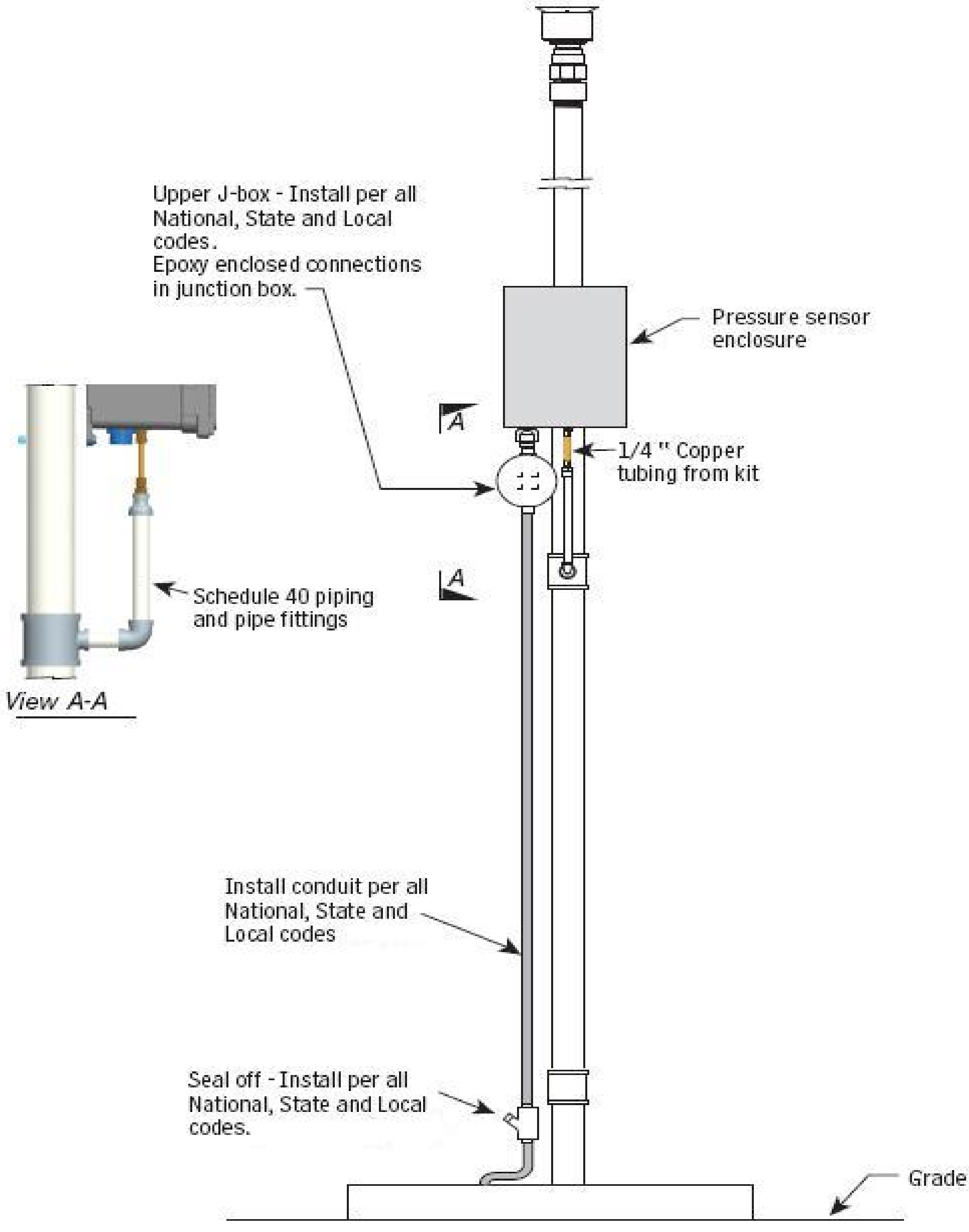


Figure 2B-16
Clean Air Separator Normal Operation Configuration

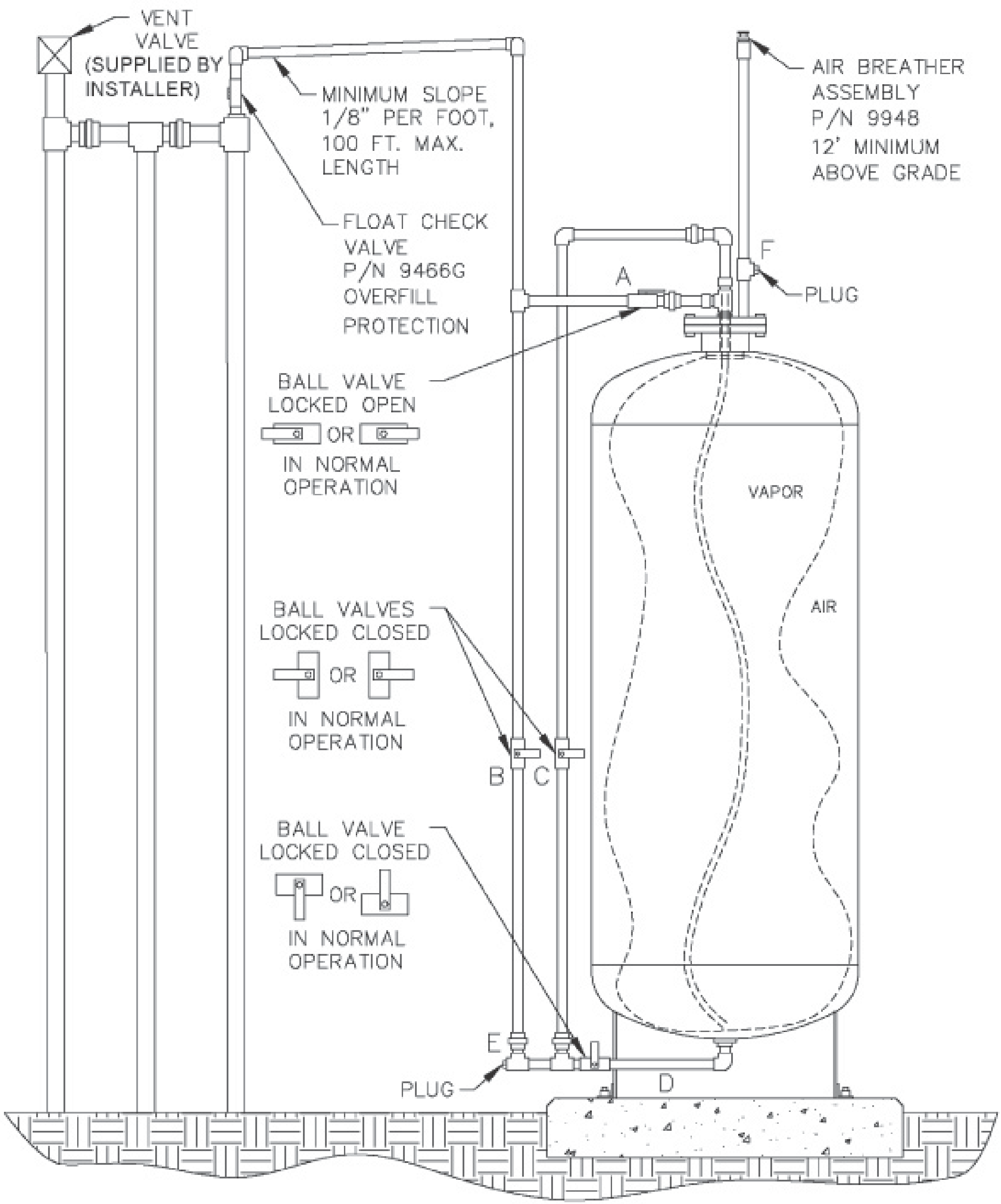


Figure 2B-16H
Clean Air Separator Normal Operation Configuration

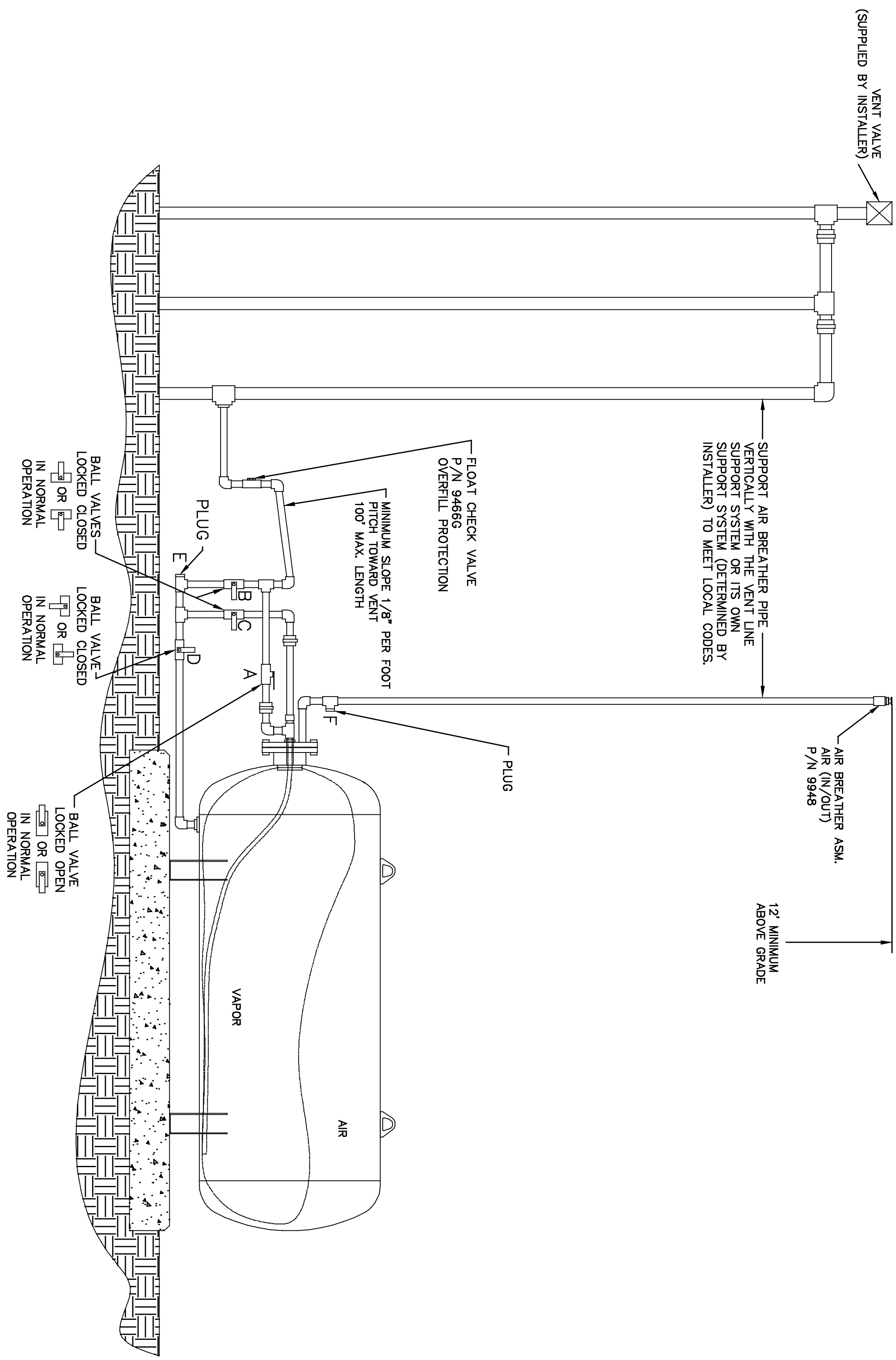


Figure 2B-17
Hirt VCS 100 Thermal Oxidizer
(shown in normal operation)

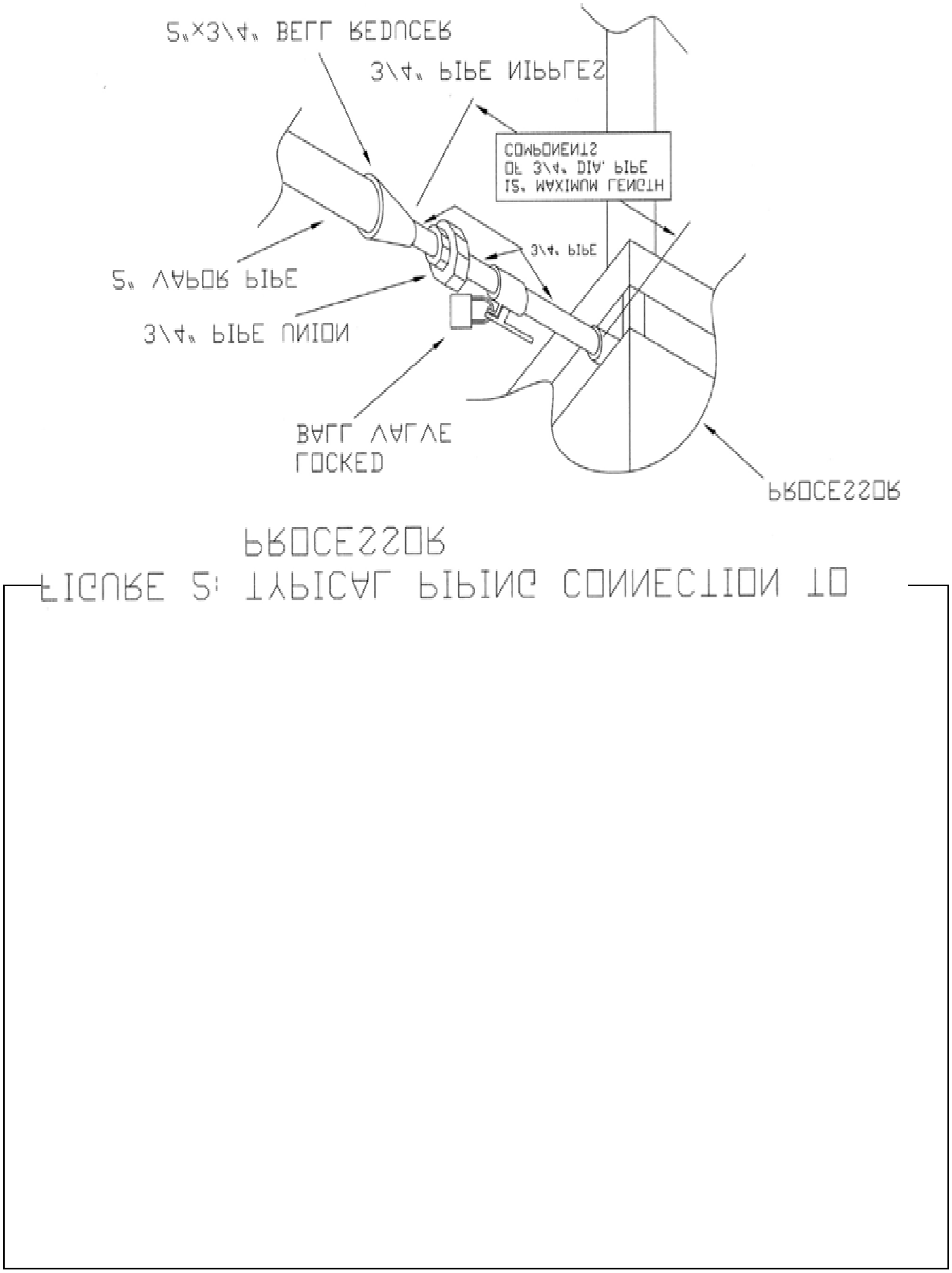
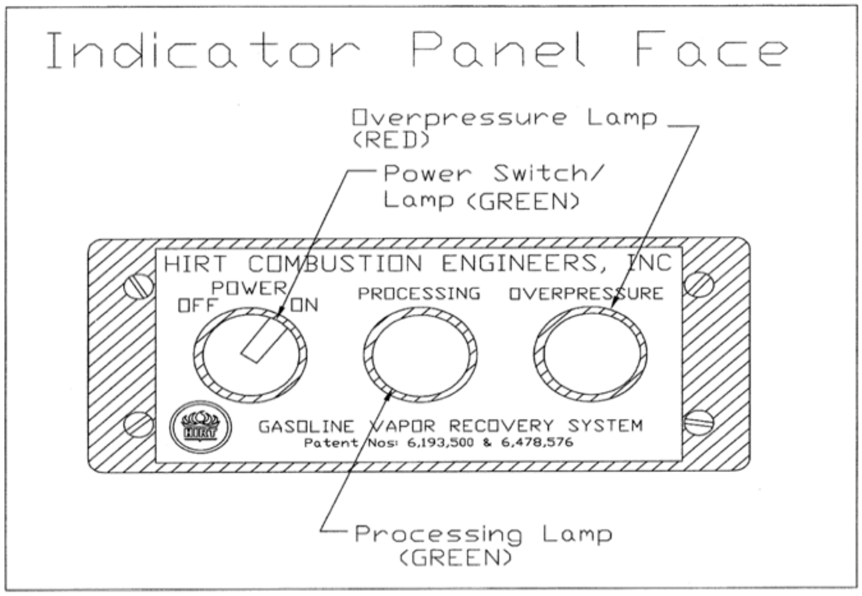


Figure 2B-18
Hirt VCS 100 Thermal Oxidizer
(3-Way Valve shown in normal operation)



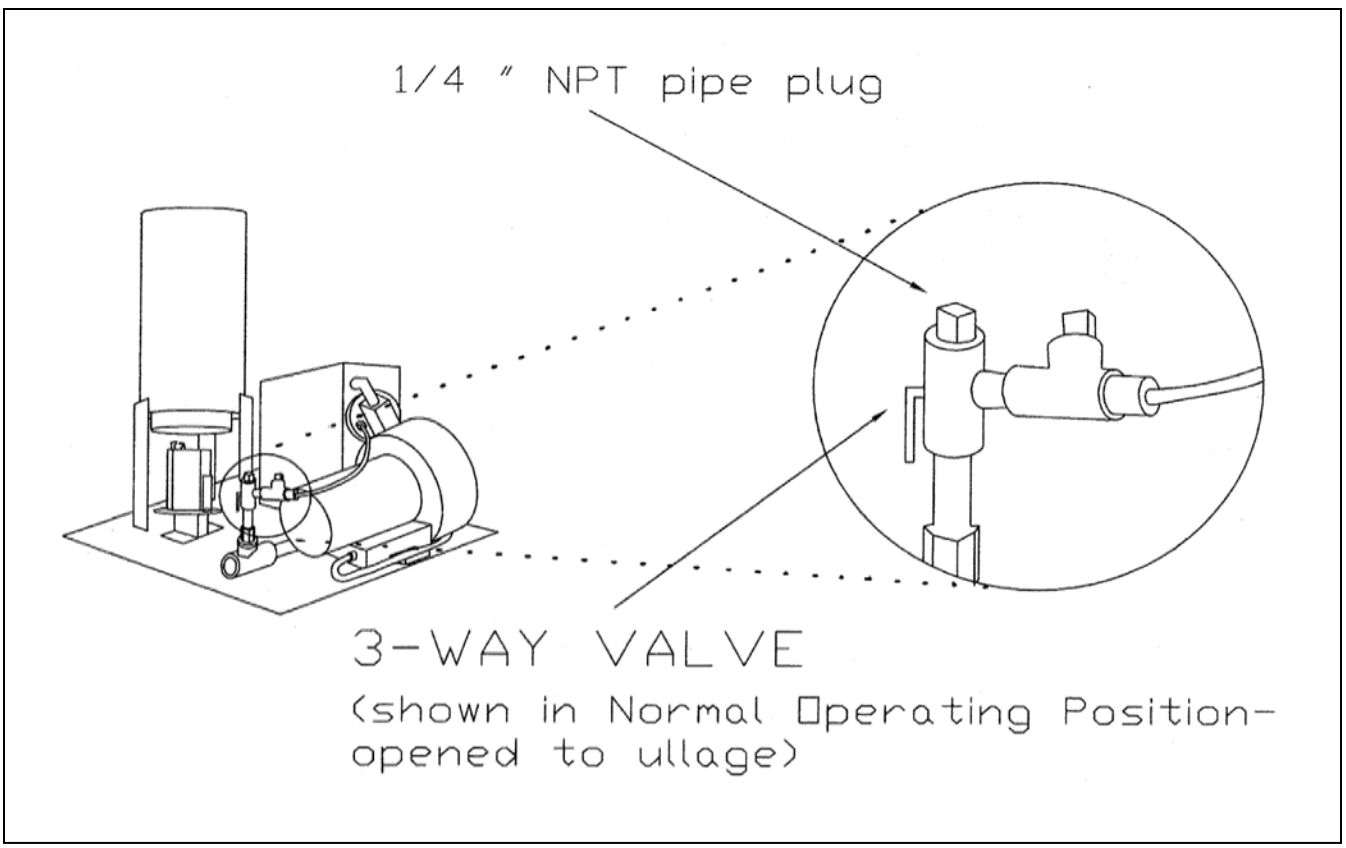


Figure 2B-19
Example of a GDF Maintenance and Alarm History Form

Date of Maintenance/ Test/Inspection/Failure/ alarm history (including date and time of maintenance call)	Repair Date To Correct Test Failure	Maintenance/Test/Inspection Performed and Outcome/Action Taken in Response to Alarm	Affiliation	Name and Technician ID Number of Individual Conducting Maintenance or Test	Telephone Number

Executive Orders VR-203-M and VR-204-M
VST Phase II EVR System

EXHIBIT 5

Liquid Removal Test Procedure

Definitions common to all certification and test procedures are in:

D-200 Definitions for Vapor Recovery Procedures

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

1. PURPOSE AND APPLICABILITY

1.1 This procedure is used to quantify the removal rate of liquid from the vapor passage of a Phase II balance system hose equipped with a liquid removal device. This procedure provides a method to determine compliance with the liquid removal requirements specified in ARB Executive Orders VR-203 and VR-204 and any subsequent amendments or revisions.

2. PRINCIPLE AND SUMMARY OF TEST PROCEDURE

2.1 This test procedure provides two options to determine the compliance of liquid removal devices. Under option 1 (short version), liquid in the vapor path of a coaxial hose is drained and measured. If the volume of liquid drained equals or exceeds 25 ml, a liquid removal test is conducted. For those hoses with less than 25 ml drained, no further testing is required. Under option 2 (long version), all hoses are evaluated regardless of the volume of liquid drained. Option 2 includes a prewetting and wall adhesion step. Both options test the liquid removal device by introducing gasoline into the vapor path of the coaxial hose through the nozzle bellows. After 7.5 gallons of gasoline is dispensed, the amount of gasoline remaining in the hose is measured and the liquid removal rate is determined. The district shall specify which testing option is to be used.

<u>Caution: When draining gasoline from the vapor side of the hose, make sure the dispenser is not activated. Gasoline is drained from the vapor side of the hose by compressing the bellows and engaging the fuel lever (note the nozzle vapor valve is on the same stem as the fuel valve). If the dispenser is activated, gasoline in the fuel hose may be pressurized when engaging the fuel lever.</u>

3. BIASES AND INTERFERENCES

3.1. Slits or tears in the hose or nozzle vapor path may bias the results towards compliance.

3.2. This test shall not be conducted on any fueling point where the hanging hardware is defective as identified in Exhibit 2.

3.3. Any spillage of gasoline invalidates the test for any volumes that are required to be measured or recorded.

3.4. A breach of the inner product hose may introduce additional gasoline into the outer vapor path resulting in a larger volume drained than introduced.

3.5. Not having the liquid extraction device (indicated by the mark on the outside of the house) at the bottom of the hose loop during liquid removal testing, as shown in Figure 1, will bias the results towards failure.

3.6. If testing a fueling point with a VST Model VST-EVR-NB nozzle, the test procedure requires the use of VST's nozzle spout plug, P/N VST-STP-100 as shown in Figure 2. If testing a fueling point with a EMCO Model A4005EVR nozzle, the test procedure requires the use of EMCO's nozzle spout plug, P/N 494635EVR as shown in Figure 3. This tool is used to plug the spout when draining liquid from the vapor side of the hose. Not plugging the spout may bias the results towards failure. Nicks, cuts, or tears in the plug o-rings will bias the results towards failure.

3.7. Dispensing rates not between 6.0 and 10.0 gallons per minute (GPM) invalidates the test.

4. SENSITIVITY, RANGE, AND PRECISION

4.1 The range of measurement of the liquid removal rate is dependent upon the range of the graduated cylinder used for testing.

4.2 To ensure precision, graduated cylinder readings shall be measured at the liquid level meniscus.

5. EQUIPMENT

5.1. Nozzle Spout Plug: If testing a fueling point with a VST Model VST-EVR-NB nozzle, use VST's spout plug, P/N VST-STP-100 (Figure 2). If testing a fueling point with a EMCO Model A4005EVR nozzle, use EMCO's nozzle spout plug, P/N 494635EVR as shown in Figure 3.

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

5.3. Funnels. Large and small gasoline compatible, non-breakable, funnels with dimensions similar to those as shown in Figure 4, or equivalent.

5.4. Graduated Cylinders. Gasoline compatible, non-breakable 0-25ml, 0-100ml, 0-250 ml, and 0-500 ml graduated cylinders with stable base plates. The 25ml cylinder may be necessary to quantify volumes of liquid less than 20 ml.

5.5. Gasoline Test Tank. (Optional) A portable tank, meeting fire safety requirements for use with gasoline, may be used to receive the gasoline dispensed during testing. The tank shall have sufficient volume so that at least 10.0 gallons may be dispensed prior to activating the primary shutoff mechanism of the nozzle. **When using a gasoline test tank, ensure that a ground strap is used and that it is properly connected to an acceptable ground.** To minimize testing-related emissions, vehicle refueling events should be used for this procedure whenever feasible.

5.6. Traffic Cones. Use traffic cones to encircle the area where testing is conducted.

5.7. Field Data Sheet. Use the appropriate data sheet to record liquid removal test information. Forms 1 and 2 serve as examples; districts may require modified versions.

5.8. Gasoline Container. Use a portable fuel container equipped with a tight fitting cap, of at least 1.0 gallon capacity.

NOTE: THIS TEST PROCEDURE PROVIDES TWO OPTIONS TO DETERMINE COMPLIANCE OF LIQUID REMOVAL DEVICES. THE DISTRICT SHALL SPECIFY WHICH TESTING OPTION IS TO BE USED

6. OPTION 1 (SHORT VERSION)

PRE-TEST PROCEDURE

6.1 Verify that the 500 ml graduated cylinder is empty. Position the large funnel into the graduated cylinder.

6.2 Remove the nozzle from the dispenser. **<u>Do not activate dispenser!</u>** If testing a fueling point with a VST Model VST-EVR-NB nozzle, install VST's spout plug, P/N VST-STP-100 in the tip of the spout (Figure 2). If testing a fueling point with an EMCO Model A4005EVR nozzle, install EMCO's nozzle spout plug, P/N 494635EVR in the tip of the spout (Figure 3). Carefully tilt the spout into the funnel/graduated cylinder assembly.

6.3 Lower the nozzle and funnel/graduated cylinder assembly as close to the ground as possible. "Walk out" the hose while keeping the nozzle lowered and hose fully extended. The hose shall slope downward from the dispenser toward the nozzle.

6.4 **<u>Do not activate dispenser!</u>** Open the nozzle's vapor check valve by compressing the bellows and engaging the fuel lever. Allow 20 seconds for all liquid to drain. Use caution to avoid spillage.

6.5 Remove VST's or EMCO's spout plug and return the nozzle to the dispenser and measure the volume of liquid drained. If the volume drained is less than 200 ml, transfer the liquid into an appropriately sized graduated cylinder. For example, if 40 ml of liquid was drained, use the 100 ml graduated cylinder to take the measurement.

6.6 Record the amount of liquid drained on Form 1 ("PRE-TEST").

6.7 If the volume drained is greater than or equal to 25 ml, proceed to Section 6.8 of the procedure. Hoses with greater than 25 ml drained are considered to be pre-wetted. If the amount drained is less than 25 ml, proceed to the next nozzle/hose to be evaluated and repeat Section 6.1-6.6

TEST PROCEDURE (FOR HOSES WITH GREATER THAN 25 ML DRAINED)

6.8 Pour 150 ml to 175 ml of gasoline into the 250 ml graduated cylinder. Measure and record this volume on Form 1 (VI).

6.9 Remove the nozzle from the dispenser and position the nozzle upright so that the spout is in a vertical position. **Do not activate dispenser!**

6.10 Open the nozzle's vapor check valve by compressing the bellows and engaging the fuel lever. Carefully insert the stem of the small funnel between the bellows and nozzle spout.

6.11 Pour the measured volume into the vapor path of the hose. Use caution not to spill the gasoline. Remove the small funnel after the gasoline has been introduced.

6.12 Insert the nozzle into a vehicle or test tank fill pipe.

6.13 Find the mark on the outside of the hose which indicates the location of the liquid pick-up device. Ensure the mark is at the bottom of the hose loop when dispensing as shown in Figure 1. This can be accomplished by lifting up the back of the hose, adjusting nozzle position, or adjusting the test tank position.

6.14 Dispense 7.5 (±0.5) gallons at the highest possible flow rate by holding the nozzle lever in the maximum handheld position. Use a stopwatch to measure the time elapsed while dispensing. Record the volume of fuel dispensed (G) and the elapsed time (T) on Form 1. Return nozzle to the dispenser.

6.15 Calculate the dispensing rate using the equation below. If the dispensing rate is not between 6.0 and 10.0 gallons per minute (GPM), the test results are invalid.

$$\text{GPM} = 60 \text{ x} \left(\frac{G}{T}\right)$$

Where:

GPM	=	dispensing rate (in gallons per minute)
G	=	gallons of fuel dispensed
T	=	number of seconds required to dispense

6.16 Using the 250 ml graduated cylinder and large funnel, carefully drain the remaining liquid from the vapor path of the hose as described in Section 6.1 through 6.5 **(make sure dispenser is not activated and spout plug is installed before draining liquid!)**. Record this quantity on Form 1 (VF).

6.17 Use Equation 9.1 to calculate the liquid removal rate for all the applicable hoses tested.

6.18 If the liquid removal rate is less than 5.0 ml/gallon, but greater than or equal to 4.5 ml/gallon, repeat the test two additional times and average the three results.

7. OPTION 2 (LONG VERSION)

PRETEST PROCEDURE

7.1 Carefully pour 150 ml of gasoline into the 250 ml graduated cylinder.

7.2 Remove the nozzle from the dispenser. **<u>Do not activate dispenser!</u>** If testing a fueling point with a VST Model VST-EVR-NB nozzle, Install VST's spout plug, P/N VST-STP-100 in the tip of the spout as shown in Figure 2. If testing a fueling point with an EMCO Model A4005EVR nozzle, install EMCO's nozzle spout plug, P/N 494635EVR in the tip of the spout (Figure 3). Position the nozzle upright so that the spout is in a vertical position.

7.3 Open the nozzle's vapor check valve by compressing the bellows and engaging the fuel lever. Carefully insert the stem of the small funnel between the bellows and nozzle spout.

7.4 Pour the gasoline from the 250 ml graduated cylinder into the vapor path of the hose. Use caution not to spill the gasoline. Remove the small funnel after the gasoline has been introduced.

7.5 Verify that the 500 ml graduated cylinder is empty. Position the large funnel into the graduated cylinder.

7.6 Carefully tilt the spout into the funnel/graduated cylinder assembly. **<u>Make sure VST's or EMCO's spout plug is installed and the dispenser is deactivated.</u>**

7.7 Lower the nozzle and funnel/graduated cylinder assembly as close to the ground as possible. "Walk out" the hose while keeping the nozzle lowered and hose fully extended. The hose shall slope downward from the dispenser toward the nozzle.

7.8 Open the nozzle's vapor check valve by compressing the bellows and engaging the fuel lever. Allow 20 seconds for all liquid to drain. Use caution to avoid spillage. If necessary, drain full graduated cylinders into a portable gas can until the hose is empty.

7.9 Remove VST's or EMCO's spout plug and return the nozzle to the dispenser.

TEST PROCEDURE

7.10 Pour 150 ml to 175 ml of gasoline into the 250 ml graduated cylinder. Measure and record this volume on Form 2 (VI).

7.11 Remove the nozzle from the dispenser. **Do not activate dispenser!** Position the nozzle upright so that the spout is in a vertical position.

7.12 Open the nozzle's vapor check valve by compressing the bellows and engaging the fuel lever. Carefully insert the stem of the small funnel between the bellows and nozzle spout.

7.13 Pour the measured volume into the vapor path of the hose. Use caution not to spill the gasoline. Remove the small funnel after the gasoline has been introduced.

7.14 Insert the nozzle into a vehicle or test tank fill pipe.

7.15 Find the mark on the outside of the hose which indicates the location of the liquid pick-up device. Ensure the mark is at the bottom of the hose loop when dispensing as shown in Figure 1. This can be accomplished by lifting up the back of the hose, adjusting nozzle position, or adjusting the test tank position.

7.16 Dispense 7.5 (±0.5) gallons at the highest possible flow rate by holding the nozzle lever in the maximum handheld position. Use a stopwatch to measure the time elapsed while dispensing. Record the volume of fuel dispensed (G) and the elapsed time (T) on Form 2. Return nozzle to the dispenser.

7.17 Calculate the dispensing rate using the equation below. If the dispensing rate is not between 6.0 and 10.0 gallons per minute (GPM), the test results are invalid.

$$GPM = 60 \times \left(\frac{G}{T}\right)$$

Where:

GPM	=	dispensing rate (in gallons per minute)
G	=	gallons of fuel dispensed
T	=	number of seconds required to dispense

7.18 Using the 250 ml graduated cylinder and large funnel, carefully drain the remaining liquid from the vapor path of the hose as described in Section 7.5 through 7.8 **(make sure dispenser is deactivated and spout plug is installed before draining liquid!)**. Record this quantity on Form 2 (VF).

7.19 Open the nozzle's vapor check valve by compressing the bellows and engaging the fuel lever. **Do not activate dispenser!** Carefully insert the stem of the small funnel between the bellows and nozzle spout

7.20 Use the 250 ml graduated cylinder and small funnel to pour 150 ml of gasoline into the vapor passage of the hose. Dispense no gasoline.

7.21 Using the 250 ml graduated cylinder and large funnel, completely drain the gasoline from the vapor passage back into the graduated cylinder as described in Section 7.5 through 7.9 **(make sure dispenser is deactivated and spout plug is installed before draining liquid!)**.

7.22 Subtract the volume drained (value from Section 7.21) from the volume added (value from Section 7.20). This value represents the volume of gasoline lost due to wall adhesion. The purpose of the wall adhesion value is to quantify the amount of gasoline lost to evaporation from transfer to and from the graduated cylinders and adhesion of liquid to vapor passage surfaces in previous measurements. Record this quantity on Form 2 (VW).

7.23 Use Equation 9.2 to calculate the liquid removal rate for all the applicable hoses tested.

7.24 If the liquid removal rate is less than 5.0 ml/gallon, but greater than or equal to 4.5 ml/gallon, repeat the test two additional times and average the three results.

8. POST TEST PROCEDURES

8.1. Ensure nozzle spout plug(s) is removed and nozzle is hung in dispenser cradle.

8.2. Empty all containers and return any excess gasoline to the underground storage tank.

8.3. Remove the traffic cones from the testing area.

9. CALCULATING RESULTS

9.1 If using OPTION 1(short version), the liquid removal rate shall be calculated as follows:

$$VR = \frac{VI - VF}{G}$$

Where:

VR	=	Gasoline removed per gallon dispensed, milliliters/gallon
VI	=	Total initial volume poured into hose vapor passage, milliliters
VF	=	Volume of gasoline remaining in the hose vapor passage after dispensing, milliliters
G	=	Total dispensed, gallons

9.2 If using OPTION 2 (long version), the liquid removal rate shall be calculated as follows:

$$VR = \frac{(VI - VW) - VF}{G}$$

Where:

VR	=	Gasoline removed per gallon dispensed, milliliters/gallon
VI	=	Total initial volume poured into hose vapor passage, milliliters
VW	=	Volume of liquid lost due to wall adhesion, milliliters
VF	=	Volume of gasoline remaining in the hose vapor passage after dispensing, milliliters
G	=	Total dispensed, gallons

10. REPORTING RESULTS

10.1. Record all applicable liquid removal rate information on the appropriate form as shown in Form 1 and 2. Districts may require the use of alternate forms provided that the alternate forms include the same parameters as identified in Forms 1 and 2.

10.2. If the calculated liquid removal rate is greater than or equal to 5 milliliters/gallon, the liquid removal device has demonstrated compliance.

10.3. If the calculated liquid removal rate is less than 5 milliliters/gallon, the liquid removal device is not in compliance.

11. ALTERNATIVE TEST PROCEDURES

This 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 14 of Certification Procedure CP-201.

Figure 1
Position of Liquid Removal Device
When Conducting Liquid Removal Testing

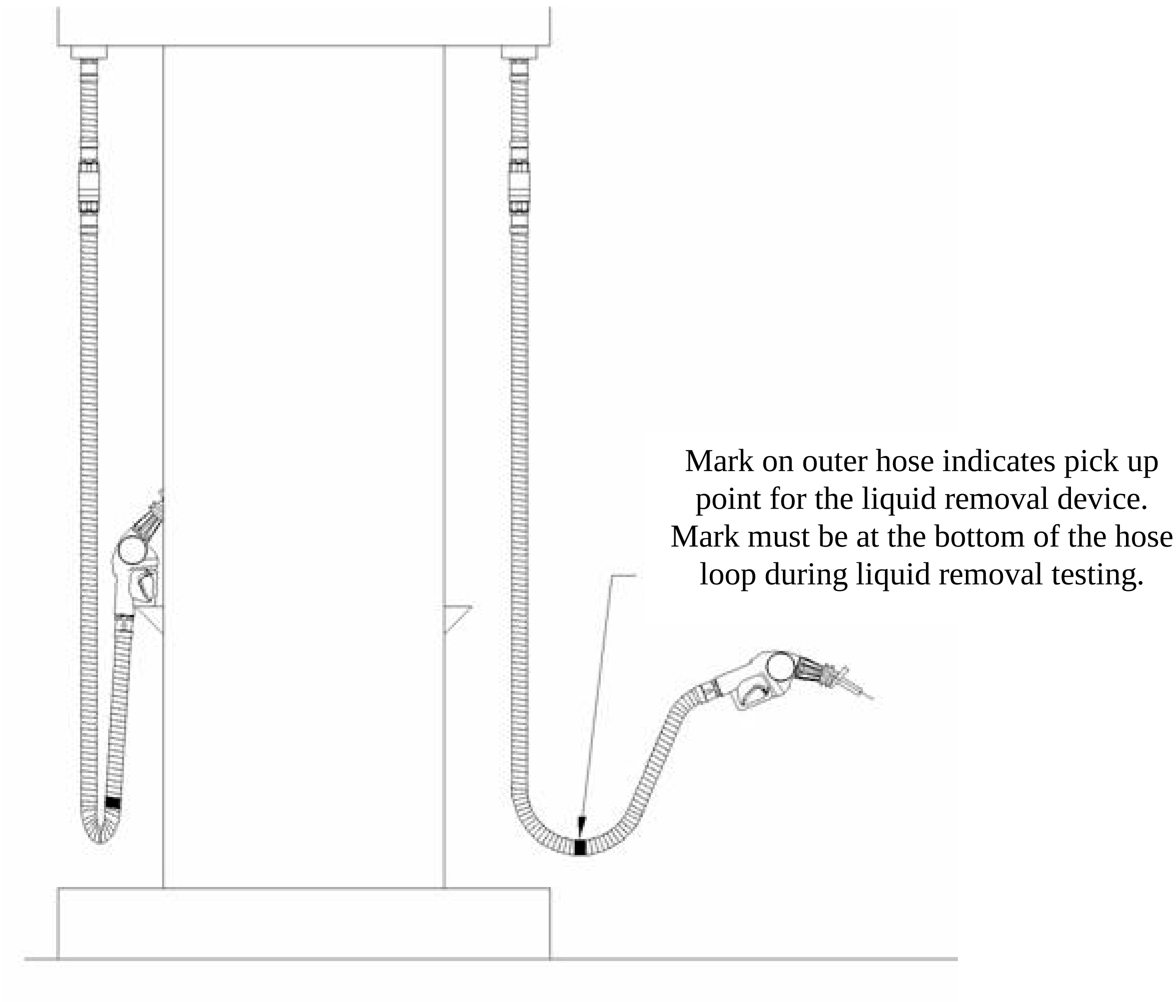
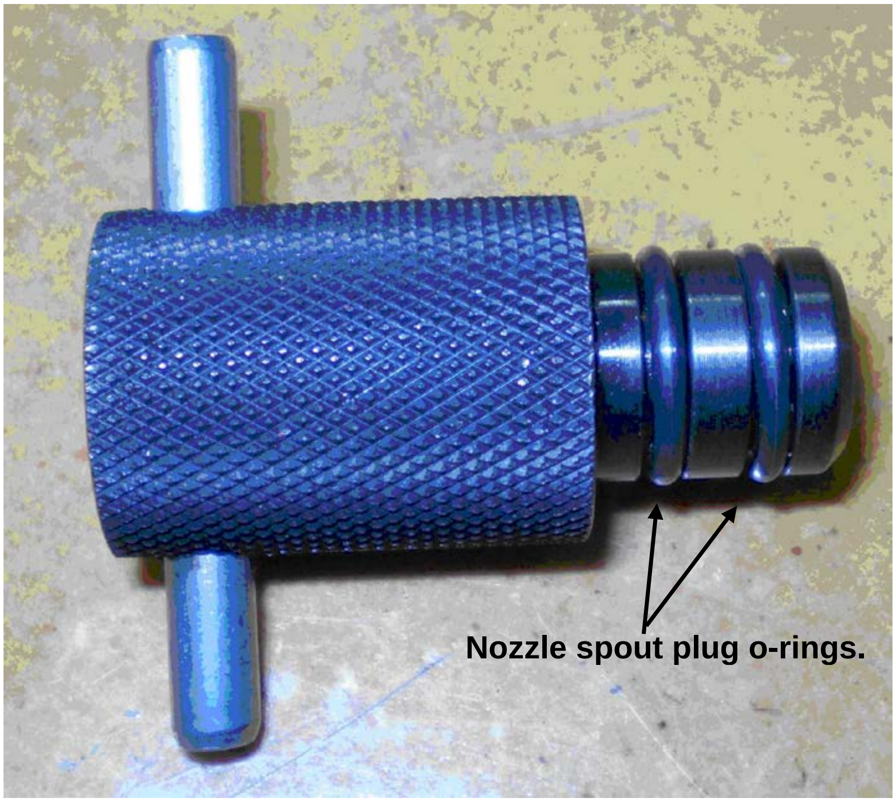
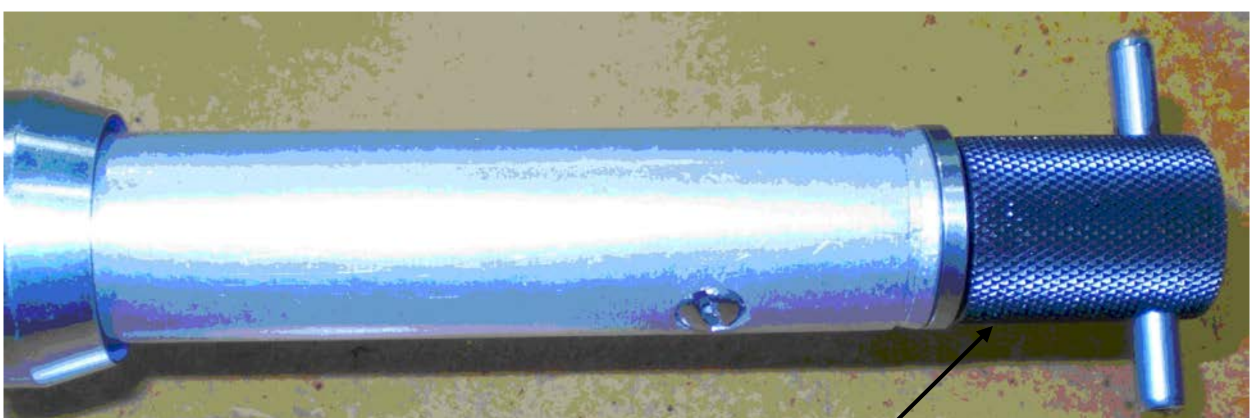


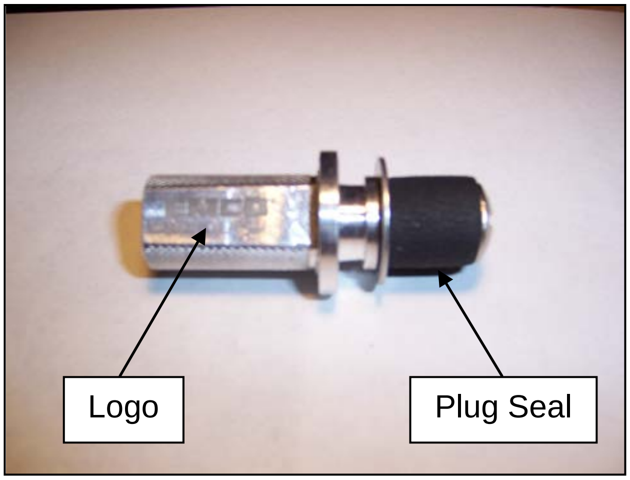
Figure 2
VST Nozzle Spout Plug P/N VST-STP-100





Plug properly inserted into nozzle spout.
Both plug o-rings seated into nozzle spout.

Figure 3
EMCO Nozzle Spout Plug P/N 494635EVR



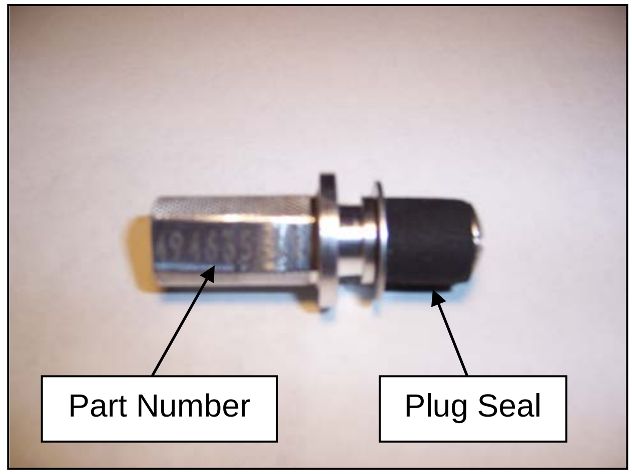
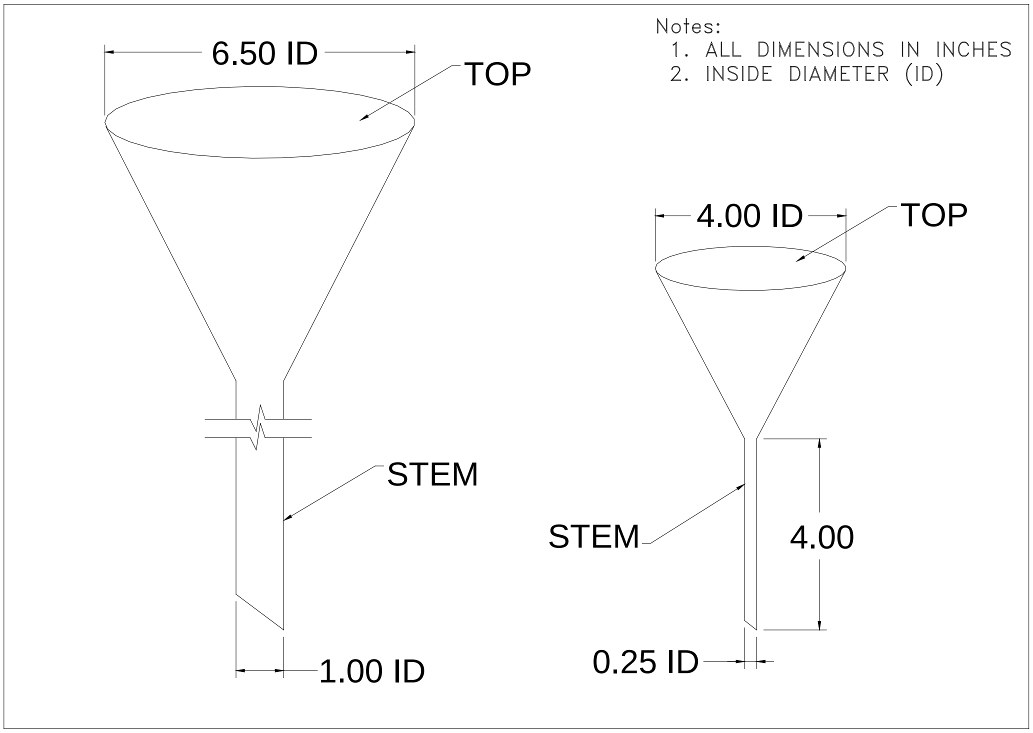


Figure 4
Recommended FUNNEL SPECIFICATIONS



FORM 1: LIQUID REMOVAL TEST DATA SHEET (OPTION 1)

Facility Name & Address	Facility Representative & Title		
		Test Date	
		A/C or Permit No.	
		Testing Company	
		Tester Name	
	Phone No.	VST Training Cert # (if applicable)	
		Inspector Name	

GENERAL INFORMATION				PRE-TEST	TEST RUN					VR=(VI-VF)/G
Dispenser Number	Product Grade	Make & Model of Hose	Serial Number of Hose	Volume Drained From Hose in mL	Volume Poured Into Hose in mL (VI)	Gallons Dispensed (G)	Seconds to Dispense (T)	Dispensing Rate (60*(G/T))	Volume Remaining in mL (VF)	Liquid Removal Rate (mL/gal)

FORM 2: LIQUID REMOVAL TEST DATA SHEET (OPTION 2)

Facility Name & Address	Facility Representative & Title		
		Test Date	
		A/C or Permit No.	
		Testing Company	
		Tester Name	
	Phone No.	VST Training Cert # (if applicable)	
		Inspector Name	

GENERAL INFORMATION				PRE-TEST	TEST RUN					VR=((VI-VW)-VF)/G
Dispenser Number	Product Grade	Make & Model of Hose	Serial Number of Hose	Volume Poured into Hose in mL (VI)	Gallons Dispensed (G)	Seconds to Dispense (T)	Dispensing Rate (60*(G/T))	Volume Remaining in mL (VF)	Volume Lost to Wall Adhension in mL (VW)	Liquid Removal Rate (mL/gal)

Executive Orders VR-203-M and VR-204-M
VST Phase II EVR System

EXHIBIT 7

Nozzle Bag Test Procedure

Verification of the integrity of the VST or EMCO EVR nozzle vapor valve shall be performed on installed nozzles by use of the following test.

1. Seal nozzle(s) at the gasoline dispensing facility (GDF) in a plastic bag, using tape or other means to secure the bag around the base of the nozzle (see Figure 1). Any plastic bag large enough to enclose the nozzle and having a thickness of no greater than 2 mils can be used.

2. Observe the bagged nozzle(s) for 30 seconds.

3. Any nozzle where the bag can be seen visually expanding or collapsing has a defective vapor valve and is not in compliance with Exhibit 2.

4. Record the test results on the “Nozzle Bag Test Results” form provided in this Exhibit. Districts may require use of an alternate form, provided that the alternate form includes the same minimum parameters.

5. Remove the bags from all the nozzles and return the nozzles to the dispenser holsters.

Figure 1
Example of Bagged Nozzle

NOZZLE BAG TEST RESULTS

SOURCE INFORMATION		TEST COMPANY INFORMATION	
Facility (DBA)/Site Address:	Facility Representative/Title:	Test Company Name	# of Nozzles:________
Print Name	Print Name	Print Name of Tester	# Nozzles Tested: ________ # Nozzles Passed: ________ # Nozzles Failed: ________ # Nozzles not Tested: ________
Street Address	Title ( )	Street Address	
City Zip	Phone No.	City Zip	
District Inspector:	☐ P/O ☐ S/A ☐ A/C Number:	Date of Test:	Time of Test:

Dispenser	Gas Grade	Nozzle Type	Bag Expanded or Collapsed after 30 Seconds
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No

Executive Orders VR-203-M and VR-204-M
VST Phase II EVR System with Hirt Thermal Oxidizer

EXHIBIT 13

Hirt VCS 100 Processor with Indicator Panel Operability Test Procedure

Definitions common to all certification and test procedures are in:

D-200 Definitions for Vapor Recovery Procedures

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

1. PURPOSE AND APPLICABILITY

This test procedure verifies the operational status of the Hirt VCS 100 Processor and Indicator Panel.

The station may remain open (normal fuel dispensing) while conducting this procedure.

2. PRINCIPLE AND SUMMARY OF TEST PROCEDURE

The Hirt VCS 100 Processor is designed to activate (e.g. thermally oxidize vapors) when the underground storage tank (UST) ullage pressure exceeds a nominal -0.40 inches water column ("w.c.). Processor activation will be verified by exposing the processor's internal vacuum sensor/switch to an atmospheric pressure input. The processor should activate and the Indicator Panel Processing lamp should light.

3. BIASES AND INTERFERENCES

3.1 This test is only valid when total ullage is 70% or less than capacity of GDF storage tanks.

3.2 At least 24 hours must have elapsed after any tests that introduce air and/or nitrogen into the vapor spaces, such as, but not limited to TP-201.3 (including Exhibit 4), TP-201.4 (including Exhibit 6) and Exhibit 5.

3.3 There shall be no Phase I bulk product deliveries into or out of the storage tank(s) within the three (3) hours prior to the test or during performance of this test procedure.

3.4 Processor should be inactive (i.e. powered but not processing gasoline vapor).

4. EQUIPMENT

4.1 Hand tools: 5/16" nut driver or equivalent, 3/8" open end wrench.

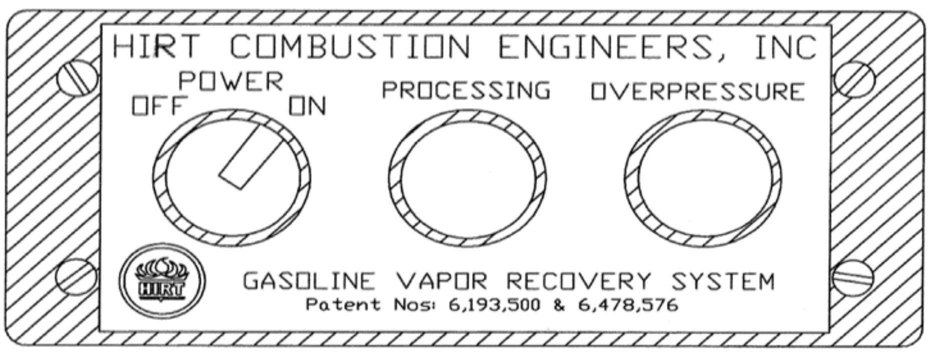
4.2 Stopwatch: Use a stopwatch with an accuracy of ±0.2 seconds.

4.3 Teflon pipe tape.

5. TEST PROCEDURE

5.1 System Status Check: Locate Hirt Indicator Panel and verify that the green lamp on the POWER switch is lit, to be sure power is ON. Record on Form 1. If the Power switch is not lit, the processor does not meet the Exhibit 2 Hirt VCS 100 Thermal Oxidizer specifications and no testing shall be conducted.

Indicator Panel Face

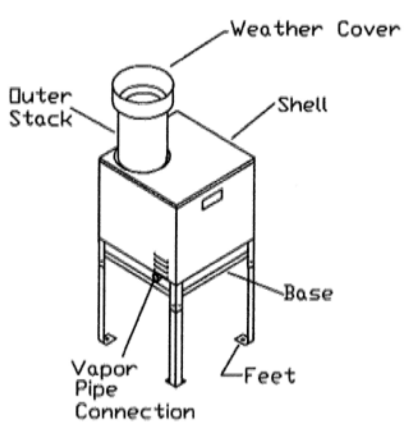


5.2 Check green PROCESSING lamp on Indicator Panel. Is the green PROCESSING lamp on? Record on Form 1. If so, then wait until PROCESSING lamp is extinguished before proceeding to step 5.3, to meet BIAS condition 3.4.

5.3 Forced Processor Operation: Turn POWER to processor OFF at Indicator Panel.

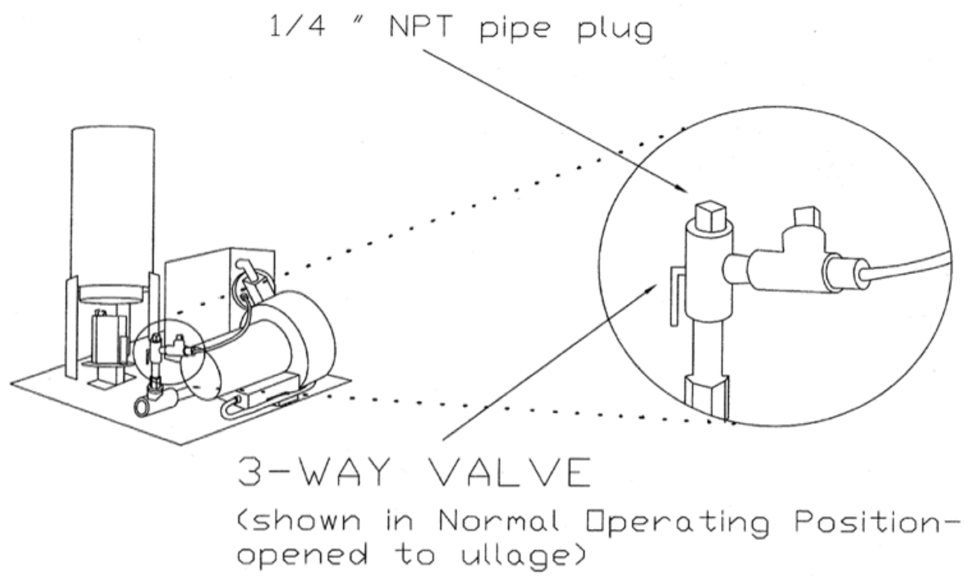
CAUTION: Processor components, such as Shell, Stack, Burner, and Weather Cover can be Hot! Use care when handling processor or removing its parts.

5.4. Remove screw from Weather Cover with 5/16" nut driver and remove Weather Cover from Outer Stack.

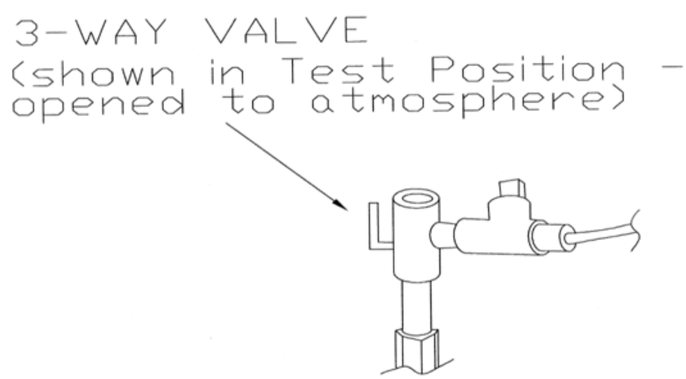


5.5 Remove (4) screws holding Shell to Base with 5/16" nut driver and then remove Shell.

5.6 Locate 3-Way Valve on tubing leading to Vacuum Sensor/Switch. The 3-Way Valve handle should be pointing down, in the Normal Operating Position – Opened to UST Ullage. Remove the 1/4" NPT pipe plug from 3-Way Valve with 3/8" wrench.



5.7 Turn 3-Way Valve handle to the up position.



5.8 Turn POWER to processor ON at Indicator Panel, and verify that green lamp on POWER switch is lit. Start the stopwatch.

5.9 Verify green PROCESSING lamp on the Indicator Panel lights within 3 minutes. Record on Form 1. If the Processing lamp is on, processor meets the Exhibit 2 Processor specifications. If the Processing lamp is not on within 3 minutes, the processor does not meet the Exhibit 2 Processor specifications and needs technical service.

5.10 Verify the OVERPRESSURE lamp on the Indicator Panel lights within sixty two (62) minutes. Record on Form 1. If the OVERPRESSURE lamp is on, processor meets the Exhibit 2 Processor specifications. If the OVERPRESSURE lamp is not on within sixty two (62) minutes, the processor does not meet the Exhibit 2 Processor specifications and needs technical service.

5.11 Turn POWER to processor OFF at Indicator Panel.

5.12 Turn 3-Way Valve handle back down to Normal Operating Position. Reinstall 1/4” NPT plug (with Teflon pipe tape) and tighten ¼ turn past snug. Reinstall Shell and Weather Cover.

5.13 Turn POWER to processor ON at Indicator Panel. Testing is completed.

6. REPORTING

Record all results on Form 1. Districts may require the use of an alternate Form, provided it includes the same minimum parameters as identified in Form 1.

FORM 1:
HIRT VCS 100 PROCESSOR OPERABILITY TEST

DATE OF TEST:

SERVICE COMPANY NAME	SERVICE COMPANY'S TELEPHONE
SERVICE TECHNICIAN	HIRT TECHNICIAN CERTIFICATION #(as applicable) CC or DISTRICT TRAINING CERTIFICATION (as applicable)
STATION NAME	DISTRICT PERMIT #
STATION ADDRESS CITY STATE ZIP	

Was TP-201.3 (Including Exhibit 4) conducted in the last 24 hours? Yes ____ No ____

Was TP-201.4 (Including Exhibit 6) conducted in the last 24 hours? Yes ____ No ____

Was Exhibit 5 conducted in the last 24 hours? Yes ____ No ____

Was there a fuel delivery within the last 3 hours? Yes ____ No ____

The % ullage of GDF storage tank(s) is ___________ gallons.

STEP 5.1	**Is POWER switch lit?**	YES ☐ NO ☐
STEP 5.2	**Is PROCESSING lamp ON?** If "YES", test cannot be performed until lamp goes off.	YES ☐ NO ☐
STEP 5.9	**Time for PROCESSING Lamp to Light? _________ minutes** **Did PROCESSING Lamp light within three (3) minutes?**	YES ☐ NO ☐
STEP 5.10	**Time for OVERPRESSURE Lamp to Light? _________ minutes** **Did OVERPRESSURE Lamp light within sixty two (62) minutes?**	YES ☐ NO ☐

Executive Orders VR-203-M and VR-204-M
VST Phase II EVR System

EXHIBIT 14

Franklin Fueling Systems Healy Clean Air Separator Static Pressure Performance Test Procedure

1 APPLICABILITY

Definitions common to all certification and test procedures are in:

D-200 Definitions for Vapor Recovery Procedures

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

1.1 This test procedure is used to quantify the vapor tightness of the Healy Clean Air Separator (CAS) pressure management system installed as part of a gasoline dispensing facility (GDF) under Executive Order VR-203 and VR-204.

2 PRINCIPLE AND SUMMARY OF TEST PROCEDURE

2.1 The Clean Air Separator, while isolated from the vapor recovery system, is evaluated for vapor integrity using a vacuum decay procedure. The vacuum decay after 5 minutes is compared with an allowable value. The allowable value is based upon the initial vacuum level when conducting the test using the table provided in this test procedure.

2.2 A positive pressure decay procedure is included that conducts the same evaluation as the vacuum decay but with positive pressure. This test is conducted if there is insufficient vacuum (not greater than – 2.00” wc) to conduct the vacuum decay. Districts have the authority to specify in the permit conditions that this positive pressure test is to be conducted even if the vacuum test has been conducted.

3 RANGE

3.1 The full-scale range of the electronic measuring device shall not exceed 0-20.00” wc with a minimum accuracy of not less than 0.25 percent of full-scale.

4 INTERFERENCES

4.1 Leaks in the piping for the Clean Air Separator could bias the test results toward non-compliance.

4.2 Introduction of gaseous nitrogen into the system at flow rates exceeding 4 CFM (240 CFH) may bias the results of the test toward non-compliance. Only gaseous nitrogen shall be used to conduct this test.

4.3 Pressurizing the Clean Air Separator bladder greater than 14.00” wc could damage the bladder, biasing the test toward non-compliance.

4.4 Thermal Bias for Electronic Manometers

Electronic manometers shall have a warm-up period of at least 15 minutes followed by a drift check of 5 minutes. If the drift exceeds 0.01” wc, the instrument should not be used.

5 APPARATUS

5.1 Nitrogen

Use commercial grade gaseous nitrogen in a high pressure cylinder, equipped with a two-stage pressure regulator.

5.2 Pressure Measurement Device

Use an electronic pressure measurement device to monitor the pressure decay in the Clean Air Separator. The pressure measurement device shall, at a minimum, be readable to the nearest 0.01” wc.

5.3 Test Port Assembly

Use a test port assembly constructed similar to the one in Figure A. The assembly should have an 8 oz. Pressure Relief valve, to ensure that the Clean Air Separator is not over pressurized. The Model 9968 Clean Air Separator Test Port Assembly can be purchased from Healy Systems, Inc.

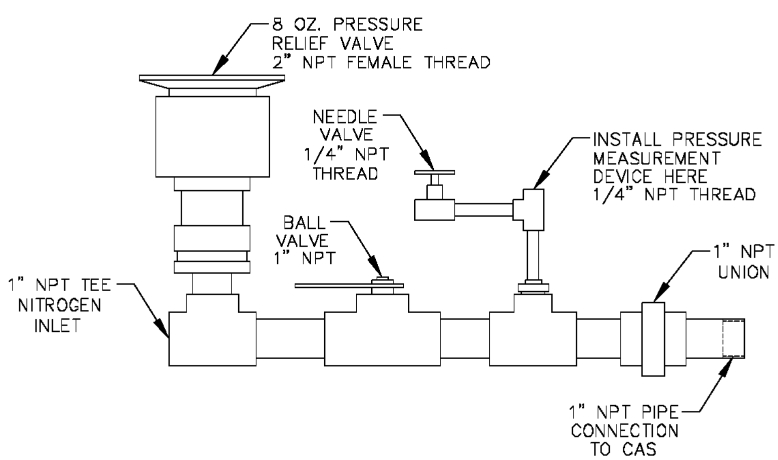


Figure A - Clean Air Separator Test Port Assembly

5.4 Stopwatch

Use a stopwatch accurate to within 0.2 seconds.

5.5 Flow Meter

Use a flow meter to determine the required pressure setting of the delivery pressure gauge on the nitrogen supply pressure regulator. This pressure shall be set such that the nitrogen flow rate is between 2.0 CFM (120 CFH) and 4.0 CFM (240 CFH).

5.6 Leak Detection Solution

Any liquid solution designed to detect vapor leaks may be used to verify the pressure integrity of the test equipment prior to conducting the test.

5.7 Condensate Collection Vessel

A container approved for use with gasoline that can hold at least a half gallon of material.

5.8 Graduated Cylinder

A graduated cylinder that is suitable for use with gasoline and capable of measuring to the nearest ounce or ml.

6 PRE-TEST PROCEDURES

6.1 The following safety precautions shall be followed:

6.1.1 Only gaseous nitrogen shall be used to pressurize the system.

6.1.2 An 8 oz. pressure relieve valve shall be installed on the Test Port Assembly to prevent the possible over-pressurizing of the Clean Air Separator.

6.1.3 A ground strap should be employed during the introduction of nitrogen into the system.

6.2 There shall be no Phase I bulk product deliveries into or out of the gasoline storage tank(s) within the three (3) hours prior to the test or during the performance of this test procedure.

6.3 All pressure measuring device(s) shall be bench calibrated using a reference standard. Calibration shall be performed at 20, 50, and 80 percent of full scale. Accuracy shall be within two percent at each of these calibration points. Calibrations shall be conducted on a frequency not to exceed 180 days. Calibration documentation shall be maintained with the equipment at all times.

6.4 Use the flow meter to determine the nitrogen regulator delivery pressures that correspond to nitrogen flow rates of 2.0 CFM (120 CFH) and 4.0 CFM (240 CFH). These pressures define the allowable range of delivery pressures acceptable for this test procedure. The flow meter shall be connected in-line between the nitrogen supply regulator and the Test Port Assembly during pressurization. The flow meter may be connected in-line between the nitrogen supply regulator and the Test Port Assembly during the test.

6.5 The electronic pressure measurement device shall be subject to warm-up and drift check before use; see Section 4.5.

6.6 The four ball valves used in the installation of the Clean Air Separator are lockable and shall be locked in the position shown in Figure 1 or Figure 1H of this Exhibit during normal operation. Figure 1 applies to vertical CAS installations and Figure 1H applies to horizontal CAS installations. The four padlocks provided by Healy Systems, Inc. in their installation kit are keyed the same. However, it is possible that one or more of the padlocks on the Clean Air Separator could have been replaced (seizing, damage, broken key, etc.). Conducting this test will require a set of keys necessary to unlock all padlocks.

6.7 Verify that the Clean Air Separator is in its normal operating configuration by confirming that all components are as indicated (See Figure 1 or Figure 1H):

Valve “A” - Open
Valve “B, C and D” - Closed
Pipe End “E” - Plugged
Tee Branch “F” – Plugged

Figure 1
Normal Clean Air Separator Operating Configuration

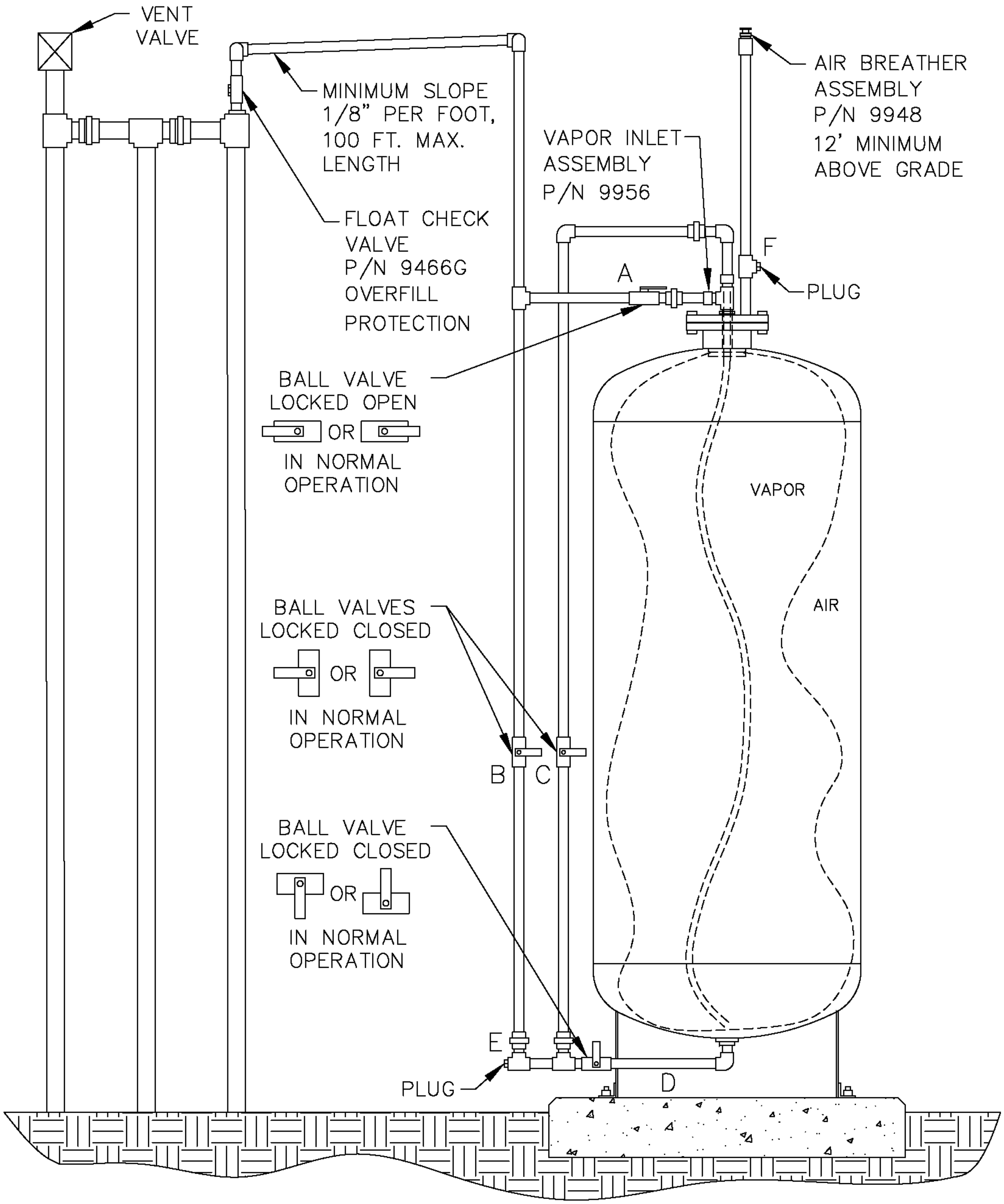
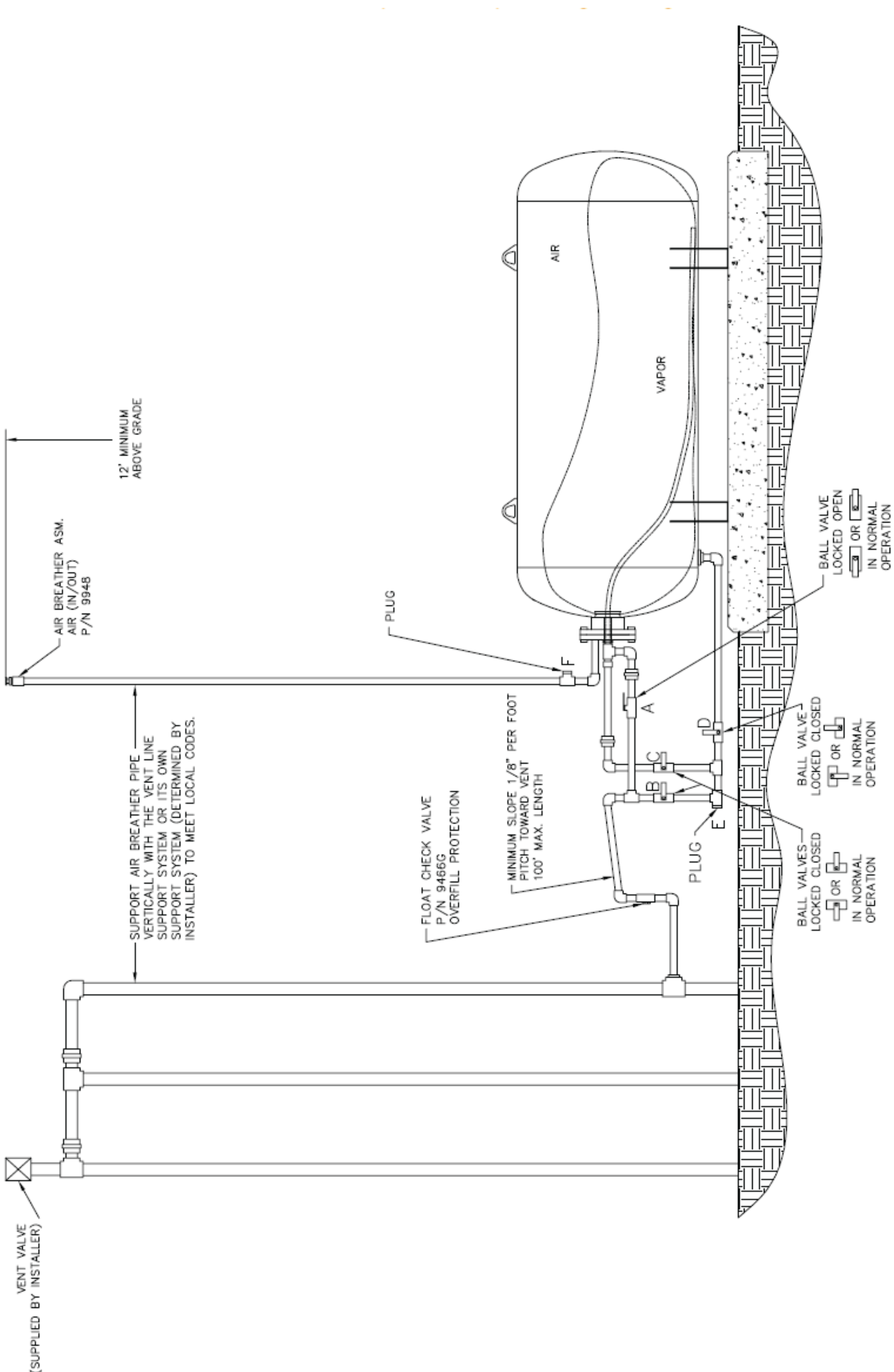


Figure 1H
Normal Clean Air Separator Operating Configuration



6.8 Installing the Test Port Assembly

6.8.1 Open the ball valve marked “B”, shown in Figure 1 or Figure 1H. This ensures that if there is any condensate in the primary connection line to the Clean Air Separator it will drop down into the lower section of the piping configuration, so that it can be measured. Close the valve after approximately 30 seconds.

6.8.2 Position the condensate collection vessel below plug “E” prior to removing it. Remove the 1” plugs from locations “E” and “F” from Figure 1 or Figure 1H. Transfer the collected condensate into the graduated cylinder. If there is more than 16 oz. (473 mL) of liquid condensate, the bladder and vapor processor vessel must be drained. Conduct the bladder and vessel draining procedures from the Clean Air Separator section of the ***ARB Approved Installation, Operation and Maintenance Manual***.

Note: Depending upon the size of the graduated cylinder and the amount of condensate, it may take multiple transfers from the condensate collection vessel to get the total condensate measurement.

6.8.3 Install the Test Port Assembly to the Clean Air Separator at location “E”. See Figure 2 or Figure 2H. Figure 2 applies to vertical CAS installations and Figure 2H applies to horizontal CAS installations.

6.8.4 Connect the gaseous nitrogen supply to the Test Port Assembly. See Figure 2 or Figure 2H.

6.8.5 Check the test equipment and piping isolated from normal Clean Air Separator operation by the ball valves “B, C and D” by pressurizing with nitrogen to a pressure of 4” wc ± 1” wc and closing the ball valve on the Test Port Assembly. Use leak detection solution. Tighten as necessary. The test equipment shall have no leaks.

6.8.6 Open the needle valve on the Test Port Assembly to bleed the pressure off the equipment. Keep ball valve on Test Port Assembly closed.

Figure 2
Clean Air Separator in Configuration to Conduct Test

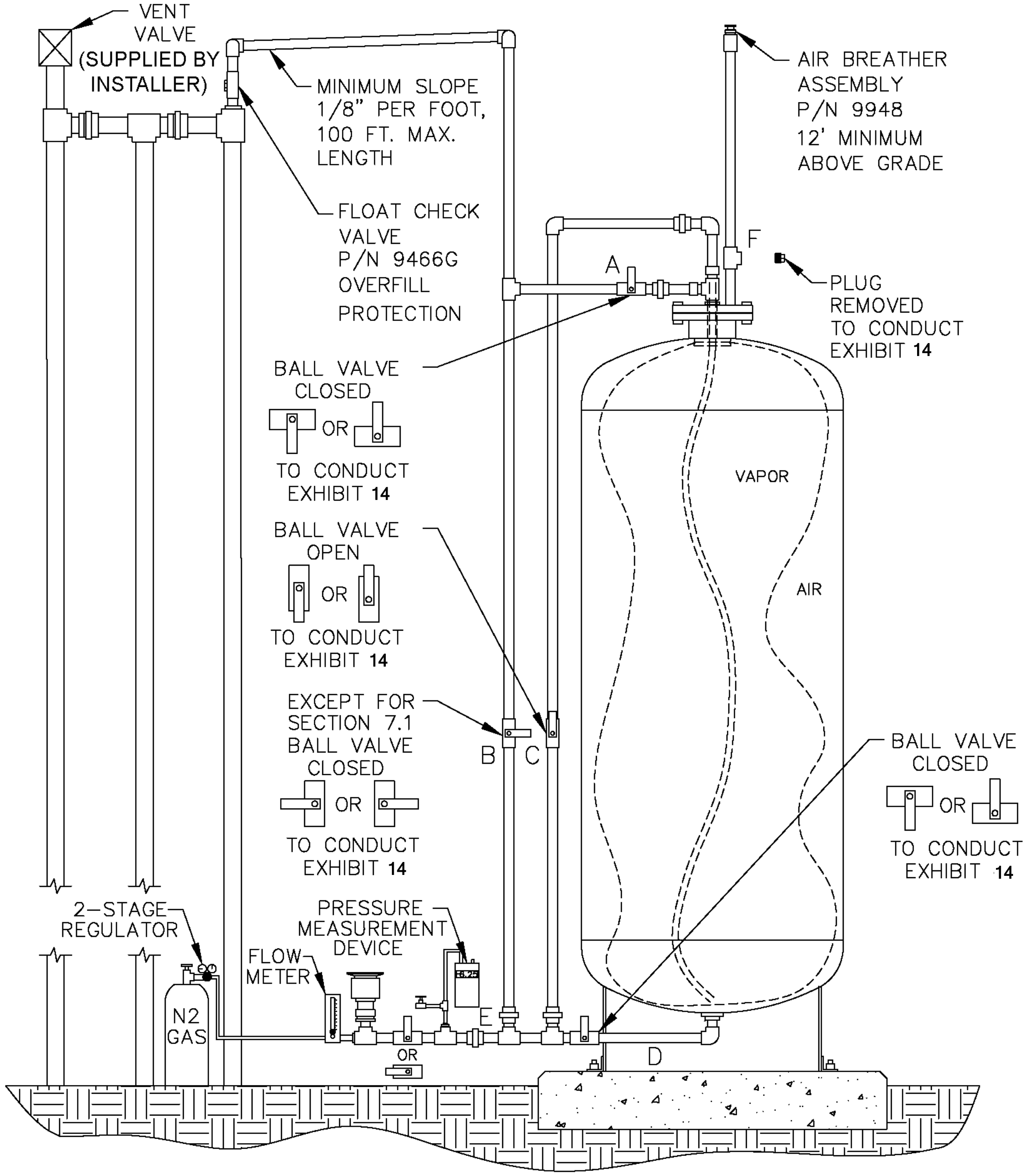
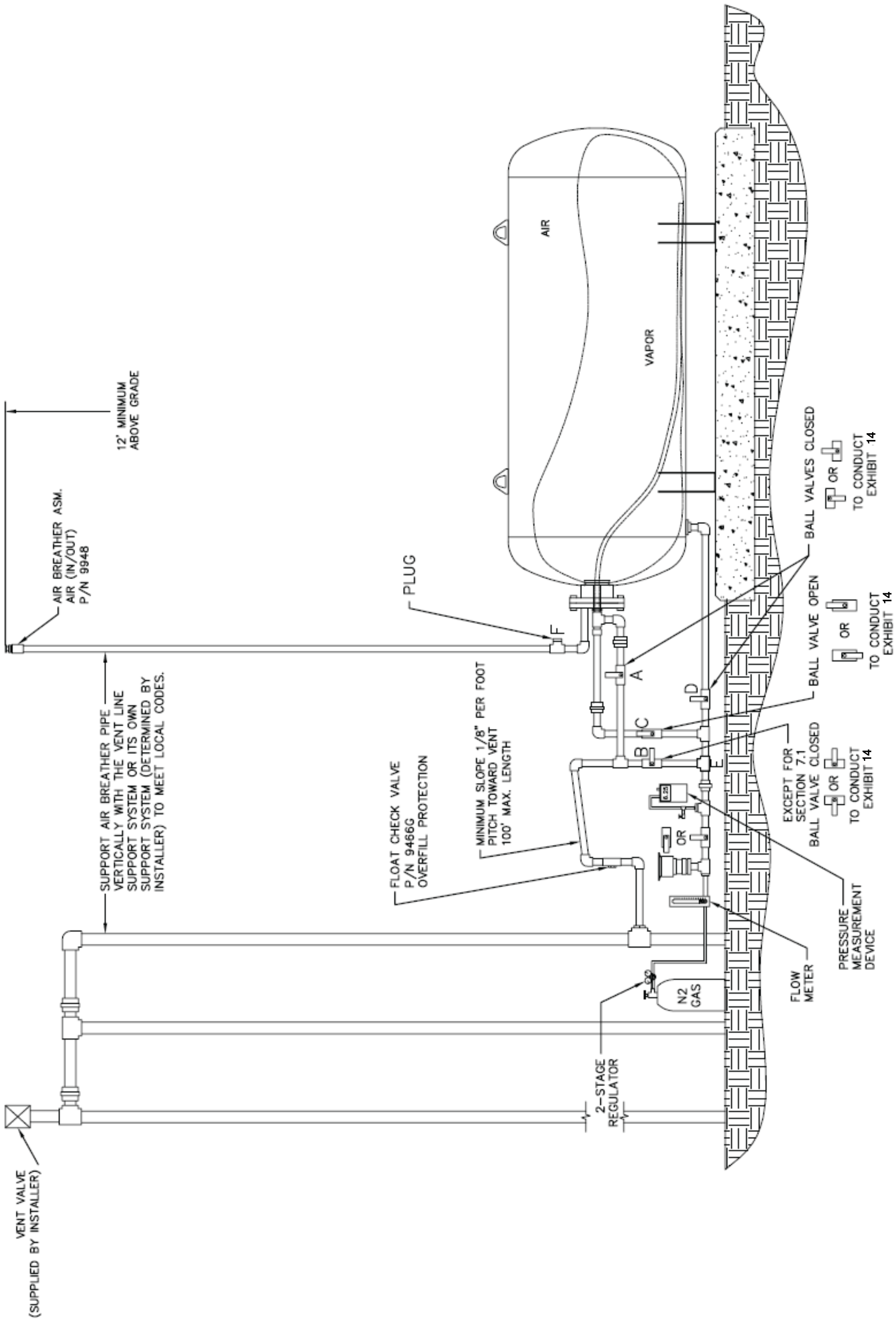


Figure 2H
Clean Air Separator in Configuration to Conduct Test



7 TESTING

7.1 Open the ball valve marked “B” from Figure 2 or Figure 2H. The pressure measurement device installed on the Test Port Assembly should now be reading UST and Clean Air Separator ullage pressure (or vacuum).

7.2 If the station vacuum is greater than (more negative) than -2.00” wc, then proceed to Section 7.2.1. If less than –2.00” wc, then proceed to Section 7.3:

7.2.1 Close the ball valves marked “A” and “B” from Figure 2.

7.2.2 Open the ball valve marked “C” from Figure 2 and wait one minute.

7.2.3 If necessary, use the needle valve on the Test Port Assembly to bleed air into the bladder until the vacuum level reaches as close to a whole number on the pressure measurement device as the accuracy of the device will provide (ie. -2.00, -3.00, -4.00, -5.00, -6.00, -7.00, -8.00). Make sure the needle valve is closed. Record this vacuum and start the stop watch to begin a 5 minute decay.

7.2.4 Record the vacuum at one-minute increments up to 5 minutes.

7.2.5 Using the information from Table 1, verify that the vacuum after 5 minutes is equal to or greater than the allowable minimum for the initial vacuum recorded from Section 7.2.3.

7.2.6 If the vacuum is greater than the allowable minimum, the Clean Air Separator passed the test.

7.2.7 If the vacuum is less than the allowable minimum, the Clean Air Separator failed the test.

TABLE 1
Allowable 5 Minute Vacuum Decay for Clean Air Separator

Vacuum at Start of Test (inches wc)	Allowable Minimum Vacuum after 5 min. (inches wc)
8.0	5.5
7.0	4.7
6.0	3.8
5.0	3.0
4.0	2.2
3.0	1.5
2.0	0.8

7.3 If the station vacuum is less than –2.00” wc (from Section 7.2), or at the direction of district (refer to Section 2.2), conduct the following:

7.3.1 Close the ball valves marked “A” and “B” from Figure 2.

7.3.2 Open the ball valve marked “C” from Figure 2.

7.3.3 Open the ball valve of the Test Port Assembly and flow nitrogen into the Clean Air Separator bladder at a flow rate between 2 and 4 CFM until the pressure in the bladder reaches 2.20” wc.

7.3.3.1 Depending upon the nitrogen flow rate used, the bladder could take up to 30 minutes to fill completely.

7.3.3.2 Because of the close proximity of the pressure measurement device to the nitrogen inlet of the Test Port Assembly, the pressure measurement device may read a higher pressure when nitrogen is flowing. The pressure measurement device is usually steady, but will start to increase rapidly when the bladder is getting full. Periodically stopping nitrogen flow will provide an accurate reading of the pressure in the bladder.

7.3.4 Once the pressure reaches 2.20” wc, shut off the flow of nitrogen to the Clean Air Separator bladder and close the ball valve of the Test Port Assembly.

7.3.5 Wait 5 minutes or until pressure stabilizes above 2.00” wc. If the pressure does not stabilize, repeat steps 7.3.3 and 7.3.4.

7.3.6 Use the needle valve on the Test Port Assembly to bleed off the nitrogen until the pressure reaches 2.00” wc. Make sure the needle valve is closed. Record the pressure.

7.3.7 Start the stop watch to begin a 5 minute decay.

7.3.8 Record the pressure in one-minute increments up to 5 minutes.

7.3.9 If the pressure in the bladder is greater than 1.77” wc at the end of 5 minutes, then the Clean Air Separator passed the test.

7.3.10 If the pressure in the bladder is less than 1.77” wc at the end of 5 minutes, then the Clean Air Separator failed the test.

7.4 If the bladder was evaluated using the vacuum procedure (Section 7.2), close the ball valve “C” to keep it in a vacuum condition. If the bladder was evaluated using the pressure procedure (Section 7.3), open the needle valve on the Test Port Assembly to bleed off all pressure from the bladder.

7.5 Close the ball valve marked “C”, if not already done.

7.6 Remove the Test Port Assembly from location “E” and install the 1” pipe plug. Use a pipe sealant approved for use with gasoline on the threads and tighten to 60 ft-lbs.

7.7 Install the 1” pipe plug to location “F”. Use a pipe sealant approved for use with gasoline on the threads and tightens to 60 ft-lbs.

7.8 Open the ball valve marked “A”. Lock all ball valves using the padlocks.

7.9 The Clean Air Separator should now be in normal operation configuration. Verify this by using the outline from Section 6.7 and Figure 1 or Figure 1H.

8 REPORTING

8.1 Record test data on the form shown in Figure 3. Districts may require the use of an alternate form, provided that the alternate form includes the same minimum parameters as in Form 1.

Form 1

Data Form for Determination of Static Pressure Performance of the
Healy Clean Air Separator for Executive Order VR-203 and VR-204

SOURCE INFORMATION

GDF Name and Address	GDF Representative and Title
______ ______ ______	______ ______ GDF Phone No. ______
Date and Time of Last Fuel Drop to GDF: ______ Date of Last Calibration of Pressure Measurement Device: ______	P/O #: ______ A/C#: ______ District Test Witness: ______

VACUUM TEST (Section 7.1 through 7.2.7)

Vacuum at start of test, inches water column (7.2.3)	______
Vacuum at one minute, inches water column	______
Vacuum at two minutes, inches water column	______
Vacuum at three minutes, inches water column	______
Vacuum at four minutes, inches water column	______
Final vacuum at five minutes, inches water column	______
Allowable minimum vacuum, inches water column (from Table 1)	______

POSITIVE PRESSURE TEST (Section 7.3 through 7.3.9)

Pressure at start of test, inches water column (7.3.6)	______
Pressure at one minute, inches water column	______
Pressure at two minutes, inches water column	______
Pressure at three minutes, inches water column	______
Pressure at four minutes, inches water column	______
Final pressure at five minutes, inches water column	______
Allowable final pressure, inches water column (7.3.9)	**1.77**

Healy Certified Technician Name, Certification Number and Expiration Date	Test Company	Date Test Conducted

Veeder-Root In-Station Diagnostics (ISD)

Install, Setup, & Operation Manual

For VST ECS Membrane Processors, Veeder-Root Polisher, Franklin Fueling System Clean Air Separator (CAS) and Hirt VCS 100

VEEDER-ROOT

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DAMAGE CLAIMS / LOST EQUIPMENT

Thoroughly examine all components and units as soon as they are received. If any cartons are damaged or missing, write a complete and detailed description of the damage or shortage on the face of the freight bill. The carrier's agent must verify the inspection and sign the description. Refuse only the damaged product, not the entire shipment.

Veeder-Root must be notified of any damages and/or shortages within 30 days of receipt of the shipment, as stated in our Terms and Conditions.

VEEDER-ROOT'S PREFERRED CARRIER

1. Contact Veeder-Root Customer Service at 800-873-3313 with the specific part numbers and quantities that were missing or received damaged.
2. Fax signed Bill of Lading (BOL) to Veeder-Root Customer Service at 800-234-5350.
3. Veeder-Root will file the claim with the carrier and replace the damaged/missing product at no charge to the customer. Customer Service will work with production facility to have the replacement product shipped as soon as possible.

CUSTOMER'S PREFERRED CARRIER

1. It is the customer's responsibility to file a claim with their carrier.
2. Customer may submit a replacement purchase order. Customer is responsible for all charges and freight associated with replacement order. Customer Service will work with production facility to have the replacement product shipped as soon as possible.
3. If "lost" equipment is delivered at a later date and is not needed, Veeder-Root will allow a Return to Stock without a restocking fee.
4. Veeder-Root will NOT be responsible for any compensation when a customer chooses their own carrier.

RETURN SHIPPING

For the parts return procedure, please follow the appropriate instructions in the "General Returned Goods Policy" pages in the "Policies and Literature" section of the Veeder-Root **North American Environmental Products** price list. Veeder-Root will not accept any return product without a Return Goods Authorization (RGA) number clearly printed on the outside of the package.

FCC INFORMATION

This equipment complies with the requirements in Part 15 of the FCC rules for a Class A computing device. Operation of this equipment in a residential area may cause unacceptable interference to radio and TV reception requiring the operator to take whatever steps are necessary to correct the interference.

INSTALLATION IN THE STATE OF CALIFORNIA

Please refer to the California Air Resources Board Vapor Recover Certification Phase II EVR Executive Order web site (*www.arb.ca.gov/vapor/eo-evrphaseII.htm*) for the latest manual revisions pertaining to VR 204 (VST Phase II EVR System Including ISD System).

WARRANTY - Please see next page, iii.

Warranty

This warranty applies only when the product is installed in accordance with Veeder-Root's specifications, and that a Warranty Registration and Checkout Form has been filed with Veeder-Root by an authorized Veeder-Root Distributor. This warranty will not apply to any product which has been subjected to misuse, negligence, accidents, systems that are misapplied or are not installed per Veeder-Root specifications, modified or repaired by unauthorized persons, or damage related to acts of God. Veeder-Root is not liable for incidental, consequential, or indirect damages or loss, including, without limitation, personal injury, death, property damage, environmental damages, cost of labor, clean-up, downtime, installation and removal, product damages, loss of product, or loss of revenue or profits. **THE WARRANTY CONTAINED HEREIN IS EXCLUSIVE AND THERE ARE NO OTHER EXPRESS, IMPLIED, OR STATUTORY WARRANTIES. WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE EXPRESSLY EXCLUDED.**

TLS-350R, TLS-350 PLUS, TLS-350J AND TLS-300I/C, AND TLS2 MONITORING SYSTEMS

We warrant that this product shall be free from defects in material and workmanship for a period of one (1) year from the date of installation or twenty-four (24 months) from the date of invoice, whichever occurs first. During the warranty period, we or our representative will repair or replace the product, if determined by us to be defective, at the location where the product is in use and at no charge to the purchaser. LAMPS, FUSES, AND LITHIUM BATTERIES ARE NOT COVERED UNDER THIS WARRANTY.

If "Warranty" is purchased as part of the Fuel Management Service, Veeder-Root will maintain the equipment for the life of the contract in accordance with the written warranty provided with the equipment. A Veeder-Root Fuel Management Services Contractor shall have free site access during Customer's regular working hours to work on the equipment. Veeder-Root has no obligation to monitor federal, state or local laws, or modify the equipment based on developments or changes in such laws.

MODULES, KITS, OTHER COMPONENTS (PARTS PURCHASED SEPARATE OF A COMPLETE CONSOLE)

We warrant that this product shall be free from defects in material and workmanship for a period of one (1) year from the date of installation or fifteen (15) months from the date of invoice, whichever occurs first. We warrant that the lithium batteries (excluding EVR BATTERY PACK) shall be free from defects in material and workmanship for a period of three (3) months from date of invoice. We will repair or replace the product if the product is returned to us; transportation prepaid by user, within the warranty period, and is determined by us to be defective. **LAMPS AND FUSES ARE NOT COVERED UNDER THIS WARRANTY.**

IN STATION DIAGNOSTICS (ISD)

For components used in ISD systems (Vapor Flow Sensor, Vapor Pressure Sensor, Software, TLS RF, Wireless Repeater, Wireless Transmitter & Wireless Receiver), excluding **LAMPS, FUSES, AND LITHIUM BATTERIES**, the following warranty applies:

We warrant that this product shall be free from defects in material and workmanship and will comply with the performance standards of California EPA CP-201 section 10 as amended July 22, 2004 for a period of one (1) year from the date of ISD start-up or twenty-four (24) months from the date of invoice, whichever occurs first. During the warranty period, we and or our representative will repair or replace the product, if determined by us to be defective, at the location where the product is in use, at no charge to the purchaser.

For ISD components installed after the initial ISD start-up, we warrant that these products shall be free from defects in material and workmanship for a period of one (1) year from the date of installation or fifteen (15) months from date of invoice. We will repair or replace the product if the product is returned to us; transportation prepaid by user, within the warranty period, and is determined by us to be defective.

EVR BATTERY PACK

We warrant that this product shall be free from defects in material and workmanship for a period of one (1) year from the date of installation or fifteen (15) months from the date of invoice, whichever occurs first. **The replacement EVR Battery Pack warranty period will be the REMAINING warranty period of the original EVR Battery Pack. LAMPS, FUSES, AND LITHIUM BATTERIES OTHER THAN THE EVR BATTERY PACK, ARE NOT COVERED UNDER THIS WARRANTY.**

Figures

Tables

1 Introduction

In-Station Diagnostic (ISD) equipment is designed to monitor the collection and containment of vapors by vapor recovery equipment. The ISD software monitors the vapor recovery equipment using the Veeder-Root (V-R) TLS console platform, sensor inputs, and dispenser fuel events. ISD provides test reports, generates alarms following test/equipment failures, and finally, shuts down the site upon the occurrence of designated alarms.

This manual provides instructions to install, setup, and operate the special components of the Veeder-Root ISD system that are not covered in existing documentation shipped with other non-ISD specific V-R equipment (e.g., Mag probes, line leak detection, etc.). The ISD feature is an option for the TLS console platform, and as such, many of the installation/setup/operation instructions for non-ISD specific tasks (e.g., line leak detection) are covered in TLS-3XX supplied literature.

WARNING! Revision or reprogramming of the TLS may require notification of the local Certified Unified Program Agency (CUPA).

Site Requirements

Below are the requirements for all vapor recovery systems except where noted.

- V-R TLS-350R/EMC w/BIR, TLS-350 Plus/EMC Enhanced, TLS-350/EMC and Red Jacket ProMax consoles with ECPUII - install as per TLS-3XX Site Prep manual, setup following instructions in TLS-3XX System Setup Manual.
- A flash memory board (NVMEM203) for ISD software storage - installed on the ECPU2 board in place of the console's 1/2 Meg RAM board - install as per TLS-350 Series Board and Software Replacement Manual, no setup required.
- An available RS-232 module is required for RS-232 access to ISD reports - install as per instructions shipped with module, connect to the port using instructions in this manual.
- An output relay or dispenser relay board is required (either 4-Output Relay module, I/O Combination module) to shut down each Submersible Turbine Pump (STP) or dispenser upon activation of certain ISD alarms (these alarms can also be assigned in Line Leak Disable setup to shut down the STP or dispenser if Line Leak detection feature is installed) - install as per instructions shipped with module or line leak system, setup ISD shut down alarms either using output relays or line leak system following instructions in this manual. Two output relays on either of these two modules are also required for vapor processor motor control - install as per instructions in this manual.
- Dispenser Interface module (DIM) for the type of dispensers installed - install as per installation manual shipped with device, setup following instructions in DIM manual and TLS-3XX Setup Manual. Note: the DIM supplies flow meter event inputs needed for ISD analysis.
- One V-R Mag probe in each of the gasoline tanks being monitored - install as per installation manual shipped with device, setup following instructions in TLS-3XX Setup Manual.
- Smart Sensor module is required to monitor Air Flow Meters and Vapor Pressure Sensor (up to 8 devices per module, or 7 if customer is using Smart Sensor module / embedded pressure). Install and connect following instructions in the Air Flow Meter and Vapor Pressure Sensor installation Guides.
- Air Flow Meters (one for each dispenser) - install as per ISD Flow Meter installation manual shipped with meter, setup following instructions in this manual. Also referred to as Vapor Flow Meters within this manual.
- Vapor Pressure Sensor (one per site) - install as per ISD Pressure Sensor installation manual shipped with sensor, setup following instructions in this manual.
- When monitoring a VST ECS membrane processor a Multi-port controller module is required.

Supported Vapor Recovery Systems

Table 1 lists V-R supported vapor recovery system.

Table 1. Vapor Recovery System

Name	CARB Executive Order
VST Phase II EVR System including ISD	VR-204

Contractor Certification Requirements

Veeder-Root requires the following minimum training certifications for contractors who will install and setup the equipment discussed in this manual:

Installer (Level 1) Certification: Contractors holding valid Installer Certification are approved to perform wiring and conduit routing; equipment mounting; probe, sensor and carbon canister vapor polisher installation; wireless equipment installation; tank and line preparation; and line leak detector installation.

ATG Technician (Level 2/3 or 4) Certification: Contractors holding valid ATG Technician Certifications are approved to perform installation checkout, startup, programming and operations training, system tests, troubleshooting and servicing for all Veeder-Root Series Tank Monitoring Systems, including Line Leak Detection. In addition, Contractors with the following sub-certification designations are approved to perform installation checkout, startup, programming, system tests, troubleshooting, service techniques and operations training on the designated system.

- Wireless 2
- Tall Tank

VR Vapor Products Certification: Contractors holding a certification with the following designations are approved to perform installation checkout, startup, programming, system tests, troubleshooting, service techniques and operations training on the designated system.

- ISD – In Station Diagnostics
- PMC – Pressure Management Control
- CCVP - Veeder-Root Vapor Polisher
- Wireless – ISD/PMC Wireless

A current Veeder-Root Technician Certification is a prerequisite for the VR Vapor Products course.

Warranty Registrations may only be submitted by selected Distributors.

Related Manuals

The manuals in Table 2 below are shipped with the equipment on the V-R Tech Docs CD-ROM and will be needed to install related equipment.

Table 2. Related Manuals

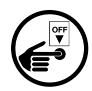
V-R Manual	Part Number
TLS-3XX Site Prep Manual	576013-879
ISD Balance Flow Meter Installation Guide	VR-204 IOM/ Section 18
Pressure Sensor Installation Guide	VR-204 IOM/ Section 13
TLS-3XX Series Consoles System Setup Manual	576013-623

Table 2. Related Manuals

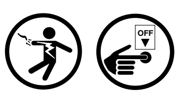
V-R Manual	Part Number
TLS-3XX Series Consoles Operator's Manual	576013-610
Serial Comm Modules Installation Guide	577013-528
ISD Troubleshooting Manual	577013-819
TLS-350 Series Board and Software Replacement Manual	576013-637
TLS-350R Point-of-Sale (POS) Application Guide	577013-401
Input/Output Modules Installation	576013-614
TLS RF Wireless 2 System (W2) Installation and Maintenance Guide	577013-964

Safety Precautions

The following symbols may be used throughout this manual to alert you to important safety hazards.

	**ELECTRICITY** High voltage exists in, and is supplied to, the device. A potential shock hazard exists.		**TURN POWER OFF** Live power to a device creates a potential shock hazard. Turn Off power to the device and associated accessories when servicing the unit.
	**READ ALL RELATED MANUALS** Knowledge of all related procedures before you begin work is important. Read and understand all manuals thoroughly. If you do not understand a procedure, ask someone who does.		**WARNING** Heed the adjacent instructions to avoid damage to equipment, property, environment or personal injury.

⚠ WARNING



The console contains high voltages which can be lethal. It is also connected to low power devices that must be kept intrinsically safe.

Turn power Off at the circuit breaker. Do not connect the console AC power supply until all devices are installed.

FAILURE TO COMPLY WITH THE FOLLOWING WARNINGS AND SAFETY PRECAUTIONS COULD CAUSE DAMAGE TO PROPERTY, ENVIRONMENT, RESULTING IN SERIOUS INJURY OR DEATH.

Example Site Diagrams

Figure 1 shows an example site with a VST ECS membrane vapor processor. The diagram shows setups unique to ISD which are discussed in this manual (marked with a star), and those setups performed following instructions in the appropriate sections of the TLS-3XX System Setup manual, such as In-Tank setup (marked with a hexagon).

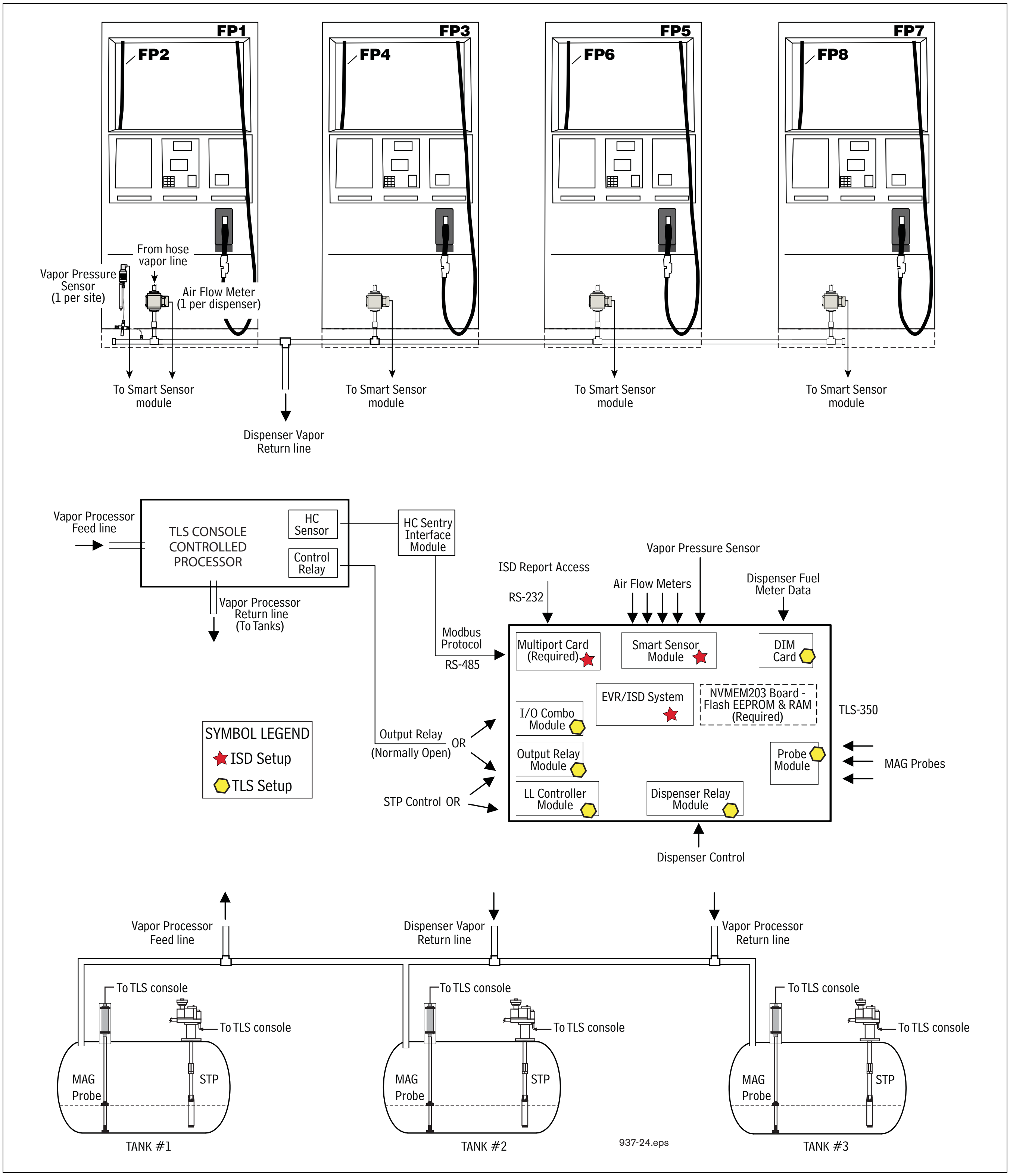


Figure 1. Example Site Diagram - TLS Console Controlled Vapor Processor

2 Installation

This section discusses the installation and wiring of the hardware required to enable the TLS console to perform ISD monitoring of the site's gasoline vapor recovery equipment (non-gas tanks are not monitored):

- Vapor Flow Meter
- Vapor Pressure Sensor
- Smart Sensor Interface Module (8 input and 7 input w/embedded pressure versions)
- NVMEM203 board - required
- 4-Relay Output Module or Dispenser Relay Module or I/O Combination Module
- Line Leak Detection
- Dispenser Interface Module
- Probe Interface Module
- Multi-port Card (for VST ECS Membrane Processor only)

All field wiring, its type, its length, etc., used for TLS console sensors must conform to the requirements outlined in the Veeder-Root TLS-3XX Site Prep manual (P/N 576013-879).

Vapor Flow Meter

Install one Vapor Flow Meter in the vapor return piping of each gasoline dispenser following the instructions in the ISD Balance Flow Meter Installation guide (VR-204 IOM / Section 18). Program the meter following instructions in this manual.

Vapor Pressure Sensor

Install one Vapor Pressure Sensor in the vapor return piping of the gasoline dispenser closest to the tanks following the instructions in the Pressure Sensor Installation guide (VR-204 IOM / Section 13). Program the meter following instructions in this manual.

Installing TLS Console Modules - General Notes

TLS consoles have three bays in which interface modules can be installed; Comm bay (left door) and Power and Intrinsically-Safe bays (right door). Smart Sensor modules are installed in the Intrinsically-Safe (I.S.) bay only (Figure 2).

Most consoles will be shipped with modules installed as ordered. If additional features are added at a later date, modules will be field installed.

In all cases, the position of the modules, their respective connectors and the devices wired to the connectors must be recorded to prevent improper replacement during installation or service. A circuit directory for Power and I.S. bay Interface Modules is adhered to the back of the right-hand door for this purpose.

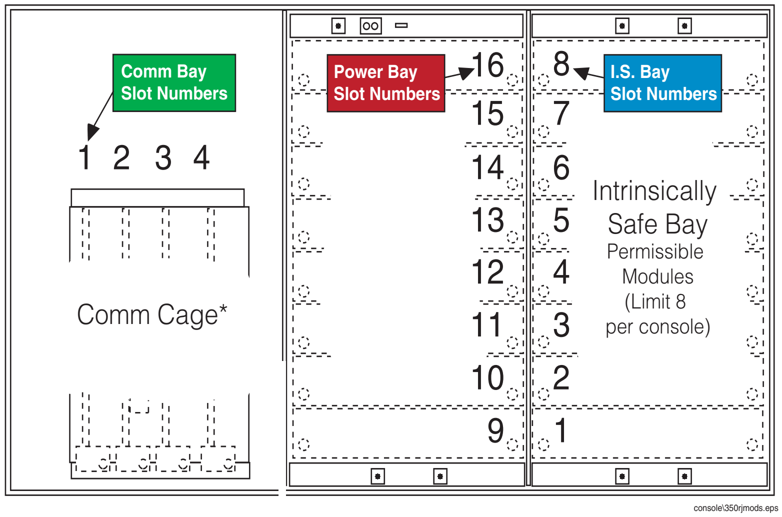


Figure 2. TLS console Interface Module Bays

CAUTION! During programming, module positions and the devices wired to each module are identified and stored in memory. If a connector is removed and reinstalled on a different module after programming, or if an entire module with its connector is removed and reinstalled in a different module slot, the system will not properly recognize the data being received.

Module Position

1. Record on the circuit directory the type of module in each slot location.
2. If a system contains multiple modules of a single type (i.e., two Smart Sensor Modules), they may be swapped between their respective slot locations, however, the connectors must remain with their original locations, not with the original modules.

Connector Position

1. Identify all connectors according to their slot location using the self-adhesive numbering labels furnished with each module. Accurately record on the circuit directory the location of each device wired to the connector as you attach wires to the module.
2. Once a device has been wired to certain terminals on a connector and the system has been programmed, the wires from that device may not be relocated to other terminals without reprogramming the system.

Grounding Probe and Sensor Shields

Connect probe and sensor cable shields to ground at the console only. Do not ground both ends of the shield.

CIRCUIT DIRECTORY

A circuit directory is adhered to the inside of the right-hand door. It should be filled out by the installer as the module's connectors are being wired.

The following information should be recorded for each slot:

- Module Type: record what type of module has been installed in the slot, e.g., Smart Sensor Module.
- Position Record: record the physical location and/or type of device wired to each terminal of the module connector in the slot, e.g., AFM1.

Smart Sensor Interface Module

The Smart Sensor Interface Module 8 input or 7 input w/embedded pressure versions monitor Air Flow Meter (AFM) and Vapor Pressure Sensor (VPS) inputs.

Switch off power to the TLS console while you install modules and connect sensor wiring.

Open the right door of the console and slide the necessary Smart Sensor modules into empty I.S. Bay slots. Connect the field wiring from each of the sensors following instructions in the Flow Meter and Pressure Sensor manuals. Setup the Smart Sensor module(s) following instructions in this manual.

NVMEM203 Board

Verify that a NVMEM203 board is installed in the TLS console (ref. Figure 2-7 in the V-R TLS-3XX Series Consoles Troubleshooting Manual P/N 576013-818, Rev Q or later). This board contains flash EEPROM and RAM needed to run ISD software and store ISD reports. No setup is required.

Site Shut Down Requirements

Normal ISD operation requires TLS console control of the STP in each of the gasoline tanks. If the site has Wireless Pressure Line Leak Detection (WPLLD), Pressure Line Leak Detection (PLLD) or Volumetric Line Leak Detection (VLLD) for each tank, you can use the line leak disable setup to control the vapor recovery tanks (diesel tanks do not require shutdown). If the site does not have line leak detection for all vapor recovery tanks, you can use output relay setup to control each tank. In lieu of line leak detection, install the necessary modules (output relay) to control each gasoline tank. Alternately, you can install Dispenser Relay Modules to control dispensing.

Dispenser Interface Module (DIM)

Verify that a dispenser interface module (DIM) is installed in the TLS console communication bay (ref. Figure 2) and that it is designed to communicate with the type of gasoline dispensers installed at the site. The ISD software requires dispenser fuel flow meter data inputs. Reference TLS-350R Point-of-Sale (POS) Application Guide to select correct DIM card. Refer to the manual shipped with the DIM for installation instructions, refer to the TLS-3XX System Setup manual to program the DIM.

Probe Interface Module

Verify that a Probe Interface Module(s) is installed (Intrinsically-Safe bay) and that a Mag probe is in each gasoline tank and is connected to the module(s). Program the Mag probes following instructions in the TLS-3XX System Setup manual.

I/O Combination or 4-Relay Module

Connect the vapor processor motor control relay to two relays on either the 4-Relay or I/O Combination module as shown in Figure .

Multi-Port Card for Vapor Processor Communication

A Multi-port card is needed for RS-485 communication with the TLS console and is required with VST ECS membrane processor installations. Verify that a Multi-port card is installed in slot 4 of the card cage in the communications bay of the TLS console (ref. Figure). When installing this card, refer to the V-R Serial Comm Modules Installation Guide (577013-528) for instructions. Connect this card to the vapor processor as shown in Figure . Program the card as instructed in this manual.

TLS Console with V-R Vapor Polisher

Figure shows the interconnection wiring between a TLS console and a V-R Vapor Polisher.

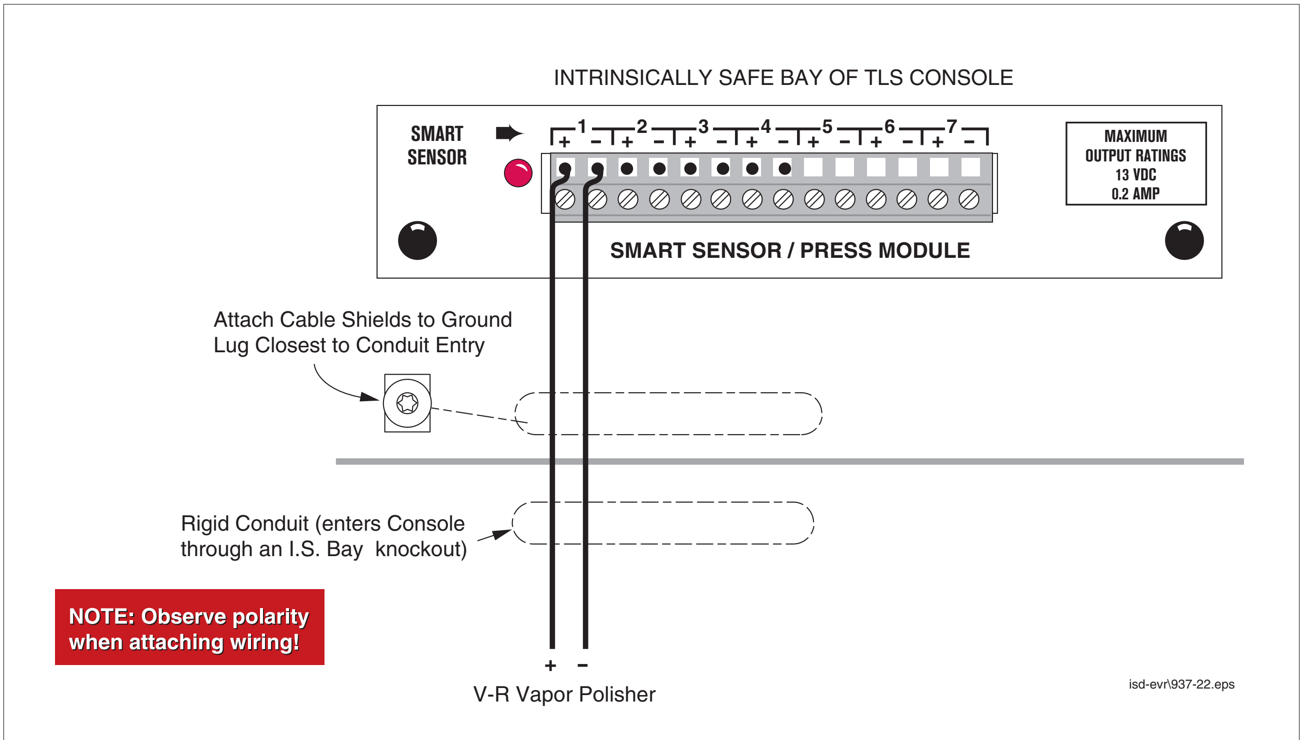


Figure 3. V-R Vapor Polisher Connections to TLS Console

TLS Console with VST Processor

Figure shows the interconnection wiring between a TLS console and a VST ECS Membrane Processor and VST Green Machine.

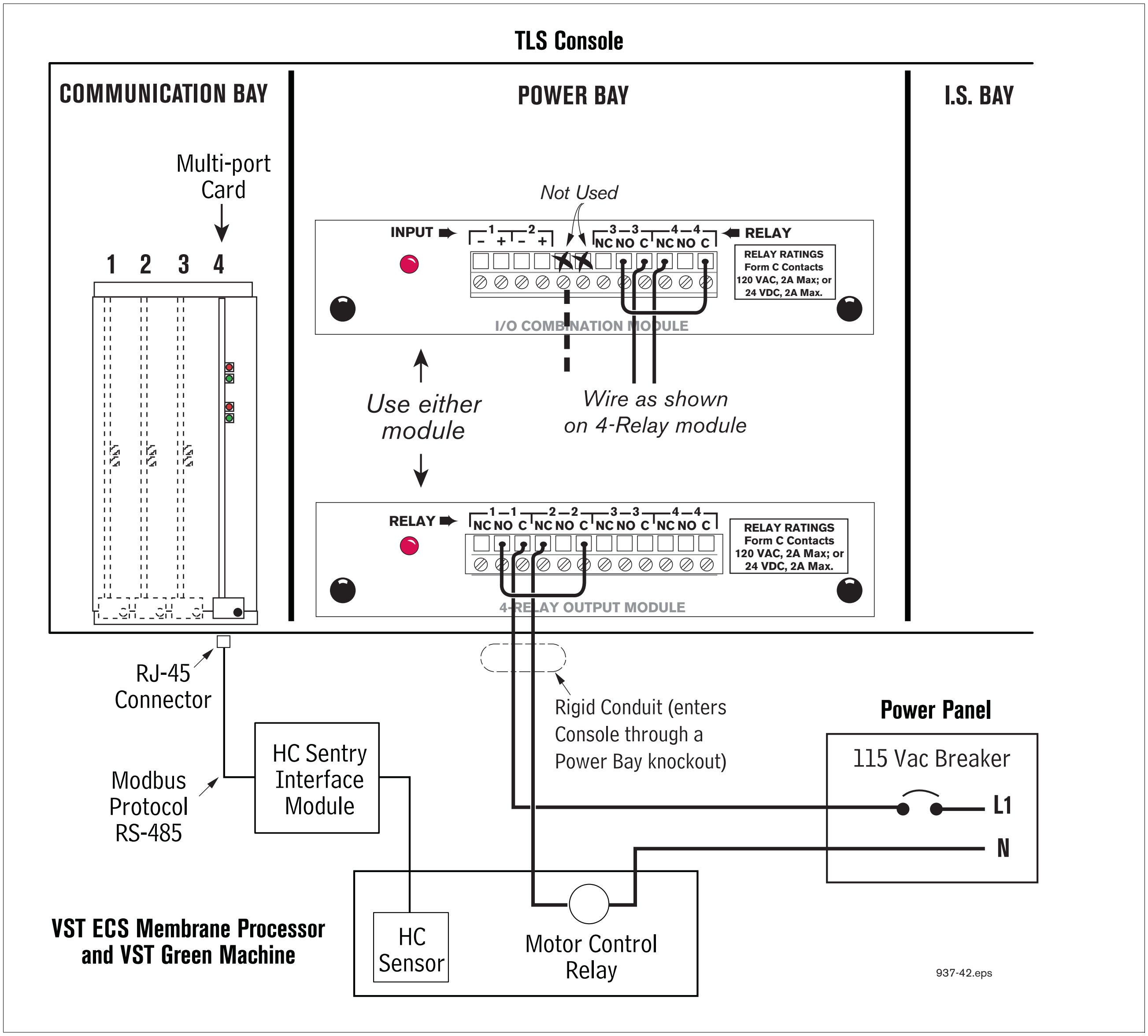


Figure 4. VST ECS Membrane Processor & VST Green Machine Connections to TLS Console

TLS Console with Hirt VSC 100 Processor

Figure shows the interconnection wiring between a TLS console and a Hirt VCS 100 Processor.

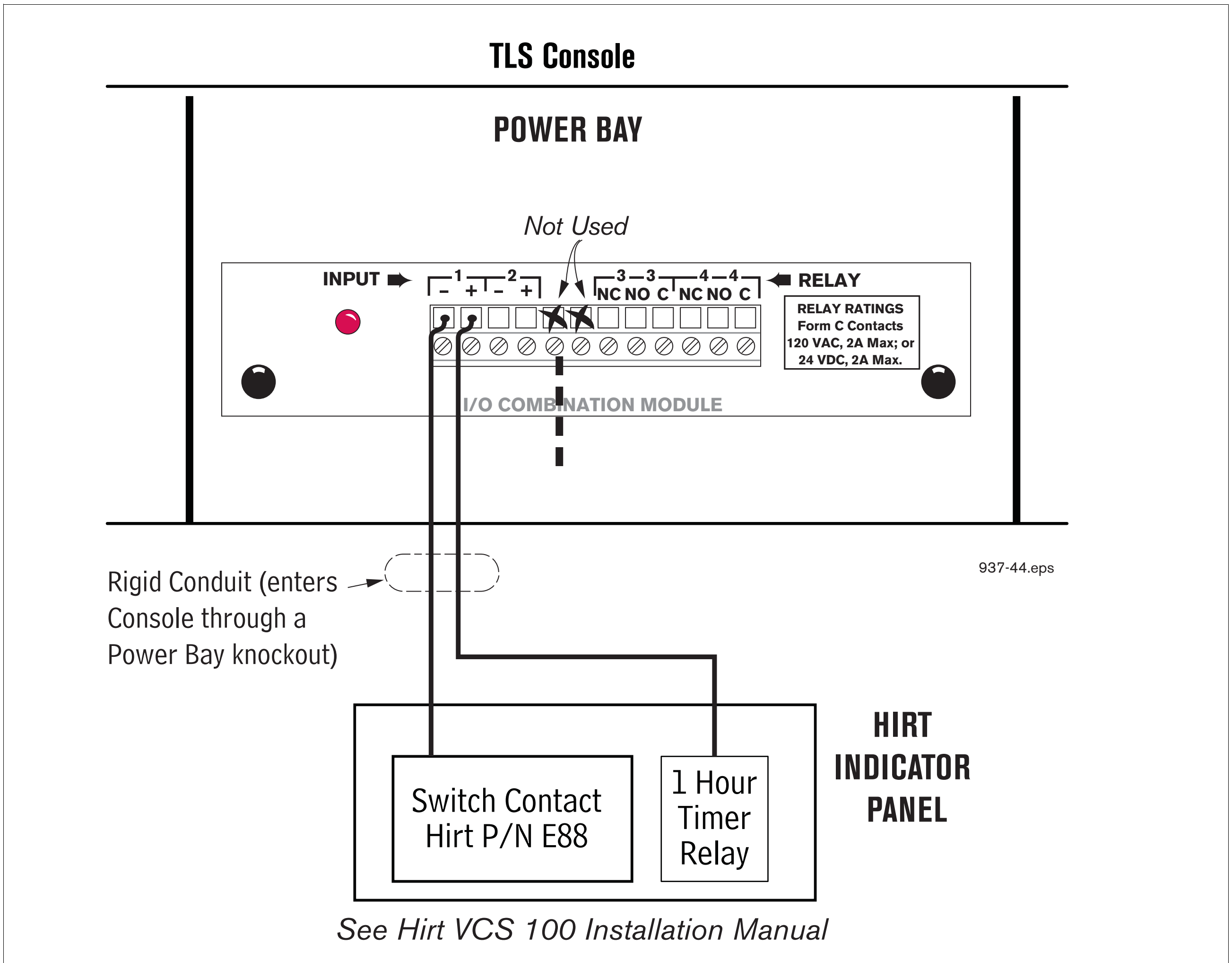


Figure 5. **Hirt VCS 100 Processor Connections to TLS Console**

3 Setup

Introduction

This section describes how to program the ISD system using the TLS console's front panel buttons and display. The procedures in this manual follow standard TLS console setup programming input, i.e., keypad/display interaction. If necessary, refer to Section 2 of the TLS-3XX System Setup manual (P/N 576013-623) to review entering data via the front panel keypads.

All ISD-related equipment must be installed at the site and connected to the TLS console prior to beginning the setups covered in this section. As with all TLS connections, you cannot change sensor wiring or module slots after programming or the system will not recognize the correct data. Reference the section entitled "Connecting Probe/ Sensor Wiring to Consoles" in the TLS-3XX Site Prep and Installation manual (P/N 576013-879) for rewiring precautions.

SYSTEM SETUPS

- External Input Setup - Hirt VCS 100 Processor Only
- Smart Sensor Setup - All ISD site (Figure 7)
  This setup mode function programs the Smart Sensor Interface module to monitor the Air Flow Meters, ATM, Vapor Valve and the Pressure Sensor.
- EVR/ISD Setup - All ISD sites (Figure 9, Figure 10 and Figure 11)
  This setup mode function programs the TLS console for EVR/ISD vapor recovery monitoring and reporting.
- Verify Console Date/Time
  Check the console front panel to confirm display of current date and time. Reset if necessary (refer to current date/current time setups in TLS-3XX System Setup manual).

ALARM SETUPS

One or more TLS setups below must be performed to shut down the tank or the dispenser should certain ISD alarms occur:

- For ISD sites with line leak detection - <u>XLLD Line Disable Setup</u> (go to Figure 18)

  This setup assigns ISD alarms to a line leak detector that will shut down the tank's STP.
- For ISD sites without line leak detection - <u>Output Relay Setup</u> (go to Figure 20)

  This setup assigns ISD alarms to a relay that will shut down the tank's STP.
- For ISD sites with dispenser shutdown - Dispenser Relay Setup (go to Figure 22)

  This setup assigns ISD alarms to a relay that will shut down the dispenser.

External Input Setup - Hirt VCS 100 Processor Only

The I/O Combination Module is installed in the Power bay of the TLS console. Figure 7 diagrams the External Input setup procedure required with the Hirt VCS 100 processor.

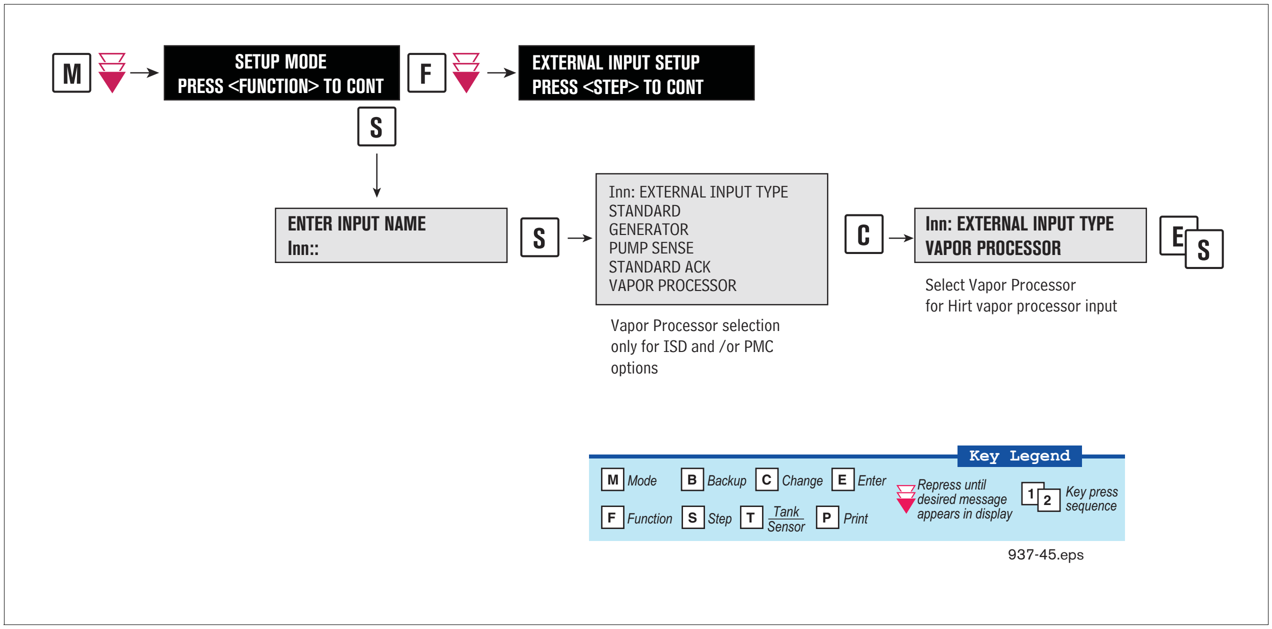


Figure 6. External Input Setup For Hirt VCS 100 Processor

Smart Sensor Setup

The Smart Sensor Interface Module is installed in the Intrinsically-Safe bay of the TLS console. This module monitors Air Flow Meters, ATM, Vapor Valve and the Vapor Pressure Sensor. Figure 7 diagrams the Smart Sensor setup procedure. Figure 8 shows a printout of the Smart Sensor setup.

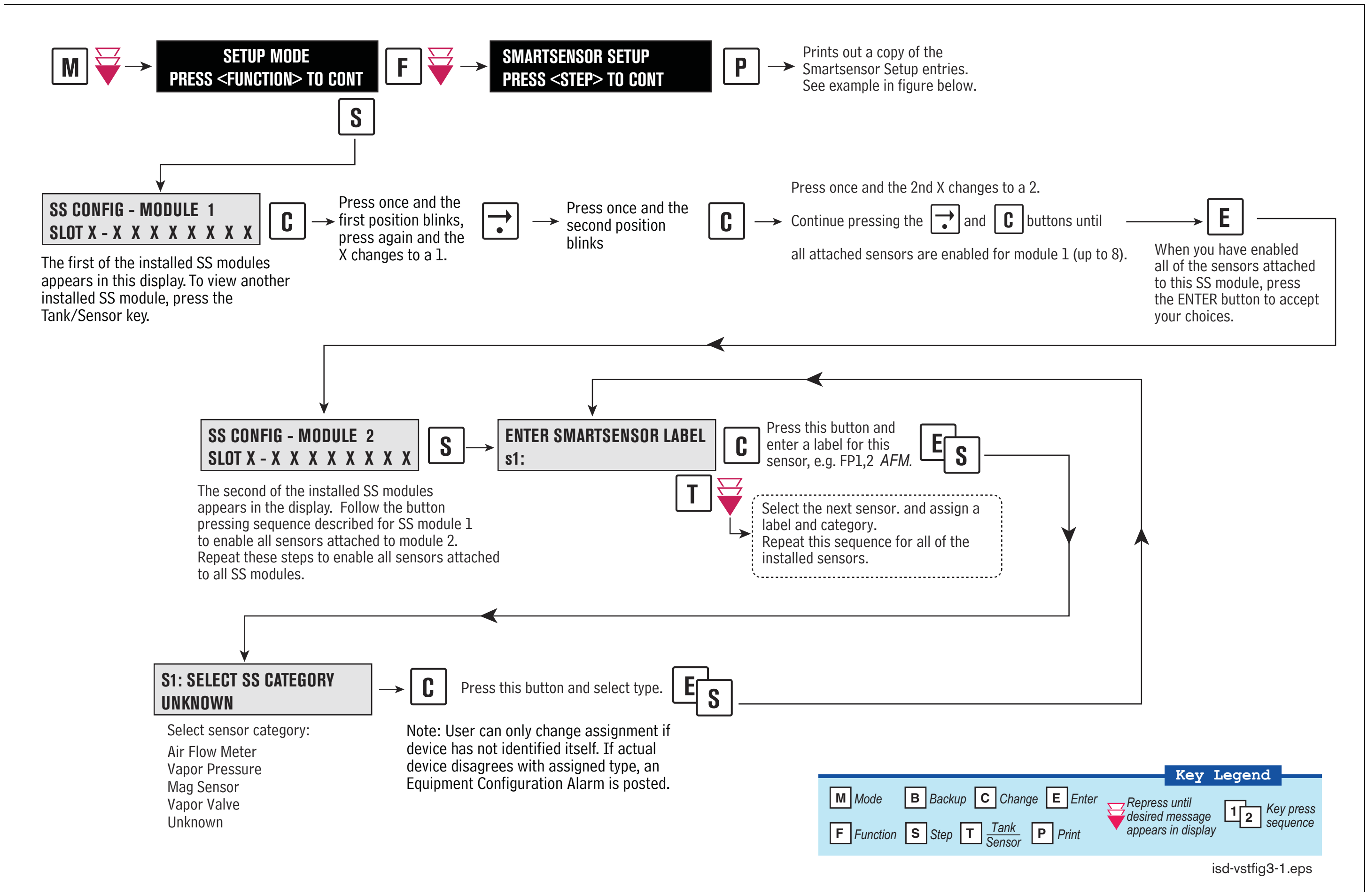


Figure 7. Smart Sensor Setup

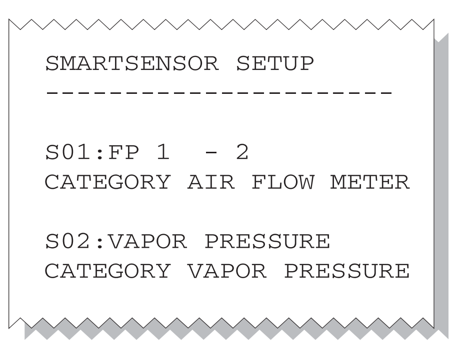


Figure 8. Smart Sensor Setup Printout Example

ATM Pressure Sensor Setup

The ATM Pressure Sensor is factory installed in the SmartSensor / Press module and preassigned to channel 8. At least one SmartSensor / Press module, which contains the ATM Pressure Sensor, must be installed in the console. You must configure at least one ATM Pressure Sensor for use by the Vapor Polisher or a PMC Set-up Fail will occur. NOTE: if more than one SmartSensor / Press module is installed, only one ATM Pressure Sensor needs to be configured.

Look in console and note the slot position of the SmartSensor / Press module. Enter the Setup Mode and press the FUNCTION key until you see the message:

SMARTSENSOR SETUP
PRESS <STEP> TO CONTINUE

Press STEP until you see the message:

SS CONFIG - MODULE *n*
SLOT *x* - X X X X X X X X

Where *x* is the slot number containing the SmartSensor / Press module. Press the → key to move the cursor to the last (8th) X. Press CHANGE and the message below should appear:

SLOT *x* - X X X X X X X 8
PRESS <STEP> TO CONTINUE

Press STEP:

ENTER SMARTSENSOR LABEL
s 8:

NOTE: In the example above, the ATM P sensor position is 8 but it could be16, 32, or 40 depending on the SmartSensor's module number.

Press CHANGE and enter a label:

ENTER SMARTSENSOR LABEL
s 8: (ATMP Sensor Label)

Press ENTER to accept your label:

s 8: (ATMP Sensor Label)
PRESS <STEP> TO CONTINUE

Press STEP:

s 8: SELECT SS CATEGORY
UKNOWN

Press CHANGE until you see the message:

s 8: SELECT SS CATEGORY
ATM P SENSOR

Press ENTER to accept the category. Press STEP, then BACKUP to return to the configuration display for Smart Sensor module 1:

SS CONFIG - MODULE 1
SLOT *x* - X X X X X X X X

This completes the ATM Pressure Sensor configuration.

EVR/ISD Setup

You must choose the appropriate data sheet from Appendix A for the vapor recovery system installed at your facility (e.g., Single or Multi-Hose Dispensers) and record in those sheets, all of the unique information from sensors/hose positions, prior to beginning the TLS EVR/ISD set up procedure below.

Figure 9 describes the first of the EVR/ISD setup programming diagrams.

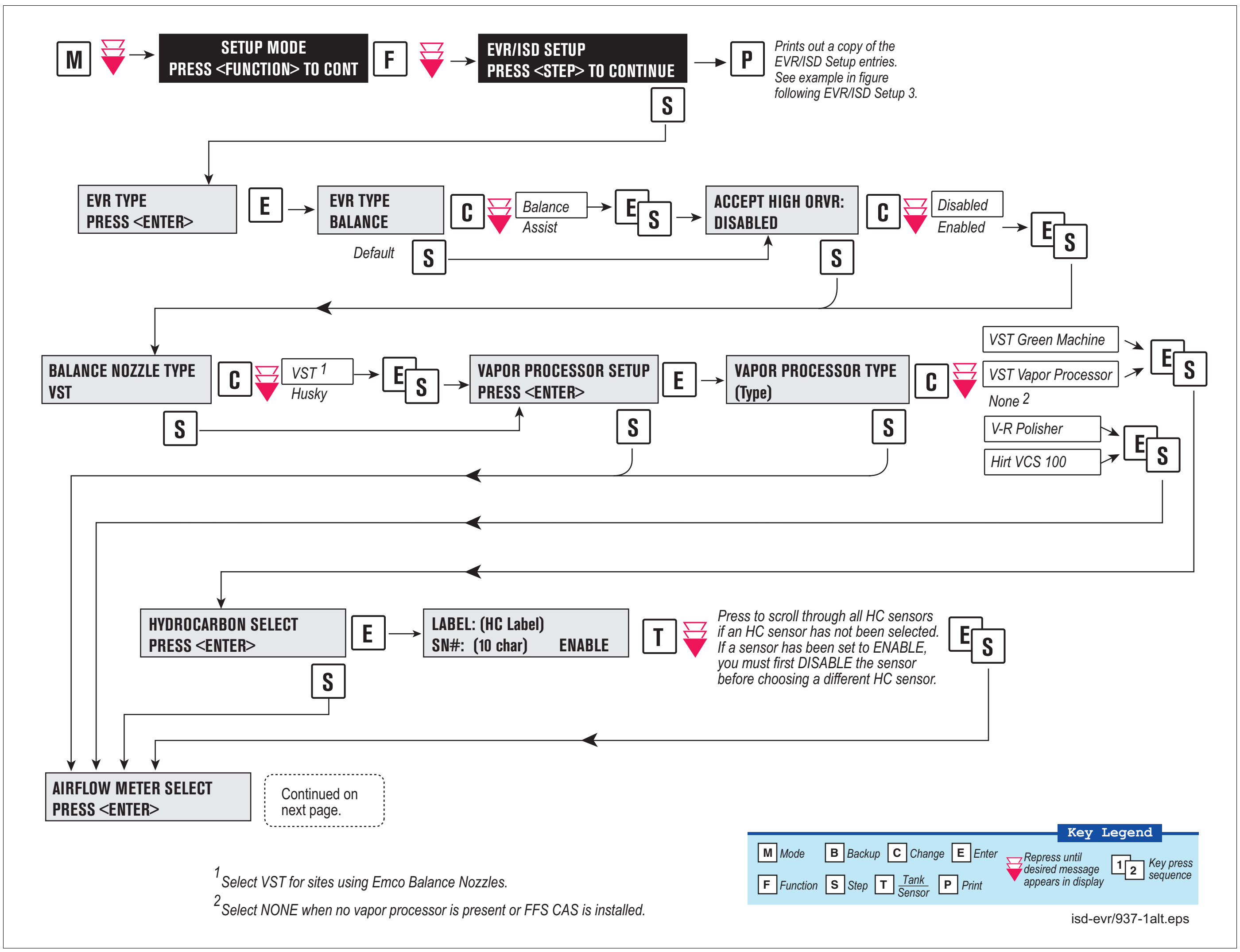


Figure 9. EVR/ISD Setup 1

Figure 10 describes the second of the EVR/ISD setup programming diagrams.

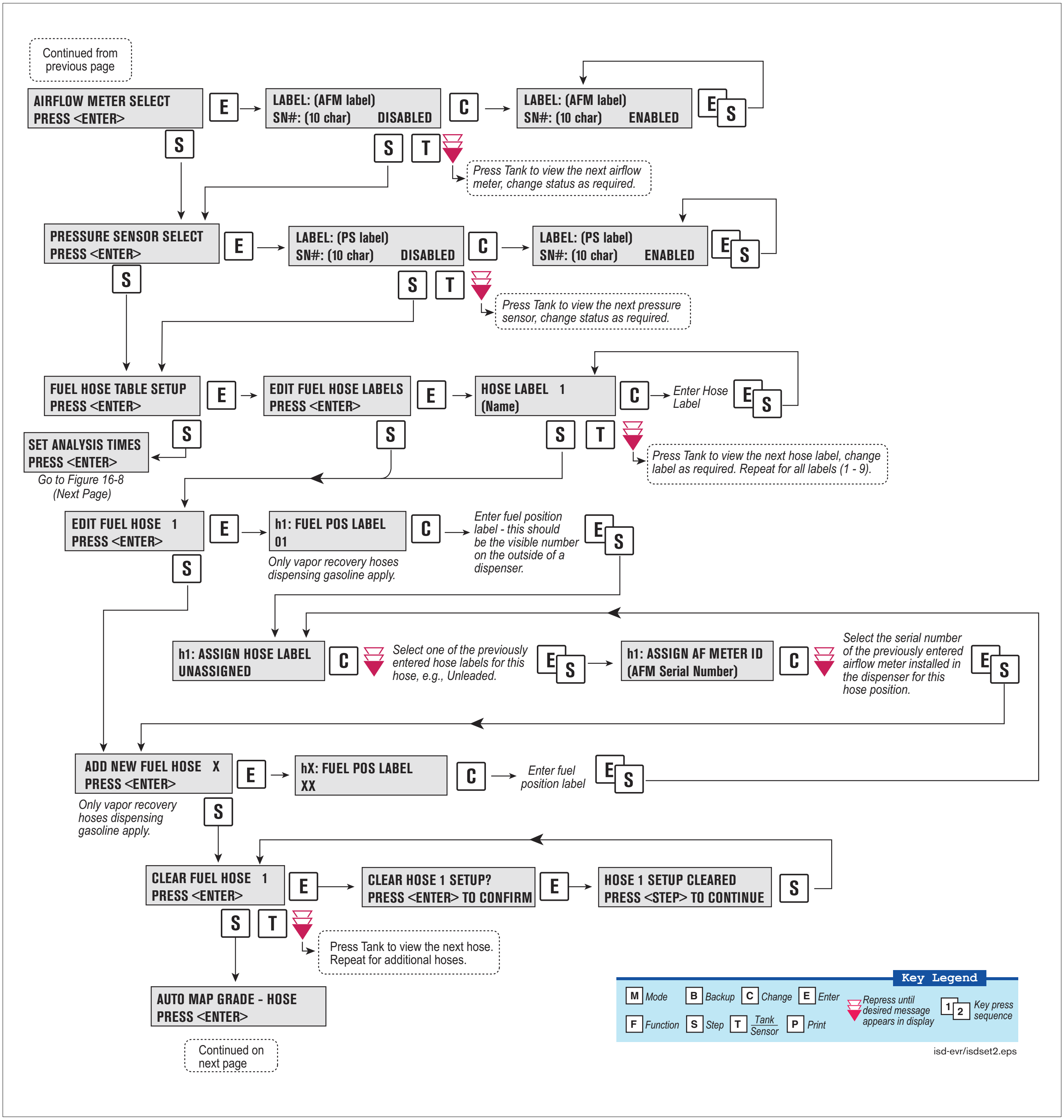


Figure 10. EVR/ISD Setup 2

Figure 11 describes the last of the EVR/ISD setup programming diagrams.

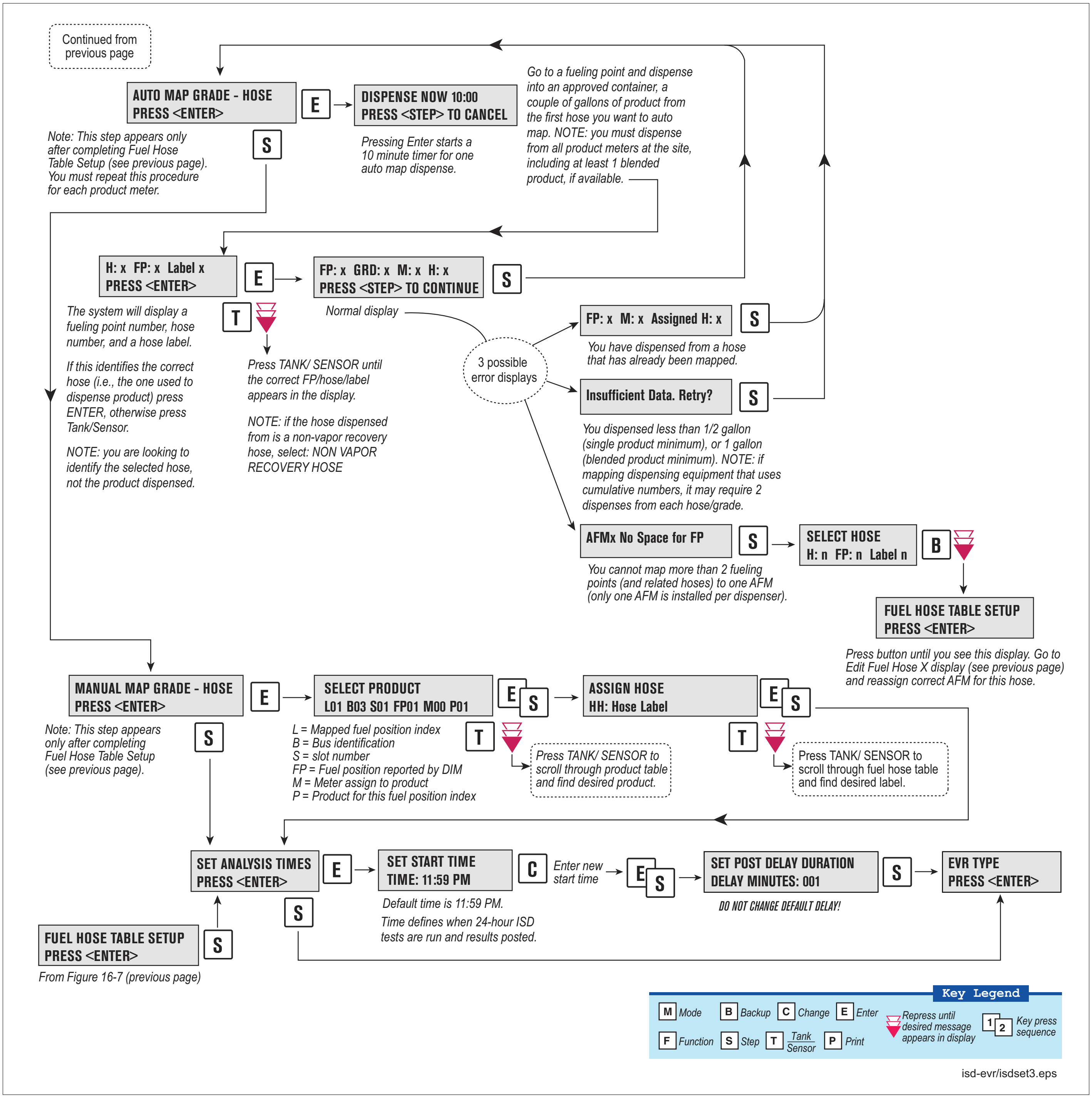


Figure 11. EVR/ISD Setup 3

```
EVR/ISD SETUP

EVR TYPE: BALANCE
BALANCE NOZZLE TYPE
VST

VAPOR PROCESSOR TYPE:
VEEDER-ROOT POLISHER

ANALYSIS TIMES
TIME: 11:59 PM
DELAY MINUTES: 1

ACCEPT HIGH ORVR:
DISABLED

ISD HOSE TABLE
ID  FP  FL  HL  AA  RR
------------------------
01  01  01  02  01  01
02  02  02  02  01  01
03  03  03  02  02  02
04  04  04  02  02  02
05  05  05  02  03  UU
06  06  06  02  03  UU
07  07  07  02  04  UU
08  08  08  02  04  UU
09  09  09  02  05  UU
10  10  10  02  05  UU
11  11  11  02  06  UU
12  12  12  02  06  UU

ISD AIRFLOW METER MAP
ID SERIAL NUM LABEL
------------------------
 1 03001401   AFM1 FP1 -
 2 03001402   AFM2 FP3 -
 3 03001403   AFM3 FP5 -
 4 03001404   AFM4 FP7 -
 5 03001405   AFM5 FP9 -
 6 03001406   AFM6 FP11

ISD FUEL GRADE HOSE MAP
    1   2   3   4
FP MHH MHH MHH MHH AA
------------------------
01 101 301 901 U U  1
02 102 302 902 U U  1
03 103 303 903 U U  2
04 104 304 904 U U  2
05 105 305 905 U U  3
06 106 306 906 U U  3
07 107 307 907 U U  4
08 108 308 908 U U  4
09 109 309 909 U U  5
10 110 310 910 U U  5
11 111 311 911 U U  6
12 112 312 912 U U  6

LABEL TABLE
------------------------
 1: UNASSIGNED
 2: BLEND3
 3: REGULAR
 4: MID GRADE
 5: PREMIUM
 6: GOLD
 7: BRONZE
 8: SILVER
 9: BLEND2
10: BLEND4
```

ID = Hose ID
FP = Mapped fuel position as TLS Console recognizes it
(-1 = unassigned)
FL = Fuel position label as written on dispenser
HL = Hose label
AA = Airflow meter ID assigned
RR = Dispenser Relay ID
UU = unassigned

ID = Airflow meter ID assigned
Serial Number = Airflow meter's serial number

FP = Mapped fuel position
M/H = Meter and hose for product X
AA = Airflow meter assigned to first (lowest X) product with meter and hose assigned (usually same for entire dispenser)
U = Unassigned
N = Not used by ISD

ID = Label ID
Label = User definable
00 = reserved, non-ISD

937-2alt.eps

Figure 12. Example VST ECS Printout

Output Relay Setup - VST ECS Membrane Processor

The Output Relay setup programs an output relay so that the TLS console can switch a controlled vapor processor on and off as shown in Figure 13.

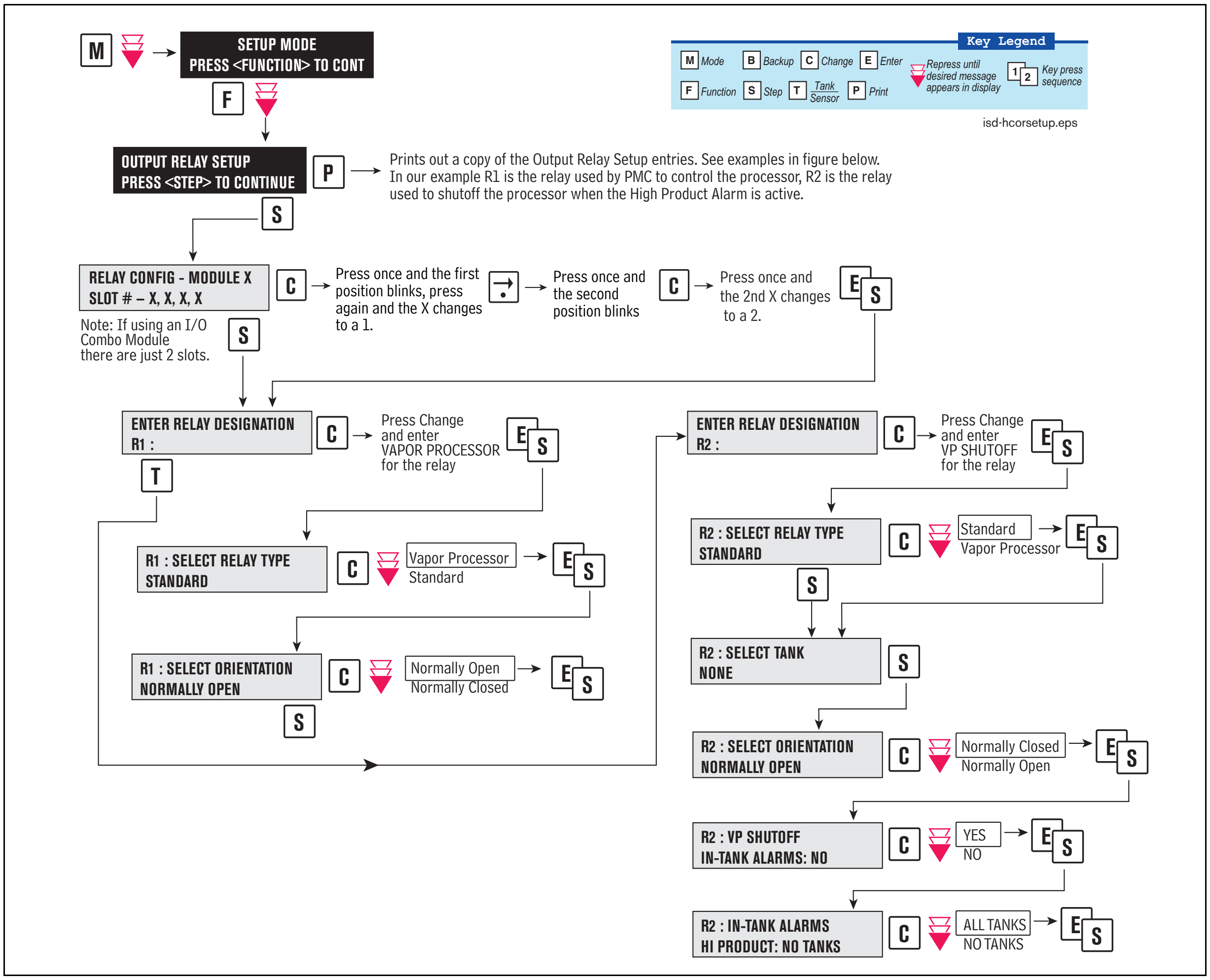


Figure 13. Output Relay Setup for VST ECS Membrane Processor

Figure 14 shows example setup printouts of the Output Relays setup.

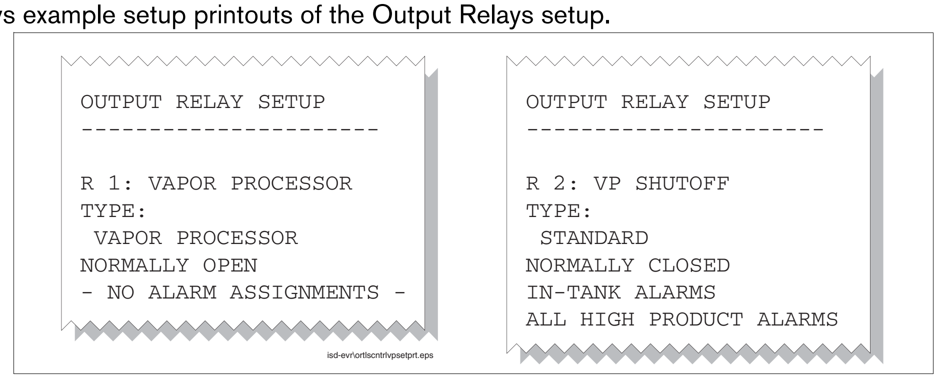


Figure 14. Output Relay Setup Printout Examples for TLS Console Controlled Processor

PMC Setup for VST ECS Membrane Processor

PMC setup allows you to select the maximum runtime and the start/stop pressure of TLS console controlled vapor processors (see Figure 15).

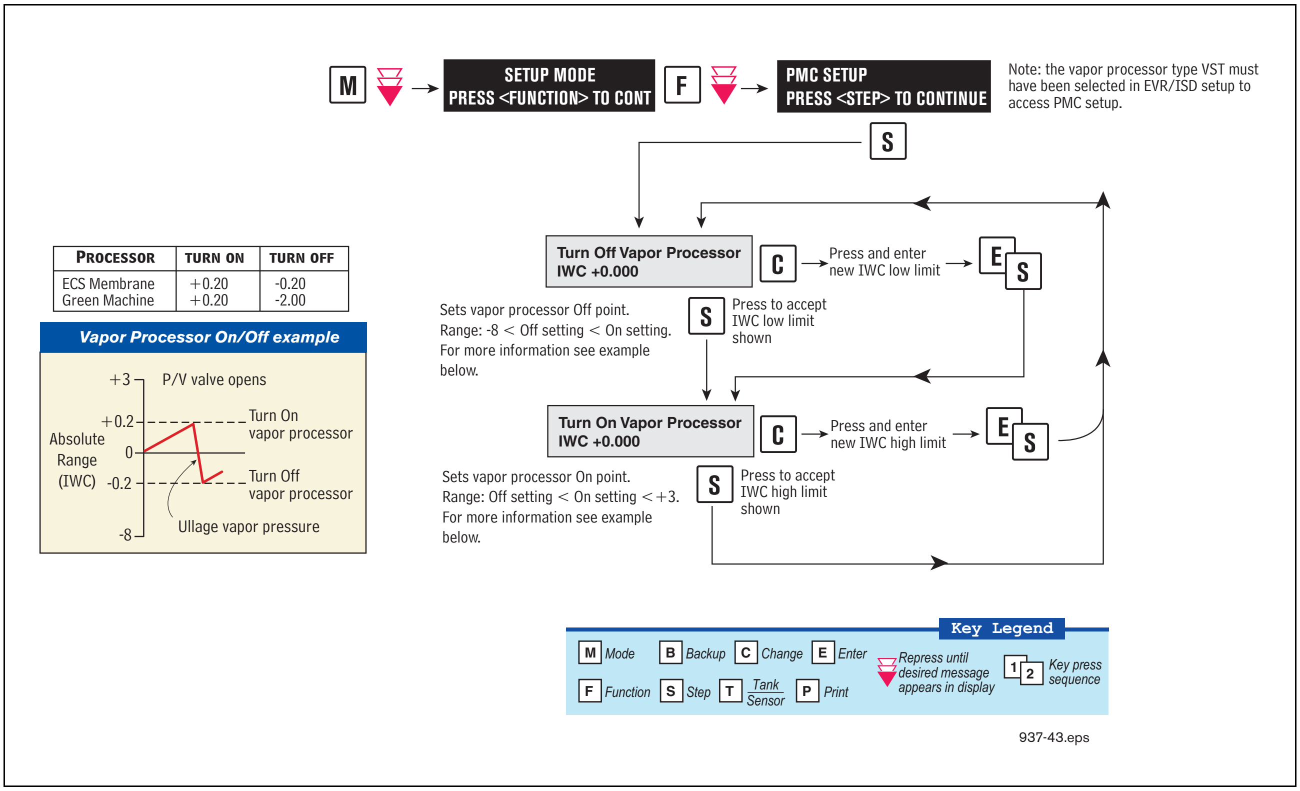


Figure 15. PMC Setup - VST ECS Membrane Processor

Alarm Setup

INTRODUCTION

California regulations (VAPOR RECOVERY CERTIFICATION PROCEDURE, CP-201, DATED MAY 25, 2006 CERTIFICATION PROCEDURE FOR VAPOR RECOVERY SYSTEMS AT GASOLINE DISPENSING FACILITIES, Sections 9.1.2) require shut down of dispensing systems that generate specific alarm conditions. To accomplish this, the TLS must be configured to control the gasoline tank's pump (diesel tanks are not monitored) or the gasoline dispensers in order to disable them when ISD shutdown alarm conditions occur. Prior to setting up ISD shut down alarms, you will need to determine how the site's tank pumps or dispensers are controlled. If the site has line leak detection, you can shut down the line (tank) by assigning the ISD alarms in Line Leak Disable setup. In the absence of line leak detection, you can assign the ISD alarms to Output Relays which in turn can be wired to shut down the tank or assign ISD alarms to Dispenser Relays which can be used to shut down the dispenser. Figure 16 illustrates two examples of tank pump control, one using a line leak/output relay combination and one using output relays.

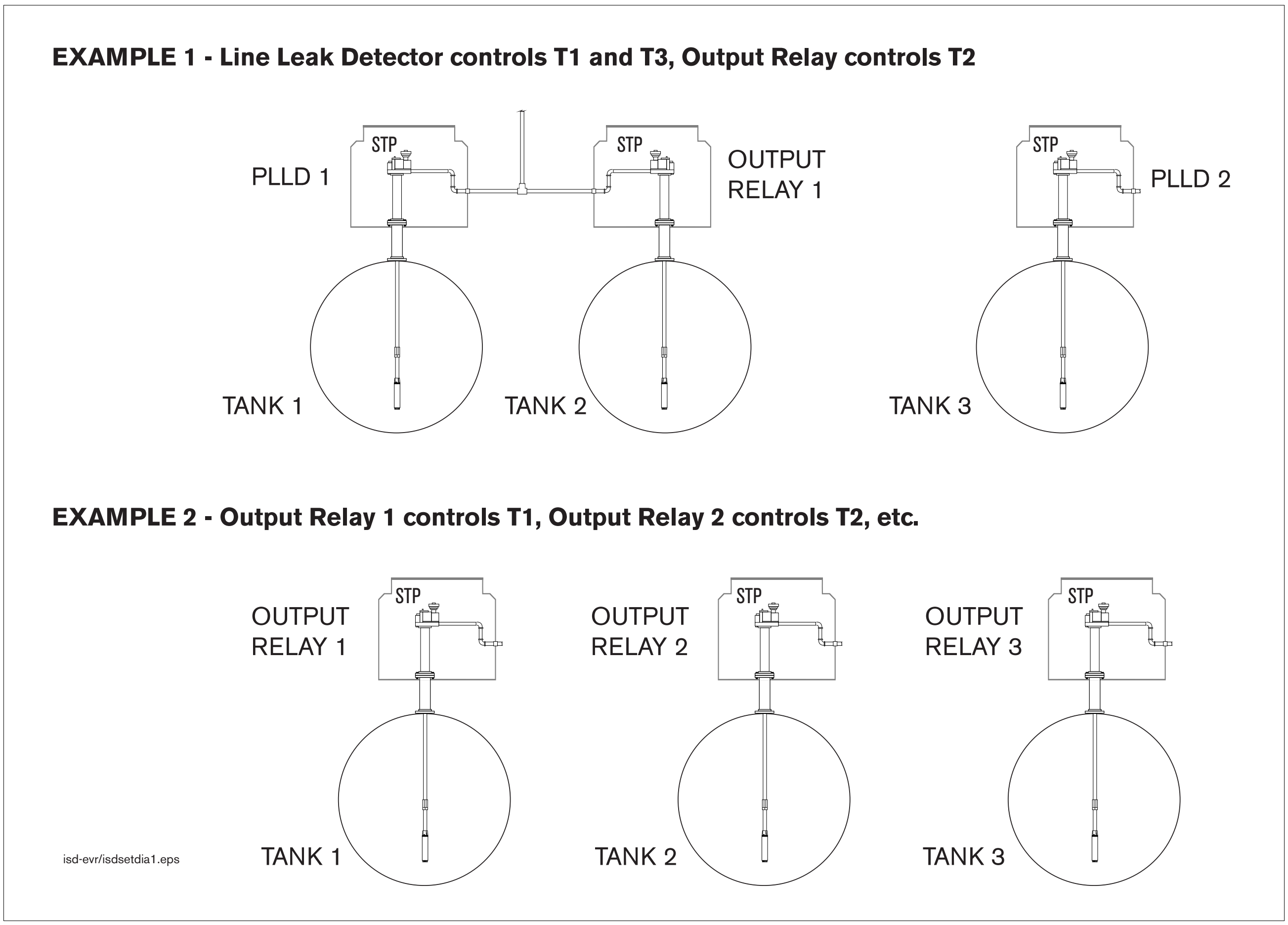


Figure 16. Site Tank Control Examples

Referencing the figure above, in example 1, you would assign the ISD shut down alarms for tank 1 to PLLD 1 in PLLD Line Leak Disable setup, for tank 2 to a relay in Output Relay Setup, and for tank 3 to PLLD 2 in PLLD Line Leak Disable setup. In example 2, you would assign the ISD shut down alarms for tank 1 to output relay 1, tank 2 to output relay 2, and tank 3 to output relay 3.

Figure 17 illustrates two examples of dispenser control using Dispenser Relay modules.

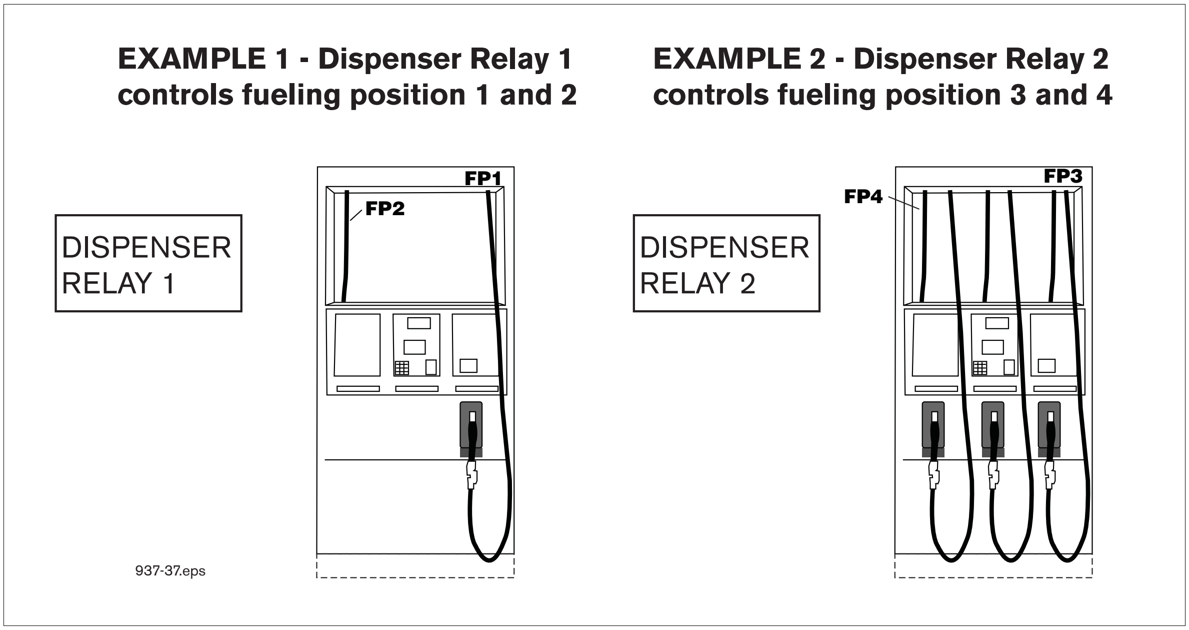


Figure 17. Dispenser Control Examples

You can assign ISD containment shut down alarms to the submersible pump output relays and assign ISD collection alarms to the dispenser relay as shown above.

ALARM SETUP FOR SITES WITH LINE LEAK DETECTION

Figure 18 illustrates the setup steps required to assign ISD Shut Down Alarms to a tank having a line leak detection system installed.

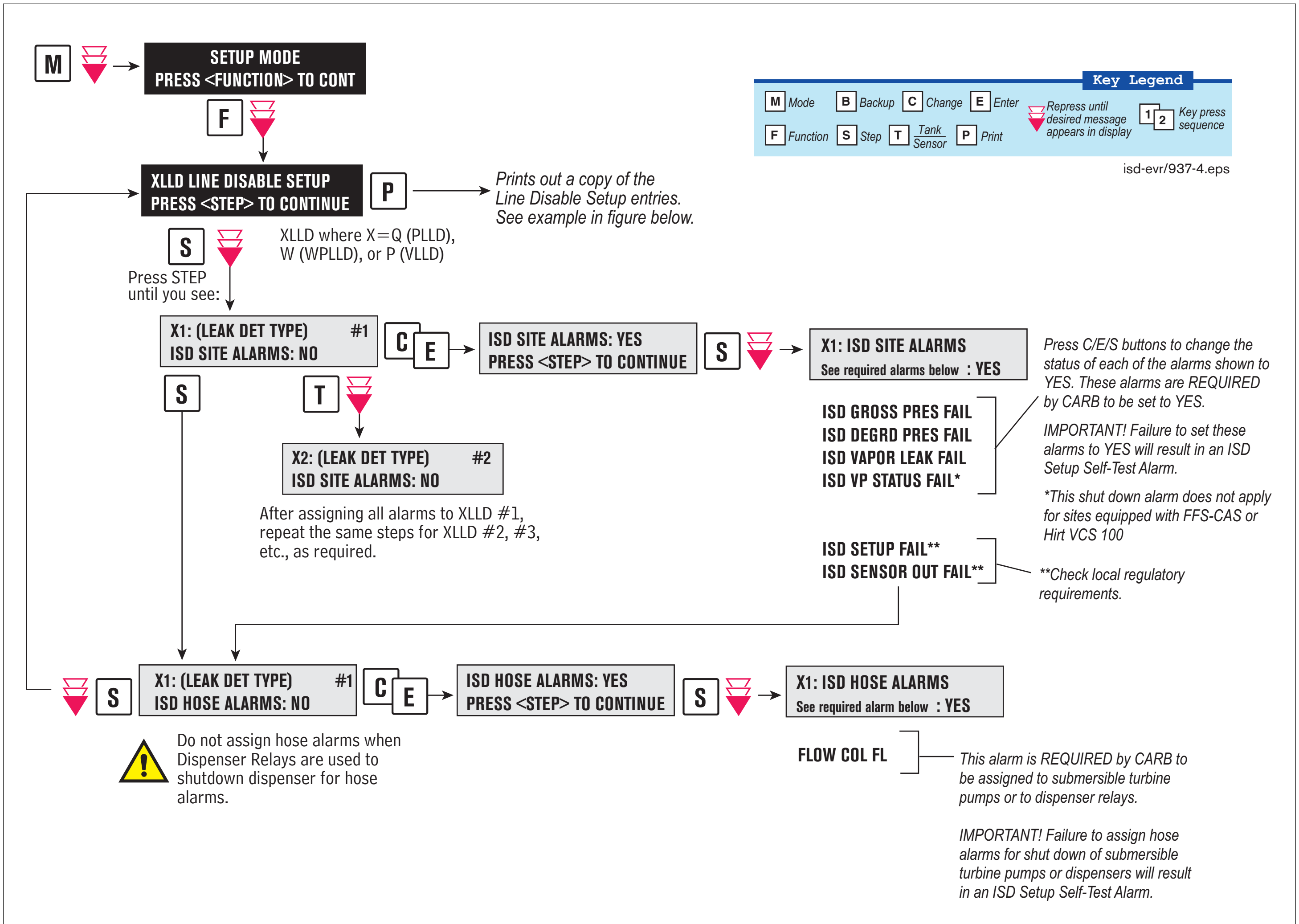


Figure 18. Assigning ISD Shut Down Alarms in Line Leak Disable Setup

Figure 19 shows a resulting printout of the Line Leak Disable setup with ISD alarms assigned when Dispenser Relay modules are not used.

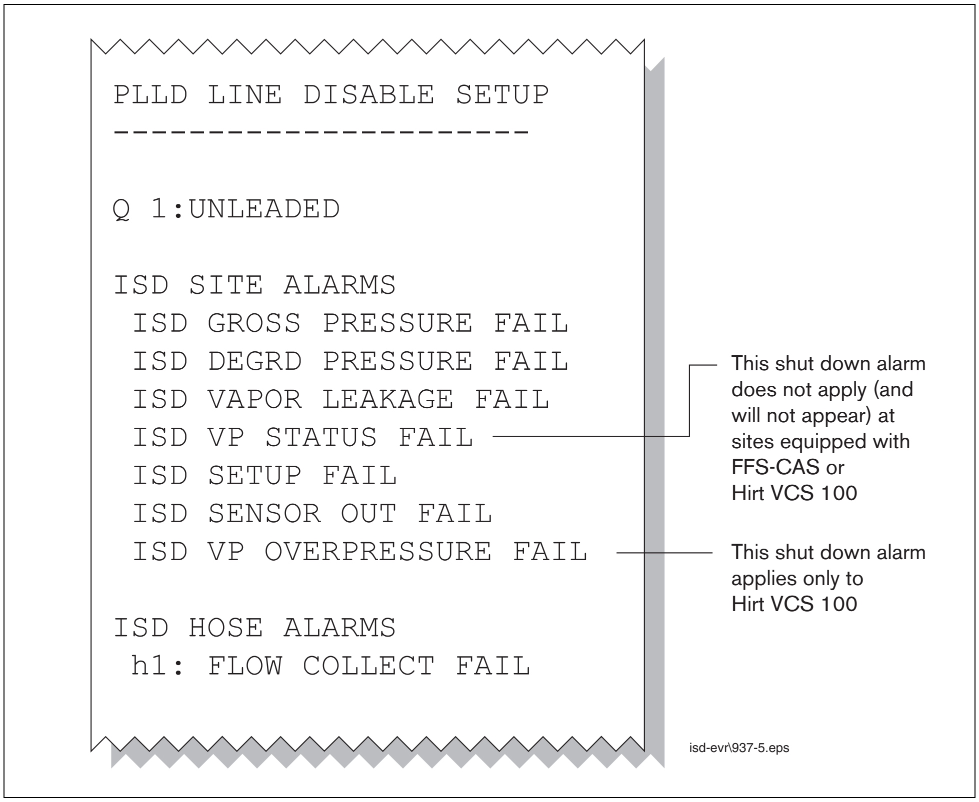


Figure 19. Example Line leak Disable Setup Printout

ALARM SETUP FOR SITES WITHOUT LINE LEAK DETECTION

Figure 20 illustrates the setup steps required to assign ISD Shut Down Alarms to a tank using either a Four Relay Output Module or an I/O Combination Module.

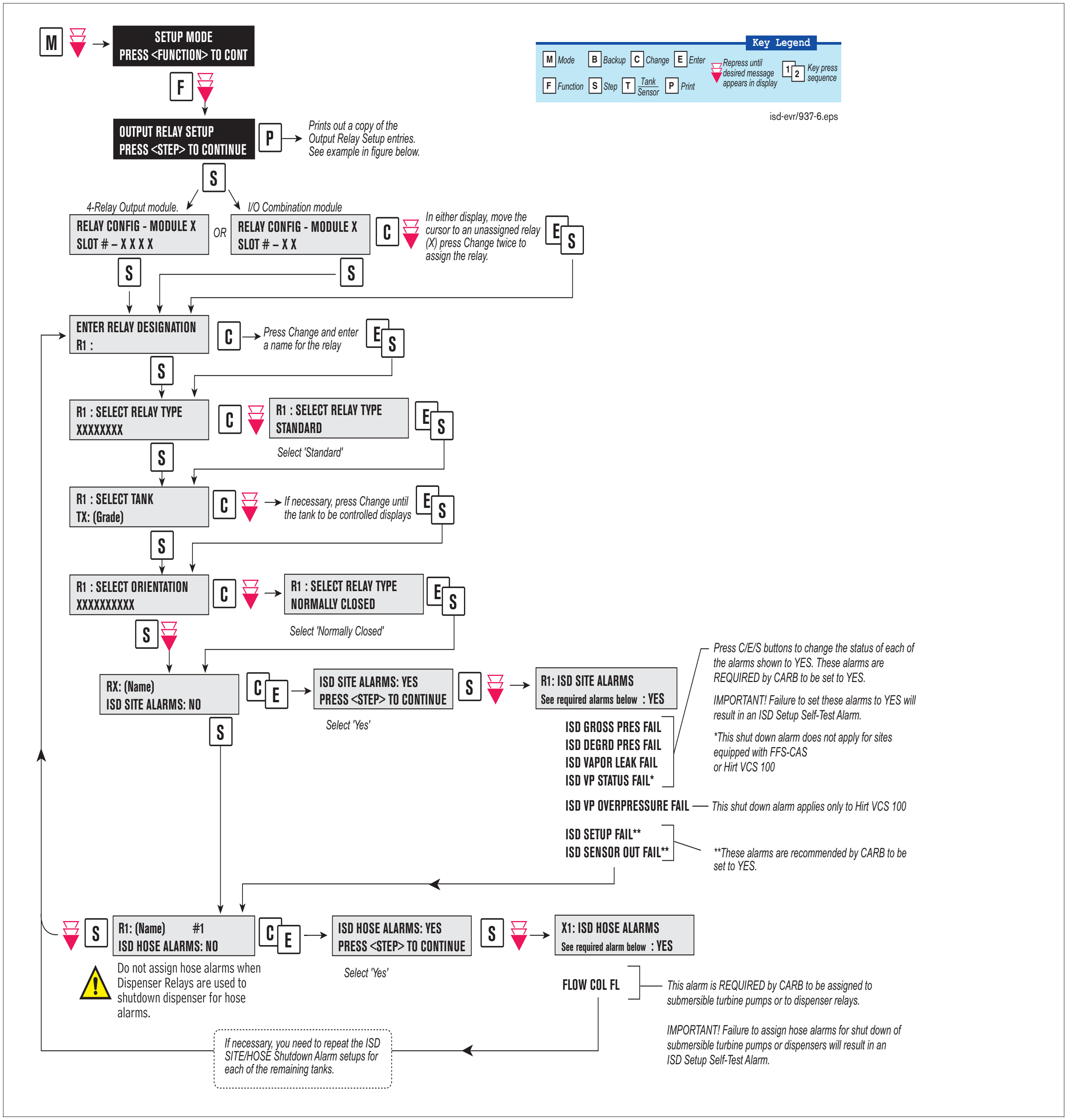


Figure 20. Assigning ISD Shut Down Alarms in Output Relay Setup

Figure 21 shows a resulting printout of the Output Relay setup with ISD alarms assigned when Dispenser Relay modules are not used.

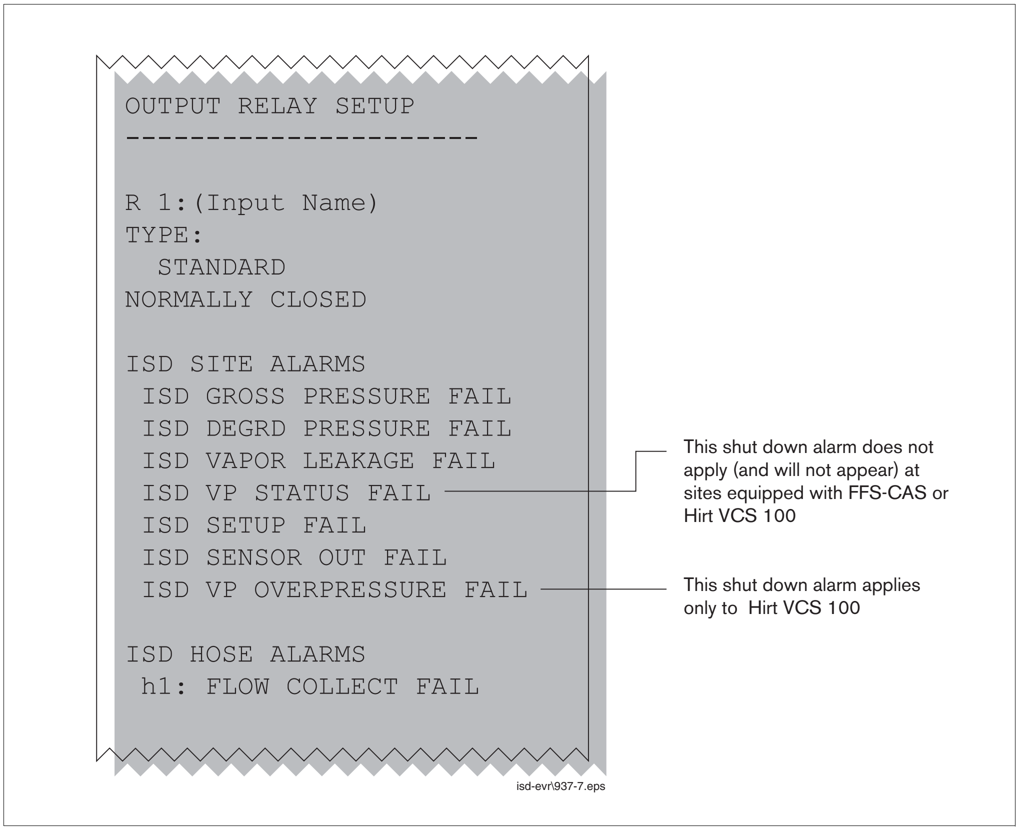


Figure 21. Example printout - ISD Alarms Assignments - Output Relay Setup

ALARM SETUP FOR SITES WITH DISPENSER RELAYS

Figure 22 illustrates the setup steps required to assign ISD Shut Down Alarms to a dispenser using a Dispenser Relay Module.

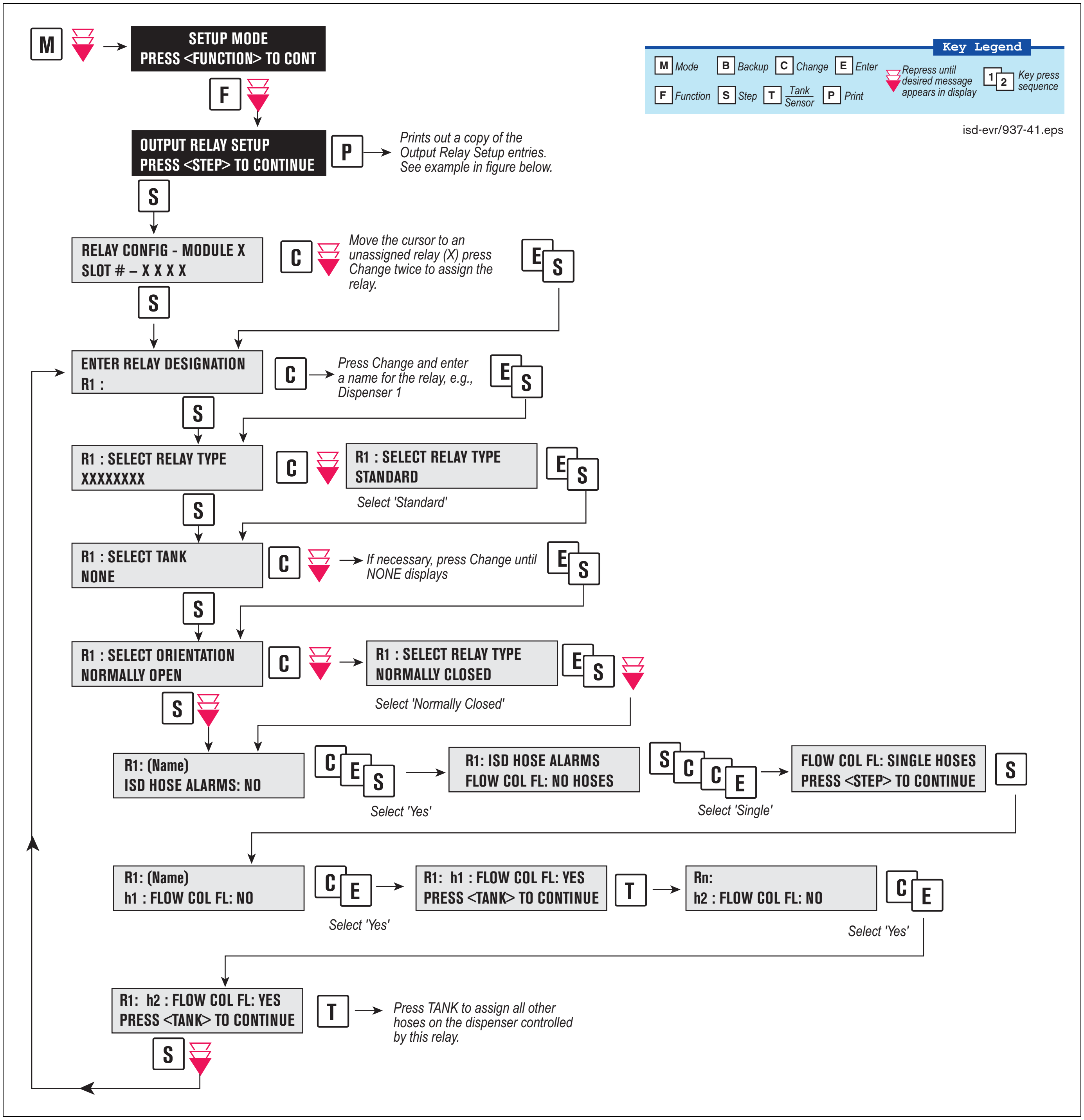
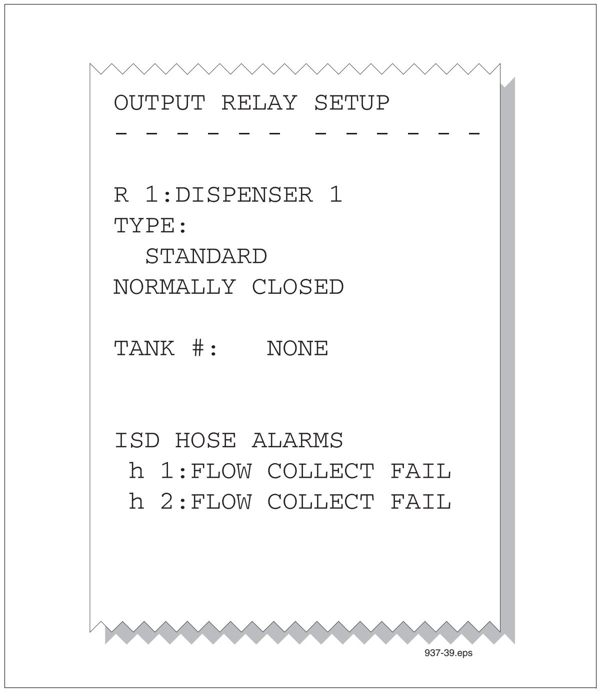


Figure 22. Assigning ISD Shut Down Alarms in Dispenser Relay Setup

Figure 23 shows a resulting printout of the Dispensor Relay setup with ISD hose alarms assigned.



```
OUTPUT RELAY SETUP
- - - - - -  - - - - - -

R 1:DISPENSER 1
TYPE:
  STANDARD
NORMALLY CLOSED

TANK #:   NONE


ISD HOSE ALARMS
 h 1:FLOW COLLECT FAIL
 h 2:FLOW COLLECT FAIL
```


Figure 23. Example printout - ISD Hose Alarm Assignments - Dispenser Relay Setup

4 ISD Operability Test Procedure

The following procedures shall be used at field sites to determine the operability of the Veeder-Root ISD system to satisfy the requirements documented in VAPOR RECOVERY CERTIFICATION PROCEDURE, CP-201, DATED MAY 25, 2006 CERTIFICATION PROCEDURE FOR VAPOR RECOVERY SYSTEMS AT GASOLINE DISPENSING FACILITIES. Testing the ISD equipment in accordance with this procedure will verify the equipment's operability for Vapor Containment Monitoring and Vapor Collection Monitoring.

Veeder-Root's TLS console ISD System Self-Test Monitoring algorithms are designed to verify proper selection, setup and operation of the TLS console modules and sensors and will not complete and report passing test results in the event of a failure of components used in the system. Completed ISD monitoring tests are evidence that:

- The system was properly powered for data collection
- All necessary ISD sensors were setup and connected
- All necessary ISD sensors were operating within specification
- All internal components including TLS console modules were properly setup and operating within specification

Veeder-Root recommends printing a copy of the ISD ALARM STATUS and ISD DAILY report (REF. Section 5, Operation of the ISD Install, Setup & Operation Manual) periodically to determine that compliance tests are being completed in accordance with local and state regulations.

Vapor Pressure Sensor Verification Test

See EO VR 204 Exhibit 10 for the Pressure Sensor Verification Test.

Vapor Flow Meter Operability Test

See EO VR 204 Exhibit 17 for the ISD Vapor Flow Meter Operability Test Procedure.

Vapor Processor Operability Test

See EO VR 204 Exhibit 8 and 9 for the VST ECS Membrane Operability Test.

5 Operation

Alarms

OVERVIEW OF TLS CONSOLE INTERFACE

The TLS console is continuously monitoring the vapor recovery system, PMC and ISD sensors for alarm conditions such as excessively high or low vapor collection, containment system vapor leakage and equipment problems.

During normal operation when the TLS console and monitored EVR/ISD System is functioning properly and no alarm conditions exist, the "ALL FUNCTIONS NORMAL" message will appear in the system status (bottom) line of the console display, and the green Power light will be On (see Figure 22).

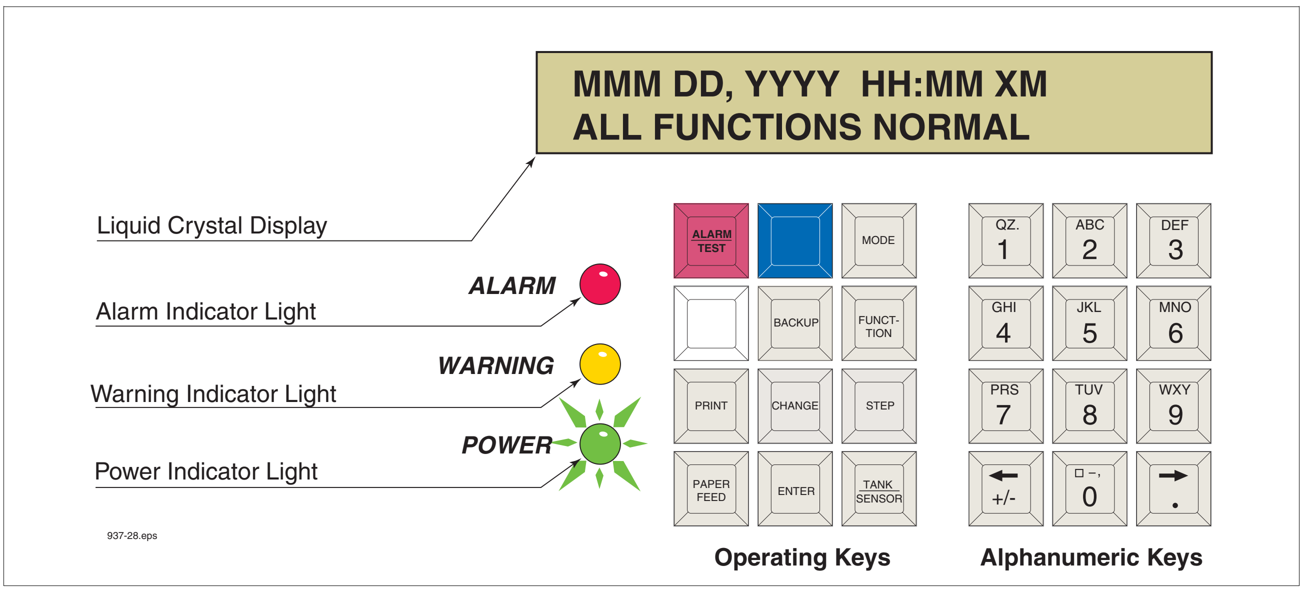


Figure 22. TLS console alarm interface

If an alarm condition occurs the system displays the condition type and its location. If more than one condition exists, the display will continuously cycle through the appropriate alarm messages. The system automatically prints an alarm report showing the alarm type, its location and the date and time the alarm condition occurred.

Warning and alarm posting causes the TLS console-based system to activate warning or failure indicator lights, an audible alarm, and an automatic strip paper printout documenting the warning or alarm. Historical reports of warning and alarm events are available for up to one year.

WARNING POSTING

Displayed messages alert you to the source and type of alarm. Printed messages show the type and location of the alarm. In the Warning example in Figure 23, the display's second line and printed message indicates that the containment system's vapor leak rate has increased above the allowed standard generating a warning.

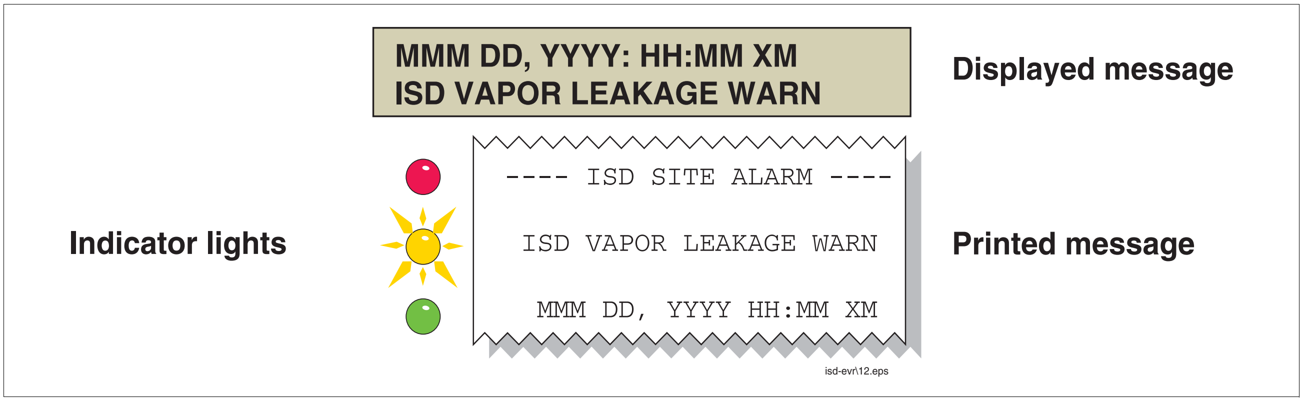


Figure 23. Example Warning posting

The TLS console also logs an entry to the Warning Log upon posting a warning.

ALARM POSTING

Displayed messages alert you to the source/number and type of alarm. Printed messages show the type and location of the alarm. In the alarm example in Figure 24 the display's second line and printed message indicates that vapor collection on hose 1, FP1 Super has dropped below the allowed standard resulting in a failure alarm. (By default, for unihose dispensers, FP1 BLEND3 will be displayed rather than FP1SUPER as shown below.)

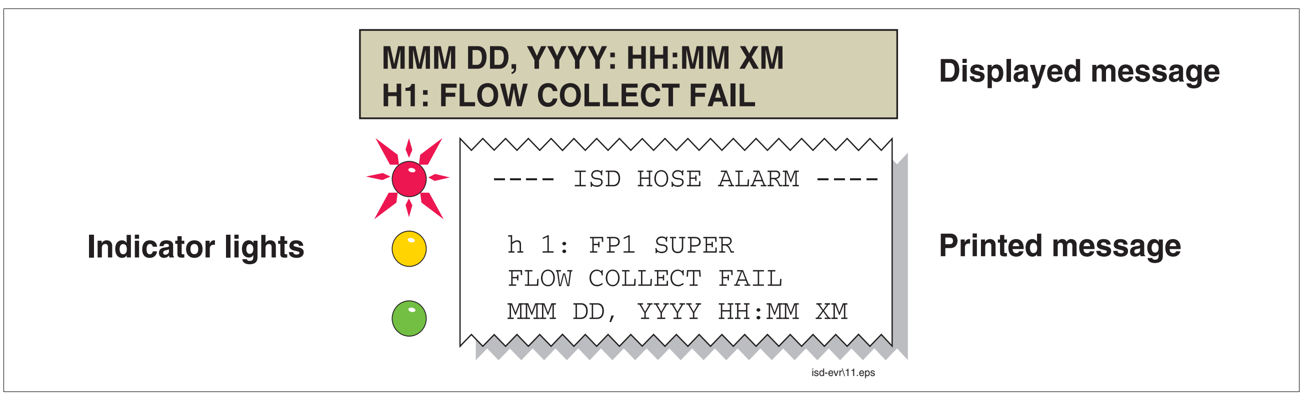


Figure 24. Example Alarm posting

Upon posting a failure alarm, the TLS console logs an entry to the Failure Log, prohibits fuel dispensing from all ISD gasoline fueling points or effected fueling points when dispenser shutdown is enabled and logs a shutdown event to the Shutdown & Misc. Event Log.

ISD can prohibit fuel dispensing from all gasoline fueling points by shutting down the submersible pumps in all gasoline tanks or individual fueling points using dispenser relays. The method of overriding an ISD Alarm shutdown is discussed in the “Site Re-enable” section.

SITE RE-ENABLE

The TLS console ALARM/TEST button allows you to perform a logged shutdown override and resume dispensing. Figure 25 illustrates the ISD alarm override procedure.

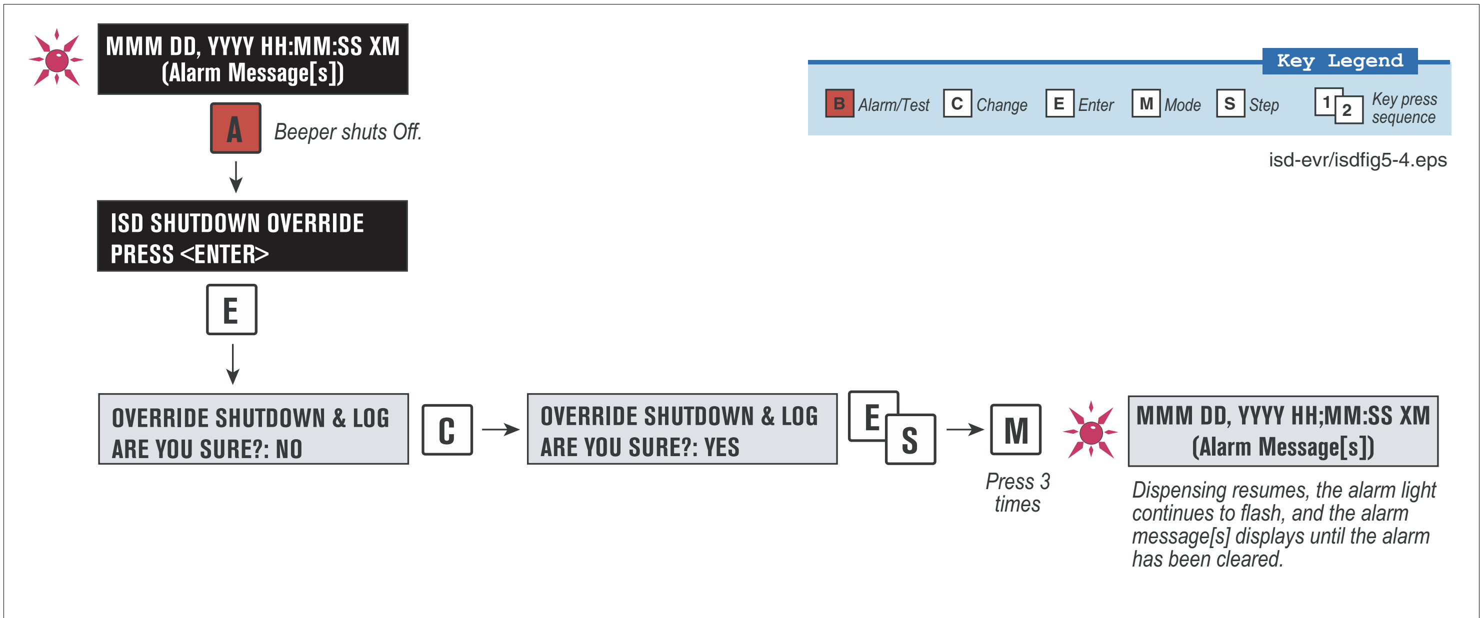


Figure 25. ISD Alarm Override Procedure

ALARM LOGS

Alarms will be recorded in the Warning Log or Failure Log of the monthly reports, which can be viewed electronically or via the integral printer (if queued in the most recent 10 events). The following example shows an excerpt from an electronically accessed monthly report.

Monthly Report Warning & Failure Log Examples:

```
WARNING ALARMS
DATE     TIME     DESCRIPTION                    READING          VALUE
08-03-15 00:01:26 FLOW PERFORMANCE HOSE BLOCKAGE FP12 BLEND4       BLKD
08-02-17 00:00:49 FLOW PERFORMANCE HOSE BLOCKAGE FP 1 BLEND4        0.59
08-02-01 00:01:07 VAPOR CONTAINMENT LEAKAGE      CFH@2 INCHES WC  22.39
FAILURE ALARMS
DATE     TIME     DESCRIPTION                    READING          VALUE
08-03-14 00:01:26 FLOW PERFORMANCE HOSE BLOCKAGE FP12 BLEND4       BLKD
08-02-13 00:01:45 VAPOR CONTAINMENT LEAKAGE      CFH@2 INCHES WC  36.56
08-02-12 00:01:46 VAPOR CONTAINMENT LEAKAGE      CFH@2 INCHES WC  37.74
08-02-11 00:01:57 VAPOR CONTAINMENT LEAKAGE      CFH@2 INCHES WC  30.10
```

937-21.eps

ALARM SEQUENCE

Each ISD monitoring test operates once each day on sensor data gathered over a fixed time interval and with a minimum required number of monitored events. The interval is a fixed number of calendar days depending on the test being run. As an example, the ISD Gross Pressure Containment Monitoring test requires seven calendar days of data. In this example, each daily test result represents a test based on the prior seven days' time period. When a test first fails, a warning is posted and a warning event is logged. If this condition persists for seven more consecutive days, an alarm is posted, a failure alarm event is logged and the site is shutdown. If the condition continues, additional failure events are logged and the site will continue to be shutdown each day.

ISD Alarm Summary

Table 3 summarizes the ISD Alarms - Alarms with a superscript 2 will result in a site shutdown.

Table 3. ISD Alarm Summary

Displayed Message	ISD Monitoring Category	Light Indicator	Description	Suggested Troubleshooting[1]
ISD VAPOR LEAKAGE WARN	Containment	Yellow	Containment system leaks at 2 times the TP-201.3 standard	• Troubleshooting Guide www.vsthose.com/carbs_components.aspx • Exhibit 4 • Exhibit 14 (when FFS-CAS is installed)
ISD VAPOR LEAKAGE FAIL[2]	Containment	Red	8th Consecutive Failure of Pressure Integrity (Vapor Leak) Test	
ISD GROSS PRESSURE WARN	Containment	Yellow	95th percentile of 7-days' ullage pressure exceeds 1.3 IWC	• VST Processor - Troubleshooting Guide www.vsthose.com/carbs_components.aspx - Exhibit 9 - Exhibit 10 - Check pressure sensor ball valve for correct position. • FFS-CAS Troubleshooting - Check FFS-CAS ball valves for correct positions. • Veeder Root Polisher - Check vent statck ball valve for correct position. - Check pressure sensor ball valve for correct position
ISD GROSS PRESSURE FAIL[2]	Containment	Red	8th Consecutive Failure of Gross Containment Pressure Test	
ISD DEGRD PRESSURE WARN	Containment	Yellow	75th percentile of 30-days' ullage pressure exceeds 0.3 IWC	
ISD DEGRD PRESSURE FAIL[2]	Containment	Red	31st Consecutive Failure of Degradation Pressure Test	
hnn: FLOW COLLECT WARN	Collection	Yellow	Vapor collection flow performance is less than 50%	• Troubleshooting Guide www.vsthose.com/carbs_components.aspx • Exhibit 5 • Exhibit 6 • Exhibit 17
hnn: FLOW COLLECT FAIL[2]	Collection	Red	2nd Consecutive Failure of Vapor Collection Flow Performance Monitoring Test	

Table 3. ISD Alarm Summary

Displayed Message	ISD Monitoring Category	Light Indicator	Description	Suggested Troubleshooting[1]
ISD VP STATUS WARN[4, 5, 6, 8.]	Processor	Yellow	Failure of Vapor Processor Effluent Emissions or Duty Cycle test	• Troubleshooting Guide www.vsthose.com/carbs_components.aspx • VP Emission Test • VP Duty Cycle Test
ISD VP STATUS FAIL[2, 4, 5, 6, 8]	Processor	Red	2nd Consecutive Failure of Vapor Processor Status test	
VP EMISSION WARN[3, 4, 5, 6, 8]	Processor	Yellow	Mass emission exceeded the certified threshold	• Troubleshooting Guide www.vsthose.com/carbs_components.aspx • Exhibit 8 • Exhibit 9 • Exhibit 11
VP EMISSION FAIL[3, 4, 5, 6, 8]	Processor	Red	2nd Consecutive Mass emission test failure	
VP DUTY CYCLE WARN[3, 4, 8]	Processor	Yellow	Duty cycle exceeds 18 hours per day 0r 75% of 24 hours	• Troubleshooting Guide www.vsthose.com/carbs_components.aspx • PMC Setup Procedure • Exhibit 4 • Exhibit 9 • Exhibit 10
VP DUTY CYCLE FAIL[3, 4, 7, 8]	Processor	Red	2nd Consecutive Duty Cycle Test Failure	
ISD SENSOR OUT WARN	Self-Test	Yellow	Failure of Sensor Self-Test	• Confirm ISD sensor & module installation / communication per VR 204 IOM Section 12, Chapter 2
ISD SENSOR OUT FAIL	Self-Test	Red	8th Consecutive Failure of Sensor Self-Test	
ISD SETUP WARN	Self-Test	Yellow	Failure of Setup Test	• Confirm EVR/ISD programming per VR 204 IOM Section 12
ISD SETUP FAIL	Self-Test	Red	8th Consecutive Failure of Setup Test	
ISD VP PRESSURE WARN[9]	Processor	Yellow	90th percentile of 1 day ullage pressure exceeds 1 IWC[4]. 90th percentile of 1 day ullage pressure exceeds 2.5 IWC[5].	Exhibit test for HIRT
ISD VP PRESSURE FAIL[9]	Processor	Red	2nd consecutive failure of Vapor Processor Overpressure Test.	

[1] See ISD Troubleshooting Manual, P/N 577013-819, and the VST ISD Troubleshooting Guide 9513-003 found at www.vsthose.com for a complete list of suggestions.

[2] ISD Shutdown Alarms - see “Site Re-enable” on page 31.

[3] This warning will result in an ISD VP Status Warn.

[4] VST ECS Membrane Processor.

[5] Veeder-Root Polisher

[6] VST Green Machine

[7] This failure will result in an ISD VP STATUS FAIL.

[8] Does not apply to FFS-CAS or Hirt VCS 100 processor.

[9] Hirt VCS 100

Other Alarms

Table 4 summarizes additional alarms that may be posted by ISD related equipment. These alarms are not critical to vapor recovery functionality, but could indicate erroneous setup or equipment malfunction. NOTE: Additional TLS console alarms listed in the TLS-3XX Operator's manual may be posted and may lead to an ISD shutdown alarm if persistent (see ISD Troubleshooting Manual for details). Table 5 lists wireless related sensor alarms.

Table 4. Other Alarms

Displayed Message	Light Indicator	Set Condition	Clear Condition
MISSING RELAY SETUP	Red	One or more required shutdown alarms have not been assigned to a relay.	Setup required shutdown alarms.
MISSING TANK SETUP	Red	There are no vapor recovery (gasoline) tanks defined or a gasoline pump has not been assigned to a control (shut down) device in at least one tank.	Complete gasoline tank setup.
MISSING HOSE SETUP	Red	There are no product meters assigned to a hose.	Assign at least 1 product meter to a hose.
hnn: VPRFLOW MTR SETUP	Red	Incoming transaction from a hose with an unavailable Vapor Flow Meter.	Configure Vapor Flow Meter (Smart Sensor) and enable it in ISD.
MISSING VAPOR PRES SEN	Red	There is no Vapor Pressure Sensor setup or detected.	Complete Vapor Pressure Sensor setup.
MISSING VAPOR FLOW MTR	Red	There is no Vapor Flow Meter setup or detected.	Complete Vapor Flow Meter setup.
fnn: CHK VAPOR FLOW MTR	Red	Failure of locked rotor test - possible locked vapor flow meter.	Locked rotor test passes or vapor flow meter deconfigured, or test cleared.

Table 5. Wireless Related Sensor Alarms

Displayed Message	Device	Light Indicator	Desription	Suggested Troubleshooting
BATTERY WARNING	Vapor Valve, Vapor Flow Meter	Yellow	Device transmitter reports battery status as 'Replace' for 24 hours	Remove and replace battery pack

Reports

There are two main reports (CP-201 required) that are stored by the ISD system: the Monthly Status Report, stored for 12-months, and the Daily Status Report, stored for 365 days. A third report discussed in this section is the ISD Status Report. You can print out ISD reports from the TLS console front panel as shown in Figure 26.

- The monthly report includes:
  - ISD operational up-time (as a percentage)
  - EVR/ISD system pass time (as a percentage)
  - The Warning Log
  - The Failure Log
  - The Misc. Event Log
- The daily report includes:
  - Maximum and minimum ullage pressures
  - Results of the Vapor Containment Monitoring Gross (75th percentile), Degradation (95th percentile) ullage pressure test and Vapor Leakage Detection (CVLD) tests
  - Vapor Collection Monitoring test results for each fueling position
  - Vapor Processor Monitoring test results
- ISD Status Report
  - Last test report results

VIEWING ISD REPORTS

You can print out ISD reports from the TLS console front panel as shown in Figure 26.

.

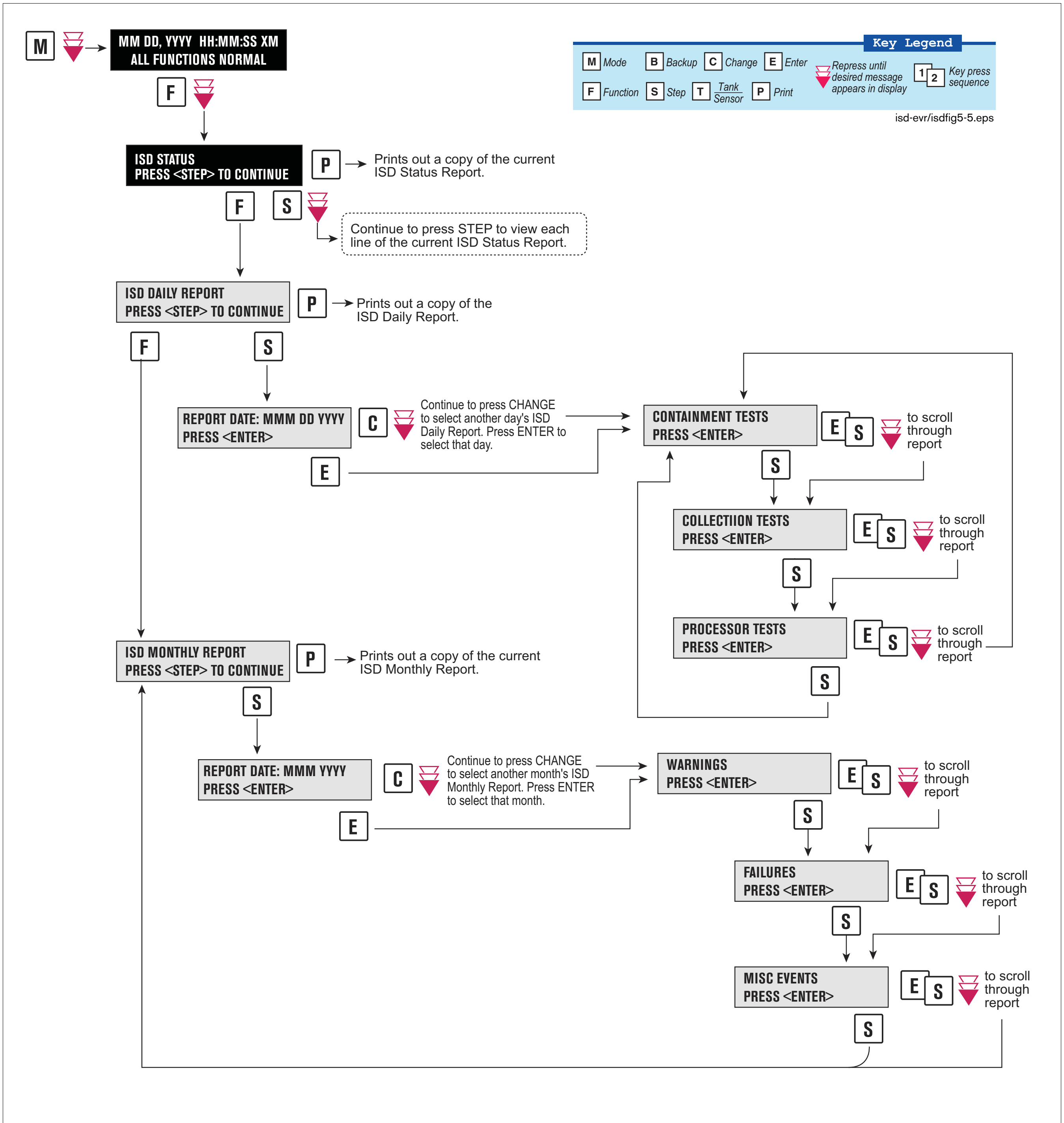


Figure 26. Printing ISD Reports on Console Printer

Figure 27 shows an example ISD Status Report.

```
ISD STATUS

(SITE NAME)
(SITE STREET)
(CITY,ST)
(PHONE)

(MMM DD, YYYY HH:MM XM)

EVR TYPE: BALANCE
ISD VERSION XX.XX
VAPOR PROCESSOR TYPE
VEEDER-ROOT POLISHER

REPORT DATE:SEP 22, 2004

CONTAINMENT TEST GROSS
STATUS: 0.1"WC NOTEST

CONTAINMENT TEST DEGRADE
STATUS: -1.1"WC NOTEST

CONTAINMENT TEST CVLD
STATUS: 3.26CFH NOTEST

COLLECTION FLOW TEST
STATUS: PASS

ISD SENSOR SELF TEST
STATUS: PASS

ISD SETUP SELF TEST
STATUS: PASS

VP STATUS TEST
STATUS: PASS

EFFLUENT EMISSIONS TEST
STATUS   0.05     PASS
```

Appears only if EVR type = BALANCE

Does not appear when Vapor Processor is set to 'None' for FFS-CAS Processor.

Does not appear for Hirt VCS 100

isd-evr\937-8alt.eps

Figure 27. ISD Status Report Example - TLS console printout

Figure 28 shows an example ISD Daily Report.

```
ISD DAILY REPORT

(SITE NAME)
(SITE STREET)
(CITY,ST)
(PHONE)
(MMM DD, YYYY HH:MM XM)

EVR TYPE: BALANCE
ISD VERSION XX.XX
VAPOR PROCESSOR TYPE
VEEDER-ROOT POLISHER

REPORT DATE: MMM  DD
ISD VERSION XX.XX

OVERALL STATUS   PASS
EVR CONTAINMENT  NOTEST
EVR COLLECTION   PASS
STAGE1   2 of   2 PASS
VAPOR PROCESSOR  PASS
SELF TEST        PASS
ISD MONITOR UP-TIME 100%

    ----------------
CONTAINMENT TESTS

GROSS    95%   -0.0N "WC
DGRD     75%   -0.7N "WC
VAPOR LEAK        0N CFH
MAX              0.9  "WC
MIN             -5.0  "WC

    ----------------
COLLECTION TESTS
GROSS
V/L(#)

FP 1: BLEND4
V/L = 0.94( 32)
FP 2: BLEND4
V/L = 0.96( 66)
::::::
FP11: BLEND4
V/L = 1.08( 40)
FP12: BLEND4
V/L = 1.09( 56)

    ----------------
PROCESSOR TESTS

VP STATUS TEST
STATUS   :       PASS

EFFLUENT EMISSIONS TEST
0.084 LB/1KG   PASS

    ----------------
SELF TEST

SETUP TEST       PASS
SENSOR OUT TEST  PASS
```

PROCESSOR TESTS section does not appear when Vapor Processor is set to 'None' for FFS-CAS Processor.

EFFLUENT EMISSIONS TEST: Does not appear for Hirt VCS 100

isd-evr\937-9alt.eps

Figure 28. ISD Daily Report Example - TLS console printout

Figure 29 shows an example ISD Monthly Report.

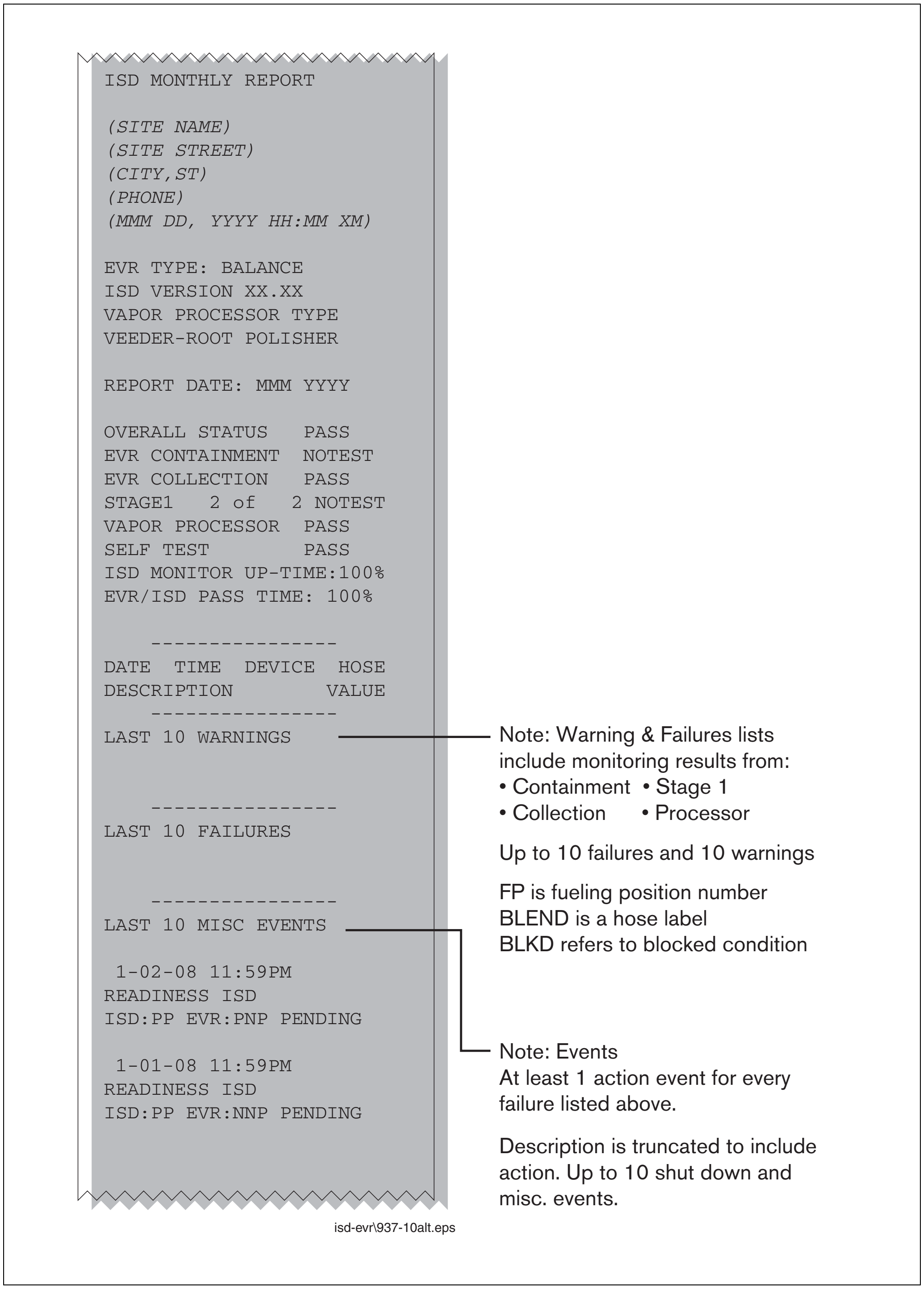
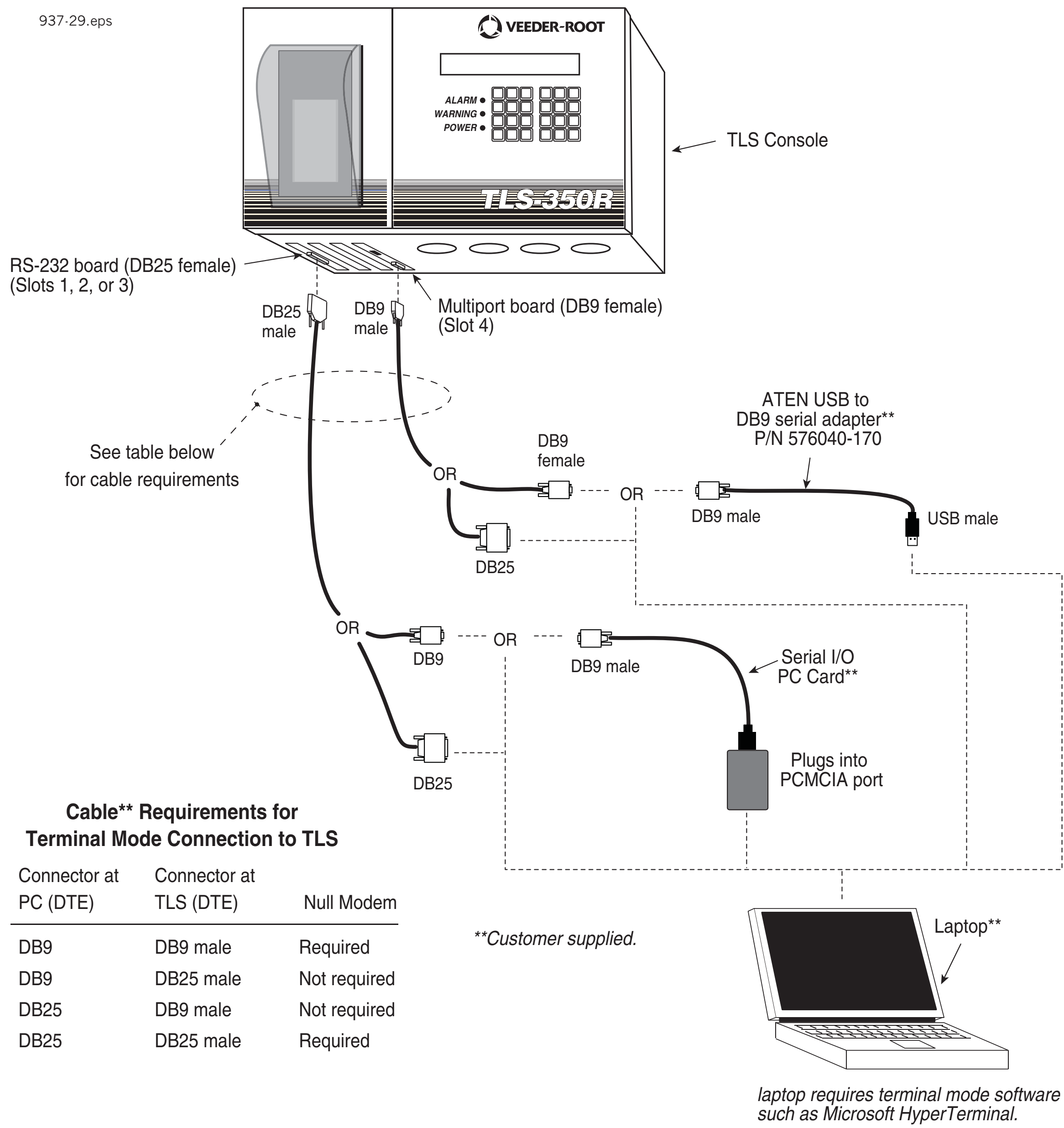


Figure 29. ISD Monthly Report Example - TLS console printout

Viewing ISD Reports via RS-232 Connection

CONNECTING LAPTOP TO CONSOLE

Connect your laptop to the TLS console's RS-232 or Multiport module using one of the methods shown in the examples in Figure 30 below.



Cable Requirements for Terminal Mode Connection to TLS**

Connector at PC (DTE)	Connector at TLS (DTE)	Null Modem
DB9	DB9 male	Required
DB9	DB25 male	Not required
DB25	DB9 male	Not required
DB25	DB25 male	Required

Figure 30. Connecting laptop to TLS console for serial communication

CONNECTING LAPTOP TO CONSOLE

1. Open your laptop's serial communication program, e.g., HyperTerminal. You can typically find HyperTerminal under: Start/Programs/Accessories/Communications.

2. After opening the terminal software program, ignore (cancel) any modem/dialing related request windows since you will be directly connecting to the console via serial communications. When the Connection Description window appears (Figure 31), enter a connection name, e.g., TLSDIRECT, and click the OK button.

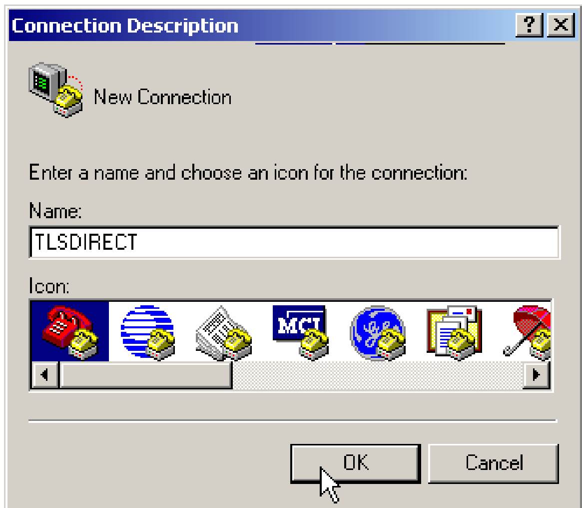


Figure 31. Connection Description window

3. After clicking the OK button, you may see a repeat of the modem/dialing windows, in which case ignore (cancel) them all.

4. When the Connect To window appears (Figure 32), depending on your connection method, select either COM1 (If RS-232 port on laptop), USB-Serial Controller (if using USB port on laptop), or Serial I/O PC Card (if using PCMCIA port on laptop) in the 'Connect using' drop down box, then click OK button.

Figure 32. Connect To window

5. Next you should see the ‘Port Settings’ window.

   IMPORTANT! The settings of the laptop’s com port must match those of the console’s com port to which you are connected.

   a. Go to the console front panel press the MODE key until you see:

   SETUP MODE
   PRESS <FUNCTION> TO CONT

   b. Press the FUNCTION key until you see the message:

   COMMUNICATIONS SETUP
   PRESS <STEP> TO CONTINUE

   c. Press the STEP key until you see the message:

   PORT SETTINGS
   PRESS <ENTER>

   d. Press the PRINT key to printout the port settings for all communication modules installed in the console. Figure 33 shows an example port settings printout with the RS-232 module installed. Using the console port settings in the example below, your HyperTerminal ‘Port Settings’ window entries would be Bits per second - 2400, Data bits - 7, Parity - Odd, Stop Bits - 1. For the ‘Flow Control’ entry select None. Click OK.

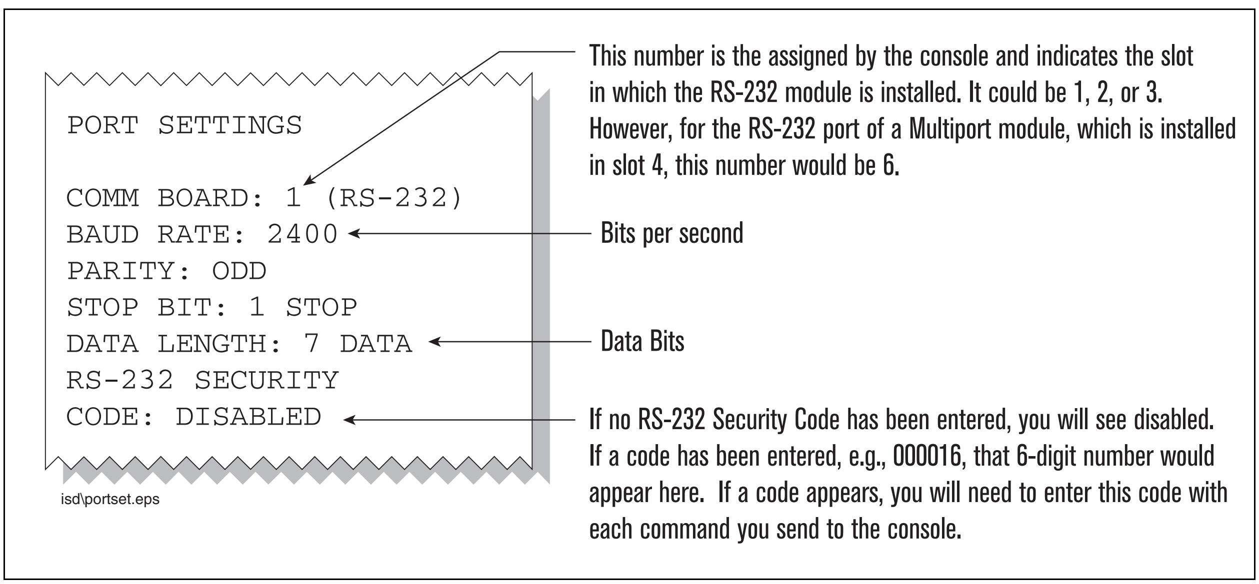


Figure 33. Console comm port settings printout example

In the example port settings printout above, the RS-232 Security Code is disabled. If the code was enabled you would see a 6-digit number which you will need to enter to access the console (refer to the ‘Sending Console Commands’ paragraph below for more information).

6. After entering your port settings, the program's main window appears (Figure 34).

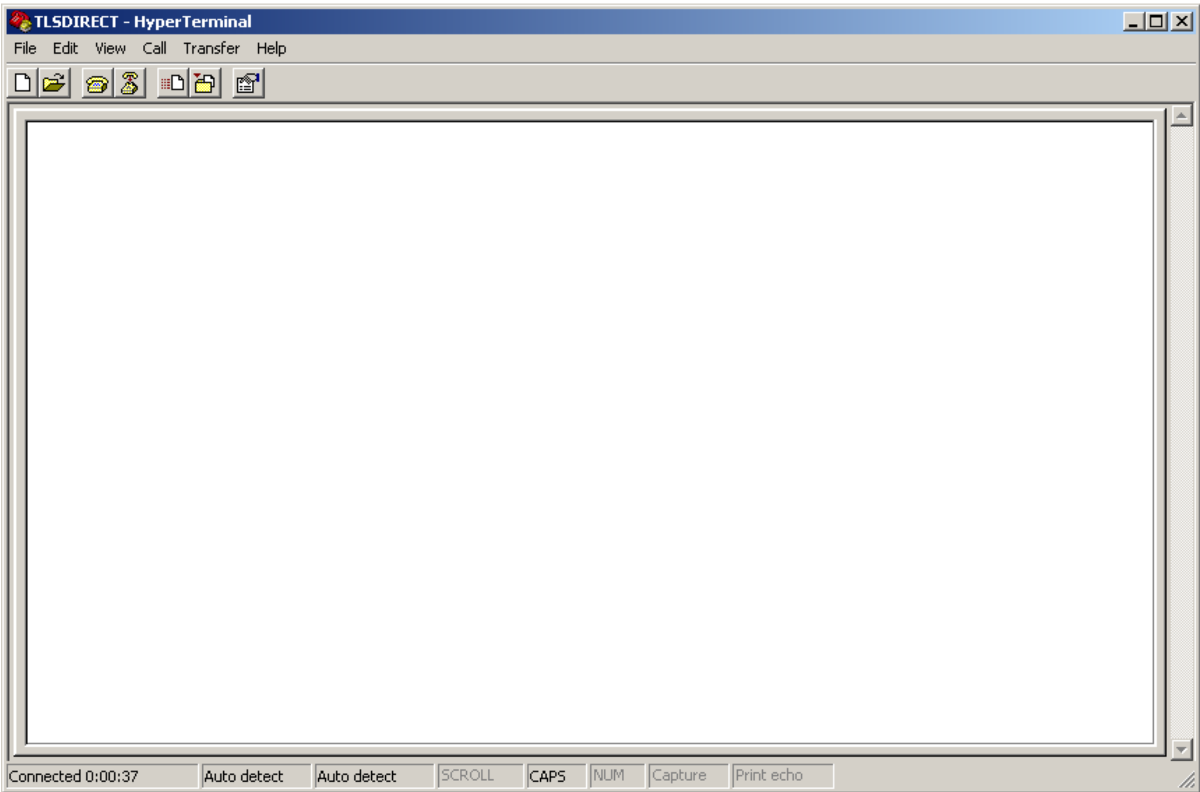


Figure 34. HyperTerminal main window

SENDING CONSOLE COMMANDS

Table 6 shows four important ISD console commands: IV0500, IV0200, IV0100, and IB6100. The <SOH> shown in the table means that you must press and hold the **Cntrl** key while you press the **A** key.

For example, let's say you want to see the Daily Report Details for the last 10 days.

Note: If you want to see the characters of the command as you type them in, click on File menu, then select Properties/Settings (tab)/ASCII Setup and click the check box for 'Echo typed characters locally', then click OK to close the window(s) and return to the main screen.

If the RS-232 Security Code is disabled - press and hold the Ctrl key while you press the A key, then type in IV0500010. If the RS-232 Security Code is enabled (e.g., 000016) you must enter the security code before the command - press and hold the Ctrl key while you press the A key, then type in 000016IV0500010.

You will see the typed command on the screen: `☺IV0500010` followed by the response (report) from the console. The ☺ symbol indicates CrtlA and the ♥ symbol indicates the end of the response.

If the console recognizes the command the response displays as soon as the command is typed in.

If the console does not recognize the command you would see something like `☺IV0500010☺9999FF1B♥` which indicates the console did not recognize the command.

All responses (Reports) can be printed or saved to a file. See the terminal program's help file for instructions.

Table 6. Serial Commands for ISD Alarm, Monthly, and Daily Reports

Report Type	Serial Command (PC to Console)[1]
Daily Report Details (See example Figure 35)	`<SOH>IV0500ddd` Where ddd = number of days, 001 = yesterday and today, 002 = two days ago, etc.
Monthly Status Report (See example Figure 36)	`<SOH>IV0200yyyymm` Where yyyy = year number, e.g. 2003, mm = month number, 01 = January, 02 = February, etc.
Alarm Status (See example Figure 37)	`<SOH>IV0100`
V80 Vapor Processor Runtime Diagnostic Report[2] (See examples Figure 38 and Figure 39)	`<SOH>IV8000`
Vapor Processor Status Report[2] (See example Figure 40)	`<SOH>IV8200`
Vapor Valve Status Report[2] (See example Figure 43)	`<SOH>IB6100`
Non-Priority Alarm History Report (See example Figure 41)	`<SOH>I11100`
Priority Alarm History Report (See example Figure 42)	`<SOH>I11200`
Smart Sensor Sub Alarm History Report (See example Figure 44)	`<SOH>IB6200`
Daily Vapor Polisher Diagnostic Report (See example Figure 45)	`<SOH>IV8800yyyymmddnnnn` Where: yyyy = year number, e.g., 2003, mm = month number (01 = January, 02 = February, etc.), dd = day of the month, nnnn = number of records after the date entered (9999 = all).

[1]<SOH> = Control A. For more information on TLS console serial commands, refer to the V-R Serial Interface Manual.

[2]Not available for FFS-CAS Processor or Hirt VCS 100.

IV0500
JAN 8, 2008 3:52 PM

isd-evr\937-11alt.eps

(SITE NAME)
(SITE STREET)
(CITY, ST)
(PHONE)

ISD DAILY REPORT DETAILS

EVR TYPE: BALANCE
ISD TYPE: XX.XX
VAPOR PROCESSOR TYPE: VEEDER-ROOT POLISHER

OVERALL STATUS	:WARN	EVR VAPOR COLLECTION	:PASS
EVR VAPOR CONTAINMENT	:WARN		
ISD MONITOR UP-TIME	:100%	STAGE I TRANSFERS:	10 of 10 PASS
EVR/ISD PASS TIME	: 81%	VAPOR PROCESSOR	:PASS

Status Codes: (W)Warn (F)Fail (D)Degradation Fail (G)Gross Fail
(ISD-W)ISD Self-Test Warning (ISD-F)ISD Self-Test Fail (N)No Test

	ISD	ISD	---CONTAINMENT TESTS---					STAGE		---COLLECTION TESTS		
	EVR	%UP	GROSS	DGRD	MAX	MIN	LEAK	I	VAPOR	FP1	FP2	FP3
DATE	STATUS	TIME	95%	75%	"WC	"WC	CFH	XFR	PRCSR	BLEND	BLEND	BLEND
12/28	W	100%	0.2	-0.3	0.7	-2.5	18W	PASS	PASS	0.94	1.07	1.10
12/29	W	100%	0.2	-0.3	0.7	-3.0	16W	PASS	PASS	0.95	0.85	1.11
12/30	PASS	100%	0.2	-0.3	0.7	-4.1	0	PASS	PASS	0.95N	0.99	1.02
12/31	PASS	100%	0.2	-0.3	0.8	-3.0	0	PASS	PASS	0.97	0.96	1.17
01/01	PASS	100%	0.2	-0.3	-0.2	-3.3	0		PASS	0.86	1.02	0.99
01/02	PASS	100%	0.2	-0.3	0.9	-5.0	0	PASS	PASS	0.94	0.96	1.20
01/03	PASS	100%	0.2	-0.3	1.1	-4.3	0	PASS	PASS	0.82	1.10	1.13
01/04	PASS	100%	0.4	-0.3	1.9	-2.8	0		PASS	1.07	1.01	1.10
01/05	PASS	100%	0.2	-0.3	2.8	-5.0	0	PASS	PASS	0.97	1.12	0.84
01/06	PASS	100%	0.2	-0.3	0.4	-5.0	0	PASS	PASS	0.80	1.23	1.11
01/07	PASS	100%	0.2	-0.3	0.6	-5.0	0	PASS	PASS	0.93	0.96	1.07

---COLLECTION TESTS-DAILY AVERAGE HOSE FLOW PERFORMANCE-----------------------

	FP4	FP5	FP6	FP7	FP8	FP9	FP10	FP11	FP12
DATE	BLEND	BLEND	BLEND	BLEND	BLEND	BLEND	BLEND	BLEND	BLEND
12/28	1.06	1.16	0.96	1.21	1.10	1.03	1.08	1.13	1.13
12/29	1.03	1.12	1.16	1.07	1.13	1.01	0.97	1.06	1.06
12/30	1.04	0.96	0.95	1.06	1.11	0.97	1.14	1.18	0.94
12/31	1.07	1.20	1.05	1.10	1.00	0.90	1.09	1.07	1.27
01/01	1.03	1.18	1.19	0.85	1.16	1.24	1.13	1.31	1.16
01/02	0.94	0.98	1.10	0.97	1.10	0.91	0.98	1.08	1.09
01/03	1.12	0.96	1.17	1.12	1.07	1.06	1.12	1.12	1.10
01/04	1.04	1.18	1.09	1.16	1.16	0.90	1.19	1.05	1.13
01/05	1.13	0.94	1.11	1.02	1.10	1.10	1.21	1.19	1.04
01/06	1.11	1.14	1.09	1.10	1.18	0.95	1.15	1.09	1.05
01/07	0.96	1.13	1.07	0.84	1.13	1.02	1.06	1.12	1.00

Figure 35. ISD Daily Report Details - Serial to PC Format (Example report with Veeder-Root Polisher)

```
IV0200
JAN  8, 2008  3:53 PM                                                 isd-evr\937-12alt.eps

(SITE NAME)
(SITE STREET)
(CITY, ST)
(PHONE)

ISD MONTHLY STATUS REPORT

EVR TYPE: BALANCE
ISD TYPE: XX.XX
VAPOR PROCESSOR TYPE: VEEDER-ROOT POLISHER


OVERALL STATUS             :FAIL           EVR VAPOR COLLECTION :FAIL
EVR VAPOR CONTAINMENT      :WARN
ISD MONITOR UP-TIME        :100%           STAGE I TRANSFERS: 33 of 33 PASS
EVR/ISD PASS TIME          : 77%           VAPOR PROCESSOR      :WARN

CARB EVR CERTIFIED OPERATING REQUIREMENTS

ISD MONITORING TEST PASS/FAIL THRESHOLDS
                                                    PERIOD    BELOW  ABOVE

VAPOR COLLECTION BALANCE SYS FLOW PERFORMANCE        1DAYS     0.60  ----
VAPOR CONTAINMENT GROSS FAIL, 95th PERCENTILE        7DAYS     ----  1.30"wcg
VAPOR CONTAINMENT DEGRADATION, 75th PERCENTILE      30DAYS     ----  0.30"wcg
VAPOR CONTAINMENT LEAK DETECTION FAIL @2"WCG         7DAYS     ---- 12.5cfh
STAGE I VAPOR TRANSFER FAIL, 50th PERCENTILE        20MINS     ----  2.50"wcg
VAPOR PROCESSOR MASS EMISSION FAIL (LB/1KG)          1DAYS     ----  0.32

WARNING ALARMS
DATE     TIME     DESCRIPTION                     READING         VALUE
07-12-30 00:02:33 VAPOR CONTAINMENT LEAKAGE       CFH@2 INCHES WC  15.51
07-12-29 00:02:07 VAPOR CONTAINMENT LEAKAGE       CFH@2 INCHES WC  18.24
07-12-28 00:02:01 VAPOR CONTAINMENT LEAKAGE       CFH@2 INCHES WC  17.34
07-12-27 00:01:36 VAPOR CONTAINMENT LEAKAGE       CFH@2 INCHES WC  17.11
07-12-26 00:01:41 VAPOR CONTAINMENT LEAKAGE       CFH@2 INCHES WC  18.66
07-12-10 00:02:05 FLOW PERFORMANCE HOSE BLOCKAGE  FP 8 BLEND4      BLKD

FAILURE ALARMS
DATE     TIME     DESCRIPTION                     READING         VALUE
07-12-11 00:02:05 FLOW PERFORMANCE HOSE BLOCKAGE  FP 8 BLEND4      BLKD

SHUTDOWN & MISCELLANEOUS EVENTS
DATE     TIME     DESCRIPTION                     ACTION/NAME
07-12-11 00:02:18 FLOW PERFORMANCE BLK           DISABLED FP 08
```

Figure 36. ISD Monthly Status Report - Serial to PC Format (Example report with Veeder-Root Polisher)

```
IV0100
JAN  8, 2008  3:53 PM                                              937-13alt.eps

(SITE NAME)
(SITE STREET)
(CITY, ST)
(PHONE)

ISD ALARM STATUS REPORT

EVR TYPE: BALANCE
ISD TYPE: XX.XX
VAPOR PROCESSOR TYPE: VST VAPOR PROCESSOR


OVERALL STATUS             :PASS            EVR VAPOR COLLECTION :PASS
EVR VAPOR CONTAINMENT      :PASS
ISD MONITOR UP-TIME        :100%            STAGE I TRANSFERS:  2 of  2 PASS
EVR/ISD PASS TIME          :100%            VAPOR PROCESSOR      :PASS

WARNING ALARMS
DATE     TIME     DESCRIPTION                     READING         VALUE
07-12-30 00:02:33 VAPOR CONTAINMENT LEAKAGE       CFH@2 INCHES WC  15.51
07-12-29 00:02:07 VAPOR CONTAINMENT LEAKAGE       CFH@2 INCHES WC  18.24
07-12-28 00:02:01 VAPOR CONTAINMENT LEAKAGE       CFH@2 INCHES WC  17.34
07-12-27 00:01:36 VAPOR CONTAINMENT LEAKAGE       CFH@2 INCHES WC  17.11
07-12-26 00:01:41 VAPOR CONTAINMENT LEAKAGE       CFH@2 INCHES WC  18.66
07-12-10 00:02:05 FLOW PERFORMANCE HOSE BLOCKAGE  FP 8 BLEND4      BLKD
07-11-16 00:02:17 FLOW PERFORMANCE HOSE BLOCKAGE  FP 8 BLEND4      BLKD
07-11-13 00:02:28 FLOW PERFORMANCE HOSE BLOCKAGE  FP 8 BLEND4      BLKD
07-11-11 00:03:19 FLOW PERFORMANCE HOSE BLOCKAGE  FP 6 BLEND4      BLKD

FAILURE ALARMS
DATE     TIME     DESCRIPTION                     READING         VALUE
07-11-14 00:02:18 FLOW PERFORMANCE HOSE BLOCKAGE  FP 8 BLEND4      BLKD
07-11-12 00:02:38 FLOW PERFORMANCE HOSE BLOCKAGE  FP 6 BLEND4      BLKD
07-11-09 00:03:41 CONTAINMENT GROSS OVER PRESSURE WEEKLY 95%        4.60
07-10-31 00:02:45 VAPOR PROCESSOR STATUS
                  VP EMISSIONS FAIL               LB/1KB           0.693
07-10-15 00:03:14 FLOW PERFORMANCE HOSE BLOCKAGE  FP 2 BLEND4      BLKD
07-10-15 00:03:13 FLOW PERFORMANCE HOSE BLOCKAGE  FP 1 BLEND4      BLKD
07-10-14 00:03:11 FLOW PERFORMANCE HOSE BLOCKAGE  FP 2 BLEND4      BLKD

SHUTDOWN & MISCELLANEOUS EVENTS
DATE     TIME     DESCRIPTION                     ACTION/NAME
07-11-03 19:52:52 VAPOR PROCESSOR                TEST MANUALLY CLEARED
07-11-18 00:02:24 READINESS ISD:PP EVR:PPP       ISD & EVR READY
07-11-17 13:09:06 READINESS ISD:PP EVR:NNN       EVR READINESS PENDING
07-11-17 13:09:06 ISD STARTUP
07-11-17 13:03:24 ISD SHUTDOWN
07-11-14 00:02:18 FLOW PERFORMANCE BLK           DISABLED FP 08 BLEND4
07-11-12 00:02:38 FLOW PERFORMANCE BLK           DISABLED FP 06 BLEND4
07-11-09 00:03:41 CONTAINMENT GROSS              DISABLED DISPENSERS
07-11-04 01:00:00 TIME CHANGE DETECTED AT:      07-11-04 02:00:13
07-11-03 00:01:25 VAPOR PROCESSOR PROBLEM        DISABLED DISPENSERS
```

Figure 37. ISD Alarm Status Report - Serial to PC Format (Example report with Veeder-Root Polisher)

Figure 38 shows an example VST Vapor Processor Runtime Diagnostic Report (not available with FFS-CAS or Hirt VCS 100).

```
IV8000
SEP 30, 2007 12:27 AM

(SITE NAME)
(SITE STREET)
(CITY,ST)
(PHONE)
(MMM DD, YYYY HH:MM XM)

VAPOR PROCESSOR
                   ELAPSED    PRESSURE INCHES H2O    RUNTIME
DATE-TIME ON       MINUTES       ON        OFF        FAULT
 5-04-07  3:31PM    8.87         0.244    -0.202        NO
 5-05-07  4:17AM    3.35         0.202    -0.212        NO
 5-07-07 10:17PM    3.50         0.206    -0.221        NO
 5-07-07 10:28PM   15.12         0.384    -0.356        NO
 5-08-07  8:16PM   21.77         0.325    -0.211        NO
 5-09-07  6:35PM   20.60         0.368    -0.276        NO
 5-10-07  8:03PM    6.18         0.226    -0.398        NO
 5-10-07  8:15PM    2.55         0.231    -0.227        NO
 5-13-07  8:55PM   18.23         0.314    -0.205        NO
```

937-35.eps

Figure 38. VST Vapor Processor Runtime Diagnostics Report - Serial to PC Format

Figure 39 shows an example V-R Vapor Polisher Runtime Diagnostic Report and Table 7 explains the `IV8000` report's event codes (not available with FFS-CAS or Hirt VCS 100).

```
IV8000
FEB  4, 2008  1:01 PM

TLS_350 UST
VEEDER-ROOT TEST LAB
125 POWDER FOREST DR
SIMSBURY, CT 06070

VAPOR POLISHER
VALVE EVENT          PRESSURE
DATE-TIME              "WC      EVENT CODE
 1-31-08  3:44PM      -0.700    OPEN PURGE
 1-31-08  3:47PM       0.038    CLOSE FORCE PURGE
 1-31-08  3:51PM      -0.255    OPEN PURGE
 1-31-08  8:08PM      -0.300    CLOSE PURGE Hi P
 2-01-08  1:59PM      -0.300    OPEN PURGE
 2-01-08  2:18PM      -0.263    OPEN PURGE
 2-01-08  2:33PM      -0.289    OPEN PURGE
 2-04-08 11:22AM      -0.560    NO EVENT
 2-04-08 11:28AM      -0.560    OPEN PURGE
 2-04-08 11:48AM      -0.300    OPEN PURGE
 2-04-08 12:28PM      -0.263    OPEN PURGE
 2-04-08 12:42PM      -0.299    OPEN PURGE
```

937-30.eps

Figure 39. V-R Vapor Polisher Runtime Diagnostics Report - Serial to PC Format

Table 7. Vapor Processor Runtime Diagnostic Report Event Codes

Event Code	Cause	Event Code	Cause
NO EVENT	The valve changed state outside of the carbon canister algorithm.	CLOSE NEAR FULL	Canister load is between 80 and 100% and pressure is <1.05.
CLOSE TEST	Manual operation of the valve	OPEN PURGE	Canister load is >0% and pressure <-0.25
OPEN TEST	Manual operation of the valve	OPEN EXCESS PURGE	Canister load is 0%, Excess purge is incomplete, pressure <-1.5, time is between 6AM and 4PM.
CLOSE PURGE HI P	The canister state is in excess purge and the pressure is above -0.5.	OPEN FILL	Canister valve is open for loading: • When pressure is greater than or equal to 0.75 IWC and Canister load is less than 80%. • Pressure is greater than or equal to 1.3 IWC and Canister load is greater than 80%.
CLOSE PURGE TIME	The canister state is in excess purge and the time is outside 6AM to 4PM.	CLOSE CVLD TEST	Valve was closed to collect data for ISD contamination leak test.
CLOSE FORCE PURGE	Canister is in startup period. Loading with pressures <+1.05 is not allowed until startup period is complete.	CLOSE LIMIT	Valve closed because canister has reached allowable extended capacity loading limit.
CANISTER EMPTY	Canister was loaded above 1% and purged to 0%. No valve state change.	CANISTER FULL	No valve state change. The canister load passed from below 95% to/thru the 100% point and not yet at day's emission limit.
CLOSE EMPTY	Excess purging has completed.		

Figure 40 shows an example Vapor Processor Status Report (not available with FFS-CAS or Hirt VCS 100).

```
IV8200
DEC  8, 2010  4:29 AM

<Site Name>
<Site Address>
<Site Address>
<Site Address>

VAPOR PROCESSOR STATUS REPORT

PMC VERSION: XX.XX

ASSESSMENT TIME: DEC  7, 2010 11:59 PM


VAPOR PROCESSOR TYPE: VEEDER-ROOT POLISHER

PMC MONITORING TEST PASS/FAIL THRESHOLDS
                                              PERIOD    BELOW  ABOVE
VAPOR PROCESSOR MASS EMISSION FAIL             1DAYS     ----   0.32 LBS/1KG

EFFLUENT EMISSIONS TEST : PASS     (0.00 LBS/1KG)

DAILY THROUGHPUT  :   6989 GALS
```

Figure 40. Vapor Processor Status Report - Serial to PC Format

Figure 41 shows an example Non-Priority Alarm History Report.

```
I11200
DEC  9, 2010  4:20 AM

<Site Name>
<Site Address>
<Site Address>
<Site Address>

NON-PRIORITY ALARM HISTORY
ID  CATEGORY  DESCRIPTION          ALARM TYPE           STATE    DATE    TIME
T 3 TANK      DIESEL               LOW TEMP WARNING     CLEAR  12-08-10  3:00PM
T 3 TANK      DIESEL               LOW TEMP WARNING     ALARM  12-08-10  3:00PM
T 3 TANK      DIESEL               HIGH PRODUCT ALARM   CLEAR  12-08-10  3:00PM
T 3 TANK      DIESEL               HIGH PRODUCT ALARM   ALARM  12-08-10  2:56PM
    SYSTEM                         PRINTER ERROR        CLEAR  11-17-10 10:51AM
    SYSTEM                         PAPER OUT            CLEAR  11-17-10 10:51AM
    SYSTEM                         PAPER OUT            ALARM  11-17-10 10:50AM
    SYSTEM                         PRINTER ERROR        ALARM  11-17-10 10:50AM
```

Figure 41. Non-Priority Alarm History Report - Serial to PC Format

Figure 42 shows an example Priority Alarm History Report.

```
I11100
DEC  9, 2010  4:20 AM

<Site Name>
<Site Address>
<Site Address>
<Site Address>

PRIORITY ALARM HISTORY
ID  CATEGORY  DESCRIPTION          ALARM TYPE           STATE    DATE    TIME
T 2 TANK      91 OCTANE            PROBE OUT            CLEAR  12-08-10  7:55PM
T 2 TANK      91 OCTANE            PROBE OUT            ALARM  12-08-10  7:07PM
T 2 TANK      91 OCTANE            OVERFILL ALARM       CLEAR  11-17-10 11:46AM
T 2 TANK      91 OCTANE            OVERFILL ALARM       ALARM  11-17-10 11:45AM
```

Figure 42. Priority Alarm History Report - Serial to PC Format

Figure 43 shows an example Vapor Valve Status report.

```
IB6100
FEB  4, 2008  1:09 PM
s 2:Vapor valve

VAPOR VALVE
SERIAL NUMBER      123456
VALVE POSITION:      OPEN
OPEN CAP:         CHARGED
CLOSE CAP:        CHARGED
AMBNT TEMP:       65.08 F
OUTLET TMP:       75.05 F
SENSOR FAULTS:
 NONE
```

937-31.eps

Figure 43. Vapor Valve Status Report - Serial to PC Format

The IB6100 command reports the current state of the Vapor Valve Components. The current position of the valve is reported as Open or Closed. The Capacitors are used to move the valve and are reported as Charged or Discharged. Outlet Temperature is the Canister thermal probe temperature. Ambient Temperature is the temperature at the Vapor Valve ambient temperature sensor. Sensor Faults are the active faults reported by the Vapor Valve. The IB6100 (Figure 43) command only provides active Sensor Fault conditions. Use the IB6200 command to see archived fault conditions (Figure 44).

937-32.eps

```
IB6200
SEP 19, 2008 1:05 PM

(SITE NAME)
(SITE STREET)
(CITY, ST)
(PHONE)

SMART SENSOR SUB ALARM HISTORY

ID  TYPE  ALARM TYPE          SUB ALARM                STATE    DATE    TIME
9   14    SENSOR FAULT ALARM  TEMPERATURE RANGE FAULT  CLEAR    9-19-08 11:50AM
9   14    SENSOR FAULT ALARM  TEMPERATURE RANGE FAULT  ALARM    9-19-08 11:46AM
```

Figure 44. Smart Sensor Sub Alarm History Report - Serial to PC Format

Figure 45 shows an example PMC Daily Vapor Polisher Diagnostic Report.

```
IV8800
OCT 2, 2008  2:58 PM

PMC DAILY VAPOR POLISHER DIAGNOSTIC

                    LOAD   PRGE   MIN%   MAX%   SELF    EMISSION
DATE/TIME            HRS    HRS   LOAD   LOAD   TEST    TEST
08-10-02 14:58:58   3.1    2.5     15     69   WARN    FAIL
```

937-33.eps

Figure 45. PMC Daily Vapor Polisher Diagnostic Report - Serial to PC Format

6 Maintenance

TLS Console

The TLS console, including interface modules, do not require scheduled maintenance, but the station operator is responsible to ensure printer paper is properly loaded and front panel indicator lights are operational. ISD System Self-Test Monitoring algorithms are designed to verify proper selection, setup and operation of the TLS console and sensors. Servicing should be performed in accordance with the In-Station Diagnostic System Troubleshooting Guide, Manual 577013-819 in response to warning or alarm conditions.

Vapor Flow Meter

There is no recommended maintenance, inspection nor calibration for the Air Flow Meter. Servicing should be performed in accordance with the In-Station Diagnostic System Troubleshooting Guide, Manual 577013-819 in response to warning or alarm conditions.

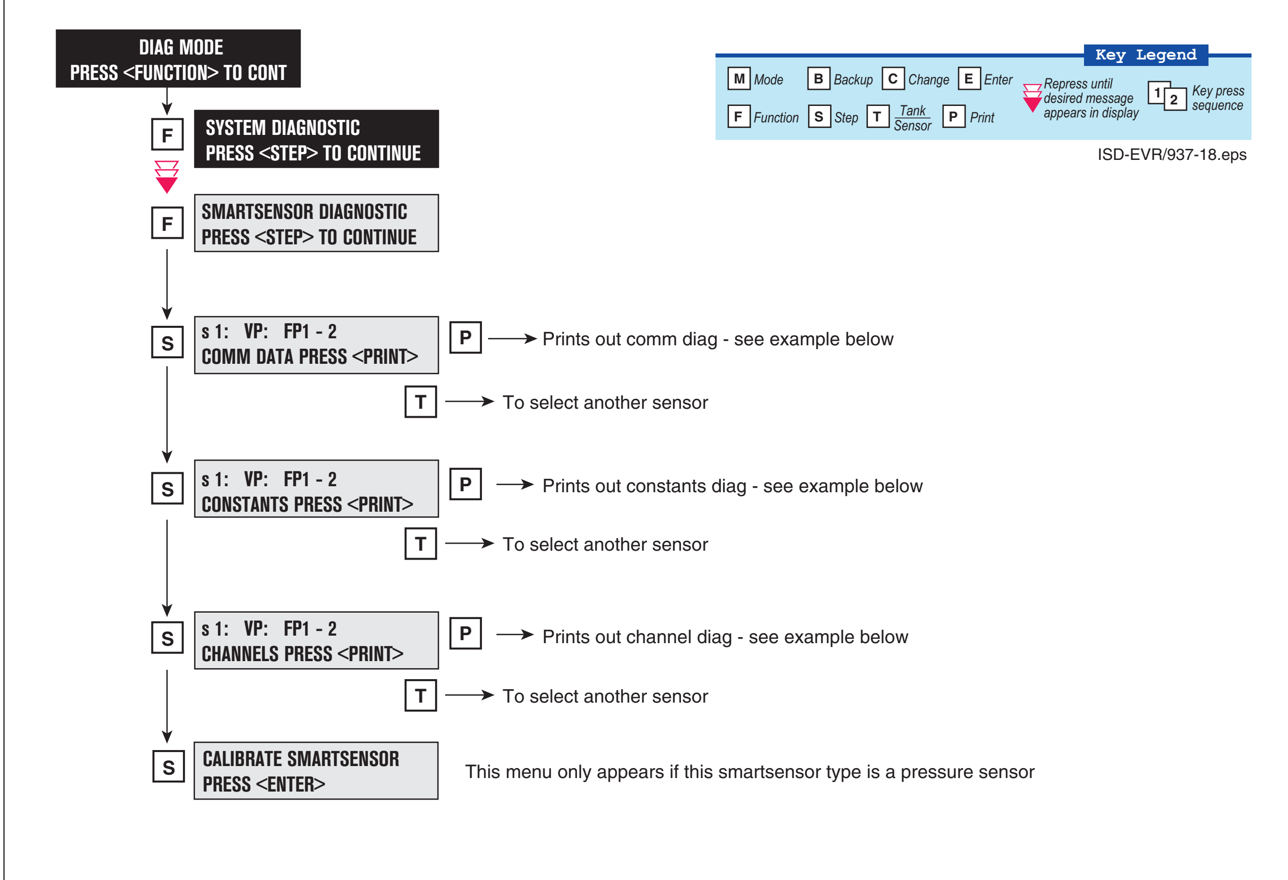
Vapor Pressure Sensor

There is no recommended maintenance, inspection nor calibration for the Vapor Pressure Sensor. Servicing should be performed in accordance with the In-Station Diagnostic System Troubleshooting Guide, Manual 577013-819 in response to warning or alarm conditions.

7 Diagnostic Menus

The diagnostic menus below are accessed and viewed from the TLS console front panel.

Smart Sensor Diagnostic Menu




```
SS COMM DIAG
-----------------------
s 1: AFM1    FP1-2
SAMPLES READ     58
SAMPLES USED     54
PARITY ERR        0
PARTIAL READ      0
COMM ERR          0
RESTARTS          0
```

```
SS CONSTANTS DIAG
-----------------------
s 1: AFM1    FP1-2

VAPOR PRESSURE
SERIAL NUMBER      1007
PROTOCOL VERSION      0
```

```
SS CHANNEL DIAG
-----------------------
s 1: AFM1    FP1-2
YY-MM-DD   HH:MM:SS
C00  B50B 3D68 00E0 0000
C04  0000 03EF 0000 0004
C08  0A3C 3D68 5693 0081
C12  80C4 80A4 0104 2579
C16  0000 0000 00A3 03D6
C20  0709 0032 04C9 880F
```

Figure 46. Smart Sensor Diagnostic Menu

Calibrate Smart Sensor Menu

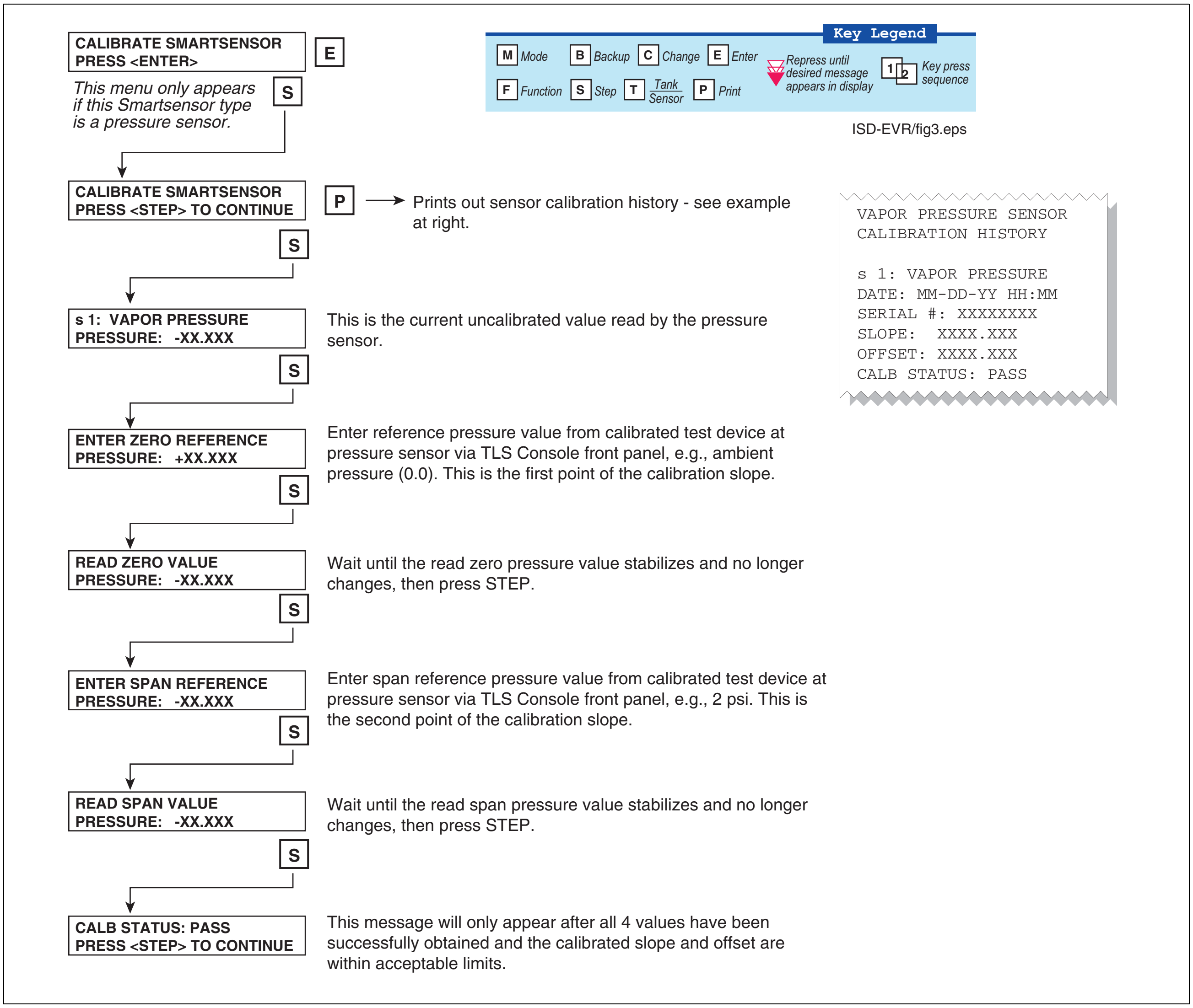
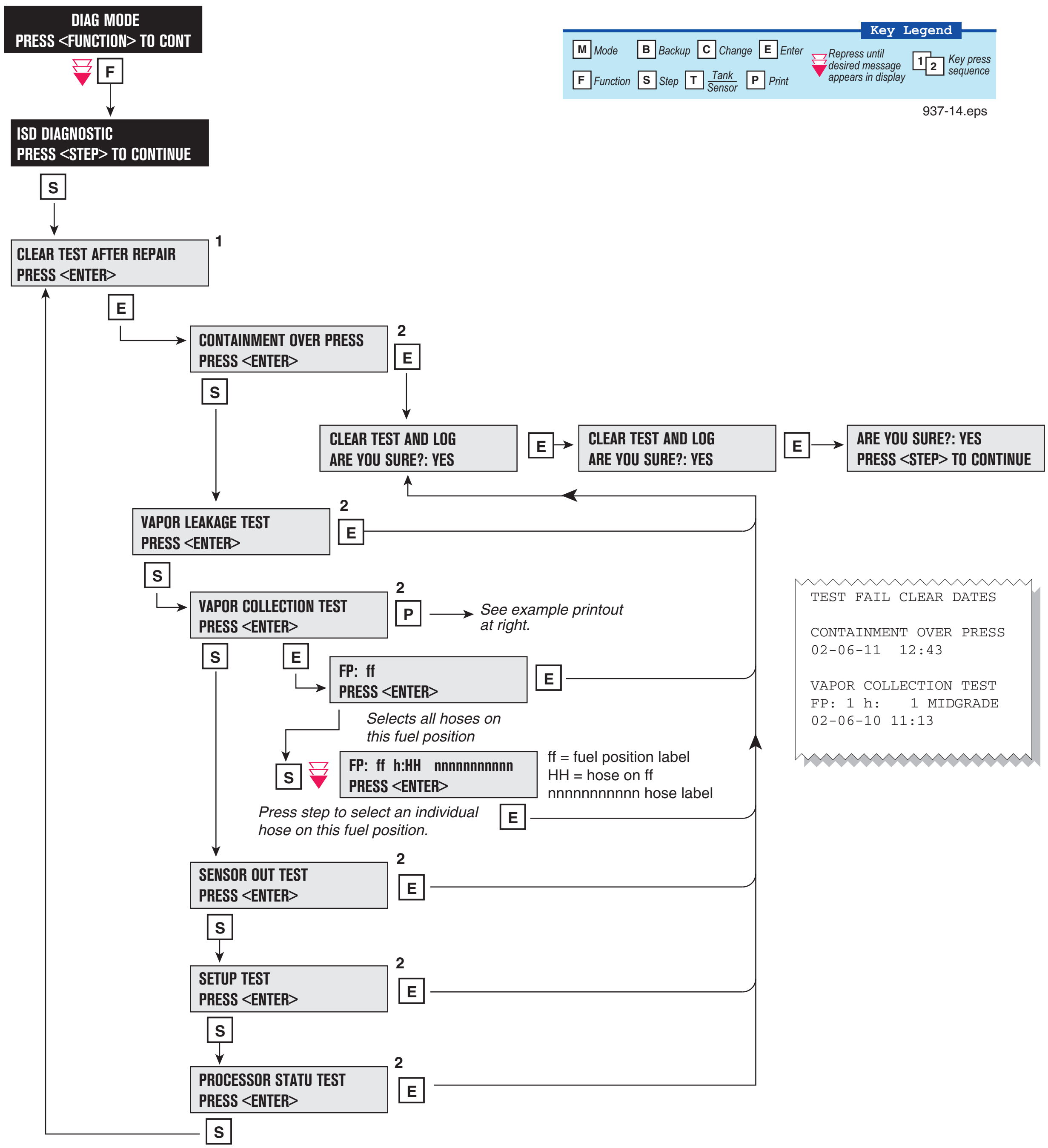


Figure 47. Smart Sensor Calibration Menu

ISD Diagnostic Menu



Notes:

1. All repair dates are saved in the Miscellaneous Event Log.
2. Reference the Clear Test Repair Menu table on the next page.

Figure 48. ISD Diagnostic Menu

Table 8. Clear Test Repair Menu

Menu Selection	Clears Alarms	Reset Dates
Containment Over Press	ISD GROSS PRESSURE WARN ISD GROSS PRESSURE FAIL ISD DEGRD PRESSURE WARN ISD DEGRD PRESSURE FAIL	Containment Test Time
Vapor Leakage Test	ISD VAPOR LEAKAGE WARN ISD VAPOR LEAKAGE FAIL	Vapor Leak Test Time
Vapor Collection Test	GROSS COLLECT WARN GROSS COLLECT FAIL DEGRD COLLECT WARN DEGRD COLLECT FAIL FLOW COLLECT WARN FLOW COLLECT FAIL AIRFLOW MTR SETUP	Hose Test Time
Sensor Out Test	ISD SENSOR OUT WARN ISD SENSOR OUT FAIL	Sensor Out Test Time
Setup Test	ISD SETUP WARN ISD SETUP FAIL	Setup Self Test Time
Processor Status Test[1]	ISD VP OVERPRESSURE WARN ISD VP OVERPRESSURE FAIL ISD VP STATUS WARN ISD VP STATUS FAIL VP EMISSIONS WARN VP EMISSIONS FAIL VP DUTY CYCLE WARN VP DUTY CYCLE FAIL	Valid Vapor Processor Test Time

[1]These tests and alarms are not available with FFS-CAS.

VST ECS Membrane Processor Diagnostic Menu

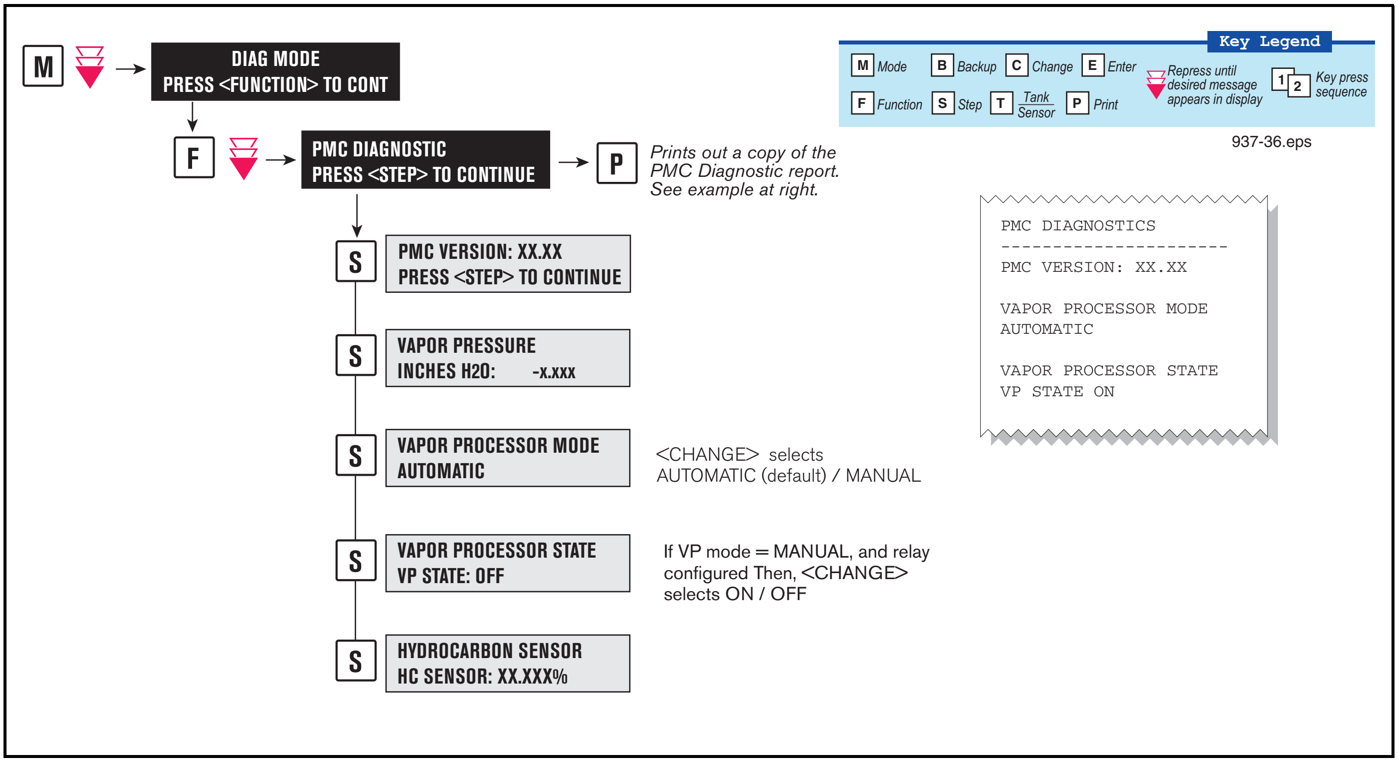


Figure 49. VST ECS Membrane Processor Diagnostic Menu

Veeder-Root Vapor Polisher Diagnostics

AUTOMATIC CONTROL

If PMC mode is in AUTOMATIC, PMC will control flow through the canister using a vapor control valve. The control algorithms will monitor tank pressure, vapor temperature and carbon temperature to monitor carbon canister loading. When the pressure is positive the valve is opened to relieve the pressure and begin loading the canister. When the UST pressure becomes negative the valve is opened and the purging process begins. The valve will close when the canister has either reached capacity or the canister is empty after purging.

MANUAL CONTROL

If PMC mode is in MANUAL, the diagnostic menu allows the valve to be opened (ON) or closed (OFF) manually. This feature is to support testing operation of the valve without waiting for canister to reach loading or purging thresholds. It also provides the necessary controls to perform 2" decay tests. The current UST ullage space vapor pressure will also be available through the diagnostic menu.

When set to Manual mode, the system will reset to Automatic mode after 4 hours.

Veeder-Root Vapor Polisher PMC Diagnostic Menu

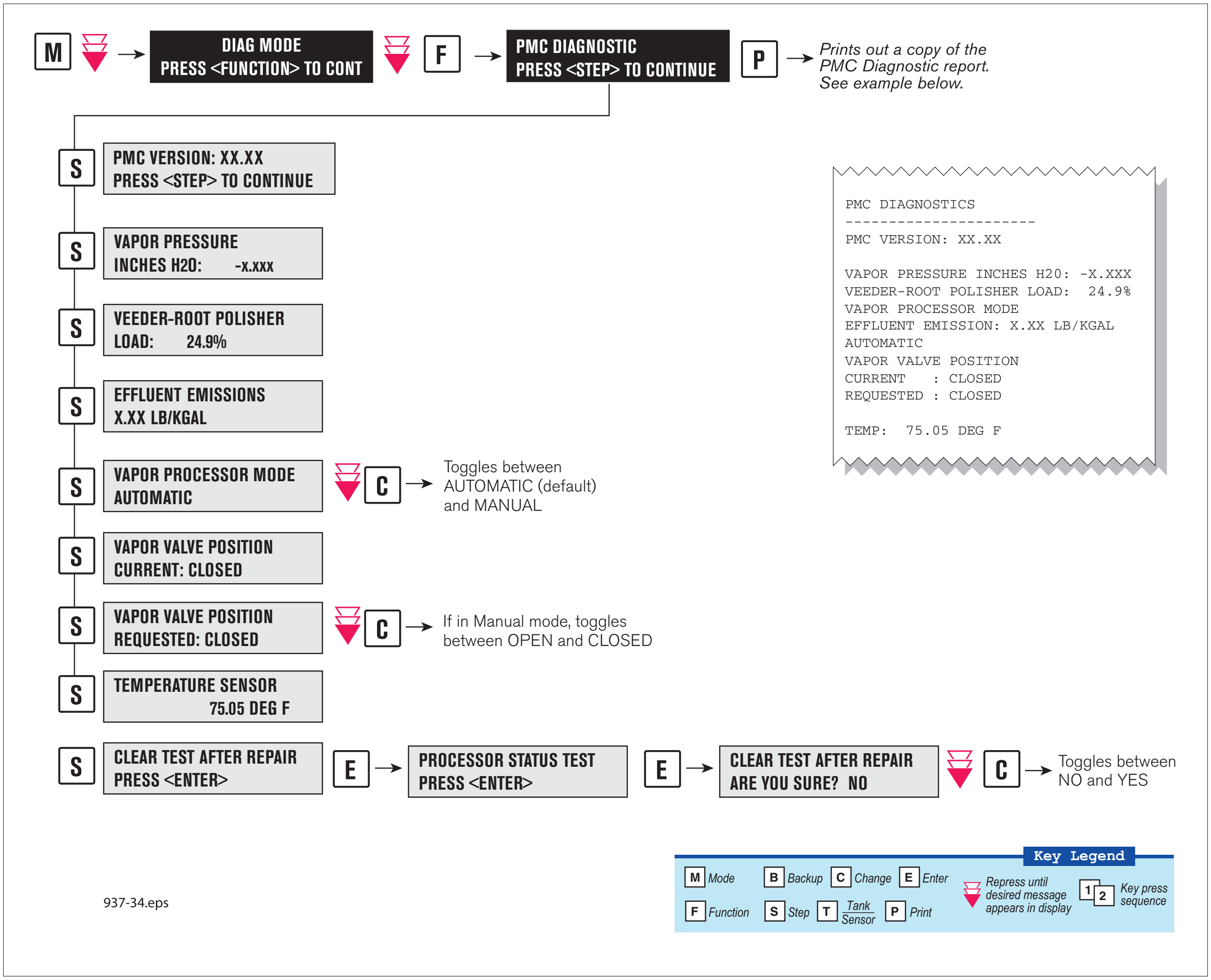


Figure 50. PMC Diagnostic Menus

Appendix A: Site EVR/ISD Equipment Location Worksheet

You should create a table listing each hose, fueling point, Air Flow Meter's serial number, etc.. This information will be required when you perform the EVR/ISD Setup hose/meter dispenses. This appendix contains blank worksheets for sites with single- and multi-hose dispensers. You are advised to fill in all of the appropriate information about your installed equipment, complete the TLS console's EVR/ISD setup, then perform the Product Meter ID dispensing procedure.

Single-Hose Fueling Position Dispensers

FILL OUT - USE TO SETUP HOSE TABLE					AUTOMAP CHECK LIST			
					Product Dispense(s)[6]			
Hose ID[1]	FP[2]	Hose Label[3]	AFM Serial Number[4]	AFM Label[5]	1st	2nd	3rd	4th
1		Blend		AFM FP__&__				
2		Blend						
3		Blend		AFM FP__&__				
4		Blend						
5		Blend		AFM FP__&__				
6		Blend						
7		Blend		AFM FP__&__				
8		Blend						
9		Blend		AFM FP__&__				
10		Blend						
11		Blend		AFM FP__&__				
12		Blend						
13		Blend		AFM FP__&__				
14		Blend						
15		Blend		AFM FP__&__				
16		Blend						

[1]Each hose must have a unique number (1 - 99).

[2]This is the Fuel Position Label which is the visible number on the outside of the dispenser (1 -2 digits).

[3]The hose label is always Blend for single-hose dispensers.

[4]This is the serial number on the Air Flow Meter (1 per dispenser).

[5]This is the AFM label entered in EVR/ISD setup (1 per dispenser and must be in the format shown, e.g., AFM FP1&2 - *where 1 and 2 refer to the one [or two] numbers on the outside of the dispenser*).

[6]After you have entered the contents of columns 1 - 5 into the TLS EVR/ISD hose table setup, you now must follow automap procedure and dispense from each gas meter AND one blend grade that feeds each hose. Enter a check beneath each product following a dispense from the hose.

FILL OUT - USE TO SETUP HOSE TABLE					AUTO MAP CHECK LIST			
					Product Dispense(s)			
Hose ID	**FP**	**Hose Label**	**AFM Serial Number**	**AFM Label**	**1st**	**2nd**	**3rd**	**4th**
17		Blend		AFM FP__&__				
18		Blend						
19		Blend		AFM FP__&__				
20		Blend						
21		Blend		AFM FP__&__				
22		Blend						
23		Blend		AFM FP__&__				
24		Blend						
25		Blend		AFM FP__&__				
26		Blend						
27		Blend		AFM FP__&__				
28		Blend						
29		Blend		AFM FP__&__				
30		Blend						
31		Blend		AFM FP__&__				
32		Blend						
33		Blend		AFM FP__&__				
34		Blend						
35		Blend		AFM FP__&__				
36		Blend						

FILL OUT - USE TO SETUP HOSE TABLE					AUTO MAP CHECK LIST			
					Product Dispense(s)			
Hose ID	FP	Hose Label	AFM Serial Number	AFM Label	1st	2nd	3rd	4th
		Blend		AFM FP__&__				
		Blend						
		Blend		AFM FP__&__				
		Blend						
		Blend		AFM FP__&__				
		Blend						
		Blend		AFM FP__&__				
		Blend						
		Blend		AFM FP__&__				
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		Blend		AFM FP__&__				
		Blend						
		Blend		AFM FP__&__				
		Blend						
		Blend		AFM FP__&__				
		Blend						

Multi-Hose Fueling Position Dispensers

<table>
<tr><th colspan="5">FILL OUT - USE TO SETUP HOSE TABLE</th><th>AUTOMAP CHECK LIST</th></tr>
<tr><th>Hose ID[1]</th><th>FP[2]</th><th>Hose Label[3]</th><th>AFM Serial Number[4]</th><th>AFM Label[5]</th><th>Product Dispense[6]</th></tr>
<tr><td></td><td rowspan="4"></td><td></td><td rowspan="8"></td><td rowspan="8">AFM FP__&__</td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td rowspan="4"></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td rowspan="4"></td><td></td><td rowspan="8"></td><td rowspan="8">AFM FP__&__</td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td rowspan="4"></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
</table>

[1]Each hose must have a unique number (1 - 99).

[2]This is the Fuel Position Label which is the visible number on the outside of the dispenser (1 -2 digits).

[3]The hose label is the grade.

[4]This is the serial number on the Air Flow Meter (1 per dispenser).

[5]This is the AFM label entered in EVR/ISD setup (1 per dispenser and must be in the format shown, e.g., AFM FP1&2 - *where 1 and 2 refer to the one [or two] numbers on the outside of the dispenser*).

[6]After you have entered the contents of columns 1 - 5 into the TLS EVR/ISD hose table setup, you now must follow automap procedure and dispense from each hose. Enter a check in this column following a dispense from the hose.

FILL OUT - USE TO SETUP HOSE TABLE					AUTOMAP CHECK LIST
Hose ID	**FP**	**Hose Label**	**AFM Serial Number**	**AFM Label**	**Product Dispense**
				AFM FP__&__	
				AFM FP__&__	
				AFM FP__&__	

FILL OUT - USE TO SETUP HOSE TABLE					AUTOMAP CHECK LIST
Hose ID	FP	Hose Label	AFM Serial Number	AFM Label	Product Dispense
				AFM FP__&__	
				AFM FP__&__	
				AFM FP__&__	

FILL OUT - USE TO SETUP HOSE TABLE					AUTOMAP CHECK LIST
Hose ID	FP	Hose Label	AFM Serial Number	AFM Label	Product Dispense
				AFM FP__&__	
				AFM FP__&__	
				AFM FP__&__	

FILL OUT - USE TO SETUP HOSE TABLE					AUTOMAP CHECK LIST
Hose ID	FP	Hose Label	AFM Serial Number	AFM Label	Product Dispense
				AFM FP__&__	
				AFM FP__&__	
				AFM FP__&__	

VEEDER-ROOT

For technical support, sales or other assistance, please visit:
www.veeder.com

Executive Order VR-207-A
Emco Phase II EVR System with Hirt Thermal Oxidizer

Exhibit 2
System Specifications

This exhibit contains the installation, maintenance and compliance standards and specifications that apply to the Emco Phase II EVR System installed at a gasoline dispensing facility (GDF). All components must be installed, maintained, and operated in accordance with the specifications in the **ARB Approved Installation, Operation and Maintenance Manual** (IOM). Installation, maintenance and repair of system components, including removal and installation of such components in the course of any required tests, shall be performed by technicians certified by the appropriate manufacturer. Additional certifications may be required in accordance with local district requirements. Provided that there are no other local district requirements, a GDF owner/operator can remove and install nozzles, hose swivels, curb hoses, safe brakes, and whip hoses without a manufacturer certification.

<u>Nozzle</u>

1. A vapor bellows shall be installed on the nozzle at the base of the spout, as shown in **Figure 2B-1**.

2. The Emco Model A4005EVR nozzle has an integral vapor valve which prevents the loss of vapor from the underground storage tanks, ensures proper operation of the system and prevents the ingestion of air into the system. The performance of the nozzle vapor valve can be determined by items 2.1 or 2.2.

   2.1. The maximum allowable leak rate for the nozzle vapor path, as determined by TP-201.2B, shall not exceed 0.07 cubic feet per hour (CFH) at a pressure of two inches water column (2.00" WC)

   2.2. Verification of the integrity of the vapor valve can be performed on installed nozzles using the nozzle bag test procedure in Exhibit 7.

3. The gasoline flow rate of the nozzle shall be between six (6.0) and ten (10.0) gallons per minute as determined by the applicable provisions of section 6 or 7 of Exhibit 5 or by direct observation for 30 seconds minimum at the maximum hand held position.

<u>Vapor Collection</u>

1. The system pressure drop from the nozzle to the UST, as determined by TP-201.4 (Methodology 1) and Exhibit 6, shall not exceed the following:

   0.35 inches WC at a flow rate of 60 CFH of Nitrogen; and
   0.62 inches WC at a flow rate of 80 CFH of Nitrogen.

Coaxial Hoses

1. The maximum length of the curb hose, hose swivel, safe break valve, and whip hose combined shall not exceed fifteen feet as measured from the base of the nozzle to the end of dispenser adapter or dispenser, as appropriate (reference Exhibit 1 Figure 1A-2).

2. The liquid removal rate shall not be less than five milliliters per gallon (5 ml/gal) as determined by Exhibit 5 when tested with a gasoline flow rate between six (6.0) and ten (10.0) gallons per minute. Liquid removal requirement is applicable to all grade of gasoline.

3. All hoses shall have a permanent marking indicating the liquid pick-up location.

4. Any hose configuration is allowed when installed in accordance with the IOM section titled “Hoses”.

Safe Break Valve

1. The Emco Safe Break Valves are non-reconnecting and shall be replaced following a drive-off.

Flow Limiter

1. No flow limiter is allowed for this system.

Hirt VCS 100 Thermal Oxidizer

1. The processor vapor integrity shall demonstrate compliance with the static pressure decay criteria of TP-201.3 and Exhibit 4.

2. Unless there is maintenance or testing being conducted on the processor, the processor shall be on (power lamp is lit) and in the automatic vapor processor mode. The ball valve on the inlet of the processor shall be locked in the open position shown in **Figure 2B-2** and the 3-Way Valve handle shall be pointing down in the Normal Operating Position (Opened to UST Ullage) shown in Figure 2B-3 during normal processor operation. The handles of the ball valves shall not be removed.

3. Piping to the processor shall be sloped 1/8” per foot minimum toward the vent line(s).

4. The VCS 100 Indicator Panel shall be installed at a location that is most likely to be occupied by the station attendant during normal station operation (i.e., cash register).

5. The processor shall activate when the processor is exposed to an atmospheric pressure input and the Processing lamp at the Indicator Panel shall light within three (3) minutes as determined by Exhibit 8.

6. When the processor is exposed to an atmospheric pressure input, the OVERPRESSURE lamp at the Indicator Panel shall light within sixty two (62) minutes as determined by Exhibit 8.

7. If the OVERPRESSURE lamp lights, the system is not in proper working order. The GDF owner/operator shall immediately take the following actions:

    a. record the date and time the OVERPRESSURE lamp lit in the station's maintenance and alarm records;
    b. investigate the cause of the OVERPRESSURE light as provided by section 8 of the Installation, Operations, and Maintenance Manual. Record results of inspections, maintenance, and/or testing conducted in the station's maintenance and alarm records; and if necessary,
    c. record the date and time when the GDF owner/operator called the maintenance contractor for service.

Pressure/Vacuum Vent Valves for Storage Tank Vents

1. All P/V vent valves shall be an ARB certified P/V valve for a Phase I system.

2. At least one pressure/vacuum (P/V) vent valve shall be installed on each tank vent. The maximum number of P/V vent valves allowed and P/V vent valve performance specifications are listed in the applicable Phase I EVR Executive Order. Vent lines may be manifold to minimize the number of P/V vent valves and potential leak sources, provided the manifold conforms to all applicable fire regulations.

Vapor Recovery Piping Configurations

NOTE: Vapor Return Piping shall meet the requirements specified in section 4.11 of CP-201.

1. Vapor Return and Vent Lines

   For facilities installed on or after April 1, 2003, all vapor return and vent lines shall be a minimum nominal internal diameter of 2 inches from the dispensers or the vent stacks to the first manifold. All lines after the first manifold and back to the underground storage tank shall have a minimum nominal internal diameter of 3 inches.

   Note: Facilities permitted by a local district prior to April 1, 2003 shall be required to meet the three inch diameter standard only upon facility modification which involves the addition, replacement, or removal of 50 percent or more of the buried vapor piping.

2. All vapor return lines shall have a minimum slope of 1/8 inch per foot from the dispenser riser to the riser of the UST. A slope of 1/4 inch or more per foot is recommended wherever feasible.

3. The dispenser shall be connected to the riser with either flexible or rigid material that is listed for use with gasoline. The dispenser-to-riser connection shall be installed so that any liquid in the lines will drain toward the storage tank. The internal diameter of the connector, including all fittings, shall not be less than one inch (1").

   Note: The dispenser-to-riser connection is defined as the piping connection between the dispenser piping and the inlet of the dispenser riser. A vapor shear valve may also be part of the riser connection.

4. There is no length restriction for the vapor return piping of the system as long as the system complies with the maximum pressure drop requirement, item 1 of the Vapor Collection section.

5. No product shall be dispensed from any fueling point at a GDF installed with the Emco Phase II EVR System if there is a vapor line that is disconnected and open to the atmosphere.

6. No liquid condensate traps are allowed with this system.

Dispensers

1. The dispenser vapor piping must be sized adequately to meet the maximum pressure drop requirement, item 1 of the Vapor Collection section.

2. Dispenser vapor piping shall be installed so that any liquid in the lines will drain toward the dispenser riser.

Phase I System

1. The Phase I system shall be an ARB-certified system that demonstrates compliance with the static pressure decay test criteria contained in TP-201.3 and Exhibit 4.

Maintenance Records

1. Each GDF operator owner shall keep records of alarms and maintenance performed at the facility. Such records shall be maintained on site in accordance with district requirements or policies. The records shall include alarm date and time, nature of the alarm, troubleshooting, maintenance or repair performed to validate and/or correct alarms, component, or system failures, date when maintenance or repair was conducted, name and Certified Technician Identification Number of individual conducting maintenance or test, affiliation, and telephone number. Additional information may be required in accordance with local district requirements. An example of a GDF maintenance and alarm record is shown in Figure 2B-4.

2. Maintenance shall be conducted in accordance with the Scheduled Maintenance section of the ARB Approved Installation, Operation, and Maintenance Manual.

Vapor Recovery Equipment Defects

The following is deemed a defect for the affected fueling point(s) or system.

1. The fueling point shall be removed from service when more than 0.38 square inches of a nozzle boot face material is missing (e.g., a triangular or similar shape in which greater than 7/16 inches of the boot face circumference is missing (accumulated)).

2. The fueling point shall be removed from service when there is slit across seven (7) consecutive bellows convolutions as determined by direct measurements.

3. The fueling point shall be removed from service when a hose is found to have greater than 150 ml of gasoline in the vapor side as determined by sections 6.1 to 6.5 of Exhibit 5. Note: Prior to draining gasoline from the vapor side of the Goodyear hose, use Emco tool P/N 494635EVR and plug the fuel spout. **Do not activate dispenser when draining gasoline from the vapor side of the Goodyear hose.**

4. The fueling point shall be removed from service when the Emco system pressure drop exceeds the following conditions as determined by Methodology 1 of TP-201.4 and Exhibit 6:

   0.95 inches WC at a flow rate of 60 CFH of Nitrogen; and
   1.52 inches WC at a flow rate of 80 CFH of Nitrogen.

5. The fueling point shall be removed from service when the dispensing rate is greater than ten (10) gallons per minute (gpm) or less than five (5) gpm as determined by the applicable provisions of section 6 or 7 of Exhibit 5 or by direct observation for 30 seconds minimum at the maximum hand held position.

6. The fueling point shall be removed from service when any hose has a visible opening as determined by direct observation.

7. The fueling point shall be removed from service when the insertion interlock mechanism allows dispensing when the bellows is uncompressed as determined by direct observation or GDF-09 (see Vapor Recovery Defects List).

8. The fueling point shall be removed from service when the nozzle automatic liquid shut-off mechanisms malfunction in any manner as determined by EPO No. 26-F (See Vapor Recovery Defects List) or direct observation.

9. The fueling point shall be removed from service when any nozzle has a defective vapor valve as determined by Exhibit 7 or when the vapor valve has a leak rate that exceeds 0.07 cubic feet per minute at a pressure of two (2) inches WC as determined by TP-201.2B.

10. The fueling point or system shall be removed from service when any component required by this Executive Order is absent, installed improperly or disconnected as determined by direct observation.

Figure 2B-1
Emco Model A4005EVR Nozzle

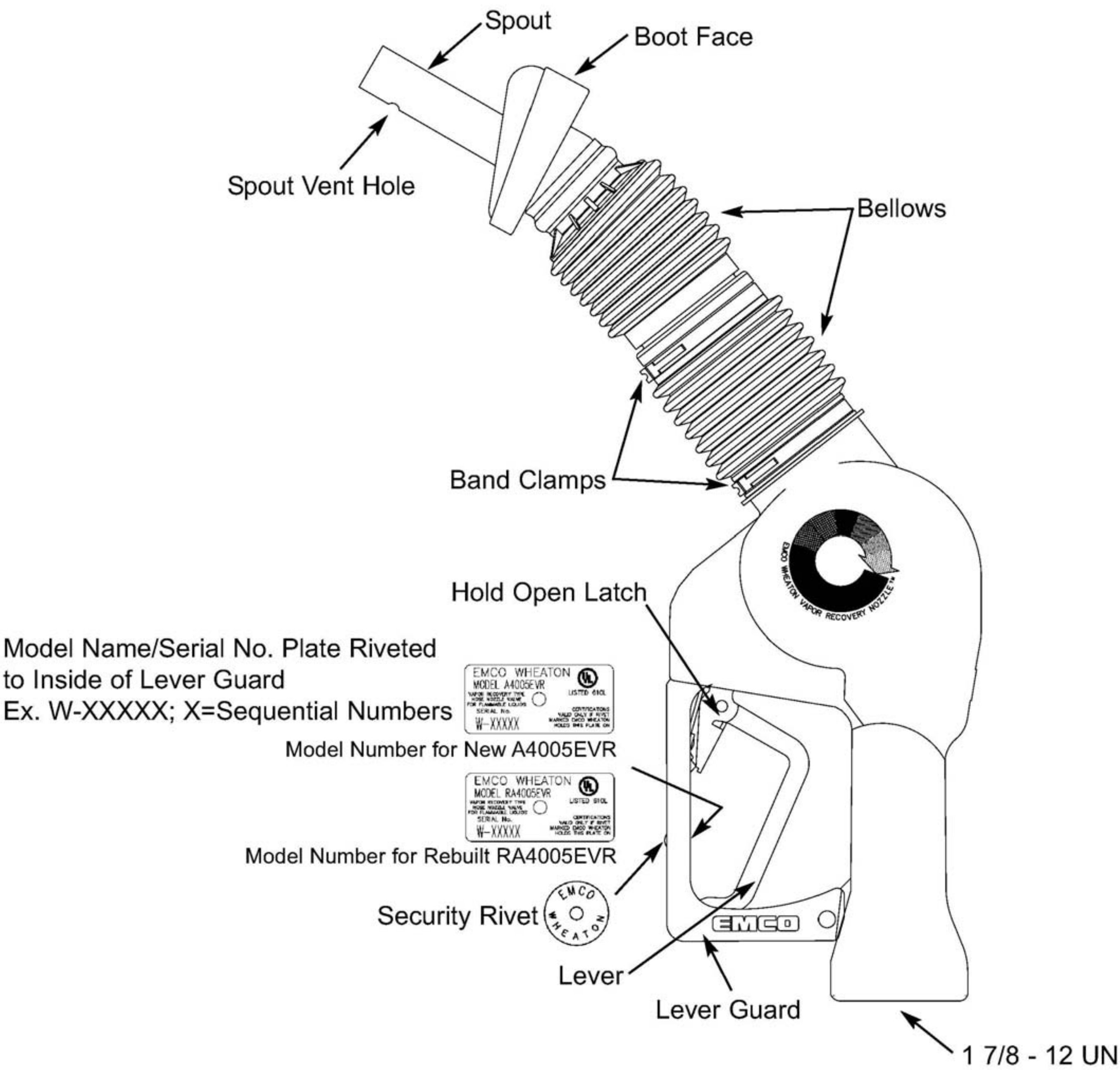


Figure 2B-2
Hirt VCS 100 Thermal Oxidizer
(shown in normal operation)

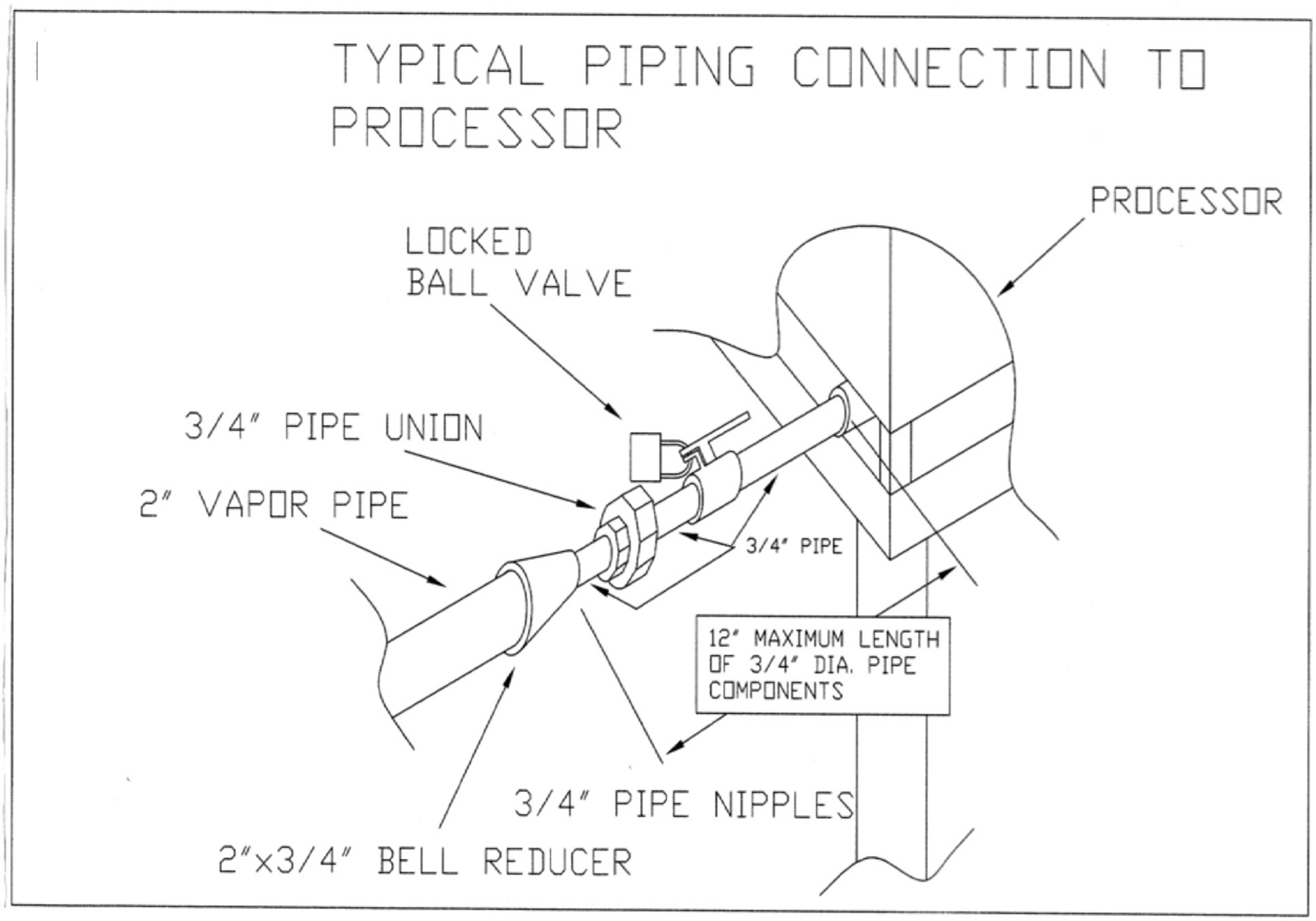


Figure 2B-3
Hirt VCS 100 Thermal Oxidizer
(3-Way Valve shown in normal operation)

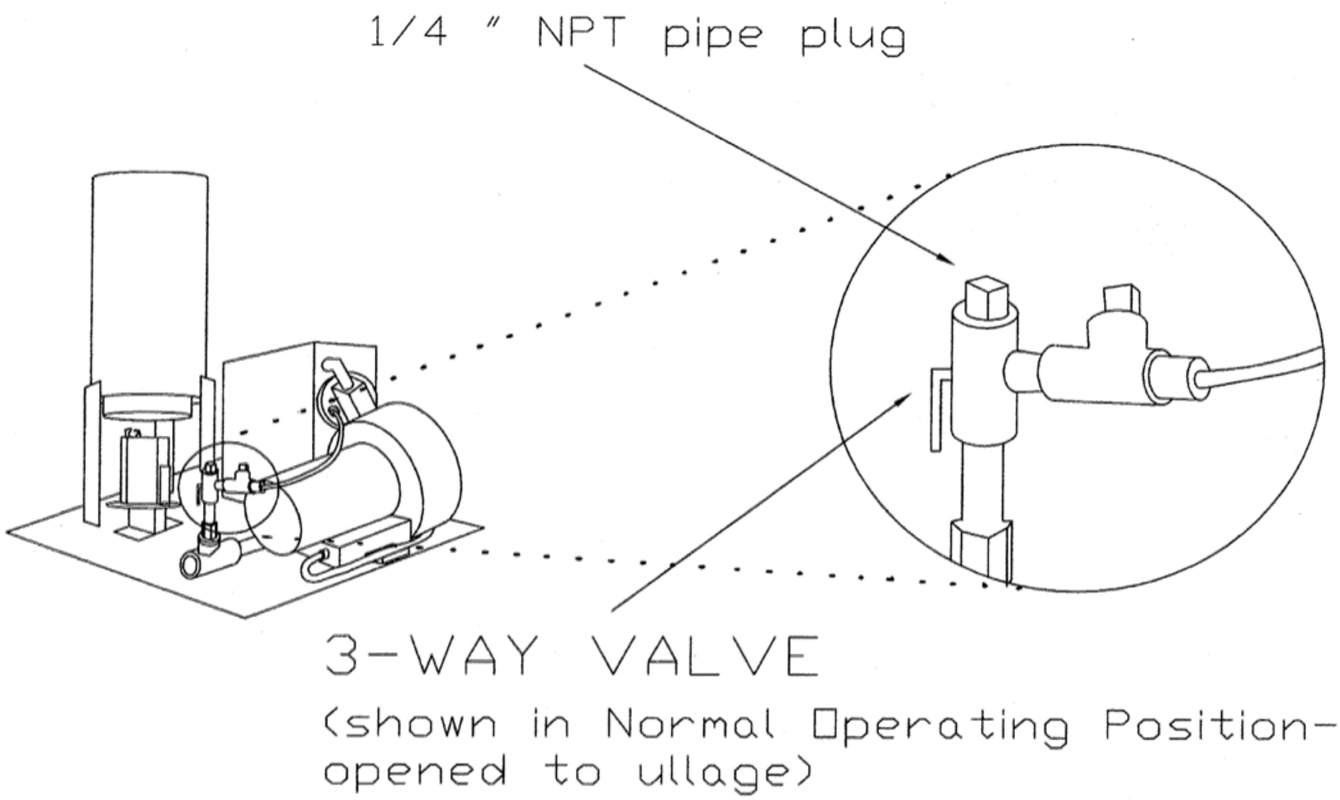


Figure 2B-4
Example of a GDF Maintenance Record and Alarm History Record

Date of Maintenance/ Test/Inspection/Failure/ alarm history (including date and time of maintenance call)	Repair Date To Correct Test Failure	Maintenance/Test/Inspection Performed and Outcome/Action Taken in Response to Alarm	Affiliation	Name and Technician ID Number of Individual Conducting Maintenance or Test	Telephone Number

Executive Order VR-207-A
Emco Phase II EVR System with Hirt Thermal Oxidizer

Exhibit 5
Liquid Removal Test Procedure

Definitions common to all certification and test procedures are in:

D-200 Definitions for Vapor Recovery Procedures

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

1. PURPOSE AND APPLICABILITY

1.1 This procedure is used to quantify the removal rate of liquid from the vapor passage of a Phase II balance system hose equipped with a liquid removal device. This procedure provides a method to determine compliance with the liquid removal requirements specified in ARB Executive Orders VR-207 and VR-208 and any subsequent amendments or revisions.

2. PRINCIPLE AND SUMMARY OF TEST PROCEDURE

2.1 This test procedure provides two options to determine the compliance of liquid removal devices. Under option 1 (short version), liquid in the vapor path of a coaxial hose is drained and measured. If the volume of liquid drained equals or exceeds 25 ml, a liquid removal test is conducted. For those hoses with less than 25 ml drained, no further testing is required. Under option 2 (long version), all hoses are evaluated regardless of the volume of liquid drained. Option 2 includes a prewetting and wall adhesion step. Both options test the liquid removal device by introducing gasoline into the vapor path of the coaxial hose through the nozzle bellows. After 7.5 gallons of gasoline is dispensed, the amount of gasoline remaining in the hose is measured and the liquid removal rate is determined. The district shall specify which testing option is to be used.

Caution: When draining liquid from the vapor side of the hose, make sure the dispenser is not activated. The nozzle vapor valve is on the same stem as the fuel valve. To drain gasoline from the vapor side of the hose, the fuel lever must be engaged. If the dispenser is activated, gasoline in the fuel hose may be pressurized when engaging the fuel lever.

3. BIASES AND INTERFERENCES

3.1. Slits or tears in the hose or nozzle vapor path may bias the results towards compliance.

3.2. This test shall not be conducted on any fueling point where the hanging hardware is defective as identified in Exhibit 2.

3.3. Any spillage of gasoline invalidates the test for any volumes that are required to be measured or recorded.

3.4. A breach of the inner product hose may introduce additional gasoline into the outer vapor path resulting in a larger volume drained than introduced.

3.5. Not having the liquid extraction device (indicated by the mark on the outside of the hose) at the bottom of the hose loop during liquid removal testing, as shown in Figure 1, will bias the results towards failure.

3.6. The test procedure requires the use of Emco's nozzle spout plug, P/N 494635EVR as shown in Figure 2. This tool is used to plug the spout when draining liquid from the vapor side of the hose. Not plugging the spout may bias the results towards failure. Nicks, cuts, or tears in the plug seal will bias the results towards failure.

3.7. Dispensing rates not between 6.0 and 10.0 gallons per minute (GPM) invalidates the test.

4. SENSITIVITY, RANGE, AND PRECISION

4.1 The range of measurement of the liquid removal rate is dependent upon the range of the graduated cylinder used for testing.

4.2 To ensure precision, graduated cylinder readings shall be measured at the liquid level meniscus.

5. EQUIPMENT

5.1. Nozzle Spout Plug: Use Emco's spout plug, P/N 494635EVR (Figure 2).

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

5.3. Funnels. Large and small gasoline compatible, non-breakable, funnels with dimensions similar to those as shown in Figure 3, or equivalent.

5.4. Graduated Cylinders. Gasoline compatible, non-breakable 0-25ml, 0-100ml, 0-250 ml, and 0-500 ml graduated cylinders with stable base plates. The 25ml cylinder may be necessary to quantify volumes of liquid less than 20 ml.

5.5. Gasoline Test Tank. (Optional) A portable tank, meeting fire safety requirements for use with gasoline, may be used to receive the gasoline dispensed during testing. The tank shall have sufficient volume so that at least 10.0 gallons may be dispensed prior to activating the primary shutoff mechanism of the nozzle. **When using a gasoline test tank, ensure that a ground strap is used and that it is properly connected to an acceptable ground.** To minimize testing-related emissions, vehicle refueling events should be used for this procedure whenever feasible.

5.6. Traffic Cones. Use traffic cones to encircle the area where testing is conducted.

5.7. Field Data Sheet. Use the appropriate data sheet to record liquid removal test information. Forms 1 and 2 serve as examples; districts may require modified versions.

5.8. Gasoline Container. Use a portable fuel container equipped with a tight fitting cap, of at least 1.0 gallon capacity.

NOTE: THIS TEST PROCEDURE PROVIDES TWO OPTIONS TO DETERMINE COMPLIANCE OF LIQUID REMOVAL DEVICES. THE DISTRICT SHALL SPECIFY WHICH TESTING OPTION IS TO BE USED

6. OPTION 1 (SHORT VERSION)

PRE-TEST PROCEDURE

6.1 Verify that the 500 ml graduated cylinder is empty. Position the large funnel into the graduated cylinder.

6.2 Remove the nozzle from the dispenser. **<u>Do not activate dispenser!</u>** Install Emco's spout plug, P/N 494635EVR in the tip of the spout (Figure 2). Carefully tilt the spout into the funnel/graduated cylinder assembly.

6.3 Lower the nozzle and funnel/graduated cylinder assembly as close to the ground as possible. "Walk out" the hose while keeping the nozzle lowered and hose fully extended. The hose shall slope downward from the dispenser toward the nozzle.

6.4 **<u>Do not activate dispenser!</u>** Open the nozzle's vapor check valve by compressing the bellows and engaging the fuel lever. Allow 20 seconds for all liquid to drain. Use caution to avoid spillage.

6.5 Remove Emco's spout plug and return the nozzle to the dispenser and measure the volume of liquid drained. If the volume drained is less than 200 ml, transfer the liquid into an appropriately sized graduated cylinder. For example, if 40 ml of liquid was drained, use the 100 ml graduated cylinder to take the measurement.

6.6 Record the amount of liquid drained on Form 1 ("PRE-TEST").

6.7 If the volume drained is greater than or equal to 25 ml, proceed to Section 6.8 of the procedure. Hoses with greater than 25 ml drained are considered to be pre-wetted. If the amount drained is less than 25 ml, proceed to the next nozzle/hose to be evaluated and repeat Section 6.1-6.6

TEST PROCEDURE (FOR HOSES WITH GREATER THAN 25 ML DRAINED)

6.8 Pour 150 ml to 175 ml of gasoline into the 250 ml graduated cylinder. Measure and record this volume on Form 1 (VI).

6.9 Remove the nozzle from the dispenser and position the nozzle upright so that the spout is in a vertical position. **<u>Do not activate dispenser!</u>**

6.10 Open the nozzle's vapor check valve by compressing the bellows and engaging the fuel lever. Carefully insert the stem of the small funnel between the bellows and nozzle spout.

6.11 Pour the measured volume into the vapor path of the hose. Use caution not to spill the gasoline. Remove the small funnel after the gasoline has been introduced.

6.12 Insert the nozzle into a vehicle or test tank fill pipe.

6.13 Find the mark on the outside of the hose which indicates the location of the liquid pick-up device. Ensure the mark is at the bottom of the hose loop when dispensing as shown in Figure 1. This can be accomplished by lifting up the back of the hose, adjusting nozzle position, or adjusting the test tank position.

6.14 Dispense 7.5 (±0.5) gallons at the highest possible flow rate by holding the nozzle lever in the maximum handheld position. Use a stopwatch to measure the time elapsed while dispensing. Record the volume of fuel dispensed (G) and the elapsed time (T) on Form 1. Return nozzle to the dispenser.

6.15 Calculate the dispensing rate using the equation below. If the dispensing rate is not between 6.0 and 10.0 gallons per minute (GPM), the test results are invalid.

$$\text{GPM} = 60 \text{ x} \left(\frac{\text{G}}{\text{T}}\right)$$

Where:

GPM	=	dispensing rate (in gallons per minute)
G	=	gallons of fuel dispensed
T	=	number of seconds required to dispense

6.16 Using the 250 ml graduated cylinder and large funnel, carefully drain the remaining liquid from the vapor path of the hose as described in Section 6.1 through 6.5 **<u>(make sure dispenser is not activated and spout plug is installed before draining liquid!)</u>**. Record this quantity on Form 1 (VF).

6.17 Use Equation 9.1 to calculate the liquid removal rate for all the applicable hoses tested.

6.18 If the liquid removal rate is less than 5.0 ml/gallon, but greater than or equal to 4.5 ml/gallon, repeat the test two additional times and average the three results.

7. OPTION 2 (LONG VERSION)

PRETEST PROCEDURE

7.1 Carefully pour 150 ml of gasoline into the 250 ml graduated cylinder.

7.2 Remove the nozzle from the dispenser. **Do not activate dispenser!** Install Emco's spout plug, P/N 494635EVR in the tip of the spout as shown in Figure 2. Position the nozzle upright so that the spout is in a vertical position.

7.3 Open the nozzle's vapor check valve by compressing the bellows and engaging the fuel lever. Carefully insert the stem of the small funnel between the bellows and nozzle spout.

7.4 Pour the gasoline from the 250 ml graduated cylinder into the vapor path of the hose. Use caution not to spill the gasoline. Remove the small funnel after the gasoline has been introduced.

7.5 Verify that the 500 ml graduated cylinder is empty. Position the large funnel into the graduated cylinder.

7.6 Carefully tilt the spout into the funnel/graduated cylinder assembly. **Make sure Emco's spout plug is installed and the dispenser is deactivated.**

7.7 Lower the nozzle and funnel/graduated cylinder assembly as close to the ground as possible. "Walk out" the hose while keeping the nozzle lowered and hose fully extended. The hose shall slope downward from the dispenser toward the nozzle.

7.8 Open the nozzle's vapor check valve by compressing the bellows and engaging the fuel lever. Allow 20 seconds for all liquid to drain. Use caution to avoid spillage. If necessary, drain full graduated cylinders into a portable gas can until the hose is empty.

7.9 Remove Emco's spout plug and return the nozzle to the dispenser.

TEST PROCEDURE

7.10 Pour 150 ml to 175 ml of gasoline into the 250 ml graduated cylinder. Measure and record this volume on Form 2 (VI).

7.11 Remove the nozzle from the dispenser. **Do not activate dispenser!** Position the nozzle upright so that the spout is in a vertical position.

7.12 Open the nozzle's vapor check valve by compressing the bellows and engaging the fuel lever. Carefully insert the stem of the small funnel between the bellows and nozzle spout.

7.13 Pour the measured volume into the vapor path of the hose. Use caution not to spill the gasoline. Remove the small funnel after the gasoline has been introduced.

7.14 Insert the nozzle into a vehicle or test tank fill pipe.

7.15 Find the mark on the outside of the hose which indicates the location of the liquid pick-up device. Ensure the mark is at the bottom of the hose loop when dispensing as shown in Figure 1. This can be accomplished by lifting up the back of the hose, adjusting nozzle position, or adjusting the test tank position.

7.16 Dispense 7.5 (±0.5) gallons at the highest possible flow rate by holding the nozzle lever in the maximum handheld position. Use a stopwatch to measure the time elapsed while dispensing. Record the volume of fuel dispensed (G) and the elapsed time (T) on Form 2. Return nozzle to the dispenser.

7.17 Calculate the dispensing rate using the equation below. If the dispensing rate is not between 6.0 and 10.0 gallons per minute (GPM), the test results are invalid.

$$GPM = 60 \text{ x} \left(\frac{G}{T}\right)$$

Where:

GPM	=	dispensing rate (in gallons per minute)
G	=	gallons of fuel dispensed
T	=	number of seconds required to dispense

7.18 Using the 250 ml graduated cylinder and large funnel, carefully drain the remaining liquid from the vapor path of the hose as described in Section 7.5 through 7.8 **(make sure dispenser is deactivated and spout plug is installed before draining liquid!)**. Record this quantity on Form 2 (VF).

7.19 Open the nozzle's vapor check valve by compressing the bellows and engaging the fuel lever. **Do not activate dispenser!** Carefully insert the stem of the small funnel between the bellows and nozzle spout

7.20 Use the 250 ml graduated cylinder and small funnel to pour 150 ml of gasoline into the vapor passage of the hose. Dispense no gasoline.

7.21 Using the 250 ml graduated cylinder and large funnel, completely drain the gasoline from the vapor passage back into the graduated cylinder as described in Section 7.5 through 7.9 **(make sure dispenser is deactivated and spout plug is installed before draining liquid!)**.

7.22 Subtract the volume drained (value from Section 7.21) from the volume added (value from Section 7.20). This value represents the volume of gasoline lost due to wall adhesion. The purpose of the wall adhesion value is to quantify the amount of gasoline lost to evaporation from transfer to and from the graduated cylinders and adhesion of liquid to vapor passage surfaces in previous measurements. Record this quantity on Form 2 (VW).

7.23 Use Equation 9.2 to calculate the liquid removal rate for all the applicable hoses tested.

7.24 If the liquid removal rate is less than 5.0 ml/gallon, but greater than or equal to 4.5 ml/gallon, repeat the test two additional times and average the three results.

8. POST TEST PROCEDURES

8.1. Empty all containers and return any excess gasoline to the underground storage tank.

8.2. Remove the traffic cones from the testing area.

9. CALCULATING RESULTS

9.1 If using OPTION 1(short version), the liquid removal rate shall be calculated as follows:

$$VR = \frac{VI - VF}{G}$$

Where:

VR	=	Gasoline removed per gallon dispensed, milliliters/gallon
VI	=	Total initial volume poured into hose vapor passage, milliliters
VF	=	Volume of gasoline remaining in the hose vapor passage after dispensing, milliliters
G	=	Total dispensed, gallons

9.2 If using OPTION 2 (long version), the liquid removal rate shall be calculated as follows:

$$VR = \frac{(VI - VW) - VF}{G}$$

Where:

VR	=	Gasoline removed per gallon dispensed, milliliters/gallon
VI	=	Total initial volume poured into hose vapor passage, milliliters
VW	=	Volume of liquid lost due to wall adhesion, milliliters
VF	=	Volume of gasoline remaining in the hose vapor passage after dispensing, milliliters
G	=	Total dispensed, gallons

10. REPORTING RESULTS

10.1. Record all applicable liquid removal rate information on the appropriate form as shown in Form 1 and 2. Districts may require the use of alternate forms provided that the alternate forms include the same parameters as identified in Forms 1 and 2.

10.2. If the calculated liquid removal rate is greater than or equal to 5 milliliters/gallon, the liquid removal device has demonstrated compliance.

10.3. If the calculated liquid removal rate is less than 5 milliliters/gallon, the liquid removal device is not in compliance.

11. ALTERNATIVE TEST PROCEDURES

This 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 14 of Certification Procedure CP-201.

FIGURE 1
Position of Liquid Removal Device
When Conducting Liquid Removal Testing

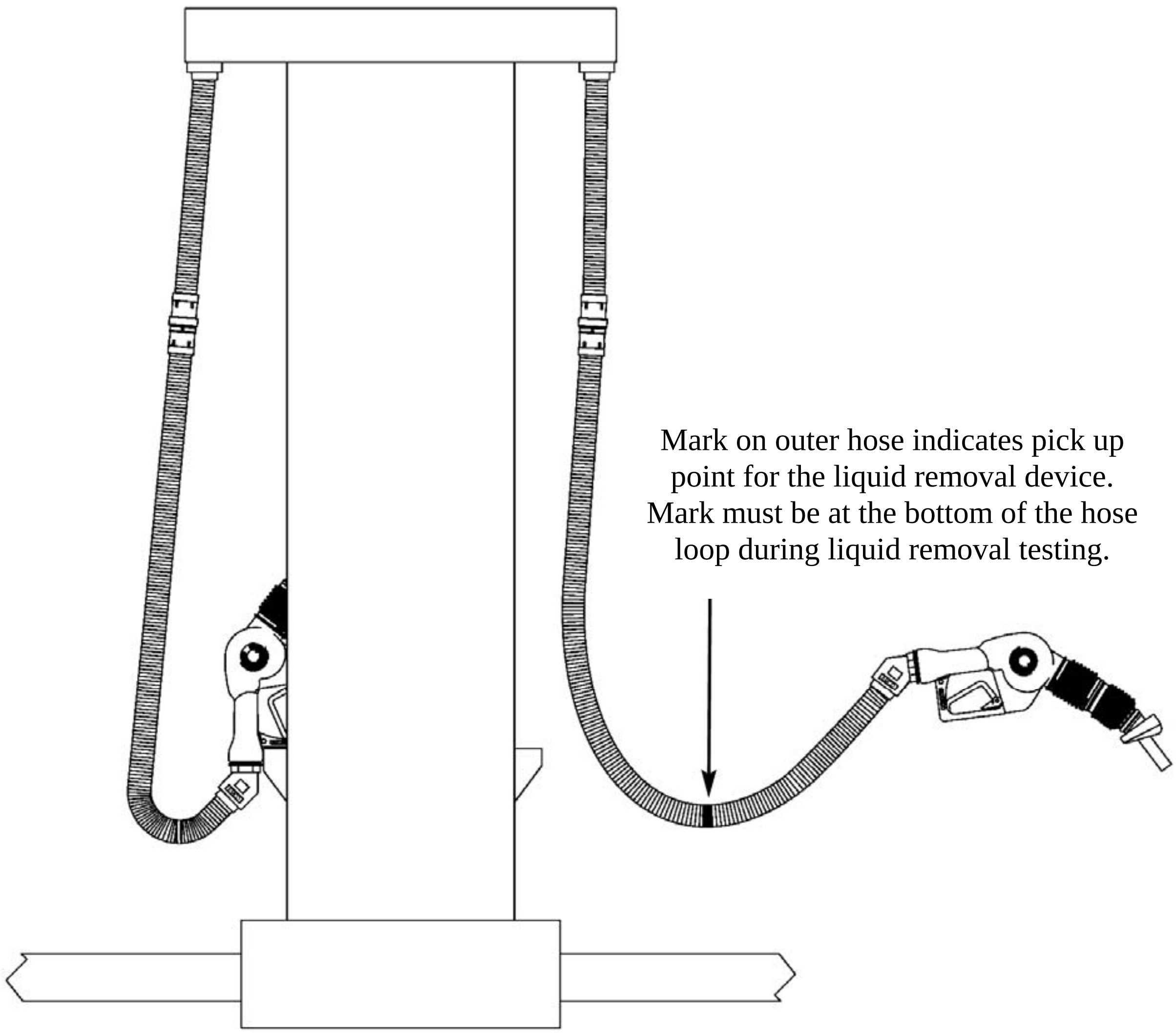


FIGURE 2
Emco Nozzle Spout Plug P/N 494635EVR

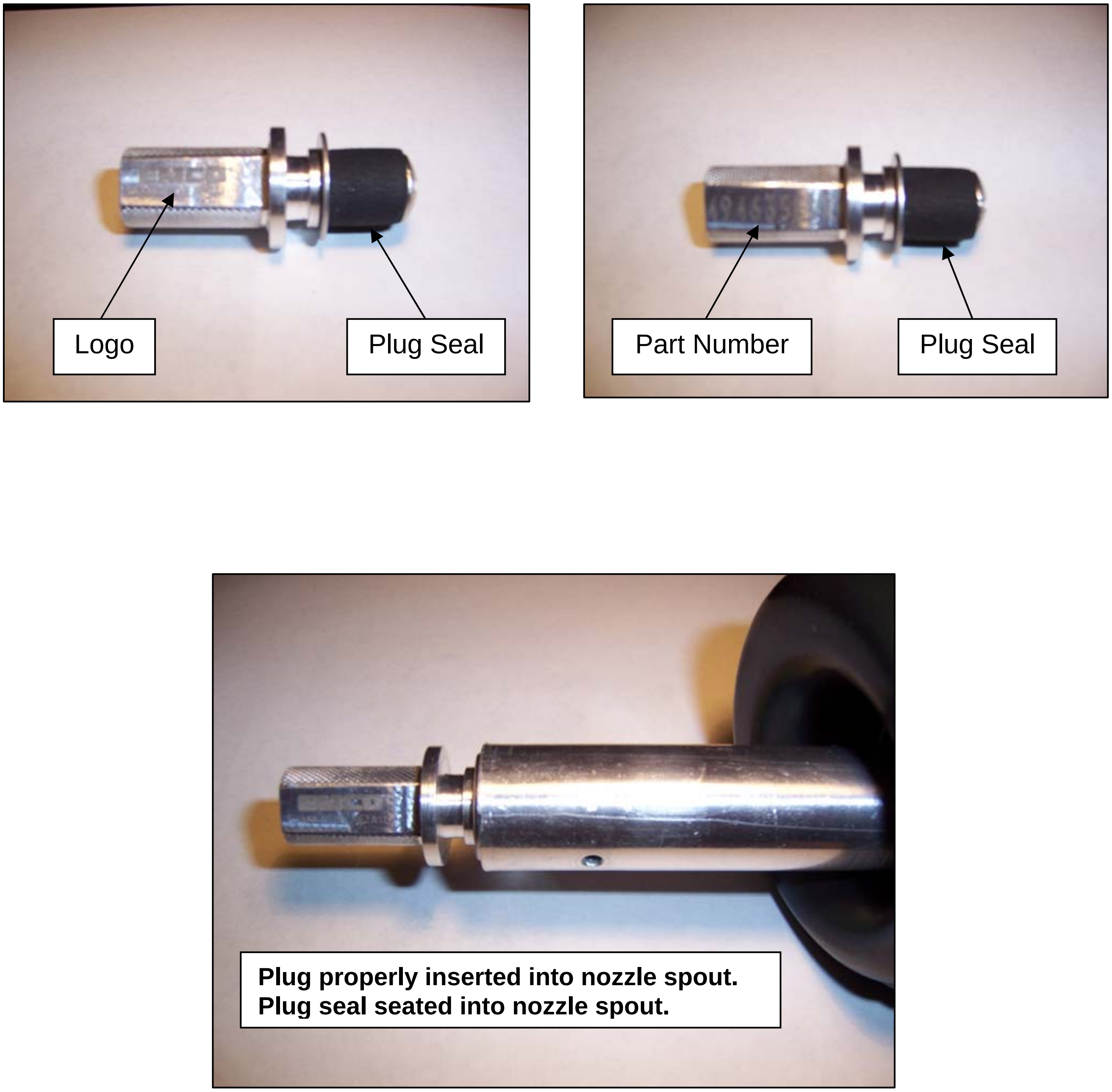
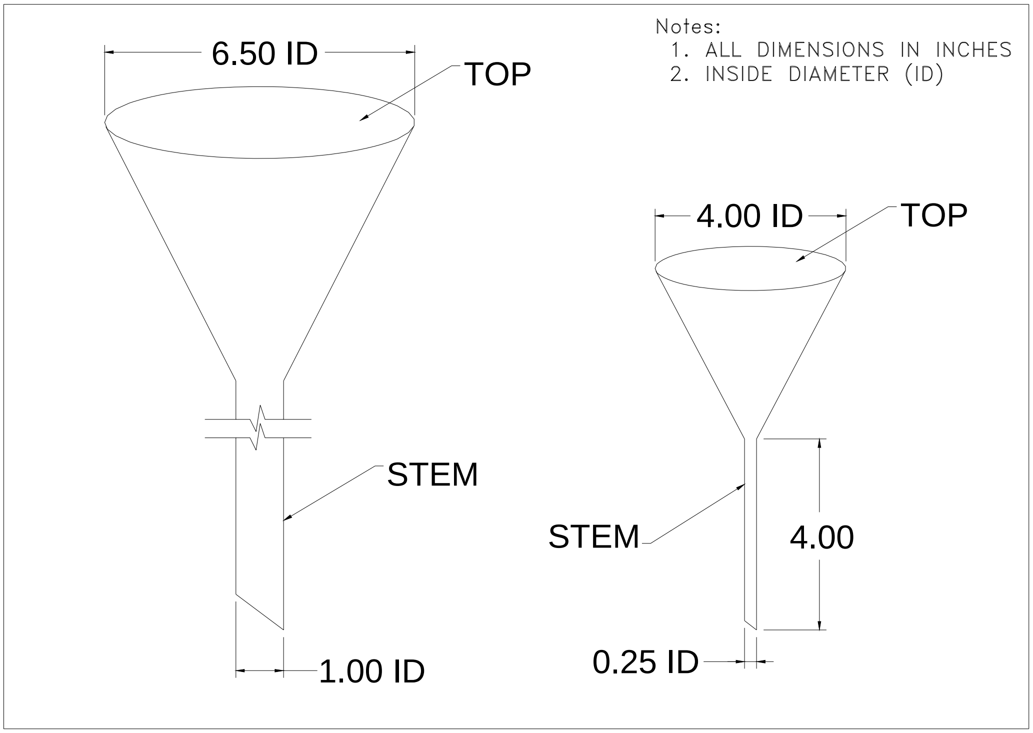


FIGURE 3
Recommended FUNNEL SPECIFICATIONS



FORM 1: LIQUID REMOVAL TEST DATA SHEET (OPTION 1)

Facility Name & Address	Facility Representative & Title		
		Test Date	
		A/C or Permit No.	
		Testing Company	
		Tester Name	
	Phone No.	Emco Training Cert # (if applicable)	
		Inspector Name	

GENERAL INFORMATION				PRE-TEST	TEST RUN					VR=(VI-VF)/G
Dispenser Number	Product Grade	Make & Model of Hose	Serial Number of Hose	Volume Drained From Hose in mL	Volume Poured Into Hose in mL (VI)	Gallons Dispensed (G)	Seconds to Dispense (T)	Dispensing Rate (60*(G/T))	Volume Remaining in mL (VF)	Liquid Removal Rate (mL/gal)

FORM 2: LIQUID REMOVAL TEST DATA SHEET (OPTION 2)

Facility Name & Address	Facility Representative & Title
	Phone No.

Test Date ____________
A/C or Permit No. ____________
Testing Company ____________
Tester Name ____________
Emco Training Cert # (if applicable) ____________
Inspector Name ____________

GENERAL INFORMATION				PRE-TEST	TEST RUN					VR=((VI-VW)-VF)/G
Dispenser Number	Product Grade	Make & Model of Hose	Serial Number of Hose	Volume Poured into Hose in mL (VI)	Gallons Dispensed (G)	Seconds to Dispense (T)	Dispensing Rate (60*(G/T))	Volume Remaining in mL (VF)	Volume Lost to Wall Adhension in mL (VW)	Liquid Removal Rate (mL/gal)

Executive Order VR-207-A
Emco Phase II EVR System with Hirt Thermal Oxidizer

Exhibit 6
Required Items in Conducting TP-201.4

The instructions below are required when conducting TP-201.4 for the Emco Phase II EVR System with Hirt Thermal Oxidizer. The tester shall document that each step was followed as indicated below and shall include this page of the Exhibit with the submission of TP-201.4 test results. Note that districts may require use of an alternate form to meet these requirements, provided the alternate form includes the same minimum parameters.

The Emco Model A4005EVR nozzle incorporates a lever-actuated vapor valve. The vapor valve is on the same stem as the fuel valve. When conducting TP-201.4, the nozzle lever must be actuated to open the vapor valve and allow vapor to flow from the nozzle to the underground storage tank. The following steps must be taken when conducting Methodology 1 of TP-201.4:

1. The dispenser shall not be activated. If the dispenser is activated, gasoline in the fuel hose may be pressurized when engaging the fuel lever.
2. The Hirt VCS 100 Thermal Oxidizer shall be turned off. At the Hirt Indicator Panel, turn the Power Switch to the “Off” position.
3. Prior to inserting the Emco EVR nozzle into the fillpipe of the Dynamic Back Pressure Test Unit in step 7.1 of TP-201.4, completely drain any gasoline in the nozzle and vapor path of the hose. The dispenser must be deactivated and the nozzle lever and bellows shall be fully engaged.
4. When flowing nitrogen per step 7.1.2, fully engage the nozzle lever to allow vapor flow from the nozzle to the UST.
5. After conducting TP-201.4, turn the Hirt VCS 100 Power Switch to the “On” position.

Required Steps	Verification (please circle)
1. Were all dispensers deactivated?	Yes No
2. Was VCS 100 Power Switch turned to “Off” position?	Yes No
3. Were all nozzles and hoses completely drained of gasoline prior to inserting nozzle into Dynamic Back Pressure Unit?	Yes No
4. Were all nozzle levers fully engaged when conducting flow test?	Yes No
5. Was VCS 100 Power Switch turned to “On” position after conducting TP-201.4?	Yes No

Test Company: ____________________ Facility Name:____________________

____
Print Name (Technician) Signature Date

____
Technician Certification Number and Expiration Date
(ICC or District Training Certification, as applicable)

Executive Order VR-207-A
Emco Phase II EVR System with Hirt Thermal Oxidizer

Exhibit 7
Nozzle Bag Test Procedure

Verification of the integrity of the Emco nozzle vapor valve shall be performed on installed nozzles by use of the following test.

1. Seal nozzle(s) at the gasoline dispensing facility (GDF) in a plastic bag, using tape or other means to secure the bag around the base of the nozzle (see Figure 1). Any plastic bag large enough to enclose the nozzle and having a thickness of no greater than 2 mils can be used.

2. Observe the bagged nozzle(s) for 30 seconds.

3. Any nozzle where the bag can be seen visually expanding or collapsing has a defective vapor valve and is not in compliance with Exhibit 2.

4. Record the test results on the “Nozzle Bag Test Results” form provided in this Exhibit. Districts may require use of an alternate form, provided that the alternate form includes the same minimum parameters.

5. Remove the bags from all the nozzles and return the nozzles to the dispenser holsters.

Figure 1
Example of Bagged Nozzle

NOZZLE BAG TEST RESULTS

SOURCE INFORMATION		TEST COMPANY INFORMATION	
Facility (DBA)/Site Address:	Facility Representative/Title:	Test Company Name	# of Nozzles:________ # Nozzles Tested: ________________ # Nozzles Passed: ________________ # Nozzles Failed: ________________ # Nozzles not Tested: ________________
Print Name	Print Name	Print Name of Tester	
Street Address	Title ( )	Street Address	
City Zip	Phone No.	City Zip	
District Inspector:	☐ P/O ☐ S/A ☐ A/C Number:	Date of Test:	Time of Test:

Dispenser	Gas Grade	Nozzle Type	Bag Expanded or Collapsed after 30 Seconds
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No

Executive Order VR-208-A
Emco Phase II EVR System with Hirt Thermal Oxidizer Including INCON ISD

Exhibit 2
System Specifications

This exhibit contains the installation, maintenance and compliance standards and specifications that apply to the Emco Phase II EVR System Including ISD installed at a gasoline dispensing facility (GDF). All components must be installed, maintained, and operated in accordance with the specifications in the **ARB Approved Installation, Operation and Maintenance Manual** (IOM). Installation, maintenance and repair of system components, including removal and installation of such components in the course of any required tests, shall be performed by technicians certified by the appropriate manufacturer. Additional certifications may be required in accordance with local district requirements. Provided that there are no other local district requirements, a GDF owner/operator can remove and install nozzles, hose swivels, curb hoses, safe brakes, and whip hoses without a manufacturer certification.

Nozzle

1. A vapor bellows shall be installed on the nozzle at the base of the spout, as shown in **Figure 2B-1**.

2. The Emco Model A4005EVR nozzle has an integral vapor valve which prevents the loss of vapor from the underground storage tanks, ensures proper operation of the system and prevents the ingestion of air into the system. The performance of the nozzle vapor valve can be determined by items 2.1 or 2.2.

   2.1. The maximum allowable leak rate for the nozzle vapor path, as determined by TP-201.2B, shall not exceed 0.07 cubic feet per hour (CFH) at a pressure of two inches water column (2.00" WC)

   2.2. Verification of the integrity of the vapor valve can be performed on installed nozzles using the nozzle bag test procedure in Exhibit 7.

3. The gasoline flow rate of the nozzle shall be between six (6.0) and ten (10.0) gallons per minute as determined by the applicable provisions of section 6 or 7 of Exhibit 5 or by direct observation for 30 seconds minimum at the maximum hand held position.

Vapor Collection

1. The system pressure drop from the nozzle to the UST, as determined by TP-201.4 (Methodology 1) and Exhibit 6, shall not exceed the following:

   0.35 inches WC at a flow rate of 60 CFH of Nitrogen; and
   0.62 inches WC at a flow rate of 80 CFH of Nitrogen.

Coaxial Hoses

1. The maximum length of the curb hose, hose swivel, safe break valve, and whip hose combined shall not exceed fifteen feet as measured from the base of the nozzle to the end of dispenser adapter or dispenser, as appropriate (reference Exhibit 1 Figure 1A-2).

2. The liquid removal rate shall not be less than five milliliters per gallon (5 ml/gal) as determined by Exhibit 5 when tested with a gasoline flow rate between six (6.0) and ten (10.0) gallons per minute. Liquid removal requirement is applicable to all grade of gasoline.

3. All hoses shall have a permanent marking indicating the liquid pick-up location.

4. Any hose configuration is allowed when installed in accordance with the IOM section titled "Hoses".

Safe Break Valve

1. The Emco Safe Break Valves are non-reconnecting and shall be replaced following a drive-off.

Flow Limiter

1. No flow limiter is allowed for this system.

Hirt VCS 100 Thermal Oxidizer

1. The processor vapor integrity shall demonstrate compliance with the static pressure decay criteria of TP-201.3 and Exhibit 4.

2. Unless there is maintenance or testing being conducted on the processor, the processor shall be on (power lamp is lit) and in the automatic vapor processor mode. The ball valve on the inlet of the processor shall be locked in the open position shown in **Figure 2B-2** and the 3-Way Valve handle shall be pointing down in the Normal Operating Position (Opened to UST Ullage) shown in Figure 2B-3 during normal processor operation. The handles of the ball valves shall not be removed.

3. Piping to the processor shall be sloped 1/8" per foot minimum toward the vent line(s).

4. The VCS 100 Indicator Panel shall be installed at a location that is most likely to be occupied by the station attendant during normal station operation (i.e., cash register).

5. The processor shall activate when the processor is exposed to an atmospheric pressure input and the Processing lamp at the Indicator Panel shall light within three (3) minutes as determined by Exhibit 8.

6. When the processor is exposed to an atmospheric pressure input, the OVERPRESSURE lamp at the Indicator Panel shall light within sixty two (62) minutes as determined by Exhibit 8.

7. If the OVERPRESSURE lamp lights, the system is not in proper working order. The GDF owner/operator shall immediately take the following actions:

   a. record the date and time the OVERPRESSURE lamp lit in the station's maintenance and alarm records;
   b. investigate the cause of the OVERPRESSURE light as provided by section 8 of the Installation, Operations, and Maintenance Manual. Record results of inspections, maintenance, and/or testing conducted in the station's maintenance and alarm records; and if necessary,
   c. record the date and time when the GDF owner/operator called the maintenance contractor for service.

Pressure/Vacuum Vent Valves for Storage Tank Vents

1. All P/V vent valves shall be an ARB certified P/V valve for a Phase I system.

2. At least one pressure/vacuum (P/V) vent valve shall be installed on each tank vent. The maximum number of P/V vent valves allowed and P/V vent valve performance specifications are listed in the applicable Phase I EVR Executive Order. Vent lines may be manifold to minimize the number of P/V vent valves and potential leak sources, provided the manifold conforms to all applicable fire regulations.

Vapor Recovery Piping Configurations

NOTE: Vapor Return Piping shall meet the requirements specified in section 4.11 of CP-201.

1. Vapor Return and Vent Lines

   For facilities installed on or after April 1, 2003, all vapor return and vent lines shall be a minimum nominal internal diameter of 2 inches from the dispensers or the vent stacks to the first manifold. All lines after the first manifold and back to the underground storage tank shall have a minimum nominal internal diameter of 3 inches.

   Note: Facilities permitted by a local district prior to April 1, 2003 shall be required to meet the three inch diameter standard only upon facility modification which involves the addition, replacement, or removal of 50 percent or more of the buried vapor piping.

2. All vapor return lines shall have a minimum slope of 1/8 inch per foot from the dispenser riser to the riser of the UST. A slope of 1/4 inch or more per foot is recommended wherever feasible.

3. The dispenser shall be connected to the riser with either flexible or rigid material that is listed for use with gasoline. The dispenser-to-riser connection shall be installed so that any liquid in the lines will drain toward the storage tank. The internal diameter of the connector, including all fittings, shall not be less than one inch (1").

   Note: The dispenser-to-riser connection is defined as the piping connection between the dispenser piping and the inlet of the dispenser riser. A vapor shear valve may also be part of the riser connection.

4. There is no length restriction for the vapor return piping of the system as long as the system complies with the maximum pressure drop requirement, item 1 of the Vapor Collection section.

5. No product shall be dispensed from any fueling point at a GDF installed with the Emco Phase II EVR System if there is a vapor line that is disconnected and open to the atmosphere.

6. No liquid condensate traps are allowed with this system.

Dispensers

1. The dispenser vapor piping must be sized adequately to meet the maximum pressure drop requirement, item 1 of the Vapor Collection section.

2. Dispenser vapor piping shall be installed so that any liquid in the lines will drain toward the dispenser riser.

3. The INCON ISD System software version 1.1.0 does not support multi-hose (six pack) dispenser configurations and is therefore limited for use with unihose dispensers.

Phase I System

1. The Phase I system shall be an ARB-certified system that demonstrates compliance with the static pressure decay test criteria contained in TP-201.3 and Exhibit 4.

Maintenance Records

1. Each GDF operator owner shall keep records of alarms and maintenance performed at the facility. Such records shall be maintained on site in accordance with district requirements or policies. The records shall include alarm date and time, nature of the alarm, troubleshooting, maintenance or repair performed to validate and/or correct alarms, component, or system failures, date when maintenance or repair was conducted, name and Certified Technician Identification Number of individual conducting maintenance or test, affiliation, and telephone number. Additional information may be required in accordance with local district requirements. An example of a GDF maintenance and alarm record is shown in Figure 2B-4.

2. Maintenance shall be conducted in accordance with the Scheduled Maintenance section of the ARB Approved Installation, Operation, and Maintenance Manual.

Vapor Recovery Equipment Defects

The following is deemed a defect for the affected fueling point(s) or system.

1. The fueling point shall be removed from service when more than 0.38 square inches of a nozzle boot face material is missing (e.g., a triangular or similar shape in which greater than 7/16 inches of the boot face circumference is missing (accumulated)).

2. The fueling point shall be removed from service when there is slit across seven (7) consecutive bellows convolutions as determined by direct measurements.

3. The fueling point shall be removed from service when a hose is found to have greater than 150 ml of gasoline in the vapor side as determined by sections 6.1 to 6.5 of Exhibit 5. Note: Prior to draining gasoline from the vapor side of the Goodyear hose, use Emco tool P/N 494635EVR and plug the fuel spout. **Do not activate dispenser when draining gasoline from the vapor side of the Goodyear hose.**

4. The fueling point shall be removed from service when the Emco system pressure drop exceeds the following conditions as determined by Methodology 1 of TP-201.4 and Exhibit 6:

   0.95 inches WC at a flow rate of 60 CFH of Nitrogen; and
   1.52 inches WC at a flow rate of 80 CFH of Nitrogen.

5. The fueling point shall be removed from service when the dispensing rate is greater than ten (10) gallons per minute (gpm) or less than five (5) gpm as determined by the applicable provisions of section 6 or 7 of Exhibit 5 or by direct observation for 30 seconds minimum at the maximum hand held position.

6. The fueling point shall be removed from service when any hose has a visible opening as determined by direct observation.

7. The fueling point shall be removed from service when the insertion interlock mechanism allows dispensing when the bellows is uncompressed as determined by direct observation or GDF-09 (see Vapor Recovery Defects List).

8. The fueling point shall be removed from service when the nozzle automatic liquid shut-off mechanisms malfunction in any manner as determined by EPO No. 26-F (See Vapor Recovery Defects List) or direct observation.

9. The fueling point shall be removed from service when any nozzle has a defective vapor valve as determined by Exhibit 7 or when the vapor valve has a leak rate that exceeds 0.07 cubic feet per minute at a pressure of two (2) inches WC as determined by TP-201.2B.

10. The fueling point or system shall be removed from service when any component required by this Executive Order is absent, installed improperly or disconnected as determined by direct observation.

Figure 2B-1
Emco Model A4005EVR Nozzle

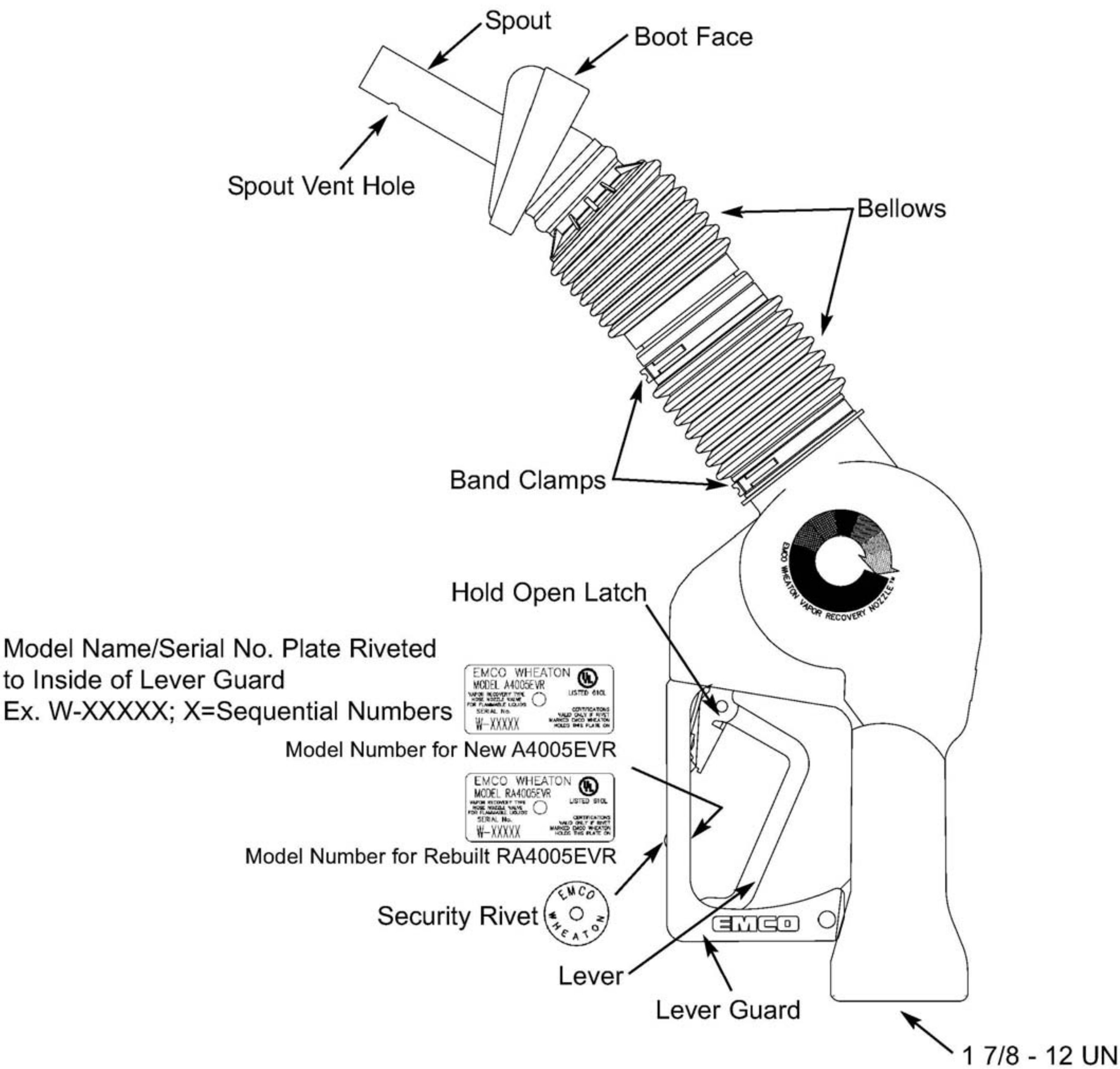


Figure 2B-2
Hirt VCS 100 Thermal Oxidizer
(shown in normal operation)

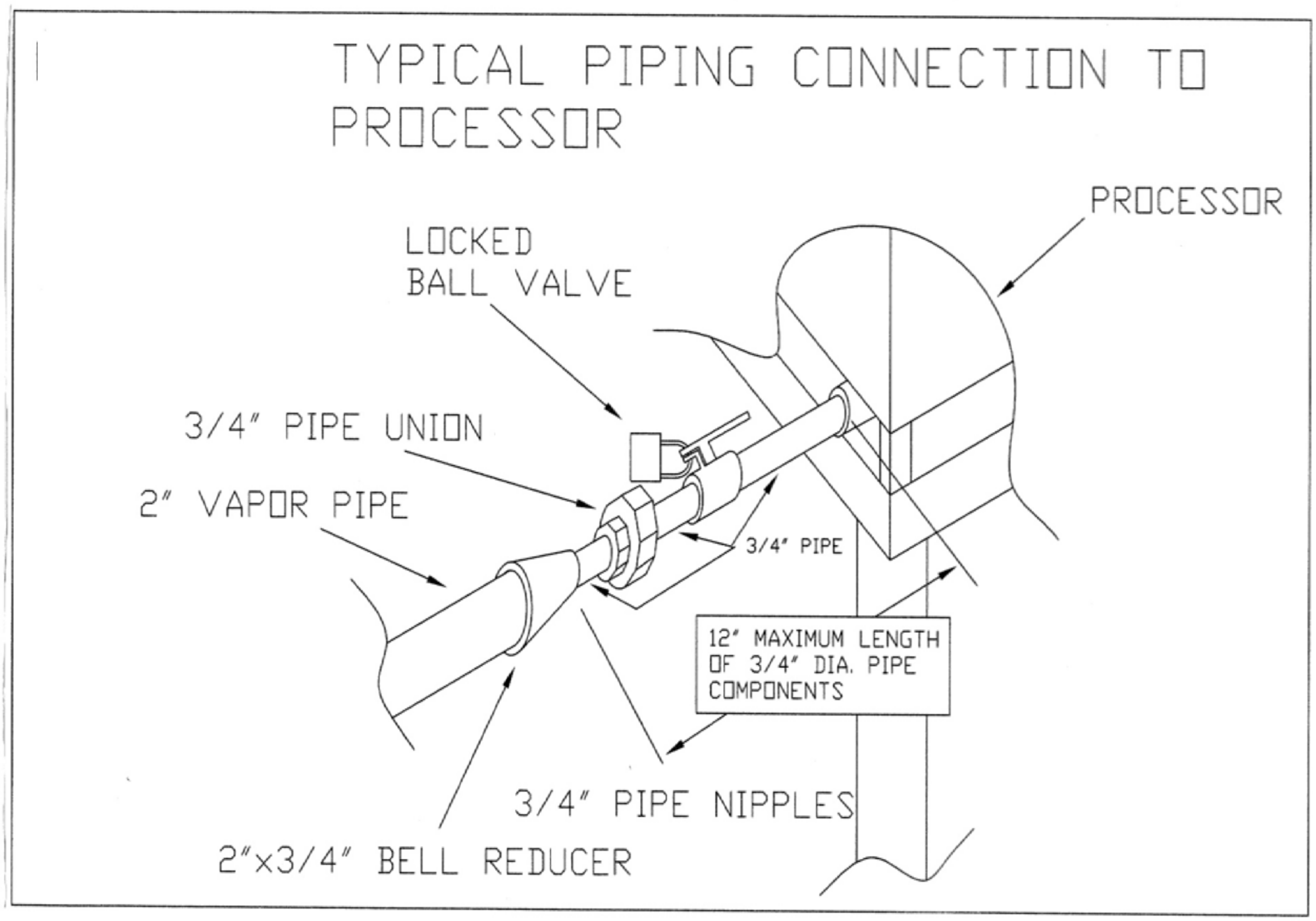


Figure 2B-3
Hirt VCS 100 Thermal Oxidizer
(3-Way Valve shown in normal operation)

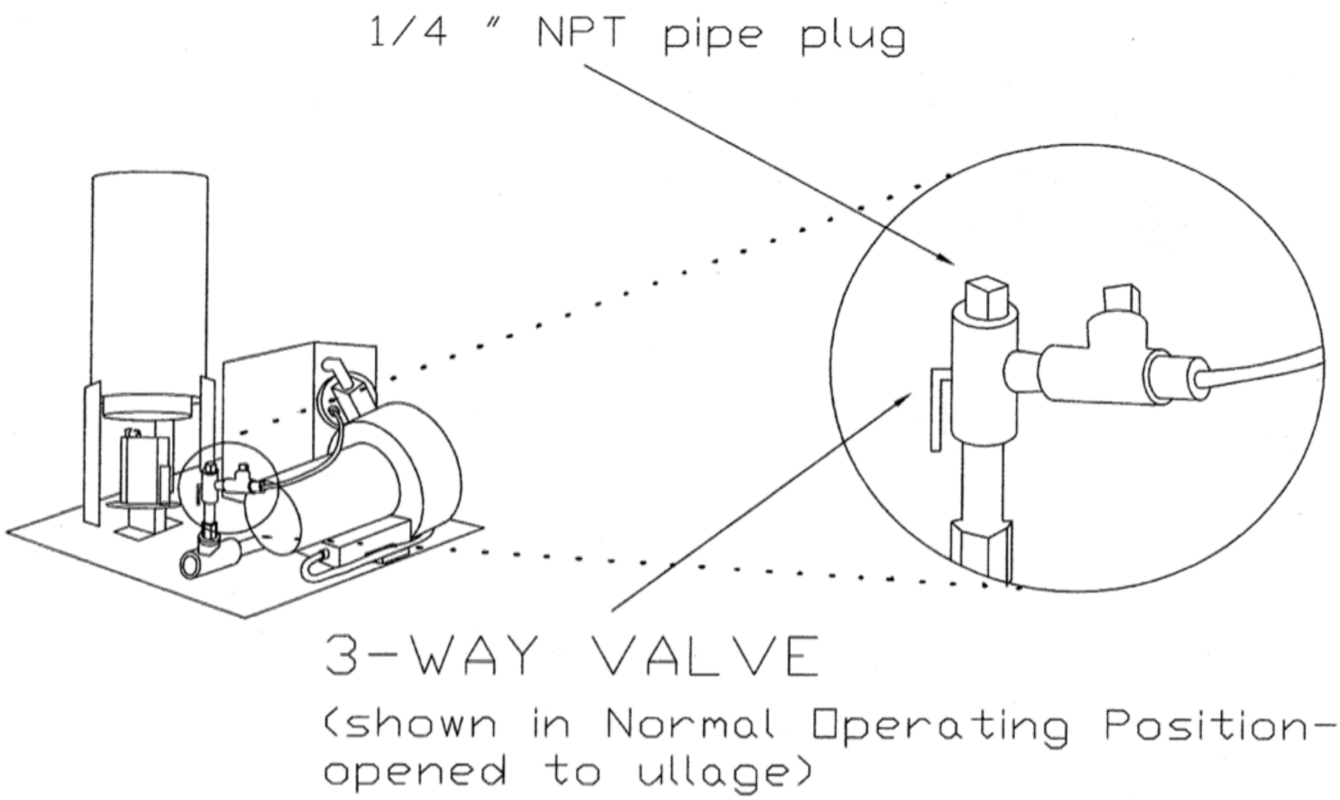


Figure 2B-4
Example of a GDF Maintenance Record and Alarm History Record

Date of Maintenance/ Test/Inspection/Failure/ alarm history (including date and time of maintenance call)	Repair Date To Correct Test Failure	Maintenance/Test/Inspection Performed and Outcome/Action Taken in Response to Alarm	Affiliation	Name and Technician ID Number of Individual Conducting Maintenance or Test	Telephone Number

INCON Vapor Recovery Monitoring (VRM) System Specifications

Console & VRM Software Version Number

The ISD audible alarms shall be installed at a location that is most likely to be heard by the station attendant during normal station operation (e.g., cash register). The console shall be installed in a location that allows the Ethernet or RS232 port (COMM 1) to be easily accessible, and if applicable, per district requirements, for use at anytime. A vacant RS232 serial port (COMM 1) shall always be available to electronically download reports.

The presence of VRM and the VRM software version number can be verified on the Console touchscreen screen by pressing the VRM Icon key or by printing a VRM Daily or Monthly Report. See **Figure 2B-5** for the verification instructions.

The Console must have a printer.

The Console is equipped with password security features which prohibit the ability to make changes to the system. Instructions and passwords shall be maintained on site in accordance with air district requirements and shall be available to the air district upon request.

The INCON ISD System software version 1.1.0 does not support multi-hose (six pack) dispenser configurations and is therefore limited for use with unihose dispensers.

Operability Test Procedure

The INCON VRM operability test procedures are provided in Exhibits 10 and 11, and in the VRM Operability Testing section of the **ARB Approved Installation, Operation and Maintenance Manual**, shall be used at GDF sites to determine the operability of the INCON VRM system to comply with applicable performance standards and performance specification in CP- 201. Testing the VRM equipment in accordance with this procedure will verify the proper selection, setup and operation of the Console sensors and interface modules.

Vapor Flow Meter

The INCON VRM system requires one Vapor Flow Meter per dispenser installed via the ARB Approved Vapor Flow Meter Manual 000-2144, Rev. A. The Vapor Flow Meter shall be installed into dispensers listed in Exhibit 1 of this Executive Order in accordance with the **ARB Approved Installation, Operation and Maintenance Manual**. The Vapor Flow Meter is an intrinsically safe sensor that is wired to the Console Probe Module via a conduit dedicated to low-voltage sensors. **Figure 2B-7** shows the Vapor Flow Meter. **Figure 2B-9** shows the installation configuration.

Vapor Pressure Sensor

The INCON VRM system requires one Vapor Pressure Sensor per GDF installed into one of the dispensers located with the shortest run to the underground storage tanks (If a row of dispensers are equal distance from the tank pad, any dispenser can be used) in accordance with the **ARB Approved Installation, Operation and Maintenance Manual**. The Vapor Pressure Sensor shall be installed into dispensers listed in Exhibit 1 of this Executive Order. The Vapor Pressure Sensor is an intrinsically safe sensor that is wired to the Console's 4-20mA Module via a conduit dedicated to low-voltage sensors. **Figure 2B-8** shows a Vapor Pressure Sensor illustration. **Figure 2B-10** shows the installation configuration.

Dispenser Interface Module (DIM)

Existing Dispenser Interface Modules or DIM communication cards are used to inter- face to the dispenser Point of Sale (POS) or controller system to gather fuel transaction data. The ISD Operability Test Procedure provided in Exhibit 11 and in the **ARB Approved Install, Operators, and Maintenance Manual** can be used to verify the proper selection and setup of the Dispenser Interface Module.

Tank Inventory Probe Sensor

Existing Tank Inventory Probe sensors (one per gasoline storage tank) are used to measure the amount of vapor space in the Underground Storage Tanks (USTs). The ISD Operability Test Procedure can be used to verify the proper selection and setup of the Tank Inventory Probes. See **Figure 2B-11** for a typical Tank Inventory Probe Sensor.

Shutdown Control

The Console must be wired per the INCON VRM Install, Operators, and maintenance Manual 000-2058, Rev. C of the **ARB Approved Installation, Operation and Maintenance Manual** such that it shall automatically prohibit the dispensing of fuel through shutdown of individual dispensers during a CP-201 ISD failure alarm.

Console Modules

The VRM Operability Test Procedure in Exhibit 11 and in the INCON VRM Install, Operators, and Maintenance Manual 000-2058, Rev C of the **ARB Approved Installation, Operation, and Maintenance Manual** shall be used to verify the proper selection and setup of the Console Modules.

Training Program

All INCON contractors must successfully complete the applicable Franklin Fueling Systems training program before they can install, startup, and service INCON Console equipment. Contractors must have up-to-date Level 1 & 2 certifications to install and startup the TS Console. Contractors must have an up-to-date Level 5 certification to install, startup and service the VRM system. The schedule, fee and registration information for the Authorized Service Contractor (ASC) training program can be found at http://www.franklinfueling.com.

A list of certified contractors with current console and VRM training will be available at the Franklin Fueling web page, www.franklinfueling.com.

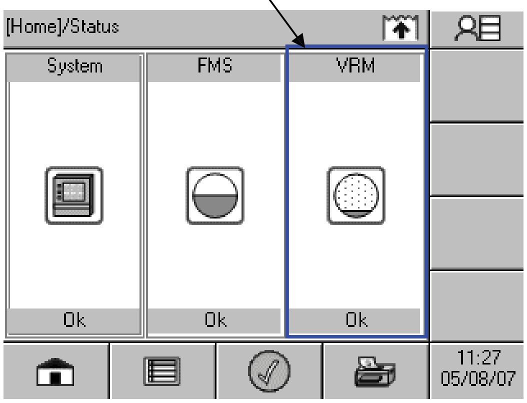
Maintenance

The console, including interface modules, do not require scheduled maintenance. The VRM System uses a Self-Test Monitoring feature that is designed to verify proper selection, setup and operation of the console and sensors. There is no recommended maintenance, inspection nor calibration for the Vapor Flow Meter or the Vapor Pressure Sensor. Servicing should be performed in response to warning or alarm conditions.

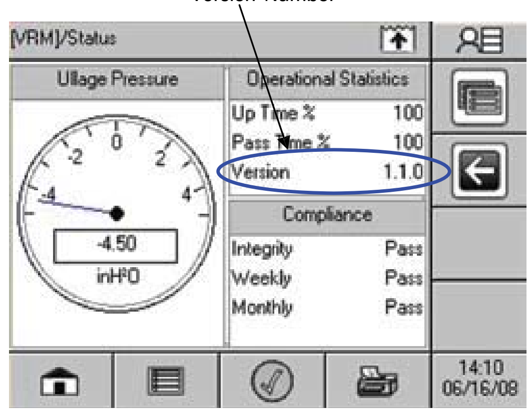
Figure 2B-5
Finding the INCON VRM Version Number

Version number on the LCD:

Press the VRM Application area

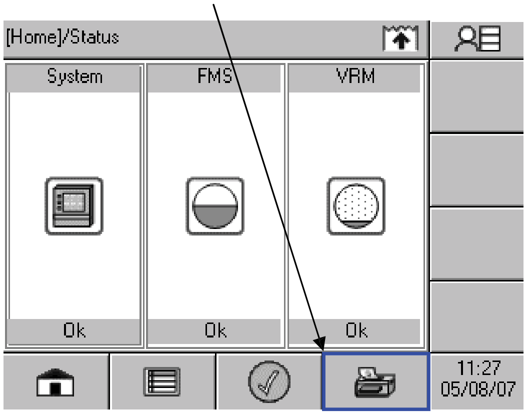


Version Number

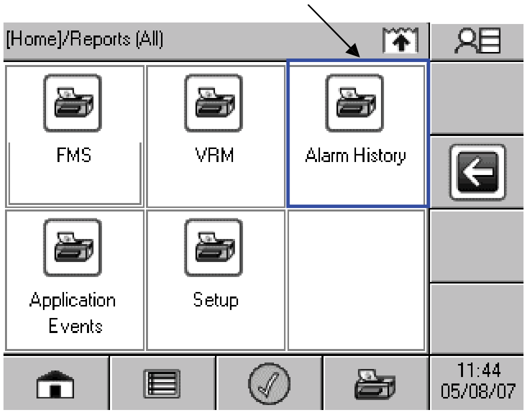


Version number on the VRM Daily Report or Monthly Report:

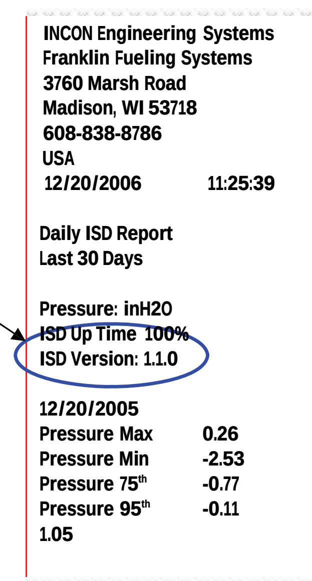
Press the Print area



Press the VRM Reports



Version Number


INCON Engineering Systems
Franklin Fueling Systems
3760 Marsh Road
Madison, WI 53718
608-838-8786
USA
12/20/2006 11:25:39

Daily ISD Report
Last 30 Days

Pressure: inH20
ISD Up Time 100%
ISD Version: 1.1.0

12/20/2005
Pressure Max 0.26
Pressure Min -2.53
Pressure 75th -0.77
Pressure 95th -0.11
1.05

Figure 2B-6
Standard Tank Sentinel Console

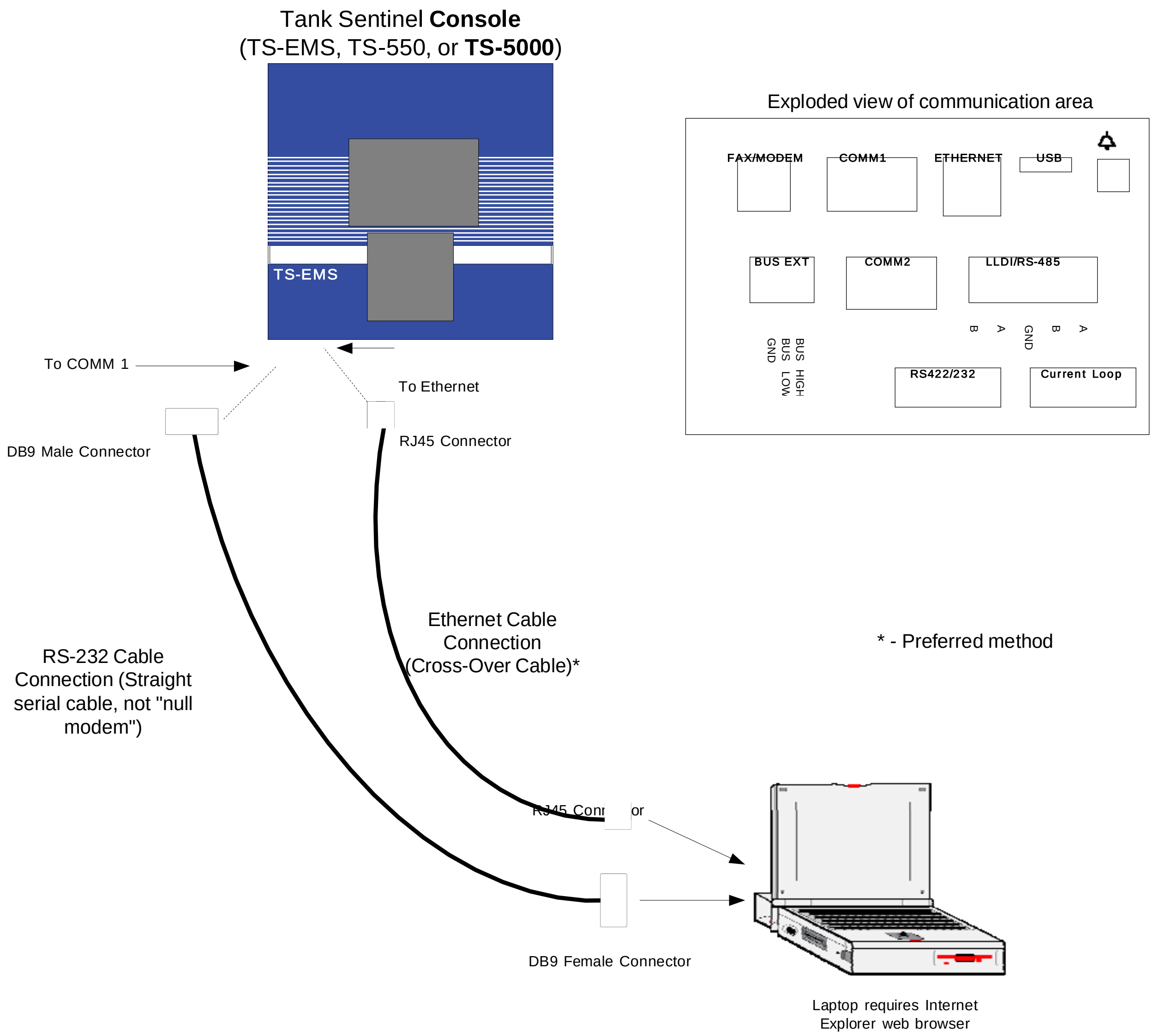
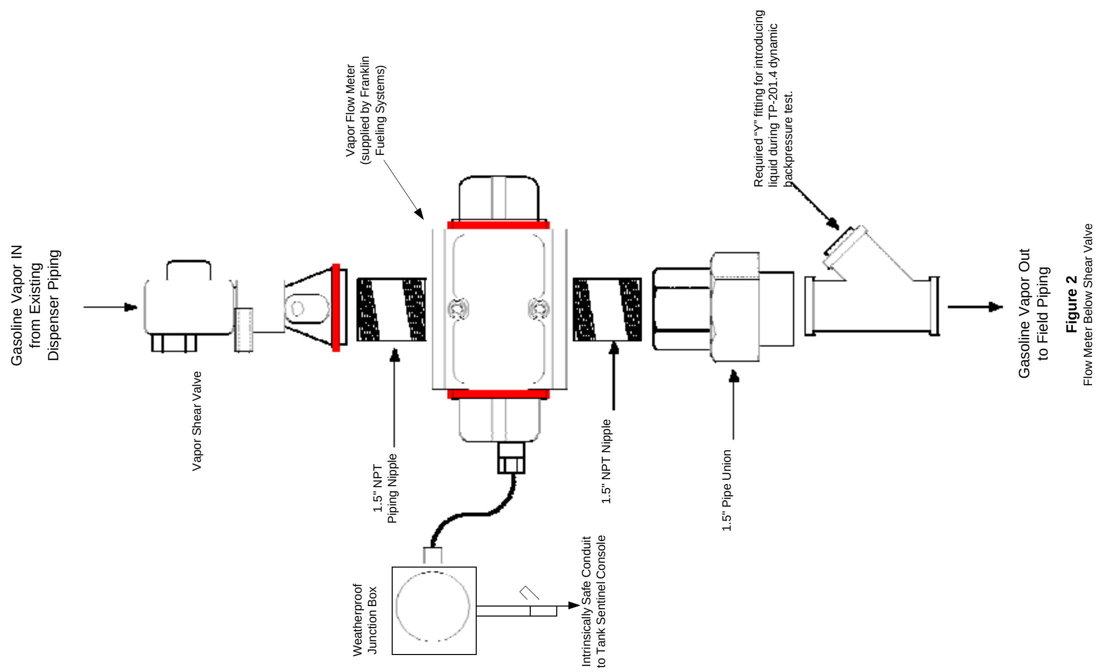


Figure 2B-7
INCON TS-VFM
Vapor Flow Meter

Figure 2B-8
INCON TS-VPS
Vapor Pressure Sensor

Figure 2B-9
Typical Installation of the INCON Vapor Flow Meter



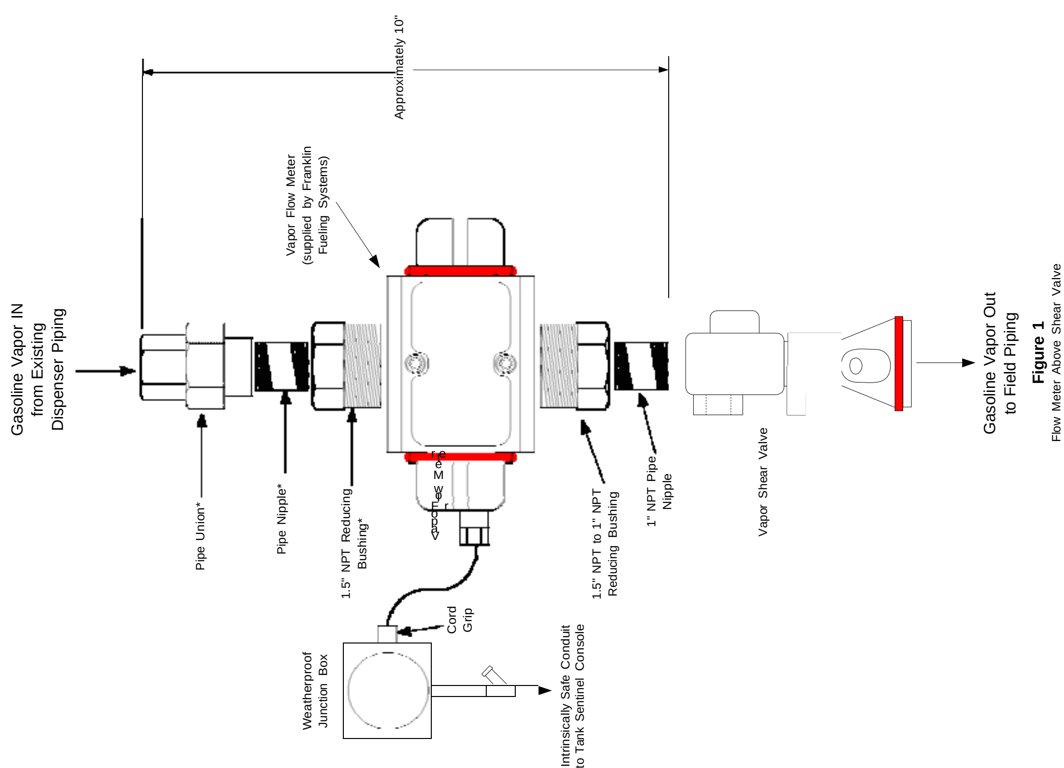


Figure 2B-10
Typical Installation of the INCON Vapor Pressure Sensor

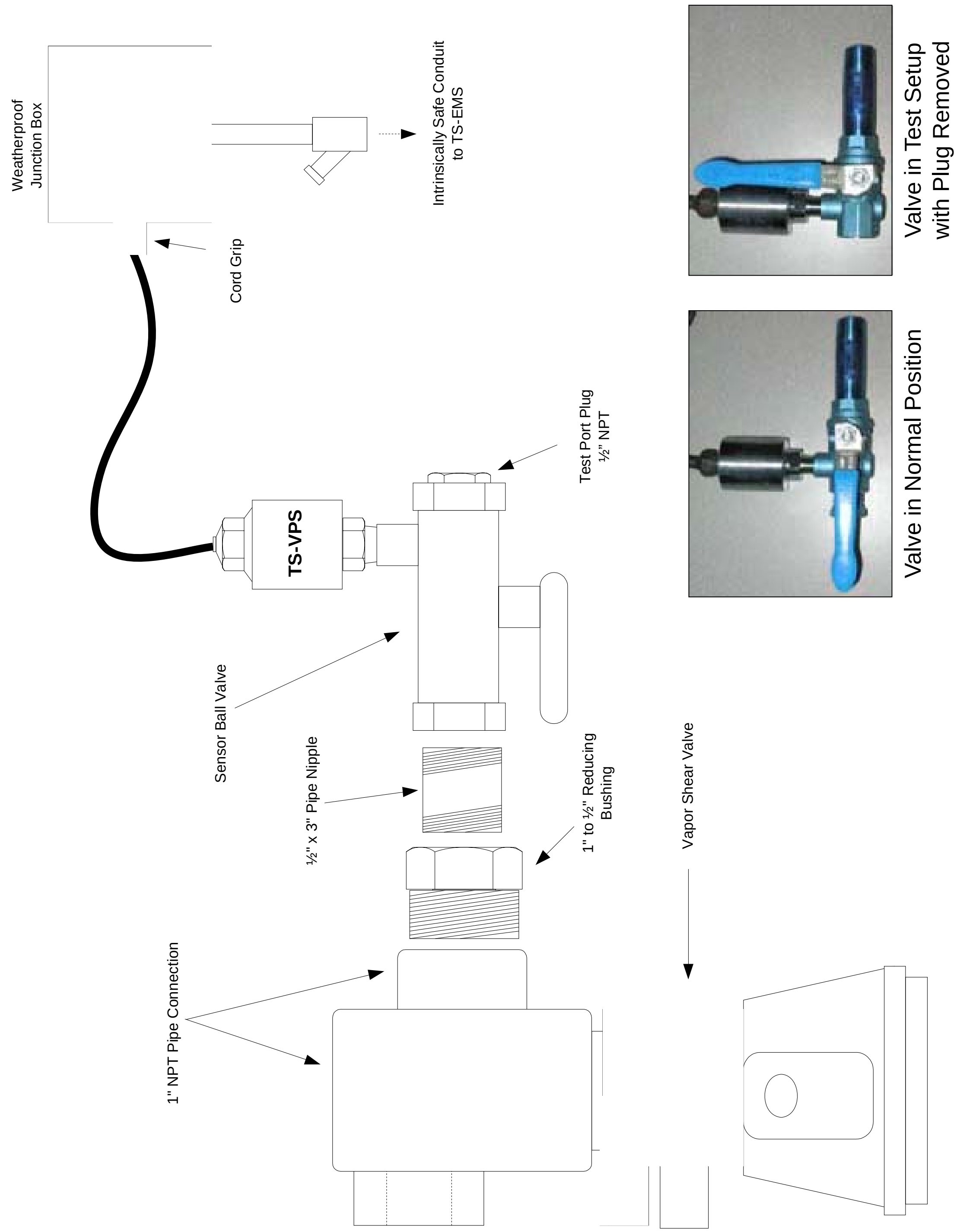
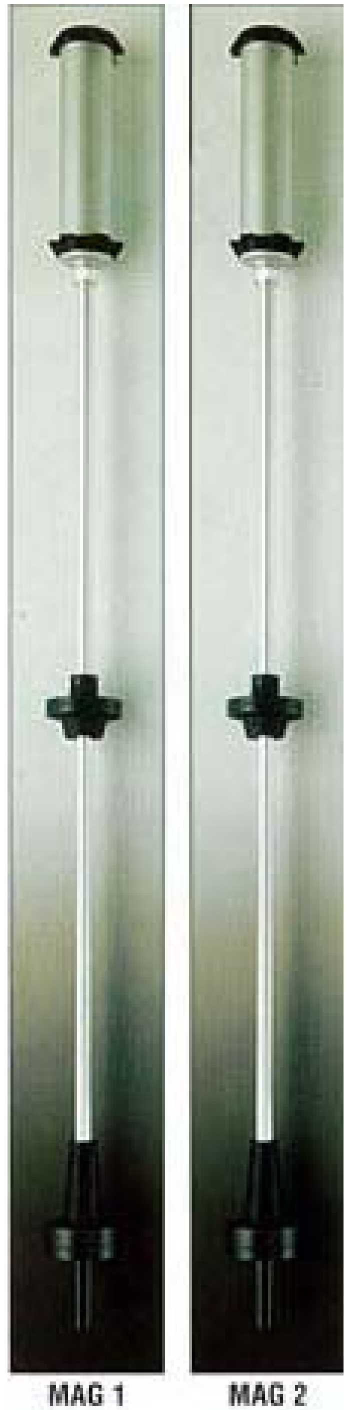


Figure 2B-11
Tank Inventory Probe Sensor



Executive Order VR-208-A
Emco Phase II EVR System with Hirt Thermal Oxidizer Including INCON ISD

Exhibit 5
Liquid Removal Test Procedure

Definitions common to all certification and test procedures are in:

D-200 Definitions for Vapor Recovery Procedures

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

1. PURPOSE AND APPLICABILITY

1.1 This procedure is used to quantify the removal rate of liquid from the vapor passage of a Phase II balance system hose equipped with a liquid removal device. This procedure provides a method to determine compliance with the liquid removal requirements specified in ARB Executive Orders VR-207 and VR-208 and any subsequent amendments or revisions.

2. PRINCIPLE AND SUMMARY OF TEST PROCEDURE

2.1 This test procedure provides two options to determine the compliance of liquid removal devices. Under option 1 (short version), liquid in the vapor path of a coaxial hose is drained and measured. If the volume of liquid drained equals or exceeds 25 ml, a liquid removal test is conducted. For those hoses with less than 25 ml drained, no further testing is required. Under option 2 (long version), all hoses are evaluated regardless of the volume of liquid drained. Option 2 includes a prewetting and wall adhesion step. Both options test the liquid removal device by introducing gasoline into the vapor path of the coaxial hose through the nozzle bellows. After 7.5 gallons of gasoline is dispensed, the amount of gasoline remaining in the hose is measured and the liquid removal rate is determined. The district shall specify which testing option is to be used.

Caution: When draining liquid from the vapor side of the hose, make sure the dispenser is not activated. The nozzle vapor valve is on the same stem as the fuel valve. To drain gasoline from the vapor side of the hose, the fuel lever must be engaged. If the dispenser is activated, gasoline in the fuel hose may be pressurized when engaging the fuel lever.

3. BIASES AND INTERFERENCES

3.1. Slits or tears in the hose or nozzle vapor path may bias the results towards compliance.

3.2. This test shall not be conducted on any fueling point where the hanging hardware is defective as identified in Exhibit 2.

3.3. Any spillage of gasoline invalidates the test for any volumes that are required to be measured or recorded.

3.4. A breach of the inner product hose may introduce additional gasoline into the outer vapor path resulting in a larger volume drained than introduced.

3.5. Not having the liquid extraction device (indicated by the mark on the outside of the hose) at the bottom of the hose loop during liquid removal testing, as shown in Figure 1, will bias the results towards failure.

3.6. The test procedure requires the use of Emco's nozzle spout plug, P/N 494635EVR as shown in Figure 2. This tool is used to plug the spout when draining liquid from the vapor side of the hose. Not plugging the spout may bias the results towards failure. Nicks, cuts, or tears in the plug seal will bias the results towards failure.

3.7. Dispensing rates not between 6.0 and 10.0 gallons per minute (GPM) invalidates the test.

4. SENSITIVITY, RANGE, AND PRECISION

4.1 The range of measurement of the liquid removal rate is dependent upon the range of the graduated cylinder used for testing.

4.2 To ensure precision, graduated cylinder readings shall be measured at the liquid level meniscus.

5. EQUIPMENT

5.1. Nozzle Spout Plug: Use Emco's spout plug, P/N 494635EVR (Figure 2).

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

5.3. Funnels. Large and small gasoline compatible, non-breakable, funnels with dimensions similar to those as shown in Figure 3, or equivalent.

5.4. Graduated Cylinders. Gasoline compatible, non-breakable 0-25ml, 0-100ml, 0-250 ml, and 0-500 ml graduated cylinders with stable base plates. The 25ml cylinder may be necessary to quantify volumes of liquid less than 20 ml.

5.5. Gasoline Test Tank. (Optional) A portable tank, meeting fire safety requirements for use with gasoline, may be used to receive the gasoline dispensed during testing. The tank shall have sufficient volume so that at least 10.0 gallons may be dispensed prior to activating the primary shutoff mechanism of the nozzle. **When using a gasoline test tank, ensure that a ground strap is used and that it is properly connected to an acceptable ground.** To minimize testing-related emissions, vehicle refueling events should be used for this procedure whenever feasible.

5.6. Traffic Cones. Use traffic cones to encircle the area where testing is conducted.

5.7. Field Data Sheet. Use the appropriate data sheet to record liquid removal test information. Forms 1 and 2 serve as examples; districts may require modified versions.

5.8. Gasoline Container. Use a portable fuel container equipped with a tight fitting cap, of at least 1.0 gallon capacity.

NOTE: THIS TEST PROCEDURE PROVIDES TWO OPTIONS TO DETERMINE COMPLIANCE OF LIQUID REMOVAL DEVICES. THE DISTRICT SHALL SPECIFY WHICH TESTING OPTION IS TO BE USED

6. OPTION 1 (SHORT VERSION)

PRE-TEST PROCEDURE

6.1 Verify that the 500 ml graduated cylinder is empty. Position the large funnel into the graduated cylinder.

6.2 Remove the nozzle from the dispenser. **<u>Do not activate dispenser!</u>** Install Emco's spout plug, P/N 494635EVR in the tip of the spout (Figure 2). Carefully tilt the spout into the funnel/graduated cylinder assembly.

6.3 Lower the nozzle and funnel/graduated cylinder assembly as close to the ground as possible. "Walk out" the hose while keeping the nozzle lowered and hose fully extended. The hose shall slope downward from the dispenser toward the nozzle.

6.4 **<u>Do not activate dispenser!</u>** Open the nozzle's vapor check valve by compressing the bellows and engaging the fuel lever. Allow 20 seconds for all liquid to drain. Use caution to avoid spillage.

6.5 Remove Emco's spout plug and return the nozzle to the dispenser and measure the volume of liquid drained. If the volume drained is less than 200 ml, transfer the liquid into an appropriately sized graduated cylinder. For example, if 40 ml of liquid was drained, use the 100 ml graduated cylinder to take the measurement.

6.6 Record the amount of liquid drained on Form 1 ("PRE-TEST").

6.7 If the volume drained is greater than or equal to 25 ml, proceed to Section 6.8 of the procedure. Hoses with greater than 25 ml drained are considered to be pre-wetted. If the amount drained is less than 25 ml, proceed to the next nozzle/hose to be evaluated and repeat Section 6.1-6.6

TEST PROCEDURE (FOR HOSES WITH GREATER THAN 25 ML DRAINED)

6.8 Pour 150 ml to 175 ml of gasoline into the 250 ml graduated cylinder. Measure and record this volume on Form 1 (VI).

6.9 Remove the nozzle from the dispenser and position the nozzle upright so that the spout is in a vertical position. **<u>Do not activate dispenser!</u>**

6.10 Open the nozzle's vapor check valve by compressing the bellows and engaging the fuel lever. Carefully insert the stem of the small funnel between the bellows and nozzle spout.

6.11 Pour the measured volume into the vapor path of the hose. Use caution not to spill the gasoline. Remove the small funnel after the gasoline has been introduced.

6.12 Insert the nozzle into a vehicle or test tank fill pipe.

6.13 Find the mark on the outside of the hose which indicates the location of the liquid pick-up device. Ensure the mark is at the bottom of the hose loop when dispensing as shown in Figure 1. This can be accomplished by lifting up the back of the hose, adjusting nozzle position, or adjusting the test tank position.

6.14 Dispense 7.5 (±0.5) gallons at the highest possible flow rate by holding the nozzle lever in the maximum handheld position. Use a stopwatch to measure the time elapsed while dispensing. Record the volume of fuel dispensed (G) and the elapsed time (T) on Form 1. Return nozzle to the dispenser.

6.15 Calculate the dispensing rate using the equation below. If the dispensing rate is not between 6.0 and 10.0 gallons per minute (GPM), the test results are invalid.

$$\text{GPM} = 60 \text{ x} \left(\frac{G}{T}\right)$$

Where:

GPM	=	dispensing rate (in gallons per minute)
G	=	gallons of fuel dispensed
T	=	number of seconds required to dispense

6.16 Using the 250 ml graduated cylinder and large funnel, carefully drain the remaining liquid from the vapor path of the hose as described in Section 6.1 through 6.5 **<u>(make sure dispenser is not activated and spout plug is installed before draining liquid!)</u>**. Record this quantity on Form 1 (VF).

6.17 Use Equation 9.1 to calculate the liquid removal rate for all the applicable hoses tested.

6.18 If the liquid removal rate is less than 5.0 ml/gallon, but greater than or equal to 4.5 ml/gallon, repeat the test two additional times and average the three results.

7. OPTION 2 (LONG VERSION)

PRETEST PROCEDURE

7.1 Carefully pour 150 ml of gasoline into the 250 ml graduated cylinder.

7.2 Remove the nozzle from the dispenser. **<u>Do not activate dispenser!</u>** Install Emco's spout plug, P/N 494635EVR in the tip of the spout as shown in Figure 2. Position the nozzle upright so that the spout is in a vertical position.

7.3 Open the nozzle's vapor check valve by compressing the bellows and engaging the fuel lever. Carefully insert the stem of the small funnel between the bellows and nozzle spout.

7.4 Pour the gasoline from the 250 ml graduated cylinder into the vapor path of the hose. Use caution not to spill the gasoline. Remove the small funnel after the gasoline has been introduced.

7.5 Verify that the 500 ml graduated cylinder is empty. Position the large funnel into the graduated cylinder.

7.6 Carefully tilt the spout into the funnel/graduated cylinder assembly. **<u>Make sure Emco's spout plug is installed and the dispenser is deactivated.</u>**

7.7 Lower the nozzle and funnel/graduated cylinder assembly as close to the ground as possible. "Walk out" the hose while keeping the nozzle lowered and hose fully extended. The hose shall slope downward from the dispenser toward the nozzle.

7.8 Open the nozzle's vapor check valve by compressing the bellows and engaging the fuel lever. Allow 20 seconds for all liquid to drain. Use caution to avoid spillage. If necessary, drain full graduated cylinders into a portable gas can until the hose is empty.

7.9 Remove Emco's spout plug and return the nozzle to the dispenser.

TEST PROCEDURE

7.10 Pour 150 ml to 175 ml of gasoline into the 250 ml graduated cylinder. Measure and record this volume on Form 2 (VI).

7.11 Remove the nozzle from the dispenser. **<u>Do not activate dispenser!</u>** Position the nozzle upright so that the spout is in a vertical position.

7.12 Open the nozzle's vapor check valve by compressing the bellows and engaging the fuel lever. Carefully insert the stem of the small funnel between the bellows and nozzle spout.

7.13 Pour the measured volume into the vapor path of the hose. Use caution not to spill the gasoline. Remove the small funnel after the gasoline has been introduced.

7.14 Insert the nozzle into a vehicle or test tank fill pipe.

7.15 Find the mark on the outside of the hose which indicates the location of the liquid pick-up device. Ensure the mark is at the bottom of the hose loop when dispensing as shown in Figure 1. This can be accomplished by lifting up the back of the hose, adjusting nozzle position, or adjusting the test tank position.

7.16 Dispense 7.5 (±0.5) gallons at the highest possible flow rate by holding the nozzle lever in the maximum handheld position. Use a stopwatch to measure the time elapsed while dispensing. Record the volume of fuel dispensed (G) and the elapsed time (T) on Form 2. Return nozzle to the dispenser.

7.17 Calculate the dispensing rate using the equation below. If the dispensing rate is not between 6.0 and 10.0 gallons per minute (GPM), the test results are invalid.

$$\text{GPM} = 60 \text{ x} \left(\frac{G}{T}\right)$$

Where:

GPM	=	dispensing rate (in gallons per minute)
G	=	gallons of fuel dispensed
T	=	number of seconds required to dispense

7.18 Using the 250 ml graduated cylinder and large funnel, carefully drain the remaining liquid from the vapor path of the hose as described in Section 7.5 through 7.8 **(make sure dispenser is deactivated and spout plug is installed before draining liquid!)**. Record this quantity on Form 2 (VF).

7.19 Open the nozzle’s vapor check valve by compressing the bellows and engaging the fuel lever. **Do not activate dispenser!** Carefully insert the stem of the small funnel between the bellows and nozzle spout

7.20 Use the 250 ml graduated cylinder and small funnel to pour 150 ml of gasoline into the vapor passage of the hose. Dispense no gasoline.

7.21 Using the 250 ml graduated cylinder and large funnel, completely drain the gasoline from the vapor passage back into the graduated cylinder as described in Section 7.5 through 7.9 **(make sure dispenser is deactivated and spout plug is installed before draining liquid!)**.

7.22 Subtract the volume drained (value from Section 7.21) from the volume added (value from Section 7.20). This value represents the volume of gasoline lost due to wall adhesion. The purpose of the wall adhesion value is to quantify the amount of gasoline lost to evaporation from transfer to and from the graduated cylinders and adhesion of liquid to vapor passage surfaces in previous measurements. Record this quantity on Form 2 (VW).

7.23 Use Equation 9.2 to calculate the liquid removal rate for all the applicable hoses tested.

7.24 If the liquid removal rate is less than 5.0 ml/gallon, but greater than or equal to 4.5 ml/gallon, repeat the test two additional times and average the three results.

8. POST TEST PROCEDURES

8.1. Empty all containers and return any excess gasoline to the underground storage tank.

8.2. Remove the traffic cones from the testing area.

9. CALCULATING RESULTS

9.1 If using OPTION 1(short version), the liquid removal rate shall be calculated as follows:

$$VR = \frac{VI - VF}{G}$$

Where:

VR	=	Gasoline removed per gallon dispensed, milliliters/gallon
VI	=	Total initial volume poured into hose vapor passage, milliliters
VF	=	Volume of gasoline remaining in the hose vapor passage after dispensing, milliliters
G	=	Total dispensed, gallons

9.2 If using OPTION 2 (long version), the liquid removal rate shall be calculated as follows:

$$VR = \frac{(VI - VW) - VF}{G}$$

Where:

VR	=	Gasoline removed per gallon dispensed, milliliters/gallon
VI	=	Total initial volume poured into hose vapor passage, milliliters
VW	=	Volume of liquid lost due to wall adhesion, milliliters
VF	=	Volume of gasoline remaining in the hose vapor passage after dispensing, milliliters
G	=	Total dispensed, gallons

10. REPORTING RESULTS

10.1. Record all applicable liquid removal rate information on the appropriate form as shown in Form 1 and 2. Districts may require the use of alternate forms provided that the alternate forms include the same parameters as identified in Forms 1 and 2.

10.2. If the calculated liquid removal rate is greater than or equal to 5 milliliters/gallon, the liquid removal device has demonstrated compliance.

10.3. If the calculated liquid removal rate is less than 5 milliliters/gallon, the liquid removal device is not in compliance.

11. ALTERNATIVE TEST PROCEDURES

This 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 14 of Certification Procedure CP-201.

FIGURE 1
Position of Liquid Removal Device
When Conducting Liquid Removal Testing

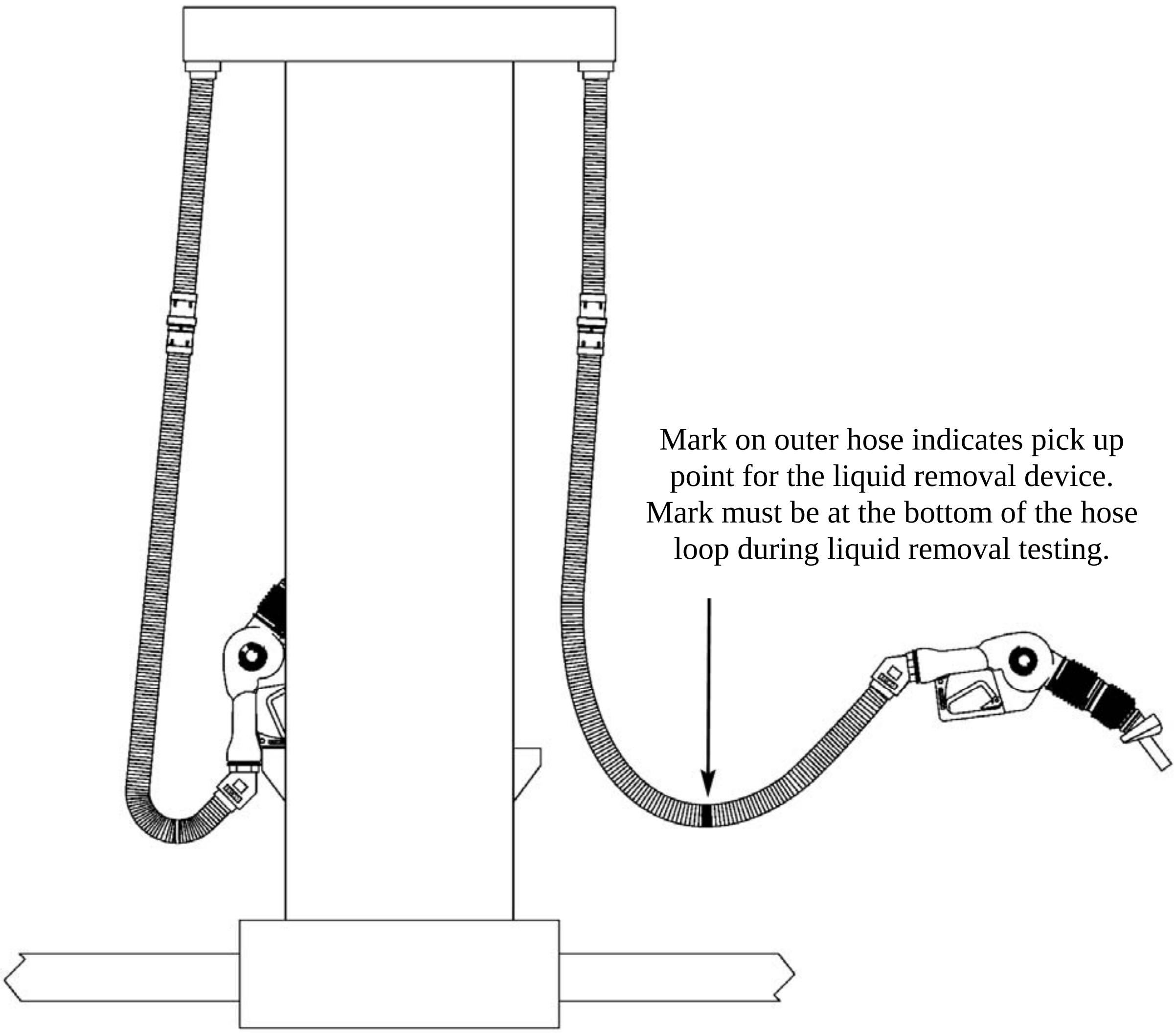
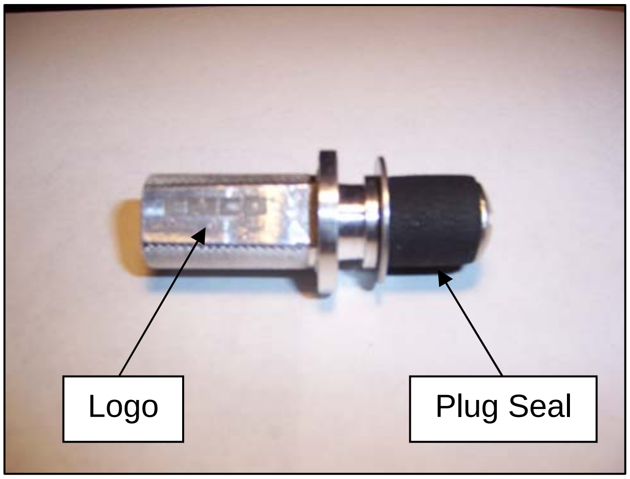


FIGURE 2
Emco Nozzle Spout Plug P/N 494635EVR



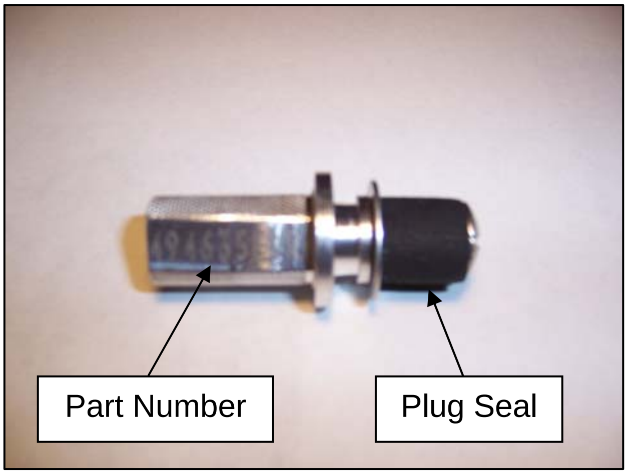
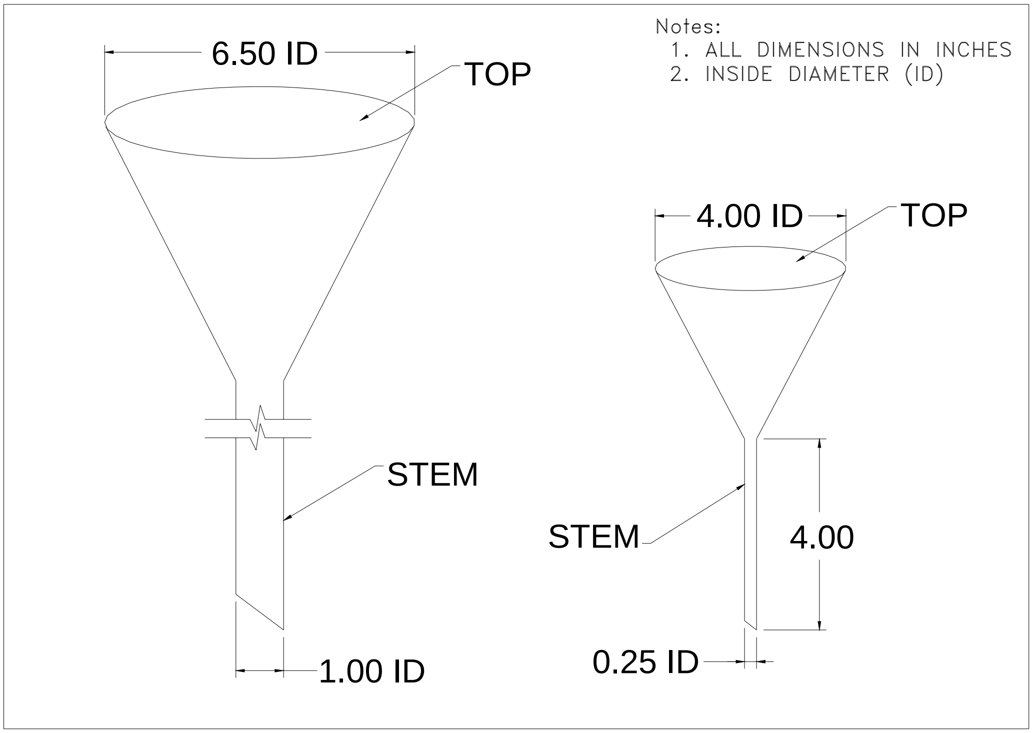


FIGURE 3
Recommended FUNNEL SPECIFICATIONS



FORM 1: LIQUID REMOVAL TEST DATA SHEET (OPTION 1)

Facility Name & Address	Facility Representative & Title		
		Test Date	
		A/C or Permit No.	
		Testing Company	
		Tester Name	
	Phone No.	Emco Training Cert # (if applicable)	
		Inspector Name	

GENERAL INFORMATION				PRE-TEST	TEST RUN					VR=(VI-VF)/G
Dispenser Number	Product Grade	Make & Model of Hose	Serial Number of Hose	Volume Drained From Hose in mL	Volume Poured Into Hose in mL (VI)	Gallons Dispensed (G)	Seconds to Dispense (T)	Dispensing Rate (60*(G/T))	Volume Remaining in mL (VF)	Liquid Removal Rate (mL/gal)

FORM 2: LIQUID REMOVAL TEST DATA SHEET (OPTION 2)

Facility Name & Address	Facility Representative & Title	
		Test Date
		A/C or Permit No.
		Testing Company
		Tester Name
	Phone No.	Emco Training Cert # (if applicable)
		Inspector Name

GENERAL INFORMATION				PRE-TEST	TEST RUN					VR=((VI-VW)-VF)/G
Dispenser Number	Product Grade	Make & Model of Hose	Serial Number of Hose	Volume Poured into Hose in mL (VI)	Gallons Dispensed (G)	Seconds to Dispense (T)	Dispensing Rate (60*(G/T))	Volume Remaining in mL (VF)	Volume Lost to Wall Adhension in mL (VW)	Liquid Removal Rate (mL/gal)

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Exhibit 6
Required Items in Conducting TP-201.4

The instructions below are required when conducting TP-201.4 for the Emco Phase II EVR System with Hirt Thermal Oxidizer. The tester shall document that each step was followed as indicated below and shall include this page of the Exhibit with the submission of TP-201.4 test results. Note that districts may require use of an alternate form to meet these requirements, provided the alternate form includes the same minimum parameters.

The Emco Model A4005EVR nozzle incorporates a lever-actuated vapor valve. The vapor valve is on the same stem as the fuel valve. When conducting TP-201.4, the nozzle lever must be actuated to open the vapor valve and allow vapor to flow from the nozzle to the underground storage tank. The following steps must be taken when conducting Methodology 1 of TP-201.4:

1. The dispenser shall not be activated. If the dispenser is activated, gasoline in the fuel hose may be pressurized when engaging the fuel lever.
2. The Hirt VCS 100 Thermal Oxidizer shall be turned off. At the Hirt Indicator Panel, turn the Power Switch to the “Off” position.
3. Prior to inserting the Emco EVR nozzle into the fillpipe of the Dynamic Back Pressure Test Unit in step 7.1 of TP-201.4, completely drain any gasoline in the nozzle and vapor path of the hose. The dispenser must be deactivated and the nozzle lever and bellows shall be fully engaged.
4. When flowing nitrogen per step 7.1.2, fully engage the nozzle lever to allow vapor flow from the nozzle to the UST.
5. After conducting TP-201.4, turn the Hirt VCS 100 Power Switch to the “On” position.

Required Steps	Verification (please circle)
1. Were all dispensers deactivated?	Yes No
2. Was VCS 100 Power Switch turned to “Off” position?	Yes No
3. Were all nozzles and hoses completely drained of gasoline prior to inserting nozzle into Dynamic Back Pressure Unit?	Yes No
4. Were all nozzle levers fully engaged when conducting flow test?	Yes No
5. Was VCS 100 Power Switch turned to “On” position after conducting TP-201.4?	Yes No

Test Company: ____________________ Facility Name:____________________

____
Print Name (Technician) Signature Date

____
Technician Certification Number and Expiration Date
(ICC or District Training Certification, as applicable)

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Exhibit 7
Nozzle Bag Test Procedure

Verification of the integrity of the Emco nozzle vapor valve shall be performed on installed nozzles by use of the following test.

1. Seal nozzle(s) at the gasoline dispensing facility (GDF) in a plastic bag, using tape or other means to secure the bag around the base of the nozzle (see Figure 1). Any plastic bag large enough to enclose the nozzle and having a thickness of no greater than 2 mils can be used.

2. Observe the bagged nozzle(s) for 30 seconds.

3. Any nozzle where the bag can be seen visually expanding or collapsing has a defective vapor valve and is not in compliance with Exhibit 2.

4. Record the test results on the “Nozzle Bag Test Results” form provided in this Exhibit. Districts may require use of an alternate form, provided that the alternate form includes the same minimum parameters.

5. Remove the bags from all the nozzles and return the nozzles to the dispenser holsters.

Figure 1
Example of Bagged Nozzle

NOZZLE BAG TEST RESULTS

<table>
<tr><th colspan="2">SOURCE INFORMATION</th><th colspan="2">TEST COMPANY INFORMATION</th></tr>
<tr><td>Facility (DBA)/Site Address:</td><td>Facility Representative/Title:</td><td>Test Company Name</td><td rowspan="4"># of Nozzles:________
Nozzles Tested:
____
Nozzles Passed:
____
Nozzles Failed:
____
Nozzles not Tested:
________________</td></tr>
<tr><td>Print Name</td><td>Print Name</td><td>Print Name of Tester</td></tr>
<tr><td>Street Address</td><td>Title
( )</td><td>Street Address</td></tr>
<tr><td>City Zip</td><td>Phone No.</td><td>City Zip</td></tr>
<tr><td>District Inspector:</td><td>☐ P/O ☐ S/A ☐ A/C
Number:</td><td>Date of Test:</td><td>Time of Test:</td></tr>
</table>

Dispenser	Gas Grade	Nozzle Type	Bag Expanded or Collapsed after 30 Seconds
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No
			☐ Yes ☐ No

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Exhibit 8
Hirt VCS 100 Processor
With Indicator Panel
Operability Test Procedure

Definitions common to all certification and test procedures are in:

D-200 Definitions for Vapor Recovery Procedures

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

1. PURPOSE AND APPLICABILITY

This test procedure verifies the operational status of the Hirt VCS 100 Processor and Indicator Panel.

The station may remain open (normal fuel dispensing) while conducting this procedure.

2. PRINCIPLE AND SUMMARY OF TEST PROCEDURE

The Hirt VCS 100 Processor is designed to activate (e.g. thermally oxidize vapors) when the underground storage tank (UST) ullage pressure exceeds a nominal -0.40 inches water column (“w.c.). Processor activation will be verified by exposing the processor’s internal vacuum sensor/switch to an atmospheric pressure input. The processor should activate, the Hirt Indicator Panel Processing lamp should light and the Incon VRM Console warning lamp should light. The Incon VRM Console should also post a VRM alarm.

3. BIASES AND INTERFERENCES

3.1 This test is only valid when total ullage is 70% or less than capacity of GDF storage tanks.

3.2 At least 24 hours must have elapsed after any tests that introduce air and/or nitrogen into the vapor spaces, such as, but not limited to TP-201.3 (including Exhibit 4), TP-201.4 (including Exhibit 6) and Exhibit 5.

3.3 There shall be no Phase I bulk product deliveries into or out of the storage tank(s) within the three (3) hours prior to the test or during performance of this test procedure.

3.4 Processor should be inactive (i.e. powered but not processing gasoline vapor).

4. EQUIPMENT

4.1 Hand tools: 5/16” nut driver or equivalent, 3/8” open end wrench.

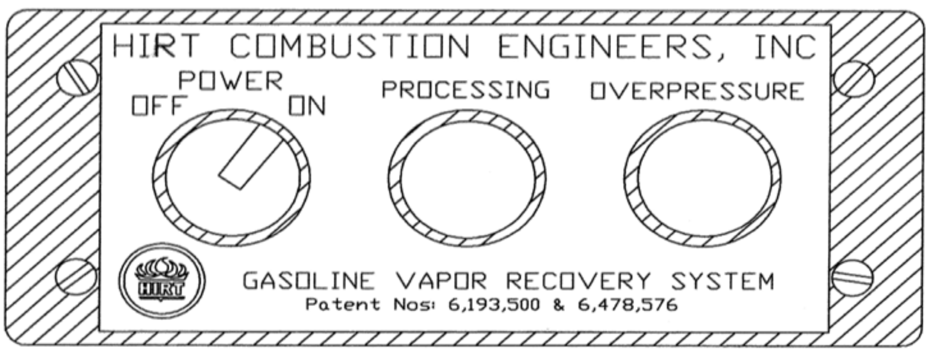
4.2 Stopwatch: Use a stopwatch with an accuracy of ±0.2 seconds.

4.3 Teflon pipe tape.

5. TEST PROCEDURE

5.1 System Status Check: Locate Hirt Indicator Panel and verify that the green lamp on the POWER switch is lit, to be sure power is ON. Record on Form 1. If the Power switch is not lit, the processor does not meet the Exhibit 2 Hirt VCS 100 Thermal Oxidizer specifications and no testing shall be conducted.

Indicator Panel Face



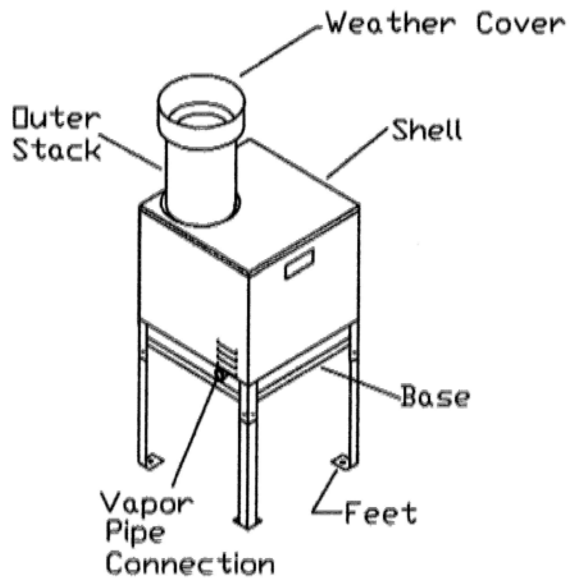
5.2 Check green PROCESSING lamp on Indicator Panel. Is the green PROCESSING lamp on? Record on Form 1. If so, then wait until PROCESSING lamp is extinguished before proceeding to step 5.3, to meet BIAS condition 3.4.

5.3 Forced Processor Operation: Turn POWER to processor OFF at Indicator Panel.

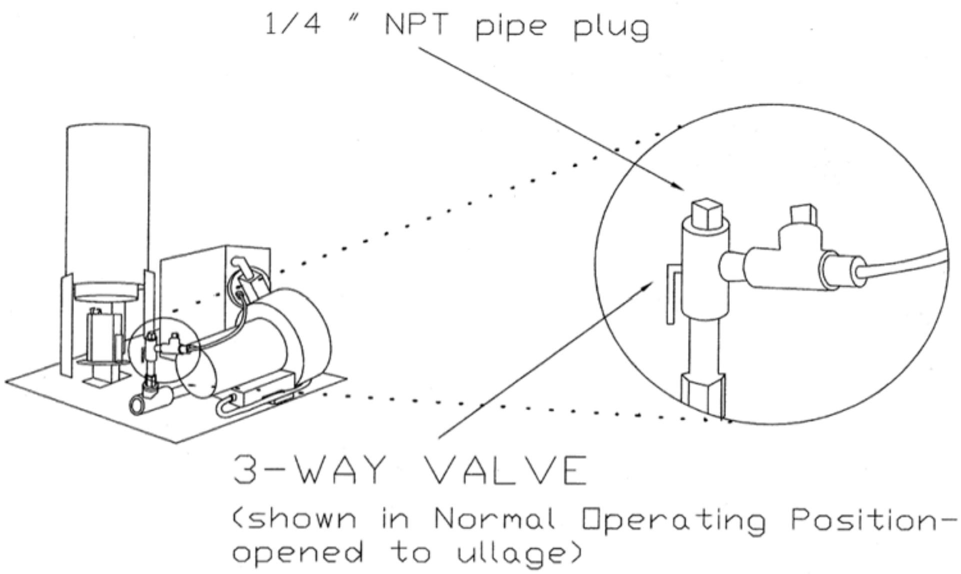
CAUTION: Processor components, such as Shell, Stack, Burner, and Weather Cover can be Hot! Use care when handling processor or removing its parts.

5.4. Remove screw from Weather Cover with 5/16” nut driver and remove Weather Cover from Outer Stack.

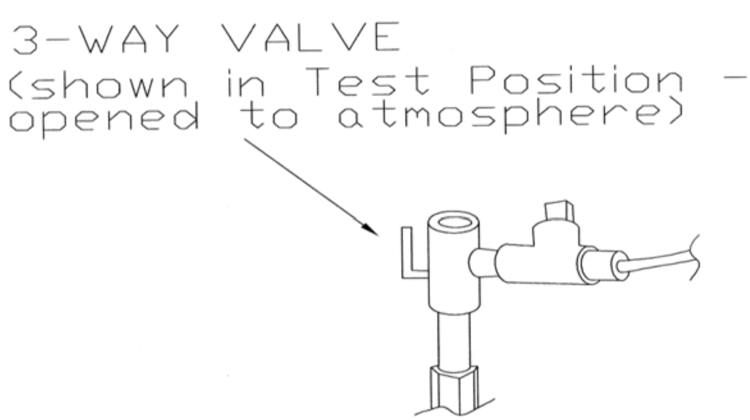
5.5 Remove (4) screws holding Shell to Base with 5/16” nut driver and then remove Shell.



5.6 Locate 3-Way Valve on tubing leading to Vacuum Sensor/Switch. The 3-Way Valve handle should be pointing down, in the Normal Operating Position – Opened to UST Ullage. Remove the 1/4" NPT pipe plug from 3-Way Valve with 3/8" wrench.



5.7 Turn 3-Way Valve handle to the up position.



5.8 Turn POWER to processor ON at Indicator Panel, and verify that green lamp on POWER switch is lit. Start the stopwatch.

5.9 Verify green PROCESSING lamp on the Indicator Panel lights within 3 minutes. Record on Form 1. If the Processing lamp is on, processor meets the Exhibit 2 Processor specifications. If the Processing lamp is not on within 3 minutes, the processor does not meet the Exhibit 2 Processor specifications and needs technical service.

5.10 Verify the OVERPRESSURE lamp on the Indicator Panel lights within sixty two (62) minutes. Record on Form 1. If the OVERPRESSURE lamp is on, processor meets the Exhibit 2 Processor specifications. If the OVERPRESSURE lamp is not on within sixty two (62) minutes, the processor does not meet the Exhibit 2 Processor specifications and needs technical service.

5.11 Verify the Warning lamp on the Incon VRM Console is lit. Press the alarm button and print the alarm posting. Record on Form 1 and attach alarm printout.

5.12 Turn POWER to processor OFF at the Hirt Indicator Panel.

5.13 Turn 3-Way Valve handle back down to Normal Operating Position. Reinstall 1/4" NPT plug (with Teflon pipe tape) and tighten ¼ turn past snug. Reinstall Shell and Weather Cover.

5.14 Turn POWER to processor ON at the Hirt Indicator Panel. Testing is completed.

6. REPORTING

Record all results on Form 1. Districts may require the use of an alternate Form, provided it includes the same minimum parameters as identified in Form 1.

FORM 1: HIRT VCS 100 PROCESSOR OPERABILITY TEST

DATE OF TEST:

SERVICE COMPANY NAME	SERVICE COMPANY'S TELEPHONE
SERVICE TECHNICIAN	HIRT TECHNICIAN CERTIFICATION #(as applicable) CC or DISTRICT TRAINING CERTIFICATION (as applicable)
STATION NAME	DISTRICT PERMIT #

STATION ADDRESS	CITY	STATE ZIP

Was TP-201.3 (Including Exhibit 4) conducted in the last 24 hours? Yes ____ No ____

Was TP-201.4 (Including Exhibit 6) conducted in the last 24 hours? Yes ____ No ____

Was Exhibit 5 conducted in the last 24 hours? Yes ____ No ____

Was there a fuel delivery within the last 3 hours? Yes ____ No ____

The % ullage of GDF storage tank(s) is ___________ gallons.

STEP 5.1	**Is POWER switch lit?**	YES ☐ NO ☐
STEP 5.2	**Is PROCESSING lamp ON?** If "YES", test cannot be performed until lamp goes off.	YES ☐ NO ☐
STEP 5.9	**Time for PROCESSING Lamp to Light? _________ minutes** **Did PROCESSING Lamp light within three (3) minutes?**	YES ☐ NO ☐
STEP 5.10	**Time for OVERPRESSURE Lamp to Light? _________ minutes** **Did OVERPRESSURE Lamp light within sixty two (62) minutes?**	YES ☐ NO ☐
STEP 5.11	**Did Warning Lamp light on Incon VRM Console?** **(Attach Active Alarm Printout)**	YES ☐ NO ☐