State of California
AIR RESOURCES BOARD

EXECUTIVE ORDER G-70-204

Gilbarco VaporVac/OPW Vaporsaver
ORVR-Compatible Phase II Vapor Recovery System

WHEREAS, the California Air Resources Board (ARB) has established, pursuant to California Health and Safety Code sections 39600, 39601 and 41954, certification procedures for systems designed for the control of gasoline vapor emissions during the filling of underground gasoline storage tanks, in its CP-201, ***Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities*** (Certification Procedure) as amended July 22, 2004, incorporated by reference in Title 17, California Code of Regulations, Section 94011;

WHEREAS, Gilbarco Incorporated (Gilbarco) requested and was granted certification of the VaporVac Phase II vapor recovery system (VaporVac System) pursuant to the Certification Procedure by Executive Order G-70-150, first issued on March 26, 1993, and by modifications G-70-150-AA through G-70-150-AE issued on August 31,1993, February 7, 1994, February 26, 1996, August 1, 1996, and July 12, 2000;

WHEREAS, OPW Fueling Components, Inc. (OPW) requested certification of the VaporVac System with the OPW Vaporsaver 1 tank pressure management system (VaporVac/Vaporsaver System);

WHEREAS, VaporVac/Vaporsaver System has demonstrated compatibility when fueling vehicles equipped with onboard refueling vapor recovery (ORVR) systems;

WHEREAS, the VaporVac/Vaporsaver System has been evaluated and shown to comply with the applicable requirements in the Certification Procedure;

WHEREAS, the Certification Procedure provides that the ARB Executive Officer shall issue an Executive Order if he or she determines that the vapor recovery system, including modifications, conforms to all of the applicable requirements set forth in the Certification Procedure;

WHEREAS, G-01-032 delegates to the Chief of the Monitoring and Laboratory Division the authority to certify or approve modifications to certified Phase I and Phase II vapor recovery systems for gasoline dispensing facilities (GDF); and

WHEREAS, I, William V. Loscutoff, Chief of the Monitoring and Laboratory Division, find that the VaporVac/Vaporsaver System conforms with all the requirements set forth in the Certification Procedure, and results in a vapor recovery system which is at least 95 percent effective for attended and/or self-service use at gasoline service stations when used in conjunction with a ARB-certified Phase I vapor recovery system.

NOW, THEREFORE, IT IS HEREBY ORDERED that the VaporVac/Vaporsaver System is certified to be at least 95 percent effective in attended and/or self-service mode when used with an ARB-certified Phase I vapor recovery system. Exhibit 1 contains a list of the equipment certified for use with the VaporVac/Vaporsaver System. Exhibit 2 contains installation and performance specifications for the equipment listed in Exhibit 1. Exhibit 3 is a list of items to consider in conducting TP-201.3 (Determination of 2 inch WC Exhibit Static Pressure Performance of Vapor Recovery Systems of Dispensing Facilities), Exhibits 4 and 5 are test procedures for determining tank pressure and air to liquid ratio.

IT IS FURTHER ORDERED that VaporVac/Vaporsaver installations shall be limited to a maximum of 16 fueling points. The term fueling point refers to one side of a dispenser, regardless of the number of nozzles per side.

IT IS FURTHER ORDERED that compliance with the applicable certification requirements, rules and regulations of the Division of Measurement Standards of the Department of Food and Agriculture, the Office of the State Fire Marshal of the Department of Forestry and Fire Protection, and the Division of Occupational Safety and Health of the Department of Industrial Relations is made a condition of this certification.

IT IS FURTHER ORDERED that the following requirements are made a condition of certification. The owner or operator of the VaporVac/Vaporsaver System shall conduct, and pass, the following tests no later than 60 days after startup and at least once in each twelve month period, using the following test procedures: TP-201.3, ***Determination of 2 Inch WC Static Pressure Performance of Vapor Recovery Systems of Dispensing Facilities*** (March 17, 1999), Exhibit 3, ***Items to Consider in Conducting TP-201.3, (Determination of 2 inch WC Static Pressure Performance of Vapor Recovery Systems of Dispensing Facilities)***, and Exhibit 5, ***Determination (by Volume Meter) of Air to Liquid Volume Ratio of Vapor Recovery Systems of Dispensing Facilities***. Shorter time periods may be specified in accordance with local district requirements. Notification of testing, and submittal of test results, shall be done in accordance with local district requirements and pursuant to the policies established by that district. Alternative test procedures may be used if determined by the Executive Officer, in writing, to yield comparable results.

IT IS FURTHER ORDERED that the following requirement is made a condition of certification. The owner or operator of the VaporVac/Vaporsaver System shall conduct, and pass, the following test no later than 60 days after startup, using the following test procedure: TP-201.4, ***Dynamic Back Pressure*** (July 3, 2002). Local districts have the authority to allow conducting of Exhibit 5, ***Determination (by Volume Meter) of Air to Liquid Volume Ratio of Vapor Recovery Systems of Dispensing Facilities***, in lieu of TP-201.4, ***Dynamic Back Pressure*** (July 3, 2002) provided that at least 2 gallons of product are introduced into the system through each dispenser riser prior to conducting the test. Notification of testing, and submittal of test results, shall be done in accordance with local district requirements and pursuant to the policies established by that district.

IT IS FURTHER ORDERED that each vapor pump and the electronic circuitry with which it is to operate shall be matched and 100 percent performance checked at the factory, including verification that the vapor recovery system performance is within the range specified in the VaporVac System section of Exhibit 2 of this Order. Vapor pumps and electronic components sold separately as replacement parts shall be tested after field installation to verify that the combination results in vapor recovery system performance within the range specified in the VaporVac System section of Exhibit 2 of this Order.

IT IS FURTHER ORDERED that all nozzles approved for use with the VaporVac/Vaporsaver System shall be 100 percent performance checked at the factory, including checks of the integrity of the vapor path, as specified in Exhibit 2 of this Order.

IT IS FURTHER ORDERED that the components certified as part of the VaporVac/Vaporsaver system shall be warranted in writing, for at least one year from the startup date of the original installation, to the ultimate purchaser and each subsequent purchaser within the warranty period. Each manufacturer's warranty shall provide that the vapor recovery system is designed, built and equipped so as to conform at the time of original installation or sale with the applicable regulations and is free from defects in materials and workmanship which would cause the vapor recovery system to fail to conform with applicable regulations. Copies of the manufacturer's warranty for the VaporVac/Vaporsaver system shall be made available to the station manager, owner or operator. Gilbarco, OPW or other manufacturers may specify that the warranty is contingent upon the use of trained installers.

IT IS FURTHER ORDERED that the certified Vaporsaver system shall, at a minimum, be installed, operated and maintained in accordance with the ARB approved Installation, Operation and Maintenance Manual for the OPW Vaporsaver System. A copy of this Executive Order and manual should be maintained at each GDF where the OPW Vaporsaver System is installed with a Gilbarco VaporVac System.

IT IS FURTHER ORDERED that any alteration in the equipment, parts, design, installation or operation of the system certified hereby is prohibited and deemed inconsistent with this certification unless the alteration has been submitted in writing and approved in writing by the Executive Officer or Executive order delegate.

IT IS FURTHER ORDERED that equipment defects set forth in the most recently approved ***Vapor Recovery Equipment Defects List*** (Section 94006, Title 17, California Code of Regulations) for the Marconi (Gilbarco) VaporVac (Executive Order G-70-150 series) are hereby incorporated for this certification.

IT IS FURTHER ORDERED that equipment listed in Exhibit 1, unless exempted, shall be clearly identified by a permanent identification showing the manufacturer's name and model number.

IT IS FURTHER ORDERED that the certification of the VaporVac/Vaporsaver System is valid through January 1, 2009.

Executed at Sacramento, California, this 17th day of November 2004.

William V. Loscutoff, Chief
Monitoring and Laboratory Division

Attachments:

| | |
|---|---|
| Exhibit 1 | Equipment List |
| Exhibit 2 | System Specifications |
| Exhibit 3 | Items to Consider in Conducting TP-201.3, (Determination of 2 inch WC Static Pressure Performance of Vapor Recovery Systems of Dispensing Facilities) |
| Exhibit 4 | Determination of Pressure in Underground Gasoline Storage Tanks |
| Exhibit 5 | Determination (by Volume Meter) of Air to Liquid Volume Ratio of Vapor Recovery Systems of Dispensing Facilities |

**Executive Order G-70-204**
**Gilbarco VaporVac/OPW Vaporsaver**
**ORVR-Compatible Phase II Vapor Recovery System**

**Exhibit 1**
**Equipment List**

| Component | Manufacturer/Model | State Fire Marshal Identification Number |
|---|---|---|
| **Tank Pressure Management System** | | |
| | OPW Vaporsaver 1 | 005:008:062 |
| | OPW 523AV (Atmospheric Vent) | |
| **Nozzles** | Catlow ICVN (Richards AstroVac) (Figure 1A-1) | 005:030:014 |
| | Emco Wheaton A4505 Figure 1A-2) | 005:007:042 |
| | Husky V34 Model 6250 (Figure 1A-3) | 005:021:008 |
| | OPW 12VW (Figure 1A-4) | 005:008:059 |
| **Inverted Coaxial Hoses** | Catlow Vapor Mate* | 005:033:005 |
| | Dayco 7282 Superflex 2000* | 005:033:005 |
| | Dayco 7292 Superflex 4000* | 005:033:006 |
| | Dayco 7246 Flex-Ever Ultimate | 005:033:007 |
| | Dayco 7253BVD Flex-Ever Ultimate | 005:033:008 |
| | Goodyear Flexsteel | 005:036:002 |
| | GT Sales/Hewitt Superflex 2000* | 005:033:005 |
| | Parker Hannifin 7282 Superflex 2000* | 005:033:005 |
| | Parker Hannifin 7292 Superflex 4000* | 005:033:006 |
| | Parker Hannifin 7246 Flex-Ever Ultimate | 005:033:007 |
| | Parker Hannifin 7253BVD Flex-Ever Ultimate | 005:033:008 |
| | Thermoid Hi-Vac | 005:037:003 |
| | Thermoid Hi-Vac S | 005:037:004 |
| | VST VSTaflex | 005:052:001 |
| | VST VST-CIS* | 005:052:001 |

* Hoses assemblies are no longer manufactured, but can still be used.

| Component | Manufacturer / Model | State Fire Marshal Identification Number |
|---|---|---|
| **Re-Connectable Breakaway Couplings**[1] | | |
| | Catlow AV2001 | 005:030:006 |
| | Catlow AVR200S | 005:030:010 |
| | Emco Wheaton A5219-001 | 005:030:010 |
| | Husky 4034 | 005:021:009 |
| | Husky 5134 (re-connectable w/tool) | 005:021:009 |
| | OPW 66CAS | 005:008:056 |
| | OPW 66CIP | 005:030:010 |
| | Richards VA-50 | 005:031:007 |
| | Richards VA-50B | 005:031:014 |
| **Non Re-Connectable Breakaway Couplings**[1] | | |
| | Catlow IVC200S | 005:030:017 |
| | Richards VA-60 (OPW 66ISU-5100) | 005:031:009 |
| | VST-IS-SBK | 005:044:008 |
| | VST-H-SBK | 005:044:008 |
| **Breakaway/Hose Combinations** | | |
| | VST-IS-BK | 005:044:004 |
| **Swivels** | OPW 43-IS | 005:008:057 |
| | Richards MFVA | 005:031:015 |
| | Husky 4605 | 005:021:016 |
| | Catlow IC3 | 005:030:018 |
| **Breakaway/Swivel Combinations** | | |
| | Richards STVA (OPW 66ISB-5100) | 005:031:016 |
| **Flow Control Units** | Catlow I10G-1A | 005:030:013 |
| | Healy 1301M | 005:027:020 |
| | Healy 1302M | 005:027:020 |
| | Husky 5837 | 005:021:012 |
| | OPW 66FL | 005:008:054 |
| | OPW 66FD | 005:008:054 |
| | Richards FRVAD | 005:031:017 |
| | Vapor Systems Technologies (VST) | 005:044:001 |
| **Breakaway/Flow Control Unit Combinations** | | |
| | OPW 66FLB | 005:008:055 |

[1] Component optional for vapor recovery system configurations; other state or local regulations may apply.

| Component | Manufacturer / Model | State Fire Marshal Identification Number |
|---|---|---|
| **Pressure/Vacuum Vent Valve** | Husky 4885 | |
| **Vapor Pump** | Blackmer VRG 3/4<br>Blackmer VRG 3/4R | |
| **Dispensers** | **Note: Unihose dispensers may be required as per EVR regulations** | |
| | Gilbarco Advantage Series B"XY"<br>Figure 1B-1<br>"X" may be 0, 2, 4, 6, 7 ,8, F ,H J, L, N, Q<br>"Y" may be 0 through 9, A through P | 001:026:015 |
| | Gilbarco Encore Series<br>Figure 1B-2 | 001:026:017 |

| Model #'s | Description: |
|---|---|
| NAO | Encore 1 Grade Multi-hose |
| NA1 | Encore 2 Grade Multi-hose |
| NA2 | Encore 3 Grade Multi-hose |
| NA3 | Encore 4 Grade Multi-hose |
| NG0 | Encore 3 Grade Single-Hose |
| NG1 | Encore 4 Grade Single-Hose plus 1 |
| NG4 | Encore 2 Grade Single-Hose |
| NJ0 | Multi-hose Blender |
| NJ2 | Multi-hose Blender plus 1 |
| NL0 NL1 NL2 NL3 | Encore X+1 Blender |
| NN0 NN1 NN2 NN3 | Encore X+0 Blender |

Gilbarco Eclipse Series 001:026:018
Figure 1B-2

| Model #'s | Description |
|---|---|
| EG0 | Eclipse Single-hose |
| EL0 EL1 EL2 EL3 | Eclipse X+1 Blender |
| EN0 EN1 EN2 EN 3 | Eclipse X+0 Blender |

Schlumberger 4000 Series
4"ABC"-"YZ"-"S"-VG
"A" may be 1 through 4 and designates the number of products on the front side
"B" may be 0 through 4 and designates the number of products on the back side

| Component | Manufacturer / Model | State Fire Marshal Identification Number |
|---|---|---|

"C" may be 0 through 3 and designates the number of hoses per side
"Y" may be 2 through 7 and designates computer options
"Z" may be A; D; or none and designates computer options
"S" may be B; L; R; -B-L; -B-R; -L-R; -B-L-R; or no characters and designates optional features
VG designates the VaporVac system)

**VaporVac Retrofit Assemblies**

CV00"XX"-"YZ"

"XX" may be 01 through 14
"Y" may be 0 through 7
"Z" may be 1 through 7 and designates cosmetic features such as color

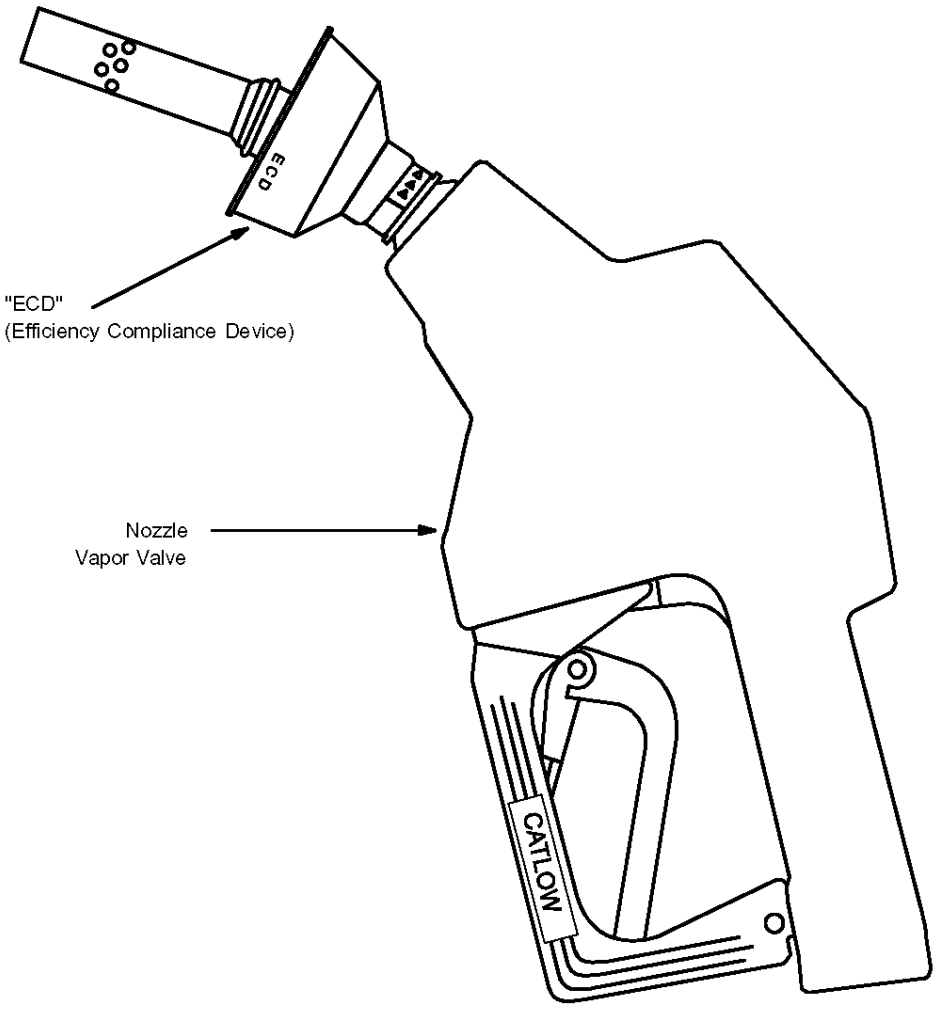
Table 1

Components Exempt from Identification Requirements

| Component Name | Manufacturer | Model Number |
|---|---|---|
| Re-connectable Breakaway Coupling | Husky | 4034 and 5134 |
| Swivel | Husky | 4605 |
| Flow Control Unit | Healy | 1301M and 1302M |
| Flow Control Unit | Husky | 5837 |
| Flow Control Unit | VST | Vapor Systems Technologies |

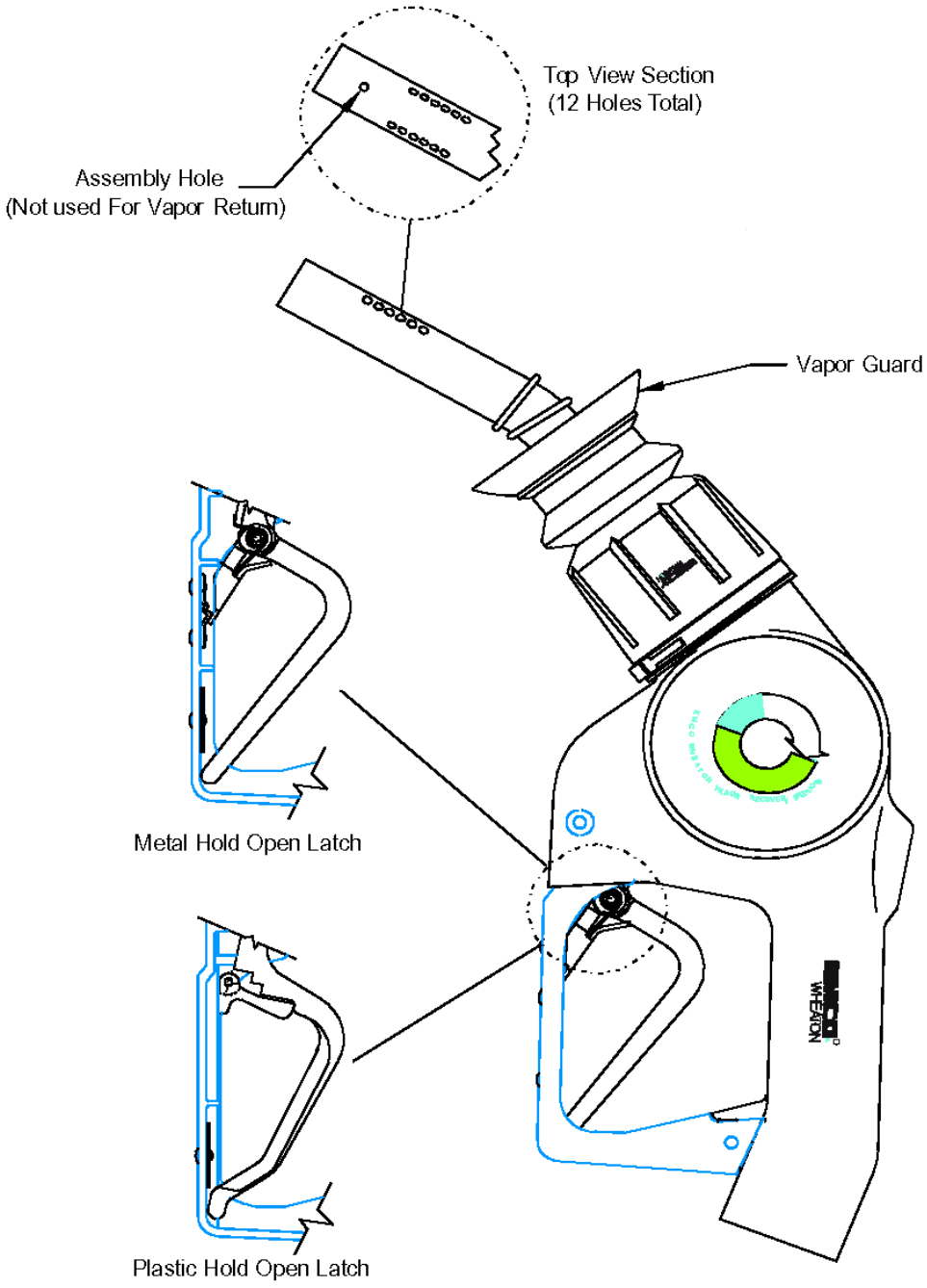
**Executive Order G-70-204**
**Gilbarco VaporVac/OPW Vaporsaver**
**ORVR-Compatible Phase II Vapor Recovery System**

**Exhibit 1**
**Figure 1A-1**
**Catlow Model ICVN (Richards AstroVac) Nozzle**



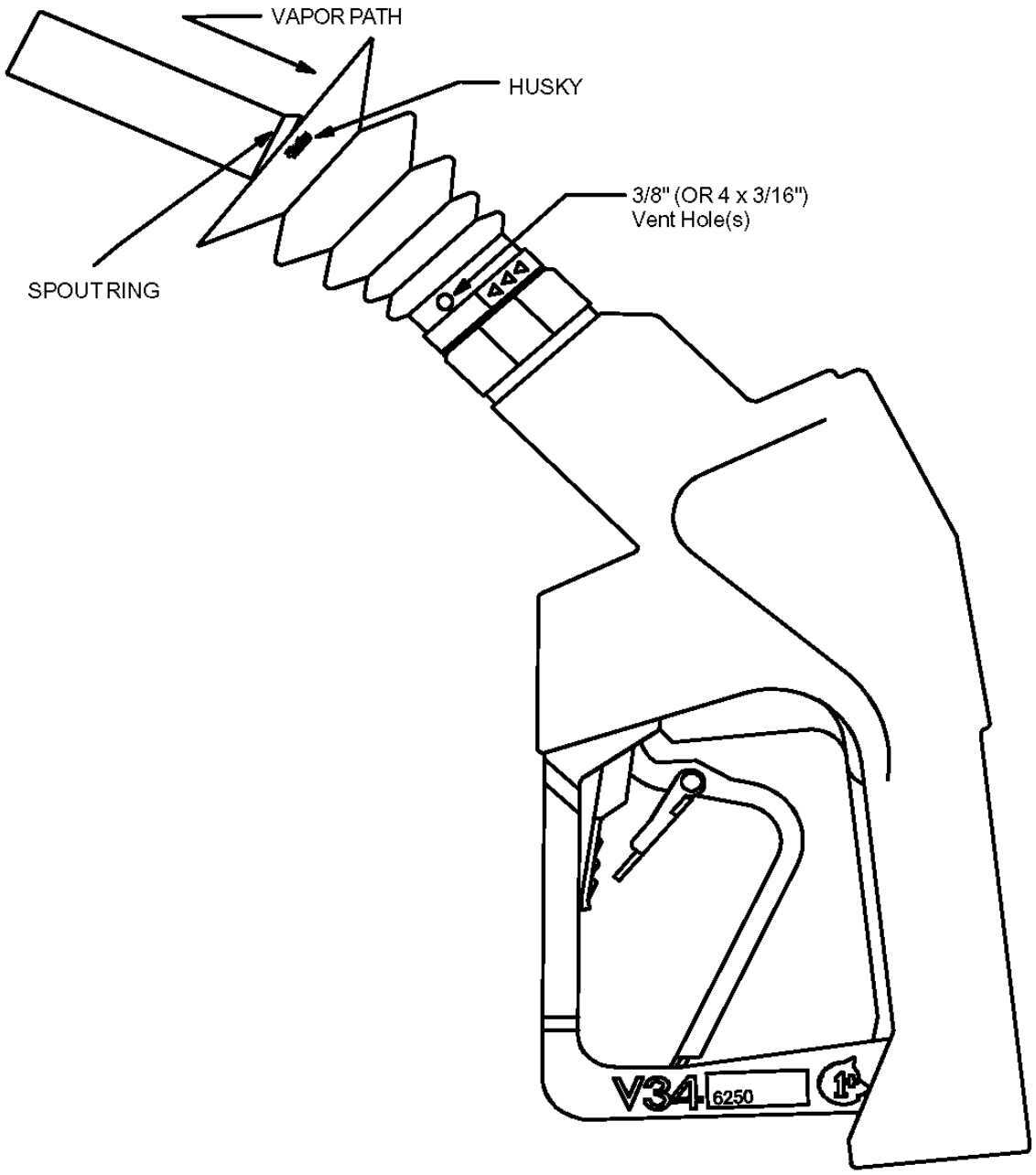
**Executive Order G-70-204**
**Gilbarco VaporVac/OPW Vaporsaver**
**ORVR-Compatible Phase II Vapor Recovery System**

**Exhibit 1**
**Figure 1A-2**
**Emco Wheaton Model A4505 Nozzle**



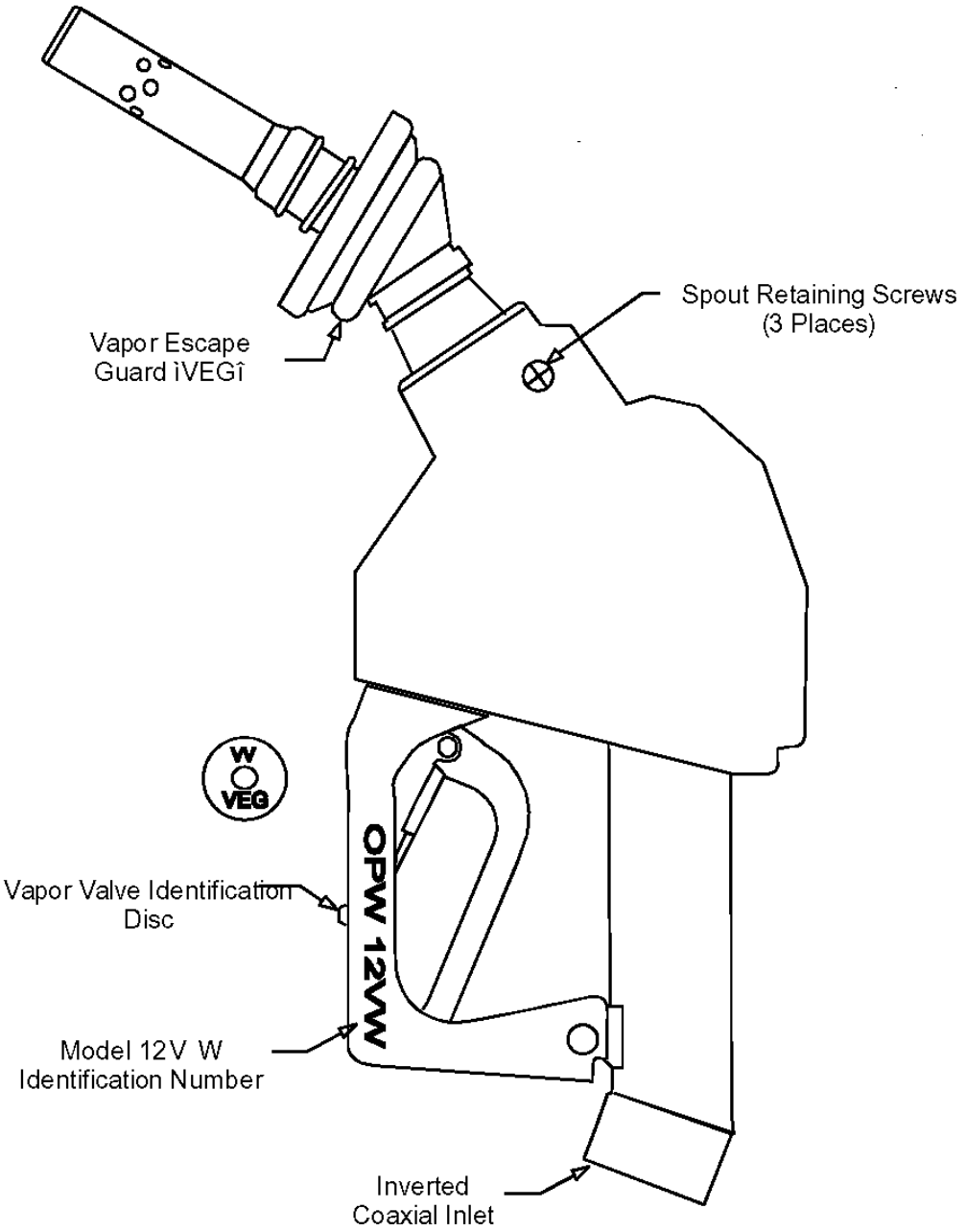
**Executive Order G-70-204**
**Gilbarco VaporVac/OPW Vaporsaver**
**ORVR-Compatible Phase II Vapor Recovery System**

**Exhibit 1**
**Figure 1A-3**
**Husky Model V34 6250 Nozzle**



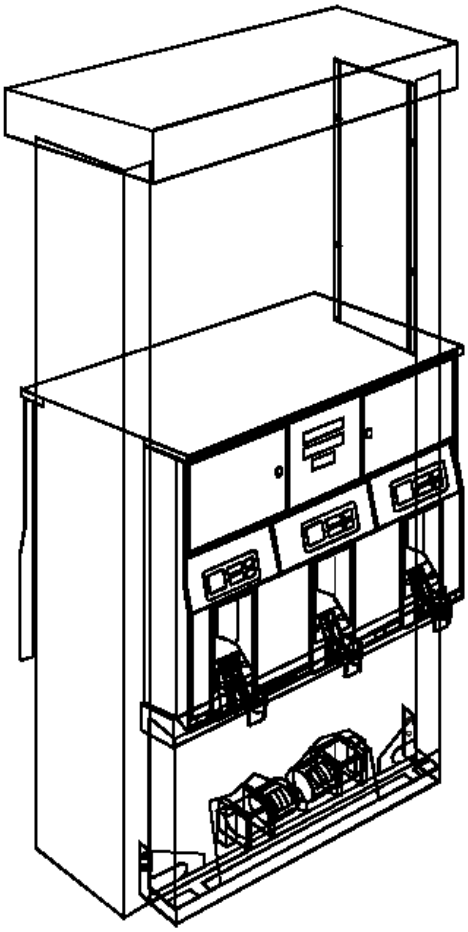
**Executive Order G-70-204**
**Gilbarco VaporVac/OPW Vaporsaver**
**ORVR-Compatible Phase II Vapor Recovery System**

**Exhibit 1**
**Figure 1A- 4**
**OPW Model 12VW Nozzle**

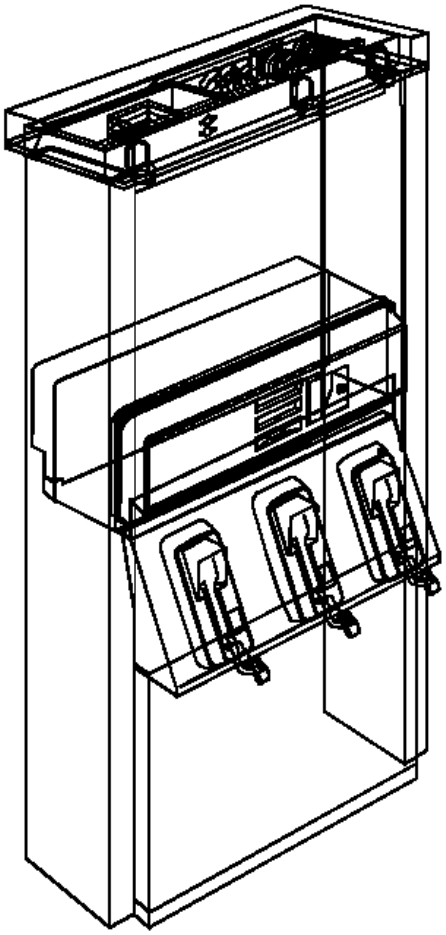


**Executive Order G-70-204**
**Gilbarco VaporVac/OPW Vaporsaver**
**ORVR-Compatible Phase II Vapor Recovery System**

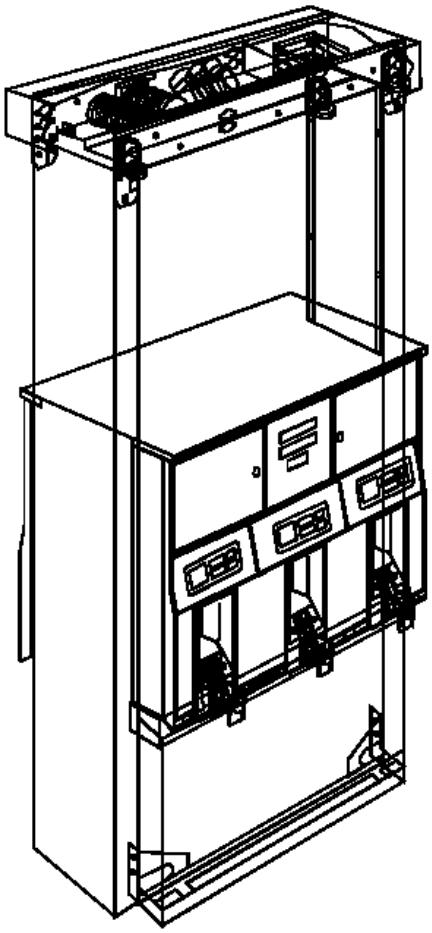
**Exhibit 1**
**Figure 1B-1**
**Gilbarco VaporVac Dispenser Types**



The Advantage MPD Dispenser
Production Models



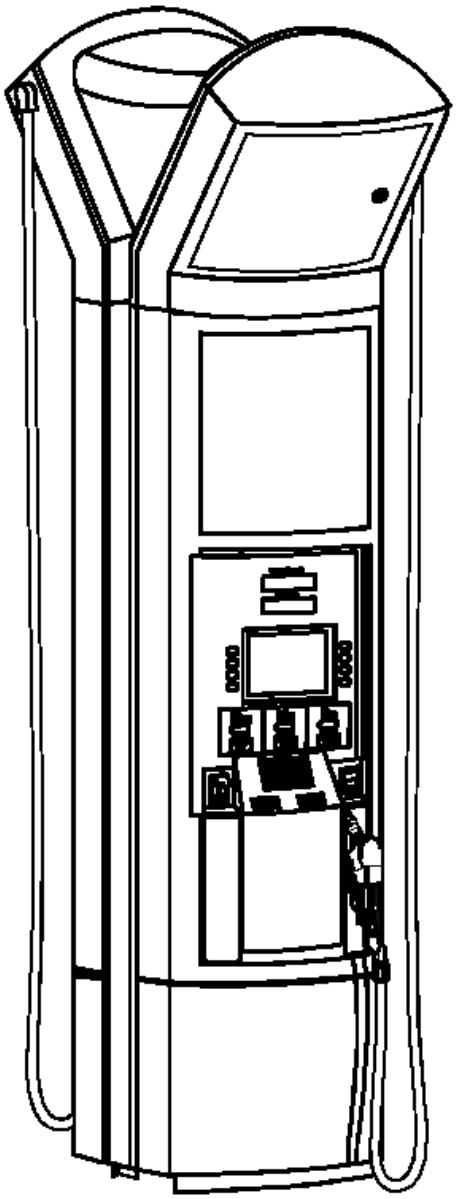
MPD 1-2/C and 3 Dispenser
Retrofits



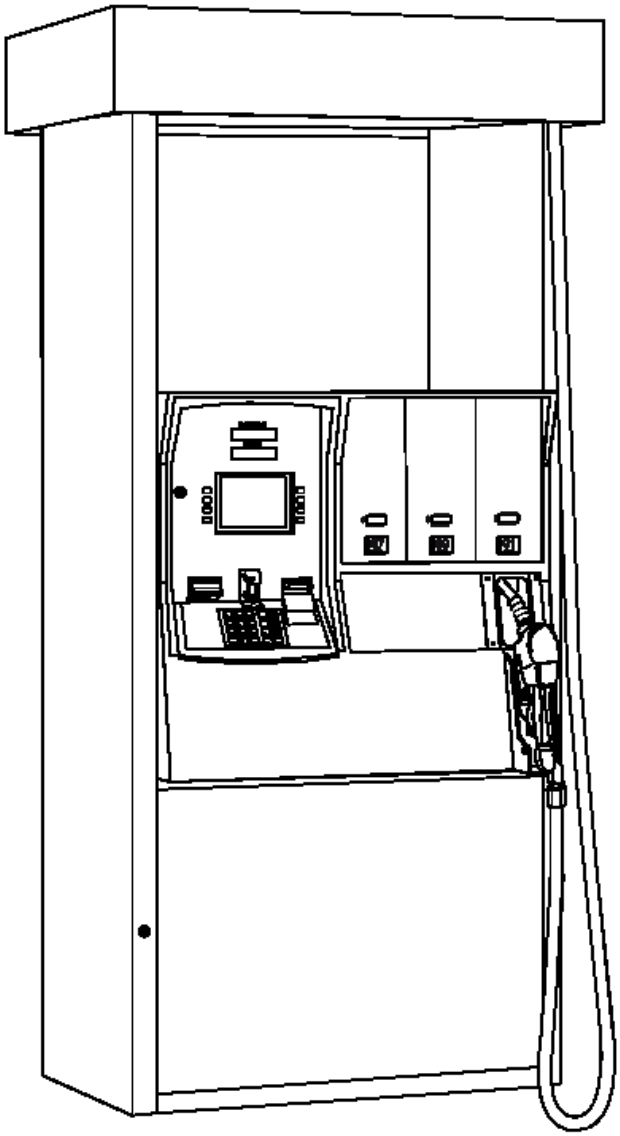
The Advantage MPD Dispenser
Retrofits

**Executive Order G-70-204**
**Gilbarco VaporVac/OPW Vaporsaver**
**ORVR-Compatible Phase II Vapor Recovery System**

**Exhibit 1**
**Figure 1B-2**
**Gilbarco VaporVac Dispenser Types**



The Eclipse MPD Dispenser
Production Model



The Encore MPD Dispenser
Production Model

**Executive Order G-70-204**
**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

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 Vaporsaver 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. 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. Failure mode testing demonstrated that pressure-related fugitive emissions, including vent emissions, significantly impair the effectiveness of the vapor recovery system when the Vaporsaver processor is not operative. 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 starting). The processor is inoperative and the system shall be removed from service.

   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 processor is inoperative and the system shall be removed from service.

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 processor is inoperative and the system shall be removed from service.

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 processor is inoperative and the system shall be removed from service. Note: After a long period of non-activity of the Vaporsaver, stagnant hydrocarbon in the residue piping can linger creating a false alarm. It may take an extra Reset or two to purge the HC sensor.

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 Vaporsaver 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 Vaporsaver 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 Vaporsaver 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 non operating Vaporsaver is considered a vapor recovery equipment defect which substantially impairs the effectiveness of the vapor recovery system. Therefore, gasoline dispensing facility that refuels motor vehicles with a non operating Vaporsaver will likely result in a notice of violation from the district.

7. 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 |

**Nozzles**

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 100 percent 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.

**Solenoid Vapor Valves**

1. The VaporVac system was originally certified with solenoid vapor valves. These valves are no longer required but, if present, may remain in place.

**Air To Liquid Ratio**

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.

**Inverted Coaxial Hoses**

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.

   Excessive vapor pump motor current; possible causes include bearing failure, locked rotor, motor winding shorts or fluid in pump cavity for more time than required to clear a blockage.

   Failure of the vapor pump to start while fuel is being dispensed (possible causes include control electronics failure, disconnected or severed motor wiring, or locked rotor).

   Vapor pump activity during idle periods when no fuel is being dispensed.

   Maximum permissible pump speed exceeded (possible causes include loose connections in vapor path or pump malfunction).

   Disconnection or accidental swapping of Side A/B vapor pumps. 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 in parallel, 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 manifolded, 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**

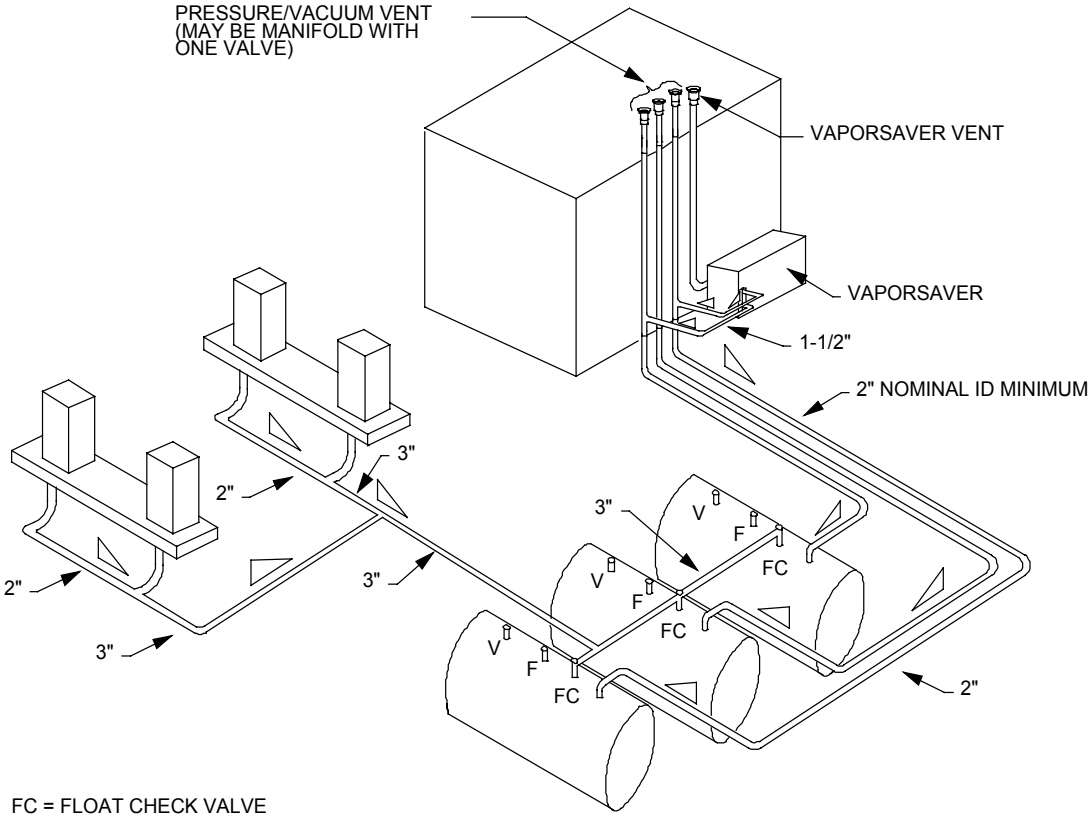
1. The Phase I system shall be an ARB-certified system which is in good working order and which demonstrates compliance with the static pressure decay test criteria contained in TP-201.3 (March 17, 1999).

**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**
**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**

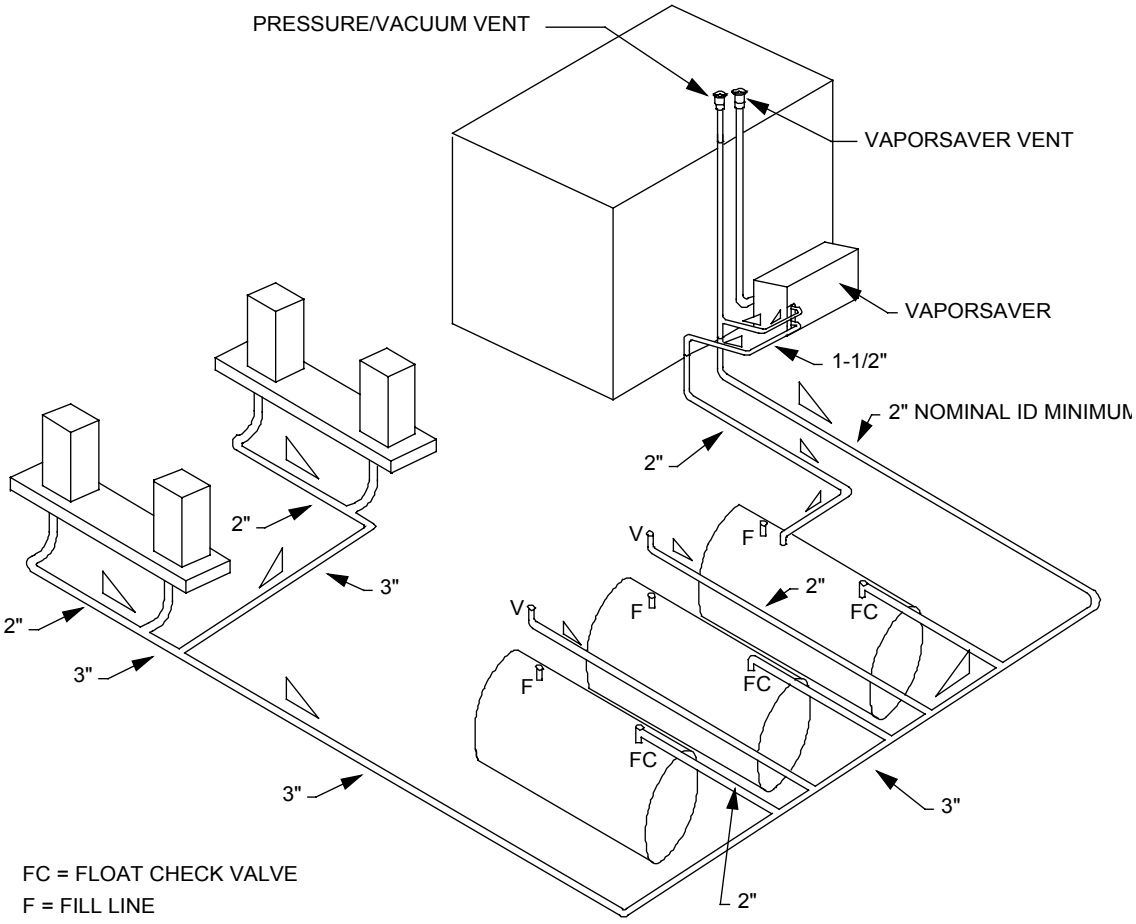



FC = FLOAT CHECK VALVE
F = FILL LINE
V = PHASE I VAPOR RECOVERY

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

**Executive Order G-70-204**
**Gilbarco VaporVac/OPW Vaporsaver**
**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**

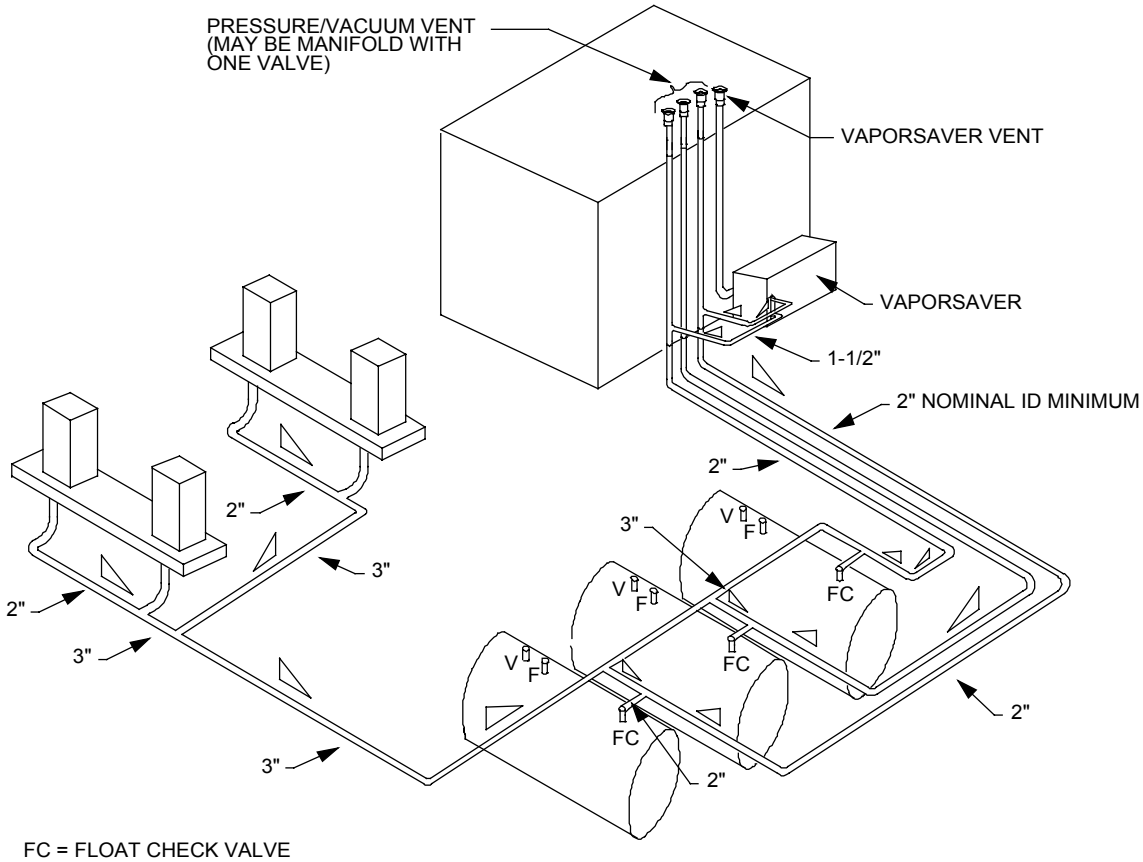



FC = FLOAT CHECK VALVE
F = FILL LINE
V = PHASE I VAPOR RECOVERY

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

**Executive Order G-70-204**
**Gilbarco VaporVac/OPW Vaporsaver**
**ORVR-Compatible Phase II Vapor Recovery System**

**Exhibit 2**
**Figure 2A- 3**
**Typical Installation of the OPW Vaporsaver**
**Phase II Tank Pressure Management System**
**with Typical Phase II Vapor Recovery System**

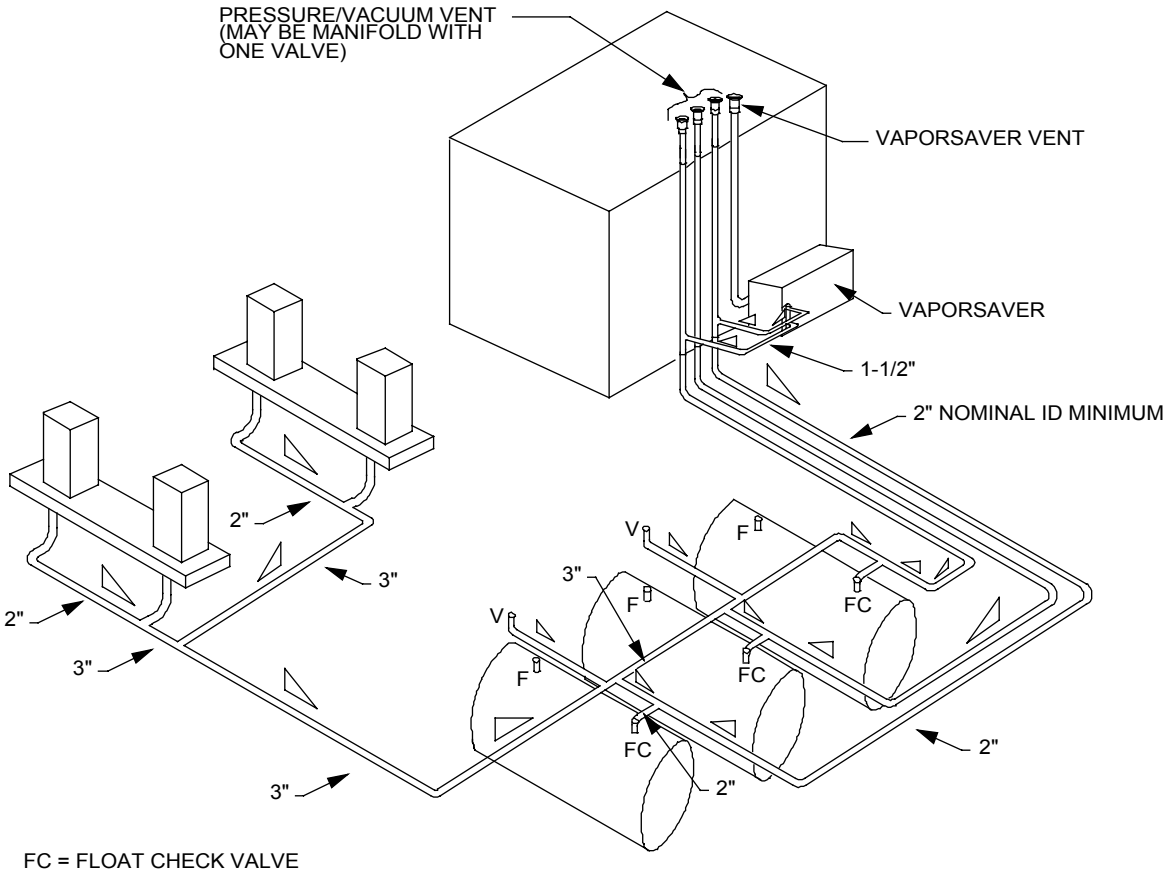



FC = FLOAT CHECK VALVE
F = FILL LINE
V = PHASE I VAPOR RECOVERY

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

**Executive Order G-70-204**
**Gilbarco VaporVac/OPW Vaporsaver**
**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**

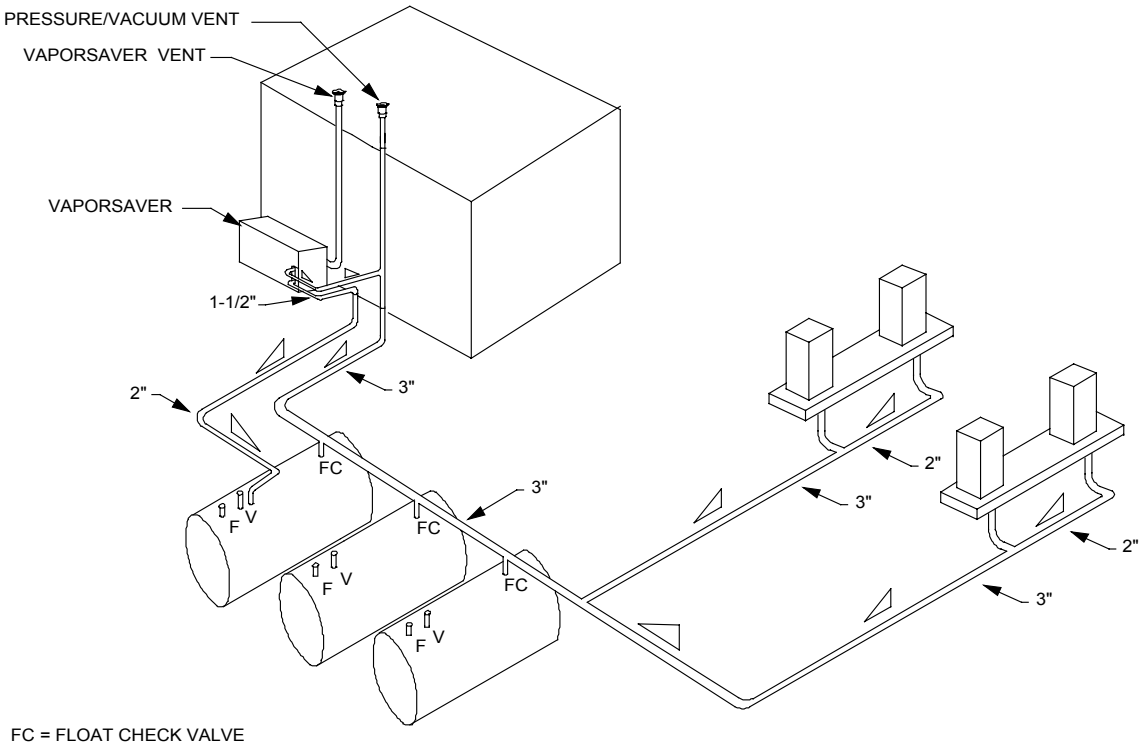



FC = FLOAT CHECK VALVE
F = FILL LINE
V = PHASE I VAPOR RECOVERY

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

**Executive Order G-70-204**
**Gilbarco VaporVac/OPW Vaporsaver**
**ORVR-Compatible Phase II Vapor Recovery System**

**Exhibit 2**
**Figure 2A- 5**
**Typical Installation of the OPW Vaporsaver**
**Phase II Tank Pressure Management System**
**with Typical Phase II Vapor Recovery System**

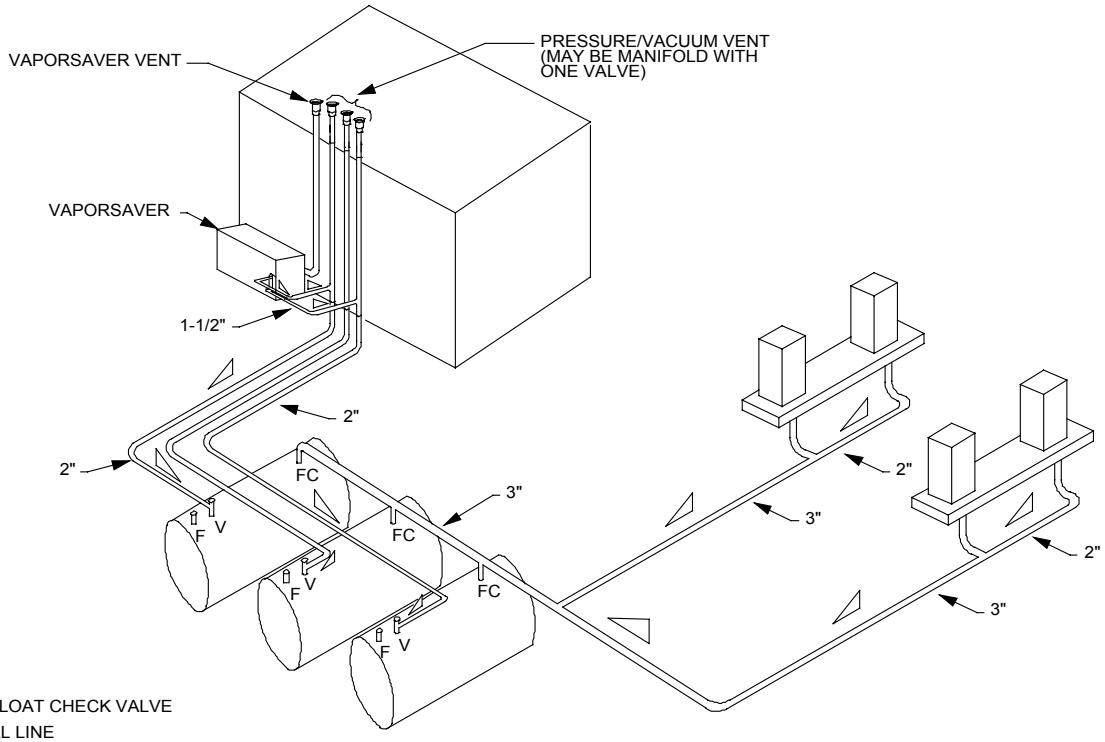



FC = FLOAT CHECK VALVE
F = FILL LINE
V = PHASE I VAPOR RECOVERY

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

**Executive Order G-70-204**
**Gilbarco VaporVac/OPW Vaporsaver**
**ORVR-Compatible Phase II Vapor Recovery System**

**Exhibit 2**
**Figure 2A- 6**
**Typical Installation of the OPW Vaporsaver**
**Phase II Tank Pressure Management System**
**with Typical Phase II Vapor Recovery System**

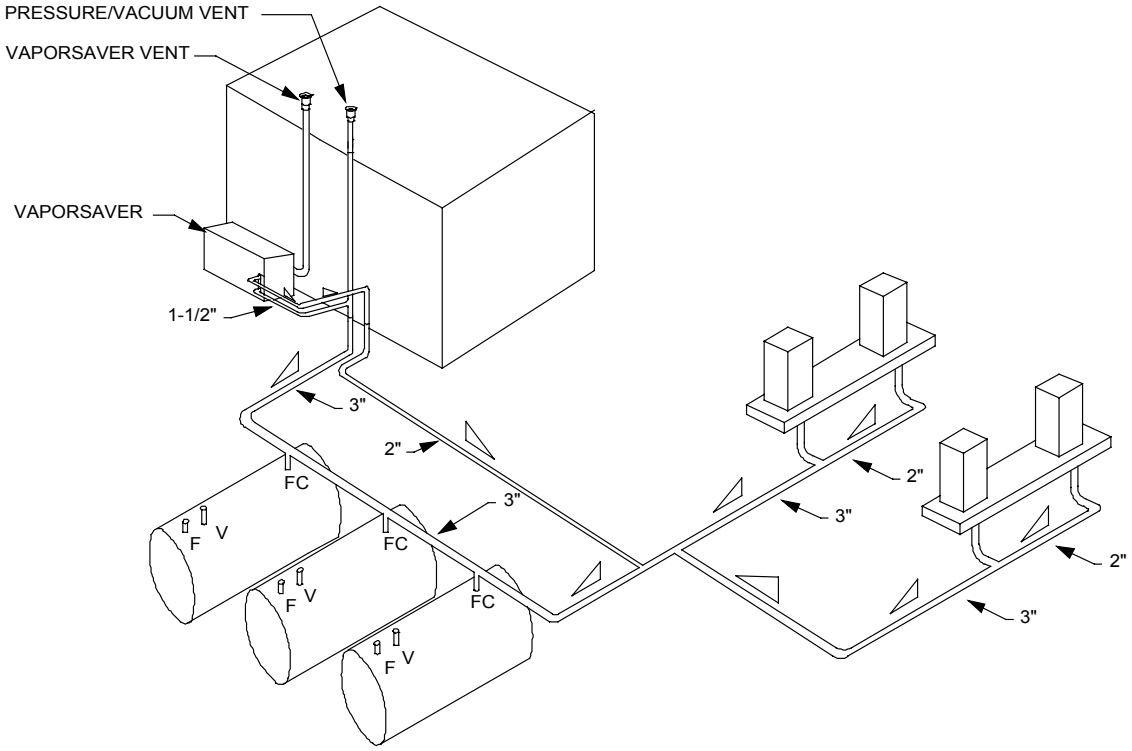



FC = FLOAT CHECK VALVE
F = FILL LINE
V = PHASE I VAPOR RECOVERY

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

**Executive Order G-70-204**
**Gilbarco VaporVac/OPW Vaporsaver**
**ORVR-Compatible Phase II Vapor Recovery System**

**Exhibit 2**
**Figure 2A- 7**
**Typical Installation of the OPW Vaporsaver**
**Phase II Tank Pressure Management System**
**with Typical Phase II Vapor Recovery System**

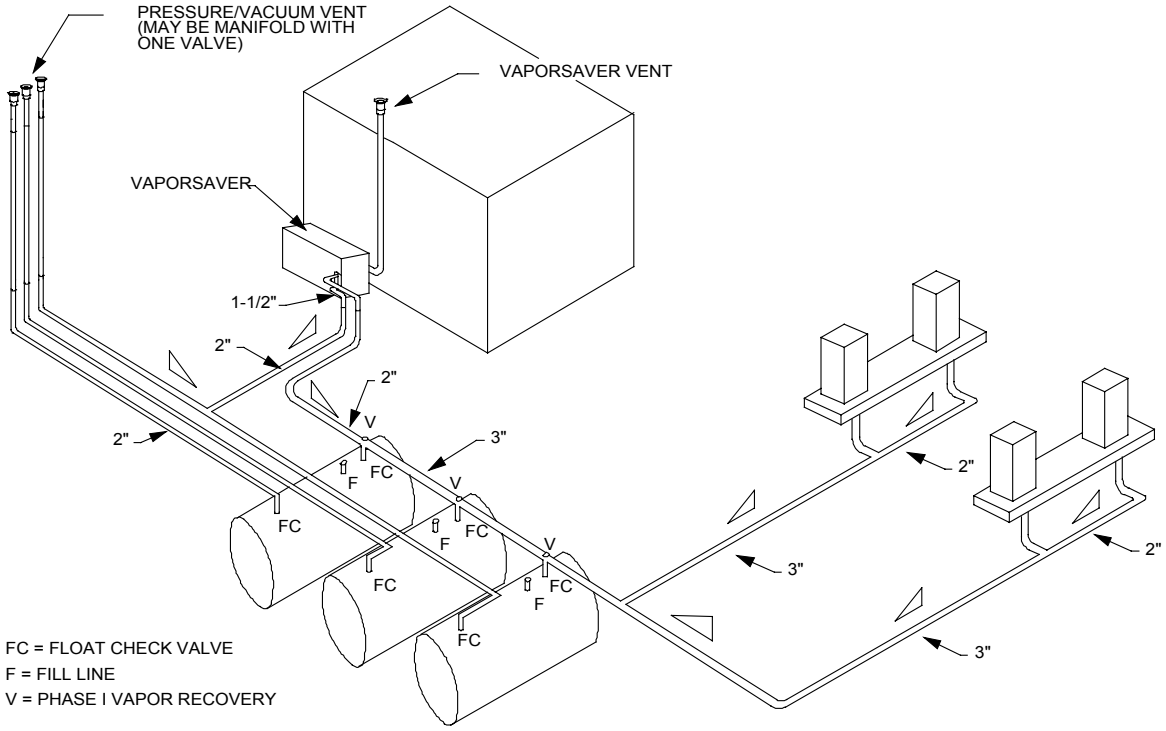



FC = FLOAT CHECK VALVE
F = FILL LINE
V = PHASE I VAPOR RECOVERY

NOTE:
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

**Executive Order G-70-204**
**Gilbarco VaporVac/OPW Vaporsaver**
**ORVR-Compatible Phase II Vapor Recovery System**

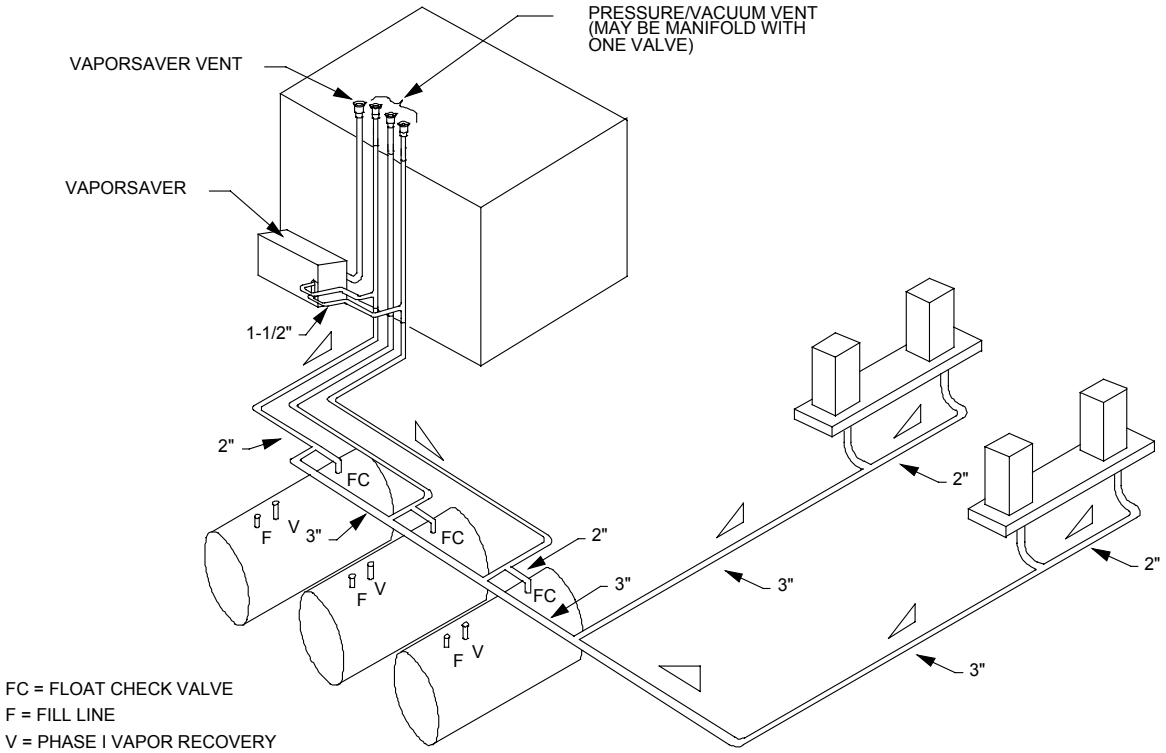
**Exhibit 2**
**Figure 2A- 8**
**Typical Installation of the OPW Vaporsaver**
**Phase II Tank Pressure Management System**
**with Typical Phase II Vapor Recovery System**




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

**Executive Order G-70-204**
**Gilbarco VaporVac/OPW Vaporsaver**
**ORVR-Compatible Phase II Vapor Recovery System**

**Exhibit 2**
**Figure 2A- 9**
**Typical Installation of the OPW Vaporsaver**
**Phase II Tank Pressure Management System**
**with Typical Phase II Vapor Recovery System**

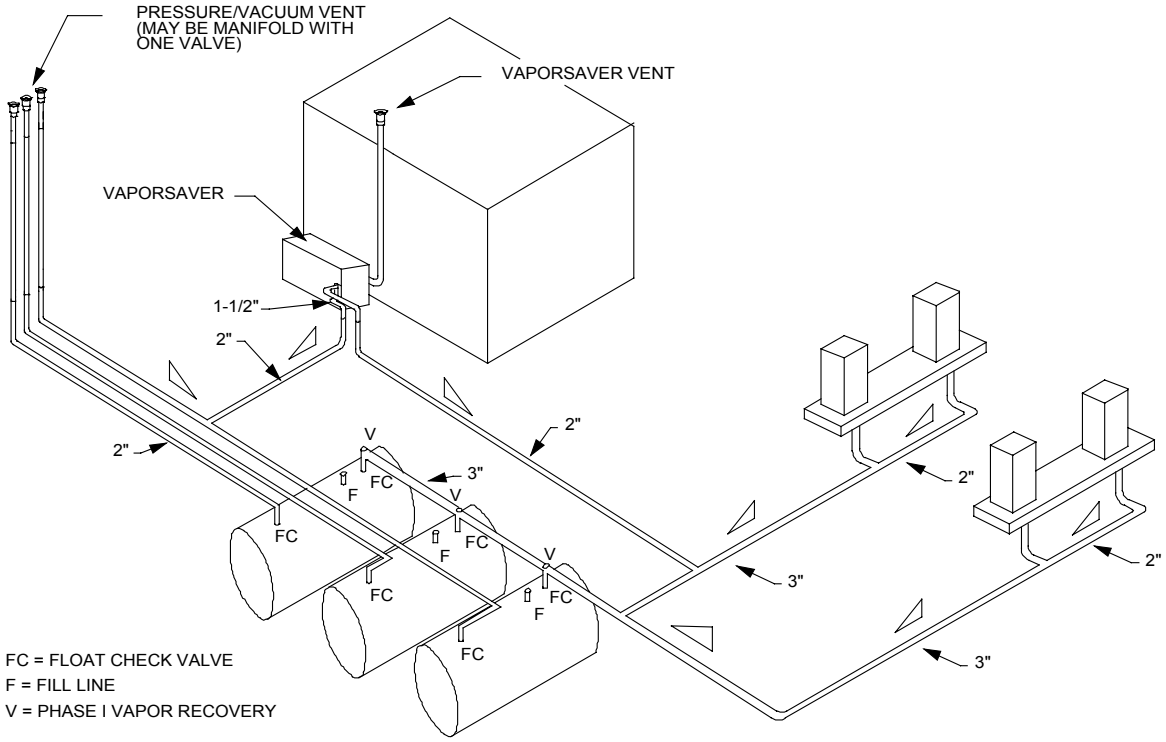



FC = FLOAT CHECK VALVE
F = FILL LINE
V = PHASE I VAPOR RECOVERY

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

**Executive Order G-70-204**
**Gilbarco VaporVac/OPW Vaporsaver**
**ORVR-Compatible Phase II Vapor Recovery System**

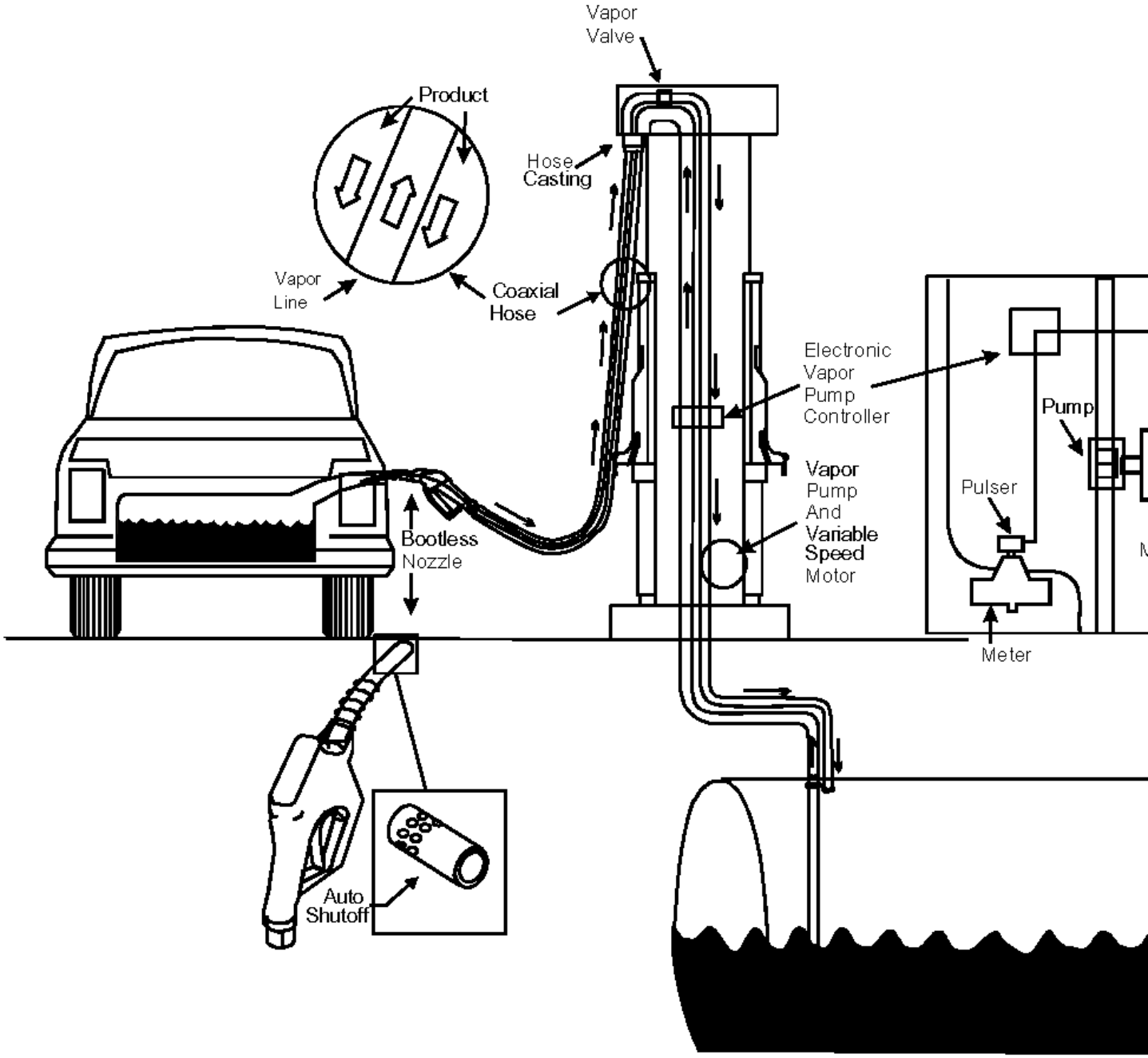
**Exhibit 2**
**Figure 2A- 10**
**Typical Installation of the OPW Vaporsaver**
**Phase II Tank Pressure Management System**
**with Typical Phase II Vapor Recovery System**




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

**Executive Order G-70-204**
**Gilbarco VaporVac/OPW Vaporsaver**
**ORVR-Compatible Phase II Vapor Recovery System**

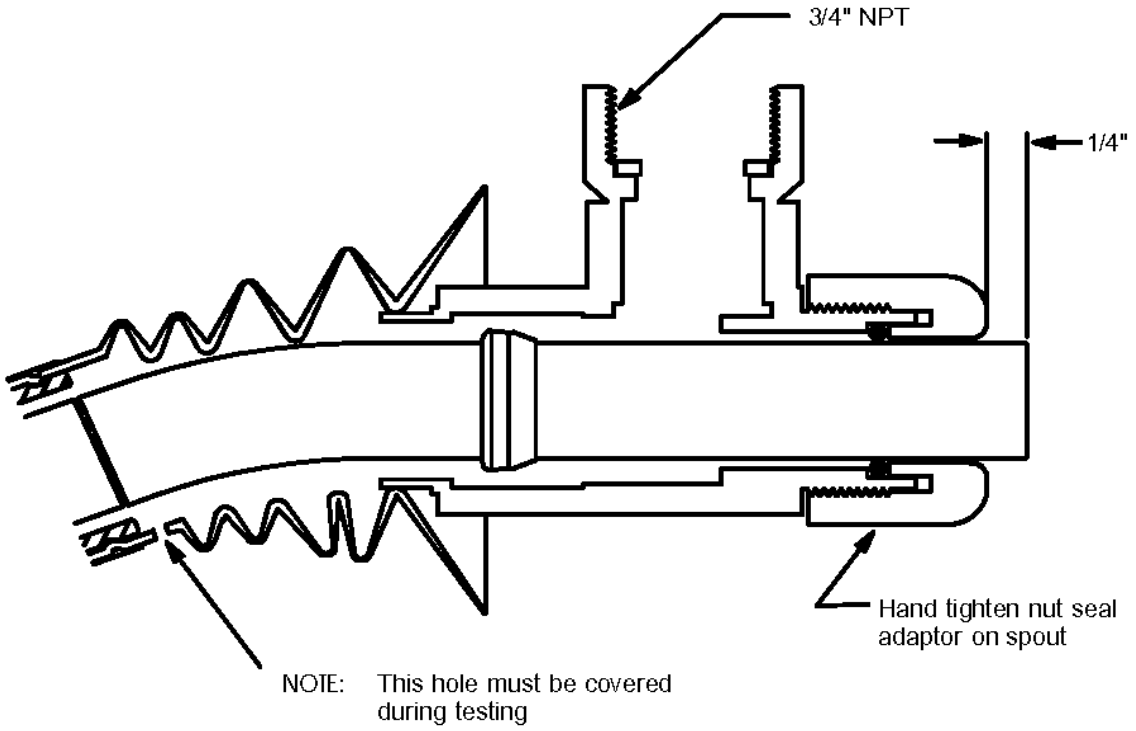
**Exhibit 2**
**Figure 2B-1**
**Component Parts of the Gilbarco VaporVac System**




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.

**Executive Order G-70-204**
**Gilbarco VaporVac/OPW Vaporsaver**
**ORVR-Compatible Phase II Vapor Recovery System**

**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.

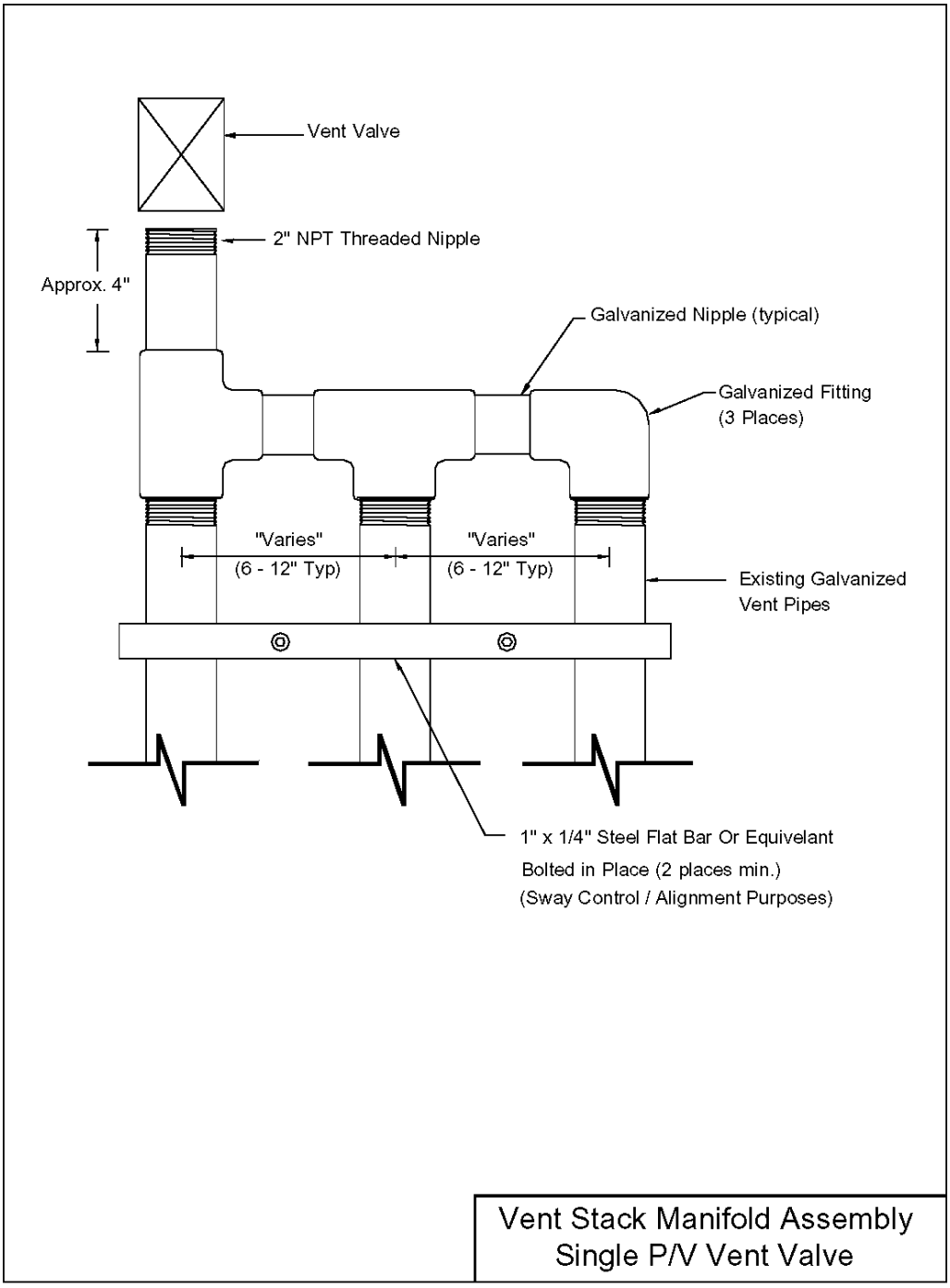
3) Hand tighten the nut. This will seal the A/L adaptor to the spout.

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.

**Executive Order G-70-204**
**Gilbarco VaporVac/OPW Vaporsaver**
**ORVR-Compatible Phase II Vapor Recovery System**

**Exhibit 2**
**Figure 2D-1**




**Typical Installation of a Single P/V Vent Valve Manifold**

**Executive Order G-70-204**
**Gilbarco VaporVac/OPW Vaporsaver**
**ORVR-Compatible Phase II Vapor Recovery System**

**Exhibit 2**

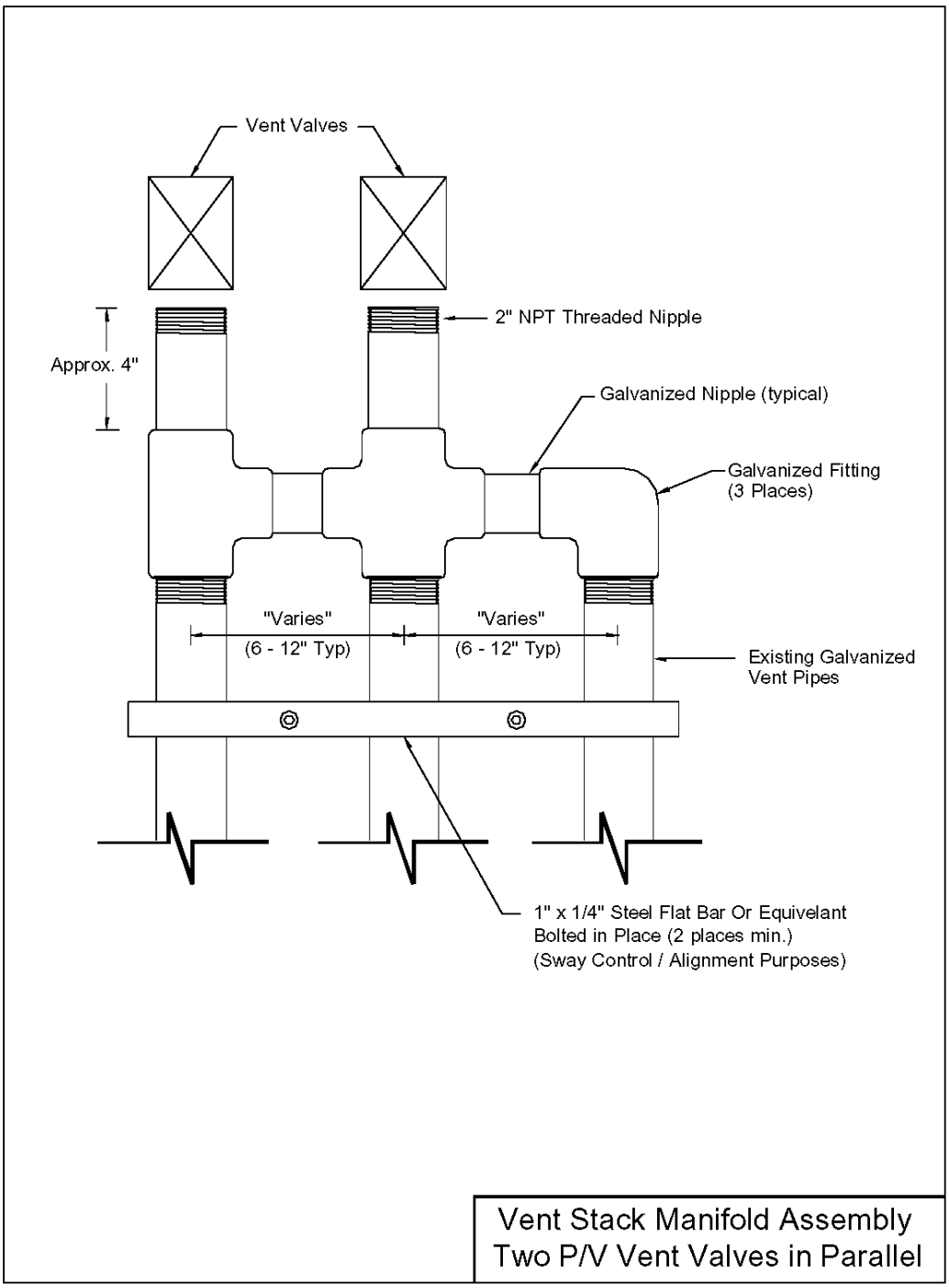



**Figure 2D-2**
**Typical Installation of a Two P/V Vent Valve Parallel Manifold**

**Executive Order G-70-204**
**Gilbarco VaporVac/OPW Vaporsaver**
**ORVR-Compatible Phase II Vapor Recovery System**

**Exhibit 2**

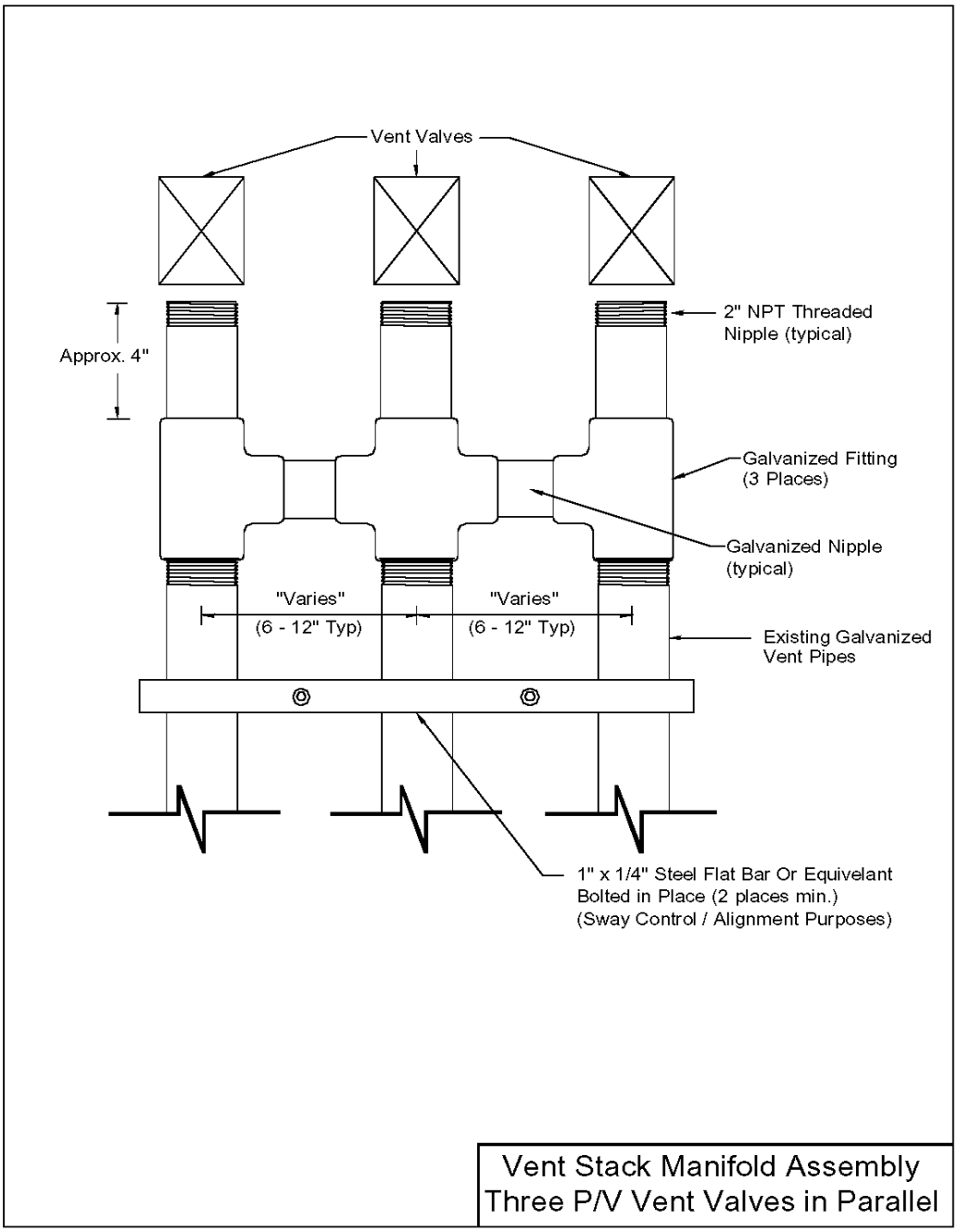



**Figure 2D-3**
**Typical Installation of a Three P/V Vent Valve Parallel Manifold**

**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 |
|---|---|---|---|---|---|
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**Executive Order G-70-204**
**Gilbarco VaporVac/OPW Vaporsaver**
**ORVR-Compatible Phase II Vapor Recovery System**

**Exhibit 3**

**Items to Consider in Conducting TP-201.3,**
**(Determination of 2 inch WC Static Pressure Performance of**
**Vapor Recovery Systems of Dispensing Facilities**

1. Prior to conducting TP-201.3, the power supply to the Vaporsaver processor shall be shut off to permit the pressurization of the UST system.

2. Sealing of the vapor holes on the nozzle spout (such as placing a balloon or the fingers of a glove over the holes on the nozzle spout, or bagging nozzles) is **not** permitted during static pressure decay tests. Sealing of the nozzle vapor holes during a static pressure decay test may mask a defective vapor valve.

3. The Vaporsaver residue (clean air exhaust) does not need a cap or P/V valve since there is a Pressure Relief Valve located within the Vaporsaver at the exhaust of the membrane housing. This Pressure Relief Valve only opens when the feed pump reaches operating pressure (~25 psi) and closes when the power supply to the Vaporsaver processor is shut off. When pressure is applied during a TP-201.3 test, pressure from the UST enters the Vaporsaver through both the inlet (feed) and outlet (permeate). Everything in the Vaporsaver up to this Pressure Relief Valve is pressurized. This includes all tubing, piping, fittings, pressure switches, pumps, cooler, separator, and membrane housing.

California Environmental Protection Agency

# Air Resources Board

**Vapor Recovery Test Procedure**

**Exhibit 4**

**Determination of Pressure in Underground Gasoline Storage Tanks**

**California Environmental Protection Agency**
**Air Resources Board**

**Vapor Recovery Test Procedure**

**Exhibit 4**

**Determination of Pressure in Underground Gasoline Storage Tanks**

## 1. Applicability

Definition common to all certification and test procedures are in:

***D-200 Definition 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 designee.

This test procedure is used to quantify the amount of pressure present in underground gasoline storage tanks (USTs) installed at gasoline dispensing facilities (GDFs) equipped with a Phase II vapor recovery system. This procedure is applicable to underground manifold tanks equipped with pressure/vacuum (P/V) valves, a two point Phase I vapor recovery system, and 4-inch vapor adaptors.

## 2. Principle and Summary of Test Procedure

The pressure of the USTs is determined at the Phase I vapor recovery adaptor (dry break assembly) with a vapor coupler test assembly as shown in Figures 2 and 3 of TP-201.3 (***Determination of 2 Inch WC Static Pressure Performance of Vapor Recovery Systems of Dispensing Facilities***) or dust cap test assembly. The test assembly is equipped with a center probe, which opens the dry break, and a quick connect fitting that is connected to an electronic pressure measuring device or digital manometer. The test assembly should open the dry break without venting the USTs. For the purpose of compliance determination, this shall be conducted at GDFs after commencing operation. This test can be performed while product is being dispensed into motor vehicles.

## 3. Range and Accuracy

3.1 The minimum full scale range for digital manometer shall be 0.00 to 4.00 inches WC. The minimum accuracy shall be ±0.5% full scale at 60 to 78 ºF, and ±1.5% full scale at 32 to 60 ºF and 78 to 104 ºF.

3.2 The temperature measuring device shall have a maximum range of 0 to 150 ºF and shall be accurate to within 2 ºF.

3.3 The stop watch shall have an accuracy of 0.1 seconds.

**4. Biases and Interference's**

4.1 No transfer of gasoline from any cargo tanks to the USTs shall occur within three hours prior to conducting this test.

4.2 Leaking vapor adaptors will not allow test assembly to achieve a leak tight seal.

4.3 This test shall not be conducted if A/L testing was conducted within the last 24 hours.

4.4 GDF's not capable of passing TP-201.3 shall be excluded from this test.

4.5 This test shall not be conducted if TP-201.3 was conducted within the last three hours.

4.6 Improper connection of dust cap or vapor coupler test assembly can result in accidental discharge of vapor due to positive pressure in UST's. Wait ten (10) minutes before retesting.

4.7 Temperature fluctuations during test period can result in erroneous values. All testing must be avoided when temperature differences exceeds 5 ºF.

**5. Equipment**

5.1 The dust cap test assembly shall be modified in the following manner:

5.1.1. Tap, thread, and install a ¾ inch NPT threaded probe in the center of the dust cap (Figure 1). The probe shall be of sufficient length to open approximately ½ inch of the dry break while allowing the cap to maintain a leak tight seal on the adaptor.

5.1.2. Tap, thread and install a ¼ inch NPT female quick connect fitting on the top of the dust cap, offset from the center probe (Figure 1). A Swagelok, part number SS-QC4-B-4-PM, quick connects fitting or equivalent is required.

5.1.3. Use approximately 24 inches of ¼ inch (internal diameter) clear "Tygon tubing" or equivalent to connect the manometer to the dust cap (Figure 2). Install a ¼ inch male quick connect fitting, Swagelok part number SS-QC4-5-400 or equivalent, on one end of

a ferrule stainless steel tube (1/8 inch internal diameter) of approximately 1.5 inches. Connect one end of the "Tygon tubing" to the stainless steel tube and connect the other end to the digital manometer (Figure 2).

5.2 Alternatively, the vapor coupler test assembly, Figures 2 and 3 of TP-201.3 may be used in lieu of the dust cap test assembly.

5.3 Digital Manometer (Electronic Pressure Measuring Device)

Use a 0 - 4.00 inches WC digital manometer to monitor the UST pressure with a minimum sensitivity of 0.01 inches of WC. Dwyer Series 475 Mark III model 475-00-FM (0-4.00 inches WC) Digital manometer or equivalent is required. A copy of the manufacturer's operating instruction shall be kept with the equipment.

5.4 Vacuum Grease or Petroleum Jelly

Use commercially available vacuum grease or petroleum jelly to apply to the dust cap or vapor coupler test assembly gasket to maintain good seal.

5.5 Soap Solution mixture with spray bottle or "Snoop."

5.6 Temperature gauge or thermometer capable of measuring ambient temperature with a resolution of 2 ºF.

5.7 Stop watch with accuracy of 0.1 seconds.

## 6 Calibration Requirements

A copy of the most current calibration shall be kept with the equipment to verify that the calibrations have been done appropriately.

6.1 Digital manometer shall be bench calibrated using a reference pressure measuring device 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. Calibration shall be conducted on a frequency not to exceed 90 days.

6.2 The temperature measurement device shall be checked at an interval not to exceed 180 days using an ice bath, ambient air, and boiling water. The accuracy of the temperature measuring device shall be checked against an NIST traceable temperature measuring device.

## 7 Pre Test Procedures

7.1 Turn on digital manometer and allow instrument to warm up for five minutes.

7.2 Zero out digital manometer using adjustment pod on top of instrument in accordance with manufactures instructions. Drift may be minimized by re-zeroing immediately after use by venting both pressure port to atmosphere and adjusting the knob until the display reads exactly zero.

7.3 Apply thin layer of vacuum grease or petroleum jelly to gasket located under the dust cap or vapor coupler test assembly.

7.4 Attach male quick connect fitting of pressure line to cap.

7.5 Attach digital manometer to open end of Tygon tubing.

7.6 Ensure that the power to the Vaporsaver is on.

## 8 Test Procedure

8.1 Attach the dust cap or vapor coupler test assembly to the vapor adaptor (Figure 2).

8.2 Apply soap solution to the dust cap or vapor coupler test assembly and vapor adaptor and check for visual leaks.

8.3 If no leaks are detected within two minutes after applying soap solution, proceed with monitoring pressure for ten minutes and record on Form 1 the time, pressure, and whether the processor is on.

8.4 Record temperature at the beginning and end of test period on Form 1. This test will be invalid if temperature differential exceeds 5 degrees F.

## 9. Reporting Results

Report pressure data and other information as required in Form 1. District may require the use of alternate forms, provided they include the same minimum parameters as identified in Form 1.

## 10. Alternate 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 CP-201.

**Figure 1: Typical Modified Vapor Adaptor Dust Cap (Bottom View)**

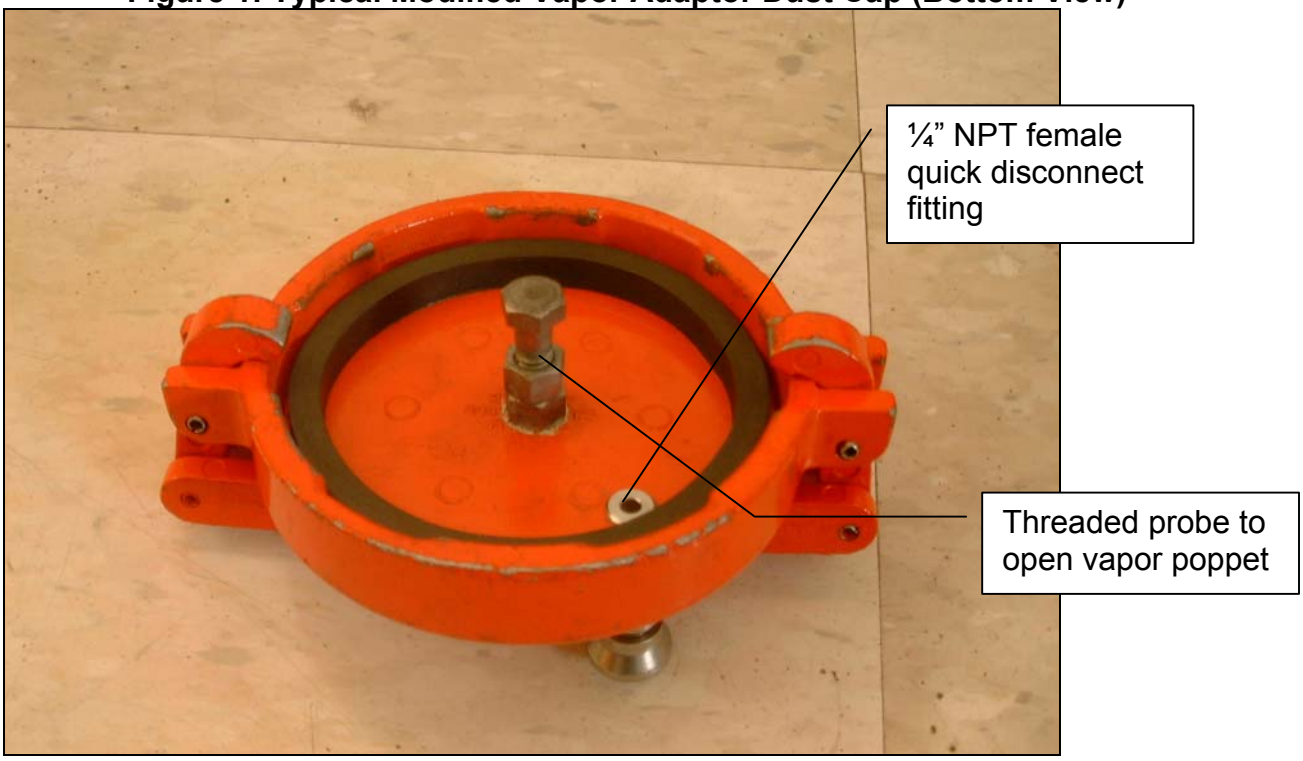


**Figure 2: Typical Field Installation of UST Pressure Measurement Assembly**

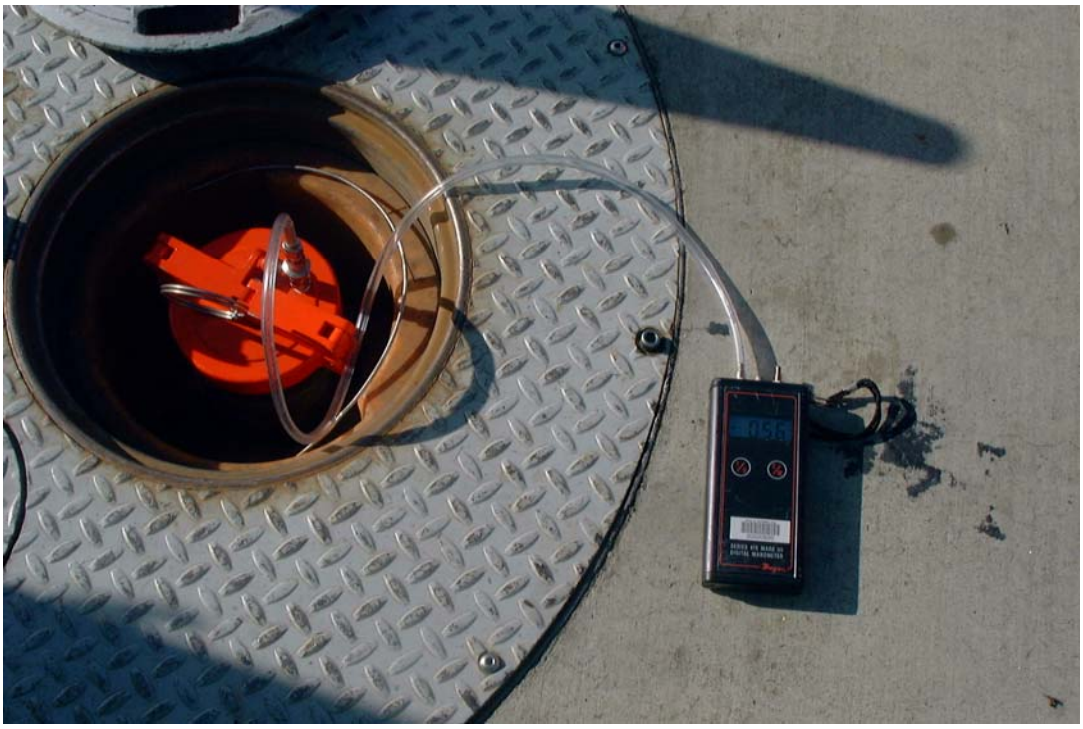

**Exhibit 4 Form 1**
**Data Sheet for Determination of Pressure In Underground Gasoline Storage Tanks**

| | | | |
|---|---|---|---|
| Facility Name: | | Test Time: | Test Date: |
| Address: | | | |
| City: | | | |
| Testing Company : | | Testing Company Address | |
| Person Conducting Test: | | Testing Company Phone Number | |
| Initial Ambient Temperature [ºF]: | | Final Ambient Temperature [ºF]: | |

**Observed Underground Storage Tank Pressure**

| Time | Pressure (In $H_2O$) | Processor On? | Time | Pressure (In $H_2O$) | Processor On? |
|---|---|---|---|---|---|
| | | | | | |
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Comments:

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**

**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) 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

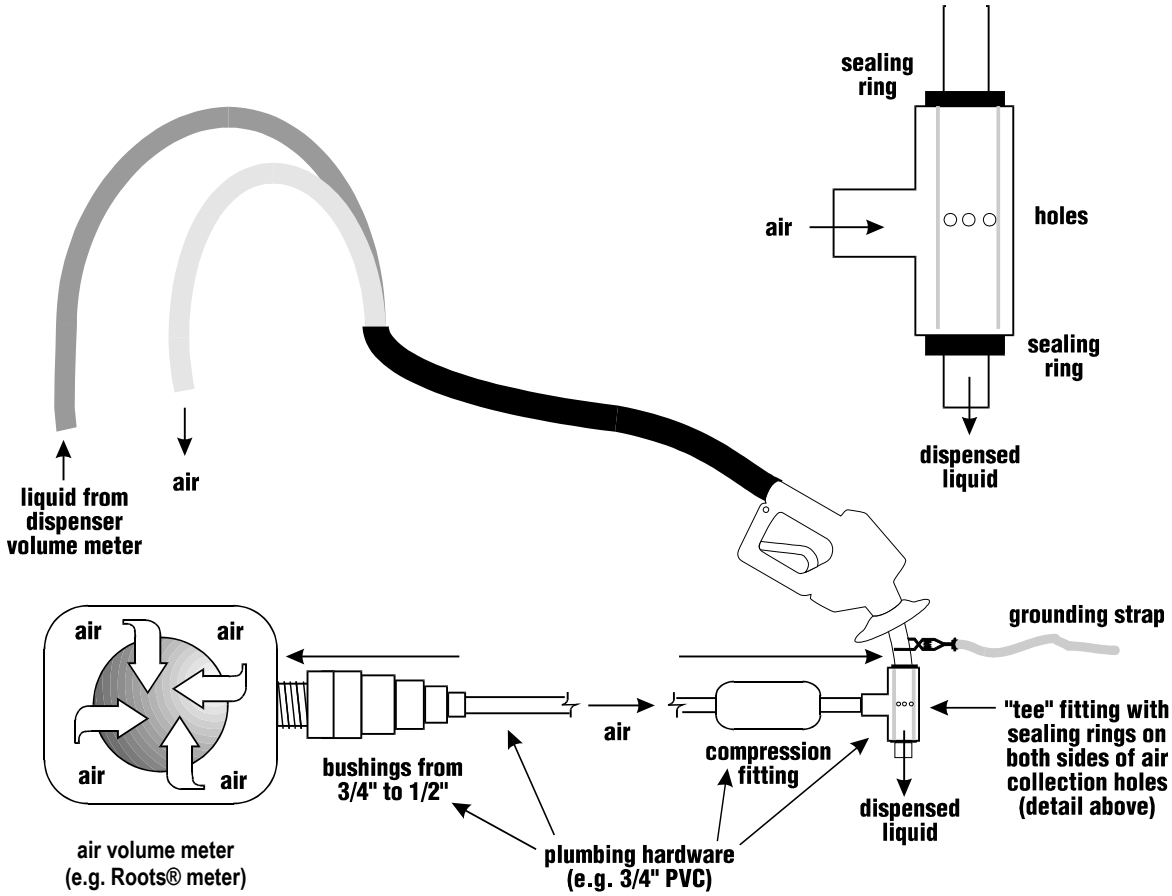
Each figure provides an illustration of an implementation that conforms to the requirements of this test procedure; other implementations that so conform are acceptable, too. Any specifications or dimensions provided in the figures are for example only, unless such specifications or dimensions are provided 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**

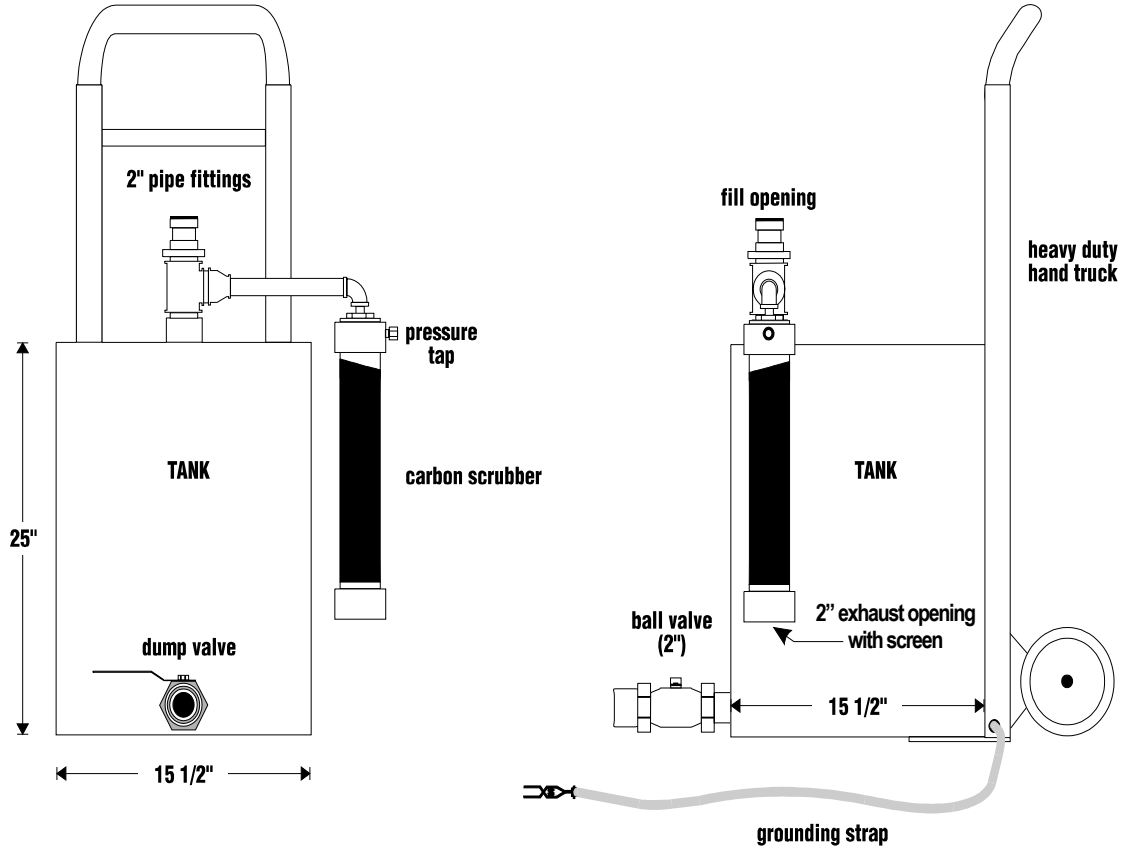
# FIGURE 1

## A/L Test Equipment for Bootless Nozzles




TP 201.5 F.1/ B. CORDOVA '95

# 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.