California Environmental Protection Agency

Air Resources Board

ARB Approved

Installation, Operation and Maintenance Manual

For the ARID Permeator System

Approved: October 05, 2006

NOTICE:

The **ARB Approved Installation, Operation and Maintenance Manual for the ARID Permeator System** describes the tools and methods required to install the ARID Permeator System. Unless specified otherwise, only technicians that are trained and certified by ARID Technologies, Inc. (i.e. ARID Certified Permeator Technicians) are able to perform installation, maintenance or repairs of components manufactured by ARID Technologies, Inc. or the warranty will be void. A list of ARID Technologies Certified Permeator Technicians (CPT) can be obtained by contacting ARID at the following:

ARID Technologies, Inc.
323 S. Hale Street
Wheaton, IL 60187
Phone: 630-681-8500
Fax: 630-681-8505
Email: sales@aridtech.com

It is the responsibility of each ARID Technologies CPT to be familiar with the current requirements of state, federal and local codes for installation and repair of gasoline dispensing equipment. It is also the responsibility of the ARID Technologies CPT to be aware of all necessary safety precautions and site safety requirements to assure a safe and trouble free installation.

Summary of Maintenance Activities Required of the ARID Permeator System[1]

Component	Interval	Maintenance Required To Be Performed
Permeator AT-150	5000 hours	Drain and Replace Oil in Vacuum Pump

[1] **These maintenance requirements shall not circumvent use of the manufacturer's installation and maintenance instructions. Maintenance contractors or owner/operators shall refer to the manufacturers complete installation and maintenance instructions found herein to ensure that all maintenance and torque requirements are met.**

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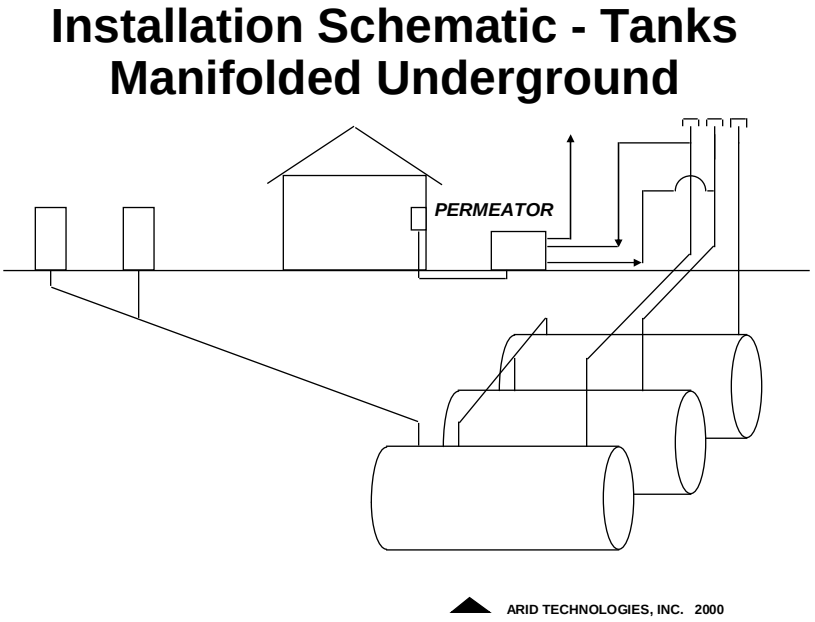
Permeator Main Cabinet

Introduction

The PERMEATOR System is a membrane based vapor recovery system which is installed on manifold storage tank vent lines to reduce evaporative losses from refueling and transfer operations, as well as atmospheric pressure variations (Figure 1). The PERMEATOR separates hydrocarbon vapors from air; exhausts the cleaned air to atmosphere and returns the enriched hydrocarbon vapors to the storage tank headspace. This process minimizes evaporative losses and the subsequent harmful emissions of ozone precursors to the environment. By using the rich vapors to “blanket” the storage tank liquid, the fundamental mechanism of evaporation loss is minimized.

See Exhibit 6 of ARB Executive Order G-70-209 for warranty information on the PERMEATOR.

FIGURE 1



In addition to reducing evaporative losses in the interval between tanker deliveries at each site, the PERMEATOR also reduces losses during Phase (Stage) I cargo tanker deliveries and losses caused by atmospheric pressure variations.

System Components

The primary components included with the PERMEATOR system are as follows:

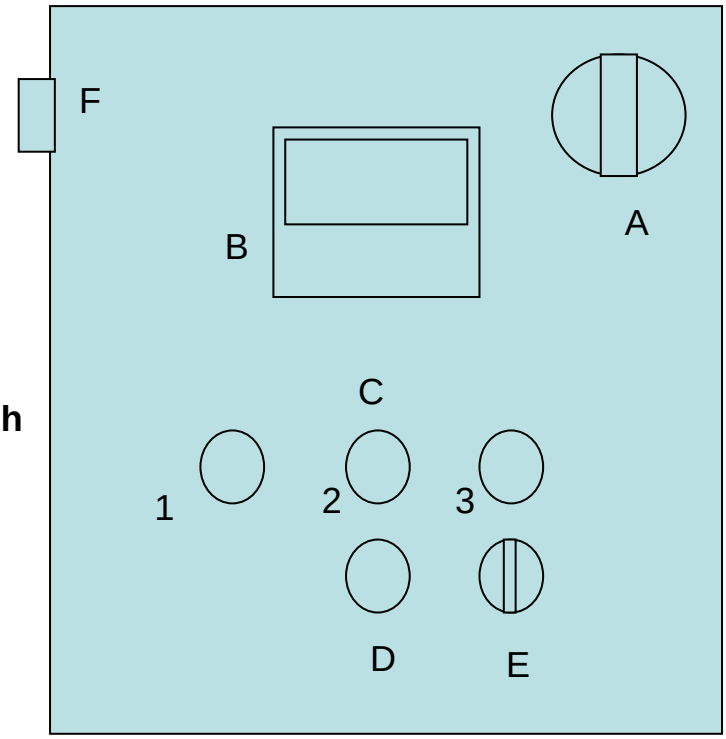
AT-150 Control Panel

The function of the control panel is to monitor storage tank pressure continuously and to actuate the PERMEATOR in response to increased pressures. The control panel houses a programmable logic controller (PLC) which displays measured tank pressure (inches H_2O), an hour meter (to log cumulative run time of the unit), a main power switch, a manual/automatic operation switch and indicator lights to provide on-going diagnostics of system operation (Figure 2). The indicator lights are used to show control voltage, vacuum pump oil level fault, and vacuum pump ON, respectively from left to right. The switch, E has three settings; manual operation, off and automatic operation (left, center and right positions, respectively).

FIGURE 2

KEY

A Main Power Switch
B Controller (PLC)
C Indicator Lights
1 Main Power
2 Oil Alarm
3 Vac Pump ON
D Oil Alarm Silence
E Manual/Off/Auto Switch
F Horn (Low Oil Alarm)

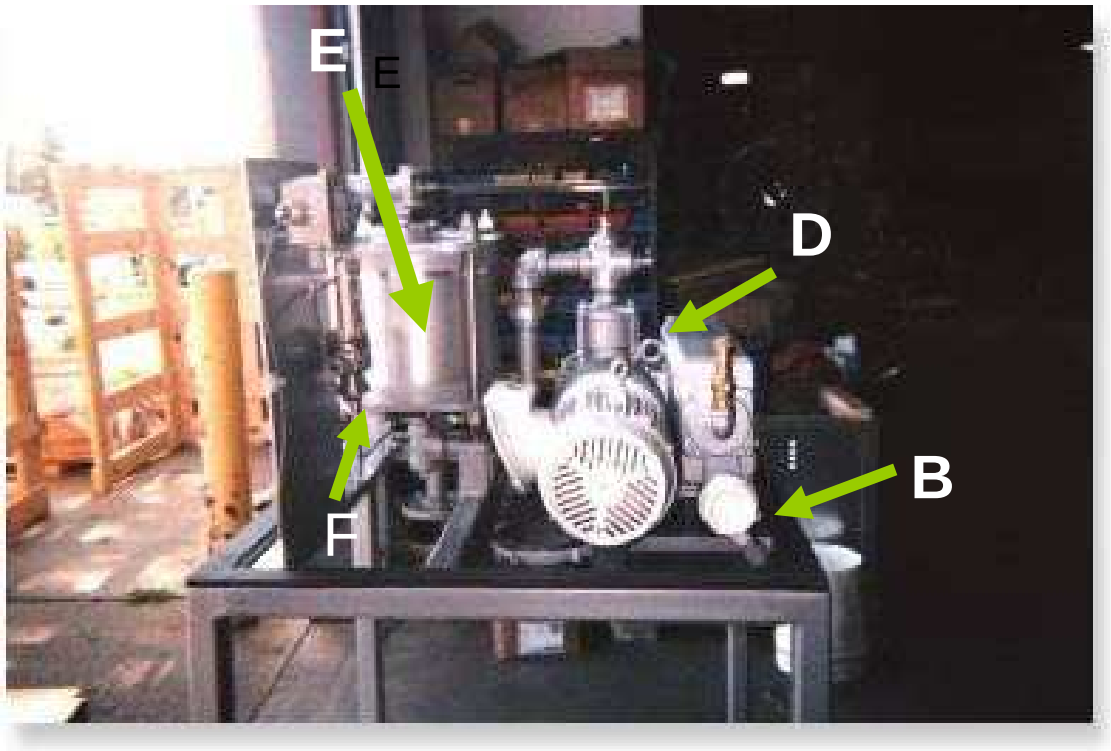


Optional features of the AT-150 Control panel include data logging, modem access and downloading capability to local or remotely located computers.

Membrane Module

The membrane module (Item E, Figure 3) houses the selectively permeable membranes used to separate hydrocarbon vapors from air. The module is a cylindrical structure containing baffle plates to ensure good contact between hydrocarbon vapors and the membrane material.

FIGURE 3
(Cover Removed from Unit)



Vacuum Pump

The vacuum pump (Item D, Figure 3) removes hydrocarbons which have passed through or permeated the membrane to ensure a constant driving force for continuous separation. The vacuum pump uses a rotary vane, shock-resistant design, and integral flame arrestors on inlet and discharge and anti-static materials to prevent static discharge. The pump is housed in the main cabinet as seen above.

Pressure Sensor/Transmitter

The pressure sensor/transmitter (Item F, Figure 3) is used to continuously monitor the ullage pressure in the gasoline storage tanks. The pressure information is sent to the PLC located in the control panel. Based on pressure actuation set-points, the vacuum pump is started and stopped.

Oil Level Sensor

The oil level sensor (Item B, Figure 3) is continuously monitors oil level in the vacuum pump. If the oil level falls below a minimum threshold value, a light is illuminated on the panel to indicate a fault, the horn sounds and the power to the vacuum pump motor is interrupted until the oil level is brought back up. The oil level horn alarm is silenced by pushing the alarm silence button on the front of the control panel.

Main Cabinet

The main cabinet houses all components except the electrical control panel, which is mounted in a zone free area. The electrical components in the main cabinet are rated for operation in hazardous locations Class I, Groups C & D (UL, TUV, PTB and BASEEFA approvals). The main cabinet dimensions are: Width: 3 ft., Depth: 3 ft., Height: 5 ft and the weight is approximately 750 pounds, uncrated.

Other items required for operation of the PERMEATOR include the following:

Pressure/Vacuum Vent Valve (P/V Valves)

P/V Valves are installed on the manifold storage tank vent lines. These valves are designed to prevent high vacuum or high pressure conditions in the storage tanks and to increase the recovery efficiency of Phase (Stage) I transfer operations. Pressure settings are +3.0 inches water column (407” water equals 1 atmosphere) pressure threshold and -8.0 inches water column vacuum threshold. See Exhibit 1 of the Phase (Stage) II WayneVac/Permeator Executive Order G-70-209 for P/V Valve listing.

Mounting Stand

The mounting stand is required to place the PERMEATOR at grade. A suitable concrete support pad is poured and cured and the stand is secured to this pad with bolts. This stand is included with the PERMEATOR and does not have to be supplied by the installation contractor.

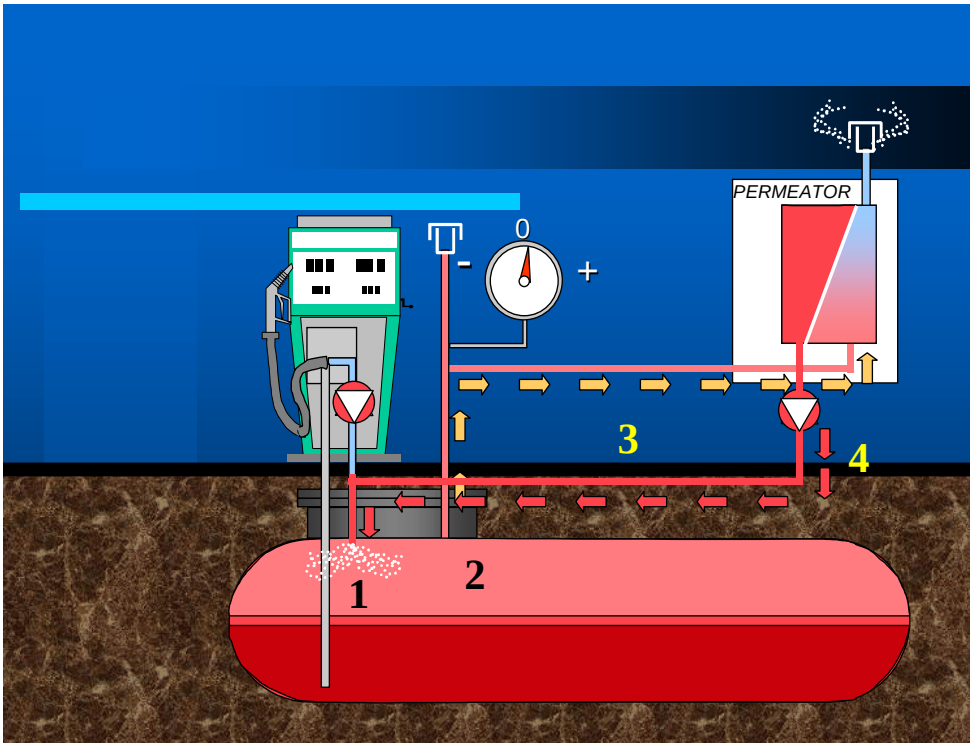
Phase (Stage) I and Phase (Stage) II Components

For incorporation of the PERMEATOR into an integrated vehicle vapor recovery and storage tank pressure management system, additional items are required for the “front-end” vapor recovery system. These components, typically referred to as “hanging hardware”, such as nozzles, vacuum pumps, hoses, and breakaways are listed in Exhibit 1 of the Phase (Stage) II WayneVac/Permeator Executive Order G-70-209. No special piping, valve or flow restriction/control modifications are required on any part of the system. The Phase (Stage) 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.

System Operation (Figure 4)

1. Air and hydrocarbon vapors fill the space left in the underground storage tank(s) when liquid gasoline is transferred to an automobile.
2. The pressure in the storage tank headspace increases as liquid gasoline in the storage tank evaporates to increase the hydrocarbon concentration in the headspace. The control panel logic monitors a pressure switch connected to the ullage to actuate the PERMEATOR system when this pressure reaches +0.30” ± 0.06” wc.
3. The air/hydrocarbon mixture expelled from the storage tank vent line is directed to a membrane module where a vacuum pump creates a differential pressure that causes the hydrocarbon molecules to preferentially permeate, or pass through, the membrane.
4. The hydrocarbon-rich permeate stream is returned to the storage tank while the air-rich non-permeate stream is vented to the atmosphere.
5. After twenty (20) minutes of runtime, the PERMEATOR control panel logic then monitors the pressure switch. If the pressure has decreased to less than +0.20” ± 0.06” wc, the pressure switch automatically deactivates the PERMEATOR system. If the pressure has not decreased to less than +0.20” ± 0.06” wc, the system will continue to operate until this condition has been met. There is no duty cycle for the PERMEATOR.
6. The above sequence repeats continuously.

FIGURE 4



System Applications

The PERMEATOR system is designed to accommodate a wide range of refueling station throughputs. See Exhibit 2 of Executive Order G-70-209 for limitations on the number of fueling points.

The Permeator System includes the following hardware:

Main cabinet housing membrane module, vacuum pump, pressure sensor/transmitter, oil level sensor, vacuum sensor/transmitter and interconnection piping. The flanged connections provided are DN50 or 2” on each of the three connection points for Feed, Exhaust and Return lines.

Electrical control cabinet including PLC, cumulative run time meter, main power switch, manual/auto/off switch and indicator lights.

Optional equipment:

Upgrade kit for data logging of critical parameters such as tank pressure, run time readings and to allow electrical control panel to communicate with computers.

Component Selection and Location

The AT-150 Control Panel operates and monitors the PERMEATOR system operation. Any anomalies of system operation will cause indicator lights to signal station operating personnel that something is wrong. The panel is factory wired and assembled. Field wiring tasks include connecting 3 phase power from the site (L1, L2, L3 and Ground) and sensor input wires from the pressure and vacuum sensors/transmitters and the oil level sensor. The electrical panel is designed for use in a ZONE FREE area, mounted indoors. The electrical panel is typically mounted within the station kiosk adjacent to existing electrical panels and switching gear.

The panel should be mounted so that the panel meter is vertical (Figure 2). Prior to connecting site power to the unit, sensor input wires should be connected in accordance with detailed instructions provided within the electrical panel ("Quick Start Guide" found in the Appendix). Also, once these connections are made, a current loop test must be carried out and correctly verified before attaching main power supply leads and switching main power switch on.

Mounting of the PERMEATOR is quickly and easily accomplished at or slightly above grade. First, a suitable concrete support pad is poured and cured. This pad should be level, because the oil level sensor will not function properly if the pad is not flat and level. Next, the PERMEATOR mounting stand is attached to the concrete pad with appropriate sized bolts and the use of a small hoist. Once secured in place, the aluminum lid is removed and the piping and electrical conduits and connections can be made. Since the main cabinet is rated for service in Class I, Division 1, Group C & D hazardous environments, the unit can be located in relatively close proximity to the manifold vent line(s) to avoid long piping runs. After all piping and wiring connections are complete; the PERMEATOR aluminum lid can be attached and fastened in place. The doors are equipped with a lock and key. Site personnel should be aware of the storage spot for the key.

Typically, a protective barrier (bollards) or fence is constructed to keep the PERMEATOR out of view and to discourage vandalism. Contractors should check with local Fire and Safety authorities prior to installation to ensure that the location chosen meets all applicable Fire Marshal codes and regulations.

Piping Layout and Installation

The PERMEATOR system requires three piping connections; one for feed flow from the storage tank vapor space to the membrane module, a second connection for returning rich vapors from the permeate side of the membrane to the vapor space of one of the low grade tanks, and a third connection for venting air discharged from the retentate (exhaust) side of the membrane to atmosphere. The PERMEATOR can be connected to existing piping configurations in various ways.

Installation is easily accomplished in accordance with Figure 5. Other variations are possible. Field experience shows that elevating the PERMEATOR approximately 3 feet above grade provides adequate slope in the interconnection piping to avoid liquid accumulation in either the feed or permeate lines. The pipe sizes used should be the same size as existing vent piping – typically 2" nominal ID for US installations. All three piping ports on PERMEATOR are equipped with flanges to ease field connections.

FIGURE 5

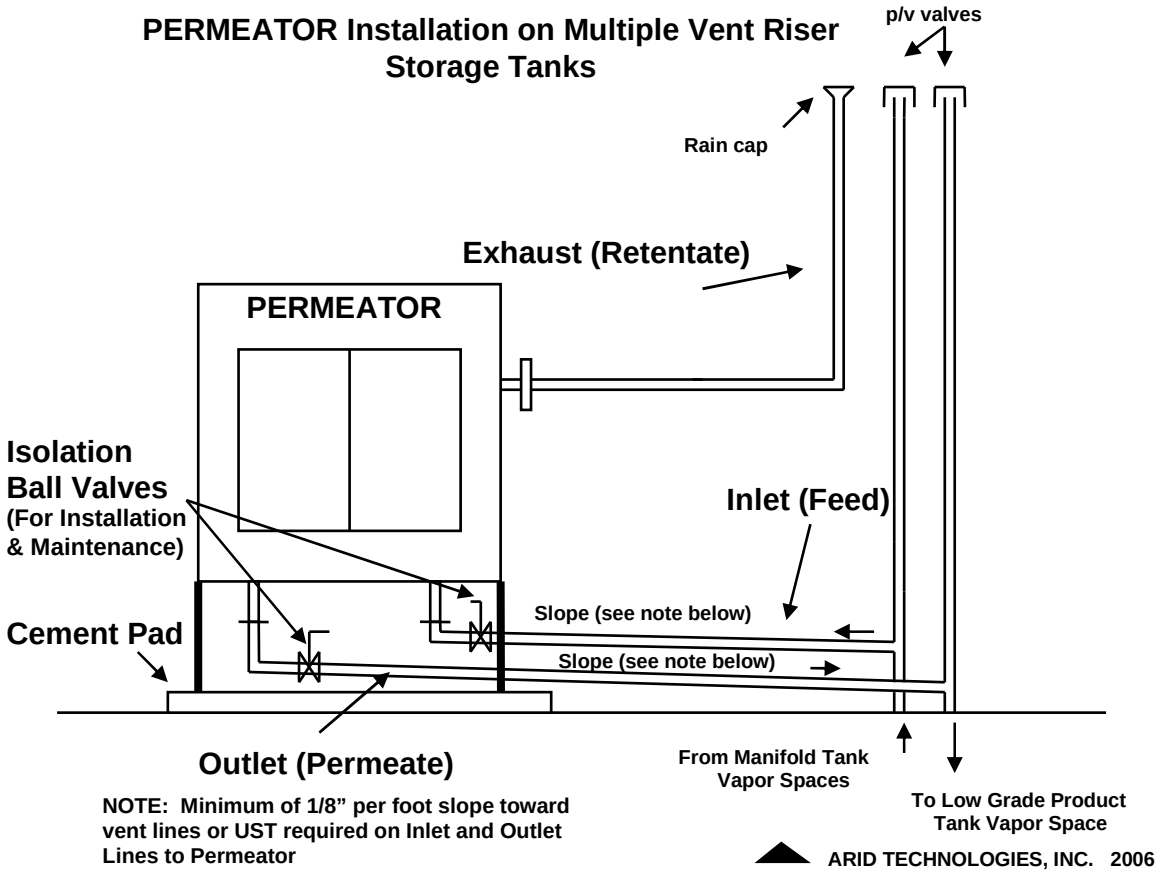


Figure 5 shows a schematic of a typical installation. In Figure 5, the PERMEATOR system is located on a stand slightly above grade and installed at a site having storage tanks which have vent lines which are manifold. This integration allows the PERMEATOR Feed and Return piping to be connected to above ground lines, with no excavation required at the site.

The piping diameter and wall thickness for all three connections; Feed, Permeate return and Retentate exhaust should be at least the same specification of the existing vent piping employed above grade at the site (corrosion resistant steel). The minimum diameter for the connections shall be 1.5". The piping contractor should ensure that pipe threads are clean cut and coated with UL listed pipe joint sealing compound and tightened to the appropriate torque to eliminate chance of leakage. The typical piping diameter for these lines is 2". If installed on a single (3" OD) vent line station configuration, 2" nominal ID piping and reducing couplings may be used as long as the vertical portion of the vent line is no smaller than 3". The PERMEATOR unit is factory supplied with DN50 (2") flanges for connection to the three conduits. All piping should be sloped back towards the tank at a minimum of 1/8 inch per foot of pipe run. After the piping is installed, the system should undergo the ARB leak decay test, TP-201.3 to ensure that there are no leaks (see **Pressure Integrity Testing** section below). For details of the 2 inch pressure decay testing using nitrogen gas, please contact ARID.

Installation of the AT-150 Control Panel

The PERMEATOR comes complete with a separate electrical control panel. This panel must be located in a zone free area and includes an hour meter to register cumulative running time of the unit and a pressure indicator/controller. The panel also contains a main power On/Off switch, and a power supply for the pressure, vacuum and oil level sensors. Also, a galvanic isolation barrier is used to ensure that no ignition sources can be passed from the control panel to the main PERMEATOR skid, located in the hazardous area. The vacuum pump is equipped with a 2.0 HP motor that operates on 208V/3-phase/60 Hz power. The system requires a 20 Amp service rating on the circuit breaker and connecting wiring used at the site. Motor wiring is typically 12 or 14 gauge, depending on run length, local codes and electrician recommendation. The 24vdc signal cables should be 18 gauge wires, depending on run length, local codes and electrician recommendations.

The detailed installation manual found in the electrical control box provides a wiring diagram and instructions for qualified electricians to connect the power supply to the electrical panel. The manual also provides further instructions for completing the control loop and power output wiring from the panel to the junction box housed within the PERMEATOR cabinet.

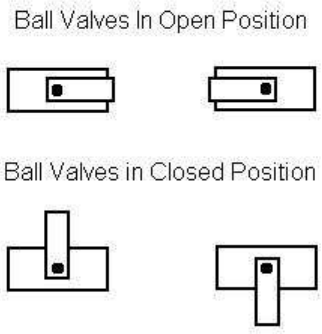
The panel should be located in a Zone Free, non-hazardous area located indoors. This area should also be easily accessible to technicians and site operating personnel. The panel is pre-wired at the factory and field tasks include only the connection of 3-phase power from the site and sensor and control inputs from components housed within the Main cabinet and previously connected to the junction box located within the Main cabinet.

Commissioning and Start-up of the PERMEATOR on site

Ball Valves on Inlet and Outlet Lines

Locking-type ball valves must be installed on the Inlet and Outlet lines to the PERMEATOR. These ball valves must be locked in the OPEN position during normal operation. Figure 6 shows the difference between an OPEN and CLOSED ball valve.

Figure 6



Pressure Integrity Testing

For installation of the PERMEATOR, the pressure integrity of the entire closed vapor space should be tested in accordance with ARB TP-201.3 or PEI (Petroleum Equipment Institute) RP/300. If the system does not pass the leak decay threshold, sources of leaks must be identified and sealed and the test repeated until passed. Vapor leaks will negatively impact the vapor recovery efficiency of the PERMEATOR.

NOTE: The PERMEATOR must be switched to the “off” position to conduct TP-201.3. This can be done at the control panel. See Exhibit 3 of G-70-209 for guidance.

For installation of the PERMEATOR at sites equipped with Phase (Stage) II systems, the “front-end” vehicle vapor recovery system piping should be checked with ARB test procedure TP-201.4 (Back Pressure Test). Ideally, this test is conducted before the vapor piping is covered by backfill at newly constructed sites. Once this test has been successfully completed, the piping can be permanently located.

Air to Liquid (A/L) Test

This test measures the volume of vapors returned to the storage tank in relation to the volume of liquid dispensed to the vehicle. This ratio provides a measure to ensure proper system collection efficiency at the nozzle fill pipe interface. Some people refer to this test as the A/L test. The A/L test should be carried out in accordance to Exhibit 5 of Executive Order G-70-209. The A/L ratio measured should fall within the range specified in Exhibit 2 of Executive Order G-70-209.

NOTE: It is not necessary to turn off the PERMEATOR while conducting A/L testing.

Pressure Control Set Points

Configuration of the High and Low Pressure Set-points is done at the Factory.

In automatic control mode, the vacuum pump is actuated when the upper control limit (P hi) is reached by the measured variable – the underground storage tank pressure. On the PLC (B, Figure 2), the Motor status box on the lower right side will indicate ON. At the same time, the minimum run relay timer will ensure operation for at least the factory pre-set minimum run time (20 minutes). If the tank pressure is reduced to the Lower Control Limit (P lo) before the minimum run time period has elapsed, the vacuum pump will continue to operate. At any time after this 20 minute interval, when the storage tank pressure reaches the low pressure set point, the vacuum pump will shut off. The vacuum pump will remain off until the underground storage tank pressure again increases to the P hi, and the above cycle will be repeated.

Vacuum Pump Motor Rotation

Having made the appropriate tests and connections, it is very important to test the direction of the rotation of the vacuum pump. This is done by quickly switching the unit on and off (E, Figure 2) and observing the rotation of the vacuum pump motor. If the motor is spinning in the direction indicated by the arrow on the housing of the vacuum pump --clockwise, everything is fine. If the direction is opposite the arrow, it must be changed immediately to avoid damaging the vacuum pump. The direction is changed by switching two of the leads within the L1, L2, L3 power strip in the electrical control cabinet or switching two wires within the electrical junction box mounted to the motor housing in the main cabinet. A quick means of determining proper rotation is to place a piece of paper in close proximity to the vacuum pump cooling fan cage. If the paper is sucked into the fan cage, the motor rotation is correct.

PERMEATOR System Details

Piping

Piping should incorporate minimum of 1.5” diameter corrosion resistant steel for all vapor carrying conduits. For installations at grade or slightly above ground level, please ensure that the PERMEATOR connections are made in accordance with manifold or non-manifold storage tanks. Please note that a Certified PERMEATOR Technician (CPT) should be present during installation to ensure proper practices are being carried out (feed and return lines properly identified, manifold vents, isolation ball valves and P/V valve installation). Before operating the system in unattended mode and initiating start-up of the unit, a CPT should ensure that the PERMEATOR connections are properly made for Feed, Return and Exhaust lines and that the unit and piping are adequately mounted and secured in place. The isolation ball valves must be opened to allow feed flow to the unit and permeate return flow from the unit (The vapor carrying piping should meet minimum slope requirements). The station vent piping should be leak tight and use at least one P/V valve listed in Exhibit 1 of G-70-209.

TP-201.4 back pressure and TP-201.3 pressure decay test results should conform to acceptable standards published by ARB.

NOTE: The PERMEATOR must be switched to the “off” position to conduct TP-201.3. This can be done at the control panel. See Exhibit 3 of G-70-209 for guidance.

Vehicle Vapor Recovery System – Phase (Stage) II System

For PERMEATOR installations, the front-end vapor recovery hanging hardware is supplied and tested by others. Exhibit 1 of ARB Executive Order G-70-209 contains the list of the approved components that can be installed to complete the Phase (Stage) II system.

Electrical Control Panel

The electrical control panel should be checked for proper wiring, accessibility and indoor location. Explosion proof conduit, junction boxes and seals should be used within the classified area.

System should be cycled between P hi and P lo to ensure proper operation. Run time meter should be referenced with detailed pressure vs. time data to verify proper system response.

Instructions to Site Operating Personnel

Station employees should receive instructions on checking panel PLC, run time meter and indicator lights. They should be able to interpret the diagnostics and reference a Frequently Asked Questions sheet which explains the impact of the

system diagnostics. If the unit is stopped and cannot be restarted by following prescribed instructions, the station personnel should be instructed to call ARID or a CPT for technical support. The station personnel should also know how to use the main power interrupt feature on the electrical control panel as well. Station management should also be instructed to relay proper filling procedures to tanker truck drivers. By following proper procedures, the pressure integrity of the station vapor connections will be maintained. A copy of this manual should be kept on file at the station site.

Checklist for Site Operating Personnel

- Verify that the ball valves on the inlet and outlet lines of the PERMEATOR are in the correct position – See Page 16 of this manual for guidance.
- Open the PERMEATOR unit cabinet (A key is needed to first unlock the cabinet).
- Visually look for any accumulated oil in the oil spill pan.
- Physically inspect fittings to ensure that they are more than hand-tight.
- Sniff (or use a HC sensor) for presence of hydrocarbon vapors from the piping to ensure leak tightness.
- Listen and feel for any noises or vibrations that may indicate vacuum pump motor bearings may be worn.
- Close cabinet and lock the doors.
- Visually inspect p/v valve(s) and the rain cap on the PERMEATOR clean air exhaust. Ensure no obstructions. Look or smell for presence of vapors exiting the p/v valve or clean air exhaust of the PERMEATOR.
- Locate the electrical control panel installed inside the station (Typically located near the electrical submersible turbine pump controls located in the back room of the station).
- Ensure that the white “Power ON” light is illuminated.
- Note the cumulative run time of the PERMEATOR unit. This time is expressed in hours, and is located in the lower right hand corner of the illuminated display screen.
- Compare the present run time with the run-time recorded on a previous visit.
- Note the current tank pressure as indicated on the PLC display screen.
- Compare the current pressure to the P hi setting on the plc display screen. If the current pressure is greater than the P hi setting, ensure that the PERMEATOR is “ON”.
- The PERMEATOR “ON” is indicated by the light green vacuum pump “ON” light illuminating.

Maintenance

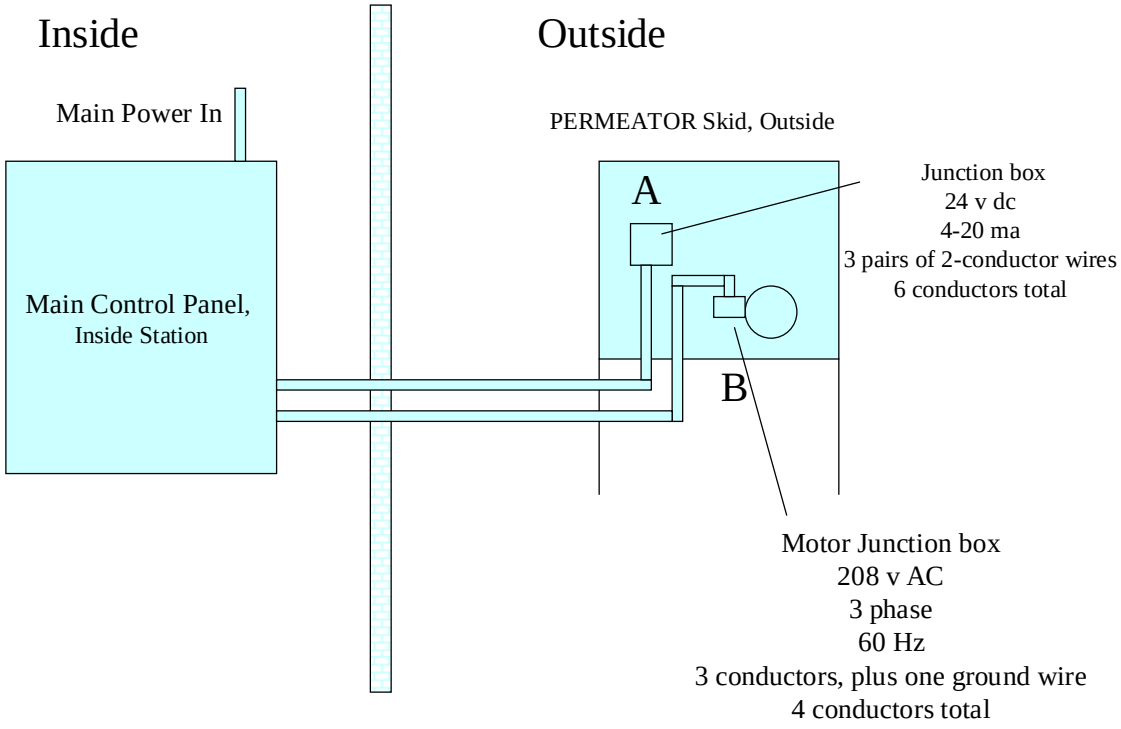
Oil Replacement

Drain and replace the oil in the vacuum pump every 5000 hours of PERMEATOR operation.

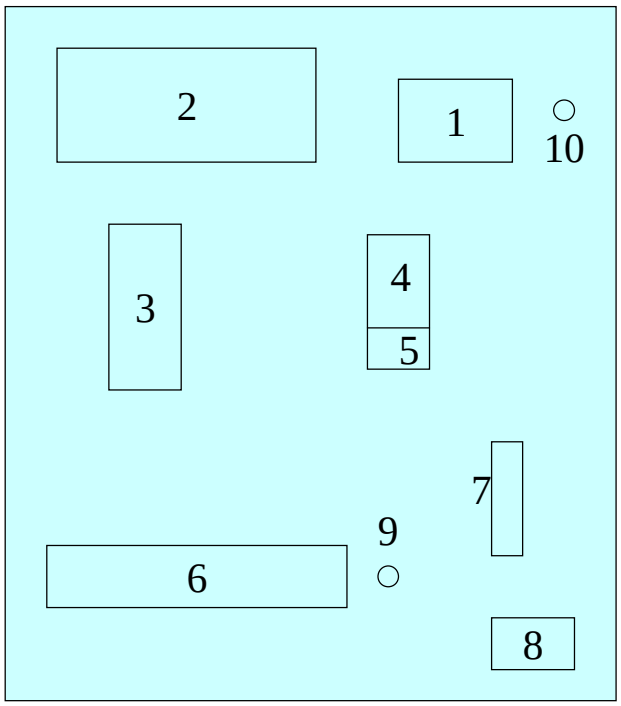
Notes Page

Appendix

Overall Installation Schematic

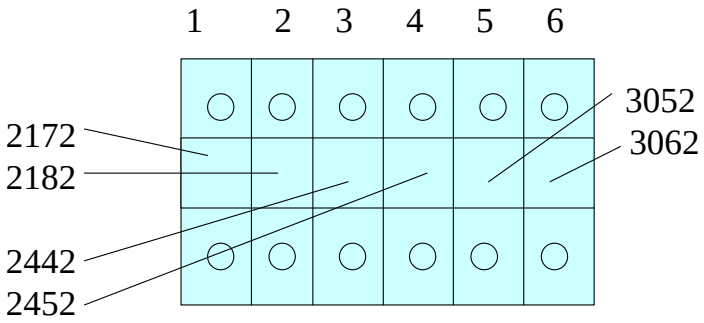


Control Panel: Main Component Outline



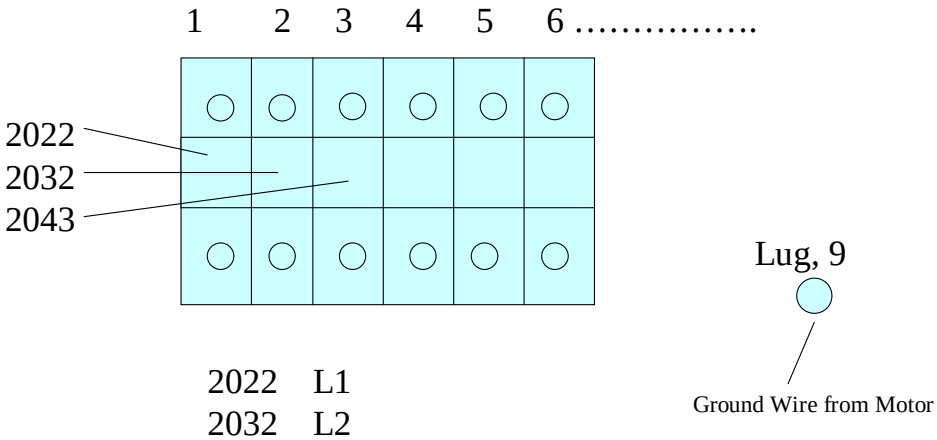
1 Main Power Switch
2 Fuse Blocks
3 Power Supply
4 Motor Relay
5 Motor Overcurrent Proctection
6 Terminal Strip (Motor)
7 Galvanic Isolation Barrier
8 Terminal Strip (Signals)
9 Ground Lug, Motor
10 Ground Lug, Main Power

Close-up View of 8, Terminal Strip (Signals)



2172	Oil Level	(+)	3052 Red P vac
2182	Oil Level	(-)	3062 Black P vac
2442	P tank	(+)	
2452	P tank	(-)	

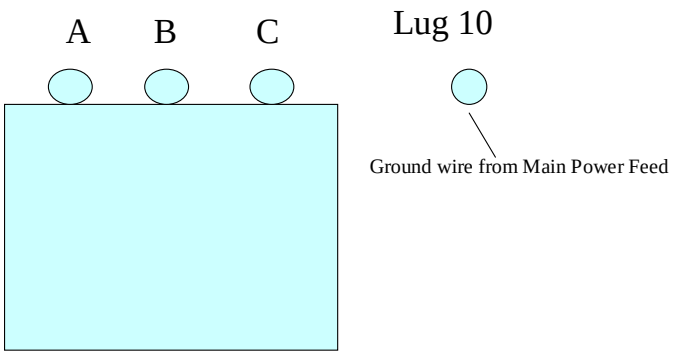
Close-up View of 6, Terminal Strip (Motor)



2022	L1
2032	L2
2043	L3

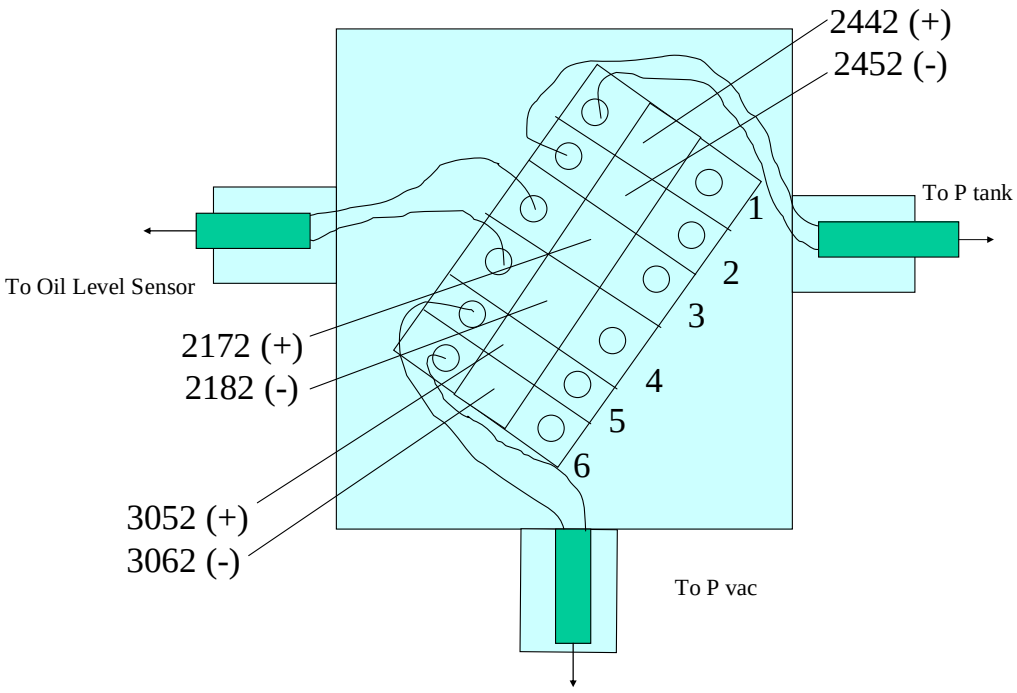
Note: If motor rotation on vacuum pump is not clockwise (in the direction of arrow on pump cooling fan), then switch any two of the L1, L2, L3 leads to reverse rotation.

Close-up View of 1, Main Power Switch



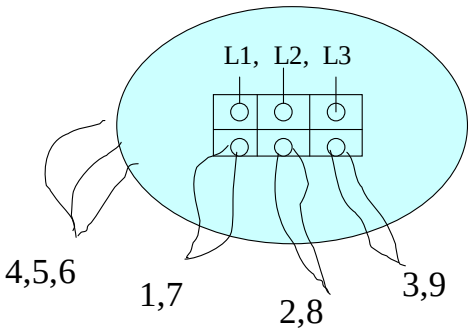
A Main Power Inlet
B Main Power Inlet
C Main Power Inlet
208v, 3 phase, 60 Hz

Junction Box A in PERMEATOR Main Skid



Motor Junction in PERMEATOR Main Skid

NEMA; Dual Voltage, WYE-Connection – 9 leads

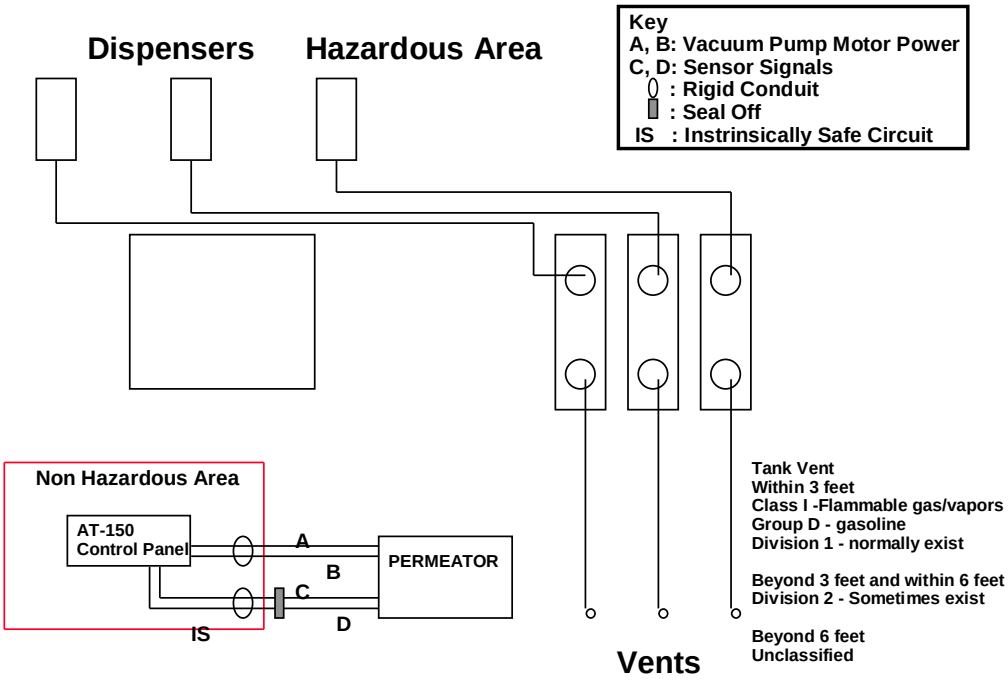


PERMEATOR Installation

- Mounting of PERMEATOR with four (4) lugs into cement slab.
- PERMEATOR must be perfectly level (Oil level limit switch).
- ¾ inch conduit for power wires (208 v, 3 phase, 60 Hz).
- 1 inch conduit for communication wires (24 v dc).
- P/V valves are 2 inch NPT threads – vent pipes should be threaded accordingly.
- After all piping and electrical conduit connections are made; a pressure decay test must be conducted before start-up and commissioning of PERMEATOR. Pressure decay test uses nitrogen gas and starting pressure of 2 inches H2O gauge (Reference ARB procedure TP-201.3).
- If data logging option is chosen, located phone jack in close proximity to control panel.

Electrical Details

Figue 1: PERMEATOR AT-150 Wiring Diagram



Troubleshooting

Controller and Software:

Vision 120: Latest version via internet (Sept 2003): V3.3.1

For contacting the controllers and downloading program changes via computer, CPT must use the above versions of the software for all units shipped as of September 2003. The updated versions of the software can be used to communicate with earlier versions. However, the older versions of the software cannot be used to communicate with the new versions.

Oil Level Limit Switch and Alarm:

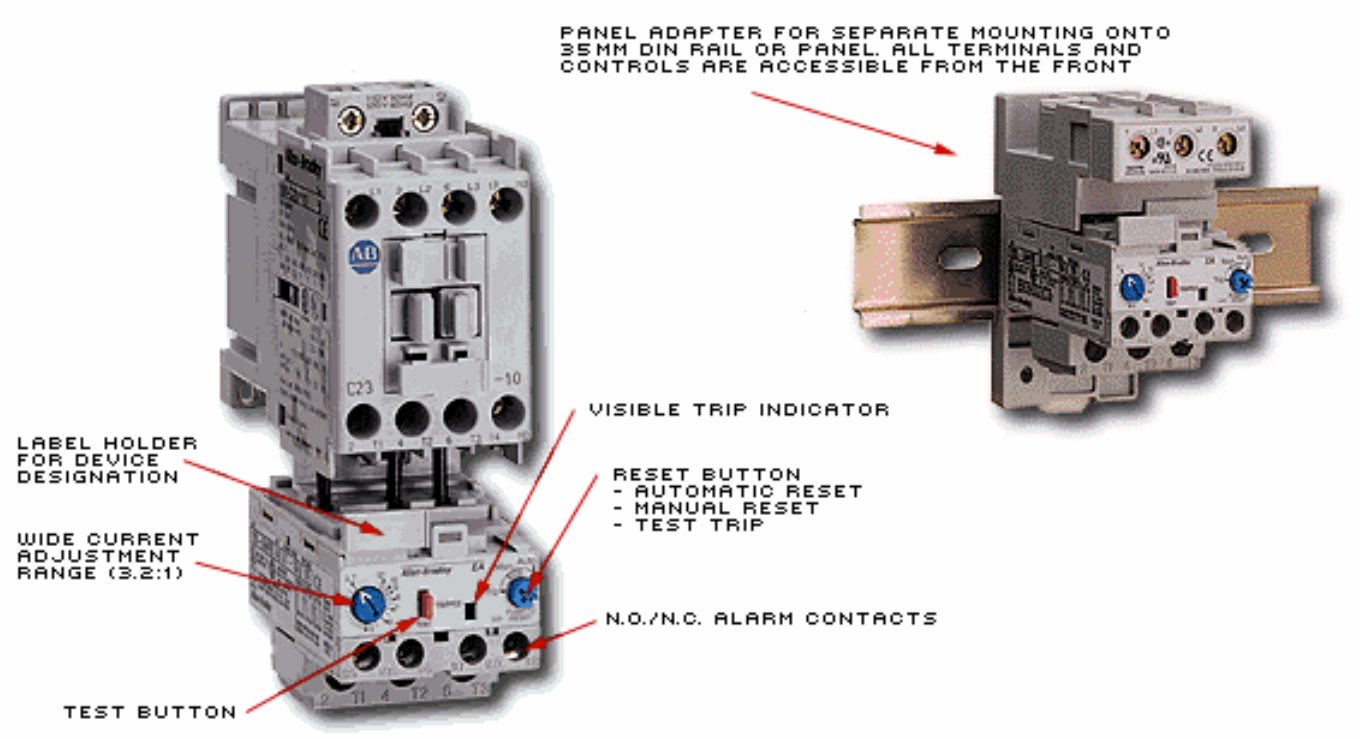
1. Ensure that oil is added until a small amount of oil just begins to overflow from the port 5B located on the exhaust box. Please reference the attached drawing of the vacuum pump exhaust box. Add oil from port 5, located on the top of the vacuum pump exhaust box.
2. If alarm persists after oil is added, change the setting of the MIN/MAX limit switch located within the Oil Level Sensor (This switch is found by unscrewing the white cap on the oil level sensor). After changing the setting, did the oil level alarm light go off? If yes, use the new setting. If no, oil level sensor or field wiring is faulty.
3. To ensure that P tank and Oil Level sensor wires are not interchanged, please verify that oil level sensor wires (2 lead wires) are connected to the proper terminals. Please reference the attached diagram as well as the detailed schematic of the main control panel wiring. Please be sure to observe proper polarity by connecting (+) to (+) and (-) to (-).
4. To ensure that the signal is carried properly by the wires from the sensor located outside to the main control panel mounted inside the station, please carry-out an electrical continuity check. If continuity is established, the integrity of the signal cable is verified. If electrical continuity is not established, then the cable which connects the PERMEATOR to the main control panel should be replaced or repaired.
5. If oil is added to suitable level, and if MIN/MAX switch does not change state of oil level alarm, and if P tank and Oil Level sensor wires are not interchanged, and if electrical continuity is established for the signal cable, and if oil alarm persists, then the oil level sensor must be replaced. Contact ARID or a CPT.

Motor Overload / Control Panel:

Items To Investigate: Before opening Control Panel cabinet, please turn OFF main power switch.

- Ensure Low Oil Level light is OFF (Red Light) – from inspection and data logger, is this True?
- Are the P tank and Oil Level sensor signals active? – From data logger, do we know this is true?
- Check wiring within the Electric Motor Junction Box (located in Main PERMEATOR skid which is mounted outside near the storage tank vent lines):
    - For Reliance motor, the following wire configuration should be used:
        - 9 wire leads; Wye Connected, dual voltage
        - 1,7 (T1)
        - 2,8 (T2)
        - 3,9 (T3)
        - 4,5 and 6 (Connected together, but NOT to T1, T2, or T3)
        - Two Red wires are thermal overloads; these wires should be sealed with wire nuts, or connected together with wire nuts. They should NOT be connected to either T1, T2, T3 or the connected bundle of 4,5,6
- Check control panel wiring strip for proper location of T1, T2 and T3 as seen in the control panel wiring diagram. Lower left hand corner of this strip should be used for connecting wires from Control Panel (located inside the Kiosk) to the Main PERMEATOR skid (located outside). The wire numbers are as follows: 2022, 2032, and 2043.
- Investigate Overload Relay, this is located above the Auxiliary contact block, M202 where T1, T2, and T3 are connected (Gray, plastic block). Press reset tab with your finger, you should feel a click if the reset was needed.
- Close cabinet and restore Main Power. Turn Manual/Off/Auto switch to Manual. Does the green light illuminate indicating that the vacuum pump is running? If yes, turn Manual/Off/Auto to Auto. If no, continue as follows.
- Investigate wiring connections to Unitronics Controller.
    - Are leads 10 and 11 firmly attached to back of Unitronics wiring terminals?
    - Is Output 1 (O1) firmly attached to back of Unitronics wiring terminal?
    - Are both Analog Inputs; 3231 and 2351 firmly attached to both V IN terminals at the back of the Unitronics unit?
    - Correct problems with loose or absent wiring as required.
- Close cabinet and restore Main Power. Turn Manual/Off/Auto switch to Manual. Does the green light illuminate indicating that the vacuum pump is running? If yes, turn Manual/Off/Auto to Auto. If no, continue as follows.
- Call ARID or CPT with a summary of the steps taken and results obtained.

Motor Overload Relay Details (Number 5. from Electrical Details)



Frequently Asked Questions

1. *Do we have to break ground to install the PERMEATOR unit?*

   No. It depends on the specific vapor-piping configuration. If the storage tanks are manifold underground, no excavation is required.

2. *How do I know that storage tank evaporative losses are between 0.1% and 0.5% of a gasoline station's throughput?*

   Third party testing has verified that the evaporative losses are within the range stated above. The variation in the range is due to various site-specific factors such as fuel RVP (Reid Vapor Pressure), fuel tank temperature, altitude, and the population of ORVR equipped vehicles.

3. *How do I know the PERMEATOR system really works?*

   The California Air Resources Board (ARB) has tested the PERMEATOR System as part of the certification process which led to the issuing of Executive Order G-70-209. The certification met the criteria established in Certification Procedure 201 (CP-201), including the conducting of a Phase II volumetric efficiency test (i.e. 200-car test, TP-201.2). In preparation for the ARB certification, third party testing, as well as a Major Oil internal study, has consistently found the PERMEATOR System to provide excellent recovery efficiencies.

4. *Is the system safe?*

   Yes, the PERMEATOR has received safety approvals from the California State Fire Marshal (# 004:059:001), Underwriters Laboratories (UL) 698A and German PTB. The vacuum pump is manufactured with ductile iron and is equipped with internal flame arrestors. The vacuum pump is rated to withstand pressure spikes of 225 psig. Worldwide, over 125 systems have been sold as of January 2005 without encountering any safety problems.

5. *Life of membrane?*

   Existing terminal vapor recovery systems have been installed in Europe since 1989 using the same membrane technology that is used in the PERMEATOR. Membrane life is anticipated to be 15-20 years for this application.

   Replacement involves only the re-packing of the module; an entire new module does not have to be purchased.

6. *Is current ATG (Automatic Tank Gauge) technology sensitive enough to measure existing evaporative losses and the savings in salable product with the PERMEATOR system?*

   Yes, these systems are capable of measuring 1/1000th of an inch difference in level. For example, in a 10,000 gallon horizontal tank, at half height (8 ft. diameter, 1/2 height = 48 inches), one inch of gasoline is equivalent to about 135 gallons. Product losses for a station pumping 150,000 gallons per month (with V/L = 1.3) are on the order of 8 gallons per day, which requires a measurement accuracy of 8/135 or .06 inches; well within the stated accuracy of these gauges.

7. *Will water vapor harm the membrane?*

   No, water vapor passes through the membrane.

8. *What happens if the station loses power?*

   Most likely, if the whole station loses power, the entire vapor recovery system will not be operational. If power is somehow only interrupted to the PERMEATOR, the rest of the station could possibly remain in operation. Each local air quality district will most likely have different requirements for dealing with this situation. It is the responsibility of the station owner/operator to contact the local air quality district to determine the correct course of action.

9. *Do you need a PERMEATOR system on each storage tank?*

   One PERMEATOR handles the vapors from a manifold storage tank station installation. See Exhibit 2 of Executive Order G-70-209 for typical installations of the PERMEATOR for different tank configurations.

10. *What are the typical maintenance items?*

    Maintaining oil level in the vacuum pump - checked continuously via our oil level sensor and remote data acquisition gear.

11. *What is the warranty on the equipment?*

    Thirty-six months; parts and labor. See Exhibit 6 of Executive Order G-70-209 for additional details.

12. *Would ARID put on a class for our technical personnel to learn the operation, installation and maintenance of the PERMEATOR unit?*

    Yes.

13. Where does the unit get mounted?

See the section titled **Component Selection and Location** of this manual for details on mounting locations/requirements.

14. How much does the PERMEATOR AT-150 weigh and what are the dimensions?

The PERMEATOR AT-150 weighs about 750 pounds and has dimensions of 3 ft. W x 3 ft. D x 5.5 ft. H.

15. What are the dimensions of the Control Panel?

The NEMA-12 Control Panel dimensions are 24 in. x 20 in. x 8 in.

16. Will the increased proportion of ORVR equipped vehicles take away the need for your system?

No, it will amplify the need.

17. Does your system impact the efficiency of Stage I vapor recovery?

Yes, since the storage tank vapors will be at a high equilibrium concentration, evaporation losses from the tanker truck during product deliveries will be reduced. Also, pressure spikes and fugitive losses during deliveries will be reduced. In addition, the recovery efficiency at the bulk terminal will be increased since the concentration of returned vapors in the bulk tanker will be increased to saturation levels (40%-60%, by volume).

18. Has ARID published any information in Trade Journals or Magazines related to gasoline marketing?

Yes. Please refer to:

“Membranes, Molecules and the Science of Permeation”, TP Tiberi, Petroleum Equipment & Technology (PE&T), April 1999; page 30-34

“Some Fugitive Emissions Remain at Large”, TP Tiberi, PE&T, August 2000, pp. 29-32;

“Vapor Recovery Around the World”, TP Tiberi, PE&T, September 2000, pp.16-20.

These publications are available in the Archives at www.pe-t.com

19. Is the PERMEATOR system or any key components covered by patents?

Yes.

Patents owned, assigned to or licensed by ARID include the following; 6,836,732; 4,994,094; 5,537,911; 5,220,799; 5,367,882; 6,059,856; P4410597; P3270475; and PCT/DE95/00383.

Also, the following US and European patents cover other aspects of the process, membrane and module technologies: 4,673,418; 4,695,380; 4,818,452; 4,933,085; 5,076,923; and 0752974.

20. What is the nominal purchase price of the PERMEATOR and the price range based on specific station conditions?

ARID provides our PERMEATOR system to customers through either a capital equipment purchase or under an operating lease. The savings in salable gasoline inventory exceed the monthly payments made by the end-user, including operating expenses. On purchased units, the magnitude of the savings yield after-tax internal rate of return is between 15% and 95%, depending on site-specific factors.

21. Is it possible to have a PERMEATOR system installed without making significant up-front payments to ARID?

Yes. There are two options relating to acquiring the PERMEATOR without significant capital outlays:

Operating Lease based on a % of monthly savings
Capital Lease

22. Do different size tank capacities present a problem?

No, headspace pressures will equalize.

23. Does the membrane accumulate hydrocarbons or become depleted?

No, the membrane selectively separates hydrocarbon molecules from air.