California Environmental Protection Agency

Air Resources Board

ARB Approved

Installation, Operation and Maintenance Manual

For the OPW Vaporsaver System

Approved: November 17, 2004

Summary of the Maintenance Activities Required of the

OPW Vaporsaver System [1]

Component	Interval	Maintenance To Be Performed
Belts	12 Months	Check all belts for wear and proper tension. Only replace with same size and type as originally installed.
Control System Operating Pressure and Vacuum	12 Months	Check Control System operating pressure and vacuum readings.
Control System	12 Months	Visually check for overall wear.
Compressor Pump	12 Months	Check total run time. OPW recommends that pump should be replaced after 5,000 hours of operation and must be replaced after 8,500 hours of operation.
Vacuum Pump	12 Months	Check total run time. OPW recommends that pump should be replaced after 10,000 hours of operation and must be replaced after 12,000 hours of operation.
Membrane Module	12 Months	Check total run time, membrane module may need to be replaced at approximately 15,000 hours of operation.
Hydrocarbon Sensor	36 Months	Replace sensor.

[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.

OPW Vaporsaver System
Installation, Operation and Maintenance Manual

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OPW

A DOVER COMPANY

VAPORSAVER

Vaporsaver 1

Installation Manual

ATTENTION:

READ AND UNDERSTAND THIS IMPORTANT SAFTEY INFORMATION BEFORE BEGINNING WORK

This product is to be installed and operated near the highly combustible environment of a gasoline storage tank. It is essential for your safety and the safety of others that you carefully read, understand, and follow the warnings and instructions in this manual. Failure to do to so could result in danger to life and property including death, serious injury, explosion, fire or electric shock.

Failure to install this product in accordance with the instructions and warnings in this manual as well as failure to follow the requirements of the National Electric Code, federal, state, and local codes will result in voiding warranties of this product.

Only OPW trained and Certified technicians are to install and start-up the system. An OPW trained and Certified technician shall start-up the system only after careful inspection of the installation. The start-up form shall be completed and returned to OPW Technical Support.

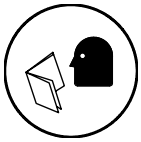
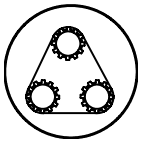
Installation, start-up, system maintenance and troubleshooting must be performed by qualified, certified service technicians. Certified technicians must be able to provide proof of certification at any time. Certification number is required for any start-up form to be completed or accepted by OPW as well for warranty purposes. Technicians requesting technical support on the Vaporsaver that do not have the necessary proof of certification will be referred to a certified service technician.

It is your responsibility to install this product in accordance with the instructions and warnings in this manual.

OPW Customer Service: 1-800-422-2525.
www.opw-fc.com

Safety Symbols

The following safety symbols may be used throughout this manual to alert you to important precautions and safety hazards that may arise during the installation and operation of this product.

	**ELECTRICITY** A potential shock hazard exists. High voltage is supplied to and exists in this device.		**TURN POWER OFF** Turn power off to the device and its accessories when installing and servicing the unit. Live power creates a potential spark hazard.
	**EXPLOSIVE** Gasoline and its vapor are extremely explosive if ignited.		**NO POWER TOOLS** Sparks from electric power tools can ignite gasoline and its vapors.
	**FLAMMABLE** Gasoline and its vapors are extremely flammable.		**NO PEOPLE IN THE AREA** Unauthorized people in the work area during installation and service of the device create a potential for personal injury.
	**NO SMOKING** Gasoline and its vapors can be ignited by sparks and embers of burning cigarettes.		**READ ALL RELATED MANUALS** Read, understand and follow all instructions, warnings and requirements before you begin work.
	**NO OPEN FLAMES** Open flames from sources like lighters, matches, etc. can ignite gasoline and its vapors.		**USE SAFETY BARRICADES** Unauthorized people or vehicles in the work area create a potential for injury and danger to property. Always isolate your work area by using safety cones, barricades, etc.
	**PINCH RISK** Stay clear. Keep hands and tools away from rotating machinery and moving parts.		**ROTATING MACHINERY** Stay clear. Keep hands and tools away from rotating machinery.

1.0 Introduction

WARNING: Only OPW trained and Certified technicians are to install and/or start-up the system. An OPW Certified technician shall start-up the system only after careful inspection of the installation, and completion of the start-up check list.

Do not power up the system unless a complete start-up inspection is completed by an OPW Certified technician.

1.1 Control System Description

The OPW Vaporsaver reduces hydrocarbon emissions from a gasoline refueling facility by controlling the storage tank pressure. Tank pressure management is achieved by releasing air from the storage tanks, while recycling the gasoline vapor. The recycling that takes place accomplishes three benefits. First, by returning vapor to the storage tank in a supersaturated form, evaporative emissions are greatly reduced. Second, during the recycling process, liquid gasoline is created and returned to the storage tank. Third, by releasing the air (and saving the gasoline), the pressure in the storage tank is reduced, and vapor emissions to the atmosphere due to venting or fugitive emissions become insignificant.

Pressure in the storage tank will rise due to thermal and pressure affects of the day, by the introduction of air from filling vehicles equipped with ORVR, or from Stage I bulk deliveries. Without the OPW Tank Pressure Management System:

- Ingested air from ORVR vehicles can evaporate the liquid product, and cause an increase in UST pressure.
- Increased pressure from all sources will be released from the UST's to the atmosphere through leaks in the vapor piping, components, and P/V vents.

1.2 Normal Operating Conditions

1. The Control System turns on when the UST pressure increases to +0.1 inches of water column pressure.
2. It turns off in the following conditions
    a. When UST pressure is reduced to approximately -0.5 inches of water column vacuum.
    b. The Control System is also designed to only operate 10 minutes continuously. After a 10 minute run, the Control System shuts down for 2 minutes, and will start again if tank pressure requires it. This allows the separator to drain returning liquid product to the storage tank. As well as not allowing the Control System to run excessively if the vapor space has significant leaks.
3. The Residue is the fresh air being released from the Control System. It is continuously monitored for the presence of hydrocarbons to ensure it is below the allowable limit.
4. The Vaporsaver, when installed and operated as designed, can allow any dispenser based Stage II Vacuum Assist System to meet both the ORVR compatibility and the CARB emission requirement with the nominal A/L = 1.00 (Maximum A/L = 1.10).
5. The Permeate being returned to the UST after vapor/air separation will consist of super saturated vapor and some condensed gasoline liquid.
6. There are many variables that influence how long the Vaporsaver will operate per day at any given site. These variables would include:

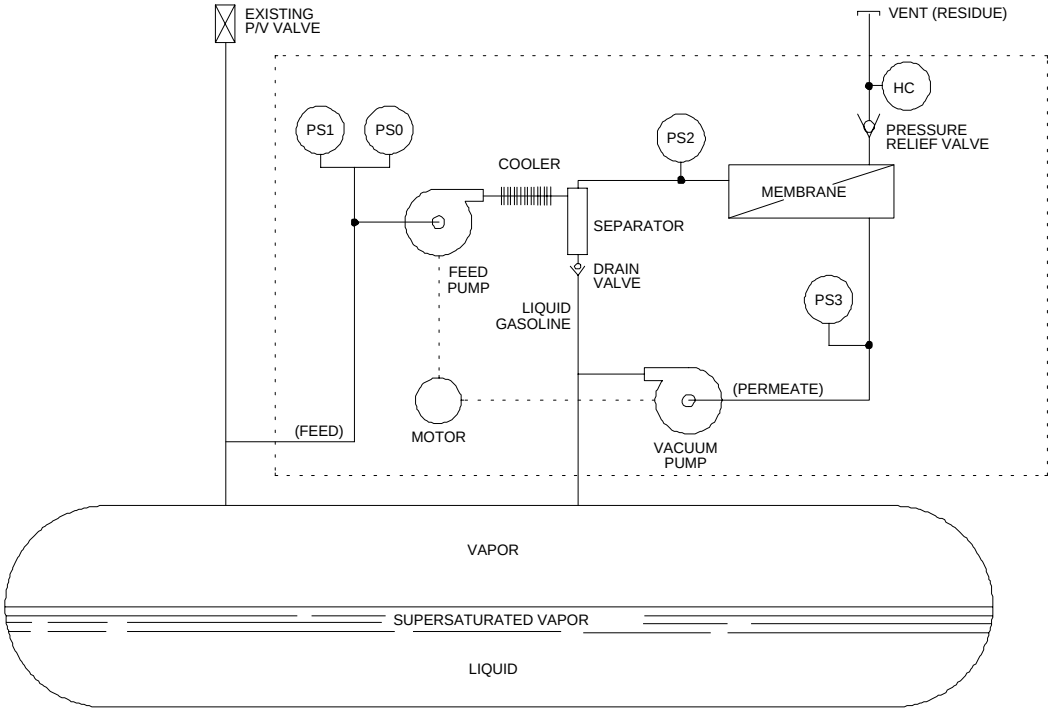
   a. station dispensing volume
   b. number and duration of drops
   c. fuel vapor pressure
   d. fuel temperature
   e. barometric pressure and temperature
   f. vapor tightness of the Stage I and Stage II Systems
   g. storage tank ullage
7. The amount of operating time per day can vary from station to station, as well as from day to day at the same station. A seemingly significant variation from day to day should not be a concern. The Vaporsaver is self-monitoring; if a fault arises, an alarm will sound.

2.0 Operation

As pressure in the storage tank rises, the pressure sensor monitoring the tanks will start the Vaporsaver Control System.

1. The feed pump draws the vapor/air (saturated vapor) mixture from the storage tank.
2. The vapor/air flow is pressurized.
3. Increasing pressure within the same volume causes the vapor stream temperature to rise.
4. The heated vapor stream passes through a cooler.
5. The cooler reduces the vapor stream to ambient temperature.
6. The cooling process causes liquid gasoline to condense.
7. The vapor/air mixture and liquid gasoline go to a separator.
8. The liquid gasoline is separated, removed from the vapor/air mixture, and stored for later removal and return to the storage tank.
9. The remaining vapor/air flow proceeds to the membrane.
10. The membrane material has two sides, a pressure (feed) side, and a vacuum (permeate) side.
11. As hydrocarbon molecules pass along the membrane pressure side, they are attracted and bond to the membrane material.
12. Air molecules are repelled by the membrane surface on the pressure side, and continue on until released from the Control System as clean air (residue).
13. The pressure differential between the pressure side and the vacuum side cause the hydrocarbon molecules to be drawn through the membrane material.
14. The vacuum pump returns the supersaturated gasoline vapor (permeate) to the storage tank where some of it will condense into liquid gasoline.
15. When the pressure in the storage tank is reduced a preset level, the Control System is shut down and put into stand-by mode waiting for the pressure to rise again.
16. The separator valve is then opened, and the stored gasoline liquid in the separator is released to the UST.

VAPORSAVER 1 CONTROL SYSTEM OPERATION SCHEMATIC



NOTE: ONLY VAPOR LINES SHOWN

MD-VR020

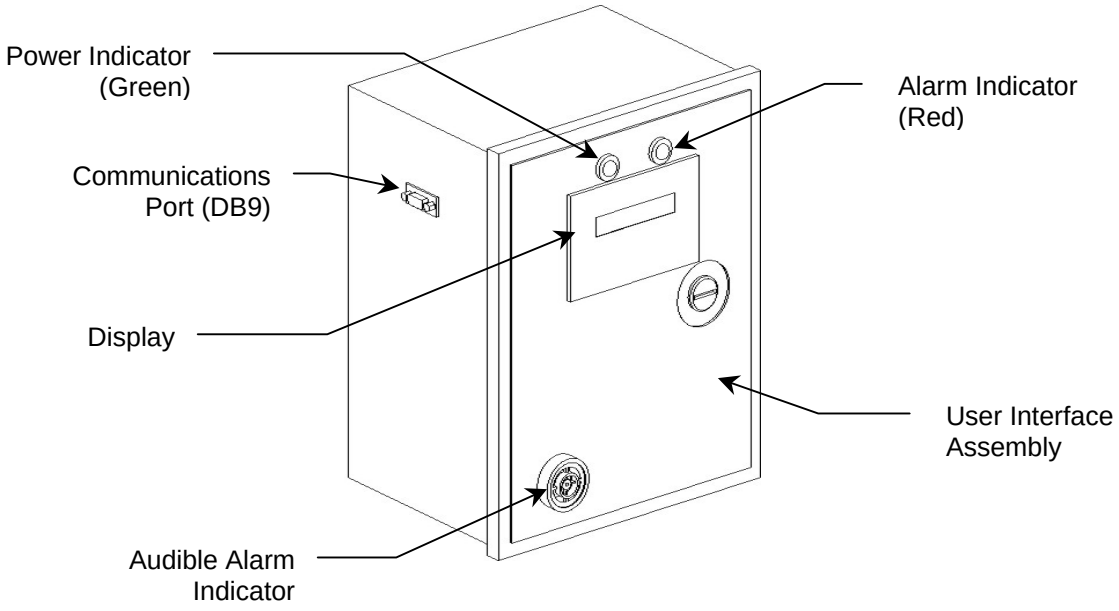
3.0 Component Identification

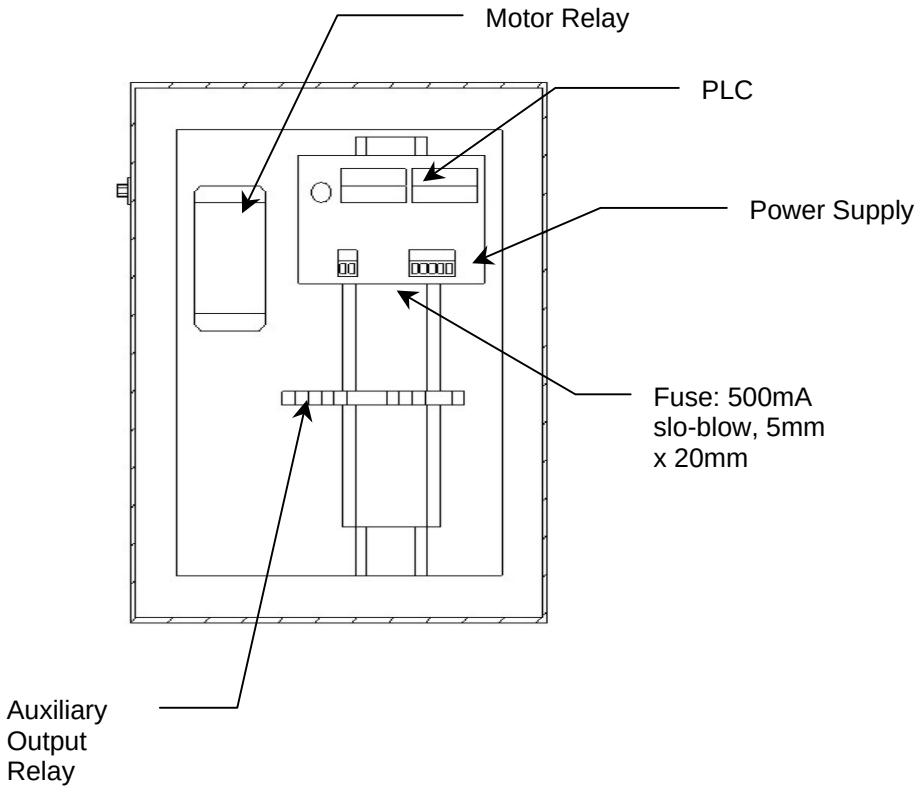
The Vaporsaver 1 consists of two major components: The User Interface and the Control System. The User Interface is the logic center of the system. It allows for interaction with the system for monitoring system status information, setting initial site configuration, and accessing recorded system history. The Control System is the active tank pressure management component which houses the pumps, motor, monitoring sensors and the membrane.

3.1 User Interface

The User Interface incorporates the following features:

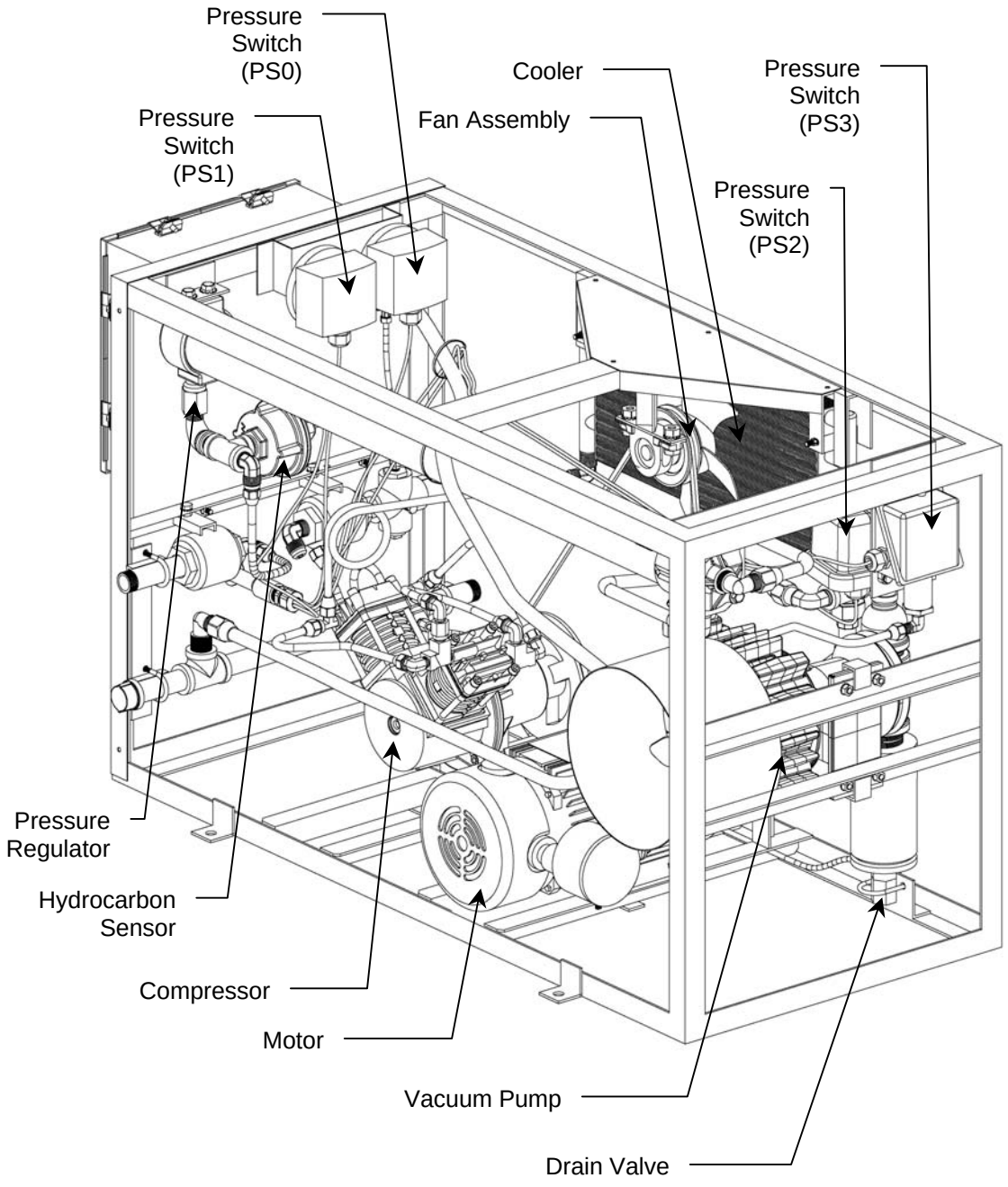
- Indicator lamps (Green - Power, Red – Alarm / Warning)
- Liquid crystal display (2 lines x 16 characters per line)
- A four button key pad
- Audible alarm indicator
- Auxiliary output alarm relay
- Port for serial communications (DB9, local or remote access)
- Operating temperature range: 32° F to 104°F (0°C to 40°C)




Motor Relay
PLC
Power Supply
Fuse: 500mA
slo-blow, 5mm
x 20mm
Auxiliary
Output
Relay

3.2 Control System

Nominal operating temperature range: -4° F to 120°F (-20°C to 50°C). Occasional and short-term excursions beyond this nominal range are acceptable, and will not cause damage to the unit.



4.0 Component Location

4.1 User Interface Location

	**WARNING: Installation of this product must comply with the National Electric Code, federal, state and local codes, as well as other applicable safety codes.**

 **WARNING**	
	**The User Interface enclosure must be installed in a non-Hazardous location. Explosion or fire resulting in serious injury or death, or property loss or damage could occur if the User Interface is installed in a Hazardous location.**
	**Do not install User Interface enclosure in a combustible or explosive atmosphere (Class 1, Division 1 or Division 2; Class IIA, Zone 0, Zone 1, or Zone 2).**

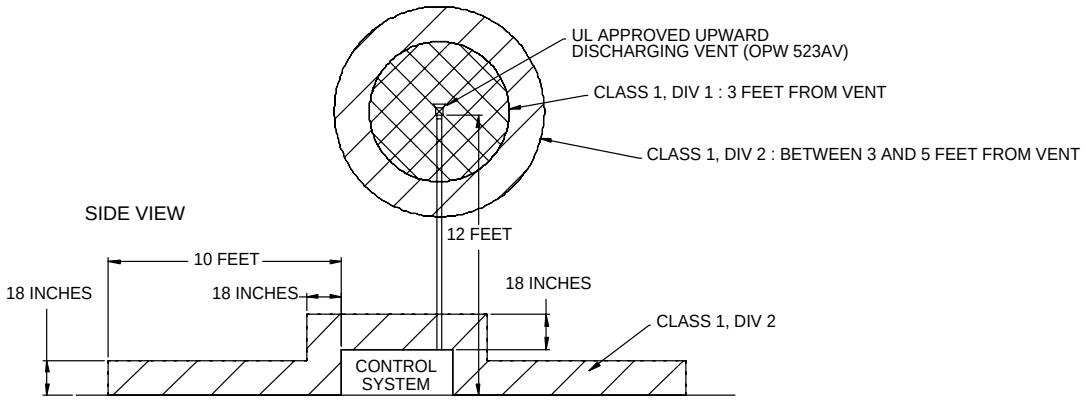
1. User Interface electrical enclosure must be installed indoors and protected from the weather.
2. The enclosure must be installed so station personnel can hear the audible alarm.
3. There must be clear access to the enclosure so station personnel can interact with it.
4. All conduit connections must be made through the factory provided knockouts in the bottom of the enclosure. All unused knockouts must be plugged. Follow NEC for approved conduit types.
5. There is a serial port on the side of the enclosure for downloading data to a computer locally or via modem.
6. There are no end user serviceable parts within the User Interface enclosure.
7. The User Interface enclosure is 10” high, 8” wide, and 6” deep.

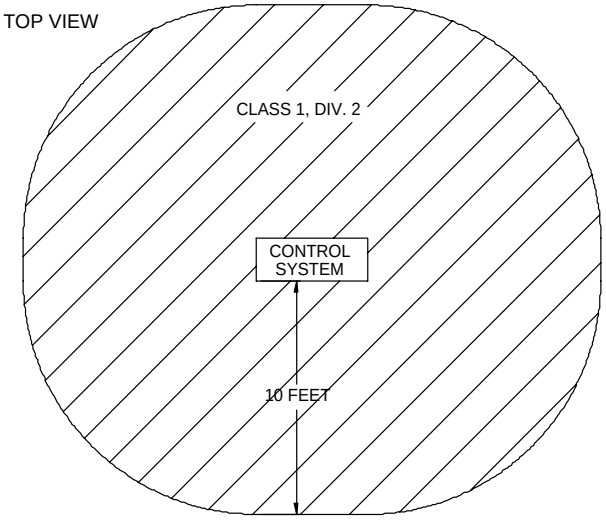
4.2 Control System Location

WARNING: Installation of this product must comply with the National Electric Code, federal, state and local codes, as well as other applicable safety codes.

1. Reference: NFPA 30A (2000) Chapter 10, Section 10.1 Vapor Processing Control Systems.
2. A hazardous location is created by the Vapor Processing Control System as per NFPA 30A (Table 8.3.1).
3. Class 1, Group D, Division 2 within 18 inches in all directions of the equipment extending to grade level. Up to 18 inches above grade level within 10 feet horizontally of the vapor processing equipment.
4. The classified area shall not extend beyond a solid floor, wall, roof, or other partition that has no communicating openings.
5. Vapor Processing Equipment shall be installed at least 10 feet from adjacent property lines that can be built upon (NFPA 10.1.6). Local authorities may grant reduced distance depending on specific circumstance (e.g. a property line with a cinderblock wall and no communicating openings).
6. Vapor Processing Equipment shall be installed at least 20 feet from dispensing devices (NFPA 10.1.6).
7. The Vaporsaver Control System **cannot** be installed within a Class I, Division 1 area created by another device or location.
8. The Vaporsaver Control System can be installed in a Class I, Division 2 area created by another device or location, but the extent of both Classified areas continue to be in affect.
    a. If this is done, be sure that all existing electrical seal-offs continue to meet NEC and NFPA requirements after the installation of the Vaporsaver.
    b. Always obtain approval from the local authority having jurisdiction.
9. If the Control System is located where vehicle or pedestrian traffic has access, measures must be taken to protect the Control System and exposed piping from damage or vandalism.
10. Installation of vehicle bumper posts or fenced enclosures may be necessary.
11. Use POMECO/OPW pipe guards (POMECO SPG, 6PGU, or 6PGR series guards).

Classified/Hazardous Areas





AUTHORITY SITED:

NFPA 30A - AUTOMOTIVE AND MARINE SERVICE STATION CODE

NFPA 70 - NATIONAL ELECTRICAL CODE

ALL DEVICES INSTALLED WITHIN THESE HAZARDOUS LOCATIONS MUST COMPLY WITH ALL APPLICABLE CODES FOR SPECIFIC HAZARDOUS LOCATION.

OBTAIN APPROVAL FROM THE LOCAL AUTHORITY HAVING JURISDICTION.

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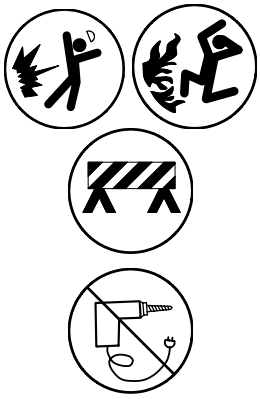
4.3 Control System Mounting

WARNING



The Control System is to be installed near locations where highly flammable and explosive vapors and liquids may be present. Risk of fire, explosion, serious injury or death.

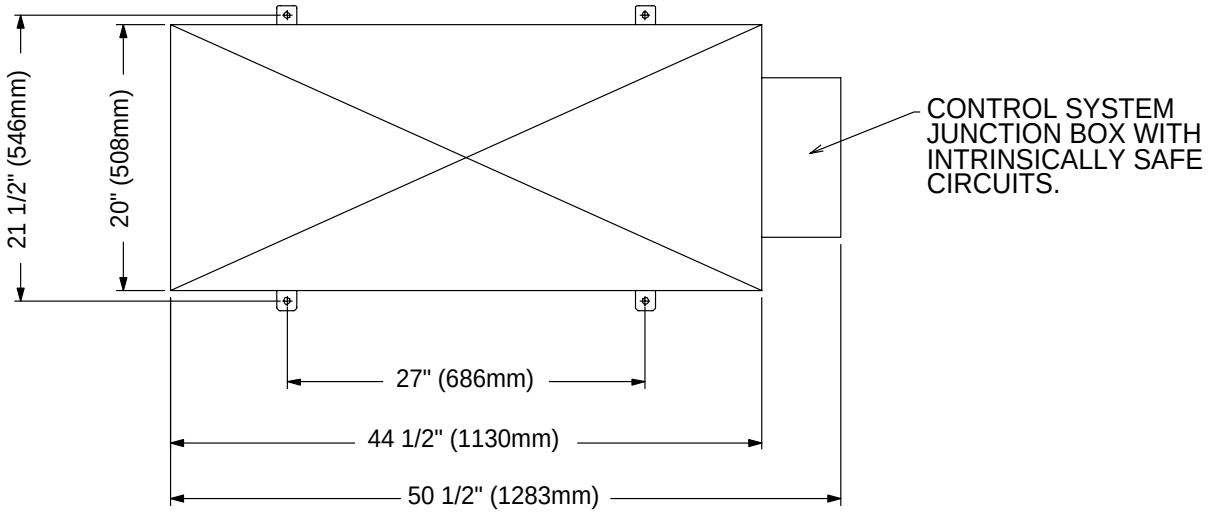
You are working in an area where vehicle traffic may occur. Always block off the work area during installation and service to protect yourself and others.

Do not use power tools that can generate sparks if there is a risk of flammable or explosive vapors or liquids being present.

1. The Control System can be installed directly on grade.
2. It must be permanently anchored to concrete or another solid base, and must be installed level.
3. Minimum clearances for service access (more clearance always makes service easier).
    a. Back: 12 inches
    b. Top: 12 inches
    c. Front: 12 inches
    d. Left: 48 inches
    e. Right: 12 inches
4. Do not install Control System where snow will accumulate or be placed when clearing lots. The above minimum clearances should be maintained at all times during operations.
5. Do not install where irrigation or sprinkler systems can spray water up through the louver vents.
6. If it is necessary to install a concrete pad, a 3 foot by 6 foot (or 3 foot by 5 foot) pad is adequate; minimum 4” thickness. To ease and speed installation, use a POMECO/OPW island-form (p/n 6013-SFR6W3L6 or 6013-SFR6W3L5).

Control System Foot Print and Mounting

TOP VIEW



APPROXIMATE UNIT WEIGHT: 300 LB (135 kg)

USE 3/8" OR 1/2" (M10 OR M12)
MOUNTING HARDWARE
TO RIGID PLATFORM

IM-VR099

5.0 Control System Piping

WARNING

The Control System is to be installed near locations where highly flammable and explosive vapors and liquids may be present. Risk of Fire, Injury and Death.

You are working in an area where vehicle traffic may occur. Always block off the work area during installation and service to protect yourself and others.

Do not use power tools that can generate sparks if there is a risk of flammable or explosive vapors or liquids being present. Open piping to the gasoline storage tank will be emitting dangerous, flammable and potentially explosive vapors. Do not smoke or have open flames in areas near open piping.

5.1 General Piping Guidelines

1. The main guide for piping is that the Control System should pull from and return to different parts of the vapor system.
2. All aboveground piping must be schedule 40 galvanized; only use pipe that is internally and externally corrosion protected.

5.2 Inlet Piping

1. With vapor manifold tanks the Control System inlet is typically connected to the high-grade gasoline storage tank or the Stage II piping between the dispensers and the tanks.
2. Inlet piping must slope away from Control System and have slope to drain towards storage tanks. Slope minimum 1/4" per foot between the Vaporsaver and the vents.
3. Piping should remain a minimum of 2" ID from the Control System inlet connection pipe to the connection to the storage tank (or storage tank vents).

5.3 Clean Air Vent Piping

1. The clean air vent (residue) must be piped so the discharge opening is 12 feet minimum above adjacent grade.
2. The clean air vent must have an NFPA and UL approved upward discharging vent (Use OPW 523AV).
3. The clean air vent piping should remain a minimum of 1-1/2" ID.
4. The vent creates a hazardous location as per NFPA 30A.
    a. Class 1, Group D, Division 1 within 3 feet in all directions of the vent opening.
    b. Class 1, Group D, Division 2 between 3 feet and 5 feet in all directions of the vent opening.
    c. Follow all applicable codes.

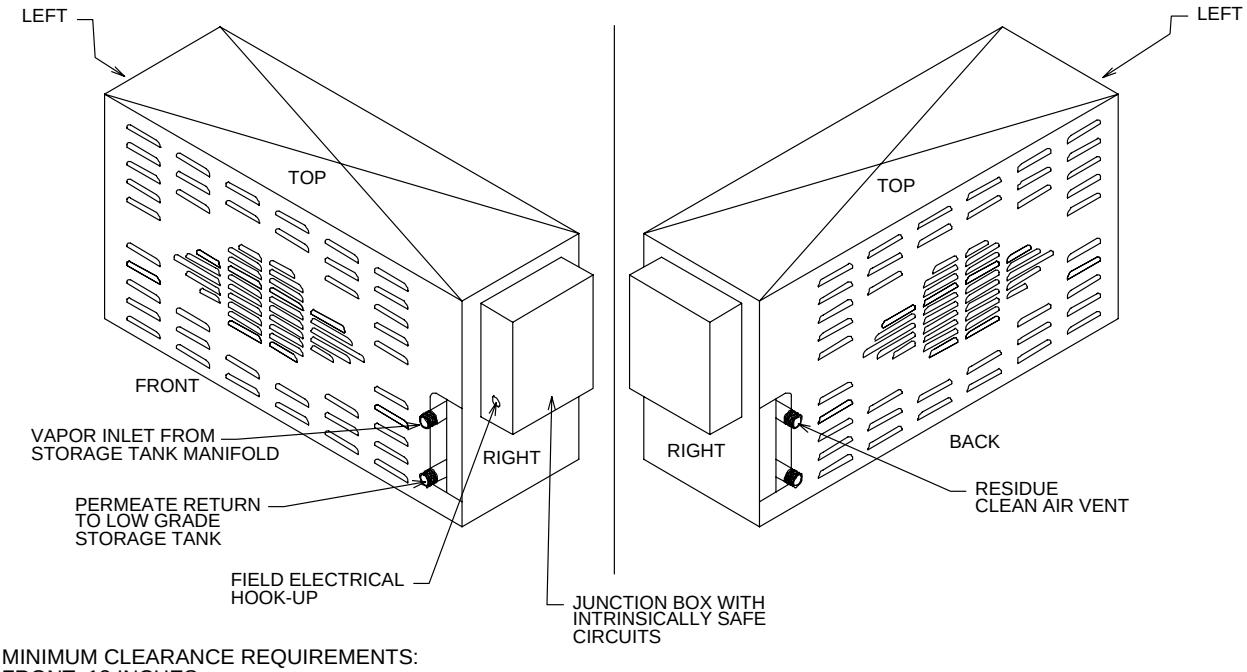
5.4 Hydrocarbon Return Piping

1. With vapor manifold tanks, the Control System hydrocarbon return (permeate) should be connected to the low-grade gasoline storage tank.
2. The hydrocarbon return piping has an extra exit – if the using the outlet on the front of the Control System causes installation problems, use the outlet on the back of the unit. The unused outlet pipe opening must be capped.
3. The hydrocarbon return piping must slope away from Control System. This pipe will be carrying liquid condensation from the separator, and supersaturated vapor. Slope minimum 1/4" per foot between the Vaporsaver and the vent.
4. The hydrocarbon return piping must remain 1-1/2" ID minimum until it returns to the storage tank.

5.5 Underground Piping

1. If the Control System is to be installed at a distance from the vents, underground piping can be installed to connect the Control System to the vent piping.
2. Minimum slope: 1/8” per foot (1/4” per foot recommended)
3. For underground piping, all of the above size and slope requirements must be met as well as all standard requirements for underground vapor piping. Never use flexible vapor piping.
4. Follow local requirements for underground vapor piping with regard to secondary containment.

Control System Piping Connections and Access



MINIMUM CLEARANCE REQUIREMENTS:
FRONT: 12 INCHES
BACK: 12 INCHES
TOP: 12 INCHES
RIGHT: 12 INCHES
LEFT: 48 INCHES
UNIT TO BE MOUNTED TO CONCRETE PAD
DIRECTLY ON GRADE, OR TO RIGID
MOUNTING PLATFORM.

ACCESS:
RIGHT: JUNCTION BOX AND I.S. CIRCUITS
LEFT: MEMBRANE MODULE
FRONT/TOP: ALL OTHER COMPONENTS

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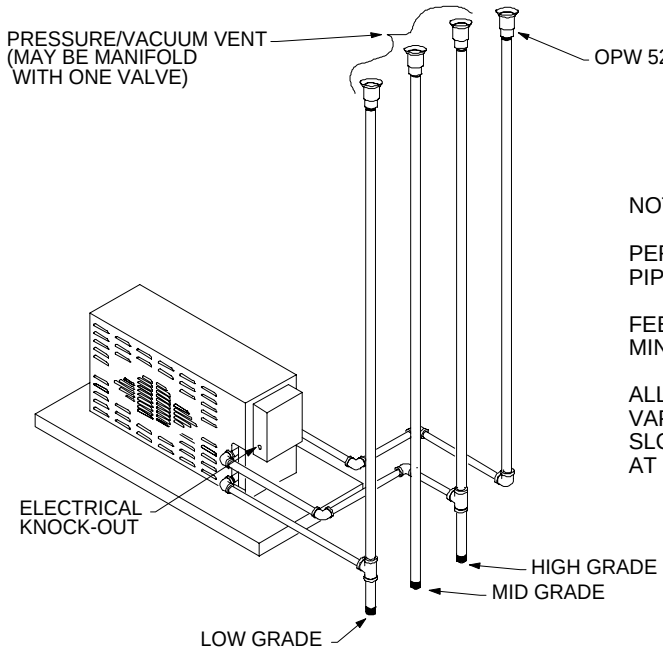
Control System Typical Piping



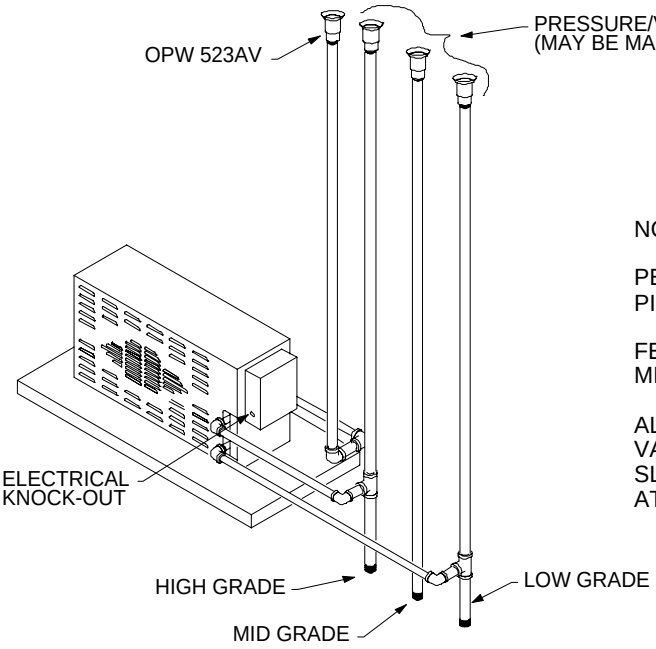
NOTES:

PERMEATE AND RESIDUE VAPOR PIPING TO BE MINIMUM 1-1/2" ID.

FEED VAPOR PIPING TO BE MINIMUM 2" ID.

ALL VAPOR PIPING CONNECTING VAPORSAVER TO VENTS MUST SLOPE DOWN TOWARD VENTS AT MINIMUM 1/4" PER FOOT

IM-VR112



NOTES:

PERMEATE AND RESIDUE VAPOR PIPING TO BE MINIMUM 1-1/2" ID.

FEED VAPOR PIPING TO BE MINIMUM 2" ID.

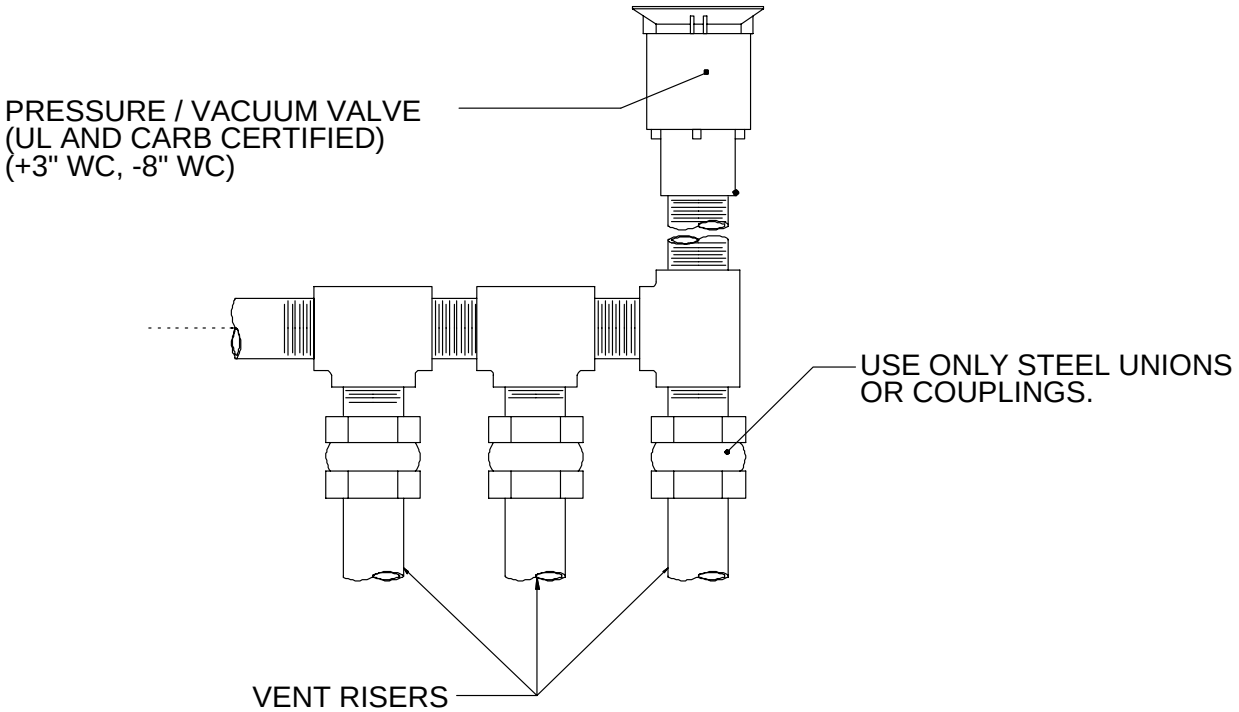
ALL VAPOR PIPING CONNECTING VAPORSAVER TO VENTS MUST SLOPE DOWN TOWARD VENTS AT MINIMUM 1/4" PER FOOT

IM-VR113

5.6 Storage Tank Vapor Manifolds

1. Storage tanks must be vapor manifold (above and/or below grade). Follow requirements of the local authority.
2. Some local authorities require manifold in one location or the other; check with the local authority having jurisdiction.
3. Above ground manifold must be minimum 12 feet above adjacent grade.
4. Tank vent openings must be greater than 12 feet above adjacent grade and have UL Listed and CARB Approved Pressure/Vacuum valves (In California, consult Executive Order G-70-204 for acceptable P/V vent valves).
5. All above ground vapor piping must be schedule 40 galvanized steel, and painted to minimize solar heat gain.
6. A hazardous location is created by the vents as per NFPA 30A.
    a. Class 1, Group D, Division 1 within 3 feet in all directions of the vent opening.
    b. Class 1, Group D, Division 2 between 3 and 5 feet in all directions of the vent opening.
    c. The classified area shall not extend beyond a solid floor, wall, roof, or other partition that has no communicating openings.

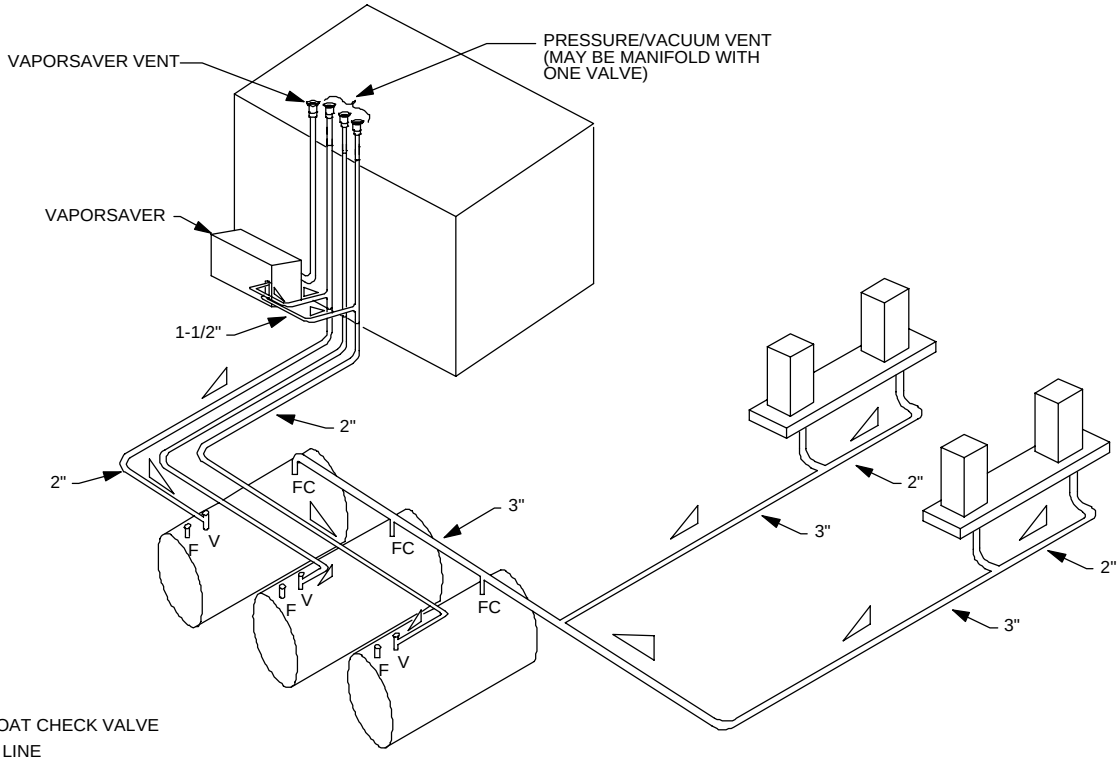
Typical Vent Manifold



5.7 Stage II Station Underground Piping

1. All underground vapor piping must be a minimum of 2” NPT. Always check with local authorities for applicable requirements; larger pipe size may be required.
2. All vapor piping must have slope for drainage to the underground storage tanks.
3. Minimum slope is 1/8 inch drop per foot run. Recommended wherever possible 1/4 inch drop per foot run.
4. Always follow the requirements of the local authorities and the manufacturer of the Stage II vapor recovery system.

Typical Vapor Piping Layout



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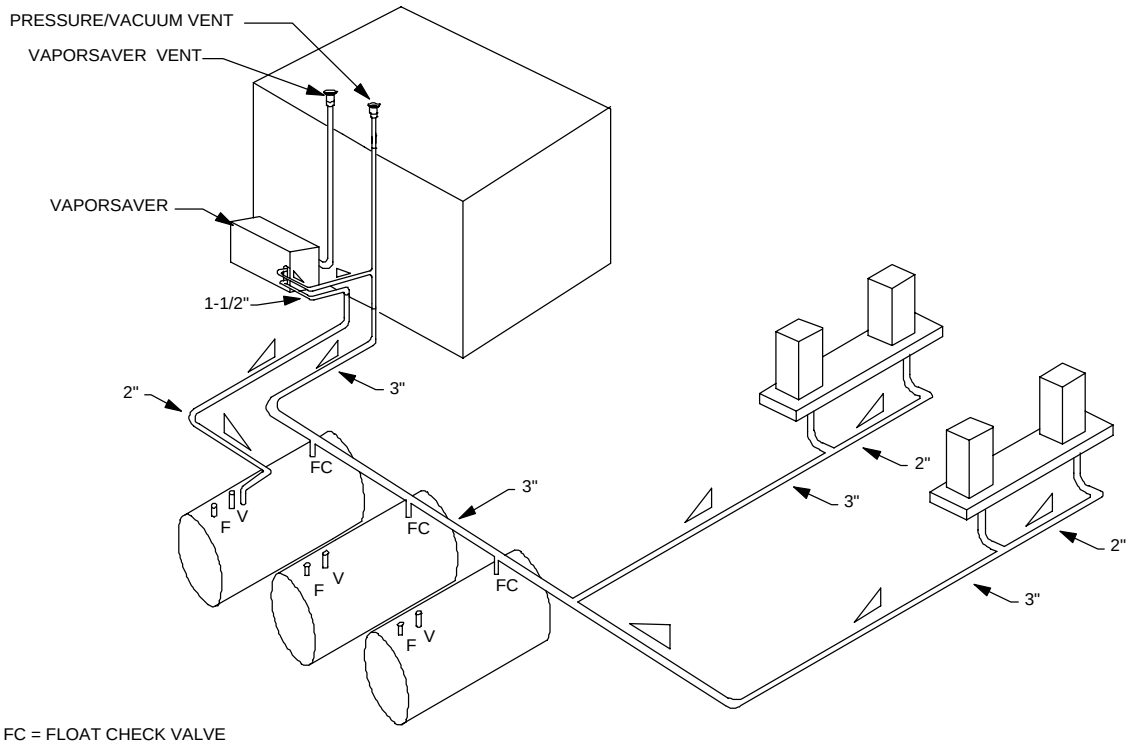
Notes:

- Always follow requirements of component and system manufacturers, local, state and national authorities for installation and operation of all equipment.
- Vent piping diameters must comply with applicable codes.
- Feed piping from the Control System to the vents shall be 2” nominal ID.
- Permeate and Residue piping from the control system to the vents shall be 1-1/2” nominal ID minimum.

Typical Vapor Piping Layout



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

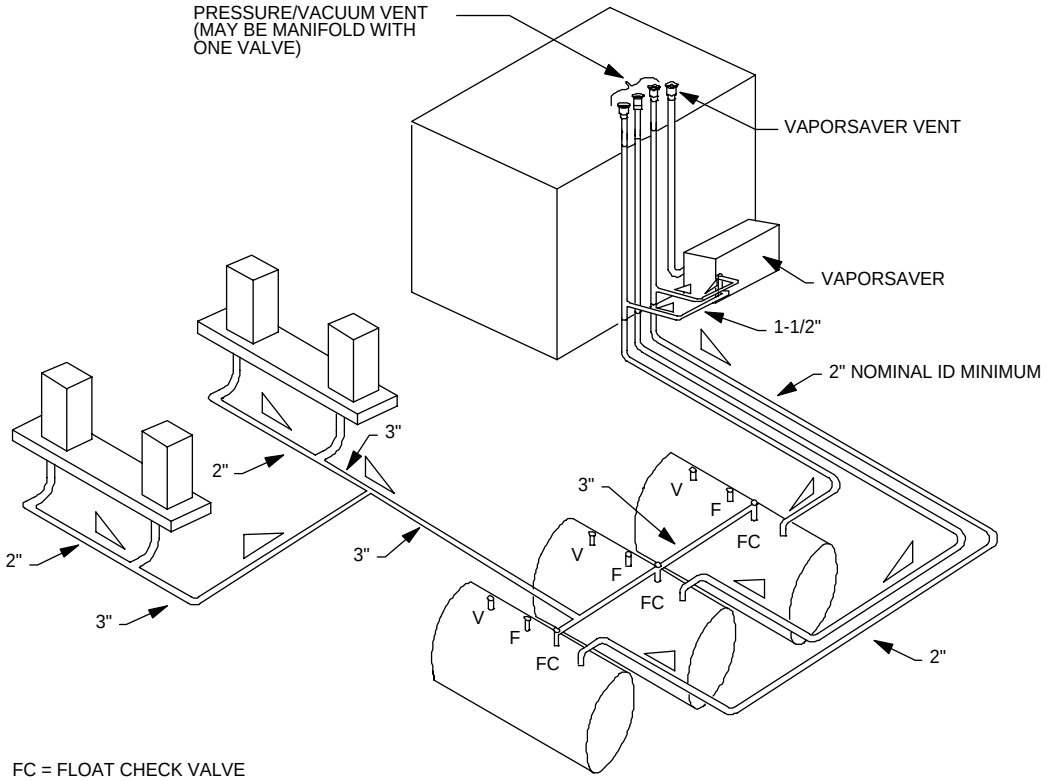
NOTE:
1. ALL VAPOR/VENT LINES ARE 3" NOMINAL ID MINIMUM EXCEPT AS NOTED
2. SLOPE: 1/8" PER FOOT MINIMUM
1/4" PER FOOT PREFERED

IM-VR094

Notes:

- Always follow requirements of component and system manufacturers, local, state and national authorities for installation and operation of all equipment.
- Vent piping diameters must comply with applicable codes.
- Feed piping from the Control System to the vents shall be 2” nominal ID.
- Permeate and Residue piping from the control system to the vents shall be 1-1/2” nominal ID minimum.

Typical Vapor Piping Layout



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

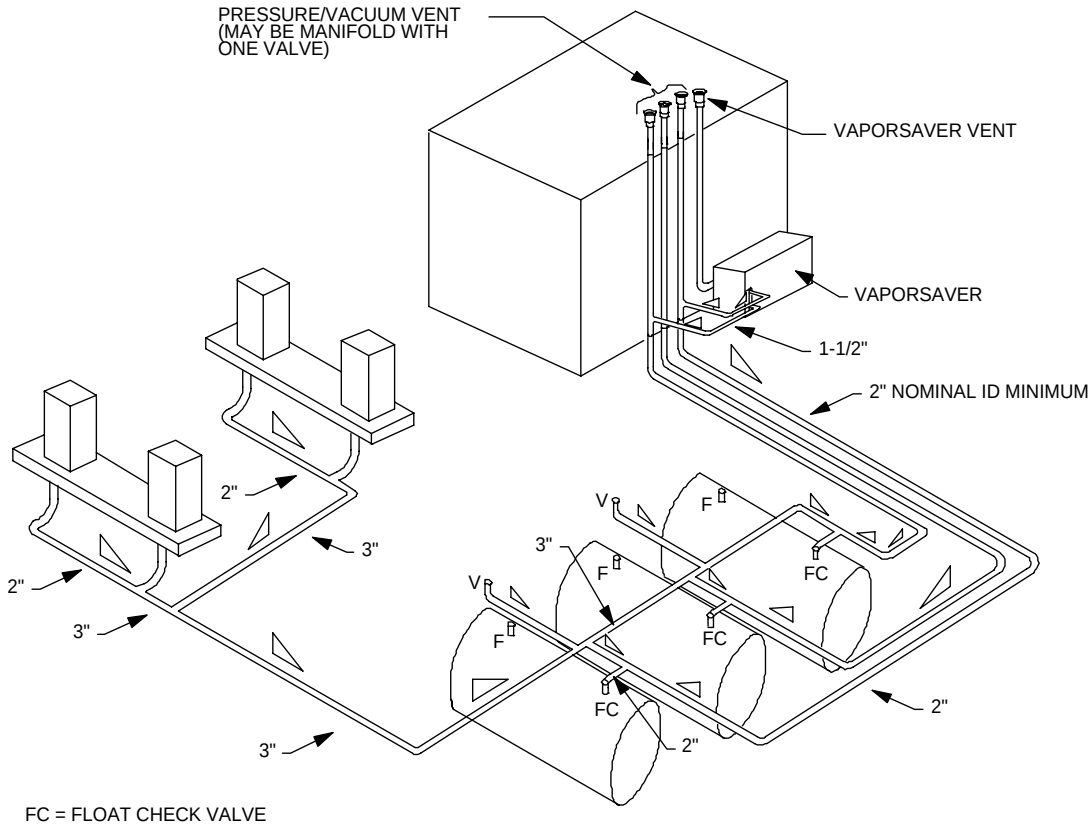
NOTE:
1. ALL VAPOR/VENT LINES ARE 3" NOMINAL ID MINIMUM EXCEPT AS NOTED
2. SLOPE: 1/8" PER FOOT MINIMUM
1/4" PER FOOT PREFERED

IM-VR130

Notes:

- Always follow requirements of component and system manufacturers, local, state and national authorities for installation and operation of all equipment.
- Vent piping diameters must comply with applicable codes.
- Feed piping from the Control System to the vents shall be 2” nominal ID.
- Permeate and Residue piping from the control system to the vents shall be 1-1/2” nominal ID minimum.

Typical Vapor Piping Layout



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

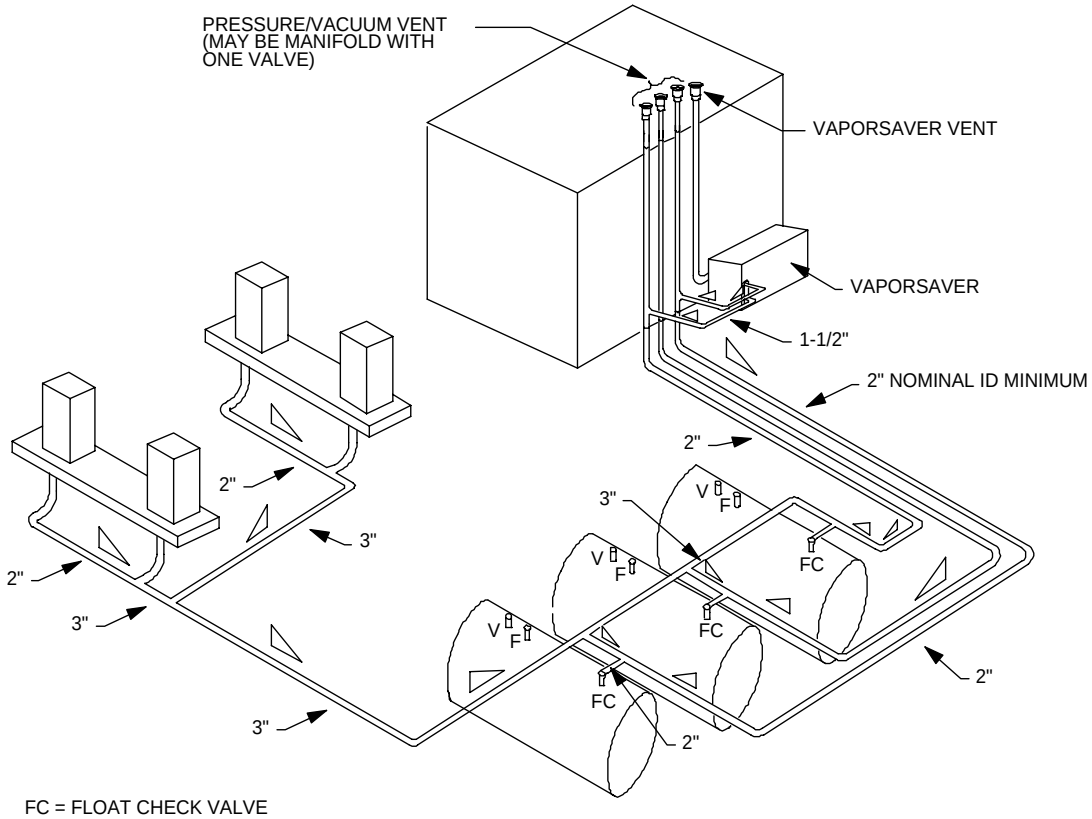
NOTE:
1. ALL VAPOR/VENT LINES ARE 3" NOMINAL ID MINIMUM EXCEPT AS NOTED
2. SLOPE: 1/8" PER FOOT MINIMUM
1/4" PER FOOT PREFERED

IM-VR131

Notes:

- Always follow requirements of component and system manufacturers, local, state and national authorities for installation and operation of all equipment.
- Vent piping diameters must comply with applicable codes.
- Feed piping from the Control System to the vents shall be 2” nominal ID.
- Permeate and Residue piping from the control system to the vents shall be 1-1/2” nominal ID minimum.

Typical Vapor Piping Layout



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

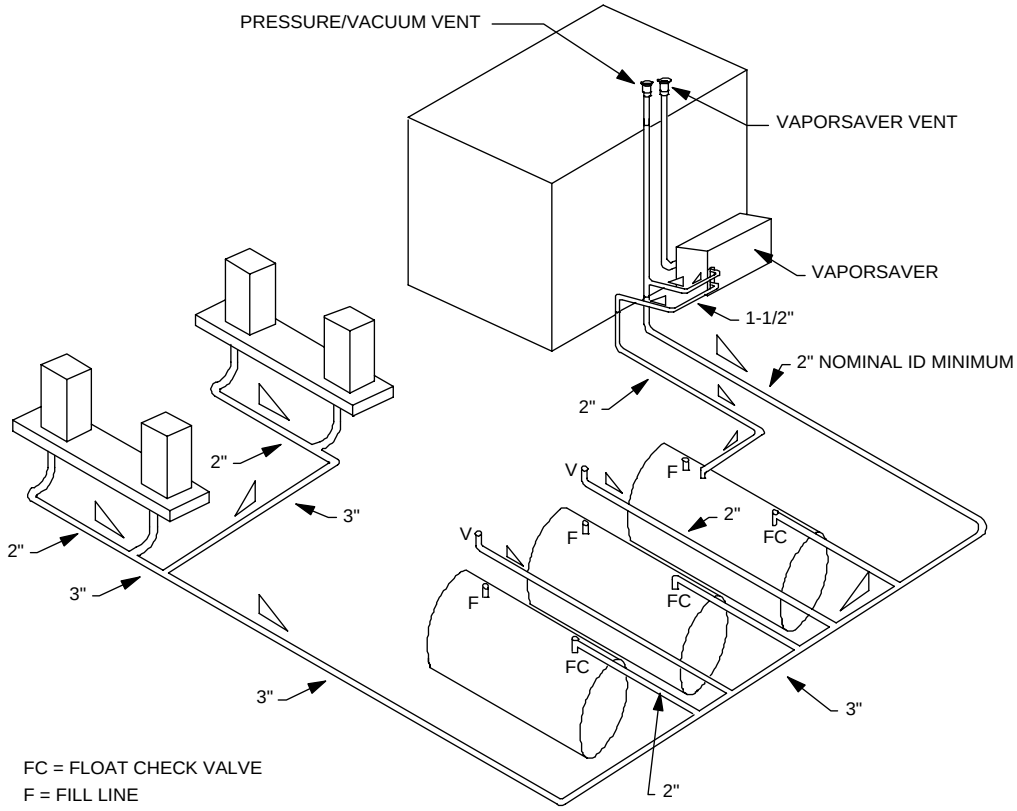
NOTE:
1. ALL VAPOR/VENT LINES ARE 3" NOMINAL ID MINIMUM EXCEPT AS NOTED
2. SLOPE: 1/8" PER FOOT MINIMUM
1/4" PER FOOT PREFERED

IM-VR132

Notes:

- Always follow requirements of component and system manufacturers, local, state and national authorities for installation and operation of all equipment.
- Vent piping diameters must comply with applicable codes.
- Feed piping from the Control System to the vents shall be 2” nominal ID.
- Permeate and Residue piping from the control system to the vents shall be 1-1/2” nominal ID minimum.

Typical Vapor Piping Layout



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

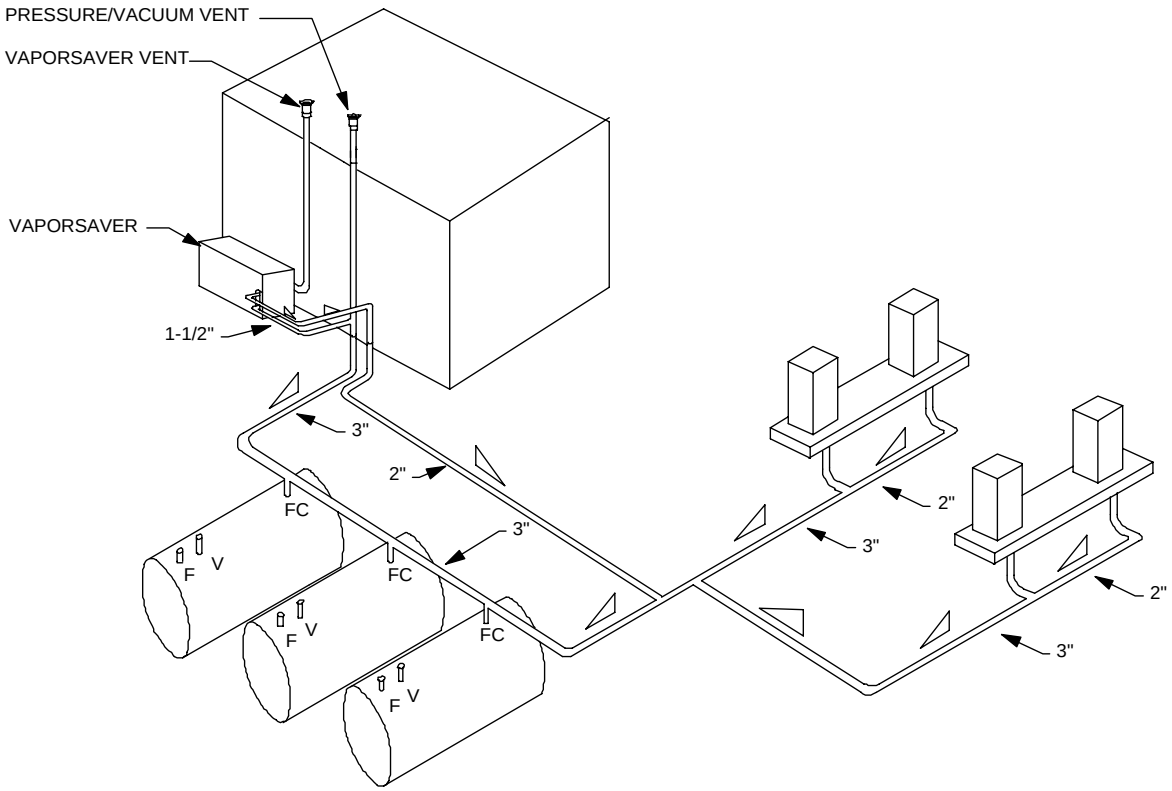
NOTE:
1. ALL VAPOR/VENT LINES ARE 3" NOMINAL ID MINIMUM EXCEPT AS NOTED
2. SLOPE: 1/8" PER FOOT MINIMUM
1/4" PER FOOT PREFERED

IM-VR133

Notes:

- Always follow requirements of component and system manufacturers, local, state and national authorities for installation and operation of all equipment.
- Vent piping diameters must comply with applicable codes.
- Feed piping from the Control System to the vents shall be 2” nominal ID.
- Permeate and Residue piping from the control system to the vents shall be 1-1/2” nominal ID minimum.

Typical Vapor Piping Layout



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

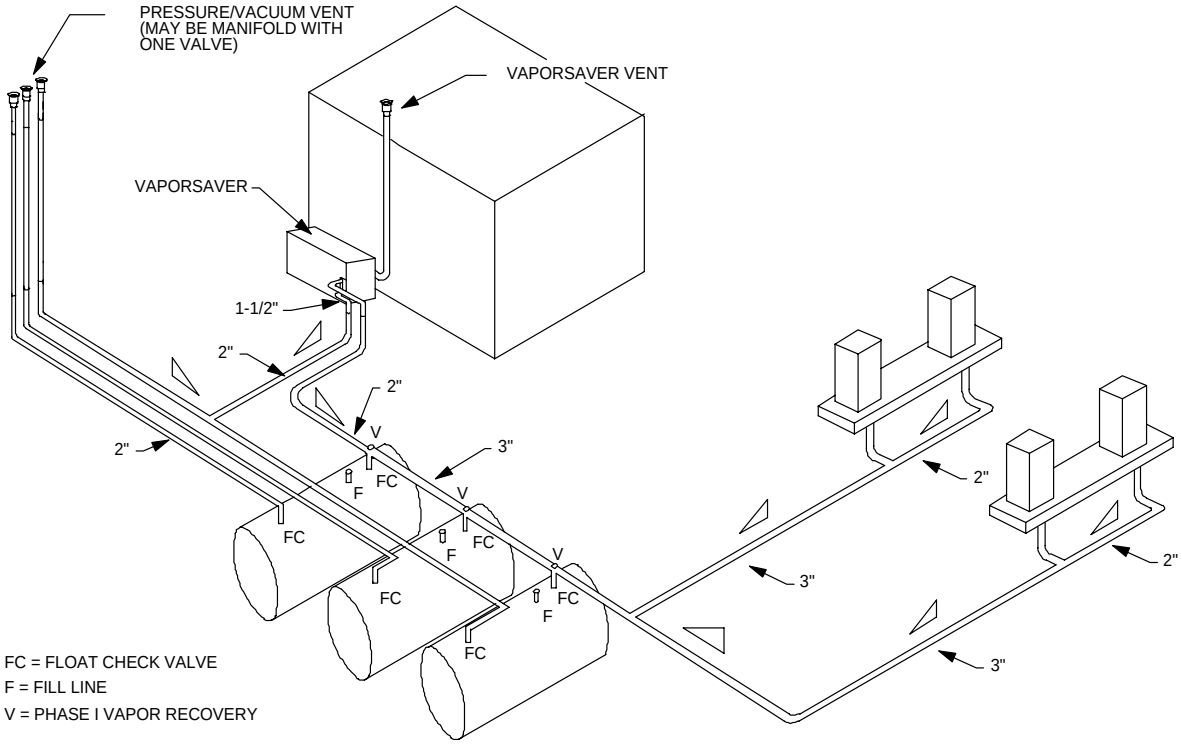
NOTE:
1. ALL VAPOR/VENT LINES ARE 3" NOMINAL ID MINIMUM EXCEPT AS NOTED
2. SLOPE: 1/8" PER FOOT MINIMUM
1/4" PER FOOT PREFERED

IM-VR134

Notes:

- Always follow requirements of component and system manufacturers, local, state and national authorities for installation and operation of all equipment.
- Vent piping diameters must comply with applicable codes.
- Feed piping from the Control System to the vents shall be 2” nominal ID.
- Permeate and Residue piping from the control system to the vents shall be 1-1/2” nominal ID minimum.

Typical Vapor Piping Layout

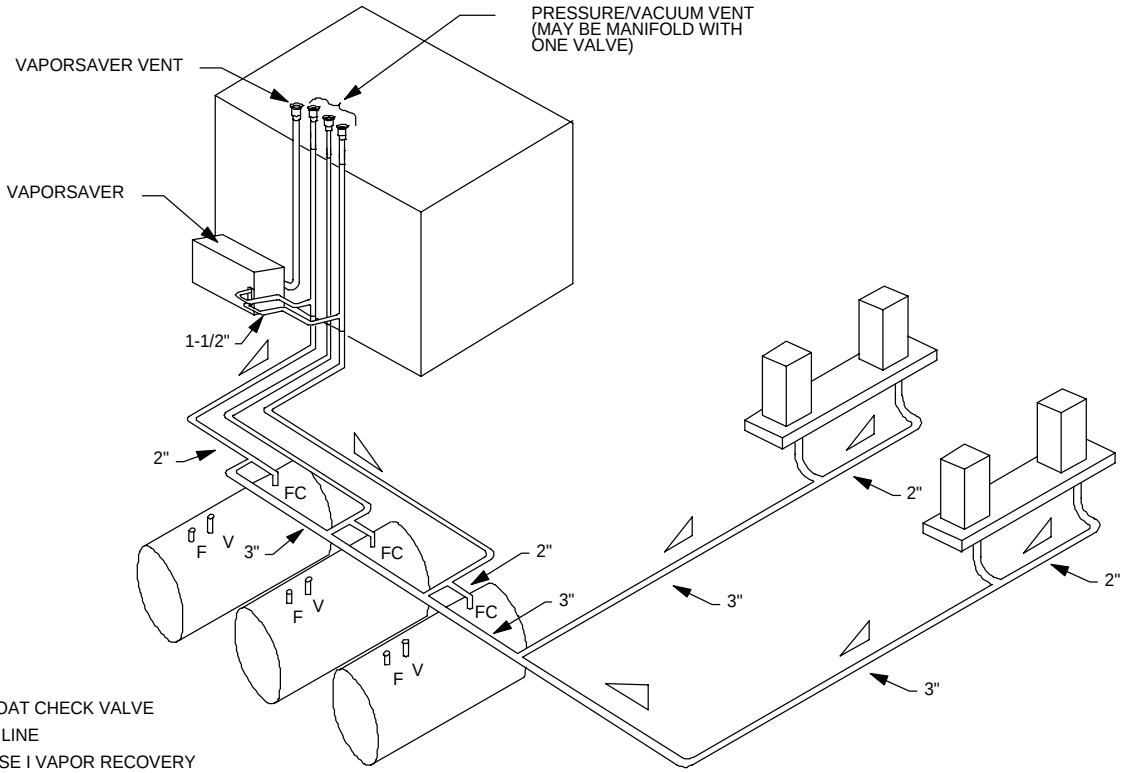


IM-VR116

Notes:

- Always follow requirements of component and system manufacturers, local, state and national authorities for installation and operation of all equipment.
- Vent piping diameters must comply with applicable codes.
- Feed piping from the Control System to the vents shall be 2” nominal ID.
- Permeate and Residue piping from the control system to the vents shall be 1-1/2” nominal ID minimum.

Typical Vapor Piping Layout



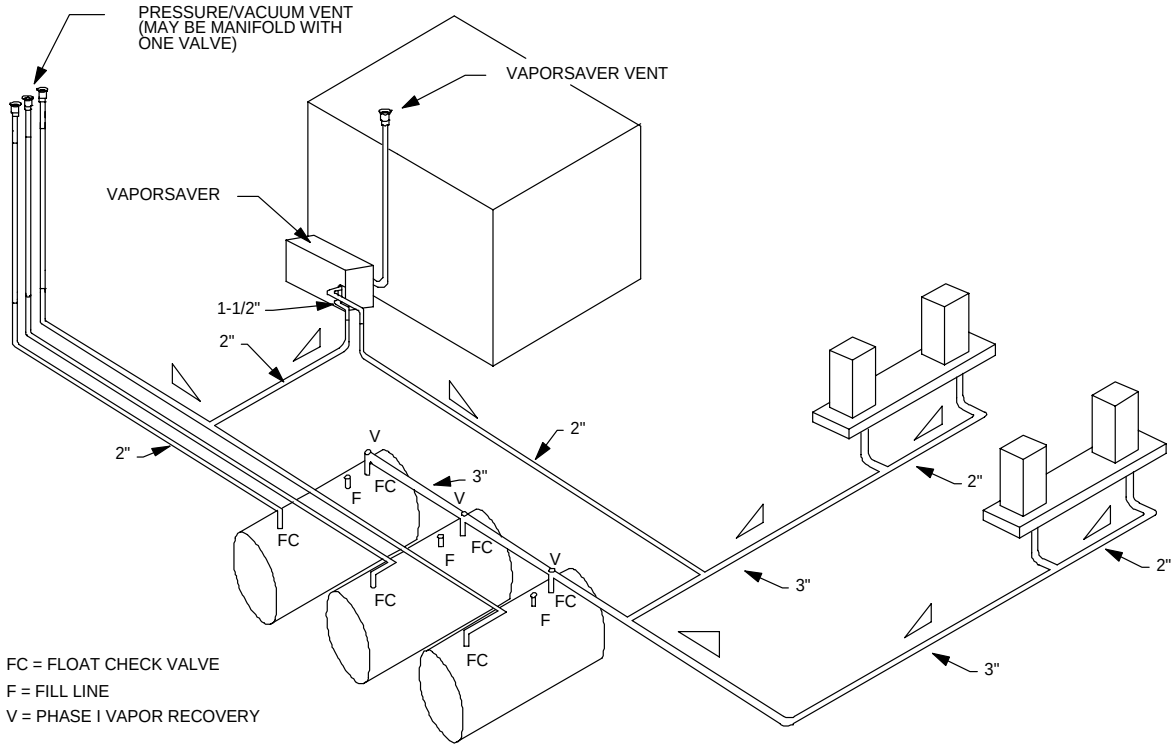
NOTE:
1. ALL VAPOR/VENT LINES ARE 3" NOMINAL ID MINIMUM EXCEPT AS NOTED
2. SLOPE: 1/8" PER FOOT MINIMUM
1/4" PER FOOT PREFERED

IM-VR117

Notes:

- Always follow requirements of component and system manufacturers, local, state and national authorities for installation and operation of all equipment.
- Vent piping diameters must comply with applicable codes.
- Feed piping from the Control System to the vents shall be 2” nominal ID.
- Permeate and Residue piping from the control system to the vents shall be 1-1/2” nominal ID minimum.

Typical Vapor Piping Layout



IM-VR135

Notes:

- Always follow requirements of component and system manufacturers, local, state and national authorities for installation and operation of all equipment.
- Vent piping diameters must comply with applicable codes.
- Feed piping from the Control System to the vents shall be 2” nominal ID.
- Permeate and Residue piping from the control system to the vents shall be 1-1/2” nominal ID minimum.

6.0 Electrical Requirements

WARNING

This system uses lethal voltages and operates in areas where flammable vapors and liquids may be present.

Serious injury or death from electrical shock, fire, or explosion may result if the power is on during installation.

Turn power off, lockout and tag power to the unit while installing the system.

Read and understand all instructions in this manual and all applicable requirements of the National Electric Code, federal, state and local codes, as well as other applicable safety codes.

6.1 Power Requirements

1. Vaporsaver System
   208-230 VAC
   50/60 Hz
   Single Phase
   2.4 Hp plus 1/2 amp
2. A circuit disconnect devise is not included with the Vaporsaver System. A readily accessible two pole disconnect device must be incorporated in the installation wiring for the motor.
3. There are no end user serviceable parts in the Vaporsaver System.
4. The User Interface has internal fuse: 500 mA (slow-blow), 250 V, 5mm x 20mm. The fuse is to only be replaced by qualified and certified technicians.
5. An electrical service (breaker) of minimum 20 amp / 240V should be used. A larger breaker may be necessary in some installations; verify required over-current protection ampacity with NEC requirements for load and conductor ampacity ratings and with the local authority having jurisdiction. Note: The motor in the Vaporsaver 1 has full load amperage rating of 12 amps, but the start-up inrush current is higher.
6. A lockable circuit breaker shall be supplied in accordance with local, state and national authorities. Some jurisdictions require that the main circuit breaker for the Vaporsaver system be locked in the ON position during normal operation. This is to avoid accidental shut-off of the system. It is also good practice to follow standard lock-out/tag-out procedures when performing service on the unit and may be required by local, state, and national authorities. (For padlock requirement use Square D model: HPAFK; Square D model: QBPA or equivalent for specific breaker).
7. This product shall be installed in accordance with the National Electrical Code (NFPA 70) and the Automotive and Marine Service Station Code (NFPA 30A).
8. Equipment connected to this device must not use, store or generate more than 250 V rms or dc with respect to ground.
9. The Vaporsaver 1 main power should be controlled by the facility's main Emergency Shut-Off system.

6.2 Control System Electrical Hook Ups

1. System Breaker shall be sized for power load based on NEC requirements.
2. Wiring between the User Interface and the Control System shall be as follows.
    a. All wiring (220VAC and 24VDC) to be TFFN or THHN with 600 V insulation, gasoline and oil resistant.
    b. Wiring for the 24 VDC control signals shall be minimum 18 AWG.
    c. Two ground wires shall be run from the Control System junction box to the load center ground; one is for equipment ground, and the second is for a dedicated Intrinsically Safe Barrier ground. Both ground wires must be minimum 12 AWG (follow all NEC requirements for equipment and Intrinsically Safe Barrier grounding). Proper grounding for the Intrinsically Safe Barrier is crucial for safe operation of the Barriers.
    d. Both the motor power (220VAC) wiring and the signal wiring (24 VDC) can be routed in the same conduit provided all wiring meet NEC 725-27; use only TFFN and/or THHN, gasoline and oil resistant wiring with 600 V insulation.
    e. Wiring for 208-230 VAC to power motor shall be minimum 12 AWG; sizing must comply with NEC requirements for motor load and wiring distance. Larger gage wire may be necessary based on conductor length and voltage supplied by load center.
        i. The following table should be used as a guide to help in correctly sizing motor conductors based on length. Always follow NEC and the requirements of the local authorities.
        ii. The following table is based on using a conductor ampacity rating of 140% of the motor nameplate rating. Motor nameplate: 12.0 A; 140% of motor nameplate: 16.8A.
        iii. NEC recommends a maximum conductor voltage drop of 3%, but notes that with a conductor voltage drop of 5%, most devices should operate with acceptable efficiency. It should been noted that with a conductor voltage drop of 5%, motor starting capabilities are reduced, and difficult starting may occur especially if the load center voltage is supplying 208 VAC. So, if the load center is supplying 208 VAC, use 3% voltage drop as the maximum allowable whenever possible. With the load center supplying 230 VAC, most installations should have acceptable operation with a maximum conductor voltage drop of 5%. But, always remember that lower conductor voltage drop is always better for motor starting and operating efficiency; so whenever possible **use the 3% conductor voltage drop**.
        iv. Running voltage at the motor must never drop below 197 VAC. Motor operation may become significantly affected.

Maximum conductor length is the total length of the conductor from the load center to the User Interface to the motor.

Maximum Conductor Length (feet)

Voltage	208	208	230	230
% Voltage Drop	3%	5%	3%	5%
AWG	Feet (maximum)			
12	91	151	100	167
10	144	240	159	265
8	229	382	254	423

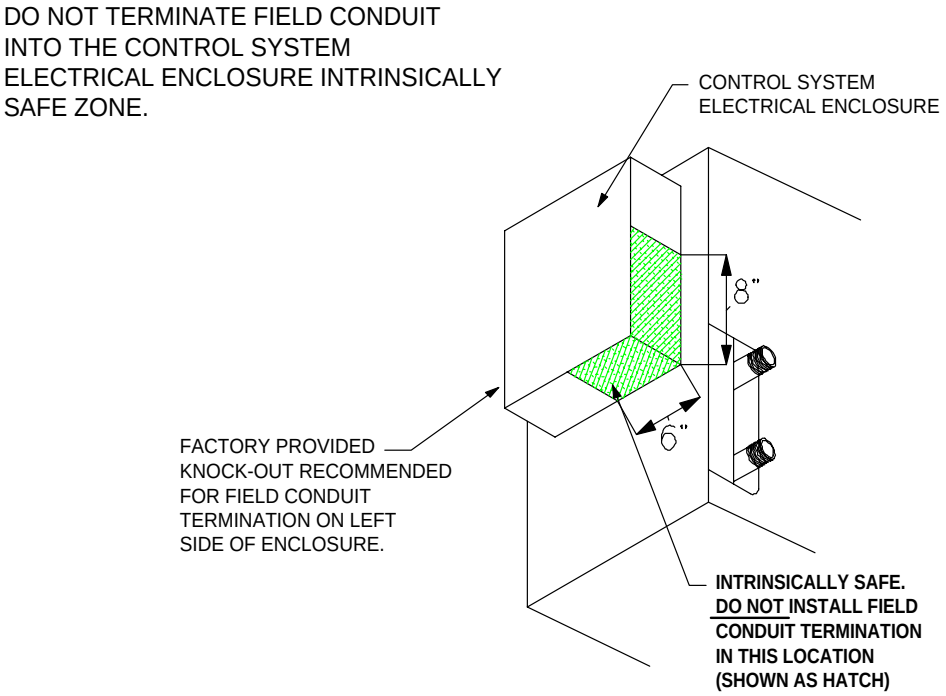
Note: This table is only a guide. Always refer to the requirements of the National Electric Code and of the local authorities.

Note: If local authority will allow conductor ampacity rating of 125% of motor nameplate instead of 140%, multiply the maximum length in the table by 1.12 to get the new maximum conductor length.

7.0 Other Requirements

7.1 Other Electrical Requirements

1. Seal-offs are required as per NPFA 70 (National Electrical Code) for a conduit run leaving a Division 2 location to an unclassified location. Install as required by NEC and local authority having jurisdiction. Other seal-offs may be necessary based on the installation and site specifics.
2. Wiring shall be sized as specified in the NEC for the load and conductor length from the load center to the motor.
3. The Control System is supplied with a knock-out for recommended field conduit termination. This knock-out is supplied with a weather tight plug. If an alternate location to terminate the field conduit in the Control System electrical enclosure is chosen, the following must be followed.
    a. Do not remove the factory knock-out weather tight plug.
    b. A field knock-out must never be installed in Control System electrical enclosure into the Intrinsically Safe zone.



7.2 Storage Tank Overfill Devices

Storage tank over fill prevention devices must be used to ensure that in the event of an overfill liquid gasoline does not enter the Control System. Damage may occur, and may result in a hazardous condition.

7.3 P/V Valve

1. Required minimum one per site (always verify requirements of the local authorities).
2. Use CARB and UL approved valve. (In California, consult Executive Order G-70-204 for acceptable P/V vent valves).
3. Pressure setting: +3" wc +/- 1/2” wc.
4. Vacuum setting: -8" wc +/- 2” wc.

7.4 Other Control System Requirements

1. The Vaporsaver should not be used with any flexible vapor or vent piping.
2. During Pressure Decay Test (CARB TP-201.3 and Exhibit 3 of Order G-70-204), the Vaporsaver must be powered off.
3. During Tie Tank Test (CARB TP-201.3C), the Vaporsaver must be powered off.
4. During Dynamic Back Pressure Test (CARB TP-201.4), the Vaporsaver must be powered off.
5. During Air/Liquid (A/L) ratio testing (Exhibit 5 of CARB Executive Order G-70-204), the Vaporsaver can be either on or off, as it has no impact on the testing. Typically the Vaporsaver is left powered to help in controlling the vapor growth associated with air ingestion and liquid return during A/L testing.
6. To ensure proper operation of all vapor recovery components and systems (including the Vaporsaver) the entire vapor system (piping, tanks, valves, dispensers…) at a minimum must be able to pass Pressure Decay (CARB TP-201.3 and Exhibit 3 of Order G-70-204), Tie Tank (TP-201.3C), Dynamic Back Pressure (TP-201.4) and A/L (Exhibit 5 of Executive Order G-70-204) tests. Always follow local authority requirements.
7. Other testing may be required by the local authority for other vapor system components, systems, or sub-systems:
    a. During Leak Rate of Drop Tube and Drain Valve Assembly Test (CARB TP 201.1C), the Vaporsaver can be either on or off, as it has no impact on the testing. Typically the Vaporsaver is left powered to continue controlling storage tank pressure.
    b. During Leak Rate of Drop Tube Overfill Prevention Devices and Spill Container Drain Valves Test (CARB TP 201.1D), the Vaporsaver must be powered off.
    c. During Leak Rate and Cracking Pressure of Pressure/Vacuum Vent Valves Test (CARB TP 201.1E), since the pressure/vacuum vent valve is removed from the vapor system, the Vaporsaver must be powered off.
    d. During Static Torque Test (CARB TP-201.1B), the Vaporsaver can be either be on or off, as it has not impact on the testing.
    e. During the Determination of Pressure of the Underground Gasoline Storage Tanks (Exhibit 4 of Executive Order G-70-204), the Vaporsaver must be powered on.

7.5 Auxiliary Output Relay

1. The User Interface is equipped with an Auxiliary Output Relay for external monitoring of the Vaporsaver system. It is located on the main terminal block. This relay will typically be used when the Vaporsaver is installed with an In-Station Diagnostic system as specified by CARB Enhanced Vapor Recovery Program.
2. When the Vaporsaver is powered and operating normally, the Auxiliary Relay is energized (green LED on Auxiliary Relay is lit); Auxiliary Relay contact position 11 to position 14 is closed and contact position 12 to position 14 is open.
3. When the Vaporsaver is either powered off, or is in Alarm, the Auxiliary Relay is de-energized; Auxiliary Relay contact position 11 to position 14 is open and contact position 12 to position 14 is closed.
4. Auxiliary Relay contact rating: 240V, 6A with 4000V isolation.

8.0 Control System Maintenance

The OPW Vaporsaver is designed to require very little scheduled maintenance. The following table is a general guide of what is required.

8.1 Maintenance

1. Every 36 months, the Hydrocarbon Sensor must be returned to OPW for calibration. There are no serviceable parts in the Hydrocarbon Sensor. The calibration of the Sensor can be verified by checking at two locations:
    a. The Hydrocarbon Sensor has a calibration label showing the calibration due date. The Sensor is accessed by removing the Control System covers.
    b. A second calibration label is located on the side of the User Interface enclosure. A label is placed on the User Interface at the factory showing the original equipment Sensor calibration due date. Also, when a Sensor is replaced in the field, the replacement sensor is supplied with a new calibration label on the Sensor and a second label to be placed by the installer on the User Interface enclosure next to the original calibration label.
2. Every 12 months, check all belts for wear and proper tension. Only replace belts with same size and type as originally installed. See Section 8.2 for belt tension guidelines.
3. Every 12 months, check Control System operating pressure and vacuum readings.
4. Every 12 months, visually check the Control System for overall wear issues.
5. Every 12 months check total run time (TRT). If approaching or greater than the maximum hours stated in Section 8.3 replace pumps. Verify records to ensure pumps have not already been changed.

8.2 General Rules for Belt Tensioning

1. Ideal belt tension is the lowest tension at which the belt will not slip under peak conditions.
2. Tension the belt when slipping.
3. Over tensioning shortens pump, bearing and belt life.
4. Keep belts free from foreign material that may cause slippage.
5. Never apply belt dressing, as this will damage the belt and cause early failure.
6. Only replace belts with OPW specified belt size and type.
7. Over tensioning belts places extra load on the motor. An overly tight belt can add several amps to the motor loading.
8. IMPORTANT: After changing or adjusting belts, always measure the motor full load amperage; it must be less than the full load rating of the motor.

8.3 Component Replacement

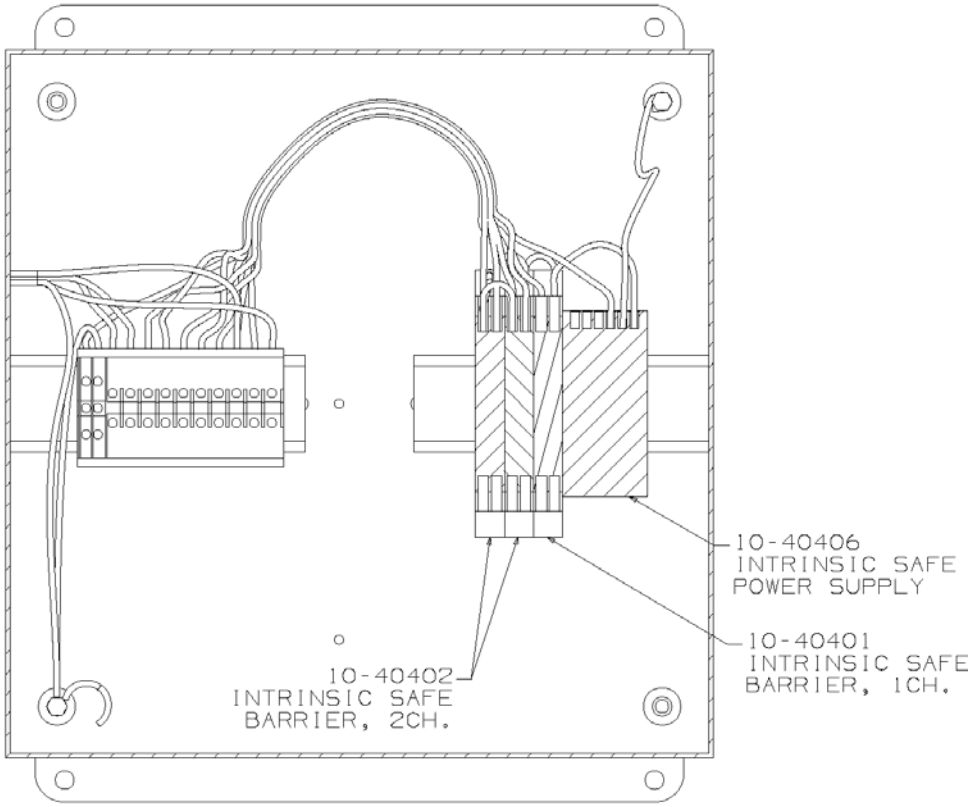
The User Interface has a totalizer (TRT: total run time since first installed) that is part of the continuous scrolling screens. This totalizer shall be used for the following maintenance/replacement items:

a. It is recommended that the compressor pump be replaced at approximately 5000 hours of operation, and is required to be replaced before 8,500 hours of operation.
b. It is recommended that the Vacuum pump be replaced at approximately 10,000 hours of operation, and is required to be replaced before 12,000 hours of operation.
c. The Membrane Module may need to be replaced at approximately 15,000 hours of operation.

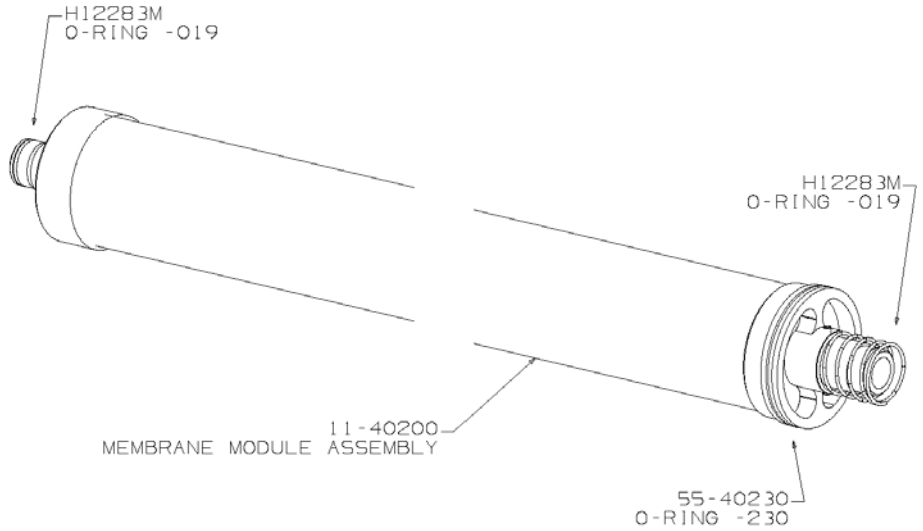
9.0 Glossary of Terms

A/L	Air to liquid ratio. With any vapor recovery system A/L relates to the volume of air (or vapor) returned by the vapor recovery system (usually measured in Cubic Ft.) divided by the volume of liquid dispensed (7.481 Gallons U.S. = 1 Cubic Ft.).
CARB	California Air Resource Board.
Control System	The enclosure that houses the membrane, motor, pumps and associated hardware that mounts to the vapor space of the UST to control tank pressure. (See Section 3.2)
Feed	Vapor flow which the Vaporsaver pulls from the storage tank, pressurizes, partially condenses and enters the membrane.
NEC	National Electric Code (NFPA 70).
ORVR	Onboard Refueling Vapor Recovery refers to vehicles equipped with their own vapor recovery system.
Permeate	Supersaturated vapor flow from the Vaporsaver returned to the storage tank.
Residue	Clean air exhaust from the Vaporsaver.
User Interface	The User Interface is the control panel for the Vaporsaver system. It contains the display and visual and audible indicators that allow personnel to observe the operational information of the Vaporsaver. It also allows end-users to set time/date and acknowledge alarms. (See Section 3.1)
UST	Underground Storage Tank
Voltage Drop	The amount of voltage lost due to any components specific resistance. All components in an electrical circuit have an inherent voltage loss. (See Section 6.0)

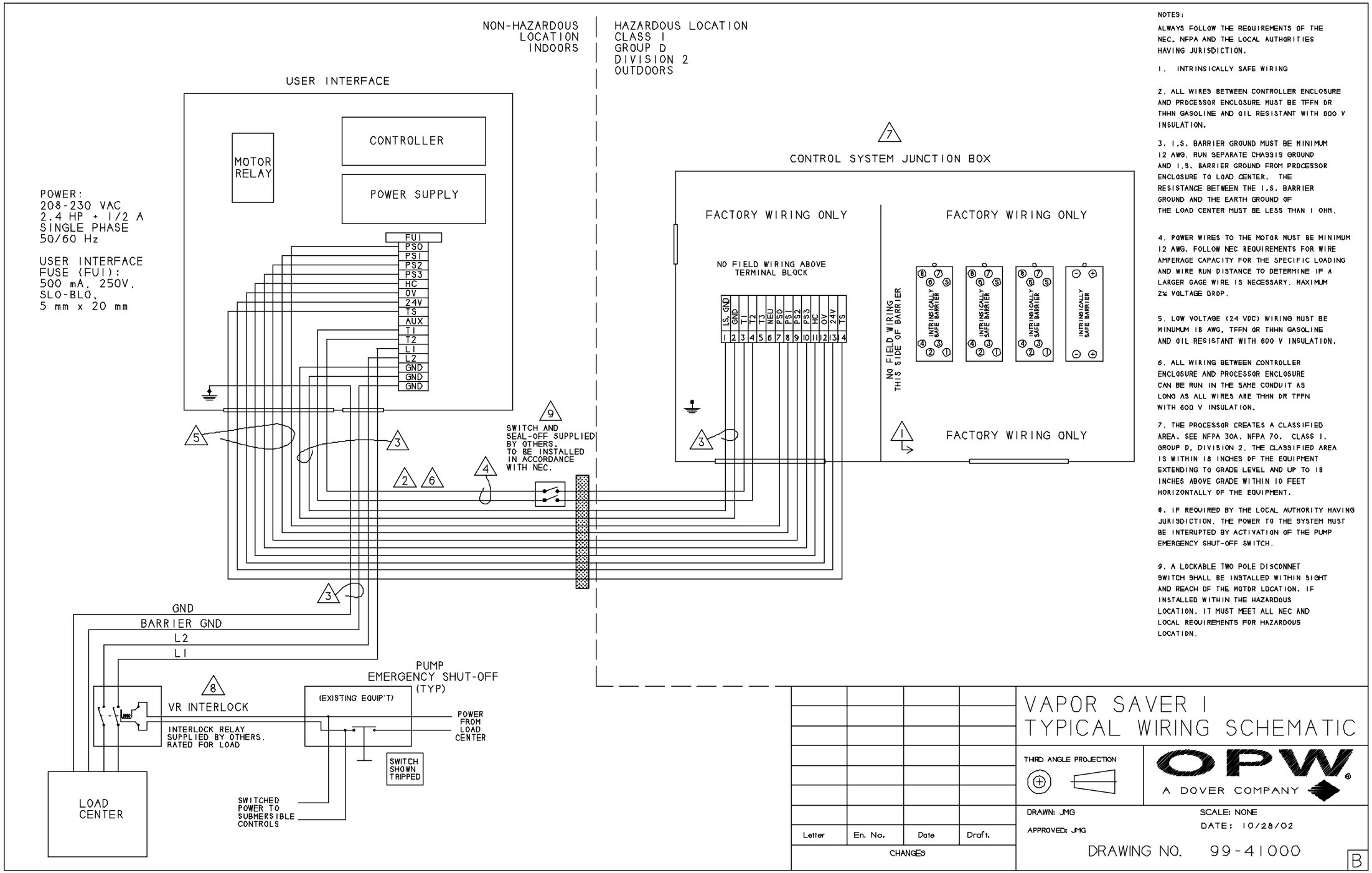
Control System Enclosure (with Intrinsically Safe Area)



Membrane Module



Membrane housing flange o-ring: H12037M



NOTES:

ALWAYS FOLLOW THE REQUIREMENTS OF THE NEC, NFPA AND THE LOCAL AUTHORITIES HAVING JURISDICTION.

1. INTRINSICALLY SAFE WIRING

2. ALL WIRES BETWEEN CONTROLLER ENCLOSURE AND PROCESSOR ENCLOSURE MUST BE TFFN OR THHN GASOLINE AND OIL RESISTANT WITH 600 V INSULATION.

3. I.S. BARRIER GROUND MUST BE MINIMUM 12 AWG. RUN SEPARATE CHASSIS GROUND AND I.S. BARRIER GROUND FROM PROCESSOR ENCLOSURE TO LOAD CENTER. THE RESISTANCE BETWEEN THE I.S. BARRIER GROUND AND THE EARTH GROUND OF THE LOAD CENTER MUST BE LESS THAN 1 OHM.

4. POWER WIRES TO THE MOTOR MUST BE MINIMUM 12 AWG. FOLLOW NEC REQUIREMENTS FOR WIRE AMPERAGE CAPACITY FOR THE SPECIFIC LOADING AND WIRE RUN DISTANCE TO DETERMINE IF A LARGER GAGE WIRE IS NECESSARY. MAXIMUM 2% VOLTAGE DROP.

5. LOW VOLTAGE (24 VDC) WIRING MUST BE MINIMUM 18 AWG, TFFN OR THHN GASOLINE AND OIL RESISTANT WITH 600 V INSULATION.

6. ALL WIRING BETWEEN CONTROLLER ENCLOSURE AND PROCESSOR ENCLOSURE CAN BE RUN IN THE SAME CONDUIT AS LONG AS ALL WIRES ARE THHN OR TFFN WITH 600 V INSULATION.

7. THE PROCESSOR CREATES A CLASSIFIED AREA, SEE NFPA 30A, NFPA 70, CLASS I, GROUP D, DIVISION 2. THE CLASSIFIED AREA IS WITHIN 18 INCHES OF THE EQUIPMENT EXTENDING TO GRADE LEVEL AND UP TO 18 INCHES ABOVE GRADE WITHIN 10 FEET HORIZONTALLY OF THE EQUIPMENT.

8. IF REQUIRED BY THE LOCAL AUTHORITY HAVING JURISDICTION, THE POWER TO THE SYSTEM MUST BE INTERUPTED BY ACTIVATION OF THE PUMP EMERGENCY SHUT-OFF SWITCH.

9. A LOCKABLE TWO POLE DISCONNET SWITCH SHALL BE INSTALLED WITHIN SIGHT AND REACH OF THE MOTOR LOCATION. IF INSTALLED WITHIN THE HAZARDOUS LOCATION, IT MUST MEET ALL NEC AND LOCAL REQUIREMENTS FOR HAZARDOUS LOCATION.

Letter	En. No.	Date	Draft.
CHANGES			

VAPOR SAVER I TYPICAL WIRING SCHEMATIC

THIRD ANGLE PROJECTION

OPW
A DOVER COMPANY

DRAWN: JMG
APPROVED: JMG
SCALE: NONE
DATE: 10/28/02

DRAWING NO. 99-41000

B

OPW

A DOVER COMPANY

VAPORSAVER

Vaporsaver 1

Start-Up and Trouble Shooting Manual

ATTENTION:

READ AND UNDERSTAND THIS IMPORTANT SAFTEY INFORMATION BEFORE BEGINNING WORK

This product is to be installed and operated near the highly combustible environment of a gasoline storage tank. It is essential for your safety and the safety of others that you carefully read, understand, and follow the warnings and instructions in this manual. Failure to do to so could result in danger to life and property including death, serious injury, explosion, fire or electric shock.

Failure to install this product in accordance with the instructions and warnings in this manual as well as failure to follow the requirements of the National Electric Code, federal, state, and local codes will result in voiding warranties of this product.

Only OPW trained and Certified technicians are to install and start-up the system. An OPW trained and Certified technician shall start-up the system only after careful inspection of the installation. The start-up form shall be completed and returned to OPW Technical Support.

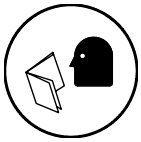
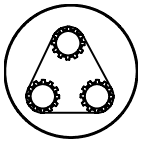
Installation, start-up, system maintenance and troubleshooting must be performed by qualified, certified service technicians. Certified technicians must be able to provide proof of certification at any time. Certification number is required for any start-up form to be completed or accepted by OPW as well for warranty purposes. Technicians requesting technical support on the Vaporsaver that do not have the necessary proof of certification will be referred to a certified service technician.

It is your responsibility to install this product in accordance with the instructions and warnings in this manual.

OPW Customer Service: 1-800-422-2525.
www.opw-fc.com

Safety Symbols

The following safety symbols may be used throughout this manual to alert you to important precautions and safety hazards that may arise during the installation and operation of this product.

	**ELECTRICITY** A potential shock hazard exists. High voltage is supplied to and exists in this device.		**TURN POWER OFF** Turn power off to the device and its accessories when installing and servicing the unit. Live power creates a potential spark hazard.
	**EXPLOSIVE** Gasoline and its vapor are extremely explosive if ignited.		**NO POWER TOOLS** Sparks from electric power tools can ignite gasoline and its vapors.
	**FLAMMABLE** Gasoline and its vapors are extremely flammable.		**NO PEOPLE IN THE AREA** Unauthorized people in the work area during installation and service of the device create a potential for personal injury.
	**NO SMOKING** Gasoline and its vapors can be ignited by sparks and embers of burning cigarettes.		**READ ALL RELATED MANUALS** Read, understand and follow all instructions, warnings and requirements before you begin work.
	**NO OPEN FLAMES** Open flames from sources like lighters, matches, etc. can ignite gasoline and its vapors.		**USE SAFETY BARRICADES** Unauthorized people or vehicles in the work area create a potential for injury and danger to property. Always isolate your work area by using safety cones, barricades, etc.
	**PINCH RISK** Stay clear. Keep hands and tools away from rotating machinery and moving parts.		**ROTATING MACHINERY** Stay clear. Keep hands and tools away from rotating machinery.

1.0 Introduction

	**WARNING: Only OPW trained and Certified technicians are to install and/or start-up the system. An OPW Certified technician shall start-up the system only after careful inspection of the installation, and completion of the start-up check list.** **Do not power up the system unless a complete start-up inspection is completed by an OPW Certified technician.**

1. The Vaporsaver when installed and operated as designed will allow any dispenser based Phase (Stage) II Vacuum Assist System to meet both the ORVR compatibility and the CARB emission requirement with the nominal A/L = 1.00 (Maximum A/L = 1.10).
2. There are many variables that influence how long the Vaporsaver will operate per day at any given site. These variables would include:
    a. Station dispensing volume
    b. Number and duration of drops
    c. Fuel vapor pressure
    d. Fuel temperature
    e. Barometric pressure and temperature
    f. Vapor tightness of the Stage I and Stage II Systems
    g. Storage tank ullage
3. The amount of operating time per day can vary from station to station, as well as from day to day at the same station. A seemingly significant variation from day to day should not be a concern. The Vaporsaver is self-monitoring; if a fault arises, an alarm will sound.

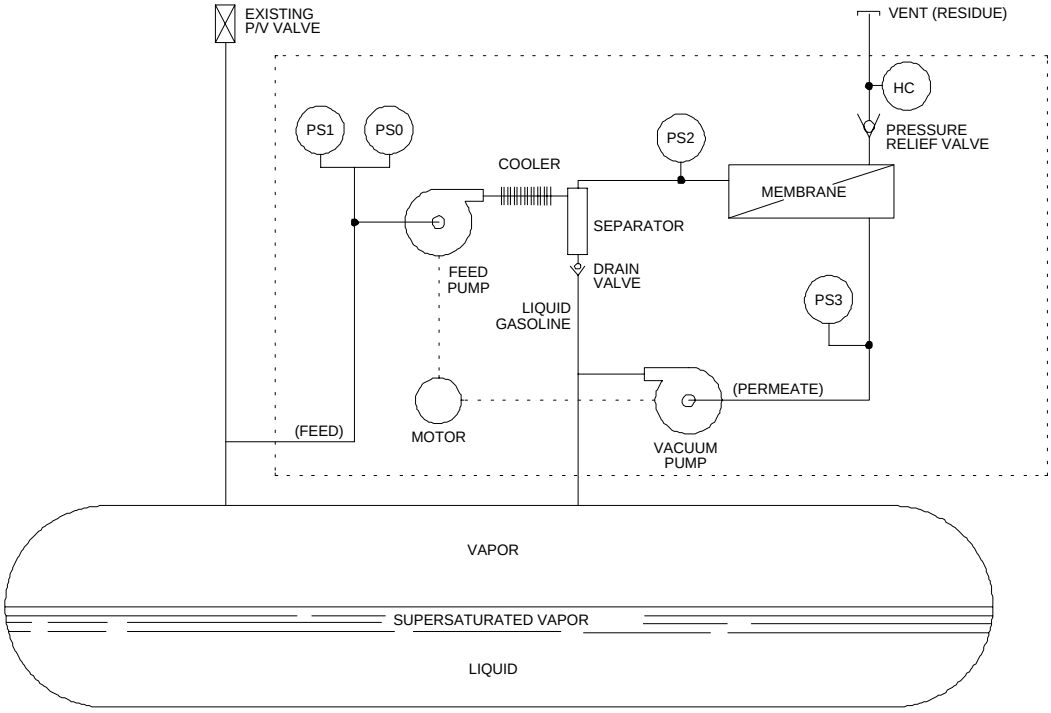
2.0 Operation

As pressure in the storage tank rises, the pressure sensor monitoring the tanks will start the Vaporsaver Control System.

1. The feed pump draws the vapor/air (saturated vapor) mixture from the storage tank.
2. The vapor/air flow is pressurized.
3. Increasing pressure within the same volume causes the vapor stream temperature to rise.
4. The heated vapor stream passes through a cooler.
5. The cooler reduces the vapor stream to ambient temperature.
6. The cooling process causes liquid gasoline to condense.
7. The vapor/air mixture and liquid gasoline go to a separator.
8. The liquid gasoline is separated, removed from the vapor/air mixture, and stored for later removal and return to the storage tank.
9. The remaining vapor/air flow proceeds to the membrane.
10. The membrane material has two sides, a pressure (feed) side, and a vacuum (permeate) side.
11. As hydrocarbon molecules pass along the membrane pressure side, they are attracted and bond to the membrane material.
12. Air molecules are repelled by the membrane surface on the pressure side, and continue on until released from the Control System as clean air (residue).

13. The pressure differential between the pressure side and the vacuum side cause the hydrocarbon molecules to be drawn through the membrane material.
14. The vacuum pump returns the supersaturated gasoline vapor (permeate) to the storage tank where some of it will condense into liquid gasoline.
15. When the pressure in the storage tank is reduced a preset level, the Control System is shut down and put into stand-by mode waiting for the pressure to rise again.
16. The separator valve is then opened, and the stored gasoline liquid in the separator is released to the UST.

VAPORSAVER 1 CONTROL SYSTEM OPERATION SCHEMATIC



NOTE: ONLY VAPOR LINES SHOWN

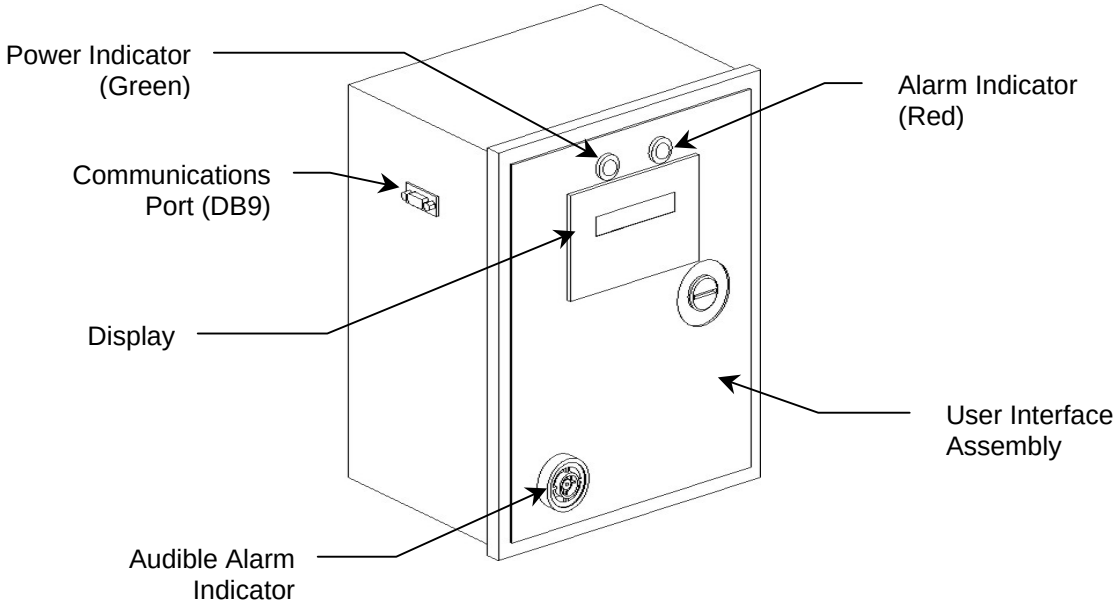
3.0 Component Identification

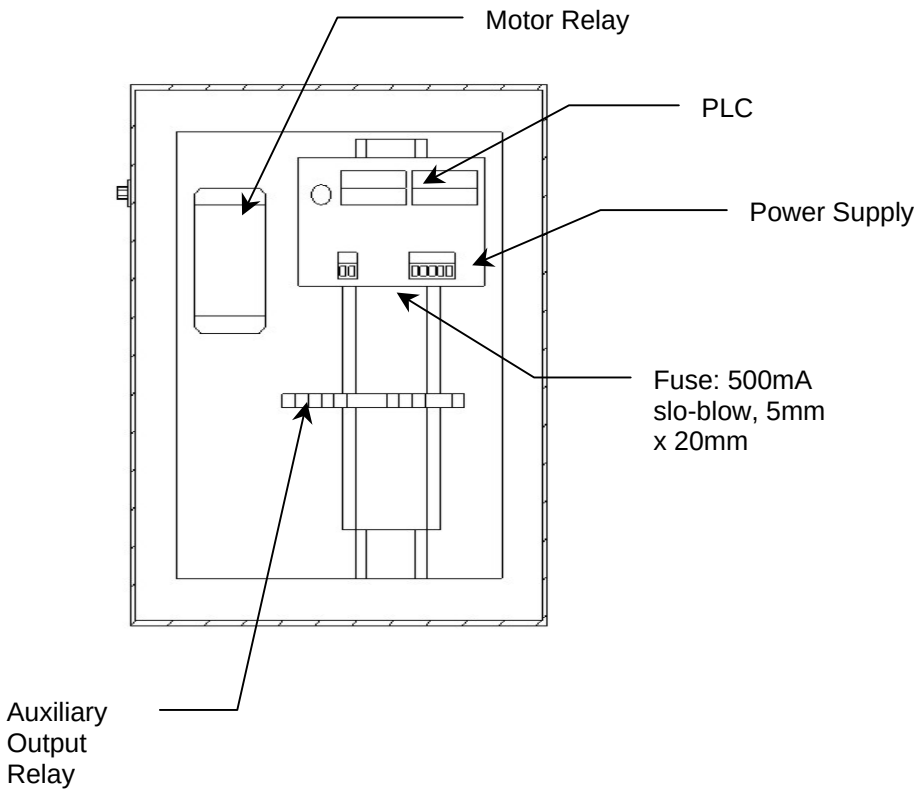
The Vaporsaver 1 consists of two major components: The User Interface and the Control System. The User Interface is the logic center of the system. It allows for interaction with the system for monitoring system status information, setting initial site configuration, and accessing recorded system history. The Control System is the active tank pressure management component.

3.1 User Interface

The User Interface incorporates the following features:

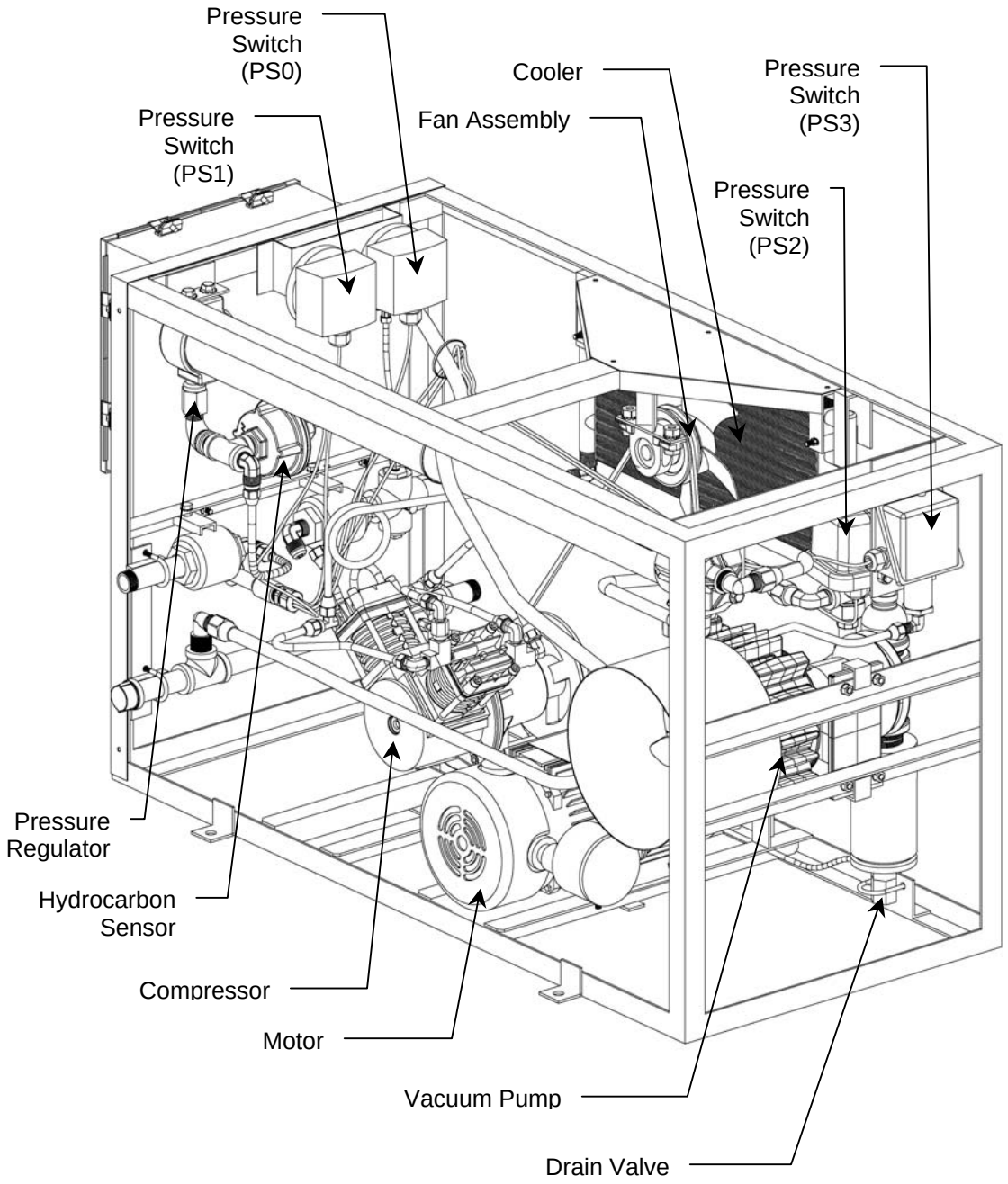
- Indicator lamps (Green - Power, Red – Alarm / Warning)
- Liquid crystal display (2 lines x 16 characters per line)
- A four button key pad
- Audible alarm indicator
- Auxiliary output alarm relay
- Port for serial communications (DB9, local or remote access)
- Operating temperature range: 32° F to 104°F (0°C to 40°C)




Motor Relay
PLC
Power Supply
Fuse: 500mA
slo-blow, 5mm
x 20mm
Auxiliary
Output
Relay

3.2 Control System

Nominal operating temperature range: -4° F to 120°F (-20°C to 50°C). Occasional and short-term excursions beyond this nominal range are acceptable, and will not cause damage to the unit.



4.0 Component Location

4.1 User Interface Location

	**WARNING: Installation of this product must comply with the National Electric Code, federal, state and local codes, as well as other applicable safety codes.**

WARNING

The User Interface enclosure must be installed in a non-Hazardous location. Explosion or fire resulting in serious injury or death, or property loss or damage could occur if the User Interface is installed in a Hazardous location.

Do not install User Interface enclosure in any combustible or explosive atmosphere (Do not install in Class 1, Division 1 or Division 2; Class IIA, Zone 0, Zone 1, or Zone 2).

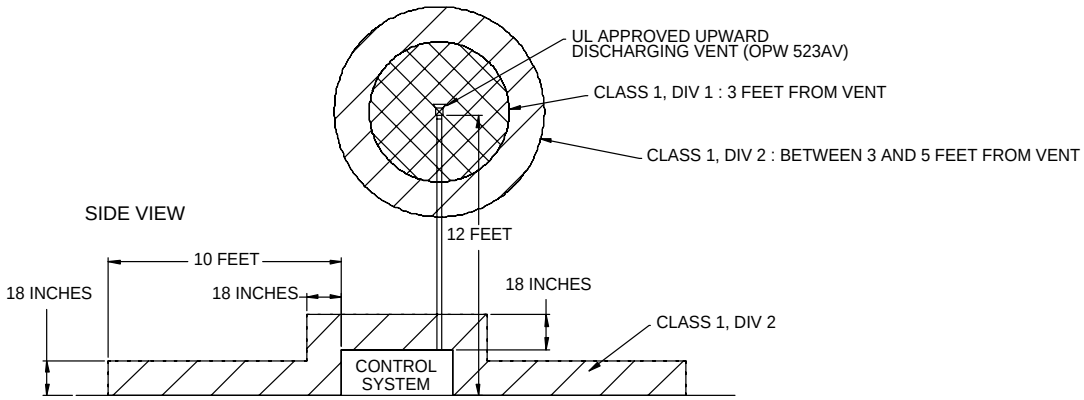
1. User Interface electrical enclosure must be installed indoors and protected from the weather.
2. The enclosure must be installed so station personnel can hear the audible alarm.
3. There must be clear access to the enclosure so station personnel can interact with it.
4. All conduit connections must be made through the factory provided knockouts in the bottom of the enclosure. All unused knockouts must be plugged. Follow NEC for approved conduit types.
5. There is a serial port on the side of the enclosure for downloading data to a computer locally or via modem.
6. There are no end user serviceable parts within the User Interface enclosure.
7. The User Interface enclosure is 10” high, 8” wide, and 6” deep.

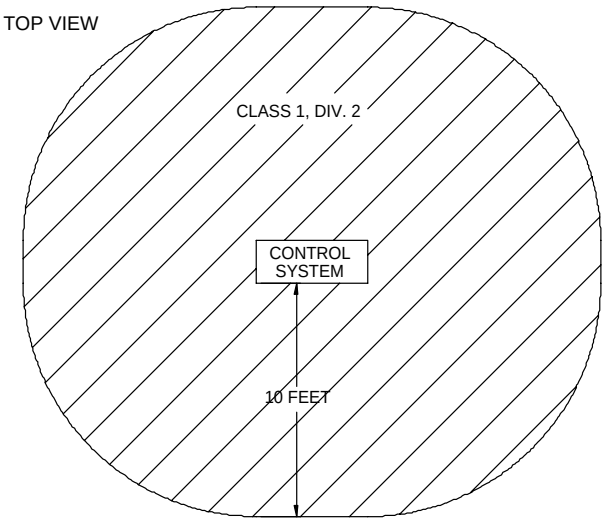
4.2 Control System Location

WARNING: Installation of this product must comply with the National Electric Code, federal, state and local codes, as well as other applicable safety codes.

1. Reference: NFPA 30A (2000) Chapter 10, Section 10.1 Vapor Processing Control Systems.
2. A hazardous location is created by the Vapor Processing Control System as per NFPA 30A (Table 8.3.1).
3. Class 1, Group D, Division 2 within 18 inches in all directions of the equipment extending to grade level. Up to 18 inches above grade level within 10 feet horizontally of the vapor processing equipment.
4. The classified area shall not extend beyond a solid floor, wall, roof, or other partition that has no communicating openings.
5. Vapor Processing Equipment shall be installed at least 10 feet from adjacent property lines that can be built upon (NFPA 10.1.6). Local authorities may grant reduced distance depending on specific circumstance (e.g. a property line with a cinderblock wall and no communicating openings).
6. Vapor Processing Equipment shall be installed at least 20 feet from dispensing devices (NFPA 10.1.6).
7. The Vaporsaver Control System **cannot** be installed within a Class I, Division 1 area created by another device or location.
8. The Vaporsaver Control System can be installed in a Class I, Division 2 area created by another device or location, but the extent of both Classified areas continue to be in affect.
9. If this is done, be sure that all existing electrical seal-offs continue to meet NEC and NFPA requirements after the installation of the Vaporsaver.
10. Always obtain approval from the local authority having jurisdiction.
11. If the Control System is located where vehicle or pedestrian traffic has access, measures must be taken to protect the Control System and exposed piping from damage or vandalism.
12. Installation of vehicle bumper posts or fenced enclosures may be necessary.
13. Use POMECO/OPW pipe guards (POMECO SPG, 6PGU, or 6PGR series guards).

Classified/Hazardous Locations





AUTHORITY SITED:

NFPA 30A - AUTOMOTIVE AND MARINE SERVICE STATION CODE

NFPA 70 - NATIONAL ELECTRICAL CODE

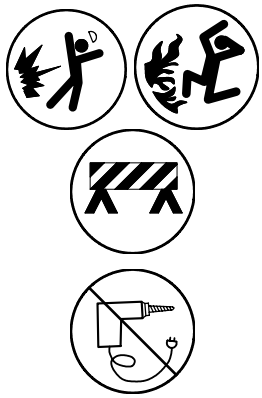
ALL DEVICES INSTALLED WITHIN THESE HAZARDOUS LOCATIONS MUST COMPLY WITH ALL APPLICABLE CODES FOR SPECIFIC HAZARDOUS LOCATION.

OBTAIN APPROVAL FROM THE LOCAL AUTHORITY HAVING JURISDICTION.

IM-VR100

4.3 Control System Mounting

WARNING



The Control System is to be installed near locations where highly flammable and explosive vapors and liquids may be present. Risk of fire, explosion, serious injury or death.

You are working in an area where vehicle traffic may occur. Always block off the work area during installation and service to protect yourself and others.

Do not use power tools that can generate sparks if there is a risk of flammable or explosive vapors or liquids being present.

1. The Control System can be installed directly on grade.
2. It must be permanently anchored to concrete or another solid base, and must be installed level.
3. Minimum clearances for service access (more clearance always makes service easier).
    a. Back: 12 inches
    b. Top: 12 inches
    c. Front: 12 inches
    d. Left: 48 inches
    e. Right: 12 inches
4. Do not install Control System where snow will accumulate or be placed when clearing lots. The above minimum clearances should be maintained at all times during operations.
5. Do not install where irrigation or sprinkler systems can spray water up through the louver vents.
6. If it is necessary to install a concrete pad, a 3 foot by 6 foot (or 3 foot by 5 foot) pad is adequate; minimum 4” thickness. To ease and speed installation, use a POMECO/OPW island-form (p/n 6013-SFR6W3L6 or 6013-SFR6W3L5).

5.0 Control System Piping

WARNING

The Control System is to be installed near locations where highly flammable and explosive vapors and liquids may be present. Risk of fire, explosion, serious injury or death.

You are working in an area where vehicle traffic may occur. Always block off the work area during installation and service to protect yourself and others.

Do not use power tools that can generate sparks if there is a risk of flammable or explosive vapors or liquids being present. Open piping to the gasoline storage tank will be emitting dangerous, flammable and potentially explosive vapors. Do not smoke or have open flames in areas near open piping.

5.1 General Piping Guidelines

1. The main guide for piping is that the Control System should pull from and return to different parts of the vapor system.
2. All aboveground piping must be schedule 40 galvanized; only use pipe that is internally and externally corrosion protected.

5.2 Inlet Piping

1. With vapor manifold tanks the Control System inlet is typically connected to the high-grade gasoline storage tank or the Stage II piping between the dispensers and the tanks.
2. Inlet piping must slope away from Control System and have slope to drain towards storage tanks. Slope minimum 1/4" per foot between the Vaporsaver and the vents.
3. Piping should remain a minimum of 2" ID from the Control System inlet connection pipe to the connection to the storage tank (or storage tank vents).

5.3 Clean Air Vent Piping

1. The clean air vent (residue) must be piped so the discharge opening is 12 feet minimum above adjacent grade.
2. The clean air vent must have an NFPA and UL approved upward discharging vent (Use OPW 523AV).
3. The clean air vent piping shall remain a minimum of 1-1/2" ID.
4. The vent creates a hazardous location as per NFPA 30A.
    a. Class 1, Group D, Division 1 within 3 feet in all directions of the vent opening.
    b. Class 1, Group D, Division 2 between 3 feet and 5 feet in all directions of the vent opening.
    c. Follow all applicable codes.

5.4 Hydrocarbon Return Piping

1. With vapor manifold tanks, the Control System hydrocarbon return (permeate) should be connected to the low-grade gasoline storage tank.
2. The hydrocarbon return piping has an extra exit – if the using the outlet on the front of the Control System causes installation problems, use the outlet on the back of the unit. The unused outlet pipe opening must be capped.
3. The hydrocarbon return piping must slope away from Control System. This pipe will be carrying liquid condensation from the separator, and supersaturated vapor. Slope minimum 1/4" per foot between the Vaporsaver and the vent.
4. The hydrocarbon return piping must remain 1-1/2" ID minimum until it returns to the storage tank.

5.5 Underground Piping

1. If the Control System is to be installed at a distance from the vents, underground piping can be installed to connect the Control System to the vent piping.
2. Minimum slope: 1/8” per foot (1/4” per foot recommended).
3. For underground piping, all of the above size and slope requirements must be met as well as all standard requirements for underground vapor piping. Never use flexible vapor piping.
4. Follow local requirements for underground vapor piping with regard to secondary containment.

5.6 Storage Tank Vapor Manifolds

1. Storage tanks must be vapor manifold (above and/or below grade). Follow requirements of the local authority.
2. Some local authorities require manifold in one location or the other; check with the local authority having jurisdiction.
3. Above ground manifold must be minimum 12 feet above adjacent grade.
4. Tank vent openings must be greater than 12 feet above adjacent grade and have UL Listed and CARB Approved Pressure/Vacuum valves (In California, consult Executive Order G-70-204 for acceptable P/V vent valves).
5. All above ground vapor piping must be schedule 40 galvanized steel, and painted to minimize solar heat gain.
6. A hazardous location is created by the vents as per NFPA 30A.
    a. Class 1, Group D, Division 1 within 3 feet in all directions of the vent opening.
    b. Class 1, Group D, Division 2 between 3 and 5 feet in all directions of the vent opening.
    c. The classified area shall not extend beyond a solid floor, wall, roof, or other partition that has no communicating openings.

5.7 Stage II Station Underground Piping

1.0 All underground vapor piping must be a minimum of 2” ID. Always check with local authorities for applicable requirements; larger pipe size may be required.

2.0 All vapor piping must have slope for drainage to the underground storage tanks.

3.0 Minimum slope is 1/8 inch drop per foot run. Recommended wherever possible 1/4 inch drop per foot run.

4.0 Always follow the requirements of the local authorities and the manufacturer of the Stage II vapor recovery system.

5.0 See Vaporsaver Installation Manual for several typical vapor piping layouts.

6.0 Electrical Requirements

WARNING

This system uses lethal voltages and operates in areas where flammable vapors and liquids may be present.

Serious injury or death from electrical shock, fire, or explosion may result if the power is on during installation.

Turn power off, lockout and tag power to the unit while installing the system.

Read and understand all instructions in this manual and all applicable requirements of the National Electric Code, federal, state and local codes, as well as other applicable safety codes.

6.1 Power Requirements

1. Vaporsaver System
   208-230 VAC
   50/60 Hz
   Single Phase
   2.4 Hp plus 1/2 amp
2. A circuit disconnect devise is not included with the Vaporsaver System. A readily accessible two pole disconnect device must be incorporated in the installation wiring for the motor.
3. There are no end user serviceable parts in the Vaporsaver System.
4. The User Interface has internal fuse: 500 mA (slow-blow), 250 V, 5mm x 20mm. The fuse is to only be replaced by qualified and certified technicians.
5. An electrical service (breaker) of minimum 20 amp / 240V should be used. A larger breaker may be necessary in some installations; verify required over-current protection ampacity with NEC requirements for load and conductor ampacity ratings and with the local authority having jurisdiction. Note: The motor in the Vaporsaver 1 has full load amperage rating of 12 amps, but the start-up inrush current is higher.
6. A lockable circuit breaker shall be supplied in accordance with local, state and national authorities. Some jurisdictions require that the main circuit breaker for the Vaporsaver system be locked in the ON position during normal operation. This is to avoid accidental shut-off of the system. It is also good practice to follow standard lock-out/tag-out procedures when performing service on the unit and may be required by local, state, and national authorities. (For padlock requirement use Square D model: HPAFK; Square D model: QBPA or equivalent for specific breaker).
7. This product shall be installed in accordance with the National Electrical Code (NFPA 70) and the Automotive and Marine Service Station Code (NFPA 30A).
8. The Vaporsaver 1 main power should be controlled by the facility's main Emergency Shut-Off system.

6.2 Control System Electrical Hook Ups

1. System Breaker shall be sized for power load based on NEC requirements.
2. Wiring between the User Interface and the Control System shall be as follows.
    a. All wiring (220VAC and 24VDC) to be TFFN or THHN with 600 V insulation, gasoline and oil resistant.
    b. Wiring for the 24 VDC control signals shall be minimum 18 AWG.
    c. Two ground wires shall be run from the Control System junction box to the load center ground; one is for equipment ground, and the second is for a dedicated Intrinsically Safe Barrier ground. Both ground wires must be minimum 12 AWG (follow all NEC requirements for equipment and Intrinsically Safe Barrier grounding). Proper grounding for the Intrinsically Safe Barrier is crucial for safe operation of the Barriers.
    d. Both the motor power (220VAC) wiring and the signal wiring (24 VDC) can be routed in the same conduit provided all wiring meet NEC 725-27; use only TFFN and/or THHN, gasoline and oil resistant wiring with 600 V insulation.
    e. Wiring for 208-230 VAC to power motor shall be minimum 12 AWG; sizing must comply with NEC requirements for motor load and wiring distance. Larger gage wire may be necessary based on conductor length and voltage supplied by load center.
        i. The following table should be used as a guide to help in correctly sizing motor conductors based on length. Always follow NEC and the requirements of the local authorities.
        ii. The following table is based on using a conductor ampacity rating of 140% of the motor nameplate rating. Motor nameplate: 12.0 A; 140% of motor nameplate: 16.8A.
        iii. NEC recommends a maximum conductor voltage drop of 3%, but notes that with a conductor voltage drop of 5%, most devices should operate with acceptable efficiency. It should been noted that with a conductor voltage drop of 5%, motor starting capabilities are reduced, and difficult starting may occur especially if the load center voltage is supplying 208 VAC. So, if the load center is supplying 208 VAC, use 3% voltage drop as the maximum allowable whenever possible. With the load center supplying 230 VAC, most installations should have acceptable operation with a maximum conductor voltage drop of 5%. But, always remember that lower conductor voltage drop is always better for motor starting and operating efficiency; so whenever possible **use the 3% conductor voltage drop**.
        iv. Running voltage at the motor must never drop below 197 VAC. Motor operation may become significantly affected.

Maximum conductor length is the total length of the conductor from the load center to the User Interface to the motor.

Maximum Conductor Length (feet)

Voltage	208	208	230	230
% Voltage Drop	3%	5%	3%	5%
AWG	Feet (maximum)			
12	91	151	100	167
10	144	240	159	265
8	229	382	254	423

Note: If local authority will allow conductor ampacity rating of 125% of motor nameplate instead of 140%, multiply the maximum length in the table by 1.12 to get the new maximum conductor length.

6.3 Other Control System Requirements

1. The Vaporsaver should not be used with any flexible vapor or vent piping.
2. During Pressure Decay Test (CARB TP-201.3 and Exhibit 3 of Order G-70-204), the Vaporsaver must be powered off.
3. During Tie Tank Test (CARB TP-201.3C), the Vaporsaver must be powered off.
4. During Dynamic Back Pressure Test (CARB TP-201.4), the Vaporsaver must be powered off.
5. During Air/Liquid (A/L) ratio testing (Exhibit 5 of CARB Executive Order G-70-204), the Vaporsaver can be either on or off, as it has no impact on the testing. Typically the Vaporsaver is left powered to help in controlling the vapor growth associated with air ingestion and liquid return during A/L testing.
6. To ensure proper operation of all vapor recovery components and systems (including the Vaporsaver) the entire vapor system (piping, tanks, valves, dispensers…) at a minimum must be able to pass Pressure Decay (CARB TP-201.3 and Exhibit 3 of Order G-70-204), Tie Tank (TP-201.3C), Dynamic Back Pressure (TP-201.4) and A/L (Exhibit 5 of Executive Order G-70-204) tests. Always follow local authority requirements.
7. Other testing may be required by the local authority for other vapor system components, systems, or sub-systems:
    a. During Leak Rate of Drop Tube and Drain Valve Assembly Test (CARB TP 201.1C), the Vaporsaver can be either on or off, as it has no impact on the testing. Typically the Vaporsaver is left powered to continue controlling storage tank pressure.
    b. During Leak Rate of Drop Tube Overfill Prevention Devices and Spill Container Drain Valves Test (CARB TP 201.1D), the Vaporsaver must be powered off.
    c. During Leak Rate and Cracking Pressure of Pressure/Vacuum Vent Valves Test (CARB TP 201.1E), since the pressure/vacuum vent valve is removed from the vapor system, the Vaporsaver must be powered off.
    d. During Static Torque Test (CARB TP-201.1B), the Vaporsaver can be either be on or off, as it has not impact on the testing.
    e. During the Determination of Pressure of the Underground Gasoline Storage Tanks (Exhibit 4 of Executive Order G-70-204), the Vaporsaver must be powered on.

6.4 Auxiliary Output Relay

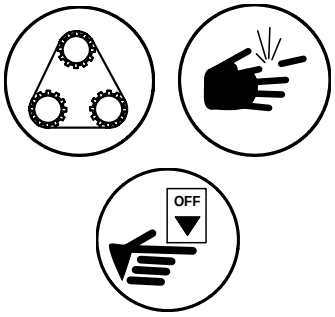
1. The User Interface is equipped with an Auxiliary Output Relay for external monitoring of the Vaporsaver system. It is located on the main terminal block. This relay will typically be used when the Vaporsaver is installed with an In-Station Diagnostic system as specified by CARB Enhanced Vapor Recovery Program.
2. When the Vaporsaver is powered and operating normally, the Auxiliary Relay is energized (green LED on Auxiliary Relay is lit); Auxiliary Relay contact position 11 to position 14 is closed and contact position 12 to position 14 is open.
3. When the Vaporsaver is either powered off, or is in Alarm, the Auxiliary Relay is de-energized; Auxiliary Relay contact position 11 to position 14 is open and contact position 12 to position 14 is closed.
4. Auxiliary Relay contact rating: 240V, 6A with 4000V isolation.

7.0 User Interface

In the following sections, bold text in **boxes** show what is displayed on the User Interface.

7.1 Start-Up & LED Identification

WARNING



Rotating machinery. Keep clear of the Control System when powering up or resetting the unit. The unit will start automatically. Be sure all covers are in place when power is applied to unit, starting or resetting the unit. Risk of serious injury.

Always power off system when performing maintenance or service. Unit starts automatically. Risk of serious injury.

LED Identification

PLC Inputs: X0-XF

N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C	HC	PS3	PS2	PS1	PS0
XF	XE	XD	XC	XB	XA	X9	X8	X7	X6	X5	X4	X3	X2	X1	X0

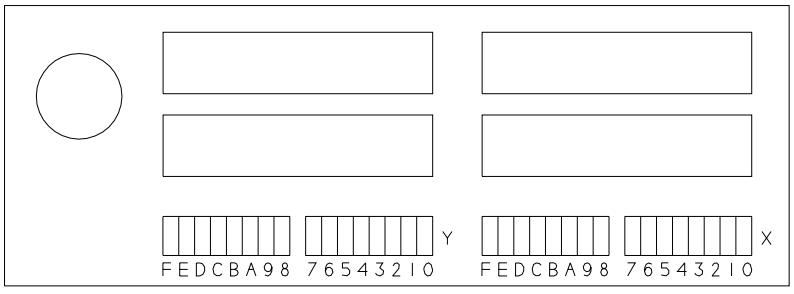
PLC Outputs: Y0-YF

Flash: VAC 1 Fail Solid: VAC 2 Fail	VAC Alarm	2 Minute Stand-by	RT Warning	PR Alarm	HC Alarm	COMP Alarm	Flash: COMP 1 Fail Solid: COMP 2 Fail	ISD Test Mode	N/C	N/C	Aux Relay	Motor Relay	Buzzer	Power Light	Alarm Light
YF	YE	YD	YC	YB	YA	Y9	Y8	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0

7.2 Controller I/O

Below is a table describing each LED on the Controller Module and it's significance. The LEDs are arranged in four arrays. The two "X" arrays are system inputs (labeled 0-F). The two "Y" arrays are system outputs and diagnostics (labeled 0-F).

LED	Signal	LED FLASH	LED ON	LED OFF
X0	PS0 (Stop)		PS0 closed; UST < -0.5"wc	PS0 open; UST > -0.5"wc
X1	PS1 (Run)		PS1 closed; UST > +0.1"wc	PS1 open; UST < +0.1"wc
X2	PS2 (Comp)		PS2 closed; Comp > 15 psi	PS2 open; Comp < 15psi
X3	PS3 (Vac)		PS3 closed; Vac > 15"hg	PS3 open; Vac < 15"hg
X4	HC sensor		HC sensor low; HC low %	HC sensor high; HC high %
X5 - XF	N/C			
Y0	Alarm Light		Alarm light on	Alarm light off
Y1	Power Light		Power light on	Power light off
Y2	Buzzer		Buzzer on	Buzzer off
Y3	Motor Relay		Motor relay energized	Motor relay not energized
Y4	Aux Relay		System Normal	Loss of power or Alarm
Y5 – Y6	N/C			
Y7	ISD Test		ISD Test Running	System Normal
Y8	Comp Fail	Compressor 1 fail	Compressor 2 fail	System Normal
Y9	Comp Alarm		COMP Alarm	System Normal
YA	HC Alarm		HC Alarm	System Normal
YB	PR Alarm		PR Alarm	System Normal
YC	RT Warn		RT Warning	System Normal
YD	Standby		2 minute standby active	System Normal
YE	Vac Alarm		VAC Alarm	System Normal
YF	Vac Fail	Vacuum 1 Fail	Vacuum 2 fail	System Normal



1. Each time the power to the Vaporsaver is cycled ON or the system is RESET, it will go through a Self Test for up to 180 seconds. It will display:

SYSTEM SELF TEST **PLEASE WAIT**	Control System is performing a self diagnostic (display shows timer)

2. During this time, the Control System will run and verify proper operation of all of 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.

During a self-test, a timer will be shown on the front display. Once the motor relay is energized, the timer will start. The motor will operate for 120 seconds. Below is the sequence of a proper self-test.

Timer	Actions
0	Motor starts (motor relay closes)
30	PS2 (X2 on) and PS3 (X3 on) must be closed (typically on/closed within 10 seconds); signals must remain in this condition until motor stops.
60	HC must be closed (X4 on) for at least 10 continuous seconds between self-test timer 60-120 seconds.
120	Motor stops (motor relay opens)
120 – 180	PS2 and PS3 must be open (X2 and X3 off) within 60 seconds of the motor deactivation.

If the above conditions are not met, the system will alarm and indicate the problem area.

Control Signals

All of the input (PS0, PS1, PS2, PS3, HC, TS) and output (motor relay coil) control signals are 24 VDC. Verification of these signals can be verified by measuring the voltage between the signal channel and 0 VDC. If measuring voltage directly on the pressure switches, the voltage will be 24 VDC if switch is open and 0 VDC if switch is closed. If measuring at the User Interface terminal block, or the Control System enclosure terminal block, the voltage will be 24 VDC if the switch is open and between 1 and 2 VDC when the switch is closed. This small voltage is attributed to the resistance in each pressure switch circuit introduced by the Intrinsically Safe barriers.

The hydrocarbon sensor is power by an intrinsically safe power supply. Input to the Intrinsically Safe power supply is 24 VDC, and the output is 6.0 – 6.5 VDC. Power is always applied to the HC sensor. The HC sensor output channel switches 24 VDC just like the pressure switches. The voltage to the HC sensor must be above 6.0 VDC for the sensor to function properly; use the small adjusting screw on the front of the power supply to increase the output voltage if necessary.

If Display shows “PLC NOT RUNNING”
Verify “RUN/PROG” switch on PLC, should be “RUN”
Green LED “RUN” on PLC is lit.

7.3 Normal Operation

Once the Self Test is successfully completed, the User Interface displays a continuous scrolling screen showing the following information.

SYSTEM NORMAL **DATE TIME**	Operational Status Current Date and Time
TRT xxxxxx HRS **DRT xxxx MIN**	Total Run Time since installed (hours) Daily Run Time so far current day (minutes)

7.4 Alarms

1. When an error has occurred in the operation of the Control System, the User Interface will sound a buzzer and the display will change from SYSTEM NORMAL to the appropriate error code. The station operator should then call for service.
2. **The alarm buzzer does <u>not</u> indicate a safety emergency.** If the Control System is not functioning properly, an alarm will sound, and the Control System will shut down.
3. The Vaporsaver is equipped with self-test capabilities to minimize false alarms.
4. Some local authorities may require notification of the local Air Quality District in the event of an alarm.

Note that if more then one alarm occurs at the same time, the most recent will appear first, then the previous one, until all the current alarms are shown.

7.5 Alarms and Their Causes

<u>Comp Alarm</u>

1. During a “System Self Test”, if PS2 is not activated (closed, 15 psi) within 30 seconds of the motor starting.
2. During “System Normal” operation, is PS2 is not activated (closed, 15 psi) within 30 seconds of the motor starting on three consecutive run cycles.

<u>Vac Alarm</u>

1. During a “System Self Test”, if PS3 is not activated (closed, 15 in Hg) within 30 seconds of the motor starting.
2. During “System Normal” operation, is PS3 is not activated (closed, 15 in Hg) within 30 seconds of the motor starting on three consecutive run cycles.

<u>HC Alarm</u>

1. During a “System Self Test”, if HC is not activated for 10 continuous seconds between 60 and 120 seconds of the Self Test Timer.
2. During “System Normal” operation, if HC is not activated for 60 continuous motor running minutes. The HC sensor has a debounce to reduce the risk of false alarms, and to ensure recognition of actual alarms.
3. This alarm indicates that the air being released to atmosphere contains a hydrocarbon concentration above the design limit. If this event occurs, the Control System shuts down, and the alarm will sound.

PR Alarm

1. After every run cycle, if PS2 and/or PS3 do not open within 60 seconds of the motor relay opening.
2. This is a general alarm that could be caused by several factors.
    a. The motor relay has failed closed leaving the Control System running continuously when is it not required.
    b. Compressor pressure switch has failed closed.
    c. Vacuum pump pressure switch has failed closed.

RT Warning

1. Three consecutive days of run time greater than 1140 minutes.
2. Three consecutive days with less than 5 minutes of run time per day.

This warning indicates that the Control System daily run time is either too much, or not enough. This alarm does not shut the System down. But, a certified service technicians should be called to investigate the abnormal behavior.

Comm Error

1. This is a result of the PLC and Display losing communications.
2. Generally caused by a failure in the cable between the PLC and the display or incompatible programs in the PLC and Display.

7.6 TS (motor internal thermal switch protection)

In the event the motor is failing, the load is too great (failing pumps, over tight belts…), the motor internal thermal switch can open. The TS is electrically in series with the motor relay coil. If the motor overheats, the TS will open, causing the motor relay to de-energize. The PLC will continue to have a motor output signal (Y3) until the system goes into COMP and VAC Alarms.

7.7 Silencing Alarms

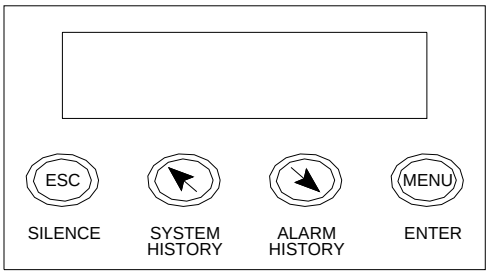
1. Once an alarm is triggered, the User Interface will emit an audible tone with a visual indication. This indicates that the Vaporsaver requires immediate attention. Service should be called.
2. Once the alarm has been noted, and the appropriate action has been taken, the alarm SILENCE button can be pushed to silence the alarm.
3. The display will continue to emit a tone every hour as a reminder that the System is in alarm, and the red alarm indicator will remain flashing.

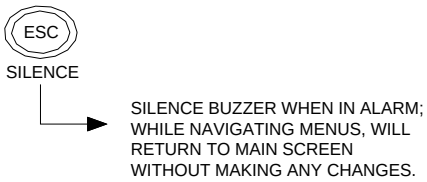
7.8 Resetting Alarms

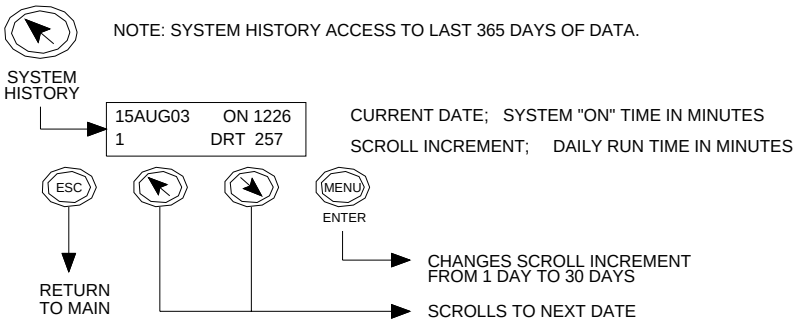
1. The alarm should only be reset by factory trained personnel.
2. When the System is reset, the Control System will start running. Be sure there are no people or tools inside the unit.
3. Press the MENU button.
4. Press the RESET button.
5. Press the YES button.
6. If the Control System completes the Self Test without any problems, the display will return to SYSTEM NORMAL.

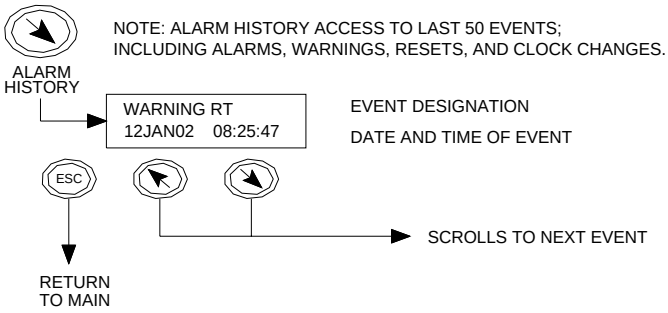
7.9 Set-up and Navigation

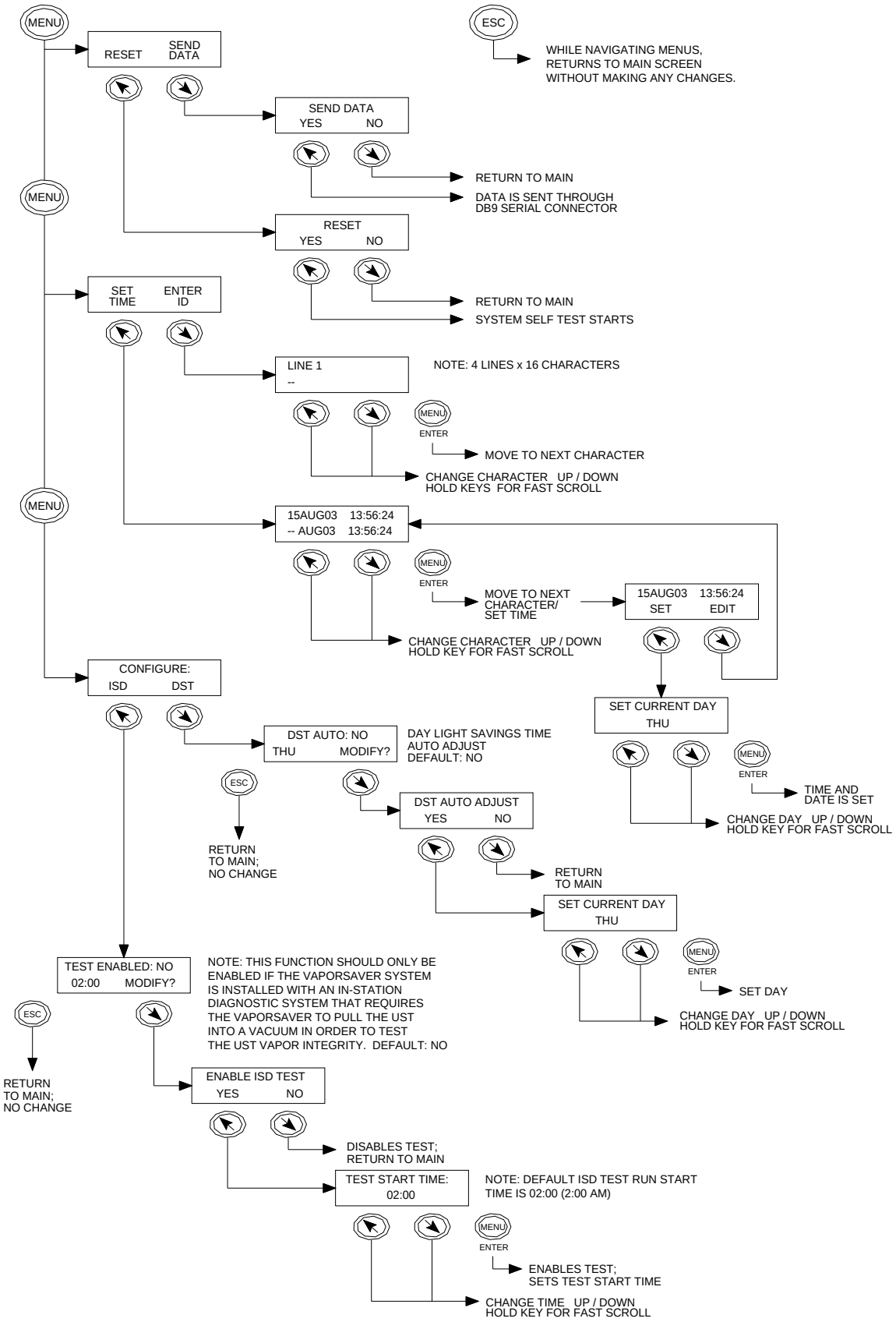
1. When first installed and started up, the following information should be installed in the User Interface:
    a) Station identification
    b) Current date
    c) Current time
    d) Daylight savings time enable/disable
    e) In Station Diagnostics test enable/disable (for use with CARB Enhanced Vapor Recovery In-Station Diagnostic systems)
2. From main screen press MENU twice to get to the set-up menus.





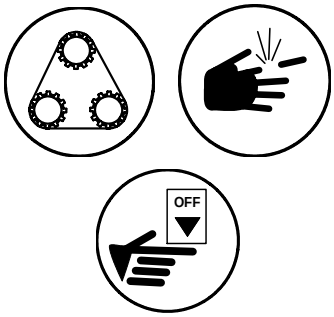





MENU
RESET SEND DATA
ESC
WHILE NAVIGATING MENUS, RETURNS TO MAIN SCREEN WITHOUT MAKING ANY CHANGES.
SEND DATA
YES NO
RETURN TO MAIN
DATA IS SENT THROUGH DB9 SERIAL CONNECTOR
MENU
RESET
YES NO
RETURN TO MAIN
SYSTEM SELF TEST STARTS
SET TIME ENTER ID
LINE 1
--
NOTE: 4 LINES x 16 CHARACTERS
MENU
ENTER
MOVE TO NEXT CHARACTER
CHANGE CHARACTER UP / DOWN
HOLD KEYS FOR FAST SCROLL
MENU
15AUG03 13:56:24
-- AUG03 13:56:24
MENU
ENTER
MOVE TO NEXT CHARACTER/ SET TIME
15AUG03 13:56:24
SET EDIT
CHANGE CHARACTER UP / DOWN
HOLD KEY FOR FAST SCROLL
CONFIGURE:
ISD DST
SET CURRENT DAY
THU
MENU
ENTER
TIME AND DATE IS SET
CHANGE DAY UP / DOWN
HOLD KEY FOR FAST SCROLL
DST AUTO: NO
THU MODIFY?
DAY LIGHT SAVINGS TIME AUTO ADJUST DEFAULT: NO
ESC
RETURN TO MAIN; NO CHANGE
DST AUTO ADJUST
YES NO
RETURN TO MAIN
SET CURRENT DAY
THU
MENU
ENTER
SET DAY
CHANGE DAY UP / DOWN
HOLD KEY FOR FAST SCROLL
TEST ENABLED: NO
02:00 MODIFY?
NOTE: THIS FUNCTION SHOULD ONLY BE ENABLED IF THE VAPORSAVER SYSTEM IS INSTALLED WITH AN IN-STATION DIAGNOSTIC SYSTEM THAT REQUIRES THE VAPORSAVER TO PULL THE UST INTO A VACUUM IN ORDER TO TEST THE UST VAPOR INTEGRITY. DEFAULT: NO
ESC
RETURN TO MAIN; NO CHANGE
ENABLE ISD TEST
YES NO
DISABLES TEST; RETURN TO MAIN
TEST START TIME:
02:00
NOTE: DEFAULT ISD TEST RUN START TIME IS 02:00 (2:00 AM)
MENU
ENTER
ENABLES TEST; SETS TEST START TIME
CHANGE TIME UP / DOWN
HOLD KEY FOR FAST SCROLL

8.0 Control System Trouble Shooting

This Trouble Shooting Guide is intended to cover the most likely causes of the alarms listed in Section 7.5.

WARNING	
	**Rotating machinery. Keep clear of the Control System when powering up or resetting the unit. The unit will start automatically. Be sure all covers are in place when power is applied to unit, starting or resetting the unit. Risk of serious injury.** **Always power off system when performing maintenance or service. Unit starts automatically. Risk of serious injury.**

8.1 ALARM COMP (Compressor/Feed Pump Alarm)

PS2 pressure switch does not close on three consecutive run cycles. Use pressure tap (1/4" NPT) on top of separator to install test gage (0-30 PSI) and measure feed pressure.

Potential Alarm Cause	**Action**	**Result**
Motor service switch OFF	Verify switch and voltage	Turn switch ON
Drive belt loose and slipping	Visual Inspection of belt tension	Tighten idler pulley See Section 9.2
Drive belt failure	Visual Inspection	Replace belt
Compressor pump failure	Pump shaft not turning; Extreme belt wear	Replace pump
Drive motor failure	Motor not spinning with power applied	Check wiring, Replace relay, replace motor
Control System not holding pressure		
Separator drain valve not closing	Not achieving 25 psi. Drain valve outlet has flow when greater than 5 psi.	Disassemble, inspect, and clean, replace drain valve.
Failure of residue check valve	Residue check valve has flow when Control System is below 25 psi.	Replace valve
Leaks in Control System piping	None of the above obvious on visual inspection.	Inspect at all tube and pipe joints and tighten; pressurize system and use soap bubble or leak detection solution to inspect all tube and pipe joints
Failure of pressure switch (PS2); failure of I.S. module	A good switch and circuit will show: at greater than 15 psi, measure approx 0 VDC across contacts; at less than 15 psi, measure 24 VDC across contacts. Measure at switch and I.S. terminal block	Check and replace switch Check wiring Check and replace I.S. module
Damaged o-ring on membrane module or housing flange	Inspect o-rings on membrane module	Replace damaged o-rings

8.2 ALARM VAC (Vacuum Pump Alarm)

PS3 pressure switch does not close on three consecutive run cycles. Use pressure tap (1/4" NPT) on vacuum pump to install test gage (0-30 in Hg) and measure vacuum.

Potential Alarm Cause	**Action**	**Result**
Motor service switch OFF	Verify switch and voltage	Turn switch ON
Drive belt loose and slipping	Visual Inspection of belt tension	Tighten idler pulley See Section 9.2
Drive belt failure	Visual Inspection; Belt torn or worn	Replace belt
Vacuum pump failure	Pump shaft not turning; Extreme belt wear	Replace vanes or pump
Drive motor failure	Motor not spinning with power applied	Replace motor
Control System not holding vacuum		
Leaks in Control System piping	None of the above obvious on visual inspection.	Inspect at all tube and pipe joints and tighten; pressurize system and use soap bubble or leak detection solution to inspect all tube and pipe joints
Failure of vacuum switch (PS3); failure of I.S. module	A good switch and circuit will show at greater than 15 inHg, measure approx 0 VDC across contacts; at less than 15 inHg, 24 VDC across contacts. Measure at switch and I.S. terminal block	Check and replace switch Check wiring Check and replace I.S. module
Damaged o-ring on membrane module or housing flange	Inspect o-rings on membrane module	Replace damaged o-rings

8.3 ALARM HC (Hydrocarbon Sensor Alarm)

HC sensor output shows high HC concentration for excessive time. If an HC Alarm occurs during a start-up Self-Test (and the pressures at PS2 and PS3 are good), try resetting the system several times. 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 out of the HC sensor. If all the other troubleshooting items referenced below do not clear a hydrocarbon sensor alarm, the only course of action is to replace the HC Sensor.

Potential Alarm Cause	**Action**	**Result**
Pumps not performing as required	Check of pressure (25 $\pm$ 2 psi) and vacuum (20 $\pm$ 3 inHg)	See Section s 8.1 and 8.2
O-ring leak on module	Inspect o-rings on membrane module	Replace damaged o-rings
Membrane damaged	Inspect for liquid contamination. Research if recent UST overfill. Separator drain valve stuck closed.	Verify operation of all other components. Replace module if liquid contamination is present.
Membrane feed end cap loose	Inspect set screw tightness and epoxy	Replace module if feed end cap is loose or epoxy is damaged
Hydrocarbon Sensor failure	Verify last calibration date	Replace sensor Reset system

8.4 Alarm PR

PS2 and/or PS3 pressure switches have not reset (open) at the end of a run cycle. Vaporsaver System has been powered off or fuse was blown.

Potential Alarm Cause	**Action**	**Result**
The motor relay has failed closed	Motor running continuously	Check and replace motor relay
Compressor pressure switch has failed closed	A good switch and circuit will show at greater than 15 psi, measure approx 0 VDC across contacts; at less than 15 psi, 24 VDC across contacts. Measure at switch and I.S. terminal block	Check and replace switch Check wiring Check and replace I.S. module
Vacuum switch has failed closed	A good switch and circuit will show at greater than 15 inHg, measure approx 0 VDC across contacts; at less than 15 inHg, 24 VDC across contacts. Measure at switch and I.S. terminal block	Check and replace switch Check wiring Check and replace I.S. module

8.5 WARNING RT

Excessive run time, or no run time. This warning is not a system shut-down. It is typically an indication to the station operator that the vapor space at the facility is extremely leaky, and if local authorities require, a pressure decay test should be performed.

Potential Alarm Cause	**Action**	**Result**
Excessive leaks in the facilities vapor piping	Verify facilities vapor tightness	Repair vapor leaks in the vapor piping and Stage I and Stage II fittings
Pressure switch failure (PS1)	A good switch and circuit will show at greater than +0.1 “wc, measure approx 0 VDC across contacts; at less than +0.1 wc, 24 VDC across contacts. Measure at switch and I.S. terminal block	Check and replace switch Check wiring Check and replace I.S. module
A/L outside certified range	Verify A/L on all hose points	Repair/reset Stage II system components

8.6 PLC Error

If the red ERROR LED on the PLC is lit, this typically means that the PLC has a clock error. The normal solution is to set the clock from the User Interface and cycle the power to the unit. The software has a clock recovery routine that will typically clear the PLC error. If this does not resolve the PLC error, it may be necessary to reload the software or replace the PLC.

8.7 Communications and Data Downloading

The Vaporsaver has a DB9 communications port on the side of the User Interface enclosure. Communication with the PLC can be made through this port using HyperTerminal.

Configuration for HyperTerminal
(Note: communications can be established with Procom or ProcomPlus, but is not described here).

Local Communications

1. Open new HyperTerminal connection.
2. Choose an icon and name the connection. After you have set the COM properties and the Port settings, it is a good idea to SAVE the HyperTerminal session. This will allow you to use this session for all local Vaporsaver communications without having to input the COM and Port setting every time.
3. Connect using: Direct to COM 1 (or COM 2 or COM 3 or COM 4).
4. COM properties/ Port Settings
    a. Data bits: 8
    b. Parity: none
    c. Stop bits: 1
    d. Flow Control: Xon/Xoff
    e. Max speed: 9600 bps
5. After all the settings are established and you are connected, press ESC to get the COMMAND line.

Remote Communications

1. Open new HyperTerminal connection.
2. Choose an icon.
3. Connect using: Modem attached to the computer.
4. COM properties/ Port Settings
    a. Data bits: 8
    b. Parity: none
    c. Stop bits: 1
    d. Flow Control: Hardware
    e. Max speed: 115200 bps

From Remote Communications use only modem kit available from OPW. This kit includes modem (pre-configured), cable to attach modem to Vaporsaver User Interface, and power supply for modem.

When communication is established either locally or via modem, HyperTerminal will show “COMMAND:”; the PLC is waiting for a command to be entered. After typing any command, press <ENTER> to execute the command. Press <ESC> will always return to “COMMAND:” (Use <ESC> if a command is mistyped or there is no “COMMAND:” line). When typing a command, what is typed is not displayed on the screen.

Always use uppercase letters when sending commands to the Vaporsaver.

COMMAND

Command must be all uppercase letters.

- SD

  Send Data

STATION #123 102 BLUE ST SACRAMENTO, CA 916-555-1234	Station header information
18SEP02 05:48:46 TRT 2045	Date and time of report generation System Total Run Time (hours)
SYSTEM HISTORY DATE ON DRT 18SEP02 349 25 17SEP02 1440 133 16SEP02 1440 146 15SEP02 1440 154 14SEP02 1440 302 13SEP02 1440 117	Last 365 day of the following: Date, System ON time, and Daily Run Time (minutes)
ALARM HISTORY DATE EVENT 09SEP02 13:44:17 RESET 09SEP02 12:09:33 COMP 06SEP02 13:09:50 RESET 06SEP02 13:06:58 VAC 06SEP02 11:43:16 RESET 06SEP02 11:30:11 CLOCK	Last 50 Events (Alarms, Resets, and Clock changes) Date and Time of Event, and Event designation

This same function can be completed while hooked up locally. With the <COMMAND> prompt showing, navigate through the User Interface Display buttons. Press <Menu> followed by <SEND DATA> and finally select <YES>. Data will then be transferred to the HyperTerminal screen.

9.0 Control System Maintenance

The OPW Vaporsaver is designed to require very little scheduled maintenance. The following table is a general guide of what is required.

9.1 Maintenance

1. Every 36 months, the Hydrocarbon Sensor must be returned to OPW for calibration. There are no serviceable parts in the Hydrocarbon Sensor. The calibration of the Sensor can be verified by checking at two locations:
    a. The Hydrocarbon Sensor has a calibration label showing the calibration due date. The Sensor is accessed by removing the Control System covers.
    b. A second calibration label is located on the side of the User Interface enclosure. A label is placed on the User Interface at the factory showing the original equipment Sensor calibration due date. Also, when a Sensor is replaced in the field, the replacement sensor is supplied with a new calibration label on the Sensor and a second label to be placed by the installer on the User Interface enclosure next to the original calibration label.
2. Every 12 months, inspect all belts for wear and proper tension. Only replace belts with same size and type as originally installed. See Section 9.2 for belt tension guidelines.
3. Every 12 months, check Control System operating pressure and vacuum readings.
4. Every 12 months, visually check the Control System for overall wear issues.
5. Every 12 months check total run time (TRT). If approaching or greater than the maximum hours stated in Section 9.3 replace pumps. Verify records to ensure pumps have not already been changed.

9.2 General Rules for Belt Tensioning

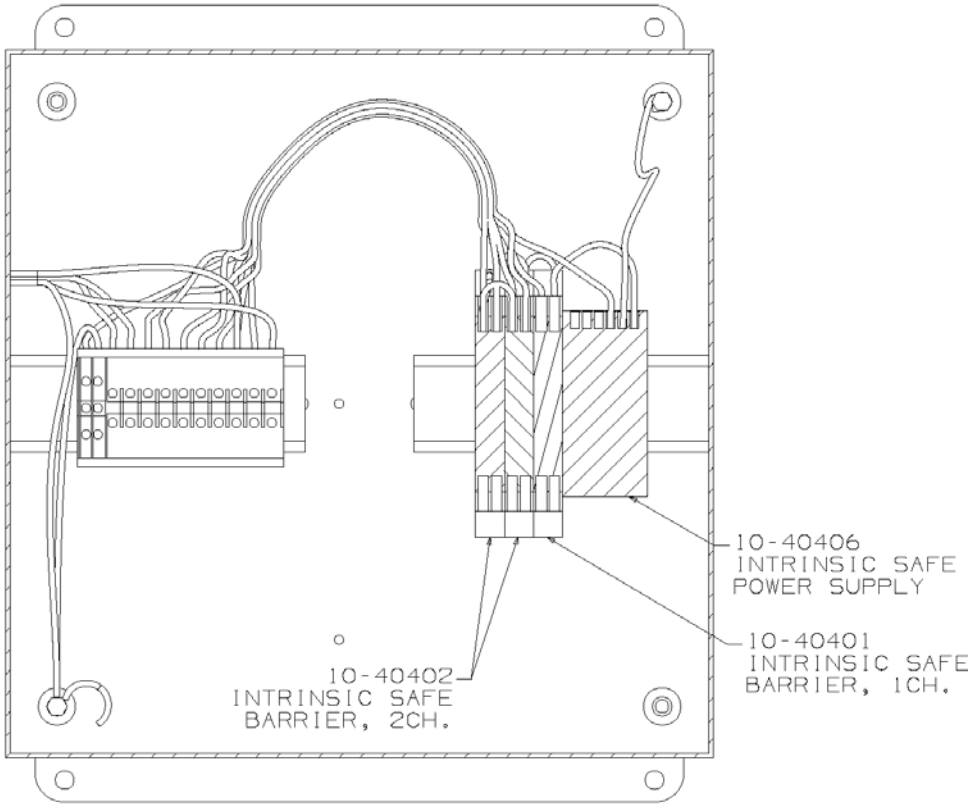
1. Ideal belt tension is the lowest tension at which the belt will not slip under peak conditions.
2. Tension the belt when slipping.
3. Over tensioning shortens pump, bearing and belt life.
4. Keep belts free from foreign material that may cause slip.
5. Never apply belt dressing, as this will damage the belt and cause early failure.
6. Only replace belts with OPW specified belt size and type.
7. Over tensioning belts places extra load on the motor. An overly tight belt can add several amps to the motor loading.
8. IMPORTANT: After changing or adjusting belts, always measure the motor full load amperage; it must be less than the full load rating of the motor.

9.3 Component Replacement

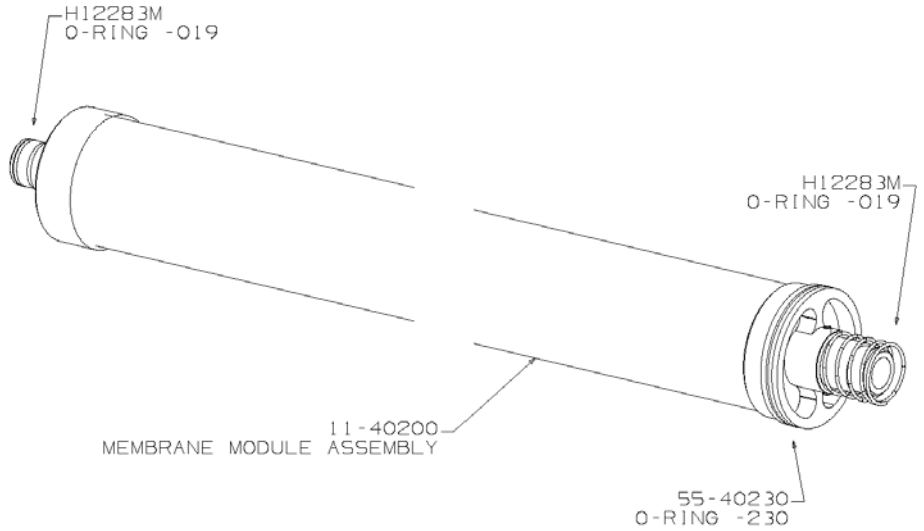
The User Interface has a totalizer (TRT: total run time since first installed) that is part of the continuous scrolling screens. This totalizer shall be used for the following maintenance/replacement items:

1. It is recommended that the compressor pump be replaced at approximately 5000 hours of operation, and is required to be replaced before 8,500 hours of operation.
2. It is recommended that the vacuum pump be replaced at approximately 10,000 hours of operation, and is required to be replaced before 12,000 hours of operation.
3. The Membrane Module may need to be replaced at approximately 15,000 hours of operation.

Intrinsically Safe Enclosure



Membrane Module



Membrane housing flange o-ring: H12037M

Vaporsaver 1

Start-up Information

This form must be completed and submitted to and approved by OPW for activation of Warranty. Submit form to OPW Technical Services.

STATION INFORMATION:

Station Name and Number:					
Street Address:					
City:					
State or Province:		Zip Code:		Country:	
Station Phone:					
Station Fax:					
Contact at Station:					

PURCHASING / INSTALLATION INFORMATION:

Distributor:					
Installation Company:					
Address:					
City:					
State or Province:		Zip Code:		Country:	
Job Site Supervisor:					
Installation Certification #:					
Installation Date:					

START-UP INFORMATION:

Start-up Company:					
Address:					
City:					
State or Province:		Zip Code:		Country:	
Start-up Technician:					
Start-up Certification #:					
Start-up Date:					

EQUIPMENT INFORMATION:

User Interface Serial Number:	
Control System Serial Number:	
Wire Gage between Breaker and Control System:	
Wire Length between Breaker and Control System:	

	Quantity	Pressure/Vacuum Ratings
Pressure/Vacuum Vent Valves:		
Storage Tank Over Fill Prevention Type: (i.e. overfill valve, ball floats, audible alarm)		

EQUIPMENT OPERATION:

	Volts	Amps
Measured at User Interface (L1 and L2):		

	Volts	Amps
Measured at Control System (T1 and T2):		

START-UP CHECK LIST:

Y/N:		
		Clock is Set on User Interface
		Station Information is set in User Interface
		ISD Test Enabled (Only if Part of CARB Certified Phase II EVR System)
		Daylight Savings Enabled
		Control System starts when storage tank has pressure +0.1 ±0.04”wc
		Control System stops when storage tank has pressure -0.5 ±0.2”wc
		Piping slope between Control System and vents meets requirements (1/4” per foot)
		Insulation Test Performed (Megometer)
		NPT conversion fittings (if applicable for international installations)
		Galvanized or corrosion protected piping (internal and external corrosion protection)
		All wiring connections verified on User Interface and Control System
		Control System protection (vehicle bumper posts, fences…)

Submit results of the following tests:

CARB TP-201.3: Determination of 2 Inch WC Static Pressure Performance of Vapor Recovery Systems of Dispensing Facilities

CARB TP-201.3C: Determination of Vapor Piping Connections to Underground Gasoline Storage Tanks (Tie-Tank Test)

CARB TP-201.4: Dynamic Back Pressure

Exhibit 5 of Executive Order G-70-204: Determination (by Volume Meter) of Air to Liquid Volume Ratio of Vapor Recovery Systems of Dispensing Facilities

> **Note: The above tests can be the same tests that are performed as part of local regulation or permit conditions. Tests do not need to be repeated. The above tests do not need to be completed during the actual Vaporsaver start-up, but can be complete before or after in conjunction with the testing required by the local authority. Results of these tests must be supplied to OPW Technical Services Department.**

Belt tension must be checked between 3 and 7 days after system activation.

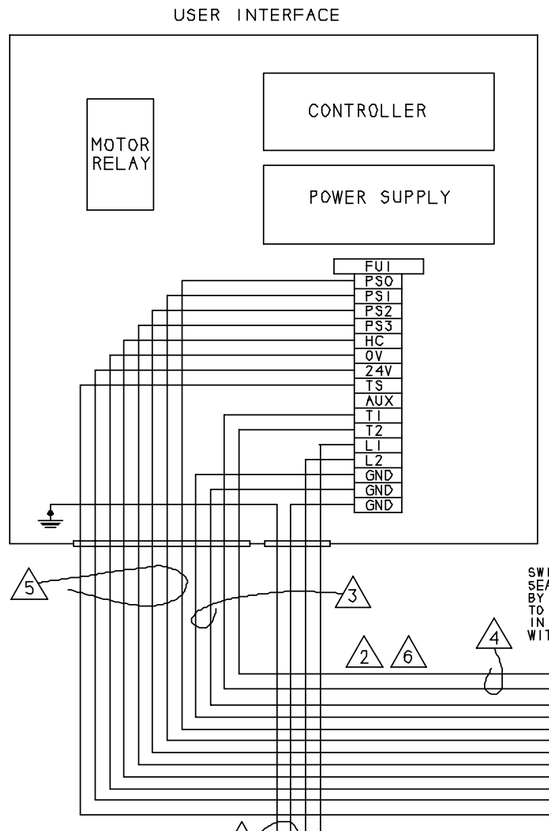
Site Layout Diagram:

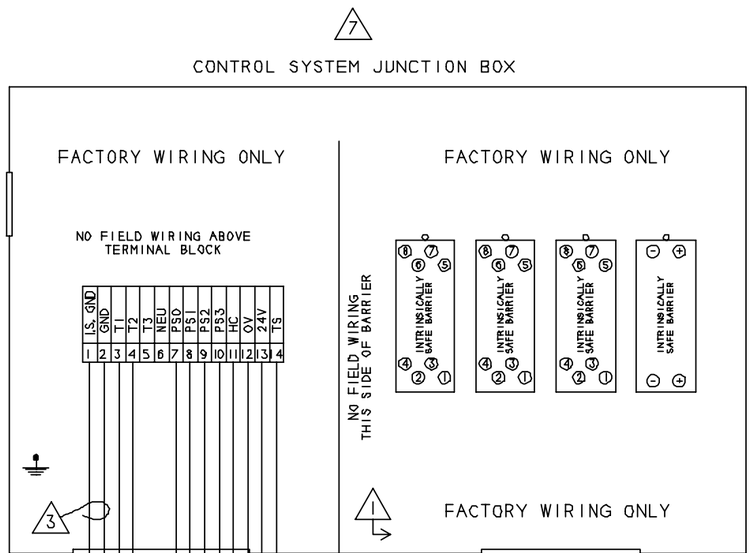
NON-HAZARDOUS LOCATION INDOORS

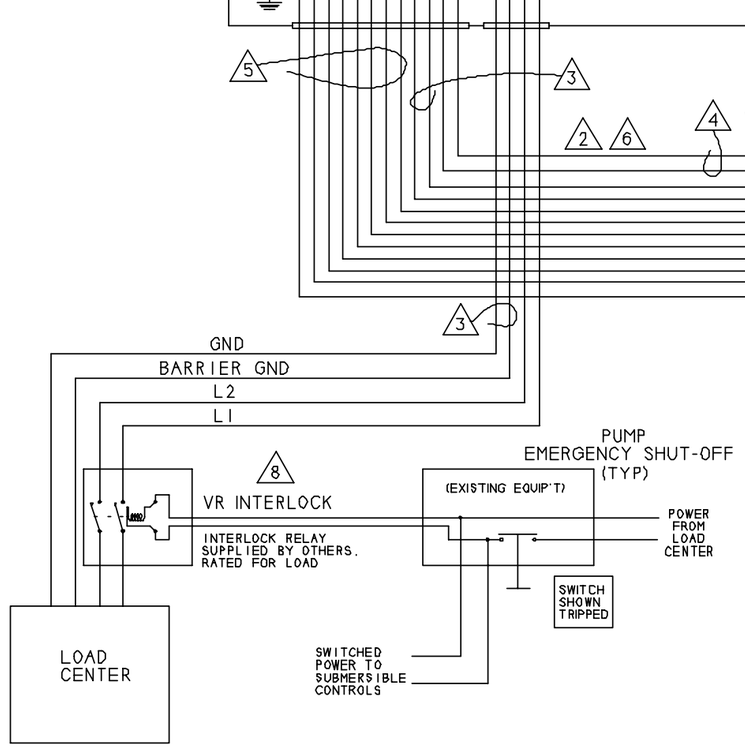
HAZARDOUS LOCATION
CLASS I
GROUP D
DIVISION 2
OUTDOORS

POWER:
208-230 VAC
2.4 HP + 1/2 A
SINGLE PHASE
50/60 Hz

USER INTERFACE FUSE (FU1):
500 mA. 250V.
SLO-BLO.
5 mm x 20 mm







NOTES:

ALWAYS FOLLOW THE REQUIREMENTS OF THE NEC, NFPA AND THE LOCAL AUTHORITIES HAVING JURISDICTION.

1. INTRINSICALLY SAFE WIRING

2. ALL WIRES BETWEEN CONTROLLER ENCLOSURE AND PROCESSOR ENCLOSURE MUST BE TFFN OR THHN GASOLINE AND OIL RESISTANT WITH 600 V INSULATION.

3. I.S. BARRIER GROUND MUST BE MINIMUM 12 AWG. RUN SEPARATE CHASSIS GROUND AND I.S. BARRIER GROUND FROM PROCESSOR ENCLOSURE TO LOAD CENTER. THE RESISTANCE BETWEEN THE I.S. BARRIER GROUND AND THE EARTH GROUND OF THE LOAD CENTER MUST BE LESS THAN 1 OHM.

4. POWER WIRES TO THE MOTOR MUST BE MINIMUM 12 AWG. FOLLOW NEC REQUIREMENTS FOR WIRE AMPERAGE CAPACITY FOR THE SPECIFIC LOADING AND WIRE RUN DISTANCE TO DETERMINE IF A LARGER GAGE WIRE IS NECESSARY. MAXIMUM 2% VOLTAGE DROP.

5. LOW VOLTAGE (24 VDC) WIRING MUST BE MINUMUM 18 AWG, TFFN OR THHN GASOLINE AND OIL RESISTANT WITH 600 V INSULATION.

6. ALL WIRING BETWEEN CONTROLLER ENCLOSURE AND PROCESSOR ENCLOSURE CAN BE RUN IN THE SAME CONDUIT AS LONG AS ALL WIRES ARE THHN OR TFFN WITH 600 V INSULATION.

7. THE PROCESSOR CREATES A CLASSIFIED AREA, SEE NFPA 30A, NFPA 70, CLASS I, GROUP D, DIVISION 2. THE CLASSIFIED AREA IS WITHIN 18 INCHES OF THE EQUIPMENT EXTENDING TO GRADE LEVEL AND UP TO 18 INCHES ABOVE GRADE WITHIN 10 FEET HORIZONTALLY OF THE EQUIPMENT.

8. IF REQUIRED BY THE LOCAL AUTHORITY HAVING JURISDICTION, THE POWER TO THE SYSTEM MUST BE INTERUPTED BY ACTIVATION OF THE PUMP EMERGENCY SHUT-OFF SWITCH.

9. A LOCKABLE TWO POLE DISCONNET SWITCH SHALL BE INSTALLED WITHIN SIGHT AND REACH OF THE MOTOR LOCATION. IF INSTALLED WITHIN THE HAZARDOUS LOCATION, IT MUST MEET ALL NEC AND LOCAL REQUIREMENTS FOR HAZARDOUS LOCATION.

Letter	En. No.	Date	Draft.

CHANGES

VAPOR SAVER I
TYPICAL WIRING SCHEMATIC

THIRD ANGLE PROJECTION

OPW
A DOVER COMPANY

DRAWN: JMG
APPROVED: JMG

SCALE: NONE
DATE: 10/28/02

DRAWING NO. 99-41000

B