California Environmental Protection Agency

Air Resources Board

ARB Approved

Installation, Operation and Maintenance Manual

for

Executive Order

VR-204-A
(VST Phase II EVR System Including
Veeder-Root In-Station Diagnostic (ISD) System)

Approved: April 1, 2008

NOTICE:

The **ARB Approved Installation, Operation and Maintenance Manual (IOM) for VR-204-A** describes the tools, methods, and skill levels required to install the **VST Phase II EVR System, including Veeder-Root ISD.**

Unless specified in Executive Order VR-204-A or this IOM, only skilled technicians that are trained, certified, and licensed by VST, Inc. (i.e. VST Authorized Service Contractors) are able to perform installation, maintenance, or repairs of components manufactured by VST Inc. or the warranty will be void. Unless specified otherwise, only skilled technicians that are trained, certified, and licensed by the Veeder-Root Company are able to perform installation, maintenance, or repairs of components manufactured by the Veeder-Root Company or the warranty will be void.

It is the responsibility of each VST Authorized Service Contractor (ASC) and/or each Veeder-Root technician to be familiar with the current requirements of state, federal, and local codes for installation and repair of gasoline dispensing equipment.

It is also the responsibility of the VST ASC and/or the Veeder-Root technician to be aware of all the manuals, necessary safety precautions, and site safety requirements to assure a safe and trouble-free installation.

To participate in a VST training class, a candidate will need to complete an enrollment form, which can be downloaded from the VST website at www.vsthose.com or requested by phone at 937-704-9333. Once the enrollment form is approved by VST, the candidate can enroll in a VST training class. A schedule of classes is also available on the above VST website.

To confirm a VST Authorized Service Contractor status, a regulator can go to the VST website at www.vsthose.com. This list is updated periodically.

Vapor Systems Technologies, Inc.
650 Pleasant Valley Drive
Springboro, Ohio 45066

PH: 937-704-9333
FX: 937-704-9443
www.vsthose.com

To confirm Veeder-Root TLS or ISD training, a regulator should send an email to technicaltraining@gilbarco.com with the name (and company) of the ASC to obtain verification of the ASC TLS/ISD training status or call 800-997-7725 and press “*” to get to the Veeder-Root menu and “*” again to speak to a representative.

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About VST

Vapor Systems Technologies, Inc. began in 1989 with the vision of **One Company – One Integrated Solution**.

Today, that philosophy is still in place and getting stronger. Recognizing that a healthier environment is a need and not an option, VST has dedicated its undivided attention to the ever-changing, stringent regulations that govern fugitive vapors at gasoline dispensing facilities (GDF).

To this challenge, VST is committed to a continual R&D campaign of developing the most current, technologically advanced solutions to service not only the United States, but also the world.

VST specializes in the development, engineering, and manufacturing of products that are sold into the GDF segment of the petroleum industry. The VST focus provides our customers and users with exceptional products, services, and innovative solutions for improving the fueling-station experience as well as for the world's air quality.

VST's product offering includes curb pump and vapor recovery hoses, safety breakaways, nozzles, and emission-control system *Processor*s. The ENVIRO-LOC™ vapor-recovery product offering represents the most innovative concept in the industry for trapping fugitive vapors from the front end (vehicle refueling) to the back end (vent risers) of the GDF site.

Notice

Table of Terms and Abbreviations

ASC:	Authorized Service Contractor
AQMD:	Air Quality Management Districts
ATG:	Automatic Tank Gauge
CARB:	California Air Resources Board
CDFA:	California Department of Food & Agriculture
CVLD:	Continuous Vapor Leakage Detection, another name for Vapor Leak Detection
ECS:	Emissions Control System
EO:	Executive Order
EVR:	Enhanced Vapor Recovery
GDF:	Gasoline Dispensing Facility
HC:	Hydrocarbon
HC IR:	Hydrocarbon Infrared
ISD:	In-Station Diagnostics
MAG Probe:	A type (brand) of Tank Inventory Probe
NEC:	National Electric Code
NFPA:	National Fire Protection Association
ORVR:	On-Board Refueling Vapor Recovery
OSHA:	Occupational Safety Health Administration
Permeate:	Air return to atmosphere
PLC:	Programmable Logic Control
PMC:	Pressure Management Control
Retentate:	Vapor return to UST
RVP:	Reid Vapor Pressure
TLS:	Tank Level System
TLS Console:	Veeder-Root's line of environmental monitoring consoles.
TS:	Troubleshooting
Ullage:	Vapor space above liquid in a UST
UST:	Underground Storage Tank
VCK:	Vapor Collection Kit
Veeder Root:	Manufacturer of the TLS-350
VOC:	Volatile Organic Compounds
VST:	Vapor Systems Technologies, Inc. - manufacturer of the ECS Membrane *Processor*
WC:	Water Column

VST Contractor Requirements

- Due to the highly volatile nature of gasoline and its handling and storage, VST requires the following certifications for its ASC's:

Level	Component	Authorized Tasks	Training Pre-Requisites
A	Hanging Hardware	Functional Testing Installation Maintenance Repair	No pre-requisite
A/B	Hanging Hardware	Functional Testing Installation Maintenance Repair	No pre-requisite
	Membrane Processor	Installation	Veeder-Root Level 1, 2/3, or 4 ASC certification
C	Membrane Processor	Annual Testing Component Replacement Maintenance Operation Post-Installation Power-Up Testing Start-Up Testing Troubleshooting	Veeder-Root Level 2/3 or 4 ASC with PMC / ISD certification VST level "A/B"

NOTE:

Depending on local codes, in addition to the VST and Veeder-Root training, contractors may be required to take air-district training or ICC certification as an approved vapor-recovery installer.

- ASC's must be able to show proof of certification if asked. Carry the wallet card or have a copy of your certification on file with the GDF.
- The ASC must record his or her certification number on the applicable paperwork for all warranties to be deemed valid.
- Contractors should **ALWAYS** verify the training and certification requirements with the air-district staff **BEFORE** beginning installation of EVR systems.

Veeder-Root Contractor Requirements

Veeder-Root Level 1	Contractors holding valid Level 1 Certification are approved to perform wiring and conduit routing, equipment mounting, probe and sensor installation, tank and line preparation, and line leak detector installation.
Veeder-Root Level 2/3 or 4	Contractors holding valid Level 2, 3, or 4 certifications are approved to perform installation checkout, startup, programming and operations training, troubleshooting and servicing for all Veeder-Root Tank Monitoring Systems, including Line Leak Detection and associated accessories.
PMC / ISD	This course of training includes In-Stations Diagnostics/Pressure Management Control (ISD/PMC) installation checkout, startup, programming, and operations training. It also includes troubleshooting and service techniques for the Veeder-Root In-Station Diagnostics system. A current level 2/3 or 4 certification is a prerequisite for the ISD/PMC course. After successful completion of this course the contractor will receive a certificate as well as a Veeder-Root ISD/PMC contractor certification card.
Warranty Registrations may only be submitted by selected distributers.	

Executive Order VR-204-A
VST Phase II EVR System Including Veeder-Root ISD

Exhibit 1
Equipment List

Component	Manufacturer/ Model
Nozzle	VST Model VST-EVR-NB, VST-EVR-NB-R (Rebuilt) (Figure 1A-1)
Coaxial Curb Hose	VST Model VDV-EVR Series (Figure 1A-2)
Coaxial Whip Hose	VST Model VSTA-EVR Series (Figure 1A-2)
Breakaway Coupling	VST Model VSTA-EVR-SBK (Figure 1A-2)
Hanging Hardware with Liquid Removal Device	(Figure 1A-3)
Membrane Processor	VST Model VST-ECS-CS3-XXX (Figure 1A-4) where XXX represents motor phase and HC Sensor -110 Single-Phase with HC Sensor -310 Three-Phase with HC Sensor
TLS Console Veeder-Root TLS-350 Series, including but not limited to TLS-350, TLS-350 Plus, TLS-350R, Red Jacket ProMax, Gilbarco EMC consoles	Veeder-Root 8482XX-XXX, 8470XX-XXX (Figure 1A-5) X = Any digit
ISD Software Version Number	1.01
Vapor Flow Meter (1 per Dispenser)	Veeder-Root 332374-XXX (Figure 1A-6) X = Any digit
Vapor Pressure Sensor (1 per GDF)	Veeder-Root 331946-001 (Figure 1A-7)
Smart Sensor Interface Module (1 per GDF)	Veeder-Root 329356-004, XXXXXX-XXX (Figure 1A-8)
Dispenser Interface Module (DIM)	Veeder-Root DIM Series (Figure 1A-9)
RS232 Interface Module	Veeder-Root RS232 Interface Module Series (Figure 1A-10)
Mod Bus Module	Veeder-Root 331944-000

Overview: EVR Balance Total System

1 VST ENVIRO-LOC Balance Vapor Recovery Hose Assembly

- The balance type hose assembly consists of two different hoses of two different sizes and constructions, with one (the fluid carrying hose) placed inside of the second hose (the vapor carrying hose). The fluid hose has a nominal ID of 5/8" and is made with a rubber tube, wire braid reinforcement, and rubber outer cover. The vapor hose has a nominal ID of approximately 1 ½" and is made of a polyurethane material, which is extruded over a spring wire helix. The hoses have been sized to meet the performance requirements of pressure drop that apply to each.

- Typically the hose assembly will consist of two separate hose assemblies with a breakaway device located between them. Usually a shorter length, the hose attached to the dispenser is often referred to as the whip hose. A longer hose is attached to the nozzle and this is often referred to as the curb hose.

- For a typical installation, the overall length of the hose assembly including the breakaway will be 9-15 feet. This length will accommodate the refueling of a vehicle in some proximity of the dispenser, and it will typically create a drape or low spot in the hose during normal use. This low spot in the hose will tend to accumulate fluid in the vapor hose due to condensation in the hose being ingested into the hose when the vehicle tank is topped off. This is a very common occurrence. The VST balance hose assembly includes a liquid removal device (VDV series), which is used to remove fluids that may accumulate in the vapor hose to maintain a clear vapor path.

2 Variable Dimension Venturi

- The VST liquid removal device, which VST refers to as the VDV (Variable Dimension Venturi), is based on the principle of a venturi.

  A venturi-type liquid-removal device has been used for some time, about 20 years, starting with the Co-Vent produced by Gilbarco. Other hose manufacturers at the time produced similar devices, all based on the principle of a fixed dimension venturi.

  The amount of vacuum produced by the venturi, at a particular flow rate, is determined directly by the dimension of the throat of the venturi, and this directly impacts the ability of the venturi to remove fluid from the vapor hose. At the time that these devices were certified there was no minimum flow-rate performance standard that applied, so this performance threshold was left up to the manufacturer. Therefore, the current fixed dimension venturies in use have a functional flow rate threshold of 6 gpm. The maximum product flow rate for the system is 10 gpm, according to federal mandate.

- VST came into existence following the initial certification of these venturi devices, and by this time, CARB had identified the deficiencies in the low flow-rate performance of the fixed venturi designs. At the time VST certified the VDV, the performance standards required a minimum evacuation rate of 10ml/gal dispensed at a minimum of 5 gpm.

- The VDV utilizes a fixed venturi with a very small throat diameter, which is surrounded by a spring-loaded outer venturi. At lower flow-rates, all or most of the flow passes through the small venturi throat so that enough vacuum is generated to evacuate fluid from the vapor hose at a minimum of 6 gpm. As the flow-rate increases, the spring-loaded outer venturi moves and allows more of the flow to bypass the small inner venturi. This allows the venturi to produce adequate vacuum for the liquid-evacuation throughout the range of flow rates, with the benefit of reducing the pressure drop through the venturi at the higher flow rates.

3 VST ENVIRO-LOC Balance Safety Breakaway

- The purpose of the breakaway device is to prevent substantial damage from occurring, particularly to the dispenser, when a drive-off occurs with the nozzle still in the vehicle filler neck. The VST breakaway design has two separating halves, with one half attached to the whip hose and one half attached to the curb hose. Two fracturable rings hold the two separating halves together. These rings are designed to break at a 350 lb load maximum.

- Each breakaway half has both a fluid passage and a vapor passage, and each passage has a spring-loaded poppet. Upon fracture of the rings and separation of the two halves, all of the spring-loaded poppets move to a seated position, which closes off both the liquid and vapor paths in both directions. The breakaway is not intended to be field serviceable, so once it has been used it must be replaced with a new unit.

4 VST ENVIRO-LOC Balance Nozzle

- The VST balance nozzle is similar in many aspects to balance nozzles that are currently in use. The nozzle incorporates both fluid and vapor passages. A boot and face seal are used to seal the vapor passage of the nozzle to the filler pipe of the vehicle. The nozzle incorporates an interlock device so that the nozzle cannot be used without the vapor boot being sealed to the vehicle filler pipe. The nozzle has an automatic shutoff device to stop the liquid flow once the filler pipe is full of liquid.

  There are two areas in particular that have been modified from current practice to meet CARB's performance specifications, one related to the nozzle vapor valve, and the second to the nozzle spout that is designed with special features so as to be substantially dripless.

- To control the flow of liquid through the nozzle, a liquid flow-valve is operated using the nozzle lever. With the VST nozzle, the lever simultaneously operates the vapor flow-valve. The vapor path is only opened when fluid is being discharged from the nozzle. In this way, the nozzle vapor-valve provides a very positive seal when the nozzle is not in use.

- The VST nozzle incorporates an interlock mechanism that interacts with the boot assembly. The interlock device prevents the nozzle lever from being engaged unless the vapor boot has been compressed, such as when it is inserted into the filler pipe of a vehicle. The interlock device provides this feature by an interaction with the automatic shutoff mechanism in the nozzle; it prevents the automatic shutoff mechanism from engaging the lever until the boot has been compressed.

- The automatic shutoff mechanism is similar in design to those used in all current dispensing nozzles.

  A spring-biased poppet valve is located at the junction of the nozzle body and the spout assembly. This poppet serves to prevent fluid in the nozzle from draining out when the nozzle is not being used. In addition, it serves to generate a vacuum via a venturi action when liquid is flowing through the nozzle. This vacuum source is connected by a passage to a rubber diaphragm that is part of the latching mechanism, and it is also connected to a passage that extends to the open end of the spout. As long as there is no fluid around the end of the spout, the vacuum being generated will be bled off to the passage-opening in the spout. When fluid reaches the end of the spout and covers up the passage-opening at the end of the spout, the vacuum being generated will act on the rubber diaphragm and will release the pins that hold the lever pivot in place.

  With the lever movement, this action closes the liquid and vapor valves in the nozzle and stops the liquid flow. To meet UL requirements, the automatic shutoff feature must operate at a minimum flow-rate, which corresponds to a fluid inlet pressure of 8 psi. This equates to a flow-rate of approximately 3 gpm.

5 VST ENVIRO-LOC Balance System ECS Membrane Processor

- The VST ECS membrane *Processor* does not interact directly with the other balance system hardware. It is in place to monitor and control the pressure in the UST to within limits specified by CARB.

  Under conditions where the GDF is operational and the balance system hardware is functioning normally, the inherent ORVR compatibility of the balance system (when using VST's ENVIRO-LOC nozzle) will produce a predominately negative gauge pressure in the ullage space of the UST. Under these conditions the ECS membrane *Processor* will typically not need to operate.

  During periods of less activity, the GDF being shut down overnight, winter fuels being present, or other conditions that promote the pressurization of the ullage space, the ECS membrane *Processor* will operate as needed to control the pressure in the ullage space to an accepted level. The ECS membrane *Processor* will turn on at an ullage pressure of +0.20 inches of water and turn it off at a pressure of –0.20 inches of water. Currently, the ECS membrane *Processor* unit is monitored and controlled through the ISD system.

- The ECS membrane *Processor* uses a type of membrane technology to enable it to selectively separate the components in the ullage vapor mixture.

  Through a somewhat complex transport means, certain molecules will selectively travel in a stream from one side of the membrane to the other. This stream is referred to as the permeate stream.

  In this case, the predominate molecules transported across the membrane will be the primary constituents of air, which are oxygen, nitrogen, and water vapor. A small amount of the hydrocarbons present in the ullage mixture will also migrate across the membrane. Typically, the permeate will contain less than 3.0% hydrocarbons. The result of this activity includes, fresh air vented to atmosphere, saturated hydrocarbon vapors returned to the UST, and UST pressurization controlled to an acceptable level.

- The process of separation by the membrane is made possible by using two pumps, one low-pressure pump which circulates the ullage vapor mixture along one side of the membrane, and one high-vacuum pump, which creates the pressure differential needed to cause the permeate transport across the membrane. These are the only moving parts in the system.

  A self-regulating heating coil is incorporated around the membrane housing to keep the membrane free from condensate.

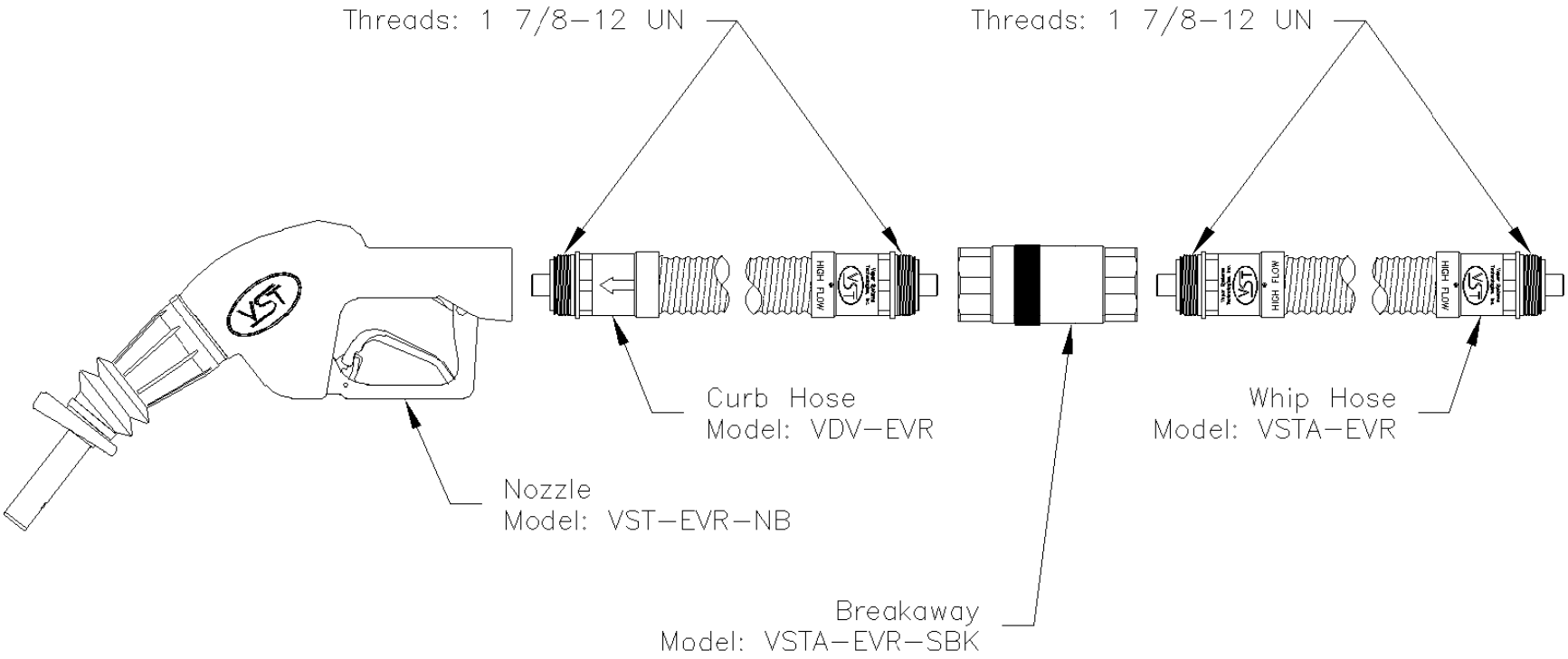


Figure 1: VST Hanging Hardware
(Nozzle, Coaxial Curb Hose, Breakaway, and Coaxial Whip Hose)

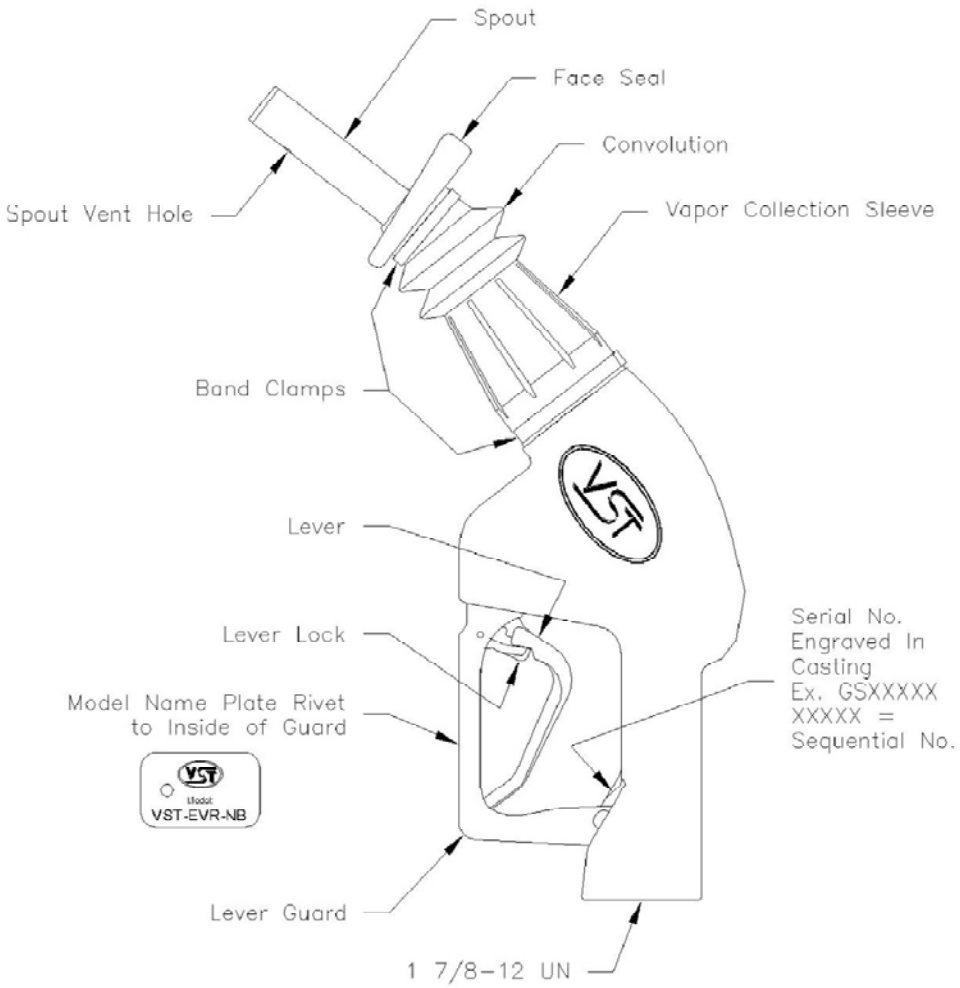


Figure 2: Model VST-EVR-NB Nozzle

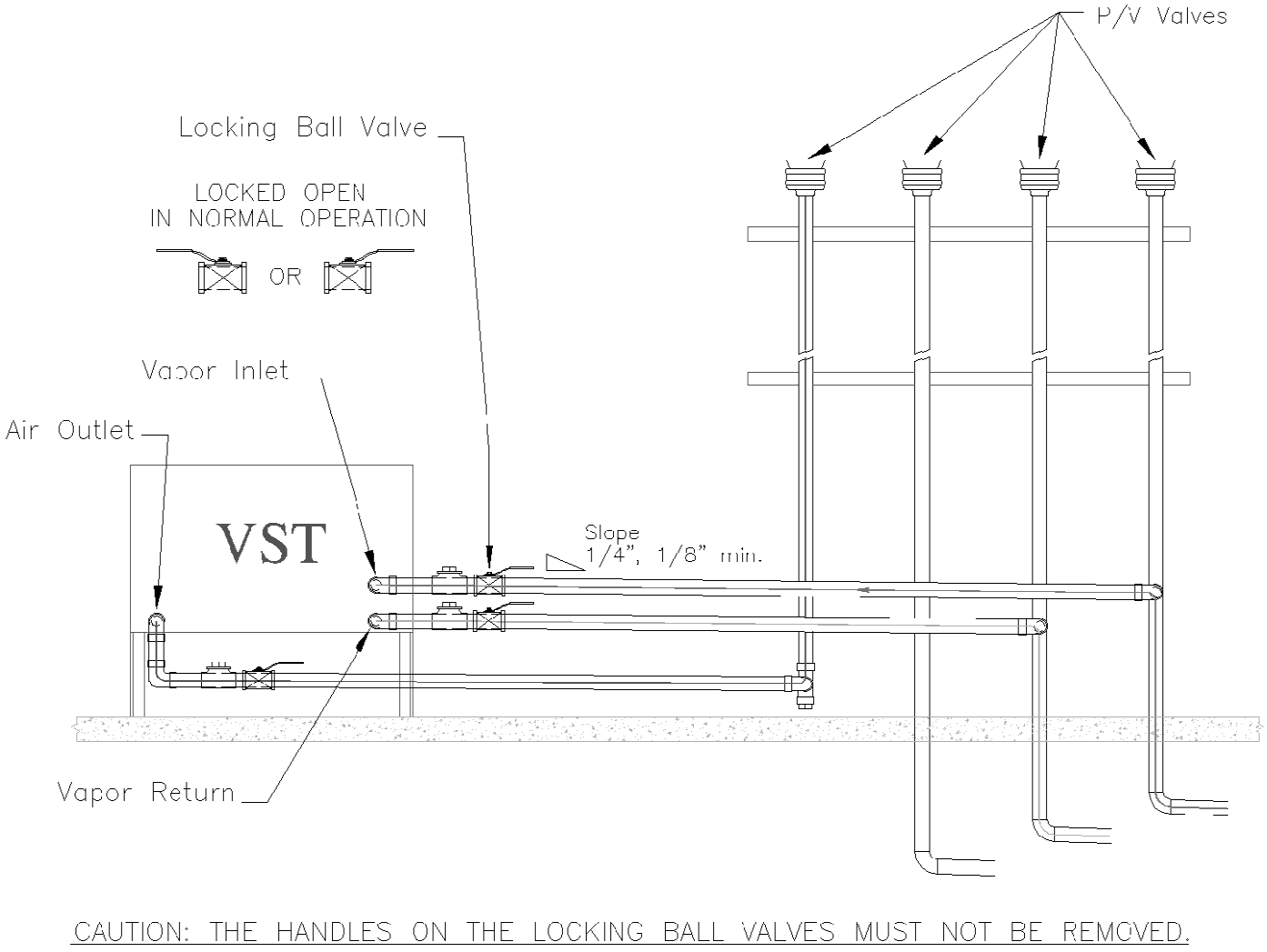


Figure 3: Model VST-ECS-CS3 Membrane Processor

Daily Inspections

HANGING HARDWARE SYSTEM					
Component	**Procedure**	**Fail Criteria**	**Corrective Action**	**Reference Manuals**	**Authorized Personnel**
Nozzle Hose Breakaway	Inspect each hose, breakaway, and nozzle for loose connections or leaks	Presence of a leak	Tighten connections or replace with new VST product	Section 10	**Nozzle, hose, or breakaway replacement**: GDF owner-operator or VST ASC Levels A, B, or C **Component repair:** VST ASC Levels A, B, or C
		Presence of residue from a leak	Tighten connections or replace with new VST product	Section 12	
		Visible o-ring between any component connection	Tighten connections or replace with new VST product	Section 13	
CO-AXIAL HOSES					
Component	**Procedure**	**Fail Criteria**	**Corrective Action**	**Reference Manuals**	**Authorized Personnel**
Coaxial Hose	Inspect hoses for wear, severe kinks, cracks, splitting, and functional swivels	Kinks, cracks, splitting, non-functional swivels, or any visible openings	Replace with new VST hose	Section 12	**Hose replacement:** GDF owner-operator or VST ASC Levels A, B, or C
BREAKAWAY					
Component	**Procedure**	**Fail Criteria**	**Corrective Action**	**Reference Manuals**	**Authorized Personnel**
Breakaway	Inspect breakaway for leaks around the scuff	Presence of a leak around the scuff	Replace with new breakaway	Section 13	**Replace breakaway:** Owner/Operator or VST ASC Levels A, B, or C

NOZZLE					
Nozzle Component	**Procedure**	**Fail Criteria**	**Corrective Action**	**Reference Manuals**	**Authorized Personnel**
Nozzle lever, lever guard, lever lock	Inspect for defects, cuts, or damage to the: • Nozzle Lever • Lever Guard • Lever Lock • Spout • Spout Vent Hole • Face Seal • Interlock Rod • Vapor Collection Sleeve.	Damaged or missing	Replace with new VST nozzle	Section 10	GDF Owner/Operator or VST ASC Levels A, B, or C
Nozzle Spout		Sheared or bent	Replace nozzle spout assembly with new VST spout or replace with new VST nozzle	Section 10 Section 11	VST ASC Levels A, B, or C
Nozzle Vent Hole		Vent hole blocked	Clear blockage	Section 10	GDF Owner/Operator or VST ASC Levels A, B, or C
Nozzle Collection Sleeve		If greater than 18 inches total length of cuts (if greater than .375 sq. inches of material missing)	Replace vapor collection kit	Section 11 EO-VR-203: Exhibit 2	VST ASC Levels A, B, or C
			Replace nozzle with new VST nozzle	Section 10 EO-VR-203: Exhibit 2	GDF Owner/Operator or VST ASC Levels A, B, or C
Nozzle Face Seal		Greater than 30% of the material is missing (if greater than 2.5 inches of the accumulated faceplate circumference is missing)	Replace vapor collection kit	Section 11	VST ASC Levels A, B, or C
			Replace nozzle with new VST nozzle	Section 10	GDF Owner/Operator or VST ASC Levels A, B, or C
Nozzle Front-End Kit (Collection sleeve and face seal)		Alignment lines are misaligned and/or the assembly is cockeyed	Replace vapor collection kit	Section 11	VST ASC Levels A, B, or C
			Replace nozzle with new VST nozzle	Section 10	GDF Owner/Operator or VST ASC Levels A, B, or C
Nozzle Interlock Rod	Section 10 Section 11	Interlock rod sticks during engagement or disengagement	Replace vapor collection kit	Section 11	VST ASC Levels A, B, or C
			Replace nozzle with new VST nozzle	Section 10	GDF Owner/Operator or VST ASC Levels A, B, or C

VR-203 Daily Inspection and Testing Checklist

Checklist results may be used to assist with filling out GDF maintenance log.		Date:	Page: ______of_____	
Dispenser Number	Unihose or Fuel Grade (circle one)	Nozzle Inspection (circle one)	Hose Inspection (circle one)	Breakaway (circle one)
	Unihose 87 89 91 other __________	Pass Fail	Pass Fail	Pass Fail
	Unihose 87 89 91 other __________	Pass Fail	Pass Fail	Pass Fail
	Unihose 87 89 91 other __________	Pass Fail	Pass Fail	Pass Fail
	Unihose 87 89 91 other __________	Pass Fail	Pass Fail	Pass Fail
	Unihose 87 89 91 other __________	Pass Fail	Pass Fail	Pass Fail
	Unihose 87 89 91 other __________	Pass Fail	Pass Fail	Pass Fail
	Unihose 87 89 91 other __________	Pass Fail	Pass Fail	Pass Fail
	Unihose 87 89 91 other __________	Pass Fail	Pass Fail	Pass Fail
	Unihose 87 89 91 other __________	Pass Fail	Pass Fail	Pass Fail
	Unihose 87 89 91 other __________	Pass Fail	Pass Fail	Pass Fail
	Unihose 87 89 91 other __________	Pass Fail	Pass Fail	Pass Fail
	Unihose 87 89 91 other __________	Pass Fail	Pass Fail	Pass Fail
	Unihose 87 89 91 other __________	Pass Fail	Pass Fail	Pass Fail
	Unihose 87 89 91 other __________	Pass Fail	Pass Fail	Pass Fail
	Unihose 87 89 91 other __________	Pass Fail	Pass Fail	Pass Fail

Annual Inspections and Replacements

Annual *Processor* Inspections and Replacements					
Component	**Procedure**	**Fail Criteria**	**Corrective Action**	**Reference Manuals**	**Authorized Personnel**
Blower	Replace the blower every ten years or 15,000 hrs. (whichever comes first).			Section 15 / Page 53 Section 15 / Page 55	VST ASC Level C
Vacuum pump	Replace blower every ten years or 15,000 hrs. (whichever comes first).				
Vacuum pump drive coupling - rubber insert	Visually inspect the drive coupling between the vacuum pump and the motor for wear	Rubber debris is found on or around the vacuum-pump base.	Replace the drive coupling rubber insert	Section 15 / Page 62	
Heat Trace Cable	Check the temperature of the membrane housing Section 15 / Page 41	If the membrane housing temperature is outside the 100°-150°F range.	Replace the heat- trace cable	Section 15 / Page 64	
HC Sensor	Test the HC sensor (EO-VR-204-A: Exhibit 6)	The difference shall be within ±1.0% HC concentration from the calibration gas concentration. Record “Pass” if within ±1.0% or “Fail” if not within ±1.0%.	Replace the HC Sensor	Section 15 / Page 76 EO-VR-204-A: Exhibit 6	

Preventative Maintenance Checklist Form

Component	Frequency	Date Inspected	Completed	Required Action Items
PROCESSOR	**Yearly**			
Inspect drive coupling on the vacuum pump			[ ]	
Check temperature of the membrane housing			[ ]	
RECIRCULATION BLOWER				
Replace every 10 years or 15,000 hours, whichever comes first			[ ]	
VACUUM PUMP				
Replace every 10 years or 15,000 hours, whichever comes first			[ ]	

Annual System Compliance Testing	
Static Pressure Test:	TP-201.3 EO-VR-204-A: Exhibit 4
Dynamic Back Pressure Test:	TP-201.4
Liquid Removal Test Procedure:	EO-VR-204-A: Exhibit 5
Hydrocarbon Sensor Verification Test:	EO-VR-204-A: Exhibit 6
Vapor Pressure Sensor Verification Test:	EO-VR-204-A: Exhibit 8
VST Processor Activation Test:	EO-VR-204-A: Exhibit 9
Nozzle Bag Test Procedure:	EO-VR-204-A: Exhibit 10
ISD Operability Test: (Flow Meter Operability Test)	EO-VR-204-A: Exhibit 11

ISD Alarm Troubleshooting Summary

ISD Alarm Troubleshooting Summary				
Message	**ISD Category**	**Light**	**Cause**	**Suggested Troubleshooting[1]**
ISD VAPOR LEAKAGE WARN	Containment	Yellow	Containment system leaks at 2 times the TP-201.3 standard.	• See Troubleshooting Guide 9513-003 found at www.vsthose.com • TP 201.3 Test, VR 204 Exhibit 4
ISD VAPOR LEAKAGE FAIL[2]	Containment	Red	8th Consecutive Failure of Pressure Integrity (Vapor Leak) Test	
ISD GROSS PRESSURE WARN	Containment	Yellow	95th percentile of 7-days' ullage pressure exceeds 1.3 IWC.	• See Troubleshooting Guide 9513-003 found at www.vsthose.com • Vapor Pressure Verification Test, VR 204 Exhibit 8 • Vapor Processor Activation Test, VR 204 Exhibit 9
ISD GROSS PRESSURE FAIL[2]	Containment	Red	8th Consecutive Failure of Gross Containment Pressure Test	
ISD DEGRD PRESSURE WARN	Containment	Yellow	75th percentile of 30-days' ullage pressure exceeds 0.3 IWC.	
ISD DEGRD PRESSURE FAIL[2]	Containment	Red	31st Consecutive Failure of Degradation Pressure Test	
hnn: FLOW COLLECT WARN	Collection	Yellow	Vapor collection flow performance is less than 50%.	• See Troubleshooting Guide 9513-003 found at www.vsthose.com. • ISD Vapor Flow Meter Operability test Procedure, VR 204 Exhibit 11.
hnn: FLOW COLLECT FAIL[2]	Collection	Red	2nd Consecutive Failure of Vapor Collection Flow Performance Monitoring Test	
ISD VP* STATUS WARN	Processor	Yellow	Failure of Vapor Processor Effluent Emissions or Duty Cycle test.	• See Troubleshooting Guide 9513-003 found at www.vsthose.com. • See VP Emission Test • See VP Duty Cycle Test
ISD VP STATUS FAIL[2]	Processor	Red	2nd Consecutive Failure of Vapor Processor Status test.	
ISD VP PRESSURE WARN	Processor	Yellow	90th percentile of 1 day ullage pressure exceeds 1 IWC.	• See Troubleshooting Guide 9513-003 found at www.vsthose.com. • Vapor Pressure Verification Test, VR 204 Exhibit 8 • Vapor Processor Activation Test, VR 204 Exhibit 9
ISD VP PRESSURE FAIL[2]	Processor	Red	2nd Consecutive Failure of Vapor Processor Overpressure Test	

***VP = Vapor Processor**

ISD Alarm Troubleshooting Summary				
Message	**ISD Category**	**Light**	**Cause**	**Suggested Troubleshooting[1]**
VP RUNTIME FAULT	Processor	Yellow	Processor has continuously run for longer than allowed. (30 min)	• See Troubleshooting Guide 9513-003 found at www.vsthose.com. • See TLS 350 PMC Setup Procedure • Vapor Pressure Verification Test, VR 204 Exhibit 8 • Vapor Processor Activation Test, VR 204 Exhibit 9
VP EMISSION WARN	Processor	Yellow	Mass emission exceeded the certified threshold.	• See Troubleshooting Guide 9513-003 found at www.vsthose.com. • Hydrocarbon Sensor Verification Test, VR 204 Exhibit 6 • Vapor Processor Activation Test, VR 204 Exhibit 9
VP EMISSION FAIL	Processor	Red	2nd Consecutive Mass emission test failure.	
VP DUTY CYCLE WARN	Processor	Yellow	Duty cycle exceeds 18 hours per day 0r 75% of 24 hours.	• See Troubleshooting Guide 9513-003 found at www.vsthose.com. • See TLS 350 PMC Setup Procedure • Vapor Pressure Verification Test, VR 204 Exhibit 8 • Vapor Processor Activation Test, VR 204 Exhibit 9 • TP 201.3 Test, VR 204 Exhibit 4
VP DUTY CYCLE WARN	Processor	Red	2nd Consecutive Duty Cycle Test Failure.	
ISD SENSOR OUT WARN	Self-Test	Yellow	Failure of Sensor Self-Test	• Confirm ISD sensor & module installation / communication per VR 204 IOM Section 16, Chapter 2
ISD SENSOR OUT FAIL	Self-Test	Red	8th Consecutive Failure of Sensor Self-Test	
ISD SETUP WARN	Self-Test	Yellow	Failure of Setup Test	• Confirm EVR/ISD programming per VR 204 IOM Section 16
ISD SETUP FAIL[2]	Self-Test	Red	8th Consecutive Failure of Setup Test	

[1]See ISD Troubleshooting Manual P/N 577013-819 and the VST ISD Troubleshooting Guide 9513-003 found at www.vsthose.com for a complete list of suggestions.
[2]ISD Site shut down alarms

***VP = Vapor Processor**

Drive-Offs and Other Customer Abuse

- If the hanging hardware components are involved in a drive-off or if they incur some customer abuse, and they are not replaced as new, each individual component of the hanging hardware **must be visually inspected and functionally tested** before the components can return to dispensing fuel.

    - A visual assessment and functional tests are outlined in the following pages.

- **ANY COMPONENT THAT DOES NOT PASS A VISUAL INSPECTION OR FUNCTIONAL TEST MUST BE REPLACED.**

- **IF THE BREAKAWAY IS INVOLVED IN A DRIVEOFF, IT MUST BE REPLACED.**

  THE BREAKAWAY IS NON-RECONNECTABLE.

- Before beginning work, barricade the work area to block customer use.

Drive Offs & Other Customer Abuse: Perform a Visual Assessment

Visually inspect the hanging hardware system as follows to determine the extent of the damage:

Action	Test Procedure	Corrective Action	Reference Material	Authorized Personnel
Perform a thorough visual examination of the exterior of the whip hose and the curb hose for any obvious imperfections.	Obvious imperfections include, but are not limited to: • Damage to the swivels • Damage to the couplings • Kinks / flat spots • Tears to the outer hose	Replace with new VST hose(s).	Section 12	**Hose replacement**: GDF Owner/Operator or VST ASC Levels A, B, or C
	If there are no imperfections to the whip and curb hose, those hoses may be reused.	After reassembly, conduct required functional tests.	Section 12	VST ASC Levels A, B, or C
		If the functional tests fail, replace the hose(s).	Section 12	GDF Owner/Operator or VST ASC Levels A, B, or C
Perform a thorough visual inspection of the nozzle for any obvious imperfections.	Obvious imperfections include, but are not limited to: • Damaged spout (broken, bent) • Damage to the face-seal collection sleeve / interlock rod assembly • Broken face seal • Torn collection sleeve • Bent interlock rod • Nozzle alignment marks • Damage to the lever and lever guard	Replace damaged components where applicable.	Section 11	**Nozzle repair:** VST ASC Levels A, B, or C
		Replace with new VST nozzle.	Section 10	**Nozzle replacement**: GDF Owner/Operator or VST ASC Levels A, B, or C
If no imperfection or damage is visibly evident, proceed to functional testing.				

Function Testing Description

Perform the following functional tests prior to re-using a hose or a nozzle following a drive-off:

Test	Test Procedure	Corrective Action	Authorized Personnel
Leak Check	• Verify that there are no liquid leaks in all components. • Dispense fuel and check each connection between the components. • A visual inspection of the nozzle can determine any obvious liquid leaks.	Any component that does not pass the functional test must be replaced. Go to Sections 10, 12, and 13	GDF Owner/Operator or VST ASC Levels A, B, or C
Meter Creep	• Checking for meter creep will verify the integrity of the connections. • Dispense 1/10 to 2/10 of a gallon of fuel into an approved container then release lever and move components around and/or gently shake the hose and verify if the displace amount on the dispenser changes.	Any component that does not pass the functional test must be replaced. Go to Sections 10, 12, and 13	GDF Owner/Operator or VST ASC Levels A, B, or C
Automatic Shut-Off and Insertion Interlock	• Section 10 • The insertion interlock mechanism shall not allow dispensing when the bellows is uncompressed as determined by direct observation or GDF-09 (See Vapor Recovery Defects list).	Repair or replace the nozzle Go to Section 11	**Nozzle replacement** GDF Owner/Operator or VST ASC Levels A, B, or C **Nozzle repair** VST ASC Levels A, B, or C
Resistance	• Section 10	Any component that does not pass the functional test must be replaced. Go to Sections 10, 12, and 13	GDF Owner/Operator or VST ASC Levels A, B, or C

VST Installation Procedure for Phase II Coaxial EVR Balance Dripless Nozzles

Part Number Series: VST-EVR-NBcc, VST-EVR-NBccR

cc = Scuff Guard Color Code and R = rebuilt

Vapor Systems Technologies, Inc.
650 Pleasant Valley Drive
Springboro, Ohio 45066 (USA)

Toll Free: 1-888-878-4673
Phone: 937-704-9333
Fax: 937-704-9443
www.vsthose.com

GENERAL INFORMATION

If hanging hardware components are involved in a drive-off or incur other customer abuse, each individual component must be functionally tested prior to customer dispensing activities.

INSTALLATION PREPARATION

This procedure must be followed to insure leak-proof installation and operation of these nozzles.

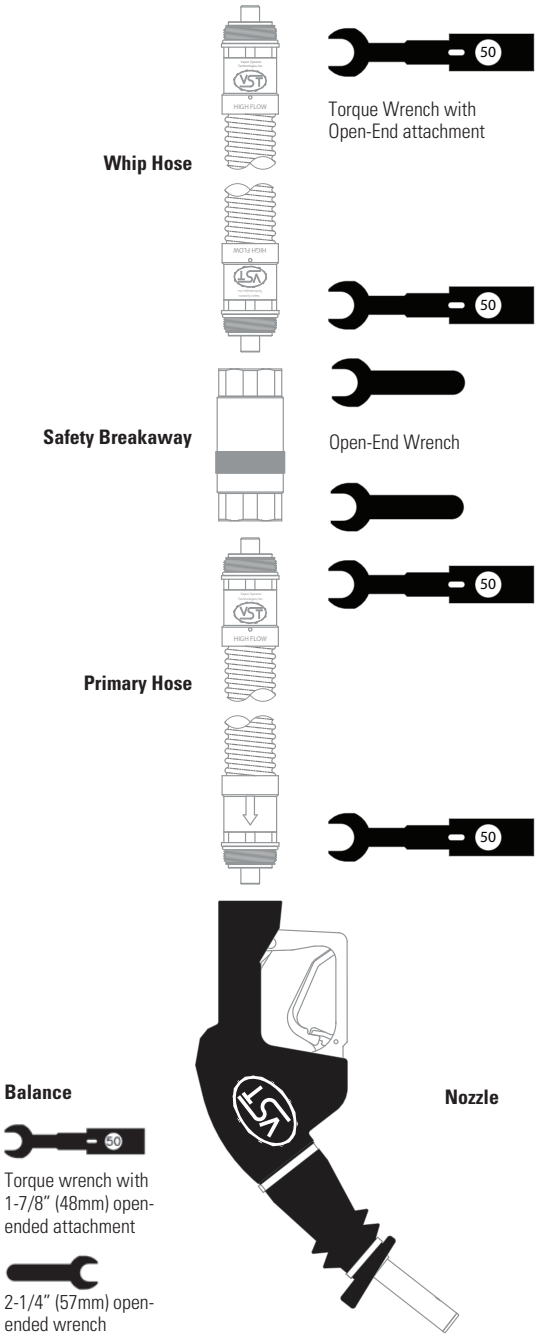
1. Turn off and tag the power to the dispenser. Dispenser must be de-energized prior to service to avoid personal injury.
2. Barricade work area to block vehicle access to the dispenser.
3. Close the dispenser shear valve prior to removing hanging hardware (hoses, safety breakaways, and nozzles).
4. Drain liquid product from the hanging hardware set into an approved container prior to replacing any hanging hardware components.
5. Remove hanging hardware from the dispenser prior to making replacement component assembly connections. VST recommends connecting the whip hose to the dispenser as the last connection during the hanging hardware assembly.

INSTALLATION AND FUNCTION TESTS

1. **STOP!** If this is a new facility installation, the fueling point must be flushed into an approved container before installing the nozzle. Using this nozzle to flush the system could result in foreign material becoming lodged in the nozzle's valve and cause it not to shut off.
2. Initial inspection and function tests:
   a. Carefully unpack nozzle from shipping carton.
   b. Inspect nozzle exterior for any damage.
   c. Inspect threads, lever, lever lock, spout, collection sleeve, band clamps, and face seal to determine that they are present and undamaged.
   d. Verify interlock rod alignment. Check interlock for engagement and release. Proper function of interlock rod requires the nozzle collection sleeve to be compressed ¼" to ½" and the lever to be engaged into the dispensing position. Nozzle will not function without interlock rod properly engaged.
   e. Inspect spout vent hole. It should be clear of debris.

Figure 1.

EVR Hanging Hardware Assembly



VST Installation Procedure for Phase II Coaxial EVR Balance Dripless Nozzles

Part Number Series: VST-EVR-NBcc, VST-EVR-NBccR

cc = Scuff Guard Color Code and R = rebuilt

3. Lightly lubricate **ALL** O-Rings on mating connections with petroleum jelly or other suitable lubricant. **DO NOT USE** pipe dope or thread sealant.
4. Attach nozzle onto mating hose connection and tighten by hand.
5. Tighten the nozzle connection to 50 ft-lbs of torque. **DO NOT OVER TIGHTEN.** Use a torque wrench with an open-end attachment to fit the hose couplings and an open-end wrench to properly tighten coupling connections. **DO NOT USE** channel-locks or pliers to tighten hose joints. Proper ft./lb. torque may not be achieved with these tools.
6. Purge air from the system by pumping one-tenth (1/10) to two-tenths (2/10) of a gallon of fuel into an approved container. Inspect the nozzle connection for liquid leaks and make proper adjustments at hose connection if necessary.
7. Check the nozzle shut-off action by dispensing fuel into an approved container at least three times to assure the proper automatic operation of the interlock rod. According to U/L requirement 842, the fuel flow-rate must be greater than 3 gpm for the automatic shut-off mechanism to operate.

   To test, operate the nozzle and submerge the spout tip in fuel until the fuel level covers the vent hole. The main valve of the nozzle automatically shuts off when the liquid covers the vent hole at the end of the spout. The nozzle is not designed to operate on gravity flow. The hold-open latch will disengage automatically when liquid covers the vent hole in the spout. Verify that the fuel flow stops when the nozzle collection sleeve is decompressed (e.g. interlock rod is disengaged). To test that the fuel flow stops, dispense some fuel into an approved container. Slowly remove the nozzle from the container while dispensing fuel. Fuel flow should stop when the nozzle collection sleeve is fully decompressed.
8. Measure the resistance between the dispenser outlet casting and the tip of the nozzle spout. Use an electronic multimeter set on the high range of the ohmmeter function. Resistance should not indicate more than 70,000 ohms per foot of hose. Example: The measured resistance for a 12-foot hose must not exceed 840,000 ohms (840 kilohms).

MAINTENANCE

Inspect nozzles daily for damaged component parts: vapor collection sleeve, face seal, interlock rod, spout, lever, lever lock, etc. Damaged components must be replaced. Vent hole at the end of the spout should be clear of debris. The nozzle will not operate properly if vent hole becomes clogged. The nozzle will not function properly without the interlock rod properly engaged. Keep the hose connections tight.

Should there be a drive-off or incidence of customer abuse, follow the initial inspection instructions found in the INSTALLATION section. The nozzle should be replaced when damaged. The nozzle is designed and constructed to give lasting service if properly handled and maintained. If for any reason it should need attention, contact your VST distributor for proper disposition.

NOTE

Due to abuse, misuse, changing gasoline formulas, variation in maintenance practices, environmental conditions, and/or conditions beyond the manufacturer's control, dispensing equipment may need replacement before five (5) years. Inspections and proper maintenance procedures should be followed by the station manager to determine if replacement is required before five (5) years.

WARNING

Unauthorized rebuilding or modifying of nozzles voids ALL approvals and warranties.

VST products must be used in compliance with applicable federal, state, and local laws and regulations.

If local regulatory codes prohibit use of the nozzle's hold-open clip, it must be removed prior to nozzle installation. Remove the nozzle to a safe work area.

Place the nozzle on a flat surface.

Locate the alloy rivet securing the hold-open clip and spring in the nozzle's handle. Use a drill with a 3/16" (5mm) drill bit, drill out the rivet securing the hold-open clip, and discard the clip, spring, and all other rivet debris.

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VST Installation Procedure for Phase II Coaxial EVR Balance Nozzle Repair Kits

Part Number Series: VST-FEK-100, VST-VCK-100, VST-NSA-100

Vapor Systems Technologies, Inc.
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TOOLS

Adjustable Wrench	Narrow End Nipper
Approved Fuel Container	Torque Wrench
Wide Mouth Funnel	Vaseline (or suitable lubricant)

GENERAL INFORMATION

If hanging hardware components are involved in a drive-off or incur other customer abuse, each individual component must be functionally tested prior to customer dispensing activities.

INSTALLATION PREPARATION

This procedure must be followed to insure leak-proof installation and operation of these nozzles.

1. Turn off and tag the power to the dispenser. Dispenser must be de-energized prior to service to avoid personal injury.
2. Barricade work area to block vehicle access to the dispenser.
3. Close the dispenser shear valve prior to removing hanging hardware (hoses, safety breakaways, and nozzles).
4. Visually inspect and assess the extent of the damage to all hanging hardware components. If there are no imperfections/damages, proceed to FUNCTIONAL TEST.
5. Drain liquid product from the hanging hardware set into an approved container prior to replacing any hanging hardware components.
6. Remove hanging hardware from the dispenser prior to making replacement component assembly connections. VST recommends connecting the whip hose to the dispenser as the last connection during the hanging hardware assembly.
7. To drain nozzle, engage nozzle interlock:
   a. Push in face seal on nozzle boot assembly
   b. Hold the backend of the nozzle over an approved container
   c. Pull nozzle lever to fully drain the nozzle

VAPOR COLLECTION KIT (VST-VCK-100) REMOVAL

(See Figure 1)

1. Remove large band clamp from the Vapor Collection assembly with end nippers.
2. Pull the Vapor Collection assembly (boot) off of the clamping groove of nozzle body.
3. Pull Vapor Collection assembly off of the spout by slightly twisting to go over the spout latch ring.
4. Properly discard the removed components.

VAPOR COLLECTION KIT (VCK) REPLACEMENT

1. Place the large band clamp on the collection sleeve. (See Figure 1)
2. Check proper orientation of the interlock rod. (See Figure 2)
3. Slide VCK over the spout.
4. Align and insert the interlock rod into the interlock port. (See Figure 2)
5. Align and center all alignment marks on top of the vapor collection kit and nozzle scuff. (See Figure 1)
6. Engage interlock a few times to check for correct alignment and functionality. (See Function Test 3)
7. Tighten collection band clamp until collection sleeve will not rotate. (See Figure 1)

NOZZLE SPOUT ASSEMBLY (VST-NSA-100) REMOVAL

1. Remove Vapor Collection Assembly.
2. Loosen spout nut with smooth-jaw wrench. (See Figure 3)
   NOTE Do not use pipe wrench or locking-type pliers.
3. Once threads are completely disengaged, pull the spout straight out.

NOZZLE SPOUT ASSEMBLY (NSA) REPLACEMENT

(See Figure 3)

1. Fuel chamber should remain in the nozzle casting with the vacuum sensing tube hole oriented at the top.
2. If the fuel chamber is pulled out of the nozzle casting:
   a. Check O-ring for damage.
   b. Replace O-ring if damaged (check for cuts, nicks, etc.).
   c. Lubricate O-ring prior to re-assembly.
3. Insert fuel chamber into nozzle casting:
   a. Poppet stem with spring goes through poppet hole in the fuel chamber (center hole).

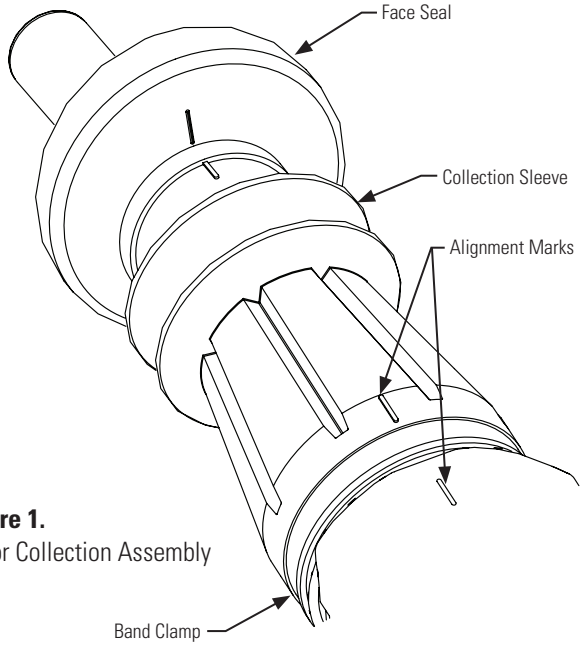


Figure 1.
Vapor Collection Assembly

VST Installation Procedure for Phase II Coaxial EVR Balance Nozzle Repair Kits

Part Number Series: VST-FEK-100, VST-VCK-100, VST-NSA-100

b. Push fuel chamber until it is flush with casting.

c. Vacuum sensing tube in the fuel chamber should be oriented at the top.

4. If the fuel chamber is not pulled out of the nozzle casting:

   a. Use pliers to carefully pull the fuel chamber flush with the nozzle casting for easier insertion of the vacuum sensing tube

5. Lightly lubricate ALL O-rings on the spout assembly.
   NOTE Do not block vacuum sensing-tube hole with lubricant.

6. Align vacuum sensing tube with mating hole in the fuel chamber.

7. Align the anti-rotation bump on the spout with the casting notch. Be careful not to damage the spout O-rings.

8. Firmly insert spout assembly into the nozzle casting.

9. Thread spout nut onto the nozzle casting and tighten firmly. Torque to 30 foot-pounds. Spout should be tight and not able to rotate. Do not over-tighten the spout nut.

10. Once the spout is replaced, re-install the vapor collection assembly per Vapor Collection Kit Replacement instructions.

FUNCTION TESTS

1. Follow the VST Installation Procedure for each hanging hardware component. (Procedures: Section 10, 12, and 13)

2. Purge air from the system by pumping one-tenth (1/10) to two-tenths (2/10) of a gallon of fuel into an approved container. Inspect the nozzle connection for liquid leaks and make proper adjustments at the hose connection if necessary.

3. Check the nozzle shut-off action by dispensing fuel into an approved container at least three times to assure the proper automatic operation of the interlock rod. According to U/L requirement 842, the fuel flow-rate must be greater than 3 gpm for the automatic shut-off mechanism to operate.

   To test, operate the nozzle and submerge the spout tip in fuel until the fuel level covers the vent hole. The main valve of the nozzle automatically shuts off when the liquid covers the vent hole at the end of the spout. The nozzle is not designed to operate on gravity flow. The hold-open latch will disengage automatically when liquid covers the vent hole in the spout. Verify that the fuel flow stops when the nozzle collection sleeve is decompressed (e.g. interlock rod is disengaged). To test that the fuel flow stops, dispense some fuel into an approved container. Slowly remove the nozzle from the container while dispensing fuel. Fuel flow should stop when the nozzle collection sleeve is fully decompressed.

4. Measure the resistance between the dispenser outlet casting and the tip of the nozzle spout. Use an electronic multimeter set on the high range of the ohmmeter function. Resistance should not indicate more than 70,000 ohms per foot of the hose. Example: The measured resistance of a 12-foot hose must not exceed 840,000 ohms (840 kilohms).

MAINTENANCE Inspect nozzles daily for damaged components parts: vapor collection sleeve, face seal, interlock rod, spout, lever, lever lock, etc. Damaged components must be replaced. Vent hole at the end of the spout should be clear of debris. The nozzle will not operate properly if vent hole becomes clogged. The nozzle will not function properly without the interlock rod properly engaged. Keep the hose connections tight.

Should there be a drive-off or incidence of customer abuse, follow the initial inspection instructions found in the VST Installation Procedure Section 10. The nozzle should be replaced when damaged. The nozzle is designed and constructed to give lasting service if properly handled and maintained. If for any reason it should need attention, contact your VST distributor for proper disposition.

NOTE Due to abuse, misuse, changing gasoline formulas, variation in maintenance practices, environmental conditions, and/or conditions beyond the manufacturer's control, dispensing equipment may need replacement before five (5) years. Inspections and proper maintenance procedures should be followed by the station manager to determine if replacement is required before five (5) years.

WARNING Unauthorized rebuilding or modifying of nozzles voids ALL approvals and warranties.VST products must be used in compliance with applicable federal, state, and local laws and regulations. If local regulatory codes prohibit use of the nozzle's hold-open clip, it must be removed prior to nozzle installation. Remove the nozzle to a safe work area. Place the nozzle on a flat surface. Locate the alloy rivet securing the hold-open clip and spring in the nozzle's handle. Use a drill with a 3/16" (5mm) drill bit, drill out the rivet securing the hold-open clip, and discard the clip, spring, and all other rivet debris.

Figure 2.
Interlock Assembly

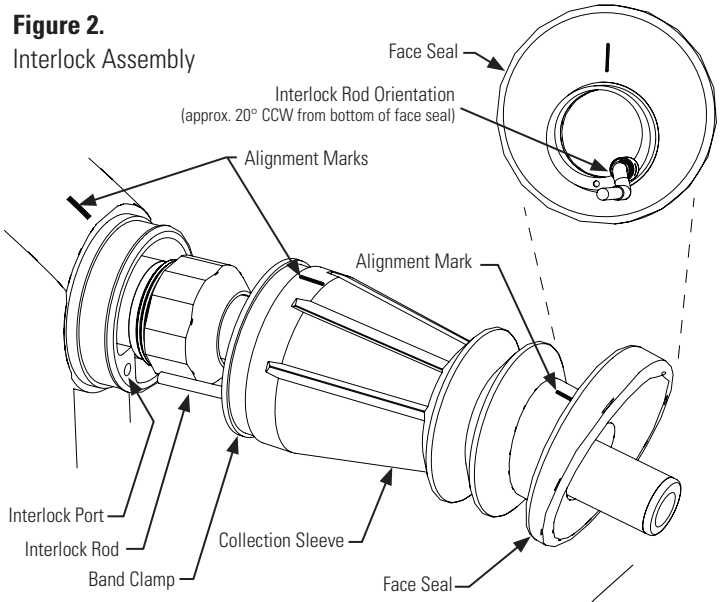
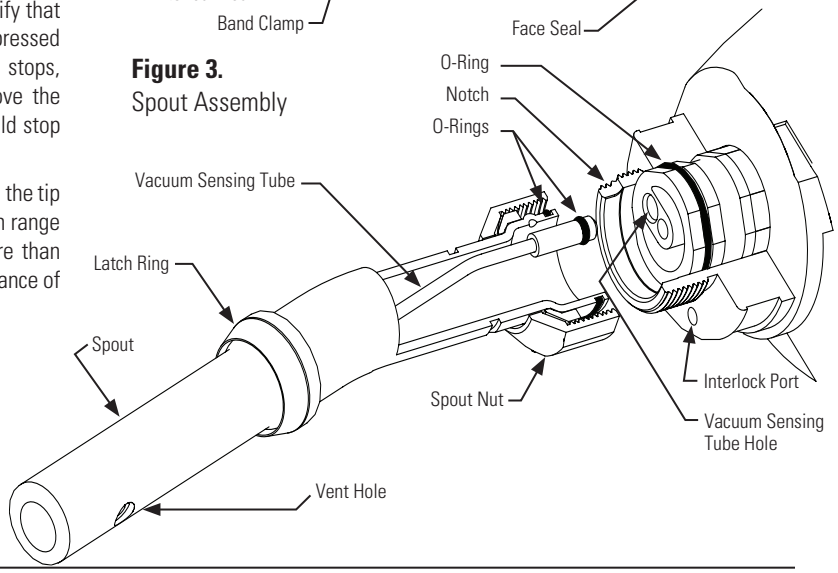


Figure 3.
Spout Assembly



VST Installation Procedure for Phase II Coaxial EVR Balance Fuel Hoses

Part Number Series: VSTA-EVR and VDV-EVR

Vapor Systems Technologies, Inc.
650 Pleasant Valley Drive
Springboro, Ohio 45066 (USA)

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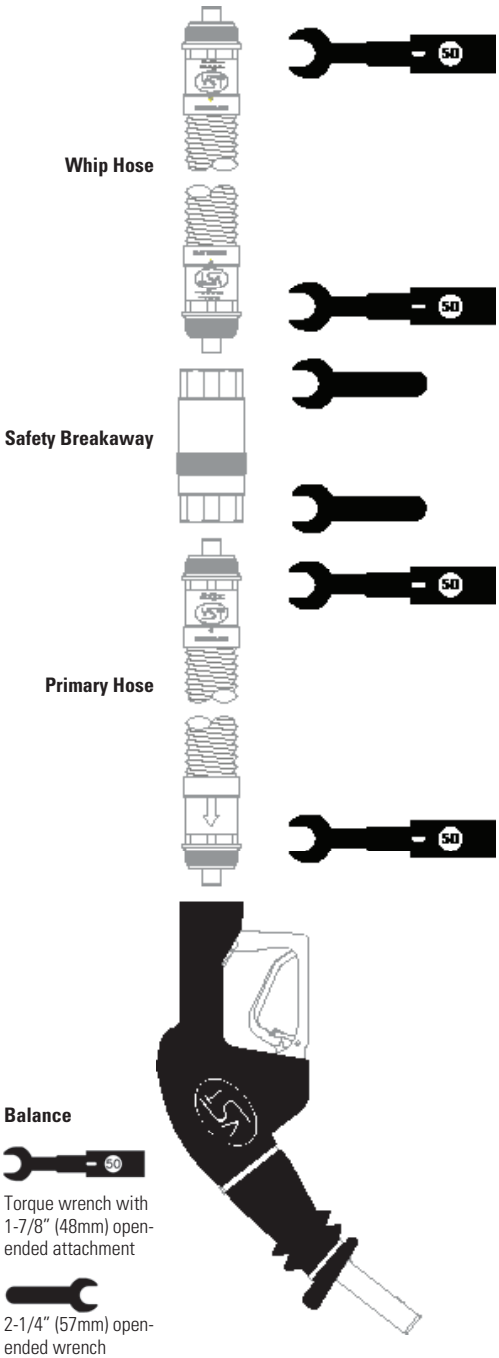
Figure 1.

EVR Balance Hanging Hardware Assembly



GENERAL INFORMATION

If hanging hardware components are involved in a drive-off or incur other customer abuse, each individual component must be functionally tested prior to customer dispensing activities.

INSTALLATION PREPARATION

This procedure must be followed to insure leak-proof installation and operation of these hose products.

1. Turn off and tag the power to the dispenser. Dispenser must be de-energized prior to service to avoid personal injury.
2. Barricade work area to block vehicle access to the dispenser.
3. Close the dispenser shear valve prior to removing hanging hardware (hoses, safety breakaways, and nozzles).
4. Drain liquid product from the hanging hardware set into an approved container prior to replacing any hanging hardware components.
5. Remove hanging hardware from the dispenser prior to making replacement component assembly connections. VST recommends connecting the whip hose to the dispenser as the last connection during the hanging hardware assembly.

INSTALLATION AND FUNCTION TESTS

1. Initial inspection:
   a. Carefully unpack hose from shipping carton.
   b. Inspect ALL O-Rings on each end of the hose to determine that they are present and undamaged.
   c. Inspect hose exterior for any damage.
   d. Inspect coupling threads for any damage.
2. Lightly lubricate ALL O-Rings on mating connections with petroleum jelly or other suitable lubricant. DO NOT USE pipe dope or thread sealant.
3. Insert the hose coupling into the mating connection and hand-tighten.
   NOTE Flow direction arrows on whip and primary hoses, where applicable, are indicated on hose coupling cuffs.
4. Tighten all the hose-joint connections to 50 foot-pounds of torque. DO NOT OVER TIGHTEN. Use a torque wrench with an open-end attachment to fit the hose couplings and an open-end wrench to properly tighten coupling connections. DO NOT USE channel-locks or pliers to tighten hose joints. Proper ft./lb. torque may not be achieved with these tools.
5. Purge air from the system by pumping one-tenth (1/10) to two-tenths (2/10) of a gallon of fuel into an approved container. Inspect each hose-joint connection for liquid leaks and make proper adjustments if necessary.

6. Check the nozzle shut-off action by dispensing fuel into an approved container at least three times to assure the proper automatic operation of the interlock rod. According to U/L requirement 842, the fuel flow-rate must be greater than 3 gpm for the automatic shut-off mechanism to operate.

   To test, operate the nozzle and submerge the spout tip in fuel until the fuel level covers the vent hole. The main valve of the nozzle automatically shuts off when the liquid covers the vent hole at the end of the spout. The nozzle is not designed to operate on gravity flow. The hold-open latch will disengage automatically when liquid covers the vent hole in the spout. Verify that the fuel flow stops when the nozzle collection sleeve is decompressed (e.g. interlock rod is disengaged). To test that the fuel flow stops, dispense some fuel into an approved container. Slowly remove the nozzle from the container while dispensing fuel. Fuel flow should stop when the nozzle collection sleeve is fully decompressed.
7. Measure the resistance between the dispenser outlet casting and the tip of the nozzle spout. Use an electronic multimeter set on the high range of the ohmmeter function. Resistance should not indicate more than 70,000 ohms per foot of hose. Example: The measured resistance for a 12-foot hose must not exceed 840,000 ohms (840 kilohms).

MAINTENANCE

Inspect hoses daily for damage, loose connection, or leaks. Replace as necessary. Subject to customer abuse, hose should be replaced when damaged.

The hose is designed and constructed to give lasting service if properly handled and maintained. If for any reason it should need attention, contact your VST distributor for proper disposition.

NOTE Due to abuse, misuse, changing gasoline formulas, variation in maintenance practices, environmental conditions, and/or conditions beyond the manufacturer's control, dispensing equipment may need replacement before five (5) years. Inspections and proper maintenance procedures should be followed by the station manager to determine if replacement is required before five (5) years.

WARNING Unauthorized rebuilding or modifying of hoses voids **ALL** approvals and warranties. VST products must be used in compliance with applicable federal, state and local laws and regulations.

PROCEDURE FOR POSITIONING THE LIQUID REMOVAL DEVICE

This procedure must be followed to insure proper positioning for the liquid removal device in Part Number Series: VDV-EVR (See Figure 2).

1. After installing the VST hanging hardware, hold the nozzle straight out from the dispenser so that the compressed bellows is 48 inches away from the front face of the dispenser and the spout tip of the nozzle is 30 inches above the pavement. The nozzle spout is to be at a 30-degree angle above the horizontal plane. (Simulate when the bellows is compressed in the filler neck of a vehicle.)
2. When the hose and nozzle are held in position as shown in Figure 2, the factory installed liquid removal device indicator mark on the vapor hose must be at the bottom of the loop. If the indicator mark is not at the bottom of the primary hose loop, the installer may choose one of the following options:

   Adjust the hose retractor (if installed)

   Use a different length whip hose

   Use a different length primary hose

IMPORTANT

It is the installing technician's responsibility to insure that the properly sized and marked hanging hardware is installed at the dispenser. Failure to properly install and locate the liquid removal device may reduce the effectiveness of the product in application resulting in outer hose liquid blockage and failure of the liquid removal test procedure.

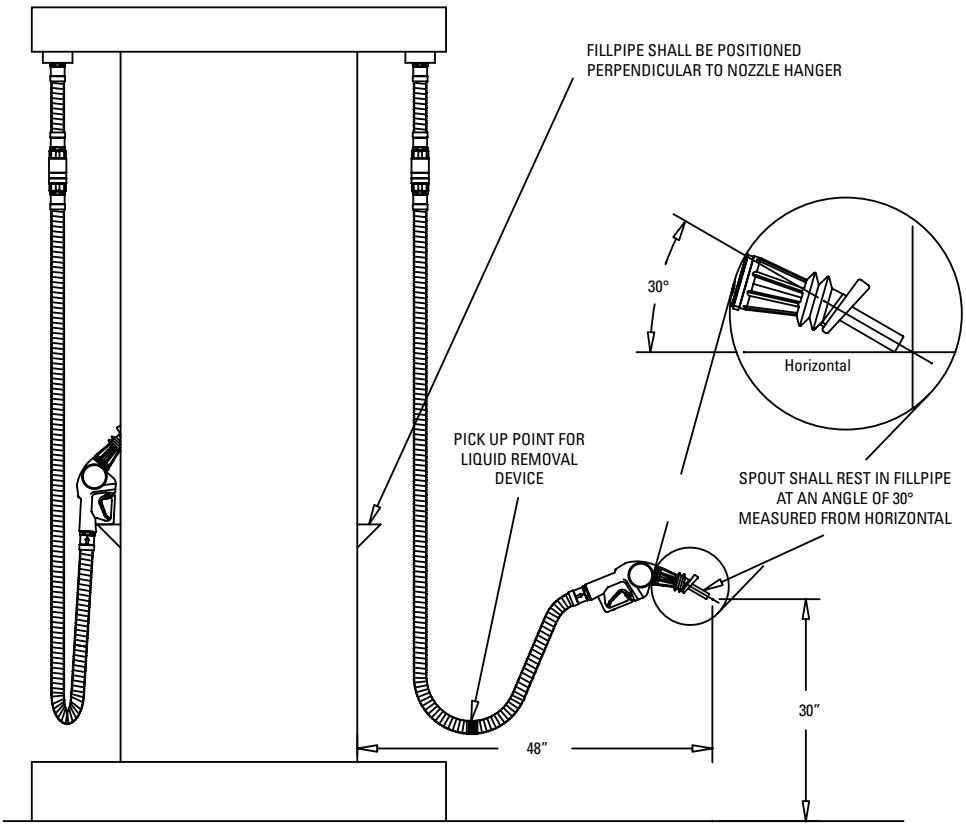


Figure 2. Procedure For Positioning the Liquid Removal Device

VST Installation Procedure for Phase II Coaxial EVR Balance Safety Breakaway Devices

NON-Reattachable Breakaway Part Number Series: VSTA-EVR

Vapor Systems Technologies, Inc.
650 Pleasant Valley Drive
Springboro, Ohio 45066 (USA)

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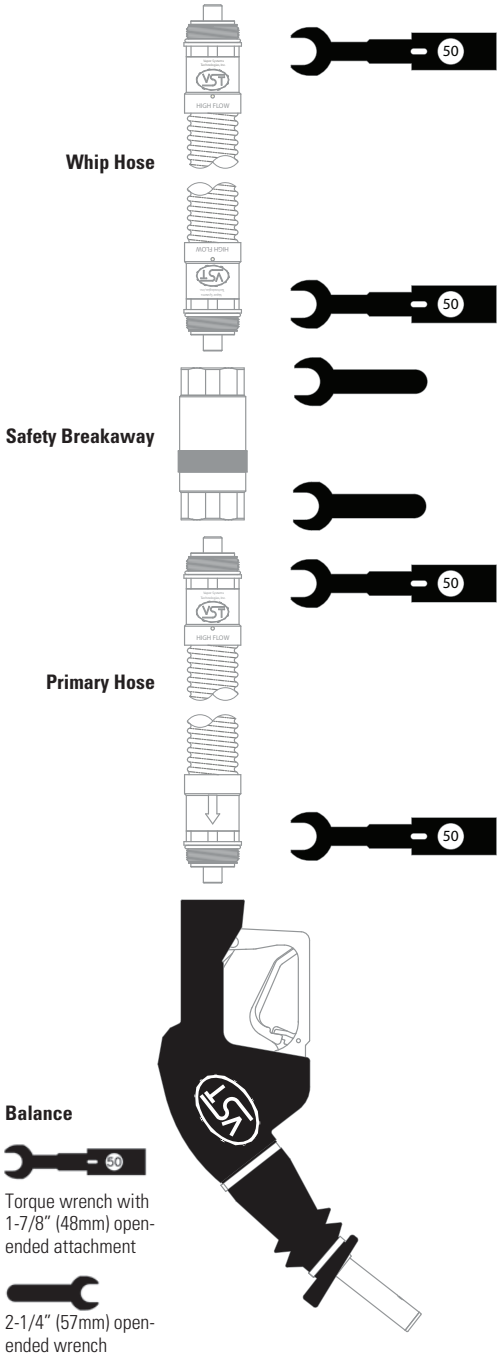
www.vsthose.com

Figure 1.

EVR Balance Hanging Hardware Assembly



APPLICATION

These VST Safety Breakaway devices are intended to prevent damage to the dispenser and hose in the event of a vehicle drive off. These devices separate at pull forces up to 350 lbs. Prior to installation (see Installation Preparation), you will need to determine that 350 lbs. of pull force will not damage the dispenser. After verifying that the dispenser is securely bolted to the island, it can be tested by using a spring scale and a length of rope. The rope must be connected at the dispenser outlet casting, which may require a threaded bushing with a hole for attaching the rope. Attach the scale to the rope and pull to 350 lbs. in several directions. Be sure to avoid damaging the dispenser.

NOTE

a. The whip hose ALWAYS attaches to the dispenser. If a retractor is being used, the retractor clamp MUST be between the breakaway and the dispenser.

b. VST hoses are made to withstand 350 pounds tensile pull without damage. If another brand of hose is present at the dispenser, VST recommends that you contact the hose manufacturer regarding the compatibility with this breakaway device.

GENERAL INFORMATION

If hanging hardware components are involved in a drive-off or incur other customer abuse, each individual component must be functionally tested prior to customer dispensing activities.

INSTALLATION PREPARATION

This procedure must be followed to insure leak-proof installation and operation of these safety breakaway products.

1. Turn off and tag the power to the dispenser. Dispenser must be de-energized prior to service to avoid personal injury.
1. Barricade work area to block vehicle access to the dispenser.
2. Close the dispenser shear valve prior to removing hanging hardware (hoses, safety breakaways, and nozzles).
3. Drain liquid product from the hanging hardware set into an approved container prior to replacing any hanging hardware components.
4. Remove hanging hardware from the dispenser prior to making replacement component assembly connections. VST recommends connecting the whip hose to the dispenser as the last connection during the hanging hardware assembly

VST Installation Procedure for Phase II Coaxial EVR Balance Safety Breakaway Devices

NON-Reattachable Breakaway Part Number Series: VSTA-EVR

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650 Pleasant Valley Drive
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www.vsthose.com

INSTALLATION AND FUNCTION TESTS

1. Initial inspection:
   a. Carefully unpack safety breakaway from shipping carton.
   b. Inspect safety breakaway for any damage to threads, O-Rings, exterior, etc.
2. Lightly lubricate ALL O-Rings on mating connections with petroleum jelly or other suitable lubricant. DO NOT USE pipe dope or thread sealant.
3. Attach breakaway on mating connection and tighten by hand. NOTE THE FLOW DIRECTION ARROW (where applicable). Use the hex on the breakaway body to tighten. DO NOT USE the breakaway body to tighten the unit.
4. Tighten breakaway connection to 50 foot-pounds torque. DO NOT OVER TIGHTEN. Use the hex on the breakaway body to tighten. Use a torque wrench with an open-end attachment to fit the hose couplings and an open-end wrench to properly tighten breakaway connections. DO NOT USE channel-locks or pliers to tighten connections. Proper ft./lb. torque may not be achieved with these tools.
5. Purge air from the system by pumping one-tenth (1/10) to two-tenths (2/10) of a gallon of fuel into an approved container. Inspect each hose joint connection for liquid leaks and make proper adjustments if necessary.
6. Check the nozzle shut-off action by dispensing fuel into an approved container at least three times to assure the proper automatic operation of the interlock rod. According to U/L requirement 842, the fuel flow-rate must be greater than 3 gpm for the automatic shut-off mechanism to operate.

   To test, operate the nozzle and submerge the spout tip in fuel until the fuel level covers the vent hole. The main valve of the nozzle automatically shuts off when liquid covers the vent hole at the end of the spout. The nozzle is not designed to operate on gravity flow. The hold-open latch will disengage automatically when liquid covers the vent hole in the spout. Verify that the fuel flow stops when the nozzle collection sleeve is decompressed (e.g. interlock rod is disengaged). To test that the fuel flow stops, dispense some fuel into an approved container. Slowly remove the nozzle from the container while dispensing fuel. Fuel flow should stop when the nozzle collection sleeve is fully decompressed.
7. Measure the resistance between the dispenser outlet casting and the tip of the nozzle spout. Use an electronic multimeter set on the high range of the ohmmeter function. Resistance should not indicate more than 70,000 ohms per foot of hose. Example: The measured resistance for a 12-foot hose must not exceed 840,000 ohms (840 kilohms).

MAINTENANCE

Inspect safety breakaways daily for damage, loose connections or leaks. Replace as necessary. Subject to customer abuse, safety breakaway should be replaced when damaged.

The safety breakaway is designed and constructed to give lasting service if properly handled and maintained. If for any reason it should need attention, contact your VST distributor for proper disposition.

NOTE

Due to abuse, misuse, changing gasoline formulas, variation in maintenance practices, environmental conditions and/or conditions beyond the manufacturer's control, dispensing equipment may need replacement before five (5) years. Inspections and proper maintenance procedures should be followed by the station manager to determine if replacement is required before five (5) years.

WARNING

Unauthorized rebuilding or modifying of safety breakaways voids **ALL** approvals and warranties.

VST products must be used in compliance with applicable federal, state, and local laws and regulations.

Section #14

Installation Manual

ECS Membrane *Processor* with ISD

Part:	VST-ECS-CS3-110 VST-ECS-CS3-310
E.O.	VR-204

Vapor Systems Technologies, Inc.
650 Pleasant Valley Drive
Springboro, Ohio 45066
PH: 937-704-9333
FX: 937-704-9443

www.vsthose.com

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UL Declaration Notice

- Acceptability of the installation of the Vapor *Processor* and all associated piping, fittings, controls, etc. is not covered under the UL Listing of the ECS Membrane *Processor*.

- NOTE: All peripheral equipment required to activate / control these units is not covered under the UL Listing of this ECS Membrane *Processor*.

    - They should be UL Listed, have the appropriate communications protocol, not installed over or in a hazardous location, and are determined to be acceptable to the authority having jurisdiction with regards to suitability and overall installation.

About VST

Vapor Systems Technologies, Inc. began in 1989 with the vision of **One Company – One Integrated Solution**.

Today, that philosophy is still in place and getting stronger. Recognizing that a healthier environment is a need and not an option, VST has dedicated its undivided attention to the ever-changing, stringent regulations that govern fugitive vapors at gasoline dispensing facilities (GDF). To this challenge, VST is committed to a continual R&D campaign of developing the most current, technologically advanced solutions to service not only the United States, but also the world.

VST specializes in the development, engineering, and manufacturing of products that are sold into the GDF segment of the petroleum industry. The VST focus provides our customers and users with exceptional products, services, and innovative solutions for improving the fueling-station experience as well as the world's air quality.

VST's product offering includes curb pump and vapor recovery hoses, safety breakaways, nozzles, and emission-control system *Processor*s. The ENVIRO-LOC™ vapor-recovery product offering represents the most innovative concept in the industry for trapping fugitive vapors from the front end (vehicle refueling) to the back end (vent risers) of the GDF site.

Notice

Warranty

- The warranty is conditional on whether the *Processor* was installed by a VST ASC Level B or a VST Level C.
- 12-month warranty becomes effective at the time of installation. If this card is not returned, the warranty becomes effective from the date of shipment at VST.
- VST cannot be held responsible for damage to the *Processor* or the *Processor* equipment (inclusive) due to acts of nature, vandalism, or neglect.
- Membranes exposed to gasoline (liquid) due to an overfill or any other reason voids the membrane warranty.
- VST products are warranted to be free of defects in material and workmanship.
- Liability under any expressed or implied warranty is limited to replacement of the product.
- Use of VST products on non-UL Listed systems, or use which falls outside intended field of use, voids any stated or implied warranty.
- VST is not responsible for misuse of, nor improperly installed, products.
- In the event of a warranty claim, the purchaser must obtain a copy of the Return Goods Authorization (RGA) prior to returning product to insure proper processing. Return shipping charges are the responsibility of the customer.
- Warranty status will be determined within 30 days of the return of suspected items.
- VST provides for a warranty program in conjunction with VST's exclusive serial number tracking system.
- Each VST product carries a unique serial number and warranty tracking card.
- Requests for warranty shall be through VST's Return Goods Authorization (RGA) procedure. Call VST at 937-704-9333.
- This warranty does not cover any components exposed to contact with fuels more than 5% menthanol, 10% ethanol, 15% MTBE by volume or any exposure to M85 / E85 fuel.

Warranty Cards

Vapor Systems Technologies, Inc.

Phone: (937)-704-9333 • Fax: (937)-704-9443
www.vsthose.com

IMPORTANT
PRODUCT WARRANTY
REGISTRATION CARD

12 MONTH WARRANTY BECOMES EFFECTIVE AT TIME OF INSTALLATION. IF THIS CARD IS NOT RETURNED, WARRANTY BECOMES EFFECTIVE FROM DATE OF SHIPMENT FROM VST.

THE MAXIMUM WARRANTY LIFE IS 18 MONTHS FROM DATE OF SHIPMENT.

PLEASE CALL VST IF THIS PRODUCT IS BEING USED AS A REPLACEMENT. REPLACEMENT WITH A NON VST PRODUCT VOIDS ANY WARRANTY.

SERIAL NUMBER:

INSTALLATION DATE:

INSTALLATION SITE:

CITY/STATE/ZIP:

DISTRIBUTOR NAME:

PRODUCT STYLE:

☐ HOSE ☐ SAFETY BREAKAWAY
☐ NOZZLE ☐ ECS PROCESSOR

Figure 1: VST Registration Card

NOTICE: THIS TAG MUST NOT BE REMOVED FOR ANY REASON

ECS MEMBRANE PROCESSOR UNIT

Serial Number: _____

Date Installed: _____

This device was factory tested and met all applicable performance standards and specifications to which it was certified.

Manufactured By: Vapor Systems Technologies, Inc.
650 Pleasant Valley Dr., Springboro, Ohio 45066
Phone: (937) 704-9333, Fax: (937) 704-9443

Figure 2: ECS Membrane Processor Sticker

Components and Warranties

PART #	DESCRIPTION	WARRANTY
5001-001	Vacuum Pump/Three-Phase Motor - Shipped with Three-Phase *Processor*	1 year
5001-002	Vacuum Pump/Single-Phase Motor - Shipped with Single-Phase *Processor*	1 year
5001-003	Vacuum Pump Drive Coupling Rubber Insert	1 year
5002-001	Circulating Blower / Three-Phase Motor - Shipped with Three-Phase *Processor*	1 year
5002-002	Circulating Blower / Single-Phase Motor - Shipped with Single-Phase *Processor*	1 year
5003-001	Check-Valve Assembly	1 year
5005-001	Membrane	1 year
5006-001	Membrane Housing, Complete	1 year
5006-011	O-Ring (2) Vertical Tube	1 year
5006-012	O-Ring (2) Base Insert	1 year
5006-013	O-Ring (2) Membrane	1 year
5007-004	Hydrocarbon Sensor	1 year
5008-001	Heat-Trace Cable	1 year
5008-002	Heat Trace Power Connection Kit	1 year
5008-003	Heat Trace End Seal Kit	1 year
5010-001	ECS Aluminum Cover	1 year
5012-100	Membrane Tubing	1 year
5012-101	Blower Inlet Tubing	1 year
5012-102	Blower Outlet Tubing	1 year
5012-103	Vacuum Pump Inlet Tubing	1 year
5012-104	Vacuum Pump Outlet Tubing	1 year
5012-105	HC Return Tubing	1 year
5012-106	HC Inlet Tubing	1 year
5012-107	Membrane Outlet Tubing	1 year
5013-001	Insulation	1 year

VST Contractor Requirements

- Due to the highly volatile nature of gasoline and its handling and storage, VST requires the following certifications for its ASC's:

Level	Component	Authorized Tasks	Training Pre-Requisites
A	Hanging Hardware	Functional Testing Installation Maintenance Repair	No pre-requisite
A/B	Hanging Hardware	Functional Testing Installation Maintenance Repair	No pre-requisite
	Membrane *Processor*	Installation	Veeder-Root Level 1, 2/3, or 4 ASC certification
C	Membrane *Processor*	Annual Testing Component Replacement Maintenance Operation Post-Installation Power-Up Testing Start-Up Testing Troubleshooting	Veeder-Root Level 2/3, or 4 ASC with PMC / ISD certification VST level "A/B"

NOTE:

Depending on local codes, in addition to the VST and Veeder-Root training, contractors may be required to take air-district training or ICC certification as an approved vapor-recovery installer.

- ASC's must be able to show proof of certification if asked. Carry the wallet card or have a copy of your certification on file with the GDF.

- The ASC must record his or her certification number on the applicable paperwork for all warranties to be deemed valid.

- Contractors should **ALWAYS** verify the training and certification requirements with the air-district staff **BEFORE** beginning installation of EVR systems.

Veeder-Root Contractor Requirements

Veeder-Root Level 1	Contractors holding valid Level 1 Certification are approved to perform wiring and conduit routing, equipment mounting, probe and sensor installation, tank and line preparation, and line leak detector installation.
Veeder-Root Level 2/3 or 4	Contractors holding valid Level 2, 3, or 4 certifications are approved to perform installation checkout, startup, programming and operations training, troubleshooting and servicing for all Veeder-Root Tank Monitoring Systems, including Line Leak Detection and associated accessories.
PMC / ISD	This course of training includes In-Stations Diagnostics/Pressure Management Control (ISD/PMC) installation checkout, startup, programming, and operations training. It also includes troubleshooting and service techniques for the Veeder-Root In-Station Diagnostics system. A current level 2/3 or 4 certification is a prerequisite for the ISD/PMC course. After successful completion of this course the contractor will receive a certificate as well as a Veeder-Root ISD/PMC contractor certification card.
Warranty Registrations may only be submitted by selected distributers.	

Safety Icons

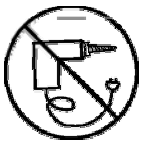
	**ELECTRICITY** A potential shock hazard exists. High voltage is supplied to and exists in this device.		**TURN POWER OFF** Turn power off to the device and its accessories when installing and servicing the unit. Live power creates a potential spark hazard.
	**EXPLOSIVE** Gasoline and its vapors are 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 MATERIALS** Read, understand, and follow all instructions, warnings, and requirements before you begin work.
	**NO OPEN FLAMES** Open flames from sources like lighters and matches can ignite gasoline and its vapors.		**USE SAFETY BARRICADES** Unauthorized people in the work area during installation and service of the device create a potential for personal injury. Therefore, always isolate your work area by using safety cones, barricades, etc.
	**PINCH RISK** Stay clear. Keeps hands and tools away from rotating machinery and moving parts.		**ROTATING MACHINERY** Stay clear. Keep hands and tools away from rotating machinery.

Table of Terms and Abbreviations

ASC:	Authorized Service Contractor
AQMD:	Air Quality Management Districts
ATG:	Automatic Tank Gauge
CARB:	California Air Resources Board
CDFA:	California Department of Food & Agriculture
CVLD:	Continuous Vapor Leakage Detection, another name for Vapor Leak Detection
ECS:	Emissions Control System
EO:	Executive Order
EVR:	Enhanced Vapor Recovery
GDF:	Gasoline Dispensing Facility
HC:	Hydrocarbon
HC IR:	Hydrocarbon Infrared
ISD:	In-Station Diagnostics
MAG Probe:	A type (brand) of Tank Inventory Probe
NEC:	National Electric Code
NFPA:	National Fire Protection Association
ORVR:	On-Board Refueling Vapor Recovery
OSHA:	Occupational Safety Health Administration
Permeate:	Air return to atmosphere
PLC:	Programmable Logic Control
PMC:	Pressure Management Control
Retentate:	Vapor return to UST
RVP:	Reid Vapor Pressure
TLS:	Tank Level System
TLS Console:	Veeder-Root's line of environmental monitoring consoles.
TS:	Troubleshooting
Ullage:	Vapor space above liquid in a UST
UST:	Underground Storage Tank
VCK:	Vapor Collection Kit
Veeder Root:	Manufacturer of the TLS-350
VOC:	Volatile Organic Compounds
VST:	Vapor Systems Technologies, Inc. - manufacturer of the ECS Membrane *Processor*
WC:	Water Column

1 ECS Membrane Processor Overview

1.1 ECS Membrane *Processor* Theory of Operation

- The VST ECS membrane *Processor* does not interact directly with the other balance system hardware. It is in place to monitor and control the pressure in the UST to within limits specified by CARB.

  Under conditions where the GDF is operational and the balance system hardware is functioning normally, the inherent ORVR compatibility of the balance system (when using VST's ENVIRO-LOC nozzle) will produce a predominately negative gauge pressure in the ullage space of the UST. Under these conditions the ECS membrane *Processor* will typically not need to operate.

  During periods of less activity, the GDF being shut down overnight, winter fuels being present, or other conditions that promote the pressurization of the ullage space, the ECS membrane *Processor* will operate as needed to control the pressure in the ullage space to an accepted level. The ECS membrane *Processor* will turn on at an ullage pressure of +0.20 inches of water and turn it off at a pressure of –0.20 inches of water. Currently, the ECS membrane *Processor* unit is monitored and controlled through the ISD system.

- The ECS membrane *Processor* uses a type of membrane technology to enable it to selectively separate the components in the ullage vapor mixture.

  Through a somewhat complex transport means, certain molecules will selectively travel in a stream from one side of the membrane to the other. This stream is referred to as the permeate stream.

  In this case, the predominate molecules transported across the membrane will be the primary constituents of air, which are oxygen, nitrogen, and water vapor. A small amount of the hydrocarbons present in the ullage mixture will also migrate across the membrane. Typically, the permeate will contain less than 3.0% hydrocarbons. The result of this activity includes, fresh air vented to atmosphere, saturated hydrocarbon vapors returned to the UST, and UST pressurization controlled to an acceptable level.

- The process of separation by the membrane is made possible by using two pumps, one low-pressure pump which circulates the ullage vapor mixture along one side of the membrane, and one high-vacuum pump, which creates the pressure differential needed to cause the permeate transport across the membrane. These are the only moving parts in the system.

  A self-regulating heating coil is incorporated around the membrane housing to keep the membrane free from condensate.

1.2 Overview of How the *Processor* Operates

- The *Processor* is a technology created for Gasoline Dispensing Facilities (GDF) to assist them in reducing the number of harmful emissions released to the atmosphere through the natural occurrence of gasoline vaporization.

- The table below lists the steps that the Veeder-Root TLS 350 and the ISD software takes to control the *Processor*.

1.	• When the UST system pressure rises above +0.2”WC, the *Processor* turns ON.
2.	• Through the vapor inlet pipe connection at the *Processor*, the VOC vapor is drawn into the suction side of the blower.
3.	• The blower discharges the VOC vapor into the membrane housing.
4.	• Inside the membrane housing, the VOC vapor is separated in to two air streams: 1. VOC depleted air (referred to as “air”) 2. Concentrated VOC vapor • The membrane is designed specifically for separating air from gasoline VOC vapor.
5.	• A vacuum pump draws the air from the membrane housing through a check valve.
6.	• A sample of the air flows through a hydrocarbon sensor to check the percent hydrocarbons.
7.	• From the vacuum pump, the air is vented to atmosphere via the air return.
8.	• The concentrated VOC vapor returns to the UST system via the vapor return.
9.	• When the UST system pressure drops below -0.2”WC, the *Processor* turns OFF.

1.3 *Processor* Dimensions and Weight

Part Number	Unit	Dimensions	Weight
VST-ECS-CS3-110	Single-Phase	L-39” x W-27” x H-43”	385 lbs.
VST-ECS-CS3-310	Three-Phase	L-39” x W-27” x H-43”	350 lbs.
Note: Cover weight is 24lbs. and is included in the overall weight of the *Processor*.			

1.4 *Processor* Components

PART #	DESCRIPTION
5001-001	Vacuum Pump/Three-Phase Motor - Shipped with Three-Phase *Processor*
5001-002	Vacuum Pump/Single-Phase Motor - Shipped with Single-Phase *Processor*
5001-003	Vacuum Pump Drive Coupling Rubber Insert
5002-001	Circulating Blower / Three-Phase Motor - Shipped with Three-Phase *Processor*
5002-002	Circulating Blower / Single-Phase Motor - Shipped with Single-Phase *Processor*
5003-001	Check-Valve Assembly
5005-001	Membrane
5006-001	Membrane Housing, Complete
5006-011	O-Ring (2) Vertical Tube
5006-012	O-Ring (2) Base Insert
5006-013	O-Ring (2) Membrane
5007-004	Hydrocarbon Sensor
5008-001	Heat-Trace Cable
5008-002	Heat Trace Power Connection Kit
5008-003	Heat Trace End Seal Kit
5010-001	ECS Aluminum Cover
5012-100	Membrane Tubing
5012-101	Blower Inlet Tubing
5012-102	Blower Outlet Tubing
5012-103	Vacuum Pump Inlet Tubing
5012-104	Vacuum Pump Outlet Tubing
5012-105	HC Return Tubing
5012-106	HC Inlet Tubing
5012-107	Membrane Outlet Tubing
5013-001	Insulation

1.5 *Processor* Auxiliary Components

PART #	DESCRIPTION
5015-001	HC Sentry Interface Module w/24VDC power supply

1.6 *Processor* Manuals and Warranty

MANUAL #	MANUAL NAME	SECTION
9520-001	ECS Membrane *Processor* with ISD: Installation Manual	14
9520-002	ECS Membrane *Processor* with ISD: Operation / Maintenance Manual	15
9514-003	ECS Membrane *Processor*: Troubleshooting Guide	www.vsthose.com
9514-004	ECS Membrane *Processor*: Pre-Installation Site Survey	www.vsthose.com
9522-001	IOM: VST EVR Balance Total System Solution	5
9998-001	Warranty Paperwork	www.vsthose.com

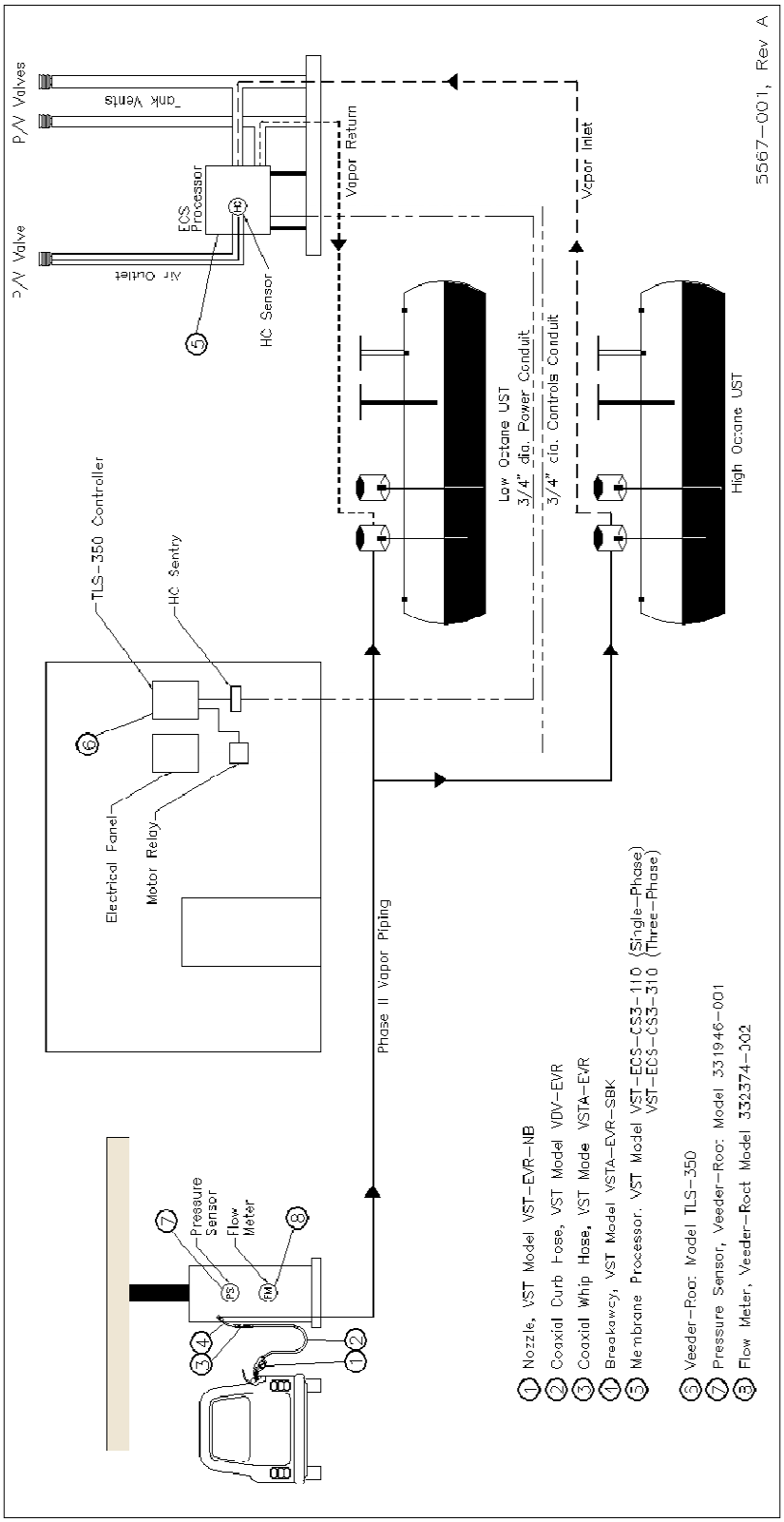


Figure 3: How the Processor fits into the GDF Layout

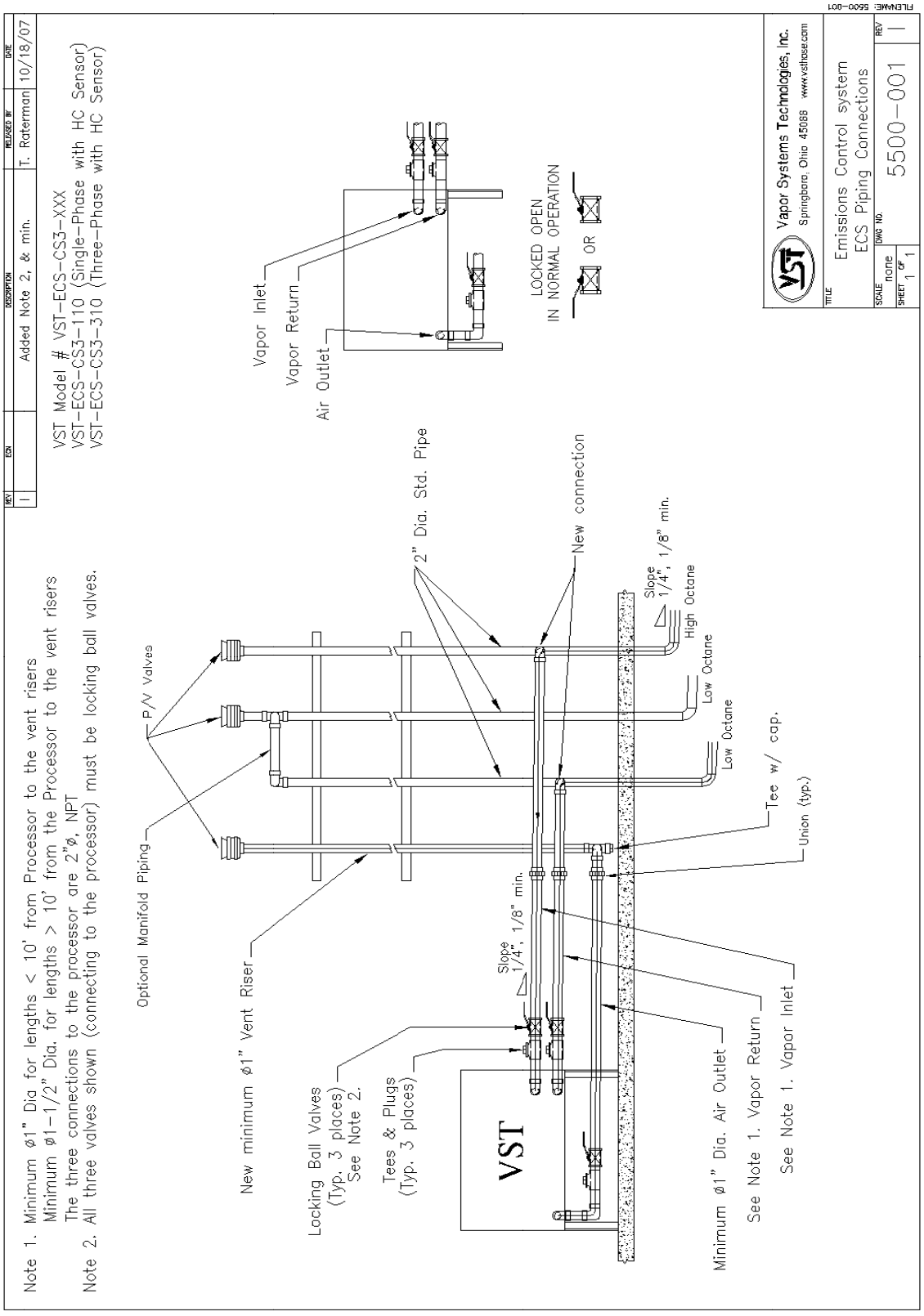


Figure 4: ECS Process Control Diagram

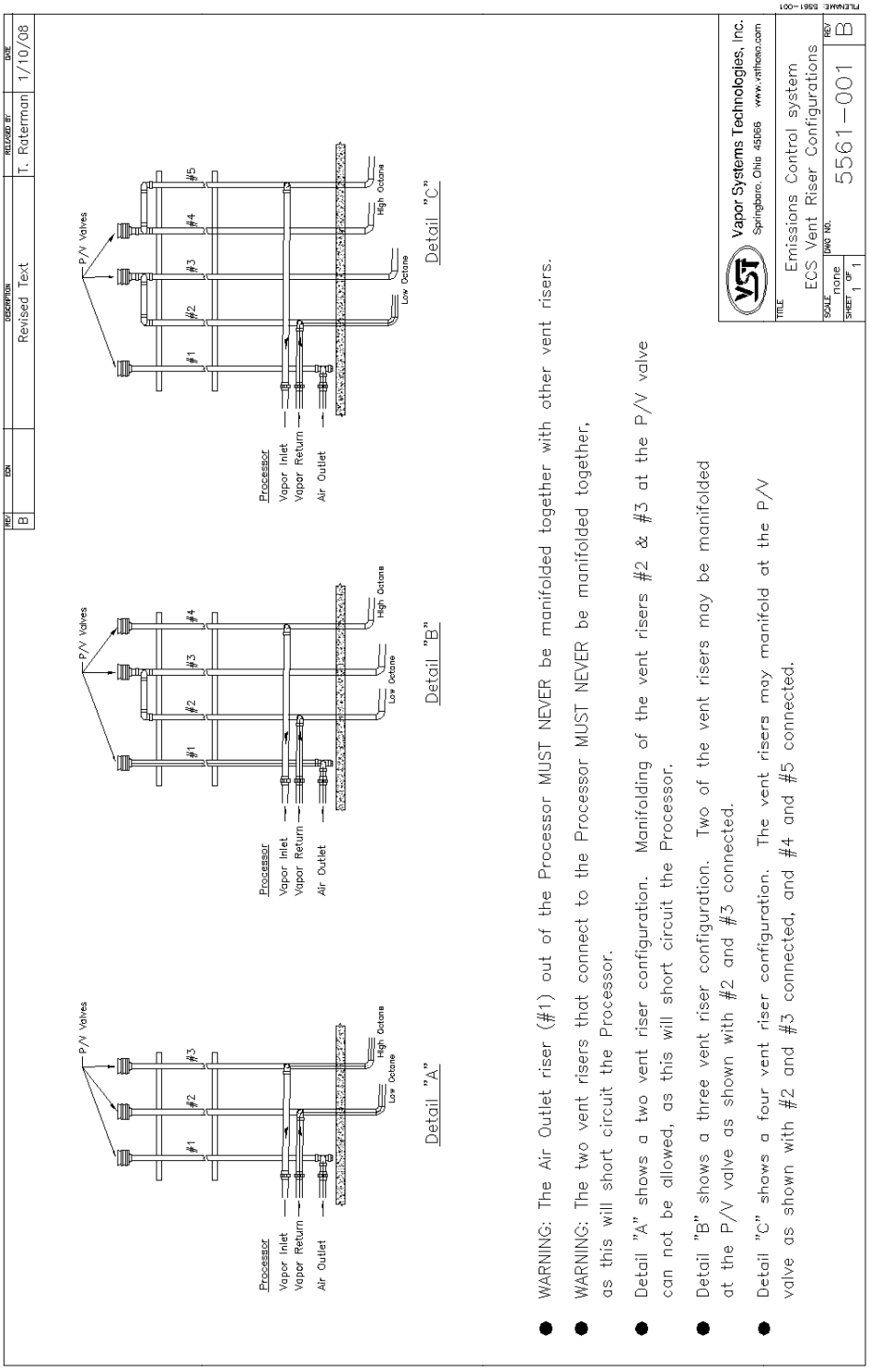


Figure 5: ECS Vent Riser Configurations

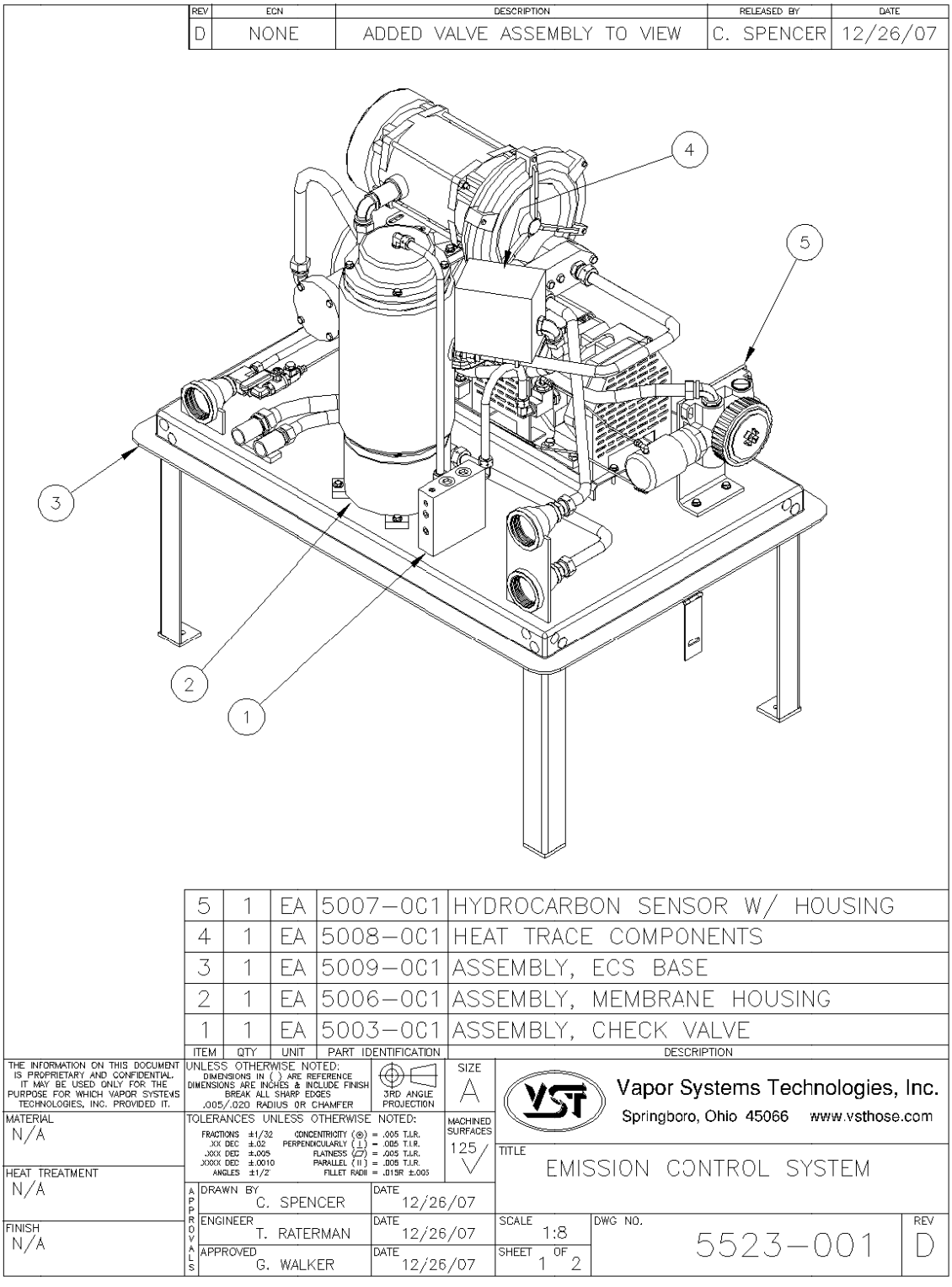


Figure 6: Processor Isometric Drawing (1 of 2)

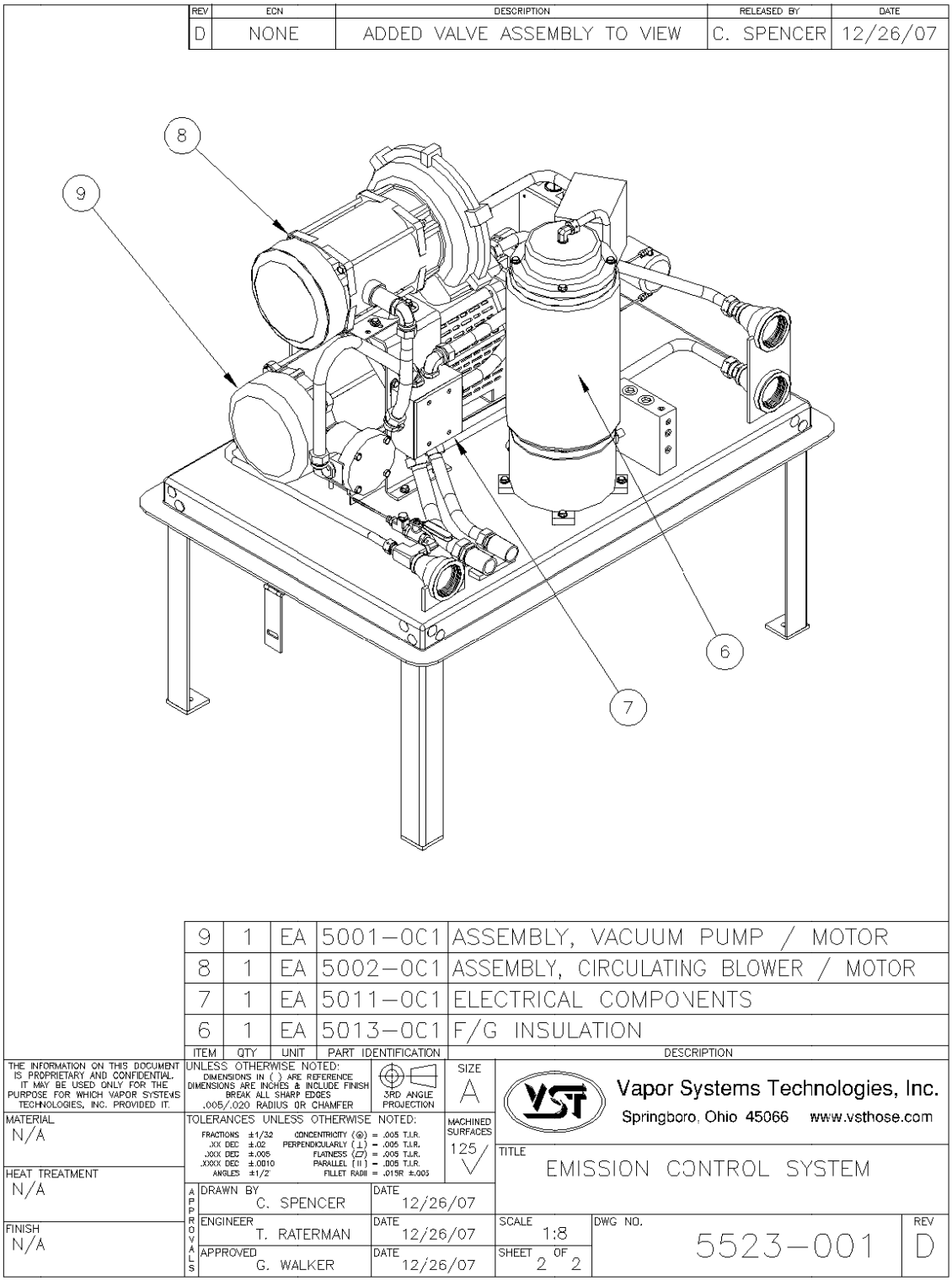


Figure 7: Processor Isometric Drawing (2 of 2)

2 *Pre-Installation Site Survey*

- Vapor Systems Technologies, Inc. created a “Pre-Installation Site Survey,” as a guide to help certified installers and troubleshooters in the planning of an ECS Membrane *Processor* installation.

- The “Pre-Installation Site Survey” is to be completely filled out in advance of an installation so that installation problems and delays are reduced or avoided.

- You will find the “Pre-Installation Site Survey” on our website at www.vsthose.com.

3 Site Requirements

Be sure to read and understand all site requirements before beginning an installation.

3.1 Regulations / Jurisdiction

- Under vapor recovery rules, air pollution control districts have primary authority for regulating GDF's.
    - Before modifying the facility, GDF operators should contact the local air district for specific information on local vapor-recovery requirements.
    - Contact information for local air pollution control districts is available on the air district permit to operate (PTO) and/or the California Air Pollution Control Officers Association (CAPCOA) website at http://www.capcoa.org.
- The area inside the *Processor* cover has been evaluated as a Class I, Division 2 hazardous area as defined by Underwriters Laboratory.
- The *Processor* must not be installed in a Class I, Division 1 or a Class I, Division 2 hazardous location as defined by the NEC (National Electric Code).
    - Because the area inside the *Processor* cover has been evaluated as a Class I, Division 2 hazardous location, be sure that all existing electrical seal-offs continue to meet NEC and NFPA requirements after installation of the *Processor*.

CAUTION

Always obtain approval from the local authority having jurisdiction.

Installation of the *Processor* must comply with (if applicable):

- **CARB CP-201**
- **VST EVR E.O.**
- **Fire Marshall**
- **Water Board**
- **Local Air Pollution District**
- **ICC**
- **NEC**
- **NFPA 30 and 30A**
- **UL**
- **Any other applicable federal, state, and local codes**

3.2 Snapshot of Site Requirements

Local Air Pollution Control District

- GDF must contact the local air pollution control district for specific local vapor-recovery requirements.

Ground-Mount Location

- The *Processor* must be protected from damage.
- *Processor* must be located at least 10' from the property line.
- *Processor* must be within 100' of the vent risers.

Roof-Mount Location

- Structure must be strong enough to hold the weight of the *Processor:*
  - Three-phase 350 lbs.
  - Single-phase 385 lbs.
- Must be a 36" perimeter around the *Processor* for maintenance and testing.
- The height of the *Processor* must be above the building parapet to allow for the proper vapor-piping slope.

Canopy-Mount Location

- The local jurisdiction must allow the *Processor* to be placed on the canopy.
- Structure must be strong enough to hold the weight of the *Processor:*
  - Three-phase 350 lbs.
  - Single-phase 385 lbs.
- Must be a 36" perimeter around the *Processor* for maintenance and testing.
- All safety and code concerns have been addressed.

Three Phase Electric

- 3 empty breaker spaces 208/230-460v panel for blower and vacuum pump motors
- (1)115v breaker for the heat-trace cable
- (1) 115v outlet for the HC sentry
- GFCI protected, weatherproof 115v convenience outlet located at the *Processor* is optional
- 2-hp vacuum pump / ½-hp blower

Single Phase Electric

- 2 empty 115v breaker spaces in the panel for the blower and vacuum pump motors
- (1) 115v breaker for the heat trace cable
- (1) 115v outlet for the HC sentry
- GFCI protected, weatherproof 115v convenience outlet located at the *Processor* is optional
- 2-hp vacuum pump / ½-hp blower

Vent Risers

- Recommended slope of ¼" per foot on all vapor-piping connecting the *Processor* to the vent risers or to any other UST connection. (VST requires a minimum of 1/8" per foot minimum slope for all vapor piping.)
- The maximum distance the *Processor* can be from the vent risers is 100-feet.
- Any type of trap, regardless of the *Processor* location, is not permitted in any vapor lines connected to the *Processor*.
- To install the *Processor*, there must be two vent risers connected at different locations to the UST's or to the underground vapor piping.
- If only one vent riser exists, another one must be added. Trenching to a UST or underground vapor piping is required in order to add the second vent riser.
- A 5' radius around the vent riser P/V valve is a Class I, Div. 2 hazardous area as defined in NFPA 70.

Snapshot of Site Requirements, continued . . .

UST Manifolding	**Dispenser**	**CARB Requirements**
• UST's must be manifolded below ground. • There must be at least two separate vent lines, which are not manifolded together.	• Must be a Balance dispenser. • Phase II vapor riser must be greater than or equal to 1" ID. • The *Processor* may not be installed in a Class 1, Division 1 or a Class 1, Division 2 hazardous location. **Veeder-Root Controls** • Must have TLS-350 with ISD installed	• VR-204 (VST Executive Order)

4 Ground Installation

4.1 Ground Installation Safety



- The *Processor* will be installed near locations where highly flammable and explosive gasoline vapors may be present.
- Installation of the ECS Membrane *Processor* must comply with the National Electric Code, federal, state and local codes, as well as other applicable safety codes.
- Use extreme caution due to the risk of fire or explosion, which could result in serious injury or even death.
- If you are working in an area where vehicle traffic may occur, always block off the work area during installation, testing, 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 being present.
- Read and understand all materials related to installing, testing, and operating the *Processor* prior to installation.

4.2 Protecting the *Processor*

- Take measures to protect the *Processor* and external vapor piping from damage in areas near vehicle traffic with guards, such as concrete-filled bollards or guardrails.
    - Check local codes for protective-device guidelines before setting the bollards or guardrails.
- A fence should not be required since there is a lockable cover on the *Processor* with lockable hasps to prevent tampering. The contractor will provide the locks for the hasps.
- VST requires lockable valves be used at the inlet and outlet connections at the *Processor*.
    - VST does not include any locks or lockable valves for the *Processor*; therefore, the contractor must provide them.
    - Lockable valves used in this application must be compatible with gasoline and gasoline vapor. For further requirements, consult the lockable-valve installation instructions provided by the manufacturer.
- The *Processor* cover is designed and built to withstand snow accumulation, rain, and landscaping sprinklers.

4.3 Ground-Mount Location

- Location to property line: according to NFPA 30A, Section 10.1.7.1
  ". . . in no case shall the vapor-processing equipment so protected be located within 3m (10-feet) of adjacent property lines that can be built upon."
    - Local authorities may grant reduced distance depending on the specific circumstances
- To minimize the installation cost and to maximize operating efficiency, locate the *Processor* adjacent to the existing vent risers.
- **See figure 4: Section 14 / Page 19**

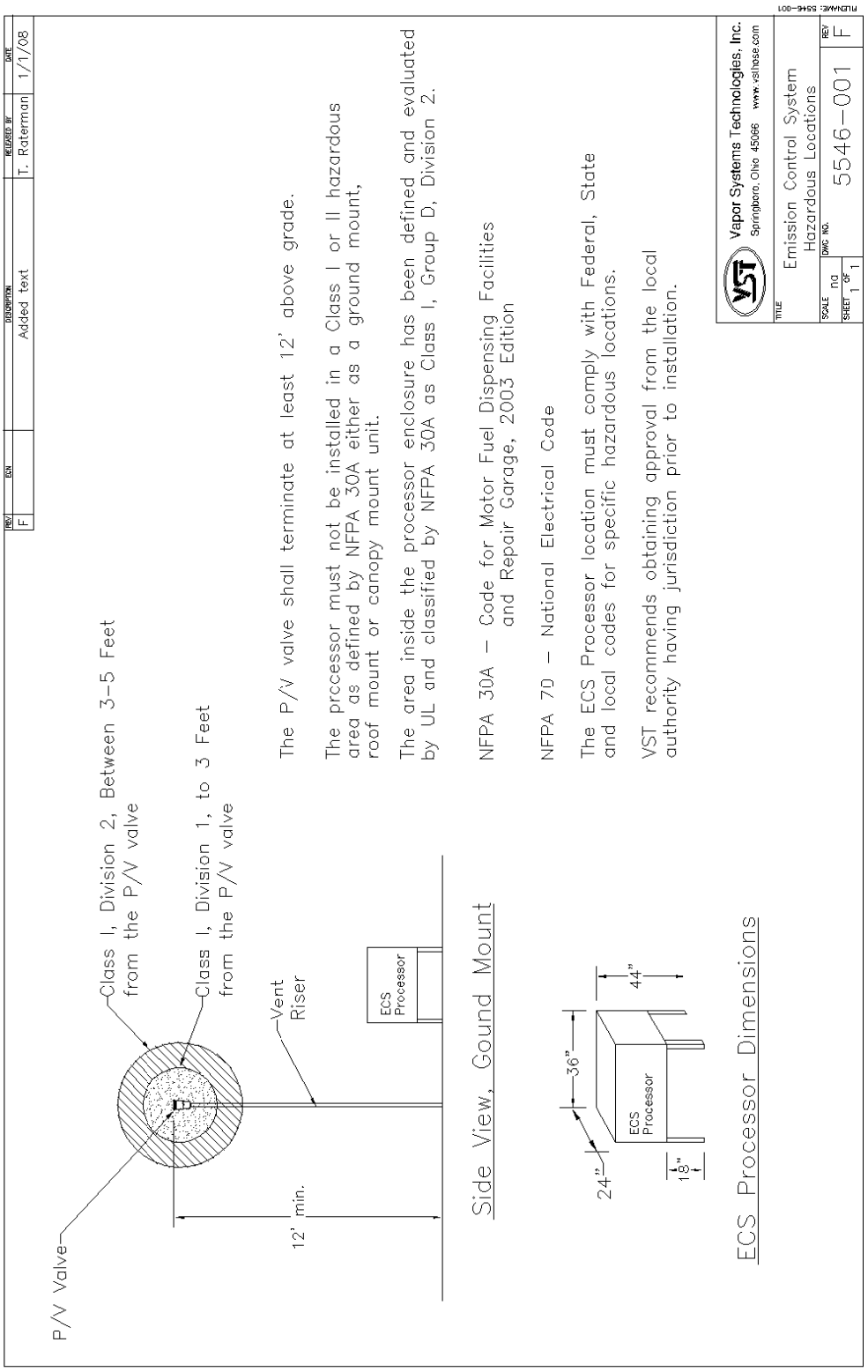


Figure 8: ECS Membrane Processor Hazardous Locations

4.4 Setting the Concrete Pad

- The *Processor* must be installed on a concrete pad, on grade, and permanently anchored to the concrete pad.
    - VST does not provide any hardware to install the *Processor* on the pad.

- Be sure to allow the minimum clearances listed below for maintenance and service:
    - Back: 36”
    - Front: 36”
    - Left: 36”
    - Right: 36”

- Concrete pad minimum dimensions:
    - 3’6” long x 2’6” wide
    - 6” thick (minimum)
    - **See figure 9: Section 14 / Page 32**

- Use steel re-enforced rebar in the pad for additional strength.

- Install the pad level.

- Install expansion-type bolts after completing the concrete pad. The bolts must be:
    - 3/8” diameter
    - embedded 3 ½” to 4” into the slab
    - extend approx. 1 ½” above the top of the slab

4.5 Installing the *Processor* on the Concrete Pad

1. After the concrete has properly cured, install the expansion anchor bolts according to the manufacturer's recommendations.

2. For non-seismic applications, VST recommends using the HILTI KWIK BOLT, KB3 3/8" X 5", item #00282524 as **shown in Figure 10: Section 14 / Page 33** or an approved equal.

3. For applications that require expansion anchors that are especially suited to seismic and cracked concrete, VST recommends using the HILTI KWIK TZ (KB-TZ) BOLT, KB-TZ 3/8" X 5", (item number 00304583) or approved equal.
   - The contractor or design engineer is responsible for sizing the expansion anchors and the concrete pad to meet seismic and cracked concrete specifications required by local, state, and federal jurisdictions.
   - Since seismic regulations may be different by location, VST has not included a specific drawing for this application.
   - For seismic design reference, www.us.hilti.com.

4. After the appropriate anchor bolts have been installed, position the *Processor* onto the anchor bolts in the cement slab.

5. Bolt the *Processor* into place (according to the manufacturer recommended installation guidelines) with 3/8" galvanized lock washers and bolts that are included with the expansion bolt.

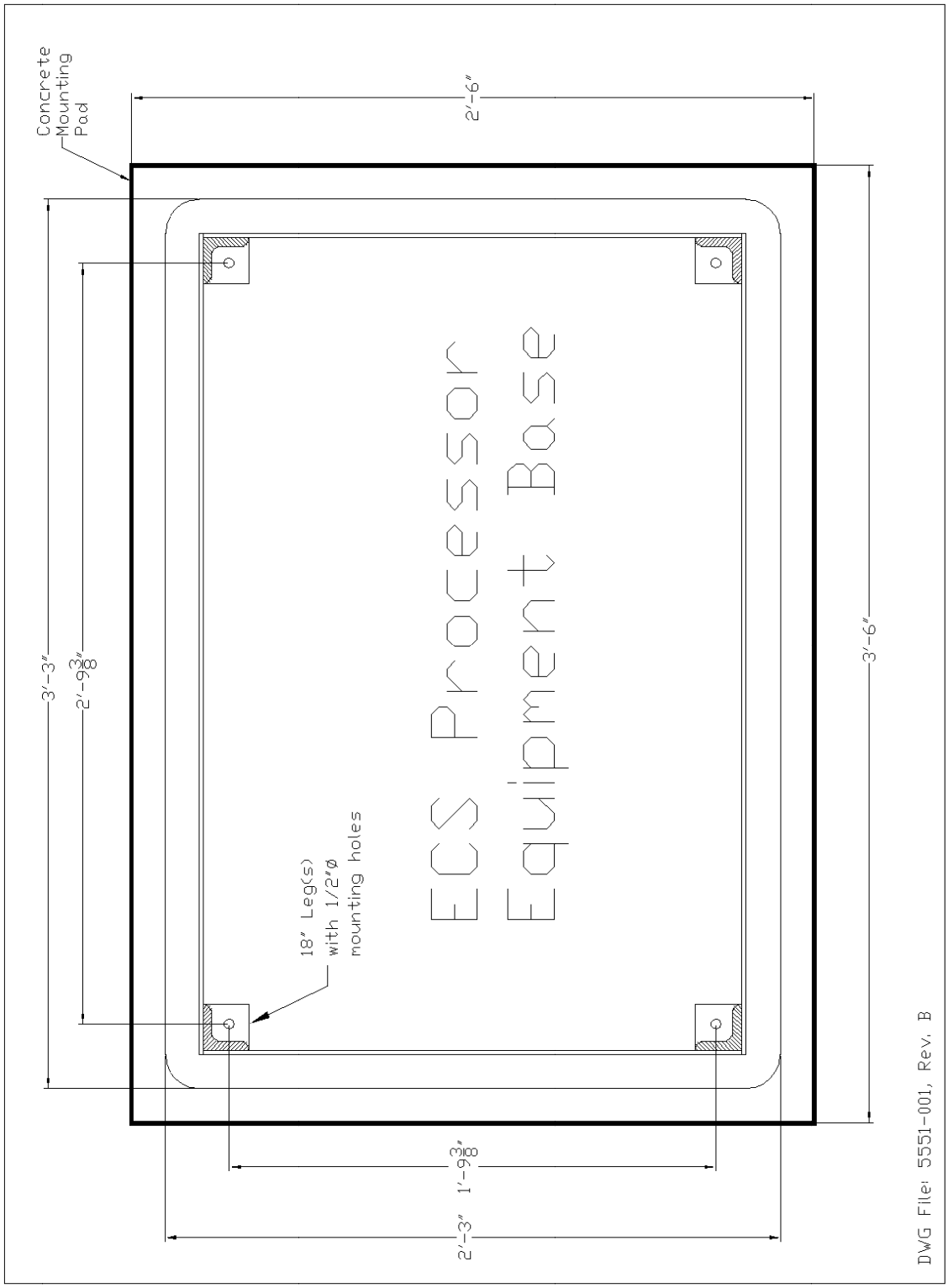


Figure 9: Concrete Mounting Pad Dimensions

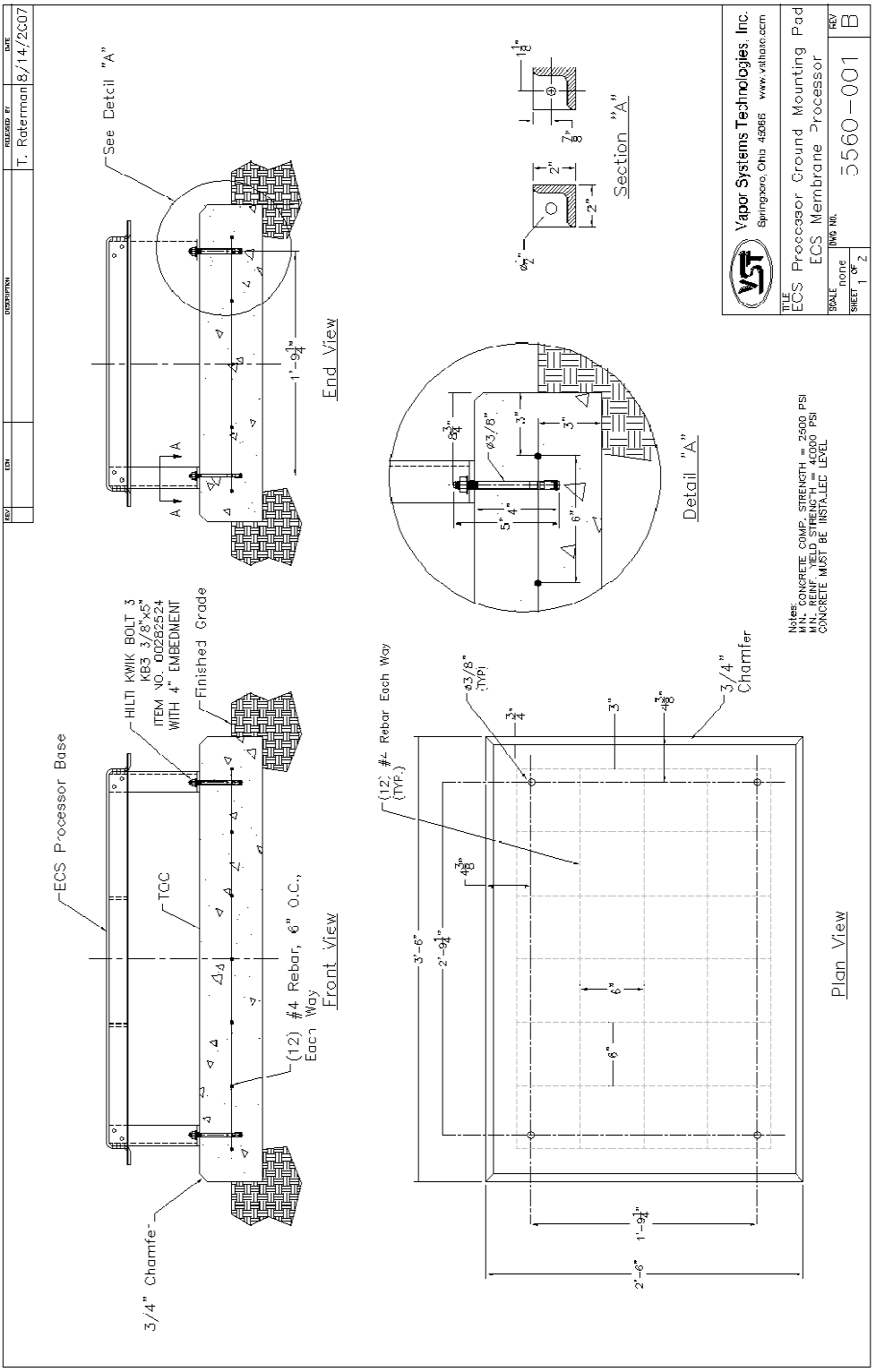


Figure 10: Processor Ground Mounting Pad

5 Roof-Top Installation

5.1 Roof-Top Installation Safety

- The *Processor* will be installed near locations where highly flammable and explosive gasoline vapors may be present.
- Installation of the ECS Membrane *Processor* must comply with the National Electric Code, federal, state and local codes, as well as other applicable safety codes.
- Use extreme caution due to the risk of fire or explosion, which could result in serious injury or even death.
- If you are working in an area where vehicle traffic may occur, always block off the work area during installation, testing, 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 being present.
- Read and understand all materials related to installing, testing, and operating the *Processor* prior to installation.

- The *Processor* may be installed on a station's roof provided the structure can support the weight of the *Processor*.

Part Number	Unit	Dimensions	Weight
VST-ECS-CS3-110	Single-Phase	L-39" x W-27" x D-43"	385 lbs.
VST-ECS-CS3-310	Three-Phase	L-39" x W-27" x D-43"	350 lbs.

Note: Cover weight is 24lbs. and is included in the overall weight of the *Processor*.

- Location to property line: according to 2003 Edition of NFPA 30A, Section 10.1.6, Page 23: Vapor-processing equipment shall be located "At least 3m (10 ft) from adjacent property lines that can be built upon."
  - Local authorities may grant reduced distance depending on the specific circumstances.

- The *Processor* must not be installed within 5' of a vent riser P / V valve.

- A 5' radius around the vent riser P/V valve is a Class I, Div. 2 hazardous area as defined in NFPA 70.

- All vapor-piping connecting to the *Processor* must be sloped away from the *Processor*. VST recommends ¼" per foot slope. (VST requires a minimum of 1/8" per foot slope.)

- Any equipment located on the roof that is rated as Class I, Div. 2 cannot be located within 10' of the *Processor,* unless the equipment is at least 18" above the roof top.

CAUTION

Always obtain approval from the local authority having jurisdiction.

Installation of the *Processor* must comply with (if applicable):

- **CARB CP-201**
- **VST EVR E.O.**
- **Fire Marshall**
- **Water Board**
- **Local Air Pollution District**
- **ICC**
- **NEC**
- **NFPA 30 and 30A**
- **UL**
- **Any other applicable federal, state, and local codes**

- The *Processor* must be installed in accordance with the NEC and the NFPA standards.

- VST recommends a minimum clearance of at least 36” around the *Processor* for maintenance and testing.

- Due to a variety of roof construction designs, VST cannot recommend how the *Processor* should be mounted on the roof; however, the *Processor* must be installed at a height allowing the piping inlet and outlets to be above the building parapet.

- The *Processor* is shipped on 18” legs bolted on the base, but the legs may be removed and the *Processor* secured to a steel structure attached to the roof.

- A new air outlet vent riser connected to the *Processor* must be installed to release air to the atmosphere.

6 *Canopy Top Installation*

6.1 Canopy Top Installation Safety

- The *Processor* will be installed near locations where highly flammable and explosive gasoline vapors may be present.
- Installation of the ECS Membrane *Processor* must comply with the National Electric Code, federal, state and local codes, as well as other applicable safety codes.
- Use extreme caution due to the risk of fire or explosion which could result in serious injury or even death.
- If you are working in an area where vehicle traffic may occur, always block off the work area during installation, testing, 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 being present.
- Read and understand all materials related to installing, testing, and operating the *Processor* prior to installation.

- The *Processor* may be installed on a station's canopy provided the structure can support the weight of the *Processor*.

Part Number	Unit	Dimensions	Weight
VST-ECS-CS3-110	Single-Phase	L-39" x W-27" x D-43"	385 lbs.
VST-ECS-CS3-310	Three-Phase	L-39" x W-27" x D-43"	350 lbs.

Note: Cover weight is 24lbs. and is included in the overall weight of the *Processor*.

- Location to property line: according to 2003 Edition of NFPA 30A, Section 10.1.6, Page 23: Vapor-processing equipment shall be located "At least 3m (10 ft) from adjacent property lines that can be built upon."
  - Local authorities may grant reduced distance depending on the specific circumstances.

- The *Processor* cannot be installed within 5' of a vent riser P / V valve.

- A 5' radius around the vent riser P/V valve is a Class I, Div. 2 hazardous area as defined in NFPA 70.

- All vapor-piping connecting to the *Processor* must be sloped away from the *Processor*. VST recommends ¼" per foot slope. (VST requires a minimum of 1/8" per foot slope).

- The *Processor* must be installed in accordance with the NEC and the NFPA standards.

CAUTION

Always obtain approval from the local authority having jurisdiction.

Installation of the *Processor* must comply with (if applicable):

- **CARB CP-201**
- **VST EVR E.O.**
- **Fire Marshall**
- **Water Board**
- **Local Air Pollution District**
- **ICC**
- **NEC**
- **NFPA 30 and 30A**
- **UL**
- **Any other applicable federal, state, and local codes**

- VST recommends a minimum clearance of at least 36” around the *Processor* for maintenance and testing.

- Due to a variety of canopy construction designs, VST cannot recommend how the *Processor* should be mounted on the canopy.

- All safety and code concerns should be taken into consideration prior to a canopy-top installation.

- The *Processor* is shipped on 18” legs bolted on the base, but the legs may be removed and the *Processor* secured to a steel structure attached to the canopy or to the roof top.

- A new air outlet vent riser connected to the *Processor* must be installed to release air to the atmosphere.

7 Vapor Piping

7.1 Vapor Piping Safety

- The *Processor* will be installed near locations where highly flammable and explosive gasoline vapors may be present.
- Installation of the ECS Membrane *Processor* must comply with the National Electric Code, federal, state and local codes, as well as other applicable safety codes.
- Use extreme caution due to the risk of fire or explosion which could result in serious injury or even death.
- If you are working in an area where vehicle traffic may occur, always block off the work area during installation, testing, 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 being present.
- Read and understand all materials related to installing, testing, and operating the *Processor* prior to installation.

7.2 Piping Connection Material

- All connections to the *Processor* must be galvanized pipe.

7.3 Piping Connections to the *Processor*

- There are 3 piping connections to be made to the *Processor*:
    1. **Vapor inlet from the UST vapor-piping system**
    2. **Vapor return back to the UST vapor-piping system**
    3. **Air outlet to atmosphere**

- The typical installation will have:
    - The *Processor* vapor inlet connected to the high-grade UST vent.
    - The *Processor* vapor return connected to the low-grade UST vent.
    - The *Processor* vapor air outlet vent riser is to be added next to the existing UST vent risers if possible.

CAUTION

Always obtain approval from the local authority having jurisdiction.

Installation of the *Processor* must comply with (if applicable):

- **CARB CP-201**
- **VST EVR E.O.**
- **Fire Marshall**
- **Water Board**
- **Local Air Pollution District**
- **ICC**
- **NEC**
- **NFPA 30 and 30A**
- **UL**
- **Any other applicable federal, state, and local codes**

7.3.1 Trenching

- The *Processor* may be installed without any trenching provided:
    - There are at least 2 vent risers connected to the UST's.
    - The vent-riser piping connecting to the UST's will not short circuit the *Processor*.
- Trenching will be required if only one vent riser exists at the GDF to connect the *Processor* to the UST's.
    - When one vent riser exists at a GDF, trenching is required to return the concentrated vapor from the *Processor* to the UST's.
    - The existing vent riser will be used as the "Vapor Inlet" connection to the *Processor*.
    - A new vent riser must be installed that connects the *Processor* to the UST's.
        - The connection pipe must be a minimum of 2" ID for all underground piping.
        - All new piping must be sloped back to the UST's.
        - VST recommends a ¼" per foot slope away from the *Processor* for all vapor piping connecting the *Processor* to the UST vent risers or to any other UST connection points. A minimum of 1/8" slope is required by VST.
        - The connection location to the UST's must be configured to prevent short-circuit of the inlet vapor piping to the *Processor*.
        - The connection should be used as the "Vapor Return" piping returning the concentrated vapor from the *Processor* to the Low Octane UST.

7.4 Underground Vapor Piping Instructions

- From the dispenser to the UST:
    - A minimum of 2” ID is acceptable unless the dispenser lines are manifolded together.
    - Manifolded dispenser lines require a minimum 3” ID piping, including the float-vent valve, if applicable.
    - Check the “Vapor-Recovery Piping Configurations” section of Exhibit 2 for Underground Piping Requirements.
- From the UST to the vent riser
    - Stations that use only one vent riser require a minimum of 3” ID vapor piping and will require trenching as well.
    - Stations that use multiple risers require a minimum of 2” ID vapor piping.
- From the *Processor* vapor return to the UST
    - When new underground piping is required from the *Processor* vapor return to the low octane UST, VST requires a minimum of 2” ID piping.

CAUTION

Always obtain approval from the local authority having jurisdiction.

Installation of the *Processor* must comply with (if applicable):

- **CARB CP-201**
- **VST EVR E.O.**
- **Fire Marshall**
- **Water Board**
- **Local Air Pollution District**
- **ICC**
- **NEC**
- **NFPA 30 and 30A**
- **UL**
- **Any other applicable federal, state, and local codes**

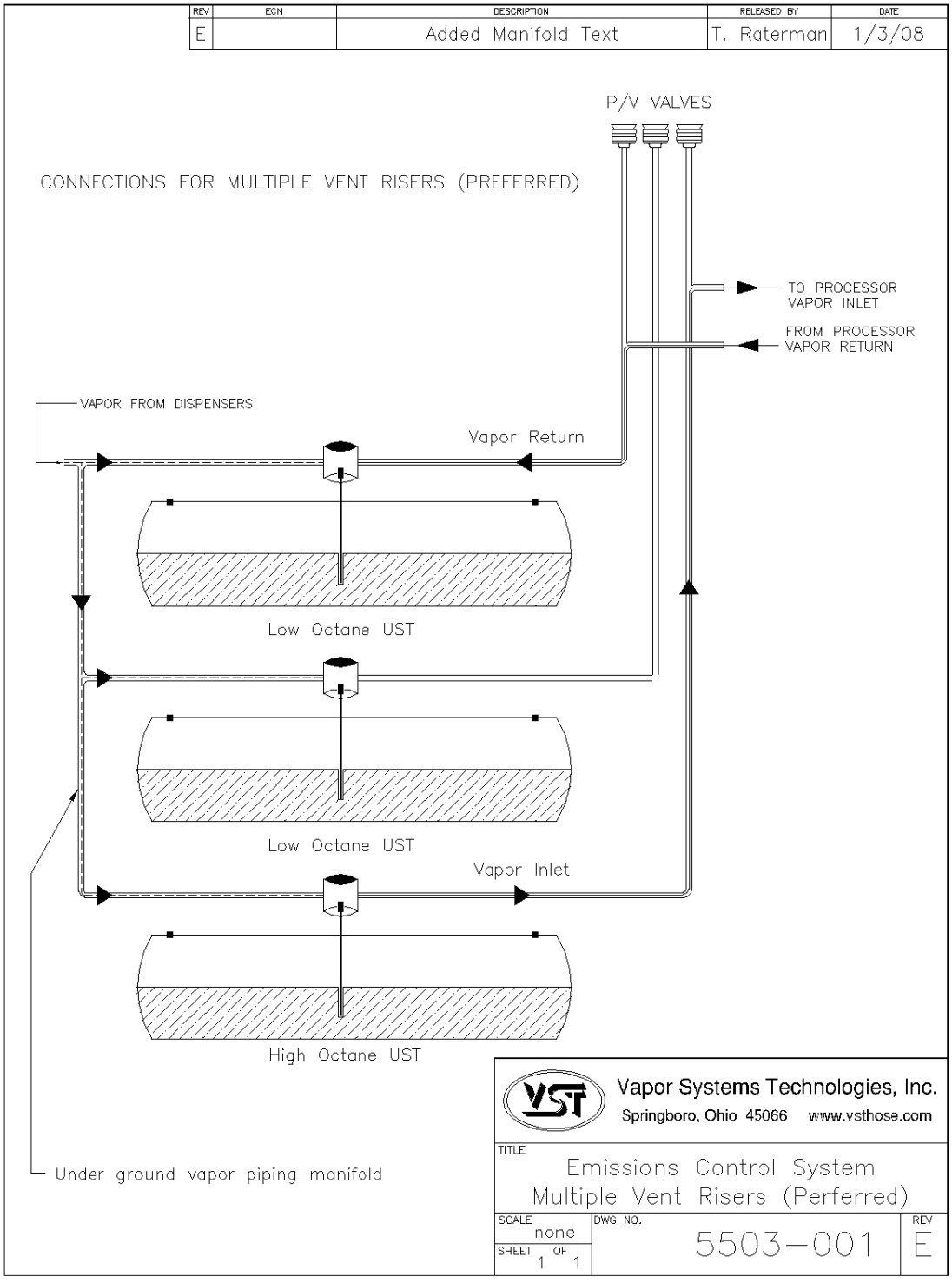


Figure 11: Processor Connections with Multiple Vent Risers

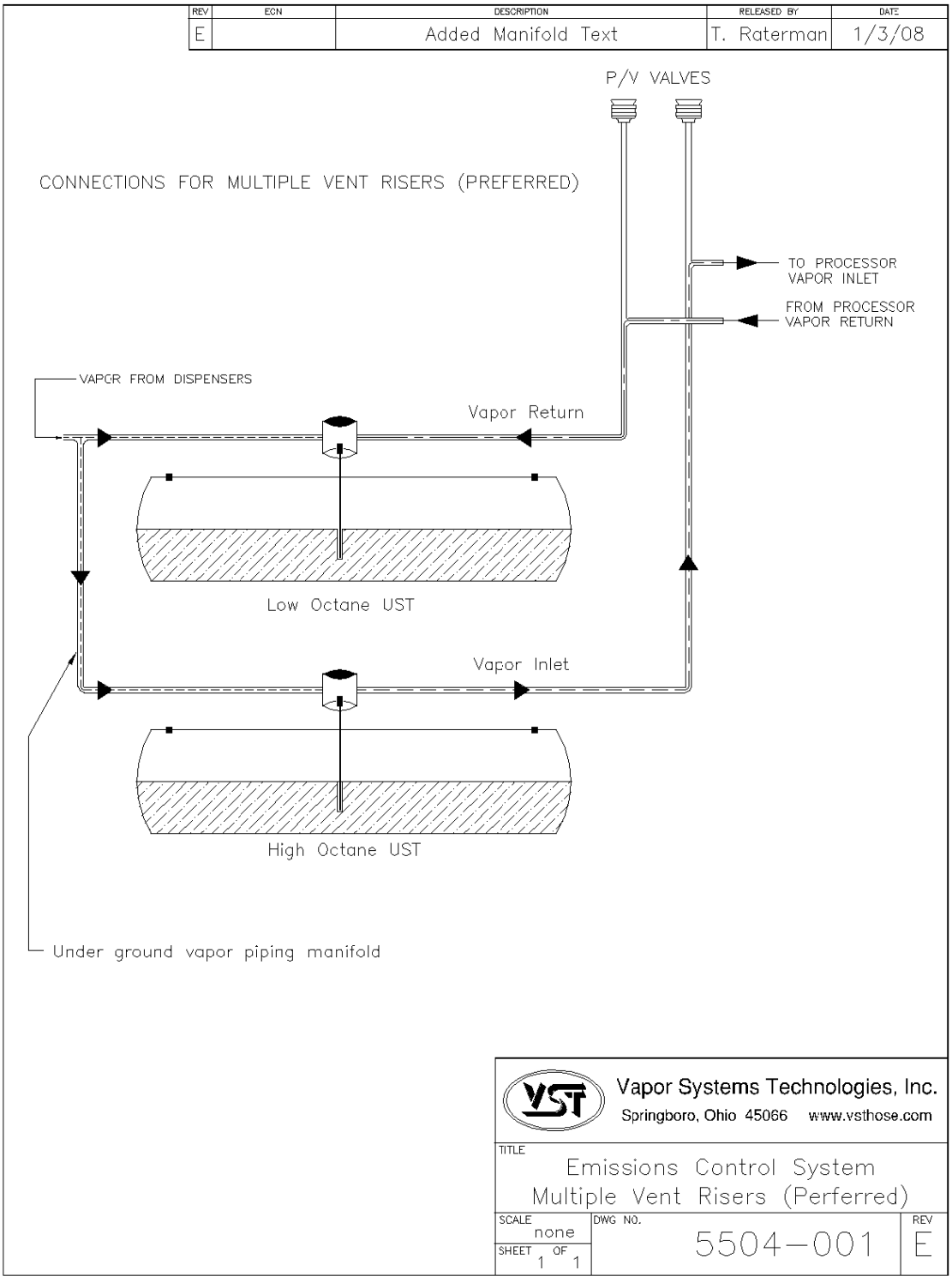


Figure 12: Processor Connections with 2 Vent Risers

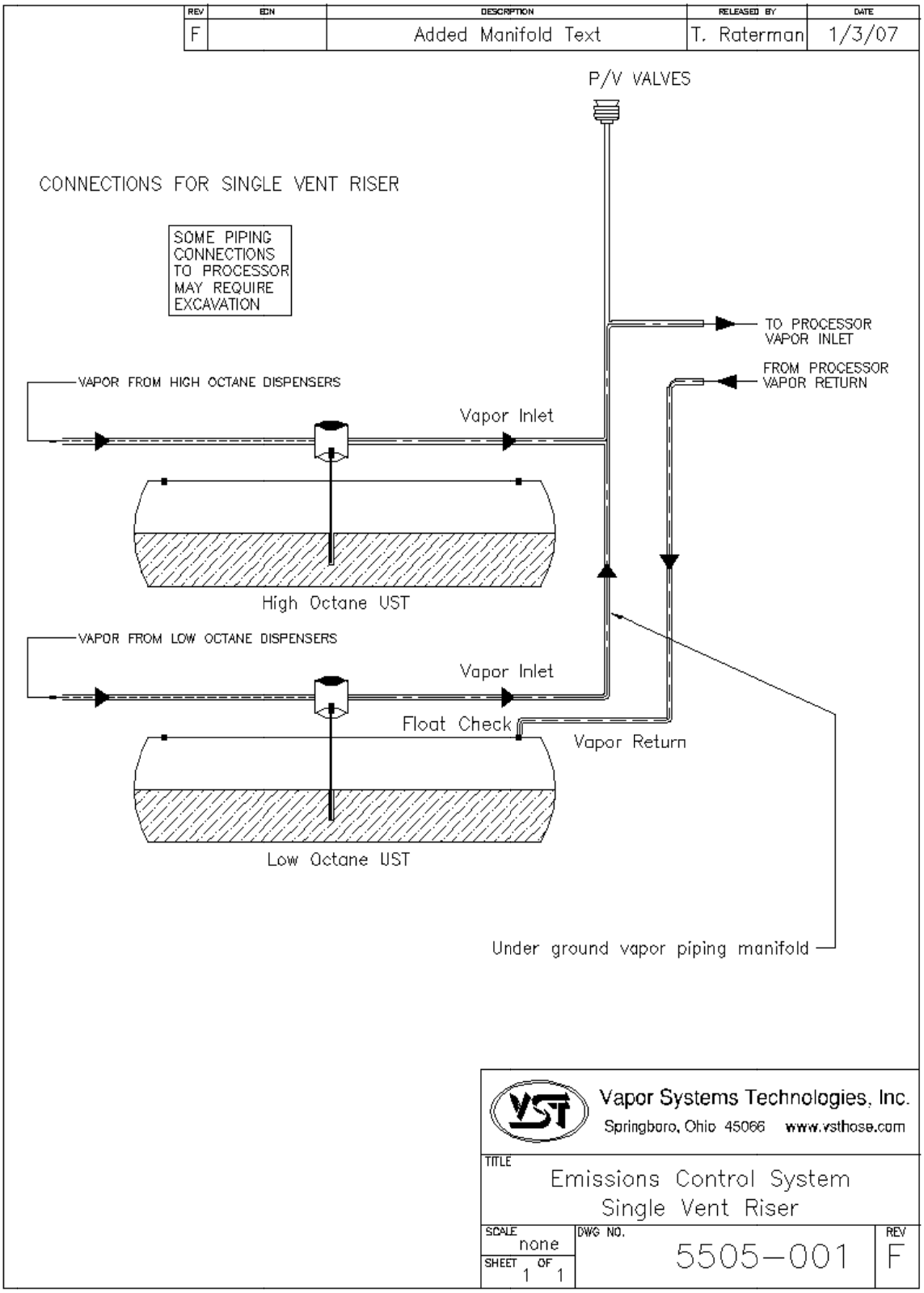


Figure 13: Processor Connections with Single Vent Riser

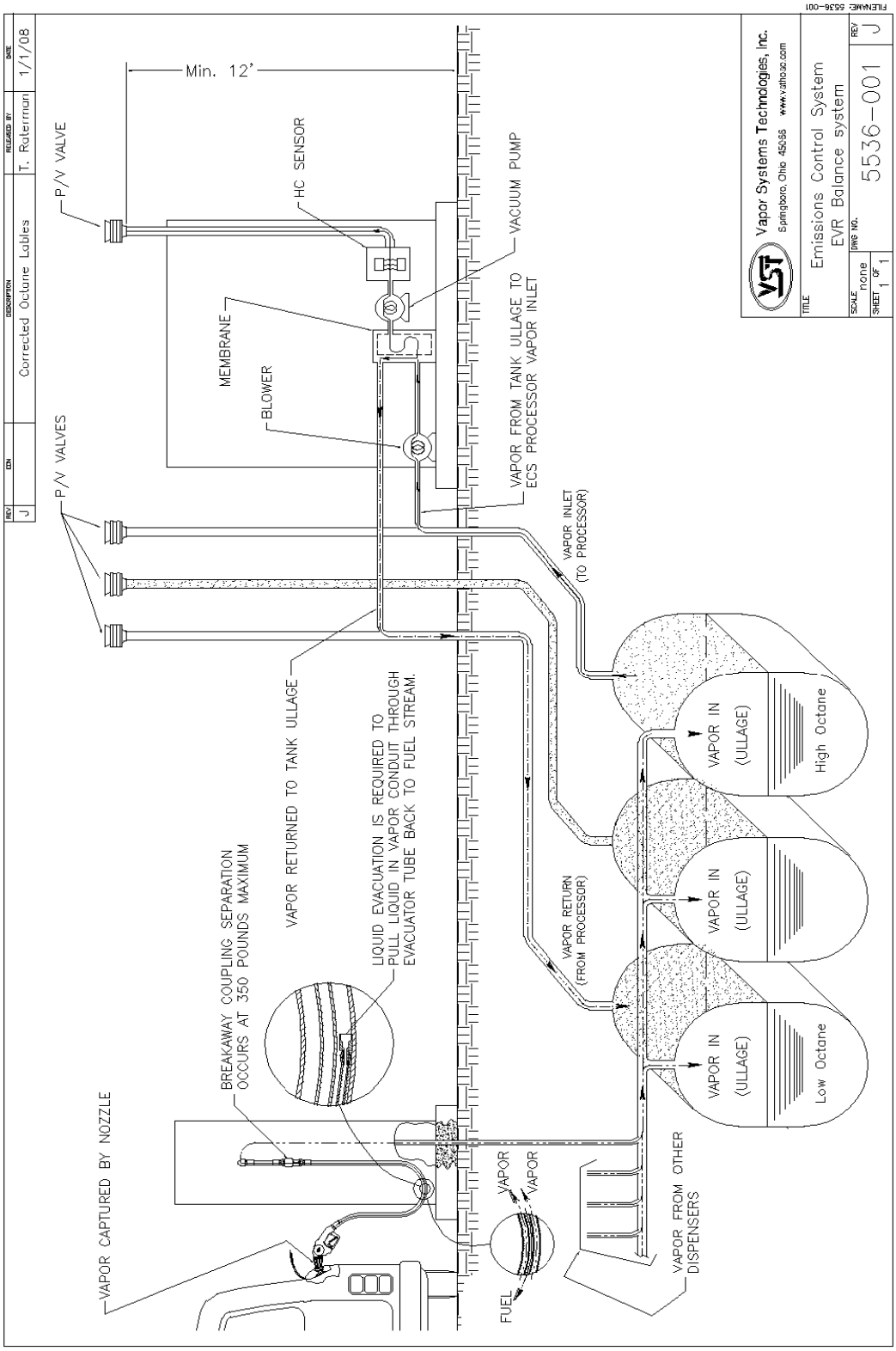


Figure 14: Typical GDF Vapor Piping Diagram for Processor

7.5 Vapor Inlet and Vapor Return Connections

- Install a minimum 1" galvanized pipe between the *Processor* and the vent riser(s) if the distance between the *Processor* and the vent riser is less than 10'.

- If the distance between the *Processor* and vent risers is greater than 10', use a minimum 1 ½" diameter pipe.

- **See Figure 15: Section 14 / Page 47** for pipe size requirements.

- When new underground piping is required from the *Processor* to the low-octane UST, a minimum of 2" ID piping is required.

- Order of installation:
    1. *Processor*
    2. Tee (sized for the pipe diameter)
    3. Valve (sized for the pipe diameter)
    4. Union (sized for the pipe diameter)
    5. Vent Riser

The tee and the ball valve allow for isolation of the *Processor* from the vapor-piping system for maintenance and testing.

See Figure 15: Section 14 / Page 47

- Provide a slope for the piping from the *Processor* of at least **¼" per foot**. VST requires a **minimum slope of 1/8" per foot**.

- Verify that all piping connections are leak tight.

- Connect the vapor inlet and vapor return for the *Processor* to existing vent risers provided there are multiple vent risers connecting to individual USTs.

- Install new tees in the existing vent risers for connection to the *Processor* vapor inlet & outlet.

- Take note that pipe connecting vent risers to the *Processor* **MUST** slope **away** from the *Processor* towards the vent risers.

8 Air Outlet Connection

- Install a minimum 1” tee and 1” lockable ball valve between the *Processor* and the new vent riser in the order of:
  1. *Processor*
  2. Tee (sized for the pipe diameter)
  3. Valve (sized for the pipe diameter)
  4. Union (sized for the pipe diameter)
  5. Vent Riser

See Figure 15 / Section 14 / Page 47

- Be sure to follow the same height and location criteria for the additional vent riser that has been used for the existing vent pipes.
  - The tee and the valve allow for isolation of the *Processor* from the vapor-piping system for maintenance and/or testing as needed.
  - Verify that all piping connections are leak tight.
- Install a new tee with a cap at the bottom of the new air outlet vent riser to provide for drainage.
- Install the new dedicated vent riser so that the discharge opening is a minimum of 12-feet above grade and a minimum of 1” diameter.
- Be sure to slope the air outlet vent-riser discharge pipe downward away from the *Processor*.
  - VST recommends a ¼” per foot slope away from the *Processor* for all vapor piping connecting the *Processor* to the UST vent risers or to any other UST connection points. A minimum of 1/8” slope is required by VST.
- A P/V valve must be installed on the air outlet vent riser to shield against rain and reduce noise.
- The air outlet discharge creates a hazardous location per the NFPA 30A, therefore:
  - Class I, Group D, Division 1 is within 3 feet in all directions of the vent opening.
  - Class I, Group D, Division 2 is within 3 and 5 feet in all directions of the vent opening.
- The new vent riser may be installed next to the existing vent risers.

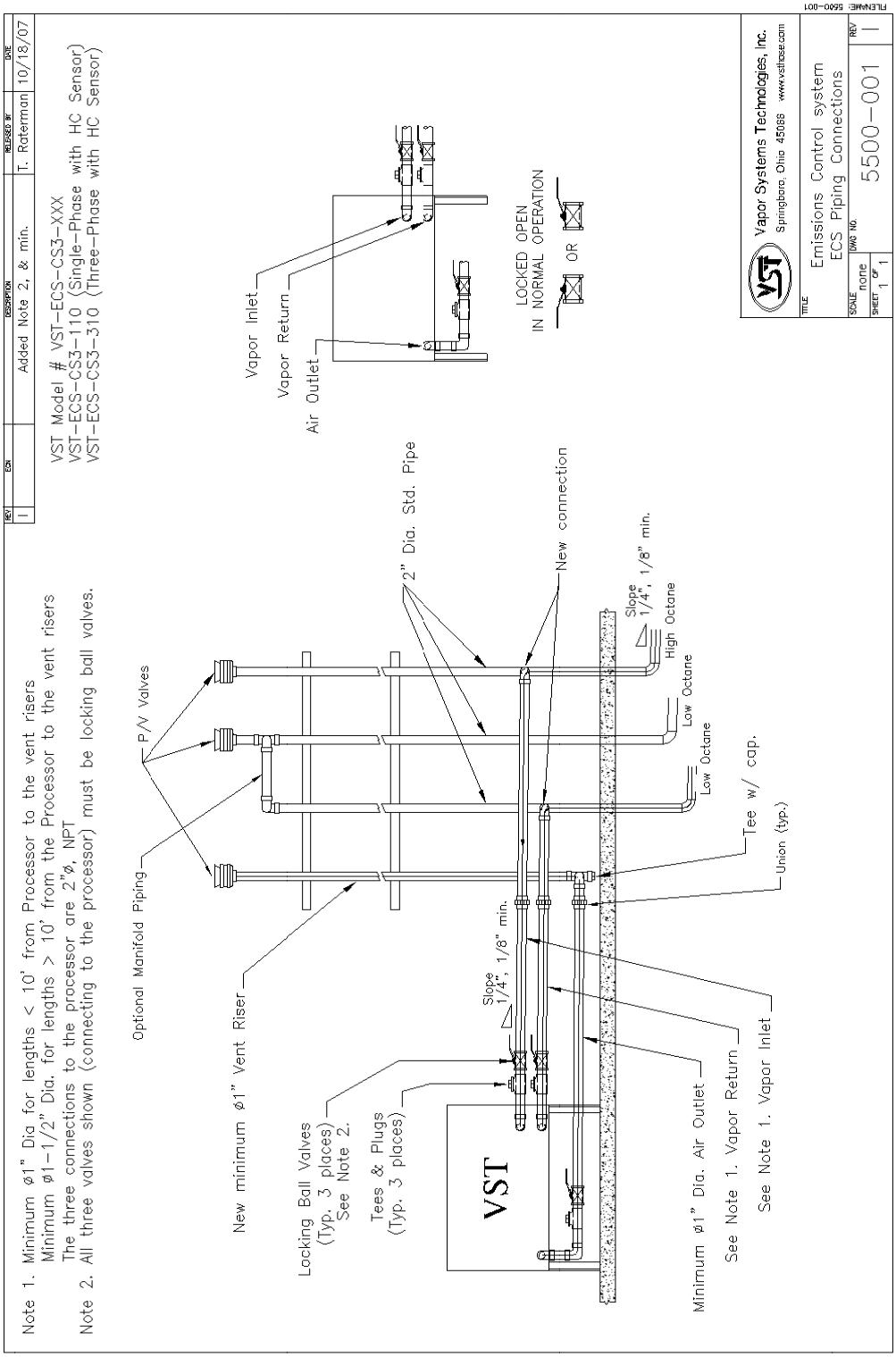


Figure 15: ECS Processor Control Diagram

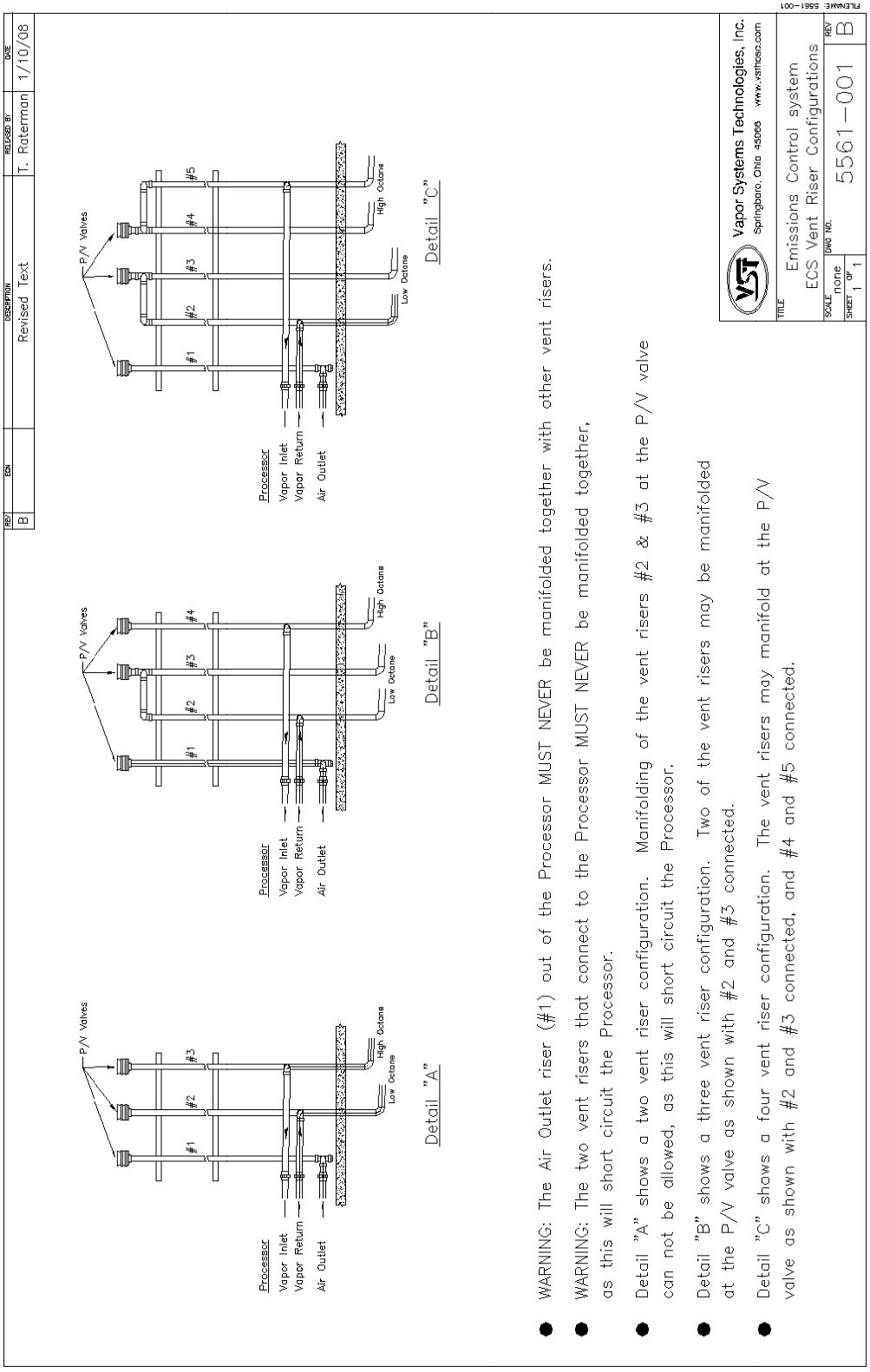


Figure 16: ECS Vent Riser Configuration

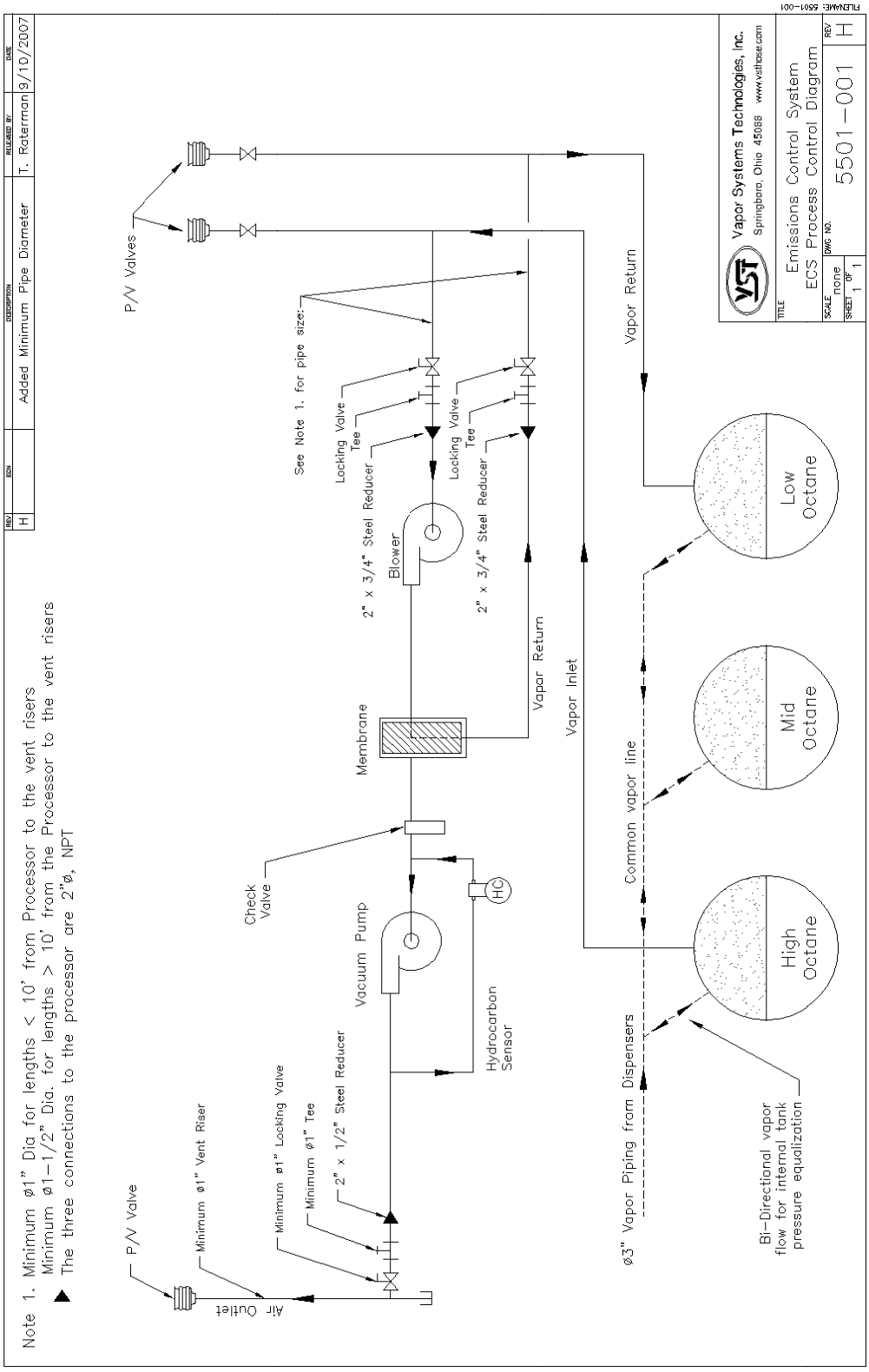


Figure 17: Processor Piping Connections

8.1 Underground Piping Connection

- Provide a slope for the vapor piping for drainage. VST recommends a ¼" per foot slope for all vapor piping. A minimum of 1/8" slope is required by VST.
- Meet all CP-201 size and slope requirements for all underground piping.
    - To avoid the possibility of an underground liquid trap, never use flexible vapor piping.
- 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.
- Refer to pipe-size requirements in VR-203, Exhibit 2.

8.2 Storage Tank Vapor Manifolds

- Storage tanks must be vapor manifolded below ground.

8.3 P / V Valves

- All of the vent risers, including the additional vent risers for the *Processor* air outlet, must have a P/V valve installed.
- The air outlet P/V valve (functional or non-functional) is not regulated by CARB and does not need to be tested by AQMD's.
- The P/V valve for each vent riser (not including the *Processor* air outlet) is part of the Phase I system, and therefore must be a CARB-certified component.

CAUTION

Always obtain approval from the local authority having jurisdiction.

Installation of the *Processor* must comply with (if applicable):

- **CARB CP-201**
- **VST EVR E.O.**
- **Fire Marshall**
- **Water Board**
- **Local Air Pollution District**
- **ICC**
- **NEC**
- **NFPA 30 and 30A**
- **UL**
- **Any other applicable federal, state, and local codes**

9 *Electrical Controls*

9.1 Electrical Controls Safety

- The *Processor* uses lethal voltages and operates in areas where gasoline vapor may be present.
- Serious injury or death from electrical shock, fire, or explosion may result if the power in ON during installation, testing, or maintenance.
- Be sure to use Lockout/Tag-Out procedures when working on or installing the *Processor* or while working on electrical components.
- Always power OFF any electrical components connected to the *Processor*. **The *Processor* can start automatically**.
- Do not use tools that can generate sparks if there is risk of flammable or explosive vapors being present.
- Read and understand all materials related to installing, testing, and operating the *Processor* prior to installation.

9.2 Single-Phase *Processor*

- A circuit disconnect device is not included with the *Processor*.
    - NEC code requires that a readily accessible disconnect device be installed within site of the *Processor*.
- At the main breaker, size the motor panel breaker according to the table below. Make sure the total amperage includes both motors.

Single-Phase Power Requirements				
Motor	**HP**	**Phase**	**Voltage**	**Amperage**
Blower	.5	Single	115	9.8
			230	4.9
Vacuum Pump	2	Single	115	24
			230	12

Table 1: Single-Phase Motor Power Requirements

- The contractor is to supply a lockable circuit breaker in accordance with local, state, and national authorities.
- It is mandatory to follow standard lock-out/tag-out procedures when performing service on the *Processor*.

- Following such procedures may be required by local, state, and national authorities.
    - You must install the *Processor* in accordance with the National Electric Code (NEC), NFPA 70, and with the Automotive and Marine Service Station Code (NFPA30A).
    - VST recommends that the *Processor's* main power be controlled by the facility's main Emergency Shut-Off System.
- The contractor shall supply a 115v fused motor starter with a 115V relay coil to start/stop the single-phase motors.

9.2.1 Power Requirements for Single-Phase Electrical Service

- 115v, single-phase, 60Hz (blower and vacuum pump motors).
    - **See Table 1 / Section 14 / Page 51 for the motor amperage.**
- 115v breaker (heat-trace cable power)
    - 115v, 2-amp service to power the heat trace
- 115v, 2-amp service to power the 24VDC power supply for the HC sensor and the HC sentry
- The ECS motor-starter relay connects to the TLS.

9.3 Three-Phase *Processor*

- A circuit disconnect device is not included with the *Processor*.
    - NEC code requires that a readily accessible disconnect device be installed with the installation wiring for the *Processor*.
- At the main breaker use a 208/230-460v, 3-phase, 60Hz electric service.
    - **See Table 2 / Section 14 / Page 53 for the motor amperage.**
- The contractor is to supply a lockable circuit breaker in accordance with local, state, and national authorities.
    - It is mandatory practice to follow standard lock-out / tag-out procedures when performing service on the unit.
- Following such procedures may be required by local, state, and national authorities.
    - You must install the *Processor* in accordance with the National Electric Code (NEC), NFPA 70, and with the Automotive and Marine Service Station Code (NFPA30A).
    - VST recommends that the *Processor's* main power be controlled by the facility's main Emergency Shut-Off System.
- The contractor shall supply a 208/230-460v fused motor starter with a 115V relay coil to start / stop the three-phase motors.

9.3.1 Power Requirements for Three-Phase Electrical Service

- **See Table 2: Section 14 / Page 53 for the motor amperage.**
    - 208/230-460v, 3-phase, 60Hz (blower and vacuum pump motors).
- Size the motor panel breaker according to the table below. Make sure the total amperage includes both motors.

Three-Phase Power Requirements				
Motor	**HP**	**Phase**	**Voltage**	**Amperage**
Blower	.5	Three	208	2.4
			230	2.2
			460	1.1
Vacuum Pump	2	Three	208	7.5
			230	6.8
			460	3.4

Table 2: Three Phase Motor Power Requirements

- 115v breaker (heat-trace cable power)
    - 115v, 2-amp service to power the heat trace
- 115v, 2-amp service to power the 24VDC power supply for the HC sensor and the HC sentry
- The ECS motor-starter relay connects to the TLS.
    - 115V, 2 amp service to power the motor-starter relay coil.
- The ECS motor-starter relay is located inside the GDF.

9.4 Reference Information for *Processor* Power Requirements

- The following information is for general reference and is not intended to replace recommended National Electric Code (NEC) procedures. It is important for the installer to understand that electrical equipment and wiring located in Class I, Division 2 installations shall comply with the latest appropriate Articles found in the National Electric Code (NFPA 70).

    1. The electrical motor starter and the HC sentry must be installed indoors in the GDF's electrical room.

    2. All electrical/control components must be installed per the NEC, with clear access for personnel.

    3. The area inside the *Processor* cover is classified as a Class I, Division 2 hazardous area as defined by UL. All electrical components inside the *Processor* are rated for this hazardous area. The *Processor* must not be installed in a Class I, Division 1 or Class I, Division 2 hazardous location as defined by the NEC.

    4. Because the area inside the *Processor* cover is defined as a Class I, Division 2 hazardous location, be sure that all existing electrical seal-offs continue to meet NEC and NFPA requirements after installation of the *Processor*.

    5. NEC code requires that an electrical disconnect be installed. VST does not provide an outside electrical disconnect for the *Processor*. The NEC requires an electrical disconnect to the *Processor* with respect to the panel location. Consult the NEC as to the correct location and type of disconnect.

    6. Install the *Processor* in accordance with the National Electrical Code (NFPA 70) and the Automotive and Marine Service Station Code (NFPA 30A).

9.5 Power for the Motors

9.5.1 Single-Phase *Processor*

- Breakers rated at 115v, single-phase power the two electric motors in the *Processor.*
  - This breaker should be a delayed-trip motor starting type.
  - **See Figure 18: Section 14 / Page 60.**
  - **See Figure 19: Section 14 / Page 61.**

- Single-phase motors wiring diagrams:
  - **See Figure 20: Section 14 / Page 62 for the vacuum pump single-phase motor wiring diagram**
  - **See Figure 21: Section 14 / Page 63 for the blower single-phase motor wiring diagram**

9.5.2 Three-Phase *Processor*

- Breakers rated at 208/230-460v, three-phase power the two electric motors in the *Processor.*
  - This breaker should be a delayed-trip motor starting type.
  - **See Figure 22: Section 14 / Page 64.**
  - **See Figure 23: Section 14 / Page 65.**

- Three-phase motors wiring diagrams:
  - **See Figure 24: Section 14 / Page 66 for the vacuum pump three-phase motor wiring diagram**
  - **See Figure 25: Section 14 / Page 67 for the blower three-phase motor wiring diagram**

9.6 Power for the HC Sensor in both the Single-Phase and the Three-Phase *Processor*

- 115v, 2-amp service to power the 24VDC power supply for the HC sensor and HC sentry.

CAUTION

Always obtain approval from the local authority having jurisdiction.

Installation of the *Processor* must comply with (if applicable):

- **CARB CP-201**
- **VST EVR E.O.**
- **Fire Marshall**
- **Water Board**
- **Local Air Pollution District**
- **ICC**
- **NEC**
- **NFPA 30 and 30A**
- **UL**
- **Any other applicable federal, state, and local codes**

9.7 Power for the Heat-Trace Cables in both Single-Phase and Three-Phase *Processor*

- 115v circuit powers the heat-trace cable.
  - The negative side of the circuit is off a common neutral with a common ground inside the electrical enclosure located inside the *Processor*.

9.8 Power for the Motor Starter Relay Coil

- 115V circuit provides power to the relay coil.

9.9 Optional Convenience Outlet at the *Processor*

- An optional convenience outlet located near the *Processor* may be installed for powering tools and test equipment.
    - The wires for the convenience outlet can go in the same conduit as the motor power wires.

- Seal-offs are required as per NFPA 70 for a conduit run leaving a Division 2 location to an unclassified location.
    - Install as required by the NEC and local authority having jurisdiction.
    - Other seal-offs may be necessary based on the installation and site specifics.

10 Electrical Installation

10.1 Electical Controls Safety

- The *Processor* uses lethal voltages and operates in areas where gasoline vapor may be present.
- Serious injury or death from electrical shock, fire, or explosion may result if the power in ON during installation, testing, or maintenance.
- Be sure to use Lockout/Tag-Out procedures when working on or installing the *Processor* or while working on electrical components.
- Always power OFF any electrical components connected to the *Processor*. **The *Processor* can start automatically**.
- Do not use tools that can generate sparks if there is risk of flammable or explosive vapors being present.
- Read and understand all materials related to installing, testing, and operating the *Processor* prior to installation.

10.2 Location and Mounting of the ECS Motor-Starter Relay and Conduit Layout

10.2.1 Single-Phase *Processor* Configuration

- Mount the ECS motor-starter relay inside the GDF's electrical room.
- Install two ¾" conduit from the *Processor* to the electrical room:
  - The first ¾" rigid conduit is for the 115v vacuum pump and blower motors. It is also for 115v power for the heat trace cable.
  - The second ¾" rigid conduit is for 24VDC and HC signal control wiring.

10.2.2 Three-Phase *Processor* Configuration

- Mount the ECS motor-starter relay inside the GDF's electrical room.
- Install two ¾" conduit from the *Processor* to the electrical room:
  - The first ¾" rigid conduit is for 208/230-460v vacuum pump and blower motors. It is also for 115v power for the heat trace cable.
  - The second ¾" rigid conduit is for 24VDC and HC signal control wiring.

10.3 Wiring the *Processor*

- Size the system breaker(s) for the power load based on NEC requirements.
- Install two 3/4" rigid conduits from the *Processor* to the electrical room:
    - First 3/4" rigid conduit is for:
        - 208/203-460v motors (vacuum pump & blower)
        - 115v heat trace
        - Optional 115v convenience power outlet
- Second ¾" rigid conduit is for:
    - HC sensor 24VDC power
    - 4-20 mA HC signal control cable

Wiring between the *Processor* and components:

- All wiring (208/203-460 VAC and 24 VDC) to be TFFN or THHN with 600 V insulation.
- All wiring must be gasoline and oil resistant.

- VST provides the 24 VDC power supply for the HC Sentry module.
    - The 24VDC power-supply plugs into a standard 115v outlet.
    - The 115v outlet must be located within 3-feet of the HC sentry module.
- The HC sensor receives 24VDC power from the HC sentry module, and the HC sentry module receives 4-20 mA control signal from the HC sensor.
    - One cable contains the 24VDC power and 4-20 mA signals.
    - The cable must be a minimum 3 conductor, 18 AWG, twisted pair with a shielded ground.
    - The isolated ground is connected to the HC Sentry. The HC Sentry receives power from a separate 115V circuit.

- Run two ground wires from the electrical panel:
    - 1st ground wire is the equipment ground.
    - 2nd ground wire is an electrical ground.
    - Both grounds must be a minimum 12 AWG (follow all NEC requirements for equipment grounding).
- Wiring the 208/230-460v or 115/230V power for the motors is a minimum 14 AWG:
    - Sizing must comply with NEC requirements for motor load and wiring distance.
    - Larger gauge wire may be necessary based on conductor length and voltage supplied by the load center.
- 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.

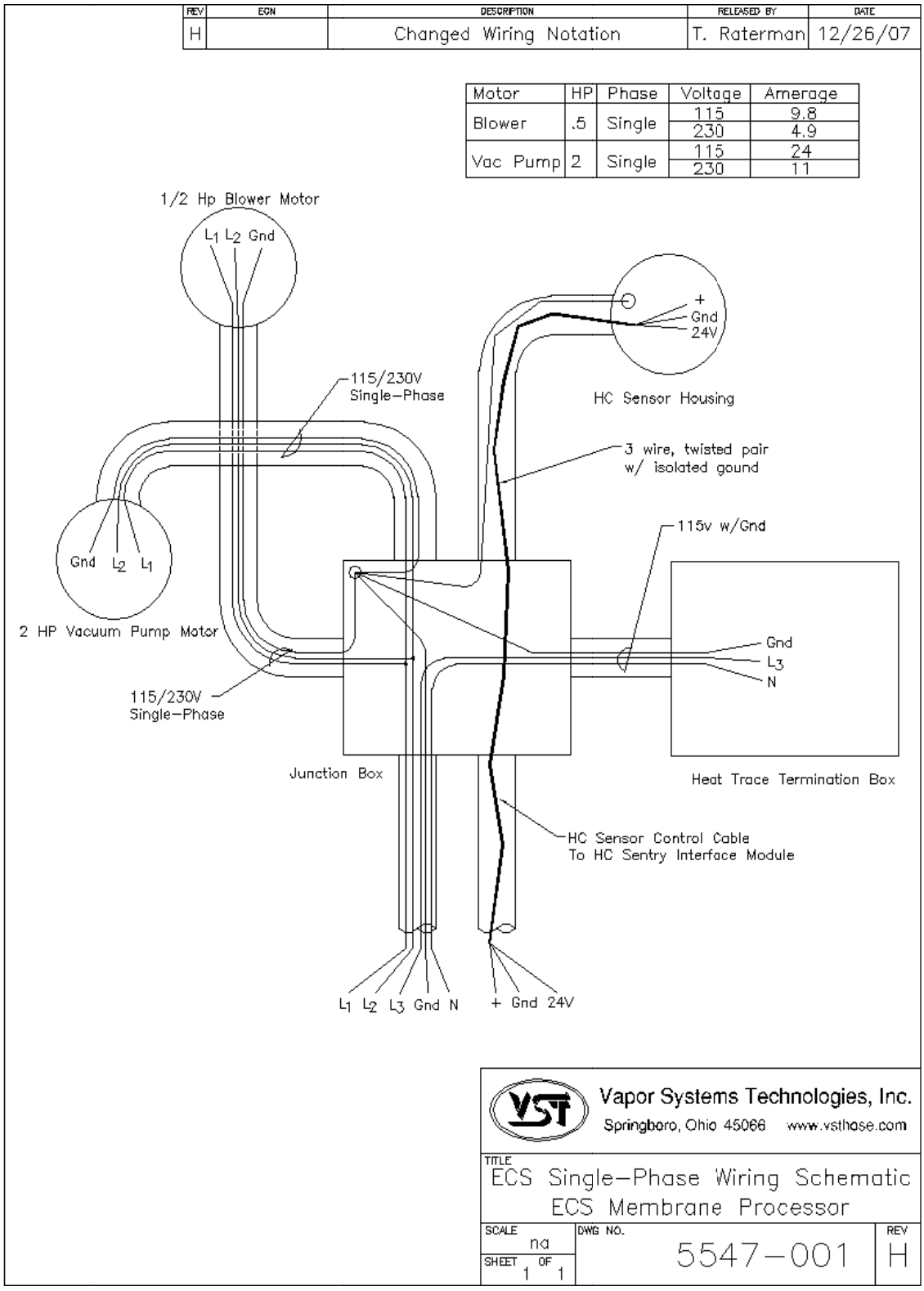


Figure 18: Single-Phase Wiring Schematic

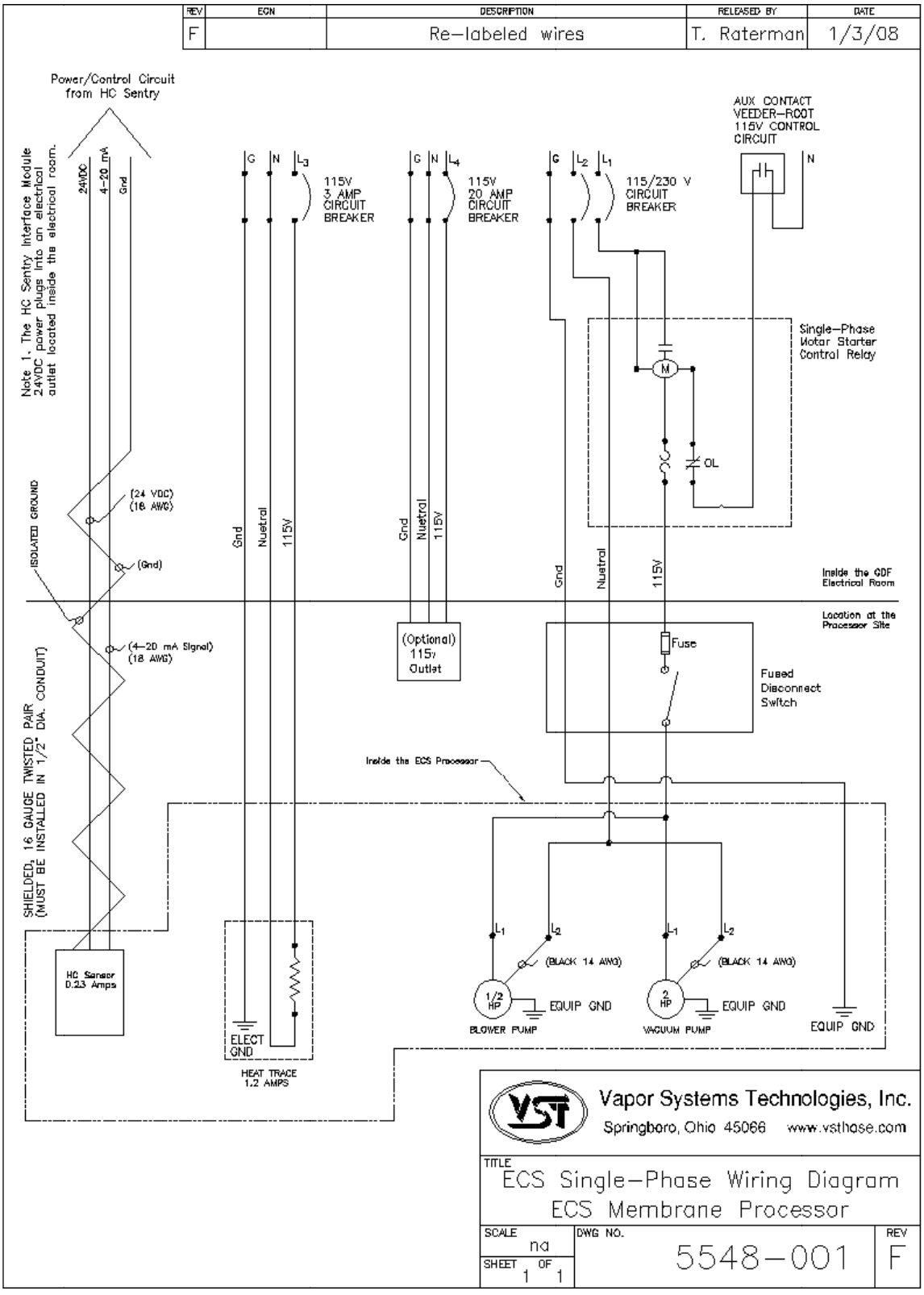


Figure 19: Processor Single-Phase Wiring Diagram

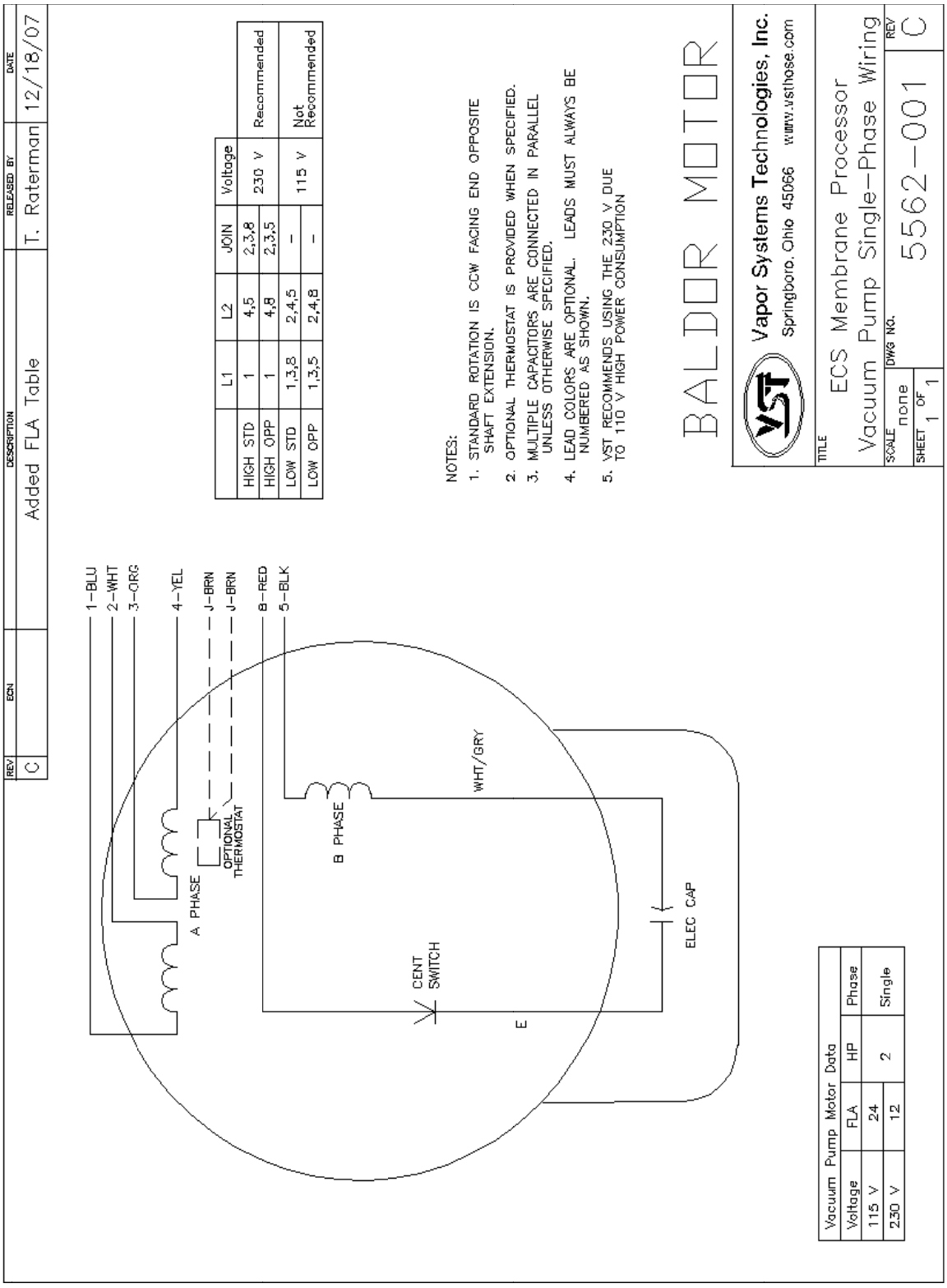


Figure 20: Vacuum Pump: Single-Phase Motor Wiring Diagram

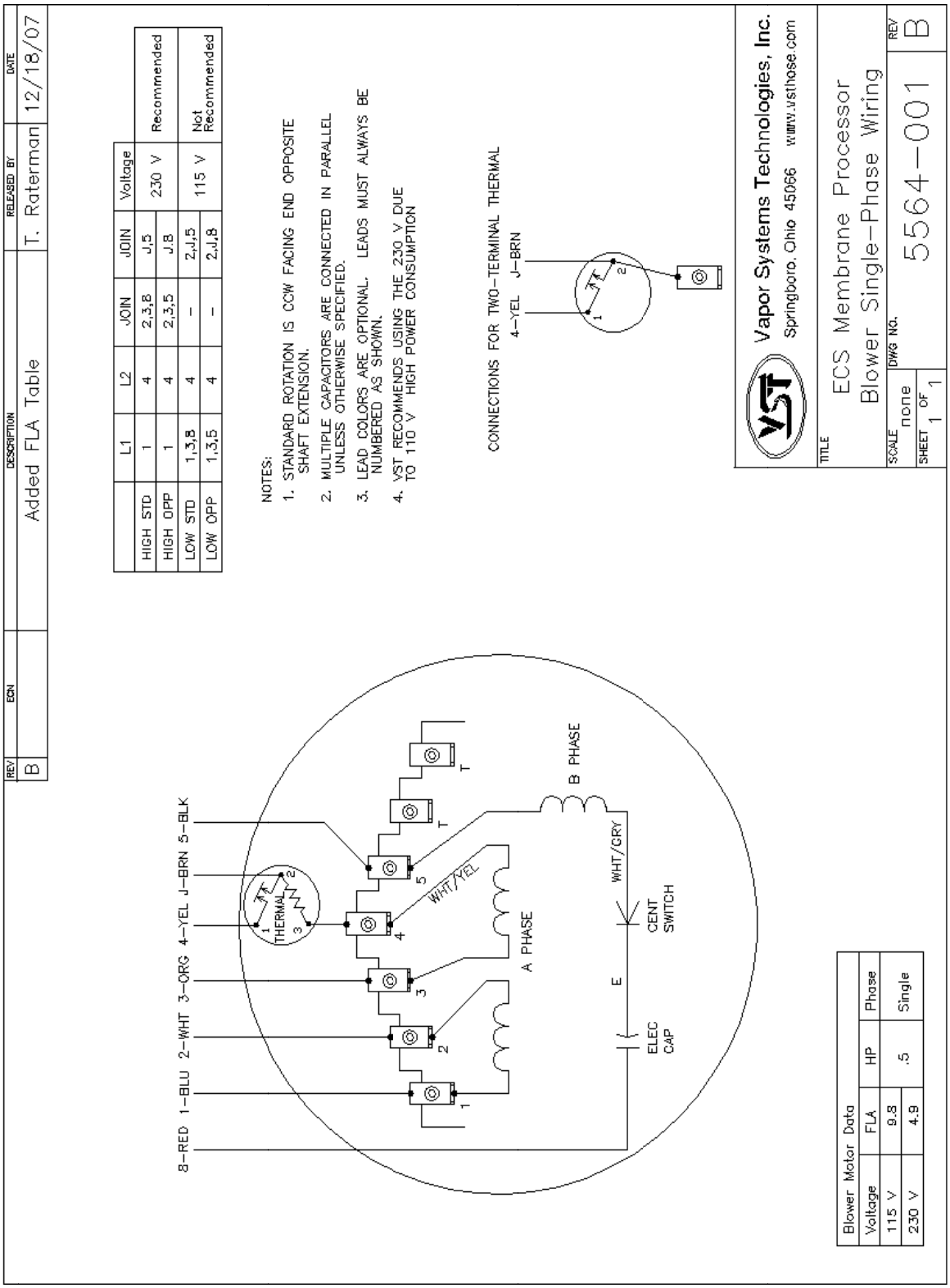


Figure 21: Blower: Single-Phase Motor Wiring Diagram

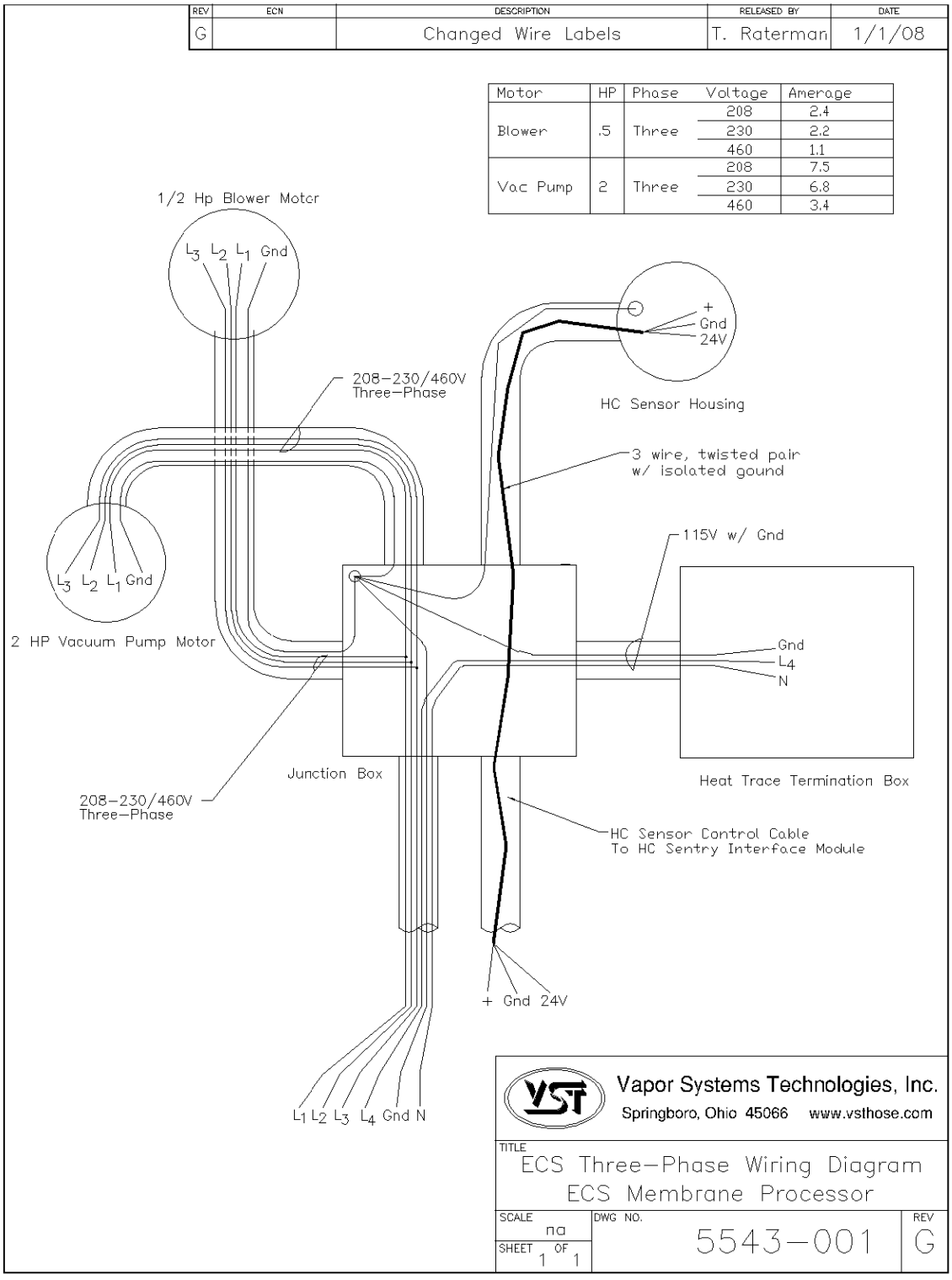


Figure 22: Processor Three-Phase Wiring Schematic

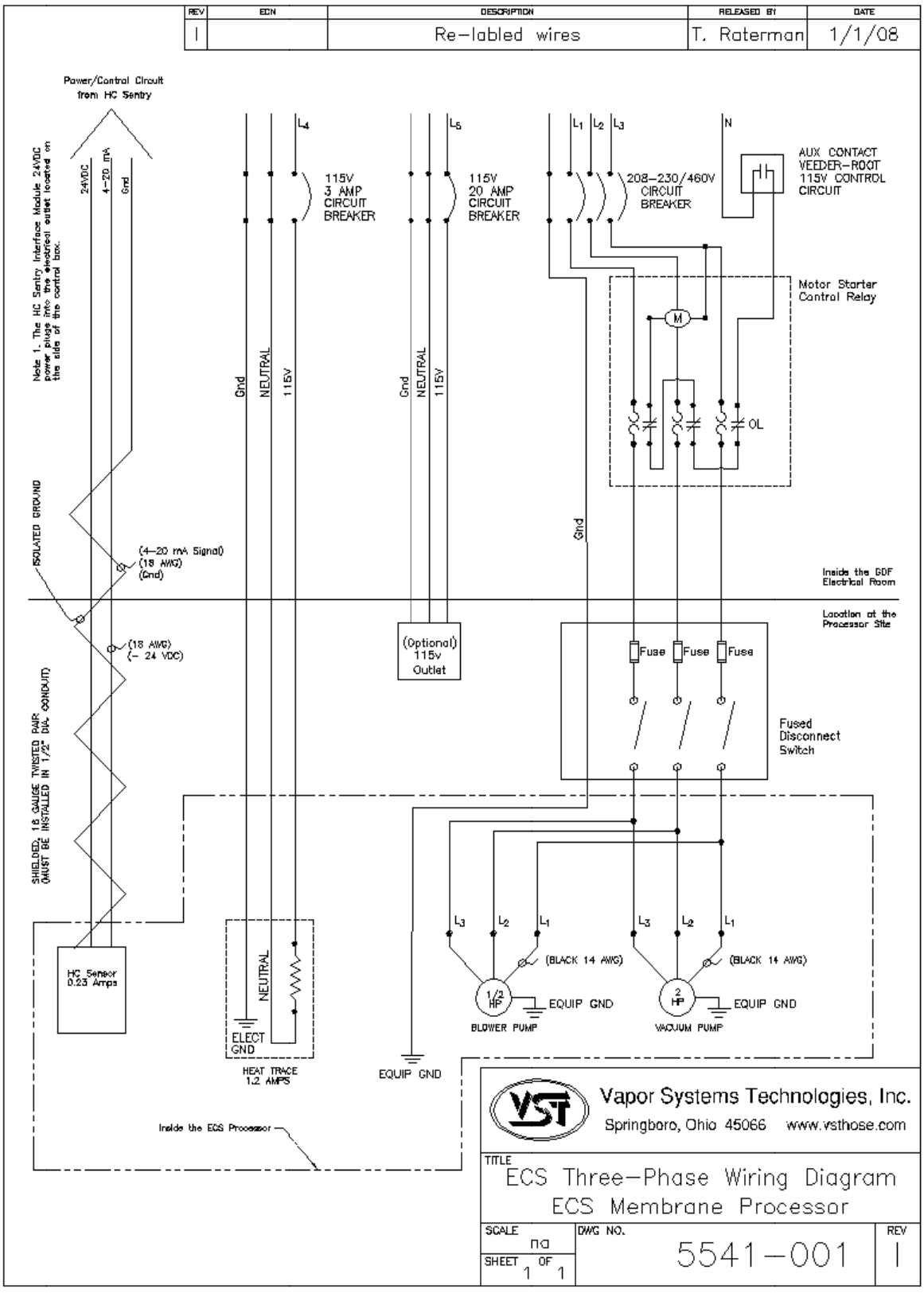


Figure 23: Processor Three-Phase Wiring Schematic

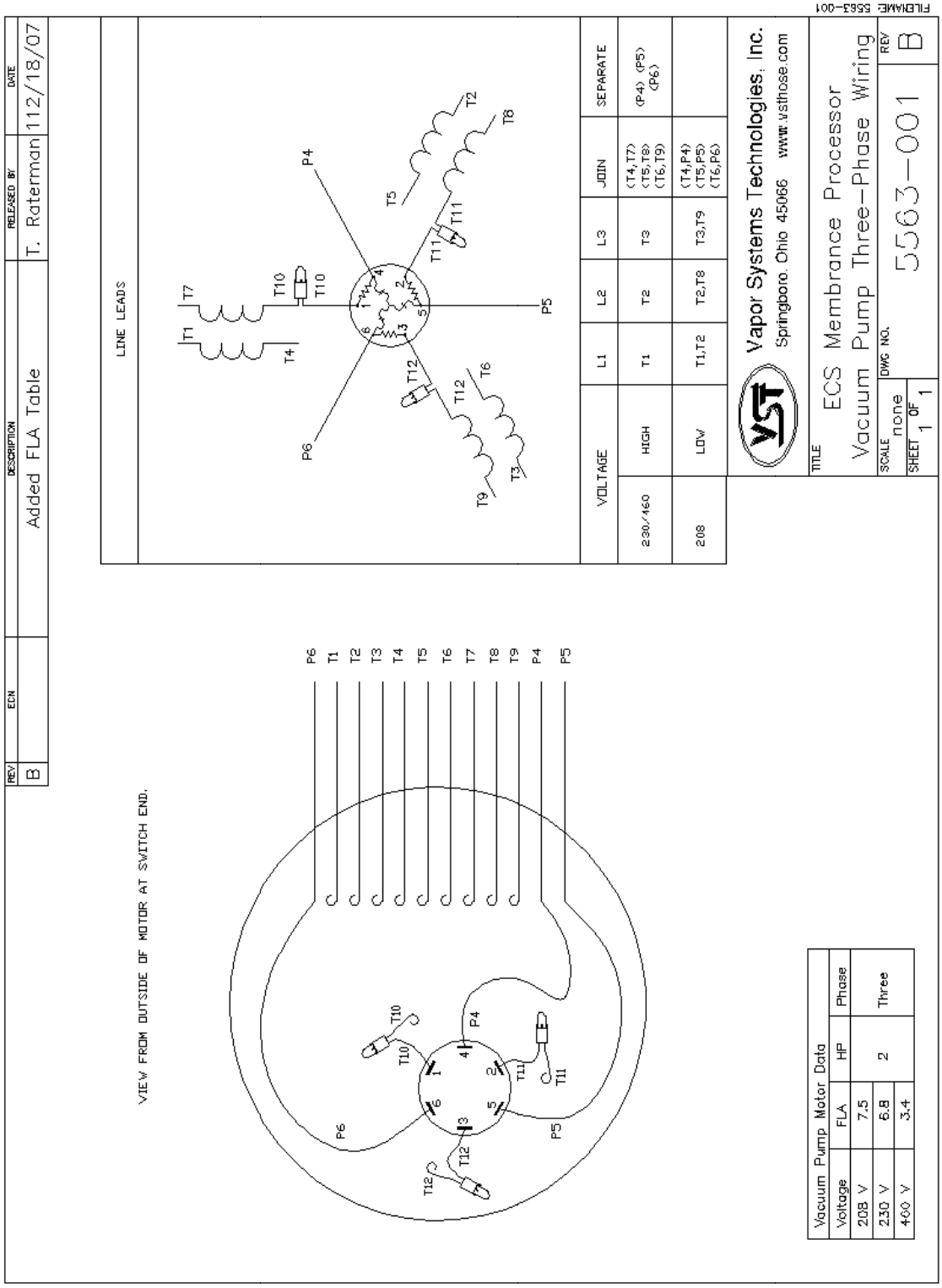


Figure 24: Vacuum Pump: Three-Phase Motor Wiring Diagram

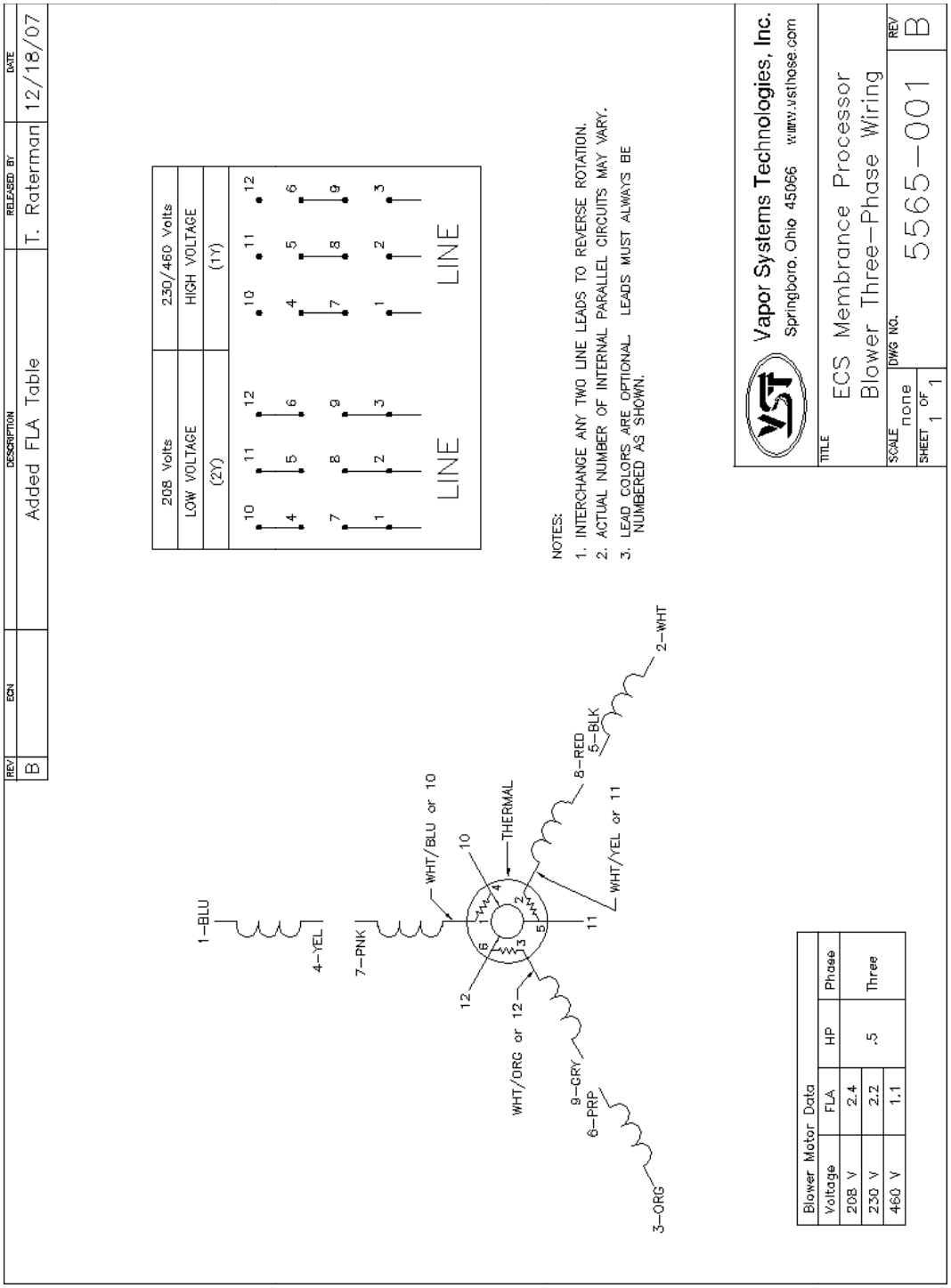


Figure 25: Blower: Three-Phase Motor Wiring Diagram

10.4 Auxiliary Output Relay

- Run two wires from motor relay contacts to the Veeder-Root TLS.
    - This action requires that the VST ASC (Level B) be a Veeder-Root Certified Contractor with a minimum of Veeder-Root level 1, or 2/3, or 4 certification.
- The 115VAC control voltage for the motor control contactors coil comes from the TLS-350 controller.
- The 115V control voltage for the motor control contactor is from the 115V electrical panel.
- The user interface is equipped with an Auxiliary Output Relay for external monitoring of the *Processor*.
- This relay will typically be used when the *Processor* is installed with an ISD system as specified by CARB Enhanced Vapor Recovery Program.
- When the *Processor* is powered and operating normally, the auxiliary relay is energized (green LED on Auxiliary Relay is lit).
- When the *Processor* is either powered off or is in alarm mode, the auxiliary relay is de-energized.
- Auxiliary relay contact rating: 240V, 6A with 4000V isolation.
    - Connect the *Processor* motor control relay on either the 4-Relay Module or the I/O Combination Module.
    - **See Figure 26: Section 14 / Page 69**
    - **See Figure 27: Section 14 / Page 70**
    - **See Figure 28: Section 14 / Page 71**

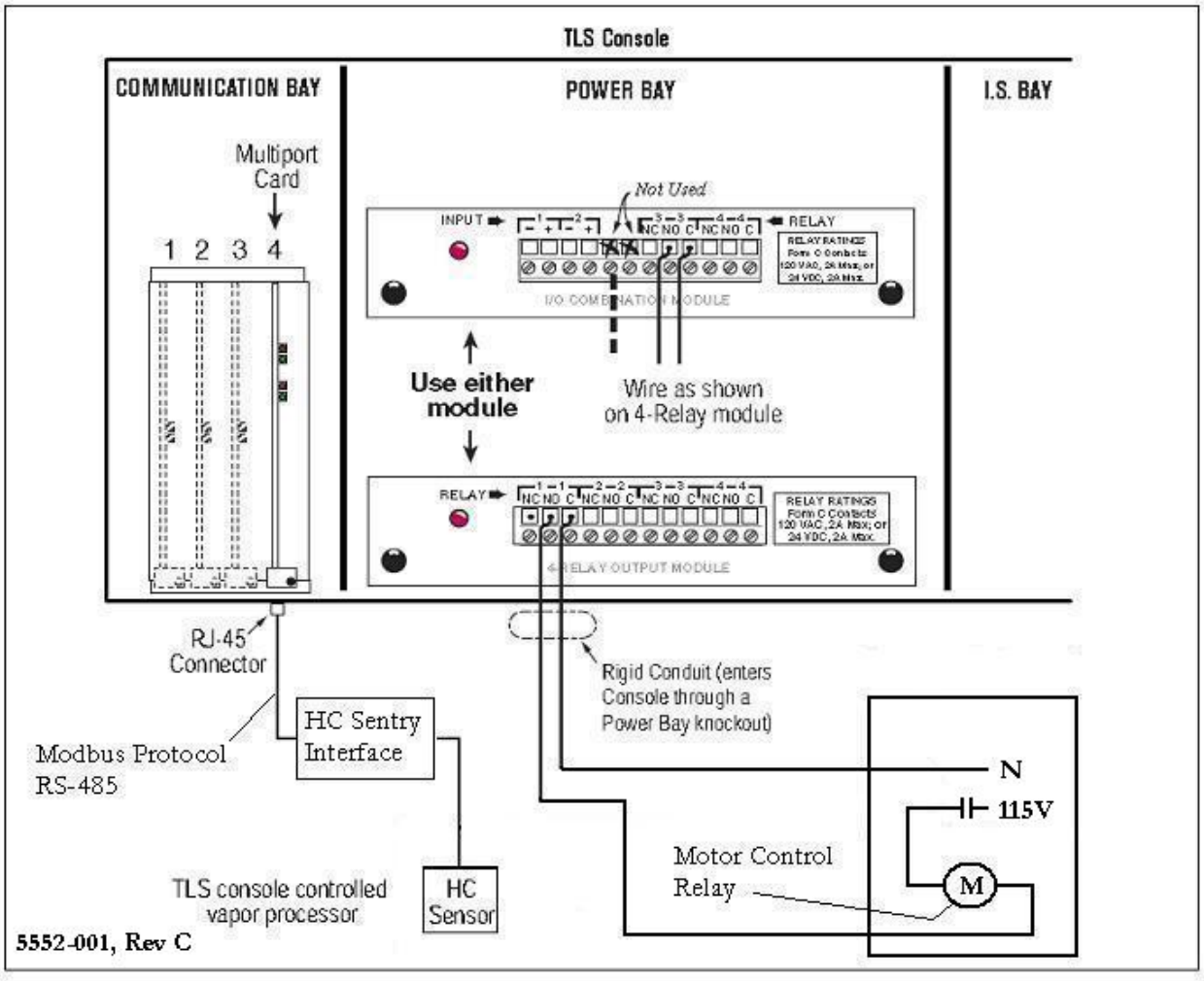


Figure 26: VR TLS Multi-Port Card Connection to HC Sentry Module

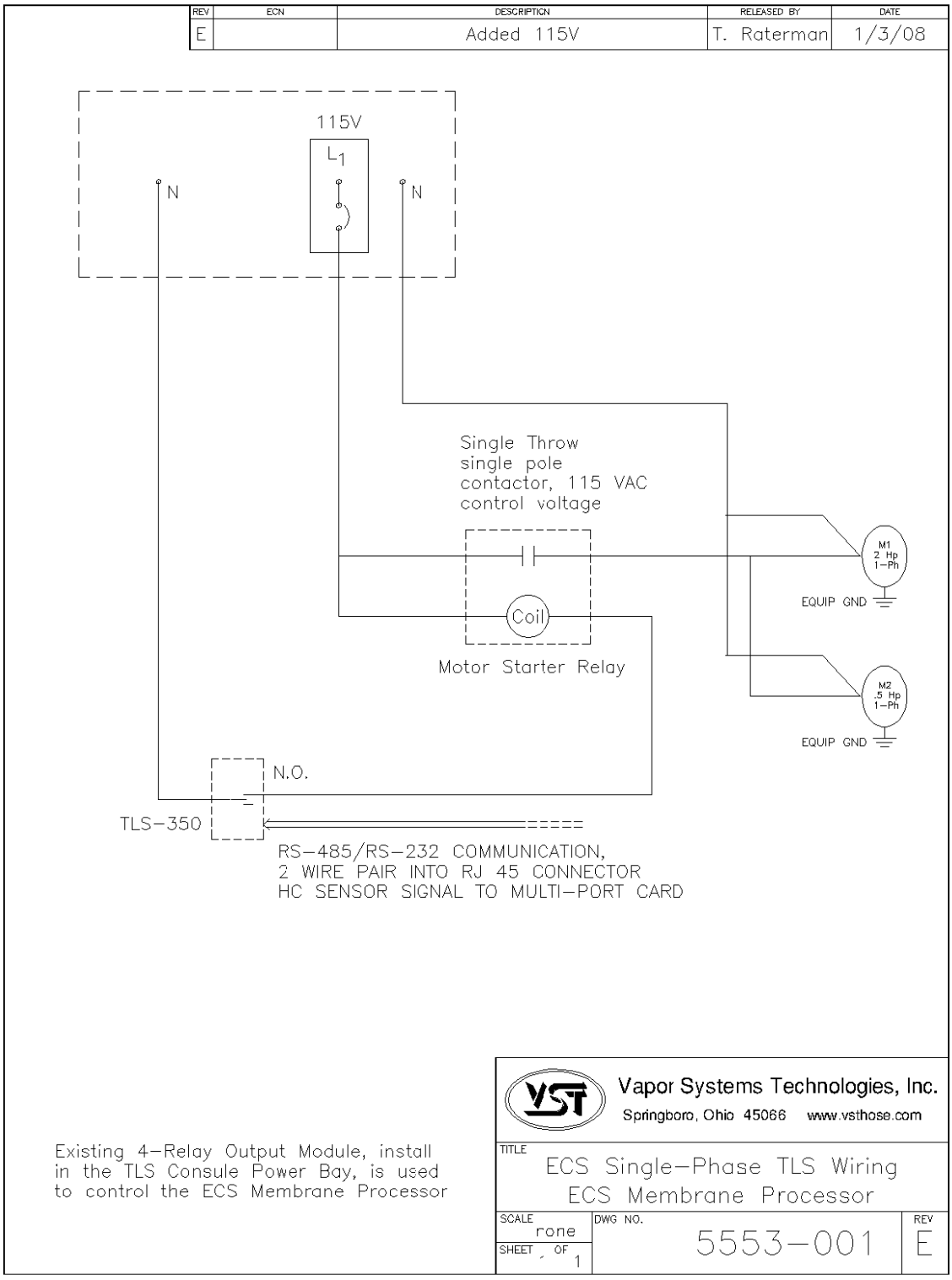


Figure 27: Processor Single-Phase TLS Wiring

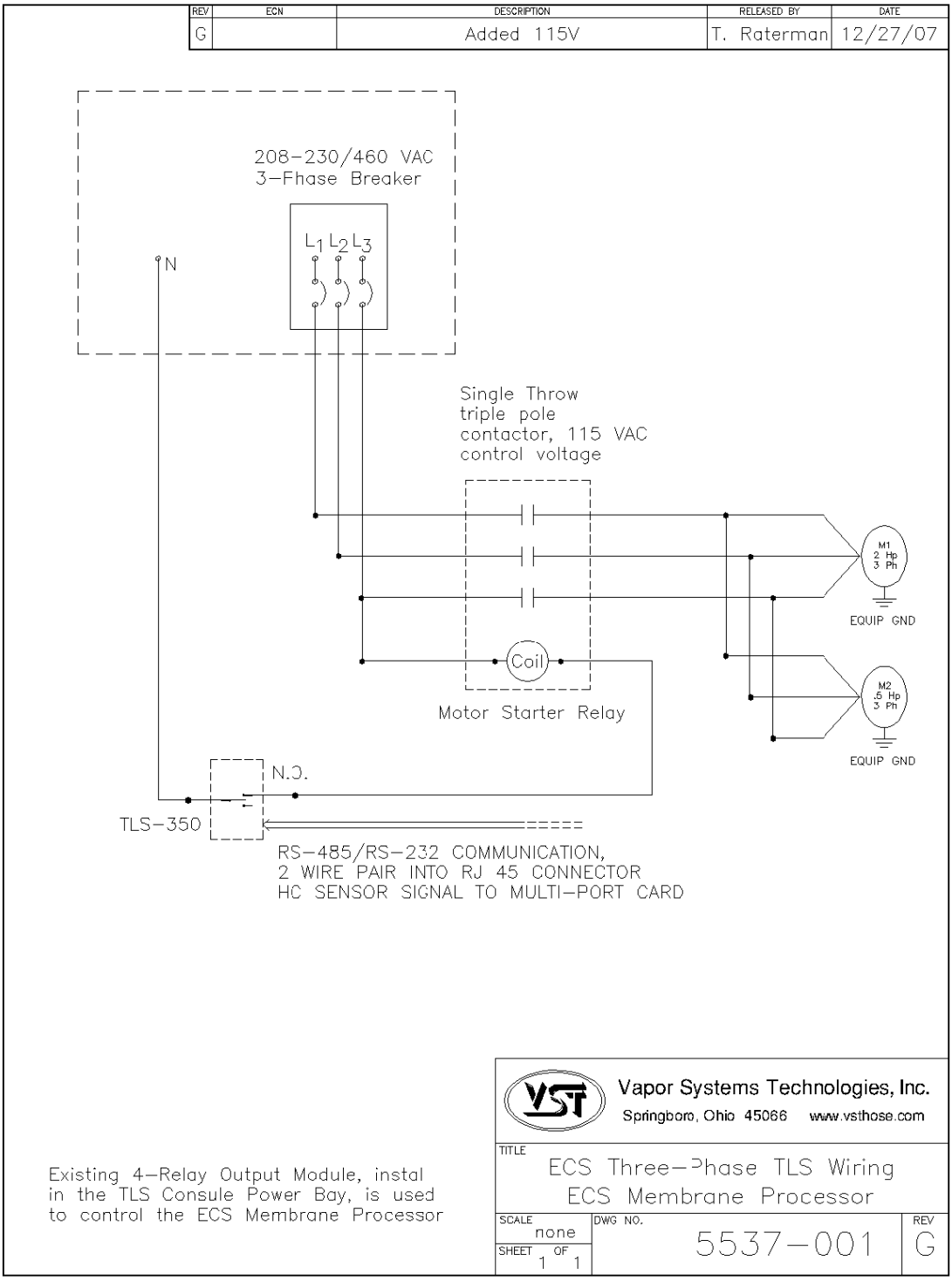
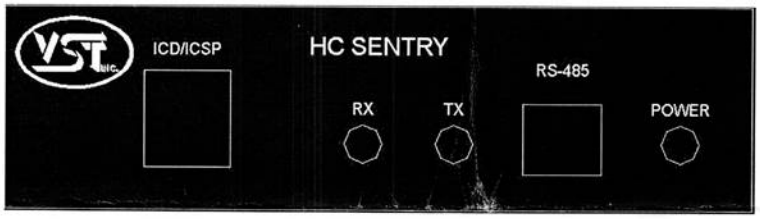


Figure 28: Processor Three-Phase Wiring

10.5 HC Sensor / HC Sentry

- Using 24 VDC, the HC sentry provides power to the HC sensor.
- A 115V / 24 VDC converter from a 115V outlet powers the HC sentry.
- A 4-wire, 18 ga. shielded twisted-pair cable connects the HC sensor to the HC sentry for the 24 VDC power, the 4-20mA signal, and an isolated ground.
- The wiring from the HC sensor is connected to the 2 twisted-pair wires inside the HC electrical housing.
- Install an equipment ground to the HC sensor housing.



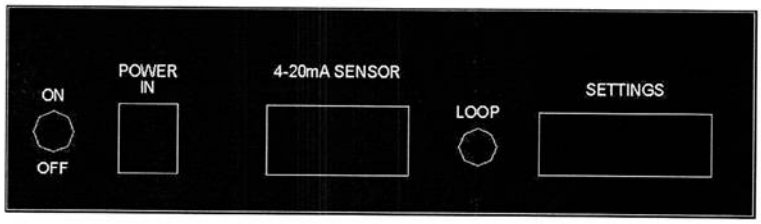
ICD/ICSP: This connector provides a means for performing in-circuit-debug and in-circuit-serial-programming utilizing the programming and debugging tools from the processor manufacturer. This connector will typically be used in production to perform initial programming, and could be used as a simple field method for updating a device.

RX: This led flashes to indicate received data via the RS485 link.

TX: This led flashes to indicate transmitted data via the RS485 link.

RS-485: This two-pin connector provides the link to the TLS, RS-485 network.

POWER: This led indicates that the HC Sentry device is powered up.



ON/OFF: Switch for turning the device power on and off.

Figure 29: HC Sentry Front and Back Views

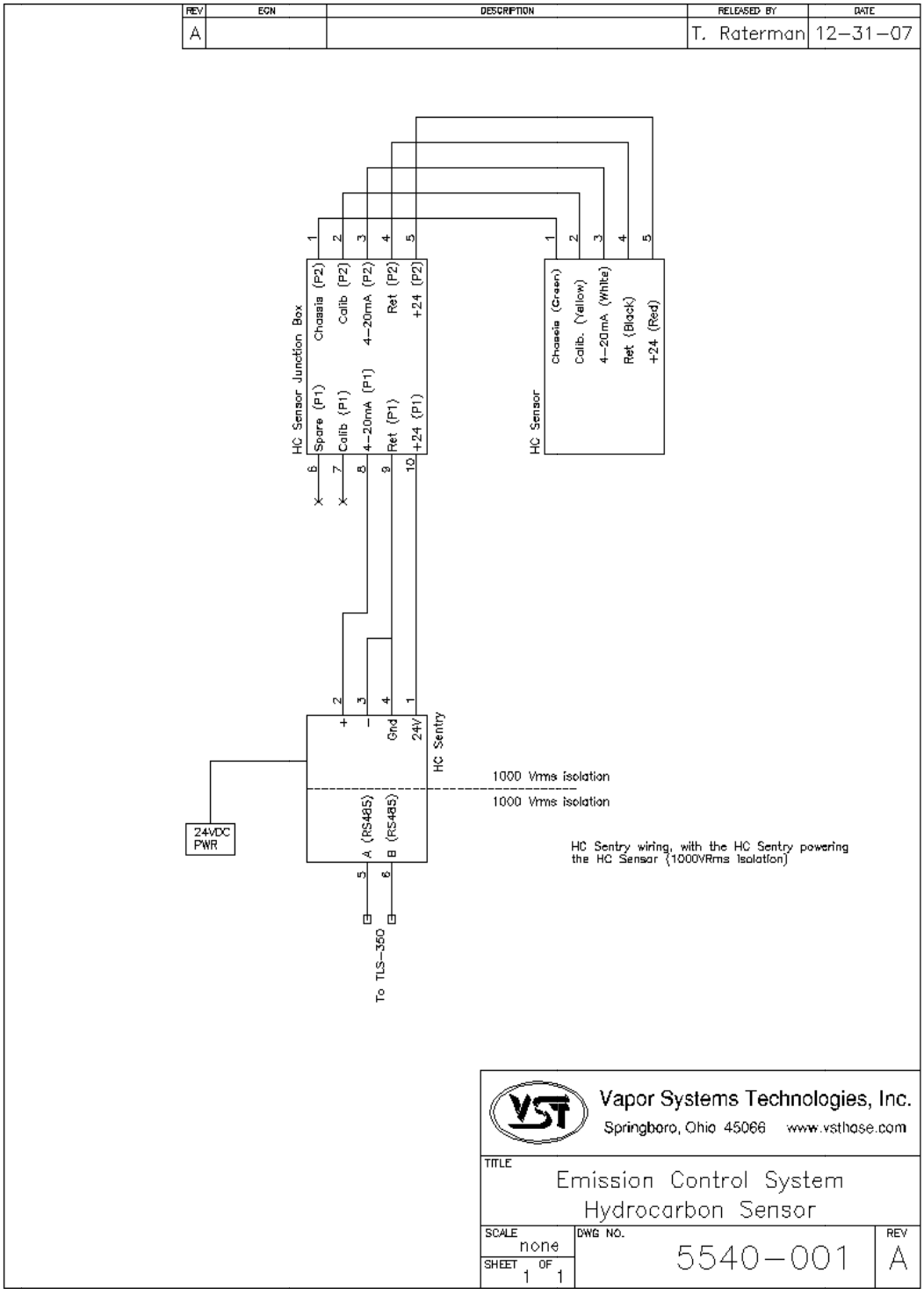
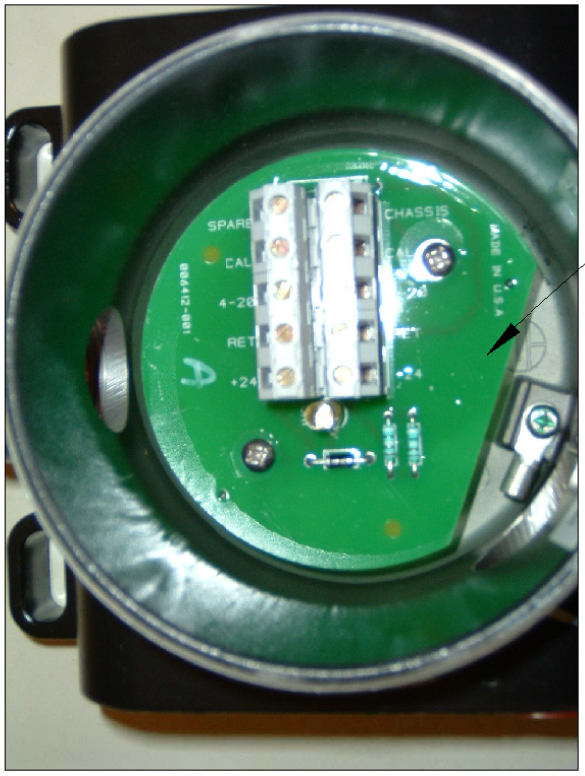


Figure 30: HC Sentry and HC Sensor Wiring Diagrams

REV	ECN	DESCRIPTION	RELEASED BY	DATE
A			T. Raterman	4/23/07



HC Sensor Junction box

HC Sentry (Front)

HC Sentry (Back)

Vapor Systems Technologies, Inc.
Springboro, Ohio 45066 www.vsthose.com

TITLE
Emission Control System
Hydrocarbon Sensor

SCALE	DWG NO.	REV
none	5538–001	A
SHEET 1 OF 1		

Figure 31: HC Sensor and HC Sentry Pictures

10.6 Multiport Card for Vapor *Processor* Communication

- Run wire from HC sentry to TLS
    - This action requires that the VST ASC (Level B) be a Veeder-Root Certified Contractor with Level 1, or 2/3, or 4 certification.
- The HC sensor is powered by the HC Sentry Interface Module using 24VDC power.
- Power required for the HC Sentry Interface Module is 24VDC power supply plugged into an 115VAC outlet.
- A four-wire, 18-gauge, shielded twisted-pair cable connects the HC sensor to the HC Sentry Interface Module for the 24VDC power, the 4-20mA signal, and an isolated ground.
- The wiring from the HC sensor is connected to the two twisted pair wires inside the HC electrical housing.
- **See Figure 33: Section 14 / Page 76** TLS – HC Sentry RS-485 Cable for the wiring diagram. VST does not provide this cable or the RJ-45 connector to the Multiport card in the TLS communication bay.

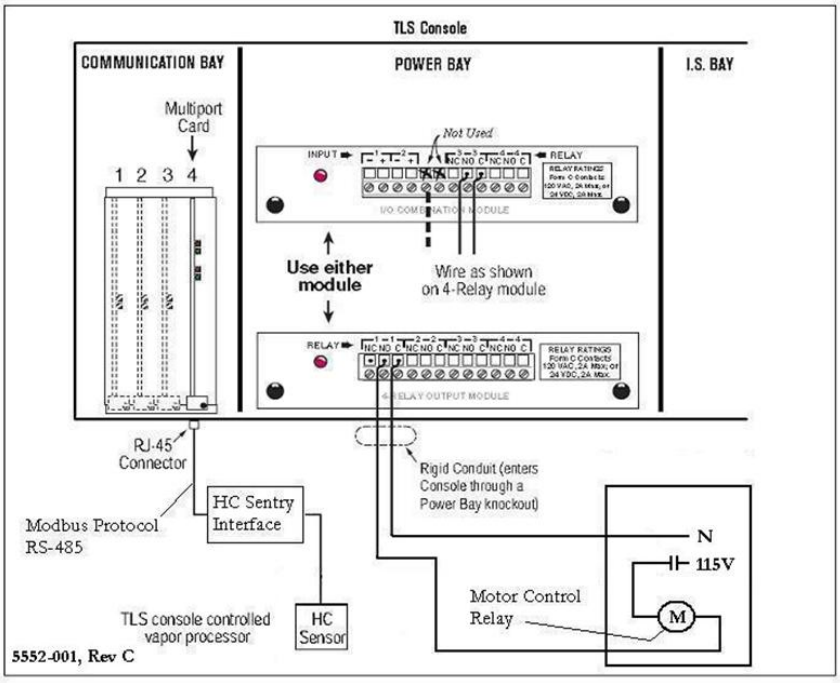


Figure 32: VR TLS Multi-Port Card Connection to HC Sentry Module

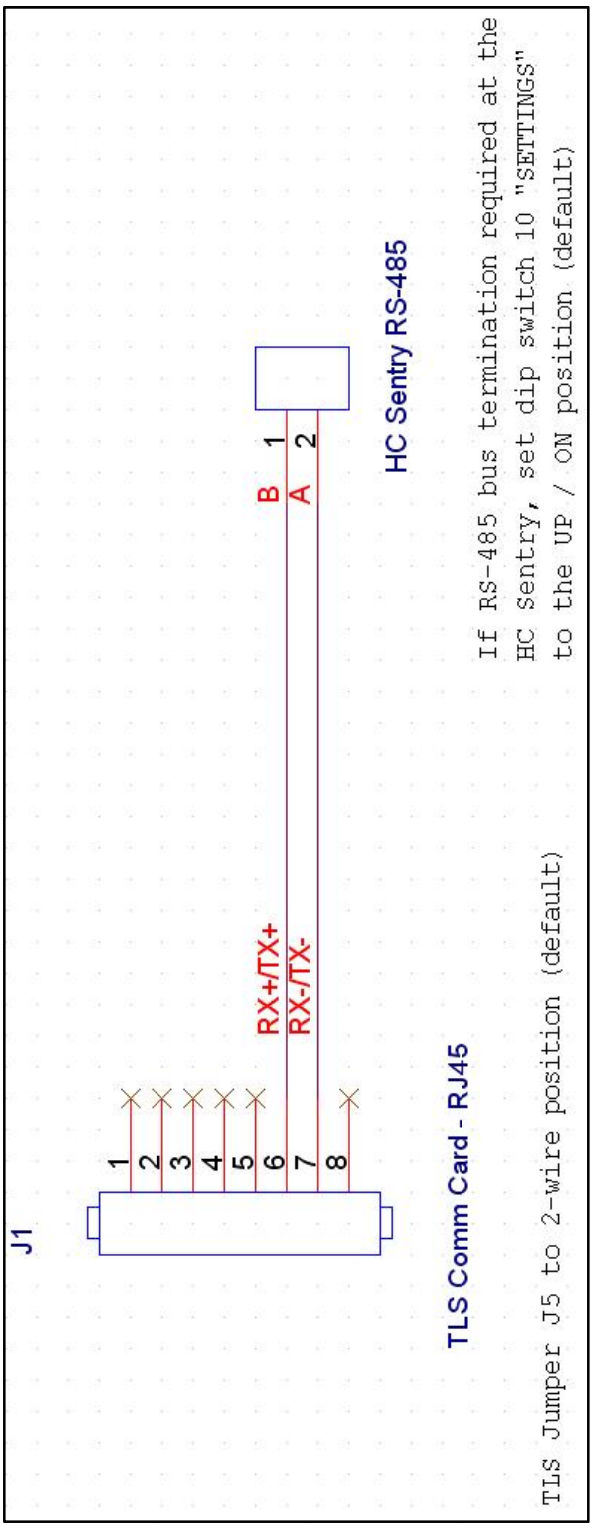


Figure 33: HC Sentry RS-485 Cable Wiring Diagram

10.7 Veeder-Root TLS 350 with ISD

- The *Processor* is controlled by a Veeder-Root (VR) TLS-350 with a ISD package.
- The pressure sensor is located in a dispenser closest to the UST's and is supplied by Veeder-Root as part of the Veeder-Root TLS-350 with a ISD control package.
- VST will supply the HC Sentry Interface Module with 115VAC/24VDC power supply as part of the *Processor*.
- The HC Sentry Interface Module converts the 4-20 mA signals from the HC sensor to a proprietary signal the TLS-350 will recognize.
- VST does not provide the required items to interface the *Processor* with the TLS-350 controller.
- VST does not provide the TLS-350 controller or the software required by the TLS-350.

Figure 34: VR TLS 350

5554-001

11 Post-Installation Checklist

Post-Installation Checklist		
ASC #:	Date:	
ASC Name:		
VST-ASC Certification Level	☐A ☐B ☐C	
ASC Company:		
GDF Name:		
Address:		
City:	State:	ZIP Code:
GDF Contact Person Name:		
GDF Contact Person Title:		
GDF Contact Person Phone:		
GDF Contact Person E-mail:		
Notes		
Use the form on the following page to note details of the post-installation.		

The following tests were performed in accordance with IOM found in the VST's Executive Order VR-203.

ASC Signature

	Site Components	Yes	No	Unknown	If "NO" or "Unknown" explain
	Pressure sensor installed	☐	☐	☐	
	TLS-350 with ISD software installed	☐	☐	☐	
	HC sentry connected to the TLS and checked	☐	☐	☐	
	Motor-starter control relay connected to the TLS and checked	☐	☐	☐	
	All vapor piping sloped away from the *Processor*	☐	☐	☐	
	All vapor piping line size meets CP-201 requirements	☐	☐	☐	
	All vapor piping slope meets CP-201 requirements	☐	☐	☐	
	Site Components	**Yes**	**No**	**Unknown**	**If "NO" or "Unknown" explain**
	All warranty information has been filled out and sent to VST	☐	☐	☐	
	All connections from the *Processor* to the UST's are correct	☐	☐	☐	
	The *Processor* has not been installed in a Class I, Div. 1 or Class I, Div. 2 area	☐	☐	☐	
	The electrical installation meets NEC, federal, state, and local standards	☐	☐	☐	
	The *Processor* installation meets CP-201 requirements	☐	☐	☐	
	The ECS *Processor* has been installed per installation instructions	☐	☐	☐	

Section #15

Operation, Maintenance, Start-Up

ECS Membrane *Processor* with ISD

Part:	VST-ECS-CS3-110 VST-ECS-CS3-310
E.O.	VR-204-A

Vapor Systems Technologies, Inc.
650 Pleasant Valley Drive
Springboro, Ohio 45066
PH: 937-704-9333
FX: 937-704-9443
www.vsthose.com

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About VST

Vapor Systems Technologies, Inc. began in 1989 with the vision of **One Company – One Integrated Solution**.

Today, that philosophy is still in place and getting stronger. Recognizing that a healthier environment is a need and not an option, VST has dedicated its undivided attention to the ever-changing, stringent regulations that govern fugitive vapors at gasoline dispensing facilities (GDF). To this challenge, VST is committed to a continual R&D campaign of developing the most current, technologically advanced solutions to service not only the United States, but also the world.

VST specializes in the development, engineering, and manufacturing of products that are sold into the GDF segment of the petroleum industry. The VST focus provides our customers and users with exceptional products, services, and innovative solutions for improving the fueling-station experience as well as the world's air quality.

VST's product offering includes curb pump and vapor recovery hoses, safety breakaways, nozzles, and emission-control system *Processor*s. The ENVIRO-LOC™ vapor-recovery product offering represents the most innovative concept in the industry for trapping fugitive vapors from the front end (vehicle refueling) to the back end (vent risers) of the GDF site.

Notice

Warranty

- The warranty is conditional on whether the *Processor* was installed by a VST ASC Level B or a VST Level C.
- 12-month warranty becomes effective at the time of installation. If this card is not returned, the warranty becomes effective from the date of shipment at VST.
- VST cannot be held responsible for damage to the *Processor* or the *Processor* equipment (inclusive) due to acts of nature, vandalism, or neglect.
- Membranes exposed to gasoline (liquid) due to an overfill or any other reason voids the membrane warranty.
- VST products are warranted to be free of defects in material and workmanship.
- Liability under any expressed or implied warranty is limited to replacement of the product.
- Use of VST products on non-UL Listed systems, or use which falls outside intended field of use, voids any stated or implied warranty.
- VST is not responsible for misuse of, nor improperly installed, products.
- In the event of a warranty claim, the purchaser must obtain a copy of the Return Goods Authorization (RGA) prior to returning product to insure proper processing. Return shipping charges are the responsibility of the customer.
- Warranty status will be determined within 30 days of the return of suspected items.
- VST provides for a warranty program in conjunction with VST's exclusive serial number tracking system.
- Each VST product carries a unique serial number and warranty tracking card.
- Requests for warranty shall be through VST's Return Goods Authorization (RGA) procedure. Call VST at 937-704-9333.
- This warranty does not cover any components exposed to contact with fuels more than 5% menthanol, 10% ethanol, 15% MTBE by volume or any exposure to M85 / E85 fuel.

Warranty Cards

Vapor Systems Technologies, Inc.

Phone: (937)-704-9333 • Fax: (937)-704-9443
www.vsthose.com

IMPORTANT
PRODUCT WARRANTY REGISTRATION CARD

12 MONTH WARRANTY BECOMES EFFECTIVE AT TIME OF INSTALLATION. IF THIS CARD IS NOT RETURNED, WARRANTY BECOMES EFFECTIVE FROM DATE OF SHIPMENT FROM VST.

THE MAXIMUM WARRANTY LIFE IS 18 MONTHS FROM DATE OF SHIPMENT.

PLEASE CALL VST IF THIS PRODUCT IS BEING USED AS A REPLACEMENT. REPLACEMENT WITH A NON VST PRODUCT VOIDS ANY WARRANTY.

SERIAL NUMBER:

INSTALLATION DATE:

INSTALLATION SITE:

CITY/STATE/ZIP:

DISTRIBUTOR NAME:

PRODUCT STYLE:

☐ HOSE ☐ SAFETY BREAKAWAY
☐ NOZZLE ☐ ECS PROCESSOR

VST-9998-04/06

Figure 1: VST Registration Card

NOTICE: THIS TAG MUST NOT BE REMOVED FOR ANY REASON

ECS MEMBRANE PROCESSOR UNIT

Serial Number: _____

Date Installed: _____

This device was factory tested and met all applicable performance standards and specifications to which it was certified.

Manufactured By: Vapor Systems Technologies, Inc.
650 Pleasant Valley Dr., Springboro, Ohio 45066
Phone: (937) 704-9333, Fax: (937) 704-9443

Figure 2: ECS Membrane Processor Sticker

Components and Warranties

PART #	DESCRIPTION	WARRENTY
5001-001	Vacuum Pump/Three-Phase Motor - Shipped with Three-Phase *Processor*	1 year
5001-002	Vacuum Pump/Single-Phase Motor - Shipped with Single-Phase *Processor*	1 year
5001-003	Vacuum Pump Drive Coupling Rubber Insert	1 year
5002-001	Circulating Blower / Three-Phase Motor - Shipped with Three-Phase *Processor*	1 year
5002-002	Circulating Blower / Single-Phase Motor - Shipped with Single-Phase *Processor*	1 year
5003-001	Check-Valve Assembly	1 year
5005-001	Membrane	1 year
5006-001	Membrane Housing, Complete	1 year
5006-011	O-Ring (2) Vertical Tube	1 year
5006-012	O-Ring (2) Base Insert	1 year
5006-013	O-Ring (2) Membrane	1 year
5007-004	Hydrocarbon Sensor	1 year
5008-001	Heat-Trace Cable	1 year
5008-002	Heat Trace Power Connection Kit	1 year
5008-003	Heat Trace End Seal Kit	1 year
5010-001	ECS Aluminum Cover	1 year
5012-100	Membrane Tubing	1 year
5012-101	Blower Inlet Tubing	1 year
5012-102	Blower Outlet Tubing	1 year
5012-103	Vacuum Pump Inlet Tubing	1 year
5012-104	Vacuum Pump Outlet Tubing	1 year
5012-105	HC Return Tubing	1 year
5012-106	HC Inlet Tubing	1 year
5012-107	Membrane Outlet Tubing	1 year
5013-001	Insulation	1 year

VST Contractor Requirements

- Due to the highly volatile nature of gasoline and its handling and storage, VST requires the following certifications for its ASC's:

Level	Component	Authorized Tasks	Training Pre-Requisites
A	Hanging Hardware	Functional Testing Installation Maintenance Repair	No pre-requisite
A/B	Hanging Hardware	Functional Testing Installation Maintenance Repair	No pre-requisite
	Membrane *Processor*	Installation	Veeder-Root Level 1, 2/3, or 4 ASC certification
C	Membrane *Processor*	Annual Testing Component Replacement Maintenance Operation Post-Installation Power-Up Testing Start-Up Testing Troubleshooting	Veeder-Root Level 2/3, or 4 ASC with PMC / ISD certification VST level "A/B"

NOTE:

Depending on local codes, in addition to the VST and Veeder-Root training, contractors may be required to take air-district training or ICC certification as an approved vapor-recovery installer.

- ASC's must be able to show proof of certification if asked. Carry the wallet card or have a copy of your certification on file with the GDF.

- The ASC must record his or her certification number on the applicable paperwork for all warranties to be deemed valid.

- Contractors should **ALWAYS** verify the training and certification requirements with the air-district staff **BEFORE** beginning installation of EVR systems.

Veeder-Root Contractor Requirements

Veeder-Root Level 1	Contractors holding valid Level 1 Certification are approved to perform wiring and conduit routing, equipment mounting, probe and sensor installation, tank and line preparation, and line leak detector installation.
Veeder-Root Level 2/3 or 4	Contractors holding valid Level 2, 3, or 4 certifications are approved to perform installation checkout, startup, programming and operations training, troubleshooting and servicing for all Veeder-Root Tank Monitoring Systems, including Line Leak Detection and associated accessories.
PMC / ISD	This course of training includes In-Stations Diagnostics/Pressure Management Control (ISD/PMC) installation checkout, startup, programming, and operations training. It also includes troubleshooting and service techniques for the Veeder-Root In-Station Diagnostics system. A current level 2/3 or 4 certification is a prerequisite for the ISD/PMC course. After successful completion of this course the contractor will receive a certificate as well as a Veeder-Root ISD/PMC contractor certification card.
Warranty Registrations may only be submitted by selected distributers.	

Safety Icons

	**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 vapors 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 MATERIALS** Read, understand, and follow all instructions, warnings, and requirements before you begin work.
	**NO OPEN FLAMES** Open flames from sources like lighters and matches can ignite gasoline and its vapors.		**USE SAFETY BARRICADES** Unauthorized people in the work area during installation and service of the device create a potential for personal injury. Therefore, always isolate your work area by using safety cones, barricades, etc.
	**PINCH RISK** Stay clear. Keeps hands and tools away from rotating machinery and moving parts.		**ROTATING MACHINERY** Stay clear. Keep hands and tools away from rotating machinery.

Table of Terms and Abbreviations

ASC:	Authorized Service Contractor
AQMD:	Air Quality Management Districts
ATG:	Automatic Tank Gauge
CARB:	California Air Resources Board
CDFA:	California Department of Food & Agriculture
CVLD:	Continuous Vapor Leakage Detection, another name for Vapor Leak Detection
ECS:	Emissions Control System
EO:	Executive Order
EVR:	Enhanced Vapor Recovery
GDF:	Gasoline Dispensing Facility
HC:	Hydrocarbon
HC IR:	Hydrocarbon Infrared
ISD:	In-Station Diagnostics
MAG Probe:	A type (brand) of Tank Inventory Probe
NEC:	National Electric Code
NFPA:	National Fire Protection Association
ORVR:	On-Board Refueling Vapor Recovery
OSHA:	Occupational Safety Health Administration
Permeate:	Air return to atmosphere
PLC:	Programmable Logic Control
PMC:	Pressure Management Control
Retentate:	Vapor return to UST
RVP:	Reid Vapor Pressure
TLS:	Tank Level System
TLS Console:	Veeder-Root's line of environmental monitoring consoles.
TS:	Troubleshooting
Ullage:	Vapor space above liquid in a UST
UST:	Underground Storage Tank
VCK:	Vapor Collection Kit
Veeder Root:	Manufacturer of the TLS-350
VOC:	Volatile Organic Compounds
VST:	Vapor Systems Technologies, Inc. - manufacturer of the ECS Membrane *Processor*
WC:	Water Column

1 ECS Membrane Processor Overview

1.1 ECS Membrane *Processor* Theory of Operation

- The VST ECS membrane *Processor* does not interact directly with the other balance system hardware. It is in place to monitor and control the pressure in the UST to within limits specified by CARB.

  Under conditions where the GDF is operational and the balance system hardware is functioning normally, the inherent ORVR compatibility of the balance system (when using VST's ENVIRO-LOC nozzle) will produce a predominately negative gauge pressure in the ullage space of the UST. Under these conditions the ECS membrane *Processor* will typically not need to operate.

  During periods of less activity, the GDF being shut down overnight, winter fuels being present, or other conditions that promote the pressurization of the ullage space, the ECS membrane *Processor* will operate as needed to control the pressure in the ullage space to an accepted level. The ECS membrane *Processor* will turn on at an ullage pressure of +0.20 inches of water and turn it off at a pressure of –0.20 inches of water. Currently, the ECS membrane *Processor* unit is monitored and controlled through the ISD system.

- The ECS membrane *Processor* uses a type of membrane technology to enable it to selectively separate the components in the ullage vapor mixture.

  Through a somewhat complex transport means, certain molecules will selectively travel in a stream from one side of the membrane to the other. This stream is referred to as the permeate stream.

  In this case, the predominate molecules transported across the membrane will be the primary constituents of air, which are oxygen, nitrogen, and water vapor. A small amount of the hydrocarbons present in the ullage mixture will also migrate across the membrane. Typically, the permeate will contain less than 3.0% hydrocarbons. The result of this activity includes, fresh air vented to atmosphere, saturated hydrocarbon vapors returned to the UST, and UST pressurization controlled to an acceptable level.

- The process of separation by the membrane is made possible by using two pumps, one low-pressure pump which circulates the ullage vapor mixture along one side of the membrane, and one high-vacuum pump, which creates the pressure differential needed to cause the permeate transport across the membrane. These are the only moving parts in the system.

  A self-regulating heating coil is incorporated around the membrane housing to keep the membrane free from condensate.

1.2 Overview of How the *Processor* Operates

- The *Processor* is a technology created for Gasoline Dispensing Facilities (GDF) to assist them in reducing the number of harmful emissions released to the atmosphere through the natural occurrence of gasoline vaporization.

- The table below lists the steps that the Veeder-Root TLS 350 and the ISD software takes to control the *Processor*.

1.	• When the UST system pressure rises above +0.2”WC, the *Processor* turns ON.
2.	• Through the vapor inlet pipe connection at the *Processor*, the VOC vapor is drawn into the suction side of the blower.
3.	• The blower discharges the VOC vapor into the membrane housing.
4.	• Inside the membrane housing, the VOC vapor is separated in two air streams: 1. VOC depleted air (referred to as “air”) 2. Concentrated VOC vapor • The membrane is designed specifically for separating air from gasoline VOC vapor.
5.	• A vacuum pump draws the air from the membrane housing through a check valve.
6.	• A sample of the air flows through a hydrocarbon sensor to check the percent hydrocarbons.
7.	• From the vacuum pump, the air is vented to atmosphere via the air return.
8.	• The concentrated VOC vapor returns to the UST system via the vapor return.
9.	• When the UST system pressure drops below -0.2”WC, the *Processor* turns **OFF**.

1.3 *Processor* Dimensions and Weight

Part Number	Unit	Dimensions	Weight
VST-ECS-CS3-110	Single-Phase	L-39" x W-27" x H-43"	385 lbs.
VST-ECS-CS3-310	Three-Phase	L-39" x W-27" x H-43"	350 lbs.
Note: Cover weight is 24lbs. and is included in the overall weight of the *Processor*.			

1.4 *Processor* Components and Their Purpose

PART #	DESCRIPTION	PURPOSE
5001-001	Vacuum Pump / Three-Phase Motor Shipped with Three-Phase *Processor*	Draws air through the membrane housing to the atmosphere.
5001-002	Vacuum Pump / Single-Phase Motor Shipped with Single-Phase *Processor*	
5001-003	Vacuum Pump Drive Coupling Rubber Insert	Drive coupling rubber insert.
5002-001	Circulating Blower / Three-Phase Motor Shipped with Three-Phase *Processor*	The blower circulates the vapor from the UST system through the separation membrane located inside the *Processor* back to the UST system.
5002-002	Circulating Blower / Single-Phase Motor Shipped with Single-Phase *Processor*	
5003-001	Check-Valve Assembly	Eliminates outside air from entering the UST's.
5005-001	Membrane	By means of the circulating blower, the vapor from the UST system continuously flows through the membrane housing, which holds the membrane cartridge. This happens only while the *Processor* is running. The membrane cartridge separates the air from the VOC inlet vapor, returning a concentrated VOC stream back into the storage tank while the air is vented to the atmosphere. The membrane and housing use UL approved o-rings.
5006-001	Membrane Housing, Complete	Houses the membrane cartridge.
5006-011	O-Ring (2) Vertical Tube	Prevents hydrocarbons from leaking into the atmosphere.
5006-012	O-Ring (2) Base Insert	Prevents the separated air from mixing with concentrated hydrocarbons.

PART #	DESCRIPTION	PURPOSE
5006-013	O-Ring (2) Membrane	
5007-004	Hydrocarbon Sensor	The HC Sensor continuously monitors the amount of hydrocarbons in the air stream being vented to the atmosphere. This happens only while the *Processor* is running. A 4-20mA signal is sent to the TLS-350 controller that monitors the hydrocarbon percentage by volume. 24VDC power is required and is supplied from the HC sentry.
5008-001	Heat-Trace Cable	A self-regulating heat trace cable wraps around the membrane housing and is designed to keep the membrane housing temperature between 100°-150° F. Power is continuously applied to the heat-trace cable 100% of the time whether the *Processor* is running or not. The power requirements are 115 VAC at 130 watts per foot, with a maximum of 2 amps draw. On the end of the heat-trace cable is an end-seal kit to terminate the cable.
5008-002	Heat Trace Power Connection Kit	Connection for 115V power.
5008-003	Heat Trace End Seal Kit	End circuit connection.
5010-001	ECS Aluminum Cover	Protective Cover
5012-100	Membrane Tubing	Internal Vapor Tubing
5012-101	Blower Inlet Tubing	
5012-102	Blower Outlet Tubing	
5012-103	Vacuum Pump Inlet Tubing	
5012-104	Vacuum Pump Outlet Tubing	
5012-105	HC Return Tubing	
5012-106	HC Inlet Tubing	
5012-107	Membrane Outlet Tubing	
5013-001	Insulation	1” thick insulation encases the membrane housing and the heat trace cable to preventing unnecessary heat loss.

1.5 *Processor* Auxiliary Components

PART #	COMPONENT	DESCRIPTION
5015-001	HC Sentry Interface Module w/24VDC power supply	The HC Sentry module acts as an interface between the TLS and the HC sensor. 115v power is supplied to the HC sentry module, which supplies 24VDC power to the HC sensor. A 4-20 mA signal is sent from the HC sensor to the HC sentry module, which converts the signal to a proprietary code for the TLS-350.

1.6 *Processor* Manuals and Warranty

MANUAL #	MANUAL NAME	SECTION
9520-001	ECS Membrane *Processor* with ISD: Installation Manual	14
9520-002	ECS Membrane *Processor* with ISD: Operation / Maintenance Manual	15
9514-003	ECS Membrane *Processor*: Troubleshooting Guide	www.vsthose.com
9514-004	ECS Membrane *Processor*: Pre-Installation Site Survey	www.vsthose.com
9522-001	IOM: VST EVR Balance Total System Solution	5
9998-001	Warranty Paperwork	www.vsthose.com

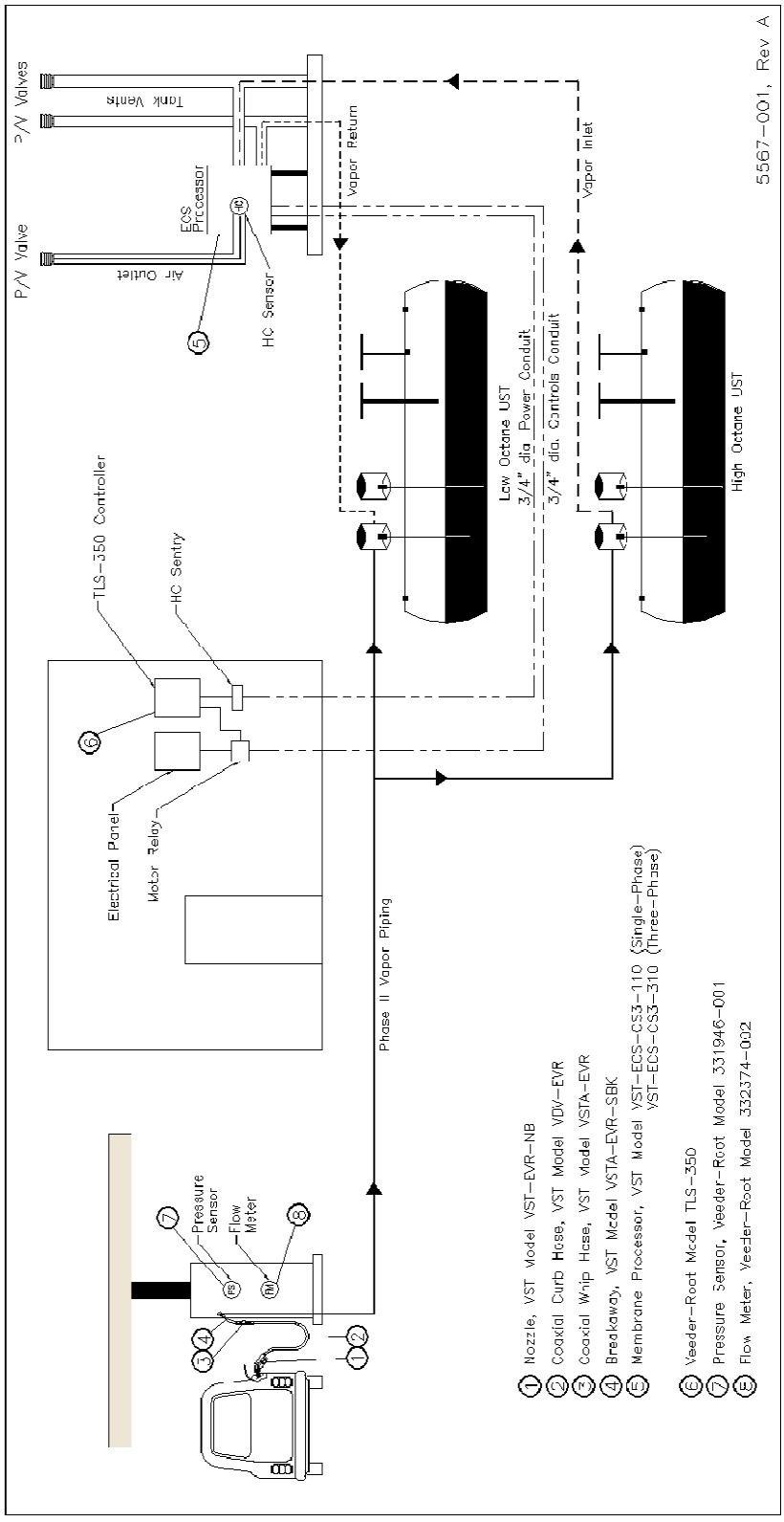


Figure 3: How the Processor fits into the GDF layout

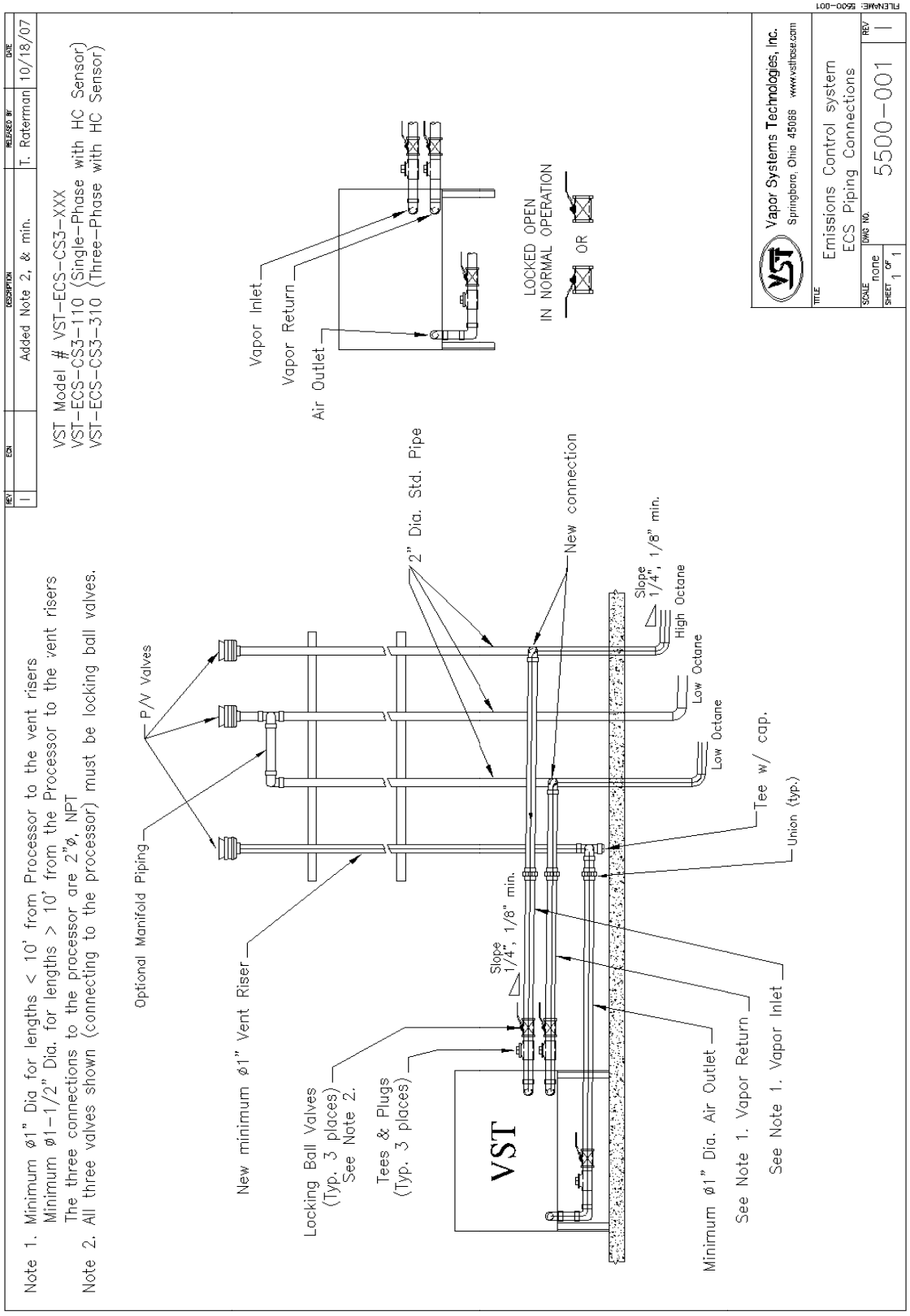


Figure 4: ECS Process Control Diagram

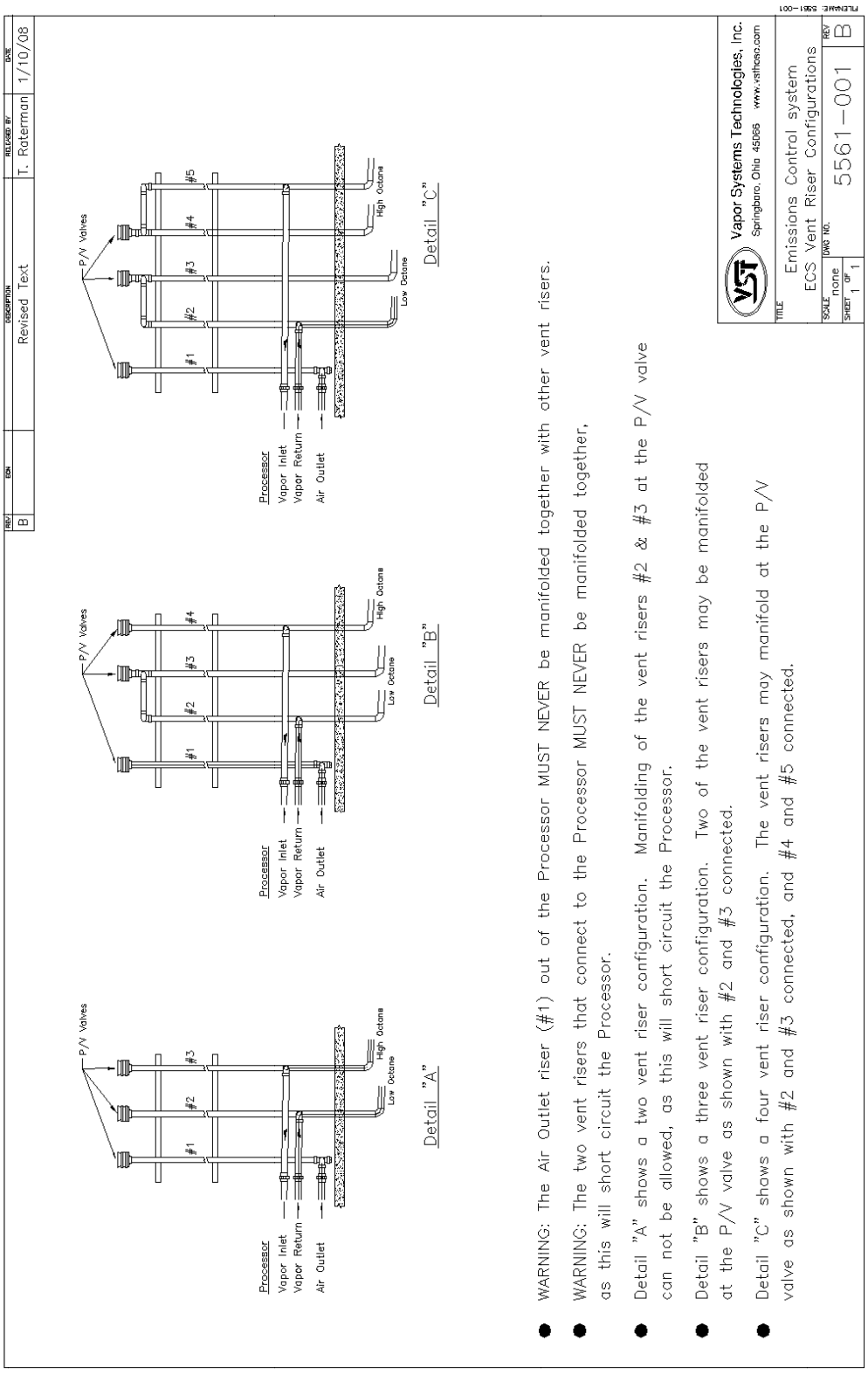


Figure 5: ECS Vent Riser Configuration

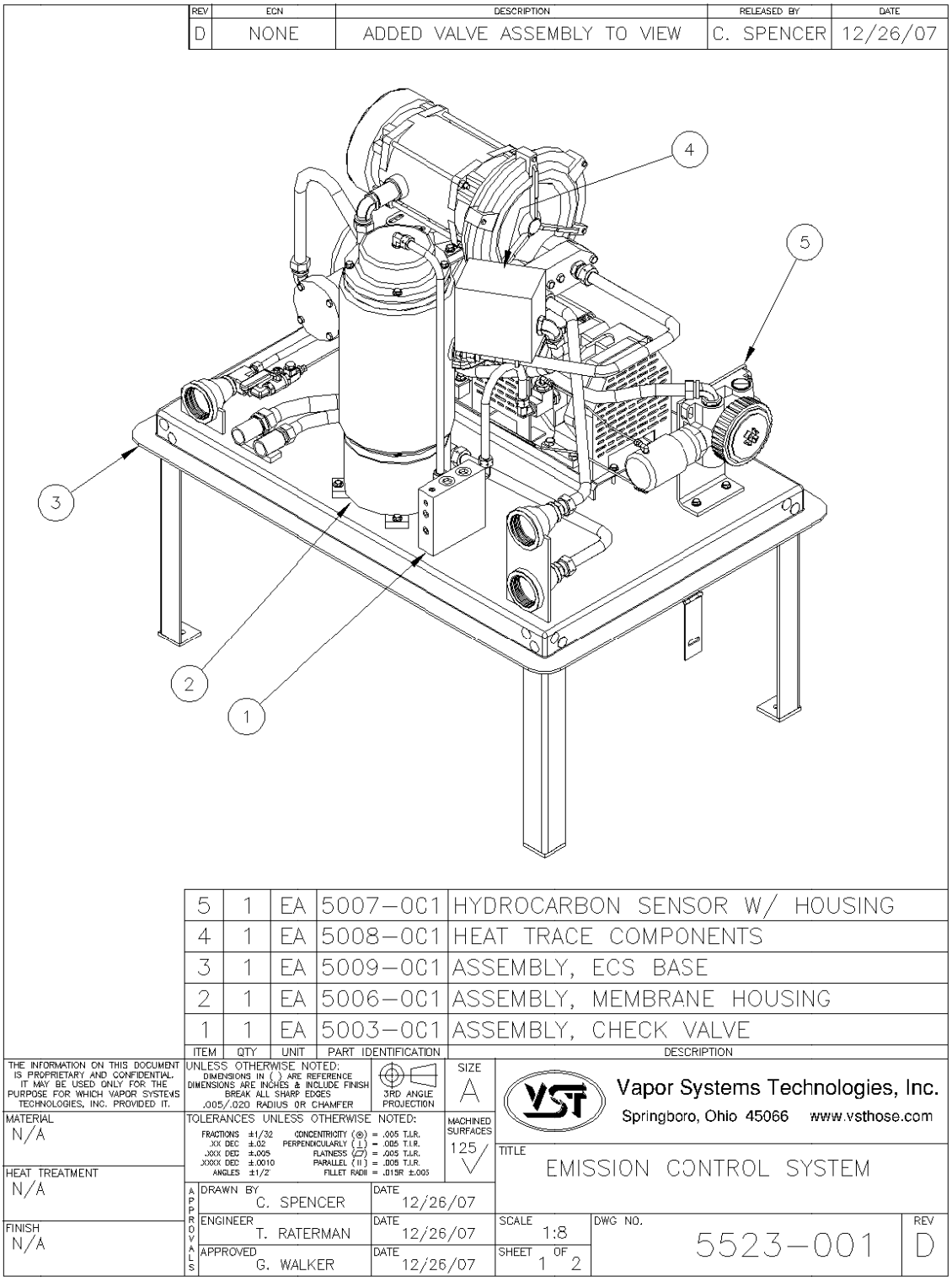


Figure 6: Processor Isometric Drawing (1 of 2)

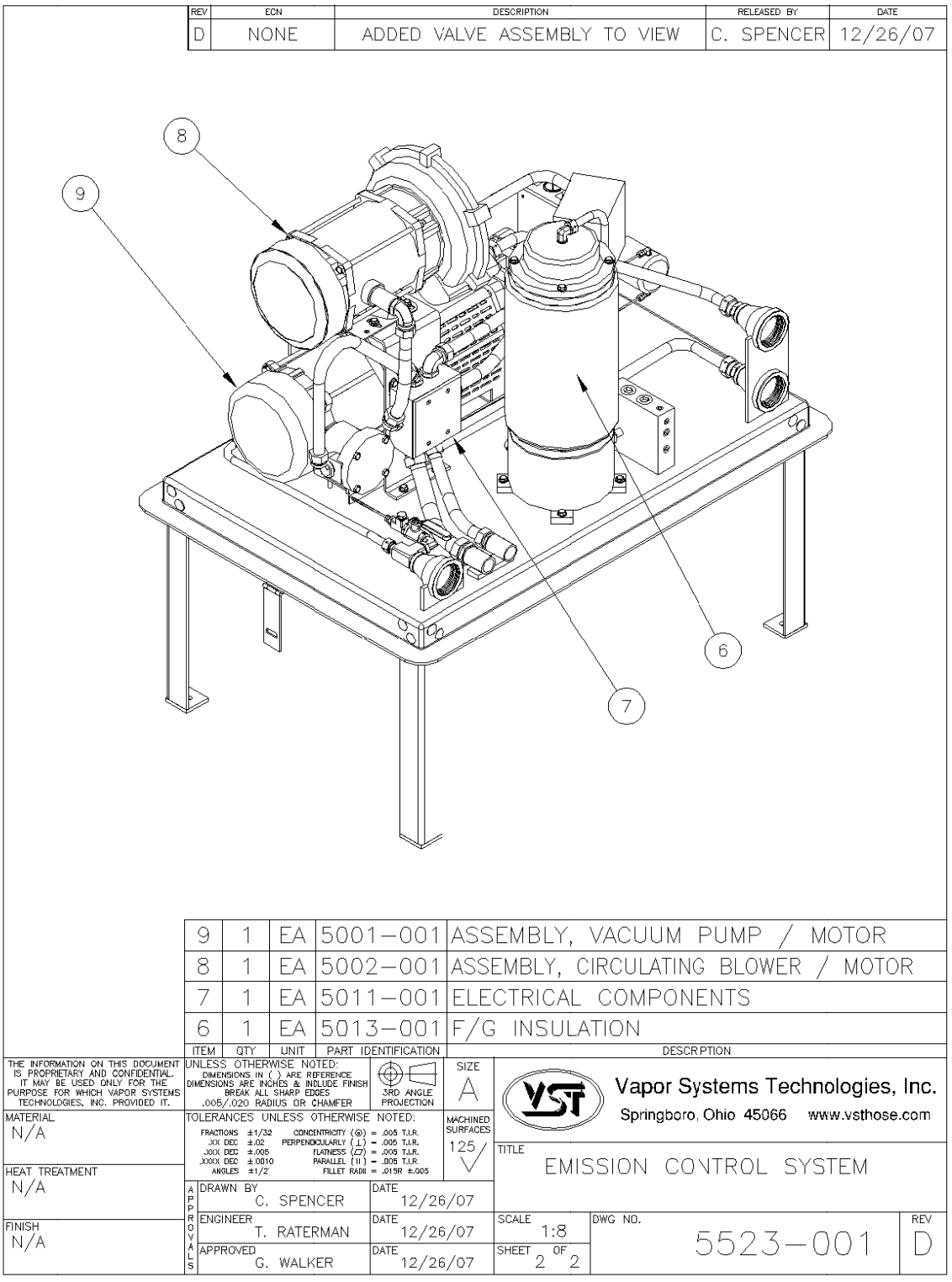


Figure 7: Processor Isometric Drawing (2 of 2)

2 *Processor Operation*

- The Veeder-Root Pressure software controls the *Processor* and is located within the TLS 350 console. The TLS 350 is an automatic tank gauging, compliance, and fuel-management system.

- The TLS console's face includes,
  - Two-line display
  - Printer
  - Red Alarm indicator
  - Yellow Warning indicator
  - Green Power indicator
  - Alphanumeric and operational keypad

- Warnings and alarms are announced through the various lights on the panel as well as through a paper print-out.

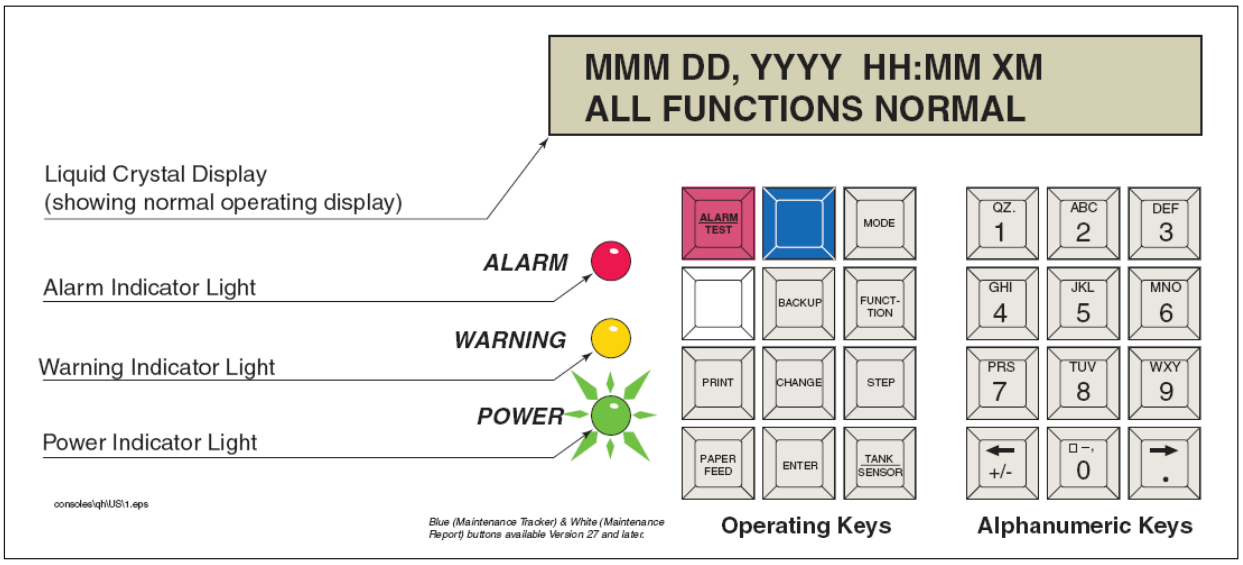


Figure 8: TLS 350 Face

2.1 TLS 350 Construction

- The *TLS Console* is constructed with fuel compatible materials and is approved for use in GDF's by UL (Underwriters Laboratories, Inc.) where wetted components and materials are tested for durability and resistance to corrosion.

- The *TLS Console* is designed to withstand power outages by storing critical system parameters in nonvolatile memory.

- The pressure sensor (supplied by Veeder-Root) is installed inside a dispenser.

2.2 Automatic Control and Runtime Fault Warning

- Under automatic control, vapor pressure readings are compared to the programmed ON/OFF thresholds to determine the appropriate *Processor* state.

    - When the *Processor* is **OFF** and the UST pressure equals or exceeds the programmed **ON** vapor pressure threshold, the *Processor* is turned **ON** and remains so until the pressure equals or is less than the programmed **OFF** vapor pressure threshold.

- During periods when there are no deliveries, if the *Processor* is **ON** continuously for longer than the programmed max 30 minutes runtime, a runtime fault warning is posted and the *Processor* is turned **OFF**.

    - It will remain **OFF** for the same number of minutes programmed as max runtime minutes before turning back **ON**.

    - It will continue to cycle on and off until the vapor pressure drops below the low/off threshold limit.

- During a delivery, if the *Processor* **ON** time exceeds the maximum run time, the *Processor* will be shut **OFF**, and a runtime fault warning will not be posted.

    - After 3 seconds the *Processor* will be turned back **ON** if the pressure is above the high pressure threshold limit.

    - This cycle will continue until the delivery has ended and a **runtime fault** is posted or the pressure goes below the low pressure threshold and the *Processor* is turned **OFF**.

2.3 Manual Control of the *Processor*

- From the diagnostic menus, the *Processor* mode can be changed from **Automatic** to **Manual**.
- When the *Processor* control mode is **Manual**, the diagnostic menu allows the *Processor* to be directly turned **ON** and **OFF**.
    - This feature is to support functional testing and maintenance of the unit.
- The current vapor pressure threshold settings are available through the diagnostic menu.
- **Note**: If the *Processor* is **ON** and the control mode is **Automatic**, changing the control mode to **Manua**l mode will turn the *Processor* **OFF**.
- This feature is to support testing functionality of the *Processor* without needing the pressure to be at operational set-points.
- This function is also to be used for conducting testing or at any time compliant-testing involves opening of the vapor space.
- It is also used to reduce the vapor pressure, and thus clear the *Processor* **Runtime Fault Alarm**.
- The current vapor pressure reading will also be available through the diagnostic menu.

During normal operation, the TLS-350 must be in the AUTOMATIC mode.

2.4 ISD Alarms

- During normal operation when the *TLS Console* and ISD *System* are functioning properly and no warning or alarm conditions exist, the "**ALL FUNCTIONS NORMAL**" message will appear in the system status (bottom) line of the console display.

- If a warning or alarm condition occurs, the system displays the condition type and its location.

- If more than one warning or alarm condition exists, the display will alternately flash the appropriate messages.

- The system automatically prints an alarm report showing the warning or alarm type, its location, and the date and time the warning or alarm condition occurred.

- Warning and alarm posting causes the TLS 350 to activate:
    - Warning lights
    - Failure-Alarm indicator lights
    - Audible alarm
    - Automatic strip paper printout documenting the warning or alarm

2.5 Thresholds and Algorithms

- Two thresholds (high and low pressure) are used to activate and deactivate the *Processor* internal TLS-350 relay.

- Three thresholds can be set via the TLS keypad or serial RS232 commands. These thresholds include:

    - Vapor *Processor* **LOW PRESSURE THRESHOLD** set at -0.2" WC
        - Maximum negative UST pressure required in order to turn **OFF** the *Processor*

    - Vapor *Processor* **HIGH PRESSURE THRESHOLD** set at +0.2" WC
        - Minimum positive UST pressure required in order to turn **ON** the *Processor*

    - Vapor *Processor* runtime set at 30 minutes
        - Maximum allowable runtime

- The TLS 350 control algorithm checks the current UST pressure level and turns the *Processor* **ON** and **OFF** according to the high and low pressure thresholds.

- If the *Processor* is **ON**, a second check confirms that it has not exceeded the TLS 350 runtime threshold.

- The Veeder-Root Pressure Sensor (VRPS) reads every 20 seconds, and this reading is compared to the vapor-pressure thresholds to determine the *Processor* state, which will be either **ON** or **OFF**.

- When the *Processor* is **OFF** and the high-vapor pressure threshold is exceeded, the relay is enabled (which starts the *Processor*) and remains enabled until the pressure drops below the low-vapor pressure threshold.

- Automatic control is the default mode.

- The internal relay must be programmed as a **VST Vapor *Processor* (VP)** through the TLS 350 relay setup menu.

- The *Processor* control algorithm will not be engaged until at least one relay of this type is detected by the TLS 350.

- Whenever the *Processor* runs more than 30 minutes, a **ISD VP RUNTIME FAULT** is declared and the *Processor* is ***automatically*** turned **OFF**.

- While this **RUNTIME FAULT** is active, the *Processor* will not be controlled by UST pressure and will remain **OFF** for 30 minutes.

- The *Processor* will then restart assuming the UST pressure is still above the lower threshold setting and the TLS is in the automatic controlled mode.

- This cycle continues until the **ISD VP RUNTIME WARNING** is posted.

- The TLS-350 will clear the alarm when the vapor pressure drops below the low pressure threshold limit.

- **Figure 9: Section 15 / Page 28** shows the *Processor* Run-Time Algorithm.

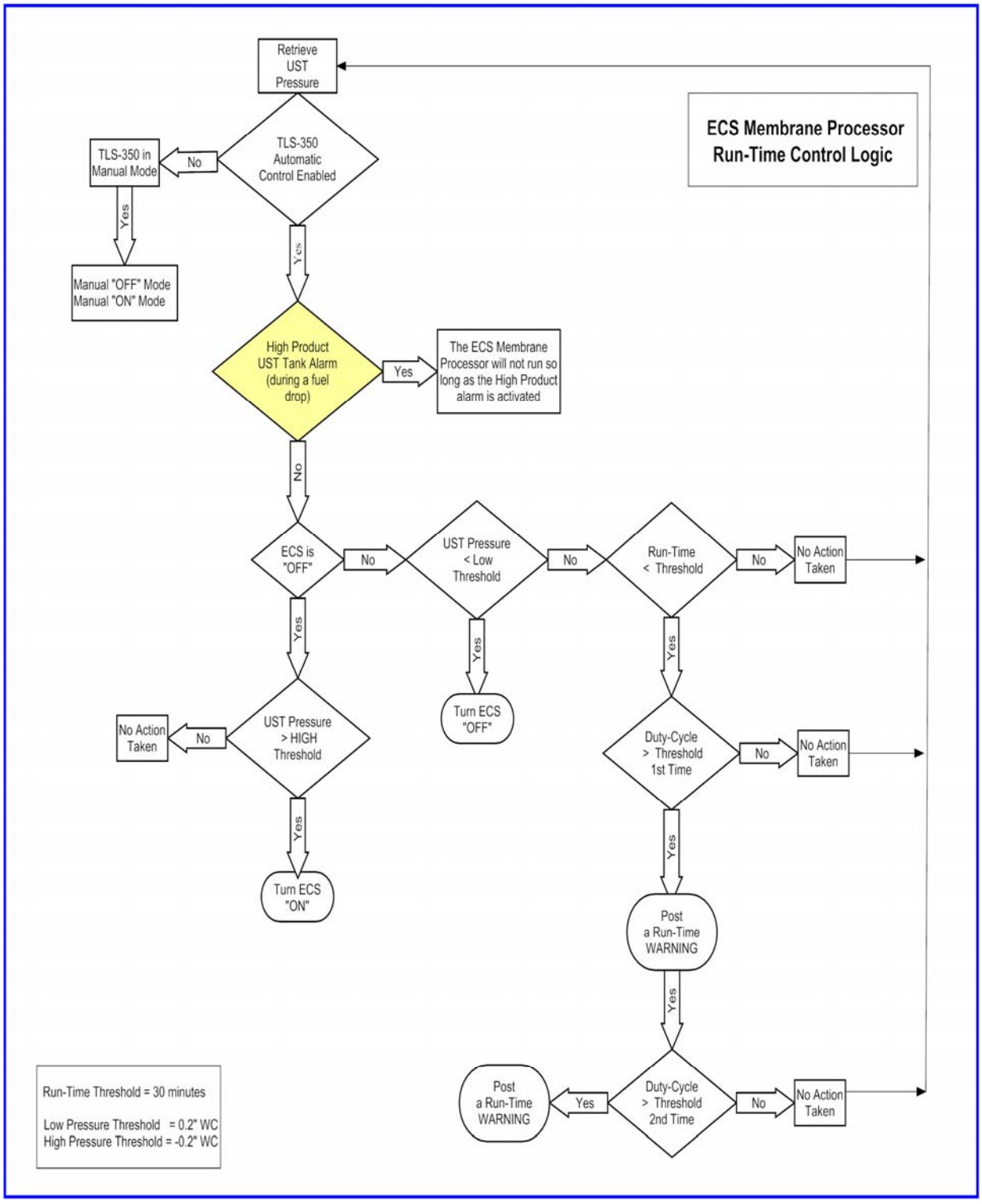


Figure 9: Processor Run-Time Algorithm

2.5.1 TLS-350 (ISD): Alarm Troubleshooting Summary

ISD Alarm Troubleshooting Summary				
Message	**ISD Category**	**Light**	**Cause**	**Suggested Troubleshooting**
ISD VP STATUS WARN	Processor	Yellow	Failure of Vapor Processor Effluent Emissions or Duty Cycle test.	• See Troubleshooting Guide 9513-003 found at www.vsthose.com. • See VP Emission Test • See VP Duty Cycle Test
ISD VP STATUS FAIL (ISD Site Shut-Down Alarm)	Processor	Red	2nd Consecutive Failure of Vapor Processor Status test.	
ISD VP PRESSURE WARN	Processor	Yellow	90th percentile of 1 day ullage pressure exceeds 1 IWC.	• See Troubleshooting Guide 9513-003 found at www.vsthose.com. • Vapor Pressure Verification Test, VR 204 Exhibit 8 • Vapor Processor Activation Test, VR 204 Exhibit 9
ISD VP PRESSURE FAIL (ISD Site Shut-Down Alarm)	Processor	Red	2nd Consecutive Failure of Vapor Processor Overpressure Test	
VP RUNTIME FAULT	Processor	Yellow	Processor has continuously run for longer than allowed. (30 min)	• See Troubleshooting Guide 9513-003 found at www.vsthose.com. • See TLS 350 PMC Setup Procedure • Vapor Pressure Verification Test, VR 204 Exhibit 8 • Vapor Processor Activation Test, VR 204 Exhibit 9
VP EMISSION WARN	Processor	Yellow	Mass emission exceeded the certified threshold.	• See Troubleshooting Guide 9513-003 found at www.vsthose.com. • Hydrocarbon Sensor Verification Test, VR 204 Exhibit 6 • Vapor Processor Activation Test, VR 204 Exhibit 9
VP EMISSION FAIL	Processor	Red	2nd Consecutive Mass emission test failure.	
VP DUTY CYCLE WARN	Processor	Yellow	Duty cycle exceeds 18 hours per day 0r 75% of 24 hours.	• See Troubleshooting Guide 9513-003 found at www.vsthose.com. • See TLS 350 PMC Setup Procedure • Vapor Pressure Verification Test, VR 204 Exhibit 8 • Vapor Processor Activation Test, VR 204 Exhibit 9 • TP 201.3 Test, VR 204 Exhibit 4
VP DUTY CYCLE WARN	Processor	Red	2nd Consecutive Duty Cycle Test Failure.	

3 Post-Installation Power-Up Tests

During post-installation testing, **the *Processor* will use outside air, not gasoline vapor from the USTs to conduct these tests.**

- **Close the 3 valves located on the inlet and the outlet of the *Processor.***
- **Remove the plugs on the 3 tees located on the inlet and the outlet of the *Processor.***

3.1 Required Post-Installation Power-Up Tests

- Once you have properly prepared the *Processor* for testing, conduct the following 5 tests:

	Test	Section #	Page #
1.	Electrical Connection Check	15	33
2.	*Processor* Leak Test	15	33
3.	Motor Rotation Test	15	36
4.	Heat-Trace Temperature Test	15	41
5.	HC Sensor & HC Sentry 24 Power Test	15	41

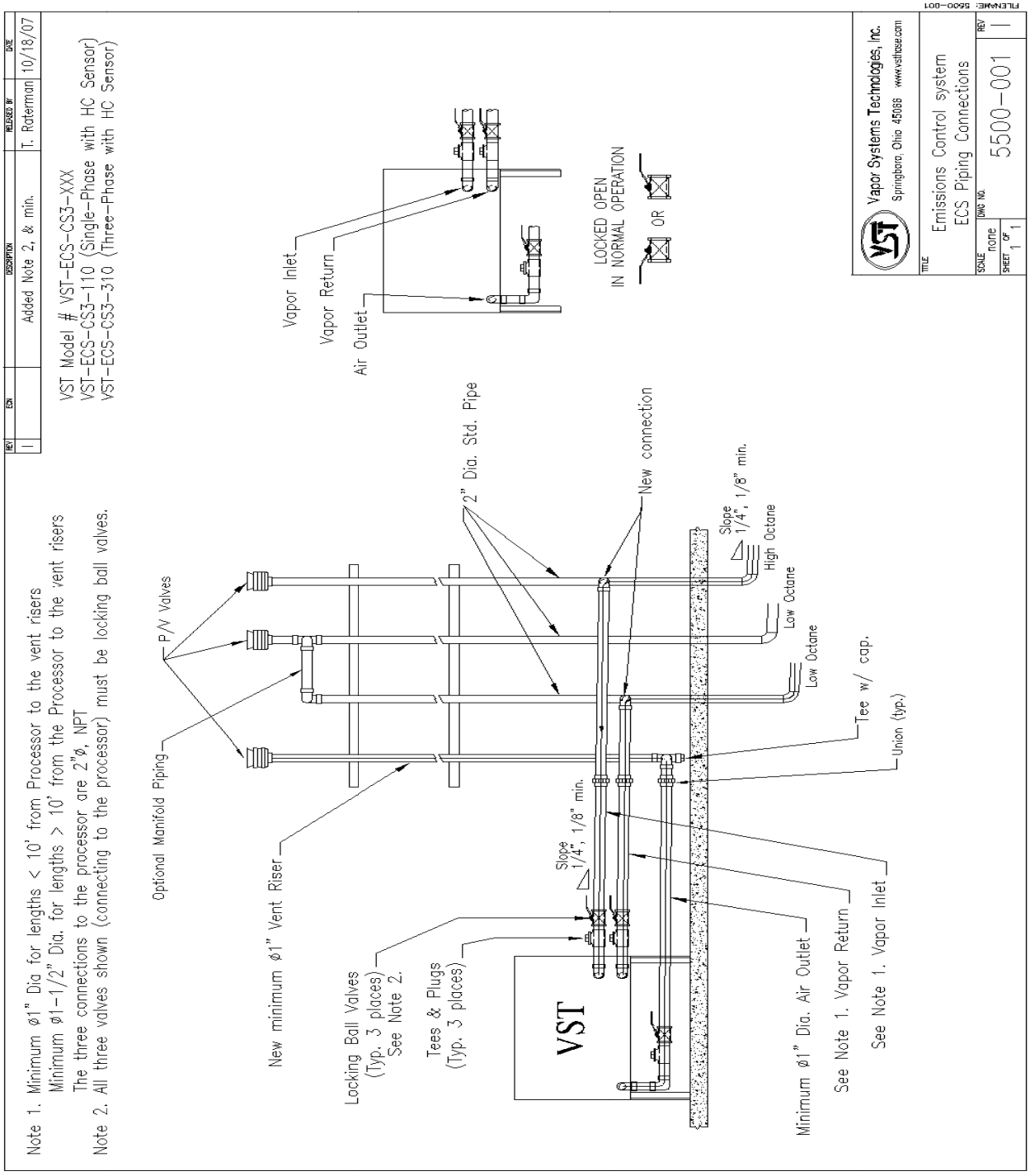


Figure 10: ECS Piping Configuration

3.2 TLS Manual Mode

- Follow the steps at the TLS console to put theTLS-350 in the Manual "**OFF**" Mode, as shown in **Figure 11: Section 15 / Page 32**.

- After the post-installation power-up tests are complete, put the *Processor* in the Manual "**OFF**" position.

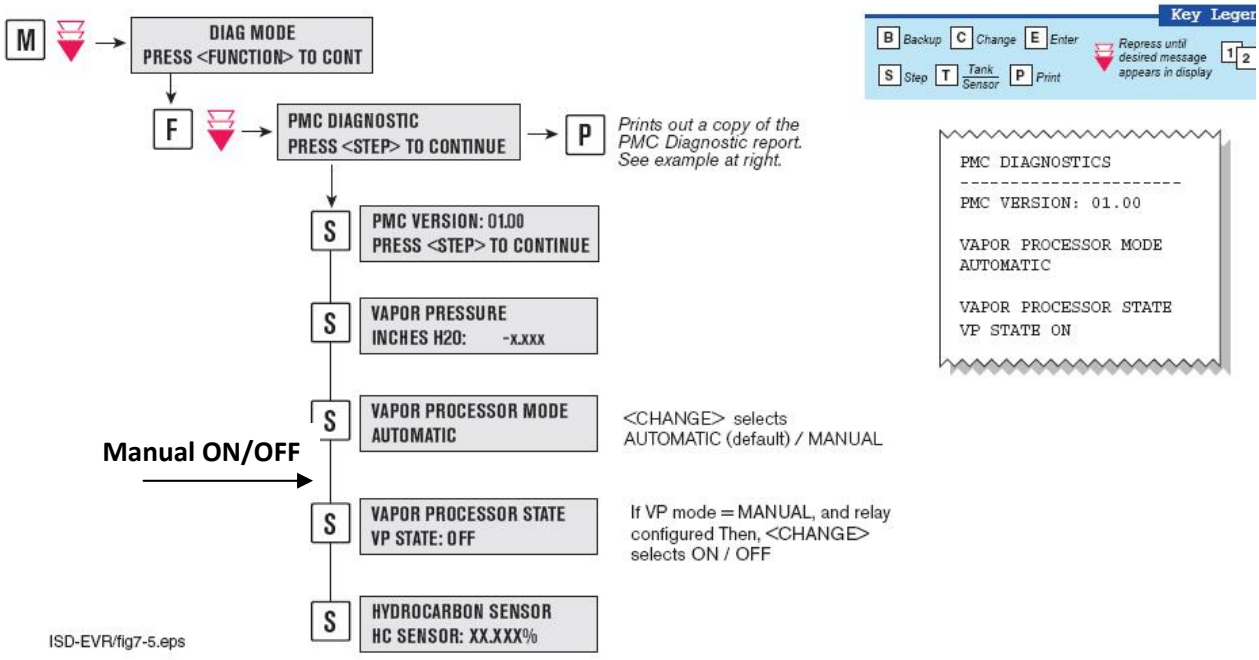


Figure 11: ISD Diagnostic Menu

3.3 Electrical Connection Test

- With the TLS in the Manual "**OFF**" Mode as shown in the diagnostic menu in **Figure 11: Section 15 / Page 32.**

- Check all electrical and control connections prior to applying power to the *Processor*.

- Make sure that all connections have been made to the proper terminals and that all connections are tight.
    - In the electrical room:
        - HC Sentry 24VDC (output) / 115V power
        - Fused disconnects
        - Panel breaker wiring connections
        - Starter
        - TLS 4-relay module
        - TLS multi-port card

    - At the ECS:
        - Blower motor
        - Vacuum pump motor
        - Heat trace cable
        - HC sensor
        - All equipment grounds

C A U T I O N

Always obtain approval from the local authority having jurisdiction.

Installation of the *Processor* must comply with (if applicable):

- **CARB CP-201**
- **VST EVR E.O.**
- **Fire Marshall**
- **Water Board**
- **Local Air Pollution District**
- **ICC**
- **NEC**
- **NFPA 30 and 30A**
- **UL**
- **Any other applicable federal, state, and local codes**

3.4 *Processor* Leak Test

- Conduct this test with the TLS in the Manual "**OFF**" Mode, as shown in **Figure 11: Section 15 / Page 32.**

- Physically check all fittings for tight connections.

- All tubing fittings are a special UL approved flare-fitting and designed for gasoline- vapor applications.

    - For a leak-proof connection, these fittings are made to be repeatedly disassembled and reassembled.

3.4.1 Tools needed to conduct the *Processor* Leak Test:

- NPT steel test plug (sized for the tee), drilled and tapped with a ¼" NPT hole, and centered in the plug.
- A pressure supply generating 2.0 ± 0.1 PSI.
- A pressure gauge, 0-5 PSI, ¼" NPT bottom connection, 2-1/2" face
  (NOSHOK, 25-200-5-PSI, ¼" NPT bottom, 2-1/2" face)
- Pressure regulator capable of an outlet pressure of 2.0 PSI, ¼" NPT connections
  (McMaster-Carr, 1888K1, 0-15 output pressure, 250 max. pressure, ¼" NPT)
- ¼" NPT 3-way isolation/line/relief valve
- ¼" NPT x 2" nipple (3-each)
- ¼" NPT tee
- ¼" NPT fitting to connect the compressed air supply
- See **Figure 12: Section 15 / Page 34**

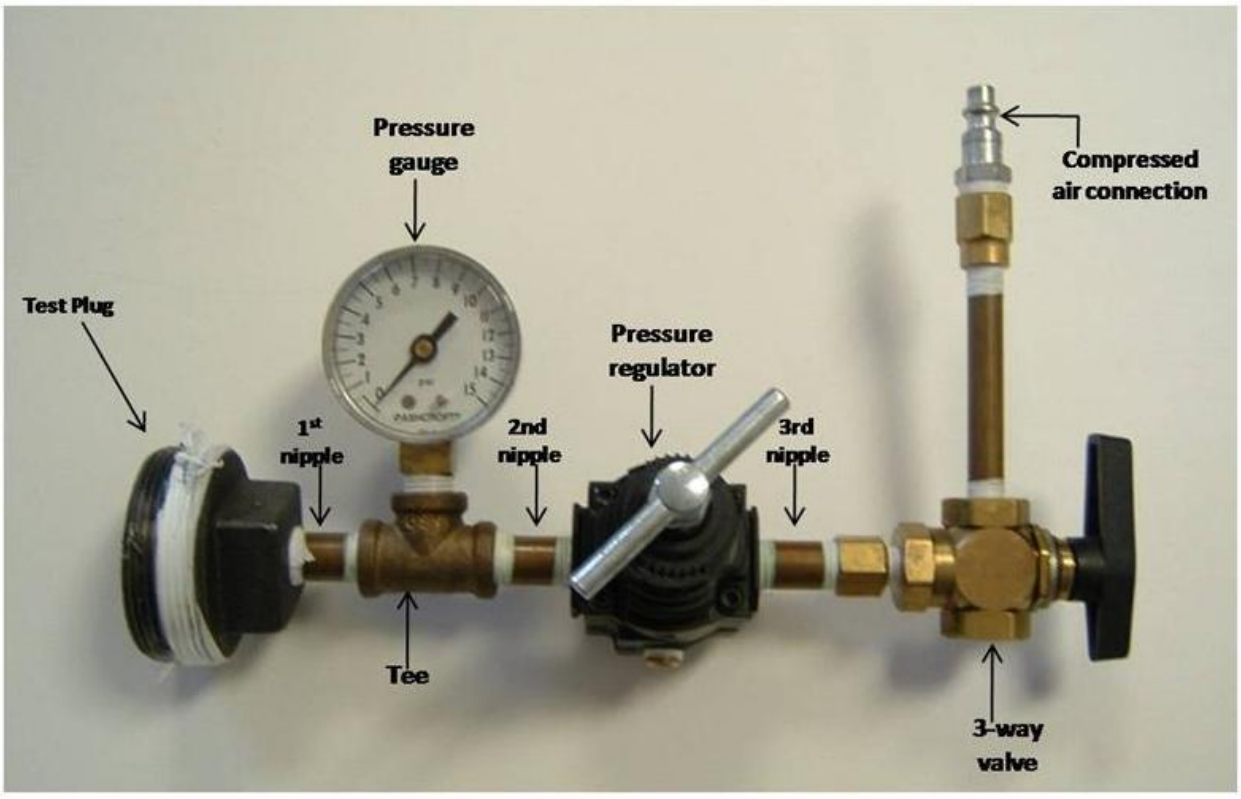


Figure 12: Leak Test Fixture

3.4.2 *Processor* Leak Test Steps

- With the TLS in the Manual "**OFF**" Mode, check all electrical connections.

- Make sure the three valves at the *Processor* are closed.

- Install NPT plugs on the vapor return and the air outlet.
  - **See ECS Membrane *Processor* Piping Configuration** as shown in **Figure 10: Section 15 / Page 31.**

- Install a NPT test-plug on the vapor inlet-tee and attach the:
  - 1st Nipple
  - Tee
  - 2nd Nipple
  - Pressure Gauge
  - Pressure Regulator
  - 3rd Nipple
  - Valve

- With the pressure-test equipment attached to the vapor inlet on the *Processor*, connect the compressed air to the test fixture.
  - Open the 3-way valve to allow the *Processor* to pressurize to 2.0 PSI.

- With the *Processor* pressurized to 2.0 PSI, spray a soapy solution on each fitting to check for bubbles.

  - If air bubbles do not appear, the connection is tight.
  - If air bubbles do appear, tighten the leaking fitting 1/8" turn and re-check for leaks.

- Continue this process until all the internal tube fittings have been checked and found to be leak free.

- Remove the compressed air connection to the *Processor*.

  - Release the pressure from inside the *Processor*.
  - Remove the test fixture and test plug.

- If the fittings cannot be tightened so the connection is leak free, replace the tube/45° flare nuts assembly.

- Once this test is complete, remove the NPT plugs on the vapor return and the air outlet.

3.5 Motor-Rotation Test

- The purpose of this test is to insure that the motors are rotating in the correct direction.
- Put the *Processor* in the manual **ON** Mode at the TLS as shown in the diagnostic menu in **Figure 11: Section 15 / Page 32** and that the cover is off the *Processor*.
    - Visually check the motor rotation for the vacuum pump and blower motor to be sure they are rotating according to the arrows that are shown on the equipment.
    - The rotation of the motors can be visually checked by looking at the rotation of the fan located on the end of each motor.
- If the motors are rotating in the proper direction, put the TLS in the manual **OFF** mode.
- If either of the motors are not rotating in the correct direction:
    - Put the *Processor* in the manual "**OFF**" Mode at the TLS.
    - Turn **OFF** and lock out power to the *Processor* at the main distribution panel.
    - Follow safety regulations regarding lock-out / tag-out procedures to insure power cannot be turned on to the *Processor*.
    - Three-Phase Motors:
        - At the motor junction box at the ECS *Processor*, switch any two of the three power circuits for the motor that is not rotating in the correct direction.
        - **See Figures: Section 15 / Page 38, Figure 14 / Page 40, Figure 16**
    - Single-Phase Motors:
        - Check the wiring connection diagrams for the specific motor that is not rotating in the correct rotation and correct as required.
        - **See Figures: Section 15 / Page 37, Figure 13 / Page 39, Figure 15** for motor wiring diagrams.
    - Remove the lock from the lock-out and apply power to the *Processor*.
    - Return the *Processor* to the manual **ON** Mode at the TLS.
    - Re-check the equipment for proper rotation.
    - Return the *Processor* to the manual **OFF** mode at the TLS.

If either motor will not run, see **the ECS Troubleshooting Guide found on the VST website at www.vsthose.com.**

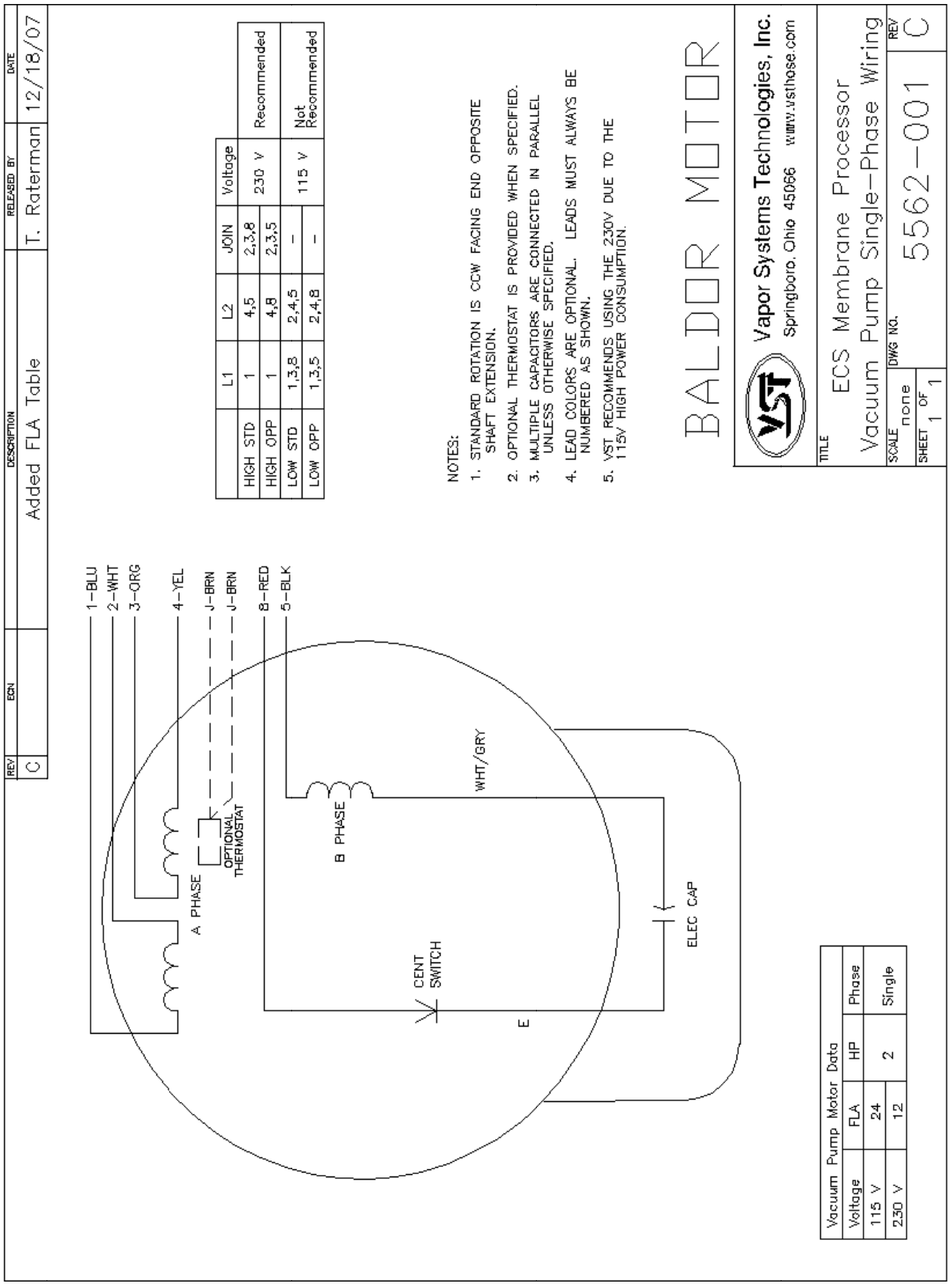


Figure 13: Vacuum Pump: Single-Phase Motor Wiring Diagram

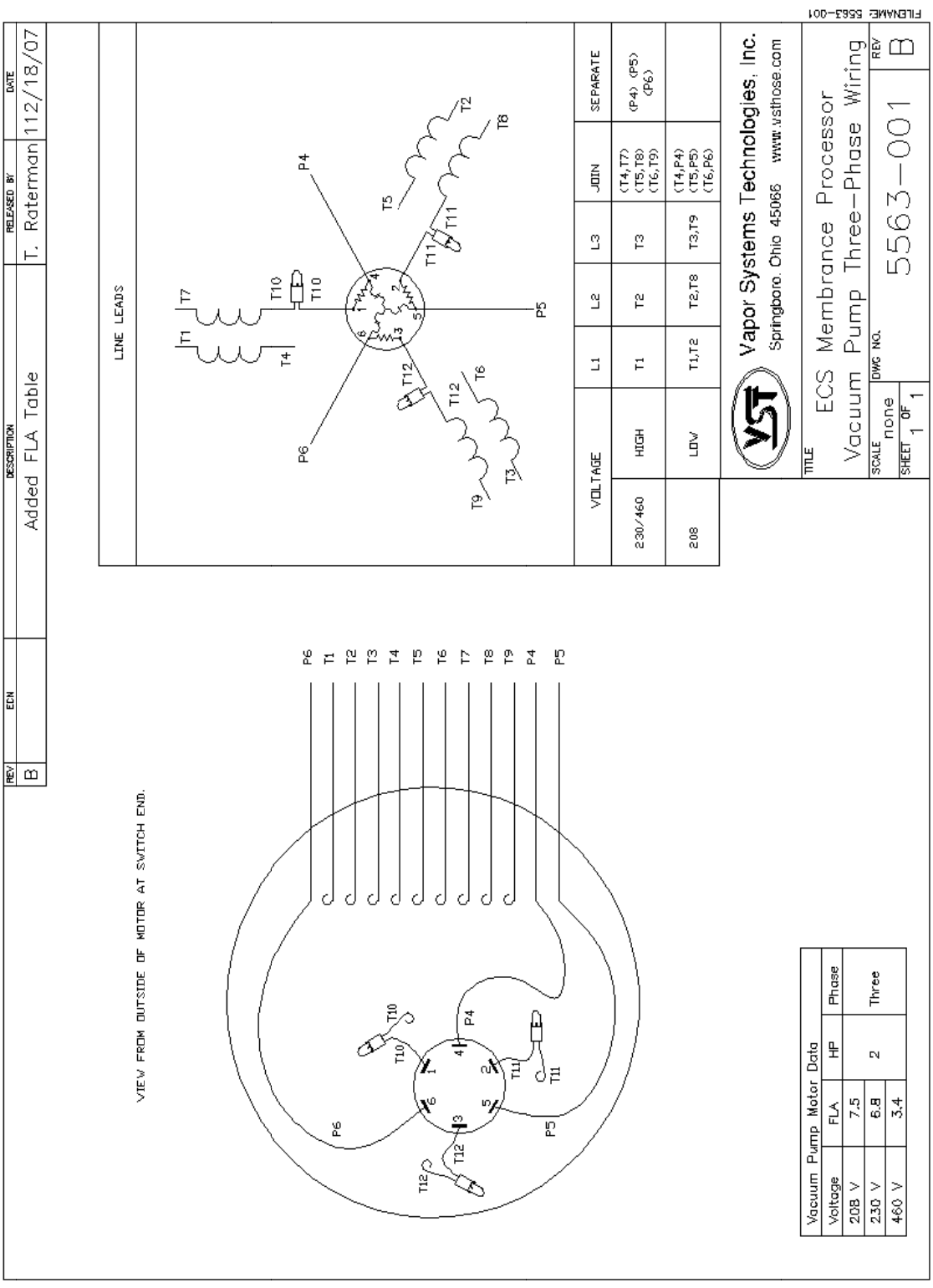


Figure 14: Vacuum Pump: Three-Phase Motor Wiring Diagram

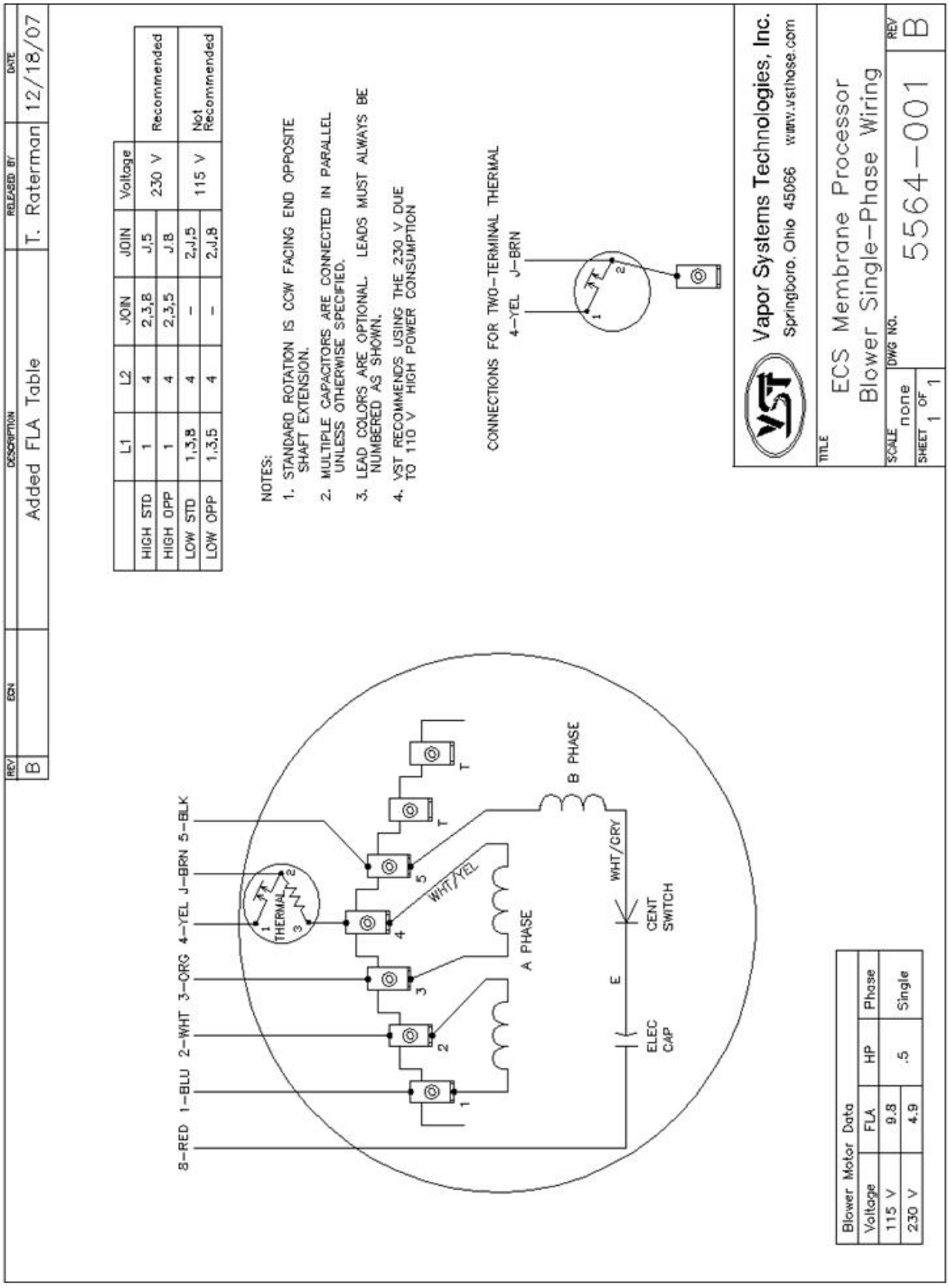


Figure 15: Blower: Single-Phase Motor Wiring Diagram

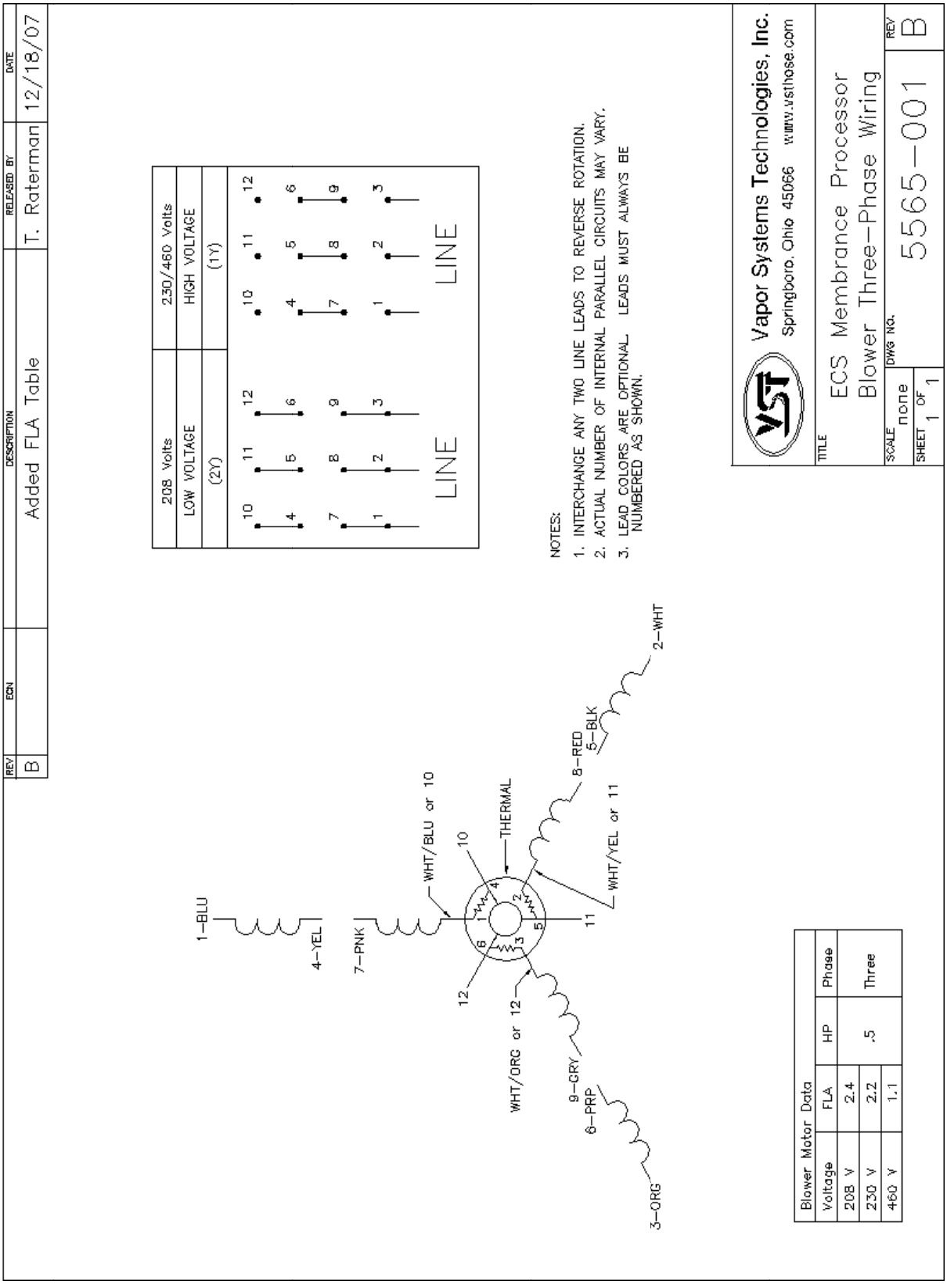


Figure 16: Blower: Three-Phase Motor Wiring Diagram

3.6 Heat-Trace Temperature Test

- The purpose of this test is to insure that the electrical connection to the heat-trace cable is properly established and that the membrane housing has a temperature between 100°-150° F.

  (Note: An infrared temperature sensor may be used in place of the temperature probe.)

- With power on to the heat-trace cable, use a temperature probe to check the temperature inside the fiberglass insulation.

  - Gently insert the probe tip 2”- 3” from the top between the membrane housing and the heat trace cable.
  - Leave the probe tip inside for two minutes for temperature stabilization.
  - The temperature should reach 100°-150°F in two minutes.
  - If the heat trace does not come up to temperature, **see the *Processor* Troubleshooting Guide at www.vsthose.com.**

3.7 HC Sensor and HC Sentry Power Test

- The purpose of this test is to insure there is 24VDC power to the HC sensor and the HC Sentry module.

3.7.1 Checking 24 VDC Power to the HC Sensor

- The 24VDC power to the HC sensor is from the HC Sentry Module.
- Using the multimeter, check the + to Gnd connection on the HC Sentry.
- If there is no 24VDC power, check power to the HC Sentry module.

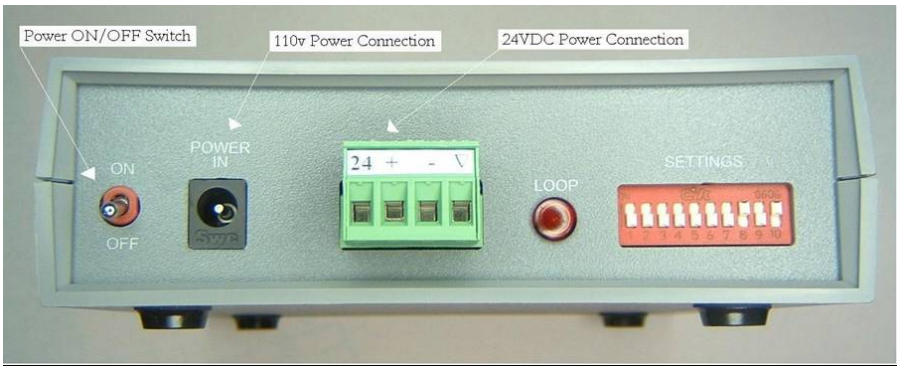


Figure 17: HC Sentry Interface Module Front View: Power and ON/OFF Switch

- If the unit does not function properly, see the **ECS Troubleshooting Guide found on the VST website at www.vsthose.com**.

3.7.2 Checking 24VDC Power to the HC Sentry Module

- The HC Sentry is powered from a 115V outlet and uses a 115v/24VDC power converter, which is VST supplied.
- Check that the unit is **ON**.
- Check that the Power Light is **ON**.
- If the power light is not **ON** when the unit is **ON**:
    - Check to make sure there is 115v power to the outlet.
    - Check the **ON** switch on the HC Sentry module.
    - Check that the 115v/24VDC power converter is functioning.
    - If the unit does not function properly, **see the ECS Troubleshooting Guide at www.vsthose.com.**

Figure 18: HC Sentry Interface Module Back View: Power "ON" Light

3.8 Preparing the *Processor* for Field Operation

- After all the post-installation power-up tests are complete:
- Replace the plugs on the 3 tees located on the inlet and the outlet of the *Processor* and tighten.
- Lock in the open position the 3 valves located on the inlet and the outlet of the *Processor.*
- Leave the *Processor* in the manual "**OFF**" mode at the TLS 350.
- See Figure 11: Section 15 / Page 32.
- Complete the Post-Installation Power-Up checklist forms.

3.9 Post-Installation Power-Up Checklist

Post-Installation Power-Up Checklist Form			
VST-ASC #:	Date:		
ASC Name:			
VST-ASC Certification Level:			
ASC Company Name:			
GDF Name:			
Address:			
City:	State:	ZIP Code:	
GDF Contact Person Name:			
GDF Contact Person Title:			
GDF Contact Person Phone:			
GDF Contact Person E-mail:			
Notes			
Use the form on the following page to note details of the power-up.			

	ECS *PROCESSOR* COMPONENTS	Passed	Failed	Repaired	Replaced	Action Items if Required
	All electrical connections checked	☐	☐	☐	☐	
	Processor internal tubing leak checked	☐	☐	☐	☐	
	Blower motor rotation checked	☐	☐	☐	☐	
	Vacuum pump motor rotation checked	☐	☐	☐	☐	
	Heat-trace temperature checked	☐	☐	☐	☐	
	HC sentry power checked	☐	☐	☐	☐	
	HC sensor power checked	☐	☐	☐	☐	

4 Processor Start-Up

- Use the following start-up procedure:

  - When initially starting the *Processor* or
  - When re-starting the *Processor* following maintenance or testing.

	START-UP PROCEDURE
1.	• Make sure the plugs are installed on the 3 tees at the *Processor*.
2.	• Make sure all 3 valves are locked in the OPEN position at the *Processor*.
3.	• Make sure power is on to the: ▸ Heat-trace cable ▸ HC sentry ▸ HC sensor ▸ ECS vacuum pump ▸ ECS recirculation blower
4.	• Make sure the pressure sensor is operational.
5.	• Make sure that the GDF is vapor tight. **(TP 201.3)** • **EO-VR- 204 Exhibit 4**
6.	• Put the TLS in the **AUTOMATIC MODE**. • If the pressure is above +0.2" WC, the *Processor* will start and the auxiliary relays will close. • If the pressure is below +0.2" WC, the *Processor* will not start because the UST system-pressure is below the high pressure threshold.

  - **CAUTION: Locking ball valve handles at the *Processor* inlet and outlet must not be removed.**

4.1 *Processor* Shut-Down

- CAUTION: POWER TO THE HC SENSOR AND THE HEAT TRACE CABLE MUST BE TURNED OFF INDIVIDUALLY FROM DIFFERENT POWER SOURCES. THEY DO NOT RECEIVE THEIR POWER FROM THE SAME SOURCE AS THE MOTORS.

- The *Processor* may be turned **OFF** for maintenance or testing.
- No special requirements are needed to turn **OFF** the *Processor*.
- The three-phase (208/230-460v) and the single-phase (115/230v) disconnect-switch or the electrical-panel breakers can be turned **OFF** to remove power from the *Processor*.

4.2 HC Sensor and HC Sentry Module

- The 115VAC/24 VDC power supply for the HC Sentry Module / HC sensor can be unplugged, which will remove power to the HC Sensor in the *Processor*.

4.3 Heat-Trace Cable

- The heat trace cable should not be turned **OFF** unless maintenance is performed in an area that could cause electrical shock.
- Turn **OFF** power to the heat-trace cable from the 115v electrical-panel breaker.

5 Processor Maintenance

- The VST Emissions Control System consists of only two components having moving parts: a blower and a vacuum pump.

- The remaining components require little scheduled maintenance:
  - Membrane with housing
  - Heat trace cable
  - HC sensor

- Because the system continually monitors itself and notifies you of any problems or situations, it requires very little attention.

- The table on the following page outlines the required annual inspections and tests.
  - Preventative Maintenance Checklist Form: **Section 15: Page 51.**
  - GDF Maintenance Records: **Section 15: Page 52**.

Annual System Compliance Testing	
Static Pressure Test:	TP-201.3 EO-VR-204: Exhibit 4
Dynamic Back Pressure Test:	TP-201.4
Liquid Removal Test Procedure:	EO-VR-204-A: Exhibit 5
Hydrocarbon Sensor Verification Test:	EO-VR-204-A: Exhibit 6
Vapor Pressure Sensor Verification Test:	EO-VR-204-A: Exhibit 8
VST *Processor* Activation Test:	EO-VR-204-A: Exhibit 9
Nozzle Bag Test Procedure:	EO-VR-204-A: Exhibit 10
ISD Operability Test: (Flow Meter Operability Test)	EO-VR-204-A: Exhibit 11

5.1 Annual Inspections and Maintenance

Annual *Processor* Inspections and Replacements					
Component	**Procedure**	**Fail Criteria**	**Corrective Action**	**Reference Manuals**	**Authorized Personnel**
Blower	Replace the blower every ten years or 15,000 hrs. (whichever comes first).			Section 15 / Page 53 Section 15 / Page 55	VST ASC Level C
Vacuum pump	Replace blower every ten years or 15,000 hrs. (whichever comes first).				
Vacuum pump drive coupling - rubber insert	Visually inspect the drive coupling between the vacuum pump and the motor for wear	Rubber debris is found on or around the vacuum-pump base.	Replace the drive coupling rubber insert	Section 15 / Page 62	
Heat Trace Cable	Check the temperature of the membrane housing Section 15 / Page 43	If the membrane housing temperature is outside the 100°-150°F range.	Replace the heat- trace cable	Section 15 / Page 64	
HC Sensor	Test the HC sensor (EO-VR-204-A: Exhibit 6)	The difference shall be within ±1.0% HC concentration from the calibration gas concentration. Record “Pass” if within ±1.0% or “Fail” if not within ±1.0%.	Replace the HC Sensor	Section 15 / Page 76 EO-VR-204-A: Exhibit 6	

Preventative Maintenance Checklist Form

Component	Frequency	Date Inspected	Completed	Required Action Items
PROCESSOR	**Yearly**			
Inspect drive coupling on the vacuum pump			[ ]	
Check temperature of the membrane housing			[ ]	
RECIRCULATION BLOWER				
Replace every 10 years or 15,000 hours, whichever comes first.			[ ]	
VACUUM PUMP				
Replace every 10 years or 15,000 hours, whichever comes first.			[ ]	

5.1.1 GDF Maintenance Record

Date of Maintenance/ Test/Inspection/Failure (including date and time of maintenance call)	Repair date to correct test failure	Maintenance/Test/Inspection Performed and Outcome	Affiliation	Name and Technician ID Number of Individual Conducing Maintenance or Test	Telephone Number

Component Replacement

6 Blower Replacement

6.1 Safety

Use lockout / tagout procedures prior to starting work.

6.2 Removing the Blower

1. Put the TLS 350 in the manual **"OFF"** mode.
   - **See Figure 11: Section 15 / Page 32 for instructions.**

2. Disconnect power to the blower and vacuum pump motors.

3. Completely remove the two blower ¾" - 45° flare inlet and out tubes.
   - **See Figure 19: Section 15 / Page 54 for instructions.**
   - **NOTE:** ***The nuts on the tubing are ¾" 45º flare, use caution not to damage the flared ends on the tubing or the threads on the nuts after removal.***

4. Remove the two 45º flare inlet and outlet connection fittings from the blower.

5. Disconnect and remove the blower electrical from the motor.
   - **See Figure 20: Section 15 / Page 54 for instructions.**

6. Remove (4) ¼" x ¾" mounting bolts.
   - The 4 holes in the blower stand are tapped 1/4".
   - Keep the (4) ¼" bolts for reuse or replace them with new ones.
   - **CAUTION: The blower end of the blower/motor assembly is heavier than the motor end, which may cause the blower to fall off the stand. USE CAUTION when removing the bolts.**

7. Remove the blower from the stand.

6.3 Installing the New Blower

1. Place the new blower on the blower stand.

2. Install and hand tighten the (4) ¼" x ¾" blower mounting bolts.

3. Install the two 45º flare inlet and outlet connection fittings into the blower.

4. Install the ¾" inlet and outlet tubing.
   - Do not use any thread-sealing compound when assembling the 45º flare nuts.
   - **NOTE: When tightening the 45° flare nuts: Clamp the tube flare between nut and nose body of the tube by screwing the nut on finger tight. Tighten with a wrench an additional ¼ turn for a metal-to-metal seal.**

5. After the tubing is installed and the 45° flare nuts tightened, tighten the (4) mounting bolts.

6. Reconnect the electrical power wires to the blower motor.

7. Remove the lock(s) and tags from the lockout & tagout.

8. Turn **ON** power to the blower and vacuum pump.

9. Put the TLS-350 in the manual **ON** mode.

10. Check rotation of the blower motor.
    - Refer to Section 15 : Post-Installation Power-Up Test: Motor Rotation Test.

11. Conduct a *Processor* Leak Check. Refer to Section 15: Post-Installation Power-Up Test.

12. After work is completed, put the TLS-350 in the **AUTOMATIC** mode.
    See Figure 11: Section 15 / Page 32 for instructions.

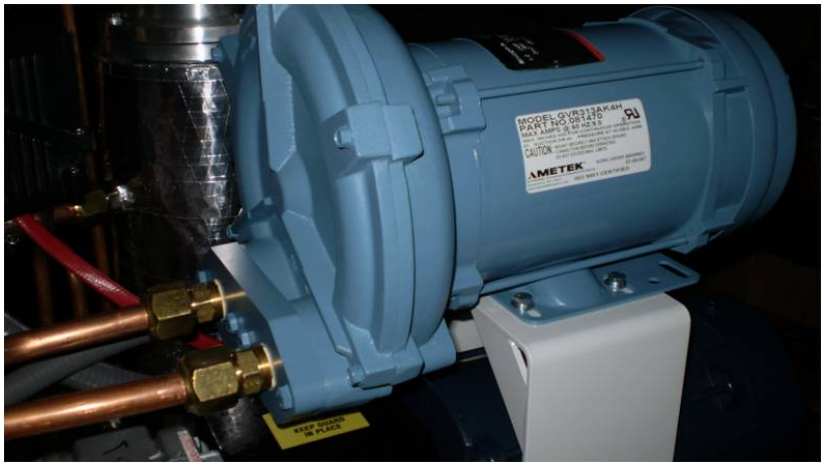


Figure 19: Blower inlet and outlet tubing connections and mounting bolts

Figure 20: Blower electrical connection conduit

7 Vacuum Pump Replacement

7.1 Safety

Use lockout / tagout procedures prior to starting work.

7.2 Removing the Vacuum Pump

1. Put the TLS 350 in the manual **"OFF"** mode.
   - **See Figure 11: Section 15 / Page 32 for instructions.**

2. Disconnect power to the blower and vacuum pump motors.

3. Completely remove the vacuum pump ½" outlet tubing
   - **See Figure 21: Section 15 / Page 57**

4. Completely remove the vacuum pump ½" and ¼" inlet 45º flare tubing and all pipe fittings connected to the vacuum pump
   - **See Figure 22: Section 15 / Page 57**

5. Completely remove the ¼" HC sensor inlet tubing at the air outlet and the HC sensor
   - **See Figure 23: Section 15 / Page 58**
   - **NOTE: The tube ends are a Parker 45º flare, use caution not to damage the flared ends on the tubing or the threads on the nuts after removal.**

6. Disconnect and remove the vacuum pump electrical from the motor.

7. Remove (4) ¼" x 1-½ " mounting bolts
   - Keep the (4) bolts for reuse or replace with new

8. Slide the vacuum pump out from under the blower stand

7.3 Installing the new Vacuum Pump

1. Slide the new vacuum pump under the blower stand and align the mounting holes.

2. Install the (4) ¼" x 1-½" vacuum pump base mounting bolts.

3. Tighten the mounting bolts so that the bottom of the vacuum pump base is ⅛" from the ECS base.

4. Re-install the ½" and ¼" inlet 45° flare tubing and all pipe fittings connected to the vacuum pump.

5. Re-install the ½" outlet tubing.

6. Re-install the ¼" HC sensor inlet tubing.
   - Do not use any thread sealing compound when assembling the 45 º flare nuts
   - **NOTE: When tightening the 45° flare nuts: Clamp the tube flare between nut and nose body of the tube by screwing the nut on finger tight. Tighten with a wrench an additional ¼ turn for a metal-to-metal seal.**

7. Reconnect the electrical power wires to the vacuum pump motor.

8. Remove the lock(s) and tags from the lockout & tagout.

9. Turn on power to the blower and vacuum pump.

10. Check rotation of vacuum pump motor.
    - **Refer to Section 15 / Page 36.**

11. Conduct a *Processor* Leak Check.
    - **Refer to Section 15 / Page 33.**

12. After work is completed, put the TLS-350 in the **AUTOMATIC** mode.
    - **See Figure 11: Section 15 / Page 32 for instructions.**

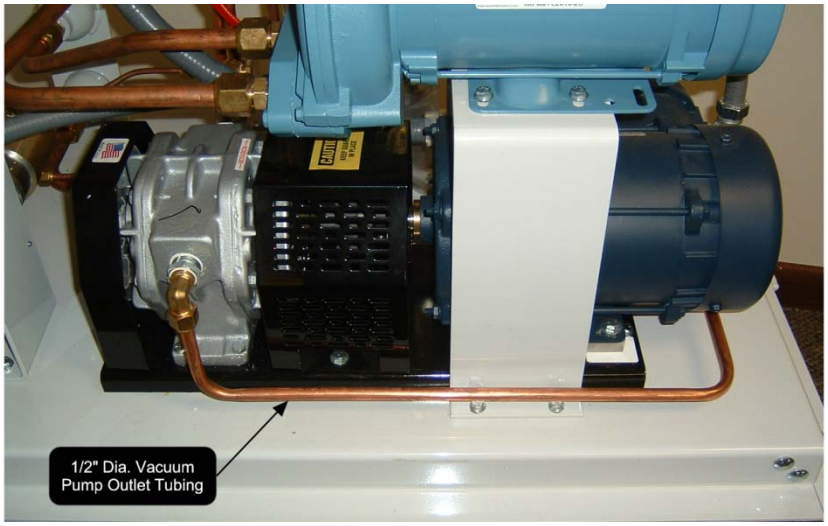


Figure 21: Vacuum pump outlet tubing connection

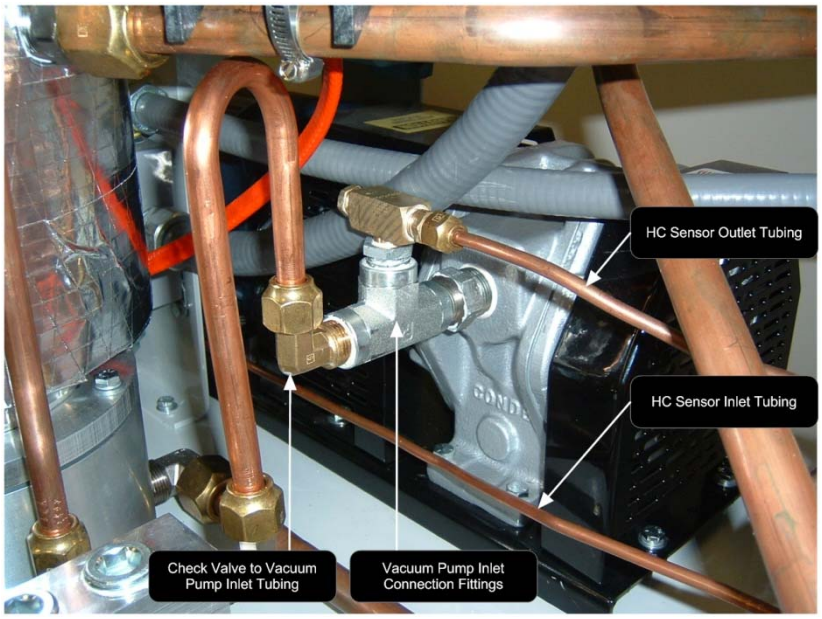


Figure 22: Vacuum pump inlet tubing and fittings

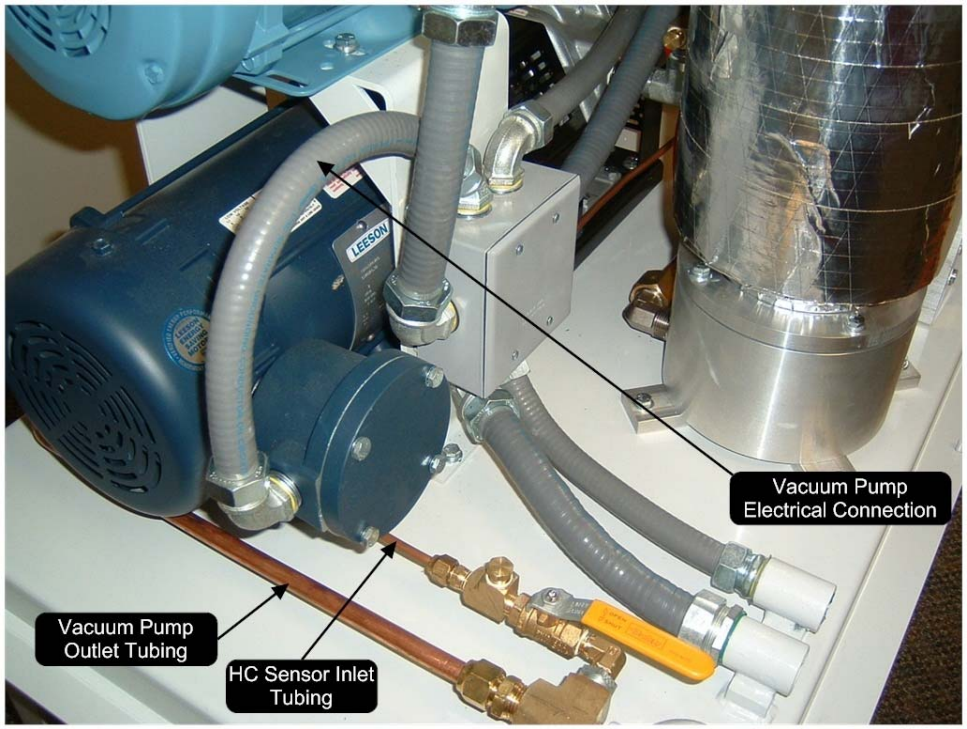


Figure 23: Vacuum pump electrical connection / vacuum pump outlet tubing / HC sensor inlet tubing

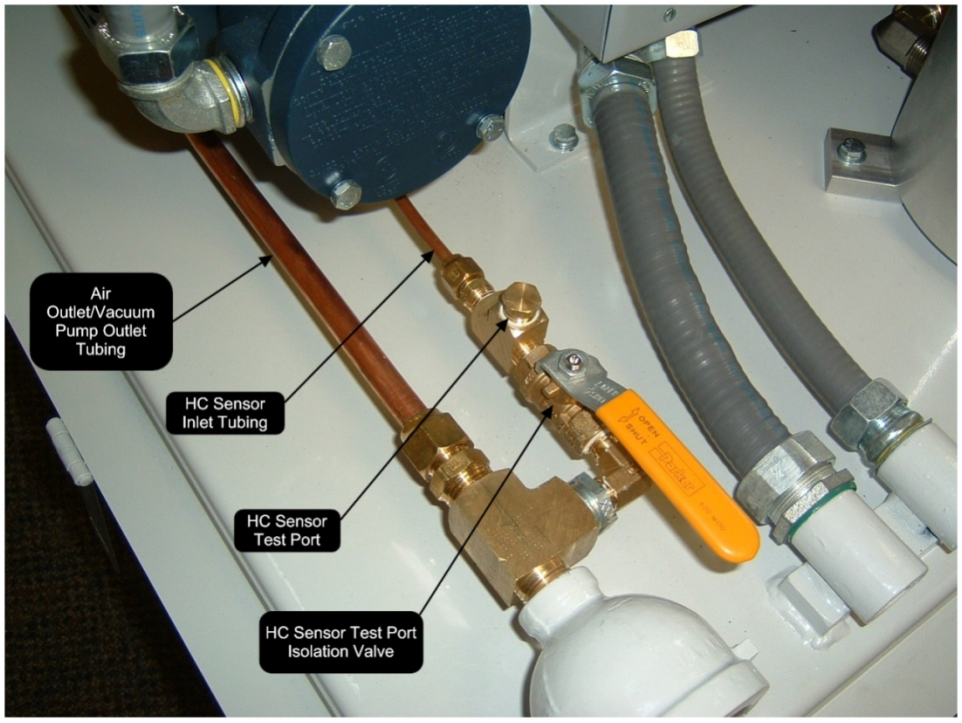


Figure 24: Air outlet / vacuum pump outlet / HC sensor inlet tubing

8 Membrane Replacement

8.1 Safety

Use lockout / tagout procedures prior to starting work.

8.2 Removing the Membrane from the Membrane Housing

1. Put the TLS 350 in the manual **"OFF"** mode.
   - **See Figure 11: Section 15 / Page 32 for instructions.**
2. Disconnect power to the heat trace cable, the vacuum pump, and the blower.
3. Disconnect and remove the ½" 45º flare tubing from the top and side of the membrane housing:
   - **See Figure 25: Section 15 / Page 59**
   - **NOTE: The nuts on the tubing are ¾" 45° flare. Use caution not to damage the flared ends on the tubing or the threads on the nuts after removal.**
4. Remove the (4) ¼" bolts from the top plate (on top of the membrane housing).

Figure 25: Membrane housing

5. Keep the (4) bolts/washers/lock washers for reuse.
6. Remove the top plate. A small lever may have to be used to gently pry the top plate off the membrane housing.
   - The top plate seals against the vertical tube with an o-ring. Use caution when removing the top plate.
   - The membrane is now exposed.
   - **See Figure 26: Section 15 / Page 59**

Figure 26: Exposed membrane with the top plate removed

7. Gently screw the membrane removal tool into the top of the membrane.
   - Screw the removal tool into the membrane until the threads bottom out.
   - **See Figure 27: Section 15 / Page 60**
   - **CAUTION: Do not over tighten the removal tool when screwing into the membrane.**

Figure 27: Membrane extraction tool

8. Gently move the removal tool side-to-side while pulling up with moderate force until the membrane becomes loose.
   - **CAUTION: Do not use excessive force or a twisting action to remove the membrane as these items may cause damage to the membrane epoxy potting**.
   - There are two o-rings on the inside bottom of the vertical tube causing resistance in removing the membrane
   - An aluminum insert **(Figure 28: Section 15 / Page 60)** may still be attached to the bottom of the membrane or will stay in the membrane-housing base.
   - **DO NOT LOSE THE INSERT AS IT WILL BE NEEDED TO COMPLETE THE MEMBRANE INSTALLATION AND MAKE THE MEMBRANE OPERATION FUNCTIONAL.**

9. Remove the removal tool from the membrane.

10. Remove and discard the (4) o-rings:
    - **(2) O-rings on the membrane**
    - **(2) O-rings on the base insert**
    - **Keep the vertical tube top o-ring for re-use.**

Figure 28: Membrane / base insert

8.3 Installing the New Membrane

1. Install (4) new O-rings:
   - (2) O-rings on the membrane (VST Part #5006-012).
   - (2) O-rings on the base insert (VST Part #5006-013).

2. Use only silicon grease (not hydrocarbon-based grease) on the o-rings prior to installation.
   - Hydrocarbon-based grease or lubricant will emit hydrocarbon vapors, which will be measured by the HC sensor and will cause inaccurate gas-level readings.

3. With (2) new o-rings on the "insert" installed, place the "insert" into the bottom of the base as orientated in **Figure 28: Section 15 / Page 60**.

4. With the (2) membrane o-rings installed, place the membrane into the membrane housing.
   - Apply a moderate downward force with a mild side-to-side action to seat the membrane in the membrane base.

5. Install the existing top vertical tube o-ring (re-lubricated). Install the top plate.
   - The top plate will seat on the vertical tube o-ring while bolting the top plate in place.
   - **DO NOT USE FORCE TO SEAT THE TOP PLATE.**

6. Install the (4) ¼" bolts/washers/lock washers in the top plate/retaining ring to secure the top plate.

7. Tighten the (4) bolts to 85 in-lbs in a cross-pattern using 20%, 40%, 60%, 80%, 90%, 100% of torque.
   - This cross-pattern torque procedure will evenly seat the top plate to the vertical tube.

8. Re-install the ½" 45° flare tubing from the top/side of the membrane housing.
   - Note: When tightening the 45° flare nuts: Clamp the tube flare between nut and nose body of the tube by screwing the nut on finger tight. Tighten with a wench an additional ¼ turn for a metal-to-metal seal.

9. Remove the lock(s) and tags from the lockout & tagout.

10. Turn **ON** power to the heat trace, blower, and vacuum pump.

11. Put the TLS-350 in the manual **ON** mode.

12. Perform a *Processor* Leak Test. **See Section 15 / Page 33 for instructions.**

13. After work is completed, put the TLS-350 in the **AUTOMATIC** mode.
    - **See Figure 11: Section 15 / Page 32 for instructions.**

9 Drive Coupling Rubber Insert Replacement

9.1 Safety

Use lockout / tagout procedures prior to starting work.

9.2 Removing the Drive Coupling Insert

1. Prior to starting work, put the TLS-350 in the Manual **OFF** mode
   - **See Figure 11: Section 15 / Page 32 for instructions.**

2. Disconnect power to the blower and vacuum pump motors

3. With the vacuum pump in-place on the ECS base, remove the drive coupling guard and the pump fan guard.
   - **See Figure 29: Section 15 / Page 62.**

Figure 29: Vacuum pump and motor assembly

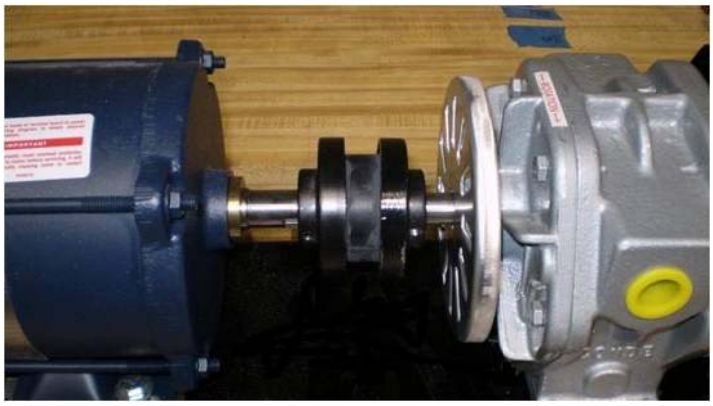


Figure 30: Vacuum pump with guard removed

4. Un-bolt the vacuum pump from the base and move away from the motor. Be sure to mark and keep any shims used under the vacuum pump for re-use.
   - Keep the bolts for re-use.
   - This will separate the drive coupling for removal of the rubber insert.
   - **See Figure 31: Section 15 / Page 63.**

Figure 31: Vacuum pump unbolted and moved away from the motor

Figure 32: Drive coupling rubber insert

5. Replace the rubber insert into the drive coupling.
   - Rubber coupling (VST Part # 5001-003)
   - **See Figure 32**: **Section 15 / Page 63.**
6. Slide the vacuum pump towards the motor.
   - Place any shims under the vacuum pump in their original location.
7. Bolt the vacuum pump to the vacuum pump base.
8. Install the drive coupling and fan guards.
9. Remove the lock(s) and tags from the lockout & tagout.
10. Turn **ON** power to the blower and vacuum pump.
11. Return the TLS-350 to the manual **ON** mode.
12. Perform a *Processor* leak test.
    - **See Section 15 / Page 33 for instructions.**
13. Perform a Motor Rotation Test
    - **Refer to Section 15 / Page 36.**
14. After work is completed, put the TLS-350 in the **AUTOMATIC** mode.
    - **See Figure 11: Section 15 / Page 32**.

10 Heat Trace Cable Replacement

10.1 Safety

Use lockout / tagout procedures prior to starting work.

10.2 Removing the Heat Trace Electrical Box

1. Prior to starting work, put the TLS-350 in the Manual "**OFF**" mode
   - **See Figure 11: Section 15 / Page 32 for instructions.**

2. Disconnect power to the heat trace cable.

3. Remove the entire heat trace electrical box from the ¾" tubing.

4. Disconnect and remove the heat trace cable from inside the electrical junction box.
   - Remove the top cover from the electrical junction box (be sure to keep the screws for reuse).
   - Remove the 115V and ground wires from the terminal block located inside the electrical junction box. **See Figure 33: Section 15 / Page 66**.
   - Remove the bottom plate (be sure to keep the screws for reuse).
   - Pull the heat trace cable out of the electrical box and bottom plate (be sure keep the rubber grommet for reuse).

5. Completely remove the 1" thick F/G insulation from the membrane housing.
   - Cutting on the insulation seam, remove the insulation (with the aluminum tape attached) in one piece and save for reuse.
   - **See Figure 34: Section 15 / Page 66**.

6. Peel the aluminum tape off the heat trace cable and discard.
   - This will expose the heat trace cable and end seal kit.

7. Disassemble the seal kit and remove the heat trace cable.
   - Retain the end seal kit parts for re-use.

10.3 Overview for Installing the New Heat Trace Cable

1. VST has found that making both the end seal kit and electrical junction box connection first to the heat trace cable works the best.

2. After both connections are made to the heat trace cable, attach the electrical junction box to the ¾" tube.

3. After the electrical junction box is attached to the ¾" tube, wrap the heat trace cable around the vertical tube starting at the bottom and wrapping towards the top, applying aluminum tape on each revolution.

4. The last step is to secure the end seal kit to the vertical tube.

10.4 Steps for Installing the New Heat Trace Cable

1. Install the end seal kit on the heat trace cable:
   - Using a multimeter, check the heat trace cable electrical circuit continuity at the electrical junction box to insure the circuit is complete and is not in a ground fault condition.
   - See **Figure 35: Section 15 / Page 66**. End Seal Kit Components
   - See the **Figures 36-37: Section 15 / Pages 67-68**. Chromalox End Seal Kit Installation Instruction (2-Pages -) to install the heat trace cable on the end seal kit
   - **Figure 38: Section 15 / Page 69**. Prepare the New Heat Trace Cable for installation into the End Seal Kit

2. Install the heat trace cable to the electrical junction box.
   - See **Figures 39-42: Section 15 / Pages 70-73**. Electrical Junction Box Installation Instructions, (4-Pages).

3. Attach the electrical junction box to the ¾" tube (attached to the membrane housing).

4. Wrap the heat trace cable around the vertical tube starting at the bottom and wrapping towards the top, applying aluminum tape on each revolution.
   - Be sure to install the heat trace cable **flat** against the membrane housing – free of twists.
   - Use nylon reinforced aluminum tape.

5. Secure the end seal kit/heat trace cable to the top section of the top section of the vertical tube.
   - See **Figure 43: Section 15 / Page 74** End Seal Kit Location and Heat Trace Cable Installation.
   - The heat trace cable on the vertical tube should be completely wrapped with aluminum tape. (Note: The nylon reinforced aluminum tape serves two purposes, it holds the heat trace cable in place while installing the heat trace cable on the vertical tube, and it insures the heat trace cable is held firmly in contact with the vertical tube).

6. The installation is now complete.
   - See **Figure 44: Section 15 / Page 75**. Installed Electrical Junction Box with Electrical Connections.

7. Check all electrical connections for loose wires.

8. Remove the lock(s) and tags from the lockout & tagout.

9. Turn on power to the Heat Trace Cable and vacuum pump.

10. After work is completed, put the TLS-350 in the **AUTOMATIC** mode.
    - **See Figure 11: Section 15 / Page 32 for instructions.**

Figure 33: Termination block inside the electrical junction box

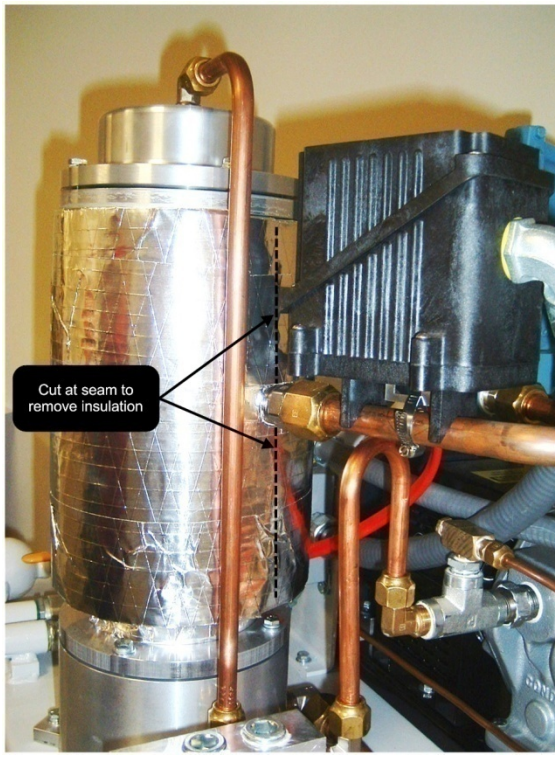


Figure 34: Seam to cut to remove the insulation

Figure 35: End seal kit components

Connection screws
End cap
Grommet
Pressure plate
Heat trace cable

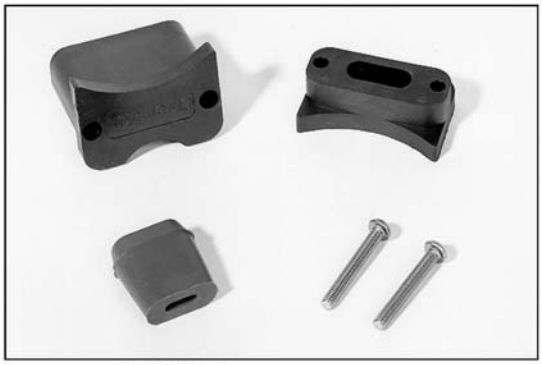
10.4.1 End Seal Kit Installation Instructions

Chromalox®

Installation Instructions

SERVICE REFERENCE		
DIVISION 4	SECTION RT	
SALES REFERENCE	(Supersedes PJ450-9)	PJ450-10
		161-562761-001
DATE	MARCH, 2004	

Type RTES End Seal Kit for Self-Regulating and Constant Wattage Rapid-Trace Heating Cable



RTES Kit Parts:
1 - End Cap
2 - Screws
1 - Pressure Plate
1 - Grommet

GENERAL

The RTES kit is used for terminating braided (-C) and overcoated (-CR or -CT) versions of Self-Regulating and Fluoropolymer insulated Constant Wattage Rapid-Trace Heating Cable. The cable grommet is furnished with this kit such that the kit suffix number is the same as the grommet number (eg., an RTES-3 kit uses a GR3 grommet). Refer to the list below to insure you have the proper grommet for the cable you are installing.

GR1 for SRL-C
GR2 for SRL-CR or SRL-CT
GR3 for CWM-C
GR4 for CWM-CT
GR5 for SRL-MC
GR6 for SRL-MCR or SRL-MCT
GR7 for SRM/E-C
GR8 for SRM/E-CT

Each kit contains enough material to make one termination. Materials required include: standard electrical cutters, screwdriver and fiberglass tape.

INSTALLATION

⚠WARNING

ELECTRIC SHOCK HAZARD. Disconnect all power before installing or servicing heating cable and accessories. A qualified person must perform installation and service of heating cable and accessories. Heating cable must be effectively grounded in accordance with the National Electrical Code. Failure to comply can result in personal injury or property damage.

Note: All electrical wiring, including GFCI (Ground Fault Circuit Interrupters), must be done in accordance with the National Electrical Code and local codes by a qualified person.

Note: These instructions are for all Self-Regulating and Constant Wattage heating cables in ordinary locations. Consult factory for installation of braided cable in hazardous locations. Not all instructions, are for all cables. Each step has a boldface heading stating what type of cable that instruction is for.

1. **FOR CONSTANT WATTAGE CABLE:**
   Using standard electrical cutters, make a perpendicular cut across the cable four inches from the last module point.

Note: Cutting the cable between module points (indentions in cable) creates a non-heated cold lead. See Figure 1.

Figure 1

Figure 36: End seal kit installation instructions, page 1 of 2

INSTALLATION

2. FOR CABLE WITH EXPOSED METAL BRAID (-C):
Push the braid back three inches to expose the base cable insulation. See Figure 2.

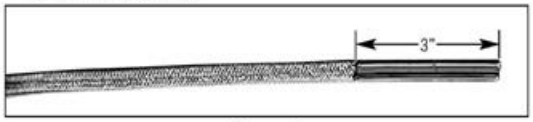


Figure 2

3. FOR ALL CABLE:
Slide the pressure plate and grommet over the end of the cable. **Note:** The pressure plate and end cap have different size curved surfaces on the top and bottom of each piece. These curved surfaces are designed to give a better fit on process equipment. The side with the smaller radius curve is for use on pipes with diameters up to three inches or on flat surfaces. The other side is for use on pipes with diameters of three inches or more. See Figure 3 and Figure 8.

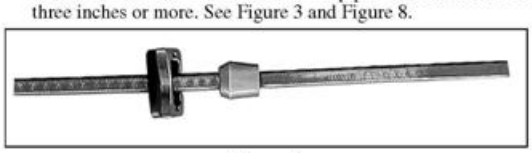


Figure 3

4. FOR OVERCOATED CABLES (-CR or -CT):
Score the outer jacket one inch from the end of the cable. Remove the jacket to expose the braid. Unravel and trim the braid flush with the outer jacket. Pull any strands of braid back towards the outer jacket. See Figure 4.

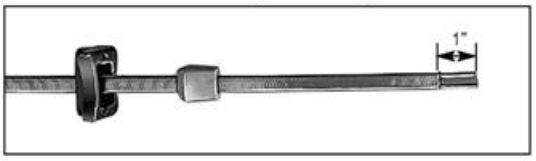


Figure 4

5. FOR ALL CABLE:
Using standard electrical cutters, cut a "VEE" notch between the buss wires. See Figure 5.

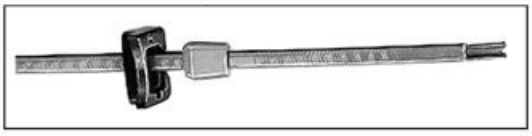


Figure 5

6. FOR ALL CABLE:
Slide the pressure plate and grommet towards the end of the cable leaving 5/8" of the cable extending past the end of the grommet. See Figure 6.

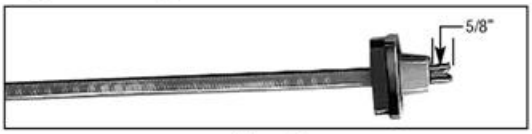


Figure 6

7. FOR ALL CABLE:
Slide the end cap over the grommet. Using a screwdriver, connect the pressure plate to the end cap. See Figure 7.

Figure 7

8. FOR ALL CABLE:
Using a fastening device, fiber re-inforced electrical tape (Chromalox FT-1 or equal), secure the assembly to the pipe. Wrap the tape around the assembly between the legs. See Figure 8.

Figure 8

WARRANTY AND LIMITATION OF REMEDY AND LIABILITY

Chromalox warrants only that the Products and parts manufactured by Chromalox, when shipped, and the work performed by Chromalox when performed, will meet all applicable specification and other specific product and work requirements (including those of performance), if any, and will be free from defects in material and workmanship under normal conditions of use. All claims for defective or nonconforming (both hereinafter called defective) Products, parts or work under this warranty must be made in writing immediately upon discovery, and in any event, within one (1) year from delivery, provided, however all claims for defective Products and parts must be made in writing no later than eighteen (18) months after shipment by Chromalox. Defective and nonconforming items must be held for Chromalox's inspections and returned to the original f.o.b. point upon request. THE FOREGOING IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES WHATSOEVER, EXPRESS, IMPLIED AND STATUTORY, INCLUDING, WITHOUT LIMITATION, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Notwithstanding the provisions of this WARRANTY AND LIMITATION Clause, it is specifically understood that Products and parts not manufactured and work not performed by Chromalox are warranted only to the extent and in the manner that the same are warranted to Chromalox by Chromalox's vendors, and then only to the extent that Chromalox is reasonably able to enforce such warranty, it being understood Chromalox shall have no obligation to initiate litigation unless Buyer undertakes to pay all cost and expenses therefor, including but not limited to attorney's fees, and indemnifies Chromalox against any liability to Chromalox's vendors arising out of such litigation.

Upon Buyer's submission of a claim as provided above and its substantiation, Chromalox shall at its option either (i) repair or replace its Products, parts or work at the original f.o.b. point of delivery or (ii) refund an equitable portion of the purchase price.

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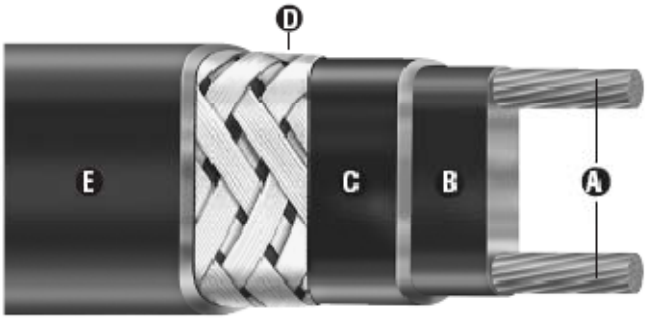
Figure 37: End seal kit installation instructions, page 2 of 2



A. Twin 14 AWG copper buss wires
B. Semi-conductive polymer core
C. High temp. fluoropolymer jacket
D. Metallic braid ground
E. High temperature fluoropolymer jacket

Figure 38: Prepare the new heat trace cable for installation into the end seal kit

Chromalox®

Installation Instructions

SERVICE REFERENCE		
DIVISION 4	SECTION RT	
SALES REFERENCE	(Supersedes PJ451-9)	PJ451-10
		161-562762-001
DATE	MARCH, 2004	

RTPC Power Connection Kit for Self-Regulating and Constant Wattage Rapid-Trace Heating Cable

RTPC Power Connection Kit Parts:

1 - Molded Junction Box consisting of: Base - Box - Lid - Hardware
1 - Three Position Terminal Block
1 - Mounting Screw for Terminal Block
1 - Cable Grommet
1 - Cover Gasket

GENERAL

⚠WARNING

ELECTRIC SHOCK HAZARD. Disconnect all power before installing or servicing heating cable and accessories. A qualified person must perform installation and service of heating cable and accessories. Heating cable must be effectively grounded in accordance with the National Electrical Code. Failure to comply can result in personal injury or property damage.

NOTE: All electrical wiring, including GFCI (Ground Fault Circuit Interrupters), must be done according to National Electrical or local codes by a qualified person.

The RTPC Kit is used to connect base, braided (-C) and overcoated (-CR or -CT) versions of Self-Regulating and Fluoropolymer insulated Constant Wattage Rapid-Trace Heating Cables to power. The cable grommet is furnished with this kit, such that the kit suffix number is the same as the grommet number (eg., an RTPC-3 kit uses a GR3 grommet). Refer to the list below to insure you have the proper grommet for the cable you are installing.

GR1 for SRL-C	GR2 for SRL-CR or SRL-CT
GR3 for CWM-C	GR4 for CWM-CT
GR5 for SRL-MC	GR6 for SRL-MCR or SRL-MCT
GR7 for SRM/E-C	GR8 for SRM/E-CT

Each kit contains enough material to make one power connection point. It is possible to connect up to three Self-Regulating or two Constant Wattage Cables in the same box. (One grommet required for each cable.)

Materials required for installation include: standard electrical cutters, screwdriver, sharp utility knife and a pipe strap (Chromalox PS or equal).

Wipe inside lip of cover with a clean cloth. Remove protective backing from the gasket and affix it to the cover lip. Press firmly all around for proper adhesion.

Figure 39: Electrical junction box installation instructions, page 1 of 4

INSTALLATION

NOTE: These instructions are for all Self-Regulating and Constant Wattage heating cables in ordinary locations. Consult factory for installation of braided cable in hazardous locations. Not all instructions are for all cables. Each step of the instructions will have a heading in boldface stating what type of cable each instruction is intended for.

1. **FOR CONSTANT WATTAGE CABLES:**
   Cut the cable 12 inches past the last module point (indentation in cable). **NOTE:** Cutting the cable between module points creates a non-heating cold lead. See Figure 1.

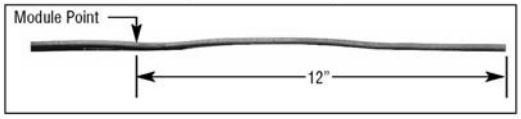


Figure 1

2. **FOR CABLE WITH EXPOSED METAL BRAID (-C):**
   Push the braid back 12 inches on the cable. See Figure 2.

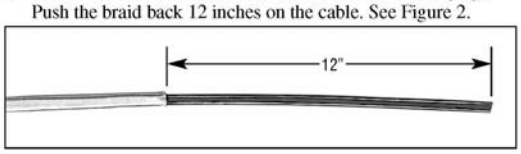


Figure 2

3. **FOR ALL CABLES:**
   Feed the ends of the cables through the appropriate hole in the base. Allow eight (8) inches of cable to extend above the top of the base. See Figure 3.

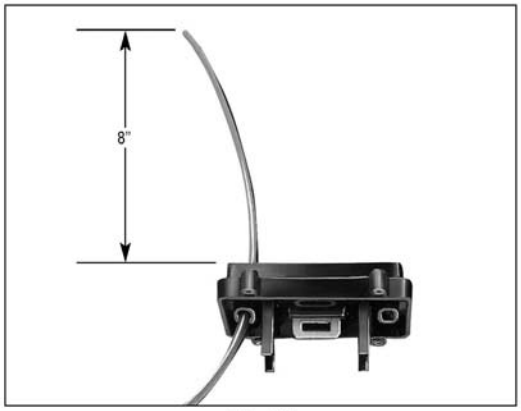


Figure 3

4. **FOR ALL CABLES:**
   Slide cable grommet over the end of the cable and insert it into the opening in the base. Secure the base to the pipe by threading the appropriate sized pipestrap through the slot in the mounting plate. Tighten the pipestrap until the base is securely attached to the pipe. See Figure 4.

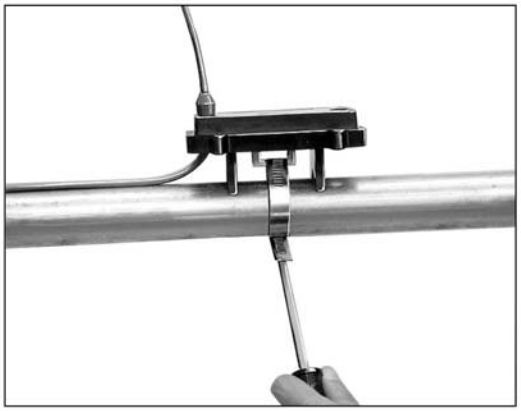


Figure 4

5. **FOR OVERCOATED CABLES (-CR or -CT):**
   Score the outer insulation seven (7) inches from the end of cable. Remove the jacket to expose the metal braid. See Figure 5. **CAUTION:** ***When removing the outer jacket, be careful not to damage the braid or the base cable insulation.***

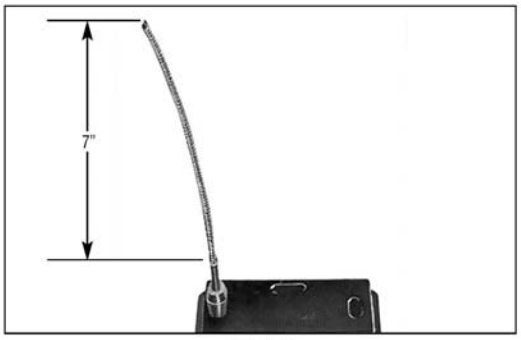


Figure 5

6. **FOR ALL CABLES:**
   Punch out the knockouts on the bottom of the box which correspond to the openings in the base through which the heating cable passes. Be careful to punch out only those knockouts to be used. If one is mistakenly punched, blank grommets can be ordered to re-establish the water tight seal. See Figure 6.

Figure 6

Figure 40: Electrical junction box installation instructions, page 2 of 4

INSTALLATION

7. FOR ALL CABLES:
Feed the cables through the corresponding holes in the box. Secure box to base using all four (8-32) screws. See Figure 7.

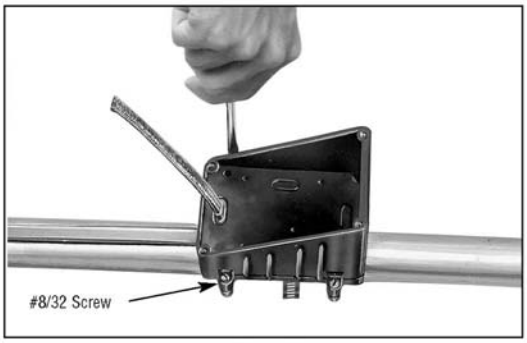


Figure 7

8. FOR OVERCOATED CABLES:
Starting from the end of the cable, unravel 2-1/2 inches of the braid. Twist the strands together to form a pigtail. See Figure 8.

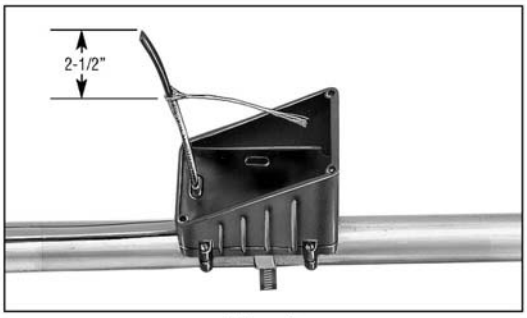


Figure 8

9. FOR SELF-REGULATING CABLES:
Using standard electrical cutters, cut a 3/4 inch long notch out of the cable between the conductor wires. Bare a 3/8 inch length of each conductor by stripping off the outside insulation and the inner black core material. See Figure 9.

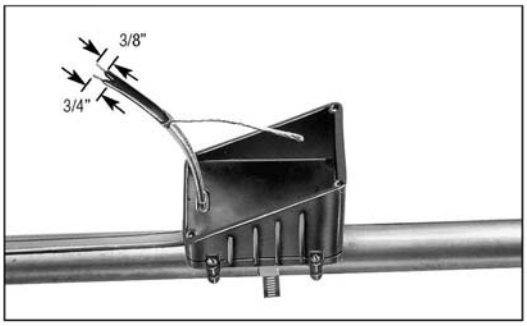


Figure 9

10. FOR CONSTANT WATTAGE CABLES:
Score the outer jacket 3/4 inch from the end of the cable and remove the jacket. Cut off the exposed nichrome wire, pushing any remainder back under the jacket. These cables have an inner layer of insulation which is also to be removed as described above. Separate the buss wires and strip off the last 3/8 inch of insulation from both buss wires. See Figure 10.

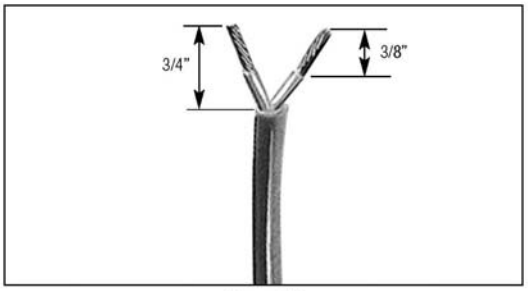


Figure 10

11. FOR ALL CABLES:
Insert the bared ends of the conductors into the openings in the terminal block. Tighten screws firmly to hold conductors in place. See Figure 11.

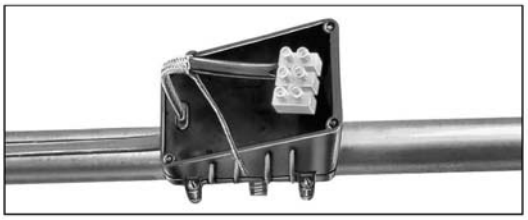


Figure 11

12. FOR OVERCOATED CABLES (-CR or -CT):
Insert the end of the braid pigtail into the remaining opening in the terminal block. Tighten screw firmly to hold the braid in place. See Figure 12.

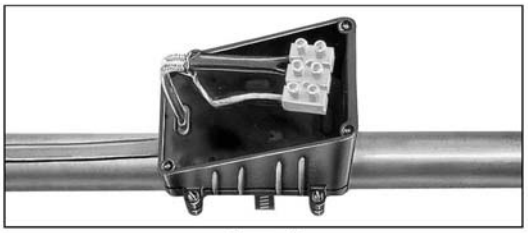


Figure 12

13. FOR ALL CABLES:
Connect conduit hub (Chromalox CCH or equal) to the box. Attach conduit to hub and bring power leads into box. See Figure 13.

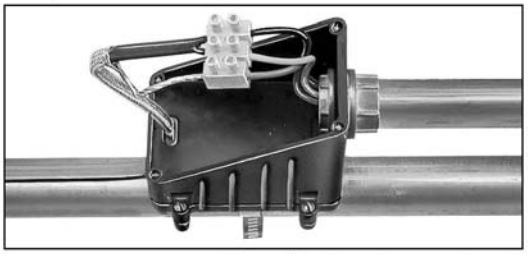


Figure 13

Figure 41: Electrical junction box installation instructions, page 3 of 4

INSTALLATION

14. FOR ALL CABLES:
Strip 3/8 inch length of each conductor of the power cord. Insert the bared ends of the conductors into the corresponding openings on the unused side of the terminal block. Remember, the green (ground) wire must be opposite of the opening of the terminal block which is either empty or contains the metal braid. See Figure 14.

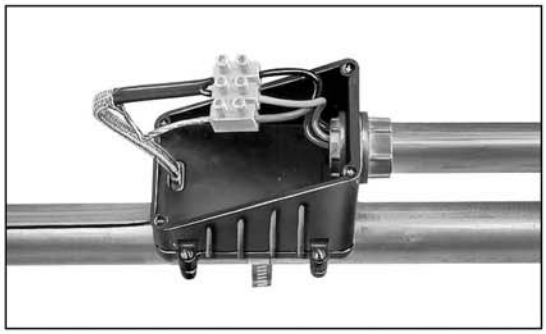


Figure 14

15. FOR ALL CABLES:
Mount terminal block to bottom of the box by driving the 6/32 self-tapping screw into the mounting hole as shown. See Figure 15.

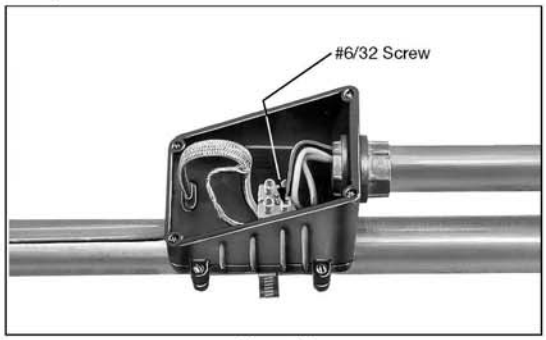


Figure 15

16. FOR ALL CABLES:
Carefully push the wires into the box. Secure the lid to box. See Figure 16.

Figure 16

17. FOR CABLE WITH EXPOSED METAL BRAID (-C):
Unravel four (4) inches of braid from the cable and twist into a pigtail.

⚠WARNING

ELECTRIC SHOCK HAZARD. The twisted braid must be effectively grounded in accordance with the National Electrical Code to eliminate electric shock hazard.

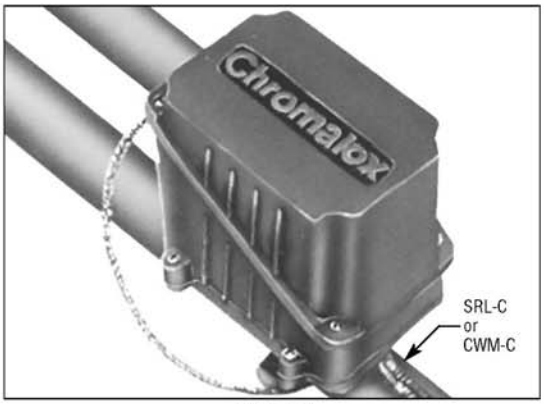


Figure 17

WARRANTY AND LIMITATION OF REMEDY AND LIABILITY

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Notwithstanding the provisions of this WARRANTY AND LIMITATION Clause, it is specifically understood that Products and parts not manufactured and work not performed by Chromalox are warranted only to the extent and in the manner that the same are warranted to Chromalox by Chromalox's vendors, and then only to the extent that Chromalox is reasonably able to enforce such warranty, it being understood Chromalox shall have no obligation to initiate litigation unless Buyer undertakes to pay all cost and expenses therefor, including but not limited to attorney's fees, and indemnifies Chromalox against any liability to Chromalox's vendors arising out of such litigation.

Upon Buyer's submission of a claim as provided above and its substantiation, Chromalox shall at its option either (i) repair or replace its Products, parts or work at the original f.o.b. point of delivery or (ii) refund an equitable portion of the purchase price.

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Figure 42: Electrical junction box installation instructions, page 4 of 4

Figure 43: End seal kit location and heat trace cable installation

Figure 44: Installed Electrical Junction Box with Electrical Connections

11 Hydrocarbon Infrared (HC IR) Sensor Module Replacement

Figure 45: HC IR Sensor Module and Electrical Housing Assembly

11.1 Safety

Use lockout / tagout procedures prior to starting work.

11.2 Removing HC IR Sensor from the HC IR Sensor Module Electrical Housing

1. Prior to starting work, put the TLS-350 in the Manual "**OFF**" mode.
   - **See Figure 11: Section 15 / Page 32 for instructions.**
2. Disconnect power to the heat trace cable, the vacuum pump, and the blower.

3. Disconnect and completely remove the ¼" 45° flare tubing from the top and bottom sides of the HC IR Sensor Module. **See Figure 46: Section 15 / Page 77**.

   NOTE: The nuts on the tubing are ¼" 45° flare. Use caution to avoid damaging the flared ends on the tubing or the threads on the nuts after removal.

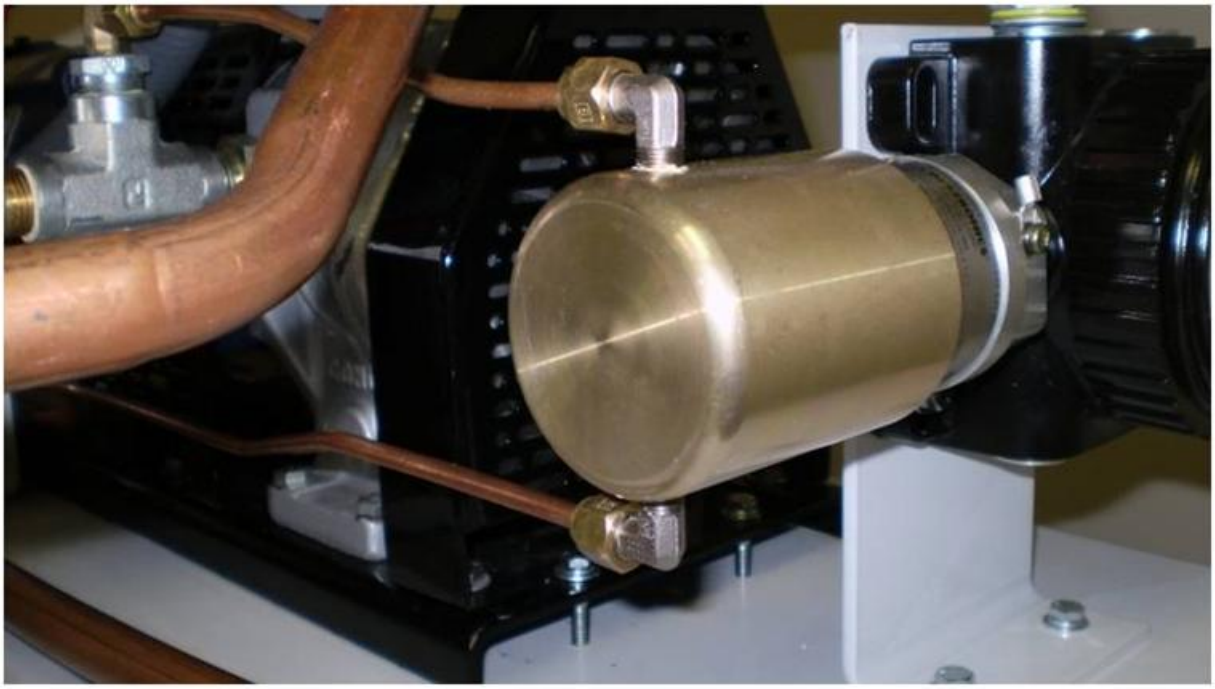


Figure 46: HC IR Sensor Module 1/4" 45-degree Tubing and Fittings

4. Remove the cover on the electrical house and keep for re-use.
   NOTE: Do not remove the HC sensor electrical housing.

5. Disconnect the following HC IR sensor wires from the electrical housing circuit board:
   - White: 4-20 mA signal sire
   - Black: -(common) RET wire
   - Red: +24VDC power wire

     NOTE: The yellow and green wires are not used in this application.
   - **See Figures 47 and 48: Section 15 / Page 78**.

6. Unscrew and remove the HC IR Sensor Module from the electrical housing.
   - Package the used HC IR Sensor Module in the anti-static bag and box that came with the new / recalibrated HC IR Sensor Module unit.
   - The used HC IR Sensor Module can be sent back to VST for re-calibration.

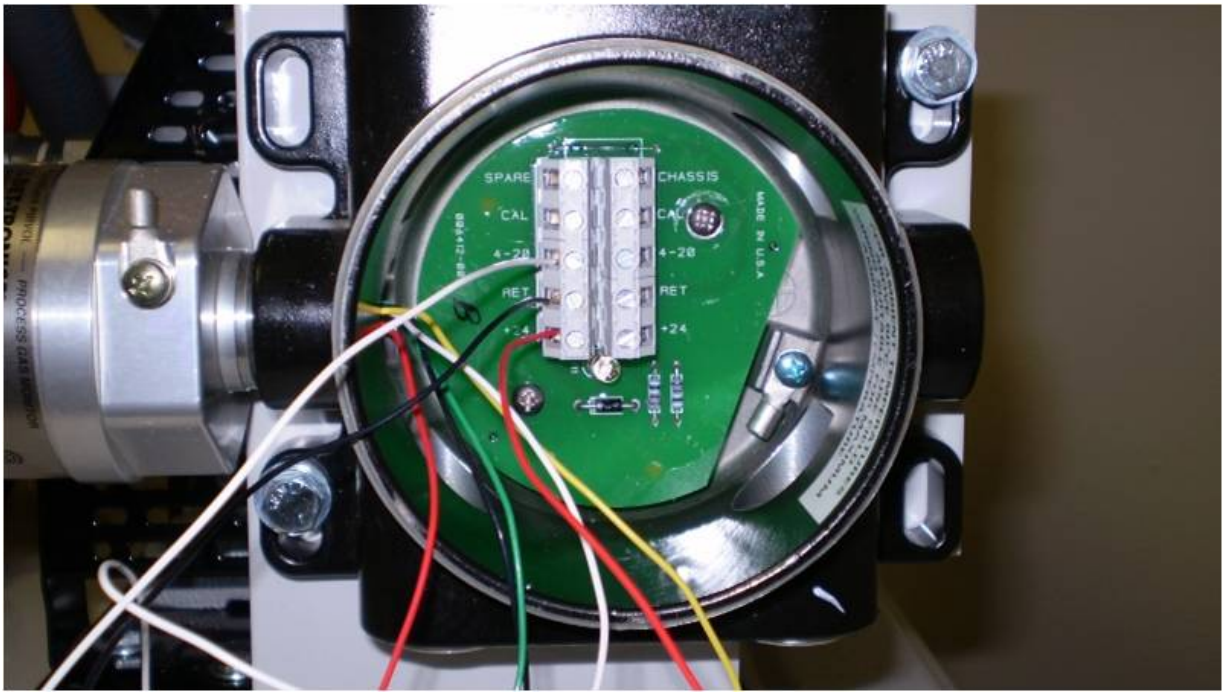


Figure 47: HC IR Sensor Electrical Housing Circuit Board

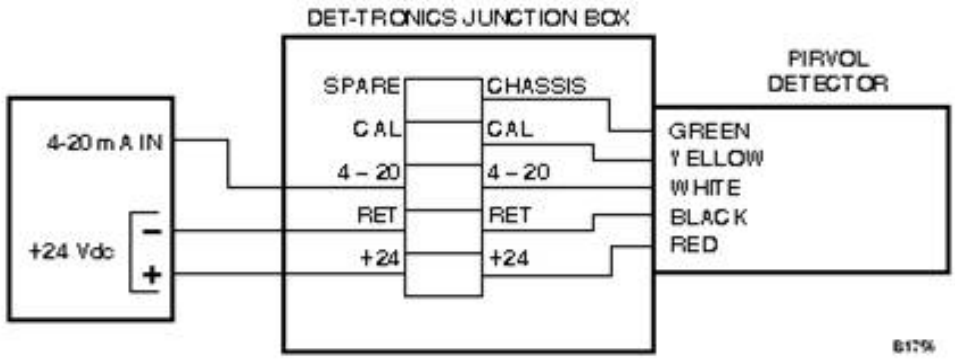


Figure 48: HC IR Sensor Electrical Housing Circuit Board Wiring Diagram

11.3 Installing a New or Re-calibrated HC IR Sensor Module to the HC IR Sensor Module Electrical Housing

1. Use only silicon grease (not hydrocarbon-based grease) to lubricate the HC IR sensor threads prior to installation.
   - Hydrocarbon-based grease or lubricant will emit hydrocarbon vapors, which will be measured by the HC sensor and will cause inaccurate gas-level readings.

2. Screw the new / re-calibrated HC IR sensor module to the electrical housing.
   - Remove the aluminum cover from the HC IR sensor.
   - While screwing on the sensor, orient the optics in the vertical position.
   - **See Figure 49: Section 15 / Page 79**.

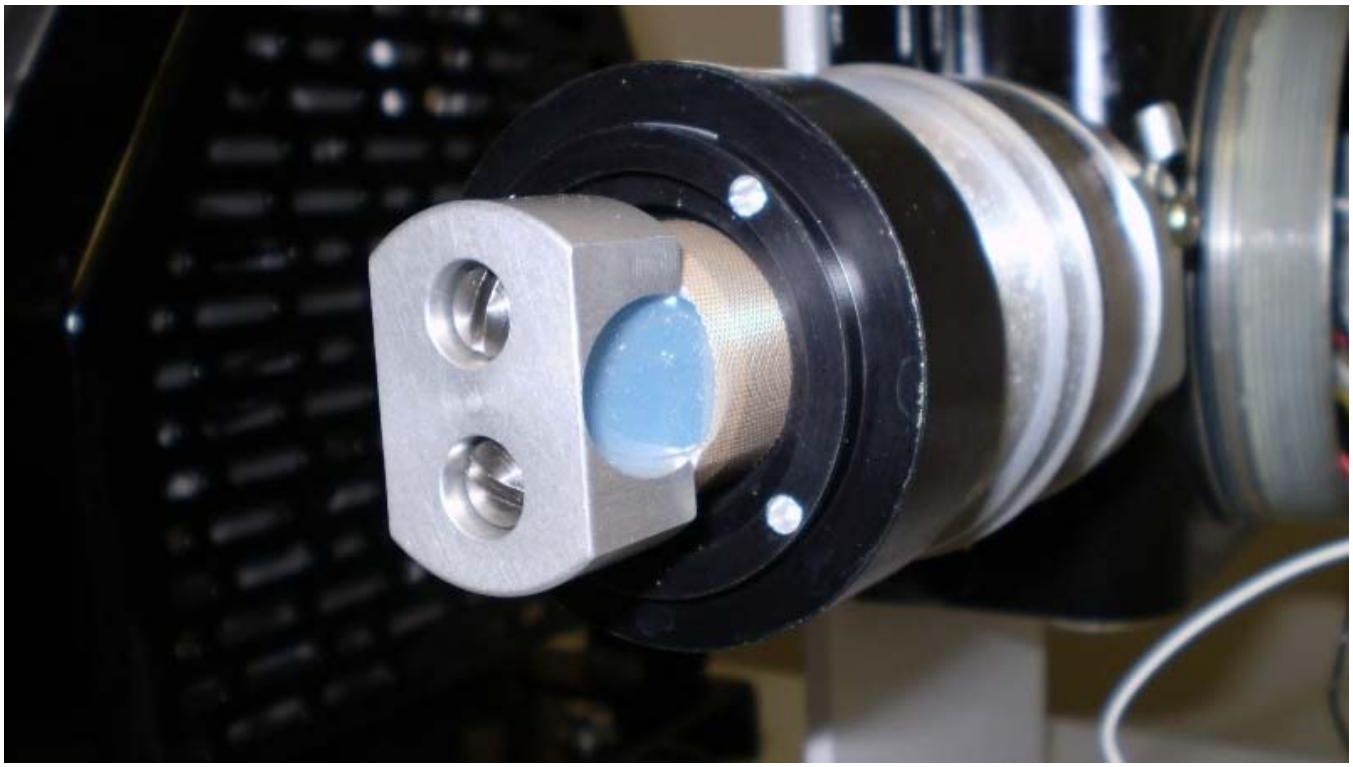


Figure 49: HC IR sensor installation orientation

3. Replace the aluminum cover on the HC IR sensor.

4. Connect the following HC IR sensor wires to the electrical housing circuit board:
   - White: 4-20 mA signal sire
   - Black: -(common) RET wire
   - Red: +24VDC power wire
     NOTE: the yellow and green wires are not used in this application.
   - See **Figures 47 and 48: Section 15 / Page 78**.

5. Install the cover on the electrical housing.
   - Use only silicon grease (not hydrocarbon-based grease) to lubricate the cover threads prior to installation.
   - Hydrocarbon-based grease or lubricant will emit hydrocarbon vapors, which will be measured by the HC sensor and will cause inaccurate gas-level readings.

6. Re-install the (2) ¼" 45° flare tubing on the top and bottom sides of the HC IR sensor module.
   - **NOTE: When tightening the 45° flare nuts, clamp the tube flare between the nut and the nose body of the tube by screwing the nut on finger-tight. Tighten with a wrench an additional ¼-turn for a metal-to-metal seal.**

7. Remove the lock(s) and tags from the lockout/tagout.

8. Turn **ON** power to the heat trace, blower, and vacuum pump.

9. Return the TLS-350 to the manual **ON** mode.

10. Perform a *Processor* Leak Test.
    - **See Section 15 / Page 33 for instructions.**

11. After the installation is complete, put the TLS-350 in the **AUTOMATIC ON** mode.
    - **See Figure 11: Section 15 / Page 32 for instructions.**

12 Forms

- The following pages contain forms for:
    - Scheduled preventative maintenance list
    - Scheduled preventative maintenance checklist

12.1 Preventative Maintenance

Preventative Maintenance			
ASC #:		Date:	
ASC Name:			
ASC Certification Level:			
ASC Company:			
GDF Name:			
Address:			
City:		State:	ZIP Code:
GDF Contact Person Name:			
GDF Contact Person Title:			
GDF Contact Person Phone:			
GDF Contact Person E-mail:			
Notes			
Use the form on the following page to note details of Preventative Maintenance activities.			

12.2 Preventative Maintenance Checklist Form

Component	Frequency	Date Inspected	Completed	Required Action
PROCESSOR	**Yearly**			
Inspect drive coupling on vacuum pump			[]	
Check temperature of membrane housing			[]	
RECIRCULATION BLOWER				
Replace every 10 years or every 15,000 hours, whichever comes first.			[]	
VACUUM PUMP				
Replace every 10 years or every 15,000 hours, whichever comes first.			[]	

In-Station Diagnostics (ISD)

Install, Setup, & Operation Manual

For VST ECS Membrane Processors

VEEDER-ROOT

Notice

Veeder-Root makes no warranty of any kind with regard to this publication, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose.

Veeder-Root shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this publication.

Veeder-Root reserves the right to change system options or features, or the information contained in this publication.

DAMAGE CLAIMS

1. Thoroughly examine all components and units as soon as they are received. If damaged, write a complete and detailed description of the damage on the face of the freight bill. The carrier's agent *must* verify the inspection and sign the description.
2. Immediately notify the delivering carrier of damage or loss. This notification may be given either in person or by telephone. Written confirmation must be mailed within 48 hours. Railroads and motor carriers are reluctant to make adjustments for damaged merchandise unless inspected and reported promptly.
3. Risk of loss, or damage to merchandise remains with the buyer. It is the buyer's responsibility to file a claim with the carrier involved.

RETURN SHIPPING

For the parts return procedure, please follow the appropriate instructions in the "General Returned Goods Policy" and "Parts Return" pages in the "Policies and Literature" section of the Veeder-Root **North American Environmental Products** price list.

FCC INFORMATION

This equipment complies with the requirements in Part 15 of the FCC rules for a Class A computing device. Operation of this equipment in a residential area may cause unacceptable interference to radio and TV reception requiring the operator to take whatever steps are necessary to correct the interference.

WARRANTY POLICY

For ISD components (Vapor Flow Sensor, Vapor Pressure Sensor & software), the following warranty applies:

We warrant that this product shall be free from defects in material and workmanship and will comply with the performance standards of California EPA CP-201 section 10 as amended July 22, 2004 for a period of one (1) year from the date of installation or twenty-four (24) months from the date of invoice, whichever occurs first. We will repair or replace the product if the product is returned to us transportation prepaid by user, within the warranty period, and is determined by us to be defective. This warranty will not apply to any product which has been subjected to misuse, negligence, accidents, systems that are misapplied or are not installed per Veeder-Root's specifications as outlined in the ARB Approved Installation, Operation and Maintenance Manuals for the VST Phase II EVR System Including Veeder-Root ISD, modified or repaired by unauthorized persons, or damage related to acts of God. We shall not be responsible for any expenses incurred by the user.

1 Introduction

2 Installation

3 Setup

4 ISD Operability Test Procedure

5 Operation

6 Maintenance

7 Diagnostic Menus

Appendix A: Site EVR/ISD Equipment Location Worksheet

Appendix B: ISD Operability Test Procedure Data Forms

Figures

Tables

1 Introduction

In-Station Diagnostic (ISD) equipment is designed to monitor the collection and containment of vapors by vapor recovery equipment. The ISD software monitors the vapor recovery equipment using the Veeder-Root (V-R) TLS console platform, sensor inputs, and dispenser fuel events. ISD provides test reports, generates alarms following test/equipment failures, and finally, shuts down the site upon the occurrence of designated alarms.

This manual provides instructions to install, setup, and operate the special components of the Veeder-Root ISD system that are not covered in existing documentation shipped with other non-ISD specific V-R equipment (e.g., Mag probes, line leak detection, etc.). The ISD feature is an option for the TLS console platform, and as such, many of the installation/setup/operation instructions for non-ISD specific tasks (e.g., line leak detection) are covered in TLS-3XX supplied literature.

WARNING! Revision or reprogramming of the TLS may require notification of the local Certified Unified Program Agency (CUPA).

Site Requirements

Below are the requirements for all vapor recovery systems except where noted.

- V-R TLS-350R/EMC w/BIR, TLS-350 Plus/EMC Enhanced, TLS-350/EMC and Red Jacket ProMax consoles with ECPUII - install as per TLS-3XX Site Prep manual, setup following instructions in TLS-3XX System Setup Manual.
- A flash memory board (NVMEM2) for ISD software storage - installed on the ECPU2 board in place of the console's 1/2 Meg RAM board - install as per TLS-350 Series Board and Software Replacement Manual, no setup required.
- A RS-232 module is required for RS-232 access to ISD reports - install as per instructions shipped with module, connect to the port using instructions in this manual.
- An output relay is required (either 4-Output Relay module, I/O Combination module) to shut down each Submersible Turbine Pump (STP) upon activation of certain ISD alarms (these alarms can also be assigned in Line Leak Disable setup to shut down the STP if Line Leak detection feature is installed) - install as per instructions shipped with module or line leak system, setup ISD shut down alarms either using output relays or line leak system following instructions in this manual.
- Dispenser Interface module (DIM) for the type of dispensers installed - install as per installation manual shipped with device, setup following instructions in DIM manual and TLS-3XX Setup Manual. Note: the DIM supplies flow meter event inputs needed for ISD analysis.
- One V-R Mag probe in each of the gasoline tanks being monitored - install as per installation manual shipped with device, setup following instructions in TLS-3XX Setup Manual.
- Smart Sensor module is required to monitor Air Flow Meters and Vapor Pressure Sensor (up to 8 devices per module, or 7 if customer is using SmartSensor module / embedded pressure). Install and connect following instructions in the Air Flow Meter and Vapor Pressure Sensor installation Guides.
- Air Flow Meters (one for each dispenser) - install as per ISD Flow Meter installation manual shipped with meter, setup following instructions in this manual. Also referred to as Vapor Flow Meters within this manual.
- Vapor Pressure Sensor (one per site) - install as per ISD Pressure Sensor installation manual shipped with sensor, setup following instructions in this manual.
- Mod Bus module connects to the VST-ECS membrane processor.

Supported Vapor Recovery Systems

Table 16-1 lists V-R supported vapor recovery system.

Table 16-1 Vapor Recovery System

Name	CARB Executive Order
VST Phase II EVR System including ISD	VR-204

Contractor Certification Requirements

Veeder-Root requires the following minimum training certifications for contractors who will install and setup the equipment discussed in this manual:

Level 1 Contractors holding valid Level 1 Certification are approved to perform wiring and conduit routing, equipment mounting, probe and sensor installation, tank and line preparation, and line leak detector installation.

Level 2/3 or 4 Contractors holding valid Level 2, 3 or 4 Certifications are approved to perform installation checkout, startup, programming and operations training, troubleshooting and servicing for all Veeder-Root Tank Monitoring Systems, including Line Leak Detection and associated accessories.

In-Station Diagnostics This course of training includes In-Stations Diagnostics installation checkout, startup, programming, and operations training. It also includes troubleshooting and service techniques for the Veeder-Root In-Station Diagnostics system. A current level 2/3 or 4 certification is a prerequisite for the In-Station Diagnostics course. After successful completion of this course the contractor will receive a certificate as well as a Veeder-Root In-Station Diagnostics contractor certification card.

Warranty Registrations may only be submitted by selected Distributors.

Related Manuals

The manuals in Table 16-2 below are shipped with the equipment on the V-R Tech Docs CD-ROM and will be needed to install related equipment.

Table 16-2.- Related Manuals

V-R Manual	Part Number
TLS-3XX Site Prep Manual	576013-879
ISD Balance Flow Meter Installation Guide	VST-IOM / Section 18 / VR-204
Pressure Sensor Installation Guide	VST-IOM / Section 17 / VR-204
TLS-3XX Series Consoles System Setup Manual	576013-623
TLS-3XX Series Consoles Operator's Manual	576013-610
Serial Comm Modules Installation Guide	577013-528
ISD Troubleshooting Manual	577013-819
TLS-350 Series Board and Software Replacement Manual	576013-637
TLS-350R Point-of-Sale (POS) Application Guide	577013-401

Safety Precautions

The following symbols may be used throughout this manual to alert you to important safety hazards.

 **ELECTRICITY** High voltage exists in, and is supplied to, the device. A potential shock hazard exists.	 **TURN POWER OFF** Live power to a device creates a potential shock hazard. Turn Off power to the device and associated accessories when servicing the unit.
 **READ ALL RELATED MANUALS** Knowledge of all related procedures before you begin work is important. Read and understand all manuals thoroughly. If you do not understand a procedure, ask someone who does.	

⚠ WARNING

The console contains high voltages which can be lethal. It is also connected to low power devices that must be kept intrinsically safe.

Turn power Off at the circuit breaker. Do not connect the console AC power supply until all devices are installed.

Touching a live circuit can cause electrical shock that may result in serious injury or death.

Example Site Diagrams

Figure 16-1 shows an example site with a VST ECS membrane vapor processor.

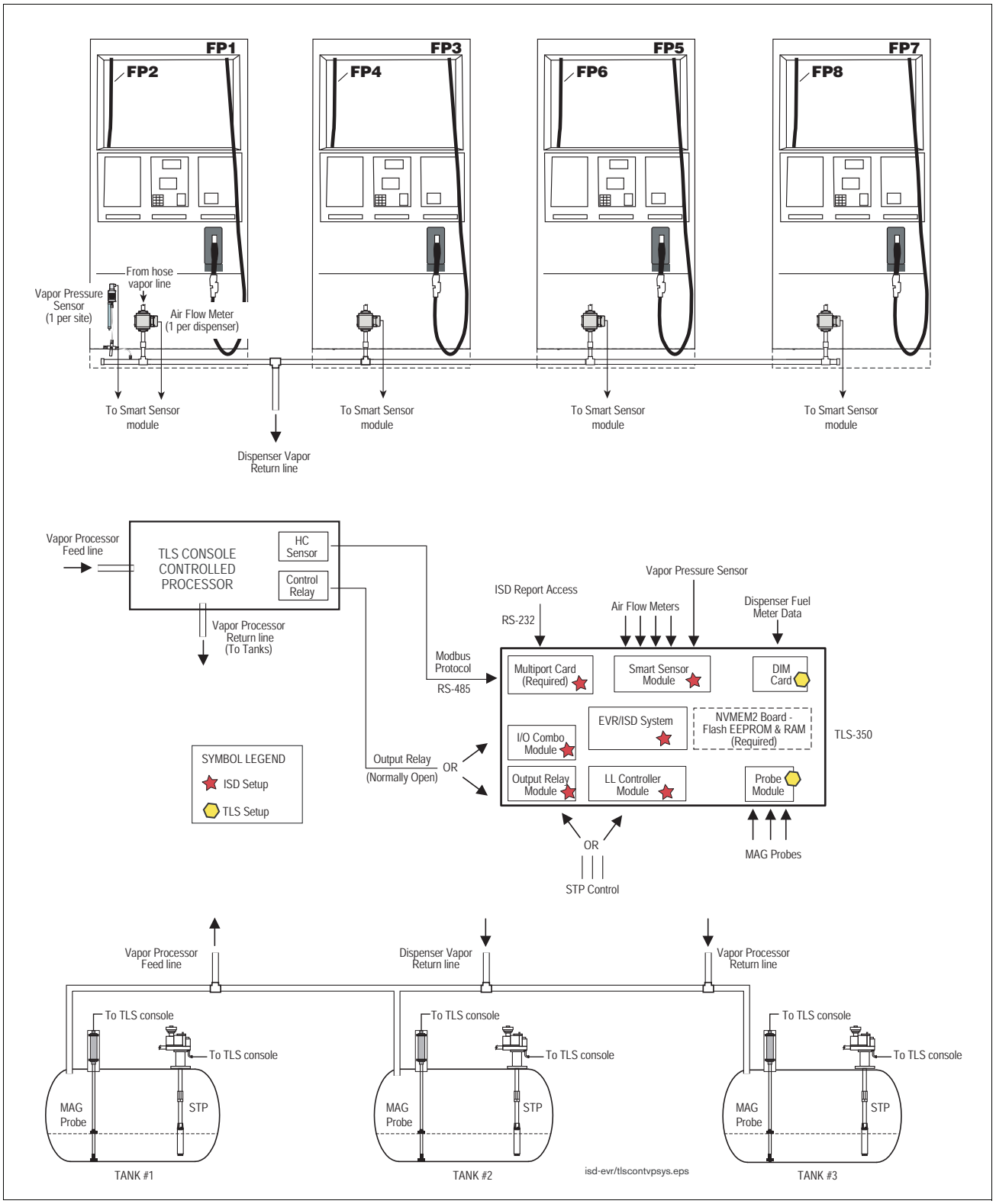


Figure 16-1. Example Site Diagram - TLS Console Controlled Vapor Processor

2 Installation

This section discusses the installation and wiring of the hardware required to enable the TLS console to perform ISD monitoring of the site's gasoline vapor recovery equipment (non-gas tanks are not monitored):

- Vapor Flow Meter
- Vapor Pressure Sensor
- Smart Sensor Interface Module (8 input and 7 input w/embedded pressure versions)
- NVMEM2 board - required
- 4-Relay Output Module
- Line Leak Detection
- Dispenser Interface Module
- Probe Interface Module
- Multiport Card
- I/O Combination Module

All field wiring, its type, its length, etc., used for TLS console sensors must conform to the requirements outlined in the Veeder-Root TLS-3XX Site Prep manual (P/N 576013-879).

Vapor Flow Meter

Install one Vapor Flow Meter in the vapor return piping of each gasoline dispenser following the instructions in the ISD Balance Flow Meter Installation guide (VST-IOM / Section 18). Program the meter following instructions in this manual.

Vapor Pressure Sensor

Install one Vapor Pressure Sensor in the vapor return piping of the gasoline dispenser closest to the tanks following the instructions in the Pressure Sensor Installation guide (VST-IOM / Section 17). Program the meter following instructions in this manual.

Installing TLS Console Modules - General Notes

TLS consoles have three bays in which interface modules can be installed; Comm bay (left door) and Power and Intrinsically-Safe bays (right door). Smart Sensor modules are installed in the Intrinsically-Safe (I.S.) bay only (Figure 16-2).

Most consoles will be shipped with modules installed as ordered. If additional features are added at a later date, modules will be field installed.

In all cases, the position of the modules, their respective connectors and the devices wired to the connectors must be recorded to prevent improper replacement during installation or service. A circuit directory for Power and I.S. bay Interface Modules is adhered to the back of the right-hand door for this purpose.

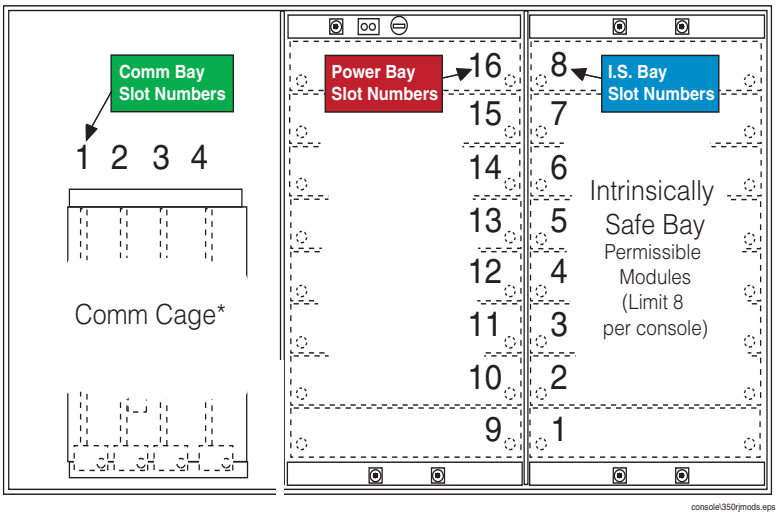


Figure 16-2. TLS console Interface Module Bays

CAUTION! During programming, module positions and the devices wired to each module are identified and stored in memory. If a connector is removed and reinstalled on a different module after programming, or if an entire module with its connector is removed and reinstalled in a different module slot, the system will not properly recognize the data being received.

Module Position

1. Record on the circuit directory the type of module in each slot location.
2. If a system contains multiple modules of a single type (i.e., two Smart Sensor Modules), they may be swapped between their respective slot locations, however, the connectors must remain with their original locations, not with the original modules.

Connector Position

1. Identify all connectors according to their slot location using the self-adhesive numbering labels furnished with each module. Accurately record on the circuit directory the location of each device wired to the connector as you attach wires to the module.
2. Once a device has been wired to certain terminals on a connector and the system has been programmed, the wires from that device may not be relocated to other terminals without reprogramming the system.

Grounding Probe and Sensor Shields

Connect probe and sensor cable shields to ground at the console only. Do not ground both ends of the shield.

CIRCUIT DIRECTORY

A circuit directory is adhered to the inside of the right-hand door. It should be filled out by the installer as the module's connectors are being wired.

The following information should be recorded for each slot:

- Module Type: record what type of module has been installed in the slot, e.g., Smart Sensor Module.
- Position Record: record the physical location and/or type of device wired to each terminal of the module connector in the slot, e.g., AFM1.

Smart Sensor Interface Module

The Smart Sensor Interface Module 8 input or 7 input w/embedded pressure versions monitor Air Flow Meter (AFM) and Vapor Pressure Sensor (VPS) inputs.

Switch off power to the TLS console while you install modules and connect sensor wiring.

Open the right door of the console and slide the necessary Smart Sensor modules into empty I.S. Bay slots. Connect the field wiring from each of the sensors following instructions in the Air Flow Meter and Vapor Pressure Sensor manuals. Setup the Smart Sensor module(s) following instructions in this manual.

NVMEM2 Board

Verify that a NVMEM2 board is installed in the TLS console (ref. Figure 2-14 in the V-R TLS-3XX Series Consoles Troubleshooting Manual P/N 576013-818, Rev J or later). This board contains flash EEPROM and RAM needed to run ISD software and store ISD reports. No setup is required.

Site Shut Down Requirements

Normal ISD operation requires TLS console control of the STP in each of the gasoline tanks. If the site has Wireless Pressure Line Leak Detection (WPLLD), Pressure Line Leak Detection (PLLD) or Volumetric Line Leak Detection (VLLD) for each tank, you can use the line leak disable setup to control the vapor recovery tanks (diesel tanks do not require shutdown). If the site does not have line leak detection for all vapor recovery tanks, you can use output relay setup to control each tank. In lieu of line leak detection, install the necessary modules (output relay) to control each gasoline tank.

Dispenser Interface Module (DIM)

Verify that a dispenser interface module (DIM) is installed in the TLS console communication bay (ref. Figure 16-2) and that it is designed to communicate with the type of gasoline dispensers installed at the site. The ISD software requires dispenser fuel flow meter data inputs. Reference TLS-350R Point-of-Sale (POS) Application Guide to select correct DIM card. Refer to the manual shipped with the DIM for installation instructions, refer to the TLS-3XX System Setup manual to program the DIM.

Probe Interface Module

Verify that a Probe Interface Module(s) is installed (Intrinsically-Safe bay) and that a Mag probe is in each gasoline tank and is connected to the module(s). Program the Mag probes following instructions in the TLS-3XX System Setup manual.

TLS Console with VST ECS Membrane Processor

Figure 16-3 shows the interconnection wiring between a TLS console and a VST ECS Membrane Processor.

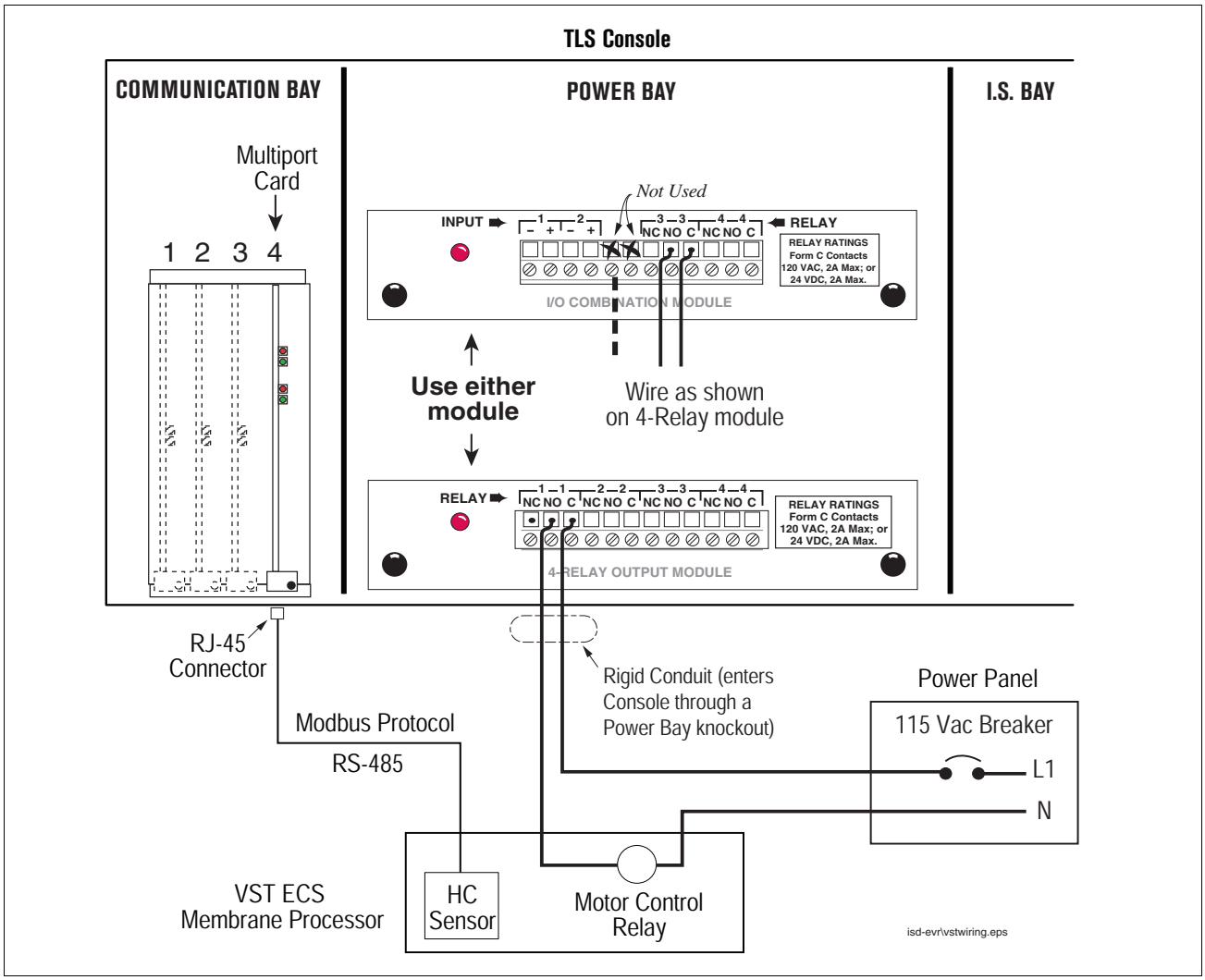


Figure 16-3. TLS Console Controlled VST ECS Membrane Processor

I/O Combination or 4-Relay Module for Vapor Processor Control

Connect the vapor processor motor control relay to one relay on either the 4-Relay or I/O Combination module as shown in Figure 16-3.

Multiport Card for Vapor Processor Communication

A Multiport card is needed for RS-485 communication with the TLS console and is required with VST ECS membrane processor installations. Verify that a Multiport card is installed in slot 4 of the card cage in the communications bay of the TLS console (ref. Figure 16-3). When installing this card, refer to the V-R Serial Comm Modules Installation Guide (577013-528) for instructions. Connect this card to the vapor processor as shown in Figure 16-3. Program the card as instructed in this manual.

3 Setup

Introduction

This section describes how to program the ISD system using the TLS console's front panel buttons and display. The procedures in this manual follow standard TLS console setup programming input, i.e., keypad/display interaction. If necessary, refer to Section 2 of the TLS-3XX System Setup manual (P/N 576013-623) to review entering data via the front panel keypads.

All ISD-related equipment must be installed at the site and connected to the TLS console prior to beginning the setups covered in this section. As with all TLS connections, you cannot change sensor wiring or module slots after programming or the system will not recognize the correct data. Reference the section entitled "Connecting Probe/ Sensor Wiring to Consoles" in the TLS-3XX Site Prep and Installation manual (P/N 576013-879) for rewiring precautions.

ALARM SETUPS

One of two TLS setups below must be performed to shut down the tank should certain ISD alarms occur:

- For ISD sites with line leak detection - XLLD Line Disable Setup (go to Figure 16-14)

  This setup assigns ISD alarms to a line leak detector that will shut down the tank's STP.

- For ISD sites without line leak detection - Output Relay Setup (go to Figure 16-16)

  This setup assigns ISD alarms to a relay that will shut down the tank's STP.

Smart Sensor Setup

The Smart Sensor Interface Module is installed in the Intrinsically-Safe bay of the TLS console. This module monitors Air Flow Meters and the Vapor Pressure Sensor. Figure 16-4 diagrams the Smart Sensor setup procedure. Figure 16-5 shows a printout of the Smart Sensor setup.

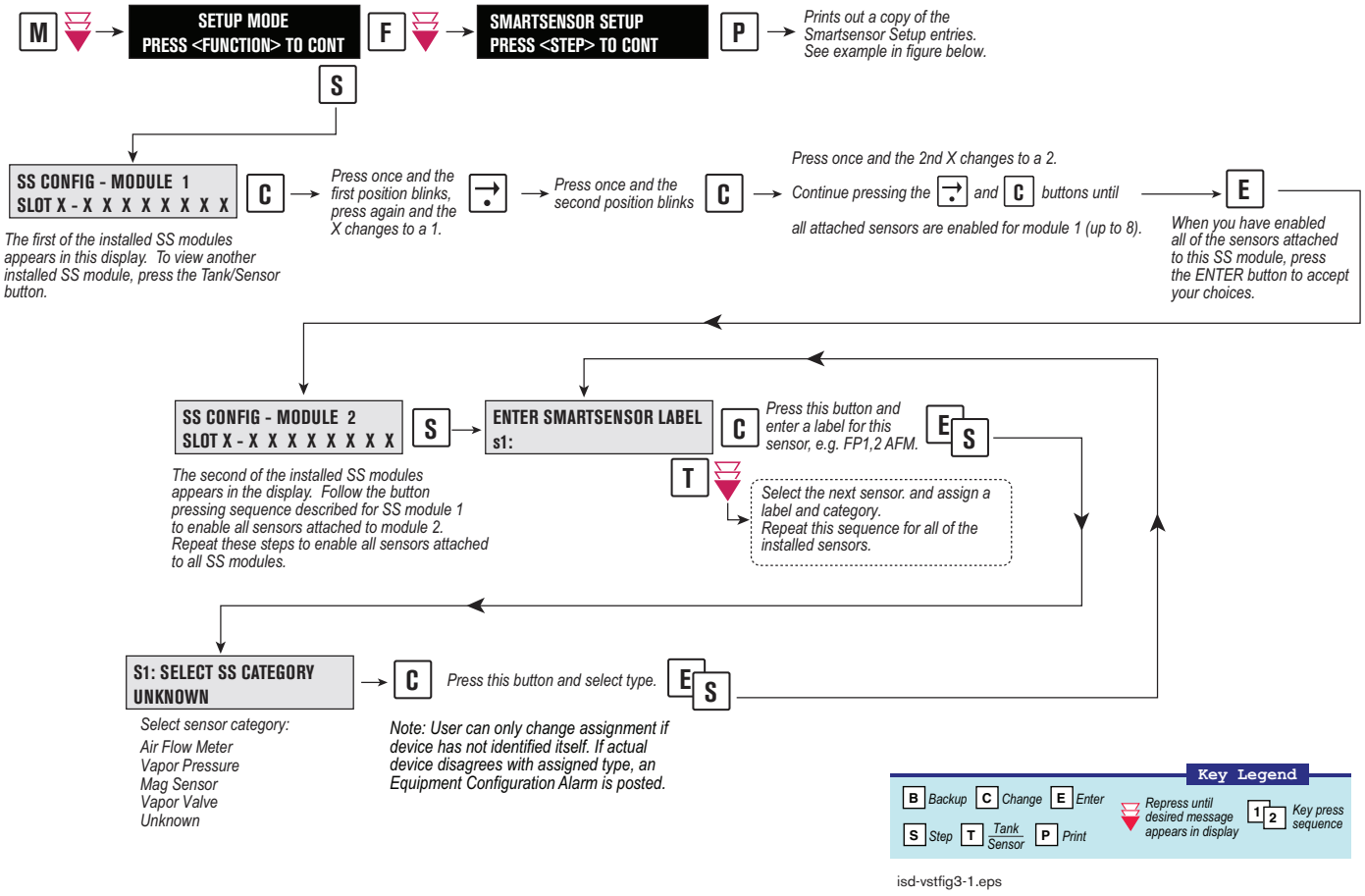


Figure 16-4. Smart Sensor Setup

```
SMARTSENSOR SETUP
----------------------

S01:FP 1   - 2
CATEGORY AIR FLOW METER

S02:VAPOR PRESSURE
CATEGORY VAPOR PRESSURE
```

isd-evr\sssetprt.eps

Figure 16-5. Smart Sensor Setup Printout Example

EVR/ISD Setup

You must choose the appropriate data sheet from Appendix A for the vapor recovery system installed at your facility (e.g., Single or Multi-Hose Dispensers) and record in those sheets, all of the unique information from sensors/hose positions, prior to beginning the TLS EVR/ISD set up procedure below.

Figure 16-6 describes the first of the EVR/ISD setup programming diagrams.

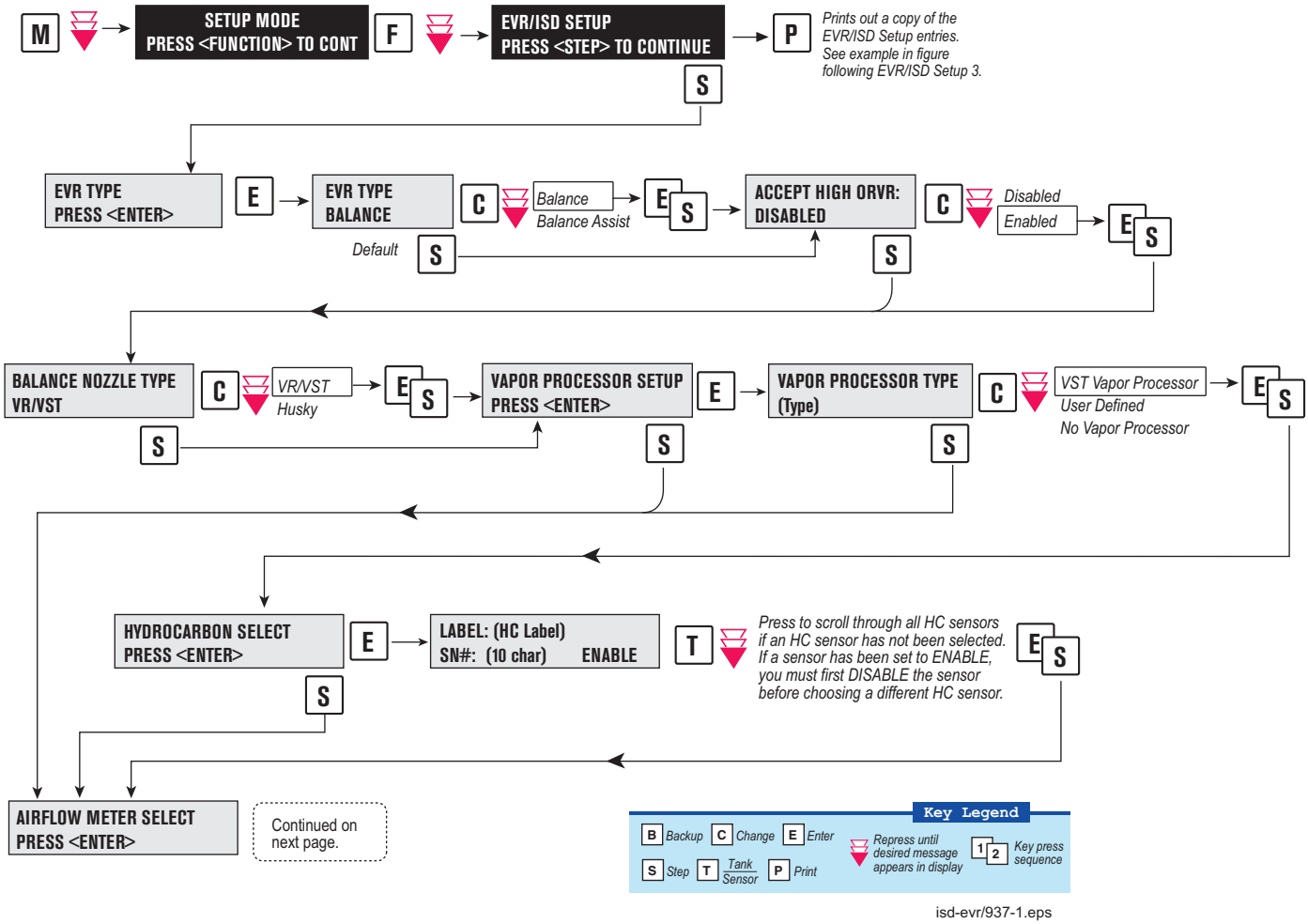


Figure 16-6. EVR/ISD Setup 1

Figure 16-7 describes the second of the EVR/ISD setup programming diagrams.

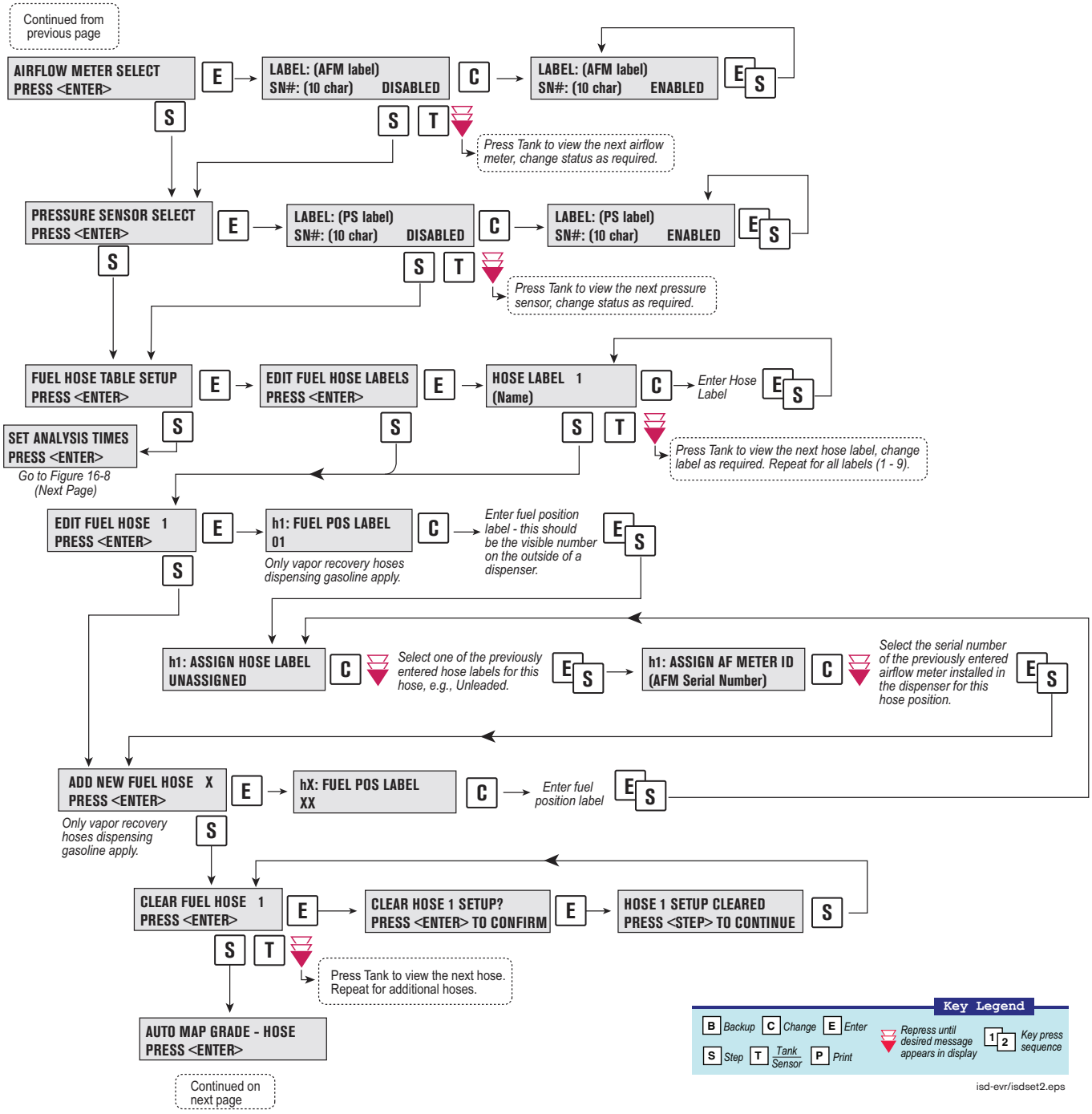


Figure 16-7. EVR/ISD Setup 2

Figure 16-8 describes the last of the EVR/ISD setup programming diagrams.

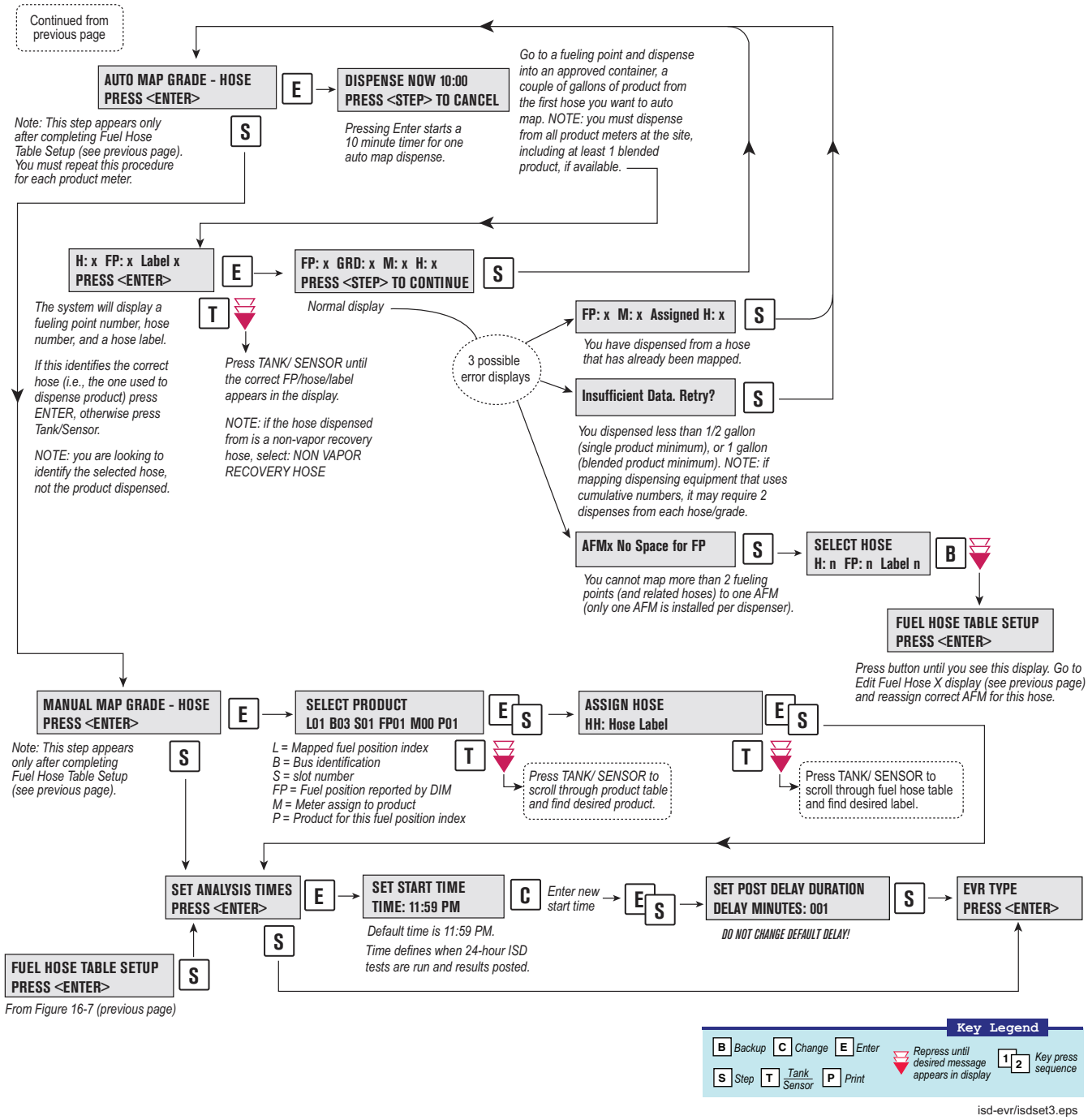


Figure 16-8. EVR/ISD Setup 3

```
EVR/ISD SETUP

EVR TYPE: BALANCE

BALANCE NOZZLE TYPE
VR/VST

VAPOR PROCESSOR TYPE
VST VAPOR PROCESSOR

ANALYSIS TIMES
TIME: 11:59 PM
DELAY MINUTES: 1

ACCEPT HIGH ORVR:
DISABLED

ISD HOSE TABLE
ID  FP  FL  HL  AA  RR
------------------------
01  01  01  02  01  UU
02  02  02  02  01  UU
03  03  03  02  02  UU
04  04  04  02  02  UU
05  05  05  02  03  UU
06  06  06  02  03  UU
07  07  07  02  04  UU
08  08  08  02  04  UU
09  09  09  02  05  UU
10  10  10  02  05  UU
11  11  11  02  06  UU
12  12  12  02  06  UU

ISD AIRFLOW METER MAP
ID SERIAL NUM LABEL
------------------------
 1 03001401   AFM1 FP1 -
 2 03001402   AFM2 FP3 -
 3 03001403   AFM3 FP5 -
 4 03001404   AFM4 FP7 -
 5 03001405   AFM5 FP9 -
 6 03001406   AFM6 FP11

ISD FUEL GRADE HOSE MAP
    1   2   3   4
FP MHH MHH MHH MHH AA
------------------------
01 101 301 901 U U  1
02 102 302 902 U U  1
03 103 303 903 U U  2
04 104 304 904 U U  2
05 105 305 905 U U  3
06 106 306 906 U U  3
07 107 307 907 U U  4
08 108 308 908 U U  4
09 109 309 909 U U  5
10 110 310 910 U U  5
11 111 311 911 U U  6
12 112 312 912 U U  6

LABEL TABLE
------------------------
 1: UNASSIGNED
 2: BLEND3
 3: REGULAR
 4: MID GRADE
 5: PREMIUM
 6: GOLD
 7: BRONZE
 8: SILVER
 9: BLEND2
10: BLEND4
```

ID = Hose ID
FP = Mapped fuel position as TLS Console recognizes it (-1 = unassigned)
FL = Fuel position label as written on dispenser
HL = Hose label
AA = Airflow meter ID assigned
RR = Relay ID
UU = unassigned

ID = Airflow meter ID assigned
Serial Number = Airflow meter's serial number

FP = Mapped fuel position
M/H = Meter and hose for product X
AA = Airflow meter assigned to first (lowest X) product with meter and hose assigned (usually same for entire dispenser)
U = Unassigned
N = Not used by ISD

ID = Label ID
Label = User definable
00 = reserved, non-ISD

isd-evr/937-2.eps

Figure 16-9. Example VST ECS Printout

Output Relay Setup - VST ECS Membrane Processor

The Output Relay setup programs an output relay so that the TLS console can switch a controlled vapor processor on and off as shown in Figure 16-10.

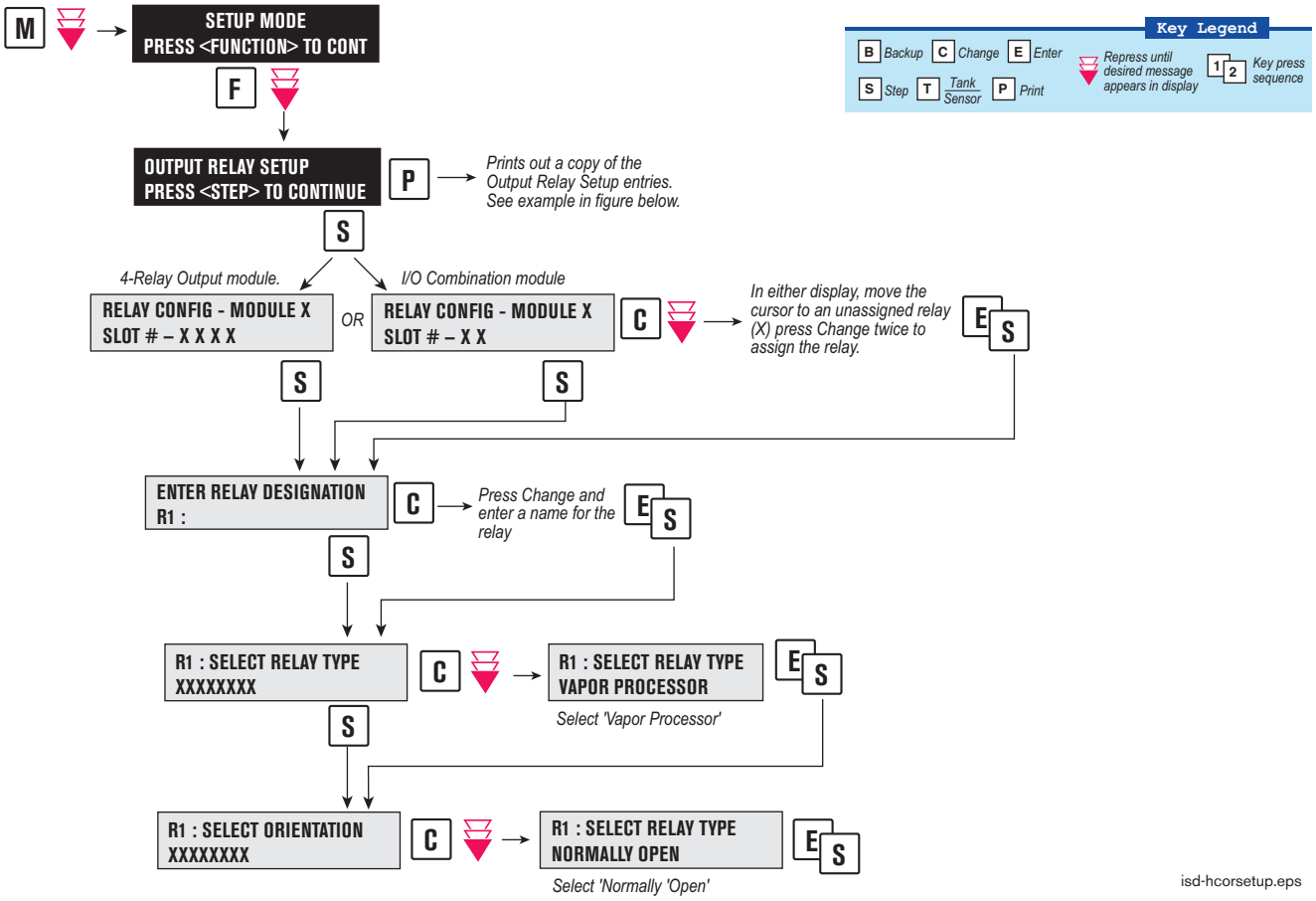


Figure 16-10. Output Relay Setup for VST ECS Membrane Processor

Figure 16-11 shows an example printout of the Output Relay setup.

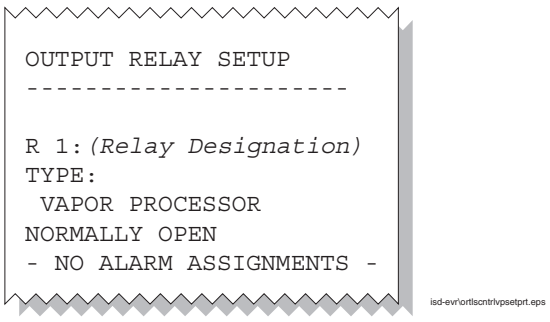


Figure 16-11. Output Relay Setup Printout Example for TLS Console Controlled Processor

PMC Setup

PMC setup allows you to select the maximum runtime and the start/stop pressure of TLS console controlled vapor processors (see Figure 16-12).

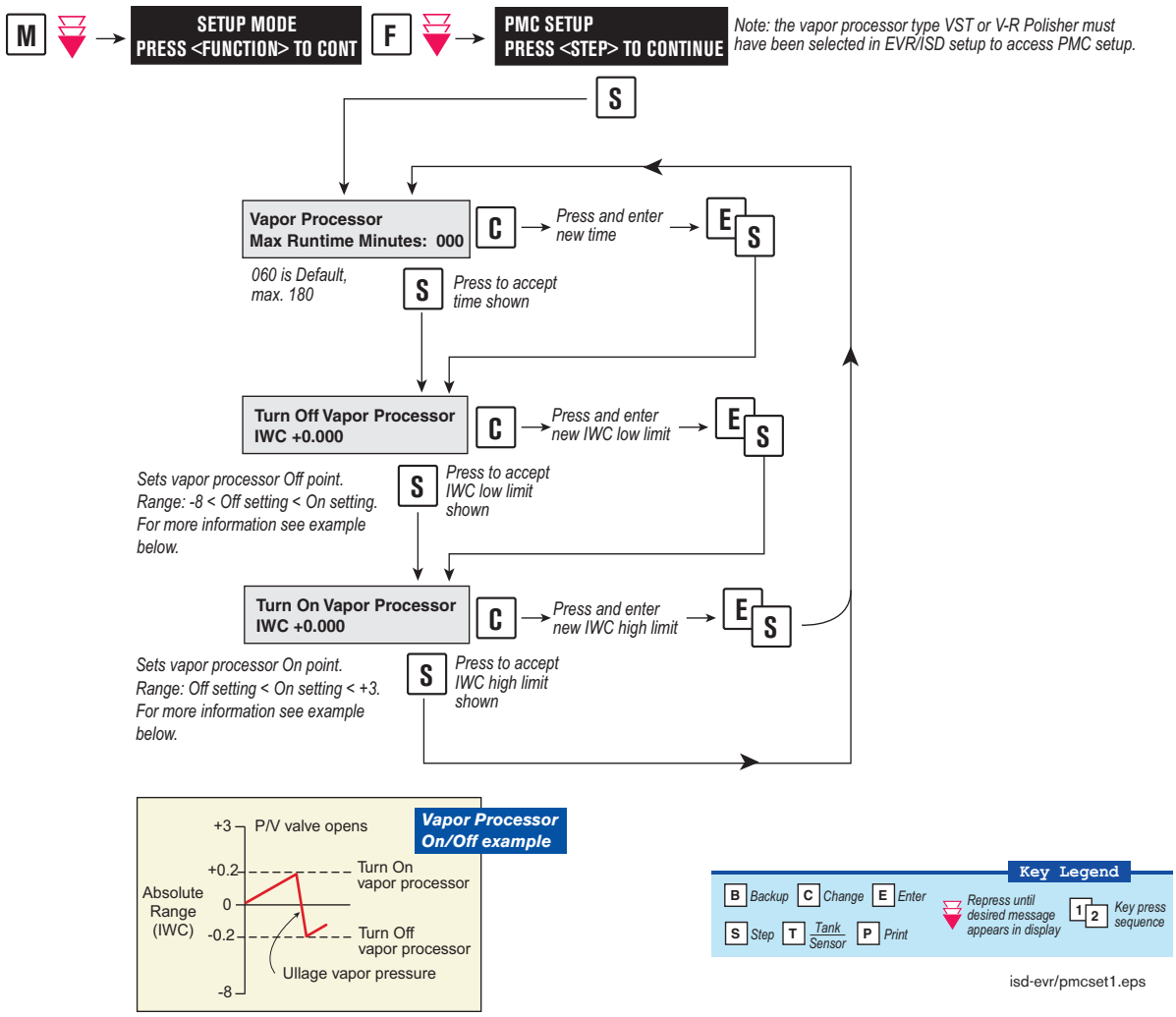


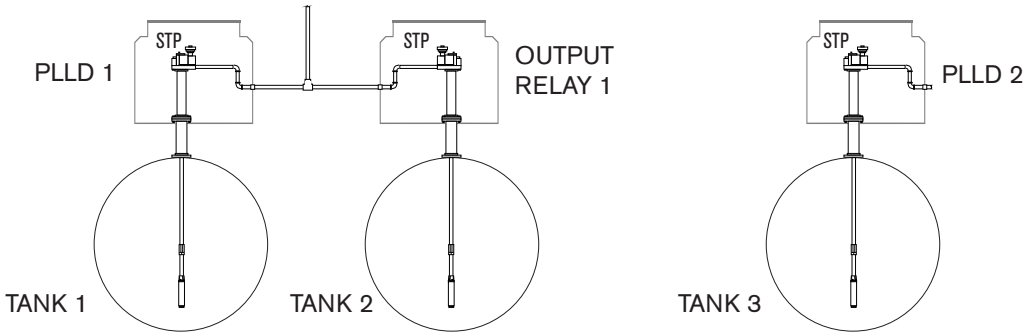
Figure 16-12. PMC Setup - VST ECS Membrane Processor

Alarm Setup

INTRODUCTION

California regulations (VAPOR RECOVERY CERTIFICATION PROCEDURE, CP-201, DATED MAY 25, 2006 CERTIFICATION PROCEDURE FOR VAPOR RECOVERY SYSTEMS AT GASOLINE DISPENSING FACILITIES, Sections 9.1.2) require shut down of dispensing systems that generate specific alarm conditions. To accomplish this, the TLS must be configured to control the gasoline tank's pump (diesel tanks are not monitored) in order to disable them when ISD shutdown alarm conditions occur. Prior to setting up ISD shut down alarms, you will need to determine how the site's tank pumps are controlled. If the site has line leak detection, you can shut down the line (tank) by assigning the ISD alarms in Line Leak Disable setup. In the absence of line leak detection, you can assign the ISD alarms to Output Relays which in turn can be wired to shut down the tank. Figure 16-13 illustrates two examples of tank pump control, one using a line leak/output relay combination and one using output relays.

EXAMPLE 1 - Line Leak Detector controls T1 and T3, Output Relay controls T2



EXAMPLE 2 - Output Relay 1 controls T1, Output Relay 2 controls T2, etc.

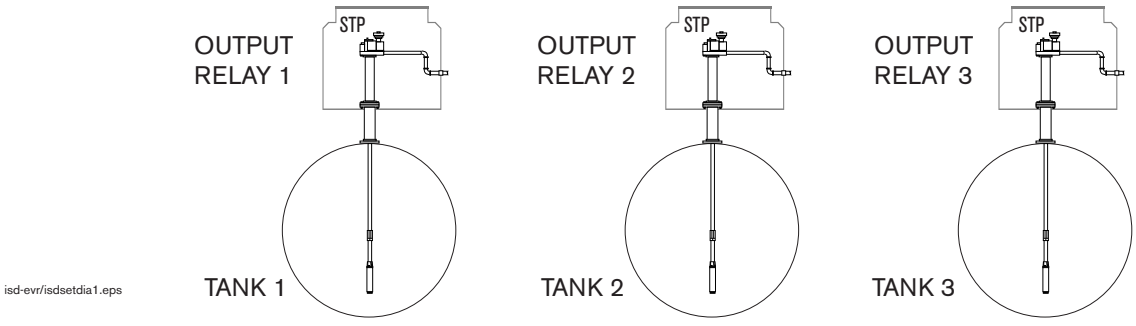


Figure 16-13. Site Tank Control Examples

Referencing the figure above, in example 1, you would assign the ISD shut down alarms for tank 1 to PLLD 1 in PLLD Line Leak Disable setup, for tank 2 to a relay in Output Relay Setup, and for tank 3 to PLLD 2 in PLLD Line Leak Disable setup. In example 2, you would assign the ISD shut down alarms for tank 1 to output relay 1, tank 2 to output relay 2, and tank 3 to output relay 3.

ALARM SETUP FOR SITES WITH LINE LEAK DETECTION

Figure 16-14 illustrates the setup steps required to assign ISD Shut Down Alarms to a tank having a line leak detection system installed.

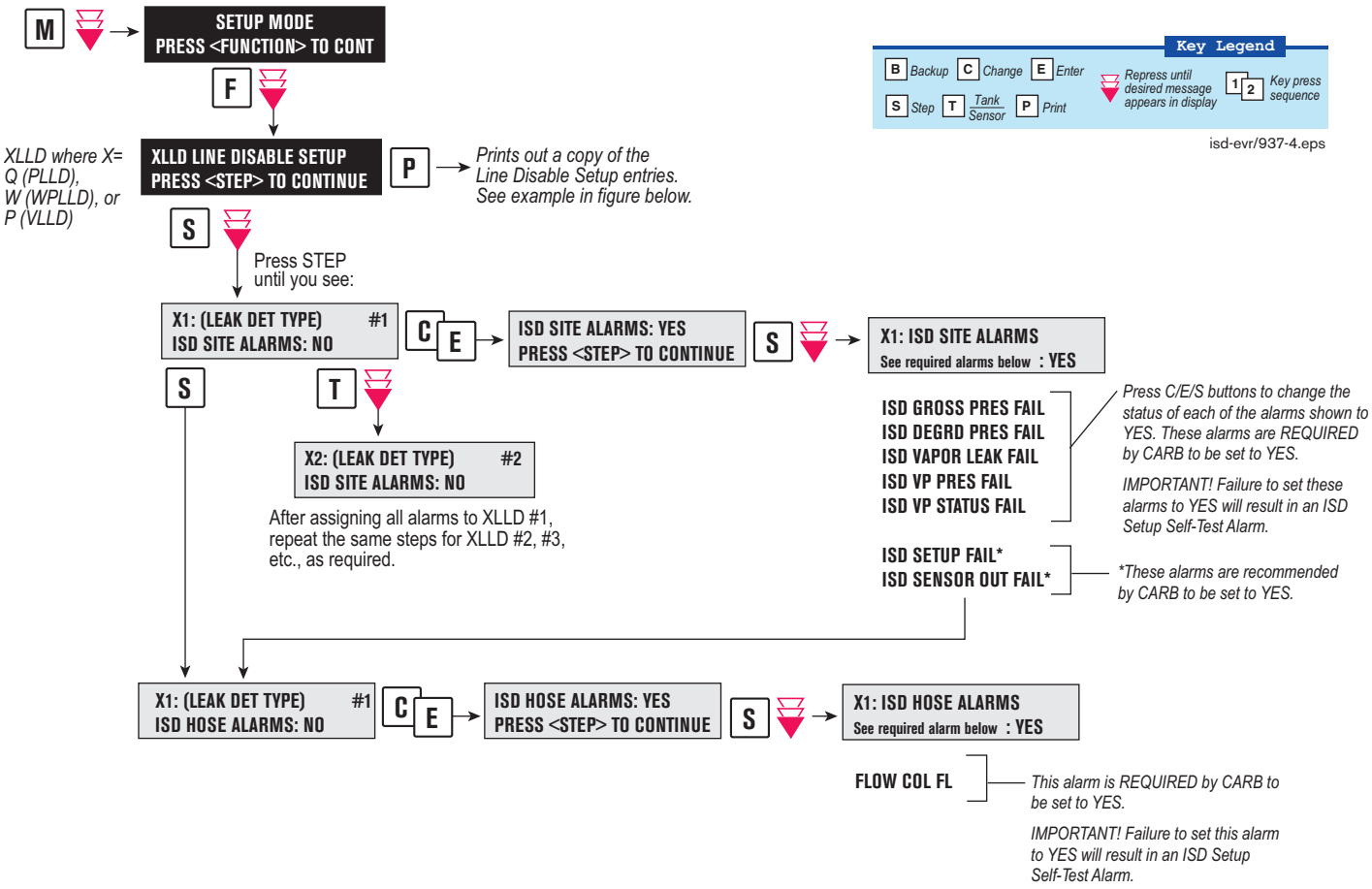


Figure 16-14. Assigning ISD Shut Down Alarms in Line Leak Disable Setup

Figure 16-15 shows a resulting printout of the Line Leak Disable setup with ISD alarms assigned.

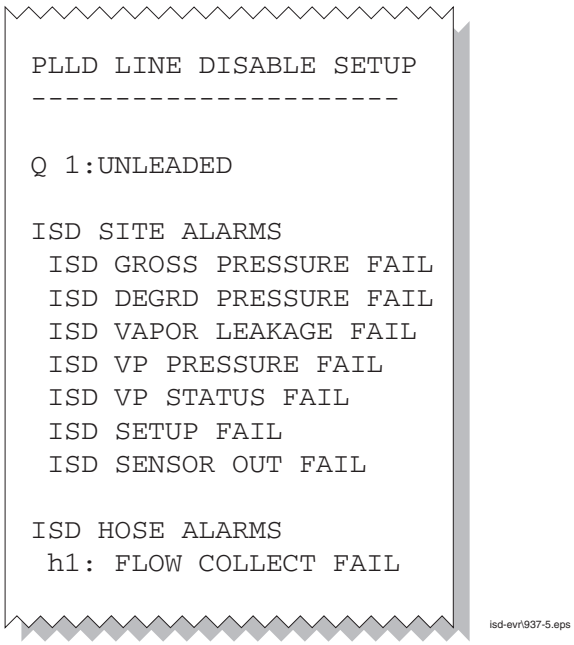


Figure 16-15. Example Line leak Disable Setup Printout

ALARM SETUP FOR SITES WITHOUT LINE LEAK DETECTION

Figure 16-16 illustrates the setup steps required to assign ISD Shut Down Alarms to a tank using either a Four Relay Output Module or an I/O Combination Module.

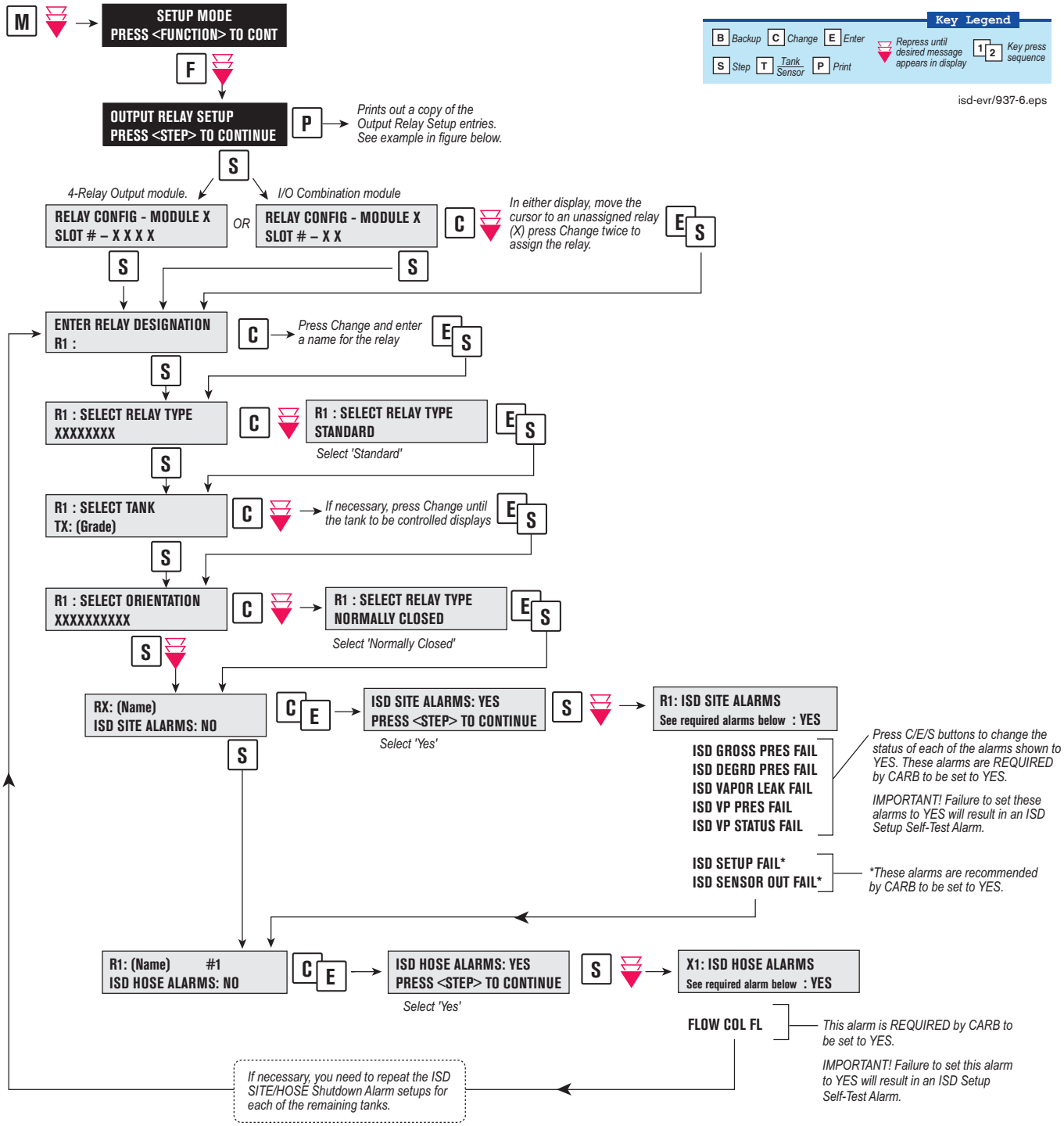


Figure 16-16. Assigning ISD Shut Down Alarms in Output Relay Setup

Figure 16-17 shows a resulting printout of the Output Relay setup with ISD alarms assigned.

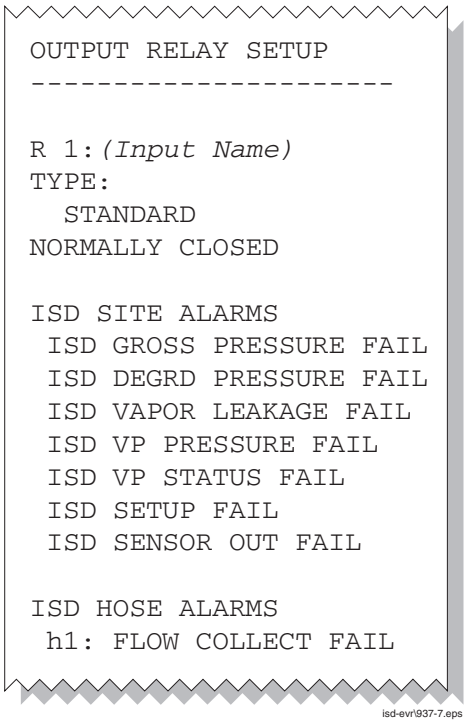


Figure 16-17. Example printout - ISD Alarms Assignments - Output Relay Setup

4 ISD Operability Test Procedure

The following procedures shall be used at field sites to determine the operability of the Veeder-Root ISD system to satisfy the requirements documented in VAPOR RECOVERY CERTIFICATION PROCEDURE, CP-201, DATED MAY 25, 2006 CERTIFICATION PROCEDURE FOR VAPOR RECOVERY SYSTEMS AT GASOLINE DISPENSING FACILITIES. Testing the ISD equipment in accordance with this procedure will verify the equipment's operability for Vapor Containment Monitoring and Vapor Collection Monitoring.

Veeder-Root's TLS console ISD System Self-Test Monitoring algorithms are designed to verify proper selection, setup and operation of the TLS console modules and sensors and will not complete and report passing test results in the event of a failure of components used in the system. Completed ISD monitoring tests are evidence that:

- The system was properly powered for data collection
- All necessary ISD sensors were setup and connected
- All necessary ISD sensors were operating within specification
- All internal components including TLS console modules were properly setup and operating within specification

Veeder-Root recommends printing a copy of the ISD ALARM STATUS and ISD DAILY report (REF. Section 5, Operation of the ISD Install, Setup & Operation Manual) periodically to determine that compliance tests are being completed in accordance with local and state regulations.

A step-by-step worksheet for recording data from the following operability tests is provided in Appendix B.

Vapor Pressure Sensor Verification Test

PRINCIPLE AND SUMMARY OF TEST PROCEDURE

Determining UST Pressure

The pressure of the USTs is determined at the Phase I vapor recovery adaptor (dry break assembly) with a vapor coupler test assembly as shown in Figures 2 and 3 of TP-201.3 (Determination of 2 Inch WC Static Pressure Performance of Vapor Recovery Systems of Dispensing Facilities) or a modified dust cap test assembly as shown in Figure 16-18 and Figure 16-19. The test assembly is equipped with a center probe, which opens the dry break, and a quick connect fitting that is connected to an electronic pressure measuring device or digital manometer. The test assembly should open the dry break with minimal venting of the USTs. This test can be performed while product is being dispensed into motor vehicles.

Determining Ambient Pressure

The Vapor Pressure Sensor is subjected to ambient pressure by turning the Vapor Pressure Sensor valve, which is located in the dispenser closest to the tanks, to the Atmospheric Valve Position as shown in Figure 16-20. This test can be performed while product is being dispensed into motor vehicles.

BIASES AND INTERFERENCES

1. This test shall not be conducted within 30 minutes following gasoline transfer from a cargo tank.
2. This test shall not be conducted if the processor is operating (audible indication that the processor is running).

RANGE AND ACCURACY

Electronic Pressure Measuring Device such as a digital manometer

Minimum readability shall be 0.01 inches WC with measurement range(s) to include at least up to positive and negative ten (±10) inches WC with a minimum accuracy of plus or minus 0.05 inches WC of full scale.

EQUIPMENT

1. The dust cap test assembly shall be modified in the following manner:
   a. Install a probe in the center of the dust cap as shown in Figure 16-18 (one method is to tap and thread probe). The probe shall be of sufficient length to open approximately ½ inch of the dry break while allowing the cap to maintain a leak tight seal on the adaptor.
   b. Install female quick connect fitting on the top of the dust cap, offset from the center probe as shown in Figure 16-18. A Swagelok, part number SS-QC4-B-4-PM, quick connect fitting or equivalent can be used.
   c. Use "Tygon tubing" or equivalent to connect the manometer to the dust cap (Figure 16-19). Install a male quick connect fitting (Swagelok part number SS QC4-5-400 or equivalent can be used) on one end of a ferrule stainless steel tube (or equivalent material). Connect one end of the "Tygon tubing" to the stainless steel tube and connect the other end to the digital manometer (Figure 16-19).
2. Alternatively, the vapor coupler test assembly, Figures 2 and 3 of TP 201.3 may be used in lieu of the dust cap test assembly.
3. Digital Manometer (Electronic Pressure Measuring Device)

   Use a minimum range ±10.00 inches WC digital manometer to monitor the UST pressure with a minimum readability of 0.01 inches of WC. Dwyer Series 475 Mark III Digital manometer or equivalent can be used. A copy of the manufacturer's operating instructions shall be kept with the equipment.

CALIBRATION REQUIREMENTS

1. A copy of the most current calibration of the electronic pressure measuring device shall be kept with the equipment.
2. All electronic pressure measuring devices shall be bench tested for accuracy using a reference gauge, incline manometer or National Institute of Standards and Technology (NIST) traceable standard at least once every twelve (12) consecutive months. Accuracy checks shall be performed at a minimum of five (5) points (e.g., 10, 25, 50, 75 and 90 percent of full scale) each for both positive and negative pressure readings. Accuracy shall meet the requirements in the Range and Accuracy section above.

DETERMINING UST PRESSURE

Pre-Test Procedure

1. Turn on digital manometer and allow instrument to warm up for five minutes.
2. Zero out digital manometer using adjustment pod on top of instrument in accordance with manufacturer's instructions. Drift may be minimized by re zeroing immediately after use by venting both pressure ports to atmosphere and adjusting the knob until the display reads exactly zero.
3. Attach the male quick connect fitting to the female quick connect fitting on the modified vapor dust cap.
4. Attach digital manometer to open end of Tygon tubing.

Test Procedure

1. Attach the dust cap or vapor coupler test assembly to the vapor adaptor (Figure 16-19).
2. On the TLS Console front panel, use the 'mode key' to scroll to "DIAG MODE" then use the function and step keys, as shown in Figure 16-21 to view the current pressure value.
3. Simultaneously record the ullage pressure from the digital manometer (connected to the vapor coupler test assembly) and the TLS Console. Record the above information on Appendix B, Form 1 "Data Form for Vapor Pressure Sensor UST Pressure Test." Districts may require the use of an alternate form, provided it includes the same minimum parameters as identified in the Data Form.
4. Verify that the pressure reading from the TLS Console is within ±0.2 inches WC from the digital manometer reading. If difference is not within ±0.2 inches WC, the pressure sensor is not in compliance with the pressure sensor requirements.
5. Press the <MODE> key to leave the 'PMC DIAGNOSTIC' menu.

DETERMINING AMBIENT PRESSURE

Test Procedure for Testing Sensor Under Ambient Pressure

1. Access the Vapor Pressure Sensor, which is located in the dispenser closest to the tanks. Record which dispenser contains the pressure sensor and the pressure sensor serial number on the data form.
2. Remove the cap from the ambient reference port of the Vapor Pressure Sensor valve and open the valve to atmosphere by turning it 90 degrees so that the flow arrows point to both the Vapor Pressure Sensor sensing port and the ambient reference port (see Figure 16-20).
3. On the TLS Console front panel, use the 'mode key' to scroll to "DIAG MODE" then use the function and step keys, as shown in Figure 16-21 to view the current pressure value.
4. Verify that the pressure value is between +0.2 and -0.2 inches WC. If the pressure value is not within this range, the pressure sensor is not in compliance with the pressure sensor requirements.
5. Replace the cap on the ambient reference port of the Vapor Pressure Sensor valve. Restore the Vapor Pressure Sensor valve by turning it 90 degrees so that the flow arrows point to both the Vapor Pressure Sensor sensing port and the UST vapor space sensing line (ref. Figure 16-20).
6. Press the <MODE> key to leave the 'PMC DIAGNOSTIC' menu.
7. Record the above information on Appendix B, Form 2 "Data Form for Vapor Pressure Sensor Ambient Reference Test." Districts may require the use of an alternate form, provided it includes the same minimum parameters as identified in the Data Form.

ALTERNATE PROCEDURES

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

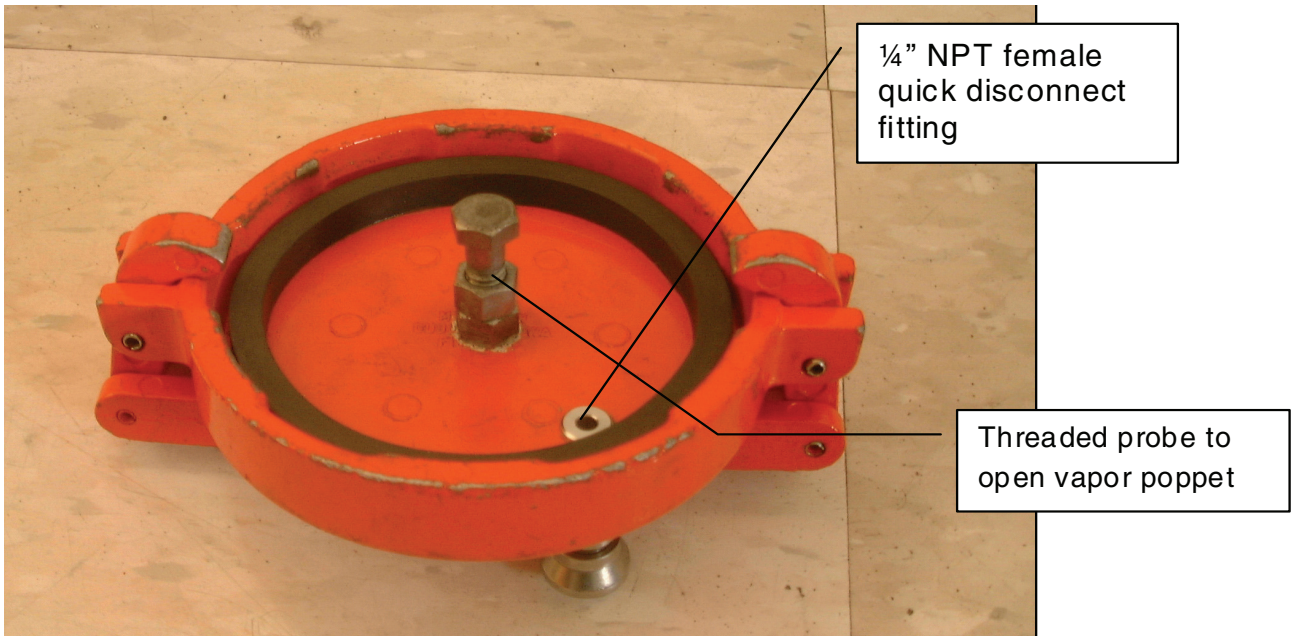


Figure 16-18. Typical modified vapor adaptor dust cap (bottom view)

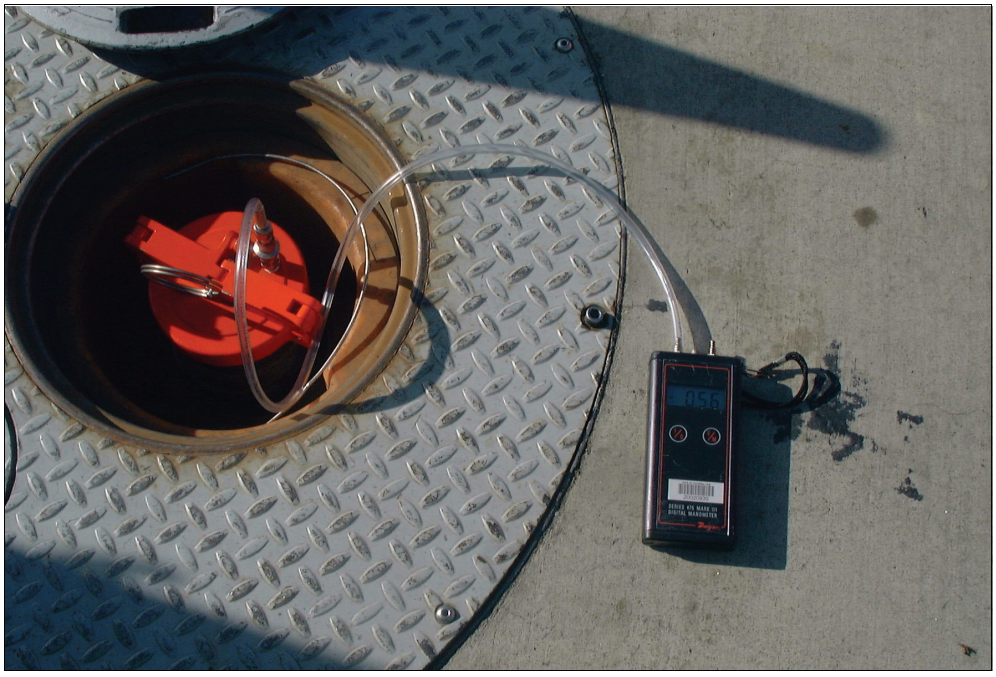


Figure 16-19. Typical field installation of UST Pressure Measurement Assembly

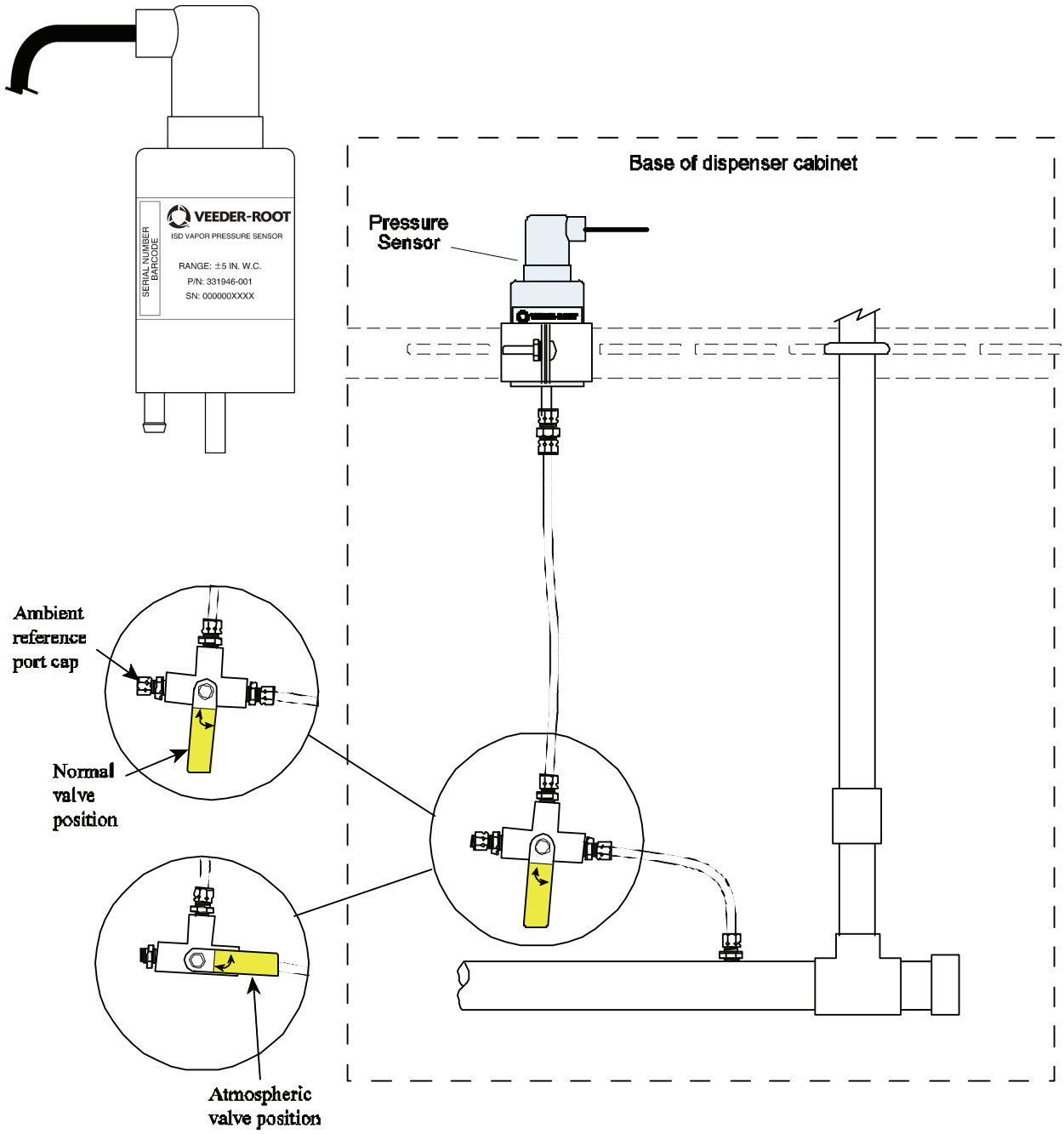


Figure 16-20. Vapor pressure sensor valve positions

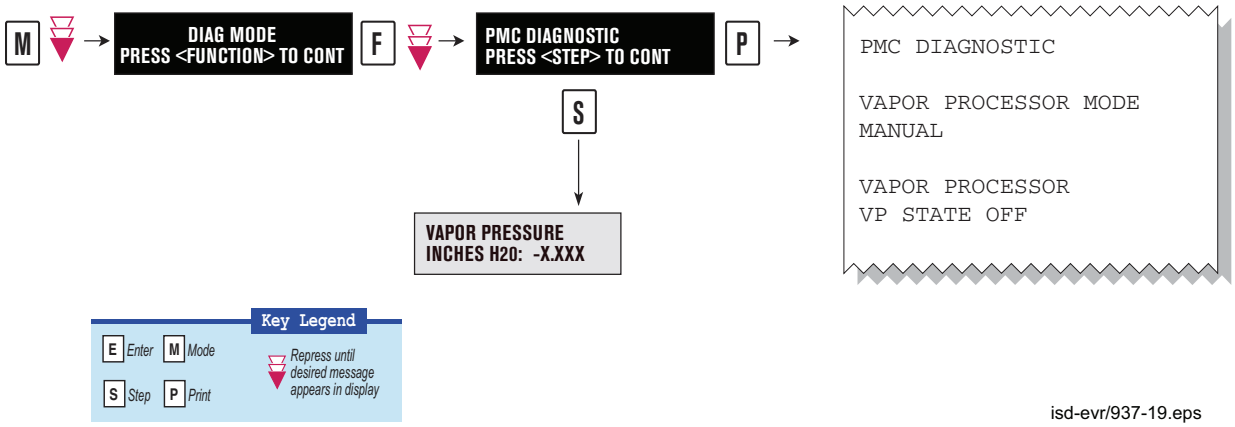


Figure 16-21. Accessing the vapor pressure sensor reading

Vapor Flow Meter Operability Test

This procedure is used to verify the setup and operation of the Vapor Flow Meter (VFM).

EQUIPMENT

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

Flow meter. Use a flow meter (Rotometer) capable of accurately measuring nitrogen flow rate of 60 cubic feet per hour (cfh).

Pressure Measuring Device. An electronic pressure measuring device with a full range that shall not exceed 0-10 inches of water column (WC) with a minimum accuracy of 0.5 percent of full-scale. A 0-20 inches WC device may be used provided the minimum accuracy is 0.25 percent of full-scale.

Squeeze Bulb. A rubberized or equivalent device used to increase pressure to 5.00" WC.

Balance Nozzle Adapter (P/N 2509-001). Provided by VST.

Surrogate Spout. Only the VST Surrogate Spout Assembly, Part No. 2510-001 , can be used to conduct the pre-test leak check. Figure 16-22 shows the VST Surrogate Spout Assembly.

Adapter Supply Hose. The nominal inside diameter of the flexible hose shall be between 0.75 and 1.00 inches, and the length of the tubing shall be between 3 feet and 6 feet.

Ball Valve. The nominal inside diameter of the ball valve shall be 0.25".

Nitrogen Supply Line. The nominal inside diameter of the flexible tubing shall be between 0.25" and 0.375".

Gas Volume Meter. Use a Dresser Measurement Roots Meter®, or equivalent (preferably fitted with a digital readout), to measure the volumetric flow rate through the Balance Nozzle Adapter. The gas volume meter shall be calibrated within180 days prior to conducting this procedure.

Stopwatch. Use a stopwatch accurate to within 0.2 seconds.

Lubricant. Appropriate lubricant, either grease or spray lubricant, shall be used to ensure a tight seal on the interface of the nozzle and the Balance Nozzle Adapter.

Leak Detection Solution. Any liquid solution designed to detect gaseous leaks may be used to verify the pressure integrity of test equipment during this test.

Notebook personal computer (PC) with ISD PC Setup Tool Version 1.03 or later. Serial communication cables are required to connect to the ISD system.

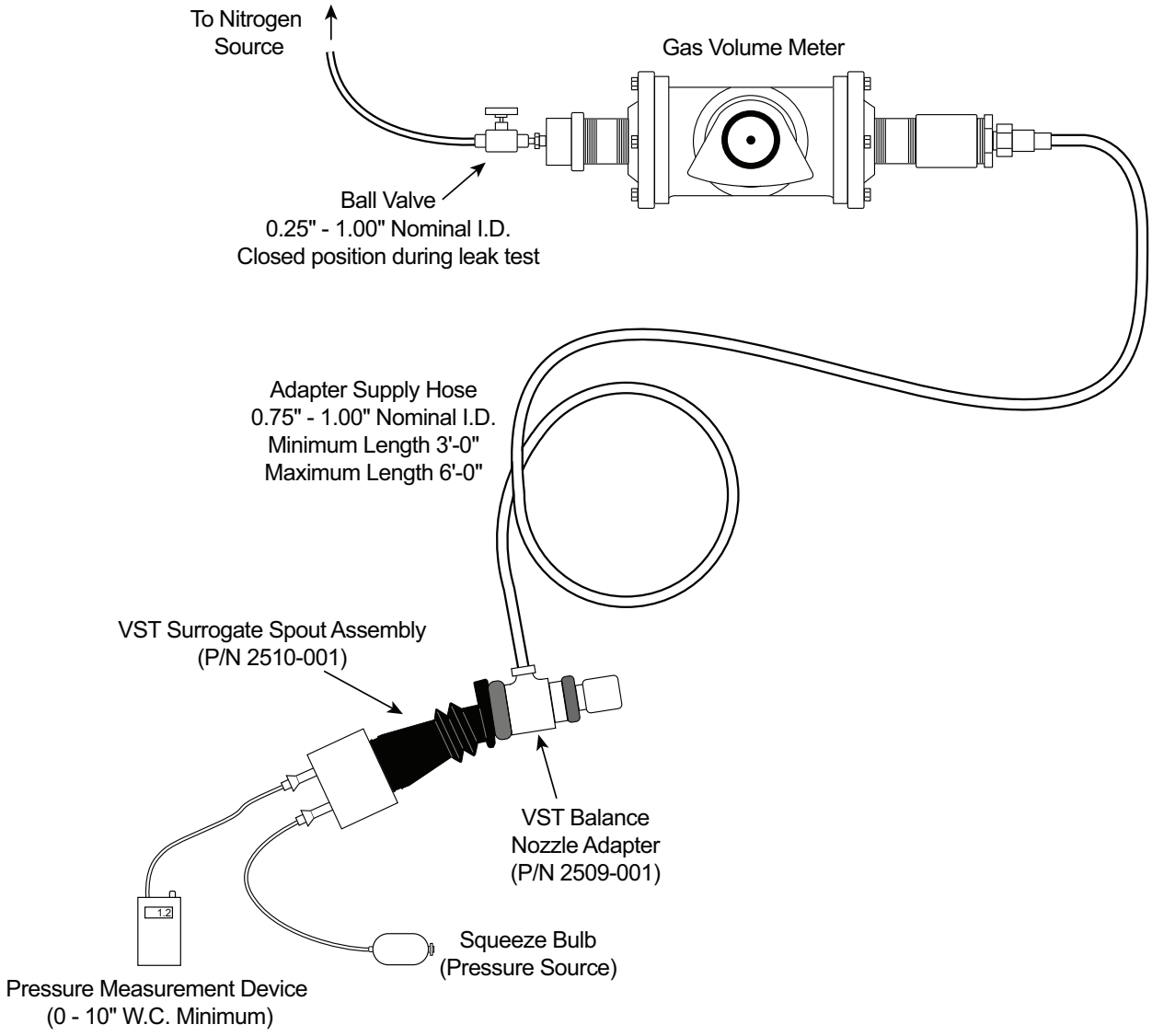


Figure 16-22. VST Surrogate Spout Assembly

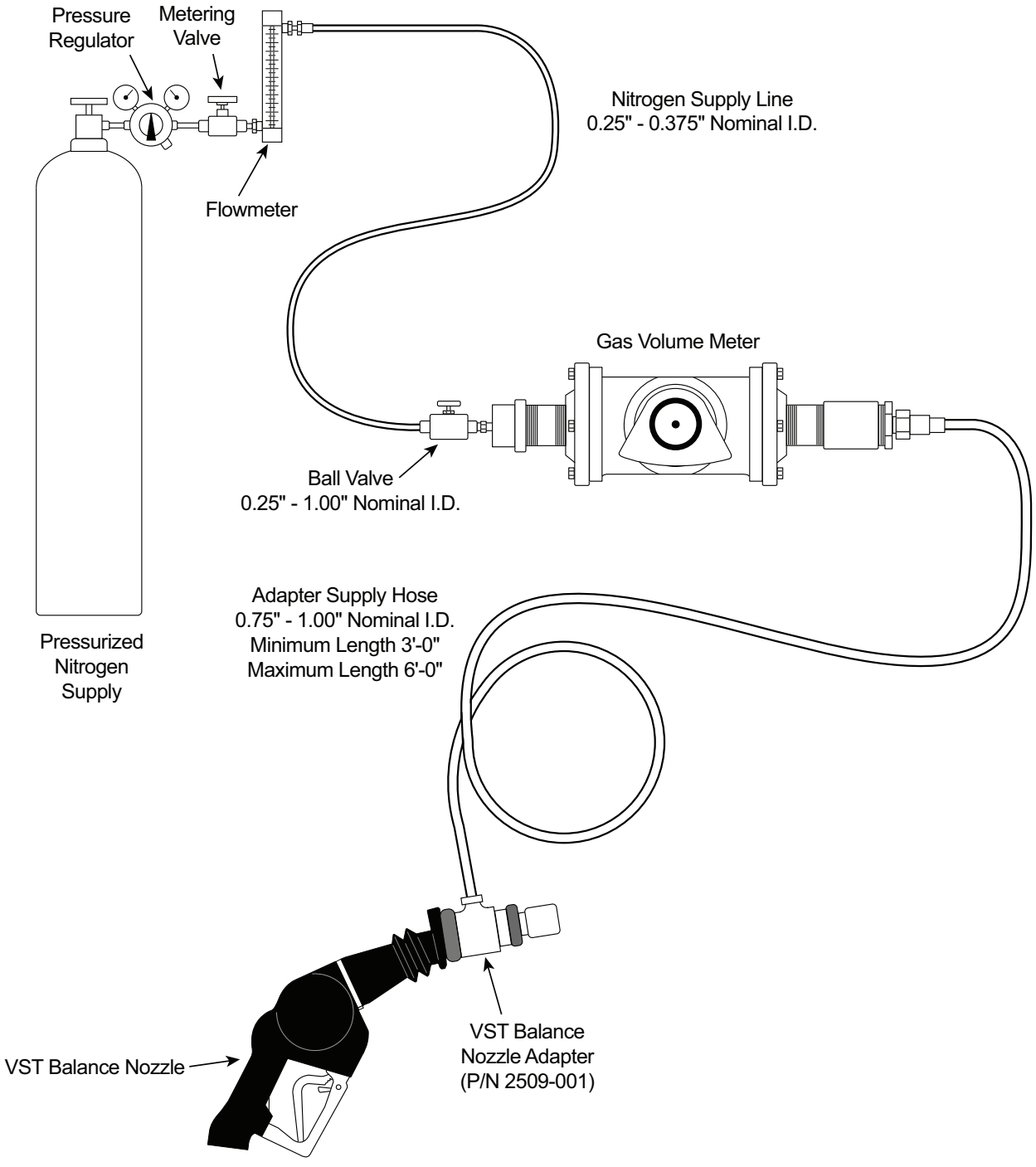


Figure 16-23. Vapor Flow Meter Test Assembly

PRE-TEST PROCEDURES

1. From the TLS, ISD Setup Menu print the ISD Setup Report. The ISD Hose Table will identify which VFM (column AA) is being used on each Fueling Position (FL).

```
ISD HOSE TABLE
ID  FP  FL  HL  AA  RR
------------------------
01  01  01  10  01  UU
02  02  02  10  01  UU
03  03  03  10  02  UU
04  04  04  10  02  UU
05  05  05  10  03  UU
06  06  06  10  03  UU
07  07  07  10  04  UU
08  08  08  10  04  UU
09  09  09  10  05  UU
10  10  10  10  05  UU
11  11  11  10  06  UU
12  12  12  10  06  UU

ISD AIRFLOW METER MAP
ID SERIAL NUM LABEL
------------------------
 1 00000111   AFM1 FP1 -
 2 00000112   AFM2 FP3 -
 3 00000113   AFM3 FP5 -
 4 00000114   AFM4 FP7 -
 5 00000115   AFM5 FP9 -
 6 00000116   AFM6 FP11
```

2. Connect the notebook PC running Veeder-Root's "ISD PC Setup Tool" terminal mode, v1.03 or higher, or use Microsoft HyperTerminal to the dedicated TLS serial port that is required for ISD reports access. Access the individual airflow meter totals for the airflow meter being tested using the following RS232 command: IV8700.

   Typical IV8700 Report

```
DEC 14, 2007  5:47 AM
AIR FLOW METER TOTALS
DATE-TIME                VOLUME
                    AFM  1    AFM  2    AFM  3    AFM  4
07-12-14 05:46:00 76739.892 63139.977 42860.023 44139.693
```

3. Conduct a pre-test leak check of the Balance Nozzle Adapter, the gas volume meter and the adapter supply hose by connecting the Balance Nozzle Adapter to a surrogate spout as shown in Figure 16-22. Turn the ball valve in the Figure 16-22 to the closed position. Raise the test pressure to 5.00" ±0.50" WC using a squeeze bulb. There shall not be a pressure drop of more than 1.00" WC from the above starting pressure for 30 seconds from the start of the test. If the leak test passes, proceed with the testing. If the leak test fails, proceed to isolate the source of the leak by pressurizing the test equipment again. Squirt liquid leak detector solution on interfaces and other potential leak sources and watch for the formation of bubbles. Once leak(s) are repaired, repeat the leak test procedure.

   Note: Leak checks shall be conducted in a shaded area or away from direct sunlight. Leak checks may be conducted during the testing to ensure leak integrity of test equipment.

4. Assemble the equipment as shown in Figure 16-23, Vapor Flow Meter Test Assembly. Leave the Balanced Nozzle Adaptor off of the nozzle at this time. Do not enable the dispenser to dispense product. Remove nozzle and utilize any method to keep the nozzle hook in the off position.
5. Ensure that the ground strap is properly connected to an acceptable ground.

   Note: The test requires that the nozzle be squeezed and liquid product must not flow from the dispenser.

TEST PROCEDURES

1. Prevent dispensing from all other fueling positions that use the VFM being tested.
2. Record the VFM serial number and fueling position being tested on the worksheet.
3. Completely drain any gasoline that may be in the nozzle and hose vapor return path by any acceptable method.
4. Continuing from Step 4 in the Pre-Test Procedures above, turn the ball valve to the open position and, adjust the nitrogen flow using the Rotometer to 60 cfh +/- 5.0 cfh.
5. Once the nitrogen flow is set, turn the ball valve to the closed position to stop the flow of nitrogen through the gas volume meter. This will ensure the nitrogen flow rate is set and the nitrogen can instantaneously be activated when the ball valve is turned to the open position.
6. Apply appropriate lubricant on the surface area in the Balance Nozzle Adapter. Lubricant can also be applied to the nozzle spout and the face seal (rubber boot) of the nozzle and the back of the Balance Nozzle Adapter if necessary.
7. Wait for two minutes of no air or liquid flow activity on the dispenser with the airflow meter being tested.
8. With the notebook PC connected to the TLS ISD, and the IV8700 Report page open, record the initial meter total for the VFM being tested on the worksheet.
9. Record the initial gas volume meter reading on the worksheet.
10. **Ensure the dispenser is <u>not</u> enabled to dispense product.** Simultaneously squeeze the nozzle handle to the full dispensing position and turn the ball valve to the open position to allow nitrogen to flow.

    Note: If the nozzle handle is not engaging the vapor/product valve within the nozzle, turn off the nitrogen flow using the ball valve; remove the Balance Nozzle Adapter from the nozzle to release the nitrogen pressure build up and repeat Steps 7 through 10. Excess pressure build up in the nozzle will engage the automatic shut-off diaphragm and not allow the vapor/product valve within the nozzle to open.
11. Monitor the gas volume meter display. Simultaneously stop the flow once 1.0 cubic feet (cf) +/- 0.10 cf of nitrogen is reached by turning the ball valve to the closed position and also releasing the nozzle handle.

    Note: Final volume values may be biased if the ball valve and the nozzle handle are not activated at the same time.
12. Record the end meter reading from the gas volume meter. Calculate the total cubic feet value by subtracting the initial meter reading obtained in Step 9 from the final meter reading in this step.
13. Convert the total cubic feet value to gallons using the equation on worksheet. Record the final gallon value on the worksheet.
14. Wait two minutes after each test run before obtaining the VFM reading from the notebook PC that is connected to the TLS ISD. A period of two minutes is required by the ISD system to receive and document total flow from the VFM.

15. Calculate the total VFM volume by subtracting the initial reading on Step 8 from the final reading on Step 14 and record the value on the worksheet.
16. Calculate the percent difference between the final gallons reading from the gas volume meter and the final VFM reading using the equation shown on the worksheet.

    Pass: If the volume percent difference between recorded ISD VFM and the gas volume meter is within 15%, check “Pass” on the worksheet, and repeat the Test Procedures for the next dispenser.

    Fail: If the volume percent difference between recorded ISD VFM and the gas volume meter is not within 15%, then go to Step 17.
17. Repeat Test Procedures using the opposite side of the dispenser. If test passes, continue to the next dispenser. If test fails, go to Step 18.
18. Conduct the leak test in Step 3 (of Pre-Test Procedures above) to evaluate the test equipment. If the equipment leak test passes go to Step 19. If the test fails, repair the leak and go to Step 17.
19. Replace the ISD flow meter and note the new vapor flow meter serial number on the form. Perform a Clear Test After Repair to reset tests for that dispenser, (see Section 7 of the ISD Install, Setup & Operation Manual, ISD/PMC Diagnostic Menus), at the TLS for both fueling positions on that dispenser.
20. After replacing the vapor flow meter repeat the Balance Vapor Flow Meter Operability Test.

POST-TEST PROCEDURES

1. Remove the Balance Nozzle Adapter and all equipment from the nozzle assembly.
2. A post-leak test of the equipment is not required if all the VFM’s are within range. For the VFM’s that are not within range, Steps 17 through 20 (of Test Procedures above) must be conducted. The leak test in Step 3 (of Pre-Test Procedures above) will be conducted to further evaluate the test equipment.
3. Prior to transportation, the inlet and outlet of the gas volume meter shall be carefully sealed to prevent foreign matter from entering the meter.

Site Shutdown Test

1. This test must be performed by a certified Veeder-Root contractor.
2. Remove power from TLS console.
3. Confirm power to submersible pumps is off by verifying that gasoline dispensing has been disabled.
4. Restore power to TLS console.
5. Complete Site Shutdown Worksheet

5 Operation

Alarms

OVERVIEW OF TLS CONSOLE INTERFACE

The TLS console is continuously monitoring the vapor recovery system, PMC and ISD sensors for alarm conditions such as excessively high or low vapor collection, containment system vapor leakage and equipment problems.

During normal operation when the TLS console and monitored EVR/ISD System is functioning properly and no alarm conditions exist, the "ALL FUNCTIONS NORMAL" message will appear in the system status (bottom) line of the console display, and the green Power light will be On (see Figure 16-24).

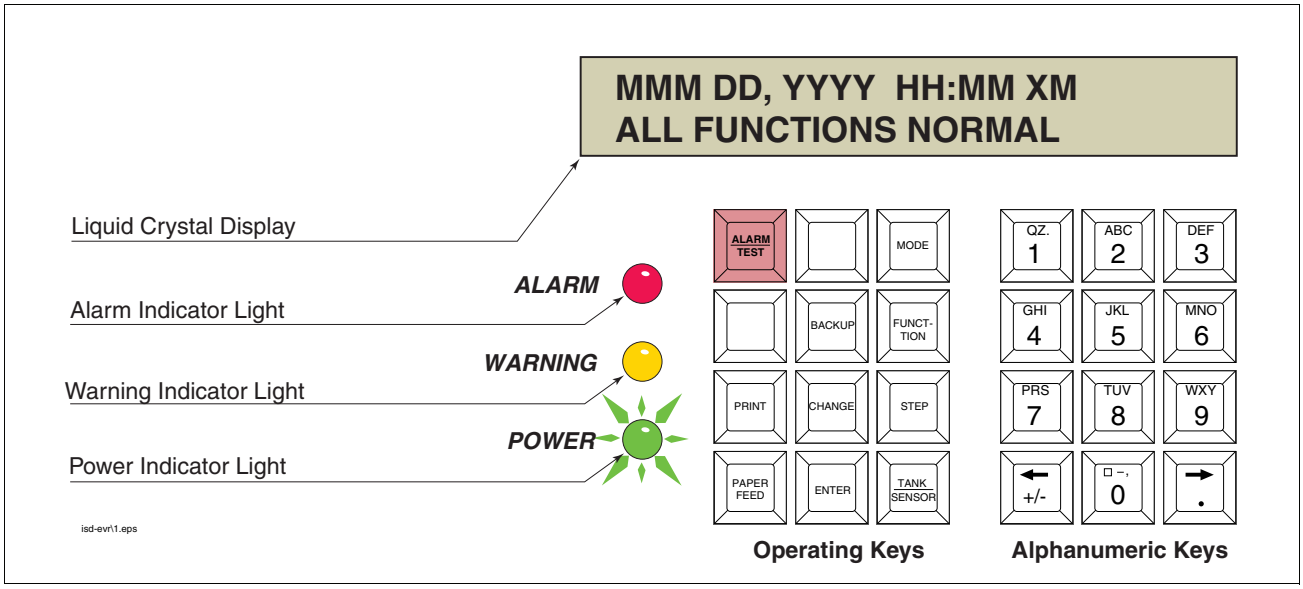


Figure 16-24. TLS console alarm interface

If an alarm condition occurs the system displays the condition type and its location. If more than one condition exists, the display will continuously cycle through the appropriate alarm messages. The system automatically prints an alarm report showing the alarm type, its location and the date and time the alarm condition occurred.

Warning and alarm posting causes the TLS console-based system to activate warning or failure indicator lights, an audible alarm, and an automatic strip paper printout documenting the warning or alarm. Historical reports of warning and alarm events are available for up to one year.

WARNING POSTING

Displayed messages alert you to the source and type of alarm. Printed messages show the type and location of the alarm. In the Warning example in Figure 16-25, the display's second line and printed message indicates that the containment system's vapor leak rate has increased above the allowed standard generating a warning.

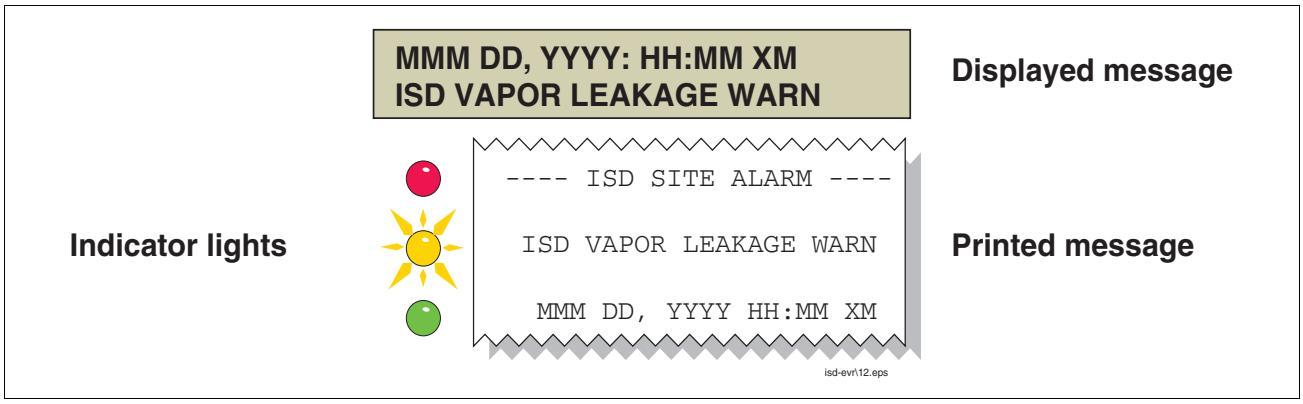


Figure 16-25. Example Warning posting

The TLS console also logs an entry to the Warning Log upon posting a warning.

ALARM POSTING

Displayed messages alert you to the source/number and type of alarm. Printed messages show the type and location of the alarm. In the alarm example in Figure 16-26 the display's second line and printed message indicates that vapor collection on hose 1, FP1 Super has dropped below the allowed standard resulting in a failure alarm. (By default, for unihose dispensers, FP1 BLEND3 will be displayed rather than FP1SUPER as shown below.)

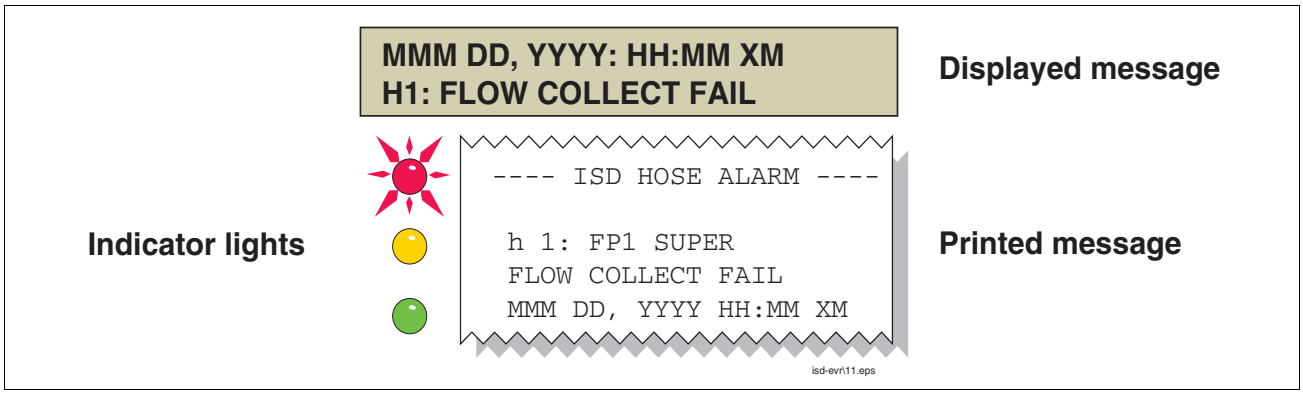


Figure 16-26. Example Alarm posting

Upon posting a failure alarm, the TLS console logs an entry to the Failure Log, prohibits fuel dispensing from all ISD gasoline fueling point(s) and logs a shutdown event to the Shutdown & Misc. Event Log.

The initial release of ISD will prohibit fuel dispensing from all gasoline fueling points by shutting down the submersible pumps in all gasoline tanks. The method of overriding an ISD Alarm shutdown is discussed in the “Site Reenable” section.

SITE REENABLE

The TLS console ALARM/TEST button allows you to perform a logged shutdown override and resume dispensing. Figure 16-27 illustrates the ISD alarm override procedure.

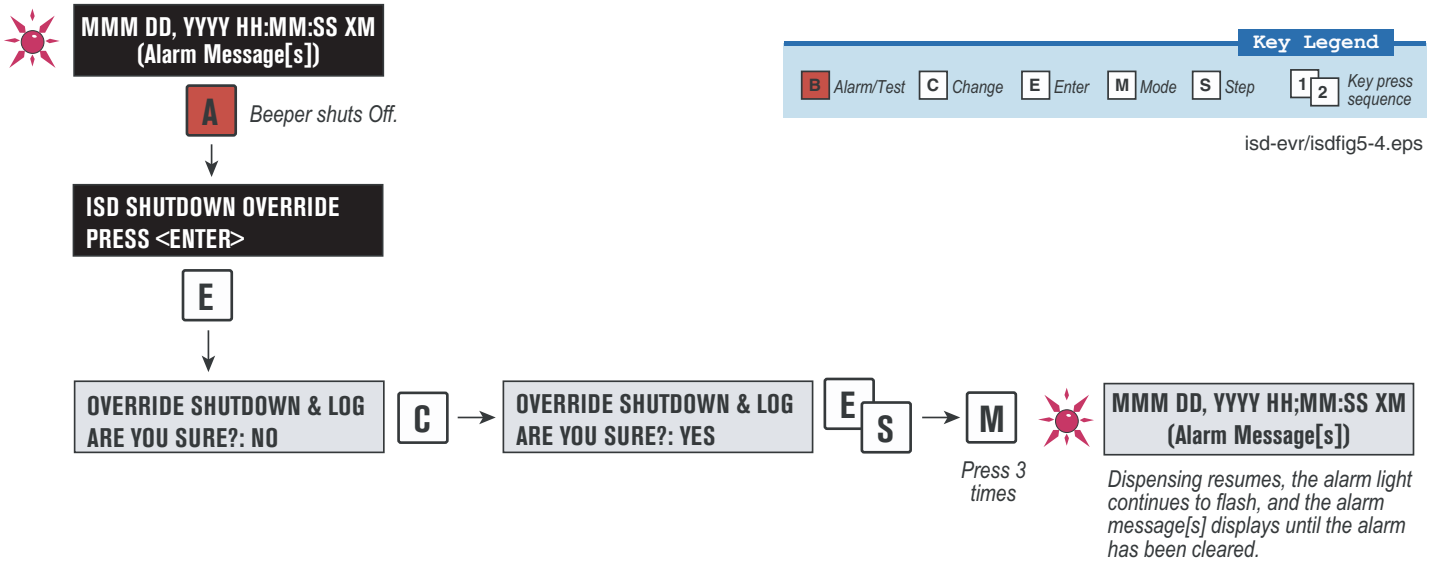


Figure 16-27. ISD Alarm Override Procedure

ALARM LOGS

Alarms will be recorded in the Warning Log or Failure Log of the monthly reports, which can be viewed electronically or via the integral printer (if queued in the most recent 10 events). The following example shows an excerpt from an electronically accessed monthly report.

Monthly Report Warning & Failure Log Examples:

Warning Alarms

Date	Time	Description	Reading	Value
2003/01/01	23:59	VAPOR VAPOR CONTAINMENT LEAKAGE	CFH@2"WC	14
2003/01/01	23:59	A/L RATIO DEGRADATION	FP2 MID	0.69
2002/12/31	23:59	VAPOR VAPOR CONTAINMENT LEAKAGE	CFH@2"WC	13
2002/12/31	23:59	A/L RATIO DEGRADATION	FP2 MID	0.67

Failure Alarms

Date	Time	Description	Reading	Value
2003/01/01	23:59	A/L RATIO GROSS BLOCKAGE	FP1 REG	0.06
2003/01/01	23:59	A/L RATIO DEGRADATION	FP1 REG	0.14
2003/01/01	23:59	A/L RATIO GROSS BLOCKAGE	FP1 MID	0.13
2003/01/01	23:59	A/L RATIO DEGRADATION	FP1 MID	0.15

ALARM SEQUENCE

Each ISD monitoring test operates once each day on sensor data gathered over a fixed time interval and with a minimum required number of monitored events. The interval is a fixed number of calendar days depending on the test being run. As an example, the A/L degradation Vapor Collection Monitoring test requires seven calendar days of data and at least 30 fueling events. In this example, each daily test result represents a test based on the prior seven days' time period. When a test first fails, a warning is posted and a warning event is logged. If this condition persists for seven more consecutive days, an alarm is posted, a failure alarm event is logged and the site is shutdown. If the condition continues, additional failure events are logged and the site will continue to be shutdown each day.

ISD ALARM SUMMARY

Table 16-3 summarizes the ISD Alarms - Alarms with a superscript 2 will result in a site shutdown.

Table 16-3.- VST ISD Alarm Summary

Displayed Message	ISD Monitoring Category	Indicator Light	Cause	Suggested Troubleshooting[1]
ISD VAPOR LEAKAGE WARN	Containment	Yellow	Containment system leaks at 2 times the TP-201.3 standard	- See Troubleshooting Guide 9513-003 found at www.vsthose.com. - TP 201.3 Test, VR 204 Exhibit 4
ISD VAPOR LEAKAGE FAIL[2]	Containment	Red	8th Consecutive Failure of Pressure Integrity (Vapor Leak) Test	
ISD GROSS PRESSURE WARN	Containment	Yellow	95th percentile of 7-days' ullage pressure exceeds 1.3 IWC	- See Troubleshooting Guide 9513-003 found at www.vsthose.com. - Vapor Pressure Verification Test, VR 204 Exhibit 8 - Vapor Processor Activation Test, VR 204 Exhibit 9
ISD GROSS PRESSURE FAIL[2]	Containment	Red	8th Consecutive Failure of Gross Containment Pressure Test	
ISD DEGRD PRESSURE WARN	Containment	Yellow	75th percentile of 30-days' ullage pressure exceeds 0.3 IWC	
ISD DEGRD PRESSURE FAIL[2]	Containment	Red	31st Consecutive Failure of Degradation Pressure Test	
hnn: FLOW COLLECT WARN	Collection	Yellow	Vapor collection flow performance is less than 50%	- See Troubleshooting Guide 9513-003 found at www.vsthose.com. - ISD Vapor Flow Meter Operability test Procedure, VR 204 Exhibit 11.
hnn: FLOW COLLECT FAIL[2]	Collection	Red	2nd Consecutive Failure of Vapor Collection Flow Performance Monitoring Test	
ISD VP STATUS WARN	Processor	Yellow	Failure of Vapor Processor Effluent Emissions or Duty Cycle test	See Troubleshooting Guide 9513-003 found at www.vsthose.com. - See VP Emission Test - See VP Duty Cycle Test
ISD VP STATUS FAIL[2]	Processor	Red	2nd Consecutive Failure of Vapor Processor Status test	

Table 16-3.- VST ISD Alarm Summary

Displayed Message	ISD Monitoring Category	Indicator Light	Cause	Suggested Troubleshooting[1]
ISD VP PRESSURE WARN	Processor	Yellow	90th percentile of 1 day ullage pressure exceeds 1 IWC	- See Troubleshooting Guide 9513-003 found at www.vsthose.com. - Vapor Pressure Verification Test, VR 204 Exhibit 8 - Vapor Processor Activation Test, VR 204 Exhibit 9
ISD VP PRESSURE FAIL[2]	Processor	Red	2nd Consecutive Failure of Vapor Processor Overpressure Test	
VP RUNTIME FAULT	Processor	Yellow	Processor has continuously run for longer than allowed. (30 min)	- See Troubleshooting Guide 9513-003 found at www.vsthose.com. - See TLS 350 PMC Setup Procedure - Vapor Pressure Verification Test, VR 204 Exhibit 8 - Vapor Processor Activation Test, VR 204 Exhibit 9
VP EMISSION WARN	Processor	Yellow	Mass emission exceeded the certified threshold	- See Troubleshooting Guide 9513-003 found at www.vsthose.com. - Hydrocarbon Sensor Verification Test, VR 204 Exhibit 6 - Vapor Processor Activation Test, VR 204 Exhibit 9
VP EMISSION FAIL	Processor	Red	2nd Consecutive Mass emission test failure	
VP DUTY CYCLE WARN	Processor	Yellow	Duty cycle exceeds 18 hours per day 0r 75% of 24 hours	- See Troubleshooting Guide 9513-003 found at www.vsthose.com. - See TLS 350 PMC Setup Procedure - Vapor Pressure Verification Test, VR 204 Exhibit 8 - Vapor Processor Activation Test, VR 204 Exhibit 9 - TP 201.3 Test, VR 204 Exhibit 4
VP DUTY CYCLE FAIL	Processor	Red	2nd Consecutive Duty Cycle Test Failure	

Table 16-3.- VST ISD Alarm Summary

Displayed Message	ISD Monitoring Category	Indicator Light	Cause	Suggested Troubleshooting[1]
ISD SENSOR OUT WARN	Self-Test	Yellow	Failure of Sensor Self-Test	Confirm ISD sensor & module installation / communication per VR 204 IOM Section 16, Chapter 2.
ISD SENSOR OUT FAIL	Self-Test	Red	8th Consecutive Failure of Sensor Self-Test	
ISD SETUP WARN	Self-Test	Yellow	Failure of Setup Test	Confirm EVR/ISD programming per VR 204 IOM Section 16.
ISD SETUP FAIL[2]	Self-Test	Red	8th Consecutive Failure of Setup Test	

[1]See ISD Troubleshooting Manual, P/N 577013-819, and the VST ISD Troubleshooting Guide 9513-003 found at www.vsthose.com for a complete list of suggestions.

[2]SD Shutdown Alarms - see “Site Reenable” on page 16-34

OTHER ALARMS

Table 16-4 summarizes additional alarms that may be posted by ISD related equipment. These alarms are not critical to vapor recovery functionality, but could indicate erroneous setup or equipment malfunction. NOTE: Additional TLS console alarms listed in the TLS-3XX Operator’s manual may be posted and may lead to an ISD shutdown alarm if persistent (see ISD Troubleshooting Manual for details).

Table 16-4.- Other Alarms

Displayed Message	Indicator Light	Set Condition	Clear Condition
MISSING RELAY SETUP	Red	One or more required shutdown alarms have not been assigned to a relay.	Setup required shutdown alarms.
MISSING TANK SETUP	Red	There are no vapor recovery (gasoline) tanks defined or a gasoline pump has not been assigned to a control (shut down) device in at least one tank.	Complete gasoline tank setup.
MISSING HOSE SETUP	Red	There are no product meters assigned to a hose.	Assign at least 1 product meter to a hose.
hnn: VPRFLOW MTR SETUP	Red	Incoming transaction from a hose with an unavailable Vapor Flow Meter.	Configure Vapor Flow Meter (Smart Sensor) and enable it in ISD.
MISSING VAPOR PRES SEN	Red	There is no Vapor Pressure Sensor setup or detected.	Complete Vapor Pressure Sensor setup.
MISSING VAPOR FLOW MTR	Red	There is no Vapor Flow Meter setup or detected.	Complete Vapor Flow Meter setup.
fnn: CHK VAPOR FLOW MTR	Red	Failure of locked rotor test - possible locked vapor flow meter.	Locked rotor test passes or vapor flow meter deconfigured, or test cleared.

Reports

There are two main reports (CP-201 required) that are stored by the ISD system: the Monthly Status Report, stored for 12-months, and the Daily Status Report, stored for 365 days. A third report discussed in this section is the ISD Status Report. You can print out ISD reports from the TLS console front panel as shown in Figure 16-28.

- The monthly report includes:
  - ISD operational up-time (as a percentage)
  - EVR/ISD system pass time (as a percentage)
  - The Warning Log
  - The Failure Log
  - The Misc. Event Log
- The daily report includes:
  - Maximum and minimum ullage pressures
  - Results of the Vapor Containment Monitoring Gross (75th percentile), Degradation (95th percentile) ullage pressure test and Vapor Leakage Detection (CVLD) tests
  - Vapor Collection Monitoring test results for each fueling position
  - Vapor Processor Monitoring test results
- ISD Status Report
  - Last test report results

VIEWING ISD REPORTS

You can print out ISD reports from the TLS console front panel as shown in Figure 16-28.

.

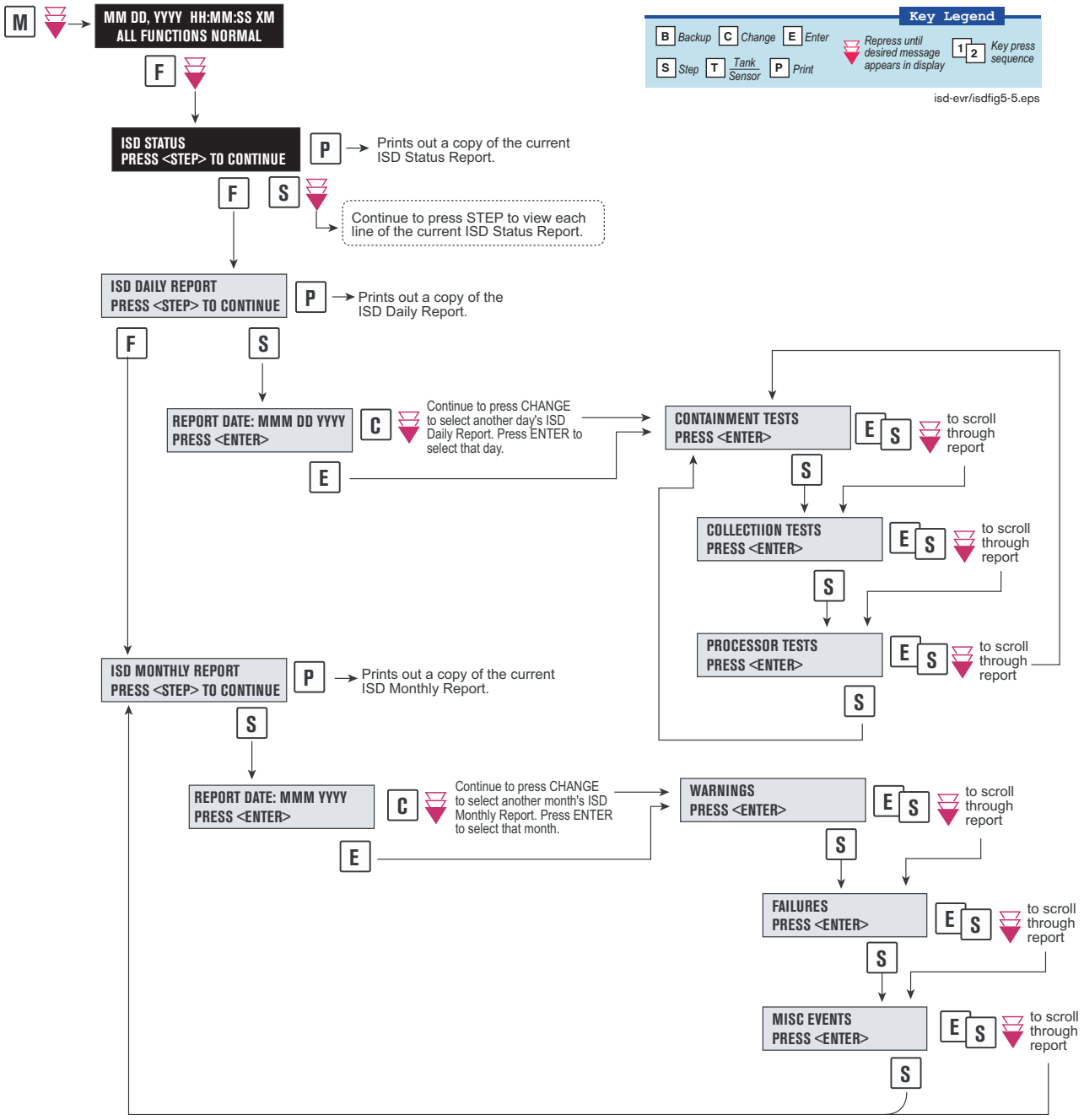


Figure 16-28. Printing ISD Reports on Console Printer

Figure 16-29 shows an example ISD Status Report.

```
ISD STATUS

(SITE NAME)
(SITE STREET)
(CITY,ST)
(PHONE)

(MMM DD, YYYY HH:MM XM)

EVR TYPE: BALANCE
ISD VERSION 01.01

REPORT DATE:SEP 22, 2004

CONTAINMENT TEST GROSS
STATUS: 0.1"WC NOTEST

CONTAINMENT TEST DEGRADE
STATUS: -1.1"WC NOTEST

CONTAINMENT TEST CVLD
STATUS: 3.26CFH NOTEST

COLLECTION FLOW TEST
STATUS: PASS

ISD SENSOR SELF TEST
STATUS: PASS

ISD SETUP SELF TEST
STATUS: PASS

VP STATUS TEST
STATUS: PASS

VP OVER PRESSURE TEST
STATUS: 0.2"WC PASS

EFFLUENT EMISSIONS TEST
STATUS  5.26     PASS

VP DUTY CYCLE TEST
STATUS  5.00     PASS
```

This menu appears only if EVR type = BALANCE

isd-evr\937-8.eps

Figure 16-29. ISD Status Report Example - TLS console printout

Figure 16-30 shows an example ISD Daily Report.

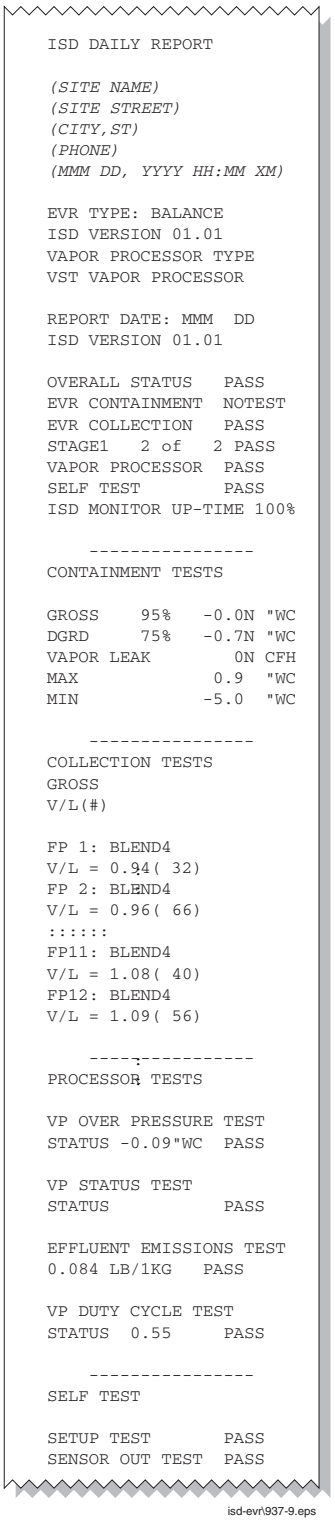


Figure 16-30. ISD Daily Report Example - TLS console printout

Figure 16-31 shows an example ISD Monthly Report.

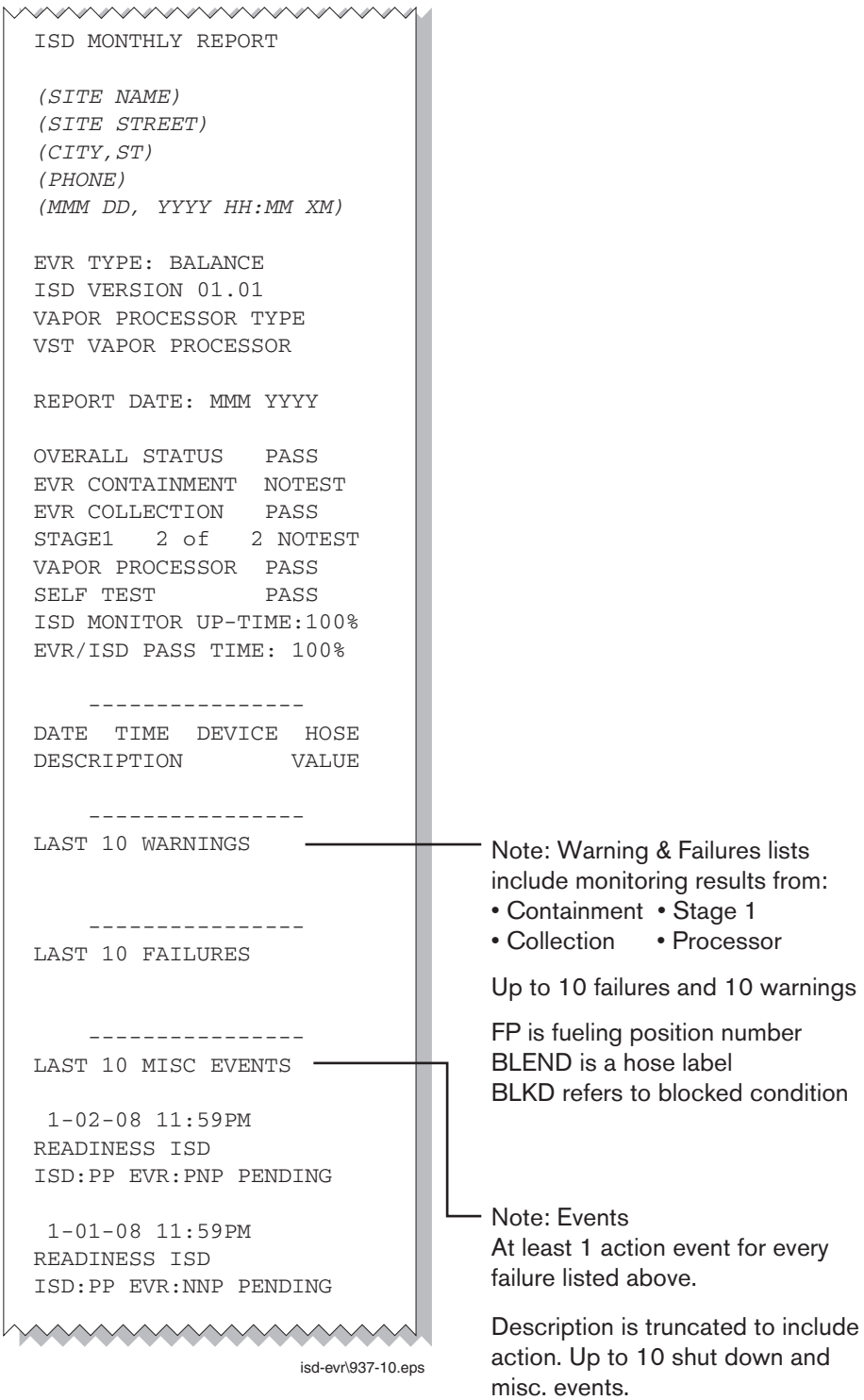
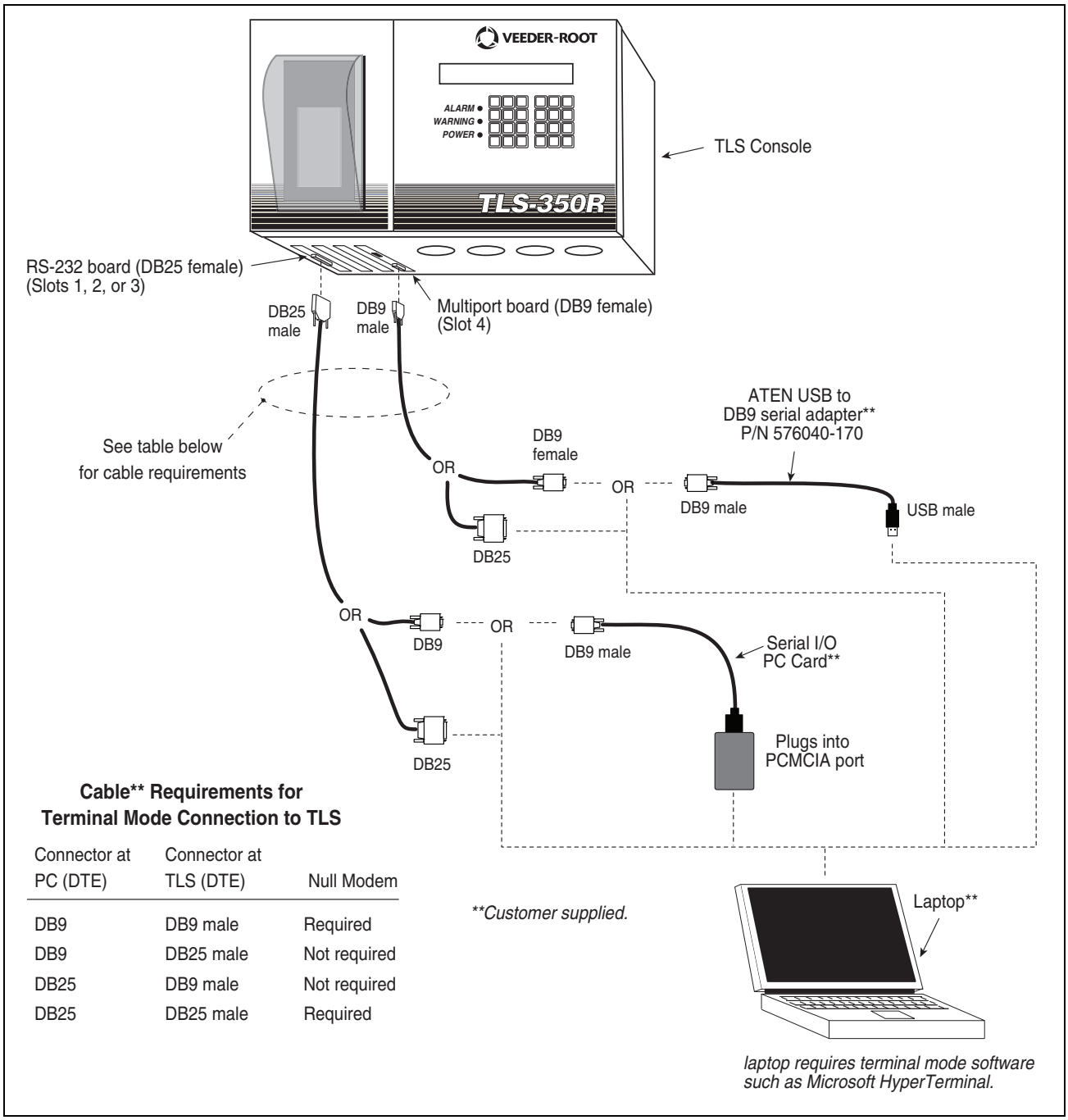


Figure 16-31. ISD Monthly Report Example - TLS console printout

Viewing ISD Reports via RS-232 Connection

CONNECTING LAPTOP TO CONSOLE

Connect your laptop to the TLS console's RS-232 or Multiport module using one of the methods shown in the examples in Figure 16-32 below.



Cable Requirements for Terminal Mode Connection to TLS**

Connector at PC (DTE)	Connector at TLS (DTE)	Null Modem
DB9	DB9 male	Required
DB9	DB25 male	Not required
DB25	DB9 male	Not required
DB25	DB25 male	Required

Figure 16-32. Connecting laptop to TLS console for serial communication

CONNECTING LAPTOP TO CONSOLE

1. Open your laptop's serial communication program, e.g., HyperTerminal. You can typically find HyperTerminal under: Start/Programs/Accessories/Communications.
2. After opening the terminal software program, ignore (cancel) any modem/dialing related request windows since you will be directly connecting to the console via serial communications. When the Connection Description window appears (Figure 16-33), enter a connection name, e.g., TLSDIRECT, and click the OK button.

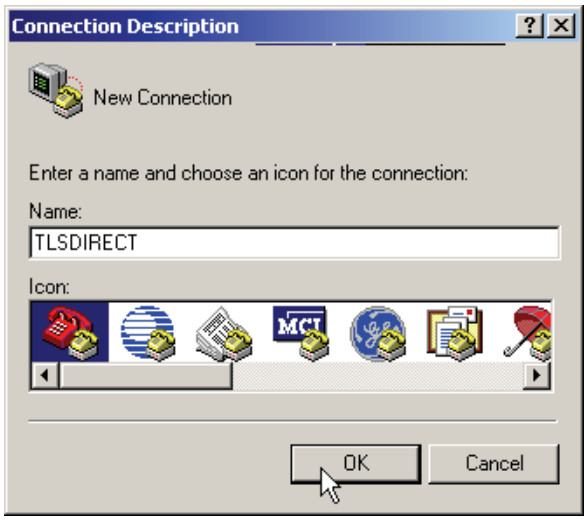


Figure 16-33. Connection Description window

3. After clicking the OK button, you may see a repeat of the modem/dialing windows, in which case ignore (cancel) them all.
4. When the Connect To window appears (Figure 16-34), depending on your connection method, select either COM1 (If RS-232 port on laptop), USB-Serial Controller (if using USB port on laptop), or Serial I/O PC Card (if using PCMCIA port on laptop) in the 'Connect using' drop down box, then click OK button.

Figure 16-34. Connect To window

5. Next you should see the 'Port Settings' window.

IMPORTANT! The settings of the laptop's com port must match those of the console's com port to which you are connected.

a. Go to the console front panel press the MODE key until you see:

```
SETUP MODE
PRESS <FUNCTION> TO CONT
```

b. Press the FUNCTION key until you see the message:

```
COMMUNICATIONS SETUP
PRESS <STEP> TO CONTINUE
```

c. Press the STEP key until you see the message:

```
PORT SETTINGS
PRESS <ENTER>
```

d. Press the PRINT key to printout the port settings for all communication modules installed in the console. Figure 16-35 shows an example port settings printout with the RS-232 module installed. Using the console port settings in the example below, your HyperTerminal 'Port Settings' window entries would be Bits per second - 2400, Data bits - 7, Parity - None, Stop Bits - 1. For the 'Flow Control' entry select None. Click OK

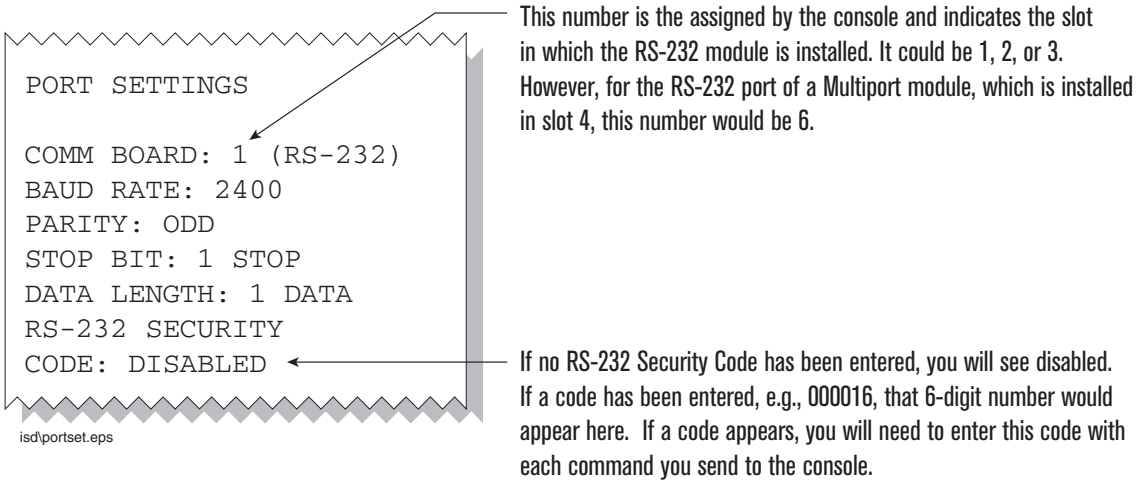


Figure 16-35. Console comm port settings prinout example

In the example port settings printout above, the RS-232 Security Code is disabled. If the code was enabled you would see a 6-digit number which you will need to enter to access the console (refer to the 'Sending Console Commands' paragraph below for more information).

6. After entering your port settings, the program's main window appears (Figure 16-36).

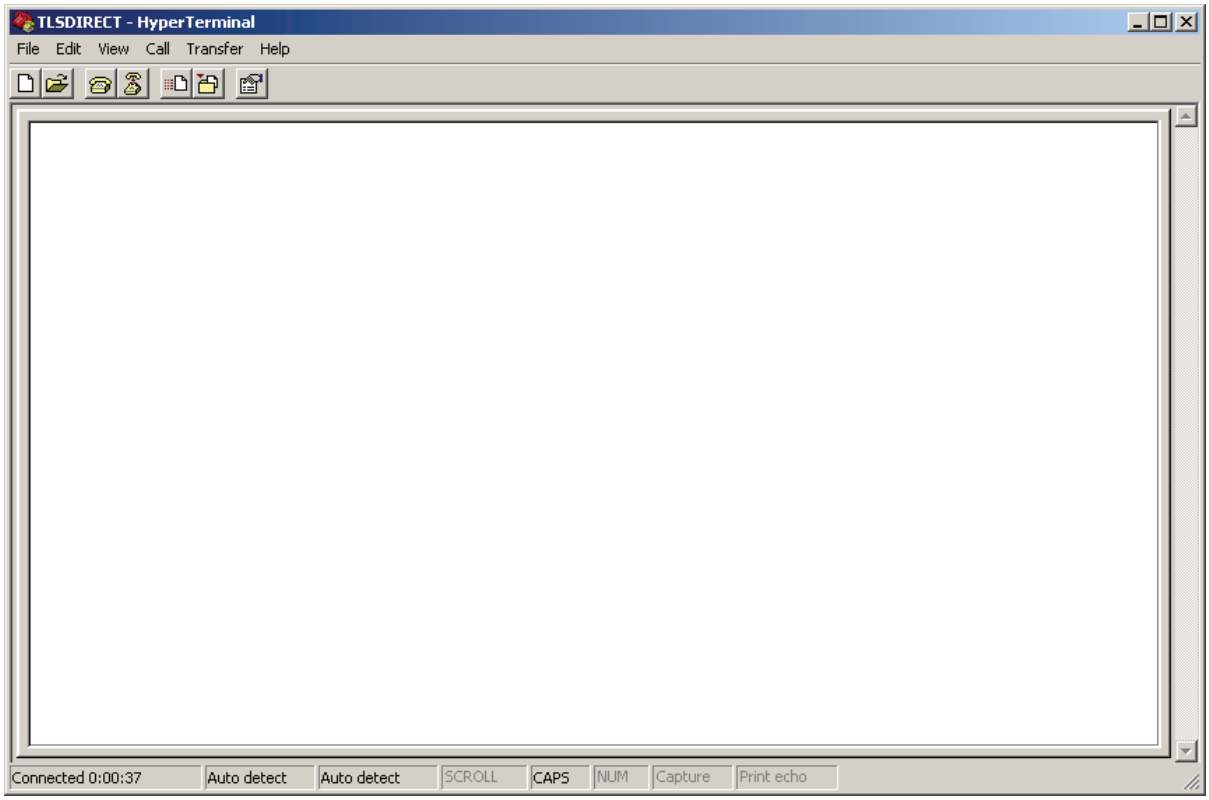


Figure 16-36. HyperTerminal main window

SENDING CONSOLE COMMANDS

Table 16-5 shows three important ISD console commands: IV0500, IV0200, and IV0100. The <SOH> shown in the table means that you must press and hold the **Cntrl** key while you press the **A** key.

For example, let's say you want to see the Daily Report Details for the last 10 days.

Note: If you want to see the characters of the command as you type them in, click on File menu, then select Properties/Settings (tab)/ASCII Setup and click the check box for 'Echo typed characters locally', then click OK to close the window(s) and return to the main screen.

If the RS-232 Security Code is disabled - press and hold the Ctrl key while you press the A key, then type in IV0500010. If the RS-232 Security Code is enabled (e.g., 000016) you must enter the security code before the command - press and hold the Ctrl key while you press the A key, then type in 000016IV0500010.

You will see the typed command on the screen: ☺IV0500010 followed by the response (report) from the console. The ☺ symbol indicates CrtlA and the ♥ symbol indicates the end of the response.

If the console recognizes the command the response displays as soon as the command is typed in.

If the console does not recognize the command you would see something like ☺IV0500010☺9999FF1B which indicates the console did not recognize the command.

All responses (Reports) can be printed or saved to a file. See the terminal program's help file for instructions.

Table 16-5.- Serial Commands for ISD Alarm, Monthly, and Daily Reports

Report Type	Serial Command (PC to Console)*
Daily Report Details (See example Figure 16-37)	<SOH>IV0500ddd Where ddd = number of days, 001 = yesterday and today, 002 = two days ago, etc.
Monthly Status Report (See example Figure 16-38)	<SOH>IV0200yyyymm Where yyyy = year number, e.g. 2003, mm = month number, 01 = January, 02 = February, etc.
Alarm Status (See example Figure 16-39)	<SOH>IV0100
V80 VST Vapor Processor Status Report (See example Figure 16-40)	<SOH>IV0800

*<SOH> = Control A. For more information on TLS console serial commands, refer to the V-R Serial Interface Manual.

```
IV0500
JAN  8, 2008  3:52 PM                                          isd-evr\937-11.eps

(SITE NAME)
(SITE STREET)
(CITY, ST)
(PHONE)

ISD DAILY REPORT DETAILS

EVR TYPE: BALANCE
ISD TYPE: 01.01
VAPOR PROCESSOR TYPE: VST VAPOR PROCESSOR

OVERALL STATUS              :WARN            EVR VAPOR COLLECTION :PASS
EVR VAPOR CONTAINMENT       :WARN
ISD MONITOR UP-TIME         :100%            STAGE I TRANSFERS: 10 of 10 PASS
EVR/ISD PASS TIME           : 81%            VAPOR PROCESSOR      :PASS

Status Codes: (W)Warn (F)Fail (D)Degradation Fail (G)Gross Fail
(ISD-W)ISD Self-Test Warning (ISD-F)ISD Self-Test Fail (N)No Test

       ISD   ISD  ---CONTAINMENT TESTS---     STAGE        ---COLLECTION TESTS
       EVR   %UP  GROSS  DGRD  MAX  MIN  LEAK   I   VAPOR  FP1   FP2   FP3
DATE  STATUS TIME  95%    75%  "WC  "WC  CFH   XFR  PRCSR  BLEND BLEND BLEND
12/28   W    100%  0.2  -0.3   0.7 -2.5   18W PASS  PASS   0.94  1.07  1.10
12/29   W    100%  0.2  -0.3   0.7 -3.0   16W PASS  PASS   0.95  0.85  1.11
12/30   PASS 100%  0.2  -0.3   0.7 -4.1    0  PASS  PASS   0.95N 0.99  1.02
12/31   PASS 100%  0.2  -0.3   0.8 -3.0    0  PASS  PASS   0.97  0.96  1.17
01/01   PASS 100%  0.2  -0.3  -0.2 -3.3    0        PASS   0.86  1.02  0.99
01/02   PASS 100%  0.2  -0.3   0.9 -5.0    0  PASS  PASS   0.94  0.96  1.20
01/03   PASS 100%  0.2  -0.3   1.1 -4.3    0  PASS  PASS   0.82  1.10  1.13
01/04   PASS 100%  0.4  -0.3   1.9 -2.8    0        PASS   1.07  1.01  1.10
01/05   PASS 100%  0.2  -0.3   2.8 -5.0    0  PASS  PASS   0.97  1.12  0.84
01/06   PASS 100%  0.2  -0.3   0.4 -5.0    0  PASS  PASS   0.80  1.23  1.11
01/07   PASS 100%  0.2  -0.3   0.6 -5.0    0  PASS  PASS   0.93  0.96  1.07

---COLLECTION TESTS-DAILY AVERAGE HOSE FLOW PERFORMANCE-----------------------
      FP4   FP5   FP6   FP7   FP8   FP9   FP10  FP11  FP12
DATE  BLEND BLEND BLEND BLEND BLEND BLEND BLEND BLEND BLEND
12/28 1.06  1.16  0.96  1.21  1.10  1.03  1.08  1.13  1.13
12/29 1.03  1.12  1.16  1.07  1.13  1.01  0.97  1.06  1.06
12/30 1.04  0.96  0.95  1.06  1.11  0.97  1.14  1.18  0.94
12/31 1.07  1.20  1.05  1.10  1.00  0.90  1.09  1.07  1.27
01/01 1.03  1.18  1.19  0.85  1.16  1.24  1.13  1.31  1.16
01/02 0.94  0.98  1.10  0.97  1.10  0.91  0.98  1.08  1.09
01/03 1.12  0.96  1.17  1.12  1.07  1.06  1.12  1.12  1.10
01/04 1.04  1.18  1.09  1.16  1.16  0.90  1.19  1.05  1.13
01/05 1.13  0.94  1.11  1.02  1.10  1.10  1.21  1.19  1.04
01/06 1.11  1.14  1.09  1.10  1.18  0.95  1.15  1.09  1.05
01/07 0.96  1.13  1.07  0.84  1.13  1.02  1.06  1.12  1.00
```

Figure 16-37. ISD Daily Report Details - Serial to PC Format

```
IV0200                                                          isd-evr\937-12.eps
JAN  8, 2008  3:53 PM

(SITE NAME)
(SITE STREET)
(CITY, ST)
(PHONE)

ISD MONTHLY STATUS REPORT

EVR TYPE: BALANCE
ISD TYPE: 01.01
VAPOR PROCESSOR TYPE: VST VAPOR PROCESSOR

OVERALL STATUS             :FAIL            EVR VAPOR COLLECTION :FAIL
EVR VAPOR CONTAINMENT      :WARN
ISD MONITOR UP-TIME        :100%            STAGE I TRANSFERS: 33 of 33 PASS
EVR/ISD PASS TIME          : 77%            VAPOR PROCESSOR      :WARN

CARB EVR CERTIFIED OPERATING REQUIREMENTS

ISD MONITORING TEST PASS/FAIL THRESHOLDS
                                                    PERIOD    BELOW  ABOVE

VAPOR COLLECTION BALANCE SYS FLOW PERFORMANCE        1DAYS     0.60  ----
VAPOR CONTAINMENT GROSS FAIL, 95th PERCENTILE        7DAYS     ----  1.30"wcg
VAPOR CONTAINMENT DEGRADATION, 75th PERCENTILE      30DAYS     ----  0.30"wcg
VAPOR CONTAINMENT LEAK DETECTION FAIL @2"WCG         7DAYS     ----  9.38cfh
STAGE I VAPOR TRANSFER FAIL, 50th PERCENTILE        20MINS     ----  2.50"wcg
VAPOR PROCESSOR PRESSURE FAIL                        1DAYS     ----  1.00"wcg
VAPOR PROCESSOR MASS EMISSION FAIL (LB/1KG)          1DAYS     ----  0.64
VAPOR PROCESSOR DUTY CYCLE FAIL                      1DAYS     ----  75.00%

WARNING ALARMS
DATE     TIME     DESCRIPTION                     READING         VALUE
07-12-30 00:02:33 VAPOR CONTAINMENT LEAKAGE       CFH@2 INCHES WC  15.51
07-12-29 00:02:07 VAPOR CONTAINMENT LEAKAGE       CFH@2 INCHES WC  18.24
07-12-28 00:02:01 VAPOR CONTAINMENT LEAKAGE       CFH@2 INCHES WC  17.34
07-12-27 00:01:36 VAPOR CONTAINMENT LEAKAGE       CFH@2 INCHES WC  17.11
07-12-26 00:01:41 VAPOR CONTAINMENT LEAKAGE       CFH@2 INCHES WC  18.66
07-12-10 00:02:05 FLOW PERFORMANCE HOSE BLOCKAGE  FP 8 BLEND4      BLKD
07-12-06 00:02:40 VAPOR PROCESSOR OVER PRESSURE   DAILY 95%         1.25
FAILURE ALARMS
DATE     TIME     DESCRIPTION                     READING         VALUE
07-12-11 00:02:05 FLOW PERFORMANCE HOSE BLOCKAGE  FP 8 BLEND4      BLKD

SHUTDOWN & MISCELLANEOUS EVENTS
DATE     TIME     DESCRIPTION                     ACTION/NAME
07-12-13 19:52:52 VAPOR PROCESSOR                TEST MANUALLY CLEARED
07-12-11 00:02:18 FLOW PERFORMANCE BLK           DISABLED FP 08
```

Figure 16-38. ISD Monthly Status Report - Serial to PC Format

```
IV0100
JAN  8, 2008  3:53 PM                                          isd-evr\937-13.eps

(SITE NAME)
(SITE STREET)
(CITY, ST)
(PHONE)

ISD ALARM STATUS REPORT

EVR TYPE: BALANCE
ISD TYPE: 01.01
VAPOR PROCESSOR TYPE: VST VAPOR PROCESSOR

OVERALL STATUS             :PASS            EVR VAPOR COLLECTION :PASS
EVR VAPOR CONTAINMENT      :PASS
ISD MONITOR UP-TIME        :100%            STAGE I TRANSFERS:  2 of  2 PASS
EVR/ISD PASS TIME          :100%            VAPOR PROCESSOR      :PASS

WARNING ALARMS
DATE     TIME     DESCRIPTION                      READING          VALUE
07-12-30 00:02:33 VAPOR CONTAINMENT LEAKAGE        CFH@2 INCHES WC  15.51
07-12-29 00:02:07 VAPOR CONTAINMENT LEAKAGE        CFH@2 INCHES WC  18.24
07-12-28 00:02:01 VAPOR CONTAINMENT LEAKAGE        CFH@2 INCHES WC  17.34
07-12-27 00:01:36 VAPOR CONTAINMENT LEAKAGE        CFH@2 INCHES WC  17.11
07-12-26 00:01:41 VAPOR CONTAINMENT LEAKAGE        CFH@2 INCHES WC  18.66
07-12-10 00:02:05 FLOW PERFORMANCE HOSE BLOCKAGE   FP 8 BLEND4       BLKD
07-12-06 00:02:40 VAPOR PROCESSOR OVER PRESSURE    DAILY 95%          1.25
07-11-16 00:02:17 FLOW PERFORMANCE HOSE BLOCKAGE   FP 8 BLEND4       BLKD
07-11-13 00:02:28 FLOW PERFORMANCE HOSE BLOCKAGE   FP 8 BLEND4       BLKD
07-11-11 00:03:19 FLOW PERFORMANCE HOSE BLOCKAGE   FP 6 BLEND4       BLKD

FAILURE ALARMS
DATE     TIME     DESCRIPTION                      READING          VALUE
07-11-14 00:02:18 FLOW PERFORMANCE HOSE BLOCKAGE   FP 8 BLEND4       BLKD
07-11-12 00:02:38 FLOW PERFORMANCE HOSE BLOCKAGE   FP 6 BLEND4       BLKD
07-11-09 00:03:41 CONTAINMENT GROSS OVER PRESSURE  WEEKLY 95%         4.60
07-11-03 00:01:25 VAPOR PROCESSOR OVER PRESSURE    DAILY 95%          5.00
07-10-31 00:02:45 VAPOR PROCESSOR STATUS
                  VP EMISSIONS FAIL                LB/1KB            0.693
07-10-28 00:00:39 VAPOR PROCESSOR OVER PRESSURE    DAILY 95%          4.89
07-10-19 00:01:27 VAPOR PROCESSOR OVER PRESSURE    DAILY 95%          5.00
07-10-15 00:03:14 FLOW PERFORMANCE HOSE BLOCKAGE   FP 2 BLEND4       BLKD
07-10-15 00:03:13 FLOW PERFORMANCE HOSE BLOCKAGE   FP 1 BLEND4       BLKD
07-10-14 00:03:11 FLOW PERFORMANCE HOSE BLOCKAGE   FP 2 BLEND4       BLKD

SHUTDOWN & MISCELLANEOUS EVENTS
DATE     TIME     DESCRIPTION                       ACTION/NAME
07-12-13 19:52:52 VAPOR PROCESSOR                  TEST MANUALLY CLEARED
07-11-18 00:02:24 READINESS ISD:PP EVR:PPP         ISD & EVR READY
07-11-17 13:09:06 READINESS ISD:PP EVR:NNN         EVR READINESS PENDING
07-11-17 13:09:06 ISD STARTUP
07-11-17 13:03:24 ISD SHUTDOWN
07-11-14 00:02:18 FLOW PERFORMANCE BLK             DISABLED FP 08 BLEND4
07-11-12 00:02:38 FLOW PERFORMANCE BLK             DISABLED FP 06 BLEND4
07-11-09 00:03:41 CONTAINMENT GROSS                DISABLED DISPENSERS
07-11-04 01:00:00 TIME CHANGE DETECTED AT:        07-11-04 02:00:13
07-11-03 00:01:25 VAPOR PROCESSOR PROBLEM          DISABLED DISPENSERS
```

Figure 16-39. ISD Alarm Status Report - Serial to PC Format

```
IV8000
SEP 30, 2007 12:27 AM

(SITE NAME)
(SITE STREET)
(CITY,ST)
(PHONE)
(MMM DD, YYYY HH:MM XM)

VAPOR PROCESSOR
                    ELAPSED    PRESSURE INCHES H2O    RUNTIME
DATE-TIME ON        MINUTES       ON        OFF       FAULT
 5-04-07  3:31PM     8.87         0.244    -0.202       NO
 5-05-07  4:17AM     3.35         0.202    -0.212       NO
 5-07-07 10:17PM     3.50         0.206    -0.221       NO
 5-07-07 10:28PM    15.12         0.384    -0.356       NO
 5-08-07  8:16PM    21.77         0.325    -0.211       NO
 5-09-07  6:35PM    20.60         0.368    -0.276       NO
 5-10-07  8:03PM     6.18         0.226    -0.398       NO
 5-10-07  8:15PM     2.55         0.231    -0.227       NO
 5-13-07  8:55PM    18.23         0.314    -0.205       NO
```

isd-evr\fig5-18.eps

Figure 16-40. V80 VST Vapor Processor Status Report - Serial to PC Format

6 Maintenance

TLS Console

The TLS console, including interface modules, do not require scheduled maintenance. ISD System Self-Test Monitoring algorithms are designed to verify proper selection, setup and operation of the TLS console and sensors. Servicing should be performed in accordance with the In-Station Diagnostic System Troubleshooting Guide, Manual 577013-819 in response to warning or alarm conditions.

Air Flow Meter

There is no recommended maintenance, inspection nor calibration for the Air Flow Meter. Servicing should be performed in accordance with the In-Station Diagnostic System Troubleshooting Guide, Manual 577013-819 in response to warning or alarm conditions.

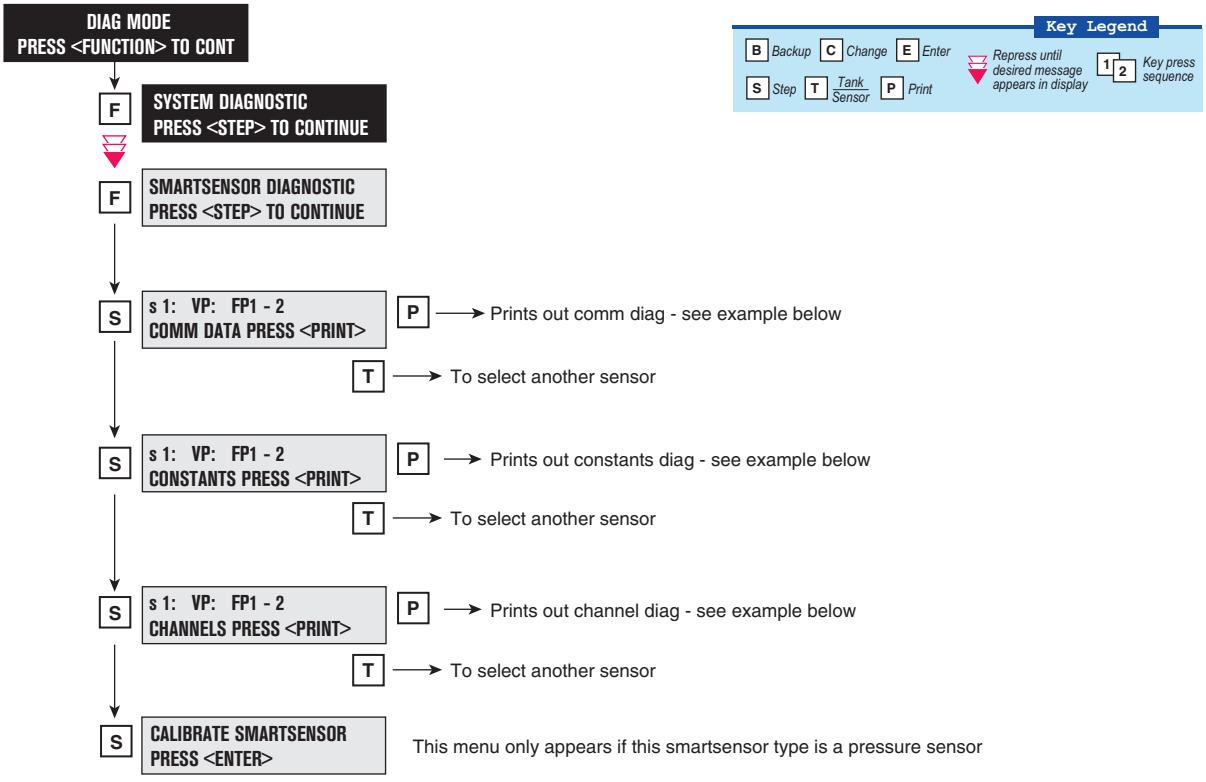
Vapor Pressure Sensor

There is no recommended maintenance, inspection nor calibration for the Vapor Pressure Sensor. Servicing should be performed in accordance with the In-Station Diagnostic System Troubleshooting Guide, Manual 577013-819 in response to warning or alarm conditions.

7 Diagnostic Menus

The diagnostic menus below are accessed and viewed from the TLS console front panel.

Smart Sensor Diagnostic Menu




```
SS COMM DIAG
----------------------
s 1: AFM1   FP1-2
SAMPLES READ    58
SAMPLES USED    54
PARITY ERR       0
PARTIAL READ     0
COMM ERR         0
RESTARTS         0
```

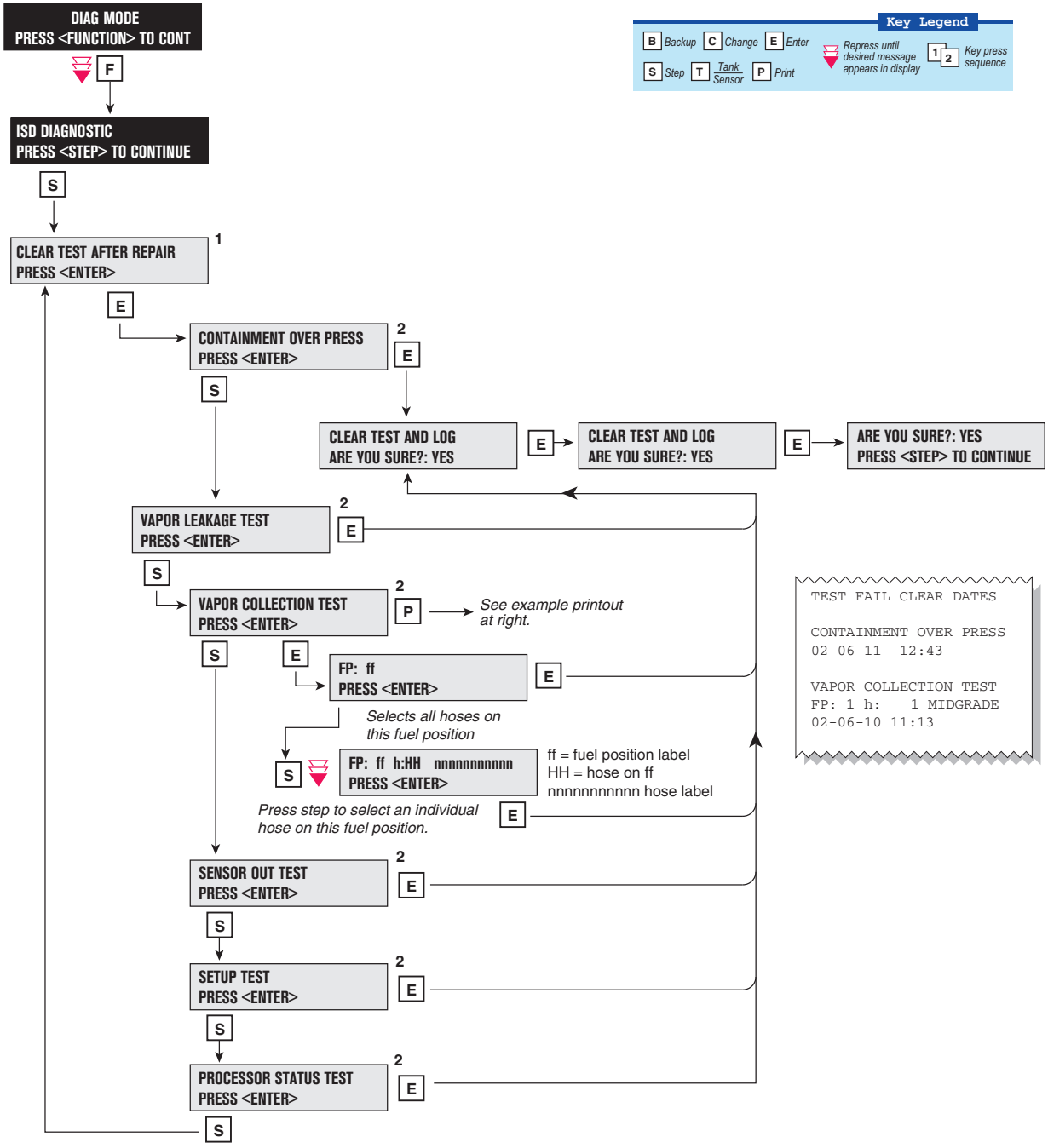
```
SS CONSTANTS DIAG
----------------------
s 1: AFM1   FP1-2

VAPOR PRESSURE
SERIAL NUMBER     1007
PROTOCOL VERSION     0
```

```
SS CHANNEL DIAG
----------------------
s 1: AFM1   FP1-2
YY-MM-DD  HH:MM:SS
C00 B50B 3D68 00E0 0000
C04 0000 03EF 0000 0004
C08 0A3C 3D68 5693 0081
C12 80C4 80A4 0104 2579
C16 0000 0000 00A3 03D6
C20 0709 0032 04C9 880F
```

ISD-EVR/937-18.eps

Figure 16-39. Smart Sensor Diagnostic Menu

ISD Diagnostic Menu



Notes:

1. All repair dates are saved in the Miscellaneous Event Log.
2. Reference the Clear Test Repair Menu table on the next page.

isd-evr/937-14.eps

Figure 16-40. ISD Diagnostic Menu

Table 16-6.- Clear Test Repair Menu

Menu Selection	Clears Alarms	Reset Dates
Containment Over Press	ISD GROSS PRESSURE WARN ISD GROSS PRESSURE FAIL ISD DEGRD PRESSURE WARN ISD DEGRD PRESSURE FAIL ISD VP PRESSURE WARN ISD VP PRESSURE FAIL	Containment Test Time
Vapor Leakage Test	ISD VAPOR LEAKAGE WARN ISD VAPOR LEAKAGE FAIL	Vapor Leak Test Time
Vapor Collection Test	GROSS COLLECT WARN GROSS COLLECT FAIL DEGRD COLLECT WARN DEGRD COLLECT FAIL FLOW COLLECT WARN FLOW COLLECT FAIL AIRFLOW MTR SETUP	Hose Test Time
Sensor Out Test	ISD SENSOR OUT WARN ISD SENSOR OUT FAIL	Sensor Out Test Time
Setup Test	ISD SETUP WARN ISD SETUP FAIL	Setup Self Test Time
Processor Status Test	ISD VP STATUS WARN ISD VP STATUS FAIL VP EMISSIONS WARN VP EMISSIONS FAIL VP DUTY CYCLE WARN VP DUTY CYCLE FAIL	Valid Vapor Processor Test Time

VST ECS Membrane Processor Diagnostic Menu

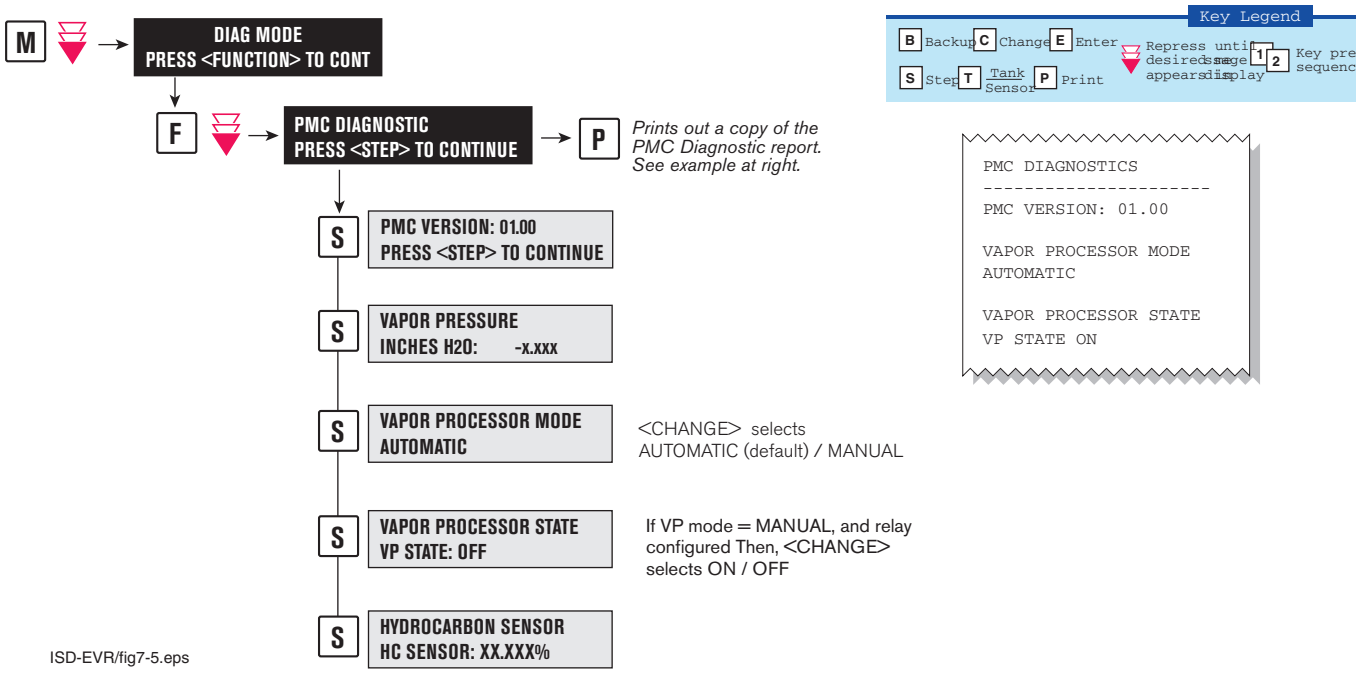


Figure 16-41. VST ECS Membrane Processor Diagnostic Menu

Appendix A: Site EVR/ISD Equipment Location Worksheet

You should create a table listing each hose, fueling point, Air Flow Meter's serial number, etc.. This information will be required when you perform the EVR/ISD Setup hose/meter dispenses. This appendix contains blank worksheets for sites with single- and multi-hose dispensers. You are advised to fill in all of the appropriate information about your installed equipment, complete the TLS console's EVR/ISD setup, then perform the Product Meter ID dispensing procedure.

Single-Hose Fueling Position Dispensers

FILL OUT - USE TO SETUP HOSE TABLE					AUTOMAP CHECK LIST			
					Product Dispense(s)[6]			
Hose ID[1]	FP[2]	Hose Label[3]	AFM Serial Number[4]	AFM Label[5]	1st	2nd	3rd	4th
1		Blend		AFM FP__&__				
2		Blend						
3		Blend		AFM FP__&__				
4		Blend						
5		Blend		AFM FP__&__				
6		Blend						
7		Blend		AFM FP__&__				
8		Blend						
9		Blend		AFM FP__&__				
10		Blend						
11		Blend		AFM FP__&__				
12		Blend						
13		Blend		AFM FP__&__				
14		Blend						
15		Blend		AFM FP__&__				
16		Blend						

[1]Each hose must have a unique number (1 - 99).

[2]This is the Fuel Position Label which is the visible number on the outside of the dispenser (1 -2 digits).

[3]The hose label is always Blend for single-hose dispensers.

[4]This is the serial number on the Air Flow Meter (1 per dispenser).

[5]This is the AFM label entered in EVR/ISD setup (1 per dispenser and must be in the format shown, e.g., AFM FP1&2 - *where 1 and 2 refer to the one [or two] numbers on the outside of the dispenser*).

[6]After you have entered the contents of columns 1 - 5 into the TLS EVR/ISD hose table setup, you now must follow automap procedure and dispense from each gas meter AND one blend grade that feeds each hose. Enter a check beneath each product following a dispense from the hose.

FILL OUT - USE TO SETUP HOSE TABLE					AUTO MAP CHECK LIST			
					Product Dispense(s)			
Hose ID	FP	Hose Label	AFM Serial Number	AFM Label	1st	2nd	3rd	4th
17		Blend		AFM FP__&__				
18		Blend						
19		Blend		AFM FP__&__				
20		Blend						
21		Blend		AFM FP__&__				
22		Blend						
23		Blend		AFM FP__&__				
24		Blend						
25		Blend		AFM FP__&__				
26		Blend						
27		Blend		AFM FP__&__				
28		Blend						
29		Blend		AFM FP__&__				
30		Blend						
31		Blend		AFM FP__&__				
32		Blend						
33		Blend		AFM FP__&__				
34		Blend						
35		Blend		AFM FP__&__				
36		Blend						

FILL OUT - USE TO SETUP HOSE TABLE					AUTO MAP CHECK LIST			
					Product Dispense(s)			
Hose ID	**FP**	**Hose Label**	**AFM Serial Number**	**AFM Label**	**1st**	**2nd**	**3rd**	**4th**
		Blend		AFM FP__&__				
		Blend						
		Blend		AFM FP__&__				
		Blend						
		Blend		AFM FP__&__				
		Blend						
		Blend		AFM FP__&__				
		Blend						
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		Blend		AFM FP__&__				
		Blend						
		Blend		AFM FP__&__				
		Blend						
		Blend		AFM FP__&__				
		Blend						

Multi-Hose Fueling Position Dispensers

FILL OUT - USE TO SETUP HOSE TABLE					AUTOMAP CHECK LIST
Hose ID[1]	**FP[2]**	**Hose Label[3]**	**AFM Serial Number[4]**	**AFM Label[5]**	**Product Dispense[6]**
				AFM FP__&__	
				AFM FP__&__	

[1]Each hose must have a unique number (1 - 99).

[2]This is the Fuel Position Label which is the visible number on the outside of the dispenser (1 -2 digits).

[3]The hose label is the grade.

[4]This is the serial number on the Air Flow Meter (1 per dispenser).

[5]This is the AFM label entered in EVR/ISD setup (1 per dispenser and must be in the format shown, e.g., AFM FP1&2 - *where 1 and 2 refer to the one [or two] numbers on the outside of the dispenser*).

[6]After you have entered the contents of columns 1 - 5 into the TLS EVR/ISD hose table setup, you now must follow automap procedure and dispense from each hose. Enter a check in this column following a dispense from the hose.

FILL OUT - USE TO SETUP HOSE TABLE					AUTOMAP CHECK LIST
Hose ID	**FP**	**Hose Label**	**AFM Serial Number**	**AFM Label**	**Product Dispense**
				AFM FP__&__	
				AFM FP__&__	
				AFM FP__&__	

FILL OUT - USE TO SETUP HOSE TABLE					AUTOMAP CHECK LIST
Hose ID	**FP**	**Hose Label**	**AFM Serial Number**	**AFM Label**	**Product Dispense**
				AFM FP__&__	
				AFM FP__&__	
				AFM FP__&__	

FILL OUT - USE TO SETUP HOSE TABLE					AUTOMAP CHECK LIST
Hose ID	**FP**	**Hose Label**	**AFM Serial Number**	**AFM Label**	**Product Dispense**
				AFM FP__&__	
				AFM FP__&__	
				AFM FP__&__	

FILL OUT - USE TO SETUP HOSE TABLE					AUTOMAP CHECK LIST
Hose ID	**FP**	**Hose Label**	**AFM Serial Number**	**AFM Label**	**Product Dispense**
				AFM FP__&__	
				AFM FP__&__	
				AFM FP__&__	

Appendix B: ISD Operability Test Procedure Data Forms
Use these forms to check off and record the results from the ISD Operability Testing

Form 1

Data Form for Vapor Pressure Sensor UST Pressure Test

DATE OF TEST _____

SERVICE COMPANY NAME	**SERVICE COMPANY'S TELEPHONE**
SERVICE TECHNICIAN	**VST or VEEDER-ROOT TECH CERTIFICATION # (as applicable)** **ICC or DISTRICT TRAINING CERTIFICATION (as applicable)**
STATION NAME	**DISTRICT PERMIT #**
STATION ADDRESS **CITY**	**STATE** **ZIP**

PRESSURE SENSOR LOCATION: DISPENSER FUELING POINT (FP) NUMBERS	**FP #_____**	**PRESSURE SENSOR SERIAL NUMBER: _____**

STEP 3	**DIGITAL MANOMETER VALUE _____ inches WC**
STEP 3	**TLS 350 SENSOR VALUE _____ inches WC** **(OBTAIN VALUE USING TLS CONSOLE KEYPAD SEQUENCE SHOWN IN FIG. 16-21, Vapor Pressure)**
STEP 4	**TLS 350 Sensor Value within ±0.2 inches WC of Digital Manometer Value?** **Yes** ☐ **No** ☐ **IF NO: THE PRESSURE SENSOR IS NOT IN COMPLIANCE WITH THE PRESSURE SENSOR REQUIREMENTS.**
STEP 5	**MODE KEY PRESSED TO EXIT PMC DIAGNOSTIC MENU?** ☐

Form 2

Data Form for Vapor Pressure Sensor Ambient Reference Test

DATE OF TEST _____

SERVICE COMPANY NAME		**SERVICE COMPANY'S TELEPHONE**
SERVICE TECHNICIAN		**VST or VEEDER-ROOT TECH CERTIFICATION # (as applicable)** **ICC or DISTRICT TRAINING CERTIFICATION (as applicable)**
STATION NAME		**DISTRICT PERMIT #**
STATION ADDRESS	**CITY**	**STATE** **ZIP**
STEP 1	**PRESSURE SENSOR LOCATION: DISPENSER FUELING POINT (FP) NUMBERS** **FP #** _____	**PRESSURE SENSOR SERIAL NUMBER:**_____
STEP 2	**REFERENCE PORT CAP REMOVED?** ☐ **VALVE SET TO AMBIENT REFERENCE PORT (PER FIG. 16-20)?** ☐	
STEP 3	**NON-CALIBRATED SENSOR VALUE** _____**Inches WC** **(OBTAIN VALUE USING TLS CONSOLE KEYPAD SEQUENCE SHOWN IN FIG. 16-21, Vapor Pressure)**	
STEP 4	**PRESSURE BETWEEN +0.20 & -0.20?** **Yes** ☐ **No** ☐ **IF NO: THE PRESSURE SENSOR IS NOT IN COMPLIANCE WITH THE PRESSURE SENSOR REQUIREMENTS.**	
STEP 5	**REFERENCE PORT CAP REPLACED?** ☐ **VALVE SET TO NORMAL VALVE POSITION (PER FIG 16-20)?** ☐	
STEP 6	**MODE KEY PRESSED TO EXIT PMC DIAGNOSTIC MENU?** ☐	

Operability Test Procedure Data Worksheet

Veeder-Root In-Station Diagnostics (ISD)
Balance Vapor Flow Meter Operability Test Procedure

	Date of Test	
Service Company Name	Service Company's Telephone	
Service Technician	Veeder-Root Tech Certification #	
Station Name	District Permit #	
Station Address	City	State Zip

		ISD Flow Meter Total			Gas Flow Meter Total						
0	0	08	4.13	4.15	4.9	4.12	4.12	4.13	4.15		
Meter SN	Fueling Pos	Start	Stop	Difference Gal (Stop – Start)	Start	Stop	Difference Cubic Feet (Stop – Start)	Cubic feet To gallons [1]	% Diff [2]	Pass	Fail

[1] $Gallons = CubicFeet \times 7.481$

[2] $\%Diff = \frac{ISDDiffGal - GasFlowMeterDiffGal}{GasFlowMeterDiffGal} \times 100$

Site Shutdown Test Data Form

DATE OF TEST _____

SERVICE COMPANY NAME	**SERVICE COMPANY'S TELEPHONE**
SERVICE TECHNICIAN	**VEEDER-ROOT TECH CERTIFICATION #**
STATION NAME	**DISTRICT PERMIT #**
STATION ADDRESS CITY ST ATE ZIP	

STEP 1.	**POWER REMOVED FROM TLS CONSOLE?**	☐
STEP 2.	**POWER TO SUBMERSIBLE PUMPS REMOVED BY TLS? (VERIFY GASOLINE FUELING DISABLED)**	☐
STEP 3.	**POWER RESTORED TO TLS CONSOLE?**	☐

COMMENTS (INCLUDE DESCRIPTION OF REPAIRS MADE)

VEEDER-ROOT

For technical support, sales or other assistance, please visit: www.veeder.com

Pressure Sensor

Installation Guide

VEEDER-ROOT

Notice

Veeder-Root makes no warranty of any kind with regard to this publication, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose.

Veeder-Root shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this publication.

Veeder-Root reserves the right to change system options or features, or the information contained in this publication.

DAMAGE CLAIMS / LOST EQUIPMENT

Thoroughly examine all components and units as soon as they are received. If any cartons are damaged or missing, write a complete and detailed description of the damage or shortage on the face of the freight bill. The carrier's agent must verify the inspection and sign the description. Refuse only the damaged product, not the entire shipment.

VEEDER-ROOT'S PREFERRED CARRIER

1. Contact VR Customer Service at 800-873-3313 with the specific part numbers and quantities that were missing or received damaged.
2. Fax signed Bill of Lading (BOL) to VR Customer Service at 800-234-5350.
3. VR will file the claim with the carrier and replace the damaged/missing product at no charge to the customer. Customer Service will work with production facility to have the replacement product shipped as soon as possible.

CUSTOMER'S PREFERRED CARRIER

1. It is the customer's responsibility to file a claim with their carrier.
2. Customer may submit a replacement purchase order. Customer is responsible for all charges and freight associated with replacement order. Customer Service will work with production facility to have the replacement product shipped as soon as possible.
3. If "lost" equipment is delivered at a later date and is not needed, VR will allow a Return to Stock without a restocking fee.
4. VR will NOT be responsible for any compensation when a customer chooses their own carrier.

RETURN SHIPPING

For the parts return procedure, please follow the appropriate instructions in the "General Returned Goods Policy" and "Parts Return" pages in the "Policies and Literature" section of the Veeder-Root **North American Environmental Products** price list.

Pressure Sensor Installation

Figures

Tables

Pressure Sensor Installation

This manual contains instructions to install a Veeder-Root (In-Station Diagnostic) Pressure Sensor in a dispenser's vapor return line.

This manual assumes all preliminary site preparation is completed, and that wiring from the console to the Pressure Sensor junction box is in place and meets the requirements set out in the console's Site Prep manual.

Contractor Certification Requirements

Veeder-Root requires the following minimum training certifications for contractors who will install and setup the equipment discussed in this manual:

Level 1 Contractors holding valid Level 1 Certification are approved to perform wiring and conduit routing, equipment mounting, probe and sensor installation, tank and line preparation, and line leak detector installation.

Level 2/3 or 4 Contractors holding valid Level 2, 3, or 4 Certifications are approved to perform installation checkout, startup, programming and operations training, troubleshooting and servicing for all Veeder-Root Tank Monitoring Systems, including Line Leak Detection and associated accessories.

Warranty Registrations may only be submitted by selected Distributors.

Related Manuals

576013-879 TLS-3XX Series Consoles Site Prep and Installation Manual

VST-IOM / Section 16 / VR-204 In-Station Diagnostics (ISD) Install, Setup, & Operation Manual

Safety Precautions

The following safety symbols may be used throughout this manual to alert you to important safety hazards and precautions.

 **EXPLOSIVE** Fuels and their vapors are extremely explosive if ignited.	 **FLAMMABLE** Fuels and their vapors are extremely flammable.
 **ELECTRICITY** High voltage exists in, and is supplied to, the device. A potential shock hazard exists.	 **TURN POWER OFF** Live power to a device creates a potential shock hazard. Turn Off power to the device and associated accessories when servicing the unit.
 **READ ALL RELATED MANUALS** Knowledge of all related procedures before you begin work is important. Read and understand all manuals thoroughly. If you do not understand a procedure, ask someone who does.	 **USE SAFETY BARRICADES** Unauthorized people or vehicles in the work area are dangerous. Always use safety cones or barricades, safety tape, and your vehicle to block the work area.

⚠ WARNING

This product is to be installed and operated in the highly combustible environment of a gasoline dispenser where flammable liquids and explosive vapors may be present.

Improper installation could cause damage to property, environment resulting in serious injury or death.

The following hazards exist:

1. **Electrical shock resulting in serious injury or death may result if power is on during installation and the device is improperly installed.**
2. **Product leakage could cause severe environmental damage or explosion resulting in death, serious personal injury, property loss and equipment damage.**

Observe the following precautions:

1. **Read and follow all instructions in this manual, including all safety warnings.**
2. **To be installed in accordance with the National Electrical Code, NFPA 70 and the Automotive And Marine Service Station Code, NFPA 30A.**
3. **Before installing this device, turn Off, tag/lock out power to the system, including console and submersible pumps.**
4. **To protect yourself and others from being struck by vehicles, block off your work area during installation or service.**
5. **Substitution of components may impair intrinsic safety.**

Before You Begin

- A level 1 or higher certified Veeder-Root Technician must be on site to assist in this type of installation.
- Comply with all recommended safety practices identified by OSHA (Occupational Safety and Health Administration) and your employer.
- Review and comply with all the safety warnings in the installation manuals and any other national, State or Local requirements.
- A 2-conductor, 18 AWG shielded cable must be installed in intrinsically safe conduit from the dispenser to the TLS console.
- The Pressure Sensor must be installed in a VERTICAL position with the sensing port pointing down, and its connection to the vapor return line must be made BELOW the vapor return line shear valve in the base of the dispenser.
- For all connections requiring sealant, use only yellow Gas/TFE teflon tape.

Veeder-Root Parts

Veeder-Root parts and kits required to install the Pressure Sensor are listed in Table 17-1.

Table 17-1. Sensor Installation Kit (P/N 330020-433)

Item	Qty.	Description	P/N
1	1	Pressure sensor	331946-001
2	4	Male connector 68CA-4-4, brass 1/4” tube to 1/4” pipe	514100-430
3	1	Union 62CA-4, brass 1/4” tube size	514100-431
4	1	Plug 59CA-4, brass 1/4” tube size	514100-432
5	1	Universal sensor mounting kit - miscellaneous assortment of U-bolts, brackets, clamps, and fasteners	330020-012
6	2	Wire nut	576008-461
7	1	Sealing pack	514100-304
8	1	Cord grip	331028-011
9	2	Tie wrap	510901-337
10	1	Shim	332061-001
11	1	Ball Valve, 3-way, 1/4”	576008-649
12	1	Copper tube, soft, 1/4” OD, 36” length	332151-001

Tools Required

1. Wrenches suitable for tightening tubing fittings.
2. Necessary pipe fitter’s equipment and a non-hazardous work space suitable to modify the dispenser vapor line for Pressure Sensor installation.

Installation Steps

1. Before installing this device, turn Off, tag/lock out power to the system, including console and submersible pumps.
2. Determine which dispenser is closest to the tank being monitored. Remove that dispenser's lower sheet metal doors to gain access to the vapor plumbing.
3. Locate a suitable port or plumb a suitable "T" fitting in one of the locations listed below (listed in order of preference):
   a. The main vapor return line (see Figure 17-1 or Figure 17-2 as required) - this is the preferred position,
   b. In the vapor return line between shear valve and main vapor return line, or
   c. If a vapor flow meter is installed in the shear valve housing below the shear valve mechanism. Note: 1 to 2 ports are typically available on a shear valve. If you have to use one of these ports, make certain it accesses the plumbing below the valve mechanism.
4. Install one of the 68CA-4-4 male connectors (item 2 in Table 17-1) from the kit into the tapped hole.
5. Install Pressure Sensor (item 1 in Table 17-1) vertically to the dispenser frame or piping using the 2-inch conduit clamp, rubber shim, and necessary bolts, nuts, and washers from the included Universal Sensor Mounting kit. Wrap the rubber shim (item 10 in Table 17-1) around the sensor before inserting it into the clamp. Also make sure the sensor cable outlet is facing up and the pressure sensing port tube in the base of the sensor is facing down.
6. Attach one end of the 62CA-4 union (item 3 in Table 17-1) to the pressure sensing port in the base of the Pressure Sensor.
7. Install the remaining 68CA-4-4 male connectors (item 2 in Table 17-1) from the kit into each of the three ports in the 3-way calibration valve (item 13 in Table 17-1).
8. Measure, fabricate, and install a ¼" OD copper tube (item 12 in Table 17-1) that runs between the 62CA-4 union in the base of the sensor and the center port of the 3-way calibration valve.
9. Measure, fabricate, and install a ¼" OD copper tube that runs between the ¼" tube end of the male connector fitting installed beneath the shear valve and one of the two unused ports on the 3-way valve, being careful not to create any potential liquid traps.
10. Screw the 59CA-4 plug, item 4, from the kit onto the last port's male connector. Make sure the valve's handle is set to connect the sensor to the vapor return line and not to the capped (ambient) port.

    Important! All plumbing's pitch to drain should be 1/4" vertical per 12" horizontal to eliminate liquid traps.
11. Route the cable from Pressure Sensor to the Pressure Sensor junction box in the dispenser. Observing polarity, connect the sensor wiring to the field wiring from console and cap with wire nuts (see Figure 17-3).

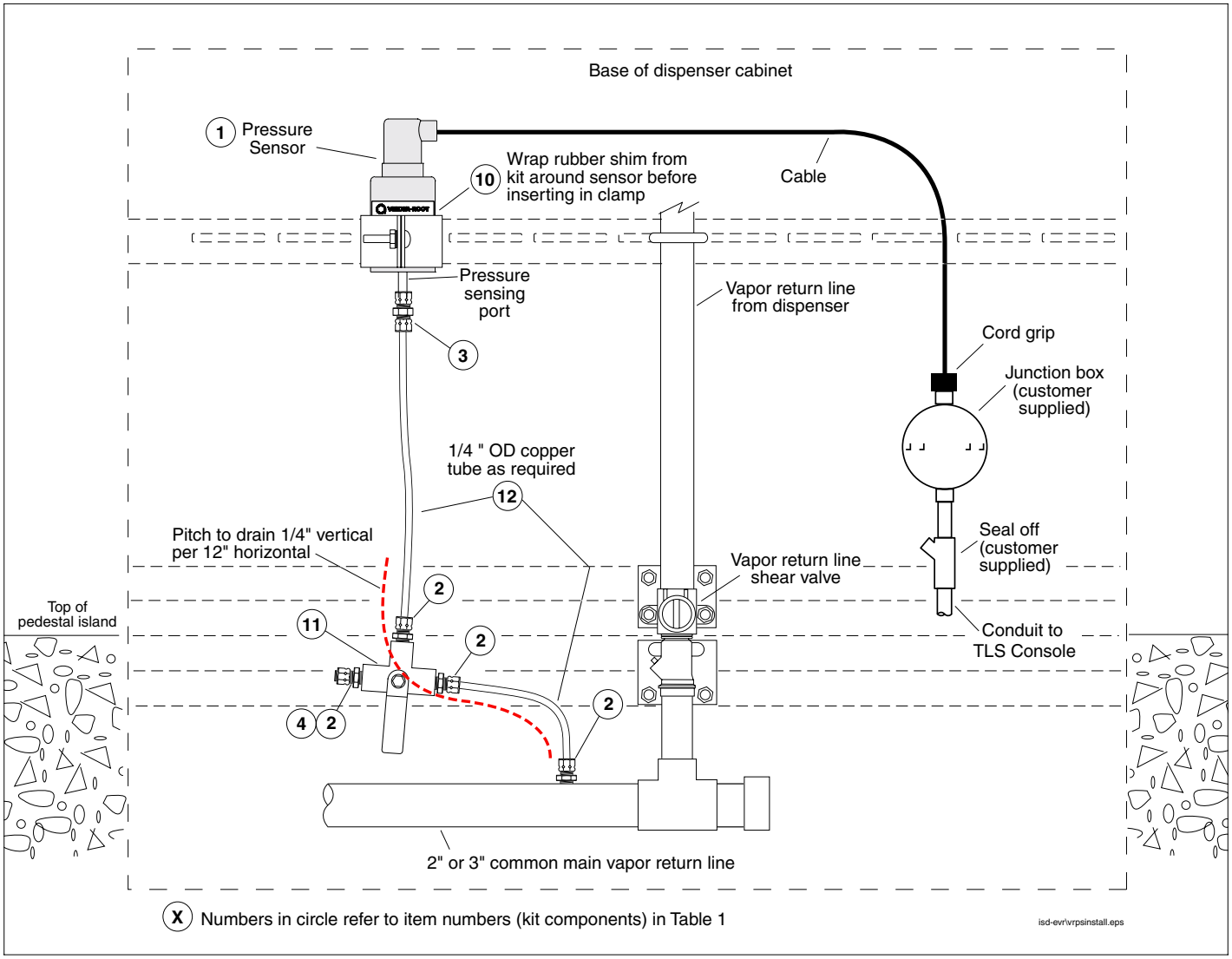


Figure 17-1. Example Pressure Sensor Install - Non-ISD Installation (without Vapor Flow Meter)

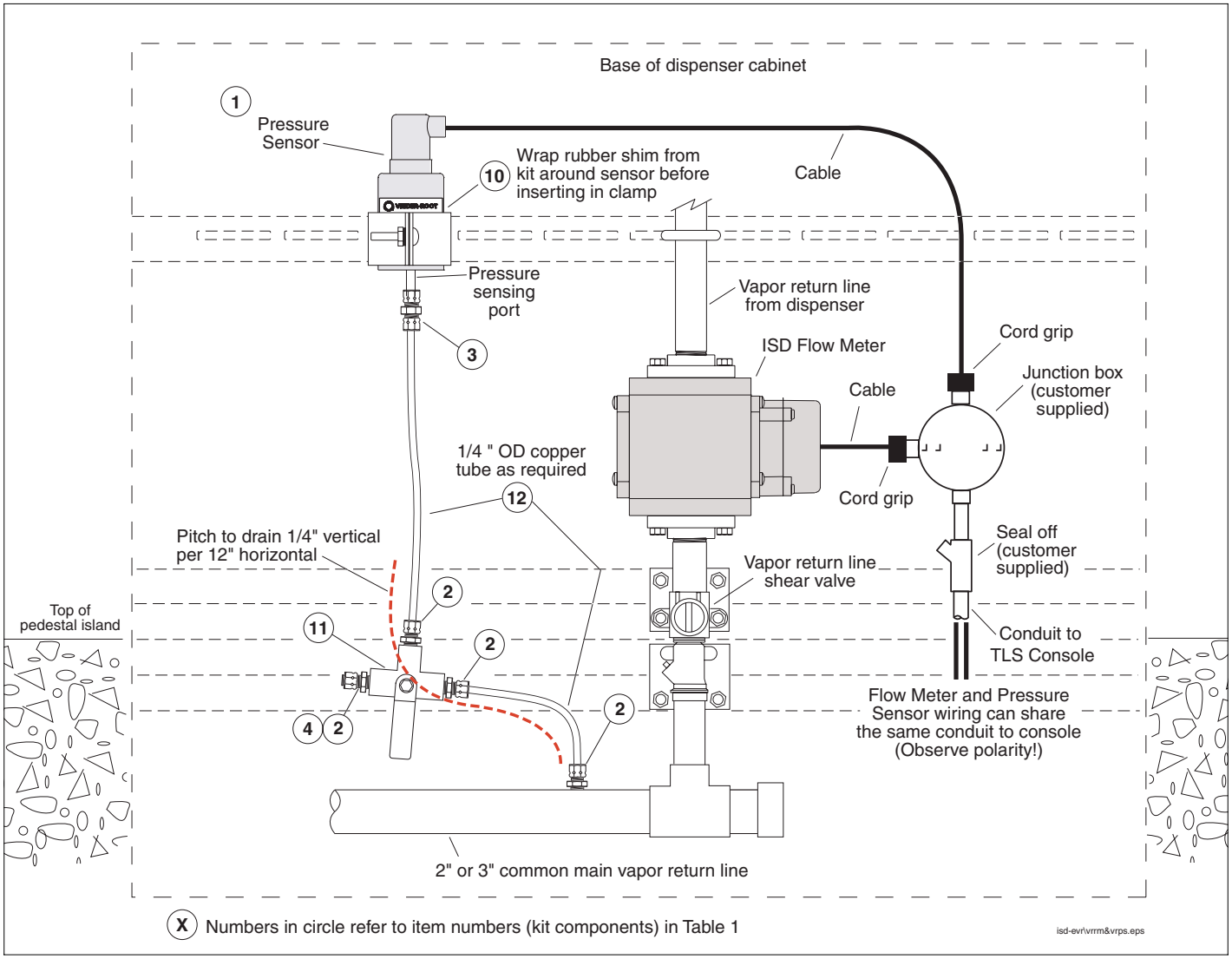


Figure 17-2. Example Pressure Sensor Install - ISD Installation (with Vapor Flow Meter)

.

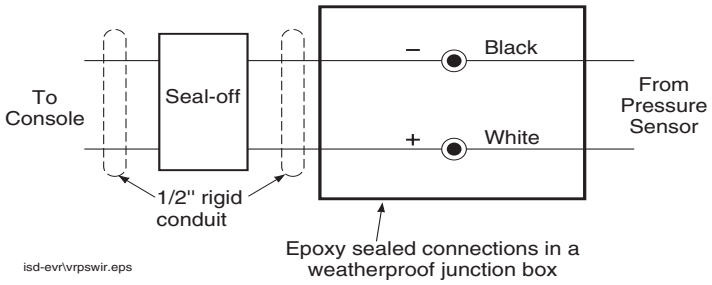
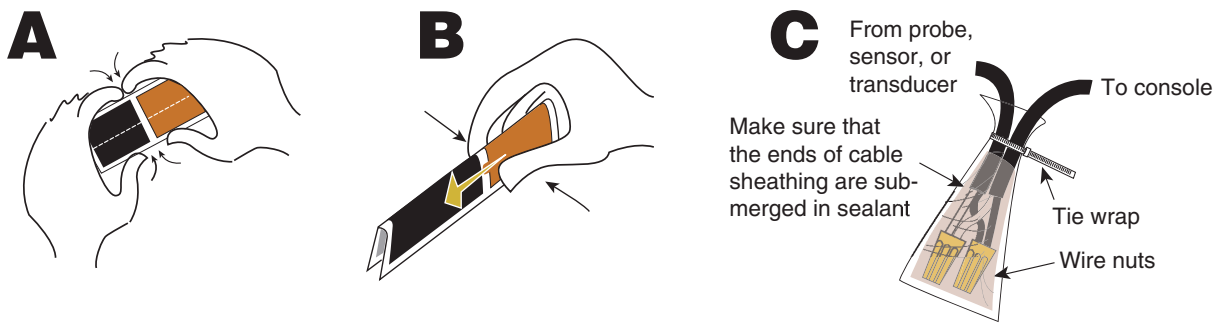


Figure 17-3. Field wiring Pressure Sensor - Observe Polarity

12.Seal wire nuts in epoxy sealant following the instructions in Figure 17-4.



Instructions:

NOTE: When temperature is below 50˚F (10˚C), keep resin in a warm place prior to mixing (e.g., in an inside pocket next to body).

1. Open epoxy sealant package, and remove resin pak.
2. Holding resin pak as shown in A, bend pak along long length.
3. As shown in B, firmly squeeze the RED SIDE of the resin, forcing it through the center seal and into BLACK SIDE.
4. Mix thoroughly to a uniform color by squeezing contents back and forth 25-30 times.
5. Squeeze mixed, warm resin into one end of bag and cutoff other end.
6. Slowly insert wiring connections into sealing pack until they fit snugly against the opposite end as shown in C.
7. Twist open end of bag and use tie wrap to close it off and position the tie wrapped end up until the resin jells.

CAUTION: Epoxy sealant is irritating to eyes, respiratory system, and skin. Can cause allergic skin reaction. Contains: epoxy resin and Cycloaliphatic epoxycarboxylate.

Precautions: Wear suitable protective clothing, gloves, eye, and face protection. Use only in well ventilated areas. Wash thoroughly before eating, drinking, or smoking.

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Figure 17-4. Epoxy sealing field wiring

13.Push the epoxy sealed bag into the junction box. Replace and tighten the junction box cover.

14.Terminate field wiring into TLS Console and connect to Smart Sensor Module (TLS-3XX - Figure 17-5). Note: observe polarity! The cable length between the console and sensor must not exceed the distance stated in the TLS-3XX Site Prep manual (P/N 576013-879).

Note: Intrinsically safe devices must be installed in accordance with Article 504 of the National Electrical Code, ANSI/NFPA 70, for installation in the United States, or Section 18 of the Canadian Electrical Code for installations in Canada.

This intrinsically safe Pressure Sensor P/N 331946-001, has only been evaluated for connection to a UL listed TLS-3XX Liquid Level Gauge / Leak Detector.

Conductors of different intrinsically safe circuits run in the same cable/conduit must have at least 0.01 inch (0.25 mm) of insulation.

15.After the Pressure Sensor is installed, pressurize the tank ullage space and vapor piping to at least 2 inches WC and test for leaks using leak detection solution.

16.Replace lower dispenser sheet metal doors onto dispensers.

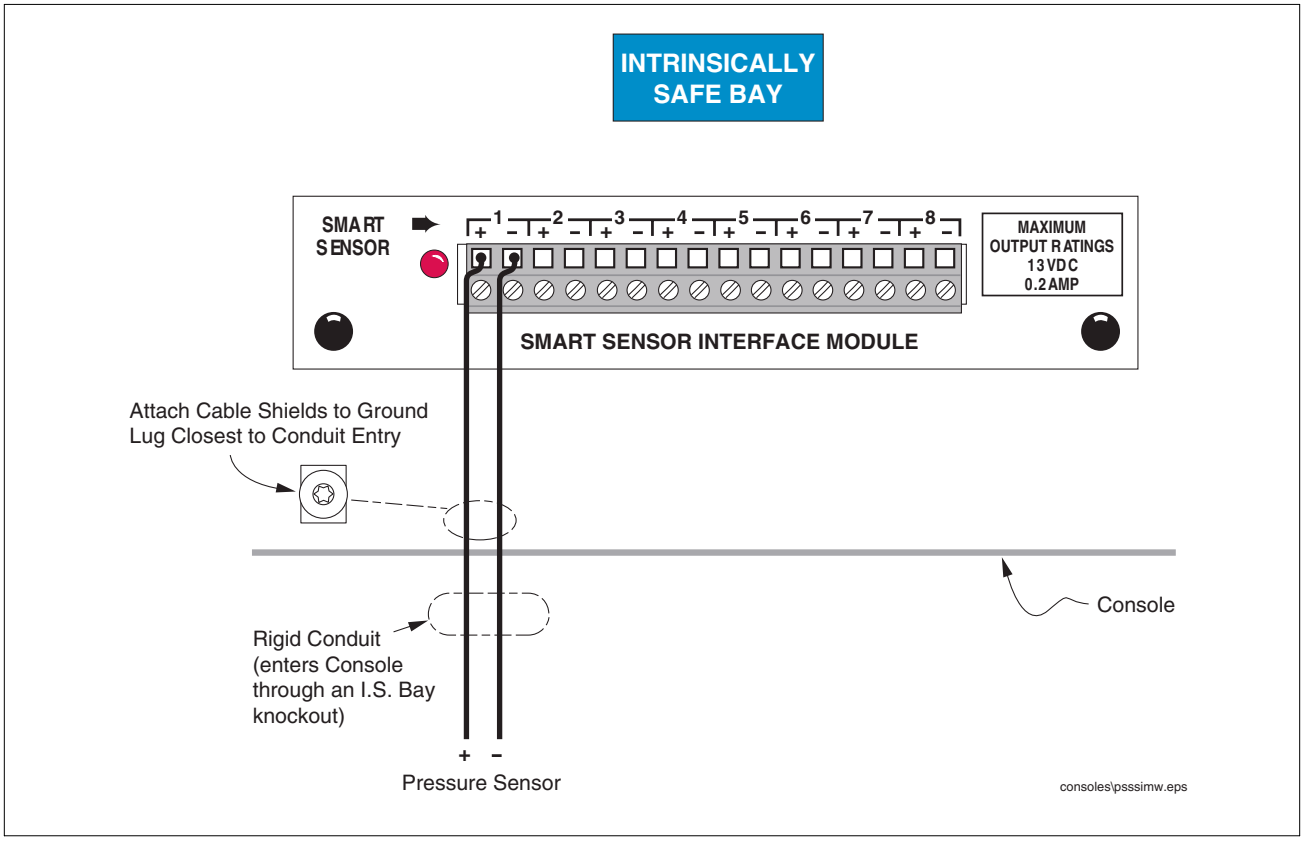

Figure 17-5. Connecting Pressure Sensor to TLS-3XX Smart Sensor Interface Module

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ISD Balance Vapor Flow Meter

Installation Guide

VEEDER-ROOT

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Veeder-Root reserves the right to change system options or features, or the information contained in this publication.

DAMAGE CLAIMS / LOST EQUIPMENT

Thoroughly examine all components and units as soon as they are received. If any cartons are damaged or missing, write a complete and detailed description of the damage or shortage on the face of the freight bill. The carrier's agent must verify the inspection and sign the description. Refuse only the damaged product, not the entire shipment.

VEEDER-ROOT'S PREFERRED CARRIER

1. Contact VR Customer Service at 800-873-3313 with the specific part numbers and quantities that were missing or received damaged.
2. Fax signed Bill of Lading (BOL) to VR Customer Service at 800-234-5350.
3. VR will file the claim with the carrier and replace the damaged/missing product at no charge to the customer. Customer Service will work with production facility to have the replacement product shipped as soon as possible.

CUSTOMER'S PREFERRED CARRIER

1. It is the customer's responsibility to file a claim with their carrier.
2. Customer may submit a replacement purchase order. Customer is responsible for all charges and freight associated with replacement order. Customer Service will work with production facility to have the replacement product shipped as soon as possible.
3. If "lost" equipment is delivered at a later date and is not needed, VR will allow a Return to Stock without a restocking fee.
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RETURN SHIPPING

For the parts return procedure, please follow the appropriate instructions in the "General Returned Goods Policy" and "Parts Return" pages in the "Policies and Literature" section of the Veeder-Root **North American Environmental Products** price list.

ISD Vapor Flow Meter Installation

Figures

Tables

ISD Vapor Flow Meter Installation

This manual contains instructions to install a Veeder-Root ISD (In-Station Diagnostic) Vapor Flow Meter in a dispenser's vapor return line in balance systems.

This manual assumes all preliminary site preparation is completed, and that wiring from the console to the Vapor Flow Meter junction box is in place and meets the requirements set out in the TLS-3XX Series Site Prep manual.

Contractor Certification Requirements

Veeder-Root requires the following minimum training certifications for contractors who will install and setup the equipment discussed in this manual:

Level 1 Contractors holding valid Level 1 Certification are approved to perform wiring and conduit routing, equipment mounting, probe and sensor installation, tank and line preparation, and line leak detector installation.

Level 2/3 or 4 Contractors holding valid Level 2, 3, or 4 Certifications are approved to perform installation checkout, startup, programming and operations training, troubleshooting and servicing for all Veeder-Root Tank Monitoring Systems, including Line Leak Detection and associated accessories.

Warranty Registrations may only be submitted by selected Distributors.

Related Manuals

576013-879 TLS-3XX Series Consoles Site Prep Manual

VST-IOM / Section 16 / VR-204 In-Station Diagnostics Install, Setup & Operation Manual

Safety Precautions

The following safety symbols may be used throughout this manual to alert you to important safety hazards and precautions.

 **EXPLOSIVE** Fuels and their vapors are extremely explosive if ignited.	 **FLAMMABLE** Fuels and their vapors are extremely flammable.
 **ELECTRICITY** High voltage exists in, and is supplied to, the device. A potential shock hazard exists.	 **TURN POWER OFF** Live power to a device creates a potential shock hazard. Turn Off power to the device and associated accessories when servicing the unit.
 **READ ALL RELATED MANUALS** Knowledge of all related procedures before you begin work is important. Read and understand all manuals thoroughly. If you do not understand a procedure, ask someone who does.	 **USE SAFETY BARRICADES** Unauthorized people or vehicles in the work area are dangerous. Always use safety cones or barricades, safety tape, and your vehicle to block the work area.
 **WARNING** Heed the adjacent instructions to avoid damage to equipment, property, environment or personal injury.	 **WEAR EYE PROTECTION** Wear eye protection when working with pressurized fuel lines or epoxy sealant to avoid possible eye injury.
 **INJURY** Careless or improper handling of materials can result in bodily injury.	 **GLOVES** Wear gloves to protect hands from irritation or injury.

⚠ WARNING

This product is to be installed and operated in the highly combustible environment of a gasoline dispenser where flammable liquids and explosive vapors may be present.

Improper installation could cause damage to property, environment, resulting in serious injury or death.

The following hazards exist:

1. **Electrical shock resulting in serious injury or death may result if power is on during installation and the device is improperly installed.**
2. **Product leakage could cause severe environmental damage or explosion resulting in death, serious personal injury, property loss and equipment damage.**

Observe the following precautions:

1. **Read and follow all instructions in this manual, including all safety warnings.**
2. **Comply with all applicable codes including: the National Electrical Code; federal, state, and local codes; and other applicable safety codes.**
3. **Before installing this device, turn Off, tag/lock out power to the system, including console and submersible pumps.**
4. **To protect yourself and others from being struck by vehicles, block off your work area during installation or service.**
5. **Substitution of components may impair intrinsic safety.**

Before You Begin

- A level 1 or higher certified Veeder-Root Technician must be available (on site) to assist in this type of installation.
- Comply with all recommended safety practices identified by OSHA (Occupational Safety and Health Administration) and your employer.
- Follow all installation requirements as per NFPA (National Fire Protection Association) 30, 30A, and 70.
- Review and comply with all the safety warnings in the installation manuals and any other national, State or Local requirements.
- A 2-conductor, 18 AWG shielded cable must be installed in intrinsically safe conduit from each dispenser to the intrinsically safe wiring compartment of the TLS console.
- Debris from plumbing modifications should be flushed through the piping system prior to installing the ISD Vapor Flow Meter.
- Use only UL recognized Gas/TFE yellow teflon tape on all fittings. Do not use pipe dope to seal pipe threads or fittings in and out of the ISD Vapor Flow Meter.

Veeder-Root Parts

- Sensor Installation Kit, see Table 18-1.

Table 18-1.- Vapor Flow Meter Installation Kit (P/N 330020-585)

Item	Qty.	Description	P/N
1	1	ISD Vapor Flow Meter	332374-002
2	2	Flange with 1” NPT threaded hole	332091-001
3	4	5/16-18 UNC-2B x 3/4” hex head bolt	514100-426
4	2	1-11.5 NPT x 2 “ male to male threaded steel nipple	576008-655
5	2	O-ring (Parker size # 2-218, Nitrile)	512700-258
6	1	Cord grip group	331028-001
7	1	Sealing pack	514100-304
8	2	Wire nut	576008-461
9	2	Tie wrap	510901-337
10	4	5/16” Lock washer	514100-436

Tools Required

- Pipe wrench suitable for tightening 1-inch NPT pipe.
- 1/2’’ socket wrench to install Vapor Flow Meter flange bolts.
- Necessary pipe fitter’s equipment and a non-hazardous work space suitable to modify dispenser vapor line for Vapor Flow Meter installation, when necessary.

Installation Steps - Balance Systems Above Shear Valve

1. Before installing this device, turn off, tag/lock out power to the system, including console and submersible pumps.
2. Remove the dispenser's lower sheet metal doors to access the vapor plumbing.
3. Loosen any factory installed mounts and/or brackets in order to provide room to disconnect any factory installed vapor return plumbing from the shear valve.
4. Disconnect the factory installed vapor return plumbing from the vapor shear valve (see Figure 18-1).
5. Remove any unneeded field installed plumbing above the vapor shear valve. The Vapor Flow Meter with flanges attached can be used for sizing the required head space of approximately 8 inches. Approximately 3 inches of clearance is required on both sides of the piping to accommodate the width of the meter body.
6. Thread one of the flanges (two provided in installation kit) onto the dispenser vapor return piping.

   Note: Prior to modifying any piping in the dispenser, consult the dispenser manufacturer to determine if ISD ready retrofit kits are available. Any factory installed plumbing that must be modified in order to install the vapor flow meter, must be removed to a non hazardous work area before any cutting or threading takes place. After modifications to any plumbing, it must be reinstalled in accordance with the dispenser manufacturers installation guidelines.
7. Install any necessary plumbing and the lower flange above the vapor shear valve.

   Note: The use of 90° elbows should be kept to a minimum to minimize pressure drop, maximize vapor collection efficiency and to prevent liquid traps. All horizontal plumbing must pitch to drain.

IMPORTANT: Upper and lower flanges must align to within 1/16" center-to-center before installing flow meter. If piping is improperly aligned, torque could damage the flow meter and result in vapor leakage.

8. Clean all debris around the inlet and outlet plumbing prior to installing the Vapor Flow Meter. Do not blow compressed air through the Vapor Flow Meter to prevent damaging the internal screens.
9. Install the o-ring into the lower mounting flange.
10. Taking care that foreign material (chips, debris, sealant, etc.) does not enter the open piping or Vapor Flow Meter, carefully insert the o-ring and then connect the Vapor Flow Meter to the upper flange. Note that the flow arrow on the side of the meter body must point down.
11. Connect the lower flange to the Vapor Flow Meter.
12. Tighten any loose fittings and hardware
13. Route the wiring into the junction box via the supplied cord grip assembly.
14. Connect the wires from the Vapor Flow Meter to the field wiring from the console and cap with wire nuts (see Figure 18-2).
15. After all other ISD Vapor Flow Meters and the ISD Pressure Sensor are installed, pressurize the tank ullage space and vapor piping to at least 2 inches WC and test for leaks using leak detection solution.

IMPORTANT: Upper and lower flanges must align to within 1/16” center-to-center before installing flow meter. If piping is improperly aligned, torque could damage the flow meter and result in vapor leakage.

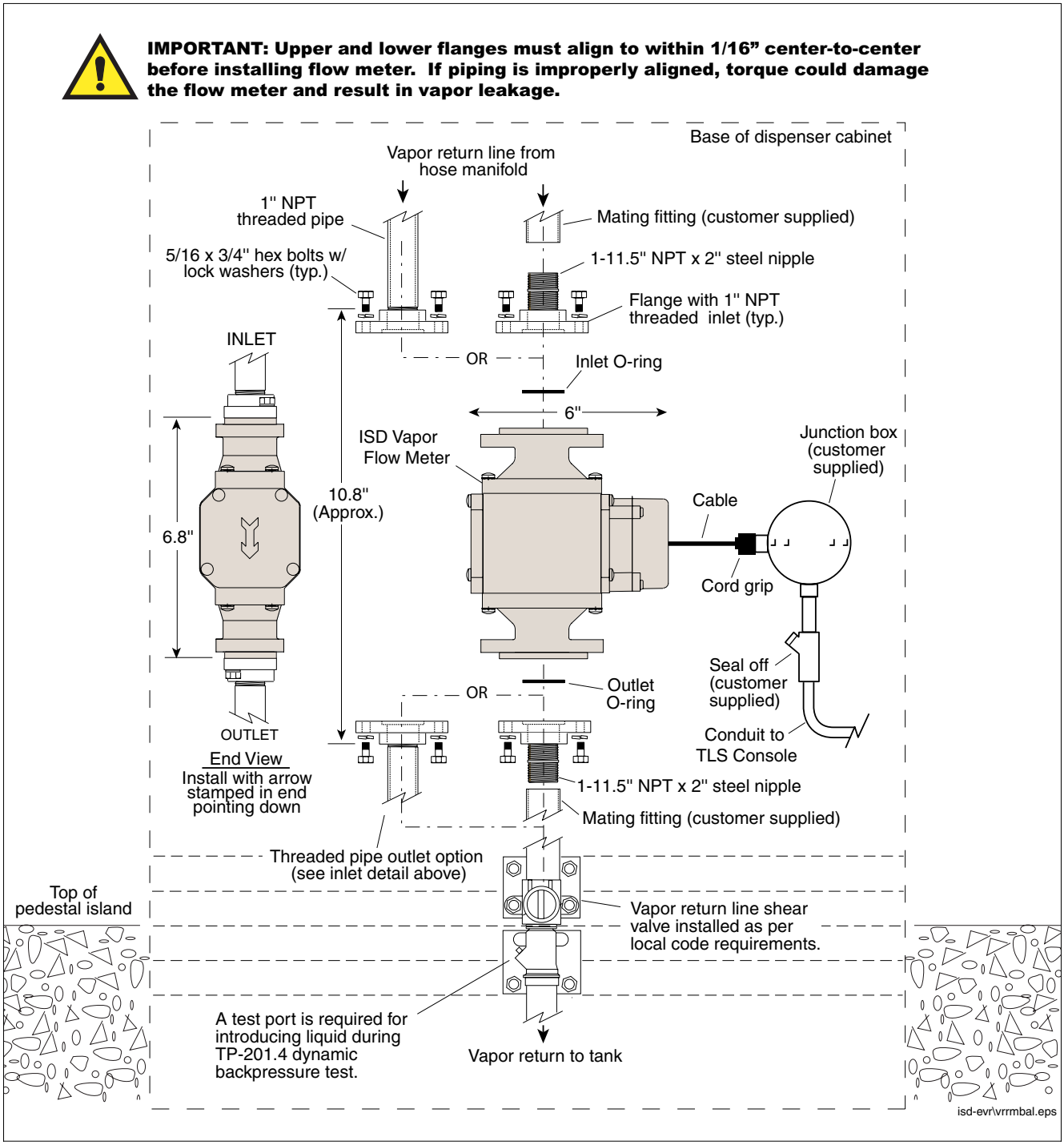

Figure 18-1. Example Vapor Flow Meter Installation Above Shear Valve

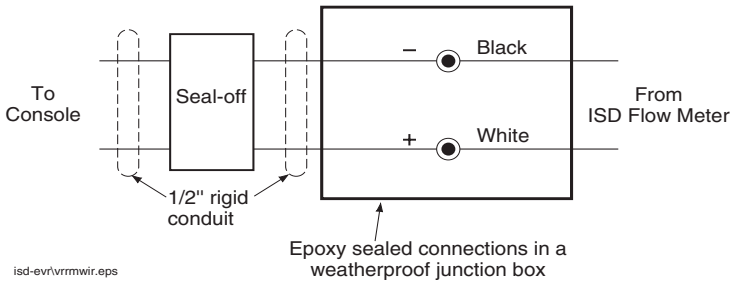

Figure 18-2. Field wiring Vapor Flow Meter - Observe Polarity

Installation Steps - Balance Systems Below Shear Valve

1. Before installing this device, turn Off, tag/lock out power to the system, including console and submersible pumps.
2. Remove the dispenser's lower sheet metal doors to access the vapor plumbing, if necessary.
3. Remove any unneeded field installed plumbing between the vapor shear valve and the vapor return line fitting. Figure 18-3 shows two example installations of the Vapor Flow Meter with the required lateral or wye fitting for running the TP-201.4 back-pressure test. Approximately 3 inches of clearance is required on both sides of the piping to accommodate the width of the meter body.

   IMPORTANT: Upper and lower flanges must align to within 1/16" center-to-center before installing flow meter. If piping is improperly aligned, torque could damage the flow meter and result in vapor leakage.
4. Connect the lower flange to the pipe that is connected to the lateral or wye access fitting (see Figure 18-4).
5. Install the Vapor Flow Meter over the lower flange.
6. Connect the upper flange with o-ring above the Vapor Flow Meter.
7. Using a close nipple, thread the shear valve into the upper flange.
8. Using nipples, unions, and other plumbing as required, connect the plumbing outlet to the shear valve.
9. Route the wiring into the junction box via the supplied cord grip assembly. Connect the wires from the Vapor Flow Meter to the field wiring from the console and cap with wire nuts (see Figure 18-2).
10. After all other ISD Vapor Flow Meters and the ISD Pressure Sensor are installed, pressurize the tank ullage space and vapor piping to at least 2 inches WC and test for leaks using leak detection solution.

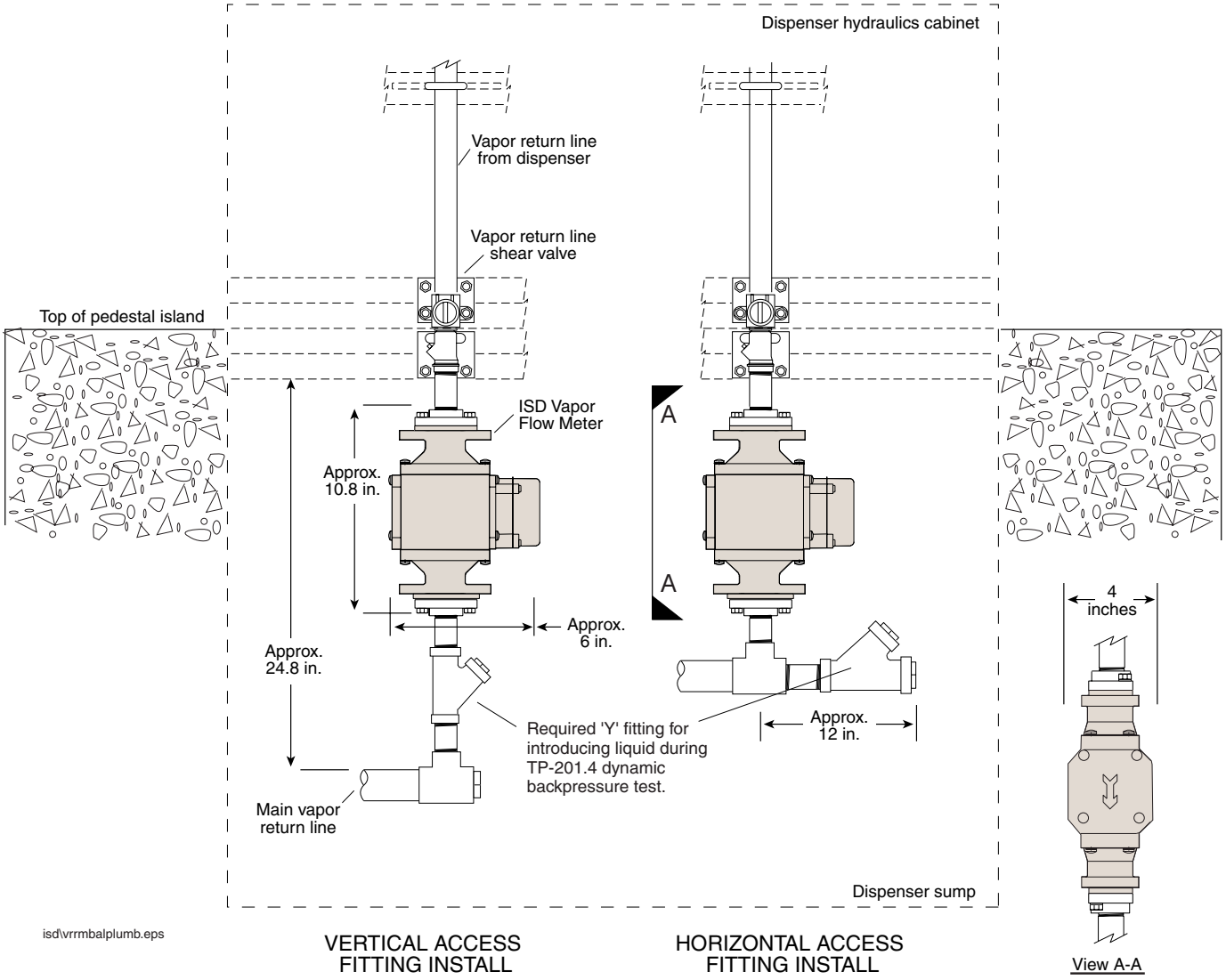

Figure 18-3. Example flow meter installations with approximate clearances

IMPORTANT: Upper and lower flanges must align to within 1/16” center-to-center before installing flow meter. If piping is improperly aligned, torque could damage the flow meter and result in vapor leakage.

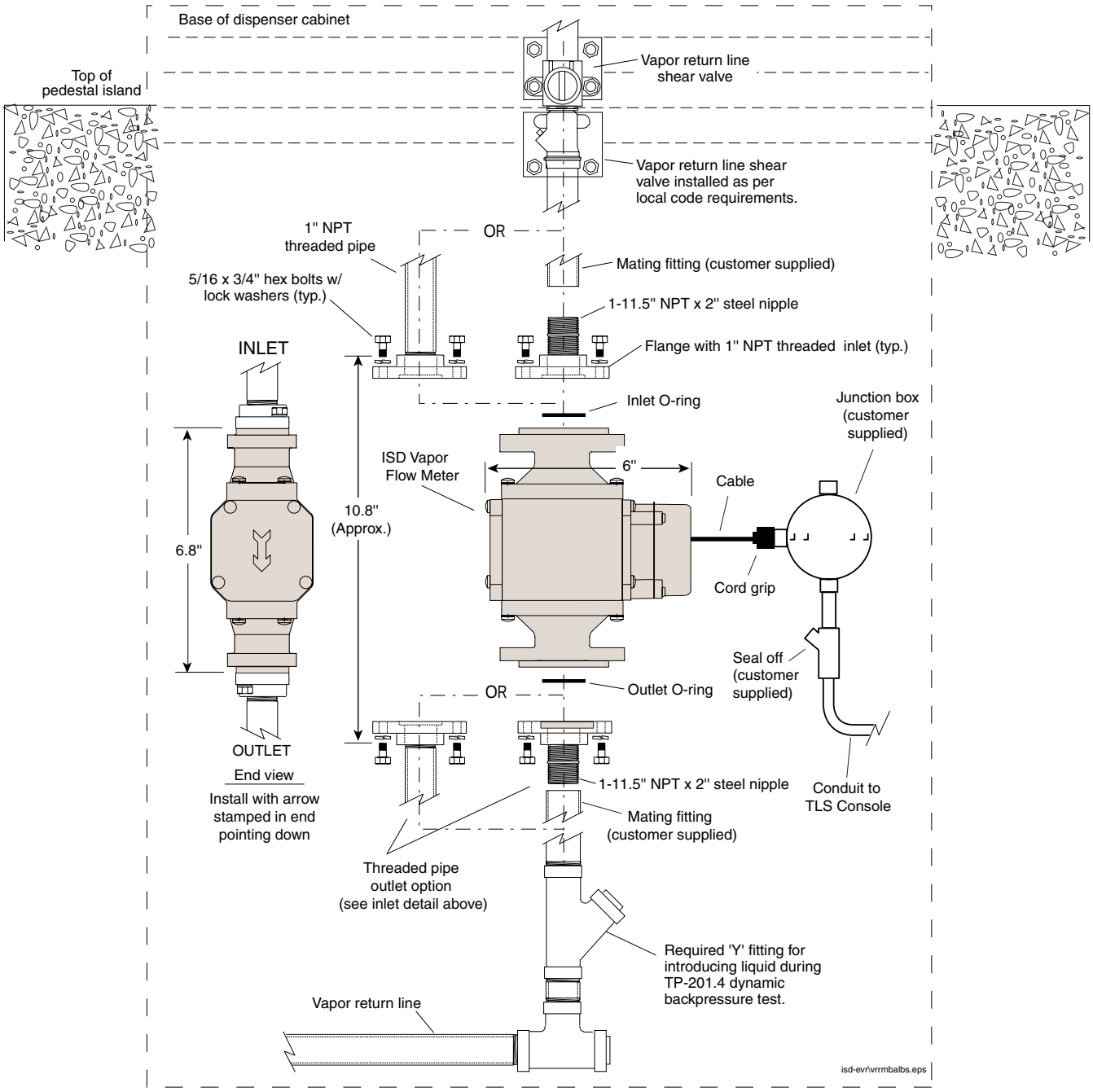

Figure 18-4. Example Vapor Flow Meter Installation Below Shear Valve

Seal and Connect Field Wiring

1. Seal wire nuts with epoxy sealant following the instructions in Figure 18-5.

CAUTION: Epoxy sealant is irritating to eyes, respiratory system, and skin. Can cause allergic skin reaction. Contains: epoxy resin and Cycloaliphatic epoxycarboxylate. Precautions: Wear suitable protective clothing, gloves, eye, and face protection. Use only in well ventilated areas. Wash thoroughly before eating, drinking, or smoking.

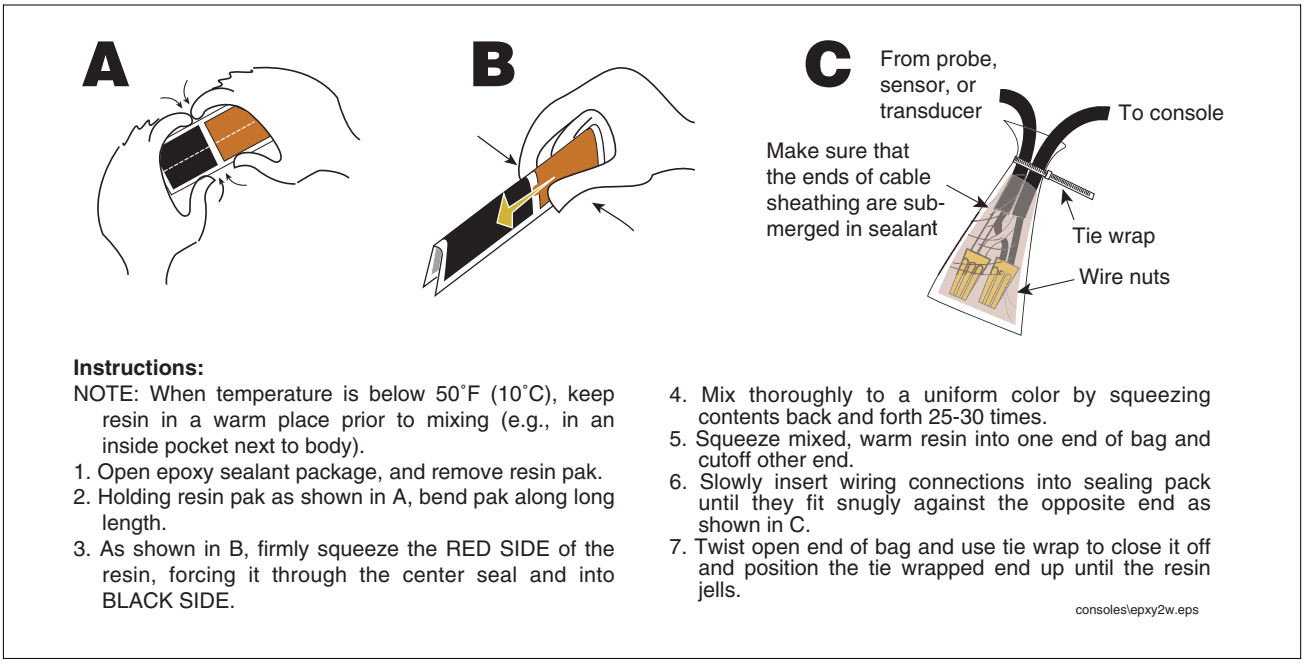

Figure 18-5. Epoxy sealing field wiring

2. Push the epoxy sealed bag into the junction box. Replace and tighten the junction box cover.
3. Terminate field wiring into TLS Console and connect to Smart Sensor Module located in the intrinsically safe wiring compartment of the TLS as shown in Figure 18-6. Note: you must observe polarity! Also, the cable length between the console and sensor must not exceed the distance stated in the TLS-3XX Site Prep manual (P/N 576013-879).
4. Replace the lower sheet metal doors in the dispenser.

   Note: Intrinsically safe devices must be installed in accordance with Article 504 of the National Electrical Code, ANSI/NFPA 70, for installation in the United States, or Section 18 of the Canadian Electrical Code for installations in Canada.

   This intrinsically safe vapor flow meter P/N 332374-002, has only been evaluated for connection to a UL listed TLS-350 Series Liquid Level Gauge / Leak Detector.

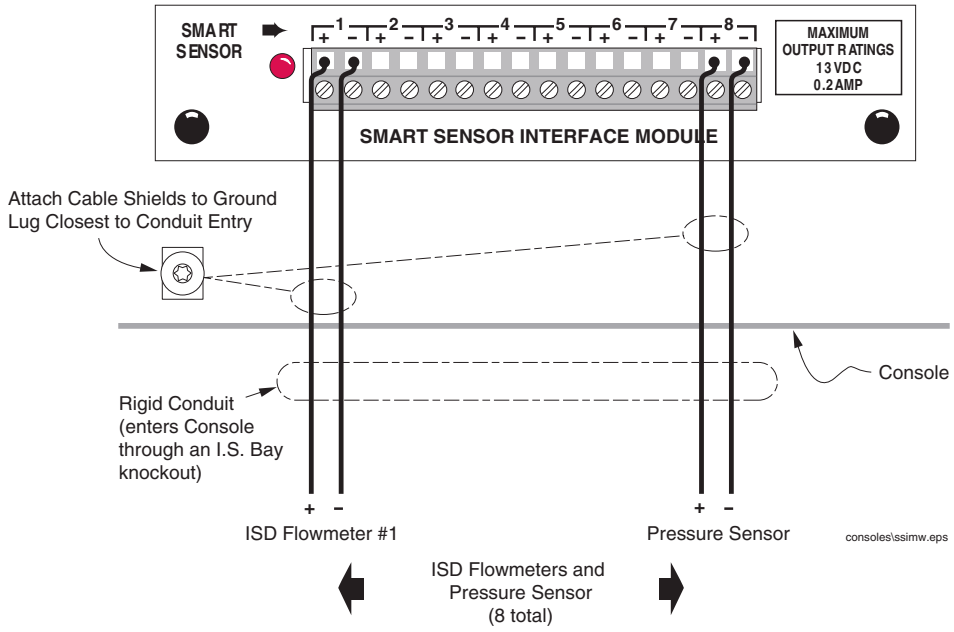

Figure 18-6. Connecting Vapor Flow Meter to Smart Sensor Interface Module

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