

Vacuum Sensor System

Troubleshooting Guide

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Introduction

Hardware Requirements for Vac Sensors - Verifying Installation 1
 Safety Precautions 1

Vac System Overview

Connecting Pump Control Field Wiring to TLS Console5
 For Sites with PLLD or WPLLD Leak Detection5
 For Sites without PLLD or WPLLD Leak Detection5

Vac Sensor Troubleshooting

High Liquid Alarm7
 Alarm Description(s)7
 Troubleshooting Process7
 Setup Data Warning8
 Alarm Description(s)8
 Additional Alarm Description8
 Communication Loss alarm9
 Alarm Description(s)9
 Troubleshooting Process9
 Vacuum Warning10
 Alarm Description(s)10
 Additional Description(s)10
 Troubleshooting Process10
 No Vac Alarm11
 Alarm Description(s)11
 Additional Description(s)11
 Troubleshooting Process12
 Procedure for isolating source of a Vacuum leak12
 Sensor Fault Alarm15
 Alarm Description(s)15
 Troubleshooting Process15
 Running a Manual Test16
 Perform the Manual Test for Each Vac Sensor16

Figures

Figure 1. Four Vac Sensor Assembly w/Tank Interstitial Sensor Install Ex.2
 Figure 2. Vacuum Sensor System Functional Diagram3
 Figure 3. Example Vac Sensor and Float Component Assembly3
 Figure 4. Example Vacuum Source Connection at The Red Jacket STP4
 Figure 5. Example Vac Sensor Field Wiring Connections4
 Figure 6. Example Vac Sensor Wiring to the Smart Sensor / Press Module5
 Figure 7. Connecting Pump Sense & 4-Relay Modules - RJ Pumps6
 Figure 8. Connecting Pump Sense & 4-Relay Modules - Non-RJ Pumps6
 Figure 9. Making a Vac Zone Test Loop13
 Figure 10. Isolating Vac Float for Leak Test13
 Figure 11. Isolating 3-Way Valve for Leak Test14
 Figure 12. TLS Console Vac Sensor Manual Test17
 Figure 13. TLS Console Vac Sensor Evac Hold Procedure18

Introduction

This guide contains suggested corrective actions for troubleshooting Vacuum Sensor problems.

Hardware Requirements for Vac Sensors - Verifying Installation







- TLS-350/350R with version 24C or later software
- At least one SmartSensor/Press Module
- Line leak (PLLD or WPLLD), or w/o line leak, a Pump Sense and a 4-Relay module is required for STP control
- STP siphon port with Siphon Check Valve (Veeder-Root P/N 188-241-5) installed. Note: An external Siphon Check Valve (Veeder-Root/Red Jacket P/N 188-241-5) must be used when making a vacuum source connection between the SCVS system sensors and the siphon port cartridge for the following STPs; Red Jacket Standard, Red Jacket Quantum and FE pumps.

NOTE: Only Veeder-Root supplied vacuum hose (Veeder-Root P/N 332310-001, -002, -003) is approved for use with the SCVS system.





- Siphon manifolded tank requirements:
 - The Red Jacket STP requires a secondary siphon assembly (Veeder-Root P/N 410151-001).
 - The Quantum STP comes with two siphons as standard equipment - no additional parts are required.
 - FE pumps require a secondary siphon kit (FE P/N 402-507-930).

Safety Precautions

The following safety symbols are used throughout this manual to alert you to important safety hazards and precautions.

 <p>EXPLOSIVE Fuels and their vapors are extremely explosive if ignited.</p>	 <p>FLAMMABLE Fuels and their vapors are extremely flammable.</p>
 <p>ELECTRICITY High voltage exists in, and is supplied to, the device. A potential shock hazard exists.</p>	 <p>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.</p>
 <p>WARNING Heed the adjacent instructions to avoid equipment damage or personal injury.</p>	 <p>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.</p>

⚠ WARNING

   	<p>This product operates in the highly combustible atmosphere of a gasoline storage tank. Failure to follow all instructions in proper order can cause personal injury or death.</p> <ol style="list-style-type: none"> 1. To be installed in accordance with the National Electrical Code, NFPA 70 and the Automotive And Marine Service Station Code, NFPA 30A. 2. Turn off, tag, and lockout power to the STP before connecting or servicing wiring to the STP. 3. Do not modify or use service parts other than those provided by Veeder-Root. 4. Substitution of components may impair intrinsic safety. 5. To protect yourself and others from serious injury, death, or substantial property damage, carefully read and follow all warnings and instructions in this manual.
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Vac System Overview

A simplified Veeder-Root Vacuum Sensor system installation in an STP sump is shown in Figure 1.

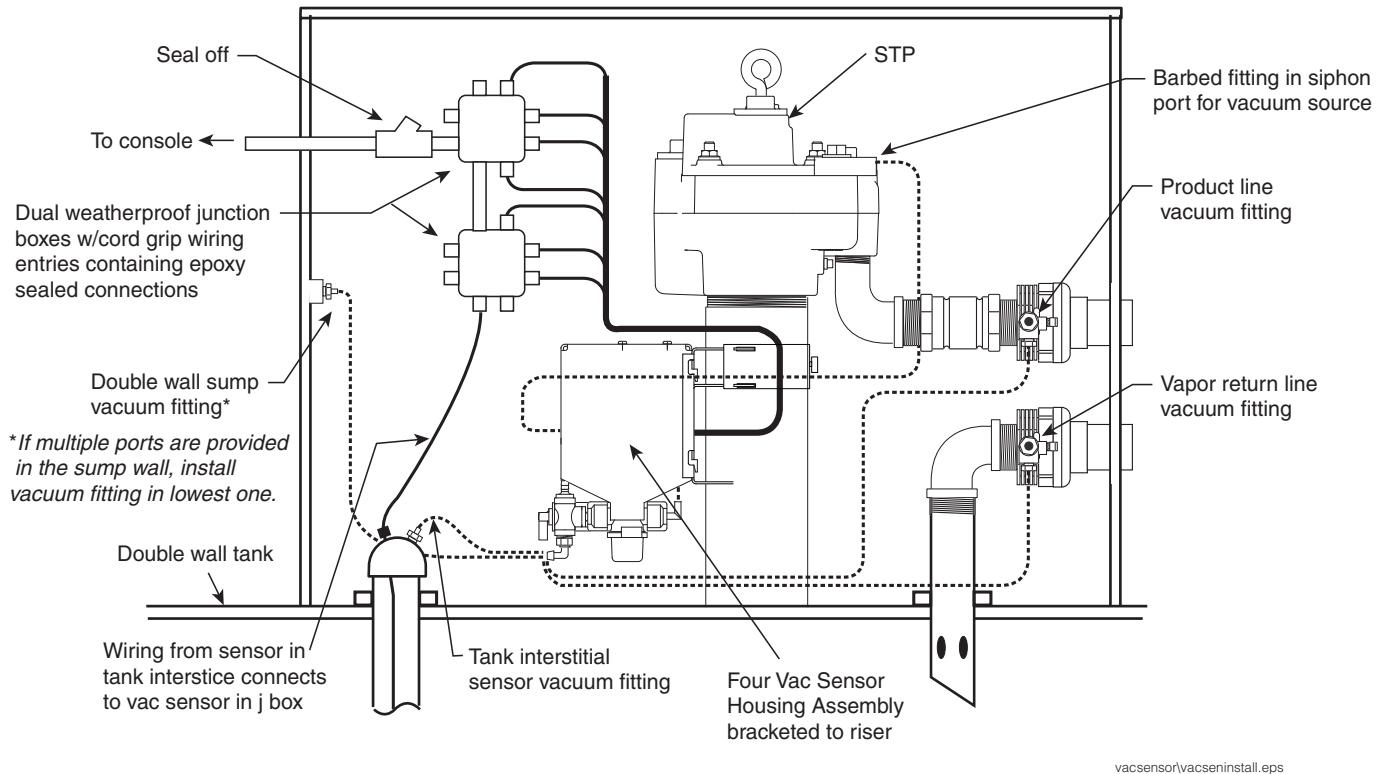


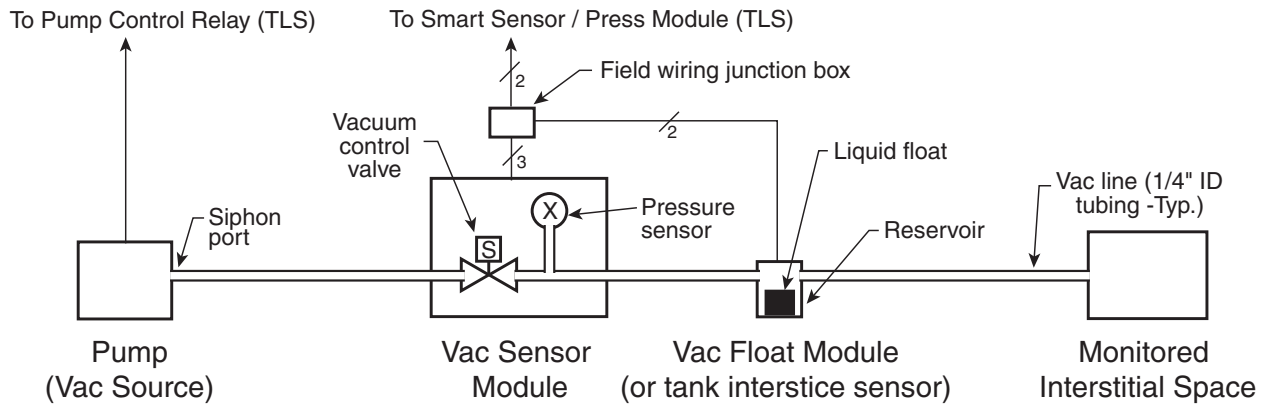
Figure 1. Four Vacuum Sensor Assembly w/Tank Interstitial Sensor Installation Example

A functional diagram of a Vac Sensor system is shown in Figure 2. The TLS Console turns the pump on, opens the vacuum control valve (in Vac Sensor), and then monitors the pressure sensor (in Vac Sensor).

Under normal operation, when the vacuum reaches either 1 psi above the entered relief valve pressure (relief valve installed), or -8 psi (no relief valve installed), unless the rate of evacuation decreases to less than 0.1 gpm, the console closes the vacuum control valve and turns off the pump. Thereafter, the console continues to monitor the pressure sensor for signs of a decrease in vacuum (leak) and the liquid float for the presence of a liquid in the vacuum line.

In the event of a decrease in vacuum the console turns on the pump in an attempt to restore the vacuum. Small leaks will be maintained by these periodic evacuations. If the system calculated leak rate exceeds approximately 25 gph a Vac Warning will be posted.

The console also monitors the liquid float in the Vac Float module or tank interstice and will post a High Liquid Alarm if enough liquid accumulates in the vac line liquid reservoir to lift the float.



vacensors/vacdiagram.eps

Figure 2. Vacuum Sensor System Functional Diagram

Figure 3 illustrates the components of a Vac Sensor/Float assembly. Note: The Vac Sensor monitoring the tank interstice does not require a Vac Float - it is connected to the tank interstice sensor wiring in the junction box.

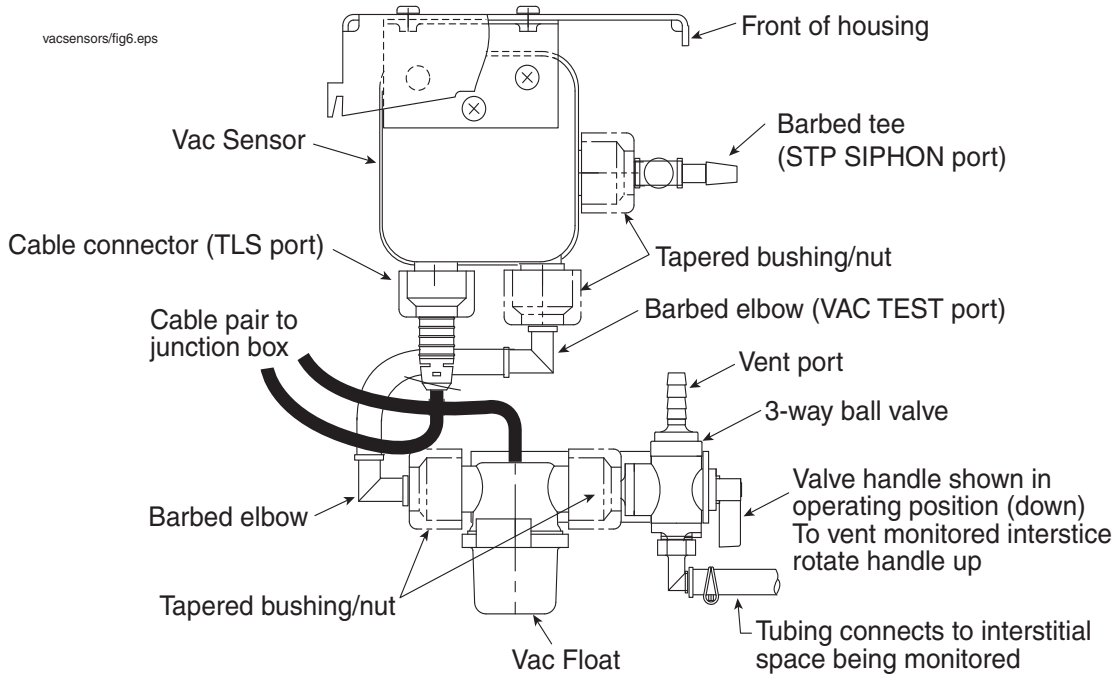


Figure 3. Example Vac Sensor and Float Component Assembly

Figure 4 is an example diagram of the vacuum connection at the The Red Jacket STP.

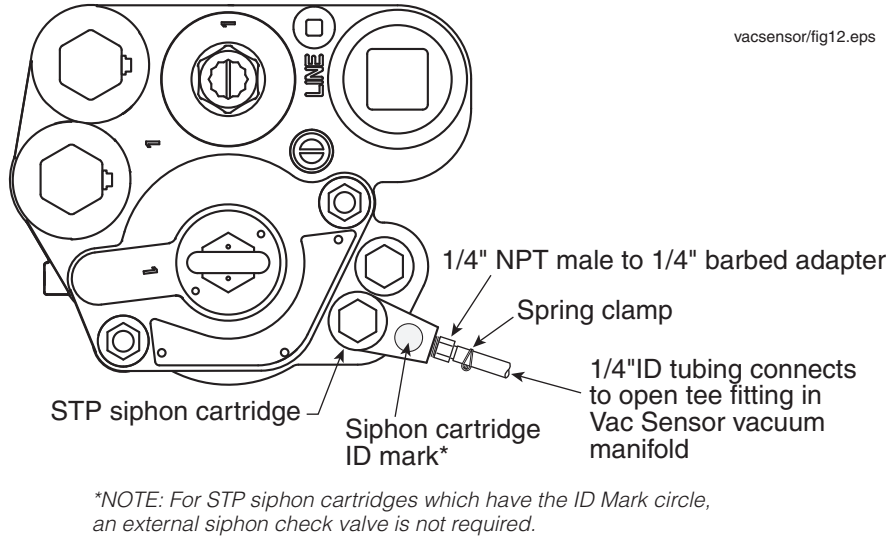


Figure 4. Example Vacuum Source Connection at The Red Jacket STP

An example field wiring diagram of a Vac Sensor/Float assembly is shown in Figure 5.

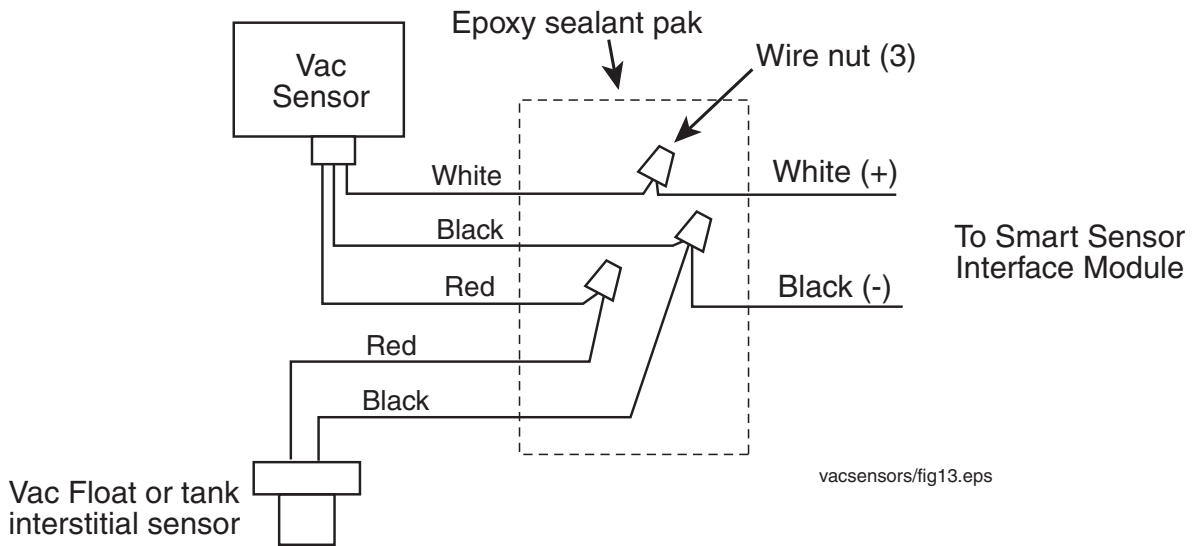


Figure 5. Example Vac Sensor Field Wiring Connections

An example of vac sensor zone wiring at the console's SmartSensor module is shown in Figure 6.

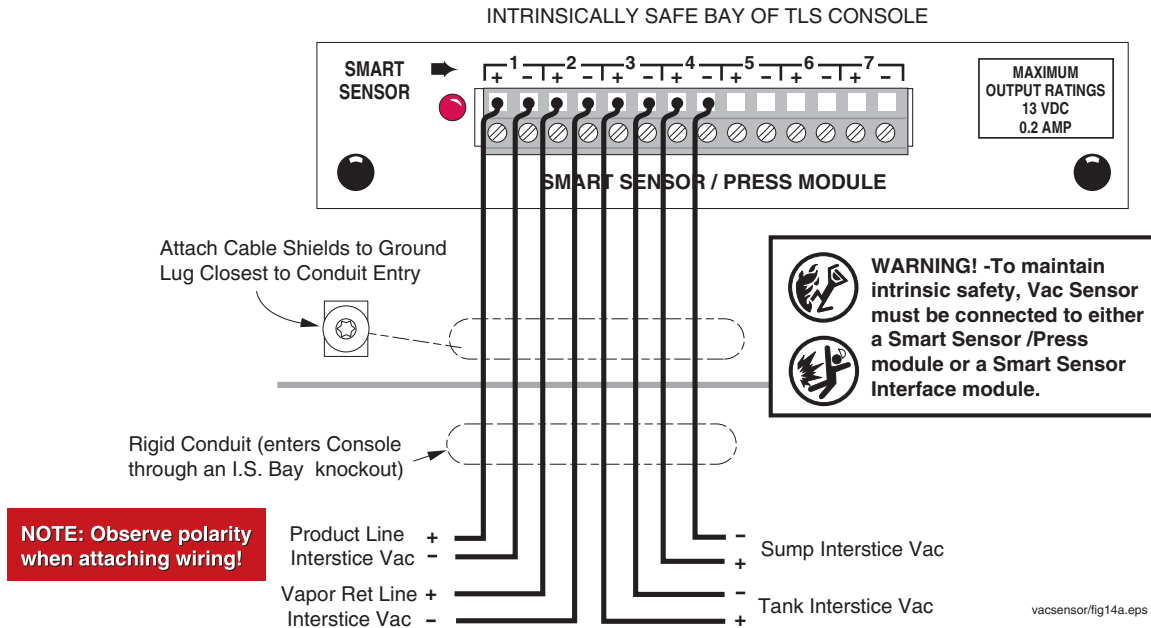


Figure 6. Example Vac Sensor Wiring to the Smart Sensor / Press Module

Connecting Pump Control Field Wiring to TLS Console

For Sites with PLLD or WPLLD Leak Detection

Pump control for Vac Sensors is shared with the line leak system. Connecting PLLD/WPLLD leak detection as per the instructions provided with those systems is all that is required.

For Sites without PLLD or WPLLD Leak Detection

A Pump Sense module and a 4-Relay module are required in the TLS Console for Vac Sensor pump control.

Field Wiring:

- For module connections with Red Jacket pumps see Figure 7. For module connections with non-Red Jacket pumps see Figure 8.

Console Setup:

- Pump Sense setup - assign each tank to Pump Sense device
- Output Relay setup - select 'Pump Control Output'

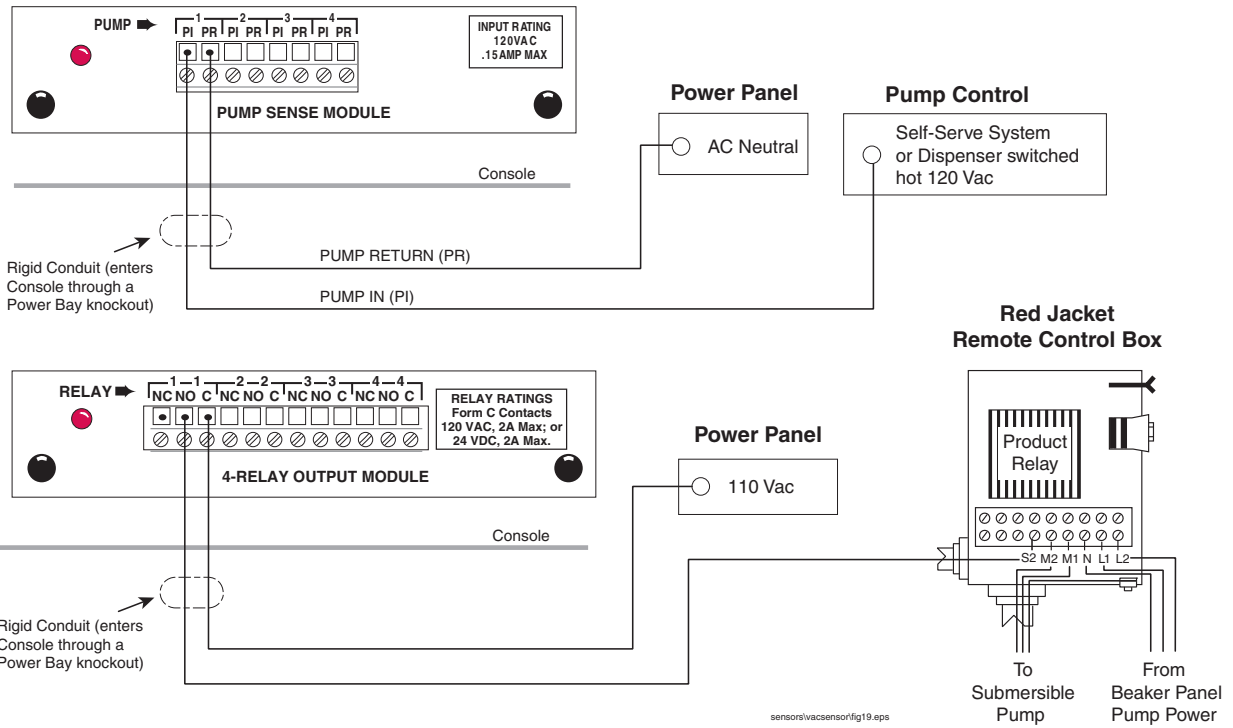


Figure 7. Connecting Pump Sense & 4-Relay Modules - Red Jacket Pumps

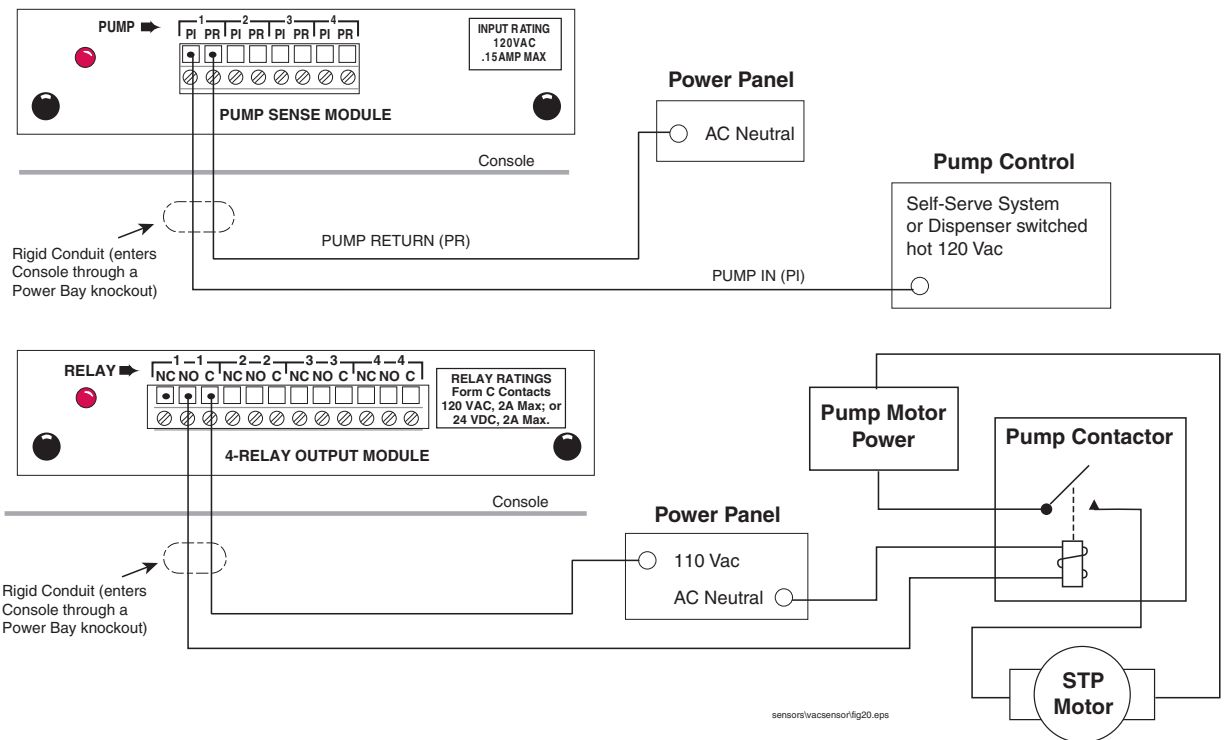


Figure 8. Connecting Pump Sense & 4-Relay Modules - Non-Red Jacket Pumps

Vac Sensor Troubleshooting

High Liquid Alarm

TLS DISPLAY: Snn: High Liquid Alarm

RS-232 Description: HI LIQ ALM

Alarm Description(s)

Alarm is posted for Vacuum Sensor when there is liquid present for 2 consecutive samples. Liquid is detected at the Vac sensor liquid sensor or interstitial double wall sensors.

Troubleshooting Process

If there is a High Liquid Alarm all evacuation attempts are stopped. No evacuation attempts will be allowed until alarm is cleared.

1. Check the following:
 - Priority (I11100) and Non-priority alarm history (I11200).
 - Current Alarms, check for related alarms to Smart Sensors, STP disable shut down alarms. Troubleshoot and repair any related Sensor Fault alarms first.
2. Verify alarm condition for Vacuum Sensor that is in alarm:
 - Unscrew the lower float bowl (about a 1/4 turn) on sensor that is in alarm.
 - Check to see if there is liquid in bowl. If liquid is found determine the source of liquid and have necessary repairs performed.
 - After repairs are made, empty bowl and clean. Push alarm reset button to clear alarm.
3. If they don't have Vac Float Sensors and they are using interstitial sensors on double wall tanks as float sensors:
 - Verify wire connections to Vacuum sensor as per Vacuum Sensor Installation Manual # 577013-836.
 - Then check interstitial space and verify if liquid is present.
 - If liquid is detected, troubleshoot for source and perform necessary repairs. Once repairs are done alarm will clear.
 - If no liquid detected, perform necessary troubleshooting procedures to verify interstitial sensor, field wiring, Smart Sensor module, channel for possible faults.

Setup Data Warning

TLS DISPLAY: SETUP WARN

RS-232 Description: SETUP DATA WARNING

Alarm Description(s)

A set up parameter is not correct or is missing.

Additional Alarm Description

There will be a Setup Data Warning if:

- The volume is not in the correct range. The volume will default to 501. The user must program the volume between 0.1 to 500 gallons.
 - A pump # is not assigned to the Vac Sensor or if a Pump Output Relay, that is assigned as a pump # is not assigned to a pump sense device.
 - There is not a configured Atmospheric pressure sensor. In this case, a Setup Data Warning will be posted for each configured Vacuum Sensor.
1. Check the following:
 - Priority (I11100) and Non-priority alarm history (I11200).
 - Current Alarms, check for related alarms to Smart Sensors, STP disable shut down alarms. Trouble shoot and repair any related Fault alarms first.
 - Verify Smart Sensor setup; Check what may be the cause of the Setup Data Warning. If you are connected via serial port, use the following RS-232 commands as applicable:
 - I721ss - Configuration Smart Sensor ('ss' is the SmartSensor number, such as 01, 02, etc.)
 - I80800 - Relay Alarm Assignments.
 - I78700 - PLLD Alarm Assignments.
 - I7A700 - WPLLD Alarm Assignments
 - I72A00 - Volume of Interstitial Zones
 2. Once the Setup Data Warning has been cleared, it is recommended that you perform the Vacuum Sensor Operability Test (See Vacuum Sensor Installation manual #577013-836).

Communication Loss alarm

TLS DISPLAY: Snn: Communication Alarm

RS-232 Description: Comm Alarm

Alarm Description(s)

Communication to the Smart Sensor has been lost with the TLS.

Possible causes:

- Faulty Smart Sensor
- Faulty Smart Sensor Module/Channel/ Slot
- Faulty field wiring
- Faulty connections

Troubleshooting Process

1. Check priority (I11100) and non-priority (I11200) Alarm History

2. "Jump Start" Procedure:

First de-configure the Smart Sensor, then re-configure Smart Sensor, either using the Front Panel, or remotely via R-S 232 Command, S721. This will "Jump Start" the Smart Sensor. Wait for 2 minutes then either print out the Smart Sensor Diagnostics, or use R-S 232 Command, IB35xx. If you get data, then communications as been re-established with the Smart Sensor. Verify if alarm has cleared.

3. If Alarm still Active, perform the following:

- a. If Smart Sensor Module was not installed with a "Cold Start", do so at this time.
- b. Perform troubleshooting procedures to determine which of the following may be contributing to this alarm.
 - Faulty Smart Sensor Module/Slot
 - Faulty Smart Sensor Channel
 - Faulty wiring connections
 - Faulty field wiring
 - Faulty Smart Sensor
- c. Use similar process as troubleshooting sensors or probes. Connect the sensor directly to the console to troubleshoot field wiring, noisy line issues. If unit is ok, check wiring connections, wire conductivity, etc., to isolate the problem.



Important Note: You must de-configure all Smart Sensors prior to powering down TLS, or disconnecting wire connections. Then after "power up" or connections complete, re-configure the Smart Sensors. If this is not done, the TLS will wait 30 minutes before trying to communicate with the sensors. This procedure is equivalent to a "Jump Start".

4. If you are connected via serial port: use the following commands only if communications restored or intermittent. These commands may help determine how severe the communications loss may be occurring.

- I10200 – System Configuration: Ensure that Smart Sensor Module was installed with a "Cold Start".
- I@32007 - Smart Sensor Communication Statistics: Looking for excessive communication errors (ComErr).
- IB35xx – Smart Sensor Data, Serial Number, Type, Date Code, and Protocol Version. This command may be useful in referencing Smart Sensor variations, (Date Code).

Vacuum Warning

TLS DISPLAY: Snn: Vacuum Warn

RS-232 Description: Vacuum Warn.

Alarm Description(s)

A Vacuum Warning will be posted under the following conditions:

- Leak Rate > 22.4 GPH for 40 minutes
- Evacuation ratio of less than 1.0 during a manual evacuation when vacuum level has not reached -4.0.

Additional Description(s)

Possible Causes:

- Faulty Vacuum sensor
- A vacuum leak, including tubing and fittings – see “vacuum leak isolation procedures” below
- STP Shut down, malfunction or no power
- STP Siphon System not working properly
- Incorrect Programming



Note: Be aware that Vacuum Sensors are arranged in zones, and up to 4 Vacuum Sensors may share a common STP as their vacuum source. These Vacuum Sensors may go into a “VACUUM WARN” or a “NO VAC ALM” if the STP supplying the vacuum is shut down due to an alarm condition or if power to the STP is down.

Troubleshooting Process

1. Check the following:
 - Current Alarms, check for related alarms to Smart Sensors, STP disable shut down alarms. Trouble shoot and repair any related “Snn: Setup Warn” or “Snn: SENSOR FAULT” alarms first.
 - Assigned STP to Smart Sensor is enabled and has power.

If connected via serial port, check:


 - Smart Sensor Diagnostic RS-232 commands
 - IB38ss – Vac Sensor Diagnostic Report
2. Start a Manual Test to attempt to increase vacuum level if the current level is less than -3 psi (if you already have sufficient vacuum, proceed directly to Step ‘a’). Let the test run for few minutes. If it stops the evacuation process because it is not ‘making headway’ (the vacuum level is not increasing or it is increasing very slowly as indicated by an ‘Evac Ratio’ less than 1.0), then start Vac sensor evacuation hold. This closes the VCV valve. Watch vacuum reading to see if it drops.



Note: During a Manual Test the TLS may go into ‘Evac Pending’ to provide a short idle period (up to 10 minutes duration-) for line testing.

- a. If vacuum holds verify if alarm clears or remains. If it does, the alarm could have been caused by the STP having lost power, or because another alarm condition had disabled the STP.
- b. If losing vacuum go to next step below.

Refer to the Vacuum Sensor System Installation Guide (# 577013-836) as needed.

3. Verify the following possible causes:
 - Incorrect Programming (if the volume is programmed significantly larger than the actual volume, a small leak will be calculated as being much larger by the TLS).
 - STP Shut down, malfunction or no power
 - STP Siphon System not working properly
 - A vacuum leak – see “Procedure for isolating source of a Vacuum leak” on page 12.
 - Faulty Vacuum sensor - To test Vacuum Sensor, turn 3-way ball valve connected to this sensor to the ‘Test’ position to see if vacuum sensor indicates atmospheric pressure (should be within 0.5 psi of zero). If Vacuum sensor does not indicate atmospheric pressure, troubleshoot further by swapping to another channel. If the issue persists replace Vac Sensor.
4. Start a Manual Test. Let the test run for a few minutes; if vacuum is ‘making headway’ then start Vac sensor evacuation hold. This closes the VCV valve. Watch vacuum level to see if it drops.
**Note:** During a Manual Test the TLS may go into ‘Evac Pending’ to provide a short idle period for line testing.
 - If vacuum level is still dropping, did you verify all possible causes listed above?
 - If vacuum holds, wait at least 30 minutes to ensure alarm does not return.

No Vac Alarm

TLS DISPLAY: Snn: NO VAC ALM

RS-232 Description: NO VACUUM ALARM

Alarm Description(s)

Alarm is posted when compensated pressure is > (greater than) –1.0 PSI. This alarm may or may not shut down the STP depending on the disable alarm assignments. A Manual Test must be performed to clear the alarm.

Additional Description(s)

The alarm will clear when vacuum pressure is < (less than) –1.1 PSI. Possible Causes:

- Faulty Vacuum sensor
- A vacuum leak, including tubing and fittings – see “Procedure for isolating source of a Vacuum leak” on page 12.
- STP Shut down, malfunction or no power
- STP Siphon System not working properly
- Incorrect Programming



Note: Be aware that Vacuum Sensors are arranged in zones, and up to 4 Vacuum Sensors may share a common STP as their vacuum source. These Vacuum Sensors may go into a “VACUUM WARN” or a “NO VAC ALM” if the STP supplying the vacuum is shut down due to an alarm condition or if power to the STP is down.

Troubleshooting Process

1. Check the following:
 - Priority (I11100) and Non-priority alarm history (I11200).
 - Current Alarms, check for related alarms to Smart Sensors, STP disable shut down alarms. Trouble shoot and repair any related “Snn: Setup Warn” or “Snn: SENSOR FAULT” alarms first.
 - Assigned STP to Vac Sensor is enabled and has power.
If connected via serial port, check:
 - Smart Sensor Diagnostic RS-232 commands
 - IB38ss – Vac Sensor Diagnostic Report
2. Verify the following possible causes:
 - Incorrect Programming
 - STP Shut down, malfunction or no power
 - STP Siphon System not working properly
 - A vacuum leak – see “Procedure for isolating source of a Vacuum leak” below.
 - Faulty Vacuum sensor - To test Vacuum Sensor, turn the 3-way ball valve connected to this sensor to the ‘Test’ position to see if vacuum sensor indicates atmospheric pressure. If Vacuum sensor does not indicate atmospheric pressure, troubleshoot further by swapping to another channel. If the issue persists replace Vac Sensor.
3. Start a Manual Test to attempt to increase vacuum level. Let it run for few minutes; when vacuum level stops increasing, then start Vac sensor Evacuation Hold. This closes the VCV valve. Watch vacuum level to see if it drops.



Note: During a Manual Test the TLS may go into ‘Evac Pending’ to provide a short idle period (up to 10 minutes duration) for line testing.

- If losing vacuum, see “Procedure for isolating source of a Vacuum leak” below.
- If vacuum level is increasing and passes the ‘Vacuum OK’ threshold, -1.1 psi, the alarm will clear.
Note: When the Vacuum level increases past -1.1 psi, the ‘No Vac’ alarm will clear and a ‘Vacuum Warning’ will be posted. The ‘Vacuum Warning’ will be cleared when the level reaches between -3 to -5 psi, depending upon the zone’s relief valve setting.

Procedure for isolating source of a Vacuum leak

Common leak points are entry boots, Schrader fittings (especially if uncapped – these fittings will hold pressure, but will vent vacuum, usually at some point after it exceeds -3 psi), ball valves (make sure handle is all the way down), etc.

1. Cut a one-foot piece of tubing and attach its ends to two ends of a barbed tee (see Figure 9).
2. On early model Vac Sensor Systems there is a piece of tubing connecting the Vac Float to the 3-way valve. On later model Vac Sensor Systems the Vac Float is directly connected to the 3-way valve. If your setup is a tubing-connected type go Step 3. If your setup is a direct-connected type skip to Step 7.
3. Loosen the bushing on the Vac Float that secures the fitting/tubing connecting to the 3-way valve and remove the fitting.

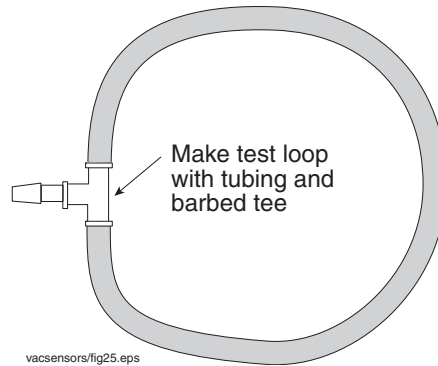


Figure 9. Making a Vac Zone Test Loop

4. Insert the open end of the test loop's tee into the Vac Float bushing and then tighten the bushing (see Figure 10).



Note: When attaching the test loop to Vac Sensor system components during leak isolation tests, remove the tubing fitting from the bushing instead of trying to remove the tubing from the barbed fitting.

5. Perform a Manual Test to evacuate to at least -4 psi (it is not necessary to pull a complete vacuum). Place the sensor into "Evac Hold" and observe if the amount of vacuum decreases.
6. If vacuum drops by more than 0.5 psi over 15 minutes, the Vac Float is leaking and must be replaced. If there is no leak, remove the test loop tee and reconnect the fitting in the tubing going to the 3-way valve.

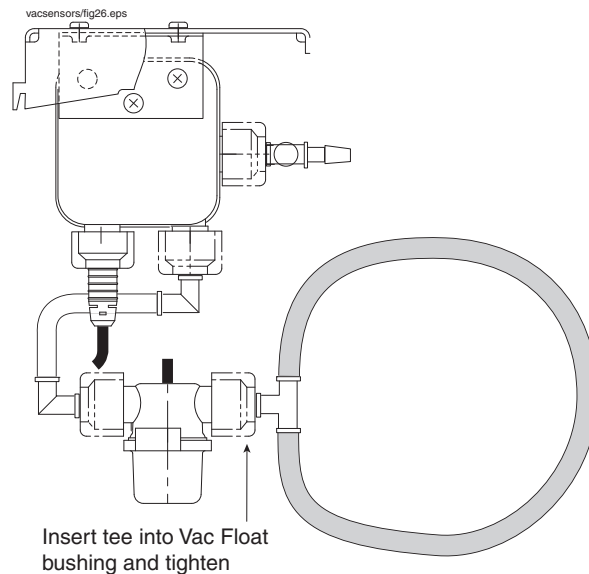


Figure 10. Isolating Vac Float for Leak Test

- Cut a 2-inch piece of tubing and attach one end to the open fitting on the test loop's tee and the other end to the 3-way valve's input port (see Figure 11).

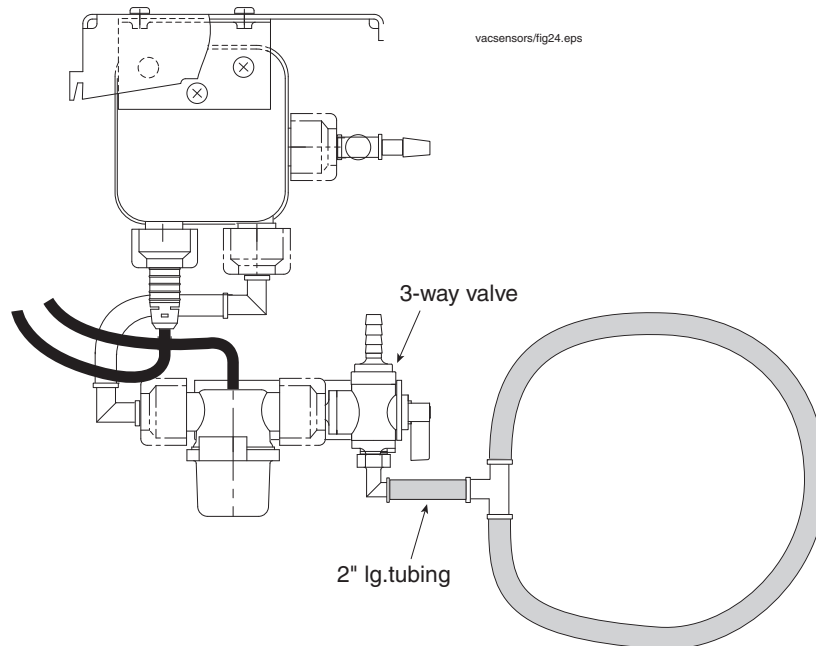


Figure 11. Isolating 3-Way Valve (and Vac Float on Later Models) for Leak Test

- Perform a Manual Test to evacuate to at least -4 psi (it is not necessary to pull a complete vacuum). Place the sensor into "Evac Hold" and observe if the amount of vacuum decreases. Note: Since the volume connected is very small, even a tiny leak will cause a large change in vacuum.
- If vacuum drops by more than 0.5 psi over 15 minutes, the 3-way valve (or the direct-connect Vac Float/3-way valve on later models) is leaking and must be replaced. If there is no leak, replace the interstice tubing to the input port of the 3-way valve.
- Repeat the basic process described above after reconnecting sections of the zone being monitored, adding small sections (as much as possible) until the leak returns.

Sensor Fault Alarm

TLS DISPLAY: Sensor Fault Alarm

RS-232 Description: SENSR FAULT

Alarm Description(s)

Alarm will be posted under the following conditions:

- Fluid Status Fault: The Vacuum Sensor has detected an open or short for the liquid sensor. Check the 'Fluid Status' in the Diagnostic Mode to determine if this is the case.
- Vacuum Pressure Sensor Stuck Reading (Pressure Sensor Fault): The system will attempt to detect the following two conditions:
 - Over a 24-hour period, if the TLS detects no change at all in the readings, a Sensor Fault Alarm will be posted.
 - Over a 90-day period if the pressure has not changed by 0.1 PSI a Sensor Fault alarm will be posted.
- Vacuum Pressure Sensor Out of Bounds Reading (Pressure Sensor Fault): If pressure is less than -14.7 psi (complete vacuum) the reading is out of bounds and sensor fault is posted.
- Relief Valve Fails Closed (Relief valve fault): There may be a relief valve in the interstitial space that the vacuum sensor is monitoring. If there is and the pressure of the interstitial space goes more than 2 psi below the relief pressure for 30 minutes a sensor fault alarm is posted.



Note: A diagnostic will show the condition(s) that made the Sensor Fault Alarm. RS-232 Command, IB38ss.

Troubleshooting Process

1. Check the following:
 - Priority (I11100) and Non-priority alarm history (I11200).
 - Current Alarms, check for related alarms to Smart Sensors, STP disable shut down alarms. Troubleshoot and repair any related Smart Sensor Setup Warning or Fault alarms first.

If connected via serial port, check:

 - Smart Sensor Diagnostic RS-232 commands
 - IB38ss – Vac Sensor Diagnostic Report. This report will describe what Fault has occurred.
 - Verify Fault type.
 - Print Vacuum Sensor Diagnostics to assist in troubleshooting - If remote communications is not available, use front panel procedure:
 - a. Push Mode button until you see Diag Mode
 - b. Push Function button until you see Smart Sensor Diag.
 - c. Push Step button until you see Vac sensor Diag.
 - d. Press Print button.
2. See above Alarm Description(s) for Fault Type. Troubleshoot fault as follows,
 - a. For Fluid Sensor Fault - Verify proper wiring installation as per Vacuum Sensor Installation manual #577013-836. Troubleshoot for possible faulty wiring, connections, interstitial sensor, and Vac Float related to Vacuum sensor.

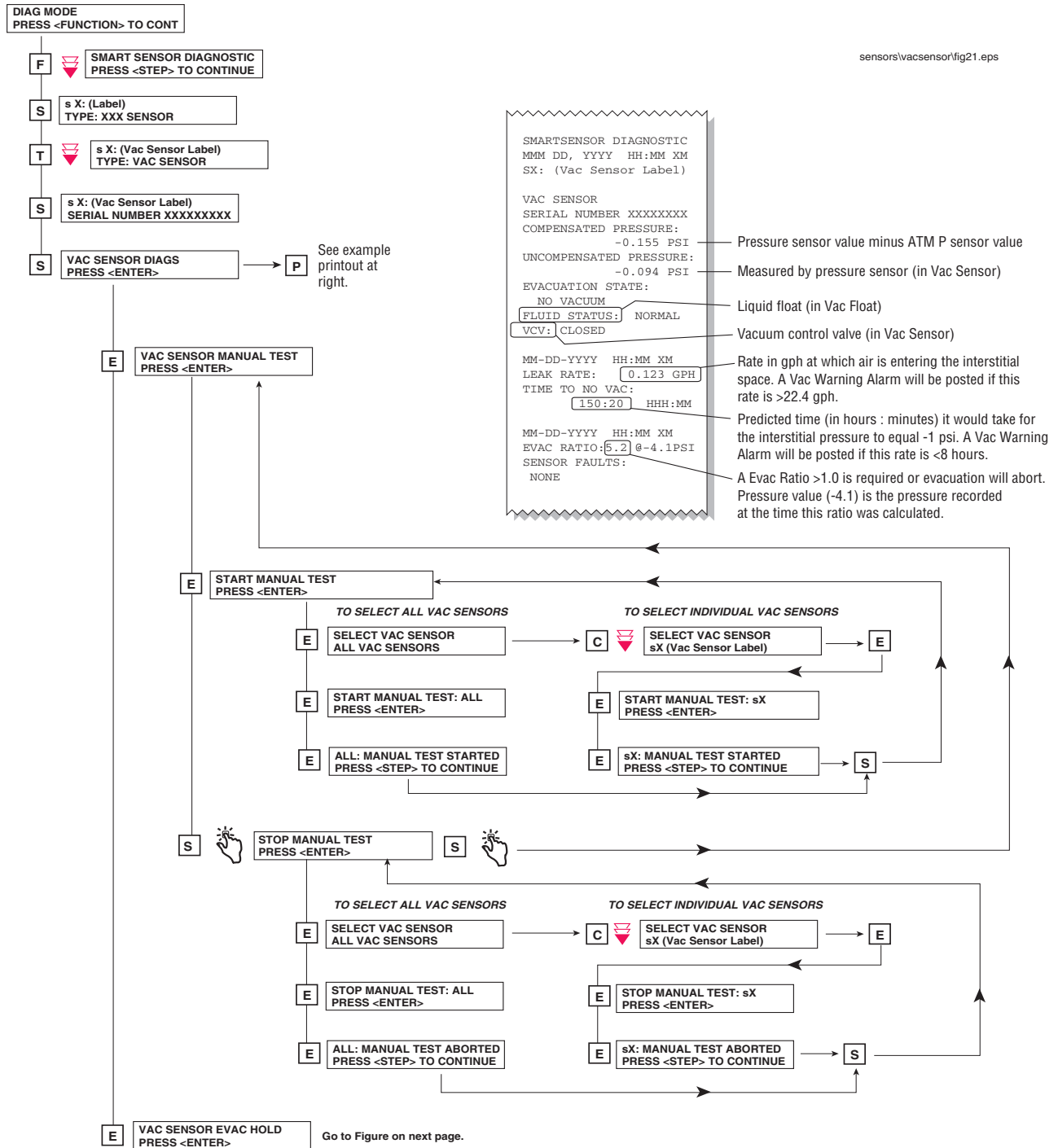
- b. For Vacuum Pressure Sensor Stuck Reading & Vacuum Pressure Sensor Out of Bounds Reading (Pressure Sensor Fault): Using the procedures below, see if Vacuum pressure will change.
 - Verify proper wiring installation as per Vacuum Sensor Installation manual #577013-836. Troubleshoot for possible faulty wiring, and connections.
 - Troubleshoot for possible faulty Smart Sensor channels and/or vacuum sensors by swapping channels and/or Vacuum Sensor.
 - If swapping out vacuum sensor, or switching channels, de-configure channels that you are swapping. Reconfigure after swapping.
 - Turn the 3-way ball valve on the vacuum fitting from the “Normal” position to the “Test” position. This will vent the sensor to atmospheric pressure, which should produce a reading within 0.5 psi of zero. Remember to turn it back to normal for “normal” operation later.
 - c. For Relief valve fails - In the programming for the Relief valve setup, the setup must be changed to yes for fiberglass tanks and any other zone using a relief valve. If this is correct, check and/or replace relief valve. After performing the Vacuum Sensor Operability Test, verify vacuum pressure does not go more than 2 psi below the relief pressure.
3. After you find and repairs possible cause of fault, the Vacuum Sensor Operability Test should be run - See Vacuum Sensor Installation manual #577013-836.

Running a Manual Test

A Manual Test is typically used when a zone has a low vacuum level or is in a 'No Vacuum' condition after a leak has been repaired. The Manual Test allows you to evacuate the zone to a desired level, then stop the evacuation to determine if the repair has corrected the leak.

Perform the Manual Test for Each Vac Sensor

You enter the DIAG MODE of the TLS Console by pressing the MODE key until its display appears. Press the FUNCTION key to select SmartSensor Diagnostic (Vacuum Sensors are considered Smart Sensors). Figure 12 displays the Vac Sensor Manual Test procedure steps and Figure 13 displays the Vac Sensor Evac Hold procedure steps.

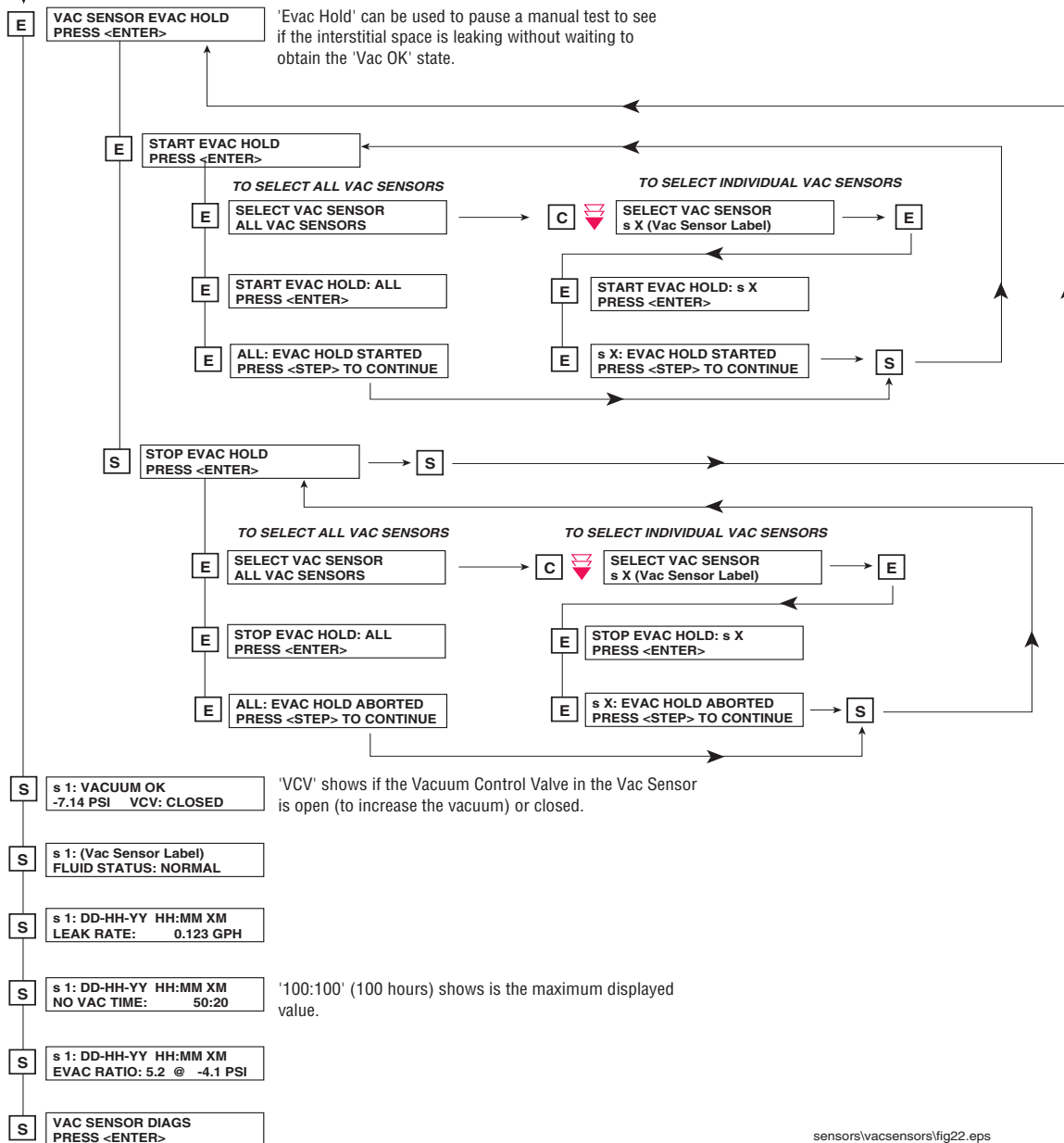


Key Legend

C	E	F	M	P	S	T	Repress for next Tank/Sensor
Change	Enter	Function	Mode	Print	Step	Tank/Sensor	

Figure 12. TLS Console Vac Sensor Manual Test

Continued from previous page.



sensors\vacsensors\fig22.eps

Figure 13. TLS Console Vac Sensor Evac Hold Procedure

