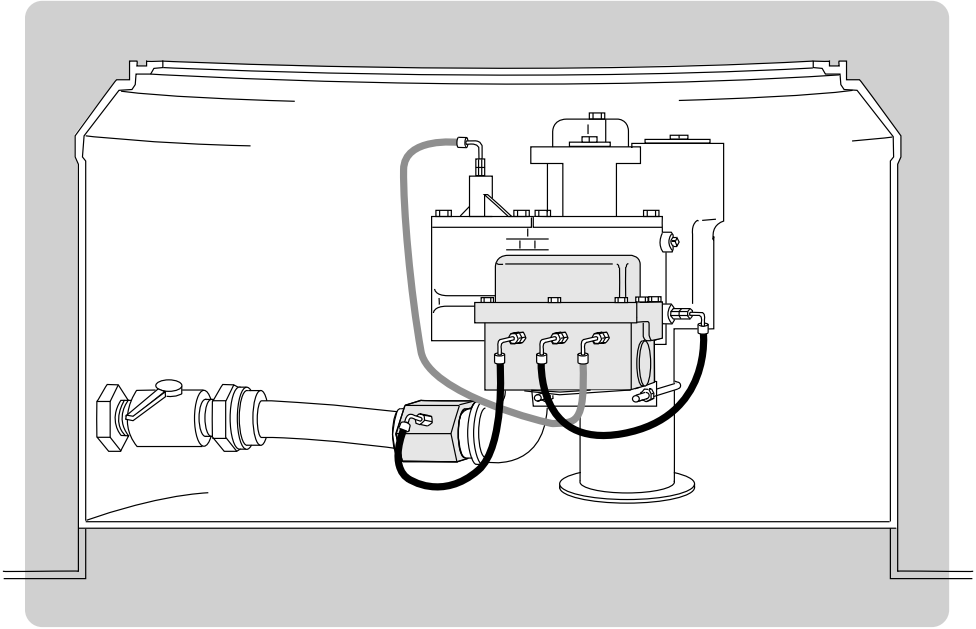
Troubleshooting/Repair Guide

Volumetric Line Leak Detection System

(For TLS-350 and TLS-350R Systems)

Manual Number 576013-849, Revision B



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577013-339, Revision B

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Introduction

IMPORTANT ☛

This manual is intended for use by Veeder-Root certified service technicians possessing a thorough knowledge of the TLS-350 and TLS-350R UST monitoring systems, Volumetric Line Leak Detectors (VLLDs), and proper and safe service techniques for electronic equipment. You should not attempt repairs unless you have received proper training.

General

This manual contains troubleshooting and repair instructions intended for servicing the Veeder-Root TLS-350 and TLS-350R Volumetric Line Leak Detector (VLLD). It contains information to establish proper procedures to be followed during a service call. The Troubleshooting Procedure Matrix helps you identify the problem and leads you to the information required for corrective action. In addition, detailed instructions are included for the removal and installation of parts and components.

Before servicing the TLS-350 and TLS-350R VLLD System, the information contained in the following Veeder-Root technical manuals relating to the VLLD System should be reviewed and thoroughly understood.

- ❑ VLLD *Site Preparation And Installation Instructions*, Manual No. 576013-873.
- ❑ TLS-350 *Setup Instructions*, Manual No. 576013-623.
- ❑ TLS-350 *Operating Instructions*, Manual No. 576013-610.
- ❑ TLS-350R *Set-up Instruction*, Manual No. 576013-880.
- ❑ TLS-350R *Operating Instructions*, Manual No. 576013-881.

These manuals should be available during a service call for use as reference if required.

Safety Symbols

The following safety symbols are 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. Always turn power off to the device and associated accessories when servicing the unit.

No Smoking

Sparks and embers from burning cigarettes or pipes can ignite fuels and their vapors

No Open Flames

Open flames from matches, lighters, welding torches, etc. can ignite fuels and their vapors.

No Power Tools

Sparks from power tools (such as drills) can ignite fuels and their vapors.

No People in the Area

Unauthorized people in the area during service can create a potential for personal injury to you and them.

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.

Wear Eye Protection

Fuel spray from residual pressure in the lines can cause serious eye injuries. Always wear eye protection.

Injury

Careless or improper handling of materials can result in bodily injury.

Gloves

Wear gloves to protect hands from irritation or injury.

Approved Containers

Use nonbreakable, clearly marked containers, suitable for collecting and transporting hazardous fuels during service

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.

Safety Warnings

⚠ WARNING

This system operates near highly combustible fuel in storage tanks.

Fire or explosion resulting in serious injury or death could result if the equipment is improperly installed or modified or is used in any way other than its intended use. Serious contamination of the environment may also occur.

To ensure proper installation, operation, and continued safe use of this product:

1. **Read and follow all instructions in this manual, including all safety warnings.**
2. **Have equipment installed by a contractor trained in its proper installation and in compliance with all applicable codes including: the National Electrical Code; federal, state, and local codes; and other applicable safety codes.**
3. **Do not modify or use service parts other than those provided by Veeder-Root.**

⚠ WARNING

This system operates near potentially hazardous fuel storage tanks.

Leaking tanks can create serious environmental and health hazards. Improper programming and operation may also result in equipment self-test failures and submersible pump shutdowns.

Advise the owner or manager of his/her responsibility to:

1. **Ensure that this equipment is properly programmed.**
2. **Promptly investigate any alarm conditions.**
3. **Operate this equipment in accordance with the instructions in this manual.**

Functional Descriptions

This section provides functions descriptions of the Volumetric Line Leak Detector (VLLD) and supporting devices.

Volumetric Line Leak Detector (VLLD)

The Veeder-Root TLS-350 or TLS-350R Volumetric Line Leak Detector (VLLD) has been third-party certified to detect leaks in underground pipelines in accordance with their requirements of EPA 40 CFR 280. The unit may be used with unleaded gasoline, leaded gasoline, 10% ethanol/90% unleaded gasoline, 5% methanol/95% unleaded gasoline, 15% MTBE/85% unleaded gasoline, diesel and kerosene.

The VLLD performs leak testing using volumetric displacement. The system indicates the presence of a leak at specific leak rate thresholds, but does not provide a direct reading of the actual leak rate.

The system has been designed to prevent false alarms due to thermal contraction. This is done by comparing the in-tank fuel temperature with the ground temperature. In installations without in-tank probes, the VLLD system determines thermal stability volumetrically (Version 4 or later) by making repeated volume measurements, allowing pipeline temperatures to stabilize before performing precision leak tests. This process improves the accuracy of leak detection. Finally, the unit has a self-test feature which ensures that it is functioning and able to perform leak tests.

This section illustrates and describes the major components of the VLLD [Figure 1 and Figure 2].

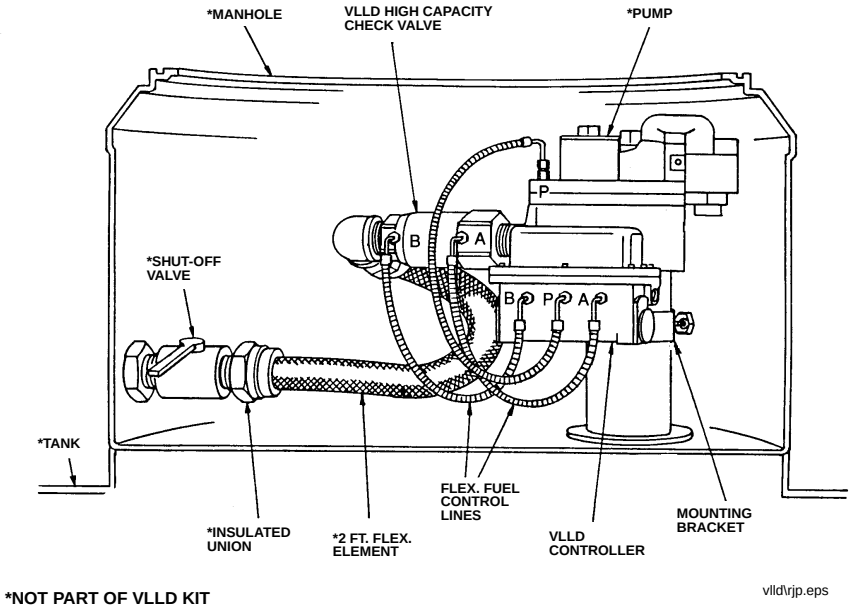


Figure 1. VLLD System Components - Red Jacket Pump

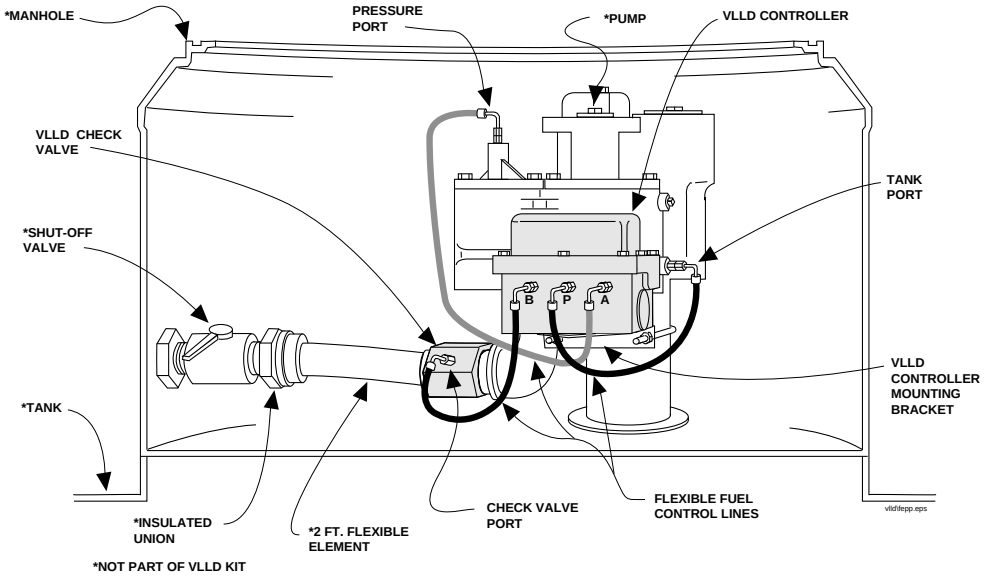


Figure 2. VLLD System Components - FE Petro Pump

VLLD Controller

The VLLD controller [Figure 3] houses the components which perform the actual sensing of leaks. This is done using a diaphragm and piston assembly which has a displacement of approximately 2 cubic inches.

A normally open solenoid valve initially equalizes the pressure across the diaphragm prior to testing. This is known as the "Equalization" valve. It also provides a relief path for pressure due to thermal expansion. This valve is closed at the start of a leak test. When the test is complete, the valve is reopened, which allows the piston to return to the start position.

The position of the piston is monitored using two reed switches, known as the "Start" and "Finish" switches. The "Start" switch is used to verify that the piston has completely reset prior to testing. Dispensing fuel will cause the piston to move.

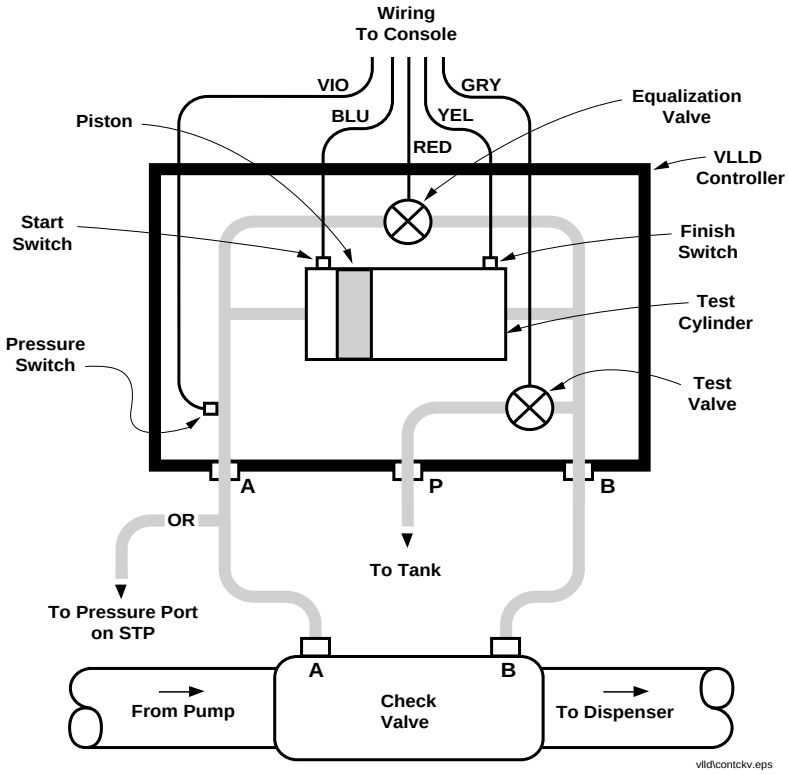


Figure 3. VLLD Controller and Check Valve

The "Finish" switch signals that the piston has reached the end of the stroke. During a leak test, this would indicate the presence of a leak. If no leak exists, the "Finish" switch will not close. During a self-test, an attempt is made to purposely force the switch to close. This verifies proper operation of the switch and diaphragm.

The VLLD controller also houses a normally closed solenoid valve, known as the “Test” valve, which is used to perform self-tests. A self-test is performed by opening the test valve. A leak back to the tank is created through the test valve and an orifice. This is a known leak rate, and a specific amount of time is allowed for the piston to complete a stroke. Proper movement of the piston is confirmed by the “Finish Switch”. If it does not complete a stroke, a self-test failure is indicated.

Finally, a pressure switch is located in the VLLD controller. This performs a pressure leak test of the piping between the Submersible Turbine Pump (STP) and the VLLD check valve inlet called the “Pumpside” test. This test is performed following the successful completion of the line test and self-test. A self-test of this function is also performed by creating a leak back to the tank through the test valve and orifice.

VLLD Check Valve

The function of the check valve [Figure 3 on page 7] is to isolate the pipeline from the STP. It has been designed to be leak-tight at normal test pressures while creating a minimal pressure drop in the pipeline. One or two ports (depending on the type of system) on the check valve connect to the controller to provide pipeline inputs in each side of the valve.

Three mounting variations exist for the check valve:

- ❑ Single-piece check valve with 2 ports [Figure 4 on page 9]. Older VLLD systems and VLLD for high capacity pumps use the single-piece check valve shown in Figure 4.
- ❑ Check valve and adapter fitting with two tubing connections to the controller and one to the STP (used as replacement for the 2-port check valve) [Figure 5 on page 9]
- ❑ One-port check valve with one tubing connection to the controller and two to the STP [Figure 6 on page 10]

See Manual No. 576013-873 for further information.

IMPORTANT ☛ The VLLD Check Valve does not contain a pressure relief! If it is installed without a Controller, the ports must be linked using a suitable, approved fuel resistant hose.

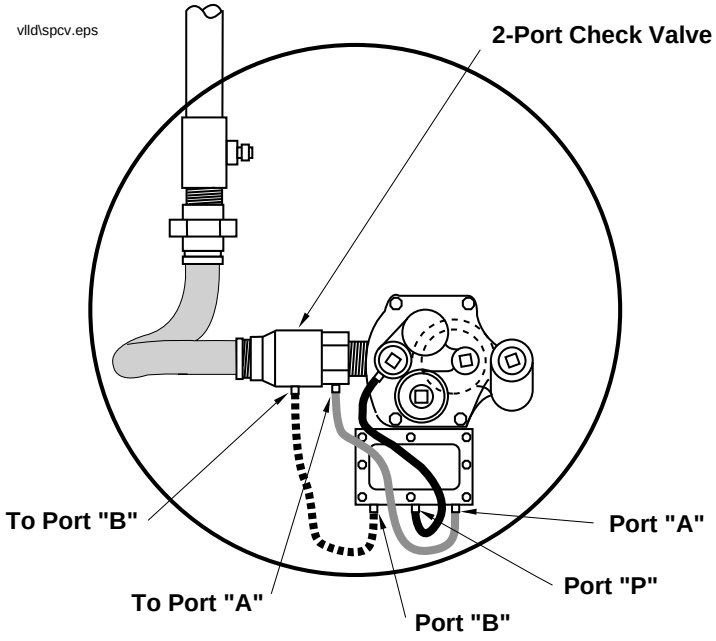


Figure 4. Single-Piece (Two-Port) Check Valve

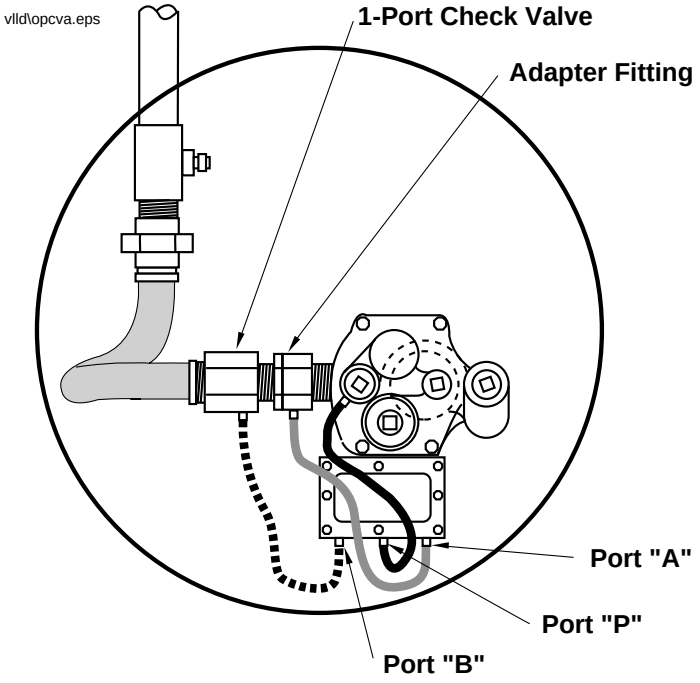


Figure 5. One-Port Check Valve and Adapter Fitting

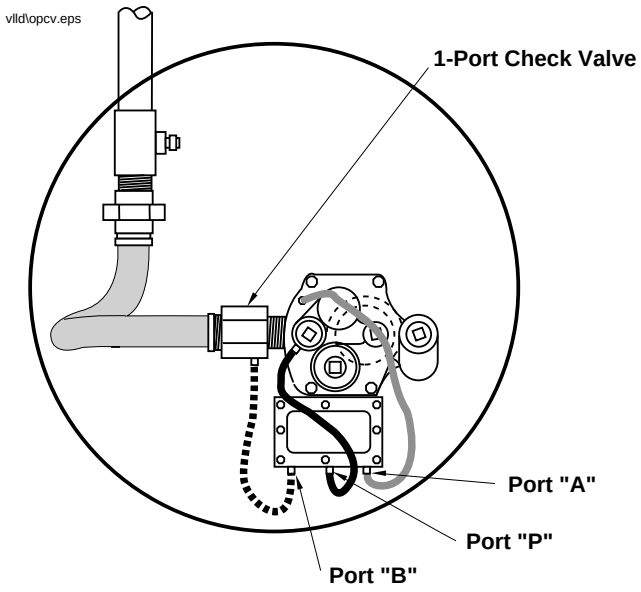


Figure 6. One-Port Check Valve

Flexible Fuel Control Lines

One or two Flexible Fuel Control Lines connect the Check Valve to the VLLD Controller. A single line connects the Controller to the tank test port on the submersible pump. Avoid “kinking” these lines during replacement, and be sure that they don’t rub against each other or any other piping in the sump. The vibration of the submersible when running can cause the flex lines to eventually leak if allowed to rub against other piping.

Shut Off Valve

Use of a shutoff valve is highly recommended in that it helps prevent product spillage when servicing VLLD hydraulic components. It can also be useful in verifying equipment operation or line leaks.

Insulated Union

The insulated union is required to electrically isolate the underground piping from the VLLD and submerged turbine pump (STP).

TLS-350 or TLS-350R UST Monitoring System

The TLS-350 or TLS-350R UST (Underground Storage Tank) Monitoring System performs the analysis of the temperature inputs to determine the waiting period required to perform a leak test, the level of a leak test due to be performed, and the analysis of the signal to determine if a leak has occurred.

The TLS-350/TLS-350R console requires one Line Leak Interface Module for each line being monitored. Line Leak Modules are in the power area of the console.

Thermistor

The thermistor reads the ground temperature and provides this input to the TLS-350/ TLS-350R. The ground temperature is compared to the in-tank product temperature to determine the wait time necessary to perform a leak test at the desired leak rate when using the “Temperature Measurement” mode.

VLLD Troubleshooting Kit

Recommended for VLLD service work, this kit (Part No. 330020-035) contains the following:

1 Pressure Gage with Flare “Tee” Fitting
1 Filter Removal Tool
4 Check Valve Filters
4 '0'-Rings
6 Cap Nuts, 37 Degree Flare
1 VLLD Troubleshooting Guide (576013-849)

Operation

Line Leak Testing

Gross Test (3.0 GPH)

Leak detection is attempted at the conclusion of dispensing. A line leak test will be performed following dispensing (providing thermal conditions permit) as often as six times per hour depending on the TLS-350 or TLS-350R software version. At the initiation of dispensing, testing is aborted.

Self-Test (3.0 GPH)

Following a successful leak test, the unit performs a self-test after pressurizing the system. This self-test is initiated by opening the test valve for certain time intervals to obtain a known leak rate. The product flowing through the valve passes through an orifice sized to produce a given leak rate at the given duty cycle. The product is returned to the UST through the pump tank port. If the “finish” switch (in the Controller) fails to close after a predetermined time (after six consecutive attempts), the TLS-350 or TLS-350R alarms to indicate system failure and that the STP is disabled.

Pumpside Test (3.0 GPH)

If enabled, the system will perform a test of piping between the VLLD check valve and the STP. The STP is activated to pressurize the piping and then turned off. At least 6.5 PSI must be maintained to pass the test. Pump side tests are typically enabled when an STP is not installed in a monitored containment sump.

Pumpside Self Test (3.0 GPH)

This test is performed after a passed pumpside test to verify that the pressure switch will close if a leak is present. To start the test, the self test valve is opened after the STP is turned off. To pass the test, the pumpside pressure must drop below 3.5 psi.

Precision Test (0.1 or 0.2 GPH)

After the Controller has determined that thermal conditions are acceptable to perform a 0.1 or 0.2 GPH test, the pressure equalizing valve is closed and the test begins. After a test time correlated to the threshold leak rate is completed, the unit checks to determine if the sensor has traveled to the “finish” position. If it has, the alarm is activated. If it has not, the test is completed and the TLS-350 or TLS-350R will print out the leak rate

threshold (0.1 and 0.2 gallon/hour tests only) and the test date. At the initiation of dispensing, testing is aborted.

Software

Software Version 001

Testing at the 0.2 gallon/hour leak rate will be attempted once daily. The 0.1 gallon/hour test will be performed only as programmed by the operator. The 0.2 and 0.1 gallon/hour test will also be programmable to occur at a specific date and time (thermal conditions permitting).

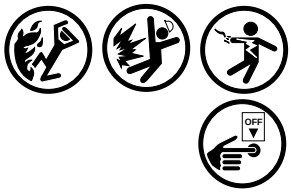
Software Versions 002 and Higher

Testing at the 0.2 and 0.1 gallon/hour leak rate will be attempted every 12 hours. The 0.2 and 0.1 gallon/hour test can also be programmable to occur at a specific date and time.

Preliminary Steps

Basic Procedures

⚠ WARNING



High voltage exists in, and is supplied to, this device.

Electrical shock, fire, or explosion resulting in serious injury or death may result if power is on while this unit is being serviced.

To avoid electrical shock, always turn power off BEFORE servicing unit.

To help ensure proper and safe troubleshooting and repair procedures for the TLS-350 or TLS-350R VLLD, the following steps should be taken IN THE ORDER THEY APPEAR, BEFORE SERVICING THE SYSTEM.

1. Review and thoroughly understand the safety warnings.
2. Review VLLD System Components [Figures 1 and 2 on page 6].
3. Perform an intrinsic safety check. (Refer to TLS-350, TLS-350R *Volumetric Line Leak Detector Checkout Procedures*, Manual No. 576013-731.) If the system fails the intrinsic safety check:
   a. Turn the AC power circuit breaker at the service panel to the off position.
   b. Disconnect and cap the ac wires in the monitor.
   c. Disconnect and cap all probe field wires in the probe junction boxes.
4. Print out all system and tank setup parameters.

   Setup parameters can be lost during some service procedures. This printout will allow you to re-profile the system with the same parameters when service is complete.
5. Perform the visual equipment inspection.
6. Refer to the Troubleshooting Charts for specific step-by-step instructions for common alarms, and refer to the Troubleshooting Procedure (Table 1 on page 21) to identify probable cause(s) of the symptom and follow the instructions shown under Troubleshooting/Corrective Procedure.

General Visual Inspection

IMPORTANT ☛

Whenever you troubleshoot, repair, or replace components, you must be alert to conditions which may affect proper operation and durability of the system. All deficiencies should be corrected and damaged components should be replaced before continuing with procedures. Inspect the equipment, with the power off, as required for the following conditions:

1. Signs of corrosion inside the monitor
2. Broken or frayed insulation on all wires that are not secure at their terminals
3. Cracked PC boards
4. Loose or missing attaching hardware for components (transformers, PC boards, brackets, etc.)
5. Interconnecting cable connectors not firmly seated; connector ends with cracks or flat cable with breaks
6. Corroded fuse holder contacts
7. Cracked display lens and damaged or missing buttons
8. Improper mounting of the equipment. Be sure all components are mounted properly in accordance with the TLS-350 and TLS-350R VLLD “Site Preparations and Installation Instructions” (576013-873).
9. All controller wiring connections at controller junction boxes are sealed in Scotchcast™ epoxy packs
10. Thermistor wiring connection at the thermistor junction are properly sealed in epoxy packs
11. Flexible fuel control lines are not rubbing against each other or other components
12. Wiring to probes and thermistors does not exceed 1000 ft.
13. All VLLD warning labels are attached to submersible pumps and dispenser hydraulics.

Troubleshooting

⚠ WARNING

This device is installed in equipment where potentially lethal voltages may exist.

Electrical shock resulting in serious injury or death may result if power is on during servicing.

Before servicing this device, turn off power to the system, including TLS-350/TLS-350R console and submersible pumps.

⚠ WARNING

You are working in an area where vehicle traffic may occur.

Serious injury or death could result if you are struck by a vehicle.

To protect yourself and others from being struck by vehicles, block off your work area during installation or service.

Troubleshooting Charts

Troubleshooting some of the more common alarms are shown in Charts 1 through 4 below. These charts diagram a simplified troubleshooting path to help you quickly correct the cause of the alarm.

Troubleshooting Table

Table 1, beginning on page 21 and following, describes the symptoms, possible causes, and corrective procedures to use when troubleshooting the TLS-350 or TLS-350R. For descriptions of these tests, refer to the section titled “Line Leak Tests, Diagnostic Mode” on page 39 and accompanying tables. If you need further assistance, you may contact a Veeder-Root Technical Support Representative.

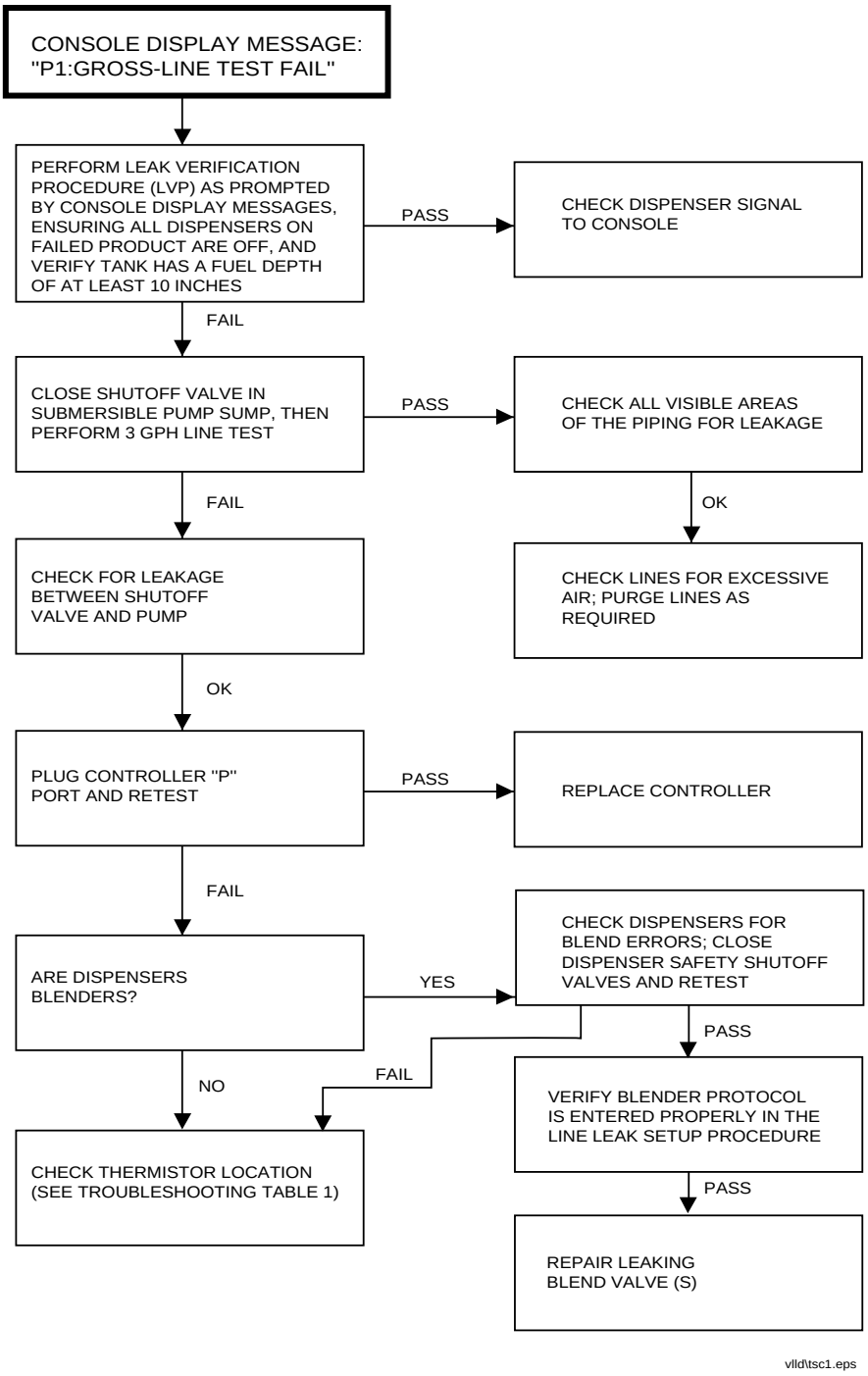


Chart 1. P1:GROSS-LINE TEST FAIL Alarm

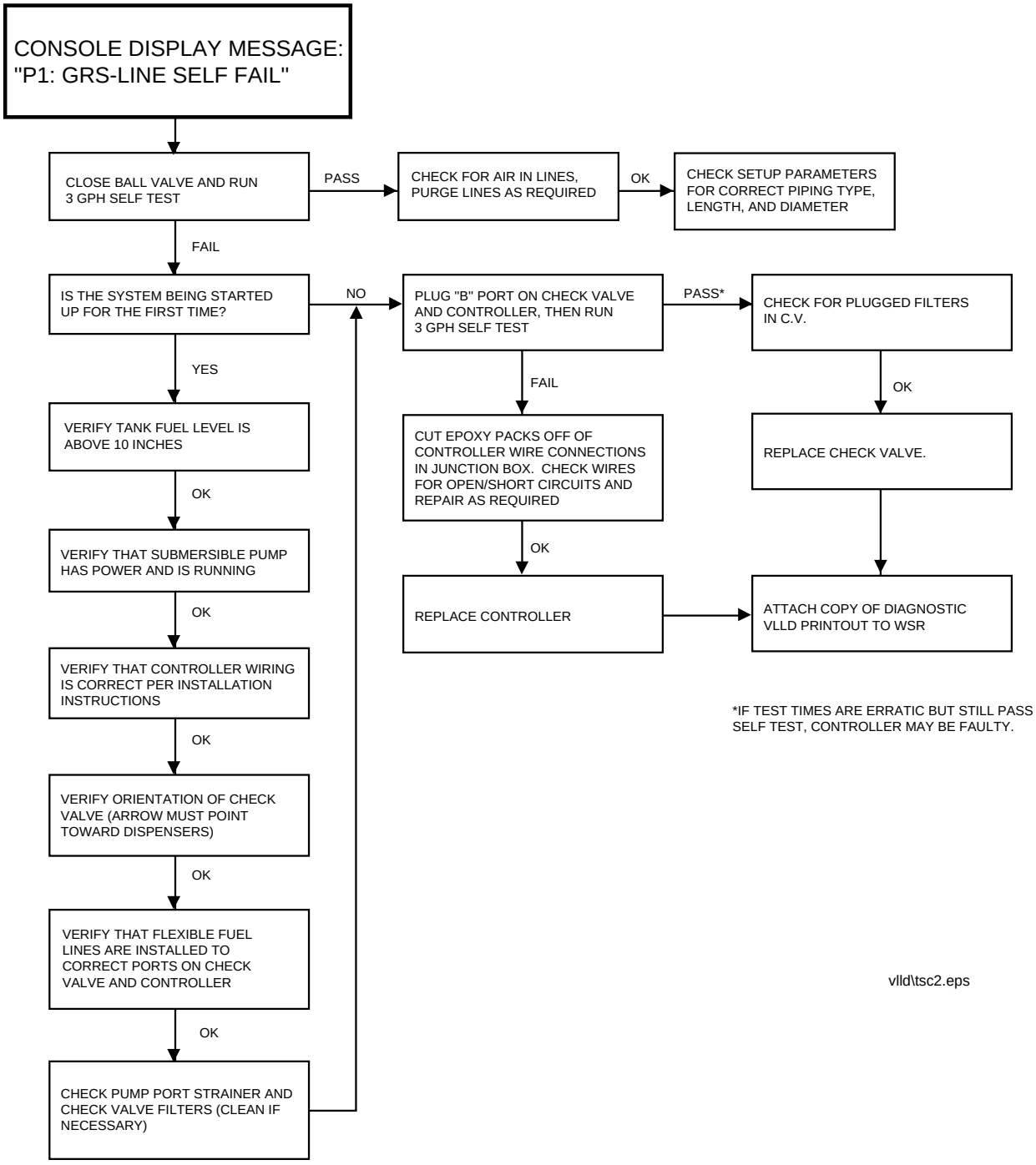


Chart 2. P1:GROSS-LINE SELF FAIL Alarm

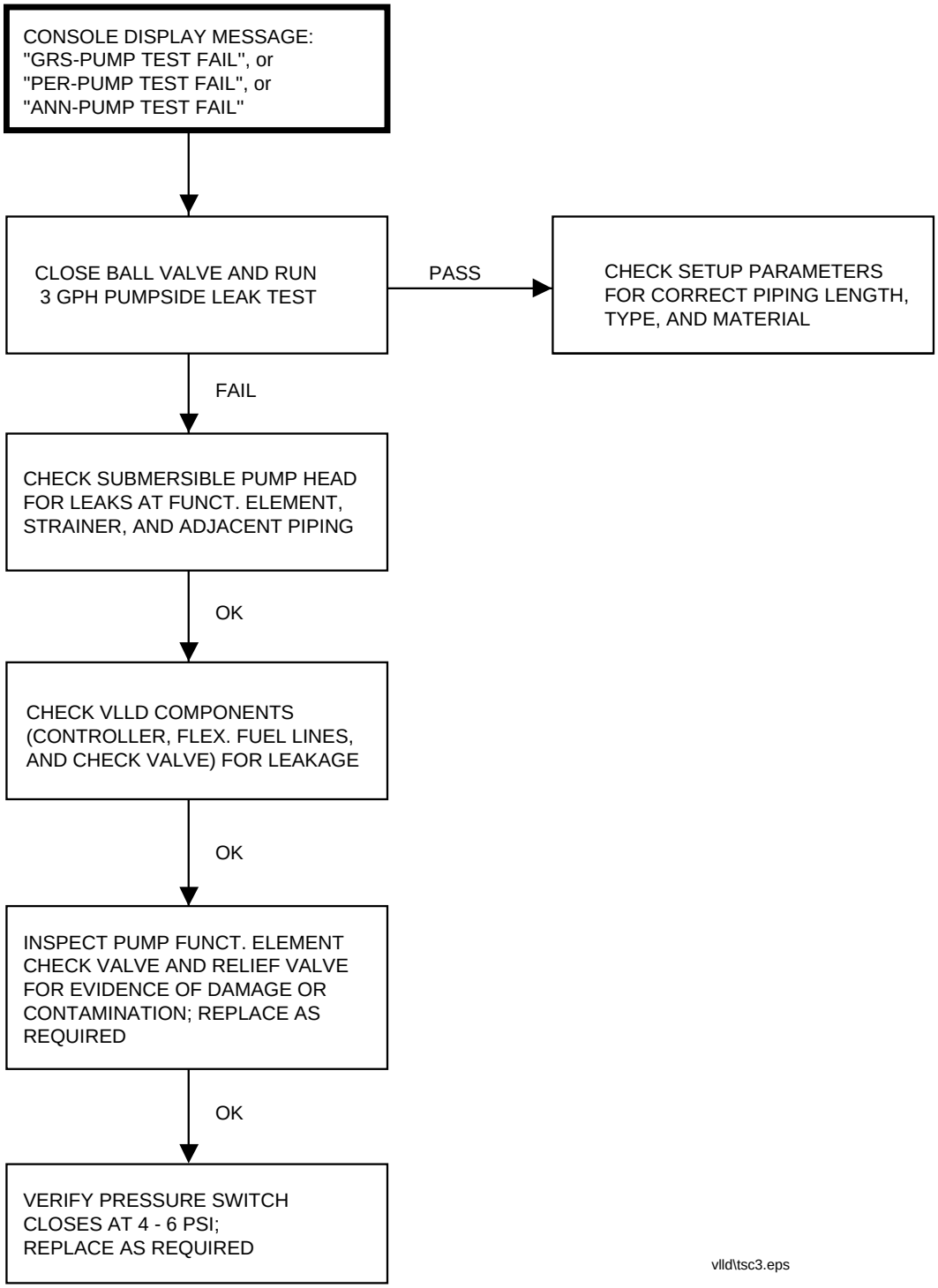


Chart 3. GRS, or PER, or ANN-PUMP TEST FAIL Alarms

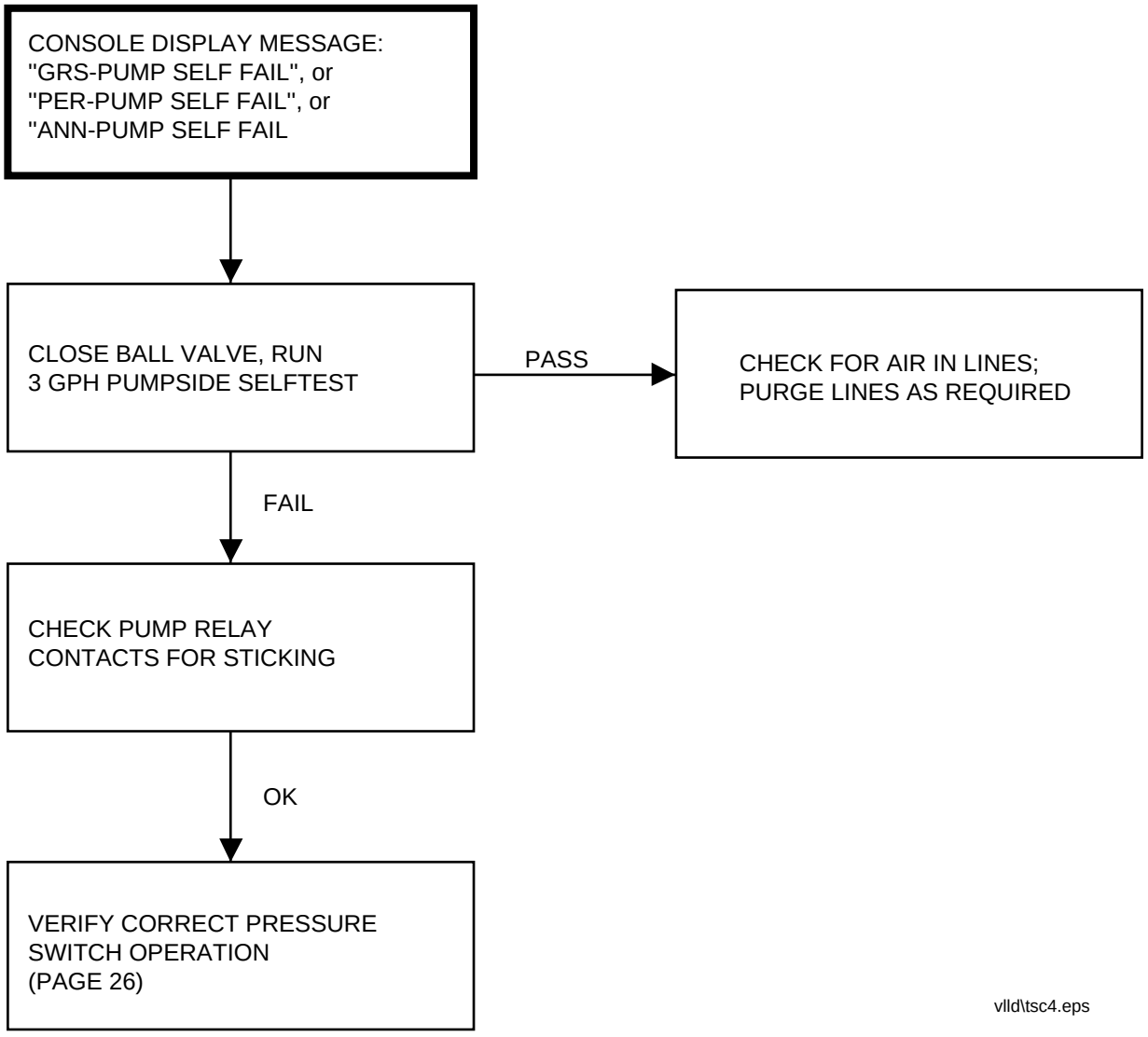


Chart 4. GRS, PER, or ANN - PUMP SELF FAIL Alarms

Table 1. Troubleshooting Procedures

Symptoms	Cause	Troubleshooting / Corrective Procedure
3.0 GPH Self-test Failures (Type 4)	Incorrect wiring	Check TLS-350 and TLS-350R VLLD *Site Preparation and Installation Instructions*, Manual No. 576013-873.
	Air in lines	Purge system per TLS-350 and TLS-350R VLLD *Site Preparation and Installation Instructions*, Manual No. 576013-873.
	Flexible fuel lines installed on wrong ports	Check TLS-350 and TLS-350R VLLD *Site Preparation and Installation Instructions*, Manual No. 576013-873.
	Incorrect check valve installation	Check direction of arrow on check valve verify that it points in the direction of flow.
	Pipeline length too short	Enter correct length.
	Wrong pipeline material entered during console setup	Enter correct material in TLS-350 or TLS-350R Setup Mode.
	Wrong pipeline diameter entered during console setup	Enter correct diameter in TLS-350 or TLS-350R Setup Mode.
	Wrong product type entered during console setup	Enter correct product type in TLS-350 or TLS-350R Setup Mode.
	Loose connector at TLS-350 or TLS-350R Console	Check connectors.
	Plugged check valve filters	Replace filters.
	Leaking internal check valve	Plug “B” port on Check Valve and Controller and run self-tests.
	Pinched wire in Controller	Remove Controller cover and check for pinched wires. If a pinched wire is found, make necessary repairs and seal termination using epoxy pack.
	Low fuel level	Check tank level; if less than 10 inches, retest after delivery.
	Blocked test port	Disconnect line from tank port; observe flow during self test.
	Pump not running	Verify lockout times, check submersible pump circuit breaker, pump wiring and relays.
	Pump pressure too low	Verify pump pressure exceeds 22 psi.
	Clogged pump port strainer	Remove and clean/replace.
	Defective VLLD Module	Replace VLLD Module and retest.
	Open/shorted “Finish” switch	Check field wiring to Controller; check Controller for pinched wire; if no problem found, replace Controller.
	Open/shorted “Start” switch	Line leak or faulty blender dispenser - close shutoff valve and retest per Note 7. Also check field wiring to Controller and Controller for a pinched wire. If test fails with shutoff valve closed, replace Controller.
	Bad “Test” valve in controller	Replace controller.
3.0 GPH Pump-side Self-test Failures (Type 6)	“P” Line connected to wrong port on submersible pump	Check for proper location of flexible lines.
	Defective test valve in controller	Replace controller.
	Submersible pump does not turn off	Check pump relay contacts for sticking condition.

Table 1. Troubleshooting Procedures (Continued)

Symptoms	Cause	Troubleshooting / Corrective Procedure
3.0 GPH Pumpside Self-test Failures (Type 6) (cont.)	Defective pressure switch in Controller	Verify pressure switch operation. Replace if bad.
3.0 GPH Line Leak Failure (Type 3)	Air in line	Purge lines.
	Leaking line or leaking filter	Close shutoff valve and retest; if it passes, line is leaking. If it still fails, plug "P" port on Controller and retest.
	Leaking blend valve in dispenser	Check dispensers for blend errors; Close dispenser safety shutoff valve to isolate leakage.
	Leaking test valve	Plug "P" port on Controller and retest.
	Incorrect thermistor location	Move to correct location per VLLD *Site Preparation and Installation Instructions*, Manual No. 576013-873.
	Bad thermistor or thermistor wiring	Check and repair as required.
3.0 GPH Pumpside Leak Test Failure (Type 5)	Leaking pump check valve	Replace pump check valve.
	Pumpside leak	Check submersible pump manway area for leaks.
VLLD Pressure Warning or Pressure Alarm	Out of product (dry lines)	Check product level in tank. Close shutoff valve and run auto air purge procedure, then enable pump.
	Bad submersible pump	Verify pump pressure exceeds 22 psi.
	Defective controller pressure switch	Verify pressure switch operation. Replace if bad.
Restricted or no product flow on all dispensers (same product)	Clogged pump port strainer	Remove and replace, clean.
	Check valve installed backwards	Check installation (flow direction arrow) and correct if wrong.
0.1 & 0.2 GPH Self-test Failures (Types 8 & 12)	Air in lines	Purge system per TLS-350 and TLS-350R VLLD *Site Preparation and Installation Instructions*, Manual No. 576013-873.
	Pipeline length too short	Enter correct length.
	Wrong pipeline material entered during console setup	Enter correct material in TLS-350 or TLS-350R Setup Mode.
	Wrong pipeline diameter entered during console setup	Enter correct diameter in TLS-350 or TLS-350R Setup Mode.
	Wrong product type entered during console setup	Enter correct product type in TLS-350 or TLS-350R Setup Mode.

Table 1. Troubleshooting Procedures (Continued)

Symptoms	Cause	Troubleshooting / Corrective Procedure
0.1 & 0.2 GPH Self-test Failures (Types 8 & 12) (cont.)	Incorrect thermistor location	Move to correct location per VLLD *Site Preparation and Installation Instructions*, Manual No. 576013-873.
	Bad thermistor or thermistor wiring	Check and repair as required.
	Leaking internal check valve	Plug “B” port on check valve and controller and run self-test.
	Partially blocked test port	Disconnect line from tank port, observe flow during self-test.
	Pump not running	Verify lockout times; check submersible pump circuit breaker, pump wiring and relays.
	Pump pressure too low	Verify pump pressure exceeds 22 psi.
	Clogged pump port strainer	Remove and clean/replace.
	Plugged check valve filters	Replace filter(s).
0.1 & 0.2 GPH Pumpside Self-test Failure (Types 10 & 14)	Submersible pump does not turn off.	Check pump relay contacts for sticking condition.
	Leaking internal check valve	Plug “B” port on check valve and controller and run self-tests.
	Defective “test” valve in controller	Replace controller.
0.1 and 0.2 GPH Line Leak Failure (Types 7 & 11)	Air in line	Purge lines.
	Leaking line or leaking filter	Close shutoff valve and retest; if it passes, line is leaking. If it still fails, plug “P” port on Controller and retest.
	Leaking blend valve in dispenser	Check dispensers for blend errors; Close dispenser safety shutoff valve to isolate leakage.
	Leaking test valve	Plug “P” port on Controller and retest.
0.1 and 0.2 GPH Pumpside Leak Test Failure (Types 9 & 13)	Leaking pump check valve	Replace pump check valve.
	Pumpside leak	Check submersible pump manway area for leaks.

Corrective Procedures

⚠ WARNING

This device is installed in equipment where potentially lethal voltages may exist.

Electrical shock resulting in serious injury or death may result if power is on during servicing.

Before servicing this device, turn off power to the system, including TLS-350/TLS-350R console and submersible pumps.

Equipment Required

To perform the procedures outlined in the following sections, you will need the following equipment:

- ❑ Two, 37 degree flare caps, Aeroquip Part No. 2102924 or equivalent.
- ❑ Measuring beaker, 100 cc minimum capacity.
- ❑ Pressure gauge, either 0 - 30 psi or 0 - 60 psi.
- ❑ Tool-Filter Extractor.

These parts, with the exception of the beaker, are contained in the Veeder-Root VLLD Troubleshooting Kit, 330020-035.

Inspecting Pump Port Strainer

To inspect the pump port strainer:

1. Turn off pump power and close shutoff valve.
2. Remove the pump port strainer from the mechanical line leak port on the submersible pump [Figure 7 on page 25].

3. Inspect screen area for debris. Screen can be cleaned using mineral spirits.
4. Install a new or cleaned strainer in the mechanical line leak detector port [Figure 7].
5. Seal the threads with a UL-classified non-toxic pipe sealant suitable for use with the fuel involved.

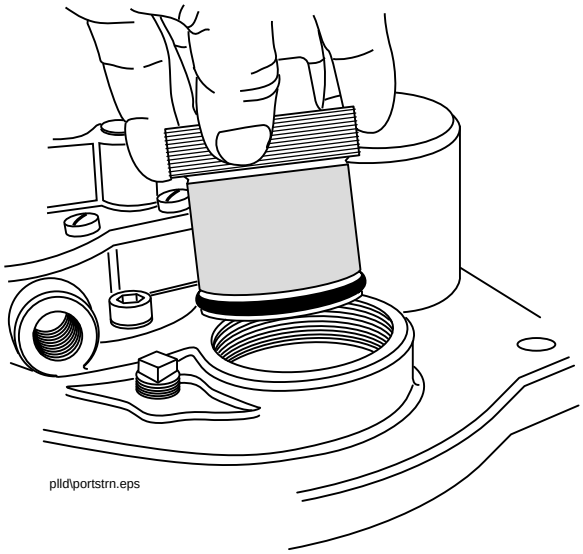


Figure 7. Pump Port Strainer

Purging Pipeline

All pipelines MUST be purged using the procedure detailed in the TLS-350 or TLS-350R VLLD *Site Preparation and Installation Instructions,* Manual No. 576013-873 following any servicing of the VLLD or STP.

Checking Thermistor Readings

The thermistor readings as indicated on the VLLD diagnostic printout should be consistent with the temperature of the ground. If the thermistor is not installed at the approximate pipeline depth, it will not yield temperature readings representative of the ground surrounding the pipeline. This can be a cause of leak test false alarms, particularly on 0.2 and 0.1 gph tests. Refer to the TLS-350 or TLS-350R VLLD *Site Preparation and Installation Instructions,* Manual No. 576013-873.

Determining If Check Valve Is Leaking

⚠ WARNING

Product spillage could create serious environmental and safety hazards.

Fire, explosion, or ground contamination could occur.

Use approved containers and procedures that will prevent product spillage.

The following test illustrates one of three possible check valve arrangements. In each case, the "B" fuel line is removed and vacated ports are capped.

1. Turn off submersible pump power.
2. Close the pipeline shutoff valve.
3. Remove the flexible fuel line from port "B" on the controller and check valve [Figure 8 on page 27].
4. Cap the "B" ports on the controller and check valve using approved caps (Aeroquip part number 210292-4 or equivalent).
5. Turn on pump power and perform a 3.0 GPH self-test from the TLS-350 or TLS-350R Diagnostic Mode. If test passes, replace check valve.

Important ☞ *If test passes but times are erratic, Controller may be faulty.*

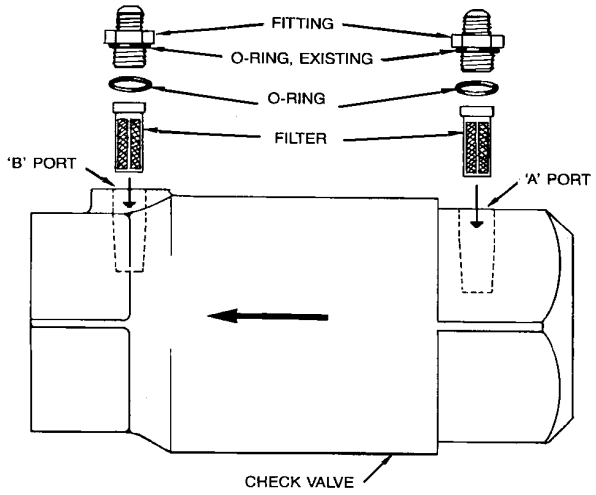


Figure 8. Check Valve Assembly with Filters

Inspecting and Servicing Filters

1. Turn off pump power and close pipe line shutoff valve.
2. Remove the flexible fuel line from ports A (if present) and B on the check valve [Figure 8].
3. Remove fittings from the check valve and set aside for reinstallation.
4. Remove the O-rings and check valve filters using Filter Extractor tool. If dirty or damaged, replace them .
5. Reinstall the O-rings and fittings.

Important ☞ *On newer systems with single-port check valves, filters are located in the Controller, not in the check valve. Follow the same procedure to replace filters in the Controller.*

Running Controller Self-Test

The Controller should produce a volume of approximately 1.2 fluid ounces (35 cc) during a self-test. A self-test is normally done as part of a line leak test. To verify controller performance, perform the steps below.

1. Close the line shutoff valve.
2. Run a controller self-test through diagnostics.

If the system passes the self-test, yet a line leak failure has occurred, a leaking line is indicated. Internal leakage in blending dispensers can cause a line leak failure.

Verifying Correct Pressure Switch Operation

⚠ WARNING

Product spillage could create serious environmental and safety hazards.

Fire, explosion, or ground contamination could occur.

Use approved containers and procedures that will prevent product spillage.

To verify correct pressure switch operation:

1. Turn off pump power.
2. Close the pipeline shutoff valve.
3. Disconnect the flexible fuel line from the "A" port on the controller or the check valve. Install a pressure gauge between the flexible fuel control line and the "A" Port [Figure 9].

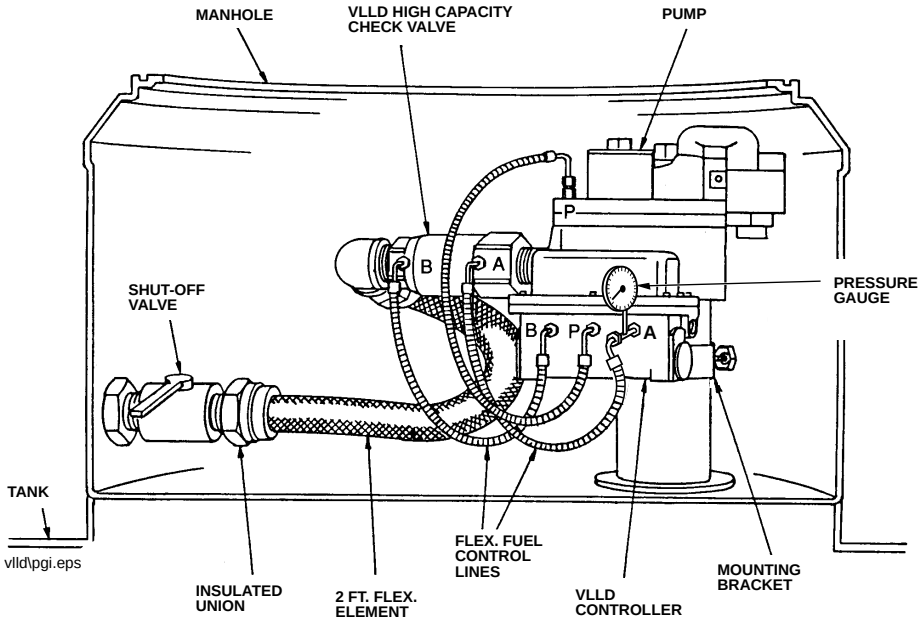


Figure 9. Pressure Gauge Installation, Pumpside Self-Test Check

4. Turn on pump power.

5. Run a 3.0 GPH pumpside test in the TLS-350 or TLS-350R Diagnostic Mode.

   The pressure gauge (installed at the "A" port) will be reading pump operation pressure for approximately 7 seconds after starting the pumpside test. The pump will then turn off and the line pressure should drop to 8 - 18 psi. After approximately 10 seconds, the pressure will start to decay until the pressure switch closes. Normal operating band for switch is 3.5 - 6.5 psi.
6. Record the reading at the end of the test. If the pressure is less than 3 psi and the switch has not closed, replace the pressure switch. If the pressure is greater than 4 psi, check to make sure the pump is not running during the test, and also check for blockage in the functional element relief valve orifice.
7. If test failure is still indicated while the line shutoff valve is closed, check for test valve leakage, functional element leakage, or pump check valve leakage.

Replacing the Pressure Switch

Follow these steps to prepare for pressure switch replacement using the Pressure Switch Replacement Kit (330020-060).

1. Turn off all power to TLS-350 or TLS-350R system.
2. Disconnect the wiring connector from the VLLD Line Leak Interface module in the TLS-350 or TLS-350R console.
3. Turn off submersible pump power.
4. Clean any fill away from the VLLD controller.
5. Close the shutoff valve on the piping system.
6. Remove the cover from the VLLD controller by removing the 8 hex head bolts.

Installing the Pressure Switch

1. Cut the two wires exiting the top of the pressure switch four inches from the top of the switch [Figure 10].

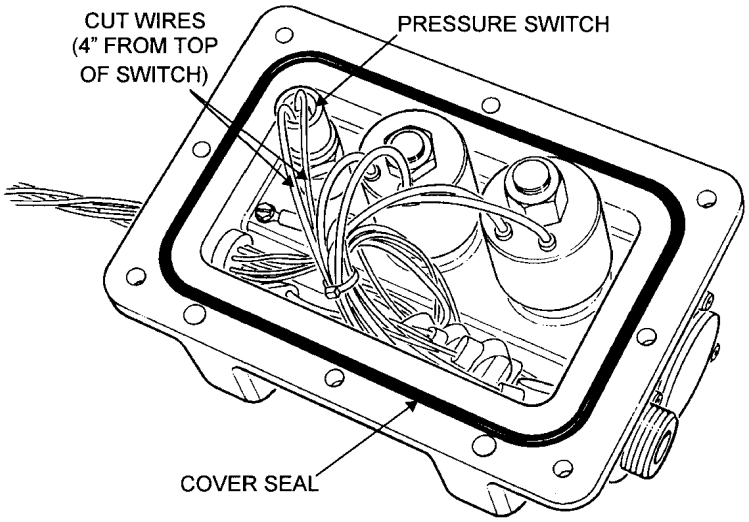


Figure 10. Pressure Switch Wiring

2. Using an open-end wrench, loosen the pressure switch. Remove it from the VLLD controller housing.

3. Take care to keep any debris from falling into the pressure switch sealing surfaces on the controller.

Notes: The replacement switch may not look like the original.

4. Remove the new pressure switch from the bag. Ensure that the new pressure switch has an O-ring installed on the body of the switch. Lightly lubricate the O-ring with silicone grease.

5. Install the pressure switch in the VLLD controller [Figure 11]).

Note: Do not install the pressure switch without the sealing O-ring in place. Failure to include the O-ring will result in a leak.

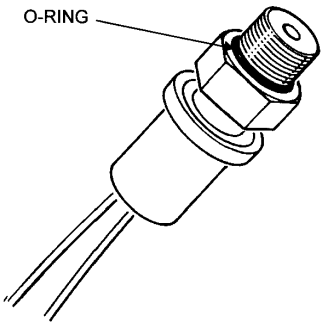


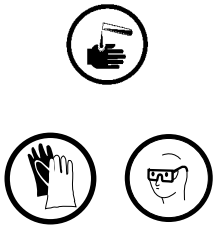
Figure 11. Pressure Switch

6. Tighten the pressure switch securely.

Connecting the Wires

1. Strip back 3/8 inch the two leads on the pressure switch.
2. Strip back 3/8 inch the two leads that were connected to the original pressure switch.

⚠ CAUTION



Epoxy sealant may be irritating to skin and eyes, absorbed through the skin, or cause skin sensitization in susceptible individuals.

Minor injury may result. Also materials contained in epoxy have caused skin cancer in animal tests.

Avoid skin and eye contact. Wear appropriate safety equipment. Use only in well ventilated areas.

3. Connect one pressure switch lead to each lead that was connected to the original pressure switch, using the two wire nuts supplied [Figure 12]. **You must seal the wire nuts to insure the switch will operate properly and to maintain warranty!**

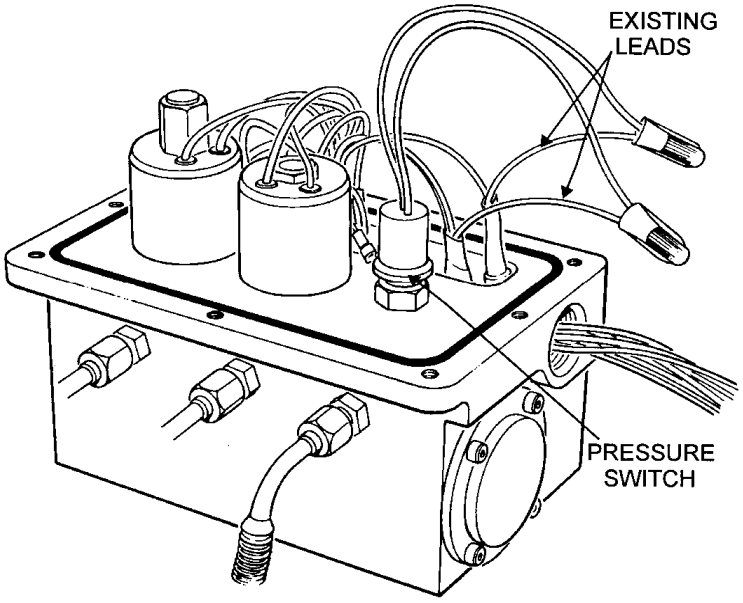


Figure 12. Wiring Connections

4. Seal the wire nut connections at this time using the epoxy sealant packets furnished with each replacement kit. Use one packet for no more than two wire nut connections [Figure 13].

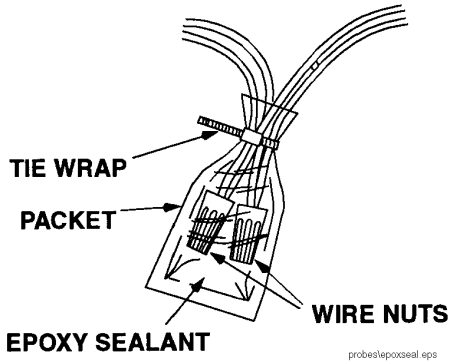


Figure 13. Epoxy Sealant Connections

5. Carefully tuck the wiring harness [Figure 12 on page 31] back into the cavity in the VLLD Controller Housing, ensuring that the wires do not extend over the flat surface the cover rests upon.

Reassembling the VLLD Controller

1. Make sure the flat surface the cover rests on is clean.
2. Make sure the O-ring is seated in its groove and is in good condition. Replace it if necessary (new O-rings are provided in the kit).
3. Taking care not to pinch the wires between the housing and the cover, replace the cover:
4. Reinstall the eight bolts.
5. Torque the bolts to 70 inch-pounds.
6. Use the 0.0015 feeler gauge supplied with the kit to check the gap between the controller cover and the housing. The feeler gauge should not slide into the gap between the cover and the VLLD housing. If the feeler gauge will slide in, remove the cover and check for pinched wires or debris on the sealing surface of the controller housing and cover.

Resuming Operation

1. Reconnect the VLLD module connector.
2. Turn on submersible pump power.
3. Run a 3 GPH test in the Diagnostics mode and verify the test passes.
4. Open the shutoff valve and resume operation.

Checking for Test Valve Leakage

⚠ WARNING

Product spillage could create serious environmental and safety hazards.

Fire, explosion, or ground contamination could occur.

Use approved containers and procedures that will prevent product spillage.

1. Turn off pump power.
2. Remove flexible fuel line from “P” port on Controller.
3. Plug “P” port on the Controller using a 37-degree plug (Aeroquip Part No. 2102924 or equivalent).
4. Turn on pump power and perform the line leak test (that had failed previously) through diagnostics [“Line Leak Tests, Diagnostic Mode” on page 39]. If test passes, test valve leakage is indicated. Replace Controller.

Line Leak Detector Diagnostics

Line leak diagnostic tests provide useful tools for confirming VLLD operation and analyzing problems. Specific segmented tests can be conducted as an alternative to complete leak and self-tests, which are normally performed when requested under the "Start Line Leak Test" option in the Operator mode.

Running VLLD Diagnostic Tests

To run a Volumetic Line Leak Detector diagnostic test:

1. Press MODE until you see the DIAG MODE message display.
2. Press FUNCTION until you see the LINE LEAK DIAG DATA message display.
3. Step through the test procedure as illustrated in the following flow chart [Figure 14 on page 35], making sure to select the appropriate pipeline and the appropriate test where indicated.

VLLD Alarm Messages

If a Volumetic Line Leak Detector diagnostic test fails, you may see one of the following alarm messages [Table 2]:

Table 2. VLLD Alarm Messages

Display Message	Audible & Visual Indicators	Cause
LINE LEAK SHUTDOWN	Audible beep. Red flashing light.	Pumpside Test or Pumpside Self-Test failure.
GROSS LINE TEST FAIL	Audible beep. Red flashing light.	3.0 GPH Pumpside Test failure.
GROSS PUMP SELF FAIL	Audible beep. Red flashing light.	3.0 GPH Pumpside Self-test failure.

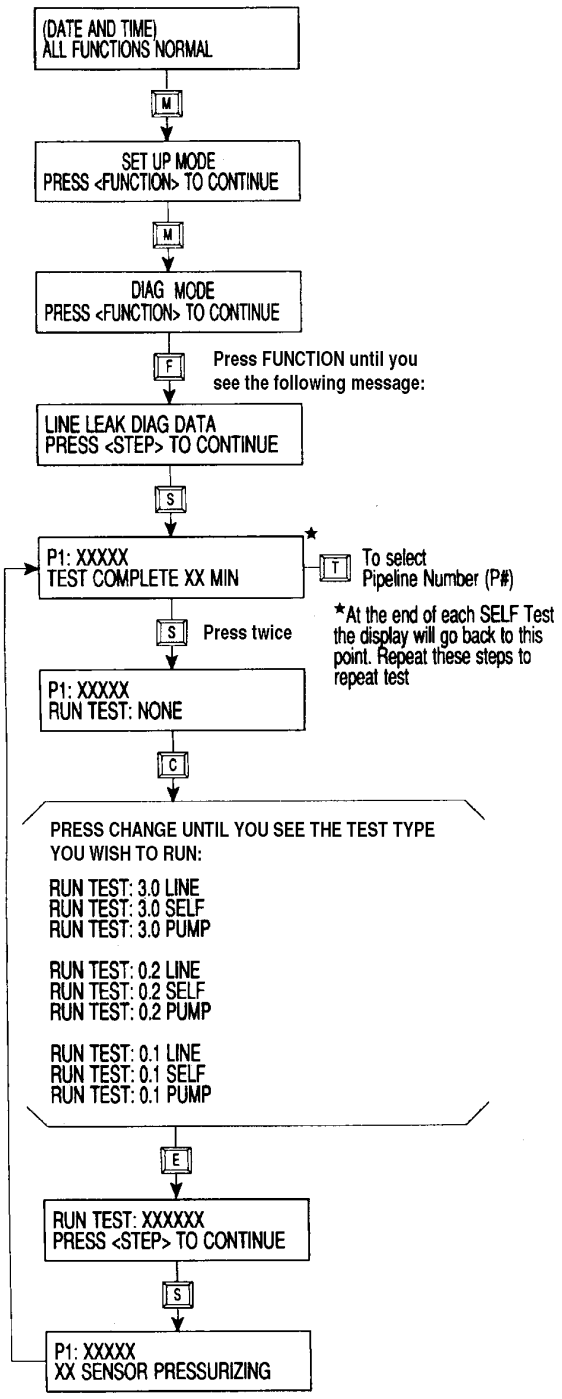


Figure 14. Flow Chart for VLLD Diagnostic Test Procedure

VLLD Switch Positions, Diagnostic Mode

The VLLD switch position display is useful for determining status of the controller switches and STP at any time during a test cycle. In the example display below, the x is either a 0 or a 1. Possible switch states (0 or 1) are decoded in the following chart [Table 3] to help in diagnosing test problems.

Ix Px Fx Sx Ox Ex Tx Dx

Table 3. VLLD Diagnostic Switches, Positions, and Wiring Codes

Switch	Description/States	VLLD Controller Wiring Color Code
I	PUMP IN. A 120 VAC Signal from Pump Control of Self-Serve System or Dispenser I0= OFF I1 = ON	
P	PRESSURE SWITCH. The Pressure Switch Signal P0= Switch Open (Line Pressure above 6.5 psi) P1 = Switch Closed (No Line Pressure)	Violet
F	FINISH SWITCH. The Finish Position of the Flow Sensor F0 = Switch Open (Piston not at Finish Position) F1 = Switch Closed (Piston at Finish Position)	Yellow
S	START SWITCH. The Start Position of the Flow Sensor S0 = Switch Open (Piston not at Start Position) S1 = Switch Closed (Piston at Start Position)	Blue
O	PUMP OUT. The 120 VAC Signal to control the Submersible Pump Relay O0 = OFF O1 = ON	
E	EQUALIZATION VALVE. A Normally Open Valve E0 = VALVE OPEN E1 = VALVED CLOSED	Red
T	TEST VALVE. A Normally Closed Valve T0 = VALVE CLOSED T1 = VALVE OPEN	Grey
D	DISABLE FLAG. Indicates Submersible Pump Status D0 = Pump Out is Enabled D1 = Pump Out is Disabled	

The following chart [Table 4] can be used to decode switch positions displayed during tests and normal dispensing. Some displays appear only briefly, and some variables are not significant relative to their status at particular moments during the tests. Test screens for 3.0, 0.2 and 0.1 GPH are similar:

Table 4. Displayed VLLD Diagnostic Switch Positions by Test State

Test State	I Pump In	P Pressure Switch	F Finish Switch	S Start Switch	O Pump Signal	E Equalizer Valve	T Test Valve	D Pump Status
STP off, system idle	I0	P1 or P0	F0	S1	O0	E0	T0	D1
STP on, dispensing fuel	I1	P0	F0	S1	O1	E0	T0	D0
Not dispensing, setup leak test, STP on	I0	P0	F0	S1	O1	E0-1-0	T0-1-0	D0
STP on, start leak test	I0	P0	F0	S1	O1	E1	T0	D0
During leak test, normal with no leaks	I0	P0	F0	S0 or S1	O1	E1	T0	D0
End of leak test, test still in process, no leaks	I0	P0	F0	S0 or S1	O1	E1	T0	D0
Leak test, upon detection of system leaks	I0	P0	F1	S0	O1	E1-0	T0	D1
Between leak and self test	I0	P0 or P1	F0	S0 or S1	O0-1-0	E0	T0-1-0	D0
Start self test, after pass leak test	I0	P0	F0	S1	O1	E1	T1	D0
End of self test, upon determining system is OK	I0	P0	F1	S0	O1	E1	T1	D0
End of self test, after determining that system is bad	I0	P0	F0	S0 or S1	O1-0	E1-0	T1-0	D1
Setup pump leak test, restart STP, equalize pressure	I0	P0	F0	S1	O1	E0-1-0	T0-1-0	D0
Begin pump leak test	I0	P0	F0	S1	O0	E1	T0	D0
During pump leak test, no leaks	I0	P0	F0	S0 or S1	O0	E1	T0	D0
At end of pump leak test, no leaks	I0	P0	F0	S0 or S1	O0	E1	T0	D0

Table 4. Displayed VLLD Diagnostic Switch Positions by Test State

Test State	I Pump In	P Pressure Switch	F Finish Switch	S Start Switch	O Pump Signal	E Equalizer Valve	T Test Valve	D Pump Status
At end of pump leak test, leaks detected	I0	P1	F0	S0 or S1	O0	E1	T0	D1
Pump self test setup, after test passes	I0	P0	F0	S0 or S1	O0	E1	T0	D0
Pump self test, at start of test	I0	P0	F0	S1	O0	E1	T0	D0
Pump self test, at end of test, system bad	I0	P0	F0 or F1	S0 or S1	O0	E1	T1	D1
Pump self test, at end of test, system passed	I0	P1	F0 or F1	S0	00	E1	T1	D0

Notes:

1. Many segments change quickly, watch closely.
2. Where “or” is used, either state is acceptable.
3. Where “-” is used, a quick indication change will occur during that test segment.
4. Generic tests are shown. Depending upon the equipment and way the unit is programmed, tests may be also run for 0.1 or 0.2 GPH. Steps are similar except the tests take longer than the 3.0 GPH tests. 3.0 GPH tests are automatic, while 0.1, 0.2 and pump tests are optionally programmed.
5. Tests are normally run after dispensing activity. They can also specially be done under the Operator mode or under Diagnostics. Complete tests are run under the Operator mode where it is possible to run segmented tests under Diagnostics.
6. A test is automatically aborted when a dispenser handle is lifted. (i.e. “I0” becomes “I1”).

Line Leak Tests, Diagnostic Mode

The following chart [Table 5] provides test type reference numbers, which can be displayed in test result messages as well as test times. More precise tests take longer to run.

Table 5. Test Type Reference Numbers and Times

Test Type/Reference	Test Length (Seconds)	Typical Test Times (Seconds)
1. = Catastrophic Line Test	5	5
2.+ = Catastrophic Line Test	5	5
3. = 3.0 GPH Line Test	13.5*	13.5*
4. = 3.0 GPH Line Self-Test	13.5*	5-7*
5. = 3.0 GPH Pumpside Test	30 + 10	10
6.+ = 3.0 GPH Pumpside Self-Test	300*	5-40*
7. = 0.2 GPH Line Test	326*	326*
8. = 0.2 GPH Line SelF-Test	326*	104-156*
9. = 0.2 GPH Pumpside Test	30 + 60	60
10.+ = 0.2 GPH Pumpside Self-Test	300*	5-40*
11. = 0.1 GPH Line Test	794*	794*
12. = 0.1 GPH Line SelF-Test	794*	250-395*
13. = 0. 1 GPH Pumpside Test	30 + 146	146
14+. = 0.1 GPH Pumpside Self-Test	300*	5-40*

* Times will be longer for Enviroflex.

+ Not used in Versions 4 and later.

VLLD Diagnostic Test Printout

```
MMM DD YYYY HH:MM XM
    TYP   = 4
  GRND = 66.2 DEG F
  TANK   = 55.0 DEG F
  DELY    = 5
 LGTH   = 13.5
 RSET    = 0.3
 TEST    = 6.1
  RSLT   = 0
```

Explanation Of Terms From A Line Leak Diagnostic Test

GRND = Temperature via ground temperature thermistor at last dispense (if 0.0, no thermistor is present).

TANK = Temperature via in-tank probe of corresponding tank contents (if 0.0, no probe is present).

DELY = Time in minutes since last handle activity.

LGTH = Test length in seconds required by software.

RSET = The time, in seconds, which it took to activate the START SWITCH.

TEST =The overall time the test actually took, in seconds.

RSLT = The test result

TLS-350 Software Versions 1 & 2 Only

Result

0 = TEST PASSED

1 = SELF-TEST FAIL (types 4,6,8,10,12,14)

2 = NOT USED

3 = LINE TEST FAIL (types 1,2,3,5,7,9,11,13)

TLS-350 Software Version 3 Only

Result

0 = TEST PASSED ..... 3.0 GPH

6 = LL GROSS TEST ALARM..... 3.0 GPH

7 = LL GROSS SELF-TEST ALARM ..... 3.0 GPH

8 = LL GROSS PUMPSIDE ALARM ..... 3.0 GPH

9 = LL GROSS PUMPSIDE SELF-TEST ALARM..... 0.2 GPH

10 = LL MONTHLY TEST WARNING..... 0.2 GPH

11 = LL ANNUAL TEST WARNING ..... 0.1 GPH

12 = LL MONTHLY TEST ALARM ..... 0.2 GPH

13 = LL ANNUAL TEST ALARM ..... 0.1 GPH

14 = LL PERIODIC TEST ALARM ..... 0.2 GPH

15 = LL PERIODIC SELF-TEST ALARM..... 0.2 GPH

16 = LL PERIODIC PUMPSIDE ALARM..... 0.2 GPH

17 = LL PERIODIC PUMPSIDE SELF-TEST ALARM ..... 0.2 GPH

18 = LL ANNUAL TEST ALARM ..... 0.1 GPH

19 = LL ANNUAL SELF-TEST ALARM ..... 0.1 GPH

20 = LL ANNUAL PUMPSIDE ALARM ..... 0.1 GPH

21 = LL ANNUAL PUMPSIDE SELF-TEST ALARM..... 0.1 GPH

22 = LL NUMBER OF ALARMS

98 = LL TEST ABORT. DISPENSER ON DURING TEST

99 = LL SINGLE TEST PIECE. SINGLE TEST RUN FROM DIAG.

TLS-350 Software Version 4 or Higher, TLS-350R Software Version 106 or Higher

PASSED = TEST PASSED

FAILED = TEST FAILED

VLLD Warnings: Software Versions 1 & 2

Table 6. VLLD Warnings: Software Versions 1 & 2

Display Message	Audible & Visual Indicators	Cause
VLLD SELF TEST FAIL	Audible beep Red flashing light	VLLD Hardware failure (1 Self-test failure in Versions lF & lG) (3 consecutive Self-test failures in Versions IH & IJ)
LINE LEAK TEST FAIL	Audible beep	Line Test or Pumpside Test failure occurred
LINE LEAK SHUTDOWN	Audible beep Red flashing light	VLLD hardware, Line Test or Pumpside Test failure occurred

VLLD Warnings: TLS-350 Versions 3 or Greater, TLS-350R Versions 106 or Higher

Table 7. VLLD Warnings: Software Versions 3/106 or Higher

Display Message	Audible & Visual Indicators	Cause
VLLD SELF TEST FAIL	Audible beep Red flashing light	VLLD failure (3 consecutive Self-Test Failures)
LINE LEAK SHUTDOWN	Audible beep Red flashing light	Line Test or Pumpside Test failure.
SELF TEST INVALID	Audible beep Yellow flashing light	A self-test failure during a requested test has occurred
CONTINUOUS PUMP WARN	Audible beep Yellow flashing light	The system has not seen the dispenser handle turn off for a period of 2 hours.
GROSS LINE TEST FAIL	Audible beep Red flashing light	3.0 GPH Line Test failure (3 consecutive Self-Test failures)
GROSS LINE SELF FAIL	Audible beep Red flashing light	3.0 GPH Line Self-test failure

Table 7. VLLD Warnings: Software Versions 3/106 or Higher (Continued)

Display Message	Audible & Visual Indicators	Cause
GROSS PUMP TEST FAIL	Audible beep Red flashing light	3.0 GPH Line Pump Test failure
GROSS PUMP SELF FAIL	Audible beep Red flashing light	3.0 GPH Pumpside Self-test failure
VLLD PERIODIC WARN	Audible beep Yellow flashing light	If enabled, and the system fails to perform a Periodic Test (0.2 GPH) in the programmed number of days, the system will display this warning
VLLD PERIODIC ALARM	Audible beep Red flashing light	If enabled, and the system fails to perform a Periodic Test (0.2 GPH) in the programmed number of days, the system will display this alarm
VLLD ANNUAL WARN	Audible beep Yellow flashing light	If enabled, and the system fails to perform an Annual Test (0.1 GPH) in the programmed number of days, the system will display this warning
VLLD ANNUAL ALARM	Audible beep Red flashing light	If enabled, and the system fails to perform an Annual Test (0.1 GPH) in the programmed number of days, the system will display this alarm
PER LINE TEST FAIL	Audible beep Red flashing light	0.2 GPH Line Test failure
PER-LINE SELF FAIL	Audible beep Red flashing light	0.2 GPH Self-test failure (2 consecutive Self-Test)
PER PUMP TEST FAIL	Audible beep Red flashing light	0.2 GPH Pumpside Test failure
ANN-LINE TEST FAIL	Audible beep Red flashing light	0.1 GPH Line Test failure
ANN-LINE SELF FAIL	Audible beep Red flashing light	0.1 GPH Line Self-test failure (2 consecutive Self-Test failures)
ANN-PUMP TEST FAIL	Audible beep Red flashing light	0.1 GPH Pumpside Test failure
ANN-PUMP SELF FAIL	Audible beep Red flashing light	0.1 GPH Pumpside Self-test failure
VLLD PRESSURE WARN (Version 5 or later)	Audible beep Yellow flashing light	Three consecutive attempts to run a test in which the pressure switch never opened (“Pump not running)
VLLD PRESSURE ALARM (Version 5 or later)	Audible beep Red flashing light	Six consecutive attempts to run a test in which the pressure switch never opened (“Pump not running).
FUEL OUT ALARM (Version 5 or later)	Audible beep Red flashing light	Product level below 10 inches and three consecutive 3.0 GPH self-test failures
TEST CURRENTLY ON HOLD	None	3.0 GPH Self-test failure or VLLD PRESSURE WARN alarm. Retest to validate outcome on next dispense. After 3rd occurrence, system will alarm. After 6th occurrence, system will shut down

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Environmental Products

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