Vaporless Manufacturing, Inc.

Quality Petroleum Equipment
Solutions for Over 20 Years

ARM-4073

AST-4010
AST-4012

CFOSI

FST-200

ISM-4080
ISM-4081
ISM-4080 MC

LD-2000
LD-2000\E

LD-2200
LD-2200\75

LD-3000
LD-3000\E
LD-3000\FL

LDT-890
LDT-890\AF

OFP-2\1
OFP-2\2
OFP-3\1
OFP-3\2
OFP-HHP
OFP-FTK

PLC-5000

SUMP-300

VMI-PMTT

Date: December 23, 2011

Subject: **Mechanical Line Leak Detector Slow Flow**

This is a review of slow flow disruptions that can occur with the installation of Mechanical Line Leak Detection. First of all, it is important to understand the function of Mechanical Line Leak Detectors and how they interact with other equipment. Some problems come from existing station setup, such as the length of solenoid delays, submersible check valves leaking pressure back into the tank, etc. Additionally, thermal contraction and diesel fuel with higher viscosity (due to the cold weather) also cause problems. These and other issues are addressed below, as well as solutions.

General Issues of Line Leak Detection

Mechanical Line Leak Detectors are pressure sensitive devices that respond to pressure in the pump – line system.

The end goal for VMI is to provide nuisance free line leak detection. When station operators experience Mechanical Line Leak Detector false alarm slow flow it is difficult to dispense fuel. What is worse, when operators frequently experience MLLD false alarms, they begin to forget what the MLLD is indicating, a possible leak. An MLLD that is ignored, bypassed, or "tricked" into delivering fuel could have negative consequences. Operators should be able to trust when they experience slow flow, they could have a problem.

Throughout the cold weather months many MLLDs are unnecessarily replaced. A failing MLLD is one that cannot restrict flow with a 3gph leak in the line. An MLLD that moves into the slow flow position without a leak in the line is not a failing unit. <u>In order for an MLLD to move into the slow flow position, line pressure must get down to 3psi or less</u>. Line pressure will obviously fall if a check valve fails or if there is a leak in the line. More difficult to diagnose is falling line pressure due to thermal contraction. Basic Physics: When things get warmer, they expand. When things get colder, they contract. Thermal contraction occurs when warm fuel from the storage tank moves into piping that is surrounded by cold ground. The fuel shrinks in the pipeline, dropping line pressure. Additionally, when pressure gets down to 3-4 PSI, the liquid fuel begins to vaporize, causing vapor pockets. When vapor pockets form in the line, it takes even longer to open the leak detector. The leak detector must compress the vapor pocket to build pressure, this takes more time.

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One other basic law of physics of the liquids we are testing is that the colder the fuel, the higher the viscosity will be. All of these fuels are metered through an orifice. Therefore, the higher the viscosity, the less fuel that will pass through this orifice at any given time. A 3 to 4 second leak detector will now take longer to open to full-flow.

In a perfect world where all lines are tight, all check valves are holding, and there is no thermal contraction, the only time an MLLD moves into the slow flow position is during post-install and annual testing.

A properly functioning MLLD installed in a typical application will open to full flow in 3-4 seconds. MLLD step through time is dependent on a number of factors. However, the two most important factors are the line's resiliency (measured in bleedback) and the liquid's viscosity. Vapor pockets add line resiliency. When a vapor pocket has formed in the line, the line's resiliency goes up, and consequently, the MLLD takes longer to open.

Solutions:

Extend Dispenser Solenoid Delay:

The MLLD is in a race to open before the dispenser solenoid opens. The MLLD must reach the full flow position before the solenoid opens. If the solenoid opens before the MLLD, we know that the nozzle will already be open and ready to deliver fuel in the customer's tank. This looks like a giant leak to the MLLD, and it will not be able to build pressure and reach full flow. Extending the solenoid delay to 6-8 seconds allows the proper amount of time for the MLLD to reach full flow before the solenoid opens. The step through time for a leak detector to open up will always be a problem if the leak detector has to open with only a 2 second delay.

LD-2000:

The LD-2000 is the only 2" MLLD on the market with an integrated check valve. The check valve of the MLLD works with the check valve in the STP (Submersible Turbine Pump) to maintain a higher static line pressure. Starting with a higher holding pressure reduces slow flow false alarms due to thermal contraction. Two check valves in a line system have a better chance of holding pressure in the line than a single check valve that may fail. The check valve of the MLLD will maintain line pressure in the event that the STP check valve has failed. This ability to maintain line pressure reduces false alarm slow flows. The LD-2000 will not prevent all thermal problems. However, it will <u>reduce</u> slow flow problems and may make the site acceptable without other assists such as the VMI ARM-4073 covered in the next paragraph. As we have been telling customers for 20+ years, if the LD-2000 saves one service call in the life of the leak detector, you have more than covered the additional cost of installing this leak detector. By addressing multiple check valves in the system, you will in fact prevent several service calls over the life of the leak detector. <u>The LD-2000 will not prevent all thermal problems</u>, but it will reduce slow flow problems.

VMI ARM-4073 or ISM-4080:

At some sites thermal contraction and/or the length of time the submersible is off is so great that slow flow false alarms will still occur after installing the LD-2000 and extending the solenoid delay. This is not the fault of the MLLD, it is just the physics of liquids. The VMI ARM and ISM units act to keep the line continually pressurized. This constant line pressure management keeps line pressure high and keeps the MLLD in a position to deliver full flow. The ARM is an inexpensive, easy to install, line pressure management solution. The ISM has added benefits including STP staging for manifolded lines, solenoid valve control for marinas and high head pressure applications, and positive STP shutdown upon detection of a line leak.

For more information on the VMI ARM and ISM solutions, click on the following links.

ARM-4073

http://vaporless.com/vmi_website_links/training/training_ppt/ARM-4073%20071310.ppt

ISM-4080 & ISM-4081

http://vaporless.com/vmi_website_links/training/training_ppt/ISM%20Presentation%20061710.ppt

On the next page are some problems that occur with regularity. These issues should be reviewed with repair and maintenance personnel.

Trouble Shooting MLLD Slow Flow Problems

Before diagnosing MLLD slow flow problems, it is necessary to have a basic understanding of how MLLDs work. MLLDs are pressure sensitive devices that move into different positions depending on line pressure conditions and pump activity. Please click the following link to view the 3 positions of the VMI 99 LD-2000, http://www.vaporless.com/vmi_drawings/LD2000_Positions.pdf. **For the MLLD to move into slow flow, line pressure must fall to 3psi or less**. Below is a list of diagnostics to look for when trouble shooting a slow flow issue.

- No matter what, always remember these devices are pressure sensitive valves. It is the testers' responsibility to insure pressure is not falling in the line due to a leak into the environment. Falling line pressure could mean a line leak.

- When checking for line leaks, remember that items besides failing submersible check valves can cause pressure to fall.

    - ❖ Check the dispenser hardware and filters.

    - ❖ Packer o-rings fail and drain fluid back into the tank.

    - ❖ It may be difficult to determine if pressure is draining into the tank or if there is a line leak. If there is a ball valve downstream of the leak detector, this can be closed when the submersible is running. Turn submersible off. Check if line pressure falls with the ball valve closed.

- Check the vent line from the leak detector going into the submersible. There is a small possibility of a leaking piston seal. This is normally something that only occurs in older leak detectors after the piston seal is worn by particles in the fuel. Under normal conditions fluid accumulates in the cylinder on top of the piston and passes through the vent when the leak detector opens. **It is normal** for the leak detector to "spurt" fuel when it opens. The leak detector may continue to drip fuel. **Dripping is okay**, a continuous **stream** of fluid out of the vent is not acceptable.

- If slow flow occurs when the first customer in the morning gets fuel, or after the fueling system sits idle for a period of time, it is an indication that the system is losing pressure from thermal or mechanical problems. After the system rests for a while, pressure falls, and the MLLD moves into slow flow. Upon the next authorization the MLLD is not able to open before the solenoid valve opens.

    - ❖ The system should be charged by authorizing all products and letting the products run for 1 minute when the station is opened.

        - ▪ The VMI ARM or ISM may be installed and will charge the system when it is first powered up, eliminating the need for an operator to include this in their opening procedures. The VMI ARM or the ISM will cycle power, check for leaks, and keep the system pressurized.

    - ❖ Extend the length of the solenoid delay.

- Verify that the line is tight.

- Verify that the submersible check valve is holding.

- Verify that the solenoid delay is set at 6 or more seconds.

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- Check that every hook handle authorization starts the pump.
- If the line is tight, the check valve is holding, and the solenoid delay is set for 6 or more seconds, the problem is almost always thermal contraction; the solution is the VMI ARM-4073 or the ISM-4080.
  - ❖ Some rare instances of non-thermal contraction caused slow flow are:
    - Electrical issues that are causing the STP to not start every time it is authorized.
    - The submersible relay may not stay closed, interrupting power to the pump.
    - Authorization issues with dispensers / prepay / submersibles.
- If slow flow occurs with multiple customers fueling, there are two potential problems.
  - ❖ The submersible cannot keep up with customer demand.
    - Is there a rag on the inlet of the submersible?
    - Should the submersible be replaced?
      - If you wish to stay with the submersible, VMI has a special leak detector, the VMI LD-2200\75 that can work with low discharge pressures. This is discussed on page 2 of the VMI LD-2200 brochure.
      - The VMI LD-2000 will not have this problem unless there is something wrong with the submersible or the system has a 1/3 hp submersible and too many nozzles open.
  - ❖ Another potential problem is a “blinking” authorization.
    - If the hook signal authorization is not constant (it disappears for a very short time), the pump will turn off for the period that the authorization disappeared. The nozzles still allow fuel into vehicles and line pressure drops rapidly.
    - When the authorization reappears and the submersible turns back on, the MLLD is in slow flow and cannot build line pressure due to the open nozzles.
    - This can be because of submersible contactor “chattering” or the contacts not staying closed.
    - Sometimes equipment interface (different systems talking to each other) causes this momentary on – off.
    - The ISM-4080 and ISM-4081 have a software latch that requires the authorization to stay off for 2 seconds before it responds. This software hook takes care of most chattering and interface signal interruptions.

Please contact VMI if you have any questions or would like any additional information.