EVO Series Electronic Line Leak Detection for Generator Systems

Presented by

Matt Schuessler, Franklin Fueling Systems

22nd Annual California CUPA Training Conference
February 3 - 6, 2020
South San Francisco

EVO™

SERIES

ELECTRONIC LINE LEAK DETECTION FOR GENERATOR APPLICATIONS

Franklin Fueling Systems

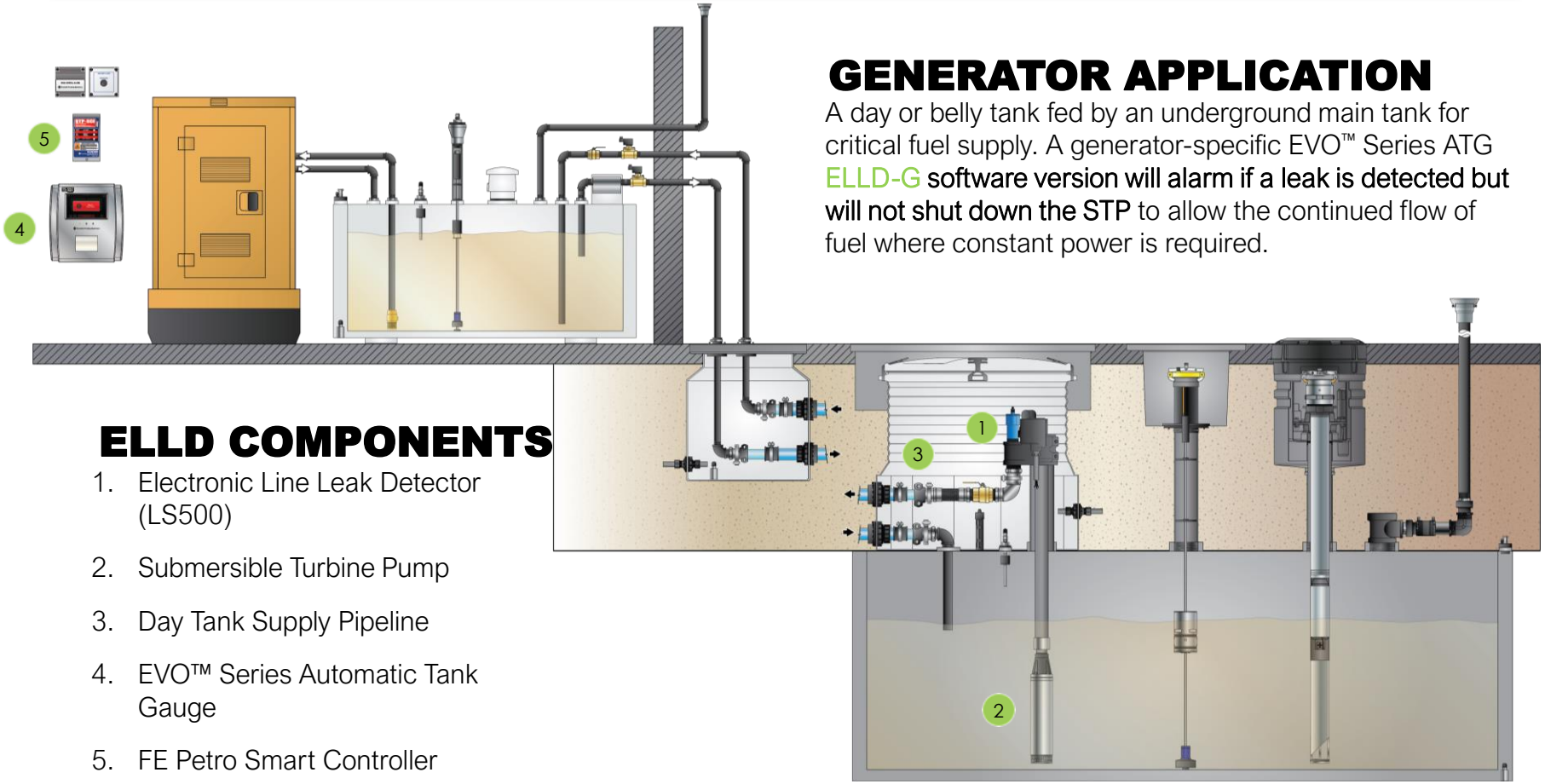
CALIFORNIA CUPA FORUM

HOW IT WORKS

Electronic Line Leak Detection (ELLD) is a pressure-based system that uses line information to monitor changes in pressure and detect leaks in pipework systems.

THEORY OF OPERATION

- Learn the pressure decay curve using leak calibration tool to establish baseline.
- In operation, algorithm compares this established reference leak curve to the pressurized pipe.
  - Does the pressure decay faster?
    - Then a leak has occurred.
  - Does the pressure decay slower?
    - Then line is tight - no leak of 3.0 GPH or greater.



GENERATOR APPLICATION

A day or belly tank fed by an underground main tank for critical fuel supply. A generator-specific EVO™ Series ATG ELLD-G software version will alarm if a leak is detected but will not shut down the STP to allow the continued flow of fuel where constant power is required.

ELLD COMPONENTS

1. Electronic Line Leak Detector (LS500)
2. Submersible Turbine Pump
3. Day Tank Supply Pipeline
4. EVO™ Series Automatic Tank Gauge
5. FE Petro Smart Controller

AUTO-LEARN® TECHNOLOGY

A standard feature of ELLD, AUTO-LEARN® technology **automatically learns and stores the pressure characteristics** of each pipeline, for precise leak detection.

- AUTO-LEARN® eliminates need to enter pipe physical characteristics, like material composition, length and diameter, **thus removing potential for human error, whether accidental or intentional.**
- AUTO-LEARN® makes the ELLD system tamper-proof, where **users are prevented from manipulating setup parameters in order to mask alarms.**

LEAK VERIFICATION

ELLD will take at least 10 minutes to confirm a leak, as **it will run the test twice to verify** that the pipeline is experiencing a 3 gph leak rate.

- Double-checks test result to rule out first alert being caused by external factors like the thermal expansion of pipe.
- **IMPORTANT:** Generator-specific EVO™ Series ATG ELLD-G software version will alarm if leak is detected but **will not shut down the STP** to allow the the critical flow of fuel.

TESTING & INSPECTING

- Leak generator kit learns what a 3 GPH leak looks like.
- Test is compared against the learned characteristics (up curve & down curve) to confirm fault, if detected.
- Test occurs automatically every 45 minutes, or after every STP run cycle.
- Report is printed to see test results.

EQUIPMENT REQUIREMENTS

Hardware

1. EVO™ Series ATG
2. TS-LS500 (Intrinsically Safe)
3. TS-420IB (Intrinsically Safe Module)
4. TS-LS500E (Explosion Proof)
5. TS-420EXP (Explosion Proof Module) for the EVO
6. TS-ACI (AC Input Module to receive call for Fuel Signal)
7. TS-RLY or Turbine Pump Interface (TPI)

Software

1. TS-ELLD-G*

**This software version will alarm if 3 GPH Gross Leak is detected but will not shut down the STP.*

Accuracy

3 GPH (gross), 0.2 GPH (monthly) & 0.1 GPH (annual)

SITE REQUIREMENTS

Capacity Table

Item	Value
Minimum Static Pressure	**18 PSI** for precision testing **15 PSI** for gross leak testing **20 PSI** for learning lines
Maximum line volume for rigid pipe	312.2 gallons
Maximum line volume for flexible pipe	95.4 gallons
Minimum volume for rigid or flexible pipe	2.5 gallons

Pipe Length Required for Holding Minimum Line Volume

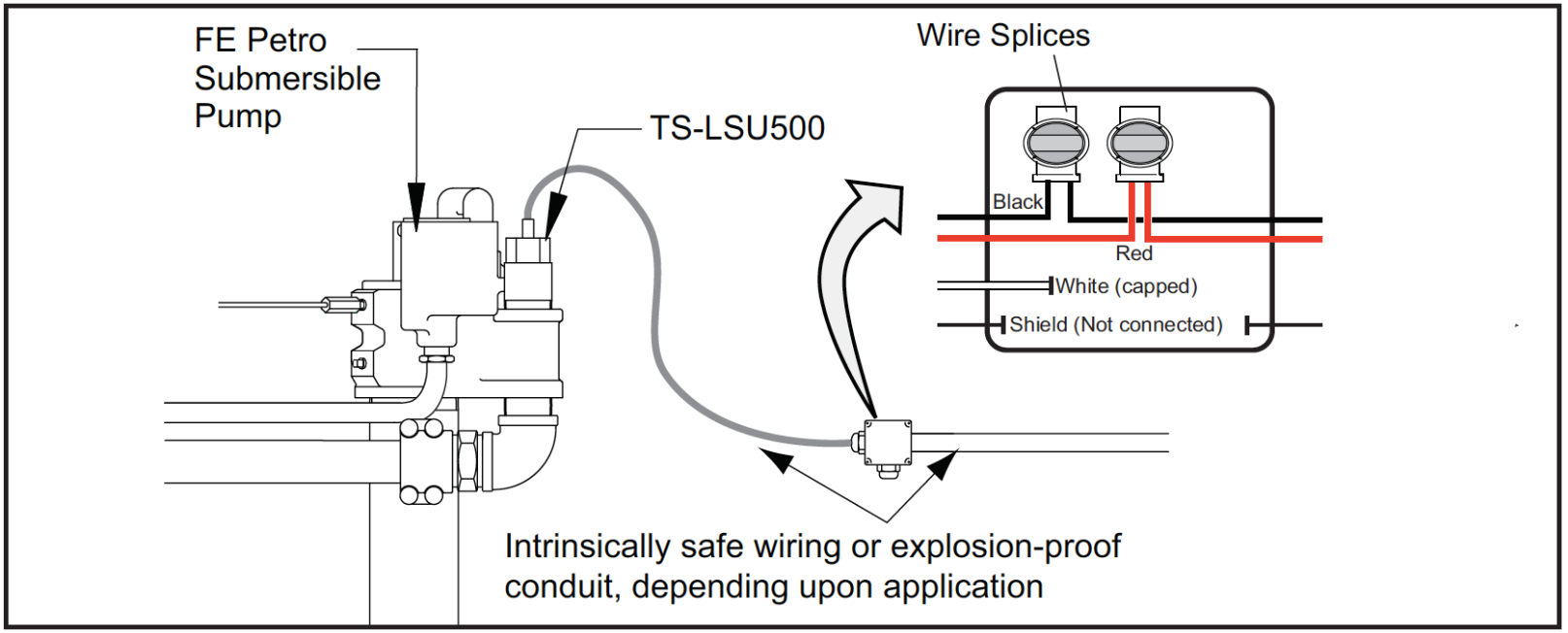
Pipe Diameter I.D.	1”	1 ½"	1 ¾”	2”	2 ½”	3”	4”	5”
Both Flex and Rigid Length	61’	27’	20’	15’	10’	7’	4’	2’

Pipe Length Required for Holding Maximum Line Volume

Pipe Diameter I.D.	1”	1 ½"	1 ¾”	2”	2 ½”	3”	4”	5”
Flex Length	2339’	1040’	764’	585’	374’	260’	146’	94’
Rigid Length	7656’	3403’	2500’	1914’	1225’	851’	479’	306’

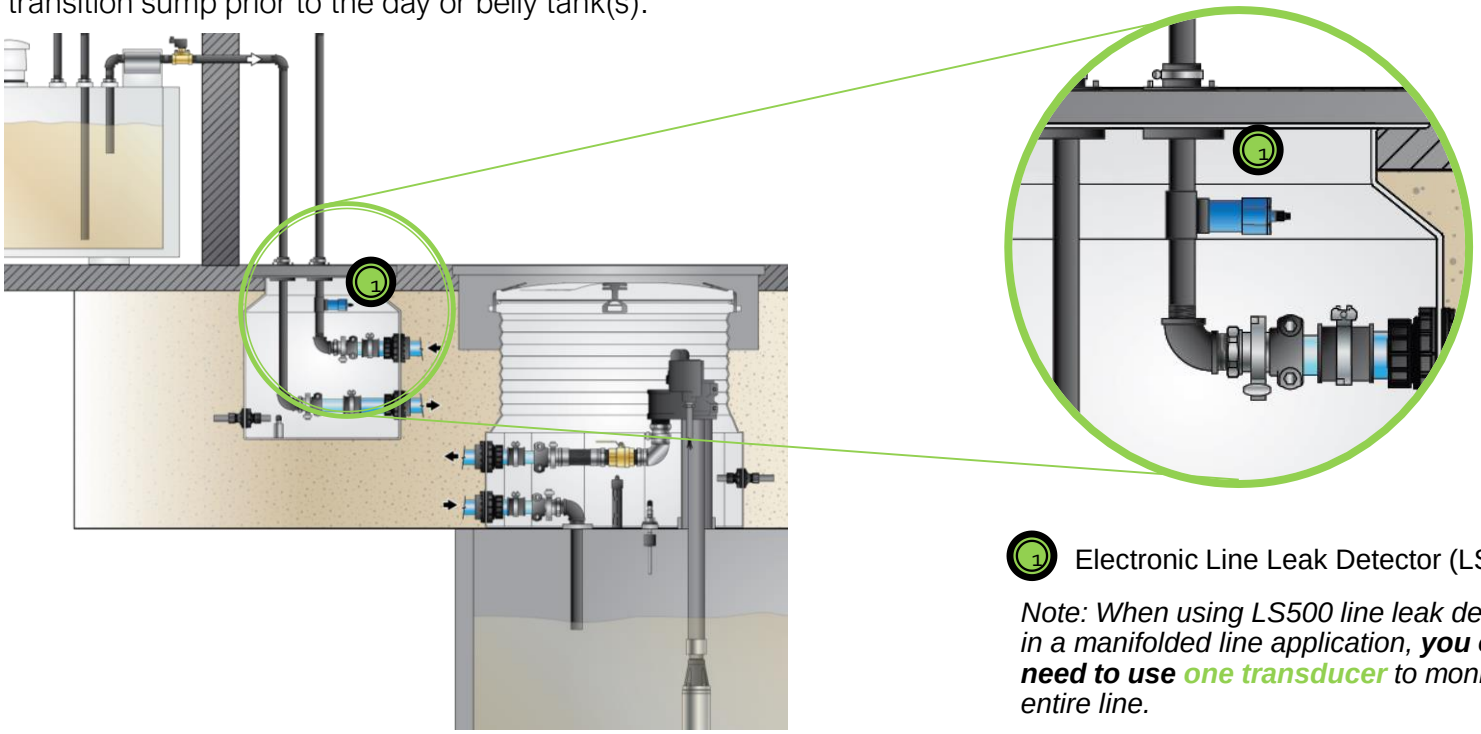
INSTALLATION – TYPICAL

The following diagram illustrates typical installation of the LS500 transducer directly in STP leak detector port.



INSTALLATION – ALTERNATE

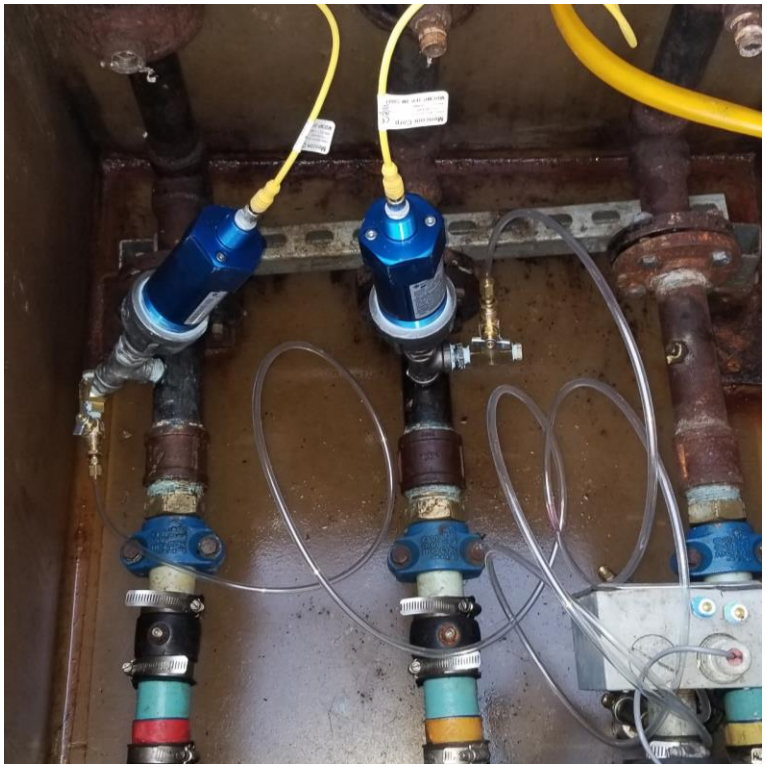
The following diagram illustrates alternate installation of the LS500 transducer downstream of the STP, inside of a transition sump prior to the day or belly tank(s).



1 Electronic Line Leak Detector (LS500)

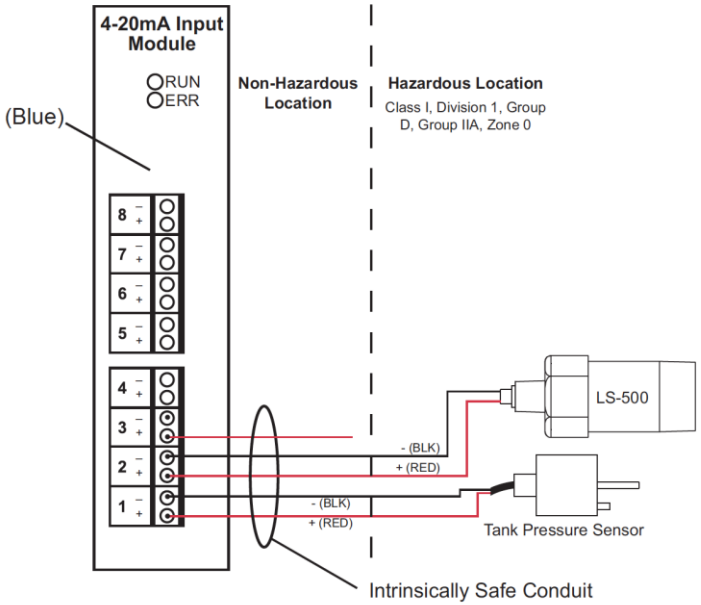
*Note: When using LS500 line leak detection in a manifolded line application, **you only need to use one transducer** to monitor the entire line.*

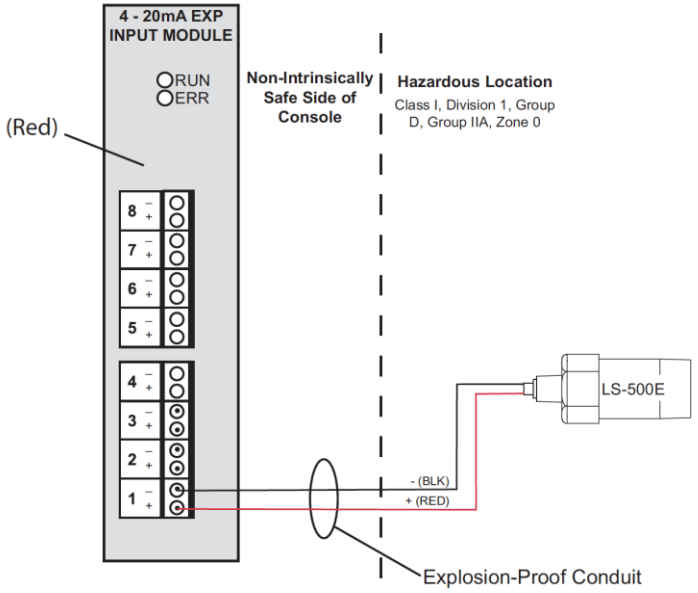
INSTALLATION – SAMPLE PHOTOS OF DOWNSTREAM



INSTALLATION – 4-20MA MODULE OPTIONS

The following diagrams illustrate the 4-20 mA Input Module wiring, whether **Intrinsically Safe** (low voltage conduits and wiring) **or Explosion Proof** (high voltage conduits and wiring)





ATG PROGRAMMING – 4-20MA MODULE

EVO™ 550 or EVO™ 5000 will need to be programmed for each product line.

4-20mA Input Module

TS-LSU500 Transducers use a single 4-20mA channel per product line which allows the console to monitor the pressure on each product line.

Parameter	Parameter Value
Channels	Select the number of channels used for LLD.
Name	Text box, name each channel to easily identify in the mapping.
Service Type	Select Line Leak Detection. This indicates that the type of device connected to the channel to indicate that the device is a TS-LS500 transducer.

Example: 4-20mA Input Module LS-500 Setup

Group Name	Parameter Name	Parameter Value
4-20mA Input Modules		
Module 1	Channels	1
Channel 1	Name	Diesel Transducer
	Service Type	Line Leak Detection

PROGRAMMING – 'DUMB' STP CONTROL USING RELAYS

In systems where analog (e.g. high voltage 110VAC) pump activation switching signals will be used, internal Relay Module channels are needed for STP control.

Example: Relay Module Setup for STP Control

Group Name	Parameter Name	Parameter Value
Relay Modules		
Module 1	Channels	1
Channel 1	Name	Diesel STP
	Enabled	Yes
	Type	Submersible Pump
	Polarity	Normal
	Logic	OR Logic
	Physically Wired As	Normally Open
	Number of inputs	4
Input 1	Type	4-20mA Input Module
	Channel	Diesel Transducer
Input 2	Type	AC Input Module
	Channel	Day Tank 1 Hook Signal
Input 3	Type	AC Input Module
	Channel	Day Tank 2 Hook Signal
Input 4	Type	AC Input Module
	Channel	Day Tank 3 Hook Signal

TURBINE PUMP INTERFACE (TPI) APPLICATIONS

In systems where TPI intelligent digital pump communication is used, relay channels are not needed. Instead, communication between EVO and FE Petro Smart Controller(s) takes place via a real-time, bidirectional RS-485 low voltage data connection; client-server hydraulics. Refer to the Programming Manual for full TPI instructions.

Example: TPI Setup

Group Name	Parameter Name	Parameter Value
Power Supply		
RS-485	Enable Interface	*Yes*
TS-TPI	Enable Interface	*Yes*
Controllers A	Number of Controllers	3
Controller 1	Name	Diesel Controller
	Enabled	Yes
	Type	Smart Controller
	Address	1
	Group	0
	Tank	1
	Height	*5.00 in*
	*Number of inputs	4
Input 1	Type	4-20 mA Input Module
	Channel	Diesel Transducer
Input 2	Type	AC Input Module
	Channel	Day Tank 1 Hook Signal
Input 3	Type	AC Input Module
	Channel	Day Tank 2 Hook Signal
Input 4	Type	AC Input Module
	Channel	Day Tank 3 Hook Signal

ATG PROGRAMMING – LS500 TRANSDUCER SETUP

For ELLD-G, the Gross Test (3 GPH) is set to not shut down in event of a fault, but will alarm, and log the event.

Example: LS500 Application Setup

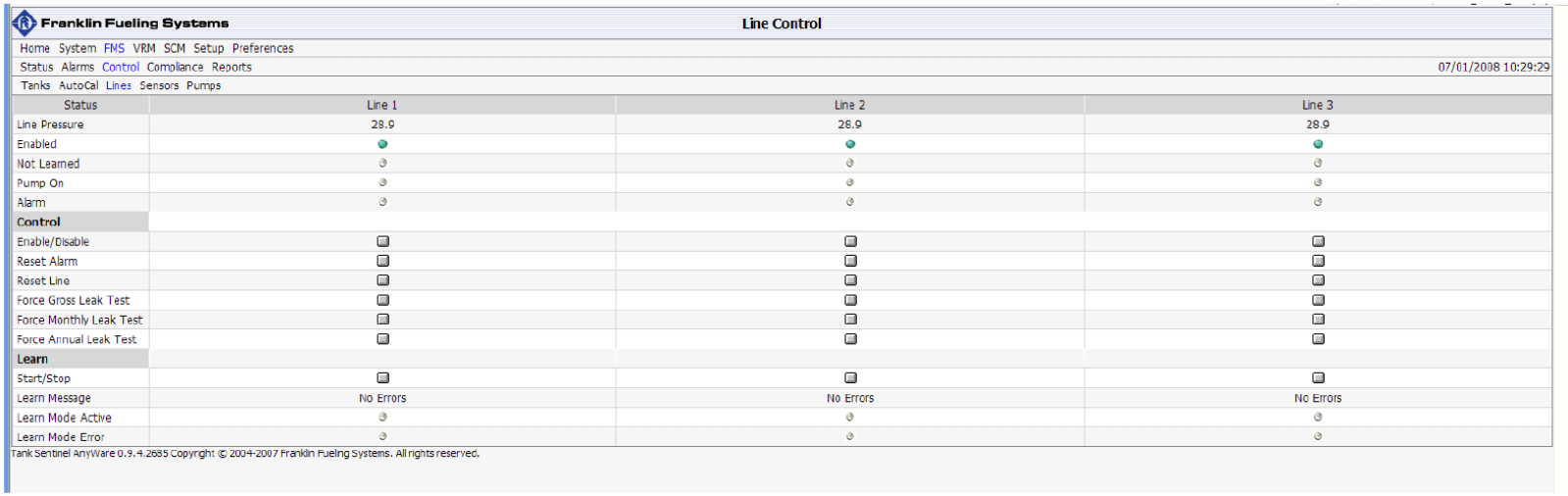
Group Name	Parameter Name	Parameter Value
Lines	Number of lines	1
Line 1	Name	Diesel Line
	Submersible Pump Module	Relay Module
	Submersible Pump Channel	Diesel STP
	Transducer	Diesel Transducer
	Enable SLLD	Yes
	Product	Diesel
	Enabled	Yes
	Pressure Up Test Wait Time	*4 Sec*
	Catch pressure Wait Time	2 Sec
	Dispenser Pressure Test	Yes
Gross Tests	Shutdown of Failed Test	*No*
Monthly Tests	Enable	yes
	Wait Period Between Passed Tests	0 Days
	Shutdown on Failed Test	*No*
Annual Tests	Enable	*Yes*
	Wait Period Between Passed Tests	0 Days
	Shutdown on Failed Test	*No*

Note: Do not enable the line in set-up until the transducers have been properly connected to the 4-20 Input Module.

LINE STATUS AND CONTROL SCREENS

The status of each line channel can be viewed at any time by navigating to the Line Status or Control screens, whether directly from the EVO touchscreen, or via any connected browser-equipped device. To get to the Line Status or Control screens, go to FMS > Status > Lines or FMS > Control > Lines.

LS500 Control Screen



Franklin Fueling Systems — Line Control

Home System FMS VRM SCM Setup Preferences

Status Alarms Control Compliance Reports — 07/01/2008 10:29:29

Tanks AutoCal Lines Sensors Pumps

Status	Line 1	Line 2	Line 3
Line Pressure	28.9	28.9	28.9
Enabled			
Not Learned			
Pump On			
Alarm			
Control			
Enable/Disable			
Reset Alarm			
Reset Line			
Force Gross Leak Test			
Force Monthly Leak Test			
Force Annual Leak Test			
Learn			
Start/Stop			
Learn Message	No Errors	No Errors	No Errors
Learn Mode Active			
Learn Mode Error			

ATG PROGRAMMING – ELLD SECTIONS

EVO™ 550 or EVO™ 5000 will need to be programmed for each product line.

Status Section

Indicator	Description
Line Pressure	Indicates the current line pressure
Enabled	Green, enabled. Red, disabled
Not Learned	Red, if not learned. Gray, if learned
Pump On	Green, if the STP is on
Alarm	Red, if in alarm. Gray, if not in alarm

Control Section

Indicator	Description
Enable/Disable	Manually enable or disable the line
Reset Alarm	Manually reset an alarm on the line
Reset Line	Manually reset line
Force Gross Leak Test	Manually start a gross leak test
Force Monthly Leak Test	Manually start a monthly leak test
Force an Annual Leak Test	Manually start an annual leak test

Learn Section

Indicator	Description
Start/Stop	Manually start or stop the learn cycle
Learn Message	Indicates the status of the learn process
Learn Mode Active	Green: The line is being learned
Learn Mode Error	Red: An error has been detected in learning the line

ATG INSPECTION – LINE LEAK REPORT

The Line Leak Report documents test history for each line, and can be accessed via either the EVO touchscreen, or any browser-equipped device.

Critical Generator Facility
123 Main St
Anytown, CA 12345

LINE LEAK REPORT
Year 2019

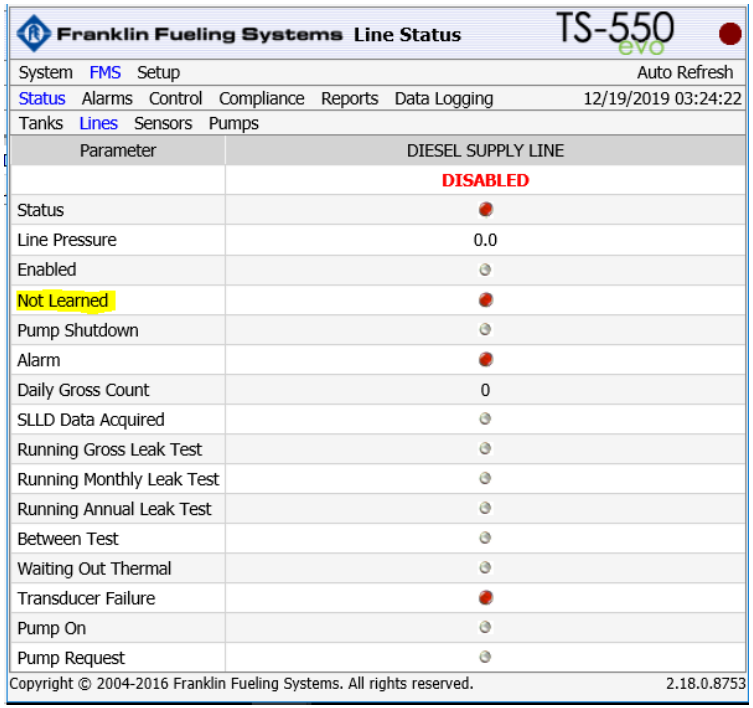
11/14/2019 14:50:43

GROSS TESTS

Name	Result	Test Date
Diesel ELLD		
	Gross Leak Test Passed	11/14/2019 14:42:14
	Gross Leak Test Passed	11/14/2019 13:41:56
	Gross Leak Test Passed	11/14/2019 12:39:24
	Gross Leak Test Passed	11/14/2019 11:39:22
	Gross Leak Test Passed	11/14/2019 10:39:20
	Gross Leak Test Passed	11/14/2019 09:39:18
	Gross Leak Test Passed	11/14/2019 08:39:16
	Gross Leak Test Passed	11/14/2019 07:38:46
	Gross Leak Test Passed	11/14/2019 06:38:44

ATG INSPECTION – LINE STATUS AND ALARMS

The Line Status screen displays what state each line is in. Our manual includes explanations of various possible fault indications.



Franklin Fueling Systems Line Status TS-550 evo

System FMS Setup Auto Refresh

Status Alarms Control Compliance Reports Data Logging 12/19/2019 03:24:22

Tanks Lines Sensors Pumps

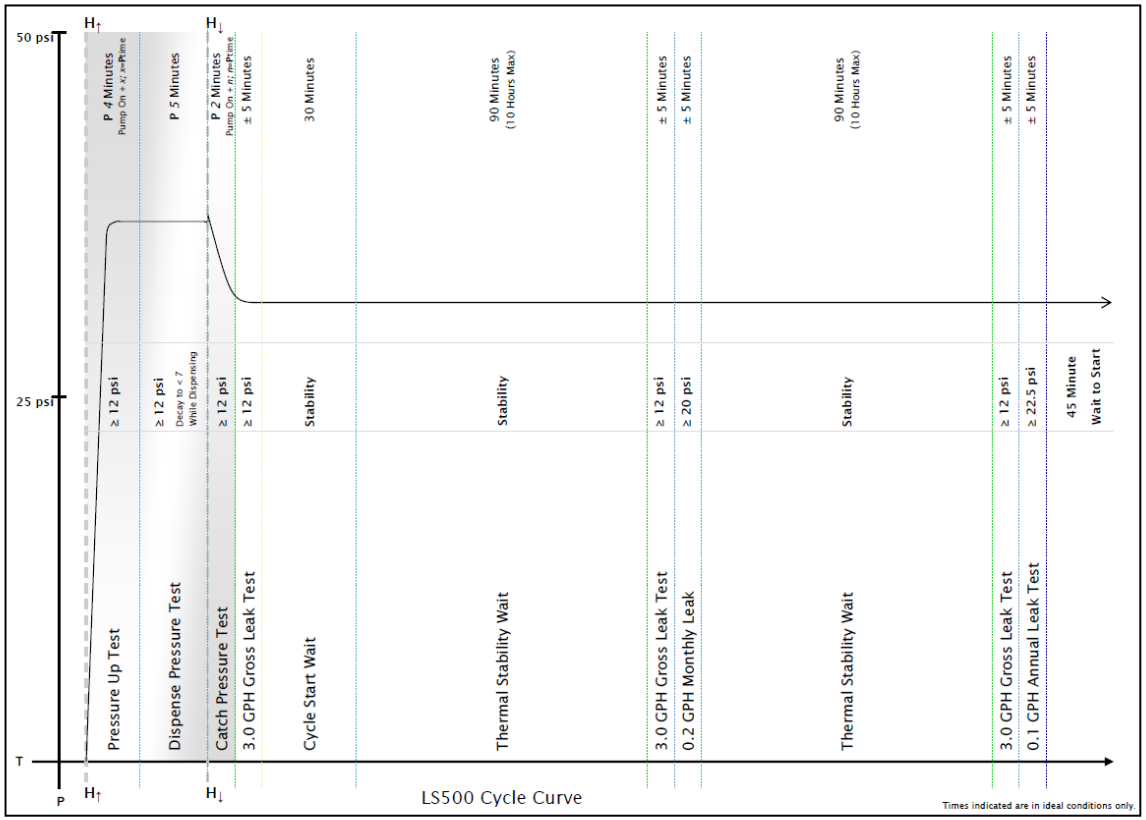
Parameter	DIESEL SUPPLY LINE
	DISABLED
Status	
Line Pressure	0.0
Enabled	
Not Learned	
Pump Shutdown	
Alarm	
Daily Gross Count	0
SLLD Data Acquired	
Running Gross Leak Test	
Running Monthly Leak Test	
Running Annual Leak Test	
Between Test	
Waiting Out Thermal	
Transducer Failure	
Pump On	
Pump Request	

Copyright © 2004-2016 Franklin Fueling Systems. All rights reserved. 2.18.0.8753

Status and alarm Indicators	Description
Status	Indicates the condition of the line
Line Pressure	Indicates the current line pressure
Enabled	Green, enabled. Red, disabled
Not Learned	Red, if not learned. Gray, if learned
Pump Shutdown	Red, if pump is shutdown. Gray, if not shutdown
Alarm	Red, if in alarm. Gray, if not in alarm
Running Gross Leak Test	Green, if running test. Gray, if not running test
Running Monthly Leak Test	Green, if running test. Gray, if not running test
Running Annual Leak Test	Green, if running test. Gray, if not running test
Between Test	Green, if running test. Gray, if not running test
Waiting out Thermal	Green, if waiting out thermal, Gray, if not
Transducer Failure	Red, if the LS-500 is not communicating with the transducer
Pump On	Green, if the STP is on
Pump Request	The LS-500 is attempting to turn the STP on

INSPECTION

LS500 CYCLE CURVE



INSPECTION – ALARMS, CAUSES, & RESOLUTIONS

Alarms and Warnings

	Cause	Resolution
* Input Error	I don't know what this means.	Verify the Device Attached is Compatible
* Module is Offline	Console Cannot 'See' '*' Module	Verify ERR LED is Off / Make Sure Module is Seated Properly
* Module Setup Error	Mapping Error (Programming)	Verify Programming
Air In Line	Console has Sensed Line Pressure Variations	Investigate / Purge Line Starting @ Furthest Dispenser
Dispenser Test Failed	Pressure Must be > 12 After Pump On / < 7.5 psi During Dispense	Pressure Must be > 12 After Pump On /
Extended Hook Signal	Hook Signal Applied for more than 4 hr	Investigate / Verify Controller Relay or Dispenser Wiring
Failed to Catch Pressure	Pressure Dropped to < 12 psi when Pump Turned Off	Investigate
Failed to Pressure Up	Pressure Remained < 12 psi when Pump Turned On	Investigate
Gross Leak Detected	Temperature Variations or Actual Leak	Investigate / Precision Leak Test
High Pump Pressure	Line Pressure > 50 psi	Replace Check Valve / Adjust Functional Element
Line is Not Configured	Mapping Error	Verify Programming
Line Monitor is Disabled	Line # or Transducer Channel (4-20mA) Disabled in Programming	Verify Programming
Marginal Pass of Gross Leak	Passing Result of Gross Test; Line is Not Thermally Stable	Force Manual Gross Leak Test
Monthly Leak Test Failed	0.2 Leak Test Failure; ONLY Cleared by Passing a Monthly Test	Check for Leaks - Inspect Check Valve
Line Not Enabled	Verify / Enable Line (FMS > Control > Lines > Enable)	Usually Accompanies Other Alarms
Line Not Learned	Verify / Learn Line (FMS > Control > Lines > Learn)	Line Must be Disabled to Learn
Precision Leak Test Failed	0.1 Leak Test Failure / ONLY Cleared by Passing a Precision Test	Check for Leaks - Inspect Check Valve
Pressure Transducer Fail	Either Wiring or Bad Transducer	Verify Wiring / Transducer Operation
Program Error Detected	Console Software Error	Reboot System
Pump Request Ignored	System is Busy or Pump is Shutdown	Investigate
Sudden Pressure Loss	Pressure Dropped from > 12 to < 5psi Within 5 Seconds	Monitor Line Pressure Using a Pressure Gauge / Suspect Leak

TROUBLESHOOTING

TS-LS500 AutoLearn Line Leak Detection Pressurized ALLD System
Quick Reference Troubleshooting Guide

Calibration			
	Reason	**Cause**	**Resolution**
Pump Off During Calibration	Improperly Mapped (Programming)		Verify / Fix
	Improperly Wired		
Error	Inadequate Line Pressure	Improper Check Valve Size	Verify / Replace Check with Proper Part
		RJ Functional Element not Adjusted Properly	Adjust Functional Element
	Air In Line	Due to Vacuum from Open Orifice (Leak Gen.)	Close Gen. if Not In Use
Insufficient Pressure for * Test	Line Learned with Inadequate Pressure for the Test Specified On-Screen		Test May Give Inaccurate Results
	Line Physically Outside Modulus Threshold (*see chart Below*)		System Will Not Be Certified

ELLD TEST TYPES AND DETAILS

Test Types

	Duration	Cycle	Line Pressure	Trigger
3.0 GPH Gross Leak Test	5 Minutes	First and Precede Precision Tests	12 psi	Pressure >=12
0.2 GPH Monthly Leak Test	5 Minutes	Second	20 psi	Pressure >= 20; Pass Gross
0.1 GPH Annual Leak Test	5 Minutes	Third	22.5 psi	Pressure >= 22.5; Pass Gross
Pressure Up Test	4 Seconds	LLD Cycle Start	>= 12 psi	Pump On + *x*; *x*=4 Seconds (default) {Programmable}
Catch Pressure Test	2 Seconds	LLD Cycle Start	>= 12 psi	Pump Off + *n*; *n*=2 Seconds (default) {Programmable}
Thermal Wait Test	90 Minutes	Process; Precede Precision Tests	Static	Monthly/Annual Enabled?
Sudden Loss Test	5 Seconds	Continuous	>= 12 psi	Decay to < 5psi
High Pressure Test	5 Seconds	3 Consecutive Catch Pressure Tests	> 50 psi	Pressure Up Over 50 psi
Dispenser Pressure Test	5 Seconds	Only When Hook is Present	> 12.5 psi	Decay to < 7 psi While Dispensing
Learned but Not Enabled	24 Hours	Post-Learn Process	N/A	Line Learned but Not Enabled Within 24 hrs.
Extended Pump Run	4 Hours	Only When Hook is Present	N/A	Extended Hook Signal; Controller Stuck, Miss Wired

Test Results

	Condition	Cause	Resolution
Pass	Line is Tight		
	Line Pressure Variations are within Threshold		
Fail	Actual Leak	Line Pressure Variation are outside Threshold	Investigate / Force Leak Test to Verify
	Temperature Instability	Temperature Fluxuations cause Pressure Var.	
	Improper Calibration	Line Not Bled to Zero (0) During Calibration	Recalibrate Line, Follow Procedures
		Air Not Bled out of Line Prior to Calibration	Bleed Air from Line, Start Furthest Disp.
	Air In Line	Line Left Open or Air Elimination Loop Inop	
Abort (No Indication)	Dispense of Product will Restart Test Cycle	A Hook Signal is Introduced to System	Allow Test Cycle to Complete Before Disp.
	Line Disabled During Testing	Either Manually or Other Application Shutdown Pump	Investigate / Find Source of Interruption
	Starting a Test Manually	User Forced Line Leak Test	Cycle will Reset After Manual Test
Incomplete (No Indication)	NOT Allowing at Least 2 hrs. for Precision Tests	"Perfect Conditions" Test Cycles - at Least 4 hrs.	Allow Sufficient Time for Test Before Disp.
Pump Shutdown	2 Consecutive 3 GPH Test Failures	Possible Gross Leak	Investigate / Force Manual Gross Test
	3 Consecutive 0.2 GPH Test Failures	Possible 0.2 Leak	Investigate / Force Manual Monthly Test
	3 Consecutive 0.1 GPH Test Failures	Possible 0.1 Leak	Investigate / Force Manual Annual Test
	3 Consecutive Catch Pressure Tests Over 50 psi	High Line Pressure	Investigate / Adjust CheckValve or FE
	Catch Pressure Test Failure	Pressure < 12 psi	Investigate / Force Manual Test
	Pressure Up Test Failure	Pressure < 12 psi	Investigate / Force Manual Test

ELLD FUNCTIONAL TESTING

Perform a functional test annually; this test will verify that the LS500 will detect and alarm on a leak condition. This test should be performed during times when there is no dispensing.

1. If the channel is Enabled, disable the channel. At the ATG, navigate to the FMS > Lines Control screen. Press the Enable/Disable button to disable the line.
2. Remove the plug in the needle valve kit on the manifold. Connect the TS-ALCAL (Leak Generator Kit) to this port.
3. Open the needle valve.
4. Enable the line. This will initiate a gross line test.
5. Verify that the console displays a gross line test fail. (Up to 10 minutes)

   Note: the system must run two separate tests, five minutes apart, and fail them both before a hard alarm occurs.
6. The channel will be disabled by the FMS application. Remove the TS-ALCAL. Replace and tighten the plug
7. At the ATG, navigate to the FMS Lines Control screen. Press the Reset Alarm button to clear the alarm and enable the channel.
8. Select OK when prompted.
9. If the Annual Functional Test passed by properly detecting the leak, please skip this step. If the system did not catch the leak and the test failed, disable the channel and run the pre-operational tests. Perform the functional test again. If the system still fails to detect the leak, please contact FFS Technical Support (1-800-984-6266).

VISIT

GO.FRANKLINFUELING.COM/ELLDG

FOR MORE INFORMATION

EVO™

SERIES

ELECTRONIC LINE LEAK DETECTION FOR GENERATOR APPLICATIONS

Franklin Fueling Systems

CALIFORNIA CUPA FORUM