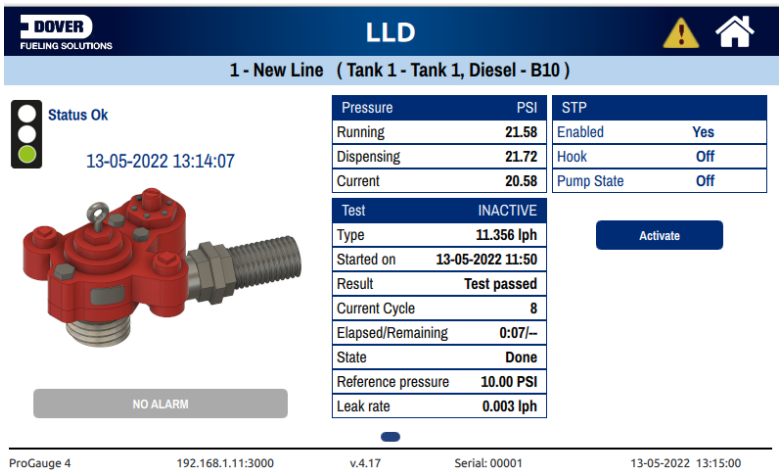
Reference Guide

ProGauge® Electronic Pressurized Line Leak Detection (PLLD)

Rev.3



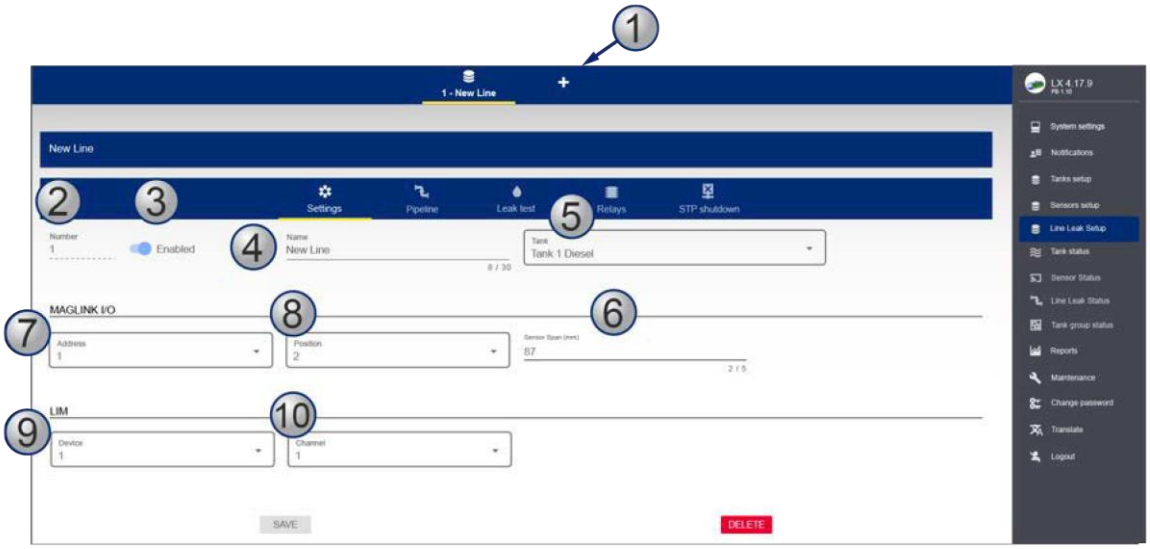
Contents

1 WEB MENU CONFIGURATION

1.1 Line Leak Setup

The Line Leak Setup menu is used for:

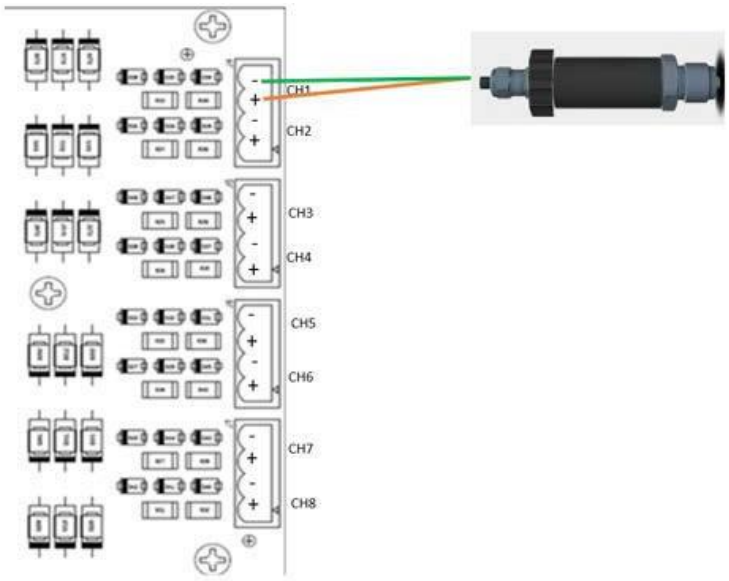
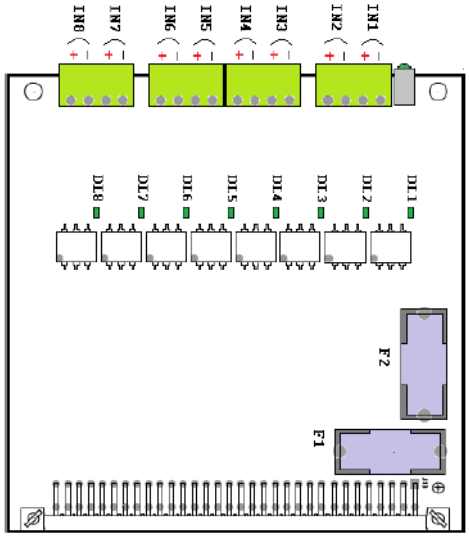
- the configuration of the PLLD-DAS (or older model I/O module), the LIM
- the configuration of the pipeline characteristics (length, size, Beta factor)
- the scheduling of leak tests (run a test now/later, run automatic testing)

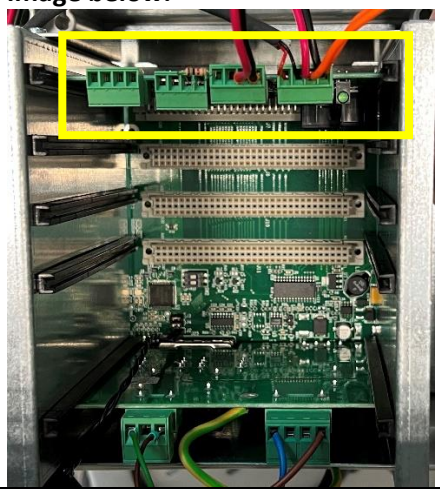


Click on the "+" to add a new PLLD configuration. Each PLLD sensor will need to have its own configuration.

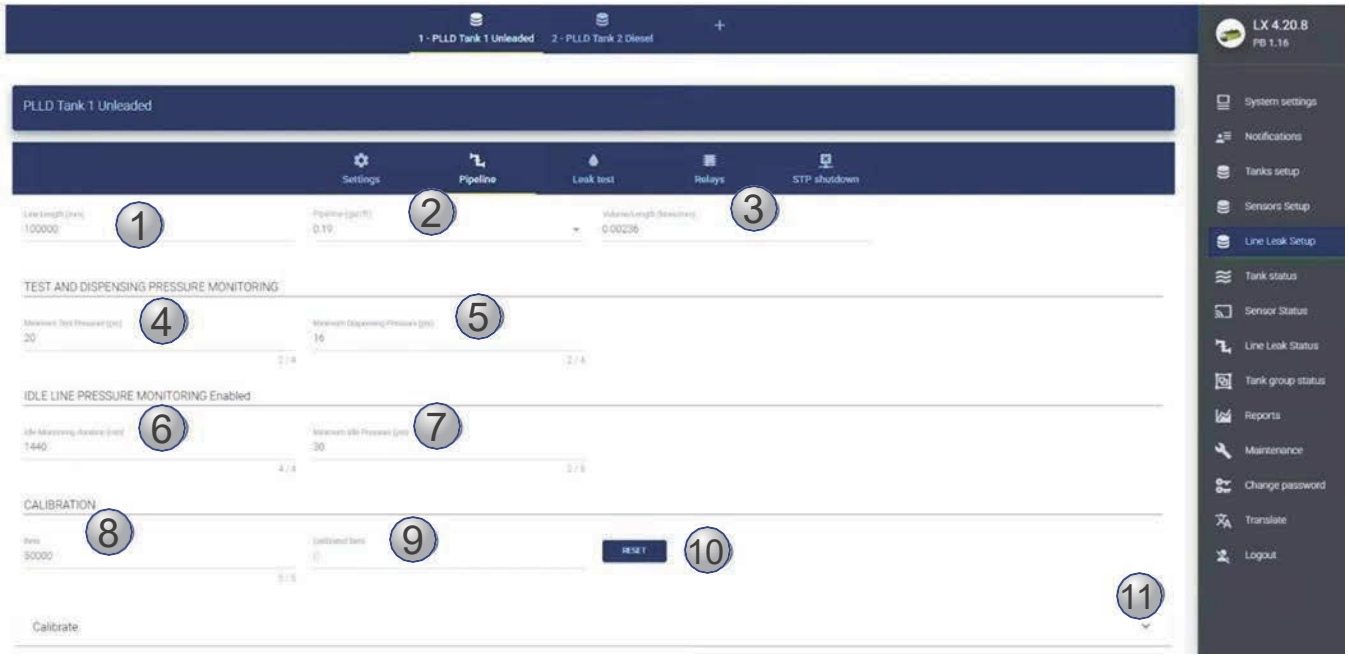
A. Settings

2. Number	Enter a number to identify the PLLD sensor configuration
3. Enabled	When the "Enabled" button is active, it means that the PLLD configuration is active. The system will attempt to run tests on the particular pipeline. If the "Enabled" button is inactive, then the system will not attempt to run tests on the particular pipeline, the pressure readings will not be received and the pipe stiffness calibration process will not be able to run.
4. Name	Enter a name to identify the line
5. Tank	Enter the tank number that has the STP with the PLLD sensor installed.
6. Sensor span	Default value is 87 psi, do not change this value.
7. MAGLINK I/O (PLLD-DAS in new	Select Address 1 for the first PLLD-DAS module, address 2 for the second PLLD-DAS module etc.

software versions)	**Note 1**: There can be multiple PLLD-DAS modules connected to the LX Plus console. Each PLLD-DAS module will need to be addressed accordingly by the dipswitches on its motherboard. **Note 2**: Only one Maglink I/O module can be connected to the LX Plus console.
8. Maglink I/O Position	Enter the connector slot where the PLLD sensor is connected onto the PLLD board. The PLLD board has 8 connector slots.  Note 1 for PLLD-DAS: Position 1 is at the top (CH1). Note 2 for Maglink I/O: Slot No1 is next to the Green LED. Slot No8 is on the opposite side of the Green LED. See schematic below. 

	Note: The PLLD board should be installed on the top slot of the I/O, see image below. 
9. LIM Device	Enter the LIM address identification number, select 1 through 4. Each LIM module must have a unique LIM address. The LIM address is configured by the rotary switch on the LIM electronic board. Consult the LIM manual for further details.  LIM Address Rotary Switch
10. LIM Channel	Select 1 through 4. Enter the LIM channel where the specific STP is connected to.

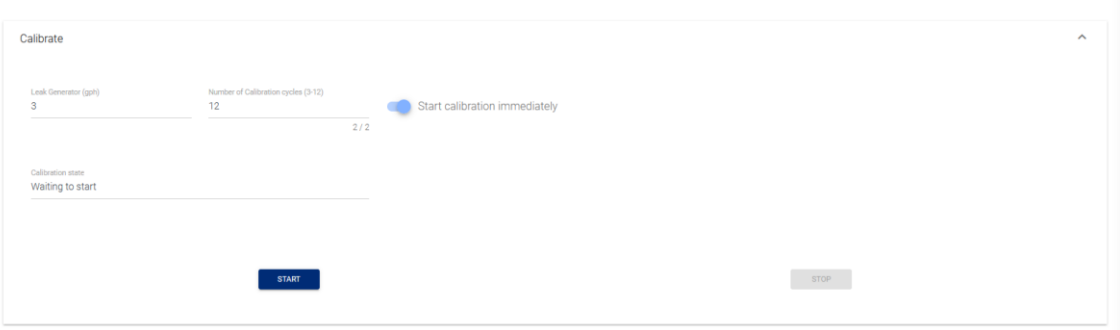
B. Pipeline



1. Line length	Enter the total length of the pipeline (from the STP to the last dispenser including the length of all branches that may exist in between)
2. Pipeline	A series of specific pipelines is included in this field. The user can select a pipeline and the system will automatically populate the volume/length parameter in the next field. Note that if your pipeline is not listed here, you can select the closest pipeline and manually enter the volume/length parameter in the next field (it will override the automatically selected volume/length).
3. Volume/length	Either leave it as default (based on the pipeline selected) or manually enter a specific value. Take good note of the measuring units involved
4. Minimum Test pressure	This is the minimum pressure in the pipeline during the leak testing. Normally the pipeline pressure should be higher than 20 psi so suggestion is to leave the default value.
5. Minimum Dispensing pressure	This is the minimum pressure in the pipeline during normal dispensing.
6. Idle Monitoring duration (mins)	Number of minutes that the system checks the line pres- sure since an idle state (STP off). Default value is 60 minutes, maximum value is 1440 minutes. Setting the value at 0 will disable the Idle Monitoring function. The console can monitor the line pressure during idle periods (no dispensing, no leak testing) and alert if the pressure drops below a threshold. A very low idle pressure would indicate either a large leak in the pipeline or a malfunction in the equipment (e.g faulty check valve in the submersible pump).

	To clear the alert (alarm “Pressure Low”) the user must run a 3 gph leak test that must pass successfully.
7. Minimum Idle pressure (psi)	The system will trigger an alarm “Pressure Low” if the idle pressure drops below the set value in psi. Default value is 8 psi. Setting the value at 0 will disable the Idle Monitoring function.
8. Beta	Pipe stiffness in psi depending on the pipe material, affects the pressure calculations. Consult the tables in the Appendix. This is a theoretical value.
9. Calibrated Beta	Actual pipe stiffness in psi that has been calculated by the console’s algorithm during the process “Beta calibration” (internal process that can calculate the pipe stiffness by inducing a controlled leak into the system). The system will use the Calibrated Beta value for the leak rate calculations once it has been calculated and shown on the field here. In the absence of a Calibrated Beta value, the system will use the theoretical Beta for the leak rate calculations.
RESET button	When hitting the “RESET” button, the Calibrated Beta value will be erased and the system will revert into using the theoretical Beta for the leak rate calculations.

Calibrate



In the **Calibrate** section the system is able to calculate the pipe stiffness. The user will need to induce a controlled leak in the system for the calibration to take place.

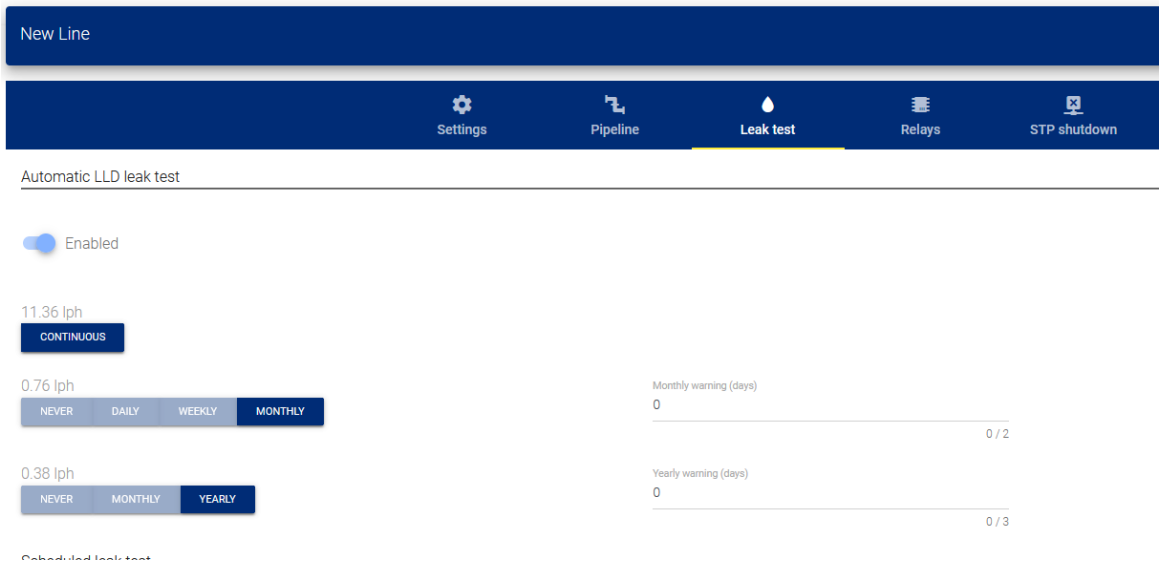
Leak generator (gph)	Enter the type of the leak generator. The most common leak generators are able to induce a 3 gallon per hour (gph) leak at 10 psi.
Number of calibration cycles (3-12)	During each calibration cycle the system will pressurize the STP for some seconds, then it will stop the STP and it will be recording the pressure in the line. It is advised to perform the maximum cycles (12) for optimum calibration results.
Start calibration immediately	If this swipe button is active (swiped to the right), then the system will start the calibration sequence as soon as the START button is pressed. If the swipe button is inactive, then as soon as the START button is pressed:

	the system will wait for the nozzle of the dispenser to be picked up for a couple of seconds and afterwards to be put back into the cradle; this will trigger the system to start the calibration once the nozzle is back into the cradle. This method is used to initiate the calibration process from the forecourt area (i.e technician lifts the nozzle for 2 secs, puts the nozzle back, then the calibration will start).
Calibration state	This is an information window showing the current status of the process
START	Starts the calibration sequence (either immediately or via nozzle signal depending on the state of the “Start calibration immediately button”)
STOP	Stops the calibration sequence

Hit the SAVE button to save the current pipeline setup.

Note (!): the DELETE button will erase this PLLD configuration.

C. Leak Test



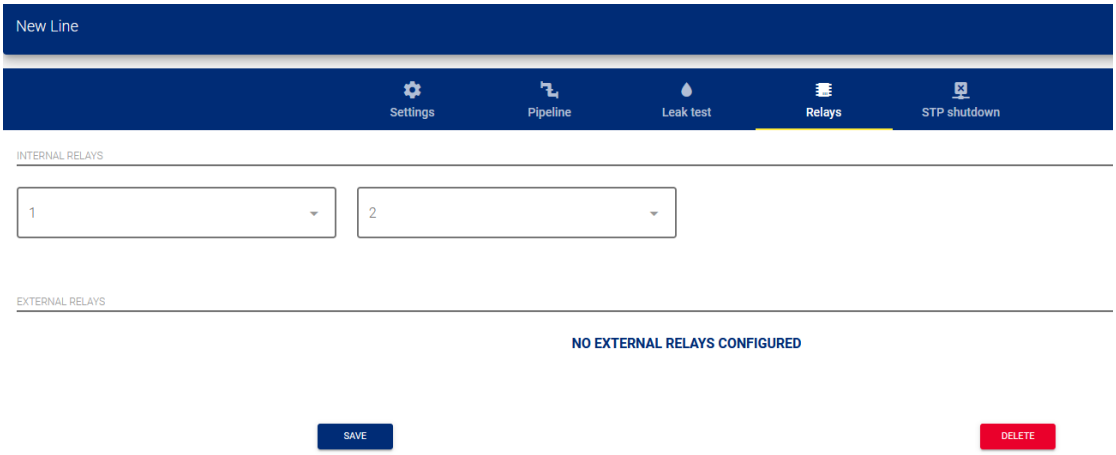
Automatic LLD leak test – hit the Save button to save the settings	
Enabled	When the button is swiped to “Enabled” the system will run a leak tests automatically based on specified frequencies.
3 gph (11.36 lph)	The automatic 3 gph (11.36 lph) test will run continuously every hour and it will start after the last dispensing transaction provided that the last test was conducted more than 1 hour ago.

0.2 gph (0.76 lph)	Select the desired frequency and select a monthly warning in days if desired (if a leak test has not been conducted within x days, then a warning will be triggered)
0.1 gph (0.38 lph)	Select the desired frequency and select a yearly warning in days if desired (if a leak test has not been conducted within x days, then a warning will be triggered)

Scheduled leak test	
Leak test Rate	Select the leak test rate and then select whether to run the test now via the NOW button or later at a scheduled date and time by selecting the SCHEDULE button
Apply	Hit Apply to execute the settings.
Delete	The Delete button will delete the scheduled leak test configuration

Hit SAVE to save the setup or DELETE to erase it.

D. RELAYS

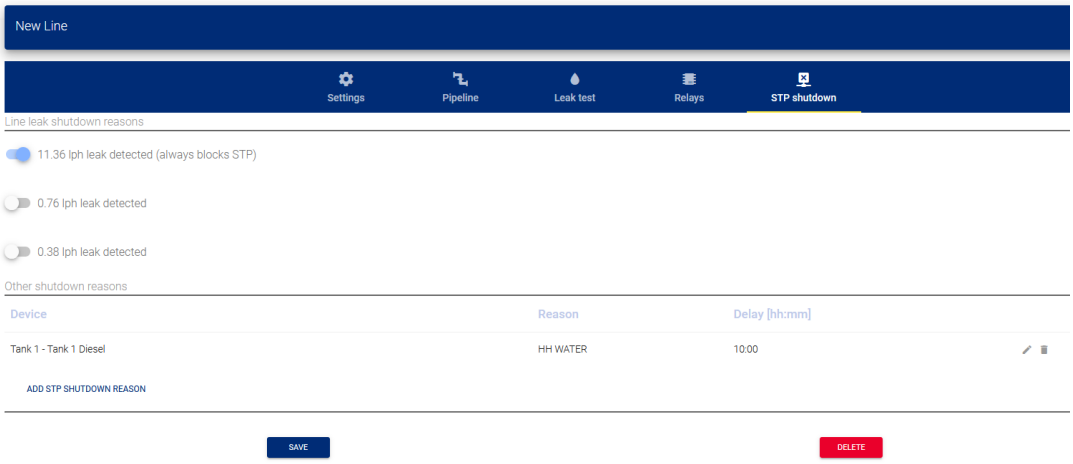


In the Relays tab, the user can program a relay to be triggered upon a LLD event. Configure the internal or external (I/O module required) or OM4 relays.
Available actions that can trigger a relay:

- SENSORS NO LINK (no communication between console and PLLD-DAS or Maglink I/O PLLD module)
- NO STP LINK (no communication between console and LIM)
- SENSOR OPEN (no reading from PLLD sensor)
- SENSOR SHORT (PLLD sensor wires shorted)
- STP CONTROLLER (STP contactor fused or stuck)
- LINE LEAK (a leak test failed)
- NO LEAK TEST (no leak test has been conducted as the WARNINGS setup in the Leak Test tab)

- NO ANNUAL LEAK TEST (no annual leak test has been conducted as the WARNINGS setup in the Leak Test tab)
- PRESSURE LOW (STP dispensing pressure lower than the Minimum Dispensing Pressure configured at the Pipeline tab or STP Idle pressure lower than the threshold configured)

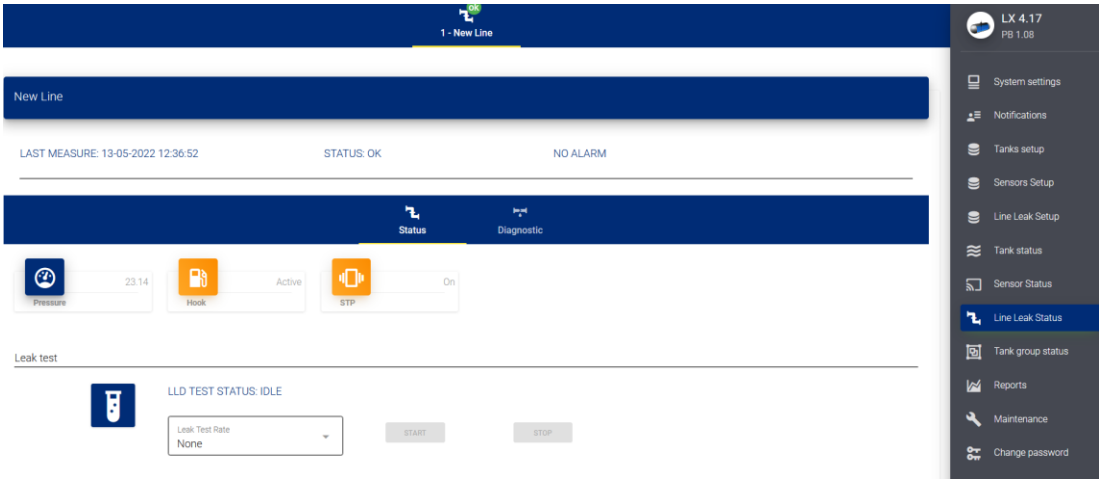
E. STP Shutdown



In the STP Shutdown tab the user is able to configure the conditions under which the STP will be automatically shutdown.
A 3 gph (11.36 lph) line leak fail will always shutdown the STP.
Select if you wish the STP to be shutdown in the case of a 0.2 gph (0.76 lph) fail and/or a 0.1 gph (0.38 lph) fail.

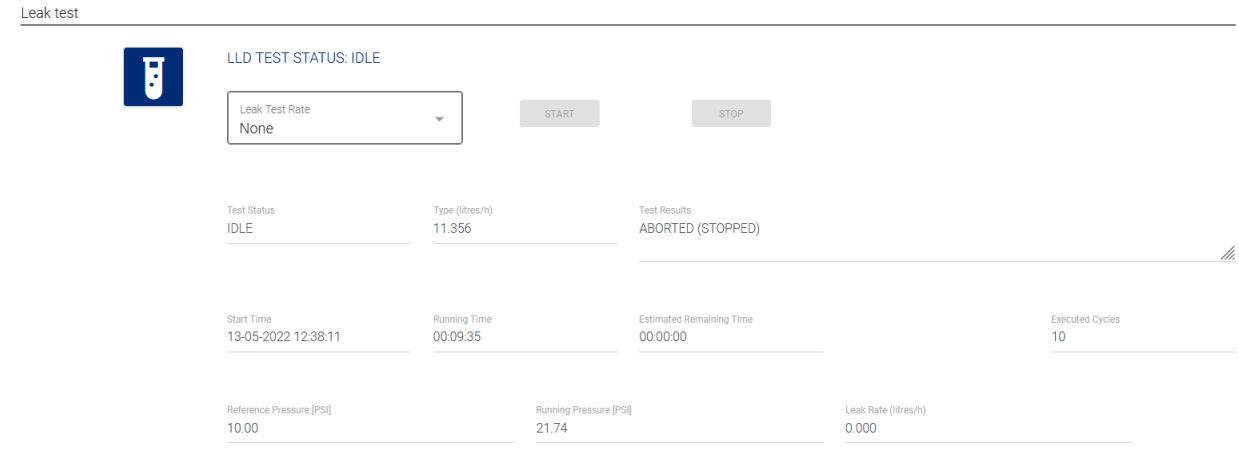
The STP can also be configured to shutdown by other reasons such as high water detected by the probe in the tank or by an environmental sensor activating.
To configure such an event that will trigger a STP shutdown select the ADD STP SHUTDOWN REASON and select the event accordingly.
The delay is a timer that starts counting from the moment the event has been triggered. The STP will shutdown once the timer has elapsed.
In the example shown in the image above, a HH Water alarm event on Tank 1 has been triggered that will shutdown the STP after 10 continuous hours of the alarm being active.

1.2 Line Leak Status



A. Status menu

Pressure icon	Displays the current pressure in the pipeline
Hook icon	Turns to “Active” when the hook signal is active
STP icon	Turns to “On” when the STP has been confirmed to turn On.



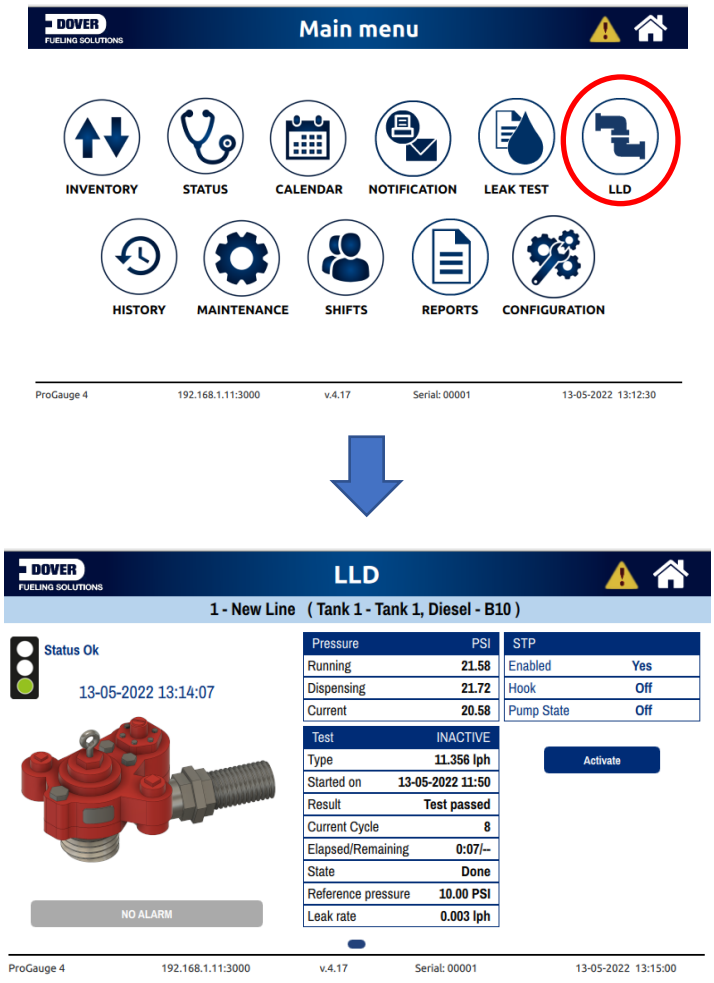
Leak test rate	Select the leak rate in order to start an on-demand test and then hit the Start button. Hitting the Stop button will stop a running test.
Test status idle	Will show Idle if a test is not running currently
Type	Displays the type of the leak test
Test results	Shows the result of the test. Possible results are PASSED, FAILED, ABORTED (STOPPED), IN PROGRESS
Start time	Shows when the test started
Running time	How long has the test been running since the start time

Estimated remaining time	How much longer is needed for the test to complete
Executed Cycles	The system will start and stop the STP several times during the test in order to acquire pressure readings. Each start and stop sequence is considered to be a cycle. This field shows how many cycles have been completed so far.
Reference pressure	The reference pressure at which the test will run at. A 3 gph test is referenced at 10 psi.
Running pressure	The pressure in the pipeline once the STP has stopped fueling.
Leak rate	The calculated leak rate in liters/gallons per hour

2 GRAPHICAL USER INTERFACE (GUI)

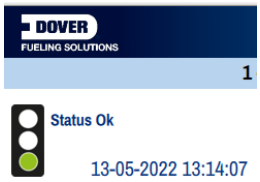
2.1 LLD Menu

From the Main menu, the user can navigate to the LLD menu by clicking on the LLD button



Pressure	
Running	The pipeline pressure once the STP has stopped running
Dispensing	The pipeline pressure during the dispensing process
Current	The current pipeline pressure

STP	
Enabled	Shows whether the STP is blocked or not. In normal condition it will show “Enable=Yes” but if the Leak is detected and the STP has been disabled then it will show “Enable=No”.
Hook	Shows the state of the hook signal
Pump state	Shows whether the STP has been confirmed to be ON (feedback signal received)



The alarm conditions are shown next to the traffic light. Possible states:
Ok – No alarm

Disabled – When the pipeline has been disabled via the web configuration

OPEN: the pressure sensor is disconnected from the I/O module (under pressure)

SHORT: the wires from pressure sensor are shorted (overpressure)

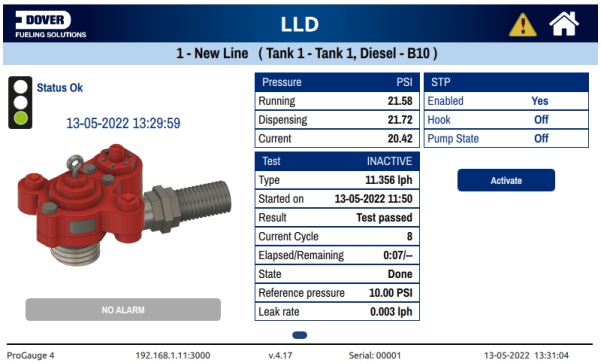
NO LINK: there is a problem with communication to the I/O module (wires can be disconnected or Maglink I/O is not powered)

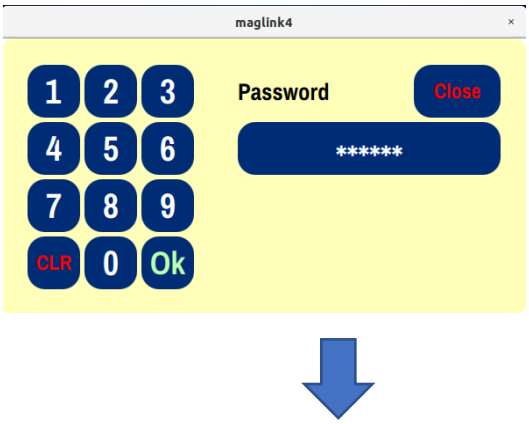
NO STP LINK: there is a problem with the communication to the LIM (wires can be disconnected or LIM is not powered)

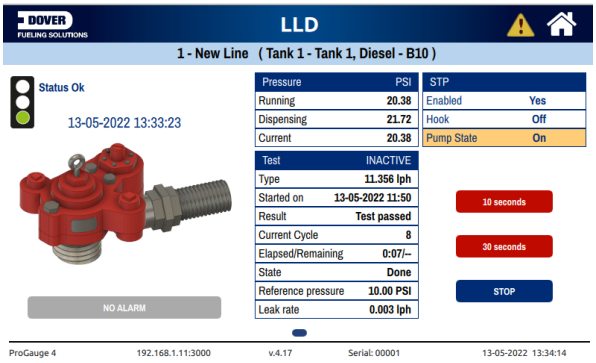
STP CONTROLLER: Two conditions,
OFF ERROR when the STP Pump can't be activated (eg broken wires to STP) or
ON ERROR when the STP is activated but it cannot be deactivated (e.g shorted wires to STP)

LEAK: test result is "Leak Detected"

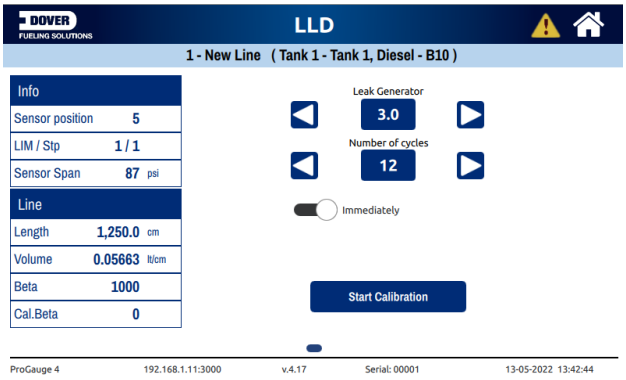
Force STP activation: Hitting the “Activate” button on the LLD screen will prompt the user to enter the 6-digit numeric password and then the two buttons “10 seconds” and “30 seconds” are revealed. By hitting any of these two buttons, the user can force the STP to activate for 10 or 30 seconds respectively as a means of checking the operation of the STP.





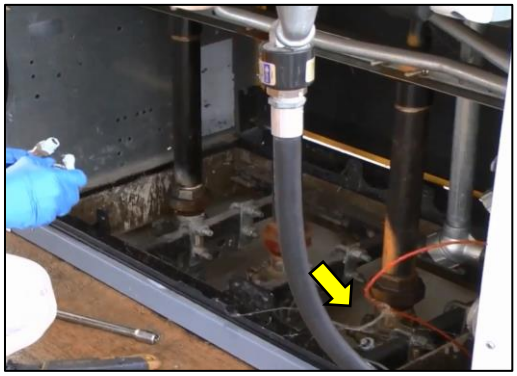


Beta calibration: From the LLD screen, by swiping up, the screen changes to display the Calibration menu. In the Calibration menu, the system can calculate the Beta pipe stiffness as long as the user has induced a controlled 3.0 gph leak in the pipeline. The console will start and stop the STP multiple times and it will gather pressure data in order to calculate the Beta.



The screen will display certain configuration parameters on the left. The user should set the "Leak Generator" to 3.0 (3.0 gph) and the "Number of cycles" to 12.

Ensure that a calibrated 3.0 gph leak generator has been installed on the shear valve under the dispenser. Also ensure that the shut-off valves have been turned off and that no dispensing from the particular STP will take place during the calibration process.

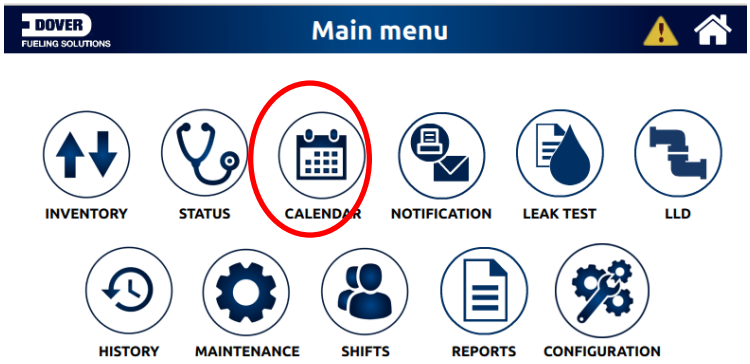


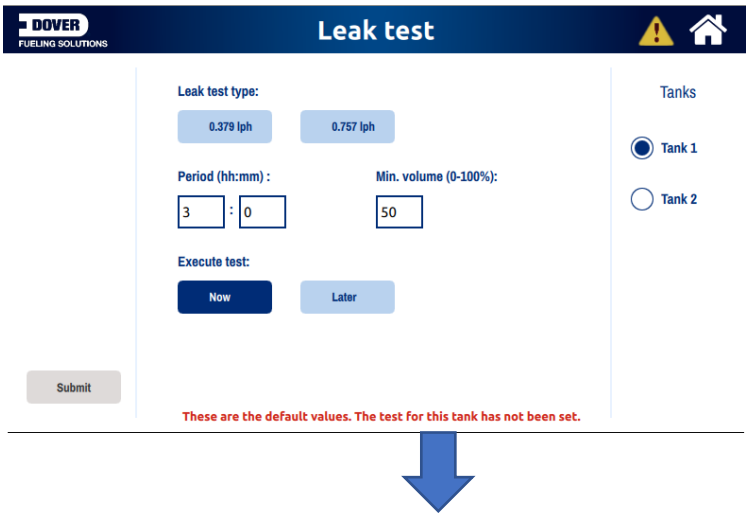
To start the calibration hit the "Start Calibration" button.

If the “Immediately” button has been swiped to be active, the system will start the process immediately.
If the “Immediately” button has not been swiped to be active, then the system will wait until it receives a hook signal (nozzle in the dispenser has been lifted). Then once the hook signal has been received and the nozzle is put back in to the boot, the system will start the calibration process. This is useful for starting the calibration process while standing in front of the dispenser. Note that the hook signal should be momentary and it should not stay active too long.

2.2 Starting a leak test from the GUI

From the main menu by clicking on the Leak test icon, the user can navigate to the LLD leak test screen where a leak test can be configured.





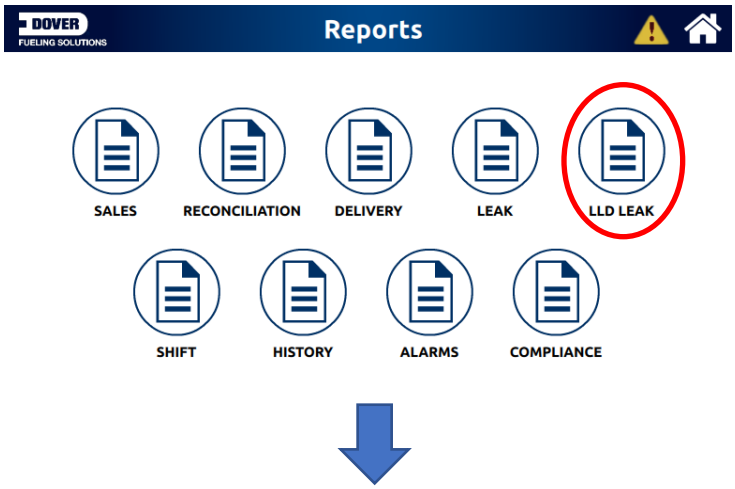
The first screen shows the tank leak settings. Swipe up to navigate to the LLD leak test screen shown below.

Select the pipeline from the right hand side of the screen and then select the leak test type.

Then configure whether to run the test now or later. Hit the Submit button when done.
When a test is running, a “Delete” button will be available above the “Submit” button and with this “Delete” button a running test can be stopped. Also if a scheduled Leak Test has been configured, the Delete function will get erase the scheduling of this test.

2.3 LLD reports

At the Report menu, hit the LLD Leak button to view the history of leak tests



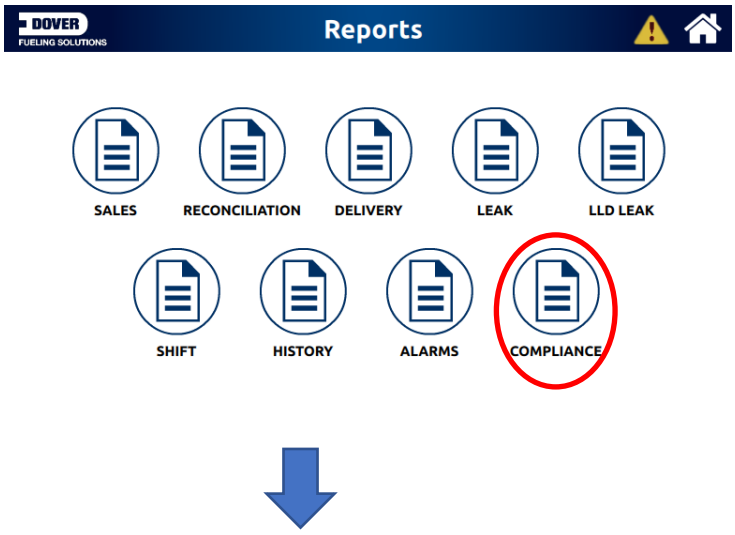
DOVER FUELING SOLUTIONS

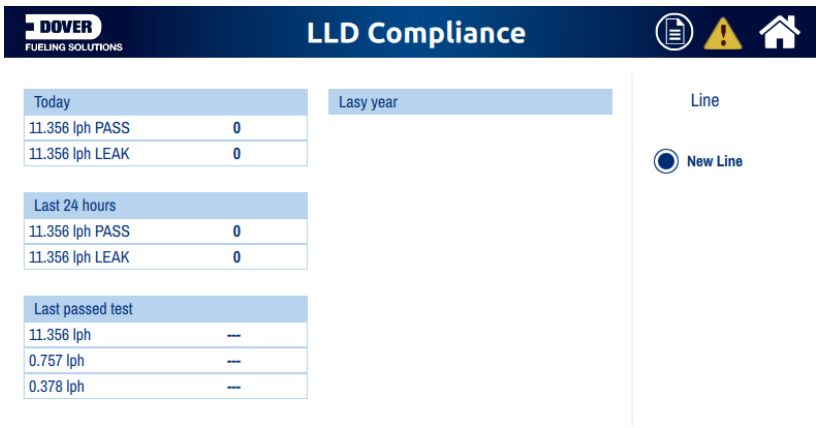
LLD Leak

Note: Report for the last 7 days

LINE	START/END TIME	DURATION	TYPE (lph)	RUNNING PRESSURE (PSI)	REFERENCE PRESSURE (PSI)	LEAK RATE (lph)	RESULT
1	13-05-2022 11:50:18 13-05-2022 11:58:14	0:07	11.356	21.56	10.00	0.003	Test passed
1	13-05-2022 11:38:11 13-05-2022 11:47:57	0:09	11.356	21.74	10.00	---	Aborted (stopped)
1	13-05-2022 10:56:37 13-05-2022 11:08:14	0:11	11.356	53.43	10.00	---	Aborted (stopped)
1	13-05-2022 09:41:07 13-05-2022 09:42:51	0:01	11.356	---	10.00	---	Aborted (stopped)
1	13-05-2022 09:20:25 13-05-2022 09:33:06	0:12	11.356	53.42	10.00	---	Aborted (stopped)
1	13-05-2022 08:03:33 13-05-2022 08:20:24	0:16	11.356	53.39	10.00	0.011	Test passed
1	13-05-2022 07:59:00 13-05-2022 08:00:01	0:01	11.356	---	10.00	---	Aborted (stopped)
1	13-05-2022 07:55:11 13-05-2022 07:56:55	0:01	11.356	---	10.00	---	Aborted (stopped)

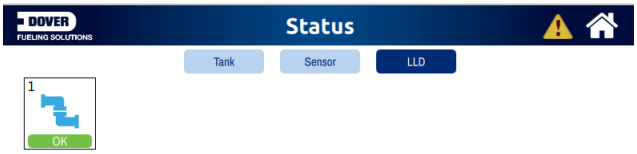
The Compliance menu will display a summary of the leak tests performed





2.4 Other LLD screens

Status screen: Selecting the LLD button will display the status of the configured pipelines.



Calendar: The calendar will display the LLD alarms

3 APPENDIX WITH PIPE DATA

The data for some industry known pipes is shown below.

RIGID PIPE TYPES	BETA	Gals/inch	Liters/cm	Liters/mm
FIBERGLASS (2 INCH)	25000	0,017	0,0253	0,0025
FIBERGLASS (3 INCH)	25000	0,038	0,0566	0,0057
STEEL (2 INCH)	50000	0,016	0,0238	0,0024
COPPER (1 INCH, TYPE K)	55000	0,003	0,0045	0,0004

ADVANCED POLYMER TECHNOLOGY FLEXIBLE PIPE TYPES	BETA	Gals/inch	Liters/cm	Liters/mm
1.5-INCH (P150SC)	8800	0,008	0,0119	0,0012
1.75-INCH (P175SC)	7400	0,01	0,0149	0,0015
2.0-INCH (P200SC)	5600	0,014	0,0209	0,0021
2.5-INCH (P250SC)	4400	0,021	0,0313	0,0031
1.5-INCH (XP-150-SC)	5042	0,008	0,0119	0,0012
2.0-INCH (XP-200-SC)	5420	0,014	0,0209	0,0021

AMERON FLEXIBLE PIPE TYPES	BETA	Gals/inch	Liters/cm	Liters/mm
DUALOY 3000/FLS III	5400	0,008	0,0119	0,0012
DUALOY 3000/FLS III	7600	0,014	0,0209	0,0021

BRUGG FLEXIBLE PIPE TYPES	BETA	Gals/inch	Liters/cm	Liters/mm
FLEXWELL HL-40 (1.5 INCH)	33000	0,008	0,0119	0,0012

ENVIRON FLEXIBLE PIPE TYPES	BETA	Gals/inch	Liters/cm	Liters/mm
GEOFLEX D (1.5 INCH)	14500	0,008	0,0119	0,0012
GEOFLEX D (2 INCH)	11000	0,014	0,0209	0,0021
GEOFLEX D (3 INCH)	4100	0,031	0,0462	0,0046
GEOFLEX PLUS D (1.5 INCH)	16500	0,008	0,0119	0,0012

FURON FLEXIBLE PIPE TYPES	BETA	Gals/inch	Liters/cm	Liters/mm
SP15 (1.5 INCH)	9000	0,008	0,0119	0,0012
SP20 (2 INCH)	7000	0,014	0,0209	0,0021
CP15 (1.5 INCH)	11650	0,008	0,0119	0,0012
CP15DW (1.5 INCH)	5400	0,008	0,0119	0,0012
CP20 (2 INCH)	7600	0,014	0,0209	0,0021
COFLEX (1.5 INCH)	14500	0,008	0,0119	0,0012
COFLEX (2 INCH)	11000	0,014	0,0209	0,0021

NUPI FLEXIBLE PIPE TYPES	BETA	Gals/inch	Liters/cm	Liters/mm
SMARTFLEX (1.5 INCH)	8600	0,008	0,0119	0,0012
SMARTFLEX (2.0 INCH)	15000	0,014	0,0209	0,0021

PETROTECHNIK FLEXIBLE PIPE TYPES	BETA	Gals/inch	Liters/cm	Liters/mm
UPP EXTRA (63 mm)	1500	0,014	0,0209	0,0021

TOTAL CONTAINMENT FLEXIBLE PIPE TYPES	BETA	Gals/inch	Liters/cm	Liters/mm
PP1500 (1.5 INCH)	2400	0,008	0,0119	0,0012
PP1501 (1.5 INCH)	3500	0,008	0,0119	0,0012
PP1502 (1.5 INCH)	7300	0,008	0,0119	0,0012
PP1503 (1.5 INCH)	2500	0,008	0,0119	0,0012
PP2500 AND PP2501				
PP2502 (2.5 INCH)	8700	0,021	0,0313	0,0031
PP2503 (2.5 INCH)	3100	0,021	0,0313	0,0031
CP1501 (1.5 INCH)	13000	0,008	0,0119	0,0012
CP1503 (1.5 INCH)	4500	0,008	0,0119	0,0012
CP2503 (2.5 INCH)	3900	0,021	0,0313	0,0031

FLEXWORKS FLEXIBLE PIPE TYPES	BETA	Gals/inch	Liters/cm	Liters/mm
C15 (1.5 INCH)	14500	0,008	0,0119	0,0012
C20 (2.0 INCH)	11000	0,014	0,0209	0,0021
C30 (3.0 INCH)	4100	0,031	0,0462	0,0046

4 WIRING DIAGRAM

See FMM2058-PLS LX Plus Wiring Diagram_r0-062922.pdf

5 SITE CONFIGURATION CHART

Use the chart below to record information that will be needed for the programming of the PLLD in the LX PLUS.

Tank No	Product	STP No	STP manifolded	Pipe inner Diameter (in/cm/mm)	Pipe Type	Beta	Pipe length (in/cm/mm)	Pipe volume (gals/in, lts/cm, lts/mm)	PLLD DAS / I/O channel	LIM1 CHANNEL	LIM2 CHANNEL

Notes:

- At “STP manifolded” record if a specific STP is manifolded with another STP and specify which one. If not manifolded, enter N/A
- At “Pipe volume”, use this formulae: If using cm, then Pipe volume liters/cm = 3.14 * Diameter (cm) * Diameter (cm) ÷ 4000. If using inches, then Pipe Volume Gallons/inch = 3.14 * Diameter (in) * Diameter (in) * 0.00108