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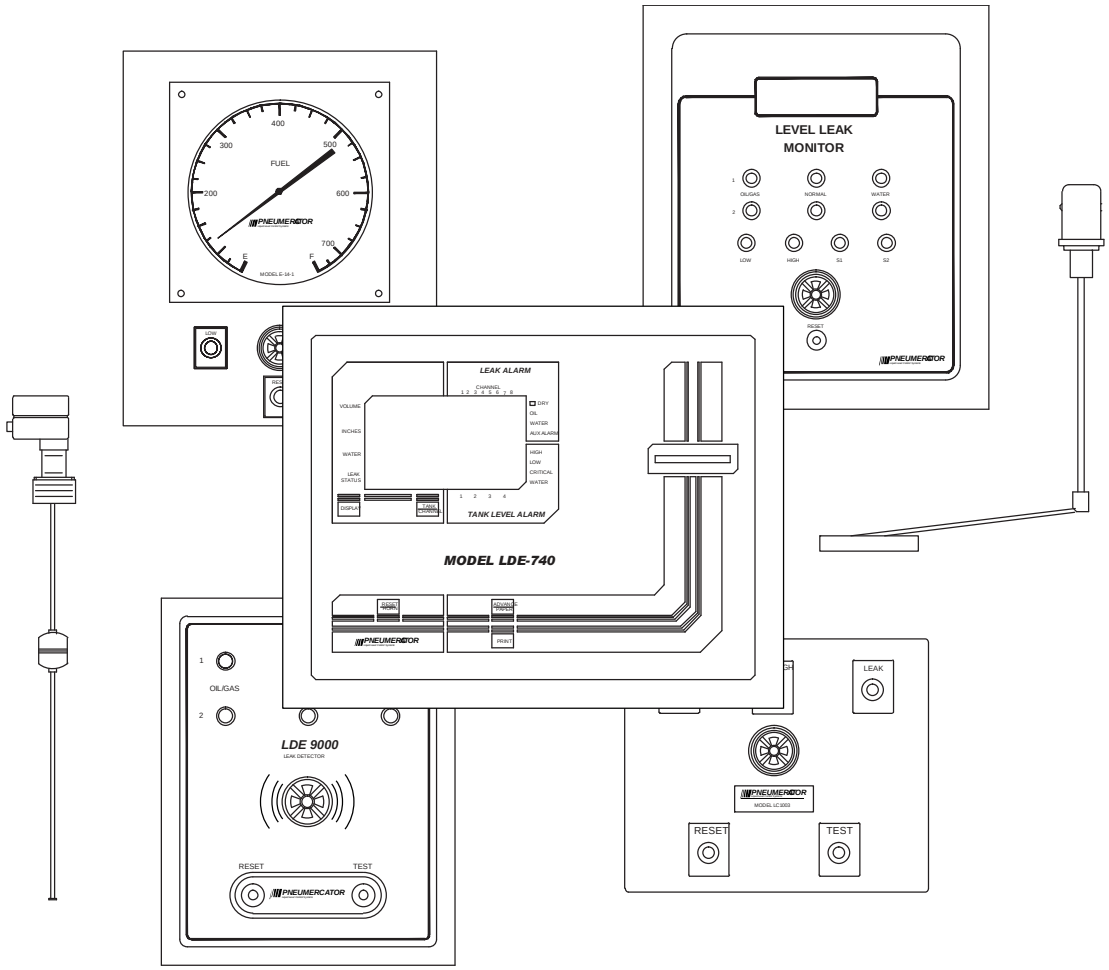
MAINTENANCE & TROUBLESHOOTING GUIDE



MODELS E-Series, E 700-1, LDE 700, LDE-740, LMS 750, LC1000, LDE 9000
2-412, 2-501, 9-900 Series, LS600, LS600LD, LS610, RSU800-2

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1785 Expressway Drive North, Hauppauge, NY 11788
(631) 293-8450 Phone
(631) 293-8533 Fax
(800) 209-7858 Product Support
http://www.pneumercator.com

Maintenance and Troubleshooting Guide

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Section 1: Gauging Consoles

Section 1.1: E-Series (E-14, E-29, E-14-1, E-29-1, LCE-14, LCE-29)

The E-Series offers a dial face that constantly indicates the product level in a liquid storage tank. Each dial face is custom fabricated to match the tank geometry submitted with the order. Options include High (overfill) and Low level lights, alarm contacts, horn and reset buttons, remote display, switch input and 4 to 20 mA output signals.

The E-Series has 4 dry contact relay outputs that will activate on jumper configured conditions. The relay contacts are available at the terminal block as 1 Form C contacts that may be configured for normally energized or de-energized states. The relay contacts are rated at 5 amps at 120 VAC.

Refer to the E-Series Instruction Manual for full configuration instructions.

System Inspection

- Verify that the power supply terminals are correctly wired.
- Verify that system power is properly wired to a separate, dedicated circuit breaker.
- Verify that all transmitters and sensors have been properly wired with color-coded or marked 18 AWG wires and that the proper color-coding or marking has been maintained throughout the wiring runs.
- Verify that all wiring splices are waterproof. An approved splice kit should be used for all wiring splices.
- Securely clamp down the intrinsic safety enclosure door.

System Functionality Tests:

Transmitter (XMTR) Input:

While pressing the simulator button, rotate the simulator knob between E (Empty) and F (Full). The pointer should move in conjunction with the rotation of the knob.

NOTE: The simulated readings should not be used to judge the accuracy of the gauge, as the simulator is only an approximation of the tank unit, which is custom made and calibrated for the particular tank.

Switch Inputs:

1. Disconnect the switch wiring from the terminal block position where testing is desired. There should be no alarm reported when the wiring is disconnected.

2. Use a jumper wire to short out the input, + to -. The input will cause an alarm when the jumper is installed.

Troubleshooting

SYMPTOM: Pointer does not respond when performing the simulator test.

ACTION: Make sure that 120 VAC power is connected to the power connection terminal block and that the power is turned on. With power off, check the fuse to make sure that it is not blown. If the fuse is blown, replace only with the proper size fuse.

SYMPTOM: Pointer responds to simulator test but gauging is inaccurate.

ACTIONS:

- Test the level transmitter.
- Check the mounting height of the level transmitter and adjust as necessary.

SYMPTOM: Pointer keeps spinning.

ACTION: Make sure that all wires are connected properly from the transmitter to the tank input (TB4). Make sure that there are no shorted or open wires. Make sure that there is no water in a wire splice or in a sensor housing.

Section 1.2: E 700-1

The E 700-1 provides audible, visible and optional printed outputs for high and low level alarms, and 2 switch input alarms. Alarms are provided for loss detection. Visible alarms are continuously on until the conditions are corrected. The audible alarm may be silenced for a particular condition by pressing the RESET pushbutton on the front panel and may be programmed from the integral keypad to automatically shut off after a specified period of time. The audible alarm may be disabled for all conditions, by using a keypad command in PROGRAMMING mode. The horn has a delay built-in, so that the same repeating alarm condition will not reactivate the audible alarm before 10 minutes. Other alarm conditions will activate the horn regardless of the delay state for a different condition.

The E 700-1 has 4 dry contact relay outputs that will activate on keypad-programmed conditions. The relay contacts are available at the terminal block as 1 Form C contacts that may be configured for normally energized or de-energized states. The relay contacts are rated at 5 amps at 120 VAC.

Refer to the 700 Series Instruction Manual for full programming instructions. Tank geometry cannot be programmed in the field. The program chip(s) must be changed when the tank geometry needs to be corrected.

System Inspection

- Verify that the power supply terminals are correctly wired.
- Verify that system power is properly wired to a separate, dedicated circuit breaker.
- Verify that all transmitters and sensors have been properly wired with color-coded or marked 18 AWG wires and that the proper color-coding or marking has been maintained throughout the wiring runs.
- Verify that all wiring splices are waterproof. An approved splice kit should be used for all wiring splices.
- Securely clamp down the intrinsic safety enclosure door.

System Functionality Tests:

Transmitter (XMTR) Input:

1. Disconnect the transmitter wiring from the terminal block position where testing is desired.

2. Connect a potentiometer (1 KΩ to 10 KΩ, the value is not critical) to the terminal block in place of the transmitter. One end of the potentiometer is connected to the terminal marked R, and the other end of the potentiometer is connected to the terminal marked B. The wiper (center terminal) of the potentiometer is connected to the terminal marked W.

3. The gauge readings will vary as the position of the potentiometer wiper is changed, typically by turning a knob. The potentiometer can be used to move the gauge readings over the full span of possible volumes.
   NOTE: The readings from the potentiometer should not be used to judge the accuracy of the gauge, as the potentiometer is only an approximation of the tank unit, which is custom made and calibrated for the particular tank.

Switch Inputs:

1. Disconnect the switch wiring from the terminal block position where testing is desired. Any input that is programmed as normally closed will go into alarm when the wiring is disconnected.

2. Use a jumper wire to short out the input, + to -. A normally open input will alarm when the jumper is installed. A normally closed input will clear the alarm when the jumper is installed.

Troubleshooting

SYMPTOM: Display blank and no lights are on.

ACTIONS:

- Make sure that 120 VAC power is connected to the power connection terminal block and that the power is turned on. With power off, check the fuse to make sure that it is not blown. If the fuse is blown, replace only with the proper size fuse.
- Measure the DC voltage, with no wires attached, between TB2 positions 1 and 3. There should be approximately 5 VDC.

SYMPTOM: Digital display flashes

ACTION: Move the switch labeled S2 on the circuit board to the NORMAL position. If theft monitoring was intentionally enabled, press the S3 button to recall the pre-theft levels.

SYMPTOMS:

- System always displays the minimum or maximum gaugeable setting no matter how much product is in the tank.
- System displays Error Code 9 (volume measurement underrange).
- System displays Error Code 7 (volume measurement overrange) or a reading greater than full capacity.

ACTIONS:

- Make sure that all wires are connected properly from the transmitter to the tank input (TB2). Make sure that there are no shorted or open wires. Make sure that there is no water in a wire splice or in a sensor housing. Make sure that the gauge calibrations are set properly.
- Recalibrate the E 700-1 Transmitter Input. Move the float to the empty position, then enter F49E, wait 10 seconds, and enter E again. Move the float to the full position, then enter F50E, wait 10 seconds, and enter E again.

SYMPTOM: Switch (S1 and/or S2) light is always on, or goes on when it shouldn't.

ACTION: Make sure that Switch input is working properly and that the switch input is programmed properly. Verify the contact state of the switch in its non-alarm state. Use the F40 command to adjust the E 700-1 configuration as necessary: Enter F 40 n s E using the following definitions for the listed variables: n is the number of the switch input that is being configured, s is the state of the switch input in a non-alarm condition where 0 = normally open and 1 = normally closed.

System Defaults

The E 700-1 has default settings that apply when the system is shipped from the factory, and when a cold reset command has been performed. If these settings are suitable for the application, no field programming of these functions has to be done. Select key factory defaults are listed below. Consult the 700 Series Instruction Manual for a complete list.

High (overfill) Level Alarm	90% of tank capacity
Low Level Alarm	20% of tank capacity
Normal Switch State	Open
Normal Relay State	De-energized
Relay Actuations	See Chart Below
Horn Actuations	See Chart Below

Condition	Relay	Horn
High Alarm	1	✓
Low Alarm	2	✓
Switch 1	3	✓
Switch 2	4	✓
Theft Alarm		

Error Codes

Error #	Description
0	Print Buffer Overflow (Full Height Zero)
1	Unimplemented Command
2	Clock has Lost Time (battery failure)
3	Range Error
4	RAM (memory) Error
5	Keypad Buffer Overflow
6	Syntax Error
7	Probe (Volume) Measurement Overrange
8	Cold Reset
9	Probe (Volume) Measurement Underrange
o	Clock Timeout (Half Height Zero)

Section 1.3: LDE 700

The LDE 700 provides audible, visible and optional printed outputs for high low level alarms, and 2 switch input alarms. Alarms are provided for loss detection. Also provided are 2 leak input channels of precision leak detection. Visible alarms are continuously on until the conditions are corrected. The audible alarm may be silenced for a particular condition by pressing the RESET pushbutton on the front panel and may be programmed from the integral keypad to automatically shut off after a specified period of time. The audible alarm may be disabled for all conditions, by using a keypad command in PROGRAMMING mode. The horn has a delay built-in, so that the same repeating alarm condition will not reactivate the audible alarm before 10 minutes. Other alarm conditions will activate the horn regardless of the delay state for a different condition.

The LDE 700 has 4 dry contact relay outputs that will activate on keypad-programmed conditions. The relay contacts are available at the terminal block as 1 Form C contacts that may be configured for normally energized or de-energized states. The relay contacts are rated at 5 amps at 120 VAC.

The LDE 700 will retain memory of a hydrocarbon or water alarm even if the alarm condition later disappears. The alarm memory is battery backed up, so the memory will remain in the event of a power failure. The alarm memory may be cleared by a keypad command.

Refer to the 700 Series Instruction Manual for full programming instructions. Tank geometry cannot be programmed in the field. The program chip(s) must be changed when the tank geometry needs to be corrected.

System Inspection

- Verify that the power supply terminals are correctly wired.
- Verify that system power is properly wired to a separate, dedicated circuit breaker.
- Verify that all transmitters and sensors have been properly wired with color-coded or marked 18 AWG wires and that the proper color-coding or marking has been maintained throughout the wiring runs.
- Verify that all wiring splices are waterproof. An approved splice kit should be used for all wiring splices.
- Securely clamp down the intrinsic safety enclosure door.

System Functionality Tests:

Transmitter (XMTR) Input:

1. Disconnect the transmitter wiring from the terminal block position where testing is desired.

2. Connect a potentiometer (1 KΩ to 10 KΩ, the value is not critical) to the terminal block in place of the transmitter. One end of the potentiometer is connected to the terminal marked R, and the other end of the potentiometer is connected to the terminal marked B. The wiper (center terminal) of the potentiometer is connected to the terminal marked W.

3. The gauge readings will vary as the position of the potentiometer wiper is changed, typically by turning a knob. The potentiometer can be used to move the gauge readings over the full span of possible volumes.
   NOTE: The readings from the potentiometer should not be used to judge the accuracy of the gauge, as the potentiometer is only an approximation of the tank unit, which is custom made and calibrated for the particular tank.

Switch Inputs:

1. Disconnect the switch wiring from the terminal block position where testing is desired. Any input that is programmed as normally closed will go into alarm when the wiring is disconnected.

2. Use a jumper wire to short out the input, + to -. A normally open input will alarm when the jumper is installed. A normally closed input will clear the alarm when the jumper is installed.

Leak Inputs:

The leak inputs cannot be tested without a 9-90x Series sensor attached. The sensors must be calibrated when installed at the end of the field cable so that the system operates reliably.

Troubleshooting

SYMPTOM: Display blank and no lights are on.

ACTIONS:

- Make sure that 120 VAC power is connected to the power connection terminal block and that the power is turned on. With power off, check the fuse to make sure that it is not blown. If the fuse is blown, replace only with the proper size fuse.
- Measure the DC voltage, with no wires attached, between TB2 positions 1 and 3. There should be approximately 5 VDC.

SYMPTOM: Digital display flashes

ACTION: Move the switch labeled S2 on the circuit board to the NORMAL position. If theft monitoring was intentionally enabled, press the S3 button to recall the pre-theft levels.

SYMPTOMS:

- System always displays the minimum or maximum gaugeable setting no matter how much product is in the tank.
- System displays Error Code 9 (volume measurement underrange).
- System displays Error Code 7 (volume measurement overrange) or a reading greater than full capacity.

ACTIONS:

- Make sure that all wires are connected properly from the transmitter to the tank input (TB2). Make sure that there are no shorted or open wires. Make sure that there is no water in a wire splice or in a sensor housing. Make sure that the gauge calibrations are set properly.
- Recalibrate the LDE 700 Transmitter Input. Move the float to the empty position, then enter F49E, wait 10 seconds, and enter E again. Move the float to the full position, then enter F50E, wait 10 seconds, and enter E again.

SYMPTOM: Switch (S1 and/or S2) light is always on, or goes on when it shouldn't.

ACTION: Make sure that Switch input is working properly and that the switch input is programmed properly. Verify the contact state of the switch in its non-alarm state. Use the F40 command to adjust the LDE 700 configuration as necessary: Enter F 40 n s E using the following definitions for the listed variables: n is the number of the switch input that is being configured, s is the state of the switch input in a non-alarm condition where 0 = normally open and 1 = normally closed.

SYMPTOM: Leak detection channel gives false water alarm.

ACTION: Check to make sure that the sensor is in contact only with air. Make sure that the ground wire (B) and the sensor input wire (W) have continuity from the sensor to the alarm console. Make sure that the sensor input wire (W) is not shorted to power. Place system in Calibrate mode by entering F43E with the sensor clean, dry, and in air.

SYMPTOM: Leak detection channel gives false alarms.

ACTIONS:

- Check to make sure that the sensor is in contact only with Air. Pull sensor from installation and make sure that it is not fouled or clogged. If sensor is fouled or clogged, clean with soap and water solution or a mild solvent and dry and unclog with compressed air. Place system in Calibrate mode by entering F43E with the sensor clean, dry, and in air. Check all wiring for continuity, proper connections and make sure that there are no shorts.
- When the sensor has been immersed in water it takes a period of time for the sensor to drain completely and dry. During this time the sensor will oscillate between water/hydrocarbon and hydrocarbon/air readings. This may cause the hydrocarbon or water alarm to latch into the system memory. This may be cleared when the sensor is clean, dry, and in air by calibrating the leak detection sensor using the F43E command.

SYMPTOM: Leak detection channel shows no lights.

ACTION: This condition indicates that when the leak sensors were calibrated either no sensor was connected to that input or a defective or miswired sensor was connected to that input. If a new sensor is connected to the input, use the F43E command to calibrate the leak detection channels. If a leak input still shows no lights, the connected sensor is probably wired incorrectly or is defective.

SYMPTOM: Leak detection channel shows all 3 lights on, system responds to pressing TEST button.

ACTION: This condition indicates that when the leak sensor was calibrated it was working correctly and either has now failed, or the wiring has become defective. Use the F43E command to calibrate the leak detection channels. If that leak input now shows no lights, the connected sensor is probably wired incorrectly or is defective.

SYMPTOM: No lights are on for a leak sensor, system responds to pressing TEST button.

ACTION: Check to make sure that all sensor wires are connected to the proper terminal block contacts. Make sure that the conduit wires in the run from the sensor to the alarm console have continuity and are not shorted to each other. A sensor that has the power wire (R) or input wire (W) disconnected or shorted to ground will show the sensor failure indication. Make sure that the metal conduits and the sensor housing do not have water in them.

SYMPTOM: More than 1 light is on for a sensor, system does not respond to pressing TEST button.

ACTION: Call factory for servicing.

System Defaults

The LDE 700 has default settings that apply when the system is shipped from the factory, and when a cold reset command has been performed. If these settings are suitable for the application, no field programming of these functions has to be done. Select key factory defaults are listed below. Consult the 700 Series Instruction Manual for a complete list.

High (overfill) Level Alarm	90% of tank capacity
Low Level Alarm	20% of tank capacity
Normal Switch State	Open
Normal Relay State	De-energized
Relay Actuations	See Chart Below
Horn Actuations	See Chart Below

Condition	Relay	Horn
High Alarm	1	✓
Low Alarm	2	✓
Switch 1	3	✓
Switch 2	3	✓
Leak 1 (Product)	4	✓
Leak 1 (Water)		
Leak 2 (Product)	4	✓
Leak 2 (Water)		
Theft Alarm		

Error Codes

Error #	Description
0	Print Buffer Overflow (Full Height Zero)
1	Unimplemented Command
2	Clock has Lost Time (battery failure)
3	Range Error
4	RAM (memory) Error
5	Keypad Buffer Overflow
6	Syntax Error
7	Probe (Volume) Measurement Overrange
8	Cold Reset
9	Probe (Volume) Measurement Underrange
o	Clock Timeout (Half Height Zero)

Section 1.4: LDE-740

The LDE-740 provides audible, visible and optional printed outputs for critical, high, and low level alarms, and 8 switch input alarms. Alarms are provided for loss detection. The LDE systems also provide 8 leak input channels of precision leak detection. Visible alarms are continuously on until the conditions are corrected. The audible alarm may be silenced for a particular condition by pressing the RESET pushbutton on the front panel and may be programmed from the integral keypad to automatically shut off after a specified period of time. The audible alarm may be disabled for all conditions, by using a keypad command in PROGRAMMING mode. The horn has a delay built-in, so that the same repeating alarm condition will not reactivate the audible alarm before 10 minutes. Other alarm conditions will activate the horn regardless of the delay state for a different condition.

The LDE-740 has 8 dry contact output relays that will activate on keypad-programmed conditions. The relay contacts are available at the terminal block as 1 Form C contacts that may be programmed for normally energized or de-energized states. The relay contacts are rated at 5 amps at 120 VAC.

The LDE-740 will retain memory of a hydrocarbon or water alarm even if the alarm condition later disappears. The alarm memory is battery backed up, so the memory will remain in the event of a power failure. The alarm memory may be cleared by a keypad command.

Refer to the LDE-740 Instruction Manual for full programming instructions. Tank geometry cannot be programmed in the field. The program chip(s) must be changed when the tank geometry needs to be corrected.

System Inspection

- Verify that the power supply terminals are correctly wired.
- Verify that system power is properly wired to a separate, dedicated circuit breaker.
- Verify that all transmitters and sensors have been properly wired with color-coded or marked 18 AWG wires and that the proper color-coding or marking has been maintained throughout the wiring runs.
- Verify that all wiring splices are waterproof. An approved splice kit should be used for all wiring splices.
- Securely clamp down the intrinsic safety enclosure door.

System Functionality Tests:

Transmitter (XMTR) Input:

1. Disconnect the transmitter wiring from the terminal block position where testing is desired.

2. Connect a potentiometer (1 KΩ to 10 KΩ, the value is not critical) to the terminal block in place of the transmitter. One end of the potentiometer is connected to the terminal marked R, and the other end of the potentiometer is connected to the terminal marked B. The wiper (center terminal) of the potentiometer is connected to the terminal marked W.

3. The gauge readings will vary as the position of the potentiometer wiper is changed, typically by turning a knob. The potentiometer can be used to move the gauge readings over the full span of possible volumes.
   NOTE: The readings from the potentiometer should not be used to judge the accuracy of the gauge, as the potentiometer is only an approximation of the tank unit, which is custom made and calibrated for the particular tank.

Switch Inputs:

1. Disconnect the switch wiring from the terminal block position where testing is desired. Any input that is programmed as normally closed will go into alarm when the wiring is disconnected.

2. Use a jumper wire to short out the input, + to -. A normally open input will alarm when the jumper is installed. A normally closed input will clear the alarm when the jumper is installed.

Leak Inputs:

The leak inputs cannot be tested without a 9-90x Series sensor attached. The sensors must be calibrated when installed at the end of the field cable so that the system operates reliably.

Troubleshooting

SYMPTOM: Display blank and no lights are on.

ACTIONS:

- Make sure that 120 VAC power is connected to the power connection terminal block and that the power is turned on. With power off, check the fuse to make sure that it is not blown. If the fuse is blown, replace only with the proper size fuse.
- Measure the DC voltage, with no wires attached, between TB4 positions 1 and 3. There should be approximately 5 VDC.

SYMPTOM: Digital display flashes

ACTION: Move the switch labeled S1 on the circuit board to the NORMAL position. If theft monitoring was intentionally enabled, press the S2 button to recall the pre-theft levels.

SYMPTOMS:

- System always displays the minimum or maximum gaugeable setting no matter how much product is in the tank.
- System displays Error Code 9 (volume measurement underrange).
- System displays Error Code 7 (volume measurement overrange) or a reading greater than full capacity.

ACTIONS:

- Make sure that all wires are connected properly from the transmitter to the tank input (TB2). Make sure that there are no shorted or open wires. Make sure that there is no water in a wire splice or in a sensor housing. Make sure that the gauge calibrations are set properly.
- Recalibrate the LDE-740 Transmitter Input. Move the float to the empty position, then enter F49TE (T=Tank Channel), wait 10 seconds, and enter E again. Move the float to the full position, then enter F50TE (T=Tank Channel), wait 10 seconds, and enter E again.

SYMPTOM: Switch (S1 and/or S2) light is always on, or goes on when it shouldn't.

ACTION: Make sure that Switch input is working properly and that the switch input is programmed properly. Verify the contact state of the switch in its non-alarm state. Use the F40 command to adjust the LDE-740 configuration as necessary: Enter F 40 n s E using the following definitions for the listed variables: n is the number of the switch input that is being configured, s is the state of the switch input in a non-alarm condition where 0 = normally open and 1 = normally closed.

SYMPTOM: Leak detection channel gives false water alarm.

ACTION: Check to make sure that the sensor is in contact only with air. Make sure that the ground wire (B) and the sensor input wire (W) have continuity from the sensor to the alarm console. Make sure that the sensor input wire (W) is not shorted to power. Place system in Calibrate mode by entering F43E with the sensor clean, dry, and in air.

SYMPTOM: Leak detection channel gives false alarms.

ACTIONS:

- Check to make sure that the sensor is in contact only with Air. Pull sensor from installation and make sure that it is not fouled or clogged. If sensor is fouled or clogged, clean with soap and water solution or a mild solvent and dry and unclog with compressed air. Place system in Calibrate mode by entering F43E with the sensor clean, dry, and in air. Check all wiring for continuity, proper connections and make sure that there are no shorts.
- When the sensor has been immersed in water it takes a period of time for the sensor to drain completely and dry. During this time the sensor will oscillate between water/hydrocarbon and hydrocarbon/air readings. This may cause the hydrocarbon or water alarm to latch into the system memory. This may be cleared when the sensor is clean, dry, and in air by calibrating the leak detection sensor using the F43E command.

SYMPTOM: Leak detection channel shows no lights.

ACTION: This condition indicates that when the leak sensors were calibrated either no sensor was connected to that input or a defective or miswired sensor was connected to that input. If a new sensor is connected to the input, use the F43E command to calibrate the leak detection channels. If a leak input still shows no lights, the connected sensor is probably wired incorrectly or is defective.

SYMPTOM: Leak detection channel shows all 3 lights on, system responds to pressing TEST button.

ACTION: This condition indicates that when the leak sensor was calibrated it was working correctly and either has now failed, or the wiring has become defective. Use the F43E command to calibrate the leak detection channels. If that leak input now shows no lights, the connected sensor is probably wired incorrectly or is defective.

SYMPTOM: No lights are on for a leak sensor, system responds to pressing TEST button.

ACTION: Check to make sure that all sensor wires are connected to the proper terminal block contacts. Make sure that the conduit wires in the run from the sensor to the alarm console have continuity and are not shorted to each other. A sensor that has the power wire (R) or input wire (W) disconnected or shorted to ground will show the sensor failure indication. Make sure that the metal conduits and the sensor housing do not have water in them.

SYMPTOM: More than 1 light is on for a sensor, system does not respond to pressing TEST button.

ACTION: Call factory for servicing.

System Defaults

The LDE-740 has default settings that apply when the system is shipped from the factory, and when a cold reset command has been performed. If these settings are suitable for the application, no field programming of these functions has to be done. Select key factory defaults are listed below. Consult the LDE-740 Series Instruction Manual for a complete list.

High Level Alarm	90% of tank capacity
Critical Level Alarm	High-High, 95% of tank capacity
Low Level Alarm	20% of tank capacity
Normal Switch State	Open
Normal Relay State	De-energized
Relay Actuations	See Chart Below
Horn Actuations	See Chart Below

Condition	Relay	Horn
Low Alarm (Any Tank)	5	✓
High Alarm (Tank 1)	1	✓
High Alarm (Tank 2)	2	✓
High Alarm (Tank 3)	3	✓
High Alarm (Tank 4)	4	✓
Critical Alarm (Any Tank)	8	✓
High Water (Any Tank)	8	✓
Aux/Switch (Any Input)	6	✓
Oil (Any Leak Input)	7	✓
Water (Any Leak Input)	8	
Theft (Any Tank)	8	
Diagnostic Failure	8	

Error Codes

Error #	Description
0	Print Buffer Overflow (Full Height Zero)
1	Unimplemented Command
2	Clock has Lost Time (battery failure)
3	Range Error
4	RAM (memory) Error
5	Keypad Buffer Overflow
6	Syntax Error
7	Probe (Volume) Measurement Overrange
8	Cold Reset
9	Probe (Volume) Measurement Underrange
o	Clock Timeout (Half Height Zero)

Section 1.5: LMS 750

The LMS 750 provides audible, visible and optional printed outputs for high and low level alarms. Alarms are provided for loss detection. Visible alarms are continuously on until the conditions are corrected. The audible alarm may be silenced for a particular condition by pressing the RESET pushbutton on the front panel.

The LMS 750 has dry contact output relays that will activate on select conditions. The relay contacts are available at the terminal block as 1 Form C contacts. The relay contacts are rated at 3 amps at 120 VAC.

The LMS 750 memory is battery backed up, so the memory will remain in the event of a power failure.

Refer to the LMS 750 Instruction Manual provided with the console for full programming instructions. Tank geometry cannot be programmed in the field. The program chip(s) must be changed when the tank geometry needs to be corrected.

Transmitter Wiring

TB1 Pin #	Wire Color	Function
1	Black	Circuit Ground
2	White	Volume Measurement
3	Red	5 VDC
4*	Green	Earth Ground*
5	Orange	Temperature Measurement
6	Blue	Water Measurement
* Note: No Earth Ground wire should be run if optional zener barriers for an intrinsically safe installation are being used.		

System Inspection

- Verify that the power supply terminals are correctly wired.
- Check that the terminal block plug-in connectors are properly seated in the terminal blocks, and that the terminal blocks are not strained.
- Verify that system power is properly wired to a separate, dedicated circuit breaker.
- Check that the fuse for the power supply is good and that the A.C. power is properly connected and on. The fuse is located under the perforated power supply cover.
- Verify that all transmitters have been properly wired with color-coded or marked 18 AWG wires and that the proper color-coding or marking has been maintained throughout the wiring runs.
- Verify that all wiring splices are waterproof. An approved splice kit should be used for all wiring splices.
- Securely clamp down the intrinsic safety enclosure door.

System Tests:
Transmitter Input (Electrical Test):

1. With the power on, use a DC Voltmeter to measure between pin 1 (ground) and pin 3 (+5V) for Tank 1 of TB1. TB1 is located on the analog circuit board, part number 900296. The expected range is between 4.75 and 5.25 VDC.

2. If the measurement is not within the acceptable range, power down the LMS 750 and remove all plug-in terminal block connectors from TB1. Power up the indicator and repeat the measurement taken in the previous step. If the measurement is now within the acceptable range, one of the tank transmitter connections is short-circuited. Replace each one (with power off), repeating the voltage measurement after each terminal block plug-in has been replaced. The block(s) which cause(s) the improper reading represent the tank wiring and transmitter which should be checked further. If no voltage is measured with all TB1 connectors unplugged, the power supply may be bad.

3. With the power on, use a DC Voltmeter to measure between pin 1 (ground) and pin 5 (temperature measurement), and between pin 1 (ground) and pin 6 (water measurement) for each tank at TB1. The voltage measured should never exceed +2.25 VDC. Measurements that exceed this voltage usually indicate water in the wiring or the 2-412A sensor housing.

Transmitter Input (Functional Test):

1. In order to verify that the gauge is properly reading a level transmitter, first shut off power to the gauge.

2. Disconnect the level transmitter from the input to be tested from the terminal block TB1.

3. Connect a potentiometer (1 KΩ to 10 KΩ, the value is not critical) to the terminal block TB1 for the input under test. One end terminal of the potentiometer is connected to terminal 1 (ground), the other end terminal is connected to terminal 3 (+5V), and the middle terminal of the potentiometer (the wiper) is connected to terminal 2 (volume measurement).

4. Power up the gauge, and select the tank under test for display of volume. The gauge readings will vary as the position of the potentiometer is changed. At the extreme ends of the potentiometer's rotational angle the gauge readings may show a negative reading or a reading greater than the tank's capacity, but the potentiometer can be used to move the gauge readings over the full span of possible volumes.
   NOTE: The readings from the potentiometer should not be used to judge the accuracy of the gauge, as the potentiometer is only an approximation of the tank unit, which is custom made and calibrated for the particular tank.

Troubleshooting

SYMPTOM: No lights or indications.

ACTIONS:

- Make sure that 120 VAC power is connected to the power connection terminal block and that the power is turned on. With power off, check the fuse to make sure that it is not blown. If the fuse is blown, replace only with the proper size fuse.
- Make sure that all wire harness connectors are seated properly.

SYMPTOMS:

- Temperature reading(s) of 3000º and above.
- False Delivery Reports.

ACTIONS:

- Check for water in the wiring or the 2-412A sensor housing.
- The tank input that shows 3000º may be tested by connecting a jumper wire between pin 1 (ground) and pin 5 (temperature measurement) of TB1. The temperature display for the tank under test should then show a temperature reading of between 100º and 120º.

SYMPTOM: Negative volume displayed, or volume greater than tank capacity.
ACTIONS:

- Check the condition of the wiring splices and terminations.
- Check for the presence of water in the 2-412A housing.
- Replace 2-412A.

SYMPTOM: Volume readings bouncing around.
ACTIONS:

- Make sure that no wires other than Pneumercator sensor wires are run in the conduit. May be due to noise pickup in the wiring, or partial shorting of the wiring.
- With the power on, use a DC Voltmeter to measure the voltage between pin 1 (ground) and pin 2 (volume measurement) of TB1 for the problem tank channel(s). TB1 is located on the analog circuit board of the LMS 750, part number 900296. The voltage measured should be steady, not fluctuating.

System Calibrations

The model LMS 750 is calibrated at the factory, and the calibration settings are not affected by power outages or system resets. System accuracy will be affected by incorrect calibrations, so it is recommended that the settings only be changed when a tank transmitter is changed or replaced or added to the system.

In order to calibrate the system, the 2-412A tank transmitter should not be installed in the tank. The 2-412A transmitter should be wired up to the LMS 750 indicator unit and placed on the ground. You must know the tank number the transmitter is to be calibrated for.

Level Measurement:

1. Turn the key to PROGRAM mode.
2. Press {VOLUME} 51 {INCHES} tank # {INCHES} 1 {ENTER}.
3. Move the float of the tank sensor to the bottom of its travel.
4. Use the EMPTY potentiometer to set the display to 0002.
5. Move the float of the tank sensor to the top of its travel.
6. Use the FULL potentiometer to set the display to 4093.
7. Repeat steps 3-6 until readings are consistent.
8. Turn the key to RUN mode. Calibration is finished.

TANK #	EMPTY POT.*	FULL POT.*
1	R25	R50
2	R26	R52
3	R27	R54
4	R28	R56
5	R29	R58
6	R30	R60
7	R31	R62
8	R32	R64
* These potentiometers are located in the LMS 750 console just above the sensor wiring terminal block, labeled TB1.		

Temperature Measurement (if so equipped):

1. The adjustment potentiometer for temperature measurement is in the housing of the 2-412A sensor, and is labeled R4.
2. The calibration for temperature measurement is performed in RUN mode, with the temperature display for the sensor number selected.
3. An accurate ambient temperature measurement must be taken, and then the pot. R4 is adjusted to set the display to match the temperature reading.
4. This adjustment must be made slowly, with incremental changes to R4. Allow 1 or 2 minutes between adjustments in order to allow the displayed temperature to stabilize.

Water Measurement (if so equipped):

1. The adjustment potentiometer for water measurement is in the housing of the 2-412A sensor, and is labeled R1.
2. Turn the key to PROGRAM mode.
3. Press {VOLUME} 51 {INCHES} tank # {INCHES} 2 {ENTER}.
4. Move the water float of the tank sensor to the top of its travel.
5. Use R1 in the sensor housing to set the display to 2700.
6. Turn the key to RUN mode. Water calibration is finished.

Section 2: Leak/Point Level Monitoring Consoles

Section 2.1: LC1000

The LC1000 Series provides audible and visible annunciation for up to 4 conditions that can include high and low level and leak alarms. Each input supports a continuity signal from a simple float switch or dry contact relay output from a variety of other systems. The inputs may be configured, per circuit board, for normally open or closed operation via a set of jumpers or shorting blocks. Each circuit board supports a maximum of two inputs. Visible alarms are continuously on until the conditions are corrected. The audible alarm may be silenced for a particular condition by pressing the RESET pushbutton on the front panel and, with the optional Autosilence Circuit (-ASC), may be configured from the integral potentiometer to automatically shut off after a specified period of time.

The LC1000 Series has 1 corresponding dry contact output relay per input that will activate on an alarm. The relay contacts are available at the terminal block as 1 Form C contacts that may be configured for normally energized or de-energized states. The relay contacts are rated at 3 amps at 120 VAC.

Refer to the LC1000 Series Instruction Manual for full configuration instructions.

System Configuration:

Jumper positions JP3, 4, 5 and 6 can be set to configure the inputs for Normally Open or Normally Closed operation. All jumpers on one circuit board must be set to match one column on the table below.

Jumper Position	Normally Open Inputs Normally De-Energized Relay Outputs	Normally Closed Normally Energized Relay Outputs
JP3	A-B	A-C
JP4	D-E	D-F
JP5	U-V	U-W
JP6	X-Y	X-Z

System Inspection

- Verify that the power supply terminals are correctly wired.
- Verify that system power is properly wired to a separate, dedicated circuit breaker.
- Verify that all sensors have been properly wired with color-coded or marked 18 AWG wires and that the proper color-coding or marking has been maintained throughout the wiring runs.
- Verify that all wiring splices are waterproof. An approved splice kit should be used for all wiring splices.
- Securely clamp down the intrinsic safety enclosure door.

System Functionality Tests:
Switch Inputs:

1. Disconnect the switch wiring from the terminal block position where testing is desired. Any input that is configured as normally closed will go into alarm when the wiring is disconnected.

2. Use a jumper wire to short out the input, + to -. A normally open input will alarm when the jumper is installed. A normally closed input will clear the alarm when the jumper is installed.

Troubleshooting
SYMPTOM: Lights do not activate for either an alarm or a press of the Test button.

ACTIONS:

- Make sure that 120 VAC power is connected to the power connection terminal block and that the power is turned on. With power off, check the fuse to make sure that it is not blown. If the fuse is blown, replace only with the proper size fuse.
- Verify presence of 12 VDC with no wires attached between TB1 positions 1 and 2.

SYMPTOM: Light is always on, or goes on when it shouldn't.

ACTION: Make sure that Switch input is working properly and that the switch input is configured properly.

Section 2.2: LDE 9000

The LDE 9000 system is a capacitance based system designed to monitor collection sumps and the annular spaces of double wall tanks for leakage of hydrocarbons. The system provides individual indications for detection of air, water, and hydrocarbons. Detection of air is indicated by a Green light. Detection of hydrocarbons is indicated by a Red light, and by sounding of an audible alarm. Detection of water is indicated by an Amber light, and optionally by sounding of an audible alarm.

A Form C dry contact relay output, rated for use at up to 5 Amps at 120 VAC is provided for each sensor and will activate when hydrocarbons are detected. Relay actuation is optionally available for water detection as well as hydrocarbon detection.

The TEST button is used to test the operation of the system alarm console, turning on all lights and the horn. During test operation, horn reset may be tested by manually pressing the RESET button, or by waiting for the selected time delay period. Pressing the TEST and RESET buttons at the same time will also clear any retained memory of hydrocarbon alarm conditions.

Sensors may be tested and calibrated by placing the system in CALIBRATE mode. This calibration is done with the sensors in air. The sensor calibration will reset the system air calibrations and will test for proper sensor operation. Installation of new sensors, up to system capacity, and replacement of existing sensors may be done by selecting the number of sensors and then placing the system in CALIBRATE mode. Sensors for both sump and annular space detection may be mixed in a system with no limitations. Placing the system in CALIBRATE mode will also clear any retained memory of hydrocarbon alarm conditions.

System Inspection:

- Verify that the power supply terminals are correctly wired.
- Verify that system power is properly wired to a separate, dedicated circuit breaker.
- Verify that all sensors have been properly wired with color-coded or marked 18 AWG wires and that the proper color-coding or marking has been maintained throughout the wiring runs.
- Verify that all wiring splices are waterproof. An approved splice kit should be used for all wiring splices.
- Securely clamp down the intrinsic safety enclosure door.

System Functionality Tests:

Leak Inputs:

Place the sensor in a container of fuel and a separate container of water. Verify that the corresponding LED activated.

Calibration:

Remove all sensors from their containment spaces. Make sure the sensor is completely dry, free of petroleum or water. Close switch 7 on each circuit board. Wait 10 seconds and return switch 7 to the open position. All channels with a connected sensor should now show the green Normal LED on.

Troubleshooting:

SYMPTOM: No lights are on.

ACTIONS:

- Make sure that 120 VAC power is connected to the power connection terminal block and that the power is turned on. With power off, check the fuse to make sure that it is not blown. If the fuse is blown, replace only with the proper size fuse.
- There should be 5 VDC, with no wires attached, between TB2 positions 1 and 3.

SYMPTOM: Leak detection channel gives false water alarm.

ACTION: Check to make sure that the sensor is in contact only with Air. Make sure that the ground wire (B) and the sensor input wire (W) have continuity from the sensor to the alarm console. Make sure that the sensor input wire (W) is not shorted to power. Place system in Calibrate mode with the sensor clean and in Air.

SYMPTOM: Leak detection channel gives false alarms.

ACTIONS:

- Check to make sure that the sensor is in contact only with Air. Pull sensor from installation and make sure that it is not fouled or clogged. If sensor is fouled or clogged, clean with soap and water solution or a mild solvent and dry and unclog with compressed air. Place system in Calibrate mode with the sensor in air. Check all wiring for continuity, proper connections and make sure that there are no shorts.
- When the sensor has been immersed in water it takes a period of time for the sensor to drain completely and dry. During this time the sensor will oscillate between water/ hydrocarbon and hydrocarbon/air readings. This may cause the hydrocarbon or water alarm to latch into the system memory. This may be cleared when the sensor is dry and in air by calibrating the leak detection sensor.

SYMPTOM: Leak detection channel shows no lights.

ACTION: This condition indicates that when the leak sensors were calibrated either no sensor was connected to that input or a defective or miswired sensor was connected to that input. If a new sensor is connected to the input, use the dip switch to calibrate the leak detection channels. If a leak input still shows no lights, the connected sensor is probably wired incorrectly or is defective.

SYMPTOM: Leak detection channel shows all 3 lights on.

ACTION: This condition indicates that when the leak sensor was calibrated it was working correctly and either has now failed, or the wiring has become defective. Recalibrate the leak detection channels using the dip switch. If that leak input now shows no lights, the connected sensor is probably wired incorrectly or is defective.

Section 3: Resistive Level Transmitters

Section 3.1: 2-412 Series (2-412, 2-412W, 2-412A)

The 2-412 tank transmitters are completely sealed units and cannot be repaired in the field. However, a series of simple measurements can be made to verify if the tank transmitter is operational. To test the 2-412 transmitter, it must be disconnected from the gauge unit. Always shut off power to the gauge when connecting or disconnecting any wiring.

Transmitter Inspection

1. Perform a visual check that all wiring is connected properly and that no water is present in any wiring splice or in the housing of the 2-412 level transmitter. If water is present in a splice or in the wiring it must be dried out. All splices should be waterproofed using Pneumercator supplied splice kits. NEMA 4 or better junction boxes should be used for all wiring splices located outdoors.
2. Make sure that the 2-412 level transmitter is installed in accordance with the supplied instructions, and according to how it was ordered (tank size and diameter, mounting specified, and tank number).
3. All wires of the 2-412 transmitter are isolated from the body and housing of the transmitter. They should all measure open circuit to these points and to the conduits. If any resistance is measured from any of these wires to any of these points, then water has seeped in from the transmitter or wiring splices.
4. If the product float has been removed from the tube of the 2-412, make sure that it is replaced facing in the same direction. The magnet in the float will only work if it is oriented correctly.
5. If water is present in the housing of the 2-412 level transmitter, it must be removed and the Header Board, if present, inspected for water damage.
6. Check that the float moves freely on the shaft. Make sure that no parts were damaged in shipping or installation.

Functionality Tests:

Product Gauging:

Select gauging systems require a Header Board, part number 900310-1, be installed in the housing of the 2-412 to convert the resistance range of 72.5Ω per inch into a fixed total resistance of 2kΩ. If the Header Board is present, disconnect the wiring connector from J1. Disconnect the field wiring from the 2-412. Use an ohmmeter to measure the resistance between the Red and the Black wires coming out of the shaft of the 2-412 transmitter. The resistance of the 2-412 is 72.5Ω per inch of sensing length.

With the float at the bottom of travel, the reading between White and Black is 0Ω. With the float at the top of travel, the reading between White and Red is 0Ω. The reading between the Black and White wires will increase as the float moves up, and will be a ratio of the percentage of float travel to overall sensing length.

Approx. Tank Dia.	Gauging Length	Resistance	Ungaugable
4’	41.125"	2980Ω	6.875"
6’	65.125"	4720Ω	6.875"
8’	85.125"	6170Ω	6.875"
10’	113.125"	8200Ω	6.875"
12’	131.125"	9500Ω	6.875"

Example:

Gauging length = 85.125".
Overall resistance = (72.5Ω X 85.125”) = 6170Ω (Red to Black).

Float travel from bottom of transmitter 20".

Black to White resistance = (72.5Ω X 20”) = 1450Ω.
Red to White resistance = (72.5Ω X 65.125”) = 4720Ω.

Water Gauging (2-412W):

The Orange and Green wires are for the water detection float. They are connected to the ends of a reed switch that will measure open circuit or short circuit depending on the water float position.

Water Float Up (activated)	Orange to Green = closed circuit.
Water Float Down (not activated)	Orange to Green = open circuit.

Water/Temperature Gauging (2-412A):

Reconnect the 2-412A wiring to TB1 of the LMS 750. Measure the DC voltage between the Orange wire (Pin 5) and Black wire (Pin 1) to test the temperature aspect of the 2-412A. Measure the DC voltage between the Blue wire (Pin 6) and Black wire (Pin 1) to test the water level aspect of the 2-412A. Neither voltage reading should exceed 2.25 VDC.

Section 3.2: 2-501

The 2-501 tank transmitters are completely sealed units and cannot be repaired in the field. However, a series of simple measurements can be made to verify if the tank transmitter is operational. To test the 2-501 transmitter, it must be disconnected from the gauge unit. Always shut off power to the gauge when connecting or disconnecting any wiring.

Transmitter Inspection

1. Perform a visual check that all wiring is connected properly and that no water is present in any wiring splice or in the housing of the 2-501 level transmitter. If water is present in a splice or in the wiring it must be dried out. All splices should be waterproofed using Pneumercator supplied splice kits. NEMA 4 or better junction boxes should be used for all wiring splices located outdoors.
2. Make sure that the 2-501 level transmitter is installed in accordance with the supplied instructions, and according to how it was ordered (tank size and diameter, mounting specified, and tank number).
3. All wires of the 2-501 transmitter are isolated from the body and housing of the transmitter. They should all measure open circuit to these points and to the conduits. If any resistance is measured from any of these wires to any of these points, then water has seeped in from the transmitter or wiring splices.
4. If water is present in the housing of the 2-501 level transmitter, it must be removed and the transmitter inspected for water damage.
5. Check that the float arm moves freely. Make sure that no parts were damaged in shipping or installation.

Functionality Test:

Disconnect the field wiring from the 2-501. Use an ohmmeter to measure the resistance between the Red and the Black wires coming out of the 2-501 transmitter. The expected resistance of the 2-501 transmitter is 2KΩ.

The Black to White reading will increase as the float moves up, and will be a ratio of the percentage of float arm arc travel to overall float arm arc travel. The important thing to look for is that your readings steadily increase or decrease as the float arm moves up or down. The calculation of resistance is much more difficult on the 2-501 as opposed to the 2-412 due to the fact that the arm pivots in an arc.

Resistance (approximate)	Empty	Full
Red & White	1745Ω	55Ω
Red & Black	2000Ω	2000Ω
Black & White	255Ω	1945Ω

Section 4: Leak/Point Level Sensors

Section 4.1: 9-90x (9-901, 9-902, 9-903)

These sensors are active electronic sensors. They cannot be tested by a continuity check. When connected to the appropriate console, and power is applied, the following DC voltage readings can serve as a rough guide:

Wires	Voltage	Condition
Red to Black	3.5 VDC ±0.3	Any
White to Black	1.5 VDC ±0.5	Dry
White to Black	2.5 VDC ±0.25	Fuel
White to Black	3.0+ VDC	Water

Section 4.2: LS600 Series

This sensor is a dry contact state switch sensor with 1 to 4 floats. When ordering, each switch can have its dry state specified as open or closed. With the float in the Dry position, the wire pair should have continuity (short circuit) with solid color wire or no continuity (open circuit) with striped color wire. With the float in the Wet position, the wire pair should have no continuity (open circuit) with solid color wire or continuity (short circuit) with striped color wire. Contact Pneumercator for instructions on reversing the dry contact state.

The sensor can be tested with a continuity meter with the wiring disconnected from the monitoring system. Manipulate each float by hand to simulate both the normal and alarm states.

Function	Dry State	
	Closed (No Stripe)	Open (White Stripe)
Overfill	Gray	Gray
High High	Violet	Violet
High	Blue	Blue
Pump Stop	Red	Red
Pump Start	Orange	Orange
Low	Yellow	Yellow
Low Low	Brown	Brown

Section 4.3: LS600LD (LS600LDBN, LS600LDSN, LS600LDSS)

This sensor is a dry contact state switch sensor with a normal contact state of Open. The normal state of the sensor can be reversed by removing the float, flipping the float upside-down, and reassembling the sensor. The sensor can be tested with a continuity meter with the wiring disconnected from the monitoring system. Flip the sensor upside-down to simulate the alarm state.

Section 4.4: LS610

This sensor is a dry contact state switch sensor with a normal contact state of Closed. The sensor can be tested with a continuity meter with the wiring disconnected from the monitoring system. Manipulate the flapper door by hand to simulate both the normal and alarm states.

Section 4.5: RSU800-2

This sensor is a dual float normally closed switch sensor that is designed to be used in glycol or brine filled reservoirs monitoring the interstitial space. With the floats in the Normal position (top float down and bottom float up), the green and black wires should have continuity (short circuit). With either or both float(s) in Alarm position, the green and black wires should have no continuity (open circuit). Each float can be tested individually as well. The green and red wires will read continuity through the top float while the black and red wires will read continuity through the bottom float. The white wire is not used with any Pneumercator equipment.

Section 5: Maintenance

The system with its related level transmitters and/or leak/point level sensors should be tested with a minimum frequency as dictated by the local regulations. If these regulations are non-specific, then it is generally considered good practice to perform a full functionality test on an annual basis. However, some circumstances may indicate a more frequent inspection frequency. These circumstances include, but are not limited to, the presence of particles or other solid debris in the tank or an observed buildup is residue on the float and/or body. Inspection cycles may need to be increased to monthly or better to avoid functionality problems that could lead to the improper operation of the system. The accuracy of product level measurement should be verified by comparison to a dipstick measurement and recalibrated, as necessary.

Leak detection sensors should be visually inspected for fouling or clogging. A fouled or clogged leak sensor can give false alarms. If a leak sensor is fouled or clogged, it should be cleaned with soap and water or a mild solvent, and unclogged with compressed air. It may be air-dried or dried with a hair dryer. It is important that the sensor be completely clean and dry before reinstallation. After visual inspection, the leak sensors should be reinstalled, and recalibrated, as necessary.

If an actual leak occurs, after corrective action is taken, the leak sensors should be cleaned and inspected and recalibrated before reinstallation.