OPW
FUEL MANAGEMENT SYSTEMS

EECO System®

LLD-*Plus* Intrinsically Safe Option

Installation Manual

 Manual 340235 Rev. D

OPW Fuel Management Systems -
System and Replacement Parts Warranty Statement

Effective September 1, 2002

System and Replacement Parts Warranty

OPW Fuel Management Systems warrants that all OPW Tank Gauge and Petro Vend Fuel Control systems supplied by OPW Fuel Management Systems to the Original Purchaser will be free from defects in material and/or workmanship under normal use and service for a period of 12 months from the date of installation or 15 months from the date of shipment. Additionally, OPW Fuel Management Systems warrants that all upgrades and replacement parts (new and remanufactured) supplied by OPW Fuel Management Systems will be free from defects in material and workmanship under normal use and service for a period of 90 days from the date of installation or for the remainder of the system's original warranty, whichever is greater, as set forth in the first sentence of this statement. The foregoing warranties will not extend to goods subjected to misuse, neglect, accident, or improper installation or maintenance or which have been altered or repaired by anyone other than OPW Fuel Management Systems or its authorized representative.

The buyer's acceptance of delivery of the goods constitutes acceptance of the foregoing warranties and remedies, and all conditions and limitations thereof.

If a claim is made within the warranted time period that any equipment and/or remanufactured part is defective in material or workmanship under normal use and service, such equipment and/or remanufactured part shall be returned to OPW Fuel Management Systems, freight prepaid. If such equipment or remanufactured part is found by OPW Fuel Management Systems in its sole judgment, to be defective in material or workmanship under normal use and service, OPW Fuel Management Systems, shall, at its sole option, repair or replace such equipment and/or remanufactured part (excluding, in all instances, fuses, ink cartridges, batteries, other consumable items, etc.)

The warranties, as set forth above, are made expressly in lieu of all other warranties, either expressed or implied, including, without limitation, warranties of merchantability and fitness for any particular purpose and of all other obligations or liabilities on OPW Fuel Management Systems part. Further, OPW Fuel Management Systems neither assumes, nor authorizes any other person to assume for it, any other liability in connection with the sale of the systems, or any new/replacement part that has been subject to any damage from any act of nature or any *force majeure*.

The term "Original Purchaser" as used in these warranties shall be deemed to mean the authorized OPW Fuel Management Systems distributor to which the system or any new/replacement part was originally sold. These warranties may be assigned by the original purchaser to any of its customers who purchase any OPW Fuel Management Systems systems or new/replacement parts.

The sole liability of OPW Fuel Management Systems, for any breach of warranty, shall be as set forth above. OPW Fuel Management Systems does not warrant against damage caused by accident, abuse, faulty or improper installation or operation. In no event shall manufacturer's liability on any claim for damages arising out of the manufacture, sale, delivery or use of the goods exceed the original purchase price of the goods. In no event shall OPW Fuel Management Systems be liable for any direct, indirect, incidental or consequential damage or loss of product.

NOTES:

INTRODUCTION

This manual contains installation instructions for the EECO SYSTEM LLD-*Plus* system with intrinsically safe sensors. Any inquiries regarding installation of the system or these instructions should be directed to:

Emco Electronics
114-300 Mackenan Drive
Cary, NC 27511 USA
Attention: Technical Support Services Mgr.
(800) 342-6125 (Toll Free)
(919) 460-6000
(919) 460-7595 (Fax)

Important safety messages are located throughout this manual. Be alert to the possibility of personal injury. Carefully read the messages that are identified by the following notations:

Imminent Hazard Exists for serious personal injury or death!

Potential Hazard Exists for serious personal injury or death!

Potential Hazard Exists for personal injury/unsafe practice!

Helps to make the task easier or more understandable!

1.1 Safety Notifications

⚠ WARNING

- The EECO LLD-*Plus* features are designed to monitor various aspects associated with hydrocarbon fuels in a safe and reliable manner when installed as instructed herein. Deviation from these procedures, including the installation or use of non-approved components, could result in unsafe conditions or unreliable operation and will void the warranty. Safe installation is the responsibility of the installer and the user.
- This system is installed and operated near the highly combustible environment of an underground fuel storage tank and lines. It is essential to read carefully and follow the warnings and instructions in this manual to protect yourself and others from serious injury, explosion, or electrical shock.
- For safety reasons, we limit power in the wiring to sensors; still, you must keep that wiring physically separated from any other wiring. Your failure to do so could create danger to life and property.
- Leaking underground tanks can create serious environmental and health hazards.
- Failure to install this product in accordance with the instructions and warnings found in this manual will result in voiding of all warranties connected with this product.
- During installation and use of this product, you must comply with the national electrical code, federal, state, and local codes, and other applicable safety codes. Failure to comply with these warnings could result in serious personal injury, property loss, and equipment damage.
- Take precautions to ensure that vehicles ***cannot*** enter the work area during installation or service of sensors.
- All conduits must enter the console through specified conduit knockouts.

Additional United States requirements:

- Installation shall be in accordance with NEC (NFPA 70) and Automotive and Marine Service Station Codes (NFPA 30A and local codes).
- Wires for intrinsically safe sensors **must not** be run in conduit or areas of wireways (wiring troughs) that contain wires from any other device except where separated in accordance with NEC ANSI/NFPA 70 ARTICLE 504-30. The conductors of different intrinsically safe circuits that run in the same cable/conduit shall have at least 0.01" thick insulation.
- Circuits within the sensors and console barriers of the intrinsically safe option form an energy-limited system. The barrier, wiring, and sensors are listed intrinsically safe for Class I, Division 1, Group D hazardous (classified) or Ex ia IIB locations when installed according to these instructions.

Additional International considerations:

- Components within this system are not designed to be repaired and must be replaced by an equivalent component.
- Equipment when installed in accordance with the installation manual will not be subjected to mechanical stresses.
- This system has been designed such that it does not:
  - give rise to physical injury or other harm due to contact
  - produce excessive surface temperature, infra-red, electromagnetic, ionizing radiation

1.2 Spilled Product Containment

There is a likelihood that the release of fuel will occur during installation so the installer **must** be prepared to perform spill containment using accepted absorbent materials and following environmentally accepted practices for the proper transport and disposal of waste contaminated materials.

1.3 FCC Notice

This equipment generates, uses, and can radiate radio frequency energy. If it is not installed and used in accordance with these instructions, interference with radio communications may result.

1.4 Certifications

One or more of the following certifications covers the system and accessories included in this document.

Apparatus	Agency	Standards	Locations	File/Certificate No.
North America				
Intrinsically Safe Barrier Model 439756	ETL	UL 913	Class I, Division 1, Group D	3013896A
Pressure Transducer Model 439757				
Europe				
Intrinsically Safe Barrier Model 439756	DEMKO	EN50020 EN50014 50081.2 50082.2	[Ex ia] IIB	01E.130703X
Pressure Transducer Model 439757			Ex ia IIB T4	01E.131149

2. General Description

The EECO SYSTEM® LLD-*Plus*, a liquid line leak detector system, consisting of a solid-state pressure sensor and a display console, is a permanently attached system for evaluating pressurized piping system integrity.

The LLD-*Plus* system works by using the electronic measurement of time and line pressure to calculate a pressure decay profile that can be compared to a standard profile for the line. The LLD-*Plus* system is designed to operate at constant pressure and has a unique memory feature that learns and compensates for piping characteristics (volume, elasticity, etc.) so accurate detection of leaking conditions will be obtained.

The LLD-*Plus* system can be installed easily in existing piping systems or be made part of a new installation during initial construction. The LLD-*Plus* system can perform the 3 GPH, .2 GPH, and.1 GPH tests for product loss evaluations in compliance with EPA UST regulations CFR Part 280 Subpart D.

An interface to the submersible pump allows the system to automatically run line tests during periods of inactivity and allows the system to shut down the pumping system when a leak test failure occurs. Test results are presented in visual form on the system console.

2.1 Sensor Options

Two (2) sensor models are available to provide the most flexibility possible for installation purposes. The choice is based on site conditions. The application possibilities are as follows:

■ The **intrinsically safe** version must have the wiring routed in dedicated conduit. This configuration is approved for use in locations accepting UL® or CENELEC certifications.

■ The **explosion-proof** version can have the wiring routed in existing conduit with control or power circuits. This configuration is only approved for use in locations accepting UL® certifications.

The **intrinsically safe** and **explosion-proof** versions of the sensor can be installed either under a dispenser or in the STP sump, and communicate with the console over a 3-wire shielded cable. The explosion-proof sensor wiring **must** be routed into an explosion-proof junction box that is located within 12 inches (30cm) of the sensor, from which point a dedicated cable can be routed to the console. The intrinsically safe wiring can be terminated to the 3-wire cable inside the pressure sensor body, and the field wiring routed either through conduit dedicated to intrinsically safe circuits or direct buried from the sensor to the console. Direct burial installation kits are available from your Emco Electronics distributor.

This document covers only intrinsically safe sensor installations. Refer to manual 340236 for explosion-proof installation instructions.

2.2 User Interface Options

Two system configurations are available for viewing and recording test results. Both provide continuous monitoring of the piping system and provide visual and audible indications of test results.

A stand-alone system provides visual indicators of the system operating status and test results on the front of the system console. Permanent records of the test results must be manually kept by the user for future reference. Leak tests of the piping system will be automatically initiated by the system or can be manually started with the front panel switch.

A connected version of the system allows the user to interface with the leak detection system through an EECO SYSTEM ATG console. The connected system automatically reports all test results to the ATG system for future retrieval of the data through the reporting tools available in the EECO SYSTEM. These may be accessed as printed reports, visual reports through the console display, or may be accessed by external systems through modem or a serial interface.

Figure 1 - LLD-Plus Stand-alone system

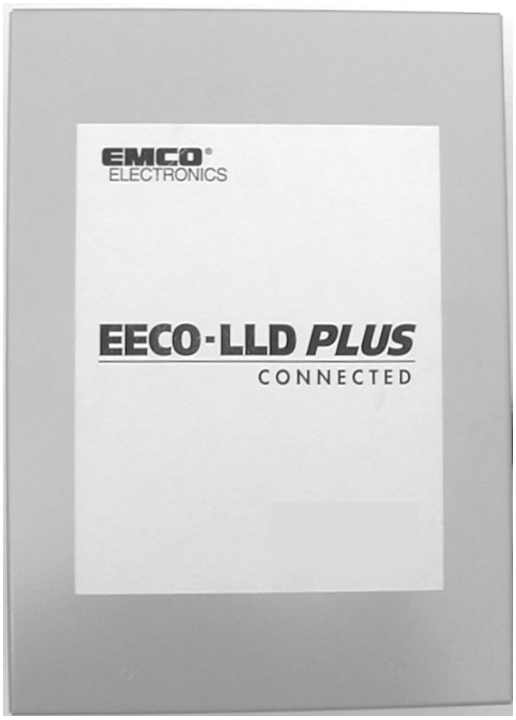

Figure 2 - LLD-Plus Connected System

2.3 Theory of Operation

Pressurized fuel is trapped in the piping between the STP and the dispenser. The pressure is monitored by a solid-state pressure sensor that is permanently installed beneath the dispenser at the shear valve test port or at the STP.

The pressure sensor measures the product line pressure and transmits the measurements to a console that is mounted in a non-hazardous location. The console's electronics control the STP operation and analyze the line for leaks.

During calibration, the system learns the piping system's characteristics. Line pressure decay measurements can later be compared to those stored during calibration to determine if the line is in compliance.

2.4 Leak Testing

A 3-gallon per hour **(3 GPH) leak test** is performed automatically every 45 minutes. Manual tests can be performed on demand. The test cycle consists of three (3) consecutive tests, spaced five (5) minutes apart. If all three tests pass, the system is declared "in compliance." If all three tests fail, the system alarms and the line is forced "off." Testing continues until the line has been idle for at least three (3) hours.

A 0.2-gallon per hour **(0.2 GPH) leak test** is performed automatically after the line has been out of service for three (3) hours. Manual tests can be performed on demand, but should be forced only after the line has been idle for at least three (3) hours. The 0.2 GPH test is conducted until a test passes or until a dispensing cycle occurs.

A 0.1-gallon per hour **(0.1 GPH) leak test** is performed automatically after the line has been out of service for six (6) hours. Manual tests can be performed on demand, but should be forced only after the line has been idle for at least six (6) hours. The 0.1 GPH test is conducted until a test passes or until a dispensing cycle occurs.

A **pressure-up check** is performed each time the pump is activated. The pressure-up check will disclose a gross (greater than 3PSI) leak condition such as a broken pipe. The line pressure must reach 15 PSI within two (2) seconds to pass this check. If this test fails, the system will alarm and the line will be forced "off." This may indicate a broken pipe, an open check valve in the STP or under the dispenser, or the fuel level is below the intake port of the STP itself. Other reasons may include the following: the STP did not operate (i.e., circuit breaker or STP power switch may be off) or there is a motor fault.

2.5 Trademarks

Trademarks and brand identifiers used in this publication other than those held by OPW Fuel Management Systems:

- Teflon® is a registered mark of E.I. DuPont de Nemours.
- Red Jacket® is a registered mark of Marley Pump Co.
- UL® is a registered mark of Underwriter's Laboratories, Inc.

3. Product Specifications

3.1 LLD-*Plus* Console Specifications

Dimension	9” W, 12.5”H, 3.75 “D (22.9 x 31.8 x 9.5 cm)
Weight	10 lbs.
Operating Temperature	32º to 104º F (0º to 40º C)
Humidity	90 % RH (maximum) non-condensing
Typical Mounting Location	Non-hazardous area, indoor, protected
Power requirements	120/240 volts AC± 10%, 50/60 Hz,

Item	Part Number	Remarks
Console, LLD-*Plus* (Figure 1& Figure 2)	439759-xxx 439758-xxx	Stand-Alone system Connected System
Calibrated leak generator kit (Figure 3)	439678	(1) supplied per system (1) Leak device assembly
Red Jacket® STP relief valve spring kit (Figure 5)	439681	(1) supplied per line (2) Springs
Accessory fitting kit (Figure 4)	439690	(1) supplied per line (1) Bushings, ¾” x ½” (1) Tubing retainer (2) Compression fitting, ¼” x ¼” NPT (1) Close nipples, ¼” (1) Tee, ¼” (1) Bushing, ¼”x 3/8” (1) Bushing, 1/8” x ¼” (1) Plug, 1/8”
Installation manual	340235	(1) supplied per system
Safety tag	270330	(2) supplied per line
Intrinsically safe barrier	439756	(1) supplied per line
Intrinsically safe Pressure sensor	439756	(1) supplied per line (1) Intrinsically safe sensor assy. (1) Reducer coupling, ¾” X ½” (2) Cable grips (3) Wire nuts

Table 1 - System Component Listing

Figure 3 - Calibrated Leak Generator

Figure 4 - Accessory Fitting Kit

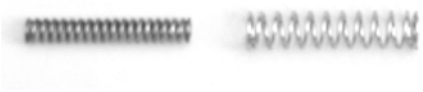

Figure 5 - Spring Kit

3.2 Pressure Sensor Specifications

The pressure sensor provided as part of the LLD-Plus system is a completely encapsulated strain gauge. All wetted surfaces are brass, stainless steel (17-4), or Teflon. Each sensor kit is supplied with an accessory fitting kit for installation either at the STP or at the dispenser. Refer to Table 1 for listing of supplied components and accessories.

Pressure Range	0 - 100 PSI
Output Signal	Voltage: 1 – 5 VDC
Supply	9 – 30 VDC
Pressure connections	¼" NPT Female
Burst Pressure	500 PSI
Accuracy	1% of full scale @ 75°F
Operating Temperature	-4°F to 185°F (-20°C to 85°C)
Thermal Sensitivity	<0.035% / °F (0.065%/°C)

The intrinsically safe sensor allows field wiring from the console barrier to be routed directly to the sensor and terminated in the body of the sensor. Dedicated conduit or armored cabling is required to maintain the intrinsically safe environment. A compression fitting seals the termination point from external moisture.

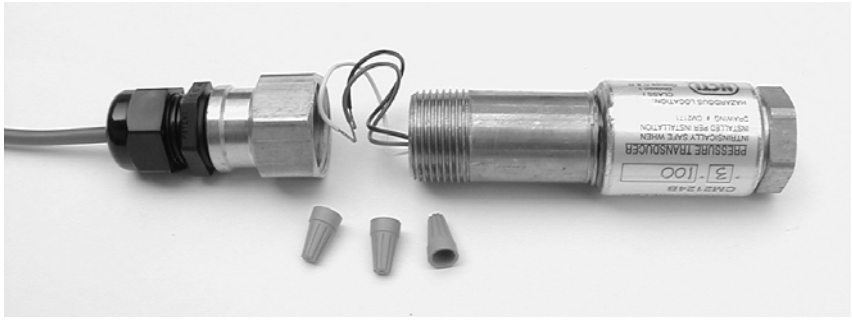

Figure 6 - Intrinsically-safe Sensor (#439675)

Figure 7 - Intrinsically-safe Barrier (#439756)

3.3 Accessory Items

Additional items (not supplied) may be needed to complete the installation. A list of likely items that will be required is as follows. Our list is by no means a complete one. Use the chart as a worksheet as part of an installation site survey presented in the next section to estimate the full scope of work.

Item	Remarks
Conduit and fittings	Conduit may be approved metal or metal-clad in the non-hazardous zones, but must be rigid in the hazardous zones.
Plug: 2" – NPT	For use in sealing the STP leak detector port upon removal of mechanical leak detector sensors.
Thread sealing compound	Use a compound rated for gasoline and other petroleum products. Avoid Teflon® tape because it may foul threads and damage cast fittings.
Rolls of 12 AWG stranded wire in green color	Rated oil and gasoline resistant.
Rolls of 12/14 AWG stranded wire in various colors	Rated oil and gasoline resistant. Choose white, and black (minimum).
Roll of 3-conductor shielded cable for field wiring	18 AWG, 600 volt, recommended.
Tools and workplace safety implements	● Electrical tape ● Fish tape ● Conduit installation tools ● Spill cleaning materials ● Wire stripper ● Wire terminal markers or tags ● Liquid damped pressure gauge (0 to 60 PSI) ● Volt – ohmmeter ● Wide selection of hand tools including the following: Wrenches (all kinds) including box, open end, pipe, and adjustable. Screwdrivers (all kinds). Power drill and bits suitable for the tasks and Materials at hand. ● Safety related implements including the following: Fire extinguishers for fuel and electrical application. Eyewear for liquid injury protection. Traffic barrier cones, "AT WORK", and "OUT OF SERVICE" signs. Safety apparel (as required at the job site). Lock out – tag out equipment.
Anchoring fasteners	Selected on the basis of mounting wall type

4. Installation

The duties explained in this document cover 5 principal tasks listed as follows:

- Site Survey and leak detector kit content verification
- Removal of previously installed mechanical or electronic leak detection devices
- Installation of the selected LLD-*Plus* System
- Purging any air from the lines that may have been introduced by the installation
- Verification that the installed system performs in accordance with its specifications

4.1 Pre-Installation Site Survey

Prior to conducting the installation, a site survey should be conducted to evaluate conditions at the location to be sure that the actual work will go smoothly. A prime issue is inspecting the job site's piping for no visible signs of leaks. Any visible leaks **must** be repaired prior to installing the LLD-*Plus* system. This survey will also help determine if the piping system to be monitored is within the operational parameters of the LLD-*Plus* with regards to performing leak tests.

The following is a guide for performing a pre-installation site survey for major hardware items.

Item	Things to look for -- actions to take
Console	Locate the console on a portion of the wall near the electrical service's breaker panel and evaluate the routing of installation conduit as well as the need for an additional junction box allowing the connection of the LLD-*Plus* product to a dedicated circuit. This circuit **must** be on the same phase as the dispenser power. Bear in mind that future access for other electrical devices as well as adequate space for ongoing maintenance must be considered when choosing the console mounting location. The console must be installed in a non-hazardous location since it is not rated for hazardous zone applications. Wiring will enter the console on both the left and the right hand side. Refer to Figure 11 on Page 15 for clearance requirements. Be sure that the console location will be well above the floor to reduce possible flood damage caused by storms or on-site plumbing failures. If the LLD-*Plus* system is being installed in a stand-alone configuration the console will be used as a results display or enunciator for the leak detection tests and it will need to be kept accessible and visible for site personnel's use. If the LLD-*Plus* system is being connected to an EECO SYSTEM automatic tank gauge system it will need to be located within 10 feet (3 meters) of the ATG system. If a second console will be installed at the same location it should be mounted as close as possible to the first console to allow interconnection of the system communications network (Refer to section 4.8).
Pressure Sensor	The pressure sensor may be threaded into a fitting on the dispenser's shear or impact valve and **must** remain below the shear line of the impact or shear valve. Clearance to gain access for the sensor at the dispenser may be limited if previous conduit runs block or obscure the connection location. Re-routing of interfering conduit may be required or the sensor may need to be installed under a different dispenser where better access is available. **Caution: The pressure sensor and wiring MUST NOT interfere with the proper operation of the shear or impact valve.** Conduit containing sensor wiring from the dispenser sump or STP sump **must** contain only cables from other intrinsically safe devices. Shielded cables **must** be used in these installations to maintain approved separation between circuits. If direct burial is desired, follow the associated instructions in the direct burial installation kit.
General	It will be necessary to remove power from the dispensing and pumping system during installation. Read and understand all procedures prior to beginning site work. Check the packing list to make certain the appropriate components have been supplied for the job.

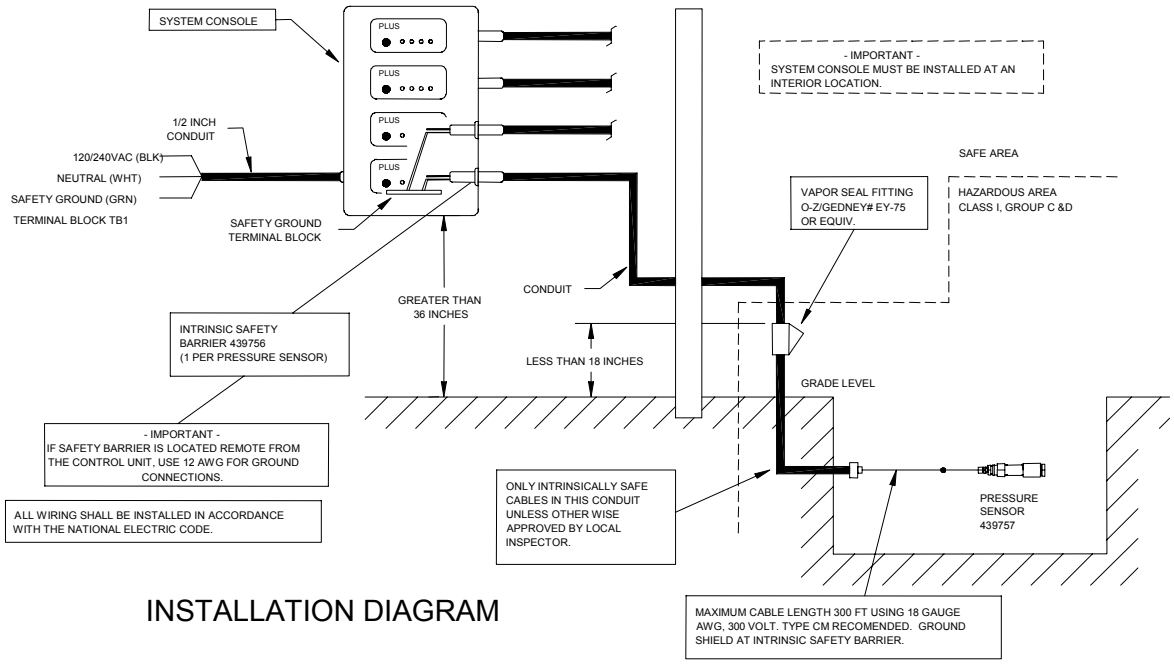

Figure 8 - Intrinsically safe Installations

4.2 Pre-Installation Piping Evaluation

A pre-installation site evaluation test **should** be performed **prior** to the installation of the EECO SYSTEM® LLD-*Plus* to insure the piping system to be monitored is within the operational parameters of the system and does not have existing problems that will affect the performance of the LLD-*Plus*. This test will evaluate two conditions for compliance; piping tightness and piping bulk modulus.

The pipeline tightness is evaluated to be in the acceptable range as follows:

1. Install a 0-60 PSI pressure gauge, preferably liquid-filled, on the pipeline. Use proper Lock-Out & Tag-Out procedures to isolate the pump from power whenever opening pump or line.
2. Operate the pump and observe the pressure gauge. The seating or check pressure must be less than the pumping pressure, and both must be at least 24 PSI. If not, adjustments must be made by either adjusting the functional element or installing the springs supplied with the LLD-*Plus*. Refer to "Submersible Pump Modifications" for instructions.
3. Observe the seating pressure for 5 minutes. If the pressure does not gain or lose more than 5 PSI in 5 minutes, the test has passed.

If this test should fail, wait thirty minutes with no fuel pumped through the line and repeat the test. A second failure indicates a leak in the piping system or possibly large thermal expansion or contraction of the line. It may take as much as three hours for all thermal activity to end.

The piping bulk modulus (springiness) is evaluated as follows:

1. Install the Leak Generating Device as shown in the Installation instructions. (The pressure gauge should still be installed in the line.) Use proper Lock-Out & Tag-Out procedures to isolate pump from power whenever opening the pump or line.
2. Operate the pump to pressurize the line, and then shut off the pump.
3. Using a stop or wrist watch, record the time it takes for the pressure to drop as fluid is being released through the Leak Generating Device into an approved container.
    - For the 0.1 GPH leak detection, the pressure must drop from 17.5 to 15.0 PSI in no more than 4.25 seconds.
    - For the 0.2 GPH leak detection, the pressure must drop from 17.5 to 15.0 PSI in no more than 8.50 seconds.
    - For the 3.0 GPH leak detection, the pressure must drop from 10.0 to 7.50 PSI in no more than 4.5 minutes.

If any of these tests fail, that type of leak detection will not be possible with the EECO SYSTEM® LLD-*Plus*.

4.3 Console Mounting

The EECO LLD–*Plus* console must be mounted on a wall surface near the submersible turbine pump (STP) relays and the AC electrical power service panel in the non-hazardous zone. Placement of the console must consider accessibility for the station operator and service requirements for all building apparatus located in the vicinity of these, and other electrical devices.

Field wiring for the pressure sensors enters the console on the right side. The intrinsically safe sensor option requires additional clearance on this side for the installation of the barrier modules and a box for field wiring termination. The AC power supply enters the console on the left side of the enclosure. Refer to Figure 11 for typical clearance requirements.

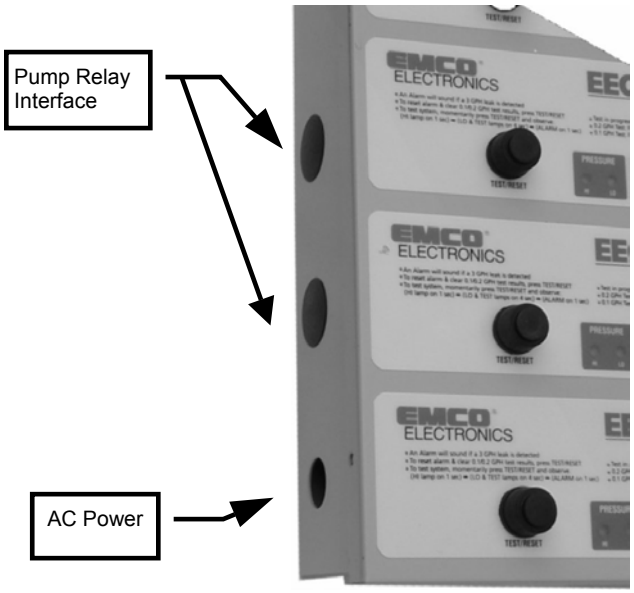

Figure 9 - Dispenser / Supply Power Wiring Entry

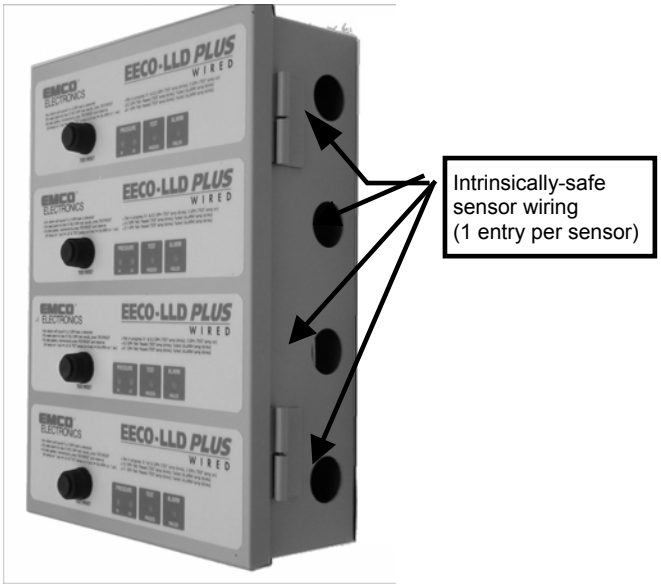

Figure 10 – Sensor Wiring Entry

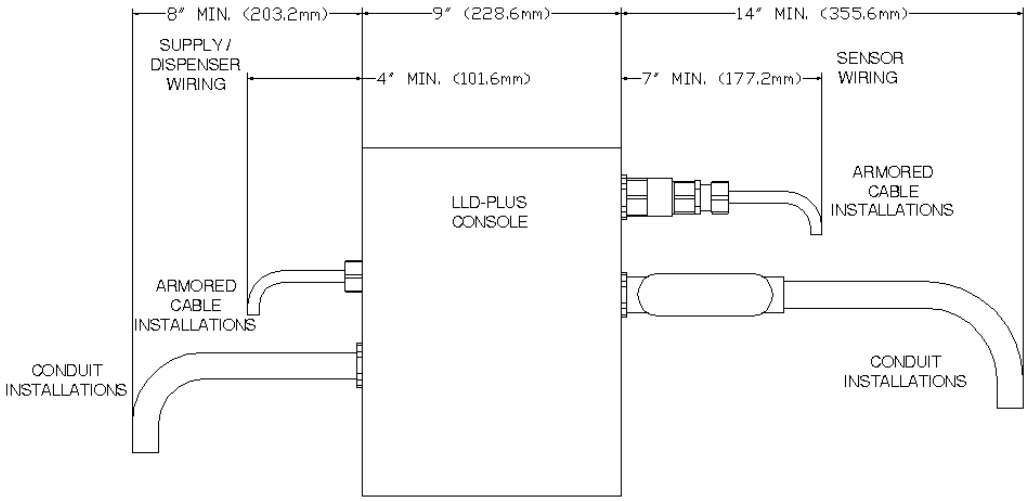

Figure 11 - Console Clearance Requirements

4.4 Submersible Pump Modifications

A line pressure of at least 24 PSI needs to be maintained after the pump is turned off for line leak detection. In some older style pumps this may require the replacement of the relief valve spring. A pair of new springs is provided for Red Jacket® submersible turbine pumps (Figure 5).

For Red Jacket® pumps equipped with the adjustable functional element, simply increase the seating pressure of the functional element by turning the brass screw clockwise. Turning the screw counter-clockwise will decrease the seating pressure.

For locations that utilize the vacuum of the functional element, i.e., vapor recovery or manifold tank systems, a minimum five (5) PSI differential **must** be maintained between the operating and seating pressure (24-PSI minimum) of the STP.

The springs are installed using the following steps:

1) Confirm that power is disabled to the STP using Lock Out – Tag Out procedures.
2) Relieve line pressure from the dispenser product line. With the STP power turned off, activate the dispenser; open the dispenser hose nozzle and direct pressurized fuel into an approved container until flow ceases.
3) Remove and retain the six- (6) screws located atop the functional element of the Red Jacket STP.
4) Remove and retain the plunger.
5) Remove and replace the plunger spring with the new ones supplied in the kit as shown in Figure 12.
6) Reassemble the functional element of the STP using the retained screws.

7) Apply a Safety Tag at the STP sump alerting personnel of the leak detection system installation.

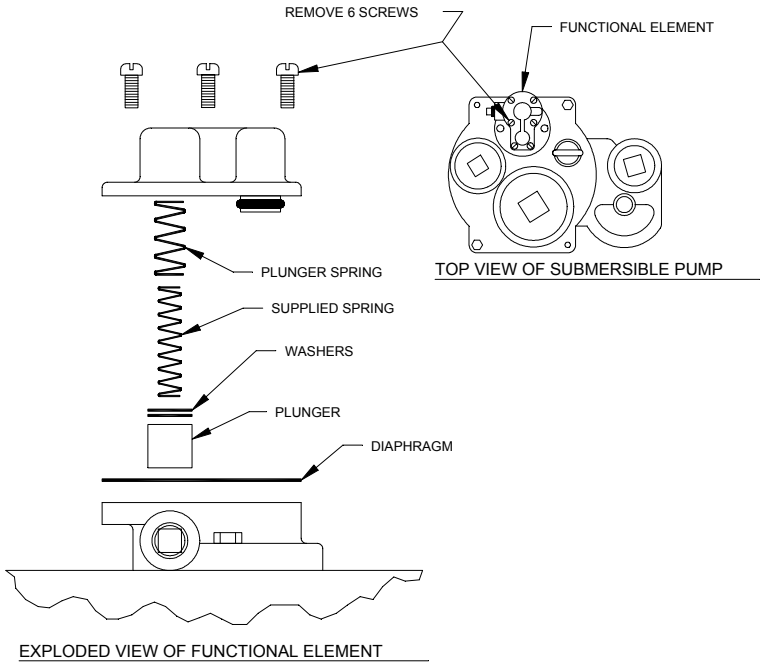

Figure 12 - Functional Element and Relief Valve Springs

4.5 Intrinsically Safe Sensor Installation

The intrinsically safe system option includes a safety certified barrier that is installed at the system console in line with the sensor field wiring. The barrier limits the available energy that can pass from the console to the sensor to an amount that is incapable of igniting the atmosphere in the hazardous area.

Special precautions must be taken to ensure that the performance of the barrier is not limited in any way. Read the instructions below carefully and contact the factory prior to installation if there is any confusion regarding the proper installation practices.

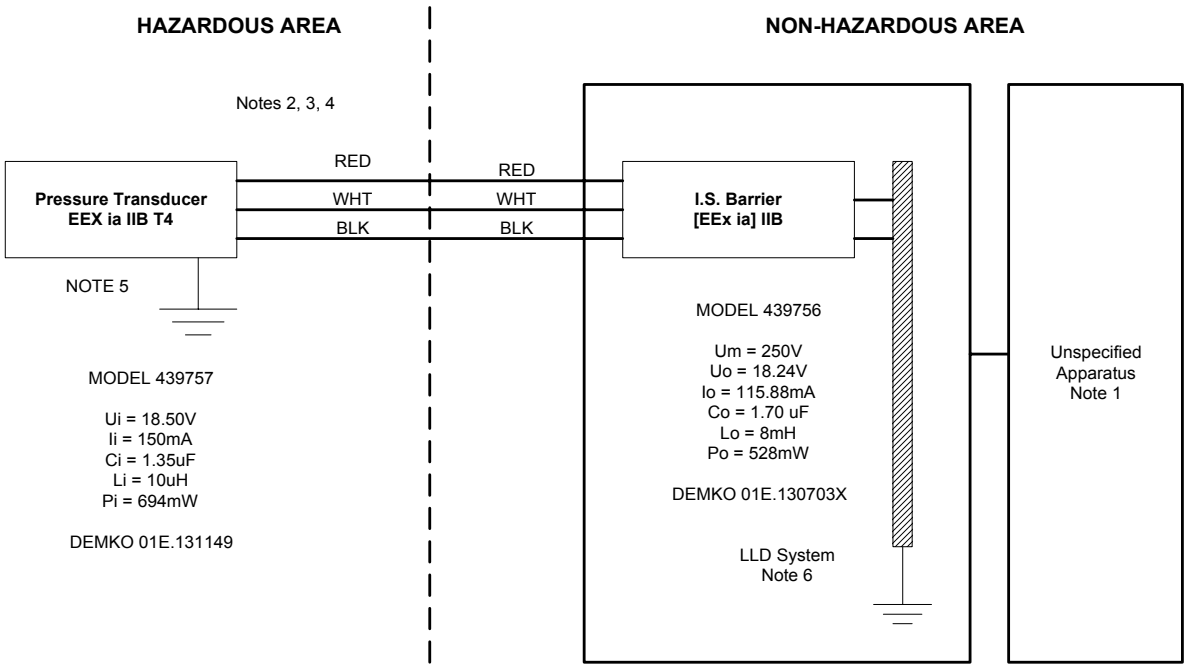

Figure 13 - Intrinsically Safe Installation Diagram

WARNING

1. Non-hazardous area apparatus unspecified except that it must not be supplied from nor contain under normal nor abnormal conditions, a source of potential with respect to earth of 250V RMS or 250V DC.
2. The electric circuit and the interconnection cables in the hazardous area must be capable of withstanding an AC test voltage of 500V RMS to earth or frame of the apparatus for 1 minute.
3. The capacitance and/or the inductance of the cable connected between the intrinsic safe barrier and the pressure transducer must not exceed the following values:
   Group IIB
   Capacitance: 0.35uF
   Inductance: 7.99mH
4. Interconnecting cables between the transducers in the hazardous area and the intrinsic safe barrier must be individual cables.
5. Transducer must only be used on earth grounded piping systems where the earth ground electrical connections can be made via the threaded pipe connection.
6. Earthing arrangements and installation must comply with the installation requirements of the country of use.
7. Earth connection at the console must be made with 12 AWG wiring (min.).
8. Installation must be performed by a trained technician according to all applicable codes and regulations.

4.5.1 Installation at the STP

Disconnect power for the submersible turbine pumps (STP) to prevent accidental operation, explosion or electrical shock while wiring connections are exposed. Follow recognized Lock Out - Tag Out procedures to prevent accidental re-connection and operation of the pumps and dispensers until the installation is made safe enough to restart the fuel delivery system.

Relieve line pressure by activating the dispenser and open the hose nozzle while directing fuel into an approved container until flow ceases.

Disconnect power from the dispensers.

Remove the mechanical leak detector from the STP leak detector port, if one is installed, and collect any spilled fuel using approved methods, absorbent materials and containers for proper disposal.

Install the intrinsically safe pressure sensor in the STP leak detector port using the supplied 2" x ¼" NPT reducer bushing using an approved thread compound and tighten to seal the plug and port against leaks.

Pull a dedicated 3-conductor shielded cable from the intended location of the LLD-*Plus* console to the intrinsically safe pressure sensor. Belden 27334AS cable is recommended. This is a 3-conductor, 18 AWG, shielded, 600 volt cable that can be used for either conduit or direct burial applications. Other shielded cables should be suitable. 18 AWG is recommended for long wiring runs (up to 1500 feet). Secure the cable from mechanical strain. The cable must not be run in ductwork containing non-intrinsically safe wiring such as pump power wiring or signal cabling. Where required by code, pull a separate 12 AWG ($4mm^2$) ground wire from the sensor to the console.

Connect the wires from the shielded cable to the 3 wires of the intrinsically safe pressure sensor using wire nuts (supplied). Note the colors of the splices for future reference. The shield wire may not be used as one of the conductors for the pressure sensor wiring. The pressure sensor must connect to three separate insulated conductors.

NOTE: DO NOT CONNECT THE SHIELD WIRE AT THIS END.

Insert the completed splices into the top end of the intrinsically safe pressure sensor and secure them by tightening the cap with its cord grip fitting. Make sure a liquid tight seal is created between the cable and the sensor housing.

Apply a Safety Tag on the STP and at each dispenser alerting service personnel of the leak detection system installation.

4.5.2 Installation at the Dispenser

Disconnect power for the submersible turbine pumps to prevent accidental operation, explosion or electrical shock while wiring connections are exposed. Follow recognized Lock Out – Tag Out procedures to prevent accidental re-connection and operation until the installation is made safe enough to restart the fuel delivery system.

Relieve fuel pressure from the dispenser product line. With the STP power turned off, activate the dispenser; open the dispenser hose nozzle and direct pressurized fuel into an approved container until flow ceases.

Disconnect power from the dispensers.

Remove the mechanical leak detector from the STP leak detector port, if one is installed, and collect any spilled fuel using approved methods, absorbent materials and containers for proper disposal.

Install a 2"- NPT plug (not supplied) in the STP leak detector port using an approved thread compound and tighten to seal the plug and port against leaks.

Remove the threaded plug from the shear or impact valve as shown in figure 5 and collect any spilled fuel using approved methods, absorbent materials and containers for proper disposal.

Install the intrinsically safe pressure sensor in the shear valve test port under a dispenser. It is vital that the sensor installation at the shear valve not hinder the valve function, which is to provide a controlled break location and to interrupt flow. To accomplish this, the sensor must not extend above the controlled break zone. The sensor must be installed in the lower section of the shear valve and its connecting wires must be positioned so as to protect the sensor and lower section of the shear valve from damaging mechanical forces.

Verify that the shear or impact valve is properly anchored.

⚠ WARNING

The Pressure Sensor may be oriented any way as needed to connect with the shear valve as long as the sensor remains below the shear line of the valve and does not interfere with the proper operation of the valve. Orientation choice may be based upon gaining the best access for making secure wiring connections.

Pull a dedicated 3-conductor shielded cable from the intended location of the LLD-*Plus* console to the intrinsically safe pressure sensor. Belden 27334AS cable is recommended.

This is a 3-conductor, 18 AWG, shielded, 600 volt cable that can be used for either conduit or direct burial applications. Other shielded cables should be suitable. 18 AWG is recommended for long wiring runs (up to 1500 feet).

Secure the cable from mechanical strain. The cable must not be run in ductwork containing non-intrinsically safe wiring such as dispenser power wiring or signal cabling.

An alternate means using direct burial may be used. Follow associated instructions in the direct burial installation kit.

Connect the wires from the shielded cable to the 3 wires of the Intrinsically Safe Pressure sensor using wire nuts (supplied). Note the colors of the splices for future reference. **The shield wire may not be used as one of the conductors for the pressure sensor wiring**. The pressure sensor must connect to three separate insulated conductors.

Note: DO NOT CONNECT THE SHIELD WIRE AT THIS END

Insert the completed splices into the top end of the intrinsically safe pressure sensor and secure them by tightening the cap and then the cord grip fitting. Make sure a liquid tight seal is created between the cable and the sensor housing.

Apply a Safety Tag at each dispenser sump alerting service personnel of the leak detection system installation.

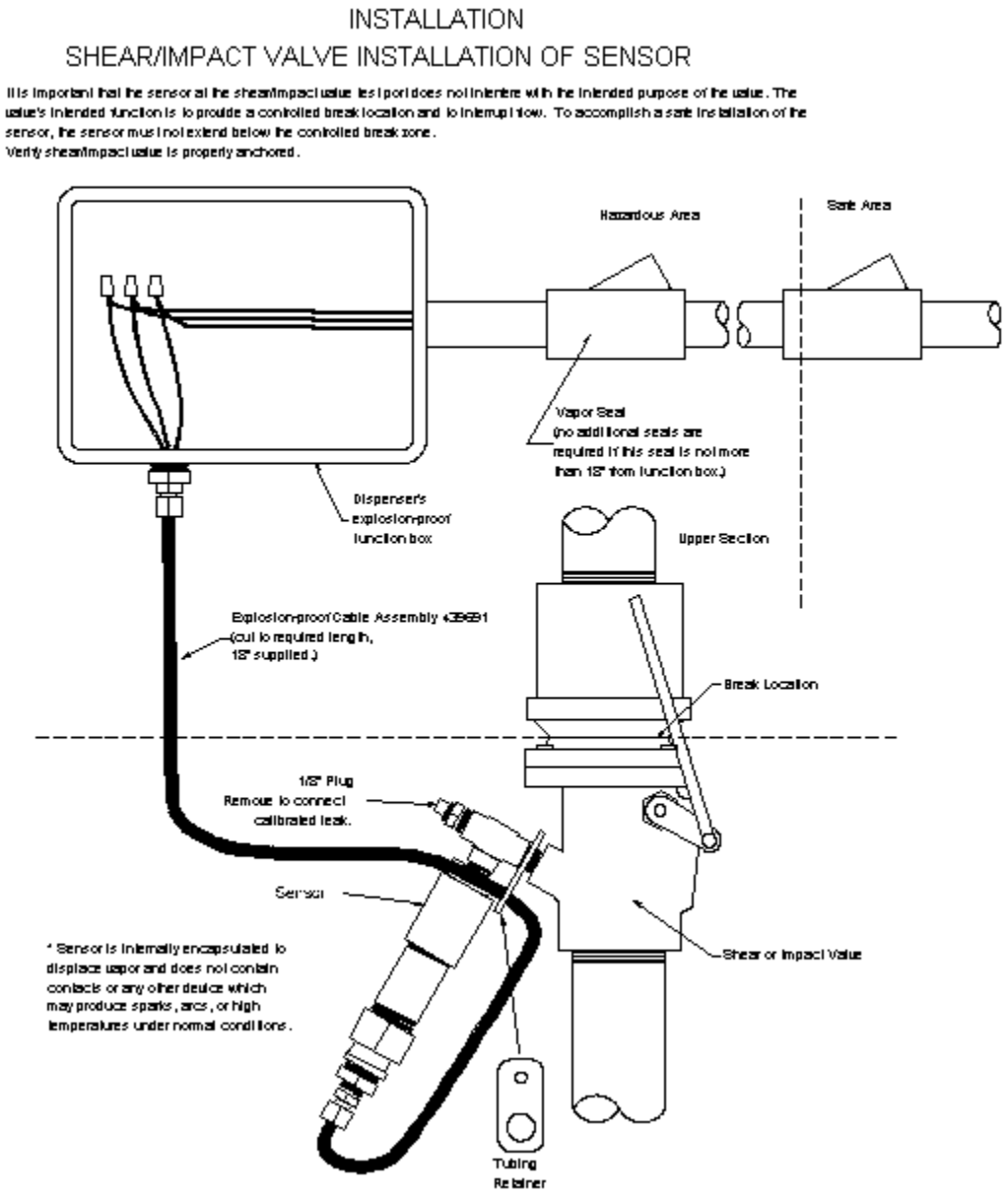

Figure 14 - Sensor Mounted at Dispenser

4.6 Console Wiring

The console wiring instructions have been divided into four sections; supply power, dispenser/pump, sensors, and ATG communications. The ATG communications section is only applicable when connecting the LLD-Plus to an automatic tank gauge system. Read the entire section prior to beginning the wiring process.

4.6.1 Supply Power Connections

Check to make certain that the system is configured for the appropriate line voltage before connecting supply wiring. Jumpers "A", "B", and "C" at the lower left corner of the console configure the line voltage. For 115VAC applications install jumpers "A" and "B". For 230VAC applications install jumper "C".

Connect the supply power wiring to connector TB9 as shown in the table below.

TB 9	Description	Remarks
1	Line (L1)	Must be SAME PHASE as dispenser power.
2	Neutral (L2)	
4	Ground (Earth)	12 AWG (4mm^2) required

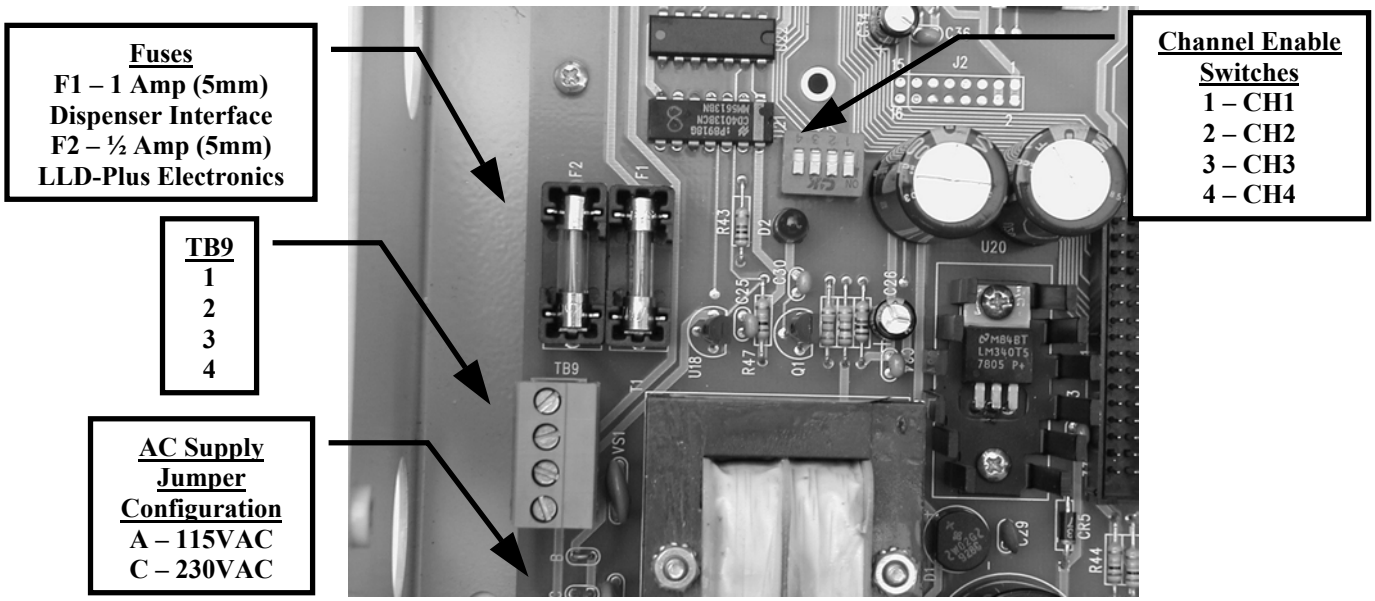

Figure 15 - AC Supply Power Connections

4.6.2 Dispenser / Pump Connections

TERMINAL BLOCKS TB2, TB4, TB6, and TB8 are the designated wiring terminals for channels 1,2,3, and 4. Conduit or a suitably armored cable should be connected between the wiring openings on the left side of the console and the pump relay box**. Note: If multiple consoles are being installed as part of the system, it is recommended that the upper left opening in the console be reserved for connecting the two consoles (Refer to section 4.8).**

Disconnect the wire from the pump relay that comes from the dispenser. Connect it to terminal 2. Connect a new wire from terminal 1 to the pump relay coil.

Channel	Terminal Block	Pump Relay	Lever Switch (Pump Request)
1	TB2	1	2
2	TB4	1	2
3	TB6	1	2
4	TB8	1	2

Table 2 - Pump Relay Wiring

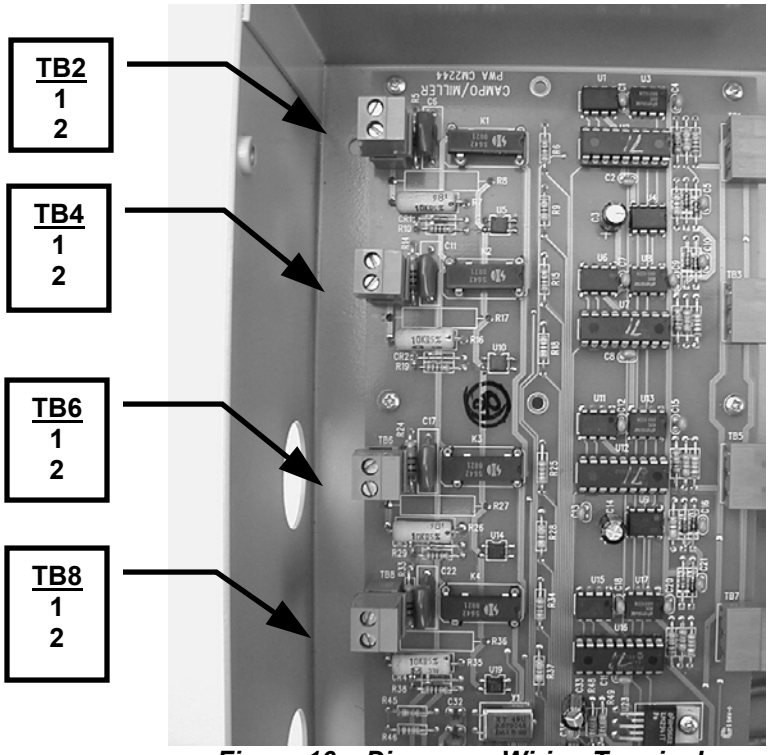

Figure 16 – Dispenser Wiring Terminals

4.6.3 Intrinsically Safe Barrier Connections

One intrinsically safe barrier must be connected between the console and each sensor. The barrier must be located in the non-hazardous area. It is recommended that the barrier be mounted on the console as shown in *Figure 17*. Wiring between the barrier and the sensor must be isolated from non-intrinsically safe circuits and wiring. If a dedicated wireway is not available, the barrier can be installed in a junction box outside the hazardous area or in an explosion-proof junction box in the hazardous area. Always follow local and national codes when selecting an installation procedure.

The barrier has two green GROUND wires protruding from the unprotected end (opposite the threaded end). Both of the green wires must be connected to earth ground at the system console. A wiring resistance of less than 1 ohm to earth must be maintained to assure proper operation of the barrier. A grounded busbar is provided in the console.

The three remaining signal wires on the unprotected end of the barrier connect to one of the four terminal blocks on the supply board. The barrier wiring for channels 1,2,3, and 4 connect to terminal blocks TB1, TB3, TB5, and TB7, respectively. Refer to *Figure 17* and Table 3.

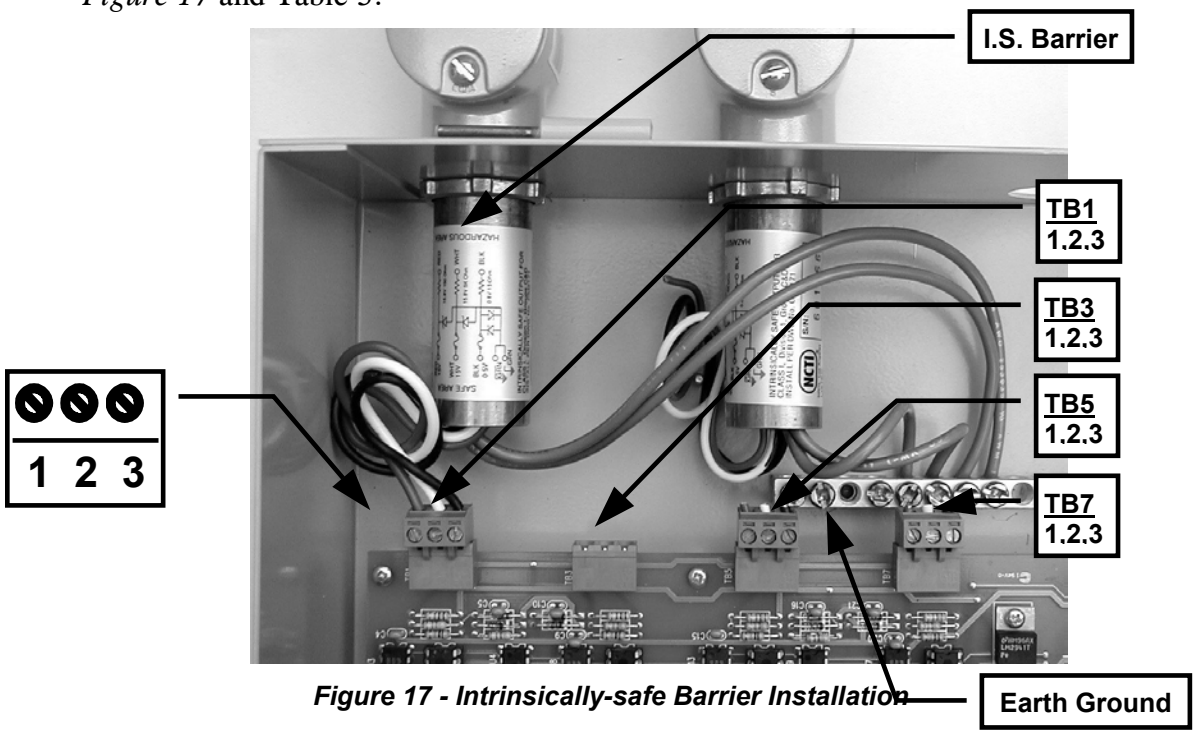

Figure 17 - Intrinsically-safe Barrier Installation

Terminal #	Wire Color	Description
1	Red	Supply (+10V)
2	White	Signal
3	Black	Ground
(Ground busbar)	Green	Earth ground
(Ground busbar)	Green	Earth ground

Table 3 - Barrier Wiring

4.6.4 Sensor Field Wiring Connections

Several options are available for terminating the field wiring from the sensors to the intrinsically safe barrier. Always follow national and local codes in selecting the appropriate method for this installation.

CONDUIT INSTALLATIONS

An electrical splicing box with a ¾" opening for connection to the intrinsically safe barrier must be connected to each I.S. barrier on the right side of the LLD-Plus console (Figure 18). Alternately, a wiring tray (Part No. 401172) is available from OPW Fuel Management Systems to reduce wall space requirements. The tray attached to the right side of the console and provides space for making field wiring terminations. The sensor and the intrinsically safe barrier wiring follow the same color-coding. Connect the shield from the field wiring to the green wire ground.

Figure 18 - Sensor Junction Box Connections

ARMORED CABLE INSTALLATIONS

Where code allows the use of armored cable in place of conduit, a termination well is available for splicing field wiring at the intrinsically safe barrier (Part No. 401171). The well consists of an adapter with 1" NPT female threads on one end and ¾ NPT threads on the opposite end and a compression fitting for strain relief of the field wiring cable. The strain relief accommodates cables from 0.25" and 0.485" diameter (6,4 – 12,3 mm). The color-coding of the wire at the sensor and the barrier are the same. Terminate the field-wiring shield (screen) to the earth ground wire (green) at the barrier.

Assemble the well by first terminating all wiring connections, then screw the well onto the exposed barrier threads (Take care that the splice is not twisted inside the well), then screw the compression fitting into the well, then tighten the compression fitting securely around the field-wiring cable.

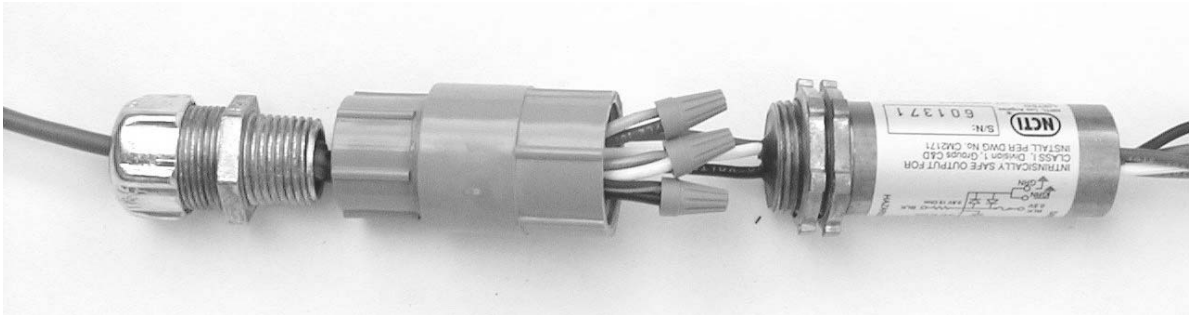

Figure 19 - Intrinsically-safe Barrier Wiring (non-conduit installation)

4.7 Connection to an EECO SYSTEM

The LLD-Plus can be connected to an EECO SYSTEM ATG console to allow leak detection reports to be stored and accessed through the ATG system console. The connection between the LLD-Plus and the ATG system is through an RS-232 serial communication link. For the system to function correctly it will be necessary to have the appropriate hardware and firmware installed in the ATG system. A communication cable must also be connected between the two system consoles. Use the following procedure to make the necessary connections:

4.7.1 Connection to an EECO SYSTEM 1000EG / 2000

- The LLD-Plus console must be located within 10 feet (3m) of the ATG system console. If the separation is greater, then a custom interface cable must be made. An 8-conductor cable with RJ-45 connectors on each end is required. Straight-thru connections should be made at each end. Maximum cable length is 50'.

- The ATG system must have a (P/N Q439992) MPU board installed with a serial communication cable (P/N 439513). Refer to Figure 20 and Figure 23 to identify the correct parts. If these are not part of the system it will be necessary to order an upgrade kit (P/N 451337) for the ATG system before proceeding.
- Locate the ATG interface cable (P/N 401136) and the Modular Adapter (P/N 401135). One of each should have been supplied with the LLD-Plus system. Refer to Figure 22 and Figure 23.
- Plug the Modular Adapter into the appropriate DB-9 serial port at the ATG console. Refer to Table 4 and Figure 24 for the port location.
- Plug the serial interface cable into the modular adapter at one end and the RJ-45 connector in the LLD-Plus Console.

EECO SYSTEM 1000EG / 2000 REQUIRED HARDWARE

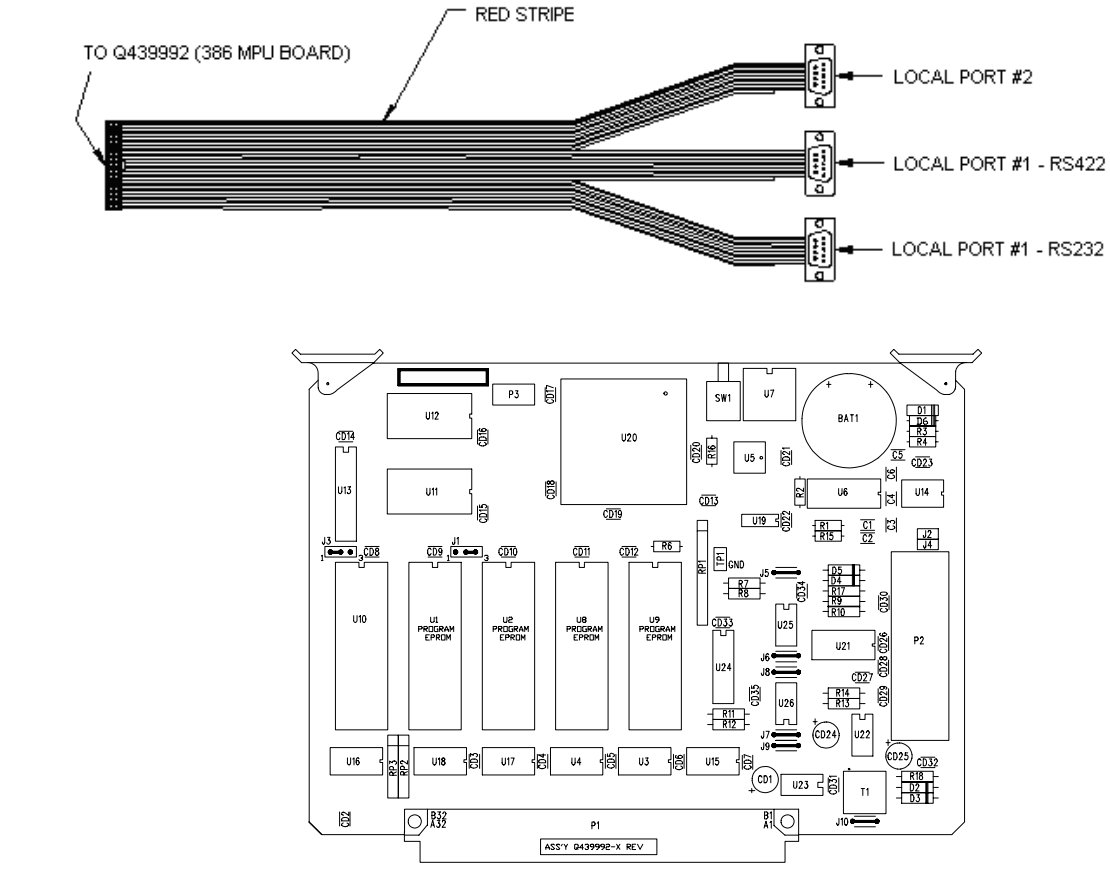

Figure 22 - 400110 RJ45 Serial Interface Cable

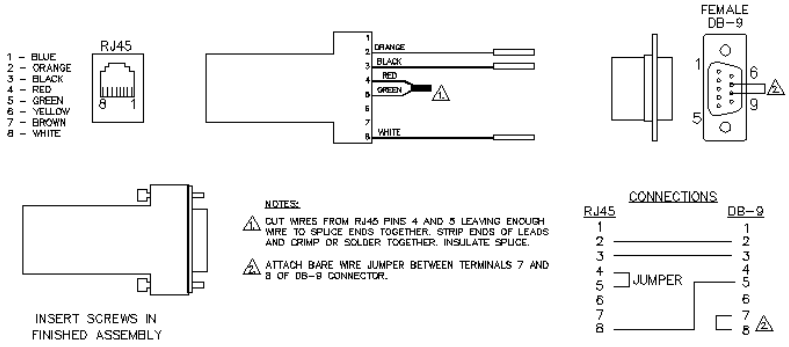

Figure 23 - 401135 Modular Adapter

EECO SYSTEM®	Communication Port	Software Version
EECO 1500	Local Port	025-083 for PLLD & SLD 025-087 for PLLD
EECO 1000EG / 2000	Local Port 2	025-030 for VLLD/PLLD 025-074 for VLLD/PLLD & SLD 025-041 for VLLD/PLLD & Reconciliation 025-042 or 025-123 for VLLD/PLLD & SLD & Reconciliation
EECO Galaxy	Com 1 Com 3 Com 3 Com 1	025-079 for PLLD & SLD 025-084 for PLLD & SLD & Reconciliation 025-119 for PLLD & Reconciliation 025-124 for PLLD

Table 4 –EECO SYSTEM Configuration

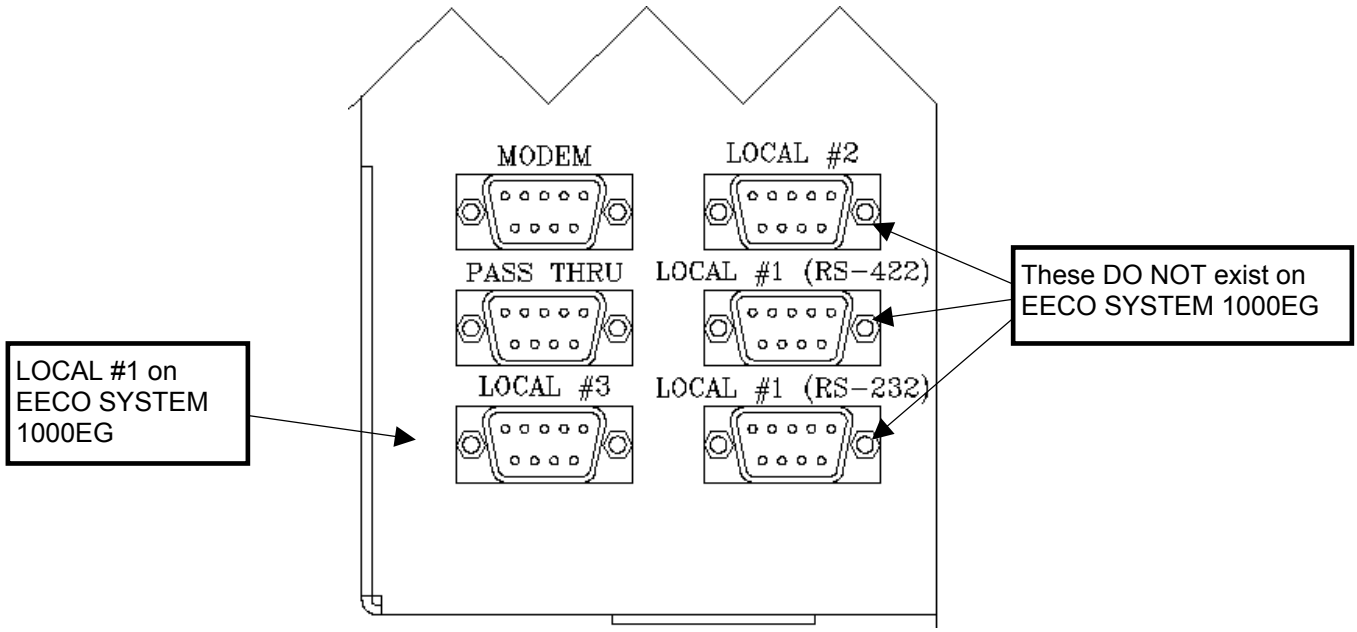

Figure 24 - EECO SYSTEM 1000EG / 2000 Serial Port Identification

4.7.2 Connection to an EECO SYSTEM 1500

- The LLD-Plus console must be located within 10 feet (3m) of the ATG system console. If the separation is greater, then a custom interface cable must be made. An 8-conductor cable with RJ-45 connectors on each end is required. Straight-thru connections should be made at each end. Maximum cable length is 50'.
- Locate the ATG interface cable (P/N 401136) and the Modular Adapter (P/N 401135). One of each should have been supplied with the LLD-Plus system. Refer to Figure 22 and Figure 23.
- Plug the Modular Adapter into the Local Port at the ATG console. Refer to Figure 25 for the Local Port location.
- Plug the serial interface cable into the modular adapter at one end and the RJ-45 connector in the LLD-Plus Console.

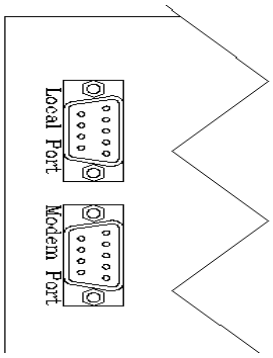

Figure 25 - EECO 1500 Serial Port Identification

4.7.3 Connection to an EECO SYSTEM Galaxy

The LLD-Plus console must be located within 10 feet (3m) of the ATG system console. If the separation is greater, then a custom interface cable must be made. An 8-conductor cable with RJ-45 connectors on each end is required. Straight-thru connections should be made at each end. Maximum cable length is 50'.

Locate the ATG interface cable (P/N 401136) and the Modular Adapter (P/N 401135). One of each should have been supplied with the LLD-Plus system. Refer to Figure 22 and Figure 23.

Plug the Modular Adapter into the Local Port at the ATG console. Refer to Table 4 and Figure 26 for the serial port location.

Plug the serial interface cable into the modular adapter at one end and the RJ-45 connector in the LLD-Plus Console.

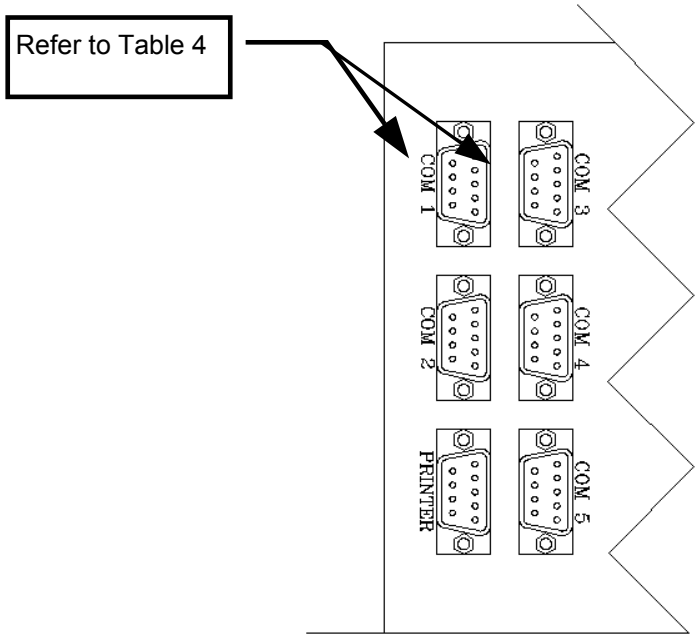

Figure 26 - EECO SYSTEM Galaxy Serial Port Identification

4.8 Installing Multiple Consoles

Installations requiring a second console will require a communication cable to be routed between the adjacent consoles if the LLD-Plus is to be connected to an ATG system. If the LLD-Plus is being used in the stand-alone configuration, no interconnection will be required.

For optimum performance it is necessary to locate the consoles as close together as possible. **The maximum cable length is 5'.** Route the 10-conductor LLD-Plus Expansion cable (400123) between the two consoles. The cable assembly should enter the console through the top left chassis opening.

Plug the end of the cable at the console that is to be connected to the ATG system into the connector marker "master". The connector is located near the top of the control board on the console door. Leave enough loose cable in the console to allow the door to open and close freely.

Connect the other end of the cable assembly to the connector marked "slave" on the control board of the second console. Maximum cable length is 3'.

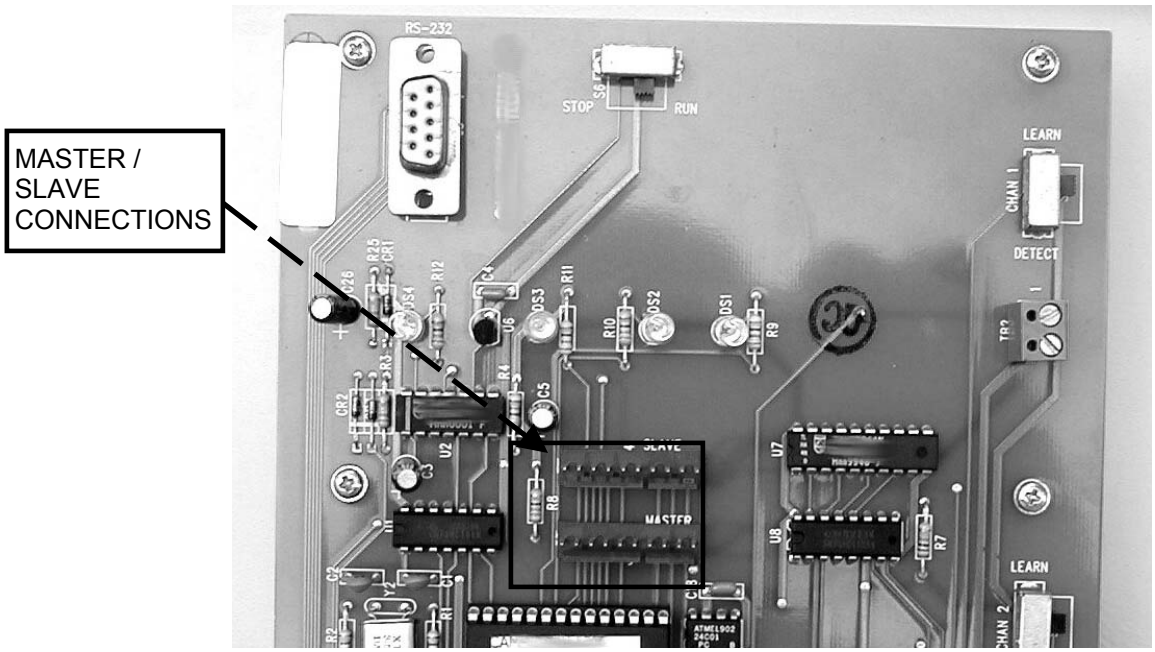

Figure 27 - System Expansion

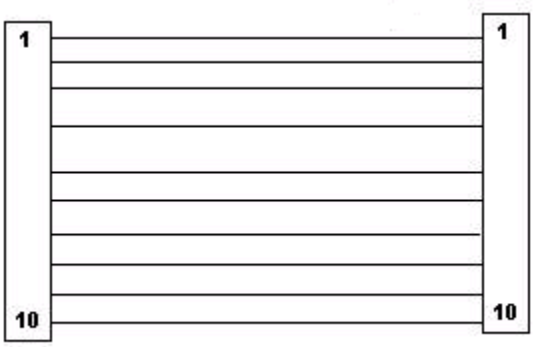

Figure 28 – 400123 LLD-Plus Expansion Cable

5. LLD Installation Checklist

The system must be installed per the EECO SYSTEM installation manual. This checklist must be completed by the installation contractor. **Note:** Any "NO" response must be corrected by the installation contractor prior to scheduling the startup contractor to inspect and commission the system. The most common installation problems are listed in ***bold italics***. **Warning: Failure to complete this checklist may cause the site owner or start-up contractor to reject portions of your installation.**

1.	☐ Yes ☐ No	Are all threaded, hydraulic connections properly sealed and tightened to prevent fuel leakage?
2.	☐ Yes ☐ No	Is the cable between the Pressure Sensor and the LLD-*Plus* console a 3-wire, shielded cable? Belden 88723 cable is recommended.
3.	☐ Yes ☐ No	Are all wiring connections terminated properly?
4.	☐ Yes ☐ No	If the Pressure Sensor is installed under the dispenser, are the sensor and all associated pressurized fittings below the shear line of the shear valve?
5.	☐ Yes ☐ No	The EECO LLD-*Plus* sensor is designed to control a submersible pump. Is the pump control relay (S2 terminal) for that pump and the LLD-*Plus* sensor cable connected to the same input channel of the LLD-*Plus* console?
6.	☐ Yes ☐ No	Is the LLD-*Plus* console AC power supplied from the same AC phase as the dispenser power ?
7.	☐ Yes ☐ No	Has enough fuel been pumped to purge the air from the filters and lines? Excessive air left in the lines will affect the leak test results.
8.	☐ Yes ☐ No	Are all cable grips and fittings properly tightened as per applicable Electrical code requirements***?***
9.	☐ Yes ☐ No	Are conduit Seal-Off fittings installed and ready to be sealed after wiring has been checked?
10.	☐ Yes ☐ No	IF this is an intrinsically-safe installation, are the Pressure Sensor cables physically isolated from all other non-intrinsically-safe wiring or wiring from other systems?
11.	☐ Yes ☐ No	Are LLD sensor wires identified with pump # and product type at the console interface?

When the installation is completed and all questions can be answered with "YES", (for the installed options), notify the startup contractor to schedule system inspection and startup. Present a completed form to the startup contractor.

Notes:

OPW Fuel Management Systems
6900 Santa Fe Drive
Hodgkins, IL 60525
708-485-4200