



**DeltaSpan  
Submersible Pressure  
Level Transmitter Manual  
LD31 Series  
22 AUG 08  
Rev A**



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## **Preface**

This manual explains how to use the DeltaSpan LD31 series submersible pressure level transmitter.

## **Warranty, Service & Repair**

To register your product with the manufacturer, go to the Flowline website for on-line registration. The website address is as follows:

[www.flowline.com](http://www.flowline.com)

On-line Warranty Registration can be found under Contact Us in the Navigation Bar along the side of the home page.

If for some reason your product must be returned for factory service, go to the Flowline website to receive a Material Return Authorization number (MRA), providing the following information:

1. Full Part Number, Full Serial Number
2. Name and telephone number of someone who can answer technical questions related to the product and its application.
3. Return Shipping Address
4. Brief Description of the Symptom
5. Brief Description of the Application

On-line Material Return Authorization can be found under Contact Us in the Navigation Bar along the side of the home page. Click on *Return Authorization* to begin the MRA request. Once you have received a MRA number, ship the product prepaid in its original packing to:

Flowline Factory Service  
MRA\_\_\_\_\_  
10500 Humbolt Street  
Los Alamitos, CA 90720

To avoid delays in processing your repair, write the MRA on the shipping label. Please include the information about the malfunction with your product. This information enables our service technicians to process your repair order as quickly as possible.

## **Warranty**

Flowline warrants to the original purchaser of its products that such products will be free from defects in material and workmanship under normal use and service for a period which is equal to the shorter of one year from the date of purchase of such products or two years from the date of manufacture of such products.

This warranty covers only those components of the products which have non-moving and not subject to normal wear. Moreover, products which are modified or altered, and electrical cables which are cut to length during installation are not covered by this warranty.

Flowline's obligation under this warranty is solely and exclusively limited to the repair or replacement, at Flowline's option, of the products (or components thereof) which Flowline's examination proves to its satisfaction to be defective. FLOWLINE SHALL HAVE NO OBLIGATION FOR CONSEQUENTIAL DAMAGES TO PERSONAL OR REAL PROPERTY, OR FOR INJURY TO ANY PERSON.

This warranty does not apply to products which have been subject to electrical or chemical damage due to improper use, accident, negligence, abuse or misuse. Abuse shall be assumed when indicated by electrical damage to relays, reed switches or other components. The warranty does not apply to products which are damaged during shipment back to Flowline's factory or designated service center or are returned without the original casing on the products. Moreover, this warranty becomes immediately null and void if anyone other than service personnel authorized by Flowline attempts to repair the defective products.

Products which are thought to be defective must be shipped prepaid and insured to Flowline's factory or a designated service center (the identity and address of which will be provided upon request) within 30 days of the discovery of the defect. Such defective products must be accompanied by proof of the date of purchase.

Flowline further reserves the right to unilaterally waive this warranty and to dispose of any product returned to Flowline where:

- a. There is evidence of a potentially hazardous material present with product.
- b. The product has remained unclaimed at Flowline for longer than 30 days after dutifully requesting disposition of the product.

THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE OF THIS WARRANTY. This warranty and the obligations and liabilities of Flowline under it are exclusive and instead of, and the original purchaser hereby waives, all other remedies, warranties, guarantees or liabilities, express or implied. EXCLUDED FROM THIS WARRANTY IS THE IMPLIED WARRANTY OF FITNESS OF THE PRODUCTS FOR A PARTICULAR PURPOSE OR USE AND THE IMPLIED WARRANTY OF MERCHANTABILITY OF THE PRODUCTS.

This warranty may not be extended, altered or varied except by a written instrument signed by a duly-authorized officer of Flowline, Inc.



## Introduction

The LD31 series DeltaSpan Submersible Level Transmitters are manufactured for years of trouble free service in the harshest applications. The transmitter measures the height of liquid above the position in the tank referenced to atmospheric pressure. The transmitter consists of a piezoresistive sensing element, encased in 316 SS housing. Bullet nose design protects the diaphragm from damage.

The DeltaSpan incorporates lightning and surge protection utilizing dual arrestor technology, grounded to case, eliminating both power supply surges and lightning ground strike transients (surge protection is not guaranteed and is not covered by warranty).

Units come equipped with a 270-pound tensile strength shielded and vented cable. Ventilation tube in the cable automatically compensates for changes in atmospheric pressure above the tank. The vent is protected with a maintenance free filter eliminating particulate or water droplets from entering the transducer.

- Excellent chemical compatibility
- Lightning and surge protection on all LD31 series transmitters
- Maintenance free vent filter
- Slim design for tight applications

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**About this Manual:**

PLEASE READ THE ENTIRE MANUAL PRIOR TO INSTALLING OR USING THIS PRODUCT. This manual includes information on all versions of the DeltaSpan Series Submersible Pressure Level Transmitter from Flowline; models LD31-\_\_\_\_. Please refer to the part number located on the transmitter label to verify the exact model which you have purchased.

**User's Responsibility for Safety:**

Flowline manufactures a wide range of liquid level sensors and technologies. While each of these technologies are designed to operate in a wide variety of applications, it is the user's responsibility to select a technology that is appropriate for the application, install it properly, perform tests of the installed system, and maintain all components. The failure to do so could result in property damage or serious injury.

**Proper Installation and Handling:**

Only properly-trained staff should install and/or repair this product. Use a proper sealant with all installations. Always check for leaks prior to system start-up.

**Wiring and Electrical:**

A supply voltage of 13 to 30 VDC is used to power the LD31 series transmitter. Electrical wiring of the sensor should be performed in accordance with all applicable national, state, and local codes.

**Temperature and Pressure:**

The LD31 series is designed for use in application temperatures from -18° to 66°C (0° to 150°F), and for use at pressures up to 2 x the full span of the LD31 series.

**Material Compatibility:**

The submersible pressure level transmitter, LD31 series, is made of 316 Stainless Steel (316 SS), 316L Stainless Steel (316L SS) with a cable of Polyurethane or Ethylene Tetrafluoroethylene (ETFE) and a bullet nose of Polyvinyl Chloride (PVC). Make sure that the model which you have selected is chemically compatible with the application liquids.

**Flammable, Explosive and Hazardous Applications:**

DO NOT USE THE DELTASPAN, LD31 SERIES LEVEL TRANSMITTER IN HAZARDOUS LOCATIONS.

**Make a Fail-Safe System:**

Design a fail-safe system that accommodates the possibility of transmitter failure or battery power loss. In critical applications, Flowline recommends the use of redundant backup systems and alarms in addition to the primary system.



### Components:

DeltaSpan is offered in eight different models, based upon pressure rating and material.

Depending on the model purchased, you may or may not have been shipped all the components shown below. .

- DeltaSpan
  - LD31-S101 – 05 psi (11.54 ft wc / 3.52 m wc), 40' (12.2 m) Polyurethane Cable
  - LD31-S111 – 10 psi (23.09 ft wc / 7.04 m wc), 40' (12.2 m) Polyurethane Cable
  - LD31-S121 – 15 psi (34.63 ft wc / 10.56 m wc), 60' (18.3 m) Polyurethane Cable
  - LD31-S131 – 20 psi (46.18 ft wc / 14.08 m wc), 60' (18.3 m) Polyurethane Cable
  - LD31-S201 – 05 psi (11.54 ft wc / 3.52 m wc), 40' (12.2 m) ETFE Cable
  - LD31-S211 – 10 psi (23.09 ft wc / 7.04 m wc), 40' (12.2 m) ETFE Cable
  - LD31-S221 – 15 psi (34.63 ft wc / 10.56 m wc), 60' (18.3 m) ETFE Cable
  - LD31-S231 – 20 psi (46.18 ft wc / 14.08 m wc), 60' (18.3 m) ETFE Cable
- Quick Start Guide

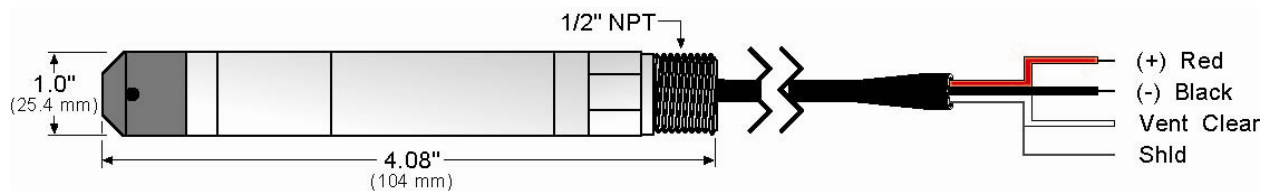
### Technology

A sealed pressure transmitter is placed near or on the bottom of the tank. A stainless steel pressure diaphragm within the pressure transmitter is exposed on one side to the application liquid. The other side is exposed to the reference pressure via a small ventilation tube located inside of the Polyurethane cable. A difference in pressure between liquid and reference pressures will slightly deflect the diaphragm. The deflection of the diaphragm is measured by a built-in microprocessor that provides greater linearity correction over common thermal compensation methods. A 4-20 mA current signal proportional the height of the liquid is generated from the microprocessor.

## Specifications

Service:	Compatible liquids.
Wetted Materials:	Body: 316 SS, 316L SS, and Buna-N; Cable: Polyurethane or ETFE; Bullet Nose: PVC.
Accuracy:	$\pm 0.25\%$ of full scale.
Temperature Limit:	0 to 150°F (-18 to 66°C).
Compensated Temperature Range:	0 to 140°F (-18 to 60°C).
Thermal Effect:	Less than $\pm 0.02\%/^{\circ}\text{F}$ .
Pressure Limit:	2X full scale.
Power Requirement:	13 to 30 VDC.
Output Signal:	Two-wire, 4 to 20 mA.
Response Time:	50 ms.
Max. Loop Resistance:	850 ohms at 30 VDC.
Electrical Connections:	Wire pigtail.
Cable Length	-_001/-_101: 40' (12.2 m) -_201/-_301: 60' (18.3 m)
Mounting Orientation:	Suspended in tank below level being measured.
Weight:	2.2 lb (1.0 kg).
Electrical Protection:	Lightning and surge protection.

## Dimensions

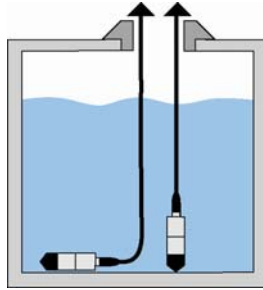


## Material Compatibility:

- The LD31 series is made of 316 Stainless Steel (316 SS), 316L Stainless Steel (316L SS) with a cable of Polyurethane or Ethylene Tetrafluoroethylene (ETFE) and a bullet nose of Polyvinyl Chloride (PVC).
- Make sure that the switch is compatible with the application liquids. To determine the chemical compatibility between the sensor and its application liquids, refer to the Compass Corrosion Guide, available from Compass Publications (858-589-9636).

## Getting Started

The LD31 series will be submersed within the application fluid. The level transmitters can either rest along the bottom of the tank or be suspended at any desired level within the tank. Please note that the physical location of the level transmitter will indicate the lowest level of measurement within the tank. For example: mounting the transmitter 1 foot from the bottom of the tank, then the lowest reading of liquid will be 1 foot from the bottom.



## Choosing the Correct Pressure Range

The DeltaSpan series are fixed range transmitters with no adjustability with respect to the 4-20 mA output. For example: at 0 psi (no liquid), the current output will be 4 mA and at maximum pressure, the current output will be 20 mA. Readings between 0 and the maximum pressure will be proportional to the 4-20 mA output. Since the density of liquid will have an influence on the range of the LD31 series, follow these simple instructions to insure the correct pressure range has been selected.

1. Determine the Specific Gravity (SG) of the liquid to be measured.
2. Determine the maximum height of liquid (H) to be measured in feet.
3. Use the following equation to determine the maximum required pressure (P):

$$P = H \text{ (feet)} * (SG) / 2.31 \text{ (feet/psi)}$$

or

$$P = H \text{ (m)} * (SG) / 0.704 \text{ (m/psi)}$$

4. Compare the maximum required pressure (P) to the pressure ranges listed above.

For example, a 16' tall tank contains a liquid with a SG of 0.9:

$$P = 16.0 \text{ feet} * (0.9) / 2.31 \text{ (feet/psi)} = \mathbf{6.23 \text{ psi}}$$

The maximum required pressure is 6.23 psi, which is above the 5 psi range for the LD31-S001. To read the full range of liquid in the tank, choose the LD31-S101.

### Effects of Specific Gravity:

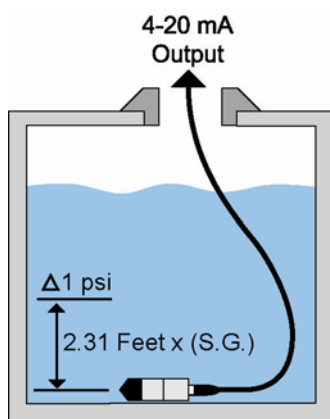
The LD31 series has a fixed span with 4 mA equal to 0 psi and 20 mA equal to the maximum psi setting. Each unit is calibrated for use in liquids with a specific gravity (SG) of 1.000. Pressure transducers may be used in liquids with a SG other than 1.000. Please note the following relationship between the pressure range and specific gravity:

$$1 \text{ psi} = 2.31 \text{ feet @ SG} = 1.000$$

or

$$1 \text{ psi} = 0.704 \text{ m @ SG} = 1.000$$

For example, the LD31-S001 has a range of 0 to 5 psi. The maximum depth the transmitter can read in water (SG = 1.000) is  $5 \text{ psi} \times (2.31 \text{ feet} / 1 \text{ psi}) = 11.5 \text{ feet}$ . For metric, the maximum depth in water is  $5 \text{ psi} \times 0.704 \text{ m} / \text{psi} = 3.52 \text{ m}$ .



For liquids with a different SG, simply divide 2.31 by the new SG to determine the new ratio. For example, the LD31-S001 is installed in a liquid with a SG = 0.85. The new ratio is as follows:

$$1 \text{ psi} = 2.31 \text{ feet} / (0.85) = 2.717 \text{ feet (0.828 m)}$$

Multiply 5 psi by the new ratio to determine the maximum depth:

$$5 \text{ psi} * (2.717 \text{ feet} / 1 \text{ psi}) = 13.6 \text{ feet (4.15 m)}$$

A lower SG will increase the maximum depth for the transmitter. Another example, the LD31-S101 is installed in a liquid with a SG = 1.2. The new ratio is as follows:

$$1 \text{ psi} = 2.31 \text{ feet} / (1.2) = 1.925 \text{ feet (0.587 m)}$$

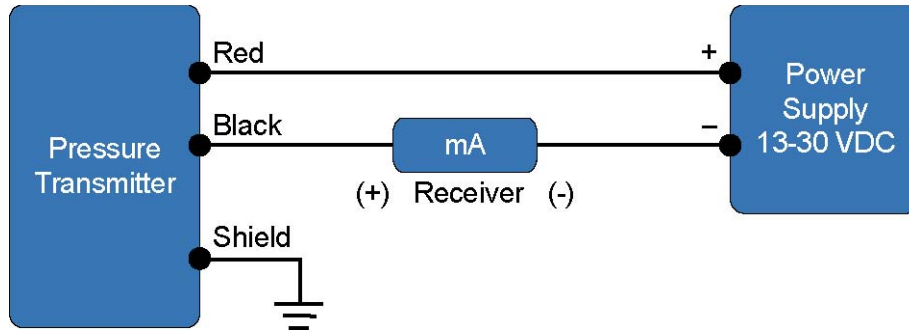
Multiply 10 psi by the new ratio to determine the maximum depth:

$$10 \text{ psi} * (1.925 \text{ feet} / 1 \text{ psi}) = 19.3 \text{ feet (5.87 m)}$$

A high SG will decrease the maximum depth for the transmitter.

## Electrical Installation

An external power supply delivering 13-30 VDC with minimum current capability of 40 mA DC (per transmitter) is required to power the control loop. See figure below for connection of the power supply, transmitter and receiver.

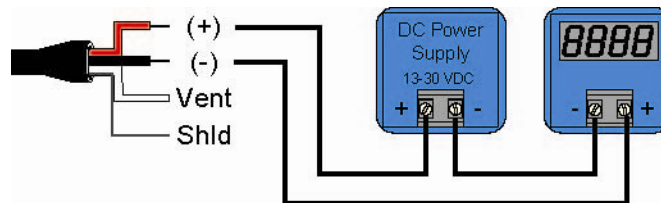


The maximum receiver load resistance (RLmax) for the DC power supply voltage (Vsup) is expressed by the formula:

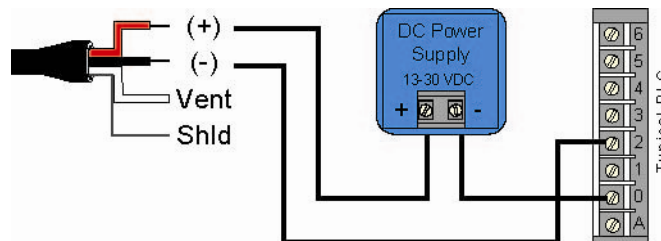
$$RL_{max} = (V_{sup} - 13V) / 0.02A$$

*Shielded cable is recommended for control loop wiring. Use the Red wire as the (+) and the Black wire as the (-).*

## Wiring to a Loop Powered Display

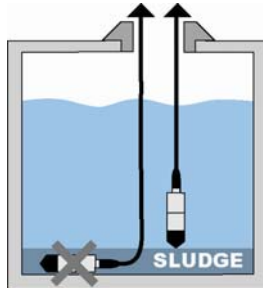


## Wiring to a Typical PLC



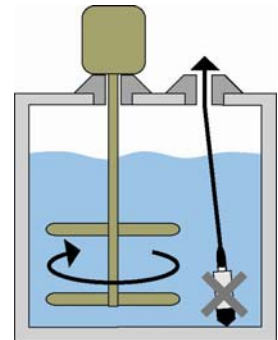
## Installation

The LD31 series is designed to operate while submerged in the actual application liquid. Avoid installing the level transmitter along the bottom of the tank if materials such as sludge will build up and coat/cover the transmitter. This also includes any debris that will settle along the bottom of the tank. In these applications, it is best to suspend the transmitter above the highest level of sludge/debris that will occur.



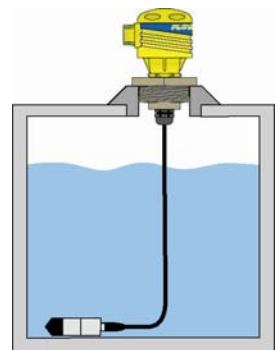
## Interference

The DeltaSpan is designed to operate under the surface of the liquid in the tank. Avoid installations where other tank requirements will cause the transmitter to move or swing. For example: a mixer blade could cause the level transmitter to whip around within the tank. An alternative would be to move the transmitter to a more stable section of the tank or to install the LD31 series inside a still well/drop tube. The still well/drop pipe will minimize the effects created by the mixer.



## Termination

The cable for the DeltaSpan is typically terminated at a junction box located on top of the tank. Since the vent tube is contained within the cable, the pressure within the junction box must always be the same as the reference (typically atmospheric) pressure for the liquid. The inside of the junction box must be clean, dry and free of moisture. Add the optional pressure fitting (LD90-\_001) to complete the package. The LD90-\_001 features a 2" NPT thread for mounting and a liquid tight connector to seal the cable interface.



**Note:** Use caution when sealing the cable at the top of the tank. The ventilation tube must be open and free to allow air to flow back to the pressure diaphragm. Avoid blocking the ventilation tube by compressing the cable. Always keep the cable termination clean, dry and free of moisture and prevent liquid from entering the vent tube.



## **Maintenance**

Maintenance should consist of inspection to see that the transmitter is free from debris and not coated with any substance, which would prevent liquid from freely entering and leaving the transmitter. If this occurs, the transmitter should be cleaned.

### **Cleaning procedure:**

1. *Power:* Make sure that all power to the transmitter, controller and/or power supply is completely disconnected.
2. *Transmitter removal:* If necessary, make sure that the tank is drained well below the switch prior to removal. Carefully, remove the transmitter from the installation.
3. *Cleaning the switch:* Using a soft bristle brush and mild detergent, carefully wash the switch. Do not use harsh abrasives such as steel wool or sandpaper, which might damage the surface of the sensor. Do not use incompatible solvents, which may damage the sensor's stainless steel body. Take particular care to remove any scaling from the body and that there is no debris inside the inlet.
4. *Transmitter installation:* Follow the appropriate steps of installation as outlined in the Installation section of this manual.

**Testing the transmitter:**

Verify proper wiring, power supply and loop resistance. If transmitter is not functioning properly, isolate the transmitter from the system and wire as shown below. Multimeter should read 4 mA with the transmitter out of liquid.

