LOOP POWERED
DIGITAL DISPLAY METER

OPERATION AND MAINTENANCE
MANUAL

P/N 1669200

Manual 300
Revision D
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JOWA Consilium

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1.0 INTRODUCTION

JOWA Consilium has selected the Devar Model 18-LPIX-WT loop powered digital indicator to support its standard tank level gauging applications. When properly installed, it is both intrinsically safe and explosion proof. This manual documents how to install, calibrate and maintain the loop powered meter in JOWA Consilium level gauging systems. JOWA Consilium has assigned this meter a part number of 1669200.

This meter is intended to be used with any of the standard JOWA Consilium liquid level sensors. Because the sensor transducer is entirely resistive, it must be first connected to signal conditioning electronics such as a transmitter that will convert the sensor resistance to a 4-20 mA process current signal. Several typical applications are provided as guidance.

The meter is a two-wire loop powered digital indicator which provides local tank readings in standard engineering units. Any values may be displayed between 1999 and -1999. It is powered by the 4 to 20 mA process current from the JOWA Consilium level sensor / electronics with the displayed value being directly proportional to this current. The display is a liquid crystal digital display (LCD) with 3½ digits. The housing of cast aluminum is corrosion resistant, dust-tight and will withstand direct salt water spray and short-term liquid immersion.

2.0 SPECIFICATIONS

Manufacturer:	
Name	Devar, Inc.
Address	705 Bostwick Ave P.O. Box 589 Bridgeport, CT 06601
Telephone	203-368-6751
FAX	203-368-3747
Approvals	
FM	Class I, Division 1, Groups A, B, C, & D
FM Entity parameters	Vmax=32VDC, Imax=150mA, Ci=0mfd, Li=0mH
CSA	Pending
Input:	
Voltage drop	3.0 VDC @ 20 mA
Current range	4-20 mA process current
Maximum current	60 mA (forward or reverse)
Display:	
Type	7 Segment, 3½ digit LCD
Digit height	0.5" [13mm]
Over range	Blinks last three digits

Enclosure:	
Housing	Cast copper-free aluminum
Rating	Explosion proof, NEMA 7
Overall size	4.5"W x 4.5"H x 3.5"D [114mm x 114mm x 89mm]
Weight	2.8 lbs [1.3 kg]
Mounting:	
Style	Wall or threaded pipe
Holes	Two .312" [7.94mm] diameter spaced at 3.25" [82.55mm]
Temperature:	
Operating	-40°F to 185°F (-40°C to 85°C)
Performance:	
Accuracy	± 0.1% of span, ± 1 count
Temperature effects:	
Zero	± 0.1 count / °C
Span	± 0.01 % of span / °C
Adjustments:	
Zero Adjust (4mA)	-1999 to +1999 counts (2 DIP switch coarse setting plus potentiometer fine adjust; does not interact with span potentiometer)
Span (20mA-4mA)	0 to 3998 counts (2 DIP switch coarse setting plus potentiometer fine adjust)
Decimal Point	xxxx xxx.x xx.xx x.xxx (3 DIP switch settings)
Minus sign	Enabled/Disabled (1 DIP switch setting)

3.0 PREPARATION

Appropriate panel, bulkhead or tank mounting space must be reserved for the explosion proof housing which measures 4-1/2" by 4-1/2". See Figure 1 for outline and mounting. Two mounting holes, 5/16" diameter, are available. Access space is required for the 1/2" NPT holes on either side of the housing.

4.0 INSTALLATION

This meter may be installed at any point along a 4 to 20 mA signal loop (subject to safety limitations) as it is powered from the loop current . Typical applications are shown in Figures 2 through 6. For non-hazardous areas, use the wiring diagram shown in Figure 2. Intrinsically safe installations are shown in Figures 3, 4, 5 and 6. Note that all installations in hazardous areas require intrinsic safety barriers because the JOWA Consilium sensor is only approved as intrinsically safe - not explosion proof. The meter, however, can be used in explosion proof applications as shown in Figure 3.

WARNING:

Proper wiring is required to maintain intrinsic safety or explosion proof ratings.

All wiring should be of a stranded copper with a minimum AWG #18 gauge (.82 square mm). Intrinsically safe wiring should be in accordance with ANSI/ISA Standard RP12.6, "Installation of Intrinsically Safe Systems for Hazardous (Classified) Locations" and the National Fire Protection Association, "National Electrical Code", Articles 500 through 504. The meter is intrinsically safe when installed per Devar Drawing B 515107 included as Figure 8.

WARNING:

In explosion proof areas, the enclosure should never be opened, while power is applied.

To wire meter, unscrew meter cover. Grasp LCD display at the corners and gently pull electronics assembly from housing and set aside. Two terminals designated "+" and "-" are available at the rear of the housing. After connections have been made and wires are properly sealed, carefully place electronics assembly back into housing. Be sure to insert vibration dampening foam sheet (supplied) around meter electronics assembly.

5.0 SETUP / CALIBRATION

The meter must be properly calibrated so that its displayed value accurately reflects the liquid level in the tank. As part of this process, the associated electronics (transmitter or other signal conditioning electronics) must be initially calibrated. It is intended that once the associated electronics is set up and calibrated, it will not have to be calibrated again unless replaced. All subsequent calibration should be done at the Devar loop powered meter.

5.1 SETUP

The general steps for a first time set up of a system are as follows:

1) Set up and calibrate the associated transmitter or signal conditioning electronics per the appropriate instructions of that equipment. It is the intent of this step to ensure that the 4-20 mA signal varies over the maximum usable range of the sensor. Typically the associated electronics may be adjusted so that 4.00 mA is obtained at the sensor bottom helix (lowest measurable point) and 20.00 mA is obtained at the sensor top helix (highest measurable point). Other systems may be setup so that 4.00 mA is at tank bottom and 20.00 mA is at tank top. During that process, note the levels calibrated at the 4.00 mA and the 20.00 mA points as those levels will be used in the calibration of the JOWA Consilium / Devar meter.

WARNING:

In explosion proof areas, the enclosure should never be opened, while power is applied.

2) DIP switches and potentiometers are located on the meter's front circuit board which also carries the liquid crystal digits. Access is obtained by unscrewing the front cover from the housing. Location of the switches and potentiometer adjustments is shown in Figure 6.

3) Determine the highest (at 20mA) and lowest (at 4mA) numbers to be displayed. These values should have been determine in step 1).

4) Determine the difference between highest (at 20mA) and lowest (at 4mA) numbers (Span). Temporarily ignore the position of the decimal point.

5) Set switches S1 and S2 for proper Span range.

SPAN	SWITCH S1	S2
3998 to 2470	On	Off
2470 to 1530	Off	Off
1530 to 000	Off	On

6) Set switches S3 and S4 for Zero value (range containing lowest value to be displayed):

ZERO	SWITCH S3	S4
1999 to 573	Off	On
573 to -573	Off	Off
-573 to -1999	On	Off

7) Set decimal point selector switch:

DECIMAL POINT LOCATION	SWITCH S6	S7	S8
1.999	On	Off	Off
19.99	Off	On	Off
199.9	Off	Off	On
1999	Off	Off	Off

8) If lowest (at 4mA) number is negative (ZERO value), set switch S5 to "On" to enable minus sign. Otherwise, set "Off".

5.2 INITIAL CALIBRATION

WARNING:

In explosion proof areas, the enclosure should never be opened, while power is applied. The meter must be brought to a safe area.

The meter may be calibrated several different ways:

a) With a current calibrator:

1) Apply 4.00 mA. Adjust ZERO potentiometer to obtain lowest number to be displayed.

2) Apply 20.00 mA. Adjust SPAN potentiometer to obtain highest number to be displayed.

3) Repeat steps 1) and 2) until no further potentiometer adjustments are required

b) With a sensor simulator and the associated signal conditioning instrument / transmitter:

1) Disconnect the sensor from the signal conditioning instrument. Connect a Sensor Simulator Model SS-904 or equivalent in its place. Connect a precision milliammeter in series with the current loop.

2) Set the Sensor Simulator to the resistance required to obtain 4.00 mA. Adjust the meter ZERO potentiometer to obtain lowest number to be displayed.

3) Set the Sensor Simulator to the resistance required to obtain 20.00 mA. Adjust the meter SPAN potentiometer to obtain highest number to be displayed.

4) Repeat steps 2) and 3) until no further potentiometer adjustments are required:

5.3 FINAL CALIBRATION

Final calibration should be performed periodically. Initially, an interval of three months is recommended. Several methods can be used. All methods require making a measurement or multiple measurements of the actual level in the tank. It is extremely important that they be made carefully and accurately so that errors are not introduced into the calibration process.

a) Simple offset, single point measurement:

1) Carefully measure the actual level in the tank.
2) Adjust the ZERO potentiometer to obtain the value determined in step 1). Do not touch the SPAN potentiometer.

b) Constant offset, multiple point measurement:

1) Carefully measure the actual level in the tank at several different levels. Record the offset between the measured value and the displayed value at each level (subtract displayed value from measured value). Average these offsets.

2) At any level, observe the displayed value. Add the average offset determined in step 1) to that value.

3) Adjust the ZERO potentiometer to obtain the value determined in step 2). Do not touch the SPAN potentiometer.

c) Variable offset, multiple point measurements:

1) Carefully measure the actual level in the tank at several different levels. Record the measured level and the process current at each level.

2) Plot the measured level versus the process current at each point recorded. Draw the best straight line between all points.

3) From the plot, determine the desired level to be displayed at 4.00 mA and 20.00 mA. These levels should be different than the original values entered.

4) Perform Initial Calibration per section 5.2 using either of the methods specified.

6.0 OPERATION

The meter has no operator controls. It will continuously display the level in the tank when the loop current is within the range of 4.00 mA and 20.00 mA.

7.0 THEORY OF OPERATION

The loop powered meter derives power from the current passing through it and a variable voltage from a series resistor. This voltage signal is amplified and fed into an analog-to-digital converter that drives the liquid crystal digital. Various scaling resistors allow the meter to operate over the zero and span ranges specified.

8.0 TROUBLESHOOTING

8.1 FAULT ISOLATION

The following table lists some of the possible problems that may occur and the solutions to the problem:

Problem	Probable Cause	Solution
Display is blank	No current through meter	Connect milliammeter in loop; if there is current in 4-20 mA range, meter is faulty; if there is no current, check wiring or associated electronics.
	Meter is reversed wired	Ensure polarity of meter is properly observed
Display blank, dim erratic	Improper calibration	Calibrate associated associated electronicsor per section 5.1
	Faulty loop powered meter	Replace meter assembly (see Section 8.2)
Display shows incorrect level	Out of calibration	Calibrate per section 5.0
Display blinks last 3 digits	Signal over range	Check associated electronics; possible short at sensor or sensor wiring

8.2 REPLACEABLE PARTS

The internal meter assembly is the only replaceable part. Its JOWA Consilium part number is 1680300. To replace the meter assembly:

a) Remove all power from the meter;

WARNING:

In explosion proof areas, the enclosure should never be opened, while power is applied.

b) Unscrew cover from the display;

c) Grasp meter assembly by the corners of the LCD display. Pull gently to remove;

d) Align replacement meter assembly banana jacks with case and push assembly gently into housing;

e) Screw cover back onto display;

g) Perform Setup and Calibration per Section 5.0

9.0 MAINTENANCE

The following maintenance steps are recommended:

1) Every three months, the Final Calibration process should be performed.

2) Clean lens as required with clean cloth and mild detergent in water.

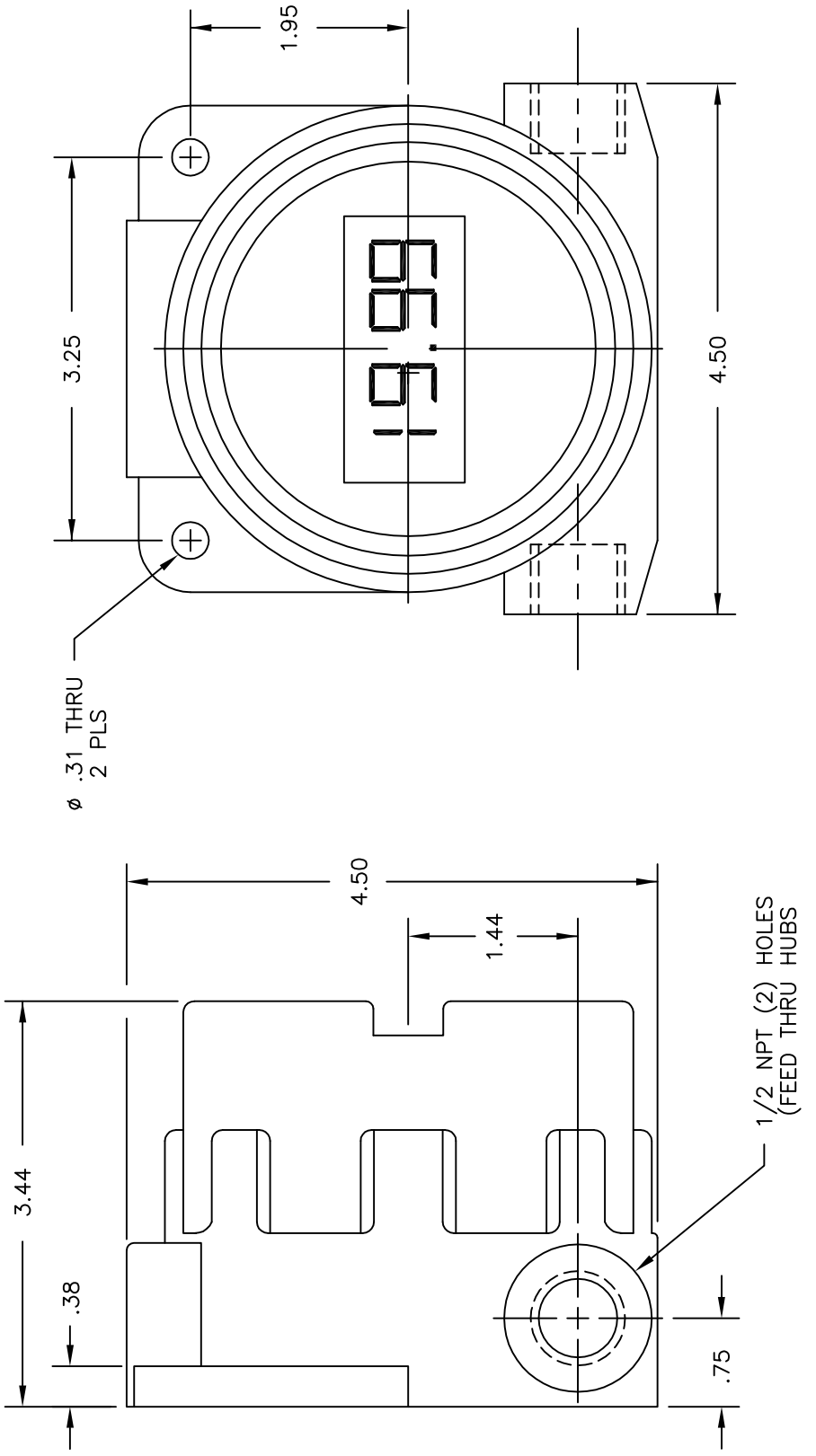


FIGURE 1
LOOP POWERED METER
OUTLINE & MOUNTING

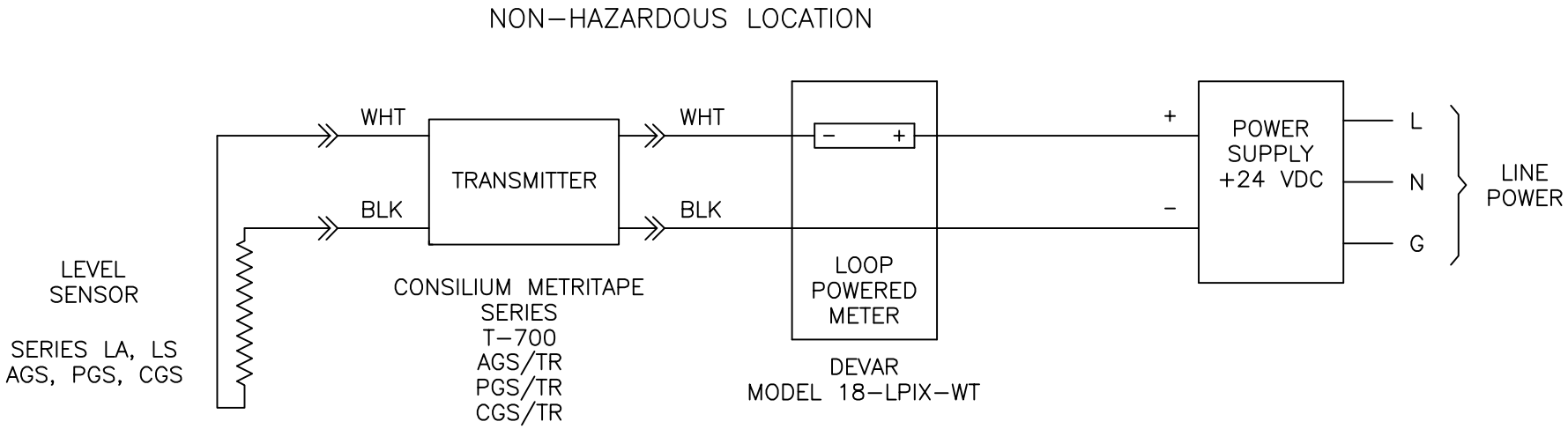


FIGURE 2
RESISTANCE–TAPE LEVEL SENSOR
WITH LOOP POWERED METER IN
NON–HAZARDOUS LOCATIONS.

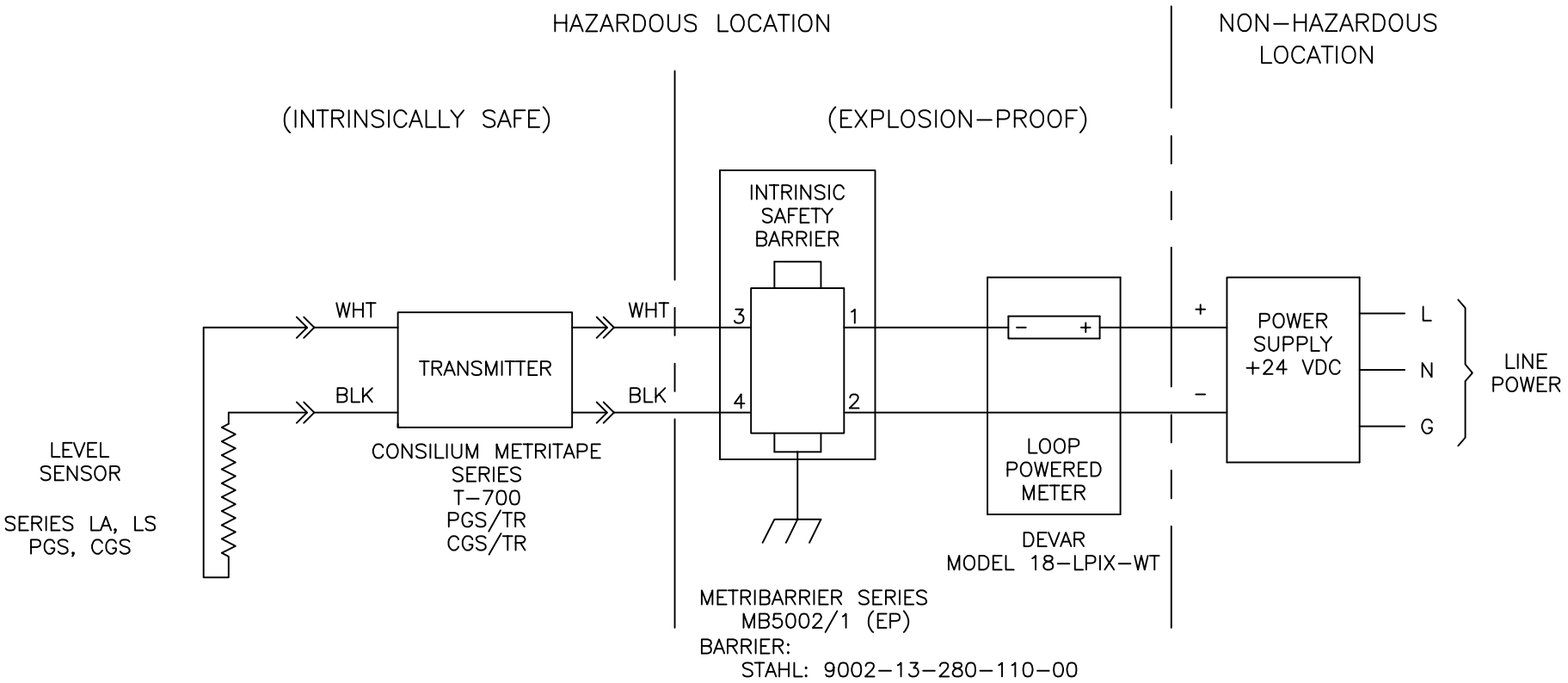
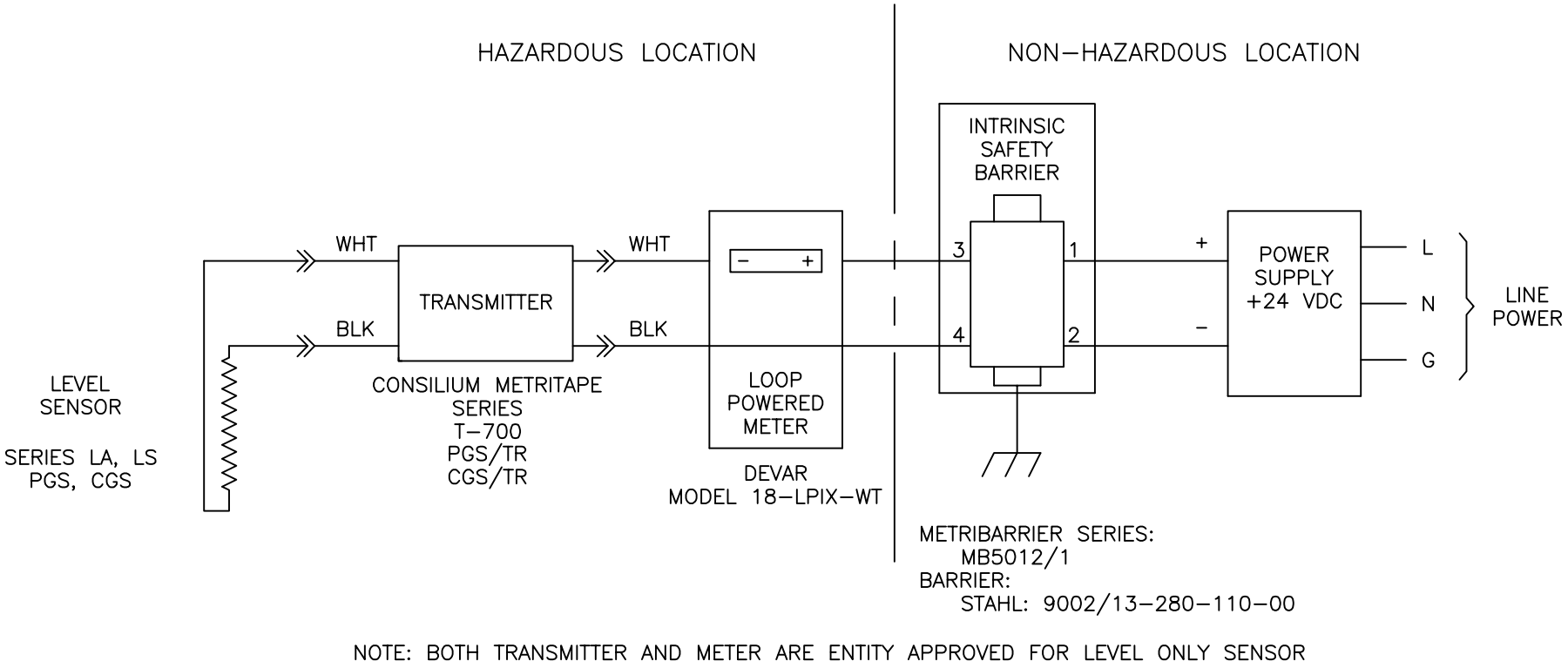


FIGURE 3
RESISTANCE–TAPE LEVEL SENSOR
WITH LOOP POWERED METER IN INTRINSICALLY
SAFE AND EXPLOSION–PROOF LOCATIONS



NOTE: BOTH TRANSMITTER AND METER ARE ENTITY APPROVED FOR LEVEL ONLY SENSOR

FIGURE 4
RESISTANCE–TAPE LEVEL SENSOR
WITH LOOP POWERED METER IN
INTRINSICALLY SAFE LOCATIONS

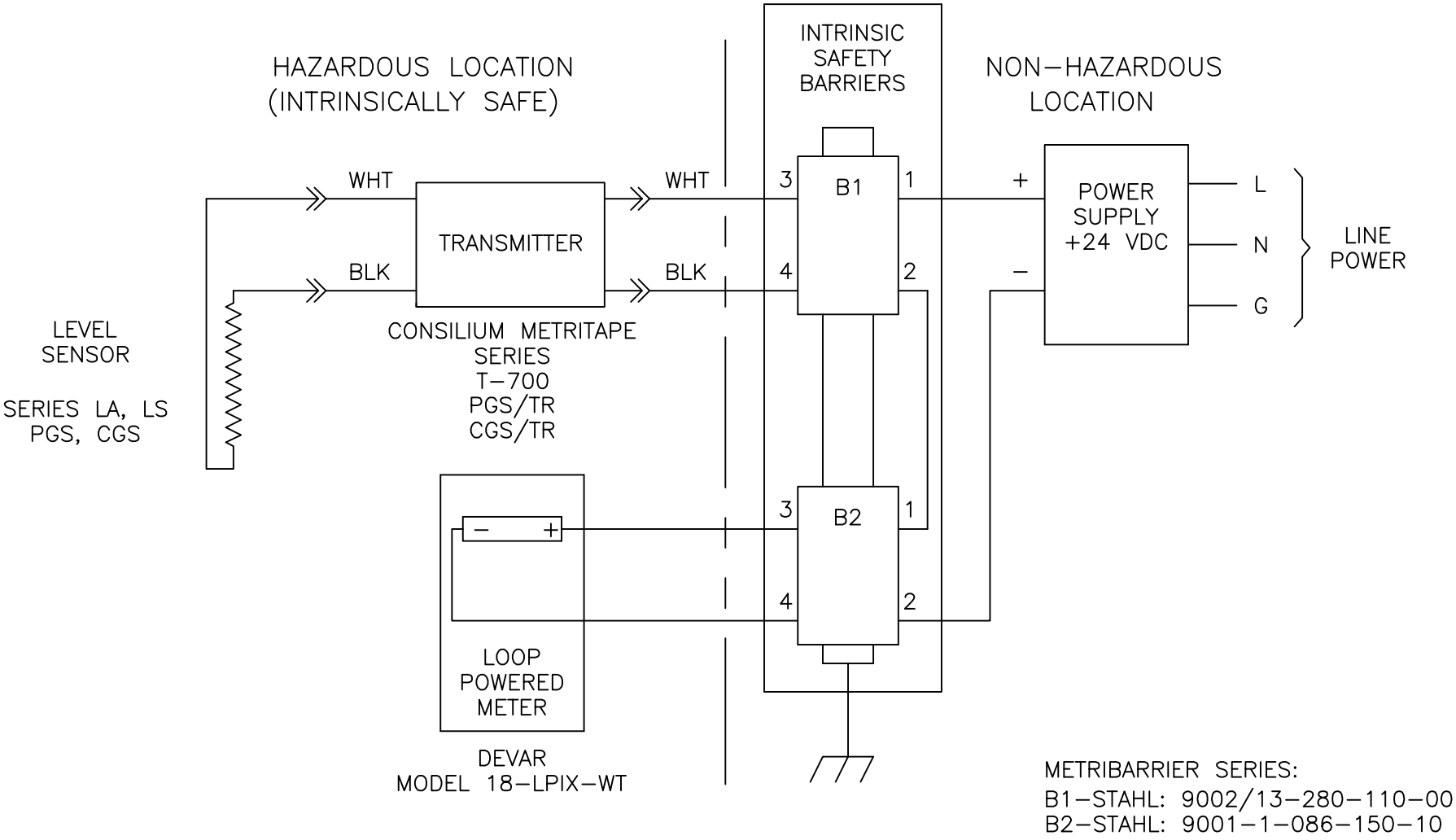


FIGURE 5
RESISTANCE–TAPE LEVEL SENSOR
WITH LOOP POWERED METER IN
INTRINSICALLY SAFE LOCATIONS
NECESSARY FOR NON–ENTITY CONFIGURATION
I.E. LEVEL/TEMP SENSORS

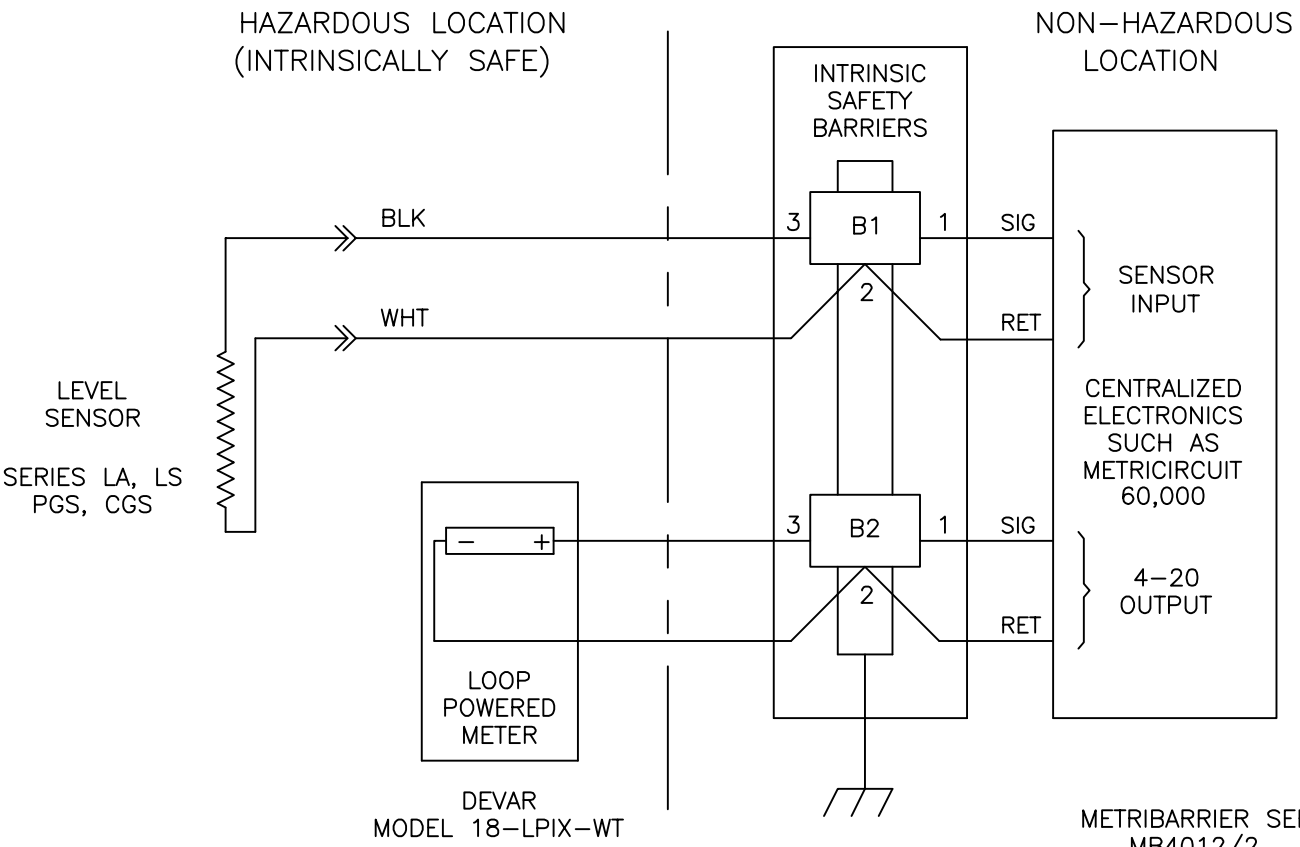


FIGURE 6
RESISTANCE–TAPE LEVEL SENSOR
WITH LOOP POWERED METER IN
INTRINSICALLY SAFE LOCATION USING
CENTRALIZED ELECTRONICS.

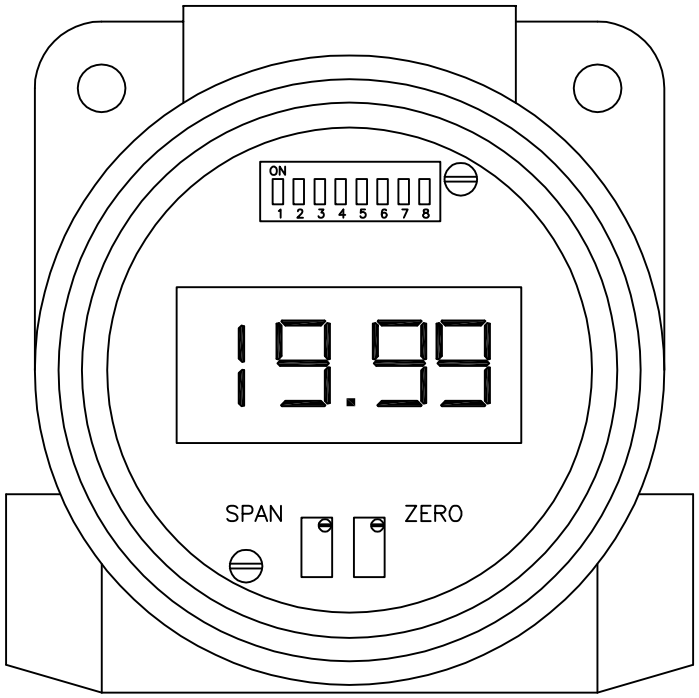


FIGURE 7
LOCATION OF CALIBRATION SWITCHES AND POTENTIOMETERS