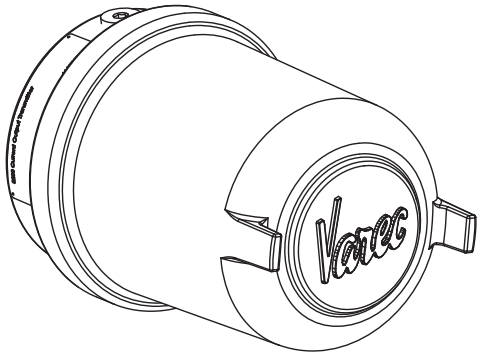
Installation and Operations Manual

8200 Current Output Transmitter

Signal transmission for accurate level measurement in storage tanks



Automation Solutions for oil & gas, defense and aviation applications

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Varec, Inc.
5834 Peachtree Corners East
Peachtree Corners (Atlanta), Georgia 30092
Phone: (770) 447-9202
Fax: (770) 662-8939

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Safety Precaution Definitions

Caution! Damage to equipment may result if this precaution is disregarded.

Warning! Direct injury to personnel or damage to equipment which can cause injury to personnel may result if this precaution is not followed.

Safety Precautions

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Note Comply with all applicable regulations, codes, and standards. For safety precautions, the user should refer to the appropriate industry or military standards.

Caution! Electrical Hazard! Read and understand static and lightning electrical protection and grounding described in API 2003. Make certain that the tank installation, operation, and maintenance conforms with the practice set forth therein.

Warning! Striking the gaugehead with a metal object could cause a spark to occur. When removing or replacing the gaugehead in flammable or hazardous liquid storage areas, take necessary measures to protect the gaugehead from impact.

Warning! Volatile fumes may be present! Ensure that the tank has been leak and pressure tested as appropriate for the liquid to be stored. Observe appropriate safety precautions in flammable or hazardous liquid storage areas. Do not enter a tank that has contained hydrocarbons, vapors, or toxic materials, until a gas-free environment is certified. Carry breathing equipment when entering a tank where oxygen may be displaced by carbon dioxide, nitrogen, or other gases. Wear safety glasses as appropriate. Use a hard hat.

Warning! Sparks or static charge could cause fire or explosion! The mechanical connections between the guide cables, the float, the tape, and the gaugehead provide a resistance to ground that is adequate for the safe electrical drain of electrostatic charges that may accumulate in the tank and the product. Worker activity and worker clothing may accumulate electrostatic charges on the body of a worker. Care should be used in flammable environments to avoid the hazard.

Warning! Broken negator motor spring pieces can cause injury when the back cover of the gaugehead is removed! Whenever the back cover is removed, stand to one side as the last bolt is removed.

Warning! The flamepath joints are not repairable by the end user. Consult the factory for repair or replacement.

Specific Conditions of Use Consult the manufacturer if dimensional information on the flameproof joints is necessary.

Contents

Change History

Revision #	Date	Author	Approved By	Description of Change
A	6/14/2021	J. M. Rollins		Initial Change History table addition
B	3/25/2022	J. M. Rollins	J. Kolb	Updated product label and added UKCA & updated the order codes Varec sells
C	1/31/2023	J. M. Rollins	T. Gibson	Updated part number descriptions

1 Introduction

This manual is designed to assist the user in the installation, operation, calibration, and maintenance of the Varec 8200 Current Output Transmitter (8200 COT).

1.1 Getting Acquainted with the Varec Current Output Transmitter

The 8200 COT is an electromechanical device that is mechanically coupled to the sprocket drive sheave of a Varec 2500 Automatic Tank Gauge (2500 ATG) gaugehead or other liquid level indicating gaugehead (see Figure 1-1).

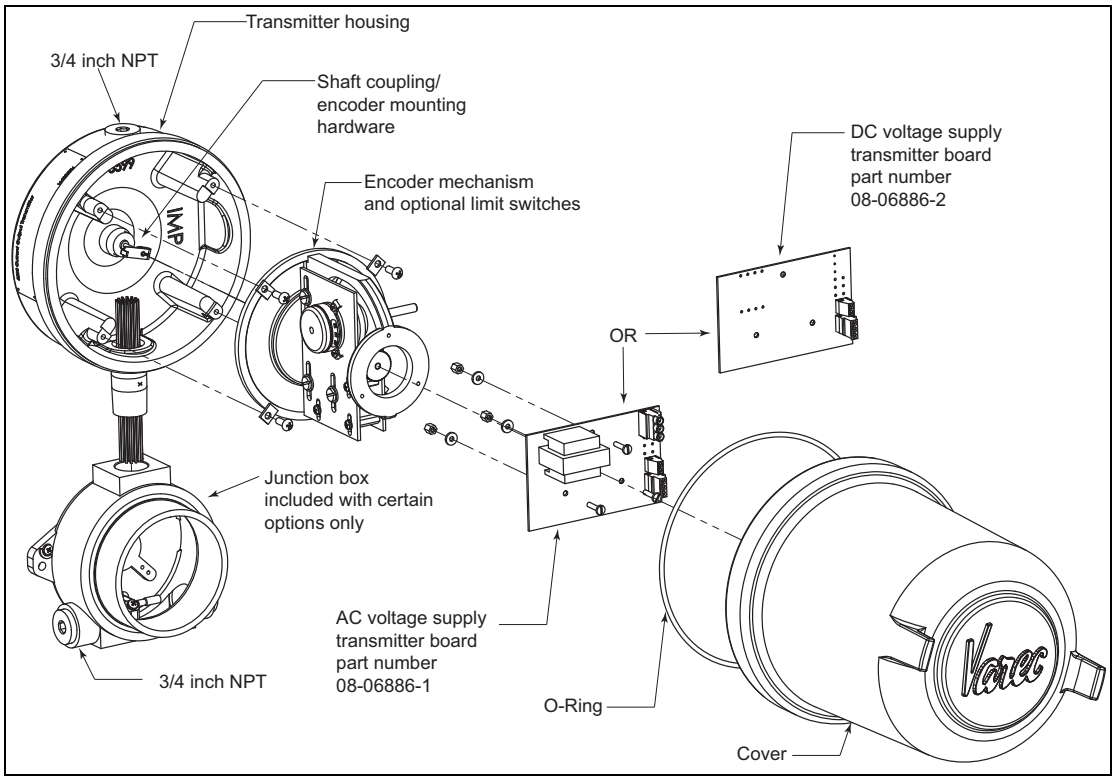

Figure 1-1: Varec 8200 Current Output Transmitter

As the liquid level gauge sprocket drive sheave rotates with liquid level changes, the motion turns the transmitter drive shaft. The drive shaft is coupled to a worm gear that drives the shaft of a potentiometer. Rotation causes the current in the instrumentation output loop of the transmitter to vary. The current loop variations are carried through a conductor pair (two wires) to a central receiver or indicator to provide the signal to an instrument that is calibrated to remotely display the level of the fluid in the tank as it is shown on the gaugehead at the tank. An increase in current normally indicates a rising liquid level. An outage (reverse) reading current output option is available.

A typical installation of the 8200 COT consists of directly mounting it onto a 2500 ATG gaugehead. It may also be mounted onto a gaugehead of other manufacturers.

The transmitter requires nominal electrical input of 15 – 48 volts of regulated direct current (VDC), or 120 VAC/220 – 240 VAC. Current sensing analog instruments that measure current ranges of either 4-20 mA or 10-50 mA signal, are required in the current instrumentation loop.

2 Installation

2.1 Unpacking

The 8200 COT(s) are shipped fully assembled and ready for installation.

Place the shipping container on a secure bench before unpacking. Open the shipping container, taking care not to damage the contents. Carefully remove transmitter from the shipping container and place it on top of the bench. Inspect it for shipping damage. Report any damage to the carrier.

2.2 Storage Prior to Installation

If the transmitter is to be stored prior to installation, it should be repacked in its shipping container and stored in a temperature and humidity controlled environment.

> **Caution!** This equipment should be installed only by qualified personnel familiar with the installation instructions in this manual and in the *2500 Automatic Tank Gauge Installation and Operations Manual*.

2.3 Mounting on Varec Gaugeheads

The 8200 COT is suitable for installation on 2500 ATG gaugeheads or on the gaugeheads of other manufacturers. This procedure provides instructions to mount the transmitter on a 2500 ATG gaugehead, as shown in Figure 2-1 on page 4.

Instructions applicable to other tank gauges follow in later paragraphs. To install the gaugehead, refer to the *2500 Automatic Tank Gauge Installation and Operations Manual*. The exploded view in that manual shows the mechanical relationship between this accessory and the gaugehead.

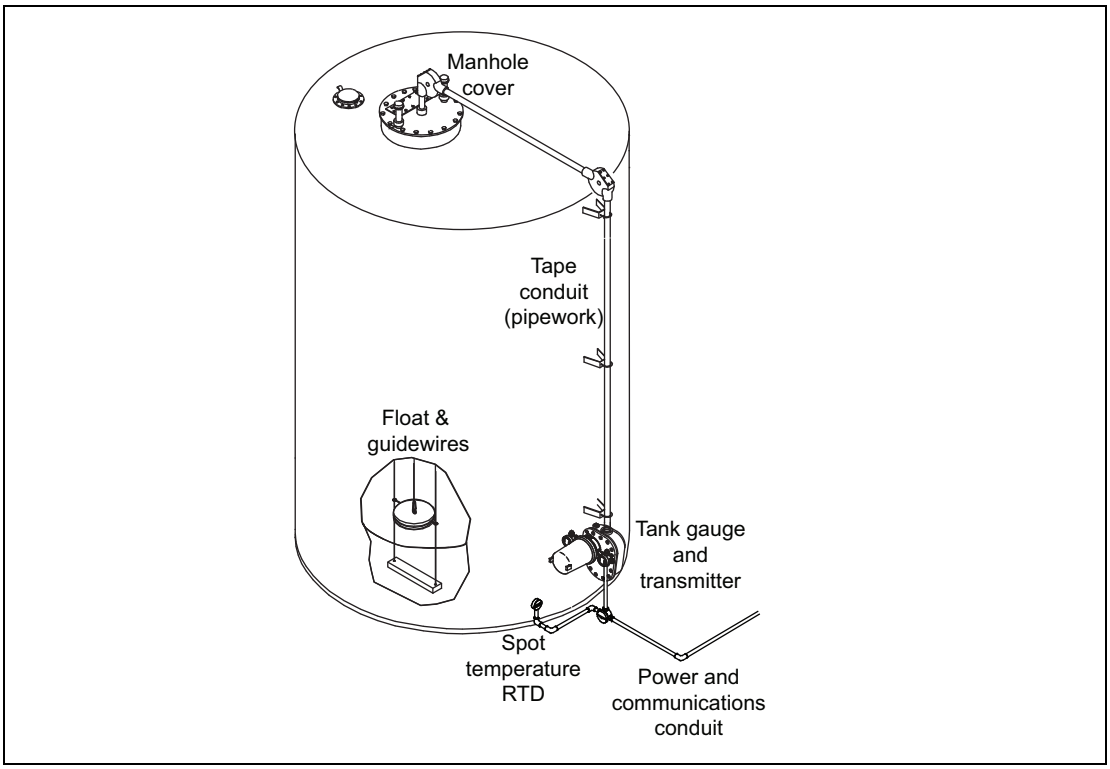

Figure 2-1: Typical Tank Installation

Each 8200 COT requires two wires for analog signals. DC versions are loop powered while AC versions require an additional three wires for power.

Warning! Whenever the back cover of the gaugehead is removed, stand to one side as the last bolt is removed. If the negator motor spring is broken, the broken pieces may cause injury when the cover is removed.

Warning! The mechanical connections between the gauge float guide cables, the float, the tape, and the gaugehead provide a resistance to ground that is adequate for the safe electrical drain of electrostatic charges that may accumulate in the tank and the product. Worker activity and worker clothing may accumulate electrostatic charges on the body of a worker. Care should be used in flammable environments to avoid the hazard.

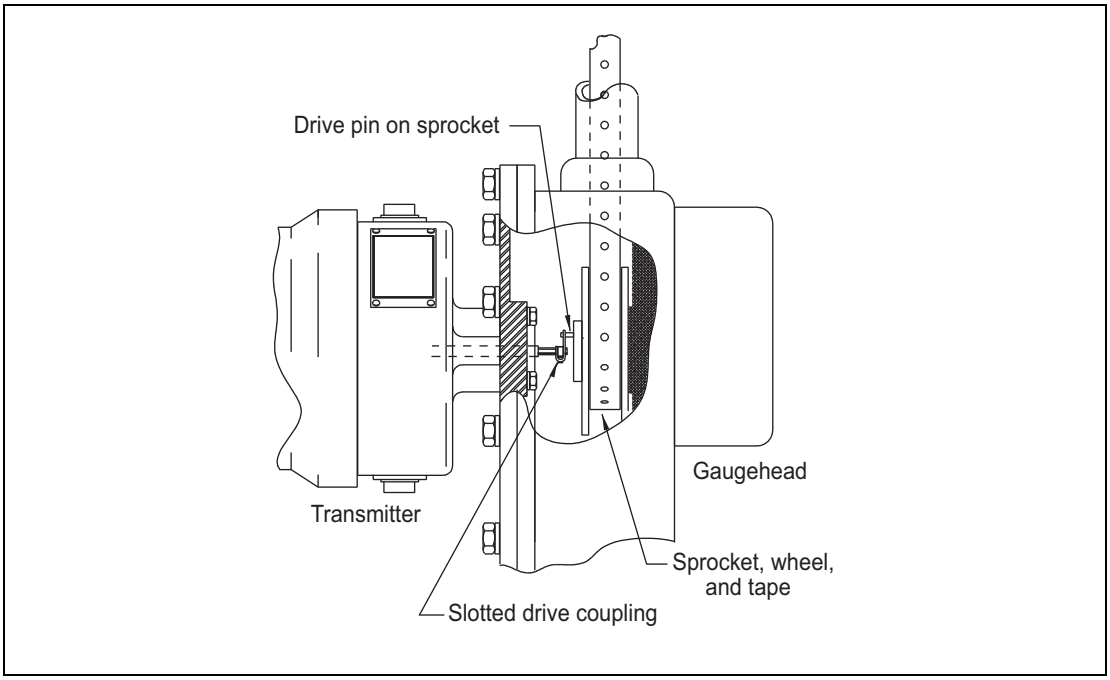

Figure 2-2: Typical Transmitter Mounting

1. If the gaugehead is oil filled, drain the oil, then remove the back cover of the gaugehead.
2. Remove the accessory back cover cap from the back cover of the gaugehead (see the *2500 Automatic Tank Gauge Installation and Operations Manual*).
3. Mount the transmitter in place of the cap onto the back cover of the gaugehead, using the four hex head cap screws that attached the cover cap.
4. Install the back cover on the gaugehead, making certain that the transmitter slotted drive coupling slot engages the pin on the gaugehead sprocket wheel. Using the field adjust knob located at the end of the shaft, make sure the slotted drive coupling is securely engaged with the drive pin.
5. Loosen the slotted drive coupling set screw using an Allen wrench. Set the transmitter to the actual liquid level in the tank by rotating the field adjust knob located at the end of the shaft. Once the level has been set, re-tighten the set screw.
6. Proceed with field wiring.

2.4 Mounting on Alternate Gaugeheads

Typical Whessoe or Shand & Jurs (L & J) Gaugehead Mounting.

The following steps describe the typical tasks required for mounting the transmitter on a Whessoe 2006, L & J 92020, 92006 (GPE), or alternate gaugehead. An adapter is required. Refer to Chapter 4, Maintenance on page 21. The gaugehead is assumed to have been previously installed on the tank. See Figure 2-2 on page 5 and perform the following steps.

1. Remove the access cover from the gaugehead.
2. Install the transmitter in place of the accessory access cover.
3. Make certain that the transmitter drive engages the gauge counter wheel.
4. Proceed with field wiring.

Note Please read the safety guidelines section before you begin.

2.5 Water and Dust Ingress Protection

The enclosure and junction boxes have been designed and tested to IP66 and NEMA 4 for water and dust ingress. To ensure that the unit is protected against water and dust ingress and that the explosion proof/flameproof integrity of the enclosure is not compromised, ensure the following:

1. Cover o-rings are installed, undamaged, and properly seated prior to tightening.
2. The plastic shipping conduit entry plugs are discarded and replaced by the metal, explosion proof/flameproof plugs that were provided with the transmitter.
3. Conduit seals are installed per the local code. Varec recommends that a potting compound be used that will not absorb water. Varec also recommends a drain on vertical conduit runs with an explosion proof/flameproof flame arrestor.
4. Seal all pipe threads (e.g., conduit and plugs) with a pipe sealant or Teflon tape.

The cover set screws are backed out enough to allow the covers to be fully tightened and the covers are fully tightened. The covers may be locked, if desired, with the set screws after the covers are tight.

2.6 Field Wiring

Warning! Do not apply power to the transmitter until all wiring connections have been made and the cover of the transmitter has been replaced.

Warning! Do not apply power until the jumper settings have been checked and the instrumentation current loop rechecked. Do not apply power in a hazardous environment until the explosion proof case is closed.

Caution! Incorrect field wiring connections can damage the transmitter electronics and cause system malfunctions. Note difference between user-furnished and on-board power.

Figure 2-3 on page 7 illustrates typical field wiring for a transmitter installation with an on-board power supply.

Each transmitter has a two-conductor signal cable back to the control room. If AC power is required, an additional three-conductor cable is wired to the 8200 COT, either 110 VAC or 220 – 240 VAC. Follow national and local codes for wiring of power and signal cables.

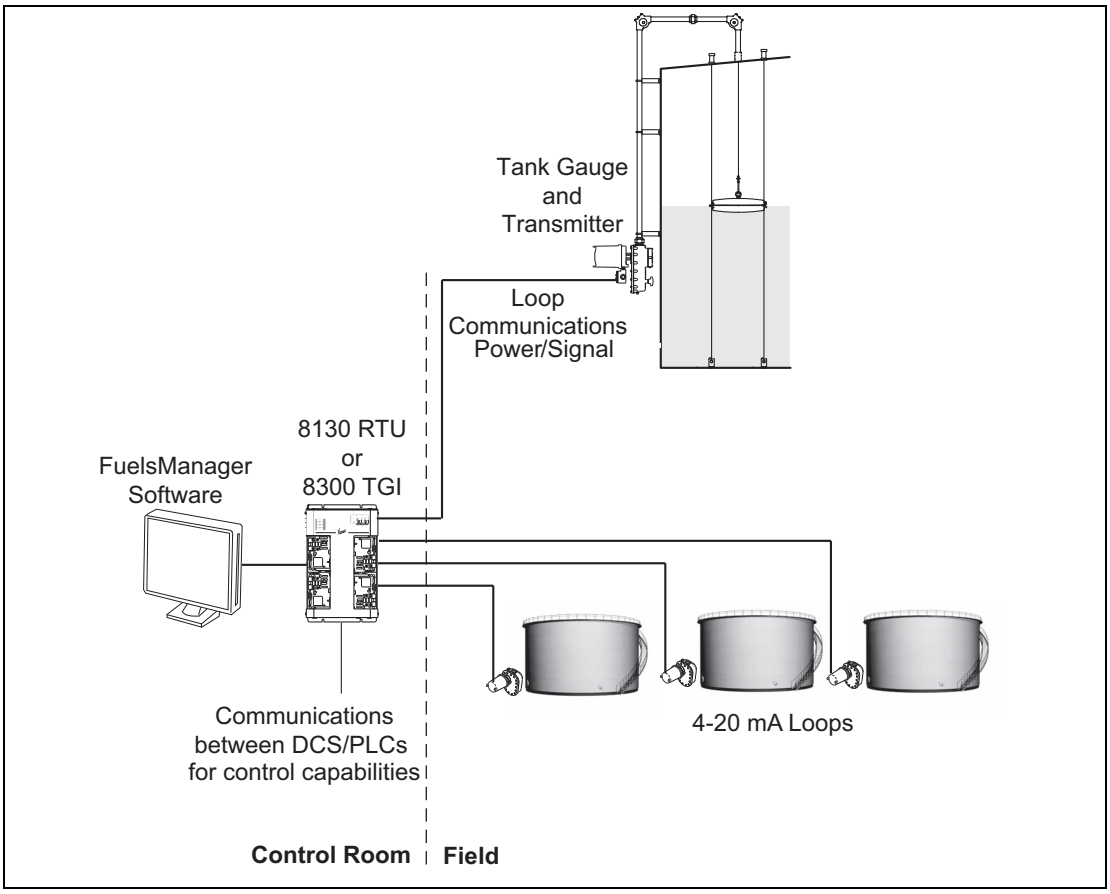

Figure 2-3: Typical Field Wiring

2.6.1 With AC Wiring

1. Connect the (-) lead of the user power to L2.
2. Connect the (+) lead of the user power to L4.

For user-furnished DC power (loop power), see the board in Figure 2-5 on page 9.

2.6.2 User-Furnished DC Power (Loop Powered)

1. Connect the (+) lead of the user power to L2.
2. Connect the (-) lead of the user power to L4.

Note No load resistor is normally necessary if the receiving device is an analog current sensing device operating within the jumpered range. Refer to the instructions for the device in use.

2.7 Jumper Settings

Two sets of jumpers provide the user the selection of the current output ranges and input voltage ranges. If the optional Varec on-board 110/220 power supply is used, the VAC selection must be made. The two AC jumpers must both be set to the applied AC voltage, 110 VAC or 220 VAC. For user-supplied DC power, only the current output range needs to be selected.

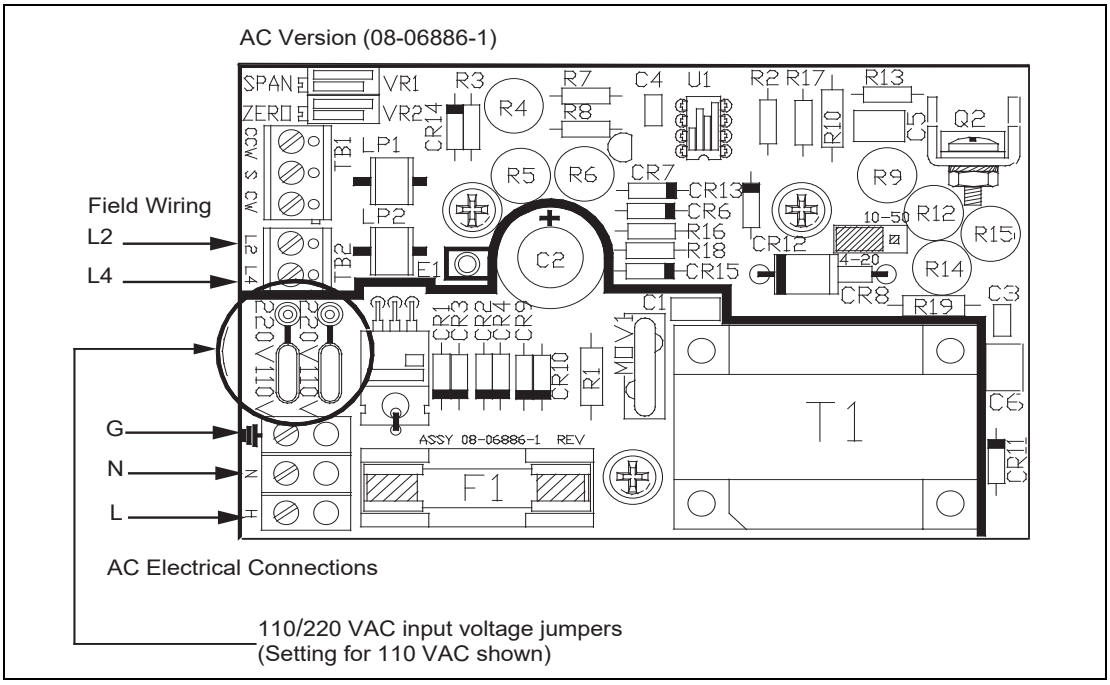

Figure 2-4: AC Supply Jumper Setting

Check that the 4-20/10-50 jumper is set for the current output range of the instrument load loop that is to be used.

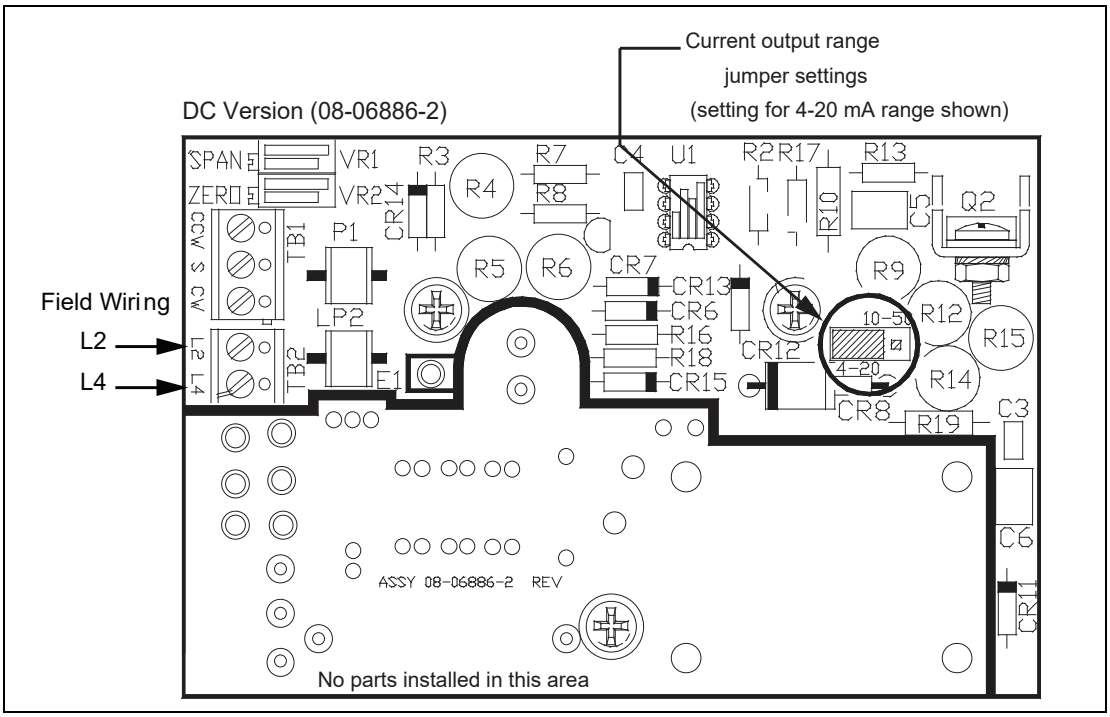

Figure 2-5: Current Output Jumper Setting

2.8 AC Electrical Connections

Connect 110 VAC or 220 – 240 VAC (50/60 Hz) at TB3, terminals N, H and Ground. The wire color code shown is NEC color coding in the U.S.A. and will vary in other countries. Please reference the local electrical code.

- Black (H) = Hot
- White (N) = Neutral
- Green = Ground

2.9 Signal and Switch Wiring Color Codes

The wiring color coding is standard regardless of the model option.

- Red = L2
- Gray = L4
- Brown = Limit switch common
- Orange = Switch #1 NC
- Violet = Switch #2 NC
- Yellow = Switch #3 NC
- Blue = Switch #4 NC

2.10 Junction Boxes and Limit Switches

The 8200 COT is shown with optional junction box in Figure 2-6. See Figures 2-8 and Figure 2-9 on page 13, and the accompanying tables for details regarding junction box connections.

The 8200 COT offers two or four limit switches as options. The wiring is pre-wired Normally Closed (N.C.). The switch has connections for N.C. and Normal Open (N.O.). All switches use one common wire. The customer may change the connection on the switch if N.O. wiring is desired.

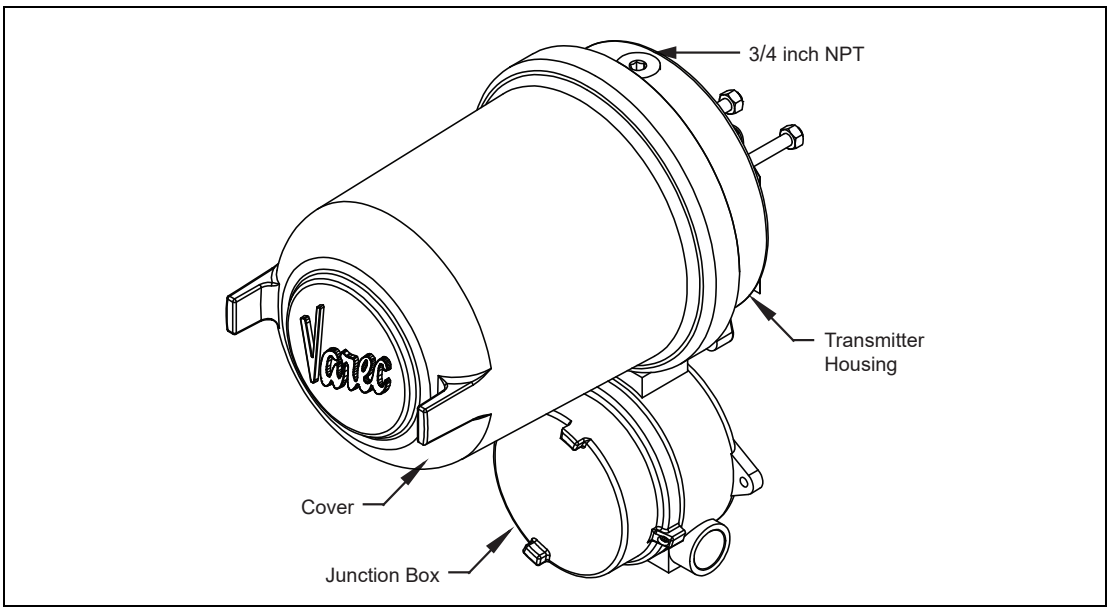

Figure 2-6: 8200 COT Housing with Junction Box

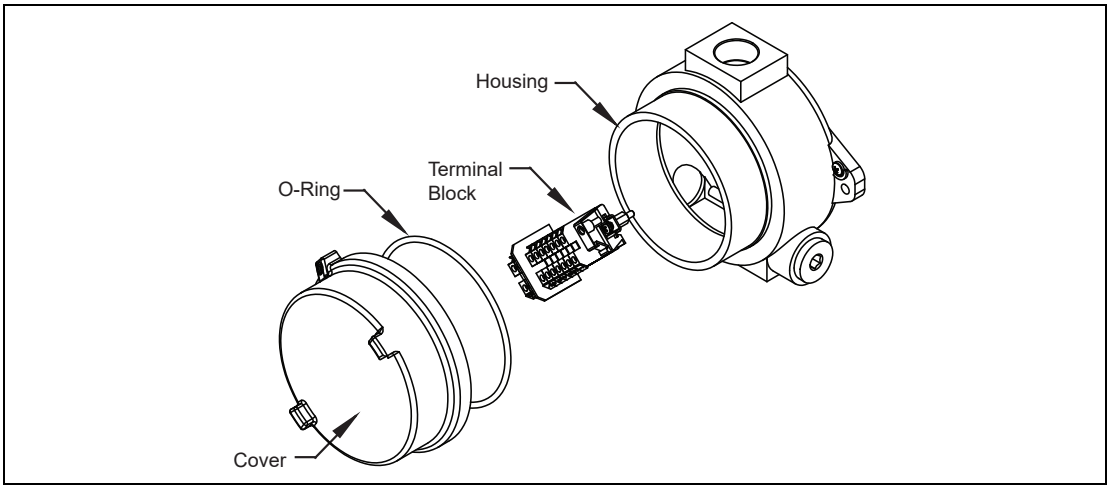

Figure 2-7: 8200 COT Junction Box Exploded View

Refer to Table 2-1 on page 12 for more information on limit switch connections.

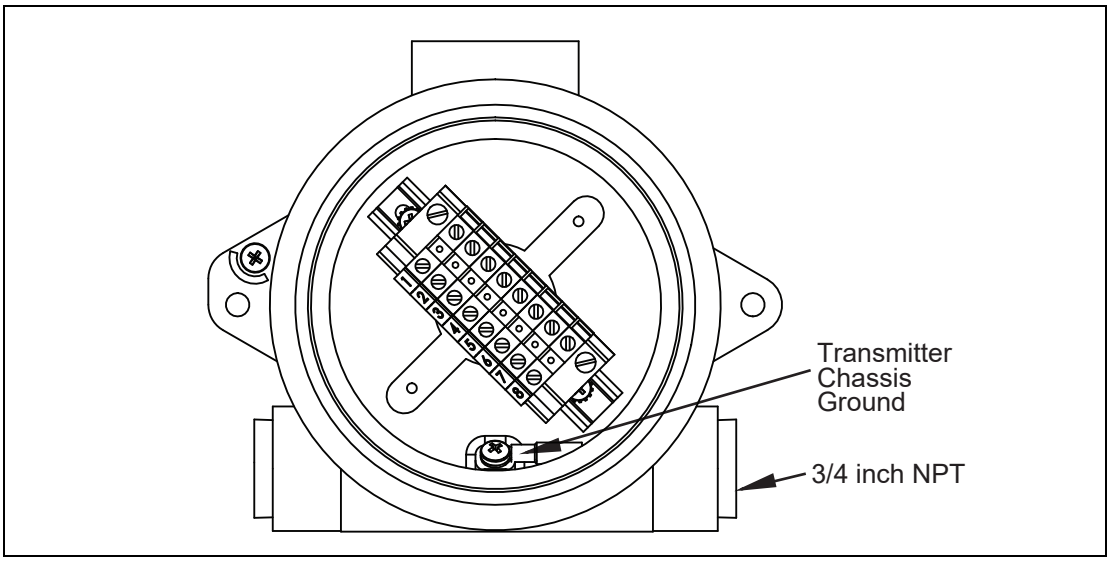

Figure 2-8: Junction Box DC Connectors

Connection	Wire Color	Description
1	Red	L2
2	Gray	L4
3	Brown	Limit switch common
4	Orange	Switch #1 NC
5	Violet	Switch #2 NC
6	Yellow	Switch #3 NC
7	Blue	Switch #4 NC
8	-	Signal reference ground

Table 2-1: Junction Box DC Limit Switch Connections

Refer to Table 2-2 for more information on AC electrical connections.

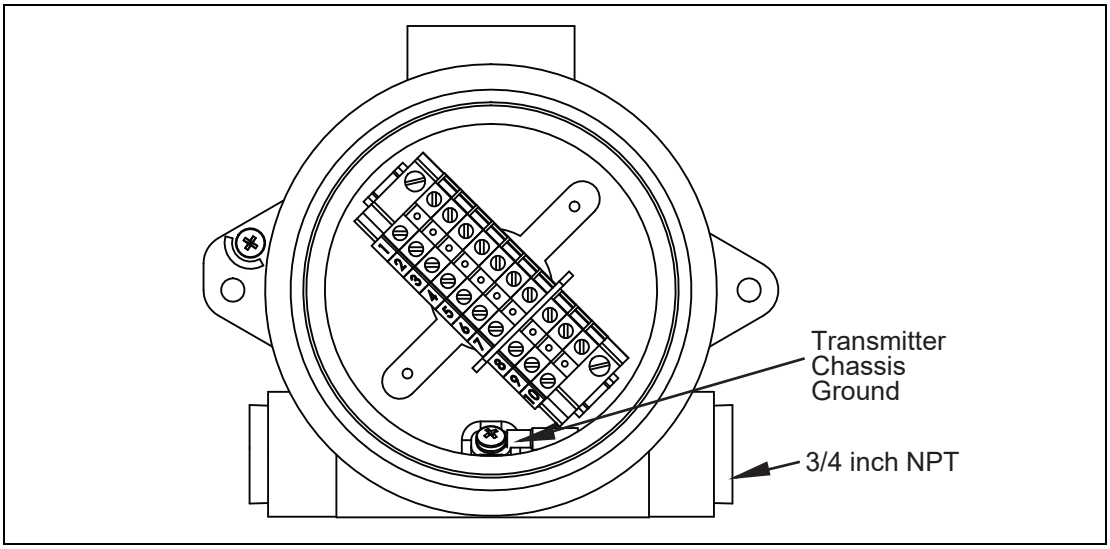

Figure 2-9: Junction Box AC Electrical Connectors

Connection	Wire Color	Description
1	Red	L2
2	Gray	L4
3	Brown	Limit switch common
4	Orange	Switch #1 N.C.
5	Violet	Switch #2 N.C.
6	Yellow	Switch #3 N.C.
7	Blue	Switch #4 N.C.
8	Black	AC line
9	White	AC neutral
10	Green	AC Ground

Table 2-2: Junction Box AC Electrical Connections

2.11 Initial Calibration

Transmitters are calibrated at the factory for full scale range operation. The scale may be selected by the user to any range between 45% and 100%. Refer to Chapter 3, Configuration on page 17 for calibration procedures. Calculate the loop resistance of the installed instrumentation for full-scale operation before installing the wiring. Then check it after the wiring has been installed.

2.12 Loop Resistance

It is necessary to compute the total circuit resistance to determine the correct gauge of field signal wire to use. The maximum allowable total loop resistance (the sum of the wire line and receiver load resistance) may be calculated with the aid of the chart in Figure 2-10 on page 15.

The following two equations can be used to calculate maximum loop resistance (line and load):

4-20 mA Current Output

MAX RESISTANCE = 50(DC POWER SUPPLY VOLTAGE -15)

10-50 mA Current Output

MAX RESISTANCE = 20(DC POWER SUPPLY VOLTAGE -15)

> **Note** If the transmitter uses an internal power supply, the value of the DC POWER SUPPLY VOLTAGE entered into the equation is 30 VDC.

Varec recommends that 22 gauge or larger size wiring be used. (The larger the gauge number the smaller the wire diameter.) Typical telephone field wiring is 21 gauge or larger. Mechanical field conditions affect the wire choice as well as cost.

As an example, determine the minimum gauge of wire that is required to connect a transmitter (30 VDC, 4-20 mA range) located 3000 feet from the receiving device. The receiving device load is 100 ohms.

From Figure 2-10 on page 15, it is seen that the maximum loop resistance is 600 ohms. According to wire data charts, 22 gauge wire has a resistance of 15.14 ohms per 1000 feet. Twice the wire run is 6000 feet, the total loop distance. The wire resistance is 91 ohms. The total loop resistance (receiving device plus loop resistance) is 191 ohms, well under the 600 ohm maximum.

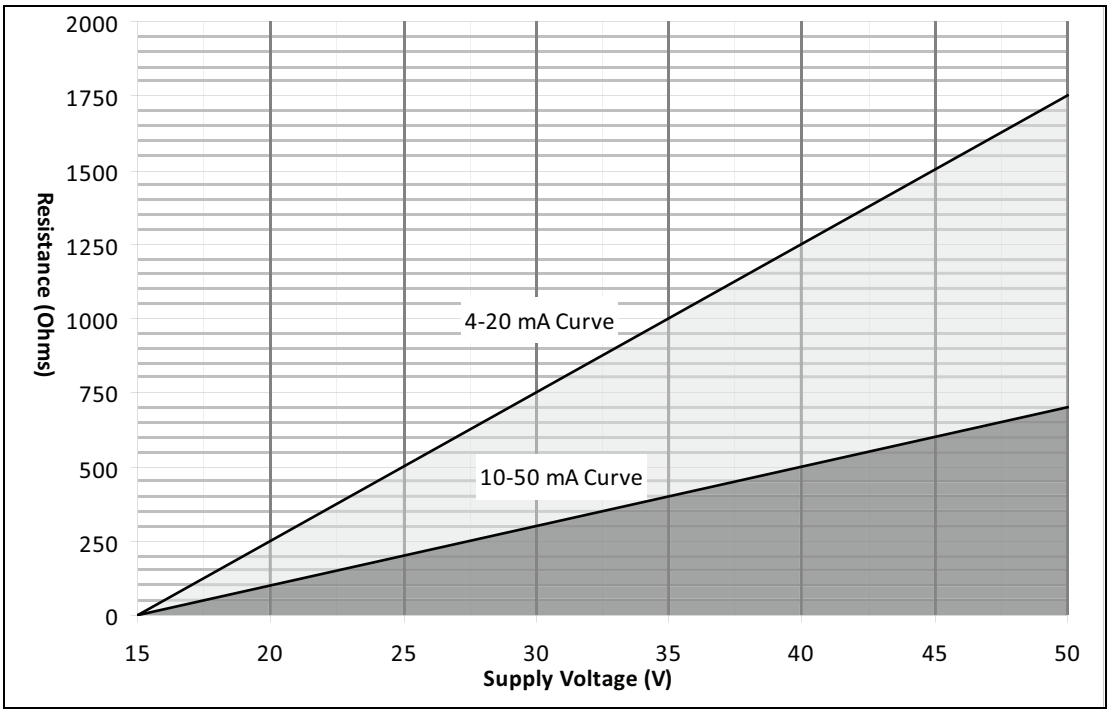

Figure 2-10: Maximum Loop Resistance vs. Supply Voltage Chart

The maximum acceptable resistance levels are at or below the indicated curve for the current range selected.

2.13 Installation Checkout

Check the rotation of the sprocket sheave and transmitter mechanical coupling. Check the installation of the instrumentation wire loop. Proceed to Initial Checkout and Power-up in Chapter 3, Configuration on page 17.

3 Configuration

3.1 Initial Checkout and Power-up

1. Recheck jumper selections.
2. Recheck wiring throughout the instrumentation loop.
3. Loosen the slotted drive coupling set screw using an Allen wrench. Set the transmitter to the actual liquid level in the tank by rotating the field adjust knob located at the end of the shaft.
4. Replace the explosion proof cover on the transmitter.
5. Bring one transmitter at a time online. Apply power.
6. Check that tank data is received and displayed correctly. At the 2500 ATG gaugehead, rotate the check knob and determine that the receiving end of the instrumentation indicates the check knob movement.

3.2 Calibration

The 8200 COT(s) are calibrated at the factory for full-scale operation. The scale of the transmitter, however, can be set to any range between 45% and 100%. See Figure 3-1 on page 18 for the calibration wiring and setup. Note that a power supply is needed for the calibration procedure. If the transmitter does not have a Varec internal power supply, an external power supply must be used for calibration.

Values without parentheses are for the 4 to 20 mA range. Values in parentheses are for the 10 – 50 mA range.

1. Place the transmitter on a work bench. (If a previously installed transmitter is being recalibrated, only the encoder/electronics subassembly need be placed on the bench.)
2. See Figure 3-1 on page 18 and connect calibration equipment to the transmitter.
3. Turn the transmitter shaft until the transmitter encoder dial is set to zero.
4. Use a jeweler's screwdriver to adjust the trimmable resistor labeled ZERO. Adjust for a meter current indication of 4 mA (10 mA).
5. Turn the transmitter shaft to set the transmitter dial to the maximum of the desired range. The range can be set anywhere greater than or equal to 45% of the maximum.
6. Use the jeweler's screwdriver to adjust the trimmable resistor labeled SPAN. Adjust for a meter current indication of 20 mA (50 mA).
7. Repeat steps 4 – 6 as needed.

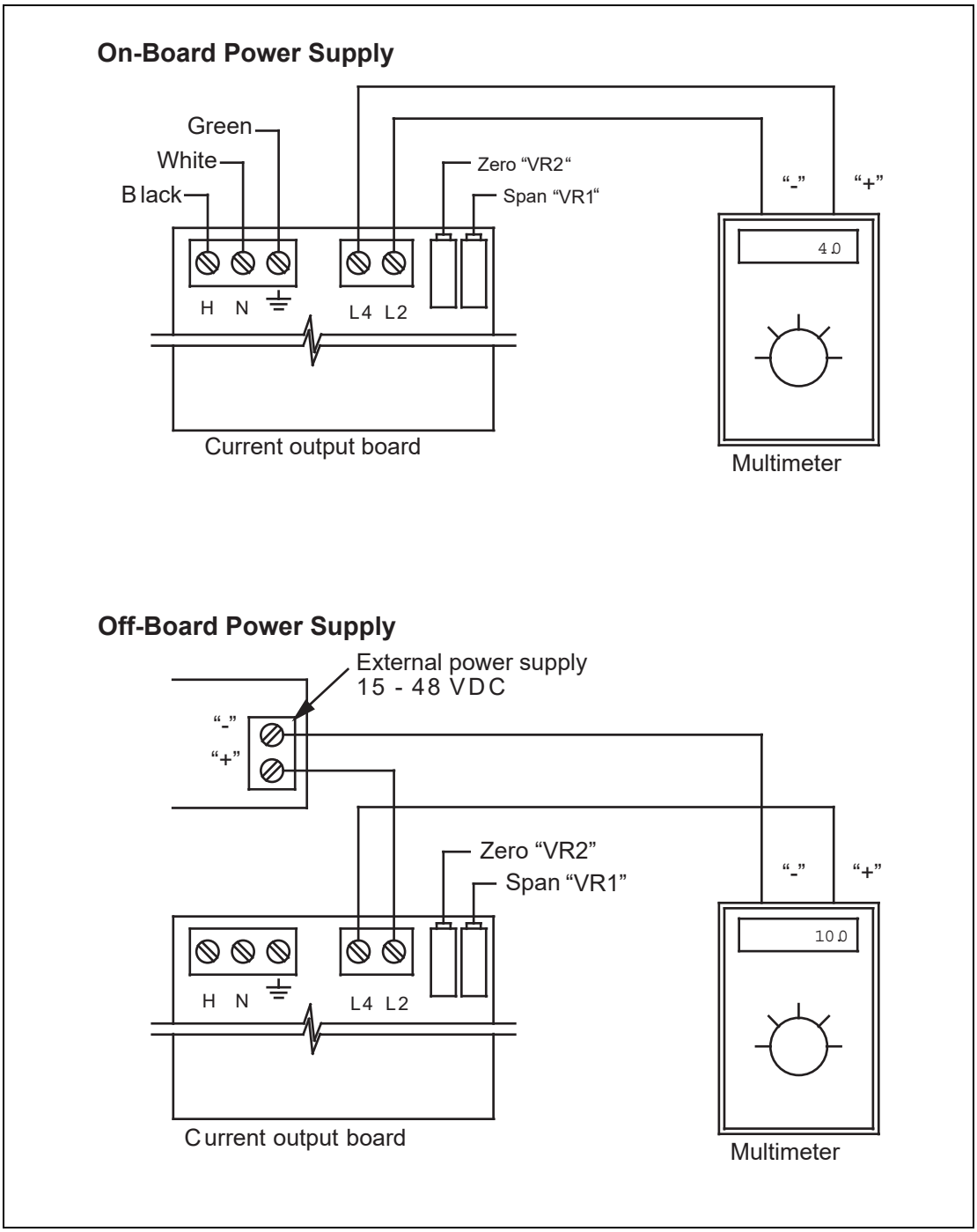

Figure 3-1: Calibration Test Setup

3.3 Limit Switch Operational Setup

Warning! Do not apply power to the transmitter until all connections have been made and the cover of the transmitter has been replaced.

The limit switches normally are configured in arrays of 2 or 4 switches. To set these switches proceed as follows:

1. Remove power or obtain a hot work permit before removing the transmitter cover.
2. Determine which switch sets which specific limit to be selected. (High, Low, etc.)
3. Use the indicator dial as a reference. Align the lobe on the cam to the selected limit. Spring washers are used to keep the cams from moving.

   Note If there are two scales on the dial pointer, it is painted the color of the scale used. If the dial pointer is red, use red numbers, and if the pointer is black, use the black numbers.
4. After calibration and alignment of the cam, loosen the slotted drive coupling set screw using an Allen wrench. Set the transmitter to the actual liquid level in the tank by rotating the field adjust knob located at the end of the shaft.
5. Tighten the Allen screw on the drive shaft coupling and install the explosion proof cover.

4 Maintenance

Maintenance of the 8200 COT consists of routine regular inspections under normal operating conditions. The user should make sure that the shaft connecting the transmitter to the gaugehead is not binding and that operation of the check knob on the gaugehead results in an appropriate change on the receiving instrument. The mechanical coupling to the potentiometer should be free and not binding.

Varec provides maintenance service contracts that provide regular periodic inspection and maintenance at substantial savings. Some repair tasks may require special tools.

4.1 Major System Assemblies and Components

The major system assemblies and components for the 8200 COT are identified in Table 4-1 and illustrated in Figure 4-1.

Item	Part No.	Description
2	P14-170	Housing Cover O-Ring, 7"
3	08-06886-1	4-20 mA Xmtr Bd 110/220 VAC
4	08-06886-2	4-20 mA Xmtr Bd 15-48 VDC User Supp
5	BME11777-001	Encoder 0-12.5 ft, FWD
	BME11777-002	Encoder 0-25 ft, FWD
	BME11777-004	Encoder 0-50 ft, FWD
	BME11777-006	Encoder 0-100 ft, FWD
	BME11777-008	Encoder 0-3.75M, FWD
	BME11777-009	Encoder 0-7.5M, FWD
	BME11777-010	Encoder 0-15M, FWD
	BME11777-011	Encoder 0-24M, FWD
	BME11777-102	Encoder 0-25ft, REV
	BME11777-110	Encoder 0-15m, REV
6	06-03313-002	AC/DC Din Rail Terminal Strip
7	06-03315-2	2 SPDT Limit Switch Parts Kit (not shown)
	06-03315-4	4 SPDT Limit Switch Parts Kit (not shown)
	13-05956-102	Adapter kit for mounting to L&J 92514, 92020, and 92030 gauges
	13-05956-202	Adapter kit for mounting to L&J 92006 and Whessoe Varec 2006, 2026, and 2036 gauges
	P109-16-034	5/8" Recessed Plug, 3/4" MNPT, Copper Free Aluminum, XP-Rated
	P31-775	Round Head Slotted Machine Screw, 10-24 x 3/8, 316SS
	13-B12133	Transmitter Slotted Drive Coupling Replacement Kit

Table 4-1: Major System Components

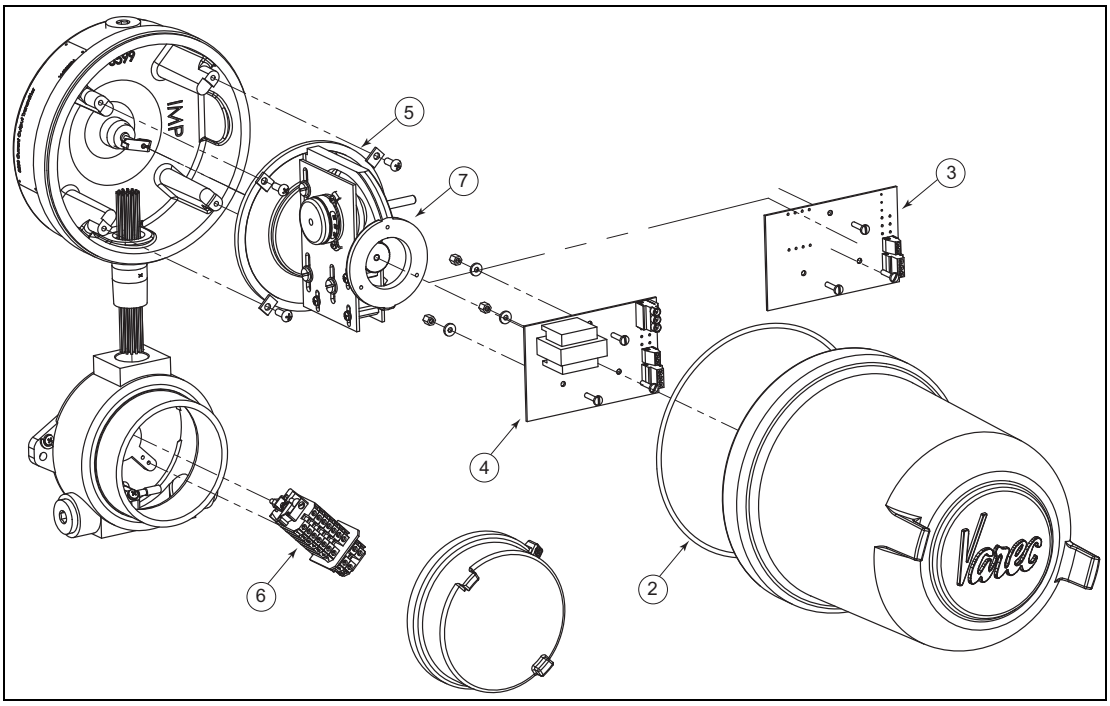

Figure 4–1: Major System Assemblies

5 Specifications

5.1 General

Item	Specification
Accuracy	+/- 0.25% Full Range
Repeatability	0.16% Full Range
Output Current Loop	4-20 mA or 10-50 mA, jumper selectable
Range Adjustment	45 - 100%
Dimensions	8.0" D x 13.25" L (203.2mm x 336.55mm)
Weight	16 lbs. (7.3 kg)
Enclosure	• Material: Impregnated Aluminum Base and Cover • NEMA 4 IP66
Electrical Requirements	• Operating voltage range 15 to 48 Volts DC (regulated) from external power supply **OR** • 115 VAC +/- 10%, 50/60 Hz or 220 - 240 VAC +/-10%, 50/60 Hz

Table 5-1: General

5.2 Available Level Ranges

Item	Specification
Feet	0-12.5', 0-25.0', 0-50.0', 0-100.0'
Meters	0-3.75m, 0-7.5m, 0-15.0m, 0-24.0m

Table 5-2: Available Level Ranges

5.3 Environmental

Item	Specification
Temperature	-13°F [-4°F] to +185°F (-25°C [-20°C] to +85°C)
Humidity	0 to 95% relative humidity (non-condensing)
Safety Approvals	Factory Mutual (cFMus) Explosion Proof, Class I, Division 1, Groups C & D, T5 -25°C ≤ Ta ≤ +85°C: Enclosure NEMA 4 Rated
	ATEX Flameproof, EX II 2 G, Ex db IIB, T5 Gb -20°C ≤ Ta ≤ +85°C
	IECEx Flameproof, Ex db IIB T5 Gb -20°C ≤ Ta ≤ +85°C
Environmental	IP66, NEMA 4

Table 5-3: Environmental

5.4 Options and Accessories

Item	Specification
Conduit Junction Box(es)	N/A
Reverse Reading Output	N/A
Limit Switches — Two (2) or four (4) SPDT limit switches (cam-operated) can be supplied as an option.	They have the following ratings: • 20 A @ 125, 250, 460 VAC • 10 A @ 125 VAC Tungsten filament Lamp Load • 1 HP @ 115 VAC, 2 HP @ 250 VDC • 1/2 A @ 125 VDC, 0.25 A @250 VDC **Note** The optional switches will be pre-wired for normally closed (N.C.) operation. They are mechanically operated directly from the main drive gearing and can be independently configured to switch at any desired tank level.

Table 5-4: Options and Accessories

6 Order Codes

	Power Supply					
	0	15 – 48 VDC				
	1	115 VAC				
	2	220 – 240 VAC				
		Level Ranges				
		1	0 – 12.5 ft			
		2	0 – 25 ft			
		3	0 – 50 ft			
		4	0 – 100 ft			
		5	0 – 3.75 m			
		6	0 – 7.5 m			
		7	0 – 15 m			
		8	0 – 24 m			
			Approvals			
			0	FMus– Explosion Proof – Class I, Division 1, Groups C & D T5 Ta = +85 °C: Flameproof Class I, Zone 1, AEx db IIB T5 Gb Ta=+85°C, Enclosure NEMA 4		
			1	cFM– Explosion Proof – Class I, Division 1, Groups C & D T5 Ta = +85 °C: Flameproof Class I, Zone 1, Ex db IIB T5 Gb Ta=+85°C, Enclosure NEMA 4		
			2	ATEX – Flameproof – Ex II 2 G, Ex db IIB T5 Gb Ta = +85 °C		
			3	IECEx – Flameproof – Ex db IIB T5 Gb Ta = +85 °C		
				General Options		
				0	Additional Option Not used	
				1	2 SPDT Switches (Normally Closed)	
				2	4 SPDT Switches (Normally Closed)	
				3	Reverse Reading	
				4	Reverse Reading with 2 SPDT Switches (Normally Closed)	
				5	Reverse Reading with 4 SPDT Switches (Normally Closed)	
					Junction Box	
					0	None
					1	Included
N8200						Complete product designation

7 Identification

7.1 Device Designation

7.1.1 Warning

The following warning is posted on the instrument:

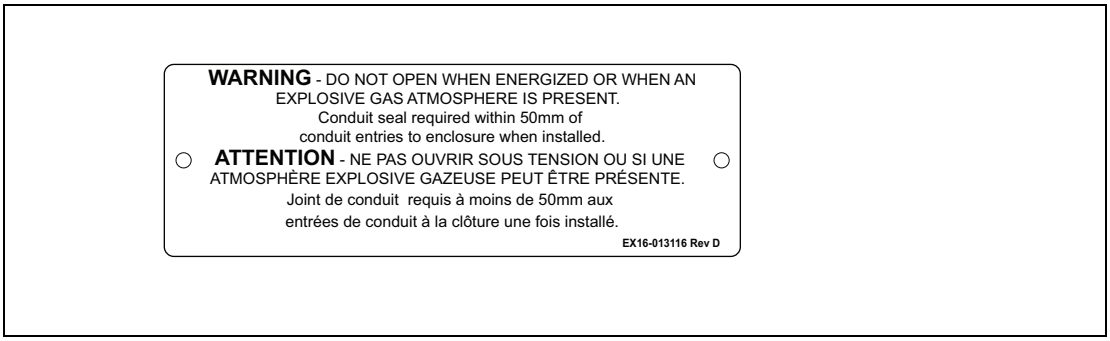

Figure 7-1: 8200 COT Warning

7.1.2 Nameplate

The following technical data are given on the instrument nameplate:

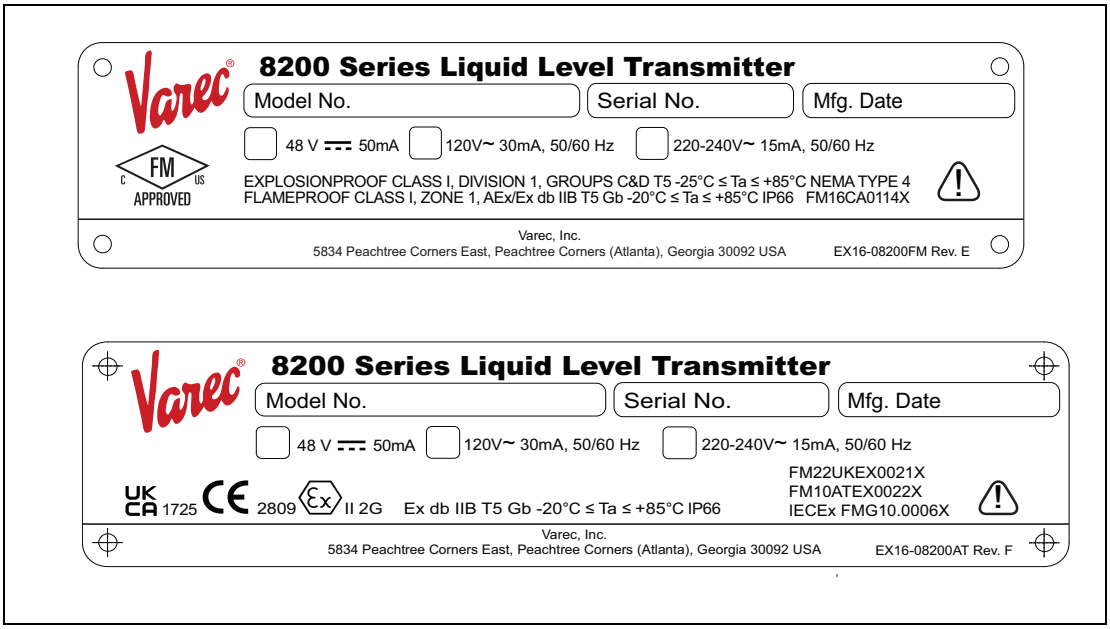

Figure 7-2: 8200 COT Nameplate

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Varec, Inc. • 5834 Peachtree Corners East, Peachtree Corners (Atlanta), GA 30092 USA
Tel: +1 (770) 447-9202 • Fax: +1 (770) 662-8939
www.varec.com