



Two-Wire Ultrasonic 4 or 20mA Horizontal, Viscous Point Level Control

General Instructions

The Ultrasonic Point Level Control indicates liquid presence/absence within a sensor cavity. Two piezoelectric crystals face each other across the sensor cavity. One crystal transmits an ultrasonic signal; the other crystal receives the signal.

When the sensor cavity is empty, the receiver detects a weak signal because air is a poor conductor of ultrasonic waves. The yellow LED is lit, indicating 8 mA current output.

When process liquid fills the sensor cavity, the receiver detects a strong signal because liquids are good conductors of ultrasonic waves. The red LED is lit, indicating 16 mA current output.

The Ultrasonic Point Level Control constantly monitors sensor integrity and changes the current output in the unlikely event of a sensor failure. The Failure Mode Detector located inside the control housing can be field selected to either 5 mA or 19 mA to indicate sensor failure.

Remote Self-Test is provided with **non-intrinsically safe** units only. Units equipped with two terminal blocks feature the remote self-test. A dry contact may be used up to 50 feet/15 meters from the control to simulate a sensor failure.

Standard 316SS and Teflon Notch-Type sensors, epoxy tip-sensitive, and 316SS viscous sensors are available for use with the point level control. Extreme care must be taken when installing units with Teflon sensors. See installation instructions beginning on page 2.

NOTE: If you suspect that a product is defective, contact the factory or the SOR® Representative in your area for a return authorization number (RMA). This product should only be installed by trained and competent personnel.

Design and specifications are subject to change without notice.

For latest revision, go to www.sorfinc.net

Table of Contents

Installation	3
Remote Cable Connection	4
Remote Electrical Connection	4
Electrical Connection	5
Calibration and Function Test	8
Sensor Replacement	9
Circuit Board Replacement	9
CE Marked Units	10
Control Drawings	11
Troubleshooting	16
Dimensions	17-19

Installation

Notch-Type and Epoxy Sensors (Series 371-N and 371-E)

Ultrasonic Level Sensors can be mounted by inserting the sensor through a fitting in a vessel, or over an open sump or basin. Special care must be taken when installing Teflon sensors.



Irreparable damage may be done to Teflon sensors by turning metal hex and Teflon hex separately. Always rotate metal hex and Teflon hex simultaneously. Do not apply more than 10 in. lbs. of torque to either hex during installation.

Keep the sensor cavity out of the direct flow of liquid fill to prevent false readings.

Avoid installation of sensor in turbulent areas such as pump discharge or suction. Air pockets may be present in these areas which may cause false indication.



DO NOT weld any part of this instrument

Tank or Vessel

Make sure that the sensor can be fully inserted and tightened without interference from obstructions inside the tank or vessel. (See **A**)

Apply suitable sealant to the process connection to prevent process leakage. (See **A**)

Use an open end wrench to tighten the sensor into the process connection.

Do not use the sensor base as a handle to tighten the process connection.

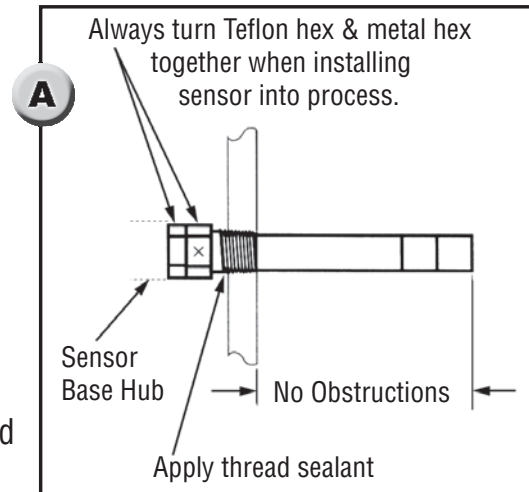
Horizontal Mounting

Horizontal mounting is recommended for use in highly viscous liquids, or liquids containing sludge and debris. When tightened securely, the sensor cavity must face sideways for optimum drainage when process liquid level drops below the sensor cavity.

An alignment mark X stamped on a wrench flat (or on the dry face of a flange below the housing) shows sensor cavity orientation. (See **B**)

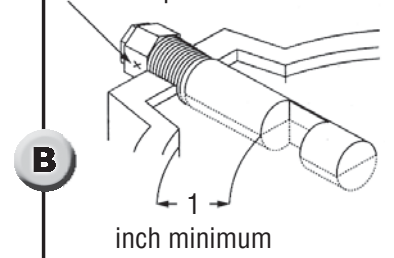
Notch Type Sensors – Optimum drainage occurs when the X mark is located at 3 or 9 o'clock.

The sensor must project through a tank fitting so that the sensor cavity is at least 1" (25.4mm) beyond the inner wall of the tank. (See **B**)



Notch Sensor

Alignment mark shown at 3 o'clock
Alternate position: 9 o'clock

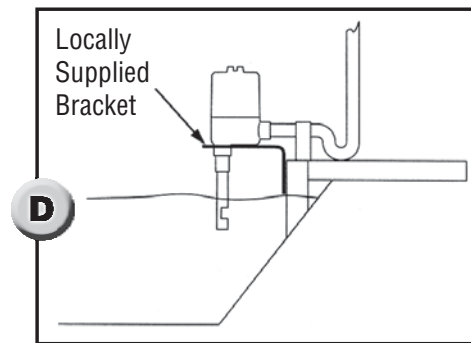


Open Sump or Basin

Do not suspend the unit by rigid conduit installed in the electrical hub. When installing the unit over an open sump or basin, use a suitable bracket to support the instrument.

NOTE: The instrument must be positioned so that overflow does not flood electrical housing. (See **D**)

Open Sump

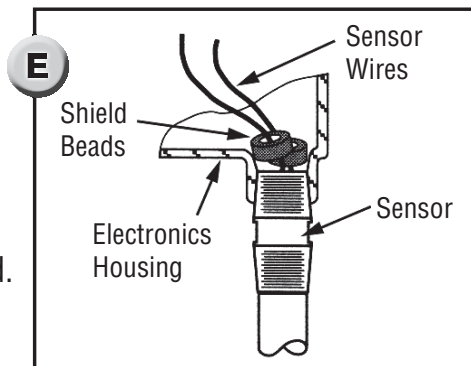


CE Marking Sensor Installation (notch type sensors only, Series 371-N)

Shield Beads

Three beads are included with your CE marked unit. Two of the beads are 5/8" dia x 1/2" long. The other bead is 3/8" dia x 3/4" long (save this bead for the electrical connection beginning on page 5).

- 1 Disconnect the sensor leads from the circuit board.
- 2 Slide one 5/8" dia. bead onto each lead.
- 3 Reinstall the sensor leads into the circuit board.
- 4 Push the beads to the bottom of the housing. (See **E**)



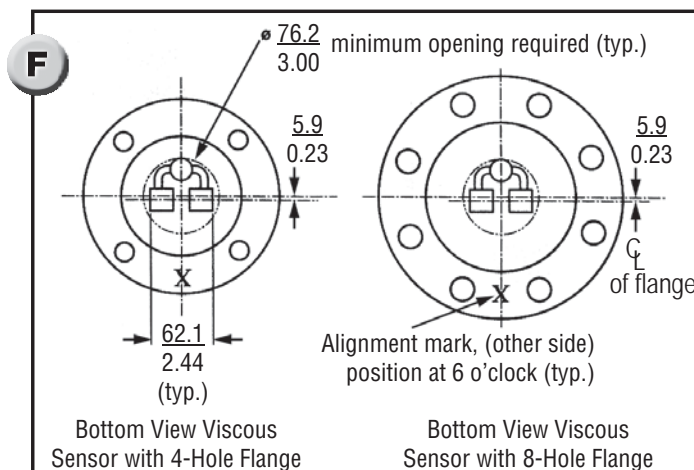
Viscous Sensor Installation (Series 371-V)

Vertical or horizontal (flange only) mounting is supported for the viscous sensor. A 3" (76.2mm) minimum opening is required for insertion.

An alignment mark X stamped on the dry face of the flange below the housing shows sensor cavity orientation. (See **F**) When mounting the viscous sensor horizontally, optimum drainage occurs when the X mark is located in the 6 o'clock position.

Take care during installation to prevent damage to the sensor

end. Slight bending of the sensor may result in loss of sensitivity due to misalignment of the ultrasonic crystals.



Remote Cable Connection

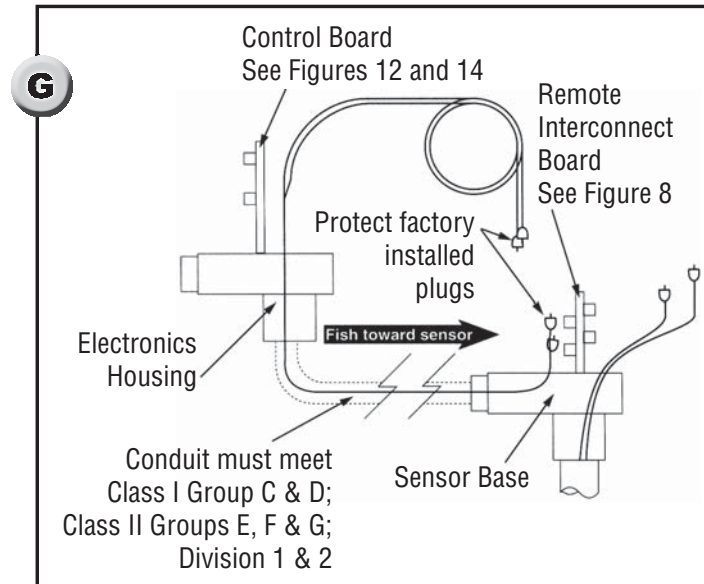
Conduit must be installed between the sensor base and the electronics housing to provide a raceway for sensor extension cables. (See **G**) The sensor base and the electronics housing are suitable for use in Class I Group C & D; Class II Groups E, F & G; Division 1 & 2 Hazardous Locations. All conduit and fittings used for the installation must equal or exceed this rating to maintain the explosion proof integrity of the assembly.

Ensure that wiring conforms to all applicable local and national electrical codes and install unit(s) according to relevant national and local safety codes.

Fishing the Sensor Extension

Cables Two sensor extension cables are supplied. Both ends of the cables are terminated and labeled at the factory.

Use care to avoid damaging the factory installed mini-phono connectors while fishing the sensor extension cables through the conduit. Pull cables from the sensor base so that the free ends follow the fish through the conduit. (See **G**)



Remote Electrical Connection



Electrical power must be disconnected from explosion proof models before the cover is removed. Failure to do so could result in severe personal injury or substantial property damage.

Sensor Coax Connections Inside Sensor Base

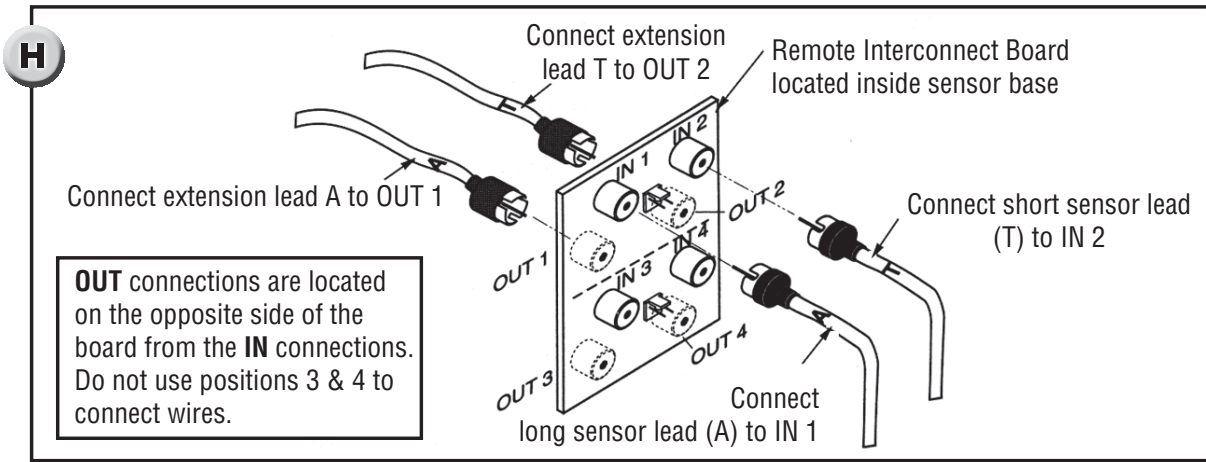
Inside the sensor base, a remote interconnect board rests in a plastic holder. Slide the interconnect board up. Attach the sensor coax connectors to the interconnect board as follows:

- 1 Connect the long sensor* (A) cable to IN 1.
- 2 Connect the short sensor (T) cable to IN 2.

***Viscous probe sensor cables are the same length. Refer to the cable markings to make correct electrical connections.**

Attach the extension cables to the interconnect board as follows:

- 3 Connect cable A to OUT 1. (See **H**)
- 4 Connect cable T to OUT 2.



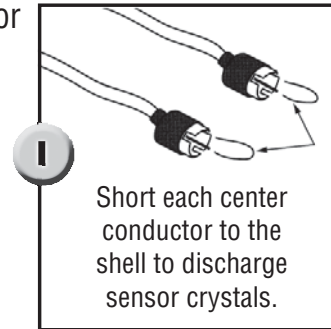
Discharge the Sensor

Temperature changes which occur during shipment may result in a small electrical charge inside the sensor crystals. This charge is harmless to humans, but may result in damage to the electronics if the sensor is plugged in before it is discharged. To discharge the sensor, touch a wire to each sensor connector so that the center conductor and outside shell make contact. (See **I**)

Plug in Connections Inside Electronics Housing

Plug sensor extension cables onto the PC board as follows:

- 5 Connect cable A to J1.
- 6 Connect cable T to J2. (See **N** to locate J1 and J2.)



Electrical Connection

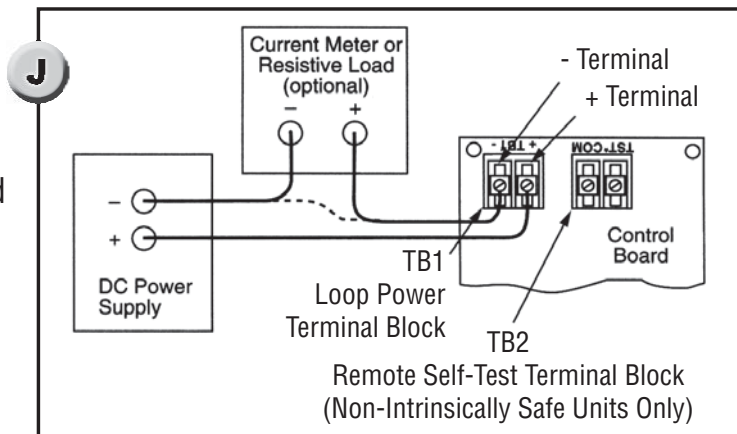
Explosion Proof and Non-Agency Listed model



Electrical power must be disconnected from explosion proof models before the cover is removed. Failure to do so could result in severe personal injury or substantial property damage.

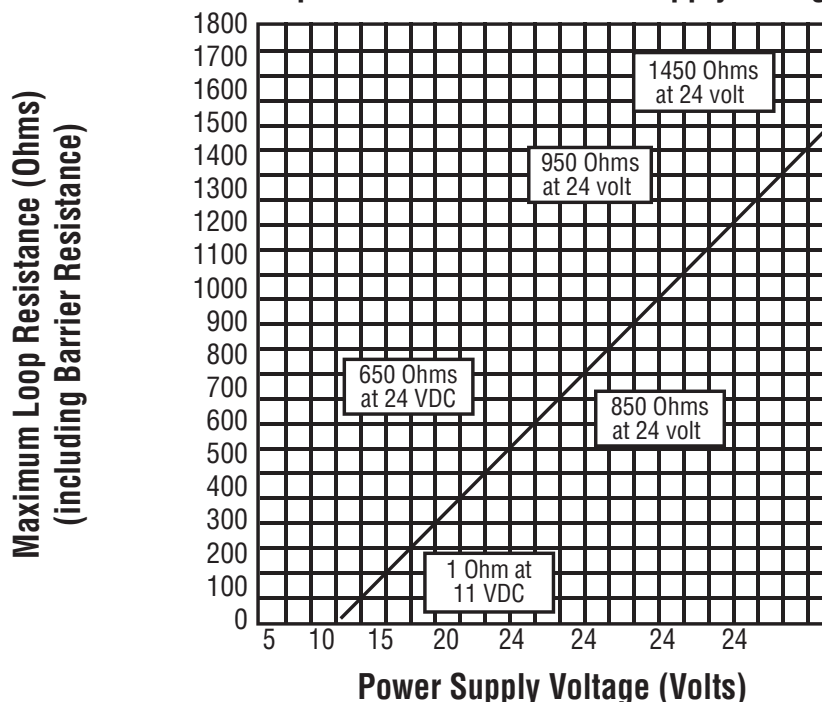
Ensure that wiring conforms to all applicable local and national electrical codes and install unit(s) according to relevant national and local safety codes.

- 1 Make sure the power source is turned off.
- 2 Remove the housing cover.
- 3 Pull power and signal wires through the conduit connection and into the control housing.
- 4 Locate TB1 on the control board. (See **J**) Terminals are labeled “+” and “-”. Connect power leads to the proper terminals.
- 5 Do not exceed the maximum loop resistance for the circuit. (See **K**)



K

Loop Resistance vs. Power Supply Voltage



Electrical Connection (Remote Self-Test)

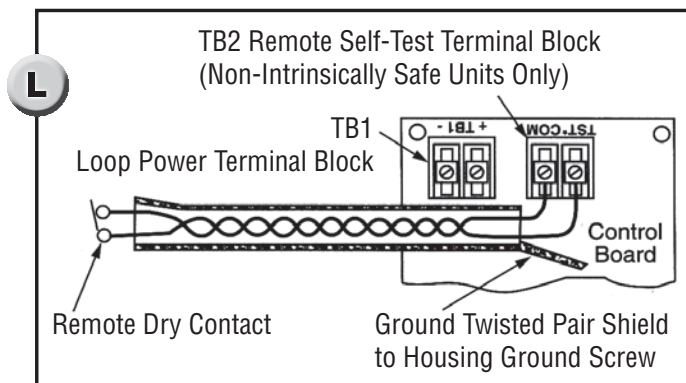
Explosion Proof and Non-Agency Listed models:



Electrical power must be disconnected from explosion proof models before the cover is removed. Failure to do so could result in severe personal injury or substantial property damage.

Ensure that wiring conforms to all applicable local and national electrical codes and install unit(s) according to relevant national and local safety codes.

- ❶ Make sure the power source is turned off.
- ❷ Remove the housing cover.
- ❸ Pull twisted pair cable through the conduit connection and into the control housing.
- ❹ Connect dry contact wires to TB2 on the control board. (See **L**) Terminals are labeled “RMT COM” and “RMT TST*”. Attach the twisted pair shield to the ground screw inside the housing. Ground only one end of the twisted pair shield.
- ❺ Do not apply power to the remote test terminals.
- ❻ Connect the open end of the wires to a dry (unpowered) contact designed for small loads. There is no polarity required for this connection.



Electrical Connection (Intrinsically Safe)

Intrinsically Safe Models (does not apply to viscous or epoxy controls and sensors):

Any model numbers containing the designators “AI”, “CI” or “FI” are listed Intrinsically Safe with CSA (AI), CENELEC (CI) or FM (FI). Please note the housing nameplate to determine the Agency Approval of your instrument. Connections must be as shown on the SOR Control Drawings shown on pages 8-12.

AI CSA Intrinsically Safe..... Class I, Div. 1, Groups C, & D; Class II, III, Div. 1, Groups E, F, & G; Class I, Div. 2, Groups A, B, C, D; Class II, III, Div. 2, Groups F, G; Type 4X; T4

Connections must be as shown on the SOR Control Drawing 9065-136.

CI CENELEC Intrinsically Safe..... EEx ia IIB T4, IP65

Connections must be as shown on the SOR Control Drawing 9065-146.

FI FM Intrinsically Safe..... Class I, Div. 1, Groups C, & D; Class II, III, Div. 1, Groups E, F, & G; Class I, Div. 2, Groups A, B, C, D; Class II, III, Div. 2, Groups F, G; NEMA 4X; T4

Connections must be as shown on the SOR Control Drawing 9065-135.

Electrical Connection (CE Marking)

Shield Beads

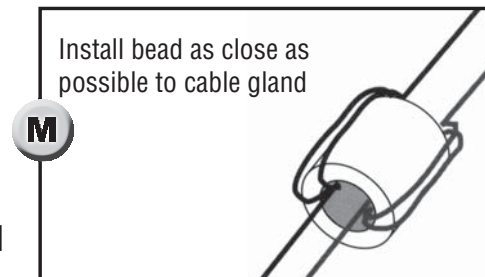
Three beads are included with your CE marked unit. Two of the beads are 5/8” dia. x 1/2” long; they are used in the sensor installation. (See page 3.) The other bead is 3/8” dia. x 3/4” long. Use this bead for the following electrical connection.

In order to achieve the stated accuracy of ± 1 mA, a customer supplied shielded cable and cable gland are used with the furnished 3/8” dia. x 3/4” bead. SOR recommends using a shielded cable made of PVC insulation around a tinned copper braid shield (Olflex CY or equivalent). Install the bead as close as possible to the cable gland.

- 1 Strip outer cable insulation and shield approx. 10 inches.
- 2 Separate the positive and negative wires.
- 3 Slide the bead over both wires.
- 4 Wrap each wire around opposite sides of the bead to make two complete loops. (See **M**)

5 Make internal power connections as shown on page 4.

6 Install the cable gland per manufacturer’s instructions. The cable gland will provide necessary grounding for the cable shield.

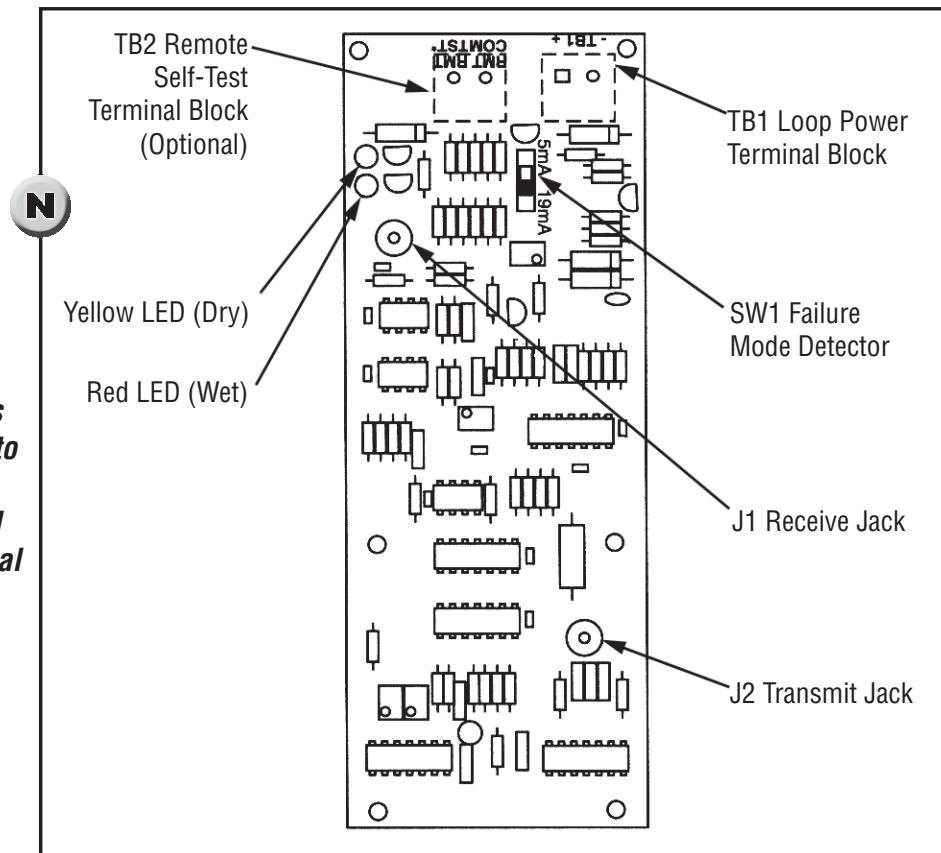


Calibration and Function Test

No calibration is needed. Units are calibrated at the factory. No user adjustments are required.



Electrical power must be disconnected from explosion proof models before the cover is removed. Failure to do so could result in severe personal injury or substantial property damage.



Functional test can be done with or without a current meter. See **J** for wiring configuration. See **N** for component location.

- 1 Connect power to the circuit board as shown in **I**. If the sensor is dry, the yellow LED will light. If using a current meter, the display should read 8 mA (± 1 mA).
- 2 Apply process liquid to the sensor. The yellow LED will turn off, and the red LED will light. Current meter will read 16 mA (± 1 mA).
- 3 With Failure Mode Detector (SW1) in the 5 mA position, disconnect one probe lead wire (J1 or J2). Both LEDs will turn off and the current meter will read 5 mA (± 1 mA). Reconnect the probe lead wire.
- 4 With Failure Mode Detector (SW1) in the 19 mA position, disconnect one probe lead wire (J1 or J2). Both LEDs will light and the current meter will read 19 mA (± 1 mA). Reconnect the probe lead wire.
- 5 To test Remote Self-Test detector connections (non-intrinsically safe units only), use the dry contact to simulate a probe failure for steps 3 and 4 instead of disconnecting the probe lead wire.

Current Output Chart				○ LED on
				● LED off
Yellow LED (Dry)	Red LED (Wet)	Current Meter (+ 1mA)	Sensor Status	Failure Mode
○	●	8 mA	Dry	—
●	○	16 mA	Wet	—
●	●	5 mA	—	5 mA
○	○	19 mA	—	19 mA

Sensor Replacement

- ① Disconnect power to the unit.
- ② Remove the housing cover.
- ③ Remove two mounting screws and slide out PC board to expose the sensor connections J1 and J2. (See **N**)
- ④ Disconnect the sensor wires from J1 and J2.
- ⑤ Unscrew the sensor from the housing.
- ⑥ Apply thread sealant to the male threads of the new sensor.
- ⑦ Thread the new sensor into the bottom of the housing.
- ⑧ Discharge the sensor. Connect the center conductor and shell of sensor wire end as shown on page 4. (See **I**)
- ⑨ Connect the sensor wire (T) into the J2 mini-phono jack on the circuit board. (See **N**)
- ⑩ Connect the sensor wire (A) into the J1 miniphono jack on the circuit board.
- ⑪ Slide the PC board into the grooves in the plastic ring inside the housing.
- ⑫ Replace the two mounting screws into the plastic ring: these screws are self-tapping. Do not overtighten.
- ⑬ Reconnect power and replace the housing cover.

Replacement Sensors

See Form #973, Ultrasonic Catalog for replacement sensor model numbers.

Circuit Board Replacement

- ① Disconnect power to the unit.
- ② Remove the housing cover.
- ③ Remove two mounting screws and slide out PC board.
- ④ Disconnect sensor plugs J1 and J2. (See **N**)
- ⑤ Slide the new board into the control housing.

- ⑥ Discharge the sensor. Connect the center conductor and shell of sensor wire end as shown on page 5. (See ⓘ)
- ⑦ Connect the sensor plugs to the new board. The sensor wire (T) plugs into J2 (transmit). The sensor wire (A) plugs into J1 (receive).
- ⑧ Replace the two mounting screws into the plastic ring. These screws are self-tapping. Do not overtighten.

Replacement Circuit Boards Match the characters of your model number with those shown below to select the proper replacement board part number. Accessory designators are located at the end of the model number in no particular order.

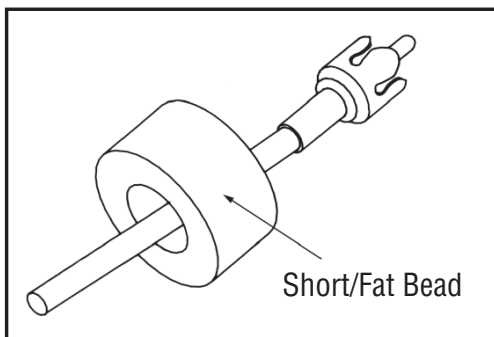
Model Number	Accessory Designator		
	I.S. CI, FI or AI	Expf FM or CS	Non-Agency (no match)
721□ 2-N-P9-G	5003-009	5003-010	5003-010
721□ 2-N-P9-C	5003-011	5003-012	5003-012
721□ 2-V-P9-C	---	---	5003-028
721□ 2-E-P9-C	---	---	5003-042

NOTE: When ordering replacements for remote units (R in the 4th position of the model number), supply cable length information and serial number. Circuit boards are tuned to remote cable length for optimum circuit performance.

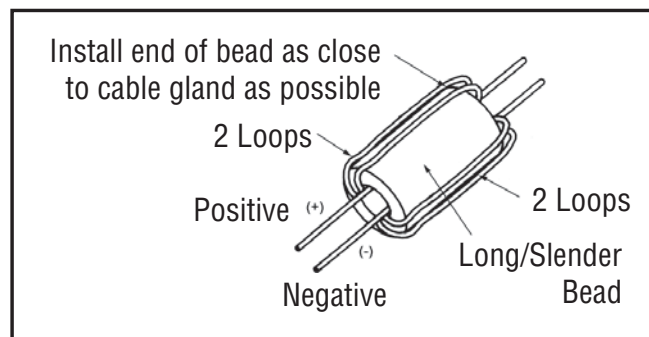
CE Marked Units

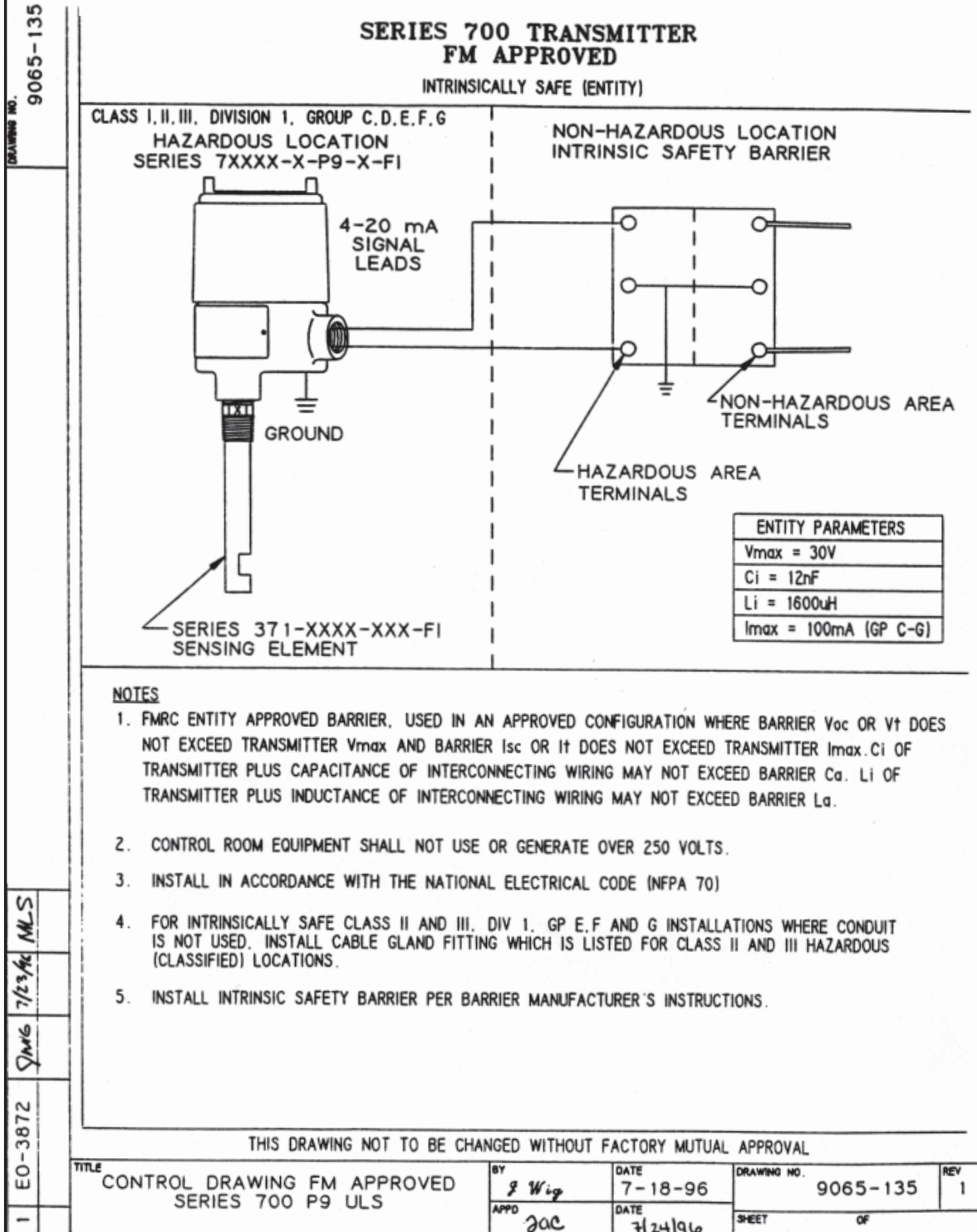
In order to achieve the stated accuracy of +/-1mA, a shielded cable, cable gland and shield beads must be used. SOR recommends using a shielded cable made of PVC insulation around a tinned copper braid shield. (Olflex CY cable or equivalent.) Refer to illustrations below for installation of shield beads.

Probe Wire Shield Bead

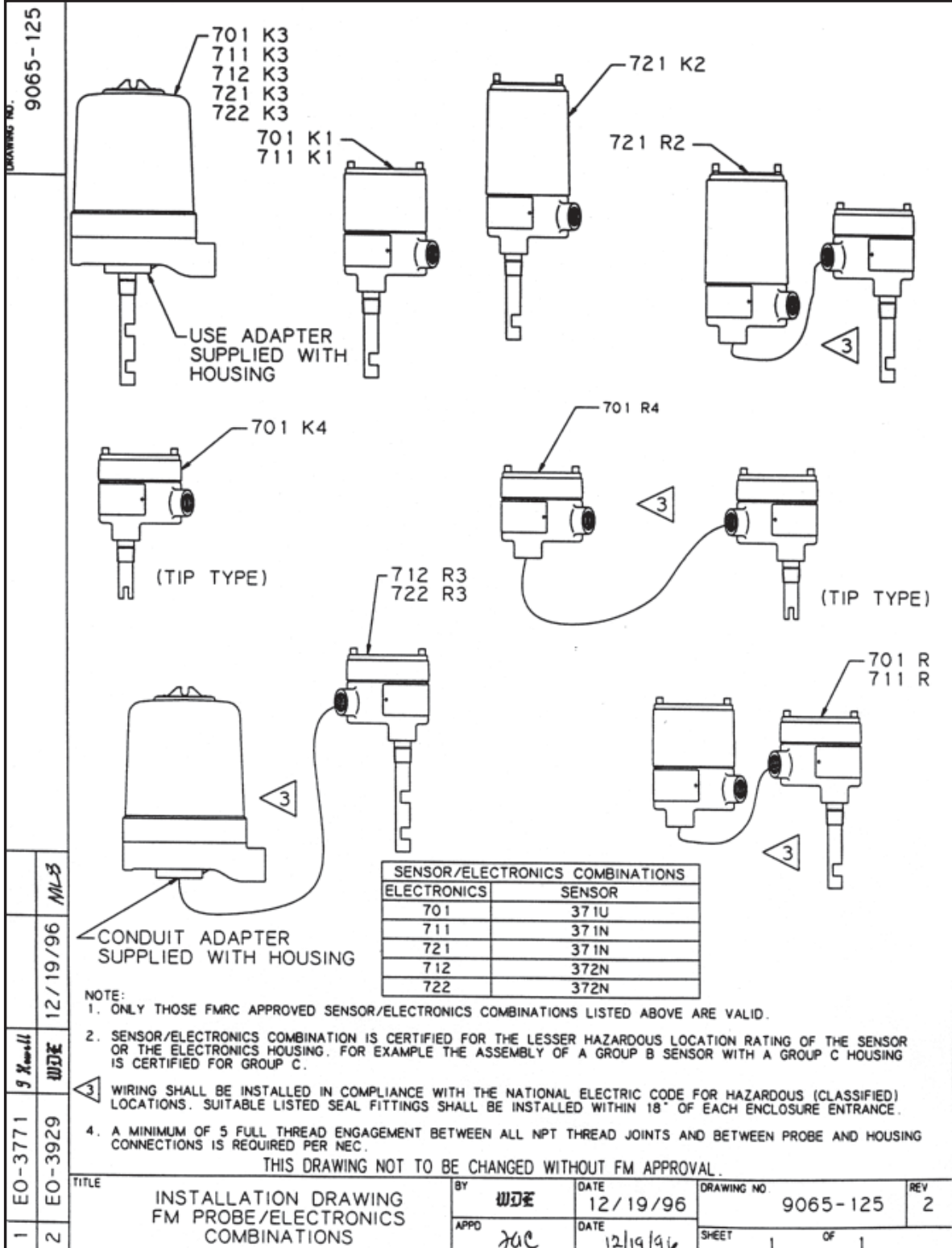


Probe Wire Shield Bead



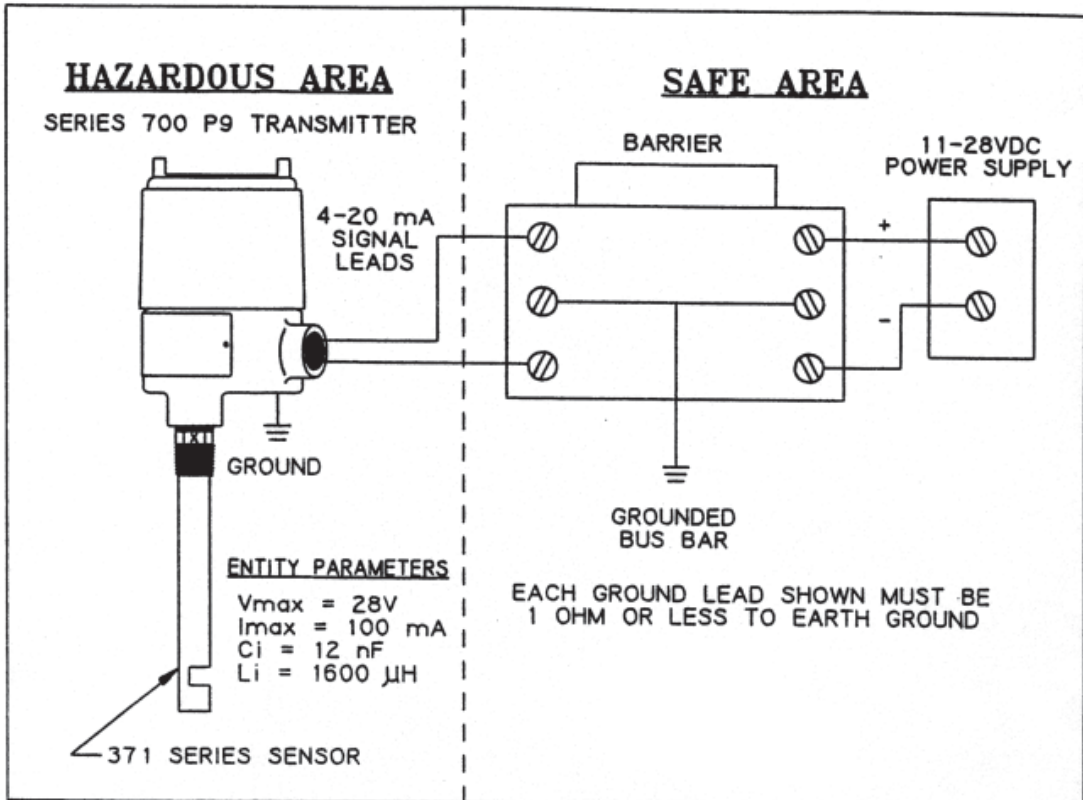


Control Drawing



Control Drawing

9065-136



1. BARRIERS MUST BE INSTALLED IN ACCORDANCE WITH MANUFACTURERS INSTRUCTIONS.
2. BARRIER PARAMETERS MUST MEET THE FOLLOWING REQUIREMENTS:
 $V_{oc} \leq V_{max}$ $C_a \geq C_i + C_{Cable}$
 $I_{sc} \leq I_{max}$ $L_a \geq L_i + L_{Cable}$
3. MAXIMUM NON-HAZARDOUS AREA VOLTAGE MUST NOT EXCEED 250 V.
4. INSTALL IN ACCORDANCE WITH CANADIAN ELECTRICAL CODE, PART I.

Exia INTRINSICALLY SAFE/SECURITE INTRINSEQUE
 WARNING: SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY.
 ADVERTISSEMENT: LA SUBSTITUTION DE COMPOSANTS PEUT COMPROMETTRE LA SECURITE INTRINSEQUE

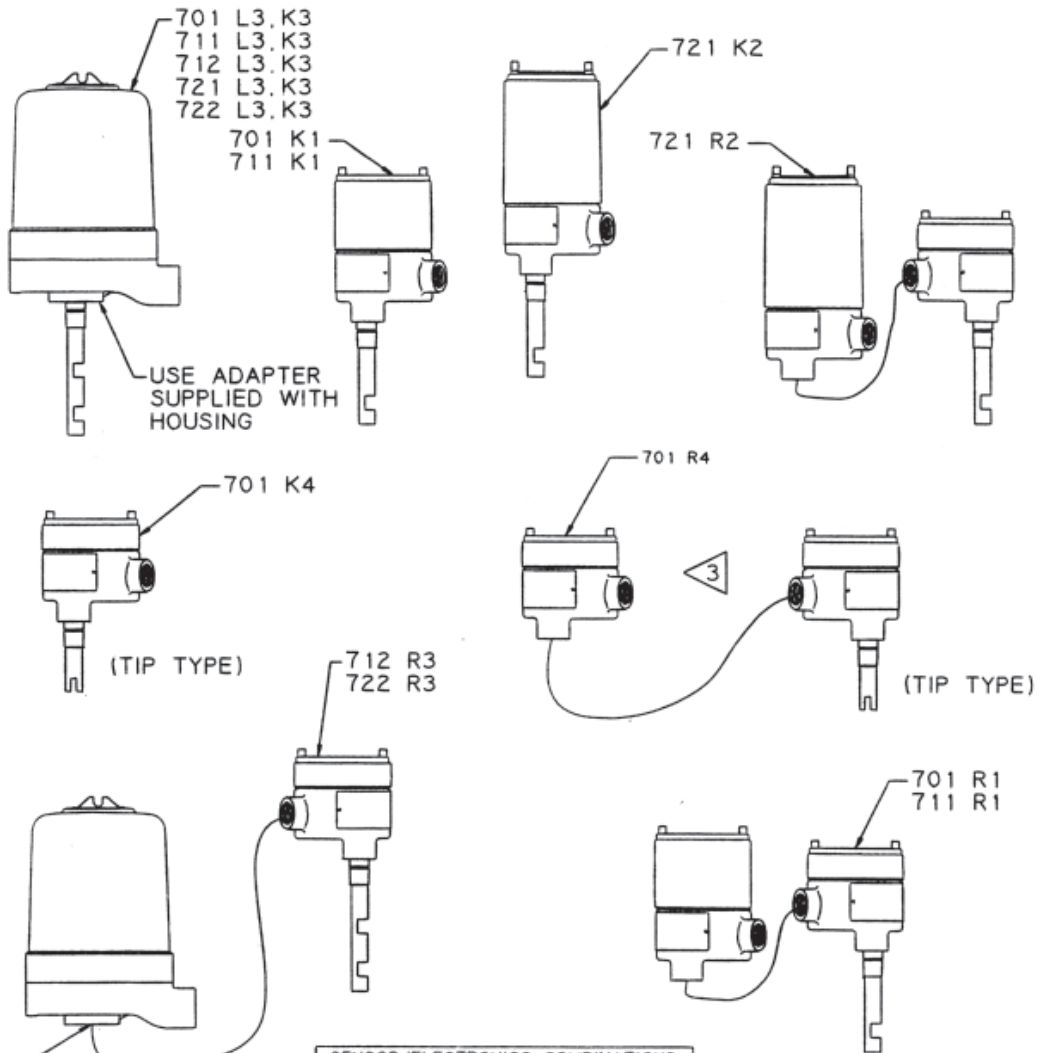
THIS DRAWING NOT TO BE CHANGED WITHOUT CSA APPROVAL.

EO-3872 Gm/G 7-25-96 M/S

TITLE CONTROL DRAWING CSA APPROVED SERIES 700 P9 ULTRASONIC POINT LEVEL CONTROL	BY WJG	DATE 04-09-96	DRAWING NO. 9065-136	REV 1
	APPD JAE	DATE 4/10/96	SHEET 1	OF 1

Control Drawing

DRAWING NO. 9065-124



SENSOR/ELECTRONICS COMBINATIONS	
ELECTRONICS	SENSOR
701	371U
711	371N OR 371G
721	371N OR 371G
712	372N
722	372N

- NOTE:
1. ONLY THOSE SENSOR/ELECTRONICS COMBINATIONS LISTED ABOVE ARE VALID.
 2. SENSOR/ELECTRONICS COMBINATION IS CERTIFIED FOR THE LESSER HAZARDOUS LOCATION RATING OF THE SENSOR OR THE ELECTRONICS HOUSING. FOR EXAMPLE THE ASSEMBLY OF A GROUP B SENSOR WITH A GROUP C HOUSING IS CERTIFIED FOR GROUP C.
 3. WIRING SHALL BE INSTALLED IN COMPLIANCE WITH APPLICABLE CSA EXPLOSION PROOF STANDARDS FOR HAZARDOUS LOCATIONS.

THIS DRAWING NOT TO BE CHANGED WITHOUT CSA APPROVAL.

1	EO-3771	TAH	8/8/95	MLS	MBS
2	EO-4242	WDE	6/7/96		

TITLE
 INSTALLATION DRAWING
 CSA PROBE/ELECTRONICS
 COMBINATIONS

BY	WDE	DATE	6/7/96	DRAWING NO.	9065-124	REV	2
APPD	jac	DATE	6/7/96	SHEET	1	OF	1

Control Drawing

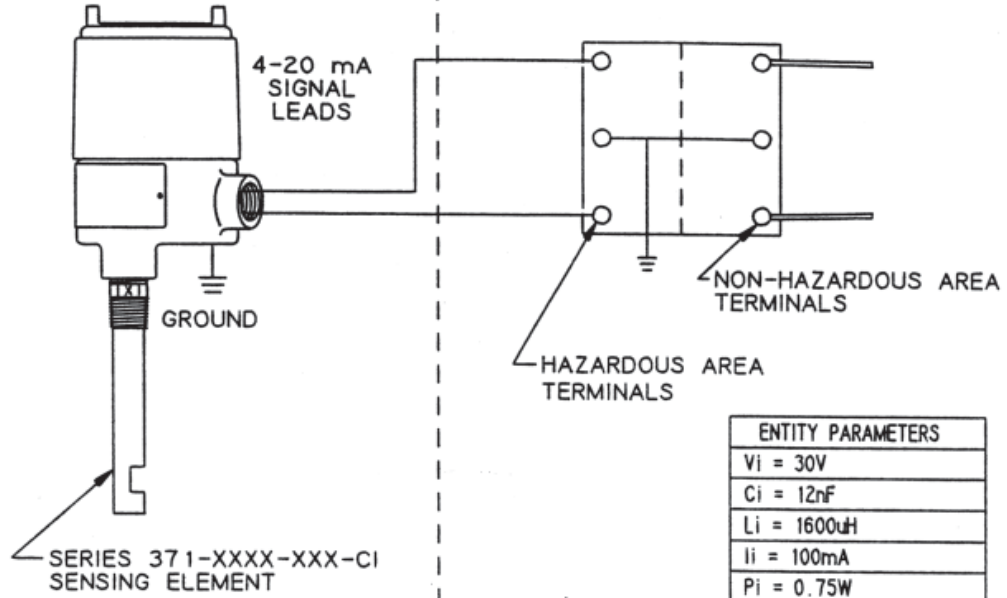
DRAWING NO. 9065-146

SERIES 700 TRANSMITTER CENELEC APPROVED

INTRINSICALLY SAFE (ENTITY)

EEx ia IIB
HAZARDOUS LOCATION
SERIES 7XXXX-X-P9-X-CI

NON-HAZARDOUS LOCATION
INTRINSIC SAFETY BARRIER



NOTES



1. CONTROL ROOM EQUIPMENT SHALL NOT USE OR GENERATE OVER 250 VOLTS.
2. INSTALL IN ACCORDANCE WITH APPLICABLE NATIONAL CODES.
3. INSTALL CENELEC CERTIFIED INTRINSIC SAFETY BARRIER PER BARRIER MANUFACTURER'S INSTRUCTIONS.

THIS DRAWING NOT TO BE CHANGED WITHOUT KEMA APPROVAL

EO-3872 WIDE 8/12/96 MLS

1	CONTROL DRAWING CENELEC APPROVED SERIES 700 ULS P9	BY	WDS	DATE	8-12-96	DRAWING NO.	9065-146	REV	1
		APPD	JAC	DATE	8/12/96	SHEET	1 OF 1		

Troubleshooting

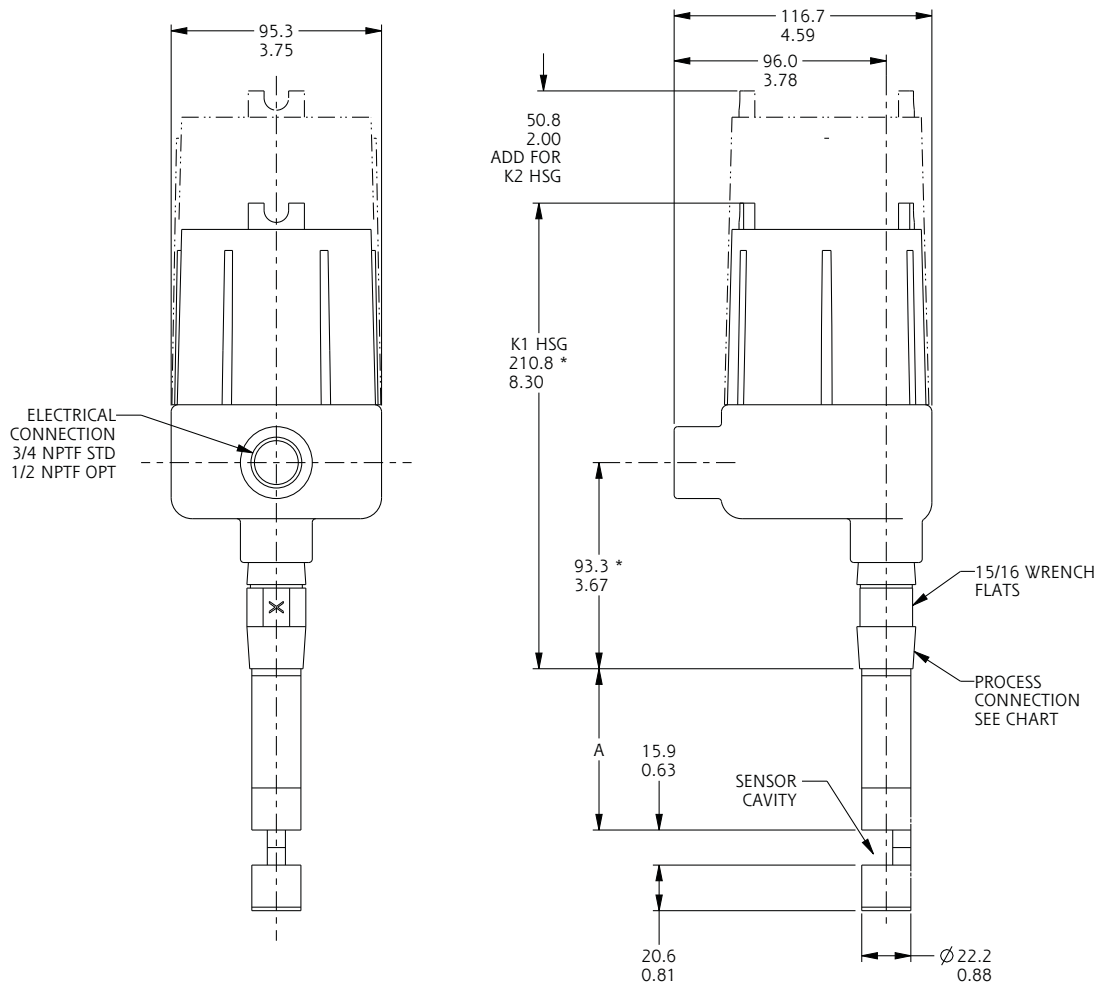
Symptom/Problem	Possible Cause	Corrective Action
No current in the loop No LEDs lit.	<ol style="list-style-type: none"> 1. Power supply turned off. 2. Improperly wired terminal block TB1. 3. Broken power supply wire. 	<ol style="list-style-type: none"> 1. Check power supply source. 2. Check terminal block wiring per  (page 5) 3. Check loop wire integrity.
Current 5 or 19 mA. No LEDs lit or both LEDs lit.	<ol style="list-style-type: none"> 1. Sensor lead unplugged. 2. Sensor integrity is compromised. 3. Remote Self-Test activated. 	<ol style="list-style-type: none"> 1. Check sensor cable connections. 2. Replace the sensor. 3. Check dry contact & TB2 wiring.
Current stays at 8 mA when liquid is in the gap. Yellow LED remains lit.	<ol style="list-style-type: none"> 1. Process is highly aerated liquid. 2. There is no liquid in the gap. 3. Remote cable length has been changed*. 4. Circuit integrity is compromised. 	<ol style="list-style-type: none"> 1. Install baffle or stilling well, or use a 651K9 RF Point Level Control. 2. Unit is operating properly. 3. Replace circuit board. 4. Replace circuit board.
Current stays at 16 mA when the gap is empty Red LED remains lit.	<ol style="list-style-type: none"> 1. Process is clogging the sensor. 2. There is liquid in the gap. 3. Remote cable length has been changed*. 4. Circuit integrity is compromised. 	<ol style="list-style-type: none"> 1. Clean the sensor. 2. Unit is operating properly. 3. Replace circuit board. 4. Replace circuit board.
Current is greater than 20 mA.	<ol style="list-style-type: none"> 1. Incorrectly wired circuit. 2. Circuit integrity is compromised. 	<ol style="list-style-type: none"> 1. Check current loop wiring per  (page 5) 2. Replace circuit board.
Remote Self-Test does not detector to 5 or 19 mA	<ol style="list-style-type: none"> 1. Open signal wire. 2. Wires hooked to the wrong terminal block. 	<ol style="list-style-type: none"> 1. Check twisted pair wire integrity. 2. Verify dry contact wired to TB2.
Current intermittently detecting to 5 or 19 mA.	<ol style="list-style-type: none"> 1. Improperly grounded shield of TB2 twisted pair. 	<ol style="list-style-type: none"> 1. Ground one end only of the twisted pair shield.

*Circuit boards for remote units are tuned at the factory for optimum performance with specified cable length. If the remote cable length is changed, circuit operation will be adversely affected.

NOTE: Agency certified units, (FM, CSA, IEC) must be returned to SOR for repairs.

Dimensions

Metal Sensor



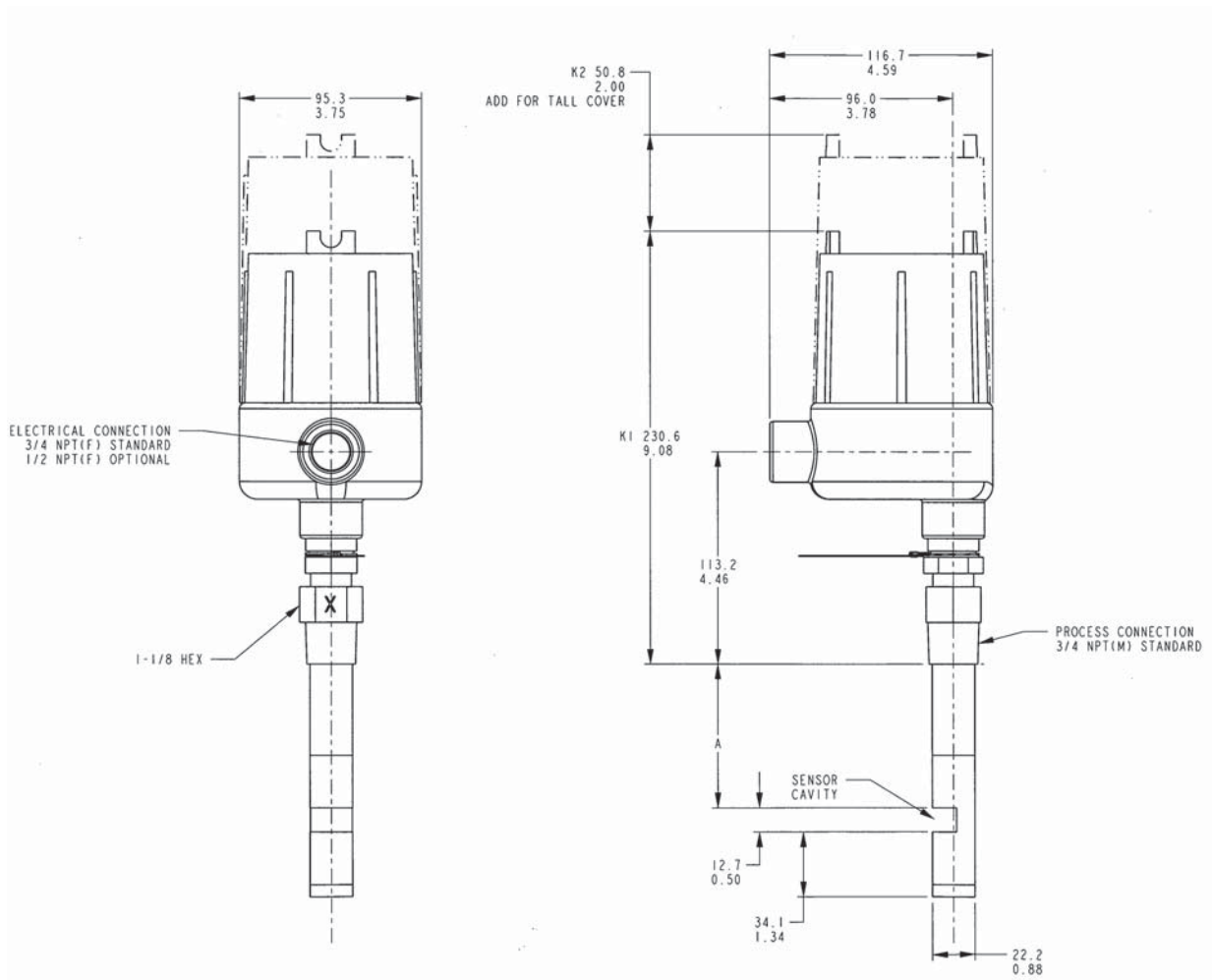
Linear = mm/inches

Drawing 0390000

*Dimensions are for reference only.
Contact the factory for certified drawings
for a particular model number.*

CONNECTION SIZE	* LENGTH
3/4 NPT(M)	SHOWN
1 NPT(M)	ADD 8.0 0.31
1-1/2 NPT(M)	ADD 9.5 0.38
2 NPT(M)	ADD 9.5 0.38
PROBE LENGTH A	

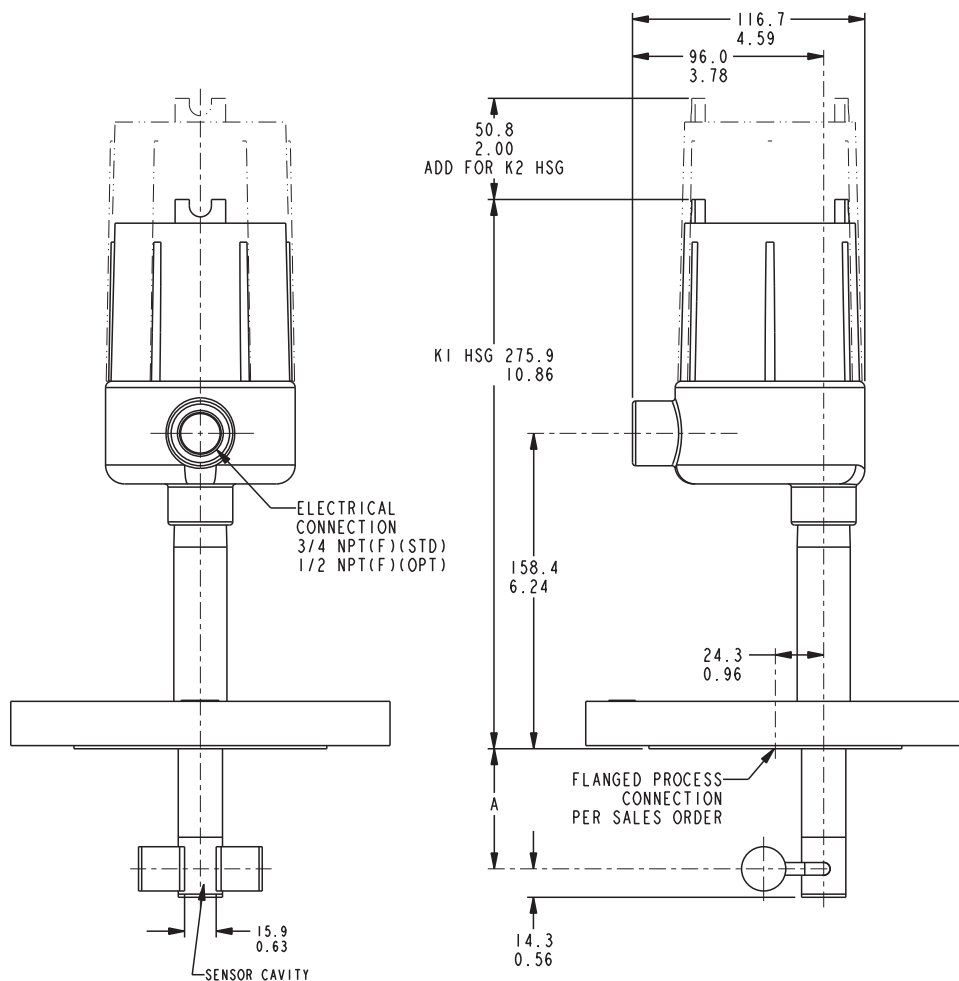
Teflon Sensor



Linear = mm/inches
Drawing 0390002

*Dimensions are for reference only.
 Contact the factory for certified drawings
 for a particular model number.*

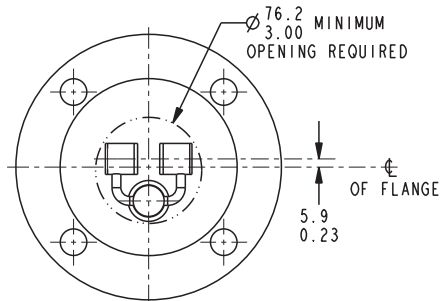
Viscous Sensor



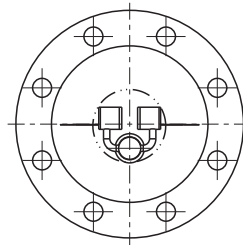
Linear = mm/inches

Drawing 0390439

*Dimensions are for reference only.
Contact the factory for certified drawings for a particular model number.*



BOTTOM VIEW
4-HOLE FLANGE
SCALE 0.35



BOTTOM VIEW
8-HOLE FLANGE
SCALE 0.25



Printed in USA

www.sorinc.net

14685 West 105th Street, Lenexa, KS 66215 ■ 913-888-2630 ■ 800-676-6794 USA ■ Fax 913-888-0767

20/20 Registered Quality System to ISO 9001:2008

Form 771 (09.11) ©2011 SOR Inc.