Instrumentation designed
with the user in mind

INSTRUCTION MANUAL

PRINCO MODELS L2720 & L2740

VERSA-POINT™

MULTI-POINT / ZONE LEVEL CONTROLLERS

with NULL-KOTE™

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Description

A. General Description

Princo models L2720 and L2740 Versa-Point™ controllers are dual function - zone and multi-point - level controllers. In conjunction with Princo L100 Series Probes, they will accurately monitor process materials ranging from low dielectric (insulating) products, such as refined oil, to conductive slurries; even sticky materials that tend to cling to the probe. Null-Kote™ technology allows the system to cancel out all but the most severe effects of coating on the probe.

Each unit has four set points and may be operated in one of two modes: 4-point Mode or Zone Mode. In 4-point Mode, each of the four independent set points controls its own relay. An example of such use is applications requiring high alarm, high-high alarm, low alarm and low-low alarm.

In Zone Mode, the L2720 and L2740 control a zone defined by two of the set points, with the other two set points remaining available to be used independently. The zone may occupy virtually any portion of the overall range, from 1 to 100%. This mode of operation is ideal for lift stations and industrial sumps. An example of a Zone Mode application would be to control a zone and to use the 2 independent set points as high and low alarms above and below the defined zone.

In both modes, each independent level set point may be set up for either Fail Safe high or Fail Safe low operation. In Fail Safe low operation, the relay is de-energized when the level is below the set point. In Fail Safe high operation the relay is de-energized when the level is above the set point. Zone Mode operation is set up for either "pump up" or "pump down" operation. This sets the control relay to be energized either when the level is rising through the zone or falling through the zone.

The L2720 and L2740 controllers are used in conjunction with Princo L100 Series Continuous Level Probes. The controllers are first calibrated for a span along the length of the probe. Then set points and zone are established within this span.

The L2720 is an "integral" controller. The electronic chassis, inside an explosion-proof, weatherproof housing, threads directly onto the probe. The L2740 is a "remote mounted" unit. It consists of a Sensor Head which screws directly onto the probe and a Control Unit, which may be mounted in a remote location such as a cabinet or control room. The Control Unit is connected to the Sensor Head by means of a shielded cable.

The controls and operation of the L2720 and L2740 are identical, the only exception being that the L2740 has a 0 to 30 second Time Delay adjustment for each of its four control points and the L2720 does not.

Models L2720 and L2740 are covered by Princo's 10-year Warranty. See Section 5 for details.

B. Functional Description

1. RF Impedance Theory

The Princo L2720 and L2740 work on the concept of monitoring changes in RF impedance between two sensing elements. The two sensing elements are the "active" element of the probe and the "ground reference", which is either a second probe element or a metal tank wall. The two elements are, effectively, the two plates of a capacitor. The electronic unit produces a 100KHz test signal that is applied across the probe elements and is monitored for changes in amplitude and phase angle.

The primary component of the measurement is the capacitive element (with a -90º phase shift, 100% resistive being the 0º reference point). With no process material touching the probe, the dielectric material between the two probe elements is air, which by definition has a dielectric constant of 1.00. As the process level rises, it displaces air as the dielectric. Since the process material has a higher dielectric constant than air, capacitance increases, RF impedance decreases and RF current flow increases, in direct proportion to level change.

The secondary component of the measurement is the resistive component. Buildup of a conductive process material coating on the probe produces increased RF current flow. This coating can be defined electronically as a complex resistive-capacitive network. Due to the resistive component, the phase angle of the measurement shifts away from a pure -90º.

The resistive component of the coating is proportional to the capacitive component of the coating and to the increased current flow produced by the coating. Therefore, by monitoring the magnitude of the phase shift away from the -90º point, the signal processing circuitry of the electronics is able to apply a proportional correction to the RF signal, thus subtracting out the error caused by the coating.

Many, if not most, process applications are water-based and, therefore, electrically conductive. If the probe elements were both bare metal, the first contact with the process material would short the capacitive plates producing an exceptionally high current flow. Covering one or both of the probe elements with an insulating material such as Teflon or Kynar solves this problem. Now, with no process material touching the probe, capacitance is determined by the combined dielectrics of air and the probe insulation material in series. As the process rises, it displaces the air and effectively shorts the gap between the two probe elements. Now, capacitance is determined by the dielectric of the Teflon or Kynar insulation alone, producing a directly proportional increase in capacitance and RF current flow as level rises. Process linearity is determined solely by the uniformity of the thickness of the insulation material.

Linearity of non-conductive process measurements depends upon uniform, parallel spacing of the probe elements. Probes used for non-conductive applications normally have at least one element insulated. This is to reduce the magnitude of measurement error that would be caused by a small amount of conductive moisture in the process, such as might result from condensation.

2. Signal Processing

The L2720 and L2740 are calibrated to operate over a capacitance span determined by the specific probe length and process material. The RF signal, proportional to level and corrected for coating error, is rectified and filtered into a proportional DC voltage. Internal comparators compare this DC level with DC levels set by each of the four set point adjustments. The comparators, in turn switch the appropriate relays and indicator LED's when the process level passes above or below the set point levels.

In Zone Mode, the internal logic of the controller is switched in such a way that set point 2 controls the upper end of the zone and set point 3 controls the lower end. Relay 3 is inactivated and the zone is controlled purely through relay 2 action.

Calibration of the unit is usually performed in the field by the user under actual operating conditions. Factory pre-calibration, using calculated capacitance values relative to the application, is also available.

3. Basic Features

- RF Impedance Sensing Technology with Null-Kote™

  The L2720 and L2740 use RF impedance technology, proven in tens of thousands of applications. With no moving parts, the controller depends solely on its modern, electronic circuitry, ensuring years of dependable operation.

- Coating Cancellation

  Null-Kote™ technology allows the cancellation of the build-up on the probe of most process materials. Units are factory set for either Mode A (non-conductive process) or Mode B (conductive process) coating cancellation.

- Multiple Independent Set Points and Zone

  May be set for four independent set points (4 PT Mode) or one zone with two independent set points (ZONE Mode). Control actuated through four SPDT relays.

- Time Delay (L2740 only)

  Relay action may be delayed up to 30 seconds to compensate for effects of process turbulence.

- Remote Mounting (L2740 only)

  Allows mounting of electronic unit in cabinet, control room, etc., connected to probe by three-wire, shielded axial cable. Standard cable length is 25 feet; optional lengths available.

- Conformal Coating

  An insulating coating (conformal coating) is applied to bottom circuit board of L2720 and to all Sensor Head boards of L2740 to protect the circuitry against condensation of moisture.

- Easy-on Probe Connection

  Threading electronic housing onto probe's NPT fitting automatically connects 2-wire measurement signal to probe as well as mechanically fastening housing to probe.

- 10-Year Warranty

  Quality backed by limited 10-year warranty. Refer to Section 5 for details.

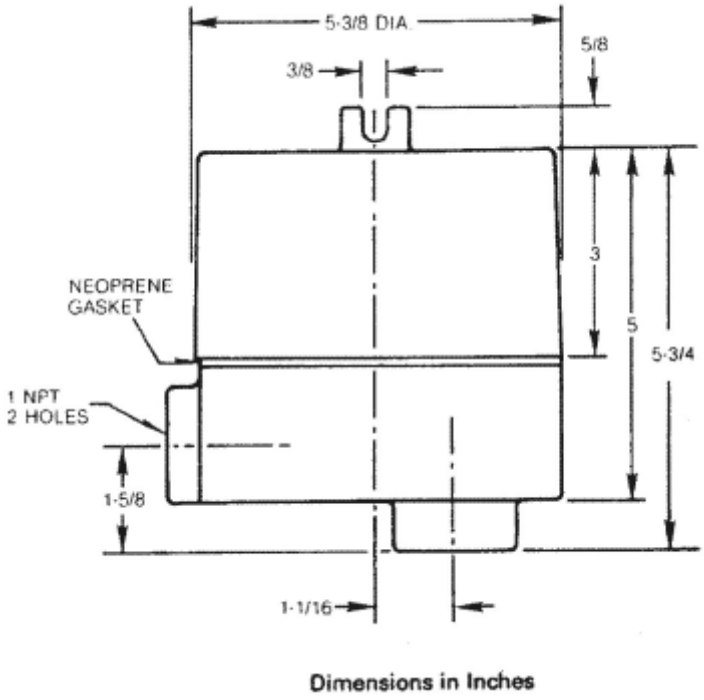


Figure 1-1
L2720 Dimensional Drawing

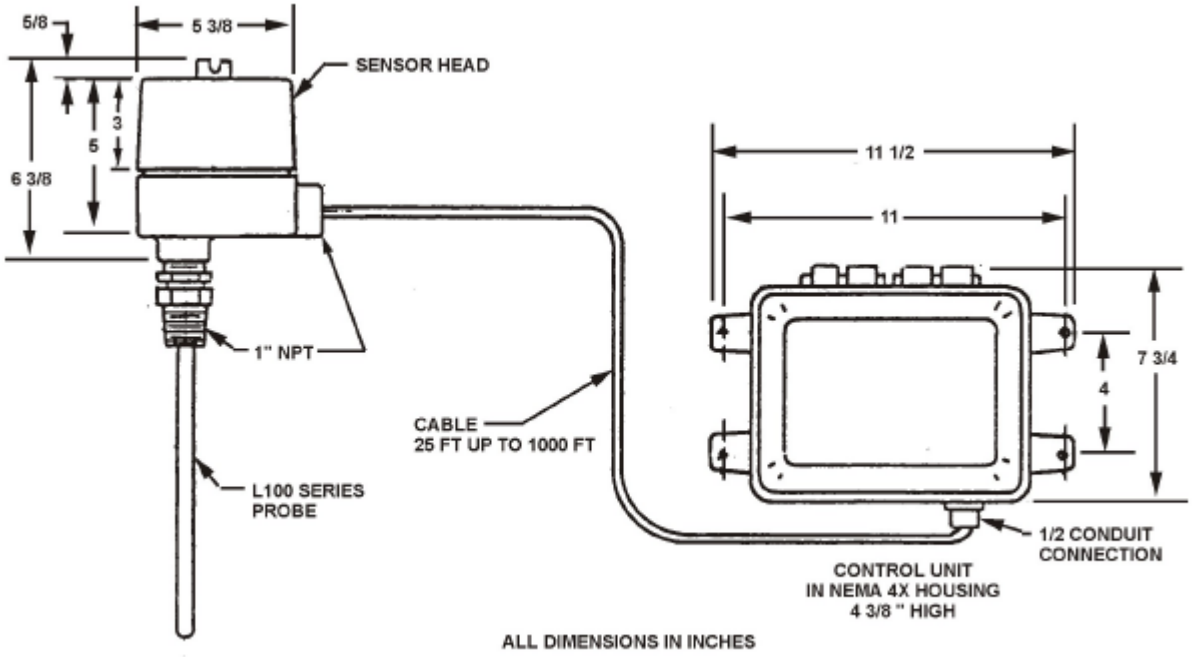


Figure 1-2
L2740 Dimensional Drawing

C. L100 Series Probes

1. General Description

Princo offers a wide variety of probes for use with its continuous transmitters and multi-point controllers. Although the measurement technology remains the same, as outlined in the previous section, different probe designs are suited for different applications.

Electrical, chemical and mechanical considerations affect probe selection. Electrically, a ground reference must be present and the probe must be built to provide proper response.

Chemically, the probe must be compatible with the process material. It must be immune to attack and must offer no chance of contaminating the process.

Mechanically, the probe must be able to withstand the pressure and temperature extremes of the application. In addition, turbulence, consistency, viscosity, abrasion and mounting configuration also play a role in probe selection. A flexible probe is required where probe length exceeds 236 inches or where physical restrictions, such as lack of headroom, prevent installation of a rigid probe.

Single element probes (L101, L104 and L109) are often used in situations where a metal tank wall can provide an adequate ground reference (second element). Non-metallic vessels require dual element probes, as do most non-conductive process applications where probe response and/or linearity would be inadequate using the vessel wall as a ground reference.

Dual element probes are made with either parallel (L115, L116, L127, L128) or concentric (L102, L107) elements. Dual concentric probes provide the best response for low dielectric, low consistency, non-conductive processes as well as minimizing the effects of agitation.

Probe sheathing (Teflon, Kynar, or bare) is chosen with regard to chemical compatibility, as well as probe response and ability to withstand abrasion.

All Princo continuous level probes connect to their respective electronic units by means of a 1" NPT threaded hub. The "ground" contact is made by the threads themselves. The "active" contact is made by the spring-loaded pin which projects from the center of the hub NPT fitting. Probes mount to the storage vessel by means of various sizes of flanges, NPT connectors and TRI-CLAMP™ fittings. Refer to Section 2.2 for details.

For detailed listings and specifications for Princo Continuous Level probes, consult Princo Bulletin L-96-4.

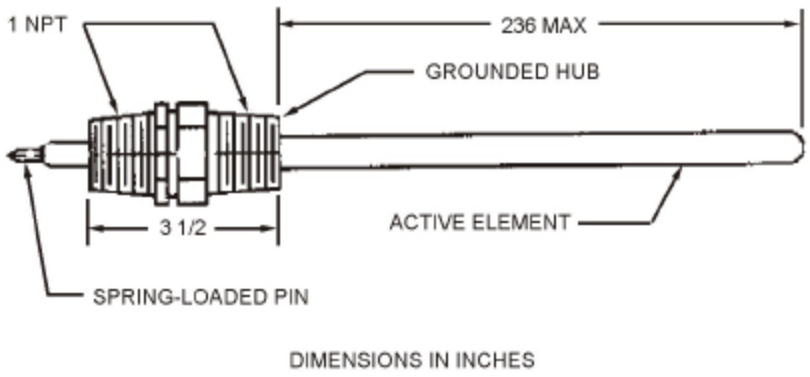


Figure 1-3
Typical 1" NPT Mounted Probe (Model L101)

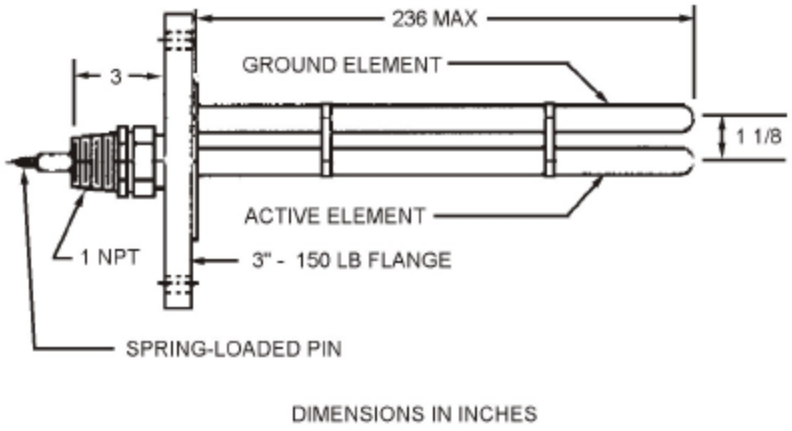


Figure 1-4
Typical 3" Flange Mounted Probe (Model L127)

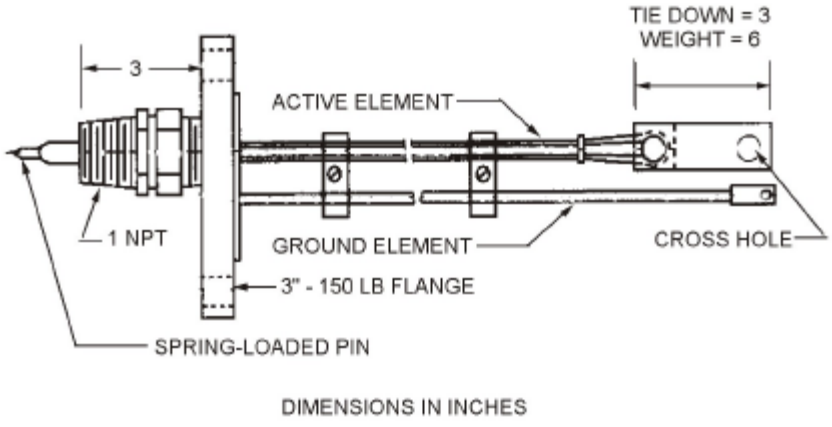


Figure 1-5
Typical Dual Flexible Probe (Model L115)

Section Two
Specifications

A. Specifications

1. L2720 & L2740 MULTI-POINT/ ZONE LEVEL CONTROLLERS

- TYPE

  NULL-KOTE™ (coating immune), RF impedance sensing, adjustable, solid-state, multiple point and zone level controller

- SPAN RANGE

  From several inches to several hundred feet. (From 20 pF to 20,000 pF.)

- ZONE ADJUSTMENT RANGE

  From 1 to 100% of probe length.

- CONTROL ACTUATION

  L2720: SPDT rated at 5 amperes, 115 Vac, resistive load.

  L2740: SPDT rated at 10 amperes, 115 Vac, resistive load.

- RELAY MODES

  Fail safe high or low, independent for each point.

- AMBIENT TEMPERATURE RANGE

  -40 to 150 °F (-40 to 66 °C)

- REMOTE MOUNTING DISTANCE (L2740 ONLY)

  25 feet standard, 1000 feet max, connected by 3-wire, shielded cable.

- DELAY TIME AND MODE (L2740 ONLY)

  Continuously adjustable from 0 to 30 seconds, delayed turn-on and delayed turn-off, independently set for each point.

- POWER REQUIREMENTS

  95 to 135 Vac, 50 to 60Hz, 5 watts; or 205 to 250 Vac, 5 watts; or 24 Vdc.

- ELECTRONIC HOUSING

  L2720 & L2740 Sensor Head:

  Heavy-duty, cast aluminum. Explosion-proof for: Class I, groups C & D; Class II, groups E, F & G. Weather proof: NEMA 4.

  L2740 Control Unit:

  Hinged type. Weather proof: NEMA 4X.

2. L100 SERIES PROBES

- TYPE

  Single and dual element continuous, RF impedance level probes.

- DESCRIPTION BY MODEL NUMBER

The below list includes the most commonly used probes. Princo also makes other variations for special applications.

Section Two
Specifications

MODEL NO.	ELEMENT CONFIGURATION	TYPE	VESSEL CONNECTION	INSULATION OPTIONS
L101	Single	Rigid	1" NPT	B, KP, KS, TP, TS
L104	Single	Rigid	1", 2", 3" OR 4" TRI-CLAMP™	B, KP, KS, TP, TS
L102	Dual Concentric	Rigid	1½" NPT	B, KP, KS, TP, TS
L107	Dual Concentric	Rigid	1" NPT	B, KS, TP, TS
L109	Single	Flexible	1" NPT	KW, TW
L113	Dual Parallel	Flexible	1" NPT	KW, TW
L115	Dual Parallel	Flexible	3" Flange	KW, TW
L116	Dual Parallel	Flexible	3" Flange	KW, TW
L127	Dual Parallel	Rigid	3" Flange	B, KP, KS, TP, TS
L128	Dual Parallel	Rigid	3" Flange	KP, KS, TP, TS

B = Bare (No insulation)

KP = Kynar® Pipe (60 mil Kynar over carbon steel)

KS = Kynar Sheath (17 mil Kynar over 316 SS rod)

TP = Teflon® Pipe (60 mil PFA Teflon over 316 SS rod)

TS = Teflon Sheath (17 mil Teflon over 316 SS rod)

KW = Kynar Wire (20 mil Kynar over 316 SS wire rope)

TW = Teflon Wire (12 mil Teflon over copper wire)

- PRESSURE / TEMPERATURE RATINGS

Model Number	Probe Covering	Pressure Rating (PSI) at Temperature Indicated (ºF)						
		-300	-40	100	250	300	400	500
L101, L102, L104, L107, L109, L113	Teflon or Bare	1250	1250	1250	550	450	350	0
	Kynar		1000	1000	250	0		
L115, L116, L127, L128	Teflon or Bare	275[1]	275[1]	275[1]	225[1]	210[1]	180[1]	0
	Kynar		275[1]	275[1]	225[1]	0		

NOTES:

1. Rating of Carbon Steel 150 lb. flange. For higher ratings, consult factory.
2. Temperature Limits: Bare or Teflon covered probes: -300ºF (-184ºC) to 500ºF (260ºC); Kynar covered probes: -40ºF (-40ºC) to 300ºF (149ºC). For temperatures beyond these limits, consult factory.

- SELECTION GUIDE / PHYSICAL DIMENSIONS

Refer to Princo Bulletin L-96-4, Continuous Probe Selection Guide

Section Three
Installation

A. Inspection

The L2720 and L2740 Controllers are supplied with one of the Princo L100 Series Level Probes. The Controller and Probe are shipped in separate packages.

Carefully remove each package's contents and check each item against the packing list. Inspect each item for shipping damage. In particular, check the spring-loaded connection pin, located on the threaded hub end of the Probe (see Figures 1-3, 1-4, and 1-5). This pin provides the necessary electrical connection from the Controller bottom printed circuit board, to the active element of the Probe. Make sure this pin is not missing, bent, jammed, or otherwise damaged.

If the Probe is sheathed in Teflon or Kynar, then carefully inspect the condition of the sheathing. Make sure the sheathing forms a smooth continuous coverage over the element. Discontinuities in the sheathing material, which breach through to the metal underneath, will render the Probe useless in most applications. Report any such damage immediately to the factory.

CAUTION !

Care must be exercised when handling probes that incorporate an insulating sheath. Do not allow the sheathed sensing element to come in contact with a rough or sharp surface, as this may cause a breach in the insulating sheath, and render the probe inoperable.

B. Mounting

1. *Headroom*

Proper specification of a Princo Model L100 Series Probe must take into consideration the amount of space available above the storage vessel from which the Probe can be lowered into the vessel. This aspect must be considered prior to probe selection and ordering.

In a situation where headroom limits the use of a rigid type probe, a flexible cable type probe can be used. Refer to Figures 1-1 and 1-2 for electronic housing dimensions. A typical cable probe with a 3-inch flange adds about 3½ inches to the height. Additional headroom is needed to remove the lid and access the top panel controls and terminal blocks.

2. *Mounting Location*

Single element probes use the metal tank wall as a ground reference. If they are used in non-conductive applications, they must be mounted close to the sidewall of the tank (6 to 8 inches recommended) and should maintain an equidistant spacing from the sidewall, as the spacing affects measurement linearity. (Princo generally recommends use of factory-made dual element probes for this reason.) When it is impossible to mount the sensing probe close to the sidewall, at least try to favor an off-center mounting. In conductive applications, single element probes may be mounted anywhere relative to metal tank walls. Refer to Figure 3-1.

Dual element probes have a built-in ground reference and generally can be mounted anywhere relative to tank walls, regardless of whether the process is conductive or non-conductive.

Be careful not to mount probes any closer than necessary to such devices as baffles, agitators, heaters, etc. This is especially important when the process is non-conductive. When the process is conductive, it is only necessary to have adequate physical clearance, since there should be little or no adverse electrical effects due to proximity of these devices.

Whether the process is conductive or non-conductive, try to mount the probe in an area where the level is stable and representative. Mounting near an input flow or near splashing might

create artificially high level readings. Mounting in a vortex created by a mixer might give an atypically low reading.

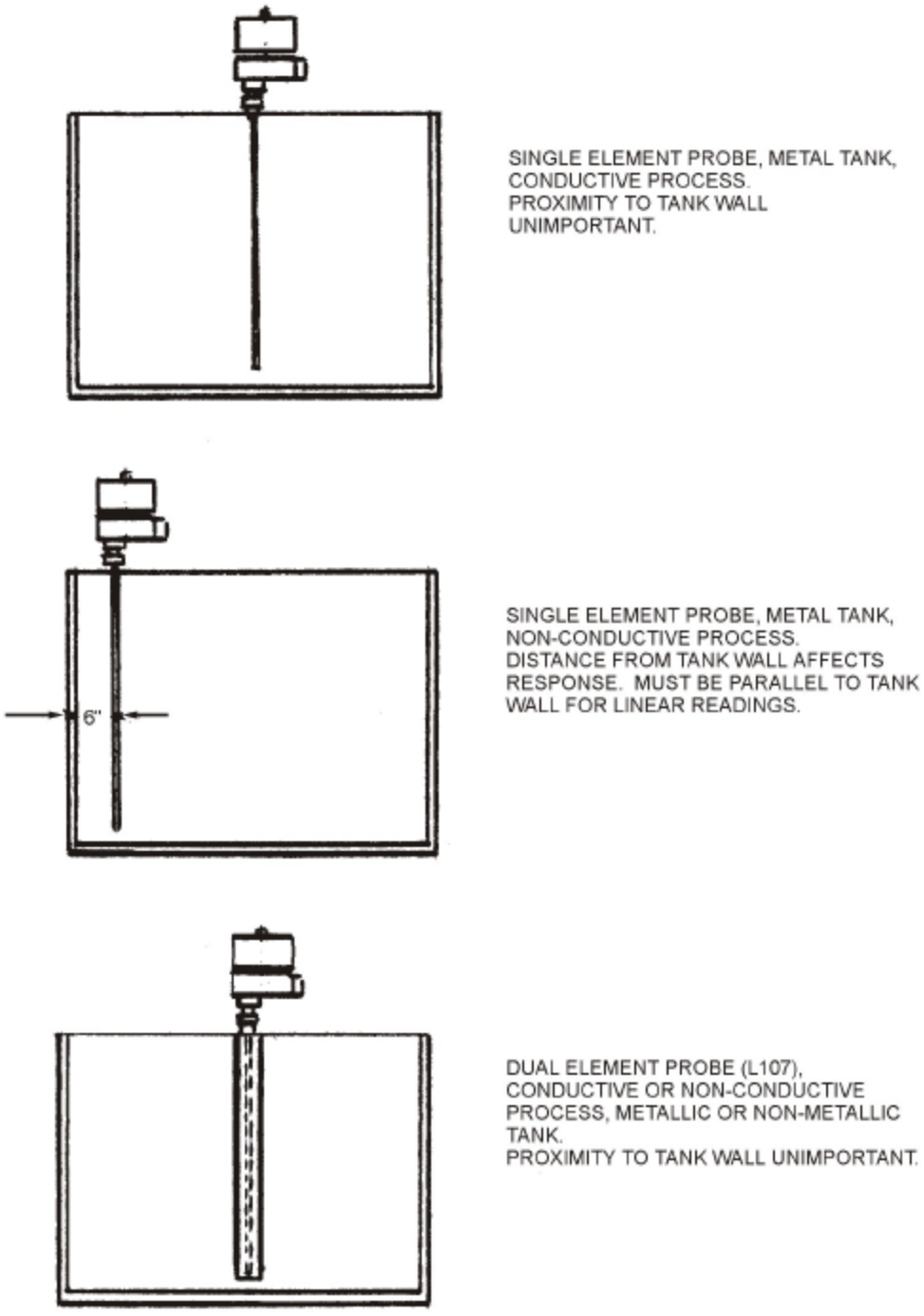


Figure 3-1
Probe Mounting Locations

3. *Ground Reference*

Normally, dual element probes (probes with built-in ground references) are used in non-metallic storage vessels. A single element probe may be adapted to the same purpose by supplying a ground reference. The ground reference should be a metal rod, equal in length to the Probe. The reference should be mounted parallel to the length of the Probe, no greater than 6 to 8 inches from it.

The reference must be electrically connected to the Controller chassis ground, either directly to the terminal strip ground terminal, or indirectly, by wiring it to the threaded hub of the probe or to the metal housing of the electronic unit. In any case, perform Ground Continuity Check, Section 4.F.2.a to ensure that a good ground connection exists.

If the process is non-conductive, non-parallel spacing between the probe and the ground rod will negatively affect the linearity of the level readings. Also, the probe response will decrease as the distance between the two elements increases.

4. *Flange or NPT Mounting*

Princo L100 Series Probes are normally mounted by means of a flange (typically two or three inch insertion hole diameter) or an NPT type fitting (standard size is one inch).

a) Flange Type. Slip the Probe tip into the storage vessel entry port. Lower the Probe into the vessel, until the probe flange seats and aligns with the corresponding mating surface on the storage vessel. Fasten the flange to the vessel using the appropriate metal fasteners, gaskets, and sealing compounds, as required by the specific installation.

CAUTION!
Single element flange type probes must be fastened to the storage vessel with metal fasteners, such that electrical continuity exists (zero ohms) between probe flange and metal storage vessel. NPT type probes must be fastened to the storage vessel such that electrical continuity (zero ohms) exists between the probe NPT hub and the metal storage vessel. Do not use any kind of thread lubricant on the NPT threads. If lubrication and/or sealing are required, a small amount of Teflon tape can be used. Refer to Section 4.F.2.a for ground continuity testing.

b) NPT Type. Slip the Probe tip into the storage vessel NPT threaded entry port. For probes sheathed with Teflon or Kynar, it is recommended to temporarily line the entry port with cardboard or plastic sheeting to avoid skiving the probe sheathing while guiding the probe through the opening. Lower the Probe into the vessel until the Probe lower hub NPT fitting seats into the vessel NPT receptacle. Tighten the Probe lower hub NPT threads into the storage vessel NPT receptacle using an appropriately sized wrench on the Probe hub-hex head fitting.

5. *Cable Probe Tie-Down*

Princo flexible cable type probes incorporate either a weight or a tie-down at the probe tip, which is designed to keep the sensing element taunt as it is immersed in the process material. Refer to Figure 1-5.

If the process material is agitated or is turbulent in any way, it may be necessary to fasten the Probe tip to the bottom of the storage vessel. This can be accomplished by using a light cable or nylon rope, looped through the hole in the bottom of the weight or tie-down and, in turn, through a hook fitting in the bottom of the storage tank.

Do not apply excessive downward force to the cable-sensing element through the tie-down. It is not necessary and could potentially damage the probe.

Also, note that the weight or tie-down is not an electrically active part of the probe. That is, it stands below the zero level of the measured process material. Standard weight length is six inches. Standard tie-down length is three inches.

Teflon spacers on dual element probes (L113, L115, & L116) are designed to keep the dual cables equidistant. Try to maintain even spacing between them, and avoid crossing of cables by excessive twisting, as this will affect accuracy and linearity.

6. *Electronic Housing Mounting*

The electronic chassis of the L2720 is contained within a cast aluminum housing. It is mounted onto the top of the probe by threading the housing's bottom NPT opening onto the probe hub's 1" NPT connector. As with the probe to tank connection, electrical continuity must be maintained through the threaded connection.

NOTE

Do not use any type of thread lubricant on the NPT probe mounting threads or the NPT threads which mount the electronic housing. Application of thread lubricant may cause faulty or improper ground connection. If required, Teflon tape may be used as a thread seal for either threaded connection. If Teflon tape thread sealant is used, the installer should make an electrical continuity check with a hand held ohmmeter. Less than 1 ohm resistance should exist between the storage vessel and the electronic housing. See Section 4.F.2.a.

The spring-loaded pin projecting from the middle of the probe NPT fitting should now be pressing against the underside of the bottom circuit board of the electronic chassis. This may be verified visually through the 1" NPT wiring port on the side of the housing. If the pin is failing to make contact, stretch the spring-loaded pin out further with a pair of pliers. To access the spring-loaded pin, either unthread the housing from the probe hub, or lift the electronic chassis out of the housing after removing the two 8-32 screws which hold it in. Hint: If the spring-loaded pin is properly contacting the circuit board, you will feel the chassis being pushed upward by it as you loosen the two 8-32 screws.

With the L2740, the procedure is basically the same, except that it is the Sensor Head assembly, which is threaded onto the probe NPT fitting. The Control Unit is contained in a plastic, NEMA 4 housing that is mounted in a location of the customer's choosing and connected by cable to the Sensor Head circuit board.

C. Fail Safe Settings, Zone Operation and Relay Logic

Fail Safe jumper switches are provided for each set point. Fail Safe jumper switches are active for all four relays in Four Point Mode and for relays 1 and 4 in Zone Mode.

The FAIL SAFE jumper connects the middle of three pins to either the H (high) pin or to the L (low) pin. In Fail Safe high operation, the corresponding relay is energized when the process level is below the set point and is de-energized when the level is above the set point. In Fail Safe low operation, the reverse is true; the relay is energized when the process level is above the set point and de-energized when below the set point. A red LED indicates the relay is de-energized (shelf state) and a green LED indicates the relay is energized.

Based on the fact that most major malfunctions, including a power failure, would cause the control relay to de-energize, the de-energized state of the relay should be the alarm condition. This means that if the external alarm had a different power source than the L2720 or L2740, the alarm would sound if power to the unit were lost.

In Zone Mode, Fail Safe jumper switches are inactive for relays 2 and 3. Relay 3 is totally inactive, and its LED is not lit. The zone is controlled solely by relay 2, set point 2 being the upper limit of the zone and set point 3 being the lower limit. The PUMP UP/DN switch controls the relay logic. The Pump Up position energizes relay 2 as the level is rising through the zone, and de-energizes it when the level reaches the upper zone limit. The Pump Down position energizes relay 2 as the level moves down through the zone, and de-energizes it when the level reaches the lower limit. As with Four Point operation, a red LED indicates the relay is de-energized (shelf state) and a green LED indicates the relay is energized.

When the relay is energized, the NO (normally open) contact is connected to C (common) and the LED is green. When the relay is de-energized, the NC (normally closed) contact is connected to C (common) and the LED is red.

Wiring of the control circuitry should take into account the above logic and relays should be wired accordingly. Refer to Tables 2 & 3 below, for a summary of relay logic.

FAIL SAFE JUMPER	PROCESS LEVEL	RELAY STATUS	LED COLOR
H (HIGH)	ABOVE SET POINT	DE-ENERGIZED	RED
	BELOW SET POINT	ENERGIZED	GREEN
L (LOW)	ABOVE SET POINT	ENERGIZED	GREEN
	BELOW SET POINT	DE-ENERGIZED	RED

Table 3-1
Relay Status: All Relays - Four Point Mode; Relays 1 & 4 - Zone Mode

PUMP UP/DN SWITCH	PROCESS LEVEL	RELAY 2 STATUS	LED COLOR
UP (PUMP UP, DRAIN DOWN)	RISING	ENERGIZED	GREEN
	FALLING	DE-ENERGIZED	RED
DN (PUMP DOWN, FILL UP)	RISING	DE-ENERGIZED	RED
	FALLING	ENERGIZED	GREEN

Table 3-2
Relay 2 Status: Zone Mode

D. L2720 Electrical Connections

Remove the lid of the L2720 Controller in preparation for connection of signal and power wires. Refer to Figure 3-2. Before drawing wires into the equipment housing, remove the electronic circuit board chassis. This may be done by removing the two 8-32 chassis mounting screws and lifting the chassis off of the mounting posts and out of the housing. Bring the relay contact and power wires into the Controller housing through the 1" NPT wiring port. Leave enough slack in each wire to make connection to the terminal block at the top of the Controller. Connect the wires to the appropriate positions on the terminal block, per Figure 3-2 and circuit diagrams for the specific control application.

Replace the electronic chassis in the housing, the flat side of the printed circuit boards facing the wiring port. Slide the chassis onto the mounting posts, keeping the wires toward the housing inner wall, so as not to interfere with the chassis. Replace the two 8-32 mounting screws and tighten firmly to ensure proper chassis electrical ground connection.

WARNING!

For installation which must be explosion-proof, and/or weatherproof, it is the customer's responsibility to install conduit seals which meet applicable safety standards and/or weatherproof requirements.

To achieve stable operation, apply power at source and allow a 15-minute warm-up time prior to calibration. Refer to Section 4 for required adjustments.

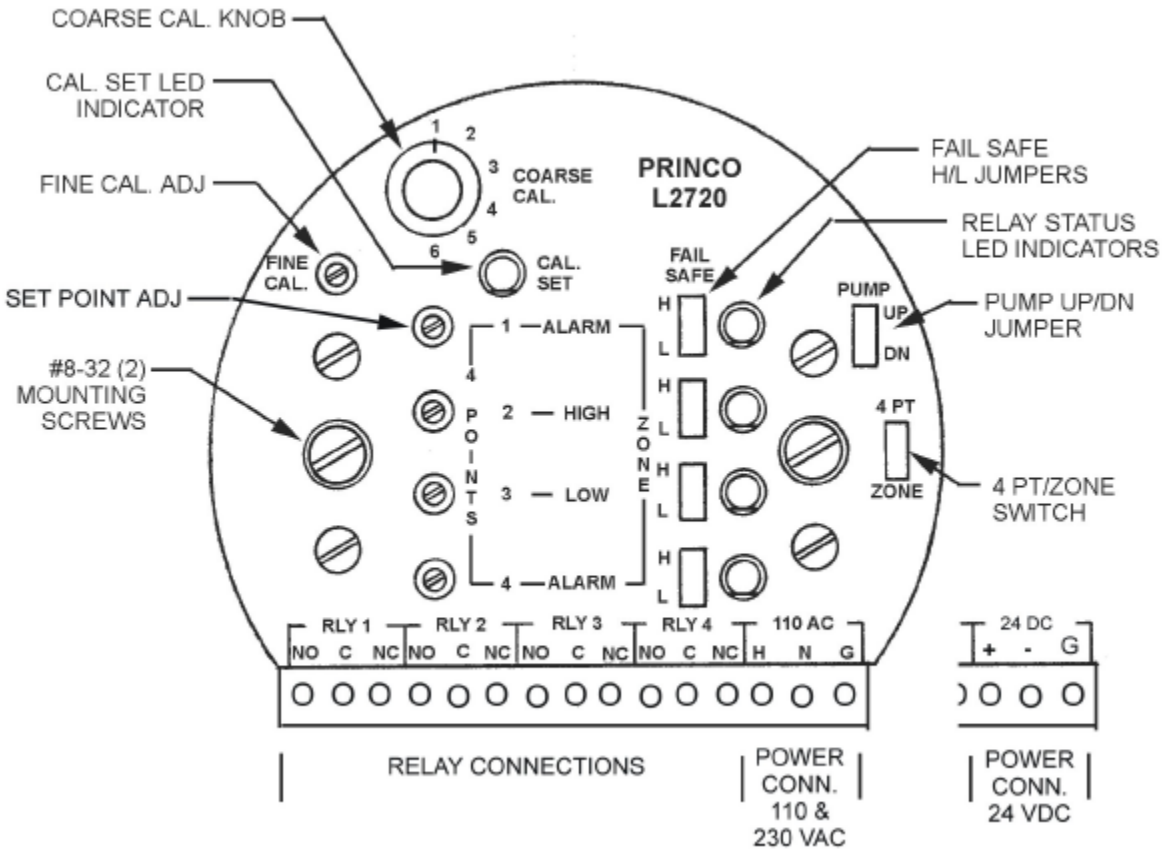


Figure 3-2
L2720 Electrical Connections and Control & Indicator Locations

E. L2740 Electrical Connections

After removing the lid of the Sensor Head assembly, draw the three-wire shielded cable through the 1" NPT wiring port on the side of the housing. Refer to Figures 1-2 and 3-3. If necessary, the electronic chassis of the Sensor Head may be temporarily lifted up by removing the two 8-32

screws on either side. Connect the cable lugs to the terminal block. The connections are, from left to right: White (+15V), Black (SIG), and Bare (GND).

At the other end, pull the cable through the ½ " NPT port in the plastic housing of the L2740 Control Unit. The wires attach in the same order to the three rightmost terminals on the 18 connector terminal block of the Control Unit. Likewise, draw the wires for the power lines and relay contacts through the same opening and connect to their appropriate terminals per Figure 3-3 and the users circuit diagram.

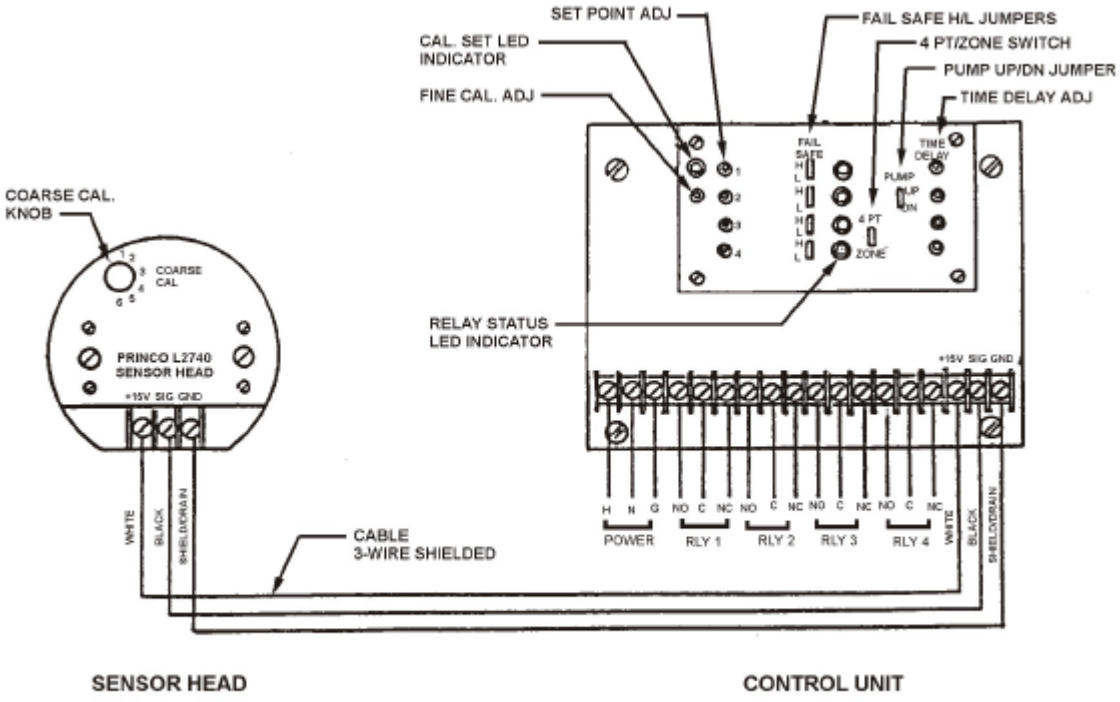


Figure 3-3
L2740 Electrical Connections and Control & Indicator Locations

F. Installation in Hazardous Areas

The aluminum housings of the L2720 Controller and of the L2740 Sensor Head are vendor rated explosion-proof for Class I, Division I, Groups C & D; Class II, Division I, Groups E, F, & G per the National Electric Code (NEC). The housing of the L2740 Control Unit does not have an explosion-proof rating. In order to take advantage of these ratings, the use of certain wiring methods and materials must be satisfied. The outline which follows points out some of the major requirements of the NEC's (National Electric Code) Section 501, as it relates to typical level control installations.

WARNING!

For applications which MUST BE explosion-proof and/or weatherproof, it is the customer's responsibility to install the required conduit, seals, wiring, etc., which meet national, as well as applicable local and plant safety codes. See Figure 3-4 below.

For Class 1 locations, rigid metal conduit must be used. At least five full threads of the conduit must be tightly engaged in the enclosure. Conduit seal fittings must also be used. These seal fittings, must be filled with an approved sealing compound and must be installed within 18 inches (or closer) of the enclosure. Conduit seals are also required when the conduit passes from a hazardous area into a non-hazardous area. Water drain seal fittings eliminate or minimize the effect of water that tends to collect in the conduit or enclosure due to condensation.

Approved wire type, such as mineral-insulated wire, is required for use in Division 1 installations. Certain types of metal-clad cable or shielded non-metallic sheathed cable are permitted in Division 2 installations. When multi-conductor cables are used in the conduit, the outer jacket must be cut away in such a manner that allows the sealing compound to surround each insulated wire as well as the jacket.

The preceding information should act as guide to assist the customer/installer in satisfying their responsibility for producing safe installations in hazardous area.

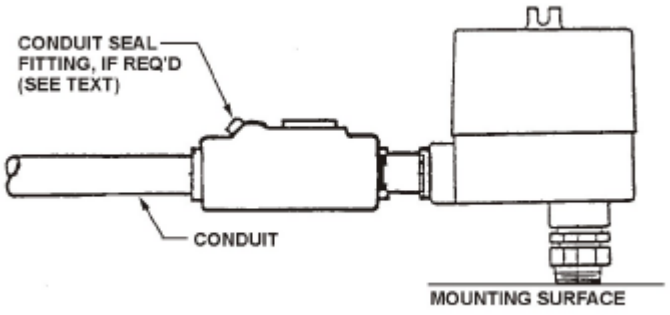


Figure 3-4
Typical Explosion-proof Installation

Section Four
Adjustments and Operation

A. Factory Pre-calibration

The Princo Models L2720 and L2740 are, more often than not, shipped from the Factory without any pre-calibration and require full calibration by the user. Princo does provide Factory pre-calibration upon request. All units are Factory set for either Mode A or Mode B coating cancellation based on process information supplied by the customer. Mode A is for insulating (non-conductive) applications and Mode B is for conductive (water-based) applications. If a change of coating cancellation mode is required, refer to Section 4.E.

B. Cancellation of Coating Effects

When a conventional capacitance type level controller monitors process materials that are electrically conductive and coating in nature, a significant error in the measurement occurs. The L2720 and L2740 incorporate a feature called Null-Kote™, which negates the effects of these conductive coatings.

The Null-Kote™ feature is actually a sophisticated electronic measurement system that cancels, or "nulls out" the effect of thick or viscous, electrically conductive, process material coatings that may build up on the sensing probe. The unique action of this measurement system automatically cancels the probe coating as the coating increases or decreases in magnitude.

If the process is known to be coating in nature, then, to obtain the highest degree of repeatability possible, pre-coat the sensing probe with the process liquid prior to field calibration.

C. Initial Checkout

1. Install the L2720 or L2740 per the information presented in Section 3 of this manual. Refer to Figure 3-2 or 3-3 for Control and Indicator Locations.
2. Apply power to the unit and allow a 15-minute warm-up time before performing the operational checkout of the equipment.
3. If the unit has **not been pre-calibrated** by the factory, check the operation as follows:

a) Set COARSE CAL. switch to position 1, FINE CAL. adjustment full counter-clockwise, and 4 PT/ZONE switch to 4 PT. Place all FAIL SAFE jumpers to H position. Turn all four Set Point adjustments to full counter-clockwise positions.

b) Verify that all four Relay Status LED's are lit to red.

c) Turn each Set Point adjustment to full clockwise position. Verify that all Relay Status LED's have switched to green.

d) Return all Set Point adjustments to full counter-clockwise position and proceed with Section 4.D. below.

4. If the unit **has been pre-calibrated** by the factory, check the operation as follows:

a) Move the process material level up and down along the length of the probe. Verify that the relays and their accompanying LED's switch at the required points. At each level position, a dipstick or sight glass may be used to measure the actual level from the bottom of the storage vessel. For units set for Zone operation, relay 2 should switch in one direction at the upper end of the zone and in the other direction at the lower end of the zone.

b) If the switch points are within acceptable limits, no adjustment is necessary. Be sure that all FAIL SAFE jumpers are set to their required positions. (Refer to Section 3.C. for relay logic.) For L2740 units, set Time Delay adjustments per Section 4.D.4.

c) If the accuracy is unacceptable, then perform the field calibration procedure per Section 4.D.

D. Calibration Procedure

If it is determined that the unit requires calibration, proceed as follows referring to Figure 3-2 or 3-3 for control and indicator locations:

1. **RANGE CALIBRATION: ZONE & FOUR POINT MODES.** This sets the unit's internal measurement range to the span required for the specific application. It is required for both Four Point and Zone Modes of operation.

a) Set 4 PT/ZONE switch to 4 PT.

b) For the L2740, turn all four TIME DELAY adjustments full counter-clockwise (zero delay).

c) Set COARSE CAL. switch to position 1. On the L2740, this switch is located on the Sensor Head.

d) Turn the FINE CAL. adjustment to its full clockwise position.

e) Apply power to the unit.

f) Raise the level of the process material within the storage vessel to a point one or two inches above the highest point, which is to be controlled.

g) Turn the COARSE CAL. switch clockwise, one step at a time, until the CAL SET LED illuminates (red).

h) Slowly turn the FINE CAL. adjustment counter-clockwise until the LED just turns off.

i) Leave COARSE CAL. and FINE CAL. in these positions.

j) Perform either 4.D.2. below for Four Point operation or 4.D.3. for Zone operation.

2. **SET POINT ADJUSTMENT: FOUR POINT MODE.**

NOTE: Each of the four set points may be set at any point along the length of the probe, as calibrated above. For the sake of convenience, it is usually easiest to set the highest-level point as Point 1, the next highest as Point 2, etc. Thus the highest-level set point corresponds visually with the highest point as laid out on the faceplate of the controller.

a) Set 4 PT/ZONE switch to 4 PT.

b) Place the FAIL SAFE jumpers in the required position. Refer to Section 3.C for Fail Safe logic.

c) Turn all four Set Point adjustments to their full counter-clockwise position. If the accompanying FAIL SAFE jumper is in the high (H) position the LED will illuminate red. If the FAIL SAFE jumper is in the low (L) position, the LED will illuminate green.

d) Raise or lower the process level to the first set point to be set.

e) Slowly adjust the desired set point adjustment until the LED just changes color.

f) If possible, slowly raise and lower the level above and below the set point and verify that the relay and LED switch. There will be a small "dead band' area between the turn-on and turn-off levels.

g) Repeat c) through f) above for other desired set points.

3. SET POINT ADJUSTMENT: ZONE MODE.

NOTE: Points 2 and 3 are used to define the limits of the zone. Point 2 **must** be used as the upper level set point for the zone and Point 3 **must** be used as the lower level set point. Points 1 and 4 may be set independently at any point along the length of the probe as calibrated above.

a) Set 4 PT/ZONE switch to 4 PT.

b) Place the FAIL SAFE jumper in the required position. Refer to Section 3.C for Fail Safe logic.

c) Turn all four Set Point adjustments to their full counter-clockwise position. If the accompanying FAIL SAFE jumper is in the high (H) position the LED will illuminate red. If the FAIL SAFE jumper is in the low (L) position, the LED will illuminate green.

d) Raise or lower the process level to the first set point to be set.

e) Slowly adjust the desired set point adjustment until the LED just changes color.

f) If possible, slowly raise or lower the level above and below the set point and verify that the relay and LED switch. There will be a small "dead band' area between the turn-on and turn-off levels

g) Repeat c) through f) above for other desired set points.

h) Slide the 4 PT/ZONE switch to the ZONE position.

i) Place the PUMP UP/DOWN jumper in the desired position.

NOTE: The unit is now in the Zone Mode of operation. Relay 3 is now inactive. LED 3 is unlit. Fail Safe jumpers 2 and 3 are inactive. The zone is controlled by the action of Relay 2, set point 2 being the upper limit and set point 3 the lower limit. Refer to Section 3.C. for control logic.

4. TIME DELAY ADJUSTMENT: L2740 ONLY

Time delay is useful in preventing control relay "chatter" from agitation of the process material within the storage vessel. It is also useful in certain process control timing applications. The three types of time delay are as follows: delayed turn-on alarm, delayed turn-off alarm, and delayed turn-on alarm / turn-off alarm.

The first two modes are normally used to suit a particular timing application. The third mode (turn-on / turn-off) is best suited to prevent relay chatter. This mode (on/off) is factory configured in the standard L2740 unit.

A single turn TIME DELAY adjustment is provided for each relay on the L2740 (see Figure 3-3). Most applications require no time delay. Therefore, adjust the TIME DELAY adjustments to the maximum counter-clockwise direction (zero time delay).

If there is significant agitation of the process material within the storage vessel, then time delay may be required. In this case, adjust the TIME DELAY adjustments clockwise, just enough to prevent control relay chatter. Use the smallest amount of delay possible.

The maximum standard delay time is 30 seconds full scale. Consult Factory for optional delay times and modes.

E. Field Resetting of Coating Cancellation Mode

L2720 and L2740 units are Factory set for coating cancellation of either conductive or non-conductive processes. Non-conductive process cancellation is referred to as Mode A and conductive process as Mode B. In the event that a unit is being used for a process other than the original application, it may be necessary to change the mode setting. This is done by moving the mode jumper from one position to the other. The mode jumper is located on the right hand side of the bottom circuit board of the L2720, and on the right hand side of the circuit board of the L2740 Sensor Head. Refer to Figure 4-1. The jumper connects the center pin to either the left or right hand pin. If uncertain as to whether a change is necessary, consult the Factory.

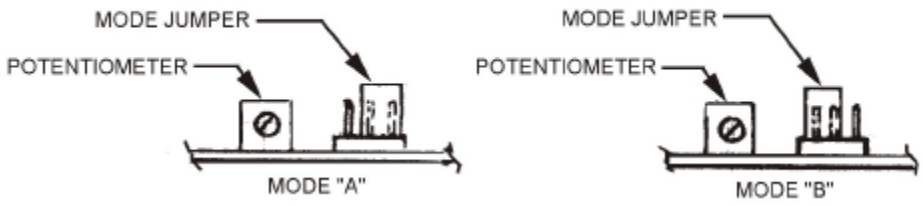


Figure 4-1
Coating Cancellation Mode Jumpers

F. System Troubleshooting

1. Problems and Remedies.

a) None of the relay status indicator LED's are lit.

✓ Ensure that proper power, either 115 Vac, 230 Vac or 24 Vdc, is applied to power input terminals.

b) One or more of the relay status LED's fails to light (except for LED 3 when in Zone Mode).

✓ Ensure that the FAIL SAFE jumpers are making good contact with two of the three pins. Pins may be temporarily shorted with a screwdriver, if contact is uncertain. If any LED fails to light, return unit to the Factory for repair or replacement.

c) After performing calibration, all relays fail to switch or all switch at the same time.

✓ Check that the spring-loaded pin on the top of the probe (see Figures 1-3, 1-4 and 1-5) is making contact with the silver pad on the bottom of the electronic circuit board. The pin normally projects about 1¼ inches above the NPT fitting on the probe. It may be stretched out further with a pair of pliers without causing damage.

✓ Check for very loose connection of probe's NPT hub in entry port of electronic housing. Tighten as required. Check ground continuity per Section 4.F.2.a.

d) After performing calibration procedure, switch points are unstable or erratic.

✓ Check ground continuity per Section 4.F.2.a.

✓ Verify that probe is not exposed to splashing or turbulent conditions within the vessel.

✓ Perform Breached Probe Check, Section 4.F.2.b or 4.F.2.c. Return probe to Factory for repair if breach is detected.

- ✓ Water or foreign liquid collected in probe port of electronic housing. Check wiring port conduit seal and dry housing.
- ✓ Conductive film or foreign material bridging probe hub at or near spring loaded connection pin. Clean and check source of problem.
- ✓ Probe Response Check, Section 4.F.2.d below, may be used to help isolate problem.

e) Unit switches correctly once or several times and then switch point drifts.

- ✓ A progressively thicker coating may be building up on the probe. This condition will require performing the adjustment procedure over again when the coating is at its thickest point.
- ✓ Significant temperature changes may change the dielectric constant of the process material and also of the probe insulation material, Kynar having a much greater change than Teflon. If output drift correlates with temperature change, consult the factory.
- ✓ There may have been a change in the dielectric constant of the process material. This would change the flow of RF current through the probe, effectively shifting the switch point. RF impedance technology is designed to operate with materials having a constant dielectric constant (therefore, a constant RF conductivity). Changes in RF conductivity negate measurement accuracy and stability.

2. Ground Continuity and Probe Checks (Refer to Figure 4-2 below):

a) Ground Continuity Check: With unit power off, using an ohmmeter on the lowest range, measuring between any of the following points should yield less than one ohm:

1) Point A (posts) to point B (electronic housing).
2) Point B to point C (probe hub, threads).
3) Point C to point D (except in non-metallic tank).
4) When electronic chassis is installed in housing, the chassis should have continuity to points A, B, & C through the two 8-32 retaining screws which fasten it to posts (A).

b) Breached Probe Check: Conductive liquids only with **bare ground reference** contacting process:

1) Remove power and remove the electronic unit from the probe, either by screwing the electronic housing off of the probe, or by removing the two 8-32 screws and lifting the electronic chassis out of the housing.
2) Raise conductive liquid to highest point on probe.
3) Using an ohmmeter on its highest range (20 megohms), connect meter probes to spring-loaded pin (point E) and hub of probe (point C), respectively.
4) An over-range meter indication indicates the probe sheathing is good. A resistance reading (for example, 1.25 megohms) can mean that sheathing is breached, or there is a short in the probe hub, or moisture in the bottom of the housing.

c) Breached Probe Check: Conductive liquids only with **insulated ground reference** - L128 & L116 probes, lined tank, etc:

1) Remove power and remove the electronic unit from the probe, either by screwing the electronic housing off of the probe, or by removing the two 8-32 screws and lifting the electronic chassis out of the housing.
2) Raise conductive liquid to highest point on probe.

3) Insert a bare metal wire or rod into the process material, depth of insertion not important.

4) Using an ohmmeter on its highest range (20 megohms), connect meter probes to spring-loaded pin (point E) and the metal wire or rod, respectively.

5) An over-range meter indication indicates the probe sheathing is good. A resistance reading (for example, 1.25 megohms) can mean that sheathing is breached, or there is a short in the probe hub, or moisture in the bottom of the housing.

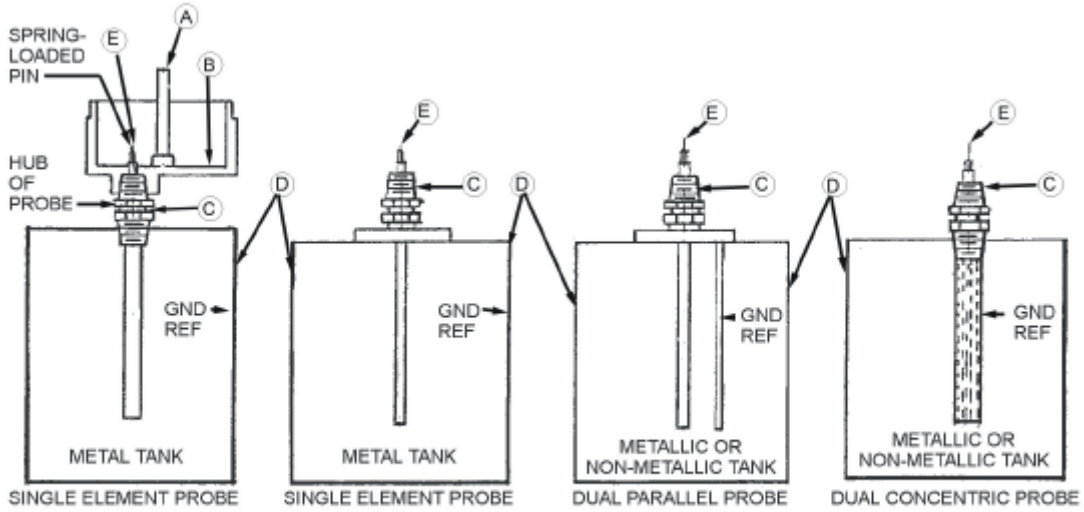
6) Repeat steps 3 & 4, this time with meter probes between the hub of the probe (point C) and the metal wire or rod.

d) Probe Response Check: If the L2720/L2740 switch points are erratic or unstable, and if there is no indication of a poor ground or a breach in the Probe per a, b and c above, the below check can be performed to help isolate the problem.

1) Remove power and remove the electronic unit from the probe, either by screwing the electronic housing off of the probe, or by removing the two 8-32 screws and lifting the electronic chassis out of the housing.

2) Connect a hand-held capacitance meter between points E (spring-loaded pin) and C (probe ground) per Figure 4-2. Capacitance readings should be stable. Changes in capacitance should be linear and directly proportional to changes in level. The approximate capacitance span for a given application may be obtained by consulting the factory.

3) If the readings are not stable and linear, the problem is coming from the probe or is associated with the process material or the tank configuration, piping, etc. If the readings are stable and linear, the problem is in the electronic chassis, wiring, readout device, etc. (Be sure to isolate the electronic chassis from all other devices before assuming that the problem is in the chassis.)



Ground Continuity and Probe Checks

Figure 4-2

Section Five
Equipment Service

A. Getting Help

If your Princo equipment is not functioning properly, and attempts to solve the problem have failed, contact the closest Princo sales representative in your area, or call the factory direct and ask for service assistance. The factory telephone number is 1-800-221-9237.

To assist us in providing an efficient solution to the particular problem, please have the following information available when you call:

1. Instrument Model Number
2. Probe Model Number
3. Purchase Order Number
4. Date of Purchase Order
5. Process Material Being Monitored
6. Detailed Description of the Problem

If your equipment problem cannot be resolved over the phone, then it may be necessary to return the equipment for checkout/repair.

Do not return equipment without first contacting the factory for a Return Material Authorization number (RMA #).

Any equipment which is returned, MUST include the following information in addition to the list above.

7. RMA Number
8. Person to contact at your Company
9. Return (Ship to) Address

Princo level instruments are covered by a 10-year limited warranty. You will not be charged if it is determined that the problem is covered under warranty. Please return your equipment with freight charges prepaid. If repair is covered under warranty, Princo will pay return freight charges.

If telephone assistance or equipment return is not a practical solution to the problem, then it may be necessary for field assistance. Trained field servicemen are available from the factory on a time/expense basis to assist in these instances.

B. Warranty Statement

All Princo level control instruments are backed by a 10-year warranty. Princo will repair or replace, at our option, any instrument that fails under normal use for up to 10 years after purchase.