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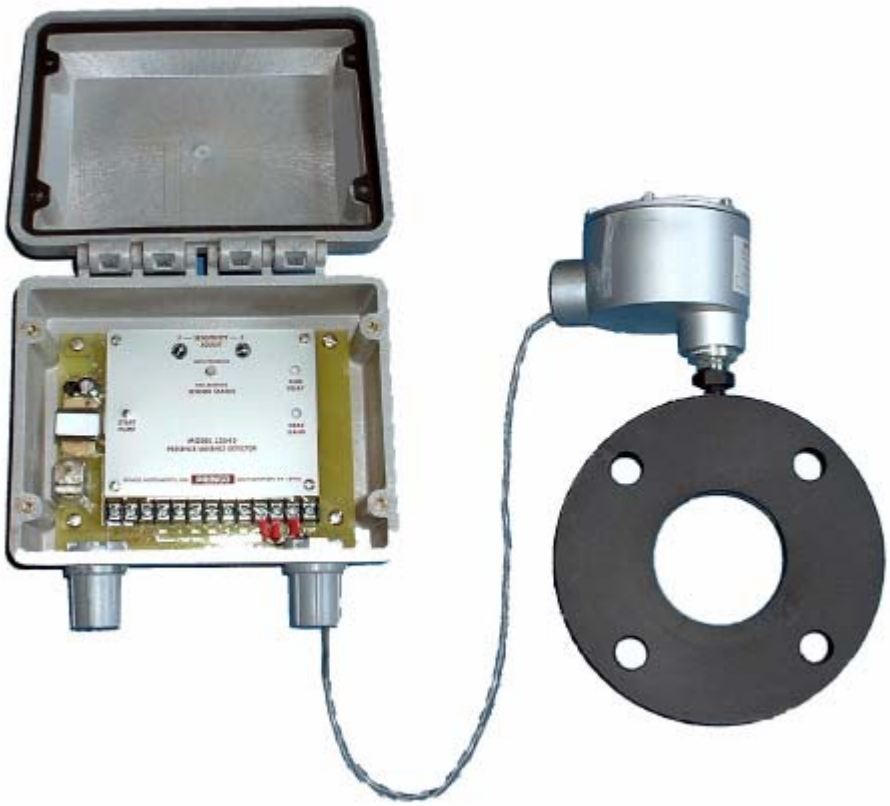
Instruction Manual

Princo Model L3545

Remotely Adjustable Presence/ Absence Detector
with NULL-KOTE™

Rev 2, 25 July 08



PRINCO INSTRUMENTS INC., 1020 INDUSTRIAL BLVD., SOUTHAMPTON, PA 18966

PHONE: 800-221-9237 or 215-355-1500 FAX: 215-355-7766

WEB SITE: www.princoinstruments.com E-Mail: info@princoinstruments.com

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1 Description

1.1 General Description

The Princo Model L3545 Presence/Absence Detector is a remotely adjustable, RF impedance-sensing device which, when connected to any Princo L600 Series Sensor Flange, can be used to detect the presence or absence of process material within a pipeline. The L3545 unit, with Sensor Flange, is used for obstruction-less presence/absence detection of liquids and solids in all types of process systems, and for run dry protection of positive displacement pumps.

The basic instrument consists of two separate devices - a Sensor Head and a Control Unit (see Figure 3-1). The Sensor Head is a modular electronic chassis, which is contained in a heavy-duty, cast aluminum, weatherproof, explosion-proof housing. The Sensor Head housing has a removable lid, which exposes the electronic chassis. The chassis is composed of two circular printed circuit boards that are held together by a removable system of mechanical spacers and electrical interconnects. The chassis is easily removed from the instrument housing, allowing convenient replacement of the boards, should troubleshooting be required.

The Sensor Head housing, with internal electronic chassis, attaches directly to any one of the Princo L600 Series Sensor Flanges. An electrical and mechanical sensor connection is made by simply screwing the housing directly onto the Sensor Flange's upper hub NPT fitting.

The Sensor Head electronic chassis performs the RF impedance measurement portion for the overall L3545 Presence/Absence Detector system. Here, the electrical impedance of the process material within the pipeline is measured and converted into an electrical DC signal. This signal is transmitted to the Control Unit via a two-conductor, shielded cable.

The Control Unit is a modular electronic chassis, which is contained within a heavy-duty, weatherproof, NEMA enclosure. The Control Unit enclosure has a hinged cover that exposes the electronic chassis. The chassis is composed of one rectangular printed circuit board. Like the Sensor Head chassis, it is easily removed from the instrument housing, allowing convenient replacement, should troubleshooting be required.

The Control Unit electronic chassis performs the "operator interface" functions, and the control portion for the overall L3545 system. The single printed circuit board performs a number of specific tasks that are relevant to these functions. The board incorporates a 13-position terminal block that provides interface to the external world. Three positions for power input, six positions for control relay output, three positions for connection to the Sensor Head, and one position for a remotely actuated "start pump" function. The board also contains the "human" operational interface, consisting of an LED status indicator, four control adjustments used to establish instrument configuration and calibration, and a push-button switch used to locally actuate the control relay to prime/start the pump.

1.2 Functional Description

The Model L3545 is a part of a new generation of presence/absence detectors that incorporates advanced technology to bring forth enhanced performance. The unit is designed to protect progressive cavity or other positive displacement type pumps, plus any other pipeline related devices, which may be damaged by running dry.

The basic function of the device is to detect the absence of process material within a pipeline, and to announce this absence by means of an "alarmed" set of relay contacts. These contacts, typically wired directly to the pump or a PLC, when "alarmed", shut down power to the pump, and thus prevent the pump from the damaging effects of running dry.

The Model L3545 can detect the presence or absence of virtually any process material that might flow through a pipeline, from low dielectric constant electrical insulators, to highly conductive electrical conductors. The mechanical nature of these materials can range from thin, low viscosity liquid materials to thick, viscous materials that severely coat the pipeline and inner surfaces of the sensor flange.

The Model L3545 is used in conjunction with a Model L600 Series Sensor Flange. These sensors are available in two distinct types: "Partial-Ring" - for conductive process materials, and "Full-Ring" - for non-conductive process materials.

The Sensor Head generates a low level, one MHz signal which is applied between the "active" sensing element on the inside diameter of the flange and the ground reference. With metal pipelines, the pipeline itself serves as the ground reference. With plastic pipelines, a metallic ground flange is required. The presence of the process material between the sensing element and the ground creates a change in the RF impedance that is sensed by the electronic circuitry. This resulting signal is amplified and rectified. The resulting DC voltage signal, which is proportional to the RF impedance, is transmitted to the Control Unit via a 3-wire, shielded cable. The Control Unit

compares this signal with a DC level established by the settings of the coarse and fine sensitivity adjustments. When the measurement signal passes above or below the set point, the relay contacts are switched accordingly.

The unit is normally hard-wired at the factory for fail-safe low operation (relays are de-energized when pipeline is empty). Fail-safe high is available upon request.

An enhanced feature of the Model L3545 is its superior temperature stability. Special electronic circuitry is incorporated into the L3545 that corrects for any changes in the measurement signal due to ambient air temperature influences on the highly sensitive electronic circuits. The result is a highly temperature stable presence/absence detector. The L3545 can be used to reliably detect even the lowest dielectric constant process materials.

1.2.1 Basic Features

- Separate Sensor Head and Control Unit.

  All control and operator adjustment functions are located in the Control Unit. The Control Unit can be mounted in a convenient and easily accessible location, up to 3000 feet away from the Sensor Head. This eliminates the need for personnel to climb high tanks, silos, bins, or enter other hazardous locations in order to make adjustments or to check instrument functionality.

- RF Impedance Sensing Technology with Null-Kote™

  The L3545 uses RF impedance technology, proven in tens of thousands of applications. With no moving parts, the measurement depends solely on its modern, electronic circuitry, ensuring years of dependable operation.

- Heavy Duty Control Relay

  Two sets of Form C (DPDT) contacts are provided via a 13-position terminal block located on the printed circuit board of the L3545 Control Unit. The contacts are rated at 5 amps at 115 Vac.

- Sensor Flange Status Indicator

  The status of the process material at the sensor is indicated by the color of the SENSOR STATUS LED. The two color (red/green) LED is located on the L3545 Control Unit. Red indicates an absence of material in the pipeline; green indicates a presence.

- Coarse and Fine Sensitivity Adjustments

  Two large diameter, linearly scaled, single turn potentiometers (SENS C & F) are provided on the Control Unit board of the L3545. These adjustments are used to establish a repeatable switch point that is calibrated to the given process material application.

- Low-Acting Alarm Action

  A low alarm condition occurs when the process material is removed from the sensor (pipeline empty - absence). The alarm condition is defined as a de-energized control relay.

- Fail Safe Alarm Action

  The L3545 is in normal, non-alarmed state when it's control relay is energized (pipeline full - presence, LED green). If the L3545 were to lose power, the control relay would de-energize (LED red). Thus a power failure would produce an alarm condition – alerting the operator that a problem exists.

- Time Delay Adjustment

  The L3545 senses the process material change (presence/absence) instantaneously. However, a delay can be inserted between the instant the instrument senses the change, and the time the control relay correspondingly de-energizes. A single turn TIME DELAY pot is provided on the Control Unit board of the L3545. The potentiometer allows an adjustment of 0 to 30 seconds of time delay.

  The time delay feature is useful to prevent momentary voids or cavities in the process material flow stream from causing the control relay to continually change state. Note that the SENSOR STATUS LED changes immediately from Green to Red, even when a delay is applied. The unit is factory-set for delay in one direction only – from energized state to de-energized.

- Dead Band Adjustment

  The L3545 provides a Dead Band adjustment. A single turn DEAD BAND pot is provided on the Control Unit.

  The Dead Band is the band of level corresponding to the points at which the L3545 recognizes process material presence and process material absence. The dead band adjustment is used in non-conductive process material applications only. The adjustment is used primarily to compensate for minute changes in the electrical characteristics of a low dielectric constant process material.

- ‘Bulls Eye’ Indicator Lights - Optional

  Two lights, one red and one green, are mounted on the hinged cover of the Control Unit such that the lights are visible with the hinged cover closed and sealed. The lights provide an externally visible indication of the internal control relay status (energized-green: de-energized-red). The enclosure's NEMA rating is maintained with optional lights installed.

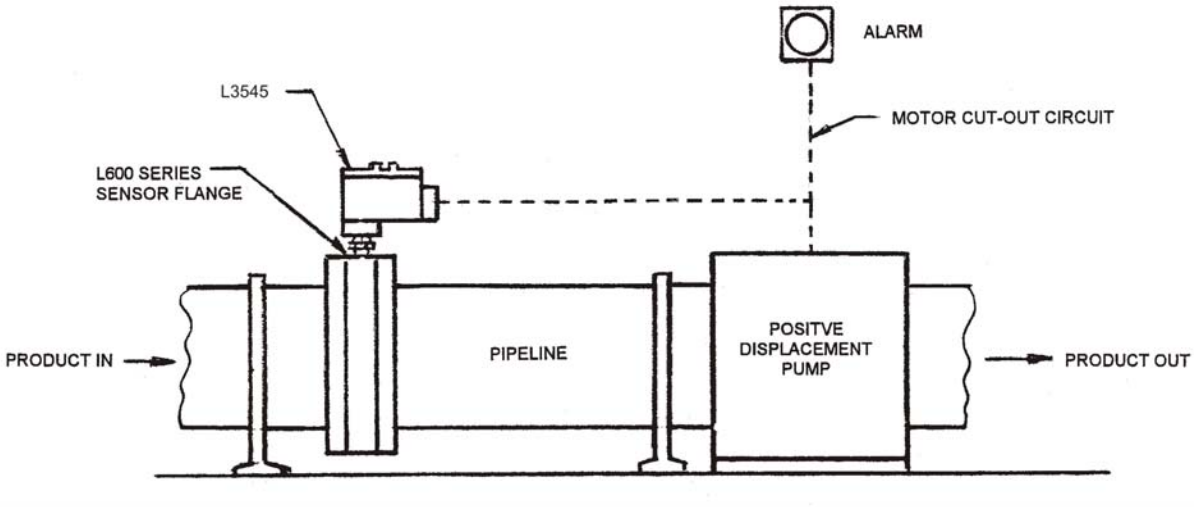


Figure 1-1. Typical Pipeline Installation

1.3 Sensor Flange Description

Princo manufactures several types of Sensor Flanges for use with the L3515 and L3545 Presence/Absence Detectors. The electrical, chemical and physical characteristics of the process material determine the best flange for a particular application.

Partial-Ring Flanges (models L632, L642, L652 and L662) are generally used for process materials that are electrically conductive. They may be used for all applications in which the pipe is 75 to 100% full under normal (safe) conditions. They are the mandatory choice for super-conductive materials such as acids, brines, or effluents and for conductive materials that tend to build up a coating on the Sensor Flange. Partial-Ring Flanges have a relatively small area of exposed stainless steel sensing element on the inside diameter of the Flange. This is desirable for conductive materials where the process material creates a virtual "short" between the sensing element and the grounded metal pipeline ground flange.

Full-Ring Flanges (L631, L641, L651 and L661) are generally used for process materials that are electrically non-conductive. They are typically used to define pipe levels from 5 to 100% full. They are not suitable for super-conductive materials such as acids, brines and effluents. They may NOT be used where conductive material builds up on the Flange. Full-Ring Flanges have a stainless steel sensing element that circles the full inside diameter of the Sensor Flange. It provides maximum contact area for non-conductive process materials, which are dependent upon a changing dielectric constant between the sensing element and the grounded metal pipeline or ground flange.

With a Full-Ring Flange, a conductive process material would possibly create a constant contact (indicating constant presence state) between the sensor element and the ground, especially if the flange were mounted in a horizontal section of pipeline. Likewise, a Partial-Ring Flange, when used in a non-conductive application, might not produce a large enough change in RF conductivity to trigger a change of state in the controller.

The standard Sensor Flanges are the L631 (Full-Ring) and the L632 (Partial-Ring). These Flanges are made from 150 lb ASTM size carbon steel flanges, with inner-diameter exposed surfaces of epoxide and 316 stainless steel. They are available in sizes of one to twelve inches. See Figure 2-1 for flange diagrams.

Other Flange options include: 316 stainless steel flanges with exposed surfaces of 316 stainless steel and Teflon®; and Flanges with Tri-Clamp connectors. Flanges with inner surfaces covered by Teflon® "boots" are available for applications incompatible with stainless steel and epoxide. Refer to the table in Section Two, Specifications, for a full listing of Sensor Flange models and their specifications. Refer to Princo Bulletin L-97-5 for complete dimensional details. Consult the factory for specific application questions.

2 Specifications

2.1 L3545 Presence Absence Detector

- TYPE

  Point type (on/off), solid state electronic, high frequency (RF), impedance sensing, remotely adjustable, Presence/Absence Detector.

- POWER REQUIREMENTS

  95 to 135 Vac, 50 to 60Hz, 1.3 watts; or 205 to 255 Vac, 1.3 watts; or 12 to 34 Vdc, <1 watt.

- AMBIENT TEMPERATURE RANGE

  -40 to 150 °F (-40 to 66 °C)

- SENSITIVITY

  Senses capacitance as low as 0.15pF. Sensitivity may be decreased to approximately 1000pF.

- TEMPERATURE STABILITY

  Less than 1.0 pF typical (-40 °F to +150 °F).

- CONTROL RELAY CONTACTS

  Two sets of form C contacts, rated at 5 amperes, 115V ac or 26V dc, resistive load.

  (Two sets of form C contacts, rated at 10 amperes, 115V ac or 26V dc, resistive load for units made before June 1, 2008.)

- ALARM TYPE

  Low Acting: Alarm occurs upon absence of process material (unless otherwise specified).

- ALARM ACTION

  Fail Safe Alarm: Control relay de-energizes (drops out) upon alarm.

- STARTUP PUSH-BUTTON

  Overrides normal control function when depressed (start/prime pump). After push-button is released, override continues for a period of time equal to pre-set delay time.

- DELAY TIME AND DELAY MODE OPTIONS

  Standard delay is adjustable from 0 to 30 seconds. Standard mode is delay turn-on alarm. Consult the factory for other configurations.

- DEAD BAND

  Adjustable over range of 1.3pF for low values of process capacity. Adjustment range increases with sensitivity control setting, up to approximately 1000pF, for high values of process capacity.

- ELECTRONIC HOUSING

  CONTROL UNIT: Structural foam, thermoplastic molded base and hinged cover.

  Weatherproof: NEMA 1-3, 3S, 4, 4X, 12, 13.

  SENSOR HEAD: Heavy-duty, cast aluminum.

  Explosion-proof for: Class I, Div. 1 & 2, Groups C & D; Class II, Div. 1, Groups E, F & G; Class III, Div. 1 & 2.

  Weatherproof: NEMA 7 CD, 9 EFG.

2.2 L600 Series Sensor Flanges

- STANDARD FLANGE SIZES, MODELS L631 AND L632

  Carbon steel, 150 lb ASTM sizes 1 to 12 inches.

- DESCRIPTION BY MODEL NUMBER

Model Number	Sensor Type	Wetted Surfaces	Flange Material	Connection
L631	Full-Ring	Epoxide, 316SS	Carbon Steel	Flanged
L632	Partial-Ring	Epoxide, 316SS	Carbon Steel	Flanged
L641	Full-Ring	Teflon®, 316SS	316SS	Flanged
L642	Partial-Ring	Teflon®, 316SS	316SS	Flanged
L651	Full-Ring	Epoxide, 316SS	Carbon Steel	Tri-Clamp
L652	Partial-Ring	Epoxide, 316SS	Carbon Steel	Tri-Clamp
L661	Full-Ring	Teflon®, 316SS	316SS	Tri-Clamp
L662	Partial-Ring	Teflon®, 316SS	316SS	Tri-Clamp

- PRESSURE / TEMPERATURE RATINGS

Model Numbers	PSI @ °F
L631*, L632*, L651*, L652*	200 @ 100
	50 @ 150
	0 @ 200
L641, L642, L661, L662	200 @ 100
	100 @ 200
	0 @ 300

*Protect from thermal shock.

- DIMENSIONAL INFORMATION
  Refer to Princo Bulletin L-97-5.

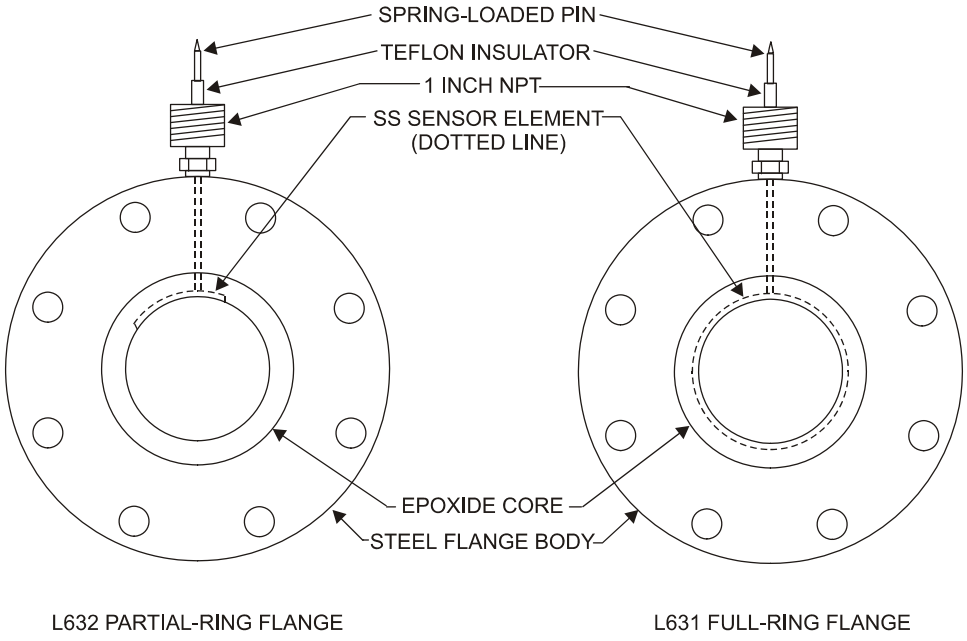


Figure 2-1. Typical L631 and L632 Sensor Flanges

3 Installation

3.1 Inspection

The L3545 Presence/Absence Detector is supplied with one of the Princo L600 Series Sensor Flanges. The L3545 and Sensor Flange 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 Sensor Flange (see Figure 2-1). This pin provides the necessary electrical connection from the L3545 Sensor Head bottom printed circuit board, to the active element of the Sensor Flange. Make sure this pin is not missing, bent, jammed, or otherwise damaged. It should be straight, free moving and should extend about 1-1/2" from the surface of the 1-inch NPT threaded hub. Also, on the L631 and L632 Flanges, check for any cracks between the steel and epoxy surfaces. The surfaces should be mated smoothly with each other with no cracks.

CAUTION!

Care must be exercised when handling the Sensor Flange. Do not allow the spring-loaded pin on the Sensor Flange threaded hub to be accidentally hit or jarred on a hard surface. An accidental blow to this pin may cause poor contact with the active sensing element, on the inner surface of the sensor flange, rendering the sensor inoperable.

Report any such damage immediately to the factory.

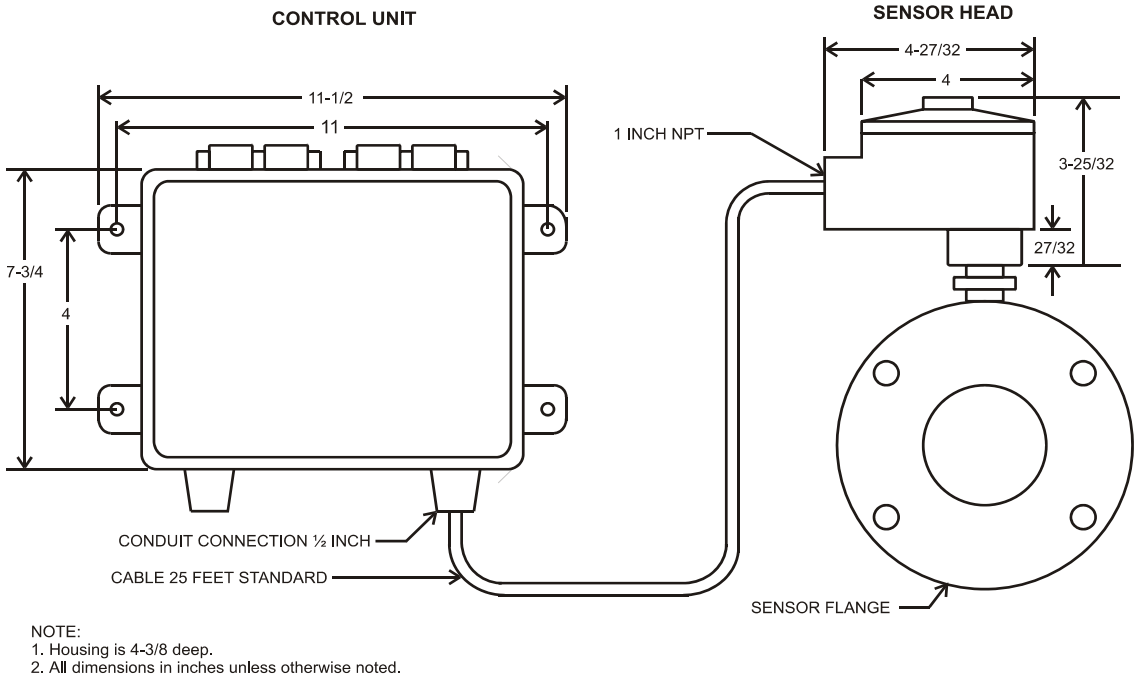


Figure 3-1. L3545 with Sensor Flange: Dimensional Drawing

3.2 Mounting

3.2.1 Partial-ring Flange (L632, L642, L652, L662) Location

The most common application of L3545 presence-absence technology is for protection of positive displacement pumps for conductive (water-based) applications. Simply put, the flange must be installed in such a position that the fluid will be touching the sensing element of the flange when the pump is to be running and not touching the sensing element when the pump is to be off. Refer to Figure 2-1 for sensing element location. It is preferred that the Sensor Flange be mounted in a vertical pipe segment as close as possible to the inlet side of the pump or other device to be protected.

If the Sensor Flange is mounted in a horizontal pipe segment, it should also be located as close as possible to the inlet side of the pump or other device to be protected. The NPT connection hub on the Sensor

Flange must always be in the 12 o'clock position, as illustrated in Figures 1-1 and 3-2. Tilting the flange orientation to one side or the other risks having the pump turned on when there is only a residual amount of fluid in the pipeline.

The dynamics of flow within a pipeline are often difficult to predict with any certainty. Experience has shown that certain locations may be problematic. These locations include immediately before or after a 90-degree bend (whether in a vertical or horizontal line of flow). These areas are prone in some cases to creating air pockets which turn the pump off, and in other cases to excess buildup of coating which may leave the pump on when it shouldn't be. Some locations in pipelines are likely to have air at the top even when there is steady flow. Princo recommends avoiding locations where this is possible. See Figures 3-2 through 3-7 below as examples of possible problematic locations and recommended locations.

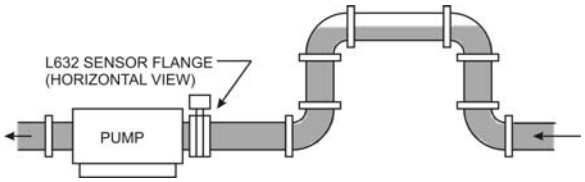


Figure 3-2. Correct Horizontal Installation (Horizontal View)

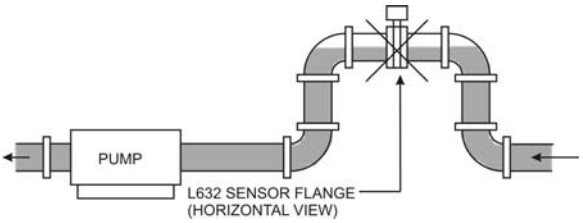


Figure 3-3. Questionable Horizontal Installation (Horizontal View)
Possible air in line

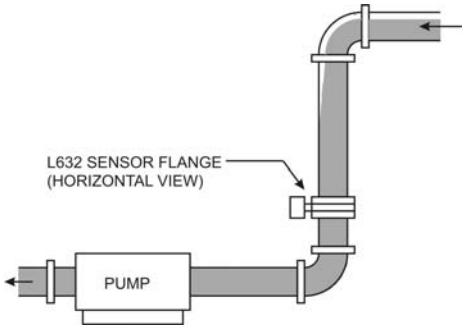


Figure 3-4. Correct Vertical Installation (Horizontal View)

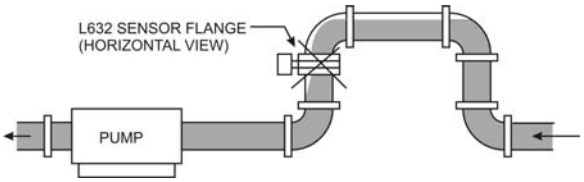


Figure 3-5. Questionable Vertical Installation (Horizontal View)
Possible air pockets near sensing element

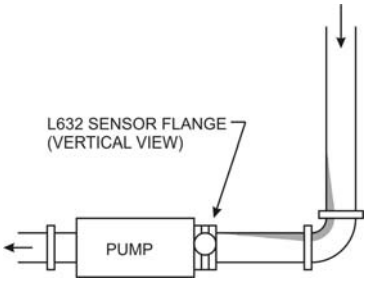


Figure 3-6. Correct Horizontal Installation (Vertical View)

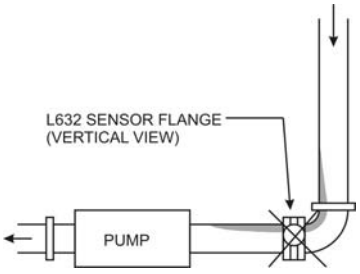


Figure 3-7. Questionable Horizontal Installation (Vertical View)
Possible excessive build-up or air pockets near 90° bend

3.2.2 Full-ring Flange (L631, L641, L651, L661) Location

Full-ring sensor flanges are used mainly for non-conductive process materials such as oils. They may safely be mounted in vertical or horizontal sections of pipeline, preferably as close as possible to the pump inlet. They do not have to be mounted at a 12 o'clock orientation. Since the sensing element circles the full inside diameter of the flange, the may be set at any orientation desired. Refer to Figure 2-1 for sensing element location.

3.2.3 Full-faced Gaskets & Flanges

Use a **full-faced type gasket** on each side of the Sensor Flange. Following these instructions will prevent product build-up around the sensing area inside the flange.

NOTE

The Sensor Flange is designed to mate against **full-faced gaskets** and **full-faced pipeline flanges**. These gaskets should have an inside diameter **exactly equal to the inside diameter of the pipeline** in the installation. Mating against raised-face flanges and gaskets could cause cracking and improper sealing of the epoxy inner ring of the Sensor Flange. Improper gaskets may result in leakage of process material inside the flange causing the pump to run dry, as well as up into the electronic housing resulting in damage to the electronics boards.

3.2.4 Sensor Head Mounting

After mounting the Sensor Flange to the pipeline, screw the L3545 Sensor Head housing onto the Sensor Flange NPT threaded hub. This is all the support it requires.

NOTE

Do not use any type of thread lubricant on the NPT probe mounting threads or the NPT threads that 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. Continuity should exist between the metal pipeline and the Sensor Head metal housing. Less than 1-ohm resistance should exist between these two points. Refer to Figure 3-9 for ground testing points.

3.2.5 Spring-loaded Pin

Make a visual check, through the Sensor Head wiring port, to verify the spring-loaded pin makes contact with the bottom printed circuit board. This may also be verified by loosening the two 8-32 mounting screws that hold the electronic chassis in the housing. The spring-loaded pin action should be felt pushing the chassis upward. If not, it may be stretched out somewhat with a pair of pliers. See figure 3-8 below. The spring-loaded pin is the electrical connection between the sensing element on the Sensor Flange and the electronic controller. Good contact is critical.

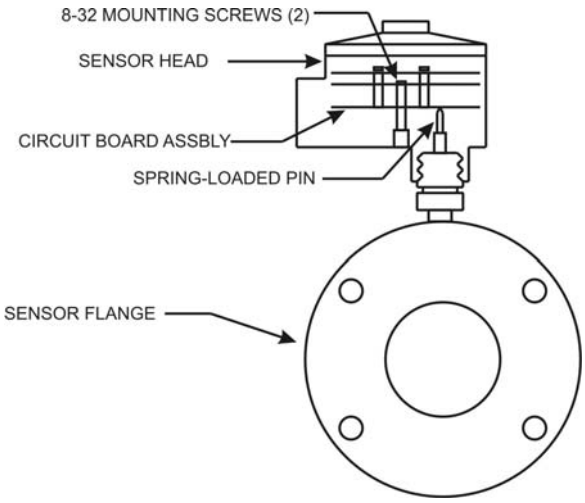


Figure 3-8. Spring-loaded Pin

3.2.6 Grounding

Reliable operation of the L3545 Presence/Absence Detector will only occur through proper installation. The most important installation consideration is a proper sensor ground return.

If the pipeline is metal, the ground return connection is made when the sensor is properly mounted onto the pipeline. To insure proper ground connection, install a ground wire between metal pipe mounting and the ground screw on Sensor Flange as shown in Figure 3-9.

If the vessel is non-metallic (i.e. plastic, or plastic lined), a separate ground return must be provided. The ground return must consist of a separate metal mounting flange, installed into the pipeline, adjacent to the Sensor Flange. A ground wire must be installed between ground screw on Sensor Flange and the ground screw on metal ground flange, as shown in Figure 3-9.

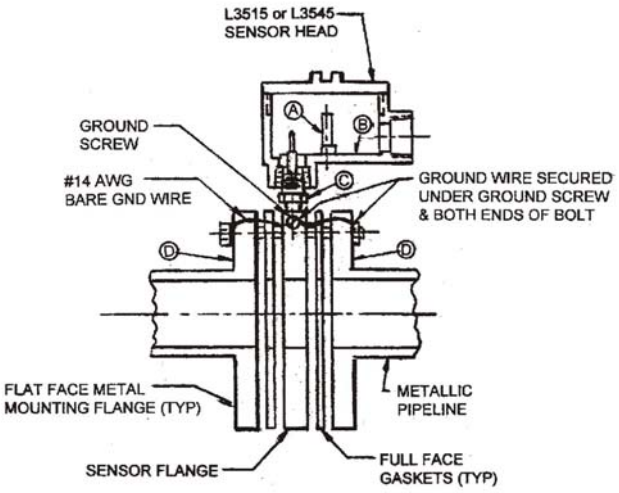


Figure A. Metal Pipe

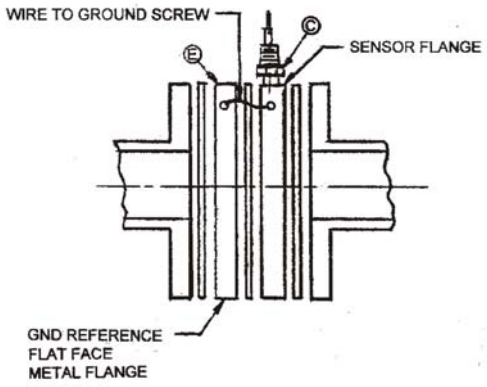


Figure B. Plastic or Plastic-lined Pipe

Ground Continuity Check (Power Off)

1. Turn L3545 power off.
2. Use ohm meter on lowest scale to check following:

- point A (two posts) to point B - less than 1 ohm.
- point B to point C - less than 1 ohm.
- point C to point D (both ends of metal pipeline) - less than 1 ohm.
- point C to point E (plastic pipeline only) - less than 1 ohm.

Figure 3-9. L3545 Installation and Ground Checks

3.3 Electrical Connections

3.3.1 Control Unit

Open the cover of the L3545 Control Unit in preparation for connection of input and output wires. Before drawing wires into the equipment enclosure, it may be necessary to remove the electronic circuit board chassis. To do so, unfasten the four 10-32 mounting screws which are located on each corner of the pc board. Once screws are unfastened, remove the circuit board chassis by lifting it out of the instrument enclosure.

Pull the power input and control relay contact wires through one of the two wiring port openings, allowing enough slack to reach the terminal block locations. Pull the Control Unit to Sensor Head cable (L3541-8, supplied with system) through the opposite wiring port opening, allowing enough slack for the individual wires to reach the terminal block locations.

Replace the electronic circuit board chassis with the terminal block side of the printed circuit board facing the wiring ports. Replace mounting screws and tighten.

a. Power and Control Relay Wiring

For 115Vac and 230Vac powered units, connect the ac power line wires: Hot (H), Neutral (N), and Ground (G) respectively, to the left side of terminal strip (TB1) as shown in Figure 3-10.

If the unit requires 24Vdc for power, the terminal strip TB1 is labeled as plus (+), minus (-) and ground (G). Connect 24Vdc power to the left side of terminal strip (TB1) as shown in Figure 3-11.

Connect the normally open (NO), normally closed (NC) and common (C), relay wires to the terminal strip (TB1) as shown in Figure 3-10 and Figure 3-11,

and as required by the specific pump motor control circuit. Most pump control and protection applications use the normally open (NO) contacts to break power to the pump if/when the pipeline runs empty. The equipment installer should keep in mind that all L3545 units are factory set to operate in the Fail Safe LOW mode, unless otherwise specified.

NOTE

The relay contact configuration, shown in Figures 3-10 and 3-11, and labeled on the instrument circuit board, is identified as such with the relay in the de-energized (shelf) state. Fail-safe operation requires relay to be normally in the energized (non-shelf) state. Upon alarm, configured as either HIGH or LOW, the relay then becomes de-energized (shelf state), as per Figure 3-10, 3-11 and TB1 labeling.

b. Remote Sensor Head Wiring

Connect the Control Unit to Sensor Head cable (supplied with the unit) to the terminal block TB1 as shown in Figure 3-10 or 3-11:

CONTROL UNIT TERMINAL (TB1)	WIRE COLOR	FUNCTION	SENSOR HEAD TERMINAL (TB2)
TB1-10	black	+9.5 volt dc supply	BLK
TB1-11	white	sensor signal	WHT
TB1-12	bare/clear	ground	BARE

c. Remote Start-Up Switch Wiring

Refer to Figure 3-9 or 3-10 below. Connect one end of a two-wire cable to TB1-12 and TB1-13. Connect the other end of the same cable to the terminals of a SPST, normally open, push-button switch (or equal). Depressing the switch will produce the same action as depressing the local PUMP START push-button (i.e. pump start/prime).

3.3.2 Sensor Head

Remove the lid of the L3545 Sensor Head in preparation for connection of input and output wires. Before drawing wires into the equipment housing, it may be necessary to remove the electronic circuit board chassis. To do so, unfasten the two 8-32 mounting screws which are located in the center position on the outboard sides of the electronic chassis. Once screws are unfastened, remove the circuit board chassis by pulling it out of the instrument housing.

Pull the Control Unit to Sensor Head cable (L3545-8) through the wiring port opening, allowing enough slack for the individual wires to reach the terminal block locations. Connect the three cable wires; Black, White, and Bare respectively, to the terminal block (TB2) as shown in Figures 3-10 and 3-11. These connections supply power to the Sensor Head from the Control Unit, and return the measurement signal from the Sensor Head to the Control Unit.

Replace the electronic circuit board chassis with the flat side of the printed circuit boards facing the wiring port. Replace mounting screws and tighten.

NOTE

The two 8-32 mounting screws MUST be fastened securely. These two screws provide the ground connection to the printed circuit board electronics. If not fastened securely, faulty equipment operation may occur.

Verify that all connections, for both the Control Unit and the Sensor Head, were made correctly. Apply power to the Control Unit, and allow 10 minutes before making required calibration adjustments.

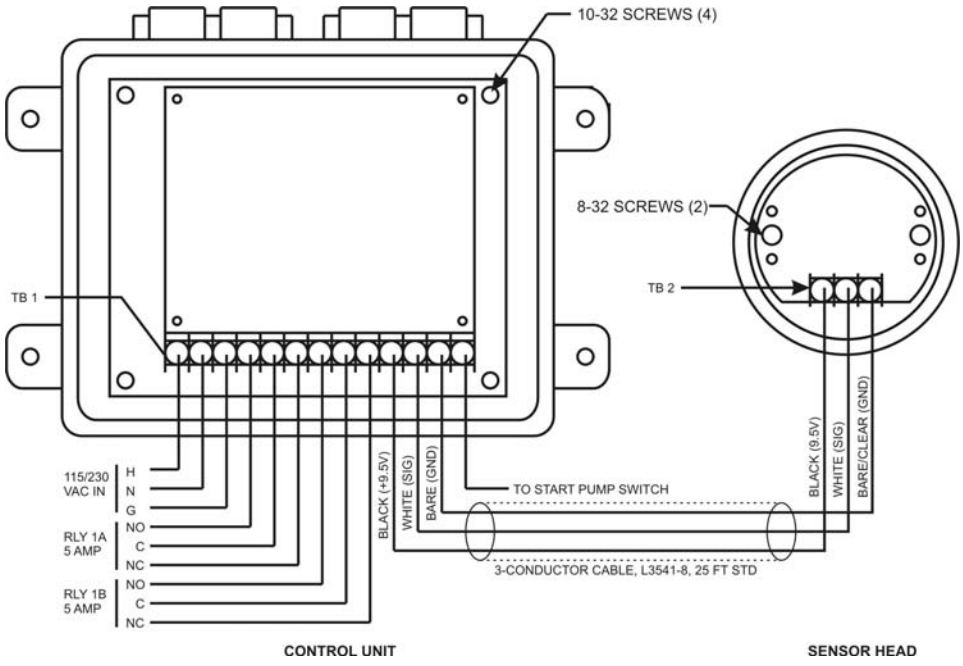


Figure 3-10. Electrical Connections – 115Vac & 230Vac Units

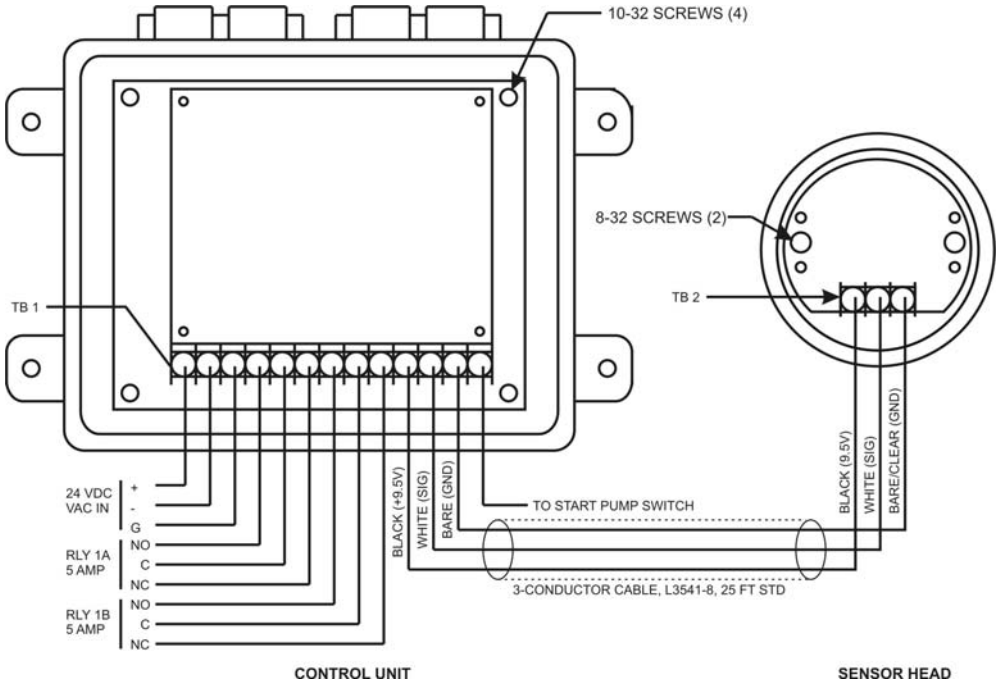


Figure 3-11. Electrical Connections – 24Vdc Units

3.4 Installation in Hazardous Areas

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!

The Princo Model L3545 Level Control is not to be considered an explosion-proof instrument. The instrument does not incorporate an enclosure that would allow for the appropriate explosion-proof approval rating (see above Section 2 for NEMA ratings).

For all applications, 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 3-12 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.

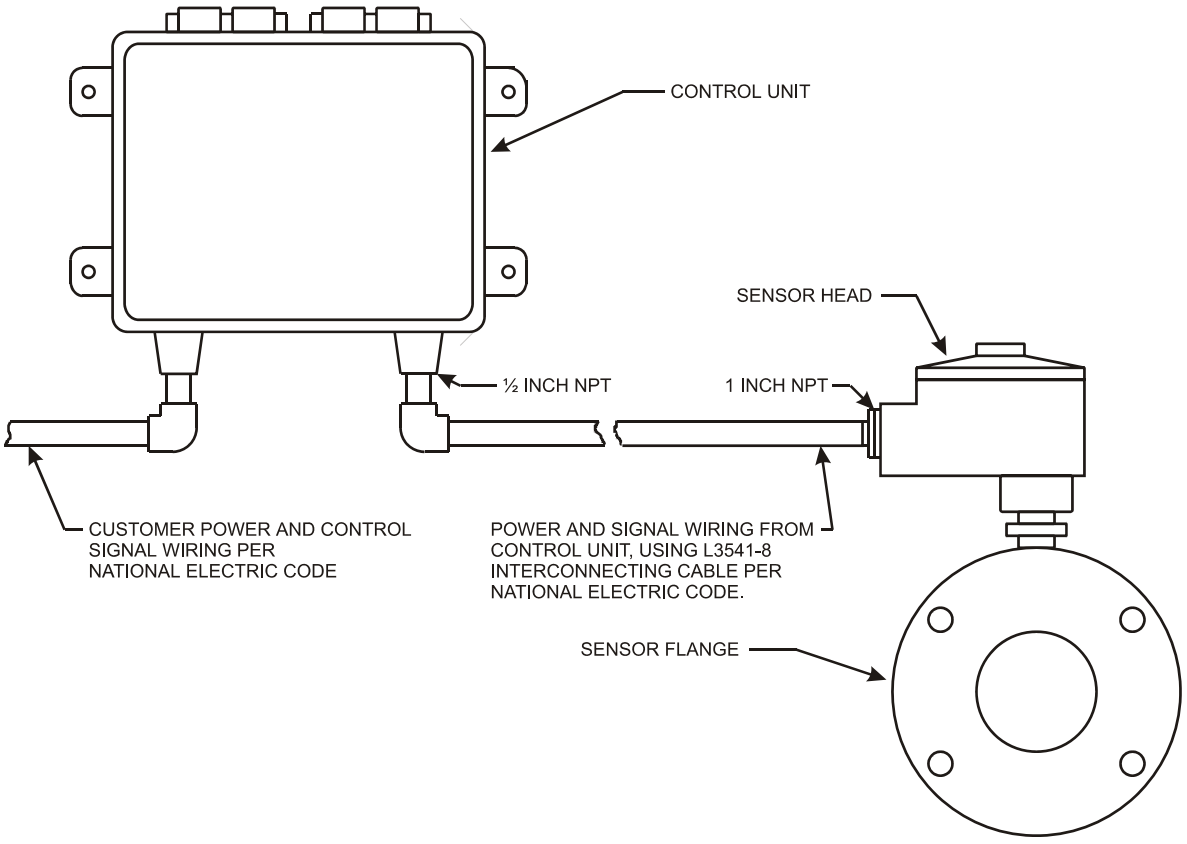


Figure 3-12. L3545 Electrical Installation

4 Adjustments and Operation

4.1 Initial Checkout

1. Refer to Figure 4-1 for L3545 adjustment and indicator locations.
2. Install the L3545 Level Controller with Sensor Flange as presented in Section 3 of this manual.
3. Apply power to the unit and allow a 15-minute warm-up time before performing the calibration procedure as outlined below.
4. Perform Section 5.1.1. Basic Electronic Checks.

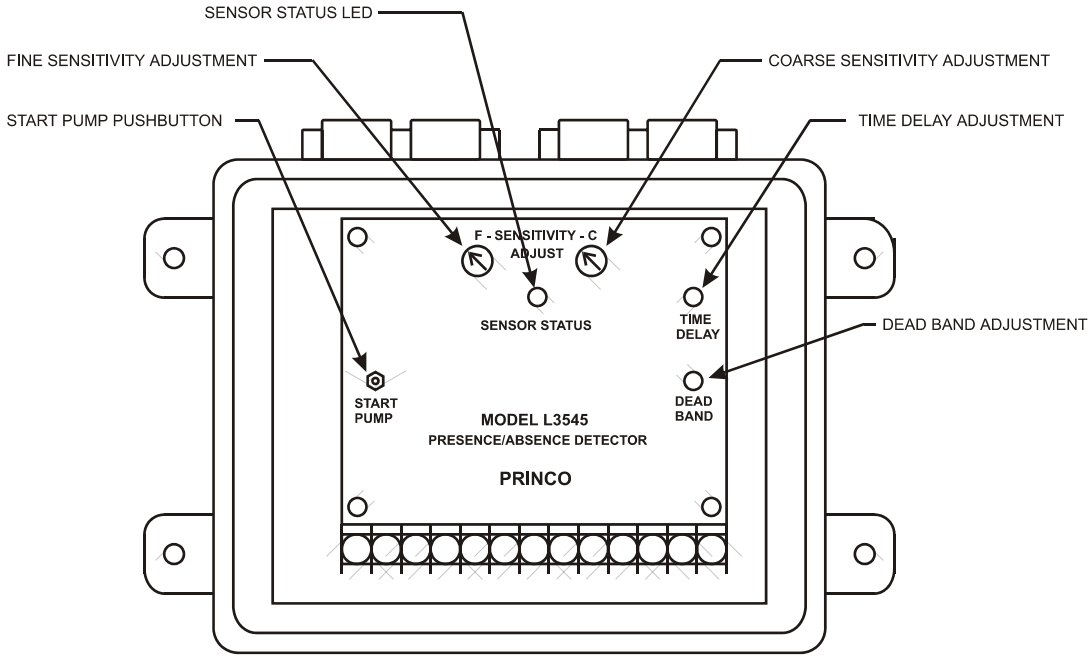


Figure 4-1. L3545 Adjustment and Indicator Locations

4.2 Calibration

The Coarse (C) and Fine (F) sensitivity (SENS) pots must be properly adjusted in order to establish a repeatable switch point for the given process material.

> NOTE
> Two adjustment procedures are listed below – one for conductive processes and one for non-conductive processes. Water-based processes will generally be conductive. However, conductive processes that leave a thick coating inside the pipeline may approximate the conditions of a non-conductive process and require the use of the non-conductive procedure.

4.2.1 Adjustment Procedure - Conductive Process Materials

a) Refer to Figure 4-1 for adjustment and indicator locations. Refer to figure 4-2 for a pictorial outline of this procedure.

b) Allow the unit to warm up (thermally stabilize) for approximately 15 minutes before proceeding with steps c through i below.

c) Preset Coarse (C) and Fine (F) sensitivity (SENS) potentiometers to mid-point positions (12 o'clock).

d) Turn the TIME DELAY and DEAD BAND pots to the fully counter-clockwise position (no delay, minimum dead band).

e) Pre-coat the Sensor Flange by filling and then emptying the pipeline with the product that normally flows through the pipeline.

f) With the pipeline and Sensor Flange completely empty (coated from step e), adjust the Coarse (C) sensitivity such that the SENSOR STATUS LED "just turns" green. Mark the Coarse (C) pot screwdriver slot or mentally note its position.

NOTE

Clockwise rotation increases sensitivity for both Coarse and Fine potentiometers.

g) Fill the pipeline and Sensor Flange with the product that normally flows through the pipeline.

h) Adjust the Coarse (C) sensitivity pot counter-clockwise such that the SENSOR STATUS LED "just turns" red. Mark or mentally note position of screwdriver slot.

i) Adjust the Coarse (C) sensitivity pot until the screwdriver slot is midway between the marks from steps f and h. The SENSOR STATUS LED should now be green (Sensor Flange and pipeline filled with product from step g). If not repeat steps a through i.

NOTE

A green SENSOR STATUS indicator denotes presence of material in the Sensor Flange, and a red indicator denotes absence of material in the Sensor Flange, when sensitivity potentiometers are properly adjusted.

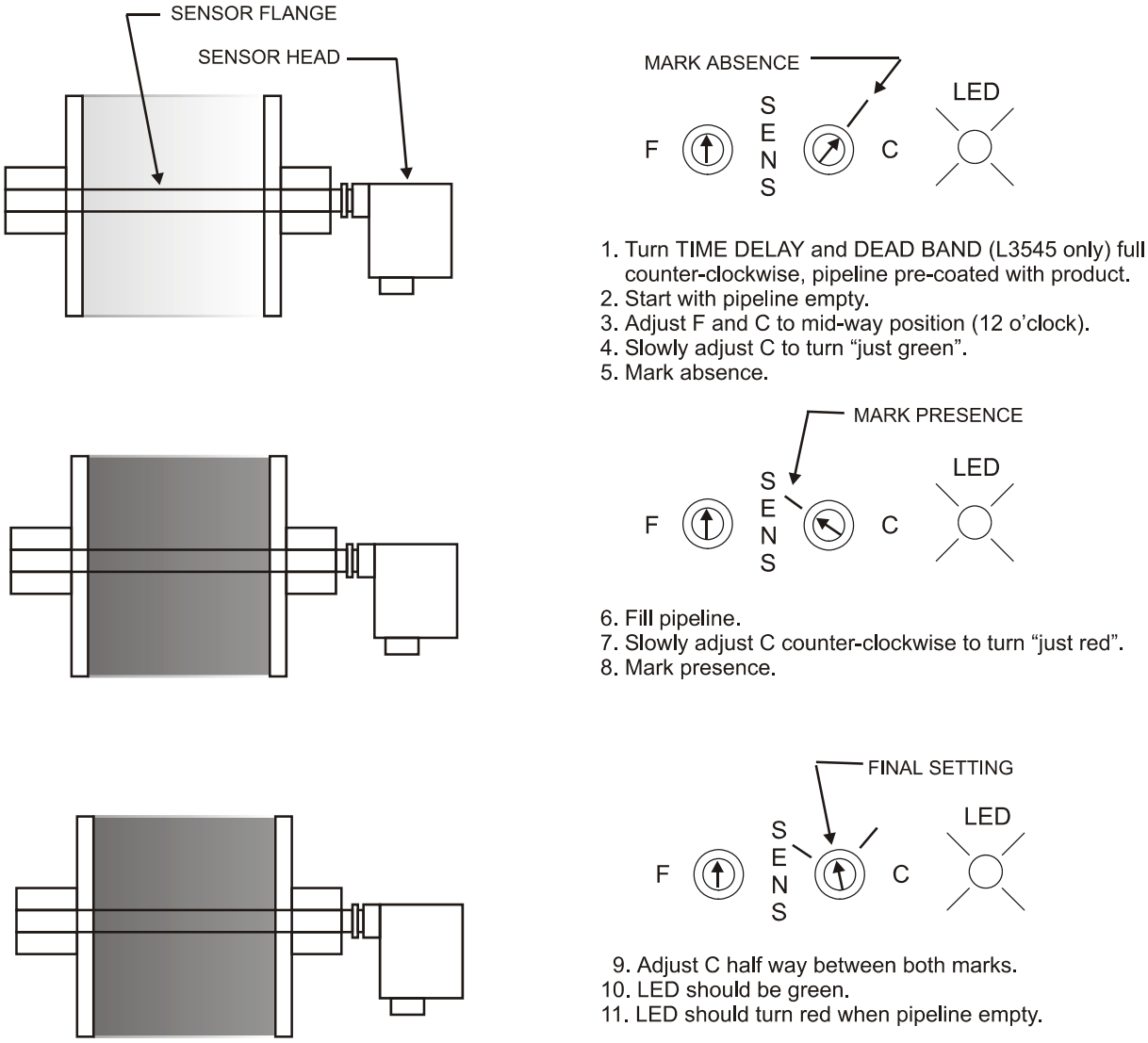
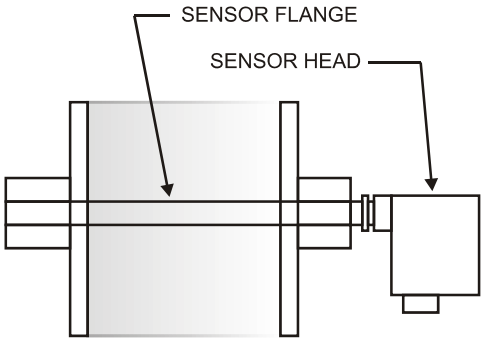
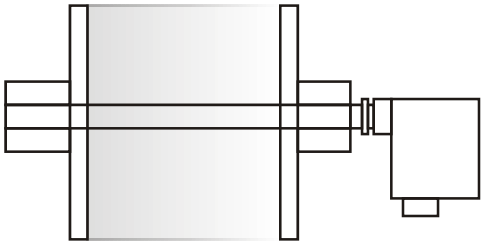
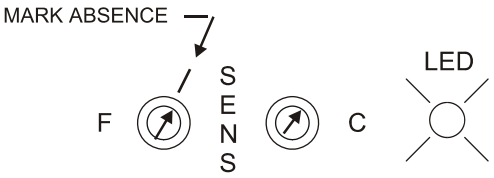


Figure 4-2. Conductive Process Calibration Procedure

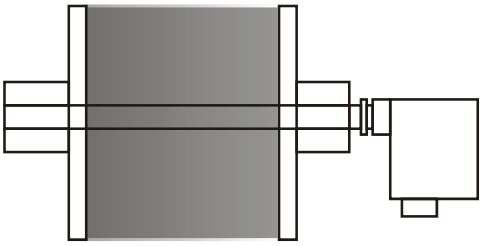


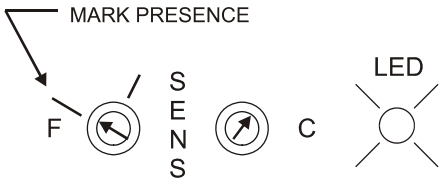
1. Turn TIME DELAY and DEAD BAND (L3545 only) full counter-clockwise, pipeline pre-coated with product.
2. Start with pipeline empty.
3. Adjust F full clockwise and C full counter-clockwise.
4. Slowly adjust C clockwise to turn “just green”.



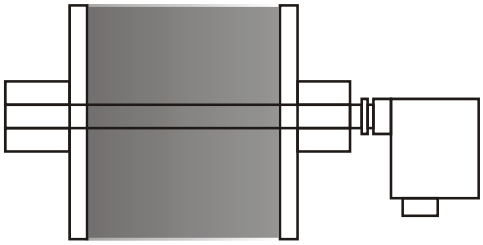


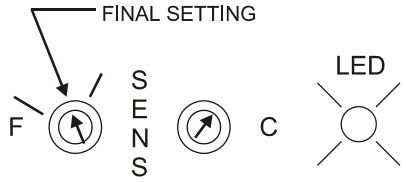
5. Slowly adjust F counter-clockwise to turn “just red”, and back clockwise to “just green”.
6. Mark absence.





7. Fill pipeline.
8. Slowly adjust F counter-clockwise to turn “just red”.
9. Mark presence.





10. Adjust F halfway between both marks.
11. LED should be green.
12. LED should turn red when pipeline empty.

Figure 4-3. Non-Conductive Process Calibration Procedure

4.2.2 Adjustment Procedure – Non-conductive (Insulating) Process Materials

a) Refer to Figure 4-1 for adjustment and indicator locations. Refer to Figure 4-3 for a pictorial outline of this procedure.

b) Allow the unit to warm up (thermally stabilize) for approximately 15 minutes before proceeding with steps c through j below.

c) Preset the Fine Sensitivity pot (F) full clockwise and the Coarse Sensitivity pot (C) to the full counter-clockwise position.

d) Turn the TIME DELAY and DEAD BAND pots to the fully counter-clockwise position (no delay, minimum dead band).

e) Pre-coat the Sensor Flange by filling and then emptying the pipeline with the product that normally flows through the pipeline.

f) With the pipeline and Sensor Flange completely empty (coated from step e), adjust the Coarse (C) sensitivity potentiometer such that the SENSOR STATUS LED "just turns" green, and stays. Don't touch the Coarse (C) sensitivity pot again.

NOTE

Clockwise rotation increases sensitivity for both Coarse and Fine potentiometers.

g) Adjust the Fine (F) sensitivity potentiometer counter-clockwise, such that the SENSOR STATUS LED "just turns" red and then back clockwise until it "just turns" green. Mark the position of the Fine (F) sensitivity pot.

h) Fill the pipeline and Sensor Flange with the product that normally flows through the pipeline.

i) Adjust the Fine (F) sensitivity pot counter-clockwise, such that the SENSOR STATUS LED "just turns" red and stays. Mark or mentally note position of screwdriver slot.

j) Adjust the Fine (F) sensitivity pot until the screwdriver slot is midway between the marks from steps g and i. The SENSOR STATUS LED should now be green (Sensor Flange and pipeline filled with product from step h). If not repeat steps a through j. If this procedure exceeds the span of the Fine (F) pot, use the procedure for conductive materials Section 4.2.1.

NOTE

A green SENSOR STATUS indicator denotes presence of material in the Sensor Flange, and a red indicator denotes absence of material in the Sensor Flange, when sensitivity potentiometers are properly adjusted.

4.3 Alarm Action

The L3545 is in the normal “non-alarmed” state when its control relay is energized. The unit is in the “alarm” state when its internal control relay is de-energized. Hence, if the unit lost power, the internal control relay would de-energize, and an “alarm” condition would occur. This type of “Fail-Safe” operation is based on the fact that most major malfunctions, including a power failure, would cause the control relay to de-energize.

1. Fail-Safe Low Operation (Low Acting Alarm):

   The control relay contacts de-energize (shelf state) upon Low Alarm. When process material absence is detected, a Low Alarm condition occurs, and the relay changes from the normal “non-alarmed” (energized) state to the “alarmed” (de-energized) state. Unless otherwise indicated, the L3545 has been factory set for Fail Safe Low operation. Consult the factory if change to Fail Safe High operation is required.

4.4 Delay Operations and Adjustments

Time delay is useful in preventing control relay "chatter" caused by momentary pockets of air or voids in the product flow stream as it passes through the Sensor Flange. 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 L3545 is normally configured at the factory for delayed turn-on alarm mode.

A single turn TIME DELAY pot is provided (see Figure 4-1). Many applications require no time delay. In this case, adjust the TIME DELAY pot to the maximum counter-clockwise direction (zero time delay).

If Time Delay is required, start by adjusting the TIME DELAY pot to approximately 30 percent of its full CW rotation (about 10 seconds). Determine the optimal setting through trial and error.

The maximum standard delay time is 30 seconds full scale. Consult factory for optional delays.

4.5 Dead Band Adjustment

A given dead band adjustment represents a certain physical distance on the active sensor element over which the process material has to move in order for the L3545 to change from a non-alarm to an alarm condition, and vice versa. The dead band adjustment is used in non-conductive process material applications only. The adjustment is used primarily to compensate for minute changes in the electrical characteristics of a low dielectric constant process material.

The physical distance on the active sensing element of this band, for a given dead band adjustment, is greater for less responsive process materials (i.e. low dielectric constant process materials) than it is for high response process materials (i.e. high dielectric constant, or conductive process materials).

When the DEAD BAND pot is turned clockwise, the trip point opens up into an ever-increasing band, above and below the original set point. The control relay would energize at the top point, and de-energize at the bottom point. Accordingly, adjust the Dead Band pot clockwise (see Figure 4-1) just enough to compensate for the adverse process effect in question (i.e. minute electrical conductivity changes in the product flowing in pipeline). Note that the action of the Dead Band adjustment will be defeated in applications where the process liquid is conductive.

4.6 Start Pump Push-button

The START PUMP push-button is used to start a pump when the pipeline is empty. Pushing the START PUMP push-button overrides the normal Low Alarm condition (energizes relays) and turns on the pump. The pump will stay on as long as the push-button is held. It will also stay on after the push-button is released for the duration of a pre-set Time Delay. Once process material contacts the Sensor Flange sensing element, the pump will remain on because of the normal control action of the system. Action of a remotely wired push-button (see Section 3.3.1.c) is the same as that of the front panel push-button.

5 Equipment Service

5.1 Trouble-Shooting Guide

5.1.1 Basic Electronic Checks

1. Basic Electronic Checks

- ✓ The PROBE STATUS LED should be lit to either red or green at all times. If not, check that proper power is applied to the Power terminals.
- ✓ With both the Coarse (C) and Fine (F) sensitivity potentiometers turned fully clockwise, the PROBE STATUS LED should be green. With both potentiometers turned fully counter-clockwise the LED should be red.
- ✓ The PROBE STATUS LED should switch crisply from green to red or from red to green. It should never hang in between in an orange color.

If the unit fails any of the above checks, return the L3545 electronic chassis to the factory for repair or replacement.

5.1.2 Adjustment Problems

- After performing the adjustment procedure, the unit fails to shut off or on properly.

- ✓ Check ground continuity (refer to Figure 3-9).
- ✓ Check that the spring-loaded pin on the Sensor Flange is making contact with the silver pad on the bottom of the electronic circuit board. Refer to Figure 3-8. The pin normally projects about 1-¼ inches above the NPT fitting on the flange. It may be stretched out further with a pair of pliers without causing damage.
- ✓ Be sure that full and empty pipeline conditions really exist when performing the adjustment procedure. It may be necessary to drain the pipeline to remove residual material before performing the empty adjustment.
- ✓ Check for the presence of process fluid in the Sensor Flange hub and in the housing of the L3545 Sensor Head. Leakage of fluid from the pipeline into the hub could produce a constant "presence" condition. If this condition exists, the Sensor Flange is defective and should be returned to the factory for repair or replacement. Likewise, if there is evidence that the electronic circuit boards have been flooded, they should be sent to the factory for testing, and repair as necessary.

NOTE

When performing the adjustment procedure, there should be a noticeable change in the position of the Coarse (C) Sensitivity potentiometer for conductive processes and in the position of the Fine (F) Sensitivity potentiometer for non-conductive processes between the empty and full adjustment points. If there is not, the electronic unit is not sensing any change, probably due to one of the above conditions.

Typically, for conductive processes, the switch point for the Coarse pot for absence will be between 1 and 3 o'clock, and for presence between 9 and 11 o'clock. In other words, when going from absence to presence, the switch point will shift in the counter-clockwise direction.

- Unit switches correctly once or several times and then fails to switch correctly.

- ✓ A progressively thicker coating may be building up inside the pipeline. This would result in a narrower span between the empty and full positions of the Sensitivity potentiometer when performing the adjustment procedure.

  Solution: This condition will require performing the adjustment procedure over again when the coating is at its thickest point.

- ✓ There may have been a change in the dielectric constant of the process material. This would change the flow of RF current through the sensor, effectively shifting the switch point.

  Solution: RF impedance technology is designed to operate with materials having a constant dielectric constant (therefore, a constant RF conductivity). It may be possible, through trial and error, to find a switch point that works for some changes in dielectric constant; but extreme changes, like oil to water, may be impossible to compensate for. Generally speaking, a unit adjusted for a low dielectric constant material will switch correctly for a higher dielectric constant material or for a conductive material. However, this could be negated by changes in the coating characteristics.

3. Problem Analysis

The connection points for the 3-wire cable connecting the L3545 Control Unit to its Sensor Head are convenient for troubleshooting purposes using a DC voltmeter.

a) Power Supply Check

Place the negative lead of the voltmeter on TB1-12 of the Control unit (bare wire - ground). Place the

positive lead on TB1-10 (black wire - +9.5 Vdc supply). Meter should read +9.5 Vdc +/- 0.25 Vdc. A low reading could indicate low power line voltage, failure in the electronic circuitry, a short in the 3-wire cable or a ground loop in the wiring.

To test for ground loop, remove ground wire from TB1-12. With voltmeter still on TB1-12 and TB1-10, see if reading rises to 9.5 Vdc. If it does, there is a short or a ground loop in the cable or the L3545 Sensor Head. If voltage remains low, the problem is in the L3545 Control Unit.

b) Sensor Head / Sensor Flange Check

If +9.5 Vdc is present per step a, place negative voltmeter lead on TB1-12 (bare wire - ground) and the positive lead on TB1-11 (white wire - signal). A dc voltage should be present. The level of this voltage is inversely proportional to the RF conductivity between the sensor flange sensing element and the ground reference. There should be a noticeable change in this voltage between the empty and full pipeline conditions. Actual voltages will vary depending on pipeline geometry, process material conductivity or dielectric constant and the thickness of the coating. A typical voltage change for a water-based process might be 4.0 Vdc dry and 0.5 Vdc wet. The difference in voltage will be less for non-conductive processes and conductive processes with heavy coatings.

- If this change is present, Sensor Head and Sensor Flange are functioning correctly.
- If the voltage level is not changing and is extremely high or low (9.5 V or 0.0 V), there could be a short in the Sensor Head or in the wiring.
- If a reasonable voltage is present (for example, 2.5 V) but not changing, it is possible that the condition inside the pipeline is not changing.
- A constant high voltage (about 4.5 V) could indicate that the spring-loaded pin on top of the Sensor Flange is not contacting the bottom of the Sensor Head circuit board or a failure of the process material inside the pipeline to contact the Sensor Flange sensing element.
- A constant low voltage (0.5V) could indicate a constant presence condition inside the pipeline. It could also indicate the presence of fluid on the Sensor Flange hub, shorting the spring-loaded pin to ground.

5.2 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 that 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 service technicians are available from the factory on a time/expense basis to assist in these instances.

5.3 Warranty Statement

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