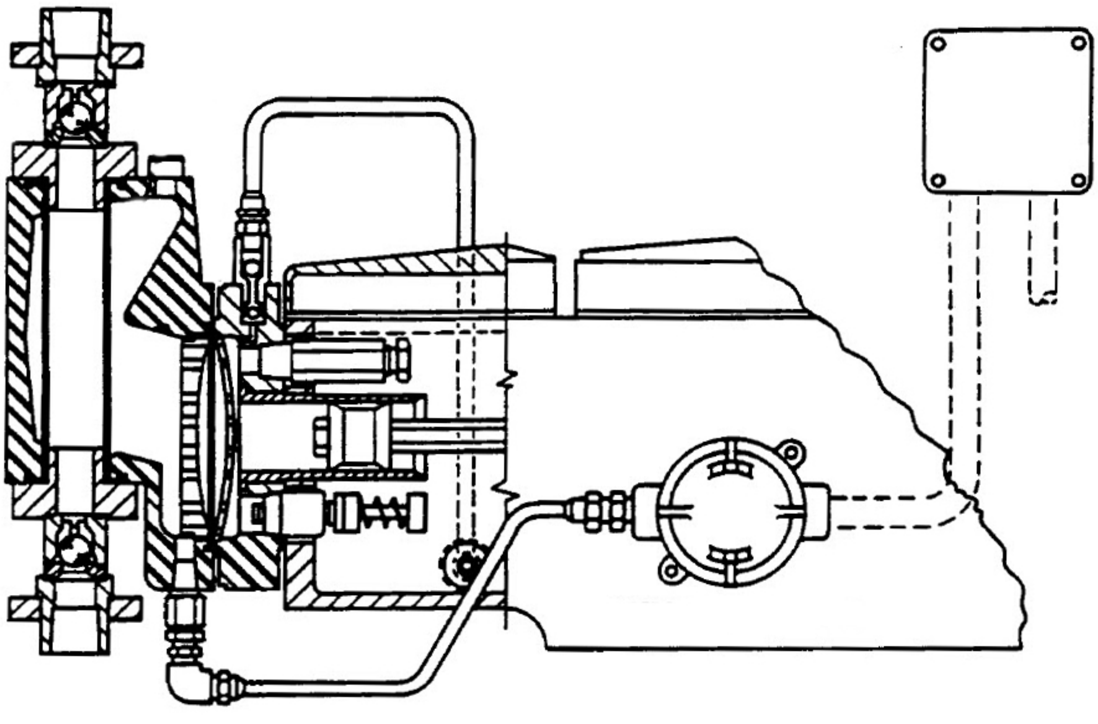
PULSAFEEDER®
ENGINEERED PRODUCTS

Installation, Operation & Maintenance Manual



CHEMAlarm
LEAK DETECTIONI

Bulletin: IOMS-PUL-1011

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1. PRINCIPLES OF OPERATION

1.1 General Description

(Figure 1)

The ChemAlarm monitors the electrical conductivity of the intermediate liquid in a double-diaphragm metering pump.

Monitoring is performed by a dual-electrode electrical probe installed in the intermediate chamber, and associated electronic circuitry. The intermediate liquid is selected to have a different conductivity from the process liquid, the hydraulic liquid, or both. Failure of the primary (process) diaphragm, or the secondary (hydraulic) diaphragm, or both, results in contamination of the intermediate chamber by a foreign liquid, changing the conductivity within the chamber accordingly. This change is sensed by the circuit as an indicator of diaphragm failure.

In a typical installation, the conductivity probe is wired at the factory to a junction box mounted on the pump. A control box containing the control module and output relay (or auxiliary contactor, if specified), is mounted remotely and wired to the junction box at the time of pump installation.

ChemAlarm output is communicated by relay or contactor operation and is typically used to signal an alarm and/or to shut down the pump in the event of diaphragm failure.

1.2 Process Specifications

ChemAlarm installations are of a custom nature, to meet the requirements of specific applications. These requirements, or process specifications, along with the resulting system specifications, are established prior to use; however, it is important for the user to be familiar with them in order to adapt to changes in process. Process specifications are:

- Conductivity of the process liquid
- Specific gravity of the process liquid
- Diaphragm monitored (Typically the primary, or process diaphragm)
- Output signal

1.3 System Specifications

These specifications are developed in response to process specifications. They define the system supplied.

Intermediate Liquid Selection
- Conductivity
- Specific gravity
- Miscibility with product liquid

Sensor Probe Location
- Top
- Bottom
- Midpoint

Sensing Mode
- Forward
- Reverse

Conductivity Range
- Standard

- Extended

Output

- Relay
- Contactor

1.4 Process Description

Since the product diaphragm is the primary containment barrier and since it is more likely to fail than the secondary diaphragm, most installations are designed to detect primary diaphragm failure. In some instances such a design will incidentally detect secondary diaphragm failure, but this is typically not the case. This discussion deals with detection of primary diaphragm failure; the same principles apply to the secondary diaphragm.

The unit of conductivity is microsiemens per centimeter. Liquid conductivity ranges from nearly a million for certain acids to nearly zero for certain oils.

To facilitate detection, the intermediate liquid is selected to have as different a conductivity as possible from the process liquid. The selection is also influenced by chemical compatibility and viscosity.

Where the conductivity of the process liquid is greater than that of the intermediate liquid, the forward mode of sensing is applied: an increase in conductivity triggers detection. Where the conductivity of the process liquid is lower, the reverse of sensing is applied: a decrease in conductivity triggers detection.

The probe can be situated at the top, bottom, or midpoint of the intermediate chamber.

Where the process and intermediate liquids are immiscible or of significantly different specific gravities, change is likely to occur first at the top or bottom of the intermediate chamber. Detection is enhanced by positioning the probe in one of these locations, depending on the specific gravities.

For example, consider an application in which nitric acid, 5% by weight, is being pumped, and for which ethylene glycol solution, 50% by weight, has been selected as an intermediate liquid. Temperature is 25°C. Forward mode sensing has been specified.

The circuit will be calibrated to the ethylene glycol, which has an approximate conductivity of 2150 microsiemens/cm. Since the nitric acid has an approximate conductivity of 275,000 microsiemens/cm, over a hundred times the initial level, effective detection can be anticipated. Note that forward mode sensing is essential as reverse mode sensing detects only a decrease, but not an increase, in conductivity.

1.5 Circuit Operation

A 24 VAC potential is applied across the two probes submerged in the intermediate chamber. The frequency of this signal is the same as that of the power supply, 50 or 60 HZ. A minute current, typically 500 microamperes, is conducted between the probes by this liquid in the chamber. Probe current is circuit-limited to a maximum of 10 milliamperes; a continuous short or ground will cause no harm.

The sensing circuit is calibrated to the normal operating condition, after which it will detect and signal a change in conductivity. The circuit will either sense an increase in conductivity (forward model or a decrease (reverse mode).

2. INSTALLATION

Connect AC power and probe leads per the pertinent wiring diaphragm (Fig. 2 or Fig. 3). Output contact ratings are given under "Specifications" below.

To minimize electrical interference with the control signals, follow the procedure below for wiring of the probe leads between junction box and control box.

1. Isolate lead wires from power wiring. Do not run lead wires in the same conduit as power wiring.
2. All lead wires should be shielded and the shields grounded.
3. Dual control cable within the same shield should not exceed a length of twenty feet. Separate lead wires, individually shielded, can be used up to a length of 100 ft.
4. If the circuit board is installed as a component within an enclosure containing sources of electromagnetic interference, shield it with a grounded cover.

3. START-UP

3.1 Calibration

Calibration adjusts the conductivity-sensing circuit so that a slight change in conductivity in the desired direction, due to diaphragm leakage, triggers the alarm.

Initial calibration is the only procedure required at startup.

1. The control box must be powered and the intermediate chamber must be filled and purged of air. It does not matter whether or not the pump is operating.
2. Liquid conductivity varies significantly with temperature, so that an increase beyond calibration temperature can trigger a false alarm with a forward- mode control. A temperature decrease can similarly affect a reverse-mode control. Therefore, final calibration should be performed at normal operating temperature.
3. Calibration will cause several alarm signals. If this is unacceptable, disconnect power to the output circuits and disconnect the lead to output terminal "NO" (standard relay output, Fig. 2) or to output terminals T1 and T2 (contactor output, Fig. 3).
4. If the alarm has been deactivated per step (3) above, connect a multimeter, set in the continuity or resistance mode, to terminals "NO" and "C1" (Relay Output) or L1, and T1, (contactor output). In both cases, an open contact corresponds to the normal operating condition and contact closure corresponds to the alarm condition.
5. The calibration potentiometer is situated on the control circuit board inside the control box. It is the only potentiometer on the board.
6. Turn the potentiometer fully counterclockwise, for minimum sensitivity.
7. Slowly and carefully turn the potentiometer clockwise, increasing sensitivity, until the alarm signal is triggered. This references the circuit to the intermediate liquid. Decrease sensitivity by backing off the potentiometer 1/8 to 1/4 turn in the counterclockwise direction. This sets the circuit to detect a slight change of conductivity in the specified direction.
8. If the intermediate liquid has a very low conductivity, potentiometer adjustment will not trigger the alarm. In this case, leave the potentiometer in the most sensitive, or fully clockwise, position.
9. Replace signal leads and restore signal power, as necessary.

4. MAINTENANCE

4.1 Periodic Checks

System operation should be confirmed on a regularly scheduled basis. Check calibration (see "Calibration"), which also verifies alarm circuit operation, except for an intermediate liquid of very low conductivity. In the latter case, confirm alarm circuit operation as follows:

1. For a forward mode system, simulate the alarm condition by momentarily shorting the probe circuit. Connect a test lead to terminal "H" on the circuit board and short to terminal "C" (or "CM") with a probe on the other end of the lead.
2. For a reverse mode system, simulate the alarm condition by opening the probe circuit. Momentarily disconnect the lead from either terminal "H" or "C" (or "CM") on the circuit board.

4.2 Conax Probe Disassembly

(See Figure 4)

1. Drain the intermediate liquid to a level below the probe. Refer to the pump operation bulletin.
2. Unscrew the tubing nut (1) and free the metal protective tubing from the elbow fitting (2).
3. Disconnect the wire leads at the junction box and withdraw them from the protective tubing to free up the probe assembly. The wire can be reused, provided sufficient length remains after trimming.
4. Unscrew bulkhead fitting (10) from the intermediate head.
5. Unscrew gland fitting (3) from the bulkhead fitting.
6. Straighten or clip the two protruding probe wires.
7. Remove all parts and inspect for damage.

4.3 Conax Probe Assembly

(See Figure 4)

1. Strip about 1/4" of insulation from both wire ends. Ensure that the lengths of the probe wires are sufficient to reach the termination point in the junction box.
2. Insert the wires through the tubing nut (1) and elbow fitting (2) down flush against the bulkhead fitting. Spread the wires into an included bottom angle of about 60° to retain the insulator. Trim the wire ends to V." approximate length. Verify that they do not contact one another and that neither will contact the walls of the probe port in the intermediate head.
3. Screw gland fitting (3) into the elbow fitting and tighten.
4. 4. Position the insulation end of both stripped wire leads even with the top of the gland fitting and insert the wires into the long insulator (4). Slide the insulator down, pushing the tubing, until the insulator extends about ¼" above the gland fitting.
5. Position antirotation set pin (6) into the blind end of the external groove in metal sleeve (5). It can be held in position during assembly by a metal- to-metal adhesive.
6. Insert the wire ends into the sleeve, with the open end of the groove in the sleeve pointing down, and lower the sleeve around the long insulator (4) until it bottoms against the gland fitting.
7. Insert the wire ends in short insulator (9) followed by Teflon gland seal (8) with beveled end up. Slide the seal down flush against sleeve (5).
8. Insert the wire ends in short insulator (9) and slide the insulator down flush against the gland seal.

9. Slip bulkhead fitting (1), straight threads down, over the assembly, taking care to engage set pin (6) in the interior groove in the bore of the bulkhead fitting. Screw the bulkhead fitting into the gland fitting (3) and tighten.
10. Insert the wire ends into short insulator (11) and slide the insulator. Install the probe assembly in the intermediate head and tighten the bulkhead fitting. Spread the wires into an included bottom angle of about 60° to retain the insulator.
11. Trim the wire ends to 1/8” approximate length. Verify that they do no contact one another and that neither will contact the walls of the probe port in the intermediate head.
12. Install the probe assembly in the intermediate head and tighten the bulkhead fitting (10) only.
13. Using a multimeter, verify that the probe leads are not shorted to one another and that neither is grounded to probe assembly or intermediate head.
14. Install the protective tubing. Install and terminate the wire leads in the junction box.
15. Refill and plug the intermediate chamber. Prime and start the pump in accordance with procedures in the pump operations manual.
16. Check calibration (see "Calibration").

4.4 Pulsafeeder Probe Disassembly

(See Figure 4A)

1. Drain the intermediate liquid to a level below the probe. Refer to the pump operation bulletin.
2. Unscrew the tubing nut (1) and free the metal protective tubing from the elbow fitting (2).
3. Disconnect the wire leads at the junction box and withdraw them from the protective tubing to free up the probe assembly. The wire can be reused, provided sufficient length remains after trimming.
4. Unscrew bulkhead fitting (8) from the intermediate head.
5. Unscrew gland fitting (3) from the bulkhead fitting.
6. Straighten or clip the two protruding probe wires.
7. Remove all parts and inspect for damage.

4.5 Pulsafeeder Probe Assembly

(See Figure 4A)

1. Strip about ¼” of insulation from both wire ends. Ensure that the lengths of the probe wires are sufficient to reach the termination point in the junction box.
2. Insert two or three inches of the wires through the tubing nut (1) and elbow fitting (2).
3. Screw gland fitting (3) into the elbow fitting and tighten.
4. Position antirotation set pin (5) into the blind end of the external groove in compression sleeve (4). It can be held in position during assembly by a metal-to-metal adhesive.
5. Insert the wire ends into the compression sleeve and lower the sleeve until it bottoms against the gland fitting.
6. Insert the wire ends in one insulator (6), followed by Teflon gland seal (7). Slide the insulator and seal down flush against sleeve (4).
7. Insert the wire ends in the other insulator (6) and slide the insulator down flush against the gland seal.
8. Slip bulkhead fitting (8), straight threads down, over the assembly, taking care to engage set pin (5) in the interior groove in the bore of the bulkhead fitting. Screw the bulkhead fitting into the gland fitting (3) and hand tighten. Pull the wires back through

from the tubing nut end until only a 1/8” extension is left. Tighten the bulkhead and gland fitting together.

9. Spread the wires into an included bottom angel of about 60°.
10. Trim the wire ends to 1/8” approximate length. Verify that they do not contact one another and that neither will contact the walls of the probe port in the intermediate head.
11. Install the probe assembly in the intermediate head and tighten the bulkhead fitting (8) only.
12. Using a multimeter, verify that the probe leads are not shorted to one another and that neither is grounded to probe assembly or intermediate head.
13. Install the protective tubing. Install and terminate the wire leads in the junction box.
14. Refill and plug the intermediate chamber. Prime and start the pump in accordance with procedures in the pump operations manual.
15. Check calibration (see “Calibration”).

5. TROUBLESHOOTI NG

DIFFICULTY	PROBABLE CAUSE
Failure to alarm	No power to circuit board
	No power to alarm circuit(s)
	Wiring discontinuity in control box
	Probe leads shorted, open, or grounded
	Relay or contractor failure
	Calibration (consider temperature change beyond the limit of previous calibration)
	Corroded probes
	Circuit board failure
False alarm	Probe leads shorted, open, or grounded
	Calibration (consider temperature change beyond the limit of previous calibration)
	Corroded probes
	Circuit board failure
Circuit board check	NOTE: Relay operation is audible and can be observed through the transparent cover
	Shut off power to supply terminals “L1” and “L2”
	Disconnect probe leads from terminals “H” and “C”
	Turn the calibration potentiometer fully counterclockwise to stop, then ¼ turn clockwise
	Apply power to terminals L1 and L2, the relay should not energize
	Apply a jumper between terminals “H” and “C”, the relay should energize, remove the jumper, the relay should de-energize
	Turn the calibration potentiometer fully clockwise. The relay should remain de-energized

	For models LCS and LCR, the relay should energize when a 9.1 K ohm or 10 K ohm resistor is connected between terminals “C” and “H”
	For models LHS, the relay should energize when a 2.7 megohm, or 3.0 megohm resister is connected between terminals “C” and “H”

6. REPLACEMENT PARTS

When ordering replacement parts, always specify:

1. Pump model and serial number (stamped on pump nameplate) e.g., Model 7120-S-AE, Serial No. 8604146-1.
2. The part name and number from the Parts List.

7. SPECIFICATIONS

Power	120 VAC, single phase, 50/60 Hz *OR* 240 VAC, single phase, 50/60 Hz (optional)		
	Maximum consumption: 3 watts		
Control signal	24 VAC, 50/60 Hz (frequency same as power supply)		
	Typical current: 500 microamperes		
	Maximum current: 10 mA (as limited)		
Control options	Model	Resistance Range	Mode
	LCS	100,000 ohms	Forward (actuates and below upon increase in conductivity)
	LCR	Up to 100,000 ohms	Reverse (actuates upon decrease in conductivity)
	LHS	3 megohms	Forward (actuates and below upon increase in conductivity)
Load contacts (LCS & LCR)	SPDT (single pole double throw)		
	10 amperes, non-inductive		
	¼ HP at 120 VAC		
	1/3 HP at 240 VAC		
Load contacts (LHS)	SPDT (single pole double throw)		
	10 amperes, non-inductive		
	1/6 HP at 120 VAC		
	1/3 HP at 240 VAC		
Load contacts (LCS, LCR, or LHS, with auxiliary contactor)	DPST (double pole, single throw), normally open		
	1 HP at 120 VAC		
	2 HP at 240 VAC		
Control box ambient temperature range	32°F to 140°F		
Control box enclosure	NEMA 3 (standard)		
	NEMA 4 (optional)		
	NEMA 7 (optional)		

8. ILLUSTRATIONS

8.1 Typical Pump Installation

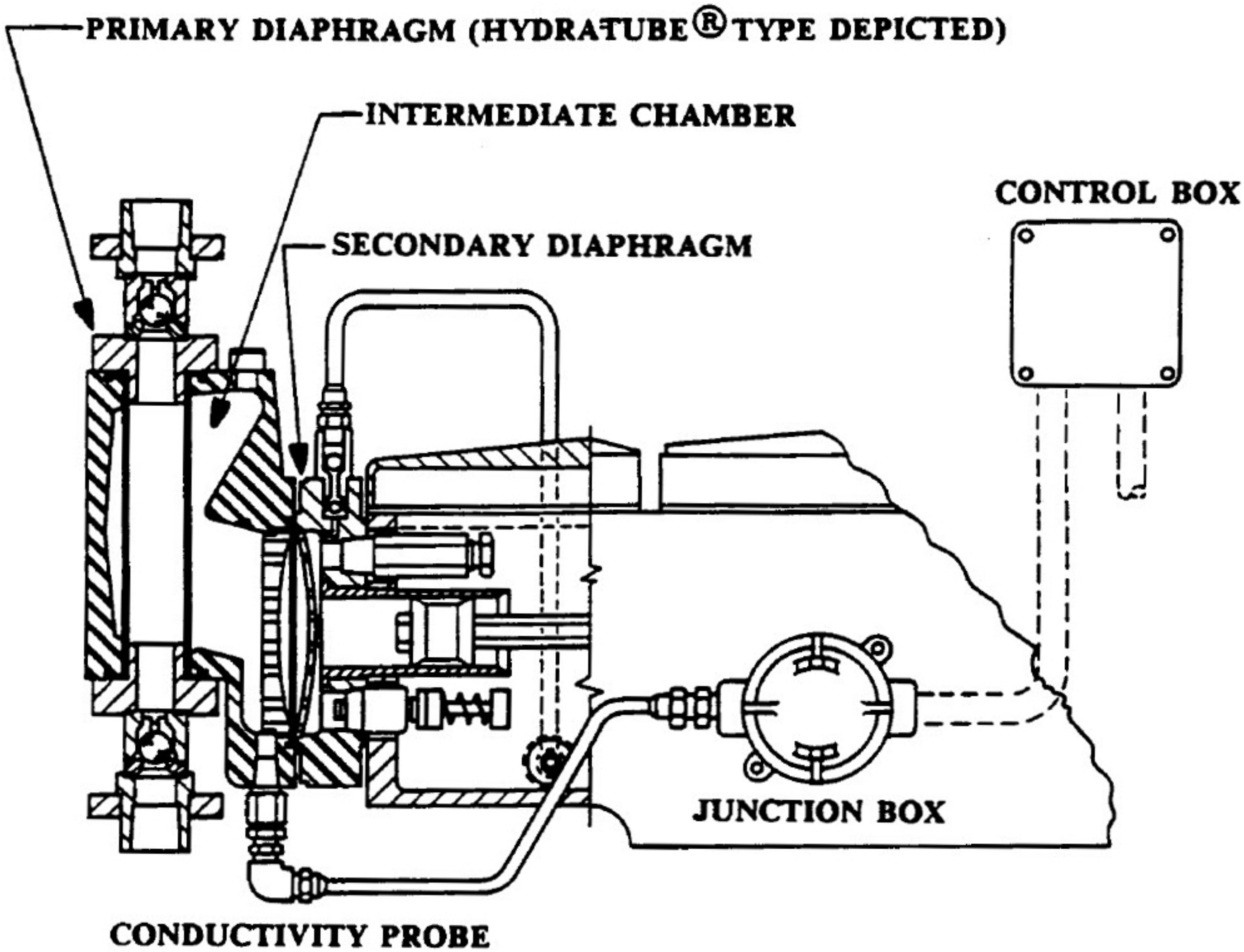


Figure 1

8.2 Wiring Diagram-Standard Relay Output

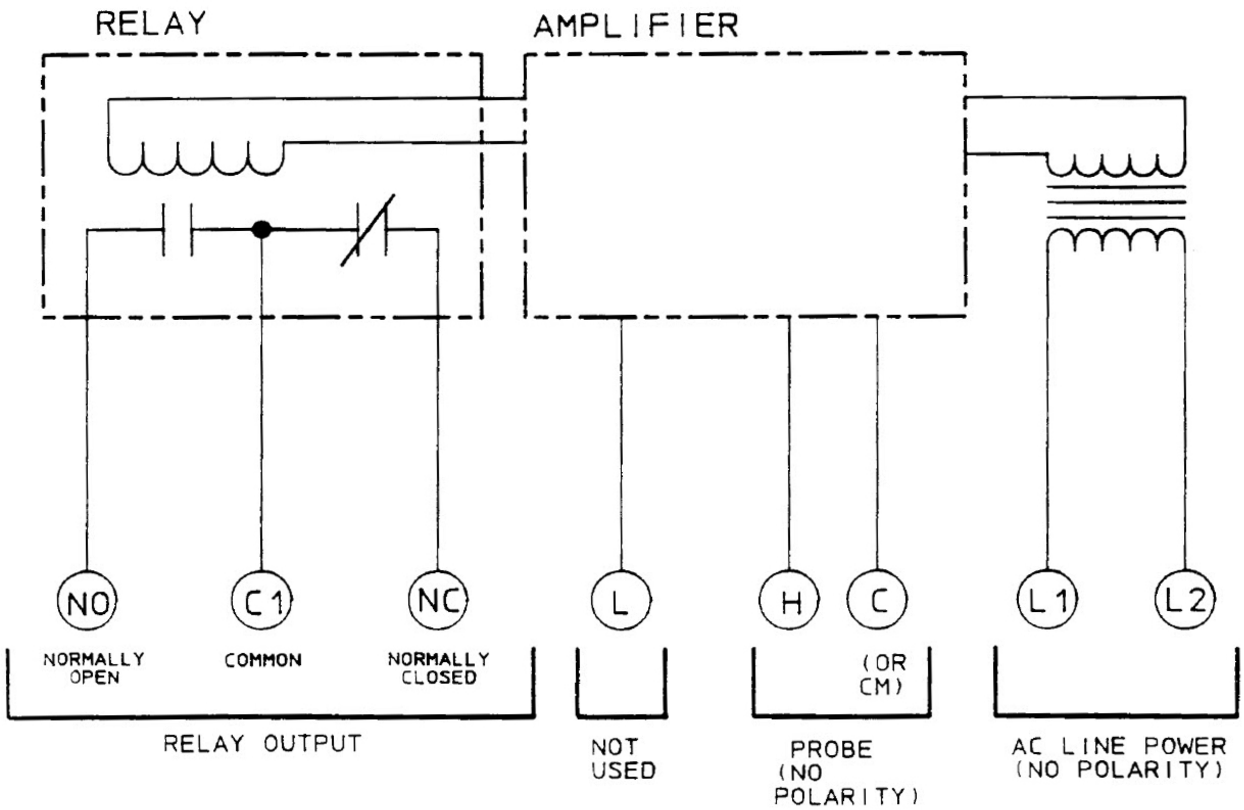


Figure 2

8.3 Wiring Diagram-Contactor Output

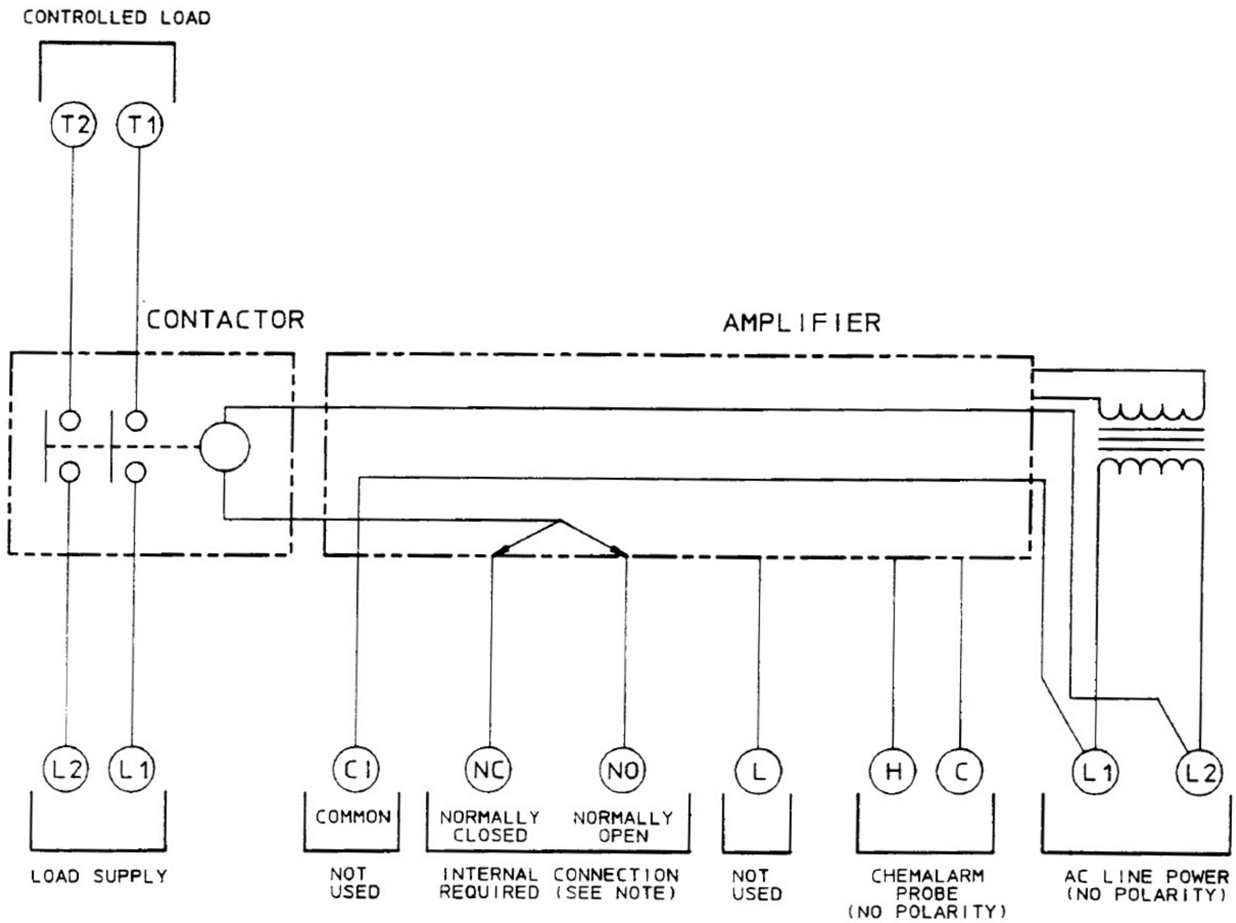


Figure 3

8.4 Conax Probe Assembly

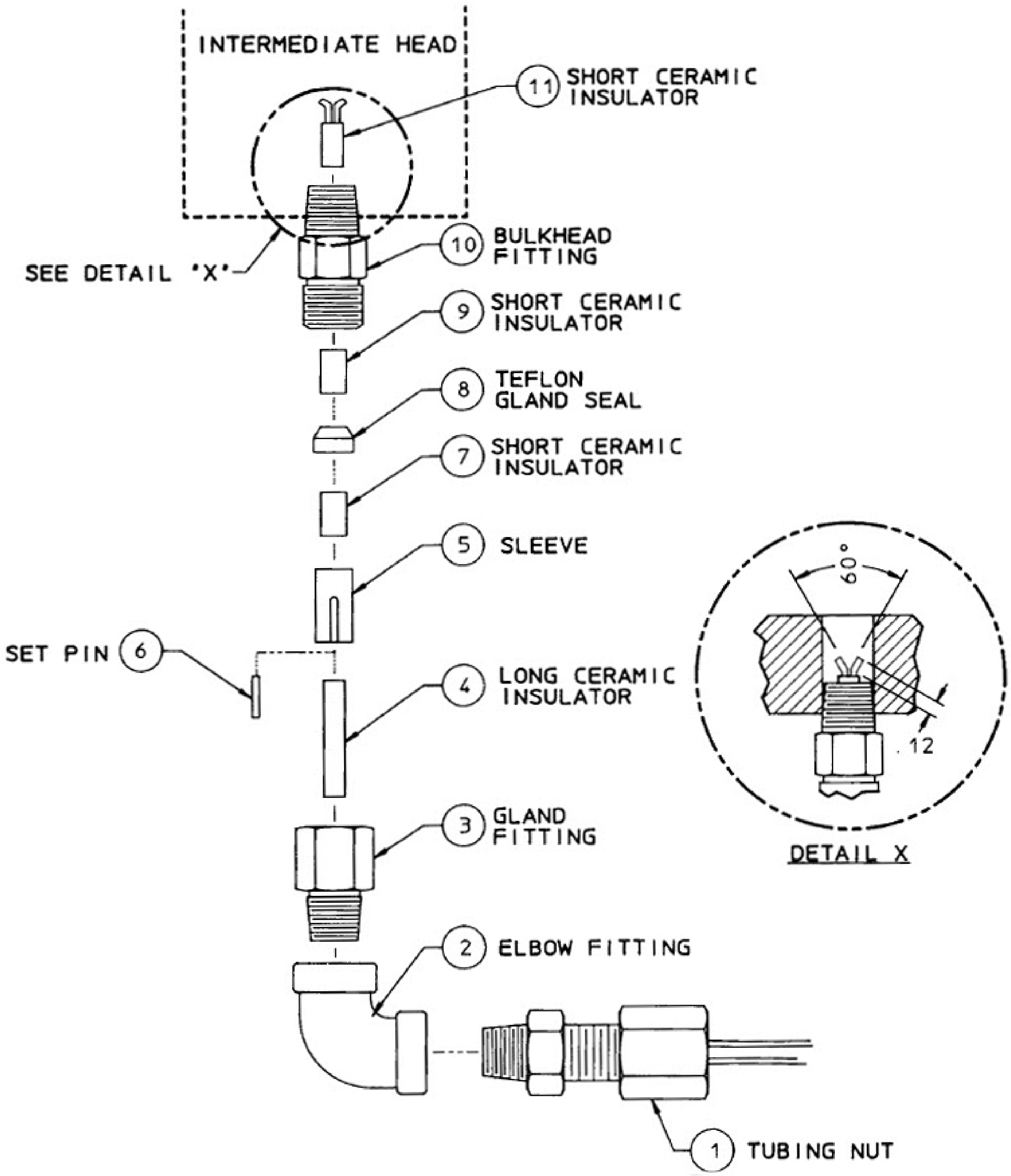


Figure 4

8.5 Pulsafeeder Probe Assembly

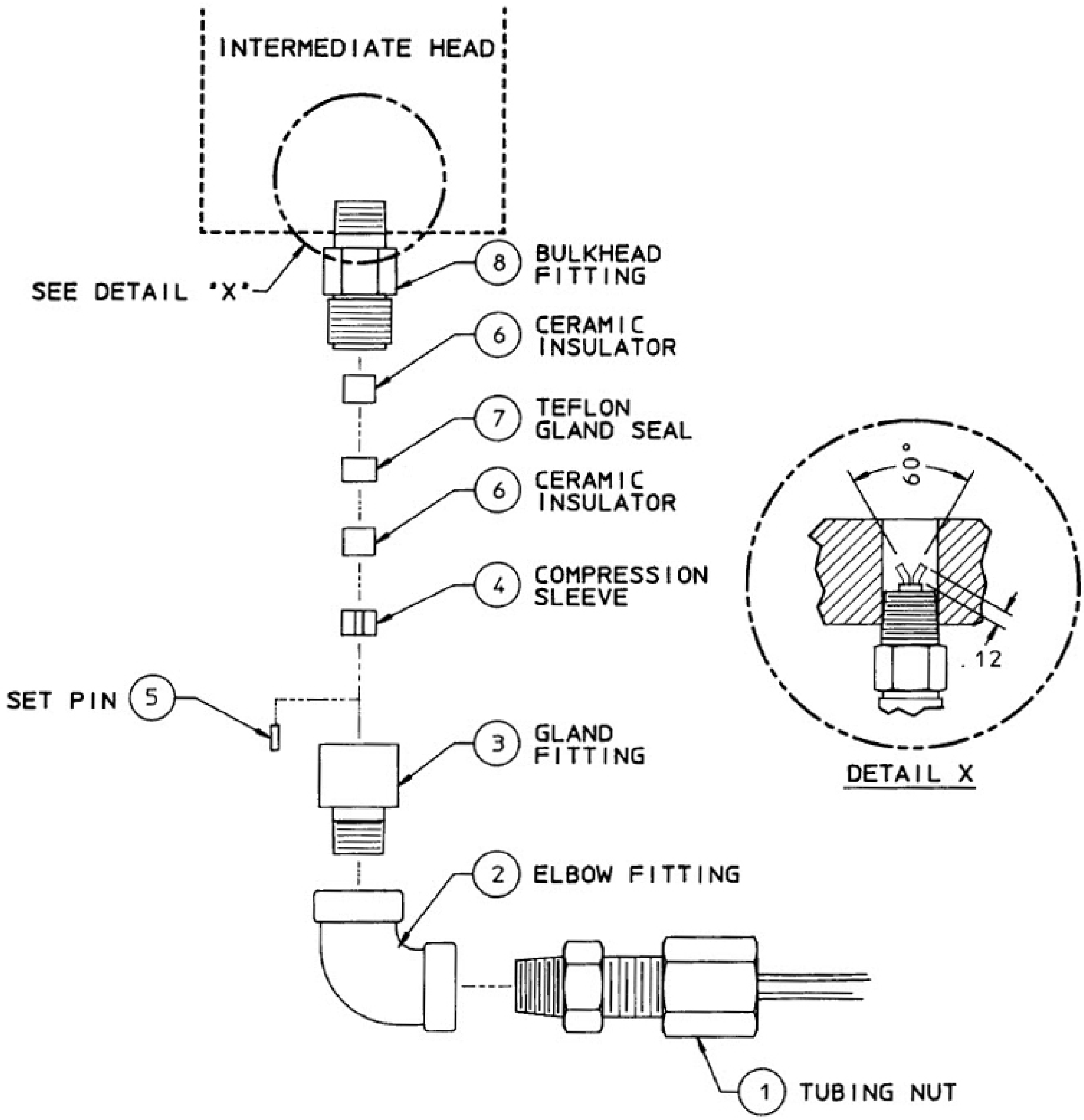
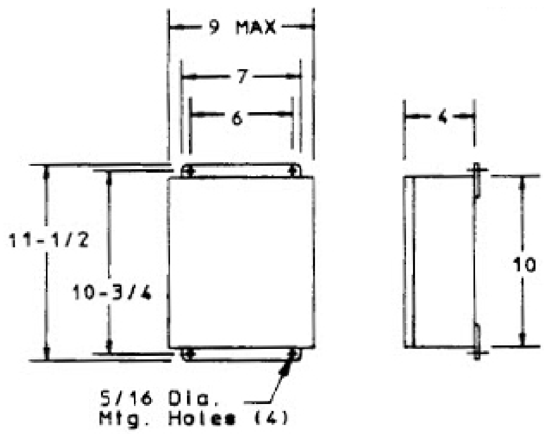
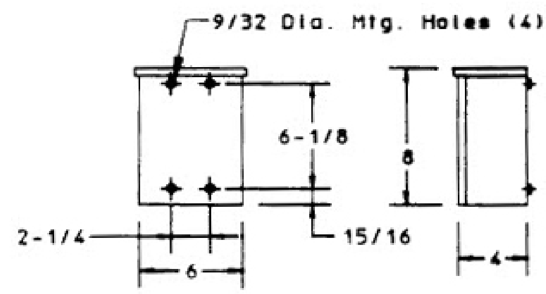


Figure 4a

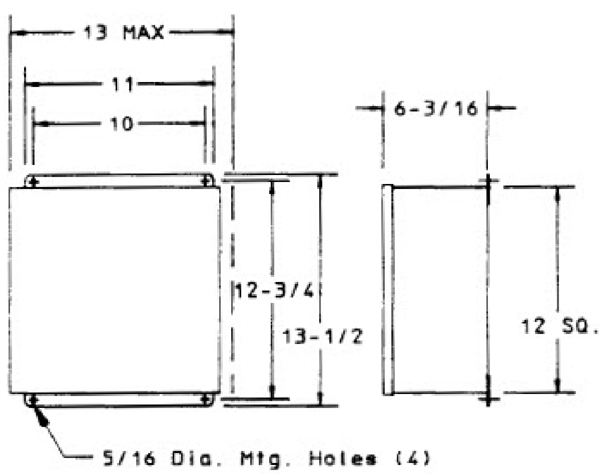
8.6 Enclosures



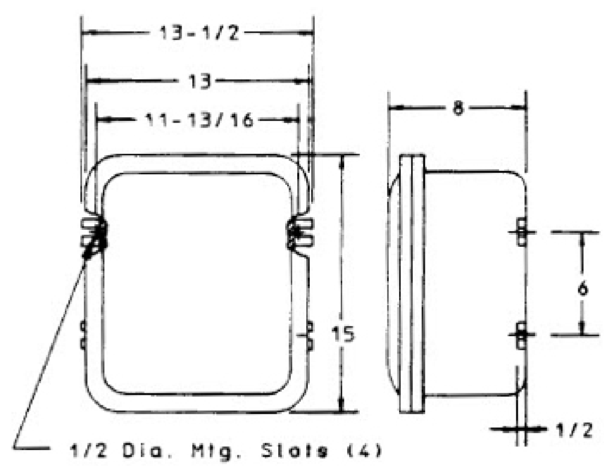
NEMA 4 (STANDARD RELAY OR
AUXILLARY CONTACTOR)



NEMA 3 (STANDARD RELAY)

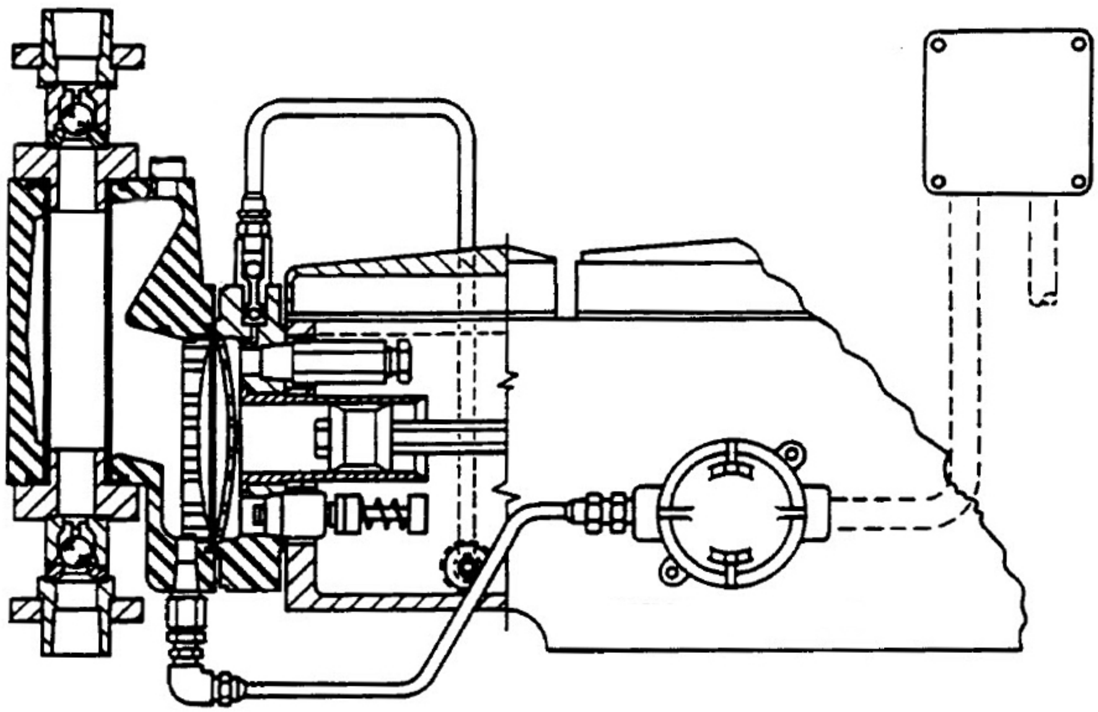


NEMA 4 (INTRINSICALLY SAFE)



NEMA 7 (INTRINSICALLY SAFE)

Figure 5



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Pulsafeeder, Inc.
A unit of IDEX Corporation
2883 Brighton Henrietta Town Line Road
Rochester NY 14623
+1 (585) 292-8000
www.pulsa.com
pulsa@idexcorp.com