HB03

IBA002
4/88

HUCKEPACK AND MONOVAC INSTRUMENTATION

All Huckepacks and Monovacs are now being delivered with several additional instruments designed specifically to protect the pumps from conditions which can result in failure to the pump.

I. Coolant Water Level - All pumps contain a water coolant sensor in the form of a Model 10 Level Lance. This is located in the top of the upper stage or as a part of the cooling water exit piping. The sensor provides a normally closed switch closure when the coolant level is adequate. This unit requires 110V 60 Hz power from a control circuit transformer located in the motor control center. Coolant level must be high enough to immerse the sensor probe at all times or the pump will not run. (Switch will open). All circuits for this sensor are contained in a Division I explosion proof electrical enclosure.

II. Oil Level Switch - In the oil reservoir of each pump is a sealed float switch which is normally closed whenever the oil level is above approximately 10% of capacity. This switch opens when the lubricating/sealing oil is below this level and stops the pump. For operations of the pump in an explosively hazardous atmosphere, the oil reservoir is modified for the installation of a Model 4302 Madison float switch, (or equivalent), by means of a special adapter flange.

III. Exhaust Temperature Sensor - The incorporation of an exhaust temperature sensor is to provide protection from operation under a temperature overload condition which can result from any of the following:

1. Restricted exhaust flow due to exhaust check valve and/or oil mist eliminators becoming plugged; or other external exhaust manifold restrictions.
2. Unusually high inlet vapor temperatures.
3. Insufficient coolant flow (002 Models) or too high radiator temperatures (014 Models); or too high ambient temperatures (014 Models).

The maximum exhaust manifold discharge pressure should be less than 2 psig under continuous operating conditions. Brief pressure excursions to 5 psig are acceptable (less than 5 minutes). If any downstream condition results in abnormally high pressure, the exhaust temperature will rise rapidly, be sensed by the sensor, and stop the pump.

The exhaust temperature is measured by a sealed bulb type sensor housed in a heat sink on the exhaust flange, and causes a normally closed switch to open and stop the pump whenever the exhaust temperature rises above the nominal factory set point of 220°F. Actual gas temperature may be 20°F higher than this, dependent on gases flowing (K values). The standard control used (United Electric Model D22BC) has an adjustable set point which can be set to any value between 50°F and 300°F. It is not recommended that this be set above 250°F under any circumstances not authorized by the factory, because pump damage can result from operation with such exhaust gas temperatures. For operation of the pump in an explosively hazardous atmosphere, a UE Model E110-7BS (or equivalent) control is used.

HUCKEPACK & MONOVAC INSTRUMENTATION (cont'd)

IV. Interstage Pressure Sensor (Huckepack only) - Sustained operation of a Huckepack pump at an inlet pressure condition above 200 Torr (0 - 22" Hg vacuum) can result in an imbalance of the compression work load between the two stages. This can result in an overheating condition in the upper (first) stage, and/or premature failure of the lower (second) stage. To protect from these conditions, an interstage absolute pressure switch has been installed. This switch (United Electric H54-9502) is factory set to be closed in an operating pump when the inlet pressure is 150 Torr or less (24" - 30" Hg vacuum). When the inlet pressure is 150 Torr, or less, the interstage pressure is between 300 Torr and 500 Torr, dependent on which Model Huckepack is being used.

The actual set point of the switch at the interstage will be approximately 500 Torr (10" Hg vacuum) for all Huckepack models. For operation of the pump in an explosively hazardous atmosphere, a UE Model J110-146 (or equivalent) control is used.

The incorporation of this type of fail-safe protection requires several special considerations in the application of Huckepacks to industrial applications.

1. Start-up requires overriding this protection with the start button, or alternative override.

2. The pump should always be installed with an inlet throttle valve which at start-up should be in the closed position.

3. After the pump has been started and is at moderate temperature (warm to the touch), open the throttle valve to permit a maximum pump inlet pressure of 150 Torr (24" Hg vacuum). This will prevent an overload condition from occurring. As the system pressure and/or the gas inlet load decreases, the throttling valve may be further opened to the full open position. It is strongly recommended that a vacuum gauge be installed between the throttle valve and the pump inlet to make this start-up procedure easy.

4. Overload conditions which can result in increased inlet pressure beyond the capacity of the pump to sustain the inlet below 150 Torr (30" - 22" Hg vacuum) are:

    4.1 Increased process gas load.
    4.2 Insufficient pump design capacity.
    4.3 Increased system in-leakage (air leaks).
    4.4 Throttle valve position too open for any of the above.
    4.5 Inoperative (stuck) vanes in bottom stage. For this condition, mechanical maintenance may be required. Consult the factory.

V. All of the above instruments are wired electrically in series with the pump motor starter to result in pump shutdown whenever their limits are exceeded. Additional protection may be advisable in particular installations such as a liquid level sensor on inlet gas-liquid separators on the inlet. If an exhaust oil mist eliminator is used, high oil level shut-down protection should be provided. It also may be desirable to incorporate into an installation, additional sensors to provide pre-shut-down warning alarm conditions to alert operators to alter operating conditions to prevent these overload conditions from resulting in a pump shut-down. Another suggested monitoring device is an ammeter. Deviations from normal load conditions are normally reflected in current draw as a forerunner of impending trouble.

VI. Typical wiring schematics (A 1009E for Huckepacks & A 1146B for Monovacs) are attached showing the details of the wiring of the above switches I thru IV with the start button override to permit start-up. A UL approved barrier (GEM Model ST 22445) is installed to provide an intrinsically safe wiring condition. All pumps are equipped with this barrier and with the barrier installed the total power available across the switches is limited to 0.9 milliwatt or less. This type of "explosion-proof" installation requires locating the motor control center in a non-hazardous location.

HUCKEPACK AND MONOVAC INSTRUMENTATION

INSTALLATION INSTRUCTIONS

All Huckepacks and Monovacs are now being delivered with the instrumentation installed. The following instructions are for the purpose of information for the wiring in an explosively hazardous area and retrofitting of pumps now in the field.

I. Mechanical.

1. Mount thermal block to exhaust check valve assembly. Threaded inlet hole goes on motor side.

   1.1 Monovac pumps - Braze block to cover of check valve assembly.

   1.2 Huckepack pumps (with turned-down bottom stage). Bolt the block to the check valve assembly above the flange connection to the muffler or oil mist eliminator using 2M8x45 bolts, nuts and lock washers.

   1.3 Huckepack pumps (without turned-down bottom stage).

      1) Disassemble check valve and braze block to bottom of assembly, near middle, with thermal block parallel to pump rotor axis,

         or

      2) Mount block by strapping it to the check valve assembly by using straps and bolts per Drawing A 1021A.

   1.4 Turned down bottom stage is used on pumps above the following serial numbers:

Model	Serial No.
429	1000
433	1000
437	2000
441	1000
445	100

2. Mount temperature switch (UE Type E54-Model D22BC - standard; UE Type E110-7BS - explosion) to pump frame on exhaust side using 2-6Mx32 bolts, nuts and lock washers. Install temperature sensor in thermal block using packing strip and reducing bushing supplied.

HUCKEPACK & MONOVAC INSTRUMENTATION - INSTALLATION INSTRUCTIONS

3. On Huckepacks, mount interstage pressure switch* (UE Type H54 Model 22 - standard; UE Type J110-126 - explosion proof) as follows:

   3.1 Remove 3/4" NPT interstage plug.

   3.2 Install 3/4" NPT x 2" L nipple.

   3.3 Install 3/4" x 1/4" NPT reducing bushing in branch of a 3/4" NPT tee.

   3.4 Install pressure switch in the 1/4" NPT connection.

   3.5 Install switch-tee assembly on 3/4" NPT nipple at interstage port, such that switch faces upward.

   3.6 Reinstall 3/4" NPT plug, which had been removed from interstage port.

   3.7 If desired, an inexpensive 0 - 30" Hg vacuum gauge can be installed at this plug position. The gauge then provides a rough check on the setting of the vacuum switch and also gives visual reassurance of satisfactory bottom stage performances.

*NOTE: This switch is not required on Monovac pumps.

4. Mount GEM Model ST 22445 Safe-Pak inside of motor control center. This requires drilling two (2) holes in side of control center. Attach GEM using 2-6-32 bolts, nuts and lock washers.

5. Mounting of Level Lance - on 002 and 014 pumps: install the Level Lance head and short probe at either of the following locations:

   5.1 Remove the 3/4" NPT plug at top stage upper left corner of pump jacket (when facing the pump inlet).

   5.2 Remove 3/8" NPT cooling water exit hose nipple (002 version), or drain valve (014 version). Install using the following extra fittings:

   1 - 3/8" NPT close nipple.
   2 - 3/4" x 3/8" NPT reducing bushing.
   1 - 3/4" NPT coupling.
   1 - 3/4" NPT x 3" L nipple
   1 - 3/4" NPT Tee (facing up).
   1 - 3/4" street elbows.

   Install the Level Lance head and probe in the tee and reinstall the hose nipple or drain valve in tee also.

NOTE: All new pumps on order will be instrumented using 5.1 configuration.

HUCKEPACK & MONOVAC INSTRUMENTATION - INSTALLATION INSTRUCTIONS

II. Electrical.

A. Non-explosion proof area

1. Install flexible conduit between motor control center and switches. Wire switches to the terminal block located inside the motor control center as follows:

1.1 Level Lance with 5 stranded #14 or larger wires as follows:

Level Lance Enclosure		Control Center (Terminal Block)
Terminals #4 & #5	2 to 110 VAC	Terminals #1 & #2
Ground terminal	1 to ground	Ground terminal
Terminal #3	1 to Terminal #3	Terminal #3
Terminal #2	1 to Terminal #4	Terminal #4

Note: See Drawing A 1020A for installation of these wires in Level Lance.

1.2 Connect the two wires from oil level switch in reservoir to terminal block, terminals #5 & #6 (in motor control center).

1.3 Exhaust temperature switch with 2 stranded #14 or larger wires (in switch) to terminals #7 & #8 (in motor control center).

1.4 Interstage pressure switch (Huckepack only) with 2 stranded #14 or larger wires to common and normally closed contacts (in switch) to terminals #9 & #10 (in motor control center).

2. Wire per attached schematic A 1009E for Huckepacks and A 1146B for Monovacs.

3. On older pumps supplied with 42V motor control center, it will be necessary to convert to 110 VAC control by:

3.1 Exchanging the 42V for 110V transformer.

3.2 Installing 120V coil on starter.

3.3 Installing Gem Model ST 22445 intrinsically safe barriers.

B. Explosion proof area

The switches are wired as above, except that the motor control center is located in a non-hazardous area and rigid sealed conduit must be used. Additional local code requirements must also be observed.

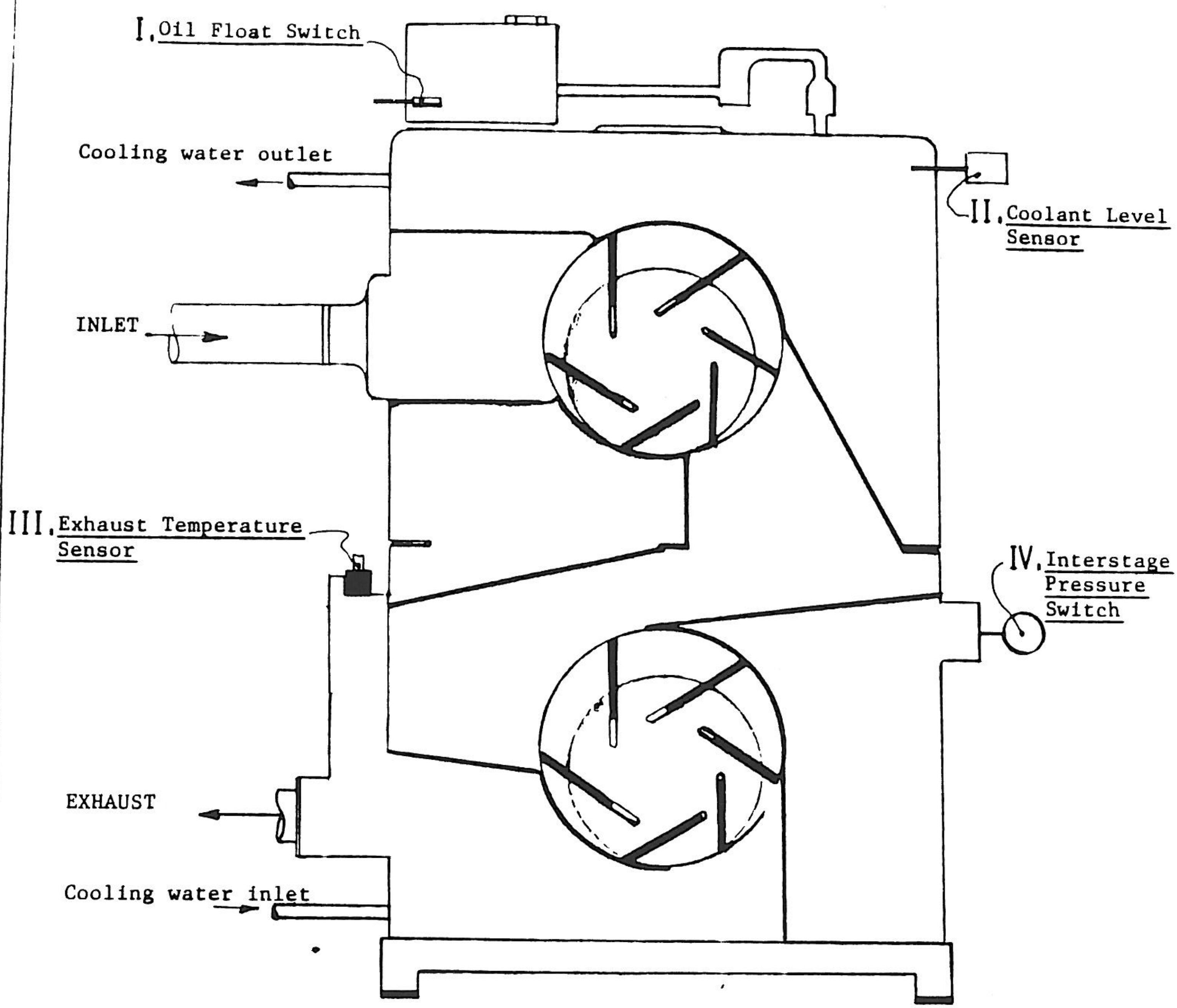
HUCKEPACK & MONOVAC INSTRUMENTATION - INSTALLATION INSTRUCTIONS

III. Set-up.

1. Set exhaust temperature by removing cover and setting dial to 220°F and reinstalling cover.

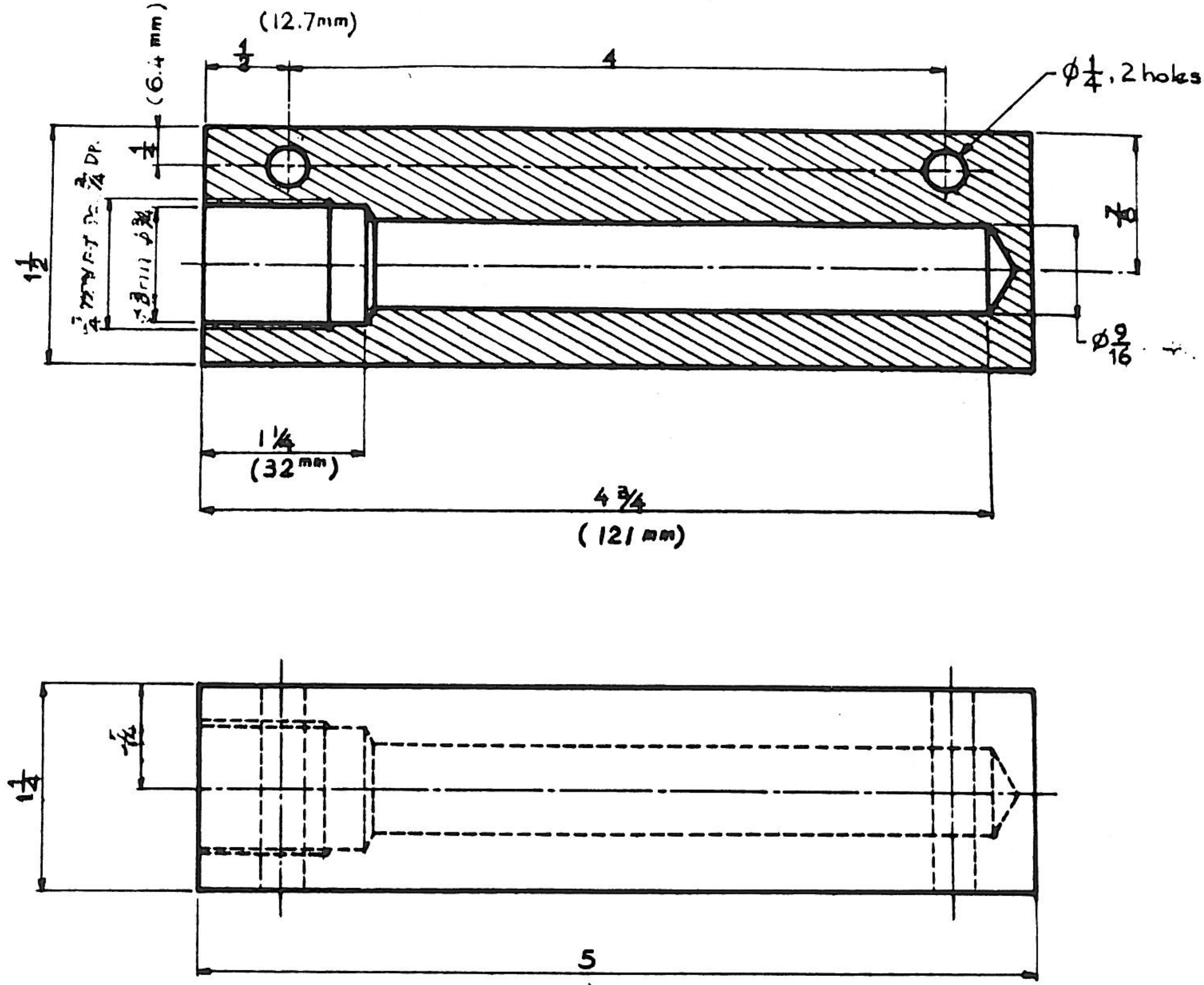
2. Set interstage pressure by removing cover and setting to 10" Hg vacuum and reinstalling cover.

3. Level Lance is to be set up using instructions per A 1020A such that, with probe immersed in water, the normally open and common contacts are closed; with no water present, contacts are open. Level Lance does require 110VAC for operation.



BUSCH

HUCKEPACK OUTLINE SHOWING INSTRUMENTATION LOCATIONS	A 1010 D



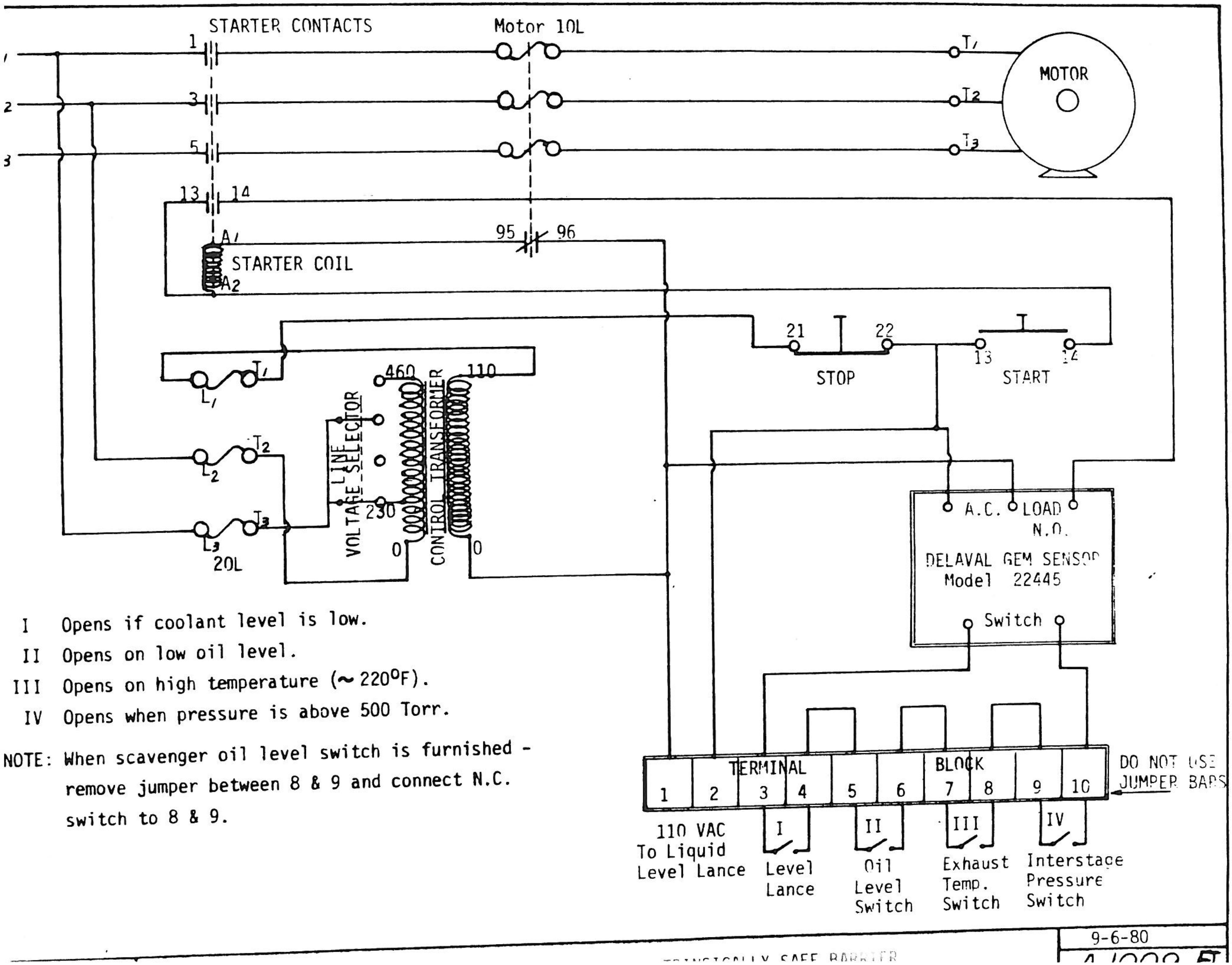
All Dimension in Inches, Material: [illegible] 1/2 HRS

EXHAUST TEMP. MTG. BLOCK

SCALE: 1 : 1	APPROVED BY:	DRAWN BY K. Thai
DATE: 3.26.80	L.J. Blumle 3/26/80	REVISED

BUSCH INC

DRAWING NUMBER



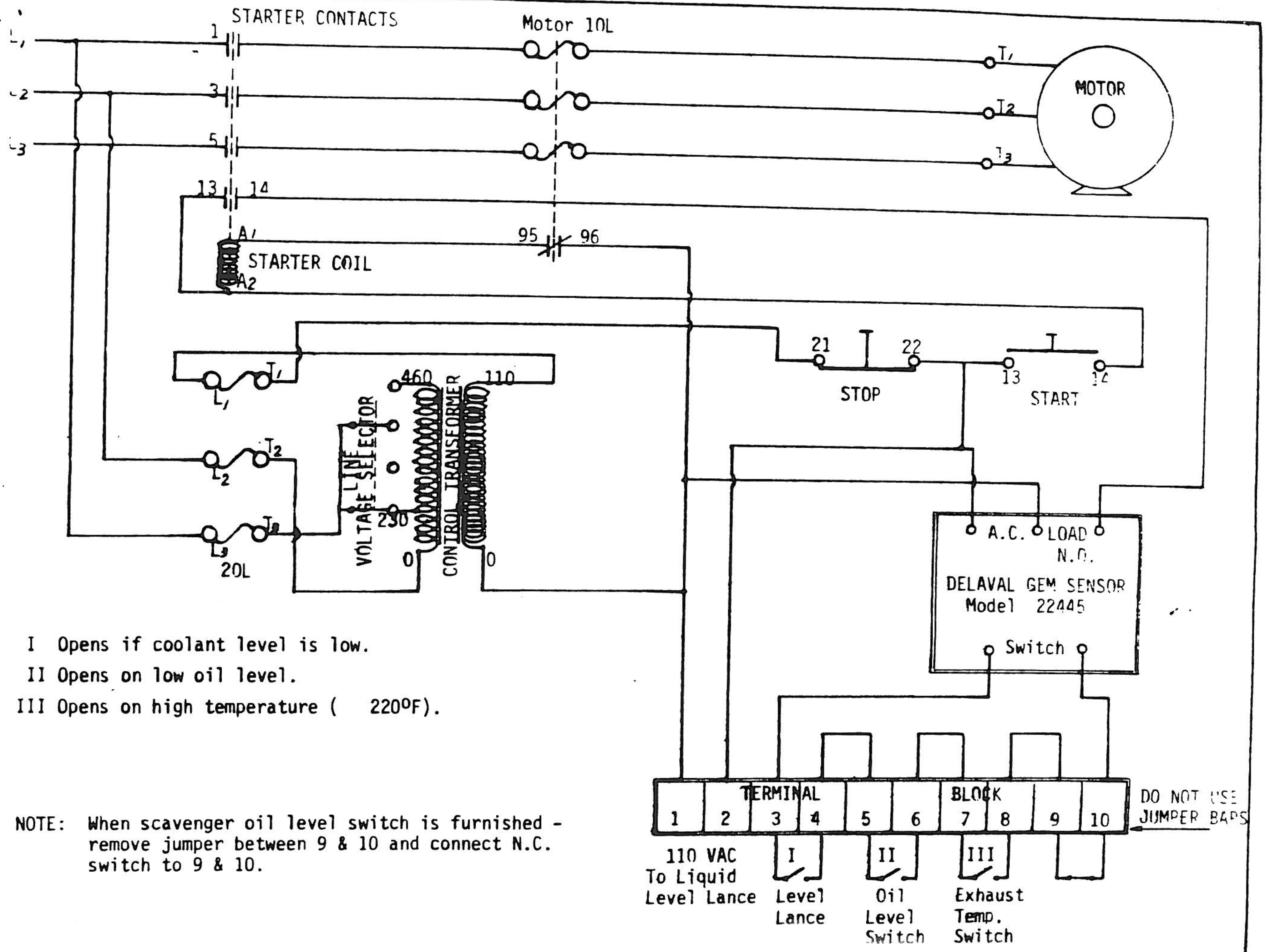
I Opens if coolant level is low.

II Opens on low oil level.

III Opens on high temperature (~ 220°F).

IV Opens when pressure is above 500 Torr.

NOTE: When scavenger oil level switch is furnished - remove jumper between 8 & 9 and connect N.C. switch to 8 & 9.



I Opens if coolant level is low.

II Opens on low oil level.

III Opens on high temperature (220°F).

NOTE: When scavenger oil level switch is furnished - remove jumper between 9 & 10 and connect N.C. switch to 9 & 10.

Transamerica Delaval

TRANSAMERICA DELAVAL INC.
GEMS SENSORS DIVISION
Farmington, Connecticut 06032

INSTALLATION GUIDE P/N 54477

FOR GEMS SAFE-PAK® LATCHING SAFE-PAK HI-LO PAK

This bulletin covers:

SAFE-PAK models **22445, 25872, 25873,**
LATCHING SAFE-PAK models **41705, 41715**
HI-LO-PAK models **38705, 38710, 38715, 38720**
for use as "intrinsically safe output" type switching units for hazardous location, non-voltage-producing sensors.

When SAFE-PAK installation is in accordance with this guide, these field sensors are suitable for Class I, Divisions I & II, Groups A,B,C,D and Class II, Divisions I & II, Groups E,F,G as defined by Article 500 of the National Electrical Code.

> IMPORTANT: Read carefully and completely before installing or connecting SAFE-PAK, LATCHING SAFE-PAK or HI-LO PAK units.

1. The Safe-Pak must be located in a non-hazardous area; only the switch or sensor terminals provide an intrinsically safe output (see Figs. 1 or 2).

2. Mounting and enclosure considerations:

   A. Field wiring of intrinsically safe circuits is to be segregated from non-intrinsically safe wiring by use of suitable barriers, separate wireways or trays (see Fig. 3).

   B. Intrinsically safe and non-intrinsically safe connection points should be located sufficiently apart to prevent any possibility of bypassing or miswiring during installation or servicing of equipment.

   C. The enclosure shall contain a cautionary statement as follows: "CAUTION: ANY SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY".

   D. The PAK mounting bracket must be grounded to ensure intrinsic safety. Resistance between bracket and ground electrode should be below one ohm. (See Figs. 4 and 5 for recommended selection of grounding hardware, and refer to Article 250 of the National Electrical Code for methods and practice.)

3. Installation of sensor switch and running of field wiring:

   A. The nature of the sensor switch must be that it is a non-voltage-producing, essentially resistive termination, or other device specifically examined and approved for use with the PAK.

   B. The conductors of the intrinsically safe circuit should be sealed in a rigid metal conduit at the point where the wiring enters the hazardous area; the wiring and contacting device should be such that conductive dusts in the area will not close the circuit in place of the contacts.

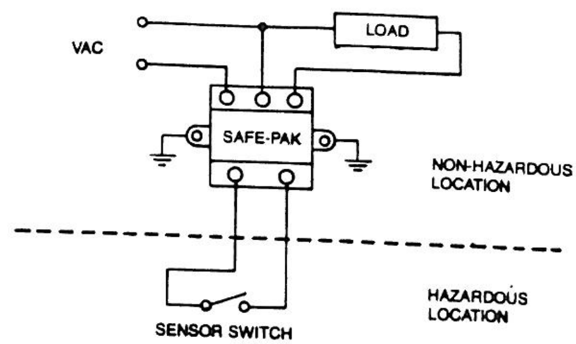


Fig. 1. Connection diagram, Gems SAFE-PAK models.

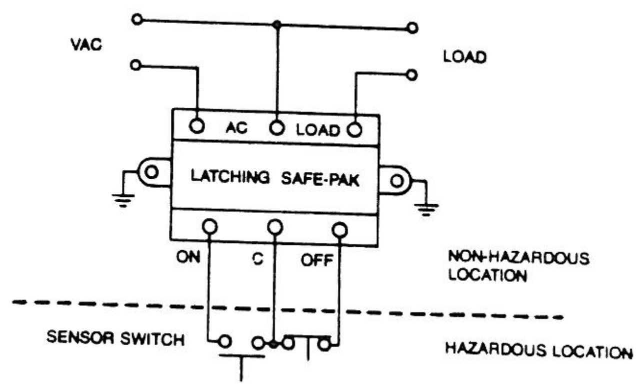


Fig. 2. Connection diagram, Gems LATCHING SAFE-PAK and HI-LO-PAK models (LATCHING SAFE-PAK shown).

NOTE: Sensitivity levels (set points) differ for various HI-LO PAK models. Consult factory for detailed information.

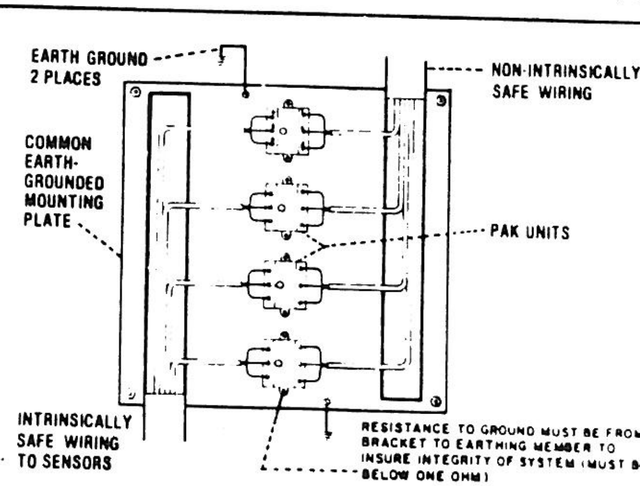


Fig. 3. Multiple PAK units grouped on common, earth-grounded mounting plate.

C. Hazardous area field wiring will store energy due to distributed capacitance and inductance in proportion to its length. It is therefore recommended that the characteristics (available from the manufacturer) of the cable be known and judged against the length of run and atmosphere of exposure. The following conservative chart is presented as a guideline in determining the limits of reactance for signal loops in the hazardous area wiring for the SAFE-PAK series.

GROUP	CAPACITANCE	INDUCTANCE
A&B	0.2 uf	7 mh
C	0.4 uf	25 mh
D	0.5 uf	50 mh

Example:
Typical values of capacitance for a twisted pair of copper wires is between 20 and 60 pf per foot. Using the maximum value of 60 pf/ft, groups A & B could have a run of 3000+ feet with safety. Inductance of a typical twisted pair is between 0.10 and 0.20 μh/ft, thus making a cable run in this example essentially determined by the capacitance.

D. Whenever possible the actual measured parameters should be used in making the determination of allowable length.

E. Shielded cable is not required, but if used in the application the shield must be returned to ground, the same as the PAK mounting bracket.

F. Non-intrinsically safe wiring cannot be run in conduit or open raceways together with intrinsically safe wiring.

G. Refer to Fig. 6 for detailed connection to terminal studs. All hardware, including terminal lugs, is supplied with unit.

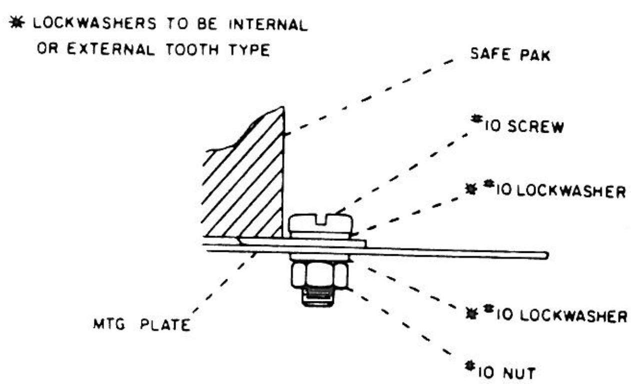


Fig. 4. Unit mounting detail.

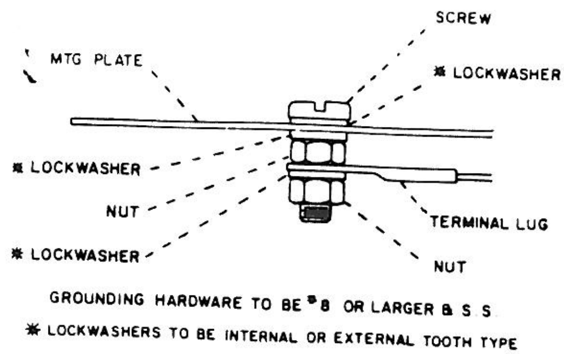
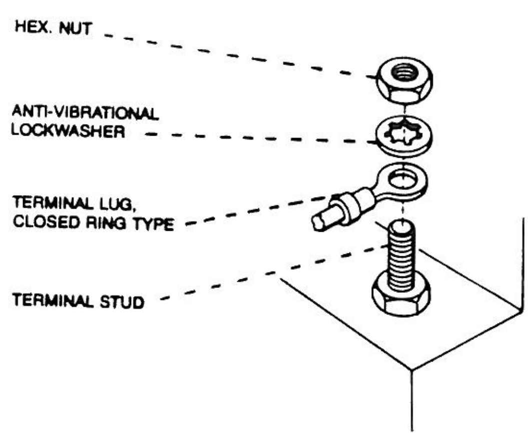


Fig. 5. Mounting plate grounding detail.



TIGHTEN ASSEMBLY TO BETWEEN 3 AND 5 IN. LBS.

Fig. 6. Recommended method of connection to electrical terminals. All terminal hardware, including lug, supplied with unit.

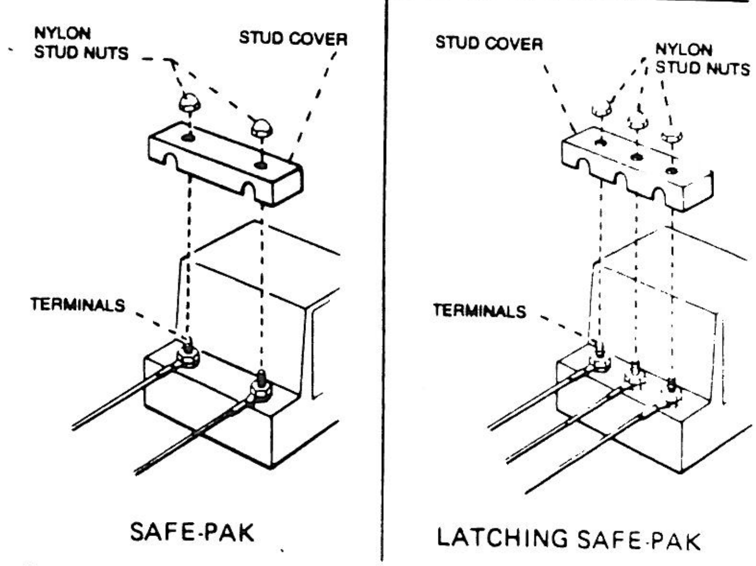
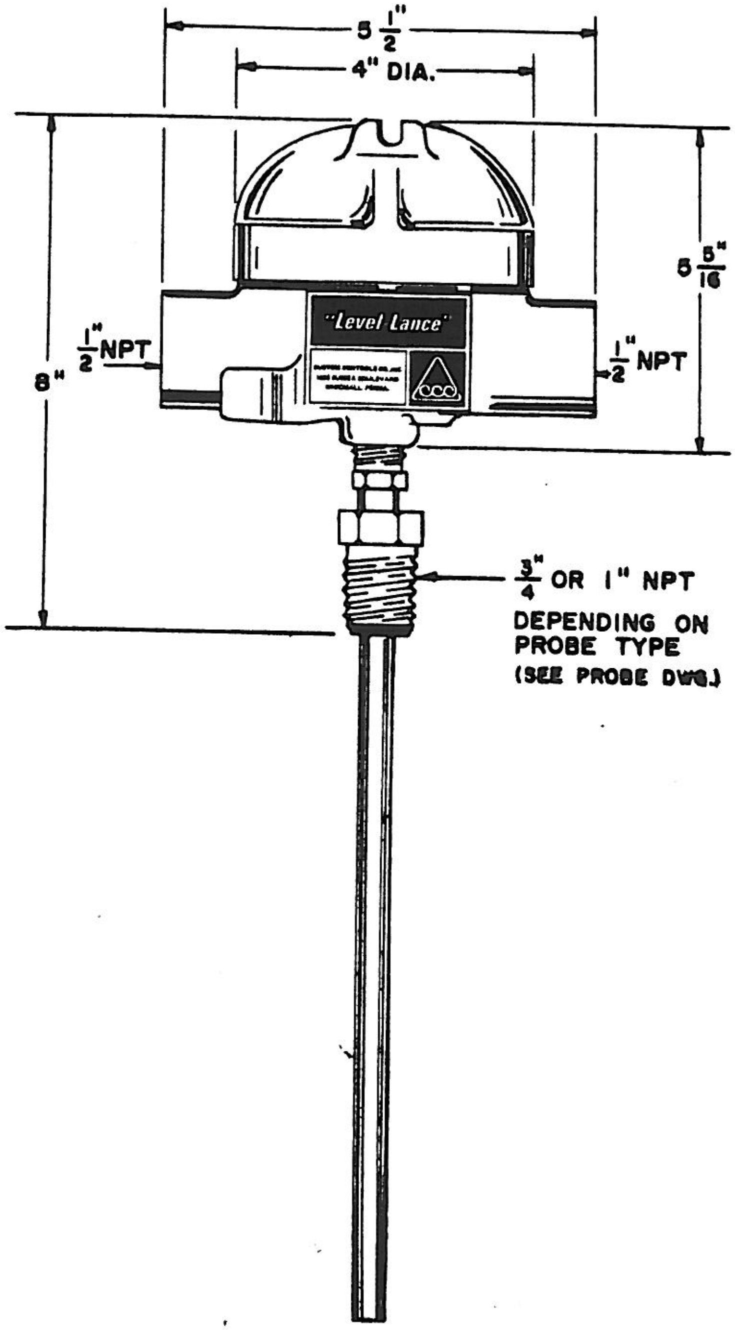


Fig. 7. Mounting of protective cover over sensor-connected terminals of unit.

"Level-Lance"

MODEL 10

ENCLOSURES



DWG. NO.

A—10MI—1

CUSTOM CONTROLS CO., INC.

1005 SUSSEX BOULEVARD ■ LAWRENCE INDUSTRIAL PARK

BROOMALL, PENNA. 19008 ■ PHONE 215–543–5000

CUSTOM CONTROLS CO. INC.

"Level-Lance"

INSTRUCTIONS

MODEL 10 "LEVEL–LANCE"

A. DESCRIPTION

The Custom Control's Co. Model 10 series "Level-Lance" system provides a means for detecting and controlling level changes in vessels or containers as a function of a capacitance change immediately surrounding the detecting probe. Control action is afforded by means of a relay closure.

The Model 10 controller is mounted directly on the probe assembly eliminating the need for electrical connections between probe and detector assembly. Maximum distance between controller assembly and external circuit wiring is limited only by the loop resistance of the interconnecting wiring.

Standard features include means for in-field selection of operational mode desired, either low level fail safe (direct acting) or high level fail safe (reverse acting) operation. See Fail Safe Mode under Par. H.

B. INSTALLATION

GENERAL

Examine the instrument for possible shipping damage. IMPORTANT: If for any reason it is determined that parts should be returned to the factory, please notify the nearest Custom Controls sales representative prior to shipment.

Choose the mounting locations in accordance with good instrument practice. Extremes of ambient temperature and vibration should be avoided (see specifications).

C. PROBE MOUNTING

"Level-Lance" probes are provided in a variety of styles and types for various specific applications involving liquids or granular materials. Usually insulated rod-type probes are used. Disc type probes can also be provided so that level can be detected without contacting the probe. (high level only).

D. HORIZONTAL

A horizontally mounted rod-type probe electrode should be mounted so that the lower surface of the electrode rod is parallel and at the level of the material at which control point is desired.

On applications involving a viscous liquid or material that has a tendency to "cling" or "build up", the rod-type probe if mounted horizontally, should be installed at a slight downward angle. This will permit the material to drain from the probe. The face of the packing gland on rod-type probes should be installed so that they are nearly flush with the vessel wall. DO NOT install a standard probe in a nozzle, recess, or open end well, as there is danger of material collecting in such a recess and causing false operation. Probes are available which include a shield of metal extending from the gland face for such applications. The shield should be about 1" longer than the length of the nozzle. The purpose of the shield is to render that portion of the probe insensitive to capacitance change. Build up in the recess of a nozzle, therefore, does not affect the operation of the "Level-Lance". It may be found, however, on some materials that the build up will continue and ultimately reach a value which will cause the "Level-Lance" to become insensitive or fail to operate. It is desirable that such installations be made so that the probe is easily removed for periodic cleaning.

E. VERTICAL

A vertically mounted rod type probe should be installed so that the mean point on the probe corresponds with the desired material level control point. Vertically mounted probes provide a possible variation of control point up and down the length of the probe by means of the zero or control point adjustment within the detector assembly.

F. PROBE INSTALLATION

1. Screw the probe into the 3/4" NPT opening [Model 70-S probes] or 1" NPT opening [Model 70-HD probes] in the vessel. Use wrench on **LOWER HEX ONLY.**

2. The probe upper and lower hex parts should not be turned with respect to each other. This is a Teflon compression seal and to turn the hex parts, with respect to one another, could destroy the seal.

CAUTION
Do not disturb the packing gland of the rod type probes, to do so will render the probe useless. The glands are sealed at the factory under controlled conditions, and once opened they cannot be re-assembled without new packing materials.

G. CONTROLLER UNIT MOUNTING

The controller unit is designed to be mounted directly on the probe external pipe thread. The controller may be mounted or oriented in any position. Exercise care in installing controller on the end of the probe.

1. Screw "Level-Lance" base housing onto the 1/2" NPT end of probe. Position instrument by holding upper hex on probe with wrench and turning instrument housing to the desired position.

2. The probe upper and lower hex parts should not be turned with respect to each other. See Par. F.

H. OPERATING PROCEDURE AND CALIBRATION ADJUSTMENTS

With system mounted and electrical connections made in accordance with Wiring and Adjustment Diagram (B-10W1-2) the following procedures should be followed in initially calibrating the "Level-Lance" systems:

All the adjustments necessary for calibrating the "Level-Lance" system are located on the upper printed circuit board and consist of the following:

Coarse Zero Adjustment [Control Point] - Consists of a four position selector switch providing increases of approximately 25pf per step in control point from Opf to 75pf.

Fine Zero Adjustment - Consists of a 45 turn screwdriver adjusted variable capacitor with a range of 1 to 30pf for fine adjustment of control point.

Fail Safe Mode — All "Level-Lance" systems are designed so that the mode of operation, either low level fail safe or high level fail safe, may be readily changed in the field to suit the particular application. Low level fail safe (direct acting) is defined as an increase in capacitance or product level causes the control relay to become energized. High level fail safe (reverse acting) causes the control relay to become energized. Thus, in the low level fail fail safe mode, the probe is normally covered by the product or material in the vessel (increased capacitance) and the control relay is energized. As the material level decreases below the probe the relay becomes de-energized actuating the alarm or control circuits. Should the material level be above the probe and a power failure or equipment failure occurs, the control relay will become de-energized, indicating a low level or unsafe condition.

J. PRINTED CIRCUIT CHASSIS REMOVAL (continued on page 3)

1. Turn power off.

2. Remove the dome cover from the condulet by unscrewing it in a counterclockwise direction.

3. Remove the 6-32 captive screw located at top of board (see Dwg. No. B-10W1–2). The printed circuit chassis is held secure to the condulet by this screw and the banana plugs located underneath the bottom printed circuit board.

4. In those "Level-Lance" models equipped with an external Fine Zero Adjustment, the lead coming from the capacitor must be disconnected. This lead is found connected to a quick disconnect terminal on the upper printed circuitboard. (see Dwg. #B-10W1-2).

5. To extract the chassis, grasp the edge of the lower upper board with extended fingers at the two 1/4" diameter tubular standoff posts. These standoff posts are located toward the bottom edge of the chassis and slide over the two guide studs on either side of the wiring terminal strip (see Dwg. B-10W1-2). Rock the chassis back and forth while lifting the assembly out of the condulet.

K. WIRING THE "LEVEL-LANCE"

1. See "Printed Circuit Chassis Removal" [Par. J-1 through J-5].

2. Use light gauge stranded wire for the connection of power and control circuit to the "Level-Lance", preferably 16AWG or 18 AWG.

3. Bring the leads in through the 1/2" NPT opening on either side of the case.

4. Observe the Hot-Neutral-Ground terminals called out in the Wiring and Adjustment Diagram (B-10W1-2).

5. Connect control circuit wiring to terminals desired [dependent on control application] using lightest gauge stranded wire adequate for current being switched and convenience of use. Heavier than 16 AWG is never recommended.

L. PRINTED CIRCUIT CHASSIS INSTALLATION

1. WARNING, power should be off before attempting to install assembly back in condulet case.

2. Electrical paper insulator inside at the bottom of the condulet should be folded back down over wires to allow for chassis insertion.

3. The assembly is fitted into the case by sliding the two tubular standoffs down over the 2 1/2" long 6-32 quide studs extending up from each end of terminal strip. As the assembly approaches the bottom of the case, engage the banana plugs into their receptacles on the terminal strip. Gently, but firmly, force the assembly down with the banana plugs going into their receptacles to the point where the receptacle's shoulder engages the shoulder of the banana plug.

4. Engage captive 6-32 mounting screw on upper chassis mounting post and tighten.

5. In those "Level-Lance" models equipped with an external Fine Zero Adjustment, the lead coming from that capacitor must be reconnected to its terminal. (see Dwg. B-10W1-2).

6. Install dome condulet cover by screwing it down on the condulet in a clockwise direction.

M. CALIBRATION FOR HIGH LEVEL FAIL SAFE DETECTOR

The standing capacity generated by the horizontally or vertically mounted probe and the tank wall must be balanced to obtain the proper operating point. See "Principles of Operation" Par. S.

1. High Level Fail Safe pins should be plugged in a vertical direction see Dwg. B-10W1-2.

2. With the tank empty, turn the Fine Zero Adjust (C_7) all the way out (fully counter-clockwise) with a small screwdriver. Energize the instrument (with cover off, see Warning Par. Q), relay should be de-energized. This can be shown by placing a suitable 12VDC meter across the test terminals. When the relay is pulled in 12VDC will appear there. When relay is dropped out OVDC will appear there. If the external circuit is wired to the controller relay contacts then observe relay operation by measuring the appropriate external circuit voltages or circuit action.

3. Coarse Zero plug is marked in 25pf steps. Start calibration by selecting Opf with the Coarse Zero plug (six o'clock position).

4. Momentarily short out the auxilary capacitor pad terminals located on top of upper printed circuit board (see Dwg. B10W1-2) with a screwdriver or any other convenient shorting means. This operation should cause the relay to energize and removing the short should cause the relay to drop out. If this simple test did not cause the pull in and drop out of the relay, check the power wiring and voltage to the appropriate power terminals. Check for possible shorts or opens in the wiring. Check to be sure that both the shorting plugs are securely inserted in the high level fail safe position. Check to see if the Coarse Zero plug is securely inserted in the zero pf position.

5. If this simple test in Step 4 is positive then–allow the material level in the vessel to fill to the point where it just touches the bottom of the horizontally mounted probe or to a point on the vertically mounted probe where high level control action is desired. Shift the Coarse Zero plug from the zero to the 25pf position (nine o'clock position) and continue going up in 25pf steps with the plug until a position is found where the putput relay pulls in. The pull in of the relay is indicated by the voltmeter reading changing from zero volts to 12VDC. When this point is found, go back to the preceding position with Coarse Zero plug. If this point is not found see "Addition of Auxiliary Balancing Capacitor". Par. D

6. Using a small screwdriver slowly turn the Fine Zero (C_7) in a clockwise direction until the relay actuates. The controller is now set to maintain the material at that level. See "Calibration Example". Par. P.

N. CALIBRATION FOR LOW LEVEL FAIL SAFE DETECTOR

The standing capacity generated by the horizontally or vertically mounted probe and the tank wall must be balanced to obtain the proper operating point. See "Principles of Operations". Par. S.

Test - The control point can be seen by connecting a 12VDC meter across the (+) plus and (-) minus test terminals. These terminals are the relay coil terminals and when a 12VDC appears there it indicates the relay is pulled in. When OVDC appears there it indicates the relay is dropped out. The point where it transfers from one to the other is called the control point.

External Fine Zero Adjustment [Optional] - A 45 turn screwdriver adjusted variable capacitor with a range of 1 to 30pf. This is accessible from the outside of the instrument housing, eliminating the need to remove the instrument cover to accomplish fine zero adjustment.

1. Low Level Fail Safe pins should be plugged in a horizontal direction (see Dwg. B-10W1-2).

2. With the tank empty, turn the Fine Zero adjust (C_7) all the way out (fully counter-clockwise) with a small screwdriver Energize the instrument (with cover off, see Warning Par. Q.) relay should be energized. This can be shown by placing a suitable voltmeter across the test terminals. When the relay is pulled in it will measure 12VDC. When relay is dropped out it will measure OVDC.

3. Coarse Zero plug is marked in 25pf steps. Start off calibration by selecting 0pf with the Coarse Zero plug (six o'clock position).

4. Momentarily short out the auxiliary capacitor pad terminals located on top of upper printed circuit board (see Dwg. B-10W1-2) with a screwdrwer or any other convenient shorting means. This operation should cause the relay to de-energize and removing the short should cause the relay to pull in. If this simple test did not cause the drop out and pull in of the relay, check the power wiring and voltage to the appropriate power terminals. Check for possible shorts or opens in the wiring. Check to be sure that both the shorting plugs are securely inserted in the low level fail safe position. Check to see if the Coarse Zero plug is securely inserted in the zero pf position.

5. If this simple test in Step 4 is positive then allow the material level in the vessel to fill to the point where it just touches the bottom of the horizontally mounted probe, or to a point on the vertically mounted probe where low level control action is desired. Shift the Coarse Zero plug from the zero to the 25pf position (nine o'clock position) and continue going up in 25pf

   steps with the Coarse Zero plug until a position is found where the output relay drops out. The drop out of the relay is indicated by the voltmeter reading changing from 12VDC to 0VDC. When this point is found, go back to the preceding position with the Coarse Zero plug. If this point is not found see "Addition of Auxiliary-Balancing Capacitor" Par. O.

6. Using a small screwdriver slowly turn the Fine Zero (C_7) in a clockwise direction until the relay actuates. The controller is now set to maintain the material at that level. See Calibration Example Par. P.

O. ADDITION OF AUXILIARY BALANCING CAPACITORS

If the relay does not pull in when the coarse zero plug is switched to the 75pf position, leave it there and perform Step 6 in Par. M or N. If the relay does not pull in by the time the fine zero (C_7) has been turned fully clockwise, then the standing capacitance is greater than 100pf and the instrument is incapable of reaching a point of balance with its built in network. A 100pf NPO type capacitor must be placed across the auxiliary padding terminals provided on the upper printed circuit board. This capacitor appears in parallel and adds directly with the built in balancing network. If, in the unlikelihood, more than 100pf is needed across the auxiliary padding terminals, then just add the required amount until the desired balance is reached. After the 100pf capacitor has been added, the remainder of the calibration is performed by repeating the calibration steps outlined in paragraphs M or N.

P. CALIBRATION EXAMPLE

It is found that the relay pulls in on High Level Fail Safe [low level drops out] when the Coarse Zero plug is inserted into the 50pf position. Since the relay did not actuate at the 25pf mark, the balance point for the standing capacity is somewhere between 25pf and 50pf. This exact point is found by going back to the 25pf position with the Coarse Zero and adding on to the fixed 25pf that amount which will balance the bridge perfectly with the Fine Zero (C_7), which has an adjustment range from 1 pf (fully CCW) to 30 pf [fully CW]. By turning the Fine Zero (C_7) in a clockwise direction [approximately 0.7 pf per turn] you will find a point where the relay pulls in [drops out on low level]. At this point the bridge is perfectly balanced and the instrument would be sensitive to as small a change as 0.1 pf increase at the probe.

WARNING

Q. HAZARDOUS AREA INSTALLATION

When calibration of an instrument must be done in a hazardous location certain extra steps and precautions must be taken. The power must be turned off whenever the cover of the instrument is removed. This requirement does not allow the performance of Step 4 in Par. M and N. To perform this step and to bring to a minimum the amount of work on the instrument in the hazardous areas, a pre-installation check of the instrument should be performed in a non-hazardous area.

Temporarily connect power to the instrument and perform the steps outlined under calibration procedures. The instrument can be checked out on the bench with no probe installed. The only difference being the capacity required to balance the standing capacity on the probe side of the bridge, will probably be lower.

After it is determined that the controller functions properly on the bench, it can then be installed at the desired location. After installation is complete, perform the required calibration steps outlined under calibration procedures by replacing instrument cover, turning power on, observe results of previous step, turn power off, remove cover, advance to next step, replace cover, turn power on, etc. until all required calibration steps are performed.

R. HAZARDOUS AREA FINE.ZERO ADJUST

Instruments that are intended for use in hazardous locations should be equipped with an external Fine Zero adjust capacitor (C_7). This factory installed option is installed in a pipe nipple extending out of the case just opposite the entrance of the external wiring entrance. It allow for adjustment of the Fine Zero (C_7) without the removal of the case cover. See Dwg. B-10W1-2

S. PRINCIPLES OF OPERATION

General

The Model 10 "Level-Lance" system is a completely self contained transistorized on-off controller consisting of a detector probe, oscillator section and relay control section. The control section is actuated by small changes in capacitance as a function of level or material changes at the detecting probe.

The unit is energized by 12 VDC from a battery source or an external DC unregulated supply. The circuit has built in zener diode regulation to compensate for any 12 VDC line variations. The controller uses all silicone semiconductors throughout and is electronically compensated against ambient temperature flucuations. Also optionally available is a Model 10-115 built in 115 V, 60 cycle power supply, to provide the controller with the required 12 VDC.

Oscillator section consists of a transistorized oscillator operating at approximately .5 mc coupled to an LC bridge circuit that varies the level of oscillation as a function of the bridge unbalance. One leg of the bridge circuit consists of a zero or balance capacitor adjustment, the other leg of the bridge consists of the detecting capacitance probe. This probe actually forms one plate of a capacitor with the tank wall or other grounded surface forming the other plate of the capacitor. The air or material between the plates is the dielectric.

The standing capacity, which is that capacity formed by the probe and tank wall and dielectric material existing just before the desired level is reached, is balanced out by adding an equal amount of capacitance to the other side of the LC bridge. This is accomplished with the Coarse and Fine Zero Adjustment. As the level increases the dielectric material is now changed, thus causing an increase in capacitance to appear at the probe side of the bridge. This increase in capacitance causes the LC bridge to unbalance and the oscillator amplitude to increase. A portion of the bridge output is rectified and fed to a transistor amplifier which in turn feeds this amplified signal to a schmidt trigger circuit. This trigger circuit converts the output to a high level on-off control current for driving the relay without chatter.

WE DO NOT RECOMMEND FIELD SERVICES ON ELECTRONIC CHASSIS UNLESS BY A QUALIFIED ELECTRONIC TECHNICIAN.

CUSTOM CONTROLS CO. INC.

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