



200A SERIES
Electronic Level Transmitter

USER MANUAL

1.0 General Description

200A Series level transmitters measure liquid levels in vented tanks, vessels and compartments. The measurement principle is based on a tank installed sensor the diaphragm of which is deflected by the hydrostatic head pressure. An interconnecting cable connects to a remote transmitter to provide an industry standard 4-20mA DC current loop output signal with range and zero adjustments.

A wide range of optional features and mounting arrangements are available. The product is designed and approved for use in hazardous Intrinsically Safe classified duties, and holds Marine Society "Type" Approvals.

2.0 Product Identification

Each transmitter enclosure bears an identification label which carries both the model code and a unique serial number. The model codes are shown in the sales leaflet at the rear of this manual. The serial number is used for calibration/factory records.

3.0 Specifications

3.1 Sensor Assembly

Body:	316L stainless steel construction . Optionally Hastelloy or inconel. (On Internally Suspended version a nylon protection cap is fitted).
Diaphragm:	Hastelloy C276 standard other material to special order.
Mounting:	Refer to model designation in the sales leaflet at the rear of this manual.
Running Nut Connection:	Brass or 316 stainless steel.
Overload:	500% of nominal range.
Operating Temperature:	-10 to +95°C standard. Option +150°C.

3.2 Sensor Cable

Construction:	Depending on duty either 4 core with overall screen or 2 core and miniature coaxial with overall screen. Integral breather tube for atmospheric reference. Outer sheathing 'Hytrel' Teflon. Maximum length 100m.
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3.3 ***Transmitter***

Housing:	GRP surface mounting to IP65.
Connection:	1 x PG9 gland for sensor cable. 1 x PG9 gland fitted with sintered breather for atmospheric reference. 1 x PG9 gland for 4-20mA output cable. If required optional M16 or M20 glands can be supplied
Power requirement:	12-30V dc.
Signal output:	2 wire 4 to 20mA dc.
Maximum load:	Dependant upon supply (1000 ohms at 30V dc).
Range adjustment:	3 to 1 electronic turndown of sensor nominal range.
Zero adjustment:	+/- 10% of set span.
Operating Temperature:	-10 to +55°C (Optional 60°C).

3.4 ***Performance***

Maximum Error:	+/-0.25% of full range output (Optional 0.1% some variants); includes effects of linearity hysteresis and repeatability.
Temperature Coefficient:	Less than 0.05%/°C range and zero (Optional 0.02%).
EMI/RFI:	To IEC801-2, 3, 4, 5, 6.

4.0 Installation

Pre-installation checks

Before installation the following checks should be made.

- I. Ensure that the factory calibration is in accordance with the process parameters and tank height. Of particular importance is the fitting position. Any discrepancies will result in inaccuracy.

- II. Ensure the length of cable to the sensor is suitable to site conditions. The cable is factory fitted to ensure a pressure tight seal on the sensors. NO ATTEMPT SHOULD BE MADE TO REMOVE THE SENSOR CABLE GLAND.

4.1 ***Mechanical Installation***

Sensor cable

The cable is factory fitted to the sensor. It contains a vent tube which provides an atmospheric reference for the sensor in submerged applications. The cable has a strain relief enabling the suspended sensor to be freely suspended by its own cable in deep wells and reservoirs. The outer sheathing is a special material suitable for continuous immersion in water, and many oils and chemicals. When handling the cable take special care not to damage the outer sheathing. Do not bend the cable to a radius less than 50mm.

When a sensor is suspended by its cable use Measurement Resources insulated cable clamp ALK2 or wind three turns around a 100mm diameter pipe or drum. Where the cable is to be brought through to the tank wall it is recommended this be done above the maximum fill point using a suitable gland, available from Measurement Resources.

4.1.1 ***Sensor fitting height***

When used in tank level or volume applications it is most important the sensor is fitted at a defined height above the bottom of the tank. All calibration data will be related to this fitting height.

4.1.2 ***Fittings***

During installation the sensor should be handled with care, especially the sensitive diaphragm assembly. Any damage to this will affect the performance and accuracy. Particular care should be taken with sensors which have a protective non-porous coating on wetted parts

When mounting the unit ensure that suitable gaskets or sealants are employed to provide pressure tight seals. The sensor should not be mounted where it will be subject to excessive vibration or mechanical damage.

Note for marine duties

For shipboard applications, where a cathodic protection system is employed, it is vital that the sensor body is firmly earth bonded to the hull. Failure to observe this will result in electrolytic corrosion of the unit. Where necessary an earth strip must be employed.

4.1.3 *Electronic Transmitter*

The transmitter provides the excitation for the sensor and amplifies and conditions the return signal to provide a standard 4-20mA output, proportional to span. Housed in a weatherproof GRP enclosure suitable for wall mounting. The unit should be mounted away from extreme temperature, not in direct sunlight, vibration, or where likely to be continuously sprayed with water.

4.2 *Electrical Installation*

The circuit should be wired as the installation instructions at the rear of this manual. The sensor cable is terminated in the transmitter following the wire colour code marked on the printed circuit board.

The sensor cable consists of the following:

Black conductor -	connect to EX-
Red conductor -	connect to EX+
Coaxial conductor (green)	connect to OP+
Coaxial screen -	connect to OP-

The overall cable screen must be terminated at the entry gland with particular care to preserve the RFI/EMC standards of the unit screen continuity via glands.

The cable also incorporates a nylon vent tube which should be cut to a length of approximately 20mm within the enclosure, care should be taken to ensure that this tube is not blocked or restricted. The sensor cable will have been supplied to suit the installation, and since it forms part of a tuned circuit any excess should be secured rather than shortened.

The signal/power loop should be connected as the diagram. Two core screened cable should be used with a minimum conductor size of 0.5mm. A larger conductor size may be employed to reduce loop impedance. All output signal connections should be made in series. The screen of the signal cable should be connected to the cable gland as described for the sensor cable.

4.2.1 *Power supply*

The transmitter requires a nominal supply of 24V dc, but will operate between 12V to 30V dc. The maximum permissible loop impedance for a given supply is derived from the following equation:

$$\frac{\text{Supply Volts} - 10}{0.02} = \text{Load in ohms.}$$

4.2.2 *Integral indicator*

The three terminals A, B, C are for connection of the lid mounted 3½ digit indicator which may be specified as an option, no other connection may be made to these terminals.

4.3 *Atmospheric Reference*

A central gland is fitted to the transmitter. This holds a sintered breather plug. This plug allows the transmitter to 'breathe' without allowing moisture to enter, thus providing (via the sensor cable) an atmospheric reference for the reverse side of the sensing diaphragm. THIS ATMOSPHERIC REFERENCE PRESSURE IS ESSENTIAL TO THE ACCURATE OPERATION OF THE TRANSMITTER.

If it is likely that the area in which the transmitter is located will be permanently wet, or at times submerged, then the vent plug must be replaced by a 6mm OD breather tube of nylon, copper or similar. This tube must be routed to, and terminated in a permanently dry area.

5.0 **Commissioning**

Each instrument is normally manufactured and calibrated in accordance with its intended application and should not need any further setting up. However it may be that an examination of the actual installation reveals some differences from original design criteria. If this is the case then the range and zero may be adjusted to suit.

5.1 *Zero adjustments*

These instruments are of the "live zero" type, therefore, with power applied and no head pressure a 4.00mA signal should be present.

Note: It is recommended that the current output is measured using accurate digital meter in preference to a process indicator since this may have been calibrated to take into account the dead volume below the transmitter fitting height.

Test pins marked + and - are provided on the transmitter terminal board to allow monitoring of the 4-20mA loop without disconnecting the signal lines. Where the signal at zero (i.e., no head pressure) is not 4.00mA correction can be made by adjustment of the zero potentiometer which will be found in the bottom right hand corner of the transmitter.

5.2 ***Range adjustment***

The actual calibrated span for the instrument will be found on the identification label of the transmitter.

Where it is necessary to adjust the span due to changes in the installation, the liquid level should be raised accurately to the required 100% level and the range potentiometer, in the top right hand corner of the transmitter, adjusted to provide a 20.00mA output signal.

Where it is impractical to adjust the actual liquid level, a suitable pressure source may be employed such as a dead weight tester or liquid column. The pressure connection required for this will depend upon the transmitter type, Measurement Resources can provide a suitable adaptor.

Note: Where it is suspected that range and/or zero setting are not correct, before making any adjustments, do first ensure that the transmitter does not have a “special” calibration. For example, some transmitter because of their mounting position relative to the liquid head may be calibrated with either a positively or negatively offset zero.

6.0 **Recalibration**

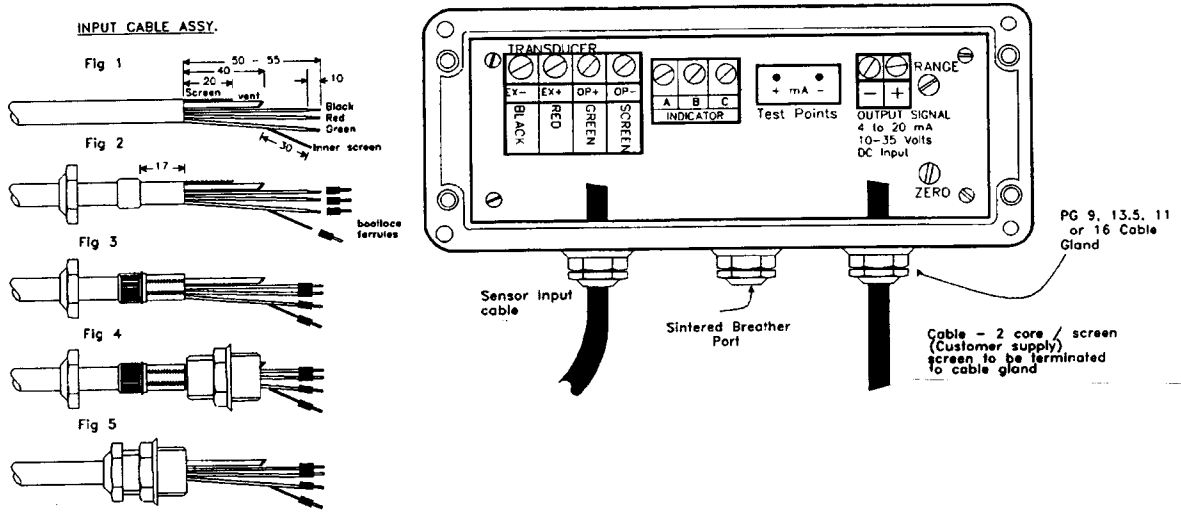
In the rare event of recalibrating, use the following procedure:

- I. With no process pressure applied turn the range adjustment control fully anti-clockwise and then by adjustment of the zero potentiometer set the output signal to 4.00mA. For applications where a raised zero is required it must first be established by calculation what signal output is required for zero process pressure. This is then set using the zero control as defined above. For applications where a suppressed zero is required again it must be established what the process pressure should be for 4.00mA signal and this should be applied prior to setting the zero as above.

III. Run the pressure up and down again checking the linearity of the instrument at 25%, 50% and 75% of nominal range. No adjustment of linearity is possible by the user, where the instrument is thought to be out of limits refer to Measurement Resources.

IV. Now apply a pressure equal to the full actual range required and by adjustment of the range potentiometer set the output signal at 20.00mA.

Note: When determining the actual range ensure that the specific gravity of the actual process fluid is accounted for.



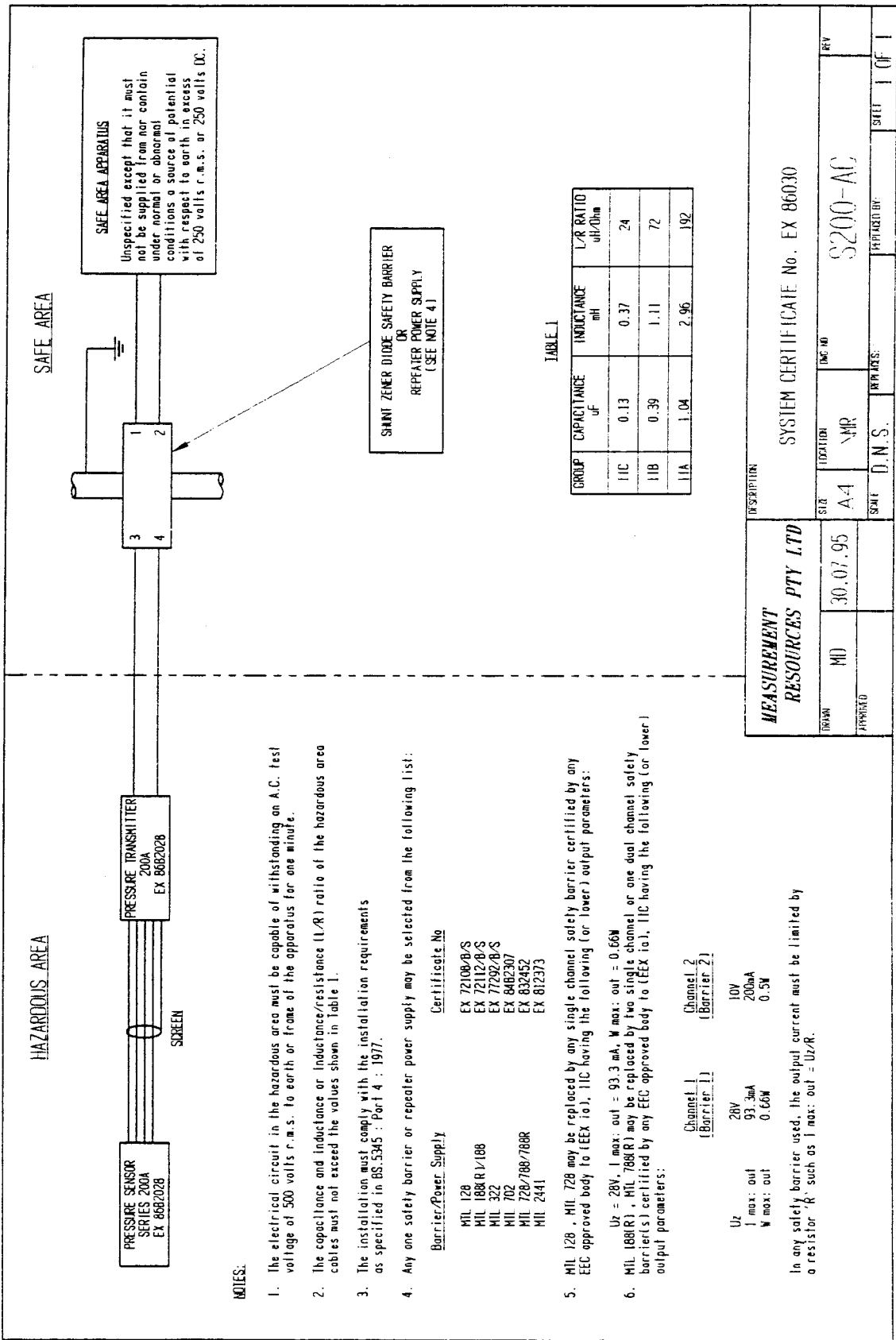
METHOD OF TERMINATION FOR INPUT AND OUTPUT CABLE GLANDS

1. Input cable:
 - a) Remove outer sheath, trim outer screen to 20mm. Cut vent tube end at 45 deg 40mm long. Cut & strip wires and inner screen as Fig 1.
 - b) Fit 20mm clear heatshrink tube to inner screen. Fit boillace ferrules to black, red, green & inner screen ends and crimp
 - c) Fit cable gland locknut and rubber sleeve as Fig 2.
 - d) Fit cable gland inner sleeve and fold outer screen wires back over sleeve as Fig 3.
 - e) Fit cable gland body over wires & vent as Fig 4 ('O' ring to outside).
 - f) Tighten cable gland in position as Fig 5.

2. Output cable: As note 1 omitting inner screen and vent tube.

NB: Output cable screen must be earthed at supply end.

7.0 Intrinsic Safety



NOTES:

1. The electrical circuit in the hazardous area must be capable of withstanding an A.C. test voltage of 500 volts r.m.s. to earth or frame of the apparatus for one minute.
2. The capacitance and inductance or Inductance/resistance (L/R) ratio of the hazardous area cables must not exceed the values shown in Table 1.
3. The installation must comply with the installation requirements as specified in BS.5345 : Part 4 : 1977.
4. Any one safety barrier or repeater power supply may be selected from the following list:

Barrier/Power Supply	Certificate No
MIL 128	EX 72108/0/S
MIL 188R 1/188	EX 72112/0/S
MIL 322	EX 77292/0/S
MIL 702	EX 8462307
MIL 728/788/788R	EX 832452
MIL 2441	EX 812373

5. MIL 128, MIL 728 may be replaced by any single channel safety barrier certified by any EEC approved body to (EEC io), IIC having the following (or lower) output parameters:
 $U_z = 28V$, $I_{max} \text{ out} = 93.3 \text{ mA}$, $W \text{ max: out} = 0.66W$
6. MIL 188R(1), MIL 788R(1) may be replaced by two single channel or one dual channel safety barrier(s) certified by any EEC approved body to (EEC io), IIC having the following (or lower) output parameters:

	Channel 1 (Barrier 1)	Channel 2 (Barrier 2)
U_z	28V	10V
$I_{max} \text{ out}$	93.3mA	200mA
$W \text{ max: out}$	0.66W	0.5W

In any safety barrier used, the output current must be limited by a resistor R_s such as $I_{max} \text{ out} = U_z/R_s$.

TABLE 1

GROUP	CAPACITANCE uF	INDUCTANCE mH	L/R RATIO uH/Ohm
IIC	0.13	0.37	24
IIB	0.39	1.11	72
IIA	1.04	2.95	192

MEASUREMENT RESOURCES PTY LTD		DESCRIPTION	
DRWEN	MD	DATE	30.07.95
APPROVED		LOCATION	MR
		SCALE	D.N.S.
		APPROVALS:	
		ISSUE NO	S200-AC
		REV	
		SYSTEM CERTIFICATE No.	EX 86030
		SAFETY	1 OF 1

8.0 General Operation and Maintenance

When correctly installed, satisfactory continuous performance over a long period may be expected. None of the units have any specific maintenance requirement. However, following periodic checks are recommended.

- I. The system components should be checked visually for good condition of the housing ensure the lid is kept firmly closed. Check that weatherproof gaskets and seals are in good condition and secure.
- II. Electrical cable runs between the system components should be inspected for condition and security and that cable glands are secure.
- III. If the sensor is to be used in an application where the accumulation of sludge may have been formed in the sensor, cleaning may be necessary.

The procedure is as follows:

- A. Remove the transmitter from service. Clean and dry the sensor externally using clean water or suitable solvents.
- B. Where fitted, by hand only, carefully unscrew the sensors end cover or flange plate from the front of the sensor. Never attempt to use sharp or hard steel tools to remove this cover. **DO NOT INSERT ANY TOOLS OR OBJECTS THROUGH THE SENSOR END CAP.** When unscrewed keep the assembly parallel and gently lift away from the body exposing the diaphragm.
- C. Using suitable solvents or clean water only, carefully clean the sludge deposits from the exposed diaphragm. Great care must be taken not to damage, distort, or otherwise manipulate the diaphragm during this operation.
- D. Clean and inspect any gaskets or seals and ensure that the seating is thoroughly cleaned. Replace seals if necessary.
- E. When refitting the end cover or flange plate ensure that it is kept parallel and clear of the diaphragm.
- F. It is recommended that system calibration should be checked following the procedure given under the section entitled RECALIBRATION. The frequency depends on the application, but typically every 2 years.

9.0 Fault Finding

Each instrument is exercised, calibrated and fully tested in our factory prior to shipment. If, however, on installation or in service, the system is thought to be providing incorrect or no reading. Check the following:

1. Check that the actual installation details are as the original order i.e. all tank dimensions, transmitter fitting height, and specific gravity.
2. Is the system wired as the instructions given in the electrical installation section.
3. Is the power connected.
4. Is there current output at the transmitter.
5. Confirm by visual inspection or dipstick the level of liquid within the vessel.
6. Check that vessel contents are fluid at the sensor ie., no blockages.
7. For externally mounted sensors check that any isolating valves are open.
8. If multiple systems have been installed check the sensor and transmitter are connected to the correct tank.
9. Confirm that the vessel is freely ventilated.
10. Confirm that the atmospheric reference for the sensor is unobstructed.

If the fault still exists after the above have been checked the sensor/transmitter should be removed from service for further examination.

1. Remove end cover/flange where fitted and clean sensor assembly as previously described.
2. Connect the transmitter to a suitable pressure source and perform a full calibration check as previously detailed.

If the foregoing fails to provide a satisfactory result then it may be assumed that the unit has developed a fault.

Careful visual inspection of the sensor body/diaphragm for signs of damage/corrosion, the sensor cable for signs of damage to the outer sheathing, and the circuit board for component failure or breakage may indicate where the problem lies. If this is the case and a spare sensor or transmitter module is available, the following matching procedure should be followed.

10.0 Sensor/Transmitter module replacement

1. To gain access to the potentiometers on the lower printed circuit board PCB of the transmitter it is necessary to remove the assembly from its enclosure taking care not to damage the boards or interconnecting ribbon cable.
2. Connect sensor to transmitter and apply power as previously described.
3. Set the potentiometer controls as follows:
 - RV1 - Phase control - fully anti-clockwise (Lower PCB).
 - RV2 - Zero control - mid-position (Upper PCB)
 - RV3 - Gain control - fully anti-clockwise (Lower PCB).
 - RV4 - Range control - fully anti-clockwise (Upper PCB).
4. With no pressure applied adjust the zero control RV2 to give an output signal of 4.00mA.
5. Apply the full nominal pressure of the instrument and adjust RV3 gain control to give an output signal of 19.5mA.
6. With full pressure still applied adjust RV1 phase control to give a maximum reading of output signal.
7. Release the pressure and recheck zero output adjusting RV2 if necessary to give 4.00mA.
8. Re-apply the full nominal pressure and check output signal adjusting to 19.5mA using RV3 as necessary.
9. Finally apply the actual calibration pressure for full scale and adjust RV4 to give 20.00mA output.

INSTALLATION INSTRUCTIONS

200A SERIES ELECTRONIC LEVEL TRANSMITTERS

This sheet provides guidance on installation and commissioning for Measurement Resources 200A Series Electronic Level Transmitters. It is intended for new instruments which have been factory calibrated.

Mechanical Installation

When wiring the sensor cable to the transmitter terminals, ensure the screen terminal is connected to the coaxial outer. The overall screen is connected via the cable gland (see over).

Actual installation will depend upon the particular sensor type. In general, ensure that appropriate thread sealants, gaskets, or seals are used for screwed or flange connections, and that pole mounted transmitters are adequately secured against vibration or product movements. Extreme care must be taken to avoid damage to the highly sensitive diaphragm which should not be touched if it can be avoided.

Where the 200A has been supplied calibrated for a particular vessel, it must be ensured that the actual fitting height above the base of the vessel agrees with the information provided at time of manufacture.

The cable which connects the sensor and transmitter is supplied fitted to the sensor. The factory sealed cable gland should NOT be undone. The cable length will have been supplied to suit the application and since it forms part of a tuned circuit, any excess should be coiled rather than cut. The cable has a heavy duty sheathing and extreme care should be taken not to damage this. The cable must be adequately supported using suitable clips and not bent to a radius of less than 50mm.

The transmitter should be wall or bulkhead mounted, and sited away from excessive heat, vibration, and moisture.

*** Note: With the exception of transmitters which have been supplied for use in Reference port or Differential applications, the sensor cable carries an integral vent tube which provides an atmospheric reference for the sensor. In either case the correct wiring arrangement is shown on the connection diagram. Where fitted, the vent tube must not be kinked or otherwise blocked within the enclosure.**

*** The transmitter enclosure is supplied with a breather plug which is fitted to the central connector. Where the module is unavoidably mounted in a wet location, the breather plug must be replaced by a extension tube of 6mm (¼") OD, which should terminate in a dry location.**

The output signal loop should be wired as shown. Two core screened cable should be used with a minimum conductor size of 0.55mm. To reduce loop impedance a larger conductor size may be employed. All connections are made in series as shown. Under normal circumstances the cable screen should be earthed at the power supply end only, and not connected to the earth terminal within the electronic transmitter, to avoid possible earth loop problems.

The transmitter requires a nominal supply of 24V DC, but will operate between 12V to 30V DC. The maximum possible loop impedance is given by the following equation:

$$\frac{\text{Supply voltage} - 10}{0.02} = \text{load in ohms}$$

Commissioning

Each instrument is calibrated in accordance with its intended application and should not need adjustment. However, it may be that examination of the actual installation reveals differences from the original design criteria. In this case the range and zero may be adjusted to suit.

Zero adjustment - the instrument is of the "live zero" type therefore with power applied and no head pressure a 4.00mA signal should be present.

*** Note: The current output should be measured using an accurate test meter in preference to the loop indicator since this may have been calibrated to show a volume. Where the signal at zero (i.e. no head pressure) is not 4.00mA correction can be made by adjustment of the zero potentiometer in the transmitter (Refer to connection diagram).**

Range adjustment - the calibrated span of the instrument will be found on the transmitter label. Where it is necessary to change this, the liquid level should be raised accurately to the required 100% level and the range potentiometer (refer to diagram), should be adjusted to provide a 20.00mA output signal.

Where adjustments are necessary and it is impractical to vary the actual liquid level, a suitable pressure source may be employed such as a dead weight tester. The pressure connection required will depend upon the transmitter type.

*** N.B: Where it is suspected that the range and/or zero settings are not correct, please check the original order details before making adjustments. For example, some transmitters because of their mounting position may have been calibrated with either a positively or negatively offset zero, i.e. with no pressure applied the output will be above 4.00mA, or a certain amount of pressure is required before the signal moves away from the 4.00mA point.**

Installation Fault Finding

Each instrument is exercised and factory calibrated, and fully tested prior to shipment. If however, on installation it is found that the system is providing either an incorrect reading or no reading at all, the following should be checked.

Check that the actual installation details are as the original manufacturing specification - i.e. all tank dimensions including the transmitter fitting height, and specific gravity of liquid.

1. Is the system wired in accordance with the above instructions?
2. Is 24V DC present across the transmitter terminals?
3. Confirm by visual inspection of dipping that the actual level within the vessel is as thought.
4. Check that vessel contents are fluid at the transmitter, i.e. no solids or other blockages are affecting the reading.
5. For externally mounted transmitters check that isolating valve is open where one is fitted.
6. For multiple input installations check that each transmitter is installed on its intended vessel and has the correct indicator attached.
7. Where fitted is the breather extension properly vented in a dry atmosphere?

If the fault still persists after the above have been checked please refer to the manual or Measurement Resources Pty Ltd.