



## O & M Manual



# B12-70

## 2-Wire Wet Acid Gas Transmitter

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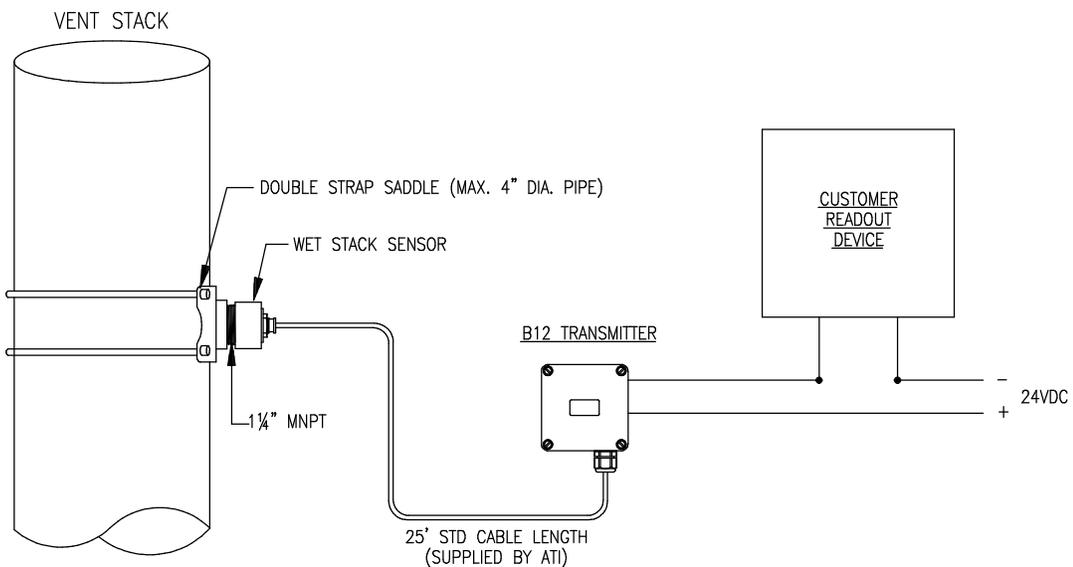
## INTRODUCTION

The Series B12-70 is a two-wire transmitter system designed for use with a special acid gas sensor (for HF, HCl, or HBr) suitable for use in very wet environments. It provides a low power method of monitoring acid gas in applications where excessive moisture causes rapid blinding of standard acid gas sensors.

Transmitters are housed in a NEMA-4X polystyrene enclosure (Figure 3) suitable for installation in virtually any environment. The sensor cable is wired to the proper terminals in the transmitter through the Pg 11 cable gland located in one of the enclosure knockouts. One cable gland and one ½" conduit hub is supplied for customer installation. An optional LCD provides local indication of gas concentration on the front of the enclosure. The display is supplied only when specified on the order, and cannot be added in the field.

B12 Transmitters are also available in an explosion-proof version. The explosion-proof version is housed in a galvanized steel enclosure (Figure 4) rated for Class 1, Div. 1, Groups B, C, & D locations. LCD is not available on the XP version.

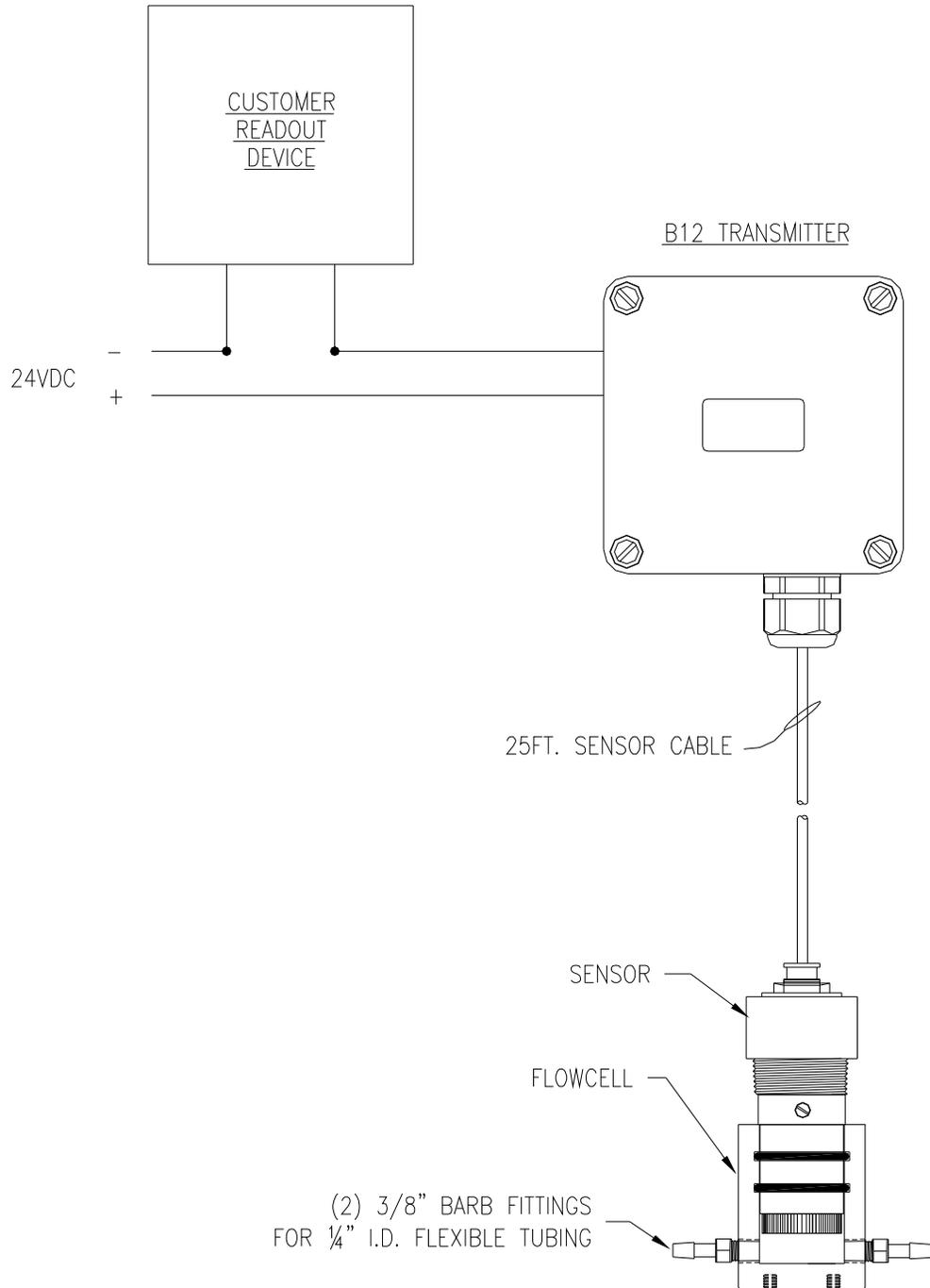
Figure 1 shows a typical insertion B12-70 gas monitoring system. The sensor is shown threaded into a blind flange of a vent stack.



**Figure 1 - Typical Insertion System Installation (ATI-0156)**

**ATI** Model B12-70 Wet Acid Gas Transmitter

Figure 2 shows a typical flow through B12-70 gas monitoring system. The sensor is shown with the low volume flowcell in place. If used in insertion applications, the low volume flowcell must be removed.



**Figure 2 - Typical Flow Through System Installation (ATI-0223)**

## **SPECIFICATIONS**

**Type:** Wet Acid Gases such as HF, HCl and HBr

**Range:** 0-10 PPM Min., 0-100 PPM Max.

**Accuracy:**  $\pm 0.2$  PPM at constant temperature

**Electronic Repeatability:**  $\pm 1\%$  of span

**Electronic Linearity:**  $\pm 0.5\%$  of span

**Output:** Loop-powered 4-20 mA, 675 ohms maximum at 24 VDC

**Power:** 12-28 VDC

**Display:** None. Optional LCD available.

**Enclosure:** NEMA 4X polystyrene  
Explosion-proof cast iron optional, Class 1, Div. 1, Groups B, C, & D.

**Controls:** Zero and span potentiometers mounted on transmitter circuit board

**Operating Temperature:**  $-5^{\circ}$  to  $+55^{\circ}$  C

**Sensor:** Model 70 Wet Acid Gas Sensor

**Weight:** 0.25 Lbs (0.12 Kg.)

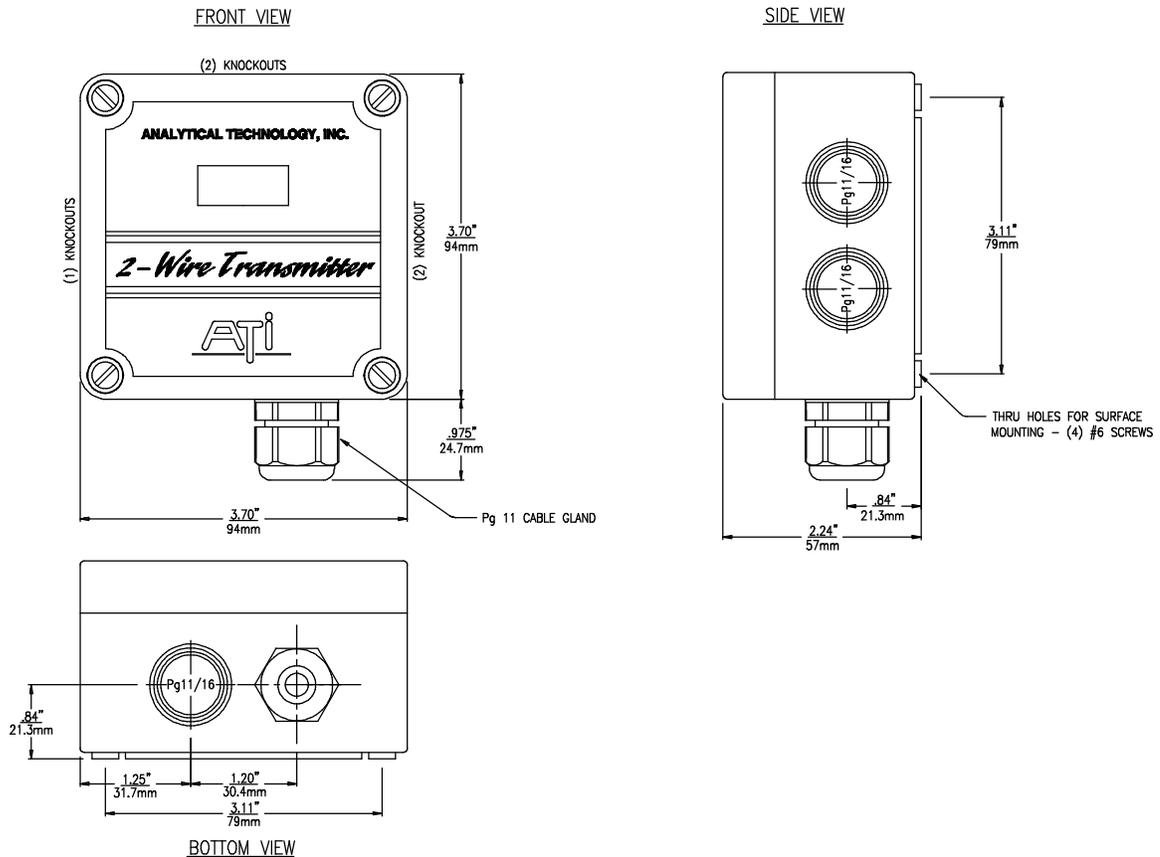
## INSTALLATION

Installation of a B12 Transmitter requires mechanically mounting the enclosure and connecting DC power to the system. In addition, the sensor must be installed as shown in either figures 1 or 2 and wired to the proper terminals in the transmitter.

### MECHANICAL MOUNTING

The NEMA 4X transmitter enclosure is surface mounted using screws inserted through the blind mounting holes accessible by removing the transmitter cover. Figure 3 shows the center to center mounting hole dimensions for this enclosure. If rigid conduit is to be used for wiring the transmitter, the transmitter can be supported directly from the conduit system without the use of mounting screws. The transmitter weighs only 4 ounces, so normal conduit supports will be adequate. If conduit is to be used, be sure that the conduit is sealed at the point where it enters the transmitter. Otherwise, condensation in the conduit system can drain into the transmitter causing failure of the electronic circuit board.

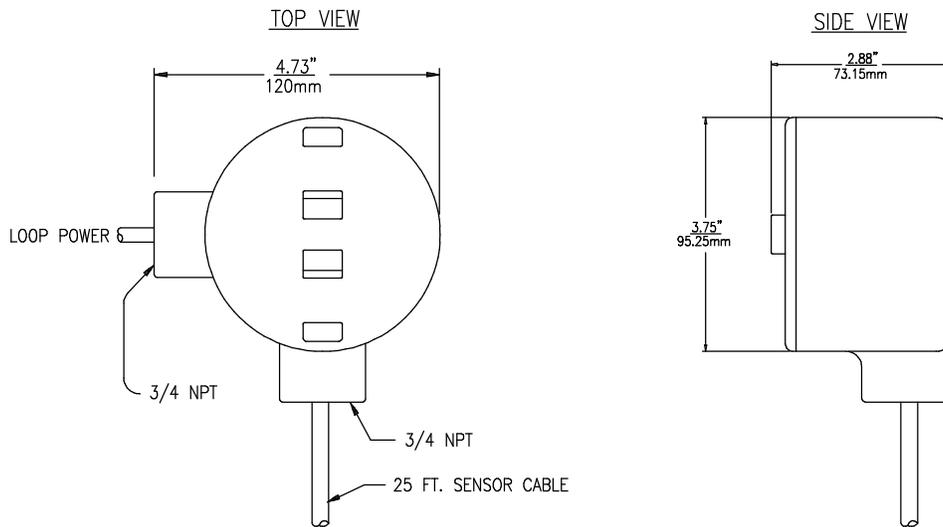
**CAUTION:** When removing the cover of a transmitter with the LCD option, do not try to separate the cover from the enclosure base by more than a few inches. The LCD is hardwired to the transmitter circuit board, and the display cable is only a few inches long.



**Figure 3 - Nema 4X Transmitter Enclosure Dimensions (ATI-0198)**

(SHOWN WITH DISPLAY OPTION)

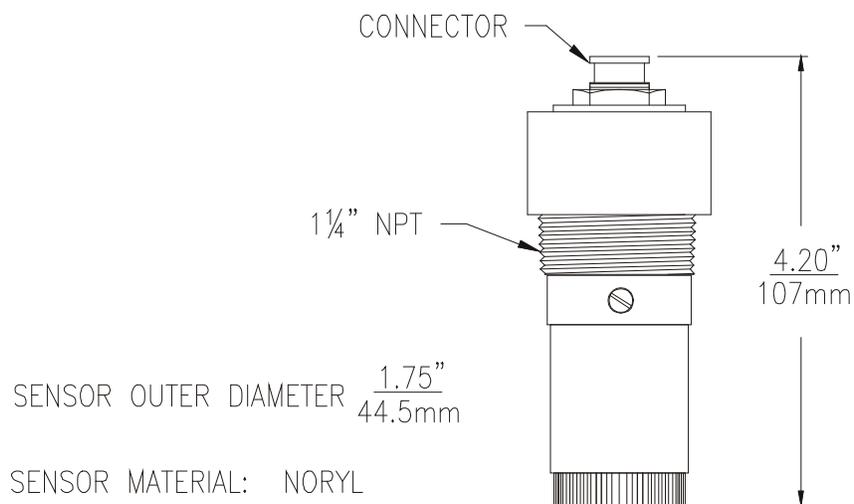
Explosion-proof transmitter enclosures should be supported by the conduit system and the installation should include proper conduit seals as required by local electrical code.



**Figure 4 - Explosion-Proof Transmitter Enclosure Dimensions (ATI-0226)**

The back of the insertion sensor is a 1 1/4" MNPT pipe thread. The sensor is normally threaded into a blind flange which is used to mount to the vent. The sensor should be installed perpendicular to the air flow and should be inserted far enough into the vent so that the sensor tip is at least 1/2" into the stack.

The sensor in a flow configuration is used in conjunction with the low volume flowcell (see Figure 2) to provide for sample to be delivered to the sensor using a pump or the sample pressure from the vent stack. The sensor simply threads into the low volume flowcell and 1/4" hose barb fittings are provided for inlet and outlet connections.



**Figure 5 - Wet Acid Gas Sensor Dimensions (ATI-0276)**

## ELECTRICAL CONNECTION

B12-70 transmitters are supplied with a gland seal for the sensor wire and a ½" conduit hub for output loop connection. The sensor connects to terminal block TB2 on the transmitter circuit board as shown in Figure 6. The output loop wiring is connected to TB1 as shown in Figure 6. The explosion-proof transmitter electrical connections are shown in Figure 7.

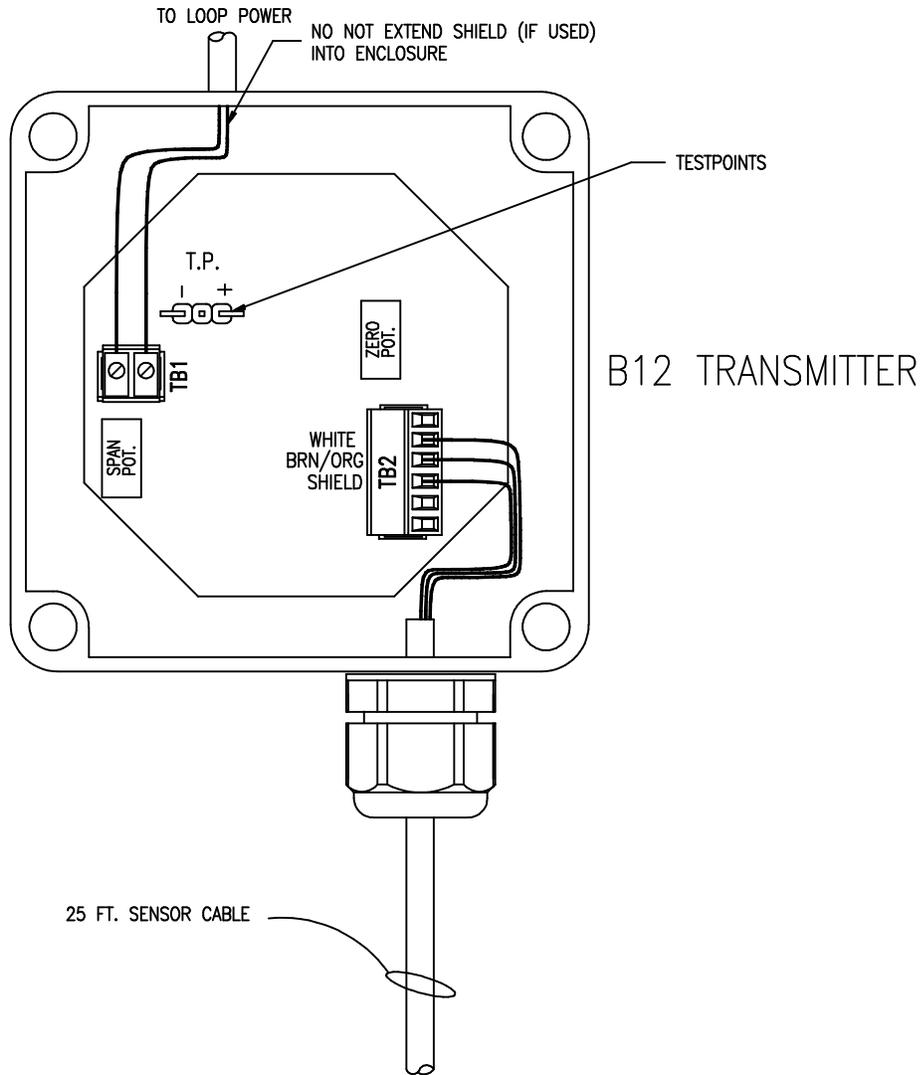
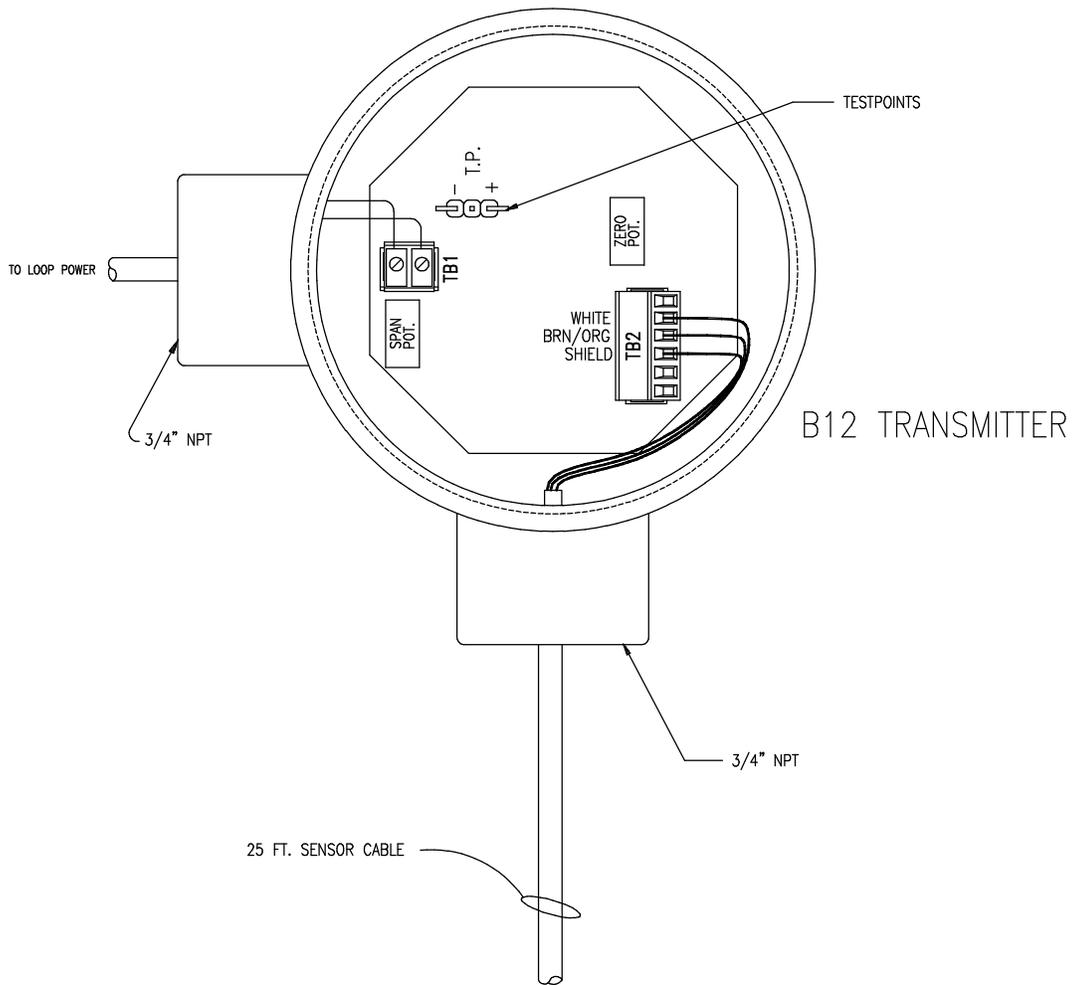


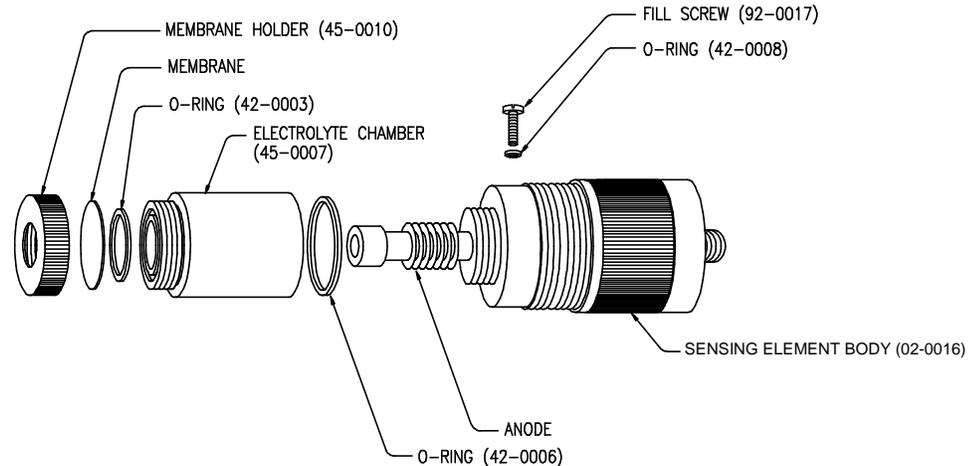
Figure 6 - Electrical Connections (ATI-0181)



**Figure 7 - Electrical Connections (ATI-0182)**

## WET ACID GAS SENSOR ASSEMBLY

Wet acid sensors require service prior to operation. Sensors are shipped dry. Prior to start-up, a new membrane must be installed and the sensor must be filled with electrolyte. Figure 8 shows an exploded view of the sensor.



**Figure 8 - Wet Acid Gas Sensor Assembly (ATI-0265)**

Follow the procedure below to prepare the sensor for operation:

1. Unscrew the electrolyte chamber from the assembled module and also remove the fill screw and o-ring from the side of the sensing element body.
2. Remove the front nut from the bottom of the chamber and discard the protective membrane. O-rings are contained in grooves on both the bottom and top of the chamber. Be sure that these o-rings remain in place.
3. From the package of membranes supplied with the sensor, place a new membrane into the front nut. **The membrane is the white disk and is separated from other membranes by a blue paper spacer.**
4. Screw the front nut onto the chamber until you feel the o-ring compress. Hand tight compression is all that is needed. Do not use tools to tighten. The membrane should be flat across the bottom of the chamber without wrinkles.
5. Fill the chamber with electrolyte until the level is about  $\frac{1}{2}$ " above the bottom of the internal threads in the chamber.
6. Slowly screw the chamber onto the sensing element body. A small amount of electrolyte will run out of the hole from which the fill screw was removed. Place a paper towel around the sensor to absorb the electrolyte overflow. Tighten the chamber until the o-ring at the top of the chamber is compressed. Once again, do not use tools to tighten.
7. Shake excess electrolyte from the vent hole on the side of the sensor and replace the fill screw and o-ring.

The sensor is now ready for operation. The membrane should be stretched tightly across the tip of the sensor. **When handling the assembled sensor, do not set the sensor on its tip or damage to the membrane will result. Severe impacts on the tip of the sensor from dropping or other misuse may cause permanent damage to the sensor.**

## OPERATION

After mechanical and electrical installation is complete, the system is ready for operation. Prior to start-up, recheck the loop wiring and sensor connections to be sure everything is correct. Reversing the loop wiring will not damage the transmitter, but other devices in the loop may be adversely affected.

As soon as DC loop power is applied, the transmitter will begin to operate, transmitting a 4-20 mA signal proportional to gas concentration. When first energized, the sensor will spike to a high value and then slowly begin to recover toward zero. This is normal and the system must be allowed to stabilize for at least a few hours before making any adjustments. The sensor must be connected to the transmitter and the transmitter must be powered for the sensor to stabilize.

## **TRANSMITTER TEST POINTS**

In order to read the transmitter output locally, a digital volt (DVM) meter is recommended for transmitters without displays. The transmitter circuit board contains test points marked TP1 (see Figure 6) that allow an operator to read the 4-20 mA output without breaking the loop wiring. The test points are across a precision 10 ohm resistor that is part of the current output circuit. Therefore, any changes at the test point are a direct indication of changes in the output signal. The test point voltage will be 40 - 200 mv. proportional to 4-20 mA. This test point is used for zero and calibration functions.

**DIGITAL DISPLAY OPTION**

Series B12 transmitters supplied with the optional LCD have the display mounted to the enclosure cover with a clear lens protecting the display from dirt and moisture. The display is connected to the cover with a short ribbon cable soldered to the transmitter circuit board. The digital display is factory scaled to the transmitter range specified on the order.

The LCD indicates gas concentration directly in PPM or % depending on the range. It is directly in the 4-20 mA output circuit so that it is a very accurate indicator of the signal being transmitted to remote equipment. The display should be used for zeroing and calibration instead of the test points described in the calibration section of this manual.

When removing the cover of a transmitter with the LCD, be careful not to pull on the display interconnect cable. When you remove the cover, it can be temporarily fastened to the enclosure base as shown in Figure 9.

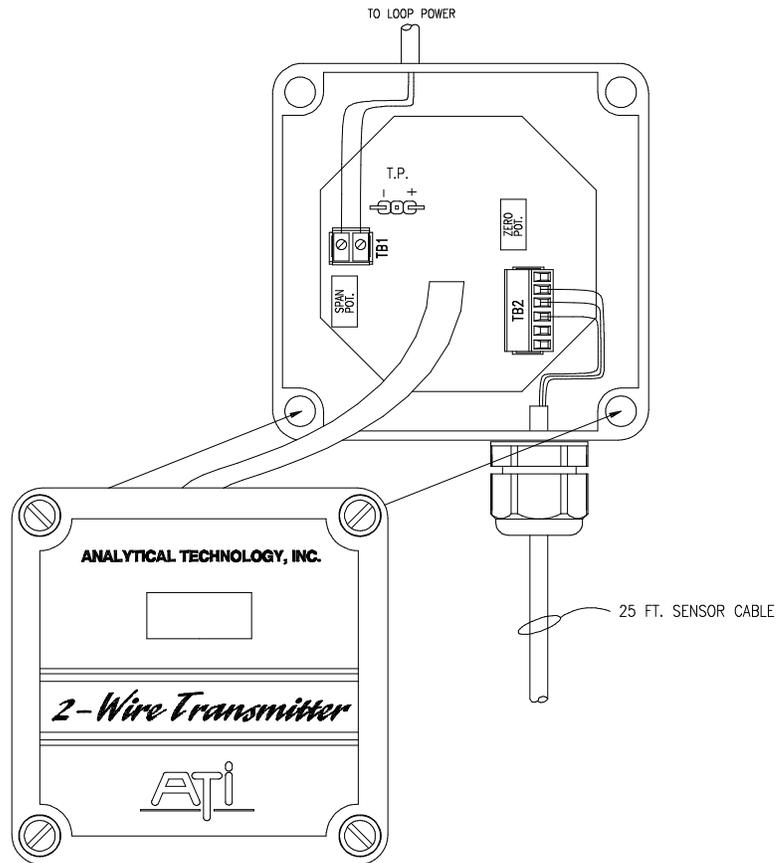


Figure 9 - Transmitter Controls & Test Points (ATI-0227)

## CALIBRATION

Transmitter calibration requires adjustment of both zero and span. Zero is adjusted when the sensor is exposed to air containing no acid gases. Span is adjusted when a gas stream containing a known concentration of acid gas is passed through the low volume flowcell.

### ZERO ADJUSTMENT

As previously mentioned, adjusting the transmitter zero requires that the sensor be exposed to acid gas free air. The simplest approach is to simply expose the sensor to ambient air that is free of gases to which the sensor will respond. Threading the low volume flowcell onto the sensor will isolate the sensor from surrounding air for zeroing purposes.

If the area in which the sensor is operating is known to be gas free, then the transmitter can be zeroed without further equipment. If not, use of "zero air" from a gas cylinder is recommended. Zero air is available as part of all ATI calibration kits, or may be obtained from any specialty gas supplier. When zero air is to be used, a low volume flowcell (part no. 00-0422) must be used. The low volume flowcell provides a confined space around the sensor into which the zero air can flow. Low volume flowcells provide tube fittings at the bottom to connect air tubing as shown in Figure 2.

To zero the transmitter, remove the cover and connect a DVM to the test points shown in Figure 6. Observe the DVM value to be sure that it is no longer declining, and that it is stable  $\pm 4$  mv. Use the zero potentiometer (Figure 6) to adjust the test point voltage to 0.040 VDC (40 mv.). If the transmitter is supplied with the LCD option, no DVM is required.

### SPAN ADJUSTMENT

Once the zero has been set, thread the low volume flowcell onto the sensor (if it is not already there from zeroing). Attach a source of gas with a known acid gas concentration and adjust the sample flowrate to 500 cc/min. For convenience, chlorine gas may be used as a simulant for calibration. A typical chlorine gas source is the electrochemical chlorine generator manufactured by Advanced Calibration Designs in Tucson, AZ. Allow sample to flow for 10 minutes.

Observe the DVM value. The reading should be relatively stable  $\pm 4$  mv. Adjust the span potentiometer (Figure 6) until the proper test point voltage is obtained. The proper voltage to set when adjusting transmitter span will vary depending on the range of the transmitter. The following formula is used to calculate the proper span voltage for any transmitter.

$$V = 0.040 V + [0.160 X (\text{Measured Concentration} \div \text{Transmitter Range})]$$

As an example, suppose you are calibrating a transmitter with a range of 0-10 PPM, and the chlorine gas standard used for calibration has a value of 5 PPM. The above formula would then become:

$$V = 0.040 V + [0.160 X (5 \div 10)] = 0.120 V.$$

Therefore, adjusting the transmitter to a reading of 120 mv. at the test point would properly calibrate the transmitter.

## **SENSOR RESPONSE TEST**

While zero and span adjustments are required only periodically, gas sensors should be checked regularly for proper response. The response test can be done using powdered calcium hypochlorite (HTH) available from any swimming pool supply.

The sensor response test will create a condition where alarm relays will be activated unless they are inhibited. To observe the response at the transmitter without display, it is necessary to connect a DVM to the test points indicated in Figure 6. If the transmitter is supplied with the LCD option, no DVM is required.

Place a teaspoon of calcium hypochlorite into a plastic bottle and keep the bottle capped until ready to test the sensor. Open the bottle and place the mouth near the sensor. The DVM reading will rise rapidly. Immediately remove the bottle as it is best to expose the sensor to the high concentrations as briefly as possible. If the sensor does not respond when the bottle is held near the sensor, the sensor membrane and electrolyte should be replaced.

## **MAINTENANCE**

The only maintenance required on the B12-70 system is periodic sensor service. The wet acid gas sensor uses a microporous membrane that can lose sensitivity with the accumulation of solids or precipitates in the membrane. As a preventive measure, sensors should be rebuilt with new membrane and electrolyte about every 3-4 months.

Follow the sensor assembly procedure on pages 10 and 11 of this manual to replace the membrane and electrolyte.

## SPARE PARTS LIST

<u>PART NO.</u>	<u>DESCRIPTION</u>
01-0065	B12-69/70 Wet Oxidant/Acid transmitter PCB (10-100 PPM)
01-0113	B12/69/70 Wet Oxidant/Acid transmitter PCB (1-10 PPM)
81-0002	NEMA 4X enclosure (top and bottom)
03-0039	Explosion-proof Enclosure Assembly
38-0002	Terminal block plug, 2 position
92-0005	Self-tapping screws, (pkg. of 4), (for NEMA-4 enclosure)
92-0007	Self-tapping screws, (pkg. of 4), (for Explosion-proof enclosure)
44-0017	Pg 16 to 1/2" NPT conduit hub with nut
44-0018	Seal ring (required for NEMA 4X rating on conduit hubs)
00-0077	Wet oxidant/acid gas sensor
02-0016	Sensing element body (for #00-0077)
03-0029	Sensor interconnect cable, 25 ft.
45-0007	Electrolyte chamber
45-0010	Front Nut, noryl
05-0035*	Membranes, pkg. of 10
05-0004*	Spare Parts Kit, screw & o-ring
09-0016*	Wet acid gas sensor electrolyte, 4 oz (120 cc)

Note: Instrument is supplied with sufficient spare parts for 6-12 months of operation. For 2 year spare parts inventory, 2 each of the items marked with an asterisk (\*) should be ordered.

# PRODUCT WARRANTY

Analytical Technology, Inc. (Manufacturer) warrants to the Customer that if any part(s) of the Manufacturer's equipment proves to be defective in materials or workmanship within the earlier of 18 months of the date of shipment or 12 months of the date of start-up, such defective parts will be repaired or replaced free of charge. Inspection and repairs to products thought to be defective within the warranty period will be completed at the Manufacturer's facilities in Collegeville, PA. Products on which warranty repairs are required shall be shipped freight prepaid to the Manufacturer. The product(s) will be returned freight prepaid and allowed if it is determined by the manufacturer that the part(s) failed due to defective materials or workmanship.

This warranty does not cover consumable items, batteries, or wear items subject to periodic replacement including lamps and fuses.

Gas sensors carry a 12 months from date of shipment warranty and are subject to inspection for evidence of misuse, abuse, alteration, improper storage, or extended exposure to excessive gas concentrations. Should inspection indicate that sensors have failed due to any of the above, the warranty shall not apply.

The Manufacturer assumes no liability for consequential damages of any kind, and the buyer by acceptance of this equipment will assume all liability for the consequences of its use or misuse by the Customer, his employees, or others. A defect within the meaning of this warranty is any part of any piece of a Manufacturer's product which shall, when such part is capable of being renewed, repaired, or replaced, operate to condemn such piece of equipment.

This warranty is in lieu of all other warranties (including without limiting the generality of the foregoing warranties of merchantability and fitness for a particular purpose), guarantees, obligations or liabilities expressed or implied by the Manufacturer or its representatives and by statute or rule of law.

This warranty is void if the Manufacturer's product(s) has been subject to misuse or abuse, or has not been operated or stored in accordance with instructions, or if the serial number has been removed.

Analytical Technology, Inc. makes no other warranty expressed or implied except as stated above.

## WATER QUALITY MONITORS

Dissolved Oxygen  
Free Chlorine  
Combined Chlorine  
Total Chlorine  
Residual Chlorine Dioxide  
Potassium Permanganate  
Dissolved Ozone  
pH/ORP  
Conductivity  
Hydrogen Peroxide  
Peracetic Acid  
Dissolved Sulfide  
Residual Sulfite  
Fluoride  
Dissolved Ammonia  
Turbidity  
Suspended Solids  
Sludge Blanket Level

**MetriNet** Distribution Monitor

## GAS DETECTION PRODUCTS

NH <sub>3</sub>	Ammonia
CO	Carbon Monoxide
H <sub>2</sub>	Hydrogen
NO	Nitric Oxide
O <sub>2</sub>	Oxygen
CO	Cl <sub>2</sub> Phosgene
Br <sub>2</sub>	Bromine
Cl <sub>2</sub>	Chlorine
ClO <sub>2</sub>	Chlorine Dioxide
F <sub>2</sub>	Fluorine
I <sub>2</sub>	Iodine
H <sub>x</sub>	Acid Gases
C <sub>2</sub> H <sub>4</sub> O	Ethylene Oxide
C <sub>2</sub> H <sub>6</sub> O	Alcohol
O <sub>3</sub>	Ozone
CH <sub>4</sub>	Methane (Combustible Gas)
H <sub>2</sub> O <sub>2</sub>	Hydrogen Peroxide
HCl	Hydrogen Chloride
HCN	Hydrogen Cyanide
HF	Hydrogen Fluoride
H <sub>2</sub> S	Hydrogen Sulfide
NO <sub>2</sub>	Nitrogen Dioxide
NO <sub>x</sub>	Oxides of Nitrogen
SO <sub>2</sub>	Sulfur Dioxide
H <sub>2</sub> Se	Hydrogen Selenide
B <sub>2</sub> H <sub>6</sub>	Diborane
GeH <sub>4</sub>	Germane
AsH <sub>3</sub>	Arsine
PH <sub>3</sub>	Phosphine
SiH <sub>4</sub>	Silane
HCHO	Formaldehyde
C <sub>2</sub> H <sub>4</sub> O <sub>3</sub>	Peracetic Acid
DMA	Dimethylamine