

Model 5000
Vortex Meter

Installation and
Instruction Manual



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Installation and Instruction

GENERAL INFORMATION

1-1 GENERAL

Vortex Shedding is not new. Da Vinci observed vortex shedding in 1513. Von Karman provided an empirically determined formula for it in 1911-1912. One observes it as eddies downstream of a rock or a piling in a fast moving stream. Yet, it wasn't until it was successfully developed and installed in the late 1960's that this significant development in the science of flow measurement was given considerable attention by industry.

1-2 PRINCIPLES OF OPERATION

With the controlled use of an obstruction installed in a given pipeline, vortices are generated downstream of the obstruction when fluid or gas flows through a pipe. A vortex is a swirling low pressure eddy which forms alternately from side to side of the bluff body. With each eddy, there is formed a corresponding high pressure pulse opposite the bluff body. (See Figure 1.) These pulses are directly proportional to the velocity of a given fluid. Each pulse represents given volumetric units of fluid for a given line size. Since each pulse represents a unit volume, the output is therefore linear with respect to flow rate.

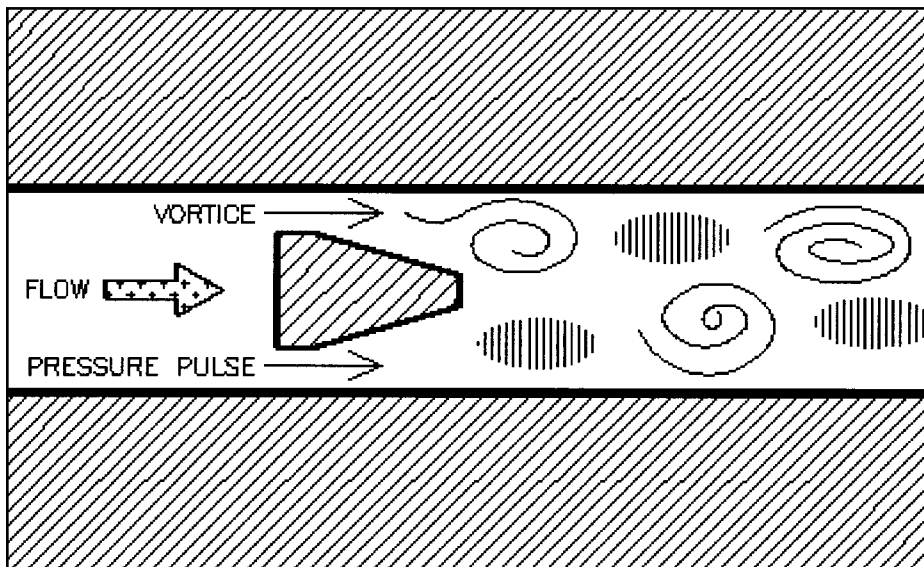


Figure 1

1-3 SENSOR OPERATION

Two pressure sensing devices are mounted internally in proximity to the stainless steel bluff body. The sensors are piezo electric crystals. The crystals convert the pressure pulses created by the vortices into voltage signals without the need of excitation current or voltage. The sensor crystals are never in direct contact with the fluid. The piezo crystals are encapsulated in a stainless steel module. These sensor assemblies can be replaced if the need ever arises.

1-4 CALIBRATION FACTOR

The frequency at which vortices are shed is a linear function of fluid velocity, and therefore, a measure of flow. In the range covered by the particular flowmeter, vortex frequency is insensitive to specific gravity, viscosity, and temperature of the fluid and depends only upon the width (d) in inches and shape of the flow element, and the inside diameter (D) of the pipeline in inches.

The frequency is : $F=SV/d$

where : F = Karman vortex frequency
S = constant (Strouhal Number)
V = fluid velocity at the flow element
d = face width of the element

The frequency relationship is accurately linear and reproducible, eliminating the need for "wet calibration." (See Figure 2.)

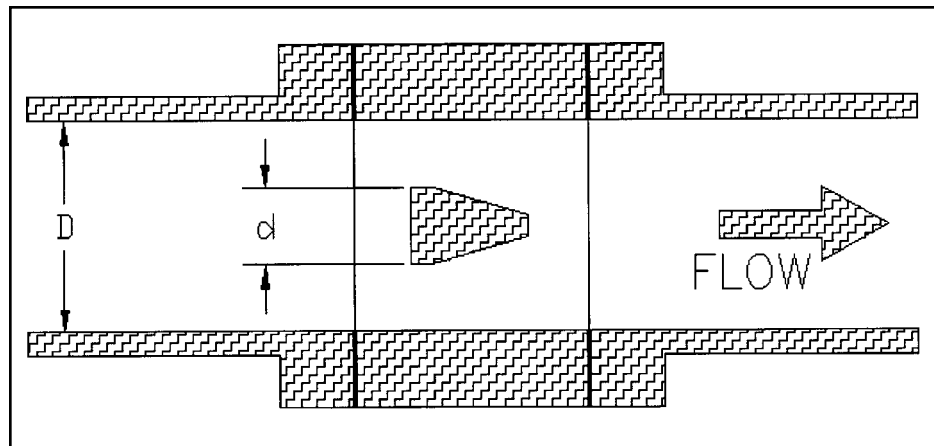


Figure 2

HANDLING AND STORAGE

2-1 HANDLING PRECAUTIONS

The Model 5000 vortex flow meter has been tested and calibrated at the factory. When the instrument is received, it should be inspected for damage due to mishandling during shipment. If damage is evident, report it to the carrier immediately and have them present when the case is opened. They are responsible for any damage during shipment. If you have any problems or questions, consult the factory or your local representative.

2-2 STORAGE

After receiving the Model 5000, care should be taken to avoid unnecessary damage. If the meter is not scheduled to be installed soon after delivery, the following steps should be observed:

- A) After inspection, the meter should be repacked into its original packing.
- B) If the meter being stored has been previously installed, care should be taken to remove all process fluids and corrosives.
- C) Select a clean, dry site free of mechanical vibration, shock and chemical corrosives.

INSTALLATION

3-1 INSTALLATION

The AALIANT Model 5000 vortex flow meter is designed to operate under a wide variety of conditions. To ensure its longevity of operation, precautions should be taken before and during its installation.

3-2 SELECTING THE INSTALLATION SITE

- A) The vortex meter requires a minimum of 20 straight diameters upstream and 5 straight unobstructed diameters of downstream piping. One diameter is equal to the internal pipe diameter. This is necessary to ensure regulated formation of vortices. (See Figure 3 for the piping requirements chart for various piping recommendations.)
- B) Choose a site with minimal mechanical vibrations.
- C) Avoid areas of high humidity or corrosive atmosphere where possible.
- D) When installing the meter, choose a site which is accessible and allows ease of wiring and maintenance.

PIPING TABLE

| | Typical Piping | Recommended Straight Pipe Length "A" | | Remarks |
|----------------------------|----------------|---------------------------------------|------------|---|
| | | Without Vanes | With Vanes | |
| All Fittings in Same Plane | | 15D* | 15D | Closed branch |
| | | 20D | 15D | Elbow, Tee, Branch pipe |
| | | 25D | 15D | Elbow, 2 places |
| | | 25D | 15D | Long-radius bends |
| Fittings in Two Planes | | 30D 25D | 15D 15D | Elbow Long-radius bend |
| | | 40D 35D | 20D 20D | Elbow Long-radius bend |
| Varied Section | | 20D | 15D | Contracting pipe |
| | | 40D | 20D | Expanding pipe |
| Valves | | Recommend Meter Be Installed Upstream | | Regulating, reducing valves Ball, check valves Shut-off valve |

Note: Straight pipe length on the downstream side to be 5 pipe diameters minimum.
*D = Pipe internal diameter

Figure 3

3-3 PIPING GUIDELINES

To ensure the high accuracy of flow measurement specified on the identification sheet, piping and installation instructions must be followed carefully.

- A) The pipe immediately up and down stream of the flow meter must be of sufficient length, straight and free of obstructions. Refer to the piping requirements chart for exact dimensions (Figure 3).
- B) It is recommended that straightening vanes be used on all vortex meters, but it is not necessary.
- C) When the vortex meter is being used as a controller, it is recommended that any regulating valve be located downstream of the flow meter.
- D) Weld beads on the internal wall of the pipe before or after the flow meter should be ground flush with the pipe wall before the meter is installed.
- E) Proper style and proper size gaskets should always be used when installing the flow meter.
- F) The meter can be rotated around the pipe in any direction.

3-4 TEMPERATURE AND PRESSURE TAPS

Installation of temperature and pressure transducers (if used) should be in accordance with the manufacturer's specifications.

- A) The temperature transducer should be installed between 2.5 and 3.5 diameters from the downstream side of the wafer body. Consult the factory for the exact dimensions, or refer to additional information at the end of this manual.
- B) The pressure transducer should be installed between 2.0 and 3.5 diameters from the upstream side of the wafer body. Consult the factory for the exact dimensions.

3-5 ORIENTATION

The Model 5000 flow meter uses piezo-electric sensing elements with no moving parts. This eliminates wear and allows for vertical or horizontal installation.

3-6 MODEL 5000 INSTALLATION PROCEDURE

- A) The MODEL 5000 will be inserted into the center line of the pipe for line sizes 3 inches and larger. For sizes which are larger than 24 inches, a one-third diameter insertion depth is used.
- B) Please refer to your part number to verify the proper installation drawing.
- C) The MODEL 5000 inserts through a 1-1/2 inch hole, the weldolet, nipple and valve. The valve must be threaded full bore 1-1/2 inches in size.
- D) When the flange version is used, a flange is supplied. This flange has an overall height of 3 inches. This must be taken into account when installing the nipple. The overall height is given on the drawings.
- E) When screwing in the 1-1/2 inch NPT threads into the valve, do not use the large nut on the top of the seal assembly to tighten the meter in the valve. Use the machined hex on the seal assembly. The large nut is only used to tighten down on a split ring, which holds the bar in place, keeping it from being pushed out of the line.
- F) After installing the meter, check for alignment. There is a mark on the top of the bar nearest the electronics which should face exactly upstream. This mark is aligned with the element and will give proper alignment of the element in the flow while facing upstream. If this mark does not face upstream after installing the meter, the bar must be rotated. There are flats on the top of the bar next to the electronics which accommodate a

one inch open ended wrench. The bar can be turned until the mark faces upstream. If the assembly is too tight to rotate the bar, the large nut on the seal assembly can be loosened.

CAUTION
DO NOT LOOSEN THE NUT UNLESS THE LINE IS DEPRESSURIZED OR A HOT-TAP MECHANISM HAS BEEN INSTALLED PROPERLY ON THE METER SHAFT.

- G) After aligning the mark, keep your 1 inch open-ended wrench on the flats on top of the bar, holding it in place, then tightening down on the larger nut on the seal. This will prevent the bar from turning when completing the final tightening on the split ring nut.

IMPORTANT NOTE

For final check, make certain that the meter has not come loose from its 1-1/2 inch NPT connection and be sure that the split ring nut and seal assembly are firmly in place.

SAFETY PRECAUTIONS

Please keep clear of the meter when the line is being pressurized. This is a good safety procedure for the installation of any equipment in a pressurized line.

3-7 INSTALLATION AND USE OF INSERTION TOOL

The purpose of the insertion tool is to remove or install a meter during flow. The insertion tool should be installed prior to making any adjustments to the meter itself. The insertion tool is a separate device which can be installed on any MODEL 5000 meter regardless of whether it is metering liquids, gases or steam.

- A) The bottom assembly is clamped around the seal assembly. This piece is bolted together just below the machined step on the seal, thus insuring that the bottom piece will not move during its operation.
- B) Attach the upper two pieces of the tool to the meter shaft 2" down from the top of the shaft.
- C) Make certain that all nuts, bolts and couplings are tightened securely.
- D) Recheck steps A through C to assure that everything is tightened and corresponds to the drawing on the insertion tool. If the above steps check out OK, open the valve.

- E) **EXTREMELY IMPORTANT**
This step is very important so that no leakage, which could cause injury, occurs.

Loosen the nut on the split ring on the top of the seal assembly making sure not to loosen the entire seal assembly out of the piping. (The larger of the hex nuts is the split ring assembly.) This should be completely loosened. This can be accomplished by holding the seal assembly in place and then loosening the large hex nut on the split ring assembly. The split ring nut should be loosened completely.

CAUTION

After the nut is completely removed, the pressure is now against the insertion tool. Do not stand in the direction of extraction as personal injury could occur.

- F) The meter can now be removed or inserted by putting a wrench on top of the threaded shaft of the insertion tool and turning the shaft until the meter is extracted from or inserted into the pipe.

CAUTION

The shaft will not go completely through the seal assembly, therefore, when the shaft stops extracting, do not apply additional force or damage could occur.

- G) After the meter has been extracted, the valve should be closed, and the entire seal assembly unscrewed from the piping. The entire meter and extraction tool is then removed from the pipe.

CAUTION

Remove the seal assembly slowly. There may be an amount of pressurized fluid in the nipple, or the valve may not be sealing properly.

- H) When reinstalling or removing the meter, repeat the entire procedure starting with step A.

ELECTRONICS

WARNING!

WIRING THE TRANSMITTER WITH THE POWER ON MAY RESULT IN INTERNAL DAMAGE OR LOSS OF MEMORY! PLEASE MAKE ALL WIRING CONNECTIONS BEFORE SWITCHING ON THE POWER.

4.1 DESCRIPTION

The Smart Transmitter is supplied with all vortex flowmeters. It is designed to be wall mounted, remote from the meter, for easy user access. The unit's large, easy-to-read LCD indicator displays flow rate, total flow and various alarms. The keypad allows the user to easily program parameters including engineering units, filtration levels, and sampling times. It also allows the user to re-calibrate for new flow conditions.

The unit simultaneously transmits 4-20mA and scaled pulse in engineering units, as well as serial communications. It also features remote data acquisition for reading all internal parameters of the flowmeter, as well as the 15,000 points of data logging.

The unit has a built-in non-volatile memory for setup and calibration data, data logging information, as well as other parameters (ten + years retention of information).

4.2 SPECIFICATIONS

Outputs:

| | |
|-------------------------------|--|
| 4-20mA output: | 14 to 36 volts at 20mA |
| Pulse output: | Optically isolated pulse output, 5 volt pulse (other voltages available) |
| Serial communications output: | RS-232 |

Inputs:

| | |
|----------------|------------------------------|
| 24 VDC: | Requires 14-36 volts at 20mA |
| 110 VAC supply | |
| 220 VAC supply | |

Operating Temperature Limits:

Minimum temperature: -20°C (-4°F)
Maximum temperature: $+54^{\circ}\text{C}$ ($+130^{\circ}\text{F}$)

Displays:

Two line, 16 characters each line, alphanumeric L.C.D. display.
Simultaneously displays both rate and total in engineering units.

| | |
|--------|--|
| Rate: | 6 digits (or 5 with a floating decimal). If rate shows E1, then value is times 10 If rate shows E2, then value is times 100 If rate shows E3, then value is times 1,000 |
| Total: | 8 digits If total shows K, then value is times 1,000 |

4.3 HANDLING AND STORAGE

The smart transmitter has been tested and programmed at the factory. When the transmitter is received, it should be inspected for damage due to mishandling during shipment. If damage is evident, report it to the carrier immediately and have them present when the carton is opened. The carrier is responsible for any damage during shipment. If you have any problems or questions, consult the factory or your local representative.

After receiving the unit, handle with care to avoid any unnecessary damage. If the unit is not scheduled to be installed immediately after delivery, the following steps should be observed:

- A) After inspection, the transmitter should be repacked into its original packing.
- B) Select a clean, dry place to store the meter.
- C) Avoid areas of extreme temperatures. The unit should be stored in an area that falls between -40°F and $+130^{\circ}\text{F}$.

4.4 MOUNTING

The transmitter enclosure has two mounting feet for easy wall mounting. The enclosure should be located within 100 feet from the pipeline sensor, and ideally should be at eye level for easy viewing and access to the keypad for programming.

4.5 WIRING CONNECTIONS

The transmitter module fits snugly within the enclosure, but will slide out by hand without the necessity of a tool for removal.

CAUTION: Make all wiring connections before switching on power.

| | |
|--------------------------------|--|
| 24 VDC two wire supply: | Refer to drawing "24VDC With Transmitter" |
| 110 VAC supply: | Refer to drawing "110VAC With Transmitter" |
| 220 VAC supply: | Refer to drawing "220VAC With Transmitter" |

18 or 20 gauge shielded twisted pair is recommended

The terminals accept 14 to 24 gauge wire, but 18 gauge shielded wire (Belden 8760) or 20 gauge shielded wire (Belden 9154) is recommended. When making wiring connections, cable glands should be fitted to prevent moisture entering the enclosure.

4.6 START-UP PROCEDURES

- A) Wire the transmitter with reference to the correct wiring drawing. **DO NOT POWER THE UNIT UNTIL THE WIRING HAS BEEN COMPLETED.**
- B) Power up the unit. The display will remain blank for several seconds, but will then show rate and total, unless it is in an alarm condition.
- C) All parameters have been set by the factory for your particular application. There should be no need for reprogramming the transmitter.

4.7 ALARM STATEMENTS

The following alarm messages may appear during operation:

Flow Turbulence/Bad Reading

The flow is erratic due to improper piping or other disturbances in the line.

Flow Above Calibrated Range

The flow is above the maximum calibration point.

Flow Below Calibrated Range

The flow is below the minimum calibration point.

Flow is Below Low Cut Off

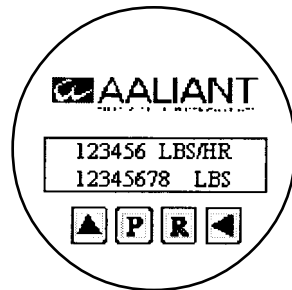
The flow is below the low frequency set point. The rate indicator will fall to zero if the condition lasts more than one minute.

Flow is Above High Cut Off

The flow is above the high frequency set point.

Note: If any of the above alarms are present for more than one minute, the 4-20mA output will oscillate +1mA from actual value at one second intervals.

4.8 RECALIBRATION AND PROGRAMMING PROCEDURES



- = Increase
- = Cursor
- = Program
- = Resets Totalizer

WARNING: If you hit the **R** key while in the Program mode, the Totalizer will reset to zero.

- A) Unscrew the cover of the enclosure.
- B) Press the **Program** key. The display will show "ENTER PASSWORD." Each meter is set with a numerical password which is located in your manual.
- C) Using the **Cursor** key to move the cursor to the desired digit you want to change, and use the **Increase** key to cycle through the digits 0 - 9 until the desired value is reached. Do this for each digit until the password

code is entered. Once you reach your value, press and hold the **Program** key. This will bring you into the program mode.

Note: Once in the program mode, you must hit a key within approximately 20 seconds of hitting the previous key, or the display will return to the main display pictured above. If this occurs, repeat the steps beginning from B).

- D) Once you are in the program mode, the display will read **4 mA SETTING**. This is the beginning of the sequence of parameters. Below is the sequence, along with an explanation of their meanings. To reset any of the parameters use the **Cursor** key to move the cursor to the desired digit you want to change, and use the **Increase** key to cycle through the digits 0-9 until the desired value is reached. Confirm and move to next parameter by pressing the **Program** key. To continue cycling the parameters, keep hitting the **Program** key until you reach the parameter you are trying to change.
- 1) **4 mA SETTING** – normally set to zero, but it can be set to an elevated level; setting is in engineering units.
Press **P**
 - 2) **20 mA SETTING** – maximum flow setting; setting is in engineering units.
Press **P**
 - 3) **SCALING FACTOR – WARNING DO NOT CHANGE THIS VALUE!!**
If you change this value, the readings and the accuracy of the meter may be affected. If the value is accidentally changed, the original scaling factor can be found on the data sheet provided with the meter. If the meter is to be used on a new application, a new scaling factor must be requested from the manufacturer.
Press **P**
 - 4) **HI FREQ CUTOFF** – this is the high frequency cutoff value; setting is in frequency units.
Press **P**
 - 5) **LOW FREQ CUTOFF** – this is the low frequency cutoff value; setting is in frequency units.
Press **P**
 - 6) **FLOW RATE PER** – use the **Increase** key to enter one of the following:
0 = per second 2 = per hour
1 = per minute 3 = per day
Press **P**
 - 7) **RESPONSE TIME** – filter setting; this setting will control the smoothing of the reading. This can be set between 1 and 10 but will normally be set to 2 for steam and gas or 5 for liquid. The larger the number the slower the response time.
Press **P**
 - 8) **FLOW SAMPLE TIME** – each digit represents 20 milliseconds with a maximum of 250 (5 seconds); this value is normally set to 50 for a one second sample window.
Press **P**
 - 9) **LOG SAMPLE TIME** – sample times from 1 to 256 minutes in real time.
Press **P**

- 10) **ENGINEERING UNITS** – The following are the units available through the keypad (Additional three character engineering units are available pre-programmed from the factory or through the serial communications port):

| | |
|------|-----------------|
| LB | = pounds |
| KG | = kilograms |
| TON | = tons |
| TONN | = metric tonnes |
| CUFT | = cubic feet |
| LITR | = liters |
| CU.M | = cubic meters |
| GAL | = US gallons |

Use the **Increase** key to scroll through the choices of units.

Press **P**

- 11) **ERROR MESSAGES** – Use the **Increase** key to select **Yes** or **No** for enabling or disabling Alarm conditions. Default setting is Yes.

Press **P**

4.9 SERIAL COMMUNICATIONS

All parameters are accessible and recalibration is available through the serial communications port.

4.10 DATA LOGGING

The data logging feature is only accessible through the serial port.

IMPORTANT NOTICE

If your meter was originally supplied for use on a liquid application and you now wish to change the fluid to steam or gas, you must change the position of the jumpers on the terminal board from the vertical to horizontal position and vice versa for a change from steam or gas to liquid.

START UP

5.1 CAUTIONS PRIOR TO START UP

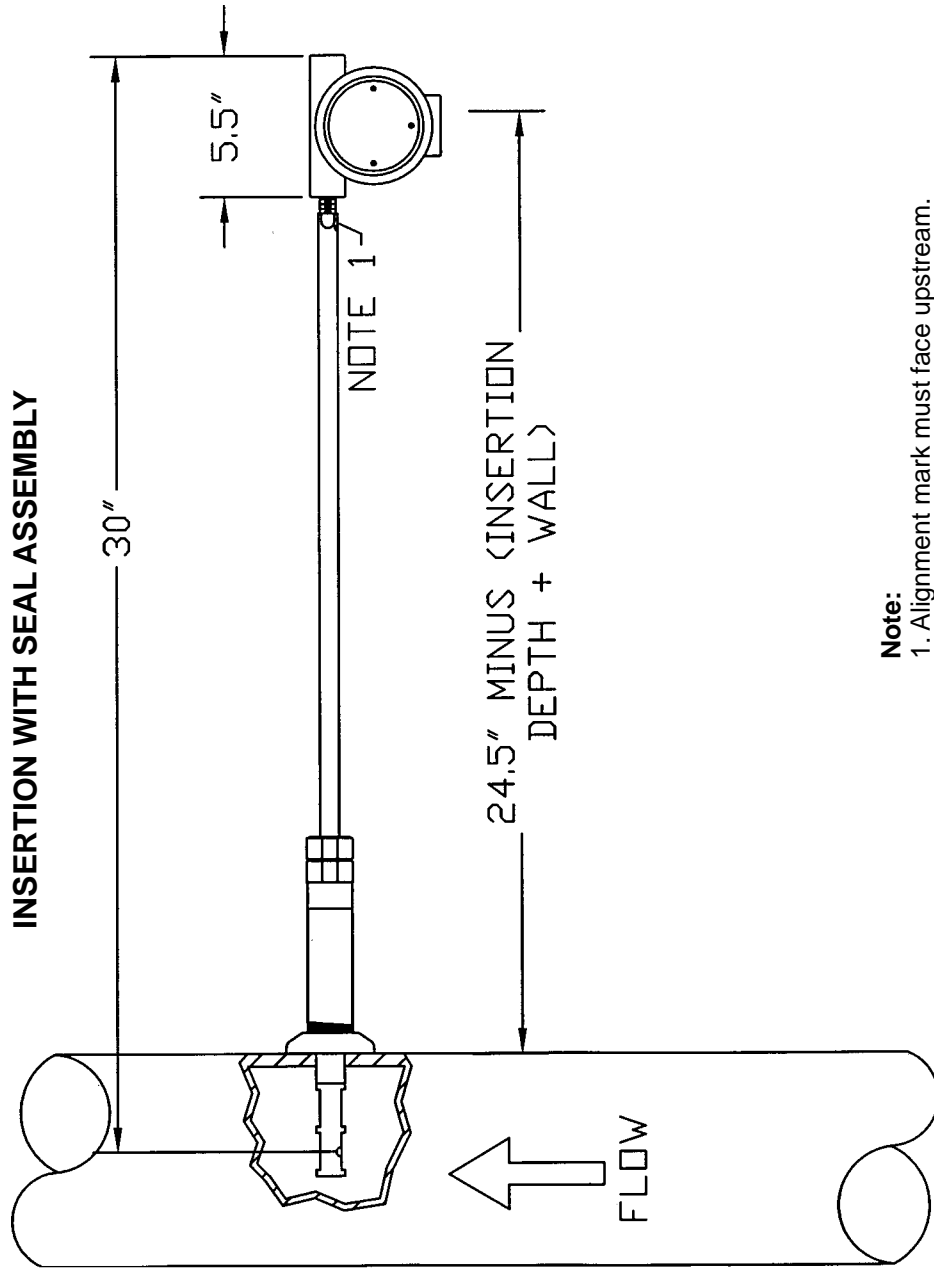
In general, it is good practice to purge the line slowly to prevent unnecessary damage to the meter.

Once the pipeline is pressurized, check the flow meter and flanges for leaks. The temperature and pressure transducers should also be checked for leaks.

The meter may give erratic outputs during purging the line if the power has been turned on before purging the line.

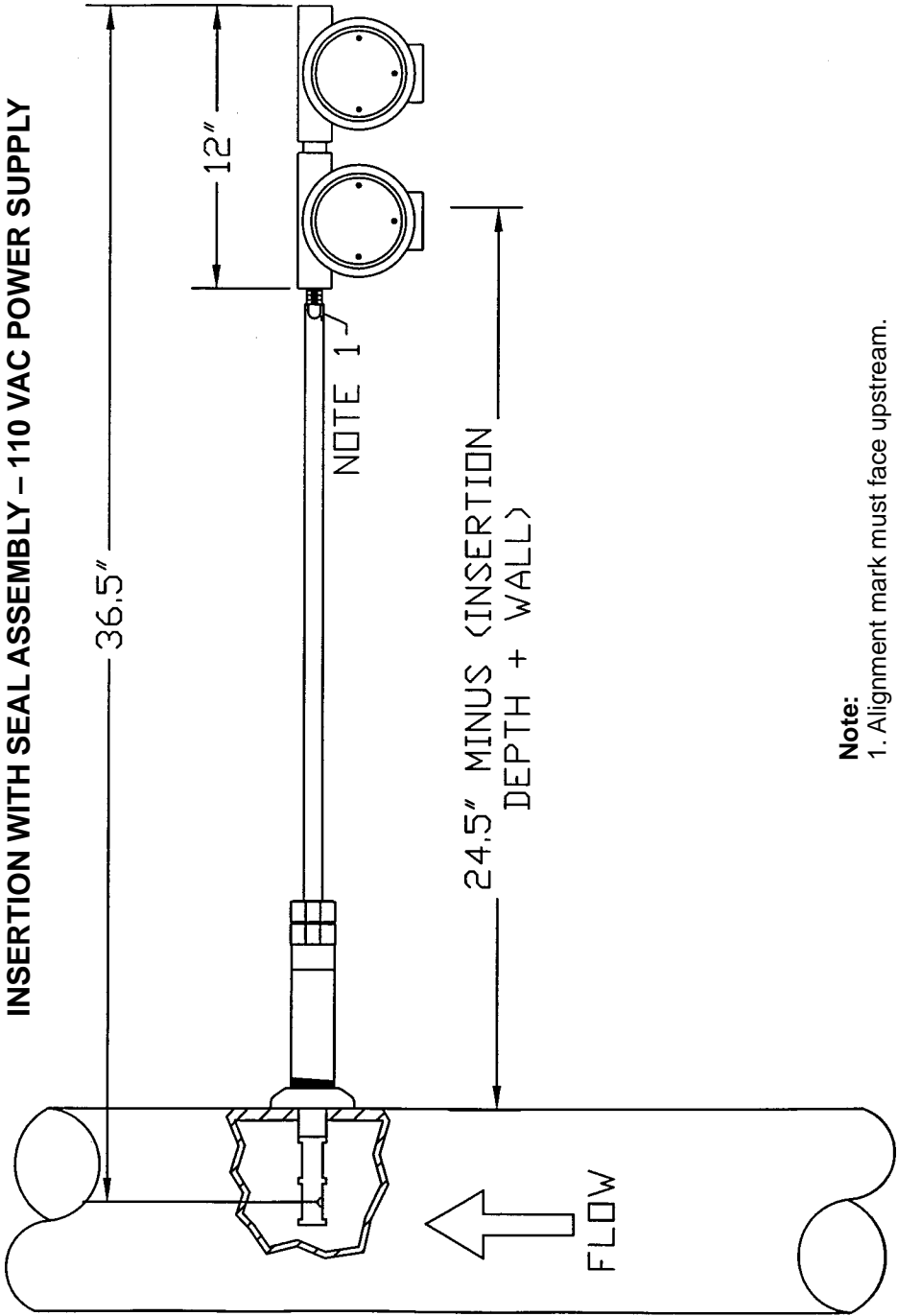
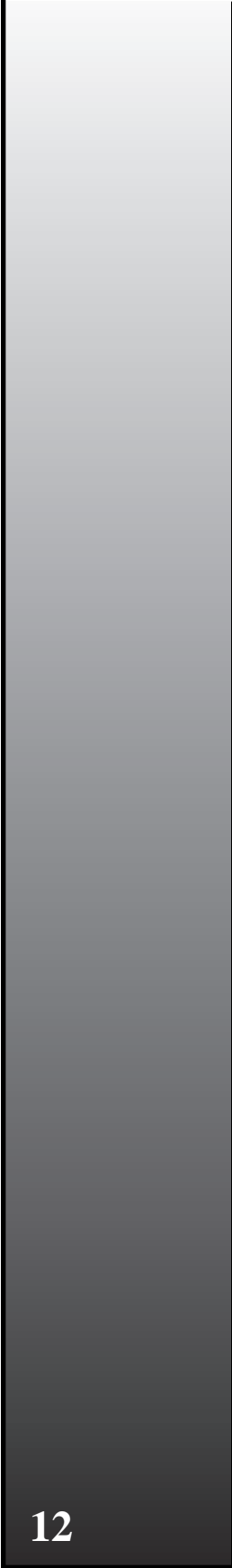
The Model 5000 flow meter does not have the capability of measuring two phase flow. In liquid applications, the line should be totally purged of air before powering the flow meter.

During start up, remember that the meter will not read accurately until the flow rate meets or exceeds the minimum flow rates stated on the I.D. sheet. The maximum and minimum flow rates for a specific flow meter can be found on the meter I.D. sheet in the beginning of this manual.

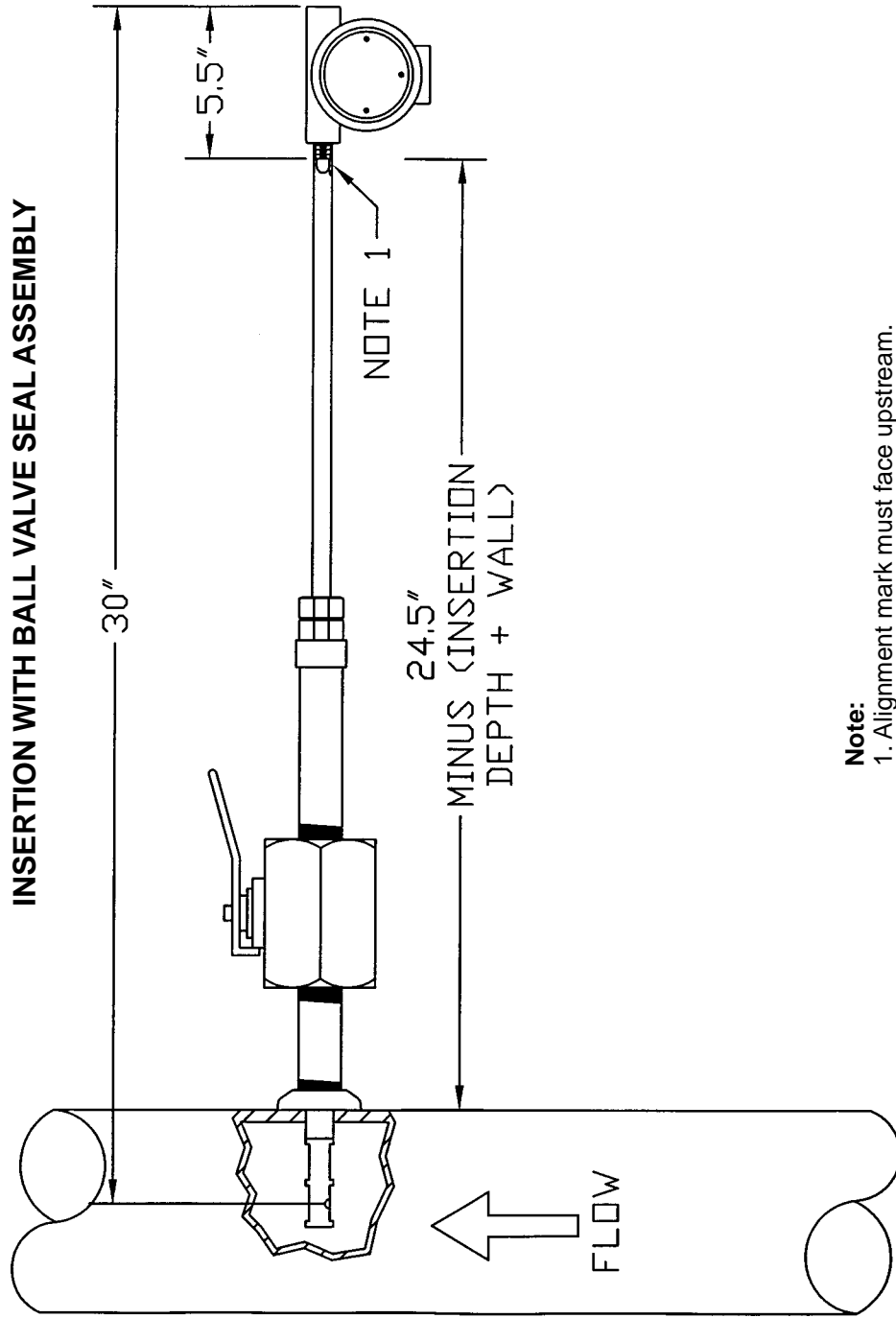


Note:
1. Alignment mark must face upstream.

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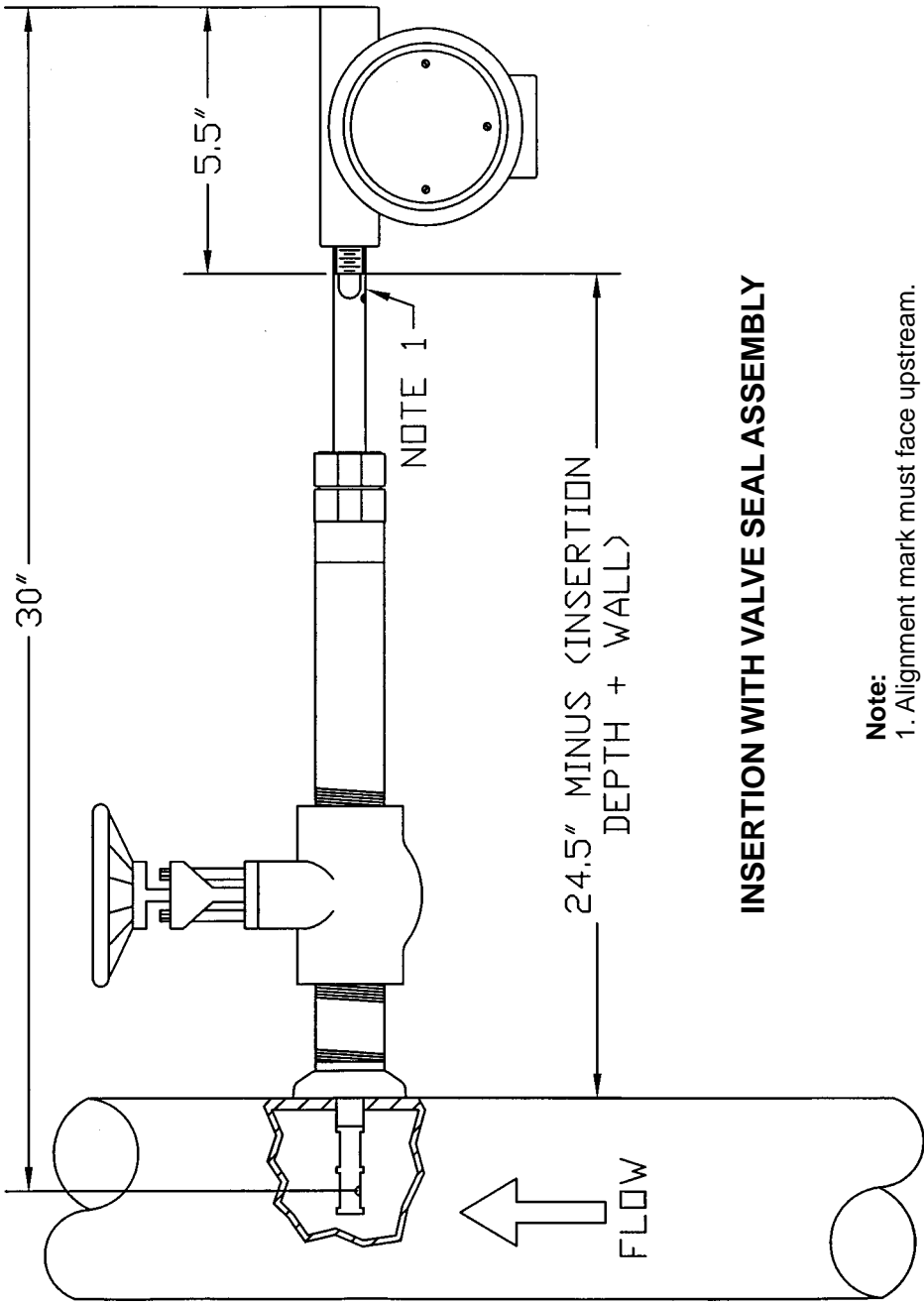


Note:
1. Alignment mark must face upstream.



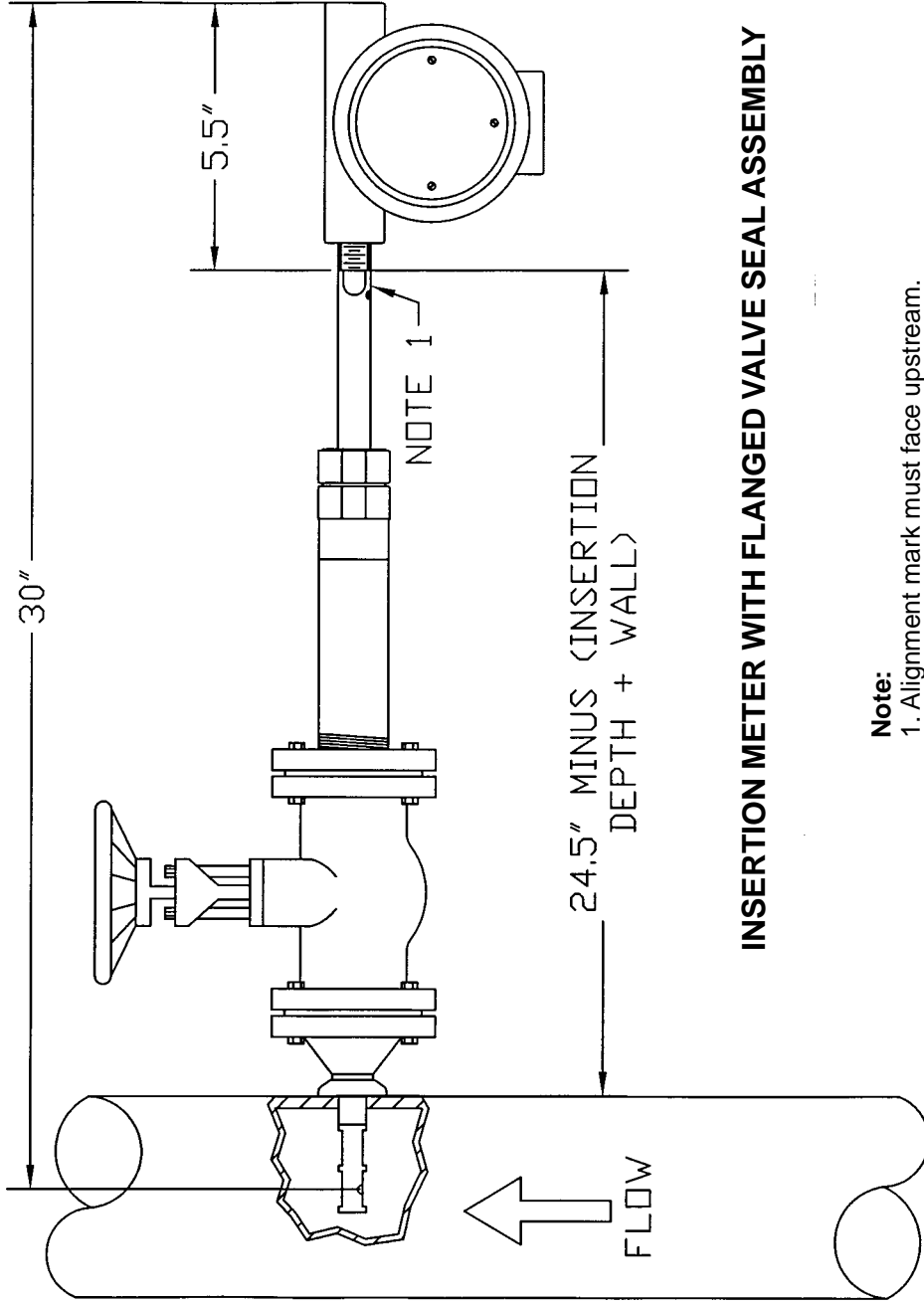
Note:
1. Alignment mark must face upstream.

VTX-2E0010



INSERTION WITH VALVE SEAL ASSEMBLY

Note:
1. Alignment mark must face upstream.

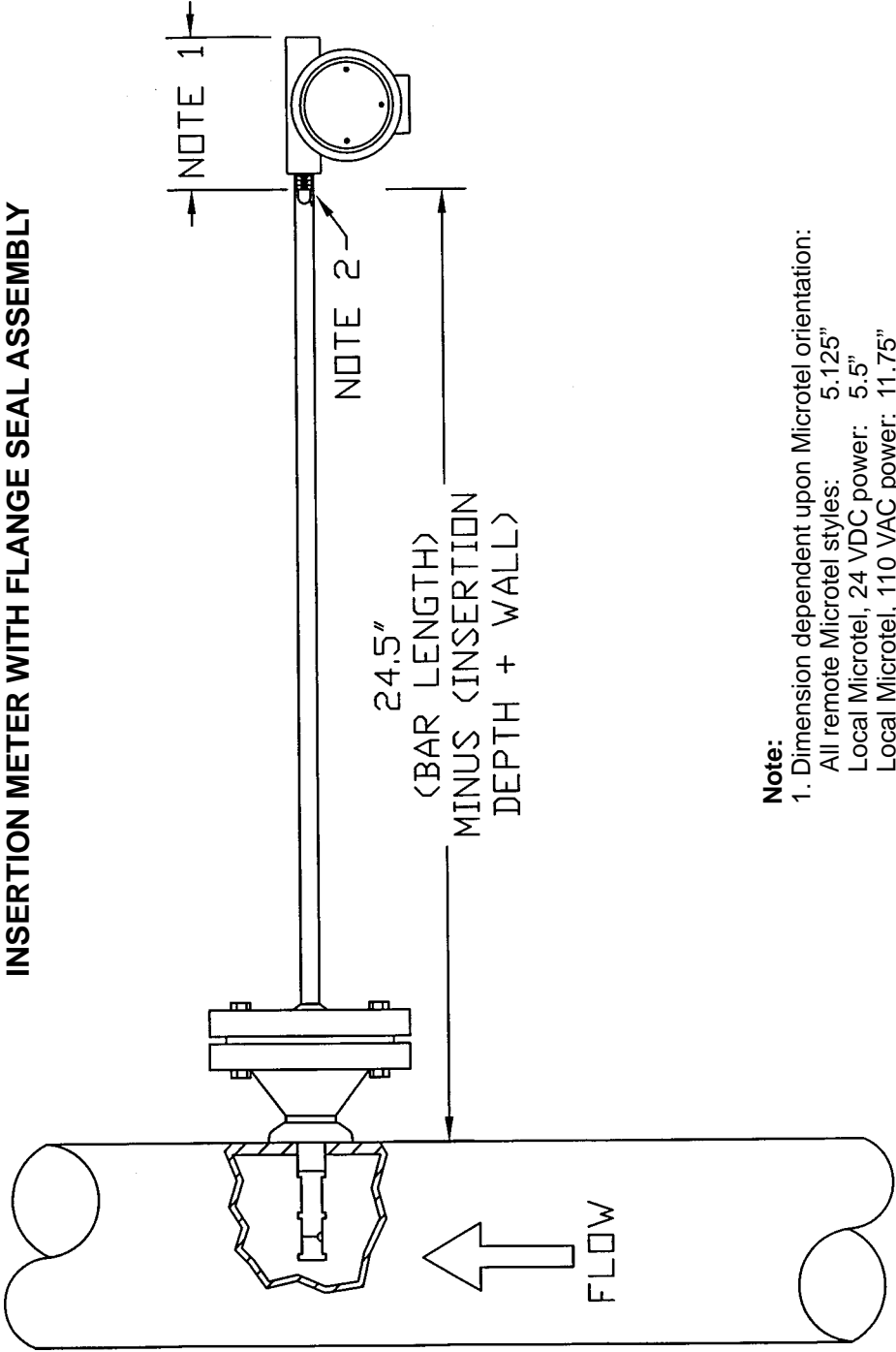


INSERTION METER WITH FLANGED VALVE SEAL ASSEMBLY

Note:
1. Alignment mark must face upstream.

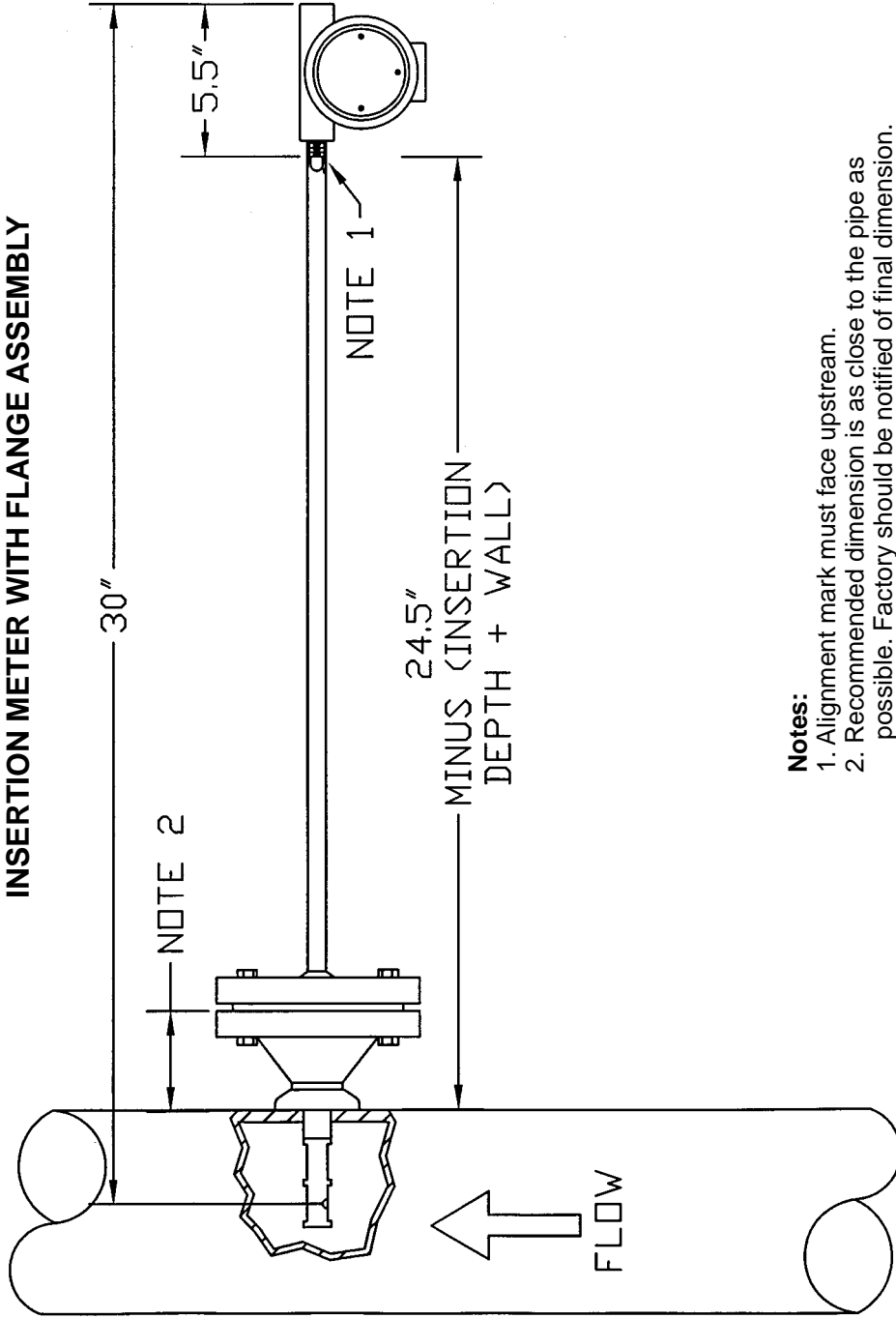
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INSERTION METER WITH FLANGE SEAL ASSEMBLY



Note:
1. Dimension dependent upon Microtel orientation:
All remote Microtel styles: 5.125"
Local Microtel, 24 VDC power: 5.5"
Local Microtel, 110 VAC power: 11.75"

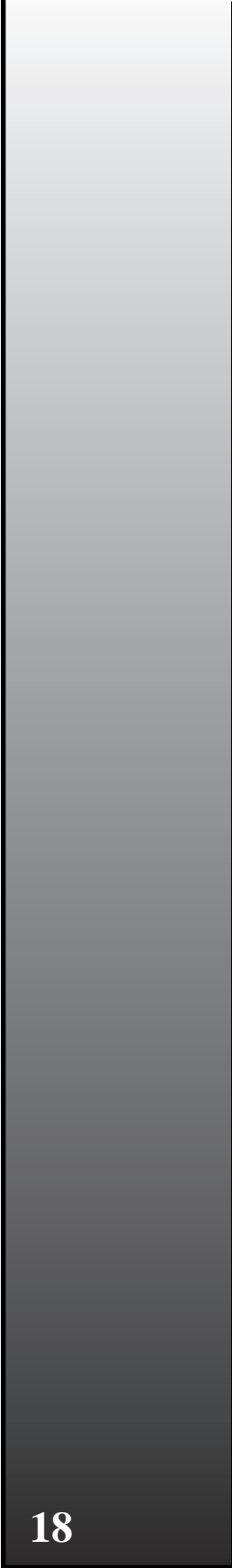
INSERTION METER WITH FLANGE ASSEMBLY



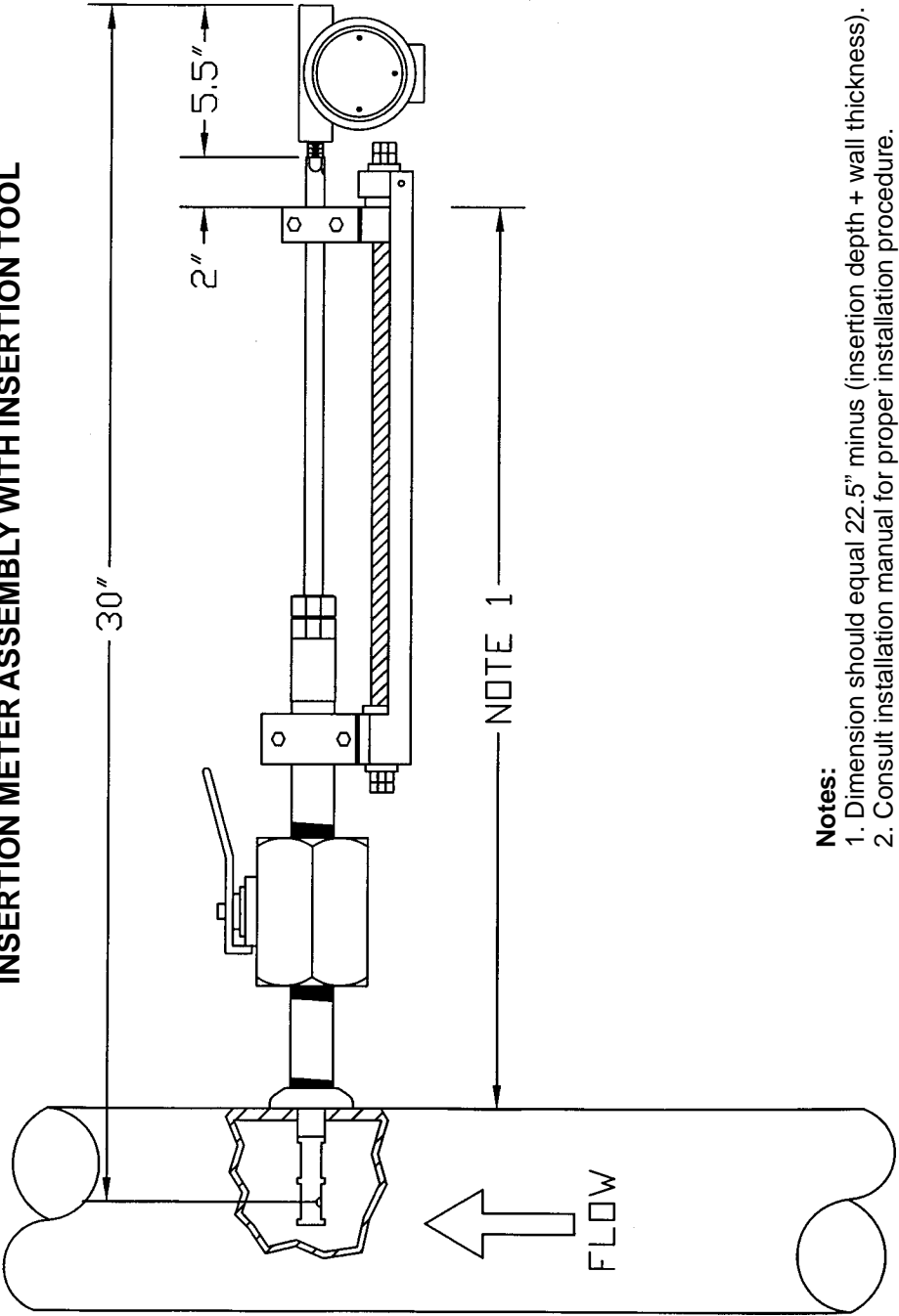
Notes:

1. Alignment mark must face upstream.
2. Recommended dimension is as close to the pipe as possible. Factory should be notified of final dimension.

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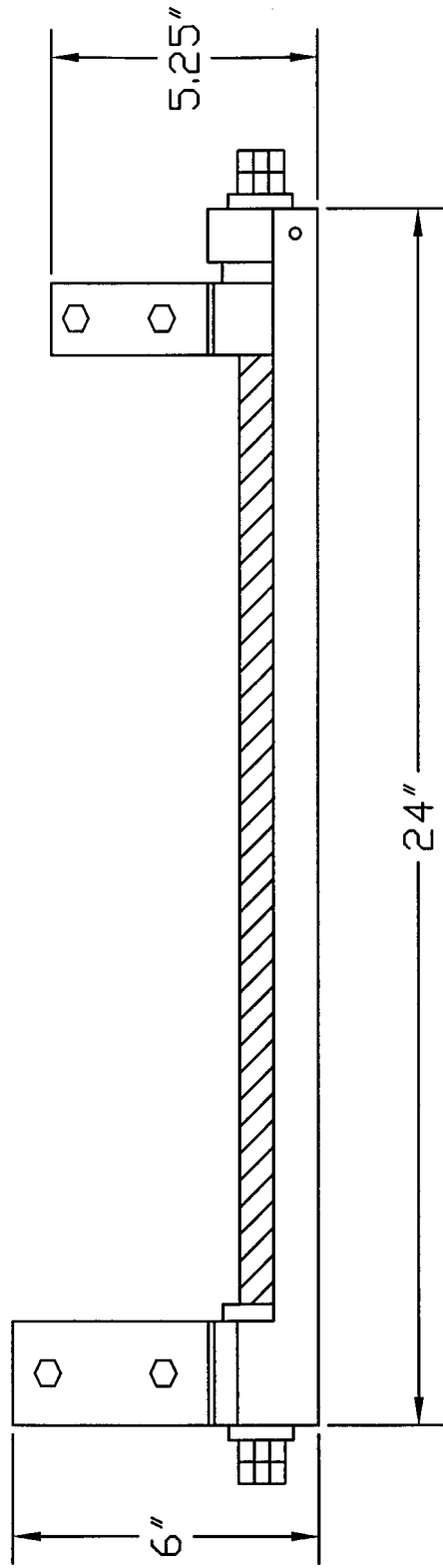


INSERTION METER ASSEMBLY WITH INSERTION TOOL

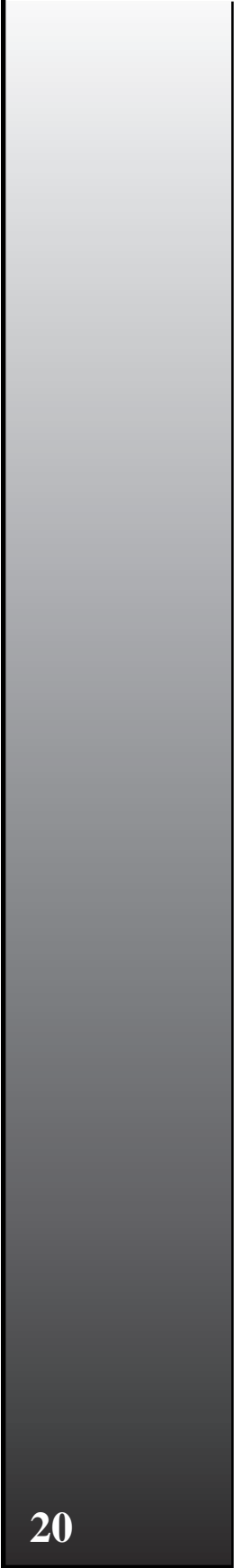


- Notes:**
- 1. Dimension should equal 22.5" minus (insertion depth + wall thickness).
 - 2. Consult installation manual for proper installation procedure.

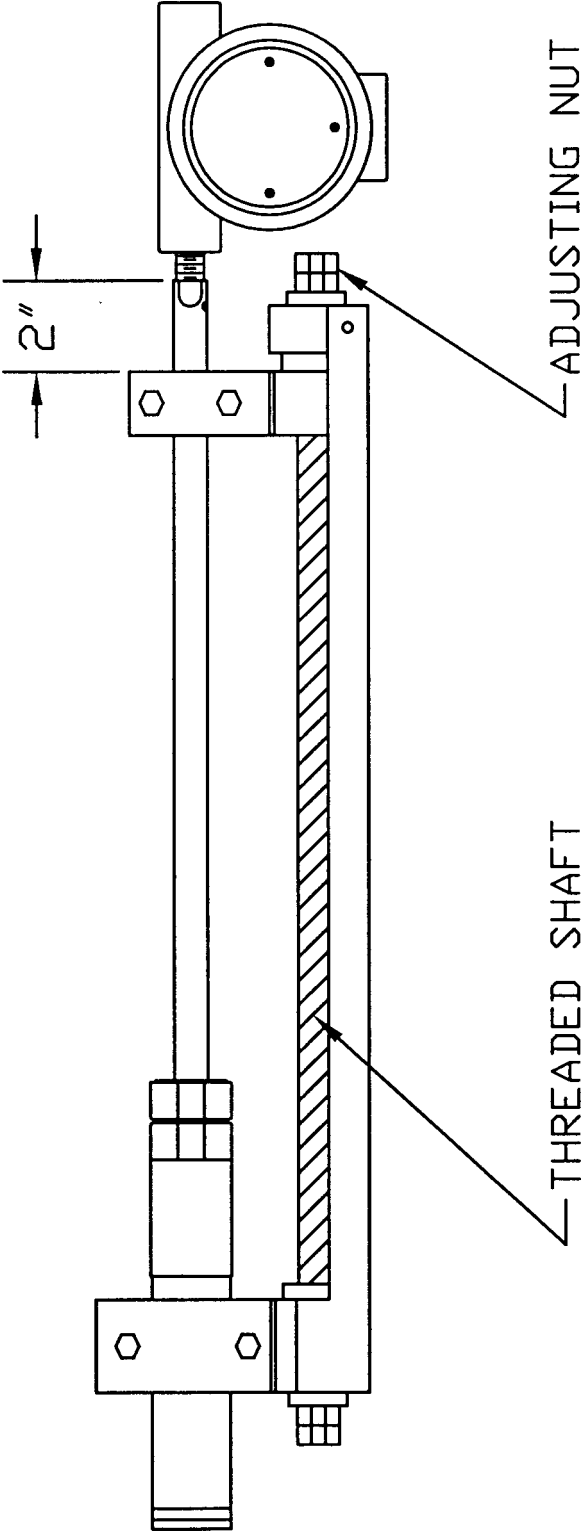
INSERTION TOOL



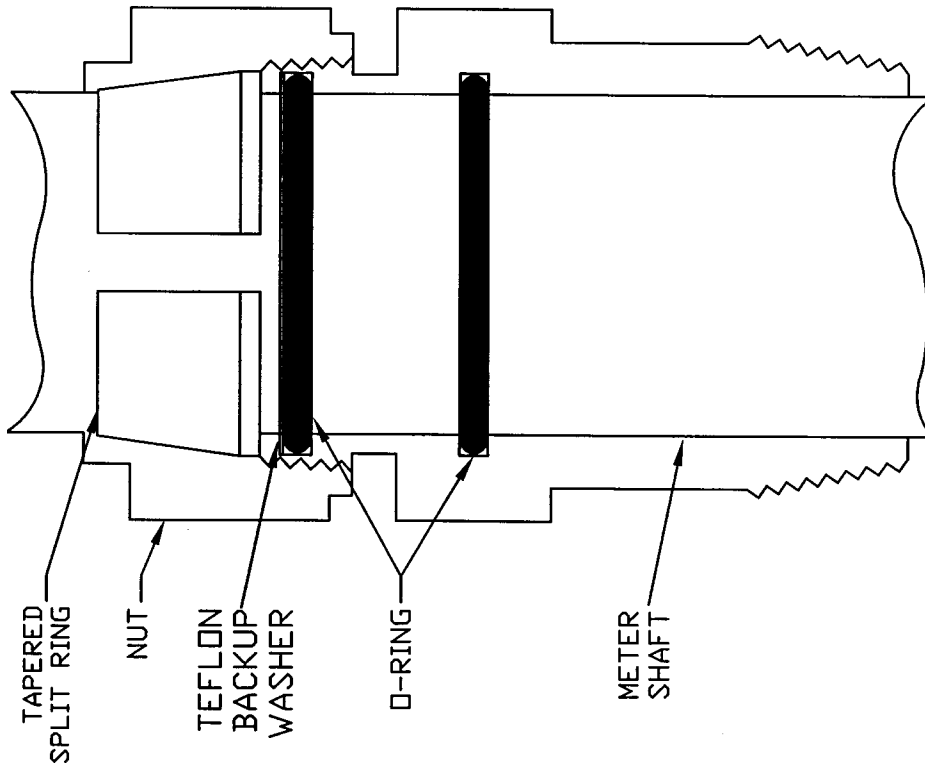
VTX-2E0016



HOT TAP INSERTION TOOL
CLAMP ON INSERTION TOOL



SEAL ASSEMBLY



Seal is not dependent on tightness of nut!
No metal to metal seal.

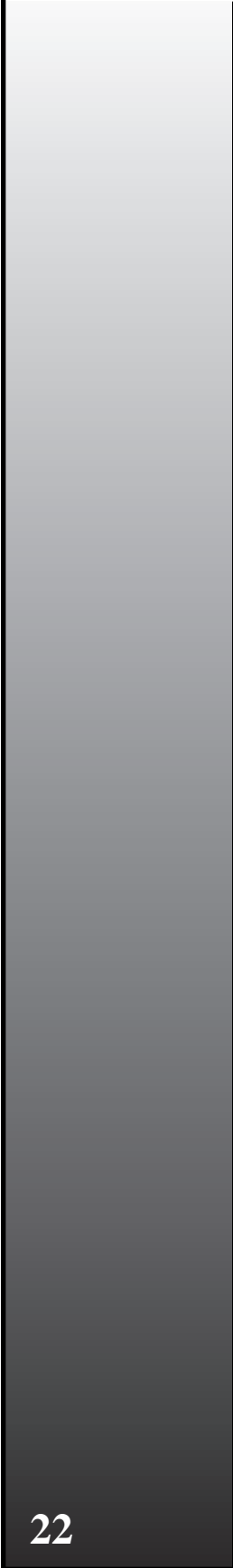
The O-rings seal the meter shaft.
The higher the pressure, the tighter the seal.

The tapered split ring grips the meter shaft.
The higher the pressure, the stronger the grip.

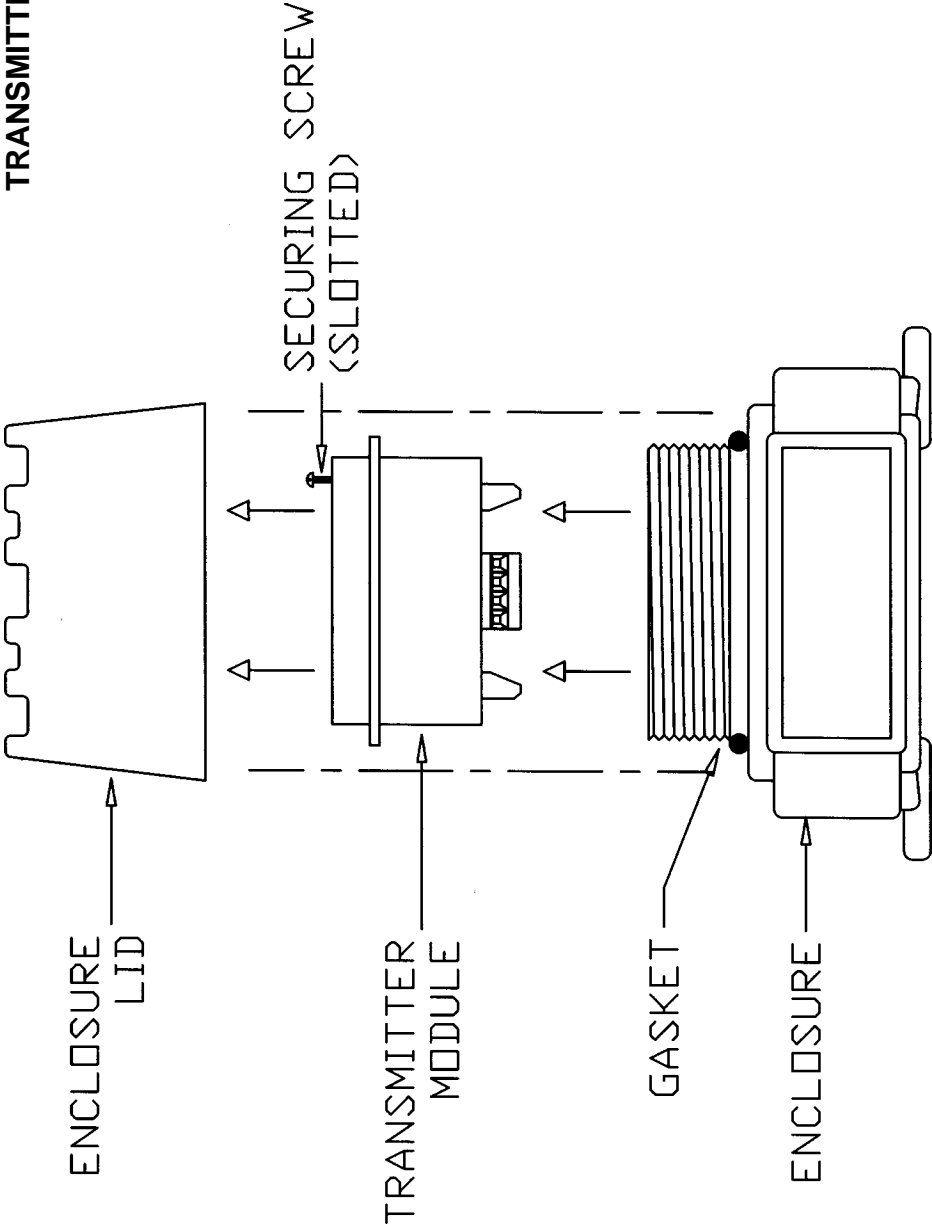
The meter shaft is held by the friction grip of tapered split ring and nut.

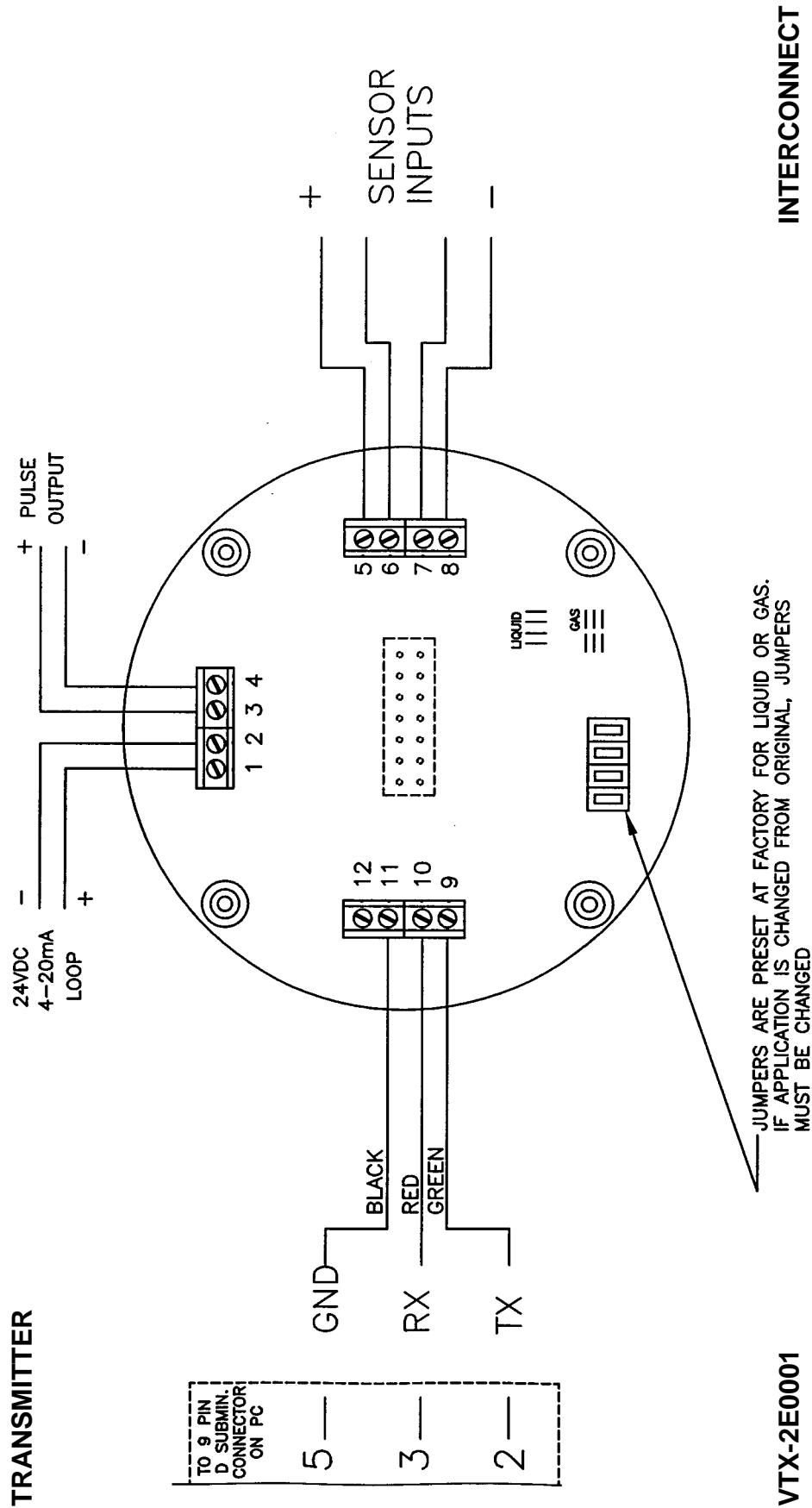
Seal is unaffected by vibration.

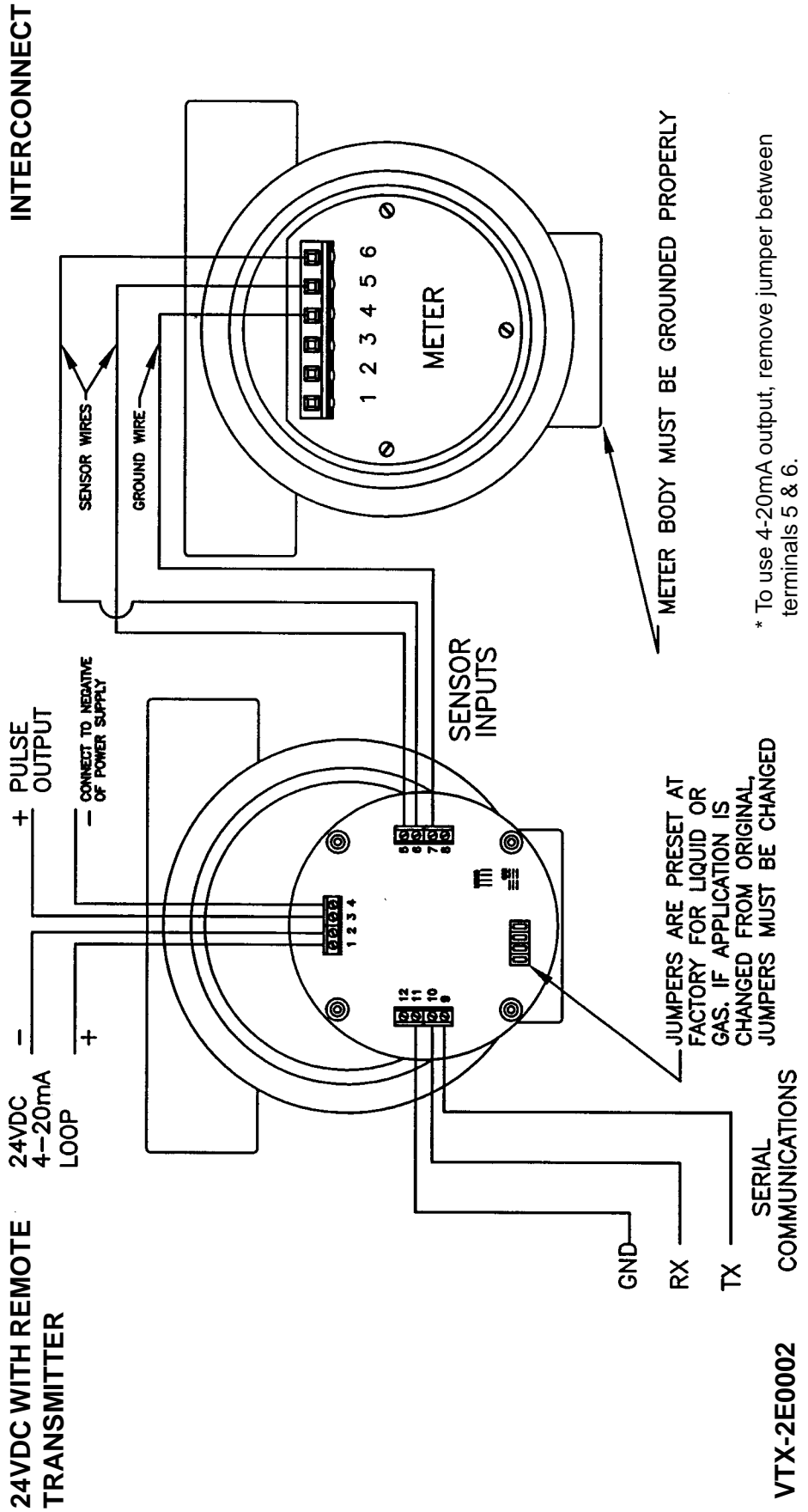
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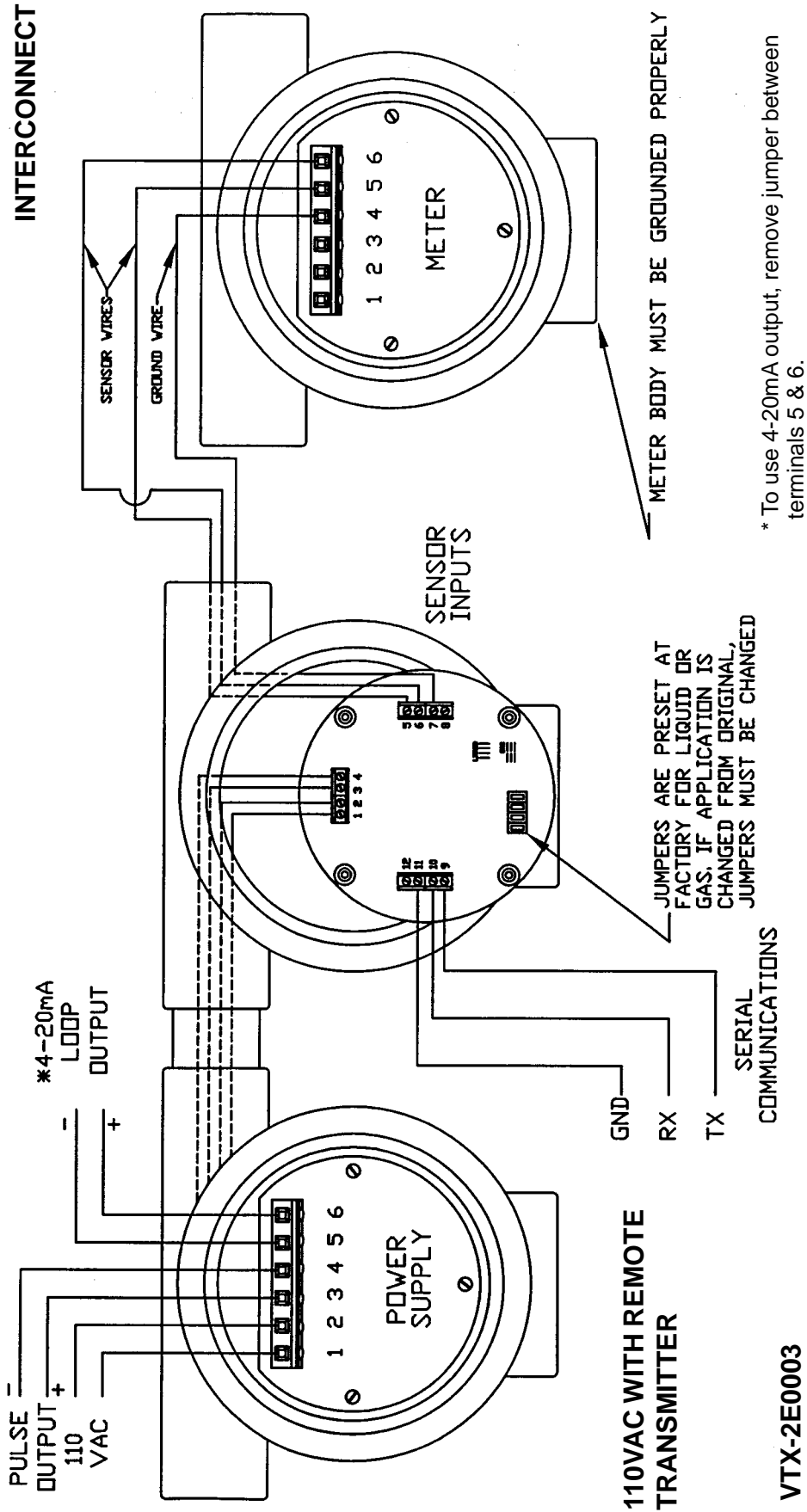


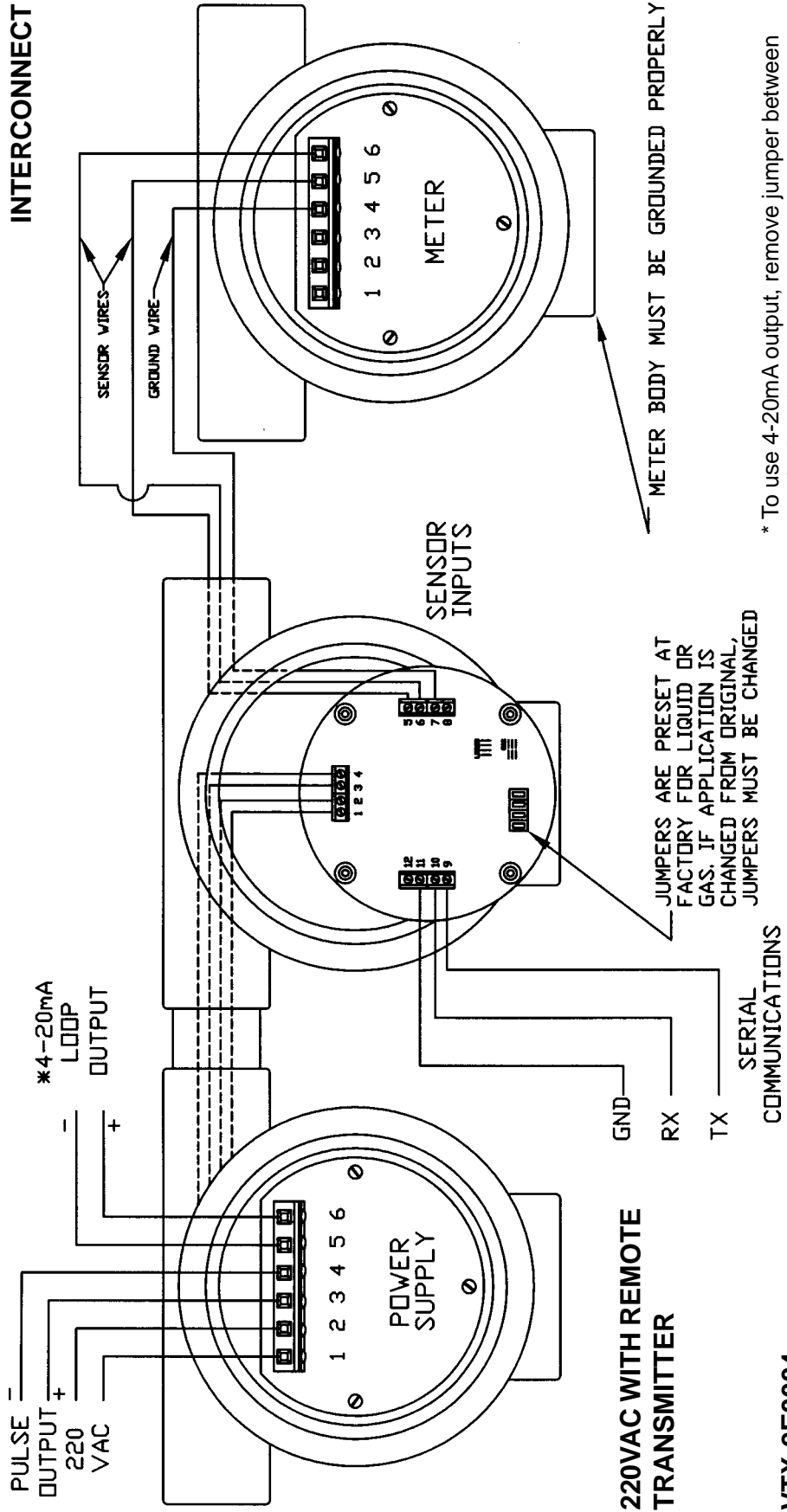
TRANSMITTER ASSEMBLY



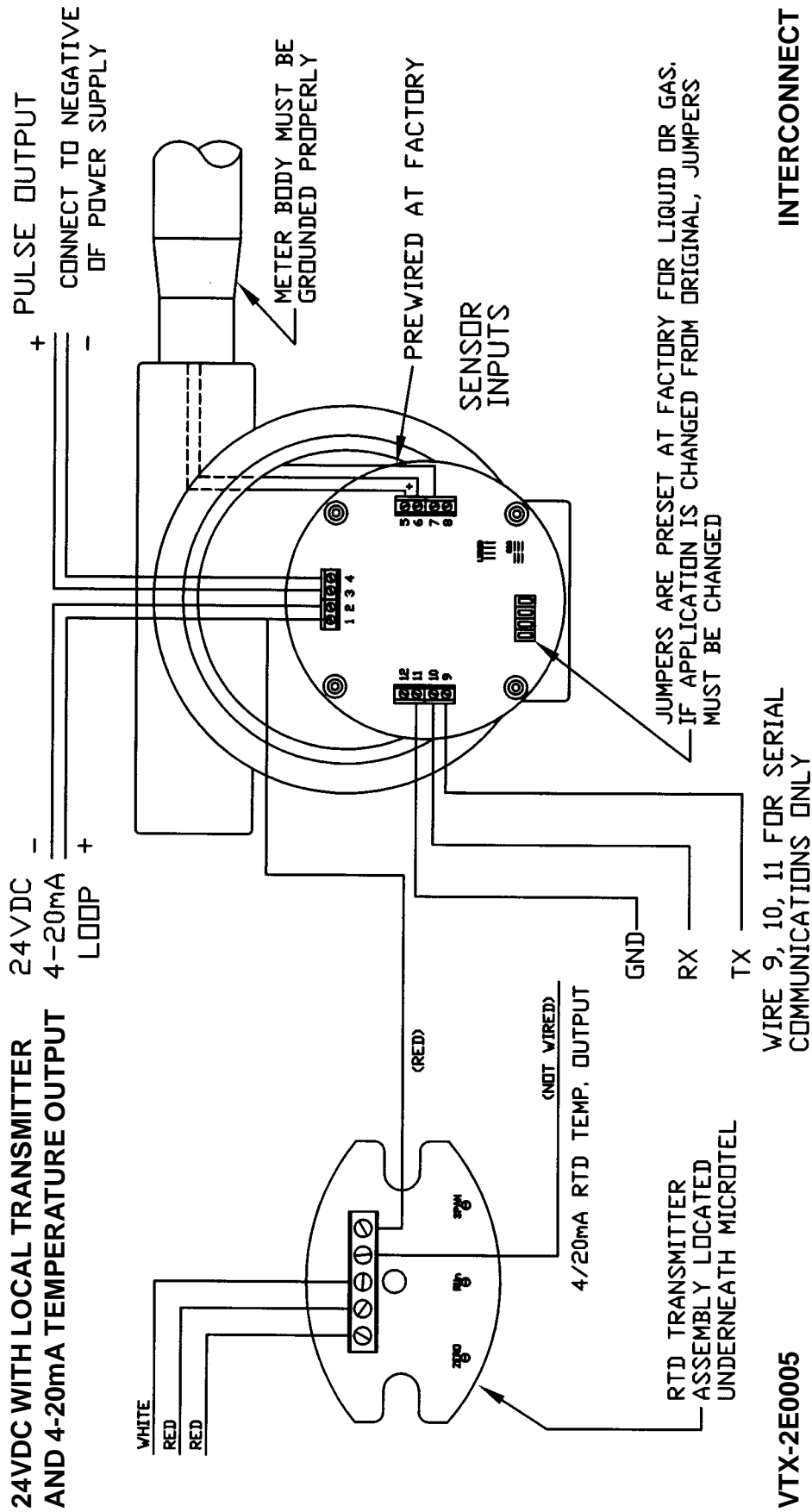


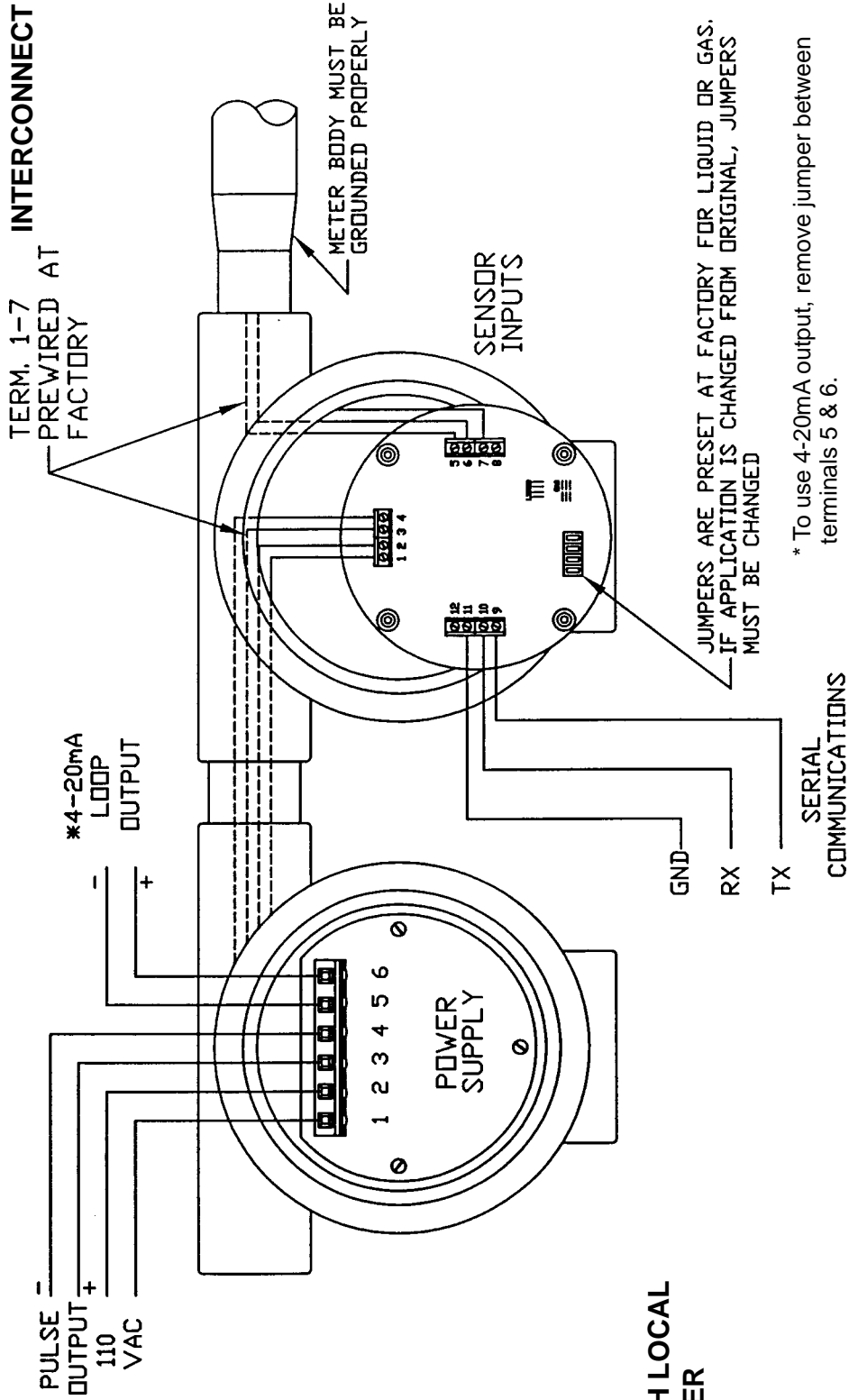






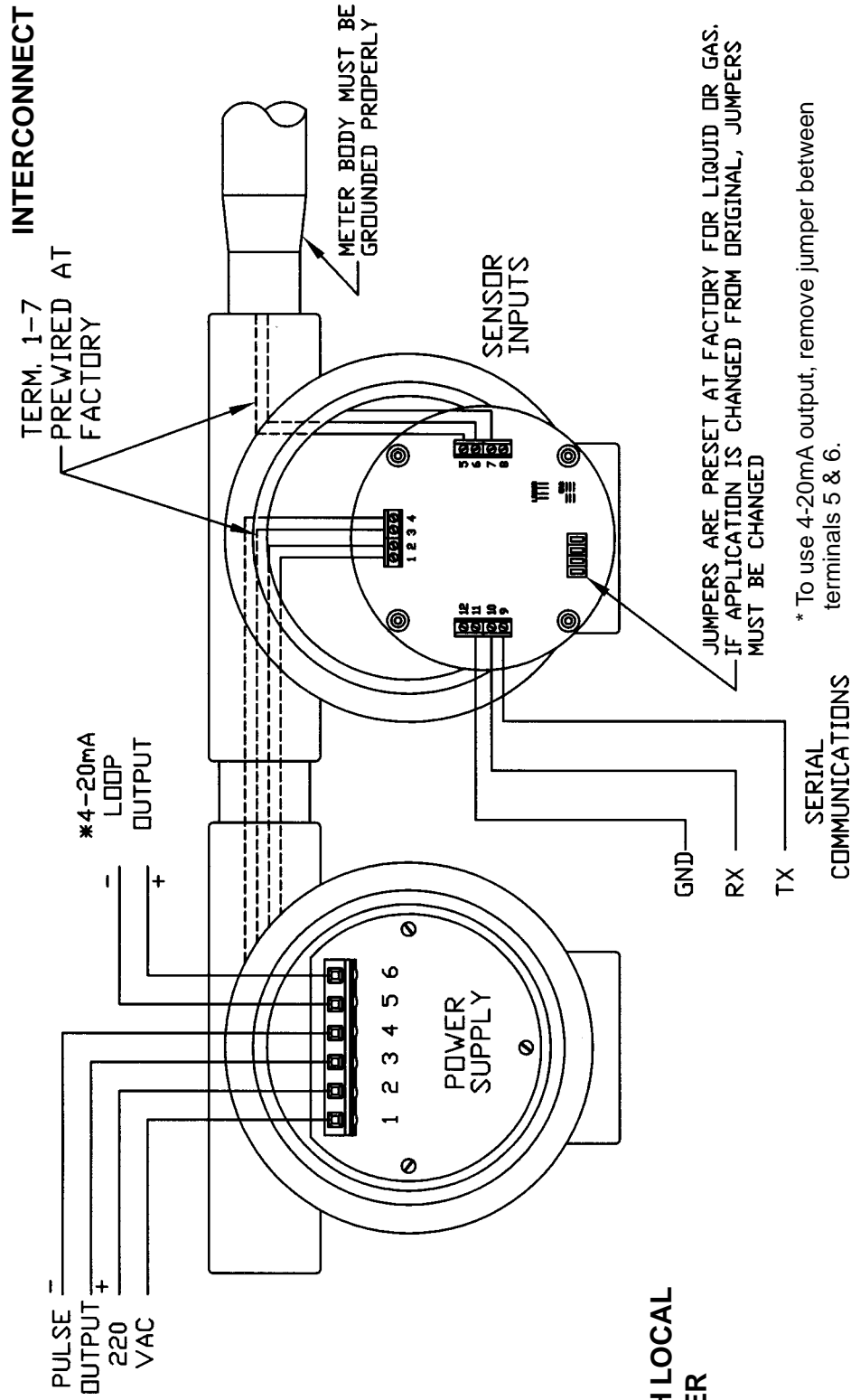
VTX-2E0004





110VAC WITH LOCAL TRANSMITTER

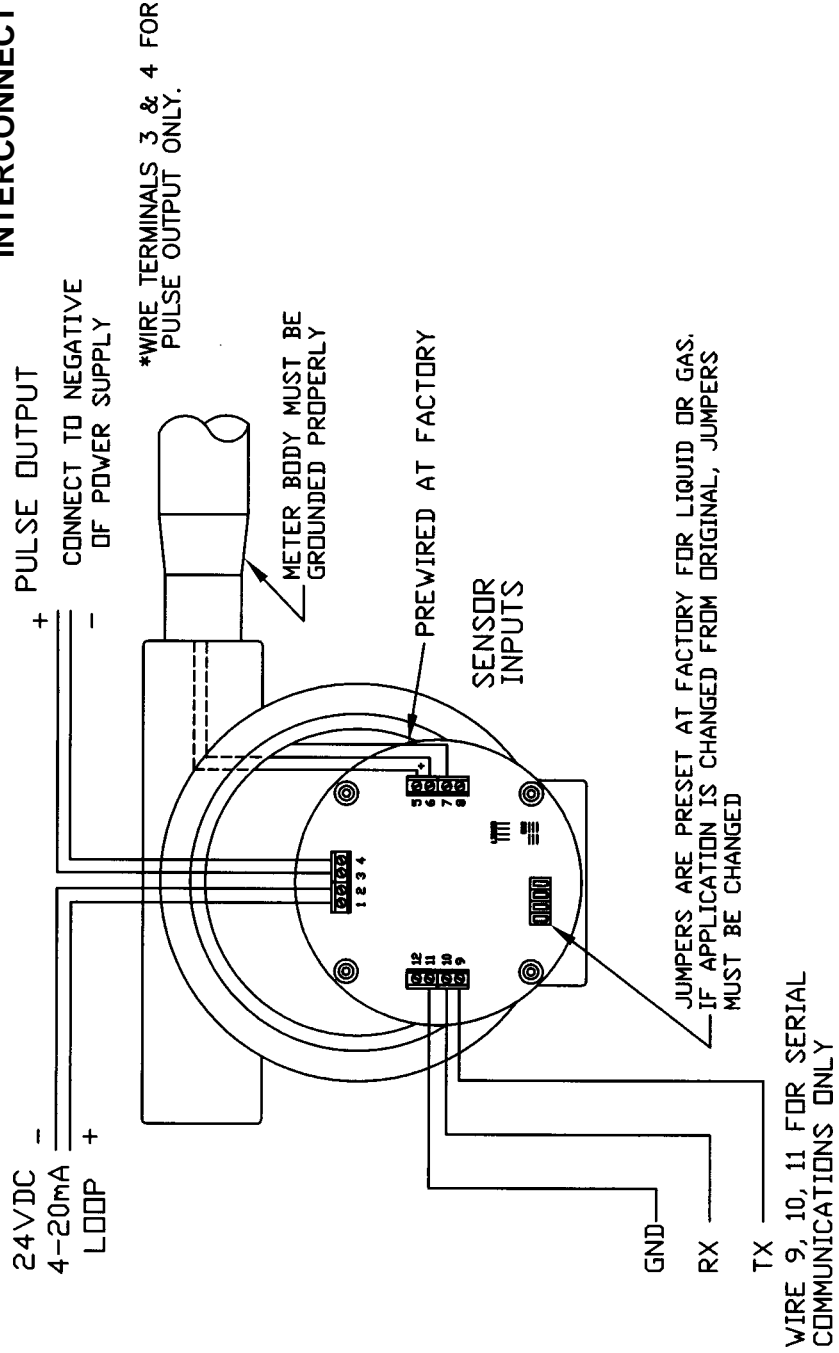
VTX-2E0006



220VAC WITH LOCAL TRANSMITTER

VTX-2E0007

INTERCONNECT



24VDC WITH LOCAL TRANSMITTER

VTX-2E0020



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