# *INSTRUCTION MANUAL*

## *VORTEX FLOWMETERS*
## *10VM1000 Design Level A*

### *10VM1000A Vortex 4™ FLOWMETERS*

PN24820

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**CAUTION** notices apply to hazards or unsafe practices which could result in property damage.

**NOTES** highlight procedures and contain information which assist the operator in understanding the information contained in this manual.



**WARNING**

**INSTRUCTION MANUALS**
**Do not install, maintain or operate this equipment without reading, understanding and following the proper ABB Inc. instructions and manuals, otherwise injury or damage may result.**

**POSSIBLE PROCESS UPSETS**
**Operation & maintenance must be performed only by qualified personnel and only after securing equipment controlled by this product. Adjusting or removing this product while it is in the system may upset the process being controlled. Some process upsets may cause injury or damage.**

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# *FIELD INSTALLATION INSTRUCTIONS*
## *VORTEX/SWIRLMETER*
## *3-WIRE SENSORS*

**CONVERSION INSTRUCTIONS**
**3-WIRE SENSOR TO 2-WIRE CONFIGURATION**

The purpose of this addendum is to provide information for converting three-wire Vortex and Swirlmeter sensors to two-wire configuration where applicable. Newer models of Vortex (Models 10VT) and Swirlmeters (Models 10ST) have terminal blocks that have been designed for use with 3-wire sensors. Models 10VM & 10VR and 10SM & 10SR continue to use 2-wire input terminal blocks and use the 3-wire sensor configured to a 2-wire mode as shown in the illustration below.

The 2-wire sensor configuration is also required when retrofitting older Vortex 10VT and Swirlmeter 10ST models with the new 3-wire sensors since the older models contain 2-wire terminal blocks on the circuit board.

**3-WIRE SENSOR PART NUMBERS**

| ABB PART NUMBER | METER SIZE | GASKET TYPE | MATERIAL | LENGTH |
|---|---|---|---|---|
| D693B027U01 | 1/2 - 6 inch (DN15 - DN150) | Flat | Steel 1.4571 | Standard |
| D693B027U09 | | O-Ring | " | |
| D693B027U11 | | O-Ring | " | |
| D693B027U03 | | Flat | Hastelloy C | |
| D693B029U01 | ≥ 8 inch (≥ DN200) | Flat | Steel 1.4571 | Long |
| D693B029U09 | | O-Ring | " | |
| D693B029U11 | | O-Ring | " | |
| D693B029U03 | | Flat | Hastelloy C | |

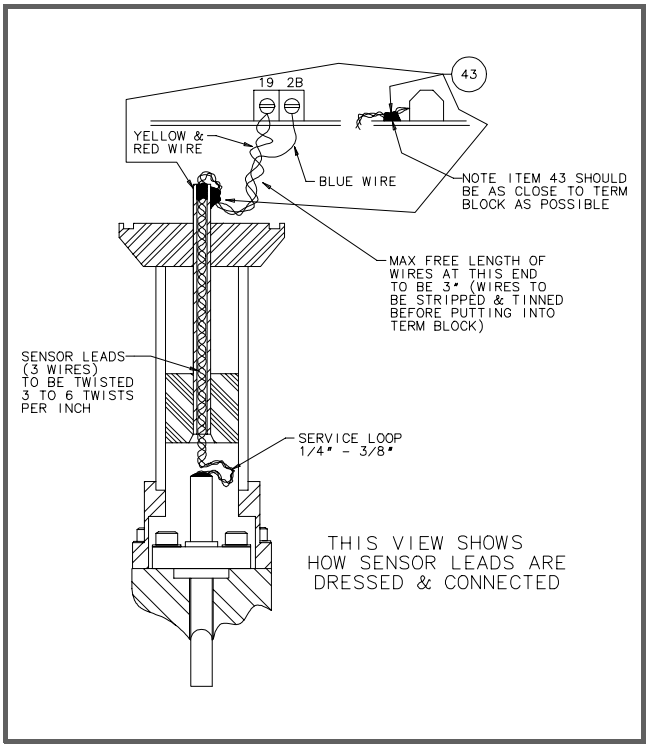
The sensors listed above have three wires:

- one **blue** lead
- one **red** lead
- one **yellow** lead

**To convert the sensors to 2-wire mode:**

- twist **yellow** & **red** wires together
- connect **yellow/red** wires to terminal 19 on the PCB terminal block
- connect **blue** wire to terminal 2B on the PCB terminal block

Refer to the generic cutaway diagram shown on the right for dressing and connection of the sensor leads. The diagram shows the newer "tower assembly" construction. Older "tower assemblies" will have different construction from that shown.



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# SAFETY SUMMARY

## GENERAL WARNINGS

**POSSIBLE PROCESS UPSETS**

**Maintenance must be performed only by qualified personnel and securing equipment controlled by this product. Adjusting product while it is in the system may upset the process being controlled. Some process upsets may cause injury or damage.**

**ELECTRICAL SHOCK HAZARD. Equipment powered by AC line voltage constitutes a potential electric shock hazard to the user. Make certain that the system power input leads are disconnected from the operating branch circuit before attempting electrical interconnections.**

**RETURN OF EQUIPMENT**

**All Flowmeters and/or Signal Converters being returned to for repair must be free of any hazardous materials (acids, alkalis, solvents, etc.). A Material Safety Data Sheet (MSDS) for all process liquids must accompany returned equipment. Contact ABB Inc. for authorization prior to returning equipment.**

**INSTRUCTION MANUALS**

**Do not install, maintain or operate this equipment without reading, understanding and following the proper ABB instructions and manuals, otherwise injury or damage may result.**

## SPECIFIC WARNINGS

**When the meter is used in a very high or low temperature process, the temperature of the meter body may be extremely hot or cold. If it is necessary to touch the sensor housing or meter body, insulated gloves must be worn to prevent serious injury. (pg. 2-2)**

**All Flowmeters and/or Signal Converters being returned to ABB Inc. for repair must be free of any hazardous materials (acids, alkalis, solvents, etc.). A Material Safety Data Sheet (MSDS) for all process liquids must accompany returned equipment. Contact ABB Inc. for authorization prior to returning equipment. (pg. III)**

**ELECTRICAL SHOCK HAZARD. Equipment powered by AC line voltage constitutes a potential electric shock hazard to the user. Make certain that the system power input leads are disconnected from the operating branch circuit before attempting electrical interconnections. (pg. 2-9)**

## SPECIFIC CAUTIONS

**The pipeline and meter body may be insulated by the user. However, the meter interconnection wiring box and the sensor housing tower must not be insulated. Ambient air is required to dissipate heat or cold build-up within the interconnection wiring box. (pg. 2-1).**

**Some of the IC devices used in the signal converter are static sensitive and may be damaged by improper handling. When adjusting or servicing the signal converter, use of a grounded wrist strap is recommended to prevent inadvertant damage to the integral solid state circuitry. (pg. 2-9)**

**All unused conduit entrances must have pipe plugs installed. This is required to maintain the NEMA 4X enclosure rating. (pg. 2-11)**

# READ FIRST

**This Instruction Bulletin contains the following changes from the previous Rev. 1 issue (PN24713):**

- **Revision of some values in Tables 1-1, 1-3 & 1-6**
- **Added information for 10 & 12 inch meter sizes**
- **Added wiring diagrams, Figures 2-8 & 2-9**
- **Revised format of Model Number table in Section 1.4**
- **General format revisions**

**WARNING**

**INSTRUCTION MANUALS**

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**RETURN OF EQUIPMENT**

**All Flowmeters and/or Signal Converters being returned to ABB Inc. for repair must be free of any hazardous materials (acids, alkalis, solvents, etc). A Material Safety Data Sheet (MSDS) for all process liquids must accompany returned equipment. Contact ABB Inc. for authorization prior to returning equipment.**

**NEMA 4X, Corrosion Resistant Finish**

**This product is painted with a high performance epoxy paint. The corrosion protection provided by this finish is only effective if the finish is unbroken. It is the users' responsibility to "touch-up" any damage that has occurred to the finish during shipping or installation of the product. Special attention must be given to: meter flange bolting, pipe mounting of electronics, conduit entries and covers that are removed to facilitate installation or repair. For continued corrosion protection throughout the product life, it is the users' responsibility to maintain the product finish. Incidental scratches and other finish damage must be repaired and promptly re-painted with approved touch-up paint. Provide the model number and size of your product to the nearest ABB Inc. representative to obtain the correct touch-up paint.**

**Read these instructions before starting installation;**
**save these instructions for future reference.**

# 1.0 INTRODUCTION

## 1.1 Description

The ABB 10VM1000 Vortex flowmeter is a system comprised of the Vortex meter Primary with an integral preamplifier box and a remotely mounted microprocessor-based 50VM1000 signal converter/flow computer. The flowmeter and signal converter are interconnected by a shielded signal cable. This arrangement allows the signal converter to be mounted a safe distance from any process fluid that may have an adverse effect on the signal converter electronics. The flowmeter, signal converter and signal cable are interconnected on-site. Information in this Instruction Bulletin is applicable only to the 10VM1000 Vortex flowmeter. For information applicable to the 50VM1000 signal converter, refer to the Instruction Bulletin supplied with the 50VM1000 converter.

The flowmeter is suitable for service with gas and liquid processes. The meter's extended temperature range permits accurate metering of saturated and superheated steam.

The flowmeter body and process connections are made from 316L stainless steel. The sensor is made from 321 stainless steel. Because the meter has no moving parts, routine maintenance is not required.

The 10VM1000 is FM (Factory Mutual Research) approved as: Intrinsically Safe for Classes I, II and III, Division 1, Groups A, B, C, D, E, F and G, ENTITY; per ID-10-1105; Dust-ignitionproof for Class II Division 1, Groups E, F and G; Suitable for Class III Division 1; Nonincendive for Class I, Division 2, Groups A, B, C and D; for indoor/outdoor Hazardous (Classified) Locations; NEMA 4X.

## 1.2 Principle of Operation

In operation, as the incoming fluid is divided past the shedder bar, vortices are successively detached and appear alternately on either side of the sensor in the form of fluidic perturbations. As the vortices move downstream from the shedder bar, they produce an alternating pattern referred to as a Karman vortex street. Over the range of Reynolds numbers corresponding to the instrument range, the frequency of vortex formation is directly proportional to flow velocity and can be stated as shown in the following equation:

$$f = \frac{V}{d} \bullet St$$

where: f = vortex frequency
V = inlet velocity
d = width of shedder bar
St = Strouhal number (constant over the range specified in the sizing tables)

## 1.3 Back Pressure Requirements for Liquid Flow

In order to prevent cavitation in the meter it is necessary to maintain a minimum back pressure in the system. The required back pressure is determined using the following formula:

$$\mathbf{P_b \geq 1.5P_v + 3\Delta P}$$

where: $P_b$ = minimum required back pressure (psig)
$P_v$ = vapor pressure of the fluid at specified conditions (psig)
$\Delta P$ = pressure drop (psig)

## 1.4 Model Number Breakdown

Refer to the ABB data sheet or the data tag on the equipment for the model number of the instrument furnished. The details of a specific number are shown below:

| | 10VM1 | _ | _ | 1 | A | _ | _ | 1 | _ | C | _ | 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Engineering Reference** | | | | | | | | | | | | |
| **Process Connection** | | | | | | | | | | | | |
| Flanged | | 1 | | | | | | | | | | |
| Wafer | | 3 | | | | | | | | | | |
| **Fluid Type** | | | | | | | | | | | | |
| Liquid | | | 1 | | | | | | | | | |
| Gas | | | 2 | | | | | | | | | |
| Natural Gas | | | 3 | | | | | | | | | |
| Saturated Steam | | | 4 | | | | | | | | | |
| Superheated Steam | | | 5 | | | | | | | | | |
| Other | | | 6 | | | | | | | | | |
| **Materials of Construction** | | | | | | | | | | | | |
| Body/Sensor 316L/321 Stainless Steel | | | | 1 | | | | | | | | |
| **Design Level** | | | | | A | | | | | | | |
| **Meter Sizes** | | | | | | | | | | | | |
| 1 in. (DN25) | | | | | | B | | | | | | |
| 1.5 in. (DN40) | | | | | | C | | | | | | |
| 2 in. (DN50) | | | | | | D | | | | | | |
| 3 in. (DN80) | | | | | | E | | | | | | |
| 4 in. (DN100) | | | | | | F | | | | | | |
| 6 in. (DN150) | | | | | | G | | | | | | |
| 8 in. (DN200) | | | | | | H | | | | | | |
| 10 in. (DN250) | | | | | | J | | | | | | |
| 12 in. (DN300) | | | | | | K | | | | | | |
| **Pressure Rating** | | | | | | | | | | | | |
| ANSI Class 150 (PN10) | | | | | | | H | | | | | |
| ANSI Class 300 (PN16) | | | | | | | J | | | | | |
| Other | | | | | | | Z | | | | | |
| **Temperature Range** | | | | | | | | | | | | |
| -40°F to +536°F (-40°C to +280°C) | | | | | | | | 1 | | | | |
| **Sensor Gasket** | | | | | | | | | | | | |
| Graphite | | | | | | | | | 1 | | | |
| Teflon (-20 to 230°C / -4 to 446°F) | | | | | | | | | 2 | | | |
| Other | | | | | | | | | 9 | | | |
| **Safety Approvals** | | | | | | | | | | | | |
| FM approved as Intrinsically Safe for Classes I, II & III, Div.1, Groups A thru G, per CID-10-1105; ENTITY; Dust-ignitionproof for Class II Div.1, Groups E, F& G; Suitable for Class III, Div.1; Nonincendive for Class I, Div.2, Groups A,B, C & D; for indoor/outdoor Hazardous (Classified) Locations; NEMA 4X. | | | | | | | | | | C | | |
| **Calibration** | | | | | | | | | | | | |
| Dry Calibration for Liquids & Gases | | | | | | | | | | | 1 | |
| Liquid Calibration on Water w/Curve | | | | | | | | | | | 2 | |
| Special Requirements | | | | | | | | | | | 3 | |
| **Language** | | | | | | | | | | | | |
| English | | | | | | | | | | | | 2 |

## 1.5 Specifications

**Fluid Types**

Gas, liquid or steam

**Sizes**

| Flanged | | Wafer | |
|---|---|---|---|
| inches | mm | inches | mm |
| 1 | 25 | --- | --- |
| 1.5 | 40 | 1.5 | 40 |
| 2 | 50 | 2 | 50 |
| 3 | 80 | 3 | 80 |
| 4 | 100 | 4 | 100 |
| 6 | 150 | 6 | 150 |
| 8 | 200 | 8 | 200 |
| 10 | 250 | --- | --- |
| 12 | 300 | --- | --- |

**Accuracy**

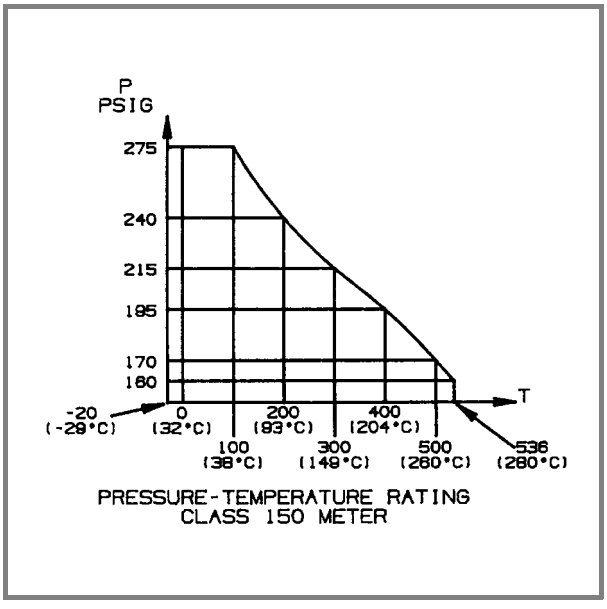
± 0.75% of rate on liquids
± 1.0% of rate on gases & steam

**Rangeability**

Typically 20 to 1. Refer to Tables 1-1 through 1-5.

**Process Pressure Limits**

Flanged or wafer rated for ANSI Class 150 or 300 (DIN PN 10 - 16) service, 275/720 psig (1.91/4.96 MPa)



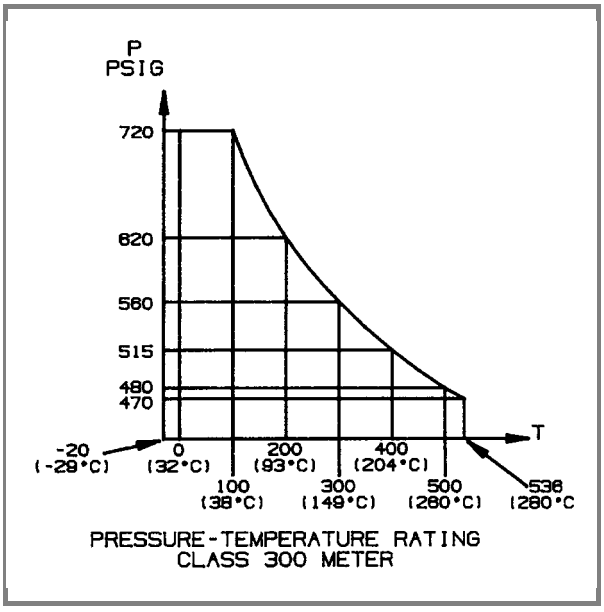




**FIGURE 1-1 PROCESS PRESSURE vs. TEMPERATURE**

**Process Temperature Limits** –40° to 536° F (–40° to 280° C)

**Ambient Temperature Limits** –10 to 140° F (–25 to 60° C)

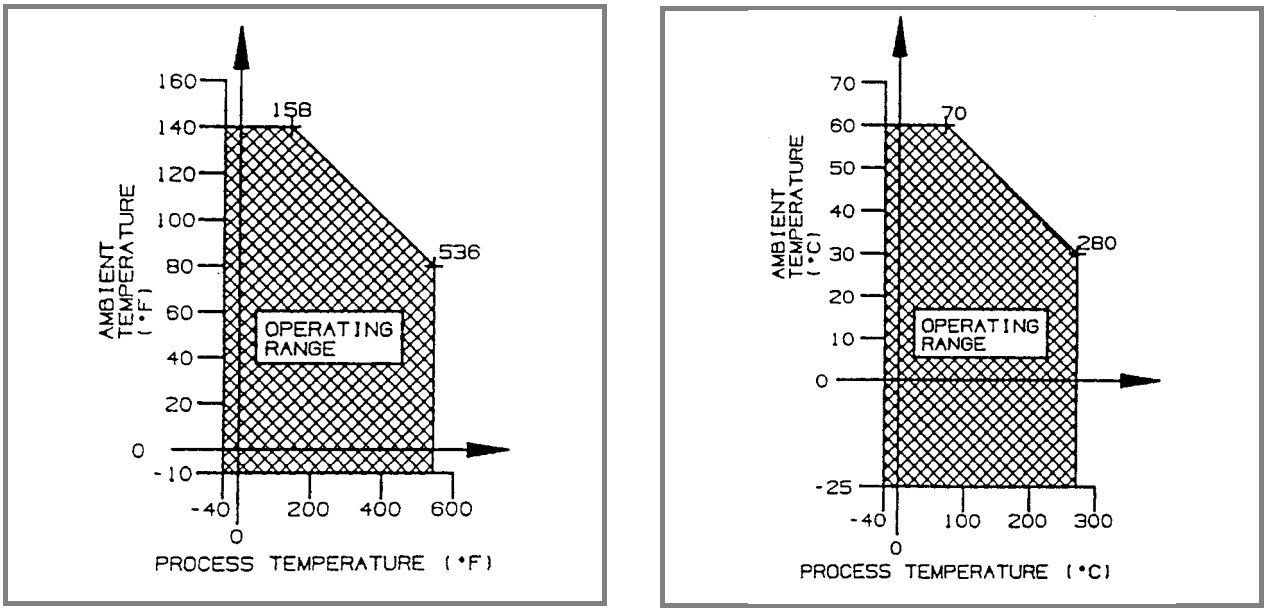



**FIGURE 1-2 PROCESS OPERATING TEMPERATURES**

**Maximum Vibration Limits** Air: 0.15g at 0 - 130 Hz
Water: 0.3g at 0 - 130 Hz

**Relative Humidity Limits** 5 - 95% non-condensing

**Materials of Construction:**

**Signal Converter Housing** Diecast aluminum with epoxy paint
NEMA 4X (IEC 529 IP65)

**Body** 316L SST

**Sensor** 321 SST

**Sensor Gasket** Graphite (standard)
TEFLON (optional)

**Certifications** Refer to Model Number Breakdown in Sub-Section 1.4.

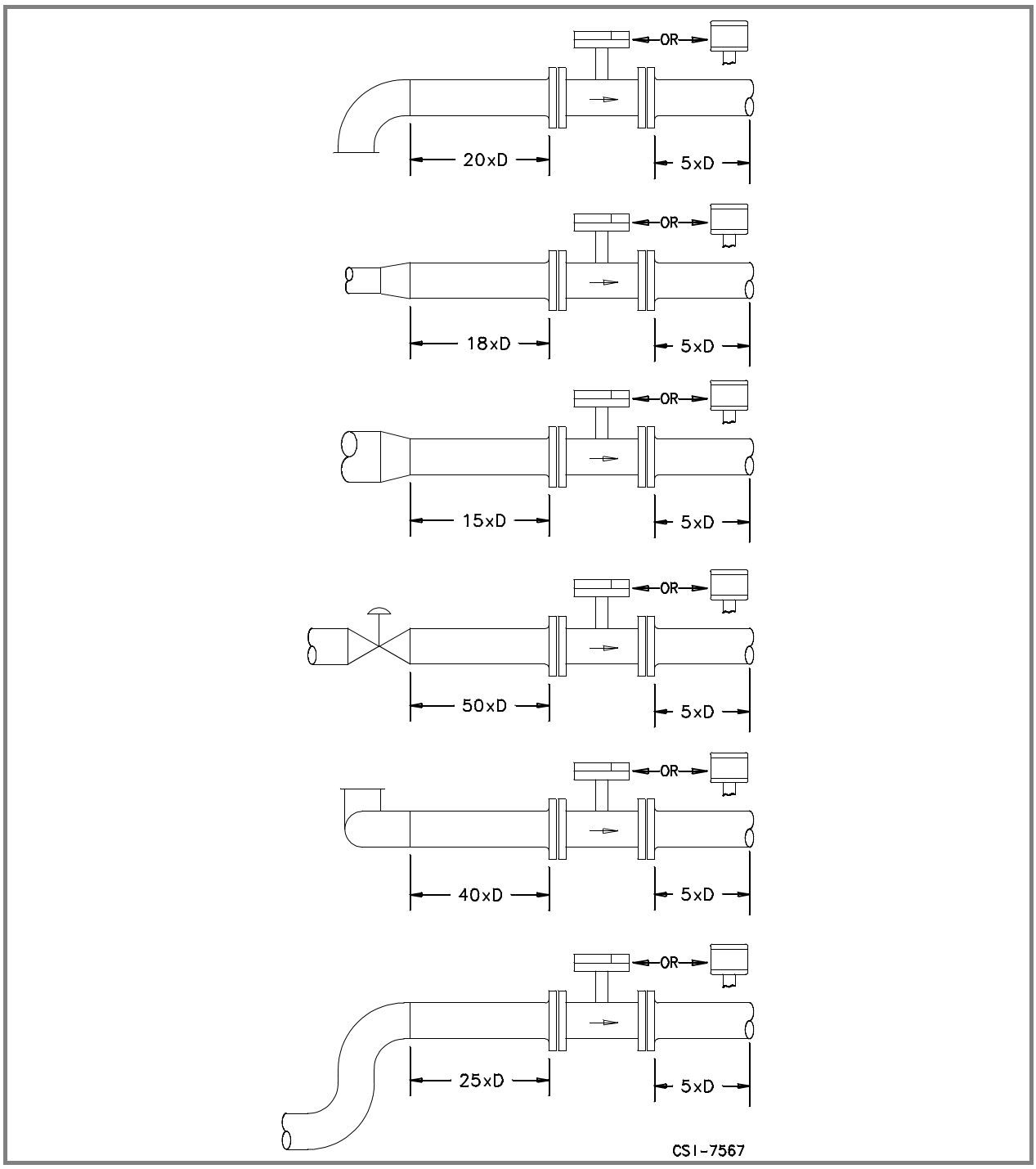
**K-Factor Correction** Inlet pipe larger than Meter ID: no correction required
Inlet pipe ID smaller than Meter ID:

$$K_{new} = K_{orig} \times \left( \frac{Meter\ ID}{Inlet\ Pipe\ ID} \right)^2$$

where $K_{new}$ = adjusted K-Factor
$K_{orig}$ = calibrated K-Factor on instrument tag

**Mounting**

A minimum straight pipe run must be maintained up and downstream of the meter for various piping configurations. Refer to Figure 1-3 for minimum straight pipe run requirements. The Vortex-4 flowmeter can be installed in any attitude.




**D = Meter Size**

**FIGURE 1-3. METER PIPING REQUIREMENTS**

## TABLE 1-1. AIR FLOW RATES

| Meter Size | | Internal Diameter | Minimum Air Flow | Maximum Air Flow | | |
|---|---|---|---|---|---|---|
| inches | mm | inches | acfh | acfh | ft/sec | max Δ p (psi) |
| 1 | 25 | 0.957 | 343 | 2895 | 161 | 0.70 |
| 1.5 | 40 | 1.500 | 742 | 11310 | 256 | 1.09 |
| 2 | 50 | 1.939 | 1519 | 15891 | 215 | 0.70 |
| 3 | 80 | 2.900 | 2649 | 35314 | 214 | 0.80 |
| 4 | 100 | 3.826 | 4238 | 67098 | 233 | 0.65 |
| 6 | 150 | 5.761 | 8829 | 143023 | 219 | 0.90 |
| 8 | 200 | 7.625 | 8829 | 282520 | 247 | 0.80 |
| 10 | 250 | 9.562 | 28248 | 494340 | 275 | 0.80 |
| 12 | 300 | 11.374 | 49434 | 706200 | 278 | 0.80 |

## TABLE 1-2. GAS PRESSURE LOSS CALCULATIONS

| Pressure Loss For Steam and Gas |
|---|
| $\Delta p_2 = \Delta p_1 \frac{\rho}{.0749} \left(\frac{Q}{Q_{max}}\right)^2$ |
| $\Delta p_2$ = Pressure drop at operating conditions |
| $\Delta p_1$ = Max. pressure drop for air from Table 1-1 |
| $\rho$ = Operating density (lbs/ft$^3$) |
| Q = Operating flow rate (acfh) |
| $Q_{max}$ = Maximum air flow rate (acfh) from Table 1-1 |

**Conversions:** kPa = 6.895 x psi
$m^3/h$ = 0.22715 x GPM

## TABLE 1- 3. WATER FLOW RATES AND FREQUENCIES

| Meter Size (inches) | K-Factor (nominal) | Flow Rate Limits (a) | | | Vortex Frequency (Hz) | |
|---|---|---|---|---|---|---|
| | | Minimum (GPM) | Maximum (GPM) (c) | Max. Δ p (psi) | Minimum | Maximum |
| 1 | 80,000 | 3.6 (7.0) (b) | 79 | 16.25 | 35.3 | 400 |
| 1.5 | 21,000 | 10.6 | 211 | 21.9 | 14.0 | 280 |
| 2 | 10,000 | 13.3 | 308 | 16.82 | 8.4 | 194.4 |
| 3 | 3,100 | 35.4 | 748 | 19.8 | 6.9 | 146.4 |
| 4 | 1,300 | 44.1 | 1,188 | 16.4 | 3.6 | 97.5 |
| 6 | 400 | 132 | 2,773 | 17.25 | 3.3 | 70 |
| 8 | 160 | 220 | 4,843 | 17.1 | 2.2 | 48.9 |
| 10 | 72 | 246 | 7,485 | 17.4 | 1.1 | 34 |
| 12 | 40 | 418 | 10,568 | 17.7 | 1.05 | 26.7 |

NOTE: (a) At Standard conditions at $70^{o}$ F ($21^{o}$ C)
(b) Values in parentheses are minimum linear flow rates if greater than minimum operating flow rate.
(c) Maximum flow rates based on velocity of 33 ft/sec.

## TABLE 1-4. LIQUID PRESSURE LOSS CALCULATIONS

| Pressure Loss For Liquid Flow |
|---|
| $\Delta p_2 = \Delta p_1 \text{ (Sp. gr.)} \left(\frac{Q}{Q_{max}}\right)^2$ |
| $\Delta p_2$ = Pressure drop at operating conditions |
| $\Delta p_1$ = Max. pressure drop for water from Table 1-3 |
| Sp. gr. = Specific gravity at operating conditions |
| Q = Operating flow rate (GPM) |
| $Q_{max}$ = Maximum meter water rate from Table 1-3 |

**Conversions:** $m^3/h = 0.22715 \times GPM$
kPa = 6.895 x psi

| Line Size (inches) | Minimum Flow Rate |
|---|---|
| 1, 1.5, 2 | $Q_{min} = 6.329 \times D \times Viscosity$ |
| 3, 4 | $Q_{min} = 11.49 \times D \times Viscosity$ |
| 6, 8, 10, 12 | $Q_{min} = 22.15 \times D \times Viscosity$ |

Where: $Q_{min}$ = Minimum flow rate in GPM.
D = Internal pipe diameter in inches (refer to Table 1-1).
Viscosity = In centistokes.

**TABLE 1-5. AIR FLOW RATES AT SELECTED PRESSURES IN SCFH**

| METER SIZE in. (mm) | AIR FLOW | Flow Rates In Standard Cubic Feet per Hour at 70° F | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | PRESSURE (psig) | | | | | | |
| | | 0 | 25 | 50 | 100 | 150 | 200 | 300 |
| 1 (25) | min. | 343 | 564 | 719 | 958 | 1148 | 1310 | 1586 |
| | max. | 2895 | 7818 | 12742 | 22589 | 32436 | 42283 | 61977 |
| 1.5 (40) | min. | 742 | 1220 | 1556 | 2072 | 2482 | 2834 | 3432 |
| | max. | 11310 | 30545 | 49779 | 88249 | 126718 | 165188 | 242126 |
| 2 (50) | min. | 1519 | 2498 | 3185 | 4241 | 5082 | 5802 | 7025 |
| | max. | 15891 | 42917 | 69942 | 123993 | 178044 | 232095 | 340197 |
| 3 (80) | min. | 2649 | 4356 | 5555 | 7396 | 8863 | 10119 | 12251 |
| | max. | 35314 | 95372 | 155430 | 275545 | 395661 | 515777 | 756008 |
| 4 (100) | min. | 4238 | 6969 | 8887 | 11832 | 14179 | 16189 | 19599 |
| | max. | 67098 | 181210 | 295322 | 523547 | 751771 | 979996 | 1436445 |
| 6 (150) | min. | 8829 | 14519 | 18513 | 24650 | 29539 | 33726 | 40831 |
| | max. | 143023 | 386259 | 629496 | 1115969 | 1602441 | 2088914 | 3061860 |
| 8 (200) | min. | 8829 | 14519 | 18513 | 24650 | 29539 | 33726 | 40831 |
| | max. | 282520 | 762996 | 1243472 | 2204425 | 3165377 | 4126330 | 6048234 |
| 10 (250) | min. | 28248 | 46454 | 59232 | 78867 | 94507 | 107904 | 130638 |
| | max. | 494340 | 1335054 | 2175769 | 3857197 | 5538626 | 7220054 | 10582911 |
| 12(300) | min. | 49434 | 81295 | 103657 | 138018 | 165388 | 188831 | 228617 |
| | max. | 706200 | 1907220 | 3108241 | 5510282 | 7912322 | 10314363 | 15118445 |

For gases with densities other than air:

$$SCFH = ACFH \bullet \left(\frac{P}{14.7}\right) \bullet \left(\frac{530}{460 + {}^{o}F}\right)$$

$$Q_{min} = ACFH_{min}\ (.0749/\rho)^{1/2}$$

$Q_{max}$ is based on maximum velocity in ft/sec (Refer to Table 1-1)

where $P$ = Operating pressure (psia)
$ACFH_{min}$ = Refer to Table 1-1
$ACFH_{max}$ = Refer to Table 1-1
$\rho$ = Density of fluid at operating conditions (lbs/ft$^3$)
.0749 = Density of air @ 14.7 psia & 70° F

| Meter Size → | FLOW RATES IN POUNDS PER HOUR (PPH) | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | .75 in. | | 1 in. | | 1.25 in. | | 2 in. | | 3 in. | | 4 in. | | 6 in. | | 8 in. | | 12 in. | | 16 in. | |
| | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. | min. | max. |
| Pressure (psi) | | | | | | | | | | | | | | | | | | | | |
| **15** | 7 | 64 | 13 | 129 | 18 | 335 | 47 | 902 | 104 | 2191 | 170 | 3876 | 313 | 9281 | 522 | 12890 | 1045 | 25780 | 2611 | 51560 |
| **30** | 8 | 94 | 16 | 187 | 22 | 487 | 57 | 1310 | 126 | 3182 | 204 | 5615 | 378 | 13476 | 629 | 18717 | 1259 | 37434 | 3147 | 74868 |
| **60** | 10 | 152 | 20 | 304 | 28 | 790 | 72 | 2126 | 160 | 5163 | 260 | 9111 | 481 | 21867 | 802 | 30371 | 1603 | 60742 | 4007 | 121484 |
| **100** | 12 | 227 | 25 | 454 | 34 | 1180 | 88 | 3177 | 196 | 7715 | 318 | 13614 | 588 | 32763 | 980 | 45380 | 1960 | 90760 | 4900 | 181519 |
| **125** | 13 | 275 | 27 | 551 | 38 | 1432 | 97 | 3856 | 216 | 9366 | 351 | 16528 | 648 | 39665 | 1080 | 55091 | 2159 | 110183 | 5399 | 220366 |
| **150** | 14 | 320 | 29 | 639 | 41 | 1662 | 105 | 4474 | 232 | 10876 | 378 | 19176 | 698 | 46022 | 1163 | 63920 | 2326 | 127840 | 5815 | 255681 |
| **200** | 16 | 411 | 33 | 823 | 46 | 2139 | 119 | 5760 | 263 | 13988 | 429 | 24685 | 792 | 59244 | 1320 | 82284 | 2639 | 164568 | 6598 | 329136 |
| **225** | 17 | 460 | 35 | 920 | 49 | 2392 | 126 | 6440 | 279 | 15639 | 453 | 27599 | 837 | 66236 | 1395 | 91996 | 2790 | 183991 | 6976 | 367982 |
| **250** | 18 | 507 | 37 | 1014 | 51 | 2635 | 132 | 7095 | 292 | 17230 | 476 | 30407 | 879 | 72974 | 1464 | 101354 | 2929 | 202708 | 7322 | 405416 |
| **300** | 20 | 600 | 40 | 1201 | 56 | 3122 | 144 | 8405 | 318 | 20412 | 518 | 36022 | 956 | 86450 | 1594 | 120071 | 3188 | 240142 | 7970 | 480284 |
| **400** | 23 | 788 | 46 | 1575 | 64 | 4095 | 164 | 11025 | 364 | 26776 | 593 | 47252 | 1095 | 113402 | 1825 | 157505 | 3650 | 315010 | 9125 | 630020 |

For other steam densities:

$$Q_{min}\ (PPH) = ACFH_{min}(.0749/\rho)^{1/2} \cdot \rho$$
$$Q_{max}\ (PPH) = ACFH_{max} \cdot \rho$$

where: $ACFH_{min}$ & $ACFH_{max}$ refer to values from Table 1-1
$\rho$ = fluid Density at operating conditions in $lbs/ft^3$
.0749 = Density of air @ 14.7 psia & $70^o$ F

TABLE 1-6. SATURATED STEAM FLOW RATES

# 2.0 INSTALLATION

## 2.1 Inspection

The equipment should be inspected for damage that may have occurred during shipment. All damage should be reported to the shipping agent. If the equipment is damaged to the extent that faulty operation may result, contact ABB before installation. Always reference the complete instrument serial number and model number in all correspondence concerning the equipment supplied.

## 2.2 Location and Mounting

The meter can be installed in any attitude.

The meter is available in either a flange or wafer style body that mounts between adjacent pipe flanges of the process piping. Since the meter is unidirectional, it must be oriented in accordance with the direction of the process flow. A flow direction arrow is provided on the meter body to assure correct orientation.

Strainers and flow straighteners are not required. Refer to Figure 1-1 for meter piping requirements.

Assuming a properly supported pipeline, vibration problems should not be encountered in normal industrial applications.

The inside diameter of the flowmeter is the same as Schedule 80 pipe. The flowmeter K-factor is based on testing with Schedule 40 pipe.

In vertical and sloping installations, the electrical conduit entries should face downward to preclude the entry of condensation. In horizontal installations, when process temperatures above $160^{o}$ F ($71^{o}$ C) or below $0^{o}$ F ($-18^{o}$ C) are encountered, the meter must be oriented so that the junction box is located to the side of the meter body, not above or below.

**CAUTION**

**The pipeline and meter body may be insulated by the user. However, the meter interconnection wiring box and sensor housing tower must not be insulated. Ambient air is required to dissipate heat or cold build-up within the interconnection wiring box.**

The meter includes a pressure relief feature described in Section 2.9. Take the location of this pressure relief into consideration when locating and orienting your meter.

### 2.2.1 Extreme Temperature Applications

For process temperatures above 160$^{o}$ F (71$^{o}$ C) or below 0$^{o}$ F (-18$^{o}$ C), it is critical that the meter be pressurized and placed into service gradually, i.e., with allowance for sufficient time delay intervals to minimize excessive thermal shock. Steam should be introduced so that the meter is brought up to operating temperature over a ten to fifteen minute interval.

**WARNING**
**When the meter is used in a very high or low temperature process, the temperature of the junction box, sensor housing or Meter body may be extremely hot or cold. If it is necessary to touch the junction box, sensor housing or meter body, sufficiently insulated gloves must be worn to prevent serious injury**

## 2.3 Temperature/Pressure Monitoring

Provisions for temperature and/or pressure monitoring are the responsibility of the user.

- The temperature sensor should be located five to eight pipe diameters downstream of the flowmeter. Measurement is from the downstream face of the meter.
- The pressure tap should be located three to five pipe diameters downstream of the flowmeter. Measurement is from the downstream face of the meter.

## 2.4 Meter Weights

The weights shown in the following table are approximate and should only be used as a guide when installing the meter.

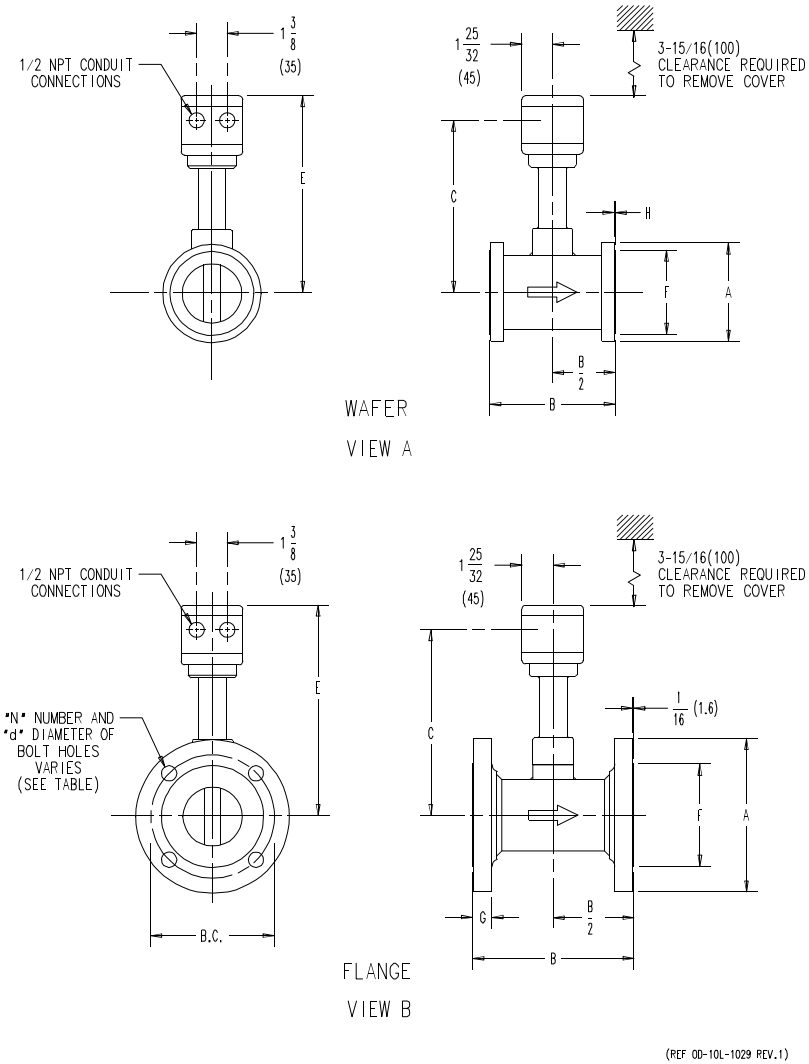
**TABLE 2-1. METER WEIGHTS**

| Meter Size | | Flange Class 150 | Flange Class 300 | Wafer |
|---|---|---|---|---|
| inch | mm | | | |
| 1 | 25 | 16 lbs (7.3 kg) | 17 lbs (7.7 kg) | ----- |
| 1.5 | 40 | 18 lbs (8.1 kg) | 22 lbs (10 kg) | 16 lbs (7.3 kg) |
| 2 | 50 | 22 lbs (10 kg) | 26 lbs (11.8 kg) | 18 lbs (8.2 kg) |
| 3 | 80 | 31 lbs (14.1 kg) | 39 lbs (17.7 kg) | 23 lbs (10.4 kg) |
| 4 | 100 | 37 lbs (16.8 kg) | 46 lbs (20.9 kg) | 28 lbs (12.7 kg) |
| 6 | 150 | 58 lbs (26.3 kg) | 75 lbs (34 kg) | 45 lbs (20.4 kg) |
| 8 | 200 | 70 lbs (31.8 kg) | 88 lbs (39.9 kg) | 61 lbs (27.7 kg) |
| 10 | 250 | 90 lbs (40.8 kg) | 110 lbs (49.9 kg) | ----- |
| 12 | 300 | 100 lbs (45.4 kg) | 125 lbs (56.7 kg) | ----- |

Refer to Figure 2-1 for outline dimensions of the flowmeter.

## OUTLINE-DIMENSIONS inches (mm)

| METER SIZE | ANSI RATING | VIEW | "A" DIA | B | C | "d" DIA | E | "F" DIA | G | H | N | BOLT CIRCLE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.0 (25) | 150 | B | 4-1/4 (108) | 7-7/8 (200) | 7-1/2 (190.5) | 5/8 (15.9) | 8-25/32 (223) | 2 (50.8) | 9/16 (14.3) | — | 4 | 3-1/8 (79.4) |
| | 300 | | 4-7/8 (123.8) | | | 3/4 (19) | | | 11/16 (17.5) | | | 3-1/2 (88.9) |
| 1.5 (40) | 150 | B | 5 (127) | 7-7/8 (200) | 7-3/16 (182.5) | 5/8 (15.9) | 8-15/32 (215.1) | 2-7/8 (73) | 11/16 (17.5) | — | 4 | 3-7/8 (98.4) |
| | 300 | | 6-1/8 (155.6) | | | 7/8 (22.2) | | | 13/16 (20.6) | | | 4-1/2 (114.3) |
| | 150/300 | A | 3-3/8 (85.7) | 4-7/16 (112.7) | 6-15/16 (176.2) | — | 8-7/32 (208.8) | 3-1/4 (82.6) | — | 9/64 (3.6) | — | — |
| 2 (50) | 150 | B | 6 (152.4) | 7-7/8 (200) | 7-1/2 (190.5) | 3/4 (19) | 8-25/32 (223) | 3-5/8 (92) | 3/4 (19) | — | 4 | 4-3/4 (120.7) |
| | 300 | | 6-1/2 (165.1) | | | | | | 7/8 (22.2) | | 8 | 5 (127) |
| | 150/300 | A | 3-7/8 (98.4) | 4-7/16 (112.7) | 7-3/16 (182.5) | — | 8-15/32 (215.1) | 3-23/32 (94.5) | — | 5/32 (4) | — | — |
| 3 (80) | 150 | B | 7-1/2 (190.5) | 7-7/8 (200) | 8-1/4 (209.5) | 3/4 (19) | 9-17/32 (242.1) | 5 (127) | 15/16 (23.8) | — | 4 | 6 (152.4) |
| | 300 | | 8-1/4 (209.6) | | | 7/8 (22.2) | | | 1-1/8 (31.8) | | 8 | 6-5/8 (168.3) |
| | 150/300 | A | 5-3/8 (136.5) | 4-3/8 (111.1) | 7-5/8 (193.7) | — | 8-31/32 (227.8) | — | — | — | — | — |
| 4 (100) | 150 | B | 9 (228.6) | 9-27/32 (250) | 8-9/16 (217.4) | 3/4 (19) | 9-7/8 (250.8) | 6-3/16 (157.2) | 15/16 (23.8) | — | 8 | 7-1/2 (190.5) |
| | 300 | | 10 (254) | | | 7/8 (22.2) | | | 1-1/4 (31.8) | | | 7-7/8 (200) |
| | 150/300 | A | 6-3/8 (161.9) | 4-9/16 (115.9) | 8-3/16 (207.9) | — | 9-15/32 (240.5) | — | — | — | — | — |
| 6 (150) | 150 | B | 11 (279.4) | 11-13/16 (300) | 9-5/8 (244.4) | 7/8 (22.2) | 10-15/16 (277.8) | 8-1/2 (215.9) | 1 (25.4) | — | 8 | 9-1/2 (241) |
| | 300 | | 12-1/2 (317.5) | | | | | | 1-7/16 (36.5) | | 12 | 10-5/8 (269.9) |
| | 150/300 | A | 8-1/2 (215.9) | 5-3/8 (136.5) | 9-1/4 (234.9) | — | 10-17/32 (267.5) | — | — | — | — | — |
| 8 (200) | 150 | B | 13-1/2 (342.9) | 13-3/4 (350) | 10-1/2 (266.9) | 7/8 (22.2) | 11-3/4 (298.7) | 10-5/8 (269.9) | 1-1/8 (28.6) | — | 8 | 11-3/4 (298.5) |
| | 300 | | 15 (381) | | | 1 (25.4) | | | 1-5/8 (41.3) | | 12 | 13 (330.2) |
| | 150/300 | A | 10-5/8 (269.9) | 6-1/4 (158.8) | 10-3/16 (258.8) | — | 11-15/32 (291.3) | — | — | — | — | — |
| 10.0 (250) | 150 | B | 16 (406.4) | 17.7 (450) | 14 (353) | 1 (25.4) | 13.3 (353) | 12.75 (323.90) | 1.2 (30.2) | — | 12 | 14.25 (365) |
| | 300 | | 17.5 (444.5) | | | 1.1 (28.4) | | | 1.85 (47.7) | | | 15.25 (387.3) |
| 12.0 (300) | 150 | B | 19 (482.6) | 19.75 (500) | 15 (379) | 1 (25.4) | 14.3 (364) | 15 (381) | 1.25 (31.8) | — | 12 | 17 (431.8) |
| | 300 | | 20.5 (520.7) | | | 1.25 (31.7) | | | 2 (50.8) | | 16 | 17.75 (450.8) |




(REF 0D-10L-1029 REV.1)

NOTES:
1. ALL DIMENSIONS ARE IN INCHES. DIMENSIONS IN PARENTHESIS ( ) ARE IN (mm).
2. ALL DIMENSIONS ARE GUARANTEED ONLY IF THIS PRINT IS CERTIFIED.
3. THIS DRAWING IS A THIRD ANGLE PROJECTION AS SHOWN.
4. FLANGE BOLT HOLES STRADDLE CENTERLINES.

**FIGURE 2-1. FLOWMETER OUTLINE DIMENSIONS**

## 2.5 Wafer Style Meter

The wafer type meter body mounts inside the pipe flange bolt circle. To assure optimum meter performance, the meter should be installed in accordance with the upstream and downstream straight run piping requirements given in Figure 1-1. The straight run piping should be schedule 80 or lighter pipe. Either flat or raised face flanges may be used.

Remove the shipping covers used to protect the meter inlet and outlet surfaces from damage during transit and handling.

### 2.5.1 Sizes 1.5 and 2 inches

Optional centering rings, mounting studs and nuts are supplied when specified at time of order.

The centering rings have an inside diameter that permits the ring to be mounted via an undercut face on the inlet and outlet ends of the meter body. Regardless of whether the meter will be installed in a horizontal, sloping, or vertical pipeline, one centering ring is used at the inlet end and the other at the outlet end of the meter. Use of the centering rings is illustrated in Figure 2-2. The rings will have several bolt alignment hole patterns that are spaced and located on different bolt circle radii. This permits a particular meter size to be adapted to various flange ratings, e.g., ANSI Class 150 or 300 flanges. When installing the centering rings, orient them so that the flange rating values stamped on the rings will face the meter body, i.e., markings must be visible. Position the centering ring so that the mounting studs will pass through the appropriate set of bolt circle radii, as designated according to the flange rating.

Place the flange gaskets (two supplied) against the upstream and downstream flange faces. Align the gaskets holes with the flange bolt pattern. When installing the flange gaskets, use care to assure that the gaskets fit properly and do not project into the pipe line causing an alteration of the flow profile. A change in flow profile can adversely effect meter accuracy.

Install the meter in the pipeline, between the inlet and outlet gaskets. Make certain that the **flow direction arrow** on the meter body is oriented in accordance with the process flow. If the meter is installed in a horizontal pipeline, insert two studs in the bottom two flange holes to support the meter. When installing the meter in a vertical pipe run, some temporary support may be required until mounting studs and nuts have been installed.

Install the remaining mounting studs, as required. Studs and nuts should be well lubricated with a graphite based lubricant. Place a hex nut on each end of the mounting stud. Tighten the stud nuts in a diagonally opposite pattern to equalize pressure on the meter face. Nut torque should be limited to that which will provide a leakproof seal.

### 2.5.2 Sizes 3 through 8 inches

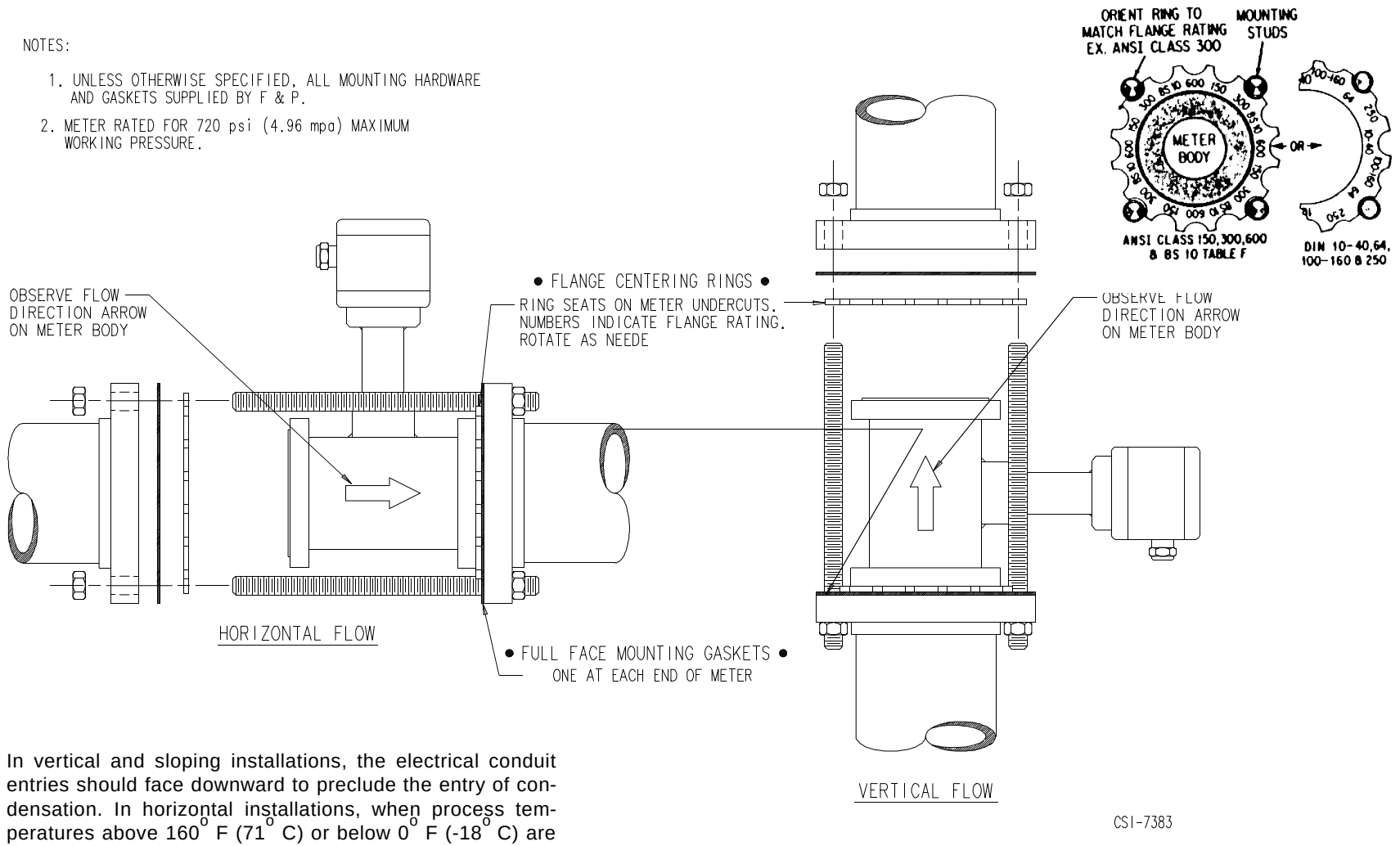
Place the flange gaskets (two supplied) against the upstream and downstream flange faces. Align the gaskets holes with the flange bolt pattern. When installing the flange gaskets, use care to assure that the gaskets fit properly and do not project into the pipe line causing an alteration of the flow profile. A change in flow profile can adversely effect meter accuracy.

Optional centering sleeves (spacers), mounting studs and nuts are supplied when specified at time of order.

Placement of the sleeves is dependent on the type of installation (vertical/horizontal/sloping). If the meter is installed in a vertical pipeline, select four equally spaced bolt holes for placement of the four centering sleeves and studs (refer to Figure 2-3). If the meter is installed in a horizontal pipeline, select the bottom two holes of the flanges on each end of the meter for placement of the four centering sleeves and studs.

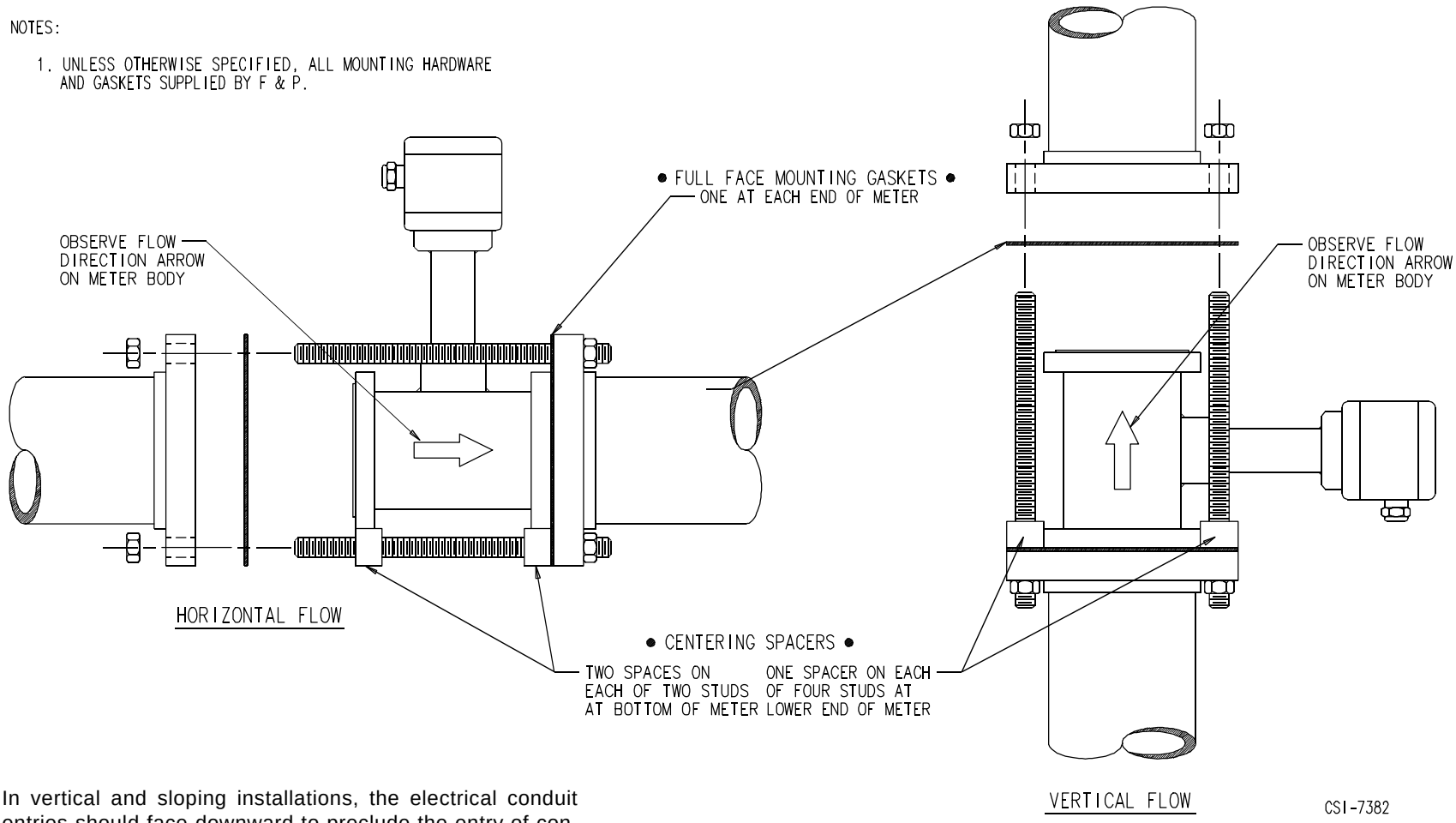
Install the meter in the pipeline between the inlet and outlet gaskets. Make certain that the **flow direction arrow** on the meter body is oriented in accordance with the process flow. In horizontal pipe runs the meter will be supported by the upstream and downstream centering spacers. When installing the meter in a vertical pipe run, some temporary support may be required until mounting studs and nuts have been installed.

Install the remaining mounting studs, as required. Studs and nuts should be well lubricated with a graphite based lubricant. Place a hex nut on each end of the mounting stud. Tighten the stud nuts in a diagonally opposite pattern to equalize pressure on the meter face. Nut torque should be limited to that which will provide a leakproof seal.




In vertical and sloping installations, the electrical conduit entries should face downward to preclude the entry of condensation. In horizontal installations, when process temperatures above 160° F (71° C) or below 0° F (-18° C) are encountered, the meter must be oriented so that the junction box is located to the side of the meter body, not above or below.

**FIGURE 2-2. WAFER PROCESS CONNECTIONS SIZES 1.5 AND 2 INCHES**




In vertical and sloping installations, the electrical conduit entries should face downward to preclude the entry of condensation. In horizontal installations, when process temperatures above 160° F (71° C) or below 0° F (-18° C) are encountered, the meter must be oriented so that the junction box is located to the side of the meter body, not above or below.

**FIGURE 2-3. WAFER PROCESS CONNECTIONS SIZES 3 THROUGH 8 INCHES**

## 2.6 Flange Style Meter

To assure optimum meter performance, the meter should be installed in accordance with the upstream and downstream straight run piping requirements given in Figure 1-3. The straight run piping should be schedule 80 or lighter pipe. Process flanges should be raised face.

Remove the shipping covers used to protect the meter inlet and outlet surfaces from damage during shipment.

Place the flange gaskets (two supplied) against the upstream and downstream flange faces. Align the gaskets holes with the flange bolt pattern.

When installing the flange gaskets, use care to assure that the gaskets fit properly and do not project into the pipe line causing an alteration of the flow profile. A change in flow profile can adversely effect meter accuracy.

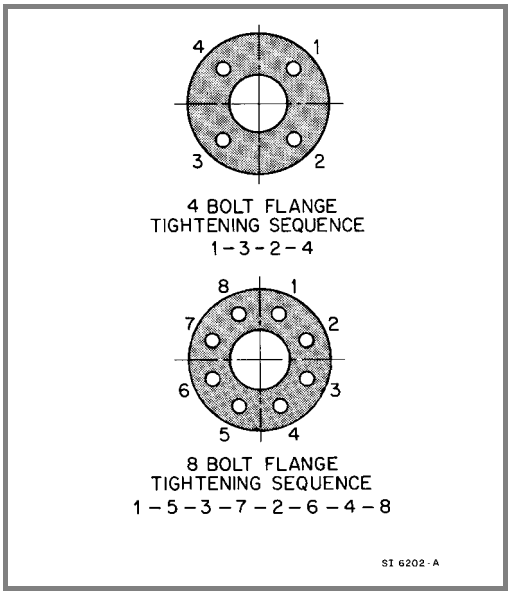



**FIGURE 2-4. FLANGE BOLT TIGHTENING SEQUENCE**

Mounting bolts and nuts are supplied by the user. Make certain that the **flow direction arrow** on the meter body is oriented in accordance with the process flow. With the meter safely supported, install the bolts through the meter and process flanges. Bolts and nuts should be lubricated with a graphite-based lubricant. Assemble the nuts to the bolts hand tight. Tighten the flange nuts in a diagonal or "star" pattern as shown in Figure 2-4.

This "star" pattern tightening sequence is recommended to equalize pressure on the flange face and gaskets. Bolt/nut torque should be limited to that which will provide a leakproof seal. When correctly installed, the installation should look like that shown in Figure 2-5.

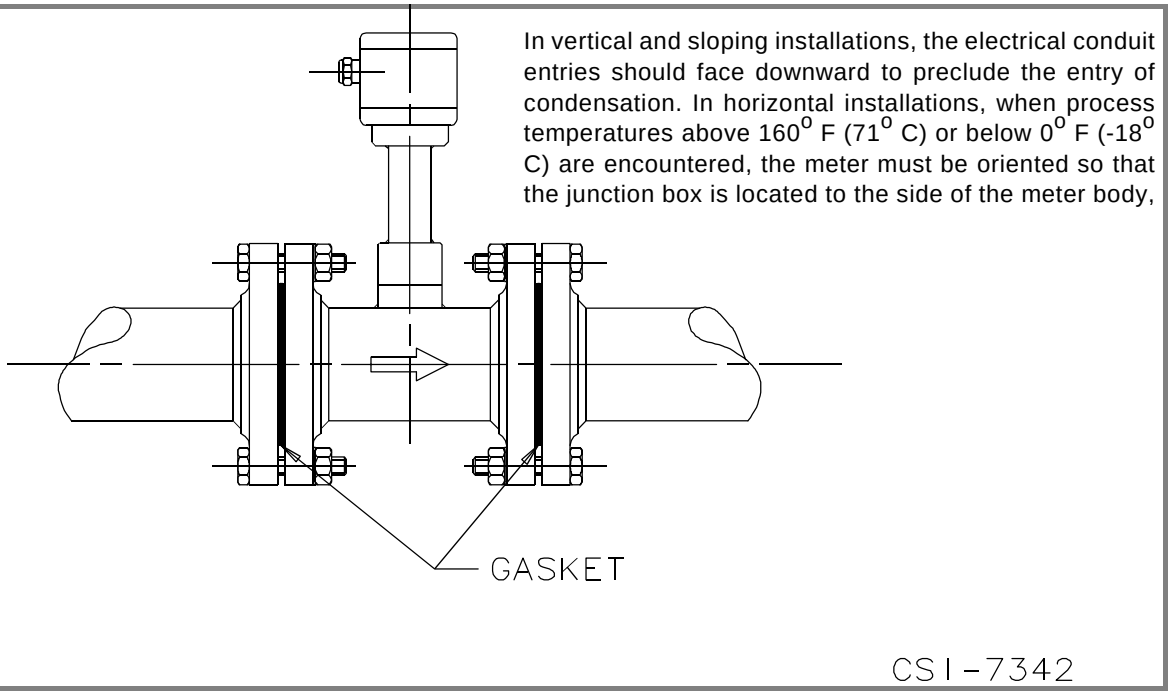



**FIGURE 2-5. FLANGE PROCESS CONNECTIONS**

## 2.7 Electrical Interconnections

The 10VM1000 Vortex flowmeter is provided with a 50VM1000 remotely-mounted signal converter. Interconnection details are provided in the Instruction Bulletin provided with the 50VM1000. If the 50VM1000 is powered by AC line voltage, proper care must be exercised when making electrical interconnections.

**WARNING**
**ELECTRICAL SHOCK HAZARD. Equipment powered by AC line voltage constitutes a potential electric shock hazard to the user. Make certain that the system power input leads are disconnected from the operating branch circuit before attempting electrical interconnections.**

The 10VM1000 electronics housing contains a preamplifier circuit board assembly which contains the terminal blocks to attach the sensor leads and interconnect cable. The circuit board assembly is a single circuit board with components mounted on both sides of the assembly. The underside of the circuit board (as-mounted) contains terminal block x1 for the connection of the sensor leads. This layout is shown in Figure 2-6 below.

**CAUTION**
**Some of the IC devices used in the signal converter are static sensitive and may be damaged by improper handling. When adjusting or servicing the signal converter, use of a grounded wrist strap is recommended to prevent inadvertant damage to the integral solid state circuitry.**

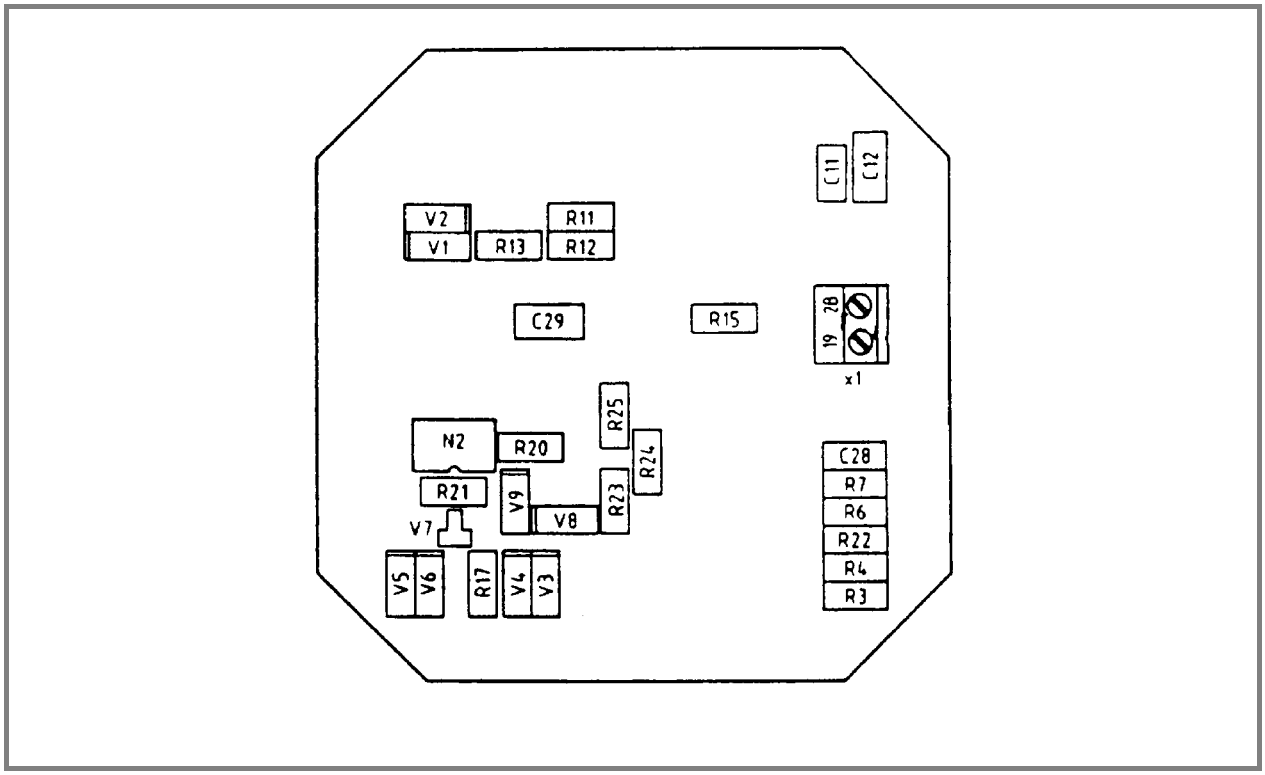



**FIGURE 2-6. PREAMPLIFIER BOARD LAYOUT (SENSOR CONNECTION SIDE)**

The top side of the preamplifier circuit board contains the bulk of the preamplifier circuitry, terminal block x2 for connection of the interconnect cable leads and the preamplifier circuit programming switches S1.1-S1.8, S2.1-S2.4 and S3.1-S3.8. These switches are discussed further in Section 2.8. The layout of the top side of the preamplifier board assembly is shown in Figure 2-7.

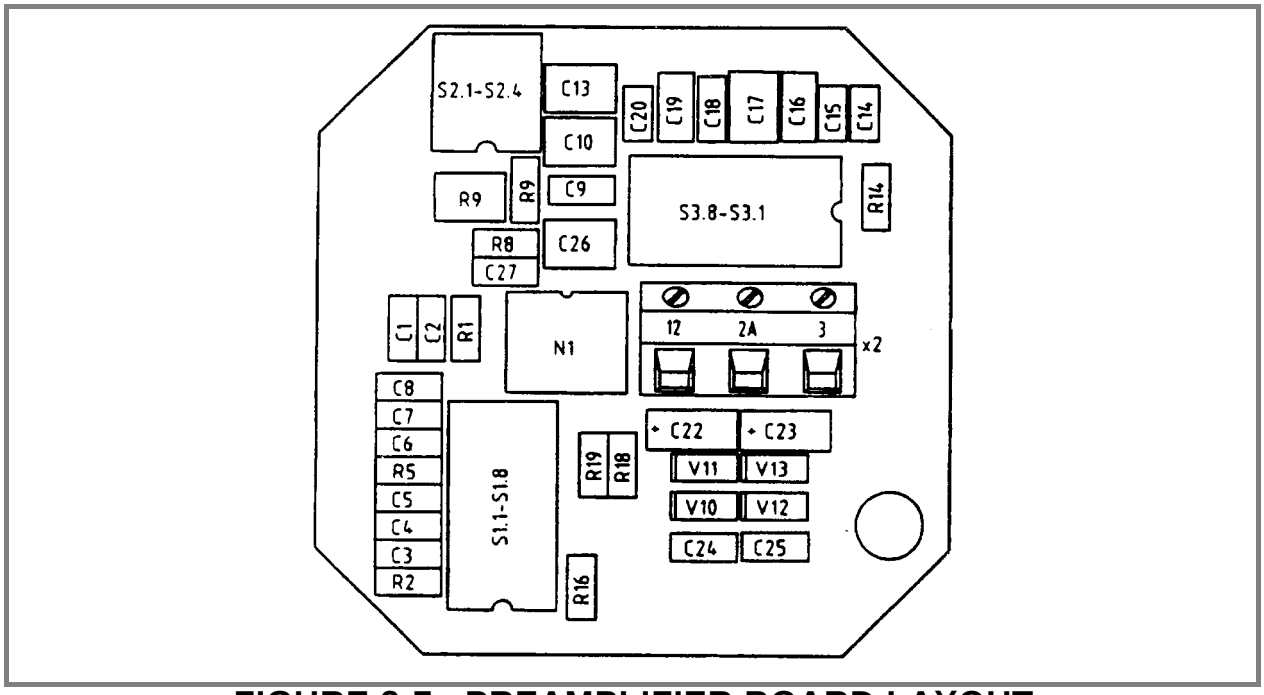



**FIGURE 2-7. PREAMPLIFIER BOARD LAYOUT (CABLE CONNECTION SIDE)**

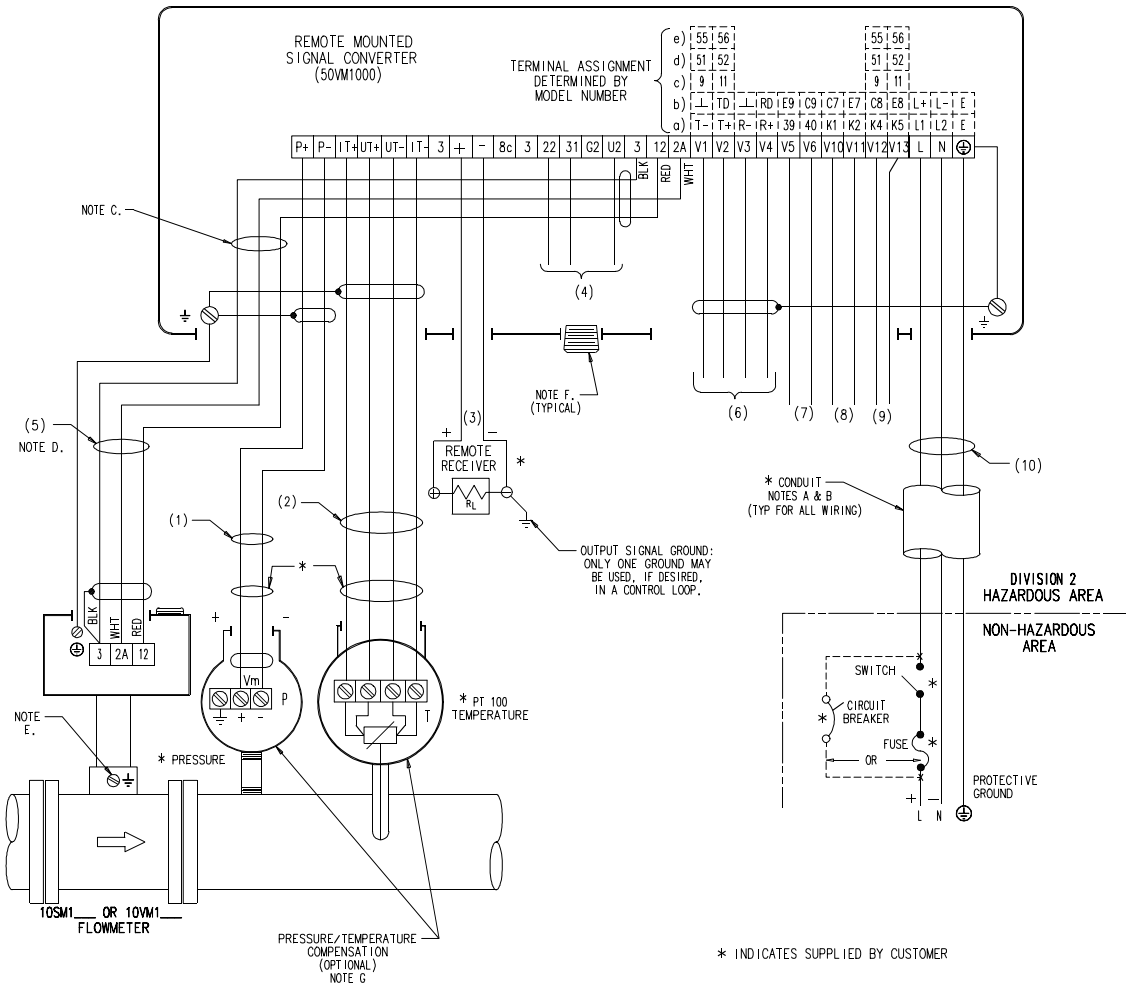
The interconnect cable attaches to terminal block x2 (terminals 12, 2A & 3). The wires in the interconnect cable are color-coded. When making the cable connections between the Primary and the converter, make certain that the wire color associated with a terminal number at the Primary is connected to the corresponding terminal at the converter since the order of the terminal numbering is different at the converter end.

Note that the interconnect cable shield is only connected at the 10VM1000 Primary terminal block and does not get connected at the 50VM1000 converter. Maximum length of the interconnect cable is 2600 feet (800 meters). Refer to Figures 2-8 & 2-9 for the interconnection wiring diagrams.

The flowmeter preamplifier housing cover is removable and may be removed for access during installation and maintenance. Remove the cover from the housing by loosening the screws on the cover. Figure 2-1 in this chapter specifies the clearance required above the preamplifier connection box to provide access to the cover retaining screws.

Replace the covers when the installation has been completed and **before** power is applied to the equipment. Make certain that covers are replaced properly after maintenance by using the following procedures:

- Check that gaskets are properly seated and are not pinched or stretched.
- Check that gasket surfaces are clean and free of grease or other contaminants.
- Align covers on housing and re-install bolts.
- Tighten bolts finger tight.
- Finish tightening bolts in a "star" pattern to distribute force evenly.




**INSTALLATION NOTES**

A. EQUIPMENT AND WIRING TO BE INSTALLED IN ACCORDANCE WITH ANSI/NFPA 70 (NATIONAL ELECTRICAL CODE) AND LOCAL CODE REQUIREMENTS.

B. HAZARDOUS LOCATIONS: WIRING TO BE IN CONDUIT, BOXES, FITTINGS AND SEALS TO COMPLY WITH ARTICLE 501 OF ANSI/NFPA 70 AND LOCAL ELECTRICAL CODE REQUIREMENTS.

C. SHIELDED CABLE IS REQUIRED. THE UNTERMINATED END OF THE SHIELD SHALL BE INSULATED FROM THE CONVERTER.

D. USE NEC TYPE CMR, 22 AWG MINIMUM (BELDEN 9363 OR EQUIVALENT). FOR PROCESS TEMPERATURES GREATER THAN 105°C AND PLENUM SERVICE, USE NEC TYPE CMP (BELDEN 83553 OR EQUIVALENT).

E. BODY OF FLOWMETER SHALL BE GROUNDED THROUGH THE PIPELINE FLANGES OR THROUGH THE METER EXTERNAL GROUND TERMINAL.

F. SEALS REQUIRED AT UNUSED CONDUIT ENTRIES TO MAINTAIN NEMA 4X ENCLOSURE RATINGS.

G. APPROVAL DOES NOT INCLUDE OPTIONAL PRESSURE TRANSDUCER AND PT100 TEMPERATURE SENSOR. THESE COMPONENTS ARE SUPPLIED BY THE END USER AND MUST BE APPROVED BY FMRC FOR THE SPECIFIC HAZARDOUS LOCATION.

**TERMINAL ASSIGNMENT TABLE**

(1) PRESSURE INPUT (CURRENT): MAXIMUM LENGTH 2600ft (800m)
PRESSURE SENSOR 0/4-20mA; **P+ - 30 V.**

(2) TEMPERATURE INPUT: MAXIMUM LENGTH 2600ft (800m)
Pt100 - RESISTANCE, IP - 1mA; VP - 19.5 - 247mV FOR -328 TO +752°F(-200 TO +400 °C)

(3) CURRENT OUTPUT: MAXIMUM LENGTH 4900ft (1500m)
SELECTABLE: LOAD ≤750 OHMS, 0-20mA, 4-20mA, 0-10mA, 2-10mA

(4) 22/U2: EXTERNAL ZERO RETURN, PASSIVE CONTACT CLOSURE
31/U2: EXTERNAL TOTALIZER RESET, PASSIVE CONTACT CLOSURE, BOTH INPUTS OPTOCOUPLER ISOLATED

(5) SIGNAL CABLE: (CONNECT SHIELD ONLY AT PREAMPLIFIER) MAXIMUM LENGTH 2600ft (800m)

(6) DATA LINK OR PULSE OUTPUT:
a) DATA LINK RS 485; MAXIMUM LENGTH 3940ft (1200m)
b) DATA LINK RS 232C/24V; MAXIMUM LENGTH 50ft (15m)
c) SCALED PULSE OUTPUT, ACTIVE, 24Vdc, LOAD ≥150 OHMS
d) SCALED PULSE OUTPUT, PASSIVE, RELAY CONTACT CLOSURE, ≤120mA, ≤30Vdc
e) SCALED PULSE OUTPUT, OPTOCOUPLER, 5V ≤$V_{CE}$ ≤25V, 5mA ≤$I_{CE}$ ≤30mA

NOTE: A SHIELDED DATA CABLE IS RECOMMENDED FOR USE WITH THE RS 232C DATA LINK; A SHIELDED CABLE WITH INDIVIDUALLY TWISTED PAIRS IS RECOMMENDED FOR USE WITH THE RS 485 DATA LINK.

(7) ALARM CONTACT, OPENS IN ALARM CONDITION
a) ALARM CONTACT, RELAY, ≤120mA, ≤30Vdc
b) ALARM OUTPUT, OPTOCOUPLER, $V_{CE}$ ≤25V, $I_{CE}$ ≤7.5mA

(8) MAX-ALARM
a) ALARM CONTACT, RELAY, OPENS, ≤120mA, ≤30Vdc
b) ALARM OUTPUT, OPTOCOUPLER, $V_{CE}$ ≤25V, $I_{CE}$ ≤7.5mA

(9) PULSE OUTPUT OR MIN-ALARM
a) ALARM CONTACT, RELAY, OPENS, ≤120mA, ≤30Vdc
b) ALARM OUTPUT, OPTOCOUPLER, $V_{CE}$ ≤25V, $I_{CE}$ ≤7.5mA
c) SCALED PULSE OUTPUT, ACTIVE, 24Vdc, LOAD ≥150 OHMS
d) SCALED PULSE OUTPUT, PASSIVE, RELAY CONTACT CLOSURE, ≤120mA, ≤30Vdc
e) SCALED PULSE OUTPUT, OPTOCOUPLER,5V ≤$V_{CE}$ ≤25V, 5mA ≤$I_{CE}$ ≤30mA

(10) POWER SUPPLY (SEE DATA TAG): a) AC 50/60Hz b) LOW VOLTAGE AC 50/60Hz c)DC

(11) TERMINALS V1 & V2, V3 & V4, V5 & V6, V10 & V11, V12 & V13 ARE APPROVED WITH NON-INCENDIVE FIELD PARAMETERS AS FOLLOWS:

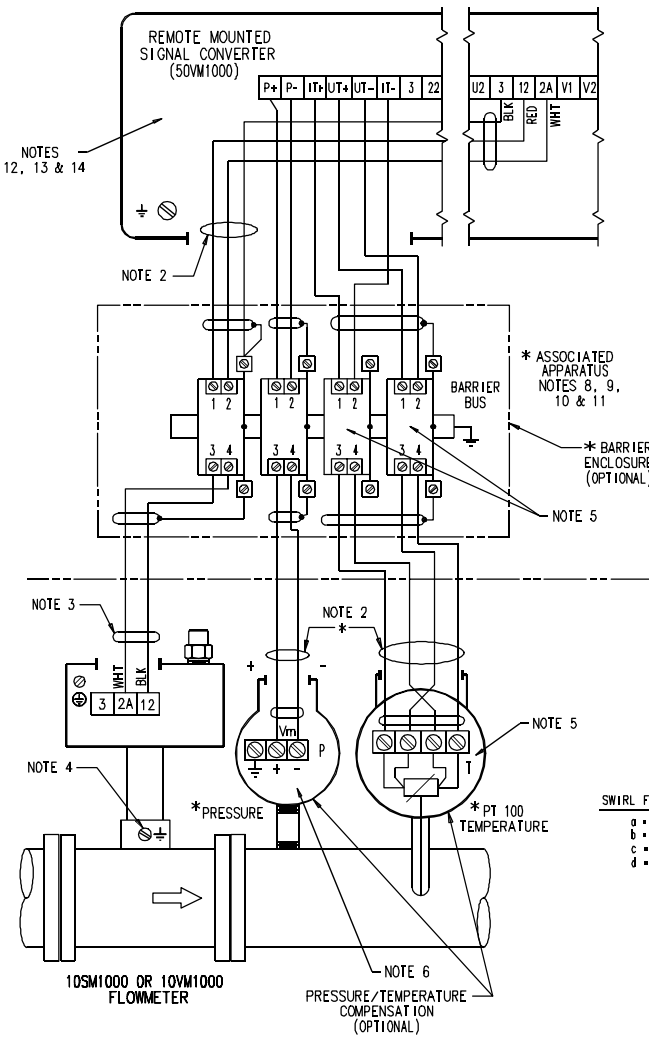
$V_{max}$ - 30 V  $C_i$ - 0 uF

$I_{max}$ - 120 mA  $L_i$ - 0 mH

(12) THE POWER SOURCE CONNECTED TO TERMINALS V1 & V2, V3 & V4, V5 & V6, V10 & V11, V12 & V13 MUST BE FMRC APPROVED WITH NON-INCENDIVE FIELD CIRCUITS SPECIFYING **$V_{oc}$. $I_{sc}$. $C_a$** AND **$L_a$.** ALL OTHER I/O ARE TERMINALS TO BE IN ACCORDANCE WITH ANSI/NFPA 70 (NATIONAL ELECTRICAL CODE).

(ID-50-1829-5 REF)

**FIGURE 2-8. INTERCONNECTION WIRING DIAGRAM FOR NON-HAZARDOUS LOCATIONS**




**INSTALLATION NOTES**

1. EQUIPMENT AND WIRING TO BE INSTALLED IN ACCORDANCE WITH ANSI/NFPA 70 (NATIONAL ELECTRICAL CODE) AND LOCAL CODE REQUIRMENTS.
2. SHIELDED CABLE IS REQUIRED AND THE SHIELD SHALL BE CONNECTED AS SHOWN AND AS SPECIFIED IN ANSI/ISA RP 12.6. THE UNTERMINATED END OF THE SHIELD SHALL BE INSULATED.
3. USE NEC TYPE CM, 22 AWG MINIMUM (BELDEN 8761 OR EQUIVALENT), FOR PROCESS TEMPERATURES GREATER THAN 100° C AND PLENUM SERVICE, USE NEC TYPE CMP (BELDEN 88671 OR EQUIVALENT).
4. BODY OF FLOWMETER SHALL BE GROUNDED THROUGH THE PIPELINE FLANGES OR THROUGH THE METER EXTERNAL GROUND TERMINAL.
5. TEMPERATURE SENSOR (RTD) SHALL BE "SIMPLE APPARATUS" NOT GENERATING MORE THAN 1.2 V, 0.1 A, 25 mW, OR 20 uJ ASSOCIATED APPARATUS USED WITH THE 4-WIRE RTD TEMPERATURE SENSOR MUST BE FMRC "ENTITY" APPROVED FOR THIS SERVICE.
6. PRESSURE TRANSMITTER MUST BE FMRC APPROVED WITH A MINIMUM OPERATING PRESSURE OF 720 psi.
7. BARRIERS MUST BE INSTALLED IN ACCORDANCE WITH THE BARRIER MANUFACTURER'S INSTRUCTIONS.

* INDICATES SUPPLIED BY USER- (APPROVAL DOES NOT INCLUDE OPTIONAL PRESSURE TRANSDUCER, PT100 TEMPERATURE SENSOR, ENCLOSURES AND BARRIERS. THESE COMPONENTS ARE SUPPLIED BY THE END USER AND MUST BE APPROVED BY FMRC FOR THE SPECIFIC HAZARDOUS LOCATION. THE BARRIERS MUST BE SUITABLE FOR USE WITH PRESSURE AND TEMPERATURE DEVICES IN A DIVISION 2 HAZARDOUS LOCATION OR NON-HAZARDOUS LOCATION).

INTRINSICALLY SAFE CL I, II, III, DIV I

APPLICABLE GROUPS A, B, C, D, E, F & G

10SM1000 & 10VM1000 APPARATUS ENTITY VALUES

$V_{max}$ = 46 V $I_{max}$ = 110 mA
$C_i$ = 5 nF $L_i$=0
$P_{max}$ = 1.2 W
TEMP. IDENT. T4

SWIRL FLOWMETER, MODEL 10SM11aAbc9AdA2

a = FLUID TYPE 1, 2, 3, 4, 5 OR 6
b = METER SIZE B, C, D, E, F, G, H, K, L
c = PRESSURE RATING P OR Q
d = SENSOR 1 OR 5

VORTEX FLOWMETER, MODEL 10VM1ab1Acd1eC

a = PROCESS CONNECTION 1 OR 3
b = FLUID TYPE 1, 2, 3, 4, 5 OR 6
c = METER SIZE B, C, D, E, F, G, H, J, K
d = PRESSURE RATING H OR J
e = SENSOR GASKET 1 OR 2

AMBIENT LIMITS: -4° TO 140° F (-20° TO 60° C)

⚠ REFER TO THE FLOWMETER INSTRUCTION BULLETIN FOR APPLICATION AND INSTALLATION REQUIREMENTS.

**WARNING** - SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFTEY.

**ASSOCIATED APPARATUS**

8. OPTIONAL ENCLOSURE AND GROUND MUST BE INSTALLED IN ACCORDANCE WITH THE BARRIER MANUFACTURER'S INSTRUCTIONS, ARTICLE 504 OF ANSI/NAPA 70 (NATIONAL ELECTRICAL CODE), AND ANSI/ISA RP12.6.
9. ASSOCIATED APPARATUS MAY BE LOCATED IN A DIVISION 2 LOCATION IF SO APPROVED. WIRING IN A DIVISION 2 AREA SHALL BE PER NEC ARTICLE 501-4, NEC TYPE PLTC (BELDEN 1033A OR EQUIVALENT).
10. THE ASSOCIATED APPARATUS CONTROL DRAWING SHALL VERIFY COMPLIANCE WITH THE FOLLOWING SPECIFICATIONS:

ENTITY PARAMETERS FOR ASSOCIATED APPARATUS USED WITH 10SM1_ & 10VM1_

| CLASS I, II, III APPLICABLE GROUPS | SUPPLY $V_{max}$ | SUPPLY $I_{max}$ | RETURN $V_{max}$ | RETURN $I_{max}$ | $P_{max}$ |
|---|---|---|---|---|---|
| A, B, C, D, E, F, G | < 46 V | < 110 mA | < 15 V | < 300 mA | ≤ 1.2 W |

ENTITY INSTALLATION REQUIREMENTS:

$V_{max} \geq V_t$ OR $V_{oc}$
$I_{max} \geq I_t$ OR $I_{sc}$
$C_a \geq C_i + C_{cable}$
$L_a \geq L_i + L_{cable}$

11. THE USER IS RESPONSIBLE FOR COMPATIBILITY AND APPROVAL OF THE USER PROVIDED ASSOCIATED APPARATUS, TEMPERATURE SENSOR (RTD) AND PRESSURE TRANSMITTER.

**CONTROL EQUIPMENT**

12. THE 50VM1000 SIGNAL CONVERTER SHALL NOT BE CONNECTED TO, UNDER NORMAL OR ABNORMAL CONDITIONS, A SOURCE OF OF SUPPLY VOLTAGE THAT EXCEEDS 250 V rms OR 250 V dc WITH RESPECT TO EARTH GROUND.
13. 50VM1000 SIGNAL CONVERTER MAY BE LOCATED IN A DIVISION 2 LOCATION.
14. FOR SIGNAL CONVERTER CONNECTIONS REFER TO ID-50-1829.

(ID-10-1105-4 REF)

**FIGURE 2-9. INTERCONNECTION WIRING DIAGRAM FOR INTRINSICALLY SAFE LOCATIONS**

**CAUTION**
**All unused conduit entrances must have pipe plugs installed. This is required to maintain the NEMA 4X enclosure rating.**

## 2.8 Preamplifier Board Switches

The programming switches are located on the top side of the Preamplifier Board and are shown shaded in Figure 2-10 below. These switches customize the sensor-signal noise filter characteristics and enable a single preamplifier assembly to adapt to all meter sizes and process media. It is important that these switches be set correctly for proper operation of the meter. The switches are generally preset at the factory and should require no re-adjustment but if a verification of the proper settings is desired, Table 2-2 correlates the filter switch positions with the applicable meter size and process fluid.

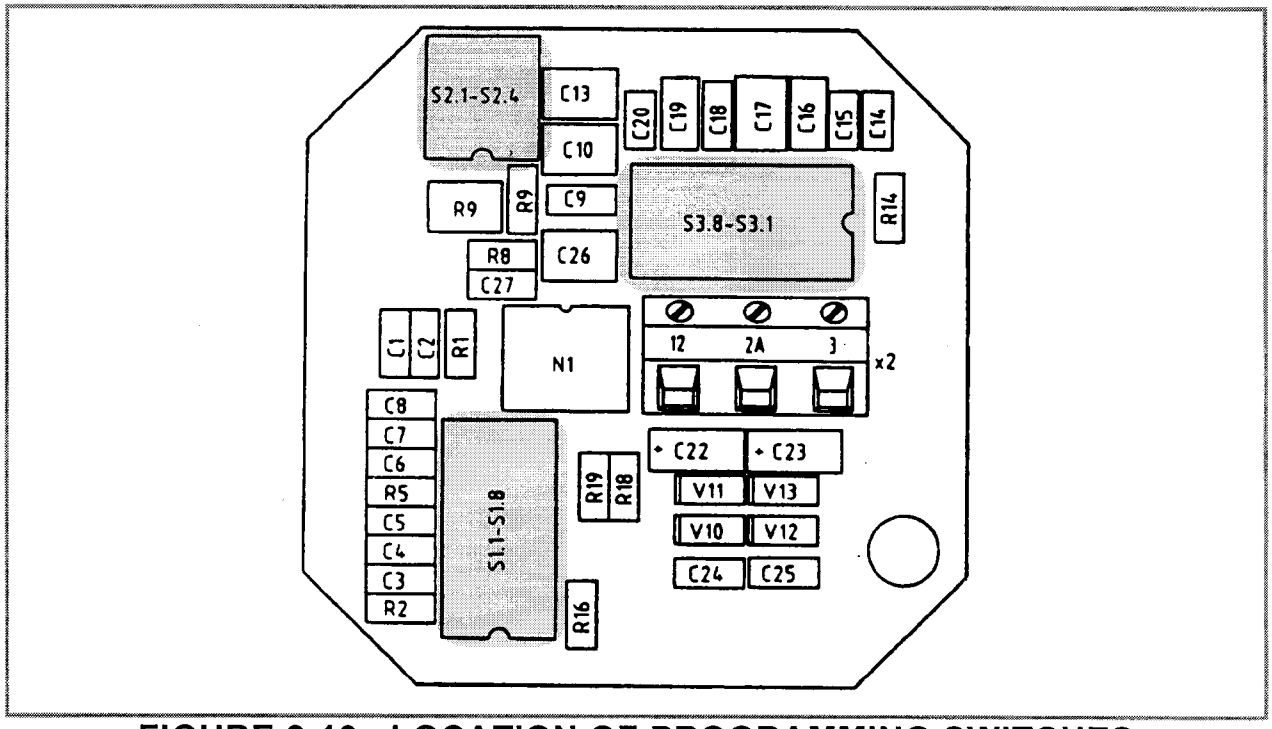



**FIGURE 2-10. LOCATION OF PROGRAMMING SWITCHES**

## 2.9 Conduit Seal and Pressure Relief

In accordance with the National Electrical Code (NEC) ANSI/NFPA 70, Article 501-5(f)(3), the flowmeter includes a **conduit entry seal** and **pressure relief** to prevent the process fluid from entering the electrical conduit system. This safety feature considers the remote possibility of a primary seal failure between the meter body and the electronic housing.

The **conduit entry seal** will prevent the process fluid from entering the electrical conduit system. The conduit entry seal consists of a conduit entry cable seal on the meter junction box. **It is the user's responsibility to properly install the conduit entry cable seal fitting supplied with the flow computer interconnection cable.** This will assure proper performance of this safety feature. Refer to Figure 2-11 for proper installation.

A **pressure relief** is provided in the electronics housing for the flowmeter. The pressure relief is located in the center of the cover joint on the side opposite from the conduit connection. If the primary seal should fail, this pressure relief will vent the process, thereby preventing an over pressurization and potentially dangerous failure of the electronics housing. It is the user's responsibility to be aware of this safety feature and to consider the unlikely event of its functioning. Based on knowledge of the process and meter application, the user should consider the use of deflectors to safely direct the vented process.

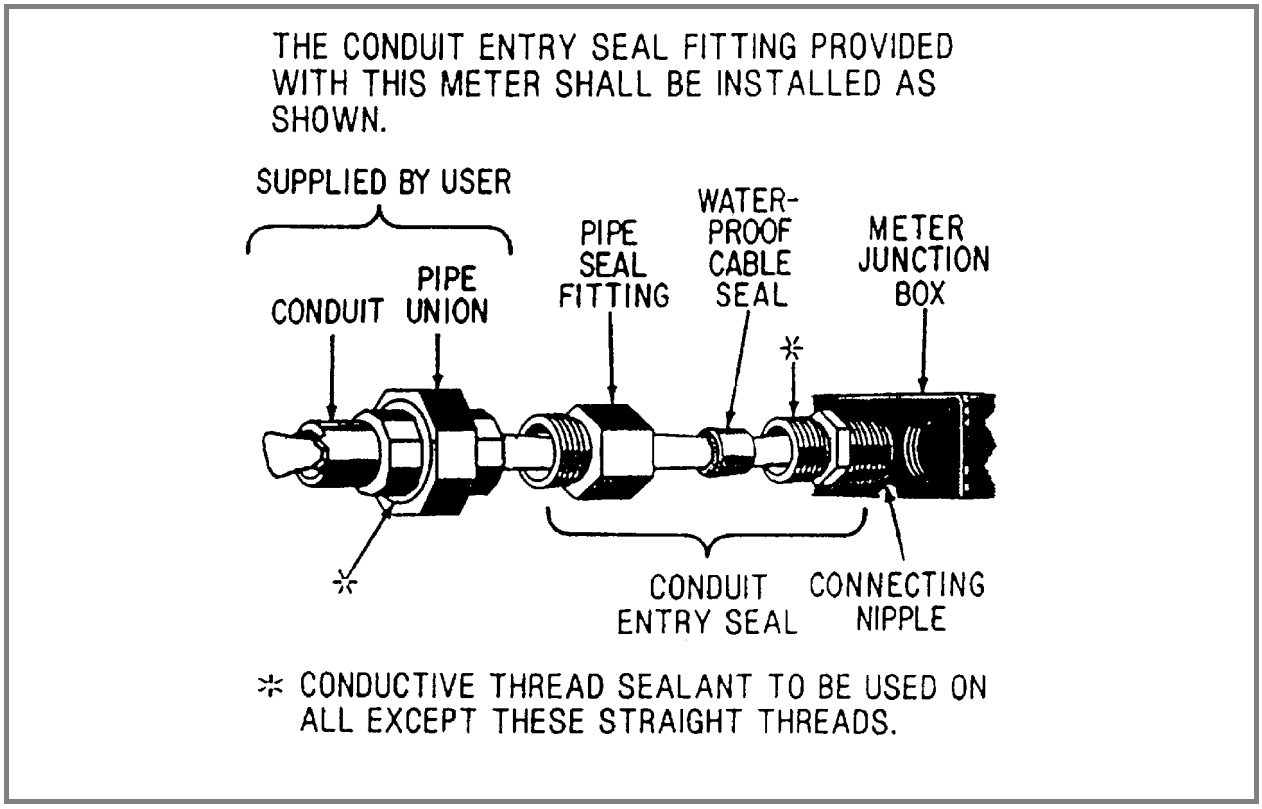



**FIGURE 2-10. CONDUIT ENTRY SEAL INSTALLATION**

| Medium | Meter Size | | SWITCHES TO BE IN CLOSED OR "ON" POSITION (ALL OTHER SWITCHES MUST BE OPEN) | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | in. | mm | S1.1 | S1.2 | S1.3 | S1.4 | S1.5 | S1.6 | S1.7 | S1.8 | S2.1 | S2.2 | S2.3 | S2.4 | S3.1 | S3.2 | S3.3 | S3.4 | S3.5 | S3.6 | S3.7 | S3.8 |
| GAS | 1 | 25 | ● | | ● | | ● | | ● | | ● | | | | | ● | | | | | | |
| | 1.5 | 40 | ● | | ● | | ● | | ● | | ● | | | | | ● | | | | | | |
| | 2 | 50 | ● | | ● | | ● | | ● | | | ● | | | | ● | | | | | | |
| | 3 | 80 | ● | | ● | | ● | | ● | | | ● | | | | | ● | | | | | |
| | 4 | 100 | ● | | ● | | ● | | ● | | | ● | | | | | ● | | | | | |
| | 6 | 150 | | | ● | | | | ● | | | | ● | | | | | ● | | | | |
| | 8 | 200 | | | ● | | | | ● | | | | ● | | | | | ● | | | | ● |
| | 10 | 250 | ● | ● | ● | ● | ● | ● | ● | ● | | | ● | | | | | ● | | | | |
| | 12 | 300 | ● | ● | ● | ● | ● | ● | ● | ● | | | ● | | | | | ● | | | | |
| LIQUID | 1 | 25 | | | | ● | | | | ● | | | | ● | | | ● | | | | | ● |
| | 1.5 | 40 | | | | ● | | | | ● | | | | ● | | | ● | ● | | | | ● |
| | 2 | 50 | | | | ● | | | | ● | | | | ● | | ● | | ● | ● | | | ● |
| | 3 | 80 | | | ● | ● | | | ● | ● | | | | ● | | | | ● | | ● | | ● |
| | 4 | 100 | | | ● | ● | | | ● | ● | | | | ● | | | ● | ● | | ● | | ● |
| | 6 | 150 | | | ● | ● | | | ● | ● | | | | ● | | | | | | ● | ● | ● |
| | 8 | 200 | | ● | ● | ● | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| | ♦ 10 | 250 | | | | | | | | | | | | | | | | | | | | |
| | 12 | 300 | | ● | ● | ● | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |

**NOTE:** ● indicates switch to be in "closed" or "ON" position
♦ to be determined

**TABLE 2-2. PREAMPLIFIER BOARD FILTER SWITCH SETTINGS**

# 3.0 PARTS LIST

**TABLE 3-1. FLANGE GASKETS**

| Meter Size | | ANSI Flange Rating | Gasket Part Number (2) required |
|---|---|---|---|
| inches | mm | | |
| 1 | 25 | 150 | 333J089U10 |
| | | 300 | 333J089U11 |
| 1.5 | 40 | 150 | 333J089U15 |
| | | 300 | 333J089U16 |
| 2 | 50 | 150 | 333J089U19 |
| | | 300 | 333J089U25 |
| 3 | 80 | 150 | 333J089U22 |
| | | 300 | 333J089U26 |
| 4 | 100 | 150 | 333J089U29 |
| | | 300 | 333J089U30 |
| 6 | 150 | 150 | 333J083U33 |
| | | 300 | 333J083U42 |
| 8 | 200 | 150 | 333J083U38 |
| | | 300 | 333J083U46 |
| 10 | 250 | 150 | N/A |
| | | 300 | N/A |
| 12 | 300 | 150 | N/A |
| | | 300 | N/A |

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