**Type 2000 I/P & E/P Transducers**

**Description**

The Marsh Bellofram Type 2000 is a robust electronic instrument that regulates an incoming supply pressure down to a precise output pressure which is directly proportional to an electrical control signal. The secret to the Type 2000’s precise, reliable performance under a variety of demanding environmental conditions is a patented piezo-ceramic actuator with many industry-wide firsts.

The Type 2000 has been designed to meet the electro-pneumatic needs of the world:

- Field-selectable inputs and direct/reverse/split ranging
- Multiple input/output/mounting configurations
- Precise, reliable performance under extreme conditions of temperature, vibration, orientation, supply pressure changes, supply voltage changes, RF/EMI, humid/oil-laden media, and corrosive surroundings

**Applications**

The Type 2000’s precisely regulated pneumatic output can be used to operate:

- Valve Actuators
- Louver and Damper Actuators
- Valve Positioners
- Relays
- Clutches and Brakes
- Controllers
- Air Cylinders

**Industry Applications Include**

- Chemical and Petrochemical Industries
- Petroleum Production
- Pipeline Transmission
- Electric Utilities
- Water and Wastewater Systems
- Pulp and Paper
- Textiles
- Semiconductor Industry
- Food and Beverage
- Environmental Control Systems
- Construction Equipment
- Agricultural Equipment
- Machine Tool
- Material Handling
- Automotive Testing and Assembly
- Medical Equipment

**Principle of Operation**

The Type 2000 I/P and E/P transducers utilize closed-loop pressure feedback-control for precision pressure output and minimized effects of temperature, supply pressure changes, supply voltage changes, and mounting angle.

Supply pressure is reduced by the supply valve to provide an output pressure which is internally routed to a precision temperature compensated piezo-resistive pressure sensor. Supply pressure is also routed to an externally removable orifice which provides a reduced pilot pressure to a chamber containing a servo diaphragm and nozzle. Pilot pressure is controlled by modulating the gap between the face of a nozzle and an adjacent piezo-ceramic actuator, which is part of a unique patented mechanism.

The piezo-ceramic actuator serves as a control link between electrical input and pressure output as follows:

- The input current (I/P) or voltage (E/P) signal is conditioned to provide a normalized control signal directly proportional to the desired pressure output.
- Simultaneously the output of the pressure sensor is amplified and conditioned to produce a feedback signal.
- The sum of the control signal and the feedback signal produce a command signal which is delivered as a DC voltage to the piezo-ceramic actuator.
- As voltage increases, the force applied by the actuator increases, so as to reduce nozzle bleed and thus increase pilot pressure.
- Increased pilot pressure applied to the servo diaphragm directly causes opening of the supply valve and an increase in the output pressure until the output feedback signal and control signal combine to produce the correct command signal.

**Fine-Tuning Your Application**

For optimal performance in your application, the calibration of the Type 2000 can be fine-tuned in the field. An easily-removable cover provides access to the isolated electronics. All potentiometers, connections, jumpers, and switches are clearly marked on the circuit board or on the handy chart located on the inside of the cover.

The three elements of calibration (Gain, Zero, and Span) are described below. Consult the Type 2000 User’s Manual for detailed calibration procedures, cautions, and instrumentation requirements.

**Gain (Damping) Adjustment**

The output response of the Type 2000 can be optimized for varying downstream volumes by adjusting the system gain of the control circuit. Adjust the Gain Pot counterclockwise for increased gain; clockwise for increased oscillation damping. For maximum allowable gain in your application, the pot should be turned clockwise until oscillation just disappears.

**Wide Rangeability**

The Type 2000 can be field calibrated to pressure ranges other than the standard ones by combinations of recalibration, pressure range switching, and split high/low ranging. A unit should not be switched to a range outside its pressure sensor family (eg., a 0-15 PSIG can be switched to a 3-15 PSIG, but not to 0-30 PSIG). (Caution: Do not exceed the range of the onboard pressure sensor.) For example, the easiest way to recalibrate a 0-30 PSIG unit to 3-15 psig would be to change the switch setting to 3-27 PSIG, then switch to split range low.

**Field-Selectable Features**

Onboard switches allow the user to easily reconfigure the Type 2000 for any of several electrical inputs, direct/reverse acting, or output split-ranging high/low. Fine tuning of the unit’s calibration may be necessary after a reconfiguration.
Transducers

Easy Access Top Cover
1) Isolated electronics
2) Calibration adjustments
3) Configuration switches
4) Switch information on inside of cover

Mounting Options
1) In-Line
2) Direct: Holes on left rear and bottom faces
3) Bracket Mounting options:
   - Panel, Pipe, Valve, DIN-Rail

Integral Booster
Flows up to 21 scfm for quick system response

Gauge Port
1/8 NPT on all models
(Not shown; rear face)

Agency Approvals - Applies only to units ordered with approvals

Factory Mutual
E Model with F approval, Explosion Proof/Intrinsically Safe
Not for use with natural gas or other Non-inert Gases
Exposure Proof: Class I, Div 1, Groups A, B, C6G; T6, Ta = 60˚C
Dust-Ignition Proof: Classes II & III, Div 1, Groups E, F6G, T6, Ta = 60˚C
Type 4X, IP 66
Intrinsically Safe: Class I, II & III, Div 1, Groups A, B, C, D, E, F & G; T4, Ta = 60˚C;
Type 4X, IP 66
Non-Incendive: Class I, Div 2, Groups A, B, C & D; T4, Ta=60˚C
Suitable: Class II, Div 2, Groups F & G; T4, Ta = 60˚C
Suitable: Class III, Div 2, T4, Ta = 60˚C
Entity Parameters:
I/P:  V_{MAX}=30V,  I_{MAX}=200 mA,  P_{MAX}=1W,  C_{i}= 0,  L_{i}=0
E/P:  V_{MAX}=30V,  I_{MAX}=100 mA,  P_{MAX}=0.75 W,  C_{i}= 0,  L_{i}=0

E Model with G approval, Explosion Proof,
United States and Canada
For use with natural gas or other non-inert gases as a process medium up to a maximum input pressure of 140 PSI when installed with suitable NRTL listed, certified or approved conduit seal installed at the enclosure.
Exposure Proof: Class I, Div 1, Groups A, B, C & D; T6 Ta = 60˚C
Dust-Ignition Proof: Classes II & III, Div 1, Groups E, F & G, T6 Ta = 60˚C
NEMA 4X, IP 66
S Model, Intrinsically Safe
Intrinsically Safe: Class I, II & III, Div 1, Groups A, B, C, D; T4, Ta = 60˚C;
Non-Incendive: Class I, Div 2, Groups A, B, C & D; T4 Ta=60˚C
Suitable: Class II, Div 2, Groups F & G; T4, Ta = 60˚C
Suitable: Class III, Div 2, T4 Ta=60˚C
Type 4X, IP 66
Entity Parameters:
I/P:  V_{MAX}=30V,  I_{MAX}=200 mA,  P_{MAX}=1.0W,  C_{i}=0µF,  L_{i}=0µH
E/P:  V_{MAX}=30V,  I_{MAX}=100 mA,  P_{MAX}=0.75W,  C_{i}=0µF,  L_{i}=0µH

CANADIAN STANDARD ASSOCIATION
E Model with F approval, Explosion Proof/Intrinsically Safe, Certified to Two Standards.
Certified to CLASS 2258 04 PROCESS CONTROL EQUIPMENT
Class I, Div 1, Groups A, B, C, D; Class II, Div 1, Groups E, F and G, Div 2, Groups F and G; Class III.
Rated: 28Vdc, 8mA, T6, Enclosure TYPE 4X, IP66; Max Ambient Temperature 60˚C.
Entity Parameters:
I/P:  V_{MAX}=30V,  I_{MAX}=200 mA,  P_{MAX}=1.0W,  C_{i}=0µF,  L_{i}=0µH
E/P:  V_{MAX}=30V,  I_{MAX}=100 mA,  P_{MAX}=0.75W,  C_{i}=0µF,  L_{i}=0µH

Certified to CLASS 2258 02 PROCESS CONTROL EQUIPMENT
Class I, Div 1 & 2, Groups A, B,C,D; Class II, Div 1, Groups E, F, G, Div 2, Groups F & G; Class III.
Rated: 28Vdc, 8mA, T6; Enclosure TYPE 4X, IP66; Max Ambient Temperature 60˚C.
Entity Parameters:
I/P:  V_{MAX}=30V,  I_{MAX}=200 mA,  P_{MAX}=1.0W,  C_{i}=0µF,  L_{i}=0µH
E/P:  V_{MAX}=30V,  I_{MAX}=100 mA,  P_{MAX}=0.75W,  C_{i}=0µF,  L_{i}=0µH

ATEX (European Model)
INTRINSIC SAFETY: II 1 G Ex ia IIC T4 (-20<T_a<+60) EN 50014: 1997 (A2) EN 50020:1994 EN 50028:1994
The Bellofram T-2000 Transducers were tested and found to comply with Electromagnetic Compatibility Directive effective January 1, 1996. The relevant EMC specifications tested were the following: EN 50081-1 (1992) and EN 50082-1 (1993). A Technical Construction File, Serial #107 was written and Certificate of Conformity issued by a Competent Body.

Direct/Reverse Acting
Direct Acting transducers regulate to their minimum output when supplied with minimum input; maximum out with maximum in. Reverse Acting transducers regulate to their maximum output at minimum input.

Split Ranging (High or Low)
The Type 2000 can be configured to regulate either half (top or bottom) of its normal output range, when supplied with its normal full-ranging electrical input. For example, a 0-10V 0-30 PSI unit set to split range low will regulate 0-15 PSI @ 0-10V. It will regulate 15-30 PSI @ 0-10V if set to split range high.

Electrical Port Options
1) 1/2 NPT Conduit
2) 20mm Conduit
3) Hirschmann® (DIN 43 650-A)
4) Terminal Block

Easy Access Orifice
Output Port
Same as Input Port
(Not shown; rear face)

Input Port Options
1) 1/4 NPT
2) 1/4 BSPP
3) 1/4 BSPT

Manifold-Mounting Option
Supply and Output ports on the bottom face rather than “through the body”

Gauge Port
1/8 NPT on all models
(Not shown; rear face)
Type 2000 Specifications

**Accuracy**
0.1% of full-scale output typical (0.25% guaranteed); includes effects of hysteresis, dead band, and repeatability

**Electrical**
Inputs
Switch-Selectable
4-20mA, 0-5, 1-5, 1-9, 1-10, or 0-10VDC

Connections
1/2 NPT or 20mm Conduit
DIN Hirschmann (S model only)
External Terminal Block (S model only)

Power Supply
5-25VDC (with voltage inputs only)

**Pneumatic**

**Outputs**
0.5, 0.15, 3.15, 1:17, 0.30, 6.30, 3.27, 0.60, 0-100, or 120 PSIG
0.0-1, 0.0-3, 0.1-0, 0.2-10, 0.07-12, 0.2-1, 0.4-2.1, 0.2-1.9,
0.4-1, 0.6-9, 0.8-3 BAR

Ports (Input/Output)
1/4” (NPT, BSPT, or BSPP threads)
Bottom-ported for Manifold Mounting

Exhaust
(Explosion proof only) 1/8 - 27 NPT

Ports (Gauge)
1/8 NPT

**Supply**

For 0–5 PSIG (0.3 BAR) Through 0–60 PSIG
From 5 PSIG (0.3 BAR) above maximum output to 100 PSIG maximum
For 0–180 PSIG and 0–120 PSIG Ranges
From 5 PSIG (0.3 BAR) above maximum output to 140 PSIG maximum

**Split-Ranging**
Switch-Selectable, Full-Range or Split-Range High or Split-Range Low

**Consumption**
4 SCFH maximum (1.9 LPM)

**Flow Capacity**

<table>
<thead>
<tr>
<th>Range</th>
<th>Sensor</th>
<th>Flow</th>
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</thead>
<tbody>
<tr>
<td>PSIG</td>
<td>BAR</td>
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</tr>
<tr>
<td>0-5</td>
<td>0-0.3</td>
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<td>0-15</td>
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<td>3-15</td>
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<td>1-17</td>
<td>0.07-12</td>
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<td>0-30</td>
<td>0-2.1</td>
<td>30</td>
</tr>
<tr>
<td>3-27</td>
<td>0.2-1.9</td>
<td>30</td>
</tr>
<tr>
<td>6-30</td>
<td>0.4-2.1</td>
<td>30</td>
</tr>
<tr>
<td>0-60</td>
<td>0-4.1</td>
<td>50</td>
</tr>
</tbody>
</table>

(Typical Flow @ 100 PSIG (6.9 BAR) in and maximum out)
0-100 0-6.9 100 6.9 21 595
0-120 0-8.3 100 6.9 21 595

(Typical Flow @ 140 PSIG (9.7 BAR) in and maximum out)
Exhaust Capacity 3 SCFM (85 LPM) @ 5 PSIG (0.3 BAR) above setpoint

(0-15 PSIG range unit set at mid range)

**Stability**

Supply Voltage Effect None
Supply Pressure Effect None
Vibration Effect <1% FS (+/-1G; 5-1000Hz)
Mounting Position Effect None
RFI/EMI CE-Compliant
Temperature Effect 0.02% FS/˚F (-40˚ to 180˚F [-40˚ to 82˚C])
Storage Temperature -40˚ to 200˚F (-40 to 93˚C)

Approximate Weight 3.0 lbs, 1.35 kg

Air Quality
Instrument-quality air consists of:
- a. A dew point less than 35˚ F
- b. No particles larger than three microns
- c. Maximum oil content of 1 ppm

It is mandatory for the user to install a suitably rated NRTL Listed or Certified conduit seal

The secret to the Type 2000’s precise, reliable performance under a variety of demanding environmental conditions is a patented piezo-ceramic actuator with many industry-wide firsts.

Type 2000 Mounting Options

<table>
<thead>
<tr>
<th>Mounting Method</th>
<th>Intrinsically-Safe (S) Model</th>
<th>Explosion-Proof (E) Model</th>
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<tbody>
<tr>
<td>In-Line</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Direct Mounting</td>
<td>Side or Bottom Holes</td>
<td>Side or Bottom Holes</td>
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<tr>
<td>Panel Bracket</td>
<td>Supplied</td>
<td>Accessory</td>
</tr>
<tr>
<td>Valve Bracket</td>
<td>Accessory</td>
<td>Supplied</td>
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<tr>
<td>Pipe Bracket</td>
<td>Accessory</td>
<td>Accessory</td>
</tr>
<tr>
<td>DIN-Rail Bracket</td>
<td>Accessory</td>
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</tr>
<tr>
<td>Manifold Plate</td>
<td>Accessory</td>
<td>Accessory</td>
</tr>
</tbody>
</table>

Mounting: The Type 2000 can be mounted in-line, or directly to a panel via mounting holes located in the side and bottom of the unit. In addition, the S model includes a panel-mounting bracket; while the E model includes a valve-mounting bracket. Kits are available for mounting of either model to panel, valve, pipe, or DIN-Rail. A custom plate is available for mounting of the bottom-ported version to a manifold. (See Accessories)
### Type 2000 Ordering Information

<table>
<thead>
<tr>
<th>2 K</th>
<th>S</th>
<th>E</th>
<th>Enclosure</th>
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<td>1/2 NPT Conduit</td>
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<td>20mm Conduit &quot;S&quot; Unit Only</td>
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<tr>
<td></td>
<td>H</td>
<td>T</td>
<td>Hirschmann²</td>
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<td>Terminal Block² &quot;S&quot; Unit Only</td>
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<tr>
<th>NT</th>
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<th>M</th>
<th>Pneumatic Port</th>
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<tr>
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<td>NPT</td>
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<td>M</td>
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<td>H</td>
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<td>Manifold Mount³</td>
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<tr>
<th>F</th>
<th>C</th>
<th>G</th>
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<td>FM/CSA</td>
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<td>4-20 mA</td>
<td>0-5 V</td>
<td>1-5 V</td>
<td>1-9 V</td>
<td>1-10 V</td>
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<th>F</th>
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<th>Pneumatic Output</th>
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<td></td>
<td>005 0-5 PSIG 0-0.3 BAR</td>
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<td>015 0-15 PSIG 0-1.0 BAR</td>
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<td>315 3-15 PSIG 0-2.1 BAR</td>
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<td>117 1-17 PSIG 0-0.07-1.2 BAR</td>
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<td>030 0-30 PSIG 0-2.1 BAR</td>
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<td>630 6-30 PSIG 0.4-2.1 BAR</td>
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<td>327 3-27 PSIG 0.2-1.9 BAR</td>
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<td>060 0-60 PSIG 0-4.1 BAR</td>
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<table>
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<tr>
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<th>Special</th>
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<tr>
<td>0-100 PSIG 0-6.9 BAR</td>
<td>0-120 PSIG 0-8.3 BAR</td>
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### Maximum Supply for these regulators is 100 PSIG

### Maximum Supply for these regulators is 140 PSIG

### Type 2000 Accessories

<table>
<thead>
<tr>
<th>Part Number</th>
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<tbody>
<tr>
<td>Panel Mounting Kit</td>
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<tr>
<td>Valve Mounting Kit</td>
</tr>
<tr>
<td>2&quot; Pipe Mounting Kit (Valve Mounting Kit is required)</td>
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<tr>
<td>DIN Rail Adapter</td>
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<tr>
<td>Manifold Adapter Kit</td>
</tr>
<tr>
<td>Filter Kit, 60 microns</td>
</tr>
<tr>
<td>Pressure Gauge Kit 15 PSIG (1 BAR)</td>
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<tr>
<td>Pressure Gauge Kit 30 PSIG (2.1 BAR)</td>
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<tr>
<td>Pressure Gauge Kit 60 PSIG (4.1 BAR)</td>
</tr>
<tr>
<td>Pressure Gauge Kit 160 PSIG (11 BAR)</td>
</tr>
</tbody>
</table>

### Type 2000 Notes

1. **Availability**
   - Enclosure
     - | S | E |
     - | Yes | Yes |
     - | No | No |

2. **Electrical Port**
   - | N | M |
   - | Yes | Yes |
   - | Yes | Yes |

3. **NEMA 4X / IP66 not available**

4. **Bottom O-Ring Ports**

5. **NRTL listed or certified conduit seal installed by user**

6. **Not Agency Approved**

### Type 2000 Wiring Connections and Switch Positions

#### Switch # 1: PSIG BAR

<table>
<thead>
<tr>
<th>Switch #</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6: psig</th>
<th>BAR</th>
<th>7</th>
<th>8</th>
<th>9</th>
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<tbody>
<tr>
<td>ON</td>
<td>0-15</td>
<td>0-10</td>
<td>0.1-0</td>
<td>0.2-1.0</td>
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<td>0-30</td>
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<td>0-60</td>
<td>0-100</td>
<td>0-8.9</td>
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<thead>
<tr>
<th>Switch #</th>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6: psig</th>
<th>BAR</th>
<th>7</th>
<th>8</th>
<th>9</th>
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</thead>
<tbody>
<tr>
<td>OFF</td>
<td>0-60</td>
<td>0-120</td>
<td>0-4.1</td>
<td>0-8.3</td>
<td>1-9 VDC</td>
<td>Full</td>
<td>0-0.3 BAR</td>
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<td>0-0.3 BAR</td>
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<td></td>
<td></td>
<td>1-10 VDC</td>
<td>4-20 mA</td>
<td>0-0.3 BAR</td>
<td>0-0.3 BAR</td>
<td>0-0.3 BAR</td>
<td>0-0.3 BAR</td>
<td>0-0.3 BAR</td>
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</tbody>
</table>

*It is mandatory for the user to install a suitably rated NRTL Listed or Certified conduit seal.*

### Type 2000 Wiring Connections and Switch Positions

#### Switch # 2: PSIG BAR

<table>
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<th>Switch #</th>
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<th>3</th>
<th>4</th>
<th>5</th>
<th>6: psig</th>
<th>BAR</th>
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<th>BAR</th>
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Type 2000 Dimensions

Type 2000 Explosion Proof Dimensions

Drawings and dimensions are for reference only.