INTRODUCTION TO

Melt Pressure Transducers

Tempco Melt Pressure Transducers
are used to sense the pressure associated with the extrusion processing of plastic materials. They range in pressure from 0-500 PSI to 0-20,000 PSI with temperatures in the range of 70-750°F. Typical transducer outputs are 3.3 mV/V, 4-20 mA, 0-5 V, or 0-10 V (at full scale output).

APPLICATION

Plastic materials are formed to shape by a process defined as extrusion. This is accomplished by first softening the material with heat. Through the use of a drive screw, which is rotated by a motor, the material is forced toward and then through an opening, called a die, used to shape the plastic melt.

Various compounds, colorants and additives can be mixed with the plastic materials as they move along the screw path. The heated materials are shaped by the die and/or other post-extrusion equipment and then cooled to retain their shape.

WHERE AND WHY TRANSDUCERS ARE USED

Melt pressure transducers can be effectively used along many points of the extrusion process for a variety of reasons:

1. From a quality control viewpoint, a transducer should be located in the die. The measurement of the melt pressure at this point is used as an indication of flow rate.
2. To indicate when a screen is in need of changing and also to insure the safety of personnel and equipment alike, a transducer will be located somewhere ahead of the screen changer. This is most likely located either in the adapter or along the screw path within the barrel. An even more accurate determination of screen plugging can be made by reading the differential pressure between transducers located on either side of the screen, one being in the adapter, the other located in the barrel ahead of the screw tip.
3. For research and development purposes, Tempco transducers should be located at various points along the barrel in order to accurately monitor the pressure and mixing characteristics of the melt.
4. Transducers are also used for pressure sensing on post-extrusion equipment such as blow-molding heads, extrusion pumps and spinnerettes.
5. Locating transducers anywhere along the apparatus also serves to improve the safety of the extruder.

END PRODUCTS OF EXTRUSION PROCESS

The end results of the extrusion process can be found in various products. Some examples include:

1. The feedstock for other plastic packaging systems used for compounding and mixing.
2. Plastic film used to create bags and packaging materials.
3. Plastic tubing, hose, and pipe to contain water, gases or chemicals.
4. Insulated cable and wire housing.
5. Filaments used to create textiles, brushes, rope and twine.
**Melt Pressure Transducer Data**

### Transducer and Gauge Standard Material Diaphragm and Options

The standard Tempco transducer diaphragm is machined out of a single piece of type 15-5 PH stainless steel (.0045") and then heat treated and finally Armoloy coated. This material gives Tempco transducers the transverse strength and toughness needed for most standard applications. There are, however, certain extrusion processes that require different types of diaphragm materials and/or coatings. Tempco is able to supply customers with diaphragms and coatings specifically suited to their needs and applications.

#### HASTELLOY® TIP AND DIAPHRAGM

This option gives the transducer a Hastelloy® C-276 tip. This Hastelloy® tip extends along the stem and includes the 45° cone and threads. The diaphragm (.0045") is also manufactured of Hastelloy®. Hastelloy® should be used when the following chemicals are present in the process:

- HCL: Hydrochloric Acid
- HF: Hydrofluoric Acid
- HBN: Hydrogen Bromine
- HI: Hydrogen Iodine

For example, HCL is present when processing PVC and HF is present when processing Teflon®. If Hastelloy® is not used during these processes, the transducer diaphragm will fail prematurely due to stress cracks as a result of stress corrosion. **Recommended Use:** Applications that are extremely corrosive.

#### SPECIAL DIAPHRAGM

Special .006" thick Inconel® diaphragm with a proprietary coating of Titanium Aluminum Nitride. This special diaphragm is designed to be used in extremely abrasive environments. Superior to all other diaphragm materials for corrosion and abrasion resistance, examples of applications requiring this diaphragm option are ceramics or glass-filled nylon. **Recommended Use:** Applications that are extremely abrasive.

#### INTERNAL RESISTANCE CALIBRATION TRACKING

An internal compensation circuit insures that the shunt calibration output will track any changes in pressure sensitivity (output) due to changes in temperature of the strain gauge housing. The simulated output, therefore, is 80%, ±0.25% of the full scale pressure output over the entire operating temperature range.

### CHROMIUM NITRIDE COATED DIAPHRAGM

The chromium nitride diaphragm option gives the transducer an advantage in abusive environments. The chromium nitride offers abrasion resistance and corrosion resistance. This is due to a phenomenon called reduced skin friction. This material will also cut down on diaphragm failures due to adhesion of melt to diaphragm during the process.

There are two different versions of this diaphragm option available. The first is a standard thickness (0.0045") diaphragm made of 15-5 PH stainless steel and then coated with a 0.0002" chromium nitride coating. This version is applicable for use in any pressure range plastic extruder. The second version is a 0.0080" thick diaphragm made of 15-5 PH stainless steel coated with a 0.0002" chromium nitride coating. This version is applicable for use in plastic extruders with pressure ranges of 7,500 PSI and up.

### TITANIUM NITRIDE DIAPHRAGM

The titanium nitride diaphragm is offered for its excellent abrasion resistance. Its abrasion resistance is superior to the chromium nitride coated diaphragm and like the latter diaphragm the titanium nitride diaphragm comes in two different versions. The first is a standard thickness (0.0045") diaphragm made of 15-5 PH stainless steel and then coated with a 0.0002" titanium nitride coating. This version is applicable for use in any pressure range plastic extruder. The second version is a 0.0080" thick diaphragm made of 15-5 PH stainless steel coated with a 0.0002" titanium nitride coating. This version is applicable for use in plastic extruders with pressure ranges of 7,500 PSI and up.

### INTERNAL RESISTANCE CALIBRATION

Tempco strain gauge sensors rely on the small change in resistance of each strain gauge to generate an analog signal that is proportional to the applied physical input. This resistance change is generated by straining a structural element to which the gauges are attached. The same output can be accomplished by electrically offsetting the resistance of one of the strain gauges through a simple shunt resistor network. This offsetting resistance network is built into each Tempco transducer.

During manufacturing, each Tempco transducer is pressure calibrated using highly accurate pressure sources and instrumentation. The signal output versus pressure input characteristic is thereby precisely known. The internal resistance network is adjusted so that the output generated by the shunt resistor simulation method matches precisely the calibrated output of the transducer at a selected point on its calibration curve. The standard simulation value is 80% of the full range rating of each transducer but other values may be chosen.

### Applications of Melt Pressure Transducers

Pressure monitoring is a fundamental quality control technique used in modern extrusion processing. Typical applications include:

**Film**
Adaptable for either blown process or slit casting, pressure monitoring can help produce thinner, more uniform film at faster process speeds. The pressure transducer also provides primary process information helpful for maximizing productivity and minimizing start-up scrap.

**Synthetic Fibers**
Accurate, reliable pressure monitoring helps deliver greater consistency with less waste by reducing high speed variations, even with high performance fibers.

**Wire Coating**
Pressure monitoring right in the crosshead die where the wire is coated with plastic insulation improves throughput, quality, and profits. This process parameter has become even more important as wire take-up systems go to higher and higher speeds.

**Pipe, Tubing, and Profile**
A basic process parameter, pressure monitoring allows tighter tolerances, improves product quality and significantly improves cost effectiveness even for complex and multi-hollow extrusion.

Call Toll Free: (800) 323-6859 • Fax: (630) 350-0232 • E-Mail: sales@tempco.com
Melt Pressure Transducers

3 Styles of Melt Pressure Transducers for Extrusion Processing

Melt pressure transducers are specifically designed for accuracy, stability, and repeatability. They can be specified with a 0.5% or 0.25% combined error accuracy, a performance that equals or exceeds any other strain gauge melt pressure transducer on the market.

**Design Features**

- **Stainless Steel Construction**
- **Fully Interchangeable with all Existing Strain Gauge Melt Pressure Transducers**
- **Fluid Filled System for Temperature Stability**
- **80% Output Signal for Easy Calibration**
- **Resistance Calibration Tracking**
- **All Stainless Steel Construction**
- **Armoloy-Coated Diaphragm**
- **Compatible with all Strain Gauge Signal Conditioning & Readout Instrumentation**
- **6- or 8-Pin Bendix Style Connectors available**
- **CE Approved**

**Rigid Stem Transducer**

This model converts applied pressure at the point of measurement to a proportional voltage output signal using well established bonded strain gauge design principles. The small capillary tube, filled with a special medium, isolates sensitive strain gauges and electronics from potential thermal damage. The rigid stem makes installation fast and easy.

**Flexible Armor Tubing Transducer**

This model offers all the advantages of the rigid stem transducer, but incorporates an 18-inch flexible capillary tubing with a stainless steel armored jacket between the strain gauge housing and the stem. This transducer is designed for applications requiring further thermal isolation or where installation would be otherwise difficult or impractical.

**Pressure and Temperature Transducer**

This model provides simultaneous measurement of pressure and temperature at a single point. Only one transducer mount is required for installation. The temperature probe is protected from process hazards and can be replaced without interrupting the pressure signal. Pressure performance is identical to other models.
**DESIGN SPECIFICATIONS**

**Mechanical**

**Ranges**

<table>
<thead>
<tr>
<th>Units (PSIG)</th>
<th>Units (BAR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-500</td>
<td>0-35</td>
</tr>
<tr>
<td>0-750</td>
<td>0-50</td>
</tr>
<tr>
<td>0-1000</td>
<td>0-75</td>
</tr>
<tr>
<td>0-1500</td>
<td>0-100</td>
</tr>
</tbody>
</table>

Combined Error/Error Band: ±0.5% or ±0.25% of full-scale

Repeatability: ±0.1% of full-scale

Hysteresis: 0.1% of full-scale

Overload Capability:
- Up to 20,000 PSIG: 2 × full-scale
- Above 20,000 PSIG: 1.5 × full-scale

Mounting Torque: 500 inch-pounds maximum

Diaphragm Material: 15-5PH stn. stl. (Armoloy plated)

**Electrical**

**Measuring Element**: Strain gauge Wheatstone bridge

**Element Resistance**: 350 ohm ±10%

**Excitation Voltage**: 6-12 Volt DC (10 V rec.)

**Sensitivity**: 3.33 millivolts/volt ±2%

**Zero Balance**: ±5.0% full-scale output

**Internal Resistance Cali. (Factory Adjusted)**: Produces precise electrical signal which is 80% of full-scale within ±0.25%

**Temperature on Strain Gauge Housing**

- Maximum Temperature: 160°F or 70°C
- Zero Drift: 1.0%/100°F or 2.0%/100°C
- Sensitivity Drift: 1.0%/100°F or 2.0%/100°C

**Temperature on Diaphragm**

- Max. Temp. (medium): 750°F or 400°C
- Zero Shift: 25 PSI/100°F or 45 PSI/100°C

**Standard Drill Pattern Specifications**

<table>
<thead>
<tr>
<th>D1</th>
<th>D2</th>
<th>D3</th>
<th>D4</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 - 20 UNF</td>
<td>.313 ± .001</td>
<td>7.95 ± .025</td>
<td>.454 ± .004</td>
<td>.515 min</td>
<td>.225 min</td>
<td>.17 max</td>
</tr>
<tr>
<td>M14 x 1.5</td>
<td>.319 ± .001</td>
<td>8.1 ± .025</td>
<td>.478 ± .004</td>
<td>.630 min</td>
<td>.24 min</td>
<td>.16 max</td>
</tr>
<tr>
<td>M18 x 1.5</td>
<td>.398 ± .01</td>
<td>10.1 ± .25</td>
<td>.634 ± .04</td>
<td>11.5 + .10</td>
<td>16 min</td>
<td>.16 max</td>
</tr>
</tbody>
</table>

**Note**: All temperature specifications relate to full-scale output or full pressure range output.

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**Temperature on Strain Gauge Housing**

- Maximum Temperature: 160°F or 70°C
- Zero Drift: 1.0%/100°F or 2.0%/100°C
- Sensitivity Drift: 1.0%/100°F or 2.0%/100°C

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12-21
# Instrumentation

## Melt Pressure Transducers

### Melt Pressure Transducers Standard Sizes and Ranges

<table>
<thead>
<tr>
<th>Style</th>
<th>Combined Error</th>
<th>Connector</th>
<th>Pressure Range</th>
<th>Output</th>
<th>Stem Length</th>
<th>Flex Length</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rigid Stem</td>
<td>0.5% CE</td>
<td>6 Pin</td>
<td>0–5000</td>
<td>3.33 mV/V</td>
<td>6&quot;</td>
<td>None</td>
<td>PDD00101</td>
</tr>
<tr>
<td>Rigid Stem</td>
<td>0.5% CE</td>
<td>6 Pin</td>
<td>0–7500</td>
<td>3.33 mV/V</td>
<td>6&quot;</td>
<td>None</td>
<td>PDD00102</td>
</tr>
<tr>
<td>Rigid Stem</td>
<td>0.5% CE</td>
<td>6 Pin</td>
<td>0–10000</td>
<td>3.33 mV/V</td>
<td>6&quot;</td>
<td>None</td>
<td>PDD00103</td>
</tr>
<tr>
<td>Rigid/Flex Armor</td>
<td>0.5% CE</td>
<td>6 Pin</td>
<td>0–5000</td>
<td>3.33 mV/V</td>
<td>6&quot;</td>
<td>18&quot;</td>
<td>PDD00105</td>
</tr>
<tr>
<td>Rigid/Flex Armor</td>
<td>0.5% CE</td>
<td>6 Pin</td>
<td>0–7500</td>
<td>3.33 mV/V</td>
<td>6&quot;</td>
<td>18&quot;</td>
<td>PDD00106</td>
</tr>
<tr>
<td>Rigid/Flex Armor</td>
<td>0.5% CE</td>
<td>6 Pin</td>
<td>0–10000</td>
<td>3.33 mV/V</td>
<td>6&quot;</td>
<td>18&quot;</td>
<td>PDD00107</td>
</tr>
<tr>
<td>Rigid/Flex Armor with T/C</td>
<td>0.5% CE</td>
<td>6 Pin</td>
<td>0–5000</td>
<td>3.33 mV/V</td>
<td>6&quot;</td>
<td>18&quot;</td>
<td>PDD00109</td>
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<tr>
<td>Rigid/Flex Armor with T/C</td>
<td>0.5% CE</td>
<td>6 Pin</td>
<td>0–7500</td>
<td>3.33 mV/V</td>
<td>6&quot;</td>
<td>18&quot;</td>
<td>PDD00110</td>
</tr>
<tr>
<td>Rigid/Flex Armor with T/C</td>
<td>0.5% CE</td>
<td>6 Pin</td>
<td>0–10000</td>
<td>3.33 mV/V</td>
<td>6&quot;</td>
<td>18&quot;</td>
<td>PDD00111</td>
</tr>
<tr>
<td>Rigid/Flex Armor with T/C</td>
<td>0.5% CE</td>
<td>6 Pin</td>
<td>0–15000</td>
<td>3.33 mV/V</td>
<td>6&quot;</td>
<td>18&quot;</td>
<td>PDD00112</td>
</tr>
</tbody>
</table>

### Ordering Code: PDD

- **Style**: Box 1
  - **A**: Rigid Stem
  - **B**: Flexible Armor Tubing
  - **C**: Transducer with Type J Thermocouple

- **Error Tolerance**: Box 2
  - 1 = 0.5% Combined Error (CE) (Most Common)
  - 2 = 0.25% CE

- **Connector**: Box 3
  - **S**: Six-Pin (Most Common)
  - **E**: Eight-Pin
  - **X**: Special

- **Pressure Range**: Box 4
  - **A**: 0–5000 PSI (0.5% CE only)
  - **B**: 0–7500 PSI (0.5% CE only)
  - **C**: 0–10000 PSI (0.5% CE only)
  - **D**: 0–15000 PSI
  - **E**: 0–3000 PSI
  - **F**: 0–5000 PSI
  - **G**: 0–7500 PSI
  - **H**: 0–10000 PSI
  - **J**: 0–15000 PSI
  - **K**: 0–20000 PSI
  - **L**: 0–35 BAR (0.5% CE only)
  - **M**: 0–50 BAR (0.5% CE only)
  - **N**: 0–70 BAR (0.5% CE only)
  - **P**: 0–100 BAR
  - **Q**: 0–200 BAR
  - **R**: 0–350 BAR
  - **S**: 0–500 BAR
  - **T**: 0–700 BAR
  - **U**: 0–1000 BAR
  - **V**: 0–1400 BAR

- **Stem Length**: Box 5
  - 1 = 6 inches (Most Common)
  - 2 = 12.5 inches
  - 3 = 3 inches
  - 0 = Other

- **Flex Length**: Box 6
  - **00**: None (Style A)
  - **18**: 18 Inches* (Styles B & C)
  - **24**: 24 Inches* (Styles B & C)
  - **30**: 30 Inches* (Styles B & C)

*Other sizes can be made on special request.

### Melt Pressure Transducers

- **Diaphragms**: Box 7
  - **A**: Stainless Steel, 0.0045" (Standard) with GTP+ Coating 750°F/400°C
  - **B**: 0.0045" Hastelloy® 570°F/300°C
  - **C**: 0.0045" Chromium Nitride
  - **D**: 0.008" Chromium Nitride (7500 PSI & up only) 570°F/300°C
  - **E**: 0.006" Inconel with Titanium Aluminum Nitride 1000°F/538°C
  - **F**: 0.0045" Titanium Nitride
  - **G**: 0.008" Titanium Nitride (7500 PSI & up only) 1000°F/538°C
  - **X**: Other

- **Output**: Box 8
  - 0 = Custom
  - 1 = 3.33 mV/V (Standard)
  - 2 = 4 to 20 ma
  - 3 = 0 to 5 Vdc
  - 4 = 0 to 10 Vdc
  - 5 = 0.5 to 9.5 Vdc

- **Capillary Fill Material**: Box 9
  - **A**: Mercury (Standard) 750°F/400°C
  - **B**: Oil-FDA approved 600°F/315°C
  - **C**: NaK (Sodium Potassium) 1000°F/528°C

- **Thread**: Box 10
  - 1 = 1/2-20 (Standard)
  - 2 = M18 x 1.5
  - X = Other

### Additional Options Available...

- **Exposed Capillary Transducer**: for applications requiring a transducer capable of fitting into extremely tight places.

- **Connectors** *(consult Tempco if you require one of these options)*
  - Gentran GT-76 compatible wiring: strain gauge connector is wired for compatibility with Gentran GT-76 connector.
  - Barber Coleman TD10 compatible wiring: strain gauge connector is wired for compatibility with Barber Coleman TD10 connector.

### Ordering Information

- **Melt Pressure Transducers** are offered with the options listed in the worksheet above. Create an ordering code by filling in the boxes with the appropriate number and/or letter designation for your requirements and a part number will be assigned.

- **Part Numbers for commonly used Melt Pressure Transducers** can be found in the table above.

- **Standard lead time is stock to 3 weeks.**

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*View Product Inventory @ www.tempco.com*
### Melt Pressure Transducers

<table>
<thead>
<tr>
<th>Description</th>
<th>TEMPCO</th>
<th>Dynisco</th>
<th>ISI</th>
<th>Gefran</th>
<th>Gentran</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Basic Melt Pressure Transducer with 0.5% Error, Armoloy Coated Tip and 6-Pin Connector</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6&quot; Rigid stem</td>
<td>PDD–A1S 100A1A1</td>
<td>PT460E-6</td>
<td>ISI 0100-T-6</td>
<td>M30-6-M-1-4-0</td>
<td>GT-76/6D6leb</td>
</tr>
<tr>
<td>6&quot; Rigid stem with 18&quot; flexible armor tubing</td>
<td>PDD–B1S 118A1A1</td>
<td>PT462E-6/18</td>
<td>ISI 0101-T-6/18</td>
<td>M31-6-M-1-4-D</td>
<td>GT-76/6D6Z1</td>
</tr>
<tr>
<td>Above transducer with Type J thermocouple</td>
<td>PDD–C1S 118A1A1</td>
<td>TPT463E-6/18</td>
<td>ISI 0102-T-6/18</td>
<td>M32-6-M-1-4-D</td>
<td>GT-76/6JD6Z1</td>
</tr>
<tr>
<td><strong>Melt Pressure Transducer with 0.5% Error, Armoloy Coated Tip and 8-Pin Connector</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>6&quot; Rigid stem</td>
<td>PDD–A1E 100A1A1</td>
<td>n/a</td>
<td>ISI 0160-T-6</td>
<td>M30-8-M-1-4-0</td>
<td>GT-76/6D8</td>
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<td>6&quot; Rigid stem with 18&quot; flexible armor tubing</td>
<td>PDD–B1E 118A1A1</td>
<td>n/a</td>
<td>ISI 0161-T-6/18</td>
<td>M31-8-M-1-4-D</td>
<td>GT-76/6D8Z1</td>
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<tr>
<td>Above transducer with Type J thermocouple</td>
<td>PDD–C1E 118A1A1</td>
<td>n/a</td>
<td>ISI 0162-T-6/18</td>
<td>M32-8-M-1-4-D</td>
<td>GT-76/6JD8Z1</td>
</tr>
<tr>
<td><strong>Low Error Melt Pressure Transducer with 0.25% Error, Armoloy Coated Tip and 6-Pin Connector</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6&quot; Rigid stem</td>
<td>PDD–A2S 100A1A1</td>
<td>PT420A-6</td>
<td>ISI 0110-T-6</td>
<td>M30-6-H-1-4-0</td>
<td>GT-72/6D6</td>
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<tr>
<td>6&quot; Rigid stem with 18&quot; flexible armor tubing</td>
<td>PDD–B2S 118A1A1</td>
<td>PT422A-6/18</td>
<td>ISI 0111-T-6/18</td>
<td>M31-6-H-1-4-D</td>
<td>GT-72/6D6Z1</td>
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<tr>
<td>Above transducer with Type J thermocouple</td>
<td>PDD–C2S 118A1A1</td>
<td>TPT432A-6/18</td>
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<td>M32-6-H-1-4-D</td>
<td>GT-72/6JD6Z1</td>
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<tr>
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<td>PDD–A2E 100A1A1</td>
<td>n/a</td>
<td>ISI 0120-T-6</td>
<td>M30-8-H-1-4-0</td>
<td>GT-72/6D8</td>
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</tr>
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<td>6&quot; Rigid stem</td>
<td>PDG–A1 100A1A1</td>
<td>PG441R-6</td>
<td>ISI 0150-T-6</td>
<td>M50-0-L-1-4-0</td>
<td>GT-90/6D</td>
</tr>
<tr>
<td>6&quot; Rigid stem with 18&quot; flexible armor tubing</td>
<td>PDG–A2 130A1A1</td>
<td>PG442R-6/30</td>
<td>ISI 0151-T-6/30</td>
<td>M51-0-L-1-4-F</td>
<td>GT-95/6Z3</td>
</tr>
<tr>
<td>Above gauge with Type J thermocouple</td>
<td>PDG–A3 130A1A1</td>
<td>TPG443R-6/30</td>
<td>ISI 0152-T-6/30</td>
<td>M52-0-L-1-4-F</td>
<td>GT-95/6JZ3</td>
</tr>
<tr>
<td><strong>Digital Melt Pressure Gauge</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>6&quot; Rigid stem</td>
<td>PDG–B1 100A1A1</td>
<td>PG541-6</td>
<td>n/a</td>
<td>M60-0-L-1-4-0</td>
<td>n/a</td>
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<tr>
<td>6&quot; Rigid stem with 18&quot; flexible armor tubing</td>
<td>PDG–B2 130A1A1</td>
<td>PG552-6/30</td>
<td>n/a</td>
<td>M61-0-L-1-4-F</td>
<td>n/a</td>
</tr>
<tr>
<td>Above gauge with Type J thermocouple</td>
<td>PDG–B3 130A1A1</td>
<td>TPG553-6/30</td>
<td>n/a</td>
<td>M62-0-L-1-4-F</td>
<td>n/a</td>
</tr>
</tbody>
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*NOTE: All transducers listed include 3.3mV/V output, mercury fill and 1/2-20 thread.*