Product Line Catalog

From basic sensors to sophisticated electronic subsystems, Measurement Systems' solutions are in use across the globe in applications requiring the measurement, monitoring, analysis and control of gas and fluid processes.

For leading oil and gas and process control businesses, Cameron’s Measurement Systems Division is the measurement and control expert that helps you continuously raise performance through field-proven product brands, a broad product portfolio and worldwide sales and service channels.
The NuFlo brand was created in 2003 and was applied to premium lines of measurement products inherited in the merger of Halliburton Measurement Systems, Barton Instrument Systems and PMC Global Industries. Today the brand represents a broad and innovative product portfolio.

The Barton brand has been synonymous with rugged, accurate and field-proven quality since the 1940’s with the introduction of the first dual-bellows meter assembly – the heart of Barton’s differential pressure chart recorders, indicators and switches.

Clif Mock introduced the first isokinetic sampler probe into the oil and gas market in the 1960’s and since then this work-horse line of sampling products has developed a reputation for accuracy and ruggedness.

The Caldon brand was created in 1987 by Caldon, Inc., and represents Cameron’s cutting edge ultrasonic measurement technology for the nuclear, defense, hydroelectric and oil and gas markets.
Cameron

Cameron (NYSE:CAM) is a leading provider of flow equipment products, systems and services to worldwide oil, gas and process industries.

**Measurement Systems Division**

Cameron’s Measurement Systems division designs, manufactures and distributes measurement and control instrumentation for global oil and gas and process control industries. The Division was established in 2003 as a result of the acquisition and merger of three well respected companies: Barton Instrument Systems, Halliburton Measurement Systems and PMC Global Industries. Since then, the Division has acquired North Star Flow Products, Caldon, Inc., the assets of Prime Measurement Products, LLC, and the technologies of Polartek 2000 Ltd. and Sentech AS.

Each of these companies brought to the Division competitive strengths such as field-proven product brands, worldwide sales and distribution channels and strategically situated teams of instrumentation professionals. Today the Division is a leader in four key product sectors: chart recorders, turbine meters, flow analyzers and positive displacement meters and is actively raising the bar for flow computers, sampling systems and ultrasonic meters.

**UK Operations**

The UK Operation of the Measurement Systems Division services European, Middle East and African customers. Situated in Bognor Regis, West Sussex the UK Operation also has regional sales offices in Aberdeen, Dubai, India and Algeria which support a network of independent distributors and representatives.

**Caldon® Ultrasonics Technology Center**

Acquired in 2005, Caldon, Inc. brought to the Measurement Systems Division a technically superior line of advanced transit time ultrasonic products and systems for both the petroleum and nuclear markets. Today, the Measurement Systems Division supports its ultrasonic offerings from its state of the art technology and manufacturing center in Pittsburgh, PA.

**Industrial Products**

In a move that reunited the oil and gas assets with the process control assets of ITT Barton, the acquisition of PRIME Measurement Products expanded the Division’s reach into the nuclear, bulk distribution, military/defense and industrial control markets.
Turbine Meters – Gas and Liquid

For the past 50 years NuFlo and Barton turbine meters have grown and developed alongside the requirements of the international oil & gas and process control industries. Today, each brand has an unsurpassed reputation for withstanding severe environmental punishment while maintaining operational and measurement integrity.

**NuFlo Liquid Turbine Meters**
- Accurate and repeatable measurement
- Long service life even in severe applications
- Easy installation
- Broad range of end connections including: threaded, grooved, flanged, EZ-IN™, and WECO® 1500

**NuFlo Gas Turbine Meters**
- Single meter handles wide range of flow rates
- Carbide bearing design eliminates need for lubrication and withstands difficult service conditions
- Low inertia rotor design provides quick response to flow rate changes
- Two-bladed rotor offers large unobstructed flow area
- Electrical output signal adapts readily to a variety of readout devices

**Barton Custody Transfer Gas Meters**
For more than 30 years Barton turbine meters have provided custody transfer accuracy into a broad base of gas measurement applications including aerospace, cryogenic metering, pipeline applications and gas service. These meters are manufactured to order with options that include materials of construction, bearing systems and end connections.

**NuFlo™**

**Orifice Fittings and Meter Runs**

With the acquisition of North Star Flow Products, the Measurement Systems division secured its position as one of the largest manufacturers and distributors of orifice fittings, orifice plates, meter runs and accessories. The product line offers both single and dual run fittings and meter runs as well as a broad spectrum of accessories including plates, seals and straightening vanes.

**Barton®**

**PD Meters**

True “industry standards”, Floco® and Flotrac® meters are staples in harsh environments that demand consistent, repeatable and rugged performance. Originally designed for raw crude oil production, the Floco F Series meter has proven itself to be a versatile unit that performs easily in a broad range of high viscosity fluids. Ideal for oils and grease, paints and coatings and even paraffin, the Floco meter can also be used to drive a proportional sampler to provide volume as well as product quality data. The Flotrac meter is a highly durable unit that provides accurate, high-pressure measurement of low viscosity liquids.
The Scanner® family of flow computers represents more than 70 years of measurement expertise and not surprisingly Barton and NuFlo are considered pioneer brands in the development of electronic flow measurement technology and its adaptation to oil and gas applications.

With an installed base of more than 30,000 units worldwide the Scanner line plays an integral role in the current move towards automation.

Cameron is committed to strengthening the Scanner product line by aggressively supporting the introduction of ground-breaking offerings such as the Scanner 2000 – an easy to use, ultra low power microEFM that delivers flow computer functionality for chart recorder pricing. Cameron is also committed to investing millions of dollars researching and developing additional functionality to ensure the entire Scanner family continues to meet both existing and changing needs of operators, integrators and end users.

The strength of the product line lies in modularity and scalability. As stand alone units each Scanner model can collect, display, process and store data for historical and real-time measurement and reporting. As part of an engineered automation system, countless options exist that can be customized to create solutions for the most specific requirements.

For this reason, Scanners are becoming a standard for major oil & gas production transmission and distribution companies.

With more than a quarter of a million units in operation, in applications around the world, Cameron is the undeniable leader in the design and manufacture of totalizers and flow analyzers. The NuFlo MC™ Family of Flow Electronics delivers a broad range of functionality and capability from the straightforward MC-I Totalizer, which provides rate and flow, to the MC-III EXP Flow Analyzer, which utilizes Modbus® communications to download extensive archival logs in less than a minute.

MC Flow Analyzers are ideal for use with NuFlo’s comprehensive line of turbine meters or any other turbine brands on the market today.

Successfully operating in: test separators; flow lines; wellheads; truck loading and unloading stations
MEASUREMENT SYSTEMS

NUFLO™ & BARTON®

Transmitters

NuFlo MVX®-II Multi-Variable Transmitters
The NuFlo MVX-II Multi-Variable Transmitter is a gas measurement unit built around a patented, silicon-based DPE cell. It combines the accurate and stable measurement of differential pressure, static pressure and temperature with high speed input sampling/averaging and communications capabilities. This low-powered, field-hardened gas measurement transmitter features an easy-to-use laptop interface and industry standard communication protocol which makes configuration, measurement, and reporting simple, accurate, and reliable.

Barton FCX™ All and CII Series Electronic Transmitters
Two decades of experience in developing capacitance based measuring devices has culminated in the FCX All and CII series of transmitters. Models span the entire range of temperature, gauge, absolute and/or differential pressure and include flanged level transmitters.

NUFLO™

Water Cut Meters & Analyzers

Cameron currently offers two watercut products: the NuFlo Series 1000 Watercut Monitor and the SeCap Series 5000 Watercut Analyzer. The Series 1000, based on traditional paired electrode capacitance technology, was designed specifically for a three phase separator and provides a 0 to 50% water cut. The Series 5000 is based on the patented Single Electrode Capacitance (SeCaP™) technology which uses a single, isolated oscillator element to measure the dielectric properties of oil/water/gas mixtures and provide a reading of the percentage of water in the mixture.
Relief Valves

In the mid-1940s, a new relief valve actuated with a pilot rather than a spring set a new standard for pressure control. The valve, manufactured over the years by companies like Garrett, USI and Axelson, is now manufactured and sold by Cameron’s Measurement Systems division. The NuFlo pilot-operated pressure relief valve represents a tradition of advanced design and high-quality manufacturing abilities. These valves offer advantages not found in other relief valves - spring or pilot operated.

Clif Mock and TrueCut are recognized pioneer brands in the international sampling industry. From as far back as the 1960’s, when Clif Mock introduced the first isokinetic sampler, to today, this sturdy, accurate and versatile family of products has proven to be a top performer in a wide range of applications. Cameron continues to differentiate the product line by marrying it to the division’s full line of measurement and control instrumentation including its DPU products, flow computers, transmitters, turbine meters and totalizers. In doing so we can provide customized sampling systems that enable a customer’s integrated network to operate at peak performance.
MEASUREMENT SYSTEMS

With more than one million Barton Differential Pressure instruments in service around the world today Cameron, through its predecessor companies, is considered a pioneer in the development of the technology and the world wide market. At the heart of this product line is the Barton DPU, a rupture-proof, dual bellows assembly that actuates the majority of the recorders, indicators, controllers, indicating switches and transmitters in this catalog.

Accurate, sensitive and reliable, Barton DPUs are known for their robustness and ability to “rebound” from varying process environments. The open secret to these critical features lies in the construction of the bellows. A bellows assembly consists of 0.003” thick stainless steel wafers “welded” or “stamped” together and placed on either side of a center plate. Once filled with liquid the bellows assembly forms the heart of the DPU. Literally hundreds of companies around the world have attempted to replicate or duplicate construction of the Barton bellows; none have succeeded. This is a decades old strategic advantage for Cameron.

Model 199 DPU

Larger and generally more sensitive than the 224C DPU, the 199 DPU is designed to measure differential pressures as low as 10" w.c. to 100 psi at safe working pressure ratings from 1,000 to 6,000 psi (while meeting NACE requirements for operation in H2S service, if required).

### MODEL 199

<table>
<thead>
<tr>
<th>SWP (psi)</th>
<th>Housing Material</th>
<th>Stainless Steel Bellows</th>
<th>Inconel Bellows</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,000 (68.9)</td>
<td>Forged Stainless Steel 316</td>
<td>0-15 psi (0-1 bar)</td>
<td>0-15 psi (0-1 bar)</td>
</tr>
<tr>
<td>2,500 (172.4)</td>
<td>Forged Steel A.I.S.I. C1018</td>
<td>0-10 psi (0-255 mm)</td>
<td>0-10 psi (0-255 mm)</td>
</tr>
<tr>
<td>3,000 (206.9)</td>
<td>Forged Stainless Steel 316</td>
<td>to</td>
<td>to</td>
</tr>
<tr>
<td>4,500 (310.3)</td>
<td>Forged Alloy Steel 4142</td>
<td>0-100 psi (0-400&quot; w.c.)</td>
<td>0-100 psi (0-400&quot; w.c.)</td>
</tr>
<tr>
<td>6,000 (413.8)</td>
<td>Forged Alloy Steel 4142</td>
<td>(0-6.9 bar) (0-1015 cm)</td>
<td>(0-6.9 bar) (0-1015 cm)</td>
</tr>
<tr>
<td>Net Volume (cu. in.)</td>
<td>L.P. Head</td>
<td>35&quot; (575 cc)</td>
<td>35&quot; (575 cc)</td>
</tr>
<tr>
<td></td>
<td>H.P. Head</td>
<td>31&quot; (510 cc)</td>
<td>31&quot; (510 cc)</td>
</tr>
<tr>
<td>Displacement in cu. in. for full-scale travel</td>
<td>0.5&quot; (8.2 cc)</td>
<td>1.5&quot; (25 cc)</td>
<td>0.5&quot; (8.2 cc)</td>
</tr>
</tbody>
</table>

**NOTES:** Zero center or split ranges available on special order (e.g., a 0-50" w.c. (0-1270 mm) range may be ordered 25-0-25" w.c. (635-0-635 mm) or 10-0-40" w.c. (254-0-1016 mm)). Intermediate differential pressure ranges available from 0-20" w.c. to 0-100 psi. Other sizes and types of connections (welding stubs, MS, A.N.D., etc.) available upon request. Standard pressure connections are 1/2" (top) and 1/4" (bottom) NPT. Range springs are not interchangeable between the different size bellows or the inconel bellows or the 10" w.c. range. Can be specified to meet NACE MR-01-75 (Revised ’80). Metric conversions ( ) are approximate. Outline dimension drawings available upon request.

BARTON®

Differential Pressure Units (DPUs)

![Diagram of Differential Pressure Units (DPUs)](image)

Center Plate

Differential Pressure Housing

Compensating Springs

Beryllium Copper Torque Tube

Liquid Filled Welded Bellows

![Diagram of Differential Pressure Units (DPUs)](image)
**BARTON®**

**Differential Pressure Units (DPUs)**

**Model 224C DPU**

Designed to measure differential pressures from 0-30’’ w.c. to 0 to 1000 psi at safe working pressure ratings from 400 to 10,000 psi.

<table>
<thead>
<tr>
<th>MODEL 224C</th>
<th>BODY</th>
<th>AVAILABLE DIFFERENTIAL PRESSURE RANGES</th>
<th>PRESSURE CONNECTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SWP psi (bar)</strong></td>
<td>Housing Material</td>
<td>Stainless Steel/ Inconel Bellows 1-5/8” (41.3 mm) O.D.</td>
<td>Inconel Bellows 1-5/8” (41.3 mm) O.D.</td>
</tr>
<tr>
<td>500 (34.5)</td>
<td>Forged Brass (ASTM-B124#2)</td>
<td>0-30” w.c. (0-762 mm) to 0-55 psi (0-3.8 bar)</td>
<td>0-30 psi (0-2.1 bar) to 0-400 psi (0-27.6 bar)</td>
</tr>
<tr>
<td>500 (34.5)</td>
<td>Stainless Steel (316)</td>
<td>0-30” w.c. (0-762 mm) to 0-55 psi (0-3.8 bar)</td>
<td>0-30 psi (0-2.1 bar) to 0-400 psi (0-27.6 bar)</td>
</tr>
<tr>
<td>1,000 (68.9)</td>
<td>Brass</td>
<td>0-60” w.c. (0-1524 mm) to 0-55 psi (0-3.8 bar)</td>
<td>0-30 psi (0-2.1 bar) to 0-400 psi (0-27.6 bar)</td>
</tr>
<tr>
<td></td>
<td>Copper Nickel (70-30) (MIL-C-15726)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,500 (103.4)</td>
<td>Cold Rolled Steel (C1018) Stainless Steel (316)</td>
<td>0-60” w.c. (0-1524 mm) to 0-55 psi (0-3.8 bar)</td>
<td>0-30 psi (0-2.1 bar) to 0-400 psi (0-27.6 bar)</td>
</tr>
<tr>
<td>3,000 (206.9)</td>
<td>Cold Rolled Steel (C1018) Stainless Steel (316)</td>
<td>0-60” w.c. (0-1524 mm) to 0-55 psi (0-3.8 bar)</td>
<td>0-30 psi (0-2.1 bar) to 0-400 psi (0-27.6 bar)</td>
</tr>
<tr>
<td>6,000 (413.8)</td>
<td>Cold Rolled Steel (C1018) Stainless Steel (316)</td>
<td>0-60” w.c. (0-1524 mm) to 0-55 psi (0-3.8 bar)</td>
<td>0-30 psi (0-2.1 bar) to 0-400 psi (0-27.6 bar)</td>
</tr>
<tr>
<td>10,000 (689.5)</td>
<td>Alloy Steel (4140)</td>
<td>0-100” w.c. (0-2540 mm) to 0-55 psi (0-3.8 bar)</td>
<td>0-100 psi (0-7.0 bar) to 0-55 psi (0-3.8 bar)</td>
</tr>
<tr>
<td></td>
<td>L.P. Head</td>
<td>1.66” (27.2 cc)</td>
<td>2.51” (41.1 cc)</td>
</tr>
<tr>
<td></td>
<td>H.P. Head</td>
<td>1.55” (25.4 cc)</td>
<td>2.42” (39.7 cc)</td>
</tr>
<tr>
<td></td>
<td>Displacement in cu. in. for full-scale travel</td>
<td>0.14” (2.3 cc)</td>
<td>0.03” (0.49 cc)</td>
</tr>
</tbody>
</table>

**NOTES:** Zero center or split ranges available on special order [e.g., a 0-60” w.c. (0-1524 mm) range may be ordered 30-0-30” w.c. (762-0-762 mm) or 15-0-45” w.c. (381-0-1143 mm)]. Absolute pressure ranges available from 30” w.c. (762 mm) to 600 psi (41.4 bar). Other sizes and types of connections (welding stubs, MS, A.N.D., etc.) available upon request. Outline dimension drawings available upon request. Metric conversions ( ) are approximate.
For decades, the name Barton has been synonymous with “recorders” and while the scope of Cameron’s business has expanded dramatically, the Barton Chart Recorder continues to maintain a strong presence in world wide oil and gas and process control industries.

**General Features:**
- Perfected construction techniques ensure linearity, low hysteresis and a long life
- Die cast aluminum cases with stainless steel linkage
- Standard 12” (300 mm) nominal diameter circular charts
- Disposable felt tip inking system
- Battery or spring wound clocks

**Model 202E Recorder**
- Four pen recorder measures and records differential pressure, static pressure (optional) and temperature (optional)
- Additional pens can be mounted to record supplementary pressure data
- Available in Stainless Steel (Model 202ES)
- Available for NACE applications (Model 202N)
- Actuated by 199 DPU

**Model 242E Recorder Receiver**
- Mounts any combination of pressure elements, thermal systems, or receiver bellows
- Accepts up to four elements
- Static pressure elements feature polished 316 stainless steel construction and ranges to 30,000 psi
- Standard thermal systems feature 10ft (3m) armored capillary with ambient temperature compensation
- Available in Stainless Steel (Model 242ES)
- Actuated by 224 DPU

**Model 335E & 338E Recording Controllers**
- Pneumatic PID control from any recorded variable
- Dual (pressure limited flow control) controllers in one case (optional)
- Cost effective integrated design
- 3-15 or 6-30 psi output
- Low air consumption
- Actuated by 199 DPU

**Model J8A Pressure / Temperature Recorder Receiver**
- Versatile and rugged this unit was designed for general temperature and pressure applications
- Records logged on 8” diameter chart
- Up to four elements or bellows-type receiver elements may be used in any combination to operate up to four individual recording pens
- Non-DPU Actuated
Barton Pneumatic Transmitters and Controllers are designed to meet the most stringent and demanding requirements for petroleum, production, navy shipboard and process plant applications.

Model 273 Transmitter
Actuated by 224C DPU

Model 274A Transmitter
Actuated by 199 DPU

Model 284C Transmitter
Actuated by 224C DPU

General features of Models 273, 274A, 284A include:
• Rugged, weatherproof, non corrosive case
• Continuous purging (pilot valve and nozzle exhaust inside)
• Operation span continuously adjustable (100 – 20%)
• Adjustable suppression (up to 80% of range)
• Large valve relays (no need for secondary booster)
• Span continuously adjustable (down to 20% of range)
• Air consumption (at balance condition) 0.05scfm ma

Model 336C Pneumatic Controller
Provides:
• Gain, gain plus integral, gain plus integral and derivative, and differential gap control actions
• Gain control, integral control derivative control, differential gap snap-acting and direct or reverse controller action modes
• Remote set controller and 2-way auto-manual bypass options
• Actuated by 224C DPU

Model 335P (Pressure) & Model 335T (Temperature) Pneumatic Controllers
Actuated by a wide selection of capsular bellows or helical bourbon tube static pressure elements and liquid or mercury-filled temperature systems to indicate, measure and control a variety of pressure or temperature processes.
These Barton transmitters address liquid, gas or vapor service. General features include:

- Liquid-tight, explosion-proof case (no aluminum)
- Any calibrated range, including absolute variations, available as standard with the stated ranges
- Insensitive to normal vibration and show with the best available zero stability
- Zero and space adjustments are easily accessible
- No RFI generation (All DC circuitry)
- Outstanding temperature stability
- Independent, limited interacting range and zero controls

Model 752 Electronic Transmitter

- Standard ranges from 0 – 50 w.c. to 0 – 300 psid
- Addresses static pressures to 3,000 psig on standard models with 6,000 and 10,000 psig on special order
- Can be ordered with zero center or split ranges
- Actuated by 224C DPU

Model 753 Electronic Transmitter

- Couples the reliability of a bourdon tube with the sensitivity of a silicon strain gage
- Delivers .05% accuracy for measurement from 0 – 25 psi to 0 – 5,000 psi
Mechanical Indicators

DP Indicators
Precise and rugged these indicators deliver crisp, clear, and consistent performance. As 100% mechanical, this line of instruments are quick and easy to install and have become integral to a wide variety of applications – from liquid level indication, measurement of liquefied gases, jet engine/mis...
Model 450C Indicator

The Model 450C indicates low DP in high static pressure applications. Its 4-1/2” dial provides excellent readability with economy of space. The M450C is a commercial version of the M316C, used by the U.S. Navy for shipboard measurement of DP, flow, and Liquid Level.

- Case: Aluminum (NEMA 4) or 316SST (NEMA 4X), Weatherproof
- Dial: 4-1/2 inch, 270° arc
- Actuated by the 224C DPU

Model 247C Portable 6” DP Indicator

The Model 247C is a portable 6” (152 mm) indicator housed in a plastic carrying case with a built in 3-valve manifold, bleed valves and neoprene hoses.

- DP ranges from 0-30” w.c. to 0-1000 psi
- Portable Backflow Testers available (Model 246 BFT – 3 inch; Model 247 BFT – 6 inch)
- Actuated by the 224C DPU

Model 227C 6-inch Indicator

The M227C is a DP Indicator that is actuated by Barton’s M224C rupture-proof DPU. The indicating pointer travels through a 270° arc over a compact 6-inch (150 mm) dial. Scales are calibrated in uniform increments for measurement of DP or liquid level. Square root gradations are available for direct reading of flow rate and special scales are available for indicating the quantity of fluid in tanks.

Applications

The M227C is used in applications where weight and space are at a premium. Widely used in jet engine and missile testing programs, aircraft ground support equipment, water treatment, and air conditioning systems. It is specified by many liquefied gas producers and distributors for liquid level indication of materials, such as: LOX, CO₂, ammonia, nitrogen, helium, hydrogen, and argon. The M227C is available in stainless steel (Model 227AS).

Model 232C 6” DP Indicator

Economical, 6-inch (152mm) indicator designed for applications where high accuracies are not required. Suitable for measurement of tank level, flowrate and DP across filters.

Features include:

- 500 psi (34.5 bar) SWP maximum
- 0-50” w.c. to 0-100 psid (0-124 mbar to 6.9 bar)
- Case and bezel are 304 SST
- Housing are forged brass with steel and SST optional

Indicating Mechanism

The indicating pointer traverses a 270° arc, providing excellent readability. It is driven by a precision, jeweled rotary movement that employs a thermally stable Ni-Span-C hair spring. The movement has a micrometer screw for range adjustments. Zero and range adjustments can be made without removing the scaleplate or pointer. Linearity adjustments are easily accessible after removal of the scaleplate.

Scales

The 4-1/2 inch diameter scale can be graduated uniformly for DP or level, or square root for direct reading of flow rate. Special scales for indicating liquid quantity in tanks can be provided.
The IT-12 DP Indicating Transmitter is designed to be retrofit into existing 6-inch Barton switch cases. These units provide local indication (process driven) and 2-wire, 4-20 mA output — an ideal low-cost alternative for low DP (at high static pressure) measurements — flow, liquid level, pressure, pressure drop, absolute pressure, etc.

Features/Benefits
- 4-20 mA output (linear with pointer)
- Mechanical indication (easy to read)
- Remote low-battery indication
- Kit or Case assembly formats
- Output calibration jacks

Operation
The pointer movement is directly coupled to a precision potentiometer that produces an electrical signal that drives a linear 4-20 mA output.

Scales
The 6-inch diameter scale can be graduated uniformly for DP and liquid level or square root for direct reading of flow rate. Special scales are available for indicating liquid quantity in tanks.

Enclosures
- Weather-tight — die-cast aluminum, with weather-resistant black epoxy resin paint finish. The cover lens is secured in the bezel with an elastomer ring, which acts as a seal between the bezel and the case. This ensures a moisture, fume, and dust free atmosphere for the indicator/switch mechanism.
- Explosion-proof — certified by CSA

<table>
<thead>
<tr>
<th>IT MODEL</th>
<th>DPU MODEL</th>
<th>CASE (6-inch Dial)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>224C</td>
<td>Watertight, Type4</td>
</tr>
</tbody>
</table>
Barton mechanical switches are responsive to relatively low magnitudes of DP at high static pressures. Actuated by Barton’s Differential Pressure Units (DPUs), they are used to energize alarm or control circuits at predetermined limits of flow through pipelines, liquid level in pressurized vessels, or pressure loss across devices, such as filters. For monitoring flow rate, they are used in conjunction with a primary element (e.g., orifice).

**199 DPU Actuated**

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>289A</td>
<td>6-inch DP Indicator-Switch in Weatherproof Case</td>
</tr>
<tr>
<td>291B</td>
<td>6-inch DP Indicator-Switch in Explosion-proof Case</td>
</tr>
</tbody>
</table>

**224 DPU Actuated**

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>288C</td>
<td>6-inch DP Indicator-Switch in Weatherproof Case</td>
</tr>
<tr>
<td>290D</td>
<td>6-inch DP Indicator-Switch in Explosion-proof Case</td>
</tr>
<tr>
<td>318C</td>
<td>6-inch DP Indicator-Switch that meets MIL Specs for Shock and Vibration</td>
</tr>
<tr>
<td>322C</td>
<td>Blind DP Switch</td>
</tr>
</tbody>
</table>

**Model 318C Indicating Switch**

The M318C DP Indicating-Switch meets MIL-S-901C Shock Grade A and MIL-STD-167 Vibration Specs. Indicating pointer travels through a 270° arc over a compact 4-1/2 inch (114 mm) dial. Scales are calibrated in uniform increments (DP) or liquid level. Square root gradations are available for direct reading of flow rate. Special scales exist for fluid quantity in tanks.

Widely used in jet engine and missile testing programs, aircraft ground support equipment, water treatment, and air conditioning systems, where weight and space are critical. Also used for liquid level indication of materials, such as: LOX, CO₂, helium, nitrogen, hydrogen, and argon.

**Switches**

All models are available in single or dual snap-acting mechanical contact (SPDT) switch configurations. They can be set for high or low, or both when two contacts are furnished.

Set points are adjustable over entire scale, using a control screw located flush with scale; settings are indicated by small reference scales in upper quadrants of the main scale.

- **AC Rating:**
  - 5 amps @125V
  - 2.5 amps @240V
- **DC Rating:**
  - (Inductive) 2.5 amps @30V
  - (Inductive) 0.1 amps @125V
  - (Resistive) 4.0 amps @30V
Mechanical Switches

Indicating Switches Models 288C / 289A / 290D / 291B

These DP Indicating Switches are responsive to relatively low magnitudes of pressure differences at high static pressures. They are offered in a wide range of DP ratings and can withstand over-ranges equal to their rated SWP. Typically they are used to energize alarm or control circuits.

- Stable calibration and negligible SP shift
- Minimal Maintenance
- Available in stainless steel (M289AS)

Application
M199-based 289A and 291B are used where maximum sensitivity is required in lower DP ranges, where a field change is anticipated, or when a built-in pulsation dampener is needed to control the unit’s response time.

M224C-based 288C and 290D are used in applications that require extended DP ranges (beyond M199-based units) or whenever size and weight are prime considerations.

Indication/Scale
The indicating pointer travels through a 270° arc over a six-inch (150mm) dial. Scales are calibrated in uniform increments for measurement of DP or liquid level; square root available for direct reading of flow rate; also special scales for tank fluid quantity.

Weather-Proof Case
The weatherproof case is made of die-cast aluminum, finished with weather-resistant black epoxy resin paint. The polycarbonate lens is secured in the bezel with elastomer ring, reducing possibility of breakage and acts as a seal between bezel and case for a moisture-, fume-, and dust-free atmosphere for the indicating mechanism.

Explosion-Proof Case
NEMA 4 case has a large cover for maximum readability; switches/adj accessible with cover removed. Case is certified for Class I, Div. 1, Group B Explosion-proof service.

Switches
All models are available in single or dual snap-acting mechanical contact (SPDT) switch configurations. They can be set for high or low, or both when two contacts are furnished. The switches are adjustable from 5% to 95% of full scale range. Switch set points are adjusted with a control screw located flush with the scale; contact setting indicated by a small scale on scaleplate. Switch contacts can be set to either open or close with increasing or decreasing DP (reverse action by reversing lead wires at terminal block).

- AC Rating:
  - 5 amps 125V
  - 2.5 amps 126V-250V
- DC Rating:
  - (Inductive) 1.0 amps 30V
  - (Resistive) 3.0 amps 30V

Switch connections are 1/2” NPT Female or an optional flexible conduit (up to 8 feet in length).
Model 322C Blind Switch

The Model 322C is a blind SPDT, snap-acting switch designed for use in hazardous areas. An optional two-switch configuration is available. The Model 322C provides a highly repeatable alarm signal capable of performing electrically controlled system functions for liquid level and flow applications.

Switch

The switch is adjustable to open (normally closed) or close (normally open) on either increasing or decreasing DP and is positively locked to prevent drift. Switch adjustments are accessible when the cover is removed.

- **AC Rating:**
  - 5 amps @125V
  - 2.5 amps @240V
- **DC Rating:**
  - (Inductive) 2.5 amps @30V
  - (Resistive) 4.0 amps @30V
- Actuated by the 224 DPU

Operation

For flow applications, the unit is connected by tubing to the LP and HP sides of the primary device (orifice plate, venturi, or flow tube) in the process run. For liquid level, the DPU is connected to measure the variations in DP produced when the liquid level varies. These changes are used to control the switch function.

The electrical alarm or control unit circuit is connected to the switch (mounted on the DPU). Movement of the DPU shaft actuates the switch mechanism when the DP reaches a pre-set level.

Series Indicating-Transmitter Switch

ITS Series DP Indicating-Transmitter Switches provide local indication (process driven), 2- or 4-switch, and 2-wire 4-20 mA output.

- Measures relatively low DP at high static pressures
- 4-20 mA output (linear with pointer)
- SPDT or DPDT switch operation
- Switches adjusted over entire scale
- Switch backup battery for failsafe
- Output calibration jacks
- Non-contact pointer position detection
- Remote low-battery indication
- Retrofits Barton 6-inch switch case using existing DPU
- Actuated by the 224 DPU

Application

Typical applications include on-off pump control, liquid level, pressure drop across a filter, flow alarms, and absolute pressure measurement, indicating, switching, and transmitting.

Operation

Switch contacts adjustable over the entire scale.

Setpoints are adjustable with a control screw, without calibration equipment. Pointer movement is directly coupled to a precision potentiometer that produces an electrical signal that drives a linear 4-20 mA output and the switches. Switches can be set for high or low, or both (with two contacts). Jumpers can be set to operate two switches together for DPDT or on/off control between two set-points.

With 4-20 mA Output (2 or 4 Switches)

<table>
<thead>
<tr>
<th>IT MODEL</th>
<th>DPU MODEL</th>
<th>CASE (6-inch Dial)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>224C</td>
<td>Watertight, Type4</td>
</tr>
<tr>
<td>24</td>
<td>224C</td>
<td>Explosion proof; Class I, Div. 1, Groups B, C, &amp; D; Class II, Groups E, F, &amp; G, hazardous locations; Class III, Type 4</td>
</tr>
</tbody>
</table>
Barton Sealed Sensor Systems are used as actuating units for measurement of liquid level, flow, and DP in applications involving:

- Corrosive process media
- Media containing suspended solids
- Process media with a viscosity that can cause clogging
- Media at temperatures that may cause freezing or solidification
- High ambient or process media temperatures
- Changing media that requires flushing to prevent contamination
- Hazardous materials
- Inconvenient measurement locations (i.e. elevation, hazards, etc.)

These systems are self-contained: no floats, levers, pins, or other mechanical devices to wear or become contaminated — essentially maintenance-free! And, they are accurate to within ±1.0%.

**Model 305 Sealed Sensor**

The M305 consists of a M224C DPU with a 1-inch pipe nipple rear-welded to the DPU. The nipple is 8-inches long and can be attached directly to a pressure tap at the bottom of a tank. An optional flange, welded to the nipple, is available as an alternative tank fitting. If a reference leg is needed, it may be field-installed.

<table>
<thead>
<tr>
<th>M305 Sensor</th>
<th>M224C DPU SWP (psi)</th>
<th>System DP Ranges</th>
<th>Sensor Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-Inch</td>
<td>500</td>
<td>0-45* w.c. 0-500 psi</td>
<td>316 SST BeCu Inconel 316 SST Inconel</td>
</tr>
<tr>
<td>2-Inch</td>
<td>1500</td>
<td>0-75* w.c. 0-600 psi</td>
<td>316 SST BeCu Inconel 316 SST Inconel</td>
</tr>
<tr>
<td>4-Inch</td>
<td>500</td>
<td>0-30* w.c. 0-500 psi</td>
<td>316 SST Inconel 316 SST Inconel</td>
</tr>
<tr>
<td>4-Inch</td>
<td>1500</td>
<td>0-60* w.c. 0-600 psi</td>
<td>316 SST Inconel 316 SST Inconel</td>
</tr>
</tbody>
</table>

**Models 351 and 352 Sealed Sensors**

The M351 features a single sealed sensor; the M352 has two sensors. Both models are available with threaded, welded, or flanged mounting connections that do not require internal vessel plumbing. These sensors are compact and lightweight — supported by their own piping connections. In most cases, this eliminates bulky pedestals or special installations. In addition, commercial raised-faced or socket-weld type flanges may be adapted to the system, if required.

<table>
<thead>
<tr>
<th>M351 M352 Sensor</th>
<th>M224C DPU SWP (psi)</th>
<th>System DP Ranges</th>
<th>Sensor Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 psi</td>
<td>500</td>
<td>0-30* w.c. 0-500 psi</td>
<td>316 SST Inconel 316 SST Forged Steel</td>
</tr>
<tr>
<td>3000 psi</td>
<td>1000 1500 3000</td>
<td>0-60* w.c. 0-600 psi</td>
<td>316 SST Inconel 316 SST Forged Steel</td>
</tr>
</tbody>
</table>
**Model S422 Diaphragm Sensor**

The MS422 is a diaphragm-type sensor that functions similarly to the bellows-type. The major difference is in the use of a thin, flexible diaphragm as the separating member between the process media and the DP instrument. The diaphragm seal is designed for use with fluids having suspended solids or with slurries. Both the diaphragm and lower housing are available in a variety of materials; see list A and list B at right. The upper housing and bolts are Carbon Steel (standard).

### List A — Diaphragm Materials
- 316 SST
- 304 SST
- 347 SST
- Carpenter #20 SST
- Bronze
- Monel 400
- Nickel 200
- Inconel 600
- Tantalum
- Titanium
- Silver
- Gold
- Platinum
- Teflon
- Viton A
- Ethylene Propylene
- Terpolymer

### List B — Wetted Surface, Lower Housing Materials
- Carbon Steel
- 316 SST
- 304 SST
- 347 SST
- Carpenter #20 SST
- Bronze
- Monel 400
- Nickel 200
- Inconel 600
- Tantalum Lined
- Titanium
- Saran
- PVC
- Teflon
- Polypropylene
- Hard Lead
- Hard Rubber
- Glass-lined Steel

### Sealed-Sensor Applications

<table>
<thead>
<tr>
<th>MS422 Sensor</th>
<th>M224C DPU SWP (psi)</th>
<th>System DP Ranges</th>
<th>Sensor Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elastomer Diaphragm</td>
<td>500 0-30&quot; w.c.</td>
<td>0-500 psi</td>
<td>Viton A (Std.)</td>
</tr>
<tr>
<td>1500 3000 0-60&quot; w.c.</td>
<td>0-600 psi</td>
<td>See List B</td>
<td></td>
</tr>
<tr>
<td>Metal Diaphragm</td>
<td>500 0-25 psi</td>
<td>0-500 psi</td>
<td>See List A</td>
</tr>
<tr>
<td>1500 3000 0-25 psi</td>
<td>0-600 psi</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Model 350 (In-Tank) System**

**Model 352 Dual Sensor**

**Model 351 Single Sensor**

**Model 305 Dual Internal Sensors**
Inventory Management Systems

CryoScan / DataScan Telemetry Systems
The CryoScan® 51 (CS51/DS51) Telemetry System combines up-to-the-minute accuracy in product level and pressure measurement with a communications system that optimizes inventory management and product delivery cycles. The remote telemetry unit (RTU) calculates the level of product inside a tank using pressure measurements from its integral sensor and/or 4-20 mA inputs, and stores the information in data logs. The logged data is transmitted regularly to a computer for on-screen viewing or printing for quick and easy analysis. Built-in alarms alert the operator when a parameter drops to a user-specified setpoint. An operator can also run a status report “on demand” for instantaneous data monitoring.

The CryoScan/DataScan’s continuous monitoring and alarm system helps eliminate the risk of running out of product. It also minimizes the need for “extra” product deliveries to ensure that tank levels do not become critically low. For companies that manage multiple mediums and/or multiple storage sites, and applications the CryoScan / DataScan is a highly practical and cost-efficient solution.

Remote Stock Management

CryoScan PC Software

Accurate & Continuous Tank Monitoring
Inventory Tracking
Aids in Delivery Scheduling & Leak/Theft Detection

No manual monitoring of tank levels
No missed phone calls
Minimized risk for product shortage
The Cameron Hydrocarbon Calibration Laboratory

The Caldon Ultrasonic Technology Center is located near Pittsburgh, Pennsylvania. The centerpiece of this facility is the Cameron Hydrocarbon Calibration Laboratory.

This flow laboratory is unequalled and sets Cameron apart from other ultrasonic meter suppliers in three distinctive ways.

Each Caldon LEFM 200 Series ultrasonic flow meter is calibrated in this laboratory over a Reynolds number range that corresponds to the actual Reynolds number range the meter will encounter in the field, when possible. This process ensures that once the meter is installed and operating, performance will be unaffected by changes in flow rate and liquid viscosity. The ability to calibrate in-house will virtually eliminate the need for Cameron to use independent facilities, thereby dramatically reducing delivery cycles.

When you talk about a flow laboratory sooner or later you will come around to talking about accuracy, or as it’s called by metrological experts, the laboratory’s measurement uncertainty. To calibrate a meter it is necessary to compare its registration to a “known volume”, i.e., if 1,000 barrels of oil are passed through the meter, does it register 1,000 barrels? The uncertainty of the flow laboratory deals with the errors that might affect the “known volume” and how it compares to an international standard. When a meter has been calibrated in a flow laboratory with a low measurement uncertainty, its measurement in the field will be more accurate. The target uncertainty of the Cameron Hydrocarbon Calibration Laboratory is 0.05%.

The extreme stability of flow rate and temperature achievable at the Cameron Hydrocarbon Calibration Laboratory provides Cameron engineers with an unsurpassed tool for conducting fundamental research. This has contributed to better understanding of the phenomena that affect ultrasonic flow meters.
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