



## TEST & MEASUREMENT

Order from: **C A Briggs Company**

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WE DESIGN AND DELIVER  
PREMIUM SENSING SOLUTIONS  
[www.setra.com](http://www.setra.com)





# WHO IS SETRA?

**Setra Systems, Inc.** was founded in an age of transducer innovation. Our founders, Dr.Y.T. Li and Dr. S.Y. Lee were Professors of engineering at the Massachusetts Institute of Technology and co-developers of the Variable Capacitance Transduction Principle. Building on this heritage of innovation, Setra has designed and developed the most comprehensive product lines of pressure sensing transducers in the world. Setra has been innovating Test & Measurement sensor designs for over 50 years and has become a leader in the pressure transducer market.

- **Made in the USA**
- **Industry Leader for 50 years**
- **Innovator of the variable capacitance principle**
- **5-Sigma Quality**
- **95% On Time Delivery**
- **99.8% Quality Rating**
- **10+ Million Sensors Shipped**

## Corporate Headquarters & Production Facility

Boxborough, Massachusetts, USA



# WHEN THERE ARE STRINGENT SENSOR REQUIREMENTS FOR YOUR APPLICATION, TRUST SETRA

Not all pressure sensors are made to withstand the harsh environments and stringent requirements of the Test & Measurement industry like Setra's capacitance sensors.

## WHETHER YOU NEED:

- High Accuracy
- Low Differential Pressure
- Long Term Stability & Reliability
- High Overpressure Capability
- Rugged Design to Withstand High Shock and Vibration
- High Line Pressure Capability
- Direct application engineering support

# SETRA HAS YOU COVERED



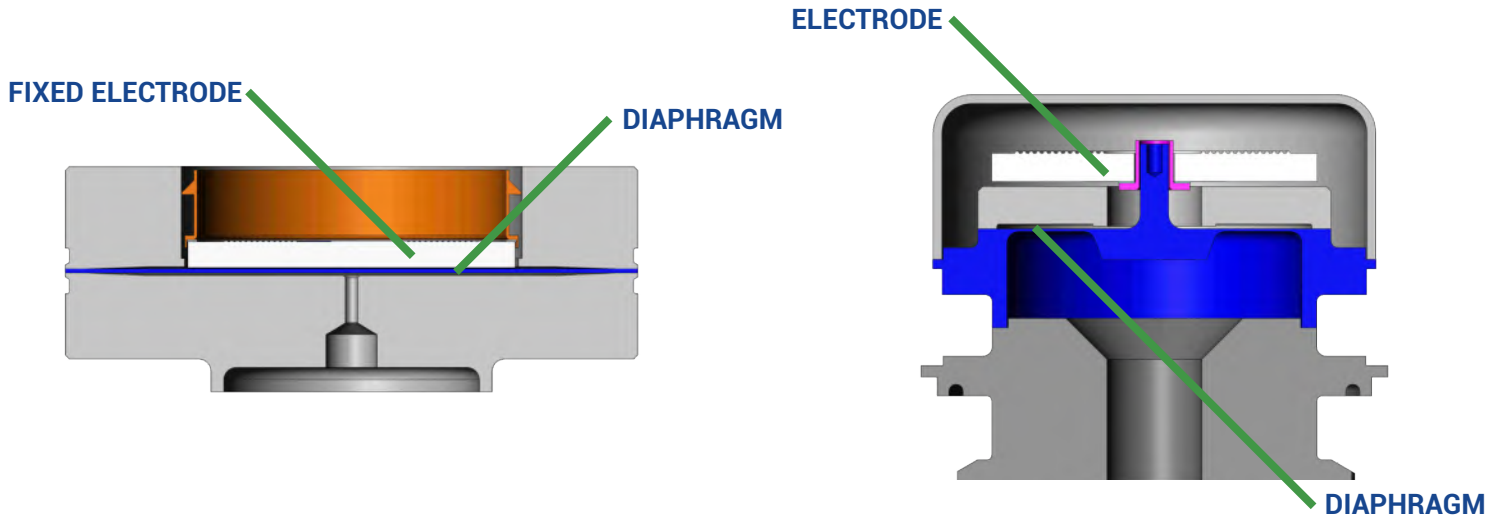
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# SETRA'S TECHNOLOGY

Since Setra was started in 1967, capacitance has been and will continue to be the core technology for our pressure transducers. Each of the capacitive sensors that we manufacture employs two closely spaced parallel plates, one of which is fixed while the other is a flexible diaphragm which allows for motion when pressure is applied. This straightforward concept combined with innovative design and world class manufacturing has enabled Setra to become a leading supplier to the pressure transducer market.



## STAINLESS STEEL STRETCHED MEMBRANE

This sensor is designed and manufactured using a stainless steel stretched membrane diaphragm that moves towards a fixed electrode. Setra uses proprietary tension control enabling the sensor to measure extremely low pressure measurements. This configuration also provides up to 100x overpressure capability in the application

**RANGES:** 0.1" W.C. to 15 PSI

**PRESSURE TYPES:** Differential, Gauge, Compound

## MACHINED STAINLESS STEEL SENSOR

This sensor is designed and manufactured using a machined stainless steel diaphragm that moves away from a fixed electrode. Setra uses proprietary manufacturing techniques to take advantage of the diaphragm's elastic properties enabling accurate mid to high pressure measurements. This configuration also provides up to 10x overpressure capability in the applications.

**RANGES:** 15 PSI to 10,000 PSI

**PRESSURE TYPES:** Gauge, Absolute, Compound

## ADVANTAGES OF CAPACITANCE SENSORS



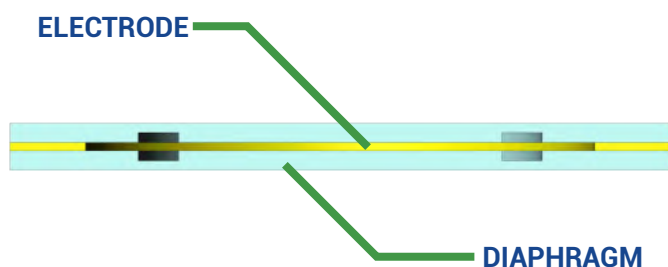
### HIGH ACCURACY

Performance in Test & Measurement applications is crucial. The data collected is used to ensure product quality, improve efficiency, and provide public safety. Setra's sensors have a long history of providing reliable test data with accuracies as high as 0.02% FS.

# WE'VE GOT YOU COVERED

Setra provides solutions, not just sensors

- Quality and reliability you can depend on
- Customizable platform products ideal for many applications
- Class leading overpressure capability
- High accuracy up to  $\pm 0.02\%$  FS
- All sensor calibration are traceable to NIST



## CERAMIC SENSOR

This sensor is designed and manufactured using ceramic material fused together with glass and gold to form the sensing element. The ceramic properties enable superior thermal performance and long term stability when compared to stainless steel or other metallic sensors.

**RANGES:** 0 to 100 PSI

**PRESSURE TYPES:** Barometric, Gauge, Compound

Setra's AccuSense™ line of products offers a 0.25% "Total Error Band" specification over a temperature range of -20 to 60°C for each of its transducers. This specification gives the user a more comprehensive look at the sensor's performance in real world installations.

### TOTAL ERROR BAND (%FS)

$$\begin{aligned}
 &= \\
 &\text{ACCURACY} \\
 &+ \\
 &\text{ZERO OFFSET} \\
 &+ \\
 &\text{SPAN OFFSET} \\
 &+ \\
 &\text{ZERO TEMP SHIFT} \\
 &+ \\
 &\text{SPAN TEMP SHIFT}
 \end{aligned}$$

## RUGGED DESIGN

Applications in the Test & Measurement industry are among the most demanding; not only with performance but also with harsh operating environments. These applications have caustic chemicals and high pulsation during testing. Setra's rugged design prolongs the life of the sensor and keeps you up and running to get the job done.

## HIGH STABILITY

The capacitance sensing element provides a high level of output that is not only accurate when first purchased, but will remain accurate over the long haul. The stable sensor will prevent the need for constant re-calibrations of the sensor.

# A SOLUTION FOR ALL APPLICATIONS

With Setra's wide variety of pressure transducers for Test & Measurement applications, there is virtually no situation we can't accommodate. With a wide range of pressure transducers, we can easily accommodate your needs whether it is high accuracy for measuring low differential pressure or high ranges in gauge, absolute or compound pressure sensing applications.



## 206

### INDUSTRIAL PRESSURE TRANSDUCER

The Model 206 is designed for Industrial and OEM customers who require high performance, reliability and versatility at an affordable price. The 206 has a rugged stainless steel design and is built to withstand the rigors of the most difficult industrial applications. The 206 has exceptional  $\pm 0.13\%$  FS accuracy for pressure ranges as low as 25 PSI up to 10,000 PSI.

#### FEATURES:

- Long-Term Stability:  $<0.5\%$  FS/YR
- Exceptional EMI/RFI
- User Accessible Zero/Span
- Reverse Wiring Protection
- Operating Voltage: 12 VDC to 28 VDC
- Calibration NIST Traceable



## 256

### INDUSTRIAL PRESSURE TRANSDUCER

The Model 256 is designed for Industrial applications that require a rugged and reliable sensor. Specifically designed for NEMA 4/IP65 rated applications, the 256 is packaged in a die-cast aluminum enclosure. Using Setra's capacitive design, the 256 is resistant to shock, vibration, temperature and EMI/RFI. The 256 features adjustable potentiometers for zero and span.

#### FEATURES:

- High Accuracy:  $\pm 0.13\%$  FS
- Long-Term Stability:  $0.5\%$  FS/YR
- Wide Operating Temperature Range
- Choice of Voltage or Current Outputs
- All Stainless Steel Wetted Parts
- Operates on Unregulated Power Supply



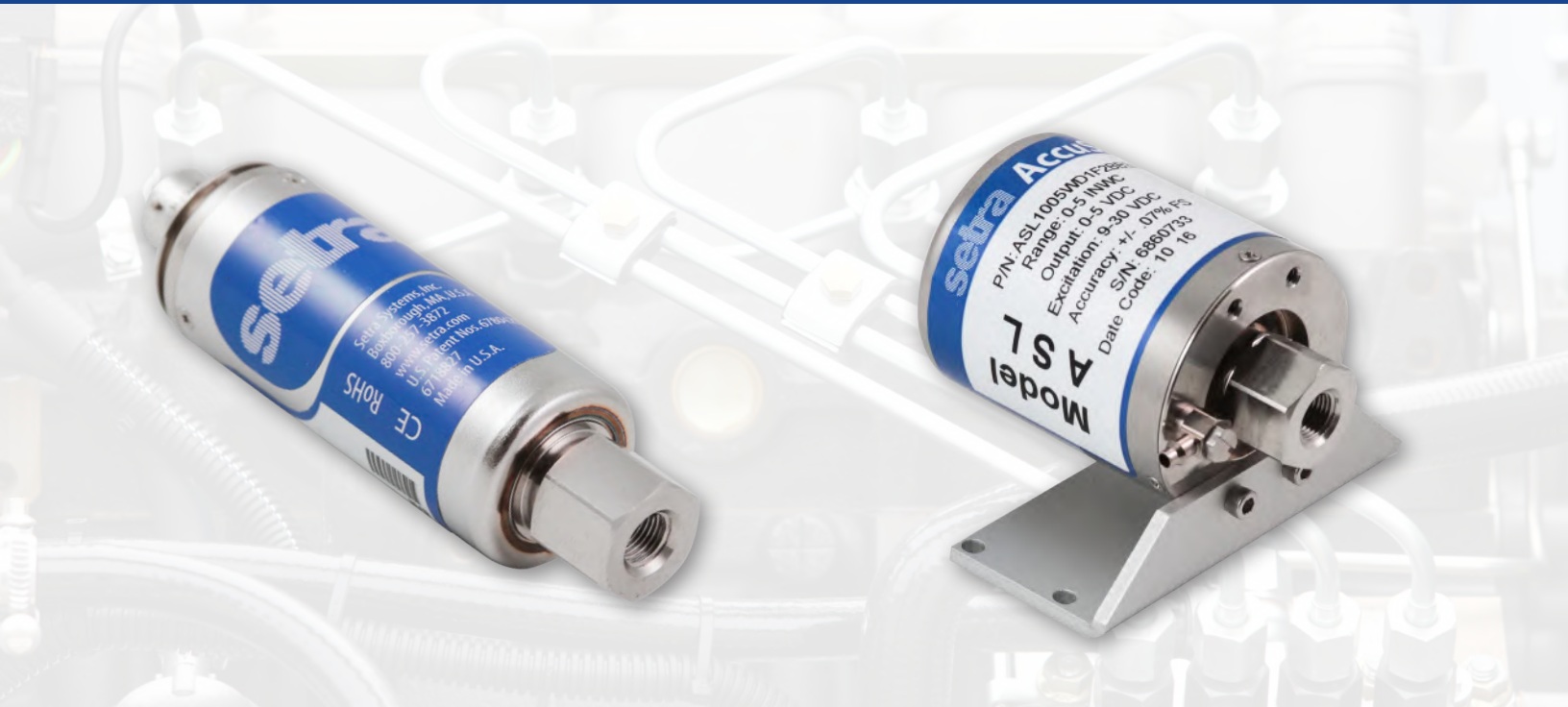
## 270

### HIGH PERFORMANCE TRANSDUCER

The Model 270 is Setra's highest performing analog pressure transducer for barometric, absolute and gauge pressure measurements. The ceramic sensor and its  $\pm 0.03\%$  FS accuracy over a wide temperature range outperforms the competitive transducer in the environmental sensing market. The 270 offers multiple options to fit the needs of difficult applications.

#### FEATURES:

- High Accuracy:  $\pm 0.03\%$  FS
- Stable Ceramic Sensor
- Repeatability Within  $0.01\%$  FS
- Long Term Stability:  $0.1\%$  FS/YR
- Low Power Consumption
- Instant Warm-Up:  $\pm 0.04\%$  FS Shift



## ASM

### HIGH PERFORMANCE TRANSDUCER

The Model ASM is the highest accuracy pressure transducer for measuring gauge, absolute, compound and vacuum pressure in the AccuSense™ product line. The ASM's  $\pm 0.05\%$  FS accuracy is calibrated using the "End Point Method" which improves linearity when compared to competitive transducers which use the "Best Fit Straight Line Method" of calibration.

### FEATURES:

- High Accuracy:  $\pm 0.05\%$  FS
- End Point Method Linearity
- High Overpressure:  $>10x$  Range
- Low Thermal Error
- Excellent Stability:  $<0.1\%$  FS/YR

## ASL

### HIGH PERFORMANCE TRANSDUCER

The Model ASL is the highest accuracy pressure transducer for measuring low differential pressure in the AccuSense™ product line. The ASL uses resonant variable capacitance sensor. This sensor is linearized and thermally compensated through a computerized curve fitting algorithm that optimizes the sensors linearity for maximum accuracy in demanding applications.

### FEATURES:

- High Accuracy:  $\pm 0.07\%$  FS
- End Point Method Linearity
- High Overpressure:  $>100x$  Range
- Low Thermal Error
- Excellent Stability:  $<0.15\%$  FS/YR
- Unidirectional & Bidirectional Modes

# SETRA SELECT

You can lean on our staff of cross-trained and highly skilled engineers and technicians to solve your most unique challenges. We call it Setra Select because the options are all yours. With Setra, you can rest assured that when everything is at stake, we will put the right technical team members on the job. With over a dozen seasoned engineers and technicians, there will likely be nothing new to us about your problem. We will first zero in on your target specs and determine if they are achievable. Then we will break down the problem and select



## CONCEPT

Can it be done? If the answer is yes (and it usually is), we move to platform choice and vetting of engineering options.



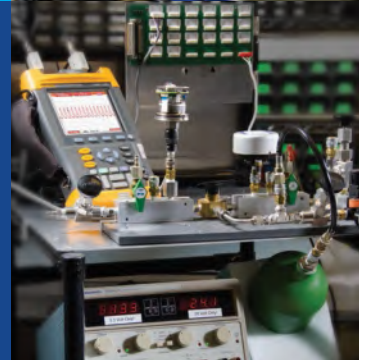
## PROTOTYPE

Next, our Design Engineers engage with our manufacturing team and collaborate on producing a functional prototype using in-house, standard manufacturing approaches wherever possible.



## EVALUATION

After in-house testing, the prototype is sent to you for evaluation and feedback. You send it back and iterations are made until you are fully comfortable that production models of the prototype will drop in perfectly.



## PRODUCTION

Documentation is finalized and production associates are trained in preparation for manufacturing a pilot run and first production order.





the right technology platform for the application. Every aspect of your application's mechanical, electrical and environmental constraints will be considered. We will then vet such controlling variables as materials, enclosure geometries, sealing methods, and manufacturing methods. Once concept engineering is complete we move to prototyping, evaluation, and production using our regimented process model.

## WHAT'S CUSTOMIZABLE?

### ELECTRICAL CONNECTOR AND OR INTERFACE

There are many standards for electrical connections. Many of our models can be modified to accommodate a variety of standard connectors or custom wiring pin-outs. We can guide you through our available options or potentially customize the electrical connector to your specifications.

**Examples include:**

- Cable-wire connections
- Wire terminals
- Military connectors
- Industrial connectors

### FIRMWARE/INTEGRATION

Setra can help customers create unique product features by modifying our standard firmware and customizing it according to specific customer or application requirements.

**Examples include:**

- Custom power-up splash screens with custom logos
- Integration of proprietary communication protocols
- Addition of specific product functionalities

### ELECTRONICS

The electronics are responsible for fundamental features and important performance aspects of a pressure transducer. Setra offers customized electronics to achieve desired excitation inputs and signal-conditioned outputs.

**Examples include:**

- Excitation range
- Signal output
- Electromagnetic interference (EMI) performance
- Improved thermal performance over specified temperature range



### ENCLOSURE

The enclosure serves an important function in protecting the transducer's electronics and sensing element from the operating environment (e.g. moisture ingress and EMI shielding). In most cases, Setra Application Engineers can work with you to find a good fit for your application. For special demanding applications, Setra can make enclosure modifications to better suit the operating environment.

**Examples include:**

- Stainless steel
- Painted or anodized aluminum
- Plastic
- Custom labels

### SENSING ELEMENT

There are many standards for electrical connections. Many of our models can be modified to accommodate a variety of standard connectors or custom wiring pin-outs. We can guide you through our available options or potentially customize the electrical connector to your specifications.

**Examples include:**

- Cable-wire connections
- Wire terminals
- Military connectors
- Industrial connectors

### PRESSURE PORT / FITTING

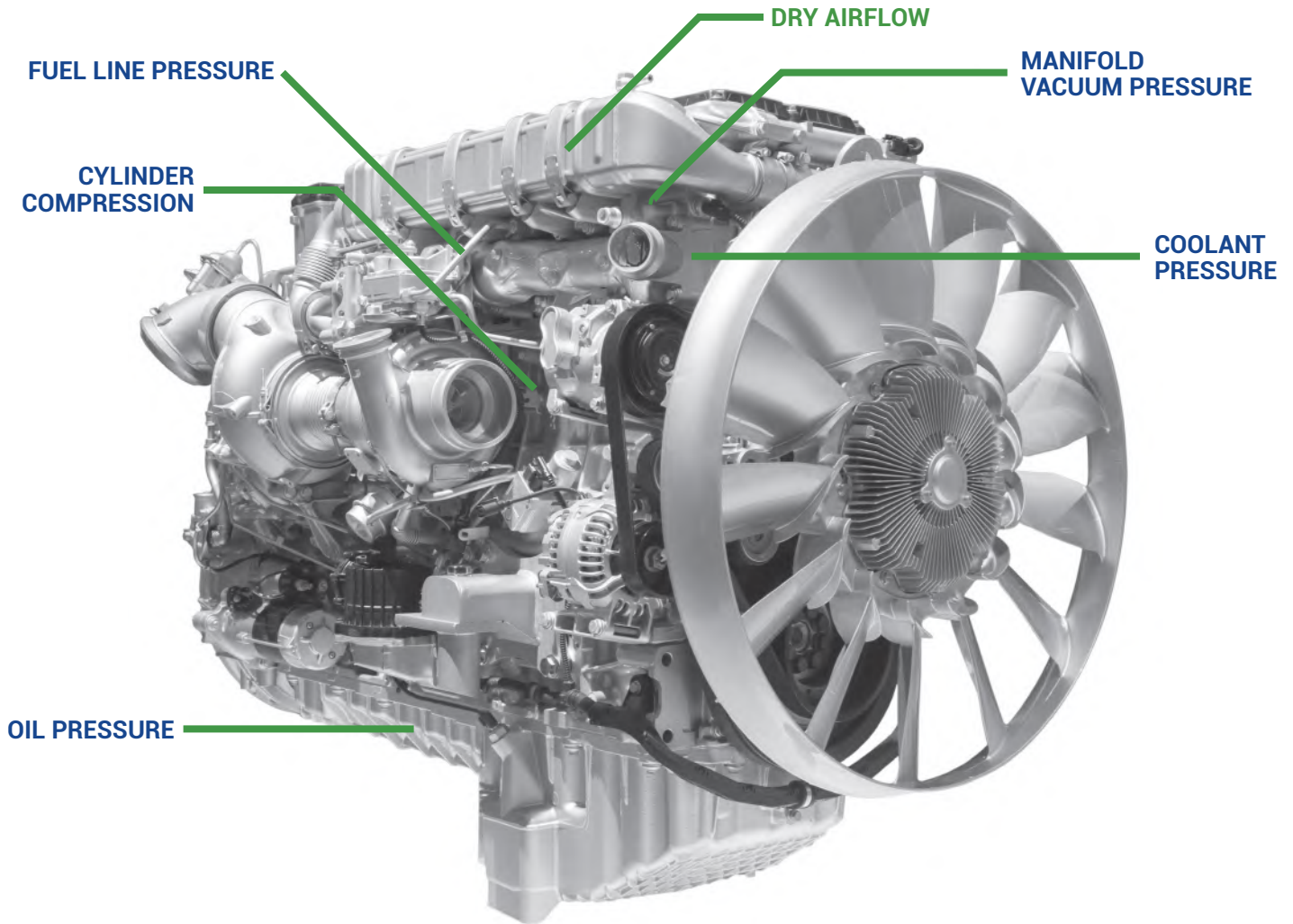
There are many ways to make a pressure connection. Call us if you cannot find your preferred pressure connector among our standard offerings. We can guide you through our available options or potentially customize the pressure port(s) to your specifications.

**Examples include:**

- Tapered threads
- Straight threads with o-ring seals
- Tube fittings
- Sanitary fittings
- Vacuum fittings

# ENGINE TEST STANDS

Engine Test Stands are complex, engineered systems designed to measure, control and record many parameters during new engine development and final verification prior to delivery. Strict legislation has made manufacturers rethink their processes and create new, innovative designs. Setra offers a wide variety of solutions to fit each pressure application on the engine test stand, empowering designers with the information and ability to ship the best product possible to the end customer.



**MODEL ASM**



**MODEL ASL**



**MODEL 270**





## OHV EMISSIONS

When the full inventory of older non-road engines are replaced by Tier 4 engines, annual emission reductions are estimated at 738,000 tons of NO<sub>2</sub> and 129,000 tons of PM. By 2030, 12,000 premature deaths would be prevented due to the implementation of the proposed standards.

TEST TYPE	APPLICATION OVERVIEW	PRESSURE TYPE	Model ASM	Model ASL	Model 270	SENSOR CHARACTERISTICS
<b>OIL PRESSURE</b>	Proper oil pressure is necessary in an engine to ensure that all moving parts are properly lubricated to prevent any component failures or engine seizures.	Gauge	<b>X</b>			High Overpressure Capability High Accuracy Chemical Resistivity Long Term Stability
<b>COOLANT PRESSURE</b>	Engine temperature is a key component in prolonging the life of engine components. The coolant system is responsible for distribution of coolant during the test.		<b>X</b>			
<b>FUEL LINE PRESSURE</b>	Internal combustion engines use different fuels to make them run, monitoring the fuel line pressure allows for calculations for efficiency and control of fuel delivery.		<b>X</b>			
<b>CYLINDER COMPRESSION</b>	Allow for detection of any defects in piston rings, bores & valves during testing.		<b>X</b>			
<b>PRESSURE DECAY</b>	Overall system leak-rate test to ensure there are no missing O-rings, gaskets or any other valve issues or system leaks.		<b>X</b>			
<b>MANIFOLD VACUUM PRESSURE</b>	This measures the amount of restriction of airflow through the engine. Accurate measurements enable calculations to see the unused power capacity in the engine.	Vacuum	<b>X</b>			
<b>DRY AIRFLOW</b>	Measuring the back pressure in the engine while knowing the crankshaft position, enables the test stand to recognize missing main bearings or plugged oil cavities.	Differential		<b>X</b>		
<b>BAROMETRIC REFERENCE</b>	Barometric sensors play a key role in the data gathered by a test stand. The sensor reads real-time barometric pressure that can be used for calculations and performance comparisons	Absolute & Barometric			<b>X</b>	

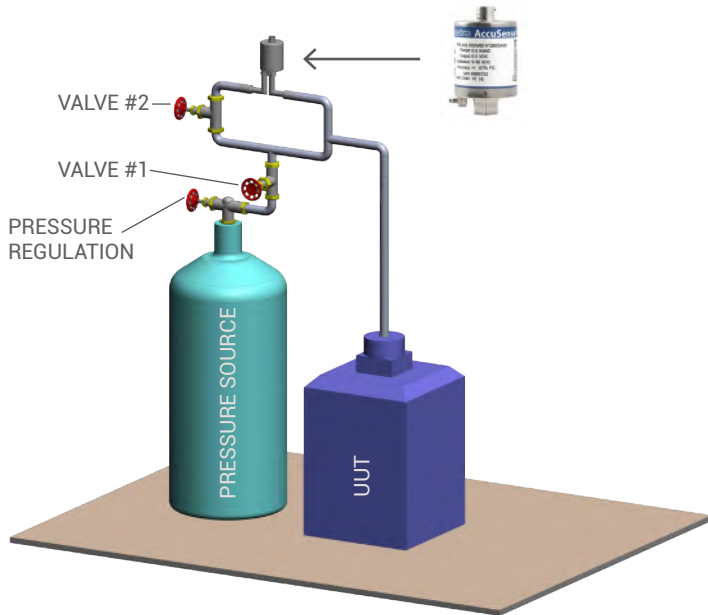


# PRESSURE DECAY LEAK DETECTION

Leak Detection is a critical test conducted to ensure quality material is being processed at each stage of the manufacturing process. Pressure decay leak detection is a trusted method for sensing small leaks in a variety of applications. The differential pressure method enables the system to test for very small leaks in filters and luer activated IV valves while the gauge pressure method enables a system to test at higher line pressures with larger leak rates on housings, engine components, etc. Setra's products offer industry leading overpressure specifications and high accuracy to exceed the needs of these demanding applications.

Pressure decay can be done using a differential system design, like Figure 1, or with a single point gauge design, like Figure 2. Incorporating either of these designs in a manual or fully automated system will increase product quality while minimizing costly returns and damaging customer complaints.

## DIFFERENTIAL PRESSURE METHOD: FIGURE 1



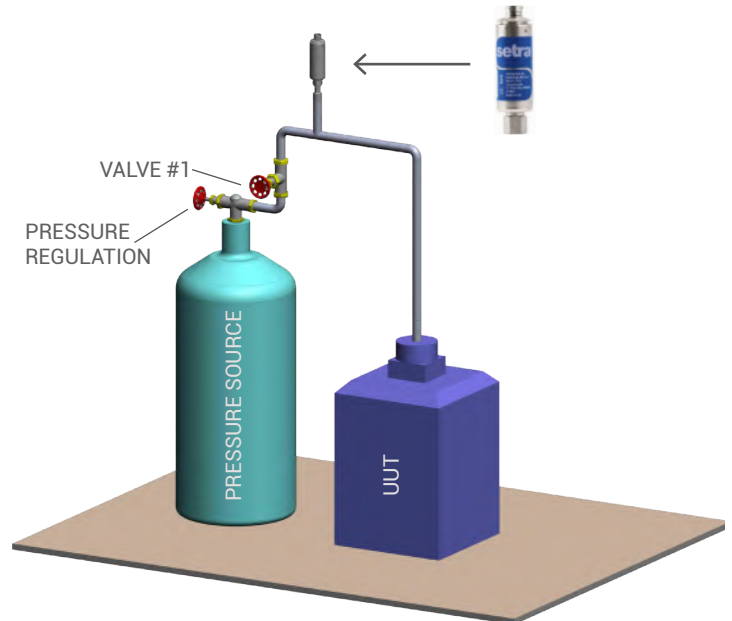
### APPLICATION OVERVIEW

This method utilizes a differential pressure transducer to read the pressure between a unit under test (UUT) and a sealed volume.

### ADVANTAGES

Low full scale pressure range sensors result in high resolution making this method ideal for low leak-rate applications.

## GAUGE PRESSURE METHOD: FIGURE 2



### APPLICATION OVERVIEW

This method utilizes a gauge pressure transducer to read the pressure between a unit under test (UUT) and the atmospheric pressure.

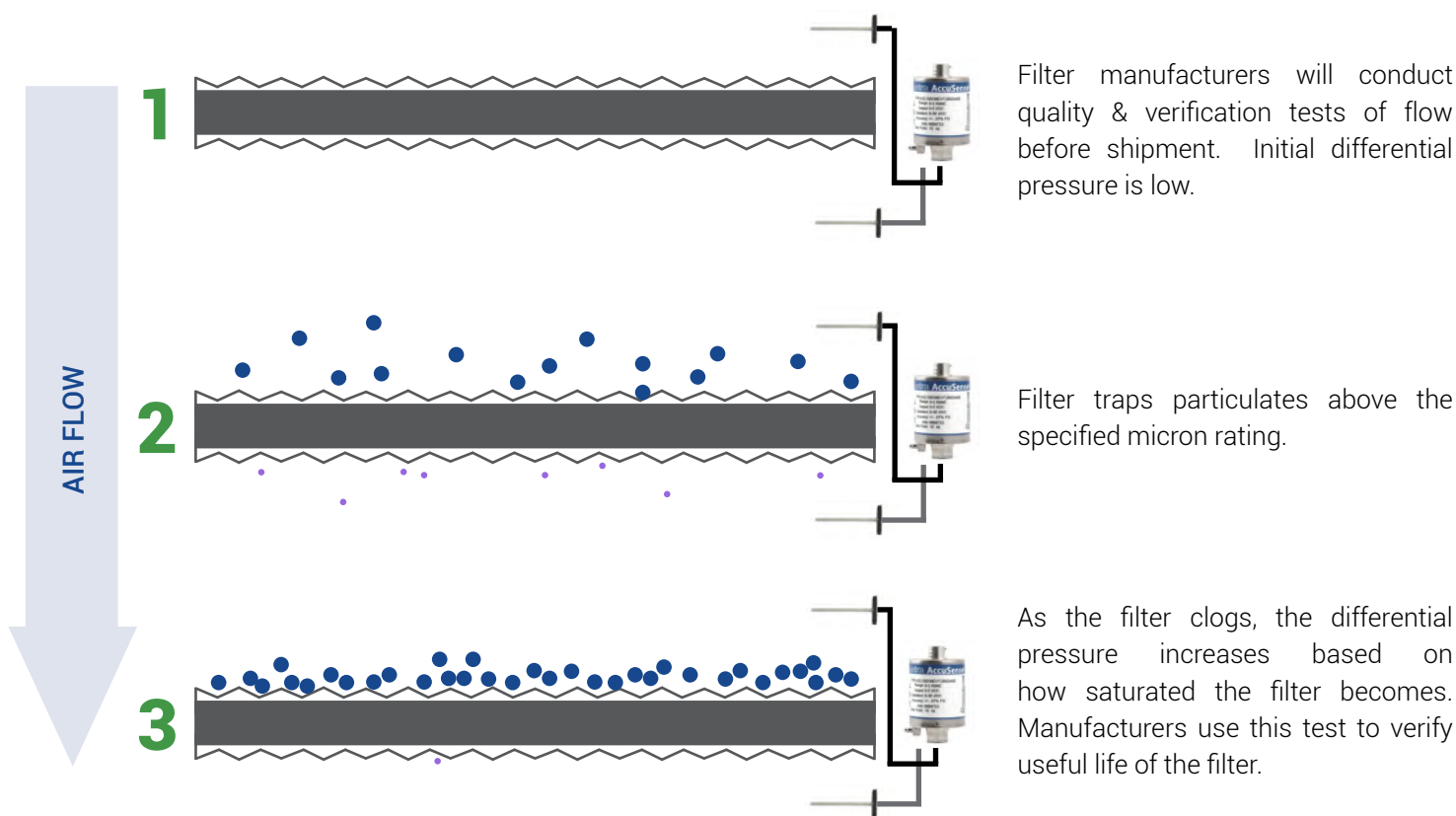
### ADVANTAGES

This method simplifies the test setup by reducing leak points allowing the sensor and test pressure to be matched. This method is ideal for high leak-rates applications.

# FILTER TEST STANDS

Filters are used in multiple applications in a variety of industries. Millions of dollars are spent developing and manufacturing products for the pharmaceutical, chemical, and automobile markets that mandate filtration to meet regulatory or performance requirements. The job of the filter is to reduce particulate matter (PM) from entering or leaving a space, being inhaled by an associate working in a hazardous environment or from entering a critical area of a machine or process. Setra's products have the ability to accurately measure both low (<1" W.C.) and high (up to 10,000 PSI) test pressure which can aid designers in the development of new filter concepts and performance verification.

## 3 STEPS OF FILTER LIFE-CYCLE TESTING



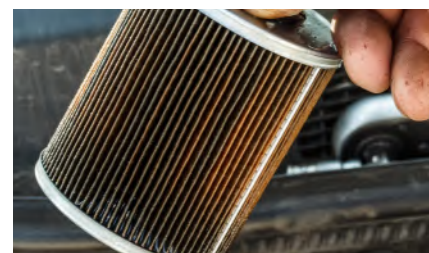
### HEPA FILTERS

High Efficiency Particulate Air (HEPA) filters are utilized across laboratories, pharmaceutical and other critical environments to prevent particulates from entering a clean space or to prevent harsh contaminants from leaving a space.



### PARTICULATE RESPIRATORS

Particulate respirators (gas masks) are used across applications in both the commercial and governmental sectors. This equipment is used to protect the user against harmful particulates and gases that are present during a required task at a job.



### OIL FILTERS

Oil filters play a critical role in how an engine operates. The job of the filter is to remove impurities in the oil before they reach the engine. Without a filter, those impurities would cause premature wear to a critical engine components.

# POROSIMETRY & SURFACE AREA SYSTEMS

Understanding pore size and surface area of any material is critical to producing high quality products. Gas Sorption is a technique used to calculate and measure those characteristics to maximize the effectiveness of the material. This method is based on van der Waals theory of attraction: the sum of attractive forces between molecules other electrostatic or chemical bonds. Setra's products provide real-time reassurance data of varying gas concentrations in the sub-atmospheric environments of the chamber. The results of a gas sorption analysis aid in the design on products across many industries.

## PHARMACEUTICALS



### APPLICATION OVERVIEW

Pharmaceutical manufacturers spend millions of dollars on the development of new medications to improve the quality of life and fight disease for patients around the world. The physical design of a capsule or tablet is equally as important as the chemical makeup of the medication itself.

### ADVANTAGES

Knowing the porosity and the surface area of the capsule or tablet will improve production efficiency, purity and the body's ability to absorb the medication.

## COATINGS



### APPLICATION OVERVIEW

Coatings are used around the world in many different applications; from adding colorant to improving wear and chemical resistivity. Coatings increase product life and performance of many products we use everyday.

### ADVANTAGES

Measurements of surface area and porosity of colorant & filler let designers know that adjustments need to be made to improve the texture, flow and adhesion of coatings to a given surface.

## CERAMICS



### APPLICATION OVERVIEW

Ceramics are used worldwide for the production of high temperature isolators, brake pads, resistors, and dinner wear. Each application has varying specifications to meet the needs of the end user.

### ADVANTAGES

Porosity and surface area measurements allow designers to determine bonding and curing times of the material to ensure the final product meets the required appearance, density, strength and texture performance specifications.

**SENSOR  
CONSIDERATIONS**

Chemical Resistance • Low Vacuum Ranges  
High Accuracy

# 4 STEPS OF GAS SORPTION

1



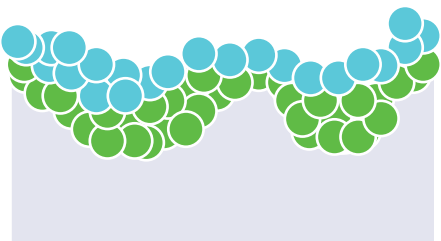
At low pressure, isolate the sample to allow adsorption of gas molecules.

2



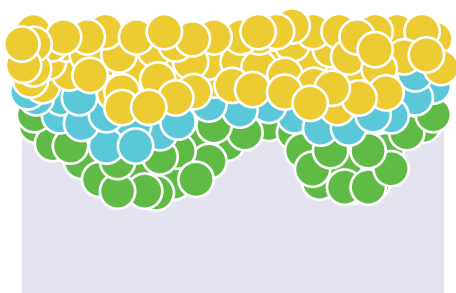
The sample begins to adsorb more molecules, creating a layer of gas that is one molecule thick, a Monolayer.

3



The gas molecules will then build on the Monolayer filling in smaller pores.

4



The gas molecules completely cover the surface, filling all pores.

INCREASING PRESSURE

## ABOUT THE SENSOR



### HIGH PERFORMANCE

The 730 uses a tensioned diaphragm variable capacitance sensing element for demanding industrial vacuum and semiconductor applications. The 730 utilizes high frequency electronics and yields extremely low noise while maintaining the fast response time required for critical control applications.

### TRUE DIRECT PRESSURE MEASUREMENT

Unlike some other vacuum sensors which infer pressure from other physical parameters of the process gas, the 730 measures actual pressure, force per unit area, independent of the gas mixture in the process.

### INCONEL® WETTED PARTS

The 730 employs an all welded, Inconel® wetted parts sensor for compatibility with virtually all process chemicals. Inconel® is highly resistive to the corrosive media used in industrial vacuum and semiconductor processes.

# TEST & MEASUREMENT



## CELEBRATING 50 YEARS

Founded in 1967, Setra Systems, Inc. is a leading designer and manufacturer of pressure, acceleration, and weight sensing devices. Setra's founders, Dr. Y.T. Li and Dr. S.Y. Lee, were co-developers of the variable capacitance transduction principle, the innovative force sensing technology which is the heart of Setra's products.

## MADE IN THE USA

Since our founding, we have been proudly producing all of our transducers for sale in the United States at our 100,000 sq. ft. Boxborough, MA facility. Setra is an ISO 9001-2008 certified manufacturer with robust and mature processes at work to continually optimize team performance.

## DISCIPLINED BUSINESS MODEL

Setra is part of the Fortive group of companies, a diversified industrial growth organization based in Everett, Washington, with 24,000 employees worldwide. The Fortive Business System (FBS) is the cornerstone of our culture and our ultimate competitive advantage. It drives every aspect of our work, our strategy and our performance. We use FBS to guide our decisions, measure how well we execute and develop innovative ways to do even better.

PREMIUM SENSING SOLUTIONS



MADE IN THE USA



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