

## Application Spotlight: Advancing Endoscopic Devices with Sensor Technology

### THE NEXT GENERATION OF ENDOSCOPY DEVICES

As minimally invasive diagnostics and interventions grow in demand, endoscopy has become a cornerstone of modern medicine across fields such as gastroenterology, pulmonology, and cardiology. Traditionally reliant on visual feedback, conventional endoscopic devices lack the ability to deliver real-time physiological data, limiting diagnostic accuracy and patient outcomes. The market is trending toward single-use endoscope platforms due to the challenges and risks associated with reprocessing traditional devices, emphasizing the need for innovative, disposable solutions. Millar's advanced sensor technology, renowned for its high accuracy, miniaturization, and reliability, addresses this gap by enabling the next generation of endoscopic devices with real-time pressure, pH, and other physiological measurements.

### ENDOSCOPY CHALLENGES

The effectiveness of endoscopic procedures is often hindered by several challenges:

- **Limited Real-Time Data:** Traditional endoscopes focus primarily on visual assessment and often lack real-time physiological data, limiting diagnostic accuracy.
- **Precision Limitations:** Precise navigation and monitoring within the human body require sensors that can operate in challenging environments with high reliability.
- **Patient Safety and Comfort:** There is an ongoing need to make procedures less invasive and reduce patient recovery time.
- **Growing Complexity of Procedures:** As more complex procedures become feasible through endoscopy, there is a need for enhanced real-time data to ensure accuracy and prevent complications.

### ENDOSCOPY APPLICATIONS



#### GASTROENTEROLOGY

In gastrointestinal endoscopy, accurate pressure measurements within the esophagus, stomach, and intestines aid in diagnosing disorders such as GERD, achalasia, and motility disorders.



#### PULMONOLOGY

Endobronchial ultrasound (EBUS) procedures, used for lung cancer staging and diagnosing various pulmonary conditions, benefit from integrated sensors that provide pressure and flow data.



#### CARDIOVASCULAR

For transesophageal echocardiography (TEE) and other cardiovascular endoscopic procedures, sensors measure intracardiac pressures and blood flow velocity, enabling real-time adjustments and a greater understanding of patient hemodynamics during interventions.



#### UROLOGY/GYNECOLOGY

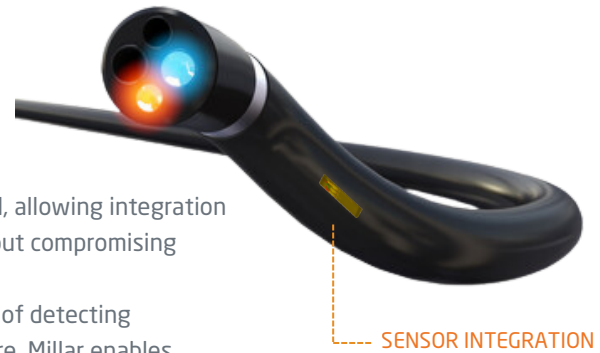
Real-time pressure monitoring enhances procedures like ureteroscopy or hysteroscopy by providing immediate feedback on tissue resistance, which helps avoid accidental damage to delicate tissues.

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## MEMS SENSOR TECHNOLOGY

Millar's sensors are designed with unique attributes that make them highly suitable for integration into endoscopic devices:

- **Miniaturization:** Millar's sensors are incredibly small, allowing integration into the narrow confines of endoscopic tools without compromising functionality or usability.
- **High Precision and Accuracy:** With sensors capable of detecting minuscule changes in pressure, pH, and temperature, Millar enables precise readings in sensitive applications.
- **Real-Time Data:** Millar's sensors provide immediate feedback on physiological metrics, which is essential for real-time decision-making during procedures.
- **Durability and Reliability:** Designed for the medical field, Millar's sensors offer durability even under the challenging environments encountered in endoscopy.



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## MEMS SENSOR OPTIONS

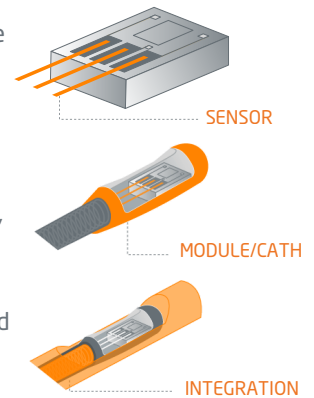
The proper selection of a MEMS pressure sensor is critical to successful integration, functionality, and manufacturability. Factors such as size, configuration, and gauge or sealed options must align with the application's specifications and required standards. Choosing the optimal sensor from the start not only ensures compliance but also provides significant cost savings.

Millar's MEMS sensors, produced in-house at our state-of-the-art microfoundry, offer high-quality off-the-shelf solutions designed to meet a wide range of application needs, with sensors ranging from 1F (0.014") to 3F (0.039"), in size. Our microfoundry serves as the heart of our sensor development process, tailoring solutions for small to medium-sized device manufacturers through end-to-end MEMS pressure and pH sensor design, fabrication, integration, and full-volume manufacturing. In addition to our off-the-shelf sensors, we specialize in custom-designed solutions tailored to meet our customers' specific requirements.

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## SENSOR ENCAPSULATION AND INTEGRATION

Encapsulation and integration of the sensor are critical to the performance of the sensor and ultimately, the device. While the raw sensor specs may meet the requirements of the device usage and application, improper encapsulation could result in higher drift and lower accuracy of pressure measurements. There are also unique challenges to consider during wire stringing and attachment to the sensor. The miniaturization of medical sensors requires working with small wires, such as 50 AWG, and must be handled carefully. Some devices may be more suitable to wall mounting the sensor while others perform better integrated directly into the device. Testing for biocompatibility and electrical leakage or fluid ingress in initial stages can ensure a higher rate of success for long-term commercialization.



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## MILLAR'S INTEGRATION PROCESS

While sensor integration can be a challenging path to navigate, Millar provides unique partnership opportunities to help guide companies through the process. Millar utilizes a staged approach to help confirm technology compatibility and long-term benefits of a continued partnership. Through feasibility studies, fit for purpose solutions and production of prototypes, Millar is quick to solve integration challenges and provide recommendations for the best path forward. With over 55 years of sensor integration expertise and a dedicated engineering team, Millar is the partner of choice to bring new MEMS sensor enabled medical devices to life.