

## Protection, condition and combustion monitoring

Power generation relies on high-value turbomachinery. Protecting and monitoring these assets is essential to reducing unexpected failures, maintenance costs, repair and overhaul time and spare parts inventory.

# A COMPLETE SOLUTION

### Intelligent systems

With one common data visualization, event management and diagnostic platform, plant operators can choose the system or combination of systems that suit the requirements of a given plant.

#### Centralized **VM600**

VM600 system can provide integrated turbomachinery protection, condition and advanced performance monitoring in a single 6U high 19 inch rack. It is a digital, modular and scalable hardware and software solution for plant usage optimization from a single advanced, flexible system. Each VM600 system can be easily configured to meet the specific needs of each application with transducer inputs from accelerometers, dynamic pressure sensors, proximity probes, and velocity, temperature and air gap sensors. These inputs are analyzed to monitor shaft vibration (relative and absolute), displacement, eccentricity, oil pressure, absolute vibration, speed, expansion (absolute, differential and casing) and combustion dynamic pressure. VM600 is SIL 1 rated.



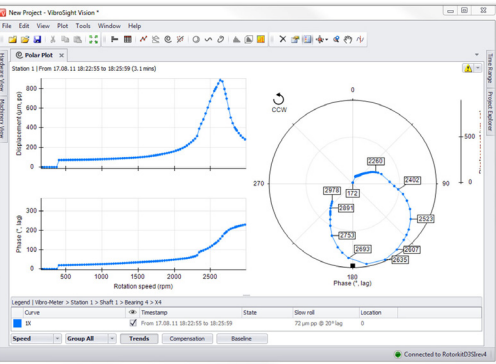
#### Distributed **VibroSmart®**

Our next generation distributed monitoring solution offers the same rock-solid safety assurance as our centralized solution, but with ATEX Zone 2 (Class I Division 2) certified modules that can be mounted directly on machinery. This simplifies installation and reduces the need for low-noise cabling, resulting in savings of up to 30%. The VibroSmart system of modular and scalable products is highly flexible. It supports all sensor types and uses real-time Ethernet technology to communicate and deliver API-standard machinery monitoring functions.



#### Visualized **VibroSight®**

The software platform through which data from both platforms are visualized, trended and analyzed. Sensor data is fed through VM600 and VibroSmart's advanced monitoring and diagnostic functions, enabling informed decisions on all aspects of power plant management. Its open architecture makes it easy to expand the system and integrate additional data with existing monitoring functions.



# GAS TURBINE MONITORING CAPABILITIES

### Machinery protection

Regulations usually dictate that power plants install protection systems to monitor and measure the events that cause a change in the level—or behavior—of vibration from critical rotating machines. Should a breakdown threaten, our system would initiate a shutdown within a fraction of a second.

### Condition monitoring

To cut the cost of unscheduled maintenance, unnecessary inspection and trouble-shooting, system operators must anticipate wear and tear and recognize incipient failure conditions. That's why, when planning operations, maintenance and inventory, they come to Meggitt for the latest sensing and condition-monitoring tools.

### Combustion monitoring

Modern gas turbines curb emissions of harmful, ozone-forming greenhouse gases and NO<sub>x</sub> through advanced combustor designs, a by-product of which involves combustion-driven pressure, heat release and flow rate oscillation which can damage the turbine package, adversely affecting performance. Our unique turnkey system aids active protection, alerting control systems to the signs of instability through variation in pressure amplitude and discrete frequencies observed within designated frequency range bands.

Combustion monitoring enables continuous output to control systems enabling engineers to determine the cause of instability or high emissions and undertake remedial action such as adjusting gas and air mixes and combustion sequencing.

### Performance monitoring

Performance limitations have a direct effect on operating costs and the production output. VibroSight online thermodynamic performance monitoring and analysis solution provides continuous tracking of equipment condition and enables corrective action when degradation is detected. Sophisticated algorithms enable the users to easily determine machine efficiency and if there has been a loss of efficiency and/or capacity.

**Meggitt is the world's leading provider of high-performance, highly-reliable sensing and monitoring solutions for extreme environments.**

Whether you need to replace monitoring equipment such as accelerometers and dynamic pressure sensors, add condition and performance monitoring capabilities or even upgrade your entire protection and monitoring package, Meggitt provides complete solutions to meet your needs. Our products are known for the quality and reliability that is required to keep your critical power generation machinery operating safely and efficiently.

Meggitt makes hardware, software, sensors and related equipment to monitor all major gas turbine power systems.

- › Alstom
- › Ansaldo
- › GE
- › Mitsubishi
- › Pratt & Whitney
- › Rolls-Royce
- › Siemens
- › Zorya-Mashproekt

### Meggitt PLC

Headquartered in the UK, Meggitt PLC is a global engineering group specializing in extreme environment components and smart sub-systems for the aerospace, defense and energy markets.

The group's growing presence in energy is driven by our core fluid controls, heat management and sensing and monitoring capabilities, many of which are deployed to help reduce maintenance costs, fuel consumption and carbon emissions and industrial gas turbines.

### Meggitt Sensing Systems product lines

- Endevco®
- Sensorex®
- Vibro-Meter®
- Wilcoxon Research®

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### Meggitt Sensing Systems

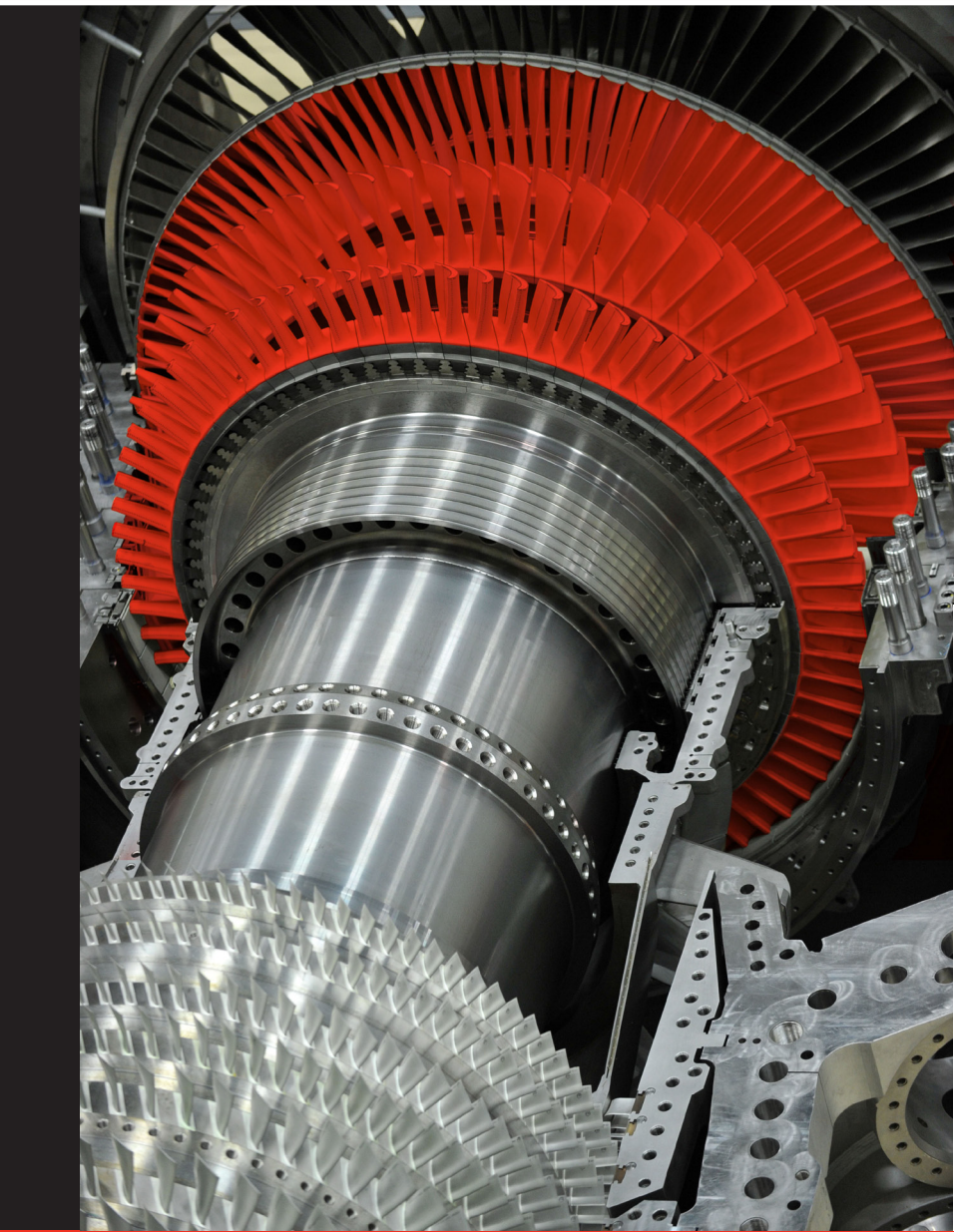
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**MEGGITT**  
smart engineering for  
extreme environments

# GAS TURBINE SENSING AND MONITORING



Meggitt sensors and systems have been the choice of turbomachinery manufacturers and users for years, and are often sold together with the turbine. As a result, Meggitt can provide direct, drop-in replacements for most transducers currently in the field and upgrades to your entire monitoring system.



# SENSOR SYSTEMS

After decades working with the world’s turbine manufacturers and power plant integrators, Meggitt has developed one of the widest ranges of active sensors for extreme environments. Today, we monitor virtually every parameter with the extreme environment sensors necessary to provide detailed information on equipment condition.

With field-proven MTBFs as high as one million hours, they are the foundation on which to integrate the advanced diagnostic tools that help users with the prognostics needed to turn data into explicit maintenance actions and monitoring into active management of system condition.

### Accelerometers

Meggitt offers a variety of high reliability accelerometers through our well known Vibro-Meter®, Endevco® and Wilcoxon Research® product lines, all with industry leading MTBFs that are typically several times greater than competitors’ products. Some accelerometers, such as the Vibro-Meter CA series, operate in the charge mode and work in the most severe and highest temperature environments, while others, such as the CE sensor series, include integrated electronics and are hence more economical and simpler to integrate.

Meggitt offers a wide range of sensors with options to suit every application

- sensitivities from 10 to 100 pC/g and 10 to 500 mV/g
- maximum operating temperatures from 120° to 700°C
- frequency ranges as low as 0.05 or as high as 20,000 Hz
- explosion proof certification

### Pressure sensors

Dynamic pressure monitoring is key to optimizing NO<sub>x</sub> emissions while maintaining ideal fuel efficiency. Meggitt’s dynamic pressure sensors, the CP series from the Vibro-Meter line and the 522 series from the Endevco line, are qualified by most major gas turbine manufacturers for combustor pulsation monitoring and offer the highest reliability in the extreme temperature of modern gas turbine combustors. The GaPO<sub>4</sub> (gallium phosphate) piezoelectric material used ensures outstanding thermal behavior (no pyro-electricity) and virtually constant sensitivity. Our acceleration compensated patented technology has

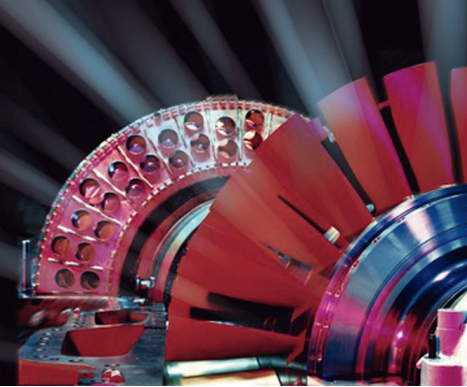
- the highest sensitivity in the industry, over 750 pC/bar
- extreme temperature capability with continuous operation up to 777°C
- high overload capability, up to 350 bar
- explosion proof certification

Meggitt’s dynamic pressure sensors lead the industry in combustion monitoring and, in conjunction with the VM600 system, provide a complete retrofit combustion monitoring system.

### Proximity transducers

Meggitt’s Vibro-Meter TQ series eddy current transducers make contactless measurements in gas turbines and turbo-compressors, including shaft relative vibration, radial or axial displacement, differential expansion, thrust and eccentricity. We offer a wide variety of performances to meet any need and Meggitt can provide direct drop-in replacements for most any proximity transducer currently in the field.

- voltage and current transmission (for long distances)
- -40° to 180°C
- a variety of measurement ranges, from 2 to 22 mm
- explosion proof certification and API 670 compliance



### Velocity sensors

The Vibro-Meter CV series measures absolute vibration down to very low frequencies, thanks to the conditioner’s low frequency linearization function. Instead of integrating an acceleration signal, the CV sensors measure velocity directly, enabling ultra low-noise monitoring at low frequencies.

### Barriers for explosion proof sensor chains

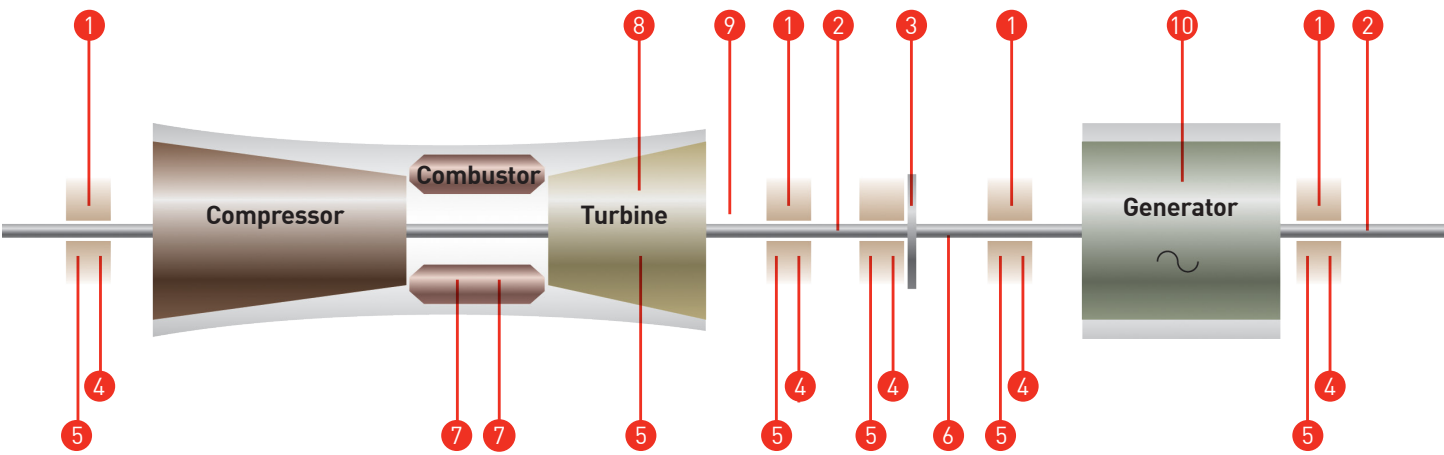
Many Meggitt sensors are certified to be explosion proof (Class I Zone 0). As an expert in the field of smart engineering for extreme environments, Meggitt designs sensors for safe operation by eliminating potential sources of ignition, such as an electrical spark or a hot surface. Our complete solution includes galvanic separation units, which power the sensors while isolating them in hazardous areas.

- Meggitt also offers sensors and safety barriers for use in Class I Division 1 (Zone 0 or 1), also called intrinsically safe, and Class I Division 2 (Zone 2) hazardous areas.



### Signal conditioners

Meggitt’s signal conditioners convert the charge-based signal from a transducer into a current or a voltage signal proportional to the measurement for direct interface with all available machine protection and condition monitoring systems.



- |                                   |                                |                      |
|-----------------------------------|--------------------------------|----------------------|
| 1 Absolute vibration              | 4 Static (oil) pressure        | 8 Blade health       |
| 2 Relative shaft vibration (x, y) | 5 Temperature                  | 9 Emissions          |
| 1 + 2 Absolute shaft vibration    | 6 Speed                        | 10 Partial discharge |
| 3 Shaft position, displacement    | 7 Dynamic (combustor) pressure |                      |

# RELATED EQUIPMENT

Meggitt offers complete systems for gas turbine and generator monitoring, as well as the important assets that support your entire operation. This includes a comprehensive subsystem integration capability to assist you in the design, development and integration of your complete solution.

### Cable assemblies and transmission cables

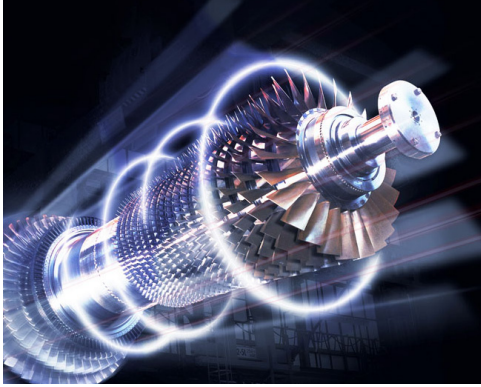
Meggitt offers cable assemblies for all sensor types and system requirements. Robust cables from our diverse Endevco, Vibro-Meter and Wilcoxon Research lines are offered in a variety of configurations and can be customized to any length, with a wide selection of connectors to meet almost any system requirement.

### Balance-of-plant

In addition to gas turbine monitoring, Meggitt solutions increase uptime for balance-of-plant equipment. Meggitt systems can be used to monitor large pumps, compressors, fans and electric motors, complemented by a full line of Meggitt’s Wilcoxon Research industrial vibration sensors. Our complete line of Wilcoxon Research 4-20 mA vibration sensors also provides continuous, simplified condition monitoring utilizing your facility’s existing process control systems, such as a DCS.

### Igniters and flame monitors

Reliability of start-up is what Meggitt’s ignition products are all about. We specialize in providing bespoke high-energy, high-tension and ATEX-certified ignition systems for large and small gas turbines. People often think an ignition system is about putting the maximum amount of power over the highest number of sparks down a cable and into an igniter. In fact the opposite is true; it’s about identifying the minimum power and least amount of sparks that will give reliable combustion, so you get the longest lifetime possible.



# SERVICE AND SUPPORT

### On-site services

Field service engineers can properly install, configure and commission systems to ensure you receive the full value and full utilization of our system capabilities. On-site troubleshooting can quickly diagnose system issues and return a system to operability, regardless of system manufacturer.

### Project management services

Tailored monitoring solutions, from design through system acceptance, ensure proper sensor selection for the application, appropriate protection criteria and data to enable effective condition monitoring.

### Diagnostic services

Meggitt can provide an objective diagnosis and recommend corrective actions to solve machinery issues over a wide range of equipment from motor driven balance-of-plant pumps and fans to main turbine generator sets and other critical assets. The remote capabilities of our condition monitoring system provide secure access to critical data for a quick response and global collaboration.

### Training

Meggitt offers comprehensive, hands-on, instructor-led training courses on all of our products and systems at Meggitt’s global training centers or your own site.

### Calibration and repair

NIST traceable certificates can be issued after factory calibration. Equipment problems will be corrected through the appropriate repair facility.