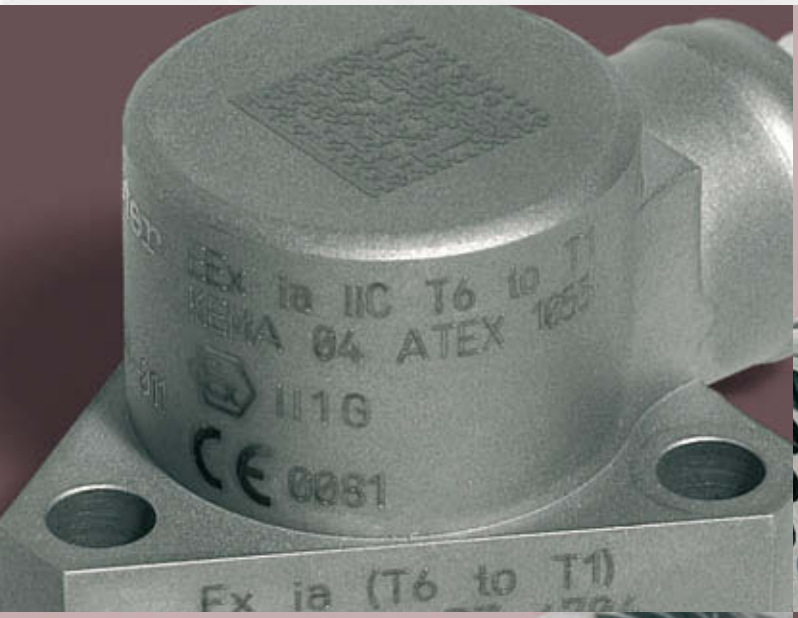
Vibro-Meter

Sensor systems for turbomachinery



Sensor systems applications

For over 50 years, Vibro-Meter has provided superior quality vibration sensing systems to monitor critical plant and equipment.

Today, our sensor systems are successfully used in numerous industries where high capital rotating machinery represents a major asset. They protect and monitor thousands of machines worldwide:

- Heavy-duty gas turbines
- Industrial and aero-derivative gas turbines
- Steam turbines (nuclear and conventional)
- Hydro turbines
- Large generators
- Large pumps, compressors and fans
- Large electric motors and propellers

Whether your business is power generation, oil and gas production, petrochemical or marine, understanding the condition of your machinery and its mechanical behavior is necessary, to prevent failure and achieve optimum efficiency.

We make it our business to provide the best solutions for your measurement and monitoring requirements, to protect your investment. This helps you reach higher levels of reliability, machine availability and output.

Today, our highly reliable sensor systems for harsh environments are adopted by most major OEMs.

Sensor systems overview

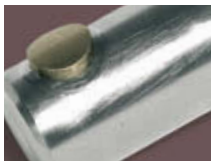
Whether measuring dynamic pressure, acceleration or displacement, Vibro-Meter offers the most accurate, reliable and cost-effective solutions available. We have a comprehensive range of sensor systems which are standard solutions with numerous OEMs.:

provide vibration measurements in harsh industrial conditions. We have a wide range of sensors with sensitivities from 10 to 100pC/g, for a wide range of temperatures:
from standard (120°C) up to extreme (700°C). The CA series work in the most severe environments, while the CE series include conditioners and are hence more economical and simpler to integrate.

are qualified by major OEMs for gas turbine combustor pulsation monitoring. The CP series use Vibro-Meter's acceleration compensation patented technology, and reach the highest sensitivity in the industry (over 750pC/bar). They have an extreme temperature capability (up to 777°C) and a very high frequency response range (up to 15 kHz).
Vibro-Meter's CP sensors are key to optimizing low NO_x emissions.

are eddy current transducers, for contactless measurements of relative vibration or axial displacement in turbines, alternators, turbo-compressors and centrifugal pumps. Our wide series of probes is API 670 compliant and available for high-pressure and watertight applications, with measuring ranges up to 12 mm.

are widely installed on all types of low speed turbomachinery, especially hydro turbine-generator sets. The CV series measure absolute vibration down to very low frequencies, thanks to the conditioner's low frequency linearization function.



detects initiation of ice on gas turbines inlets. The EW system discriminates between ice and water, and optimizes the use of bleed air in gas turbine de-icing systems.

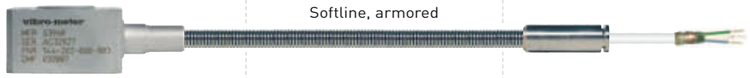
measures the air gap between rotor and stator, using a capacitive technology. LS systems are an important indicator of machine condition in hydroelectric generators.

Accelerometers with external charge amplifiers

Transducer | Cable | Ext. cable | Conditioner | Cable | Galvanic separation

CA 202

100pC/g (400g)
-55 to 260°C
0.5 to 8000 Hz



Softline, armored

For heavy duty gas and steam turbines. Piezoelectric accelerometer for use over an extended temperature range.

CA 280

100pC/g (500g)
-55 to 260°C
0.5 to 10000 Hz

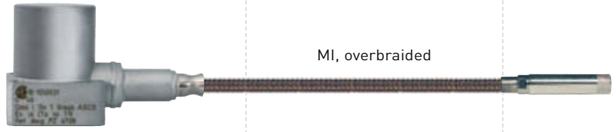
EC 222 - softline

EC 119 (390) - softline, armored

For heavy duty and aero-derivative gas turbines, gear boxes, compressors and marine applications. Multi-purpose, compact piezoelectric accelerometer for use over an extended temperature range.

CA 306

50pC/g (100g)
-55 to 500°C
5 to 3000 Hz



MI, overbraided

EC 153 - softline

For aero-derivative and industrial gas turbines. Piezoelectric accelerometer for use at high temperatures. Similar parts are standard with numerous OEMs.

CA 134

10pC/g (500g)
-196 to 500°C
0.5 to 6000 Hz

EC 069 - MI

EC 119 (390)

Softline, armored

EC 112 - MI

EC 153 - softline

For cryogenic applications and gas turbines. Piezoelectric accelerometer for use over a very wide temperature range.

CA 901

10pC/g (500g)
-196 to 700°C
3 to 3700 Hz

MI

EC 153 - softline

For heavy duty gas turbines. Piezoelectric accelerometer for use at extreme temperatures. Similar parts are standard with numerous OEMs.

IPC 704 in ABA 160

K2xx (3xx)

2 or 3-wire transmission

GSI 124

IPC 704 conditioner

- Signal conditioner for CA and CP sensors
- Configurable high and low-pass filters. Freq. range 0.5 Hz to 20 kHz
- Optional integrator for a velocity signal output
- Optional 2-wire current or 3-wire voltage transmission
- Ex certified versions

ABA 1xx industrial housings

- Protection against mechanical damage, water and dust (IP66 class)
- Several models and configurations, suitable for 1 up to 10 conditioners
- Diecast polyester or aluminium enclosure, fully insulated and corrosion-resistant
- Ex certified versions

GSI 124 galvanic separation unit

- Power supply for 2-wire transmission systems installed in potentially explosive environments
- AC signal transmission over long distances (1000 m)
- Galvanic separation, 4 kVRMS
- High rejection of frame voltage
- DIN-rail mounting
- Ex certified versions

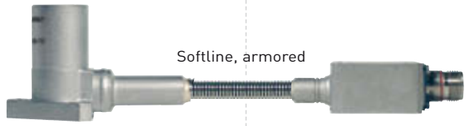
MI = Mineral integral
Certified products versions for use in potentially explosive atmospheres are available.

Accelerometers with built-in or attached electronics

Transducer | Cable | Ext. cable | Junction box | Cable | Galvanic separation

CE 134

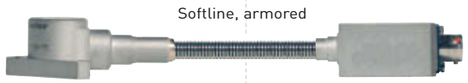
5µA/g (400g)
-55 to 350°C
5 to 10000 Hz



For heavy duty gas turbines, aero-derivative gas turbines and compressors. Piezoelectric accelerometer with attached electronics, for use over an extended temperature range.

CE 281

10µA/g (200g)
-55 to 260°C
3 to 10000 Hz



For gear boxes, compressors, pumps and fans. Compact piezoelectric accelerometer with attached electronics, for use over an extended temperature range.

CE 311

50µA/g (40g)
-55 to 125°C
2 to 8000 Hz

For heavy duty gas and steam turbines. Piezoelectric accelerometer with built-in electronics, for use in industrial environments.

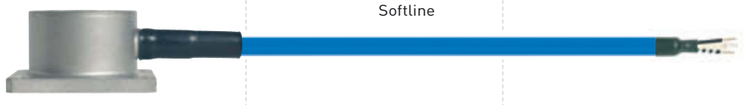
CE 680

100mV/g (80g)
-55 to 120°C
0.5 to 9000 Hz

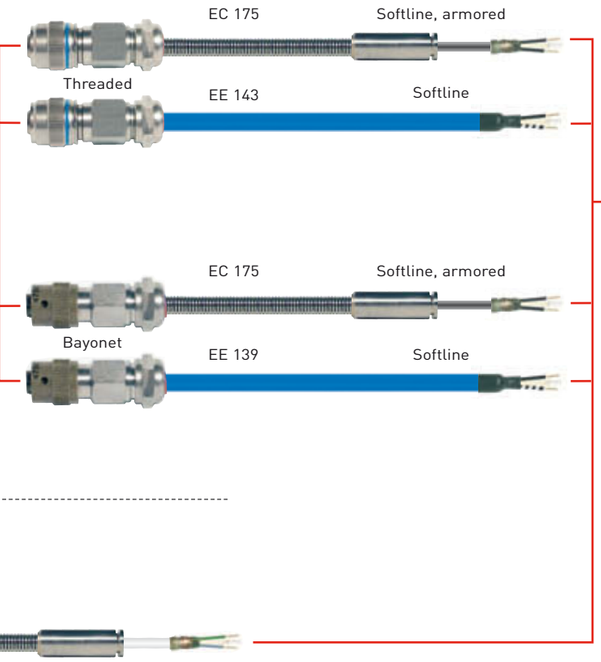
For auxiliary machines. Multi-purpose, compact piezoelectric accelerometer with built-in electronics, for use in industrial environments.

SE 120

2 mA/g (4g)
0 to 75°C
0.2 to 750 Hz



For slow speed rotating machines, hydro turbines and fans. High-sensitivity piezoresistive accelerometer.



K2xx
2-wire transmission

K2xx
2-wire transmission

JB 1xx junction boxes

- Protection against mechanical damage, water and dust (IP65 class)
- Several models available
- Diecast polyester or aluminium enclosure, fully insulated and corrosion-resistant
- Ex certified versions

GSI 124 galvanic separation unit

- Power supply for 2-wire transmission systems installed in potentially explosive environments
- AC signal transmission over long distances (1000 m)
- Galvanic separation, 4 kVRMS
- High rejection of frame voltage
- DIN-rail mounting
- Ex certified versions

MI = Mineral integral
Certified products versions for use in potentially explosive atmospheres are available.

Dynamic pressure sensors for combustion monitoring

Transducer | Cable | Ext. cable | Conditioner | Cable | Galvanic separation

CP 103

232pC/bar (20 bar)
Overload up to 250 bar
-196 to 700°C
2 to 10000 Hz

Very high temperature dynamic pressure sensor. Similar parts are standard with numerous OEMs.

MI

EC 153

Softline

IPC 704 in ABA 150

K2xx

2-wire transmission

GSI 124

CP 235

750pC/bar (20 bar)
Overload up to 100 bar
-55 to 520°C
2 to 10000 Hz

High temperature, very high sensitivity dynamic pressure sensor. Similar parts are standard with numerous OEMs.

MI, overbraided

3 x IPC 704 in ABA 151

CP 211

25pC/bar (250 bar)
Overload up to 350 bar
-196 to 777°C
2 to 15000 Hz

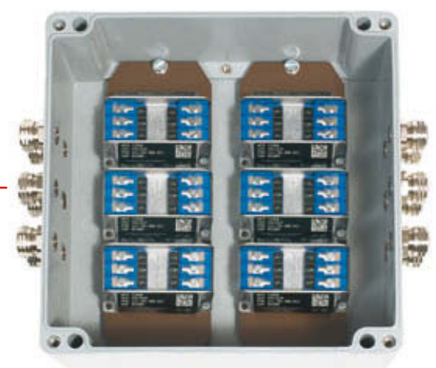
Very high temperature, compact dynamic pressure sensor. Mostly used for laboratory measurements in extreme environments.

MI

EC 119 (390)

Softline, armored

6 x IPC 704 in ABA 153



CP 216

200pC/bar (250 bar)
Overload up to 350 bar
-70 to 520°C
2 to 15000 Hz

High temperature, compact dynamic pressure sensor. Similar parts are standard with numerous OEMs.

MI

GSI 124 galvanic separation unit

- Power supply for 2-wire transmission systems installed in potentially explosive environments
- AC signal transmission over long distances (1000 m)
- Galvanic separation, 4 kVRMS
- High rejection of frame voltage
- DIN-rail mounting
- Ex certified versions

IPC 704 conditioners

- Signal conditioner for CA and CP sensors
- Configurable high and low-pass filters. Freq. range 0.5 Hz to 20 kHz
- Optional integrator for a velocity signal output
- Optional 2-wire current or 3-wire voltage transmission
- Ex certified versions

MI = Mineral integral
Certified products versions for use in potentially explosive atmospheres are available.

Proximity probes for all displacement measurements

Transducer | Cable | Junction box / protection | Conditioner | Cable | Galvanic separation

TQ 401

8 mV/µm or 2.5 µA/µm (2 mm range)
-40 to 180°C
5mm Ø tip

Softline

Softline

TQ 402

8 mV/µm or 2.5 µA/µm (2 mm range)
4 mV/µm or 1.25 µA/µm (4 mm range)
-40 to 180°C
8.2mm Ø tip

Softline

SG 101 (102)

Movable, armored

TQ 422

4 mV/µm or 1.25 µA/µm (4 mm range)
-25 to 140°C
12.7mm Ø tip
Pressure proof, 100 bar (tip)

Softline

KS 107

Flexible conduit

TQ 432

4 mV/µm or 1.25 µA/µm (4 mm range)
-25 to 140°C
12.7mm Ø tip
Pressure proof, 100 bar (tip)
Reverse mount

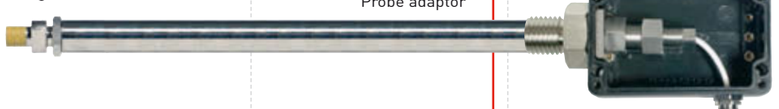
Softline

JB 118

EA 401 (402, 403)

TQ 412

8 mV/µm or 2.5 µA/µm (2 mm range)
4 mV/µm or 1.25 µA/µm (4 mm range)
-40 to 180°C
8.2mm Ø tip
Reverse mount



Probe adaptor

PA 151

EA 401 (402, 403)

TQ 403

1.33 mV/µm or 0.417 µA/µm (12 mm range)
-40 to 180°C
18mm Ø tip

Softline

TQ 423

1.33 mV/µm or 0.417 µA/µm (12 mm range)
-25 to 140°C
25 mm Ø tip
Pressure proof, 100 bar (tip)

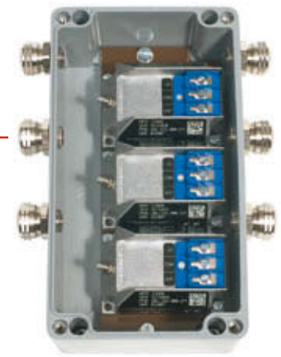
Softline

Displacement range from 0.2 to 12mm. For measuring relative vibration, axial thrust, differential expansion, and phase reference on turbomachinery. Transmission distances over 1000 m.

Various body lengths and tip diameters are standard. High pressure versions, reversible mounting, armoured cable protection and probe adapters are available. These products are compliant with API 670 standards.

IQS 45x in ABA 150

3 x IQS 45x in ABA 151



6 x IQS 45x in ABA 153

K2xx (3xx)

2 or 3-wire transmission

GSI 124

GSV 14x

GSI 124 advantages:

- See p. 7

GSV 14x safety barriers

- Power supply for 3-wire transmission systems installed in potentially explosive environments
- Wide input voltage range
- Ex certified versions

IQS 45x conditioners

- Signal conditioner matched with TQ4xx probes
- Optional 2-wire current or 3-wire voltage transmission
- Diecast aluminium enclosure
- Ex certified versions

All “softline” cables can be delivered in armored version.

Velocity sensors

Transducer | Ext. cable | Junction box | Conditioner | Cable | Controller

CV 210

50 mV / mm/s
50 µA/ mm/s
(50 mm/s)
-40 to 100°C
1 to 400 Hz

For hydroelectric generators. Low-speed velocity transducer, with stainless steel body, ideal for moist or corrosive environments.

ED 109 - softline (112 - armored)

IVC 632 in ABA 150

K2xx (3xx)

2 or 3-wire transmission

CV 213

20 mV / mm/s
(1000 mm/s)
-29 to 204°C
10 to 1000 Hz

ED 120 - softline

IVC 632 conditioner

- Signal conditioner for CV 210 velocity sensor
- Includes low-frequency compensation. Operates as low as 1 Hz (-3 dB)
- Optional 2-wire current or 3-wire voltage transmission
- 2-wire transmission over long distances (1000 m)
- Diecast aluminium enclosure

CV 214

20 mV / mm/s
(1000 mm/s)
-29 to 121°C
10 to 1000 Hz

For hydro and steam turbines. Low-speed velocity transducers, resistant to dust and moisture (IP64).

ED 121 - softline

ILS 730 conditioner

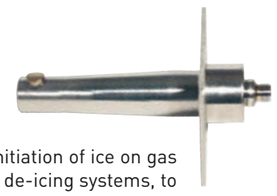
- Signal conditioner for LS air gap transducer
- Three voltage-based outputs (Pole Profile, Rotor Profile, Min. Gap). One selectable 4-20 mA output (factory setting)
- Diecast aluminium enclosure

Ice detection system

EW 140

0.2 to 2 mm ice
-55 to 120°C

For all gas turbines. Detects initiation of ice on gas turbine inlets. Used by turbine de-icing systems, to optimize the use of bleed air.



EC 119 - softline, armored

JB 116 (105)

K2xx

2-wire transmission

DIC 413

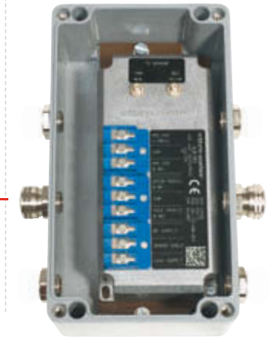
Air gap monitoring system

LS 120

2 to 33 mm
-15 to 125°C

For large hydroelectric generators. Monitors the air gap between the rotor and stator.

ILS 730 in ABA 151



K509 (709)

Certified products versions for use in potentially explosive atmospheres are available.

Complete monitoring solutions

One source

Request a complete solution from Vibro-Meter! In our Fribourg headquarters (Switzerland), more than 550 employees combine their expertise and commitment to designing and building all parts of your system: Sensors for harsh environments (measuring vibration, dynamic pressure, displacement, blade tip clearance...), high performance monitoring systems and software. Our sales and support network delivers outstanding service worldwide.

Plant asset management

Reduces the risk of failures and downtimes, enables maintenance to be planned, increase global plant effectiveness

Turbine health management

Safety, return on assets and environment impact

VM600
Protection, condition & performance monitoring

Blade tip clearance
efficiency optimization

Microwave sensors

Up to 900°C

Structural damages
combustion humming, outer segments

Dynamic pressure sensors

Piezoelectric accelerometers

Up to 700°C

Bearing
defect detection

Piezoelectric accelerometers

Proximity probes

Up to 260°C / 180°C

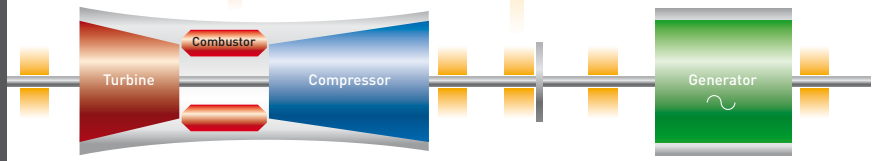
Very high

High

Standard

Turbomachinery operation

Safety, maintenance optimization, lower spare parts inventory, improved efficiency, reduced emissions



Case studies

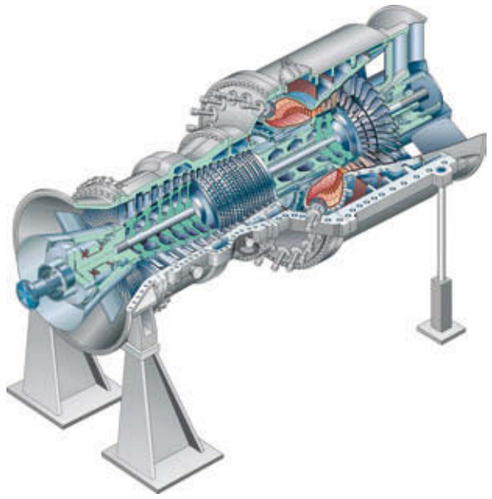
Heavy duty gas turbine: Siemens SGT5-4000F
Combustion and vibration monitoring (CP and CA sensors, with VM600)

The SGT5-4000F (V94.3A) dry-low NO_x Gas Turbine (GT) is one of the most powerful in operation, designed for large-scale applications with more than 280 MW ISO output. Vibro-Meter is the exclusive supplier of protection & monitoring equipment for this GT, Siemens' proven workhorse, with more than three hundred units in operation worldwide.

One of the major industrial challenges with heavy-duty GTs is to combine the highest possible efficiency with extremely low NO_x emissions and low combustion temperatures. Measuring the dynamic pressure at different locations in the combustor is a proven way to control combustion. Thus, pulsation monitoring systems are essential both during the GT tuning and operation.

The sensors and monitoring equipment provided by Vibro-Meter allow Siemens to control combustion parameters such as fuel injection, which leads to extremely low emissions, reduced fuel consumption and long intervals between major inspections. Our sensing and monitoring systems on the SGT5-4000F include extreme temperature dynamic pressure sensors (CP 216), high sensitivity piezoelectric accelerometers (CA 201 and CA 901) and protection and monitoring systems (VM 600).

Vibro-Meter is proud to have contributed to making the SGT5-4000F one of the most efficient available for power generation applications.



SGT5-4000F
(copyright Siemens AG)

Balance-of-plant: Yonghung Thermal Power Plant (South Korea)
Proximity, displacement and vibration monitoring (TQ and CE sensors, with VM600)

Yonghung is the largest coal fired power plant in south Korea. Each 870 MW supercritical unit is designed for variable pressure operation at 3600 RPM and 560 °C. Yonghung is designed with the philosophy of preserving the environment using a two stage combustion with low-NO_x burners followed by selective catalytic reduction.

To ensure efficient plant operation and to achieve their environmental objectives, Yonghung TPP (units 3 & 4) has 22 VM600 protection and condition monitoring systems, managing over 400 dynamic measurement points per unit. These sensors systems are provided by Vibro-Meter to secure and monitor a variety of machines for the steam turbine and the balance-of-plant in Yonghung. These include: BFP (Boiler Feed water Pump) Turbine, BFP Motor, Forced Daft Fans, Primary Air Fans, Condensate Pumps (Booster and Water), blowers and air compressors.

At Yonghung TPP, Vibro-Meter's highly reliable sensors for harsh environments measure a range of vibration and displacement characteristics. Proximity probes (TQ 402) and piezoelectric accelerometers (CE 680) measure shaft position, relative shaft vibration (x-y), rotational speed of shaft and bearing broad-band absolute vibration. Furthermore, Vibro-Meter sensors on the primary air fan enable the pre-heater system to use hot air to remove moisture from coal before the combustion process, which reduces NO_x emissions. The VM 600 protection & condition monitoring systems then processes the signals, and provide an overall data overview: this is necessary to maintain an efficient plant operation through diagnostics and plant health management.

Yonghung TPP (courtesy of Vibro Korea)

Hydro turbine-generator: Cahora Bassa Hydro Power Plant (Mozambique)
Air gap and vibration monitoring (VM600 with CE, LS, SE and TQ sensors)

The Cahora Bassa dam on the Zambezi river was completed in 1975 and renovated in 2003; its plant comprises 5 Francis turbines, with a total power of 2.1 GW. Within the renovation project, Alstom selected Vibro-Meter to provide machinery vibration, generator air gap, with a networked Protection and Condition Monitoring System.

Condition monitoring of hydroelectric generators is critically important, especially the monitoring of the distance between the rotor poles and the stator walls, called air gap. To increase efficiency in generators, the air gap is reduced to a minimum. However, both the stator and the rotor on large hydroelectric machines can be quite flexible and their shape and location are affected in operation by centrifugal, thermal, and magnetic forces. This means that the air gap can only be effectively measured whilst the generator is in service. In the absence of effective monitoring, efficiency would decrease and potential machine damage could occur.

In Cahora Bassa, each generator is equipped with a capacitive air gap measurement system (4x LS 120 sensors with ILS 730 conditioners). This on-line system is used when the machine is rotating and withstands the extremely high magnetic fields in the air gap. Furthermore, each turbo generator has piezoresistive, low-noise low-frequency SE 120 accelerometers, to measure the bearings' absolute vibrations. On rotating parts, the relative shaft vibration is performed by the Eddy Current TQ 402 proximity probes. And the stator's structural vibrations are monitored with compact piezoelectric accelerometers (CE 680). Coupled with our sensors, the VM600 protection & condition monitoring systems ensures the highest safety level during operation.

Early detection of air gap anomalies using the equipment provided by Vibro-Meter enables condition monitoring of Cahora Bassa hydroelectric generators. As a result, plant efficiency is optimized, generator damage can be avoided and operators can more efficiently predict and plan maintenance outages.

Cahora Bassa HPP
(courtesy of Hidroelectrica de Cahora Bassa)

Our expertise

Engineering

Thanks to its experienced engineers and experts, Vibro-Meter's R&D department provides our customers with the latest technology in sensing systems for turbomachinery, often used in harsh environments.

Vibro-Meter has ongoing collaborations with several renowned universities and institutes of technology. As a result of our continuous innovative effort, we own a range of patents, guaranteeing the uniqueness of our technology and know-how.

We maintain our cutting edge by using modern tools, in-house developed software and top-notch simulation and design software such as Matlab®, Simulink®, Cadence®, Allegro® and Solidworks® among others.

Manufacturing

Vibro-Meter's large and modern manufacturing facility in Fribourg (Switzerland) is designed to ensure the highest quality standards and organized to efficiently produce large scale orders as well as small batches. Already in the 80's, we introduced our first Production Planning System, to reach high quality and productivity objectives.

Sensors are manufactured from a large number of miniature, precisely-machined parts. Our experts use CNC-based equipment for precision machining, vacuum annealing, vacuum welding, argon arc welding and electron beam welding, among other techniques. To produce our electronic sub-assemblies, we invested into fully-programmable SMD assembly lines and automatic visual inspection equipment.

As a 21st century high-tech international organization, we are concentrating on strategic manufacturing processes, with the aim of increasing added value, from the point of view of the customer.

Quality management

The quality and reliability of Vibro-Meter's products have been widely recognized by customers for many years. Following our entry into the aviation sector in the 70's, a Quality System was put in place so that we could be certified by the associated customers and certifying bodies. Vibro-Meter was first certified ISO9000 in1995 and has been recertified regularly since then. Our latest BS EN ISO9001:2000 certification has been awarded in April 2007.

Today, we have a very large team of experts working for quality assurance, ensuring the quality of engineering and software, the standardisation, the calibration of equipment, qualification tests and certification.

Our quality policy applies to everything we undertake. All employees strive to consistently develop, maintain and improve our quality management system at every opportunity. External as well as internal customers are the focus of everything we do.

Since its foundation in 1952, Vibro-Meter in Fribourg (Switzerland) has been supplying reliable, high quality instrumentation for aviation and industrial customers worldwide. Vibro-Meter has been part of the Meggitt group since 1998. With its headquarters in the United Kingdom, Meggitt PLC is an international group of companies specialising in aerospace equipment, high performance sensing systems and defence.

Vibro-Meter's quality policy is fundamental to its success. The excellent reputation of our company is built on our dedication to fulfil our customers' needs, our continuous investment in technical innovation and the skills and experience of our staff.

We develop and supply engine monitoring units for new airliners produced by all leading aircraft manufacturers. For more than 30 years, our aerospace division has been the leading supplier of vibration and pressure monitoring systems for aircraft engines.

The power generation industry widely uses the complete monitoring solutions for turbomachinery offered by our Energy division. Our integrated systems are adopted by major manufacturers of gas turbines, steam turbines and water turbines.

Our international network of subsidiaries and distributors delivers outstanding support worldwide, for both our aerospace and power industry customers.

Vibro-Meter

Vibro-Meter SA
Route de Moncor 4
PO Box
CH - 1701 Fribourg
Switzerland

Tel: +41 (0)26 407 11 11
Fax: +41 (0)26 407 13 01
info@ch.meggitt.com

www.vibro-meter.com

www.meggitt.com

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smart engineering for
extreme environments