

THE LEADING TECHNOLOGY



Pressure Sensors

Miniature & High Performance

圧力センサー

小型 超小型 高性能

チタン及びステンレス構造 軽量



www.efe-sensor.com

ABOUT US

Technology and Quality



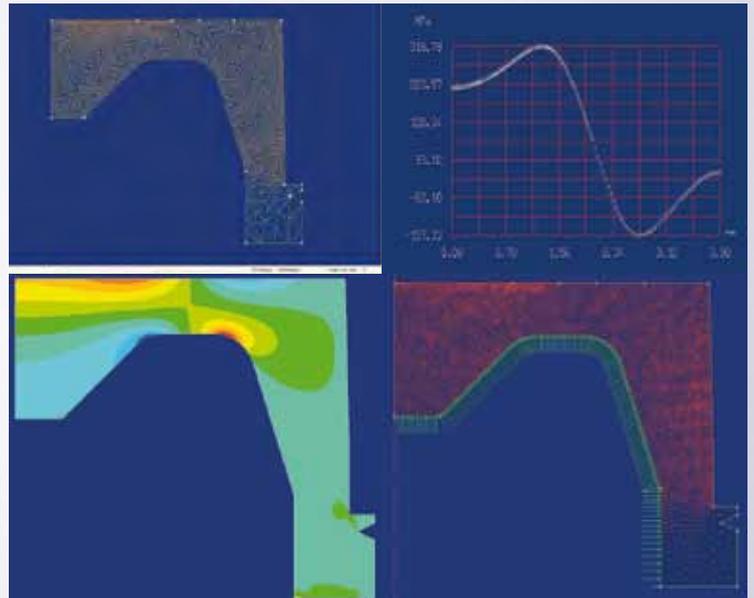
L'Essor Français Electronique (EFE) has been developing and manufacturing a complete range of pressure transducers since 1973.

During this time, we have designed our proprietary advanced sensing technologies and created a unique range of high performance and miniature pressure transducers.

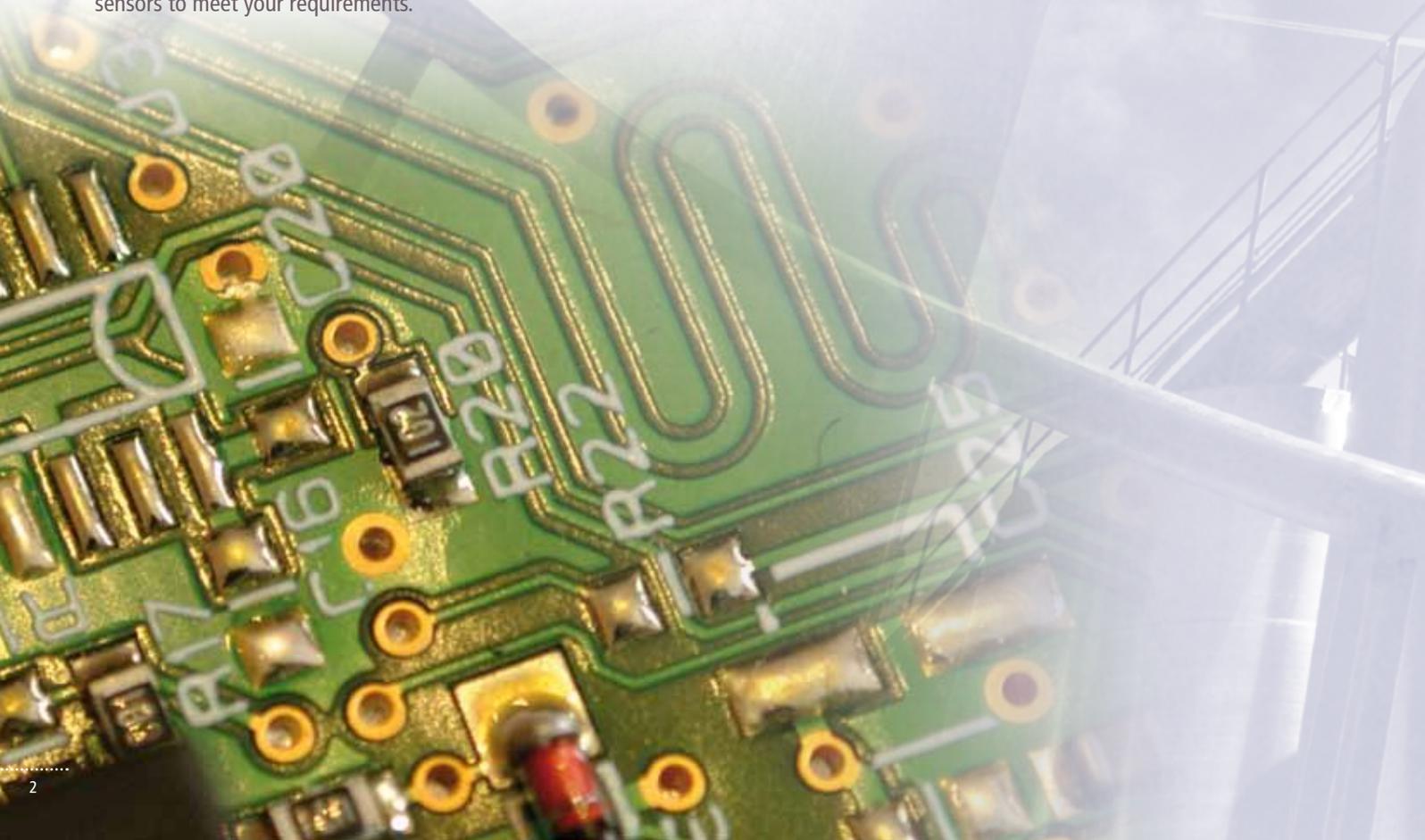
From the beginning, we have catered for customers in the aerospace, marine, military, automotive, Formula-One & Rally, nuclear, oil & gas, research sectors and numerous industrial applications. Our products are designed to be used in the most demanding operating environments and to give highly accurate and reliable measurements.

Sensors from EFE are sold in France and overseas: in Europe, the United States and Asia. Our company devotes considerable resources to research and development programs, co-operating with several research institutes, universities and schools of engineering in France.

Located 60 km west of Paris, we have over 1500 m² of research and manufacturing facilities including the most advanced automated equipment for manufacturing high performance transducers. Our Engineering Department, responsible for designing all our sensors, from sensing elements to state of the art PCBs, can also develop specific sensors to meet your requirements.



We are using the most advanced techniques and components to develop our sensors: 3D, digital simulation and finite elements software by our engineering department.





To meet our customers' high requirements, EFE decided very early on to develop its proprietary sensing technology for pressure transducers.

This technology, thin film, is manufactured mainly using a physical vapour deposit, and more precisely sputtering process on a metal diaphragm (stainless steel, titanium, inconel, hastelloy, etc.).

Thin film as used by EFE is the only technology which does not require any intermediary between the sensing element and the fluid to be measured as with an oil separator for silicon based sensors or O-rings for ceramic technology.

These intermediaries are a weak point regarding the reliability and performances requested in customer's applications.

With our technology, the diaphragm is welded on to the pressure port and our wetted parts are fully metallic (stainless steel, titanium, inconel, etc.).

Main advantages of thin film technology

- Very limited shifts with temperature, easily correctable
- Standard capability to measure negative pressure (down to -1 bar)
- High accuracy capability at 20°C and in the compensated temperature range (total error band).
- Active compensation integrated directly on the diaphragm for very quick changes of temperature of the measured fluid.
- Long life and excellent long term stability
- No internal seals, no oil separator
- Direct compatibility with most corrosive fluids: oils, Skydrol, brake fluids, etc.
- High temperature capability (up to 250°C) with limited thermal shifts

For low pressure ranges, we have developed our proprietary silicon-based technology, devoting every effort to achieve the highest performance in comparison to our thin film. That's why our silicon piezo-resistive sensing element is all stainless steel, welded on pressure port (no O-ring) and with high temperature capability.



Latest and highest quality electronic PCBs and components to withstand the harshest environments

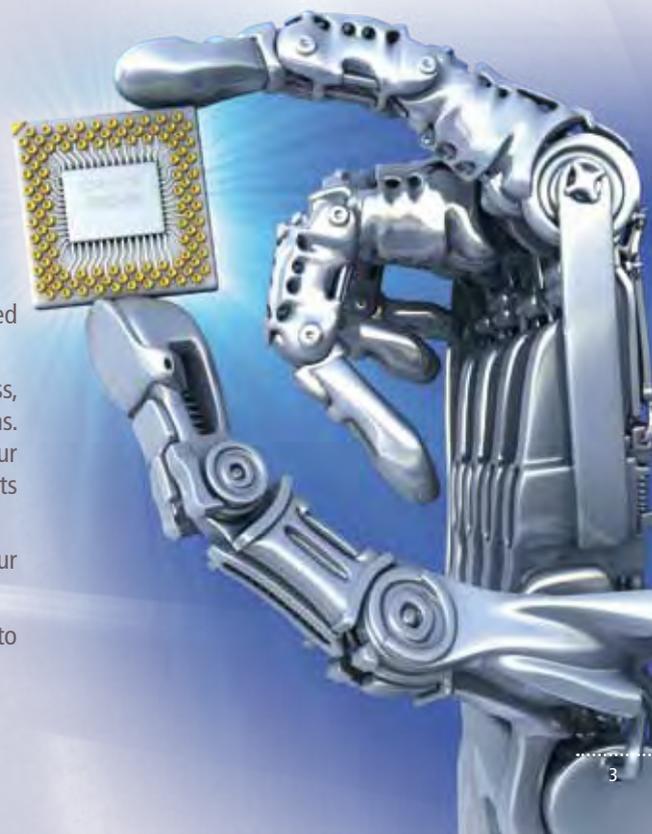


Our quality system is ISO 9001-2008 certified. Our organisation has been designed to target 100% customer satisfaction.

Every sensor manufactured in our factory passes a long burn-in and control process, ensuring the highest performance and stability in our customers' applications. In the case of custom-made or specific sensors we can add additional tests in our manufacturing process to guarantee the reliability and performance of our products in a specific application.

Most of these tests are recorded in our database to ensure good traceability of our production.

All our calibration equipment is Cofrac traceable or equivalent and we are able to provide calibration certificates with new or used units.



HIGH PERFORMANCE

Pressure Sensors



Our range of high performance pressure sensors and transducers offers a solution to most applications.

They are available from 50 mbar up to 3000 bar. We also propose negative and positive pressure from ± 50 mbar up to $-1/+10$ bar and higher on request.

Analogue transducers offer standard outputs (2mV/V, 0.5-4.5V DC, 0-5V DC, 1-6V DC, 0-10V DC, 4-20mA) while digital sensors have CANbus outputs.

Thanks to the latest linearization and digital correction techniques, our transducers, both analogue and digital, have high accuracy at room temperature ($\pm 0.05\%$ fs) as well as ultimate total error band (all errors included $\pm \pm 0.1\%$ fs) over compensated temperature range.

With our high performance transducers, accuracy does not limit other major specifications for our customers' applications such as:

- bandwidth, available up to 5kHz with built-in electronics
- large temperature capability, from -55°C to 125°C (140°C on option)
- robust construction, all stainless steel or inconel

Some models, analogue or digital, offer software-controlled zero and span.



PST220

Industrial pressure transducer
The high quality at a standard price
Analogue outputs: mV/V, 0-5V, 0-10V & 4-20mA
1 kHz bandwidth standard



PTA220

Accurate pressure transducer
 $\pm 0.1\%$ fs non linearity & hysteresis
Analogue outputs: mV/V, 0-5V, 0-10V & 4-20mA
Very limited temperature shifts



PGP220

For applications requiring excellent total error band
Accuracy at 20°C up to $\pm 0.05\%$ fs
And $\pm 0.5\%$ fs max. including temperature effects
Ideal for test bench measurements



Our company has been ISO 9001 certified since 1999.

Every sensor manufactured in our factory passes a long burn-in and control process, ensuring the highest performance and stability in our customer's applications.

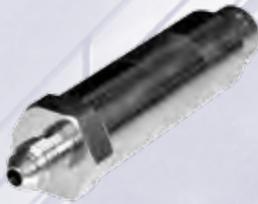


PHP220

High pressure transducer
Ranges up to 3000 bar
Thin film technology ensuring accuracy & stability
Qualified M250C / F250C pressure connections



- ▶ 50 mbar to 3000 bar
- ▶ Analogue or digital outputs
- ▶ Accuracy up to $\pm 0.05\%$ fs
- ▶ Total error band up to $\pm 0.1\%$ fs
- ▶ Software-controlled zero & span
- ▶ Choice of threads & electrical connections



PDC220

Highest total error band with digital compensation
Analogue and digital outputs available
Bandwidth capability ≥ 1 kHz
10-40°C or -25/+85°C compensated



PGA220

General purpose aerospace transducer
Compensated over -55°C /+70°C up to -55°C /+125°C
All stainless steel, compatible with Skydrol and Kerosene
High accuracy at 20°C and in temperature



PDS220

Pressure transducer with digital output
CANBus with CANOpen protocol
High accuracy at room temperature and polynomial correction over the compensated temperature range



PDM220 (wet/wet) and PWD220 (wet/dry)

Differential pressure transducer for liquids and gases
 ± 100 mbar to 250 bar uni- and bi-directional
Compact with amplified output
Operating temperature - 40°C to +125°C



PAX220

High accuracy pressure sensor
Analogue output with digital correction
Robust and high bandwidth capability
Operating and compensated -40/+125°C
Ideal for embedded applications

MINIATURE & SUB-MINIATURE

Pressure Sensors



With over 40 years of experience, we have developed a unique range of miniature and sub-miniature pressure transducers. This complete range includes:

- Low pressure (from 100 mbar), high pressure (up to 3000 bar) and negative positive pressure ranges (from -1 bar).
- Unamplified sensors,
- Transducers with analogue or digital built-in electronics
- Standard or high accuracy with digitally corrected transducers offering ultimate total error band including all errors in the compensated temperature range ($\leq \pm 0.1\%$ fs).
- Large temperature capability: from -55°C to 250°C for unamplified sensors and -55°C to $+175^{\circ}\text{C}$ for amplified transducers (225°C on request).
- High dynamic capability with semi-flush diaphragms
- High performance built-in electronics adapted to on-board applications (8-16V or 8-30V power supply), high bandwidth capability (up to 5 or 10 kHz), low noise and low consumption (<10 mA)
- All stainless steel construction allowing compatibility with corrosive media
- Robust construction proven in the harshest environments



PST160

All stainless steel miniature sensor
Available with mV/V, 0.5-4.5V, 0-5V outputs
From 1 up to 600 bar, absolute & gage
Cable or connector output



PSF160

Miniature sensor for dynamic measurements
Semi-flush diaphragm: 0-5 to 0-400 bar
0.5-4.5V DC or 0-5V DC outputs
Natural frequency of the diaphragm up to 100kHz
(according pressure ranges)



Our miniature sensors are available with numerous options:
- Large choice of mechanical connections
Including Swagelok® 6mm tubing, 1/4 VCR...
- Cable and connector outputs
Their stainless steel construction makes them compatible with most fluids



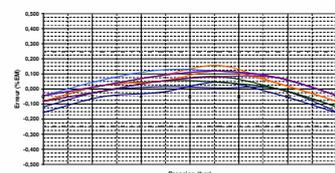
PGP160

All stainless steel miniature sensor
Available with tension and current outputs
Excellent accuracy ($\pm 0.1\%$ or $\pm 0.05\%$ NLH)
Cable or connector output

We can provide calibration certificates for pressure, pressure and temperature as well as certificate of conformity with delivered sensors.

PDC	Pressure (bar)	-45°C		0°C		25°C		85°C		125°C		Tol. +	Tol. -	Error (FS/FS)	Point de mesure de l'origine du capteur (V)	Erreur de l'origine du capteur (V)
		Signal (V)	Error (mV)													
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	200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	300	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	400	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	600	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	700	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	800	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	900	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
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Précision globale du capteur PDC127 N°990745126



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HARSH ENVIRONMENT

Pressure Sensors



Our products are designed to withstand the harshest environments. Supplying pressure sensors for on-board applications for over 40 years has made us aware of the constraints of such environments on sensors, especially miniature.

Our robust thin film technology, associated with proven high quality electronics have been successfully used on board applications in automotive, motor sport, military and aerospace applications.

Harsh environments for our sensors consist often in applications combining high levels of shocks, vibrations, accelerations and temperature.

Nevertheless unsuitable sensors can also be damaged by corrosive fluids, radiations (nuclear), pressure pulsations or spikes.

In all these cases we are offering dedicated proven solutions. Our thin film technology has many advantages, being 100% metallic, capable of high numbers of pressure cycles and adapted to gamma radiation environments.

Our manufacturing process, with adapted burn-in and high numbers of quality controls applied at 100% of our production, as well as the choice of high quality components, is a guarantee of the reliability of our sensors in your application.



PHE220

Compact transducer for the harshest environments
Very robust design for reliable measurements
Built in electronics (0,5-4,5V, 0-5V or 1-6V)
Operating temperature - 40°C /+125°C
High accuracy from -1 bar up to +600 bar



PHE160

Miniature transducer with built in electronics
Available from -1 to 400 bar
Operating temperature -40°C to +125°C
Tension output with 8-30V DC power supply



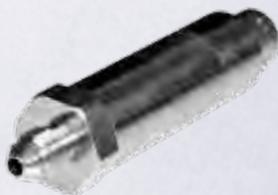
PHP160

High pressure transducer: 2000, 2500 and 3000 bar
Built in electronics: 0-5V with 8-30V DC power supply
High speed electronics: 5kHz bandwidth available
High accuracy: up to $\pm 0.05\%$ fs
Compatible with embedded & test bench applications



PST160

Miniature pressure sensors
1/4 VCR connection for metal/metal sealing
All stainless steel, ideal for aggressive fluids
Large choice of pressure, temperature ranges and accuracy



PDX220

Highest total error band ($\pm 0.25\%$ fs)
Analogue and digital outputs available
Bandwidth capability ≥ 1 kHz
Digital compensation over the temperature range
Operating -40/+125°C

We can provide you a turn key solution with display, connector assemblies and accessories (O-ring, dowty seals) adapted to our sensors.





- ▶ All metallic wetted parts
- ▶ Stainless steel, titanium, inconel
- ▶ No internal O-rings, no oil separator
- ▶ Compatible with corrosive fluids
- ▶ Compensated -55 to +250°C
- ▶ Designed for harshest environments
- ▶ Reliable and long term stable measurements



PHE100
 Subminiature sensor with built-in electronics
 Very robust design
 Compatible with harsh environments
 Available from -1 to 250 bar



PHE860
 Smallest transducer with built-in electronics
 Low mass : only 5 grams
 Operating temperature -40°C to +140°C
 High dynamic measurements



PET160
 Pressure sensor for extreme temperature
 Operating and compensated up to 250°C
 Optional remote amplifier in the cable
 All stainless steel and robust sensor



PHT220
 High temperature pressure sensor
 Operating temperature -40°C to +175°C
 And up to 225°C on request
 Excellent accuracy in temperature
 Built-in or remote amplifier



SPECIFIC AND CUSTOMIZED

Pressure Sensors



If your application requires a specific pressure sensor, we can provide you a solution within a reasonable time frame. Our team of applications engineers are ready to study your requirements and define with you the right sensor for your application.

We can offer to customize one of our standard sensors for you. With our large range of products, we are usually able to answer most of the customer's requirements. Every year we design customized solutions for our customers to tight timeframes.

However, if we are unable to do so, we can develop a specific sensor based on your requirements. We can also manage the qualification of the product to your specifications with internal or external tests thanks to our partnership with specialist laboratories: EMC, environmental tests, vibrations, qualification to a norm (RTCA-160 D0 for instance) For these special developments, we will compile a complete design specification, guaranteeing manufacture of your products over their working life and will provide you with the technical support needed for your project to succeed.

Do not hesitate to contact us and draw on our experience of specific solutions in numerous applications: automotive, aerospace, military, oil & gas, nuclear, research, etc.



Highly accurate and reliable transmitter
Designed for sonar applications
Waterproof to a depth of 3000 metres
Proven technology: 20 years of experience



Miniature pressure sensor for Marine applications
All inonel robust construction
Total error band of $\pm 0.5\%$ fs over 100°C
Includes redundant sealing



Highly accurate and stable pressure transducer
Wetted parts in Inconel with flange connection
Qualified for nuclear applications
Radiations resistant



Submersible miniature pressure sensor
Subsea compliant connector output
Rated up to 1000 metres depth
Pressure ranges, thread and accuracy can be adapted to your needs



Miniature pressure sensor with flush diaphragm
All stainless steel
mV/V output with optional remote amplifier
High pressure and high bandwidth capabilities



Miniature pressure sensor with built-in-electronics
All stainless steel robust construction
Design to withstand harsh environments and immersion in oil (automatic transmission applications)
Operating from -40 to $+150^\circ\text{C}$
3kHz bandwidth

AEROSPACE

Pressure Sensors



- ▶ Standard sensors customized to your applications
- ▶ Specific sensors developed on your specifications
- ▶ Sensors qualified per RTCA DO-160
- ▶ Sensors for ground testing, flight tests and programs
- ▶ Full documentation delivery including FMEA



Miniature and dynamic pressure sensor
Designed for missile applications
Robust and high shock resistant construction
Highly reliable
Qualified for embedded applications



Aerospace pressure transducer
Fully qualified per RTCA DO-160
Built-in electronics
Compact and light (<120g)
Extremely robust design
MTBF > 100.000 Hours



Flight test pressure transducer
Analogue tension outputs
Extreme accuracy over temperature range ($\pm 0.2\%$ fs)
Available from -55 to +140°C



Miniature sensor for embedded missile measurements
0-5V DC output with built-in electronics
High performance over -40/+125°C
3/8-UNJF thread and miniature DCS welded connector
Compatible with aggressive fluids



Large choice of accurate sensors for test bench applications
Digital and analogue outputs
Error band up to $\pm 0.1\%$ fs over temperature range
Available up to -55/+125°C.



Miniature pressure transducer for flight tests
0.5-4.5V DC output
Total error band up to $\pm 0.5\%$ fs
Operating from -55 to +130°C

Pressure Sensors

Miniature and High Performance



A complete range of unique high performance and miniature pressure sensors

- > From 50 mbar up to 3000 bar
- > Analogue or digital outputs
- > Designed for the harshest environments
- > Sub-miniature to industrial sizes
- > All metallic: stainless steel, titanium, inconel (...)
- > Highly dynamic models available (semi-flush)
- > High temperature capabilities:
from -55°C to 250°C
- > Customized or specific products to meet your requirements



THE LEADING TECHNOLOGY

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ご注意:記載の仕様等のご通知無く改定されます。2019.7.3.