

GE  
Sensing

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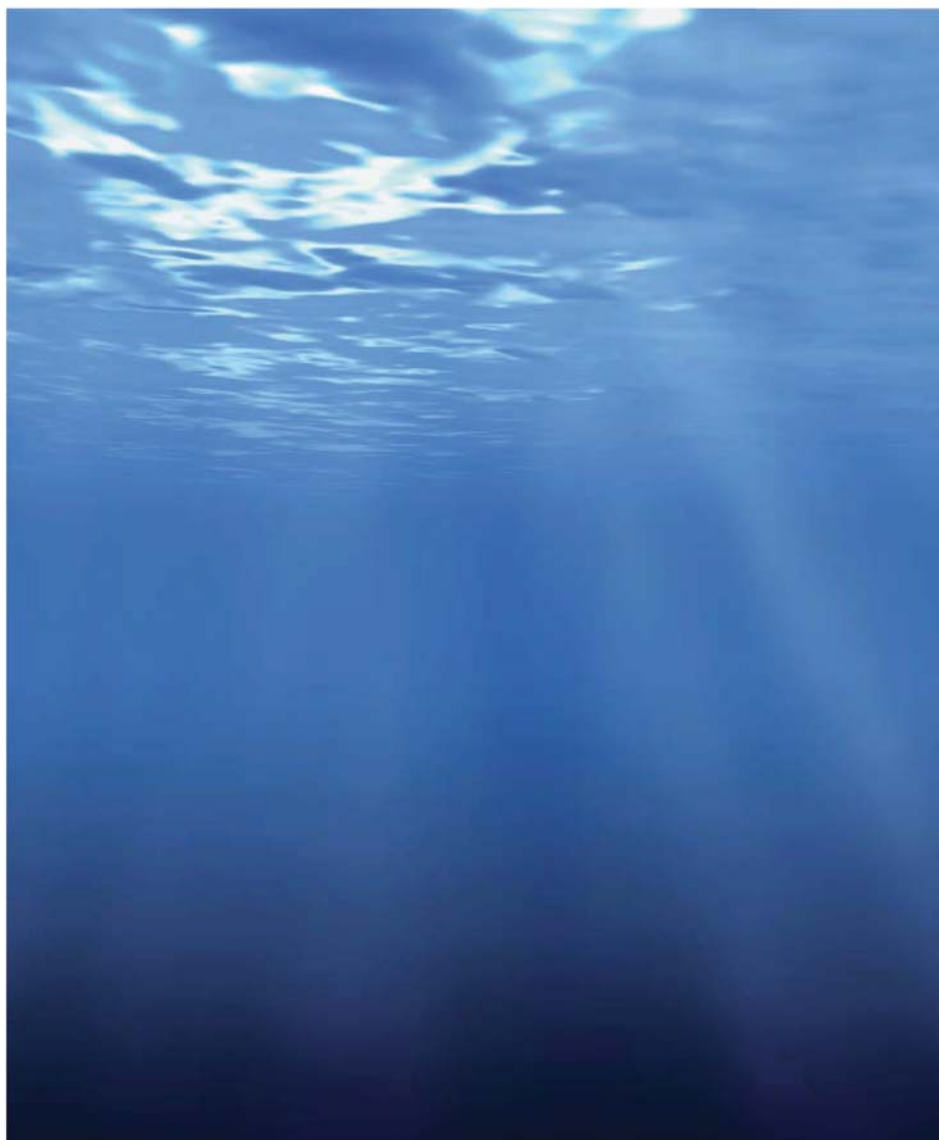
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Rio de Janeiro

# subsea sensors



# About US

GE has united the technological innovation and experience of industry leaders in the design and manufacture of advanced sensing and measurement solutions into one world-class business—GE Sensing.

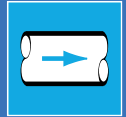
GE's sensing products measure temperature, pressure, liquid level, moisture and humidity, gas concentration, and flow rate for applications ranging from environmental, medical, and pharmaceutical to automotive, aerospace, chemical, and petrochemical.

From high-quality hand-held and portable field calibrators to stand-alone measurement instruments and systems, GE Sensing provides end-to-end solutions that can help you monitor, protect, and control your critical processes and applications.

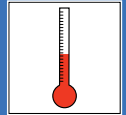
*Pressure*



*Flow*



*Temperature*



*Gas*



*Moisture*



*Humidity*



*Level*



# Delivering Sensing Solutions

In the demanding world of subsea oil and gas production, the ability of the operator to control the asset is determined by a complex set of variables, however, this ability to control relies essentially on the quality of information from the subsea production field. This information is provided by subsea sensors and these are the cornerstone of the product system as operators seek to drive up subsea recovery rates.

GE Sensing are uniquely placed within the market to provide subsea sensor solutions encompassing a broad range of applications from drilling to Floating Production Storage and Offloading (FPSO) areas. For example we are involved in :

- Wellhead Pressure/Temperature/Flow
- Control Pod Pressure/Temperature
- Downhole Tool Pressure/Temperature/Flow
- Subsea Processing Pressure/Temperature/Flow
- Pipe Wall Thickness
- FPSO Flow/Moisture/Flare Gas
- FPSO Hydraulic Power Unit Pressure
- Blow Off Preventers Sensors (BOP)
- Subsea Sensor Simulators

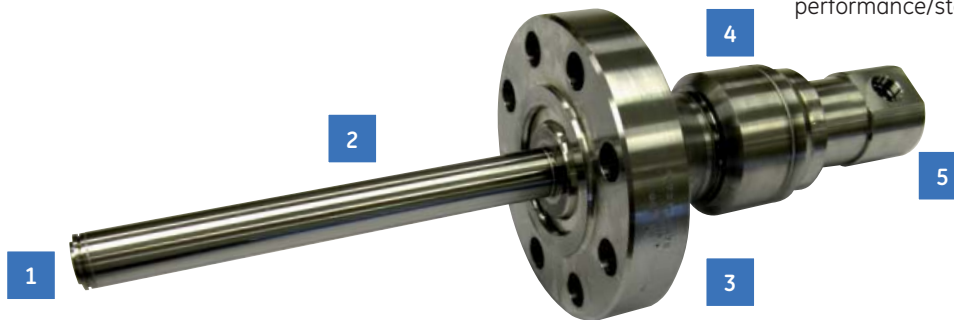
The fusion of the innovative technology and packaging skills of the heritage Druck and Panametrics oil & gas companies, coupled with the financial stability, investment capability R&D and advanced manufacturing processes of GE Measurement Solutions provides a powerful new partner to project manage your oil & gas measurement needs. We will deliver low-risk solutions, innovative and high-performing products and the finest customer support—bringing the best results to you and your customers.

# Wellhead Pressure and Temperature Sensors

Pressure and temperature measurements across the tree are critical to controlling the well and to the asset management of the field. The expansion of the field-proven PTX 400 wellhead PT/TT sensor to a wide capability product with accuracies up to 0.025% FS and a full suite of analogue and digital interfaces provides customers with a full product solution within a controlled delivery period.

**1** Module - Proven piezo resistive silicon technology for pressure and PT100 technology for temperature, single or dual configuration.

**4** Electronics Housing - Single or dual PCB configurations located in the sea water area for ultra long life and high performance/stability.



**2** Nose Tube - Customer length specified and electron beam welded to the flange and module.

**3** Flange - Customer specified mechanical flange. Duplex stainless with an Inconel overlay on the process media areas.

**5** Electrical Seawater Connection - Flexible configuration for any Diver, ROV or Jumper proprietary mechanical design requirement.

## Product Capabilities

- Large 2500 installed product base
- Rapid tree delivery capability
- Ownership of the peizo resistive and resonating technology
- New state of the art manufacturing facility
- Single multifunction site of 650 people

## Electrical Interface

- 4 to 20 mA (all analogue)
- 20 to 4 mA (all analogue)
- 4 to 20 mA High Performance
- 20 to 4 mA High Performance
- PROFibus High Performance
- MODbus High Performance
- CANbus High Performance

## Sensors Specification

Pressure Range	upto 1035 bar/15000 psi
Flange Pressure	5k, 10k, 15k
Flange Type	2 1/16, 1 13/16, Custom
Wetted Material	Inconel 625
Total Accuracy	Up to 0.025% FS over -40° to 150°C/-40° to 302°F
Operating Temperature Range	-46° to 150°C/-51° to 302°F
Storage Temperature Range	-54° to +70°C/-65° to 158 F
Material Traceability	3.1, 3.2 to BS EN 10204:3.1 or 3.2
Environment Stress Screening	ISO 13628-6:2006
Design Life	Excess of 25 years mean time before failure (MTBF)
Sensor Redundancy	Single/Dual selectable
Design Standards	ISO13628-6:2006 and API 6A/17D

# Control Pod Sensors

Measurement of hydraulic pressure within the subsea control module (SCM) at high hyperbaric pressures demands a reliable, compact and rugged pressure sensor to report on the health of the hydraulic control valves (DCV). The PTX 300 series control pod sensor combines all these features within a ASME IX welded construction and consists, of qualified sub components, which combine to build a customised contract solution within a controlled delivery period.

**5** Mechanical housing -  
Electron beam welded housing to ISO 13628 standards providing a hyperbaric protection up to 3000 metres.

**1** Pressure connection -  
A broad range of subsea configurations from flange, screw thread for custom contract designs.



**4** Electrical connection -  
A broad range of field proven designs available with qualified hyperbaric pressure ratings.

**3** Electronics housing -  
High accuracy digital characterised electronics with 4-20mA or CANbus output with moisture protection.

**2** Pressure module -  
Field proven silicon technology housed in a 316 Stainless or all Inconel assembly designed for a fatigue life in excess of 25 years.

## Product Capabilities

- Large 20000 installed product base
- Latest generation EB welder - Weld integrity
- New lean manufacturing facility
- Comprehensive documentation packages
- Environmental sensor stress screening (optional)
  - Covers the most demanding contract specifications

## Electrical Interface

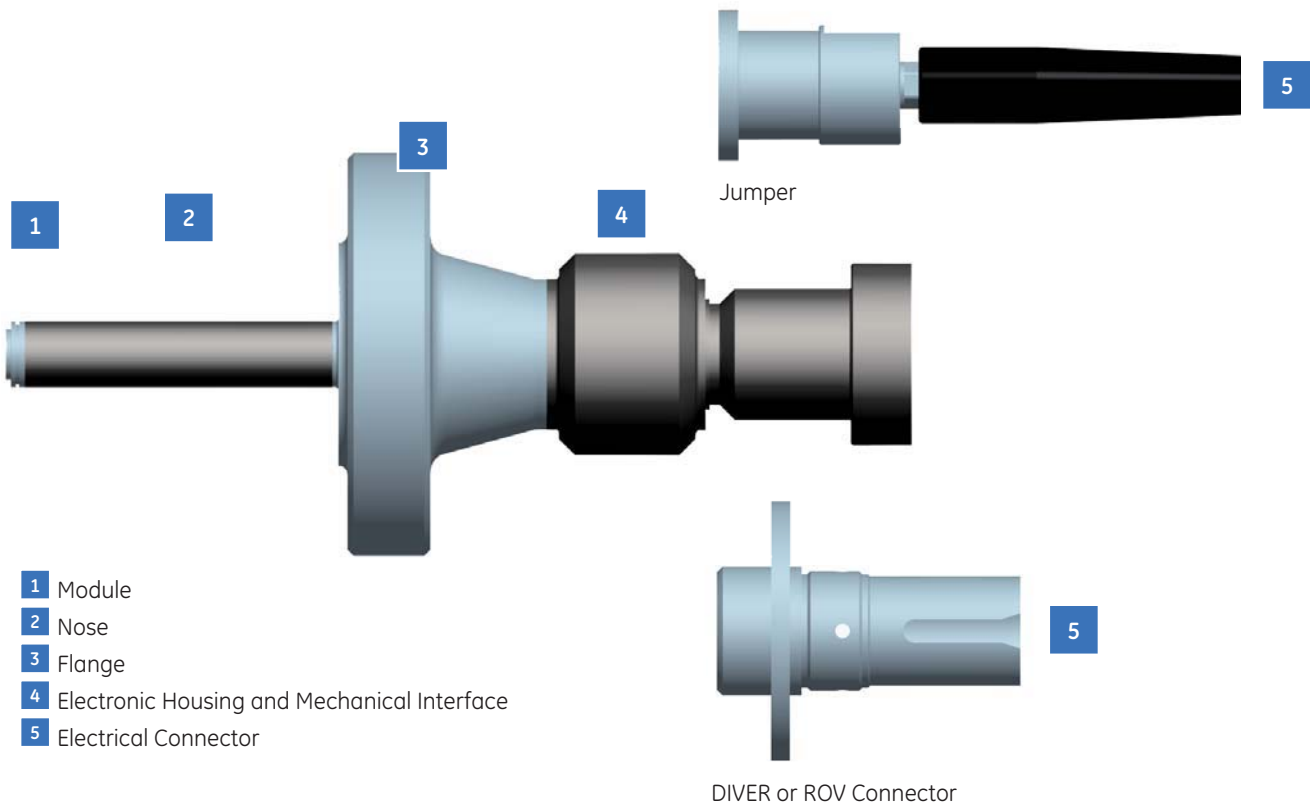
- 4 to 20mA (all analogue)
- 4 to 20 mA High Performance
- CANbus High Performance

## Sensors Specification

Pressure Range	Upto 1500 bar/22500 psi
Proof Pressure	X1.5 Full Scale
Hyperbaric Pressure	3000 metres
Pressure Connection	Flange, screw thread, custom
Wetted Material	316 stainless steel or Inconel 625
Accuracy	0.1% FS
Operating Temperature Range	-30° to 50°C/-22° to 122°F
Storage Temperature Range	-40° to 50°C/-40° to 122°F
Material Traceability	3.1 to BS EN 10204:3.1
Environment Stress Screening	ISO 13628-6:2006 optional
Design Life	Excess of 25 years mean time before failure (MTBF)
Welding Standard	ASME IX
Design Standards	ISO13628-6:2006

# PTX 400—Wellhead Sensor Configuration

The PTX 400 series sensor is a qualified set of sub components, which are brought together to produce a contract specific sensor solution. The configuration of the unit is detailed in the following schematic and configuration table.

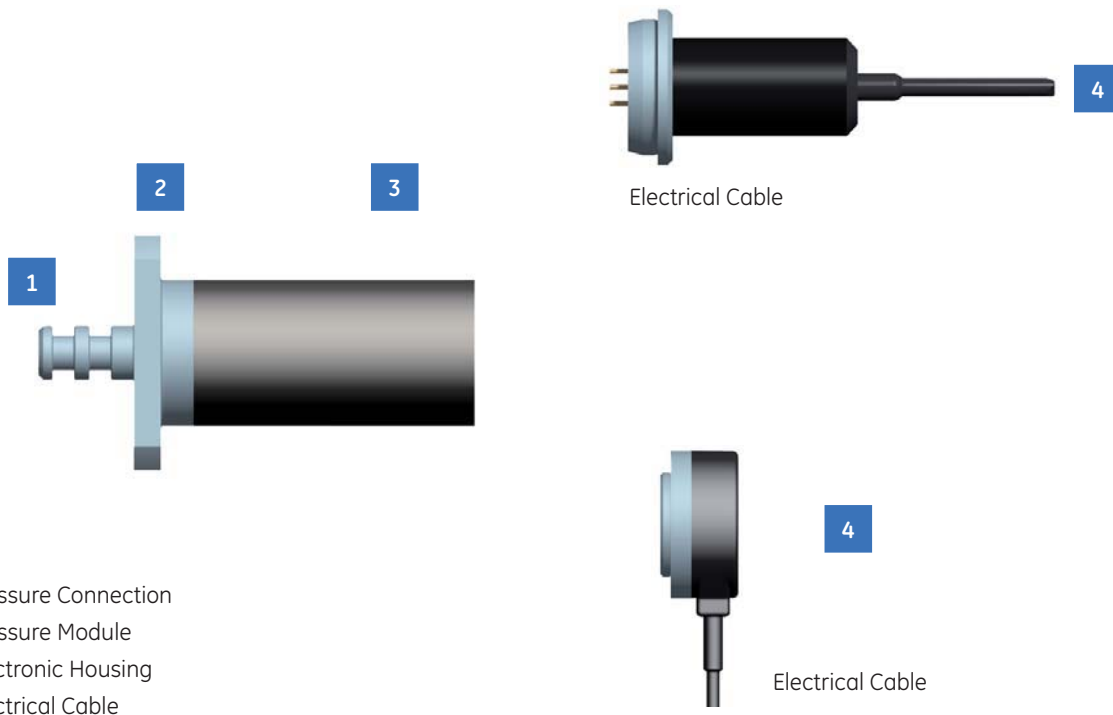


- 1 Module
- 2 Nose
- 3 Flange
- 4 Electronic Housing and Mechanical Interface
- 5 Electrical Connector

PTX4	X	X	XX	X	XXX	X	XXXX
Model	Physical configuration	Electronic Interface	Pressure Range	Pressure Reference	Probe Length in mm	Flange Type	Data Sheet
0	Single Pressure PT	0 - 4 to 20 mA (all analogue)	17 - upto 160 bar / 2320 psi	A - Absolute	State Length	S - Special	Defined at order
1	Single Pressure/ Temperature PT/TT	1 - 20 to 4 mA (all analogue)	18 - upto 250 bar / 3620 psi	SG - Sealed Gauge		T - 10K 1 13/16	
2	Single Temperature TT	2 - PROFibus Quartz	19 - upto 390 bar / 5650 psi			U - 15K 1 13/16	
3	Dual Pressure PT/PT	3 - MODbus Quartz	20 - upto 600 bar / 8700 psi			V - 20K 1 13/16*	
4	Dual Pressure/ Temperature PT/PT & TT/TT	4 - CANbus Quartz	21 - upto 690 bar/ 10000 psi			W - 5K 2 1/16	
5	Dual Temperature TT/TT	5 - 4 to 20 mA High Performance	22 - above 690 bar/ 10000 psi			X - 10K 2 1/16	
6	Custom Flangeless	6 - 20 to 4 mA High Performance				Y - 15K 2 1/16	
7	Thermowell	7 - PROFibus High Performance				Z - 20K 1 1/16*	
8	Dual Pressure/ Single Temperature PT/PT & TT	8 - CANbus High Performance					
9	Single Pressure/Dual Temperature PT & TT/TT	9 - Modbus High Performance					* future development

# PTX 300—Control Pod Configuration

The PTX 300 series sensor is a customised sensor to produce a contract specific sensor solution. The construction of the unit is detailed in the following schematic and configuration table.



PTX30	X	XX	X	XXXX
Model	Electronic Interface	Pressure Range	Pressure Reference	Data Sheet
	0 - 4 to 20 mA (all analogue)	17 - upto 160 bar / 2320 psi	A - Absolute	Defined at order
	8 - CANbus High Performance	18 - upto 250 bar / 3620 psi	SG - Sealed Gauge	
		19 - upto 390 bar / 5650 psi		
		20 - upto 600 bar / 8700 psi		
		21 - upto 690 bar / 10000 psi		
		22 - upto 1035 bar / 15000 psi		
		23 - above 1035 bar/15000 psi		

# Project-Managed Solutions



## Project Shipment and Closure

Process is completed with the packing, checking and shipping of the product to any worldwide destination.



## Contract Inspection and Documentation

Independent Quality and Documentation team inspecting product before shipment to ensure repeatable accuracy of the delivered product package.



## Final Acceptance Testing (FAT)

Automated Pressure/Temperature Calibration system to ensure accuracy of calibration at working pressures and temperatures.



## Reliability Proving

Environmental stress screening system with in-house vibration, burn-in and temperature cycling logging system guaranteeing long life product reliability.



## Welding Specialists

Latest Electron Beam welder manufacturing technology for repeatable and reliable in-house welding on all subsea sensors and assemblies.







### Project Management

Project Manager-led multifunctional team engaged with the customer from enquiry to contract completion.



### Product Design Engineers

Subsea Six Sigma trained engineering team design the custom contract solution with strong interaction with the customer during the design phase.



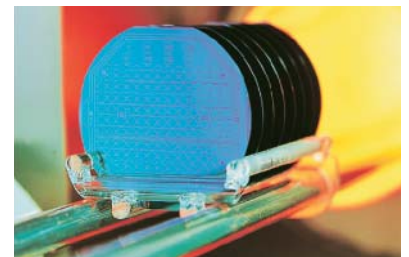
### Project Quality Assurance

Certified for design, development and manufacture ISO 9001 (from 1987), ISO14000 manufacturing (from 1996) and use of Det Norske Veritas external verification body for subsea designs.



### Manufacturing Technology

On site Class 100 silicon piezo resistive fabrication plant producing class leading piezo resistive and resonating measuring elements.



### Manufacturing Traceability

Full factory material traceability and latest GE Fanuc Proficy work order control system providing process control to the manufacturing system.



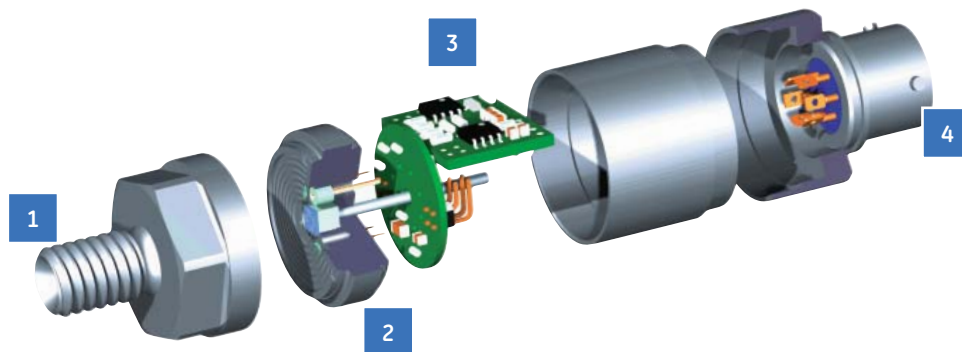


# Downhole Gauge Sensor

Stable and accurate measurements of pressure and temperature within a downhole gauge are critical to the capture of reliable data maps within the reservoir. The new-silicon-on insulator 250°C/482°F high temperature pressure/temperature measuring element is incorporated into the established Druck sensor package to provide reliable information over extended installed time periods at an economical market cost in a high temperature environment.

**1** Pressure Connection – A broad range of high pressure flanges or screw thread connections.

**3** Electronics Housing – The sensor generates a raw mV signal which can be enhanced with high accuracy characterisation across any customised pressure/temperature spectrum.



**2** Module – Silicon on Insulator element technology providing a reliable pressure and optional temperature signal.

**4** Electrical Connection – A broad range of high temperature mechanical configurations, available to meet a customer's specific space envelope.

## Product Capabilities

- Specialised mechanical packing capability
- Proven data characterisation techniques
- IP and manufacturing ownership
- Field proven high temperature/high pressure experience
- 100% in house manufacturing processes

## Electrical Interface

- Output Signal: 4 wire mV
- Power Supply: 2.5 to 12.5 V ratiometric
- Insulation Resistance: Greater than 100 M ohm at 500 V
- Characterised Temperature Range: customer specified
- Switch on/Sample Time: Less than 5 m secs

## Sensors Specification

Pressure Range	Upto 1035 bar / 15000 psi
Wetted Material	Inconel 625 or 316 stainless
Accuracy	Upto 0.06% FS
Operating Temperature Range	-55° to 250°C / -67° to 482°F
Storage Temperature Range	-55° to 275°C / -67° to 527°F
Temperature Signal	Derived bridge signal



Welding Processes

# Field Proven Oil and Gas Technology

## Piezo Resistive Pressure/Temperature

In house design, manufacture of MEMS sensing elements encompassing any full scale pressure from 0.1 mbar/0,001 psi to 1500 bar/20000 psi across temperature ranges for -40° to 250°C / -40° to 482°F.



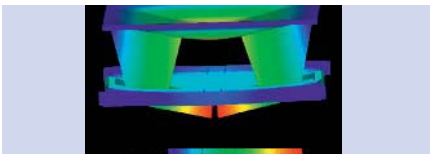
## Gas and Moisture

Gas and Moisture analyzers for process control, plant safety, product quality and plant efficiency. The products include moisture measurement in gas and liquid, oxygen from ppb to percentage in gas, air and flue gasses.



## Resonant Pressure/Temperature

Designed for applications, which require ultra high stability, the trench etched resonant pressure sensor (TERPS) is the leading edge technology providing Quartz performance levels with the benefits of a piezo resistive package.



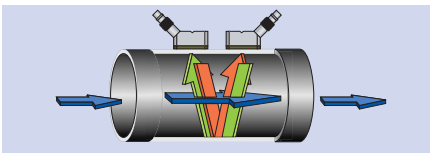
## Wall Thickness

Technology solution for corrosion and erosion monitoring using permanently installed sensor technology for continuous wall thickness measurement. This technology uses an array of 14 ultrasonic sensors, multi channel data loggers and proprietary software for pipe temperatures of up to 120°C/248°F.



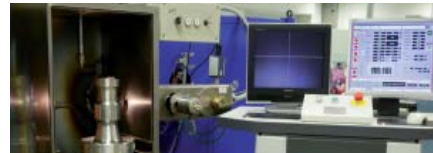
## Flow Metering

Leading specialists in the use of clamp on ultrasonic transducers to correlate velocity and flow rate, derived from the transit time between transmission and receipt of ultrasonic pulses in a pipe structure.



## Welding Processes

The leading specialists in the design and manufacture of sensors, using an electron beam welding technique of exotic materials for high temperature/high pressure process and hyperbaric pressures for subsea applications.

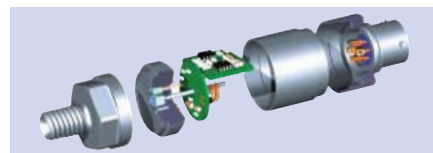


Leading specialists in direct mass flow Coriolis meters for high accuracy custody transfer measurement and compact metering skids. Sizes up to 30.5 cm/12 inches in standard, corrosion resistant and extreme temperature designs.



## Mechanical Packaging

The leading mechanical specialist in the design of complex coplanar mechanical sensor assemblies in a broad range of challenging harsh environment sensor applications.



# Related Oil and Gas Products



## Supporting Services

Our highly trained staff can support you, no matter where you are in the world.

- Rental calibration unit
- Fast nationally accredited calibration service



## Model 2482 Differential Pressure Piston Gauge

Custody transfer, fiscal monitoring and turbine efficiency.

- Exceptional Accuracy and ease of use
- Hydraulic and pneumatic operation



## Ruska 7615 Hydraulic Pressure Controller

- High Pressure hydraulic controller for fast calibration of a broad range of oil and gas pressure sensors and gauges
- Pressure ranges upto 2750 bar/4000 psi
- Precision 0.01% FS



## Advanced Modular Calibrator

Modular, durable and accurate portable calibration system for all encompassing calibration solutions on all sensor measurands.

- Pressure and Temperature
- Flexible and modular

Test and Calibration

Drilling

Topside



#### PTX 661 Mud Sensor

Rugged "Hammer Union" high integrity design for mud drilling signal feedback applications.

- Ultra high resolution
- Excellent reliability



#### PTX 7900 HPU Pressure

Process pressure measurements for a broad range of Oil and Gas applications.

- 1000 bar/15000 psi capability
- Hazardous area approved



#### Rightrax Riser Thickness

- Non invasive wall thickness measurement on riser pipes to detect effects of erosion and corrosion.
- Hazardous area approved



#### RHM160 Coriolis Flow Meter

Coriolis mass flow measurements for custody transfer and compact metering skids.

- Very high accuracy of 0.1%
- Sizes to 300 mm (11.8 inches)



#### HygroPro Moisture Transmitter

Moisture measurement in natural gas dehydration process.

- Intrinsically safe certified, loop powered
- Three function capability - moisture, temperature, and pressure sensors



#### GF 868 Flare Gas

Measurement of flare gas flow for compliance with emissions consent and ETS legislation.

- Standard volume or mass flow
- Retrofit without welding or shut down



#### RTX1000 Topside Pressure

Topside pressure measurements in standard and niche applications.

- Ultra high accuracy of 0.075% FS
- 1400 Bar /20,000 PSI capability



GE imagination at work

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