

## RING PAIR CORROSION MONITORING (RPCM™) SPOOL



# real-time pipeline integrity management

The RPCM™ spool provides real-time internal corrosion monitoring for the proactive management of pipeline integrity. It is not an inspection device but provides true real-time information that allows corrective actions to prevent or limit corrosion within the process.



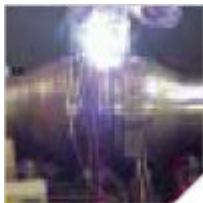
Fully tested and qualified, the RPCM™ spool is an established technology with a proven track record capable of the most demanding HT/HP deepwater service.

The system can be rated to :  
1035 bar (15,000psi)  
180 degrees C (350 deg F) and  
3050m (10,000 ft) water depth.

The data generated from monitoring systems can be employed to provide on-going refinement of the models and predictive forecasting.

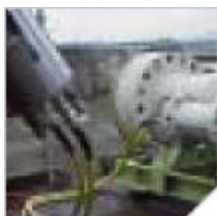
### User benefits include:

- Greater system integrity, reduced maintenance and no unplanned shutdowns
- Justification to employ carbon steel and corrosion inhibition in place of corrosion resistant alloys
- Visibility to ensure high corrosion inhibitor availability and optimised dosing
- Potential to employ reduced corrosion allowances
- Potential for reduced pigging facilities and pigging runs
- Alarming of process upsets and visible response to corrective actions
- Extended facility life



The RPCM™ spool is an in-line, piggable, monitor for pipelines and flow lines giving full circumferential corrosion rate measurement plus pressure and temperature.

The exceptional resolution of the embedded CEION® metal loss measurement technology makes RPCM™ a uniquely effective tool for pipeline integrity applications.



When the RPCM™ is combined with modelling, the two work together to provide true real-time flow assurance integrity. Strategically placed monitoring, combined with modelling, results in full visualisation of the corrosion profile and other flow assurance variables along the line.

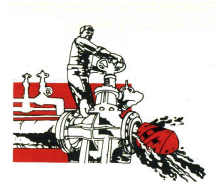
### Suggested locations: \*

- Topside pipelines
- Production Risers

- Subsea flowlines
- Subsea pipelines
- Onshore pipelines

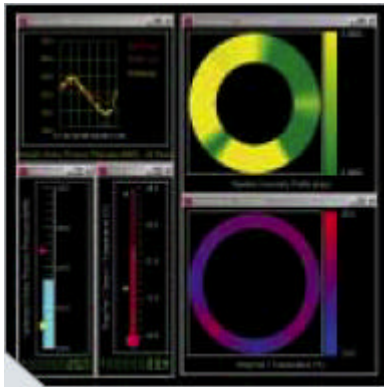
\* For single point subsea pipeline corrosion monitoring please refer to our PTEC product information

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## Technology Overview

An inner spool sensing array, using rings of actual pipe material, detects metal loss to very high resolution, allowing real-time monitoring and alarming of process upsets. This inner spool array is contained within an outer pressure retaining envelope and is connected to the external instrumentation via a high integrity HT/HP penetrator assembly.



The dual redundant instrumentation can be ROV retrievable and the data output is provided in engineering units directly to the subsea control module or production control system without the need for additional data processing. Surface installations connect to control room systems.

A change in system conditions, such as increased water production or insufficient corrosion inhibitor can produce a dramatic change in the corrosivity of a system. These changes can be detected by the RPCM spool and corrective actions can be put in place and verified before any significant damage takes place.

The mechanical integrity, reliability and performance of the RPCM™ spool has been established for the most demanding of deepwater HT/HP applications. The system can be rated to :  
1035 bar (15,000psi)  
180 degrees C (350 deg F) and  
3050m (10,000 ft) water depth.



## Product Features:

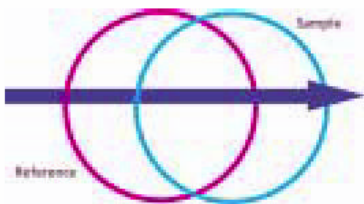
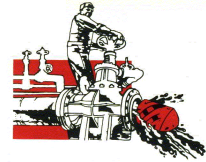
- Real-time CEION® metal loss measurement technology
- Full circumferential corrosion and temperature profiles
- Targets preferential weld, localised and pitting corrosion
- Pressure measurement option
- Fully dual redundant ring-pair, measurement and communications Instrumentation
- Subsea retrievable instrumentation is ROV compatible. Surface instruments are Intrinsically Safe.
- Versatile communications interface and long distance communication options
- Low power consumption
- Compatible with lay barge installation
- Fully qualified for HT/HP Deepwater service
- Long life – service life exceeding field design life
- No topside processing of data required

## Potential cost savings:

- Impact at system design through reduced capital expenditure
- Material selection: potential for employing carbon steel over corrosion resistant alloy
- Reduced corrosion allowance
- Minimal pigging facilities
- Use of higher inhibitor availability value
- Impact on operations through lower operational costs
- Optimised Production
- Reduced unplanned shutdown
- Reduced pigging frequency
- Corrosion inhibitor optimisation



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## The Ring-pair concept

The 'Ring-pair' design consists of co-axially spaced closed rings pairing a corrosion-sensing ring with a ceramic coated electrically isolated reference ring. The process flow is unimpeded through the rings. The arrangement provides the optimum compensation for temperature and stress while closely simulating the corrosion interface at the internal wall of the pipeline. Precision monitoring of metal loss from thick rings is possible by virtue of the high resolution CEION® measurement system. The innovative inner/outer spool arrangement ensures total pressure integrity and no on-site calibration is necessary.

- RPCM™ measures and reports temperature and pressure
- Preferential weld, localised and pitting corrosion is characterised
- Sensing element wall thickness may be varied
- Multiple materials may be used in one RPCM

## Topside applications

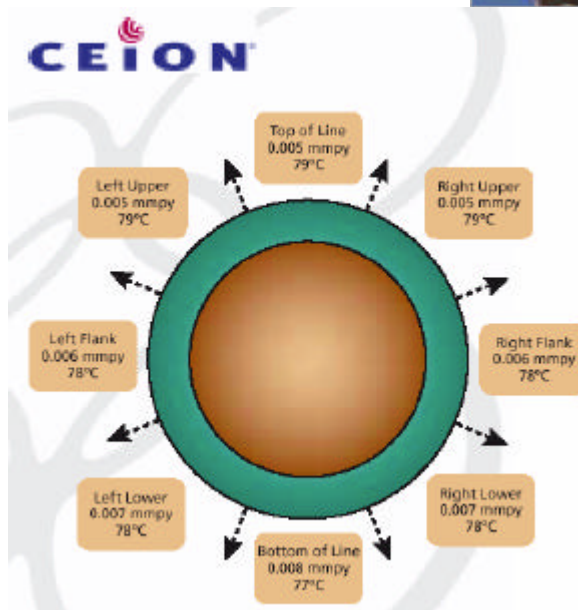
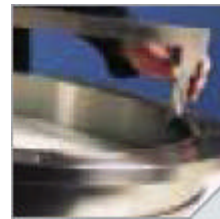
Surface installation and hook up methods are similar to most other pipe spool / instrument routines. Intrinsically Safe certified electronics are available and communication packages can be employed that utilize remote power sources and satellite data recovery.

## Subsea applications

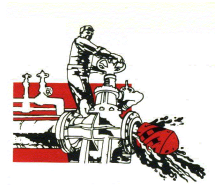
Subsea units may be installed from a lay barge or by diver support vessel after full factory testing and calibration. Communications are flexible and interfacing simple. Once on location the unit is connected via a jumper cable to the SCM using underwater mateable connectors. Electronics pods are low power consumers

## Performance

Resolution is dependent on pipeline diameter and sensing element wall thickness. A typical resolution is of the order of 0.1 to 1 micron (0.004 to 0.04 mils). At this resolution the time to establish an uninhibited corrosion rate of 10 mm/yr (400 mpy) is <1 hour and the time to establish an inhibited corrosion rate of 0.2 mm/yr (8 mpy) is 44 hours



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- SIMPLE
- RELIABLE
- ROBUST
- QUALIFIED

## Action

One easy way to receive further information or a proposal is to complete and return the subsea checklist on our website [www.petrosystem.it](http://www.petrosystem.it). This form is also available by fax or mail.

## Specifications

Power: 24v dc / 150mA per ring pair  
Ambient temperature: -10°C to 50°C (14°F to 122°F)  
Process temperature: -70°C up to 200°C (-94°F to 392°F)  
Pressure: rated to match line rating up to 1035 bar (15000 psi)  
Service depth: 3050m (10000 ft)  
Time base: selectable multiple of minutes  
Ring Sensor material: client selected  
Ring Sensor life: up to pipe wall thickness  
Pipe Interface: flange/pup-piece, client selected  
Metal loss resolution: From 0.1 microns (0.004 mils) dependent on ring thickness  
Temperature resolution:  $\pm 0.5^{\circ}\text{C}$  ( $\pm 1^{\circ}\text{F}$ )  
Pressure resolution: 0.1% full scale  
Typical communications: RS 232, RS 485 (Modbus, Profibus, Canbus). Interface experience with all major SCM suppliers.

## References

With an unparalleled track record, the RPCM Spool is an established technology with systems operational on the seabed since 2001. RPCM users include:

Apache Energy  
BP Exploration  
Conoco Phillips  
Shell  
Statoil  
Woodside