ULTRASONIC INTELLIGENT SENSORS

ClampOn DSP Corrosion-Erosion Monitor

DIGITAL SIGNAL PROCESSING

CLAMPON®
ULTRASONIC INTELLIGENT SENSORS

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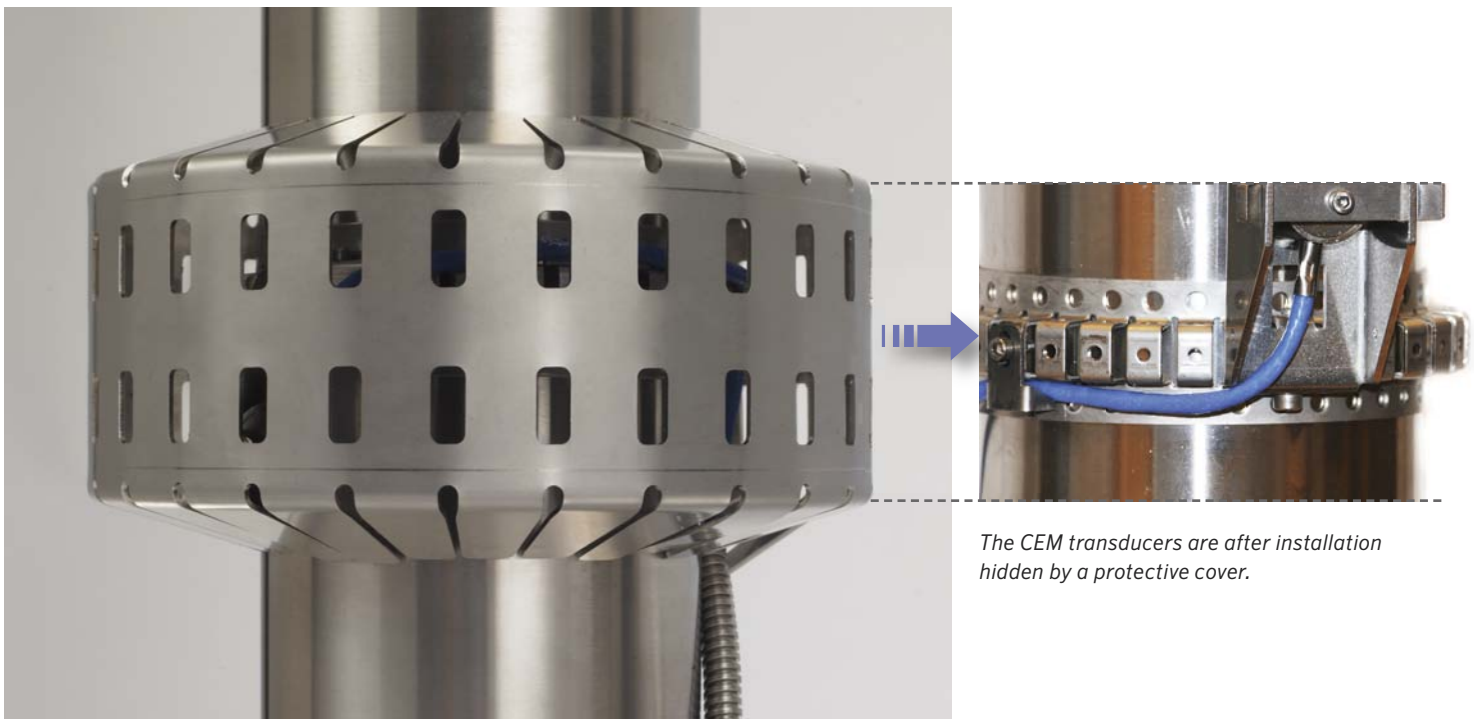
The patented ClampOn DSP Corrosion-Erosion Monitor (CEM) has been designed to monitor the average wall thickness of pipes, containers and any large object that requires corrosion/erosion monitoring. The ClampOn CEM system utilizes a unique method of monitoring wall thickness loss by the use of clamp-on sensors. A number of transducers measure corrosion-erosion by transmitting ultrasonic signals that propagate through pipe material. Using ClampOn acoustic transducers means that no drilling or welding that would cause loss of production is required.



The CEM transducers are after installation hidden by a protective cover.

Principle of operation

The working principle of the ClampOn CEM is based on transmitting ultrasonic signals that propagate through the pipe-wall. The dispersive characteristics of a group of guided acoustic waves, called Lamb modes, are exploited to indicate a mean change in wall thickness relative to reference values acquired during the installation of the CEM system.

The permanently installed CEM system ensures that measurements are repeated frequently and in exactly the same manner, thereby eliminating the weaknesses of manual ultrasonic thickness gauging. Wall thickness trends are generated automatically and can be observed in real time.

The Corrosion-Erosion Monitor consists of a Head Unit and up to eight smaller transducers. The Head Unit processes and controls the signals, communicating with the electromagnetic ultrasonic transducers which are fixed to the selected pipe section. The signal path follows the metal structure between the transceivers in operation, generating a matrix of measurements with thickness information. The number of Head Units and transducers to be used is decided by the client in consultation with ClampOn.

Testing has shown the ClampOn CEM to be both physically robust and capable of withstanding changes in pipe temperature. The system is capable of performing measurements on pipe diameters from 50 mm (2") and upwards and on material thicknesses ranging from 4 mm to 35 mm (0.157" to 1.378"). Changes in average wall thickness of as little as 1% can be measured in real time.

The signal path follows the metal structure between the transducers in operation, which in turn generates a matrix of all the measurements.

Installation

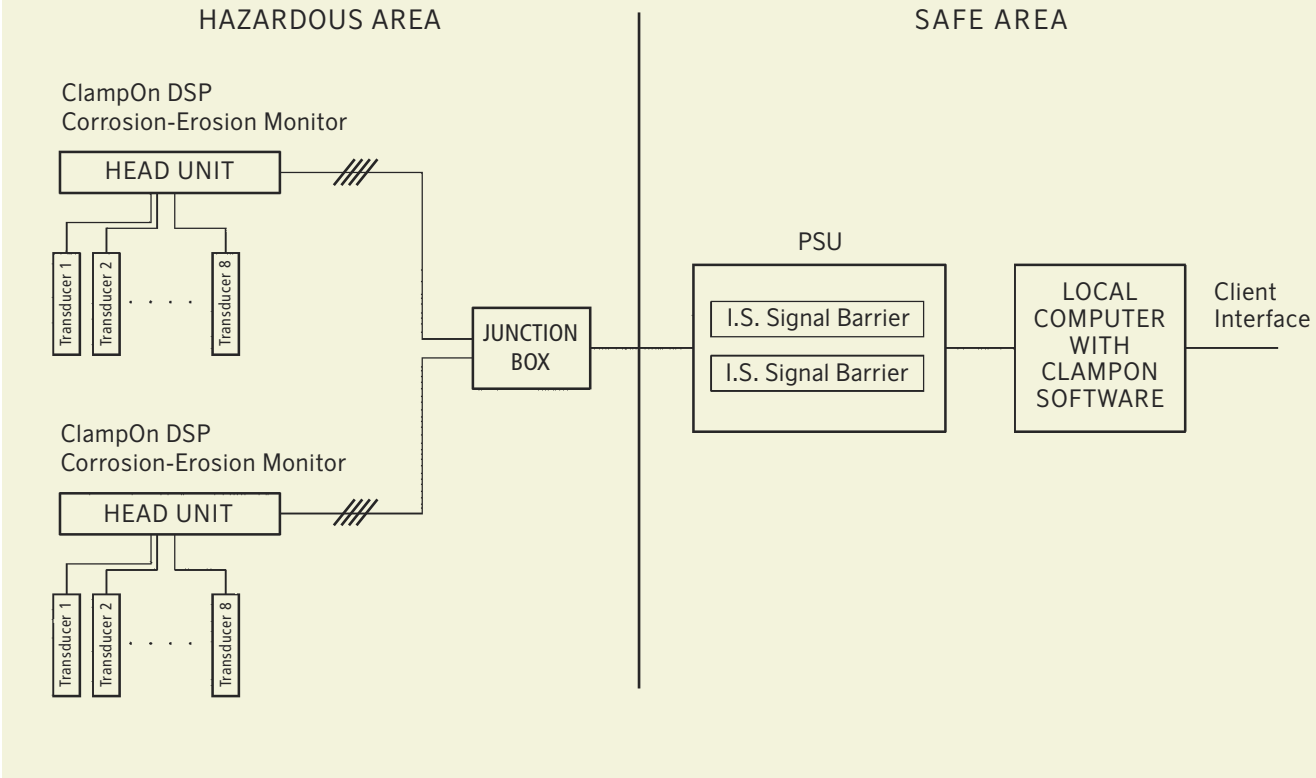
Installing the ClampOn CEM system is quick and simple. Two to eight transducers are fixed to the pipe surface (or other metal plate structure) and connected to the Head Unit, which continuously sends and receives guided waves between the transducers, resulting in a network of measurement paths that covers the selected area.

A given pair of transducers covers more area than is defined by the transducer dimensions. Figure 1 shows a schematic diagram (top view) of the ultrasonic beam width for a pair of transducers separated by approximately 400 mm.

In a CEM installation with six transducers in operation the coverage area is large, (see Figure 2), covering 60% of the pipe circumference. The transducers have separations of 700 mm and the pipe is 8” in diameter.

The CEM monitors continuously in real time or according to chosen sequences. Connected to a control system the CEM will provide trends and alarms, enabling the operator to evaluate how trends in corrosion or erosion are related to other process parameters.

Typical system set-up



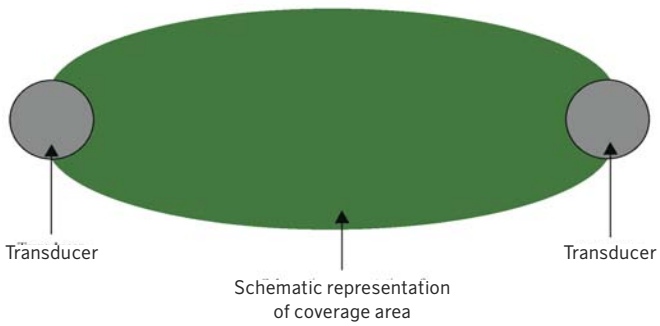


Figure 1. Approximate beam width and profile as estimated by 2D models for a representative transducer separation.

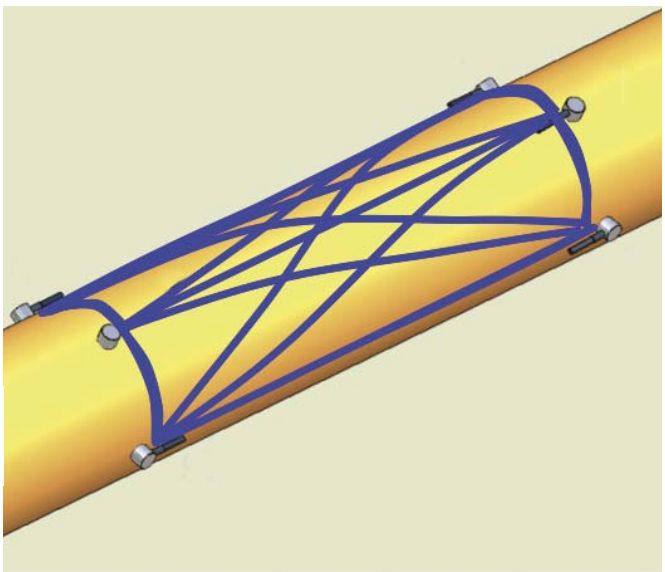


Figure 2. CEM coverage area on an 8" OD pipe, with a total separation of 700 mm and a six-transducer set-up, giving a total coverage of approximately 60%.

Product specifications

ULTRASONIC INTELLIGENT SENSOR	
Principle of operation	Ultrasonic intelligent sensor, Active ultrasound, guided waves
Sensor electronics	DSP 66 MIPS, A/D converter 24bit, 5MS/sec, 0-1MHz
Sensor electronics input bandwidth	0.02 – 2 MHz
Sensor electronics output	20-1500KHz, ±70 Volt
Inputs	8 Ch.
Power consumption	Normal operation: 2.5 W
Self testing	Yes
Sensor output	Digital

INTRINSICALLY SAFE APPROVAL	
ATEX	Ⓔx II2 (2) G Ex mb [ib] IIC T4, Zone 1
	Ⓔx II2 (2) G Ex ib mb [ib] IIB T4, Zone 1
Enclosure standard	IP67
Enclosure material	AISI 316 Stainless Steel
Dimensions / Weight	240 mm x 180 mm x 155 mm/ 6 kg (13,2 lbs)
Max. pipe surface temperature	-40 to 180 °C (-40 to 356 °F)
Operating pipe temperature	-40 to 150 °C (-40 to 302 °F)
Method of installation	Head Unit to be placed near pipe, transducers to be in contact with pipe
Interface options	RS485
Two-way communication	Yes
Software upgradable	Yes
Sensor configuration	Up to 8 transducers
	Distance to main sensor 0.15-1m (6”- 40”)
	Coverage distance max. 2 m (80”)

CORROSION & EROSION MONITOR TECHNICAL DATA	
Pipe diameter	Min OD 75mm (3”)
Pipe-wall thickness	4 to 35mm (0,157 to 1,378")
Pipe OD /wall thickness	> 8
Distance between transceivers	0.15m to 2m
Response time	Real-time
Sensitivity	1% of wall thickness. The presence of liquid in the pipe does not affect sensitivity
Frequency range	20 to 1500 kHz
Fluid in pipe	Oil, gas, water, multiphase or other liquids
Pipe material	All metal pipes
Calibration	Once, on installation
Cable interface	Cable with connector/Flying lead/Gland for cable access
Cabling	Minimum 4x 0.75 mm2 (pending system configuration)

COMPUTER / CONTROLLER	
Minimum hardware	Computer: Pentium III (or equivalent) with 512 MB RAM
	Controller: Fieldpoint or RIO Programmable Automation Controller (PAC)
Software requirements for ClampOn’s software	Windows™ XP/Vista/2000-2008
Input	Serial, Modbus, Ethernet, OPC
Signal output	Serial, Modbus, Ethernet, 4-20mA, Relay, Client Server

SAFE AREA EQUIPMENT	
Mains power supply	12 - 48 VDC or 100-260 VAC 50-60 Hz
Power Consumption	Max 2.5W per detector + computer rack module

Areas of application

- Pipelines
- Pipe components
- Storage tanks
- Plate sections
- Corrosion detection
- Erosion detection

Typical customers

- Refineries
- Chemical plants
- Process industry
- Power plants
- Oil and gas industry
- Transport lines

Product advantages

- Non-intrusive
- Wide temperature range
- Not operator-dependent
- Covers large area of pipeline
- High sensitivity
- Easy to install
- Designed for «lifetime» operation

Intelligence and self-calibration

The ClampOn Corrosion-Erosion Monitor self-tests the following system parameters: input level, RAM, internal voltage, internal temperatures, all internal buses and the elements.

ClampOn - the leader in sand, pig and corrosion-erosion monitoring

Since its beginnings in 1995, ClampOn AS has grown to be the largest supplier of passive ultrasonic systems for sand/particle monitoring to the international oil and gas sector. All products supplied by ClampOn; particle monitor, pig detector, corrosion-erosion monitor and leak monitor, are based on the same, well-proven technology platform. Both topside and subsea instruments incorporate Digital Signal Processing (DSP), complete digitalization that eliminates analogue filters, circuits and amplifiers.

The ClampOn Ultrasonic Intelligent Sensor processes all data in the sensor itself (patented principle), thus enabling the instrument to discriminate between sand-generated and flow-generated noise. This is of importance to the user since changes in flow rates and the gas/oil ratio do not affect the performance of the system.

A good signal-to-noise (s/n) ratio is vital for quality measurements of this sort, and ClampOn's sensors are the very best in this respect. With the new version, external noise has been completely eliminated.

The sensor has a memory capacity for storing up to 60 days of data, and can even be reprogrammed to function either as a sand monitor, a pig detector or a corrosion-erosion monitor for monitoring changes in wall thickness.

Subsea Sensors

The subsea sensors were developed in close collaboration with Shell Deepwater Development Inc. in Houston and FMC Energy Systems in Norway. The successful outcome of the project was a sand monitoring system that combined an extremely long working life with excellent acoustic properties, and offering a high degree of reliability in the high-pressure deepwater environment. Since 1998, ClampOn has supplied approximately 1000 subsea sensors to the oil and gas industry. The subsea meters have been under continuous development in order to optimize quality and performance, and to meet the requirements of the market.

ClampOn DSP Pig Detector

The ClampOn DSP Pig Detector is a non-intrusive pig detection system designed to act as a first-stage alarm system for pig detection. It provides accurate and reliable registration of the time when a pig is passing and transmits the signal to the operator. The detector can also indicate the amount of debris preceding the pig during cleaning operations.

ClampOn SandQ™ & ClampOn DSP-06 Particle Monitor

All sensors are identical and interchangeable, which is a real advantage if sensors need to be moved/relocated or in case of service. The DSP's increase in processing capacity enables the sensor to combine signals from several frequency ranges when analysing the flow. ClampOn sensors are versatile, and are the only instruments on the market that offer two-way communi-cation between sensor and control system. This solution enables future upgrades of the sensor to be installed via a simple download of new software. When using digital output from the sensors, they can be installed in a «multi-drop» system.

The sensor is installed after a bend, where the particles (chalk or sand) are forced out of the flow and impact the inside of the pipe wall, generating an ultrasonic pulse. The ultrasonic signal is transmitted through the pipe wall and is picked up by the acoustic sensor itself.

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CLAMPON®
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