The ClampOn DSP Corrosion-Erosion Monitor (CEM) is an ultrasonic instrument designed to measure wall thickness loss in pipes, plates or other metal structures. It uses active ultrasound where transducer pairs work in a pitch catch mode of operation, giving the average wall thickness between the transducers. As a part of the ClampOn family, it is non-intrusive. A permanently installed CEM system will measure the wall thickness frequently and at a very high repeatability, thereby eliminating the weaknesses that are commonly encountered in manual ultrasonic thickness gauging. Wall thickness trends are generated automatically and can be observed in real time, logged internally in a datalogger or presented in a wireless solution. This technique has been installed topside and will now also be made available subsea.

The CEM uses up to 8 transducers, resulting in a coverage area of up to 65% of a selected pipe section and of up to 2 meters in length. The subsea version will utilize up to 32 transducers, increasing distance to a maximum of 8 meters. Installation is easy and the system virtually maintenance free, due to the newly developed Dry Contact transducers which utilize electromagnetism to transmit and receive acoustic signals. Therefore no glue is required and the transducers can be placed on the exterior on up to 3 mm of paint or coating. The CEM is a versatile instrument and can in practice be used to monitor all metal structures, such as:

- **Subsea production templates**
- **Jumpers/Flow Lines**
- **Manifolds**
- **Retrofit solution**

The ClampOn CEM is based on Acoustic Guided Lamb Waves (AGLW). One of the most important properties of AGLW is the dependence on the velocity of the frequency and the thickness of the structure through which they propagate. Knowing the dispersion curves of various materials enables ClampOn to calculate the wall thickness and observe the change along the signal path. Any change in plate thickness can be detected by the change in the Lamb wave velocity due to the dispersive nature of the modes. Wall thickness changes of 1% can positively be detected and the system has a repeatability of ±0.04%. The technique is robust and will not break down. The subsea system will be available for pipe OD of 6" (15.2 cm) and greater and wall thicknesses in the range of 4-35mm (0.158-1.378 inches)
ClampOn Subsea Corrosion-Erosion Monitor
Preliminary Technical Data

CEM Outline Specifications:

**Design Data**
- Design life: 30 Years (10+ Years for ROV mounted system)
- Electronics: 8 Ch. CEMAT with PAC controller
- Battery solution: 320Ah – 5 Years
- Communication: Digital
- Power supply: 12 to 36 Vdc
- Power consumption: Typical 1.2 Watt – Max 4 Watt
- Pipe temperature: -20 to 150 °C (-4 to 302 °F)
- Electronic working temp: -20 to 60 °C (-4 to 140 °F)
- Storage temp: -40 to 60 °C (-40 to 140 °F)
- Design depth: 3000 meters (9842 feet)
- Jumper interface: Oil filled hose – Bennex Mk. II or similar

**Ambient Operation Conditions**
- External pres.(design depth): Working: 1 – 250 Bar (1 - 2500 meter water depth) Test: Min 300 bar
- External medium: Sea water
- External temperature: Operation: +3 to +45°C (37.4 to 113°F)
- Vibration Electronic: 5 g, 5 - 1000 Hz
- Vibration Assembly: 2.5 g, 5 - 150 Hz
- Shock Electronic: 30 g, 11 millisecond, ½ sine all 6 orthogonal axes
- Shock Assembly: 6 g, 11 millisecond, ½ sine all 6 orthogonal axes

**CEM Operation**
- Manner of operation: Real-time wall thickness wear rate/trends
- Technology transducer: Dry-Contact Transducers, Active ultrasonic, CEMAT
- Coverage distance: 20 to 100 cm (7.9 to 39.4 inches) (depending on wall thickness)
- Flow conditions: Oil / water / gas / multiphase / none
- Transducer lift-off: <3 mm (0.118 inches)
- Processing: DSP in sensor unit
- Sensitivity/Accuracy: <1 % of wall thickness
- Repeatability: ±0.04 % of wall thickness
- Frequency range: 40 kHz to 280 kHz
- Wall thickness range: 4 to 35 mm (0.158 to 1.378”)
- Maximum coverage area: 3 m²/32 ft² with 8 transducers
- Minimum pipe OD: Subsea 6” (topside 2”) pipe
- Surface material: All conductive metals

SYSTEM DESIGN

ClampOn DSP Corrosion-Erosion Monitor is designed to monitor/trend wall thickness and wear rate. The system is non-intrusive hence no parts are in contact with the flow. The system has two-way communication via RS-485 and can be upgraded/customized by software download.