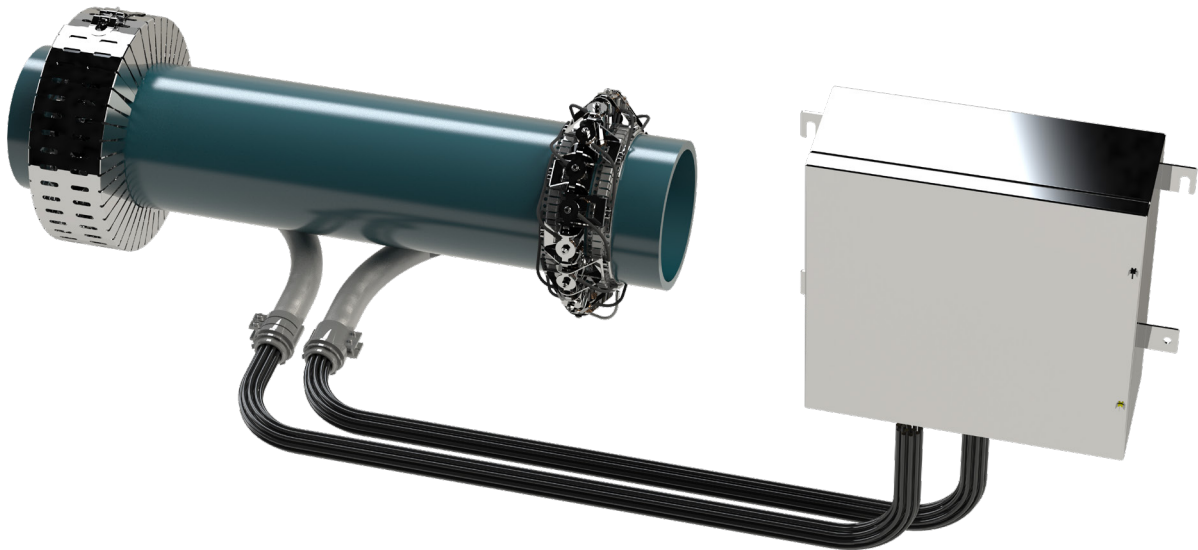


ClampOn CEM® Corrosion-Erosion Monitor

DIGITAL SIGNAL PROCESSING



ClampOn Topside CEM® Corrosion-Erosion Monitor

ADVANTAGES

- **Real-time**
- **Non-intrusive**
- **Retrofit installable**
- **Large coverage area**
- **Accurate / high resolution**

MOTIVATION

Corrosion and erosion are recognized as some of the most serious problems facing industries worldwide, and result in losses worth hundreds of billions of dollars every year. Corrosion and erosion also represent significant challenges to the global oil and gas industry, causing serious threats to the environment, people, and to transport and production systems. Major savings can be realized by establishing a code of Best Practice in order to

deal with these issues. Accurate and reliable measurement of corrosion and erosion is a natural part of such a Best Practice, as this will enable you to monitor the condition of your pipes, determine inspection intervals more accurately, and ensure safer and more cost effective operation. Major operators have selected the ClampOn topside CEM® (Corrosion-Erosion Monitor) as the best solution for their topside assets and operations.

OPERATING PRINCIPLE

The ClampOn Topside CEM® is an ultrasonic instrument designed to measure wall thickness loss in pipes over a defined area. It uses active ultrasound and exploits the properties of Acoustic Guided

Lamb Waves to detect the changes in wall thickness relative to the reference values obtained during the installation of the system.

Changes to wall thickness is detected by a grid of signal paths, generated by up to thirty-two transducers. Tomography enable us to monitor the actual and minimum wall thickness, and generate a 3D visualization of the monitored section.

The coverage area and the accuracy / sensitivity depend on the number of transducers installed / pipe-size. With the right number of transducers up to 100 percent coverage of a given area can be obtained. As little as 0,1% change in wall thickness can be measured in real-time.

INSTALLATION

With its clamp-on design, the system is easy to install, and the absence of moving parts means it is virtually maintenance free. This gives the Topside CEM the required robustness to endure challenging conditions throughout its field life. There is also no need for recalibration after installation. By carefully choosing the position of the transducers, it is possible to monitor infrastructure that is normally inaccessible for inspection. The topside CEM

is a permanently installed system. Installing a CEM is quick and simple. Two to thirty-two transducers are fastened to the surface of the pipe (or other metal plate structure) and connected to a clamp-on control unit. The control unit continuously sends and receives guided waves between the transducers, resulting in a grid of measurement paths that covers the selected area. This is a more cost effective accurate and reliable solution than other methods, e.g.

spot measurement, as it monitors an entire section of pipe and not just single points, which could miss localized corrosion or erosion entirely. A variety of system configurations are possible, ranging from standalone monitoring stations with internal data logging to full real-time integration into existing data infrastructure. The system can cover a large section of pipe, typically 2-5 OD, depending on how many transducers are used.

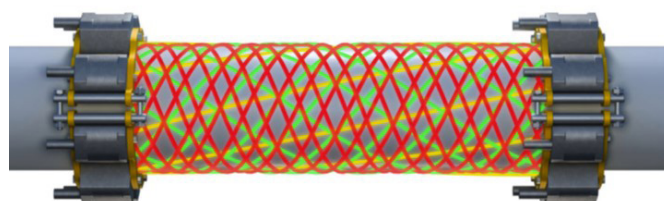


Illustration of transducer paths with 16 transducers on a horizontal pipe, giving 100% actual coverage.



KEY SPECIFICATIONS

- | | |
|--------------------------|---|
| • Method of operation : | Active ultrasound, guided Lamb waves |
| • Transducer technology: | EMAT |
| • Maximum coverage area: | 3 m ² (32 ft ²) |
| • Sensitivity: | 0,1 % |
| • Repeatability: | Better than 1 % |
| • Wall thickness range: | 8 to 50 mm (0.315" to 1.968") |
| • Minimum pipe OD: | 114 mm (4") |
| • Wall material: | Conductive metals and alloys |
| • Design life: | 25 years |
| • Electronics: | 32 channel main unit and PC/ automation controller |
| • Pipe temperature: | -40 °C to 180 °C (-40 °F to 356 °F) |
| • Ambient temperature: | -40 °C to 60 °C (-40 °F to 140 °F) |
| • Power Consumption: | 6.5 W operation 4.5 W standby |
| • Communication: | Serial, Modbus, Ethernet, OPC |
| • Cable interface: | Cable with connector/Flying lead/Gland for cable access |
| • Cabling minimum: | 4 * 0.75 mm ² - Pending system configuration |

All specifications are subject to change without notice



ULTRASONIC INTELLIGENT SENSORS

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Instrument datasheet

ClampOn CEM® Corrosion-Erosion Monitor



1	General	Note
1.1	Model name	ClampOn CEM® Corrosion-Erosion Monitor
1.2	Model number	TSE.CE2M.SR00.G10
1.3	Explosion protection principle	Increased safety, Ex e Encapsulation, Ex m Non-incendive, NI
1.4	Serial number	YY-MM-7XXXX, unique for each unit 1

2	Physical	
2.1	Dimensions (w × h × d)	406 mm × 406 mm × 163 mm [16 in × 16 in × 6.4 in] 2
2.2	Enclosure material	Stainless steel 316L
2.3	Enclosure protective coating	None, not certified with any type of coatings
2.4	Weight	15 kg (±1 kg) [33.1 lb (±2.2 lb)]
2.5	Ambient temperature	See "Approvals & certification"
2.6	Ingress protection enclosure	IP66, in accordance with IEC 60529
2.7	Ingress protection cable glands	IP66/IP68 (30 meters for 7 days), in accordance with IEC 60529
2.8	Equipment marking	Metallised polyester certification label Stainless steel tag plate where applicable
2.9	Number of EMAT transducers	4 to 32 3
2.10	Cable entry configuration	8, 16, 24 or 32 off Ø16 mm clearance holes, depending on number of EMAT transducers. Unused entries fitted with Ex certified blanking elements by default 4
2.11	Cable gland	321 series or ADE 1F2 series Ex cable gland for EMAT transducers 4



3	Electrical	Note
3.1	Rated voltage range, U_{dc}	18 V to 32 V, 24 V_{nom} (electronics equipped with inverse polarity and transient protection) 5
3.2	Power consumption (@ V_{nom})	6.5 W operational (4.5 W in standby/idle)
3.3	Electronics platform/generation	CEMAT II
3.4	Processor	FPGA (close to front-end and with 58 DSP resources)
3.5	Non-volatile memory	16 MB
3.6	Sampling	8 × 24 bit ADCs, parallel sampled with FPGA
3.7	ADC sampling rate	4 mega samples per second

4	Operation	
4.1	Manner of operation	Real-time wall thickness trending using guided waves 6
4.2	Unit of measurement	Remaining wall thickness (mm)
4.3	Design life	25 years
4.4	Sensitivity	0.1 % 7
4.5	Wall thickness range	8 mm to 50 mm [0.3 in to 2.0 in] depending on EMAT transducer 8
4.6	Coverage distance	Typical 30 cm to 100 cm [11.8 in to 39.4 in] 8
4.7	Coverage area	Typical 0.3 m² to 1 m² [3.2 ft² to 10.8 ft²] 8
4.8	Minimum pipe OD	114 mm [4 inch NPS] with no limitation in maximum pipe diameter 8
4.9	Flow conditions	Any
4.10	Pipe material	All steel alloys

5	Signal	
5.1	RS-485 (half duplex) protocol	Modbus RTU 9, 10
5.2	RS-485 baud rate	115.2 kbps

6	Installation	
6.1	Mounting	To be installed in close vicinity of pipe using mounting lugs attached to the enclosure exterior
6.2	Terminal block connection data	0.25 mm² to 2.5 mm² [AWG 24 to AWG 12] conductor (stranded) cross section with ferrule with plastic sleeve

INDONESIA DISTRIBUTOR



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7 Approvals & certification		14
7.1 Hazardous area location approval	Zone 1, 2 for ATEX/IECEx installations and Division 2 for cULus (NEC/CEC) installations	
7.2 ATEX marking	Ex II 2 G Ex eb mb IIC T6... T3 Gb	12
7.3 ATEX certificate	DEMKO 16 ATEX 1530X	13
7.4 ATEX ambient temperature range	-40 °C ≤ T _{amb} ≤ +60 °C (head unit) -40 °C ≤ T _{amb} ≤ +180 °C (transducer)	11
7.5 IECEx marking	Ex eb mb IIC T6... T3 Gb	12
7.6 IECEx certificate	IECEx ULD 16.0024X	13
7.7 IECEx ambient temperature range	-40 °C ≤ T _{amb} ≤ +60 °C (head unit) -40 °C ≤ T _{amb} ≤ +180 °C (transducer)	11
7.8 cULus marking	Class I Division 2 Groups A, B, C, D, T6... T3	12
7.9 cULus certificate	E354507	13
7.10 cULus ambient temperature range	-40 °C ≤ T _{amb} ≤ +60 °C (head unit) -40 °C ≤ T _{amb} ≤ +180 °C (transducer)	11
7.11 CE marking in conformance with	2014/34/EU (ATEX Directive) and 2014/30/EU (EMC Directive)	

Notes

1. Serial number breakdown: yy (year of manufacture), mm (month of manufacture), 7xxxx (unique electronics ID).
2. Listed dimensions excluding cable entry components.
3. Two transducer rings with 2 to 16 transducers in each ring. Separation between the rings is from 2 × OD to 5 × OD, depending on system configuration. Transducers are typically mounted equidistantly around the circumference of the pipe. Numbers of transducers and their positions are project dependent.
4. Various solutions/configurations available.
5. The head unit must be powered from a safety extra low voltage (SELV) power supply and with an external fuse rated 10 A, 230 V, 1 500 A breaking capacity, supplied or approved by ClampOn.
6. For system designs, an automation controller/computer running ClampOn CEM® Server is required to handle communication with the instrument, data processing, and (if applicable) communication with the client control system.
7. Sensitivity refers to wall thickness change, relative to correctly set baseline wall thickness. The repeatability of single measurements is <1 %.
8. Limitations depend upon pipe geometry and configuration.
9. ClampOn CEM® Client software for Windows is required for system configuration. Supported operating systems for CEM® Client software is XP (SP3, 32 bit), Windows Vista, Windows 7, Windows 8/8.1, or Windows 10 (32 bit and 64 bit).
10. Communication protocol according to Modicon PI-MBUS-300.
11. The ambient temperature (T_{amb}) marked on the equipment refers to the temperature of the surroundings, irrespective of any external source of heating, such as process temperature, or direct sunlight. If there is a risk the ambient temperature of the surroundings will exceed T_{amb}, steps must be taken to mitigate this risk, such as installing a sunshade, insulating the pipe, or moving the equipment to another location.
12. Head unit is T5 classified at listed T_{amb} while the EMAT transducers are T6... T3 classified depending on T_{amb}. See certificate and/or installation instructions for correlation between T_{amb} and temperature class.
13. See certificate and/or installation instructions for specific conditions of use.
14. The head unit may not be marked with all certificates at the same time.

Instrument datasheet

ClampOn EMAT transducer

1	General	Note
1.1	Model name	ClampOn EMAT transducer
1.2	Model number	TTR.000M.0000.A10
1.3	Explosion protection principle	Encapsulation, Ex m Non-incendive, NI
1.4	Serial number	Unique for each unit

2	Physical	
2.1	Dimensions (ø × h)	25.4 mm × 41 mm [1.0 in × 1.6 in]
2.2	Enclosure material	PEEK and stainless steel 316L
2.3	Enclosure protective coating	None, not certified with any type of coatings
2.4	Weight	300 g (±50 g) [0.66 lb (±0.11 lb)]
2.5	Ambient temperature	See "Approvals & certification"
2.6	Ingress protection	IP67, in accordance with IEC 60529
2.7	Equipment marking	Serial number and model number engraved
2.8	Cable type	Tray cable, 2 conductors (+ screen) 18 AWG
2.9	Cable length	5 m [16.4 ft]



3	Operation	
3.1	Manner of operation	Real-time wall thickness trending
3.2	Technology	Electromagnetic acoustic transducer (EMAT)
3.3	Design life	25 years
3.4	Wall thickness range	8 mm to 30 mm [0.3 in to 1.2 in]
3.5	Transducer lift-off	<1 mm [0.04 in]
3.6	Minimum pipe OD	114 mm [4 inch NPS] with no limitation in maximum pipe diameter
3.7	Flow conditions	Any
3.8	Pipe material	All steel alloys

4	Installation	
4.1	Mounting	Clamped to pipe by non-invasive, non-intrusive stainless steel clamping bands
4.2	Mechanical protection	Use only clamping bands, flex protection covers and other installation accessories supplied by ClampOn. See installation instructions for further details

5	Approvals & certification	11
5.1	Hazardous area location approval	Zone 1, 2 for ATEX/IECEx installations and Division 2 for cULus (NEC/CEC) installations
5.2	ATEX marking	Ex II 2 G Ex eb mb IIC T6... T3 Gb
5.3	ATEX certificate	DEMKO 16 ATEX 1530X
5.4	ATEX ambient temperature range	-40 °C ≤ T _{amb} ≤ +180 °C
5.5	IECEx marking	Ex eb mb IIC T6... T3 Gb
5.6	IECEx certificate	IECEx ULD 16.0024X
5.7	IECEx ambient temperature range	-40 °C ≤ T _{amb} ≤ +180 °C
5.8	cULus marking	Class I Division 2 Groups A, B, C, D, T6... T3
5.9	cULus certificate	E354507
5.10	cULus ambient temperature range	-40 °C ≤ T _{amb} ≤ +180 °C

Notes
1. Ex m explosion protection principle for ATEX/IECEx installations and non-incendive (NI) explosion protection principle for cULus (NEC/CEC) installations.
2. Transducer front is PEEK and remaining metallic components are stainless steel 316L.
3. Weight including 5 meter [16.4 feet] cable. Cable weight is 42 g [0.09 lb] per 1 meter [3.3 feet] when longer cables are utilized.
4. Cable is pre-fitted (non-replaceable) to transducer, with flying lead in other end. Up to 15 meter [49.2 feet] cable can be pre-fitted.
5. Transducer only to be operated by a ClampOn CEM® Corrosion-Erosion Monitor.
6. Insulation/coating material must be clarified before ClampOn can confirm its suitability.
7. The transducer cable is laid in a cable tray and protected by a flexible stainless steel conduit. Entire transducer assembly is protected by a flex protection cover.
8. The ambient temperature (T _{amb}) marked on the equipment refers to the temperature of the surroundings, irrespective of any external source of heating, such as process temperature, or direct sunlight. If there is a risk the ambient temperature of the surroundings will exceed T _{amb} , steps must be taken to mitigate this risk, such as installing a sunshade, insulating the pipe, or moving the equipment to another location.
9. The EMAT transducers are T6... T3 classified depending on T _{amb} . See certificate and/or installation instructions for correlation between T _{amb} and temperature class.
10. See certificate and/or installation instructions for specific conditions of use.
11. Ex information is marked on the CEM® Corrosion-Erosion Monitor head unit. It may not be marked with all certificates at the same time.