smart PIMS ®

Permanently installed monitoring system

Remote Asset-Integrity Monitoring

Measuring Metal Loss with
Installed Ultrasonic Sensors & IoT

NDT GLOBAL SERVICES

Sensor Networks, Inc. is a US-based IoT technology company specializing in networked installed ultrasonic sensor systems engineered for precision, scalability and versatility in safety-critical, energy-sector assets. Our unique, patent-pending product and service offering helps customers cost-effectively manage their corrosion and erosion measurement challenges with plant piping, vessels and other components—both for regulatory compliance and improved asset management.

Ultrasound

Ultrasonic nondestructive testing (NDT) is a 70-year-old, proven, established and refined technology. Recent advances with microelectronics, software, wireless communications and the "internet of things" have made "installed ultrasound" an extremely attractive and cost-effective solution for corrosion & erosion monitoring.

Metal loss due to corrosion & erosion is a major issue and cost for:

- Refineries: overhead crude lines and naphthenic acid corrosion
- Chemical plants: hydrofluoric acid corrosion
- Oil production facilities: sand erosion
- Mid-stream assets: general ID corrosion and individual pit monitoring
- Electric power generators: FAC and MIC
- Any PSM-regulated sites: compliance and loss prevention

Multiple cable-drops of installed sensors can be manually accessed above grade with a tablet PC and dataPIMS™.

- Safe. Non-invasive to the asset's pressure boundary.
- Absolute in its ability to directly measure remaining wall thickness. (Not a proxy for wall loss.)
- Extremely accurate to 0.001″ (0.025 mm), with ability to measure down to 0.040″ (1 mm) in carbon steel, especially for fixed-location probes.
- Rugged, reliable and portable. Low recurring maintenance costs.
- Versatile and cost-effective.

A fundamental tenet of any asset-integrity strategy is to accurately measure metal loss so it can be properly managed. Sensor Networks' smartPIMS provides that as a safe and cost-effect solution.
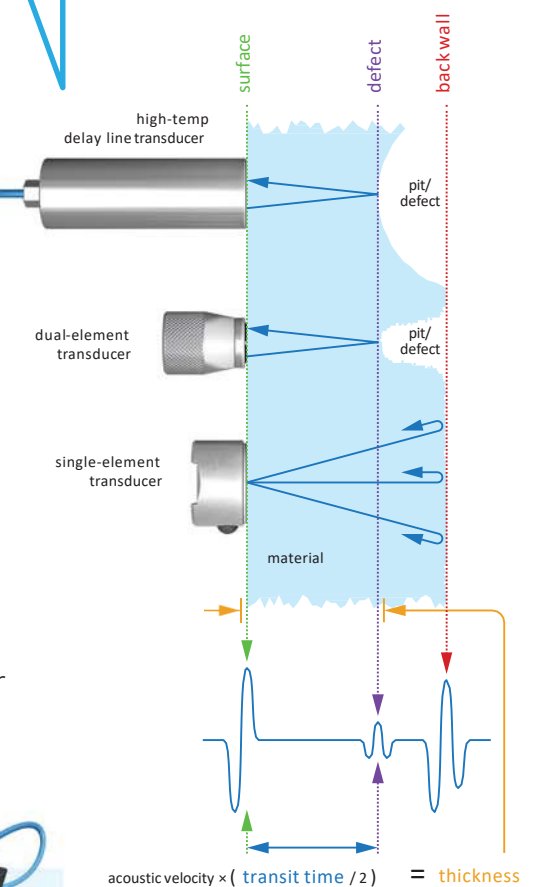
"Measure It, Manage It"

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smartPIMS components, software and systems are highly configurable, from just a few sensors to thousands of TMLs per network—and available for purchase, rent or as a service. Leveraging the low-cost and ubiquitous aspects of the Internet and wireless networks—including cellular—systems can be more easily and cost-effectively installed and maintained at most industrial facilities.

Installed sensors are ideally suited for monitoring areas of active metal loss due to corrosion/erosion.

For long-term installations, including underground or harsh environments, the transducer is encapsulated for extended protection.

Flexible matPIMS linear or area arrays, with 16 ultrasonic elements can be wrapped around pipes and elbow extrados, with up to 1,000′ (305 m) of cable.

surface — defect — back wall

high-temp delay line transducer

pit/defect

dual-element transducer

pit/defect

single-element transducer

material

$$\text{acoustic velocity} \times (\text{transit time} / 2) = \text{thickness}$$

Wired solutions

Best suited for:

- Buried installations
- Integration with plant control systems via Modbus/RS485
- Lowest hardware cost per TML/CML
- Manual, automated and integrated data collection options
- High data-collection frequency (>2X/day) incl. control room
- Data-logging model can take & store 3,000 readings. (batteries req'd)
- Resistance to RF interference

midstream
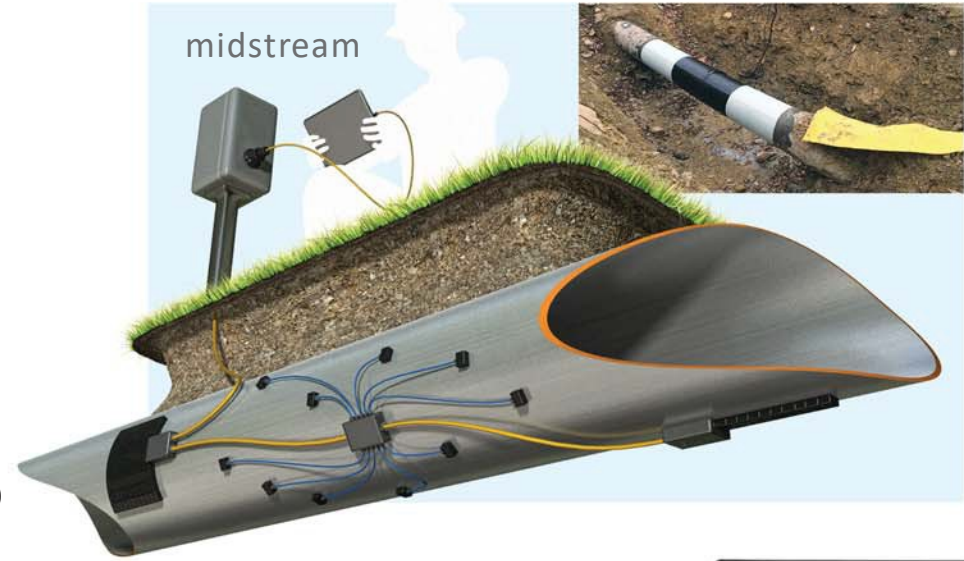
Modbus tablet systems address buried pipe and mobile assets (tanker cars and trailers) that require accurate, repeatable, infrequent measurements.
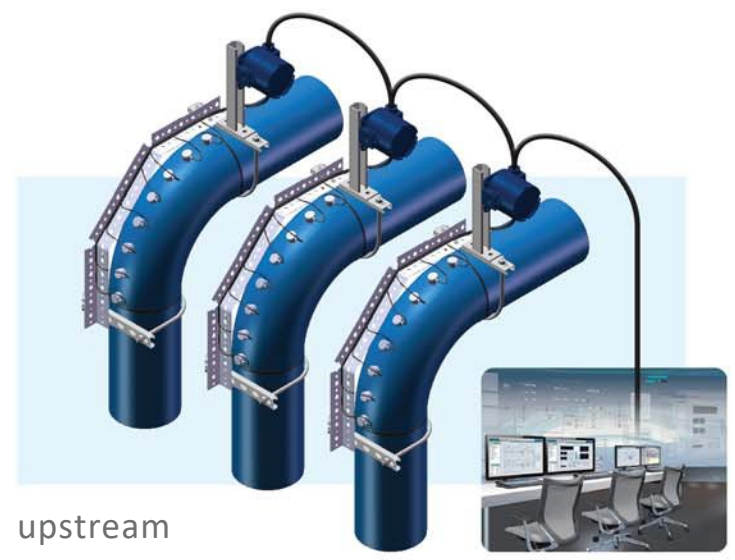
upstream

Modbus control room systems are ideal for offshore platforms when wired directly into the asset's plant control system or DCS. The installed sensors provide automatic closed-loop monitoring of the production process.

The matPIMS™ 3×5 transducer array is a 16-element device that can wrap radially or axially on a pipe as small as 4" diameter. It plugs directly into a Modbus tablet with up to 1,000' (305 m) of cable for signal/data capture.

Wireless solutions
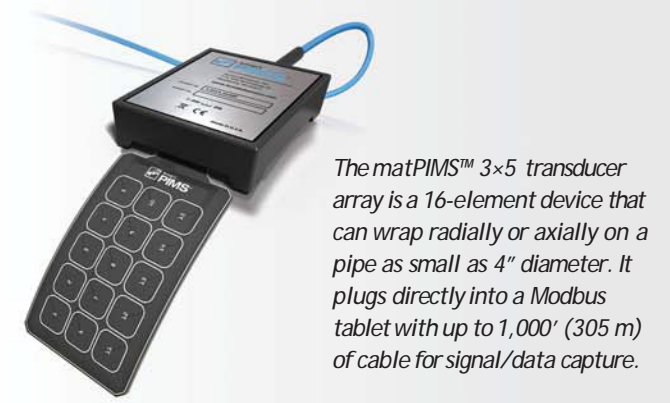
Best suited for:

- Situations where wiring is cost prohibitive or impractical
- Fully-automated and integrated data collection
- Measurement intervals less than twice daily
- Periodic repositioning

Cellular systems are battery powered, environmentally sealed, self-contained, CI, D2 safety rated and 100% autonomous. Programmed to turn-on at any desired periodic time interval and powering up to 8 dual-element or 16 single-element probes, the smartPIMS device transmits all data and measurements to the cloud/web portal. These units transmit the data using secure HTTPS-SSL encryption protocols.
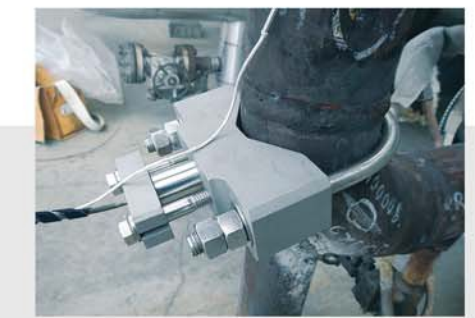
midstream

downstream

SNI's Pit-track™ hardware/software solution can monitor the growth of many individual pits with a high degree of thickness resolution.

Transducer model XD-201 is an ultra-high temp probe which can operate in 900° F (500°C) continuous-duty service. These probes and their temperature-measuring RTDs are mechanically clamped onto the plant asset.

smart PIMS™
Permanently installed monitoring system

Modbus

up to 32 daisy-chained transmitters per cable drop

maximum number of dual-element transducers per transmitter:

8

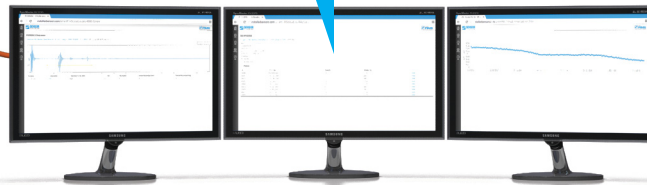*maximum number of single-element high-temp transducers per transmitter:*

16

networked to control room for continuous remote measurement

direct link to tablet PC for on-demand field datalogging

Remote, Permanently-Installed Wall Thickness Monitoring.

smartPIMS Modbus is an ultrasonic transducer network that can automate wall-thickness measurement and flaw monitoring of your most critical plant assets.

- Installation of up to 512 TMLs (or 256 dual-element probes) on a single multi-drop network.

- View real-time data from any connected tablet PC or your control room.

- Upload for cloud-based data viewing and analysis.

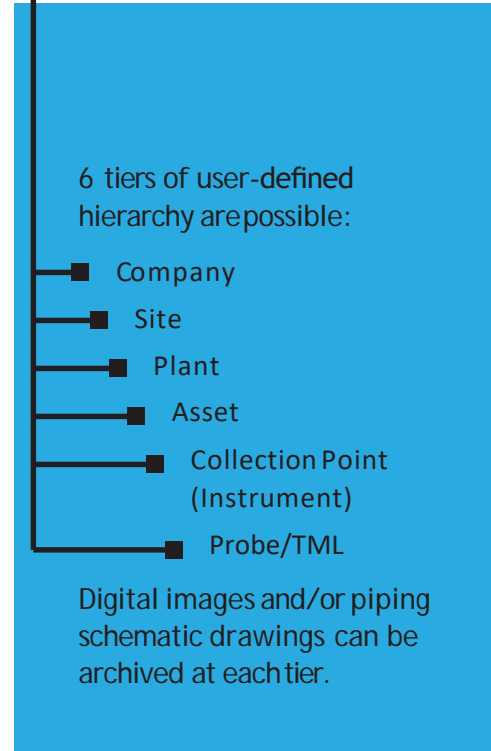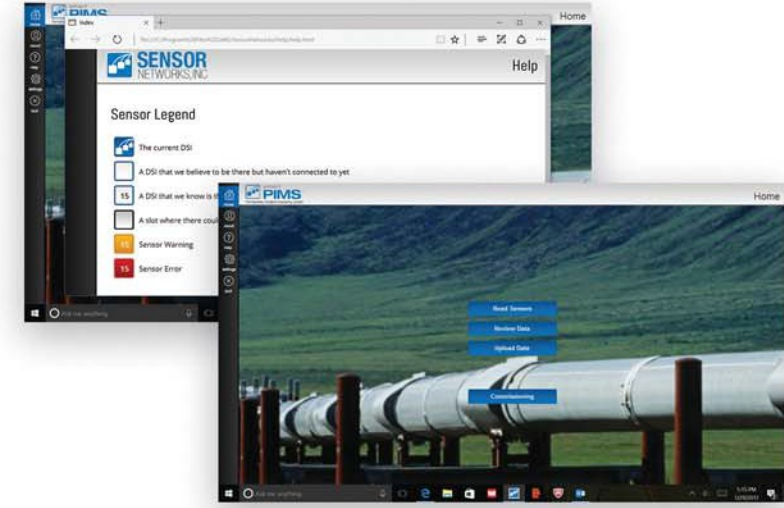**productivity**   **cost savings**   **data integrity**   **safety**

AWS-hosted cloud-based data management system for ultrasonic thickness measurements from installed UT sensors.
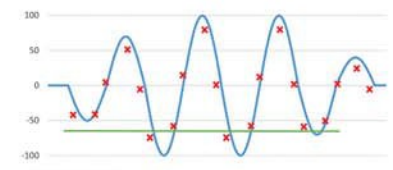
webPIMS can automatically or manually receive data from ultrasonic sensors for web-based display, storage, trending and analysis. Users can access this data from anywhere with an internet-enabled device such as a PC, tablet or smart phone.

An intuitive user's interface allows easy access to stored images or pdf drawings of the actual installed set-up. Temperature sensors at the TMLs record the asset's temperature while software automatically compensates for thermal changes.
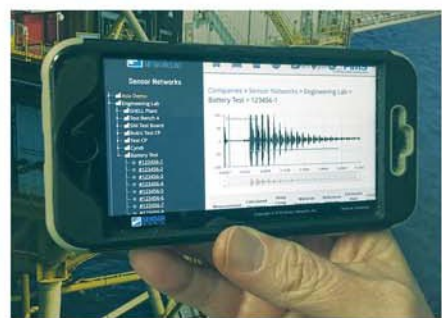
6 tiers of user-defined hierarchy are possible:

- Company
- Site
- Plant
- Asset
- Collection Point (Instrument)
- Probe/TML

Digital images and/or piping schematic drawings can be archived at each tier.

dataPIMS™ software is used for system setup, commissioning, calibration, data-logging, data-uploading and CSV file export.

The smartPIMS & webPIMS products store the digitized RF waveform from every thickness reading. Changes in wall thickness, due to corrosion and/or erosion, can be accurately trended while metal-loss rates are precisely calculated using statistical noise-reduction algorithms. Per-TML alarms can be set for either minimum thickness or a maximum metal-loss rate.

webPIMS data can be easily accessed from any mobile device or smartphone.

Executive Summary view shows the GPS location of your assets, the in-or-out-of-spec status and an exportable tabular summary with time / date stamp and temperature status. Ultrasonic test data can be automatically uploaded to this cloud app via SNI's cellular smartPIMS device, at any periodic time interval or manually via the tablet-based Modbus system.
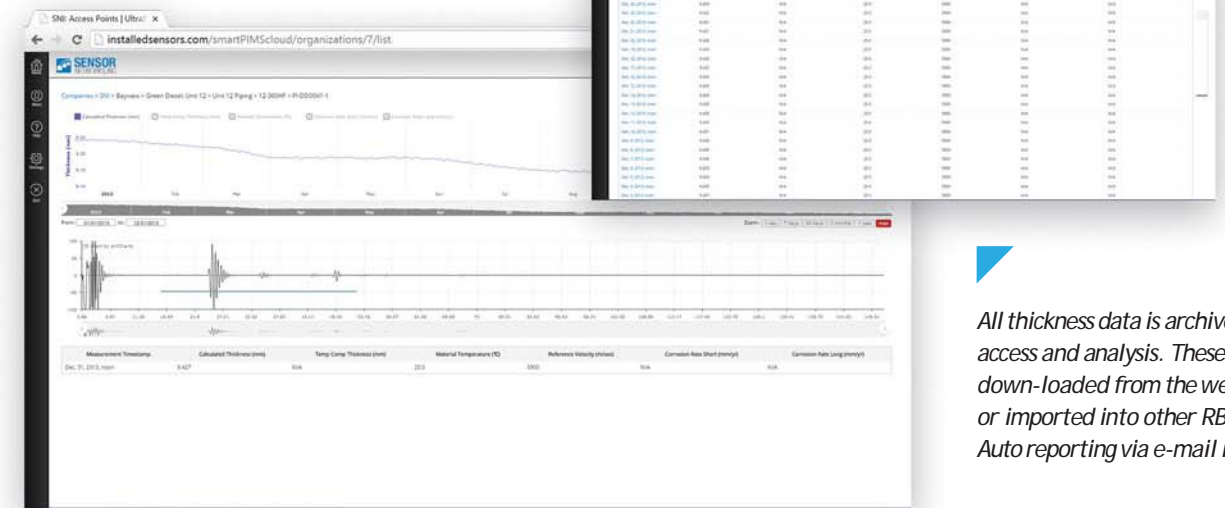
All thickness data is archived for easy future access and analysis. These files can be down-loaded from the web for further analysis or imported into other RBI software platforms. Auto reporting via e-mail is easily set-up.

smart PIMS®

cellular

transmitter

type	cellular (3G/4G-LTE)
encryption type	SSL
model no.	smartPIMS Cell
battery type	Li D-cell, 3.6 VDC, qty. 2
battery life	5 years (typical, based on 1 reading/day)

ultrasonic system

channels	16 ultrasonic, 1 temperature
pulser voltage	±5V bipolar square wave
analog frequency	1–10 MHz (-3dB)
gain	-10dB to +70dB
digitizer frequency	40 Msps
certification	Class 1, Div. 2

enclosure

type	instrumentation housing
material	aluminum
rating	NEMA 4X, IP66
temperature range	-4°F to + 140°F (-20°C to +60°C)
dimensions	5.44″ × 5.59″ × 5.11″ (138 ×140×130mm)
weight	5.2 lbs. (2.36 kg)

Modbus

transmitter

model no.	smartPIMS Modbus and Modbus DL

Modbus DL with batteries can collect and store 3,000 thickness readings.

protocol	Modbus
communication	RS-485, 2-wire, max. 1000′ (305m)
power	10-20 VDC
ultrasonic system and enclosure	[same as cellular model]

tablet datalogger

|		
performance	*processor*	Intel i5-4200U 1.6GHz w/ 3MB L3 cache (dual-core)
	memory	8 GB RAM
	storage	M2-SATA SSD, 64 GB
	operating system	Windows 10
connections		network power, data via RS-485-to-USB adapter
physical	*drop/shock resistance*	MIL-STD-810G
	environmental	IP65, 14–131°F (-10 to +55 °C)
	dimensions/weight	11.4″ × 7.48″ ×0.78″ /2.73 lbs.

transducer cable

type	co-ax, ¼″ dia.
maximum length to transducer	standard 10′ (3.0m), custom to 50′ (15.2m)

transducers

	single-element contact	dual-element contact	delay-line contact	matPIMS
model	XD-101	XD-301	XD-201	XD-401
application	general purpose	severe pitting	ultra-high temp	general wall loss
frequency	5 MHz	5 MHz	7 MHz	7.5 MHz
active area (dia.)	0.25″/6.35mm	0.375″/10mm	0.375″/10mm	0.25″/6.35mm
overall (dia. x h)	1.0× 1.0″ 25.4× 25.4mm	0.75× 0.75″ 19 × 19mm	0.8× 2.25″ 20.3× 57.2mm	1.0 × 9.12″ 25.4× 231.6mm
# of transducers	1–16	1–8	1–16	16 (1 reference, 15 active)
resolution	0.001″/0.025mm	0.001″/0.025mm	0.001″/0.025mm	0.001″/0.025mm
thickness range†	0.200-6.0″ 5.1–150.0mm	0.040-6.0″ 1.0–150.0mm	0.125-1.0″ 3.0–25.0mm	0.125-6.0″ 3.0–150.0mm
temp range	-5 to +150 °F -20 to +80 ℃	-5 to +300 °F -20 to +150 ℃	-5 to +932 °F -20 to +500 ℃	-5 to +150 °F -20 to +80 ℃
attachment	magnet/adhesive	magnet/adhesive	mechanical clamp	adhesive

†minimum resolutions stated as typical values, but will vary with pipe condition

135.43mm 5.33in
103.19mm 4.06in
143.33mm 5.64in
225.74mm 8.89in
129.86mm 5.11in
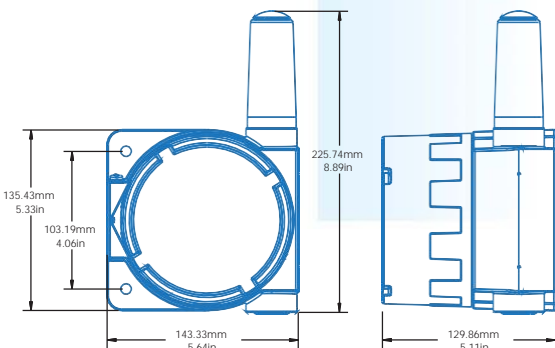
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