smart PIMS®
Permanently installed monitoring system

Remote Asset-Integrity Monitoring

Measuring Metal Loss with
Installed Ultrasonic Sensors & IoT

SENSOR® NETWORKS, INC
Inspection, Testing & Asset-Integrity Solutions

176-500 Technology Drive • Boalsburg, PA, 16827, USA
(814) 466-7207 • www.sensornetworksinc.com
offices in Houston, Hong Kong and Beijing

SENSOR® NETWORKS, INC
Inspection, Testing & Asset-Integrity Solutions

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.

Productivity advantage

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™.

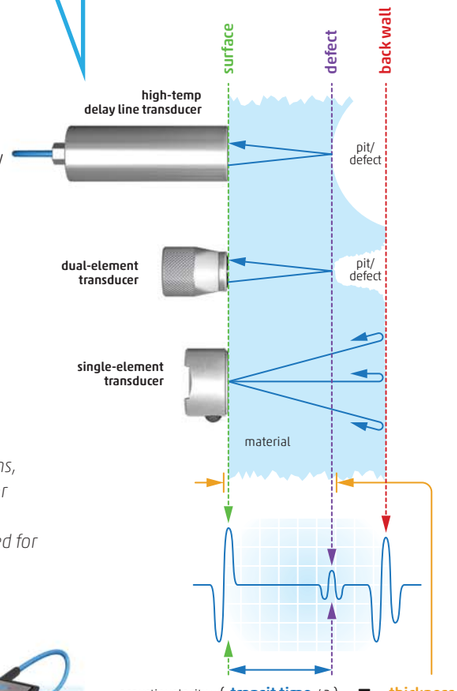
A fundamental tenet of any asset-integrity strategy is to accurately measure metal loss so it can be properly managed. Sensor Networks' smartPIMS provides that as a safe and cost-effect solution.

"Measure It, Manage It"

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.

- **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.**



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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.

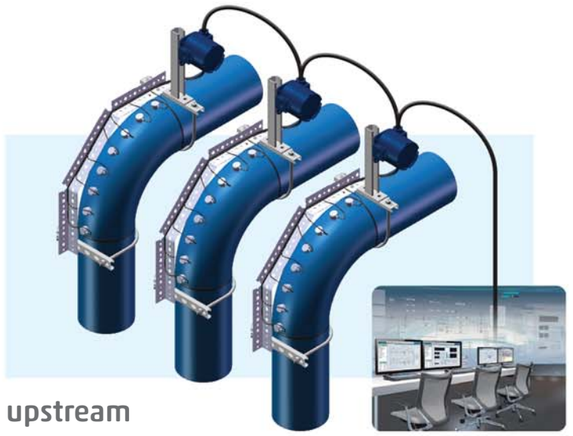
Flexible matPIMS linear or area arrays, with 16 ultrasonic elements can be wrapped around pipes and elbow extrados, with up to 1,000' (305 m) of cable.

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

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

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

downstream

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.

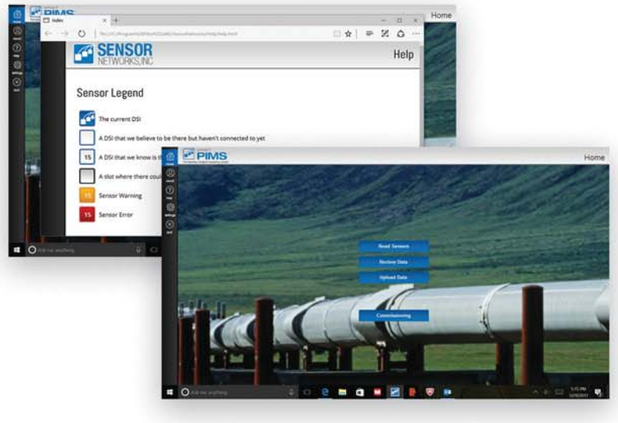
Data Flow & Management

with webPIMS™ and dataPIMS™

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.

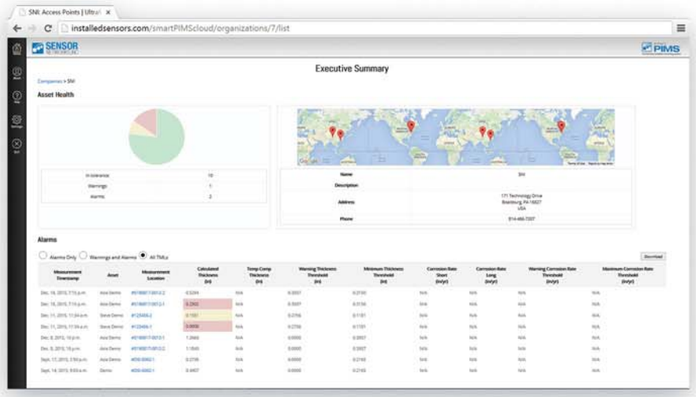


dataPIMS™ software is used for system setup, commissioning, calibration, data-logging, data-uploading and CSV file export.

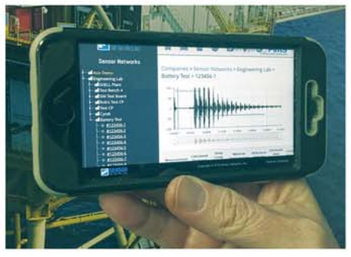
6 tiers of user-defined hierarchy are possible:

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

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

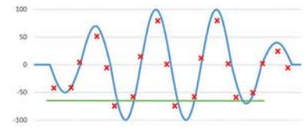


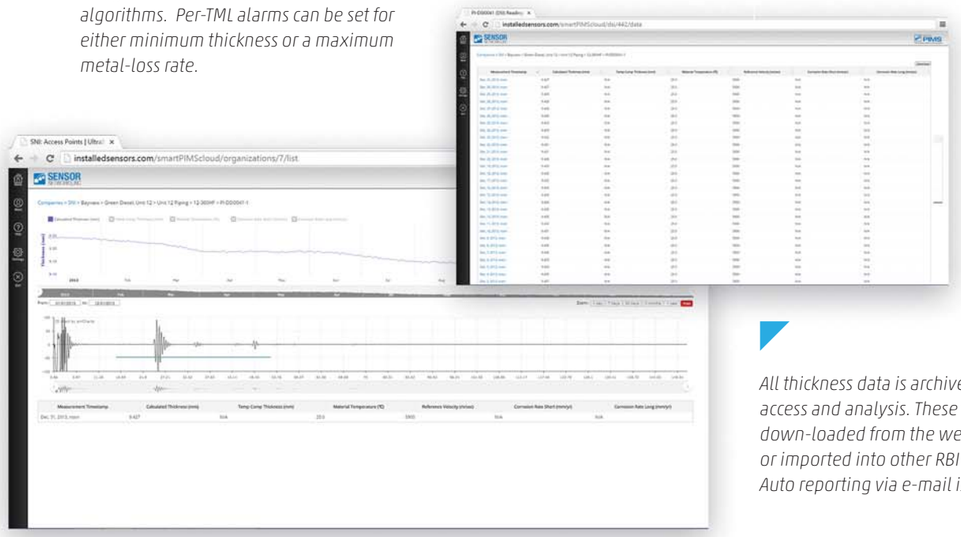
Executive Summary view shows the GPS location of your assets, the in-or-out-of-spec status and an exportable tabular summary with time / date stamp and temperature status. Ultrasonic test data can be automatically uploaded to this cloud app via SNI's cellular smartPIMS device, at any periodic time interval or manually via the tablet-based Modbus system.



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

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.





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® specifications

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]

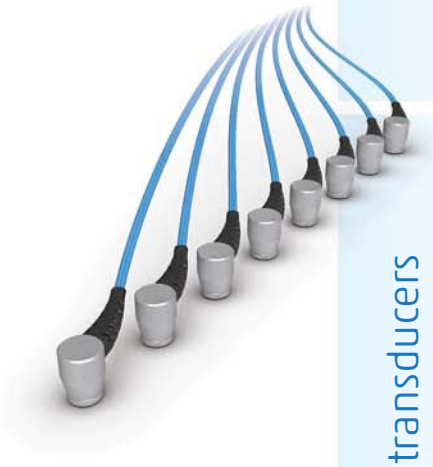
tablet datalogger

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.

transducers



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 × 25.4 mm	0.75 × 0.75″ 19 × 19 mm	0.8 × 2.25″ 20.3 × 57.2 mm	1.0 × 9.12″ 25.4 × 231.6 mm
# 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 °C	-5 to +300 °F -20 to +150 °C	-5 to +932 °F -20 to +500 °C	-5 to +150 °F -20 to +80 °C
attachment	magnet/adhesive	magnet/adhesive	mechanical clamp	adhesive

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