Remote Asset-Integrity Monitoring

Measuring Metal Loss with Installed Ultrasonic Sensors & IoT

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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.

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

Throughput advantage

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.

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

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-effective solution.

“Measure It, Manage It”

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.

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.
### 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.

**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.

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

### 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, O2 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.

**Transducer model XD-201** is an ultra-high temp probe which can operate in 980°F (530°C) continuous-duty service. These probes and their temperature-measuring RTDs are mechanically clamped onto the plant asset.
Data Flow & Management

AWS-hosted cloud-based data management system for ultrasonic thickness measurements from installed UT sensors.

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

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.

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 downloaded from the web for further analysis or imported into other RBI software platforms. Auto reporting via e-mail is easily set up.
### Transmitter Specifications

#### Model No.
- **SmartPIMS Modbus** and **Modbus DL**
- **Modbus DL with batteries** can collect and store 3,000 thickness readings.

#### Protocol
- **Modbus**
- **SmartPIMS DL** with batteries

#### Communication
- **RS-485, 2-wire, max. 1000’ (305m)**
- **Network power,** data via **RS-485-to-USB adapter**

#### Power
- 10-20 VDC

#### Ultrasonic System and Enclosure
- [same as cellular model]

#### Performance
- **Processor**
- Intel i5+4200U 1.6GHz w/ 3MB L3 cache (dual-core)

#### 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

<table>
<thead>
<tr>
<th>Transducer Type</th>
<th>Single-Element Contact</th>
<th>Dual-Element Contact</th>
<th>Delay-Line Contact</th>
<th>MatPIMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>XD-101</td>
<td>XD-301</td>
<td>XD-201</td>
<td>XD-401</td>
</tr>
<tr>
<td>Application</td>
<td>General Purpose</td>
<td>Severe Pitting</td>
<td>Ultra-High Temp</td>
<td>General Wall Loss</td>
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<tr>
<td>Frequency</td>
<td>5 MHz</td>
<td>5 MHz</td>
<td>5 MHz</td>
<td>5 MHz</td>
</tr>
<tr>
<td>Active Area (Dia.)</td>
<td>0.25”/6.35mm</td>
<td>0.375”/10mm</td>
<td>0.375”/10mm</td>
<td>0.25”/6.35mm</td>
</tr>
<tr>
<td>Overall (Dia. x H)</td>
<td>1.0 x 1.0”</td>
<td>0.75 x 0.75”</td>
<td>0.8 x 2.25”</td>
<td>1.0 x 9.12”</td>
</tr>
<tr>
<td># of Transducers</td>
<td>1-16</td>
<td>1-8</td>
<td>1-16</td>
<td>16 (1 reference, 15 active)</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.001”/0.025mm</td>
<td>0.001”/0.025mm</td>
<td>0.001”/0.025mm</td>
<td>0.001”/0.025mm</td>
</tr>
<tr>
<td>Thickness Range</td>
<td>5.1-150.0mm</td>
<td>5.1-150.0mm</td>
<td>5.1-150.0mm</td>
<td>5.1-150.0mm</td>
</tr>
<tr>
<td>Temp Range</td>
<td>-5 to +150 °F</td>
<td>-5 to +150 °F</td>
<td>-5 to +150 °F</td>
<td>-5 to +150 °F</td>
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<tr>
<td>Attachment</td>
<td>Magnet/Adhesive</td>
<td>Magnet/Adhesive</td>
<td>Mechanical Clamp</td>
<td>Adhesive</td>
</tr>
</tbody>
</table>

*Minimum resolutions stated as typical values, but will vary with pipe condition.

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