



COMPANY OVERVIEW

VERSION 1.2 (09.28.17)



Smarter Solutions For Your Complex Asset Integrity Challenges

sensornetworksinc.com

OVERVIEW

Smarter Solutions for your complex asset-integrity challenges

Contents:

- ❑ Intro: 2 – 4
- ❑ IS: 5 - 23
- ❑ UTS: 24 - 37
- ❑ RVI: 38 - 42



Ultrasonic Solutions

Applications Engineering
Customized Transducers
Standard Transducers

Non-intrusive Ultrasonic based Corrosion Monitoring Solutions



Semi-permanent Large area or discrete
point Corrosion rate/monitoring SW



Remote Visual

Inspection Cameras
Retrieval Tools
Sampling Tools



WHO WE ARE

WE OFFER

The very best minds in the highly specialized fields of ultrasonic and remote visual technologies

WE DELIVER

Smarter solutions with a refreshingly personalized approach for the world's critical asset-management applications

WE SPECIALIZE

In the design and fabrication of industrial remote visual, installed sensors and ultrasonic transducers and tooling for demanding in-situ test and inspection applications

COMPANY PROFILE

Offices

HQ: Boalsburg, Pennsylvania. Sales offices in Houston, Hong Kong & Beijing

Founded

October 1, 2014

Core Offering

Non-intrusive ultrasonic-based corrosion monitoring systems, ultrasonic transducers for automated & portable inspection, pan-tilt-zoom remote visual cameras & retrieval tooling

Business Model

Technology company with decades of experience focused on asset-integrity solutions

Patent Position

7 Patents Pending

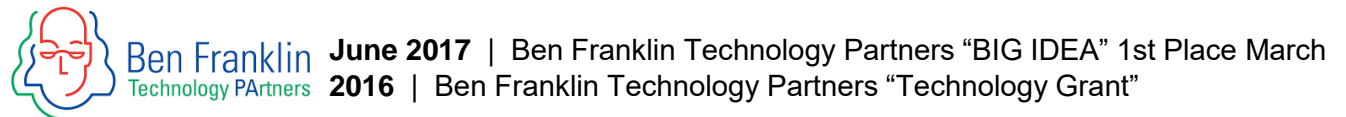
Employees

24

Key Customers



Awards



Non-Intrusive UT Corrosion Monitoring Meets The Internet of Things

... Seamlessly translate remote ultrasonic thickness measurements into on stream corrosion rates and asset integrity data used for real time infrastructure life extension, safety, & retirement projection ...

SOLUTIONS

Non-Intrusive UT Corrosion Monitoring



smartPIMS
Wired, data logger, or cellular | 16 channel capable

microPIMS
Single point sensors | 900 MHz wireless

matPIMS
Large area scalable mats | Permanently installed

webPIMS
Corrosion monitoring SW



SOLUTIONS

Data-Enabled Operational Efficiency

Corrosion Rate Monitoring

Accurate to .001" | High risk areas |
Historically problematic locations

Monitoring "Low Spots"

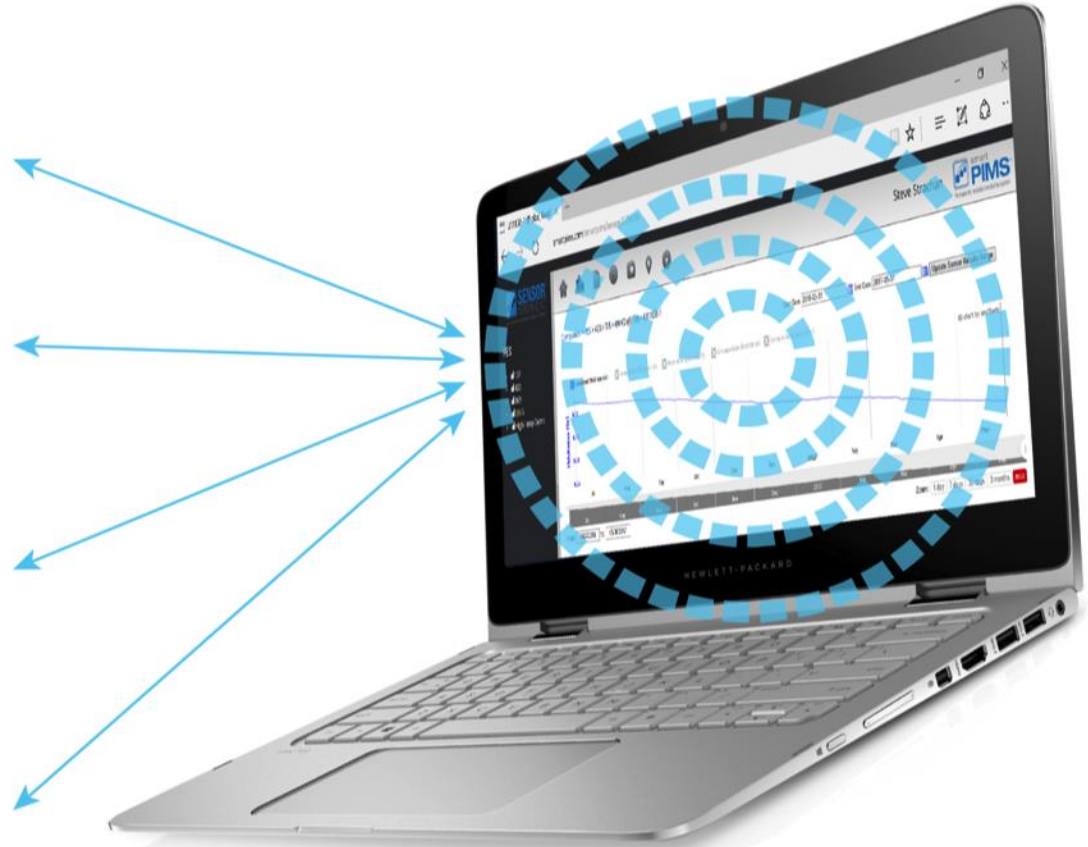
Post NDE screening of pits to monitor for T-min
| Thicknesses down to .040"

In Lieu of or in Conjunction w/ Intrusive Technologies

Validation of coupons, ER probes, etc. |
Reduce intrusive requirements

Cost Reduction

Reduce scaffolding & insulation prep |
Access to more and better data to improve
operations & efficiency



OVERVIEW

Applications

Refining & Petrochem	Crude Units, Vacuum Distillation Units, HF & Sulfuric Alkylation Units, Vessels & Spheres, Reducers & Elbows, Overhead & Transfer Lines, Injection Ports, Tube Sheets
Transmission & Distribution	Area Monitoring for Buried Assets, Microbiologically Induced Corrosion Monitoring (MIC), Un-pigable Lines, High Pressure Storage/Injection, Facilities & Compressor Sites
Mining	Slurry lines, Autoclaves, Mixing, Pumps/Vessels
Upstream & Production	Offshore Sand Monitoring, Slurry Erosion , U-bends T's & Risers, High Pressure Blow-out, Well Head Erosion Mgmt.
Power Generation	Flow Accelerated Corrosion (FAC), Grid Monitoring, High Point Vent / Gas Void, Emergency Service Water Line
Pulp & Paper	Boilers, Digesters, Fiber Lines, Cooking Zones, Screens & Blanks





Modbus Static



Modbus Data Logger



Cellular

	Modbus Static	Modbus Data Logger	Cellular
Communication	Modbus Wired to Tablet or DCS	Modbus Wired to Data Logger to Tablet	Wireless - Cellular to Cloud
Number of Sensors	16 Single or 8 Dual	16 Single or 8 Dual	16 Single or 8 Dual
Length of Sensor	10'/3m or 25'/7.6m	10'/3m or 25'/7.6m	10'/3m or 25'/7.6m
Sensor Temp Range	-30F to 900F (480C)	-30F to 900F (480C)	-30F to 900F (480C)
Sensor Accuracy	.001" / 0.025mm	.001" / 0.025mm	.001" / 0.025mm
Pipe Thickness Range	.040"/1mm - 4.0"/102mm	.040"/1mm - 4.0"/102mm	.040"/1mm - 4.0"/102mm
Haz. Loc. Rating	UL/CSA, CID2, A-D, T4	UL/CSA, CID2, A-D, T4	UL/CSA, CID2, A-D, T4
Installation	Permanent or Temporary	Permanent or Temporary	Permanent or Temporary
Installation Time	1-3 Hours	1-3 Hours	1-3 Hours
webPIMS Required	Optional	Optional	Required
Data Output	.xml/.csv or webPIMS	.xml/.csv or webPIMS	webPIMS to .xml/.csv

Safe

Non-invasive to the asset's pressure boundary

Absolute

Ability to directly measure remaining wall thickness or asset. NOT a proxy for wall loss

Accurate & Repeatable

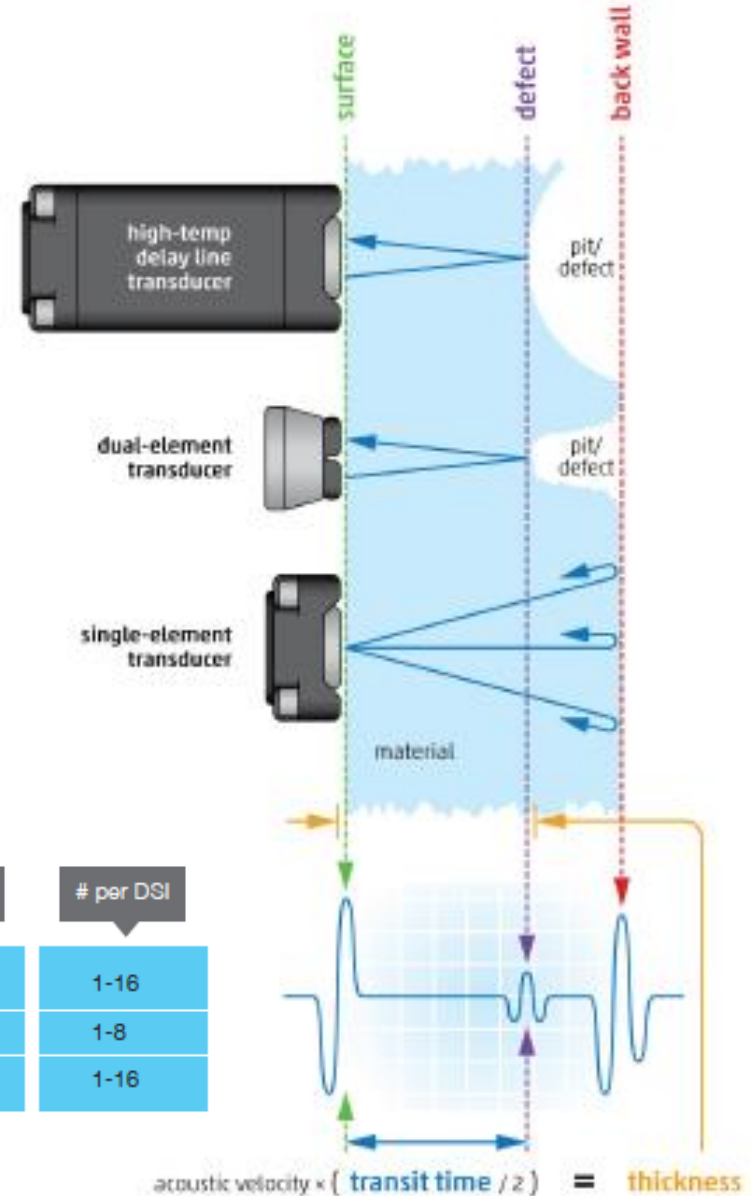
To 0.001" (0.025 mm), with ability to measure down to 0.040" (1 mm)

Rugged & Portable

Low recurring maintenance costs

Probes

Probe Type	Temp	Thickness Range	Msmt. Resolution	# per DSI
LT Single	-30F to 150F/66C	4.0"/101mm to 0.100"/3mm	0.001" / .025mm	1-16
LT Dual	-30F to 300F/150C	4.0"/101mm to 0.040"/1mm	0.001" / .025mm	1-8
HT Single	-30F to 900F/480C	1.0"/25mm to 0.125/3mm	0.001" / .025mm	1-16



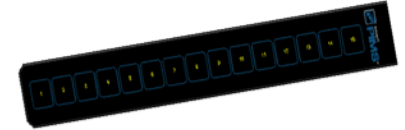
Scalable Area Monitoring



1x15 Array



3x5 Area



Custom

	1x15 Array	3x5 Area	Custom
Communication	Modbus Wired to Tablet or DCS	Modbus Wired to Tablet or DCS	Modbus Wired to Tablet or DCS
Number of Sensors	15 Live + 1 Reference	15 Live + 1 Reference	Up to 32
Length of Sensor	7.0"/17.8cm (L) 0.5"/1.3cm (W) 0.01"/.25mm (H)	2.5"/6.34cm (L) 1.5"/3.81cm (W) 0.01"/.25mm (H)	Up to 100"/254cm (L) Up to 14"/35cm (W) 0.01"/.25mm (H)
Sensor Temp Range	-30F to 150F (65C)	-30F to 150F (65C)	-30F to 150F (65C)
Sensor Accuracy	.001" / 0.025mm	.001" / 0.025mm	.001" / 0.025mm
Pipe Thickness Range	.1"/.25cm - 2"/5cm	.1"/.25cm - 2"/5cm	.1"/.25cm - 2"/5cm
Haz. Loc. Rating	Not Rated	Not Rated	Not Rated
Installation	Permanent	Permanent	Permanent
Installation Time	1hr / 24hr Bond	1hr / 24hr Bond	1hr / 24hr Bond
Data Output	.xml/.csv or webPIMS	.xml/.csv or webPIMS	webPIMS to .xml/.csv

webPIMS

Web-Based Management Software

Corrosion management SW

Trend, monitor, analyze, report
View waveforms (A-scans)
GPS sensor locations

Corrosion RATE analysis

Set alarms & notifications
Remote collaboration w/ experts
Access data from anywhere

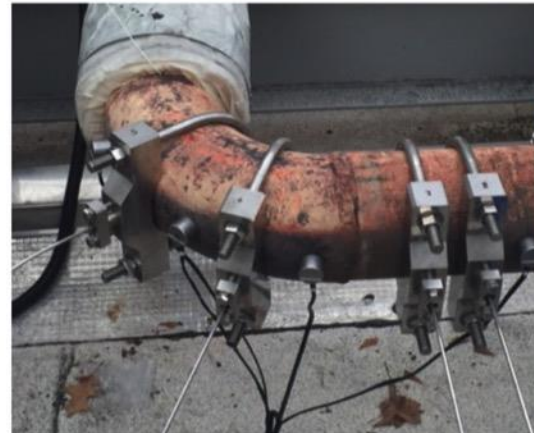
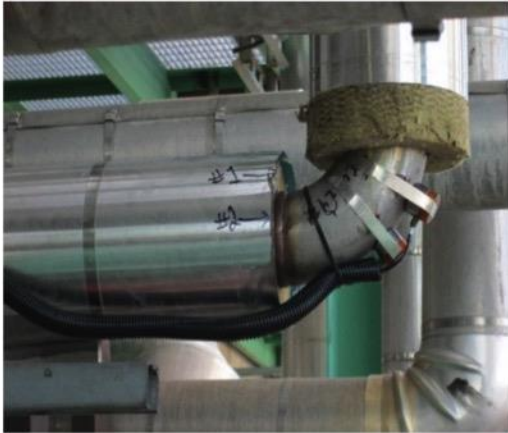


SAMPLE DATA

Monitoring & Trending Using webPIMS



INSTALLATIONS



LT Singles

- Temporary: Stopaq (up to 150F/65C)
- Permanent: Epoxy (up to 150F/65C)
- Each probe can be mounted using magnetic housing, strap, or band
- Insulate over top or buried

Mid Range Duals

- Temporary: Stopaq (up to 200F/93C)
- Permanent: Epoxy (up to 300F/150C)
- Each probe can be mounted using magnetic housing, strap, or band
- Insulate over top or buried

HT Singles

- Temporary OR permanent: Dry couple using foil, probe housing & band clamp
- Temperature ranges: -40°F-900F/480C

INSTALLATIONS



Long Term (Permanent)

Epoxy used as adhesive & couplant
Max temp: 150F/65C



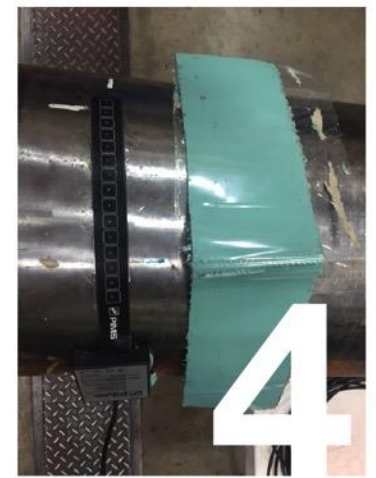
1



2



3



4

4-Step Process

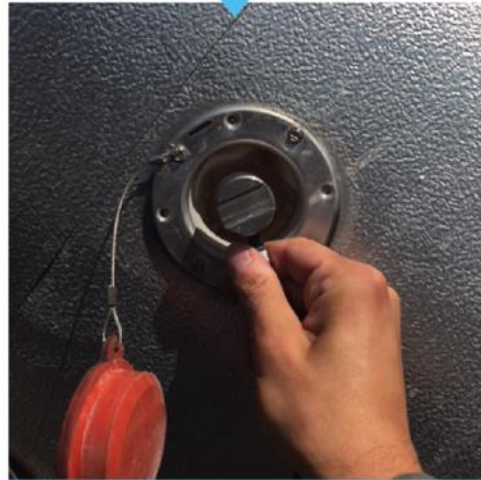
1. 80/100 grit finish ... no coatings |
2. Dispensing gun used to spread two-part epoxy over sensors
3. Magnets placed on sensors while drying |
4. Wrap / cover entire area (strip & prepped area) and run cable top of grade

CASE STUDY

Manual vs. Installed Sensor Data



Installed Sensor Read CML



Manually Read CML



Asset owner selected two CMLs to monitor manually and using installed sensors over 1-yr. time period. Manual readings were taken bi-monthly vs. installed sensors readings taken once per day. After one year, readings were plotted on the same chart for comparison...

CASE STUDY

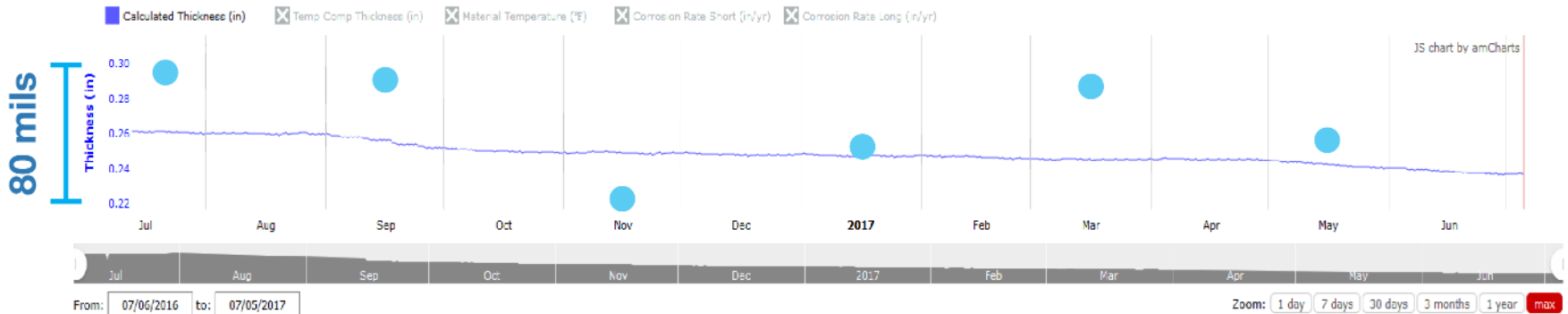
Manual vs. Installed Sensor Data

Navigation icons: Home, Bar Chart, Document, Information, Camera, Location, Gear. | Represent manual UT readings

smart PIMS
Permanently installed monitoring system

Companies > [Redacted]

Start Date: 2016-07-06 | End Date: 2017-07-06 | Update Sensor Results Range



Manual UT Results

Precise: No | Accurate: Maybe | Repeatable: No
Corrosion Rate: Undiscernible
6 readings x \$75/CML = \$450 for 1 yr

Installed Sensor Results

Precise: Yes | Accurate: 0.001" (1 mil) | Repeatable: Yes
Corrosion Rate: ~20mpy (~10mils loss in Sept-Oct)
6 readings x \$75/CML = \$450 for 1 yr

APPLICATIONS



CASE STUDY

Pipeline Integrity | Liquid Line

Operator performed ILI using a smart pig to inspect a segment of their crude oil pipeline.

The ILI report showed a number of pits which were not present the last time the ILI was completed.

The operator wanted to know if the pits were episodic in nature or were growing (if so, at what rate).



Application

Asset integrity post inspection

ILI run was performed, DA is executed, inspection company evaluated and marked pits

SNI installed probes on exact pits called out by inspection

Product Used

smartPIMS Modbus configuration w/ 8 dual element probes permanently attached to monitor pits

smartPIMS systems are completely buried after DA is complete

Operator will send personnel to defined locations quarterly to collect data w/ tablet

Outcome | Operator did NOT have to fix / repair, kept line running and continue normal ILI inspection intervals | Saved \$750K material/labor & ZERO downtime

CASE STUDY

Refinery | Overhead Lines



Overhead Line

New Vacuum Distillation Unit (VDU) installed, needed corrosion RATE data

Too expensive to manually inspect due to scaffolding/rope access cost

Too expensive to heat trace and insulate

Were not getting trustworthy data from ER probe (had to replace line ahead of schedule)



smartPIMS Cellular

8 permanently installed dual element probes

Readings once per day

Installation at four locations took one day and customer was collecting data

Outcome |

Avoided scaffolding & repeated inspection cost | Access to data 24/7
Saved \$750K in steam trace & insulation

CASE STUDY

Pipeline | Area Monitoring



Natural Gas Line

Operator had to replace a portion of the pipeline due to internal corrosion

Corrosion team could not understand the cause of the failure and wanted to ensure they had a way to monitor the area should the same issues arise again



matPIMS

While asset was still uncovered, inspection team installed three matPIMS at different locations along 6 o'clock position of the pipe where previous corrosion formed

Sensors buried

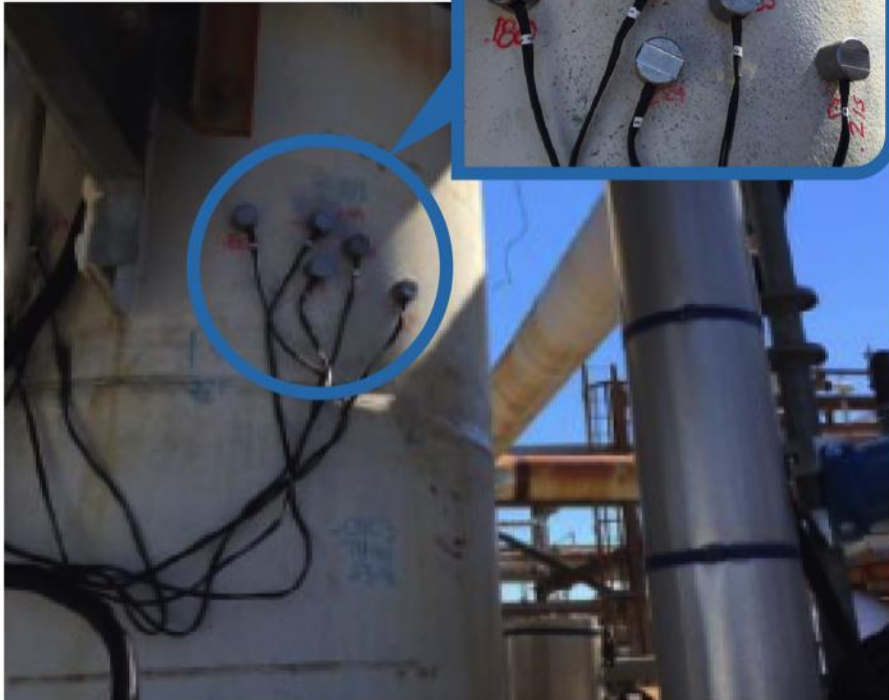
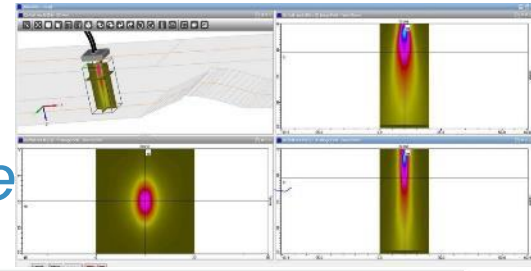
Technician is sent quarterly to manually collect readings from each matPIM

Outcome |

Customer now has access to corrosion data w/out having to excavate OR send ILI tools | Maintain regular inspection intervals (save ~\$250K/tool run) | Installs matPIMS for regulatory purposes during every dig

CASE STUDY

Low-spot Pit Tracking™ With 3 mm-beam spot size



Vessel Monitoring

Sulfuric Acid Alkylation unit routine inspection discovered significant pitting which was near T-min

Operator was sending UT technicians daily to map low spots to determine rate they were thinning

Was costly, putting inspection group behind schedule, and readings were not consistent/reliable operator to operator

smartPIMS Cellular

8 temporarily installed dual element probes

Readings once every four hours

Installation took two hours

Outcome |

Saved >\$100K in inspection | Kept unit safely operating until scheduled shut down | Was able to redeploy smartPIM equipment on different asset

CASE STUDY

HF Alkylation Unit

Manual & infrequent HF Alkylation Unit inspections cost were extremely high & data was inconsistent

Asset owner could not confidently predict health status of unit due to varying corrosion rates, so they installed a cellular smartPIM w/ 8 sensors



Outcome | Found accurate corrosion rates for each orientation of the HF piping and able to EXTEND useful life of asset | Saved estimated \$10.4M in turn-around cost

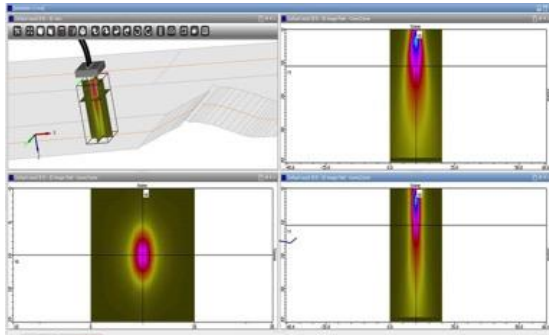
OVERVIEW

Ultrasonic Solutions



Customized Transducers

Standard Transducers



Applications Engineering

OVERVIEW

Applications Engineering and Integrated Ultrasonic Solutions



Instrument Agnostic

Reference Standard Dev.

Transducer & Fixture

Procedure & Training

Conventional Transducers

- Utilizing state-of-the-art piezo-composite elements
- Offered with Quick Swap wedges for shear-wave weld inspection
- New MCX-style, low profile, swivel connectors
- Wide variety of sizes and frequencies
- Shipped with certification documents
- RF waveform, frequency spectrum, average center-frequency calculations



SENSOR NETWORKS, INC.
 175-600 Technology Drive
 Bozberg, IL 10022
 Phone: 814-666-7207
 Website: www.sensornetworks.com

Transducer Information
 Part Number: 00-00377
 Serial Number: U12106
 Transducer Description: 9 Inverse, 10
 10MHz/25° HR, 9

Transducer Measurements per ASTM E2106
 Frequency: 10 MHz
 Element Size: 20°
 Date: Jul 16, 2017
 Operator: JSA/PM
 Transducer Description: 9 Inverse
 Calibration Method: PASS
 Center Frequency: 9.98MHz
 6dB Bandwidth: 72.20%

Test Setup & Conditions
 Test Transducer Number: TP
 Test Object: 1" A50 to A57
 Pulse Repetition Rate: 4
 Pulse Amplitude: 1-10VZ
 Pulse Energy: 9
 Damping: Pulse Echo
 20 + 1
 30 MHz
 1 MHz

Receiver Settings
 Mode: Low Pass Filter (MHz)
 Gain: High Pass Filter (MHz)
 Customer:

RF Waveform Image
 Image of Transducer

Frequency Spectrum

Test Equipment
 Probe Receiver: RA D97100
 Probe Serial Number: 040790
 Probe Calibration Date: Sep 13, 2017
 Oscilloscope Model: 40003034
 Oscilloscope Serial Number: 021129
 Oscilloscope Calibration Date: Oct 4, 2017
 Software: 3.8
 Cable: 6T 60124

*Please reference Transducer Part Number and Serial Number in any correspondence



Customized Transducers



Using industry-preferred design and simulation tools to create an optimized mechanical, electrical and ultrasonic model of the inspection task, including its scan plan

SolidWorks to CAM and 5-axis CNC

- Parametric 3D CAD
- Mechanical Properties Modeling

AutoCAD

- 2D CAD and Ray-tracing

CIVA

- Acoustic Beam Modeling and Delay Law Calculation for Conventional and Phased Arrays

PiezoCad & Field II

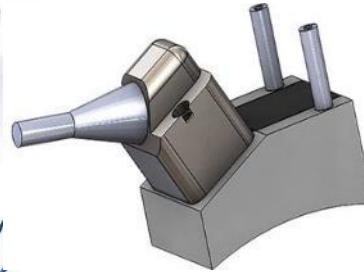
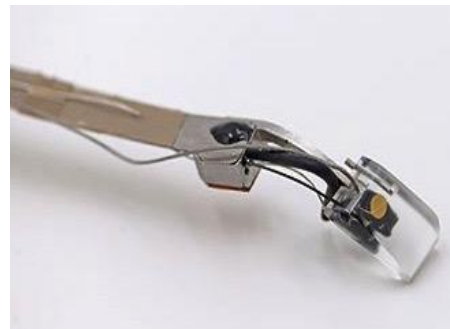
- Transducer Construction & Performance Modeling

UltraVision 3D

- NDT data imaging and analysis software for Conventional and Phased Arrays

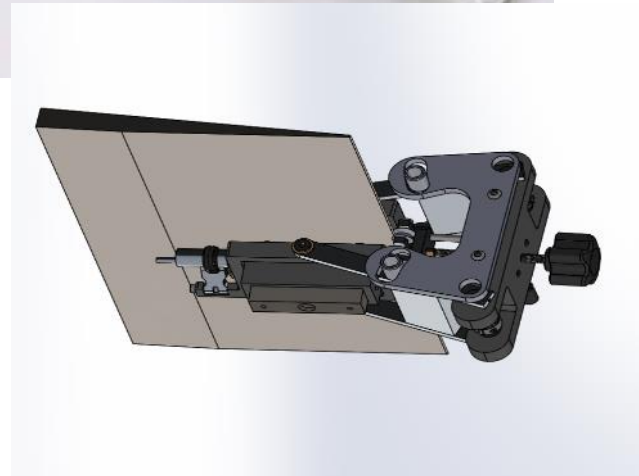
ES Beam Tool

- Ultrasonic Inspection Plan Design and Validation Software



Aerospace & Nuclear Power Applications

- In-Situ
- Phased Array
- O.D. Transducers
- Pulse-echo Arrays
- ASME Section XI
- Compound-radius Wedges
- 7 MHz Ultra-high-temp Delay Line
- SensorScan™ QS
- Small-diameter (< 0.25" / 6mm) ID Bore Probes
- 2 MHz PAUT Dual



Self-aligning wand and T-T fixtured PAUT transducers for hard-to-access rotating equipment and composite material inspections

- ↙ 1-20MHz
- ↙ 0.1- 0.5" diameters
- ↙ Conventional shear-wave and PAUT types
- ↙ Available options: single-axis articulation, integral couplant delivery and CCTV



Linear & Matrix Models

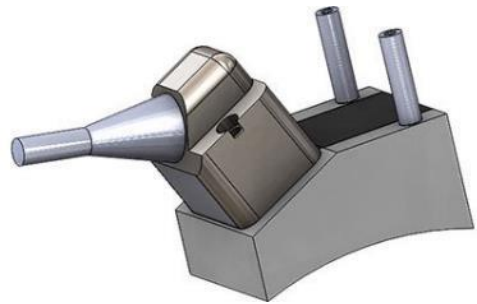
- ↪ Annular, Daisy & Circular
- ↪ Contact & Immersion
- ↪ Single & Dual
- ↪ Flat & Curved

O.D. Transducers



For tubing weld or braze joints

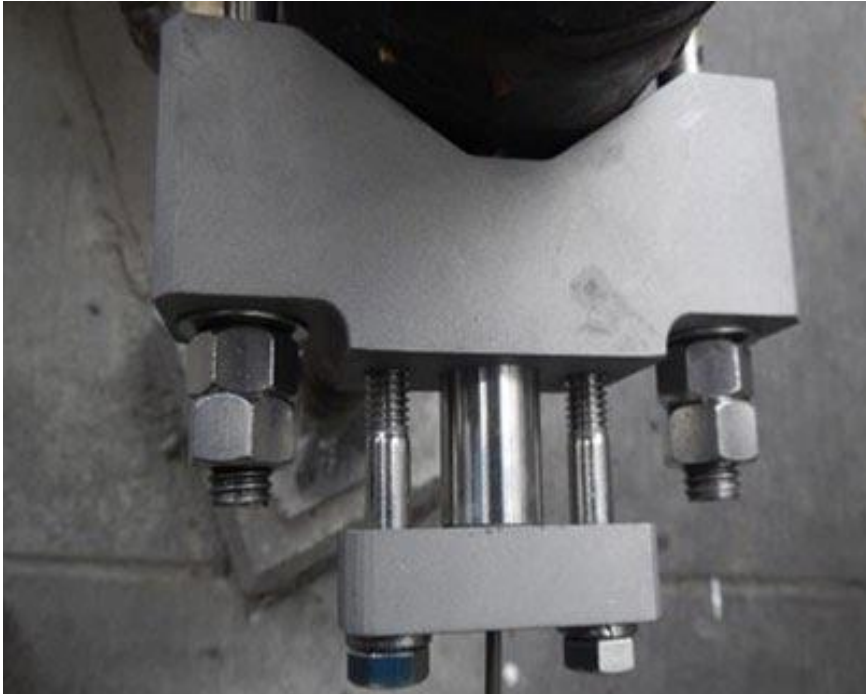
- ↪ Clip-on fixture with integral transducer and couplant supply improves POD and consistency
- ↪ Scalable to any size tube or pipe O.D.
- ↪ Normal-incident longitudinal or angle-beam shear wave
- ↪ Any frequency



Compound-Radius Wedges and TOFD

- ↙ Refracted longitudinal
- ↙ Phased-array duals
- ↙ Contact or immersion
- ↙ TOFD
- ↙ Complex wedges & delays with integral couplant-irrigation channels

Delay Line



7 MHz Ultra-high-temp

- ↶ Transducer and mounting clamp
- ↶ Continuous duty at 500°C (932°F)
- ↶ Delay-line type using gold foil for acoustic coupling

CONVENTIONAL TRANSDUCERS



SensorScan™ QS

Conventional transducers for
Quick Swapping onto delay
lines or wedges

AWS Transducers &
Wedges incl. PAUT



Small-diameter (< 0.25" / 6mm)

↩ Shear-wave

↩ L-wave

↩ Duals

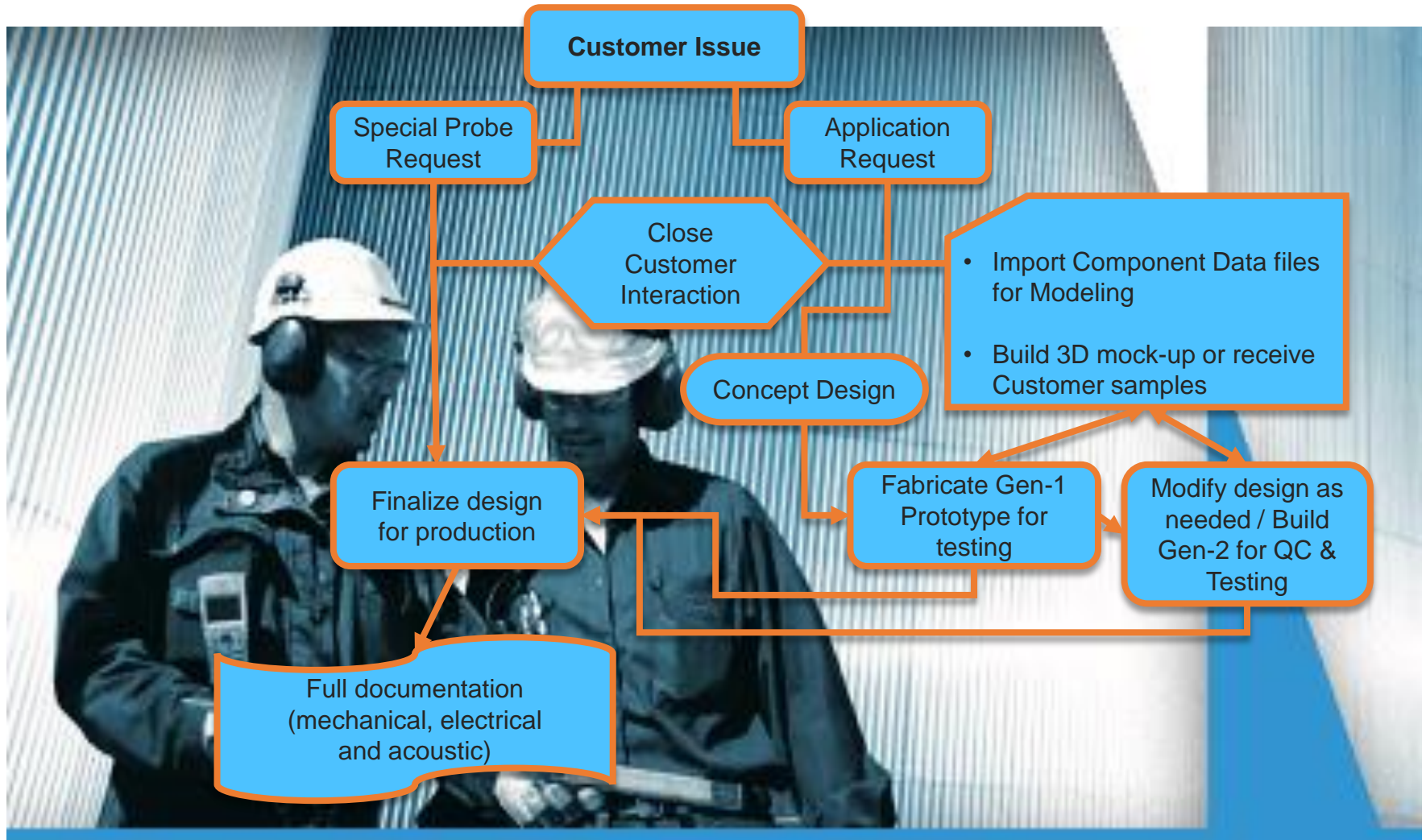
↩ Tandem

Phased-array duals & wedges

With 2 x 16 elements per probe and detachable wedge



Our Process



SOLUTIONS

Remote Visual Tools



Inspection Cameras

Retrieval Tools

Sampling Tools

Specializing in visual inspection technologies, Foreign Object Search and Retrieval (FOSAR) tools and custom design services



**Portable, Industrial, Waterproof
Rugged, Intuitive, Field Hardened**

A Pan-Tilt-Zoom-Lights, High-Resolution
Color Video Inspection System

- ↗ State-of-the-art CCD Camera with white LEDs. > 1700 lumens of cool white-light.
- ↗ Add-on auxiliary lighting to brighten the darkest of environments

Loaded with features to efficiently inspect tanks, vessels, drums and other large areas & confined spaces including piping systems

Loose-Parts Retrieval



Complete Retrieval Tool Kits
and Standard Tools for
FOSAR: Foreign Object
Search and Retrieval



- ↪ Including: alligators, magnets, snares, grippers and more
- ↪ Made of rugged, polished stainless steel construction
- ↪ Submersible and portable

Ideal for hazardous environments and confined spaces

loose parts retrieval tooling

Sampling of items retrieved

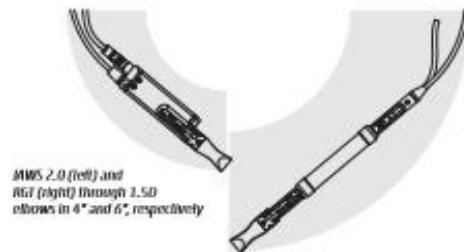


jaws

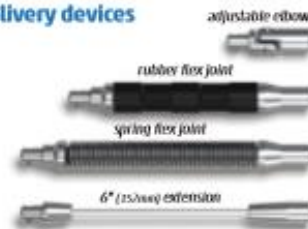
left to right: sampling cups, curved serrated jaws, fork & live, pliers, magnet, snare, hook



below: standard retrieval tool kit



delivery devices





THANK YOU!

Bruce Pellegrino – VP Marketing



Smarter Solutions For Your Complex Asset Integrity Challenges

sensornetworksinc.com