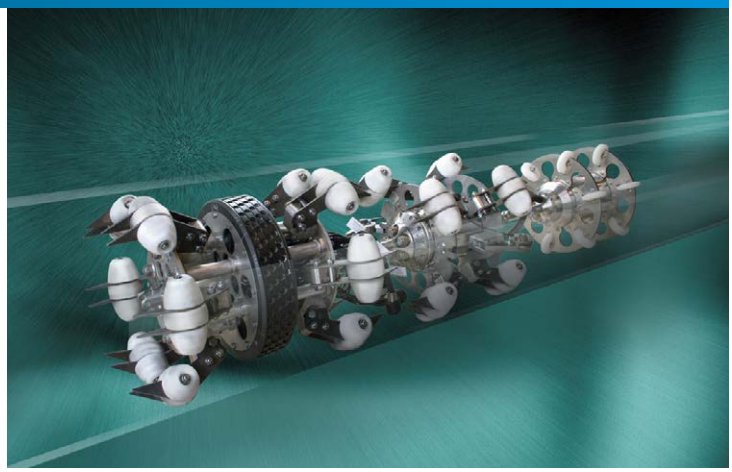
Ultrasonic Robotic Inspection Solution

High-Resolution Crack Detection (Circumferential Shear Wave)

- Accurate and precise feature classification and sizing
- Remotely controlled crawler module with bidirectional motion
- The inspection system allows for combining technologies
- Unlimited power and real-time data through cable connection
- Economical in-service inspection with a single entry/exit point

Cracking in pipelines can occur in any stage of its lifecycle, during manufacturing or operation.To manage these threats most pipelines can be inspected using off-the-shelf in-line inspection (ILI) solutions, for example with UT crack-detection tools. However, there are pipelines that are not designed or operated for the use of a conventional ILI tool. They can be classified as "challenging" ("unpiggable") for various reasons, including single access and limited pumping abilities. Modification of these pipelines to enable standard ILI procedures can be both expensive and technically complicated.



Solution

The inspection and crack inspection of these pipelines is made possible using a bi-directional robotic inspection unit, which specifically addresses the challenges of single access and limited pumping abilities. The robotic crawler is powered and connected via a tether, allowing it to travel both forward and backward through bends for up to 24 km (14.9 mi) consistently showing valuable high-resolution data in real time.

The bi-directional capability is achieved through adapting the sensor-carrier, electronics and data-storage modules into light-weight low-friction modules and combining them with a powerful wheel-driven crawler. The tether supplies electrical power to the tool, bringing the collected data to the control unit at the launching site. This allows for remote steering of the crawler and acts as a means of recovery in emergencies.

The ultrasonic shear wave/angular beam technology for this solution can be calibrated for axial and circumferential feature detection and is performed by ASNT qualified personnel and ATEX Zone 2 certified equipment. Using the valuable data, certified data analysts provide a final report according to POF, API 1163 and agreed boundary conditions.

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Advantages of the System

- Accurate and precise feature classification and sizing by ultrasonic measurement
- Two sets of data (on both the inbound and outbound run) mean double coverage
- Real-time data availability and preliminary report on-site, followed by a thoroughly reviewed final report
- Economical in-service inspection with a single entry/exit point and no pumping required
- Unique tool configurations addressing individual operational requirements

Remarks and Features

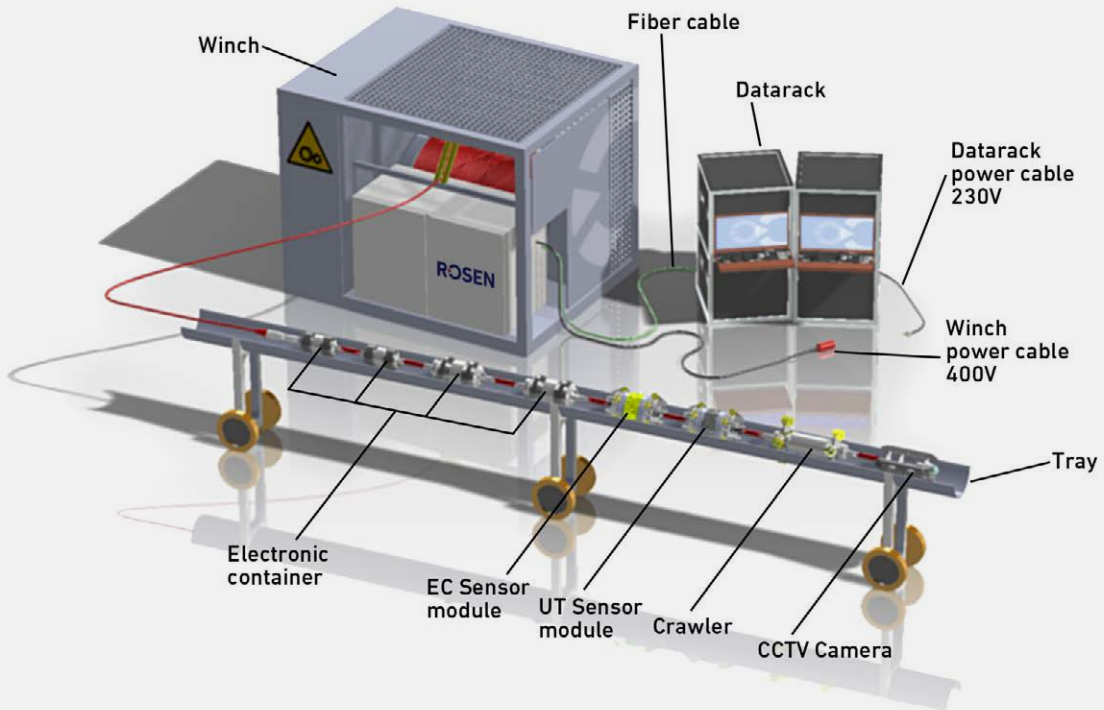
- Tool for axial cracks on request
- Other tool sizes available on request
- Tailored solutions with different specifications available
- API 1163 certified services
- CE and ATEX certification available for winches
- Contact ROSEN for more detailed information about the presented service
- Specifications subject to change, depending on specific requirements and tool configurations

Standard Services

- ≥ 9" (dual-/multi-diameter on request)
- Geometry and wall thickness inspection

Optional Services

- Post ILI – data alignment and combined evaluation
- Integrity assessments – RBI, FFP, CGA
- Easy-to-use visualization software
- On-board camera (for use in clear product)
- Grinding machine



Technical Specifications

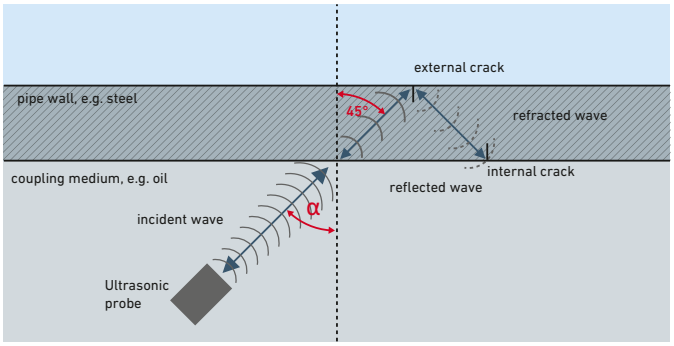
Standard Operating Specifications

Tool sizes available	9"–48" (56")
Pipeline product	Liquids
Product temperature range	Up to 60°C (140 °F)
Maximum operating pressure	12 MPa (1740 psi) depending on tool, typical pipeline out of operation
Operating speed range	Up to 0.1 m/s (0.22 mph)
Wall thickness range	0.2" – 0.9" (5 mm – 22 mm)
Minimum pipeline bend radius	1.5D
Maximum operating time	Unlimited

Note: Contact ROSEN for more detailed information.

Location and Orientation Capabilities

Axial position from closest weld	±4" (±0.1 m)
Circumferential position accuracy	±5° for d ≥ 20", else ±10°



		Isolated radial cracks with axial orientation		Colonies (e.g. SCC colonies)
		In pipe body, minimum length 25mm (1.0")	**In longitudinal weld area, minimum length 25mm (1.0")**	**In pipe body, minimum length 25mm (1.0")**
Minimal depth at POD 90%		1mm (0.04")	2 mm (0.08")	1mm (0.04")
Depth sizing accuracy at 80% certainty	**for depth <4mm** **for depth ≥4mm**		±1mm (0.04") reported as 4mm (0.16")	
Length sizing accuracy at 80% certainty			±10 mm (±0.39")	
Width sizing accuracy at 80% certainty		n/a	n/a	±30 mm (1.18")
Orientation limits for detectability (°to pipe axis)	**Detection** **Detection and sizing**	-18° < 0° < +18° 0°	-18° < 0° < +18° 0°	n/a
Inclination limits for detectability (°to pipe surface)	**Detection** **Detection and sizingv**	40° to ≤90° 90°	40° to ≤90° 90°	n/a

Note: The above values represent the capabilities of the ILI service and are valid for straight pipe.
These values are no reporting thresholds and can deviate for specific ILI tools and specific essential variables

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