

PII Pipeline Solutions
a GE Oil & Gas and Al Shaheen joint venture

Crack Management

Pipeline inspection and integrity services



Protect the future of your pipeline

We provide a comprehensive range of crack inspection services for pipeline operators. Our inspection tools and data analysis draw on an extensive history of technological innovation and in-field success. For more than 35 years, we have identified and measured key injurious crack defects in liquid and gas pipelines, under diverse conditions worldwide. The information gathered thus far helps you move beyond detection – to integrity management solutions.

The nature of crack detection

Every crack, regardless of its type or origin, weakens the structural integrity of your pipeline. There are many types of cracks, including Stress Corrosion Cracking (SCC), fatigue, Hydrogen-Induced Cracking (HIC) and Sulfide Stress Cracking (SSC). They occur in the base material of the pipe, in welds and in heat-affected zones, and can develop from dents or other defects. Since each type exhibits distinct attributes and growth characteristics, accurate and timely crack detection is a major challenge.

Specialized inspection capabilities are essential in order to identify and accurately describe cracks, and PII Pipeline Solutions, a GE Oil & Gas and Al Shaheen joint venture, offers four proven crack detection services for this critical task. Our advanced ultrasonic and magnetic technologies obtain accurate descriptions in the widest range of pipe diameters and wall thicknesses for gas and liquid pipelines. Our experienced analysts then use sophisticated software tools and the industry's largest database of pipeline anomalies to produce reports that are clear and actionable.

Going beyond crack detection

It is valuable to integrate detection capabilities with integrity solutions that explicitly address tool performance and the critical crack sizes of your pipeline. By providing both high-quality inspection and assessment services under one roof, PII helps ensure the seamless integration of appropriately customized detection, integrity assessment and optimized remediation.

Our crack management capabilities are highly reliable and cost effective. We can help you more accurately determine the risks involved in each case and substantially reduce the number of excavations necessary for validation and repair.

Primus USCD client

Primus USCD Client reporting software gives our clients a powerful examination tool for crack detection (CD) data collected by our UltraScan™ and EmatScan™ in-line inspection tools. It enables easy viewing of all reported features as well as the complex underlying signals and scans. It can also load data from multiple inspections for parallel access and comparison using a variety of visualization, navigation and listing utilities – including top-down signal visualization, data scrolling, absolute and relative positioning, plus numerous listing display and export options.

Pipeline Integrity Crack Assessment (PICA)

PICA is a three-step process for crack management: assessment optimization, integrity assessment through inspection, and crack evaluation services. Our assessment optimization process is tailored around your operational needs – from tool choice and deployment to crack evaluation and reporting methodologies. We evaluate the detection needs of your pipeline based on the critical crack sizes, growth rates, operational conditions and budget. We also document the justification for your choice of assessment.

The crack evaluation service assesses crack-like features detected by the inspection. It establishes the pipeline's integrity at each feature, the desired operating pressure, as well as developing a cost-effective remediation plan and re-inspection interval. Our evaluation follows the Failure Assessment Diagram (FAD) procedures of industry standard API 579-2000 (USA) and British Standard BS 7910. You can choose between three assessment levels designed to meet various needs – from Fitness-for-Purpose with minimum supporting data, to structural/material specific and reliability-based life predictions.

Our FAD-based method has been tested against non-FAD crack assessment methods currently used in the pipeline industry, and has been shown to give more reliable and more consistent results.



Single SCC

Single cracks grow at the steel grain boundaries in the presence of stress, coating damage (soil plus moisture), temperature, etc.



SCC Colonies

Single cracks grow in length and coalesce with others to produce much longer, wider cracks. Parallel cracks begin to develop.



Fatigue/Toe Cracks

Long, very tight cracks develop at the toe of the weld under the action of pressure cycling from within the pipe.



Hook Cracks

Manufacturing defects found in pre-1970 ERW pipe and A.O. Smith Flashweld pipe.



Lack of Fusion

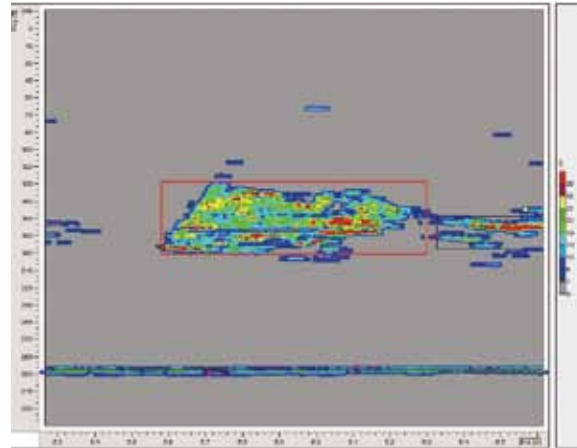
Poor control of welding process causing lack of fusion within the weld.



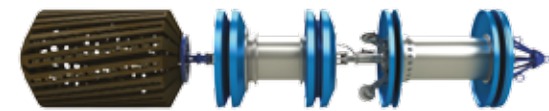
Dents with Cracking

Mechanical damage to pipe causes denting and localized work hardening that later results in cracking.

Better data. Safer pipelines.



Developed view of a pipe section with SCC.



UltraScan CD

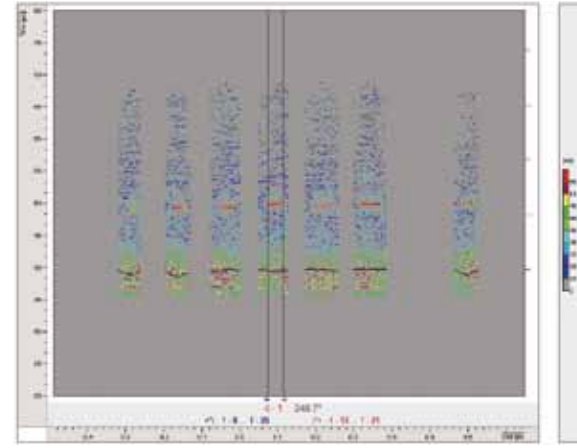
Detect and manage even sub-critical cracks in liquid pipelines

The UltraScan CD inspection tool was designed for high precision location of SCC even in its sub-critical stage. It has been used to successfully inspect more than 81,000 kilometres of pipeline around the world, enabling operators to establish effective programs for the mitigation and management of risk associated with the presence of SCC in its earliest stages. The tool uses the 45° shear-wave inspection technique to detect cracks regardless of their width – from hairline cracks to wide opening cracks. It is so sensitive it can reliably detect cracks, scratches and grooves as short as 25 mm and as shallow as 1 mm, and has accurately reported defects of half that depth.

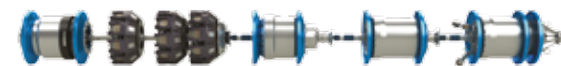
UltraScan CD is coupled to the pipe steel by a liquid medium, making it the tool of choice for oil, refined products and other liquid lines. Since its introduction, UltraScan CD's range of sizes has been continuously expanded. It is currently available in sizes from 10" to 34".

Key strengths

- SCC colonies
- Sub-critical SCC
- Fatigue, weld-toe and shrinkage cracks
- Longitudinal weld, lack-of-fusion and hook cracks
- Axial laps
- No flow reduction on single pass runs for long section (speed up to 5 m/s)



Sequence of shots from one sensor showing exact sizing of a series of artificial defects with different depths.



UltraScan Duo

One tool with many capabilities

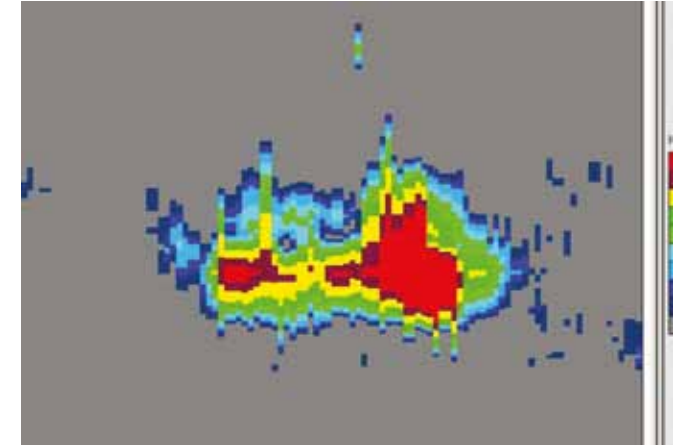
UltraScan Duo is the industry's first in-line tool capable of performing both crack detection and metal loss inspections at the same time (it can also run just one inspection type if desired).

UltraScan Duo uses Phased Array Technology developed by GE Healthcare for higher resolution brain, spinal and soft tissue diagnostics. This same technology can help prevent pipeline failure by achieving greater data resolution and accuracy during in-line inspections. Duo's simultaneous use of adaptable perpendicular and angled ultrasonic beams optimizes both the Probability of Detection and Probability of Identification for all types of crack and metal loss defects. It can detect a minimum crack length of 25 mm with a depth of 1 mm.

Duo's pioneering two-in-one capability can significantly reduce pipeline operators' inspection costs while enabling a seamless correlation of crack detection (CD) and wall-measurement (WM) data ideal for SCC modeling and other integrity management activities. It results in higher confidence levels for important integrity-related decisions.

Key strengths

- More advanced modes for resolution and alternative firing angles
- Combined CD and WM measurement capability
- Discrimination between cracks and metal loss, even in SCC areas
- Discrimination between laminations and SCC
- Less susceptibility to echo loss
- Better detection of pitting corrosion
- Multi-angle phasing capability
- Multi-focusing capability for wall measurement
- Enhanced sizing and detection configurations



SCC Colony 4.5 mm deep and 300 mm long.



EmatScan CD

Innovative new tool for managing cracking in gas lines

The high resolution EmatScan CD tool is available for the detection of cracks in gas pipelines, with no need for liquid batching.

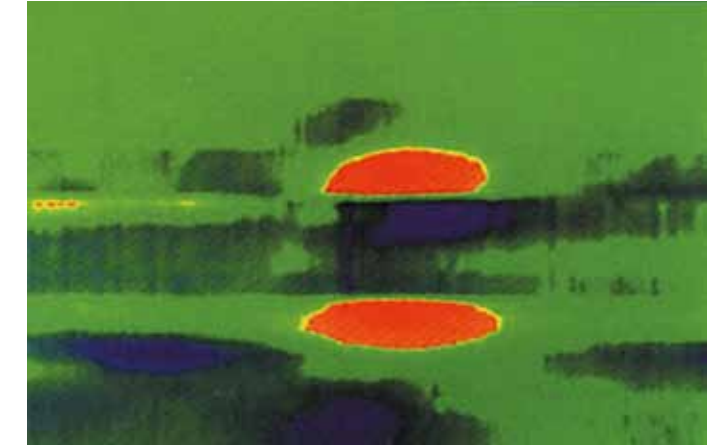
EmatScan CD successfully applies Electro Magnetic Acoustic Transducer (EMAT) technology to the special demands of the pipeline environment.

Pipe steel has many ultrasonic reflectors that can be misinterpreted by some technologies. PII has addressed this challenge with an advanced system for high discrimination and sizing confidence. Another of EmatScan CD's strengths is its ability to detect even sub-critical SCC and coating disbondment. This capability gives operators the advanced warning essential for the initiation of effective SCC management programs – without the high costs and loss of production associated with the common method of hydrostatic testing.

It also detects and measures other forms of longitudinal cracks, including fatigue cracks, toe cracks, hook cracks, long cracks in or along the seam and lack-of-fusion cracks. High detection rate of cracks in dents caused by mechanical damage is also provided.

Key strengths

- SCC colonies
- Sub-critical SCC
- Longitudinal fatigue cracks, toe cracks
- Hook cracks
- Cracks in or along the seam weld
- Lack-of-fusion cracks
- Detection of coating variances and disbondment
- Short- and long-term savings versus hydrostatic testing
- High detection rates providing high confidence for application of EMAT for Cracks in Dent



Coincident OD and ID hook cracks, 33% and 16% respectively.



TranScan

Detect seam weld defects, axial flaws and third-party damage

The innovative TranScan™ inspection tool detects long, narrow defects that run parallel to the axis of the pipeline. TranScan uses well-proven MFL technology but, unlike MagneScan™, the magnetic field is induced around the circumference of the pipe instead of along its length. This ensures that axial flaws (cracks and elongated metal loss) present their largest dimension to the magnetic flow, creating a strong signal from flaws that have previously been invisible to magnetic tools.

TranScan tools are very robust and equally at home in gas or oil pipelines. They can inspect up to 4 m/s and tolerate dirt and wax in the pipeline. They have even been used to detect flaws in seam welds as narrow as 0.1 mm. TranScan has become the tool of choice among operators and regulators for the detection of hook cracks and lack-of-fusion in pre-1970 ERW gas pipe. Its sensitivity to dents, associated cracking and metal loss also makes it ideal for the detection and classification of third-party damage.

Since its introduction in 1998, TranScan has been used to inspect over 12,000 kilometres of pipeline. It is available in all diameters from 8 to 30 inches, plus a maximum diameter of 48 inches.

Key strengths

- Pre-1970 ERW seam welds – hook and lack-of-fusion cracks
- Seam weld defects
- Narrow axial corrosion
- Preferential seam weld corrosion
- Axial laps

The right tool for every challenge

Operating Specifications	UltraScan CD	UltraScan Duo	EmatScan CD	TranScan	
Media	Liquid	Liquid	Liquid & Gas	Liquid & Gas	
Max. Pressure	120 bar	120 bar	190 bar	220 bar	
Max. Speed	Up to 5 m/s	0.78 m/s -3.2 m/s*	2.5 m/s	4.0 m/s	
Min. Speed	0.0 m/s	0.0 m/s	0.0 m/s	0.2 m/s	
Min./Max. Temperature**	-20-60°C	0-50°C	0-50°C	0-40°C	
Min. Bend Radius	3 D/1.5 D	3 D/1.5 D	1.5 D 90°	3 D/1.5 D	
Inspection Specifications	90% POD			Short	Long
Min. Detectable Crack Width	0.0 mm	0.0 mm	0.0 mm	0.1 mm	
Detectable Crack Length	≥ 25 mm	≥ 25 mm	≥ 50 mm	25-50 mm	> 50 mm
Min. Detectable Crack Depth	1 mm	1 mm	2 mm	50%	25%
Crack Features					
Hook/seam weld crack	●	●	●	●	●
Hydrogen induced crack	●	●	●	●	●
Fatigue crack	●	●	●	●	●
Shrinkage crack	●	●	●	●	●
SCC	●	●	●	●	●
Lack of fusion	●	●	●	●	●
Circumferential crack	○				
Crack in dents		○	●		
Integrity Assessments					
Fitness-for-purpose (FFP)	●	●	●	●	●
Crack threat integrity assessment	●	●	●	●	●
Crack growth assessment	●	●	●		

- Best fit
- Strong fit
- Optional

More details available on tool-specific fact sheets.

*UltraScan Duo - the velocity provided in the table is for a minimum length of 60 mm.

** Higher temperature available on request.

Why choose PII?



Best solutions

Every technological innovation we offer is firmly grounded in the reality of your business. We don't sell static tools. We are continually evolving the science of pipeline integrity, and the benefit to you is the most comprehensive suite of solutions available.

Total service

A successful inspection is just the beginning. The real objective is to enhance the long-term integrity of your pipeline. The breadth of our expertise is always at your disposal – from Fitness-for-Purpose assessments and mapping surveys to remediation services and long-term integrity planning. Different tools with different specifications can be used depending on different situations.

Unmatched experience

Our teams have inspected more pipelines than any other company, and we maintain the industry's most extensive and detailed database of pipeline defects. We've inspected over 1 million kilometres of pipeline and documented every known type of pipewall anomaly. This experience, combined with a steadfast commitment to technological advancement, enables us to identify and predict changes in pipewall condition with the utmost accuracy.

Global support

PII Pipeline Solutions has the global infrastructure and local presence to deliver advisory, technical and support services 24 hours a day. Whenever and wherever you need us, we'll be there – equipped with the highest level of experience and technology every time.

Continuous improvement

A triumph in one area can lead to remarkable enhancements in the next, so we leave no stone unturned. As we transform in-field discoveries into new software utilities, we use other programming innovations to increase our data resolution and inspection efficiency. Because so many environmental and operational factors are beyond your control – our job is to maximize control everywhere it is possible. And we've been doing just that for over 35 years.

Integrity services

Our pipeline services go far beyond data gathering. We have the experience and resources required to offer complete pipeline integrity solutions from a single source. All our inspection services are grounded in the most advanced technology and statistically significant procedures available. The information provides a solid, highly detailed foundation upon which future pipeline integrity can be monitored, maintained and improved.

A historical perspective: UltraScan instills confidence after crisis

UltraScan CD: a better way to manage SCC

The Rainbow pipeline, operated by Mobil Oil Canada, carries crude oil from northwestern Alberta to Edmonton. Early in 1993, a rupture occurred in the 300 km long, 24" diameter southern section of the pipeline. A second rupture occurred a few months later. The company voluntarily reduced the MAOP of this section, significantly decreasing its return on investment.

To gain a better understanding of the nature and progress of SCC, Mobil immediately started a series of excavations to look for SCC and to gather pertinent data. Remediation work was carried out, including complete replacement of 44 kilometres of pipe. A fracture mechanics-based model was developed to quantify the future integrity of the pipeline, and a hydrostatic test was used to confirm the validity of the model. Late in 1994, the original MAOP was

restored and the pipeline was back to normal operation, with the prospect of regular hydrostatic testing to confirm its integrity.

Mobil contracted with PII Pipeline Solutions to inspect for cracks using its UltraScan CD tool. Subsequent excavation confirmed that all defect locations and lengths had been predicted accurately. With one exception, all 61 incidents of SCC were within or below the predicted depth range.

UltraScan CD brought new assurance to the Rainbow pipeline integrity management program. Whereas before, 382 excavations revealed only 25 significant occurrences of SCC, with guidance from UltraScan, 72 excavations revealed 61 instances of SCC. Best of all, the abilities of the UltraScan CD to detect, identify and report even sub-critical SCC, affirms the integrity planning for future operations and mitigation.



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Western Europe and Africa

Atley Way, Cramlington
Northumberland NE23 1WW
United Kingdom
T +44 191 247 3200
F +44 191 247 3101

Southern Europe

Via Felice Matteucci 2
50127 Florence, Italy
T +39 055 423 211
F +39 055 423 8308

Central Europe and CIS

Lorenzstrasse 10
D-76297 Stutensee-Blankenloch
Germany
T +49 7244 732 0
F +49 7244 732 123

Middle East

Al-Emadi, Financial Square
Building No 1, First Floor
Doha C-Ring Rd.
Qatar
T +974 401 31300
F +974 442 93460

Asia Pacific

No. 7, Jalan Pemberita U1/49
Section U1, Temasya Industrial Park
Glenmarie
40150 Shah Alam
Selangor D. E.
Malaysia
T +6 03 5569 5548
F +6 03 5569 4895

North America

7105 Business Park Drive
Houston, Texas
77041-4040 USA
T +1 713 849 6300
F +1 713 937 0740

4908 52nd Street SE
Calgary, Alberta
T2B 3R2 Canada
T +1 403 262 7447
F +1 403 237 9693

Av. Antonio Dovali Jaime 70, 4th floor
Col. Santa Fe, Del. Alvaro Obregon
CP 01210, Mexico City
T +52 55 9177 6601
F +52 55 9177 6606

For complete contact information,
please refer to our website.

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