Advanced Pipeline Diagnostics
Take control of cracks
The Challenge

Failure prevention – aspiring for zero incidents
Analytic Task

Finding the cracks that matter

Cracks threaten pipeline integrity. And pipeline cracks are not all the same. RoCD (ROSEN Crack Detection) identifies a variety of crack formations, including cracks in the pipe body and cracks located in the complex geometry of girth welds and seam welds. Our technologies detect cracks with a very small physical footprint. It also addresses manufacturing defects and cracks caused by environmental factors.
At ROSEN, pipeline integrity is our business. Our integrity group has unrivaled experience in interpreting in-line inspection (ILI) data, providing fitness-for-purpose (FFP) assessments and crack growth analysis. All existing data sources, processes, procedures and industry standards are properly integrated. That’s why we can offer a complete suite of complementary pipeline management services. From inspection requests to the rehabilitation of pipelines, ROSEN allows customers the flexibility to choose from a collection of service options tailored to their individual needs. By delivering the right balance of field validation and field repair services, ROSEN helps its customers minimize costs – without compromising operational confidence and quality.
Verification & Rehabilitation

Preliminary Reporting

- Automated data processing
- Assessment of all critical information

Final Reporting

- Performance review
- Comprehensive project close-out

Crack Prioritization

- Accepted methods
- Rapid turnaround

Crack Assessment

- Qualified engineering
- Holistic mindset

Post ILI Assessment

- Fitness for Service
- Crack Growth
- ILI interval

Field Verification

- On-site data support
- Link to analysis team

Pipeline Repair
Competent technologies – the foundation of diagnostic services

Our Solution
Accurate Inspection Data

Your key to integrity

ROSEN uses the latest generation of crack detection tools to find axial and circumferential cracking in pipelines. Using liquid coupled ultrasonic or dry coupled electromagnetic acoustic technologies, RoCD provides reliable crack detection and accurate crack sizing. The technology also establishes appropriate baseline standards for the successful and effective management of pipeline integrity. Our proven tool configurations maintain data quality while supporting individual operational pipeline requirements.

EMAT-C Technology
- Patented measurement principle for high-resolution electromagnetically generated ultrasound
- Highly dependable detection and accurate continuous sizing of crack anomalies
- Reliable detection of coating disbondment, a precursor of cracking
- Application across all pipeline products, e.g. natural gas, LNG, crude oil and gasoline

UT-C Technology
- Advanced circumferential UT technology based on ultrasonic shear wave generation
- Increased sensitivity for crack detection by special probe design and high-resolution
- A-scan, B-Scan and C-scan

MFL-C Technology
- Circumferential magnetic flux leakage (MFL) technology
- Precise long seam categorization and assessment using magnetic saturation
- Extra high sensor density and high sampling rate support crack identification and exact location.
We cover as much data as possible
- Data recording for the entire pipe surface
- No amplitude threshold limitations
- Detection of intermittent cracks (SCC)
- Data gathering for sub-spec anomalies

We size for cracks in depth
- Continuous and absolute depth sizing
- Special EMAT-C feature: full wall sizing capability of cracks
- MFL-C: sizing of narrow axial corrosion and volumetric cracks

We characterize crack profiles thoroughly
- Depth contour across entire crack length
- Accurate burst pressure assessment

How do we manage to be that accurate?

We collect and save every data file
- Database with large number of field verifications
- Repository of pipe samples
- Incorporation of historical data into active projects

We constantly optimize our mechanical tool setup
- Patented sensor suspension avoids carrier lift-off over weld bead
- Tool body centralization mechanics ensure a proper sensor alignment in bends for excellent acoustic results
- Multi diameter solutions help fulfill special needs
ROSEN crack services are process driven. Services are adjusted to the specific requirements of each pipeline and to the needs of the individual operator. We carefully select the services that deliver operational excellence in each and every project.

**Performance Specifications**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. crack depth</td>
<td>1 mm in pipe body; 2 mm in weld area</td>
</tr>
<tr>
<td>Min. crack length</td>
<td>25 mm</td>
</tr>
<tr>
<td>Continuous depth sizing accuracy</td>
<td>+/- 15 %*t</td>
</tr>
<tr>
<td></td>
<td>t = wallthickness</td>
</tr>
<tr>
<td>Length sizing accuracy</td>
<td>+/- 10 mm</td>
</tr>
<tr>
<td>Axial crack orientation</td>
<td>+/- 15º</td>
</tr>
<tr>
<td>Radial crack orientation</td>
<td>40º - 90º</td>
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</tbody>
</table>

**Operating Standard Specification**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Tool sizes</td>
<td>6” – 56”</td>
</tr>
<tr>
<td>Speed control system</td>
<td>Up to 4 m/s bypass flow</td>
</tr>
<tr>
<td>Minimum pipeline bend radius</td>
<td>1.5 D</td>
</tr>
<tr>
<td>Maximum inspection length</td>
<td>300 km</td>
</tr>
<tr>
<td>Dual- and multi-diameter operation</td>
<td>available</td>
</tr>
<tr>
<td>Bi-directional operation</td>
<td>available</td>
</tr>
<tr>
<td>Product temperature range</td>
<td>Up to 65ºC</td>
</tr>
<tr>
<td>Maximum operating pressure</td>
<td>15 MPa</td>
</tr>
<tr>
<td>Extra high pressure option</td>
<td>30 MPa</td>
</tr>
<tr>
<td>Extra high temperature option</td>
<td>Up to 95ºC</td>
</tr>
</tbody>
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Integrity management – closing the loop

Our Solution
Reporting and Analysis

Making inspection data work

VIRTUALYZE
ROSEN has developed the next level of reporting software. Our inspection data provides easy access to the information needed to review potentially harmful anomalies. The key features:
- Data visualization based on fully analyzed inspection data covering the entire pipeline
- Intuitive and effective user guidance to competently manage inspection results
- Combined visualization of multiple inspection datasets
- Executive summary for management/operational goal setting and action
- Individually sentenced feature reports (ISFR)
- Seamless integration into the ROSEN asset integrity management software (ROAIMS)

ROAIMS
ROAIMS effectively manages SCC threats with a structured process. This process features an integrated view of all relevant data needed to address the sensitive issue of cracking. The key features:
- Collects and integrates all data relevant to the assessment of SCC (i.e.: soil data, ILI and indirect inspection data, pipe attributes such as coating type, manufacturer, etc.)
- Aligns all data to a common consistent linear reference system
- Applies a consistent logic (in the form of a risk model algorithm) to identify and prioritize areas where the pipeline appears vulnerable
Crack Prioritization and Assessment

The next steps

Prioritization
Based on the preliminary ILI report, RoCD prioritizes repairs that need immediate attention and identifies where further field validation is suitable. Pipeline operators receive a ranking of cracks for further investigation. Identified crack issues are then diagnosed and the data is included in the final report. That report:

- Determines failure risks for all reported anomalies
- Recommends anomalies that merit field investigation
- Identifies pipeline compliance with API 579 / ASME FFS-1, British Standard 7910 (2013) and other industry standards

Assessment
An integrated strategy helps pipeline operators manage the long-term integrity of pipelines that are susceptible to cracking. To put that strategy in place, pipeline operators need access to assessment expertise in the fields of fracture mechanics, materials, welding and inspection. ROSEN's comprehensive crack management service includes:

- Susceptibility analysis; identification of cracking mechanisms and at-risk locations
- In-line inspection recommendations
- Assessment of ILI crack inspection data
- Application of the Engineering Critical Assessment (ECA) approach to determine tolerable defect dimensions
- Assessment of the status of crack-like defects (fatigue analysis and or SCC growth analysis)
- Failure investigation that incorporates a full range of material testing and inspection services
- Development of crack management plans to address repairs, maintenance, operational changes, future inspection and hydrostatic testing requirements
Validation and Rehabilitation

On-site support – saving your time and resources

Inspection results are best validated on-site. This helps gain operator confidence, validates and demonstrates data outcomes and supports the subsequent risk analysis. On-site support also makes it easier to meet regulatory requirements. Standards like API 1163 explicitly demand an adequate field validation program.

Advantages of ROSEN’s On-Site Support:
- Guidance with the selection of appropriate NDT equipment
- On-site support by pipeline integrity experts
- In the ditch NDT services executed by qualified engineers
- Direct link to ILI-analysis team
- Meets requirements for field validation and performance

NDT Technology Range
- UT time of flight diffraction (TOFD)
- UT phased-array (PA)
- Magnetic particle inspection (MPI)
- Corrosion mapping (EMAT IFSE CIRC/AXUS)
- Long range UT inspection (LRUT)
- Corrosion scanning by laser
- 360° in the ditch reporting
- Repair scoping
Our promise: keeping your asset safe, making it last
RoCD Services

Take control of cracks

RoCD services helps pipeline operators identify cracks at a very early stage. That data is critical. RoCD also puts cracks and other pipeline anomalies into context. This allows a high definition picture of the remaining life of your asset.

Pipeline operators profit from

- **A unique framework**
  Access to ROSEN’s comprehensive pipeline integrity expertise includes best-in-class ILI detection with advanced data integration and risk management. That’s one example of how we combine the elements of our RoCD service to deliver solutions ideally suited to your individual needs.

- **An experienced partner**
  ROSEN’s experienced team helps our partners achieve their objectives. The RoCD service optimally addresses the customer’s needs by incorporating complementing units, components, methods and market knowledge.

- **Outstanding technology**
  We deliver more than mere inspection. Significant investment in R&D puts ROSEN at the forefront of the pipeline integrity business. Backed by a commitment to excellence in engineering, ROSEN applies what the company learns to every multi-disciplinary project we deliver.

- **Cost-effective services**
  ROSEN provides complete solutions. We excel at network repair and rehabilitation and at helping our customers manage the remaining life of their assets. Our clients use ROSEN’s expertise to keep control of their maintenance budget.