

eGuide

How to Detect Corrosion Under Insulation (CUI) in Your In-Service Piping & Pipelines



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Introduction

01



How to Detect Corrosion Under Insulation (CUI) in Your In-Service Piping & Pipelines

When it comes to operating your piping and pipeline assets, detecting internal corrosion and corrosion under insulation (CUI) tops the list as one of the most pressing tasks to be accounted for.

Traditional inspection methods used to detect internal corrosion and CUI in piping and pipeline assets can be time-consuming and costly. Shutting down in-service lines and stripping insulation and coating before starting an inspection is an inefficient allocation of money and resources for inspection and integrity managers.

Throughout this eGuide, operators will gain insight on how to detect CUI in in-service piping and pipelines, and discover the time and cost efficiencies advanced inspection technology can provide.

You'll also be introduced to automated radiographic testing (ART), along with state-of-the-ART robotics, providing unprecedented, large-scale corrosion inspections at a rapid, cost-effective pace.

Explore the eGuide and discover the inspection solution that will help you find value for the long run.

CUI Inspection Methodology Guide

02



Maintaining the health of your piping and pipeline assets is critically important to running a safe, efficient, and profitable operation.

However, corrosion under insulation can derail your operations if not dealt with in a timely and effective manner. While detecting CUI is only half the battle, identifying the right service to meet your operational needs is of the utmost importance.

Let's take a closer look at some of the advantages and disadvantages CUI inspection methodologies present, and the ways advanced technology can help modernize CUI detection.



Corrosion Under Insulation (CUI) Inspection Methodology Selection Guide

INSPECTION METHOD	ADVANTAGES	DISADVANTAGES
VISUAL (VT)	<ul style="list-style-type: none"> → Qualitative inspection → Immediate validation of results 	<ul style="list-style-type: none"> → Requires stripping of all insulation → Extensive staging or scaffolding may be required → Slow and has potential to miss critical locations → Expensive where hazardous materials are present
CONVENTIONAL RADIOGRAPHY (RT)	<ul style="list-style-type: none"> → Qualitative & quantitative thickness measurements → Identifies OD & ID conditions → No insulation removal required 	<ul style="list-style-type: none"> → Longer exposure times → Accuracy ±10% → Film processing required leading to delayed results → Environmental issues w/chemicals → Archival restrictions and allows no image adjustments
COMPUTED/DIGITAL RADIOGRAPHY (CR/DR)	<ul style="list-style-type: none"> → Qualitative & quantitative accurate measurements → OD & ID conditions → No insulation removal required → Software image enhancement → Electronic media 	<ul style="list-style-type: none"> → Covers limited area → Requires direct access to inspection area → Cost control is based on access and production rate → Radiation hazards → Imaging plate care required
REAL-TIME RADIOGRAPHY (RTR)	<ul style="list-style-type: none"> → Identifies OD conditions → Fast-immediate results → No insulation removal → No radiation hazards 	<ul style="list-style-type: none"> → Close proximity piping runs and pipe geometry can restrict inspection → Production slower in close-spaced piping → Inspection unit is cumbersome in tight spaces
GUIDED WAVE	<ul style="list-style-type: none"> → Rapid inspection of long lengths of pipe (1500 – 3500 feet/day) → 100% volumetric coverage → Limited insulation removal for inspection → Accurate location of pipe features and corrosion → Semi-qualitative analysis of wall loss → Temperature range to 550° F 	<ul style="list-style-type: none"> → Qualitative screening → Requires secondary method for verification of anomalies → Geometry can restrict inspection
MAGNETIC FLUX LEAKAGE (MFL) INLINE INSPECTION (ILI)	<ul style="list-style-type: none"> → Can be used on all ferromagnetic materials → Highly portable → High-speed inspection → Detects gradual wall loss and subsurface cracks → Sensitivity to pits in carbon steel → Distinguishes between internal and external defects 	<ul style="list-style-type: none"> → Lines need to be shut down and cleaned → Qualitative measurement; limited defect sizing → May increase process safety risks → Unreliable at detecting axial cracks → May need to be verified by other NDT methods
AUTOMATED RADIOGRAPHY	<ul style="list-style-type: none"> → Utilizes digital imaging with rapid inspection results → No insulation/coating removal required → Permanently-archived DICOM-compliant images → Small exclusion zones 	<ul style="list-style-type: none"> → Higher upfront costs → Requires data storage space → Additional training required to operate equipment

**STILL UNSURE OR CONFUSED?
SPEAK TO AN EXPERT**

 1-877-ART-4-CUI

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CUI Case Studies

03

You've seen that more advanced methodologies are able to detect CUI without many of the resource-draining hassles common to many traditional techniques.

The following case studies examine projects where automated radiography was used in place of manual radiography techniques to conduct large-scale CUI screenings.

By maintaining uptime, keeping insulation intact, and preserving your bottom line, ART checks all the boxes as an effective CUI inspection service.

CASE STUDY 1

Comparison of handheld digital radiography (DR) versus a combination of ART and handheld DR for **3-view CUI inspection of 50,000 feet** of insulated pipeline

Manual

ART-focused

69

Production Days

7

Production Days

\$7.60*
Cost Per Foot

\$1.30*
Cost Per Foot

\$382,000*
Cost

\$63,300*
Cost

TIME AND COST SAVINGS USING ART-FOCUSED SCREENING

Production Days Savings

62 Days

Total Cost Savings

\$318,700*

CASE STUDY 2

Comparison of handheld DR versus a combination of ART and handheld DR for **1-view CUI inspection of 95,000 feet** of insulated pipeline

Manual

ART-focused

238

Production Days

16

Production Days

\$14.00*
Cost Per Foot

\$1.50*
Cost Per Foot

\$1,307,000*
Cost

\$141,000*
Cost

TIME AND COST SAVINGS USING ART-FOCUSED SCREENING

Production Days Savings

222 Days

Total Cost Savings

\$1,166,000*

CASE STUDY 3

Comparison of handheld DR versus a combination of ART and handheld DR for **3-view CUI inspection of 200,000 feet** of insulated pipeline

Manual

ART-focused

278

Production Days

33

Production Days

\$7.60*
Cost Per Foot

\$1.70*
Cost Per Foot

\$1,528,000*
Cost

\$333,300*
Cost

TIME AND COST SAVINGS USING ART-FOCUSED SCREENING

Production Days Savings

245 Days

Total Cost Savings

\$1,194,700*

EXPLORE THE SAVINGS YOU CAN UNCOVER WITH ART

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*All figures rounded to approximate values.

ART Crawler

Inspection Technology to Revisualize Pipeline Integrity

04

The previous sections have examined the pros and cons of various traditional and advanced NDT techniques, and highlighted methodologies you can use to detect CUI while maintaining uptime, keeping insulation intact, and saving time and money.

Now, experience how a state-of-the-ART innovation in CUI detection – MISTRAS Group's ART Crawler – makes inspections highly effective, economical, and productive for inspection and integrity management personnel.



ART Crawler: A Non-Invasive CUI Inspection Innovation

MISTRAS' ART Crawler is an advanced inspection service that utilizes digital radiography (DR) to screen for internal corrosion and corrosion under insulation (CUI) in insulated and uninsulated aboveground piping and pipelines, even with product flowing through the lines. The ART Crawler utilizes modern robotic technology to accurately detect damage locations quicker than traditional techniques and with no need to remove insulation or take the pipe out of service.

Designed, developed, and manufactured in-house by MISTRAS Group, the ART Crawler has various iterations each designed to detect different damage mechanisms in piping and pipelines in the upstream, midstream, and downstream sectors of the oil & gas industry. ART Crawlers designed to detect CUI are applicable for pipes ranging from 2"-20" in diameter, while the systems designed to detect internal corrosion are used in piping 4"-48" in diameter.





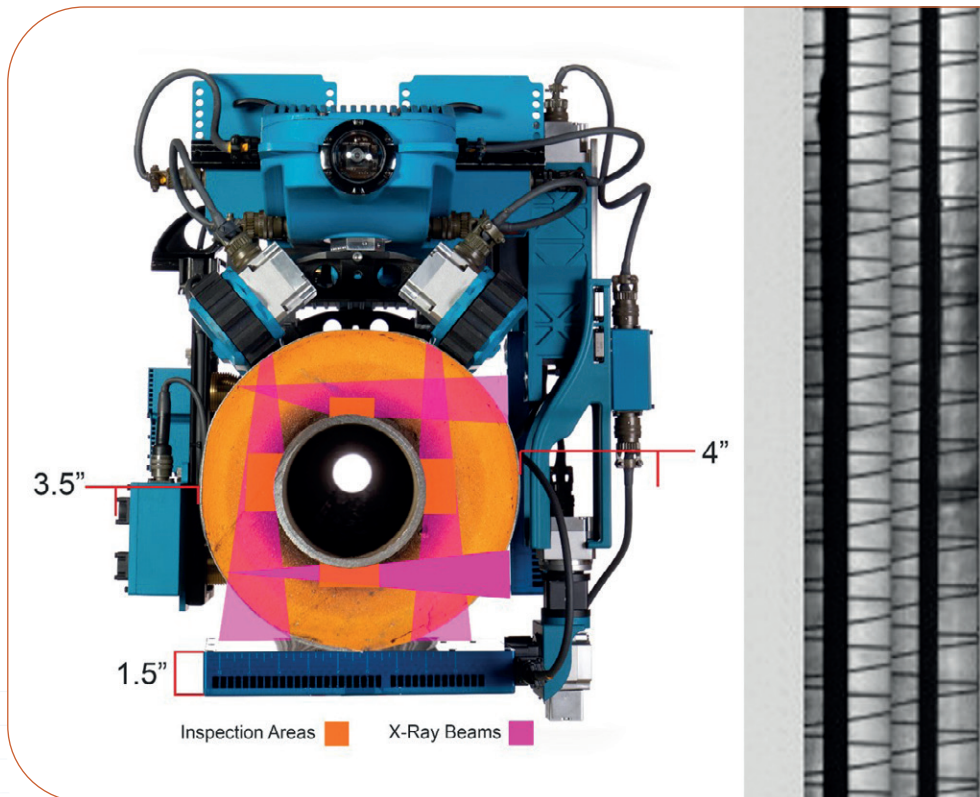
Automated Radiographic Testing (ART) Explained

The ART Crawler produces digital images during pipeline inspections and offers the ability for operators to review inspection video and DICONDE-compliant radiographic results simultaneously for faster data collection, processing, and analysis.

When inspecting for CUI, MISTRAS' ART Crawler services utilize a tangential radiography technique. It can inspect all four axes of a pipe simultaneously with 4 low-powered X-ray tubes that shoot tangentially across the pipe to produce silhouettes of the pipe wall. Two state-of-the-art, high-sensitivity X-ray detectors on the opposite sides of the pipe acquire the images, which are then displayed in real-time on the laptop used by the technician operating the crawler.

A certified MISTRAS technician can mark areas of concern as the system scans, and the crew can quickly move the crawler between runs by detaching the modular arms and reassembling the crawler on the new run. The X-ray images and video from the onboard cameras can be sent immediately to the customer for critical decisions, and the crawler's 100% scanning coverage allows piping to be audited year after year.

MISTRAS' ART Crawler services apply the digital radiography advanced non-destructive testing (ANDT) method, referring to advanced radiographic techniques that use digital imaging instead of traditional film.



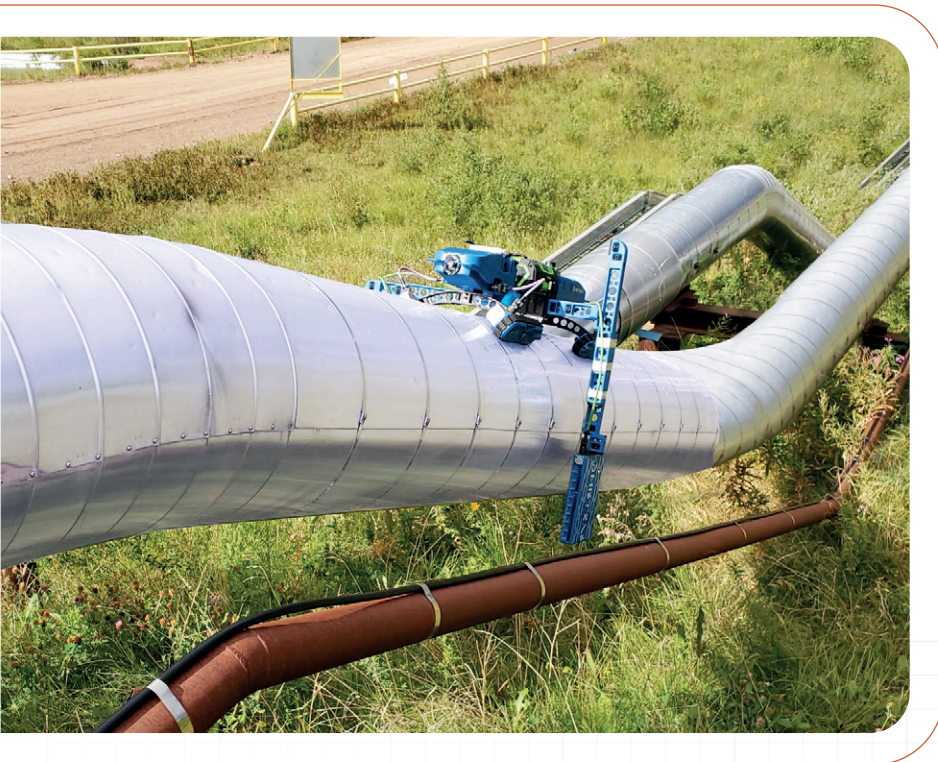


Large-Scale Corrosion Screening Informs Decision-Making

Because of the high speed at which the ART Crawler collects and processes data (often exceeding 1000 meters per day in an upstream environment), **the system can screen 100% of a pipe in the time it typically takes to inspect 5-10% using manual methods.**

This makes it particularly impactful as a large-scale screening tool to help identify which pipe sections require further investigation.

Instead of needing to fully inspect a line to gain complete asset integrity visibility – which may far exceed the inspection & maintenance budget – or inspecting a sampling of the line and potentially missing a detection opportunity, the ART Crawler enables integrity and inspection personnel to pinpoint the areas of a line that require remediation while leaving insulation on non-corroded pipe sections intact. The ART Crawler can also be deployed with a hybrid approach, providing rapid screening first and then comprehensive inspection for the areas where it is required.



ART Crawler Large-Scale Screening



Prioritize remaining asset condition levels



Optimize inspection schedule and spend



Optimize fabric maintenance schedule and spend



Drive time and dollars toward worst conditions



Detect wet insulation before corrosion forms



Take Action with Multi-Disciplined Asset Protection Support

When damage is detected, MISTRAS offers support to help identify and remediate the damage as quickly, cost-effectively, and non-invasively as possible.

MISTRAS' trained and certified technicians can be quickly mobilized to provide additional maintenance support where you need it, and when you need it most, with services including:



Best-practice techniques to further investigate and confirm damaged areas



Traditional and advanced non-destructive testing (NDT) follow-up inspections, including automated ultrasonics (AUT) and inline inspection (ILI)



At-height inspections through experienced rope access personnel and drone pilots



Maintenance services to remove and re-install insulation and protective coating



DIVE DEEPER INTO THE INNOVATIVE ART CRAWLER TECHNOLOGY AND FIND VALUE FOR THE LONG RUN



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The Automated Radiographic Testing (ART) Crawler is a large-scale corrosion inspection service for aboveground insulated and uninsulated piping and pipelines.

Designed, developed, and manufactured in-house by MISTRAS Group (NYSE: MG) – a leading “one source” multinational provider of integrated technology-enabled asset protection solutions – ART Crawler services incorporate MISTRAS’ legacy of innovation, expertise, and leadership to help operators maximize the uptime and safety of their critical piping and pipeline assets.

Discover more at
mistrasgroup/artcrawler.com

SPEAK TO A MISTRAS REPRESENTATIVE TODAY

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