

# DIRECT ASSESSMENT

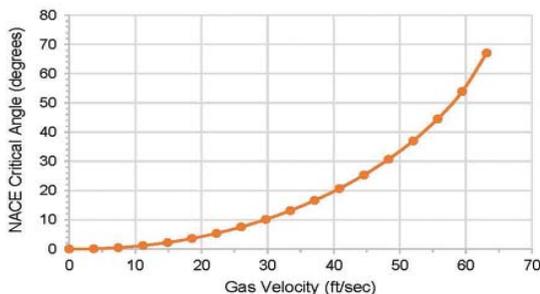
A critical tool for pipeline integrity management

## 36" Natural Gas Pipeline - Dry Gas ICDA Critical Angle Calculations NACE SP0206 Critical Angle Plots

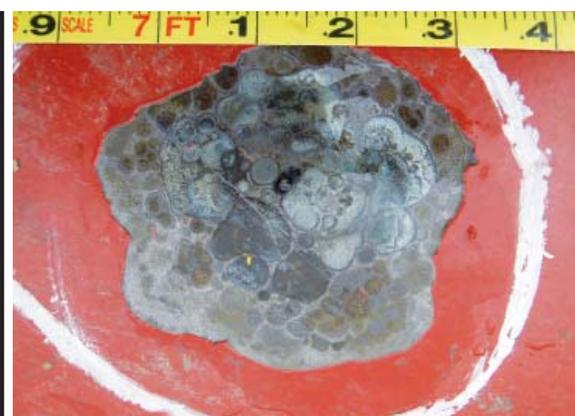
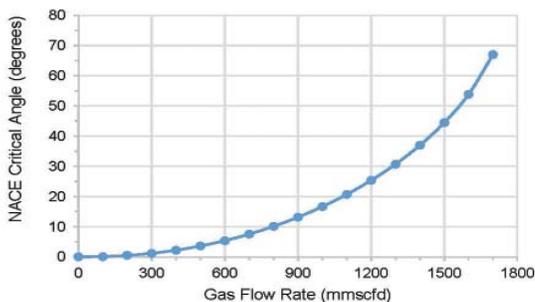
### Input Information

Natural Gas Density	0.0432 lbs/ft <sup>3</sup>
Liquid Density - Water	62.32 lbs/ft <sup>3</sup>
Acceleration of Gravity	32.174 ft/sec <sup>2</sup>
Nominal Pipe OD	36.000 inches
Nominal Pipe w.t.	0.438 inches
Nominal Pipe ID	35.124 inches
Operating Temperature	68.0 °F
Operating Pressure	644 psig
Gas Compressibility	0.900 unitless

NACE SP0206 Critical Angle vs Gas Velocity



NACE SP0206 Critical Angle vs Gas Flow Rate



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## A critical tool for pipeline integrity management

Protective coatings and cathodic protection systems provide significant protection for pipelines. Water and corrosive contaminants in the product stream can cause internal corrosion damage, and high operating stress levels in conjunction with environments conducive for stress corrosion cracking can cause cracking failures.

Regular pipeline assessments are critical in order to mitigate these issues. Direct assessment is a cost-effective preventative inspection method that can enable you to identify and act upon issues before they cause a costly leak or rupture.

## The key to direct assessment success

Of the approved techniques for validating and assessing pipeline integrity, direct assessment is often the preferred technique to identify external corrosion, internal corrosion and stress corrosion cracking in shorter pipe segments – generally from 0.5 to 2 miles – or in pipelines that cannot easily accommodate in-line inspection tools.

The effectiveness of a direct assessment rests largely on the service provider’s expertise in locating past or currently active corrosion along with accurately predicting future problem areas. This process is enhanced when the assessment is conducted using “smart” tools that collect and push data directly to a GIS enabled database. Pipeline condition information is then automatically updated, eliminating data collection errors.

## At a glance: three types of direct assessments

	External Corrosion Direct Assessment (ECDA)	Internal Corrosion Direct Assessment (ICDA)	Stress Corrosion Cracking Direct Assessment (SCCDA)
<b>What is its purpose?</b>	Assessing and reducing the impact of external corrosion on pipeline integrity	Assessing and reducing the impact of internal corrosion on pipeline integrity	Assessing and reducing the impact of stress corrosion cracking on pipeline integrity
<b>What causes this type of corrosion?</b>	External corrosion typically occurs at pipeline protective coating anomalies caused by rocks, poor pipe installation, coating deterioration or third-party damage.	Internal corrosion is typically caused by water, carbon dioxide, hydrogen sulfide, oxygen or other corrosive contaminants present in the product stream.	Stress corrosion cracking (SCC) occurs in pipelines when corrosion and mechanical stress combine to create cracks.
<b>Corrpro’s methods and tools</b>	<ul style="list-style-type: none"> <li>• Close interval survey (CIS) for cathodic protection assessment and coating assessments</li> <li>• Direct current voltage gradient (DCVG) for coating fault assessments</li> <li>• Alternating current voltage gradient (ACVG) for coating fault assessments</li> <li>• Alternating current - current attenuation (ACCA) for coating fault assessments</li> <li>• Electromagnetic surveys</li> <li>• Soil studies</li> <li>• Resistivity surveys</li> <li>• Depth of cover</li> <li>• Sub-meter GPS locating</li> </ul>	<ul style="list-style-type: none"> <li>• Laboratory analysis of gas, liquids and solids</li> <li>• Microbiologically influenced corrosion (MIC) testing, studies and evaluation</li> <li>• Corrosion monitoring, including insertion of coupons, probes and other steel devices into a pipeline for later corrosion analysis</li> <li>• Non-destructive testing, including using in-line and ultrasonic testing to measure wall thickness</li> <li>• Mitigation program planning and design, including inhibitor and bactericides to application</li> </ul>	<ul style="list-style-type: none"> <li>• ECDA tools plus additional identification of conditions that make pipe steel susceptible to SCC</li> <li>• Solutions for both near neutral pH and high pH SCC</li> </ul>

## The Four-Step Direct Assessment Process

Whether we are conducting an ECDA, ICDA or SCCDA, Corrpro follows the NACE Standard Practice four-step process to evaluate and mitigate the impact of corrosion on pipeline integrity.

### Step one: Pre-assessment

Pre-assessment begins with collecting historic information, including pipe and construction data, corrosion protection data, operating parameters and soil and other environmental conditions. If a direct assessment is feasible, the pipeline is divided into regions and the appropriate inspection and complementary evaluation techniques are selected based on conditions.

### Step two: Indirect inspection

The purpose of this step depends on the type of direct assessment undertaken:

**ECDA** - Indirect inspection is used to identify the locations of coating faults, insufficient cathodic protection, electrical shorts, electrical interference, geologic current shielding and other pipeline anomalies.

**ICDA** - Indirection inspection is used to identify locations at risk for internal corrosion, with consideration of the gases, liquids and solids passing through the pipeline.

**SCCDA** - Indirect inspection is used to identify the corrosive agents and tensile stresses at work on a pipeline.

Data from these inspections is consolidated and compared. Specialists then analyze the results to identify indications of corrosive activity.

### Step Three: Direct examination

The pipe is examined to assess the degree of corrosion damage. Direct examination requires excavation so physical inspections and non-destructive tests can be conducted on pipe surfaces and, in some cases, the surrounding soil and water.

If corrosion damage is found, the pipe's remaining strength is calculated using standard formulas and estimated corrosion rates. Our corrosion professionals then conduct root-cause analyses and develop applicable corrosion mitigation plans.

### Step four: Post-assessment

Finally, we work with you to assess the overall effectiveness of the direct assessment and determine a timeframe for reassessment. Because ECDA, ICDA and SCCDA are continuous improvement processes, it helps to streamline future assessments. With an assessment plan in place, accumulated data makes it easier over time to identify locations where corrosion has occurred, is occurring or may occur.



Example of blistering found during ECDA.

## A reliable partner for pipeline integrity management

Corrpro, an Aegion company, is one of North America's largest providers of direct assessments. Direct assessment is one of our core competencies and our NACE-certified professionals are experienced in performing either a single step or a full direct assessment. In every case, we are focused on helping identify and address potential corrosion activity, repair defects and remediate their causes, all with minimal disruption and in accordance with federal pipeline regulations.

Our ability to mobilize resources quickly enables us to deliver rapid turnaround on projects of all sizes. Our large talent pool can be especially helpful in northern climates, where cold weather and frozen ground conditions limit the inspection season. Our staff includes:

- 16 experienced pipeline integrity specialists
- approximately 100 technical staff trained in direct assessment
- more than 200 corrosion specialists
- more than 25 direct assessment survey crews

With over 600 direct assessments completed, you can be confident that Corrpro has the necessary experience to provide reliable information about your pipelines—regardless of project size.



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**Easy-to-use visuals of your data** – Instead of a spreadsheet with tables of voltage readings and GPS coordinates, we deliver maps that visually represent pipeline segments of concern. We provide this data in a format that can be instantly uploaded, rather than providing raw data that you must manually input into your GIS system.

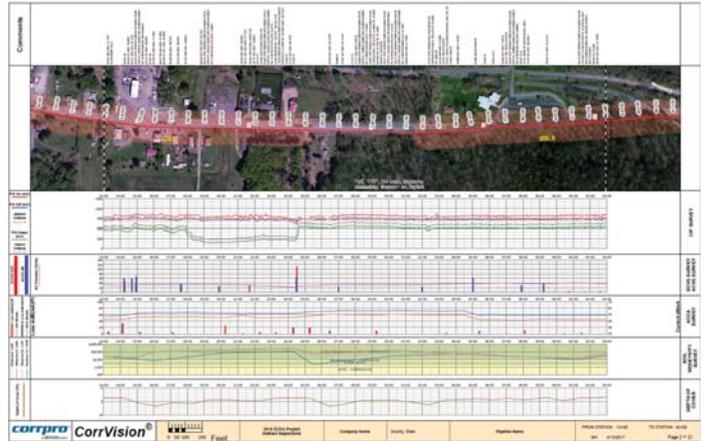
With Corpro's Asset Integrity portal and FieldLine™ application, your results will be stored on a secure site, making it simple to download reports or upload data to your GIS system. Multiple surveys can also be layered onto a map, giving you a complete picture of a pipeline's condition, making it easy to visualize areas of concern. New data can be aligned almost instantly with existing data, reducing preparation time for compliance audits and enabling you to focus your time on the areas with issues.

**Predictive capabilities** – Ordinary direct assessments deliver a snapshot in time. Our Asset Integrity portal makes it possible to compare multiple survey results and provide a trend analysis. Our ability to provide trend analyses can alert you to potential problems before they escalate and let you know if corrosion is likely to get worse. Our detailed analyses can help inform your decision-making process and prevent catastrophe.

**Safety culture** – Our rigorous safety program consistently achieves some of the best safety performance results in the industry. We attribute our strong safety record to our emphasis on leading indicators that help prevent safety issues before they occur, as well as our company-wide focus on empowering front-line supervisors with the authority and tools they need to operate a safe jobsite.

**Industry leadership** – Corpro has played an instrumental role in developing industry standards and practices for ECDA, ICDA and SCCDA. Our work includes the development of the ECDA process validation, as well as PRCI's Guidelines for Implementing the External Corrosion Direct Assessment (ECDA) Process manual for the pipeline industry.

We continue to conduct ECDA studies, projects and forums with PRCI, INGAA, NACE and other organizations.



CorrVision® is a graphical representation of combined and aligned survey data.



Aegion's Asset Integrity portal allows engineers to access survey results and other GIS data.

An ISO 9001:2015 Certified Company (U.S.)



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