**Instructor Guide**

Cathodic Protection/Corrosion Control

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Overview and Goals

Corrosion is the primary means by which metals deteriorate. Atmospheric corrosion occurs as a result of moisture contacting the pipe.

In this unit of work the instructor will:

* Highlight the concepts introduced in the online course.
* Demonstrate how to use the relevant tools and reference guides, applicable to the content and activities.
* Guide the participants through hands-on activities to work safely with natural gas, as a qualified operator would on the job.

Upon completion of this unit of work, participants will be able to:

* Define the corrosion process.
* Explain the causes of corrosion.
* Identify types of corrosion.
* Define:
	+ Stress Corrosion Cracking (SCC).
	+ Selective Seam Corrosion (SSC).
* List locations to inspect.
* Identify elements to look for during an inspection.
* Explain how to handle corroded materials.

Preparation – Facilitation Guidelines

Ensure the participants have completed:

* ASME-0141 Visual Inspection for Atmospheric Corrosion, including the pre-test and the 25 question course assessment.

Conduct this training in a classroom setting, with a simulated lab and/or field site allowing the participants to work independently or in groups (dependent on the number of participants) and then present findings to the workshop for further discussion.

Use a flipchart to capture key lessons learned from the group discussions, or to identify questions that will be answered in upcoming units of work or that require further research and discussion.

Reinforce the importance of damage prevention programs and the best practices and guidelines of the Compressed Gas Association (CGA), the Occupational Safety and Health Administration (OSHA), and the Federal Government.

Ensure the participants have a copy of the Common Ground Alliances (CGA) Best Practices guide: <http://www.commongroundalliance.com>

Review the following regulations as tasks are introduced, demonstrated, and practiced.

* §192.459 External corrosion control: Examination of buried pipeline when exposed.
* §192.479 Atmospheric corrosion control: General.
* §192.481 Atmospheric corrosion control: Monitoring.
* §195.569 Do I have to examine exposed portions of buried pipelines?
* §195.581 Which pipelines must I protect against atmospheric corrosion and what coating material may I use?
* §195.583 Atmospheric corrosion control: Monitoring. What must I do to monitor atmospheric corrosion control?

Materials

Provide the following to each participant:

* A copy of the Activity Worksheet and the Appendix 2 Performance Checklist.
* Access to the Internet, as needed, for OSHA, federal, and industry resources/references supporting course related discussions, demonstrations, and hands-on activities.
* Access to manufacturers’ instructions as needed.

Provide the following to each participant:

* Examples of :
* Corroded pipes
* Coatings, paint, tape
* Painted pipe
* Stress corrosion cracking (SCC)
* Selective Seam Corrosion (SSC)

***Note****:*

*These items, and any other materials used for demonstrations and participant activities, will be determined by the materials and tools used at the training facility.*

Schedule

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| **Time**  | **Topics for Discussion, Demonstrations, and Activities**  |
| **60 minutes** | **Introduction** * Review the corrosion process.
* Review the causes of corrosion.
* Explain:
* The conditions that must be present for corrosion to occur.
* Environmental factors that contribute to corrosion.
* Importance of determining the extent of deterioration/visual inspection.
* Present “real-world,” on-the-job experiences that focus on the need to follow all company procedures for reporting and correcting corrosion damage.

***Note****: The tools, PPE, and materials used in the demonstrations will be determined by the materials and tools used at the training facility.* |
| **30 minutes** | **Corrosion****Discussion with Examples**Show examples of corrosion, and point out the characteristics which identify these types:* Atmospheric
* Localized (pitting or crevices)
* Generalized (result of improper coating application or maintenance)
* Galvanic
* Microbiological
* Graphite
* Flow-Assisted

Explain the causes and show examples of:* Stress Corrosion Cracking (SCC)
* Selective Seam Corrosion (SSC)

***Note:*** *Show items from the training facility or refer to the online course materials or Internet sources to illustrate piping that shows the different example of corroded materials.* |
| **30 minutes** | **Corrosion Coatings** **Discussion with Examples**Show examples of common corrosion control coatings, for example paint, tape, or insulation. |

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| --- | --- |
| **Time**  | **Topics for Discussion, Demonstrations, and Activities**  |
| **60 minutes** | **Inspections****Discussion*** Review the appropriate intervals to inspect for corrosion (as required by the Code of Federal Regulations).
* Explain that early inspection for coating flaws, holes, or thin spots will prevent the expense and inconvenience of coating failure.
* Identify locations to inspect.
	+ Above grade
	+ Where soil and air meet
	+ At bolted connections
	+ At pipe supports
	+ In splash zones
	+ Where pipe spans water
	+ Under thermal insulation
	+ Under disbonded coating
	+ At deck penetrations

***Note:****Use the materials at the training facility to show examples of the areas to inspect*.  |
| **45 minutes** | **Inspections****Discussion**Point out what to look for during an inspection* + Rust
	+ Cracking, flaking, or chalking
	+ Thin or rough spots
	+ Discolored or mottled surfaces
	+ Holes, cuts, or gouges
	+ Wrinkled or disbonded coating (difficult to detect)
	+ Cracked, chipped, flaking, or peeling paint
* Emphasize, if deterioration is found on bare or coated pipe:
* Inspect the adjacent pipe to determine the extent of deterioration.
* Active corrosion could result in a hazardous condition if not controlled.
* Review inspection standards.
* Discuss appropriate procedures for, managing any problems, documenting and reporting corrosion or any abnormal operating conditions.

Instruct participants to complete **Activity Worksheet #1.** |

Boot Camp Activities

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| Working with a partner or partners, answer the following questions and complete the tasks, according to the materials, equipment, and manufacturers’ instructions used. Activity Worksheet #1*–* Corrosion  |
| Lab | * Use Appendix 2 - Performance Checklist - Corrosion
	+ Perform the tasks.
	+ Identify the materials, tools, and instructions used to complete the task(s).
	+ Answer any question presented.
* Take notes in the sections below (as needed).
* Be prepared to participate in workshop discussions.
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| Tools used PPE |  |
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| Steps - actions  |  |
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| References/Guidelines including:* Industry sources
* Online course materials
* CFR

Indicate, if applicable, measures that appear to be a potential problem and or an abnormal operating condition (AOC). |  |
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| Lessons learned |  |
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| General discussion questions or notes |  |
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# Appendix 1

Appendix 1 – Corrosion Performance Checklist (Instructor)

Participants will complete the task(s) and answer the question(s). When finished, provide appropriate feedback.

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|  | **Tasks** | **Actions and Question** | **Facilitator Notes** |
| 1 | Identifying causes of atmospheric corrosion.  | What causes atmospheric corrosion? | *Answer: Atmospheric corrosion occurs as a result of moisture contacting the pipe.* |
| 2 | Determining how metals affect corrosion. | 1. Explain how the differences in metals and variations in environment affect corrosion.
2. Indicate if a common corrosion control coating, for example paint, tape or insulation could prevent corrosion in some of the metals and explain why.
 | *The higher the purity of the metal, the more resistant it is to corrosion.* *Answers will vary.* |
| 3 | Identifying type and potential cause of corrosion. | Look at the following examples (A-H). Identify the type/cause of the corrosion.

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| Type  | Possible cause? |
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| *Type of joint* | *Method used* |
| *Answers should include the following however, the types and the examples will be determined by the materials used at the training site.* |
| 1. Localized
 | Concentrated in an area—pitting or crevices |
| 1. Generalized
 | Improper coating application or poor maintenance |
| 1. Galvanic
 |  |
| 1. Microbiological
 |  |
| 1. Graphite
 |  |
| 1. Flow-Assisted
 |  |

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| 4 | Stress Corrosion Cracking (SCC) | Explain stress corrosion cracking (SCC), and what happens when this occurs.  | *SCC results from a combination of normal operating stress, a corrosive environment, and temperature. Clusters or colonies of cracks occur, and over time the cracks increase in depth and length, become linked together and may eventually reach a critical depth and length combination that can result in a pipeline failure.*  |
| 5 | Selective Seam Corrosion (SSC) | Explain selective seam corrosion (SSC), and what happens when this occurs. | *SSC is a localized corrosion attack along the bond line of low-frequency electric resistance welds (LR-ERW) and electric flash welds (EFW).* *This type of corrosion will create a wedge shaped groove that is often filled with corrosion products.*  |

# Appendix 2

Appendix 2 – Corrosion Performance Checklist

Complete the task(s) and answer the question(s). The instructor will provide appropriate feedback.

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| --- | --- | --- | --- |
|  | **Tasks** | **Actions and Questions** | **Answers** |
| 1 | Identifying causes of atmospheric corrosion.  | What causes atmospheric corrosion? |  |
| 2 | Determining how metals affect corrosion. | 1. Explain how the differences in metals and variations in environment affect corrosion.
2. Indicate if a common corrosion control coating, for example paint, tape or insulation could prevent corrosion in some of the metals and explain why.
 |  |
| 3 | Identifying type and potential cause of corrosion. | Look at the following examples (A-H). Identify the type/cause of the corrosion.

|  |  |
| --- | --- |
| Type  | Possible cause? |
|  |  |
|  |  |
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 |  |
| 4 | Stress Corrosion Cracking (SCC) | Explain stress corrosion cracking (SCC), and what happens when this occurs.  |  |
| 5 | Selective Seam Corrosion (SSC) | Explain selective seam corrosion (SSC), and what happens when this occurs. |  |