Common Covered Task 417OP
Atmospheric Corrosion Monitoring

Directions

This training guide is to be used by a Veriforce Authorized Evaluator/Trainer and Trainee during on-the-job training (OJT) or prior to an evaluation as a resource. (S) Indicates a demonstration or skill task; (K) indicates a knowledge task.

OJT Reminder

OJT is an active hands-on process. Practice should be as similar to the actual job task as possible. However, if the training is being provided on an actual job site while a covered task is actually being performed, the Evaluator either needs to be qualified on that covered task or be assisted by someone who is qualified on the covered task. The Evaluator should closely monitor the Trainee's practices to ensure safe and correct task performance. At no time should a non-qualified individual perform, or train for, a covered task unless directed and observed by a qualified individual. However, if the “span of control” for that particular covered task is “1:0” (requiring only qualified individuals to perform the covered task), the training must be simulated. Training is simulated by "walking through" the task and simulating all actual manipulations (valves, switches, tools, etc.) an individual would use during the performance of a covered task. Simulating includes the use of safety and administrative requirements as if the task were being performed live. Refer to the Veriforce Evaluator Training Program for more on how to conduct formal OJT.

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**Recommended Student Training or Resources:**
- DOT 49 CFR 192.481
- DOT 49 CFR 195.581

**Introduction**

Atmospheric corrosion is a corrosion process where some metals gradually degrade or alter from their present form. This type of corrosion happens when metal is exposed to substances present in the atmosphere, such as oxygen, carbon dioxide, moisture, sulfur, and chloride compounds. When exposed to the Earth's atmosphere under typical conditions, most metals have a tendency to slowly return to their natural state as a metallic ore.

Corrosion causes rusting or pitting of a metal surface that can attack the integrity of the pipeline. This is due to the chemical reaction or oxidation of the steel pipe when it comes into contact with the different elements in the atmosphere.

Atmospheric corrosion is the most visible of all corrosion processes. It is responsible for more metal damage than any other form of environmental corrosion. It causes nearly 400 billion dollars in damage annually in the U.S., and it is estimated that 5% of the total U.S. income is spent in combating or repairing corrosion damage.

As a result, DOT regulations require each operator to clean and coat each pipeline or portion of pipeline that is exposed to the atmosphere, and inspect these areas for evidence of atmospheric corrosion, except as outlined in 49 CFR 195.581(c) and 192.479(c)(1-2).

Except portions of pipelines in offshore splash zones or soil-to-air interfaces, you need not protect against atmospheric corrosion any pipeline for which you demonstrate by test, investigation, or experience appropriate to the environment of the pipeline that corrosion will:
- Only be a light surface oxide; or
- Not affect the safe operation of the pipeline before the next scheduled inspection

**Knowledge:** Explain what is required prior to performing task.

**Pipeline Operator-Approved Procedures**

Before starting any atmospheric corrosion monitoring, you need to refer to the pipeline operator-approved procedures on how to perform this task. Example procedures may include, but are not limited to, specific areas of concern on a particular pipeline, how to measure corrosion, or how to document the findings of the inspection.

**Appropriate Equipment/Material**

Before performing atmospheric corrosion monitoring, you will need to gather all appropriate equipment and material needed to safely complete the task. Examples of appropriate equipment and material could include personal protective equipment (PPE) and specific tools needed to complete the task, such as a non-metallic brush.
Knowledge: Describe areas where particular attention must be focused during an atmospheric corrosion inspection.

There are certain areas where atmospheric coating damage and/or corrosion damage are likely to occur. These areas must receive particular attention and be inspected thoroughly. This includes:

- Soil-to-air interfaces
- Under insulation
- Under disbonded coatings
- At pipe supports
- In splash zones
- At deck penetrations
- In spans over water

Skill: Identify indications of atmospheric coating damage and/or corrosion damage.

Coating Damage

Atmospheric coating damage can be caused by numerous environmental factors such as:

- Sunlight
- Extreme hot or cold ambient temperatures

Extreme temperatures can cause brittleness, poor impact resistance, shrinkage, flaking, or loss of adhesion and may alter the corrosion-prevention characteristics of the coating system. Sunlight can rapidly degrade a coating and will cause a complete loss of film integrity, resulting in chalking, loss of gloss, fading, and brittleness in a rather short period of time.

Although coating systems help protect the integrity of the pipe, they have a limited life and eventually deteriorate. Deterioration of the coating can lead to disbonding or lack of adhesion from the pipe surface exposing the metal to the environment. Disbonding creates gaps between the coating and pipe surface that fill with water, introducing microorganisms that create corrosion cells.

Indications of atmospheric coating damage include coatings that are flaking, cracking, or separated from the pipeline. Flaking is a result of improper adhesion of the coating. Cracks formed in coatings are breaks in the bonding of the coating and extend through the surface of the pipe, ultimately exposing the pipe to further corrosion damage.

Corrosion Damage

Corrosion damage on a pipeline can be indicated by the presence of any of the following:

- Pitting
- Scale
- Rust
- Thinning

Pitting

Pitting is a serious form of randomly occurring, highly localized corrosion. Pitting is characterized by small indentations or cavities in the pipe’s surface. The depth of the pits caused by this form of corrosion is usually
much greater than the diameter of the affected area. Pitting is one of the most destructive forms of corrosion. If neglected, even a single pit can cause extensive pipeline damage.

**Scale**

Scale is any dense, cohesive material that forms a tightly adhering mass on a metallic surface.

**Rust**

Rust is the red or orange coating that forms on the surface of iron when exposed to air and moisture. Rust or discoloration in the coating is a probable indicator of corrosion.

**Thinning**

Thinning is metal loss that is caused by the oxidation (rusting) of bare pipe and can be determined with a pit gauge and/or ultrasonic thickness meter. (Refer to your operator’s requirements and procedures for proper instructions.)

In addition, carefully look for any unusual colors in the coating where corroded areas are suspected. With the discovery of pipeline rust, discoloration, or corrosion by-products, document the location and notify the proper pipeline operator representative.

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**Knowledge:** Identify steps required to conduct an atmospheric corrosion inspection.

According to regulation 49 CFR 192.481, each operator must inspect each pipeline or portion of pipeline that is exposed to the atmosphere for evidence of atmospheric corrosion. In addition, personnel that conduct such inspections (or atmospheric corrosion surveys) are required to be qualified.

Both on and offshore pipelines require recurring surveys for monitoring corrosion. For onshore pipelines, an atmospheric corrosion survey must be performed at least once every 3 calendar years, but with intervals not exceeding 39 months. For offshore pipelines, the survey should be performed at least annually, but with intervals not exceeding 15 months.

Atmospheric corrosion inspections on exposed pipe should be performed in accordance with the operator’s specific requirements. However, at a minimum, you should:

1. Clean loose soil or other debris with a non-metallic brush to expose coating.

2. Visually inspect the condition of the coating. Inspect where pipe supports come into contact with the pipe, under thermal insulation, and at 90 degree angles. These areas tend to be the most difficult areas to coat, thus increasing the probability of identifying atmospheric coating and/or corrosion damage. Inspect the transition zone of pipe entering the ground to confirm that it is properly coated to prevent the penetration of water between the pipe and the coating. This area is often referred to as the surface/ground interface and is typically where most of the corrosion damage will occur.

3. If visual inspection shows evidence of corrosion damage, assess the extent of coating deterioration. It is recommended to investigate beyond the damaged area to determine whether additional corrosion requiring remedial action exists in the vicinity of the damaged area.

   If visual inspection shows evidence of corrosion damage, measure the area using a pit gauge, if qualified to do so. If the affected area is significant, consult with a corrosion expert, but most importantly, contact the designated pipeline operator representative.

If areas of atmospheric corrosion are identified during an inspection, those areas must be protected before the next scheduled inspection. However, if the corrosion is severe, remediation or replacement of the pipe or components may be necessary before coating.
In conclusion, no matter how well pipelines are designed, constructed, and protected, once in place, they are still exposed to the numerous atmospheric elements that can cause corrosion. Being able to identify indicators of atmospheric coating and corrosion damage, along with knowing how to properly conduct atmospheric corrosion inspections, is crucial to the safety, integrity, and serviceability of the pipeline.

Abnormal Operating Conditions (AOCs)

Candidates are required to possess the ability to RECOGNIZE and REACT to the listed AOCs for each task. Be prepared to answer questions concerning additional AOCs that may be relevant. Evaluators may ask questions about AOCs throughout the evaluation.

An AOC is defined in 49 CFR §§ 192.803 and 195.503 as:

A condition identified by the pipeline operator that may indicate a malfunction of a component or deviation from normal operations that may:

- Indicate a condition exceeding design limits; or
- Result in a hazard(s) to persons, property, or the environment.

Recognize: Unintentional releases, vapors, or hazardous atmosphere could be signs that an abnormal operating condition has occurred. Examples could include, but are not limited to:

- Blowing gas
- Puddles
- Dead vegetation

React/Respond: Proper reactions/responses to take in the event of an unintentional release, vapors, or hazardous atmosphere include the following:

- Eliminate potential ignition sources.
- Move to a safe location.
- Notify emergency response personnel, as appropriate.
- Limit access to the location, as necessary.
- Follow appropriate procedures for notification, documentation, and remedial action.

Recognize: Material defects, anomalies, or physical damage of pipe or a component that have impaired or are likely to impair the serviceability of the pipeline are abnormal operating conditions. Examples could include, but are not limited to:

- Mechanical damage
- Soil to air transition damage

React/Respond: Proper reactions/responses to take in the event material defects, anomalies, or physical damage of pipe or a component that has impaired or is likely to impair the serviceability of the pipeline include the following:

- Determine the extent, cause, and potential hazard(s) of the defect, anomaly, and/or damage.
- Mark the location so it may be easily located, as appropriate.
- Follow appropriate procedures for notification, documentation, and remedial action.

Glossary
AOC
abnormal operating condition

CCT
common covered task

CFR
Code of Federal Regulations