Task 2.1—Verify Test Lead Continuity

1.0 Task Description

This task consists of the electrical inspection of test leads connected to a structure.

This task begins with identification of the test lead wire. The task ends when a determination is made about whether valid data may be obtained using the test lead wire.

This task does not include but may lead to the performance of other covered tasks such as the following.

— Repair Damaged Test Lead (reference Task 2.2).

— Install Test Leads by Non-exothermic Welding Methods (reference Task 2.3).

— Install Test Leads by Exothermic Welding Methods (reference Task 2.4).

— Measure Structure-to-Soil Potentials (reference Task 1.1).

2.0 Knowledge Component

The purpose of this task is to test for electrical continuity between a structure

and test station. **An individual performing this task must have knowledge**

of:

— Interpretation of structure-to-soil (electrolyte) potential measurements taken at a test station [which may not meet expected results (lower than anticipated, unstable, or erratic) and may be indicative of a broken test lead].

— Multimeters (which are used to measure resistance between a structure and a test-lead wire to determine if continuity exists).

Abnormal operating conditions (AOC) associated with the performance of this task include:

AOC Recognition	AOC Reaction
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3.0 Skill Component

To demonstrate proficiency of this task, an individual must perform the following steps.

Step	Action	Explanation
1	Identify the test lead to be tested.	This step is to confirm that measurements are taken on the intended test lead.
2	Select the proper instrumentation (multimeter, data logger, reference electrodes, etc.) to be used and verify the proper operation.	Incorrect or faulty equipment will not provide accurate results. Damaged, incorrect, or faulty equipment will not provide accurate results and shall be repaired, replaced, or calibrated, as required. Make appropriate notifications if there are missing, damaged, or malfunctioning components.
3	Connect the test equipment to the structure, as required, to perform the test.	Improper connection of equipment will lead to inaccurate potential or continuity measurements.
4	Measure the structure-to-soil (electrolyte) potential and/or continuity.	This step determines the potential and/or continuity of the structure and test lead. A potential may be compared with historical data to determine continuity. If test lead wire, test points, and/or test stations are damaged, missing, or loose, implement mitigation measures per Operator's procedures.
5	Document all required information per Operator's procedures.	Up-to-date records are essential for maintaining a corrosion control system.

Task 2.3—Install Test Leads by Non-exothermic Welding Methods

1.0 Task Description

This task consists of making an electrical connection by mechanical means that may include magnetic coupling, conductive epoxy, clamp, and/or split bolt connectors.

The task begins after the test point is properly located. The task ends when the installation is documented. The performance of this covered task may require the performance of other covered tasks such as the following.

— Verify Test Lead Continuity (reference Task 2.1).

— Prepare Surface for Coating Using Hand and Power Tools (reference Task 7.2).

— Apply Coating Using Hand Application Methods (reference Task 7.5).

2.0 Knowledge Component

The purpose of this task is to install test leads on a structure by methods other than exothermic welding. **An individual performing this task must have knowledge of:**

— Proper connection preparations such as cleaning metallic surfaces and/or connecting wires.

— Proper size clamps or split bolt connectors for a given wire size.

— Manufacturer’s specifications (if using a conductive epoxy).

Manufacturer’s recommended safety procedures.

Abnormal operating conditions (AOC) associated with the performance of this task include:

AOC Recognition	AOC Reaction
This section intentionally left blank.	*This section intentionally left blank.*

3.0 Skill Component

To demonstrate proficiency of this task, an individual must perform the following steps:

Step	Action	Explanation
1	Identify the location where the test lead will be installed.	This step confirms that work is done on the intended pipeline or pipe component.
2	Determine the size of wire to be used.	The normal gauge of a general test wire is per Operator specifications. If the test station is to be used for an interference bond between two facilities, the wire gauge will be greater to eliminate any unwanted wire resistance.
3	Determine the method to attach the wire to the pipeline or facility.	The actual method used will be based on the existing structure.
4	Prepare the pipe surface for wire installation according to manufacturer or Operator's specifications.	If foreign materials are not removed, they could cause a failure to bond reducing or eliminating electrical continuity.
5	Install the wires to the structure using magnetic connection, epoxy adhesive or clamp method verifying electrical continuity.	The actual connection is dependent on Operator requirements and the test lead location.
6	Document installation as required by the Operator's procedures.	Up-to-date records are essential for maintaining a corrosion control system.

Task 2.4—Install Test Leads by Exothermic Welding Methods

1.0 Task Description

This task consists of installation of test leads on a structure by exothermic weld.

The task begins after the test point is properly located. The task ends when documentation of the connection is complete.

Exothermic welding, generally known as thermite welding, is a process using a graphite mold into which a charge-containing mixture of copper alloy and magnesium starting powder is poured. The mixture is ignited with a flint gun or electronic device, melts, and drops down, welding the wire to the structure.

Pin brazing is a means of thermite welding that involves using electrical current to melt solder to provide a connection.

The performance of this covered task may require the performance of other covered tasks such as the following.

— Prepare Surface for Coating Using Hand and Power Tools (reference Task 7.2).

— Apply Coating Using Hand Application Methods (reference Task 7.5).

— Measure Wall Thickness with Ultrasonic Meter (reference Task 8.2).

2.0 Knowledge Component

The purpose of this task is to install test leads by exothermic welding methods such as thermite welding and pin brazing.

An individual performing this task must have knowledge of:

— The proper size mold and charge for different sizes of wires and structures.

— Different alloy charges (which are used for steel and cast/ductile iron structures).

— Hazards associated with melting materials and using extreme heat.

  — Contact between hot molten metal and moisture or contaminants may result in spewing of hot material. Moisture and contaminants in mold and materials being welded are to be avoided. The exothermic weld device must be used according to the manufacturer's procedure. This process involves heat above 2500 °F, and all safety concerns must be addressed.

— Manufacturer's specifications for the pin brazing method [this includes the use of equipment that uses lower temperatures (approximately 600 °F)].

Terms applicable to this task:

alloy charges

A charge is the mixture of a copper alloy and magnesium starting powder.

Abnormal operating conditions (AOC) associated with the performance of this task include:

AOC Recognition	AOC Reaction
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3.0 Skill Component

To demonstrate proficiency of this task, an individual must perform the following steps.

Step	Action	Explanation
1	Identify the location where the test lead will be installed.	This step confirms that work is performed on the intended location.
2	Remove a window of paint or coating from the section of pipe to be welded.	An exothermic weld needs to adhere to bare pipe.
3	Ensure that actual wall thickness has been determined and meets minimum Operator requirements.	Sufficient wall thickness is necessary to maintain pipe integrity and personnel safety.
4	Prepare and inspect the pipe surface to receive an exothermic weld.	Verify that the surface profile meets manufacturer or Operator specifications. If foreign materials are not removed, they could cause the exothermic weld to fail.
5	Remove sufficient insulation from the wire and crimp the copper sleeve to bare the wire, as required.	Insulation must be removed to ensure proper adhesion to the pipe. Some smaller gauge wires require a copper sleeve.
6	Select and prepare the proper weld mold with a properly sized charge. If using pin brazing, this step does not apply.	Different wire sizes and applications require the use of different molds and weld charge.
7	Insert the wire and place the graphite mold on the desired location to be welded. Insert the appropriate charge into the mold. If using pin brazing, this step does not apply.	Centering the wire in the mold helps to ensure proper adhesion.
8	Ignite the charge to create the exothermic weld. Hold the graphite mold firmly in place until the weld sets according to the manufacturer's specification. If using pin brazing, this step varies. For this method, the wire is held in place as the pin brazing current is applied.	This begins the weld process. NOTE Charges may be ignited electronically or with a sparking device. Pin brazing uses electric current to melt solder material to adhere the wire to structures.
9	Verify the integrity of the weld.	Carefully remove the slag with a hammer and wire brush. Verify adhesion of weld. File the sharp edges off of the exothermic weld .
10	Document installation according to Operator's procedures.	Documents are essential for maintaining a corrosion control system.

Task 3—Obtain a Voltage and Current Output Reading from a Rectifier to Verify Proper Performance

1.0 Task Description

This task consists of measuring and documenting the electrical output of a rectifier.

The task begins with the identification of the rectifier. The task ends with the measurement of a rectifier output and documentation of data.

This task does not include data analysis.

2.0 Knowledge Component

The purpose of this task is to verify the proper performance

of a rectifier. An individual performing this task must have

knowledge of:

- CP systems and components comparable to AMPP/NACE Certification Level CP 1.
- Voltmeters
- Clamp-on ammeters
- Calculating current from shunt factor and voltage measurement [current output may be calculated based on shunt factor (ratio) and voltage drop across the shunt].
- Validation of display meters with observed readings and with remote read devices, if applicable.
- Proper rectifier output polarity.

Abnormal operating conditions (AOC) associated with the performance of this task include:

AOC Recognition	AOC Reaction
Energized rectifier shell/case.	Make appropriate notifications per Operator’s procedures.

3.0 Skill Component

To demonstrate proficiency of this task, an individual must perform the following steps:

Step	Action	Explanation
1	Identify the rectifier.	
2	Determine the voltage by connecting a voltmeter across the output terminals of the rectifier. — Connect the positive lead to the rectifier positive terminal. — Connect the negative lead to the rectifier negative terminal.	Obtaining accurate voltage and polarity are essential to maintaining CP. If the polarity is reversed, take action, if qualified, and make appropriate notification per Operator's procedures.
3	Obtain the shunt factor by reading the value labeled on the shunt and dividing the amp value by the mV value.	Obtaining a shunt factor is essential to calculate current from millivolt reading obtained from a shunt.
4	Determine the current on a pre-installed shunt by reading the millivolt drop across the shunt and multiplying by the shunt factor.	Obtaining accurate current is essential to determining the effectiveness of a CP system. If the rectifier is inoperable, make appropriate notification per Operator's procedures.
5	Check voltage and current readings against display meters and/or remote monitoring devices, if applicable.	Validating remote devices and display meters is necessary to ensure accurate data is being received.
6	Document all required readings per Operator's procedures.	Documents are essential to maintaining a corrosion control system.