Common Covered Task 482
Apply Approved Coatings by Mechanical Spray and Hand Application Methods

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

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Recommended Student Training or Resources:

- DOT 49 CFR 192.461 (a)
- DOT 49 CFR 195.557
- DOT 49 CFR 195.559
- DOT 49 CFR 195.581

Knowledge: Explain what is required prior to performing task.

Operator-approved procedures

Before beginning your task, consult with the operator. Typically, operators provide information including, but not limited to, the type(s) of coating that will be used, the technique(s) that could be used, the required coating thickness (this can vary depending on where a section of pipe will be laid), and the section(s) of pipe to be coated. The operator's specifications or procedures may dictate the primer and what type of top coat to use, if these are necessary.

The operator may have specific requirements for how to repair or replace any damaged coating. Environmental conditions can also play a role in the coating application selection. If you're applying coating to an existing coating, the operator could also inform you of the coating that was previously applied.

Engineers collect environmental demographics to figure out what type of coating is best suited for protecting the pipe. Therefore, it's important to adhere to the operator's requirements for coating along with the coating manufacturer's limitations.

Manufacturer procedures

Manufacturers provide product data sheets for you to use. Product data sheets provide all sorts of specifications, and they are specific to the product that they are intended for. Product data sheets typically include: ideal minimum and maximum temperature ranges for the coating, mixing ratios, the coating's finish, shelf life/storage requirements, and what kind of surface preparation needs to be done prior to application.

Be aware of any compatibility issues when one type of coating is used over another type. It's important to follow the manufacturer's specifications for coating-to-coating compatibility. This will help prevent re-coating.

Before beginning a coating task, you should always make sure that you have the most current product data sheets and read all specifications from the manufacturer beforehand.

Sometimes a product data sheet is prepared for coating application to take place in the summer, but you may not be able to coat until winter and would then have irrelevant information if the product data sheet isn't the most current version.

Appropriate equipment/material

Before coating can be applied, you'll need to have the necessary equipment ready before you're able to perform the task. Required equipment can include, but isn't limited to: holiday detectors (also known as jeeps, these can be either high or low-voltage), a sling psychrometer, a surface temperature thermometer, a dry film thickness gauge, a wet film thickness gauge, mixing tools, surface preparation equipment (approved filing tools, grinders, blasting media and equipment, etc.), application equipment (rollers, brushes, etc.), coating, and approved solvent cleaners.

It's recommended to have a notebook handy to document all of the temperatures and measurements you'll be taking while performing coating work. In addition, you should always wear all required PPE.

Knowledge: Describe factors to consider when applying coatings.

Application method (mechanical spray, hand applied, brush, rolled, and spray can)

When applying coating, whether it's by hand application or mechanical spray, there are many options to consider. These include, but aren't limited to: brush, roller, aerosol spray, and mechanical spray. The pipeline operator should specify what method(s) should be used for coating application.

Dew point reading at time of application

The dew point reading identifies the temperature at which the moisture in the air will condense into water on a solid surface. The pipe surface temperature must be measured to determine if it's above or below the dew point. In general, the pipe surface temperature should be at least 5°F above the dew point to ensure proper performance of the coating.

Since even the smallest amount of moisture can cause premature coating failures, you'll need to take a reading and reference the dew point reading at the time of application with the allowable manufacturer's minimum levels.

Pipe sweating

Pipe sweating occurs when the product inside the pipe is colder than the air surrounding the pipe. You usually find moisture when warm air touches a cold pipe. If there's any moisture between the coating and the pipe, it can cause holidays, rust, and a failed coating since the coating will not end up adhering directly on the pipe because of the moisture in between the pipe and the coating.

Ambient and surface temperature

You should be aware of ambient and surface temperatures before applying coating. Ambient air temperature is the temperature of the surrounding environment. Surface temperature is the temperature on the surface of the pipe segment or component you are coating. Some coatings require surface and ambient temperatures to be within a certain range before mixing. You must ensure that you follow the manufacturer's instructions and that the selection of the coating is compatible with the environment and operating temperatures of the pipeline.

Surface contaminates

Surface contaminates need to be taken into consideration before applying coating. Grease, oil, loose rust, welding slag, frost, moisture, mill scale, dirt, dust, and other foreign debris can all rest on the pipe's surface. If surface contaminates aren't removed from the pipe, the coating will adhere to the layer of contaminates instead of to the substrate. This can cause poor adhesion and coating failure.

Airborne contaminates and weather conditions (current and forecasted)

Weather conditions and airborne contaminates can also affect application. High winds can change curing and drying times and can create airborne contaminates. In addition, equipment that's moving around your site can cause contaminates to become airborne. Airborne particles that mix with the coating or settle on the pipe prior to coating application can cause air pockets. These air pockets will create weak points and degrade the effectiveness of the coating. Temperature, humidity, and dew point are all important factors. These are directly impacted by the weather conditions at your site. You don't want to apply the coating when you're due for inclement weather, such as a rain storm. You should avoid coating applications during inclement weather conditions.

Blasting media

For a new coating to adhere properly, the surface must be properly prepared. Typically, this process involves media blasting the area. Coating specifications may call for a particular blasting media, such as sand, grit, walnut shell, glass, or plastic. Some jobs will also require one or more cleaning methods.

Knowledge:	Describe how to assure the surface is properly prepared for coating application.

Verify surface is prepared per manufacturer's procedures and is free from contaminates

Surface preparation is the removal of foreign matter from a metal by any of several means. Poor surface preparation is a major cause of coating failure. It's a necessary first step before the application of any coating. Think of it this way, surface preparation to a coating system is what a foundation is to a building. If the surface preparation is done poorly, the coating won't perform well. On the other hand, if surface preparation is done in accordance with the manufacturer's recommendations, the coating applied to the pipe is likely going to perform well, given that the right coating system has been selected.

Surface preparation is vital to the success of the coating's adhesion to the pipeline, as well as the lifespan of the coating. Coating manufacturer instructions should be followed when it comes to surface preparation. SSPC and NACE have coating standards that are referenced by most manufacturers on their product data sheets. Generally, these requirements specify the use and type of surface cleaning tools. Examples include, but are not limited to: solvents for grease/oil removal and the possible methods for achieving the proper surface profile or finish. Some methods may require heating the surface with an induction coil or propane torch before coating application.

Surface preparation is important in two ways. Mechanically, it creates an anchor profile for the coating to adhere to. Chemically, it allows the coating material molecules to make close contact with the pipe's steel surface and form a strong bond. If surface preparation isn't done properly and contaminates haven't been removed from the surface, the coating won't bond directly to the pipe. Surface preparation can range from hand tool cleaning to machine blasting with abrasives. Some types of coatings require one or more cleaning methods depending on the type of surface, the surface condition, and how clean the surface needs to be for the coating to bond properly.

Most manufacturer procedures regarding surface preparation that are developed for pipeline coatings refer to standards set forth by the Society for Protective Coatings (SSPC) and the National Association of Corrosion Engineers (NACE). There are different ways to make sure the surface is free of contaminates before applying the coating. These include, but are not limited to, solvent cleaning, hand tool cleaning, power tool cleaning, abrasive blast cleaning, and water blast cleaning.

Solvent cleaning is used for removing all visible oil, grease, soil, markings, and other soluble contaminates. It's essential to remove all surface contaminates prior to further surface preparation or painting of the steel. This method is often used prior to the other methods.

Power-assisted hand tools, such as a wheel grinder or a wire brush, are used to remove loose mill scale, rust, paint, and other loose foreign matter.

If the material you're trying to remove is bonded to the pipe, you may need to resort to other methods such as abrasive blast cleaning. This method uses abrasive materials, such as sand, metal, plastic beads, etc., by means of forced air.

Finally, there's water blasting, also known as water jetting. This method uses a power washer machine and can also use detergents and heated water to assist with cleaning. This method is a substitute to abrasive blasting when hazards, such as risk of fire, prohibit the use of abrasive materials.

Knowledge:	Describe the terms typically used in general manufacturer's recommendations pertaining to the application of coatings.

Surface profile

When a surface is very smooth, coatings have a difficult time adhering strongly to the surface. For instance, a scraper or even a fingernail can remove a coating off of glass easily. On the other hand, it's difficult to remove a coating from a rough surface, like sandpaper. When steel is blasted with abrasives, its surface becomes rough like sandpaper and the coating bonds strongly. After preparing the surface, it will have lots of tiny peaks and valleys and will no longer be smooth. This roughness is called the surface profile. Coatings anchor themselves to the valleys and peaks of the surface profile. You may have heard the terms "anchor profile" or "mechanical tooth" for a surface profile that's been created by blasting since abrasive blasting cleans the pipe and roughens it. The product data sheet will specify the surface preparation method and how rough the surface must be before a coating is applied.

Pot life

The pot life is the period of time that a coating is usable. Pot life is a term used for two-part epoxies or coatings that require mixing components together. This mixing causes a chemical reaction to take place, which causes the components mixed together to start hardening. Applying a coating after the end of its pot life can lead to a variety of failures such as the coating not bonding to the substrate properly, poor chemical resistance, poor gloss, wrinkling of subsequent coatings (if the coating is a primer or intermediate), and grittiness of the finish. If a coating has exceeded its pot life, it should be disposed of properly by following company procedures.

Mixing ratios

The term mixing ratio is used for most two-part epoxies and indicates the amounts of components that are required to be mixed to create the coating. For example, mixing ratio instructions could say something along the lines of, "add one ounce of part A for every pint of part B." It's important to follow the product manufacturer's mixing ratio instructions.

Curing/drying times

The drying time is the period of time that it takes for a coating to be dry to the touch. The drying time usually starts when the coating is applied to the pipe. There are a number of factors that can affect the amount of time it takes for a coating to dry, for example: wind, humidity, temperature, and ventilation. As a general rule, the colder the temperature and the higher the humidity, the longer it will take for the coating to dry.

The curing time is the amount of time that's required for the coating to completely dry and adhere to the substrate's surface. As the coating cures, it solidifies. If the coating isn't given the required curing time, it will fail to bond properly to the pipe. For curing to occur, heat, light, or a specific amount of time may be necessary. The product manufacturer will have curing and drying times for their specific product listed on the product data sheet. You should refer to the manufacturer's recommended drying and curing times.

Re-coating

Re-coating is a term used for the application of a coating onto an existing coating. Because of coating differences, you should always follow the manufacturer's instructions when it comes to re-coating to avoid adhesion problems since this can eventually lead to coating failure.

Shelf life

The shelf life is the time frame in which a coating can remain in storage without the coating's serviceability being affected. The shelf life is based on the coating being in a tightly-sealed container that's stored within the temperature range set forth by the manufacturer. If the temperature range exceeds the manufacturer's recommendations for storage, the shelf life can be reduced drastically.

Knowledge:	Describe the following coating application methods and use of the related equipment.

There are multiple application methods for you to use when it's time to apply coating.

Brush

One of the more common methods for applying coating to small repairs or hard to reach areas is using a brush. You need to be sure and choose the correct type of brush as some are designed strictly for water-based coatings while others are designed specifically for oil-based coatings. The brush application method should be undertaken using an appropriately sized, good quality synthetic or natural fiber brush compatible with the product being applied.

Roller

A second method of application is the use of rollers. Rollers can be used for small sections or repair work. A roller consists of a roller cover installed on a roller frame. Always follow manufacturer and operator specifications regarding knap size. The roller application method is faster than using a brush and more suited for large surfaces. The length and thickness of the roller is dependent on the surface of the pipeline and coating itself.

Aerosol spray (handheld spray can)

The aerosol spray method, also known as the spray can or rattle can method, is a simple and inexpensive method for temporarily covering small jobs and repairs. Because the paint is thinned to come out of the nozzle of the spray can, multiple coatings may be needed to build thickness. The paint can be color matched to your specific pipeline or component.

Mechanical spray (mechanized system)

The mechanical spray method is another option when it comes to applying coating. This method is typically used for larger surface applications as there is more involved with setting up and, cleaning the equipment when completed. The mechanical spray method is the fastest and cheapest method of applying a liquid-based coating. When this method is performed properly, it offers the most consistent covering. For the purposes of this course, we will focus on mechanical spray guns.

There are several different types and sizes of spray guns, ranging from manual to large machine-operated guns. There's also a wide range of adjustments for each type that allow for different angles of spray and the amount of fluid flow. Spray guns work by atomizing the paint and expelling it through a nozzle by force. Some mechanized systems include, but aren't limited to: pressure pots, gravity fed, airless sprayers, and mechanical flocking.

Pressure pots pressurize a paint "pot" that is connected to the air gun. A compressor provides the pressure that pushes the paint to the spray gun. Since the pot is not attached to the gun, you can apply coating with the gun held at any angle.

Gravity fed spray guns typically use a gun with a small cup or pot directly attached. A compressor pushes the air through the gun and when triggered, siphons the coating. You will need to be careful when using this type of gun because it must be kept in a near upright position when applying.

Airless sprayers are handy because they don't require an air compressor. Instead, they use a motorized pump to pressurize and push the coating out of the spray nozzle onto the substrate. Airless sprayers are useful since they allow the gun to be held at any angle for application. The high pressure built up within the tube atomizes the coating into a fine mist. This creates a smooth finish with a minimum amount of coating.

The flock spray application method is generally used with two-part powder epoxies. It is sprayed onto the pipe with a specialized gun that functions via electrostatic force or air. The electrostatic coating process works by applying a high voltage charge to the spraying material which is then expelled onto the pipe's surface. This results in the electrostatic attractive forces from the coating bonding with the pipe.

Skill:	Demonstrate how to properly prepare for coating application.

Measure surface temperature of component

It's important to obtain the surface temperature of the pipe segment or the component that's going to be coated. Coating can require the pipe or component to be within a specific temperature range. The surface temperature is important for curing and drying times as well as the coating's performance. There are many coating manufacturers that provide multiple coating products. Refer to the specific coating instructions regarding the required surface temperature.

Typically you'll get the surface temperature by using a non-contact infrared thermometer. These are often called temperature guns. You simply point the device at the pipe or component, and pull the trigger to get a reading. A second method of obtaining a surface temperature is using a contact thermometer. This may not be a preferred method for obtaining surface temperatures. When using contact thermometers the probe will have to actually make contact with the pipe or component. This can lead to contamination or even coating damage, such as scratches.

Measure surface profile, as applicable

The degree of the substrate's profile affects the coating's overall performance. It also helps to determine adhesion, coverage, and the volume of the coating(s). As you already know, for a coating to bond properly to the substrate, the surface must be prepared as recommended by the manufacturer. Once the surface has been prepared, you will need to measure the surface profile if necessary.

A common method for measuring the surface profile is by using replica tape, a burnishing tool, and a thickness gauge or spring micrometer. The gauge should be specifically designed to be used with replica tape. The backside of the tape has an emulsion of microscopic bubbles. When the emulsion is placed down on a blasted substrate, you rub it with a burnishing tool and break the bubbles with the peaks of the profile. The tape creates a reverse copy of the surface profile. The gauge or micrometer is then used to obtain a measurement of the profile. You may be required to keep the tape for documentation purposes.

There's also a wide array of electronic/digital surface profile gauges that can be used to obtain measurements. You should always review a tool's manual before using it.

Determine dewpoint

Determining the dew point is critical when applying coating. Typically, coating specifications require that the surface temperature of the component or pipe segment be at least 5°F higher than the dew point temperature. Dew point can be determined using the appropriate meter that will perform the calculations or by obtaining the ambient air temperature and humidity and referring to a dew point chart.

Ensure area to be coated is free of contaminates

One of the most important steps for properly coating a pipeline or a component is ensuring that the surface is free from contaminates. Some common contaminates are dirt, dust, grease, oils, weld slag, rust, mill scale, and compromised coating. At this point, you probably know that a substrate's surface must be properly cleaned prior to coating application. Coating specifications typically indicate what cleaning method will work best. Some coatings require more than one method to ensure that the area to be coated is free of contaminates.

You can visually inspect for contaminates and use sand paper, a sanding wheel, or wire wheel to clean off the substrate's surface. You will need to consult the product specifications for the proper grit rating when using these methods to ensure a proper surface profile. In addition, while acetone is a common solvent used for cleaning off the substrate, the manufacturer may specify a particular degreaser or cleaner that should be used to rid the surface of contaminates.

Prepare coating (example, but not limited to, mixing epoxy), as applicable

Coating will require some method of preparation before application. Coatings may be a single component in need of stirring, while others will consist of two parts that require mixing. For example, a two-part epoxy will require measuring out the correct amount of resin and hardener and then mixing as recommended. Always refer to the manufacturer product data sheet for the coating that you'll be using.

Skill:	Demonstrate the proper application of coating using each of the following methods/coating systems

Remember to always refer to the manufacturer's data and operator's procedures for specific instructions since coatings are unique.

Mechanical spray system

For mechanical spray systems, you should become familiar with the type of spray gun you'll be using. Most spray guns have controls that regulate air pressure, spray patterns, and fluid flow. Because these controls are adjustable, spray guns can meet a variety of finishing requirements. Not only that, but your spray patterns can vary depending on how you rotate the gun's nozzle. You can adjust the spray pattern to apply the coating in a manner that's most efficient for the area that you're trying to coat. Ensure that your spray gun has the pressures adjusted in accordance with the tool's recommended settings and the coating manufacturer's recommendations.

Hand Method - Rolled

Before using a roller, you should remove any loose fibers from the cover by "wiping" the roller cover with your hand. To use a roller, saturate the fibers on the entire roller with the coating using a paint tray. Be careful not to oversaturate the roller. After saturating the roller, you can roll it on the pipe in a straight line to transfer the coating onto the substrate. It should be noted that there are multiple patterns that you can follow when it comes to rolling. Rollers work best on smooth surfaces and serve as a good alternative over a spray method in windy conditions.

Hand Method – Brushed

To use a brush, you should saturate the bristles with the coating and spread the coating on the pipe in one direction with moderate, even pressure. Avoid runs and sags in the coating, especially at the 6 o'clock region of the pipe. You should also keep an eye out when using the brush method on weld buttons. Remember to work dry-to-wet, meaning you should coat from the uncoated area towards your newly-coated section.

Hand Method – Aerosol

The aerosol application method requires very little preparation and little to no mixing. Make sure you move the can around as you spray to avoid drips and runs. Additionally, rattle cans may be difficult to use during windy conditions.

Apply primer, intermediate coat (if required), and topcoat according to manufacturer's specifications

The product data sheet will tell you whether or not a coating requires a primer to be applied before the intermediate coat. It will also prescribe a topcoat, if necessary.

Measure thickness of applied coating paint to confirm proper application thickness using both wet film and dry film methods

Coatings all have a required thickness that must be met to ensure the coating functions as designed. Coatings that are too thin can't prevent abrasion or corrosion. If a coating is too thick, it will crack, flake, blister, or fail to cure properly. It's fundamental that you apply a coating to the desired thickness established by the pipeline operator and the coating manufacturer. The coating thickness shall be as specified by the coating manufacturer or the coating specification provided by the pipeline operator.

There are two methods that can be used to verify the coating thickness: the wet film and dry film thickness measurements. The wet film method is used when the coating is still wet. This measurement is taken to

ensure the amount of coating that is present and allows for immediate corrections or adjustments to coating thickness prior to the coating drying.

The wet film thickness gauge is a notch-type gauge. It has progressively deeper notches which resemble a hair comb. It's designed to be inserted into the coating and measure the thickness as it covers the teeth of the "comb." The gauge is applied perpendicular to the wet film and the film thickness can be read off on the last tooth that made contact with the wet coating.

Dry film testing is typically performed by using a magnetic film gauge that nondestructively measures coating thickness. There are three common dry gauges that you may end up using to measure a coating's thickness. These include magnetic pull-off, electromagnetic induction, and ultrasonic gauge (UGT). When using these devices, you should follow the manufacturer's instructions to ensure proper use.

Knowledge: Explain how to protect coating during curing/drying.

There are three methods that can be used to protect your coating from environmental conditions. These include: tarps, lean-tos and canopies. These controls can be set up during the application phase or after coating has been applied.

Tarps

The use of tarps can provide coverage of the area that has been coated. A tarp can protect the top and the sides of the pipe from rain, dust, and debris. These are typically constructed to resemble a tent. You'll need to make sure that the tarp doesn't come into contact with the pipe during curing or drying by using some type of structure.

Lean-to's

Lean-to's can help shield a coating job. A lean-to is usually constructed with poles and a tarp. The tarp is weighted or staked on one end and then propped up on the other to provide coverage of the top and one side of the pipe. Again, you should make sure that the lean-to doesn't come in to contact with the pipe or component.

Canopies

A canopy can be used to shield coating during curing/drying times. These are sometimes considered the easiest to erect because all of the needed materials, the poles and cover material, are included. You simply expand them and extend the legs. While they offer increased convenience, canopies only provide coverage to the top of the pipe. The sides and ends of the pipe will be exposed to the elements.

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 and/or 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.
- Notify designated operator representative.

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

- Damaged risers
- Exposed pipeline
- Dents
- Gouges

React/Respond: Proper reactions/responses to take in the event of 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:

- Stop activity and notify designated operator representative.
- Mark the location so it may be easily located.

Recognize: An unintended fire and/or explosion on or near the pipeline is an abnormal operating condition.

React/Respond: Proper reactions/responses to take in the event of an unintended fire and/or explosion on or near the pipeline include the following:

- Move to a safe location.
- Notify emergency response personnel, as appropriate.
- Notify designated operator representative.

Recognize: Failure or malfunction of pipeline component(s) is an abnormal operating condition. Examples could include, but are not limited to:

- Valve leaking
- Pipe support failure

React/Respond: Proper reactions/responses to take in the event of a failure or malfunction of pipeline component(s) include the following:

- Stop activity.
- Notify designated operator representative.

Recognize: Corrosion on pipeline component that has impaired or is likely to impair the serviceability of the pipeline. Examples could include, but are not limited to:

- Evidence of damaged coating or loss of adhesion
- Notable metal loss
- Evidence of soil stress

React/Respond: Proper reactions/responses to take in the event that corrosion of a pipeline component(s) has taken place include the following:

- Notify designated operator representative.

Glossary

AOC
abnormal operating condition

CCT
common covered task

CFR
Code of Federal Regulations