Common Covered Task 605
Locate Line/Install Temporary Marking of Buried Pipeline

Directions

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Recommended Student Training or Resources:

- DOT 49 CFR 192.614(c)(5)
- DOT 49 CFR 195.442(c)(5)

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

Pipeline Operator-Approved Procedures and Appropriate Equipment/Material

Prior to performing this task, you will need to have the pipeline operator-approved procedures as well as the appropriate equipment and materials. The procedures will outline requirements for performing this task that are specific to the pipeline operator. Operators may also have specific requirements regarding the type of equipment that can be used to perform this task.

Therefore, it's important to follow the specific requirements of the procedures and only use operator-approved equipment. Doing so can ensure the task is performed correctly and according to the pipeline operator's standards.

Knowledge:	Describe what details should be considered in selecting the proper line-locating device.

There are over 2.2 million miles of pipelines that transport gas and liquid product throughout the U.S. To put that in perspective, that is enough pipe to reach the moon and back 5 times.

The majority of the pipeline system is buried below the ground. This is done for safety, security, protection from the elements, and aesthetic purposes, amongst others.

Buried pipelines have numerous advantages, but they also have some disadvantages. The number one disadvantage is that you cannot physically see the pipe. This can cause problems for any type of construction, whether it's a home owner digging holes to install a fence or major construction.

To mitigate damages caused by digging, regulations have been written to ensure buried facilities are located and marked. Amongst the numerous regulations that govern buried facilities, one of the most important is locating and marking buried pipelines/facilities prior to any construction or excavation work.

Often the first step in locating a buried facility is the selection of the tools needed to properly locate a line.

There are several methods and types of line locators available. The direct connect method, which uses an electromagnetic locator, is the most common and preferred method used for locating pipelines.

Other locating devices are dowsing rods and passive magnetic locators. They are not as accurate or widely accepted, and they are not approved methods of locating by the majority of pipeline operators.

When selecting the type of locator, as well as the method for locating, there are several considerations that must be taken into account. Some of the main considerations are:

- Electrical interference
- Depth of pipe
- Access to pipe
- Line size
- Line material
- Presence of other facilities

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Electrical interference such as power lines, cathodic protection systems, and radio signals can give mixed or bleed-off signals to an electromagnetic locator.

Electricity takes the path of least resistance. Metallic objects, such as pipes, provide less resistance, and therefore they almost always have passive currents flowing through them. This produces a broadcast signal that a line locator can detect.

The depth of the pipe plays an important role in selecting a line locating device as well as subsequent equipment. For example, if you need to locate a line with an approximate depth of 10', a 5' probe rod would not be a good choice to verify depth.

Furthermore, some locating devices may only be rated for certain depths when being operated in inductive or passive modes.

Access to the pipe plays a role in the selection of a line locator because of the type of method you can use in locating a line. Most electromagnetic line locators available on the market can locate either by direct connection (conductive), broadcasted signal (inductive), or magnetically (passive). However, they may not all share those features.

The most accurate and preferred method is the direct connect method. If the pipe is exposed or there is a connected test station, you can direct connect to the pipe. However, if there is no connection point available, you will need to use another method.

Line size plays a role in both the signal strength as well as the "footprint" of the signal that it can give off when using an inductive or passive line locator.

The best line locator to use with smaller diameter pipe is one that can operate in the conductive mode.

Electromagnetic line locators need a metallic material to operate. If the pipe material is not metallic, such as polyurethane or cement, there will be no signal for the line locator to read.

In cases where the need is to locate and identify all foreign facilities, the use of multiple types of line locators may be needed.

Always ensure that the line locator you are using is compatible with the type of pipe you are trying to locate.

The presence of other facilities can cause interference when locating a specific line.

The line locator doesn't know what is below the ground or where the signal is actually coming from. It simply reads the signal that is produced. Therefore, if there are other pipes/facilities present, they will also send a signal.

Direct connect methods can also have this problem. When using this method, you should be aware of possible "bleed-over" signals to lines that are in close proximity of the line you are locating.

Knowledge:	Explain the different types of ways to use a locating device to place a signal or locate a signal on a target line and explain the advantage of each type.

There are several different types of line locating devices available. Each may have its own method of operation depending on the manufacturer's design and layout of the locator.

Regardless of setup, most line locators can be operated by either conductive, inductive, or passive mode.

The conductive method is a direct connect method. Basically, a "metal-on-metal" connection is made from the transmitter to the pipe.

The inductive method (or "dropping the box") involves introducing an open air broadcasted signal on the target. This is accomplished by setting the transmitter in line with the buried pipeline, which generates an electric field.

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The main limitation with this method is the charge/signal is not sent solely to the pipe you are trying to locate. If there are other facilities near the pipe, they will also produce a signal.

This method may be the best method to locate when you cannot connect to the pipe directly.

Passive line locating is locating lines without the use of a transmitter. The receiver is utilized by detecting natural frequencies in the ground, such as those frequencies sent out by metal objects.

This method is often used to quickly locate unknown foreign facilities in the area of excavation.

While all methods may be used to locate a line, the most accurate and preferred method is the direct connect method. You should make every effort to locate a pipeline using direct connect.

Knowledge: Identify common problems with locate signals.

A line locator is nothing more than a tool that is used to help the operator determine the location of a line. As previously mentioned, the line locator doesn't know what is below the ground or where the signal is actually coming from. It simply reads the signal being produced.

The person operating the tool actually finds the line by understanding the operation of the equipment. In order to do this effectively, the person operating the locator must also understand the tool's limitations as well as any known problems that are associated with the use of the tool.

Some of the most common problems associated with the use of electromagnetic line locating devices are:

- Air coupling
- Distorted signals
- Interference
- Inadequate/improper connection

Air coupling happens when the transmitter and the receiver are too close together.

When the receiver is too close to the transmitter, the direct signal the transmitter produces is much stronger than the signal coming from the pipeline you're trying to locate.

Air coupling is always present. The closer you are to the transmitter, the greater the false signal. As you move further from the transmitter, the induced signal from the transmitter gets weaker and the signal from the pipeline will get stronger.

If you suspect that you are receiving false readings and or distortion, simply tilt the locator 45° toward the transmitter, while leaving the lower antenna of the locator touching the ground, and record the depth.

Then tilt it about 45° away from the transmitter, and record the depth. If the depth changes significantly, air-coupling is more than likely the cause of the distortion/false reading.

Always refer to the equipment's manufacturer's operating instructions for procedures in checking for air coupling as well as any minimum distances the transmitter and locator must be to mitigate air coupling.

Distorted signal problems from the transmitter can be caused by the presence of multiple buried facilities or metallic sediments. The presence of these items mentioned can distort the electromagnetic field from the transmitter by attracting and/or repelling the signal produced from the transmitter.

To mitigate the effects of this type of distortion, you can move the transmitter, or if possible, use the direct connect method to locate.

Electrical interference can also affect the transmitter signal as well as produce false readings to the receiver.

Electrical interference can come from overhead or buried power lines. In addition to power lines, cell towers, cell phones, and cathodic protection systems can also create electrical interference to the receiver or cause bleed-over signal to other lines in the area. Grounding wires can also cause interference.

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Even though the conductive method of locating is the preferred method and often has fewer associated signal problems, there are still signal problems that can arise. The most common is caused by inadequate connection of the associated wires, such as the pipe connection lead wire and the grounding wire.

To alleviate this problem, ensure the connection to the pipe has a metal-on-metal connection and no corrosion is present on the connection wire and the pipe you are connecting to.

In addition, the ground wire and grounding stake must also be free of corrosion.

Some common problems associated with grounding are soil conditions and the selection of ground location.

If the ground is too dry, the connection to the soil may not produce a good ground. To help mitigate this problem, you can saturate the ground with water to create a better connection to the ground and the grounding lead.

Selecting the location to place the ground is very important. You should not connect the grounding lead to the pipe or other facility present, such as a fence post.

You should always use the grounding stake that is supplied with the locating device.

Knowledge: Identify methods used to perform an inductive sweep search.

Inductive line locating (or “dropping the box”) is a method that is generally used when the conductive method cannot be used.

Inductive methods work by actively transmitting a signal from the transmitter to the ground. This method works best when the transmitter is directly over and in alignment with the pipe to be located. This can often be achieved by looking for signs of the buried pipe, such as environment/vegetation changes, casing vents, and permanent pipeline markers.

There may be times where you will not be able to detect the approximate location of the pipeline you need to locate. In these cases, locating a buried pipe in a proposed excavation area can seem like finding a needle in a haystack. However, there are some simple searching methods that you can use to better narrow your search to find the line. A few searching methods that you can use are the following:

- Circle sweep
- Perimeter sweep
- Spoke sweep

The circle sweep method is performed by placing the transmitter in the center point of the excavation area and moving the receiver in a circle around the center of the transmitter. When trying to locate a line using this method, you will need to ensure the receiver and the transmitter are facing each other.

Lastly, you should ensure that the transmitter is far enough away from the receiver so that air coupling does not present a distorted signal.

The perimeter sweep method is accomplished by keeping the transmitter and receiver apart at a set distance to avoid air coupling. Walk in unison together until you reach a predetermined point or find a line.

This method requires a second person to move the transmitter at the same time you move the receiver.

The spoke sweep method is accomplished by traversing the excavation area with the transmitter and receiver at 45 and 90 degree paths.

If you were to trace the path while performing this sweep, it would show a wagon wheel spoke pattern.

There is no one right method. The terrain and size of area to locate may play a role on your selection of a sweep method. Regardless of your selection, you should always refer to the manufacturer’s instructions for range and use of the line locator.

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Knowledge: Explain how to determine the temporary marking requirements for the area to be located/marked.

There are several methods used to mark the location of buried lines. Some of the considerations that should be taken into account when selecting the method are:

- Pipeline operator procedures
- State or local marking requirements
- Environmental conditions
- Terrain type

The pipeline operator must follow any requirements set forth by the DOT. In addition, operators may have specific methods that they require when placing temporary markers.

You should always ensure you are following the operator's specific procedures when performing temporary markings.

In addition to the pipeline operator's specific requirements, any local or state mandated requirements must also be followed.

If there is ever a conflict between the state/local requirements for line markers and the operator's specific requirements, you should immediately notify the operator's representative for clarification before placing temporary markers.

The environment and location also play a role in what type of marker to use. For example, if you are placing temporary markings in an environment that has frequent precipitation, you should use a marker that will not wash away with the rain.

The location should also be considered. If you are placing markings on private property, you may want to ensure the markings can be removed without permanent damage to the property.

Knowledge: Describe the national color code requirements for marking (APWA Uniform Color Code).

Having our pipeline systems and other facilities, such as power, communication, water, and sewage lines, buried below the ground has several advantages. However, it doesn't come without limitations. The most obvious limitation is the fact that you cannot see where the facilities are located.

Luckily there are established measures in place to help mitigate this problem.

Much like established color codes for electrical wires, there are also established color codes to identify various types of buried facilities. The American Public Works Association (APWA) has established guidelines using ANSI standard Z535.1 Safety Colors for temporary marking and facility identification.

The color codes established for marking and identifying the placement of buried facilities are as follows:

- White – proposed excavation
- Pink – temporary survey marking
- Red – electric power lines, cables, conduit and lighting cables
- Yellow – gas, oil, steam, petroleum or gaseous materials
- Orange – communication, alarm/signal lines, cables/conduit
- Blue – potable water
- Purple – reclaimed water, irrigation and slurry lines
- Green – sewers and drain lines

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Knowledge: Identify acceptable types of temporary markings.

Locating and identifying buried facilities are only a part of the job. Once you have located the line or facilities, you will have to mark the location appropriately. This is accomplished by marking the location of the line with approved temporary markers.

Temporary markers are extremely important for identifying the location of buried facilities. Therefore, they should be placed accordingly, and the selection of the markers used should be able to remain readable during any construction process.

Temporary markings are usually in the form of the following:

- Stakes
- Flags
- Paint
- Chalk
- Whiskers

To prevent accidental damage to buried facilities, care must be taken when working around temporary markings. You should make every effort to ensure traffic is diverted around the markings as well as informing personnel not to remove the markings until they are no longer needed.

Knowledge: Describe methods of documenting and communicating locate.

Locating a pipeline would be useless without documenting and communicating the location of the pipeline.

Without documenting and/or communicating your findings of the location of the buried pipeline, construction workers would not be aware of the location of the pipeline and could inadvertently hit it.

As mentioned previously, the DOT and local/state authorities have requirements for color codes and methods of temporary markings. In addition, there are also requirements for documenting and communicating the locate.

The DOT requires that all pipeline operators establish an acceptable method of communicating their locate markings and participate in applicable One-Call systems. In addition to this, each state may have additional requirements.

Communicating the location of the pipeline can be accomplished in the form of properly marking the location. Each pipeline operator may have specific requirements, from what type of markers to use and what needs to be written on the markings, to the distance interval between each marked point.

While operators have their own requirements, each state will also have some additional requirements.

Prior to marking the line, you should ensure that you are following all state and local requirements.

If for some reason the state and operator requirements conflict with each other, you should notify the designated pipeline operator representative prior to communicating and documenting the location of the pipeline.

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Skill:	Demonstrate how to use maps, as-built survey information, and/or drawings to identify the general location of the pipeline and possible conditions that may affect the ability to locate the pipeline accurately.

Locating pipelines is not a straightforward type of job. The environment, terrain, and pipeline demographics are never the same.

Additionally, there are several factors and conditions that can add to the diverse job of line locating, making it potentially confusing when trying to locate a line.

There are several different factors that can cause false or distorted readings when locating lines. To help mitigate those factors, it is important to gather as much information as possible to be able to identify and account for any conditions that may affect your ability to locate a pipeline accurately.

To properly prepare for line locating, you should gather as much information about the area as you can.

The best way to do this is by obtaining info from facility owners/operators. This includes the following:

- Maps
- As-builts
- Survey maps or drawings of existing, abandoned, and out-of-service facilities
- Cathodic protection
- Grounding systems

When reading any type of map or as-built, familiarize yourself with the layout of the area and the drawing depicted on the map. Additionally, you should ensure you fully understand the legend for each type of map.

Some key areas to identify that could affect the ability to locate the pipeline accurately are:

- Crossovers
- Multiple lines
- Foreign facilities
- Pipeline size and depth

Buried foreign facilities, crossovers, multiple line, pipeline depths, and the size of pipelines are key knowledge criteria in line locating.

Using a map to know what is below will aid the line locator to find the correct pipeline location. Additionally, it will allow the person performing the locate to account for and understand what is or may be causing signal variances that can be caused by other facilities or lines.

While efforts are made by companies to document and plot their buried pipeline or facilities, you should not solely rely on locations plotted in maps.

If you do find that the location indicated on a map is not accurate with the location of the pipeline, you should notify the pipeline operator of your findings.

Skill:	Demonstrate the ability to operate the device and perform initial startup operation and verification activity as indicated in manufacturer's user information.

There are several types of line locating devices on the market. To cover the specific operating instructions on each would be next to impossible. For the purpose of this training module, we will cover some of the basic features and operating components that the majority of all electromagnetic line locators share.

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Prior to going on a jobsite, you should ensure the equipment you are using is operational and that all required components of the equipment are serviceable and in good working order.

The first thing you should do is perform a visual inspection of the device and look for any signs of damage. Additionally, you may also need to verify that the device is properly calibrated.

Each manufacturer has its own calibration requirements. You should refer to the manufacturer's instructions for calibration requirements.

After you have performed a visual inspection and verified calibration requirements, you should then inspect the operation of the device.

Electromagnetic line locators come with two main components: a transmitter and a receiver. You should turn the power on to both devices to ensure operation.

The next step is to verify the battery levels are good.

It is always a good idea to take an extra set of batteries with you.

Once you have verified the transmitter and receiver are on and checked the battery levels, you should run any required pre-use steps outlined in the manufacturer's operating instructions.

In addition to any required pre-use steps recommended by the manufacturer, you should test the line locator's accuracy by locating a known buried line.

During this verification, you should also check to ensure the device is accurate in reading the depth of the pipe.

Successfully locating a pipeline requires you to be fully knowledgeable of the area and the line locating equipment. You must also verify that the equipment used is in proper working order. Ensuring the device is operating within design parameters is essential to successfully locating a pipeline.

Skill: Demonstrate the use of the line locator.

As mentioned previously, there are several types of line locators.

For the purpose of this training module, we will be referring to the basic use and operation of an electromagnetic line locator.

Electromagnetic line locators are the most commonly used and the most preferred/accepted type of line locators available.

There are several different styles of electromagnetic line locators available. They all may vary slightly by design and by the types of added functions available in the unit (such as ***Bluetooth***, ***GPS***, and even ***Wi-Fi*** capabilities).

However, they all share the same basic operating functions and modes of pipeline detection.

Electromagnetic line locators have a receiver and transmitter.

The transmitter sends a signal out, and the receiver reads the return signal bounced back from the pipeline.

Electromagnetic line locators can operate in two basic modes: passive and active.

As mentioned previously, passive line locating is locating lines without the use of a transmitter. The receiver is utilized by detecting natural frequencies in the ground, such as those frequencies sent out by metal objects.

This method is often used to quickly locate unknown foreign facilities in the area of excavation.

Active line locating is locating with the use of a transmitter. The transmitter sends a frequency, or signal tone, on the line by either conductive or inductive modes. The signal from the line is then picked up by a receiver.

It is important to note that the equipment does not locate the line. It simply reads the signal produced.

The person operating the device locates the line by interpreting the signal that is read from the receiver.

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Therefore, prior to attempting a locate, you should function check the device by locating a known line and depth.

If you were to look at a street map from 100 years ago and overlay it with a current map, you will find that our roadways have grown. The same is the case for buried facilities.

As a result, an area that once had one pipeline present may now have added sewage lines, fiber optic cables, power lines etc., causing the area to be crowded.

Locating a pipeline may be as simple as performing a locate with only one pipeline on a ROW or more complex due to multiple pipelines and or foreign facilities present.

Regardless of the difficulties or scenarios you may face, the way you perform the locate is the same.

While the methods may be the same, the level of difficulty in locating increases when more than one pipeline or facility is in the area.

Whether you are locating a pipeline in an area that has only one line or multiple lines, the most accurate and preferred method is the conductive/direct connect method.

If the direct connect method is not available, the next best method is the inductive method, also known as "dropping the box."

To perform a locate using the conductive mode, you will need to connect the transmitter to an exposed portion of the pipeline or a source that has an established direct connection to the pipeline, such as CP test stations, aboveground piping, etc.

One of the lead wires needs to be connected to an exposed portion of the pipeline you are trying to locate. The other wire (usually colored black) will need to be connected to the ground.

The lead wire that connects to the pipeline should have a connection that is metal on metal with no paint, coating, or rust present. The cleaner the connection, the better the signal.

You should also make sure you are connecting to the correct pipeline.

To ground the transmitter, you will need to push the supplied grounding stake in the ground and connect the grounding wire to the stake.

When selecting a grounding point, keep in mind that extremely dry soil will produce a weak ground. This will cause the signal to be weak or non-existent.

As previously mentioned, if you are performing locate in an area where the soil is extremely dry and cannot get a good ground, simply saturating the soil with water will usually solve the problem.

Once you have established a good connection to the pipeline and ground, you can set the signal strength and begin locating the pipeline.

When performing your search, you should avoid fast and rapid movements of the receiver. Waving the receiver from side to side in a rapid and high swinging fashion can result in incorrect or missed readings on the device.

Direct connect is considered a locating best practice and should be the first choice for applying an active signal to a pipeline. However, connection by means of direct connect is not always an option.

For cases where direct connect is not a viable option, you should use the inductive mode.

The inductive method can be considered a high risk method to locate a pipeline, but more often than not, it is the only choice for locators to apply current indirectly to the conductor/pipeline.

Induction (or "dropping the box") transfers energy from the transmitter to a nearby conductor (such as a pipeline) without any metal-to-metal contact.

It accomplishes this by broadcasting the signal through open air, similar to a radio station.

Locating a pipeline by the inductive method can be difficult because unlike the direct connect method, the signal is broadcasted everywhere.

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This means that every conductor of electricity in the area will send out the signal broadcasted from the transmitter - in a sense, “lighting up the entire area.”

Some ways to help mitigate this phenomenon is by placing the transmitter over the line and selecting the appropriate signal strength.

The transmitter will usually have a marking located on the device showing the direction you should place the transmitter over the expected path of the pipeline when using induction mode.

A signal that is induced onto a line will be strongest when the transmitter’s antenna is positioned directly over the top of, and directly in line with, the underground conductor/pipeline.

Selecting the best frequency for the job is critical to success. As a rule of thumb, you should always use the lowest frequency that will produce a traceable signal over the distance you need to cover.

However, the ideal frequency for one scenario may be the worst frequency choice for another scenario.

A tip for frequency choice is to start with the lowest frequency first and adjust the power setting as needed.

The reason is that the higher the frequency/power setting, the greater the chance for bleed over.

As a basic rule, the proper setting is one that has the lowest possible power and frequency settings that provides a clean, traceable signal throughout the entire area you need to locate.

Most line locators come with a recommended frequency setting chart. The charts are not all inclusive. They should be used as a baseline to start with. You may find that you will often have to adjust the settings to achieve a correct reading, especially in more complex pipeline systems.

Whether you are locating in conductive or inductive modes, you should always review all available maps and schematics as well as looking for any signs of buried facilities in the area.

Doing this will help you understand and interpret the signals received, which will allow you to be able to account for bleed over, multiple signals, and signal distortion that are caused from crossovers, diverging pipeline segments, and foreign facilities.

It is good practice to always verify what you are interpreting from the receiver. When you believe you have found the pipeline you need to locate, you should verify that the signal is not distorted.

A common practice to accomplish this is to verify that the signal is the same in null and peak modes.

Peak and null modes provide the highest level of versatility for users. Null mode uses easy to follow guiding arrows for quick tracing of lines. Peak mode pinpoints exact location.

The percentage of current measured increases or decreases as it is moved toward or away from the pipeline.

To verify that the signal matches in the null and peak modes, switch the receiver to null mode and then to peak mode.

> *Note*: Some models may switch automatically.

The signals that you receive in both modes should match. If they do not match, this is an indication that there is distortion.

Because manufacturer settings may vary from locator to locator, you should refer to the locator’s specific operator’s manual for instructions.

> *Caution*: The methods presented for depth check using an electromagnetic device may not be all inclusive with every make and model. Always refer to the unit’s specific manufacturer’s instructions.

Another method to verify distortion is by the depth check method.

To perform this check, you simply locate the peak signal with the receiver on the ground level and record the depth.

Then you will need to perform the same step; only this time, you will take the depth reading with the receiver 1’ off the ground.

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The depth reading should match the raised reading plus one foot. If there is a greater variance in the reading than 1', then that is an indication that the signal is distorted.

Thus far we have discussed active methods of performing a locate with an electromagnetic device. As stated previously, electromagnetic devices are able to perform locate in active and passive modes.

While the active method in conductive mode is the preferred method, there may be times when you will need to conduct a passive locate.

Locating lines in the passive mode is a quick method commonly used by construction workers to get an idea if anything lies below. It is also used in situations when maps and schematics are not available or when you may need to locate an unmarked facility.

Passive locating is accomplished without the use of a transmitter. The devices used pick up signals that are already present.

Some common types of passive locators include the following:

- Witching sticks (or dowsing rods)
- Metal detectors
- Electromagnetic (EM) locators without a transmitter

Witching sticks, or dowsing rods, detect interference in the earth's magnetic field.

Line locating by using this method is not an accurate or reliable method of locating. Therefore, it should not be used as a sole method of detecting and identifying the location of pipelines or other facilities.

Metal detectors work by picking up the magnetic field given off by all metal objects to include metals contained in sediment.

Metal detectors have a disadvantage in locating because they are indiscriminate to the metals detected.

Like witching sticks, metal detectors should not be used as a sole method in locating pipelines.

Unlike witching sticks and magnetic-type passive locators, electromagnetic line locators can perform a passive locate and are able to translate the type of signal received.

Most electromagnetic receivers will indicate the type of signal it is reading on the unit's control screen. For example, it may read:

- CPS
- Power
- Radio

A CPS reading indicates the receiver is picking up the presence of a cathodic protection signal.

A power reading indicates that the receiver has detected a signal from an induced AC electrical frequency.

This type of signal commonly occurs when there are power lines nearby that bleed off signals to nearby conductors, such as pipelines and metallic facilities.

A radio indication on the receiver indicates that there are other frequencies present that are being transmitted from various sources, such as, but not limited to:

- Cell phones
- Telephone lines
- Radio frequencies

As you can see through the brief explanation of electromagnetic line locators, there are several methods available when using this type of device to locate.

You should always keep in mind that no one scenario will be perfect for another. For example, a method's signal or power setting may be good for one area but bad for an area that has a more complex pipeline system or a congested amount of buried facilities.

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Lastly, it is important to note that whenever possible, you should always use the direct connect method. In addition, you should always follow the operator's and any local- or state-mandated procedures when performing a locate.

Skill: Demonstrate how to determine the vertical depth of the pipeline.

Determining the depth of the pipeline is an important factor in preserving the integrity of the pipeline during excavation work.

A pipeline with an unknown or incorrect reported depth can cause the excavator to inadvertently strike the pipeline.

To help mitigate this from occurring, the depth of the pipe should also be measured during line locating.

There are several tools that can be used in determining the pipeline depth. The most common are the T-bar and electromagnetic line locator.

The T-bar method is accomplished by driving the bar in the ground until you feel positive contact with the pipeline.

> ***Caution***: There is always a possibility of power lines or a charged facility. You should use a T-bar with rubber handles to alleviate the possibility of electric shock.

Additionally, the tip of the T-bar should not be pointed, and care should be taken to avoid coating and pipe damage when probing.

To measure the depth, you simply measure the distance the rod traveled in the ground.

Using the features on the line locator to determine the depth is less physical, in that you do not need to drive a long rod in the ground. Instead, you simply select the depth option on the locator.

To accomplish this, you will need to locate the peak signal. This informs you that you are in the center of the pipe.

Once you have found the peak signal, place the receiver on the ground level and take the depth reading.

> ***Note***: Line locators work by locating the center of the pipe. You have to deduct half of the pipe diameter from the reading on the locator to get an accurate reading. Some line locators have built in features that account for this automatically. Consult the manufacturer's instructions for specifics on taking depth readings.

Consider an example for determining the depth of a 42 inch pipe.

The line locator indicates a depth of 48 inches.

You'll need to subtract half of the pipe diameter (21") from the locator reading (48").

48"-21"=27"

The actual depth of earth cover to the top of the pipeline is 27 inches.

It is good practice to always verify that the depth reading is not distorted.

To accomplish this, you raise the receiver 1' off the ground and retake the depth. Then subtract one foot from the raised reading and the depth should match your ground reading.

For example, you take a reading at ground level and get a depth measurement of 2'. Then you raise the receiver 1' off the ground and get a depth measurement of 3'. You subtract 1' from the raised depth reading of 3', giving you 2', which matches the depth taken at ground level.

While both of these methods work, there is a potential for inaccurate readings. Therefore, extreme caution should be considered when communicating the depth taken by either of the methods mentioned.

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You should never communicate these depth readings unless they have been verified by potholing.

Skill:	Demonstrate how to properly place appropriate temporary line markings.

As previously discussed in this training module, there are several different types of temporary markings that are approved for use when marking the location of pipelines.

When selecting the type and placement/interval and annotating the required information on the markings, you should refer to the pipeline operator's written requirements for placing temporary markings.

In addition to the operator's requirements, there may also be local and state requirements that must be considered.

For example, some states require that you just mark the centerline of the pipeline's location, while other states may require that you mark the centerline and place markings 12" on both sides of the marked centerline.

If you find that the pipeline operator's requirements differ from any local or state requirements, you should immediately notify the designated pipeline operator's representative for further guidance.

There may also be times when locating and marking pipelines is accomplished on private property.

In these cases, consideration should be taken for the property owner.

For example, if the property owner expresses that they do not want paint painted on their property and the state and operator requirements allow for flags to be used, you should consider placing flags instead of using paint.

Pipeline damage through excavation is a serious and potentially deadly problem that occurs way too often. Your ability to correctly locate a pipeline on a single pipeline ROW or on a complex ROW with multiple facilities is vital to the overall safety of construction workers as well as maintaining the integrity of the pipeline.

Lastly, the training presented in this training module covers basic requirements and basic operation of electromagnetic line locators. This training is not intended to replace any hands-on or on-the-job training.

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: Unreported encroachment activities that have impaired or are likely to impair the serviceability of the pipeline are an abnormal operating condition.

React/Respond: Proper reactions and/or responses to take in the event of unreported encroachment activities that have impaired or are likely to impair the serviceability of the pipeline include the following:

- Stop the activity immediately.

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- Notify designated pipeline operator representative.

Recognize: An improperly marked and or an unmarked pipeline is an abnormal operating condition.

React/Respond: Proper reactions/responses to take in the event of improperly marked and/or unmarked pipelines include the following:

- Stop any excavation activity near affected pipeline.
- Mark the location so it may be easily located.
- Notify the designated pipeline operator representative.

Recognize: Incorrect drawings or schematics are abnormal operating conditions.

React/Respond: Proper reactions/responses to take in the event of incorrect drawings or schematics include the following:

- Notify the designated pipeline operator representative.

Recognize: An unintentional release, vapors, or hazardous atmosphere are abnormal operating conditions. Examples could include, but are not limited to:

- Blowing gas
- 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 the designated pipeline operator representative.

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 the designated pipeline operator representative.

Recognize: Unintended movement or unusual loading of a pipeline that has impaired or is likely to impair the serviceability of the pipeline is an abnormal operating condition. Examples could include, but are not limited to:

- Earthquake
- Washout/erosion
- Soil subsidence

React/Respond: Proper reactions/responses to take in the event of unintended movement or unusual loading of a pipeline that has impaired or is likely to impair the serviceability of the pipeline include the following:

- Stop the activity.
- Notify the designated pipeline operator representative.

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Glossary

AOC
abnormal operating condition

bluetooth
A wireless short-range communications technology that operates in the unlicensed industrial, scientific, and medical (ISM) band at 2.4 to 2.485 GHz. The most common everyday devices that use this technology are hands-free devices that communicate to cellphones, such as wireless headphones/earpieces.

CFR
Code of Federal Regulations

CCT
common covered task

Global Positioning System (GPS)
A satellite-based navigation system made up of a network of 24 satellites placed into orbit by the U.S. Department of Defense. A device with a GPS receiver can record the exact position on the earth.

Wi-Fi
A wireless standard for connecting electronic devices. A Wi-Fi-enabled device, such as a personal computer, video game console, smartphone, or digital audio player, can connect to the internet when within range of a wireless network connected to the internet.

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