Common Covered Task 702
Leakage Survey with Leak Detection Device

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.

Disclaimer

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Recommended Student Training or Resources:

- DOT 49 CFR 192.706

Introduction

Every day, billions of gallons of crude oil and millions of cubic feet of natural gas are transported from where they are gathered to the consumer. While many forms of transportation are used to transport/distribute products to marketplaces, pipelines remain the safest, most efficient, and most economical method of transportation.

The vast majority of the 2.5 million miles of pipelines used to transport and distribute product within the US are buried safely below the ground. Even though these pipes are buried, the possibility of a leak remains.

To ensure public safety, environmental protection, and to comply with federal and state regulations, pipeline operators must regularly conduct leak surveys on all regulated gas pipelines. Any issues identified as a threat to public safety must be addressed immediately.

These are the federal regulations:

49 CFR 192.706 - Transmission lines: Leakage surveys

49 CFR 192.723 - Distribution systems: Leakage surveys

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 Means of Identifying Leaks

The extent and scope of each leak survey is determined by the nature of the operations and the local conditions. Leakage surveys may be conducted in the following areas (as applicable):

- Over all mains, services, transmission lines, manholes and other underground structures
- Through cracks in the pavement and sidewalks
- On all above ground piping
- Where gas service lines exist (at the building wall at the point of entrance)
- Within all buildings where gas leakage has been detected at the outside wall and at locations where escaping gas could potentially migrate into and accumulate inside the building

Pipeline patrollers must be very aware of their surroundings during a leakage survey. Small changes in the environment or even a dust cloud may indicate a leak.

The following methods can be used to identify leaks:

- Utilizing a leak detection device
- Smell
- Visual signs
- Sound

Leak Detection Devices

Leak detection devices are used to identify potentially hazardous gas leaks by means of various sensors.

Users must be trained on the specific make and model they use. Always refer to the manufacturer's instructions. Each device is equipped to alarm as levels of hazardous gases are encountered.

Smell (Rotten Egg Odor)

Because natural gas is colorless and odorless, gas companies add odorant to aid in the discovery of a leak. All distribution lines must be odorized. Transmission lines that meet certain criteria must also be odorized.

If you notice the presence of strong odors or have been notified from an outside source (such as the police or fire department, other utilities, or the general public), it must be followed up with the use of an appropriate leak detection device. This will aid in determining the presence of a combustible gas. (A few of the indicators will tell you which combustible gas is present.)

The sulfurous smell, or lack thereof, should not be used alone to confirm the presence of a gas leak. The odorant may have faded or there may be other reasons for the smell. Natural gas odorants will cause the olfactory senses to deaden and provide a false sense of security.

Visual Signs

There are many visual signs of a gas leak. Do not depend solely on your device to tell you when there is a leak. Always look for changes in the environment. Some of the visual signs that are most indicative of a leak are:

- Changes in vegetation
- Ice accumulation
- Dust cloud
- Bubbling in water

Changes in Vegetation

While performing pipeline inspections you may encounter changes in vegetation.

Vegetation in an area of gas leakage may improve or deteriorate, depending on the soil, the type of vegetation, the environment, the climate, and the volume and duration of the leak.

Any detection of abnormal, unusual, no growth, or dead vegetation spots within places of live vegetation could be an indicator of a potential leak.

Ice Accumulation

Ice accumulation in a warm environment is a sign that a pipeline component or components is failing or malfunctioning.

Ice formation can occur in areas where pressurized gas is forced through a small area (e.g., crack, loose fitting) in a weak or malfunctioning pipeline component. The sudden drop in pressure results in a significant temperature drop, which may cause ice to form at the location of the leak.

Several factors will affect whether or not ice forms, so it should not always be expected.

Dust Cloud

The failure or malfunction of the pipeline may lead to the release of gas vapors into the atmosphere. The resulting gas release could cause dust clouds to form around the failed component.

Dust clouds may also be accompanied by hissing sounds or ice accumulations.

Bubbling in Water

There are thousands of miles of natural gas pipelines that run under America's waterways. Even the smallest of gas leaks will form bubbles that rise to the surface of the water and escape into the atmosphere.

Bubbling is also used to conduct simplistic leak tests using soapy liquid mixture, much like checking a tire for a leak.

The pipe and/or component must be completely exposed, clean and under pressure prior to applying the soapy mixture.

Leaks are then detected by the formation of bubbles. This method is only viable for exposed facilities and is not practical for long lengths of pipeline.

Sound

Depending on the conditions, there may be times when you will be able to detect a leak by sound. Location of the leak is the biggest factor when considering detecting leaks through sound.

- If the leak is from an under or above ground pipe, you may hear a hissing, whistling, or roaring sound.
- If the leak is underwater, you may hear the bubbling caused by the leak.

When leak indications are found, prompt actions should be taken where necessary to protect life and property.

Potentially hazardous leaks should be reported promptly to the operator, and where appropriate, to the police department, fire department, or other governmental agency. (Follow applicable procedures.)

Operators must take prompt remedial action when leaks are discovered. That action will vary on the severity of the leak.

Skill: Demonstrate Use of Gas Detection Devices

Leak detecting devices, such as combustible gas indicators, are now regularly used in the oil and gas industry to identify potentially hazardous gas leaks.

However, before using a combustible gas indicator, it is important to understand some terms related to its use.

- Safety Data Sheets (SDS)
- Vapor Density
- Lower Explosive Limit, or LEL
- Upper Explosive Limit, or UEL
- Explosive or Flammable Range

Safety Data Sheet (SDS)

A Safety Data Sheet (SDS) is the primary source of information for when dealing with any substance and is required by OSHA to have on hand for any hazardous substance handled on the job site, as determined by the Hazard Communication regulation.

An SDS follows an internationally agreed-upon 16 section format, which consists of:

- Identification of the substance/mixture and of the company/undertaking
- Hazards identification
- Composition/information on ingredients
- First aid measures
- Firefighting measures
- Accidental release measures
- Handling and storage
- Exposure controls/personal protection
- Physical and chemical properties
- Stability and reactivity
- Toxicological information
- Ecological information
- Disposal considerations
- Transport information
- Regulatory information
- Other information

Vapor Density

Vapor density is the relative weight of a gas or vapor compared to air; it is a factor that determines how a gas behaves once it has leaked out of the pipe.

Always check the Safety Data Sheet (SDS) of the gas that you are attempting to detect to find its vapor density. Vapor density is commonly expressed as a ratio of the mass of a substance (e.g., natural gas) to the mass of an equal volume of air, when measured at standard temperature and pressure.

The density of air is given a value of one. Light gases, which have densities less than one, will rise in air. If there is inadequate ventilation, heavy gases and vapors, with densities greater than one, can accumulate in low-lying areas, such as pits, and along floors. To better understand this, recall how dry ice vapor falls to the ground.

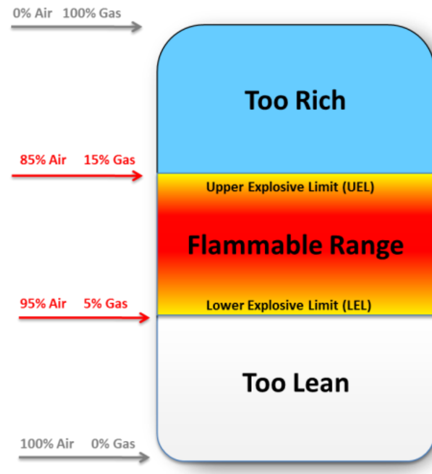
Here is an example of an SDS of natural gas. As you can see, the vapor density is 0.6, which is a little over half that of air. This tells us that natural gas will rise in air.

Vapor density is not the only factor that determines gas distribution; air currents, temperature gradients, and other ambient conditions can affect gas/vapor diffusion characteristics. You must keep these factors in mind when attempting to detect gas leaks.

Lower Explosive Limit, Upper Explosive Limit, and Flammable Range

The lower explosive limit (LEL) of a flammable gas is the minimum concentration of that gas, at normal ambient conditions, necessary to cause a flash or combustion when exposed to an ignition source (e.g. arc, flame). At a concentration below the LEL, there is too much oxygen and not enough gas to burn-the atmosphere is considered "too lean" to burn.

For example, natural gas has a LEL of 5%. At a concentration of 4%, an explosion would not occur even in the presence of an ignition source.



The upper explosive limit (UEL) of a flammable gas is the highest concentration of that gas, at normal ambient conditions, at which it will burn if there is a source of ignition present.

When the concentration of gas is above the UEL, there is too much gas and not enough oxygen to burn - the combination of gas and air is considered "too rich" to burn. The UEL standard for natural gas is 15% gas in the air.

Remember that a concentration above the UEL does not mean the atmosphere is safe; it is just not explosive. There are other hazards associated with excessive concentration of gas, such as suffocation.

The difference between the LEL and the UEL constitutes the flammable range of a substance, also called the explosive range. Therefore, if the LEL of natural gas is 5% and the UEL is 15%, then the explosive range is 5% to 15%.

> *NOTE:* It is important to understand that detection equipment and monitors DO NOT indicate percentage of a gas present in an area, but percentage of the LEL. Some may also indicate parts per million (PPM).

While the LEL itself is based on the percentage of gas in the atmosphere, combustible gas indicators measure the amount of gas present as a percentage of the LEL.

Using natural gas as an example, 5% gas in atmosphere is equal to 100% LEL, which is 50,000 PPM; 2.5% gas in atmosphere is equal to 50% LEL, and so on. Keep this in mind when monitoring your device; a reading of 25% doesn't mean that the atmosphere is 25% natural gas, but that the gas present reaches 25% of the LEL- this would mean the atmosphere is 1.25% natural gas.

Most detectors have two sets of alarms - **warning** and **danger**.

The warning alarm alerts the user that the environment has a detectable concentration of gas and is therefore potentially hazardous.

Some detectors will begin to warn the user at 10% LEL. Some procedures require even lower warning levels.

> *Note:* Detectors come with default warning and danger levels. Refer to your detector for specifics.

The danger alarm indicates that the gas concentration exceeds the programmed "hazard" threshold, and the area is approaching a hazardous level.

Some models of detectors will activate the danger alarm at 50% LEL. Some procedures require even lower danger levels.

Common Gases

While many of the older, standard gas detector units were originally fabricated to detect one gas, modern multifunctional or multi-gas devices are capable of detecting several gases at once.

Besides LEL, some of the most common substances that multi-gas detectors may monitor for are:

- oxygen (O_2),
- hydrogen sulfide (H_2S)
- carbon monoxide (CO)

> *Note:* Detectors are set to read certain gases. Refer to your detector for specifics.

Oxygen (O_2)

- Normal breathing air is primarily made up of nitrogen (78.09%) and oxygen (20.95%). The remaining 1% is made up of argon, carbon dioxide, and other trace gases.
- Without an adequate concentration of oxygen in the air, the atmosphere is considered Immediately Dangerous to Life and Health (IDLH).
- OSHA requires a minimum of 19.5% oxygen to be present, or the atmosphere is considered oxygen-deficient and requires respiratory protection.
- An oxygen-enriched atmosphere is defined as one containing more than 23.5% oxygen. This atmosphere will increase the flammability range of combustible gases.
- Detectors are set to alarm at 19.5% O_2, indicating an oxygen-deficient atmosphere, and 23.5 %, indicating an oxygen-enriched atmosphere.

Hydrogen Sulfide (H_2S)

- Hydrogen sulfide is a colorless, flammable, extremely hazardous gas with a “rotten egg” smell. It occurs naturally in crude petroleum, natural gas, and hot springs.
- The primary route of exposure is inhalation, and it is rapidly absorbed by the lungs.
- People can smell the “rotten egg” odor of hydrogen sulfide at low concentrations in air. However, with continuous low-level exposure, or at high concentrations, a person loses his/her ability to smell the gas even though it is still present (olfactory fatigue). This can happen very rapidly, and at high concentrations, the ability to smell the gas can be lost instantaneously.
- Most detectors are set to alarm a warning at 10 parts per million (PPM), and a danger alarm at 30 PPM. Remember that 10,000 PPM is equal to 1% gas.

The University of Minnesota provides some analogies that may help you visualize the scale involved with PPM. One PPM is like:

- one inch in 16 miles
- one second in 11.5 days
- one minute in two years
- one car in bumper-to-bumper traffic from Cleveland to San Francisco

10,000 PPM is equal to 1% gas.

Carbon Monoxide (CO)

- Carbon monoxide (CO) is a poisonous, colorless, odorless, and tasteless gas.
- CO is a common industrial hazard resulting from the incomplete burning of natural gas and any other material containing carbon, such as gasoline, kerosene, oil, propane, coal, or wood.
- Exposure to carbon monoxide can occur through inhalation and eye or skin contact with the liquid form.
- Most detectors are set to alarm a warning at 25 PPM and a danger alarm at 50 PPM.

Parts and Components

There are many brands and types of combustible gas indicators, but the basic functions remain the same.

The basic components of a CGI are a meter, a probe, and a pump that is generally an internal part of the unit, or an aspirator bulb if not equipped with an internal pump.

The pump is used to bring a sample of air through the probe, which is usually connected to the instrument with a hose.

The dial or display screen on the instrument will indicate the reading through percent of the LEL scale or as parts per million (PPM) of combustible gases by volume.

It is imperative that CGIs be used correctly. This is one example of what can happen.

Recently, a fatality in which an employee, from a small welding firm, was cutting up a 4,000 gallon tank that had contained leaded gasoline, when the tank exploded.

The investigation uncovered that the tank had been repeatedly steam cleaned and purged with nitrogen gas prior to the explosion.

Although combustible gas readings were taken prior to welding, with the last reading indicating below the LEL, it was evident that improper use of the instrument and an incomplete understanding of its limitations by the operator were the cause of the fatality.

For more information on the accident, go to: https://www.osha.gov/dts/hib/hib_data/hib19900118.html

So what went wrong? In tank removal operations it is common practice to purge a tank containing flammable vapors with either carbon dioxide or an inert gas, such as nitrogen.

However, in oxygen-deficient atmospheres, a false combustible gas indicator reading can occur.

Let's look at some of the other precautions and warnings. (Note: Refer to your make and model for specific operating procedures.)

In some models, certain materials such as silicon, silicates (such as in certain hydraulic fluids) and organic lead (such as in leaded gasoline) will poison the combustible gas sensor thereby giving erroneously low readings.

Sometimes, combustible gas readings, either negative or greater than 100% LEL, may indicate an explosive concentration of gas beyond the accurate response range of the combustible gas sensor.

Acid gases, such as carbon dioxide, may shorten the service life of the oxygen sensor.

Some instruments will not indicate the presence of combustible airborne mists or dusts such as lubricating oils, coal dust or grain dust.

And, as mentioned earlier, CGIs can give a false reading in an oxygen-deficient atmosphere, which is one that contains less than 19.5% oxygen. For this reason, if your CGI does not have oxygen detection capabilities, you need to use a separate oxygen detector in conjunction with the CGI.

Remember, the instrument you are using must be calibrated to and intended for use on the type of gas being detected. CGIs can be purchased that are factory-calibrated for specific gases. It is important to make sure that the calibration of the CGI is current. Refer to company policy and the user's manual to determine the frequency of required calibration. The CGI must also be rated as safe for use in the intended test environment.

As you can see, it is important that you become familiar with your specific make and model.

Remember, simple CGIs will not indicate if a given atmosphere contains hazardous or toxic compounds, nor will it indicate whether or not an atmosphere is oxygen-deficient. More complex CGIs, sometimes referred to as multi-gas detectors, will detect oxygen content as well as LEL for multiple substances.

The following instructions are generic, as CGIs vary greatly in type. Again, it is important to be familiar with the specific type of meter you are using, and have access to the operator's manual. Refer to the operator's manual and manufacturer's guidelines for your specific unit if needed.

Types of Detectors

When describing leak detector devices or gas detectors, they are generally categorized by the type of gas they detect:

- Combustible Gas (methane, propane, gasoline, etc.)
- Toxic Gas (hydrogen sulfide, carbon monoxide, etc.)

Detectors may also be digital or analog (non-digital). Whether the device is digital or not does not affect how it works as much as how you interact with and read the device.

This is an example of a digital detector screen configured to measure four gases.

This is an example of an analog or non-digital meter configured to measure combustible gases.

Gas detectors can be further classified according to the operation mechanism of detector:

- Catalytic (for combustible gas)
- Infrared (for combustible gas)
- Flame ionization (for combustible gas)
- Electrochemical (for toxic gas)
- Metal oxide semiconductor (for toxic gas)

  Note: Always refer to your detector's specific manufacturer's instructions and guidelines for safe operating procedures.

We will focus on the three most common combustible gas detectors used in the industry today.

- Catalytic
- Infrared
- Flame ionization

Each type of detector will have precautions that the user must be aware of. These precautions will be spelled out in the operating manuals.

Catalytic Detectors

Catalytic technology is used to detect combustible gases such as hydrocarbon, and works with catalytic oxidation. The sensors of this type of detector are typically constructed from a platinum-treated wire coil. As a combustible gas comes into contact with the catalytic surface, it is oxidized, releasing heat that changes the wiring resistance. A bridge circuit is typically used to indicate the resistance change.

Catalytic Detectors – Details

- These devices require oxygen for detection.
- Use only those instruments that are certified safe for use in atmospheres containing vapors or gases in concentrations greater than 25% of the LEL.
- Catalysts can become poisoned or inactive due to contamination (prolonged exposure to H_2S and other sulfur and/or corrosive compounds, chlorinated and silicone compounds, etc.).
- The only means of identifying detector sensitivity loss is by checking with the appropriate gas on a routine basis and recalibrating as required.
- Prolonged exposure to high concentrations of combustible gas may degrade sensor performance.
- Catalytic sensors cannot read gas concentrations below the LEL (limited by fuel) or above the UEL (limited by oxygen).
- It is important to pay close attention to analog/non-digital detectors; the meter pointer may move rapidly across the scale then return to below zero. This is an indication of gas above the UEL. Users may be required to investigate alarm conditions using other instruments.

Consult your specific model's manufacturing guidelines and safe operating procedures.

Infrared Detectors

Infrared detectors work with a system of transmitters and receivers to detect combustible gases, specifically hydrocarbon vapors. Typically, the transmitters are light sources and receivers are light detectors. If a gas is present in the optical path, it will interfere with the power of the light transmission between the transmitter and receiver. The altered state of light determines if and what type of gas is present.

Infrared Detectors – Details

- Some gases that do not absorb infrared energy, such as hydrogen, are not detectable.
- High humidity, dusty, and/or corrosive field environments can increase infrared detector maintenance costs.
- Temperature range for detector use is limited compared to catalytic detectors.
- May not perform well where multiple gases are present.

Flame Ionization Detectors

The flame ionization detector (FID), sometimes called a flame pack, uses a hydrogen fuel to power a small flame in a detector cell. A pump system is used to pass continuous air samples through the detector cell. If the air contains hydrocarbons such as natural gas, they will be burned or ionized in the hydrogen flame.

Flame Ionization Detectors – Details

- As there is a flame in the detector, personnel should be familiar with the potential hazards and know the appropriate safety and health measures needed to ensure a safe working environment.
- The FID does not respond to nongaseous organic compounds.
- In wet, frozen, or windy conditions, the gas may be restricted from venting or be rapidly diluted below the equipment's detection levels.
- Requires oxygen for detection.

Inspection and Maintenance

Knowing the common types of detectors will help you in performing your leakage survey. You must remember that each brand varies in use and capabilities so it is vital to worker safety that these instruments are maintained, used, and calibrated all according to the manufacturer's recommendations.

Consult your specific model's manufacturing guidelines and safe operating procedures.

No matter which type or brand of detector you use, it is always important to inspect your equipment and ensure that you have all the necessary components. This list of components will be found in the manufacturer's instructions, so refer to your piece of equipment's user guide.

The following steps must be taken to ensure the device is in proper working order. Note: some functions may be performed automatically with different makes and models of detectors.

- Calibration
- Physical Inspection
- Battery Life Status Check
- Bump Test
- Zero Device

Calibration

Calibration is the process of verifying your device is within the manufacturer's specifications. Calibrations will be conducted at intervals specified in the device's user guide. Some devices will tell you when they require calibration.

Calibration usually requires other pieces of equipment. These may include, in addition to the device itself, a calibration unit and a calibration bottle of specified gas or gases.

Always refer to the specific unit's manufacturer's instructions and user guide for information on calibration requirements. Some models may have internal or self-calibrating features.

Calibration must be maintained and documented throughout the life of the device. Calibration data must be recorded according to the device manufacturer's instructions and/or company policy.

This information will track devices with excessive issues (e.g., frequent miscalibrations).

> *WARNING:* These instruments are designed to detect potentially life threatening gas levels. Users must follow the instructions and warnings for their specific model to assure proper and safe operation of the instrument.

Physical Inspection

While calibration should be performed according to the manufacturer's schedule, a physical inspection should be done every time a leak detecting device is used, prior to conducting your leakage survey.

Leak detection devices are often mistreated: sliding around in pick-ups, dropped or kicked, or not stored properly. However, they must be treated with care to ensure accurate readings.

Look over the device for obvious defects, such as cracks. Each part should be inspected, including the hose and probe.

The presence of cracks will allow fresh air into the unit, resulting in false readings.

Sometimes the physical appearance of the device is misleading. The outside may seem fine, but the internal components may be damaged leading to inaccurate readings or instrument failure.

Calibrating your detector is the only way to be certain it is fully functional. Regular calibration is a "safety must" when dealing with lifesaving equipment.

Battery Life Status

To ensure you get accurate and reliable readings it is important to check battery serviceability or charge before beginning your leakage survey.

Leak detectors may or may not have rechargeable batteries. Most devices have a battery charge indicator display. Digital detectors indicate the battery charge on screen. In some non-digital type detectors, the needle will point below zero when the batteries are dead and will not move.

Bump Check/Test

To verify proper calibration, it is important to expose each sensor to a known level of gas before each day's use; this is referred to as a "bump check."

Without the bump check, the user could falsely assume that the detector is properly calibrated to indicate the presence of gas.

According to the International Safety Equipment Association (ISEA):

"[A] bump test (function check) or calibration check of portable gas monitors should be conducted before each day's use in accordance with the manufacturer's instructions. Any portable gas monitor which fails a bump test (function check) or calibration check must be adjusted by means of a full calibration procedure before further use, or removed from service."

http://www.safetyequipment.org/

Bump testing the unit should be done with a premium grade test gas that is approved by the National Institute of Standards and Technology (NIST). The bump test gas needs to be specific to the type of gas you will be detecting.

Be sure to verify the expiration date of the bump test gas. The additives used to stabilize the gases inside the cylinders dissipate over time. The accuracy of the gas cannot be guaranteed past the warranty period and should not be used.

It is important to monitor the readings on the unit to ensure it is measuring correctly. Remember to document all bump tests.

Note: Do not perform a bump test if the unit is known to be out of calibration.

Zeroing Device in Fresh Air

Prior to beginning the leakage survey, leak detectors must be zeroed in clean, fresh air. Be sure to turn on the device in a clean environment. Zeroing a device sets the oxygen sensor to 20.9% and the other sensors to zero.

Some detectors will zero themselves once they are turned on, while others require the user to "zero" the machine after device is warmed up.

Consult your specific model's manufacturing guidelines and safe operating procedures.

Skill:	Demonstrate Use of Leak Detecting Device on a Leak Survey According to Manufacturer's Guidelines

Operating the Leak Detector

Once you attach your hoses and probes, you are ready to operate your detector. Make sure you follow manufacturer operating instructions precisely.

Place the end of the sampling line at the point where the sample is to be taken.

If applicable, squeeze the bulb the appropriate number of times. If a sampling line or additional tubing is used, you may need to add additional squeezes. Refer to your model's manufacturer's guidelines for the proper amount of squeezes.

Consult your specific model's manufacturer's guidelines and safe operating procedures.

During surface leakage surveys, a continuous sampling of air is taken close to the ground near the buried pipeline or near any above ground facilities. You should hold the device as close to the ground as you can while walking slowly over the pipe. For exposed piping or above ground facilities, take the reading adjacent to the facilities.

This method is not recommended during windy or wet conditions, nor is it recommended on frozen or snow covered soil.

When detecting gases in an open air setting, you will want to pass the probe around seals, fittings, valves, and any other areas where there is a potential for leaks. Utilize **slow sweeping motions** to ensure problem areas are not missed. The probe should be as close to the areas of potential leaks as possible but not in contact with the surface.

If the detector is functioning properly, readings will display instantly.

When detecting for gas, it is important that no liquids or contaminants are present. Moisture drawn in by the probe can damage the equipment.

Leak Detector Device

A sub-surface leakage survey (also known as bar holing) is conducted by driving or boring holes at regular intervals along the route of buried piping and testing the subsurface atmosphere in the holes with a combustible-gas detector or other suitable device.

Bar hole tests are generally done to confirm, grade, or pinpoint a leak. An adequate amount of sample points must be made available in order for this method to be properly utilized.

Bar Hole (Sub-Surface) Surveys/Tests

It may be required to insert a probe rod into the ground to open a hole in which to stick the gas detector's bar hole probe.

Bar hole probes are available with some leak detecting devices. The bar has the end plugged and four holes close to the bottom. The device is set to "Bar Hole Mode" which allows only the combustible gas and oxygen sensors to be displayed.

Other devices utilize a probe tubing which is inserted into the bar holes.

A leak survey can be done more rapidly with an FI unit than with a CGI using the bar hole method. FI units can be carried by hand for a walking survey or mounted on a vehicle for a mobile survey. Any gas indications detected by the FI should be confirmed using a combustible gas indicator. Leak pinpointing is also done with a CGI.

When detecting for leaks in a ditch line, it is important to check the areas above and within the excavation.

> *NOTE:* If there is excavation equipment being operated, the exhaust fumes can alter the readings displayed by the detector.

Gas detecting in a tank should be done in accordance with your safety/confined space procedures. Generally, tank atmosphere samples are done in increments, for example, every four feet of depth in the tank. It is best to let out a length of hose attached to the probe to take readings.

It is critical that your leak detecting device is checking for the correct gas. Each monitor is designed to test for a specific gas or set of gases, so do not attempt to detect a gas for which the unit was not designed.

Now that we know how to perform a leakage survey, let's look at how often you must perform one. Pipelines are classified by how close they are to populated places. This is called pipeline class location, and it has an effect on how often leakage surveys must be performed.

Pipeline Class Location

The Department of Transportation (DOT) regulates the transportation of natural and other gases by pipeline. In 49 CFR 192.5, the DOT designated the criteria for the classes of pipelines.

This section classifies pipeline locations for purposes of this part of pipeline regulations. The following criteria apply to classifications under this section:

- A "class location unit," or location, is an onshore area that extends 220 yards (200 meters) on either side of the centerline of any continuous 1-mile (1.6 kilometers) length of pipeline.
- Each separate dwelling unit in a multiple dwelling unit building is counted as a separate building intended for human occupancy.

Class location is determined by using a sliding mile. In other words, as long as there are dwellings that establish a class location unit within the span of a mile as it moves along the pipe, that class will continue until the number of dwellings changes the class location.

Pipeline locations are classified as follows:

A Class 1 location is:

- An offshore area or
- Any location that has 10 or fewer buildings intended for human occupancy.

A Class 2 location is:

- Any location that has more than 10 but fewer than 46 buildings intended for human occupancy.
- When a cluster of buildings intended for human occupancy requires a Class 2 designation, the class location ends 220 yards (200 meters) from the nearest building in the cluster.

A Class 3 location is:

- Any location unit that has 46 or more buildings intended for human occupancy
- An area where the pipeline lies within 100 yards (91 meters) of either a building or a small, well-defined outside area (such as a playground, recreation area, outdoor theater, or other place of public assembly) that is occupied by 20 or more persons on at least five days a week for 10 weeks in any 12-month period (the days and weeks need not be consecutive)
- When a cluster of buildings intended for human occupancy requires a Class 3 location, the class location ends 220 yards (200 meters) from the nearest building in the cluster

A Class 4 location is:

- Any class location unit where buildings with four or more stories above ground are prevalent.
- A Class 4 location ends 220 yards (200 meters) from the nearest building with four or more stories above ground.

Frequency of Leakage Survey

The required frequency of leakage surveys can be found in 49 CFR 192.706 transmission lines: leakage survey. Let's look at the basic requirements of how often a leakage survey must be performed:

Leakage surveys of a transmission line must be conducted at intervals not exceeding 15 months, but at least once each calendar year. However, in the case of a transmission line which transports gas without an odor or odorant, leakage surveys using leak detector equipment must be conducted as follows:

- In Class 3 locations, at intervals not exceeding 7-1/2 months, but at least twice each calendar year
- In Class 4 locations, at intervals not exceeding 4-1/2 months, but at least four times each calendar year

Knowledge: Describe How to Test Casing Vents with a Gas Detector

Casings are used to protect pipelines that are laid under railroads, roads, or other heavy traffic areas. As the casing is made out of durable material, leaks in the pipe cannot be detected on the surface above the encased pipe. To compensate, casing vents are added to indicate leaks in the encased portion of pipe.

> ***Note:*** remember to turn on the detector, perform a "bump test," and zero your device prior to inserting the probe into a casing vent. Failure to do so will result in improper readings.

Pipeline casing vents allow for the escape of gases into the atmosphere if a leak has occurred in the pipeline inside the casing.

When checking the vent, you can check at the opening or by inserting a sampling tube or probe into the vent.

Ensure you have a sufficient length of tubing between the test unit and the probe to get as far into the vent as possible. This will give you the most accurate reading of gases that may be leaking.

One of the most critical pieces of equipment used on the pipeline is a leak detector device. These life saving instruments must be maintained, used, and calibrated in accordance with manufacturer's recommendations.

It is vital that each person utilizing a leak detector becomes familiar with the operation of the device.

Conclusion

Now that you have learned how to identify and survey leaks, you can perform common covered task 702. Always be on the look out for any AOCs that you may come across when performing a leakage survey. Remember, this training does not qualify you for that task, but you should be prepared for evaluation with the knowledge that you now possess.

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
- Vapors from casing vents

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.
- Notify designated 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 designated operator representative.

Recognize: Physical damage of pipe or a component 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:

- Casing vent damage
- Unintended exposed pipe
- Coating damaged to aboveground facilities
- Vandalism

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

- Notify designated operator representative.

Recognize: Unreported encroachment activities are abnormal operating conditions.

React/Respond: Proper reactions/responses to take in the event of unreported encroachment activities include the following:

- Record the location so it may be easily located.
- Notify designated operator representative.

Glossary

AOC
abnormal operating condition

CCT
common covered task

CFR
Code of Federal Regulations