INDUSTRIAL
TRAINING SERVICES

DANNY SHROUT

OQ Compliance Series
Student Manual

OQ Task CM-10
v10.2

Abandon or Deactivate Gas Pipeline Facilities

INDUSTRIAL
TRAINING SERVICES

ITS OQ Compliance Series
CM-10 Abandon or Deactivate Gas Pipeline Facilities
v10.2

Student Manual

INTRODUCTION

When a gas pipeline is abandoned or deactivated certain procedures must be followed to ensure the contents present no potential hazard. To complete this module you will be required to complete the check-out activities listed below.

OBJECTIVE

1. Identify procedures basic to abandoning or deactivating gas pipeline facilities.

CHECK-OUT ACTIVITIES

Your instructor will provide you with a list of incomplete statements related to abandoning or deactivating gas pipeline facilities and a list of responses. Select the response that most correctly completes each statement. Cut-off score is 80%. (Knowledge Verification)

Your instructor will provide you with a Skill and Ability Verification Checklist. At the appropriate time demonstrate your skill and ability by correctly performing each operation required under the task. (Skill and Ability Verification)

OQ CM-10 covers requirements indicated in the following codes/regulations:

ITS OQ Covered Task:	ASME B-31 Q*	ITS***	49 CFR 192**
OQ CM-10.1 Abandon/Deactivate Mains		5081	192.727
OQ CM-10.2 Abandon/Deactivate Service Lines		5091	
OQ CM-10.3 Temporary Isolation of Service Lines and Service Discontinuance	1201		

***ASME B31Q Covered Tasks:**

1201 Temporary Isolation of Service Lines and Service Discontinuance.

****49 CFR Part 192 Covered Regulations:**

49 CFR 192 covered regulations are identified within the appropriate section of this module.

*****ITS Covered Tasks:**

5081 Abandon/Deactivate Mains.
5091 Abandon/Deactivate Service Lines.

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INSTRUCTION SHEET I

Identifying Procedures Basic to Abandoning or Deactivating Gas Pipeline Facilities

When a gas pipeline is abandoned it must be physically disconnected from the piping system and the open ends effectively sealed. In addition, the operator must determine the necessity of purging the line, taking into consideration the location and size of the main or service.

In cases where the main and all the service lines connected to it are abandoned, the service line(s) must be capped at the customer's end. Also, the abandoned main must be sealed at both ends. Records must be kept on all abandoned facilities. This includes location, date, and method of disconnecting service (abandoning the facility).

D.O.T. Regulation

§ 192.727 Abandonment or deactivation of facilities.

(a) Each operator shall conduct abandonment or deactivation of pipelines in accordance with the requirements of this section.

(b) Each pipeline abandoned in place must be disconnected from all sources and supplies of gas; purged of gas; in the case of offshore pipelines, filled with water or inert materials; and sealed at the ends. However, the pipeline need not be purged when the volume of gas is so small that there is no potential hazard.

(c) Except for service lines, each inactive pipeline that is not being maintained under this part must be disconnected from all sources and supplies of gas; purged of gas; in the case of offshore pipelines, filled with water or inert materials; and sealed at the ends. However, the pipeline need not be purged when the volume of gas is so small that there is no potential hazard.

(d) Whenever service to a customer is discontinued, one of the following must be complied with:

(1) The valve that is closed to prevent the flow of gas to the customer must be provided with a locking device or other means designed to prevent the opening of the valve by persons other than those authorized by the operator.

(2) A mechanical device or fitting that will prevent the flow of gas must be installed in the service line or in the meter assembly.

(3) The customer's piping must be physically disconnected from the gas supply and the open pipe ends sealed.

(e) If air is used for purging, the operator shall insure that a combustible mixture is not present after purging.

(f) Each abandoned vault must be filled with a suitable compacted material.

(g) For each abandoned offshore pipeline facility or each abandoned onshore pipeline facility that crosses over, under or through a commercially navigable waterway, the last operator of that facility must file a report upon abandonment of that facility.

(1) The preferred method to submit data on pipeline facilities abandoned after October 10, 2000 is to the National Pipeline Mapping System (NPMS) in accordance with the NPMS "Standards for Pipeline and Liquefied Natural Gas Operator Submissions." To obtain a copy of the NPMS Standards, please refer to the NPMS homepage at *http://www.npms.phmsa.dot.gov* or contact the NPMS National Repository at 703–317–3073. A digital data format is preferred, but hard copy submissions are acceptable if they comply with the NPMS Standards. In addition to the NPMS-required attributes, operators must submit the date of abandonment, diameter, method of abandonment, and certification that, to the best of the operator's knowledge, all of the reasonably available information requested was provided and, to the best of the operator's knowledge, the abandonment was completed in accordance with applicable laws. Refer to the NPMS Standards for details in preparing your data for submission. The NPMS Standards also include details of how to submit data. Alternatively, operators may submit reports by mail, fax or e-mail to the Office of Pipeline Safety, Pipeline and Hazardous Materials Safety Administration, U.S. Department of Transportation, Information Resources Manager, PHP–10, 1200 New Jersey Avenue, SE., Washington, DC 20590-0001; fax (202) 366–4566; e-mail *InformationResourcesManager@phmsa.dot.gov*. The information in the report must contain all reasonably available information related to the facility, including information in the possession of a third party. The report must contain the location, size, date, method of abandonment, and a certification that the facility has been abandoned in accordance with all applicable laws.

(2) [Reserved]

[Amdt. 192–8, 37 FR 20695, Oct. 3, 1972, as amended by Amdt. 192–27, 41 FR 34607, Aug. 16, 1976; Amdt. 192–71, 59 FR 6585, Feb. 11, 1994; Amdt. 192–89, 65 FR 54443, Sept. 8, 2000; 65 FR 57861, Sept. 26, 2000; 70 FR 11139, Mar. 8, 2005; Amdt. 192–103, 72 FR 4656, Feb. 1, 2007; 73 FR 16570, Mar. 28, 2008; 74 FR 2894, Jan. 16, 2009]

Abandonment of Transmission Pipeline and Distribution Mains[1]

(1) Check Prior to Abandonment. Office records should be checked and necessary field checks should be made to ensure the pipeline or mains scheduled for abandonment are disconnected from all sources and supplies of gas (such as other pipelines, mains, crossover piping, meter stations, customer piping, control lines, and other appurtenances).

[1] 49 CFR, 192.727 Guide Material 1

(2) **Residual Gas or Hydrocarbons.**
Abandonment should not be completed until it has been determined that the volume of natural gas or liquid hydrocarbons contained within the abandoned section poses no potential hazard. Generally, it is advisable to purge 8-inch and larger diameter pipe, and long segments of smaller diameter pipe.

(3) **Purging.** For the purpose of abandonment, pipelines or mains may be purged using air, inert gas, or water. If air is used as the purging medium precautions should be taken to ensure that no liquid hydrocarbons are present. Hazards, which must be considered, include:

> **Note:**
> The EPA requires that any purge performed with water is done in a way to prevent leakage of any contaminants that could affect the environment.

- Prevention of ignition in the area of purge discharge
- Prevention of ignition within the piping, should purge discharge be ignited
- The larger the diameter and length of pipe to be purged, the greater the chance is for ignition and the possibility of injury and/or damage
- The presence of liquids and their release

(4) **Sealing.** Acceptable methods of sealing pipeline or main openings include, as applicable, the following:

(a) Using normal end closures such as:
- welded or screwed caps
- screwed plugs
- blind flanges
- welded joint caps
- plugs

(b) Welding steel plate to pipe end
(c) Filling pipe ends with a suitable plug material
(d) Pinching the pipe ends closed

(5) **Additional Considerations in Addition to Purging and Sealing.** In addition to purging and sealing, consideration should be given to the following:

(a) Filling the abandoned pipe segment with water or an inert gas to prevent potential combustion hazard.
(b) Other action designed to prevent hazardous cave-ins resulting from pipe collapse caused by corrosion or external loading.

(6) **Segmenting the Abandoned Pipeline Section.** All valves left in the abandoned pipeline section should be closed. If the segment is long and there are few line valves, consideration should be given to plugging the segment at intervals.

(7) **Removal of Above-Grade Facilities and Filling Voids.** All above-grade valves, risers, and vault and valve box covers should be removed. Vault and valve box voids should be filled with suitable compacted backfill material.

Abandonment of Distribution Service Lines in Conjunction with Main Abandonment[2]

(1) **Curb Valves and Curb Boxes.** All curb valves should be closed. The top section of curb boxes located in dirt areas should be removed and the void filled with suitable compacted back-fill material. If curb boxes are set in concrete or asphalt, they should be filled with suitable compacted backfill material to an appropriate distance from the top of the box and the fill completed with suitable paving material.

(2) **Meter Risers and Headers.** Meter risers and headers should be dismantled and removed from the premises.

(3) **Service Lines Below Grade Through a Basement Wall.** Where a service line enters below grade through a basement wall, the end of the service line should be plugged and a cap should be installed as close to the face of the wall as practical. It is not necessary to remove the pipe from the wall unless required by particular circumstances.

(4) **Outside Meter Set and Above-Grade Entrances.** Service lines terminating at an outside meter set or an above-grade entrance should be cut and capped at an appropriate depth below grade.

Abandonment of Service Lines From Active Mains[3]

(1) **Disconnecting.**
Service lines abandoned from active mains should be disconnected as close to the main as practicable.

(2) **Sealing.** The end of the abandoned portion of the service line nearest the main should be plated, capped, plugged, pinched, or otherwise effectively sealed.

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[2] 49 CFR, 192.727 Guide Material 2
[3] 49 CFR, 192.727 Guide Material 3

(3) **Other Actions.** The remainder of the service line should be abandoned as recommended in "Abandonment of Distribution Service Lines in Conjunction with Main Abandonment."

Inactive Pipelines[4]

(1) **General.** Each operator should consider the following elements when determining whether to abandon or continue maintaining an inactive pipeline.

(a) Location (e.g., business district, urban, suburban, rural)
(b) Type of joining material
(c) Joining method (e.g., welding, fusion, compression couplings)
(d) Cathodic protection
(e) Operating pressure
(f) Likelihood of reactivation
(g) Leakage and maintenance history
(h) Proposed construction

(2) **Continuing Maintenance.** Provisions for continuing maintenance of inactive pipelines should be included in the procedural manual for operations, maintenance, and emergencies required under 49 CFR, 192.605. Examples of such maintenance include the following:

(a) Regularly scheduled leakage surveys and patrolling
(b) Corrosion control monitoring of cathodically protected systems
(c) Maps and records for damage prevention
(d) Evaluating aboveground piping for the following:
(i) Atmospheric corrosion
(ii) Susceptibility to damage from vehicles and other forces
(iii) Unauthorized activities

Inactive Service Lines[5]

In addition to the guidelines presented in "Continuing Maintenance" for Inactive Pipelines, the operator should consider the following for continuing maintenance of inactive service lines.

(a) Identifying and documenting the location of inactive service lines in a record management system.
(b) Developing criteria for abandonment.

[4] 49 CFR, 192.727 Guide Material 4
[5] 49 CFR, 192.727 Guide Material 5

Note:

The following Abnormal Operating Conditions (AOCs) and their reactions listed are for guidance only. This AOC list is not presented as an exhaustive treatment of AOCs and appropriate responses. You may be required to know and apply other AOCs and AOC responses for different tasks. Properly recognizing and reacting to covered task AOCs are the responsibility of persons qualified to perform the covered task. Always follow your company's policies and procedures.

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(1) **Things to Consider When Responding to Abnormal Operating Conditions.** The following information is basic knowledge that will assist you in assessing and responding to abnormal operating conditions:

(a) **Basic Properties of Natural Gas.**

- Natural gas is lighter than air, colorless and odorless.
- Natural gas has a specific gravity of approximately 0.6.
- The natural gas Lower Explosive Limit (LEL) is approximately 5%.
- The natural gas Upper Explosive Limit (UEL) is approximately 15%.
- The ignition temperature of natural gas is about 1100°-1200° F.

(b) **Eliminating Ignition Sources.** Some of the ways to eliminate ignition sources are very obvious. For example:

- Smoking and open flames should be prohibited in structures or areas containing gas facilities where possible leakage or presence of gas constitutes a hazard of fire or explosion.
- Smoking and open flames should be prohibited in the open when accidental ignition of a gas-in-air mixture could cause personal injury or property damage.
- Do NOT smoke or use open flames near a jobsite/gas pipeline facility.
- Sparks range in temperature from 1500°F in an electrical switch to 9,000°F in an arc welder. Do NOT use equipment or create situations that generate sparks. Sparks may be generated by the following conditions:

  Communication equipment
  Portable electrically powered tools and equipment
  Internal combustion engines

Breaking electrical continuity
Static electricity on plastic pipe

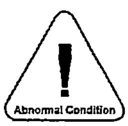
(c) Personal Protection Equipment.

Always follow your company's policies and procedures for the use of personal protection equipment (PPE).

Working around gas pipeline facilities requires practical safety practices and basic PPE may include:

- Head protection (e.g. hard hat)
- Eye and face protection (e.g. goggles, face shield, etc.)
- Hearing protection (e.g. ear plugs, ear muffs, etc.)
- Hand protection (proper glove material for the specific job)
- Respiratory protection (proper respiratory equipment when air content is insufficient)

(2) Abnormal Operating Conditions.



Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Ignition	• Stop the flow of gas at the nearest valve. Put flame out with fire extinguisher. Notify appropriate personnel
• Overpressure	• Make area safe; contact proper personnel
• Leakage	• Make area safe; protect life and property; evacuate if necessary; notify proper personnel; repair leak
• Uncontrolled escaping gas	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Underpressure	• Make area safe, then contact appropriate personnel
• Damaged pipe or coating	• Repair or replace or notify appropriate personnel
• Valve inoperable, unable to turn	• Repair or replace
• Unable to locate curb valve	• Generate order to locate and turn off

REVIEW I

Identifying Procedures Basic to Abandoning or Deactivating Gas Pipeline Facilities

Directions: Select from the list below the response, which most correctly completes each of the following statements. Write the letter of your choice in the space provided, NOTE: Some answers may be used more than once.

A. water	G. 8
B. disconnected from all sources of gas	H. ignition
C. locked	I. closed
D. 10	J. removed
E. screwed caps	K. main
F. piping system	L. contact appropriate personnel
	M. raise line pressure

F ~~[illegible]~~ 1. When a gas pipeline is abandoned, it must be physically disconnected from the _____.

B 2. A necessary field check before the abandonment of a pipeline facility is made to ensure the piping scheduled for abandonment is _____.

G 3. Generally, it is advisable to purge _____ inch and larger diameter pipe to ensure there is no residual gas or hydrocarbon.

A 4. For the purpose of abandoned pipelines, facilities may be purged using _____.

C 5. When service to a customer is discontinued, the valve used to prevent the flow of gas to the customer must be _____.

H 6. When air is used as a purging mechanism the larger the diameter and length of pipe being purged the greater the chance of _____.

E 7. An acceptable method for sealing abandoned pipe ends is _____.

I 8. If valves are left in an abandoned pipeline, the valves should be _____.

J 9. All above-grade valves in an abandoned pipeline should be _____.

I 10. When abandoning distribution service lines all curb valves should be _____.

A. water
B. disconnected from all sources of gas
C. locked
D. 10
E. screwed caps
F. piping system
G. 8
H. ignition
I. closed
J. removed
K. main
L. contact appropriate personnel
M. raise line pressure

K 11. When abandoning service lines from active mains, the service line should be disconnected as close to the _____ as practicable.

L 12. If an underpressure condition occurs on a pipeline, you should _____.

Knowledge Verification Checklist

OQ Task CM-10
Abandon or Deactivate Gas Pipeline Facilities

Directions: Use the following performance criteria statements as a self-evaluation in preparation for the final exam.

I can identify:

- ☐ 1. A required action to be taken when a gas pipeline is abandoned. (CM-10.1.1)
- ☐ 2. Precautions that must be taken whenever service to a customer is discontinued. (CM-10.1.2)
- ☐ 3. A field check that is necessary before a gas pipeline is disconnected. (CM-10.1.3)
- ☐ 4. A potential hazard that must be eliminated before abandoning a pipeline facility. (CM-10.1.4)
- ☐ 5. A medium that may be used when purging gas pipeline facilities. (CM-10.1.5)
- ☐ 6. A potential hazard associated with using air to purge a large diameter and length of pipe. (CM-10.1.6)
- ☐ 7. An acceptable method of sealing abandoned pipe ends. (CM-10.1.7)
- ☐ 8. Action taken if valves are left in an abandoned underground pipeline. (CM-10.1.8)
- ☐ 9. Action taken if valves are above-grade in an abandoned pipeline. (CM-10.1.9)
- ☐ 10. Appropriate action taken on curb valves when abandoning distribution service lines. (CM-10.1.10)
- ☐ 11. Appropriate action taken when abandoning service lines from active mains. (CM-10.1.11)
- ☐ 12. An abnormal operating condition and reaction specific to abandoning or deactivating gas pipeline facilities. (CM-10.1.12)

Skill and Ability Verification Packet

OQ Task CM-10
Abandon or Deactivate Gas Pipeline Facilities

I. General Instructions

Instructions for Use

The Skill and Ability Verification Packet is designed to standardize conditions under which the employee demonstrates his/her performance of tasks that meet the operator qualification requirements established by the employee's company.

Completing the enclosed affidavit and uploading the data to Industrial Training Services OnBoard LMS for recordkeeping, documents the satisfactory completion of tasks. Both the OQ Authorized Evaluator (AE) and employee must sign the affidavit.

Instructions to the Employee

Your OQ AE will check your performance using the suggested evaluator guide included in each hands-on task assignment. This suggested guide must be supplemented or replaced by the individual company's policies and procedures related to the task being evaluated.

You must adhere to all safety precautions according to your company's policies and procedures and applicable federal, state, and local codes and regulations.

II. Task Information

OQ Task CM-10:	**Abandon or Deactivate Gas Pipeline Facilities**
Qualification Standard:	The employee's qualification is based on the enabling operation(s) that have been successfully completed. The operations task or tasks are listed below:
OQ Task CM-10.1:	Abandon/Deactivate Mains (ITS 5081)
OQ Task CM-10.2:	Abandon/Deactivate Service Lines (ITS 5091)
OQ Task CM-10.3:	Temporary Isolation of Service Lines and Service Discontinuance (B31Q 1201)
Recommended Requirement:	The employee must demonstrate proficiency to an acceptable level based on the Skill and Ability Checklist associated with each operation.
References:	49 CFR, Part 192.727. B31Q Task 1201. ITS Tasks 5081, 5091.

Note:

The following Abnormal Operating Conditions (AOCs) and their reactions listed are for guidance only. This AOC list is not presented as an exhaustive treatment of AOCs and appropriate responses. You may be required to know and apply other AOCs and AOC responses for different tasks. Properly recognizing and reacting to covered task AOCs are the responsibility of persons qualified to perform the covered task. Always follow your company's policies and procedures.

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Abnormal Operating Conditions

(Not limited to the examples listed below)

Recognize	React
• Ignition	• Stop the flow of gas at the nearest valve. Put flame out with fire extinguisher. Notify appropriate personnel
• Overpressure	• Make area safe; contact proper personnel
• Leakage	• Make area safe; protect life and property; evacuate if necessary; notify proper personnel; repair leak
• Uncontrolled escaping gas	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Underpressure	• Make area safe, then contact appropriate personnel
• Damaged pipe or coating	• Repair or replace or notify appropriate personnel
• Valve inoperable, unable to turn	• Repair or replace
• Unable to locate curb valve	• Generate order to locate and turn off

III. Skill and Ability Verification Checklist

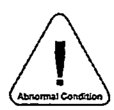
OQ Task CM-10
Abandon or Deactivate Gas Pipeline Facilities

I verify that (Please Print) ____ **is qualified to perform OQ Task CM-10 according to his/her company's procedures:**

(CM-10.1) Abandon/Deactivate Mains. (5081)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Verify the use of proper personal protective equipment.
- ☐ Verify proper company operating procedures are performed.
- ☐ Verify mains are abandoned/deactivated according to company operating procedures.
- ☐ If required, verify that documentation is completed.
- ☐ Verify learner's ability to recognize and properly react to AOC's.



Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Accidental ignition	• Evacuate to safe area; establish and maintain safe area
• Discover illegal tap	• Notify supervisor

Comments / Additional Company Procedures:

____

____

____

____

____

____

____

____

(CM-10.2) Abandon/Deactivate Service Lines. (5091)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Verify the use of proper personal protective equipment.
- ☐ Verify proper company operating procedures are performed.
- ☐ Verify service lines are abandoned/deactivated according to company operating procedures.
- ☐ If required, verify that documentation is completed.
- ☐ Verify learner's ability to recognize and properly react to AOC's.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Overpressure	• Make area safe; contact proper personnel
• Gas leak	• Remove ignition sources
• Discover illegal tap	• Notify supervisor

Comments / Additional Company Procedures:

(CM-10.3) Temporary Isolation of Service Lines and Service Discontinuance (1201)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Discontinue service or isolate service line by the following, as applicable:
  - Verify meter/address.
  - Close valve.
  - Lock valve.
  - Install mechanical device or fitting.
  - Cut, and cap.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Accidental ignition	• Evacuate to safe area; establish and maintain safe area
• Gas Leak	• Perform leak test and repair leak
• Discover illegal tap	• Notify supervisor

Comments / Additional Company Procedures:

IV. Employer Record

OQ Task CM-10

Abandon or Deactivate Gas Pipeline Facilities

Employee Information (Please Print):

Name ______________________________

Last 4 Digits of Social Security Number ______________________________

Company Name ______________________________

Company Mailing Address ______________________________

City ______________________ State __________ Zip ______________

Affidavit

I acknowledge the performance of this task is solely for the purpose of operator qualification, and is not intended to replace or modify company operating procedures or policies and may not be appropriately used in all circumstances. I acknowledge that I am responsible for recognizing hazards and abnormal conditions in my work place and must exercise care and good judgment; always using appropriate equipment, procedures and tools for tasks I perform. Industrial Training Services, Inc. assumes no liability for my actions nor for my application of the qualification performance guides used in this evaluation checklist.

Employee's Signature ______________________ Date ______________

Evaluator Information (Please Print):

Name ______________________________

Organization/Employer ______________________________

Telephone Number ______________________________

Affidavit

I affirm that I am the person who has administered this checklist and that I have conducted this assessment with integrity. I also affirm that the above named employee is the person assessed and that the above named person performed the tasks at the indicated level.

Evaluator's Signature ______________________ Date ______________

The employee is qualified according to company standards to perform the tasks listed below as indicated:

	Not Applicable	TASK/OPERATIONS	Method of Skill/Ability Verification Enter Number From List Below
1.	☐	(CM-10.1) Abandon/Deactivate Mains. (5081)	☐
2.	☐	(CM-10.2) Abandon/Deactivate Service Lines. (5091)	☐
3.	☐	(CM-10.3) Temporary Isolation of Service Lines and Service Discontinuance. (1201)	☐

Method of Knowledge Verification

- Written Exam

Method of Skill/Ability Verification Observed During:

1. Performance on the Job
2. Simulation

After completion of Section IV, "Employer Record," remove section from the packet for your records. For third party verification and database reporting service, upload the data to Industrial Training Services OnBoard LMS.

INDUSTRIAL
TRAINING SERVICES

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INDUSTRIAL
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DANNY SHROUT

OQ Compliance Series
Student Manual

OQ Task CI-11
v11.1

Install Sacrificial Anodes and Test Stations

INDUSTRIAL
TRAINING SERVICES

ITS OQ Compliance Series
CI-11 Install Sacrificial Anodes and Test Stations
V11.1

Student Manual

INTRODUCTION

The installation of sacrificial anodes is a task among many tasks performed by natural gas system operating personnel and gas pipeline construction contractors. To ensure the effectiveness of a sacrificial anode installation the correct performance of the operations associated with this task is necessary. To complete this module you will be required to complete the check-out activities listed below.

OBJECTIVE

1. Identify construction practices basic to installing sacrificial anodes and test stations.

CHECK-OUT ACTIVITIES

Your instructor will provide you with a list of incomplete statements related to installing sacrificial anodes and test stations and a list of responses. Select the response that most correctly completes each statement. Cut-off score is 80%. (Knowledge Verification)

Your instructor will provide you with a Skill and Ability Verification Checklist. At the appropriate time demonstrate your skill and ability by correctly performing each operation required under the task. (Skill & Ability Verification)

OQ CI-11 covers requirements indicated in the following codes/regulations:

ITS OQ Covered Task:	ASME B-31 Q*	ITS***	49 CFR 192**
OQ CI-11.1 Inspect and Monitor Galvanic Ground Beds/Anodes	0031		192.465 192.469
OQ CI-11.2 Installation and Maintenance of Mechanical Electrical Connections	0041		
OQ CI-11.3 Installation of Exothermic Electrical Connections.	0051		
OQ CI-11.4 Install Sacrificial Anodes		5071	

*ASME B31Q Covered Tasks:

0031 Inspect and Monitor Galvanic Ground Beds/Anodes
0041 Installation and Maintenance of Mechanical Electrical Connections.
0051 Installation of Exothermic Electrical Connections.

**49 CFR Part 192 Covered Regulations:

49 CFR 192 covered regulations are identified within the appropriate section of this module.

***ITS Covered Tasks:

5071 Install sacrificial anodes.

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INSTRUCTION SHEET I

Identifying Construction Practices Basic to Installing Sacrificial Anodes and Test Stations

A commonly used method of cathodically protecting buried metal pipe is the attachment of a sacrificial anode to the pipe. The installation of sacrificial anodes is a task that is performed by natural gas system operating personnel and pipeline construction contractors. Although gas system operating companies may have company specific procedures for installing sacrificial anodes, the information provided in this learning event focuses on basic operations within the task. Always follow company operating procedures as required.

Installing Sacrificial Anodes

To ensure effectiveness and longevity, correct handling and installation of the sacrificial anode is important. The prepackaged anode unit consists of a metal anode, an electrical connector lead wire, and the backfill material.

The electrical lead wire from the anode is susceptible to damage and must be given special attention. It serves as the conductor carrying electrical current from the steel pipe to the sacrificial anode. If the lead wire should become damaged, thus interrupting the current flow, the anode will fail to function.

(1) **Factors to Consider When Installing Sacrificial Anodes.** There are several important factors to consider when installing sacrificial anodes. These factors include the following:

- The sacrificial anode performs best when placed in the ground below the pipeline depth.
- The anode should be placed at least two feet from the pipeline.
- The anode may be positioned either horizontally in a ditch or vertically in an augured hole.
- The anode unit, after being placed in position, should be moistened with water to start immediate action.
- The anode's connector lead wire should be inspected for damage and repaired prior to thermite welding to the pipeline.
- The anode lead wire connection must be coated after welding.

(2) **Selecting Backfill.** The sacrificial anode's operating efficiency and length of life can be increased when placed in specific soil environments. Careful selection of the backfill material can improve the electrical contact between the sacrificial anode and the surrounding soil by reducing the resistance characteristics of the soil. The absence of a proper backfill can result in

irregular consumption of the anode, thus providing erratic current output per pound of anode consumed.

To provide a proper environment for the sacrificial anode, the backfill must be able to retain adequate moisture. Natural earth seldom has this capability and therefore the moisture content is dependent on weather conditions. Therefore, a commercially prepared general purpose backfill commonly contains from 50% to 75% gypsum. Gypsum has the ability to absorb and retain moisture and is widely used over other backfill material due to its availability, inexpensiveness, and low solubility, which allows for long life installations.

Additional specialized backfill mixtures are available for a diversity of soil environments. These commercially prepared mixtures are designed to meet soil environment requirements ranging from those formulated for low resistance areas of high water content to those formulated for high resistance areas of low water content as illustrated in Figure 1.

Backfills	#2	#5	#10
Usage Areas	Dry areas of high resistance	Wet areas of low resistance	General purpose (magnesium only)
Mixture Compositions	25% Gypsum 50% Bentonite 25% Sodium Sulfate	50% Gypsum 50% Bentonite	75% Gypsum 17% Bentonite 8% Soda Ash & Lime Mixture
	100%	100%	100%

Figure 1. Common Backfill Mixtures

(3) Placement and Action of Sacrificial Anodes. When using sacrificial anodes the anode lead wire is connected to the pipe and the anode is placed in the ground as illustrated in Figure 2, or according to your company's policies and procedures.

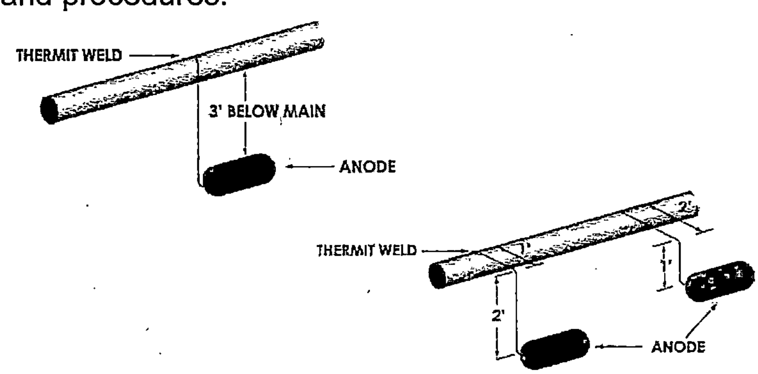

Figure 2. Standard Anode Placement

The electrical current in the galvanic cell created by the buried metal pipe and the sacrificial anode is produced the same way as any other galvanic cell, such as those found in a car battery. The pipe functions as the cathode to the sacrificial anode. The anode corrodes to protect the pipe. A good connection between the anode lead and the pipe is critical to the protection of the pipe from corrosion. Therefore, a procedure referred to as a thermite weld is used to connect the anode lead to the metal pipe.

Installing Impressed Current Systems

An impressed current system is used to protect bare or coated mains in high-resistivity soil. The principle advantage of impressed current cathodic protection is its much greater output capacity as compared to galvanic anode systems. Impressed current systems require the use of an external DC power supply that is usually energized by standard AC current.

Design of an impressed current system must consider the potential for causing coating damage and the possibility of creating stray currents, which adversely affect other structures. Advantages of impressed current cathodic protection systems include flexibility, applicability to a variety of applications, controllable current output, and effectiveness in high-resistivity soils. Disadvantages include greater maintenance needs, higher operating costs, and possible interference on other structures.

Before installing the impressed current system, it is important to consider the following:

- Soil resistivity
- Current requirements
- Continuity
- Groundbed location
- Backfill

(1) **Soil Resistivity.** Soil resistivity should be determined for the specific area where the groundbed is to be installed. Even small differences in location can cause large differences in soil resistivity. Soil resistivity may be determined by using any of the following:

- Soil box procedure
- Wenner (4-pin) procedure
- Single rod test procedure

(2) **Current Requirements.** Whenever possible, a trial and error process using a temporary groundbed and a portable power supply should be used to determine the current required to protect the structure.

- Set up a temporary groundbed with ground rods and a temporary power supply.
- Energize the system.
- Perform an on-off survey over the structure to be protected.
- Increase the current and repeat the survey.
- Repeat steps 3 and 4 until the structure is protected according to established criteria.

If the above process is not feasible, make an assumption about current density requirements and calculate current requirement for the area of the structure to be protected. Use typical current densities for your area.

(3) **Continuity.** All metallic components that are to be cathodically protected by an impressed anode system must be electrically continuous. Other metallic components for which cathodic protection is not necessarily desired but which are in the immediate vicinity of the system anodes must also be made continuous. The Corrosion Engineer must locate and test all such metallic components for continuity. Where such continuity does not exist, electrically bonding in these components must be evaluated.

(4) **Groundbed Location.** Impressed current anodes are typically installed at depths of 10 to 20 feet in augured holes. They are usually installed in banks on 10 to 30 foot center-to-center spacing with the first anode typically being placed 100 to 500 feet from the pipeline depending on the soil resistivity and the structure coating.

Groundbed location should be determined early in the design process because its location may affect the choice of groundbed type. The following factors should be considered when choosing a groundbed location:

- Soil resistivity
- Soil moisture
- Interference with other structures
- Availability of power supply
- Accessibility
- Vandalism or other damage
- Purpose of the groundbed
- Availability of Right of Way

Groundbed types include conventional groundbeds, distributed anode groundbeds, deep anode groundbeds, and shallow vertical groundbeds.

(a) **Conventional Groundbeds.** Conventional groundbeds are normally used to distribute protective current over a broad area of the structure to be protected. These are frequently called remote groundbeds because the structure is outside the anodic gradient of the groundbed caused by the discharge of current from the anodes to the surrounding soil.

(b) **Distributed Anode Groundbeds.** Distributed anode groundbeds are used to reduce the potential for interference effects on neighboring structures. They are used to protect sections of bare or poorly coated structure. They are used in congested areas where electrical shielding might occur with other groundbeds.

(c) **Deep Anode Groundbeds.** Deep anode groundbeds are remote to the structure by virtue of the vertical distance between anode and structure. Deep anode groundbeds therefore achieve results similar to remote surface groundbeds. A deep anode groundbed is an appealing choice when space is not available for a conventional groundbed or when surface soil has high resistivity and deeper strata exhibit low resistivities.

(d) **Shallow Vertical Groundbeds.** Shallow vertical groundbeds are commonly used where space is limited.

Graphite and high silicon cast iron anodes are often used for underground cathodic protection systems.

(5) **Backfill.** All impressed current anodes are generally installed in a select backfill to enhance their useful life and reduce their contact resistance to earth. Carbon backfill is often used as a sacrificial buffer between the anode and the reaction environment. Carbon backfill is used to maintain stability of the excavation, serve as the primary anodic reaction surface, and lower resistance-to-earth of the system.

The primary objective of a carbon backfill is to electronically conduct the current discharged from the anode surface to the carbon-earth interface where the electrochemical reaction can occur with least impact on the anode. Backfill selection should be based on a consideration of the following coke characteristics:

- Resistivity, or more significantly in-situ bulk resistivity determines how well the objective of the carbon backfill is achieved.
- Specific Gravity affects compact setting. A high specific gravity helps to insure compact settling.
- Carbon content of the backfill material determines the anode system life.
- Particle sizing determines the amount of contact between anode and backfill. For optimum contact, particle size should be small relative to the

anode diameter. Very small (less than 7.5 microns) particles should be avoided because they are high in ash content.

- Particle shape affects how well the backfill settles and the tendency for the backfill to trap gases. A spherical shape is preferred over flat, irregularly shaped particles.

Calcined petroleum coke breeze is most commonly used for impressed anode backfill.

Attaching Anodes and Test Leads to Metal Piping

A method used to attach the anode lead to a metal pipe is referred to as the thermite weld process. For the thermite weld process to be effective, the pipe surface must be cleaned to bright metal. During the cleaning, care should be taken not to disband too much of the pipe coating. The thermite welding process provides low resistance connections between lead wires and the metal structure. The thermite welding process is illustrated in Figure 3.

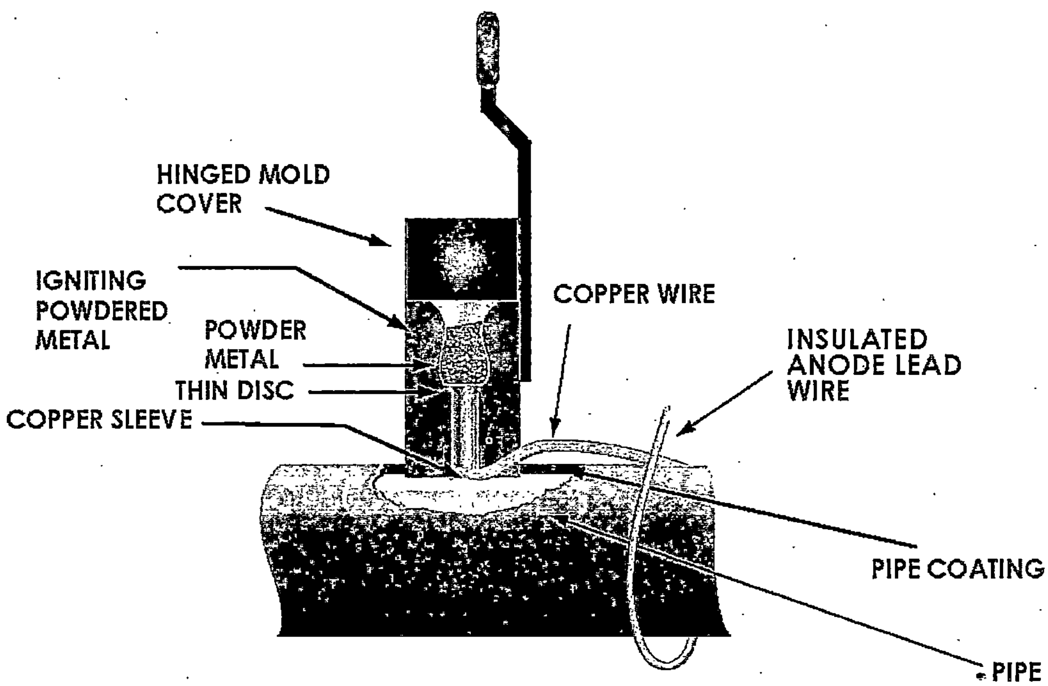

Figure 3. Thermite Welding Process

The following steps for making a thermite weld are for illustration purposes only. Always follow the manufacturer's indicated procedures and your company's policies and procedures.

Safety precautions: Always wear gloves and goggles when igniting powder.

Step 1: Clean pipe thoroughly. It must be bright, clean, and dry.

Step 2: Place the copper sleeve on anode lead so that the lead wire is flush with the end of the sleeve and crimp the sleeve in place with pliers.

Step 3: Dry the mold out by heating before making the first weld (especially if the humidity is high).

Step 4: Place the sleeve in the mold so it comes just to the center of the tap hole under the crucible. Do not push the sleeve all the way back and block the tap hole.

Step 5: Place the steel disc over the tap hole in the crucible. Be sure the disc covers the tap hole so that the powder cannot leak into the mold weld cavity.

Step 6: Dump the cartridge (thermite charge) into the mold in one motion—do not pour.

> **Note:**
> Thermite weld cartridges shall be of quality equal to or better than Cadweld CA15.

Step 7: Spread the starting powder over the top of the weld powder and break up any lumps.

Step 8: Close the hinged cover over the top of the mold before igniting the powder.

Step 9: For ease of starting, place a small portion of the starting powder on the lip of the mold. Ignite this part and snap the flint gun away to prevent fouling of the flint gun.

Step 10: Hold the mold square on the pipe to prevent weld metal leakage out around the cavity. Hold the mold steady for approximately 10 seconds to allow the weld metal to solidify.

Step 11: Remove the slag from the mold using a cleaner blade. Be sure the slag is removed from the tap hole prior to making the next weld.

After the anode lead has been attached, tap the weld with a hammer to ensure that the wire is securely welded to the pipe. The weld must be cleaned, primed, and coated to protect the area from corrosion.

Note:
In order to help protect the thermite weld from failing during ground settlement, it is common practice to loop the lead wire around the pipe prior to placing the anode in the ditch below the pipe.

Splicing Bonding Cables[1]

Connecting, or splicing, bonding cables may involve exothermic welding, high compression crimpets, or split bolts. Split bolts may loosen with age and are generally used only for magnesium anode header cable splices. Figure 4 shows each of these methods.

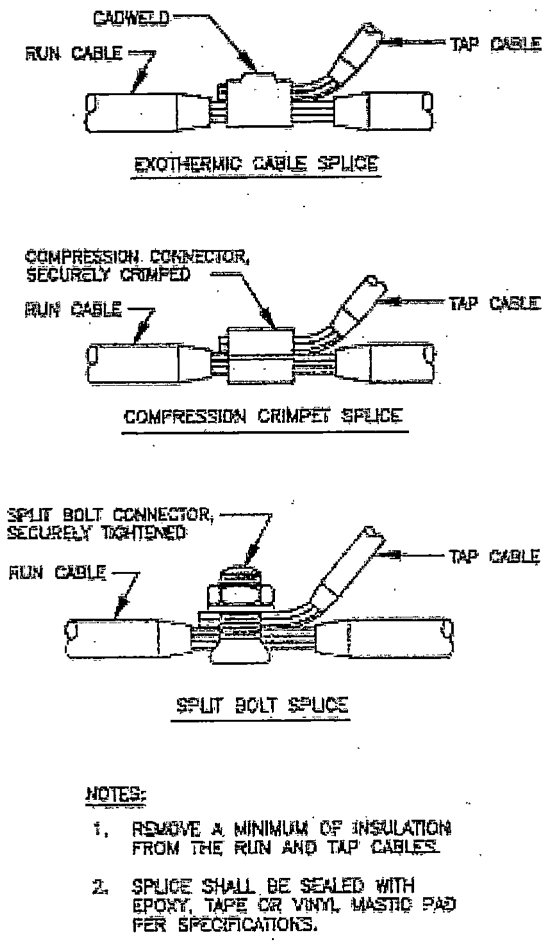

Figure 4. Cable Splicing Methods

[1] U.S. Army Corps of Engineers Installation Support Division. Operation and Maintenance of Cathodic Protection Systems. 1999.

There are many methods available for protecting cable splices from moisture or damage:

- Hand wrapping
- Epoxy molds
- Heat shrinking
- Elastomer wrap

(1) **Hand Wrapping.** Hand wrapping is the most reliable method of moisture proofing cable splices. The exposed splice area is cleaned with a clean, solvent-dampened rag and then wrapped with electrical rubber insulating tape. Pay special attention to the crease area if wrapping a "Y" connection, as in an anode header cable splice. The entire area is then wrapped with PVC electrical tape to complete the splice.

(2) **Epoxy Molds.** Epoxy molds have been used extensively over the years with some mixed results. Epoxy doesn't bond to the release oils used on wire, permitting moisture to eventually travel into the connection. Since there is no chemical bond to polyethylene, the mold must extend far enough over the adjacent insulation to prevent hygroscopic moisture migration. Before backfilling, be sure to allow the mold to set for the proper amount of time according to the manufacturer's instructions.

(3) **Heat Shrinking.** Heat shrinkable tubing of irradiated polyethylene with an effective electrical sealant is used to repair in-line cable splices. Care must be taken when using a propane torch so as not to melt or distort the cable insulation while shrinking the sleeve.

(4) **Elastomer Wrap.** Elastomer sealant kits involve wrapping a pliable strip of sealant around the splice area to moisture proof the connection. An outer wrap of elastic fabric, impregnated with a quick-setting, moisture-cured urethane, is wrapped around the sealant and sprayed with water to harden the fabric. This forms a hard shell to eliminate cold flow of the sealant and prevents rocks or soil stress from damaging the encapsulation.

Connections in Junction Boxes

Cathodic protection junction boxes provide a junction or termination point for multiple anode cables before routing to a rectifier. In the junction box, anode cables are normally routed through current measurement shunts and terminated on a common copper buss bar with cable lugs and connectors. A single positive cable is then routed directly to the cathodic protection rectifier.

It is important to make sure there are no unsealed openings in the junction box. If an entry point is not secure, insects or rodents may build nests in the box, or water may leak in, both of which may result in damage to the cables or connections.

D.O.T. Regulation

§ 192.465 External corrosion control: Monitoring.

(a) Each pipeline that is under cathodic protection must be tested at least once each calendar year, but with intervals not exceeding 15 months, to determine whether the cathodic protection meets the requirements of § 192.463. However, if tests at those intervals are impractical for separately protected short sections of mains or transmission lines, not in excess of 100 feet (30 meters), or separately protected service lines, these pipelines may be surveyed on a sampling basis. At least 10 percent of these protected structures, distributed over the entire system must be surveyed each calendar year, with a different 10 percent checked each subsequent year, so that the entire system is tested in each 10-year period.

(b) Each cathodic protection rectifier or other impressed current power source must be inspected six times each calendar year, but with intervals not exceeding 2 ½ months, to insure that it is operating.

(c) Each reverse current switch, each diode, and each interference bond whose failure would jeopardize structure protection must be electrically checked for proper performance six times each calendar year, but with intervals not exceeding 2 ½ months. Each other interference bond must be checked at least once each calendar year, but with intervals not exceeding 15 months.

(d) Each operator shall take prompt remedial action to correct any deficiencies indicated by the monitoring.

(e) After the initial evaluation required by §§ 192.455(b) and (c) and 192.457(b), each operator must, not less than every 3 years at intervals not exceeding 39 months, reevaluate its unprotected pipelines and cathodically protect them in accordance with the subpart in areas in which active corrosion is found. The operator must determine the areas of active corrosion by electrical survey. However, on distribution lines and where an electrical survey is impractical on transmission lines, areas of active corrosion may be determined by other means that include review and analysis of leak repair and inspection records, corrosion monitoring records, exposed pipe inspection records, and the pipeline environment.

[Amdt. 192-4, 36 FR 12302, June 30, 1971, as amended by Amdt. 192-33, 43 FR 39390, Sept. 5, 1978; Amdt. 192-35A, 45 FR 23441, Apr. 7, 1980; Amdt. 192-85, 63 FR 37504, July 13, 1998; Amdt. 192-93, 68 FR 53900, Sept. 15, 2003; Amdt. 192-114, 75 FR 48603, Aug. 11, 2010]

§ 192.469 External corrosion control: Test stations.

Each pipeline under cathodic protection required by this subpart must have sufficient test stations or other contact points for electrical measurement to determine the adequacy of cathodic protection.

[Amdt. 192–27, 41 FR 34606, Aug. 16, 1976]

Installing Test Stations

As corrosion control testing procedures have become more refined, it has become apparent that there is a need for standard types of test stations in sufficient quantity along the pipeline to enable electrical tests to be made at critical points in the piping system. An important location where test stations should be installed is at anode installations.

Several types of test station units are available commercially. Illustrated in Figure 5 is a typical test station at a magnesium anode location:

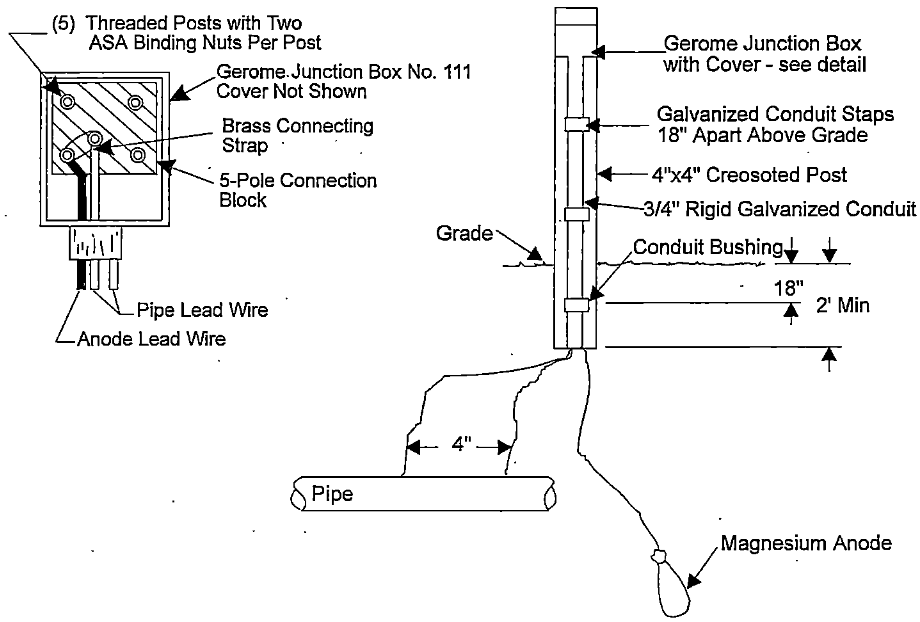

Figure 5. Typical Test Station and Magnesium Anode Location

(1) Test Point Construction. Test points should be located where they will be as convenient as practicable for the corrosion engineer. While some type of post mounting is preferable, in some areas test points may have to be in grade level boxes or even buried.

Typical methods of mounting above-ground test points are illustrated in Figure 6. Terminal boxes used should be of heavy cast construction to resist gunfire -- test points in rural areas become convenient targets. A screw-on cover as shown in the figure is convenient. Many terminal boxes and matching terminal blocks are available commercially. Terminal blocks obtained to fit the box selected should have heavy studs (at least 1/4 in.) of solid brass (may be nickel or cadmium plated) with hex nuts and washers. The conduit used should be reamed carefully after cutting to length to remove all sharp edges and a conduit bushing should be installed at the lower end as shown.

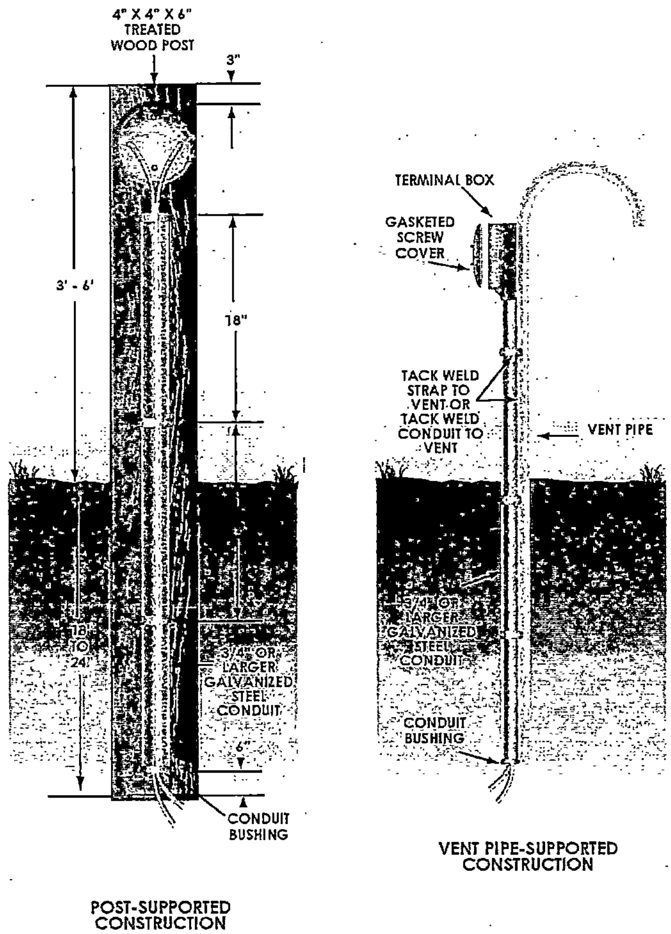

Figure 6. Above-Ground Test Point Construction

Each wire terminated in the box should have at least six inches of slack coiled as shown. The last two requirements are necessary to prevent the insulation from being cut through or having them pulled off the terminals in case the wires are subjected to tension by backfill settlement. Where a test point conduit is tack welded to vent pipes or other steel structures, all welding should be done before wires are pulled in so that there will be no heat damage to wire insulation.

Test points installed at grade level may use an arrangement such as illustrated in Figure 7. In its simplest form, the grade level test point utilizes a common street valve box with cover and test wires coiled and left in the box with their ends taped to avoid contacts. Terminal boards may be made to fit such boxes. However, test point boxes are available which are manufactured specifically for this purpose and include covers identifying them as such. Some designs are completely water-tight. When installing grade level test points, ample wire slack should be left in the housing below the terminal panel to allow for backfill settlement and for withdrawing the terminal panel should it be necessary during test work. Each grade level terminal box should be located precisely with respect to permanent reference points and entered on pipeline maps or other permanent records. This is necessary to avoid time loss in hunting for the boxes in case they are covered with grass, weed, dirt, snow, or pavement renewals.

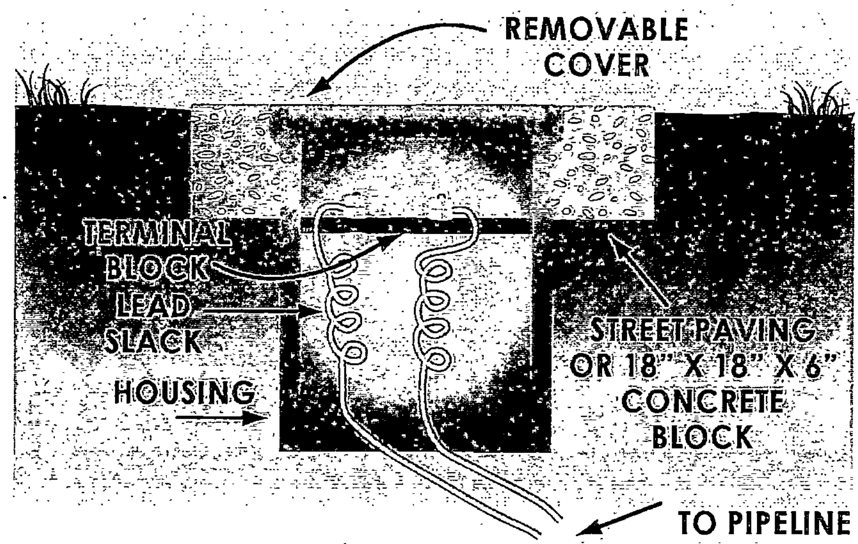

Figure 7. Grade-Level Test Point Construction

Buried test points usually may be installed as shown in Figure 8. A water-tight box is desirable. A protective plank should be placed directly above the box and wires as shown to prevent damage to the wires when excavating the box for testing.

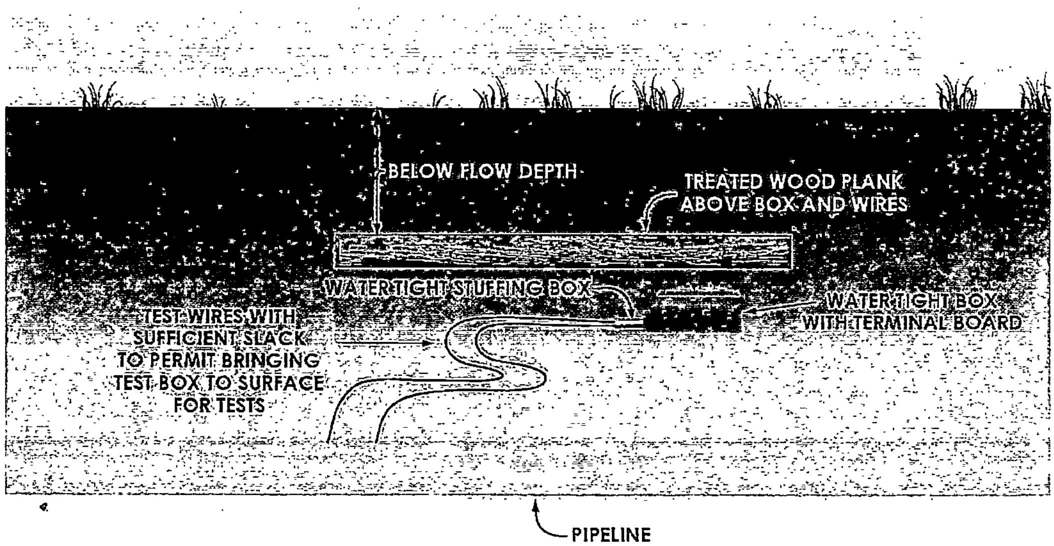

Figure 8. Buried Test Point Construction

Because of the time required for excavating them, buried test points should be used only when unavoidable. Where possible, it may be preferable to extend leads several hundred feet to a point where an above-ground test point can be installed. If buried test points are installed, they must be located precisely with respect to permanent land marks and the location information recorded where it will be available when tests are to be made.

(2) **Types of Test Points.** Test point types by function are illustrated in Figure 9. The types shown are not necessarily representative of any particular standard, but are intended to represent the variety that may be encountered. A color code is shown to illustrate a system whereby leads may be identified. Whatever color code is adopted should be made standard throughout the pipeline system.

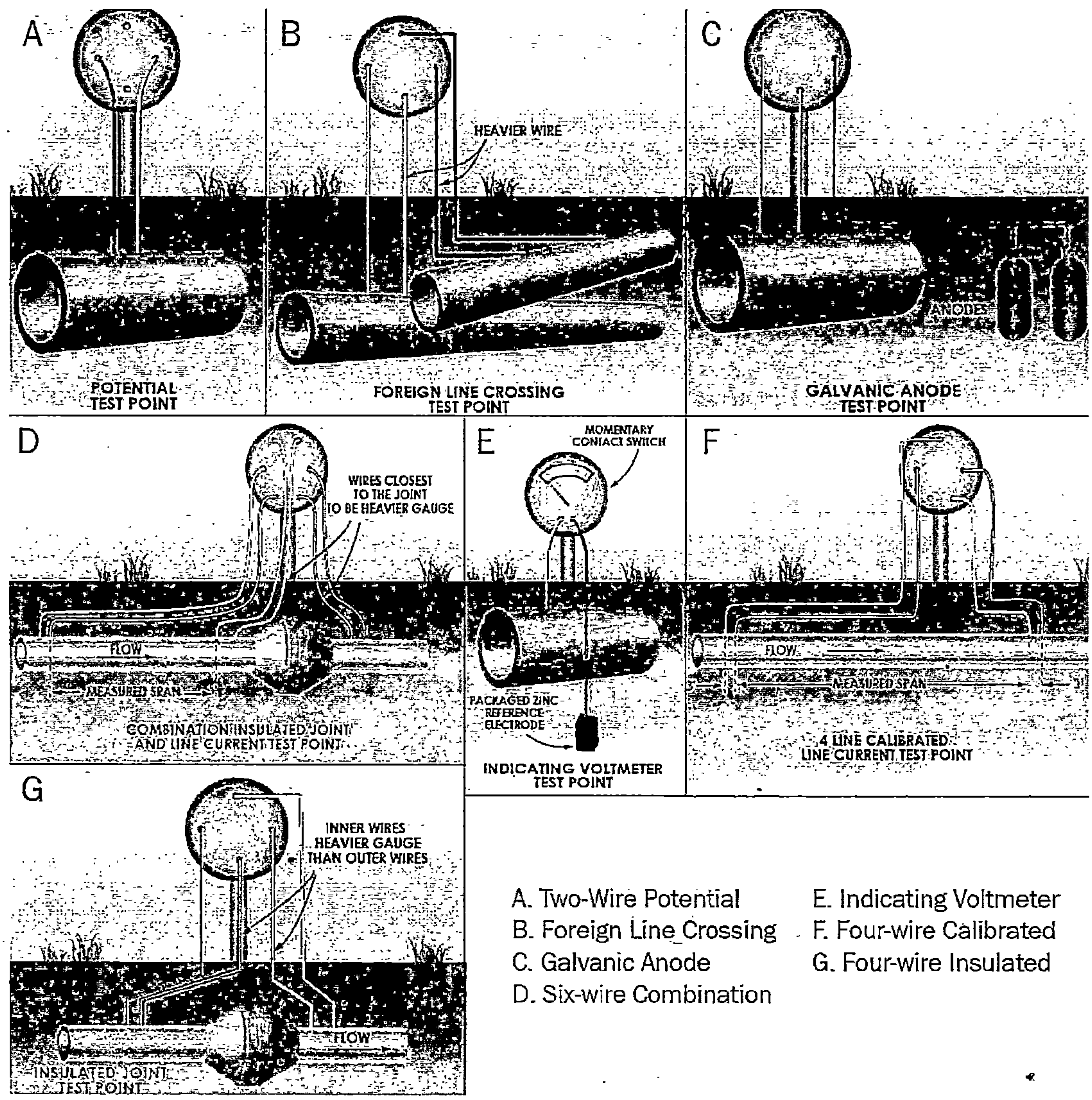

Figure 9. Typical Test Point Types

The two-wire potential test point is the one used most frequently. Two wires make it possible to check pipe-to-earth potential with one wire while test current is being applied to the line (if desired) using the other wire.

The four-wire insulated joint test point permits measuring pipe-to-earth potentials on each side of an insulated joint. The second pair of heavier gauge wires are available for inserting a resistance or solid bond across the insulated joint if found necessary.

The four-wire calibrated line current test point permits accurate measurement of pipeline current flow.

The six-wire combination insulated joint and line current test point is useful, particularly at terminal insulated flanges, because it permits positive measurement of current flow through an insulated flange should it become totally or partially shorted for any reason. Likewise, it will measure the current flowing through a solid or resistance bond should one be found necessary. One heavier gauge wire is provided on each side of the insulated joint for bonding purposes.

An indicating voltmeter test point is installed at key points in some systems. These meters may be read by operating personnel on a routine basis and the indicated values recorded and reported to the corrosion engineer. A voltmeter may be connected between the pipe and a zinc anode used as the potential reference. The voltmeter scale may be calibrated to read the equivalent of a pipe-to-copper sulfate electrode based on zinc having an open circuit potential of approximately -1.1 volt. If the indicating voltmeter has a zero center scale, electrically, this zero point may be marked -1.1 volt to copper sulfate, because if there is zero potential between the pipe and zinc anode, the pipe, too, must be -1.1 volt to copper sulfate. If the pipe is positive or negative to the zinc reference, the meter will read lower or higher, respectively, than the -1.1 volt value. Indicating voltmeters are available commercially for permanent installation at test points as described above. Small variations in the potential of the zinc reference electrode may be compensated for with the instrument zero adjustment.

The foreign line crossing test point provides two wires to each line. One wire is used for potential measurements, or other tests as required, while the other (heavier gauge wire) is available for installing a bond when needed. It should be noted that test wires should never be attached to another company's pipeline unless the pipeline owner authorizes it. Furthermore, many companies will allow such attachments only if made by their own personnel or at least with one of their representatives present while they are being made.

The galvanic anode test point is used primarily in connection with beds comprising several anodes at one location.

Testing and Monitoring Cathodic Protection Systems

One of the most common methods of testing cathodic protection systems is the annual test station survey. This requires the measurement and recording of pipe-to-soil potentials at designated test stations each year. While this is very useful information, particularly for well-coated pipelines, the test station data only represents the potentials on less than 1% of the pipeline surface. The test station data does not provide any information on the pipe-to-soil potentials at a distance from the test station.

On bare or poorly coated pipelines, the test station data may not represent potentials more than a few feet from the test station.

Other methodologies used for external corrosion control in underground pipelines consist of coating inspection and effectiveness of cathodic protection to evaluate the balance between both systems. These inspections are carried out by using a combination of the following techniques:

- Close Interval Survey (CIS) Technique
- Direct Current Voltage Gradient (DCVG) Technique
- Pipeline Current Mapper (PCM) Technique
- Alternating Current Voltage Gradient (ACVG) Technique

Consequently, it has become a standard practice to undertake "Close Interval Surveys" (CIS) on pipelines, every few years, in order to provide the data for assessing the effectiveness of the Cathodic Protection System over the full length of the pipeline. The CIS measures and records the pipe-to-soil potential on a regular spacing of between 1 and 3 meters (2.5 to 5 feet) depending on requirements, field conditions and pipeline physical properties.

Prior to the introduction of computerized dataloggers, undertaking the CIS was very difficult due to the volumes of data that needed to be recorded and plotted. The availability of computerized dataloggers for Cathodic Protection System monitoring creates a viable means of assessing system effectiveness.

Project planning, cooperation of the client and contractor, a high level of technical expertise, fieldcraft and dedicated equipment are required to benefit from this type of survey. The CIS will generate large volumes of data, and it is essential that this data be technically correct and its management and reporting efficient.

In order to properly undertake the close interval survey, the survey crew needs to be educated and trained in the all aspects of the work.

REVIEW I

Identifying Procedures Basic to Abandoning or Deactivating Gas Pipeline Facilities

Directions: Select from the list below the response, which most correctly completes each of the following statements. Write the letter of your choice in the space provided. NOTE: Some answers may be used more than once.

A. water	G. 8
B. disconnected from all sources of gas	H. ignition
C. locked	I. closed
D. 10	J. removed
E. screwed caps	K. main
F. piping system	L. contact appropriate personnel
	M. raise line pressure

F ~~[illegible]~~ 1. When a gas pipeline is abandoned, it must be physically disconnected from the _____.

B 2. A necessary field check before the abandonment of a pipeline facility is made to ensure the piping scheduled for abandonment is _____.

G 3. Generally, it is advisable to purge _____ inch and larger diameter pipe to ensure there is no residual gas or hydrocarbon.

A 4. For the purpose of abandoned pipelines, facilities may be purged using _____.

C 5. When service to a customer is discontinued, the valve used to prevent the flow of gas to the customer must be _____.

H 6. When air is used as a purging mechanism the larger the diameter and length of pipe being purged the greater the chance of _____.

E 7. An acceptable method for sealing abandoned pipe ends is _____.

I 8. If valves are left in an abandoned pipeline, the valves should be _____.

J 9. All above-grade valves in an abandoned pipeline should be _____.

I 10. When abandoning distribution service lines all curb valves should be _____.

A. water	G. 8
B. disconnected from all sources of gas	H. ignition
C. locked	I. closed
D. 10	J. removed
E. screwed caps	K. main
F. piping system	L. contact appropriate personnel
	M. raise line pressure

__K__ 11. When abandoning service lines from active mains, the service line should be disconnected as close to the _____ as practicable.

__L__ 12. If an underpressure condition occurs on a pipeline, you should _____.

Knowledge Verification Checklist

OQ Task CM-10
Abandon or Deactivate Gas Pipeline Facilities

Directions: Use the following performance criteria statements as a self-evaluation in preparation for the final exam.

I can identify:

- ❑ 1. A required action to be taken when a gas pipeline is abandoned. (CM-10.1.1)
- ❑ 2. Precautions that must be taken whenever service to a customer is discontinued. (CM-10.1.2)
- ❑ 3. A field check that is necessary before a gas pipeline is disconnected. (CM-10.1.3)
- ❑ 4. A potential hazard that must be eliminated before abandoning a pipeline facility. (CM-10.1.4)
- ❑ 5. A medium that may be used when purging gas pipeline facilities. (CM-10.1.5)
- ❑ 6. A potential hazard associated with using air to purge a large diameter and length of pipe. (CM-10.1.6)
- ❑ 7. An acceptable method of sealing abandoned pipe ends. (CM-10.1.7)
- ❑ 8. Action taken if valves are left in an abandoned underground pipeline. (CM-10.1.8)
- ❑ 9. Action taken if valves are above-grade in an abandoned pipeline. (CM-10.1.9)
- ❑ 10. Appropriate action taken on curb valves when abandoning distribution service lines. (CM-10.1.10)
- ❑ 11. Appropriate action taken when abandoning service lines from active mains. (CM-10.1.11)
- ❑ 12. An abnormal operating condition and reaction specific to abandoning or deactivating gas pipeline facilities. (CM-10.1.12)

Skill and Ability Verification Packet

OQ Task CM-10
Abandon or Deactivate Gas Pipeline Facilities

I. General Instructions

Instructions for Use

The Skill and Ability Verification Packet is designed to standardize conditions under which the employee demonstrates his/her performance of tasks that meet the operator qualification requirements established by the employee's company.

Completing the enclosed affidavit and uploading the data to Industrial Training Services OnBoard LMS for recordkeeping, documents the satisfactory completion of tasks. Both the OQ Authorized Evaluator (AE) and employee must sign the affidavit.

Instructions to the Employee

Your OQ AE will check your performance using the suggested evaluator guide included in each hands-on task assignment. This suggested guide must be supplemented or replaced by the individual company's policies and procedures related to the task being evaluated.

You must adhere to all safety precautions according to your company's policies and procedures and applicable federal, state, and local codes and regulations.

II. Task Information

OQ Task CM-10:	**Abandon or Deactivate Gas Pipeline Facilities**
Qualification Standard:	The employee's qualification is based on the enabling operation(s) that have been successfully completed. The operations task or tasks are listed below:
OQ Task CM-10.1:	Abandon/Deactivate Mains (ITS 5081)
OQ Task CM-10.2:	Abandon/Deactivate Service Lines (ITS 5091)
OQ Task CM-10.3:	Temporary Isolation of Service Lines and Service Discontinuance (B31Q 1201)
Recommended Requirement:	The employee must demonstrate proficiency to an acceptable level based on the Skill and Ability Checklist associated with each operation.
References:	49 CFR, Part 192.727. B31Q Task 1201. ITS Tasks 5081, 5091.

Note:

The following Abnormal Operating Conditions (AOCs) and their reactions listed are for guidance only. This AOC list is not presented as an exhaustive treatment of AOCs and appropriate responses. You may be required to know and apply other AOCs and AOC responses for different tasks. Properly recognizing and reacting to covered task AOCs are the responsibility of persons qualified to perform the covered task. Always follow your company's policies and procedures.

Industrial Training Services, Inc. assumes no liability for any act or act of omission performed by the person seeking qualification under the pipeline operator's OQ program, or during the actual pipeline operations of the pipeline operator or any contractor performing work on the pipeline operator's pipeline system.

Abnormal Operating Conditions

(Not limited to the examples listed below)

Recognize	React
• Ignition	• Stop the flow of gas at the nearest valve. Put flame out with fire extinguisher. Notify appropriate personnel
• Overpressure	• Make area safe; contact proper personnel
• Leakage	• Make area safe; protect life and property; evacuate if necessary; notify proper personnel; repair leak
• Uncontrolled escaping gas	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Underpressure	• Make area safe, then contact appropriate personnel
• Damaged pipe or coating	• Repair or replace or notify appropriate personnel
• Valve inoperable, unable to turn	• Repair or replace
• Unable to locate curb valve	• Generate order to locate and turn off

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III. Skill and Ability Verification Checklist

OQ Task CM-10
Abandon or Deactivate Gas Pipeline Facilities

I verify that (Please Print) ______________________________ is qualified to perform OQ Task CM-10 according to his/her company's procedures:

(CM-10.1) Abandon/Deactivate Mains. (5081)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Verify the use of proper personal protective equipment.
- ☐ Verify proper company operating procedures are performed.
- ☐ Verify mains are abandoned/deactivated according to company operating procedures.
- ☐ If required, verify that documentation is completed.
- ☐ Verify learner's ability to recognize and properly react to AOC's.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Accidental ignition	• Evacuate to safe area; establish and maintain safe area
• Discover illegal tap	• Notify supervisor

Comments / Additional Company Procedures:

(CM-10.2) Abandon/Deactivate Service Lines. (5091)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Verify the use of proper personal protective equipment.
- ☐ Verify proper company operating procedures are performed.
- ☐ Verify service lines are abandoned/deactivated according to company operating procedures.
- ☐ If required, verify that documentation is completed.
- ☐ Verify learner's ability to recognize and properly react to AOC's.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Overpressure	• Make area safe; contact proper personnel
• Gas leak	• Remove ignition sources
• Discover illegal tap	• Notify supervisor

Comments / Additional Company Procedures:

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(CM-10.3) Temporary Isolation of Service Lines and Service Discontinuance (1201)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Discontinue service or isolate service line by the following, as applicable:
  - Verify meter/address.
  - Close valve.
  - Lock valve.
  - Install mechanical device or fitting.
  - Cut, and cap.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Accidental ignition	• Evacuate to safe area; establish and maintain safe area
• Gas Leak	• Perform leak test and repair leak
• Discover illegal tap	• Notify supervisor

Comments / Additional Company Procedures:

IV. Employer Record

OQ Task CM-10

Abandon or Deactivate Gas Pipeline Facilities

Employee Information (Please Print):

Name ______________________________

Last 4 Digits of Social Security Number ______________________________

Company Name ______________________________

Company Mailing Address ______________________________

City ______________________ State __________ Zip ______________

Affidavit

I acknowledge the performance of this task is solely for the purpose of operator qualification, and is not intended to replace or modify company operating procedures or policies and may not be appropriately used in all circumstances. I acknowledge that I am responsible for recognizing hazards and abnormal conditions in my work place and must exercise care and good judgment; always using appropriate equipment, procedures and tools for tasks I perform. Industrial Training Services, Inc. assumes no liability for my actions nor for my application of the qualification performance guides used in this evaluation checklist.

Employee's Signature ______________________ Date ______________

Evaluator Information (Please Print):

Name ______________________________

Organization/Employer ______________________________

Telephone Number ______________________________

Affidavit

I affirm that I am the person who has administered this checklist and that I have conducted this assessment with integrity. I also affirm that the above named employee is the person assessed and that the above named person performed the tasks at the indicated level.

Evaluator's Signature ______________________ Date ______________

The employee is qualified according to company standards to perform the tasks listed below as indicated:

	Not Applicable	TASK/OPERATIONS	Method of Skill/Ability Verification Enter Number From List Below
1.	☐	(CM-10.1) Abandon/Deactivate Mains. (5081)	☐
2.	☐	(CM-10.2) Abandon/Deactivate Service Lines. (5091)	☐
3.	☐	(CM-10.3) Temporary Isolation of Service Lines and Service Discontinuance. (1201)	☐

Method of Knowledge Verification

- Written Exam

Method of Skill/Ability Verification Observed During:

1. Performance on the Job
2. Simulation

After completion of Section IV, "Employer Record," remove section from the packet for your records. For third party verification and database reporting service, upload the data to Industrial Training Services OnBoard LMS.

INDUSTRIAL
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INDUSTRIAL
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DANNY SHROUT

OQ Compliance Series
Student Manual

OQ Task CH-1
v10.4

Install Customer Gas Meter and Regulator Sets

INDUSTRIAL TRAINING SERVICES

ITS OQ Compliance Series

CH-1 Install Customer Gas Meter and Regulator Sets v10.4

Student Manual

INTRODUCTION

It is essential to learn and understand the proper procedures for installing customer gas meter and regulator sets to insure their correct operation when placed in service. To complete this module you will be required to complete the check-out activities listed below.

OBJECTIVE

1. Identify installation procedures for customer gas meter and regulator sets.

CHECK-OUT ACTIVITIES

Your instructor will provide you with a list of incomplete statements related to installing customer gas meter and regulator sets and a list of responses. Select the response that most correctly completes each statement. Cut-off score is 80%. (Knowledge Verification)

Your instructor will provide you with a Skill and Ability Verification Checklist. At the appropriate time demonstrate your skill and ability by correctly performing each operation required under the task. (Skill & Ability Verification)

OQ CH-1 covers requirements indicated in the following codes/regulations:

ITS OQ Covered Task:	ASME B-31 Q*	49 CFR 192**
OQ CH-1.1 Joining of Pipe: Threaded Joints	0721	
OQ CH-1.2 Joining of Pipe: Flange Assembly	0731	
OQ CH-1.3 Installation of Customer Meters and Regulators: Residential and Small Commercial	1161	192.353, 192.355 192.357, 192.359
OQ CH-1.4 Installing Customer Meters: Large Commercial and Industrial	1171	

*ASME B31Q Covered Tasks:

0721 Joining of Pipe: Threaded Joints.
0731 Joining of Pipe: Flange Assembly.
1161 Installation of Customer Meters and Regulators: Residential and Small Commercial.
1171 Install Customer Meters: Large Commercial and Industrial.

**49 CFR Part 192 Covered Regulations:

49 CFR 192 covered regulations are identified within the appropriate section of this module.

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Table of Contents

INSTRUCTION SHEET I

Identifying Installation Procedures for Customer Gas Meter and Regulator Sets

When selecting a meter/regulator set location, consideration should be given to the potential damage by outside forces, such as those from vehicles, construction equipment, tools, materials that might be placed on the meter, and falling objects such as packed snow or ice from a roof.

Meter/Regulator Set Location

When installing meter/regulator sets, always follow your company's policies and procedures.

(1) DOT Regulations.

> **§ 192.353 Customer meters and regulators: Location.**
>
> (a) Each meter and service regulator, whether inside or outside a building, must be installed in a readily accessible location and be protected from corrosion and other damage, including, if installed outside a building, vehicular damage that may be anticipated. However, the upstream regulator in a series may be buried.
>
> (b) Each service regulator installed within a building must be located as near as practical to the point of service line entrance.
>
> (c) Each meter installed within a building must be located in a ventilated place and not less than 3 feet (914 millimeters) from any source of ignition or any source of heat which might damage the meter.
>
> (d) Where feasible, the upstream regulator in a series must be located outside the building, unless it is located in a separate metering or regulating building.
>
> [35 FR 13257, Aug. 19, 1970, as amended by Amdt 192–85, 63 FR 37503, July 13, 1998; Amdt. 192–93, 68 FR 53900, Sept. 15, 2003]

(2) Access to Meter/Regulator Set. As required by 49 CFR 192.353a, each meter/service regulator set must be installed in a readily accessible location. Each location should accommodate access for reading, inspecting, repairs, testing, changing, and operating of the gas shutoff valve.[1]

---

1 49 CFR, 192.353 Guide Material 1(d)

Meter/regulators should not be installed in contact with the soil or other potentially corrosive materials. The potential for shorting out the insulating fittings should be considered.[2]

Gas meters must not be located where they will be subjected to extreme temperatures. The meter must be located not less than 3 feet from any source of ignition or any source of heat which might damage the meter.

A meter installed in a building must be located in a ventilated space. Regulators installed inside must be vented to the outside atmosphere. The regulator vent shall terminate at least 3 feet from a source of ignition[3].

Protection of Meter Set Installation

(1) DOT Regulations.

§ 192.355 Customer meters and regulators: Protection from damage.

(a) Protection from vacuum or back pressure. If the customer's equipment might create either a vacuum or a back pressure, a device must be installed to protect the system.

(b) Service regulator vents and relief vents. Service regulator vents and relief vents must terminate outdoors, and the outdoor terminal must—

(1) Be rain and insect resistant;

(2) Be located at a place where gas from the vent can escape freely into the atmosphere and away from any opening into the building; and

(3) Be protected from damage caused by submergence in areas where flooding may occur.

(c) Pits and vaults. Each pit or vault that houses a customer meter or regulator at a place where vehicular traffic is anticipated, must be able to support that traffic.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192–58, 53 FR 1635, Jan. 21, 1988]

(2) Protection from Back Pressure. A suitable protection device should be installed downstream of the meter/regulator set if the customer utilization equipment, such as a gas compressor, could produce an excessive drop in gas pressure or a vacuum at the meter/regulator set.[4]

[2] 49 CFR, 192.353 Guide Material 1(g)

[3] NFPA 54, National Fuel Gas Code, 2015 Ed., Section 5.8.5.1(3).

[4] 49 CFR, 192.355 Guide Material 1(a)

(3) **Protecting Outside Vents and Vent Piping Termination.** All outside regulator vents and the outside terminations of all service regulator vents and relief lines should be equipped with vented caps, fittings, or other protection. The protection should be installed in accordance with the manufacturer's instructions and should meet the following requirements:

- Rain and insect resistant
- Pointing downward
- Located in a place where gas from the vent can escape freely into the atmosphere and away from any opening into the building
- Protected from damage caused by submergence in areas where flooding may occur

(4) **Protection of Meter/Sets in Pits and Vaults.** Gas meters shall not be placed where they are highly likely to be subjected to damage, such as adjacent to a driveway, under a fire escape, in public passages, halls, or coal bins, or where they will be subject to excessive corrosion or vibration.

Making Threaded Pipe Connections

The most important objective in any gas piping installation is to be sure that the piping connections are gas tight. To accomplish this objective, every threaded connection must be carefully assembled. To properly assemble a threaded pipe connection, certain precautions should be taken. The precautions include:

✓ Clean the threads of both the pipe and fitting to be assembled. Remove all metal chips, dirt, scale, or rust from the inside of the pipe and both the male and female threads. Once cleaned, check the threads carefully to be sure they are in good condition.

✓ Apply a thread lubricating compound (pipe joint compound) to the male threads except on the first 2 threads at the end of the pipe.

✓ Secure all sections of pipe before making the connection. When assembling a fitting to a new section of pipe, hold the pipe in a pipe vise. When assembling a piece of pipe or fitting to an existing piping system, hold the existing pipe in place with a wrench or vise. This will prevent the existing piping from twisting or breaking.

✓ Assemble the fitting on the pipe by hand and use a pipe wrench to complete the connection.

✓ Do not put the piping system into service until all connections have been checked for leaks.

Making Flanged Pipe Connections

A pipe flange is a disc, collar, or ring that attaches to a pipe for the purpose of providing increased support strength, blocking off a pipeline, or implementing the attachment of more items, as illustrated in Figure 1. Pipe flanges are usually welded or screwed to the pipe end and are connected with bolts. A gasket is inserted between the two mating flanges to provide a tighter seal. Gaskets may be ring type or full face type. Ring gaskets extend only to the inside diameter of the flange bolt holes and are self centering. The full face gaskets cover the entire flange face and are pierced by the bolt holes.

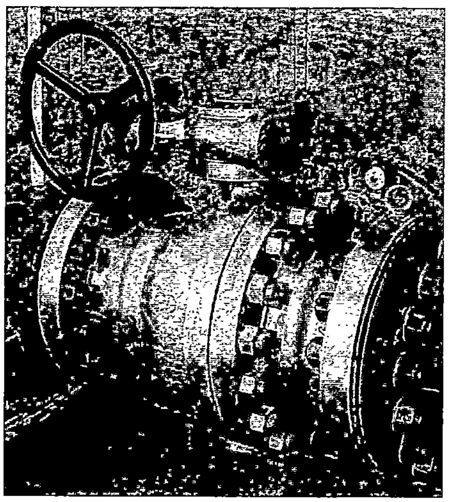
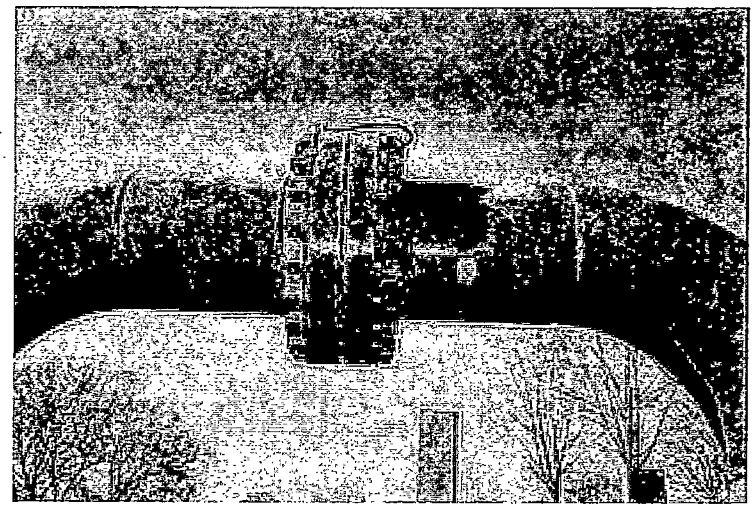

Figure 1. Examples of Flanged Pipe Connections

Various types of steel pipe flanges used for flange connection are available which include: threaded, slip-on-welding, lap joint, socket-welding, welded neck, and blind. These various types are illustrated in the following examples:

Threaded pipe flanges are similar to slip-on pipe flanges except the bore of threaded pipe flange has tapered threads. Threaded pipe flanges are used with pipes that have external threads. The benefit of these pipe flanges is that it can be attached without welding. Threaded pipe flanges are often used for small diameter, high pressure requirements. Threaded pipe flanges are available from 1/2" thru 24"

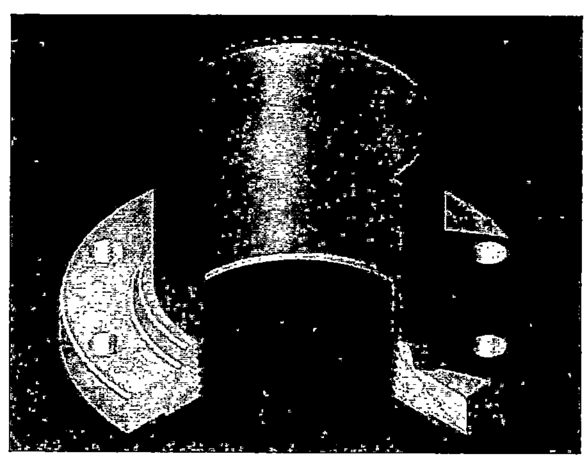

Figure 2. Threaded Pipe Flange

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Slip-on pipe flanges actually slip over the pipe. These pipe flanges are typically machined with an inside diameter of the pipe flange slightly larger than the outside diameter of the pipe. This allows the flange to slide over the pipe but to still have a somewhat snug fit. Slip-on pipe flanges are secured to the pipe with a fillet weld at the top and the bottom of the slip-on pipe flanges. These pipe flanges are also further categorized as a ring or a hub. Ring pipe flanges and hub pipe flanges are both considered slip on pipe flanges because they both slip over the pipe. Slip on pipe flanges are available from 1/2" thru 144"

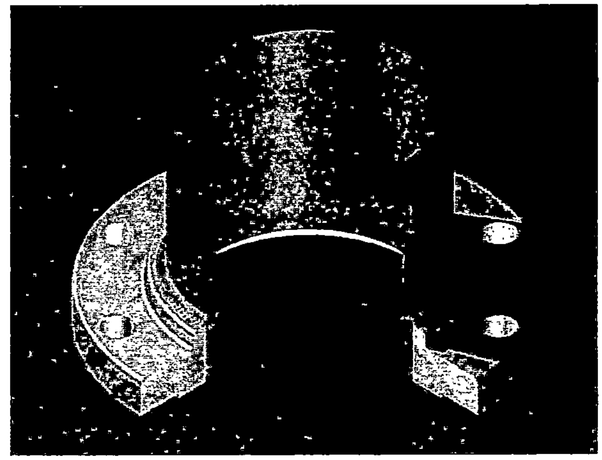


Figure 3. Slip-On Pipe Flange

Lap Joint Pipe Flanges slide over the pipe and are most commonly used with stub end fittings. A pipe is typically welded to the stub end and the lap joint pipe flange is free to rotate around the stub end. The benefit of this is that there will not be any issues with bolt hole alignment. Lap Joint pipe flanges are often used for applications that require frequent dismantling. Lap joint pipe flanges are available from 1/2" thru 24".

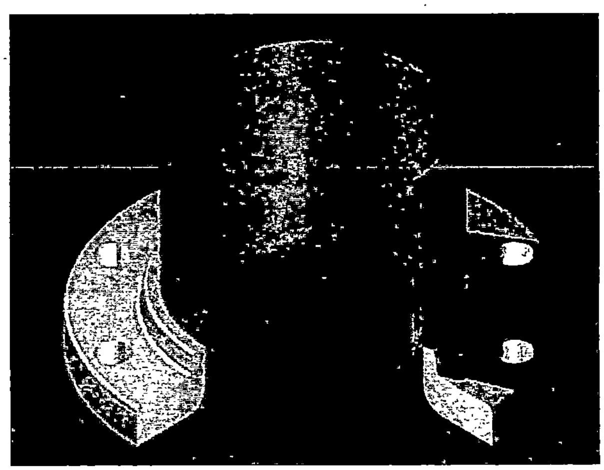


Figure 4. Lap Joint Pipe Flange

Socket-weld pipe flanges are typically used on smaller sizes of high pressure pipes. These pipe flanges are attached by inserting the pipe into the socket end and applying a fillet weld around the top. This allows for a smooth bore and better flow of the fluid or gas inside of the pipe. Socket-weld pipe flanges are available from 1/2" thru 24".

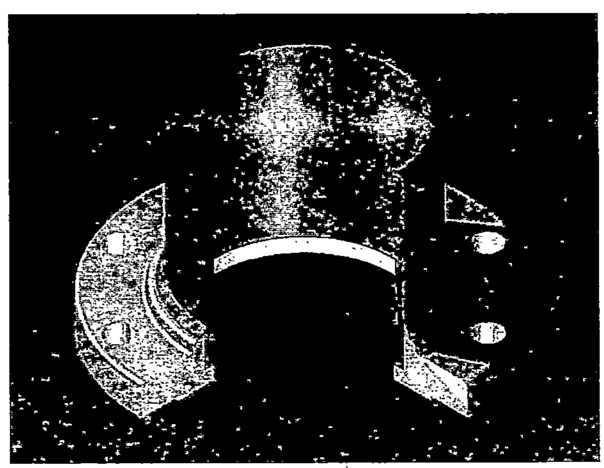


Figure 5. Socket-Weld Pipe Flange

Weld neck pipe flanges attach to the pipe by welding the pipe to the neck of the pipe flange. This allows for the transfer of stress from the weld neck pipe flanges to the pipe itself. This also reduces high stress concentration at the base of the hub of the weld neck pipe flanges. Weld neck pipe flanges are often used for high pressure applications. The inside diameter of a weld neck pipe flange is machined to match the inside diameter of the pipe. Weld neck pipe flanges are available from 1/2" thru 96".

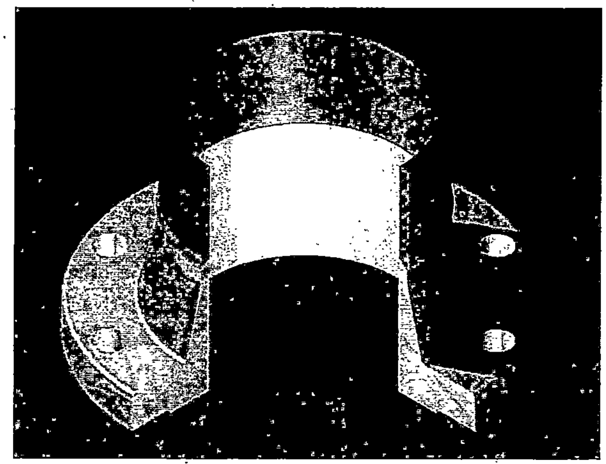


Figure 6. Weld Neck Pipe Flange

Blind pipe flanges are pipe flanges used to seal the end of a piping system or pressure vessel openings to prevent flow. Blind pipe flanges are commonly used for pressure testing the flow of liquid or gas through a pipe or vessel. Blind pipe flanges also allow easy access to the pipe in the event that work must be done inside the line. Blind pipe flanges are often used for high pressure applications. Blind pipe flanges are available from 1/2" thru 96".

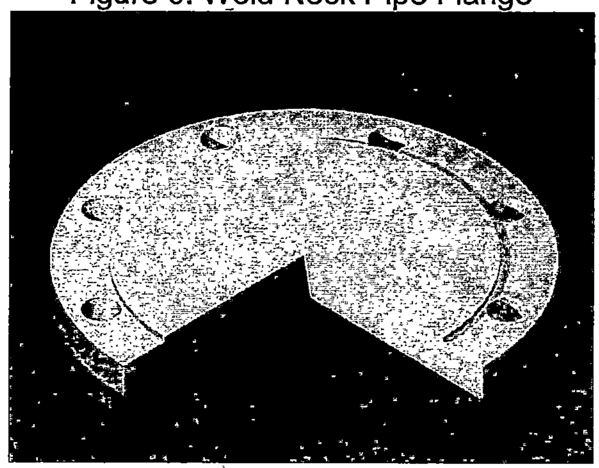


Figure 7. Blind Pipe Flange

The assembling of a flange connection may vary depending on the particular installation. Always follow your company's policies and procedures when making a flange connection. However, the following steps provide a general idea of the process.

Step 1: Clean the flange faces until they are free of dirt, rust, scale coating, and old gasket materials.

Step 2: Align the flange faces so that the faces are parallel to each other and the bolt holes are aligned.

Step 3: Select the correct grade, size, and length of bolt (or stud) for the specific flanges being assembled.

Step 4: Lubricate the bolt threads with a thread lubricant.

Step 5: Place and center the gasket between the two aligned flange faces.

Step 6: Insert the bolt through the flange hole and fasten the nut hand tight, beginning at the bottom half of the flange.

Step 7: Assemble the remaining bolts hand tight around the flange then begin to wrench them up lightly, alternately tightening diametrically opposite bolts until all the bolts have been tightened and the gasket begins to be depressed as illustrated in Figure 8. Following that, go around the bolt circle and successively final tighten each bolt. Repeat this until all bolts have been completely secured.

Note:[5]

Methods for tightening flange bolts may include the use of torque wrenches or the use of hydraulic stud tensioners. Some companies may recommend tightening the bolt with a star pattern. During the bolt tightening process, keep any gap between the flanges even all around the circumference and the nuts made up approximately the same amount on each end of the bolt.

1. First time around, snug the nuts with a hand wrench.
2. Second time around, tighten the nuts firmly with the same wrench.
3. Third time around, apply approximately 25% recommended torque.
4. Fourth time around, apply approximately 75% recommended torque.
5. Fifth time around, apply 100% of recommended torque.
6. Continuing tightening nuts all around until nuts do not move under 100% recommended torque.
7. If possible, re-torque after 24 hours.

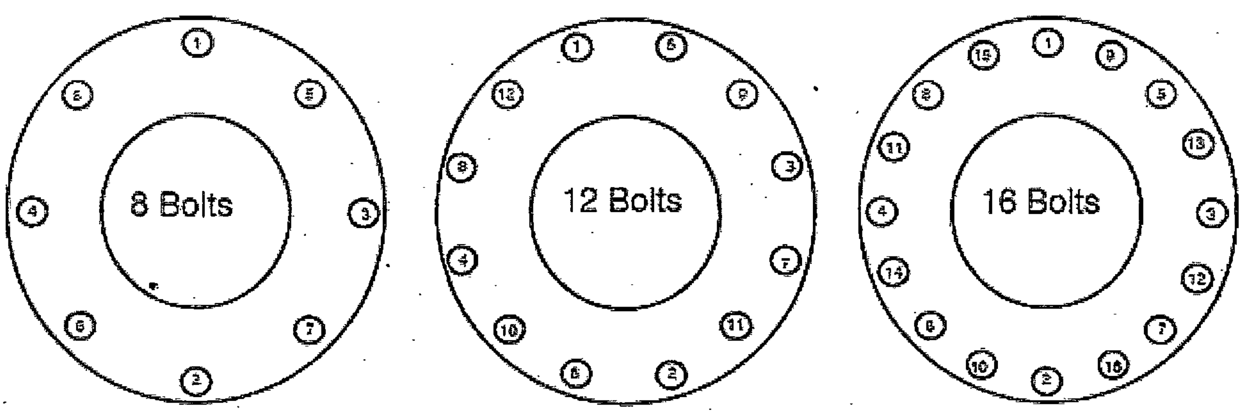


Figure 8. Examples of Flange Bolt Tightening Sequences

[5] Woodco, USA. Bolt Tightening Sequence for Flanges. www.woodcousa.com

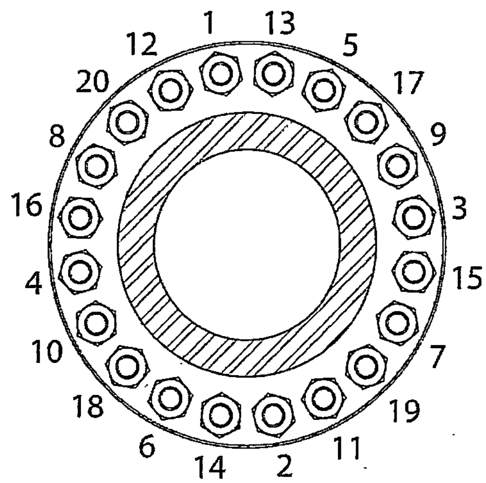
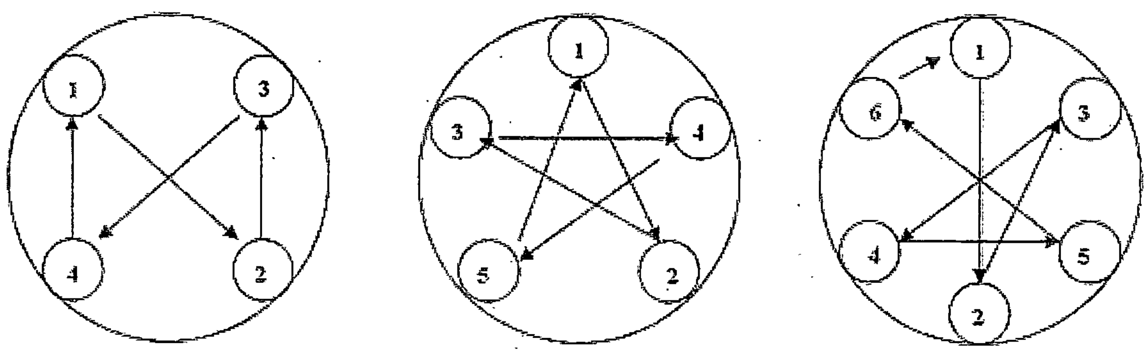


Figure 9. Bolt Tightening Sequence for Flanges Using 20 Bolts



Four-Bolt **Five-Bolt** **Six-Bolt**

Figure 10. Star Pattern Sequence for Tightening Bolts

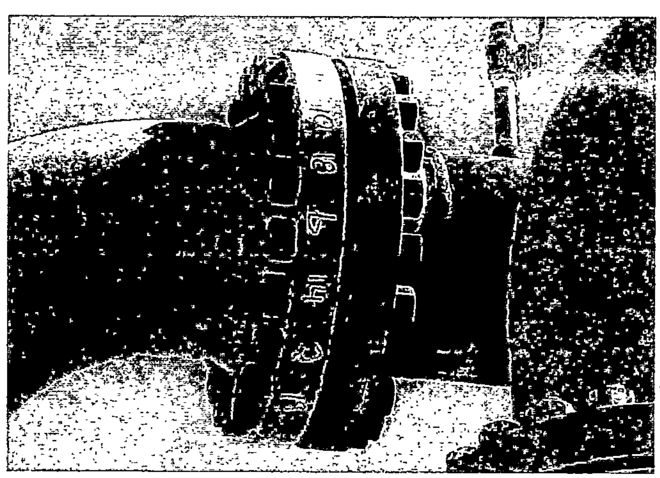


Figure 11. Number the Flange Bolts to Tighten in the Correct Pattern

Note:
Recommended torque values for the bolts are often available from the manufacturer or from your company's engineering department. The proper bolt torque values are based on gasket material, flange size, flange type, flange rating, bolt size, bolt material, and thread lubricant. Always remember bolts should be tightened according to the manufacturer's specifications and your company's policies and procedures.

Installing Meter Regulator Sets

§ 192.357 Customer meters and regulators: Installation.

(a) Each meter and each regulator must be installed so as to minimize anticipated stresses upon the connecting piping and the meter.

(b) When close all-thread nipples are used, the wall thickness remaining after the threads are cut must meet the minimum wall thickness requirements of this part.

(c) Connections made of lead or other easily damaged material may not be used in the installation of meters or regulators.

(d) Each regulator that might release gas in its operation must be vented to the outside atmosphere.

When installing the meter and regulator, verify that the quarter-turn valve stopped the gas flow in the closed position.

(1) Meter Connection Parts. Before discussing actual installations, take a moment to look at Figure 12, which shows the terminology of meter connection parts. The connection of the meter swivel to the meter spud is similar to that of a pipe union with a washer. The swivel and swivel nut make up one-half of the union with the meter spud representing the other half. The washer is utilized in helping to make a gas-tight connection. Swivels are available in different sizes. The inlet of a customer meter is on the left side (when facing the index) and the outlet is on the right side.

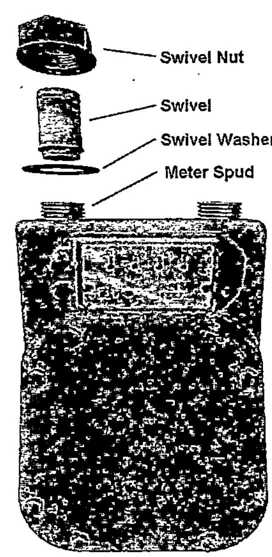


Figure 12. Identification of Meter Connection Parts

Meter bars are preassembled units designed to connect gas meters to supply piping. The use of the meter bar, as illustrated in Figure 13, prevents the transmission of piping stresses to the meter body.

(2) **Installation Practices.** Cleanliness during the installation of meters and regulators is a "must" for correct operation of the equipment. Pipe scale, chips, rust flakes, etc. must be removed from the inlet or service piping. Thread sealant, or pipe dope, and lubricated plug valve lubricants are commonly known causes of equipment malfunctions, resulting in costly "call-backs" to correct.

During the actual installation, the meter must be plumb and level in all directions. This is not only for aesthetic value but for accurate meter operation. A meter installed in a tilted position, especially front to back, will cause it to operate with a slow proof.[6]

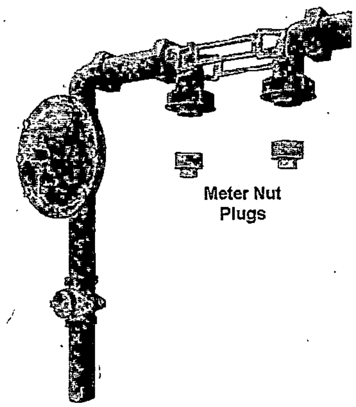


Figure 13.
Meter Bar Assembly

When a number of meters are placed in the same location, each meter shall be tagged or marked to indicate the customer served by it and such identification shall be preserved and maintained by the owner of the premises served.[7]

A typical installation showing a service regulator and meter is illustrated in Figure 14:

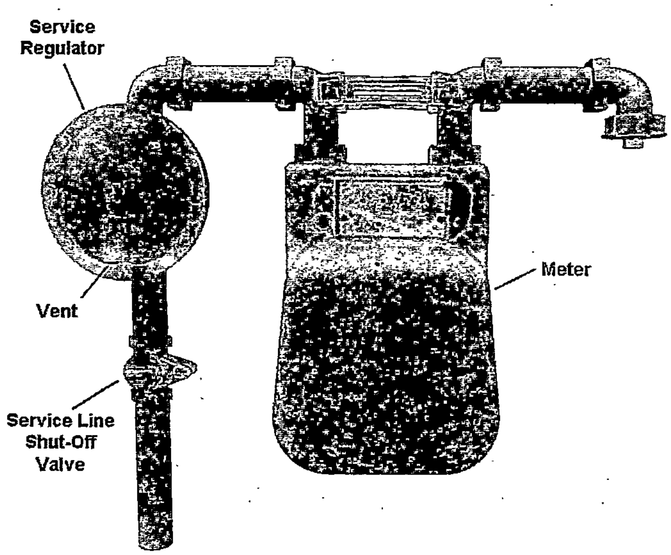


Figure 14. Field Regulator Installation

[6] Berghegger, Howard, "Importance of Proper Handling of Gas Meters and Service Regulators During Storage, Transit and Installation," p. 1.
[7] National Fuel Gas Code. 2015 ed. NFPA 54. Section 5.7.5.

Service regulators are generally used to control gas to individual homes from intermediate pressure distribution lines. The inlet pressure will usually be 0.5 psi to 60 psi and the outlet pressure setting about four ounces. A service regulator is always installed ahead of the gas meter so that the meter will be operating at a constant low pressure. An installation of this type can be used for inlet pressures up to 60 pound per square inch.[8] A clearance on all sides of the meter of at least 6 inches and at least 30 inches in the front is recommended.

If the inlet pressure is greater than 60 pounds per square inch, it is necessary to have an initial pressure cut reducing the pressure to the service regulator to a value less than 60 pounds per square inch. A regulator of this type is often referred to as a field regulator, or HPR (high pressure regulator).

A typical installation is illustrated in Figure 15 in which a field regulator with an internal relief valve is used to control the inlet pressure to the service regulator. The orifice of the field regulator should be selected so that with the maximum inlet pressure, the internal relief valve will have sufficient capacity so that the outlet pressure cannot exceed 60 pounds per square inch.[9]

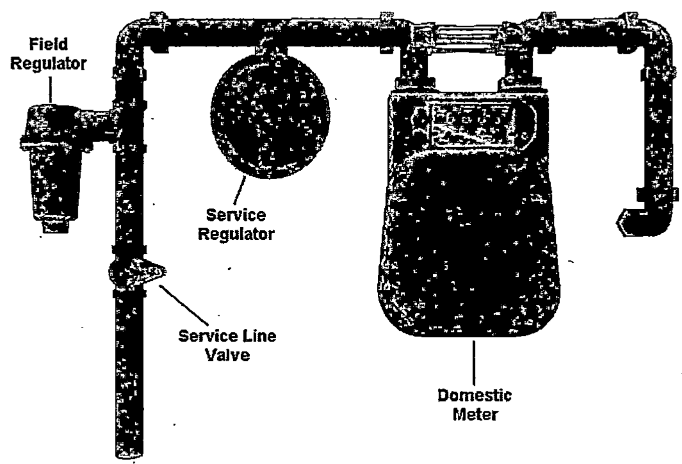


Figure 15. Farm Tap Installation

The following criteria are used as a guide for determining meter set design:

- Meter: Meter accuracy to meet state and company standards.
- Regulator: Adequate to provide control needed to maintain measurement accuracy.
- Pressure Relief: Provide overpressure protection equal to code requirements.
- Meter Support: To provide accuracy by maintaining level, plumb, and stable meters. Protect piping as required by state and federal codes.

---

[8] Rockwell International, "Gas Pressure Regulator Part V, Installation and Operation", pp. 11 and 12.
[9] Ibid.

- Meter Bypass: Used, when required, to allow meter testing, routing, or maintenance during normal working hours.
- Test Conditions: To allow meter testing required by state and company regulations.

Check the Meter Set Installation

§ 192.359 Customer meter installations: Operating pressure.

(a) A meter may not be used at a pressure that is more than 67 percent of the manufacturer's shell test pressure.

(b) Each newly installed meter manufactured after November 12, 1970, must have been tested to a minimum of 10 p.s.i. (69 kPa) gage.

(c) A rebuilt or repaired tinned steel case meter may not be used at a pressure that is more than 50 percent of the pressure used to test the meter after rebuilding or repairing.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192–1, 35 FR 17660, Nov. 17, 1970; Amdt. 192–85, 63 FR 37503, July 13, 1998]

Before leaving any installation, inspect all surfaces for nicks, breaks, scratches, or gouges in the paint, especially where a pipe wrench has been applied, and touch up the damaged surface with paint. One small break in a painted surface will cause more rapidly concentrated corrosion than if the complete installation was left unpainted.

If an insulated union or joint is installed, make sure a sealing wire or mounting brace is not accidentally or deliberately installed or strapped across the insulation. This would defeat the purpose of the electrolytic control.

After installation, verify that the regulator can provide necessary gas pressure at flow with a lock-up pressure not exceeding specifications. Verify that there is no leakage from the vent.

Note:
The following Abnormal Operating Conditions (AOCs) and their reactions listed are for guidance only. This AOC list is not presented as an exhaustive treatment of AOCs and appropriate responses. You may be required to know and apply other AOCs and AOC responses for different tasks. Properly recognizing and reacting to covered task AOCs are the responsibility of persons qualified to perform the covered task. Always follow your company's policies and procedures.

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(1) **Things to Consider When Responding to Abnormal Operating Conditions.** The following information is basic knowledge that will assist you in assessing and responding to abnormal operating conditions:

(a) **Basic Properties of Natural Gas.**
- Natural gas is lighter than air, colorless and odorless.
- Natural gas has a specific gravity of approximately 0.6.
- The natural gas Lower Explosive Limit (LEL) is approximately 5%.
- The natural gas Upper Explosive Limit (UEL) is approximately 15%.
- The ignition temperature of natural gas is about 1100°-1200° F.

(b) **Eliminating Ignition Sources.** Some of the ways to eliminate ignition sources are very obvious. For example:
- Do NOT smoke or use open flames near a jobsite/gas pipeline facility including structures or areas where possible leakage or presence of gas constitutes a hazard of fire or explosion, or in the open when accidental ignition of a gas-in-air mixture could cause personal injury or property damage.
- Sparks range in temperature from 1500°F in an electrical switch to 9,000°F in an arc welder. Do NOT use equipment or create situations that generate sparks. Sparks may be generated by the following conditions:
  Communication equipment
  Portable electrically powered tools and equipment
  Internal combustion engines
  Breaking electrical continuity
  Static electricity on plastic pipe

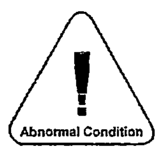
(c) **Personal Protection Equipment.**

Always follow your company's policies and procedures for the use of personal protection equipment (PPE).

Working around gas pipeline facilities requires practical safety practices and basic PPE may include:

- Head protection (e.g. hard hat)
- Eye and face protection (e.g. goggles, face shield, etc.)
- Hearing protection (e.g. ear plugs, ear muffs, etc.)
- Hand protection (proper glove material for the specific job)
- Respiratory protection (proper respiratory equipment when air content is insufficient)

(2) Abnormal Operating Conditions for Installing Customer Gas Meter and Regulator Sets.



Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Regulator will not lock up or not operate properly	• Repair, replace regulator, or notify appropriate personnel
• Regulator venting gas	• Repair, replace regulator, or notify appropriate personnel
• No regulator installed on service line operating above low pressure	• Install regulator
• Operating above proper pressure	• Adjust for proper output
• Regulator vent in wrong position	• Reposition to safely vent and protect opening. If vent is directed towards an air intake it may have to be vented up and away by positioning and installing proper piping
• Meter not level	• Level meter
• Meter installed in hazardous location	• Relocate setting or install meter protection

REVIEW I

Identifying Installation Procedures for Customer Gas Meter and Regulator Sets

Directions: Select from the list below the response that most correctly completes each of the following statements. Write the letter of your choice in the space provided.

A. insect screen
B. necessary gas pressure
C. not smoke
D. connecting piping
E. 3 feet
F. 2 feet
G. readily accessible areas
H. damage
I. free of dirt, rust, or scale
J. manufacturer's shell test pressure
K. install a regulator
L. vented to the outside
M. wrench or pipe vise
N. male
O. female
P. vented to the inside

G 1. Gas meter and pressure regulator sets should be installed in _____.

H 2. Gas meters should **not** be placed where they will be subjected to _____.

L 3. Regulators that are installed inside a building must be _____.

A 4. Regulator vents must be installed pointing down and protected with a(n) _____.

D 5. Meters and regulators must be installed to minimize anticipated stresses upon _____.

E 6. When installing the meter set, the regulator vent shall terminate at least _____ from a source of ignition.

B 7. After installation, you should verify that the regulator can provide the _____ at flow with a lock up pressure not exceeding specifications.

J 8. A meter may not be used at a pressure that is more than 67% of the _____.

K 9. If you locate a service line operating above low pressure with no regulator, you should _____.

C 10. One way to eliminate a source of ignition is to _____ near the worksite.

A. insect screen
B. necessary gas pressure
C. not smoke
D. connecting piping
E. 3 feet
F. 2 feet
G. readily accessible areas
H. damage
I. free of dirt, rust, or scale
J. manufacturer's shell test pressure
K. install a regulator
L. vented to the outside
M. wrench or pipe vise
N. male
O. female
P. vented to the inside

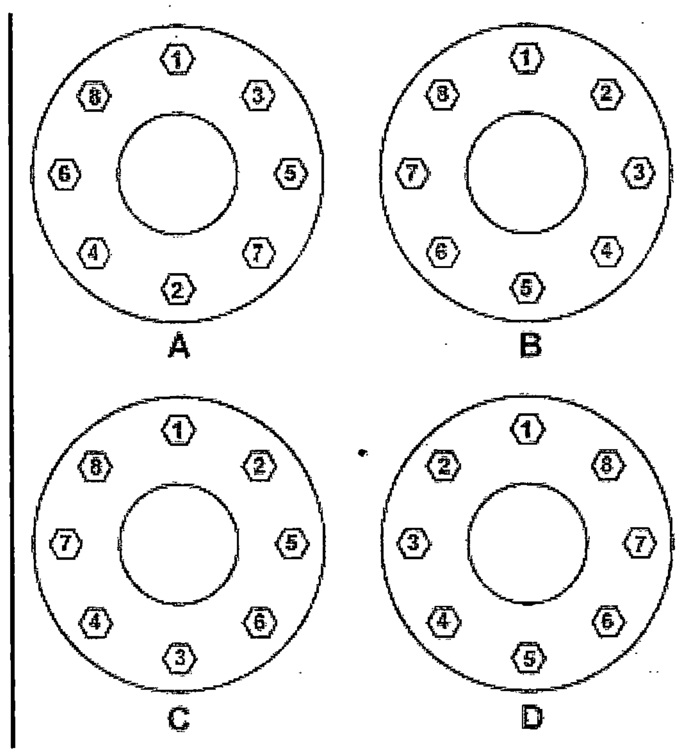
I 11. Before making a pipe flange connection, the flange face must be _____.

m 12. When making a threaded pipe joint, the best way to prevent twisting and breaking the pipe when installing the fitting is to use a _____ to hold the piping.

N 13. When making a threaded pipe connection, pipe joint compound should be applied to all of the _____ threads, except the first 2 threads.

Directions: Select the illustration that correctly answers the question.

A 14. Which of the following illustrations shows the correct bolt tightening sequence for flanged pipe connections?



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Knowledge Verification Checklist

OQ Task CH-1
Install Customer Gas Meter and Regulator Sets

Directions: Use the following performance criteria statements as a self-evaluation in preparation for the final exam.

I can identify:

- ❑ 1. The correct way to vent a regulator that is installed inside a building. (CH-1.1.1)
- ❑ 2. The proper location to terminate a meter set vent. (CH-1.1.2)
- ❑ 3. The correct way to install the regulator vent and relief vents. (CH-1.1.3)
- ❑ 4. The proper location to install gas meter and pressure regulator sets. (CH-1.1.4)
- ❑ 5. The proper way to apply pipe joint compound. (CH-1.1.5)
- ❑ 6. The proper way to secure threaded pipe connections. (CH-1.1.6)
- ❑ 7. The proper way to prepare a flanged pipe fitting for assembly. (CH-1.1.7)
- ❑ 8. The proper bolt tightening sequence for flanged pipe fittings. (CH-1.1.8)
- ❑ 9. The proper way to install a regulator and meter. (CH-1.1.9)
- ❑ 10. The proper installation for a gas meter. (CH-1.1.10)
- ❑ 11. The way to verify the regulator can provide the necessary gas pressure at flow. (CH-1.1.11)
- ❑ 12. Ways to eliminate ignition sources. (CH-1.1.12)
- ❑ 13. An abnormal operating condition relating to installing, replacing, and repairing meter and regulator sets. (CH-1.1.13)

Skill and Ability Verification Packet

OQ Task CH-1
Install Customer Gas Meter and Regulator Sets

I. General Instructions

Instructions for Use

The Skill and Ability Verification Packet is designed to standardize conditions under which the employee demonstrates his/her performance of tasks that meet the operator qualification requirements established by the employee's company.

Completing the enclosed affidavit and uploading the data to Industrial Training Services OnBoard LMS for recordkeeping, documents the satisfactory completion of tasks. Both the OQ Authorized Evaluator (AE) and employee must sign the affidavit.

Instructions to the Employee

Your OQ AE will check your performance using the suggested evaluator guide included in each hands-on task assignment. This suggested guide must be supplemented or replaced by the individual company's policies and procedures related to the task being evaluated.

You must adhere to all safety precautions according to your company's policies and procedures and applicable federal, state, and local codes and regulations.

II. Task Information

OQ Task CH-1:	**Install Customer Gas Meter and Regulator Sets**
Qualification Standard:	The employee's qualification is based on the enabling operation(s) that have been successfully completed. The operation's tasks are listed below:
OQ Task CH-1.1	Joining of Pipe: Threaded Joints (B31Q 0721)
OQ Task CH-1.2	Joining of Pipe: Flange Assembly (B31Q 0731)
OQ Task CH-1.3	Installation of Customer Meters and Regulators: Residential and Small Commercial. (B31Q 1161)
OQ Task CH-1.4	Install Customer Meters: Large Commercial and Industrial (B31Q 1171)
Recommended Requirement:	The employee must demonstrate proficiency to an acceptable level based on the Skill and Ability Checklist associated with each operation.
References:	49 CFR Part 192.353, 192.355, 192.357, 192.359. B31Q Tasks 0721, 0731, 1161, 1171.

Note:

The following Abnormal Operating Conditions (AOCs) and their reactions listed are for guidance only. This AOC list is not presented as an exhaustive treatment of AOCs and appropriate responses. You may be required to know and apply other AOCs and AOC responses for different tasks. Properly recognizing and reacting to covered task AOCs are the responsibility of persons qualified to perform the covered task. Always follow your company's policies and procedures.

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Abnormal Operating Conditions

(Not limited to the examples listed below)

Recognize	React
• Regulator will not lock up or not operate properly	• Repair, replace regulator, or notify appropriate personnel
• Regulator venting gas	• Repair, replace regulator, or notify appropriate personnel
• No regulator installed on service line operating above low pressure	• Install regulator
• Operating above proper pressure	• Adjust for proper output
• Regulator vent in wrong position	• Reposition to safely vent and protect opening. If vent is directed towards an air intake it may have to be vented up and away by positioning and installing proper piping
• Meter not level	• Level meter
• Meter installed in hazardous location	• Relocate setting or install meter protection

III. Skill and Ability Verification Checklist

OQ Task CH-1
Install Customer Gas Meter and Regulator Sets

I verify that (Please Print) ______________________________________ **is qualified to perform OQ Task CH-1 according to his/her company's procedures:**

(CH-1.1) Joining of Pipe: Threaded Joints. (0721)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Verify pipe and components are adequate for intended service.
  - schedule (wall thickness) and grade
  - diameter
  - thread type
  - pressure rating
  - material
- ☐ Perform actions to join threaded pipe with threaded fittings.
  - Mating surfaces are clean, dry, and free of rust or other contaminants.
  - Approved thread compound or tape has been applied.
  - Pipe and fittings are threaded together to obtain a leak-free joint.
- ☐ Inspect the completed joint for defects.
  - cracks
  - cross-threading
  - general defects
  - leaks
  - proper fit
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Condition

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Meter not level • Meter in hazardous location • Operating above or below proper pressure	• Level meter • Relocate or install barricade • Readjust for proper output

Comments / Additional Company Procedures: ______________________________

____

____

(CH-1.2) Joining of Pipe: Flange Assembly. (0731)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Verify components to assemble flanges, including bolt sequence and torquing.
  - gasket type as specified
  - bolt and nut length and diameter as specified
  - flange assembly (rating and size)
- ☐ Perform actions to prepare flange and components.
  - Faces are clean, dry, and free of material that might be detrimental to the flange assembly.
  - Components are free of defects.
    - nicks or gouges
    - cracks or other imperfections
  - Rust and dirt are removed from threads of bolts and nuts before assembly.
- ☐ Install gasket as specified.
  - gasket integrity
  - alignment
- ☐ Align flanges as specified.
  - Flange faces are square to each other.
  - Bolt holes are aligned.
- ☐ Perform actions to install, as applicable.
  - insulators
  - washers
  - bolts and nuts
- ☐ Perform actions to tighten.
  - sequence as specified
  - torquing as specified
- ☐ Perform actions to inspect flange assembly, as applicable.
  - bolt ends similar in length
  - washers installed
  - insulators installed
  - properly aligned
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Condition

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Meter not level • Meter in hazardous location • Operating above or below proper pressure	• Level meter • Relocate or install barricade • Readjust for proper output

Comments / Additional Company Procedures:

(CH-1.3) Installation of Customer Meters and Regulators: Residential and Small Commercial. (1161)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Verify meter and regulator to be installed.
  - proper size meter
  - regulator(s) specification(s) within pressure range
- ☐ Locate meter set to ensure the following:
  - accessibility
  - protection from corrosion
  - protection from other damages (crash barriers/bollards)
  - proper distance from ignition sources
  - proper ventilation requirements (piping to safe atmosphere) are met
  - protection from flooding
- ☐ Install or verify the installation of the meter bracket, if applicable.
- ☐ Assemble meter set.
  - Select proper fittings.
  - Install fittings to service riser (use of pipe dope/tape).
- ☐ Install and test relief device as specified.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Operating Conditions

(Not limited to the examples listed below)

Recognize	React
• Regulator vent in wrong position	• Reposition to safely vent and protect opening. If vent is directed towards an air intake it may have to be vented up and away by positioning and installing proper piping
• Meter in hazardous location	• Relocate or install barricade
• No relief valve on excess pressure setting	• Add a relief valve or additional regulator as needed

Comments / Additional Company Procedures:

(CH-1.4) Install Customer Meters: Large Commercial and Industrial. (1171)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use of proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate materials and equipment.
- ☐ Identify meter(s) to be installed.
  - size
  - type
    - diaphragm
    - rotary
    - turbine
    - ultrasonic
    - other
- ☐ Identify meter installation location.
  - location restrictions
    - outdoor
      - not under fire escape, etc.
    - indoor
      - not under interior stairways, in engine or boiler rooms, etc.
  - regulator vent requirements
    - free escape of gas to the atmosphere
    - away from openings into the building
    - away from sources of ignition
  - protection from flooding
  - protection from vehicular damage
  - protection from snow loads
- ☐ Install meter(s).
  - Assemble meter set.
  - Support meter, as needed.
  - Purge meter set.
  - Check delivery and lock-up pressures.
  - Determine if any pressure abnormalities exist, and respond appropriately.
  - Check all components for leakage.
  - Ensure adequate coating.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Condition

Abnormal Operating Conditions

(Not limited to the examples listed below)

Recognize	React
• Meter not level	• Level meter
• Meter in hazardous location	• Relocate or install barricade
• Operating above or below proper pressure	• Readjust for proper output

Comments / Additional Company Procedures:

IV. Employer Record

OQ Task CH-1

Install Customer Gas Meter and Regulator Sets

Employee Information (Please Print):

Name ______________________________

Last 4 Digits of Social Security Number ______________________________

Company Name ______________________________

Company Mailing Address ______________________________

City ____________________ State __________ Zip ____________

Affidavit

I acknowledge the performance of this task is solely for the purpose of operator qualification, and is not intended to replace or modify company operating procedures or policies and may not be appropriately used in all circumstances. I acknowledge that I am responsible for recognizing hazards and abnormal conditions in my work place and must exercise care and good judgment; always using appropriate equipment, procedures and tools for tasks I perform. Industrial Training Services, Inc. assumes no liability for my actions nor for my application of the qualification performance guides used in this evaluation checklist.

Employee's Signature ____________________ Date ____________

Evaluator Information (Please Print):

Name ______________________________

Organization/Employer ______________________________

Telephone Number ______________________________

Affidavit

I affirm that I am the person who has administered this checklist and that I have conducted this assessment with integrity. I also affirm that the above named employee is the person assessed and that the above named person performed the tasks at the indicated level.

Evaluator's Signature ____________________ Date ____________

The employee is qualified according to company standards to perform the tasks listed below as indicated:

	Not Applicable	TASK/OPERATIONS	Method of Skill/Ability Verification Enter Number From List Below
1.	☐	(CH-1.1) Joining of Pipe: Threaded Joints (0721)	☐
2.	☐	(CH-1.2) Joining of Pipe: Flange Assembly (0731)	☐
3.	☐	(CH-1.3) Installation of Customer Meters and Regulators: Residential and Small Commercial (1161)	☐
4.	☐	(CH-1.4) Install Customer Meters: Large Commercial and Industrial (1171)	☐

Method of Knowledge Verification

- Written Exam

Method of Skill/Ability Verification Observed During:

1. Performance on the Job
2. Simulation

After completion of Section IV, "Employer Record," remove section from the packet for your records. For third party verification and database reporting service, upload the data to Industrial Training Services OnBoard LMS.

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OQ Compliance Series
Student Manual

OQ Task CH-2
v10.5

Install Customer Gas Service Lines

INDUSTRIAL
TRAINING SERVICES

ITS OQ Compliance Series
CH-2 Install Customer Gas Service Lines
v10.5

Student Manual

INTRODUCTION

It is essential that customer gas service lines be properly installed to ensure safe and efficient service to the customer. To complete this module you will be required to complete the check-out activities listed below.

OBJECTIVE

1. Install customer gas service lines.

CHECK-OUT ACTIVITIES

Your instructor will provide you with a list of incomplete statements related to installing customer gas service lines and a list of responses. Select the response that most correctly completes each statement. Cut-off score is 80%. (Knowledge Verification)

Your instructor will provide you with a Skill and Ability Verification Checklist. At the appropriate time demonstrate your skill and ability by correctly performing each operation required under the task. (Skill and Ability Verification)

OQ CH-2 covers requirements indicated in the following codes/regulations:

ITS OQ Covered Task:	ASME B-31 Q*	49 CFR 192**
OQ CH-2.1 Installation of Steel Pipe in a Ditch	0861	192.151, 192.361, 192.363, 192.365, 192.367, 192.369, 192.379, 192.381, 192.383
OQ CH-2.2 Installation of Plastic Pipe in a Ditch	0901	192.151, 192.361, 192.363, 192.365, 192.367, 192.369, 192.375, 192.379, 192.381, 192.383
OQ CH-2.3 Install Tracer Wire	0941	
OQ CH-2.4 Backfilling	0981	192.361

§§ 192.373 Service lines: Cast iron and ductile iron & 192.377 Service lines: copper are also covered in this module.

***ASME B31Q Covered Tasks:**

0861 Installation of Steel Pipe in a Ditch.
0901 Installation of Plastic Pipe in a Ditch.
0941 Install Tracer Wire.
0981 Backfilling.

****49 CFR Part 192 Covered Regulations:**

49 CFR 192 covered regulations are identified within the appropriate section of this module.

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INSTRUCTION SHEET I

Installing Customer Gas Service Lines

A service line is installed upstream of the service regulator. If there is no service regulator, the service line is installed upstream of the meter. Each service line must have an outside shut-off valve in a readily accessible location that, if feasible, is outside of the building. Underground service-line valves must be located in a covered, durable curb box or standpipe that allows ready operation of the valve and is supported independently of the service lines.

D.O.T. Regulations

§ 192.361 Service lines: Installation.

(a) *Depth.* Each buried service line must be installed with at least 12 inches (305 millimeters) of cover in private property and at least 18 inches (457 millimeters) of cover in streets and roads. However, where an underground structure prevents installation at those depths, the service line must be able to withstand any anticipated external load.

(b) *Support and backfill.* Each service line must be properly supported on undisturbed or well-compacted soil, and material used for backfill must be free of materials that could damage the pipe or its coating.

(c) *Grading for drainage.* Where condensate in the gas might cause interruption in the gas supply to the customer, the service line must be graded so as to drain into the main or into drips at the low points in the service line.

(d) *Protection against piping strain and external loading.* Each service line must be installed so as to minimize anticipated piping strain and external loading.

(e) *Installation of service lines into buildings.* Each underground service line installed below grade through the outer foundation wall of a building must:

(1) In the case of a metal service line, be protected against corrosion;
(2) In the case of a plastic service line, be protected from shearing action and backfill settlement; and
(3) Be sealed at the foundation wall to prevent leakage into the building.

(f) *Installation of service lines under buildings.* Where an underground service line is installed under a building:

(1) It must be encased in a gas tight conduit;
(2) The conduit and the service line must, if the service line supplies the building it underlies, extend into a normally usable and accessible part of the building; and
(3) The space between the conduit and the service line must be sealed to prevent gas leakage into the building and, if the conduit is sealed at both

ends, a vent line from the annular space must extend to a point where gas would not be a hazard, and extend above grade, terminating in a rain and insect resistant fitting.

(g) *Locating underground service lines.* Each underground nonmetallic service line that is not encased must have a means of locating the pipe that complies with §192.321(e).

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192–75, 61 FR 18517, Apr. 26, 1996; Amdt. 192–85, 63 FR 37503, July 13, 1998; Amdt. 192–93, 68 FR 53900, Sept. 15, 2003]

Installing Service Lines Underground[1]

(1) **Depth.** When a buried service line is installed, it must have at least 12 inches of cover in private property and at least 18 inches of cover in streets and roads. If the service line cannot be buried at these depths, the service line must be able to withstand any anticipated external load and stress. This can be accomplished by protecting the service line with a casing pipe. All service lines must be installed to minimize anticipated piping strain and external loading.

(2) **Support.** Service lines must be properly supported on undisturbed or well-compacted soil.

(3) **Backfill.** The appropriate backfill must be free of debris that may harm the piping or pipe coating.

(4) **Grading for Drainage.** In areas where condensate in the gas might cause interruption in the gas supply to the customer, the service line should be graded to provide drainage into the main or into drips at the low points.

(5) **Protection Against Piping Strain and External Loading.** If the service line is metal, it must be protected against corrosion. If the service line is plastic, it must be protected from shearing action and backfill settlement.

(6) **Pipe Cover Consideration.** Where cover requirements cannot be met due to existing substructures, the portions of the service lines which could be subjected to superimposed loads should be cased or bridged, or the pipe should be appropriately strengthened[2].

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[1] 49 CFR 192.361

[2] 49 CFR 192.361 Guide Material (1)

(7) Installing Service Lines into Buildings. Each underground service line installed below grade through the outer foundation wall of a building must be sealed at the foundation wall to prevent entry of gas or water into the building.

Underground steel or wrought iron pipe and fittings must be coated with an approved material that will retard corrosion.

A protective sleeve designed for the specific type of connection should be used to reduce stress concentrations. Sleeves entering concrete walls containing reinforcing steel must not touch the reinforcing steel.

(8) Installing Service Lines Under Buildings. If a service line is installed below grade through the outer foundation wall of a building, it must be sealed at the foundation wall to prevent leakage into the building,

Services should not be installed under buildings or mobile homes. If a service must be installed under a building, it **must** be encased in a gas-tight conduit. This conduit must vent to the outside at a point where gas would not be a hazard and must terminate above ground with a rain, snow, ice, and insect resistant fitting.

Where the installation of gas piping underground, beneath buildings, is unavoidable, the piping must be encased in an approved conduit designed to withstand the superimposed loads. The conduit shall extend into a normally usable and accessible portion of the building and, at the point where the conduit terminates in the building, the space between the conduit and the gas piping must be sealed to prevent the possible entrance of any gas leakage. If the end sealing is of a type that will retain the full pressure of the pipe, the conduit shall be designed for the same pressure as the pipe. The conduit shall extend outside the building, be vented above grade to the outside, and be installed so as to prevent the entrance of water and insects.

(9) Installation of Tracer Wire and Warning Tapes. According to CFR 192.321(e), "Plastic pipe that is not encased must have an electrically conductive wire (tracer wire) or other means of locating the pipe while it is underground." NFPA 54 recommends the use of a minimum AWG 14 tracer wire.[3]

(a) Tracer Wire.

- Tracer wire may be installed physically separated from, or immediately adjacent to, the plastic pipe. In determining placement of tracer wire relative to plastic pipe, consider the relative importance of locating the pipe versus potential pipe damage from

[3] NFPA 54 2015 edition, Section 7.1.7.3

a current surge through tracer wire. Lightning strikes are a source of current surges.

- Tracer wire should not be wrapped around plastic pipe. It may be taped to the outside of the plastic pipe, especially for installation by boring or plowing-in, or placed loosely in the trench directly adjacent to the pipe.

- Leads from tracer wire into curb boxes and valve boxes, and on outside service risers, can be used for direct connections of locating instruments. Consideration should be given to ensuring that no bare tracer wire is exposed such that a lightning strike could cause a current surge through the wire.

(b) **Warning Tape.** A highly visible warning tape may be used in addition to one of the means for locating the pipe. Such tapes are usually yellow with a legend such as "Warning: Buried Gas Pipeline." Warning tapes are generally installed approximately 12" directly above the plastic pipe so that it will be struck first by someone digging in the vicinity of the pipe.

(10) Consolidating the Backfill. If trench flooding is used to consolidate the backfill, care should be taken to see that the pipe is not floated from its firm bearing on the trench bottom. Where service lines are installed in existing or proposed roadways or in unstable soil, flooding should be augmented by wheel rolling or mechanical compaction. Multi-lift mechanical compaction can be used in lieu of flooding[4].

(11) Considering Adjacent Underground Structures[5]. When installing a new service or replacing an existing service, the proximity and condition of existing conduits, ducts, sewer lines, and similar structures, including abandoned structures, should be considered since they have the potential to provide a path for the migration of leaking gas.

Further, consideration should be given to not installing services in close proximity to specific types of trees or shrubs that have extensive root growth, particularly the younger ones. Such growth could exert forces on the pipe and nearby joints.

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[4] 49 CFR 192.361 Guide Material (4)
[5] 49 CFR 192.361 Guide Material (5)

Considerations for Plastic Service Lines

§ 192.375 Service lines: Plastic.
(a) Each plastic service line outside a building must be installed below ground level, except that—
(1) It may be installed in accordance with §192.321(g); and
(2) It may terminate above ground level and outside the building, if—
(i) The above ground level part of the plastic service line is protected against deterioration and external damage; and
(ii) The plastic service line is not used to support external loads.
(b) Each plastic service line inside a building must be protected against external damage.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192–78, 61 FR 28785, June 6, 1996]

The excavation below the piping at the main connection should be tamped using compactable material. Where non-compactable material (such as very wet mud) is present, it may be necessary to substitute compactable material.

The transition from plastic pipe to more rigid piping should be protected from shear and bending as at the main connection. If there is neither a basement excavation nor a footing excavation, the trench bottom should be compacted and smoothed.

If there is either a basement excavation or a footing excavation, compaction may not be feasible because of possible damage to the building wall. Where compaction is not feasible, some other method of continuous support for the service line should be provided over the disturbed soil.

Plastic pipe may not be deflected to a radius smaller than the minimum recommended by the manufacturer for the kind, type, grade, wall thickness, and diameter of the particular plastic pipe used.

Installing Service Line Valves

§ 192.365 Service lines: Location of valves.
(a) *Relation to regulator or meter.* Each service-line valve must be installed upstream of the regulator or, if there is no regulator, upstream of the meter.
(b) *Outside valves.* Each service line must have a shut-off valve in a readily accessible location that, if feasible, is outside of the building.
(c) *Underground valves.* Each underground service-line valve must be located in a covered durable curb box or standpipe that allows ready operation of the valve and is supported independently of the service lines.

Each service line must have a service line valve that meets the applicable requirements of DOT §192.363.

> **§ 192.363 Service lines: Valve requirements.**
> (a) Each service line must have a service-line valve that meets the applicable requirements of subparts B and D of this part. A valve incorporated in a meter bar, that allows the meter to be bypassed, may not be used as a service-line valve.
> (b) A soft seat service line valve may not be used if its ability to control the flow of gas could be adversely affected by exposure to anticipated heat.
> (c) Each service-line valve on a high-pressure service line, installed above ground or in an area where the blowing of gas would be hazardous, must be designed and constructed to minimize the possibility of the removal of the core of the valve with other than specialized tools.

Underground service line valves must be located in a covered, durable curb box or standpipe that allows ready operation of the valve and is supported independently of the service lines.

Installing Excess Flow Valves

> **§ 192.381 Service lines: Excess flow valve performance standards.**
> (a) Excess flow valves to be used on single residence service lines that operate continuously throughout the year at a pressure not less than 10 p.s.i. (69 kPa) gage must be manufactured and tested by the manufacturer according to an industry specification, or the manufacturer's written specification, to ensure that each valve will:
>
> (1) Function properly up to the maximum operating pressure at which the valve is rated;
> (2) Function properly at all temperatures reasonably expected in the operating environment of the service line;
> (3) At 10 p.s.i. (69 kPa) gage:
>
> (i) Close at, or not more than 50 percent above, the rated closure flow rate specified by the manufacturer; and
> (ii) Upon closure, reduce gas flow—
>
> (A) For an excess flow valve designed to allow pressure to equalize across the valve, to no more than 5 percent of the manufacturer's specified closure flow rate, up to a maximum of 20 cubic feet per hour (0.57 cubic meters per hour); or
> (B) For an excess flow valve designed to prevent equalization of pressure across the valve, to no more than 0.4 cubic feet per hour (.01 cubic

meters per hour); and

(4) Not close when the pressure is less than the manufacturer's minimum specified operating pressure and the flow rate is below the manufacturer's minimum specified closure flow rate.

(b) An excess flow valve must meet the applicable requirements of Subparts B and D of this part.

(c) An operator must mark or otherwise identify the presence of an excess flow valve in the service line.

(d) An operator shall locate an excess flow valve as near as practical to the fitting connecting the service line to its source of gas supply.

(e) An operator should not install an excess flow valve on a service line where the operator has prior experience with contaminants in the gas stream, where these contaminants could be expected to cause the excess flow valve to malfunction or where the excess flow valve would interfere with necessary operation and maintenance activities on the service, such as blowing liquids from the line.

[Amdt. 192–79, 61 FR 31459, June 20, 1996, as amended by Amdt. 192–80, 62 FR 2619, Jan. 17, 1997; Amdt. 192–85, 63 FR 37504, July 13, 1998]

§192.383 Excess flow valve installation.

(a) Definitions. As used in this section:

Replaced service line means a gas service line where the fitting that connects the service line to the main is replaced or the piping connected to this fitting is replaced.

Service line serving single-family residence means a gas service line that begins at the fitting that connects the service line to the main and serves only one single-family residence.

(b) *Installation required.* An excess flow valve (EFV) installation must comply with the performance standards in §192.381. The operator must install an EFV on any new or replaced service line serving a single-family residence after February 12, 2010, unless one or more of the following conditions is present:

(1) The service line does not operate at a pressure of 10 psig or greater throughout the year;

(2) The operator has prior experience with contaminants in the gas stream that could interfere with the EFV's operation or cause loss of service to a residence;

(3) An EFV could interfere with necessary operation or maintenance activities, such as blowing liquids from the line; or

(4) An EFV meeting performance standards in §192.381 is not commercially available to the operator.

(c) *Reporting.* Each operator must report the EFV measures detailed in the annual report required by §191.11.

[Amdt. 192-113, 74 FR 63934, Dec. 4, 2009, as amended at 75 FR 5244, Feb. 2, 2010; 76 FR 5499, Feb. 1, 2011]

Excess flow valves (EFV) are one means to reduce the consequences of a potential accident. The valves automatically shut off the flow of gas in a service line when the gas flow in the line exceeds the rate normally experienced. Such significant increases in gas flow rate are most often caused by excavation damage that ruptures the service line downstream of the valve. Without an EFV, such damage can result in rapid accumulation of released gas and potential explosion and fire.

(1) **Action Required.** The Pipeline Inspection, Protection, Enforcement and Safety Act (PIPES Act) of 2006 mandated the PHMSA require distribution pipeline operators to include EFVs in all new and replaced single family residential gas services for which they are feasible. This requirement has been incorporated into the proposed Integrity Management (IM) Rule.

(2) **Installation of the Excess Flow Valve.**

- An operator must mark or otherwise identify the presence of an excess flow valve in the service line. The EFV manufacturer's tag can be installed on the house regulator indicating that an excess flow valve is installed.
- An operator shall locate an excess flow valve as near as practical to the fitting connecting the service line to its source of gas supply. Be sure to follow your company's policies and procedures regarding when an EFV should or should not be installed.
- An operator should not install an excess flow valve on a service line where the operator has prior experience with contaminants in the gas stream.

Connecting Service Lines to Main Piping

§ 192.367 Service lines: General requirements for connections to main piping.

(a) *Location.* Each service line connection to a main must be located at the top of the main or, if that is not practical, at the side of the main, unless a suitable protective device is installed to minimize the possibility of dust and moisture being carried from the main into the service line.

(b) *Compression-type connection to main.* Each compression-type service line to main connection must:

(1) Be designed and installed to effectively sustain the longitudinal pull-out or thrust forces caused by contraction or expansion of the piping, or by anticipated external or internal loading; and

(2) If gaskets are used in connecting the service line to the main connection fitting, have gaskets that are compatible with the kind of gas in the system.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-75, 61 FR 18517, Apr. 26, 1996]

(1) **Tap Location.** Service line connections to the main piping must be located at the top of the main. If a tap on the top of the main is not possible because of the location and cover of the main, a side installation may be required. If this is not possible, the service line must be equipped with a suitable protective device to minimize the possibility of dust and moisture being carried from the main into the service line.

(2) **Compression-Type Connections to Main.** Compression-type service lines connected to the main must be designed and installed to effectively sustain the longitudinal pull-out or thrust forces caused by contraction or expansion of the piping, or by anticipated external or internal loading. If gaskets are used in the connection of the service line to the main fitting, the gaskets must be compatible with the kind of gas in the system.

Connecting Plastic Service Lines to Mains[6]

The excavation below the plastic pipe at the main connection, as illustrated in Figure 1, should be tamped using a compactable material.

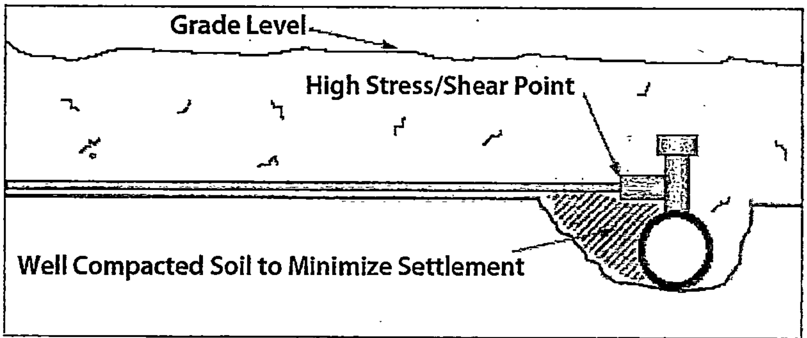

Figure 1. Point of Service Line and Main Connection

The area represented by the lines near the main and service line connection, illustrated in Figure 1, is a critical stress area. The backfill in this area should be compacted around and under the connection. Also, a protective bridging sleeve should be considered, in addition to providing adequate backfill and compaction around the transition area, to reduce excessive binding and shear stresses as illustrated in Figure 2.

[6] 49 CFR 192.361 Guide Material 3.1

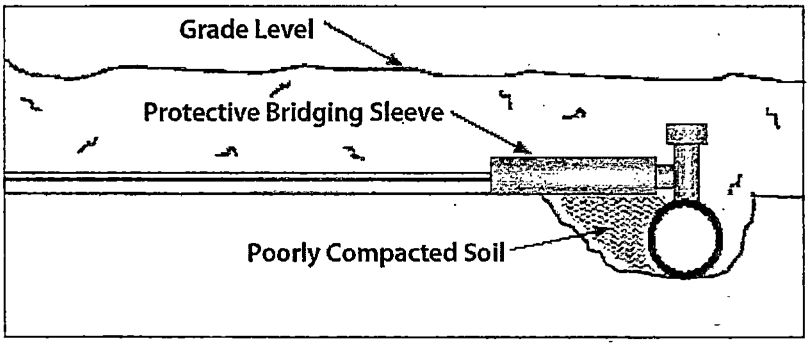

Figure 2. Point of Service Line and Main Connection with Bridge Sleeve

Connection to Cast Iron or Ductile Iron Mains

§ 192.369 Service lines: Connections to cast iron or ductile iron mains.
(a) Each service line connected to a cast iron or ductile iron main must be connected by a mechanical clamp, by drilling and tapping the main, or by another method meeting the requirements of §192.273.
(b) If a threaded tap is being inserted, the requirements of §192.151 (b) and (c) must also be met.

§ 192.373 Service lines: Cast iron and ductile iron.
(a) Cast or ductile iron pipe less than 6 inches (152 millimeters) in diameter may not be installed for service lines.
(b) If cast iron pipe or ductile iron pipe is installed for use as a service line, the part of the service line which extends through the building wall must be of steel pipe.
(c) A cast iron or ductile iron service line may not be installed in unstable soil or under a building.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192–85, 63 FR 37503, July 13, 1998]

192.151(b,c) provides specifications for the appropriate use of a threaded tap:

§ 192.151 Tapping.
(b) Where a ductile iron pipe is tapped, the extent of full-thread engagement and the need for the use of outside-sealing service connections, tapping saddles, or other fixtures must be determined by service conditions.
(c) Where a threaded tap is made in cast iron or ductile iron pipe, the diameter of the tapped hole may not be more than 25 percent of the nominal diameter of the pipe unless the pipe is reinforced, except that
(1) Existing taps may be used for replacement service, if they are free of cracks and have good threads; and
(2) A 11/4-inch (32 millimeters) tap may be made in a 4-inch (102 millimeters)

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cast iron or ductile iron pipe, without reinforcement.

However, in areas where climate, soil, and service conditions may create unusual external stresses on cast iron pipe, unreinforced taps may be used only on 6-inch (152 millimeters) or larger pipe.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-85, 63 FR 37502, July 13, 1998]

Installing Copper Service Lines

§ 192.377 Service lines: Copper.
Each copper service line installed within a building must be protected against external damage.

(1) **Location of Copper Service Lines.** Except when passing through walls and partitions, concealed locations should be avoided. When concealed locations are unavoidable, the service line should be located in hollow partitions rather than solid ones. The piping should be protected from physical damage by tools and other materials penetrating the wall or partition. Considerations should be given to appropriate guards and additional supports when an exposed service may reasonably be expected to be subject to physical damage due to normal activities in its vicinity.

(2) **Support for Copper Service Lines.** A horizontal run of service line should be supported to resist buckling or bending. The recommended maximum support spacing for commonly used tubing sizes is given in the following table.

Recommended Maximum Support Spacing for Copper Service Lines

Tube Size (OD inches)	Support Spacing (feet)
1/2	4
5/8 or 3/4	6
7/8 or 1 1/8	8

New Service Lines Not in Use

§ 192.379 New service lines not in use.
Each service line that is not placed in service upon completion of installation must comply with one of the following until the customer is supplied with gas:

(a) The valve that is closed to prevent the flow of gas to the customer must be provided with a locking device or other means designed to prevent the opening of the valve by persons other than those authorized by the operator.
(b) A mechanical device or fitting that will prevent the flow of gas must be installed in the service line or in the meter assembly.
(c) The customer's piping must be physically disconnected from the gas supply and the open pipe ends sealed.

[Amdt. 192-8, 37 FR 20694, Oct. 3, 1972]

Pressure Testing Service Lines

Before the meter loop is connected to the stop cock (lock wing valve), a service line test must be performed.

Service lines are to be tested with a minimum five-minute service line test as recommended by 49 CFR 192[7].

This test serves as a final test and qualifies the line for gas service. Conduct the five-minute service line test before backfilling. Soap test each joint during the test. Weld or fuse the service tee to the main. Do not tap the tee. Always include the service tee and meter stop valve stopcock in the test.

Recognizing and Reacting to Abnormal Operating Conditions

Note:

The following Abnormal Operating Conditions (AOCs) and their reactions listed are for guidance only. This AOC list is not presented as an exhaustive treatment of AOCs and appropriate responses. You may be required to know and apply other AOCs and AOC responses for different tasks. Properly recognizing and reacting to covered task AOCs are the responsibility of persons qualified to perform the covered task. Always follow your company's policies and procedures.

Industrial Training Services, Inc. assumes no liability for any act or act of omission performed by the person seeking qualification under the pipeline operator's OQ program, or during the actual pipeline operations of the pipeline operator or any contractor performing work on the pipeline operator's pipeline system.

[7] GPTC Guide Material Appendix G-192-10

(1) Things to Consider When Responding to Abnormal Operating Conditions. The following information is basic knowledge that will assist you in assessing and responding to abnormal operating conditions:

(a) Basic Properties of Natural Gas.

- Natural gas is lighter than air, colorless and odorless.
- Natural gas has a specific gravity of approximately 0.6.
- The natural gas Lower Explosive Limit (LEL) is approximately 5%.
- The natural gas Upper Explosive Limit (UEL) is approximately 15%.
- The ignition temperature of natural gas is about 1100°-1200° F.

(b) Eliminating Ignition Sources. Some of the ways to eliminate ignition sources are very obvious. For example:

- Do NOT smoke or use open flames near a jobsite/gas pipeline facility including structures or areas where possible leakage or presence of gas constitutes a hazard of fire or explosion, or in the open when accidental ignition of a gas-in-air mixture could cause personal injury or property damage.
- Sparks range in temperature from 1500°F in an electrical switch to 9,000°F in an arc welder. Do NOT use equipment or create situations that generate sparks. Sparks may be generated by the following conditions:

  Communication equipment
  Portable electrically powered tools and equipment
  Internal combustion engines
  Breaking electrical continuity
  Static electricity on plastic pipe

(c) Personal Protection Equipment.

Always follow your company's policies and procedures for the use of personal protection equipment (PPE).

Working around gas pipeline facilities requires practical safety practices and basic PPE may include:

- Head protection (e.g. hard hat)
- Eye and face protection (e.g. goggles, face shield, etc.)
- Hearing protection (e.g. ear plugs, ear muffs, etc.)
- Hand protection (proper glove material for the specific job)
- Respiratory protection (proper respiratory equipment when air content is insufficient)

(2) Abnormal Operating Conditions for Installing Customer Gas Service Lines.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Uncontrolled escaping gas	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Accidental ignition	• Control fire and make area safe and notify appropriate personnel
• Unacceptable visual inspection	• Repair, or do not establish service
• Unacceptable pressure test	• Repair, or do not establish service
• Installation not performed by a qualified individual	• Do not establish service and notify appropriate personnel
• Damaged pipe or coating	• Repair or replace
• Fitting defect	• Replace fitting
• Improper pipe size	• Replace pipe
• Blowing gas	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Failed pressure test	• Repair leak
• Regulator venting gas	• Make area safe

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REVIEW I

Installing Customer Gas Service Lines

Part A. Installing Service Lines

Directions: Select from the list below the response that most correctly completes each of the following statements. Write the letter of your choice in the space provided. NOTE: Some answers may be used more than once.

A. corrosion
B. 18
C. shut-off valve
D. sealed at the foundation wall
E. concealed
F. piping strain
G. shearing action and backfill settlement
H. sealed
I. free of debris
J. vented
K. rain and insect resistant fitting
L. 12
M. above ground level
N. undisturbed or well-compacted soil
O. tracer wire
P. below ground level

L 1. A buried service line must have at least _____ inches of cover in private property.

B 2. A buried service line must have at least _____ inches of cover in streets and roads.

FG + 3. All service lines must be installed to minimize anticipated _____ and external loading.

N 4. Service lines must be properly supported on _____.

I 5. To keep from harming the pipe and pipe coating, the backfill must be _____.

A 6. If the service line is metal, it must be protected against _____.

G 7. If the service line is plastic, it must be protected from _____.

O 8. Determining the location of buried plastic pipe is facilitated by the installation of ________.

L 9. "Warning Tape" is generally installed approximately _____ inches directly above plastic pipe.

J 10. The service line conduit extending outside the building must be _____ above the grade.

A. corrosion	I. free of debris
B. 18	J. vented
C. shut-off valve	K. rain and insect resistant fitting
D. sealed at the foundation wall	L. 12
E. concealed	M. above ground level
H. piping strain	N. undisturbed or well-compacted soil
I. shearing action and backfill settlement	O. tracer wire
H. sealed	P. below ground level

K 11. The service line conduit vent must be installed with a _____.

P 12. Plastic service lines outside a building must be installed _____.

Part B. Installing Service Line Valves

Directions: Select from the list below the response that most correctly completes each of the following statements. Write the letter of your choice in the space provided.

A. meter bar
B. shut-off valve
C. 10
D. soft seat service line valve
E. high-pressure service line
F. upstream
G. fitting connection at the source
H. excess flow valve
I. covered, durable curb box or standpipe

F 13. The service line valve must be installed _____ of the regulator or meter.

B 14. All service lines must be installed with a _____ in an readily accessible location and if possible, outside the building.

I 15. Underground service line valves must be located in a _____.

C 16. According to 49 CFR 192.381, an excess flow valve installed on a single residence service line operating at not less than 10 psi gauge and remains in operation throughout the year is required to function properly at _____ psi gauge.

H 17. An operator must mark or otherwise identify the presence of an _____ in the service line.

Part C. **Installing Service Lines to Main Piping**

Directions: Select from the list below the response that most correctly completes each of the following statements. Write the letter of your choice in the space provided.

A. dust and moisture
B. compatible with the gas
C. colorless and odorless
D. top of the main
E. compression-type
F. mechanical clamp
G. side of the main
H. longitudinal pull-out or thrust forces
I. opened
J. closed
K. bridging sleeve

D 18. Service line connections to the main piping must be located at the _____ if at all possible.

G 19. To comply with minimum cover requirements, the service line connection to the main piping may be at the _____.

A 20. If it is not possible to connect the service line to the main at the top or side of the main, it must be equipped with a protective device to minimize _____.

H 21. Compression-type service lines connected to the main must be designed and installed to sustain _____.

E 22. External or internal loading must be controlled in _____ connections to the main.

B 23. If gaskets are used in the connection of the service line to the main fitting, the gaskets must be _____.

F 24. A service line that is connected to a cast iron or ductile iron main must be connected by a _____.

C 25. Natural gas has a specific gravity of approximately 0.6 and is lighter than air, and is _____.

K 26. A _____ may be used at the connection of a plastic service line to a main for the purpose of protecting the service line against stress.

J 27. When new service lines are installed and are not placed in service upon completion, in order to prevent the flow of gas the valve used to prevent the flow of gas is _____.

Knowledge Verification Checklist

OQ Task CH-2
Install Customer Gas Service Lines

Directions: Use the following performance criteria statements as a self-evaluation in preparation for the final exam.

I can identify:

- ❑ 1. The correct depth to bury service lines. (CH-2.1.1)
- ❑ 2. The proper way to install service lines to minimize strain and external loading. (CH-2.1.2)
- ❑ 3. The type of soil suitable for a service line installation. (CH-2.1.3)
- ❑ 4. The appropriate type of backfill for a service line installation. (CH-2.1.4)
- ❑ 5. The special protection needed for a metal service line and a plastic service line. (CH-2.1.5)
- ❑ 6. The correct way to install a service line that is installed below grade through the outer foundation wall of a building. (CH-2.1.6)
- ❑ 7. The correct way to prevent gas leakage in the space between the conduit and the gas piping. (CH-2.1.7)
- ❑ 8. The proper way to vent the service line conduit. (CH-2.1.8)
- ❑ 9. An installation procedure used to facilitate locating of buried plastic pipe. (CH-2.1.9)
- ❑ 10. The appropriate distance "warning tape" is installed above plastic pipe. (CH-2.1.10)
- ❑ 11. The installation method used to protect plastic pipe outside buildings. (CH-2.1.11)
- ❑ 12. The correct way to install a service line valve. (CH-2.1.12)
- ❑ 13. The appropriate site to install a shut-off valve. (CH-2.1.13)
- ❑ 14. The correct way to install an underground service line valve. (CH-2.1.14)

I can identify:

- ☐ 15. The minimum operating pressure that an excess flow valve is required to operate at on single residence service lines that operate continuously throughout the year according to 49 CFR 192.381. (CH-2.1.15)
- ☐ 16. The proper procedure to identify the presence of an excess flow valve required during the installation on a service line. (CH-2.1.16)
- ☐ 17. The most appropriate place to install a service line connection to the main piping. (CH-2.1.17)
- ☐ 18. The proper place to install a service line connection to the main piping when minimum cover is required. (CH-2.1.18)
- ☐ 19. The correct way to install a service line connection to the main piping when top or side connections are not possible. (CH-2.1.19)
- ☐ 20. The proper design and installation of compression-type connections. (CH-2.1.20)
- ☐ 21. The problems that must be dealt with when installing compression-type connections to the main. (CH-2.1.21)
- ☐ 22. The type of gaskets used in compression-type connections to the main fitting. (CH-2.1.22)
- ☐ 23. The purpose of installing a bridging sleeve at the connection of a plastic service line to a main. (CH-2.1.23)
- ☐ 24. The correct way to connect a service line to a cast iron or ductile iron main. (CH-2.1.24)
- ☐ 25. An acceptable method to prevent unauthorized gas flow in new service lines that have not been placed in service. (CH-2.1.25)
- ☐ 26. The basic properties of natural gas. (CH-2.1.26)

Skill and Ability Verification Packet

OQ Task CH-2
Install Customer Gas Service Lines

I. General Instructions

Instructions for Use

The Skill and Ability Verification Packet is designed to standardize conditions under which the employee demonstrates his/her performance of tasks that meet the operator qualification requirements established by the employee's company.

Completing the enclosed affidavit and uploading the data to Industrial Training Services OnBoard LMS for recordkeeping, documents the satisfactory completion of tasks. Both the OQ Authorized Evaluator (AE) and employee must sign the affidavit.

Instructions to the Employee

Your OQ AE will check your performance using the suggested evaluator guide included in each hands-on task assignment. This suggested guide must be supplemented or replaced by the individual company's policies and procedures related to the task being evaluated.

You must adhere to all safety precautions according to your company's policies and procedures and applicable federal, state, and local codes and regulations.

II. Task Information

OQ Task CH-2:	**Install Customer Gas Service Lines**
Qualification Standard:	The employee's qualification is based on the enabling operation(s) that have been successfully completed. The operation's tasks are listed below:
OQ Task CH-2.1	Installation of Steel Pipe in a Ditch. (B31Q 0861)
OQ Task CH-2.2	Installation of Plastic Pipe in a Ditch. (B31Q 0901)
OQ Task CH-2.3	Install Tracer Wire. (B31Q 0941)
OQ Task CH-2.4	Backfilling. (B31Q 0981)
Recommended Requirement:	The employee must demonstrate proficiency to an acceptable level based on the Skill and Ability Checklist associated with each operation.
References:	49 CFR, Part 192.151, 192.361, 192.363, 192.365, 192.367 192.369, 192.373, 192.375, 192.377, 192.379, 192.381. B31Q Tasks 0861, 0901, 0941, 0981.

Note:

The following Abnormal Operating Conditions (AOCs) and their reactions listed are for guidance only. This AOC list is not presented as an exhaustive treatment of AOCs and appropriate responses. You may be required to know and apply other AOCs and AOC responses for different tasks. Properly recognizing and reacting to covered task AOCs are the responsibility of persons qualified to perform the covered task. Always follow your company's policies and procedures.

Industrial Training Services, Inc. assumes no liability for any act or act of omission performed by the person seeking qualification under the pipeline operator's OQ program, or during the actual pipeline operations of the pipeline operator or any contractor performing work on the pipeline operator's pipeline system.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Uncontrolled escaping gas	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Accidental ignition	• Control fire and make area safe and notify appropriate personnel
• Unacceptable visual inspection	• Repair, or do not establish service
• Unacceptable pressure test	• Repair, or do not establish service
• Installation not performed by a qualified individual	• Do not establish service and notify appropriate personnel
• Damaged pipe or coating	• Repair or replace
• Fitting defect	• Replace fitting
• Improper pipe size	• Replace pipe
• Blowing gas	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Failed pressure test	• Repair leak
• Regulator venting gas	• Make area safe

III. Skill and Ability Verification Checklist

OQ Task CH-2
Install Customer Gas Service Lines

I verify that **(Please Print)** ______________________________ **is qualified to perform OQ Task CH-2 according to his/her company's procedures:**

(CH-2.1) Installation of Steel Pipe in a Ditch. (0861)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Handle pipe to prevent damage.
  - Inspect slings, rollers, or installation equipment.
  - Pad boom in case pipe swings back.
  - Check pipe coating while handling.
- ☐ Visually inspect ditch.
  - Remove objects that will interfere with adequate uniform support of the pipe.
  - Verify ditch depth for coverage after pipe is installed.
  - Verify clearance on ditch sides to enable room for padding without damaging the coating.
  - Verify soil conditions will support equipment.
  - Verify ditch configuration to minimize pipe stress.
- ☐ Install pipe with firm and even support.
  - Install appropriate support (e.g., sandbags, foam, padding dirt, etc.), if necessary (e.g., uneven ditch depth, potential pipe sag, etc.).
  - Verify bends in pipe will not move during backfilling.
- ☐ Visually inspect prior to backfill to ensure the following:
  - proper installation
  - no damage occurred during installation
  - ditch still free of rocks and debris
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Improper size pipe	• Replace pipe
• Damaged pipe or pipe coating	• Repair/replace pipe or pipe coating
• MAOP factors	• Verify pressure within proper range for repair or notify proper personnel

Comments / Additional Company Procedures: ______________________________

____

____

(CH-2.2) Installation of Plastic Pipe in a Ditch. (0901)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Handle pipe to prevent damage.
  - Inspect slings, rollers, or installation equipment.
  - Pad boom in case pipe swings back.
- ☐ Visually inspect ditch to ensure it is
  - proper depth and width
  - free of rocks and debris
  - padded properly with suitable backfill material
  - able to supply firm support to installed pipe
  - constructed to fit pipe
- ☐ Visually inspect pipe for the following:
  - scrapes
  - cuts
  - gouges
  - kinks
  - bends
- ☐ Install pipe and tracer wire.
  - Ensure plastic pipe is installed to
    - minimize shear and installation stresses
    - allow for expansion and contraction
    - prevent damage to pipe
    - fit contour of ditch
  - Install tracer wire in accordance with Task 0941.
- ☐ Visually inspect installed pipe and tracer wire.
  - Inspect prior to backfill to ensure the following:
    - proper installation
    - no damage occurred during installation
    - ditch still free of rocks and debris
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Condition

Abnormal Operating Conditions

(Not limited to the examples listed below)

Recognize	React
• Improper size pipe	• Replace pipe
• Damaged pipe or pipe coating	• Repair/replace pipe or pipe coating
• Fitting defect	• Replace fitting

Comments / Additional Company Procedures:

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(CH-2.3) Install Tracer Wire. (0941)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Install tracer wire.
  - Inspect and protect wire against damage during installation.
  - Install wire in close proximity to pipe while ensuring contact with pipe is at a minimum.
  - Correctly install wire connectors.
  - Expose wires for necessary connections where applicable.
- ☐ Verify mechanical integrity and electrical continuity.
  - Test strain relief prior to backfilling.
  - Locate facility after backfill.
  - Test for electrical continuity.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Improper size pipe	• Replace pipe
• Damaged pipe or pipe coating	• Repair/replace pipe or pipe coating
• MAOP factors	• Verify pressure within proper range for repair or notify proper personnel

Comments / Additional Company Procedures:

(CH-2.4) Backfilling. (0981)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Visually inspect backfill material.
  - Remove items that may damage pipe or pipe coating (rocks, metal, masonry, frozen chunks, etc.).
  - Ensure backfill material meets standards or adheres to special instructions.
- ☐ Install pipe protective material (e.g., padding, shading, and rock shield).
- ☐ Place the backfill material around the pipe to provide firm support under and around the pipe.
  - Avoid damage to the pipe or coating.
  - Ensure the pipe is properly supported and no voids exist.
  - Layer and compact as applicable.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Condition

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Improper size pipe	• Replace pipe
• Damaged pipe or pipe coating	• Repair/replace pipe or pipe coating
• MAOP factors	• Verify pressure within proper range for repair or notify proper personnel

Comments / Additional Company Procedures:

IV. Employer Record

OQ Task CH-2

Install Customer Gas Service Lines

Employee Information (Please Print):

Name ______________________________

Last 4 Digits of Social Security Number ______________________________

Company Name ______________________________

Company Mailing Address ______________________________

City ______________________________ State __________ Zip ______________

Affidavit

I acknowledge the performance of this task is solely for the purpose of operator qualification, and is not intended to replace or modify company operating procedures or policies and may not be appropriately used in all circumstances. I acknowledge that I am responsible for recognizing hazards and abnormal conditions in my work place and must exercise care and good judgment; always using appropriate equipment, procedures and tools for tasks I perform. Industrial Training Services, Inc. assumes no liability for my actions nor for my application of the qualification performance guides used in this evaluation checklist.

Employee's Signature ______________________________ Date ______________

Evaluator Information (Please Print):

Name ______________________________

Organization/Employer ______________________________

Telephone Number ______________________________

Affidavit

I affirm that I am the person who has administered this checklist and that I have conducted this assessment with integrity. I also affirm that the above named employee is the person assessed and that the above named person performed the tasks at the indicated level.

Evaluator's Signature ______________________________ Date ______________

The employee is qualified according to company standards to perform the tasks listed below as indicated:

	Not Applicable	TASK/OPERATIONS	Method of Skill/Ability Verification Enter Number From List Below
1.	☐	(CH-2.1) Installation of Steel Pipe in a Ditch. (0861)	☐
2.	☐	(CH-2.2) Installation of Plastic Pipe in a Ditch. (0901)	☐
3.	☐	(CH-2.3) Install Tracer Wire. (0941)	☐
4.	☐	(CH-2.4) Backfilling. (0981)	☐

Method of Knowledge Verification

- Written Exam

Method of Skill/Ability Verification Observed During:

1. Performance on the Job
2. Simulation

After completion of Section IV, "Employer Record," remove section from the packet for your records. For third party verification and database reporting service, upload the data to Industrial Training Services OnBoard LMS.

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INDUSTRIAL
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DANNY SHROUT

OQ Compliance Series
Student Manual

OQ Task CL-2
v10.3

Purge Pipelines
(Small & Large Diameter)

ITS OQ Compliance Series
CL-2 Purge Pipelines (Small & Large Diameter)
V10.3

Student Manual

INTRODUCTION

The act of purging the content of a pipe or container and replacing it with another gas or liquid is an operation common to the job of a pipeliner. To ensure a successful and safe purging operation the pipeliner should have knowledge of the principles concerning the formation, analysis and control of gas mixtures. To complete this module you will be required to complete the check-out activities listed below.

OBJECTIVE

1. Purge pipelines.

CHECK-OUT ACTIVITIES

Your instructor will provide you with a list of incomplete statements related to purging pipelines and a list of responses. Select the response that most correctly completes each statement. Cut-off score is 80%. (Knowledge Verification)

Your instructor will provide you with a Skill and Ability Verification Checklist. At the appropriate time demonstrate your skill and ability by correctly performing each operation required under the task. (Skill and Ability Verification)

OQ CL-2 covers requirements indicated in the following codes/regulations:

ITS OQ Covered Task:	ASME B-31 Q*	49 CFR 192**
OQ CL-2.1 Purge – Flammable or Inert Gas	1651	192.629
OQ CL-2.2 Purge: Hazardous Liquids	1661	192.629

*ASME B31Q Covered Tasks:

1651 Purge – Flammable or Inert Gas
1661 Purge: Hazardous Liquids

**49 CFR Part 192 Covered Regulations:

49 CFR 192 covered regulations are identified within the appropriate section of this module.

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Table of Contents

INSTRUCTION SHEET I

Purging Pipelines

The process of removing the contents of a pipe or container and replacing it with another gas or liquid is referred to as purging. The purging operation of a pipeline may be described as:

- **Purging a Pipeline into Service.**[1] Replacement of the air in a closed system by an inert substance, which is in turn replaced by combustible gas, vapor, or liquid; or,

- **Purging a Pipeline Out of Service.**[2] Replacement of the normal combustible content of a closed system by an inert substance, which is in turn replaced by air.

Standards relating to the task of purging pipelines into and/or out of service are covered in 49 CFR, Part 192.629.

D.O.T. Standards

§ 192.629 Purging of pipelines.

(a) When a pipeline is being purged of air by use of gas, the gas must be released into one end of the line in a moderately rapid and continuous flow. If gas cannot be supplied in sufficient quantity to prevent the formation of a hazardous mixture of gas and air, a slug of inert gas must be released into the line before the gas.

(b) When a pipeline is being purged of gas by use of air, the air must be released into one end of the line in a moderately rapid and continuous flow. If air cannot be supplied in sufficient quantity to prevent the formation of a hazardous mixture of gas and air, a slug of inert gas must be released into the line before the air.

Isolation of Equipment/Piping[3]

When equipment or piping is to be purged it is essential for it to be isolated from the rest of the system either by blocking or by disconnecting. Isolating the section to be purged from the rest of the piping system serves two objectives:

[1] American Gas Association, Gas Engineer's Handbook (1974) p. 14/3
[2] American Gas Association, Gas Engineer's Handbook (1974) p. 14/3
[3] American Gas Association, Gas Engineer's Handbook (1974) p. 14/5

- Prevent any leakage of vapors (or air) or any out-leakage of inert gases during the purging operation; and,

- Prevent any leakage of vapors after the purging, when the equipment is out of service for inspection, repair, demolition, etc.

Hazardous Liquid Pipelines

Prior to purging a pipeline containing a hazardous liquid, the pipeline must be emptied by draining the contents. Due to potential environmental impact, the contents of the pipeline should be pumped or drained off to the lowest possible level and not allowed to empty into the environment. The contents of the pipeline should be stored in suitable storage devices such as barrels or vacuum trucks, or transferred to an active section of pipeline. At no time should a purge proceed until the section of pipeline to be purged has been emptied to the lowest possible level.

CAUTION

Care should be taken to avoid spontaneous combustion, which might occur with sludge removed from a crude oil pipeline containing significant quantities of hydrogen sulfide (sour stock). These materials may contain finely divided iron polysulfide deposits, which are combustible on exposure to air.[4] Also take note that if any hydrogen sulfide is suspected of being present, use appropriate PPE and follow your company's policies and procedures to ensure the safety of all personnel.

Once a liquid pipeline has been emptied of its contents, the process for purging the pipeline is essentially the same as a gas pipeline. However, always follow your company's policies and procedures when purging any pipeline whether it contains a hazardous liquid or gas.

Organizing the Purging Operation[5]

To ensure a successful purging operation, organization, planning, and preparation with full agreement of all concerned is essential. Listed below are factors that should be decided before starting the purging operation.

- ☑ Equipment and/or piping to be purged, and how it should be isolated.
- ☑ The purge medium to be used.
- ☑ How the purge medium is introduced into the equipment and/or piped and vented.
- ☑ Method for testing the completeness of the purge and end point to be attained.

[4] AGA, Purging Principles and Practices, American Gas Association (2001) p. A5-5
[5] American Gas Association, Gas Engineer's Handbook (1974) p. 14/4

- ☑ Selection and assignment of a responsible project supervisor and operating personnel.
- ☑ With the exception of purging service lines, document the existence of a purge plan detailing the sequence of all operations related to the purge, including the time of performance and estimated duration.
- ☑ Establish the location of the planned purge outlet(s) so that the point of discharge from the purge is located a minimum of 10 feet from adjacent buildings or points of ignition, but in all cases far enough to prevent accidental ignition or unnecessary odor from entering adjacent buildings.

Responsibility and Authority[6]

Responsibility and authority for the purging operations should be given to a person who is familiar with the properties and nature of the materials involved and the construction and function of the equipment and/or piping system to be purged. Other characteristics of the person with the responsibility and authority for the purging operations are:

- He/she should be capable of deciding how the purge should be done, judging whether it is proceeding satisfactorily, and when the purge is properly completed.
- He/she should be able to recognize and react to any hazardous conditions that might arise.
- He/she should plan and discuss the schedule of the entire operation with other personnel.

Personnel selected to aid in the purging operation should have definite responsibilities. These individuals should concentrate all their attention on their indicated duties and should not be expected to perform other tasks. Persons not involved in the purging operations must be evacuated at least 10 feet from the point of discharge or further depending on the purging operation, environmental circumstances, and atmospheric conditions.[7]

Special Precautions

In purging from combustible gas to air, especially when old piping is being purged, it should be kept in mind that purging removes only gaseous or volatile materials. Undetected liquid combustibles can be ignited by sparks carried back into the purged line when the line is cut. It is possible that solid combustible material remains in the lines after purging is completed and that auto-ignition can take place as soon as an adequate air supply is available. Deposits of iron sulfide (especially common if hydrogen sulfide has been previously present in the pipeline) and other

[6] American Gas Association, Gas Engineer's Handbook (1974) p. 14/4
[7] NFPA 54 2015 edition, Section 8.3.1.3(5)

easily oxidized materials can provide centers for auto-ignition. Therefore, special care should be exercised after purging and before such piping is entered or disassembled. Iron sulfide deposits should be kept wet to avoid auto-ignition.

General Static Electricity.[8] Static electricity is one of the most difficult ignition hazards to control. There are few operations in which it may not be present, and it is more likely when the relative humidity is low. Static electricity is generated in several ways:

- Friction
- Making and breaking of physical contact between two objects
- Passage of solids, liquids, or gases at high velocity through a small opening

Static electricity on materials that are conductors of electricity may be eliminated by grounding all machinery, pipes, and other equipment when charges may accumulate. Before severing or disconnecting a pipe, a bond wire should be attached to the metallic pipe at two points to provide a connection across the proposed severance or disconnection.

Static Electricity on Plastic Pipe.[9] This presents a different problem because the pipe is a nonconductor (dielectric) and the charge cannot be drained by a ground connection. Polyethylene pipe, for example, can gain an unbalanced static charge on its surface. The lack of conductivity in a dielectric means that each small section, if it comes in contact with another dielectric, will acquire its own local charge and potential.

Charges on plastic pipe are produced by normal handling. Contact between hands or clothing and the pipe can produce voltages of about 9kV. The charges on the human body or clothing can be produced by normal walking or by sliding down the sides of a ditch. These charges can then be transferred to the pipe. Removal of dirt and dust prior to joining can produce voltages of 14kV. Any cause of static electricity must be recognized and safely managed. Up to 5,000 volts (5kV) can be produced by pulsing gas from no flow to full flow quickly. The voltages are increased to that level by a cascading effect. The presence of particles in the gas stream, such as sand, produces charges as high as 24kV. The voltage is especially high in areas of turbulence, such as elbows. The inside of the pipe will have a charge if the outside is charged and vice versa.

Application of a wet cloth over the outside of the pipe causes an instantaneous reduction in the static charge to a value below 500 volts on both the inside and outside pipe surfaces. All pipes in the work area should be kept wet with a soapy (liquid dishwashing detergent) water solution. A soft absorbent material such as

[8] AGA, Purging Principles and Practices, American Gas Association (2001) p. 14
[9] AGA, Purging Principles and Practices, American Gas Association (2001) p. 14-15

cotton terry cloth should be made wet by submerging it in the soapy water solution and applying the wet cloth to the pipe. All pipe which may be touched by workers should be kept wet throughout work which might cause the release of gas. Leaving wet cloth on the pipe will accomplish this as long as the cloth is kept wet. [10] Follow your company's policies and procedures at all times.

Purge Area

Since combustible gas may be present in the purge area, it is essential that the purge area be open to the atmosphere. Direct communication between the purge area and the purge control point must be maintained at all times. Other precautions include: (1) Safety equipment, (2) Grounding, (3) Sources of ignition, (4) Purge stack, and (5) Sampling purged gas.

(1) **Safety Equipment.** During a purge operation you must ensure that the following safety equipment is utilized:

- Personal protective equipment used at all times
- Portable fire extinguisher located at all purge points and manned

(2) **Grounding.** Ensure all machinery; pipes, and other equipment are grounded to eliminate static charges that may accumulate.[11]

(3) **Sources of Ignition.**[12] During purging operations it is of utmost importance that all possible sources of ignition be eliminated. Categorized examples of various sources of ignition are listed below; this list is not comprehensive in any way:

- **Flames.**
  - Open lights: pilot lights, blow torches
  - Matches and cigarette lighters
  - Lanterns
  - Fire in boilers/water heaters
  - Burning material/incinerators

- **Sparks and Arc.**
  - Non-approved flashlights
  - Torch igniters
  - Sparks from engines, stacks, etc.
  - Static electricity
  - Electrical shorts
  - Lightning: a possibility miles away from precipitation

[10] AGA, Purging Principles and Practices, American Gas Association (2001) p. 14-15
[11] AGA, Purging Principles and Practices, American Gas Association (2001) p. 14
[12] AGA, Purging Principles and Practices, American Gas Association (2001) p. 13

Sparks from tools; cutting or welding equipment
Solids traveling at high velocity in pipe

- **Heated Materials.**
  Glowing metals, cinders, and filaments
  Electric lights

- **Pyrophoric Materials.**
  Materials that can ignite spontaneously in the presence of a gas-air mixture.

(4) **Purge Stack.**[13] The purge stack (vent pipe) carries gas from the equipment being purged to a point from which it can diffuse safely into the atmosphere. For outdoor discharge of purged gases, it is essential that the combustible gas be diffused into the air without hazard to the workers, the public, or property. Vertical vent stacks of sufficient height and capacity with valving to provide safe control should be used. The pipe used should be metallic and grounded at all times. Pipes 6 to 10 feet long usually suffice for most purging jobs performed on equipment located outdoors; however, you should always follow your company's specific purging procedures and consider the surrounding environment, such as sources of ignition, weather conditions, building proximities, mechanical air intake openings, etc..[14]

(5) **Sampling Purged Gas**. Control of purging operations is based on sampling and testing of the gas mixtures discharged from equipment during its purging.[15] An approved/calibrated combustible gas indicator is required to monitor the percentage of gas-in-air during a purge operation.[16] One method of establishing the end point of purging is to continue the operation until no combustible gas is present in the equipment being purged out of service or until no air is present in that being purged into service.[17]

Note:
To employees who purge house lines, the National Fuel Gas Code §8.3 Purging Requirements, have updated requirements effective 8-25-10. Large volume (over 2" pipe and/or greater than 2 psig) shall be purged to the outdoors, away from building openings and ignition sources; shall be controlled at the point of discharge with a valve; and shall be monitored with a CGI. Small volume (2" or smaller and 2 psig or less) shall be purged to the outdoors; or shall be purged to an open burner; or shall be monitored with a CGI.

[13] American Gas Association, Gas Engineer's Handbook (2008) 1st Ed. 10th printing. p. 14/6
[14] American Gas Association, Purging Principles and Practice, 3rd Ed. (2001) pgs 15, 64.
[15] American Gas Association, Gas Engineer's Handbook (2008) 1st Ed. 10th printing. p. 14/10
[16] NFPA 54, 2015 edition, Section 8.3.1.3(3)
[17] American Gas Association, Gas Engineer's Handbook (2008) 1st Ed. 10th printing. p. 14/8

Recognize and React to Abnormal Operating Conditions

Note:

The following Abnormal Operating Conditions (AOCs) and their reactions listed are for guidance only. This AOC list is not presented as an exhaustive treatment of AOCs and appropriate responses. You may be required to know and apply other AOCs and AOC responses for different tasks. Properly recognizing and reacting to covered task AOCs are the responsibility of persons qualified to perform the covered task. Always follow your company's policies and procedures.

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(1) **Things to Consider When Responding to Abnormal Operating Conditions.** The following information is basic knowledge that will assist you in assessing and responding to abnormal operating conditions:

(a) **Basic Properties of Natural Gas.**

- Natural gas is lighter than air, colorless and odorless.
- Natural gas has a specific gravity of approximately 0.6.
- The natural gas Lower Explosive Limit (LEL) is approximately 5%.
- The natural gas Upper Explosive Limit (UEL) is approximately 15%.
- The ignition temperature of natural gas is about 1100°-1200° F.

(b) **Eliminating Ignition Sources.** Some of the ways to eliminate ignition sources are very obvious. For example:

- Smoking and open flames should be prohibited in structures or areas containing gas facilities where possible leakage or presence of gas constitutes a hazard of fire or explosion.
- Smoking and open flames should be prohibited in the open when accidental ignition of a gas-in-air mixture could cause personal injury or property damage.
- Do NOT smoke or use open flames near a jobsite/gas pipeline facility.
- Sparks range in temperature from 1500°F in an electrical switch to 9,000°F in an arc welder. Do NOT use equipment or create situations that generate sparks. Sparks may be generated by the following conditions:

  Communication equipment
  Portable electrically powered tools and equipment
  Internal combustion engines

Breaking electrical continuity
Static electricity on plastic pipe

(c) **Personal Protection Equipment.**

Always follow your company's policies and procedures for the use of personal protection equipment (PPE).

Working around gas pipeline facilities requires practical safety practices and basic PPE may include:

- Head protection (e.g., hard hat)
- Eye and face protection (e.g., goggles, face shield)
- Hearing protection (e.g., ear plugs, ear muffs)
- Hand protection (proper glove material for the specific job)
- Respiratory protection (proper respiratory equipment when air content is insufficient)

(2) Abnormal Operating Conditions for Purging.

For All Purging and Isolating, Deactivating, and Abandoning Pipeline Facility Tasks
Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Flammable gas atmosphere	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Blowing/escaping gas/grade one leak	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Fire on a pipeline	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Odor complaint	• Conduct leak investigation
• Low oxygen atmosphere	• Use suitable PPE; monitor atmosphere with a company approved detector/analyzer; ventilate or use SCBA
• Water or other liquids in the pipeline	• Determine the type of liquid; treat as combustible until identification is made; confirm proper pipeline location; report; if possible locate source of liquid and start remediation if authorized
• Low flow/Low pressure	• For compressed air or inert gas purging—check supply and pressure regulators; for combustible gas—check valves; record, report and communicate low flow/pressure to measurement & regulation personnel; delay purging operations until condition is corrected
• Under Odorization	• Record and report; follow up with Odorization personnel
• Leakage	• Make area safe; protect life and property; evacuate if necessary; notify proper personnel; repair leak
• Moisture or other contaminants	• Pig; repeat purging; consider dehydrating agent

REVIEW I

Purging Pipelines

Directions: Select from the list below the response, which most correctly completes each of the following statements. Write the letter of your choice in the space provided. Some answers may be used more than once.

A. static electricity
B. 15%
C. metallic and grounded
D. grounding
E. gaseous
F. nonconductor
G. before the gas
H. after the gas
I. open
J. 10
K. isolated
L. no combustible gas is present in the discharge
M. purge medium to be used
N. hazardous liquid pipeline

E 1. In purging combustible gas to air, especially in old piping, purging removes only _____ materials.

A 2. The most difficult ignition hazard to control is _____.

D 3. Static electricity on materials that are conductors of electricity may be eliminated by _____.

F 4. Polyethylene pipe cannot be drained of static electricity with a ground connection, therefore it is known as a _____.

B 5. Natural gas is odorless, colorless, lighter than air, and has an upper explosive limit (UEL) of _____ .

C 6. Purge stacks should be _____.

10 J 7. Persons not involved in the purge operation must be evacuated from all areas within a distance of _____ feet from the purge.

L 8. When purging a pipeline out of service, one method for determining when a purge operation is complete is to verify _____ using a CGI.

K 9. Before a section of pipeline is purged, it is _____ to prevent any leakage of vapors during the purge operation.

J 10. The point of discharge from a purge should be located a minimum of _____ feet, from any source of ignition or building opening.

A.	static electricity	I.	open
B.	15%	J.	10
C.	metallic and grounded	K.	isolated
D.	grounding	L.	no combustible gas is present in the discharge
E.	gaseous	M.	purge medium to be used
F.	nonconductor	N.	hazardous liquid pipeline
G.	before the gas		
H.	after the gas		

m 11. Before starting a purging operation a factor to be decided is the _____ because that affects the method used for testing the completion of the purge.

G 12. When purging a section of pipeline with gas, if gas cannot be supplied in sufficient quantity to prevent the formation of a gas-air mixture, an action to take is release a slug of inert gas in the pipeline _____.

N 13. When preparing to purge a _____, it is important to first drain the pipe contents before proceeding with the purging operation.

Directions: Match the appropriate reaction with the abnormal operating condition and write your choice in the space provided.

	AOC:	**Appropriate Reaction:**
C 14.	Low oxygen atmosphere	A. Determine type of liquid and treat as combustible until identified; report, locate source and start remediation if authorized.
A 15.	Water or other liquids in the pipeline	B. If compressed air or inert gas purging, check supply and pressure regulators; if combustible gas purge, check valves; report to appropriate personnel; delay purging operations until corrected.
B 16.	Low flow or low pressure	C. Use suitable PPE, monitor the atmosphere, ventilate or use SCBA.

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Knowledge Verification Checklist

OQ Task CL-2
Purge Pipelines (Small & Large Diameter)

Directions: Use the following performance criteria statements as a self-evaluation in preparation for the final exam.

I can identify:

- ❒ 1. An action to take if gas cannot be supplied in sufficient quantity to prevent the formation of a hazardous mixture of gas-in-air when purging a section of pipeline with gas. (CL-2.1.1)
- ❒ 2. An objective for isolating a section of pipeline before it is purged. (CL-2.1.2)
- ❒ 3. A procedure that must be performed prior to purging a hazardous liquid pipeline. (CL-2.1.3)
- ❒ 4. Factors to be decided before starting a purging operation. (CL-2.1.4)
- ❒ 5. The distance the point of discharge from a purge should be located from any sources of ignition and building openings. (CL-2.1.5)
- ❒ 6. The distance persons not involved in the purge operation must be evacuated from the point of discharge. (CL-2.1.6)
- ❒ 7. What is removed when purging combustible gas to air. (CL-2.1.7)
- ❒ 8. The most difficult ignition hazard to control. (CL-2.1.8)
- ❒ 9. How to eliminate static electricity on materials that are conductors of electricity. (CL-2.1.9)
- ❒ 10. Why polyethylene pipe cannot be drained of static electricity with a ground connection. (CL-2.1.10)
- ❒ 11. The material that a purge stack should be constructed from. (CL-2.1.11)
- ❒ 12. The percent of fuel gas-in-air that should be present when a purge operation is stopped. (CL-2.1.12)
- ❒ 13. The basic properties of natural gas. (CL-2.1.13)
- ❒ 14. The proper reaction to a low oxygen atmosphere. (CL-2.1.14)

Skill and Ability Verification Packet

OQ Task CL-2
Purge Pipelines (Small & Large Diameter)

I. General Instructions

Instructions for Use

The Skill and Ability Verification Packet is designed to standardize conditions under which the employee demonstrates his/her performance of tasks that meet the operator qualification requirements established by the employee's company.

Completing the enclosed affidavit and uploading the data to Industrial Training Services OnBoard LMS for recordkeeping, documents the satisfactory completion of tasks. Both the OQ Authorized Evaluator (AE) and employee must sign the affidavit.

Instructions to the Employee

Your OQ AE will check your performance using the suggested evaluator guide included in each hands-on task assignment. This suggested guide must be supplemented or replaced by the individual company's policies and procedures related to the task being evaluated.

You must adhere to all safety precautions according to your company's policies and procedures and applicable federal, state, and local codes and regulations.

II. Task Information

OQ Task CL-2: **Purge Pipelines (Small & Large Diameter)**

Qualification Standard: The employee's qualification is based on the enabling operation(s) that have been successfully completed. The operation's tasks are listed below:

OQ Task CL-2.1 Purge – Flammable or Inert Gas. (B31Q 1651)

OQ Task CL-2.2 Purge: Hazardous Liquids. (B31Q 1661)

Recommended Requirement: The employee must demonstrate proficiency to an acceptable level based on the Skill and Ability Checklist associated with each operation.

References: 49 CFR, Part 192.629.
B31Q Tasks 1651, 1661.

Note:

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Abnormal Operating Conditions

(Not limited to the examples listed below)

Recognize	React
• Flammable gas atmosphere	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Blowing/escaping gas/grade one leak	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Fire on a pipeline	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Odor complaint	• Conduct leak investigation
• Low oxygen atmosphere	• Use suitable PPE; monitor atmosphere with a company approved detector/analyzer; ventilate or use SCBA
• Water or other liquids in the pipeline	• Determine the type of liquid; treat as combustible until identification is made; confirm proper pipeline location; report; if possible locate source of liquid and start remediation if authorized
• Low flow/Low pressure	• For compressed air or inert gas purging—check supply and pressure regulators; for combustible gas—check valves; record, report and communicate low flow/pressure to measurement & regulation personnel; delay purging operations until condition is corrected
• Under Odorization	• Record and report; follow up with Odorization personnel
• Leakage	• Make area safe; protect life and property; evacuate if necessary; notify proper personnel; repair leak
• Moisture or other contaminants	• Pig; repeat purging; consider dehydrating agent

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III. Skill and Ability Verification Checklist

OQ Task CL-2
Purge Pipelines (Small & Large Diameter)

I verify that (Please Print) ______________________________________ is qualified to perform OQ Task CL-2 according to his/her company's procedures:

(CL-2.1) Purge – Flammable or Inert Gas. (1651)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Identify and verify valves/control methods on pipeline facilities are in correct position.
  - Ensure direction of flow for purge.
  - Ensure segment to be purged is bonded as required.
  - Isolate the pipeline sections to be purged, where required.
  - Ensure gauges are set as specified by procedure.
- ☐ Verify adequate handling capability for purge (flares, silencers, stacks, etc.), if required.
  - Monitor weather conditions to ensure safe environment for the purge.
  - Establish use of flares, silencers, stacks, etc., as specified by procedure(s) when applicable.
- ☐ Ensure proper placement and grounding of air handler(s) as specified by procedure, if required.
- ☐ Perform purge.
  - Open control point valve.
  - Establish purge pressure as specified by procedure and purge plan, if applicable.
- ☐ Verify the pipeline facilities have been purged of all air or hazardous vapors by use of an acceptable instrument.
  - Sample air at purge outlet with use of calibrated equipment.
  - Continue purge as specified by procedure and purge plan, if applicable.
  - Upon successful purge, close all purge points as specified by procedure.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Condition

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	**React**
• Accidental ignition	• Evacuate to safe area; establish and maintain safe area
• Sudden decrease in flow rate	• Inspect for factors that may affect flow rate

Comments / Additional Company Procedures:

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(CL-2.2) Purge: Hazardous Liquids. (1661)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Identify the requirements for purging hazardous liquids from pipeline facilities.
  - Determine what method of product isolation will be used.
- ☐ Identify the correct valves for isolating the segment of pipeline to be purged.
  - Ensure each valve identified for isolation is in its correct position, open or closed.
  - Ensure all appropriate lockout/tagout procedures and permitting are followed.
  - Identify pipeline condition-monitoring points to determine tight shut-off of isolation valves.
  - Ensure pipeline condition-monitoring points indicate the pipeline is empty and no residual product remains.
- ☐ Ensure the identification of any drain-down equipment has been made and the equipment is staged correctly for the purging process.
  - Locate low-point drain connections as required to evacuate any remaining product.
  - Install any low-point drain connections as required to evacuate any remaining product.
  - Ensure all connecting components are compatible with the product in the pipeline being purged.
  - Ensure any flaring equipment is properly located and configured to process pipeline product as it exits the pipeline.
- ☐ Following the purging procedure for the pipeline facilities being purged, perform the following procedure:
  - Properly monitor the pipeline facility operating conditions to determine the extent of the purge.
  - Ensure all temporary connections are leak free.
  - Ensure any temporary product tankage is monitored for proper level and pressure.
- ☐ Using the drain connections, ensure all product has been purged from the pipeline.
  - Using operating condition-monitoring equipment (pressure and temperature indicators), verify all product is purged from the pipeline segment.
  - Isolate the segment being purged, and monitor pressures and temperatures to determine if any trapped product remains in the pipeline.
  - Ensure proper use of flammable mixture detectors is followed to ensure the purge material doesn't interfere with the detector's operation.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Operating Conditions

(Not limited to the examples listed below)

Recognize	React
• Accidental ignition	• Evacuate to safe area; establish and maintain safe area
• Sudden decrease in flow rate	• Inspect for factors that may affect flow rate

Comments / Additional Company Procedures:

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IV. Employer Record

OQ Task CL-2

Purge Pipelines (Small & Large Diameter)

Employee Information (Please Print):

Name ____

Last 4 Digits of Social Security Number ________________________

Company Name ____

Company Mailing Address ________________________________

City ____________________ State __________ Zip ______________

Affidavit

I acknowledge the performance of this task is solely for the purpose of operator qualification, and is not intended to replace or modify company operating procedures or policies and may not be appropriately used in all circumstances. I acknowledge that I am responsible for recognizing hazards and abnormal conditions in my work place and must exercise care and good judgment; always using appropriate equipment, procedures and tools for tasks I perform. Industrial Training Services, Inc. assumes no liability for my actions nor for my application of the qualification performance guides used in this evaluation checklist.

Employee's Signature ____________________ Date ______________

Evaluator Information (Please Print):

Name ____

Organization/Employer ________________________________

Telephone Number ____________________________________

Affidavit

I affirm that I am the person who has administered this checklist and that I have conducted this assessment with integrity. I also affirm that the above named employee is the person assessed and that the above named person performed the tasks at the indicated level.

Evaluator's Signature ____________________ Date ______________

The employee is qualified according to company standards to perform the tasks listed below as indicated:

	Not Applicable	TASK/OPERATIONS	Method of Skill/Ability Verification Enter Number From List Below
1.	☐	(CL-2.1) Purge – Flammable or Inert Gas. (1651)	☐
2.	☐	(CL-2.2) Purge: Hazardous Liquids. (1661)	☐

Method of Knowledge Verification

- Written Exam

Method of Skill/Ability Verification Observed During:

1. Performance on the Job
2. Simulation

After completion of Section IV, "Employer Record," remove section from the packet for your records. For third party verification and database reporting service, upload the data to Industrial Training Services OnBoard LMS.

INDUSTRIAL
TRAINING SERVICES

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INDUSTRIAL
TRAINING SERVICES

DANNY SHROUT

OQ Compliance Series
Student Manual

OQ Task CI-1
v12.2

Perform Pipe-to-Soil Potential Surveys on Effectively Coated, Buried, or Submerged Pipelines

ITS OQ Compliance Series
CI-1 Perform Pipe-to-Soil Potential Surveys on Effectively Coated, Buried, or Submerged Pipelines
v12.2

Student Manual

INTRODUCTION

Operators of natural gas facilities use effective and practical methods to evaluate and monitor cathodically protected pipelines. These methods may vary depending on the type and location of facilities. It is essential for natural gas employees to understand the basic concepts of monitoring these protected pipelines. To complete this module you will be required to complete the check-out activities listed below.

OBJECTIVE

1. Perform pipe-to-soil potential surveys on effectively coated buried or submerged pipelines.

CHECK-OUT ACTIVITIES

Your instructor will provide you with a list of incomplete statements related to performing pipe-to-soil potential surveys on effectively coated buried or submerged pipelines and a list of responses. Select the response that most correctly completes each statement. Cut-off score is 80%. (Knowledge Verification)

Your instructor will provide you with a Skill and Ability Verification Checklist. At the appropriate time demonstrate your skill and ability by correctly performing each operation required under the task. (Skill & Ability Verification)

OQ CI-1 covers requirements indicated in the following codes/regulations:

ITS OQ Covered Task:	ASME B-31 Q*	49 CFR 192**
OQ CI-1.1 Measure Structure to Electrolyte Potential	0001	192.463

***ASME B31Q Covered Tasks:**

0001 Measure Structure to Electrolyte Potential.

****49 CFR Part 192 Covered Regulations:**

49 CFR 192 covered regulations are identified within the appropriate section of this module.

PLEASE READ – INDUSTRIAL TRAINING SERVICES, INC. DISCLAIMERS – PLEASE READ

Table of Contents

INSTRUCTION SHEET I

Performing Pipe-to-Soil Potential Surveys on Effectively Coated Buried or Submerged Pipelines

The majority of testing related to corrosion control of buried pipelines and other metallic structures is generally in the following areas:

- Application of cathodic protection for both new and existing structures
- Evaluation, inspection, and monitoring of installed systems
- Investigations of deficient systems

Corrosion control personnel performing measurement and analysis of cathodic protection field test data must have a working knowledge of field measurement techniques. The ability to detect and analyze abnormal conditions in the application of cathodic protection systems, or in unprotected operating systems while taking field measurements, is necessary to define and correct problems.

The pipe-to-soil potential measurement is one of the standard techniques employed by corrosion personnel in underground corrosion work. The purpose of the following information is to review the process of performing pipe-to-soil potential surveys to determine if cathodic protection is adequate.

Pipe-to-soil potential readings are measurements of the voltage between an underground metallic structure and a reference electrode (half-cell) in contact with the soil. These readings are used to determine the areas of a structure experiencing corrosion and the effectiveness of cathodic protection on a structure.

A steel structure in contact with moisture in the soil is more negative with respect to a copper-copper sulfate reference electrode (half-cell), but the question is how negative does it have to be in order to resist corrosion. The criteria for the cathodic protection of steel, cast iron, and ductile iron structures when using pipe-to-soil measurements is a negative voltage of at least -0.85 volt, with reference to a standard copper-copper sulfate half cell.[1]

[1] CFR 192, Subpart I- Requirements for Corrosion Control. Appendix D.

D.O.T. Regulation

§ 192.463 External corrosion control: Cathodic protection.

(a) Each cathodic protection system required by this subpart must provide a level of cathodic protection that complies with one or more of the applicable criteria contained in appendix D of this part. If none of these criteria is applicable, the cathodic protection system must provide a level of cathodic protection at least equal to that provided by compliance with one or more of these criteria.

(b) If amphoteric metals are included in a buried or submerged pipeline containing a metal of different anodic potential—

(1) The amphoteric metals must be electrically isolated from the remainder of the pipeline and cathodically protected; or

(2) The entire buried or submerged pipeline must be cathodically protected at a cathodic potential that meets the requirements of appendix D of this part for amphoteric metals.

(c) The amount of cathodic protection must be controlled so as not to damage the protective coating or the pipe.

*An amphoteric metal is one which is susceptible to corrosion in both acidic and alkali soil environments. They are often more susceptible to corrosion and can sometimes function as an anode or cathode depending on the soil environment.

Pipe-to-Soil Potential Measurements

The electrical potential between the pipe and its environment may be obtained with a suitable instrument by using an electrically stable reference electrode.

Contact is made to the earth or ground with a device called an electrode. It is usually a bakelite or plastic tube with a porous plug in the bottom to allow a liquid to seep out slowly.

The electrode used in pipeline corrosion investigation is called a copper-to-copper sulfate half-cell, as illustrated in Figure 1. The abbreviation generally used is $CuSO_4$ electrode. It might also be technically labeled $Cu|CuSO_4$ (note the bar between the two Cu's).

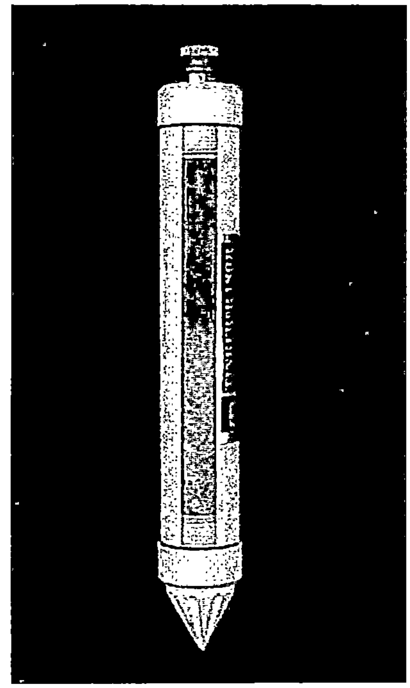

Figure 1. Copper-Copper Sulfate Half-Cell

To measure the electrical potential of a pipeline, the half-cell is placed on wet ground to ensure good contact. Errors in the potential reading will result due to high resistance if there is poor electrical contact between the ground and plug. Always loosen the soil, wet with ordinary water, and force the half-cell into the soil. An error may still be introduced and is somewhat compensated by proper selection of the instrument.

When the pipe is coated, moisture in the soil penetrates the areas where breaks or holidays exist and where large chunks of coating are missing. The moisture in the soil makes contact with the bare steel pipe. Galvanic cells or batteries are set up and the process of corrosion begins. The soil is made up of many different elements and products. When connected to the pipe through moisture, these products cause a current to flow from the pipe and a natural potential is produced.

The pipe-to-soil potential can be measured anywhere along the pipeline by placing the half-cell in contact with the ground, contacting the pipe, and connecting it to a proper instrument. The catch is that the pipe is buried and contact to the pipe is not always easy. The preferred method is to uncover the pipeline at predetermined locations, remove a small area of the coating, and permanently attach a wire. The pipe is then recoated and the wire is brought to the surface and attached to a test station. A copper wire, such as a No. 12 plastic covered copper wire, is generally used for this purpose.

Depending upon the diameter of the pipeline, condition of coating, nearness of other pipelines or structures, and other factors, these wires are spaced at intervals from a few feet to a mile or so apart. Each specific pipeline must have its own design as to the location and number of test wires or test stations required.

The half-cell in Figure 2 can be moved along the pipeline at varying intervals of a few inches or several feet. Pipe-to-soil potentials are observed and will reflect a general idea of corrosion occurring on the pipe in the area of the electrode location. When properly interpreted, pipe-to-soil potentials can help determine where corrosion may be occurring and the effectiveness of cathodic protection applied to a bare or coated pipeline.

Procedural Condition for Performing Pipe-to-Soil Measurements

If we connect a voltmeter between the structure (pipe) and the buried half-cell ($Cu/CuSo_4$), a reading of -0.85 volts or slightly more negative (-0.90 volts) would indicate full cathodic protection. This means that the structure (pipe) potential is -0.85 volts with respect to the copper-copper sulfate half-cell.

The minimum value of -0.85 volts for protected steel is based on the value of -0.80 volts which denotes the most anodic (negative) areas on steel pipe in most soils and waters. For routine potential measurements, it is not practical to excavate close to the pipeline so that the half-cell can be placed at a pipe depth slightly above the pipeline. For this reason, the acceptable approach is to locate the half-cell in contact with the ground, directly above the pipeline.

Before performing a pipe-to-soil potential measurement, it is important that certain procedural conditions be reviewed. The conditions for pipe-to-soil measurements should be obtained using the following:

High resistance (impedance) voltmeter

- A high resistance voltmeter, such as 10,000 ohm, is recommended and will provide the most accurate potential reading.

Calibrated copper-copper sulfate reference electrode

- The half-cell should be cleaned with distilled water and filled with saturated copper sulfate solution and crystals.

Electrolyte present over the pipe where the reference electrode can be placed	• The preferred electrolyte for the placement of the reference electrode is soil, moistened concrete, or water, but not asphalt.
Method by which to contact the structure under test	• The preferred connection to the pipeline under test is made through a test wire. A valve, service riser, or pipe may also be used. Any point electrically continuous with that part of the pipeline being evaluated is acceptable.

Performing Pipe-to-Soil Potential Measurements

The following steps are presented as a general basic guideline. Always remember to follow your company's policies and procedures and manufacturer's instructions when performing this task.

Step 1: Locate and electrically isolate (if necessary) the piping to be surveyed.

- In order to ensure the accuracy of an over-the-line measurement, the pipeline should be first electronically located and staked out. This will help to ensure the potential measurements are taken directly over the pipeline.
- Ensure the pipeline being tested is electrically continuous for the length of the pipe being surveyed.

Step 2: Locate (or install) the test points.

- The electrical contact to the pipeline is made through a test lead or other suitable connection point.

Step 3: Turn on and adjust the setting to volts DC on a standard voltmeter.

Step 4: Follow your company's procedures and the operating instructions for your specific meter. Connect voltmeter to a test point on the pipe and to the half-cell.

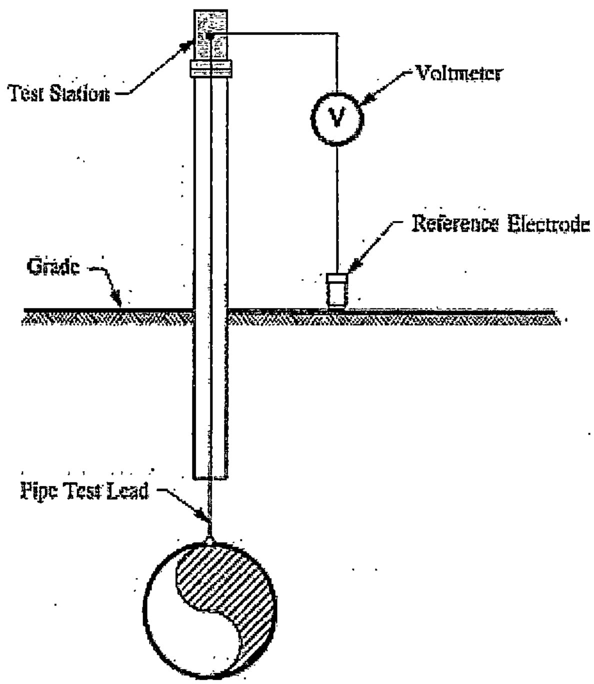

Figure 2. Connecting the Voltmeter to Measure Pipe-to-Soil Potentials

Notes:
Caution must be used when obtaining measurements by means of mechanical connections due to possible high resistance contacts. Certain connection points such as meter risers should be checked to ensure they are electrically continuous with the pipeline or structure of interest.

- The half-cell is placed directly over or as close as practical to the pipeline or structure of interest. The half-cell must have good electrical contact with the soil as high resistance in the contact may occur. This may require removal of sod, gravel, etc. For extremely dry soil, the area immediately around the point of contact between the half-cell and the soil may need to be saturated with water to reduce the contact resistance.

Step 5: Read and record voltage measurements between the pipe and soil at identified intervals.

- It is important to note that **consistency** is critical when taking measurements and recording these potential values (whether it is a negative or positive value).

Step 6: Review the pipe-to-soil potential voltages (data) collected during the survey to determine if the pipe is adequately protected from corrosion.

Copper-Copper Sulfate Half-Cell

A widely used reference electrode for cathodic protection application is the copper-copper sulfate half-cell. Figure 3 is an example of a typical copper-copper sulfate half-cell with a Bakelite, or plastic tube, and porous plug in the bottom to allow liquid to seep out slowly. A copper rod is used to establish electrical contact with a solution. Pure (chemically pure) copper sulfate crystals are dissolved in distilled water in a quantity sufficient to make a saturated solution and placed in the half-cell. Copper sulfate is selected because it is stable and generally unaffected by the electric currents. Good electrical continuity through the half-cell is essential.

A half-cell is usually a plastic tube with a clear vertical window to allow observation of the level of liquid. A copper rod is attached to a screwed cap and inserted into the tube. Electrical connections are made to the copper rod. The other end of the tube has a porous ceramic or wooden (birch) plug inserted as illustrated in Figure 4. An appropriate plastic or rubber cap is placed over the porous plug when the half-cell is not in use as illustrated in Figure 5.

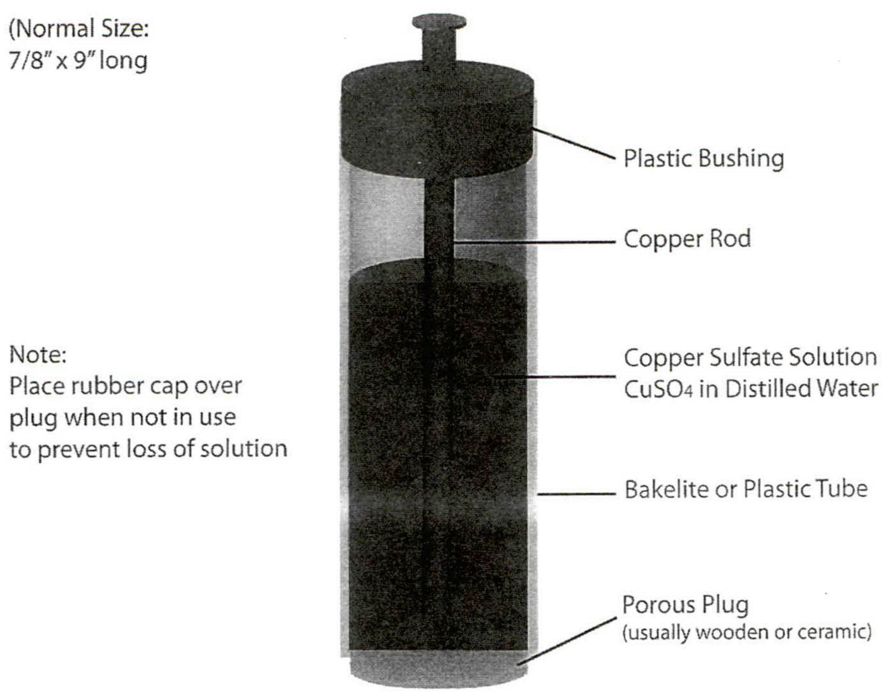

Figure 3. Copper-Copper Sulfate Half-Cell

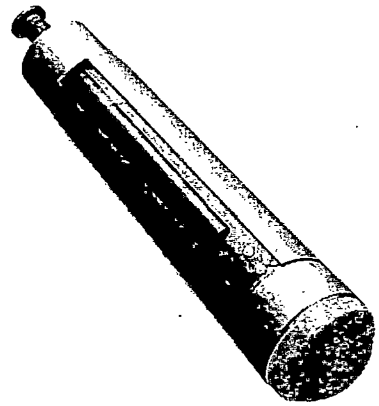

Figure 4. Copper-Copper Sulfate Half-Cell w/porous plug

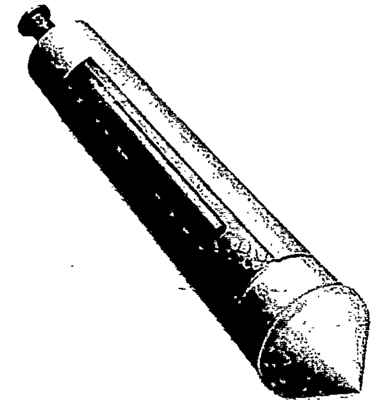

Figure 5. Copper-Copper Sulfate Half-Cell w/rubber cap

(1) Preparing New Copper-Copper Sulfate Half-Cells.

Step 1: Remove plastic cap and copper rod assembly as illustrated in Figure 6.

- Do not remove copper-sulfate crystals from the plastic tube (unless crystals are contaminated).

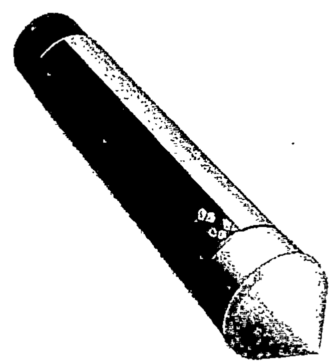

Figure 6. Remove Plastic Cap and Copper Rod Assembly

Step 2: Fill tube with previously prepared super-saturated copper-sulfate solution.

- Special pre-mixed copper sulfate antifreeze solution may also be used to fill the half-cell. DO NOT USE AUTO TYPE ANTIFREEZE OR ALCOHOL.
- DO NOT add distilled water to crystals in plastic tube (half-cell). Add only pre-mixed saturated copper-sulfate solution.

Step 3: After adding solution, replace the plastic cap and copper rod assembly and shake the filled plastic tube to ensure a saturated solution. Some crystals should remain in bottom of tube. The observation of some crystals remaining after the tube has been sufficiently shaken serves to confirm that the solution inside is, in fact, saturated.

Step 4: Allow sufficient time for solution to soak through porous plug (approximately one hour or more) before using half-cell.

(2) **Instructions for Using Copper-Copper Sulfate Half-Cells.** Always follow the manufacturer's instructions and your company's policies and procedures when using copper-copper sulfate half-cells.

Step 1: Remove protective cap from porous plug at bottom end of half-cell.

Step 2: Place porous plug in contact with moist soil or water.

Step 3: Connect the half-cell to the voltmeter with #18 A.W.G. (or larger) test wire.

Step 4: After using the half-cell, replace protective cap on lower end of electrode and store in upright position until next use.

> **Notes:**
>
> In winter, store half-cell in a warm place and use antifreeze type copper-sulfate solution only. (The solution must usually be ordered.)
>
> When a half-cell plug is used frequently in water or very wet soil, it can become contaminated. Soak the plug in copper-sulfate solution overnight.
>
> Half-cells frequently submersed in water should always be completely full of clean solution and crystals. Use special cap with attached test lead for water use. Change solution and crystals frequently.
>
> Half-cells in which the solution has been allowed to freeze may cause the tube or plug to crack, allowing contamination.

(3) Maintaining the Copper-Copper Sulfate Half-Cell.

- Add saturated copper-sulfate solution to make-up for evaporation losses. There should be undissolved crystals in the half-cell tube. Never add distilled water directly to the half cell.

- Half-cells used under average conditions should have solution and crystals changed every two to three months. Change more often if needed when used in seawater or rivers. Polish the copper rod with a company-approved abrasive material, such as a Scotch-Brite™ pad.

- Keep protective cap over the porous plug when not in use. This will keep the solution from evaporating and the half-cell from drying out.

- Antifreeze copper-sulfate solution can be used all year.

- When solution is prepared by user, use chemically pure copper-sulfate (drugstore grade) and distilled water. Mix prior to putting into electrode. Add saturated solution and crystals to electrode.

- Store the half-cell in a plastic container with the plug down so spilled solution will not come in contact with anything that could be damaged. Label containers of saturated copper sulfate solution and store in a safe place. Discard old solution carefully at an authorized location.

- Change out the porous plug when contaminated or broken, or replace the half-cell entirely.

Recognizing and Reacting to Abnormal Operating Conditions

Note:

The following Abnormal Operating Conditions (AOCs) and their reactions listed are for guidance only. This AOC list is not presented as an exhaustive treatment of AOCs and appropriate responses. You may be required to know and apply other AOCs and AOC responses for different tasks. Properly recognizing and reacting to covered task AOCs are the responsibility of persons qualified to perform the covered task. Always follow your company's policies and procedures.

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(1) **Things to Consider When Responding to Abnormal Operating Conditions.** The following information is basic knowledge that will assist you in assessing and responding to abnormal operating conditions:

(a) **Basic Properties of Natural Gas.**

- Natural gas is lighter than air, colorless and odorless.
- Natural gas has a specific gravity of approximately 0.6.
- The natural gas Lower Explosive Limit (LEL) is approximately 5%.
- The natural gas Upper Explosive Limit (UEL) is approximately 15%.
- The ignition temperature of natural gas is about 1100°-1200° F.

(b) **Eliminating Ignition Sources.** Some of the ways to eliminate ignition sources are very obvious. For example:

- Smoking and open flames should be prohibited in structures or areas containing gas facilities where possible leakage or presence of gas constitutes a hazard of fire or explosion.
- Smoking and open flames should be prohibited in the open when accidental ignition of a gas-in-air mixture could cause personal injury or property damage.
- Do NOT smoke or use open flames near a job site or gas pipeline facility.
- Sparks range in temperature from 1500°F in an electrical switch to 9,000°F in an arc welder. Do NOT use equipment or create situations that generate sparks. Sparks may be generated by the following conditions:
  Communication equipment
  Portable electrically powered tools and equipment
  Internal combustion engines
  Breaking electrical continuity
  Static electricity on plastic pipe

(c) **Personal Protection Equipment.**

Always follow your company's policies and procedures for the use of personal protection equipment (PPE).

Working around gas pipeline facilities requires practical safety practices and basic PPE may include:

- Head protection (e.g. hard hat)
- Eye and face protection (e.g. goggles, face shield, etc.)
- Hearing protection (e.g. ear plugs, ear muffs, etc.)
- Hand protection (proper glove material for the specific job)
- Respiratory protection (proper respiratory equipment when air content is insufficient)

(2) Abnormal Operating Conditions for all Corrosion Tasks.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Blowing/escaping/grade one leak	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Fire on a pipeline	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Odor complaint	• Conduct a leak investigation
• Improper voltage reading, for example extremely high or low voltage reading or meter reading fluctuates while trying to take a pipe-to-soil reading	• Check all connections in the reading circuit for high resistance. Check half-cell solution and wet ground for better contact. If condition persists, notify proper personnel.
• No reading	• Check volt meter
• Shorts with foreign structures	• Locate and clear shorts and/or notify proper personnel
• External corrosion on exposed pipe	• Repair or replace as needed or report condition to the proper personnel.
• Inoperable/Failure of a test station	• Locate break in wiring or connection; check for continuity after making repairs
• Stray current on pipeline	• Notify proper personnel. Determine the source of the stray current, locate the current pick up and discharge points, notify the party responsible for the stray current and work with them to mitigate the problem. Take measures to prevent accidental ignition of gas; protect personnel from electrocution hazard; locate source and make repairs or corrections to eliminate stray current.
• Low structure-to-soil potential	• If qualified, check for failed insulators, broken or corroded bond wires, and shorts with foreign structures. After eliminating these as the cause of the low potential readings, review the pipe-to-soil history of the system. If the pipeline is protected by an impressed current rectifier, adjustments to the rectifier may be required.
• Pipe-to-soil potential has the wrong polarity	• Check to see if the meter is hooked up properly. If meter is hooked up correctly, notify the proper personnel of the polarity change immediately.

REVIEW I

Performing Pipe-to-Soil Potential Surveys on Effectively Coated Buried or Submerged Pipelines

Directions: Select from the list below the response that most correctly completes each of the following statements. Write the letter of your choice in the space provided.

A. copper-copper sulfate half-cell
B. pipe
C. soil
D. water
E. -0.85
F. pipe-to-soil potential reading
G. directly over the pipeline
H. half cell
I. electronically located and staked out

F 1. The measurement of the voltage difference between an underground metallic structure (pipeline) and a half-cell in contact with the soil is known as a _____.

E 2. The criteria for cathodic protection of steel, cast iron and ductile iron when using pipe-to-soil measurements is _____ volts.

A 3. A widely used reference electrode for measuring pipe-to-soil voltage is _____.

C 4. An appropriate electrolyte for the placement of the half cell when performing pipe-to-soil potential measurement is a(n) _____.

I 5. To ensure accuracy of an over the pipe-to-soil potential survey, the pipeline should be _____.

G 6. When taking pipe-to-soil measurements, the half-cell is placed _____.

D 7. To reduce contact resistance between the electrode and extremely dry soil when performing a pipe-to-soil potential measurement, saturate the soil with _____ at the point of contact.

H 8. The electrode used in pipeline corrosion investigation is called a _____.

J. eye protection
K. remove a small amount of coating and permanently attach a wire
L. measure the depth
M. odorless
N. has a distinctive odor
O. heavier
P. lighter
Q. test wire
R. position the electrode to the side of the pipe
S. electrode
T. internal combustion engine
U. conduct a leak investigation
V. failed insulators
W. appropriate personnel
X. battery

P 9. Natural gas is _____ than air.

M 10. Natural gas is colorless and _____.

S 11. When making a pipe-to-soil potential measurement, contact is made to the earth or ground with the _____.

K 12. The preferred way to make electrical contact with a pipeline when performing a pipe-to-soil measurement is to uncover the pipeline and _____.

T 13. One item that could generate a spark/ignition source is a/an _____.

W 14. If an abnormal operation condition exists that is a fire on a pipeline, you should immediately make the area safe, notify _____, initiate emergency plan and procedures, and if authorized, stop gas flow at the appropriate valve(s).

U 15. If there is an odor complaint, you should _____ .

V 16. Errors can be introduced in your pipe-to-soil readings if there are _____ in your pipe-to-soil reading circuit.

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Knowledge Verification Checklist

OQ Task CI-1

Perform Pipe-to-Soil Potential Surveys on Effectively Coated Buried or Submerged Pipelines

Directions: Use the following performance criteria statements as a self-evaluation in preparation for the final exam.

I can identify:

- ☐ 1. The measurement taken of the voltage difference between an underground metallic structure and an electrode helf-cell in contact with the soil. (CI-1.1.1)
- ☐ 2. The criteria for cathodic protection of steel, cast iron and ductile iron when using pipe-to-soil potential measurements. (CI-1.1.2)
- ☐ 3. The component that is used to make contact with the earth or ground in pipe-to-soil potential measurements. (CI-1.1.3)
- ☐ 4. The name used to describe the electrode used in pipeline corrosion investigation. (CI-1.1.4)
- ☐ 5. The preferred way to make electrical contact to a pipeline when taking a pipe-to-soil potential. (CI-1.1.5)
- ☐ 6. The widely used reference electrode for measuring pipe-to-soil voltage. (CI-1.1.6)
- ☐ 7. The proper position of the half-cell when making a pipe-to-soil measurement. (CI-1.1.7)
- ☐ 8. A requirement to ensure accuracy of an over the line pipe-to-soil potential measurement survey. (CI-1.1.8)
- ☐ 9. The proper position of the half-cell in relation to the pipe. (CI-1.1.9)
- ☐ 10. A method used to reduce contact resistance between the half-cell and extremely dry soil. (CI-1.1.10)
- ☐ 11. The basic properties of natural gas. (CI-1.1.11)

I can identify:

- ☐ 12. The proper reaction to an abnormal operating condition for a fire on a pipeline. (CI-1.1.12)
- ☐ 13. The proper reaction to an abnormal operating condition when measuring structure-to-electrolyte potential. (CI-1.1.13)

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Skill and Ability Verification Packet

OQ Task CI-1
Perform Pipe-to-Soil Potential Surveys on Effectively Coated Buried or Submerged Pipelines

I. General Instructions

Instructions for Use

The Skill and Ability Verification Packet is designed to standardize conditions under which the employee demonstrates his/her performance of tasks that meet the operator qualification requirements established by the employee's company.

Completing the enclosed affidavit and uploading the data to Industrial Training Services OnBoard LMS for recordkeeping, documents the satisfactory completion of tasks. Both the OQ Authorized Evaluator (AE) and employee must sign the affidavit.

Instructions to the Employee

Your OQ AE will check your performance using the suggested evaluator guide included in each hands-on task assignment. This suggested guide must be supplemented or replaced by the individual company's policies and procedures related to the task being evaluated.

You must adhere to all safety precautions according to your company's policies and procedures and applicable federal, state, and local codes and regulations.

II. Task Information

OQ Task CI-1:	**Perform Pipe-to-Soil Potential Surveys on Effectively Coated Buried or Submerged Pipelines**
Qualification Standard:	The employee's qualification is based on the enabling operation(s) that have been successfully completed. The operation's tasks are listed below:
OQ Task CI-1.1	Measure Structure to Electrolyte Potential. (B31Q 0001)
Recommended Requirement:	The employee must demonstrate proficiency to an acceptable level based on the Skill and Ability Checklist associated with each operation.
References:	49 CFR, Part 192.463. B31Q Task 0001.

Note:

The following Abnormal Operating Conditions (AOCs) and their reactions listed are for guidance only. This AOC list is not presented as an exhaustive treatment of AOCs and appropriate responses. You may be required to know and apply other AOCs and AOC responses for different tasks. Properly recognizing and reacting to covered task AOCs are the responsibility of persons qualified to perform the covered task. Always follow your company's policies and procedures.

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Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Blowing/escaping/grade one leak	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Fire on a pipeline	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Odor complaint	• Conduct a leak investigation
• Improper voltage reading, for example extremely high or low voltage reading or meter reading fluctuates while trying to take a pipe-to-soil reading	• Check all connections in the reading circuit for high resistance. Check half-cell solution and wet ground for better contact. If condition persists, notify proper personnel.
• No reading	• Check volt meter
• Shorts with foreign structures	• Locate and clear shorts and/or notify proper personnel
• External corrosion on exposed pipe	• Repair or replace as needed or report condition to the proper personnel.
• Inoperable/Failure of a test station	• Locate break in wiring or connection; check for continuity after making repairs
• Stray current on pipeline	• Notify proper personnel. Determine the source of the stray current, locate the current pick up and discharge points, notify the party responsible for the stray current and work with them to mitigate the problem. Take measures to prevent accidental ignition of gas; protect personnel from electrocution hazard; locate source and make repairs or corrections to eliminate stray current.
• Low structure-to-soil potential	• If qualified, check for failed insulators, broken or corroded bond wires, and shorts with foreign structures. After eliminating these as the cause of the low potential readings, review the pipe-to-soil history of the system. If the pipeline is protected by an impressed current rectifier, adjustments to the rectifier may be required.
• Pipe-to-soil potential has the wrong polarity	• Check to see if the meter is hooked up properly. If meter is hooked up correctly, notify the proper personnel of the polarity change immediately.

III. Skill and Ability Verification Checklist

OQ Task CI-1
Perform Pipe-to-Soil Potential Surveys on Effectively Coated Buried or Submerged Pipelines.

I verify that (Please Print) ______________________________ is qualified to perform OQ Task CI-1 according to his/her company's procedures:

(CI-1.1) Measure Structure to Electrolyte Potential. (0001)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Perform test equipment check.
  - Verify half-cell condition.
  - Verify calibration of proper equipment.
  - Verify equipment functions within specified parameters.
- ☐ Identify and locate correct test point.
  - Verify location.
  - Verify location of half-cell placement.
- ☐ Measure the structure-to-electrolyte potential.
  - Connect lead to structure.
  - Contact half cell with electrolyte.
  - Verify polarity.
  - Obtain reading.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Condition

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Improper voltage reading • No reading	• Notify proper personnel • Check volt meter

Comments: ______________________________

____

____

____

IV. Employer Record

OQ Task CI-1

Perform Pipe-to-Soil Potential Surveys on Effectively Coated Buried or Submerged Pipelines

Employee Information (Please Print):

Name ______________________________

Last 4 Digits of Social Security Number ______________________________

Company Name ______________________________

Company Mailing Address ______________________________

City ____________________ State __________ Zip ______________

Affidavit

I acknowledge the performance of this task is solely for the purpose of operator qualification, and is not intended to replace or modify company operating procedures or policies and may not be appropriately used in all circumstances. I acknowledge that I am responsible for recognizing hazards and abnormal conditions in my work place and must exercise care and good judgment; always using appropriate equipment, procedures and tools for tasks I perform. Industrial Training Services, Inc. assumes no liability for my actions nor for my application of the qualification performance guides used in this evaluation checklist.

Employee's Signature ____________________ Date ______________

Evaluator Information (Please Print):

Name ______________________________

Organization/Employer ______________________________

Telephone Number ______________________________

Affidavit

I affirm that I am the person who has administered this checklist and that I have conducted this assessment with integrity. I also affirm that the above named employee is the person assessed and that the above named person performed the tasks at the indicated level.

Evaluator's Signature ____________________ Date ______________

The employee is qualified according to company standards to perform the tasks listed below as indicated:

	TASK/OPERATIONS	**Method of Skill/Ability Verification** **Enter Number From List Below**
1.	(CI-1.1) Measure Structure to Electrolyte Potential. (0001)	☐

Method of Knowledge Verification

- Written Exam

Method of Skill/Ability Verification Observed During:

1. Performance on the Job
2. Simulation

After completion of Section IV, "Employer Record," remove section from the packet for your records. For third party verification and database reporting service, upload the data to Industrial Training Services OnBoard LMS.

INDUSTRIAL
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INDUSTRIAL
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DANNY SHROUT

OQ Compliance Series
Student Manual

OQ Task CM-2
v10.3

Locate and Mark Underground Pipeline Facilities

INDUSTRIAL
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ITS OQ Compliance Series
CM-2 Locate and Mark Underground Pipeline Facilities
v10.3

Student Manual

INTRODUCTION

In order to safely and efficiently maintain and repair the piping in a natural gas system, it becomes necessary to pinpoint the location of buried underground structures including the gas piping system. To complete this module you will be required to complete the check-out activities listed below.

OBJECTIVE

1. Locate and mark underground facilities.

CHECK-OUT ACTIVITIES

Your instructor will provide you with a list of incomplete statements related to locating and marking underground pipeline facilities and a list of responses. Select the response that most correctly completes each statement. Cut off score is 80%. (Knowledge Verification)

Your instructor will provide you with a Skill and Ability Verification Checklist. At the appropriate time demonstrate your skill and ability by correctly performing each operation required under the task.
(Skill & Ability Verification)

OQ CM-2 covers requirements indicated in the following codes/regulations:

ITS OQ Covered Task:	ASME B-31 Q*	ITS***	49 CFR 192**
OQ CM-2.1 Locate Underground Pipelines	1291		192.614
OQ CM-2.2 Install and Maintain Pipeline Markers	1301		192.614 192.707
OQ CM-2.3 Temporarily Mark Underground Pipeline Facilities		5101	

*ASME B31Q Covered Tasks:

1291 Locate Underground Pipelines.
1301 Install and Maintain Pipeline Markers.

**49 CFR Part 192 Covered Regulations:

49 CFR 192 covered regulations are identified within the appropriate section of this module.

***ITS Covered Tasks:

5101 Temporarily Mark Underground Pipeline Facilities.

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Table of Contents

INSTRUCTION SHEET I

Locating and Marking Underground Facilities

Most of the utility and communications systems that make modern urban living possible lie buried under busy streets and sidewalk pavements. The number of such systems at any one location is larger than the average person would think; in large cities, 18-20 may occur in a single intersection. Physical sizes range from 1/2-inch diameter street lighting cables to subway tubes. For these reasons it is important that pipeline operators be able to accurately pinpoint and mark underground pipeline facilities.

Note:

Calling the National One Call Number, **811**, starts the process of getting underground utility lines marked for free. When you call 811 from anywhere in the country, your call will be routed to your local One Call Center. Local One Call Center operators will ask you for the location of your digging job and route your call to the effected utility companies.

Needs for Locating Underground Structures

Needs for locating underground structures include:

(1) damage prevention,
(2) long-range planning,
(3) maintenance both emergency and scheduled,
(4) map verification and up-dating, and
(5) planning for expansion or replacement.

(1) **Damage Prevention.** The more intensely urbanized an area becomes the more essential it is to know precisely what utility and communication systems lie under the streets, where they are located and how deep they are, what materials were used, and what conditions they are in. Systems need maintenance and repair. Everything known about them in advance promotes economical and expeditious work and minimizes public inconvenience. Such information is needed for operation and maintenance as well as for planning new construction.

(2) **Long-Range Planning.** Before long range plans can be developed involving the location of future underground utilities, the location of existing underground structures in the area affected should be determined. This would provide information needed for purposes of system design and cost consideration.

(3) **Maintenance.** Maintenance, both emergency and scheduled, is extremely important to the safe operation of a natural gas system. Therefore, the location of gas piping is essential to this process. Without knowledge of the accurate location of the underground pipe or pipe fitting it is very time consuming to perform maintenance procedures or to respond to a gas related emergency.

(4) **Map Verification.** Map verification is an area of operation which is on-going. In order to be assured of accurate maps, the location of pipes and valves should be confirmed.

(5) **Planning for Expansion or Replacement.** New underground systems as they become necessary, either to replace or improve facilities or to provide some entirely new service, will have to be threaded through existing systems. A lack of knowledge or uncertainty about what will be encountered when starting to excavate adds to the cost and risk of new construction. Therefore, it is important that underground structures in the affected area be located and marked.

Methods of Locating Underground Structures

The practice of marking multiple facilities by a single locator has several advantages. Among these advantages are:

- More responsive to the excavator
- Better communication with the excavator (fewer points of contact)
- Improved safety due to less traffic at the site
- Improved worker safety
- Reduced environmental impact, and
- Maps of multiple facilities[1]

Locating facilities may require more information than electronic locating equipment can provide. A wide scope of supporting information including maps, service line records, employee experience and knowledge of the piping system, as well as above ground signs at the excavation site can contribute to accurately locating a buried facility. Probe bars and digging equipment are sometimes used to physically locate underground facilities. Each additional piece of information should verify that the pipe is in the suspected location. Contradictory information is cause to reflect.

The One-Call ticket should carry all of the locate request information. If the request is vague, call the excavator, ask about details of the excavation, and note the conversation on the locate request ticket. Clearly marking facilities and responding as required to the One-Call system will reduce the probability of damages. While One-Call tickets and response systems vary from state to state there are many

[1] CGA, *Best Practices*, December 2009

similarities. Each system identifies key information and requires the facility owner to respond within a 48-hour to 3-day period.

(1) **Maps.** A commonly used method of locating underground gas pipes is to refer to a map of the gas system being considered. The system map, when available, provides various types of information such as size of the pipe, pressure in pipe, type of pipe coating, material used in pipe, and location of valves, tee's etc. This method is effective if the map is accurate.

(2) **Digging Equipment.** Digging equipment, such as vacuum excavation, is sometimes used as a method of locating a gas pipe. This method can be expensive. It involves both special equipment and employee time.

(3) **Service Line Records.** Maintenance records and work orders on service lines provide valuable information for locating buried pipeline facilities.

(4) **Probing Bars.** Probing, with the use of steel rods or other similar type devices, is sometimes used to locate gas piping. The rod is used to probe in the soil in an effort to hit the gas pipe, therefore pinpointing its location.

All safety precautions, including the use of proper personal protection equipment (PPE), should be followed when probing. The following safety procedures are suggested. Always follow your company's policies and procedures when probing.

- Use a stop collar devise on the probing rod to limit penetration to less than the depth of the facilities.
- All probing tools should be blunted.
- Before probing, look for the presence of underground structures. Some indications that an underground structure may exist include:
  - Aboveground or level ground markers
  - Manhole lids
  - Electric distribution transformers
  - Pre-existing mark outs
  - Valve boxes (e.g., water, gas)
  - Pedestals
  - Telephone, cable, and electric drops
- Remove the lids from valve boxes to determine the approximate depth of the facility.
- Locate all facilities and gas facility shut-offs and gain access to them prior to driving barholes.
- Stay within the limits of the locate request.

(5) **Employee Experience.** Employee experience is sometimes used to help identify the location of a pipe in a natural gas system. Using this method, which depends on the employee's remembering physical features of the area where the pipe was buried, the employee attempts to pinpoint the pipe location based on such things as the location of utility poles, curb lines, drive ways, trees, breaks in the pavement, patches in the pavement and etc., in relation to the pipeline. This method of pipe location should be used with caution as human memory has been shown on countless occasions to be much less reliable than individuals believe. For this reason, employee experience should only act as a supplement to other forms of pipe location.

(6) **Aboveground Signs.** Aboveground signs such as the location of meter/regulator sets, line shut-off valve locations, indications of ground settlement, etc., are sometimes used to establish approximate locations of buried pipeline facilities.

(7) **Instruments.** Instruments such as pipe locators are also used to pinpoint the location of a buried metal structure.

(8) **Record Updates.** During the course of a locating activity, a locator may become aware of errors or omissions in existing records. A method of notification in the event errors and omissions are found should be provided by the facility owner/operator that includes the following information:

- Name (and company if contracted),
- Contact phone number of the individual(s) submitting change,
- Location (either address or reference points),
- Size and type of facility,
- Nature of the error or omission, and
- Sketch of the change in relation to the other facilities.

Errors and omissions may occur due to misdrawn records, changes during construction at the job site, repair or abandonment of facilities, or delays in posting new records. Failure to note errors and omissions when found could result in damages to the facility at a later date.

Modes of Operation

The equipment used to locate buried metallic conductors is operated in two different modes. The modes of operation are (1) conductive mode and (2) inductive mode.

(1) **Conductive Mode.** The conductive mode is primarily used in areas where several conductors are located in close proximity to each other. This mode of direct connection allows the operator to energize only the conductor which is being traced. This mode of operation is used because the signal is less likely to jump to other structures than in the inductive mode. The direct connection

is made by attaching the end of two cables to the terminal posts marked conductor and ground. The unattached end of the cable connected to the conductor terminal is attached to the conductor usually by means of a clamp. The unattached end of the cable connected to the ground terminal of the locator is attached to a grounding source, such as a ground rod. The signal which is detected by the receiver is transmitted through the underground structure and air.

The signal transmitted at the transmitter can be picked up by the receiver in two ways, a maximum signal response and a null signal response. The maximum signal response is used to determine the general location of the buried conductor.

To determine the exact location of the buried conductor, the receiver should be used in the null position. The strength of the signal increases as the receiver is moved to each side of the energized conductor and decreases sharply as the receiver is moved directly over the conductor. This sharp null response (absence of signal) allows the operator to identify the precise location of the conductor.

(2) **Inductive Mode.** The inductive mode is sometimes preferred over the conductive mode for two basic reasons. First, ease of operation; the transmitter does not have to be attached to the conductor or grounded. Secondly, the inductive mode permits locating conductors in areas where a conductive hook-up is impractical or impossible.

When operating in the inductive mode the following factors should be taken into consideration:

(a) **Air Lock or Air Coupling.** This phenomenon occurs when a transmitter and receiver are operated too close to each other. As a result, the signal from the transmitter will travel through the air to the receiver rather than penetrating the soil and reaching the conductor. The transmitter and receiver should be kept separated by a distance of at least 35 feet when operating in the inductive mode.

(b) **Other Conductors.** When there are several other conductors in close proximity the inductive mode may not be effective. Without the transmitter directly connected, the signal can jump to more conductive conductors located nearby.

(c) **Energized Conductors.** Energized cables, power lines, and other utilities may disrupt or distort the electromagnetic signal of the transmitter since each of these produce their own electromagnetic fields.

The inductive mode functions by transmitting a signal through the air and ground cover, rather than directly attaching a cable and impressing a signal onto the buried conductor.

Factors Affecting the Impressed Signal Voltage

The ability of the conductor to be impressed with the signal is affected by the following factors:

(1) Frequency of the signal
(2) Type of material used for the conductor
(3) Soil condition

(1) Frequency of the Signal. A low frequency signal provides better adherence to the conductor than a high frequency signal. However, the low frequency signal, because of its low penetration ability, is more likely to be stopped by high resistance structures such as stubs, fittings, or joints.

A high frequency signal displays a better ability to cross through sources of resistance. However, because of a skimming quality, the high frequency can easily be deflected and jump to a more conductive conductor nearby.

(2) Type of Material Used for the Conductor. The material from which the conductor is made greatly influences the ability of the signal to travel along the conductor. Conductors are manufactured from a wide variety of materials. Metallic conductors may be very conductive, such as copper pipe or energized cable, or less conductive material such as cast iron. Structures on the conductor may distort, disrupt, or totally impede the signal traveling along the conductor. An insulator by its nature will totally stop the signal, whereas stubs and joints will cause the signal to be reduced.

(3) Soil Condition. The soil is an important factor in the transmission of the impressed signal. A dry, sandy, loosely-packed soil provides a high resistivity and a poor conductive atmosphere. A damp, closely packed soil provides a good conductive medium. The deeper the conductor is buried the more difficult it is to induce the signal through the soil and onto the conductor.

The primary function of the pipe locator is to impress the signal onto the conductor by the transmitter, and then tuning in the transmitted signal with the receiver to pinpoint the location of the conductor.

Procedures Used When Locating Buried Piping

Three general procedures are involved when using pipe locators to locate buried piping. The procedures are:

(1) the search procedure
(2) the trace procedure
(3) depth determination procedure

(1) Search Procedure. The search procedure is utilized when there is no knowledge or indication of the location of the buried structure.

(2) Trace Procedure. The trace procedure is utilized when one position of the structure is known or has been located and the actual path of the structure is to be determined.

(3) Depth Determination Procedure. The depth determination procedure requires the use of a 45 degree tilt of the receiver. The approximate depth of the pipe is determined by triangulation, starting at the center of the pipe on a vertical axis. (Depth determination is not required when performing a locate.)

Locating Pipe with a Pipe Locator Using the Inductive Mode

(1) Physical Arrangement of the Transmitter and Receiver. As illustrated in Figure 1, a minimum distance of 35 feet is maintained between the transmitter and receiver to prevent air lock, or air coupling, as a result of the signal from the transmitter traveling through the air to the receiver.

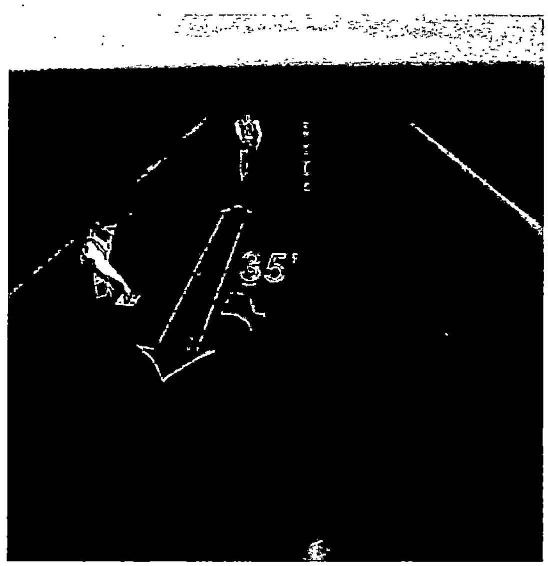

Figure 1. Transmitter and Pipe Inductively Coupled

(2) Techniques for Common Operation Using the Pipe Locator in the Inductive Mode. Common operations using a pipe locator in the inductive mode are as follow:

(a) locating a service
(b) locating a bend
(c) locating a dead end
(d) locating buried piping or added masses of metal

(e) determining depth of pipe

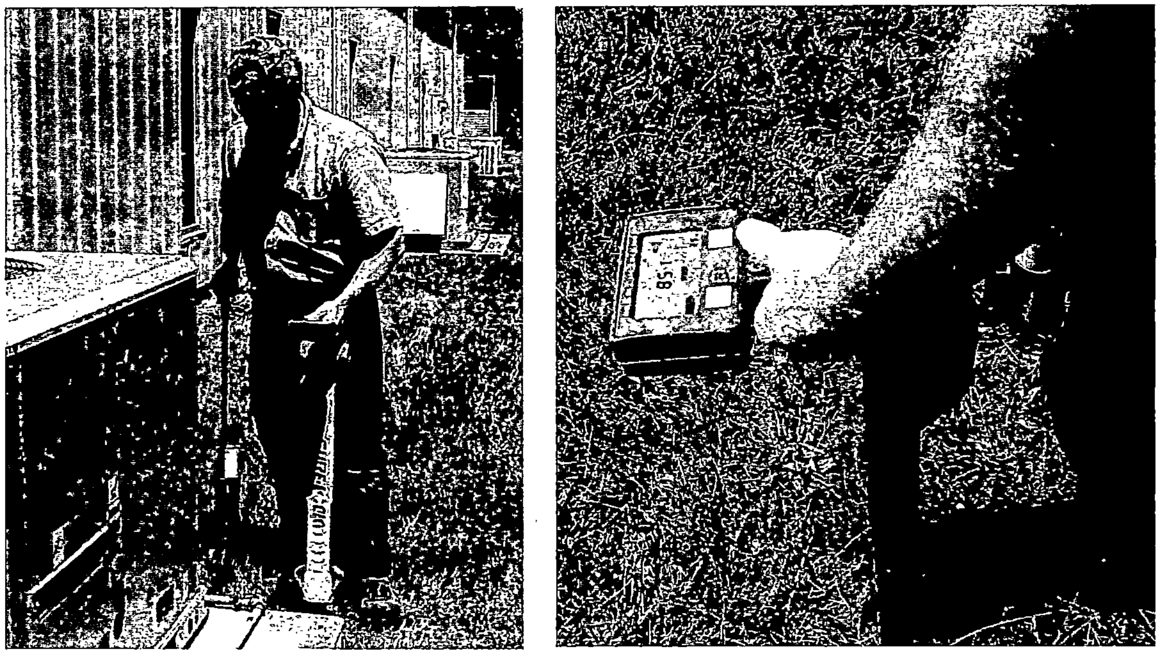

Figure 2. Locating a Service

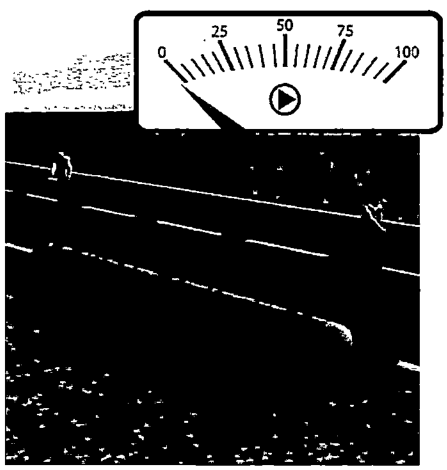

Figure 3. Locating a Dead End

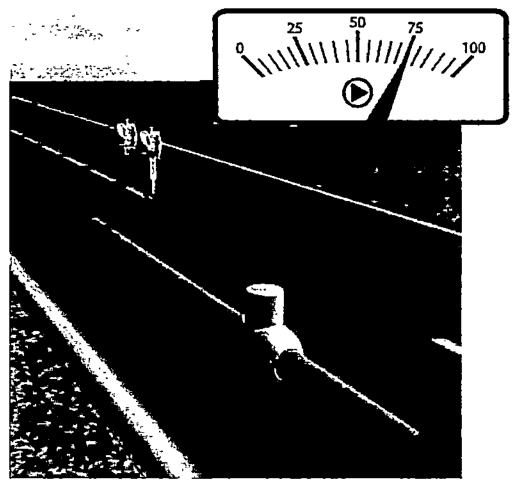

Figure 4. Location of Buried Metal or Added Masses of Metal

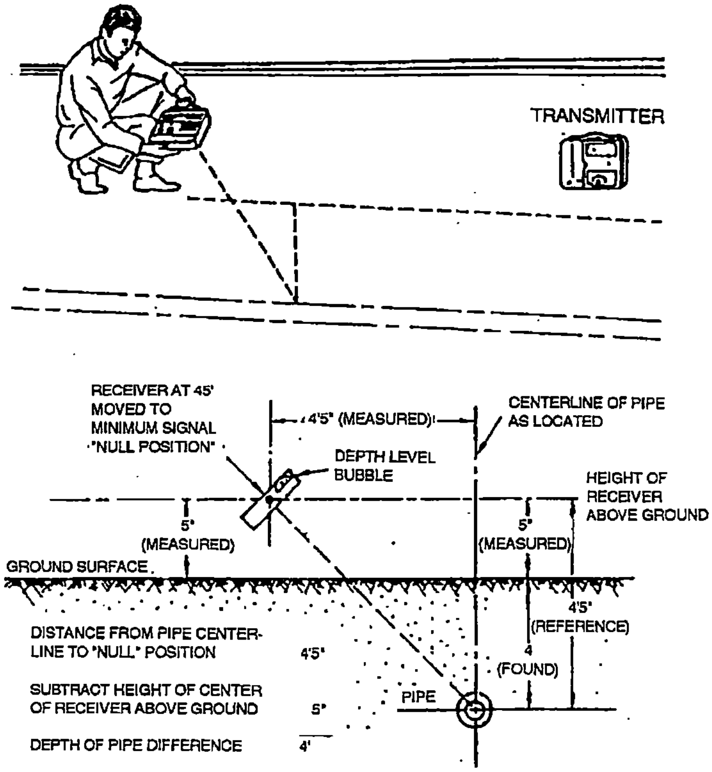

Figure 5. Determining Depth of Pipe

(3) Problems Associated with Inductive Coupling. The magnetic field of the pipeline to be located can also be induced on other nearby pipelines, overhead lines, cables, trolley tracks, etc. Therefore, every adjacent line or cable can form its own magnetic field. The overlapping of the individual fields results in a magnetic field on the pipeline, which in general is no longer circular, but somehow distorted. The maximum signal or pull is no longer directly over the pipeline but offset to the side.

Locating a Pipe with a Pipe Locator Using the Conductive Mode

(1) Physical Arrangement of the Transmitter and Receiver. When using the pipe locator in the conductive mode the transmitter is physically connected to the pipe or metal structure, as illustrated in Figure 6.

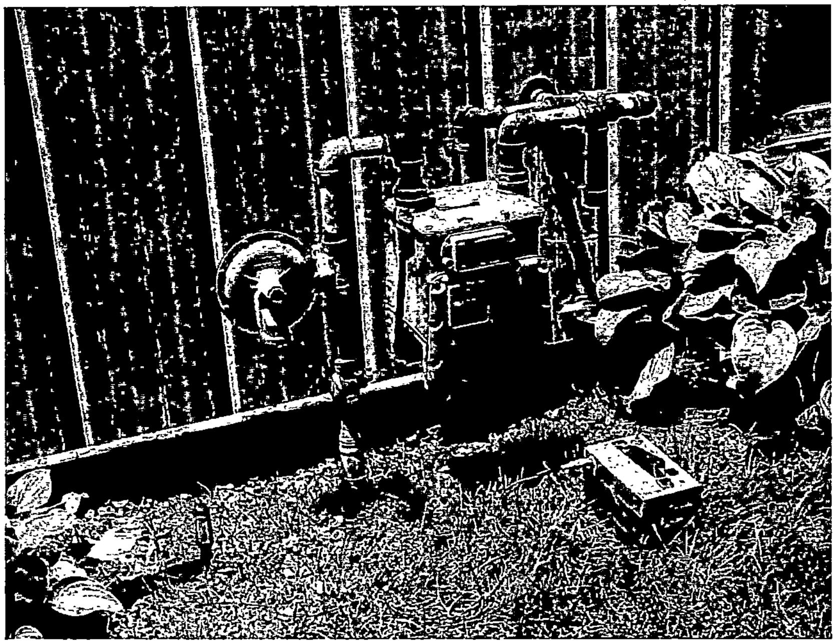

Figure 6. Transmitter and Pipe Conductively Coupled

(2) **Problems Associated with Conductive Coupling.** Good contacts are necessary. Rust or paint should be removed from points of contact. Connecting wires and clamps should be in good condition with no partial breaks or loose clamps. The ground plate or ground rod should be placed as far from the connection on the meter, wire, or valve as possible. This extends the length of the signal that can be received. The ground plate should be pushed deeply in a damp place, if possible. If the ground is dry, pour water over the grounded rod or plate. Never place the ground plate or rod directly over another pipeline. Lightning or hydro protection grounds should not be used as they may cause errors due to the fact that their layout is unknown relative to the pipe being located.

Advantages of a Signalator (Pulse Tone)

The advantages of a signalator include the following:

(1) The pulse tone can be detected and easily recognized in spite of disturbances through other frequencies on adjacent pipes or structures.

(2) Reduces battery consumption during transmission, resulting in longer battery life.

(3) If a garbled noise is picked up when approaching the maximum range of the transmitter, or at locations where impingement of other magnetic fields occurs, the pulse tone often enables the operator to distinguish the desired signal and hence establish the proper line location.

Special Locates and Locating Pitfalls

(1) **Depth Determination.** Refer to the equipment manufacturer's operating instructions for this step to determine depth of the pipe.

(2) **Location of Short Dead End Branch Lines or Stub Ends.**

(a) Difficult by conductive coupling methods.
(b) The current or magnetic field flowing into branch lines depends on the length of the branch line and decreases to zero towards the end.
(c) No magnetic field strong enough for locating can be built up with short branch lines.
(d) Therefore, it is generally more successful to locate stub ends or dead end branch lines by inductive method.

(3) **Crossing Other Pipelines - Displacement of the Signal.**

(a) Crossing pipelines can cause a displacement of the signal by distorting the magnetic field at the crossing in such a way that a clear signal is no longer detectable.
(b) At such places, the pipe-run should be determined after the crossing point and projected, maintaining as short a distance as possible.

(4) **Field Distortions.**

(a) Caused by iron masses in parallel positions or a metallic pipeline with overlapping individual fields.
(b) This can be verified by taking depth determination on both sides of the pipeline.
(c) Results in maximum signal being obtained off-set from the actual location of the pipeline in question.

(5) **House Connections.**

(a) Watch for insulation.
(b) To locate the service line from the main to the house, connect at the shut-off or before.
(c) A conductive signal energizing both the gas system and water system can occur through a water heater if an insulator is not present or is faulty.
(d) If a doubt exists in cases of an emergency, or other hook-ups are not available, separate the system by isolation.

(6) **Poor Conductivity or Signal Transmission.**

(a) Can be caused by excessive pipeline corrosion.
(b) Can be caused by poor contacts or damaged cable connections.

(c) Can be caused by insulators or rubber sleeves on the system.
(d) Can be caused by poor grounding of the transmitter on conductive couplings.

(7) Sudden Changes in Signal Tone.

(a) Increase in tone.
- A change in mass of metal (possibly a valve)
- A decrease in pipe depth (less cover)
- A possible increase in pipe size (more mass)

(b) Decrease in tone.
- An insulated fitting
- An increase in pipe depth (more cover)
- A decrease in pipe size (less mass)

(c) Confused or interrupted tone.
- A cross, tee, or other connection
- The crossing of another utility
- A short or fault in the system
- A section of badly corroded pipe or a change in pipe-to-soil resistance

(8) Signal Transmission. The signal from the transmitter always seeks the path of least resistance. If a good ground is not established on the conductive attachment signal, seeking the path of least resistance is spread inductively as well. This inductive signal can create an electromagnetic field on the utilities so you may not be isolating the gas piping as you expect. This is why a good ground connection is very important.

(9) Excavation Using Power Equipment. If a line location is given where power equipment is to be used for excavating around or near gas lines, the nearest control valves must be located and checked for accessibility and operation at the time the locate(s) are made.

(10) Conductive Coupling to a Pipe by Means of a Conductive Loop. Conductive coupling is used only under difficult conditions such as insulating joints or where influencing factors of nearby pipelines predominate.

§ 192.707 Line markers for mains and transmission lines.

(a) *Buried pipelines.* Except as provided in paragraph (b) of this section, a line marker must be placed and maintained as close as practical over each buried main and transmission line:
(1) At each crossing of a public road and railroad; and
(2) Wherever necessary to identify the location of the transmission line or main to reduce the possibility of damage or interference.

(b) *Exceptions for buried pipelines.* Line markers are not required for the following pipelines:
(1) Mains and transmission lines located offshore, or at crossings of or under waterways and other bodies of water.
(2) Mains in Class 3 or Class 4 locations where a damage prevention program is in effect under §192.614.
(3) Transmission lines in Class 3 or 4 locations until March 20, 1996.
(4) Transmission lines in Class 3 or 4 locations where placement of a line marker is impractical.

(c) *Pipelines aboveground.* Line markers must be placed and maintained along each section of a main and transmission line that is located aboveground in an area accessible to the public.

(d) *Marker warning.* The following must be written legibly on a background of sharply contrasting color on each line marker:
(1) The word "Warning," "Caution," or "Danger" followed by the words "Gas (or name of gas transported) Pipeline" all of which, except for markers in heavily developed urban areas, must be in letters at least 1 inch (25 millimeters) high with1/4inch (6.4 millimeters) stroke.
(2) The name of the operator and the telephone number (including area code) where the operator can be reached at all times.

[Amdt. 192-20, 40 FR 13505, Mar. 27, 1975; Amdt. 192-27, 41 FR 39752, Sept. 16, 1976, as amended by Amdt. 192-20A, 41 FR 56808, Dec. 30, 1976; Amdt. 192-44, 48 FR 25208, June 6, 1983; Amdt. 192-73, 60 FR 14650, Mar. 20, 1995; Amdt. 192-85, 63 FR 37504, July 13, 1998]

(1) **Marking Buried Pipelines.** A line marker must be placed and maintained as close as practical over each buried main and transmission line at:

- each crossing of a public road
- each crossing of a railroad
- wherever necessary to identify the location of the transmission line or main to reduce the possibility of damage or interference

(2) **Exceptions For Marking Buried Pipelines.** Line markers are not required for the following pipelines:

- Mains and transmission lines located offshore
- Mains and transmission lines at crossing or under waterways and other bodies of water
- Mains in class 3 or 4 location where a damage prevention program is in effect under 192.614
- Transmission lines in class 3 or 4 location where placement of a line marker is impractical

(3) **Marking Pipelines Located Above Ground.** Line markers must be placed and maintained along each section of a main and transmission lines that is located above ground in an area accessible to the public.

Tranmission line markers must be placed within line of sight of each other. Gathering line markers must be placed within 500 feet of each other unless there is a change in direction, then they must be placed within line of sight.

(4) **Pipeline Marker Warning.** The word "Warning," "Caution," or "Danger" followed by the words "Gas (or name of gas transported) Pipeline" must be in letters at least one inch high with a one-quarter inch wide stroke, with the exception for line markers in heavily developed urban areas.

All lettering on the line markers must be written legibly on a background of sharp contrasting color.

Information on the line markers must include the name of the pipeline operator and the telephone number (including area code) where the operator can be reached at all times.

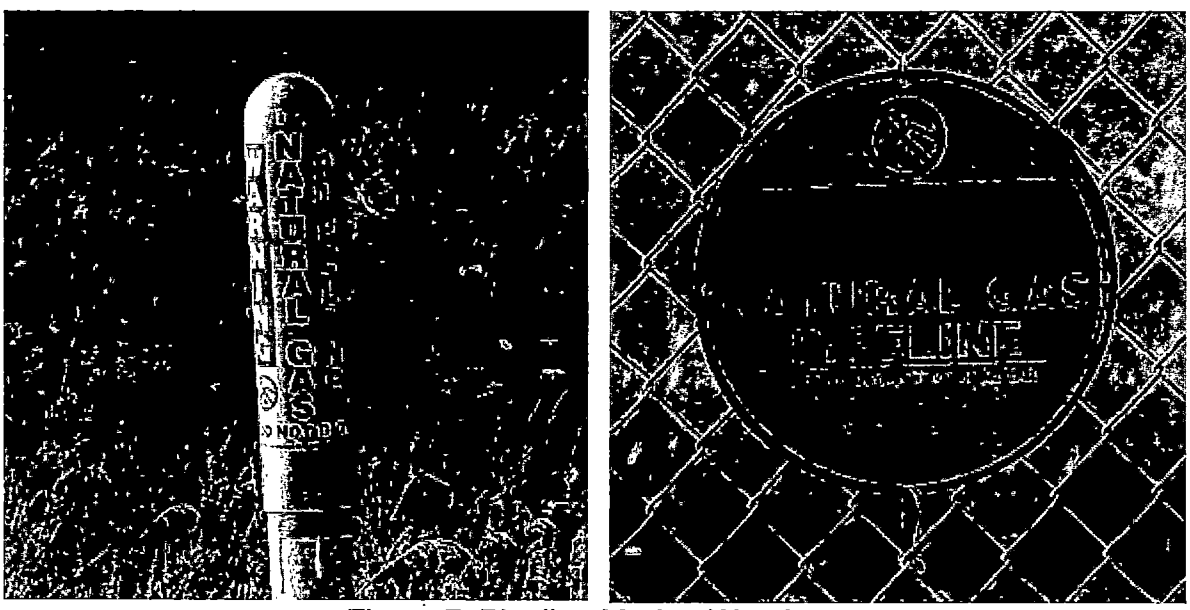

Figure 7. Pipeline Marker Warning

(5) **Responding to a Notification of Planned Excavation.** When responding to an excavation notification, you should follow established procedures for notification of intent to excavate. Consideration should be given to the following:

- Information about the location of facilities should be obtained and the location of the facility marked.
- Methods for marking facilities should be consistent with the field conditions (including items such as the use of paint on paved areas and stakes, signs or flags in unpaved areas).
- Trained personnel should be available to mark facilities as necessary.
- The potential for facility marking to be observed prior to or during excavation activity should be evaluated and appropriate action taken.
- The excavator should be advised how and when the facilities will be marked.
- It should be pointed out to the excavator that the marking represents only the approximate horizontal position of the facilities and that the facilities should be exposed by hand excavation to verify their location.
- Any maps, drawings, or records supplied to an excavator to assist in locating underground facilities should be reviewed for accuracy. Unless field checked, it is suggested that they be marked with a note such as "Not responsible for accuracy, verify by hand digging."
- All aspects of the excavation activities, and marking schedules should be discussed and lines of communication established.

(6) **Temporary Marking for Excavation.** Preventing damage to the pipeline during excavation operations is a critical issue for pipeline operating companies. This is especially true where third-party damage is possible. Locating and temporarily marking buried piping when construction is planned for areas around or along pipelines is important for the safety of pipeline personnel, construction workers, and the general public. It is also required by federal and state regulations when requested by contractors, other utilities, municipal authorities, property owners, or other entities that conduct excavation, boring, or tunneling operations.

In many cases, a call for live locating and temporary marking of pipeline facilities will come from a One-Call 811 service. Most One-Call services will assign a locate and mark identification number for each case. This Identification number should be recorded on all work orders or field reports that relate to the location and marking job.

§ 192.614 Damage prevention program.

(a) Except as provided in paragraphs (d) and (e) of this section, each operator of a buried pipeline must carry out, in accordance with this section, a written program to prevent damage to that pipeline from excavation activities. For the purposes of this section, the term "excavation activities" includes excavation, blasting, boring, tunneling, backfilling, the removal of aboveground structures by either explosive or mechanical means, and other earthmoving operations.

(b) An operator may comply with any of the requirements of paragraph (c) of this section through participation in a public service program, such as a one-call system, but such participation does not relieve the operator of responsibility for compliance with this section. However, an operator must perform the duties of paragraph (c)(3) of this section through participation in a one-call system, if that one-call system is a qualified one-call system. In areas that are covered by more than one qualified one-call system, an operator need only join one of the qualified one-call systems if there is a central telephone number for excavators to call for excavation activities, or if the one-call systems in those areas communicate with one another. An operator's pipeline system must be covered by a qualified one-call system where there is one in place. For the purpose of this section, a one-call system is considered a "qualified one-call system" if it meets the requirements of section (b)(1) or (b)(2) of this section.

- (1) The state has adopted a one-call damage prevention program under §198.37 of this chapter; or
- (2) The one-call system:
  - (i) Is operated in accordance with §198.39 of this chapter;
  - (ii) Provides a pipeline operator an opportunity similar to a voluntary participant to have a part in management responsibilities; and
  - (iii) Assesses a participating pipeline operator a fee that is proportionate to the costs of the one-call system's coverage of the operator's pipeline.

(c) The damage prevention program required by paragraph (a) of this section must, at a minimum:

- (1) Include the identity, on a current basis, of persons who normally engage in excavation activities in the area in which the pipeline is located.
- (2) Provides for notification of the public in the vicinity of the pipeline and actual notification of the persons identified in paragraph (c)(1) of this section of the following as often as needed to make them aware of the damage prevention program:
  - (i) The program's existence and purpose; and
  - (ii) How to learn the location of underground pipelines before excavation activities are begun.
- (3) Provide a means of receiving and recording notification of planned excavation activities.
- (4) If the operator has buried pipelines in the area of excavation activity, provide for actual notification of persons who give notice of their intent to excavate of

the type of temporary marking to be provided and how to identify the markings.

(5) Provide for temporary marking of buried pipelines in the area of excavation activity before, as far as practical, the activity begins.

(6) Provide as follows for inspection of pipelines that an operator has reason to believe could be damaged by excavation activities:

(i) The inspection must be done as frequently as necessary during and after the activities to verify the integrity of the pipeline; and

(ii) In the case of blasting, any inspection must include leakage surveys.

(d) A damage prevention program under this section is not required for the following pipelines:

(1) Pipelines located offshore.

(2) Pipelines, other than those located offshore, in Class 1 or 2 locations until September 20, 1995.

(3) Pipelines to which access is physically controlled by the operator.

(e) Pipelines operated by persons other than municipalities (including operators of master meters) whose primary activity does not include the transportation of gas need not comply with the following:

(1) The requirement of paragraph (a) of this section that the damage prevention program be written; and

(2) The requirements of paragraphs (c)(1) and (c)(2) of this section.

[Amdt. 192–40, 47 FR 13824, Apr. 1, 1982, as amended by Amdt. 192–57, 52 FR 32800, Aug. 31, 1987; Amdt. 192–73, 60 FR 14650, Mar. 20, 1995; Amdt. 192–78, 61 FR 28785, June 6, 1996; Amdt.192–82, 62 FR 61699, Nov. 19, 1997; Amdt. 192–84, 63 FR 38758, July 20, 1998]

Acceptable temporary underground facility markers may consist of paint, flags, stakes, or any combination of these marking methods, as illustrated in Figure 8. Where more than one gas pipeline operating company has facilities in the same area, it is suggested that each company use its initials or other unique marking to identify its facilities as shown in the illustration below.

Figure 8. Temporary Line Markings

Temporary markings should conform to the American Public Works Association uniform color code as shown in the following table.

> **Note:**
> For many years natural gas lines were marked with Safety Alert Orange. Safety Alert Orange is now used to mark communications lines. This should be noted when uncovering older lines to avoid confusion.

AMERICAN PUBLIC WORKS ASSOCIATION UNIFORM COLOR CODE		
Electric power distribution and transmission		Safety Red
Municipal electric systems		Safety Red
Gas distribution and transmission		High Visibility Safety Yellow
Oil distribution and transmission		High Visibility Safety Yellow
Dangerous materials, product lines		High Visibility Safety Yellow
Telecommunications systems and cable television		Safety Alert Orange
Temporary survey markings		Safety Pink
Police and fire communications		Safety Alert Orange
Potable water		Safety Precaution Blue
Sewer and storm drainage systems		Safety Green
Proposed excavation or construction boundaries		White
Reclaimed water, slurry, and irrigation facilities		Purple

Figure 9. Color Code

(7) **Marking Multiple Facilities[2].** Typically, the number of lines marked on the surface at a locate is equal to the number of lines buried below. In situations where the total number of lines buried in the same trench by a single facility owner/operator may not be readily known, a corridor marker is used. The corridor markings indicate the width of the facility.

(8) **Marking Abandoned Facilities[3].** When the presence of an abandoned facility within an excavation site is known, an attempt is made to locate and mark the abandoned facility. If an abandoned facility is located or exposed it is treated as a live facility.

(9) **Locate Documentation[4].** A facility locator always documents his/her work on a locate report. This practice assists in the locate process by making a locator review what was located and then verify that all facilities within the

[2] CGA, *Best Practices*, December 2009
[3] Ibid.
[4] Ibid.

requested area were marked. Careful documentation helps ensure there is an accurate record of the work that was performed by the locator and helps eliminate confusion over what work was requested by the excavator.

(10) Damage to a Marked Facility. Any time a facility is damaged an investigation is performed. The focus of the investigation is to determine not only the responsible party, but also the root cause of the damage. The information gathered from damage investigations is essential in preventing future damages.

(11) Assuring Locate and Marking Quality[5]**.** Conducting audits for locate and marking is critical to the protection of underground facilities against damage from excavation. Guidelines for the work of locators may include the following:

- ☑ Conduct random field audits of the locator's work
- ☑ Check the locator's work against accuracy within governed, contractual, minimum tolerance levels
- ☑ Check the locator's time against regulations/statute
- ☑ Check for completion of the request
- ☑ Check for evidence of accuracy and proper communication
- ☑ Check for proper documentation
- ☑ Verify proper hook-up and grounding procedures are used, where applicable
- ☑ Verify that appropriate safety equipment and procedures were used by the locator
- ☑ Verify tools and equipment are in proper working order and properly calibrated

Systems Location Records

Records of the geographic location of piping and other components of a gas distribution system are almost always provided on scale maps of the system. The maps show the locations of the system components with respect to geographical features, such as streets, rivers, lakes, and railroads. Precise locations are indicated by notations of distances from property lines, street center lines, or other landmarks. Notations are also used to indicate pipe size, installation dates, and work order numbers. Symbols represent pipe accessories such as valves, insulating fittings, regulators, and corrosion control devices. A standard set of pipe mapping symbols has been developed by an A.G.A. task group.

[5] Ibid.

Maintaining Pipeline Integrity[6]

To guard the integrity of buried pipelines and prevent injury, death, and property and environmental damage, pipeline operators are advised by PHMSA to take the following damage prevention measures:

- Use safe locating excavation practices. Follow your procedures and processes for excavation and backfill. When constructing a new pipeline, honor the marking of existing pipelines.
- Locate and mark pipelines accurately before locating excavation begins. Do not rely solely on maps, drawings, or other written materials to locate pipelines.
- Make sure that individuals locating and marking the pipelines have the knowledge, skills, and abilities to read and understand pipeline alignment and as-built drawings; and that they know what other buried utilities exist in the construction area.
- Make sure that individuals locating and marking the pipelines have up-to-date pipeline alignment and as-built drawings.
- Make sure that individuals locating and marking the pipelines are familiar with state and local requirements on marking.
- Mark all pipelines, including laterals. This is especially important in areas where there is a considerable amount of new pipeline and utility construction.
- Consider environmental conditions such as rain and snow when selecting marking methods.
- In areas where the pipelines are curved or make sharp bends to avoid other utilities or obstructions, consider the visibility and frequency of markers.
- Confirm the accuracy of pipe locating before excavation begins. This applies when the pipeline operator conducts the excavation using its own employees or a contractor.
- Use qualified personnel for locating and marking pipelines. At a minimum, they should have received appropriate training such as that outlined in the National Utility Locating Contractors Association locator training standards and practices.
- Make sure excavators have sufficient information about underground pipelines at the construction site to avoid damage to the pipeline. Facilitate communication during the construction activity.
- Calibrate tools and equipment used for line locating and make sure they are in proper working order.
- Individually mark pipelines located within the same trench where possible.
- Follow the best practices on locating and marking pipelines developed by the Common Ground Alliance (CGA).
- When pipelines are hit or almost hit during excavation, evaluate the practices and procedures in use before continuing the construction activity.

[6] Federal Register, Vol. 71, No. 225, November 22, 2006, (ADB-06-03)

Operators should use the full range of safe locating excavation practices. In particular, pipeline operators should ensure the use of qualified personnel to accurately locate and mark the location of its underground pipelines.

Recognizing and Reacting to Abnormal Operating Conditions

Note:
The following Abnormal Operating Conditions (AOCs) and their reactions listed are for guidance only. This AOC list is not presented as an exhaustive treatment of AOCs and appropriate responses. You may be required to know and apply other AOCs and AOC responses for different tasks. Properly recognizing and reacting to covered task AOCs are the responsibility of persons qualified to perform the covered task. Always follow your company's policies and procedures.

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(1) **Things to Consider When Responding to Abnormal Operating Conditions.** The following information is basic knowledge that will assist you in assessing and responding to abnormal operating conditions:

(a) **Basic Properties of Natural Gas.**
- Natural gas is lighter than air, colorless and odorless.
- Natural gas has a specific gravity of approximately 0.6.
- The natural gas Lower Explosive Limit (LEL) is approximately 5%.
- The natural gas Upper Explosive Limit (UEL) is approximately 15%.
- The ignition temperature of natural gas is about 1100°-1200° F.

(b) **Eliminating Ignition Sources.** Some of the ways to eliminate ignition sources are very obvious. For example:
- Smoking and open flames should be prohibited in structures or areas containing gas facilities where possible leakage or presence of gas constitutes a hazard of fire or explosion.
- Smoking and open flames should be prohibited in the open when accidental ignition of a gas-in-air mixture could cause personal injury or property damage.
- Do NOT smoke or use open flames near a jobsite/gas pipeline facility.
- Sparks range in temperature from 1500°F in an electrical switch to 9,000°F in an arc welder. Do NOT use equipment or create situations that generate sparks. Sparks may be generated by the following conditions:

Communication equipment
Portable electrically powered tools and equipment
Internal combustion engines
Breaking electrical continuity
Static electricity on plastic pipe

(c) **Personal Protection Equipment.**

Always follow your company's policies and procedures for the use of personal protection equipment (PPE).

Working around gas pipeline facilities requires practical safety practices and basic PPE may include:

- Head protection (e.g. hard hat)
- Eye and face protection (e.g. goggles, face shield, etc.)
- Hearing protection (e.g. ear plugs, ear muffs, etc.)
- Hand protection (proper glove material for the specific job)
- Respiratory protection (proper respiratory equipment when air content is insufficient)

(2) **Abnormal Operating Conditions for Locate and Mark Underground Pipeline Facilites.**

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Pipeline markers that are improperly located	• Install new markers as needed or notify appropriate personnel
• When required pipeline markers are missing	• Install new markers as needed or notify appropriate personnel.
• Damaged, missing, or unreadable markers	• Re-label or replace as needed or notify appropriate personnel.
• Unable to locate using pipeline locator	• Check maps, tap cards, or expose line.
• Improperly located pipeline markers	• Install new markers as needed.
• Missing required pipeline markers	• Install new markers as needed.
• Damaged or unreadable markers	• Re-label or replace as needed.
• Failure to notify the One-Call System and requesting a locate prior to excavating	• Stop excavation activities; notify the One-Call System; obtain locate, and mark before resuming
• Inaccurate maps of existing pipeline facilities	• Correct maps and related documents to reflect actual locations and conditions
• Inaccurate temporary facilities location marking within the excavation area	• Stop excavation activities until actual locations can be verified and marked
• Missing or damaged PE tracing wire	• Install new wire or repair wire
• Failure to use a spotter/swamper during excavation using excavation machinery	• Stop excavation until a qualified spotter/swamper is in place

• Operating excavation machinery within 2 feet of pipeline facilities or other utilities	• Stop excavation with machinery; use probing and hand-digging to expose the pipeline or other utility's facilities

REVIEW I

Locating and Marking Underground Facilities

A. Select from the list below the word or phrase that best completes each of the following incomplete statements. Write the letter of your choice in the space provided.

A. inductive
B. lighter
C. conductive
D. heavier
E. implement emergency response procedures
F. smoking
G. install new markers as needed
H. trace procedure
I. search procedure
J. depth determination procedure

E 1. If an abnormal operating condition presents an immediate danger, you must make the decision to either make repairs, if possible, replace component(s) at the time of discovery, or E.

B 2. Natural gas is B than air and odorless.

F 3. One way to eliminate ignition sources is to prohibit F and open flames near gas facilities and the worksite.

A 4. Air lock or air coupling may occur when the A mode of operation is used to locate buried metal structures.

C 5. A mode of operating the pipe locator that insures the signal does not jump to other conductors is the C mode.

G 6. If you locate improperly located pipeline markers, you should G.

I 7. The procedure used to locate a pipe when there is no knowledge or indication of the location is referred to as the I.

J 8. The procedure used during pipe locating that requires the receiver to be tilted at a 45 degree angle is the J.

H 9. The H is used when one position of the buried structure is known and the actual path of the structure Is to be determined.

B. Identify the true statements listed below by placing an "X" in the appropriate space.

_____ a. A dry, sandy, loosely-packed soil provides a good conductive environment.

__X__ b. The inductive mode functions by transmitting a signal through the air and ground cover over the metal structures being located where a conductive hook-up is impractical.

__X__ c. The frequency of the signal is one of the factors which affect the ability of the signal to be impressed onto the conductor.

Directions: Respond to the following items.

1. List a minimum of three reasons why underground utility structures should be located.

<u>Any three of the following</u>:

a. FOR DIGGING SOND DAMAGE

b. MAP [illegible]

c. [illegible]

2. Identify the true statements listed below by placing an "X" in the appropriate blanks.

__X__ a. System maps are a commonly used method to locate underground gas pipes.

_____ b. The most dependable method of locating underground structures is relying on the memory of the employee.

__X__ c. Vacuum excavation to locate a pipe is expensive.

__X__ d. A steel rod is sometimes used to probe into the soil in an effort to pinpoint the location of a pipe.

3. List the three procedures generally involved when using pipe locators.

   a. SEARCH

   b. TRACE

   c. DEPTH

4. Temporary underground facility markers consist of any one or a combination of:

   a. PAINT

   b. FLAGS

   c. STAKES

Match the following utility systems with the proper color codes used by the American Public Works Association.

A. white
B. safety green
C. safety alert orange
D. high visibility safety yellow
E. safety red
F. safety precaution blue

E 5. Municipal electric systems

D 6. Oil and gas distribution and transmission

C 7. Cable television

F 8. Potable water

B 9. Sewer and storm drainage systems

A 10. Proposed excavation or construction boundaries

Knowledge Verification Checklist

OQ Task CM-2
Locate and Mark Underground Pipeline Facilities

Directions: Use the following performance criteria statements as a self-evaluation in preparation for the final exam.

I can identify:

- ☐ 1. Why it is important to know the exact location of buried piping. (CM-2.1.1)
- ☐ 2. The most obvious way of locating underground gas pipes. (CM-2.1.2)
- ☐ 3. An expensive method of locating underground pipe. (CM-2.1.3)
- ☐ 4. A method used to locate underground pipe in a natural gas system using steel rods. (CM-2.1.4)
- ☐ 5. A method sometimes used to locate pipe in a natural gas system that involves remembering physical features of the area. (CM-2.1.5)
- ☐ 6. The method that is primarily used when using a pipe locator in close proximity to other conductors. (CM-2.1.6)
- ☐ 7. The method that permits locating conductors in areas where a conductive hook-up is impractical or impossible. (CM-2.1.7)
- ☐ 8. What occurs when a transmitter and receiver are operated too close to each other. (CM-2.1.8)
- ☐ 9. Whether or not dry, sandy, or loosely-packed soil provides a good conductive path. (CM-2.1.9)
- ☐ 10. What is impressed on a pipe from the transmitter when using a pipe locator. (CM-2.1.10)
- ☐ 11. The procedure used when there is no knowledge or indication of the location of the buried structure. (CM-2.1.11)
- ☐ 12. The procedure used to locate the actual path of the pipe when one location of the pipe is known. (CM-2.1.12)

I can identify:

- ❑ 13. The angle a receiver should be held when determining the depth of a buried pipe. (CM-2.1.13)
- ❑ 14. The correct way to mark a temporary underground facility. (CM-2.1.14)
- ❑ 15. The correct color codes used by the American Public Works Association. (CM-2.1.15)
- ❑ 16. An abnormal operating condition associated with locating and marking underground facilities. (CM-2.1.16)

Skill and Ability Verification Packet

OQ Task CM-2
Locate and Mark Underground Pipeline Facilities

I. General Instructions

Instructions for Use

The Skill and Ability Verification Packet is designed to standardize conditions under which the employee demonstrates his/her performance of tasks that meet the operator qualification requirements established by the employee's company.

Completing the enclosed affidavit and uploading the data to Industrial Training Services OnBoard LMS for recordkeeping, documents the satisfactory completion of tasks. Both the OQ Authorized Evaluator (AE) and employee must sign the affidavit.

Instructions to the Employee

Your OQ AE will check your performance using the suggested evaluator guide included in each hands-on task assignment. This suggested guide must be supplemented or replaced by the individual company's policies and procedures related to the task being evaluated.

You must adhere to all safety precautions according to your company's policies and procedures and applicable federal, state, and local codes and regulations.

II. Task Information

OQ Task CM-2:	**Locate and Mark Underground Pipeline Facilities**
Qualification Standard:	The employee's qualification is based on the enabling operation(s) that have been successfully completed. The task operations are listed below:
OQ CM-2.1:	Locate Underground Pipelines (B31Q 1291)
OQ CM-2.2:	Install and Maintain Pipeline Markers (B31Q 1301)
OQ CM-2.3:	Temporarily Mark Underground Pipeline Facilities (ITS 5101)
Recommended Requirement:	The employee must demonstrate proficiency to an acceptable level based on the Skill and Ability Checklist associated with each operation.
References:	49 CFR, 192.614, 192.707. B31Q Tasks 1291, 1301.

Note:

The following Abnormal Operating Conditions (AOCs) and their reactions listed are for guidance only. This AOC list is not presented as an exhaustive treatment of AOCs and appropriate responses. You may be required to know and apply other AOCs and AOC responses for different tasks. Properly recognizing and reacting to covered task AOCs are the responsibility of persons qualified to perform the covered task. Always follow your company's policies and procedures.

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Abnormal Operating Conditions

(Not limited to the examples listed below)

Recognize	React
• Pipeline markers that are improperly located	• Install new markers as needed or notify appropriate personnel.
• When required pipeline markers are missing	• Install new markers as needed or notify appropriate personnel.
• Damaged, missing or unreadable markers	• Re-label or replace as needed or notify appropriate personnel.
• Unable to locate using pipeline locator	• Check maps, tap cards or expose line.
• Improperly located pipeline markers	• Install new markers as needed.
• Missing required pipeline markers	• Install new markers as needed.
• Damaged or unreadable markers	• Re-label or replace as needed.
• Failure to notify the One-Call System and requesting a locate prior to excavating	• Stop excavation activities; notify the One-Call System; obtain locate, and mark before resuming
• Inaccurate maps of existing pipeline facilities	• Correct maps and related documents to reflect actual locations and conditions
• Inaccurate temporary facilities location marking within the excavation area	• Stop excavation activities until actual locations can be verified and marked
• Missing or damaged PE tracing wire	• Install new wire or repair wire
• Failure to use a spotter/swamper during excavation using excavation machinery	• Stop excavation until a qualified spotter/swamper is in place
• Operating excavation machinery within 2 feet of pipeline facilities or other utilities	• Stop excavation with machinery; use probing and hand-digging to expose the pipeline or other utility's facilities

III. Skill and Ability Verification Checklist

OQ Task CM-2
Locate and Mark Underground Pipeline Facilities

I verify that (Please Print) ______________________________________ **is qualified to perform OQ Task CM-2 according to his/her company's procedures:**

(CM-2.1) Locate Underground Pipelines. (1291)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Select method for locating the following:
  - direct connection/conductive
  - indirect connection/inductive
  - appropriate frequency, if applicable
- ☐ Perform test equipment check to verify that equipment functions ithin specified parameters.
- ☐ Inspect equipment.
  - Verify battery strength.
  - Verify audible and visual indicators.
  - Check gain adjustments, as applicable.
  - Test equipment with known sources, as applicable.
- ☐ Visually inspect locate area for the following, as applicable:
  - identification of the locate area (white lines)
  - pipeline markers
  - pipeline facilities (valve box, meter sets, regulator stations, etc.)
  - evidence of excavations
  - evidence of other utilities
  - previous locate marks (paint, whiskers, flags, etc.)
  - high-tension lines or other foreign lines that may have any effect on the signal
- ☐ Locate pipeline.
  - Evaluate signal strength, as applicable.
  - Identify direction changes.
- ☐ Pothole/expose/probe pipeline, as applicable.
- ☐ Place temporary markers on successfully located pipeline following universal color codes and marking procedures/methods, as applicable. Use methods such as the following:
  - paint
  - flags/chasers/whiskers
  - stakes
- ☐ Validate/compare physical locate with existing documentation, including, but not limited to, the following:
  - maps
  - service cards
  - as-builts
  - construction drawings
- ☐ Make notifications, as appropriate.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Pipeline markers that are improperly located	• Install new markers/relocate markers as needed
• When required pipeline markers are missing	• Install new markers as needed
• Damaged, improper or unreadable markers	• Re-label or replace as needed

Comments / Additional Company Procedures:

(CM-2.2) Install and Maintain Pipeline Markers. (1301)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Evaluate existing pipeline marker against requirements.
  - Verify identified lines marked in accordance with requirements.
  - Verify marker information/legibility.
  - Verify documentation of markers/locations.
  - Observe ROW, and report abnormalities to appropriate personnel.
- ☐ Prepare to install pipeline marker.
  - Determine marker type and method of installation/repair.
  - Identify locations for marker placement.
  - Confirm pipe location.
- ☐ Install pipeline markers.
  - Observe ROW, and report abnormalities to appropriate personnel.
  - Clear location where marker is going to be placed.
  - Verify line location.
  - Verify marker information matches line specifications.
  - During installation, verify proper depth to prevent movement and contact/damage on the pipe.
  - Verify proper placement over pipe.
  - Verify pipeline is sufficiently identified by the markers.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Pipeline markers that are improperly located	• Install new markers/relocate markers as needed
• When required pipeline markers are missing	• Install new markers as needed
• Damaged, improper or unreadable markers	• Re-label or replace as needed

Comments / Additional Company Procedures:

(CM-2.3) Temporarily mark underground pipeline facilities. (5101)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Perform task according to company operating procedures.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Pipeline markers that are improperly located	• Install new markers/relocate markers as needed
• When required pipeline markers are missing	• Install new markers as needed
• Damaged, improper or unreadable markers	• Re-label or replace as needed

Comments / Additional Company Procedures:

IV. Employer Record

OQ Task CM-2

Locate and Mark Underground Pipeline Facilities

Employee Information (Please Print):

Name ______________________________

Last 4 Digits of Social Security Number ______________________________

Company Name ______________________________

Company Mailing Address ______________________________

City ______________________ State __________ Zip ______________

Affidavit

I acknowledge the performance of this task is solely for the purpose of operator qualification, and is not intended to replace or modify company operating procedures or policies and may not be appropriately used in all circumstances. I acknowledge that I am responsible for recognizing hazards and abnormal conditions in my work place and must exercise care and good judgment; always using appropriate equipment, procedures and tools for tasks I perform. Industrial Training Services, Inc. assumes no liability for my actions nor for my application of the qualification performance guides used in this evaluation checklist.

Employee's Signature ______________________ Date ______________

Evaluator Information (Please Print):

Name ______________________________

Organization/Employer ______________________________

Telephone Number ______________________________

Affidavit

I affirm that I am the person who has administered this checklist and that I have conducted this assessment with integrity. I also affirm that the above named employee is the person assessed and that the above named person performed the initialed tasks at the indicated level.

Evaluator's Signature ______________________ Date ______________

The employee is qualified according to company standards to perform the tasks listed below as indicated:

	Not Applicable	TASK/OPERATIONS	Method of Skill/Ability Verification Enter Number From List Below
1.	☐	(CM-2.1) Locate Underground Pipelines. (1291)	☐
2.	☐	(CM-2.2) Install and Maintain Pipeline Markers. (1301)	☐
3.	☐	(CM-2.3) Temporarily Mark Underground Pipeline Facilities. (5101)	☐

Method of Knowledge Verification

- Written Exam

Method of Skill/Ability Verification Observed During:

1. Performance on the Job
2. Simulation

After completion of Section IV, "Employer Record," remove section from the packet for your records. For third party verification and database reporting service, upload the data to Industrial Training Services OnBoard LMS.

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INDUSTRIAL
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DANNY SHROUT

OQ Compliance Series
Student Manual

OQ Task CM-1
v11.6

Perform Patrol and Leakage Surveys on Gas Pipeline Facilities

INDUSTRIAL TRAINING SERVICES

ITS OQ Compliance Series

CM-1 Perform Patrol and Leakage Surveys on Gas Pipeline Facilities v11.6

Student Manual

INTRODUCTION

Detecting the presence of natural gas is an important operation performed by workers in the natural gas industry. To complete this module you will be required to complete the check-out activities listed below.

OBJECTIVES

1. Identify factors basic to patrol and leakage surveys on gas pipeline facilities.
2. Perform patrol and leakage surveys of gas distribution systems.
3. Perform patrol and leakage surveys of gas transmission piping facilities.

CHECK-OUT ACTIVITIES

Your instructor will provide you with a list of incomplete statements related to performing patrol and leakage surveys on gas pipeline facilities and a list of responses. Select the response that most correctly completes each statement. Cut off score is 80%. (Knowledge Verification)

Your instructor will provide you with a Skill and Abilities Verification Checklist. At the appropriate time demonstrate your skill and ability by correctly performing each operation required under the task. (Skill & Ability Verification)

OQ CM-1 covers requirements indicated in the following codes/regulations:

ITS OQ Covered Task:	ASME B-31 Q*	49 CFR 192**
OQ CM-1.1 Outside Gas Leak Investigation	1241	192.5, 192.613, 192.706, 192.723
OQ CM-1.2 Walking Gas Leakage Survey	1261	
OQ CM-1.3 Mobile Gas Leakage Survey: Flame Ionization	1271	
OQ CM-1.4 Mobile Gas Leakage Survey: Optical Methane	1281	
OQ CM-1.5 Inspect Pipeline Surface Conditions: Patrol Right of Way or Easement	1311	192.5, 192.613, 192.705, 192.721

***ASME B31Q Covered Tasks:**

1241 Outside Gas Leak Investigation.
1261 Walking Gas Leakage Survey.
1271 Mobile Gas Leakage Survey: Flame Ionization.
1281 Mobile Gas Leakage Survey: Optical Methane.
1311 Inspect Pipeline Surface Conditions: Patrol Right of Way or Easement.

****49 CFR Part 192 Covered Regulations:**

49 CFR 192 covered regulations are identified within the appropriate section of this module.

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Table of Contents

INSTRUCTION SHEET I

Identifying Factors Basic to Patrol and Leakage Surveys on Gas Pipeline Facilities

Patrol and leakage surveys on gas pipeline facilities are basic to hazard prevention and leak control programs. Gas companies give the highest priority to these programs.

D.O.T. Standard

§ 192.613 Continuing surveillance.

(a) Each operator shall have a procedure for continuing surveillance of its facilities to determine and take appropriate action concerning changes in class location, failures, leakage history, corrosion, substantial changes in cathodic protection requirements, and other unusual operating and maintenance conditions.

(b) If a segment of pipeline is determined to be in unsatisfactory condition but no immediate hazard exists, the operator shall initiate a program to recondition or phase out the segment involved, or, if the segment cannot be reconditioned or phased out, reduce the maximum allowable operating pressure in accordance with §192.619 (a) and (b).

Continuing surveillance should be conducted so as to identify any pipeline facilities experiencing abnormal or unusual operating and maintenance conditions. This may be accomplished by the following:

(1) Periodic visual inspection of facilities such as the following:

- Changes of population densities
- Effect of exposure or movement of pipeline facilities
- Changes in topography which may have an effect on pipeline facilities
- Potential for, or evidence of, tampering, vandalism, or damage
- Effects of encroachments on pipeline facilities
- Potential for gas migration into buildings from vaults and pits through air intakes
- Specific circumstances relating to patrolling and leakage
- Potential for, or evidence of, soil or water accumulation in vaults or pits

(2) Periodic review and analysis of records, such as the following:

- Patrols
- Leakage surveys
- Valve inspections
- Vault inspections
- Pressure regulating, relieving, and limiting equipment inspections
- Corrosion control inspections
- Facility failure investigations

Physical Properties of Natural Gas

Gas leak detection requires the use of proper techniques and equipment. An analytical strategy must be adopted to effectively detect a gas leak and respond properly to dangerous or potentially dangerous conditions. A basic understanding of the physical properties of natural gas and its action under various conditions is essential in order to properly perform gas leakage and patrolling surveys.

The specific gravity of natural gas is approximately 0.6, which is lighter than air. This property facilitates the venting and dissipation of natural gas leakage into the atmosphere.

The flammable range of natural gas is approximately 5 to 15 percent gas in air.

The lowest flammable natural gas-in-air mixture that will ignite is referred to as the L.E.L. (lower explosive limit).

Table 1. Significant Physical Properties of Natural Gas

Normal State at atmospheric pressure at 60°F	Gas
Specific Gravity (Air=1.0)	0.6
Flammability Limits: Lower limit % Gas in Air Upper limit % Gas in Air	 5 15

192.625 (a) Odorization of Gas states "a combustible gas in a distribution line must contain a natural odorant or be odorized so that at a concentration in air of one-fifth of the lower explosive limit, the gas is readily detectable by a person with a normal sense of smell."

Definitions Applicable to Performing Patrol and Leakage Surveys

Bar hole	A hole that is made in the soil or paving for the specific purpose of testing the subsurface atmosphere with a CGI.
Building	The structure which is normally or occasionally entered by humans for business, residential, or other purposes, and in which gas could accumulate.
Class 1 Location	A location along a transmission pipeline that has 10 or fewer buildings intended for human occupancy in the equivalent area of one mile along the pipeline, and 220 yards either side of the pipeline, or any offshore area.
Class 2 Location	A location along a transmission pipeline that has more than 10 but fewer than 46 buildings intended for human occupancy in the equivalent area of one mile along the pipeline, and 220 yards either side of the pipeline.
Class 3 Location	A location along a transmission pipeline that has 46 or more buildings intended for human occupancy in the equivalent area of one mile along the pipeline, and 220 yards either side of the pipeline, or a pipeline within 100 yards of a public place of assembly (such as a park, playground, church, school etc.) that is occupied by 20 or more persons on at least 5 days a week for 10 weeks in any 12-month period.
Class 4 Location	Any location where buildings with four or more stories aboveground are prevalent.
Combustible Gas Indicator (CGI)	A device capable of detecting and measuring gas concentrations (of the gas being transported) in the atmosphere.
Confined space	Any subsurface structure (such as vaults, tunnels, catch basins, or manholes) of sufficient size to accommodate a person and in which gas could accumulate. For the purpose of OSHA's Confined Space Permit Entry Standard, *confined space* means a space that: is large enough and so configured that an employee can bodily enter and perform assigned work; and has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry and exit)

and is not designed for continuous employee occupancy. A confined space meeting the description under OSHA's definition requires compliance with all provisions of the permit entry standard, including the use of Class 4-gas monitors, personal protective equipment, personnel retrieval equipment, and the attendance of a qualified attendant outside of the confined space who has the training and ability to extricate the person working in the confined space without entering the confined space.

Follow-up inspection An inspection performed after a repair has been completed to determine the effectiveness of the repair.

Gas Associated Substructure A device or facility utilized by a gas company (such as a valve box, vault, test box or vented casing pipe) which is not intended for storing, transmitting, or distributing gas.

L.E.L. The lower explosive limit of the gas being transported.

Natural gas A mixture of gases, primarily methane, that is lighter than air.

Petroleum gas Mixtures of propane, butane (other than a gas-air mixture that is used to supplement supplies to a natural gas distribution system) that is heavier than air.

Prompt-action Dispatching qualified personnel without delay for the purpose of evaluating and, where necessary, abating the existing or probable hazard.

Reading A repeatable deviation on a CGI or equivalent instrument, expressed in LEL. Where the reading is in an unvented confined space, consideration should be given to the rate of dissipation when the space is ventilated, and the rate of accumulation when the space is resealed.

Small Substructures (Other than gas associated substructures) are any subsurface structures that are of insufficient size to accommodate a person (such as telephone and electrical ducts and conduit or non-gas-associated valve and meter boxes), and in which gas could accumulate or migrate.

Tunnel A subsurface passageway large enough for a person to enter and in which gas could accumulate.

Leak Detection Instruments and Their Applications

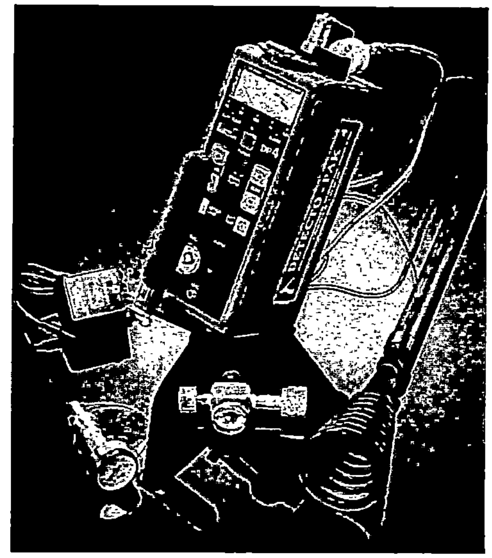

Figure 1. Flame Ionization Detector

Gas leak indicators are sophisticated instruments that require regular care, maintenance, and calibration, and should be used by trained personnel. Three types are commonly used by the gas industry for surveying and pinpointing leaks:

- Flame ionization (FI) gas detector (For surveying), and
- Combustible gas indicator (CGI) (for pinpointing gas leaks).
- Remote Methane Leak Detector (RMLD™)

A fourth type of instrument, called a bead sensor type detector, is most often used for inspecting exposed piping and appliances to test for leaks on those facilities. Bead sensor instruments are not generally used for leak surveys of underground piping and cannot be used to classify gas leaks.

(1) Flame Ionization Instruments—Leak Patrolling and Locating

The FI detector uses a hydrogen fuel to power a small flame in a detector cell. A pump or venturi 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.

This is detected electronically and displayed on a meter readout. FI units are equipped with meters that indicate gas concentrations from one part per million (PPM) to 10,000 PPM (which is the same as one-percent gas in air). They are also equipped with audible alarms to alert the operator when there is a meter deflection.

Leak surveys 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.

(2) Combustible Gas Indicators—Leak Classification (Measurement)

The CGI illustrated in Figure 2 consists of a meter, a probe, and an aspirator bulb. The bulb is pumped by hand to bring a sample of air into the probe and the instrument. The dial on the instrument indicates the percentage of flammable gas-in - air (percent gas scale) or percent of the lower explosive limit (LEL) scale.

These instruments must be calibrated for the type of gas in the system. The CGI should be calibrated for natural gas for use on a natural gas system.

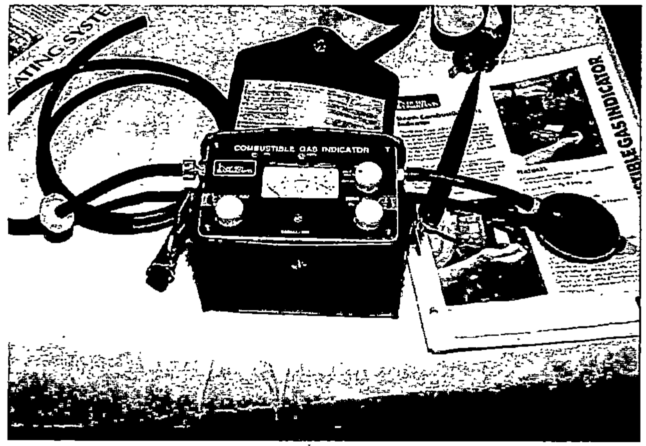

Figure 2. Combustible Gas Indicator (Analog Scale, Bulb–Aspirated)

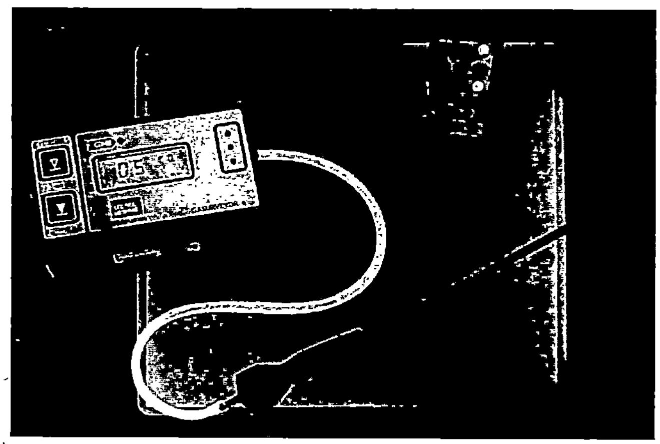

Figure 3. Combustible Gas Indicator (Digital Meter, Vacuum Pump Sampling)

Figure 3 illustrates a CGI that is equipped with a digital meter which automatically switches from LEL to percentage scales on start-up. It also has operator controls for selecting scales. Gas-in-air sampling is automatic, with samples drawn into the instrument by a battery-powered pump.

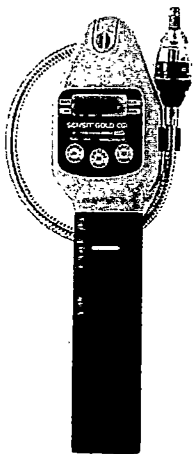

Figure 4. Sensit® Gold CGI

These instruments must be calibrated for the type of gas in the system. The CGI should be calibrated for natural gas for use on a natural gas system.

Figure 4 illustrates a Sensit® Gold CGI in which the display shows all gas concentrations simultaneously fulfilling any confined space entry requirements. A bar hole test feature helps to accurately locate belowground leaks. An operator controlled tick rate assists in finding leaks on exposed piping.

The CGI is not suitable for sampling unconfined air over a pipeline or near the ground surface. CGIs are designed primarily for use in a confined space. Its two main applications for outside surveys are termed "available openings" and "bar holing." A bar hole is a small diameter hole made in the ground in the vicinity of gas piping to extract a sample of the ground atmosphere for leak analysis. **NOTE: Use extra caution to prevent damage to piping when bar holing in the area of Polyethylene pipe.**

Because most CGIs give gas concentration readings using a two-scale meter, which indicates gas-in-air concentrations in terms of lower explosive limit (LEL) and percent gas, they are ideally suited to measuring and classifying gas leaks.

(3) **Remote Methane Leak Detector (RMLD).** The RMLD is a laser-based natural gas sensor used to locate leaks in natural gas transmission and distribution pipelines. The RMLD can detect leaks up to 100 feet away allowing remote detection of hard-to-reach areas and difficult terrains.

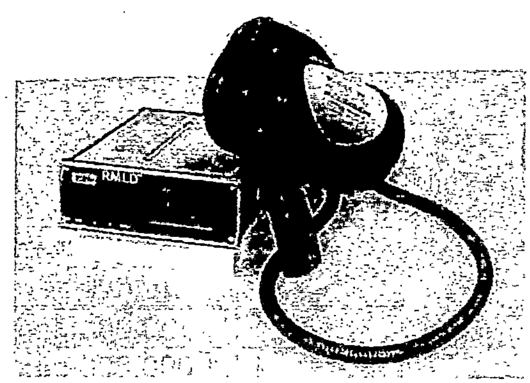

Figure 5. Example of a Handheld, Eye-Safe RMLD

When the infrared laser beam passes through a gas plume, the methane absorbs a portion of the light which the RMLD detects. This signal is processed so that methane concentrations can be reported in parts per million meter or PPM-M.

(4) Reading Instrument Measurements: Gas Concentrations in Air.

Flammability limits for natural gas are illustrated in Figure 6. According to industry standards, gas-in-air concentrations below 5% are normally considered too lean for ignition to occur, while concentrations higher than 15% are normally considered too rich for ignition to occur. Locations that have gas-in-air mixtures above 5% are **NOT** safe locations and classified as hazardous atmospheres, and work in and near such areas requires special precautions, personal protection equipment, and procedures.

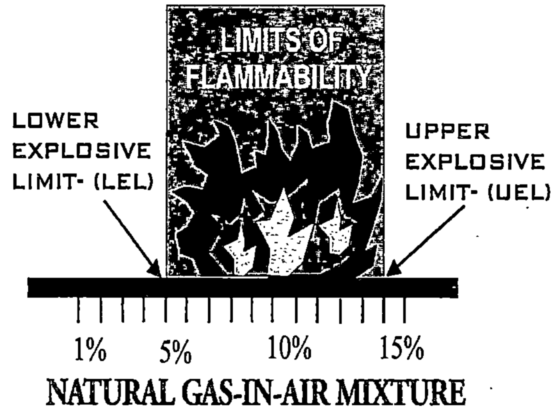

Figure 6.
Natural Gas Flammability Limits

When measurements of gas-in-air concentrations are made, it is important to understand fundamental units of measurement. Table 2 can be used to compare measurements expressed in parts per million (ppm), gas-in-air percentages, and in terms of LEL for natural gas in air mixtures.

1,000 ppm gas-in-air	= 0.1% gas-in-air mixture
5,000 ppm gas-in-air	= 0.5% gas-in-air mixture
50,000 ppm gas-in-air	= 5% gas-in-air mixture = 100% of L.E.L

Decimal expression of parts per million and gas-in-air percentages.

0.000001	1 part per million	
0.00001	10 parts per million	
0.0001	100 parts per million	
0.001	1,000 parts per million	
0.01	10,000 parts per million	= 1% Gas-in-air; 1/5 of L.E.L.
0.1	100,000 parts per million	= 10% Gas-in-air
1	1,000,000 parts per million	= 100% Gas-in-air

Table 2. Comparison of Percent Gas-In-Air Mixtures and Gas in Parts Per Million

A 1 percent gas-in-air mixture for natural gas can be expressed as 10,000 ppm, and is significant because it is 1/5 of the LEL, and the level at which gas odorization should be detectible to a person with a normal sense of smell. When working with gas detection and concentration measurements, do not rely on gas odorization for personal safety or the protection of life and property. When correctly applied and operated, a properly calibrated gas detection instrument that has a sufficiently

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charged battery should always be considered more reliable than odorization for determining possibly hazardous gas concentrations.

Calibration of Instruments

Each instrument used for leak detection and evaluation should be calibrated in accordance with the manufacturer's recommended calibration instructions, and:

- After any repair or replacement of parts.
- On a regular schedule giving consideration to the type and usage of the instrument involved. HFI systems and CGI instruments should be checked for calibration at least once each month while in use.
- At any time it is suspected that the instrument's calibration has changed.

Leakage Classification and Action Criteria

When evaluating any gas leak indication, the initial step is to determine the perimeter of the leak area. When this perimeter extends to a building wall, the investigation should continue into the building. A widely used classification system, developed by the American Society of Mechanical Engineers, is illustrated in the following table. Leaks are classified into three basic grades designated by gas industry operating personnel as Grade 1 (Group 1), Grade 2 (Group 2), and Grade 3 (Group 3).

Guidelines for leak classification and leakage control are provided in Table 3 on the next page. The examples of leak conditions provided in Table 3 are presented as guidelines and are not exclusive. The judgment of the company personnel at the scene is of primary importance in determining the grade assigned to a leak.

Table 3. Leak Classification and Action Criteria

Grade	Definition	Action Criteria	Examples
1	A leak that represents an existing or probable hazard to persons or property, and requires immediate repair or continuous action until the conditions are no longer hazardous.	Requires *prompt action** to protect life and property, and continuous action until the conditions are no longer hazardous. *The prompt action in some instances may require one or more of the following. a. Implementation of company emergency plan(192.615). b. Evacuating premises. c. Blocking off an area. d. Rerouting traffic. e. Eliminating sources of ignition. f. Venting the area. g. Stopping the flow of gas by closing valves or other means. h. Notifying police and fire departments.	1. Any leak which, in the judgment of operating personnel at the scene. is regarded as an immediate hazard. 2. Escaping gas that has ignited. 3. Any indication of gas which has migrated into or under a building, or into a tunnel. 4. Any reading at the outside wall of a building, or where gas would likely migrate to an outside wall of a building. 5. Any reading of 80% LEL, or greater, in a confined space. 6. Any reading of 80% LEL, or greater in small substructures (other than gas associated substructures) from which gas would likely migrate to the outside wall of a building. 7. Any leak that can be seen, heard, or felt, and which is in a location that may endanger the general public or property.
2	A leak that is recognized as being non-hazardous at the time of detection, but justifies scheduled repair based on probable future hazard.	Leaks should be repaired or cleared within one calendar year, but no later than 15 months from the date the leak was reported. In determining the repair priority, criteria such as the following should be considered. a. Amount and migration of gas. b. Proximity of gas to building and subsurface structures. c. Extent of pavement. d. Soil type, and soil conditions (such as frost cap, moisture and natural venting). Grade 2 leaks should be reevaluated at least once every six months until cleared. The frequency of reevaluation should be determined by the location and magnitude of the leakage condition. Grade 2 leaks may vary greatly in degree of potential hazard. Some Grade 2 leaks, when evaluated by the above criteria, may justify scheduled repair within the next 5 working days. During the working day on which the leak is discovered, these situations should be brought to the attention of the individual responsible for scheduling leak repair. On the other hand, many Grade 2 leaks, because of their location and magnitude, can be scheduled for repair on a normal routine basis with periodic reinspection as necessary.	A. Leaks Requiring Action Ahead of Ground Freezing or Other Adverse Changes in Venting Conditions Any leak which, under frozen or other adverse soil conditions, would likely migrate to the outside wall of a building. B. Leaks Requiring Action Within Six Months 1. Any reading of 40% LEL, or greater, under sidewalk in a wall-to-wall paved area that does not qualify as Grade I leak. 2. Any reading of 100% LEL, or greater, under a street in a wall-to-wall paved area that has significant gas migration and does not qualify as a Grade 1 leak. 3. Any reading less than 80% LEL in small substructures (other than gas associated substructures) from which gas would likely migrate creating a probable future hazard. 4. Any reading between 20% LEL and 80% LEL in a confined space. 5. Any reading on a pipeline operating at 30 percent SMYS, or greater, in a class 3 or 4 location, which does not qualify as a Grade 1 leak. 6. Any reading of 80% LEL, or greater, in gas associated substructures. 7. Any leak which, in the judgment of operating personnel at the scene, is of sufficient magnitude to justify scheduled repair.
3	A leak that is non-hazardous at the time of detection and can be reasonably expected to remain non-hazardous.	These leaks should be reevaluated during the next scheduled survey, or within 15 months of the date reported, whichever occurs first, until the leak is regarded or no longer results in a reading.	Leaks Requiring Reevaluation at Periodic Intervals 1. Any reading of less than 80% LEL in small gas associated substructures. 2. Any reading under a street in areas without wall-to-wall paving where it is unlikely the gas could migrate to the outside wall of a building. 3. Any reading of less than 20% LEL in a confined space.

Pinpointing Gas Leaks

Pinpointing a gas leak refers to determining the location of the ground surface which is directly over a leak in a buried pipeline. Reasonable accuracy is necessary to avoid needless excavations.

(1) **Converging Barhole Test Method.** The converging barhole test method is the most widely used method for pinpointing leaks in buried piping. Before a leak is pinpointed, the perimeter of the leak is established and the area of the strongest concentrations of gas is determined. The procedure is referred to as "centering." Centering is done by making combustible-gas-indicator tests of available openings and small-diameter hand barholes. This determines the extent of spread and establishes the area of highest concentration.

Centering allows a quick evaluation of the situation and accomplishes two major goals:

- It establishes whether a potential hazard exists by showing if the pattern extends to foundation walls and other underground structures like ducts or sewers
- It establishes the area where pinpointing efforts should be concentrated

The centering information shows only the perimeter of the leak, so you must pinpoint to locate the exact place of the leak. Testing is started at the outside edge of the pattern. A frequent practice is to drill barholes 12 feet apart at first to determine the areas of the highest concentration of gas. Barholes are tested with a combustible gas indicator until readings start to decrease, which shows the concentration of gas is lower in these areas. Gradually, the combustible gas indicator is used to sample the atmosphere in barholes drilled closer together (about four to six feet apart) in the vicinity of the barhole with the highest reading. In the area of the highest reading from this second set of barholes, more barholes are then made two feet on either side of this hole to pinpoint the area of the highest reading. The hole with the highest reading is usually closest to the leak source.

The soil over a wide area adjacent to a leak is often saturated with gas. Meter readings of 100 percent may show in several barholes. When this happens, purge the gas from the barholes and retest at scheduled time intervals. The hole where the gas reading increases the fastest is considered to be closest to the leak. Ejector aerators or purge bars, operated by compressed air, are used in barhole purging to pull the gas out of each barhole.

Barhole depths should be uniform in diameter and depth from hole to hole and extend to a point slightly deeper than the bottom of the main. This does much to eliminate variations in soil type and compaction. Frequently, soil directly below the pipeline is the least compacted area to a point where the gas can migrate toward the surface.

In any leakage situation, there are a number of factors, such as type of soil, depth of pipe, presence of utilities, etc., that are not controllable. These factors should be identified and/or located in order to reduce the number of unknown variables in any given leakage situation.

All safety precautions, including the use of proper personal protection equipment (PPE), should be followed when conducting a barhole test. The following safety procedures are suggested. Always follow your company's policies and procedures when performing a barhole test.

- Use a stop collar devise on the probing rod to limit penetration to less than the depth of the facilities.

- All probing tools should be blunted.

- Before performing a barhole test, look for the presence of underground structures. Some indications that an underground structure may exist include:

  - Aboveground or level ground markers
  - Manhole lids
  - Electric distribution transformers
  - Pre-existing mark outs
  - Valve boxes (e.g., water, gas)
  - Pedestals
  - Telephone, cable, and electric drops

- Remove the lids from valve boxes to determine the approximate depth of the facility.

- Locate all facilities and gas facility shut-offs and gain access to them prior to driving barholes.

- Stay within the limits of the locate request.

(2) **Barhole Placement Over Pipelines.** Very little positive information can be obtained from a single barhole, therefore a series of three barholes should be used initially and placed as close to the pipeline as possible. One hole should be placed at the point where centering and line-location data indicate the leak should occur. For example, if the highest centering test is 3 feet from a service tap, the first hole should be placed adjacent to the tap. The other two test holes should be placed 12 feet to 15 feet on each side of the center hole and as close to the pipeline as possible.

Comparative testing of the three holes with a combustible gas indicator should follow. Uniformity and control are mandatory in this step as well. In most cases, centering usually will have indicated that the CGI should be turned directly to the "percent gas" scale. If it is necessary to change the LEL range in order to obtain readings or if the tests show negative, there is, in all probability, something seriously wrong.

Pipe location and depth information should be rechecked before additional test holes are made. The barholes may not be deep enough or may be too deep, the leak may be on an unmapped line, or gas may be traveling to the centered area from a considerable distance. Normally, the original three barholes should be uniform in depth. Testing is done by placing the probe tip in the hole near the top of the barhole.

The aspirator bulb on the CGI should be squeezed until the lowest possible reading is obtained and holds. These readings should then be recorded and compared. The highest reading will determine the position of the next hole. Additional hole intervals should be maintained at 5 feet to 8 feet until the leak is "bracketed" within a 12 foot to 15 foot area. A few test holes in the bracketed area in most instances will establish the actual leak location.

(3) Basic Actions to Pinpointing Gas Leaks.[1]

- Establish the complete perimeter of the leak area with CGI positive readings in the soil and at any available openings. (This determines if a potential hazard exits.)
- Locate underground gas piping.
- Be aware of other underground utilities and how they might affect the migration of gas.
- Bar a series of evenly spaced holes of equal depth along and just offset from the line. Depth should be the full depth of the pipe. (Approximately 12-foot spacings.)
- Test holes with CGI. Aspirate instrument until lowest reading is obtained and holds.
- Compare readings.
- Determine area of greatest gas concentration and then place barholes at 3-foot intervals.
- Test and determine the barhole with highest gas concentration.
- Retest all barholes, if readings remain the same, excavate at barhole with greatest concentration. If readings change, allow barholes to vent or use a purger and retest.
- After leak repair, check to make sure the source of leak has been eliminated.

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[1] Instruction Book, Davis 'D-15' Gastester (9.3.2.7)

Having and following a systematic leak surveying, locating and classification routine is important due to the migration characteristics of natural gas leaks, as illustrated in Figures 7 and 8.

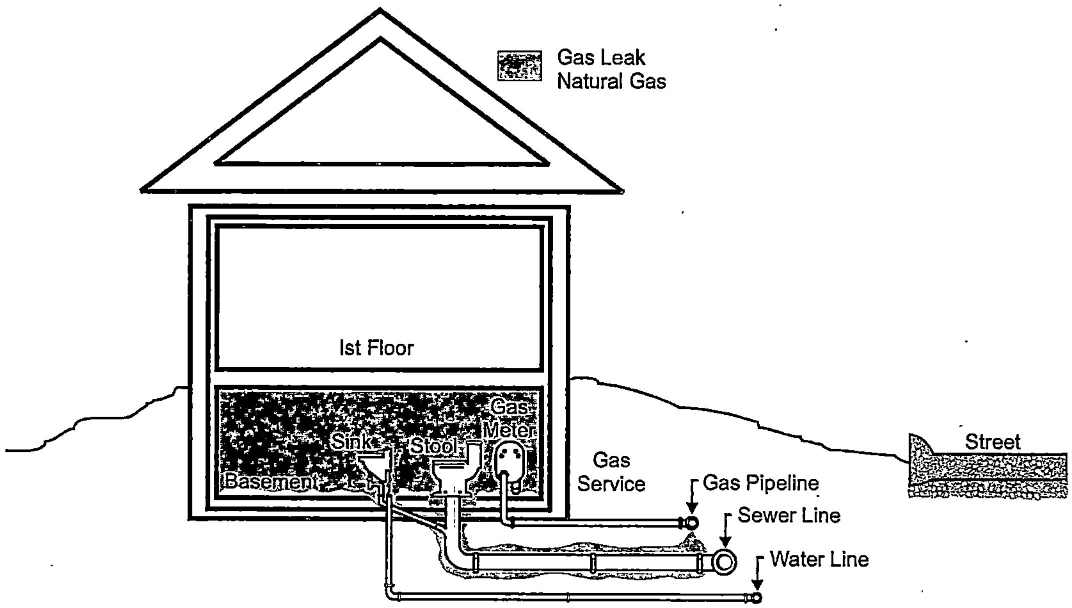

Figure 7.
Possible Gas Migration Pattern for a Natural Gas Leak Near a Structure

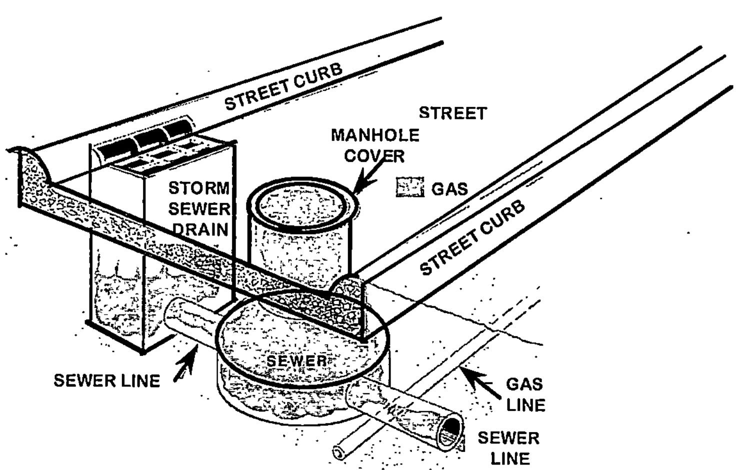

Figure 8.
Possible Natural Gas Migration Pattern for a Leak Near Sewer Drainage Structures, Streets, Curbs, and Gutters

Generally, a leak from a low-pressure pipe will move slower and spread more widely than a leak from a high-pressure pipe, which will tend to move more directly to the surface. Applying knowledge of these factors during leak locating, pinpointing, and repair operations is very important.

A good way to remember the fundamentals of leak detection, location, classification, and repair process is to ask, "WHERE is the Gas?" as follows:

- Where is the gas? (Use a detector to confirm gas is present)
- How much is there? (Take readings on the CGI)
- Extent of the spread? (Determine the migration pattern)
- Relation to other structures? (Is gas detected in or near buildings or in manholes?)
- Evaluate/evacuate? (Classify the leak and take appropriate action)

Mobile Gas Leakage Survey

The idea of conducting a leakage survey from a moving vehicle results in a reduction in the cost of performing a leakage survey.

The basic method of operation is to drive the unit over, along, or adjacent to the buried pipeline to be inspected. The sample is collected through numerous intake points mounted on the front of the unit as illustrated in Figure 9.

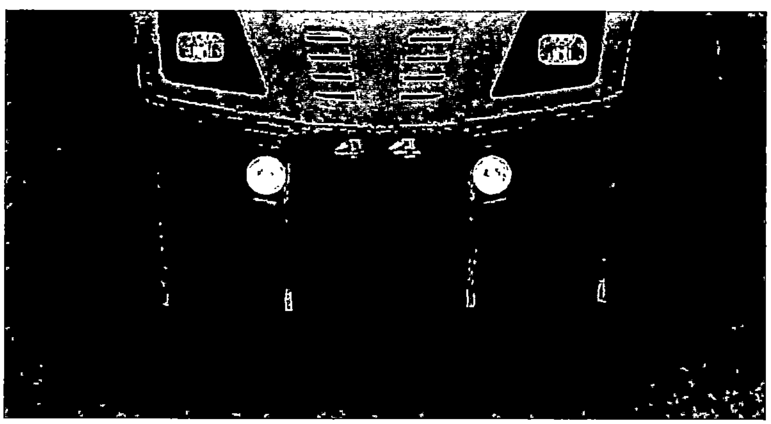

Figure 9. Mobile Flame Ionization Gas Leakage Detectors
Courtesy of Health Consultants

Mobile gas detection can be used to inspect production, transmission, or distribution lines as well as service lines. In situations where the unit cannot be driven over or adjacent to the pipe being inspected, the survey can be conducted by using a remote probe.

Current technologies allow the use of two types of gas detectors to be mounted to a vehicle. They are the (1) flame-ionization detector, and the (2) optical methane leak detector.

(1) **Mobile Gas Leakage Survey – Flame Ionization.** These detectors offer a sampling system that can survey an area at speeds of 300-400 feet per minute, depending on weather conditions, soil conditions, and gas-system design.

(2) **Mobile Gas Leakage Survey – Optical Methane.** Through the use of advanced sensing equipment, optical methane detectors are less sensitive to atmospheric conditions than flame ionization detectors and can detect leak indications in concentrations of less than 1 part per million.

Similar in design to the mobile flame ionization detector setup, the optical methane detector is mounted on the front of a vehicle and driven over or adjacent to the pipeline being inspected, as illustrated in Figure 10. A remote probe is also employed to allow access to areas that cannot be reached by the vehicle mounted system.

Figure 10. Mobile Optical Methane Leakage Detector

Follow-Up Inspection and Reevaluation of a Leak

The adequacy of leak repairs should be checked before backfilling. The perimeter of the leak area should be checked with a CGI. Where there is residual gas in the ground after the repair of a Grade 1 leak, a follow-up inspection should be made as soon as practical after allowing the soil atmosphere to vent and stabilize according to your company's policies and procedures. In the case of other leak repairs, qualified personnel should determine the need for a follow-up inspection. When a leak is to be reevaluated, it should be classified using the same criteria as when the leak was first discovered.

Documenting Leak Surveys, Repairs, and Pipeline Patrols

In order for your company to demonstrate that it is complying with state and federal pipeline safety regulations, it is imperative that adequate records are kept of all leak surveys, repairs, and other pipeline patrolling activities.

Part of your duties as a gas pipeline professional include completing accurate documentation of your work and the actions taken following the discovery of abnormal operating conditions such as leaks, vegetation abnormalities, or recent construction or excavation activity.

Follow company procedures when documenting patrol and leakage surveys.

PHMSA Advisory

The Pipeline and Hazardous materials Safety Administration (PHMSA), remind pipeline operators of the requirement of 49 CFR 192.613 for establishing a reliable procedure for continuing surveillance of pipeline facilities to identify problems and take appropriate action. This procedure includes the surveillance of cast iron and appropriate action concerning graphitization.

PHMSA asks operators of cast iron distribution pipelines to consider the following:

- Request, review, update, and monitor operator cast iron replacement plans and programs.
- Establish accelerated leakage survey frequencies or leak testing considering results from failure investigations and environmental risk factors.
- Focus on pipeline safety efforts on identifying the highest risk pipe.
- Use rate adjustments and flexible rate recovery mechanisms to incentivize pipeline rehabilitation, repair, and replacement programs.
- Strengthen pipeline safety inspections, accident investigations and enforcement actions.
- Install interior/home methane gas alarms

(Reference: PHMSA-2012-0039, Federal Register, Vol. 77, No. 57, 3-23-12.)

REVIEW I

Identifying Factors Basic to Patrol and Leakage Surveys on Gas Pipeline Facilities

Directions: Select from the list below the response, which most correctly completes each of the following statements. Write the letter of your choice in the space provided. Answers may be used only one time.

A.	lower explosive limit	G.	confined space
B.	bar hole	H.	0.6
C.	Grade 1	I.	100-200
D.	Grade 3	J.	optical methane
E.	5% to 15%	K.	RMLD
F.	converging barhole	L.	300-400

H 1. The specific gravity of natural gas is approximately _____.

E 2. The approximate flammability range for natural gas-in-air concentrations is _____.

A 3. A term sometimes used when referring to the lowest flammable natural gas-in-air mixture that will ignite is _____.

B 4. A hole made in the soil or paving for the specific purpose of testing the subsurface atmosphere with a CGI is called a _____.

G 5. Any subsurface structure of sufficient size to accommodate a person in which gas can accumulate is known as a _____.

C 6. A leak that represents an existing or probable hazard to persons or property, and requires immediate repair or continuous action until the conditions are no longer hazardous is classified as a _____ leak.

D 7. A leak that should be reevaluated during the next scheduled survey, or within 15 months of the date reported is classified as a _____ leak.

F 8. The most widely used method for pinpointing leaks in buried piping is the _____ test method.

J 9. The two types of leak detectors used in mobile gas leakage surveys are the flame ionization detector and the _____.

L 10. Mobile flame ionization detectors can be operated at _____ feet per minute given suitable atmospheric and soil conditions.

Directions: Select from the list below the response, which most correctly completes each of the following statements. Write the letter of your choice in the space provided.

A.	Class 1	G.	follow-up [leak] inspection
B.	continuing surveillance	H.	calibrated
C.	Class 3	I.	100% of LEL
D.	Class 4	J.	1 part per million
E.	hazardous atmospheres	K.	OSHA Confined Space Permit Entry Standard
F.	odorant is normally detectible		

C 11. The class location that identifies a transmission pipeline that has 46 or more buildings intended for human occupancy or a pipeline within 100 yards of a public place of assembly occupied by 20 or more persons for 50 days during any 12 month period is a _____ location.

K 12. A space that requires compliance under _____ includes the use of Class 4-gas monitors, personal protective equipment, personnel retrieval equipment, and the attendance of a qualified attendant outside the working space.

D 13. Any class location where buildings with four or more stories aboveground are prevalent is a _____ location.

A 14. An offshore transmission pipeline area is defined as a _____ location.

E 15. Locations that have gas-in-air concentrations above 15% are classified as _____.

I 16. A natural gas-in-air concentration of 50,000 ppm is equal to _____.

F 17. A natural gas-in-air concentration of 10,000 ppm is the minimum level at which _____.

H 18. Gas detection instruments should be _____ after repairs, in accordance with manufacturer's instructions, on a scheduled basis, and while they are in use, at least monthly.

G 19. A Grade 1 leak must have a _____ as soon as practical after allowing the soil atmosphere to vent and stabilize.

J 20. Optical methane leak detectors are capable of detecting leak concentrations of less than _____.

B 21. Operators of cast iron distribution pipelines must meet the requirements of DOT 49 CFR 192.613 and PHMSA recommendations to establish a reliable procedure for _____ to identify problems and take appropriate action.

INSTRUCTION SHEET II

Performing Patrol and Leakage Surveys of Gas Distribution Systems

Patrol and leakage surveys are basic to gas leak control programs used in distribution systems. They are systematic surveys made for the purpose of facilities surveillance to determine and take appropriate action concerning changes in class location, failures, leakage history, corrosion, substantial changes in cathodic protection requirements, and other unusual operating and maintenance conditions.

Performing Patrol Surveys on Gas Distribution Systems

(1) D.O.T. Standards.

§ 192.721 Distribution systems: Patrolling.

(a) The frequency of patrolling mains must be determined by the severity of the conditions which could cause failure or leakage, and the consequent hazards to public safety.
(b) Mains in places or on structures where anticipated physical movement or external loading could cause failure or leakage must be patrolled—

(1) In business districts, at intervals not exceeding 4 ½ months, but at least four times each calendar year; and
(2) Outside business districts, at intervals not exceeding 7 ½ months, but at least twice each calendar year.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192–43, 47 FR 46851, Oct. 21, 1982; Amdt. 192–78, 61 FR 28786, June 6, 1996]

(2) Observing Surface Conditions[2]. Distribution mains should be patrolled, as necessary, to observe factors affecting safe operation and to enable corrections of potentially hazardous conditions. In addition to visual evidence of leakage, patrol considerations should include observations and reporting of potential hazards such as the following:

(a) Excavation, grading, demolition, or other construction activity which could result in:
- Damage to the pipe
- Loss of support due to settlement or shifting of soil around the pipe
- Undermining or damage to pipe supports
- Loss of pipe cover

[2] 49 CFR, 192.721 Guide Material (1)

- Excessive fill

(b) Physical deterioration, including atmospheric corrosion of exposed piping, pipeline spans, and structural pipeline supports, such as:
- Bridges
- Pilings
- Headwalls
- Casings
- Foundations

(c) Natural causes that can result in impressed secondary loads, such as:
- Land subsidence
- Earth Slippage
- Soil erosion
- Extensive tree root growth
- Flooding
- Climatic conditions

(d) Need for additional distribution pipeline identification and marking in private right-of-way and in rural areas.

(e) Damage to casing vents and carrier pipe leakage at cased crossings.

(3) Scheduling Patrols[3]. Patrol of the system may be accomplished in conjunction with leakage surveys, scheduled inspections and other routine activities. Locations or areas that are considered potentially hazardous should be patrolled as frequently as deemed necessary based on the probable severity, timing, and duration of the hazard.

(4) Patrol Reports[4]. Patrol reports should indicate hazardous conditions observed, corrective action taken or recommended, and the nature and location of any deficiencies.

Performing Leakage Surveys on Gas Distribution Systems

Leakage surveys are basic to gas leak control programs of distribution systems. They are systematic surveys made for the purpose of locating leaks in gas distribution systems. Early detection is the best way to control leak hazards. The most frequent and intensive leak surveys are made on portions of the system with the highest leakage frequencies and in areas where leaks could be more hazardous, such as business districts and public buildings. Quicker and less costly surveys are used for other parts of the system. The data obtained from leakage surveys is the

[3] 49 CFR, 192.721 Guide Material (2)
[4] 49 CFR, 192.721 Guide Material (4)

basis for most replacement/repair decisions. It plays an important role in the operating costs of a company.

(1) D.O.T. Standards for Leakage Surveys.

> **§ 192.723 Distribution systems: Leakage surveys.**
>
> (a) Each operator of a distribution system shall conduct periodic leakage surveys in accordance with this section.
>
> (b) The type and scope of the leakage control program must be determined by the nature of the operations and the local conditions, but it must meet the following minimum requirements:
>
> (1) A leakage survey with leak detector equipment must be conducted in business districts, including tests of the atmosphere in gas, electric, telephone, sewer, and water system manholes, at cracks in pavement and sidewalks, and at other locations providing an opportunity for finding gas leaks, at intervals not exceeding 15 months, but at least once each calendar year.
>
> (2) A leakage survey with leak detector equipment must be conducted outside business districts as frequently as necessary, but at least once every 5 calendar years at intervals not exceeding 63 months. However, for cathodically unprotected distribution lines subject to §192.465(e) on which electrical surveys for corrosion are impractical, a leakage survey must be conducted at least once every 3 calendar years at intervals not exceeding 39 months.
>
> [35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192–43, 47 FR 46851, Oct. 21, 1982; Amdt. 192–70, 58 FR 54528, 54529, Oct. 22, 1993; Amdt. 192–71, 59 FR 6585, Feb. 11, 1994; Amdt. 192–94, 69 FR 32895, June 14, 2004; Amdt. 192–94, 69 FR 54592, Sept. 9, 2004]

(2) Determining the Location of Business Districts[5]. Business districts are the principle business areas in an urban community. In determining business districts, the following areas should be considered:

- The general public regularly congregates for economic, industrial, religious, educational, health or recreational purposes.
- The majority of the buildings on either side of the street are utilized for commercial, industrial, religious, educational, health, or recreational purposes.
- Gas facilities are under continuous paving that extends either from the center line of the thoroughfare to the building wall or from the main to the building wall.

[5] 49 CFR, 192.723 Guide Material (1.1)

- Any other location or site, which in the judgment of the operator should be so designated.

(3) **Minimum Requirements for Performing Leakage Surveys.**

(a) **Business Districts.** A leakage survey with leak detector equipment must be conducted in business districts, including tests of the atmosphere in manholes related to the following systems:

- Gas
- Electric
- Telephone
- Sewer
- Water

Also included are tests of the atmosphere at:

- Cracks in pavement and sidewalks
- Other locations providing an opportunity for finding gas leaks

A leakage survey with leak detector equipment must be conducted in business districts at intervals not exceeding 15 months, but at least once each calendar year.

(b) **Outside Business Districts.** A leakage survey with leak detector equipment must be conducted outside business districts as frequently as necessary, but at intervals not exceeding 5 years. However, for cathodically unprotected distribution lines subject to 192.465(e) on which electrical surveys are impractical, survey intervals may not exceed 3 years.

(4) **Factors to Consider when Establishing the Frequency of Leakage Surveys**[6]. Consideration should be given to increased frequency for leakage surveys based on the particular circumstances and conditions. Surveys should be conducted most frequently in those areas with the greatest potential for leakage and where leakage could be expected to create a hazard.

Leakage survey frequencies should be based on operating experience, sound judgment, and a knowledge of the system. Once established, frequencies should be reviewed periodically to affirm that they are still appropriate. Leakage surveys may be accomplished in conjunction with patrolling, scheduled inspections, and other routine activities.

Factors to be considered in establishing the frequency of leakage surveys include the following:

---

[6] 49 CFR, 192.723 Guide Material (1.3)

(a) **Piping Systems.** The condition of a piping system is a factor to consider when establishing the frequency of leakage surveys. Important considerations include the following:

- age of pipe
- material
- type of facility
- operating pressure
- leak history records
- other studies

(b) **Corrosion.** Close consideration should be given to known areas of significant corrosion or areas where corrosive environments are known to exist. Areas susceptible to unique corrosive conditions are cased crossings of roads, highways, railroads, etc.

(c) **Pipe Location.** Proximity to buildings or other structures and the type and use of the buildings are main considerations; also, the proximity to the concentration of people.

(d) **Environmental Conditions and Construction Activity.** Consideration should be given to conditions that could increase the potential for leakage or that could cause leaking gas to migrate to an area where it could create a hazard such as:

- weather conditions
- wall-to-wall pavement
- porous soil conditions
- areas of high construction activity
- blasting
- large earth moving equipment
- heavy traffic
- unstable soil
- areas subject to earth movement

(e) **Other Conditions.** Other conditions that require special consideration are conditions known to the operator that have significant potential to initiate a leak or to permit leaking gas to migrate to an area where it could result in a hazardous condition, such as:

- earthquake
- subsidence
- flooding
- increase in operating pressure
- extensive growth of tree roots around pipeline facilities, which can exert substantial longitudinal force in the pipe and nearby joints

Special one-time surveys should be considered following exposure of the pipeline to unusual stresses, such as earthquakes, flooding, blasting, or construction/excavation along or across the pipeline.

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REVIEW II

Performing Patrol and Leakage Surveys of Gas Distribution Systems

Directions: Select from the list below the response that most correctly completes each of the following statements. Write the letter of your choice in the space provided.

A. 5 years	D. 15 months
B. earthquakes	E. 7½ months
C. corrosion	F. 4½ months

_F_ 1. According to D.O.T. standard 192.721, business districts where anticipated physical movement or external loading could cause failure or leakage, must be patrolled at intervals not exceeding _____ where anticipated physical movement could cause damage.

_D_ 2. Leakage surveys with leak detector equipment must be conducted in business districts at intervals not exceeding _____, but at least once each calendar year.

_A_ 3. A leakage survey with leak detector equipment must be conducted outside business districts as frequently as necessary, but at intervals not exceeding _____ unless not cathodically protected then the interval should not exceed 3 years.

_B_ 4. Special one-time surveys should be considered following exposure to the pipeline from unusual stresses, such as _____.

_C_ 5. Crossings of roads, highways, and railroads are areas that are known to be susceptible to _____.

6. List potentially hazardous surface conditions that you should observe when patrolling pipeline rights-of-way or easements.

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INSTRUCTION SHEET III

Performing Patrol and Leakage Surveys of Gas Transmission Piping Facilities

Performing Patrols on Gas Transmission Piping Facilities

(1) D.O.T Standards.

§ 192.705 Transmission lines: Patrolling.

(a) Each operator shall have a patrol program to observe surface conditions on and adjacent to the transmission line right-of-way for indications of leaks, construction activity, and other factors affecting safety and operation.

(b) The frequency of patrols is determined by the size of the line, the operating pressures, the class location, terrain, weather, and other relevant factors, but intervals between patrols may not be longer than prescribed in the following table:

	Maximum interval between patrols	
Class location of line	**At highway and railroad crossings**	**At all other places**
1, 2	7 1/2 months; but at least twice each calendar year	15 months; but at least once each calendar year.
3	4 1/2 months; but at least four times each calendar year	7 1/2 months; but at least twice each calendar year.
4	4 1/2 months; but at least four times each calendar year	4 1/2 months; but at least four times each calendar year.

(c) Methods of patrolling include walking, driving, flying or other appropriate means of traversing the right-of-way.

[Amdt. 192–21, 40 FR 20283, May 9, 1975, as amended by Amdt. 192–43, 47 FR 46851, Oct. 21, 1982; Amdt. 192–78, 61 FR 28786, June 6, 1996]

(2) Observing Surface Conditions. As required by Pipeline Safety Regulations, 49 CFR 192.705, operators of gas transmission lines shall have a patrol program to observe surface conditions on and adjacent to the transmission line right-of-way for indications of:
(a) Leaks
(b) Construction Activity
(c) Factors Affecting Safety and Operation

(a) **Leaks.** When patrolling gas transmission lines for evidence of leaks, notice the following problems:

- audible leaks (hissing sounds)
- bubbling in a water hole or wet place
- dead vegetation
- smell of gas

(b) **Construction Activity.** When patrolling gas transmission lines for construction activity, look for:

- new construction (such as fences, barns, and storage sheds)
- new roads
- new homes
- encroachments (such as house trailers located on the right-of-way)

(c) **Factors Affecting Safety and Operation.** When patrolling gas transmission lines for factors affecting safety and operation, you should watch for the following problems:

- wash outs
- RV and ATV/ Snowmobile trails
- line exposure
- ground slippage
- downed trees on the right-of-way
- atmospheric corrosion
- line markers down or missing

Any new indications of the situations or conditions underlined above should be considered abnormal conditions that should be documented on patrolling records.

(3) **Aerial Patrolling.** Aerial inspections are necessary for the safe operation of the pipeline and to ensure public safety. Aerial patrol is the only practical method of inspecting thousands of miles of right-of-way. Aerial surveillance allows company pilots to effectively inspect the pipeline rights-of-way and adjacent surface conditions. Aerial markers are used to identify routes of pipelines that are patrolled by aircraft. Aerial patrolling can help identify the following:

- Unauthorized activities on or near the right-of-way
- Heavy equipment on the right-of-way without authorization
- Urban encroachment
- Construction activities on or near the right-of-way
- Soil defects
- Erosion at water crossings, flooding on the right-of-way or sedimentation in streams

- Damage to company property
- Missing or moved aerial markers, pipeline markers or identification signs
- Evidence of leaking gas
- Exact mowing side trim canopy
- Pipeline leaks (Dead vegetation, discoloration, etc.)
- Sunken backfill
- Exposed pipes
- Evidence of encroachments on to the right-of-way
- Land erosion
- Broken terraces
- Construction or excavation on or adjacent to the right-of-way
- Evidence of heavy traffic across the right-of-way

(4) **Patrolling Right-of-Way.** A right-of-way is the actual strip of land granted to a company as result of the easement agreement allowing the company to cross private property to install, inspect, operate, and maintain the pipeline and equipment. The company's right-of-way extends along, across, below, and above the easement.

Visual inspections help maintain a clear right-of-way to facilitate access to perform routine activities as well as respond in the unlikely event of an emergency. The inspection and patrolling of right-of-way conditions should include observation for all possible abnormal conditions, such as leaks, construction activity, invasive vegetation, evidence of encroachment, and any factors affecting safety and operation of the pipeline.

Performing Leakage Survey on Gas Transmission Piping Facilities

(1) **D.O.T Standards.**

§ 192.706 Transmission lines: Leakage surveys.
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 in conformity with §192.625 without an odor or odorant, leakage surveys using leak detector equipment must be conducted—

(a) In Class 3 locations, at intervals not exceeding 7 ½ months, but at least twice each calendar year; and
(b) In Class 4 locations, at intervals not exceeding 4 ½ months, but at least four times each calendar year.

[Amdt. 192–21, 40 FR 20283, May 9, 1975, as amended by Amdt. 192–43, 47 FR 46851, Oct. 21, 1982; Amdt. 192–71, 59 FR 6585, Feb. 11, 1994]

(2) Classification of Pipeline Location.

§ 192.5 Class locations.

(a) This section classifies pipeline locations for purposes of this part. The following criteria apply to classifications under this section.

(1) A "class location unit" 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.

(2) Each separate dwelling unit in a multiple dwelling unit building is counted as a separate building intended for human occupancy.

(b) Except as provided in paragraph (c) of this section, pipeline locations are classified as follows:

(1) A Class 1 location is:

(i) An offshore area; or

(ii) Any class location unit that has 10 or fewer buildings intended for human occupancy.

(2) A Class 2 location is any class location unit that has more than 10 but fewer than 46 buildings intended for human occupancy.

(3) A Class 3 location is:

(i) Any class location unit that has 46 or more buildings intended for human occupancy; or

(ii) 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 5 days a week for 10 weeks in any 12-month period. (The days and weeks need not be consecutive.)

(4) A Class 4 location is any class location unit where buildings with four or more stories above ground are prevalent.

(c) The length of Class locations 2, 3, and 4 may be adjusted as follows:

(1) A Class 4 location ends 220 yards (200 meters) from the nearest building with four or more stories above ground.

(2) When a cluster of buildings intended for human occupancy requires a Class 2 or 3 location, the class location ends 220 yards (200 meters) from the nearest building in the cluster.

[Amdt. 192–78, 61 FR 28783, June 6, 1996; 61 FR 35139, July 5, 1996, as amended by Amdt. 192–85, 63 FR 37502, July 13, 1998]

(3) **Documentation of Facility Patrol and Leakage Survey.** Use appropriate forms, such as a "Record of Facility Patrol," to document specific actions taken when doing patrol and leakage surveys on gas transmission piping facilities.

Recognizing and Reacting to Abnormal Operating Conditions

> **Note:**
> The following Abnormal Operating Conditions (AOCs) and their reactions listed are for guidance only. This AOC list is not presented as an exhaustive treatment of AOCs and appropriate responses. You may be required to know and apply other AOCs and AOC responses for different tasks. Properly recognizing and reacting to covered task AOCs are the responsibility of persons qualified to perform the covered task. Always follow your company's policies and procedures.
>
> Industrial Training Services, Inc. assumes no liability for any act or act of omission performed by the person seeking qualification under the pipeline operator's OQ program, or during the actual pipeline operations of the pipeline operator or any contractor performing work on the pipeline operator's pipeline system.

(1) **Things to Consider When Responding to Abnormal Operating Conditions.** The following information is basic knowledge that will assist you in assessing and responding to abnormal operating conditions:

(a) **Basic Properties of Natural Gas.**

- Natural gas is lighter than air, colorless, and odorless.
- Natural gas has a specific gravity of approximately 0.6.
- The natural gas Lower Explosive Limit (LEL) is approximately 5%.
- The natural gas Upper Explosive Limit (UEL) is approximately 15%.
- The ignition temperature of natural gas is about 1100°-1200° F.

(b) **Eliminating Ignition Sources.** Some of the ways to eliminate ignition sources are very obvious. For example:

- Smoking and open flames should be prohibited in structures or areas containing gas facilities where possible leakage or presence of gas constitutes a hazard of fire or explosion.
- Smoking and open flames should be prohibited in the open when accidental ignition of a gas-in-air mixture could cause personal injury or property damage.
- Do NOT smoke or use open flames near a jobsite/gas pipeline facility.
- Sparks range in temperature from 1500°F in an electrical switch to 9000°F in an arc welder. Do NOT use equipment or create situations that generate sparks. Sparks may be generated by the following conditions:

Communication equipment
Portable electrically powered tools and equipment
Internal combustion engines
Breaking electrical continuity
Static electricity on plastic pipe

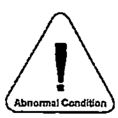
(c) Personal Protection Equipment.

> **Always follow your company's policies and procedures for the use of personal protection equipment (PPE).**

Working around gas pipeline facilities requires practical safety practices and basic PPE may include:

- Head protection (e.g., hard hat)
- Eye and face protection (e.g., goggles, face shield)
- Hearing protection (e.g., ear plugs, ear muffs)
- Hand protection (proper glove material for the specific job)
- Respiratory protection (proper respiratory equipment when air content is insufficient)

(2) Abnormal Operating Conditions for Patrol and Leakage Surveys.



Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Structure built over gas line	• Ensure no gas leakage, then notify proper personnel
• Abnormal stress on pipeline	• Ensure no gas leakage, then notify proper personnel
• Exposed plastic pipe	• Notify proper personnel
• Unexpected weather conditions	• Discontinue survey if appropriate
• Unauthorized taps or vandalism to pipeline	• Ensure no gas leakage, then notify proper personnel
• Leak	• Make area safe; protect life and property; evacuate if necessary; notify proper personnel; repair leak
• Contacts to foreign structure	• Clear short or notify proper personnel
• Shorted casing	• Notify proper personnel
• Indication of potential leak	• Investigate, then notify proper personnel

REVIEW III

Performing Patrol Surveys of Gas Transmission Piping Facilities

Directions: Select from the list below the response that most correctly completes each of the following statements. Write the letter of your choice in the space provided.

A. washout
B. 7½ months
C. ensure no gas leakage and notify proper personnel
D. 4½ months
E. flying
F. take action to protect life and property

______1. Class 1 and 2 pipeline locations require patrolling at intervals not to exceed _____, but at least twice each calendar year.

______2. Class 3 and 4 pipeline locations require patrolling at intervals not to exceed _____, but at least 4 times each calendar year.

______3. Methods of patrolling include walking, driving, or _____.

______4. When patrolling gas transmission lines, you should be especially careful when there has been a _____.

______5. At any time when an abnormal condition such as a gas leak or damage to a pipeline is observed, the first response should always be to _____.

______6. While performing a leakage survey, you locate an unauthorized tap on the pipeline. You should _____.

Knowledge Verification Checklist

OQ Task CM-1
Perform Patrol and Leakage Surveys on Gas Pipeline Facilities

Directions: Use the following performance criteria statements as a self-evaluation in preparation for the final exam.

I can identify:

❒ 1. The specific gravity of natural gas. (CM-1.1.1)

❒ 2. The approximate flammability range for gas-in-air concentrations for natural gas. (CM-1.1.2)

❒ 3. The meaning of L.E.L. for natural gas. (CM-1.1.3)

❒ 4. The hole that is made in the soil or paving for the specific purpose of testing the subsurface atmosphere with a CGI. (CM-1.1.4)

❒ 5. The difference between a Class 2 and a Class 3 location for transmission lines. (CM-1.1.5)

❒ 6. The difference between a Class 3 and a Class 4 location for transmission lines. (CM-1.1.6)

❒ 7. The subsurface structure, such as vault or tunnel, that is large enough to accommodate a person and in which gas could accumulate. (CM-1.1.7)

❒ 8. The classification that applies to work areas having gas-in-air concentrations above the LEL. (CM-1.1.8)

❒ 9. The significance of 50,000 ppm natural gas-in-air. (CM-1.1.9)

❒ 10. The meaning of a 10,000 ppm reading in terms of LEL for natural gas. (CM-1.1.10)

❒ 11. When gas leak detection instruments should be calibrated. (CM-1.1.11)

❒ 12. The classification of leaks that represents existing or probable hazards to persons or property, and requires immediate repair or continuous action until the conditions are no longer hazardous. (M.1.1.12)

I can identify:

- ☐ 13. The classification of a leak that is non-hazardous at the time of detection and can be reasonably expected to remain non-hazardous. (CM-1.1.13)
- ☐ 14. The test method that is the most widely used method for pinpointing leaks in buried piping. (CM-1.1.14)
- ☐ 15. The types of equipment used to perform mobile gas leakage surveys. (CM-1.1.15)
- ☐ 16. The sampling speed for mobile flame ionization detectors. (CM-1.1.16)
- ☐ 17. The leak detection capabilities of optical methane leak detectors. (CM-1.1.17)
- ☐ 18. Steps required to ensure there are no leaks after a Grade 1 leak repair. (CM-1.1.18)
- ☐ 19. The minimum time between patrolling distribution systems in business districts according to the D.O.T. standards 192.721. (CM-1.2.1)
- ☐ 20. Pipeline surface conditions to be aware of when performing patrol of right-of-way or easement. (CM-1.2.2)
- ☐ 21. The minimum time between leakage surveys on distribution systems with a leak detector in business districts according to the D.O.T. standards 192.723. (CM-1.2.3)
- ☐ 22. The minimum time between leakage surveys on distribution systems with leak detection equipment outside business districts according to D.O.T. standards 192.723. (CM-1.2.4)
- ☐ 23. When special one-time surveys are conducted. (CM-1.2.5)
- ☐ 24. The maximum interval between patrols of a Class 1 or Class 2 line at highway and railroad crossings according to D.O.T. standards on patrolling transmission lines 192.705. (CM-1.3.1)
- ☐ 25. The maximum interval between patrols of a Class 1 or Class 2 line at all other places except highway and railroad crossings according to D.O.T. standards on patrolling transmission lines 192.705. (CM-1.3.2)
- ☐ 26. Abnormal conditions that should be documented during patrolling operations. (CM-1.3.3)
- ☐ 27. The proper reaction to indication of unauthorized taps or vandalism to pipelines. (CM-1.3.4)

Skill and Ability Verification Checklist

OQ Task CM-1
Perform Patrol and Leakage Surveys on Gas Pipeline Facilities

I. General Instructions

Instructions for Use

The Skill and Ability Verification Packet is designed to standardize conditions under which the employee demonstrates his/her performance of tasks that meet the operator qualification requirements established by the employee's company.

Completing the enclosed affidavit and uploading the data to Industrial Training Services OnBoard LMS for recordkeeping, documents the satisfactory completion of tasks. Both the OQ Authorized Evaluator (AE) and employee must sign the affidavit.

Instructions to the Employee

Your OQ AE will check your performance using the suggested evaluator guide included in each hands-on task assignment. This suggested guide must be supplemented or replaced by the individual company's policies and procedures related to the task being evaluated.

You must adhere to all safety precautions according to your company's policies and procedures and applicable federal, state, and local codes and regulations.

II. Task Information

OQ Task CM-1:	Perform Patrol and Leakage Surveys on Gas Pipeline Facilities
Qualification Standard:	The employee's qualification is based on the enabling operation(s) that have been successfully completed. The task operations are listed below:
OQ Task CM-1.1:	Outside Gas Leak Investigation. (B31Q 1241)
OQ Task CM-1.2:	Walking Gas Leakage Survey. (B31Q 1261)
OQ Task CM-1.3:	Mobile Gas Leakage Survey: Flame Ionization. (B31Q 1271)
OQ Task CM-1.4:	Mobile Gas Leakage Survey: Optical Methane. (B31Q 1281)
OQ Task CM-1.5:	Inspect Pipeline Surface Conditions: Patrol Right of Way or Easement. (B31Q 1311)
Recommended Requirement:	The employee must demonstrate proficiency to an acceptable level based on the Skill and Ability Checklist associated with each operation.
References:	49 CFR, Part 192.5, 192.613, 192.705, 192.706, 192.721, 192.723. B31Q Tasks 1241, 1261, 1271, 1281, 1311.

Note:

The following Abnormal Operating Conditions (AOCs) and their reactions listed are for guidance only. This AOC list is not presented as an exhaustive treatment of AOCs and appropriate responses. You may be required to know and apply other AOCs and AOC responses for different tasks. Properly recognizing and reacting to covered task AOCs are the responsibility of persons qualified to perform the covered task. Always follow your company's policies and procedures.

Industrial Training Services, Inc. assumes no liability for any act or act of omission performed by the person seeking qualification under the pipeline operator's OQ program, or during the actual pipeline operations of the pipeline operator or any contractor performing work on the pipeline operator's pipeline system.

Abnormal Operating Conditions

(Not limited to the examples listed below)

Recognize	React
Structure built over gas line	Ensure no gas leakage, then notify proper personnel
Abnormal stress on pipeline	Ensure no gas leakage, then notify proper personnel
Exposed plastic pipe	Notify proper personnel
Unexpected weather conditions	Discontinue survey if appropriate
Unauthorized taps or vandalism to pipeline	Ensure no gas leakage, then notify proper personnel
Leak	Make area safe; protect life and property; evacuate if necessary; notify proper personnel; repair leak
Contacts to foreign structure	Clear short or notify proper personnel
Shorted casing	Notify proper personnel
Indication of potential leak	Investigate, then notify proper personnel

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III. Skill and Ability Verification Checklist

OQ Task CM-1
Perform Patrol and Leakage Surveys on Gas Pipeline Facilities

I verify that (Please Print) ______________________________ **is qualified to perform OQ Task CM-1 according to his/her company's procedures:**

(CM-1.1) Outside Gas Leakage Investigation. (1241)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Field startup of equipment, as applicable.
  - Check filters, probes, fuel supply, batteries, etc.
  - Perform operational check as required by manufacturer.
  - Perform periodic calibration check.
- ☐ Perform leakage investigation.
  - Make customer/caller contact, if applicable.
  - Review documentation to determine where the facilities are located.
  - Check for the presence of a combustible gas throughout the area, such as in the following:
    - electric, telephone, sewer, and water system manholes
    - cracks in pavement and sidewalks
    - other locations that provide an opportunity for finding gas leaks
  - Grade (classify) the leak, if applicable.
- ☐ Initiate precautionary actions if leak detected, based on leak grade (classification), as applicable.
  - Implement emergency response actions.
  - Evacuate.
  - Secure the area.
  - Eliminate sources of ignition.
  - Request emergency services.
  - Continue to monitor, and determine leak spread.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Condition

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Indication of potential leak	• Investigate then notify proper personnel
• Exposed plastic pipe	• Notify proper personnel
• Structure built over gas line	• Ensure no gas leakage then notify proper personnel

Comments / Additional Company Procedures:

____

____

(CM-1.2) Walking Gas Leakage Survey. (1261)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Perform test equipment check to verify that equipment functions within specified parameters.
  - Inspect equipment.
  - Verify equipment is calibrated.
  - Test equipment with known sources, as applicable.
- ☐ Perform survey.
  - Survey appropriate locations in accordance with requirements.
  - Classify leaks per requirements.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Indication of potential leak	• Investigate then notify proper personnel
• Exposed plastic pipe	• Notify proper personnel
• Abnormal stress on pipeline	• Ensure no gas leakage then notify proper personnel

Comments / Additional Company Procedures:

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(CM-1.3) Mobile Gas Leakage Survey: Flame Ionization. (1271)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Perform test equipment check to verify that equipment functions within specified parameters.
  - Inspect equipment.
  - Verify equipment is calibrated.
  - Test equipment with known sources, as applicable.
- ☐ Perform survey.
  - Set instrument sensitivity if necessary.
  - Survey at appropriate speed in accordance with requirements.
  - Investigate leaks per requirements.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Operating Conditions

(Not limited to the examples listed below)

Recognize	React
• Indication of potential leak	• Investigate then notify proper personnel
• Exposed plastic pipe	• Notify proper personnel
• Abnormal stress on pipeline	• Ensure no gas leakage then notify proper personnel

Comments / Additional Company Procedures:

(CM-1.4) Mobile Gas Leakage Survey: Optical Methane. (1281)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Perform test equipment check to verify that equipment functions within specified parameters.
  - Inspect equipment.
  - Verify equipment is calibrated.
  - Test equipment with known sources, as applicable.
- ☐ Perform survey.
  - Set instrument sensitivity.
  - Survey at appropriate speed in accordance with requirements.
  - Investigate leaks per requirements.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Operating Conditions

(Not limited to the examples listed below)

Recognize	React
• Indication of potential leak	• Investigate then notify proper personnel
• Exposed plastic pipe	• Notify proper personnel
• Abnormal stress on pipeline	• Ensure no gas leakage then notify proper personnel

Comments / Additional Company Procedures:

(CM-1.5) Inspect Pipeline Surface Conditions: Patrol Right of Way or Easement. (1311)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Perform patrol, examining for the following:
  - signs of leaks
    - dead vegetation
    - vapor cloud
    - odor
    - visual or auditory evidence of escaped product
  - encroachments
    - disturbed or displaced soil
    - unauthorized structures/equipment on or near the right-of-way
  - signs of conditions with potential impact to pipeline safety or integrity
    - unintentional exposed pipeline
    - earth movement
    - vandalism
    - missing or damaged markers
- ☐ Make notifications, as appropriate.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Indication of potential leak	• Investigate then notify proper personnel
• Exposed plastic pipe	• Notify proper personnel
• Abnormal stress on pipeline	• Ensure no gas leakage then notify proper personnel

Comments / Additional Company Procedures:

IV. Employer Record

OQ Task CM-1

Perform Patrol and Leakage Surveys on Gas Pipeline Facilities

Employee Information (Please Print):

Name ____________________

Last 4 Digits of Social Security Number ____________________

Company Name ____________________

Company Mailing Address ____________________

City ____________________ State __________ Zip ____________

Affidavit

I acknowledge the performance of this task is solely for the purpose of operator qualification, and is not intended to replace or modify company operating procedures or policies and may not be appropriately used in all circumstances. I acknowledge that I am responsible for recognizing hazards and abnormal conditions in my work place and must exercise care and good judgment; always using appropriate equipment, procedures and tools for tasks I perform. Industrial Training Services, Inc. assumes no liability for my actions nor for my application of the qualification performance guides used in this evaluation checklist.

Employee's Signature ____________________ Date ____________

Evaluator Information (Please Print):

Name ____________________

Organization/Employer ____________________

Telephone Number ____________________

Affidavit

I affirm that I am the person who has administered this checklist and that I have conducted this assessment with integrity. I also affirm that the above named employee is the person assessed and that the above named person performed the initialed tasks at the indicated level.

Evaluator's Signature ____________________ Date ____________

The employee is qualified according to company standards to perform the tasks listed below as indicated:

	Not Applicable	TASK/OPERATIONS	Method of Skill/Ability Verification Enter Number From List Below
1.	☐	(CM-1.1) Outside Gas Leak Investigation. (1241)	☐
2.	☐	(CM-1.2) Walking Gas Leakage Survey. (1261)	☐
3.	☐	(CM-1.3) Mobile Gas Leakage Survey: Flame Ionization. (1271)	☐
4.	☐	(CM-1.4) Mobile Gas Leakage Survey: Optical Methane. (1281)	☐
5.	☐	(CM-1.5) Inspect Pipeline Surface Conditions: Patrol Right Of Way Or Easement. (1311)	☐

Method of Knowledge Verification

- Written Exam

Method of Skill/Ability Verification Observed During:

1. Performance on the Job
2. Simulation

After completion of Section IV, "Employer Record," remove section from the packet for your records. For third party verification and database reporting service, upload the data to Industrial Training Services OnBoard LMS.

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DANNY SHROUT

OQ Compliance Series
Student Manual

OQ Task CL-3a
v10.2
Monitor Odorant Levels

INDUSTRIAL
TRAINING SERVICES

ITS OQ Compliance Series
CL-3a Monitor Odorant Levels
v10.2

Student Manual

INTRODUCTION

Natural gas is odorized to give it a distinctive odor. The odorization of gas provides a means of early gas leak detection. In order to ensure the level is adequate to be detected, odorization tests are performed. To complete this module you will be required to complete the check-out activities listed below.

OBJECTIVE

1. Monitor odorant levels.

CHECK-OUT ACTIVITIES

Your instructor will provide you with a list of incomplete statements related to monitoring odorant levels and a list of responses. Select the response that most correctly completes each statement. Cut-off score is 80%. (Knowledge Verification)

Your instructor will provide you with a Skill and Ability Verification Checklist. At the appropriate time, demonstrate your skill and ability by correctly performing each operation required under the task. (Skill & Ability Verification)

OQ CL-3a covers requirements indicated in the following codes/regulations:

ITS OQ Covered Task:	ASME B-31 Q*	49 CFR 192**
OQ CL-3a.1 Odorization: Periodic Sampling	1211	192.625

***ASME B31Q Covered Tasks:**

1211 Odorization: Periodic Sampling.

****49 CFR Part 192 Covered Regulations:**

49 CFR 192 covered regulations are identified within the appropriate section of this module.

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INSTRUCTION SHEET I

Monitoring Odorant Levels

The odorization of natural gas has become an established practice throughout the United States. Effective odorization permits the detection of natural gas leaks before gas concentrations reach a hazardous level and reduces gas losses through early detection and repair of leaks.

D.O.T. Regulation

192.625 Odorization of gas.

(a) A combustible gas in a distribution line must contain a natural odorant or be odorized so that at a concentration in air of one-fifth of the lower explosive limit, the gas is readily detectable by a person with a normal sense of smell.

(b) After December 31, 1976, a combustible gas in a transmission line in a Class 3 or Class 4 location must comply with the requirements of paragraph (a) of this section unless:

(1) At least 50 percent of the length of the line downstream from that location is in a Class 1 or Class 2 location;

(2) The line transports gas to any of the following facilities which received gas without an odorant from that line before May 5, 1975;

(i) An underground storage field;

(ii) A gas processing plant;

(iii) A gas dehydration plant; or

(iv) An industrial plant using gas in a process where the presence of an odorant:

(A) Makes the end product unfit for the purpose for which it is intended;

(B) Reduces the activity of a catalyst; or

(C) Reduces the percentage completion of a chemical reaction;

(3) In the case of a lateral line which transports gas to a distribution center, at least 50 percent of the length of that line is in a Class 1 or Class 2 location; or

(4) The combustible gas is hydrogen intended for use as a feedstock in a manufacturing process.

(c) In the concentrations in which it is used, the odorant in combustible gases must comply with the following:

(1) The odorant may not be deleterious to persons, materials, or pipe.

(2) The products of combustion from the odorant may not be toxic when breathed nor may they be corrosive or harmful to those materials to which the products of combustion will be exposed.

(d) The odorant may not be soluble in water to an extent greater than 2.5 parts to 100 parts by weight.

(e) Equipment for odorization must introduce the odorant without wide variations in the level of odorant.

(f) To assure the proper concentration of odorant in accordance with this section, each operator must conduct periodic sampling of combustible gases using an instrument capable of determining the percentage of gas in air at which the odor becomes readily detectable. Operators of master meter systems may comply with this requirement by—

(1) Receiving written verification from their gas source that the gas has the proper concentration of odorant; and

(2) Conducting periodic "sniff" tests at the extremities of the system to confirm that the gas contains odorant.

[35 FR 13257, Aug. 19, 1970]

Gas entering distribution systems must be odorized. The odor must be produced from natural constituents present in the gas stream or by the injection of commercial odorants. The intensity of the odorization must be such that the gas is readily detectable at concentrations in air of one-fifth (1/5) of the lower explosive limit.

Periodic Sampling (B31Q Task 1211)

The location of odorant sampling sites and frequency of odorant tests are significant to ensure the proper concentration of odorant is present in a natural gas distribution system.

(1) **Sampling Sites.**[1] Sampling sites should be selected to ensure that all gas within the piping system contains the required odorant concentration. The number of sites selected depends upon the size and configuration of the system, location of gate stations, and locations suspected of low odorant level within the system.

(2) **Frequency of Tests.**[2] The testing should be performed at sufficiently frequent intervals to ensure that the gas is odorized to the required level.

Odorant Tests[3]

Odor concentration tests should be conducted by personnel having a normal sense of smell and trained in the operation and use of odor concentration meters and procedures. The sniff tests used to qualitatively measure the concentration of odorant should be performed by individuals with a normal sense of smell. Such tests should be conducted by releasing small amounts of gas for a short duration in a controlled manner to determine whether odorant is detectable. A program should be considered to periodically check personnel who perform odorant sampling to verify

[1] 49 CFR, Part 192.625 Guide Material 2.1
[2] 49 CFR, Part 192.625 Guide Material 2.2
[3] 49 CFR, Part 192.625 Guide Material 2.3

that they possess normal olfactory senses, because a normal sense of smell may be affected by smoking, eating spicy foods, chewing tobacco or gum, or the presence of other strong odors.

A normal sense of smell may also be affected by health-related conditions, such as a head cold that may interfere with the sense of smell. Prolonged or repetitive exposure to natural gas should be avoided because the sense of smell will fatigue with extended exposure to the odorant.

A chemical analysis instrument, such as a chromatograph, may be used to support or supplement odorant level information.

Records[4]

Records of odor level and odorant concentration test results should be retained by the operator of the gas system. In the case of master meter system operators who do not perform odorant level testing, their own records of sniff testing and records received from gas suppliers should be retained.

Records of sniff testing should include the name of the person conducting the test, the date and location of the test, and whether odorant was detected.

Testing for Odorant Levels (B31Q Task 1211)

Note: Testing odorant levels is included in this learning activity to meet B31Q Task 1211 requirements.

The examples of the Odorometer® and Odorator® are included in this learning activity for the purpose of discussing the procedures used to measure odorant levels. For all odorometers, including those discussed here, refer to the manufacturer's instructions for complete and accurate operation procedures.

(1) **Odorometer® Operating Instructions.** (Manufactured by Bacharach) The odorometer, as illustrated in Figure 1, uses a constant-speed motor-driven blower to produce a constant flow of air. The air is discharged from a glass sniffing funnel through an opening in the top of the case, where the operator can sniff for the presence of a detectable odor. The gas to be tested is supplied to the odorometer at its own pressure and metered by a flowmeter and needle valve. The concentration of gas in the effluent air is determined from the flowmeter reading by referring to the calibration chart on the inside of the front cover, as illustrated in Figure 2.

[4] 49 CFR, Part 192.625 Guide Material 2.4

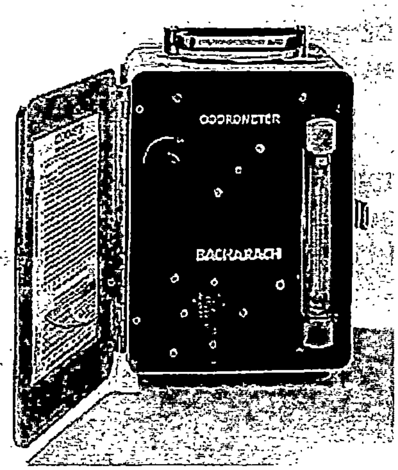

Figure 1. Odorometer
Courtesy of Bacharach

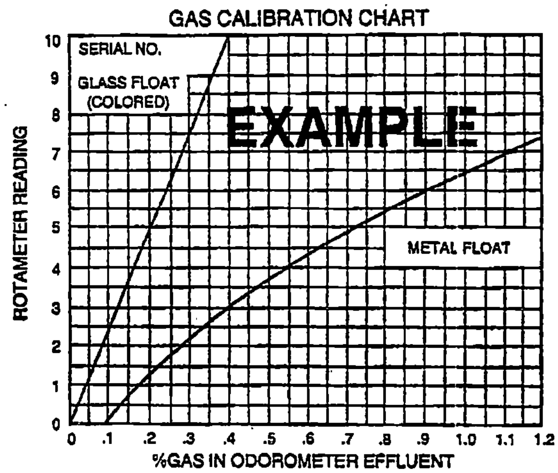

Figure 2. Odorometer Gas Calibration Chart

(a) **Operating Instructions.** The following steps are included in the operating procedures:

Step 1: Power the odorometer.

- For the DC type, be sure the batteries are in place.
- The AC type will operate from a 115 volt, 60 cycle power supply.

Step 2: Connect the gas supply to the odorometer.

- The gas supply should be connected to the inlet fitting on the front panel, and the gas pressure should be below 5 psig.
- Connection should be made with an aluminum or plastic tubing only. Do not use copper or rubber, as these materials tend to remove odorant compounds.
- Where possible, tests should be run in an odor and draft free area.
- When connecting an odorometer to the gas supply, always refer to the manufacturer's operating instructions to determine the input pressure range.

Step 3: Setup the odorometer.

- Set the odorometer on a level bench or desk.
- Swing top cover open.
- For the DC type, start motor by turning the switch clockwise to "on" and rotate the knob clockwise until air flow is achieved.
- Set ammeter to red mark for proper air flow.

- For the AC type, plug-in line cord and turn switch to start air flow. Pilot light will indicate that power is connected to the motor.

Step 4: Open the gas inlet needle valve slowly while sniffing the air being discharged from the opening in the top of the case.

- Care must be taken to hold the nose within one inch of the funnel to avoid dilution with the surrounding air.
- Odor level rating must be based on the first sniff or two because the olfactory senses fatigue rapidly with continued exposure to an odor.
- Between sniffs, the observer should breathe deeply but slowly through his/her nose to "regenerate" his/her perception.

(b) Odor Characteristics at Standard Concentrations.

(i) Have the observer sniff the unodorized air stream.

(ii) Adjust the gas rate to the desired concentration.

(iii) Have the observer sniff the effluent air stream, rating the odor intensity as (1) absent, (2) barely detectable, (3) readily detectable, (4) strong, (5) very strong (obnoxious).

(iv) If desired, a description of the character of the odor, such as onion, garbage, refinery, etc., can also be noted.

(v) Repeat the test after a short time to check the first determination.

(c) Range of Measurement. The standard instrument has two ranges, obtained by using a lightweight glass and a heavier tantalum (metal) float, both in the same metering tube. Take readings on the glass float when both are within the range of measurement. Take readings on the metal float when the glass float reaches the top of the tube. Useful ranges are approximately 0.04 to 0.4% for the glass float, and 0.2 to 1.2% for the tantalum float.

When taking readings, observe the flowmeter graduation corresponding to the bottom of the ball float. Find the gas concentration corresponding to this reading by looking at the calibration chart on the inside of the front cover. This chart has been drawn to give the percent gas concentration over the useful ranges for natural gas with a specific gravity of 0.620 relative to air.

Concentrations of gases of other densities may be read using the correction factors shown on the graph below the calibration chart.

(d) **How to Use the Odorometer Gas Calibration Chart.** When the odor (frequently mercaptan) in gas has been detected, observe the reading indicated by the Rotameter float. Depending on the range required, use either the upper glass float (colored) for values 0.04 to 0.4% or lower metal float (silver) for values 0.2 to 1.2%.

Example: Rotameter (silver float) indicates 7: use second curve and observe that percent gas indicated by the chart is 1.1% (IN ODOROMETER EFFLUENT).

(2) **Odorator® Operating Instructions.** (Manufactured by Heath Consultants). When operating the odorator, as illustrated in Figure 3, following the manufacturer's operating instructions:

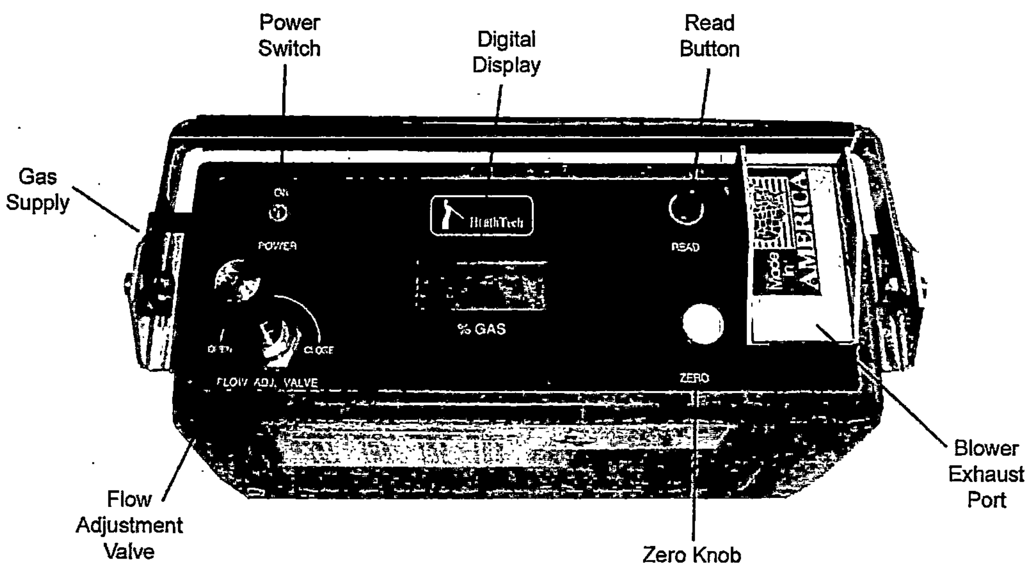

Figure 3. Odorator

The following steps are included in the operating procedures.

Step 1: Connect the odorator to the gas supply.

- Inlet supply gas pressure should not exceed 4 psig.
- Keep odorator away from open flame when operating.
- Connect the odorator to the gas supply with a non-absorbing, odor-free hose.

Step 2: Slowly turn the **flow adjustment valve** clockwise until closed.

Step 3: Push the **power switch** to the "on" position.

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Step 4: Push the **read button.**

- When the low air indicator, "L" on the digital display goes out, the odorator is ready for use.

Step 5: Open the gas supply outlet valve.

Step 6: Condition the odorator system.

- To fully open the **flow adjustment valve**, rotate the valve control counterclockwise to the maximum position.
- Wait for about thirty (30) seconds or until the observer smells an odor of gas at the **blower exhaust**, whichever occurs first.

THEN IMMEDIATELY:

Step 7: Turn the **flow adjustment valve** clockwise to fully close the valve.

Step 8: Push the **read button** and hold it down, adjust the **zero knob** until the digital display reads .00, and then release the **read button**.

Step 9: Sniff the un-odorized air stream at the **exhaust port**.

- Slowly open the **flow adjustment valve** counter-clockwise while sniffing directly over the **blower exhaust port** at a distance of approximately ¾ of an inch.
- The operator's upper lip should lightly touch the front edge of the sniff chamber.
- When a change in odor or first faint smell of gas is detected, push the **read button**.
- Make a note of the gas percent reading shown on the digital display. This is the threshold limit value or threshold value for the operator.

Step 10: Continue opening the **flow adjustment valve** until a readily detectable odor is sensed.

Step 11: Stop opening the **flow adjustment valve** and push the **read button,** then record the gas percent reading from the **digital display**. This is the readily detectable gas-air concentration.

Step 12: Close the gas supply valve.

Step 13: Disconnect the sample hose from the gas supply outlet.

Step 14: Fully open the **flow adjustment valve** by turning it counter-clockwise and leave the odorator on for approximately one (1) minute after the test to purge the system.

> **Note:**
> When doing Step 11, the operator should frequently pause when sniffing for odorant, moving away from the odorator and breathing fresh air, then continuing the test. This precaution is necessary because the sense of smell fatigues rapidly during this type of test.

Recognizing and Reacting to Abnormal Operating Conditions

> **Note:**
> The following Abnormal Operating Conditions (AOCs) and their reactions listed are for guidance only. This AOC list is not presented as an exhaustive treatment of AOCs and appropriate responses. You may be required to know and apply other AOCs and AOC responses for different tasks. Properly recognizing and reacting to covered task AOCs are the responsibility of persons qualified to perform the covered task. Always follow your company's policies and procedures.
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(1) **Things to Consider When Responding to Abnormal Operating Conditions.** The following information is basic knowledge that will assist you in assessing and responding to abnormal operating conditions:

(a) **Basic Properties of Natural Gas.**

- Natural gas is lighter than air, colorless, and odorless.
- Natural gas has a specific gravity of approximately 0.6.
- The natural gas Lower Explosive Limit (LEL) is approximately 5%.
- The natural gas Upper Explosive Limit (UEL) is approximately 15%.
- The ignition temperature of natural gas is about 1100°-1200° F.

(b) **Eliminating Ignition Sources.** Some of the ways to eliminate ignition sources are very obvious. For example:

- Smoking and open flames should be prohibited in structures or areas containing gas facilities where possible leakage or presence of gas constitutes a hazard of fire or explosion.

- Smoking and open flames should be prohibited in the open when accidental ignition of a gas-in-air mixture could cause personal injury or property damage.
- Do NOT smoke or use open flames near a jobsite/gas pipeline facility.
- Sparks range in temperature from 1500°F in an electrical switch to 9000°F in an arc welder. Do NOT use equipment or create situations that generate sparks. Sparks may be generated by the following conditions:
  - Communication equipment
  - Portable electrically powered tools and equipment
  - Internal combustion engines
  - Breaking electrical continuity
  - Static electricity on plastic pipe

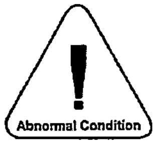
(c) Personal Protection Equipment.

Always follow your company's policies and procedures for the use of personal protection equipment (PPE).

Working around gas pipeline facilities requires practical safety practices and basic PPE may include:

- Head protection (e.g., hard hat)
- Eye and face protection (e.g., goggles, face shield)
- Hearing protection (e.g., ear plugs, ear muffs)
- Hand protection (proper glove material for the specific job)
- Respiratory protection (proper respiratory equipment when air content is insufficient)

(2) Abnormal Operating Conditions for Odorization.



Abnormal Operating Conditions for Odorization
(Not limited to the examples listed below)

Recognize	React
• Improper odorant level	• Notify proper personnel
• Leakage	• Make area safe; protect life and property; evacuate if necessary; notify proper personnel; repair leak
• No gas pressure at test point	• Select alternate and appropriate test point at end of pipe or branch line
• Operating pressure out of range	• Notify proper personnel
• Blowing/escaping/grade one leak	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Fire on a pipeline	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Odor complaint	• Conduct leak investigation
• Under odorization	• Record and report; follow up with odorization personnel

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REVIEW I

Monitoring Odorant Levels

Directions: Select from the list below the word or phrase that best completes each of the following incomplete statements. Write the letter of your choice in the space provided.

A.	gas system operator	I.	three-fourths
B.	blower exhaust port	J.	one-fifth
C.	one	K.	gas supply outlet
D.	normal sense of smell	L.	breathe fresh air
E.	the first or second	M.	odorometer
F.	number and location of gas sampling sites	N.	lighter than air
G.	manufacturer's instructions	O.	1100° to 1200°F
H.	odorized	P.	0.04 to 0.4
		Q.	0.2 to 1.2

J 1. According to the D.O.T. Standard 192.625, Odorization of gas (7-8-96), a combustible gas in a distribution line must contain a natural odorant to be odorized so that at a concentration in air of _____ of the lower explosive limit, the gas is readily detectable by a person with a normal sense of smell.

H 2. D.O.T. requirements require that natural gas must be _____ before entering a gas distribution system.

A 3. The _____ should retain and file records of odorant tests.

F 4. The configuration of a gas distribution system is a factor that affects the _____ in the system.

D 5. An individual conducting an odorant concentration test of natural gas should have a _____.

L 6. During the odorant level testing, the operator should frequently pause when sniffing for odorant and _____.

B 7. When using an odorator, the observer sniffs for gas at the _____ of the odorator.

M 8. A(n) _____ is an instrument that measures the concentration of odorant in gas in the effluent air. The concentration is determined from the flowmeter reading by referring to the calibration chart on the inside front cover of the instrument.

A. gas system operator
B. blower exhaust port
C. one
D. normal sense of smell
E. the first or second
F. number and location of gas sampling sites
G. manufacturer's instructions
H. odorized
I. three-fourths
J. one-fifth
K. gas supply outlet
L. breathe fresh air
M. odorometer
N. lighter than air
O. 1100° to 1200°F
P. 0.04 to 0.4
Q. 0.2 to 1.2

E 9. When sniffing the air being discharged from the opening in the top of the odorometer, your odor level rating should be based on _____ sniff.

I 10. When sniffing the air stream from the odorator, you should sniff directly over the blower exhaust port at a distance of approximately _____-inch.

G 11. When measuring odorant levels using an odorometer, the gas supply input pressure is determined by referring to _____.

C 12. When you are finished taking a sample with the odorator, you should fully open the flow adjustment valve by turning it counterclockwise and leave the odorator on for _____ minute to purge the system.

N 13. Natural gas is colorless, odorless, and _____.

O 14. The ignition temperature of natural gas is about _____.

Q 15. The range of measurement when taking a reading on the tantalum float of a standard odorometer manufactured by Bacharach is approximately _____%.

16. List some ways to eliminate an ignition source:

(a) NO SMOKING + OPEN FLAMES
EQUIPMENT

(b) ELEC TOOLS
COMBUSTIBLE ENGINES

(c)

17. List 5 items that can generate sparks:

(a) Electric tools

(b) Engines

(c) static

(d) Elect cont.

(e) Comm Equip

Directions: Match the appropriate reaction with the abnormal operating condition. Write your choice in the space provided.

	AOC:	Appropriate Reaction:
C 18.	Fire on a pipeline	A. Record and report your findings and follow up with odorization personnel
A 19.	Under odorization	B. Conduct a leak investigation
D 20.	Blowing or escaping gas	C. Notify fire and emergency responders; initiate emergency plan and if authorized, stop gas flow
B 21.	Odor complaint	D. Use appropriate PPE; eliminate ignition sources and protect life and property; stop gas flow and make repairs

Knowledge Verification Checklist

OQ Task CL-3a
Monitor Odorant Levels

Directions: Use the following performance criteria statements as a self-evaluation in preparation for the final exam.

I can identify:

❐ 1. The standards specified in D.O.T. 192.625, Odorization of gas(7-8-96). (CL-3a.1.1)

❐ 2. A condition that must be met before natural gas is allowed to enter a gas distribution system according to D.O.T. requirements. (CL-3a.1.2)

❐ 3. Factors that determine the number of gas sampling sites and their locations. (CL-3a.1.3)

❐ 4. A requirement of the individual conducting an odorant concentration test of natural gas distribution systems. (CL-3a.1.4)

❐ 5. Who should retain the records of odorant level and odorant concentration tests. (CL-3a.1.5)

❐ 6. The source of information to determine the gas supply input pressure range when measuring odorant level or concentration. (CL-3a.1.6)

❐ 7. How to correctly rate the odor level when sniffing the air being discharged from the opening in the top of the odorometer case, based on the fact that the olfactory senses fatigue rapidly with continued exposure to an odor. (CL-3a.1.7)

❐ 8. The range of measurement (for the glass float and the tantalum float) when using an odorometer manufactured by Bacharach. (CL-3a.1.8)

❐ 9. The location on the odorator the observer sniffs for the presence of an odor of gas. (CL-3a.1.9)

❐ 10. The correct distance to sniff air directly over the blower exhaust port of the odorator. (CL-3a.1.10)

❐ 11. The minimum amount of time you should allow the odorator to purge after its use. (CL-3a.1.11)

I can identify:

- ❒ 12. A practice that should be performed by the operator of an odorant level test when sniffing for odorant to help prevent fatigue of the sense of smell. (CL-3a.1.12)
- ❒ 13. The basic properties of natural gas. (CL-3a.1.13)
- ❒ 14. An abnormal operating condition that calls for conducting a leak survey. (CL-3a.1.14)
- ❒ 15. Proper reactions to the abnormal operating condition "under odorization." (CL-3a.1.15)

Skill and Ability Verification Packet

OQ Task CL-3a
Monitor Odorant Levels

I. General Instructions

Instructions for Use

The Skill and Ability Verification Packet is designed to standardize conditions under which the employee demonstrates his/her performance of tasks that meet the operator qualification requirements established by the employee's company.

Completing the enclosed affidavit and uploading the data to Industrial Training Services OnBoard LMS for recordkeeping, documents the satisfactory completion of tasks. Both the OQ Authorized Evaluator (AE) and employee must sign the affidavit.

Instructions to the Employee

Your OQ AE will check your performance using the suggested evaluator guide included in each hands-on task assignment. This suggested guide must be supplemented or replaced by the individual company's policies and procedures related to the task being evaluated.

You must adhere to all safety precautions according to your company's policies and procedures and applicable federal, state, and local codes and regulations.

II. Task Information

OQ Task CL-3a: **Monitor Odorant Levels**

Qualification Standard: The employee's qualification is based on the enabling operation(s) that have been successfully completed. The task operations are listed below:

OQ CL-3a.1: Odorization: Periodic Sampling. (B31Q 1211)

Recommended Requirement: The employee must demonstrate proficiency to an acceptable level based on the Skill and Ability Checklist associated with each operation.

References: 49 CFR, Part 192.625.
B31Q Task 1211.

> **Note:**
> The following Abnormal Operating Conditions (AOCs) and their reactions listed are for guidance only. This AOC list is not presented as an exhaustive treatment of AOCs and appropriate responses. You may be required to know and apply other AOCs and AOC responses for different tasks. Properly recognizing and reacting to covered task AOCs are the responsibility of persons qualified to perform the covered task. Always follow your company's policies and procedures.
>
> Industrial Training Services, Inc. assumes no liability for any act or act of omission performed by the person seeking qualification under the pipeline operator's OQ program, or during the actual pipeline operations of the pipeline operator or any contractor performing work on the pipeline operator's pipeline system.

Abnormal Operating Conditions

(Not limited to the examples listed below)

Recognize	React
• Improper odorant level	• Notify proper personnel
• Leakage	• Make area safe; protect life and property; evacuate if necessary; notify proper personnel; repair leak
• No gas pressure at test point	• Select alternate and appropriate test point at end of pipe or branch line
• Operating pressure out of range	• Notify proper personnel
• Blowing/escaping/grade one leak	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Fire on a pipeline	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Odor complaint	• Conduct leak investigation
• Under odorization	• Record and report; follow up with odorization personnel

III. Skill and Ability Verification Checklist

OQ Task CL-3a
Monitor Odorant Levels

I verify that **(Please Print)** ______________________________ **is qualified to perform OQ Task CL-3a according to his/her company's procedures:**

(CL-3a.1) Odorization: Periodic Sampling. (1211)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Verify odorant concentration by obtaining a gas sample.
    - Identify appropriate location(s) to test concentration.
    - Identify conditions that could interfere with obtaining accurate test results.
    - Ensure instrument is calibrated and functioning properly.
    - Select appropriate settings (e.g., gas type, concentration range).
    - Connect instrument to sample site.
    - Take gas sample, as specified by the manufacturer, and determine concentration.
    - Take appropriate actions if improper concentration is discovered.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Condition

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Test instrument is not performing correctly	• Repair, calibrate or replace instrument
• Improper gas sample tap location	• Install probe or choose alternate tap
• Improper gas sample transport line	• Replace with non-absorbing type tubing with proper pressure rating

Comments / Additional Company Procedures: ______________________________

____

____

____

____

IV. Employer Record

OQ Task CL-3a

Monitor Odorant Levels

Employee Information (Please Print):

Name ______________________________

Last 4 Digits of Social Security Number _ ______________________________

Company Name ______________________________

Company Mailing Address ______________________________

City ______________________ State __________ Zip ______________

Affidavit

I acknowledge the performance of this task is solely for the purpose of operator qualification, and is not intended to replace or modify company operating procedures or policies and may not be appropriately used in all circumstances. I acknowledge that I am responsible for recognizing hazards and abnormal conditions in my work place and must exercise care and good judgment; always using appropriate equipment, procedures and tools for tasks I perform. Industrial Training Services, Inc. assumes no liability for my actions nor for my application of the qualification performance guides used in this evaluation checklist.

Employee's Signature ______________________ Date ______________

Evaluator Information (Please Print):

Name ______________________________

Organization/Employer ______________________________

Telephone Number ______________________________

Affidavit

I affirm that I am the person who has administered this checklist and that I have conducted this assessment with integrity. I also affirm that the above named employee is the person assessed and that the above named person performed the initialed tasks at the indicated level.

Evaluator's Signature ______________________ Date ______________

The employee is qualified according to company standards to perform the tasks listed below as indicated:

	TASK/OPERATIONS	Method of Skill/Ability Verification Enter Number From List Below
1.	(CL-3a.1) Odorization: Periodic Sampling. (1211)	☐

Method of Knowledge Verification

- Written Exam

Method of Skill/Ability Verification Observed During:

1. Performance on the Job
2. Simulation

After completion of Section IV, "Employer Record," remove section from the packet for your records. For third party verification and database reporting service, upload the data to Industrial Training Services OnBoard LMS.

INDUSTRIAL
TRAINING SERVICES

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INDUSTRIAL
TRAINING SERVICES

Danny Shrout

OQ Compliance Series
Student Manual

OQ Task CM-5a
v10.4

Inspect Emergency Valves

INDUSTRIAL TRAINING SERVICES

OQ Compliance Series Student Manual

OQ Task CM-5a v10.4 — Inspect Emergency Valves

INTRODUCTION

Emergency valves are devices used to control the flow of gas through piping systems when a critical situation arises, typically requiring the shutoff of the gas (and are therefore typically located away from potentially hazardous areas). To complete this module you will be required to complete the check-out activities listed below.

OBJECTIVES

1. Perform inspections on emergency valves.

CHECK-OUT ACTIVITIES

Your instructor will provide you with a list of incomplete statements related to inspecting emergency valves and a list of responses. Select the response that most correctly completes each statement. Cut-off score is 80%. (Knowledge Verification)

Your instructor will provide you with a Skill and Abilities Verification Checklist. At the appropriate time demonstrate your skill and ability by correctly performing each operation required under the task. (Skill & Ability Verification)

OQ CM-5a covers requirements indicated in the following codes/regulations:

ITS OQ Covered Task:	B-31Q 2010	49 CFR 192
OQ CM-5a.1 Valve – Visual Inspection and Partial Operation	0331	192.745 192.747 192.803

ASME B31Q Covered Tasks:

0331 Valve – Visual Inspection and Partial Operation

49 CFR Part 192

49 CFR 192 covered regulations are identified within the appropriate section of this module.

Description of Activity	This learning activity provides a review of knowledge and skills that are basic to the proper inspection of emergency valves located on service lines.

PLEASE READ – INDUSTRIAL TRAINING SERVICES, INC. DISCLAIMERS – PLEASE READ

Table of Contents

INSTRUCTION SHEET I

Performing Inspections on Emergency Valves

Typical Valve Design and Operation

Valves are devices used to control the flow of gas through piping systems. Valve designs vary but all valves have two features in common:

- A passageway through which gas can flow; and
- Some kind of movable part that opens and closes the passageway.

Emergency Valves. An emergency valve is a valve deemed necessary for the safe operation of a distribution system and/or transmission line. They are almost always manually activated to facilitate the shutdown of the supply of gas in an emergency situation. . These types of valves are typically installed away from potentially hazardous areas.[1]

Plug Valve

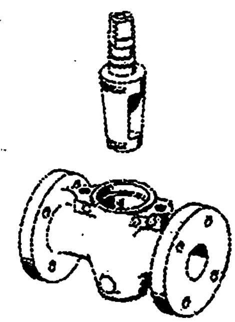

Figure 1. Plug Valve

(1) **Core.** The core of the plug is shaped like a cone. The center of the core is cast with an opening in the center so that facing the core in one direction allows gas flow through the opening, and turning the core in the other direction blocks the flow of gas with the solid sides of the core.

(2) **Opening/Closing the Valve.** The plug valve is operated by turning the wrench head adapter a ¼ turn, lending to the valve commonly being referred to as a ¼ turn valve. The position of the adapter will show if the gas is off or on. If the length of the adapter runs in the same direction as the pipe, the valve is in the "ON" position. If the length of the adapter is running perpendicular to the pipe, the valve is

[1] Smith, Ken, *The Illustrated Natural Gas Glossary*; Lane Publishing; Lewiston, NY; 1992.

in the "OFF" position. If the adapter is a square head, a visible slot running from corner to corner will indicate the position of the stop.

(3) **Placement.** Plug valves can be found belowground and aboveground.

(4) **Tools.** Some aboveground plug valves may have a built-in handle. If not, a wrench can be used to operate them. Belowground valves will operate with slotted or square-head curb keys.

(5) **Lubrication.** The core of the valve is suspended in a layer of lubricant sealant. Periodic lubrication may be necessary. To lubricate the valve, use the proper lubricant sealant and inject the sealant with a grease gun equipped with a pressure gauge. Also, valves may be manually lubricated by removing a center plug or stem on the valve and inserting the proper lubricating stick, then re-installing the center stem and tightening.

> **WARNINGS!**
> Over-pressuring the sealant can damage the valve!
> (Exception—polyethylene valves do not need lubrication.)
>
> **Do not** use a pipe wrench.
>
> **Do not** drop the valve key into the valve gate box.

Ball Valve

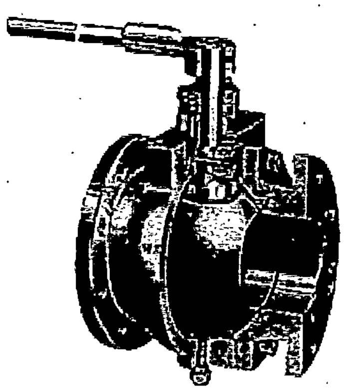

Figure 2. Ball Valve

(1) **Core.** The core of the ball valve is shaped like a ball, cast with a hole in the center. Facing the ball in one direction will allow gas to flow through the opening, and facing the ball in the other direction allows the solid sides to block the flow of gas.

(2) **Opening/Closing the Valve.** The ball valve is operated by turning the wrench head adapter a ¼ turn. The position of the adapter will show if the gas is off or on. If the length of the adapter runs in the same direction as the pipe, the valve is in the "ON" position. If the length of the adapter is running perpendicular to the pipe, the valve is in the "OFF" position. If the adapter has a square head, a visible slot running from corner to corner will indicate the position of the stop.

(3) **Placement.** Ball valves can be found belowground and aboveground.

(4) **Tools.** Some aboveground plug valves may have a built-in handle. If not, a wrench can be used to operate them. Belowground valves will be operated with slotted or square head curb keys.

Gate Valve

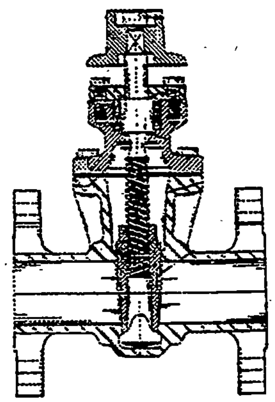

Figure 3. Gate Valve

(1) **Core.** The core of the gate valve consists of a closing element that is raised and lowered into the gas stream to open or close off the gas flow. A screwed stem attached to a wedge on one end and a wheel (aboveground installations) or wrench adapter (belowground installations) provides the means of raising and lowering the disks.

(2) **Opening/Closing the Valve.** The gate valve is operated by turning the wheel or wrench head adapter in consecutive turns until the disks are fully lowered or raised. Generally, the valves are turned clockwise to close, and counterclockwise to open. Verify the valve is in the complete open position prior to leaving.

(3) **Placement.** Gate valves can be found aboveground and belowground.

(4) **Tools.** No tools are needed for aboveground valves with wheels. The wheel is grasped and turned. For aboveground and belowground

valves with wrench adapters, a wrench or square head gate key of various sizes is used.

(5) **Lubrication.** See the manufacturer's installation instructions for lubrication practices.

Butterfly Valve

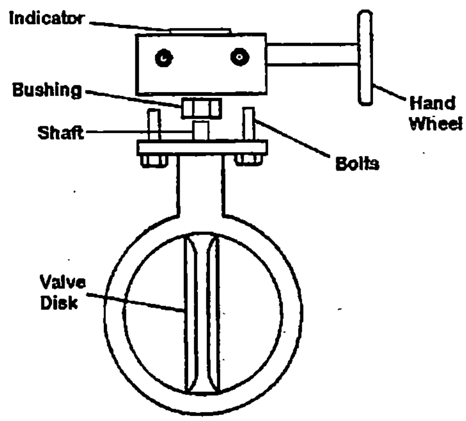

Figure 4. Butterfly Valve

(1) **Core.** The core of the butterfly valve contains a disk connected to a shaft. The shaft is attached on the other end to a wheel and gear mechanism or a handle. When the disk is turned parallel to the pipe, it is in the open position and allows gas to flow through the pipe. When it is turned perpendicular to the pipe, the disk shuts off the flow of gas through the pipe.

(2) **Opening/Closing the Valve.** The disk is turned 90 degrees by turning the handle ¼ turn or by consecutive turns of the wheel and gear mechanism.

(3) **Placement.** Generally, butterfly valves are located on aboveground large volume sales settings.

(4) **Tools.** Tools are not necessary for most butterfly valves. To open the valves with the wheel and gear mechanisms, grasp the wheel and turn it toward the word "OPEN" until the free movement of the wheel stops. To close the valve, turn the wheel toward the word "CLOSE" until the free movement of the wheel stops. To open butterfly valves with handles, grasp the handle and move the handle to the word "OPEN." To close the valve, grasp the handle and move the handle to the word "CLOSE."

(5) **Lubrication.** Internal lubrication is not needed for the butterfly valve.

Valve Inspections and Maintenance Schedules

§ 192.747 Valve maintenance: Distribution systems.

(a) Each valve, the use of which may be necessary for the safe operation of a distribution system, must be checked and serviced at intervals not exceeding 15 months, but at least once each calendar year.
(b) Each operator must take prompt remedial action to correct any valve found inoperable, unless the operator designates an alternative valve.

[Amdt. 192–43, 47 FR 46851, Oct. 21, 1982, as amended by Amdt. 192–93, 68 FR 53901, Sept. 15, 2003]

The valves that are considered "emergency valves" are the valves needed to shut down the system, or part of the system, in case of an emergency.

Emergency Valve Inspection Requirements

(1) Inspection of Emergency Valves. Always follow your company's policies and procedures for specific directions on proper emergency valve inspection. However, emergency valve inspections must include the following:

- Verify that the valve location measurements on your records and orders are correct.
- Clean debris from the valve box or vault to make operating the valve easier.
- Verify that the type and size of operating nut or curb valve type matches the listing and can be operated with keys and tools normally carried by gas company personnel.
- Make sure that the valve box lid is clearly identified with the word "GAS."
- Verify the valve number identification for each valve found in a cluster. Work them one at a time.
- Check that all pipeline facilities are properly coated to prevent atmospheric corrosion.
- Partially operate the valve to ensure it is operable. **Do not** shut the valve off completely—an outage may result.
- Lubricate the valve if necessary (this must be performed by a qualified individual only).
- For above ground valves it is a good practice to note the type of valve and its pressure limit. Valves have a maximum pressure limit (MAOP). If a system is up-rated, sometimes the valves must be changes to go along

with the up-rate. Many times in valve inspections, valves are found that have a pressure rating lower than the system operating pressure. A system is not permitted to be operated at a pressure greater than its weakest or lowest rated component.

(2) **Frequency of Inspections.** Emergency valves shall be inspected at intervals not exceeding 15 months, but at least once each calendar year.

(3) **Inoperable Emergency Valves.** An inoperable condition (including the inability to locate the emergency valve) shall be corrected within 15 months of the previous year's inspection or the end of the current calendar year, whichever occurs first. If the inoperable condition cannot be corrected within this time period, an alternate valve(s) must be designated to replace its function.

(4) **Record of Inspection.** Inspection of an emergency valve(s) must be documented according to Company Policy.

Note:
If any changes have occurred in reference measurements or other pertinent information, records must be updated.

(5) **Prevention of Accidental Operation.** Precautions must be taken to prevent unauthorized operation of valves. Valves before or upstream of a relief valve must be locked in the on position even inside a chain link security fence or locked building.

Many companies do not lock the main valve to large meter sets so that emergency personnel can shut down the gas for public or large facilities (school, factory, hospital, etc.) in case of a natural gas emergency. This is part of the federally mandated Public Awareness Program: explaining to emergency personnel how to turn off natural gas to public buildings, etc. in case of an emergency.

The following actions should be taken to prevent unauthorized or accidental operation of buried valves:

- Lock valves housed in unsecured regulator or valve vaults.
- Identify each valve in a cluster of valves by placing a piece of plastic pipe inside the valve box marked with the valve number (the pipe shall be of adequate size to require removal before valve can be operated); or affix the valve number and/or the functional purpose inside the valve box.

Operation of Valves

At times it may become necessary to isolate or reduce the pressure in any section of a pipeline (e.g., control the flow of gas) by fully closing or opening valves in a pipeline system. Reasons for this include (but are not limited to) the following:

- Facilitating normal pipeline construction, maintenance, and retirement activities; or
- Responding to emergency situations.

> **Note:**
> Operating personnel must be aware of the potential consequences of operating a valve before taking any action to open, close, or partially operate a valve.
>
> Verify that the valve is in the **fully-open position** (or fully-closed on an exterior by-pass) before performing an inspection.
>
> Always follow your company's policies and procedures when inspecting emergency valves.

Valve Operator Inspection/Maintenance

- All aboveground valves, operators, and related components must be checked for corrosion that could be detrimental to the operation.
- Ensure that the mounting equipment is secure.
- Ensure that all vent, control, and supply lines are free of obstructions; and are properly supported and protected.
- Drain fluid in gear housing (if equipped) enough to remove any water that may have infiltrated. Remove one of the cap bolts as necessary.
- Inspect, clean, and lubricate gearing in accordance with procedures described in the respective manufacturer's maintenance manual.
- Establish that the operator is functioning properly. For valves remotely controlled and operated by electric or pneumatic actuators, do not make any adjustments.
- Record results of the inspection.

Valve maintenance on transmission lines is primarily regulated through 49 CFR 192.745 as follows:

§ 192.745 Valve maintenance: Transmission lines.

(a) Each transmission line valve that might be required during any emergency must be inspected and partially operated at intervals not exceeding 15 months, but at least once each calendar year.
(b) Each operator must take prompt remedial action to correct any valve found inoperable, unless the operator designates an alternative valve.

[Amdt. 192–43, 47 FR 46851, Oct. 21, 1982, as amended by Amdt. 192–93, 68 FR 53901, Sept. 15, 2003]

Valve and/or Operator Replacement/Repair

If valves are found to be leaking, hard to operate, or inoperable, servicing may be necessary before the valve is returned to a good, operable, leak-tight condition.

Recognizing and Reacting to Abnormal Operating Conditions

Note:
The following Abnormal Operating Conditions (AOCs) and their reactions listed are for guidance only. This AOC list is not presented as an exhaustive treatment of AOCs and appropriate responses. You may be required to know and apply other AOCs and AOC responses for different tasks. Properly recognizing and reacting to covered task AOCs are the responsibility of persons qualified to perform the covered task. Always follow your company's policies and procedures.

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(1) **Things to Consider When Responding to Abnormal Operating Conditions.** The following information is basic knowledge that will assist you in assessing and responding to abnormal operating conditions:

(a) **Basic Properties of Natural Gas.**
- Natural gas is lighter than air, colorless and odorless.
- Natural gas has a specific gravity of approximately 0.6.
- The natural gas Lower Explosive Limit (LEL) is approximately 5%.
- The natural gas Upper Explosive Limit (UEL) is approximately 15%.
- The ignition temperature of natural gas is about 1100°-1200° F.

(b) **Eliminating Ignition Sources.** Some of the ways to eliminate ignition sources are very obvious. For example:

- Smoking and open flames should be prohibited in structures or areas containing gas facilities where possible leakage or presence of gas constitutes a hazard of fire or explosion.
- Smoking and open flames should be prohibited in the open when accidental ignition of a gas-in-air mixture could cause personal injury or property damage.
- Do NOT smoke or use open flames near a jobsite/gas pipeline facility.
- Sparks range in temperature from 1500°F in an electrical switch to 9,000°F in an arc welder. Do NOT use equipment or create situations that generate sparks. Sparks may be generated by the following conditions:

  Communication equipment
  Portable electrically powered tools and equipment
  Internal combustion engines
  Breaking electrical continuity
  Static electricity on plastic pipe

(c) Personal Protection Equipment.

Always follow your company's policies and procedures for the use of personal protection equipment (PPE).

Working around gas pipeline facilities requires practical safety practices and basic PPE may include:

- Head protection (e.g. hard hat)
- Eye and face protection (e.g. goggles, face shield, etc.)
- Hearing protection (e.g. ear plugs, ear muffs, etc.)
- Hand protection (proper glove material for the specific job)
- Respiratory protection (proper respiratory equipment when air content is insufficient)

(2) Abnormal Operating Conditions for Inspecting Emergency Valves.

Abnormal Condition

Abnormal Operating Conditions
(Not limited to the examples listed below.)

Recognize	React
• Stuck Valve	• Flush and/or grease – Do not force
• Broken stem valve	• Establish safe area, notify appropriate personnel – schedule repair
• Uncontrolled escape of gas	• Safe shutdown and repair
• Leaking gas	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Inaccurate documentation of valve information	• Update documentation

REVIEW I

Performing Inspections on Emergency Valves

A. Directions: Select from the list below the response that most correctly completes each of the following statements. Write the letter of your choice in the space provided. Answers may be used more than one time.

A.	closing element	H.	18 months
B.	emergency valve	I.	15 months
C.	turning of a disc-shaped closing element	J.	¼
D.	turning of a ball-shaped closing element	K.	½
E.	turning of a cone shaped closing element	L.	corrosion
F.	raising and lowering of a closing element	M.	clockwise
G.	turning of a rectangular metal within a ball mount	N.	counter-clockwise

__B__ 1. A(n) _____ is a valve deemed necessary for the safe operation of a distribution system.

__J__ 2. Ball valves and plug valves are considered _____ turn valves..

__F__ 3. The core of a plug valve operates by the _____.

__D__ 4. The core of a ball valve operates by the _____.

__F__ 5. The core of a gate valve operates by the _____.

__C__ 6. The core of a butterfly valve operates by the _____.

__I__ 7. According to the U.S. Department of Transportation, Pipeline Safety Regulation 49 CFR 192.747, each distribution line valve that might be required during any emergency must be inspected and serviced each calendar year, but not to exceed _____.

__L__ 8. All aboveground valves, operators, and related components must be checked for _____ that could be detrimental to the operation of the valve operator.

__m__ 9. A gate valve is operated by the turning of the wrench-head in the ______ direction.

B. Directions: Read each statement and write the correct answer in the blank to provide a correct response.

1. If you are presented with the abnormal operating condition of a stuck valve, what is the appropriate response?

   FLUSH AND GREASE DON'T FORCE IT

2. If you are presented with the abnormal condition associated with a broken stem valve, what is the appropriate response?

   SET UP TIME TO FIX SAFE AREA

3. If an abnormal operating condition presents an immediate danger, you must ____.

   MAKE AREA SAFE FOR REPAIR PURPOSE

4. List the appropriate actions to prevent unauthorized or accidental operation of buried valves.

   LOCK THEM OFF

   IDENTIFY VALVE TO ACCESS

Knowledge Verification Checklist

OQ Task CM-5a
Inspect Emergency Valves

Directions: Use the following performance criteria statements as a self-evaluation in preparation for the final exam.

I can identify:

- ❑ 1. The term for a distribution system valve that is deemed necessary for the safe operation of that system. (CM-5a.1.1)
- ❑ 2. The operation of the core for a plug valve. (CM-5a.1.2)
- ❑ 3. The appropriate way to operate a plug valve. (CM-5a.1.3)
- ❑ 4. The operation of the core for a ball valve. (CM-5a.1.4)
- ❑ 5. The operation of the core for a gate valve. (CM-5a.1.5)
- ❑ 6. The correct operation of a gate valve. (CM-5a.1.6)
- ❑ 7. The operation of the core for a butterfly valve. (CM-5a.1.7)
- ❑ 8. The interval that each distribution line valve used during any emergency must be inspected, according to 49 CFR 192.747. (CM-5a.1.8)
- ❑ 9. The appropriate actions taken to prevent unauthorized or accidental operation of buried valves. (CM-5a.1.9)
- ❑ 10. The problem that can be detrimental to the operation of aboveground valves, operators, and related components. (CM-5a.1.10)
- ❑ 11. The appropriate response to an abnormal operating condition associated with a stuck valve. (CM-5a.1.11)
- ❑ 12. The appropriate response to an abnormal operating condition associated with a broken stem valve. (CM-5a.1.12)

Skill and Ability Verification Packet

OQ Task CM-5a
Inspect Emergency Valves

I. General Instructions

Instructions for Use

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You must adhere to all safety precautions according to your company's policies and procedures and applicable federal, state, and local codes and regulations.

II. Task Information

OQ Task CM-5a	Inspect Emergency Valves
Qualification Standard:	The employee's qualification is based on the enabling operation(s) that have been successfully completed.
OQ CM-5a.1:	Valve – Visual Inspection and Partial Operation (B31Q 0331)
Recommended Requirement:	Successful completion of OQ Task M-5a Inspect Emergency Valves Knowledge Verification.
References:	49 CFR 192.745, 192.747, 192.803 B31Q Task 0331

Note:

The following Abnormal Operating Conditions (AOCs) and their reactions listed are for guidance only. This AOC list is not presented as an exhaustive treatment of AOCs and appropriate responses. You may be required to know and apply other AOCs and AOC responses for different tasks. Properly recognizing and reacting to covered task AOCs are the responsibility of persons qualified to perform the covered task. Always follow your company's policies and procedures.

Industrial Training Services, Inc. assumes no liability for any act or act of omission performed by the person seeking qualification under the pipeline operator's OQ program, or during the actual pipeline operations of the pipeline operator or any contractor performing work on the pipeline operator's pipeline system.

Abnormal Operating Conditions

(Not limited to the examples listed below.)

Recognize	React
• Stuck Valve	• Flush and/or grease – Do not force
• Broken stem valve	• Establish safe area, notify appropriate personnel – schedule repair
• Uncontrolled escape of gas	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Leaking gas	• Classify and repair leakage; repack or grease; or notify appropriate personnel
• Inaccurate documentation of valve information	• Update documentation

III. Skill and Ability Verification Checklist

OQ Task CM-5a
Inspect Emergency Valves

Note:
The person being evaluated must always observe all safety procedures.

I verify that **(Please Print)** ______________________________ **is qualified to perform OQ Task CM-5a according to his/her company's procedures:**

(CM-5a.1) Valve – Visual Inspection and Partial Operation. (0331)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use appropriate and approved PPE.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Identify correct valve to be inspected and operated by
  - review of records
  - use of identification cards or tags
  - location description
  - size and type (plug/gate)
  - valve position (open/closed)
  - system feed (one way or two way)
- ☐ Make notifications, as appropriate.
- ☐ Perform inspection and partial operation.
  - Check for the correct locking device installed, if applicable.
  - Verify the valve is accessible.
  - Check for damage.
  - Check for signs of corrosion.
  - Use correct valve key or tool to perform partial operation of valve. (Valve should move freely.)
  - Return valve to its operational position.
- ☐ Lubricate valve as specified by manufacturer, if applicable.
- ☐ Document, as required.
- ☐ Recognize and react to AOC's.

Comments / Additional Company Procedures:

IV. Employer Record

OQ Task CM-5a

Inspect Emergency Valves

Employee Information (Please Print):

Name ______________________________

Last 4 Digits of Social Security Number ______________________________

Company Name ______________________________

Company Mailing Address ______________________________

City ______________ State ________ Zip ____________

Affidavit

I acknowledge the performance of this task is solely for the purpose of operator qualification, and is not intended to replace or modify company operating procedures or policies and may not be appropriately used in all circumstances. I acknowledge that I am responsible for recognizing hazards and abnormal conditions in my work place and must exercise care and good judgment; always using appropriate equipment, procedures and tools for tasks I perform. Industrial Training Services, Inc. assumes no liability for my actions nor for my application of the performance guides used in this evaluation checklist.

Employee's Signature ______________________ Date ______________

Evaluator Information (Please Print):

Name ______________________________

Organization/Employer ______________________________

Telephone Number ______________________________

Affidavit

I affirm that I am the person who has administered this checklist and that I have conducted this assessment with integrity. I also affirm that the above named employee is the person assessed and that the above named person performed the tasks at the indicated level.

Evaluator's Signature ______________________ Date ______________

The employee is qualified according to company standards to perform the tasks listed below as indicated:

	TASK/OPERATIONS	Method of Skill/Ability Verification Enter Number From List Below
1.	(CM-5a.1) Valve – Visual Inspection and Partial Operation. (0331) a. Ball ☐ b. Plug ☐ c. Gate ☐	☐

Method of Knowledge Verification

- Written Exam

Method of Skill/Ability Verification Observed During:

1. Performance on the Job
2. Simulation

After completion of Section IV, "Employer Record," remove section from the packet and photocopy. Retain photocopy for your files. For third party verification and database reporting service, mail original to:

Industrial Training Services, Inc.
310 C. C. Lowry Drive
Murray, KY 42071

Appendix A

Contact List of Manufacturers

MILLIKEN
J.G.M. Valve Corp.
1155 Welch Rd. Suite D
Commerce Mi. 48390
Ph. 248 926-6200
Local Rep. 419 697-3735

CAMERON
Cooper Cameron Valves
166500 South Main
Missouri City TX 77489-1300
281 261-3714
Leon Brooks

KEROTEST/GROVE VALVE
Precision Pipeline Equipment
Raymond Schebelen
Toledo Ohio
419 466-2422

WALWORTH COMPANY
Huff Avenue
P.O. Box 758, 15602
Greensburg, Pa. 15601
412 837-6100
1 800 735-6007

NORDSTROM VALVES INC.
1511 Jefferson St. Sulphur Springs, Texas
903 885-4691
Rep. Kevin Doughtery 513 607-1739

HOMESTEAD VALVE
Kerr Marketing Agency
3508 Brecksville Rd.
Richfield, OH 44286
330 659-7171

VAL-TEX INC OF TEXAS
Houston, Texas
713-530-4848

KRAVITCH MACHINE CO.
3706 Rebecca Street
Pittsburgh, Pa 15234
1-800-437-5801

CLIMAX LUBRICANTS AND EQUIPMENT CO.
Po Box 5235
Houston, Texas 77262-5235
713-923-2626

SEAL WELD
Contact: Bart Duggan
P O Box 665
Connellsville, PA 15425
Ph-724-628-7446

IGS, INC./ROPE PACKING
Contact: Tom Delaney
200 Country Club Rd., P O Box 368
Meadows Land, PA 15347
Ph-1-800-229-1447
Ph-724-222-5800

LUBCHEM, INC.
Contact: Randy
P O Box 2626
Spring, TX 77383-2626
Ph-1-800-929-0244

INDUSTRIAL
TRAINING SERVICES

Industrial Training Services, Inc.

www.ITS-training.com

1.800.333.1566

310 C.C. Lowry Drive
Murray, KY 42071

Phone: 270.753.2150
Fax: 270.753.9807

INDUSTRIAL

TRAINING SERVICES

DANNY SHRODT

OQ Compliance Series

Student Manual

OQ Task CI-10

v11.1

Inspect and Monitor Exposed Piping for Evidence of Atmospheric Corrosion

INDUSTRIAL
TRAINING SERVICES

ITS OQ Compliance Series
CI-10 Inspect and Monitor Exposed Piping for Evidence of Atmospheric Corrosion V11.1

Student Manual

INTRODUCTION

Atmospheric corrosion of exposed gas piping facilities is a condition that is monitored continually by operating personnel of natural gas systems. The presence of atmospheric corrosion can be determined by visual inspection. To complete this module you will be required to complete the check-out activities listed below.

OBJECTIVE

1. Inspecting and monitoring exposed piping for evidence of atmospheric corrosion.

CHECK-OUT ACTIVITIES

Your instructor will provide you with a list of incomplete statements related to inspecting and monitoring exposed piping for evidence of atmospheric corrosion and a list of responses. Select the response that most correctly completes each incomplete statement. Cut-off score is 80%. (Knowledge Verification)

Your instructor will provide you with a Skill and Ability Verification Checklist. At the appropriate time demonstrate your skill and ability by correctly performing each operation required under the task.
(Skill and Ability Verification)

OQ CI-10 covers requirements indicated in the following codes/regulations:

ITS OQ Covered Task:	ASME B-31 Q*	49 CFR 192**
OQ CI-10.1 Visual Inspection for Atmospheric Corrosion	0141	192.479 192.481
OQ CI-10.2 Measure Atmospheric Corrosion	0191	

*ASME B31Q Covered Tasks:

0141 Visual Inspection for Atmospheric Corrosion.
0191 Measure Atmospheric Corrosion.

**49 CFR Part 192 Covered Regulations:

49 CFR 192 covered regulations are identified within the appropriate section of this module.

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Table of Contents

INSTRUCTION SHEET I

Inspecting and Monitoring Exposed Piping for Evidence of Atmospheric Corrosion

Atmospheric corrosion may occur where metal is exposed to the atmosphere with no protective coating. It generally will exhibit pitting where the metal is corroded at distinct spots, as illustrated in Figure 1. However, there may be a uniform deterioration where layers of the metal are converted to corrosion products in such a way that the thickness or pipe wall is uniformly decreased. Surface oxidation, commonly known as rust, is not considered "atmospheric corrosion." Rust does not generally impact pipe wall thickness to the extent the wall strength would be impaired. However, the oxidation (rust) on a metal surface, as illustrated in Figure 2, should be removed and the metal painted with an approved paint.

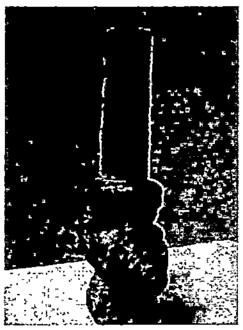

Figure 1. Galvanic Corrosion

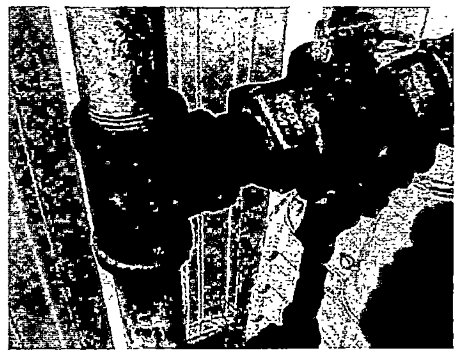

Figure 2. Surface Oxidation (Rust)

D.O.T. Regulations

§ 192.479 Atmospheric corrosion control: General.

(a) Each operator must clean and coat each pipeline or portion of pipeline that is exposed to the atmosphere, except pipelines under paragraph (c) of this section.

(b) Coating material must be suitable for the prevention of atmospheric corrosion.

(c) Except portions of pipelines in offshore splash zones or soil-to-air interfaces, the operator need not protect from atmospheric corrosion any pipeline for which the operator demonstrates by test, investigation, or experience appropriate to the environment of the pipeline that corrosion will—

(1) Only be a light surface oxide; or

(2) Not affect the safe operation of the pipeline before the next scheduled inspection.

[Amdt. 192–93, 68 FR 53901, Sept. 15, 2003]

§ 192.481 Atmospheric corrosion control: Monitoring.

(a) Each operator must inspect each pipeline or portion of pipeline that is exposed to the atmosphere for evidence of atmospheric corrosion, as follows:

If the pipeline is located:	Then the frequency of inspection is:
Onshore	At least once every 3 calendar years, but with intervals not exceeding 39 months
Offshore	At least once each calendar year, but with intervals not exceeding 15 months

(b) During inspections the operator must give particular attention to pipe at soil-to-air interfaces, under thermal insulation, under disbonded coatings, at pipe supports, in splash zones, at deck penetrations, and in spans over water.

(c) If atmospheric corrosion is found during an inspection, the operator must provide protection against the corrosion as required by §192.479.

[Amdt. 192–93, 68 FR 53901, Sept. 15, 2003]

Causes of Atmospheric Corrosion

The most important factor in atmospheric corrosion (except for pollution or lack of it) is moisture in the form of rain, dew, or condensation. Without moisture, most contaminants would have little or no corrosive effect. Rain may have a beneficial effect by washing away atmospheric pollutants that have settled on exposed surfaces. However, if rain collects in pockets or crevices, it may accelerate the corrosion process by supplying continued wetness in localized areas.

Dew and condensation are very damaging because they accelerate the corrosion process if they are not washed away. A film of dew, saturated with sea salt or acid sulfates and acid chlorides in an industrial atmosphere, provides a very aggressive electrolyte for the promotion of atmospheric corrosion.

Temperature also plays an important role in atmospheric corrosion. There is a normal increase in corrosion activity which is said to double for each ten degree (10^{o}) increase in temperature.

The quantity and composition of pollutants in the atmosphere and the amount of pollutants collected on the metal surface under a variety of conditions are also important factors in the overall assessment of atmospheric corrosion.

Determining Areas of Atmospheric Corrosion[1]

The presence of atmospheric corrosion can be determined by visual inspection. Standard procedures or test methods for evaluating materials and coatings are available from the American Society for Testing and Materials.

When performing visual inspections of pipeline facilities, attention should be given to locations such as clamps, sleeved openings, and air to soil interface areas. This may require the use of ladders, scaffolds, hoists, or other suitable means, or permitting the inspector access to the structure being inspected.

Evidence of atmospheric corrosion on meters and regulators may also be determined by inspection by operator employees such as meter readers and leak survey personnel.

Controlling Atmospheric Corrosion[2]

The following methods for controlling atmospheric corrosion should be considered for exposed piping and related facilities:

- Use of coating
- Selection of corrosion resistant materials
- Avoidance of areas where prevailing winds or other conditions will deposit corrosive materials (such as salt, moisture or industrial effluent). Protection in these areas can be provided by selecting a more appropriate meter and regulator location or by using a protective housing.
- Use of more durable materials and/or coatings suitable for the environment may be required for facilities that are installed in pits or vaults and which may be periodically submerged or exposed to excessive condensation.

(a) Protection of regulator vent lines from plugging by corrosion products. Where practical, the vent line should be installed in a self-drain position and, where necessary, extended above possible flood level.

(b) Use of material for vent tubing that is compatible with the environment encountered. (For example, some kinds of plastic tubing should not be exposed to direct sunlight, and certain aluminum alloys should not be submerged or placed in contact with concrete.)

[1] 49 CFR, 192.481, Guide Material (1.1)
[2] 49 CFR, 192.479 Guide Material (2)

Atmospheric Corrosion Control Requirements[3]

(1) **Pipelines Installed After July 31, 1971.** All metallic pipelines installed after July 31, 1971 that are exposed to the atmosphere must be cleaned and either coated or jacketed with a material suitable for the prevention of atmospheric corrosion.

(2) **Pipelines Installed Before August 1, 1971.** Remedial measures listed below shall be followed when atmospheric corrosion has been identified on above ground metallic pipelines installed before August 1, 1971.

- Determine the areas of atmospheric corrosion on the pipeline;
- If atmospheric corrosion is found, take remedial measures to the extent required by the applicable paragraphs of 192.485, 192.487, or 192.489; and,
- Clean and either coat or jacket the area of atmospheric corrosion on the pipeline with a material suitable for the prevention of atmospheric corrosion.

(3) **Monitoring.** Each operator shall maintain a continuing program to re-evaluate each pipeline exposed to the atmosphere and take remedial action whenever necessary to maintain protection against atmospheric corrosion. Each pipeline shall be evaluated at intervals not exceeding three (3) years. This inspection may be done in connection with at least one of the following:

- Programmed line patrols
- Leakage Surveys including customer service lines
- Regulator and measurement inspections
- Work involving meters (changing, reconnections, etc.)
- Meter reading operations

Measurement of the Corroded Area

If atmospheric corrosion on the pipe requires remedial action, an investigation of the extent of the corrosion is done circumferentially and longitudinally beyond the exposed portion of the corroded pipe to determine if additional corrosion requiring action exists in the vicinity of the exposed portion.[4]

Measurement of the extent of corrosion shall include the following:

- The depth of corrosion is measured with a pit depth gauge and recorded.

[3] 49 CFR, 192.455 and 192.457
[4] 49 CFR, 192.459

- The length of the corrosion as oriented with the longitudinal axis of the pipe and recorded in inches.

- The width of the corrosion as oriented perpendicular with the axis of the pipe and recorded in inches.

The profile of the corroded pipe wall may be measured and quantified as illustrated in Figure 3.

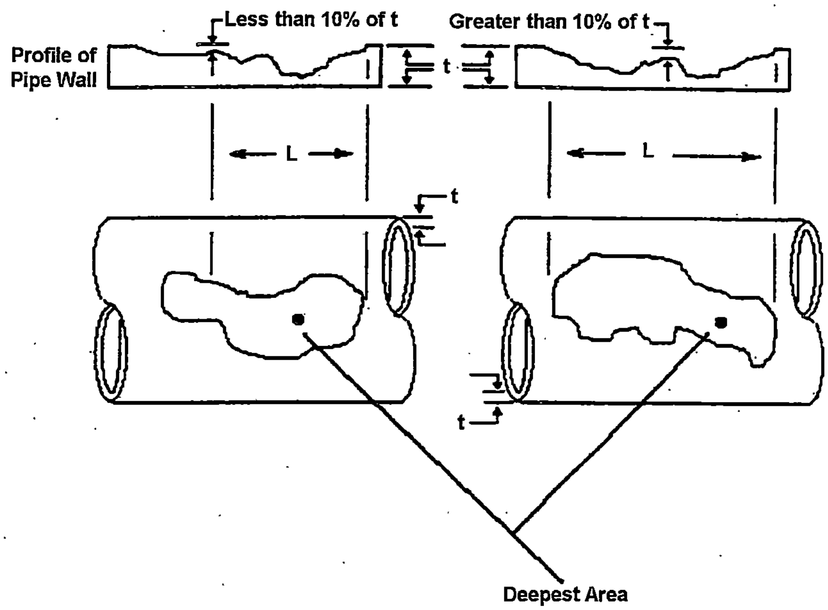

Figure 3. Measurement of the Corroded Area

Inspections

The identification and recording of atmospheric corrosion areas on exposed piping may be included when inspecting regulator settings, performing leakage surveys, patrolling, etc.

(1) **Regulator Settings.** Visually inspect for atmospheric corrosion on above ground yard piping, regulator setting piping, and equipment.

(2) **Leakage Surveys.** Observations for atmospheric corrosion should be made of all exposed piping during any programmed survey. Exposed piping in areas that are surveyed on a five year cycle, which are not being evaluated for atmospheric corrosion by another inspection program must be identified and inspected at intervals not exceeding three (3) years.

(3) **Patrolling.** Patrolling is the act of surveying facilities that have been identified as being exposed to severe conditions which could cause failure or leakage and the consequent hazards to public safety.

Facilities which, because of actual or potential exposure to dangerous conditions, require more frequent observation than is provided by leak survey programs and/or valve inspection or regulator inspection programs, should be identified in order to establish a patrolling schedule.

Recognizing and Reacting to Abnormal Operating Conditions

Note:
The following Abnormal Operating Conditions (AOCs) and their reactions listed are for guidance only. This AOC list is not presented as an exhaustive treatment of AOCs and appropriate responses. You may be required to know and apply other AOCs and AOC responses for different tasks. Properly recognizing and reacting to covered task AOCs are the responsibility of persons qualified to perform the covered task. Always follow your company's policies and procedures.

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(1) **Things to Consider When Responding to Abnormal Operating Conditions.** The following information is basic knowledge that will assist you in assessing and responding to abnormal operating conditions:

(a) **Basic Properties of Natural Gas.**

- Natural gas is lighter than air, colorless and odorless.
- Natural gas has a specific gravity of approximately 0.6.
- The natural gas Lower Explosive Limit (LEL) is approximately 5%.
- The natural gas Upper Explosive Limit (UEL) is approximately 15%.
- The ignition temperature of natural gas is about 1100°-1200° F.

(b) **Eliminating Ignition Sources.** Some of the ways to eliminate ignition sources are very obvious. For example:

- Smoking and open flames should be prohibited in structures or areas containing gas facilities where possible leakage or presence of gas constitutes a hazard of fire or explosion.
- Smoking and open flames should be prohibited in the open when accidental ignition of a gas-in-air mixture could cause personal injury or property damage.
- Do NOT smoke or use open flames near a jobsite/gas pipeline facility.
- Sparks range in temperature from 1500°F in an electrical switch to 9,000°F in an arc welder. Do NOT use equipment or create situations that generate sparks. Sparks may be generated by the following conditions:

Communication equipment
Portable electrically powered tools and equipment
Internal combustion engines
Breaking electrical continuity
Static electricity on plastic pipe

(c) Personal Protection Equipment.

Always follow your company's policies and procedures for the use of personal protection equipment (PPE).

Working around gas pipeline facilities requires practical safety practices and basic PPE may include:

- Head protection (e.g. hard hat)
- Eye and face protection (e.g. goggles, face shield, etc.)
- Hearing protection (e.g. ear plugs, ear muffs, etc.)
- Hand protection (proper glove material for the specific job)
- Respiratory protection (proper respiratory equipment when air content is insufficient)

(2) Abnormal Operating Conditions.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Improper location of company facilities	• Move or protect or notify proper personnel
• Metal loss or pitting due to atmospheric corrosion	• Measure depth; determine remaining wall thickness; repair or replace section as needed; apply protective coating
• External examination reveals need for replacement	• Notify proper personnel
• Internal corrosion	• Inform proper person and/or testing
• External corrosion caused by outside interference	• Inform proper personnel

REVIEW I

Inspecting and Monitoring Exposed Piping for Evidence of Atmospheric Corrosion

Directions: Select from the list below the response that most correctly completes each of the following statements. Write the letter of your choice in the space provided. Some answers may be used more than once.

A. patrolling
B. prohibit smoking near jobsite
C. rust
D. thickness
E. 3 years
F. temperature
G. moisture
H. measured
I. cleaned and coated
J. sleeved openings
K. prevailing winds
L. repair, replace, or apply protective coating as required
M. 5 years

__I__ 1. According to the Federal Standard 192.479, each aboveground pipeline that is exposed to the atmosphere must be _____ for the prevention of atmospheric corrosion.

__E__ 2. According to the Federal Standard 192.481, operators must reevaluate each onshore pipeline that is exposed to the atmosphere and take remedial action at intervals not exceeding _____.

__G__ 3. The two important factors contributing to atmospheric corrosion are _____ (3) and _____ (4).

__F__ 4.

__A__ 5. Facilities that have been identified as being exposed to severe conditions that might cause failure or leakage and possible hazards to public safety are scheduled for frequent observations called _____.

__C__ 6. The type of surface oxidation that does not generally impact pipe wall thickness to the extent the wall strength would be impaired is _____.

__J__ 7. When performing visual inspections of pipelines facilities, one area that should be given special attention is _____.

__B__ 8. One way to eliminate sources of ignition is to _____.

A. patrolling
B. prohibit smoking near jobsite
C. rust
D. thickness
E. 3 years
F. temperature
G. moisture
H. measured
I. cleaned and coated
J. sleeved openings
K. prevailing winds
L. repair, replace, or apply protective coating as required
M. 5 years

L 9. If atmospheric corrosion on a steel pipe requires remedial action, the corroded area should be _____.

D 10. The depth of corrosion on a pipe is quantified with reference to the _____ of the pipe.

L 11. If you find evidence of atmospheric corrosion with pitting and metal loss, you should measure depth, determine remaining wall thickness, and _____.

K 12. A method used to help control atmospheric corrosion on exposed piping is to construct the facility in a manner that has limited exposure to _____, which may deposit corrosive materials.

E 13. DOT regulations require each operator to maintain a continuing program to reevaluate each exposed pipeline and take remedial action whenever necessary at intervals not exceeding _____.

Knowledge Verification Checklist

OQ Task CI-10
Inspect and Monitor Exposed Piping for Evidence of Atmospheric Corrosion

Directions: Use the following performance criteria statements as a self-evaluation in preparation for the final exam.

I can identify:

- ☐ 1. The type of corrosion that generally does not impact pipe wall thickness to the extent the wall strength is impaired. (CI-10.1.1)
- ☐ 2. The guidelines stated in D.O.T. regulation 192.479, Atmospheric Corrosion Control, General. (CI-10.1.2)
- ☐ 3. The guidelines stated in D.O.T. regulation 192.481, Atmospheric Corrosion Control, Monitoring, relating to the requirements for reevaluating onshore pipelines. (CI-10.1.3)
- ☐ 4. An important factor contributing to atmospheric corrosion. (CI-10.1.4)
- ☐ 5. Areas given special attention when performing visual inspections of pipelines facilities for atmospheric corrosion. (CI-10.1.5)
- ☐ 6. An area that should be avoided when installing exposed piping and related facilities. (CI-10.1.6)
- ☐ 7. D.O.T. requirements concerning monitoring exposed pipelines for evidence of atmospheric corrosion. (CI-10.1.7)
- ☐ 8. A procedure to be performed if atmospheric corrosion on a pipe requires remedial action. (CI-10.1.8)
- ☐ 9. A method to quantify the depth of a corrosion pit. (CI-10.1.9)
- ☐ 10. The act of surveying facilities that are identified as being exposed to severe conditions, which could cause failure or leakage and the consequent hazards to public safety. (CI-10.1.10)

I can identify:

- ❐ 11. An appropriate action to an abnormal operating condition of atmospheric corrosion detected with pitting and metal loss. (CI-10.1.11)
- ❐ 12. Evidence of atmospheric corrosion on metallic piping. (CI-10.1.12)
- ❐ 13. Evidence of rust on metallic piping. (CI-10.1.13)

Skill and Ability Verification Packet

OQ Task CI-10
Inspect and Monitor Exposed Piping for Evidence of Atmospheric Corrosion

I. General Instructions

Instructions for Use

The Skill and Ability Verification Packet is designed to standardize conditions under which the employee demonstrates his/her performance of tasks that meet the operator qualification requirements established by the employee's company.

Completing the enclosed affidavit and uploading the data to Industrial Training Services OnBoard LMS for recordkeeping, documents the satisfactory completion of tasks. Both the OQ Authorized Evaluator (AE) and employee must sign the affidavit.

Instructions to the Employee

Your OQ AE will check your performance using the suggested evaluator guide included in each hands-on task assignment. This suggested guide must be supplemented or replaced by the individual company's policies and procedures related to the task being evaluated.

You must adhere to all safety precautions according to your company's policies and procedures and applicable federal, state, and local codes and regulations.

II. Task Information

OQ Task CI-10:	**Inspect and Monitor Exposed Piping for Evidence of Atmospheric Corrosion**
Qualification Standard:	The employee's qualification is based on the enabling operation(s) that have been successfully completed. The operation's tasks are listed below:
OQ Task CI-10.1	Visual Inspection for Atmospheric Corrosion (B31Q 0141)
OQ Task CI-10.2	Measure Atmospheric Corrosion (B31Q 0191)
Recommended Requirement:	The employee must demonstrate proficiency to an acceptable level based on the Skill and Ability Checklist associated with each operation.
References:	49 CFR, Part 192.479 and 192.481. B31Q Tasks 0141, 0191.

Note:

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Abnormal Operating Conditions

(Not limited to the examples listed below)

Recognize	React
• Improper location of company facilities	• Move or protect or notify proper personnel
• Metal loss or pitting due to atmospheric corrosion	• Measure depth; determine remaining wall thickness; repair or replace section as needed; apply protective coating
• External examination reveals need for replacement	• Notify proper personnel
• Internal corrosion	• Inform proper person and/or testing
• External corrosion caused by outside interference	• Inform proper personnel

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III. Skill and Ability Verification Checklist

OQ Task CI-10
Inspect and Monitor Exposed Piping for Evidence of Atmospheric Corrosion

I verify that **(Please Print)** ______________________________ **is qualified to perform OQ Task CI-10 according to his/her company's procedures:**

(CI-10.1) Visual Inspection for Atmospheric Corrosion. (0141)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

☐ Use proper personal protective equipment.

Select task procedure(s) and appropriate equipment.

Inspect the following locations for atmospheric corrosion as applicable:

- pipe, pipe supports, and other pipeline components
- under thermal insulation
- at ground level on risers and other pipe to soil-air interfaces
- spans over water
- other areas necessary to determine extent of corrosion

Inspect the following indications of corrosion:

- indications of rust
- surface pitting
- missing, damaged, or disbonded coating
- other forms of corrosion

Document, as required.

Recognize and properly react to AOC's.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Internal corrosion • External corrosion caused by outside interference	• Inform proper person and/or testing • Inform proper personnel

Comments / Additional Company Procedures:

____

____

____

(CI-10.2) Measure Atmospheric Corrosion. (0191)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Assess/confirm surface condition for the following:
  - deterioration
  - flaking
  - peeling
  - cracking
  - sags
  - blisters
  - wrinkles
- ☐ Prepare surface.
  - Remove foreign material and/or damaged coating to expose corrosion, as applicable.
- ☐ Perform test equipment check to verify that equipment functions within specified parameters.
  - Inspect equipment.
  - Verify equipment is calibrated.
  - Test equipment with known sources, as applicable.
- ☐ Take measurements by the following methods, as applicable:
  - pit depth gage
  - ultrasonic thickness meter
- ☐ Identify corrosion associated with
  - gouges
  - dents
  - scratches
- ☐ Identify characteristics of corrosion.
  - pitting
  - scale
  - rust
- ☐ Record findings.
  - depth, length, and spacing of corrosion (pits)
  - type of damage to pipe
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Operating Conditions

(Not limited to the examples listed below)

Recognize	React
• Internal corrosion • External corrosion caused by outside interference	• Inform proper person and/or testing • Inform proper personnel

Comments / Additional Company Procedures:

IV. Employer Record

OQ Task CI-10

Inspect and Monitor Exposed Piping for Evidence of Atmospheric Corrosion

Employee Information (Please Print):

Name ______________________________

Last 4 Digits of Social Security Number ______________________________

Company Name ______________________________

Company Mailing Address ______________________________

City ______________ State ________ Zip ____________

Affidavit

I acknowledge the performance of this task is solely for the purpose of operator qualification, and is not intended to replace or modify company operating procedures or policies and may not be appropriately used in all circumstances. I acknowledge that I am responsible for recognizing hazards and abnormal conditions in my work place and must exercise care and good judgment; always using appropriate equipment, procedures and tools for tasks I perform. Industrial Training Services, Inc. assumes no liability for my actions nor for my application of the qualification performance guides used in this evaluation checklist.

Employee's Signature ______________________ Date ____________

Evaluator Information (Please Print):

Name ______________________________

Organization/Employer ______________________________

Telephone Number ______________________________

Affidavit

I affirm that I am the person who has administered this checklist and that I have conducted this assessment with integrity. I also affirm that the above named employee is the person assessed and that the above named person performed the tasks at the indicated level.

Evaluator's Signature ______________________ Date ____________

The employee is qualified according to company standards to perform the tasks listed below as indicated:

	Not Applicable	TASK/OPERATIONS	Method of Skill/Ability Verification Enter Number From List Below
1.	☐	(CI-10.1) Visual Inspection for Atmospheric Corrosion. (0141)	☐
2.	☐	(CI-10.2) Measure Atmospheric Corrosion. (0191)	☐

Method of Knowledge Verification

- Written Exam

Method of Skill/Ability Verification Observed During:

1. Performance on the Job
2. Simulation

After completion of Section IV, "Employer Record," remove section from the packet for your records. For third party verification and database reporting service, upload the data to Industrial Training Services OnBoard LMS.

Industrial Training Services, Inc.

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INDUSTRIAL
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DANNY SHROUT

OQ Compliance Series

Student Manual

OQ Task CL-1a
v10.2

Hot Tapping Pipelines Using Self-Tapping Tees

INDUSTRIAL
TRAINING SERVICES

ITS OQ Compliance Series

CL-1a Hot Tapping Pipelines Using Self-Tapping Tees v10.2

Student Manual

INTRODUCTION

Tapping is a means to access the inside of an operational gas pipeline. It is done for any number of reasons, including attachment of a branch connection to the line, installation of an internal probe or monitor, relocating or diverting the pipeline, or stopping or redirecting flow in a line for maintenance purposes. To complete this module, you will be required to complete the check-out activities listed below.

OBJECTIVE

1. Identify procedures for installing self-tapping tees.

CHECK-OUT ACTIVITIES

Your instructor will provide you with a list of incomplete statements related to hot tapping pipelines using self-tapping tees and a list of responses. Select the response that most correctly completes each statement. Cut-off score is 80%. (Knowledge Verification)

Your instructor will provide you with a Skill and Ability Verification Checklist. At the appropriate time demonstrate your skill and ability by correctly performing each operation required under the task. (Skill and Ability Verification)

OQ CL-1a covers requirements indicated in the following codes/regulations:

ITS OQ Covered Task:	ASME B-31 Q*	49 CFR 192**
OQ CL-1a.1 Tapping a Pipeline With a Built-In Cutter	1101	192.627

***ASME B31Q Covered Tasks:**

1101 Tapping a Pipeline With a Built-In Cutter

****49 CFR Part 192 Covered Regulations:**

49 CFR 192 covered regulations are identified within the appropriate section of this module.

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Table of Contents

INSTRUCTION SHEET I

Identifying Procedures for Installing Self-Tapping Tees

Hot tapping is the procedure used when cutting or drilling an opening into a pipeline that has a product under pressure. A hot tap allows access to the inside of an operating pipeline without shutdown or spillage. Check the necessary documentation to ensure the pressure on the main is correct for the pressure rating of the tapping tee being used. This is important especially when there is more than one main in a location. The content of this module is limited to hot tapping steel or plastic pipelines using self-tapping tees.

> **§ 192.627 Tapping pipelines under pressure.**
> Each tap made on a pipeline under pressure must be performed by a crew qualified to make hot taps.

Hot Tapping a Plastic Gas Main Using a Plastic Self-Tapping Tee

Before tapping the gas main, the service line is joined to the tapping tee and pressure tested. Inspect the fusion to be sure that the melt has squeezed out completely around the edge of the saddle base in a three roll bead. Check to be certain that the saddle fitting is entirely within the pipe melt pattern. A properly made tapping tee is shown in Figure 1. Only accept joints meeting these requirements. Never allow a questionable joint to be installed or to remain.

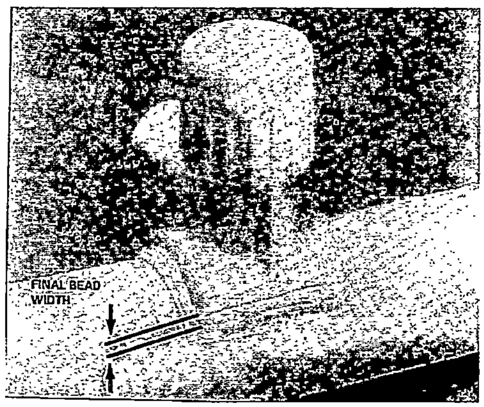

Figure 1. Properly Made Tapping Tee Fusion

The American Gas Association recommends allowing fusion joints to cool at least 30 minutes before pressure testing or tapping.[1] However, the condition of the fusion equipment, pipe size, and environmental conditions may affect the cooling time. Refer to the Plastic Pipe Institute (PPI), manufacturer's recommendations, and your company's policies and procedures for proper cooling times.

> **Instructions for installing self tapping tees are provided for discussion purposes only. Follow the manufacturer's installation instructions and your company's policies and procedures.**

A hot tapping procedure using a self-tapping tee typically includes the following steps:

[1] American Gas Association, AGA Plastic Pipe Manual for Gas Service, 8th Edition, 2006, pg 65.

Step 1: Slip the protective sleeve over the service line and then join the line to the outlet of the tapping tee. Position the protective sleeve as illustrated in Figure 2.

The area of the service line extending out from the point where it is connected to the main is a critical stress area. As illustrated in Figure 2, the backfill in this area should be compacted around and under tie-ins. Also, a protective bridging sleeve should support the service line in this critical area.

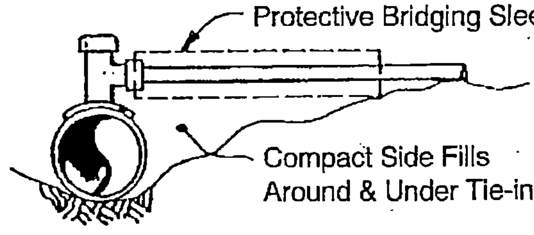

Figure 2. Critical Stress Area

Step 2: Tighten the cap located on top of the tapping tee.

Step 3: Pressure test all joints (fusion or mechanical) including the saddle base of the tapping and service line at the tee and meter riser.

- If a leak occurs, release pressure, cut off the tapping tee outlet or stack, and abandon the tee.
- If it passes the pressure test, release the pressure in preparation for tapping.

Step 4: Remove the cap.

- It is important to keep both the cap and seal areas free of dirt.

Step 5: Insert the shank of the tap tool the entire way into the socket portion of the punch. Be sure to follow the tapping tee manufacturer's instructions.

Step 6: Using an appropriate "drive wrench," turn down the tapping tool at a steady rate until the main is tapped.

- Refer to the tapping tee manufacturer's instructions for gauging the travel distance of the punch. It will vary with the diameter of the pipe being punched.

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Caution!
Turning the punch down appreciably beyond the stop point could result in dropping the punch into the main or the punch contacting the pipe wall on the opposite side.

Step 7: Raise the punch back out of the pipe wall, following the punch tee manufacturer's instructions.

- Typically the punch is raised up until the top of the punch is flush with the top of the stack. It never extends above the top of the stack.

Step 8: Replace cap and tighten following the tapping tee manufacturer's instructions.

- Typically the cap is tightened hand-tight.

Instructions for installing self tapping tees are provided for discussion purposes only. Follow the manufacturer's installation instructions and your company's policies and procedures.

Installing and Operating the Mueller® Autoperf® Tee[2]

(1) Installing the Mueller® Autoperf® Tee.

Step 1: After removing the tee body from the package, remove completion cap and perforator from tee body and place these parts in the package to keep them clean.

Step 2: Attach tee body to the main and service line and extend service line to the first shut-off, such as a curb or meter valve.

Step 3: Close the curb or meter valve, then attach a test cap to the tee body and pressure test the tee and service line.

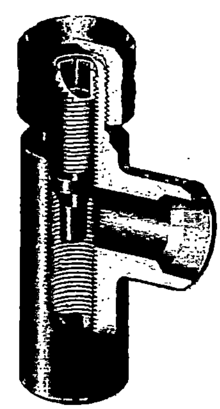

Figure 3. Mueller® Autoperf® Tee

[2] Mueller Company, Gas Products Division, Form 10766, "Installation and Operating Instructions for Mueller Autoperf Tees."

Step 4: Remove the perforator from its package and insert the perforator into the tee body until the top of the perforator is ¼" below flush with the top of the tee body.

Step 5: Attach the H-18092 crimping tool to the tee body and ratchet the crimping tool shaft approximately one full turn in the clockwise direction to crimp over the top of the tee body.

Step 6: Remove the crimping tool by rotating the wrench handle in counter-clockwise direction.

Step 7: To perforate the main, place the H-18090 NO-BLO® operating wrench shaft into the hex socket of the perforator and attach the wrench to the tee body.

Step 8: Place the ratchet handle on the operating wrench and maintain a downward pressure on the handle to keep shaft in place in the hex socket of the perforator.

Step 9: Rotate ratchet handle clockwise until perforator contacts the main and then continue ratcheting the handle clockwise until the main is perforated and the perforator seats tightly in the main.

Step 10: Rotate the ratchet handle counter-clockwise until the perforator contacts the top of the tee body and makes a pressure-tight metal-to-metal seal.

Step 11: Remove the operating wrench from the tee body.

Step 12: Test for pressure tightness of the perforator.

Step 13: Remove the completion cap from its package and apply a good grade pipe dope to the pipe threads on the tee body.

Step 14: Attach completion cap and tighten securely.

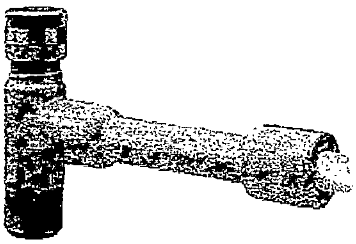

Figure 4. Installed Tee

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(2) Instructions for Making a Shut-Off at the Main.

Step 1: Remove the completion cap and attach the operating wrench to the tee body.

Step 2: Rotate the ratchet handle clockwise until the perforator contacts the top of the main.

Step 3: Ratchet the handle clockwise until positive shut-off is made.

Installing and Operating Bolt-on Saddle Service Tee

Instructions for installing and operating bolt-on saddle service tees are provided for discussion purposes only. Follow the manufacturer's installation instructions and your company's policies and procedures.

Bolt-on saddle service tees are equipped with a built-in cutter. The bolt-on saddle service tee, illustrated in Figure 5, is secured to the main with the use of a clamp. Typically, gaskets or O-rings are used to form a seal between the saddle base and the OD (outside diameter) of the main. The seal prevents leakage when the pipe is pierced using the built-in cutter. The manufacturer's instructions must be followed when installing bolt-on saddle service tees.

Connection styles to the outlet of the service tee include stab fittings, threaded compression end fittings and heat fusion.

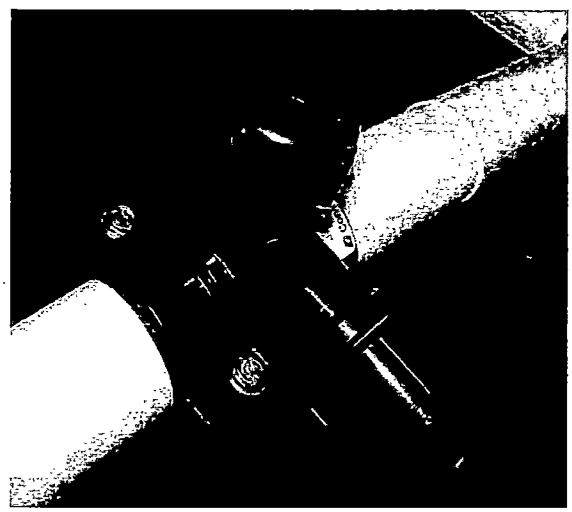

Figure 5. Bolt-on Saddle Service Tee

The bolt-on saddle service tee, illustrated in Figure 6 on the next page, is equipped with a threaded compression end fitting. The design concept of this type of fitting typically includes an elastomer seal (armored gasket) in the assembly. The seal, when compressed by tightening of a threaded compression nut, grips the outside of the pipe, offsetting a pressure seal and in some designs providing pull-out resistance. It is important that the inside of the pipe wall be supported by the stiffener under the seal ring and under the gripping ring (if incorporated in the design), to prevent collapse of the plastic. This type fitting is normally used on service line piping.

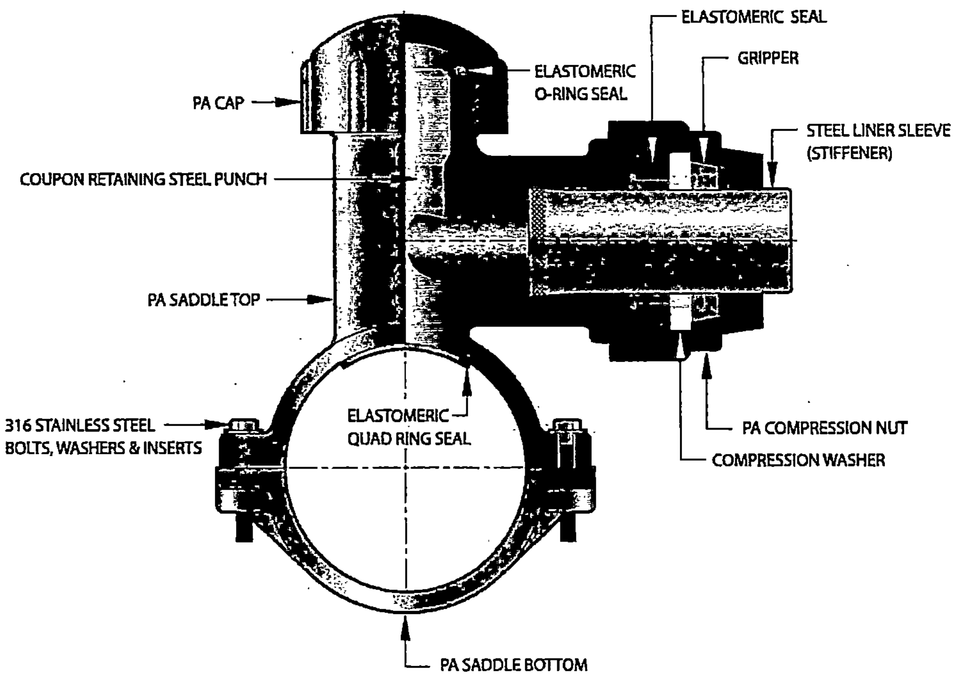

Figure 6. Bolt-on Saddle Service Tee
Equipped With a Threaded Compression End Fitting

(1) Installing the Bolt-on Saddle Service Tee:

Step 1: Ensure the mounting surface on the pipe is clean and free of cuts and scratches.

Step 2: Place the top and bottom halves of the saddle on the main.

Step 3: Insert bolts through the saddle flanges and tighten until the flanges come together. (Do not rotate the saddle on the main.)

(2) Installing the Threaded Compression End Fitting:

Step 1: Prepare the pipe ends to be inserted into the compression fitting.

- Cut the pipe end square.
- Deburr the outside and inside of the pipe.
- Clean the assembly area of the pipe to ensure there is no dirt, oils, grease, etc.

Step 2: Mark the stab length on the pipe. See example below for correct pipe or tubing size corresponding length.

Step 3: Insert the pipe into the fitting.

- Loosen the compression nut until the seal ring is no longer compressed.
- Insert the pipe until it bottoms in the outlet as illustrated in Figure 7.

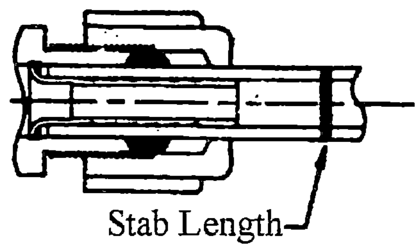

Figure 7. Pipe Properly Inserted

Step 4: Tighten the compression nut.

- Tighten the compression nut until it shoulders against the outlet. (See illustration in Figure 8).
- Do not over-tighten.

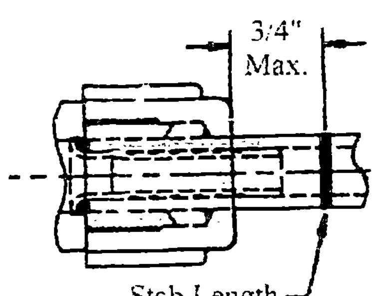

Figure 8. Pipe Properly Installed

- The line marking the stab length should be no more than ¾ inch from the face of the nut.

(3) **Tapping the Main (if required):**

Step 1: Tap the main (if required).

- Remove the cap and O-ring.
- Insert the drive key into the punch.
- Seat the guide bushing into the top of the saddle after beginning the tap.
- Screw the punch down until the stops on the drive key contact the top of the tee (the tap is now complete).

Step 2: Restore Service.

- Back the punch up until the top of the punch is flush with the top of the tee (it is important that the punch does not extend above the tee).
- Replace the O-ring and caps. Screw the tap down hand tight. Do not use wrenches on the caps.

Recognizing and Reacting to Abnormal Operating Conditions

Note:

The following Abnormal Operating Conditions (AOCs) and their reactions listed are for guidance only. This AOC list is not presented as an exhaustive treatment of AOCs and appropriate responses. You may be required to know and apply other AOCs and AOC responses for different tasks. Properly recognizing and reacting to covered task AOCs are the responsibility of persons qualified to perform the covered task. Always follow your company's policies and procedures.

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(1) **Things to Consider When Responding to Abnormal Operating Conditions.** The following information is basic knowledge that will assist you in assessing and responding to abnormal operating conditions:

(a) **Basic Properties of Natural Gas.**

- Natural gas is lighter than air, colorless and odorless.
- Natural gas has a specific gravity of approximately 0.6.
- The natural gas Lower Explosive Limit (LEL) is approximately 5%.
- The natural gas Upper Explosive Limit (UEL) is approximately 15%.
- The ignition temperature of natural gas is about 1100°-1200° F.

(b) Eliminating Ignition Sources. Some of the ways to eliminate ignition sources are very obvious. For example:

- Smoking and open flames should be prohibited in structures or areas containing gas facilities where possible leakage or presence of gas constitutes a hazard of fire or explosion.
- Smoking and open flames should be prohibited in the open when accidental ignition of a gas-in-air mixture could cause personal injury or property damage.
- Do NOT smoke or use open flames near a jobsite/gas pipeline facility.
- Sparks range in temperature from 1500°F in an electrical switch to 9,000°F in an arc welder. Do NOT use equipment or create situations that generate sparks. Sparks may be generated by the following conditions:

  Communication equipment
  Portable electrically powered tools and equipment
  Internal combustion engines
  Breaking electrical continuity
  Static electricity on plastic pipe

(c) Personal Protection Equipment.

Always follow your company's policies and procedures for the use of personal protection equipment (PPE).

Working around gas pipeline facilities requires practical safety practices and basic PPE may include:

- Head protection (e.g. hard hat)
- Eye and face protection (e.g. goggles, face shield, etc.)
- Hearing protection (e.g. ear plugs, ear muffs, etc.)
- Hand protection (proper glove material for the specific job)
- Respiratory protection (proper respiratory equipment when air content is insufficient)

(2) Abnormal Operating Conditions for Hot Tapping Pipelines.

Abnormal Operating Conditions

(Not limited to the examples listed below)

Recognize	React
• Uncontrolled escaping gas	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Accidental ignition	• Control fire and make area safe and notify appropriate personnel
• Ignition	• Stop the flow of gas at the nearest valve. Put flame out with fire extinguisher.
• Leaking fitting	• Repair leak; repeat leak test
• Overpressure	• Make area safe; contact proper personnel
• Improper shutoff	• Verify pressure was maintained, pull stopple out and reset
• Pipe lamination	• Move to different location
• Improper alignment of fitting	• Do not install fitting; relocate
• Improper travel	• Check measurement of travel

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REVIEW I

Identifying Procedures for Installing Self-Tapping Tees

Directions: Select from the list below the response that most correctly completes each of the following statements. Write the letter of your choice in the space provided.

A. free of dirt and debris
B. pressure tested
C. counter-clockwise
D. follow the manufacturer's instructions
E. abandon the tee
F. clockwise
G. protective bridging sleeve
H. rotate the saddle on the main
I. clean and free of cuts and scratches
J. 30
K. hot tapping

K 1. The procedure that is used to cut or drill an opening into a pipeline that has a product under pressure to allow access to the inside of the pipeline is called _____.

B 2. Before hot tapping a plastic gas main, the service line is joined to the tapping tee and _____.

J 3. For tapping tees and service saddles, the AGA recommends allowing an additional _____ minutes cooling before pressure testing and tapping.

G 4. The area of the service line extending out from the point where it is connected to the main must have a _____ to support this critical stress area.

E 5. When pressure testing all joints, if a leak occurs, you should release pressure, cut off the tapping tee outlet or stack and _____.

D 6. While turning down the tapping tool using an appropriate drive wrench, you should _____ for gauging the travel distance of the punch, taking into consideration the diameter of the pipe.

C 7. To make contact with the Mueller Autoperf perforator to the top of the tee body and make a pressure-tight metal-to-metal seal, you must rotate the ratchet handle _____.

F 8. When performing a shut-off at the main with the Mueller Autoperf, you should turn the handle _____ until positive shut-off is made.

I 9. When installing the bolt-on saddle service tee, make sure the mounting surface on the pipe is _____.

A.	repair the leak and retest	F.	clockwise
B.	pressure tested	G.	protective bridging sleeve
C.	counter-clockwise	H.	rotate the saddle on the main
D.	follow the manufacturer's instructions	I.	clean and free of cuts and scratches
		J.	30
E.	abandon the tee	K.	hot tapping

_H___10. As you insert the bolts through the saddle flanges of the bolt-on saddle service tee, you must tighten until the flanges come together; but do NOT _____.

_A___11. After performing a tap with a self-tapping tee, a leak test reveals a leaking fitting. You should _____.

Knowledge Verification Checklist

OQ Task CL-1a

Hot Tapping Pipelines Using Self-Tapping Tees

Directions: Use the following performance criteria statements as a self-evaluation in preparation for the final exam.

I can identify:

- ☐ 1. The procedure of cutting or drilling an opening into a pipeline that has a product under pressure. (CL-1a.1.1)
- ☐ 2. The procedure performed to the service line before tapping the gas main. (CL-1a.1.2)
- ☐ 3. The recommended additional cooling time for tapping tees and service saddles before pressure testing and tapping. (CL-1a.1.3)
- ☐ 4. The proper protection used on the critical area of the service line extending out from the point where it is connected to the main. (CL-1a.1.4)
- ☐ 5. The action taken if a leak occurs while performing a pressure test on all joints during a tap. (CL-1a.1.5)
- ☐ 6. The proper way to gauge the travel distance of the punch. (CL-1a.1.6)
- ☐ 7. The correct direction to rotate the ratchet handle when making contact with the perforator of a Mueller Autoperf and the top of the tee body to make a pressure-tight metal-to-metal seal. (CL-1a.1.7)
- ☐ 8. The correct direction to rotate the ratchet handle when performing a shut-off at the main with the Mueller Autoperf. (CL-1a.1.8)
- ☐ 9. The steps taken to ensure a leak free installation when attaching a bolt-on saddle tee to a plastic main (CL-1a.1.9)
- ☐ 10. An action that must be avoided after a bolt-on saddle has been attached to a plastic main. (CL-1a.1.10)
- ☐ 11. The proper reaction to a leaking fitting. (CL-1a.1.11)

Skill and Ability Verification Packet

OQ Task CL-1a
Hot Tapping Pipelines Using Self-Tapping Tees

I. General Instructions

Instructions for Use

The Skill and Ability Verification Packet is designed to standardize conditions under which the employee demonstrates his/her performance of tasks that meet the operator qualification requirements established by the employee's company.

Completing the enclosed affidavit and uploading the data to Industrial Training Services OnBoard LMS for recordkeeping, documents the satisfactory completion of tasks. Both the OQ Authorized Evaluator (AE) and employee must sign the affidavit.

Instructions to the Employee

Your OQ AE will check your performance using the suggested evaluator guide included in each hands-on task assignment. This suggested guide must be supplemented or replaced by the individual company's policies and procedures related to the task being evaluated.

You must adhere to all safety precautions according to your company's policies and procedures and applicable federal, state, and local codes and regulations.

II. Task Information

OQ Task CL-1a: **Hot Tapping Pipelines Using Self-Tapping Tees**

Qualification Standard: The employee's qualification is based on the enabling task(s) that have been successfully completed. The enabling tasks are listed on the associated employer record:

OQ Task CL.1a.1 Tapping a Pipeline With a Built-In Cutter. (B31Q 1101)

Recommended Requirement: The employee must demonstrate proficiency to an acceptable level based on the Skill and Ability Checklist associated with each operation.

References: DOT 192.627.
B31Q Task 1101.

Note:

The following Abnormal Operating Conditions (AOCs) and their reactions listed are for guidance only. This AOC list is not presented as an exhaustive treatment of AOCs and appropriate responses. You may be required to know and apply other AOCs and AOC responses for different tasks. Properly recognizing and reacting to covered task AOCs are the responsibility of persons qualified to perform the covered task. Always follow your company's policies and procedures.

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Abnormal Operating Conditions

(Not limited to the examples listed below)

Recognize	React
• Uncontrolled escaping gas	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Accidental ignition	• Control fire and make area safe and notify appropriate personnel
• Ignition	• Stop the flow of gas at the nearest valve. Put flame out with fire extinguisher.
• Leaking fitting	• Repair leak; repeat leak test.
• Overpressure	• Make area safe; contact proper personnel
• Improper shutoff	• Verify pressure was maintained, pull stopple out and reset
• Pipe lamination	• Move to different location
• Improper alignment of fitting	• Do not install fitting; relocate
• Improper travel	• Check measurement of travel

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III. Skill and Ability Verification Checklist

OQ Task CL-1a
Hot Tapping Pipelines Using Self-Tapping Tees

I verify that (Please Print) ______________________________ is qualified to perform OQ Task CL-1a according to his/her company's procedures:

(CL-1a.1) Tapping a Pipeline With a Built-In Cutter. (1101)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Determine the travel or tap requirements of the fitting selected.
- ☐ Perform the tap.
  - Lower cutter to pipe (steel only).
  - Bottom out cutter in accordance with requirements (steel only).
  - Lower cutter in accordance with requirements (plastic).
- ☐ Isolate the tap.
  - Raise cutter to top of fitting (steel).
  - Raise cutter in accordance with requirements (plastic).
  - Replace cap to fitting in accordance with requirements.
  - Check for leaks.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Condition

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Ignition	• Stop the flow of gas at the nearest valve. Put flame out with fire extinguisher.
• Overpressure	• Make safe using your company procedures
• Leaking fitting	• Repair leak; repeat leak test.

Comments / Additional Company Procedures:

____

____

____

____

____

IV. Employer Record

OQ Task CL-1a

Hot Tapping Pipelines Using Self-Tapping Tees

Employee Information (Please Print):

Name ____

Last 4 Digits of Social Security Number ____________________

Company Name ____________________________________

Company Mailing Address ___________________________

City ____________________ State __________ Zip ______________

Affidavit

I acknowledge the performance of this task is solely for the purpose of operator qualification, and is not intended to replace or modify company operating procedures or policies and may not be appropriately used in all circumstances. I acknowledge that I am responsible for recognizing hazards and abnormal conditions in my work place and must exercise care and good judgment; always using appropriate equipment, procedures and tools for tasks I perform. Industrial Training Services, Inc. assumes no liability for my actions nor for my application of the qualification performance guides used in this evaluation checklist.

Employee's Signature ______________________ Date ______________

Evaluator Information (Please Print):

Name ____

Organization/Employer _____________________________

Telephone Number ________________________________

Affidavit

I affirm that I am the person who has administered this checklist and that I have conducted this assessment with integrity. I also affirm that the above named employee is the person assessed and that the above named person performed the tasks at the indicated level.

Evaluator's Signature ______________________ Date ______________

The employee is qualified according to company standards to perform the tasks listed below as indicated:

	TASK/OPERATIONS	**Method of Skill/Ability Verification**
		Enter Number From List Below
1.	(CL-1a.1) Tapping a Pipeline With a Built-In Cutter. (1101)	☐

Method of Knowledge Verification

- Written Exam

Method of Skill/Ability Verification Observed During:

1. Performance on the Job
2. Simulation

After completion of Section IV, "Employer Record," remove section from the packet for your records. For third party verification and database reporting service, upload the data to Industrial Training Services OnBoard LMS.

INDUSTRIAL
TRAINING SERVICES

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DANNY SHROUT

OQ Compliance Series
Student Manual

OQ Task CF-2
v11.1

Join Plastic Pipe with Mechanical Fittings

INDUSTRIAL
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ITS OQ Compliance Series
CF-2 Join Plastic Pipe with Mechanical Fittings
v11.1

Student Manual

INTRODUCTION

Common among natural gas production and distribution companies is the use of plastic pipe as a means of gathering and distributing natural gas. In order to ensure the safe and efficient use of plastic pipe, specific joining procedures have been established and governing agencies enforce compliance to these procedures. To complete this module you will be required to complete the check-out activities listed below.

OBJECTIVES

1. Identify the material specifications for plastic pipe.
2. Join plastic pipe with mechanical fittings.
3. Identify methods to control static electricity on plastic piping.

CHECK-OUT ACTIVITIES

Your instructor will provide you with a list of incomplete statements related to joining plastic pipe with mechanical fittings and a list of responses. Select the response that most correctly completes each statement. Cut-off score is 80%. (Knowledge Verification)

Your instructor will provide you with a Skill and Ability Verification Checklist. At the appropriate time demonstrate your skill and ability by correctly performing each operation required under the task. (Skill and Ability Verification)

OQ CF-2 covers requirements indicated in the following codes/regulations:

ITS OQ Covered Task:	ASME B-31 Q*	49 CFR 192**
OQ CF-2.1 Joining of Pipe—Non-Bottom Out Compression Couplings	0691	192.123 192.273 192.281 192.285 192.287
OQ CF-2.2 Joining of Pipe—Bottom Out Compression Couplings	0701	
OQ CF-2.3 Joining of Pipe—Stab Fittings	0681	
OQ CF-2.4 Joining of Pipe—Compression Couplings	0711	

***ASME B31Q Covered Tasks:**

0691 Joining of Pipe – Non-Bottom Out Compression Couplings.
0701 Joining of Pipe – Bottom Out Compression Couplings.
0681 Joining of Plastic Pipe – Stab Fittings.
0711 Joining of Pipe – Compression Couplings.

****49 CFR Part 192 Covered Regulations:**

49 CFR 192 covered regulations are identified within the appropriate section of this module.

PLEASE READ – INDUSTRIAL TRAINING SERVICES, INC. DISCLAIMERS – PLEASE READ

Table of Contents

INSTRUCTION SHEET I

Identifying the Material Specifications for Plastic Pipe

There are several types and grades of plastic which can be used for gas piping. The three most common types of plastic pipe include polyethylene (PE), polyamide (PA), and polyvinyl chloride (PVC). Polyethylene is the most commonly used for natural gas distribution. Polyethylene and polyamide are known as thermoplastics and may be joined either by heat fusion (welding) or by mechanical couplings.

In order for polyethylene to be used for gas, it must meet specific test requirements as outlined in ASTM (American Society of Testing and Materials) D-2513 and must be marked at intervals not to exceed two feet.[1] Either type PE 2406 or PE 3408 may be used for gas distribution.

Material Specifications

Each manufacturer of polyethylene pipe has information printed on the pipe that describes the physical and chemical properties of the pipe along with other pertinent information. Figure 1 illustrates the kind of information that is typically printed on polyethylene pipe.

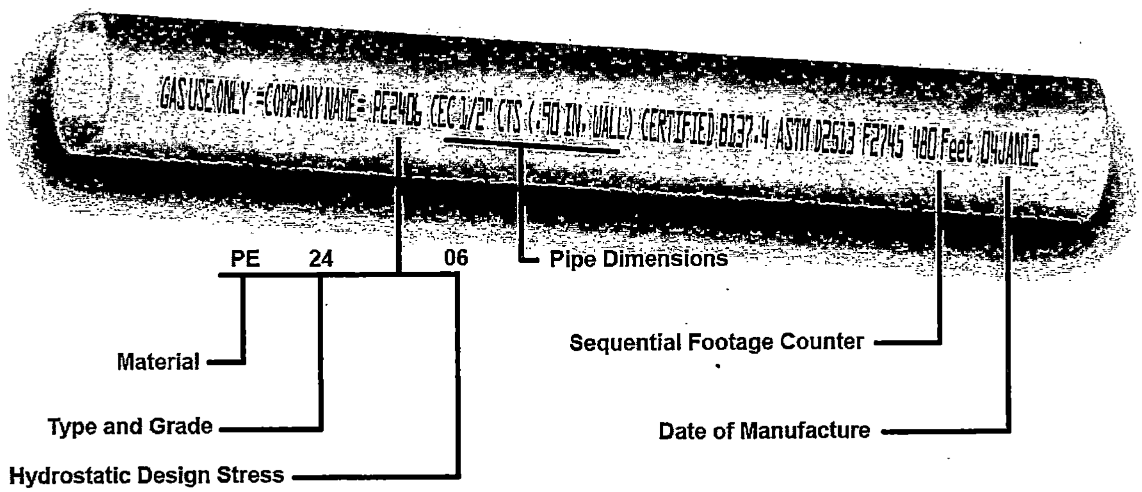


Figure 1. Manufacturer's Production Code

(1) **PE Pipe Material.** The letters "PE" in a pipe designation code such as PE 2406 represent polyethylene. Polyethylene is classified as a "thermoplastic" material. Thermoplastics, as the name implies, soften when heat is applied and harden when cooled.

---

[1] ASTM Standard D 2513-08b, Standard Specification for Thermoplastic Gas Pressure Piping, Tubing, and Fittings, 2009.

(2) **Type and Grade.** The first two numbers in a polyethylene pipe designation code represents the type and grade. Type and grade include:

(a) **Density.** Polyethylene is classified as medium density or high density. Medium density polyethylene pipe is designated as PE 24 and high-density polyethylene pipe is designated as PE 34. Density is defined as the unit weight of the polyethylene pipe material.

(b) **Mechanical Properties.** Mechanical properties include:

- Flexibility of the polyethylene when bent as a beam
- The amount of tension that can be applied to polyethylene without permanent damage
- Stress due to temperature, chemicals, and mechanical stress such as rock impingement

(c) **Melt Index.** Melt index is a measure of the flow rate of molten polyethylene.

(3) **Hydrostatic Design Base (HDB).** The last two digits of a PE pipe designation code represent the hydrostatic design stress for water at 23°C (73°F) and are based on the HDB at that temperature. Figure 2 shows typical HDBs at that temperature. Figure 2 also shows typical HDBs for widely used PE materials at various design temperatures.[2]

Material Designation Per ASTM D 2513	DESIGN TEMPERATURE *			
	23°F (73°F)	38°C (100°F)	49°C (120°F)	60°C (140°F)
PE 2306, PE 2406,	1250	1250	1000	800 or 1000
PE 3408	1600	1250	1000	800 or 1000

*See PPI TR-4 for actual HDB listings

Figure 2. Typical HDBs for Widely Used PE Materials at Various Design Temperatures[3]

(4) **Pipe Dimensions.** Polyethylene pipe is available in a variety of IPS and CTS sizes. **IPS** indicates "iron pipe size" and means the plastic pipe has the same outside diameter as iron pipe of the same nominal size. **CTS** indicates "copper tubing size" and means the plastic pipe has the same outside diameter as copper tubing of the same nominal size. The actual outside diameter of CTS sizes will be .125" (1/8") or greater than the nominal size.

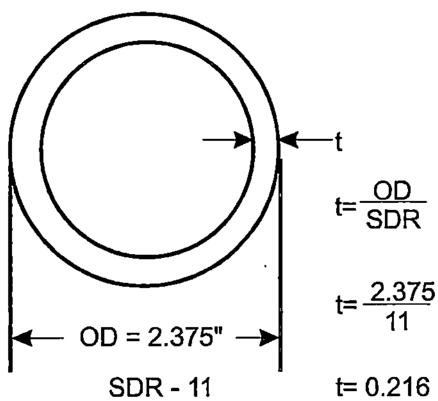
Each IPS and CTS size of polyethylene is available in more than one wall thickness. The wall thickness must be identified in the marking on the pipe

[2] American Gas Association, AGA Plastic Pipe Manual for Gas Service, 8th Edition, 2006, pg. 36.
[3] 49 CFR 192.121

either directly or by SDR number. The SDR number (standard dimensional ratio) is the outside diameter of the pipe divided by the wall thickness of the pipe. When the SDR is known, the wall thickness can be determined by the following formula:

$$t = \frac{OD}{SDR}$$

As illustrated in Figure 3, a 2-inch IPS nominal size polyethylene pipe with an SDR number of 11 has a wall thickness of 0.216 and an inside diameter of 1.943 inches (Inside Diameter = Outside Diameter -2*wall thickness).



	Nominal Pipe Size	Outside Diameter
Iron Pipe Size	2"	2.375
	3"	3.500
	4"	4.500
	6"	6.625

Figure 3. Common SDR – 11 Pipe Sizes

Design Limitation for Plastic

D.O.T. 49 CFR 192.123 states:

§ 192.123 Design limitations for plastic pipe.

(a) Except as provided in paragraph (e) and paragraph (f) of this section, the design pressure may not exceed a gauge pressure of 100 psig (689 kPa) for plastic pipe used in:
(1) Distribution systems; or
(2) Classes 3 and 4 locations.

(b) Plastic pipe may not be used where operating temperatures of the pipe will be:
(1) Below −20 °F (−20 °C), or −40 °F (−40 °C) if all pipe and pipeline components whose operating temperature will be below −29 °C (−20 °F) have a temperature rating by the manufacturer consistent with that operating temperature; or
(2) Above the following applicable temperatures:
(i) For thermoplastic pipe, the temperature at which the HDB used in the design formula under §192.121 is determined.
(ii) For reinforced thermosetting plastic pipe, 150 °F (66 °C).

(c) The wall thickness for thermoplastic pipe may not be less than 0.062 inches (1.57 millimeters).

(d) The wall thickness for reinforced thermosetting plastic pipe may not be less than that listed in the following table:

Nominal size in inches (millimeters).	Minimum wall thickness inches (millimeters).
2 (51)	0.060 (1.52)
3 (76)	0.060 (1.52)
4 (102)	0.070 (1.78)
6 (152)	0.100 (2.54)

(e) The design pressure for thermoplastic pipe produced after July 14, 2004 may exceed a gauge pressure of 100 psig (689 kPa) provided that:
(1) The design pressure does not exceed 125 psig (862 kPa);
(2) The material is a PE2406 or a PE3408 as specified within ASTM D2513–99 (incorporated by reference, *see* §192.7);
(3) The pipe size is nominal pipe size (IPS) 12 or less; and
(4) The design pressure is determined in accordance with the design equation defined in §192.121.

(f) The design pressure for polyamide-11 (PA–11) pipe produced after January 23, 2009 may exceed a gauge pressure of 100 psig (689 kPa) provided that:
(1) The design pressure does not exceed 200 psig (1379 kPa);
(2) The pipe size is nominal pipe size (IPS or CTS) 4-inch or less; and
(3) The pipe has a standard dimension ratio of SDR–11 or greater (*i.e.* , thicker pipe wall).

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192–31, 43 FR 13883, Apr. 3, 1978; Amdt. 192–78, 61 FR 28783, June 6, 1996; Amdt. 192–85, 63 FR 37502, July 13, 1998; Amdt. 192–93, 68 FR 53900, Sept. 15, 2003; 69 FR 32894, June 14, 2004; Amdt. 192–94, 69 FR 54592, Sept. 9, 2004; Amdt. 192–103, 71 FR 33407, June 9, 2006; 73 FR 79005, Dec. 24, 2008; Amdt. 192–114, 75 FR 48603, Aug. 11, 2010]

Subject to the limitations of §192.123, the design pressure for plastic pipe is determined in accordance with either of the following formulas:

$$P = 2S\frac{t}{(D\text{-}t)}(DF) \qquad\qquad P = \frac{2S}{(SDR\text{-}1)}(DF)$$

Where:

P = Design pressure, gauge, kPa (psig)

S = For thermoplastic pipe the long-term hydrostatic strength determined in accordance with the listed specification at a temperature equal to 23°C (73°F), 38°C (100°F), 49°C (120°F), or 60°C (140°F); for reinforced thermosetting plastic pipe, 75,842 kPa (11,000 psi).

t = Specified wall thickness, mm (in.)

D = Specified outside diameter, mm (in.)

DF = 0.32 or 0.40 for PA-11 pipe produced after January 23, 2009 with a nominal pipe size (IPS or CTS) 4-inch or less, and a SDR of 11 or greater.

SDR = Standard Dimension Ratio, the ratio of the average specified outside diameter to the minimum specified wall thickness, corresponding to a value from a common numbering system that was derived from the American National Standards Institute preferred number series 10.[4]

[4] 49 CFR 192.121

TABLE II-6
Minimum Wall Thickness by Pipe Size and Dimension Ratio for Thermoplastic Pipe*

Nominal Pipe Size Inches	Outside Diameter Inches	Dimension Ratio (DR)								
		32.5	26	21	17	13.5	11.5	11	10	9.33
½	0.840	--	--	0.062	0.062	0.062	0.073	0.076	0.084	0.090
¾	1.050	--	--	0.090	0.090	0.090	0.091	0.095	0.105	0.113
1	1.315	--	--	0.090	0.090	0.097	0.114	0.119	0.132	0.141
1 ¼	1.660	--	--	0.090	0.098	0.123	0.144	0.151	0.166	0.178
1 ½	1.900	--	--	0.090	0.112	0.141	0.165	0.176	0.190	0.204
2	2.375	--	0.091	0.113	0.140	0.176	0.207	0.216	0.238	0.255
3	3.500	0.108	0.135	0.167	0.206	0.259	0.307	0.318	0.350	0.375
4	4.500	0.138	0.173	0.214	0.264	0.333	0.395	0.409	0.450	0.482
6	6.625	0.204	0.255	0.316	0.390	0.491	0.576	0.602	0.663	0.710
8	8.625	0.265	0.332	0.410	0.508	0.639	0.750	0.785	0.863	0.924
10	10.750	0.331	0.413	0.511	0.633	0.797	0.935	0.977	1.075	1.152
12	12.750	0.392	0.490	0.608	0.750	0.945	1.109	1.159	1.275	1.367

* Dimension Ration (DR) System enables the user to select different sizes of pipe for a piping system, all of which will have the same design pressure. Shaded wall thicknesses are minimums required by 49 CFR 192.321 for pipe that is not encased. They are not a function of dimension ratio.

Figure 4. Minimum Wall Thickness by Pipe Size and Dimension Ratio for Thermoplastic Pipe [5]

Recognize and React to Abnormal Operating Conditions

Note:

The following Abnormal Operating Conditions (AOCs) and their reactions listed are for guidance only. This AOC list is not presented as an exhaustive treatment of AOCs and appropriate responses. You may be required to know and apply other AOCs and AOC responses for different tasks. Properly recognizing and reacting to covered task AOCs are the responsibility of persons qualified to perform the covered task. Always follow your company's policies and procedures.

Industrial Training Services, Inc. assumes no liability for any act or act of omission performed by the person seeking qualification under the pipeline operator's OQ program, or during the actual pipeline operations of the pipeline operator or any contractor performing work on the pipeline operator's pipeline system.

[5] American Gas Association, AGA Plastic Pipe Manual for Gas Service, 8th Edition, 2006, pg.39.

(1) **Things to Consider When Responding to Abnormal Operating Conditions.** The following information is basic knowledge that will assist you in assessing and responding to abnormal operating conditions:

(a) **Basic Properties of Natural Gas.**

- Natural gas is lighter than air, colorless and odorless.
- Natural gas has a specific gravity of approximately 0.6.
- The natural gas Lower Explosive Limit (LEL) is approximately 5%.
- The natural gas Upper Explosive Limit (UEL) is approximately 15%.
- The ignition temperature of natural gas is about 1100°-1200° F.

(b) **Eliminating Ignition Sources.** Some of the ways to eliminate ignition sources are very obvious. For example:

- Smoking and open flames should be prohibited in structures or areas containing gas facilities where possible leakage or presence of gas constitutes a hazard of fire or explosion.
- Smoking and open flames should be prohibited in the open when accidental ignition of a gas-in-air mixture could cause personal injury or property damage.
- Do NOT smoke or use open flames near a jobsite/gas pipeline facility.
- Sparks range in temperature from 1500°F in an electrical switch to 9,000°F in an arc welder. Do NOT use equipment or create situations that generate sparks. Sparks may be generated by the following conditions:

  Communication equipment
  Portable electrically powered tools and equipment
  Internal combustion engines
  Breaking electrical continuity
  Static electricity on plastic pipe

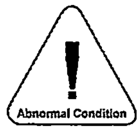
(c) **Personal Protection Equipment.**

Always follow your company's policies and procedures for the use of personal protection equipment (PPE).

Working around gas line facilities requires practical safety practices and basic PPE may include:

- Head protection (e.g. hard hat)
- Eye and face protection (e.g. goggles, face shield, etc.)
- Hearing protection (e.g. ear plugs, ear muffs, etc.)
- Hand protection (proper glove material for the specific job)
- Respiratory protection (proper respiratory equipment when air content is insufficient)

(2) Abnormal Operating Conditions.



Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Defect of pipe surface	• Evaluate and replace as necessary
• Surface contamination	• Clean surfaces
• Leaking fitting	• Cut out and replace
• Angle cut pipe/pipe prep	• Square pipe ends/chamfer if required
• SDR on pipe and fitting not compatible	• Use proper fitting
• Stiffener improperly sized or installed	• Replace fitting
• Improper stab depth into the mechanical fitting	• Replace fitting
• Improper alignment	• Loosen fitting, adjust and realign fitting
• Scratched or gouged pipe	• Remove pipe

REVIEW I

Identifying the Material Specifications for Plastic Pipe

Directions: Select from the list below the response that most correctly completes each of the following statements. Write the letter of your choice in the space provided.

A. SDR
B. iron pipe size
C. replace the fitting
D. 125
E. PE
F. high
G. 2406
H. hydrostatic design stress
I. abnormal operating condition

E 1. Polyethylene pipe is marked with a pipe designation code of _____.

G 2. Medium density polyethylene pipe is designated as PE _____ pipe.

F 3. A polyethylene pipe designated as PE 3408 is classified as a _____ density pipe.

H 4. The last two digits of a PE pipe designation code represent the _____.

B 5. When referring to the dimensions of polyethylene pipe, the term IPS means _____.

A 6. The wall thickness of polyethylene pipe is indicated on the pipe directly or by the _____ number.

D 7. The maximum design pressure for an 8-inch PE2406 pipe produced after July 14, 2004, must not exceed _____ psig.

C 8. While joining polyethylene pipe with a stab-type mechanical fitting, the improper stab depth is achieved during assembly. The proper reaction to this condition is to _____.

INSTRUCTION SHEET II

Joining Plastic Pipe with Mechanical Fittings

The purpose of this instruction sheet is to provide a guide for the joining of plastic pipe in accordance with D.O.T. Title 49, Part 192 Subpart F. This subpart prescribes minimum requirements for joining materials in pipelines, other than by welding.

D.O.T. Regulations

§ 192.273 General.

(a) The pipeline must be designed and installed so that each joint will sustain the longitudinal pullout or thrust forces caused by contraction or expansion of the piping or by anticipated external or internal loading.
(b) Each joint must be made in accordance with written procedures that have been proven by test or experience to produce strong gastight joints.
(c) Each joint must be inspected to insure compliance with this subpart.

§ 192.281 Plastic pipe.

(a) *General.* A plastic pipe joint that is joined by solvent cement, adhesive, or heat fusion may not be disturbed until it has properly set. Plastic pipe may not be joined by a threaded joint or miter joint.
(b) *Solvent cement joints.* Each solvent cement joint on plastic pipe must comply with the following:
  (1) The mating surfaces of the joint must be clean, dry, and free of material which might be detrimental to the joint.
  (2) The solvent cement must conform to ASTM Designation D 2513-99, (incorporated by reference, see §192.7).
  (3) The joint may not be heated to accelerate the setting of the cement.
(c) *Heat-fusion joints.* Each heat-fusion joint on plastic pipe must comply with the following:
  (1) A butt heat-fusion joint must be joined by a device that holds the heater element square to the ends of the piping, compresses the heated ends together, and holds the pipe in proper alignment while the plastic hardens.
  (2) A socket heat-fusion joint must be joined by a device that heats the mating surfaces of the joint uniformly and simultaneously to essentially the same temperature.
  (3) An electrofusion joint must be joined utilizing the equipment and techniques of the fittings manufacturer or equipment and techniques shown, by testing joints to the requirements of §192.283(a)(1)(iii), to be at least equivalent to those of the fittings manufacturer.
  (4) Heat may not be applied with a torch or other open flame.
(d) *Adhesive joints.* Each adhesive joint on plastic pipe must comply with the following:

(1) The adhesive must conform to ASTM Designation D 2517.
(2) The materials and adhesive must be compatible with each other.

(e) *Mechanical joints.* Each compression type mechanical joint on plastic pipe must comply with the following:

(1) The gasket material in the coupling must be compatible with the plastic.
(2) A rigid internal tubular stiffener, other than a split tubular stiffener, must be used in conjunction with the coupling.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192–34, 44 FR 42973, July 23, 1979; Amdt. 192–58, 53 FR 1635, Jan. 21, 1988; Amdt. 192–61, 53 FR 36793, Sept. 22, 1988; 58 FR 14521, Mar. 18, 1993; Amdt. 192–78, 61 FR 28784, June 6, 1996; Amdt. 192–114, 75 FR 48603, Aug. 11, 2010]

§ 192.285 Plastic pipe: Qualifying persons to make joints.

(a) No person may make a plastic pipe joint unless that person has been qualified under the applicable joining procedure by:
(1) Appropriate training or experience in the use of the procedure; and
(2) Making a specimen joint from pipe sections joined according to the procedure that passes the inspection and test set forth in paragraph (b) of this section.
(b) The specimen joint must be:
(1) Visually examined during and after assembly or joining and found to have the same appearance as a joint or photographs of a joint that is acceptable under the procedure; and
(2) In the case of a heat fusion, solvent cement, or adhesive joint:
(i) Tested under any one of the test methods listed under §192.283(a) applicable to the type of joint and material being tested;
(ii) Examined by ultrasonic inspection and found not to contain flaws that would cause failure; or
(iii) Cut into at least 3 longitudinal straps, each of which is:
(A) Visually examined and found not to contain voids or discontinuities on the cut surfaces of the joint area; and
(B) Deformed by bending, torque, or impact, and if failure occurs, it must not initiate in the joint area.
(c) A person must be requalified under an applicable procedure, if during any 12-month period that person:
(1) Does not make any joints under that procedure; or
(2) Has 3 joints or 3 percent of the joints made, whichever is greater, under that procedure that are found unacceptable by testing under §192.513.
(d) Each operator shall establish a method to determine that each person making joints in plastic pipelines in the operator's system is qualified in accordance with this section.

[Amdt. 192–34A, 45 FR 9935, Feb. 14, 1980, as amended by Amdt. 192–34B, 46 FR 39, Jan. 2, 1981; Amdt. 192–93, 68 FR 53900, Sept. 15, 2003]

§ 192.287 Plastic pipe: Inspection of joints.

No person may carry out the inspection of joints in plastic pipes required by §§192.273(c) and 192.285(b) unless that person has been qualified by appropriate training or experience in evaluating the acceptability of plastic pipe joints made under the applicable joining procedure.

[Amdt. 192–34, 44 FR 42974, July 23, 1979]

Mechanical Connections

Because of the increased use of plastic piping in gas distribution, it has become necessary to find ways of adapting plastic materials to the system of metal pipe already in use. Since joints between plastic and metal piping will be between unlike materials, mechanical type fittings are used. These devices will provide gas-tight connections when installed according to the manufacturer's specifications.

Mechanical type fittings may also be used to join two pieces of polyethylene. All plastic pipe currently in use in gas distribution may be joined mechanically. Mechanical fittings used to connect steel pipe and plastic pipe sections must be made from steel and must have cathodic protection applied to it. This mechanical steel fitting will need to be monitored as any other short section under 192.465.

192.465 External corrosion control: Monitoring.
(a) Each pipeline that is under cathodic protection must be tested at least once each calendar year, but with intervals not exceeding 15 months, to determine whether the cathodic protection meets the requirements of §192.463. However, if tests at those intervals are impractical for separately protected short sections of mains or transmission lines, not in excess of 100 feet (30 meters), or separately protected service lines, these pipelines may be surveyed on a sampling basis. At least 10 percent of these protected structures, distributed over the entire system must be surveyed each calendar year, with a different 10 percent checked each subsequent year, so that the entire system is tested in each 10-year period.

Many types of mechanical connection styles and methods are available. Each of the mechanical connections has particular advantages or limitations of performance in some applications.

As illustrated in Figure 1, a compression coupling is one type of connection used when fusion is not used. The Plastic Pipe Institute recommends that the user be well-informed about the performance limitation of the particular mechanical connector being used.

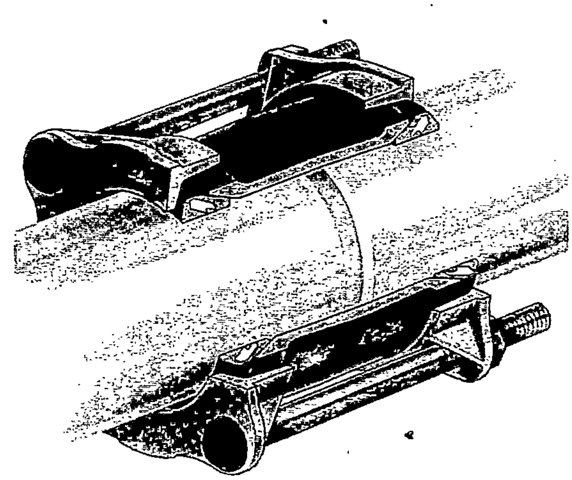


Figure 1. Compression Coupling

(1) Threaded Nut Compression End Fitting. Fittings come in many forms and materials. The components are generally the following:

- Body
- Threaded compression nut or follower and bolt arrangement
- Elastomer ring
- Stiffener
- Gripping ring (optional)

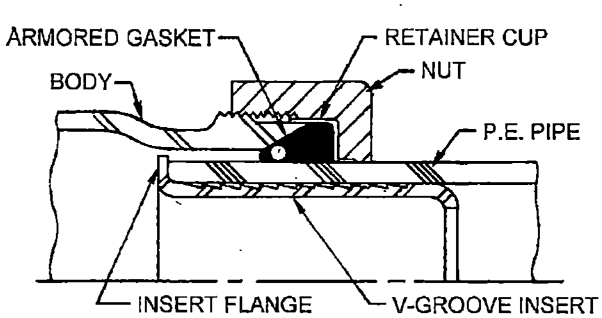
(a) Select Coupling. Normally the design concept of this type of fitting typically includes an elastomer seal (armored gasket) in the assembly, as illustrated in Figure 2. The seal, when compressed by tightening of a threaded compression nut, grips the outside of the pipe, offsetting a pressure seal and in some designs providing pull-out resistance. It is important that the inside of the pipe wall be supported by the rigid tubular stiffener[6] under the seal ring and under the gripping ring (if incorporated in the design), to prevent collapse of the plastic. This type fitting is normally used on service line piping. These fittings are available with compression ends for polyethylene and steel pipe. One type is recommended to provide a seal only and another is recommended to provide a seal plus restraint against pull out[7].

§192.273 General.

(a) The pipeline must be designed and installed so that each joint will sustain the longitudinal pullout or thrust forces caused by contraction or expansion of the piping or by anticipated external or internal loading.

(b) Each joint must be made in accordance with written procedures that have been proven by test or experience to produce strong gastight joints.

(c) Each joint must be inspected to insure compliance with this subpart.



Courtesy Dresser Industries

Figure 2. Threaded Nut Compression End Fitting

[6] 49 CFR 192.281(e)(2).

[7] "What you need to know about PE joining", Gas Industries, December 1993. (9.7.1.1)

(b) Install Compression Coupling - B31Q (0691 & 0701):

> **Note:**
> Always follow manufacturer's installation instructions.
>
> Threaded nut compression end fittings come in two styles: (1) non-bottom out and (2) bottom-out. For non-bottom out fittings, the compression nut is tightened to a specified torque setting. The bottom-out fittings are tightened until the compression nut makes contact with the body of the fitting.

The following installation procedure is typical for installing compression couplings on plastic pipe.

Step 1: Prepare Pipe and Fitting. PE pipe surface must be clean and free of linear scratches or gouges that would affect the sealing ability of the gasket. Squareness of the cut must be such that when insert is in place with flange butted to the pipe end, ensure there is no gap between flange and pipe end in excess of 1/8". Remove all burrs from inside and outside of plastic pipe after cutting.

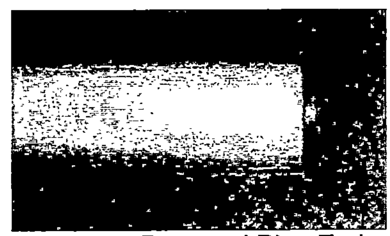


Figure 3. Prepared Pipe End

Step 2: Install Coupling. Install coupling according to manufacturer's instructions.

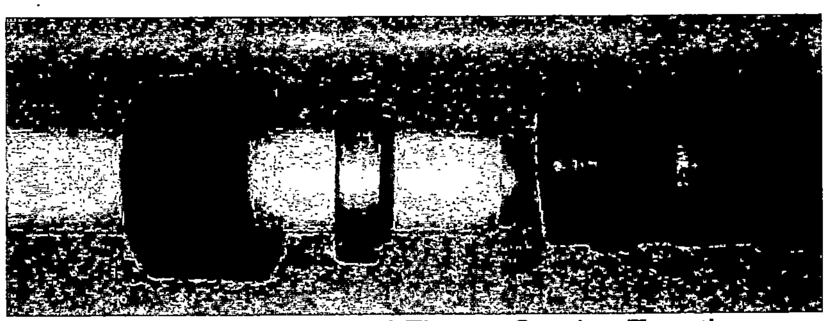


Figure 4. Pipe End and Flange Coming Together

Step 3: Visually Inspect Completed Joint. Visually inspect completed joint according to manufacturer's instructions.

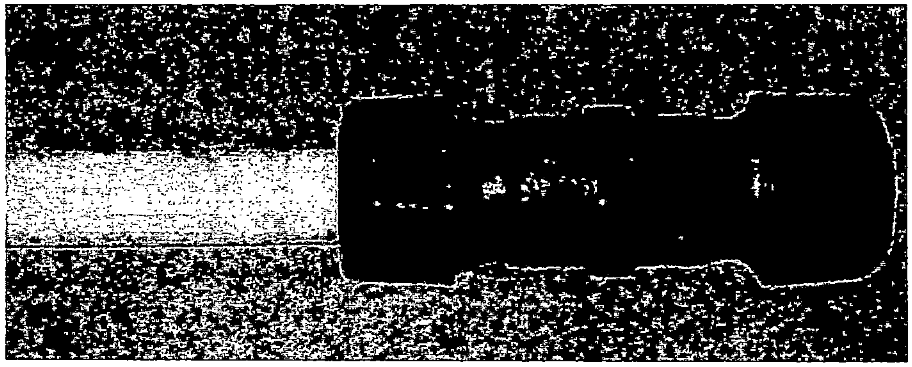


Figure 5. Joined Components

(2) Stab-Type Mechanical Fittings. Stab fittings are available in many styles, as illustrated in Figure 6.

Figure 6. Various Styles of Stab Fittings

(a) Select Coupling: The design concept is similar in most styles. As illustrated in Figure 7, internally there are specially designed components including an elastomer seal, such as an O-ring, and a gripping device to affect pressure sealing and pull-out resistance capabilities[8].

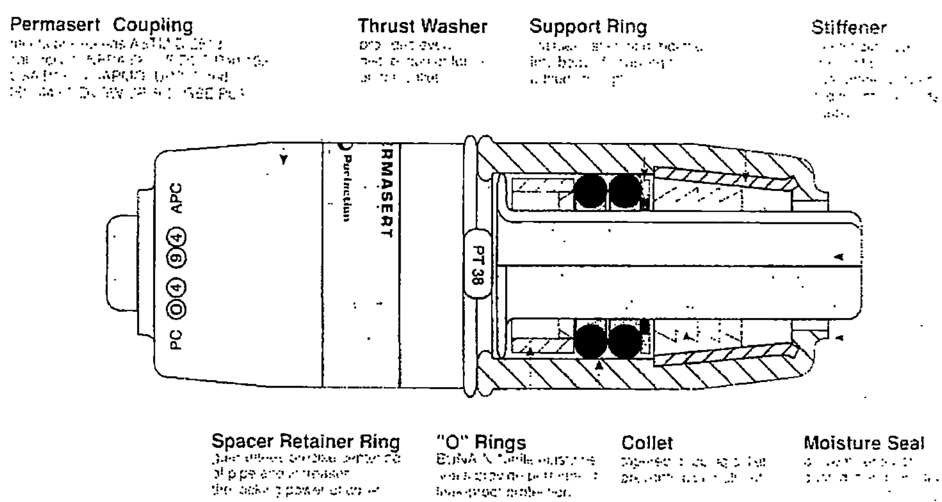


Figure 7. Stab Fittings

[8] "What you need to know about PE joining", Gas Industries, December 1993. (9.7.1.1)

Self-contained stiffeners are included in stab fittings. With this style fitting the operator must:

(b) **Install Stab Fittings:** The following installation procedure is typical for stab fittings.

Step 1: Prepare pipe and fitting.

Step 2: Install fitting.

Step 3: Mark the stab depth on the pipe.

Step 4: Stab the pipe in to the depth prescribed for the fitting being used.

Step 5: Visually inspect completed joint. Inspect the completed joint according to the manufacturer's instructions.

(3) **Bolted Couplings (compression coupling greater than 2") B31Q (0711).** The term "bolted coupling" is used to describe a mechanical fitting designed to use a nut and bolt arrangement to obtain the gasket sealing force.

(a) **Select Coupling.** As illustrated in Figure 8, the coupling components are:

- Bolt and Nut—provides means of compressing a bolted coupling, preventing a seal or seal and restraint, depending on the coupling design.
- Grip Ring—holds the pipe against pullout in couplings made for seal and restraint.
- Gasket—sealing component, which is compressed upon installation, providing a pressure seal.
- Middle Ring or Body—pressure containing component that bridges the gap between pipe ends.
- Insert Stiffener—a tubular reinforcement sleeve used on all plastic pipe ends to prevent collapses.

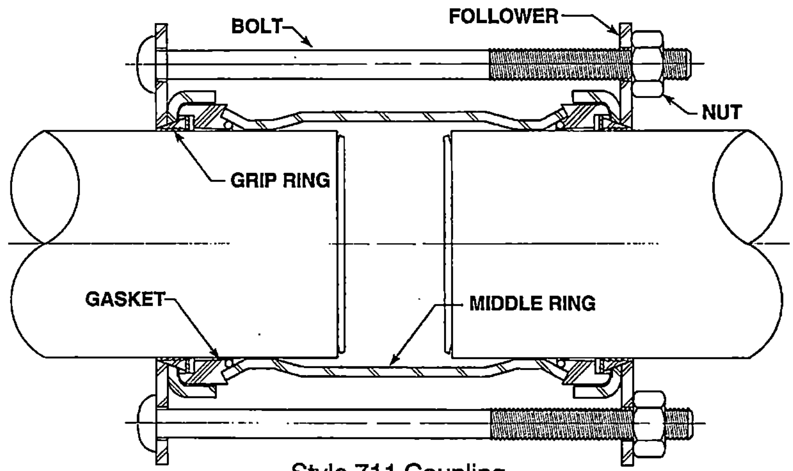


Figure 8. Bolted Coupling.

(b) Installing Compression Couplings.

Step 1: Prepare pipe and fitting.

- Clean the steel by removing oil, dirt, loose scale, and rust from the pipe surface.
- Wipe the pipes surface with a clean rag, removing any material that could interfere with the operation of the gasket or gripping ring as specified by the fitting manufacturer's installation instructions.

Step 2: Prepare the surface of the plastic pipe to receive the coupling.

- Ensure the plastic pipe is free of dirt, longitudinal scratches, grooves or burrs as specified by the fitting manufacturer's installation instructions.
- Insert the appropriate stiffener into the end of the plastic pipe. Be sure the SDR number on the stiffener corresponds to the SDR number on the pipe.
- Mark the ends of the pipe with a grease pencil to indicate the depth the pipe will be stabbed into the fitting.

Step 3: Prepare the coupling to receive the pipe ends.

- Check inside the coupling to be sure the coupling is free of dirt or any foreign material.
- Lubricate the gaskets and grip rings with a soapy water solution.

Step 4: Install coupling.

- Stab the coupling on one of the pipe ends to the mark indicating the stab depth.
- Stab the remaining pipe end into the coupling and pipe assembly to the mark indicating the proper stab depth.
- Tighten the nuts on the bolts using a crisscross pattern and to a tightness specified in the coupling manufacturer's installation instructions.

Step 5: Visually inspect completed joint.

Safety Considerations for Mechanical Joints in Plastic Pipe

In addition to understanding the kinds and purposes of mechanical fittings to be used with plastic pipe, the gas industry worker must also take certain precautions in the field to be sure that the new joint is adequate.

- Plastic pipe being joined mechanically must not be gouged or scratched. Deep scratches on the pipe end could result in leakage around the fitting's gasket or O-ring.

- Before being joined to steel, plastic pipe must be temperature conditioned in the ground to keep it from expanding or contracting from temperature change. This can be accomplished by backfilling over much of the plastic pipe and then letting it set overnight, if necessary.

- Transition connections should be made over firm ground whenever possible. If the ground is not well compacted, it will be necessary to tamp the backfill under the transition connection or otherwise support the connection. If there is the possibility of excessive ground settlement, a split piece of rigid pipe which spans the settlement area should be installed under the connection.

- Backfill material under a plastic-to–steel connection should be a material that will compact well. These materials include sand, sandy-loam, sand-gravel, and such. Unsuitable materials include clays and frozen earth.

- Allow as much slack as possible in the pipe sections to be joined to allow for expansion and contraction.

Standards for Testing Mechanical Joints

§ 192.287 Plastic pipe: Inspection of joints.

No person may carry out the inspection of joints in plastic pipes required by §§192.273(c) and 192.285(b) unless that person has been qualified by appropriate training or experience in evaluating the acceptability of plastic pipe joints made under the applicable joining procedure.

[Amdt. 192–34, 44 FR 42974, July 23, 1979]

The Department of Transportation's Office of Pipeline Safety Operations (OPSO) has established general requirements for joining of plastic pipe with mechanical fittings. Mechanical joints must be made in accordance with written procedures that have been proven by test or experience to produce strong gas-tight joints. This means that mechanical joints made in plastic pipe in the field must be made with connectors which have been qualified as set out by DOT Rules and Regulations Title 49 CFR, Part 192.

In addition, before workers can be qualified in the joining of plastic pipe with mechanical fittings, they must produce sample joints that will be inspected during and after assembly and found to have the same appearance as a joint, or photographs of a joint, that are acceptable under the procedure.

In order to be able to produce mechanical joints that will meet the required visual test, it is important that the gas industry worker understands both the kinds and characteristics of mechanical fittings and methods of joining plastic pipe with these fittings.

REVIEW II

Joining Plastic Pipe with Heat Fusion

Directions: Select from the list below the response that most correctly completes each of the following statements. Write the letter of your choice in the space provided.

A. inspected
B. threaded
C. 1/16
D. to a specified torque
E. bolted coupling
F. stiffener
G. crisscross
H. split piece of rigid pipe
I. ASME
J. clean and free of scratches or gouges
K. until it bottoms out
L. 1/8
M. stab
N. OPSO

A 1. D.O.T. regulations require that every plastic pipe joint be _____.

B 2. When joining plastic pipe, you may not use a _____ joint.

[illegible] 3. The general requirements for joining plastic pipe with mechanical fittings are established by _____.

D 4. When installing a non-bottom out compression coupling, you must tighten the compression nut _____.

J 5. Plastic pipe must be _____ before a connection is made using a threaded compression nut end fitting.

G 6. When tightening the nuts on the bolts of a bolted coupling, they should be tightened in a _____ pattern.

E 7. A mechanical fitting designed to use a nut and bolt arrangement to obtain a gasket sealing force is a _____.

F 8. It is important that the plastic pipe wall under the gripping ring of a mechanical fitting be supported by a ___________.

L 9. The maximum gap between the flange on the pipe stiffener and pipe end is _________ inch.

A.	inspected	I.	ASME
B.	threaded	J.	clean and free of scratches or gouges
C.	1/16	K.	until it bottoms out
D.	to a specified torque	L.	1/8
E.	bolted coupling	M.	stab
F.	stiffener	N.	OPSO
G.	crisscross		
H.	split piece of rigid pipe		

m 10. A step that must be included when installing a stab type fitting is to mark the __________ depth on the pipe.

K 11. When installing plastic pipe, if there is the possibility of excessive ground settlement, the pipe should be supported by a __________.

INSTRUCTION SHEET III

Identifying Methods to Control Static Electricity on Plastic Piping

Static electricity in its simplest form is not dangerous and may cause mild shocks, unruly hair, or clinging clothes:

However, to those involved with replacing, purging, or extending existing plastic, static electricity is recognized as a possible ignition source and thus a potential hazard.

Source of Static Electricity on Plastic Pipe

Static electricity on plastic pipe is generated by friction. This friction may occur from:

- The physical handling of plastic pipe
- Particulate matter (such as scale, rust, or dirt) in the gas flowing through the pipe
- Gas turbulence at breaks, elbows, and squeeze-off points
- Impingement point of a gas leak into dry soil

Simply wiping the pipe with a rag, paper towel, or glove (causing small amounts of friction) can generate a local charge of several thousand volts.

Conditions Related to the Hazard of Static Electricity on Plastic Pipe

Static electricity on plastic pipe can accumulate on both the inner and outer surfaces of the pipe wall. The charges only become hazardous when the voltage associated with the static charges becomes large enough to produce an arc to a grounded conductor, such as a person touching the pipe.

Static electric charges that accumulate on the wall surface of a plastic pipe are not uniform and may be located in different spots on the pipe. A five hundred volt charge may be at one spot on the wall surface of the pipe and a four thousand volt charge may occur at a spot only inches away.

The possibility of a dangerous static charge is increased when the surface of the pipe is exposed to the atmosphere or when purging a new line. Be cautious of any ungrounded isolated metal fitting such as a valve or squeeze-off tool that is in close proximity to the plastic pipe. In effect, a metal object in close proximity to a charged surface can be considered as one plate of a capacitor.

Since a capacitor is capable of storing electricity, accumulated charges can be quite large (thousands of volts). When a conducting path is made available, the stored energy is suddenly released, possibly producing a spark. Therefore, in a gaseous atmosphere, all tools (such as squeeze-off tools) must be properly grounded with a wire or braided strap and rod to reduce the potential of static discharge, as illustrated in Figure 1.

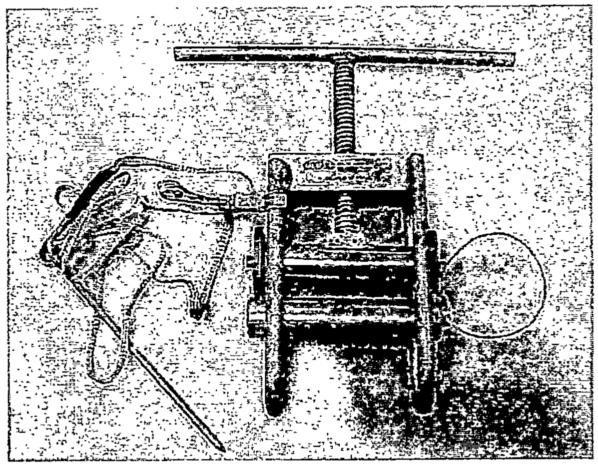
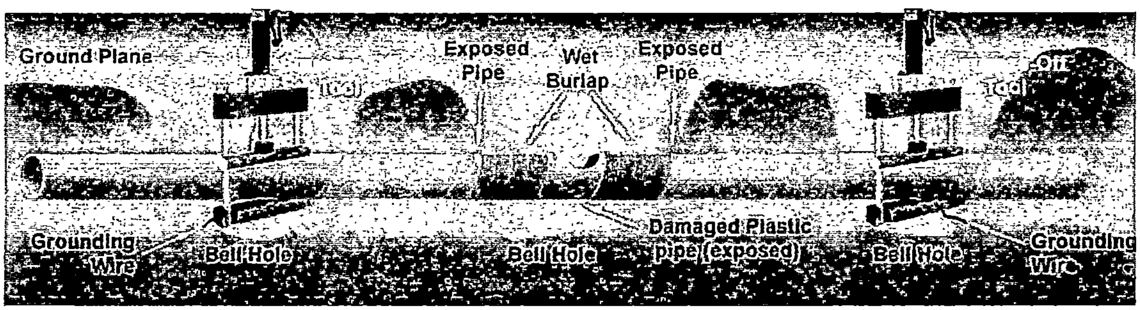


Figure 1. Four-Inch IPS Squeeze Tool with Static Electric Grounding Device

It takes approximately 3000 volts of static charge to generate the approximate 1200° spark temperature required to ignite a flammable gas-in-air mixture.

Controlling Static Electricity on Plastic Pipe

When confronted with a gas leak from damaged plastic piping, stopping the flow of gas by squeeze-off in separate bell holes is the initial consideration. As illustrated in Figure 2, these bell holes should be adjacent to, but far enough away from the gaseous atmosphere, to prevent ignition (should a static discharge occur). Be sure to properly ground squeeze-off tools while working with them. A method used to control static electricity on plastic pipe in a gaseous atmosphere is to, before entering the bell hole, wet the pipe with anti-static spray or a diluted solution of water and dishwashing type detergent.[9]



Wet Burlap must be touching ground (both sides)

Figure 2. Controlling Static Electricity When a Squeeze-Off Tool is Used

[9] American Gas Association, AGA Plastic Pipe Manual for Gas Service, 8th Edition, 2006, pg 98-99.

(1) Preliminary Precautions. Arc-preventing safety precautions are necessary if conditions exist that a flammable gas-in-air mixture may be encountered and static charges may be present, such as when:

- ↓ repairing a leak
- ↓ squeezing-off an open pipe
- ↓ purging
- ↓ making a connection, etc.

Recommended precautions to take when working with a plastic pipe of any kind where there is or may be the possibility of a flammable gas-air atmosphere are:

- Closing and opening rates are key elements to squeezing-off without damaging the pipe. It is necessary to close slowly and release slowly, with slow release being more important. The pipe must be allowed sufficient time to adjust to the high compressive and tensile stresses applied to the pipe's inside wall during squeeze-off. Low temperatures will reduce material flexibility and ductility and closing and opening times must be slowed further. Procedures that meet ASTM F-1041 should be used.[10]

- Use a cold ring clamp to check for roundness after the pipe has been squeezed-off.

- Do not squeeze-off plastic pipe more than once in the same location. Wrap a piece of tape or install a band clamp around the pipe at the squeeze-off point to mark the area affected by the squeeze-off. The squeeze-off location should also be recorded.

- Always follow proper safety procedures. Keep an approved, manned fire extinguisher available when making repairs and installations where gas is or may become present. Always wear appropriate PPE and follow your company's policies and procedures.

- When working in a gaseous atmosphere, all tools (such as squeeze-off tools) must be properly grounded with a wire or braided strap and rod to reduce the potential of static discharge.

- Additional precautions recommended by the American Gas Association (2006) when working with gas filled plastic pipe are:

    - Wrap the entire circumferential area of exposed piping with wet, soapy rags made of burlap or other non-synthetic material from the ground to the pipe to the ground. Do not permit the material to dry out.
    - If gas is already present, the pipe should be wet with anti-static spray or a diluted solution of liquid soap suitable for use with plastic (within

[10] American Gas Association, AGA Plastic Pipe Manual for Gas Service, 8th Edition, 2006, pg. 98.

manufacturer's recommendations), starting from the ground end. The tape should then be applied immediately and left in place.

- The tape should be kept wet by occasional applications of solution. Where ambient temperatures below 0°C (32°F) are encountered, glycol (such as ethylene glycol, also known as common antifreeze) may be added to the water to prevent freezing. The tape should be grounded with a metal pin driven into the ground.
- Do not vent gas using ungrounded plastic pipe or tubing. Even with grounded metal piping, venting gas with high scale or dust content could generate a charge in the gas itself and result in an arc from the dusty gas cloud back to the pipe causing ignition. Venting should be done at a downwind location remote from personnel or flammable material.
- Do not vent gas or purge using ungrounded plastic pipe or tubing. **Ground all tools and remove potential sources of ignition.**
- In all cases, appropriate personal protective equipment (PPE) such as flame-resistant clothing treated to avoid static buildup and respiratory equipment should be used.
- Commercially available electrostatic discharger systems may be considered as a means of eliminating static electricity from both the inside and outside of the PE pipe.[11]

(2) **Controlling Static Charges During Repair.** If repairs must be made in a bell hole and gas is already present, the pipe and the hole should be wet with anti-static spray or a very dilute solution of water and dishwashing type detergent. The wetting process should start from the point in the bell hole where the pipe is in contact with the ground. This detergent solution should be sprayed on the pipe and the earth in the hole before a person enters the space to work.[12]

One of the most effective methods to ground off static charges is to spiral wrap the pipe with wet burlap or cotton tape, as illustrated in Figure 3.

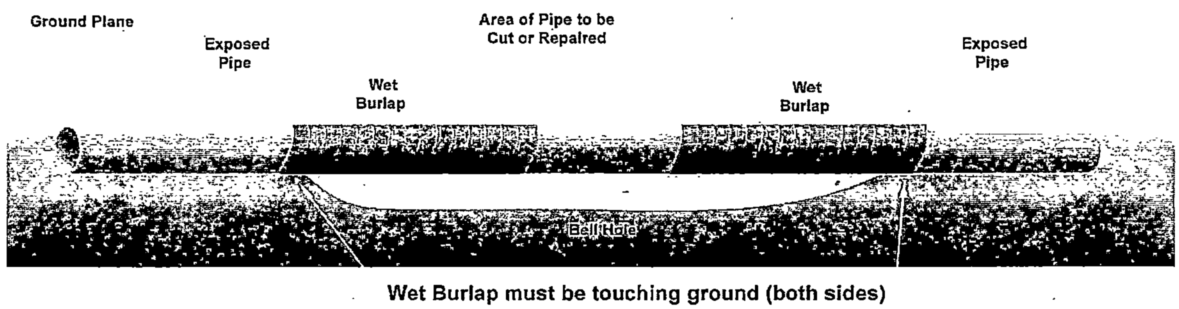


Figure 3. Wrapping Plastic Pipe to Control Static Electricity

[11] American Gas Association, AGA Plastic Pipe Manual for Gas Service, 8th Edition, 2006, pg 98-99.
[12] Southern Gas Association (SGA), "Controlling Static Electricity in Plastic Pipes."

Dip the burlap or cotton tape in a bucket of detergent solution prior to using it. The material will only remain conductive, and therefore helping to minimize static electricity, as long as it remains moist.

Do not use any synthetic materials for this grounding application—they are not absorbent enough to provide the conductivity required.

Always wrap the wet material (burlap or cotton tape) from the point where the pipe and soil are in contact towards the leak or work area. It is important for the wrapping material be kept wet with the detergent solution. Ground all tools that come in contact with the pipe.

(3) **Purging Operations.** Remember, it is possible for a static charge to be generated by flowing gas, especially if it contains any particulate matter.

An essential procedure used to control static electricity on plastic pipe is grounding. Methods used as grounding procedures to reduce the potential for static discharge include:

- Removal of static electricity using a detergent and water solution
- The application of wet grounding material
- Use of grounded tools that come in contact with the pipe

(4) **Controlling the Purge Discharge.** The point of discharge should be controlled with a shutoff valve. The discharge point shall be at least 10 feet from sources of ignition, located a minimum of 10 feet from building openings, and a minimum of 25 feet from mechanical air intake openings. The discharge purge should be controlled through a grounded metal vent stack at the point of discharge. The discharge must be continuously attended and monitored with an approved combustible gas indicator with a numerical reading of 1% to 100% gas-in-air with increments no greater than 1%.[13]

[13]NFPA 54, Tentative Interim Amendment 09-3, Reference 8.3 (August 25, 2010) http://www.nfpa.org/Assets/files/AboutTheCodes/54/TIA54-09-3.pdf

REVIEW III

Identifying Methods to Control Static Electricity on Plastic Piping

Directions: Select from the list below the response that most correctly completes each of the following statements. Write the letter of your choice in the space provided.

A.	grounded	G.	separate bell holes
B.	moist	H.	not uniform
C.	static electricity	I.	leak
D.	ignition source	J.	soapy water
E.	the same bell hole	K.	uniform
F.	friction	L.	electrical conductor

D 1. Static electricity on plastic is considered a potential hazard in a gaseous atmosphere because it can be an ___________.

F 2. Static electricity on plastic pipe is caused by _____.

K 3. Static electric charges that accumulate on the wall surface of a plastic pipe are _____.

A 4. In a gaseous atmosphere, all tools, such as squeeze-off tools, must be ________to reduce the ignition hazard of static electricity.

B 5. Burlap or cotton tape used to ground plastic pipe will remain conductive only as long as it is ________.

I 6. Always wrap the moist burlap or cotton tape from the point where the pipe and soil come in contact towards the _______area.

G 7. When confronted with a gas leak from damaged plastic piping, stopping the gas flow by squeeze-off in _____ is the initial consideration.

C 8. Grounding is the most essential procedure used to control _______on plastic pipe.

J 9. A method used to control static electricity on plastic pipe is _____.

Knowledge Verification Checklist

OQ Task CF-2
Join Plastic Pipe with Mechanical fittings

Directions: Use the following performance criteria statements as a self-evaluation in preparation for the final exam.

I can identify:

- ❑ 1. The meaning of IPS when referring to the dimensions of plastic pipe. (CF-2.1.1)
- ❑ 2. The maximum design pressure for a polyethylene piping system according to 49 CFR 192.123. (CF-2.1.2)
- ❑ 3. The proper reaction to improper stab depth into a mechanical fitting. (CF-2.1.3)
- ❑ 4. A condition that must be met when joining plastic pipe, to ensure compliance with D.O.T. Regulations according to 49 CFR 192.273. (CF-2.2.1)
- ❑ 5. A pipe joining method that is unacceptable when joining plastic pipe. (CF-2.2.2)
- ❑ 6. The method used to reinforce the part of the plastic pipe that is subjected to the compressive force of the grip ring of a compression type fitting. (CF-2.2.3)
- ❑ 7. The proper technique for tightening a non-bottom out compression coupling. (CF-2.2.4)
- ❑ 8. The characteristics of a pipe surface prepared for a threaded compression nut end fitting. (CF-2.2.5)
- ❑ 9. The maximum gap that is acceptable between the flange of the pipe stiffener and the end of the plastic pipe. (CF-2.2.6)
- ❑ 10. The step that must be included when installing a stab fitting. (CF-2.2.7)
- ❑ 11. The characteristics of a bolted coupling. (CF-2.2.8)
- ❑ 12. The procedure for tightening the nuts on the bolts of a bolted coupling. (CF-2.2.9)

I can identify:

- ❑ 13. The procedure to use to support plastic pipe if there is a possibility of excessive ground settlement. (CF-2.2.10)
- ❑ 14. The agency, which establishes the general requirements for joining plastic pipe with mechanical fittings. (CF-2.2.11)
- ❑ 15. The reason static electricity on plastic pipe is considered a potential hazard. (CF-2.3.1)
- ❑ 16. The cause of static electricity on plastic pipe. (CF-2.3.2)
- ❑ 17. The condition associated with the location of static charges on plastic pipe. (CF-2.3.3)
- ❑ 18. Safety procedure practiced when squeeze-off tools are used in a gaseous atmosphere. (CF-2.3.4)
- ❑ 19. A procedure on a damaged plastic pipeline that exhibits accepted safety practices for controlling gas flow. (CF-2.3.5)
- ❑ 20. The method used to control static charges on plastic pipe in a gaseous atmosphere. (CF-2.3.6)
- ❑ 21. The condition that is essential for burlap or cotton tape to effectively ground static charges on plastic pipe. (CF-2.3.7)
- ❑ 22. The proper wrapping procedure of moist burlap or cotton tape around the plastic pipe to effectively control static electricity. (CF-2.3.8)
- ❑ 23. The essential procedure used to control static electricity on plastic pipe. (CF-2.3.9)

Skill and Ability Verification Packet

OQ Task CF-2
Join Plastic Pipe with Mechanical fittings

I. General Instructions

Instructions for Use

The Skill and Ability Verification Packet is designed to standardize conditions under which the employee demonstrates his/her performance of tasks that meet the operator qualification requirements established by the employee's company.

Completing the enclosed affidavit and uploading the data to Industrial Training Services OnBoard LMS for recordkeeping, documents the satisfactory completion of tasks. Both the OQ Authorized Evaluator (AE) and employee must sign the affidavit.

Instructions to the Employee

Your OQ AE will check your performance using the suggested evaluator guide included in each hands-on task assignment. This suggested guide must be supplemented or replaced by the individual company's policies and procedures related to the task being evaluated.

You must adhere to all safety precautions according to your company's policies and procedures and applicable federal, state, and local codes and regulations.

II. Task Information

OQ Task CF-2:	**Join Plastic Pipe with Mechanical Fittings**
Qualification Standard:	The employee's qualification is based on the enabling operation(s) that have been successfully completed. The operation's tasks are listed below:
OQ CF-2.1	Joining of Pipe – Non-Bottom Out Compression Couplings. (B31Q Task 0691)
OQ CF-2.2	Joining of Pipe – Bottom Out Compression Couplings. (B31Q Task 0701)
OQ CF-2.3	Joining of Plastic Pipe – Stab Fittings. (B31Q Task 0681)
OQ CF-2.4	Joining of Pipe – Compression Couplings. (B31Q Task 0711)
Recommended Requirement:	The employee must demonstrate proficiency to an acceptable level based on the Skill and Ability Checklist associated with each operation.
References:	49 CFR, 192.273, 192.281, 192.285, 192.287. B-31Q Tasks 0691, 0701, 0681, 0711.

Note:

The following Abnormal Operating Conditions (AOCs) and their reactions listed are for guidance only. This AOC list is not presented as an exhaustive treatment of AOCs and appropriate responses. You may be required to know and apply other AOCs and AOC responses for different tasks. Properly recognizing and reacting to covered task AOCs are the responsibility of persons qualified to perform the covered task. Always follow your company's policies and procedures.

Industrial Training Services, Inc. assumes no liability for any act or act of omission performed by the person seeking qualification under the pipeline operator's OQ program, or during the actual pipeline operations of the pipeline operator or any contractor performing work on the pipeline operator's pipeline system.

Abnormal Operating Conditions

(Not limited to the examples listed below)

Recognize	React
• Defect of pipe surface	• Evaluate and replace as necessary
• Surface contamination	• Clean surfaces
• Leaking fitting	• Cut out and replace
• Angle cut pipe/pipe prep	• Square pipe ends/chamfer if required
• SDR on pipe and fitting not compatible	• Use proper fitting
• Stiffener improperly sized or installed	• Replace fitting
• Improper stab depth into the mechanical fitting	• Replace fitting
• Improper alignment	• Loosen fitting, adjust and realign fitting
• Scratched or gouged pipe	• Remove pipe

III. Skill and Ability Verification Checklist

OQ Task CF-2
Join Plastic Pipe with Mechanical Fittings

I verify that (Please Print) ____ is qualified to perform OQ Task CF-2 according to his/her company's procedures:

(CF-2.1) Joining of Pipe – Non-Bottom Out Compression Couplings. (B31Q Tasks 0691)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Verify the use of proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Verify components and tools are adequate for intended service.
  - Coupling size
  - Proper material
  - Type of joint connection (similar/dissimilar pipe material)
  - Type of wrench(es) for installation
- ☐ Prepare pipe and fitting
  - Remove burrs and square pipe ends.
  - Clean and inspect sealing surfaces and fittings/couplings, and remove any debris or obstructions.
  - Measure and mark stab depth.
- ☐ Install coupling by performing the following as applicable:
  - Proper Alignment
  - Proper stab depth met
  - Tighten to required torque or number of turns
- ☐ Visually inspect completed joint, as applicable.
  - Inspect with a mirror.
  - Verify proper alignment of pipe and fitting/coupling.
  - Check stab depth marks for any movement during installation
- ☐ If required, verify that documentation is completed.
- ☐ Verify learner's ability to recognize and properly react to AOCs.

Abnormal Operating Conditions

(Not limited to the examples listed below)

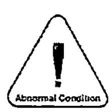
Recognize	React
• Surface contamination	• Clean surfaces
• SDR on pipe and fitting not compatible	• Use proper fitting
• Stiffener improperly sized or installed	• Replace fitting

Comments / Additional Company Procedures:

(CF-2.2) Joining of Pipe – Bottom Out Compression Couplings. (B31Q Tasks 0701)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Verify the use of proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Verify components and tools are adequate for intended service.
  - Coupling size
  - Proper material
  - Type of joint connection (similar/dissimilar pipe material)
  - Type of wrench(es) for installation
- ☐ Prepare pipe and fitting:
  - Remove burrs and square pipe ends.
  - Clean and inspect sealing surfaces and fittings/couplings, and remove any debris or obstructions.
  - Measure and mark stab depth.
- ☐ Install coupling by performing the following as applicable:
  - Proper alignment.
  - Proper stab depth met.
  - Tighten to bottom out.
- ☐ Visually inspect completed joint, as applicable.
  - Inspect with a mirror.
  - Verify proper alignment of pipe and fitting/coupling.
  - Check stab depth marks for any movement during installation.
- ☐ If required, verify that documentation is completed.
- ☐ Verify learner's ability to recognize and properly react to AOCs.



Abnormal Operating Conditions

(Not limited to the examples listed below)

Recognize	React
• Surface contamination	• Clean surfaces
• SDR on pipe and fitting not compatible	• Use proper fitting
• Stiffener improperly sized or installed	• Replace fitting

Comments / Additional Company Procedures:

(CF-2.3) Joining of Plastic Pipe – Stab Fittings. (B31Q Task 0681)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Verify the use of proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Verify correct selection of stab fitting.
  - Pipe material
  - Pipe diameter
  - Pipe wall thickness
- ☐ Perform preparation of pipe and fitting:
  - Verify pipe conditions (gouges not to exceed 10% of nominal wall thickness).
  - Pipe ends cut square.
  - Pipe and fittings should be clean and dry, with ends chamfered and free of burrs and other defects.
  - Verify fitting condition.
  - Prepare pipe for installation by marking stab depth.
- ☐ Perform actions to install fitting:
  - Install fitting to pipe, ensuring proper stab depth is achieved.
  - Verify fitting is locked into place by gripper ring.
  - Verify proper stab depth has been achieved.
- ☐ If required, verify that documentation is completed.
- ☐ Verify learner's ability to recognize and properly react to AOCs.

Abnormal Operating Conditions

(Not limited to the examples listed below)

Recognize	React
• Surface contamination	• Clean surfaces
• SDR on pipe and fitting not compatible	• Use proper fitting
• Leaking fitting	• Cut out and replace

Comments / Additional Company Procedures:

(CF-2.4) Joining of Pipe – Compression Couplings. (B31Q Task 0711)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

☐ Verify the use of proper personal protective equipment.

☐ Select task procedure(s) and appropriate equipment.

☐ Perform selection of compression coupling based on the following:
  Pipe materials
  Pipe diameter
  Pipe wall thickness
  Type of joint

☐ Perform preparation of pipe and coupling
  Verify pipe conditions
  Verify pipe ends are cut square
  Keep pipe and coupling clean and dry
  Verify coupling condition
  Prepare pipe for installation by marking stab depth

☐ Perform actions to install coupling:
  Install stiffener if fitting is being installed in conjunction with plastic pipe and is not attached to coupling.
  Correctly align pipe and coupling.
  Install coupling to pipe, ensuring proper stab depth is achieved.
  Tighten and torque as specified.

☐ Inspect installed coupling.
  Maintenance of stab depth
  Pipe alignment

☐ If required, verify that documentation is completed.

☐ Verify learner's ability to recognize and properly react to AOCs.

Abnormal Condition

Abnormal Operating Conditions

(Not limited to the examples listed below)

Recognize	React
• Defect on pipe surface	• Evaluate and replace as necessary
• SDR on pipe and fitting not compatible	• Use proper fitting
• Stiffener improperly sized or installed	• Replace fitting

Comments / Additional Company Procedures:

IV. Employer Record

OQ Task CF-2

Join Plastic Pipe with Mechanical Fittings

Employee Information (Please Print):

Name ____________________

Last 4 Digits of Social Security Number ____________________

Company Name ____________________

Company Mailing Address ____________________

City ____________________ State __________ Zip __________

Affidavit

I acknowledge the performance of this task is solely for the purpose of operator qualification, and is not intended to replace or modify company operating procedures or policies and may not be appropriately used in all circumstances. I acknowledge that I am responsible for recognizing hazards and abnormal conditions in my work place and must exercise care and good judgment; always using appropriate equipment, procedures and tools for tasks I perform. Industrial Training Services, Inc. assumes no liability for my actions nor for my application of the qualification performance guides used in this evaluation checklist.

Employee's Signature ____________________ Date __________

Evaluator Information (Please Print):

Name ____________________

Organization/Employer ____________________

Telephone Number ____________________

Affidavit

I affirm that I am the person who has administered this checklist and that I have conducted this assessment with integrity. I also affirm that the above named employee is the person assessed and that the above named person performed the tasks at the indicated level.

Evaluator's Signature ____________________ Date __________

The employee is qualified according to company standards to perform the tasks listed below as indicated:

	Not Applicable	TASK/OPERATION	Method of Skill/Ability Verification Enter Number From List Below
1.	☐	(CF-2.1) Joining of Pipe – Non-Bottom Out Compression Couplings. (0691)	☐
2.	☐	(CF-2.2) Joining of Pipe – Bottom Out Compression Couplings. (0701)	☐
3.	☐	(CF-2.3) Joining of Plastic Pipe – Stab Fittings. (0681)	☐
4.	☐	(CF-2.4) Joining of Pipe – Compression Couplings. (0711)	☐

Method of Knowledge Verification

- Written Exam

Method of Skill/Ability Verification Observed During:

1. Performance on the Job
2. Simulation

After completion of Section IV, "Employer Record," remove section from the packet for your records. For third party verification and database reporting service, upload the data to Industrial Training Services OnBoard LMS.

INDUSTRIAL
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Murray, KY 42071

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INDUSTRIAL

TRAINING SERVICES

Danny Shirout

OQ Compliance Series

Student Manual

OQ Task CI-13

v11.2

Identify Procedures Basic to Inspecting, Applying, and Repairing Pipeline Coatings

OQ Compliance Series Student Manual

INDUSTRIAL TRAINING SERVICES

OQ Task CI-13 v1.1.2 — Identify Procedures Basic to Inspecting, Applying, and Repairing Pipeline Coatings

INTRODUCTION

The pipeline coating is the most integral part of a cathodic protective system. Without the proper use of pipeline coatings, a cost effective corrosion control program cannot be maintained. In this module you will learn how to inspect and repair pipeline coatings. To complete this module you will be required to complete the check-out activities listed below.

OBJECTIVES

1. Inspect coatings and coating application on steel pipe.
2. Apply or repair pipeline coating.

CHECK-OUT ACTIVITIES

Your instructor will provide you with a list of incomplete statements related to identifying procedures basic to inspecting, applying, and repairing pipeline coatings and a list of responses. Select the response that most correctly completes each statement. Cut-off score is 80%. (Knowledge Verification)

Your instructor will provide you with a Skill and Ability Verification Checklist. At the appropriate time demonstrate your skill and ability by correctly performing each operation required under the task. (Skill & Ability Verification)

OQ CI-13 covers requirements indicated in the following codes/regulations:

ITS OQ Covered Task:	ASME B-31 Q*	ITS***	49 CFR 192**
OQ CI-13.1 Visual Inspection of Buried Pipe and Components When Exposed	0151		192.459 192.461
OQ CI-13.2 Coating Application and Repair: Brushed or Rolled	0991		
OQ CI-13.3 Coating Application and Repair: Sprayed	1001		
OQ CI-13.4 External Coating Application and Repair: Wrapped	1011		
OQ CI-13.5 Pipe Surface Preparation for Coating Application		5541	

***ASME B31Q Covered Tasks:**

0151 Visual Inspection of Buried Pipe and Components When Exposed.
0991 Coating Application and Repair: Brushed or Rolled.
1001 Coating Application and Repair: Sprayed.
1011 External Coating Application and Repair: Wrapped.

****49 CFR Part 192 Covered Regulations:**

49 CFR 192 covered regulations are identified within the appropriate section of this module.

*****ITS Covered Tasks:**

5541 Pipe Surface Preparation for Coating Application.

Description of Activity	The focus of this module is on the review of the best practices and government regulations concerning the application of protective coatings to gas pipelines and related facilities made of steel. Ample consideration is also given to the inspection of these coatings on existing pipelines and the proper methods of repair if a coating area is found to be deficient during inspection.

PLEASE READ – INDUSTRIAL TRAINING SERVICES, INC. DISCLAIMERS – PLEASE READ

Table of Contents

INSTRUCTION SHEET I

Inspecting Coatings and Coating Application on Steel Pipe

During normal operations on most pipeline systems there are frequent occasions to uncover the line for maintenance work. Many times this work involves damage to the coating or removal of portions of the coating. When a pipeline is exposed, a coating inspection must be performed to check for deterioration.

If cracks of disbondment are found the coating should be repaired or removed and new coating applied.

Examination of Buried Metal Pipelines When Exposed

(1) D.O.T. Standard.

§ 192.459 External corrosion control: Examination of buried pipeline when exposed.

Whenever an operator has knowledge that any portion of a buried pipeline is exposed, the exposed portion must be examined for evidence of external corrosion if the pipe is bare, or if the coating is deteriorated. If external corrosion requiring remedial action under §§192.483 through 192.489 is found, the operator shall investigate circumferentially and longitudinally beyond the exposed portion (by visual examination, indirect method, or both) to determine whether additional corrosion requiring remedial action exists in the vicinity of the exposed portion.

[Amdt. 192–87, 64 FR 56981, Oct. 22, 1999]

A field work report or similar form is useful for describing the condition of the coating or exposed pipe surface in qualitative terms. General criteria for rating the existing conditions should be established company-wide to provide for consistency in field reporting and analysis. Where possible, the report or form should include an evaluation of the following:

- Pitting condition
- Coating condition

When inspecting the exposed pipeline, consideration should be given to the proximity and condition of existing conduits, ducts, sewer lines, and similar structures, including abandoned facilities, which might have the potential to provide a path for the migration of leaking gas.

Inspecting the Coating on Steel Pipe

Each buried or submerged pipeline installed after July 31, 1971 must be protected against external corrosion. Specifically the pipeline must be protected with an external protective coating and a cathodic protection system designed to protect the pipeline in its entirety.

(1) **Qualities of Effective Coatings.** Coatings are effective in preventing pipeline deterioration from corrosion if they possess the following basic qualities once applied:

(a) **Good Electrical Insulation.** Since the primary forces of corrosion are recognized to be electro-chemical in nature, resistance to electrical forces for this and subsequent protection reasons is considered vital. This property is commonly referred to as dielectric strength.

(b) **Low Moisture Absorption.** The presence of moisture adjacent to metal would serve to lower electrical resistance of a coating and to accelerate electro-chemical attack.

(c) **Resistance to Water Vapor Transmission.** There must be an extremely high degree of impermeablity to transfer water vapor through the coating film. It must seal against moisture penetration. This property complements resistance to water absorption mentioned in (b).

(d) **Environmental Contaminants and Abnormalities.** Soil or water with industrial, chemical, and natural contamination was an early consideration. Today, this problem is increasing in seriousness and magnitude.

(e) **Resistance to Physical Damage by Impact and Handling.** It is inevitable that a coated structure must be handled several times between coating and burying. The coating film must possess properties such as to not easily crack, disbond, or deform in these operations. The coating must withstand the forces of bending, such as normally done with pipe.

(f) **Resistance to Deformation by Soil Pressure and Stresses.** After placing the coated structure in its final environment, coating damage is possible due to non-uniform backfill pressure, due to clods or to alternate wetting and drying of the environment. In soils of appreciable clay content, swelling and shrinking actions are created by varying moisture contents. This results in pulling the coating away from the structure, creating cracks, voids, or thin spots.

(g) **Withstand Impressed Electrical Potential**. Cathodic protection of the structure by impressed currents, with or without the presence of stray currents, is considered elementary to the proper prevention of corrosion attack. This is a requirement supplementary to that mentioned in (a) above and represents the need for electrical resistance supplementing the natural electro-chemical resistance. This is another example of the need for dielectric strength.

(h) **Ease of Application and Maintenance**. A coating system requires application by reasonable and practical means and should serve indefinitely. Since the structures are generally being built for long service life, the life of the coating system shall be equivalent to that of the structure. The retention of initial coating integrity is recognized as necessary to facilitate maintenance.

(i) **Resistance to Cathodic Disbondment**. As coating systems were developed, and the need for cathodic protection to supplement the basic protection afforded by the coating became apparent, the need for the coatings to withstand electrical pressure that could separate coating and structure was recognized to be very important.

(j) **Adhesion and Cohesion**. The coating film must bond securely to the structure surface and resist all the forces being mentioned which tend to separate the two. In addition, cohesive internal strength within the coating film is required to resist cracking and physical deterioration.

(k) **Ability to Withstand Outdoor Weathering**. Pipe or structures, due to logistics on many occasions, may be coated well in advance of use. Resistance to ultra-violet rays, temperature changes, and stacking pressure must be an elemental feature of the coating.

(l) **Compatibility with Joints and Coating Repair Materials**. After the basic coating application, it is necessary that materials available for use in general operations can be properly used to bond the basic system and in so doing, economically and effectively maintain basic integrity.

(2) **Types of Protective Coatings**. There are many types and kinds of coatings available for use on underground piping. These types include:

(a) **Enamels**. For many years, the most widely used coatings were the coal tar and asphalt enamels. These enamels are formulated from coal tar pitches or petroleum asphalt filled with inert fillers such as lime or slate dust for mechanical strength, impact, and resistance to deformation. These coatings gave excellent performance if they were installed correctly.

(b) **Mastics.** These materials are a formulation of sand, lime dust, fibers, and a selected temperature range asphalt binder. The binder comprises approximately 12 percent by weight of all constituent materials. The mastic material is applied hot by a pressure-extrusion process to an average ½"-5/8" thickness, although thickness to 1" is available. These materials are widely recognized and used since they have very good coating integrity and service performance resulting from the heavier thickness.

(c) **Micro Crystalline Wax.** This is a hot applied coating used without primer, but with external thin film plastic wrapper for mechanical strength, and is applied to an average 40 mils thickness. Application is similar to the enamels. Operating temperature limits are lower, however.

(d) **Greases.** These are grease-based, cold-applied materials, reinforced with outside wrapper for mechanical strength. These materials are formulated with inhibitors and are of a wax grease nature in appearance. They are generally used in limited quantities for a specific assignment.

(e) **Cold Applied Mastics.** These materials are manufactured from either coal or asphalt tar and gilsonite stock. They rely upon release and evaporation of a solvent for curing and hardening. There may also be a chemical cure in the drying process. Internal reinforcement is recommended with these materials. Best results are obtained in 40 to 50 mils range. If hardening is dependent upon solvent release, backfilling time may become critical.

(f) **Prefabricated Films - (Tapes).** These are polyethylene and polyvinyl chloride films with various types of adhesives to bond the structure surface, resulting in best application when used over a primed surface with the proper amount of tension during the wrapping process. Best results are obtained in the 10 to 25 mils range total thickness, with adequate overlap - about 1 inch minimum. Protective outer wraps of reinforced paper or felt may be specified for protection during backfill.

(g) **Extruded Plastic Films.** These hot, applied films of polyethylene or polypropylene are 30-50 mils thick and extruded over a rubberized mastic primer film of about 10 mils thickness, and thereby providing a continuous jacket similar to insulation on direct burial cable. Joints are made with tapes or shrunk-on irradiated films of the same basic material, flash heated to activate the shrink process.

(h) **Thermo-Setting Coatings.** These are synthetic coatings, primarily epoxies and/or phenolics, of extremely tough and excellent bonding characteristics applied to an average 10 mils thickness with or without primer, are chemically and/or heat cured immediately after application. This coating system is the most recent development for underground use and may lead to realization of the long desired concept of structural materials delivered for construction that are ready for burying (except for joints) which can be handled practically as if they were uncoated. It is a successor to the thermoplastic systems which did not display all the attributes desired for 'tough' coatings.

(3) **Protecting Welded Steel Pipe Joints.** All welded steel pipe joints should be protected with primer and tape. When coal tar enamel or tape is used for coating welds, a clean pipe is a necessity. For coal tar, the pipe must be dry and cleaned to shiny metal. Remove all rust and scale. Use only the primer specified for the coating. Apply the primer in a smooth, thin coat, free of runs. When the primer is thoroughly dry, it may be coated with the coal tar. Heat the coal tar to the proper temperature (approximately 425°F).

If the primer is not dry or the enamel is not hot enough, the bond to the pipe will not be properly formed. If not properly formed, water will flow between the pipe and coating creating galvanic cells. Corrosion will occur under the coating.

If the pipe is taped, it must be dry and clean. It is necessary to use the primer specified for the tape. Tapes vary with application. Some go over dry primer and some on "tacky" primer. No matter which, the tape is applied in a firm manner with no wrinkles.

Coatings are the first line of defense against corrosion. However, a perfect coating application seldom stays perfect. After a while, voids and cracks show up in the coating, possibly due to movement of the ground during freezing and thawing. A void or hole in the coating is called a "holiday." This term describes any defect in the coating. It means a portion of the metal is exposed to the soil and subject to corrosion. When this happens, current must be applied to counteract the corrosion. This is called cathodic protection.

(4) **Testing Protective Coatings**. After the weld joints, as well as the holidays and scraped places, have been patched, a test of the coating must be made before the pipe is lowered into the ditch.

As a final backup to application of coating and patching, a common practice includes tests of the coatings with a holiday detector or "jeep."

This device impresses an electrical voltage across the coating. An electrode is passed over the entire coated surface of the pipe. As the electrode passes over a coating defect, there is an electrical discharge between the electrode and pipe. This discharge, or spark, actuates a signaling device in the holiday detector, which warns the operator that a holiday has been detected. The operator marks the defect for the repair crew to patch.

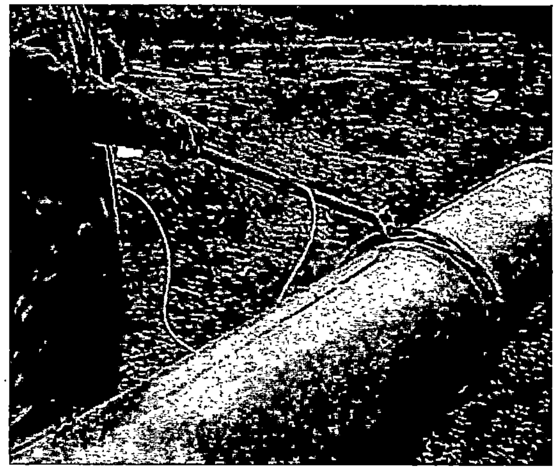
Figure 1. Holiday Detector

Pipe coated at a coating plant is normally passed through a holiday detector prior to shipment. However, both mill coated pipe and field coated pipe should be tested for holidays before going into the ditch. Typical voltage to use on various coatings is as follows:

Coal Tar - 93 mils - 12,000 volts
X-TRU-COAT™ - 40 mils - 8,000 volts
Thin Film - 14 mils - 2,000 volts

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REVIEW I

Inspecting Coatings and Coating Application on Steel Pipe

Directions: Select from the list below the response that most correctly completes each of the following statements. Write the letter of your choice in the space provided.

A. dielectric strength
B. primer and tape
C. non-uniform backfill pressure
D. pit depth gauge
E. exposed
F. electrical pressure on the pipe
G. graphitization

E 1. According to D.O.T. Standards, a pipeline must be examined for evidence of corrosion if the pipe is bare or if the coating is deteriorated whenever any portion of the pipe is _____.

A 2. The resistance to electrical forces provided by an insulating material, such as a pipe coating, is referred to as _____.

C 3. Damage to the protective coating on pipe is possible due to _____.

F 4. The disbondment of the pipe coating from the pipe on a cathodically protected system can be caused by _____.

B 5. All welded steel pipe joints should be protected with _____.

INSTRUCTION SHEET II

Applying or Repairing Pipeline Coatings

A pipeline coating is a barrier between the pipe and the electrolytic processes found in the earth. An effective pipeline coating system must possess excellent cohesive and adhesive bond strength to the pipe, be highly resistant to water penetration, and provide good electrical resistance

D.O.T. Standard

§ 192.461 External corrosion control: Protective coating.

(a) Each external protective coating, whether conductive or insulating, applied for the purpose of external corrosion control must—
  (1) Be applied on a properly prepared surface;
  (2) Have sufficient adhesion to the metal surface to effectively resist underfilm migration of moisture;
  (3) Be sufficiently ductile to resist cracking;
  (4) Have sufficient strength to resist damage due to handling and soil stress; and
  (5) Have properties compatible with any supplemental cathodic protection.
(b) Each external protective coating which is an electrically insulating type must also have low moisture absorption and high electrical resistance.
(c) Each external protective coating must be inspected just prior to lowering the pipe into the ditch and backfilling, and any damage detrimental to effective corrosion control must be repaired.
(d) Each external protective coating must be protected from damage resulting from adverse ditch conditions or damage from supporting blocks.
(e) If coated pipe is installed by boring, driving, or other similar method, precautions must be taken to minimize damage to the coating during installation.

Basic Fundamentals for Applying Pipeline Coatings

There are a number of procedural considerations which must be followed as basic fundamentals during coating applications to assure that the properly formulated and manufactured material is applied in such manner to serve its intended use.

Fundamental application procedures should incorporate the following:[1]

- **Properly Cleaned Surfaces**
  Surfaces to be coated must be free of dirt, scale, oil, grease, and all other materials foreign to the steel. Shot and/or grit-blasted surfaces, with anchor patterns suitable to provide the mechanical ability for the primer and coating to secure themselves to the surface of the structure, are considered ideal.

  When this method of cleaning is not used, the same result should be attained by other processes, such as mechanical brushing or chemical processing; being extremely aware that contaminants created, and not completely removed, may produce undesirably weak bonding of coating to the structure.

- **Proper Priming of the Surface**
  Apply sufficient primer if the coating system so demands, to properly wet the surface, but not so much as to delay drying or even build a film of excess primer which will result in a plane of weakness between structure and coating.

- **The Best Available Coating Site**
  If a stationary plant is used, the availability of properly operating dust removal equipment and temperature control equipment for the surface coated and the material applied is desirable. At a temporary plant or in the open, as in the case of an over-the-ditch pipe coating operation, the elimination of dust and moisture that will gather on the structure is an absolute requirement.

- **Proper Application of Coating Materials**
  Manufacturers' recommendations should be followed as to application temperature, tensions of wrappers used, spacing, and sequence of successive layers of film building materials. Cleanliness throughout all phases of this operation is extremely important.

- **Proper Handling and Storing of Materials**
  This is critical in most materials irrespective of generic type. Store materials so as to prevent contamination, degradation, or deformation; any of which preclude a proper application.

- **Proper Handling of Coated Surface**
  The coated structure shall be properly handled to prevent any damage to the integrity of the coating. Any repair will likely not result in a quality comparable to the intact and undamaged coating film. The field joint or repair, therefore, is critical. It should be realized that coating of field repairs and/or joints will represent about 1% to 3% of the entire surface area. But if coatings are not

[1] S.J. Bellassia, "Coating Fundamentals," Proceedings of the 17th Annual Underground Corrosion Short course, pp. 94-99.

properly made, these areas may represent up to 99% of the cathodic protection requirement.

- **Thorough Inspection**
  All phases of the operation must be scrutinized carefully to assure compliance with good practices, manufacturers' recommendations, and owners' specifications. This aspect alone will mean the difference between a successful or inadequate coating application. The concept of thorough inspection cannot be over emphasized.

Surface Preparation for Coating Applications

Surface preparation for any coating application is one of the most important steps for successful coating performance and effectiveness. Coating integrity and service life will be reduced because of improperly prepared surfaces. Selection and implementation of the proper surface preparation ensures coating adhesion and prolongs the service life of the coating system.

The purpose of preparing the surface is to clean and abrade the surface for proper adhesion of the coating. Selection of the proper method for surface preparation depends on the piping, the environment, the coating selected, and the expected service life of the coating system.

Note:
The coating manufacturer will specify the type of surface preparation required. Always follow manufacturer's instructions, company policies and procedures, and industry standards (e.g. Steel Structures Painting Council and NACE International).

The Steel Structures Painting Council (SSPC) recommends the following:

- SSPC-SP1 Solvent Cleaning – Removes grease/oil and debris.
- SSPC-SP2 Hand Tool Cleaning – Removes loose mill scale, rust, paint, and other detrimental foreign material with the proper hand tools.
- SSPC-SP3 Power Tool Cleaning – Removes loose mill scale, rust, paint, and other detrimental foreign material with the proper power tools.

(1) **Solvent Cleaning.**[2] Solvent cleaning is a method that removes all visible oil, grease, soil, drawing, and cutting compounds and other soluble contaminants. Solvent cleaning does not remove rust or mill scale. You should change rags and cleaning solution frequently so that deposits of oil and grease are not spread over additional areas in the cleaning process. Be sure to allow adequate ventilation. (For complete instructions, refer to Society of Protective Coatings Surface Preparation Specification No. 1.)

[2] Steel Structures Painting Council (SSPC). Surface Preparation-1.

(2) **Hand Tool Cleaning.**[3] Hand tool cleaning prepares the pipe surface by removing all loose mill scale, loose rust, and other detrimental foreign matter. Surface cleaning by hand tools such as scrapers and wire brushes is relatively ineffective in removing mill scale or adherent rust. It is not intended that adherent mill scale, rust, and paint be removed by this process. Mill scale, rust, and paint are considered adherent if they cannot be removed by lifting with a dull putty knife. Before hand tool cleaning, remove visible oil, grease, soluble welding residues and salts by solvent cleaning (SSPC-SP1). (For complete instructions, refer to Society of Protective Coatings Surface Preparation Specification No. 2.)

(3) **Power Tool Cleaning.**[4] Power tool cleaning removes all loose mill scale, loose rust, and other detrimental foreign matter. It is not intended that adherent mill scale, rust, and paint be removed by this process. Mill scale, rust, and paint are considered adherent if they cannot be removed by lifting with a dull putty knife. Before power tool cleaning, remove visible oil, grease, soluble welding residues, and salts by solvent cleaning (SSPC-SP1). (For complete instructions, refer to Society of Protective Coatings Surface Preparation Specification No. 3.)

Other methods of cleaning and surface preparation include the following:

(4) **White Metal Blast Cleaning.**[5] A white metal blast cleaned surface, when viewed without magnification, is free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter. Before blast cleaning, visible deposits of oil or grease must be removed by any of the methods specified in SSPC-SP1, Solvent Cleaning, or other agreed upon methods by your company's policies and procedures. (For complete instructions, refer to Joint Surface Preparation Standard SSPC-SP5/NACE 1.)

(5) **Commercial Blast Cleaning.**[6] A commercial blast cleaned surface, when viewed without magnification, must be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except for staining. Staining should be limited to no more than 33% of each square inch of surface area and may consist of light shadows, slight streaks or minor discoloration caused by stains of rust, stains of mill scale or stains of previously applied paint. Before blast cleaning, visible deposits of oil or grease must be removed by any of the methods specified in SSPC-SP1, Solvent Cleaning, or other agreed upon methods by your company's policies and procedures. (For complete instructions, refer to Joint Surface Preparation Standard SSPC-SP6/NACE 3.)

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[3] Steel Structures Painting Council (SSPC). Surface Preparation-2.
[4] Steel Structures Painting Council (SSPC). Surface Preparation-3.
[5] Steel Structures Painting Council (SSPC). Surface Preparation-5/NACE 1.
[6] Steel Structures Painting Council (SSPC). Surface Preparation-6/NACE 3.

(6) **Brush-Off Blast Cleaning.**[7] A brush-off blast cleaned surface, when viewed without magnification, must be free of all visible oil, grease, dirt, dust, loose mill scale, loose rust, and loose paint. Tightly adherent mill scale, rust and paint may remain on the surface. Mill scale, rust and coating are considered adherent if they cannot be removed by lifting with a dull putty knife after abrasive blast cleaning has been performed. Before blast cleaning, visible deposits of oil or grease must be removed by any of the methods specified in SSPC-SP1, Solvent Cleaning, or other agreed upon methods by your company's policies and procedures. (For complete instructions, refer to Joint Surface Preparation Standard SSPC-SP7/NACE 4.)

(7) **Near White Blast Cleaning.**[8] A near-white blast cleaned surface, when viewed without magnification, should be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except for staining. Staining shall be limited to no more than 5 percent of each square inch of surface area and may consist of light shadows, slight streaks or minor discoloration caused by stains of rust, stains of mill scale or stains of previously applied paint. Before blast cleaning, visible deposits of oil or grease must be removed by any of the methods specified in SSPC-SP1, Solvent Cleaning, or other agreed upon methods by your company's policies and procedures. (For complete instructions, refer to Joint Surface Preparation Standard SSPC-SP10/NACE 2.)

(8) **Power Tool Cleaning to Bare Metal.**[9] Metallic surfaces that are prepared according to this specification, when viewed without magnification, must be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxide corrosion products, and other foreign matter. Slight residues of rust and paint may be left in the lower portions of pits if the original surface is pitted. The profile should not be less than 1 mil. Prior to power tool surface preparation, remove visible deposits of oil or grease by any of the methods specified in SSPC-SP1, Solvent Cleaning, or other agreed upon methods by your company's policies and procedures. (For complete instructions, refer to Society of Protective Coatings Surface Preparation Specification No.11.)

(9) **High and Ultra-High Pressure Water Jetting for Steel and Other Hard Materials.**[10] This standard provides requirements for the use of high and ultra-high pressure water jetting to achieve various degrees of surface cleanliness. This standard is limited in scope to the use of water only, without the addition of solid particles in the stream. (For complete instructions, refer to Joint Surface Preparation Standard SSPC-SP12/NACE 5.)

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[7] Steel Structures Painting Council (SSPC). Surface Preparation-7/NACE 4.
[8] Steel Structures Painting Council (SSPC). Surface Preparation-10/NACE 2.
[9] Steel Structures Painting Council (SSPC). Surface Preparation-11.
[10] Steel Structures Painting Council (SSPC). Surface Preparation-12/NACE 5.

(10) Etch or Profile. An anchor pattern (i.e. etch or profile) is a term used to describe the roughness created on the metal surface when it is sandblasted. The anchor pattern is measured in 1/1000th of an inch, which is called a MIL. Coatings are also measured in MILS. Coatings require specific mils of anchor pattern in order to properly adhere to the surface. Each coating will have different requirements, so be sure to meet the specifications of the manufacturer's mils profile for that particular coating.

Figure 2. Example of Abrasive that Creates a High Degree of Etch for Permanent Bonding of Coatings

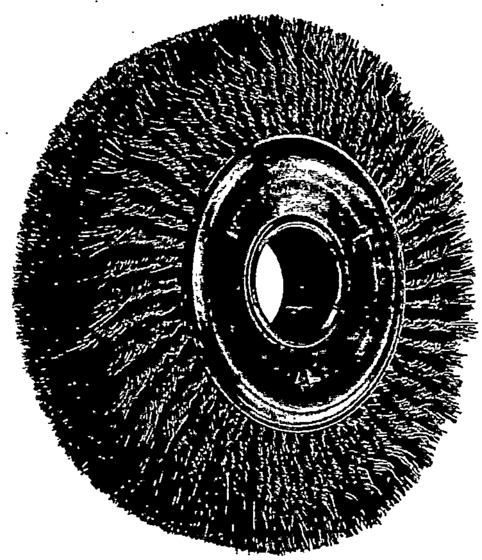


Figure 3. Example of Wire Wheel for Rust Removal

Condensation

The presence of water in the form of condensation on cleaned surfaces can affect the adhesion and performance of coatings. Many factors influence the possibility of condensation, including heat conduction of the surface, solar radiation on the surface, air flow around the structure, and the presence of hygroscopic substances on the surface.

Steel surface temperature generally should be 3°C above the dew point before application of coat painting; but you should always follow the specific manufacturer's instructions.

To measure the dew point, you must measure air humidity and air and surface temperatures. The minimum surface temperature (above the dew point) that is needed to avoid condensation can then be estimated. Always follow your company's policies and procedures and appropriate standards for estimation of the probability of condensation.

Various Types of Field Applied Coatings Used on New Pipeline Installations[11]

Once the pipe is shipped to the jobsite from the coating plant, the field coating of girth welds and fittings as well as the repair of damaged areas become important. Various types of common field-applied coatings used for pipeline installation include:

(1) Hot-applied coal tar tape
(2) Cold-applied polyethylene tape
(3) Heat-shrink sleeves
(4) Fusion-bond field applied epoxy

(1) Hot Applied Coal-Tar Tape. Hot-applied tape is generally a 60 mil thick coal-tar tape that consists of coal-tar pitch saturated into a cotton fabric. Applied in conjunction with a primer, the tape is heated and tightly wrapped around the pipe. A 50% overlap of tape can be used to attain 120 mil thickness of coal-tar material.

Coal-tar hot applied tape possesses excellent hot-melt bond strength to steel, excellent impact resistance, good dielectric strength, and excellent chemical resistance. Hot applied coal-tar tape provides good conformability and performance when properly heated with tension. Since hot applied coal-tar tape is very forgiving in its application, a clean, dry surface preparation of SSPC #1, #2, or #3 (Solvent Cleaning, Hand Tool Cleaning, or Power Tool Cleaning) is all that is generally required for its application.

(2) Cold Applied Polyethylene Tape. Cold applied polyethylene tape with an elastometric synthetic butyl adhesive is available in thicknesses ranging from 30 mils to upwards of 65 mils. Traditionally, cold-applied tape requires liquid primer with its application. However, a new process whereby primer is directly applied to the surface of the adhesive, thus creating a "dry" primer, has become very popular. With the elimination of liquid primer in most instances, the MSDS (Material Safety Data Sheets) hazards and disposal problems associated with primers are virtually eliminated. However, a clean and dry surface preparation including SSPC #1, #2, or #3 (Solvent, Hand Tool Cleaning, or Power Tool Cleaning) minimum becomes more critical than ever to the application process.

[11] "Basic Course, Introduction to Pipe Coatings," Apalachian Underground Corrosion Short Course, pp. 4-1.

(3) **Heat-Shrink Sleeves.** The heat-shrink sleeve is another method of coating girth welds. Heat-shrink sleeves are available in either tubular or split sleeve form. The heat-shrink sleeve is normally 70 to 90 mils in thickness and consists of cross-linked radiated polyethylene. On the surface of the sleeve, there are built-in design features that indicate to the user when enough heat has been applied to the shrink-sleeve.

The tubular shrink-sleeve application requires that the user remove a release paper and slide the sleeve over the girth weld. The sleeves must be in position near the place of application prior to welding. The application of heat should be applied from the middle out towards the edges in a horizontal and/or vertical fashion.

With the split shrink-sleeve application, a filler material/sealant should be used over the longitudinal seams and girth weld beads. A pre-cut shrink-sleeve of correct length with a width of 12" or 18" is wrapped around the girth weld area. Heat then is applied with a torch proceeding from the weld seam outward towards the edge of the sleeve. Upon completion of the heating process, a closure strip is often applied over the end of the lap to ensure that a 3" to 4" overlap of material is maintained on top. Split shrink-sleeves are economical when used on larger diameter pipe. Tubular sleeves are more practical to apply on smaller diameter pipe.

(4) **Fusion-Bond Field Applied Epoxy.** The fusion-bond epoxy type of field application for girth welds can be used on large diameter pipe where substantial footage is involved. The process is similar to the plant coating application, whereby the pipe must be sandblasted to an SSPC #10 Near-White Surface Preparation. An induction heater warms the pipe to 450°F. Powder epoxy is then sprayed onto the weld surface using a wheel applicator that transverses around the circumference of the pipe. Typically, several passes of the wheel are required to achieve the specified coating thickness.

By using the fusion-bond epoxy process in the field, one can achieve a factory-type coating that is consistent in terms of application. Tight standards regarding surface preparation (SSPC #10) and application temperature (450°F range) must constantly be maintained. A certified coatings technician is usually hired to monitor the coating operation.

Various Coatings Used for Maintenance Applications[12]

Several of the field applied coatings used on new pipeline installations (such as hot-applied coal tar tapes, cold-applied polymer tapes, and surface tolerant liquid amine

[12] "Basic Course, Introduction to Pipe Coatings," Appalachian Underground Corrosion Short Course, pp. 4-5.

epoxies) are also used for maintenance applications. In addition, liquid mastics, sealants, hot-applied waxes, cold-applied waxes/petrolatum, liquid coal tar epoxies, high-temperature tapes, and flange fillers are used for numerous maintenance coating applications.

Applying/Repairing Pipeline Coatings

Reconditioning applications involve the following:

(1) Welds and cut-back areas
(2) Riser pipe
(3) Pipeline fittings
(4) High-temperature installations
(5) Gas meter and/or regulators installations
(6) Exposed piping attached along bridges

(1) **Welds and Cut-Back Areas.** Welds and cut-back areas on pipelines are typically coated with primer and tape or heat-shrink sleeves. A typical preparation for coating a cut-back area involving a weld joint is illustrated in Figure 4.

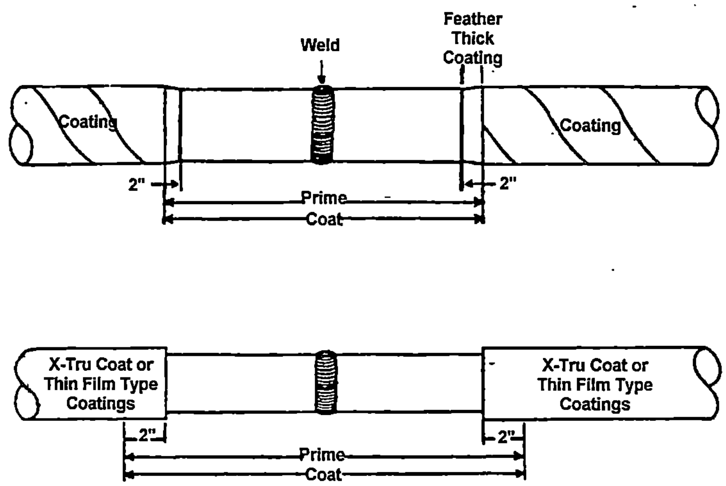


Figure 4. Preparation for a Tape Coating

(2) **Riser Pipe.** Some of the most severe corrosion occurs at the pipe and soil interface area of a riser, as illustrated in Figure 5.

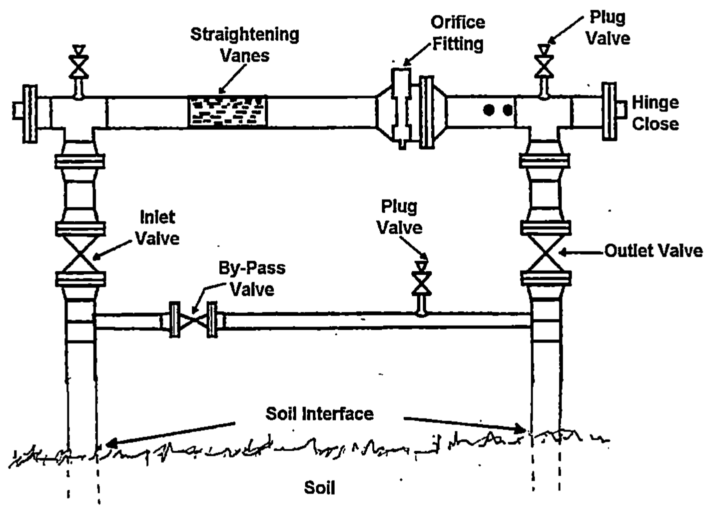


Figure 5. Meter Setting

Several maintenance coatings that are used for riser applications include ultra-violet (UV) resistant cold applied tapes, UV resistant cold-applied wax/petrolatum tapes, surface tolerant liquid amine epoxies, and hot-applied tapes (whitewashed). The coating of choice must be durable and provide good resistance to the atmosphere.

(3) **Pipeline Fittings.** Irregular bolted couplings, valve pits, or fittings associated with the maintenance of piping would be another type of coating application. In these instances, ease of application with a 'field friendly' coating material is very important. A liquid mastic or a wax/petrolatum type of application have been used frequently in these situations. In wet conditions or where pipe constantly sweats, wax/petrolatum tape coatings work very well.[13]

(4) **High-Temperature Installations.** Another area where existing coatings often become deteriorated and sometimes fail is on high-temperature discharge header type applications. These areas are found at natural gas compressor sites a where pipe runs out from the after-coolers. In the past, plant-applied coatings were used because little else was available at that time. Coal-tar epoxy or high-temperature cold-applied tape combined with epoxy primer is currently being used to recondition those areas.[14]

(5) **Gas Meter and/or Regulator Installations.** As part of an atmospheric inspection program, operators of gas meter, regulator, and compressor sites often check flanges and bolts within flanges. Because of the high cost of bolts coupled with the safety factor, there is a willingness on the part of station supervisors to deal with the problem from a maintenance mode. There are

[13] "Basic Course, Introduction to Pipe Coatings," Appalachian Underground Corrosion Short Course, pp. 4-5.
[14] Ibid, pp. 4-5.

numerous ways to coat existing flange bolts and arrest the corrosion process. One method involves pumping flange-filler with a caulking gun into the flange until the entire area is filled. This in essence stops any corrosion processes from continuing. The flange-filler, however, must not shrink, must provide dielectric resistance, and must be easily removable upon re-entry into the flange.

(6) **Exposed Piping Attached Along Bridges.** Another reconditioning application involves exposed piping strung along bridges. In these instances, atmospheric corrosion has corroded the pipe and/or disturbed the original coating through ultra-violet (UV) degradation. A UV resistant cold-applied tape coating or a UV resistant cold-applied wax/petrolatum tape coating works well in those instances. Ordinary paint could be used as a short-term solution, but requires considerable ongoing maintenance.[15]

Considerations for Field Coating Steel Pipelines

- Remove all rust, scale, dirt, dust, oil, grease, and moisture from the surface to be coated.
- Remove any paints or lacquers from the surface to be coated.
- Remove all slag, burrs, and slivers from weld areas.
- Remove loose or poorly bonded coatings from the surface to be coated.
- Remove the existing coating to the extent necessary to ensure the remaining coating is firmly bonded.
- Ensure the existing coating is free of dirt and moisture at the areas to be overlapped.
- Feather (or taper) thick coating at the area of overlap or roughen the surface of thin coatings.
- Apply primer when required (Tape coats require a primer to be applied prior to coating.)
- Cold-applied mastics and heat-shrink coatings do not require a primer. (Heat-shrink coatings incorporate a primer-adhesive on the sleeves.)
- Coal tar epoxy requires primer in some cases.
- Apply primer immediately following the surface preparation to prevent flash rusting on the cleaned surface.
- Ensure the cleaned surface is free of moisture or frost before applying the primer.
- Allow heat from welding to dissipate before applying primer.
- Stir primer before and during application to prevent settlement of components. (If the primer components do not mix after stirring, the primer should not be used.)

[15] "Basic Course, Introduction to Pipe Coatings," Apalachian Underground Corrosion Short Course, pp. 4-5.

- Ensure primer is not contaminated by dirt or moisture before application.
- Apply primer in a uniform, thin coat by brush or sprayer. Runs should be avoided.
- Extend the coat of primer at least 2 inches beyond the area to be coated.
- Apply the coating to overlap an existing coating by at least 2 inches. The overlap is necessary to ensure adequate adhesion to the existing coating.

Applying Cold-Applied Mastics

Cold-applied mastics are used for general maintenance coating and situations where it is impractical to apply tape. Mastics are particularly suitable for use on bolted couplings, leak repair devices, and other fittings of irregular contour.

After the surface is prepared, a coat of mastic should be applied by brush and followed with a second application after the first coat has dried to touch. Mastics rely on solvent release to dry, so they are slow drying. Generally, mastics will dry sufficiently in 25 to 60 minutes.

Where backfilling must proceed prior to sufficient drying, a layer of approved outer wrap shall be placed loosely over the coating to prevent penetration by dirt clods.

Applying Tape Coatings

Tape should be applied in a cigarette or spiral wrap with a minimum overlap of one inch as shown in the following figures:

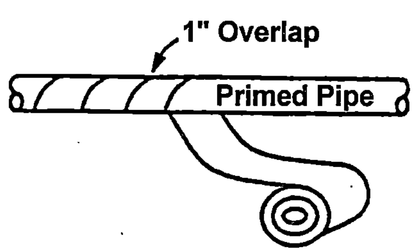


Figure 6.
Spiral Wrap Tape
With No Release Paper

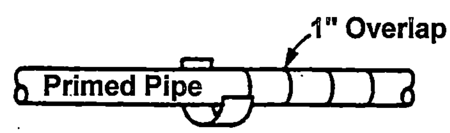


Figure 7.
Cigarette Wrap Tape
With No Release Paper

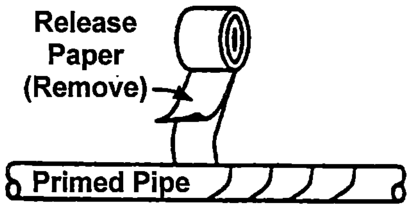


Figure 8.
Spiral Wrap Tape
With Release Paper

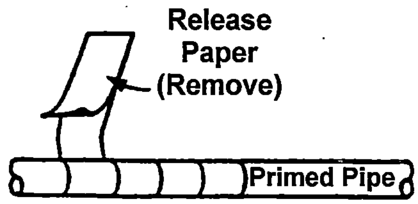


Figure 9.
Cigarette Wrap Tape
With Release Paper

Applying Heat-Shrink Coatings

Apply heat-shrink coatings according to manufacturer's instructions. Heat shrink coatings are available in three forms:

- Tube-type sleeve
- Wrap-around sleeve with a separate closure patch
- One-piece wrap-around sleeve with a built-in closure

(1) **Inspection.** Inspect the following points for proper sleeve application using visual inspection to ensure the following are visible:

- As the sleeve cools, adhesive flow is seen on both edges of the sleeve.
- Adhesive is on the edges to ensure proper bonding to the coating.
- Sleeve is well conformed to the weld beads and the coating.
- No cracks, or holes, in sleeve backing.
- No air pockets in the sleeves.

(2) **Lowering In and Backfill.** Allow the joint and sleeve to cool for at least 30 minutes or below 110°F before lowering in. Selected backfill containing no large or sharp stones should be used to avoid damaging the sleeve or coating during the backfilling operation.

(3) **Storage.** For installation in sub-zero temperatures, store the sleeves in a warm place (such as a truck) above 32°F, and remove immediately prior to installation.

Applying Paint to Pipeline Installations

Weld areas, flanges, various fasteners (including bolts, nuts, and their threads) that have crevices and sharp edges are problem areas for paints.

Principal areas and conditions for significant corrosion that will create leaks or deteriorate the facilities to the point they require replacement are:

- Condensations on piping, fittings and in flange voids
- Piping near ground level
- Junctions with soil or concrete where piping or supports are entering or exiting at grade level
- Piping within unsealed wall sleeve

Recognizing and Reacting to Abnormal Operating Conditions

Note:
The following Abnormal Operating Conditions (AOCs) and their reactions listed are for guidance only. This AOC list is not presented as an exhaustive treatment of AOCs and appropriate responses. You may be required to know and apply other AOCs and AOC responses for different tasks. Properly recognizing and reacting to covered task AOCs are the responsibility of persons qualified to perform the covered task. Always follow your company's policies and procedures.

Industrial Training Services, Inc. assumes no liability for any act or act of omission performed by the person seeking qualification under the pipeline operator's OQ program, or during the actual pipeline operations of the pipeline operator or any contractor performing work on the pipeline operator's pipeline system.

(1) **Things to Consider When Responding to Abnormal Operating Conditions.** The following information is basic knowledge that will assist you in assessing and responding to abnormal operating conditions:

(a) **Basic Properties of Natural Gas.**
- Natural gas is lighter than air, colorless and odorless.
- Natural gas has a specific gravity of approximately 0.6.
- The natural gas Lower Explosive Limit (LEL) is approximately 5%.
- The natural gas Upper Explosive Limit (UEL) is approximately 15%.
- The ignition temperature of natural gas is about 1100°-1200° F.

(b) **Eliminating Ignition Sources.** Some of the ways to eliminate ignition sources are very obvious. For example:

- Smoking and open flames should be prohibited in structures or areas containing gas facilities where possible leakage or presence of gas constitutes a hazard of fire or explosion.
- Smoking and open flames should be prohibited in the open when accidental ignition of a gas-in-air mixture could cause personal injury or property damage.
- Do NOT smoke or use open flames near a jobsite/gas pipeline facility.
- Sparks range in temperature from 1500°F in an electrical switch to 9,000°F in an arc welder. Do NOT use equipment or create situations that generate sparks. Sparks may be generated by the following conditions:

  Communication equipment
  Portable electrically powered tools and equipment
  Internal combustion engines
  Breaking electrical continuity
  Static electricity on plastic pipe

(c) Personal Protection Equipment.

Always follow your company's policies and procedures for the use of personal protection equipment (PPE).

Working around gas pipeline facilities requires practical safety practices and basic PPE may include:

- Head protection (e.g. hard hat)
- Eye and face protection (e.g. goggles, face shield, etc.)
- Hearing protection (e.g. ear plugs, ear muffs, etc.)
- Hand protection (proper glove material for the specific job)
- Respiratory protection (proper respiratory equipment when air content is insufficient)

Abnormal Operating Conditions

(Not limited to the examples listed below.)

Recognize	React
• Blowing or escaping gas / Grade One Leak	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Fire on a pipeline	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Odor complaint	• Conduct leak investigation
• External corrosion	• Notify proper personnel
• Oxidation discovered	• Coat all exposed piping or notify proper personnel
• Metal loss or pitting due to atmospheric corrosion	• Measure depth; determine remaining wall thickness; repair or replace section as needed; apply protective coating
• External examination reveals need for replacement	• Notify proper personnel
• Adhesive contaminated prior to coating installation	• Re-clean and reapply coating
• Damaged coating	• Install/repair/replace coating
• Excavation shows signs of material that could damage pipe coating	• Use approved coating or notify proper personnel

REVIEW II

Applying or Repairing Pipeline Coatings

Directions: Select from the list below the response that most correctly completes each of the following statements. Write the letter of your choice in the space provided.

A.	primer	G.	flash rusting
B.	heat-shrink sleeves	H.	feathered (tapered)
C.	cigarette	I.	properly prepared
D.	solvent	J.	2
E.	irregular bolted couplings	K.	spiral
F.	flange filler	L.	re-clean and reapply coating

I 1. Each external coating applied for the purpose of external corrosion control must be applied on a _____ surface.

B 2. Welds and cut-back areas on pipelines are typically coated with primer and tape or _____.

E 3. A liquid mastic or a wax/petrolatum type application are frequently used in situations involving _____.

F 4. In order to arrest corrosion in existing flange bolts, _____ is pumped into the flange until the entire area is filled.

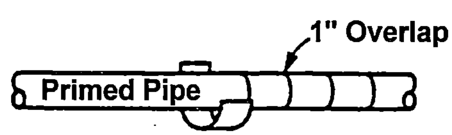
H 5. Thick coatings at the area of overlap should be _____.

A 6. Cold-applied mastics and heat shrink sleeve coatings do not require a _____ as part of the application process.

G 7. Primer must be applied immediately to the prepared surface to prevent _____ of the cleaned surface.

J 8. A properly applied coat of primer extends at least _____ inches beyond the area to be coated.

C 9. The type of coating wrap illustrated below is a _____ wrap.



L 10. The proper response if the adhesive is found to be contaminated prior to coating is to _______.

D 11. _______ cleaning does not remove rust or mill scale.

Knowledge Verification Checklist

OQ Task CI-13

Identify Procedures Basic to Inspecting, Applying, and Repairing Pipeline Coatings

Directions: Use the following performance criteria statements as a self-evaluation in preparation for the final exam.

I can identify:

1. The D.O.T. standard for examining a pipeline for evidence or coating deterioration. (CI-13.1.1)
2. The term used when referring to the resistance to electrical forces provided by an insulating material, such as a pipe coating. (CI-13.1.2)
3. Factors that tend to place stress on a buried pipeline. (CI-13.1.3)
4. A condition on a cathodically protected pipe that can cause disbondment of the coating from the pipe. (CI-13.1.4)
5. The proper protection against corrosion on all welded steel pipe joints. (CI-13.1.5)
6. The proper way to apply external protective coating according to D.O.T. standard 192.461. (CI-13.2.1)
7. The type of cleaning that removes all visible oil, grease, soil, drawing and cutting compounds and other soluble contaminants. (CI-13.2.2)
8. The typical coating applications for welds and cut-back areas. (CI-13.2.3)
9. The typical coating applications used for irregular bolted couplings, valve pits, and fittings associated with the maintenance of piping. (CI-13.2.4)
10. The proper way to coat existing flange bolts and arrest the corrosion process. (CI-13.2.5)
11. A process used to prepare the pipe surface for coating. (CI-13.2.6)
12. The type of coatings that do not require a primer. (CI-13.2.7)

I can identify:

13. The reason primer is applied immediately following surface preparation. (CI-13.2.8)

14. The minimum distance to extend the primer coating beyond the area to be coated. (CI-13.2.9)

15. The type of tape wrapping given in an illustration. (CI-13.2.10)

16. The proper response to the abnormal operating condition of coating contamination. (CI-13.2.11)

Skill and Ability Verification Packet

OQ Task CI-13
Identify Procedures Basic to Inspecting, Applying, and Repairing Pipeline Coatings

I. General Instructions

Instructions for Use

The Skill and Ability Verification Packet is designed to standardize conditions under which the employee demonstrates his/her performance of tasks that meet the operator qualification requirements established by the employee's company.

Completing the enclosed affidavit and returning it to Industrial Training Services for recordkeeping, documents the satisfactory completion of tasks. Both the OQ evaluator and employee must sign the affidavit.

Instructions to the Employee

Your OQ Evaluator will check your performance using the suggested evaluator guide included in each hands-on task assignment. This suggested guide must be supplemented or replaced by the individual company's policies and procedures related to the task being evaluated.

You must adhere to all safety precautions according to your company's policies and procedures and applicable federal, state, and local codes and regulations.

II. Task Information

OQ Task CI-13:	**Identify Procedures Basic to Inspecting, Applying, and Repairing Pipeline Coatings**
Qualification Standard:	The employee's qualification is based on the enabling operation(s) that have been successfully completed. The operation's tasks are listed below:
OQ Task CI-13.1	Visual Inspection of Buried Pipe and Components When Exposed (B31Q 0151)
OQ Task CI-13.2	Coating Application and Repair: Brushed or Rolled (B31Q 0991)
OQ Task CI-13.3	Coating Application and Repair: Sprayed (B31Q 1001)
OQ Task CI-13.4	External Coating Application and Repair: Wrapped (B31Q 1011)
OQ Task CI-13.5	Pipe Surface Preparation for Coating Application (ITS 5541)
Recommended Requirement:	The employee must demonstrate proficiency to an acceptable level based on the Skill and Ability Checklist associated with each operation.
References:	49 CFR, Part 192.459, 192.461. B31Q Tasks 0151, 0991, 1001, 1011.

Note:

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Abnormal Operating Conditions

(Not limited to the examples listed below)

Recognize	React
• Blowing or escaping gas / Grade One Leak	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Fire on a pipeline	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Odor complaint	• Conduct leak investigation
• External corrosion	• Notify proper personnel
• Oxidation discovered	• Coat all exposed piping or notify proper personnel
• Metal loss or pitting due to atmospheric corrosion	• Measure depth; determine remaining wall thickness; repair or replace section as needed; apply protective coating
• External examination reveals need for replacement	• Notify proper personnel
• Adhesive contaminated prior to coating installation	• Re-clean and reapply coating
• Damaged coating	• Install/repair/replace coating
• Excavation shows signs of material that could damage pipe coating	• Use approved coating or notify proper personnel

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III. Skill and Ability Verification Checklist

OQ Task CI-13
Identify Procedures Basic to Inspecting, Applying, and Repairing Pipeline Coatings

I verify that (Please Print) ______________________________ **is qualified to perform OQ Task CI-13 according to his/her company's procedures:**

(CI-13.1) Visual Inspection of Buried Pipe and Components When Exposed (0151)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Inspect and evaluate protective coating for
  - deterioration
  - cracks
  - holidays
  - disbondment
- ☐ Inspect external surfaces of pipe and components when exposed.
  - Examine bare pipe for external corrosion.
  - Investigate circumferentially and horizontally if external corrosion found.
- ☐ Make notifications, as appropriate.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• External corrosion • Gas leak • Gas leakage after a repair operation	• Repair or replace as needed • Remove ignition sources • Locate leaking section and/or points and repair/replace leak source

Comments / Additional Company Procedures:

____

____

____

(CI-13.2) Coating Application and Repair: Brushed or Rolled (0991)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Prepare surface.
  - Check for loose material or surface rust.
  - Remove loose materials/rust.
  - Remove moisture and contaminants from surface.
  - Clean surface.
- ☐ Apply coating.
  - Prepare approved coating materials.
  - Apply approved coating materials in uniform layer/thickness.
  - Cover all prepared/cleaned surfaces.
- ☐ Inspect applied coating.
  - Visually inspect for areas of inadequate coverage/thickness.
  - Perform wet film and/or dry film thickness measurement, as applicable.
  - Ensure coating is protected until cured.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Accidental ignition	• Evacuate to safe area; establish and maintain safe area
• External corrosion	• Repair or replace as needed
• Gas leakage after a repair operation	• Locate leaking section and/or points and repair/replace leak source

Comments / Additional Company Procedures:

(CI-13.3) Coating Application and Repair: Sprayed (1001)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Prepare surface.
  - Remove moisture and contaminants from surface.
  - Clean surface.
  - Check for loose material or surface rust.
  - Remove loose materials/rust.
- ☐ Apply coating.
  - Prepare approved coating materials.
  - Apply approved coating materials in uniform layer/thickness.
  - Cover all prepared/cleaned surfaces.
- ☐ Inspect applied coating.
  - Visually inspect for areas of inadequate coverage/thickness.
  - Perform wet film and/or dry film thickness measurement, as applicable.
  - Ensure coating is protected until cured.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Condition

Abnormal Operating Conditions

(Not limited to the examples listed below)

Recognize	React
• Accidental ignition	• Evacuate to safe area; establish and maintain safe area
• Gas leak	• Remove ignition sources
• External corrosion	• Repair or replace as needed

Comments / Additional Company Procedures:

(CI-13.4) External Coating Application and Repair: Wrapped (1011)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Prepare surface according to the following steps, as applicable:
  - Remove moisture and contaminants from surface.
  - Clean surface.
  - Remove loose materials/rust.
  - Ensure surface temperature is within appropriate range.
  - Apply primer, and allow to cure.
- ☐ Apply coating according to the following steps, as applicable:
  - Prepare coating material for application, including heating as applicable.
  - Apply coating in spiral motion. Use sufficient force to remove voids.
  - Overlap coating seams.
  - Wrap from bottom to top, if coating a vertical section of pipe.
  - Smooth/seal all seams.
  - Ensure coating is protected until cured.
- ☐ Inspect coating for the following, as applicable:
  - areas of inadequate coverage
  - smooth seams to ensure required seal
  - proper coating thickness
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Condition

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• External corrosion • Gas leak • Gas leakage after a repair operation	• Repair or replace as needed • Remove ignition sources • Locate leaking section and/or points and repair/replace leak source

Comments / Additional Company Procedures:

(CI-13.5) Pipe Surface Preparation for Coating Application (5541)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Verify the use of proper personal protective equipment.
- ☐ Verify the appropriate method of surface preparation is chosen according to the type of repair and coating application to be performed. **NOTE:** Not all pipe preparation procedures are appropriate for natural gas. Follow your company's policies and procedures.
- ☐ Verify the use of proper tools for surface preparation.
- ☐ Verify the proper procedure is performed in the following areas, where applicable:
  - ☐ Solvent cleaning
  - ☐ Hand tool cleaning
  - ☐ Power tool cleaning
  - ☐ White metal blast cleaning
  - ☐ Commercial blast cleaning
  - ☐ Brush-off blast cleaning
  - ☐ Near white blast cleaning
  - ☐ Power tool cleaning to bare metal
  - ☐ High and ultra-high pressure water jetting for steel and other hard metals
  - ☐ Etching and profiling
- ☐ Verify pipe surface is cleaned to the appropriate degree according to company policies and procedures and coating application manufacturer's recommendations.
- ☐ Verify that the pipe integrity and wall thickness are adequate once the pipe has been cleaned.
- ☐ Verify that the cleaned area is properly covered or protected before coating according to company policies and procedures.
- ☐ If required, verify that documentation is completed.
- ☐ Verify learner's ability to recognize and properly react to AOC's.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• External corrosion • Atmospheric corrosion detected with pitting or metal loss	• Repair or replace as needed • Clean and coat with acceptable material and/or notify proper personnel

Comments / Additional Company Procedures:

310 C.C. Lowry Dr. • Murray, KY 42071 • Phone: 270/753-2150

IV. Employer Record

OQ Task CI-13

Identify Procedures Basic to Inspecting, Applying, and Repairing Pipeline Coatings

Employee Information (Please Print):

Name ______________________________

Last 4 Digits of Social Security Number ______________________________

Company Name ______________________________

Company Mailing Address ______________________________

City ______________________ State __________ Zip ______________

Affidavit

I acknowledge the performance of this task is solely for the purpose of operator qualification, and is not intended to replace or modify company operating procedures or policies and may not be appropriately used in all circumstances. I acknowledge that I am responsible for recognizing hazards and abnormal conditions in my work place and must exercise care and good judgment; always using appropriate equipment, procedures and tools for tasks I perform. Industrial Training Services, Inc. assumes no liability for my actions nor for my application of the qualification performance guides used in this evaluation checklist.

Employee's Signature ______________________ Date ______________

Evaluator Information (Please Print):

Name ______________________________

Organization/Employer ______________________________

Telephone Number ______________________________

Affidavit

I affirm that I am the person who has administered this checklist and that I have conducted this assessment with integrity. I also affirm that the above named employee is the person assessed and that the above named person performed the tasks at the indicated level.

Evaluator's Signature ______________________ Date ______________

The employee is qualified according to company standards to perform the tasks listed below as indicated:

	Not Applicable	TASK/OPERATIONS	Method of Skill/Ability Verification Enter Number From List Below
1.	☐	(CI-13.1) Visual Inspection of Buried Pipe and Components When Exposed. (0151)	☐
2.	☐	(CI-13.2) Coating Application and Repair: Brushed or Rolled. (0991)	☐
3.	☐	(CI-13.3) Coating Application and Repair: Sprayed. (1001)	☐
4.	☐	(CI-13.4) External Coating Application and Repair: Wrapped. (1011)	☐
5.	☐	(CI-13.5) Pipe Surface Preparation for Coating Application. (5541)	☐

Method of Knowledge Verification

- Written Exam

Method of Skill/Ability Verification Observed During:

1. Performance on the Job
2. Simulation

After completion of Section IV, "Employer Record," remove section from the packet and photocopy. Retain photocopy for your files. For third party verification and database reporting service, mail original to:

Industrial Training Services, Inc.
310 C. C. Lowry Drive
Murray, KY 42071

INDUSTRIAL
TRAINING SERVICES

Industrial Training Services, Inc.

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1.800.333.1566

310 C.C. Lowry Drive
Murray, KY 42071

Phone: 270.753.2150
Fax: 270.753.9807

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DANNY SHROUT

OQ Compliance Series
Student Manual

OQ Task CM-3
v10.3

Pressure Testing Gas Pipelines

INDUSTRIAL TRAINING SERVICES

ITS OQ Compliance Series
CM-3 Pressure Testing Gas Pipelines
v10.3

Student Manual

INTRODUCTION

To ensure the safe and efficient operation of gas pipelines, natural gas system operating personnel are required to pressure test gas piping systems according to established regulatory/company standards. To complete this module you will be required to complete the check-out activities listed below.

OBJECTIVES

1. Identify procedures basic to pressure testing pipelines (other than plastic).

2. Identify procedures basic to pressure testing plastic pipelines.

3. Identify procedures basic to pressure testing service lines.

CHECK-OUT ACTIVITIES

Your instructor will provide you with a list of incomplete statements related to pressure testing gas pipelines and a list of responses. Select the response that most correctly completes each statement. Cut-off score is 80%. (Knowledge Verification)

Your instructor will provide you with a Skill and Ability Verification Checklist. At the appropriate time demonstrate your skill and ability by correctly performing each operation required under the task. (Skill & Ability Verification)

OQ CM-3 covers requirements indicated in the following codes/regulations:

ITS OQ Covered Task:	ASME B-31 Q*	49 CFR 192**
OQ CM-3.1 Pressure Test: Nonliquid Medium – MAOP Less Than 100 psi.	0561	192.503, 192.505 192.507, 192.509 192.511, 192.513 192.725
OQ CM-3.2 Pressure Test: Nonliquid Medium – MAOP Greater Than or Equal to 100 psi.	0571	192.503, 192.505, 192.507, 192.511, 192.513, 192.725
OQ CM-3.3 Pressure Test: Liquid Medium	0581	192.503
OQ CM-3.4 Leak Test at Operating Pressure	0591	192.503, 192.725

*ASME B31Q Covered Tasks:

0561 Pressure Test: Nonliquid Medium – MAOP Less Than 100 psi.
0571 Pressure Test: Nonliquid Medium – MAOP Greater Than or Equal to 100 psi.
0581 Pressure Test: Liquid Medium.
0591 Leak Test at Operating Pressure.

**49 CFR Part 192 Covered Regulations:

49 CFR 192 covered regulations are identified in their entirety within the appropriate section of this module.

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INSTRUCTION SHEET I

Identify Procedures Basic to Pressure Testing Pipelines (other than plastic)

Prior to pressure testing pipelines, it is important to take note of the general requirements describing the operation of pipelines and pipeline systems on a normal basis. Such requirements are described in 49 CFR 192.503:

§ 192.503 General requirements.

(a) No person may operate a new segment of pipeline, or return to service a segment of pipeline that has been relocated or replaced, until—

(1) It has been tested in accordance with this subpart and §192.619 to substantiate the maximum allowable operating pressure; and
(2) Each potentially hazardous leak has been located and eliminated.

(b) The test medium must be liquid, air, natural gas, or inert gas that is—

(1) Compatible with the material of which the pipeline is constructed;
(2) Relatively free of sedimentary materials; and
(3) Except for natural gas, nonflammable.

(c) Except as provided in §192.505(a), if air, natural gas, or inert gas is used as the test medium, the following maximum hoop stress limitations apply:

Class location	Maximum hoop stress allowed as percentage of SMYS	
	Natural gas	Air or inert gas
1	80	80
2	30	75
3	30	50
4	30	40

(d) Each joint used to tie in a test segment of pipeline is excepted from the specific test requirements of this subpart, but each non-welded joint must be leak tested at not less than its operating pressure.

(e) If a component other than pipe is the only item being replaced or added to a pipeline, a strength test after installation is not required, if the manufacturer of the component certifies that:

(1) The component was tested to at least the pressure required for the pipeline to which it is being added.
(2) The component was manufactured under a quality control system that ensures that each item manufactured is at least equal in strength to a prototype and that the prototype was tested to at least the pressure required for the pipeline to which it is being added; or
(3) The component carries a pressure rating established through applicable ASME/ANSI, Manufacurers Standardization Society of the Valve and Fittings Industry, Inc. (MSS) specifications, or by unit strength calculations as described in §192.143.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192–58, 53 FR 1635, Jan. 21, 1988; Amdt. 192–60, 53 FR 36029, Sept. 16, 1988; Amdt. 192–60A, 54 FR 5485, Feb. 3, 1989; Amdt. 192-120, 80 FR 12779, March 11, 2015]

The test medium must be liquid, air, natural gas, or inert gas that is:

- Compatible with the material of which the pipeline is constructed;
- Relatively free of sedimentary materials; and
- Except for natural gas, nonflammable.[1]

The test procedures should give consideration to such items as:

- The test method and equipment used
- The test medium and maximum test pressure
- The duration of the test
- The volumetric content of the piping and its location[2]

Therefore, it is essential that gas service pipelines be tested for leaks to ensure safe and efficient service to customers.

Pressure Testing Gas Pipelines to Operate at a Hoop Stress of 30% or More of SMYS

(1) DOT Regulation.

§ 192.505 Strength test requirements for steel pipeline to operate at a hoop stress of 30 percent or more of SMYS.

(a) Except for service lines, each segment of a steel pipeline that is to operate at a hoop stress of 30 percent or more of SMYS must be strength tested in accordance with this section to substantiate the proposed maximum allowable operating pressure. In addition, in a Class 1 or Class 2 location, if there is a building intended for human occupancy within 300 feet (91 meters) of a pipeline, a hydrostatic test must be conducted to a test pressure of at least 125 percent of maximum operating pressure on that segment of the pipeline within 300 feet (91 meters) of such a building, but in no event may the test section be less than 600 feet (183 meters) unless the length of the newly installed or relocated pipe is less than 600 feet (183 meters). However, if the buildings are evacuated while the hoop stress exceeds 50 percent of SMYS, air or inert gas may be used as the test medium.

(b) In a Class 1 or Class 2 location, each compressor station regulator station, and measuring station, must be tested to at least Class 3 location test requirements.

(c) Except as provided in paragraph (d) of this section, the strength test must be conducted by maintaining the pressure at or above the test pressure

[1] 49 CFR, 192.503(b)

[2] 49 CFR, 192.503 Guide Material(a)

for at least 8 hours.
(d) For fabricated units and short sections of pipe, for which a post installation test is impractical, a preinstallation strength test must be conducted by maintaining the pressure at or above the test pressure for at least 4 hours.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-85, 63 FR 37504, July 13, 1998; Amdt. 192-94, 69 FR 32895, June 14, 2004; Amdt. 195-94, 69 FR 54592, Sept. 9, 2004; Amdt. 192-120, 80 FR 12779, March 11, 2015]

(2) **Preliminary Considerations.**[3] The following preliminary considerations should be noted.

(a) Because of the requirements of 192.611 and the possibility of a change in class location, especially in Class 1 and Class 2 locations, a strength test to at least 90 percent SMYS is recommended.
(b) Pipelines and mains crossing highways and railroads may be tested in the same manner and to the same pressure as the pipeline on each side of the crossing.
(c) Fabricated assemblies (e.g., mainline valve assemblies, crossover connections, and river crossing headers) installed in pipelines in Class 1 locations may be tested as required for Class 1 locations (even though 192.111 requires a Class 2 design factor).
(d) Testing against closed valves is not recommended. Testing should include the use of test manifolds. Blinds (e.g., flanges or plates) should be used as necessary to minimize testing against any closed valves. Where valves exist in a test section, they should remain in the open or manufacturer's recommended position during the test. To ensure that air does not enter the gas system, testing with air against a closed valve that is connected to the gas system is not advisable.
(e) A single component with a valid ASME or MSS specification pressure rating may be installed without a pressure test. Rating examples are common designations, such as ASME Class 600. Corresponding temperature limits need to be considered for each pressure rating.

(3) **Selecting Test Procedure.**[4] The test procedure used should be selected after giving due consideration to items such as the following.

(a) Equipment to be used
(b) Test medium*
(c) Environment
(d) Elevation profile
(e) Volumetric content of the line
(f) Test pressure*

---

[3] 49 CFR, 192.505 Guide Material (1)
[4] 49 CFR, 192.505 Guide Material (2)

(g) Duration of the test*
(h) Location of the line
(i) The effects of temperature changes on the pressure of the test medium

*See 49 CFR Guide Material Appendix G-192-9

(4) Hydrostatic Test.[5]

- **Test Preparation**

  It is recommended that the pipeline segment to be tested be physically isolated from all other pipelines. Testing against closed valves is not recommended. Weld caps, blind flanges, or other devices of appropriate design should be utilized to seal pipe ends. It is also recommended that spheres or squeegees be inserted in the pipeline ahead of the water to reduce air entrapment while filling and to facilitate dewatering operations.

- **Test Evaluation**

  (a) General.

  In order that intelligent interpretation of pressure variations can be made, it is important that accurate thermometers, deadweight pressure gauges, meters, etc., be used and that the readings be taken at properly located points and at proper intervals of time. The use of a pressure-volume pilot is recommended for tests that are planned to approach SMYS.

[5] 49 CFR, 192.505 Guide Material (3)

(b) Small changes in pressure during hold period.

Experience has shown that a small steady decline in pressure often occurs during the hold period. This does not necessarily indicate the existence of a leak. Such declines can often be caused by a change in temperature of the test liquid, a small entrapment of air, or a leaking gauge connection. A pressure rise is usually caused by the warming of air trapped in the structure, the warming of the test liquid, or both. When an appreciable amount of pipe is exposed to the atmosphere (not backfilled) during the test, temperature effects are sometimes quite pronounced.

In the event of a small steady pressure decline, it is considered good practice to periodically add liquid, thereby maintaining the desired pressure until the hold period is completed. Likewise, it is also considered good practice to bleed off small quantities of test liquid to prevent exceeding the maximum selected pressure.

- **Locating Minor Leaks**

  When a hydrostatic strength proof test has been completed and there are indications of a minor leak which was not located during the test, the line may be filled with natural or other detectable gas at a pressure less than or equal to the maximum allowable operating pressure of the section of line being tested. Also, a suitable gas detection device (e.g., flame ionization analyzer, controlled catalytic combustion unit, infrared analyzer, or nitrous oxide detector) can be used to search for the leak.

- **Repairs**

  Temporary repairs may be made in order to not interrupt the test, and a permanent repair made after completing the test and before placing the line into service. If permanent repairs are made after the conclusion of the test using pretested pipe, the tie-in welds must be inspected in accordance with 192.241.

(5) **Air, Inert, or Natural Gas Test.**[6] Maximum hoop stress limitations are specified by 192.503(c). More stringent requirements after conducting such strength tests within 300 feet of buildings designed for human occupancy are specified by 192.505(a).

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[6] 49 CFR, 192.505 Guide Material (4)

- **Test Preparation**

  (a) It is recommended that the pipeline segment to be tested be physically isolated from all other pipelines. Testing against closed valves is not recommended. Weld caps, blind flanges, or other devices of appropriate design should be utilized to seal pipe ends.
  (b) Purging should be considered to prevent an explosive gas-air mixture in the test segment. Refer to 192.629 and 192.751 and the accompanying guide materials.
  (c) In order that intelligent interpretation of pressure variations can be made, it is important that accurate thermometers, deadweight gauges, meters, etc. be used and that the readings are taken at properly located points and at proper intervals of time.

- **Test Procedure**

  It is recommended that pressure in the test segment be applied in increments equal to 25 percent of the total test pressure. At the end of each incremental increase, the pressure should be maintained while the test segment is checked for leaks or other sources of rapid decline in pressure.

- **Locating Leaks**

  The location of leaks may be determined visually, by sound, by smell, or by utilizing leak detection equipment. The leak detection method to be used is dependent upon the test medium. Caution—multiple leaks may exist.

- **Repairs**

  It may be prudent to lower pressure in the test segment prior to exposing the pipe for repair. While temporary repairs may be made to accommodate the test, permanent repairs must satisfy requirements of 192.309, 192.711, 192.713, 192.715, or 192.717 as applicable.

(6) Test Conditions for Pipelines to Operate at a Hoop Stress of 30% or More of SMYS at all Pressures.[7]

	Other Than Plastic				Plastic
	Under 30% SMYS			**30% SMYS and Over**	
Maximum operating pressure	Less than 1 psig	1 psig but less than 100 psig	100 psig and over	**All pressures**	All pressures
Test Medium	Water Air Natural Gas Inert Gas	Water Air Natural Gas Inert Gas	Water Air Natural Gas Inert Gas See Note (1)	**Water Air Natural Gas Inert Gas**	Water Air Natural Gas Inert Gas See Note (2)
Maximum test pressure	See Note (3)	See Note (3)	See Note (3)	**See Note (3)**	3 x design pressure
Minimum test pressure	10 psig	90 psig	Maximum operating pressure multiplied by class location factor in 192.619(a)(2)(ii); See Notes (1) & (4)	**Maximum operating pressure multiplied by class location factor in 192.619(a)(2)(ii); See Notes (4) & (5)**	50 psig or 1.5 x maximum operating pressure, whichever is greater
Minimum test duration	See Note (6)	See Note (6)	1 Hour and see Notes (4) & (6)	**8 Hours and see Notes (6) & (7)**	See Notes (6) & (8)

Notes:

(1) Whenever test pressure is 20 percent SMYS or greater and natural gas, inert gas or air is the test medium, the line must be checked for leaks either by a leak test at a pressure greater than 100 psig but less than 20 percent SMYS or by walking the line while the pressure is held at 20 percent SMYS (192.507(b)).
(2) See temperature limitations for thermoplastic material in 192.513(d).
(3) Refer to 192.503(c) for limitations when testing with air, natural gas, or inert gas. There are no limitations for water test. For all test media, pipeline components must be taken into consideration when determining the maximum test pressure.
(4) Refer to 192.65(b) for pipe transported before November 12, 1970.
(5) Refer to 192.505(a) for testing criteria covering pipelines located within 300 feet of buildings and 192.505(b) covering compressor stations.
(6) Duration determined by volumetric content of test station, test medium, test pressure, thermal effects, leak criteria, and instrumentation in order to ensure discovery of all potentially hazardous leaks.
(7) Refer to 192.505(e) for fabricated units and short sections of pipe.
(8) See 4 of the guide material under 192.513.

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[7] 49 CFR, Guide Material Appendix G-192-9

Pressure Testing Gas Pipelines to Operate at a Hoop Stress Less than 30% of SMYS and At or Above 100 psig

(1) DOT Regulation.

§ 192.507 Test requirements for pipelines to operate at a hoop stress less than 30 percent of SMYS and at or above 100 p.s.i. (689 kPa) gage.

Except for service lines and plastic pipelines, each segment of a pipeline that is to be operated at a hoop stress less than 30 percent of SMYS and at or above 100 p.s.i. (689 kPa) gage must be tested in accordance with the following:

(a) The pipeline operator must use a test procedure that will ensure discovery of all potentially hazardous leaks in the segment being tested.

(b) If, during the test, the segment is to be stressed to 20 percent or more of SMYS and natural gas, inert gas, or air is the test medium—

(1) A leak test must be made at a pressure between 100 p.s.i. (689 kPa) gage and the pressure required to produce a hoop stress of 20 percent of SMYS; or

(2) The line must be walked to check for leaks while the hoop stress is held at approximately 20 percent of SMYS.

(c) The pressure must be maintained at or above the test pressure for at least 1 hour.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192–58, 53 FR 1635, Jan. 21, 1988; Amdt. 192–85, 63 FR 37504, July 13, 1998]

(2) Test Condition for Pipelines to Operate at a Hoop Stress Less than 30% of SMYS and at or Above 100 psig.[8]

	Other Than Plastic				Plastic
	Under 30% SMYS			30% SMYS and Over	
Maximum operating pressure	Less than 1 psig	1 psig but less than 100 psig	**100 psig and over**	All pressures	All pressures
Test Medium	Water Air Natural Gas Inert Gas	Water Air Natural Gas Inert Gas	**Water Air Natural Gas Inert Gas See Note (1)**	Water Air Natural Gas Inert Gas	Water Air Natural Gas Inert Gas See Note (2)
Maximum test pressure	See Note (3)	See Note (3)	**See Note (3)**	See Note (3)	3 x design pressure
Minimum test pressure	10 psig	90 psig	**Maximum operating pressure multiplied by class location factor in 192.619(a)(2)(ii); See Notes (1) & (4)**	Maximum operating pressure multiplied by class location factor in 192.619(a)(2)(ii); See Notes (4) & (5)	50 psig or 1.5 x maximum operating pressure, whichever is greater
Minimum test duration	See Note (6).	See Note (6)	**1 Hour and see Notes (4) & (6)**	8 Hours and see Notes (6) & (7)	See Notes (6) & (8)

Notes:

(1) Whenever test pressure is 20 percent SMYS or greater and natural gas, inert gas or air is the test medium, the line must be checked for leaks either by a leak test at a pressure greater than 100 psig but less than 20 percent SMYS or by walking the line while the pressure is held at 20 percent SMYS (192.507(b)).
(2) See temperature limitations for thermoplastic material in 192.513(d).
(3) Refer to 192.503(c) for limitations when testing with air, natural gas, or inert gas. There are no limitations for water test. For all test media, pipeline components must be taken into consideration when determining the maximum test pressure.
(4) Refer to 192.65(b) for pipe transported before November 12, 1970.
(5) Refer to 192.505(a) for testing criteria covering pipelines located within 300 feet of buildings and 192.505(b) covering compressor stations.
(6) Duration determined by volumetric content of test station, test medium, test pressure, thermal effects, leak criteria, and instrumentation in order to ensure discovery of all potentially hazardous leaks.
(7) Refer to 192.505(e) for fabricated units and short sections of pipe.
(8) See 4 of the guide material under 192.513.

[8] 49 CFR, Guide Material Appendix G-192-9

Pressure Testing Gas Pipelines to Operate Below 100 psig

(1) DOT Regulation.

§ 192.509 Test requirements for pipelines to operate below 100 p.s.i. (689 kPa) gage.

Except for service lines and plastic pipelines, each segment of a pipeline that is to be operated below 100 p.s.i. (689 kPa) gage must be leak tested in accordance with the following:

(a) The test procedure used must ensure discovery of all potentially hazardous leaks in the segment being tested.

(b) Each main that is to be operated at less than 1 p.s.i. (6.9 kPa) gage must be tested to at least 10 p.s.i. (69 kPa) gage and each main to be operated at or above 1 p.s.i. (6.9 kPa) gage must be tested to at least 90 p.s.i. (621 kPa) gage.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192-58, 53 FR 1635, Jan. 21, 1988; Amdt. 192-85, 63 FR 37504, July 13, 1998]

(2) Test Condition for Pipelines to Operate Below 100 psig.[9]

	Other Than Plastic				Plastic
	Under 30% SMYS			30% SMYS and Over	
Maximum operating pressure	**Less than 1 psig**	**1 psig but less than 100 psig**	100 psig and over	All pressures	All pressures
Test Medium	**Water Air Natural Gas Inert Gas**	**Water Air Natural Gas Inert Gas**	Water Air Natural Gas Inert Gas See Note (1)	Water Air Natural Gas Inert Gas	Water Air Natural Gas Inert Gas See Note (2)
Maximum test pressure	**See Note (3)**	**See Note (3)**	See Note (3)	See Note (3)	3 x design pressure
Minimum test pressure	**10 psig**	**90 psig**	Maximum operating pressure multiplied by class location factor in 192.619(a)(2)(ii); See Notes (1) & (4)	Maximum operating pressure multiplied by class location factor in 192.619(a)(2)(ii); See Notes (4) & (5)	50 psig or 1.5 x maximum operating pressure, whichever is greater
Minimum test duration	**See Note (6)**	**See Note (6)**	1 Hour and see Notes (4) & (6)	8 Hours and see Notes (6) & (7)	See Notes (6) & (8)

Notes:

(1) Whenever test pressure is 20 percent SMYS or greater and natural gas, inert gas or air is the test medium, the line must be checked for leaks either by a leak test at a pressure greater than 100 psig but less than 20 percent SMYS or by walking the line while the pressure is held at 20 percent SMYS (192.507(b)).

(2) See temperature limitations for thermoplastic material in 192.513(d).

(3) Refer to 192.503(c) for limitations when testing with air, natural gas, or inert gas. There are no limitations for water test. For all test media, pipeline components must be taken into consideration when determining the maximum test pressure.

(4) Refer to 192.65(b) for pipe transported before November 12, 1970.

(5) Refer to 192.505(a) for testing criteria covering pipelines located within 300 feet of buildings and 192.505(b) covering compressor stations.

(6) Duration determined by volumetric content of test station, test medium, test pressure, thermal effects, leak criteria, and instrumentation in order to ensure discovery of all potentially hazardous leaks.

(7) Refer to 192.505(e) for fabricated units and short sections of pipe.

(8) See 4 of the guide material under 192.513.

[9] 49 CFR, Guide Material Appendix G-192-9

REVIEW I

Identify Procedures Basic to Pressure Testing Pipelines (other than plastic)

Directions: Select from the list below the response that most correctly completes each of the following statements. Write the letter of your choice in the space provided.

A. inert
B. patrolled in a vehicle
C. 10 psig
D. is not required
E. cooling of the test medium
F. oxygen
G. walked
H. is required
I. 2 hours
J. 4 hours
K. ensure discovery of all leaks
L. 1 hour
M. 25
N. warming of the test medium
O. 15
P. physically isolated

A 1. When leak testing natural gas service lines with gas (other than natural gas), the gas must be ______.

D 2. According to 192.505, if a component such as a valve is the only item replaced or added to a pipeline, a strength test _____, if the manufacturer of the component certifies that the component carries a pressure rating established through applicable ASME/ANSI specifications.

C 3. According to 192.509, a steel main that is to be operated at less than 1 psig must be tested to a pressure of at least _____.

I 4. According to 192.505, a fabricated unit or short section of pipe, for which a post installation test is impractical, must have a pre-installation strength test and must be conducted by maintaining the pressure at or above the test pressure for at least _____.

K 5. According to 192.509, when leak testing a segment of steel pipeline that is to be operated below 100 psig, the test procedure used must _____.

L 6. According to 192.507, when performing a pressure test on a steel pipeline that is to be operated at a hoop stress of less than 30% SMYS and at or above 100 psig, the pressure must be maintained at or above the test pressure for at least _____.

A. inert
B. patrolled in a vehicle
C. 10 psig
D. is not required
E. cooling of the test medium
F. oxygen
G. walked
H. is required
I. 2 hours
J. 4 hours
K. ensure discovery of all leaks
L. 1 hour
M. 25
N. warming of the test medium
O. 15
P. physically isolated

G 7. A steel pipeline is to be operated at a hoop stress less than 30% of SMYS and at or above 100 psig. If, during the test, the segment is to be stressed to 20% SMYS or more using a non-liquid test medium, the line must be _____ to check for leaks while the hoop stress is held at approximately 20% SMYS.

P 8. When performing a hydrostatic test on a pipeline, it is recommended that the segment of pipeline being tested be _____.

M 9. When performing a pressure test utilizing air, inert or natural gas, it is recommended that pressure in the test segment be applied in increments equal to _____ percent of the total test pressure.

N 10. When performing a hydrostatic test on a segment of pipeline, a rise in pressure is usually caused by _____.

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INSTRUCTION SHEET II

Identify Procedures Basic to Pressure Testing Plastic Pipelines

49 CFR 192.513 requires that all plastic pipes installed for the distribution of gas must be pressure tested after construction and before placing into service. This is done to ensure the discovery of all potentially hazardous leaks in the piping system being tested.

Pressure Testing Plastic Pipelines

(1) DOT Regulation.

§ 192.513 Test requirements for plastic pipelines.

(a) Each segment of a plastic pipeline must be tested in accordance with this section.

(b) The test procedure must insure discovery of all potentially hazardous leaks in the segment being tested.

(c) The test pressure must be at least 150 percent of the maximum operating pressure or 50 p.s.i. (345 kPa) gage, whichever is greater. However, the maximum test pressure may not be more than three times the pressure determined under §192.121, at a temperature not less than the pipe temperature during the test.

(d) During the test, the temperature of thermoplastic material may not be more than 100°F (38°C), or the temperature at which the material's long-term hydrostatic strength has been determined under the listed specification, whichever is greater.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192–77, 61 FR 27793, June 3, 1996; 61 FR 45905, Aug. 30, 1996; Amdt. 192–85, 63 FR 37504, July 13, 1998]

(a) **Test Pressure.**[10] The test pressure for plastic pipelines used to transport natural gas must be at least 150 percent of the maximum operating pressure or 50 psig, whichever is greater.

(b) **Temperature During Test.** During the test, the temperature of the thermoplastic material may not be more than 100°F.

[10] 49 CFR, 192.513

(2) Test Conditions for Plastic Pipelines.[11] The table below is presented as a guide to the application of the test requirements of 49 CFR, 192.513. Always follow your company's operating and maintenance procedures.

	Other Than Plastic				**Plastic**
	Under 30% SMYS			30% SMYS and Over	
Maximum operating pressure	Less than 1 psig	1 psig but less than 100 psig	100 psig and over	All pressures	**All pressures**
Test Medium	Water Air Natural Gas Inert Gas	Water Air Natural Gas Inert Gas	Water Air Natural Gas Inert Gas See Note (1)	Water Air Natural Gas Inert Gas	**Water Air Natural Gas Inert Gas See Note (2)**
Maximum test pressure	See Note (3)	See Note (3)	See Note (3)	See Note (3)	**3 x design pressure**
Minimum test pressure	10 psig	90 psig	Maximum operating pressure multiplied by class location factor in 192.619(a)(2)(ii); See Notes (1) & (4)	Maximum operating pressure multiplied by class location factor in 192.619(a)(2)(ii); See Notes (4) & (5)	**50 psig or 1.5 x maximum operating pressure, whichever is greater**
Minimum test duration	See Note (6)	See Note (6)	1 Hour and see Notes (4) & (6)	8 Hours and see Notes (6) & (7)	**See Notes (6) & (8)**

Notes:

(1) Whenever test pressure is 20 percent SMYS or greater and natural gas, inert gas or air is the test medium, the line must be checked for leaks either by a leak test at a pressure greater than 100 psig but less than 20 percent SMYS or by walking the line while the pressure is held at 20 percent SMYS (192.507(b)).
(2) See temperature limitations for thermoplastic material in 192.513(d).
(3) Refer to 192.503(c) for limitations when testing with air, natural gas, or inert gas. There are no limitations for water test. For all test media, pipeline components must be taken into consideration when determining the maximum test pressure.
(4) Refer to 192.65(b) for pipe transported before November 12, 1970.
(5) Refer to 192.505(a) for testing criteria covering pipelines located within 300 feet of buildings and 192.505(b) covering compressor stations.
(6) Duration determined by volumetric content of test station, test medium, test pressure, thermal effects, leak criteria, and instrumentation in order to ensure discovery of all potentially hazardous leaks.
(7) Refer to 192.505(e) for fabricated units and short sections of pipe.
(8) See 4 of the guide material under 192.513.

[11] 49 CFR, Guide Material Appendix G-192-9

(3) **Joints.** The joints in the plastic piping should be set, cured, or hardened before the test is initiated.[12] When testing exposed joints a leak detection fluid, free of detergents, is recommended. The chemical resistance of the plastic to the fluid used should be considered.[13]

(4) **Odorant.**[14] Odorant in the liquid form may be detrimental to certain kinds of plastic and should not be used to locate leaks in plastic pipelines.

(5) **Temperature Limitations.**[15] The operator should ensure that piping being leak tested does not exceed the maximum temperature at which it has been qualified, as indicated by the markings on the pipe and fittings. The operator should consider the influence of ambient, test medium, and ground temperatures that can affect the pipe temperature during the test. Sunlight may significantly elevate the pipe temperature; black plastic pipe can exceed 140°F when exposed to direct sunlight. Some methods used to control or reduce temperatures during testing are as follows:

(a) Spraying the piping with water.
(b) Protecting the piping from direct sunlight.
(c) Placing the piping in the ditch to shade the piping.
(d) Performing the pressure test during the cooler parts of the day.

(6) **End Connections.**[16] When using compression type couplings to cap off and test plastic piping, the longitudinal resistance to pullout of the mechanical connectors must be considered.

Some mechanical couplings and end caps have built-in end load restraint. Joints utilizing other couplings and end caps must be provided with properly designed auxiliary restraint. Blocking, strapping, or other anchoring methods can be employed to prevent pullout at the pipe ends.

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[12] 49 CFR, 192.513 Guide Material (1)
[13] AGA Plastic Pipe Manual for Gas Service, 2006, p.93
[14] 49 CFR, 192.513 Guide Material (2)
[15] 49 CFR, 192.513 Guide Material (3)
[16] AGA Plastic Pipe Manual for Gas Service, 2006, p.93

REVIEW II

Identify Procedures Basic to Pressure Testing Plastic Pipelines

Directions: Select from the list below the response that most correctly completes each of the following statements. Write the letter of your choice in the space provided.

A. set, cured, or hardened	E. 100
B. 150	F. cooled
C. plastic	G. steel
D. 50	H. cast iron

__A__ 1. Prior to performing a leak test on a section of thermoplastic pipe, all pipe joints must be _____.

__D__ 2. The minimum test pressure when leak testing thermoplastic gas piping is _____ psig.

__E__ 3. When pressure testing plastic service lines the temperature of the thermoplastic material must not exceed _____ degrees F.

__C__ 4. Odorant in the liquid form may be detrimental to certain types of _____ pipe.

INSTRUCTION SHEET III

Identify Procedures Basic to Pressure Testing Service Lines

49 CFR 192.511 requires that all service lines installed for the distribution of gas must be leak tested before being placed in service. This is done to ensure the piping system is safe to operate.

Pressure Testing Service Lines

(1) DOT Regulation.

§ 192.511 Test requirements for service lines.

(a) Each segment of a service line (other than plastic) must be leak tested in accordance with this section before being placed in service. If feasible, the service line connection to the main must be included in the test; if not feasible, it must be given a leakage test at the operating pressure when placed in service.

(b) Each segment of a service line (other than plastic) intended to be operated at a pressure of at least 1 p.s.i. (6.9 kPa) gage but not more than 40 p.s.i. (276 kPa) gage must be given a leak test at a pressure of not less than 50 p.s.i. (345 kPa) gage.

(c) Each segment of a service line (other than plastic) intended to be operated at pressures of more than 40 p.s.i. (276 kPa) gage must be tested to at least 90 p.s.i. (621 kPa) gage, except that each segment of a steel service line stressed to 20 percent or more of SMYS must be tested in accordance with §192.507 of this subpart.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192–74, 61 FR 18517, Apr. 26, 1996; Amdt 192–85, 63 FR 37504, July 13, 1998]

(2) Test Conditions for Service Lines.[17] The table below is presented as a guide to the application of the test requirements of 49 CFR, 192.511. Always follow your company's operating and maintenance procedures.

	Other Than Plastic				Plastic
Maximum operating pressure	Less than 1 psig	1 psig To 40 psig	Over 40 psig but less than 100 psig	100 psig and over	0 to 100 psig
Test Medium	Water Air Natural Gas Inert Gas	Water Air Natural Gas Inert Gas	Water Air Natural Gas Inert Gas	Water Air Natural Gas Inert Gas	Water Air Natural Gas Inert Gas See Note (1)
Maximum test pressure	See Note (2)	See Note (2)	See Note (2)	See Note (2)	3 x design pressure
Minimum test pressure	See Note (3) 10 PSIG	50 psig	90 psig See Note (4)	1.5 x maximum operating pressure See Notes (4) & (5)	50 psig or 1.5 x maximum operating pressure, whichever is greater
Minimum test duration	See Note (6) 5 MIN	See Note (6) 5 MIN	See Notes (4) & (6)	See Notes (4) & (6)	See Notes (6) & (7)

Notes:

(1) See temperature limitations for thermoplastic material in 192.513(d).

(2) Refer to 192.503(c) for limitation when testing with air, natural gas or inert gas. Limited also to the design pressure of service line component (192.619).

(3) Recommended practice is a minimum of 10 psig.

(4) Whenever test pressure stresses pipe to 20 percent SMYS or more, see 192.507 and 192.511(c) for additional requirements.

(5) See 192.619 for Class 1 and Class 2 locations.

(6) Time duration to be sufficient to ensure discovery of all potentially hazardous leaks. Recommended practice is minimum of 5 minutes.

(7) See 4 of the guide material under 192.513.

(a) **Operating at Less Than 1 psig.** For an operating pressure of less than 1 psig, the minimum test pressure is 10 psig. The minimum test duration is 5 minutes with the pipe section being tested isolated from the pressure source.

(b) **Operating at 1 psig to 40 psig.** For an operating pressure of 1 psig to 40 psig the minimum test pressure is 50 psig. The minimum test duration is for a minimum of 5 minutes (a recommended practice) with the section of pipe being tested isolated from the pressure service.

[17] 49 CFR, 192.511 Guide Material Appendix G-192-10

(c) **Operating at Pressures Over 40 psig but less than 100 psig.** For an operating pressure over 40 psig but less than 100 psig, the minimum test pressure is 90 psig for a test duration of not less than 5 minutes with the section of pipe being tested isolated from the pressure service.

(3) **Testing Service Lines Equipped with Excess Flow Valves[18].**

PRESSURIZING THE SERVICE LINE

(a) When pressurizing a service line equipped with an excess flow valve (EFV) during either testing or service activation, the operator should introduce either the test medium or gas at a flow rate that does not activate the EFV. EFV activation may be indicated by a sudden increase in pressure as noted on a pressure gauge at the injection point or the lack of a rapid buildup of pressure at the service line riser. If activated, bypass-type EFVs (EFVB) should reset automatically; non-bypass types (EFVNB) should be reset following their manufacturer's instructions.

TESTING THE EFV

(b) Prior to service line testing or service activation, the operator may opt to test the EFV for shut-off by first introducing the test medium at a high flow rate. If the EFV does not operate as designed, it should be replaced.

Leak Testing Before Reinstating Service Lines

(1) **DOT Regulation.**

192.725 Test requirements for reinstating service lines.

(a) Except as provided in paragraph (b) of this section, each disconnected service line must be tested in the same manner as a new service line, before being reinstated.

(b) Each service line temporarily disconnected from the main must be tested from the point of disconnection to the service line valve in the same manner as a new service line, before reconnecting. However, if provisions are made to maintain continuous service, such as by installation of a bypass, any part of the original service line used to maintain continuous service need not be tested.

[18] 49 CFR, Guide Material Appendix G-192-10

(2) Conditions for Leak Testing Before Reinstating Service Lines.

(a) With the exception as noted in paragraph (b) of this section, each disconnected service line must be leak tested in the same manner as a new service line before being reinstated.[19]

(b) Each service line temporarily disconnected from the main must be tested from the point of disconnect to the service line valve in the same manner as a new service line, before reconnecting.[20]

(c) Any part of the original service line used to maintain continuous service need not be leak tested.[21]

Recognizing and Reacting to Abnormal Operating Conditions

Note:

The following Abnormal Operating Conditions (AOCs) and their reactions listed are for guidance only. This AOC list is not presented as an exhaustive treatment of AOCs and appropriate responses. You may be required to know and apply other AOCs and AOC responses for different tasks. Properly recognizing and reacting to covered task AOCs are the responsibility of persons qualified to perform the covered task. Always follow your company's policies and procedures.

Industrial Training Services, Inc. assumes no liability for any act or act of omission performed by the person seeking qualification under the pipeline operator's OQ program, or during the actual pipeline operations of the pipeline operator or any contractor performing work on the pipeline operator's pipeline system.

(1) Things to Consider When Responding to Abnormal Operating Conditions. The following information is basic knowledge that will assist you in assessing and responding to abnormal operating conditions:

(a) **Basic Properties of Natural Gas.**

- Natural gas is lighter than air, colorless, and odorless.
- Natural gas has a specific gravity of approximately 0.6.

[19] 49 CFR, 192.725(a)
[20] 49 CFR, 192.725(b)
[21] 49 CFR, 192.725(b)

- The natural gas Lower Explosive Limit (LEL) is approximately 5%.
- The natural gas Upper Explosive Limit (UEL) is approximately 15%.
- The ignition temperature of natural gas is about 1100°-1200° F.

(b) **Eliminating Ignition Sources.** Some of the ways to eliminate ignition sources are very obvious. For example:

- Smoking and open flames should be prohibited in structures or areas containing gas facilities where possible leakage or presence of gas constitutes a hazard of fire or explosion.
- Smoking and open flames should be prohibited in the open when accidental ignition of a gas-in-air mixture could cause personal injury or property damage.
- Do NOT smoke or use open flames near a jobsite/gas pipeline facility.
- Sparks range in temperature from 1500°F in an electrical switch to 9000°F in an arc welder. Do NOT use equipment or create situations that generate sparks. Sparks may be generated by the following conditions:
    - Communication equipment
    - Portable electrically powered tools and equipment
    - Internal combustion engines
    - Breaking electrical continuity
    - Static electricity on plastic pipe

(c) **Personal Protection Equipment.**

Always follow your company's policies and procedures for the use of personal protection equipment (PPE).

Working around gas pipeline facilities requires practical safety practices and basic PPE may include:

- Head protection (e.g., hard hat)
- Eye and face protection (e.g., goggles, face shield)
- Hearing protection (e.g., ear plugs, ear muffs)
- Hand protection (proper glove material for the specific job)
- Respiratory protection (proper respiratory equipment when air content is insufficient)

(2) Abnormal Operating Conditions for Testing Customer Gas Service Lines.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Uncontrolled escaping gas	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Accidental ignition	• Control fire and make area safe and notify appropriate personnel
• Unacceptable test results	• Isolate and pinpoint leak(s) and repair using an acceptable method, or, do not reestablish service until acceptable test results have been achieved
• When service line tests indicate leakage	• Isolate and pinpoint leak(s)
• When leaks are located	• Apply appropriate repair methods

REVIEW III

Identify Procedures Basic to Pressure Testing Service Lines

Directions: Select from the list below the response that most correctly completes each of the following statements. Write the letter of your choice in the space provided. Some answers may be used more than once.

A. set, cured, or hardened	G. in the same manner
B. 0.6	H. 50
C. 10	I. 100
D. 1.6	J. 75
E. service line valve	K. immediately
F. inert	L. 5

C 1. The minimum test pressure for a steel service line with an operating pressure of less than 1 psig is ______ psig.

H 2. The minimum test pressure for steel service lines with an operating pressure of 1 psig to 40 psig is ______ psig.

G 3. Each disconnected service line must be tested _____ as a new service line.

L 4. Based on GPTC recommendations, the minimum test duration for a steel service line with an operating pressure of 1 psig to 40 psig is ______ minutes.

A 5. Prior to performing a leak test on a section of thermoplastic pipe, all pipe joints must be _____.

B 6. The specific gravity of natural gas is _____.

H 7. The minimum test pressure when leak testing thermoplastic gas piping is _____ psig.

I 8. While pressure testing plastic service lines; the temperature of the thermoplastic material must not exceed _____ degrees F.

E 9. Service lines temporarily disconnected from the gas main are tested from the point of disconnect to the _____.

Knowledge Verification Checklist

OQ Task CM-3
Pressure Testing Gas Pipelines

Directions: Use the following performance criteria statements as a self-evaluation in preparation for the final exam.

I can identify:

- ❑ 1. The type of gas (other than natural gas), that must be used when leak testing service lines. (CM-3.1.1)
- ❑ 2. The pressure test duration requirements a fabricated unit or short section of pipe as outlined in 192.505. (CM-3.1.2)
- ❑ 3. A procedure that is recommended when performing a hydrostatic test on a segment of pipeline. (CM-3.1.3)
- ❑ 4. A cause for an increase in pressure on a segment of pipeline being hydrostatically tested. (CM-3.1.4)
- ❑ 5. The percent of total pressure to be applied in increments when pressurizing segments of a pipeline. (CM-3.1.5)
- ❑ 6. The pressure test duration requirements as outlined in 192.507. (CM-3.1.6)
- ❑ 7. The leak test requirements as outlined in 192.509. (CM-3.1.7)
- ❑ 8. The minimum test pressure when leak testing thermoplastic gas piping. (CM-3.2.1)
- ❑ 9. The maximum temperature at which thermoplastic can be tested under 49 CFR 192. (CM-3.2.2)
- ❑ 10. A physical condition that is essential in plastic pipe joints before performing a leak test. (CM-3.2.3)
- ❑ 11. The minimum test pressure for a service line (other than plastic) with an operating pressure of less than 1 psig. (CM-3.3.1)
- ❑ 12. The minimum test pressure for a service line (other than plastic) with an operating pressure of 1 psig to 40 psig. (CM-3.3.2)

I can identify:

- ☐ 13. The minimum test duration for a steel service line with an operating pressure of 1 psig to 40 psig according to GPTC recommendations. (CM-3.3.3)
- ☐ 14. A method used to test reinstated service lines. (CM-3.3.4)
- ☐ 15. The section of a temporarily disconnected service line to the main that must be leak tested before being reinstated. (CM-3.3.5)
- ☐ 16. The specific gravity of natural gas. (CM-3.3.6)

Skill and Ability Verification Packet

OQ Task CM-3
Pressure Testing Gas Pipelines

I. General Instructions

Instructions for Use

The Skill and Ability Verification Packet is designed to standardize conditions under which the employee demonstrates his/her performance of tasks that meet the operator qualification requirements established by the employee's company.

Completing the enclosed affidavit and uploading the data to Industrial Training Services OnBoard LMS for recordkeeping, documents the satisfactory completion of tasks. Both the OQ Authorized Evaluator (AE) and employee must sign the affidavit.

Instructions to the Employee

Your OQ AE will check your performance using the suggested evaluator guide included in each hands-on task assignment. This suggested guide must be supplemented or replaced by the individual company's policies and procedures related to the task being evaluated.

You must adhere to all safety precautions according to your company's policies and procedures and applicable federal, state, and local codes and regulations.

II. Task Information

OQ Task CM-3:	**Pressure Testing Gas Pipelines**
Qualification Standard:	The employee's qualification is based on the enabling operation(s) that have been successfully completed. The operations tasks are listed below:
OQ Task CM-3.1	Pressure Test: Nonliquid Medium – MAOP Less Than 100 psi. (B31Q 0561)
OQ Task CM-3.2	Pressure Test: Nonliquid Medium – MAOP Greater Than or Equal to 100 psi. (B31Q 0571)
OQ Task CM-3.3	Pressure Test: Liquid Medium. (B31Q 0581)
OQ Task CM-3.4	Leak Test at Operating Pressure. (B31Q 0591)
Recommended Requirement:	The employee must demonstrate proficiency to an acceptable level based on the Skill and Ability Checklist associated with each operation.
References:	49 CFR, Part 192.503, 192.505, 192.507, 192.509, 192.511, 192.513, 192.725. B31Q Tasks 0561, 0571, 0581, 0591.

Note:

The following Abnormal Operating Conditions (AOCs) and their reactions listed are for guidance only. This AOC list is not presented as an exhaustive treatment of AOCs and appropriate responses. You may be required to know and apply other AOCs and AOC responses for different tasks. Properly recognizing and reacting to covered task AOCs are the responsibility of persons qualified to perform the covered task. Always follow your company's policies and procedures.

Industrial Training Services, Inc. assumes no liability for any act or act of omission performed by the person seeking qualification under the pipeline operator's OQ program, or during the actual pipeline operations of the pipeline operator or any contractor performing work on the pipeline operator's pipeline system.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Uncontrolled escaping gas	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Accidental ignition	• Control fire and make area safe and notify appropriate personnel
• Unacceptable test results	• Isolate and pinpoint leak(s) and repair using an acceptable method, or, do not reestablish service until acceptable test results have been achieved
• When service line tests indicate leakage	• Isolate and pinpoint leak(s)
• When leaks are located	• Apply appropriate repair methods

III. Skill and Ability Verification Checklist

OQ Task CM-3
Pressure Testing Gas Pipelines

I verify that (Please Print) ____ is qualified to perform OQ Task CM-3 according to his/her company's procedures:

(CM-3.1) - Pressure Test: Nonliquid Medium - MAOP Less than 100 psi. (0561)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Prepare for test.
- ☐ Review the pressure test design.
  - duration of test
  - maximum/minimum test pressure
  - bleed-off/repressurize pressures
  - test medium
- ☐ Calibrate/certify/test equipment used to perform and monitor the test.
  - leak detection equipment
  - pressure gages
  - pressure-inducing equipment
- ☐ Perform leak test.
  - Install accurate test instruments at points that will provide required test data.
  - Install pressure-inducing equipment, and make connections to introduce the test medium into the facility.
  - Ensure isolation of the segment, component, or unit.
  - Introduce the test medium into the facility.
  - Increase pressure, making adjustments to compensate for temperature or other effects.
  - Maintain pressure and duration as specified.
  - Ensure inspection of pipe segment, fitting, component, or unit for leaks. (Utilize leak detection equipment, as appropriate.)
  - Collect/record test data, and log during test execution.
  - Depressurize the segment, component, or unit.
  - Remove isolation devices and test equipment.
- ☐ Make notifications, as appropriate.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• When leaks are located	• Apply appropriate repair methods

Comments / Additional Company Procedures:

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(CM-3.2) - Pressure Test: Nonliquid Medium – MAOP Greater Than or Equal to 100 psi. (0571)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Prepare for test.
  - Determine the type of pressure test.
    - strength test
    - leak test
  - Determine appropriate test pressure and duration.
  - Install pressure-inducing and test-monitoring equipment.
  - Isolate segment to be tested.
- ☐ Perform test. (Include data analysis, and check for leaks.)
  - Pressurize segment at a controlled rate.
  - Search for leaks by appropriate methods.
  - Maintain test pressure for established holding period.
  - Record test data.
  - Depressurize segment.
  - Remove isolation and test equipment.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Operating Conditions

(Not limited to the examples listed below)

Recognize	React
• When service line tests indicate leakage	• Isolate and pinpoint leak(s)
• When leaks are located	• Apply appropriate repair methods

Comments / Additional Company Procedures:

(CM-3.3) - Pressure Test: Liquid Medium. (0581)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Prepare for test.
- ☐ Review the pressure test design.
  - duration of test
  - maximum/minimum test pressure
  - bleed-off/repressurize pressures
  - liquid test medium
- ☐ Calibrate/certify/test equipment used to perform and monitor the test.
  - leak detection equipment
  - pressure gages
  - pressure-inducing equipment
- ☐ Perform leak test.
  - Install accurate test instruments at points that will provide required test data.
  - Install pressure-inducing equipment, and make connections to introduce the liquid test medium into the facility.
  - Ensure isolation of the segment, component, or unit.
  - Introduce liquid test medium into the facility in a manner that reduces air entrapment.
  - Increase pressure, making adjustments to compensate for temperature effects, air entrapment, etc.
  - Maintain pressure and duration as specified, adding liquid test medium to maintain pressure or bleeding off small quantities to avoid exceeding the maximum test pressure.
  - Inspect pipe segment, fitting, component, or unit for leaks. (Utilize leak detection equipment, as appropriate.)
  - Collect/record test data, and log during test execution.
  - Evacuate/drain/purge the segment, component, or unit.
  - Remove isolation devices and test equipment.
- ☐ Make appropriate notifications for remediation, as applicable.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Operating Conditions

(Not limited to the examples listed below)

Recognize	React
• When service line tests indicate leakage	• Isolate and pinpoint leak(s)
• When leaks are located	• Apply appropriate repair methods

Comments / Additional Company Procedures:

(CM-3.4) - Leak Test at Operating Pressure. (0591)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Calibrate/certify/test equipment or medium used to perform and monitor the test, as applicable.
  - leak detection equipment
  - pressure gages
  - soap or other medium
- ☐ Perform leak test.
  - Ensure inspection of pipe segment, fitting, component, or unit for leaks. (Utilize leak detection equipment or medium, as applicable.)
  - Collect/record test data, and log during test execution, as applicable.
- ☐ Make appropriate notifications for remediation, if applicable.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• When service line tests indicate leakage	• Isolate and pinpoint leak(s)
• When leaks are located	• Apply appropriate repair methods

Comments / Additional Company Procedures:

IV. Employer Record

OQ Task CM-3

Pressure Testing Gas Pipelines

Employee Information (Please Print):

Name ____

Last 4 Digits of Social Security Number _______________________

Company Name ______________________________________

Company Mailing Address _____________________________

City ______________________ State _________ Zip ____________

Affidavit

I acknowledge the performance of this task is solely for the purpose of operator qualification, and is not intended to replace or modify company operating procedures or policies and may not be appropriately used in all circumstances. I acknowledge that I am responsible for recognizing hazards and abnormal conditions in my work place and must exercise care and good judgment; always using appropriate equipment, procedures and tools for tasks I perform. Industrial Training Services, Inc. assumes no liability for my actions nor for my application of the qualification performance guides used in this evaluation checklist.

Employee's Signature ______________________ Date _____________

Evaluator Information (Please Print):

Name ____

Organization/Employer ______________________________

Telephone Number __________________________________

Affidavit

I affirm that I am the person who has administered this checklist and that I have conducted this assessment with integrity. I also affirm that the above named employee is the person assessed and that the above named person performed the tasks at the indicated level.

Evaluator's Signature ______________________ Date _____________

The employee is qualified according to company standards to perform the tasks listed below as indicated:

	Not Applicable	TASK/OPERATION	Method of Skill/Ability Verification Enter Number From List Below
1.	☐	(CM-3.1) Pressure Test: Nonliquid Medium – MAOP Less Than 100 psi. (0561)	☐
2.	☐	(CM-3.2) Pressure Test: Nonliquid Medium – MAOP Greater Than or Equal to 100 psi. (0571)	☐
3.	☐	(CM-3.3) Pressure Test: Liquid Medium. (0581)	☐
4.	☐	(CM-3.4) Leak Test at Operating Pressure. (0591)	☐

Method of Knowledge Verification

- Written Exam

Method of Skill/Ability Verification Observed During:

1. Performance on the Job
2. Simulation

After completion of Section IV, "Employer Record," remove section from the packet for your records. For third party verification and database reporting service, upload the data to Industrial Training Services OnBoard LMS.

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DANNY SAROUT

OQ Compliance Series
Student Manual

OQ Task CM-8
v11.2

Make Field Repairs on Gas Pipelines

ITS OQ Compliance Series

CM-8 Make Field Repairs on Gas Pipelines v11.2

Student Manual

INTRODUCTION

It is essential for gas system operating personnel to know and understand the proper safety precautions and correct repair procedures when making repairs on pipelines. To complete this module you will be required to complete the check-out activities listed below.

OBJECTIVE

1. Identify construction practices basic to repairing gas piping.

CHECK-OUT ACTIVITIES

Your instructor will provide you with a list of incomplete statements related to making field repairs on gas pipelines and a list of responses. Select the response that most correctly completes each statement. Cut-off score is 80%. (Knowledge Verification)

Your instructor will provide you with a Skill and Ability Verification Checklist. At the appropriate time demonstrate your skill and ability by correctly performing each operation required under the task. (Skill and Ability Verification)

OQ CM-8 covers requirements indicated in the following codes/regulations:

ITS OQ Covered Task:	ASME B-31 Q*	49 CFR 192**
OQ CM-8.1 Visual Inspection of Installed Pipe and Components for Mechanical Damage	0201	192.307
OQ CM-8.2 Measure and Characterize Mechanical Damage on Installed Pipe and Components	0211	
OQ CM-8.3 Visually Inspect Pipe and Components Prior to Installation	0641	
OQ CM-8.4 Install Mechanical Clamps and Sleeves: Bolted	1041	192.245, 192.309, 192.703, 192.711, 192.713, 192.717
OQ CM-8.5 Fit-up of Weld Type Repair Sleeves	1051	
OQ CM-8.6 Install Composite Sleeves	1061	
OQ CM-8.7 Repair of Steel Pipe by Grinding	1071	192.245, 192.309, 192.703, 192.711, 192.713, 192.715, 192.717
OQ CM-8.8 Squeeze Off Plastic Pipe	1141	192.311

*ASME B31Q Covered Tasks:

0201 Visual Inspection of Installed Pipe and Components for Mechanical Damage
0211 Measure and Characterize Mechanical Damage on Installed Pipe and Components
0641 Visually Inspect Pipe and Components Prior to Installation
1041 Install Mechanical Clamps and Sleeves: Bolted
1051 Fit-up of Weld Type Repair Sleeves
1061 Install Composite Sleeves
1071 Repair of Steel Pipe by Grinding
1141 Squeeze Off Plastic Pipe

**49 CFR Part 192 Covered Regulations:

49 CFR 192 covered regulations are identified within the appropriate section of this module.

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INSTRUCTION SHEET I

Identifying Construction Practices Basic to Repairing Gas Piping

Prior to repairing a pipeline, the operator should consider the operating conditions, design, and maintenance history as necessary to ensure that repair actions do not further damage the pipe. Where warranted, the operating pressure should be lowered, pipe exposure should be limited, access to the area should be limited, personnel protection should be provided, and fire-extinguishing equipment should be available.[1]

D.O.T. Requirements for the Repair of Steel Pipe

(1) Repair Procedures. DOT states the following:

§ 192.711 Transmission lines: General requirements for repair procedures.

(a) *Temporary repairs.* Each operator must take immediate temporary measures to protect the public whenever:

(1) A leak, imperfection, or damage that impairs its serviceability is found in a segment of steel transmission line operating at or above 40 percent of the SMYS; and
(2) It is not feasible to make a permanent repair at the time of discovery.

(b) *Permanent repairs.* An operator must make permanent repairs on its pipeline system according to the following:

(1) Non integrity management repairs: The operator must make permanent repairs as soon as feasible.
(2) Integrity management repairs: When an operator discovers a condition on a pipeline covered under Subpart O–Gas Transmission Pipeline Integrity Management, the operator must remediate the condition as prescribed by §192.933(d).

(c) *Welded patch.* Except as provided in §192.717(b)(3), no operator may use a welded patch as a means of repair.

[Amdt. 192–114, 75 FR 48604, Aug. 11, 2010]

[1] 49 CFR 192.703 GPTC Guide Material 2.1

(2) Repair Procedures on Steel Pipe. DOT 192.309 gives specific guidelines on identifying imperfections and damages on steel pipe that require repair. Not only does the pipeline operator visually inspect the installed pipe and components for mechanical damage (e.g. dents, gouges, cracks), but must also measure, investigate, and record the extent of damage. Make sure you use your company's policies and procedures for performing visual inspections, measuring, and recording pipeline damage and repairs.

DOT states the following:

§ 192.309 Repair of steel pipe.

(a) Each imperfection or damage that impairs the serviceability of a length of steel pipe must be repaired or removed. If a repair is made by grinding, the remaining wall thickness must at least be equal to either:

(1) The minimum thickness required by the tolerances in the specification to which the pipe was manufactured; or

(2) The nominal wall thickness required for the design pressure of the pipeline.

(b) Each of the following dents must be removed from steel pipe to be operated at a pressure that produces a hoop stress of 20 percent, or more, of SMYS, unless the dent is repaired by a method that reliable engineering tests and analyses show can permanently restore the serviceability of the pipe:

(1) A dent that contains a stress concentrator such as a scratch, gouge, groove, or arc burn.

(2) A dent that affects the longitudinal weld or a circumferential weld.

(3) In pipe to be operated at a pressure that produces a hoop stress of 40 percent or more of SMYS, a dent that has a depth of:

(i) More than1/4 inch (6.4 millimeters) in pipe 12 ¾ inches (324 millimeters) or less in outer diameter; or

(ii) More than 2 percent of the nominal pipe diameter in pipe over 12 ¾ inches (324 millimeters) in outer diameter.

For the purpose of this section a "dent" is a depression that produces a gross disturbance in the curvature of the pipe wall without reducing the pipe-wall thickness. The depth of a dent is measured as the gap between the lowest point of the dent and a prolongation of the original contour of the pipe.

(c) Each arc burn on steel pipe to be operated at a pressure that produces a hoop stress of 40 percent, or more, of SMYS must be repaired or removed. If a repair is made by grinding, the arc burn must be completely removed and the remaining wall thickness must be at least equal to either:

(1) The minimum wall thickness required by the tolerances in the specification to which the pipe was manufactured; or

(2) The nominal wall thickness required for the design pressure of the pipeline.

(d) A gouge, groove, arc burn, or dent may not be repaired by insert patching or by pounding out.
(e) Each gouge, groove, arc burn, or dent that is removed from a length of pipe must be removed by cutting out the damaged portion as a cylinder.

[35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192–1, 35 FR 17660, Nov. 17, 1970; Amdt. 192–85, 63 FR 37503, July 13, 1998; Amdt. 192–88, 64 FR 69664, Dec. 14, 1999]

(3) **Permanent Field Repair.** The DOT Standard for the permanent field repair of imperfections and damages on steel transmission lines is as follows:

§ 192.713 Transmission lines: permanent field repair of imperfections and damages.

(a) Each imperfection or damage that impairs the serviceability of pipe in a steel transmission line operating at or above 40 percent of SMYS must be--
  (1) Removed by cutting out and replacing a cylindrical piece of pipe; or
  (2) Repaired by a method that reliable engineering tests and analyses show can permanently restore the serviceability of the pipe.
(b) Operating pressure must be at a safe level during repair operations.

[Part 192 - Org., Aug. 19, 1970, as amended by Amdt. 192-27, 41 FR 34598, Aug. 16, 1976; Amdt. 192-88, 64 FR 69660, Dec. 14, 1999]

(4) **Inspection of Materials.** The DOT Standard for the inspection of materials prior to installation is as follows:

§ 192.307 Inspection of materials.

Each length of pipe and each other component must be visually inspected at the site of installation to ensure that it has not sustained any visually determinable damage that could impair its serviceability.

The inspection is to ensure the pipe has not sustained any visual determinable damage that could impair its serviceability.

Pipe and other components may be exposed to damage during the handling and transportation required to reach the installation location. Persons performing the visual inspection at the installation site should be alert for such damage. Also, care should be taken to prevent damage during installation.

Be on the alert for the following conditions:

- Gouged or grooved pipe
- Harmful gouges and grooves caused by the coating machine during a coating operation

- Lacerations of the protective coating that might include pipe surface damage
- All repairs, replacements, or changes should be inspected before they are covered

Making Permanent Field Repair of Welds

(1) Precautions. Precautions related to making field repairs on steel pipe include (a) welding practices, (b) care of the pipe, and (c) preventing accidental ignition.

> **§ 192.715 Transmission lines: Permanent field repair of welds.**
>
> Each weld that is unacceptable under §192.241(c) must be repaired as follows:
>
> (a) If it is feasible to take the segment of transmission line out of service, the weld must be repaired in accordance with the applicable requirements of §192.245.
> (b) A weld may be repaired in accordance with §192.245 while the segment of transmission line is in service if:
>
> (1) The weld is not leaking;
> (2) The pressure in the segment is reduced so that it does not produce a stress that is more than 20 percent of the SMYS of the pipe; and
> (3) Grinding of the defective area can be limited so that at least1/8-inch (3.2 millimeters) thickness in the pipe weld remains.
>
> (c) A defective weld which cannot be repaired in accordance with paragraph (a) or (b) of this section must be repaired by installing a full encirclement welded split sleeve of appropriate design.
>
> [35 FR 13257, Aug. 19, 1970, as amended by Amdt. 192–85, 63 FR 37504, July 13, 1998]

(a) Welding. Appropriate procedures for welding on steel pipelines in service should be used. Some important factors to be considered in these procedures are:

- The use of a low hydrogen welding process
- The welding sequence
- The effect of wall thickness
- Heat input
- The quenching effect of the gas flow

Welding should be done only on sound metal far enough from the defect so that the localized heating will not have an adverse effect on the defect. The soundness of the metal may be determined by visual and other nondestructive inspections.

(b) **Care of Pipe.** Care should be taken in excavating around the pipe so that it is not damaged. Also, pounding on the pipe (such as to remove corrosion products, pipe coating, or to improve the fit of a sleeve) should be avoided.[2]

(c) **Preventing Accidental Ignition.** To prevent arcing and the possible ignition of gas when a steel main is to be separated, install temporary bonding clamps across the area where the cut is to be made. This will allow a path for electrical current that could be on the main and will prevent an electric arc.

(2) Pipe Replacement. When replacing a section of pipe, the operator should consider the possibility that some degree of impairment may have occurred beyond the area of immediate concern. The impairment may be due to a defect in the longitudinal weld, external or internal corrosion, or damage by excavation equipment at another location when excavation work covers a large area. The pipe on each side of the known impairment should be examined to determine the extent of the replacement.[3]

(3) Repair or Removal of Weld Defects.

§ 192.245 Repair or Removal of Defects.

(a) Each weld that is unacceptable under §192.241(c) must be removed or repaired. Except for welds on an offshore pipeline being installed from a pipeline vessel, a weld must be removed if it has a crack that is more than 8 percent of the weld length.

(b) Each weld that is repaired must have the defect removed down to sound metal and the segment to be repaired must be preheated if conditions exist which would adversely affect the quality of the weld repair. After repair, the segment of the weld that was repaired must be inspected to ensure its acceptability.

(c) Repair of a crack, or of any defect in a previously repaired area must be in accordance with written weld repair procedures that have been qualified under §192.225. Repair procedures must provide that the minimum mechanical properties specified for the welding procedure used to make the original weld are met upon completion of the final weld repair.

[Amdt. 192–46, 48 FR 48674, Oct. 20, 1983]

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[2] 49 CFR 192.713 GPTC Guide Material 1.1 and 1.2
[3] 49 CFR 192.713 GPTC Guide Material 2

A qualified repair welding procedure is required to be used whenever a repair is made to a weld using a process different from that used to make the original weld or when repairs are made in a previously repaired area.[4]

Field Repair of Leaks

Repairs on piping may be classified by the following types:

(1) Temporary Repairs
(2) Permanent Repairs

(1) Temporary Repairs. A temporary repair is a provisional means of restoring a pipeline to operating conditions, but is not recognized to be installed for the remaining life of the facility. Temporary repairs include:

- A full encirclement bolt-on split sleeve installed over gouges, grooves, and injurious dents
- A bolt-on clamp or bolt-on sleeve installed over leaks and defective girth welds

§ 192.717 Transmission lines: Permanent field repair of leaks.

Each permanent field repair of a leak on a transmission line must be made by—
(a) Removing the leak by cutting out and replacing a cylindrical piece of pipe; or
(b) Repairing the leak by one of the following methods:
(1) Install a full encirclement welded split sleeve of appropriate design, unless the transmission line is joined by mechanical couplings and operates at less than 40 percent of SMYS.
(2) If the leak is due to a corrosion pit, install a properly designed bolt-on-leak clamp.
(3) If the leak is due to a corrosion pit and on pipe of not more than 40,000 psi (267 Mpa) SMYS, fillet weld over the pitted area a steel plate patch with rounded corners, of the same or greater thickness than the pipe, and not more than one-half of the diameter of the pipe in size.
(4) If the leak is on a submerged offshore pipeline or submerged pipeline in inland navigable waters, mechanically apply a full encirclement split sleeve of appropriate design.
(5) Apply a method that reliable engineering tests and analyses show can permanently restore the serviceability of the pipe.

[Amdt. 192–88, 64 FR 69665, Dec. 14, 1999]

(2) Permanent Repairs. A permanent repair becomes an integral piece of the pipeline and remains in service for the life of the facility.

[4] API Std 1104, Welding Pipelines and Related Facilities, Section 10, Repair and Removal of Defects

(a) **Replacement.** Permanent repair of a segment of pipeline should, where feasible, be made by removing the defective segment of pipe and replacing with piping material and/or devices as described in 192.717. All leaking welds should be eliminated by pipe replacement or a method that provides equal strength, protection, and a gas-tight condition.[5]

(b) **Alternate Methods.** Where replacement of pipe is not feasible for operating reasons, alternate methods of permanent repair may be used so long as they comply with the company recommended installation practice. For example:

- A full encirclement welded split sleeve should be constructed to fit as tightly as possible to the pipeline. The sleeve should be designed to withstand a pressure equal to or greater than the maximum allowable operating pressure of the pipeline on which it is installed.

- Grinding may be used to repair the pipeline if the defect is a shallow crack or gouge of the pipe wall. Removal of material by hand filing or power disk grinding constitutes a repair of a defect or imperfection if the stress-concentrating effect of the defect or imperfection is eliminated and the amount and distribution of metal removed does not significantly reduce the pressure-carrying capacity of the pipe. Many operators do not permit grinding to be used as a method of repair.[6]

- The sides or shoulders of the ground-out area should be smooth and uniformly contoured from the outside surface of the pipe wall to the depth of the ground area. No sharp or abrupt changes in contour should be allowed to remain within the ground area.

Identifying Commonly Used Pipe Repair Methods

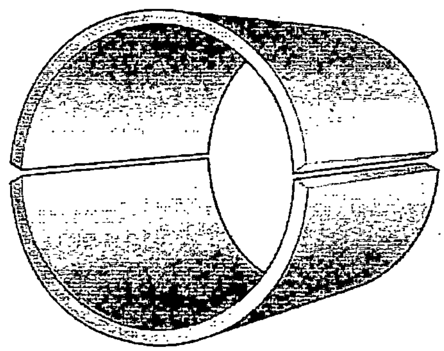
Commonly used pipe repair methods include the following:

(1) Full encirclement welded split sleeves
(2) Mechanical bolt-on clamps

(1) **Full Encirclement Welded Split Sleeves.** The full encirclement split sleeve, as illustrated in Figure 1, should have a strength at least equal to that

[5] 49 CFR 192.717
[6] PHMSA: U.S. DOT, Fact Sheet: Pipeline Repairs (Pipeline Safety Stakeholder Communications).

required for the maximum allowable operating pressure of the repaired pipe.[7] The end welds should be capable of withstanding the anticipated stress, both circumferential and longitudinal, including stress due to external loading. Full encirclement sleeves should not be less than 4-inches in length. When determining the length of the sleeve, the operator should consider that some degree of impairment may have occurred beyond the area of immediate concern.



Courtesy of Dresser

Figure 1. Full Encirclement Welding Split Sleeve

A wide variety of sleeve designs have been used successfully in the natural gas pipeline industry. Sleeves may be used to reduce stress or reinforce a pipe defect that is not leaking or to repair a leaking defect.[8]

(a) **Fillet Welds.** Fillet welds on pressurized carrier piping are prone to cracking due to the extreme cooling action. Examination of completed welds by radiographic or ultrasonic means may not detect such cracking due to the geometry of the fillet weld. Therefore, the following is recommended:

- Use of low-hydrogen welding processes;
- Employment of multi-pass welding techniques with visual examination after each pass; and
- If visual examination indicates further nondestructive inspection is necessary, either magnetic particle or liquid penetrant inspection may be used.[9]

(b) **Repair Pressure.** In establishing a safe level of pressure in a pipeline that is to remain in service during the installation of a full encirclement welded split sleeve, the primary consideration is the severity of the defect to be repaired. This includes consideration of both depth and

[7] 49 CFR 192.717 GPTC Guide Material 3.3(a)
[8] 49 CFR 192.713 GPTC Guide Material 3.1
[9] 49 CFR 192.713 GPTC Guide Material 3.2

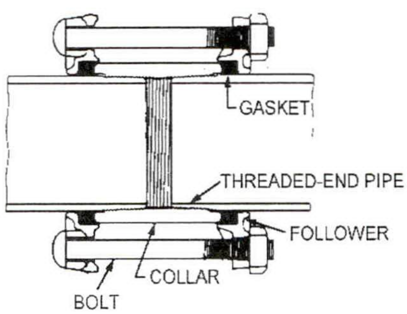
geometry (e.g., the amount of stress concentration, such as in sharp bottomed gouges). Severe defects should not be repaired under pressure unless the operator has sufficient experience to make a sound evaluation of the defect. In addition, the effect of any known secondary stresses should be considered.[10]

(2) **Mechanical Bolt-On Clamps.** Mechanical bolt-on clamps include:

(a) Collar clamps
(b) Porous weld clamps
(c) Band clamps
(d) Bell-pack sleeves

(a) **Collar Clamps.** Collar clamps are designed to stop leaks through the threads of screw collars (threaded couplings). Repairs are positive and permanent, normally made without interrupting service or dismantling the line.

Clamps in most sizes can be used on collars of the latest American Pipe Institute (API) standards. In case of doubt as to the correct clamps, check with the manufacturer, giving pipe or casing size, over-all diameter, and length of collar to be clamped. A collar clamp installation is illustrated in Figure 2.

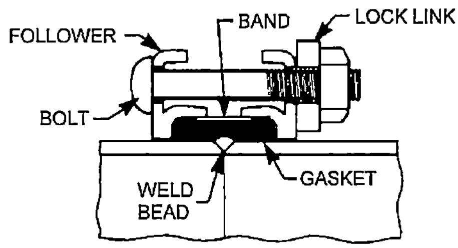


Courtesy of Dresser

Figure 2. Collar Clamp Installation

(b) **Porous Weld Clamps.** Porous weld clamps are designed to be used when repairing leaking circumferential pipe welds, small pinholes, and leaks in steel pipe. A porous weld clamp installation is illustrated in Figure 3.

[10] 49 CFR 192.713 GPTC Guide Material 4.1



Courtesy of Dresser

Figure 3. Porous Weld Clamp Installation

(c) **Band Clamp.** Band clamps are designed for repairing small pinhole leaks, corroded areas, and pits in straight runs of steel pipe. They are suitable for practically all working pressures and line contents.

Each band clamp consists of a flexible one-piece circular steel band, as illustrated in Figure 4. The steel band is sprung apart to fit over the pipe and rubber gasket. There are no bending stresses on the bolt.

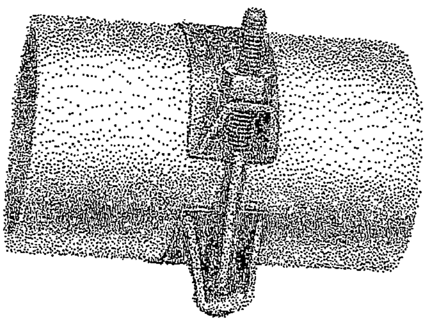


Figure 4.
Band Clamp Installation
Courtesy Of Dresser

Installation Procedure:

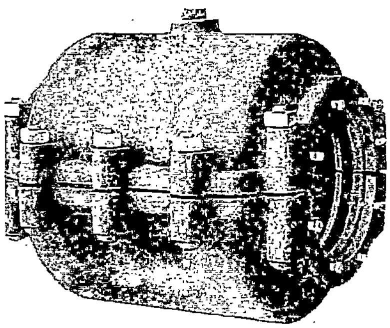
Step 1: Clean pipe to bare metal.

Step 2: Snap the clamp around the pipe.

Step 3: Drop the bolt head through open slotted lug and tighten the nuts.

Step 4: Test for leaks according to company procedures.

(d) **Bell-Pack Sleeve.** A split bell or leaking joint presents one of the more difficult maintenance problems. The Bell-Pack Sleeve, illustrated in Figure 5, can be used for temporary makeshift repairs and to avoid time-consuming and costly shutdowns.



Courtesy of Dresser

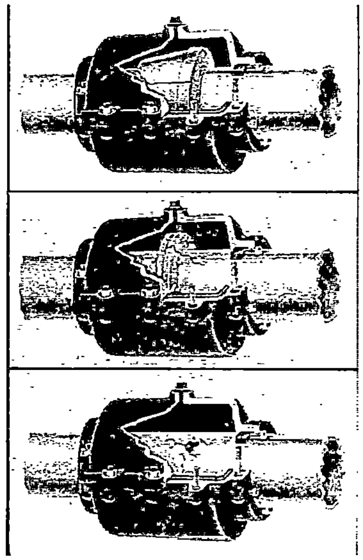


Figure 5. Bell-Pack Sleeve

Composite Sleeves[11]

When properly installed, the composite sleeve wrap is a permanent pipeline repair that restores the pressure-containing capability of the pipe. This type of repair is suitable for non-leaking defects such as pits, dents, gouges, and external corrosion. Defects of up to 80% loss of wall thickness can be repaired with composite wrap. Composite wrap can be performed on an operating pipeline without taking it out of service.

When considering the use of composite wrap, important decision factors include:

- Depth and length of wall loss or deformation
- Yield strength
- Defect depth
- Defect axial length
- Pipeline diameter
- Wall thickness
- Pipeline operating pressure

Detailed field measurements are needed to make a final decision as to whether composite wraps will restore the pipe to American Society of Mechanical Engineers (ASME) standards.

Composite wrap systems use different materials for wraps and adhesives, and some systems use epoxy polymers and curing agents. Examples include Clock Spring®, StrongBack, Power Sleeve™, Armor Plate®, and PermaWrap™.

[11] US Environmental Protection Agency, Natural Gas STAR, "Composite Wrap for Non-Leaking Pipeline Defects."

The following list outlines the basic procedure for installing a composite wrap/reinforcement system and is to be used for discussion purposes only. Always follow your company's policies and procedures and the specific manufacturer's instructions.

- Characterize the defect to determine a suitable repair.
- Use appropriate personal protection equipment and make sure all equipment and supplies are available (e.g. primer, banding, spreader, starter pad, adhesive, filler, gloves, safety glasses, mixing sticks, brushes, UV protective paint, topcoat, etc.).
- Prepare the pipe surface for repair by removing any pipe coating, corrosion residue, primer or adhesive.
- Appropriately mark the entire repair area.
- Install/apply composite wrap or reinforcement system according to the specific manufacturer's instructions.
- Seal and coat all edges, seams, piping and let cure according to instructions.

Repair and Replacement of Plastic Pipe

> **§ 192.311 Repair of plastic pipe.**
>
> Each imperfection or damage that would impair the serviceability of plastic pipe must be repaired or removed.
>
> [Amdt. 192–93, 68 FR 53900, Sept. 15, 2003]

It will be necessary to replace or repair polyethylene piping on occasion. The more common occurrences will be during installation prior to initiating service and because of mechanical damage by others once in service. The repair or replacement must be made in accordance with requirements of:

> **192.703 General.**
>
> (a) No person may operate a segment of pipeline, unless it is maintained in accordance with this subpart.
> (b) Each segment of pipeline that becomes unsafe must be replaced, repaired, or removed from service.
> (c) Hazardous leaks must be repaired promptly.

Mechanical couplings appropriate for plastic gas piping systems are frequently used for economical and convenient replacement of damaged plastic pipe segments. The flow is stopped, the damaged section cutout and replaced with a new segment using either two mechanical couplings, a fusion joint, and a mechanical coupling; or a single mechanical coupling of the slide type or elongated repair fitting type that facilitates replacement of the damaged section. Joints fabricated from mechanical fittings used in replacement must be designed to restrain the pipe against pullout forces and, if metallic fittings are utilized, be protected from corrosion.[12]

According to PHMSA 192.1009, each operator must report, on an annual basis, information related to failure of compression couplings, excluding those that result only in non-hazardous leaks, as part of the annual report required by §191.11, beginning with the report submitted March 15, 2011. This information must include, at a minimum, location of the failure in the system, nominal pipe size, material type, nature of failure including any contribution of local pipeline environment, coupling manufacturer, lot number and date of manufacture, and other information that can be found in markings on the failed coupling. An operator also must report this information to the state pipeline safety authority if a state exercises jurisdiction over the operator's pipeline.[13]

Full-encirclement-type band clamps are recommended for repairs only where the pipe is able to maintain its structural integrity. These clamps are not recommended for permanent repair of pipe where the damage could propagate outside the clamp under anticipated field conditions. In such situations, cut out and replace the damaged pipe with a new piece of pipe.[14]

Squeeze-Off Procedure

Using approved tools, plastic pipe can be safely and effectively "squeezed-off" to stop the flow of gas.

- Before thermoplastic pipe is squeezed-off and reopened, investigations and tests should be made to determine that the particular type, grade, size, and wall thickness of pipe of the same manufacturer can be squeezed-off and reopened without causing failure under the conditions that will prevail at the time of the squeeze-off and reopening. References for squeeze-off procedures, tools, and precautions are included in the following:
    - AGA XR0104, "Plastic Pipe Manual for Gas Service."
    - GRI-92/0147.1, "User's Guide on Squeeze-Off of Polyethylene Gas Pipes."

[12] 49 CFR 192.281 GPTC Guide Material 3.5(d)
[13] 49 CFR 192.1009, Subpart P, "Gas Distribution Pipeline Integrity Management."
[14] ASTM Standard F 1025.4.1 (2009)

- GRI-94/0205, "Guidelines and Technical Reference on Gas Flow Shut-Off in Polyethylene Pipes Using Squeeze Tools."
- ASTM F 1041, Standard Guide for Squeeze-Off of Polyolefin Gas Pressure Pipe and Tubing."
- ASTM F 1563, "Standard Specification for Tools to Squeeze-Off Polyethylene (PE) Gas Pipe or Tubing."

- Procedures that meet ASTM F 1041 should be used.[15]

- The work should be done utilizing equipment and procedures that have been established and proven by test to be capable of performing the operation safely and effectively.[16]

- Unless it has been determined by investigation and test that squeeze-off and reopening does not significantly affect the long-term properties of the pipe, the squeezed-off and reopened area of the pipe should be reinforced in accordance with the guide material under 192.311.[17]

- When squeezing-off plastic pipe to stop the flow of gas, a static charge of electricity tends to build up at the point of squeeze-off. To discharge static electricity on the pipe, spray the exposed pipe with anti-static spray or a mixture of soapy water. Wrap the pipe with wet burlap from the ground to the point of squeeze-off in both directions. Make sure the wet burlap material is touching the ground on both sides of the bell hole. This procedure is illustrated in Figure 14.[18]

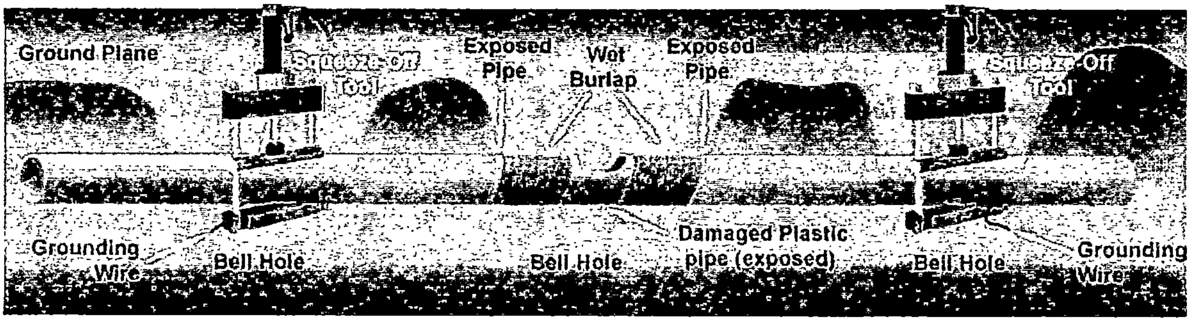


Figure 14. Squeezing-Off Plastic Pipe

- Closing and opening rates are key elements to squeezing-off without damaging the pipe. It is necessary to close slowly and release slowly, with slow release being more important. The pipe must be allowed sufficient time to adjust to the

[15] American Gas Association, AGA Plastic Pipe Manual for Gas Service, 8th Edition, 2006
[16] 49 CFR 192.321 GPTC Guide Material 5.2(a)
[17] 49 CFR 192.321 GPTC Guide Material 5.2(b)
[18] American Gas Association, AGA Plastic Pipe Manual for Gas Service, 8th Edition, 2006, "Static Electricity," pg. 98-99

high compressive and tensile stresses applied to the pipe's inside wall during squeeze-off. Low temperatures will reduce material flexibility and ductility, meaning closing and opening times must be slowed further.[19]

- Use a cold ring clamp to check for roundness after the pipe has been squeezed-off.

- Do not squeeze-off plastic pipe more than once in the same location. Wrap a piece of tape or install a band clamp around the pipe at the squeeze-off point to mark the area affected by the squeeze-off. The squeeze-off location should also be recorded.[20]

- Always follow proper safety procedures. Keep an approved fire extinguisher available when making repairs and installations where gas is or may become present. Always wear appropriate PPE and follow your company's policies and procedures.

- When working in a gaseous atmosphere, all tools (such as squeeze-off tools) must be properly grounded with a wire or braided strap and rod to reduce the potential of static discharge.

- Additional precautions recommended by the American Gas Association (2006) when working with gas filled plastic pipe are:

    - Wrap the entire circumferential area of exposed piping with wet, soapy rags made of burlap or other non-synthetic material from the ground to the pipe to the ground. Do not permit the material to dry out.
    - If gas is already present, the pipe should be wet with anti-static spray or a diluted solution of liquid soap suitable for use (within manufacturer's recommendations) with plastic starting from the ground end. The tape should then be applied immediately and left in place.
    - The tape should be kept wet by occasional applications of solution. Where ambient temperatures below 0°C (32°F) are encountered, forms of glycol (typically known as varieties of antifreeze) may be added to the water to prevent freezing. The tape should be grounded with a metal pin driven into the ground.
    - Do not vent gas using ungrounded plastic pipe or tubing. Even with grounded metal piping, venting gas with high scale or dust content could generate a charge in the gas itself and could result in an arc from the dusty gas cloud back to the pipe and ignition. Venting should be done at a downwind location remote from personnel or other flammable material.
    - Do not vent gas or purge using ungrounded plastic pipe or tubing. **Ground all tools and remove potential sources of ignition.**

[19] American Gas Association, AGA Plastic Pipe Manual for Gas Service, 8th Edition, 2006, "Squeeze Off," pg. 97
[20] 49 CFR-192.321 GPTC Guide Material 5.2(c)

- In all cases, appropriate personal protective equipment (PPE), such as flame-resistant clothing treated to avoid static buildup and respiratory equipment, should be used.
- Commercially available electrostatic discharger systems may be considered as a means of eliminating static electricity from both the inside and outside of the PE pipe.[21]

Recognizing and Reacting to Abnormal Operating Conditions

> **Note:**
>
> The following Abnormal Operating Conditions (AOCs) and their reactions listed are for guidance only. This AOC list is not presented as an exhaustive treatment of AOCs and appropriate responses. You may be required to know and apply other AOCs and AOC responses for different tasks. Properly recognizing and reacting to covered task AOCs are the responsibility of persons qualified to perform the covered task. Always follow your company's policies and procedures.
>
> Industrial Training Services, Inc. assumes no liability for any act or act of omission performed by the person seeking qualification under the pipeline operator's OQ program, or during the actual pipeline operations of the pipeline operator or any contractor performing work on the pipeline operator's pipeline system.

(1) **Things to Consider When Responding to Abnormal Operating Conditions.** The following information is basic knowledge that will assist you in assessing and responding to abnormal operating conditions:

(a) **Basic Properties of Natural Gas.**

- Natural gas is lighter than air, colorless and odorless.
- Natural gas has a specific gravity of approximately 0.6.
- The natural gas Lower Explosive Limit (LEL) is approximately 5%.
- The natural gas Upper Explosive Limit (UEL) is approximately 15%.
- The ignition temperature of natural gas is about 1100°-1200° F.

(b) **Eliminating Ignition Sources.** Some of the ways to eliminate ignition sources are very obvious. For example:

- Smoking and open flames should be prohibited in structures or areas containing gas facilities where possible leakage or presence of gas constitutes a hazard of fire or explosion.
- Smoking and open flames should be prohibited in the open when accidental ignition of a gas-in-air mixture could cause personal injury or property damage.

[21] American Gas Association, AGA Plastic Pipe Manual for Gas Service, 8th Edition, 2006, "Static Electricity," pg. 98-99.

- Do NOT smoke or use open flames near a jobsite/gas pipeline facility.
- Sparks range in temperature from 1500°F in an electrical switch to 9,000°F in an arc welder. Do NOT use equipment or create situations that generate sparks. Sparks may be generated by the following conditions:
  - Communication equipment
  - Portable electrically powered tools and equipment
  - Internal combustion engines
  - Breaking electrical continuity
  - Static electricity on plastic pipe

(c) Personal Protection Equipment.

Always follow your company's policies and procedures for the use of personal protection equipment (PPE).

Working around gas pipeline facilities requires practical safety practices and basic PPE may include:

- Head protection (e.g. hard hat)
- Eye and face protection (e.g. goggles, face shield, etc.)
- Hearing protection (e.g. ear plugs, ear muffs, etc.)
- Hand protection (proper glove material for the specific job)
- Respiratory protection (proper respiratory equipment when air content is insufficient)

(2) Abnormal Operating Conditions.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Uncontrolled escaping gas	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Accidental ignition	• Control fire and make area safe and notify appropriate personnel
• Potential ignition sources	• Prevent/control sources of ignition
• Unacceptable visual inspection	• Repair; or do not establish service
• Unacceptable pressure test	• Repair; or do not establish service
• Installation not performed by a qualified individual	• Do not establish service and notify appropriate personnel
• Damaged pipe or coating	• Repair or replace
• Fitting defect	• Replace fitting

REVIEW I

Identifying Construction Practices Basic to Repairing Gas Piping

Directions: Select from the list below the response that most correctly completes each of the following statements. Write the letter of your choice in the space provided.

A. at a safe level
B. pounding
C. visually inspected
D. qualified welding procedure
E. grounded
F. water and dishwasher-type detergent
G. removing and replacing
H. corrosion
I. nominal wall thickness required for the design pressure of the pipeline
J. collar clamp
K. dent
L. 4
M. temporary clamps with bonding cable
N. band clamp
O. 1
P. abnormal operating conditions
Q. take immediate temporary measure to protect the public
R. in service
S. 80

_K_ 1. A depression in the surface of the pipe that produces a gross disturbance in the curvature of the pipe without reducing the pipe wall thickness is referred to as a _____.

_Q_ 2. When damage that impairs the serviceability of a transmission line, operating at or above 40 percent of the SMYS is found, the operator should _____.

_I_ 3. When grinding is used to repair damage, the remaining wall thickness of the pipe must be at least equal to the _____.

_A_ 4. According to 49 CFR 192.713, during a permanent field repair on a steel transmission line, the operating pressure must be _____.

_S_ 5. Defects up to _____% loss of wall thickness can be repaired with composite wraps.

_B_ 6. When removing corrosion products or pipe coating, _____ on the pipe should be avoided.

_M_ 7. To prevent arcing and the possible ignition of gas when a steel main is to be separated, you must install _____ across the area where the cut is to be made.

_R_ 8. A pipeline can be repaired while _____ when using a composite wrap.

A. at a safe level
B. pounding
C. visually inspected
D. qualified welding procedure
E. grounded
F. water and dishwasher-type detergent
G. removing and replacing
H. corrosion
I. nominal wall thickness required for the design pressure of the pipeline
J. collar clamp
K. dent
L. 4
M. temporary clamps with bonding cable
N. band clamp
O. 1
P. abnormal operating conditions
Q. take immediate temporary measure to protect the public
R. in service
S. 80

L 9. Full encirclement sleeves should not be less than _____ inches in length.

H 10. When metallic fittings are used in the replacement of a section of plastic piping, the fitting must be protected from _____.

D 11. When repairing a weld, a _____ is required if the repair is made using a process different from the one used to make the original weld.

O 12. Do not squeeze-off plastic more than _____ time(s) in the same location.

E 13. When working in a gaseous atmosphere, all tools must be properly _____ with a wire or braided strap and rod to reduce the potential of static discharge.

F 14. A method used to control static charges on plastic pipe is to wet the pipe with anti-static spray or _____.

G 15. According to DOT 192.717, one method for permanent repair of a leaking segment of pipeline is that the repair should be made by _____ the leaking segment.

C 16. Each length of pipe and each other component must be ______ at the site of installation.

N 17. A repair device designed to stop small pinhole leaks on steel pipe is the ______.

Directions: Complete the following statement by filling in the blanks provided.

18. List some abnormal operating conditions associated with making permanent repairs on natural gas pipelines.

____

____

____

____

____

____

____

____

Knowledge Verification Checklist

OQ Task CM-8
Make Field Repairs on Gas Pipelines

Directions: Use the following performance criteria statements as a self-evaluation in preparation for the final exam.

I can identify:

- ❑ 1. The action an operator must take immediately when damage is found that impairs the serviceability of a transmission line that operates at or above 40 percent of SMYS. (CM-8.1.1)
- ❑ 2. The remaining wall thickness required of a length of steel pipe that has been repaired by grinding. (CM-8.1.2)
- ❑ 3. The meaning of the term dent as related to the wall of a pipe. (CM-8.2.3)
- ❑ 4. The required operating pressure level on a steel transmission pipeline during repair operations. (CM-8.1.4)
- ❑ 5. The inspection requirements for the installation of gas steel piping according to CFR 192.307. (CM-8.1.5)
- ❑ 6. The practices that should be avoided when excavating around a steel pipe. (CM-8.1.6)
- ❑ 7. The action taken to prevent arcing and possible ignition of gas when a steel main is to be separated. (CM-8.1.7)
- ❑ 8. The conditions a qualified welding process is required when repairing a weld on a pipeline. (CM-8.1.8)
- ❑ 9. The requirements of DOT 192.717 regarding permanent field repair of leaks. (CM-8.1.9)
- ❑ 10. The minimum length of a full encirclement sleeve. (CM-8.1.10)
- ❑ 11. The designed use for band clamps. (CM-8.1.11)
- ❑ 12. The percentage of wall loss allowable when making pipeline repairs with composite wraps. (CM-8.1.12)

I can identify:

- ❑ 13. The pipeline service when performing a repair with a composite wrap/sleeve. (CM-8.1.13)
- ❑ 14. The protection that is required when metallic fittings are used to join plastic pipe. (CM-8.1.14)
- ❑ 15. The method used to control static charges on plastic pipe. (CM-8.1.15)
- ❑ 16. The number of squeeze offs allowed on a pipeline in one location. (CM-8.1.16)
- ❑ 17. A safe procedure practiced when squeeze off tools are used in a gaseous atmosphere. (CM-8.1.17)
- ❑ 18. An abnormal operating condition associated with making permanent repairs on natural gas pipelines. (CM-8.1.18)

Skill and Ability Verification Packet

OQ Task CM-8
Make Field Repairs on Gas Pipelines

I. General Instructions

Instructions for Use

The Skill and Ability Verification Packet is designed to standardize conditions under which the employee demonstrates his/her performance of tasks that meet the operator qualification requirements established by the employee's company.

Completing the enclosed affidavit and uploading the data to Industrial Training Services OnBoard LMS for recordkeeping, documents the satisfactory completion of tasks. Both the OQ Authorized Evaluator (AE) and employee must sign the affidavit.

Instructions to the Employee

Your OQ AE will check your performance using the suggested evaluator guide included in each hands-on task assignment. This suggested guide must be supplemented or replaced by the individual company's policies and procedures related to the task being evaluated.

You must adhere to all safety precautions according to your company's policies and procedures and applicable federal, state, and local codes and regulations.

II. Task Information

OQ Task CM-8:	**Make Field Repairs on Gas Pipelines**
Qualification Standard:	The employee's qualification is based on the enabling operation(s) that have been successfully completed. The operation's tasks are listed below:
OQ CM-8.1:	Visual Inspection of Installed Pipe and Components for Mechanical Damage. (B31Q 0201)
OQ CM-8.2:	Measure and Characterize Mechanical Damage on Installed Pipe and Components. (B31Q 0211)
OQ CM-8.3:	Visually Inspect Pipe and Components Prior to Installation. (B31Q 0641)
OQ CM-8.4:	Install Mechanical Clamps and Sleeves: Bolted. (B31Q 1041)
OQ CM-8.5:	Fit-Up of Weld Type Repair Sleeves. (B31Q 1051)
OQ CM-8.6:	Install Composite Sleeves. (B31Q 1061)
OQ CM-8.7:	Repair of Steel Pipe by Grinding. (B31Q 1071)
OQ CM-8.8:	Squeeze Off Plastic Pipe. (B31Q 1141)
Recommended Requirement:	The employee must demonstrate proficiency to an acceptable level based on the Skill and Ability Checklist associated with each operation.
References:	49 CFR, Part 192.245, 192.307, 192.309, 192.311, 192.703, 192.711, 192.713, 192.715, 192.717. B31Q Tasks 0201, 0641, 0841, 1041 1051, 1061, 1071, 1141.

Note:

The following Abnormal Operating Conditions (AOCs) and their reactions listed are for guidance only. This AOC list is not presented as an exhaustive treatment of AOCs and appropriate responses. You may be required to know and apply other AOCs and AOC responses for different tasks. Properly recognizing and reacting to covered task AOCs are the responsibility of persons qualified to perform the covered task. Always follow your company's policies and procedures.

Industrial Training Services, Inc. assumes no liability for any act or act of omission performed by the person seeking qualification under the pipeline operator's OQ program, or during the actual pipeline operations of the pipeline operator or any contractor performing work on the pipeline operator's pipeline system.

Abnormal Condition

Abnormal Operating Conditions

(Not limited to the examples listed below)

Recognize	React
• Uncontrolled escaping gas	• Make area safe; evacuate if necessary; notify appropriate personnel; shut down and repair leak
• Accidental ignition	• Control fire and make area safe and notify appropriate personnel
• Potential ignition sources	• Prevent/control sources of ignition
• Unacceptable visual inspection	• Repair; or do not establish service
• Unacceptable pressure test	• Repair; or do not establish service
• Installation not performed by a qualified individual	• Do not establish service and notify appropriate personnel
• Damaged pipe or coating	• Repair or replace
• Fitting defect	• Replace fitting

III. Skill and Ability Verification Checklist

OQ Task CM-8
Make Field Repairs on Gas Pipelines

I verify that **(Please Print)** ______________________________ **is qualified to perform OQ Task CM-8 according to his/her company's procedures:**

(CM-8.1) Visual Inspection of Installed Pipe and Components for Mechanical Damage. (0201)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Inspect the following locations for damage, as applicable:
    - pipe, pipe supports, and other pipeline components
    - at ground level on risers
    - spans over water
    - under damaged or missing thermal insulation
    - other areas necessary to determine extent of damage
- ☐ Inspect the following indications of mechanical damage, as applicable:
    - missing, damaged, or disbonded coating
    - cuts, dents, gouges, and cracks
    - wrinkle bends and buckling
- ☐ Inspect internal surfaces of pipe and components for physical damage, as applicable.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Unacceptable visual inspection	• Repair; or do not establish service
• Installation not performed by a qualified individual	• Do not establish service and notify appropriate personnel
• Damaged pipe or coating	• Repair or replace

Comments / Additional Company Procedures: ______________________________

____

____

____

____

(CM-8.2) Measure and Characterize Mechanical Damage on Installed Pipe and Components. (0211)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Perform equipment check.
- ☐ Prepare surface for type of
  - measurement
  - device
  - damage
- ☐ Measure and characterize mechanical damage.
  - Measure depth and length.
  - Determine orientation and location.
  - Look for deformation associated with the mechanical damage.
  - Determine if the mechanical damage involves a girth weld or longitudinal seam.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Operating Conditions

(Not limited to the examples listed below)

Recognize	React
• Unacceptable inspection	• Repair; or do not establish service
• Damaged pipe or coating	• Repair or replace

Comments / Additional Company Procedures:

(CM-8.3) Visually Inspect Pipe and Components Prior to Installation. (0641)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Perform visual inspection for the following as applicable:
  - missing, damaged, or disbonded coating
  - cuts, dents, gouges, and cracks
  - bends and buckling
  - missing or damaged parts and components
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Unacceptable visual inspection	• Repair; or do not establish service
• Installation not performed by a qualified individual	• Do not establish service and notify appropriate personnel
• Damaged pipe or coating	• Repair or replace

Comments / Additional Company Procedures:

(CM-8.4) Install Mechanical Clamps and Sleeves: Bolted. (1041)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Select clamp or sleeve material and size.
- ☐ Perform equipment check.
  - Calibrate fastener tool, if applicable.
- ☐ Prepare pipe for installation of clamp or sleeve.
  - Verify safe atmospheric levels prior to installing the repair sleeve.
  - Ensure adequate surface preparation for type of sleeve.
- ☐ Install clamp or sleeve.
  - Take precautions when installing each type of sleeve (e.g., Skinner-type, Dresser-type), including operating pressure of pipeline.
  - Install clamp or sleeve.
  - Torque bolts, if applicable.
  - Support pipe, as necessary.
- ☐ Inspect the installed clamp or sleeve for
  - leaks
  - pullout
  - rubber roll
  - insertion depth
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Condition

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Accidental ignition	• Evacuate to safe area; establish and maintain safe area
• Gas leak	• Remove ignition sources
• Gas leakage after a repair operation	• Locate leaking section and/or points and repair/replace leak source

Comments / Additional Company Procedures:

(CM-8.5) Fit-Up of Weld Type Repair Sleeves. (1051)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Select and prepare sleeve.
  - Select sleeve material, design, and size.
- ☐ Prepare pipe for fit-up of sleeve.
  - Ensure adequate surface preparation for type of sleeve.
  - Prepare bevels on sleeve.
- ☐ Fit up sleeve.
  - Take precautions when fitting each type of sleeve.
  - Install filler material, if applicable.
  - Fit up sleeve.
  - Support pipe, as necessary.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Uncontrolled escaping gas	• Safe shutdown and repair or notify appropriate personnel
• Potential ignition sources	• Prevent/control sources of ignition
• Fitting defect	• Replace fitting

Comments / Additional Company Procedures:

(CM-8.6) Install Composite Sleeves. (1061)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Prepare pipe surface, as specified by the manufacturer, so that
  - the pipe surface is clean and free of rust
  - the surface has the proper profile
- ☐ Ensure correct working clearance around pipe.
- ☐ Install composite wrap, as specified by the manufacturer, to ensure
  - sufficient surface adhesiveness
  - correct overlap, if applicable
  - no sagging or wrinkles are present
  - no dry spots are present
  - composite material is thoroughly coated, as applicable
  - correct tightness, as applicable
- ☐ Visually inspect, as specified by the manufacturer, for
  - curing
  - dry spots
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Uncontrolled escaping gas	• Safe shutdown and repair or notify appropriate personnel
• Potential ignition sources	• Prevent/control sources of ignition
• Fitting defect	• Replace fitting
• Gas leakage after a repair operation	• Locate leaking section and/or points and repair/replace leak source

Comments / Additional Company Procedures:

(CM-8.7) Repair of Steel Pipe by Grinding. (1071)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Determine wall thickness is acceptable.
- ☐ Initiate removal of defect by grinding.
  - Take precautions when grinding, with consideration of the operating pressure of pipeline.
  - Perform grinding operation.
  - Confirm defect is removed and minimum wall thickness remains.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	**React**
• Uncontrolled escaping gas	• Safe shutdown and repair or notify appropriate personnel
• Accidental ignition	• Control fire and make area safe and notify appropriate personnel
• Potential ignition sources	• Prevent/control sources of ignition

Comments / Additional Company Procedures:

(CM-8.8) Squeeze Off Plastic Pipe. (1141)

Suggested performance guide, must be supplemented or replaced by your company's procedures.

- ☐ Use proper personal protective equipment.
- ☐ Select task procedure(s) and appropriate equipment.
- ☐ Identify segment(s) of pipe that will need to be squeezed off.
  - Verify single feed or multiple feeds.
  - Verify operating pressure.
- ☐ Make notifications, as appropriate.
- ☐ Ensure static ground equipment is in place, as applicable.
- ☐ Install squeeze-off tool, in accordance with manufacturer's specifications.
  - Ensure the tool is square to the pipe with the squeeze plates parallel to each other.
  - Inspect the pipe for cuts, scrapes, gouges, or anomalies before placing of the squeeze-off tool.
  - Ensure squeeze location is free of obstruction.
  - Ensure pipe is supported.
  - Verify stop blocks are correct for the pipe size.
- ☐ Squeeze pipe.
  - Engage the squeeze-off tool.
  - Continue steady squeeze while allowing pipe to cold flow in accordance with pipe manufacturer's specifications.
  - Discontinue squeeze once the blocks engage each other.
- ☐ Monitor pressure, as applicable.
- ☐ Release and remove squeezer, in accordance with pipe manufacturer's specifications.
- ☐ Mark squeeze point on pipe.
  - Ensure tape or some other method is used to identify the squeeze-off point.
- ☐ Document, as required.
- ☐ Recognize and properly react to AOC's.

Abnormal Condition

Abnormal Operating Conditions
(Not limited to the examples listed below)

Recognize	React
• Accidental ignition	• Evacuate to safe area; establish and maintain safe area
• Gas leak	• Remove ignition sources
• Damage to PE piping requiring repair or replacement	• Cut out section; replace section

Comments / Additional Company Procedures:

IV. Employer Record

OQ Task CM-8

Make Field Repairs on Gas Pipelines

Employee Information (Please Print):

Name ____

Last 4 Digits of Social Security Number _ _______________________

Company Name ____

Company Mailing Address _________________________________

City ______________________ State ________ Zip _____________

Affidavit

I acknowledge the performance of this task is solely for the purpose of operator qualification, and is not intended to replace or modify company operating procedures or policies and may not be appropriately used in all circumstances. I acknowledge that I am responsible for recognizing hazards and abnormal conditions in my work place and must exercise care and good judgment; always using appropriate equipment, procedures and tools for tasks I perform. Industrial Training Services, Inc. assumes no liability for my actions nor for my application of the qualification performance guides used in this evaluation checklist.

Employee's Signature ______________________ Date _____________

Evaluator Information (Please Print):

Name ____

Organization/Employer __________________________________

Telephone Number _____________________________________

Affidavit

I affirm that I am the person who has administered this checklist and that I have conducted this assessment with integrity. I also affirm that the above named employee is the person assessed and that the above named person performed the tasks at the indicated level.

Evaluator's Signature ______________________ Date _____________

The employee is qualified according to company standards to perform the tasks listed below as indicated:

	Not Applicable	TASK/OPERATIONS	Method of Skill/Ability Verification Enter Number From List Below
1.	☐	(CM-8.1) Visual Inspection of Installed Pipe and Components for Mechanical Damage. (0201)	☐
2.	☐	(CM-8.2) Measure and Characterize Mechanical Damage on Installed Pipe and Components. (0211)	☐
3.	☐	(CM-8.3) Visually Inspect Pipe and Components Prior to Installation. (0641)	☐
4.	☐	(CM-8.4) Install Mechanical Clamps and Sleeves: Bolted. (1041)	☐
5.	☐	(CM-8.5) Fit-Up of Weld Type Repair Sleeves. (1051)	☐
6.	☐	(CM-8.6) Install Composite Sleeves. (1061)	☐
7.	☐	(CM-8.7) Repair of Steel Pipe by Grinding. (1071)	☐
8.	☐	(CM-8.8) Squeeze Off Plastic Pipe. (1141)	☐

Method of Knowledge Verification

- Written Exam

Method of Skill/Ability Verification Observed During:

1. Performance on the Job
2. Simulation

After completion of Section IV, "Employer Record," remove section from the packet for your records. For third party verification and database reporting service, upload the data to Industrial Training Services OnBoard LMS.

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