Pipefitting

Overview

Pipefitters work with many kinds of pipe, ranging from small, half-inch piping to that which is three or more feet in diameter. A pipefitter must know how to work with threaded, grooved, and welded piping systems and must be able to master a variety of tools and equipment.

Although both work with pipe, there is a major difference between pipefitters and plumbers. Pipefitters lay out and install piping systems primarily for industrial facilities such as chemical plants, oil refineries, food processing plants, and paper mills. Plumbers install and service water distribution and waste systems, primarily in residential and commercial applications. The successful pipefitter works well with all craft professionals, displaying a positive attitude and other qualities of professionalism, as well as an ongoing commitment to safety.

Learning Objective 1

Successful completion of this module prepares trainees to:

Describe the pipefitting craft and the knowledge, skills, behaviors, and attitudes which contribute to a pipefitter’s success.

a. Describe the tools that pipefitters use and explain how they are chosen for a particular job.

b. Explain the nature of pipefitting work and factors which influence it.

c. State the basic safety obligations of construction-industry employees and employers.

Learning Objective 2

Successful completion of this module prepares trainees to:

Describe training pathways for the pipefitting professional and identify characteristics of successful crafters.

a. List the components and requirements of an apprenticeship program and conditions which affect the length of time to complete the training.

b. Describe the structure of NCCER craft-training programs and how they relate to pipefitting apprenticeships.

c. Define professionalism and Identify characteristics common to successful craft workers.
d. Explain the meaning and importance of human relations in the workplace.

Performance Tasks

This is a knowledge-based module; there are no Performance Tasks.
Recommended Teaching Time: 5.0 hours

Classroom Equipment and Materials

- Whiteboard and markers
- Pencils and paper
- PowerPoint® Presentations for Module 08101
- A variety of standard marker sizes
- Poster board
- Flip chart
- LCD projector and screen
- Computer with Internet access
- Module Review answer key
- Module Examinations
Pipefitting Hand Tools

Overview

Pipefitters use hand tools to grip, level, fabricate, cut, and bend pipe. Fabrication tools include squares, clamps, gauges, wraparounds, and pins. Vises and stands hold the work to free the crafter to work with both hands; levels are used to ensure that a pipe is level or plumb. Specialized tools are used to cut, thread, bend, and flare pipe.

Pipefitters must learn not only how and when to use their tools but also how to take care of them. Properly maintained tools are safer and more accurate. Using the correct tool – in a safe and appropriate manner – allows a crafter to skillfully complete the job.

Learning Objective 1

Successful completion of this module prepares trainees to:

Identify and describe common pipefitting hand tools and their safe use.

a. Identify general safety guidelines for hand tool use.
b. Identify and describe the use of pipe vises and stands.
c. Identify and describe the use of pipe wrenches and other common wrenches.
d. Identify and describe the use of various levels.
e. Identify and describe the use of various layout and fabrication tools.
f. Identify and describe the use of common pipe clamps and alignment tools.
g. Identify and describe the use of pipe cutting and reaming tools.
h. Identify and describe the use of pipe threading tools.
i. Identify and describe the use of bending and flaring tools.

Performance Tasks

1. Identify various pipefitting hand tools.
2. Secure a section of pipe in a vise and pipe stand.
3. Demonstrate the proper use of a wraparound.
4. Demonstrate the proper use of two of the following:
• Straight pipe wrenches
• Offset pipe wrenches
• Strap wrenches

5. Demonstrate the proper use of two of the following:
   • Laser level
   • Torpedo and larger levels
   • Center finder

6. Check square and level:
   • Turn tongue 180 degrees from where it was
   • Flip level to ensure it is level
   • Using a square, check square from a fitting to a fitting, or a fitting to a pipe

Recommended Teaching Time: 20 hours

**Classroom Equipment and Materials**

• Whiteboard and markers
• Pencils and paper
• PowerPoint® Presentations for Module 08102
• A variety of standard marker sizes
• Poster board
• Flip chart
• LCD projector and screen
• Computer with Internet access
• Module Review answer key
• Module Examinations
• Appropriate PPE as directed by the instructor or training facility provider
• Pipe vises and jack stands
• Various types and sizes of pipe wrenches
• Levels
• Layout and fabrication tools, such as squares and wraparounds
• Various types of pipe alignment tools
• Pipe and tubing cutting and reaming tools
• Pipe threading hand tools
• Pipe and tube bending and flaring tools
• Pipe vise and jack stand
• Length or section of threaded pipe
• Wraparound
• Tape measures
• Soapstone
• Pipe vise and jack stand
• At least two of the following types of pipe wrenches:
  ◦ Straight pipe wrenches
  ◦ Offset pipe wrenches
  ◦ Strap wrenches
• Length or section of threaded pipe
• Threaded fittings to fit the pipe size used
• Appropriate PPE as directed by the instructor or training facility provider
• Pipe vise and jack stand
• Length or section of pipe
• At least two of the following tools:
  ◦ Laser level
  ◦ Torpedo or larger level
  ◦ Center finder
• Four jack stands
• Two lengths or sections of non-threaded pipe
• Pipefitter’s or framing squares
• Combination try square
Pipefitting Power Tools

Overview

Pipefitters use power tools to cut, grind, thread, and shape all types of materials. It is very important to select the right tool for the job and make sure it is in good working order before use. Specialty tools, like threading machines and bevelers, should only be used for the specific jobs they were designed to perform. With power and pneumatic tools, it is especially important to follow all operating instructions and safety precautions because they pose safety hazards. When used correctly, these tools can greatly increase a pipefitter’s productivity.

Learning Objective 1

Successful completion of this module prepares trainees to:
State safety guidelines for power tool use.

a. State general safety guidelines for power tool use.
b. State electrical safety guidelines for power tool use.

Learning Objective 2

Successful completion of this module prepares trainees to:
Identify and describe the use of power tools for cutting pipe.

a. Identify and describe the use of portable band saws.
b. Identify and describe the use of abrasive saws.

Learning Objective 3

Successful completion of this module prepares trainees to:
Identify and describe the use of power tools for grinding and beveling pipe.

a. Identify and describe the use of pipe grinding tools.
b. Identify and describe the use of pipe beveling tools.

## Learning Objective 4

**Successful completion of this module prepares trainees to:**

Identify and describe the use of power tools for pipe threading.

- a. Explain how to use a threading machine to load, cut, and ream pipe.
- b. Explain how to perform pipe threading operations.
- c. Identify and describe the use of portable power drives for pipe threading.

## Performance Tasks

1. Cut pipe using a portable band saw (do not use a threading machine).
2. Use an end grinder/die grinder.
3. Operating a portable grinder, properly prep and bevel the end of a pipe.
4. Identify several types of pipe bevelers.
5. Replace dies in a threading machine.
6. Cut, ream, and thread pipe using a threading machine.
7. Cut and thread nipples using a nipple chuck.
8. Thread pipe using a portable power drive.

**Recommended Teaching Time:** 15 hours

## Classroom Equipment and Materials

- Whiteboard and markers
- Pencils and paper
- PowerPoint® Presentations for Module 08103
- A variety of standard marker sizes
- Poster board
- Flip chart
- LCD projector and screen
- Computer with Internet access
- Module Review answer key
- Module Examinations
- Appropriate PPE as directed by the instructor or training facility provider
• Pipe vise and/or jack stands
• Portable band saw
• Band saw blades appropriate for the material
• Wraparound
• Soapstone
• Grinders, such as an end, die, and right-angle grinder
• Scrap pipe; 1" to 1-1/2" IPS steel pipe is suggested
• Multiple beveling tools, both mechanical and thermal
• Pipe threading machine with necessary die heads, dies, and a nipple chuck
• Portable power drive with appropriate dies and torque arm
• Threading oil sump and manual pump
• Threading oil
• Pipe vise
• Scrap pipe; 1/2" to 1" IPS is recommended
Module Two (29102) introduces the trainees to the methods and procedures of the oxyfuel cutting process. Trainees will learn safety procedures, equipment setup, fuel gas types, flow rates, and techniques. Hands-on practice and the completion of cutting-related Performance Tasks complete the learning process.

**Objectives**

**Learning Objective 1**
- Describe oxyfuel cutting and identify related safe work practices.
  a. Describe basic oxyfuel cutting.
  b. Identify safe work practices related to oxyfuel cutting.

**Learning Objective 2**
- Identify and describe oxyfuel cutting equipment and consumables.
  a. Identify and describe various gases and cylinders used for oxyfuel cutting.
  b. Identify and describe hoses and various types of regulators.
  c. Identify and describe cutting torches and tips.
  d. Identify and describe other miscellaneous oxyfuel cutting accessories.
  e. Identify and describe specialized cutting equipment.

**Learning Objective 3**
- Explain how to setup, light, and shut down oxyfuel equipment.
  a. Explain how to properly prepare a torch set for operation.
  b. Explain how to leak test oxyfuel equipment.
  c. Explain how to light the torch and adjust for the proper flame.
  d. Explain how to properly shut down oxyfuel cutting equipment.

**Learning Objective 4**
- Explain how to perform various oxyfuel cutting procedures.
  a. Identify the appearance of both good and inferior cuts and their causes.
  b. Explain how to cut both thick and thin steel.

**Learning Objective 4 (continued)**
- c. Explain how to bevel, wash, and gouge.
- d. Explain how to make straight and bevel cuts with portable oxyfuel cutting machines.

**Performance Tasks**

**Performance Task 1 (Learning Objective 3)**
- Set up oxyfuel cutting equipment.

**Performance Task 2 (Learning Objective 3)**
- Light and adjust an oxyfuel torch.

**Performance Task 3 (Learning Objective 3)**
- Shut down oxyfuel cutting equipment.

**Performance Task 4 (Learning Objective 3)**
- Disassemble oxyfuel cutting equipment.

**Performance Task 5 (Learning Objective 3)**
- Change empty gas cylinders.

**Performance Task 6 (Learning Objective 4)**
- Cut shapes from various thicknesses of steel, emphasizing:
  - Straight line cutting
  - Square shape cutting
  - Piercing
  - Beveling
  - Cutting slot

**Performance Task 7 (Learning Objective 4)**
- Perform washing.

**Performance Task 8 (Learning Objective 4)**
- Perform gouging.

**Performance Task 9 (Learning Objective 4)**
- Use a track burner to cut straight lines and bevels.

**Teaching Time: 17.5 hours**
(Seven 2.5-Hour Classroom Sessions)
Session time may be adjusted to accommodate your class size, schedule, and teaching style.

**Prerequisites**

*Core Curriculum*
Before You Begin
As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider the time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the written examinations and performance profile sheets from www.nccerirc.com. The passing score for submission into NCCER’s Registry is 70% or above for the written examination; performance testing is graded pass or fail.

Safety Considerations
This module requires that trainees work with a cutting torch, oxygen, and fuel gases, and very hot materials. Safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and give due respect to hazards related to oxyfuel cutting equipment. Ensure all trainees use the proper lens tints to avoid eye damage and use the proper type of gloves. Any deficiencies must be corrected to ensure future trainee safety. All practice sessions and performance tasks must be completed under the instructor’s direct supervision.

Classroom Equipment and Materials
- Whiteboard/chalkboard
- Markers/chalk
- Pencils and paper
- Welding Level One PowerPoint® Presentation
- DVD player or a computer with a DVD drive
- LCD projector and screen
- Computer with Internet access
- Selection of usable and non-usable hoses
- Pressure regulators
- Assorted thin steel pieces cut and exhibiting distortion
- Module Review Question and Trade Terms Quiz answer keys
- Copies of the Module Examination and Performance Profile Sheets

Equipment and Materials for Laboratories and Performance Testing
- Appropriate PPE:
  - Appropriate flame-retardant clothing
  - Safety glasses
  - Welding gloves
  - Appropriate goggles or face shield
  - Proper footwear as designated by the instructor or training facility provider
  - Hearing protection as designated by the instructor or training facility provider
- Oxygen cylinder
- Fuel gas cylinder
- Pressure regulators (oxygen and fuel gas)
- Hose set
- Cutting torches, combination or one-piece
- Assorted torch tips (cutting, washing, and gouging)
- Cylinder cart
- Files
- Squares
- Tape measure or steel rule
- Soapstone
- Common hand tools
- Chipping hammers
- Friction lighters
- Tip cleaners, drills, and files
- Approved leak testing solution
- Torch wrenches
- Sufficient carbon steel plate (≥¼” or 6 mm thick)
- Sufficient carbon steel plate (<¼” or 6 mm thick)
- Portable oxyfuel track burner

Additional Resources
This module presents thorough resources for task training. The following resource material is suggested for further study:


There are a number of online resources available for trainees who would like more information on oxyfuel cutting. A search for additional information may be assigned as homework to interested trainees.

Instructors should view any videos that may be identified in the lesson plan before using them to ensure their suitability. There are a number of accessible videos related to oxyfuel cutting on the Internet. For example, The Harris Products Group, a division of Lincoln Electric, offers well-produced videos related to oxyfuel cutting. The videos can provide teachable moments in both proper and improper work processes and behaviors. Be prepared to stop the videos at appropriate times to point out and discuss both proper and improper conduct and techniques.
The Lesson Plan for this module is divided into seven 2.5-hour sessions. This time includes 10 minutes for administrative tasks and a 10-minute break per session.

**SESSION ONE**

Session One explains the oxyfuel cutting processes and identifies related safety precautions. Trainees will also be introduced to cylinder handling and storage. This session covers Sections 1.0.0 through 2.3.3.

1. Show the Session One PowerPoint® presentation.
2. Use the Kickoff Activity to get trainees engaged and give them an idea of what they will learn from this module.
3. Describe basic oxyfuel or flame cutting processes.
4. Identify safe work practices, including PPE, fire/explosion prevention, and work area ventilation.
5. Identify precautions associated with cylinder handling and storage.
6. Describe how to identify oxyfuel cutting equipment and consumables.
7. Describe how to identify cutting torches and tips.

**SESSION TWO**

Session Two describes how the equipment is used to perform oxyfuel cutting, including the use of various gases, portable units, regulators, hoses, and cutting torches. This session covers Sections 2.4.0 through 3.4.2.

1. Show the Session Two PowerPoint® presentation.
2. Use the Kickoff Activity to review the information covered in the previous session.
3. Describe how to identify the specialized cutting equipment.
4. Describe how to properly prepare a torch for operation.
5. Describe how to leak-test oxyfuel equipment.
6. Describe how to light the torch and adjust for the proper flame.
7. Describe how to properly shut down oxyfuel cutting equipment.
**Session Outline for 29102**

**OXYFUEL CUTTING**

**Session Three**

Session Three describes how to set up, light, and shut down oxyfuel equipment. This session covers Sections 4.0.0 through 4.4.3.

1. Show the Session Four PowerPoint® presentation.
2. Describe how to identify good cuts, inferior cuts, and their causes.
3. Describe how to cut thick steel and thin steel.
4. Describe straight, bevel, wash, and gouge techniques.
5. Describe how to make straight and bevel cuts with portable oxyfuel cutting machines.

**Sessions Four through Six**

Sessions Four through Six are laboratory sessions.

1. Note that no PowerPoint® presentation is associated with this laboratory session.
2. Demonstrate how to set up oxyfuel equipment, light and adjust the oxyfuel torch, and change empty cylinders.
3. Demonstrate cutting shapes in thin and thick steel using the various cutting techniques discussed.
4. Demonstrate how to shut down oxyfuel cutting equipment.
5. Trainees practice and complete the specific tasks required by Performance Tasks 1 through 9.
6. The completion of all Performance Tasks can also be used towards completion of the Performance Accreditation Task.

**Session Seven**

Session Seven is a review and testing session. Have trainees complete the Module Review Questions and Trade Terms Quiz. Alternatively, these may be assigned as homework at the end of Session Six. Go over the Module Review questions in class prior to the exam and answer any questions that the trainees may have.

1. Have trainees complete the written examination. Any outstanding performance testing must be completed during this session as well.
2. Record the testing results on the Registration of Training Modules form, and submit the report to your Training Program Sponsor.
## Materials Checklist for Module 29102, Oxyfuel Cutting

<table>
<thead>
<tr>
<th>Equipment and Materials</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Personal protective equipment:</td>
<td>Selection of usable and non-usable hoses</td>
</tr>
<tr>
<td>Appropriate flame-retardant clothing</td>
<td>Assorted thin steel pieces cut and exhibiting distortion</td>
</tr>
<tr>
<td>Safety glasses</td>
<td>Fuel gas cylinder</td>
</tr>
<tr>
<td>Welding gloves</td>
<td>Hose set</td>
</tr>
<tr>
<td>Appropriate goggles or face shield</td>
<td>Assorted torch tips (cutting, washing, and gouging)</td>
</tr>
<tr>
<td>Proper footwear as designated by the instructor or training facility provider</td>
<td>Files</td>
</tr>
<tr>
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<tr>
<td>Pencils and paper</td>
<td>Approved leak testing solution</td>
</tr>
<tr>
<td><strong>Welding Level One PowerPoint® Presentation</strong> Slides</td>
<td>Torch wrenches</td>
</tr>
<tr>
<td>DVD player or a computer with a DVD drive</td>
<td>Portable oxyfuel track burner</td>
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</tr>
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To the extent possible, and as required for performance testing, provide a selection of the tools listed for each session; alternatively, photos may be used to teach tool identification.
Ladders and Scaffolds

Pipefitting

Overview

Ladders and scaffolds are some of the most important tools on a job site. Used properly, they make a pipefitter's job much easier. Carelessness, however, can be fatal. Common accidents like falling, being struck by falling objects, and electrocution can be avoided if safety precautions are followed. Considerations for the type of ladder or scaffolding being used, as well as environmental factors, personal positioning, fall arrest systems, and proper assembly and care of all equipment contribute to safe operations.

Learning Objective 1

Successful completion of this module prepares trainees to:

Identify various types of ladders and describe how to safely use them.

a. Identify common ladders and basic safety guidelines.
b. Explain how to use stepladders.
c. Explain how to use straight ladders and extension ladders.

Learning Objective 2

Successful completion of this module prepares trainees to:

Identify and describe how to use scaffolding.

a. Identify common scaffolds and explain how to use them safely.
b. Explain how to use and care for tubular buck scaffolds.
c. Explain how to use and care for pole scaffolds.
d. Explain how to use and care for rolling scaffolds.

Learning Objective 3

Successful completion of this module prepares trainees to:

Identify scaffold hazards and state guidelines for safe use.
a. Identify specific scaffold hazards.
b. State specific scaffold safety guidelines.

**Performance Tasks**

1. Select, inspect, and use stepladders, straight ladders, and extension ladders.
2. Demonstrate 3-point contact and the 4-to-1 rule.
3. Erect, inspect, and disassemble tubular buck scaffolding.

Recommended Teaching Time: 12.5 hours

**Classroom Equipment and Materials**

- Whiteboard and markers
- Pencils and paper
- PowerPoint® Presentations for Module 08105
- A variety of standard marker sizes
- Poster board
- Flip chart
- LCD projector and screen
- Computer with Internet access
- Module Review answer key
- Module Examinations
- Appropriate PPE and fall protection gear as directed by the instructor or training facility provider
- Stepladders
- Extension ladders
- Tubular buck scaffolding set (at least two bucks)
Overview
Pipefitters work with various types of motorized equipment to speed up production. From smaller items such as generators and compressors to larger machinery such as forklifts and backhoe loaders, a pipefitter must understand the capacities and limitations of each item in order to work safely and efficiently. This is because increased power means increased hazards. Anyone operating motorized equipment must be properly trained, and in some cases certified, to use it. Always follow the recommended safety precautions, manufacturer’s instructions, and maintenance schedule.

Learning Objective 1
Successful completion of this module prepares trainees to:
Describe the types of motorized equipment found in the pipefitting environment and state general safety precautions for their use.

a. Identify safety precautions common to motorized equipment.

Learning Objective 2
Successful completion of this module prepares trainees to:
Identify and describe how to use portable generators.

a. Identify typical generator controls.
b. Explain how to operate a portable generator.
c. State generator safety guidelines and describe their maintenance needs.

Learning Objective 3
Successful completion of this module prepares trainees to:
Identify and describe how to use portable air compressors.

a. Identify typical air-compressor controls.
b. Explain how to operate a portable air compressor.
c. State air-compressor safety guidelines and describe their maintenance needs.

**Learning Objective 4**

*Successful completion of this module prepares trainees to:*
Identify aerial-lift controls and describe how to use aerial lifts.

a. Identify typical aerial-lift controls.
b. Explain how to operate aerial lifts.
c. State aerial-lift safety guidelines and describe their maintenance needs.

**Learning Objective 5**

*Successful completion of this module prepares trainees to:*
Identify and describe how to use forklifts.

a. Identify typical forklift controls.
b. Explain how to operate forklifts.
c. State forklift safety guidelines and describe their maintenance needs.

**Learning Objective 6**

*Successful completion of this module prepares trainees to:*
Identify and describe how to use trenchers.

a. Identify typical trencher controls.
b. Explain how to operate trenchers.
c. State trencher safety guidelines and describe their maintenance needs.

**Learning Objective 7**

*Successful completion of this module prepares trainees to:*
Identify and describe the use of support equipment.

a. Identify and describe the use of portable welding machines.
b. Identify and describe the use of portable pumps.
c. Identify and describe the use of portable compactors.

**Learning Objective 8**

Successful completion of this module prepares trainees to:

Identify and describe the use of backhoes and mobile cranes.

a. Identify and describe the use of backhoes.
b. Identify and describe the use of mobile cranes.

**Performance Tasks**

1. Perform all prestart checks for engine-driven generators.
2. Operate engine-driven generators.
3. Set up and operate engine-driven welding machines.
4. Perform all prestart checks for portable air compressors.
5. Operate portable air compressors.
6. Identify forklift trucks and recognize safety hazards involved in working around them.
7. Identify portable pumps to use for specific applications.
8. Identify types of hydraulic cranes and recognize safety hazards involved in working around them.

Recommended Teaching Time: 10 hours

**Classroom Equipment and Materials**

- Whiteboard and markers
- Pencils and paper
- PowerPoint® Presentations for Module 08106
- A variety of standard marker sizes
- Poster board
- Flip chart
- LCD projector and screen
- Computer with Internet access
- Module Review answer key
- Module Examinations
- Appropriate PPE as directed by the instructor or training facility provider
- Engine-driven generator
• Generator operating manual
• Sufficient fuel and oil supply
• Engine-driven welding machine
• Welding machine operating manual
• Sufficient fuel and oil supply
• Welding leads, accessories, consumables, and required PPE for welding (optional)
• Engine-driven air compressor
• Compressor operating manual
• Sufficient fuel and oil supply
• Forklifts of various types
• Centrifugal trash pump (or photo of same)
• Diaphragm mud pump (or photo of same)
• Submersible pump (or photo of same)
• Various types of mobile cranes (or photos of specific types)