

MODULE OVERVIEW

This module introduces the tools and procedures used by industrial maintenance mechanics in layout work.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum* and *Industrial Maintenance Mechanic Level One*.

OBJECTIVES

Upon completion of this module, the trainee will be able to do the following:

1. Identify layout tools and explain their uses.
2. Lay out base lines using the arc method.
3. Lay out base lines using the 3-4-5 method.
4. Scribe straight lines.
5. Scribe perpendicular lines to base lines using a square.
6. Scribe perpendicular lines to an edge using a combination square.
7. Lay out angled lines using a combination square and a protractor.
8. Lay out circles using dividers and trammel points.
9. Lay out perpendicular lines from base lines using dividers and reference points.
10. Bisect lines using dividers.
11. Divide a line into equal parts.
12. Divide a circle into equal parts.
13. Lay out equipment locations.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to do the following:

1. Lay out perpendicular lines from a reference line using:
 - Arc method
 - 3-4-5 method
2. Scribe the following:
 - Straight lines
 - Perpendicular lines to a base line using a square
 - Perpendicular lines to an edge using a combination square
 - Angled lines using a combination square
 - Angled lines using a protractor
 - Circles using dividers
 - Perpendicular lines from base lines using dividers
 - Perpendicular lines from base lines using reference points
3. Bisect lines using dividers.
4. Divide lines into equal parts.
5. Divide circles into equal parts.
6. Lay out equipment locations.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen	Center punch set
Transparencies	Transfer punch set
Blank acetate sheets	Straightedge
Transparency pens	Blueprints
Whiteboard/chalkboard	Chalk box
Markers/chalk	Wood
Pencils and scratch paper	Hammer
Appropriate personal protective equipment	Nails
Scribers	Drill and bits
Steel rules	Flange with bolt holes
Steel squares	Bolts
Combination set	Optical level
Protractors	Measuring tape
Dividers	Copies of Quick Quizzes *
Trammel points	Module Examination**
Prick punch set	Performance Profile Sheets**

* Located in the back of this module.

**Located in the Test Booklet.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Emphasize basic hand tool safety. This module may require trainees to visit job sites. Make sure that all trainees are briefed on site safety procedures.

ADDITIONAL RESOURCES

This module is intended to present thorough resources for task training. The following reference work is suggested for both instructors and motivated trainees interested in further study. This is optional material for continued education rather than for task training.

Audel Millwrights and Mechanics Guide. Latest Edition. Thomas B. Davis, Carl A. Nelson. Hoboken, NJ: John Wiley & Sons.

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 20 hours are suggested to cover *Basic Layout*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Sessions I and II. Introduction to the Drawing Set	
A. Introduction	_____
B. Layout Tools	_____
C. Laying Out Base Lines: Arc Method	_____

- D. Laboratory
Trainees practice laying out perpendicular lines using the arc method.
This laboratory corresponds to Performance Task 1. _____
- E. Laying Out Base Lines: 3-4-5 Method _____
- F. Laboratory
Trainees practice laying out perpendicular lines using the 3-4-5 method.
This laboratory corresponds to Performance Task 1. _____

Session III. Scribing Lines

- A. Scribing Straight Lines _____
- B. Scribing Perpendicular Lines _____
- C. Scribing Angled Lines _____
- D. Scribing Circles and Arcs _____
- E. Laying Out Perpendicular Lines _____
- F. Laboratory
Trainees practice scribing various lines. This laboratory corresponds to
Performance Task 2. _____

Sessions IV and V. Basic Layout

- A. Bisecting Angles Using Dividers _____
- B. Laboratory
Trainees practice bisecting lines using dividers. This laboratory
corresponds to Performance Task 3. _____
- C. Dividing Lines into Equal Parts _____
- D. Laboratory
Trainees practice dividing lines into equal parts. This laboratory
corresponds to Performance Task 4. _____
- E. Dividing Circles into Equal Parts _____
- F. Laboratory
Trainees practice dividing circles into equal parts. This laboratory
corresponds to Performance Task 5. _____

Sessions VI and VII. Equipment Layout

- A. Laying Out Equipment Locations _____
- B. Laboratory
Trainees practice laying out equipment locations. This laboratory
corresponds to Performance Task 6. _____

Session VIII. Review and Testing

- A. Review _____
- B. Module Examination _____
 - 1. Trainees must score 70% or higher to receive recognition from NCCER. _____
 - 2. Record the testing results on Craft Training Report Form 200, and submit
the results to the Training Program Sponsor. _____
- C. Performance Testing _____
 - 1. Trainees must perform each task to the satisfaction of the instructor to receive
recognition from NCCER. If applicable, proficiency noted during laboratory
exercises can be used to satisfy the Performance Testing requirements. _____
 - 2. Record the testing results on Craft Training Report Form 200, and submit the
results to the Training Program Sponsor. _____

MODULE OVERVIEW

This module introduces chemical, compressed air, fuel oil, steam, and water systems and explains how to identify them by color-code. It also explains thermal expansion of pipes and pipe insulation.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Industrial Maintenance Mechanic Level One*; and *Industrial Maintenance Mechanic Level Two*, Module 32201-07.

OBJECTIVES

Upon completion of this module, the trainee will be able to do the following:

1. Identify and explain the types of piping systems.
2. Identify piping systems according to color-coding.
3. Explain the effects and corrective measures for thermal expansion in piping systems.
4. Explain types and applications of pipe insulation.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to do the following:

1. Identify the type of piping system designated by the following:
 - Red color-code
 - Yellow color-code
 - Green color-code
 - Bright blue color-code

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen	Various types of pipe from different piping systems
Transparencies	Sections of color-coded pipe for identification
Blank acetate sheets	Samples of various insulation materials
Transparency pens	Bimetallic strip
Whiteboard/chalkboard	Acetylene torch with rosebud
Markers/chalk	Calculator
Pencils and scratch paper	Copies of the Quick Quiz*
Appropriate personal protective equipment	Module Examination**
MSDSs for commonly used chemicals	Performance Profile Sheets**

* Located in the back of this module.

** Located in the Test Booklet.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly.

ADDITIONAL RESOURCES

This module is intended to present thorough resources for task training. The following reference works are suggested for both instructors and motivated trainees interested in further study. This is optional material for continued education rather than for task training.

Audel Mechanical Trades Pocket Manual, 1990. Carl Nelson. New York, NY: Macmillan Publishing Company.

The Pipe Fitters Blue Book, 2002. W. V. Graves. Clinton, NC: Construction Trades Press.

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 5 hours are suggested to cover *Introduction to Piping Components*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Piping Systems	
A. Introduction	_____
B. Types of Piping Systems	_____
C. Identifying Piping Systems	_____
D. Laboratory	_____
Trainees practice identifying piping systems as designated by various color-codes. This laboratory corresponds to Performance Task 1.	
Session II. Thermal Expansion, Insulation, Review and Testing	
A. Thermal Expansion	_____
B. Pipe Insulation	_____
C. Review	_____
D. Module Examination	_____
1. Trainees must score 70% or higher to receive recognition from NCCER.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	
E. Performance Testing	_____
1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	

MODULE OVERVIEW

This module covers various types of plastic and copper pipe and fittings, and provides step-by-step instructions for measuring, cutting, and joining plastic and copper piping.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Industrial Maintenance Mechanic Level One*; and *Industrial Maintenance Mechanic Level Two*, Modules 32201-07 and 32202-07.

OBJECTIVES

Upon completion of this module, the trainee will be able to do the following:

1. Identify types of materials and schedules of copper and plastic piping.
2. Identify proper and improper applications of copper and plastic piping.
3. Identify the material properties, storage, and handling requirements of copper piping.
4. Identify types of fittings and valves used with plastic piping.
5. Identify types of fittings and valves used with copper piping.
6. Identify and determine the types of hanging and supporting copper and plastic piping.
7. Identify the various techniques used in hanging and supporting copper and plastic piping.
8. Properly measure, cut, and join copper and plastic piping.
9. Explain proper procedures for the safe handling, storage, and protection of copper and plastic pipes.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to do the following:

1. Correctly measure the diameter of copper tubing.
2. Cut and ream copper tubing using a tube cutter.
3. Correctly bend copper tubing using bending tools.
4. Make a swage joint in a section of copper tubing.
5. Make and join single flare connections.
6. Join two sections of tubing using a compression fitting.
7. Cut and join two sections of plastic pipe using appropriate fittings.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen	Samples of copper pipe
Transparencies	Rulers
Blank acetate sheets	Measuring tape
Transparency pens	Fittings and valves used with copper pipe
Whiteboard/chalkboard	Tube cutter
Markers/chalk	Copper pipe reamers
Pencils and scratch paper	Copper pipe bending tools
Appropriate personal protective equipment	Soldering torches
MSDSs for solvents used to join plastic pipe	Flux and flux brushes
Samples of various types of plastic pipe	Solder paste
Manufacturers' literature on various types of plastic pipe	Wire solder
Various types of fittings for plastic pipe	Flaring tools
Hacksaw	Flared fittings
Plastic pipe cutters	Swage fittings
Plastic pipe reamers	Swaging tool
Transition and fusion fittings	Various types of copper pipe supports
Solvent cements and instructions	Copies of Quick Quizzes*
Bell-and-spigot pipe	Module Examination**
Tools and materials used to join PEX	Performance Profile Sheets**
Tools used to join PE tubing	

* Located in the back of this module.

** Located in the Test Booklet.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module requires trainees to work with plastic and copper pipe. Ensure that they are briefed on shop safety procedures. Emphasize chemical and hand tool safety.

ADDITIONAL RESOURCES

This module is intended to present thorough resources for task training. The following reference works are suggested for both instructors and motivated trainees interested in further study. These are optional materials for continued education rather than for task training.

www.plasticpipe.org/publications/pe_handbook.html

www.copper.org/applications/plumbing/techref/cth/cth_main.htm

www.charlottepipe.com/Default.aspx?Page=ABSPVCDWVTechInstall&type=ABSPVCDWV

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 5 hours are suggested to cover *Copper and Plastic Piping Practices*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction to Plastic and Copper Pipe	
A. Introduction	_____
B. Plastic Pipe and Fittings	_____
C. Laboratory Trainees practice cutting and joining two sections of plastic pipe. This laboratory corresponds to Performance Task 7.	_____
D. Copper Pipe	_____
E. Laboratory Trainees practice measuring the diameter of copper pipe. This laboratory corresponds to Performance Task 1.	_____
F. Fittings and Valves	_____
G. Measuring, Cutting, Bending, Joining, and Grooving	_____
H. Laboratory Trainees practice cutting and reaming copper pipe. This laboratory corresponds to Performance Task 2.	_____
I. Laboratory Trainees practice bending copper pipe. This laboratory corresponds to Performance Task 3.	_____
Session II. Joining Copper Pipe, Review and Testing	
A. Joining Copper Pipe	_____
B. Laboratory Trainees practice joining copper pipe. This laboratory corresponds to Performance Tasks 4–6.	_____
C. Hangers and Supports	_____
D. Insulating Pipes and Pressure Testing	_____
E. Review	_____
F. Module Examination	_____
1. Trainees must score 70% or higher to receive recognition from NCCER.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	
G. Performance Testing	_____
1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	

MODULE OVERVIEW

This module covers various types of iron and steel pipe and fittings, and provides step-by-step instructions for cutting, threading, and joining ferrous piping.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Industrial Maintenance Mechanic Level One*; and *Industrial Maintenance Mechanic Level Two*, Modules 32201-07 through 32203-07.

OBJECTIVES

Upon completion of this module, the trainee will be able to do the following:

1. Identify the types of ferrous metal pipes.
2. Measure the sizes of ferrous metal pipes.
3. Identify the common malleable iron fittings.
4. Cut, ream, and thread ferrous metal pipe.
5. Join lengths of threaded pipe together and install fittings.
6. Describe the main points to consider when installing pipe runs.
7. Describe the method used to join grooved piping.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to do the following:

1. Identify types of carbon steel pipe.
2. Identify pipe sizes and weights.
3. Identify various pipe fittings.
4. Use three methods for measuring pipe.
5. Apply pipe dope to pipe threads.
6. Apply Teflon® tape to pipe threads.
7. Assemble threaded pipe to fittings.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen	Assorted fittings
Transparencies	Tees
Blank acetate sheets	Elbows
Transparency pens	Unions
Whiteboard/chalkboard	Couplings
Markers/chalk	Nipples
Pencils and scratch paper	Crosses
Appropriate personal protective equipment	Plugs
Sections of black iron and galvanized steel pipe of different sizes and weights	Caps
Short sections of pipe for cutting and threading	Bushings
Threaded sections of pipe	Examples of grooved pipe, typical fittings, and gaskets
	Examples of flanged pipe and fittings
	Drift pins

continued

Pipe drawings and specifications
Cutting oil
Measuring tape
Framing squares
Fitting manufacturer's makeup chart
Pipe stand
Yoke and chain vises
Pipe cutters
Reamers
Pipe wrenches
Chain wrenches

Strap wrenches
Stock and dies
Thread gauge
Powered pipe threader
Rags
Teflon® tape
Pipe dope
Pipe hangers and supports
Module Examination*
Performance Profile Sheets*

*Located in the Test Booklet.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module requires trainees to work with hand tools. Ensure that they are briefed on shop safety procedures.

ADDITIONAL RESOURCES

This module is intended to present thorough resources for task training. The following reference works are suggested for both instructors and motivated trainees interested in further study. These are optional materials for continued education rather than for task training.

Cast Iron Soil Pipe Institute website, www.cispi.org, "*Cast Iron Soil Pipe and Fittings Handbook*," reviewed August 2003.

National Standard Plumbing Code, 2003. Falls Church, VA: Plumbing, Heating, and Cooling Contractors National Association.

Plumbing: Design and Installation, Second Edition, 2002. L.V. Ripka. Homewood, IL: American Technical Publishers.

Plumbing and Mechanical website, www.pmmag.com, "*Forecasting the Lifespan of a Sprinkler System*," Mark Bromann, reviewed August 2003.

Plumbing and Mechanical website, www.pmmag.com, "*Point/Counterpoint: Domestic vs. Imported Cast-Iron Pipe*," Joe Christiansen and Paula M. Bowe, reviewed August 2003.

Victaulic website, www.victaulic.com, "*Pipe Preparation Tools and Parts*," reviewed November 2003.

Water and Plumbing, Volume 3, 2000. Ifte Choudhury and J. Trost. Upper Saddle River, NJ: Prentice Hall.

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 5 hours are suggested to cover *Introduction to Ferrous Metal Piping Practices*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction to Ferrous Metal Pipe	
A. Introduction	_____
B. Introduction to Ferrous Metal Pipe	_____
C. Laboratory Trainees practice identifying types of carbon steel pipe and pipe sizes and weights. This laboratory corresponds to Performance Tasks 1 and 2.	_____
D. Fittings and Valves	_____
E. Pipe Fittings	_____
F. Laboratory Trainees practice identifying various pipe fittings. This laboratory corresponds to Performance Task 3.	_____
Session II. Joining Methods, Review, and Testing	
A. Measuring Steel Pipe	_____
B. Laboratory Trainees practice using three methods to measure steel pipe. This laboratory corresponds to Performance Task 4.	_____
C. Assembling Threaded Pipe	_____
D. Laboratory Trainees practice assembling steel pipe. This laboratory corresponds to Performance Tasks 5–7.	_____
E. Hangers and Supports	_____
F. Review	_____
G. Module Examination	_____
1. Trainees must score 70% or higher to receive recognition from NCCER.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	
H. Performance Testing	_____
1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	

MODULE OVERVIEW

This module explains how to remove threaded and flanged valves, how to replace a valve stem O-ring and bonnet gaskets, and how to repack a valve stuffing box. It also discusses the purpose of valve packing.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Industrial Maintenance Mechanic Level One*; and *Industrial Maintenance Mechanic Level Two*, Modules 32201-07 through 32204-07.

OBJECTIVES

Upon completion of this module, the trainee will be able to do the following:

1. Remove and install threaded valves.
2. Remove and install flanged valves.
3. Replace valve stem O-rings.
4. Replace bonnet gaskets.
5. Explain the purpose of valve packing.
6. Repack a valve.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to do the following:

1. Identify types of valves and explain their purposes and installation.
2. Repack a valve.
3. Replace a bonnet gasket.
4. Replace a valve stem O-ring.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen	Tape measure
Transparencies	Torque wrenches
Blank acetate sheets	Tri squares
Transparency pens	Valve O-rings
Whiteboard/chalkboard	Valve packing removal tools
Markers/chalk	Antiseize compound
Pencils and scratch paper	Bonnet gaskets
Appropriate personal protective equipment	Carbon steel pipe to match valve sizes
Assorted screwdrivers	Flange gaskets
Channel-lock pliers	Flanged valves in a small system
Combination wrenches	Pipe joint compound
Drift pins	Thread cutting oil
Hacksaws	Threaded pipe unions
Levels	Threaded valves in a small system
Pipe cutters	Valve packing
Pipe threaders	Valves that contain O-rings
Pipe vises	Copies of the Quick Quiz*
Pipe wrenches	Module Examination**
Putty knives	Performance Profile Sheets**
Sharp knives	

* Located in the back of this module.

**Located in the Test Booklet.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module requires trainees to work with valves. Ensure that all trainees are properly briefed on equipment use and hand tool safety procedures. This module may require that the trainees visit job sites. Ensure that trainees are briefed on site safety policies prior to any site visits.

ADDITIONAL RESOURCES

This module is intended to present thorough resources for task training. The following reference works are suggested for both instructors and motivated trainees interested in further study. These are optional materials for continued education rather than for task training.

Choosing the Right Valve, Crane Company; 300 Park Avenue, New York, NY.

Piping Pointers; Application and Maintenance of Valves and Piping Equipment, Crane Company; 300 Park Avenue, New York, NY.

www.dezurikwater.com/basic_valves_instruction_index.htm

www.valmatic.com/manuals.jsp

www.velan.com/products/index.htm

www.acipco.com

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 10 hours are suggested to cover *Identify, Install, and Maintain Valves*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Removing and Installing Valves	
A. Introduction	_____
B. Removing and Installing Threaded Valves	_____
C. Removing and Installing Flanged Valves	_____
D. Troubleshooting Valves	_____
E. Laboratory Trainees practice identifying valves and explaining their purposes and installation. This laboratory corresponds to Performance Task 1.	_____
Session II. Valve Stem O-Rings and Bonnet Gaskets	
A. Types of O-Rings	_____
B. Replacing Valve Stem O-Rings	_____
C. Laboratory Trainees practice replacing valve stem O-rings. This laboratory corresponds to Performance Task 4.	_____
D. Replacing Bonnet Gaskets	_____
E. Laboratory Trainees practice replacing bonnet gaskets. This laboratory corresponds to Performance Task 3.	_____
Session III. Repacking Valves	
A. Packing Shapes and Materials	_____
B. Repacking Valves	_____
C. Laboratory Trainees practice repacking valves. This laboratory corresponds to Performance Task 2.	_____
Session IV. Review and Testing	
A. Review	_____
B. Module Examination	_____
1. Trainees must score 70% or higher to receive recognition from NCCER.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	
C. Performance Testing	_____
1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	

MODULE OVERVIEW

This module explains the basics of nondestructive examination (NDE) procedures, including weld inspection, ultrasonic, electromagnetic, and radiographic testing. It also explains hydrostatic and pneumatic testing and pretest procedures.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Industrial Maintenance Mechanic Level One*; and *Industrial Maintenance Mechanic Level Two*, Modules 32201-07 through 32205-07.

OBJECTIVES

Upon completion of this module, the trainee will be able to do the following:

1. Perform pretest requirements.
2. Perform service and flow tests.
3. Perform head pressure tests.
4. Perform hydrostatic tests.
5. Explain how to perform steam blow tests.
6. Explain nondestructive examinations (NDE).

PERFORMANCE TASKS

This is a knowledge-based module. There are no performance tasks.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen	Scaffolding (optional)
Transparencies	Slip blinds
Blank acetate sheets	Test plugs
Transparency pens	Test tree
Whiteboard/chalkboard	Sample test report
Markers/chalk	Teflon® tape
Pencils and scratch paper	Borescopes
Appropriate personal protective equipment	Undercut gauges
Hi-Lo gauge	Butt weld reinforcement gauges
Taper gauge	Liquid penetrant inspection materials
Welded piping system for inspection	X-ray films of welds
Samples of welds with and without discontinuities	Piping drawings
Samples of cracked welds	Pressure gauges
Samples of incomplete joint penetration	Bleeder valves
Samples of incomplete fusion	Magnetic particle testers
Hydrostatic test pump	Ultrasonic testers
Mechanical test plugs	Holiday testers
Pipe vise	Pigs
Piping system or spool to be tested	Copies of Quick Quizzes*
Pneumatic test plugs	Module Examination**

* Located in the back of this module.

** Located in the Test Booklet.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module may require trainees to observe pressure testing. Ensure all trainees are properly briefed on the hazards and required precautions. This module may require that the trainees visit job sites. Ensure that trainees are briefed on site safety policies prior to any site visits.

ADDITIONAL RESOURCES

This module is intended to present thorough resources for task training. The following reference works are suggested for both instructors and motivated trainees interested in further study. These are optional materials for continued education rather than for task training.

The United Kingdom's largest testing and calibrations laboratory for pipe fittings and materials has a website at www.wrcnsf.com/plastic_pipe.htm

Pipeline Maintenance, 2002. National Center for Construction Education and Research. Upper Saddle River, NJ: Prentice Hall.

Ashtead Technology Rentals describes many types of testing equipment at www.ashtead-technology.com/?kc=qwRVB.

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 10 hours are suggested to cover *Hydrostatic and Pneumatic Testing*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources.

Topic	Planned Time
Session I. Introduction and Pretest Requirements	
A. Introduction	_____
B. Performing Visual Inspections	_____
C. Nondestructive Examination and Evaluation	_____
D. Pretest Requirements	_____
Session II. Service, Flow, and Head Pressure Tests	
A. Performing Service and Flow Tests	_____
B. Head Pressure Testing	_____
Session III. Hydrostatic, Pneumatic, Equipment, and Steam Blow Testing	
A. Performing Hydrostatic Testing	_____
B. Pneumatic Testing	_____
C. Equipment Testing	_____
D. Steam Blow Testing	_____
Session IV. Review and Testing	
A. Review	_____
B. Module Examination	_____
1. Trainees must score 70% or higher to receive recognition from NCCER.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	

MODULE OVERVIEW

This module introduces different types of bearings, including plain, ball, roller, thrust, and guide bearings. It describes bearing mountings, including flanged, pillow block, and takeup bearings. It also covers bearing materials and bearing designation systems.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Industrial Maintenance Mechanic Level One*; and *Industrial Maintenance Mechanic Level Two*, Modules 32201-07 through 32206-07.

OBJECTIVES

Upon completion of this module, the trainee will be able to do the following:

1. Identify various types of bearings.
2. Identify and explain bearing materials.
3. Identify parts of bearings.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to do the following:

1. Identify various types of bearings.
2. Identify parts of bearings.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen	Roller bearings
Transparencies	Thrust bearings
Blank acetate sheets	Guide bearings
Transparency pens	Flanged bearings
Whiteboard/chalkboard	Pillow block bearings
Markers/chalk	Takeup bearings
Pencils and scratch paper	Bearing materials
Appropriate personal protective equipment	Copies of Quick Quizzes*
Plain bearings	Module Examination**
Ball bearings	Performance Profile Sheets**

* Located in the back of this module.

**Located in the Test Booklet.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module may require that the trainees visit job sites. Ensure that trainees are briefed on site safety policies prior to any site visits.

ADDITIONAL RESOURCES

This module is intended to present thorough resources for task training. The following reference work is suggested for both instructors and motivated trainees interested in further study. This is optional material for continued education rather than for task training.

NTN is a bearing manufacturer whose website provides information on many types of bearings. It also has technical articles on the care and maintenance of bearings. www.NTNBower.com

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 15 hours are suggested to cover *Introduction to Bearings*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction and Bearings I	
A. Introduction	_____
B. Plain Bearings	_____
C. Ball Bearings	_____
Session II. Bearings II	
A. Roller Bearings	_____
B. Thrust Bearings	_____
Sessions III and IV. Bearings III	
A. Guide Bearings	_____
B. Flanged Bearings	_____
C. Pillow Block Bearings	_____
D. Takeup Bearings	_____
E. Laboratory	_____
Trainees practice identifying bearings. This laboratory corresponds to Performance Task 1.	
Session V. Bearing Materials	
A. Bearing Materials	_____
B. Laboratory	_____
Trainees practice identifying parts of bearings. This laboratory corresponds to Performance Task 2.	
Session VI. Review and Testing	
A. Review	_____
B. Module Examination	_____
1. Trainees must score 70% or higher to receive recognition from NCCER.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	
C. Performance Testing	_____
1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	

MODULE OVERVIEW

This module identifies types of steam traps, including mechanical, thermostatic, and thermodynamic. It explains how to install, troubleshoot, and maintain steam trap systems.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Industrial Maintenance Mechanic Level One*; and *Industrial Maintenance Mechanic Level Two*, Modules 32201-07 through 32207-07.

OBJECTIVES

Upon completion of this module, the trainee will be able to do the following:

1. Explain the terms and concepts used to describe steam and steam systems.
2. Describe the basic steam heating cycle.
3. Recognize the components of a basic steam heating system, including steam traps, and describe their function(s).
4. Describe the safeguards associated with the operation of a low-pressure steam system.
5. Explain how a blowdown system works.
6. Demonstrate how to install, troubleshoot, and maintain selected steam traps.
7. Describe how basic one-pipe and two-pipe steam heating systems work.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to do the following:

1. Identify types of steam traps and components of installations.
2. Diagnose specific problems on faulty steam traps, and demonstrate safety procedures and proper corrective actions.
3. Identify piping distribution systems used with steam systems.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen	Sample steam traps
Transparencies	Manufacturers' instructions for steam trap installation
Blank acetate sheets	Pyrometer
Transparency pens	Ultrasonic tester
Whiteboard/chalkboard	Copies of Quick Quiz*
Markers/chalk	Module Examination**
Pencils and scratch paper	Performance Profile Sheets**
Appropriate personal protective equipment	

* Located in the back of this module.

**Located in the Test Booklet.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module requires that trainees install and troubleshoot steam traps. Ensure that all trainees are briefed on equipment and hot hazard safety. This module may require that the trainees visit job sites. Ensure that trainees are briefed on site safety policies prior to any site visits.

ADDITIONAL RESOURCES

This module is intended to present thorough resources for task training. The following reference works are suggested for both instructors and motivated trainees interested in further study. These are optional materials for continued education rather than for task training.

ASHRAE Handbook – Equipment, American Society of Heating and Air Conditioning Engineers, Inc., Atlanta, GA.

ASHRAE Handbook – HVAC Systems and Applications, American Society of Heating and Air Conditioning Engineers, Inc., Atlanta, GA.

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 10 hours are suggested to cover *Low-Pressure Steam Systems*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction to Low-Pressure Steam Systems	
A. Introduction	_____
B. Fundamentals	_____
C. Steam Cycle Principles of Operation	_____
D. Boilers, Boiler Controls, and Accessories	_____
E. Valves	_____
Session II. Terminals and Steam Traps	
A. Heat Exchangers/Converters	_____
B. Terminals	_____
C. Identifying Steam Traps/Strainers	_____
D. Laboratory Trainees practice identifying different types of steam traps. This laboratory corresponds to Performance Task 1.	_____
E. Maintaining Steam Traps	_____
F. Laboratory Trainees practice identifying specific problems and corrective actions required for faulty steam traps. This laboratory corresponds to Performance Task 2.	_____
G. Strainers	_____
Session III. Additional System Components	
A. Condensate Return/Feedwater System Components	_____
B. Flash Tanks	_____
C. Steam System Piping	_____
D. Laboratory Trainees practice identifying piping distribution systems. This laboratory corresponds to Performance Task 3.	_____
E. Boiler Blowdown and Skimming	_____
F. Water Treatment	_____

Session VI. Review and Testing

A. Review

B. Module Examination

1. Trainees must score 70% or higher to receive recognition from NCCER.
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.

C. Performance Testing

1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.

MODULE OVERVIEW

This module introduces the high-pressure steam system, its components, and auxiliaries.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Industrial Maintenance Mechanic Level One*; and *Industrial Maintenance Mechanic Level Two*, Modules 32201-07 through 32208-07.

OBJECTIVES

Upon completion of this module, the trainee will be able to do the following:

1. Describe the components and operation of a high-pressure steam system.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to do the following:

1. Identify the components of a high-pressure steam system and its auxiliaries.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen

Transparencies

Blank acetate sheets

Transparency pens

Whiteboard/chalkboard

Markers/chalk

Pencils and scratch paper

Appropriate personal protective equipment

Copies of Quick Quizzes*

Module Examination**

Performance Profile Sheets**

* Located in the back of this module.

** Located in the Test Booklet.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module may require that the trainees visit job sites. Ensure that trainees are briefed on site safety policies prior to any site visits.

ADDITIONAL RESOURCES

This module is intended to present thorough resources for task training. The following reference works are suggested for both instructors and motivated trainees interested in further study. These are optional materials for continued education rather than for task training.

www.eere.energy.gov/industry/bestpractices/pdfs/steamsourcebook.pdf

www.eere.energy.gov/industry/bestpractices/energymatters/topic.cfm/topic_id=13

Spirax Sarco is a British firm that maintains a very informative website on steam.

www.spiraxsarco.com/resources/steam-engineering-tutorials.asp

Many useful tables and sources of information can be found at www.engineeringtoolbox.com/control-valves-dimensions-t_41.html

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 20 hours are suggested to cover *High-Pressure Steam Systems and Auxiliaries*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction to High-Pressure Steam Systems	
A. Introduction	_____
B. Precipitators	_____
C. Pulverizers	_____
Sessions II. Scrubbers and Coal Handling	
A. Scrubbers	_____
B. Coal Feeders	_____
C. Coal Crushers	_____
Session III. Water Handling	
A. Dissolving Tanks	_____
B. Evaporators	_____
Session IV. Air and Ash Handling Systems	
A. Fans	_____
B. Ash Handling System	_____
Session V. Feed Systems	
A. Stokers	_____
B. Feedwater Systems	_____
Session VI and VII. System Cleaning	
A. Soot Blowers	_____
B. Blowdown Tanks	_____
C. Laboratory	_____
Trainees practice identifying the components of a high-pressure steam system and its auxiliaries. This laboratory corresponds to Performance Task 1.	
Session VIII. Review and Testing	
A. Review	_____
B. Module Examination	_____
1. Trainees must score 70% or higher to receive recognition from NCCER.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	
C. Performance Testing	_____
1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	

MODULE OVERVIEW

This module covers the operations, maintenance, and repair of distillation towers and vessels. It also covers design characteristics and the removal and installation of trays.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Industrial Maintenance Mechanic Level One*; and *Industrial Maintenance Mechanic Level Two*, Modules 32201-07 through 32209-07.

OBJECTIVES

Upon completion of this module, the trainee will be able to do the following:

1. Identify all safety procedures for confined space entry in towers and vessels.
2. Identify all safety precautions for towers and vessels.
3. Explain the difference between coded and non-coded vessels.
4. Identify the various types of towers and their components.
5. Discuss the functions of various types of towers.
6. Identify the types of trays and their applications.
7. Identify materials, components, and layout of a tray.
8. Identify types of packing and packing materials.
9. Explain the shakeout for a repair job.
10. Describe typical maintenance procedures on a tower, including:
 - Removal of trays
 - Cleaning and inspection
 - Installation of trays
 - Installation of demisters and ceramics

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to do the following:

1. Explain the proper safety procedures and correct PPE to work in confined spaces.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen	DVD/video on confined spaces (optional)
Transparencies	TV/DVD/video player (optional)
Blank acetate sheets	Safety procedures on confined space entry
Transparency pens	Safety procedures on lockout/tagout
Whiteboard/chalkboard	Refining company safety manual
Markers/chalk	Pictures of different types of towers
Pencils and scratch paper	Copies of Quick Quizzes*
Appropriate personal protective equipment	Module Examination**
Packing	Performance Profile Sheets**
DVD/video on lockout/tagout (optional)	

*Located in the back of this module.

**Located in the Test Booklet.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module may require that the trainees visit job sites. Ensure that trainees are briefed on site safety policies prior to any site visits.

ADDITIONAL RESOURCES

This module is intended to present thorough resources for task training. The following reference works are suggested for both instructors and motivated trainees interested in further study. These are optional materials for continued education rather than for task training.

www.chevron.com/products/learning_center/refinery

www.lorien.ncl.ac.uk/ming/distil/distil10.htm

www.science.howstuffworks.com/oil-refining.htm

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 20 hours are suggested to cover *Distillation Towers and Vessels*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Sessions I and II. Introduction to Towers	
A. Introduction	_____
B. Towers	_____
C. Safety	_____
D. Confined Spaces	_____
E. Laboratory	_____
Trainees practice explaining the proper safety procedures and correct PPE to work in confined spaces. This laboratory corresponds to Performance Task 1.	
Session III. Vessels and Drums	
A. Vessels	_____
B. Drums	_____
Session IV. Trays and Packing	
A. Trays	_____
B. Packing	_____
Session V. Crackers and Cyclones	
A. Crackers	_____
B. Cyclones	_____
Sessions VI and VII. Drip Legs and Solids Flow Control	
A. Drip Legs	_____
B. Solids Flow Control	_____
C. The Refinery Process	_____
D. Equipment and Component Problems	_____

Session VIII. Review and Testing

A. Review

B. Module Examination

1. Trainees must score 70% or higher to receive recognition from NCCER.
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.

C. Performance Testing

1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.

MODULE OVERVIEW

This module introduces types of heat transfer and heating and cooling apparatus.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Industrial Maintenance Mechanic Level One*; and *Industrial Maintenance Mechanic Level Two*, Modules 32201-07 through 32210-07.

OBJECTIVES

Upon completion of this module, the trainee will be able to do the following:

1. Identify and describe the basic types of heaters and furnaces.
2. Explain the functions of heaters and furnaces within industry.
3. Identify various types of exchangers and cooling towers and their components.
4. Discuss the functions of various types of exchangers.
5. Describe the proper safety procedures and personal protective equipment associated with each type of equipment.
6. Explain how to remove and install an exchanger.
7. Describe the construction and operation of a cooling tower.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to do the following:

1. Identify the components of heat exchangers chosen by the instructor.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen

Transparencies

Blank acetate sheets

Transparency pens

Whiteboard/chalkboard

Markers/chalk

Pencils and scratch paper

Appropriate personal protective equipment

Copies of Quick Quizzes*

Module Examination**

Performance Profile Sheets**

* Located in the back of this module.

**Located in the Test Booklet.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module may require that the trainees visit job sites. Ensure that trainees are briefed on site safety policies prior to any site visits.

ADDITIONAL RESOURCES

This module is intended to present thorough resources for task training. The following reference works are suggested for both instructors and motivated trainees interested in further study. These are optional materials for continued education rather than for task training.

A number of web-based publications provide information on heating and cooling equipment:

www.pipingnews.com/heat_exchangers.htm has a calculator for heat exchange designations

The English website at www.lorien.ncl.ac.uk/ming/distil/distileqp.htm has information on different aspects of the distillation process.

The site at www.spiraxsarco.com has information on steam equipment and applications

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 30 hours are suggested to cover *Heaters, Furnaces, Heat Exchangers, Cooling Towers, and Fin Fans*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Sessions I through III. Introduction, Heaters, and Heat Exchangers I	
A. Introduction	_____
B. Heaters	_____
C. Heat Exchangers	_____
Sessions IV through VI. Heat Exchangers II	
A. Heat Exchangers	_____
B. Types of Reboilers	_____
C. Safe Removal and Installation of Heat Exchangers	_____
D. Heat Exchanger Types and Codes	_____
E. Common Problems with Heat Exchangers/Coolers	_____
F. Bellows	_____
Sessions VII and VIII. Air-Cooled Heat Exchangers	
A. Air-Cooled Heat Exchangers	_____
B. Laboratory	_____
Trainees practice identifying the components of a heat exchangers. This laboratory corresponds to Performance Task 1.	
Sessions IX through XI. Cooling Towers	
A. Cooling Towers	_____
B. Modular Towers	_____
C. Large Cooling Towers	_____
D. Distribution Systems	_____
E. Fans	_____

Session XII. Review and Testing

A. Review

B. Module Examination

1. Trainees must score 70% or higher to receive recognition from NCCER.
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.

C. Performance Testing

1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.

MODULE OVERVIEW

This module describes the various aspects of identifying problem tubes, tube rolling, tube plugging, and tube extraction.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Industrial Maintenance Mechanic Level One*; and *Industrial Maintenance Mechanic Level Two*, Modules 32201-07 through 32211-07.

OBJECTIVES

Upon completion of this module, the trainee will be able to do the following:

1. Identify rolling equipment.
2. Identify problem tubes.
3. Explain methods of rolling tubes, plugging tubes, and extracting tubes.

PERFORMANCE TASKS

Under the supervision of the instructor, the trainee should be able to do the following:

1. Identify rolling equipment.
2. Select the tools necessary for rolling tubes.
3. Identify types of plugs.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen

Transparencies

Blank acetate sheets

Transparency pens

Whiteboard/chalkboard

Markers/chalk

Pencils and scratch paper

Appropriate personal protective equipment

NDE testing equipment as available

Rolling equipment or manufacturers' literature

Various types of plugs

Copies of Quick Quiz*

Module Examination**

Performance Profile Sheets**

* Located in the back of this module

**Located in the Test Booklet.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module may require that the trainees visit job sites. Ensure that trainees are briefed on site safety policies prior to any site visits.

ADDITIONAL RESOURCES

This module is intended to present thorough resources for task training. The following reference works are suggested for both instructors and motivated trainees interested in further study. These are optional materials for continued education rather than for task training.

www.jfe-steel.co.jp/en/products/pipes/index.html

www.tcwilson.com/literature.php

www.goodway.com/company_info/news_events/boiler_tube_cleaning.aspx

www.watercressline.co.uk/tw/pages/92212bo2.htm

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 10 hours are suggested to cover *Introduction to Tube Work*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction and Identifying Tube Problems	
A. Introduction	_____
B. Identifying Tube Problems	_____
C. Condition Assessment Examination Methods	_____
D. Condition Assessment of Boiler Components and Auxiliaries	_____
E. Damage Mechanisms	_____
F. Overall Evaluation Program	_____
G. Detailed Inspection Program	_____
Session II. Tube Replacement	
A. Tubing Extraction	_____
B. Tube Sheet and Tubing End Hole Preparation	_____
C. Tube Placement	_____
D. Cleanliness and Use of Lubricants	_____
Sessions III. Tube Expanding	
A. Guideline Procedures for Expanding Tube Ends	_____
B. Tube Expanding Equipment	_____
C. Laboratory	_____
Trainees practice identifying rolling equipment. This laboratory corresponds to Performance Task 1.	
D. Expansion (Rolling) Procedure	_____
E. Sounding	_____

Sessions IV. Plugging of Tubes, Review and Testing

A. Pluggable Tubes

B. Guideline Procedures for Plugging Tubes in Drums and Headers

C. Review

D. Module Examination

1. Trainees must score 70% or higher to receive recognition from NCCER.

2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.

E. Performance Testing

1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.

2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.

