Tools of the Trade
Annotated Instructor's Guide

Module 40102-07

MODULE OVERVIEW

This module provides an introduction to the hand and power tools used in industrial maintenance. It covers safety procedures and techniques for use of these tools.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum* and *Industrial Maintenance E & I Technician Level One,* Module 40101-07.

OBJECTIVES

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

1. Explain the purpose of each of the tools commonly used by industrial maintenance craftworkers.
2. Describe how to maintain each of the tools used by industrial maintenance craftworkers.
3. Demonstrate the proper use and basic maintenance of selected industrial maintenance tools.

PERFORMANCE TASKS

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

1. Correctly use a pipe vise.
2. Correctly use a pipe threading machine.
3. Correctly use a cut-off machine.
4. Correctly use a portable power drive.
5. Demonstrate inspection and basic maintenance of tools 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
Pictures of various tools (optional)
Damaged or unsafe tools
Assorted diameters of pipe
Strap wrench/chain wrenches
Spanner wrenches
Taper gauges
Pipe and tubing cutters
Honing stones
Putty knives/scrapers
Drift pins
Barrel pins
Mallets
Steel hammers
Soft steel
Diagonal cutters
Tin snips
Taps and dies
Scribers
Tension meters
Sheave gauges
Cylinder hones
Gear pullers
Packing pullers
Reamers
Inspection mirrors
Retaining ring pliers
Spiral screw extractors
Tap extractors
Dial indicator
Feeler gauge

Sleever and alignment bars
Pipe sections
Scrap metal and equipment
Sheet metal
Patterns for shapes commonly cut in sheet metal
Old or broken motors, pumps, appliances, or other machines and equipment that trainees can disassemble and reassemble
Pipe sections
Portable band saw and blades
Grinders
Grinder accessories
Pipe vise
Pipe threading machine and die set
Operator's manual for pipe threading machine
Portable power drive
Geared threader and universal drive shaft
Cutting oil
Nipple chuck kit
Assorted hand tools for maintaining equipment
Copies of the Quick Quiz *
Module Examinations**
Performance Profile Sheet**

* 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 use hand and power tools. Ensure that all trainees are briefed on hand and power tools safety and any shop 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.

Tools and Their Uses, Latest Edition. Naval Education and Training Program and Development Center. Washington, DC: US Government Printing Offices.

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 *Tools of the Trade*. 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, Safety, and Hand Tools

A. Introduction _____

B. Hand Tools Safety _____

C. Use and Care of Hand Tools _____

D. Laboratory – Trainees practice using and caring for selected hand tools. This laboratory corresponds to Performance Tasks 1 and 5. _____

Session II. Power Tools, Review, and Performance Testing

A. Power Tool Safety _____

B. Power Tools _____

C. Laboratory – Trainees practice using a pipe threading machine, cut-off machine, and portable power drive. This laboratory corresponds to Performance Tasks 2 through 4. _____

D. Review _____

E. 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.

F. 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.

Fasteners and Anchors
Annotated Instructor's Guide

Module 40103-07

MODULE OVERVIEW

This module covers the hardware and systems used by an industrial maintenance craftperson. It also describes various types of anchors and supports, their applications, and how to install them safely.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum;* and *Industrial Maintenance E & I Technician Level One*, Modules 40101-07 and 40102-07.

OBJECTIVES

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

1. Identify and explain the use of threaded fasteners.
2. Identify and explain the use of non-threaded fasteners.
3. Identify and explain the use of anchors.
4. Select the correct fasteners and anchors for given applications.
5. Install fasteners and anchors.

PERFORMANCE TASKS

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

1. Install threaded fasteners.
2. Install selected screws.
3. Install selected anchors.
4. Install selected toggle bolts.

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
Miscellaneous hand tools used with screws and bolts
Various types of screws and bolts
Various types of nuts
Several types of washers
Torque wrench
Retaining rings
Keys
Motor
Pin fasteners
Taper, spring, and cotter pins
Pop rivets
Rivet gun
Tie wraps
Eye bolts
Threaded inserts
J-nuts
Cage nuts
One-step anchors
Wedge anchors
Stud bolt anchors
Sleeve anchors
Hammer-set anchors
Threaded rod anchors
Lead or caulk-in anchors
Single- and double-expansion anchors
Manufacturer's literature on anchors
Masonry anchors

Two-part epoxy anchor
Collection of odd screws, bolts, and fasteners
Thread gauges
Micrometers
Gypsum wallboard (optional)
Plywood (optional)
Weights or other loads
Copies of the Quick Quiz*
Module Examinations**
Performance Profile Sheet**

* 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 use hand and power tools. Emphasize basic 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. This is optional material for continued education rather than for task training.

http://www.Thomasglobal.com
http://www.confast.com
http://www.boltdepot.com/fastenerinformation

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 *Fasteners and Anchors*. 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, Threaded Fasteners, and Non-Threaded Fasteners	
A. Introduction	_____
B. Thread Standards	_____
C. Bolt and Screw Types	_____
D. Nuts and Washers	_____
E. Installing Threaded Fasteners	_____
F. Laboratory – Trainees practice installing threaded fasteners, screws, and toggle bolts. This laboratory corresponds to Performance Tasks 1, 2, and 4.	_____
G. Non-Threaded Fasteners	_____
H. Special Threaded Fasteners	_____
Session II. Anchors, Review, and Testing	
A. Mechanical Anchors	_____
B. Epoxy Anchoring Systems	_____
C. Laboratory – Trainees practice installing anchors. This laboratory corresponds to Performance Task 3.	_____
D. Review	_____
E. 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.	
F. 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.	

Oxyfuel Cutting
Annotated Instructor's Guide

Module 40104-07

MODULE OVERVIEW

This module explains the safety requirements for oxyfuel cutting. It identifies oxyfuel cutting equipment and provides instruction for setting up, lighting, and using the equipment. It includes straight line cutting, piercing, beveling, and washing.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Industrial Maintenance E & I Technician Level One*, Modules 40101-07 through 40103-07.

OBJECTIVES

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

1. Identify and explain the use of oxyfuel cutting equipment.
2. State the safety precautions for using oxyfuel equipment.
3. Set up oxyfuel cutting equipment.
4. Light and adjust an oxyfuel torch.
5. Shut down oxyfuel cutting equipment.
6. Disassemble oxyfuel equipment.
7. Change empty cylinders.
8. Perform oxyfuel cutting:
   - Straight line and square shapes
   - Piercing and slot cutting
   - Bevels
   - Washing
9. Apply a rosebud flame to remove frozen components (also for preheat and expanding larger fittings).
10. Operate a motorized, portable oxyfuel gas cutting machine.

PERFORMANCE TASKS

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

1. Set up oxyfuel equipment.
2. Light and adjust an oxyfuel torch.
3. Shut down and disassemble oxyfuel cutting equipment.
4. Perform oxyfuel cutting:
   - Straight line and square shapes
   - Piercing and slot cutting
   - Bevels
   - Washing
5. Operate a track burner.

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
  Safety goggles
  Face shields
  Welding helmets
  Ear protection
  Welding cap
  Leather jacket
  Leather pants or chaps
  Gauntlet-type welding gloves
  Respirators
ANSI Z49.1-1999
OSHA 29 CFR 1910.146
Brass valves
MSDS for cutting products
Oxygen cylinder with cap
Fuel gas cylinder with cap
Regulators (oxygen and fuel gas)
Hose set
One-piece cutting torch
Combination cutting torch and torch tips
Assorted acetylene, liquefied fuel gas, and special-purpose cutting torch tips
Tip cleaners
Tip drills
Mechanical guide
Cylinder cart
Motorized oxyfuel track cutter
Framing squares
Combination squares with protractor head
Tape measure
Soapstone
Penknife
Pliers
Chipping hammer
Friction lighter
Tip manuals and tip manufacturer's charts
Vendor cutting tip chart
Wrenches (torch, hose, and regulator)
Examples of good and bad cuts
Steel plate
  Thin (16 to 10 gauge)
  Thick (¼ inch to 1 inch)
Steel pipe
Vises and pipe jacks to hold steel for cutting
Grinding equipment
Safety video/DVD (optional)
TV/VCR/DVD player (optional)
Copies of the Trade Terms Quiz*
Module Examinations**
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 requires that the trainees operate oxyfuel cutting equipment. Ensure that trainees are briefed on fire and shop safety policies prior to performing any work. Emphasize the special safety precautions associated with the use of cylinders and oxyfuel cutting equipment.

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.

Safety in Welding, Cutting, and Allied Processes, ANSI Z49.1-99, 1999. Miami, FL: American Welding Society.

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 17½ hours are suggested to cover *Oxyfuel Cutting*. 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, Safety, and Oxyfuel Cutting Equipment	
A. Introduction	_____
B. Oxyfuel Cutting Safety	_____
C. Oxyfuel Cutting Equipment	_____
1. Cylinders, Regulators, and Hoses	_____
2. Cutting Torch, Tips, and Tip Equipment	_____
3. Friction Lighters	_____
4. Cylinder Cart	_____
5. Soapstone Markers	_____
6. Specialized Equipment	_____
Session II. Setting Up Oxyfuel Equipment	
A. Setting Up Oxyfuel Equipment	_____
1. Cylinders	_____
2. Hoses and Regulators	_____
3. Torches and Tips	_____
4. Purging and Testing	_____
B. Laboratory – Trainees practice setting up oxyfuel equipment. This laboratory corresponds to Performance Task 1.	_____
Sessions III and IV. Torch Operations	
A. Controlling the Oxyfuel Torch Flame	_____
B. Shutting Down Oxyfuel Equipment	_____
C. Laboratory – Trainees practice lighting, adjusting, and shutting down the equipment. This laboratory corresponds to Performance Tasks 2 and 3.	_____
D. Disassembling Oxyfuel Equipment	_____
E. Changing Empty Cylinders	_____
F. Laboratory – Trainees practice disassembling the equipment. This laboratory corresponds to Performance Task 3.	_____
Sessions IV and V. Performing Cutting Operations	
A. Performing Cutting Procedures	_____
B. Laboratory – Trainees practice oxyfuel cutting. This laboratory corresponds to Performance Task 4.	_____

Session VI. Portable Cutting Machine Operation

A. Portable Oxyfuel Cutting Machine Operation _____

B. Laboratory – Trainees practice operating a track burner. This laboratory corresponds to Performance Task 5. _____

Session VII. 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.

Gaskets and Packing
Annotated Instructor's Guide

Module 40105-07

MODULE OVERVIEW

This module introduces types of gaskets and gasket material, types of packing and packing material, and types of O-ring material. It also explains the use and choice of gaskets, packing, and O-rings, and teaches how to fabricate a gasket.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Industrial Maintenance E & I Technician Level One,* Modules 40101-07 through 40104-07.

OBJECTIVES

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

1. Identify the various types of gaskets and explain their uses.
2. Identify the various types of gasket materials and explain their applications.
3. Lay out, cut, and install a flange gasket.
4. Describe the use of O-rings.
5. Explain the importance of selecting the correct O-ring for an application.
6. Select an O-ring for a given application and install it.
7. Describe the uses and methods of packing.

PERFORMANCE TASKS

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

1. Lay out and install a gasket.
2. Cut and install packing.
3. Install O-rings.

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

Assorted gaskets

Gasket manufacturer's literature including color coding chart

Pump manufacturer's literature specifying replacement gaskets

Samples of some of the more common gasket materials

Hand tools for measuring and cutting gaskets

Dividers

Scribers

Steel rules

Adjustable gasket cutters

Hole punch sets

Mallets

Compasses with an ink pen holder and ink pens with silver or white ink

Gasket materials or old rubber inner tubes that can be cut up as substitute gasket material

Various types of packing

Old appliances, pumps, or valves with packing seals

Sheet metal

Tin snips

Bluing

Rags

Hand tools for assembling and disassembling valves and motors

Torque wrenches

Flanges

Old or broken equipment such as pumps, motors, and old appliances

Assorted O-rings

Packing manufacturer's literature

Copies of Quick Quiz*

Module Examinations**

Performance Profile Sheet**

* 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 work with equipment and cut gaskets. Ensure that all trainees are briefed on hand tool safety and have appropriate personal protection equipment.

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.

Specifications for Gaskets, O-Rings, and Packing. Washington, DC: American National Standards Institute. (ANSI).

Specifications for Gaskets, O-Rings, and Packing. West Conshohoken, PA: American Society for Testing and Materials.

Specifications for Gaskets, O-Rings, and Packing. Warrendale, PA: Society of Automotive Engineers.

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 *Gaskets and Packing*. 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, Gaskets, and Gasket Materials	
A. Introduction	_____
B. Types of Gaskets	_____
C. Gasket Materials	_____
Session II. Fabricating and Installing Gaskets	
A. Laying Out a Gasket	_____
B. Tracing a Gasket	_____
C. Machine Gaskets	_____
D. Installing Gaskets	_____
E. Laboratory – Trainees practice laying out and installing a gasket. This laboratory corresponds to Performance Task 1.	_____
Session III. Installing Packing and O-Rings	
A. Packing	_____
B. Laboratory – Trainees practice cutting and installing packing. This laboratory corresponds to Performance Task 2.	_____
C. O-Rings	_____
D. Laboratory – Trainees practice installing an O-ring. This laboratory corresponds to Performance Task 3.	_____

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.

Craft-Related Mathematics

Annotated Instructor's Guide

Module 40106-07

MODULE OVERVIEW

This module explains how to use ratios and proportions, solve basic algebra, area, volume, and circumference problems, and solve for right triangles using the Pythagorean theorem.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Industrial Maintenance E & I Technician Level One,* Modules 40101-07 through 40105-07.

OBJECTIVES

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

1. Identify and explain the use of special measuring devices.
2. Use tables of weights and measurements.
3. Use formulas to solve basic problems.
4. Solve area problems.
5. Solve volume problems.
6. Solve circumference problems.
7. Solve right triangles using the Pythagorean theorem.

PERFORMANCE TASKS

This is a knowledge-based module; there are no Performance Tasks.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Architect's scale
Engineer's scale
Copies of the Quick Quiz*
Module Examinations**

* 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.

Pipe Fitter's Math Guide, 1989. Johnny Hamilton. Clinton, NC: Construction Trade Press.

Applied Construction Math, Latest Edition. Upper Saddle River, NJ: Prentice Hall Publishing.

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 *Craft-Related Mathematics*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources.

Topic	**Planned Time**
Sessions I and II. Measuring and Using Tables and Formulas	
A. Introduction	_____
B. Special Measuring Devices	_____
C. Using Tables	_____
D. Using Ratios and Proportions	_____
E. Using Formulas	_____
Session III. Solving Area Problems	
A. Rectangles	_____
B. Triangles	_____
C. Circles	_____
Session IV. Solving Volume Problems	
A. Rectangular Solids	_____
B. Cylinders	_____
C. Spheres	_____
D. Pyramids	_____
E. Cones	_____
Session V. Solving Circumference Problems and Right Triangles	
A. Solving Circumference Problems	_____
B. Pythagorean Theorem	_____
Session VI. Review and Testing	
A. Module 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.

Construction Drawings
Annotated Instructor's Guide

Module 40107-07

MODULE OVERVIEW

This module introduces the trainee to plot plans, structural drawings, elevation drawings, as-built drawings, equipment arrangement drawings, P&IDs, isometric drawings, spool sheets, and detail sheets.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Industrial Maintenance E & I Technician Level One,* Modules 40101-07 through 40106-07.

OBJECTIVES

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

1. Explain the basic layout of a blueprint.
2. Describe the information included in the title block of a blueprint.
3. Identify the types of lines used on blueprints.
4. Identify common symbols used on blueprints.
5. Understand the use of architect's and engineer's scales.
6. Demonstrate the use of an architect's scale.

PERFORMANCE TASKS

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

1. Identify parts of a drawing:
   - Title block
   - Scales and measurements
   - Symbols and abbreviations
   - Notes
   - Revision blocks
   - Coordinates
2. Interpret the following:
   - Drawing indexes
   - Line lists
3. Identify the following types of drawings:
   - Plot plans
   - Structural drawings
   - Elevation and section drawings
   - P&IDs
   - Schematics
   - Circuit diagrams
   - Orthographic drawings

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
Set of blueprints
  Site plan
  Floor plan
  Cross sections and detail drawings
Circuit diagrams
Architect's scale
Engineer's scale
Metric scale
Digital scaling tool (optional)
Schematics
Exploded diagrams
Specifications
Calculators
Copies of the Quick Quizes*
Module Examinations**
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 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.

American Electrician's Handbook, 2002. Terrell Croft, Winfred Summers. New York, NY: McGraw-Hill.

National Electrical Code® Handbook, Latest Edition. Quincy, MA: National Fire Protection Association.

The Pipefitter's Bluebook, Latest Edition. 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 12½ hours are suggested to cover *Construction Drawings*. 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. Identifying and Interpreting Drawings	
A. Introduction	_____
B. Blueprint Layout	_____
C. Scale Drawings	_____
D. Analyzing Drawings	_____
E. Laboratory – Trainees practice identifying parts of drawings. This laboratory corresponds to Performance Task 1.	_____
F. Drafting Lines	_____
G. Laboratory – Trainees practice interpreting drawing indexes and line lists. This laboratory corresponds to Performance Task 2.	_____
Sessions III through IV. Identifying Different Types of Drawings	
A. Circuit Diagrams	_____
B. Scale Drawings	_____
C. Site Plans	_____
D. Floor Plans	_____
E. Elevation and Section Drawings	_____
F. P&IDs	_____
G. Schematics	_____
H. Exploded Diagrams	_____
I. Writing Specifications	_____
J. Laboratory – Trainees practice identifying different types of drawings. This laboratory corresponds to Performance Task 3.	_____
Session V. Review and Testing	
A. Module 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.	

Pumps and Drivers
Annotated Instructor's Guide

Module 40108-07

MODULE OVERVIEW

This module explains centrifugal, rotary, reciprocating, metering, and vacuum pump operation and installation methods, as well as types of drivers. It also covers net positive suction head and cavitation.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Industrial Maintenance E & i technician Level One,* Modules 40101-07 through 40107-07.

OBJECTIVES

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

1. Identify and explain centrifugal pumps.
2. Identify and explain rotary pumps.
3. Identify and explain reciprocating pumps.
4. Identify and explain metering pumps.
5. Identify and explain vacuum pumps.
6. Explain net positive suction head and cavitation.
7. Identify types of drivers.

PERFORMANCE TASKS

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

1. Identify centrifugal pumps.
2. Identify rotary pumps.
3. Identify reciprocating pumps.
4. Identify metering pumps.
5. Identify vacuum pumps.

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
Various types of centrifugal pumps
Various types of rotary pumps
Glass of water
Small object
Several types of reciprocating pumps
Hot water bottle with small hose
Several types of metering pumps
Various types of vacuum pumps
Manufacturer's installation instructions for a pump
Copies of the Quick Quizzes*
Module Examinations**
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. If you require trainees to visit power plants or utility areas, ensure that they 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.

Mechanical and Electrical Systems in Building, Third Edition. Upper Saddle River, NJ: Prentice Hall Publishing.

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 *Pumps and Drivers*. 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. Identifying Pumps I	
A. Introduction	_____
B. Centrifugal Pumps	_____
C. Laboratory – Trainees practice identifying centrifugal pumps. This laboratory corresponds to Performance Task 1.	_____
D. Rotary Pumps	_____
E. Laboratory – Trainees practice identifying rotary pumps. This laboratory corresponds to Performance Task 2.	_____
F. Reciprocating Pumps	_____
G. Laboratory – Trainees practice identifying reciprocating pumps. This laboratory corresponds to Performance Task 3.	_____
H. Metering Pumps	_____
I. Laboratory – Trainees practice identifying metering pumps. This laboratory corresponds to Performance Task 4.	_____

Session II. Pumps II, Cavitation, Drivers, Review and Testing

A. Vacuum Pumps _____

B. Laboratory – Trainees practice identifying vacuum pumps. This laboratory corresponds to Performance Task 5. _____

C. Cavitation _____

D. Installing Pumps _____

E. Drivers _____

F. Module 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.

Valves

Annotated Instructor's Guide

Module 40109-07

MODULE OVERVIEW

This module identifies and provides installation methods for different types of valves. It also covers valve storage and handling.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Industrial Maintenance E & I Technician Level One,* Modules 40101-07 through 40108-07.

OBJECTIVES

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

1. Identify types of valves that start and stop flow.
2. Identify types of valves that regulate flow.
3. Identify valves that relieve pressure.
4. Identify valves that regulate the direction of flow.
5. Explain how to properly store and handle valves.
6. Explain valve locations and positions.

PERFORMANCE TASKS

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

1. Identify types of valves that start and stop flow.
2. Identify types of valves that regulate flow.
3. Identify valves that relieve pressure.
4. Identify valves that regulate the direction of flow.
5. Demonstrate how to properly store and handle valves.
6. Demonstrate valve locations and positions.

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
Gate valves with various types of bonnets and stems
Knife gate valve
Ball valves
Venturi-type and top-entry ball valves
Various types of plug valves
Plug lubricants
Globe valves
Angle valves
Y-type valves
Butterfly valves
Diaphragm valves
Needle valves
Control valves
Safety valves
Pressure-relief valves
Various types of check valves
Swing check valves
Lift check valves
Ball check valves
Butterfly check valves
Foot valves
Gear operators
Chain operators

Electric motor-driven actuators
Pneumatic and hydraulic actuators
Photograph or picture of valve boxes
Manufacturers' literature on pressure-relief valves
Backflow preventer
Copies of the Quick Quizzes*
Module Examinations**
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. If you require trainees to visit construction sites or utility areas, ensure that they are briefed on site 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. This is optional material for continued education rather than for task training.

Choosing the Right Valve. New York, NY: Crane Company.

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

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 *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. Introduction to Valves	
A. Introduction	_____
B. Valves That Start and Stop Flow	_____
C. Laboratory – Trainees practice identifying valves that start and stop flow. This laboratory corresponds to Performance Task 1.	_____
D. Valves that Regulate Flow and Pressure	_____
E. Laboratory – Trainees practice identifying valves that regulate flow. This laboratory corresponds to Performance Task 2.	_____
F. Valves That Relieve Pressure	_____
G. Laboratory – Trainees practice identifying valves that relieve pressure. This laboratory corresponds to Performance Task 3.	_____
H. Valves That Regulate the Direction of Flow	_____
I. Laboratory – Trainees practice identifying valves that regulate the direction of flow. This laboratory corresponds to Performance Task 4.	_____

Session II. Installation, Applications, Review, and Testing

A. Valve Actuators _____

B. Storing and Handling Valves _____

C. Laboratory – Trainees practice properly handling and storing valves. This laboratory corresponds to Performance Task 5. _____

D. Installing Valves _____

E. Valve Selection, Types, and Applications _____

F. Valve Markings _____

G. Laboratory – Trainees practice identifying valve locations and positions. This laboratory corresponds to Performance Task 6. _____

H. Module Review _____

I. 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.

J. Performance Testing _____

1. Trainees must perform each task to the satisfaction of the instructor to receive 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.

Introduction to Test Instruments
Annotated Instructor's Guide

Module 40110-07

MODULE OVERVIEW

This module introduces the basic test equipment that an industrial maintenance E & I technician might use, including tachometers, pyrometers, strobe meters, voltage testers, and automated diagnostic tools.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Industrial Maintenance E & I Technician Level One*, Modules 40101-07 through 40109-07.

OBJECTIVES

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

1. Explain the operation of and describe the following pieces of test equipment:
   - Tachometers
   - Pyrometers
   - Multimeters
   - Automated diagnostic tools
   - Wiggy® voltage tester
   - Stroboscope
2. Explain how to read and convert from one scale to another using the above test equipment.
3. Define frequency and explain the use of a frequency meter.

PERFORMANCE TASKS

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

1. Demonstrate the use of the following pieces of test equipment:
   - Tachometer
   - Pyrometer
   - Multimeter
   - Voltage tester
   - Strobe light
2. Demonstrate the use of automated diagnostic tools 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
  Gloves
  Rubber sleeves
  Rubber blankets
Test circuits
Volt-ohm-milliammeter and operator's manual
Digital multimeter and operator's manual
Clamp-type multimeter and operator's manual
Frequency meter and operator's manual
Tachometer and operator's manual
Voltage tester and operator's manual
Strobe light and operator's manual
Pyrometer and operator's manual
Company safety manual
Copies of the Quick Quiz*
Module Examinations**
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 requires trainees to use various types of test equipment. Ensure that all trainees are briefed on electrical safely and any other shop 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.

Electronics Fundamentals, Thomas L. Floyd. New York: Prentice Hall.

Principles of Electric Circuits, Thomas L. Floyd. New York: 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 7½ hours are suggested to cover *Introduction to Test Instruments*. 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 Meters I	
A. Introduction	_____
B. Volt-Ohm-Milliammeter	_____
C. Digital Meters	_____
D. Laboratory – Trainees practice using selected test equipment. This laboratory corresponds to Performance Task 1.	_____
Session II. Meters II and Safety	
A. Frequency Meter	_____
B. Continuity Tester	_____
C. Voltage Tester	_____
D. Laboratory – Trainees practice using selected test equipment. This laboratory corresponds to Performance Task 1.	_____
E. Safety	_____

Session III. Troubleshooting Motors, Review, and Testing

A. Troubleshooting Motors _____

B. Laboratory – Trainees practice using selected automated diagnostic tools. This laboratory corresponds to Performance Task 2. _____

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.

Material Handling and Hand Rigging
Annotated Instructor's Guide

Module 40111-07

MODULE OVERVIEW

This module introduces the maintenance craftworker to the equipment and techniques of material handling, and to the basic knowledge required for rigging and communicating with riggers.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum*; *Industrial Maintenance E & I Technician Level One*, Modules 40101-07 through 40110-07.

OBJECTIVES

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

1. Identify and describe the uses of common rigging hardware and equipment.
2. Inspect common rigging equipment.
3. Select, use, and maintain special rigging equipment, including:
   - Jacks
   - Block and tackle
   - Chain hoists
   - Come-alongs
4. Tie knots used in rigging.
5. Use and understand the correct hand signals to guide a crane operator.
6. Identify basic rigging and crane safety procedures.

PERFORMANCE TASKS

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

1. Perform a safety inspection on hooks, slings, and other rigging equipment.
2. Select, inspect, and use special rigging equipment, including:
   - Block and tackle
   - Chain hoists
   - Come-alongs
   - Jacks
   - Tuggers
3. Tie knots used in rigging.
4. Determine the center of gravity of a load.
5. Properly attach rigging hardware for routine lifts.
6. Use and interpret hand signals.
7. Perform sling tension calculations.

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
Manufacturer's literature on different rigging hooks
Various rigging hooks with wear, cracks, and corrosion
Manufacturer's literature on shackles
Various types of shackles
Various eyebolts
Various lifting lugs
Turnbuckles
Manufacturer's literature on beam clamps
Manufacturer's literature on plate clamps
Various rigging plates and links
Various types of slings
Rigging pocket guide
29 CFR Section 1926.251, Rigging Equipment for Material Handling
Samples of wire rope that have failed inspection
Rope for tying knots
Block and tackle lifting system
Sample loads for lifting
Spur-geared chain hoist
Electric chain hoist
Ratchet-lever hoist or come-along
Ratchet jack
Screw jack
Hydraulic jack
Tugger
Walkie-talkies
Throat microphone
Hardwired communication system
ASME B30.5 Consensus Standard
29 CFR 1926.550
Completed lift plan
Crane manufacturer's literature
Typical teeter-totter and weights
Various lifting eyebolts
Rigging hardware
Copies of the Quick Quizzes*
Module Examinations**
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 requires trainees to use various types of hoists, jacks, and tuggers. Ensure that all trainees are briefed on lifting safely and any other shop safety procedures. If you require trainees to visit job sites, ensure that trainees are briefed on site safety policies.

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.

Machinery's Handbook, Latest Edition. Erik Oberg, Franklin D. Jones, Holbrook L. Horton, and Henry H. Ryffel. New York, NY: Industrial Press Inc.

Occupational Safety and Health Standards for the Construction Industry, 29 CFR Part 1926. Washington, DC: OSHA Department of Labor, U.S. Government Printing Office.

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 *Material Handling and Hand Rigging*. 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 and Rigging Hardware	
A. Introduction	_____
B. Rigging Hardware	_____
C. Laboratory – Trainees practice attaching rigging hardware for routine lifts. This laboratory corresponds to Performance Task 5.	_____
D. Determining Sling Tension	_____
E. Laboratory – Trainees practice calculating sling tension. This laboratory corresponds to Performance Task 7.	_____
F. Slings	_____
G. Laboratory – Trainees practice performing a safety inspection on hooks, slings, and other rigging equipment. This laboratory corresponds to Performance Task 1.	_____
H. Tag lines	_____
I. Laboratory – Trainees practice tying knots used in rigging. This laboratory corresponds to Performance Task 3.	_____
Session III. Block and Tackle and Hoists	
A. Block and Tackle	_____
B. Chain Hoists	_____
C. Ratchet-Lever Hoists and Come-Alongs	_____
D. Jacks	_____
E. Tuggers	_____
F. Laboratory – Trainees practice selecting, inspecting, and using special rigging equipment. This laboratory corresponds to Performance Task 2.	_____

Sessions IV and V. Cranes

A. Cranes _____

B. Laboratory – Trainees practice using and interpreting hand signals. This laboratory corresponds to Performance Task 6. _____

C. General Rigging Safety _____

D. Laboratory – Trainees practice determining the center of gravity. This laboratory corresponds to Performance Task 4. _____

E. Working Around Power Lines _____

F. Site Hazards and Emergency Response _____

G. Using Cranes to Lift Personnel _____

H. Lift Planning _____

I. Crane Component Terminology _____

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.

Mobile and Support Equipment
Annotated Instructor's Guide

Module 40112-07

MODULE OVERVIEW

This module explains the safety procedures and methods of operation for motorized support equipment, including forklifts, manlifts, compressors, and generators.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum;* and *Industrial Maintenance E & I Technician Level One*, Modules 40101-07 through 40111-07.

OBJECTIVES

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

1. State the safety precautions associated with the use of motor-driven equipment in industrial plants.
2. Explain the operation and applications of the following motor-driven equipment commonly used in industrial plants:
   - Portable generators
   - Air compressors
   - Portable pumps
   - Aerial lifts
   - Forklifts
   - Mobile cranes
3. Operate and perform preventive maintenance on the following equipment:
   - Portable generators
   - Air compressors
   - Aerial lifts

PERFORMANCE TASKS

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

1. Describe an aerial lift inspection.

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
Portable generators and accessories
Portable generator operator's manual
Portable air compressor and accessories
Portable air compressor operator's manual
29 CFR 1926.453
Aerial lift operator's manual
Pallet jack and pallets
Copies of the Quick Quiz*
Module Examinations**
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 requires trainees to use various types of mobile and support equipment. Review hazards associated with each type of equipment and general precautions needed when operating mobile and support equipment.

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.

Construction Equipment Guide, Latest Edition. New York, NY: John Wiley & Sons.

Machinery's Handbook, Latest Edition. Erik Oberg, Franklin D. Jones, Holbrook L. Horton, and Henry H. Ryffel. New York, NY: Industrial Press, Inc.

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 *Mobile and Support Equipment*. 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, Safety, and Generators	
A. Introduction	_____
B. Safety Precautions	_____
C. Generators	_____
Session II. Air Compressors and Aerial Lifts	
A. Air compressors	_____
B. Aerial Lifts	_____
C. Laboratory – Trainees describe an aerial lift inspection. This laboratory corresponds to Performance Task 1.	_____
Session III. Forklifts and Cranes	
A. Forklifts	_____
B. Cranes	_____

Session IV. Review, Module Examination, and Performance 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.

Lubrication
Annotated Instructor's Guide

Module 40113-07

MODULE OVERVIEW

This module explains lubrication safety, storage, and classifications. It also explains selecting lubricants, additives, lubrication equipment, and lubricating charts.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum;* and *Industrial Maintenance E & I Technician Level One*, Modules 40101-07 through 40112-07.

OBJECTIVES

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

1. Explain OSHA hazard communication as pertaining to lubrication.
2. Read and interpret a material safety data sheet (MSDS).
3. Explain the EPA hazardous waste control program.
4. Explain lubricant storage.
5. Explain lubricant classification.
6. Explain lubricant film protection.
7. Explain properties of lubricants.
8. Explain properties of greases.
9. Explain how to select lubricants.
10. Identify and explain types of additives.
11. Identify and explain types of lubricating oils.
12. Identify and use lubrication equipment to apply lubricants.
13. Read and interpret a lubrication chart.

PERFORMANCE TASKS

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

1. Read and interpret an MSDS.
2. Identify and use lubricating equipment to apply lubricants.
3. Read and interpret a lubrication chart.

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

MSDS for lubricants

Lubricants with various viscosities

Heat source

Various types of grease

Product literature for lubricants with additives or lubricant additives

Lubricating oils or product literature on lubricating oils

Manual lubricating equipment:

- Lever gun
- Transfer pump
- Gear lube dispenser
- Bucket pump

Power-operated lubrication equipment

Lubrication fittings
Lubrication chart
Old or broken equipment, such as pumps or motors, and corresponding lubrication charts

Copies of the Quick Quiz*
Module Examinations**
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 requires trainees to use various types of lubricants and lubricating equipment. Review hazards associated with each type of lubricant and additive and general precautions needed when using, storing, and disposing of lubricants.

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.

Shell Lubricants Handbook, available through Shell Lubricant Sales Offices and Suppliers, published yearly.

Chevron Salesfax Digest, available through Chevron Lubricant Sales Offices and Suppliers, published yearly.

Mobil Brief Products Descriptions, available through Mobil Lubricant Sales Offices and Suppliers, published yearly.

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 12½ hours are suggested to cover *Lubrication*. 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 Safety	
A. Introduction	_____
B. Lubrication Safety and OSHA standards	_____
C. MSDS	_____
D. Laboratory – Trainees practice reading and interpreting an MSDS. This laboratory corresponds to Performance Task 1.	_____
E. EPA Programs	_____
F. Storing Lubricants	_____
Session II. Lubricants	
A. Lubricant Film Protection	_____
B. Properties of Lubricants	_____
C. Properties of Grease	_____
D. Selecting Lubricants	_____
E. Additives	_____
F. Lubricating Oils	_____

Sessions III and IV. Equipment and Methods

A. Manual Lubricating Equipment _____
B. Power-Operated Lubricating Equipment _____
C. Lubrication Fittings _____
D. Lubricating Methods _____
E. Laboratory – Trainees practice identifying and using lubricating equipment to apply lubricants. This laboratory corresponds to Performance Task 2. _____
F. Lubrication Charts _____
G. Laboratory – Trainees practice reading a lubrication chart. This laboratory corresponds to Performance Task 3. _____

Session V. Review, Module Examination, and Performance 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.

SMAW – Equipment and Setup
Annotated Instructor's Guide

Module 29107-09

Module Overview

This module covers shielded metal arc welding (SMAW) safety, types of SMAW equipment, and how to set up SMAW equipment for use.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum* and *Welding Level One*, Modules 29101-09 through 29106-09.

Objectives

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

1. Identify and explain shielded metal arc welding (SMAW) safety.
2. Explain welding electrical current.
3. Identify welding power supplies and their characteristics.
4. Explain how to set up welding power supplies.
5. Set up a machine for welding.
6. Identify tools used for weld cleaning.

Performance Tasks

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

1. Set up a SMAW machine for welding.

Materials and Equipment List

Markers/chalk
Pencils and scratch paper
Whiteboard/chalkboard
Welding 1 PowerPoint® Presentation Slides (ISBN 0-13-609092-3)
Multimedia projector and screen
Desktop or laptop computer
Appropriate personal protective equipment
Welding cables
Lugs and quick disconnects
Workpiece clamps
Electrode holders
Electrical plugs used with welding machines and matching electrical outlets
Chipping hammers
Wire brushes
Files
Pneumatic weld flux chipper
Pneumatic needle scaler
Transformer welding machine
Transformer-rectifier welding machine
Motor generator welding machine
Engine-driven generator welding machine and alternator
(If any of these welding machines are unavailable, provide photos instead)
Module Examinations*
Performance Profile Sheets*

*Located in the Test Booklet

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment. Review general safety guidelines associated with arc welding and engine-driven machinery, including electrical safety and procedures to prevent carbon monoxide poisoning. Explain that welding machines are heavy and can cause injury if they fall on people. Proper rigging devices and procedures must be used when lifting and moving welding machines. Emphasize that welding sparks can cause batteries to explode, showering the area with acid.

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.

OSHA Standard 1926.351, Arc Welding and Cutting.
The Procedure Handbook of Arc Welding, 2000. Cleveland, OH: The Lincoln Electric Company.
Stick Electrode Welding Guide, 2004. Cleveland, OH: The Lincoln Electric Company.
Stick Electrode Product Catalog, 2008. Cleveland, OH: The Lincoln Electric Company.

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 *SMAW – Equipment and Setup.* 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. Shielded Metal Arc Welding	
A. Introduction	_____
B. SMAW Safety	_____
1. Moving Welding Equipment	_____
2. Electrical Hazards	_____
3. Lifting Hazards	_____
4. Working at Heights	_____
5. Welding Hazards	_____
C. Welding Current	_____
1. Types of Welding Current	_____
2. Polarity	_____
3. Characteristics of Welding Current	_____
D. SMAW Machines	_____
1. SMAW Machine Classifications	_____
2. SMAW Machine Types	_____
3. SMAW Machine Ratings	_____
4. Welding Cable	_____
5. SMAW Cable Connectors	_____
E. SMAW Equipment Setup	_____
1. Selecting the Proper SMAW Equipment	_____
2. Welding Machine Location	_____
3. Moving a Welding Machine	_____
4. Stringing Welding Cable	_____
5. Locating the Workpiece Clamp	_____
F. Starting SMAW Welding Machines	_____
1. Energizing Electrically Powered Welding Machines	_____
2. Starting Engine-Driven Welding Machines	_____
G. Tools for Cleaning Welds	_____
1. Hand Tools	_____
2. Pneumatic Cleaning and Slag Removal Tools	_____

Session II. Laboratory; Review and Testing

A. Laboratory _____

Trainees practice setting up a machine for welding.

B. Module Review _____

C. Module Examination _____

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

D. Performance Testing _____

1. Trainees must complete each task to the satisfaction of the instructor to receive recognition from the 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.