

15201

Craft-Related Mathematics

Millwright

Overview

Craftworkers constantly use math to solve problems as they complete their tasks. Geometry helps them calculate the areas and volumes of real objects. Equations provide answers to difficult questions. Tables, calculators, and smartphone apps simplify problem solving. Without math, craftworkers can only guess and hope. With math, they can confidently expect a solution to work exactly as planned. While building math skills takes time and effort, the benefits greatly outweigh the investment.

Learning Objective 1

Successful completion of this module prepares trainees to:

Use formulas to solve craft-related math problems.

- a. Calculate with fractions, factors, powers, and roots.
- b. Construct and evaluate formulas using symbols and rules.
- c. Solve problems containing ratios and proportions.
- d. Solve right triangle problems.
- e. Solve circle problems.
- f. Calculate the area of various geometric figures.
- g. Calculate the volume of three-dimensional objects.
- h. Calculate an object's weight from its volume.

Performance Tasks

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

Recommended Teaching Time: 20 hours

Classroom Equipment and Materials

- Whiteboard and markers
- Pencils and paper
- PowerPoint® Presentations for Module 15201
- A variety of standard marker sizes

- Poster board
- Flip chart
- LCD projector and screen
- Computer with internet access
- Module Review answer key
- Module Examinations

15302

Precision Measuring Tools

Millwright

Overview

This module explores the tools required to measure and work to the close tolerances required for modern machinery. Many precision measuring tools are presented here, along with their applications and handling practices. Millwrights and comparable craftworkers have great respect for these special tools, and professionals show that respect in how they care for them.

Learning Objective 1

Successful completion of this module prepares trainees to:

Recognize and explain how to use various precision measuring tools and accessories.

- a. Identify and explain how to use common precision measuring devices and gauges.
- b. Recognize various precision levels and describe their applications.
- c. Recognize and explain how to use various types of calipers and height gauges.
- d. Identify and explain how to use micrometers and gauge blocks.
- e. Distinguish between and explain how to use dial indicators.
- f. Identify and explain how to use tools that measure rotational speed.
- g. Recognize unique electronic tools and state their related applications.

Performance Tasks

1. Use a telescoping gauge to transfer a measurement.
2. Use one or more levels to establish a level condition.
3. Use calipers to make and transfer a measurement.
4. Use a micrometer to measure shim stock or similar materials.
5. Use a standard to test micrometer accuracy.
6. Use a dial indicator for measurement.
7. Use a pyrometer to take temperature measurements.

Recommended Teaching Time: 20 hours

Classroom Equipment and Materials

- Whiteboard and markers
- Pencils and paper
- PowerPoint® Presentations for Module 15302
- A variety of standard marker sizes
- Poster board
- Flip chart
- LCD projector and screen
- Computer with internet access
- Module Review answer key
- Module Examinations

Performance Task 1

- Appropriate PPE
- Variety of instructor-selected telescoping gauges
- Variety of instructor-selected workpieces including hole
- Appropriate outside micrometer or caliper to transfer the measurement
- Performance Profile sheets

Performance Task 2

- Appropriate PPE
- Machinist's levels, master levels, optical levels, and/or laser levels
- Reliable straightedges
- Assortment of shims
- Performance Profile sheets

Performance Task 3

- Appropriate PPE
- Standard inside and outside calipers
- Instructor-selected workpieces
- Vernier calipers or dial calipers
- Performance Profile sheets

Performance Task 4

- Appropriate PPE
- Zero-to-one outside micrometers
- Lint-free cloth
- Raw shim stock or similar materials within the capacity of the micrometers

- Performance Profile sheets

Performance Task 5

- Appropriate PPE
- Instructor-selected outside micrometer (greater than 1") with manufacturer-supplied standard.
- Lint-free cloth
- Performance Profile sheets

Performance Task 6

- Appropriate PPE
- Dial indicator with base accessories
- Rotating shaft
- Performance Profile sheets

Performance Task 7

- Appropriate PPE
- Pyrometer
- Performance Profile sheets

15205

Millwright Power Tools

Millwright

Overview

Certain power tools provide millwrights and comparable crafts with the ability to accomplish tasks they could not do otherwise. Pipe threading machines cut, ream, and thread pipe. Drill presses create precise holes in material. Bandsaws cut stock into usable pieces. Millwrights also use special heaters when working with bearings and may also use a hydraulic press to press a bearing into place. This module will familiarize you with some of the power tools that are commonly used by millwrights and similar craftworkers.

Learning Objective 1

Successful completion of this module prepares trainees to:

Identify and explain how to operate various power tools used by millwrights and industrial maintenance personnel.

- a. Explain how to operate drill presses and select and maintain drill bits.
- b. Identify and describe the use of various presses.
- c. Identify and describe bandsaws and bandsaw blades.
- d. Describe pipe threaders and explain how to cut, ream, and thread pipe.
- e. Identify various bearing heaters and explain how they are used.
- f. Identify and explain how to use other power tools occasionally needed by millwrights and industrial maintenance personnel.

Performance Task

1. Demonstrate the safe use and care of four instructor-selected tools from the following list:
 - Standard or magnetic drill press
 - Hydraulic or pneumatic press
 - Horizontal or vertical bandsaw
 - Pipe threader
 - Bearing heater
 - Nibbler

- Conveyor belt cutter

Recommended Teaching Time: 22.5 hours

Classroom Equipment and Materials

- Whiteboard and markers
- Pencils and paper
- PowerPoint® Presentations for Module 15205
- A variety of standard marker sizes
- Poster board
- Flip chart
- LCD projector and screen
- Computer with internet access
- Module Review answer key
- Module Examinations

Performance Task 1

- Appropriate PPE
- Variety of instructor-selected tools from the provided list
- Scrap material on which the tools may be used (pipe, key stock, sheet metal, bearings, conveyor belt fabric)
- Appropriate lubricant for threader and drill press
- Performance Profile sheets

15207

Setting Baseplates and Soleplates

Millwright

Overview

Large machinery requires a firm, unyielding base to maintain its alignment. In some cases, the equipment must remain aligned with other equipment on the same base, or with equipment situated on another base. Baseplates and soleplates provide the strong base that allows precise and reliable equipment alignment and stands up to the punishment that large equipment can deliver. This module describes the process of siting, installing, and preparing baseplates and soleplates for various types of equipment.

Learning Objective 1

Successful completion of this module prepares trainees to:

Explain how to establish baseplate and soleplate installation locations.

- a. Identify various layout instruments used to establish location, elevation, and a level condition.
- b. Explain how to establish the precise location and elevation of a baseplate.

Learning Objective 2

Successful completion of this module prepares trainees to:

Explain how to set and install a baseplate or soleplate.

- a. Identify and describe the use of various tools to prepare a concrete surface.
- b. Identify and describe how to install plate anchor bolts.
- c. Explain how to establish piano-wire jigs and finalize a plate installation.

Performance Tasks

1. Establish baseplate and soleplate locations and elevations.
2. Set shim packs.
3. Set a baseplate or soleplate as part of a team.

4. Verify the accuracy of a baseplate or soleplate installation.

Recommended Teaching Time: 20 hours

Classroom Equipment and Materials

- Whiteboard and markers
- Pencils and paper
- PowerPoint® Presentations for Module 15207
- A variety of standard marker sizes
- Poster board
- Flip chart
- LCD projector and screen
- Computer with internet access
- Module Review answer key
- Module Examinations

Performance Task 1

- Appropriate PPE
- Set of construction drawings containing the location and elevation of a baseplate
- Tape measure
- Chalk line
- Optical or laser level
- Performance Profile sheets

Performance Tasks 2, 3, and 4

- Appropriate PPE
- Set of construction drawings containing the location and elevation of a baseplate
- Existing or precast foundation with anchor bolts in place and offset lines marked
- Appropriately sized shims for selected foundation
- Machinist level
- Spirit level
- Optical or laser level
- Piano wire jigs with wire, turnbuckles, and appropriate anchors
- Hammer drill with bit sized for selected anchors
- Tram plate
- Combination square
- Precision square
- Feeler gauges
- Rubber mallet, pinch bar, and jack bolts

- Torque wrench
- Performance Profile sheets

RIGGING PRACTICES

Module 38102 presents basic rigging, which refers to the preparation of a load for movement, as well as the preparation of hardware and other components used to connect the load to the crane. Rigging must be completed safely and effectively, resulting in a reliable connection to the load. An understanding of rigging fundamentals is essential to safely operate cranes and move/position heavy equipment, components, and structures.

Objectives

Learning Objective 1

- Identify and describe various types of rigging hardware.
 - a. Identify and describe various hooks, shackles, eyebolts, and clamps.
 - b. Identify and describe various lugs, turnbuckles, plates, and spreader beams.

Learning Objective 2

- Identify and describe various types of slings and sling hitches.
 - a. Identify and describe wire-rope slings and their proper care.
 - b. Identify and describe synthetic slings and their proper care.
 - c. Identify and describe chain slings and their proper care.
 - d. Explain the significance of sling angles and describe common hitches.
 - e. Describe how to properly rig and handle piping materials and rebar.
 - f. Identify and describe how to use taglines and knots for load control.
 - g. Identify common rigging-related safety precautions.

Learning Objective 3

- Identify and describe how to use various types of hoisting and jacking equipment.
 - a. Identify and describe how to use manual and powered hoisting equipment.
 - b. Identify and describe how to use jacks.

Performance Tasks

Performance Task 1 (Learning Objectives 1 and 2)

- Inspect various types of rigging components and report on the condition and suitability for a task.

Performance Task 2 (Learning Objective 2)

- Configure a sling to produce a single-wrap basket hitch.

Performance Task 3 (Learning Objective 2)

- Configure a sling to produce a double-wrap basket hitch.

Performance Task 4 (Learning Objective 2)

- Configure a sling to produce a single-wrap choker hitch.

Performance Task 5 (Learning Objective 2)

- Configure a sling to produce a double-wrap choker hitch.

Performance Task 6 (Learning Objective 2)

- Select the correct tagline for a specified application.

Performance Task 7 (Learning Objective 2)

- Tie specific instructor-selected knots.

Performance Task 8 (Learning Objective 3)

- Select, inspect, and demonstrate the safe use of the following rigging equipment:
 - Block and tackle
 - Chain hoist
 - Ratchet-lever hoist
 - One or more types of jack

Recommended Teaching Time: 15 Hours

This Lesson Plan (LP) is divided into sections that correspond to the sections in the Trainee Guide module. As you plan your class times, review the objectives, content, and lesson plan outline for the section you plan to teach. Allow sufficient class time for demonstrations, laboratories, field trips, and testing. Each class period should also include time for administrative tasks and periodic breaks.

Be sure to gather the required equipment, materials, visual aids, and answer keys. Using your access code, download the PowerPoint® presentations and Performance Profile Sheets for this module from NCCER's Instructor Resource Center at www.nccerirc.com.

It is advisable to assign the reading of a module section prior to the classroom instruction. The Section Review and Module Review questions may be assigned as homework. At their discretion, instructors may assign additional homework to meet the teaching objectives.

Performance Testing may be administered at any suitable time in the course of the module training. Tasks are graded pass/fail. Trainee performance and proficiency during practice sessions that meets or exceeds the standards for a task can be accepted as Performance Task completion. Complete the Performance Profile Sheet for each trainee.

The final class is generally reserved for a brief review of the module and administering the module examination. For information about accessing the Module Examinations, visit www.nccer.org/testing. The passing score for submission into NCCER's Registry is 70% or above for the module exam. Submit the testing results for each trainee to your Training Program Sponsor through the Registry system.

Prerequisites

Core

Safety Considerations

This module requires require trainees to work with and around rigging equipment including various slings, hoists, and jacks. Work in the vicinity of mobile cranes is also possible. Safety must be emphasized at all times. Gloves should be worn at all times when working with slings. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and give due respect to unseen hazards related to rigging and the mobile crane environment. Any deficiencies must be corrected to ensure the future safety of all trainees. All practice sessions and Performance Tasks must be completed under your direct supervision.

Equipment, Materials, and Resources

Whiteboard	A varied selection of wire-rope slings (some damaged)
Dry-erase markers	A varied selection of synthetic web slings (some damaged)
Pencils and paper	A varied selection of chain slings (some damaged)
PowerPoint® presentations for Module 38102	A varied selection of lifting hooks (some damaged)
LCD projector and screen	A varied selection of shackles (some damaged)
Computer (Internet access optional)	Lengths of rope sufficient for tying knots
Module Review answer key	Block and tackle (simple or compound)
Module Examinations	Chain hoist
Performance Profile sheets	Ratchet-lever hoist
Appropriate PPE as directed by the instructor or training facility provider, including but not limited to:	Various types of jacks, including a ratchet jack, bottle jack, and a hydraulic jack with an external pump
Safety glasses	Portable gantry or suitable permanent structure from which hoists can be suspended
Proper footwear	
Hearing protection	
Hard hat	

Lesson Plans for Module 29102

OXYFUEL CUTTING

Module 29102 introduces the trainees to the methods and procedures of the oxyfuel cutting process. Trainees will learn safety procedures, equipment setup, fuel gas types, flow rates, and techniques. Hands-on practice and the completion of cutting-related PerformanceTasks complete the learning process.

Objectives

Learning Objective 1

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

Learning Objective 2

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

Learning Objective 3

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

Learning Objective 4

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

Learning Objective 4 (continued)

- c. Explain how to bevel, wash, and gouge.
- d. Explain how to make straight and bevel cuts with portable oxyfuel cutting machines.

Performance Tasks

Performance Task 1 (Learning Objective 3)

- Set up oxyfuel cutting equipment.

Performance Task 2 (Learning Objective 3)

- Light and adjust an oxyfuel torch.

Performance Task 3 (Learning Objective 3)

- Shut down oxyfuel cutting equipment.

Performance Task 4 (Learning Objective 3)

- Disassemble oxyfuel cutting equipment.

Performance Task 5 (Learning Objective 3)

- Change empty gas cylinders.

Performance Task 6 (Learning Objective 4)

- Cut shapes from various thicknesses of steel, emphasizing:
 - Straight line cutting
 - Square shape cutting
 - Piercing
 - Beveling
 - Cutting slot

Performance Task 7 (Learning Objective 4)

- Perform washing.

Performance Task 8 (Learning Objective 4)

- Perform gouging.

Performance Task 9 (Learning Objective 4)

- Use a track burner to cut straight lines and bevels.

Teaching Time: 17.5 hours

(Seven 2.5-Hour Classroom Sessions)

Session time may be adjusted to accommodate your class size, schedule, and teaching style.

Prerequisites

Core; *Welding Level One*, Module 29101.

Before You Begin

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

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

Safety Considerations

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

Classroom Equipment and Materials

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

Equipment and Materials for Laboratories and Performance Testing

Appropriate PPE:
Appropriate flame-retardant clothing
Safety glasses
Welding gloves
Appropriate goggles or face shield
Proper footwear as designated by the instructor or training facility provider
Hearing protection as designated by the instructor or training facility provider
Oxygen cylinder
Fuel gas cylinder
Pressure regulators (oxygen and fuel gas)
Hose set
Cutting torches, combination or one-piece

Assorted torch tips (cutting, washing, and gouging)
Cylinder cart
Files
Squares
Tape measure or steel rule
Soapstone
Common hand tools
Chipping hammers
Friction lighters
Tip cleaners, drills, and files
Approved leak testing solution
Torch wrenches
Sufficient carbon steel plate ($\geq \frac{1}{4}$ " or 6 mm thick)
Sufficient carbon steel plate ($< \frac{1}{4}$ " or 6 mm thick)
Portable oxyfuel track burner

Additional Resources

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

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

Uniweld Products, Inc. Numerous videos are available at uniweld.com/en/uniweld-videos. Last accessed: November 30, 2014.

The Harris Products Group, a division of Lincoln Electric. Numerous videos are available at <http://www.harrisproductsgroup.com/en/Expert-Advice/videos.aspx>. Last accessed: November 30, 2014.

"Victor Safety Summary" Victor Technologies, last accessed November 26, 2014 <http://www.youtube.com>

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

Instructors should view any videos that may be identified in the lesson plan before using them to ensure their suitability. There are a number of accessible videos related to oxyfuel cutting on the Internet. For example, The Harris Products Group, a division of Lincoln Electric, offers well-produced videos related to oxyfuel cutting. The videos can provide teachable moments in both proper and improper work processes and behaviors. Be prepared to stop the videos at appropriate times to point out and discuss both proper and improper conduct and techniques.

Materials Checklist for Module 29102, Oxyfuel Cutting

Equipment and Materials					
Personal protective equipment:		Selection of usable and non-usable hoses		Pressure regulators	
Appropriate flame-retardant clothing		Assorted thin steel pieces cut and exhibiting distortion		Pressure regulators (oxygen and fuel gas)	
Safety glasses		Fuel gas cylinder		Oxygen cylinder	
Welding gloves		Hose set		Cutting torches, combination or one-piece	
Appropriate goggles or face shield		Assorted torch tips (cutting, washing, and gouging)		Cylinder cart	
Proper footwear as designated by the instructor or training facility provider		Files		Squares	
Hearing protection as designated by the instructor or training facility provider		Tape measure or steel rule		Soapstone	
Whiteboard/chalkboard		Common hand tools		Chipping hammers	
Markers/chalk		Friction lighters		Tip cleaners, drills, and files	
Pencils and paper		Approved leak testing solution		Torch wrenches	
<i>Welding Level One</i> PowerPoint® Presentation Slides		Sufficient carbon steel plate (≥¼" or 6 mm thick)		Sufficient carbon steel plate (<¼" or 6 mm thick)	
DVD player or a computer with a DVD drive		Portable oxyfuel track burner			
Computer with internet access					
Copies of the Module Examination and Performance Profile Sheets					
Module Review Question and Trade Terms Quiz answer keys					

To the extent possible, and as required for performance testing, provide a selection of the tools listed for each session; alternatively, photos may be used to teach tool identification.

15107

Gaskets and Packing

Millwright

Overview

Gaskets and packing are materials used consistently by millwrights and industrial maintenance mechanics in a variety of applications. Both are generally applied to prevent the leakage of fluids and gases. Leaks in piping and equipment can be hazardous, interfere with the proper operation of a plant, and waste valuable resources. Although craft professionals are not always required to select the proper configuration and material for an application, it is important to understand the characteristics of these materials and know how to properly apply and install them.

Learning Objective 1

Successful completion of this module prepares trainees to:

Describe various types of gaskets, match gasket materials with applications, and state installation considerations.

- a. Identify different types of pipe flange faces.
- b. Describe gasket applications and the importance of compatibility.
- c. Identify common materials used in gaskets and align materials with applications.
- d. Explain how to fabricate and install gaskets.

Learning Objective 2

Successful completion of this module prepares trainees to:

Identify packing configurations and materials of construction and explain how packing is serviced.

- a. Identify common packing configurations.
- b. Compare packing construction materials and their applications.
- c. Explain how to remove compression packing.
- d. Explain how to install various types of packing.

Performance Tasks

1. Lay out and cut a full-face flange gasket.
2. Install an instructor-specified gasket.
3. Remove and replace the packing in a valve or pump stuffing box.

Recommended Teaching Time: 15 hours

Classroom Equipment and Materials

- Whiteboard and markers
- Pencils and paper
- PowerPoint® Presentations for Module 15107
- A variety of standard marker sizes
- Poster board
- Flip chart
- LCD projector and screen
- Computer with internet access
- Module Review answer key
- Module Examinations

Performance Task 1

- Appropriate PPE
- Full-face flange
- Calipers or similar measuring tool
- Compass or dividers
- Gasket material
- Gasket cutter kit
- Appropriately sized arch punch
- Ball peen hammer
- Performance Profile sheets

Performance Task 2

- Appropriate PPE
- Pair of mating flanges with bolts
- Gasket removal tool or putty knife
- Appropriate size and shape gasket for the selected flanges
- Drift pin
- Calibrated torque wrench

- Performance Profile sheets

Performance Task 3

- Appropriate PPE
- Valve or pump that contains packing
- Packing pullers
- Appropriate size and shape of packing (with alternates)
- Packing cutting tools
- Common hand tools
- Torque wrench
- Performance Profile sheets

15304

O-Rings and Non-Mechanical Seals

Millwright

Overview

O-rings and seals are typically used to prevent the leakage of fluids. O-rings are very simple and economical to use. Although non-mechanical seals aren't complicated, they are often designed for specific applications and have a unique cross-section when compared to a simple O-ring. The applications and service limitations for both of these important components are presented in this module, along with basic handling and installation guidance.

Learning Objective 1

Successful completion of this module prepares trainees to:

Identify and explain how to apply and service O-rings.

- a. Describe O-ring applications and state common handling and installation practices.
- b. List O-ring and seal materials of construction and their limitations.

Learning Objective 2

Successful completion of this module prepares trainees to:

Identify and explain how to apply and service non-mechanical seals.

- a. Describe common types of non-mechanical seals and their applications.
- b. Explain how to service non-mechanical seals.

Performance Tasks

1. Visually identify various types of O-rings and non-mechanical seals.
2. Remove and replace an O-ring and a non-mechanical seal.

Recommended Teaching Time: 7.5 hours

Classroom Equipment and Materials

- Whiteboard and markers
- Pencils and paper
- PowerPoint® Presentations for Module 15304
- A variety of standard marker sizes
- Poster board
- Flip chart
- LCD projector and screen
- Computer with internet access
- Module Review answer key
- Module Examinations

Performance Task 1

- Variety of instructor selected O-rings and non-mechanical seals
- Performance Profile sheets

Performance Task 2

- Appropriate PPE
- Variety of instructor selected O-rings and non-mechanical seals with their associated workpieces
- Clean, soft rags
- Appropriate lubricant for selected O-rings and seals
- Variety of seal removal and installation tools
- Performance Profile sheets

15209

Introduction to Bearings

Millwright

Overview

Rotating shafts and sliding components require support as they transfer power between machines. The supports, however, rub against the moving parts and as time goes by, both will wear out and eventually fail. Bearings provide support while minimizing wear. They accomplish this task in various ways, each appropriate to certain applications.

Learning Objective 1

Successful completion of this module prepares trainees to:

Describe bearing operation and common bearing types.

- a. Explain bearing principles and operating issues.
- b. Describe plain bearings and their qualities.
- c. Describe antifriction bearings and their qualities.
- d. Describe fluid thrust bearings and their qualities.
- e. Describe miscellaneous bearing technology.
- f. Interpret bearing designations.

Performance Tasks

1. Identify instructor-provided bearings.
2. Identify bearing components, describing their purposes.

Recommended Teaching Time: 15 hours

Classroom Equipment and Materials

- Whiteboard and markers
- Pencils and paper
- PowerPoint® Presentations for Module 15209
- A variety of standard marker sizes

- Poster board
- Flip chart
- LCD projector and screen
- Computer with internet access
- Module Review answer key
- Module Examinations

Performance Task 1

- Selection of different bearings
- Performance Profile sheets

Performance Task 2

- Disassembled antifriction bearings
- Performance Profile sheets

15306

Removing and Installing Bearings

Millwright

Overview

Millwrights work with rotating equipment daily. Motors, pumps, compressors, turbines, conveyors, and fans all rely on bearings. While they can last a long time, most bearings eventually do need attention. Millwrights must service them quickly to minimize downtime. They must also service them skillfully and not damage the equipment they support.

Learning Objective 1

Successful completion of this module prepares trainees to:

Outline removing and installing common bearings.

- a. Summarize removing bearings safely and correctly.
- b. Summarize inspecting bearings and identifying problems.
- c. Summarize installing bearings safely and correctly.

Performance Tasks

1. Remove a bearing using a puller or press.
2. Install a bearing using cold or hot fitting.
3. Install pillow-block bearings.

Recommended Teaching Time: 22.5 hours

Classroom Equipment and Materials

- Whiteboard and markers
- Pencils and paper
- PowerPoint® Presentations for Module 15306
- A variety of standard marker sizes
- Poster board
- Flip chart

- LCD projector and screen
- Computer with internet access
- Module Review answer key
- Module Examinations

Performance Task 1

- Appropriate PPE
- Shaft stock with attached bearings
- Emery paper
- Light oil
- Bearing puller and/or press
- Appropriate shaft supports (for press)
- Wrenches (for puller)
- Performance Profile sheets

Performance Task 2

- Appropriate PPE
- Instructor-selected bearings
- Appropriately sized shaft stock
- Emery paper
- Light oil
- Bearing heater (for hot fitting)
- Infrared thermometer, temperature probe, or temperature stick (for hot fitting)
- Inside micrometer (for hot fitting)
- Press (for cold fitting)
- Performance Profile sheets

Performance Task 3

- Appropriate PPE
- Instructor-selected pillow block bearings
- Appropriately sized shaft stock
- Suitable mounting surface
- Wrenches (regular and torque)
- Emery paper
- Light oil
- Performance Profile sheets

Lesson Plans for Module 29103

PLASMA ARC CUTTING

Module 29103 introduces the trainees to the methods and procedures related to the plasma arc cutting process. Trainees will learn safety procedures, equipment setup, gas types, flow rates, and techniques.

Objectives

Learning Objective 1

- Explain plasma arc cutting processes and identify related safety precautions.
 - a. Describe the plasma arc cutting processes.
 - b. Identify safety practices related to plasma arc cutting.

Learning Objective 2

- Identify and describe plasma arc cutting equipment.
 - a. Identify and describe plasma arc power units.
 - b. Identify and describe plasma arc torches and accessories.
 - c. Identify and describe plasma arc cutting gases and gas control devices.

Learning Objective 3

- Describe how to set up, safely operate, and care for plasma arc cutting equipment.
 - a. Describe how to set up plasma arc cutting equipment and the adjacent work area.
 - b. Describe how to safely operate plasma arc cutting equipment.
 - c. Describe how to care for plasma arc cutting equipment.

Performance Tasks

Performance Task 1

(Learning Objectives 1, 2, and 3)

- Set up plasma arc cutting equipment.

Performance Task 2

(Learning Objectives 2 and 3)

- Set the amperage and gas pressures or flow rates for the type and thickness of metal to be cut using plasma arc equipment.

Performance Task 3 (Learning Objective 3)

- Square-cut metal using plasma arc equipment.

Performance Task 4 (Learning Objective 3)

- Bevel-cut metal using plasma arc equipment.

Performance Task 5 (Learning Objective 3)

- Pierce and cut slots in metal using plasma arc equipment.

Performance Task 6 (Learning Objective 3)

- Dismantle and store the equipment.

Teaching Time: 7.5 hours

(Three 2.5-Hour Classroom Sessions)

Session time may be adjusted to accommodate your class size, schedule, and teaching style.

Prerequisites

Core; Welding Level One, Module 29101.

Before You Begin

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

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

Safety Considerations

This module requires that trainees work with equipment that generates high voltages, extremely high temperatures, and intense ultraviolet radiation. Safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and give due respect to hazards related to plasma arc cutting equipment. Any deficiencies must be corrected to ensure future trainee safety. All practice sessions and performance tasks must be completed under the instructor's direct supervision.

Classroom Equipment and Materials

Whiteboard/chalkboard
Markers/chalk
Pencils and paper
Welding Level One PowerPoint® Presentation
DVD player or a computer with a DVD drive
LCD projector and screen
Computer with Internet access
Module Review and Trade Terms Quiz answer keys
Copies of the Module Examination and Performance Profile Sheets
An example of the plasma arc cutting unit and torch trainees will operate
Manufacturer's documentation for the cutting units to be used (a copy for each trainee is recommended)
Gas cylinders and regulators (if required)

Equipment and Materials for Laboratories and Performance Testing

Appropriate PPE:
Appropriate flame-retardant clothing
Eye and face protection, properly tinted
Welding or cutting gloves
Proper footwear as designated by the instructor or training facility provider
Hearing protection as designated by the instructor or training facility provider
Hard hat or welding helmet as designated by the instructor or training facility provider

Plasma arc cutting power units and accessories
Clean, dry compressed air supply
Other gases (if required)
Gas pressure regulators (if required)
Plasma torch cutting guides
Sufficient carbon steel plate for all trainees to create the specified workpieces
Soapstone
Tape measures or steel rules
Squares
Wire brushes

Additional Resources

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

AWS F3.2M/F3.2, Ventilation Guide for Weld Fume. Latest Edition. Miami, FL: American Welding Society.

Plasma Cutters Handbook: Choosing Plasma Cutters, Shop Safety, Basic Operation, Cutting Procedures, Advanced Cutting Tips, CNC Plasma Cutters, Troubleshooting, and Sample Projects. Eddie Paul. New York, NY: Penguin Group.

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

Instructors should view any videos that may be identified in the lesson plan before using them to ensure their suitability. The videos can provide teachable moments in both proper and improper work processes and behaviors. Be prepared to stop the videos at appropriate times to point out and discuss both proper and improper conduct and techniques. The Lincoln Electric web site at <http://newsroom.lincolnelectric.com/Video> offers a video entitled "Tech Tips: Plasma Cutting Basics" along with many other welding-related videos. Video length is 5:09.

Instructors are also encouraged to locate additional audiovisual aids available on the Internet, make personal videos, and take still pictures related to the subject matter and add them to the PowerPoint® presentations throughout the program.

Materials Checklist for Module 29103, Plasma Arc Cutting

Equipment and Materials					
Personal protective equipment:		Clean, dry compressed air supply		Tape measures or steel rules	
Appropriate flame-retardant clothing		Other gases (if required)		Wire brushes	
Eye and face protection, properly tinted		Sufficient carbon steel plate for all trainees to create the specified workpieces		Squares	
Welding or cutting gloves		Plasma arc cutting power units and accessories		Plasma torch cutting guides	
Proper footwear as designated by the instructor or training facility provider		Gas pressure regulators (if required)		Soapstone	
Hearing protection as designated by the instructor or training facility provider					
Hard hat or welding helmet as designated by the instructor or training facility provider					
Whiteboard/chalkboard					
Markers/chalk					
Pencils and paper					
<i>Welding Level One</i> PowerPoint® Presentation Slides					
DVD player or a computer with a DVD drive					
Computer with Internet access					
Copies of the Module Examination and Performance Profile Sheets					
Module Review and Trade Terms Quiz answer keys					
An example of the plasma arc cutting unit and torch trainees will operate					
Manufacturer's documentation for the cutting units to be used (a copy for each trainee is recommended)					
Gas cylinders and regulators (if required)					

To the extent possible, and as required for performance testing, provide a selection of the tools listed for each session; alternatively, photos may be used to teach tool identification.

15301

Craft-Related Algebra and Trigonometry

Millwright

Overview

Some problems demand aggressive solutions. Occasionally, craftworkers must use special tools that require much practice to master. Being able to solve these problems brings great satisfaction. Advanced mathematics is one of these tools. Solving some challenges requires more than basic math or simple formulas. This module introduces algebra and trigonometry, two very practical types of math. Mastering these tools expands your problem-solving ability. That, in turn, increases your job satisfaction.

Learning Objective 1

Successful completion of this module prepares trainees to:

Manipulate and solve basic equations with algebra techniques.

- a. Describe the nature and purposes of variables.
- b. Evaluate equations by replacing variables with numbers.
- c. Manipulate basic equations to solve for an unknown variable.
- d. Define and evaluate mathematical functions.

Learning Objective 2

Successful completion of this module prepares trainees to:

Solve triangle problems with trigonometry techniques.

- a. List and define the three basic trigonometric functions and their inverses.
- b. Solve triangle problems using the three basic trigonometric functions and their inverses.
- c. Solve triangle problems using the law of sines.

Performance Tasks

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

Recommended Teaching Time: 30 hours

Classroom Equipment and Materials

- Whiteboard and markers
- Pencils and paper
- PowerPoint® Presentations for Module 15301
- A variety of standard marker sizes
- Poster board
- Flip chart
- LCD projector and screen
- Computer with internet access
- Module Review answer key
- Module Examinations