

MODULE OVERVIEW

This module offers advanced practice in geometry, ratios, trigonometry, and algebra.

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*; *Millwright Level One*; and *Millwright Level Two*.

OBJECTIVES

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

1. Use tables of equivalents.
2. Use unit conversion tables.
3. Perform right angle trigonometry.
4. Calculate weights of objects.

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

Scientific calculator

Ruler

Framing square

Quick Quiz*

Module Examination**

* Located in the back of this module

**Located in the Test Booklet

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.

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 20 hours are suggested to cover *Advanced Trade Math*. 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; Tables of Equivalents; Unit Conversion Tables	
A. Introduction	_____
B. Tables of Equivalents	_____
C. Unit Conversion Tables	_____
Sessions II through VI. Trigonometry	
A. Trigonometry	_____
B. Pythagorean Theorem	_____
C. Trigonometric Functions	_____
D. Triangle Calculation	_____
E. Determining the Angles When Side Lengths Are Known	_____
F. Interpolation	_____
G. Law of Sines	_____
Session VII. Calculating the Weight of an Object	
A. Calculating the Weight of an Object	_____
Session VIII. 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.	

MODULE OVERVIEW

This module presents information on precision measuring tools used by millwrights, and explains how to select, inspect, use, and care for them.

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; Millwright Level One; Millwright Level Two; and Millwright Level Three, Module 15301-08.*

OBJECTIVES

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

1. Use levels.
2. Use calipers.
3. Use micrometers.
4. Use dial indicators.
5. Use universal bevel protractors.
6. Use gauge blocks.
7. Use speed measurement tools.
8. Use pyrometers.

PERFORMANCE TASKS

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

1. Use levels.
2. Use calipers.
3. Use micrometers.
4. Use dial indicators.
5. Use universal bevel protractors.
6. Use gauge blocks.
7. Use speed measurement tools.
8. Use pyrometers.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen	Outside, inside, and depth micrometers
Transparencies	Various micrometer tips
Blank acetate sheets	Height gauges and surface plates
Transparency pens	Various sized dial indicators
Whiteboard/chalkboard	Universal bevel protractor
Markers/chalk	Stroboscopic and mechanical tachometers
Pencils and scratch paper	Optical, thermocouple, and infrared pyrometers
Appropriate personal protective equipment	Module Examination*
Master, mechanic's, optical, and electronic levels	Performance Profile Sheets*
Inside, outside, vernier, and dial calipers	

* 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.

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 20 hours are suggested to cover *Precision Measuring Tools*. 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; Levels	
A. Introduction	_____
B. Levels	_____
C. Laboratory	_____
Trainees practice using levels. This laboratory corresponds to Performance Task 1.	
Session II. Calipers	
A. Calipers	_____
B. Laboratory	_____
Trainees practice using calipers. This laboratory corresponds to Performance Task 2.	
Session III. Micrometers	
A. Micrometers	_____
B. Laboratory	_____
Trainees practice using micrometers. This laboratory corresponds to Performance Task 3.	
Session IV. Dial Indicators; Universal Bevel Protractors	
A. Dial Indicators	_____
B. Laboratory	_____
Trainees practice using dial indicators. This laboratory corresponds to Performance Task 4.	
C. Universal Bevel Protractors	_____
D. Laboratory	_____
Trainees practice using universal bevel protractors. This laboratory corresponds to Performance Task 5.	
Session V. Gauge Blocks	
A. Gauge Blocks	_____
B. Laboratory	_____
Trainees practice using gauge blocks. This laboratory corresponds to Performance Task 6.	
Session VI. Speed Measurement Tools	
A. Speed Measurement Tools	_____
B. Laboratory	_____
Trainees practice using speed measurement tools. This laboratory corresponds to Performance Task 7.	

Session VII. Pyrometers

A. Pyrometers

B. Laboratory

Trainees practice using pyrometers. This laboratory corresponds to Performance Task 8.

Session VIII. 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.

MODULE OVERVIEW

This module describes the types of packing and packing materials found in a typical stuffing box, and explains how to remove and install packing.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Millwright Level One; Millwright Level Two; and Millwright Level Three*, Modules 15301-08 and 15302-08.

OBJECTIVES

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

1. Identify and explain the types of packing.
2. Identify and explain packing materials.
3. Remove packing.
4. Install packing.

PERFORMANCE TASKS

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

1. Identify the types of packing.
2. Identify packing materials.
3. Remove packing.
4. Install compression packing.
5. Install lip-type packing.

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

Basic trainee tools and packing tools

Samples of packing configurations, including:

Square-braid

Braid-over-braid

Interlocking braid

Twisted

Multi-cord, wrapped, and laminated

Metal

Graphite ribbon

Samples of lip-type packings, including:

V-packing

U-ring packing

Cup packing

Flange packing

Samples of packing materials, including:

Graphite yarn

Teflon[®]

Carbon yarn

Vegetable fiber

Duck and rubber

Plastic

Metal

Fiberglass

Aramid yarn

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 that the trainees use hand tools. Ensure that trainees are briefed on shop safety procedures.

ADDITIONAL RESOURCES

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

EPM, Inc., www.epm.com/styles.htm

Draco Mechanical Supply, Inc., www.dracomech.com/comppack/pumpinstall.htm

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 10 hours are suggested to cover *Installing 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; Packing Configurations	
A. Introduction	_____
B. Packing Configurations	_____
C. Laboratory Trainees practice identifying types of packing. This laboratory corresponds to Performance Task 1.	_____
Session II. Packing Materials	
A. Packing Materials	_____
B. Laboratory Trainees practice identifying packing materials. This laboratory corresponds to Performance Task 2.	_____
Session III. Removing and Installing Packing	
A. Removing Packing	_____
B. Laboratory Trainees practice removing packing. This laboratory corresponds to Performance Task 3.	_____
C. Installing Packing	_____
D. Laboratory Trainees practice installing compression packing. This laboratory corresponds to Performance Task 4.	_____
E. Laboratory Trainees practice installing lip-type packing. This laboratory corresponds to Performance Task 5.	_____

Session IV. 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.

MODULE OVERVIEW

This module explains the applications, removal, and installation procedures for various types of seals.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Millwright Level One; Millwright Level Two; and Millwright Level Three*, Modules 15301-08 through 15303-08.

OBJECTIVES

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

1. Identify and explain types of seals.
2. Identify and explain seal materials.
3. Remove and install seals.

PERFORMANCE TASKS

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

1. Identify seals and seal materials.
2. Remove and install seals.

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 sized O-rings

Lip seals

Oil seals

Labyrinth seals

Cup seals

Various types of seal materials, including:

Buna-N

Silicone

Neoprene

Plastic and elastomer compounds

Metal O-rings

Leather

Module Examinations*

Performance Profile Sheets*

* Located in the Test Booklet

SAFETY CONSIDERATIONS

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

Flowserve Corporation,
www.flowserve.com/eim/Services/Services/PumpsServiceandRepairInformation

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 *Installing Seals*. 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. Types of Seals; Seal Materials; Removing and Installing Seals	
A. Introduction	_____
B. Types of Seals	_____
C. Seal Materials	_____
D. Laboratory Trainees practice identifying seals and seal materials. This laboratory corresponds to Performance Task 1.	_____
E. Removing and Installing Seals	_____
F. Laboratory Trainees practice removing and installing seals. This laboratory corresponds to Performance Task 2.	_____
Session II. 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.	

MODULE OVERVIEW

This module explains the function and advantages of mechanical seals. It identifies parts and types of seals, lists mechanical seal classifications, and includes procedures for removing, inspecting, and installing mechanical seals.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Millwright Level One; Millwright Level Two; and Millwright Level Three*, Modules 15301-08 through 15304-08.

OBJECTIVES

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

1. Identify and explain types of mechanical seals.
2. Explain mechanical seal classification.
3. Remove, inspect, and install mechanical seals.

PERFORMANCE TASKS

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

1. Identify types of mechanical seals.
2. Remove, inspect, and install mechanical seals.

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

Basic trainee tools

Centrifugal pump with mechanical seal

Samples of various mechanical seals, including:

Inside

Outside

Tandem

Cartridge

Balanced

Multiple-spring

Welded metal bellows

Elastomer bellows

Rotating

Stationary

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 that the trainees use hand tools. Ensure that trainees are briefed on shop safety procedures.

ADDITIONAL RESOURCES

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

Flowserve Corporation, www.flowserve.com/eim/EducationalServices

Mechanical Seals.Net, www.mechanicalseals.net/Mechanical_Seal_Repair.htm

McNally Institute, www.mcnallyinstitute.com/10-html/10-2.html

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 20 hours are suggested to cover *Installing Mechanical Seals*. 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; Basic Design	
A. Introduction	_____
B. Basic Design	_____
Sessions II and III. Mechanical Seal Classifications	
A. Classifying Mechanical Seals by Arrangement	_____
B. Classifying Mechanical Seals by Design	_____
C. Laboratory Trainees practice identifying types of mechanical seals. This laboratory corresponds to Performance Task 1.	_____
Sessions IV through VI. Replacing Mechanical Seals	
A. Removing Mechanical Seals	_____
B. Inspecting Mechanical Seals	_____
C. Installing Mechanical Seals	_____
D. Laboratory Trainees practice removing, inspecting, and installing mechanical seals. This laboratory corresponds to Performance Task 2.	_____
Session VII. Module Review	
A. Module Review	_____
Session VIII. Testing	
A. 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.	
B. Performance Testing	_____
1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	

MODULE OVERVIEW

This module explains how to remove, install, and maintain different types of bearings.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Millwright Level One; Millwright Level Two; and Millwright Level Three*, Modules 15301-08 through 15305-08.

OBJECTIVES

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

1. Identify common bearing failure modes and describe the conditions that cause them.
2. Describe the safety precautions that must be followed and the personal protective equipment that must be worn when removing and installing bearings.
3. Remove defective bearings using manual pullers and/or a press.
4. Describe using heat to remove a defective bearing.
5. Install new bearings by heating the bearing or applying pressure.
6. Install pillow block bearings.

PERFORMANCE TASKS

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

1. Remove a defective bearing using manual pullers and/or a press.
2. Install a new bearing by heating the bearing or applying pressure.
3. Install a pillow block bearing.

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

Manual puller

Hydraulic press (optional)

Manual (arbor) press (optional)

Aluminum heating ring

Pillow block bearing

Split housing pillow block bearing

Angular-contact ball bearing

Bearings with the following conditions:

Flaking

Spalling

Brinelling

Misalignment damage

Thrust failure

Broken cam

Electric arcing damage

Fluting

Lubrication failure

Contamination failure

Induction-type bearing heater

Module Examinations*

Performance Profile Sheets*

* Located in the Test Booklet

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module may require that the trainees visit job sites. Ensure that trainees are briefed on site safety policies prior to any site visits. This module requires trainees to use heat removal methods. Make sure trainees are briefed on appropriate safety procedures for using heat and cutting torches to remove bearings.

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.

Installing and Replacing Bearings, TPC Training Systems; 310 S. Michigan Avenue, Chicago, IL 60604, (312) 987-4100.

Care and Maintenance of Bearings, Cat. No 3017/E, NTN Corporation; 1-3-17 Kyomachibori Nishi-ku, Osaka-shi, Japan.

TEACHING TIME FOR THIS MODULE

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

Topic	Planned Time
Session I. Introduction	
A. Introduction	_____
Session II. Removing Bearings	
A. Removing Bearings	_____
B. Removal Methods	_____
C. Laboratory	_____
Trainees practice removing a defective bearing using manual pullers and/or a press. This laboratory corresponds to Performance Task 1.	
Session III. Troubleshooting Antifriction Bearings	
A. Troubleshooting Antifriction Bearings	_____
B. Types of Failures	_____
Session IV. Installing Bearings	
A. Installing Tapered Roller Bearings, Thrust Bearings, Spherical Roller Bearings	_____
Session V. Installing Bearings	
A. Installing Pillow Block Bearings and Angular-Contact Ball Bearings	_____
Session VI. Installing Bearings	
A. Laboratory	_____
Trainees practice installing a new bearing by heating the bearing or applying pressure. This laboratory corresponds to Performance Task 2.	
B. Laboratory	_____
Trainees practice installing a pillow block bearing. This laboratory corresponds to Performance Task 3.	

Session VII. Module Review

A. Module Review

Session VIII. Testing

A. 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.
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B. 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.
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MODULE OVERVIEW

This module explains how couplings are installed and aligned, and introduces some of the mounting systems used for various couplings.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum; Millwright Level One; Millwright Level Two; and Millwright Level Three, Modules 15301-08 through 15306-08.*

OBJECTIVES

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

1. Identify and explain coupling types.
2. Install couplings.
3. Remove couplings.

PERFORMANCE TASKS

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

1. Identify and explain coupling types.
2. Install an interference coupling.
3. Install a slip fit coupling.
4. Remove couplings using either the manual or hydraulic method.

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
Basic trainee tools

Samples of various types of couplings, including:
Rigid sleeve Tubular sleeve
Gear Chain
Spring Tire
Flexible disc Pin and bushing
Spacer
Horizontal split and vertical split grid couplings
Single- and double-joint universal joint couplings
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 that the trainees use hand tools. Ensure that trainees are briefed on shop safety procedures.

ADDITIONAL RESOURCES

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

Couplings.ca, <http://www.couplings.ca/>

Lovejoy, Inc., <http://www.lovejoy-inc.com/>

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 15 hours are suggested to cover *Couplings*. 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; Rigid Couplings	
A. Introduction	_____
B. Rigid Couplings	_____
1. Flanged Couplings	_____
2. Sleeve Couplings	_____
3. Clamp Couplings	_____
Session II. Flexible Couplings	
A. Mechanical Flexible Couplings	_____
B. Material Flexible Couplings	_____
Session III. Soft-Start Couplings	
A. Soft-Start Couplings	_____
B. Fluid Couplings	_____
C. Shot Couplings	_____
D. Clutch-Style Couplings	_____
E. Laboratory	_____
Trainees practice identifying and explaining coupling types. This laboratory corresponds to Performance Task 1.	
Session IV. Installing Couplings	
A. Installing Couplings	_____
B. General Coupling Installation Procedures	_____
C. Split Coupling Installation	_____
D. Interference-Fit Installation	_____
E. Laboratory	_____
Trainees practice installing an interference coupling. This laboratory corresponds to Performance Task 2.	
F. Setting the Coupling Gap	_____
G. Grid Coupling Installation	_____
H. Installing Hydraulic Couplings	_____
I. Laboratory	_____
Trainees practice installing a slip fit coupling. This laboratory corresponds to Performance Task 3.	

Session V. Removing Couplings

- A. Removing Couplings
- B. General Coupling Removal Procedures
- C. Mechanical Pullers
- D. Hydraulic Removal Method
- E. Laboratory

Trainees practice removing couplings using either the manual or hydraulic method. This laboratory corresponds to Performance Task 4.

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.

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

MODULE OVERVIEW

This module explains the use of shims, how shims are made, and the types of shims available.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum; Millwright Level One; Millwright Level Two; and Millwright Level Three, Modules 15301-08 through 15307-08.*

OBJECTIVES

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

1. Identify and explain types of shim stock.
2. Identify and explain shim materials.
3. Fabricate shims.

PERFORMANCE TASKS

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

1. Identify types of shim stock.
2. Identify shim materials.
3. Fabricate shims.

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

Basic trainee tools

Various samples of shim stock, including:

Hard

Roll

Flat

Laminated

Ring

Precut shims

Module Examinations*

Performance Profile Sheets*

* Located in the Test Booklet

SAFETY CONSIDERATIONS

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

ADDITIONAL RESOURCES

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

Precision Brand Products, Inc., <http://www.precisionbrand.com/>

SPIROL International Corporation, <http://www.spirol.com/>

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 5 hours are suggested to cover *Fabricating Shims*. 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; Shim Stock; Shim Materials; Fabricating Shims	
A. Introduction	_____
B. Shim Stock	_____
C. Laboratory Trainees practice identifying types of shim stock. This laboratory corresponds to Performance Task 1.	_____
D. Shim Materials	_____
E. Laboratory Trainees practice identifying shim materials. This laboratory corresponds to Performance Task 2.	_____
F. Fabricating Shims	_____
G. Laboratory Trainees practice fabricating shims. This laboratory corresponds to Performance Task 3.	_____
Session II. 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.	

MODULE OVERVIEW

This module explains how to make mounting fixtures for alignment fixtures and how to use and set up fixtures for reverse alignment.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum; Millwright Level One; Millwright Level Two; and Millwright Level Three*, Modules 15301-08 through 15308-08.

OBJECTIVES

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

1. Identify and explain types of jigs.
2. Fabricate jigs.
3. Set up jigs.

PERFORMANCE TASKS

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

1. Identify types of jigs.
2. Fabricate one or more of the following:
 - Angle iron jig
 - Chain jig
 - Christmas tree jig
 - Piano wire jig
3. Set up three or more of the following:
 - Angle iron jig
 - Chain jig
 - Complex reverse-indicator jig
 - Christmas tree jig
 - Piano wire jig

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

Basic trainee tools

Sample jigs, including:

Angle iron

Chain

Christmas tree

Piano wire

Complex reverse-indicator

Module Examinations*

Performance Profile Sheets*

* Located in the Test Booklet

SAFETY CONSIDERATIONS

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

L.S. Starrett Company, <http://www.starrett.com>

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 10 hours are suggested to cover *Alignment Fixtures and Specialty Jigs*. 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; Types of Jigs	
A. Introduction	_____
B. Types of Jigs	_____
C. Laboratory Trainees practice identifying types of jigs. This laboratory corresponds to Performance Task 1.	_____
Session II. Fabricating Jigs	
A. Fabricating Jigs	_____
B. Laboratory Trainees practice fabricating one or more of the following: angle iron jig, chain jig, Christmas tree jig, and/or piano wire jig. This laboratory corresponds to Performance Task 2.	_____
Session III. Setting Up Jigs	
A. Setting Up Jigs	_____
B. Laboratory Trainees practice setting up three or more of the following: angle iron jig, chain jig, complex reverse-indicator jig, Christmas tree jig, and/or piano wire jig. This laboratory corresponds to Performance Task 3.	_____
Session IV. 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.	

MODULE OVERVIEW

This module explains how to perform preliminary alignment procedures for driver and driven units, including inspecting, setting up, and leveling the equipment. It also covers coupling installation.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum; Millwright Level One; Millwright Level Two; and Millwright Level Three*, Modules 15301-08 through 15309-08.

OBJECTIVES

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

1. Inspect equipment.
2. Install couplings.
3. Set STAT equipment.
4. Set MTBM equipment.

PERFORMANCE TASKS

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

1. Inspect equipment.
2. Install couplings, using either the key and setscrew or the tapered shaft and locking nut method.
3. Set STAT equipment.
4. Set MTBM equipment.

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

Basic trainee tools

Samples of split clamping couplings

Samples of tapered clamp hubs

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 that the trainees work with hand tools. Ensure that trainees are briefed on shop safety procedures.

ADDITIONAL RESOURCES

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

R+W America L.P., www.rw-america.com

Coupling Corporation of America, www.couplingcorp.com

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 15 hours are suggested to cover *Prealignment for Equipment Installation*. 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; Inspecting Equipment; Setting Up and Leveling Baseplates	
A. Introduction	_____
B. Inspecting Equipment	_____
C. Laboratory Trainees practice inspecting equipment. This laboratory corresponds to Performance Task 1.	_____
D. Setting Up and Leveling Baseplates	_____
Session II. Installing Couplings	
A. Installing Couplings	_____
B. Laboratory Trainees practice installing couplings, using either the key and setscrew or the tapered shaft and locking nut method. This laboratory corresponds to Performance Task 2.	_____
Session III. Setting the Driven Piece of Equipment	
A. Setting the Driven Piece of Equipment	_____
B. Laboratory Trainees practice setting STAT equipment. This laboratory corresponds to Performance Task 3.	_____
Session IV. Setting the Driver	
A. Setting the Driver	_____
B. Laboratory Trainees practice setting MTBM equipment. This laboratory corresponds to Performance Task 4.	_____
Session V. Review	
A. Module Review	_____

Session VI. Testing

A. 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.
-

B. Performance Testing

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

MODULE OVERVIEW

This module explains how belts and chains are used to drive parallel shafts. It also provides information on different types of chains and belts.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum; Millwright Level One; Millwright Level Two; and Millwright Level Three*, Modules 15301-08 through 15310-08.

OBJECTIVES

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

1. Identify and explain belt drive types.
2. Install belt drives.
3. Identify and explain chain drive types.
4. Install chain drives.

PERFORMANCE TASKS

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

1. Identify belt drive types.
2. Install belt drives.
3. Identify chain drive types.
4. Install chain drives.

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

Basic trainee tools

ANSI Standard B29.1, Transmission Roller Chains and Sprocket Teeth

ANSI Standard B29.2, Inverted-Tooth Chains and Sprocket Teeth

Specialized tools, including laser alignment tools, simple sprocket alignment tools, and chain tools

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 may require that the trainees visit job sites. Ensure that trainees are briefed on site safety policies prior to any site visits.

ADDITIONAL RESOURCES

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

The Complete Guide to Chain, <http://chain-guide.com/>

Michigan Industrial Belting, Inc.,

http://www.mibelting.com/indbelt.htm?gclid=CL_d0aS0rZECFQIglgodrx6Aew

GlobalSpec: The Engineering Search Engine, http://mechanical-components.globalspec.com/Industrial-Directory/drive_belt

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 *Installing Belt and Chain Drives*. 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; Belt Drive Types	
A. Introduction	_____
B. Belt Drive Types	_____
C. Laboratory Trainees identify belt drive types. This laboratory corresponds to Performance Task 1.	_____
Session II. Installing Belt Drives	
A. Installing Belt Drives	_____
B. Laboratory Have trainees install belt drives. This laboratory corresponds to Performance Task 2.	_____
Session III. Chain Drive Types; Installing Chain Drives; Chain Tools	
A. Chain Drive Types	_____
B. Laboratory Have trainees identify chain drive types. Note the proficiency of each trainee. This laboratory corresponds to Performance Task 3.	_____
C. Installing Chain Drives	_____
D. Laboratory Have trainees install chain drives. Note the proficiency of each trainee. This laboratory corresponds to Performance Task 4.	_____

Session IV. 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.

MODULE OVERVIEW

This module explains the principles of operation of various types of fans and blowers, and explains how they are used. It also covers basic maintenance procedures.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum; Millwright Level One; Millwright Level Two; and Millwright Level Three*, Modules 15301-08 through 15311-08.

OBJECTIVES

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

1. Identify and explain types of fans.
2. Explain how to install fans.
3. Identify and explain types of blowers.
4. Explain how to install blowers.

PERFORMANCE TASKS

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

1. Identify types of fans.
2. Identify centrifugal fan wheel types.
3. Identify types of blowers.

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

Basic trainee tools

Various types of fans

Various types of blowers

Module Examinations*

Performance Profile Sheets*

* Located in the Test Booklet

SAFETY CONSIDERATIONS

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

Greenheck Fan Corporation, <http://www.greenheck.com/>

Gardner Denver, Inc., <http://www.gardnerdenver.com/>

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 10 hours are suggested to cover *Installing Fans and Blowers*. 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; Types of Fans	
A. Introduction	_____
B. Types of Fans	_____
C. Laboratory Trainees practice identifying types of fans. This laboratory corresponds to Performance Task 1.	_____
D. Laboratory Trainees practice identifying centrifugal fan wheel types. This laboratory corresponds to Performance Task 2.	_____
Session II. Installing Fans	
A. Installing Fans	_____
B. Installing Preassembled Fans	_____
C. Installing Disassembled Fans	_____
Session III. Types of Blowers; Installing Blowers	
A. Types of Blowers	_____
B. Laboratory Trainees practice identifying types of blowers. This laboratory corresponds to Performance Task 3.	_____
C. Installing Blowers	_____
Session IV. 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.	