Advanced Trade Math
Annotated Instructor's Guide

Module 32301-08

MODULE OVERVIEW

This module provides trainees with advanced practice in geometry, ratios, trigonometry, and algebra.

PREREQUISITES

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

OBJECTIVES

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

1. Use tables of equivalents.
2. Perform right angle trigonometry.
3. Calculate takeouts, using 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
Basic trainee tools
Ruler
Framing square
Scientific calculator
Quick Quiz*
Module Examinations**

* Located at 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 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.

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 30 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**

Sessions I and II. Introduction; Tables of Equivalents; Unit Conversion Tables; Trigonometry I

A. Introduction _____
B. Tables of Equivalents _____
C. Unit Conversion Tables _____
D. Trigonometry _____
   1. Pythagorean Theorem _____

Sessions III through V. Trigonometry II

A. Trigonometry _____
   1. Trigonometric Functions _____
   2. Triangle Calculation _____

Sessions VI through VIII. Trigonometry III

A. Determining the Angles When Side Lengths are Known _____
B. Interpolation _____

Sessions IX and X. Calculating Takeouts Using Trigonometry; Calculating the Weight of an Object

A. Calculating Takeouts Using Trigonometry _____
   1. Takeouts _____
   2. Odd Angles _____
B. Calculating the Weight of an Object _____

Session XI. Review

A. Module Review _____

Session XII. Testing

A. Module Examination _____
   1. Trainees must score 70 percent 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.

Precision Measuring Tools
Annotated Instructor's Guide

Module 32302-08

MODULE OVERVIEW

This module explains how to select, inspect, use, and care for measuring tools common to the industrial maintenance trade.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Industrial Maintenance Mechanic Level One*; *Industrial Maintenance Mechanic Level Two*; and *Industrial Maintenance Mechanic Level Three*, Module 32301-08.

OBJECTIVES

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

1. Use a level.
2. Use a feeler gauge.
3. Use calipers.
4. Use a micrometer.
5. Use a dial indicator.
6. Use a protractor.
7. Use gauge blocks.
8. Use speed measurement tools.
9. Use a pyrometer.
10. Describe the functions of thermal imaging, vibration analysis, and acoustic vibrations.

PERFORMANCE TASKS

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

1. Use a level.
2. Use a feeler gauge.
3. Use calipers.
4. Use a micrometer.
5. Use a dial indicator.
6. Use a protractor.
7. Use gauge blocks.
8. Use speed measurement tools.
9. Use a pyrometer.

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
Master, mechanic's, optical, and electronic levels
Feeler gauges
Inside, outside, vernier, and dial calipers
Outside, inside, and depth micrometers
Various micrometer tips
Height gauges and surface plates
Various sized dial indicators
Universal bevel protractor
Gauge blocks
Stroboscopes, stroboscopic and mechanical tachometers
Optical, thermocouple, and infrared pyrometers
Sample parts to be measured
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.

www.starrett.com
www.mitutoyo.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 25 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**

Sessions I through III. Introduction; Levels; Feeler Gauges; Calipers

A. Introduction _____
B. Levels _____
   1. Master Levels _____
   2. Mechanic's Levels _____
   3. Optical Levels _____
   4. Electronic Levels _____
C. Laboratory _____

   Have the trainees practice using levels. This laboratory corresponds to Performance Task 1.

D. Feeler Gauges _____
E. Laboratory _____

   Have the trainees practice using feeler gauges. This laboratory corresponds to Performance Task 2.

F. Calipers _____
   1. Inside and Outside Calipers _____
   2. Vernier Calipers _____
   3. Dial Calipers _____
G. Laboratory _____

   Have the trainees practice using calipers. This laboratory corresponds to Performance Task 3.

Session IV. Micrometers

A. Micrometers _____
   1. Outside Micrometers _____
   2. Inside Micrometers _____
   3. Depth Micrometers _____
   4. Height Gauges and Surface Plates _____
B. Laboratory _____

   Have the trainees practice using micrometers. This laboratory corresponds to Performance Task 4.

Session V. Dial Indicators; Universal Bevel Protractors

A. Dial Indicators _____

B. Laboratory _____

Have the trainees practice using dial indicators. This laboratory corresponds to Performance Task 5.

C. Universal Bevel Protractors _____

D. Laboratory _____

Have the trainees practice using protractors. This laboratory corresponds to Performance Task 6.

Session VI. Gauge Blocks

A. Gauge Blocks _____

B. Laboratory _____

Have the trainees practice using gauge blocks. This laboratory corresponds to Performance Task 7.

Sessions VII through IX. Speed Measurement Tools; Pyrometers; Thermal and Vibration Analysis

A. Speed Measurement Tools _____

1. Stroboscopes _____
2. Stroboscopic Tachometers _____
3. Mechanical Tachometers _____

B. Laboratory _____

Have the trainees practice using speed measurement tools. This laboratory corresponds to Performance Task 8.

C. Pyrometers _____

D. Laboratory _____

Have the trainees practice using pyrometers. This laboratory corresponds to Performance Task 9.

E. Thermal and Vibration Analysis _____

Session X. Review and Testing

A. Module Review _____

B. Module Examination _____

1. Trainees must score 70 percent 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.

Installing Bearings
Annotated Instructor's Guide

Module 32303-08

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 *Core Curriculum*; *Industrial Maintenance Mechanic Level One*; *Industrial Maintenance Mechanic Level Two*; and *Industrial Maintenance Mechanic Level Three*, Modules 32301-08 and 32302-08.

OBJECTIVES

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

1. Remove bearings.
2. Troubleshoot bearing failures.
3. Install bearings.

PERFORMANCE TASKS

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

1. Remove a bearing.
2. Install a 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)
Induction-type bearing heater
Aluminum heating ring
Pillow block bearing
Split-housing pillow block bearing
Angular-contact ball bearing
Sample bearings with the following characteristics:
- Flaking
- Spalling
- Brinelling
- Misalignment damage
- Thrust failure
- Broken cam
- Electric arcing damage
- Fluting
- Lubrication failure
- Contamination failure

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, Chicago, IL: TPC Training Systems.

Care and Maintenance of Bearings, Cat. No 3017/E, NTN® Corporation. www.ntn.ca/index.htm

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 20 hours are suggested to cover *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; Removing Bearings	
A. Introduction	_____
B. Removing Bearings	_____
1. Using Bearing Pullers	_____
2. Presses	_____
3. Hydraulic Bearing Removal	_____
4. Bearing Removal Using Heat	_____
5. Using a Cutting Torch	_____
C. Laboratory Have the trainees practice removing a bearing. This laboratory corresponds to Performance Task 1.	_____
Sessions II and III. Troubleshooting Antifriction Bearings	
A. Troubleshooting Antifriction Bearings	_____
1. Fatigue Failure	_____
2. Brinelling	_____
3. False Brinelling	_____
4. Misalignment	_____
5. Thrust Failure	_____
6. Broken Cam	_____
7. Electric Arcing	_____
8. Lubrication Failure	_____
9. Failure Due to Contamination	_____
Sessions IV through VI. Installing Bearings	
A. Installing Bearings	_____
1. Installing Tapered Roller Bearings, Using the Temperature Mounting Method	_____
2. Installing Thrust Bearings Using Press Mounting	_____
3. Installing Spherical Roller Bearings Using a Hydraulic Nut or Locknut	_____
4. Installing Pillow Block Bearings	_____
5. Installing Angular-Contact Ball Bearings	_____
B. Laboratory Have the trainees practice installing a bearing. This laboratory corresponds to Performance Task 2.	_____

Session VII. Review

A. Module Review _____

Session VIII. Testing

A. Module Examination _____

1. Trainees must score 70 percent 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.

Installing Couplings
Annotated Instructor's Guide

Module 32304-08

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*; *Industrial Maintenance Mechanic Level One*; *Industrial Maintenance Mechanic Level Two*; and *Industrial Maintenance Mechanic Level Three*, Modules 32301-08 through 32303-08.

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, assemble, and install couplings as assigned by the instructor.
2. Remove a coupling using mechanical pullers.
3. Remove a coupling using the hydraulic or thermal method.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen

Transparencies

Blank acetate sheets

Transparency pens

Whiteboard/chalkboard

Markers/chalk

Pencils and scratch paper

Basic trainee tools

Oil

Rags

Hone or emery cloth

Dial indicator

Micrometer

Feeler gauge

Appropriate personal protective equipment
- Protective gloves
- Eye protection

Samples of various types of couplings, including:
- Rigid couplings
  - Flanged, sleeve, clamp
- Mechanical flexible couplings
  - Slider, gear, chain, grid
- Material flexible couplings
  - Spider, spring, tire, flexible disc, pin and bushing, pin and disc, spacer, universal joint
- Soft-start couplings
  - Fluid, shot, clutch-style

Mechanical pullers

Hydraulic pump

Heating blanket or heating coil

Quick Quiz*

Module Examinations**

Performance Profile Sheets**

* Located at 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.

www.lovejoy-inc.com

www.davidbrown.com

pt.rexnord.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 *Installing 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. Flexible Couplings	_____
1. Mechanical Flexible Couplings	_____
2. Material Flexible Couplings	_____
Session III. Soft-Start Couplings	
A. Soft-Start Couplings	_____
1. Fluid Couplings	_____
2. Shot Couplings	_____
3. Clutch-Style Couplings	_____
Session IV. Installing Couplings	
A. Installing Couplings	_____
1. General Coupling Installation	_____
2. Split Coupling Installation	_____
3. Interference-Fit Installation	_____
4. Setting the Coupling Gap	_____
5. Grid Coupling Installation	_____
B. Laboratory	_____
Have the trainees practice identifying, assembling, and installing couplings as assigned. This laboratory corresponds to Performance Task 1.	

Session V. Removing Couplings

A. Removing Couplings _____

1. General Coupling Removal _____
2. Mechanical Pullers _____
3. Hydraulic Removal _____

B. Laboratory _____

Have the trainees practice removing a coupling using mechanical pullers. This laboratory corresponds to Performance Task 2.

C. Laboratory _____

Have the trainees practice removing a coupling using the hydraulic or thermal method. This laboratory corresponds to Performance Task 3.

Session VI. Review and Testing

A. Module Review _____

B. Module Examination _____

1. Trainees must score 70 percent 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.

Setting Baseplates and Prealignment
Annotated Instructor's Guide

Module 32305-08

MODULE OVERVIEW

This module teaches trainees how to lay out and install baseplates. It also explains the process of prealignment.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Industrial Maintenance Mechanic Level One*; *Industrial Maintenance Mechanic Level Two*; and *Industrial Maintenance Mechanic Level Three*, Modules 32301-08 through 32304-08.

OBJECTIVES

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

1. Establish baseplate and soleplate locations.
2. Install baseplates and soleplates.
3. Identify proper anchor bolts for installation.
4. Field-verify a plate installation.
5. Set driven equipment.
6. Set a driver.

PERFORMANCE TASKS

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

1. Establish baseplate and soleplate locations and elevations for a specified plate installation.
2. Set anchor bolts and shim packs.
3. Set up a piano wire jig.
4. Set a baseplate and soleplate.
5. Field-verify a plate installation.
6. Set a piece of driven equipment.
7. Set a driver.

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
Alignment simulator
Blueprints
Optical or laser level
GPS unit (optional)
Chalk box
Measuring tape
Anchor, jack, and foundation bolts
Plywood jig
Piano wire jig / piano wire
Shim packs
Drill and drill bits
Precision square
Feeler gauge
Straightedge
Grouting
Plywood or planking (for form)
Rigid and flexible couplings
Transfer punch
Tram plate
A piece of driven equipment
A driver
Dial indicator
Theodolites
Electronic transits
Screw jack
Screw jack and wedge type levelers
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.

www.ludeca.com

www.giantpumps.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 30 hours are suggested to cover *Setting Baseplates and Prealignment*. 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; Establishing Baseplate and Soleplate Locations

A. Introduction _____

B. Establishing Baseplate and Soleplate Locations _____

1. Laying Out Baseplates and Soleplates _____
2. Establishing Plate Elevation _____
3. Optical Theodolites _____
4. Electronic Transits and Theodolites _____
5. Using a String Line Level _____

C. Laboratory _____

Have the trainees practice establishing baseplate and soleplate locations and elevations for a specified plate installation. This laboratory corresponds to Performance Task 1.

Sessions III through V. Installing Baseplates and Soleplates

A. Installing Baseplates and Soleplates _____

1. Setting Anchor Bolts _____
2. Setting Shim Packs _____
3. Setting Up Piano Wire Jigs _____
4. Setting the Plate _____

B. Laboratory _____

Have the trainees practice setting anchor bolts and shim packs. This laboratory corresponds to Performance Task 2.

C. Laboratory _____

Have the trainees practice setting up a piano wire jig. This laboratory corresponds to Performance Task 3.

D. Laboratory _____

Have the trainees practice setting a baseplate and soleplate. This laboratory corresponds to Performance Task 4.

Session VI. Field-Verifying Installation

A. Field-Verifying Installation _____

B. Laboratory _____

Have the trainees practice field-verifying a plate installation. This laboratory corresponds to Performance Task 5.

Session VII. Grouting; Inspecting the Equipment

A. Grouting _____

B. Inspecting the Equipment _____

Session VIII. Installing Couplings

A. Installing Couplings _____

1. Clearance Installation _____

Sessions IX and X. Setting the Driven Piece of Equipment; Setting the Driver; Alignment

A. Setting the Driven Piece of Equipment _____

B. Setting the Driver _____

C. Alignment _____

D. Laboratory _____

Have the trainees practice setting a piece of driven equipment. This laboratory corresponds to Performance Task 6.

E. Laboratory _____

Have the trainees practice setting a driver. This laboratory corresponds to Performance Task 7.

Session XI. Review

A. Module Review _____

Session XII. Testing

A. Module Examination _____

1. Trainees must score 70 percent 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.

Conventional Alignment
Annotated Instructor's Guide

Module 32306-08

MODULE OVERVIEW

This module explains how to align machinery and couplings. Trainees will learn how to use dial indicators to achieve accurate alignment. Also covered is information on coupling stress, its causes, and how to correct it.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Industrial Maintenance Mechanic Level One*; *Industrial Maintenance Mechanic Level Two*; and *Industrial Maintenance Mechanic Level Three*, Modules 32301-08 through 32305-08.

OBJECTIVES

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

1. Explain types of misalignment.
2. Align couplings using feeler gauge, straightedge, and dial indicator methods.
3. Identify and eliminate coupling stress.

PERFORMANCE TASKS

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

1. Use the straightedge and feeler gauge methods, and then a dial indicator to:
   - Level and align the driven on a base.
   - Adjust vertical angularity of the driver.
   - Adjust vertical offset of the driver.
   - Adjust horizontal angularity of the driver.
   - Adjust horizontal offset of the driver.
   - Adjust vertical offset and angularity.
   - Adjust horizontal offset and angularity.
2. Check for and eliminate coupling stress.
3. Check for and calculate indicator sag.

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
Alignment simulator
Straightedge
Square
Chalk or grease pencils
Feeler gauges
Machinist's rule
Dial indicators
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.

www.ludeca.com

www.peopleflo.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 30 hours are suggested to cover *Conventional Alignment*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	**Planned Time**
Sessions I through IV. Introduction; Types of Misalignment; Coupling Stress	
A. Introduction	_____
B. Types of Misalignment	_____
1. Vertical Offset	_____
2. Vertical Angularity	_____
3. Horizontal Offset	_____
4. Horizontal Angularity	_____
5. Alignment Terminology	_____
C. Coupling Stress	_____
1. Causes of Coupling Stress	_____
2. Checking for Coupling Stress	_____
3. Eliminating Coupling Stress	_____
D. Laboratory	_____
Have the trainees practice checking for and eliminating coupling stress. This laboratory corresponds to Performance Task 2.	
Sessions V through X. Aligning Couplings, Using the Straightedge and Feeler Gauge Method; Aligning Couplings, Using the Dial Indicator Method	
A. Aligning Couplings, Using the Straightedge and Feeler Gauge Method	_____
1. Adjusting Vertical Angularity	_____
2. Adjusting Vertical Offset	_____
3. Adjusting Horizontal Angularity	_____
4. Adjusting Horizontal Offset	_____
5. Adjusting Vertical Angularity and Offset	_____
6. Adjusting Horizontal Angularity and Offset	_____
B. Aligning Couplings, Using the Dial Indicator Method	_____
1. Setting Up Dial Indicators	_____
2. Taking Top View Measurements	_____
3. Taking Side View Measurements	_____
4. Taking Angularity and Offset Measurements	_____

C. Laboratory _____

Have the trainees practice using the straightedge and feeler gauge methods, and then a dial indicator to: level and align the driven on a base; adjust vertical angularity of the driver; adjust vertical offset of the driver; adjust horizontal angularity of the driver; adjust horizontal offset of the driver; adjust vertical offset and angularity; and adjust horizontal offset and angularity. This laboratory corresponds to Performance Task 1.

D. Laboratory _____

Have the trainees practice checking for and calculating indicator sag. This laboratory corresponds to Performance Task 3.

Session XI. Review

A. Module Review _____

Session XII. Testing

A. Module Examination _____

1. Trainees must score 70 percent 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.

Installing Belt and Chain Drives
Annotated Instructor's Guide

Module 32307-08

MODULE OVERVIEW

This module provides information on different types of chains and belts, and how they are used to drive parallel shafts.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Industrial Maintenance Mechanic Level One*; *Industrial Maintenance Mechanic Level Two*; and *Industrial Maintenance Mechanic Level Three*, Modules 32301-08 through 32306-08.

OBJECTIVES

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

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

PERFORMANCE TASKS

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

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

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
V-belts
Timing belts
Roller chains
Silent chains
Cleaning solvent
Oil
Rags
Hone, fine file, light grinder, or emery cloth
Straightedge
Piano wire
Micrometer
Chain breaker and riveter
Oil
Sprocket alignment tool
Various types of belt drives
Various types of chain drives
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
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.

www.gates.com
www.beltcorp.com
www.hitmax.com
www.tsubakimoto.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 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	_____
1. V-Belts	_____
2. Synchronous Belts	_____
C. Laboratory	_____
Have the trainees practice identifying belt drive types. This laboratory corresponds to Performance Task 1.	
Session II. Installing Belt Drives	
A. Installing Belt Drives	_____
B. Laboratory	_____
Have the trainees practice installing a belt drive. This laboratory corresponds to Performance Task 2.	
Session III. Chain Drive Types; Installing Chain Drives; Chain Tools	
A. Chain Drive Types	_____
1. Roller Chains	_____
2. Silent Chains	_____
B. Laboratory	_____
Have the trainees practice identifying chain drive types. This laboratory corresponds to Performance Task 3.	
C. Installing Chain Drives	_____
D. Laboratory	_____
Have the trainees practice installing a chain drive. This laboratory corresponds to Performance Task 4.	
E. Chain Tools	_____

Session IV. Review and Testing

A. Module Review _____

B. Module Examination _____

1. Trainees must score 70 percent 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.

Installing Mechanical Seals
Annotated Instructor's Guide

Module 32308-08

MODULE OVERVIEW

This module introduces the many types of mechanical seals available, including their characteristics and applications. Note that this module is an elective; it is not required for successful level completion.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Industrial Maintenance Mechanic Level One*; *Industrial Maintenance Mechanic Level Two*; and *Industrial Maintenance Mechanic Level Three*, Modules 32301-08 through 32307-08.

OBJECTIVES

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

1. Identify types of mechanical seals and explain their applications.
2. Safety and accurately remove and inspect mechanical seals.
3. Safety and accurately install mechanical seals.

PERFORMANCE TASKS

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

1. Identify given mechanical seals and explain their applications.
2. Safety and accurately remove and inspect a mechanical seal.
3. Safely and accurately install a mechanical seal.

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
Hone or emery cloth
Oil
Rags
Micrometer
Dial indicator
Soft-blow mallet

Samples of various mechanical seals, including:
- Single inside / outside
- Double mechanical
- Tandem
- Cartridge
- Balanced /unbalanced
- Single-spring / multiple-spring
- Welded metal bellows
- Elastomer bellows
- Rotating / stationary

Centrifugal pump with mechanical seal
Samples of manufacturer's instructions for seals
Quick Quiz*
Module Examinations**
Performance Profile Sheets**

* Located at 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.

www.flowserve.com
www.chesterton.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 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 and Basic Design	
A. Introduction	_____
B. Basic Design	_____
Sessions II and III. Mechanical Seal Classifications	
A. Mechanical Seal Classifications	_____
1. Classifying Mechanical Seals by Arrangement	_____
2. Classifying Mechanical Seals by Design	_____
B. Laboratory	_____
Have the trainees practice identifying mechanical seals and explaining their applications. This laboratory corresponds to Performance Task 1.	
Sessions IV through VI. Replacing Mechanical Seals	
A. Replacing Mechanical Seals	_____
1. Removing Mechanical Seals	_____
2. Inspecting Mechanical Seals	_____
3. Installing Mechanical Seals	_____
B. Laboratory	_____
Have the trainees practice safely and accurately removing and inspecting a mechanical seal. This laboratory corresponds to Performance Task 2.	
C. Laboratory	_____
Have the trainees practice safely and accurately installing a mechanical seal. This laboratory corresponds to Performance Task 3.	
Session VII. Review	
A. Module Review	_____
Session VIII. Testing	
A. Module Examination	_____
1. Trainees must score 70 percent 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.	