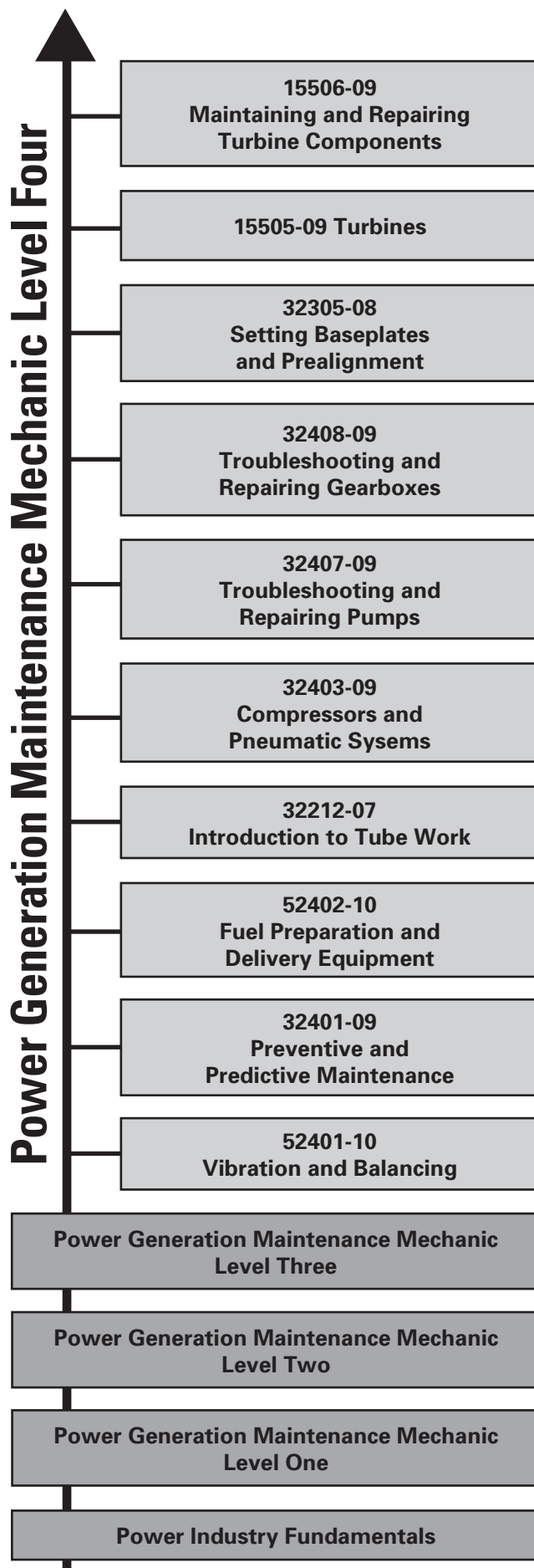


COMPETENCIES, OBJECTIVES, AND PERFORMANCE TASKS



Module Overview

There are good vibrations and bad vibrations in machinery. Bad vibrations are often caused by things being damaged or out of balance. This module reviews machine basics and addresses where vibrations can be found and how they can be detected. It also addresses how vibration collection and analysis can be used to detect unbalanced equipment, and how it can be used to balance the equipment.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Power Industry Fundamentals*; *Power Generation Maintenance Mechanic Level One*; *Power Generation Maintenance Mechanic Level Two*; and *Power Generation Maintenance Mechanic Level Three*.

Objectives

When you have completed this module, you will be able to do the following:

1. Explain machine basics.
2. Explain the causes of vibration.
3. Explain vibration analysis.
4. Identify and explain the different kinds of basic vibration test equipment.
5. Explain vibration monitoring.
6. Explain field balancing of machines.
7. Using a vibration monitor, analyze a piece of rotating equipment to determine if vibration is within tolerance.

Performance Tasks

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

1. Collect and analyze vibrational data from a rotating part inside an operational machine.
2. Demonstrate or identify where to place a temporary weight, based on a given set of balance data.

Materials and Equipment

Markers/chalk	Small gauge pipe and small weights to fit on the ends
Pencils and scratch paper	T-joints
Whiteboard/chalkboard	Access to different types of new and used:
<i>Power Generation Maintenance Mechanic Level 4</i>	Electric motors
PowerPoint® Presentation Slides (ISBN 978-0-13-257323-8)	Gearboxes/reducers
Multimedia projector and screen	Pumps
Computer	Fans
Appropriate personal protective equipment	Compressors
Copies of balancing standards from ISO, NEMA, and API	Conveyors
Copies of company's lockout and tagout procedures	Bearings (plain and antifriction) for rotating and non-rotating equipment
Copies of company's fall-protection procedures	Couplings (both installed and not installed)
Vendor manuals and drawings for machines being evaluated	Drive belts (installed)
Vendor manuals and drawings for any machines being used with this module	Drive chains (installed)
Tools of the trade	A small variable-speed electric motor equipped with a test pulley
	A small weigh scale
	Dial indicators for checking shaft runout

continued

A handheld infrared thermometer
 Locks and tags needed for proper lockout
 Any required barrier materials
 One or more of the following:
 Vibration data collection instrument with all attachments and accessories
 Samples of different types of transducers
 Vibration analyzer and associated software
 Stroboscope and/or Stroboscopic tachometer
 Balancing machine
 Vibration meter
 Oscilloscope
 Spectrum analyzer

Tensionmeter
 Round steel rod, 4' long
 Samples of machine parts damaged due to poor lubrication, misalignment, bent shafts, and unbalance
 Play putty
 Cutaway models of motors, gearboxes, and pumps
 A straight shaft mounted in two pillow block bearings
 Module Examinations*
 Performance Profile Sheets*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment. Review safety guidelines associated with collecting and analyzing vibrational data, and equipment balancing. Emphasize the importance of proper housekeeping. Point out the hazards of working near or on rotating equipment.

Additional Resources

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

- ReliabilityWeb.Com, for vibration analysis testing resources and links: www.reliabilityweb.com.
- Plant Maintenance Resource Center, for articles on bearings and vibration analysis: www.plant-maintenance.com.
- Commtest, for vibration analysis information, products, and training: <http://commtest.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 12½ hours are suggested to cover *Vibration and Balancing*. 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; Machine Basics; Causes of Vibration	
A. Introduction	_____
B. Machinery Basics	_____
1. Rotating Equipment	_____
2. Non-Rotating Equipment	_____
3. Data-Collecting Devices	_____
4. Reasons for Collecting and Analyzing Data	_____

Session V. Review and Testing

A. Review

B. Module Examination

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

MODULE OVERVIEW

This module provides an overview of the preventive and predictive maintenance processes. Information about nondestructive testing is also included.

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*.

OBJECTIVES

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

1. Explain preventive and predictive maintenance.
2. Explain nondestructive testing.
3. Explain ultrasonics.
4. Explain radiography.
5. Explain eddy current inspection.
6. Explain visual and optical inspection.
7. Explain liquid penetrant inspection.
8. Explain magnetic particle inspection.
9. Explain acoustic emissions.
10. Explain infrared testing.
11. Explain vibration analysis.
12. Explain tribology.

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
Appropriate personal protective equipment
Examples of flawed welds, stress cracks, etc.

NDT equipment, including:
Ultrasonic tester
Pyrometer
Eddy current tester
Borescope
Liquid penetrant kit
Magnetic particle yoke
Copies of the Quick Quizzes*
Module Examination**

* 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.

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.

An Introduction to Predictive Maintenance, 2002. R. Keith Mobley. Woburn, MA: Butterworth-Heinsmann.

Encyclopedia of Materials Science and Engineering – Supplementary, Vol. 1, 1989. Michael B. Bever and Robert W. Cahn, ed. Cambridge, MA: The MIT Press.

Encyclopedia of Materials Science and Engineering – Supplementary, Vol. 2, 1990. Robert W. Cahn, ed. Cambridge, MA: The MIT Press.

Nondestructive Evaluation and Quality Control Metals Handbook, Vol. 17, 9th Ed. 1989. Materials Park, OH: ASM International.

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 *Preventive and Predictive Maintenance*. 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; Preventive Maintenance; Predictive Maintenance	
A. Introduction	_____
B. Preventive Maintenance	_____
1. Program Benefits	_____
C. Predictive Maintenance	_____
1. Requirements and Priorities	_____
2. Documentation	_____
Session II. Nondestructive Testing and Evaluation, Part One	
A. Introduction	_____
B. Ultrasonics	_____
C. Radiography	_____
D. Eddy Current Inspection	_____
E. Visual and Optical Inspection	_____
Session III. Nondestructive Testing and Evaluation, Part Two	
A. Liquid Penetrant Inspection	_____
B. Magnetic Particle Inspection	_____
C. Acoustic Emission Testing	_____
D. Infrared Testing	_____
E. Vibration Analysis	_____
F. Tribology	_____

Session IV. Review and Testing

A. Trade Terms and Quick Quizzes

B. Module Review

C. 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 describes equipment used to move solid fuels into the boiler house facilities. It explains how the fuels are prepared, how the fuels are delivered into the furnaces, and how the fuel residues are removed from the furnaces. The module also covers the maintenance needed to keep the fuel preparation and delivery equipment operating.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Power Industry Fundamentals*; *Power Generation Maintenance Mechanic Level One*; *Power Generation Maintenance Mechanic Level Two*; *Power Generation Maintenance Mechanic Level Three*; and *Power Generation Maintenance Mechanic Level Four*, Modules 52401-10 and 32401-09.

Objectives

When you have completed this module, you will be able to do the following:

1. Explain the basic operations of a coal-fired boiler system.
2. Describe the path that coal takes from the storage area(s) to the coal-preparation equipment.
3. Explain why coal must be prepared, and the methods and equipment used to prepare coal.
4. Describe the checks to make on coal-preparation equipment during overhauls.
5. Explain how solid fuel wastes are disposed of in coal-burning furnace systems.
6. Explain the operation of other solid-fuel furnaces used with boilers.

Performance Tasks

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

1. Identify solid fuel preparation equipment from drawings or pictures of actual equipment.
2. Inspect, lubricate, and adjust or repair belt conveyors and feed conveyors used in the delivery of solid fuels to a furnace.
3. Inspect, lubricate, and adjust or repair breakers and crushers or shredders used in the preparation of solid fuels for a furnace.
4. Inspect, lubricate, and adjust or repair coal pulverizers.

Materials and Equipment

Markers/chalk
Pencils and scratch paper
Whiteboard/chalkboard
Power Generation Maintenance Mechanic Level 4
PowerPoint® Presentation Slides
(ISBN 978-0-13-257323-8)
Multimedia projector and screen
Computer
Appropriate personal protective equipment
Access to coal-furnace equipment:
Delivery conveyors (belt, flight, and bucket)
Feed conveyors
Breakers
Crushers
Ball pulverizers
Wheel pulverizers

FD fans
PA fans
ID fans
Access to one or more water-tube boilers
Tools of the trade
Tools for measuring clearances
Grease guns with applicable lubricants
Flashlights
Copies of company's lockout and tagout procedures
Locks and tags needed for proper lockout
Any required barrier materials
Copies of company's fall protection procedures
Vendor manuals and drawings for selected machines used with coal-burning furnaces

continued

Access to biomass-furnace equipment:	machines used with biomass furnaces
Shredder	Lab beaker with water, heat source, and balloon
Pulverized fuel firing furnace	Whistling tea kettle
Grate firing furnace	6" wide pipe at least 3' long and stick matches
Fluid bed firing furnace	Materials and tools to repair belt conveyors
Horizontal pulverizers	Cleaning tools and materials
Bowl mill pulverizer	Module Examinations*
Ball and tube pulverizer	Performance Profile Sheets*
Vendor manuals and drawings for selected	

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment. Review safety guidelines associated with working on or near conveyors, large fans, crushers, breakers, and pulverizers used to transport, prepare, and deliver solid coal and biomass fuels into furnaces. Emphasize the importance of proper housekeeping.

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.

Power Plant Primer. A.W. Kramer. Barrington, IL: PennWell. This book was originally distributed by Power Engineering International (<http://pepei.pennnet.com>), which is also associated with PennWell Publishing (www.pennwell.com).

Steam: Its Generation and Use. Barberton, OH: The Babcock and Wilcox Company (www.babcock.com).

Almost any subject associated with energy can be found on the US Department of Energy's website: www.energy.gov.

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 *Fuel Preparation and Delivery Equipment*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction; Coal-Fired Boiler Basics; Coal Delivery	
A. Introduction	_____
B. Coal-Fired Boiler Basics	_____
1. Fires	_____
2. Boiling Water to Make Steam	_____
3. Boilers	_____
4. Heating Sources	_____
C. Coal Delivery	_____
1. Distribution Conveyors and Feed Hoppers	_____

Session II. Laboratory

A. Laboratory

From actual machine manuals and equipment drawings, have the trainees identify specific equipment items used between the solid fuel storage area and the feed hoppers. This laboratory corresponds to Performance Task 1.

Session III. Coal Preparation, Part One

A. Coal Preparation

1. Breakers
2. Crushers
3. Feed Conveyors

Sessions IV and V. Laboratories

A. Laboratory

From actual machine manuals and equipment drawings of breakers, crushers or shredders, and feed conveyors, have the trainees identify specific equipment items used in the preparation of solid fuels for a furnace. This laboratory corresponds to Performance Task 1.

B. Laboratory

Have trainees inspect, lubricate, and adjust or repair belt conveyors and feed conveyors used in the delivery of solid fuels to a furnace. This laboratory corresponds to Performance Task 2.

C. Laboratory

Have trainees inspect, lubricate, and adjust or repair breakers and crushers or shredders used in the preparation of solid fuels for a furnace. This laboratory corresponds to Performance Task 3.

Session VI. Coal Preparation, Part Two

A. Coal Preparation

1. Air Systems
2. Ball and Wheel Pulverizers
3. Other Types of Pulverizers

Sessions VII and VIII. Laboratories

A. Laboratory

From actual machine manuals and equipment drawings of air systems and pulverizers used in the preparation of solid fuels for a furnace, have the trainees identify specific equipment items. This laboratory corresponds to Performance Task 1.

B. Laboratory

Have trainees inspect, lubricate, and adjust or repair coal pulverizers. This laboratory corresponds to Performance Task 4.

Session IX. Waste Disposal Systems; Other Solid Fuel Systems

A. Waste Disposal System

1. Fly Ash
2. Bottom Ash

B. Other Solid Fuel Systems

1. Wood Fuels
2. Biomass Fuels

Session X. Review and Testing

A. Review

B. Module Examination

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

MODULE OVERVIEW

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

PREREQUISITES

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

OBJECTIVES

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

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

PERFORMANCE TASKS

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

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

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen

Transparencies

Blank acetate sheets

Transparency pens

Whiteboard/chalkboard

Markers/chalk

Pencils and scratch paper

Appropriate personal protective equipment

NDE testing equipment as available

Rolling equipment or manufacturers' literature

Various types of plugs

Copies of Quick Quiz*

Module Examination**

Performance Profile Sheets**

* Located in the back of this module

**Located in the Test Booklet.

SAFETY CONSIDERATIONS

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

ADDITIONAL RESOURCES

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

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

www.tcwilson.com/literature.php

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

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

TEACHING TIME FOR THIS MODULE

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

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

Sessions IV. Plugging of Tubes, Review and Testing

A. Pluggable Tubes

B. Guideline Procedures for Plugging Tubes in Drums and Headers

C. Review

D. Module Examination

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

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

E. Performance Testing

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

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

Annotated Instructor's Guide

MODULE OVERVIEW

This module presents the basics of compressed air (pneumatic) systems, including descriptions of the machinery used in these systems. Procedures for troubleshooting pneumatic systems are also explained.

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; Industrial Maintenance Mechanic Level Three; and Industrial Maintenance Mechanic Level Four, Modules 32401-09 and 32402-09.*

OBJECTIVES

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

1. Explain compressed-air treatment.
2. Identify and explain pneumatic system components and symbols.
3. Explain pneumatic safety.
4. Explain the physical characteristics of gases.
5. Explain compressing gases.
6. Explain the pneumatic transmission of energy.
7. Explain the principles of compressor operation.
8. Identify and explain types of compressors.

PERFORMANCE TASKS

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

1. Identify at least four components of basic pneumatic equipment.
2. Identify various types of compressors.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen	Reciprocating compressors
Transparencies	Dry intake air filters
Blank acetate sheets	Mechanical filters
Transparency pens	Pictures of coolers
Whiteboard/chalkboard	Samples of various lubricants
Markers/chalk	Grease gun
Pencils and scratch paper	Appropriate machine oil
Appropriate personal protective equipment	Silicone lubricant
Safety video or DVD	Allen wrenches
Video/DVD player	Flare nut wrenches
Various types of compressors	Shaft key wrenches
Photographs or diagrams of different types of compressors	Pipe wrenches
Manufacturers' maintenance and repair manuals	Arbor press or length of pipe to install bearings
Compressor system setups	Assorted screwdrivers
Old or broken compressors	Ball-peen hammers
	Bearing pullers

(continued)

Carpenter's levels
Feeler gauges
Pressure gauges
Needle-nose pliers
Sharp knives
Torque wrenches
Anti-seize compound

Gaskets
O-rings
Teflon® tape
Copies of Quick Quizzes*
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. Trainees will identify compressors and compressor components and may be asked to operate a compressor.

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.

Industrial Fluid Power, vols. 1, 2, and 3. Dallas, TX: Womack Educational Publications, ©2005.

Industrial Pneumatic Technology, Bulletin 0275-B1. Cleveland, OH: Parker Hannifin Corporation, ©1980.

Ingersoll-Rand Company for hydraulic and pneumatic products and product information
(literature, specifications, drawings)
<http://fluids.ingersollrand.com>

MFD Pneumatics, for pneumatic products and product information
(literature, specifications, drawings)
<http://www.mfdpneumatics.com>

Parker Hannifin Corporation, for training materials, products, and product information
(literature, specifications, drawings)
<http://www.parker.com>

Quincy Compressor, for training materials, products, and product information
(literature, specifications, drawings)
<http://www.quincycompressor.com>

Womack Machine Supply Company, for training materials
<http://www.womackmachine.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 35 hours are suggested to cover *Compressors and Pneumatic Systems*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction; Pneumatic System Safety	
A. Introduction	_____
B. Pneumatic System Safety	_____
Session II. Physical Characteristics of Gases; Effects of Atmospheric Pressure; Compressing Gases; Pneumatic Transmission of Energy	
A. Physical Characteristics of Gases	_____
B. Effects of Atmospheric Pressure	_____
C. Compressing Gases	_____
D. Pneumatic Transmission of Energy	_____
Sessions III and IV. Compressor Operation and Types	
A. Positive-Displacement Compressors	_____
B. Continuous-Flow Compressors	_____
C. Laboratory	_____
Have trainees identify various types of compressors. This laboratory corresponds to Performance Task 2.	
D. Compressor Controls	_____
Sessions V–VIII. Treatment of Compressed Air	
A. Intake Filters	_____
B. Intercoolers and Aftercoolers	_____
C. Separators and Chemical Dryers	_____
D. Receivers, In-Line Filters, and Pressure Regulators	_____
E. Lubricators, F-R-Ls, and Air Treatment Controls	_____
Sessions IX and X. Pneumatic System Components; Pneumatic Symbols	
A. Valves	_____
B. Actuators	_____
C. Mufflers	_____
D. Laboratory	_____
Have trainees identify at least four components of basic pneumatic equipment. This laboratory corresponds to Performance Task 1.	
E. Pneumatic Symbols	_____

Sessions XI–XIII. Troubleshooting Pneumatic Systems

- A. Drive Section Problems
- B. Compression Section Problems
- C. Pre-Storage Problems
- D. Storage Section Problems
- E. Post-Storage Problems
- F. Troubleshooting Air-Driven Devices

Session XIV. Review and Testing

- A. Trade Terms Quick Quiz
- B. Module Review
- C. 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.
- D. 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.

Annotated Instructor's Guide

MODULE OVERVIEW

This module covers how to inspect, troubleshoot, and prepare pumps for shutdown. It also covers removing pumps from the system, disassembly, and reassembly.

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; Industrial Maintenance Mechanic Level Three; and Industrial Maintenance Mechanic Level Four, Modules 32401-09 through 32406-09.*

OBJECTIVES

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

1. Inspect a pump.
2. Troubleshoot a pump.
3. Prepare a pump for shutdown and repair.
4. Remove a pump from the system.
5. Disassemble a pump.
6. Reassemble a pump.
7. Install a pump.
8. Prepare a checklist for pump startup.

PERFORMANCE TASKS

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

1. Inspect and/or troubleshoot a pump.
2. Disassemble and reassemble a pump.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen	Assorted screwdrivers
Transparencies	Ball-peen hammer
Blank acetate sheets	Needle-nose pliers
Transparency pens	Snap-ring pliers
Whiteboard/chalkboard	Arbor press or length of pipe to install bearings
Markers/chalk	Bearing pullers
Pencils and scratch paper	Combination wrench sets
Appropriate personal protective equipment	Torque wrenches
Company safety manual	Allen wrenches
Manufacturers' maintenance and repair manuals	Shaft key wrenches
Lock washers	Flare nut wrenches
Gaskets	Socket sets
O-rings	Emery cloths and hones
Various types of pumps	600-grit sandpaper
Pump setups	Feeler gauges
Old or broken pumps	

(continued)

Dial indicators
 Portable crane/rigging device
 Sling and hardware for rigging
 Grease gun
 Appropriate machine oil

Silicone lubricant
 Copies of the Quick Quizzes*
 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 trainees to work with pumps. Ensure that they are briefed on appropriate 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: <http://www.flowserve.com/eim/Literature>
 Goulds Pumps: http://www.gouldspumps.com/literature_ioms.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 10 hours are suggested to cover *Troubleshooting and Repairing Pumps*. 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 and Troubleshooting Pumps	
A. Introduction	_____
B. Inspecting Pumps	_____
C. Performing Preventive Maintenance on Pumps	_____
D. Troubleshooting Pumps	_____
E. Laboratory	_____
Have trainees practice inspecting and troubleshooting a pump. This laboratory corresponds to Performance Task 1.	
Sessions II and III. Disassembling and Reassembling Pumps	
A. Preparing a Pump for Shutdown and Repair	_____
B. Removing a Pump from the System	_____
C. Disassembling a Split-Casing Pump	_____
D. Laboratory	_____
Have trainees practice disassembling a pump. This laboratory corresponds to Performance Task 2.	
E. Reassembling a Pump	_____
F. Laboratory	_____
Have trainees practice reassembling a pump. This laboratory corresponds to Performance Task 2.	

Session IV. Installing a Pump; Startup Procedures; Review and Testing

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

Annotated Instructor's Guide

MODULE OVERVIEW

This module covers gearboxes and how to inspect, remove, reassemble, install, and maintain them. It also includes information about gear types, gear operation, and measuring and adjusting backlash and bearing clearance.

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; Industrial Maintenance Mechanic Level Three; and Industrial Maintenance Mechanic Level Four, Modules 32401-09 through 32407-09.*

OBJECTIVES

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

1. Identify and explain gearboxes.
2. Explain how gears operate and identify types of gears.
3. Identify types of gearboxes and use diagnostic charts.
4. Troubleshoot gearboxes.
5. Remove and disassemble gearboxes.
6. Identify gear wear patterns.
7. Measure and adjust backlash and bearing clearance.
8. Install and maintain gearboxes.

PERFORMANCE TASKS

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

1. Identify types of gears.
2. Identify types of gearboxes.
3. Inspect and/or troubleshoot a gearbox.
4. Disassemble and reassemble a gearbox.
5. Identify gear wear patterns.
6. Measure backlash and bearing clearance.

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

Manufacturers' service and repair manuals

Non-working gearboxes for troubleshooting and disassembly

Lockout/tagout devices

Ultrasonic tester

Various types of gears, including:

Spur

Helical

Double helical

Herringbone

Worm

Bevel

Spiral bevel

Hypoid bevel

Zerol bevel

Various types of gearboxes, including:

Parallel

In-line

Right-angle drive

Shaft mount

(continued)

Wrenches
 Pans for oil
 Cleaning solvent
 Rags
 Solvent MSDS
 High-spot blue and applicator
 Dead-blow hammer
 Dial indicator
 Feeler gauge
 Gear pullers

Heating torch
 Hydraulic press
 Lifting devices
 Bearing heater
 Video or DVD on chemical safety
 Video or DVD player
 Copies of the Quick Quizzes*
 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 trainees to troubleshoot, disassemble, and reassemble gearboxes. Ensure that they are briefed on appropriate shop safety procedures.

ADDITIONAL RESOURCES

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

Mobil Brief Product Descriptions, Mobil Oil Corporation, published annually

Maintenance Resources, Inc.: <http://www.maintenanceresources.com/referencelibrary/gears/gearing.htm>

Plant Services: <http://www.plantservices.com/articles/2004/393.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 *Troubleshooting and Repairing Gearboxes*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction to Gearboxes	
A. Introduction	_____
B. Understanding Gearboxes	_____
C. Gear Types	_____
D. Laboratory	_____
Have trainees practice identifying gear types. This laboratory corresponds to Performance Task 1.	
E. Types of Gearboxes	_____
F. Laboratory	_____
Have trainees practice identifying types of gearboxes. This laboratory corresponds to Performance Task 2.	

Session II. Troubleshooting Gearboxes

A. Troubleshooting Gearboxes _____

B. Laboratory _____

Have trainees practice troubleshooting gearboxes. This laboratory corresponds to Performance Task 3.

Sessions III and IV. Disassembling and Reassembling Gearboxes

A. Repairing Gearboxes _____

B. Removing Gearboxes _____

C. Disassembling and Reassembling Gearboxes _____

D. Laboratory _____

Have trainees practice disassembling and reassembling gearboxes. This laboratory corresponds to Performance Task 4.

Session V. Gear Wear Patterns

A. Identifying Gear Wear Patterns _____

B. Laboratory _____

Have trainees practice identifying gear wear patterns. This laboratory corresponds to Performance Task 5.

Sessions VI and VII. Repairing Gearboxes

A. Measuring and Adjusting Backlash _____

B. Measuring and Setting Bearing Clearance _____

C. Laboratory _____

Have trainees practice measuring backlash and bearing clearance. This laboratory corresponds to Performance Task 6.

D. Installing Gearboxes _____

E. Maintaining Gearboxes _____

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 teaches trainees how to lay out and install baseplates. It also explains the process of pre-alignment.

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	Drill and drill bits
Transparencies	Precision square
Blank acetate sheets	Feeler gauge
Transparency pens	Straightedge
Whiteboard/chalkboard	Grouting
Markers/chalk	Plywood or planking (for form)
Pencils and scratch paper	Rigid and flexible couplings
Appropriate personal protective equipment	Transfer punch
Alignment simulator	Tram plate
Blueprints	A piece of driven equipment
Optical or laser level	A driver
GPS unit (optional)	Dial indicator
Chalk box	Theodolites
Measuring tape	Electronic transits
Anchor, jack, and foundation bolts	Screw jack
Plywood jig	Screw jack and wedge type levelers
Piano wire jig / piano wire	Module Examinations*
Shim packs	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.

MODULE OVERVIEW

This module describes steam, gas, and hydraulic turbines. Trainees will become familiar with turbine components as they learn the principles by which turbines operate.

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; Millwright Level Three; Millwright Level Four; and Millwright Level Five*, Modules 15501-09 through 15504-09.

OBJECTIVES

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

1. Identify and explain impulse and reaction blades.
2. Identify and explain types of turbines.
3. Identify and explain steam turbine components.
4. Identify and explain gas turbine components.
5. Explain types of water turbines.

PERFORMANCE TASKS

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

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen	Examples or pictures of impulse and reaction blades
Transparencies	Examples, photos, videos, or DVDs of Pelton wheels, Francis Wheels, and Kaplan wheels
Blank acetate sheets	Examples or pictures of turbine components:
Transparency pens	Compressor parts
Whiteboard/chalkboard	Combustor parts
Markers/chalk	Turbine section parts
Pencils and scratch paper	Auxiliary support systems
Appropriate personal protective equipment	Bearings
Photos or videos/DVDs showing the components and/or operation of steam, gas, and water turbines	Copies of the Quick Quiz*
TV/VCR/DVD player	Module Examinations**

*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.

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.

- Environmental Protection Agency
www.epa.gov/CHP/documents/tech_turbines.pdf
- General Electric Company
www.gepower.com/home/index.htm
- Siemens Corporation
www.powergeneration.siemens.com/home
- <http://mysite.du.edu/~jcalvert/tech/fluids/turbine.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 *Turbines*. 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; Turbine Operating Principles; Types of Turbines	
A. Introduction	_____
B. Turbine Operating Principles	_____
1. Impulse Turbines	_____
2. Reaction Turbines	_____
C. Types of Turbines	_____
1. Steam Turbines	_____
2. Gas Turbines	_____
3. Hydroelectric Turbines	_____
Session II. Steam Turbine Casing Parts	
A. Inlet Parts	_____
B. Blade Supports	_____
C. Extraction and Exhaust	_____
D. Safety	_____
E. Bearings	_____
F. Seals	_____
Session III. Steam Turbine Rotor Parts	
A. Turbine Rotor	_____
B. Blades	_____
C. Turning Gear and Coupling	_____
D. Lube Oil Gear Pump	_____
Session IV. Steam Turbine Auxiliary Systems	
A. Lubrication and Jacking Oil Equipment	_____
B. Turbine Control and Protection System	_____
C. Electrohydraulic Governor Equipment	_____
D. Seal Steam System	_____
E. Steam Distribution System	_____
F. Condensate System	_____

Session V. Gas Turbine Compressor Parts

- A. Inlet Guide Vanes
- B. Rotor and Stator Blades
- C. Discharge Section
- D. Bleed-Off Lines

Session VI. Gas Turbine Combustor and Turbine Section Components

- A. Combustor Components
 - 1. Combustion Chambers
 - 2. Fuel Nozzles
 - 3. Igniters and Crossfire Tubes
 - 4. Flame Detectors
 - 5. Transition Pieces
- B. Turbine Section Components
 - 1. Nozzles
 - 2. Rotor Blades
 - 3. Exhaust Silencer

Session VII. Gas Turbine Auxiliary Support Systems

- A. Starting Systems
- B. Lube Oil System
- C. Fuel System
- D. Water Cooling System

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 covers basic turbine components, typical problems encountered when working with turbines, and guidelines for maintaining and repairing various types of turbines. Techniques for gaining access to components and replacing them are also covered.

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 *Core Curriculum; Millwright Level One; Millwright Level Two; Millwright Level Three; Millwright Level Four; and Millwright Level Five*, Modules 15501-09 through 15505-09.

OBJECTIVES

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

1. Inspect sealing glands and carbon rings.
2. Replace nozzle rings and reversing blade assemblies.
3. Inspect governor systems.
4. Replace rotor bearings.
5. Adjust overspeed trip mechanisms.
6. Inspect rotor assemblies.

PERFORMANCE TASKS

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

1. Identify six of the following pieces of turbine equipment:
 - Sealing glands
 - Carbon rings
 - Rotor bearings
 - Nozzle rings
 - Governor
 - Trip linkage
 - Rotor
 - Oil pump

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen	Paste sealing compound
Transparencies	Antigalling compound
Blank acetate sheets	Silicone grease
Transparency pens	Bearing puller
Whiteboard/chalkboard	Dial indicator
Markers/chalk	Sleeve-type bearing driver
Pencils and scratch paper	Torch
Appropriate personal protective equipment	Hot oil or bearing heater
Toolbox with common mechanic tools	Shims
Plastic sealing compound	Compressed air

continued

Examples of the following turbine components:

Turbine casing

Sealing glands

Carbon rings

Rotor bearing

Nozzle rings

Governor

Trip linkage

Bearing pedestals and housings

Rotor assembly

Hydraulic jack or wooden blocks

Applicable rigging equipment

Hand-held grinder

Dry ice

Prussian blue

Photos or videos/DVDs showing the components and/or operation of large turbines

Copies of the Quick Quizzes*

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.

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.

Environmental Protection Agency

www.epa.gov/CHP/documents/tech_turbines.pdf

General Electric Company

www.gepower.com/home/index.htm

Siemens Corporation

www.powergeneration.siemens.com

<http://mysite.du.edu/~jcalvert/tech/fluids/turbine.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 15 hours are suggested to cover *Maintaining and Repairing Steam Turbine Components*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic

Planned Time

Session I. Introduction; Maintaining and Repairing Turbine Casings, Sealing Glands, and Carbon Rings

A. Introduction

B. Maintaining and Repairing Turbine Casings

C. Maintaining and Repairing Sealing Glands and Carbon Rings

1. Disassembling Sealing Glands

2. Replacing Carbon Rings

3. Assembling Sealing Glands

Session II. Maintaining Governor Systems; Replacing Nozzle Rings, Reversing Blade Assemblies, and Rotor Locating Bearings

- A. Maintaining Governor Systems
 - 1. Removing and Replacing Governor Components
- B. Replacing Nozzle Rings and Reversing Blade Assemblies
- C. Replacing Rotor Locating Bearings

Session III. Replacing Bearing Pedestals and Housings; Maintaining Overspeed Trip Mechanisms, Part One

- A. Replacing Bearing Pedestals and Housings
 - 1. Replacing Exhaust-End Bearing Pedestals
 - 2. Replacing Steam-End Bearing Housings
 - 3. Aligning Exhaust-End Bearing Pedestals and Steam-End Housings
- B. Maintaining Overspeed Trip Mechanisms
 - 1. Disassembling/Assembling Overspeed Trip Mechanisms
 - 2. Replacing Plunger Assemblies and Trip Bodies

Session IV. Maintaining Overspeed Trip Mechanisms, Part Two

- A. Maintaining Overspeed Trip Mechanisms
 - 1. Adjusting Trip Pin and Plunger Clearance
 - 2. Adjusting Turbine Trip Speeds
 - 3. Disassembling/Assembling Trip Valves
 - 4. Backseating Trip Valves
 - 5. Maintaining Governor Valves

Session V. Maintaining Rotor Assemblies and Large Steam Turbines

- A. Maintaining Rotor Assemblies
- B. Maintaining Large Steam Turbines
- C. Laboratory

Have trainees practice identifying turbine components. This laboratory corresponds to Performance Task 1.

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.
