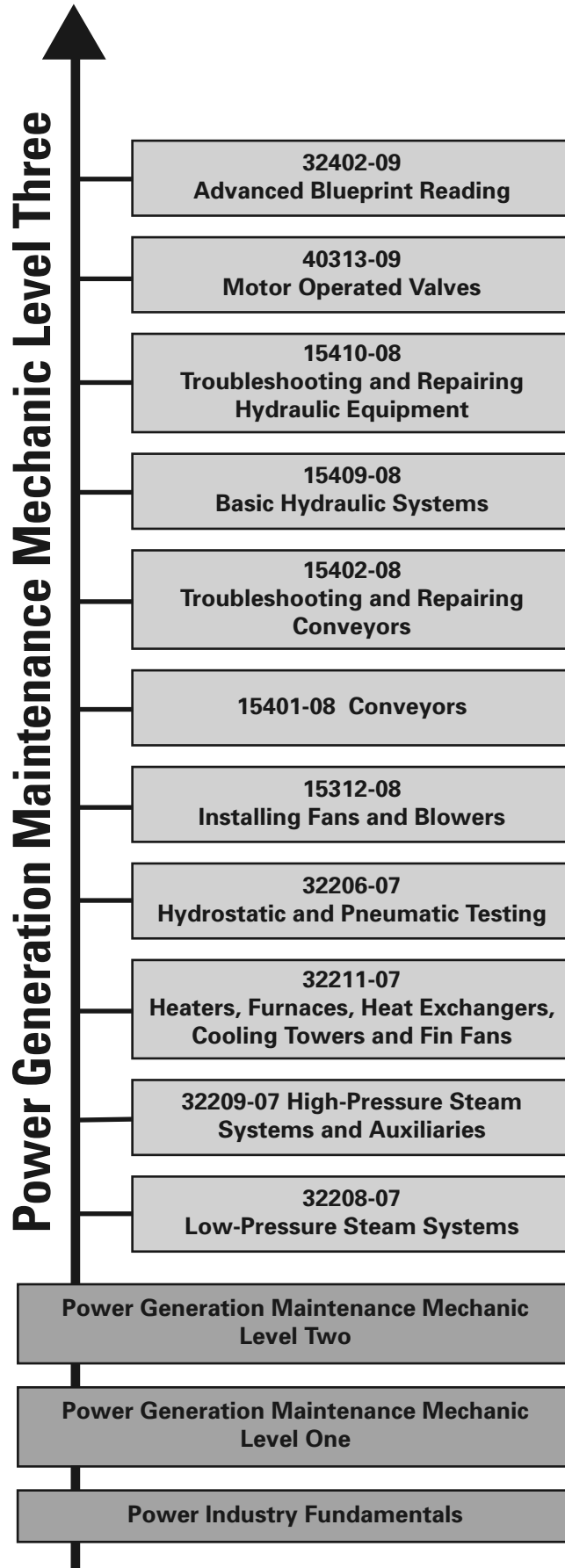


COMPETENCIES, OBJECTIVES, AND PERFORMANCE TASKS



MODULE OVERVIEW

This module identifies types of steam traps, including mechanical, thermostatic, and thermodynamic. It explains how to install, troubleshoot, and maintain steam trap systems.

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 32207-07.

OBJECTIVES

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

1. Explain the terms and concepts used to describe steam and steam systems.
2. Describe the basic steam heating cycle.
3. Recognize the components of a basic steam heating system, including steam traps, and describe their function(s).
4. Describe the safeguards associated with the operation of a low-pressure steam system.
5. Explain how a blowdown system works.
6. Demonstrate how to install, troubleshoot, and maintain selected steam traps.
7. Describe how basic one-pipe and two-pipe steam heating systems work.

PERFORMANCE TASKS

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

1. Identify types of steam traps and components of installations.
2. Diagnose specific problems on faulty steam traps, and demonstrate safety procedures and proper corrective actions.
3. Identify piping distribution systems used with steam systems.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen	Sample steam traps
Transparencies	Manufacturers' instructions for steam trap installation
Blank acetate sheets	Pyrometer
Transparency pens	Ultrasonic tester
Whiteboard/chalkboard	Copies of Quick Quiz*
Markers/chalk	Module Examination**
Pencils and scratch paper	Performance Profile Sheets**
Appropriate personal protective equipment	

* Located in the back of this module.

**Located in the Test Booklet.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module requires that trainees install and troubleshoot steam traps. Ensure that all trainees are briefed on equipment and hot hazard safety. 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.

ASHRAE Handbook – Equipment, American Society of Heating and Air Conditioning Engineers, Inc., Atlanta, GA.

ASHRAE Handbook – HVAC Systems and Applications, American Society of Heating and Air Conditioning Engineers, Inc., Atlanta, GA.

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 *Low-Pressure Steam 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 to Low-Pressure Steam Systems	
A. Introduction	_____
B. Fundamentals	_____
C. Steam Cycle Principles of Operation	_____
D. Boilers, Boiler Controls, and Accessories	_____
E. Valves	_____
Session II. Terminals and Steam Traps	
A. Heat Exchangers/Converters	_____
B. Terminals	_____
C. Identifying Steam Traps/Strainers	_____
D. Laboratory Trainees practice identifying different types of steam traps. This laboratory corresponds to Performance Task 1.	_____
E. Maintaining Steam Traps	_____
F. Laboratory Trainees practice identifying specific problems and corrective actions required for faulty steam traps. This laboratory corresponds to Performance Task 2.	_____
G. Strainers	_____
Session III. Additional System Components	
A. Condensate Return/Feedwater System Components	_____
B. Flash Tanks	_____
C. Steam System Piping	_____
D. Laboratory Trainees practice identifying piping distribution systems. This laboratory corresponds to Performance Task 3.	_____
E. Boiler Blowdown and Skimming	_____
F. Water Treatment	_____

Session VI. Review and Testing

A. Review

B. Module Examination

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

C. Performance Testing

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

MODULE OVERVIEW

This module introduces the high-pressure steam system, its components, and auxiliaries.

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 32208-07.

OBJECTIVES

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

1. Describe the components and operation of a high-pressure steam system.

PERFORMANCE TASKS

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

1. Identify the components of a high-pressure steam system and its auxiliaries.

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

Copies of Quick Quizzes*

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.eere.energy.gov/industry/bestpractices/pdfs/steamsourcebook.pdf

www.eere.energy.gov/industry/bestpractices/energymatters/topic.cfm/topic_id=13

Spirax Sarco is a British firm that maintains a very informative website on steam.

www.spiraxsarco.com/resources/steam-engineering-tutorials.asp

Many useful tables and sources of information can be found at www.engineeringtoolbox.com/control-valves-dimensions-t_41.html

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 20 hours are suggested to cover *High-Pressure Steam Systems and Auxiliaries*. 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 High-Pressure Steam Systems	
A. Introduction	_____
B. Precipitators	_____
C. Pulverizers	_____
Sessions II. Scrubbers and Coal Handling	
A. Scrubbers	_____
B. Coal Feeders	_____
C. Coal Crushers	_____
Session III. Water Handling	
A. Dissolving Tanks	_____
B. Evaporators	_____
Session IV. Air and Ash Handling Systems	
A. Fans	_____
B. Ash Handling System	_____
Session V. Feed Systems	
A. Stokers	_____
B. Feedwater Systems	_____
Session VI and VII. System Cleaning	
A. Soot Blowers	_____
B. Blowdown Tanks	_____
C. Laboratory	_____
Trainees practice identifying the components of a high-pressure steam system and its auxiliaries. This laboratory corresponds to Performance Task 1.	
Session VIII. Review and Testing	
A. Review	_____
B. Module Examination	_____
1. Trainees must score 70% or higher to receive recognition from NCCER.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	
C. Performance Testing	_____
1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	

MODULE OVERVIEW

This module introduces types of heat transfer and heating and cooling apparatus.

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 32210-07.

OBJECTIVES

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

1. Identify and describe the basic types of heaters and furnaces.
2. Explain the functions of heaters and furnaces within industry.
3. Identify various types of exchangers and cooling towers and their components.
4. Discuss the functions of various types of exchangers.
5. Describe the proper safety procedures and personal protective equipment associated with each type of equipment.
6. Explain how to remove and install an exchanger.
7. Describe the construction and operation of a cooling tower.

PERFORMANCE TASKS

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

1. Identify the components of heat exchangers chosen by the instructor.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen

Transparencies

Blank acetate sheets

Transparency pens

Whiteboard/chalkboard

Markers/chalk

Pencils and scratch paper

Appropriate personal protective equipment

Copies of Quick Quizzes*

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.

A number of web-based publications provide information on heating and cooling equipment:

www.pipingnews.com/heat_exchangers.htm has a calculator for heat exchange designations

The English website at www.lorien.ncl.ac.uk/ming/distil/distileqp.htm has information on different aspects of the distillation process.

The site at www.spiraxsarco.com has information on steam equipment and applications

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 *Heaters, Furnaces, Heat Exchangers, Cooling Towers, and Fin Fans*. 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, Heaters, and Heat Exchangers I	
A. Introduction	_____
B. Heaters	_____
C. Heat Exchangers	_____
Sessions IV through VI. Heat Exchangers II	
A. Heat Exchangers	_____
B. Types of Reboilers	_____
C. Safe Removal and Installation of Heat Exchangers	_____
D. Heat Exchanger Types and Codes	_____
E. Common Problems with Heat Exchangers/Coolers	_____
F. Bellows	_____
Sessions VII and VIII. Air-Cooled Heat Exchangers	
A. Air-Cooled Heat Exchangers	_____
B. Laboratory	_____
Trainees practice identifying the components of a heat exchangers. This laboratory corresponds to Performance Task 1.	
Sessions IX through XI. Cooling Towers	
A. Cooling Towers	_____
B. Modular Towers	_____
C. Large Cooling Towers	_____
D. Distribution Systems	_____
E. Fans	_____

Session XII. Review and Testing

A. Review

B. Module Examination

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

C. Performance Testing

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

MODULE OVERVIEW

This module explains the basics of nondestructive examination (NDE) procedures, including weld inspection, ultrasonic, electromagnetic, and radiographic testing. It also explains hydrostatic and pneumatic testing and pretest procedures.

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 32205-07.

OBJECTIVES

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

1. Perform pretest requirements.
2. Perform service and flow tests.
3. Perform head pressure tests.
4. Perform hydrostatic tests.
5. Explain how to perform steam blow tests.
6. Explain nondestructive examinations (NDE).

PERFORMANCE TASKS

This is a knowledge-based module. There are no performance tasks.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen	Scaffolding (optional)
Transparencies	Slip blinds
Blank acetate sheets	Test plugs
Transparency pens	Test tree
Whiteboard/chalkboard	Sample test report
Markers/chalk	Teflon® tape
Pencils and scratch paper	Borescopes
Appropriate personal protective equipment	Undercut gauges
Hi-Lo gauge	Butt weld reinforcement gauges
Taper gauge	Liquid penetrant inspection materials
Welded piping system for inspection	X-ray films of welds
Samples of welds with and without discontinuities	Piping drawings
Samples of cracked welds	Pressure gauges
Samples of incomplete joint penetration	Bleeder valves
Samples of incomplete fusion	Magnetic particle testers
Hydrostatic test pump	Ultrasonic testers
Mechanical test plugs	Holiday testers
Pipe vise	Pigs
Piping system or spool to be tested	Copies of Quick Quizzes*
Pneumatic test plugs	Module Examination**

* Located in the back of this module.

** Located in the Test Booklet.

SAFETY CONSIDERATIONS

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

ADDITIONAL RESOURCES

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

The United Kingdom's largest testing and calibrations laboratory for pipe fittings and materials has a website at www.wrcnsf.com/plastic_pipe.htm

Pipeline Maintenance, 2002. National Center for Construction Education and Research. Upper Saddle River, NJ: Prentice Hall.

Ashtead Technology Rentals describes many types of testing equipment at www.ashtead-technology.com/?kc=qwRVB.

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 *Hydrostatic and Pneumatic Testing*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources.

Topic	Planned Time
Session I. Introduction and Pretest Requirements	
A. Introduction	_____
B. Performing Visual Inspections	_____
C. Nondestructive Examination and Evaluation	_____
D. Pretest Requirements	_____
Session II. Service, Flow, and Head Pressure Tests	
A. Performing Service and Flow Tests	_____
B. Head Pressure Testing	_____
Session III. Hydrostatic, Pneumatic, Equipment, and Steam Blow Testing	
A. Performing Hydrostatic Testing	_____
B. Pneumatic Testing	_____
C. Equipment Testing	_____
D. Steam Blow Testing	_____
Session IV. Review and Testing	
A. Review	_____
B. Module Examination	_____
1. Trainees must score 70% or higher to receive recognition from NCCER.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	

MODULE OVERVIEW

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

PREREQUISITES

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

OBJECTIVES

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

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

PERFORMANCE TASKS

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

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

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen

Transparencies

Blank acetate sheets

Transparency pens

Whiteboard/chalkboard

Markers/chalk

Pencils and scratch paper

Appropriate personal protective equipment

Basic trainee tools

Various types of fans

Various types of blowers

Module Examinations*

Performance Profile Sheets*

* Located in the Test Booklet

SAFETY CONSIDERATIONS

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

ADDITIONAL RESOURCES

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

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

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

TEACHING TIME FOR THIS MODULE

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

Topic	Planned Time
Session I. Introduction; Types of Fans	
A. Introduction	_____
B. Types of Fans	_____
C. Laboratory Trainees practice identifying types of fans. This laboratory corresponds to Performance Task 1.	_____
D. Laboratory Trainees practice identifying centrifugal fan wheel types. This laboratory corresponds to Performance Task 2.	_____
Session II. Installing Fans	
A. Installing Fans	_____
B. Installing Preassembled Fans	_____
C. Installing Disassembled Fans	_____
Session III. Types of Blowers; Installing Blowers	
A. Types of Blowers	_____
B. Laboratory Trainees practice identifying types of blowers. This laboratory corresponds to Performance Task 3.	_____
C. Installing Blowers	_____
Session IV. Review and Testing	
A. Module Review	_____
B. Module Examination	_____
1. Trainees must score 70% or higher to receive recognition from NCCER.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	
C. Performance Testing	_____
1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	

Annotated Instructor's Guide**MODULE OVERVIEW**

This module explains and identifies the uses of conveyors, their operation, and the major parts of roller, belt, chain, screw, and pneumatic conveyors. It also describes the principles of conveyor safety.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Millwright Level One; Millwright Level Two; and Millwright Level Three.*

OBJECTIVES

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

1. Explain conveyor safety.
2. Identify and explain the use of roller conveyors and their components.
3. Identify and explain the use of belt conveyors and their components.
4. Identify and explain the use of chain conveyors and their components.
5. Identify and explain the use of screw conveyors and their components.
6. Identify and explain the use of pneumatic conveyors and their components.

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

Manufacturers' literature for various types of conveyors

Safety videos or CD and appropriate devices for viewing, guest speaker, or online safety training

Photographs or illustrations of various types of conveyors

Appropriate personal protective equipment

Samples of conveyor chains

Copies of the Quick Quiz*

Module Examinations**

* Located in the back of this module.

** Located in the Test Booklet.

SAFETY CONSIDERATIONS

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

ADDITIONAL RESOURCES

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

Rexnord Power Transmission and Conveying Components, Catalog #R85. Rexnord Inc. Atlanta, GA.

Goodyear Conveyor Maintenance. Goodyear Tire and Rubber Co. Akron, OH.

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 5 hours are suggested to cover *Conveyors*. 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; Safety; Conveyors I	
A. Introduction	_____
B. Conveyor Safety	_____
C. Roller Conveyors	_____
D. Belt Conveyors	_____
Session II. Conveyors II; Review and Testing	
A. Chain Conveyors	_____
B. Screw Conveyors	_____
C. Pneumatic Conveyors	_____
D. Review	_____
E. Module Examination	_____
1. Trainees must score 70% or higher to receive recognition from NCCER.	
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	

Annotated Instructor's Guide

MODULE OVERVIEW

This module explains how to maintain, troubleshoot, and repair conveyors, including how to splice belts and replace sprockets, bearings, and conveying devices.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Millwright Level One; Millwright Level Two; Millwright Level Three; and Millwright Level Four, Module 15401-08.*

OBJECTIVES

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

1. Maintain, troubleshoot, and repair belt and roller conveyors.
2. Maintain, troubleshoot, and repair chain conveyors.
3. Maintain, troubleshoot, and repair screw conveyors.
4. Maintain, troubleshoot, and repair pneumatic conveyors.

PERFORMANCE TASKS

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

1. Splice a belt.
2. Repair one of the following:
 - Belt conveyor
 - Chain conveyor
 - Screw conveyor
 - Pneumatic conveyor

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen	Conveyor setups or broken or damaged conveyors for the repair of belt, chain, screw, or pneumatic conveyors
Transparencies	Damaged drive rollers, sprockets, and bearings
Blank acetate sheets	Damaged chains, sprockets, and carrying devices
Transparency pens	Maintenance manuals for belt, chain, screw, and pneumatic conveyors
Whiteboard/chalkboard	Replacement links for chain conveyors
Markers/chalk	Replacement belt materials
Pencils and scratch paper	Sling and hardware for rigging
Appropriate personal protective equipment	Tools for marking, measuring, cutting, and splicing conveyor belts
Gloves	Tools for installing replacement links
Straightedge	Allen wrenches
Tape measures	Arbor press or length of pipe to install bearings
Plywood or other suitable surface on which to cut and repair belts	Assorted screwdrivers
Mechanical belt fasteners or other splicing materials	

continued

Bearing pullers
 Grease gun and lubricant
 Needle-nose pliers
 Torque wrenches

Copies of the Quick Quizzes*
 Module Examinations**
 Performance Profile Sheets**

* Located in the back of this module

** Located in the Test Booklet

SAFETY CONSIDERATIONS

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

ADDITIONAL RESOURCES

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

Rexnord Power Transmission and Conveying Components, Catalog #R85, 1984. Atlanta, GA: Rexnord Inc.
Goodyear Belt Splicing Manual. Akron, OH: Goodyear Tire and Rubber Co.

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 *Troubleshooting and Repairing Conveyors*. 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; Maintaining, Troubleshooting, and Repairing Belt and Roller Conveyors	
A. Introduction	_____
B. Maintaining and Repairing Belt and Roller Conveyors	_____
C. Laboratory	_____
Have trainees practice splicing a belt. This laboratory corresponds to Performance Task 1.	
D. Laboratory	_____
Have trainees practice repairing a belt conveyor. This laboratory corresponds to Performance Task 2.	
Sessions III and IV. Maintaining, Troubleshooting, and Repairing Chain, Screw, and Pneumatic Conveyors	
A. Chain Conveyors	_____
B. Laboratory	_____
Have trainees practice repairing a chain conveyor. This laboratory corresponds to Performance Task 2.	
C. Screw Conveyors	_____

D. Laboratory

Have trainees practice repairing a screw conveyor. This laboratory corresponds to Performance Task 2.

E. Pneumatic Conveyors

F. Laboratory

Have trainees practice repairing a pneumatic conveyor. This laboratory corresponds to Performance Task 2.

Session V. Review and Testing

A. Module Review

B. Module Examination

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

C. Performance Testing

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

MODULE OVERVIEW

This module covers hydraulic system safety and the basic principles of hydraulics, including Pascal's law and Bernoulli's principle. It also explains the function of hydraulic fluids, system parts, pumps, and motors.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Millwright Level One; Millwright Level Two; Millwright Level Three; and Millwright Level Four*, Modules 15401-08 through 15408-08.

OBJECTIVES

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

1. Explain hydraulic system safety.
2. Explain the principles of hydraulics.
3. Identify and explain hydraulic fluids.
4. Identify and explain hydraulic system parts.
5. Identify and explain hydraulic pumps.
6. Identify and explain hydraulic motors.

PERFORMANCE TASKS

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

1. Identify hydraulic pumps and motors.
2. Identify at least four hydraulic system components.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen	Various types of hydraulic pumps or manufacturers' literature on pumps
Transparencies	Various types of hydraulic motors or manufacturers' literature on motors
Blank acetate sheets	Hydraulic hoses
Transparency pens	Hydraulic valves
Whiteboard/chalkboard	Hydraulic cylinders and seals
Markers/chalk	Various types of piping, tubing, and fittings
Pencils and scratch paper	Specialty fittings
Appropriate personal protective equipment	Strainers and filters
Samples of hydraulic fluids	Copies of the Quick Quizzes*
MSDS for several hydraulic fluids	Module Examinations**
Hydraulic accumulators or manufacturers' literature on accumulators	Performance Profile Sheets**
Hydraulic reservoirs or manufacturers' literature on hydraulic reservoirs	

* Located in the back of this module.

** Located in the Test Booklet.

SAFETY CONSIDERATIONS

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

Industrial Hydraulic Technology, Second Edition, Bulletin 0232-B1, 1997. Cleveland, OH: Parker Hannifin Corporation.

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

Hydraulic Fittings Company: <http://www.discounthydraulicchase.com> for products, and job aids.

Viking Pump, Inc.: <http://www.vikingpump.com> for products and product information (literature, specifications, drawings).

Bosch Rexroth Corporation: <http://www.boschrexroth-us.com> for training materials, products, and product information (literature, specifications, drawings).

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 *Basic Hydraulic 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 to Hydraulic Systems; Hydraulic Fluids	
A. Introduction	_____
B. Hydraulic System Safety	_____
C. Principles of Hydraulics	_____
D. Hydraulic Fluids	_____
Session II. Hydraulic System Parts	
A. Strainers and Filters	_____
B. Reservoirs	_____
C. Accumulators	_____
D. Piping, Tubing, and Fittings	_____
E. Directional-Control Valves	_____
F. Pressure-Control Valves	_____
G. Cylinders	_____
H. Laboratory	_____
Have trainees practice identifying hydraulic system components. This laboratory corresponds to Performance Task 2.	

Session III. Hydraulic Pumps and Motors

A. Hydraulic Pumps

C. Hydraulic Motors

D. Laboratory

Have trainees practice identifying hydraulic pumps and motors. This laboratory corresponds to Performance Task 1.

Session IV. Review and Testing

A. Review

B. Module Examination

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

C. Performance Testing

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

MODULE OVERVIEW

This module explains how to inspect, troubleshoot, and repair hydraulic systems and components. It also includes information about reading system schematic diagrams.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Millwright Level One; Millwright Level Two; Millwright Level Three; and Millwright Level Four, Modules 15401-08 through 15409-08.*

OBJECTIVES

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

1. Inspect hydraulic system equipment.
2. Read hydraulic system schematic diagrams.
3. Explain the basic hydraulic principles that must be considered before troubleshooting.
4. Troubleshoot hydraulic systems.
5. Repair or replace hydraulic system components.

PERFORMANCE TASKS

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

1. Inspect hydraulic system components.
2. Troubleshoot and repair or replace at least three of the following:
 - Hydraulic fluid reservoirs
 - Filters and strainers
 - Hydraulic pumps
 - Hydraulic motors
 - Control valves
 - Cylinders
 - Hoses
 - Fittings
 - Gauges

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen	Hydraulic system components to inspect and troubleshoot
Transparencies	Hydraulic system components to repair/replace
Blank acetate sheets	Set of flare nut wrenches
Transparency pens	Assorted screwdrivers
Whiteboard/chalkboard	Emery cloths and hones
Markers/chalk	Needle-nose pliers
Pencils and scratch paper	Set of Allen wrenches
Appropriate personal protective equipment	Copies of the Quick Quiz*
Manufacturers' maintenance and repair manuals	Module Examinations**
Sample troubleshooting charts	Performance Profile Sheets**
Hydraulic schematic diagrams	

* Located in the back of this module.

**Located in the Test Booklet.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module requires trainees to inspect, troubleshoot, and repair or replace hydraulic system components. 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.

Industrial Hydraulic Technology, Second Edition, Bulletin 0232-B1. Cleveland, OH: Parker Hannifin Corporation.

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

Hydraulic Fittings Company: <http://www.discounthydraulichose.com> for products and job aids.

Eaton Hydraulics: <http://www.eaton.com/hydraulics> for training materials, products, and product information (literature, specifications, drawings).

Hosecraft USA: <http://www.hosecraftusa.com> for products and product information (literature, specifications, drawings).

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 7½ hours are suggested to cover *Troubleshooting and Repairing Hydraulic 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; Inspecting Hydraulic System Components; Schematic Diagrams	
A. Introduction	_____
B. Inspecting Hydraulic System Components	_____
C. Laboratory	_____
Have trainees practice inspecting hydraulic system components. This laboratory corresponds to Performance Task 1.	
D. Reading Hydraulic System Schematic Diagrams	_____
Session II. Troubleshooting and Repairing	
A. Troubleshooting Hydraulic Systems	_____
B. Repairing Hydraulic System Components	_____
C. Laboratory	_____
Have trainees practice troubleshooting and repairing or replacing hydraulic system components. This laboratory corresponds to Performance Task 2.	

Session III. Review and Testing

A. Review

B. Module Examination

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

C. Performance Testing

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

MODULE OVERVIEW

This module introduces the trainees to motor-operated valves that are controlled by programmable devices, such as PLCs.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum; Industrial Maintenance E & I Technician Level One; Industrial Maintenance E & I Technician Level Two; and Industrial Maintenance E & I Technician Level Three, Modules 40301-09 through 40312-09.*

OBJECTIVES

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

1. State safety regulations associated with motor-operated valves (MOVs).
2. Explain the operating principles of various types of MOVs.
3. Identify applications of MOVs.
4. Set up a MOV.
5. Remove and replace a limit switch.

PERFORMANCE TASKS

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

1. Set up a MOV.
2. Remove and replace a limit switch.

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

*Located in the Test Booklet

Examples of automatic valve actuators:

Electrical

Hydraulic

Pneumatic

Limit switches

Screwdriver

Module Examinations*

Performance Profile Sheets*

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.

The Steam and Condensate Loop Book, Spirax Sarco, 2007.

Flowserve Corporation – Limitorque website: <http://www.flowserve.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 *Motor-Operated Valves*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction; MOV Safety Issues	
A. Introduction	_____
B. MOV Safety Issues	_____
1. Hazardous Atmospheres	_____
2. Emergency Shutdowns	_____
3. MOV Operation Control	_____
Session II. Types of MOVs	
A. Actuator Gearing	_____
1. Worm-Gear Actuators	_____
2. Bevel-Gear Actuators	_____
3. Variable-Reduction Actuators	_____
B. Pneumatic and Hydraulic Actuators	_____
1. Gas Actuators	_____
2. Rotary Vane Actuator	_____
3. Double-Cylinder Hydraulic Actuators	_____
4. Electro-Hydraulic Actuators	_____
5. Pneumatic Rack and Pinion Actuators	_____
6. Pneumatic Fail-Safe Actuators	_____
Sessions III–V. Setup Activities for MOVs	
A. Initial Installation	_____
B. Verifying Pneumatic, Hydraulic, and Electrical MOV Controls	_____
C. Test Operating Electrical MOVs	_____
D. Inspecting and Adjusting Electrical MOV Cams and Limit Switches	_____
E. Removing and Replacing Switching Assemblies	_____
F. Laboratory	_____
Have the trainees set up a MOV and remove and replace a limit switch.	
These laboratories correspond to Performance Tasks 1 and 2.	
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 the NCCER.	
2. Record the training results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.	

MODULE OVERVIEW

This module builds on the skills developed in earlier training, providing the industrial maintenance mechanic with the information needed to determine the specific machine and parts required for a repair. Various facets of advanced blueprint reading are covered, including numbering systems, pipe drawings, drawing hierarchy, machine drawing information, and drawing system usage and practices.

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, Module 32401-09.*

OBJECTIVES

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

1. Explain the use of a drawing numbering system.
2. Read and interpret foundation layout drawings.
3. Read and interpret assembly drawings.
4. Read and interpret all title block and bill of materials information.
5. Read and interpret detail drawings.
6. Identify and explain the parts of a machine drawing.
7. Locate an assembly drawing using a detail part.
8. Read and interpret P&IDs, GAs, and ISO piping drawings.

PERFORMANCE TASKS

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

1. Find detail drawings using assembly drawings.
2. Find assembly drawings using detail drawings.
3. Use a bill of materials to perform a materials takeoff.
4. Do a takeoff from an ISO drawing.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen	Sketches of parts with different types of dimensioning
Transparencies	Detail drawings
Blank acetate sheets	Assembly drawings
Transparency pens	Bill of materials
Whiteboard/chalkboard	Pipe drawings
Markers/chalk	Copies of the Quick Quizzes*
Pencils and scratch paper	Module Examinations**
Set of drawings to show hierarchy	Performance Profile Sheets**
Samples of various drawing types	

* 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 work is suggested for both instructors and motivated trainees interested in further study. This is optional material for continued education rather than for task training.

Geometrics II, The Application of Geometric Tolerancing Techniques. Lowell Foster. Reading, MA: Addison-Wesley Publishing Co., 1986.

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 *Advanced Blueprint Reading*. 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; Numbering System; Drawing Hierarchy	
A. Introduction	_____
B. Numbering System	_____
C. Drawing Hierarchy	_____
D. Laboratory	_____
Have trainees practice identifying types of drawings from examples.	
Sessions II and III. Drawing Information	
A. Lines	_____
B. Dimensions	_____
C. Notes and Symbols	_____
D. Scale	_____
E. Revisions	_____
F. Vendor Information	_____
G. Material Specifications	_____
H. Laboratory	_____
Have trainees practice reading various types of drawings.	
Sessions IV–VII. Drawing System Usage	
A. Finding Details	_____
1. Laboratory	_____
Have trainees find detail drawings using assembly drawing. This laboratory corresponds to Performance Task 1.	
B. Finding Assembly Drawings	_____
1. Laboratory	_____
Have trainees find assembly drawings using detail drawings. This laboratory corresponds to Performance Task 2.	
C. Bill of Materials	_____
1. Laboratory	_____
Have trainees use a bill of materials to perform a materials takeoff. This laboratory corresponds to Performance Task 3.	

