

Module Overview

This module provides an introduction to the theory of alternating current, along with AC circuits, inductors, capacitors, transformers, and three-phase systems.

Objectives

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

1. Describe how single-phase and three-phase alternating current is developed.
2. Calculate the peak and effective voltage or current values for an AC waveform.
3. Describe phase relationships in AC circuits.
4. Describe impedance and explain how it affects AC circuits.
5. Describe the operating principles and functions of inductors.
6. Describe the operating principles and functions of capacitors.
7. Explain the principles and functions of transformers.
8. Explain the following terms as they relate to AC circuits:
 - True power
 - Apparent power
 - Reactive power
 - Power factor

Performance Tasks

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

Materials and Equipment

Markers/chalk

Pencils and scratch paper

Whiteboard/chalkboard

Wind Turbine Maintenance Technician Level One
PowerPoint® Presentation Slides (ISBN 978-0-13-272054-0)

Multimedia projector and screen

Computer

Appropriate personal protective equipment

Calculator

Common capacitors

Inductors, resistors, capacitors, power sources,
and wiring to build RL, RC, RLC, and LC
circuits

Voltmeter

Transformers

Copies of the Quick Quiz*

Module Examinations**

* Located at the back of this module.

* 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 and know how to use it properly. Ensure that trainees are briefed on basic electrical safety and shop safety policies.

Additional Resources

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

Principles of Electric Circuits: Conventional Current Version, 2009. Thomas L. Floyd. New York: Prentice Hall.

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 17½ hours are suggested to cover *Alternating Current and Three-Phase Systems*. 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; Sine Wave Generation and Terminology	
A. Introduction	_____
B. Sine Wave Generation	_____
C. Sine Wave Terminology	_____
Session II. AC Phase Relationships; Resistance; Inductance and Capacitance; Types of AC Circuits	
A. AC Phase Relationships	_____
B. Resistance in AC Circuits	_____
C. Inductance in AC Circuits	_____
D. Capacitance	_____
E. RL, RC, LC, and RLC Circuits	_____
Session III. Power in AC Circuits	
A. Power in AC Circuits	_____
1. True Power	_____
2. Apparent Power	_____
3. Reactive Power	_____
4. Power Factor	_____
5. Power Triangle	_____
Sessions IV and V. Transformers	
A. Transformers	_____
1. Transformer Construction	_____
2. Operating Characteristics	_____
3. Turns and Voltage Ratios	_____
4. Types of Transformers	_____
5. Transformer Selection	_____
Session VI. Three-Phase Power Distribution Systems	
A. Three-Phase Power Distribution Systems	_____
1. Voltage and Current Imbalance in a Three-Phase System	_____

Session VII. Review and Testing

A. Module Review

B. Module Examination

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



Module Overview

The module introduces trainees to the various overcurrent protection devices applied in the wind turbine environment. The operating characteristics of circuit breakers and fuses are presented, along with explanations of fault currents and the importance of proper protection against such extreme levels of current.

Objectives

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

1. Explain the necessity of proper overcurrent protection devices in electrical circuits.
2. Define the terms associated with fuses and circuit breakers.
3. Describe the operation of a circuit breaker.
4. Describe the operation of single-element and time-delay fuses.
5. Describe the application of circuit breakers and fuses in wind turbines.
6. Locate information found on circuit breakers and fuses, and explain its relevance.

Performance Task

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

1. Locate information found on circuit breakers and fuses, and explain its relevance.

Materials and Equipment

Markers/chalk

Pencils and scratch paper

Whiteboard/chalkboard

Wind Turbine Maintenance Technician Level One

PowerPoint® Presentation Slides (ISBN 978-0-13-272054-0)

Multimedia projector and screen

Computer

Copy of the latest edition of the *National Electrical Code*®

Samples of various cartridge fuse types

Samples of various GFCI devices

Samples of various circuit breaker types

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 and know how to use it properly. This module requires trainees to handle circuit breakers and fuses, outside of an energized environment. Make sure that all trainees are briefed on appropriate safety procedures. Emphasize electrical safety and the importance of proper housekeeping as an important measure to avoid hazards and prevent injuries in the workplace.

Additional Resources

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

National Electric Code® Handbook, Latest Edition. Quincy, MA. National Fire Protection Association

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 *Circuit Breakers and Fuses*. 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; Circuit Breaker Ratings	
A. Introduction	_____
B. Circuit Breaker Ratings	_____
1. Current Rating	_____
2. Interrupting Capacity Rating	_____
Session II. Circuit Breaker Ratings; Ground Fault Current Circuit Protection; Fuses	
A. Circuit Breaker Ratings	_____
1. Fuse and Circuit Breaker Markings	_____
2. Additional <i>NEC</i> [®] Regulations	_____
B. Ground Fault Current Circuit Protection	_____
C. Fuses	_____
Session III. Overcurrents; Fuse Applications in the Wind Industry; Safety; Coordination	
A. Overcurrents	_____
B. Fuse Applications in the Wind Industry	_____
C. Safety	_____
D. Coordination	_____
E. Laboratory	_____
Have trainees locate information found on circuit breakers and fuses, and explain its relevance. This laboratory corresponds to Performance Task 1.	
Session IV. 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 covers the operating principles of common switching devices, such as contactors and relays. Both solid-state and mechanical relay styles are presented, as well as protective overload relays. Simple control diagrams are introduced as an aid to following and troubleshooting control circuits.

Objectives

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

1. Describe the operating principles of contactors and relays.
2. Explain how mechanical and solid-state relays operate.
3. Describe how overload relays operate.
4. Read wiring diagrams involving contactors and relays.
5. Connect a simple control circuit.
6. Troubleshoot, replace, and rewire relays.

Performance Tasks

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

1. Connect a simple control circuit.
2. Troubleshoot, replace, and rewire relays.

Materials and Equipment

Markers/chalk	Miscellaneous wire and terminals to fit available relays and contactors
Pencils and scratch paper	Various mechanical relays
Whiteboard/chalkboard	Various solid-state relays
<i>Wind Turbine Maintenance Technician Level One</i>	Various timing relays
PowerPoint® Presentation Slides (ISBN 978-0-13-272054-0)	Various contactors
Multimedia projector and screen	Various overload relays or complete motor starters with overload relays attached
Computer	Various melting alloy and bimetallic overload thermal elements
Copy of the latest edition of the <i>National Electrical Code</i> ®	Magnetic overload relay assembly
Electrical tool set	Module Examinations*
120V/24V control transformer	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 and know how to use it properly. This module requires trainees to work with energized power circuits, equal to or less than 240 volts. Make sure that all trainees are briefed on appropriate safety procedures. Emphasize electrical safety and the importance of proper housekeeping as an important measure to avoid hazards and prevent injuries in the workplace.

Additional Resources

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

National Electric Code® Handbook, Latest Edition. Quincy, MA. National Fire Protection Association

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 *Switching Devices*. 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; Magnetic Contactors	
A. Introduction	_____
B. Magnetic Contactors	_____
Session II. Relays; Solid-State Relays	
A. Relays	_____
B. Solid-State Relays	_____
Sessions III and IV. Overload Relays; Applications of Relays in Wind Turbines; Relay and Contactor Troubleshooting	
A. Overload Relays	_____
B. Applications of Relays in Wind Turbines	_____
C. Relay and Contactor Troubleshooting	_____
D. Laboratory	_____
Have trainees practice wiring simple control circuits, troubleshooting control devices, and replacing them. This laboratory corresponds to Performance Tasks 1 and 2.	
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 presents the basics of wind-generated electrical power. The process of distributing and collecting the power provided by all wind turbines at an energy site is also included. The module covers simple one-line diagrams as a means of tracing the path of power to the electrical grid. Elements of electrical safety and safe work practices are emphasized.

Objectives

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

1. Discuss the fundamentals of generated electrical power.
2. Identify sections and components of a power distribution system.
3. Interpret one-line diagrams of a power distribution system.
4. Describe power distribution during different modes of operation.
5. Identify electrical hazards associated with the power distribution system.
6. Discuss safe work practices when exposed to power distribution equipment.

Performance Task

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

1. Interpret one-line diagrams of a power distribution system.

Materials and Equipment

Markers/chalk

Pencils and scratch paper

Whiteboard/chalkboard

Wind Turbine Maintenance Technician Level One

PowerPoint® Presentation Slides (ISBN 978-0-13-272054-0)

Multimedia projector and screen

Computer

Copy of the latest edition of the *National Electrical Code*®

One-line diagrams for a wind turbine power distribution system

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 any appropriate PPE and know how to use it properly. This module is knowledge-based and no activities are expected to result in contact with energized electrical circuits.

Additional Resources

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

National Electric Code® Handbook, Latest Edition. Quincy, MA: National Fire Protection Association.

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 *Wind Turbine Power Distribution 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; Generator Fundamentals	
A. Introduction	_____
B. Generator Fundamentals	_____
Session II. Power Distribution Sections	
A. Power Distribution Sections	_____
Session III. Modes of Operation; Electrical Hazards	
A. Modes of Operation	_____
B. Electrical Hazards	_____
Session IV. Electrical Safe Work Practices	
A. Electrical Safe Work Practices	_____
B. Laboratory	_____
Have trainees interpret one-line diagrams of a power distribution system.	
This laboratory corresponds to Performance Task 1.	
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 introduces the many different types of fasteners used in the wind turbine environment and similar industries. Their metallurgical and physical characteristics are explored. In addition, the module presents torquing and tensioning principles, from the basic concepts through the operation and use of various torquing equipment and devices. The use of taps and dies is also covered.

Objectives

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

1. Explain the metallurgical characteristics of wind turbine fasteners.
2. Identify the different types of fasteners and related hardware.
3. Define torque theory.
4. Define tensioning.
5. Explain the various torquing and tensioning processes.
6. Identify the different types of torque wrenches.
7. Inspect, maintain, and use various torque equipment.
8. Torque nuts and bolts to specified newton-meter values.
9. Inspect, maintain, and use tension equipment.
10. Explain the use of taps and dies.
11. Remove a broken bolt using an easy-out.

Performance Tasks

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

1. Identify the different types of torque wrenches.
2. Inspect, maintain, and use various torque equipment.
3. Torque nuts and bolts to specified newton-meter values.
4. Inspect, maintain, and use tension equipment.
5. Remove a broken bolt using an easy-out.

Materials and Equipment

Markers/chalk	Various keys
Pencils and scratch paper	Taper, spring, and cotter pins
Whiteboard/chalkboard	Tap and die set
<i>Wind Turbine Maintenance Technician Level One</i>	Tapping fluid
PowerPoint® Presentation Slides (ISBN 978-0-13-272054-0)	Screw extractor set
Multimedia projector and screen	Appropriate drill bits for rivets and screw extractors
Computer	Drill motor
Appropriate personal protective equipment	Pop rivets and handheld rivet tool
Miscellaneous hand tools appropriate for screws, bolts, and nuts	Retaining ring pliers
Various screws, bolts, and nuts of differing grades, both Unified and SI standards	Thread gauge
Various washers	Manual torque wrenches, including: <ul style="list-style-type: none">Beam-type torque wrenchClick-type torque wrenchDigital torque wrench
Soft and hard joint tensioning disks	Torque multiplier
Load indicating washers	Torque angle gauge
Retaining rings	

continued

Hydraulic torquing equipment, complete with sockets and necessary attachments for tensioning

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 trainees are equipped with all the appropriate PPE and know how to use it properly. This module requires trainees to use various types of torquing and tensioning equipment, as well as common hand tools. Review the hazards associated with each type of equipment to be used and the general safety precautions to follow in their use and maintenance.

Additional Resources

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

- Concrete Fastening Systems. www.confast.com.
- Bolt Depot Online. www.boltdepot.com.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 20 hours are suggested to cover *Fasteners and Torquing*. 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-III. Introduction; Threaded Fasteners	
A. Introduction	_____
B. Threaded Fasteners	_____
1. Thread Standards	_____
2. Bolt and Screw Types	_____
3. Nuts	_____
4. Washers	_____
5. Taps and Dies	_____
6. Wind Turbine Fasteners	_____
7. Installing Threaded Fasteners	_____
C. PT/Laboratory	_____
Have trainees practice using various manual torque wrenches to torque a threaded fastener. This laboratory corresponds to Performance Tasks 1, 2, and 3.	
D. PT/Laboratory	_____
Have trainees practice extracting damaged or broken screws. This laboratory corresponds to Performance Task 5.	

Sessions IV-VI. Hydraulic Torquing and Tensioning, Part One

A. Hydraulic Torquing and Tensioning

- 1. Torquing and Tensioning Basics
- 2. Torquing and Tensioning Devices
- 3. Torquing and Tensioning Hazards

B. PT/Laboratory

Have trainees practice equipment inspection, hydraulic torquing, hydraulic tensioning, fastener removal, and post-use equipment cleaning and care. This laboratory corresponds to Performance Tasks 2, 3, and 4.

Session VII. Hydraulic Torquing and Tensioning, Part Two; Non-Threaded Fasteners; Special Threaded Fasteners

A. Hydraulic Torquing and Tensioning

- 1. Maintenance of Torquing and Tensioning Tools
- 2. Calibrated Wrench Tightening
- 3. Load-Indicating Washers
- 4. Torque-To-Yield Method

B. Non-Threaded Fasteners

C. Special Threaded Fasteners

Session VIII. 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 introduces different types of bearings, including plain, ball, roller, thrust, and guide bearings. It describes bearing mountings, including flanged, pillow block, and takeup bearings. It also covers bearing materials and bearing designation systems.

Objectives

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

1. Identify various types of bearings.
2. Identify and explain bearing materials.
3. Identify parts of bearings.

Performance Tasks

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

1. Identify various types of bearings.
2. Identify parts of bearings.

Materials And Equipment

Markers/chalk
Pencils and scratch paper
Whiteboard/chalkboard
Wind Turbine Maintenance Technician Level One
PowerPoint® Presentation Slides (ISBN 978-0-13-272054-0)
Multimedia projector and screen
Computer
Appropriate personal protective equipment
Plain bearings
Ball bearings

Roller bearings
Thrust bearings
Guide bearings
Flanged bearings
Pillow block bearings
Takeup bearings
Bearing materials
Copies of Quick Quizzes*
Module Examination**
Performance Profile Sheets**

* Located in the back of this module.

** 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 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 presents thorough resources for task training. The following resource material is suggested for further study.

NTN is a bearing manufacturer whose website provides information on many types of bearings. It also has technical articles on the care and maintenance of bearings. www.NTNBower.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 *Introduction to Bearings*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	Planned Time
Session I. Introduction; Bearings, Part One	
A. Introduction	_____
B. Plain Bearings	_____
C. Ball Bearings	_____
Session II. Bearings, Part Two	
A. Roller Bearings	_____
B. Thrust Bearings	_____
Sessions III and IV. Bearings, Part Three	
A. Guide Bearings	_____
B. Flanged Bearings	_____
C. Pillow Block Bearings	_____
D. Takeup Bearings	_____
E. Laboratory	_____
Have trainees practice identifying bearings. This laboratory corresponds to Performance Task 1.	
Session V. Bearing Materials	
A. Bearing Materials	_____
B. Laboratory	_____
Have trainees practice identifying parts of bearings. This laboratory corresponds to Performance Task 2.	
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 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 identifies and explains the many different types of lubricants used in the commercial/industrial environment. The basic concept of lubrication is explored, along with detailed coverage of MSDS entries and hazard communication concepts. A variety of lubrication application methods are explained, including those that apply to the wind turbine environment.

Objectives

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

1. Explain OSHA's hazard communication program relative to lubricants.
2. Read and interpret a material safety data sheet (MSDS).
3. Describe the EPA hazardous waste control program as it applies to wind turbines.
4. Identify and explain types of lubricating oil and greases.
5. Explain lubricant storage, handling, and transportation issues.
6. Explain lubricant film protection.
7. Identify and use lubrication equipment to apply lubricants.
8. Read and interpret the requirements shown on a wind turbine lubrication chart.

Performance Tasks

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

1. Read and interpret a material safety data sheet (MSDS).
2. Read and interpret the requirements shown on a wind turbine lubrication chart.
3. Identify and use lubrication equipment to apply lubricants.

Materials and Equipment

Markers/chalk

Pencils and scratch paper

Whiteboard/chalkboard

Wind Turbine Maintenance Technician Level One

PowerPoint® Presentation Slides (ISBN 978-0-13-272054-0)

Multimedia projector and screen

Computer

Appropriate personal protective equipment

MSDS for various lubricants

Liquid lubricants with different viscosities

Heat source to heat lubricants

Various types of grease

Product literature for various lubricating oils and lubricant additives

Manual lubricating equipment, including:

Lever-type grease gun

Transfer pump

Gear lube dispenser

Bucket pump

Power-operated lubrication equipment

Lubrication fittings

Lubrication chart for a wind turbine

Old or broken equipment, such as pumps or

motors, and related lubrication charts

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 all appropriate PPE and know how to use it properly. This module requires trainees to use various types of lubricating equipment and apply lubricants. Review the hazards associated with each type of lubricant (using the MSDS) and the general precautions to follow for using, storing, and disposing of lubricants.

Additional Resources

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

Shell Lubricants Handbook, available through Shell Lubricant Sales Offices and Suppliers, published yearly.

Chevron Salesfax Digest, available through Chevron Lubricant Sales Offices and Suppliers, published yearly.

Mobil Brief Product Descriptions, available through Mobil Lubricant Sales Offices and Suppliers, published yearly.

Lubrication and Lubricant Selection, A.R. Lansdown. ASME Press and Professional Engineering Publishing, UK.

OSHA Safety & Health Topics, Metalworking Fluids, available at www.osha.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 17½ hours are suggested to cover *Lubrication*. 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; Lubricant Safety, Part One	
A. Introduction	_____
B. Lubricant Safety	_____
1. OSHA Hazard Communication Standards	_____
2. Material Safety Data Sheets	_____
C. Laboratory	_____
Have trainees practice reading and interpreting an MSDS. This laboratory corresponds to Performance Task 1.	
Sessions II-IV. Lubricant Safety, Part Two; Lubricants; Lubricant Equipment	
A. Lubricant Safety	_____
1. EPA Program	_____
2. Lubricant Storage	_____
B. Lubricants	_____
1. Lubricant Film Protection	_____
2. Properties of Lubricants	_____
3. Properties of Grease	_____
4. Selecting Lubricants	_____
5. Additives	_____
6. Lubricating Oils	_____
7. Dry Film Lubricants	_____
C. Lubrication Equipment	_____

Sessions V. Lubricating Methods; Lubricating Charts; Wind Turbine System Lubrication

- A. Lubricating Methods
- B. Lubrication Charts
- C. Wind Turbine System Lubrication

Session VI. Laboratory

- A. PT/Laboratory
 - 1. Have trainees practice reading a lubrication chart. This laboratory corresponds to Performance Task 2.
 - 2. Have trainees practice identifying and using lubricating equipment to apply lubricants. This laboratory corresponds to Performance Task 3.

Session VII. 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 covers hydraulic system safety, as well as the basic principles and components of hydraulic systems. The functions of individual components are included. Trainees also learn how to interpret hydraulic schematics and perform basic maintenance activities on hydraulic systems in the wind turbine environment.

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.
7. Explain how to identify and interpret hydraulic schematics and symbols.
8. Explain how to perform preventive maintenance actions on hydraulic system components:
 - Check hydraulic fluid level.
 - Inspect and replace hydraulic system strainers and filters.
 - Change an accumulator.
 - Perform necessary record keeping.

Performance Tasks

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

1. Interpret hydraulic schematics and symbols.
2. Check hydraulic fluid levels.
3. Inspect and replace hydraulic system strainers and filters.
4. Charge an accumulator.
5. Perform necessary record keeping.

Materials and Equipment

Markers/chalk
Pencils and scratch paper
Whiteboard/chalkboard
Wind Turbine Maintenance Technician Level One
PowerPoint® Presentation Slides (ISBN 978-0-13-272054-0)
Multimedia projector and screen
Computer
Appropriate personal protective equipment
Samples of hydraulic fluids
MSDS for various hydraulic fluids, including those on hand
Hydraulic accumulators and manufacturers' literature for the ones on hand
Hydraulic reservoirs and manufacturers' literature for the ones on hand

Various types of hydraulic pumps or manufacturers' literature on pumps
Various types of hydraulic motors or manufacturers' literature on motors
Various types of hydraulic control valves or manufacturers' literature on valves
Hydraulic hoses
Hydraulic valves
Hydraulic cylinders and seals
Miscellaneous piping, tubing, and fittings suitable for hydraulic use
Hydraulic system strainers and filters
Schematics and matching symbol legends for hydraulic systems
Hydraulic system maintenance forms and documents

(continued)

Nitrogen gas supply and appropriate regulator
Gas chuck assembly, including gauge, hand
valve, and bleeder/relief valve

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 trainees are equipped with all the appropriate PPE and know how to use it properly. This module requires trainees to work with, and conduct maintenance activities on, hydraulic systems and their components. Ensure that trainees are briefed on all appropriate shop safety procedures.

Additional Resources

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

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

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

Hydraulic Fittings Company: www.discounthydraulicchase.com for products and job aides.

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

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

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

Hosecraft USA: 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 20 hours are suggested to cover *Introduction to 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; Hydraulic System Safety; Principles of Hydraulics	
A. Introduction	_____
B. Hydraulic System Safety	_____
C. Principles of Hydraulics	_____

Sessions II-III. Hydraulic Fluids; Hydraulic System Parts

A. Hydraulic Fluids _____

B. Hydraulic System Parts _____

1. Strainers and Filters _____

2. Reservoirs _____

3. Accumulators _____

4. Piping, Tubing, and Fittings _____

5. Directional Control Valves _____

6. Pressure Control Valves _____

7. Cylinders _____

Session IV. Hydraulic Pumps; Hydraulic Motors

A. Hydraulic Pumps _____

B. Hydraulic Motors _____

Session V. Hydraulic Schematics and Symbols

A. Hydraulic Schematics and Symbols _____

B. PT/Laboratory _____

Have trainees practice reading hydraulic schematics and interpreting the symbols. This laboratory corresponds to Performance Task 1.

Session VI. Preventive Maintenance on Hydraulic Equipment

A. Preventive Maintenance on Hydraulic Equipment _____

Session VII. Laboratories

A. PT/Laboratory _____

Have trainees practice checking and adjusting hydraulic fluid levels. This laboratory corresponds with Performance Tasks 2 and 5.

B. PT/Laboratory _____

Have trainees practice the service and replacement of filters and strainers. This laboratory corresponds with Performance Tasks 3 and 5.

C. PT/Laboratory _____

Have trainees practice checking and adjusting the pre-charge of an accumulator. This laboratory corresponds with Performance Tasks 4 and 5.

Session VIII. 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.