This course map shows all of the modules in Weatherization Crew Chief Level Two. The suggested training order begins at the bottom and proceeds up. Skill levels increase as you advance on the course map. The local Training Program Sponsor may adjust the training order.
Module Overview

This module explains how to solve problems involving the measurement of lines, area, volume, weights, angles, pressure, vacuum, and temperature. It also introduces scientific notation, powers, roots, and basic algebra and geometry.

Prerequisites

Before you begin this module, it is recommended that you successfully complete Fundamentals of Weatherization and Weatherization Technician Level One.

Objectives

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

1. Identify similar units of measurement in both the inch-pound (English) and metric systems and state which units are larger.
2. Convert measured values in the inch-pound system to equivalent metric values and vice versa.
3. Express numbers as powers of ten.
4. Determine the powers and roots of numbers.
5. Solve basic algebraic equations.
6. Identify various geometric figures.
7. Use the Pythagorean theorem to make calculations involving right triangles.
8. Convert decimal feet to feet and inches and vice versa.
9. Calculate perimeter, area, and volume.
10. Convert temperature values between Celsius and Fahrenheit.

Performance Tasks

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

Materials and Equipment

Multimedia projector and screen
Building Auditor Level Two
PowerPoint® Presentation Slides
Computer
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Containers to demonstrate units of measure:
- Bottle of oil or soda
- Length of pipe
- Bag of grout

Paper
Scissors
Rulers (English and metric)
Measuring tape
Temperature-pressure chart
Scientific calculator
Gauge manifold set
Vacuum pump
Vacuum gauge
Module Examinations*

* 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.
Additional Resources

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


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 *Trade Mathematics*.

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<th>Topic</th>
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<td></td>
<td>A. Introduction</td>
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<td>B. Metric Units</td>
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<td>C. Length, Area, and Volume</td>
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<td>D. Mass Versus Weight</td>
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<td>E. Pressure and Acceleration</td>
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<td>F. Temperature Scales</td>
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<td>II.</td>
<td>Scientific Notation; Powers and Roots; Algebra</td>
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<td></td>
<td>A. Scientific Notation</td>
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<td>B. Powers and Roots</td>
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<td></td>
<td>C. Introduction to Algebra</td>
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<td>III.</td>
<td>Geometry; Right Triangles</td>
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<td>IV.</td>
<td>Converting Units; Review and Testing</td>
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<td></td>
<td>A. Converting Decimal Feet to Feet and Inches and Vice Versa</td>
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<td>B. Module Review</td>
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<td></td>
<td>C. Module Examination</td>
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</table>

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.
Module Overview

This module covers the basic principles of heat transfer, refrigeration, and pressure-temperature relationships and describes the components and accessories used in air conditioned systems.

Objectives

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

1. Explain how heat transfer occurs in a cooling system, demonstrating an understanding of the terms and concepts used in the refrigeration cycle.
2. Calculate the temperature and pressure relationships at key points in the refrigeration cycle.
3. Under supervision, use temperature- and pressure-measuring instruments to make readings at key points in the refrigeration cycle.
4. Identify commonly used refrigerants and demonstrate the proper procedures for handling these refrigerants.
5. Identify the major components of a cooling system and explain how each type works.
6. Identify the major accessories available for cooling systems and explain how each works.
7. Identify the control devices used in cooling systems and explain how each works.
8. State the correct methods to be used when piping a refrigeration system.

Performance Tasks

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

1. Measure temperatures in an operating air conditioning system.
2. Use cylinder color codes to identify refrigerants.
3. Identify compressors, condensers, evaporators, metering devices, controls, and accessories.
4. Use service valves to gain access to an air conditioning system in order to measure pressures using a gauge manifold set.

Materials and Equipment

Multimedia projector and screen
Building Auditor Level Two
   PowerPoint® Presentation Slides
Computer
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Barometers
Temperature-pressure charts
Various types of thermometers, including infrared
Material Safety Data Sheets for refrigerants
One or more operating refrigeration and/or air conditioning systems
Compressors
Condensers
Evaporators
Gauge manifold sets
Metering devices
Service valves
Refrigerant cylinders
Accessories
Primary controls
Secondary controls
Portable hot plate and suitable container for boiling water
Multimeters
Manometers
Copies of the Quick Quiz*
Module Examinations**
Performance Profile Sheets**

* 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. This module requires trainees to work on equipment that is operating and to operate testing equipment. Ensure that they are briefed on shop safety procedures and emphasize electrical safety precautions.

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


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 *Introduction to Cooling*. 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.

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<td>B. Heat</td>
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<td>C. Heat Transfer</td>
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<td>D. Pressure</td>
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<td>E. Instruments Used to Measure Temperature and Pressure</td>
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<td>F. Laboratory</td>
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<tr>
<td>Trainees practice measuring temperatures in an operating air conditioning system. This laboratory corresponds to Performance Task 1.</td>
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<td><strong>Session III. Mechanical Refrigeration System</strong></td>
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<td>B. Refrigeration Cycle</td>
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<td><strong>Session IV. Refrigerants</strong></td>
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<td>A. Trade Names</td>
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<td>B. Ammonia</td>
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<td>C. Fluorocarbon Refrigerants</td>
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<td>D. Refrigerant Containers</td>
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<td>E. Identifying Refrigerants</td>
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<td>F. Laboratory</td>
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<tr>
<td>Have trainees practice identifying refrigerants. This laboratory corresponds to Performance Task 2.</td>
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<td>G. Refrigerant Safety Precautions</td>
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</table>
Session V. Compressors
   A. Reciprocating Compressors
   B. Rotary Compressors
   C. Scroll Compressors
   D. Screw Compressors
   E. Centrifugal Compressors

Session VI. Condensers
   A. Air-Cooled Condensers
   B. Water-Cooled Condensers
   C. Evaporative Condensers

Session VII. Evaporators
   A. Direct Expansion (DX) Evaporators
   B. Flooded Evaporators
   C. Evaporator Construction

Session VIII. Expansion (Metering) Devices
   A. Fixed Metering Devices
   B. Adjustable Metering Devices

Session IX. Other Components
   A. Filter-Drier
   B. Sight-Glass Moisture Liquid Indicator
   C. Suction Line Accumulator
   D. Crankcase Heater
   E. Oil Separator
   F. Heat Exchanger
   G. Receiver
   H. Service Valves
   I. Laboratory
      Have trainees practice using service valves to gain access to air conditioning systems to measure pressure. This laboratory corresponds to Performance Task 4.
   J. Compressor Muffler

Session X. Controls
   A. Primary Controls
   B. Secondary Controls

Session XI. Piping
   A. Basic Principles
   B. Suction Line
   C. Hot Gas Line
   D. Liquid Line Layout
   E. Pipe Supports
   F. Insulation
   G. Laboratory
      Have trainees practice identifying air conditioning components. This laboratory corresponds to Performance Task 3.
Session XII. 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 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. Classroom
**Module Overview**

This module covers heating fundamentals, types and designs of furnaces and their components, and basic procedures for installing and servicing furnaces.

**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: *Fundamentals of Weatherization and Energy Auditor Level Two*, Module 03107-07.

**Objectives**

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

1. Explain the three methods by which heat is transferred and give an example of each.
2. Describe how combustion occurs and identify the byproducts of combustion.
3. Identify various types of fuels used in heating.
4. Identify the major components and accessories of an induced draft and condensing gas furnace and explain the function of each component.
5. State the factors that must be considered when installing a furnace.
6. Identify the major components of a gas furnace and describe how each works.
7. With supervision, use a manometer to measure and adjust manifold pressure on a gas furnace.
8. Identify the major components of an oil furnace and describe how each works.
9. Describe how an electric furnace works.
10. With supervision, perform basic furnace preventive maintenance procedures such as cleaning and filter replacement.

**Performance Tasks**

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

1. Identify the components of an induced draft and condensing gas furnace and state their purpose.
2. With supervision, turn on and check a gas furnace.
3. Identify symptoms of combustion problems in a gas furnace and adjust the manifold pressure.
4. With supervision, perform preventive maintenance procedures on a gas furnace, including filter replacement, cleaning of components, and temperature measurements.
5. Identify the components of an oil furnace and state their purpose.
6. With supervision, turn on and check an oil furnace.
7. With supervision, perform preventive maintenance procedures on an oil furnace, including filter replacement, cleaning of components, and temperature measurements.

**Materials and Equipment**

- Multimedia projector and screen
- Desktop or laptop computer
- Whiteboard/chalkboard
- Markers/chalk
- Pencils and scratch paper
- Appropriate personal protective equipment
- GAMA venting tables
- Copper pipe and light plastic bags for heat transfer experiments
- Hair dryer for heat transfer experiments
- Thermometers or temperature probes
- Operating gas-fired furnace
- Operating oil-fired furnace
- Pressure-type oil burner
- Gas manifold
- Drill and brush
- Manometer
- Various grades of oil
- Manufacturer’s literature on various types of forced-air furnaces
- Manufacturer’s literature on multi-poise furnaces

(continued)
Manufacturer’s literature on condensing furnaces
Furnace air filters
Nozzles
Safety switches

Hydronic heat radiators
Copies of the Quick Quizzes*
Module Examinations**
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 requires trainees to work on equipment that is operating and to operate testing equipment. Ensure that they are briefed on shop safety procedures and emphasize electrical safety precautions.

Additional Resources

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


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 Heating. 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.

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<td>C. Temperature and Heat Measurement</td>
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<td>D. Combustion</td>
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<td>Session II. Forced-Air Furnaces</td>
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<td>B. Heat Exchangers</td>
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<td>C. Condensing Furnaces</td>
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<td>D. Fans, Motors, Air Filters, and Blowers</td>
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<td>E. Humidifiers</td>
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<td>F. Installation</td>
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<td>G. Laboratory</td>
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</table>

Have trainees practice identifying the components of an induced draft and condensing gas furnace and state their purpose. This laboratory corresponds to Performance Task 1.
Session III. Gas Furnaces

A. Flame Ignition

B. Laboratory
   Have trainees practice turning on and checking a gas furnace. This laboratory corresponds to Performance Task 2.

C. Gas Valve Assembly

D. Components

E. Safety Switches

F. Maintenance

G. Laboratory
   Have trainees practice performing preventive maintenance procedures on a gas furnace. This laboratory corresponds to Performance Task 4.

H. Manifold Pressure

I. Laboratory
   Have trainees practice identifying symptoms of combustion problems in a gas furnace and adjusting the manifold pressure. This laboratory corresponds to Performance Task 3.

Session IV. Oil Furnaces

A. Oil Burner Operation

B. Laboratory
   Have trainees practice turning on and checking an oil furnace. This laboratory corresponds to Performance Task 6.

C. Combustion Chamber

D. Regulators and Safety Controls

E. Oil Storage

F. Laboratory
   Have trainees practice identifying the components of an oil furnace. This laboratory corresponds to Performance Task 5.

G. Maintenance

H. Laboratory
   Have trainees practice performing preventive maintenance procedures on an oil furnace. This laboratory corresponds to Performance Task 7.

Session V. Electric Heating

A. Heating Elements

B. Components

C. Power Supply

D. Hydronic Heating Systems

E. Summary

Session VI. Review and Testing

A. Module Review

B. Module Examination
   1. Trainees must score 70 percent or higher to receive recognition from NCCER.
   2. Record the testing results on 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. 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 proper venting of fossil-fuel furnaces and the procedures for selecting and installing vents in all types of gas furnaces.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed Fundamentals of Weatherization; Weatherization Technician Level One; and Building Auditor Level Two, Modules 03102-07, 03107-07, and 03108-07.

Objectives

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

1. Describe the principles of combustion and explain complete and incomplete combustion.
2. Describe the content of flue gas and explain how it is vented.
3. Identify the components of a furnace vent system.
4. Describe how to select and install a vent system.
5. Perform the adjustments necessary to achieve proper combustion in a gas furnace.
6. Describe the techniques for venting different types of furnaces.
7. Explain the various draft control devices used with natural-draft furnaces.
8. Calculate the size of a vent required for a given application.

Performance Tasks

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

1. Measure supply and return temperature and determine the temperature rise of a furnace.
2. Adjust a thermostat heat anticipator.
3. Calculate the correct size and type of PVC pipe using manufacturer’s instructions or National Fuel Gas Code or American Gas Association specifications.
4. Calculate the correct size and type of furnace vent connector and metal vent using manufacturer’s instructions or National Fuel Gas Code or American Gas Association specifications.

Materials and Equipment

Multimedia projector and screen
Building Auditor Level Two
Computer
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Copy of latest edition of the National Fuel Gas Code or American Gas Association specifications
Various vent manufacturers’ product data and catalogs
Videotape (optional) Principles of Gas Combustion
Videotape (optional) Ventinox Chimney Solution
TV/VCR/DVD player
Thermometer
Selection of vent piping:
  - Double wall (Types B, L, and B-W)
  - Single wall
  - Schedule 40 PVC
  - High-temperature plastic
  - PVC and metal tubes
  - Smoke source
  - Flame source
  - Concentric vent termination
  - Temperature probes
  - Operating gas-fired furnace
  - Copies of the Quick Quiz*
  - Module Examinations**
  - 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. The module requires that trainees work with operating gas-fired furnaces. Ensure that all trainees are briefed on fire safety procedures.

Additional Resources

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


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 *Chimneys, Vents, and Flues*. 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.

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<td>C. Flue Gases</td>
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<td>D. Furnace Venting</td>
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<td>E. Vent System Components</td>
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<td>F. Natural-Draft Furnaces</td>
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<td>G. Induced-Draft Furnaces</td>
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<tr>
<td>H. Laboratory</td>
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<tr>
<td>Have trainees practice measuring the temperature and determining the temperature rise. This laboratory corresponds to Performance Task 1.</td>
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<tr>
<td>I. Laboratory</td>
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<tr>
<td>Have trainees practice adjusting the thermostat anticipator. This laboratory corresponds to Performance Task 2.</td>
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</tbody>
</table>
Session II. Vent Calculations; Review, and Testing

A. Venting Considerations

B. Laboratory
   Have trainees practice calculating the correct size and type of vent connector and metal vent. This laboratory corresponds to Performance Task 4.

C. Condensing Gas Furnaces

D. Laboratory
   Have trainees practice calculating the correct size and type of PVC pipe. This laboratory corresponds to Performance Task 3.

E. Draft Controls

F. Review

G. 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.

H. Performance Testing
   1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from the 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 hydronic systems. It covers the types of systems available and the various system components including boilers, valves, radiators, and piping. Radiant floor heating systems are also covered.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed Fundamentals of Weatherization; Weatherization Technician Level One; and Building Auditor Level Two, Modules 03102-07, 03107-07, 03108-07, and 03202-07.

Objectives

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

1. Explain the terms and concepts used when working with hot-water heating.
2. Identify the major components of hot-water heating.
3. Explain the purpose of each component of hot-water heating.
4. Demonstrate the safety precautions used when working with hot-water systems.
5. Demonstrate how to operate selected hot-water systems.
6. Demonstrate how to safely perform selected operating procedures on low-pressure systems.
7. Identify the common piping configurations used with hot-water heating.
8. Read the pressure across a water system circulating pump.
10. Select a pump for a given application.

Performance Tasks

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

1. Demonstrate the safety precautions used when working on hot-water systems.
2. Identify the major components of a selected hot-water heating system.
3. Demonstrate how to safely perform selected operating procedures on hot-water boilers.
4. Identify the types of common piping configurations used with hot-water systems.
5. Calculate heating water gpm requirements from base information provided by the instructor.
6. Select a pump from manufacturer’s data given the friction loss of a piping system and the gpm requirements from the previous performance task.

Materials and Equipment

Multimedia projector and screen
Building Auditor Level Two
PowerPoint® Presentation Slides
Computer
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Hot-water heating system(s) and assorted system components, including:
  Cast-iron and steel boiler parts
  Electric boiler heating elements and other parts
  Differential pressure gauges
  Pump curve chart

Pressure-temperature gauges
Pressure relief valves
Low water controls
Aquastats
Electronic-type water level controls
Expansion/compression tanks
Air control devices
Circulating pumps
Assorted gate, ball, globe, and angle valves
Pressure-reducing valves
Backflow preventer valves
Zone control valves
Multipurpose valves
Balancing and flow control valves

(continued)
Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. The module requires that trainees work with operating hot-water boilers. Ensure that all trainees are briefed on appropriate safety procedures.

Additional Resources

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


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 Introduction to Hydronic 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.

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<tr>
<td>E. Safety Controls</td>
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<tr>
<td>F. Laboratory</td>
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<tr>
<td>Have trainees practice demonstrating safety precautions when working on a boiler. This laboratory corresponds to Performance Task 1.</td>
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<tr>
<td>G. Laboratory</td>
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<tr>
<td>Have trainees practice safely performing selected operating procedures on a boiler. This laboratory corresponds to Performance Task 3.</td>
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</tbody>
</table>
Session II. Hot-Water Heating System Components

A. Expansion/Compression Tanks
B. System Air Control Devices
C. Pumps and Valves
D. Terminals
E. Tankless and Indirect Water Heaters
F. Laboratory
   Have trainees practice identifying the major components of a hot-water heating system. This laboratory corresponds to Performance Task 2.
G. Radiant Floor Heating Systems

Session III. Piping

A. One-Pipe Systems
B. Two-Pipe Systems
C. Hot-Water Zoning
D. Laboratory
   Have trainees practice identifying common piping configurations. This laboratory corresponds to Performance Task 4.
E. Dual-Temperature Water Systems

Session IV. Water Balance

A. Water Flow Measuring Devices and Flow-Control Devices
B. Laboratory
   Have trainees practice calculating the water gpm requirements. This laboratory corresponds to Performance Task 5.
C. Friction Losses
D. Laboratory
   Have trainees practice selecting a pump, given gpm requirements and piping system friction loss. This laboratory corresponds to Performance Task 6.

Session V. 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 the factors that affect the heating and cooling loads of a building. It describes the process by which heating and cooling loads are calculated and shows how load information is used to select heating and cooling equipment, including duct systems.

Prerequisites

Before you begin this module, it is recommended that you successfully complete Fundamentals of Weatherization; Weatherization Technician Level One; and Building Auditor Level Two, Modules 03102-07, 03107-07, 03108-07, 03202-07, and 03203-07.

Objectives

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

1. Identify and describe the steps in the system design process.
2. From construction drawings or an actual job site, obtain information needed to complete heating and cooling load estimates.
3. Identify the factors that affect heat gains and losses to a building and describe how these factors influence the design process.
4. With instructor supervision, complete a load estimate to determine the heating and/or cooling load of a building.
5. State the principles that affect the selection of equipment to satisfy the calculated heating and/or cooling load.
6. With instructor supervision, select heating and/or cooling equipment using manufacturers’ product data.
7. Identify the various types of duct systems and explain why and where each type is used.
8. Demonstrate the effect of fittings and transitions on duct system design.
9. Use a friction loss chart and duct sizing table to size duct.
10. Install insulation and vapor barriers used in duct systems.
11. Following proper design principles, select and install refrigerant and condensate piping.
12. Estimate the electrical load for a building and calculate the effect of the comfort system on the electrical load.

Performance Tasks

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

1. Develop a list of factors that affect heating and cooling loads.
2. Develop a floor plan that contains all the information needed to perform a load estimate.
3. Perform a load estimate using a standardized method.
4. Use manufacturer’s product data to select the appropriate heating and cooling equipment based on a load estimate and airflow requirements.
5. Determine the number, location, and sizes of supply outlets and return inlets needed in a building.
6. Use a friction chart and/or standard duct sizing tables to size the trunk and branch ducts for a selected low-volume air distribution system.
7. Use a duct design calculator to size the trunk and branch ducts for a selected low-volume air distribution system.
8. Calculate the total system friction loss (external static pressure) for a selected air distribution system.
Materials and Equipment

Multimedia projector and screen

* Located in the back of this module

Building Auditor Level Two


Computer

Whiteboard/chalkboard

Markers/chalk

Pencils and scratch paper

Appropriate personal protective equipment

ACCA Manual J (one copy for each trainee, if possible)

Load estimating software

Metal duct sections of various sizes and shapes

Metal duct installation fasteners and attaching hardware

Ductboard sections of various sizes and shapes

Ductboard installation materials and attaching hardware

Safety Considerations

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

Additional Resources

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


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 Heating and Cooling System Design. 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.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
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<tbody>
<tr>
<td><strong>Session I. Introduction; Overview of the Design Process; Building Evaluation/Survey; Load Estimating I</strong></td>
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<tr>
<td>A. Introduction</td>
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<tr>
<td>B. Overview of the Design Process</td>
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<td>C. Building Evaluation/Survey</td>
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<tr>
<td>D. Load Estimating</td>
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<tr>
<td>1. Heat Transfer</td>
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<td>2. Heat Gain and Loss</td>
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<tr>
<td><strong>Session II. Load Estimating II</strong></td>
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<tr>
<td>A. Load Estimating</td>
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<tr>
<td>1. Cooling and Heating Load Factors</td>
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<tr>
<td><strong>Session III. Load Estimating III</strong></td>
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<tr>
<td>A. Load Estimating</td>
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<tr>
<td>1. Preparing the Load Estimate</td>
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<tr>
<td>2. Load Estimating Software</td>
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<tr>
<td><strong>Session IV. Laboratory</strong></td>
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<tr>
<td>A. Laboratory</td>
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<tr>
<td>Have trainees develop a list of factors that affect heating and cooling loads. This laboratory corresponds to Performance Task 1.</td>
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<tr>
<td>B. Laboratory</td>
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<tr>
<td>Have trainees develop a floor plan that contains all the information needed to perform a load estimate. This laboratory corresponds to Performance Task 2.</td>
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<tr>
<td><strong>Session V. Laboratory</strong></td>
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<tr>
<td>A. Laboratory</td>
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<tr>
<td>Have trainees prepare a load estimate based on their floor plan. This laboratory corresponds to Performance Task 3.</td>
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<tr>
<td><strong>Session VI. Equipment Selection</strong></td>
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<tr>
<td>A. Equipment Selection</td>
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<tr>
<td>1. Cooling Equipment Selection</td>
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<tr>
<td>2. Heating Equipment Selection</td>
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<tr>
<td>3. Heat Pump Selection</td>
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<tr>
<td>B. Laboratory</td>
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<tr>
<td>Have trainees use manufacturer’s product data to select the appropriate heating and cooling equipment based on a load estimate and airflow requirements. This laboratory corresponds to Performance Task 4.</td>
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</tbody>
</table>
Session VII. Air Distribution System Duct Design

A. Air Distribution System Duct Design
   1. Duct System Basics
   2. Air Distribution Duct Systems
   3. Duct System Components
   4. Duct System Design
   5. Other Duct System Design Considerations

Session VIII. Laboratories

A. Laboratory
   Have trainees determine the number, location, and sizes of supply outlets and return inlets needed in a building. This laboratory corresponds to Performance Task 5.

B. Laboratory
   Have trainees use a friction chart and/or standard duct sizing tables to size the trunk and branch ducts for a selected low-volume air distribution system. This laboratory corresponds to Performance Task 6.

C. Laboratory
   Have trainees use a duct design calculator to size the trunk and branch ducts for a selected low-volume air distribution system. This laboratory corresponds to Performance Task 7.

D. Laboratory
   Have trainees calculate the total system friction loss (external static pressure) for a selected air distribution system. This laboratory corresponds to Performance Task 8.

Session IX. Support Systems; Load Estimating for Commercial Buildings

A. Support Systems
   1. Refrigerant Piping
   2. Condensate Piping
   3. Electrical Service

B. Load Estimating for Commercial Buildings

Session X. 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 covers various heat recovery/reclaim devices and other energy conservation equipment.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed Fundamentals of Weatherization; Weatherization Technician Level One; and Building Auditor Level Two, Modules 03102-07, 03107-07, 03108-07, 03202-07, 03203-07, and 03407-09.

Objectives

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

1. Identify selected air-to-air heat exchangers and describe how they operate.
2. Identify selected condenser heat recovery systems and explain how they operate.
3. Identify a coil energy recovery loop and explain how it operates.
4. Identify a heat pipe heat exchanger and explain how it operates.
5. Identify a thermosiphon heat exchanger and explain how it operates.
6. Identify a twin tower enthalpy recovery loop system and explain how it operates.
7. Identify air-side and water-side economizers and explain how each type operates.
8. Identify selected steam system heat recovery systems and explain how they operate.
9. Identify an ice bank-type off-peak hours energy reduction system.
10. Operate selected energy conversion equipment.

Performance Task

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

1. Adjust an economizer for the proper setting in a local area.

Materials and Equipment

Multimedia projector and screen
Computer
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Manufacturer’s operation and service literature for demonstration equipment
As available, operating HVAC systems incorporating one or more of the following:
Heat recovery ventilators/fixed-plate ERV
and/or HRV energy/heat recovery units
Dual-condenser refrigeration system
Chilled-water system with heat recovery condenser
Swimming pool heat recovery system
Coil energy recovery loops
Heat pipe heat exchangers
Coil-loop thermosiphon heat exchangers
Twin tower enthalpy recovery loops
Air-side economizers
Water-side economizers
Flash steam (flash tank) heat recovery system
Flue gas heat recovery system
Blowdown and heat recovery system
Electric utility energy demand reduction system interface equipment, such as modems, radio receivers, etc.
Copies of the Quick Quiz*
Module Examinations**
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. Trainees will be required to operate selected energy conservation equipment.

Additional Resources

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


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 *Energy Conservation 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.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
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<tbody>
<tr>
<td>Session I. Introduction; Heat Recovery/Reclaim Methods and Equipment</td>
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<tr>
<td>A. Introduction</td>
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<tr>
<td>B. Heat Recovery/Reclaim Methods and Equipment</td>
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</tr>
<tr>
<td>1. Energy and Heat Recovery Ventilators</td>
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<tr>
<td>2. Fixed-Plate and Rotary Air-to-Air Heat Exchangers</td>
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<tr>
<td>3. Condenser Heat Recovery Systems</td>
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<td>4. Coil Energy Recovery Loops</td>
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<td>5. Heat Pipe Heat Exchangers</td>
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<td>6. Thermosiphon Heat Exchangers</td>
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<tr>
<td>7. Twin Tower Enthalpy Recovery Loops</td>
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<tr>
<td>Session II. Economizers; Heat Recovery in Steam Systems</td>
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<tr>
<td>A. Economizers</td>
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<tr>
<td>1. Air-side Economizers</td>
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<td>2. Water-side Economizers</td>
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<tr>
<td>B. Heat Recovery in Steam Systems</td>
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<tr>
<td>1. Flash Steam (Flash Tank) Heat Recovery</td>
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<td>2. Flue Gas Heat Recovery System</td>
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<tr>
<td>3. Blowdown and Heat Recovery System</td>
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<tr>
<td>C. Laboratory</td>
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<tr>
<td>Have trainees adjust an economizer for the proper setting in a local area. This laboratory corresponds to Performance Task 1.</td>
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</tbody>
</table>
Session III. Electric Utility Energy Demand Reduction Systems; Food Processing Cooling Water Recovery System

A. Electric Utility Energy Demand Reduction Systems
   1. Off-Peak Utility Usage

B. Food Processing Cooling Water Recovery System

Session IV. Review and Testing

A. Review

B. Module Examination
   1. Trainees must score 70% or higher to receive recognition from the 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 indoor air quality and its effect on the health and comfort of building occupants. It provides guidelines for performing a building IAQ survey and identifies the equipment and methods used to test and control indoor air quality.

Objectives

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

1. Explain the need for good indoor air quality.
2. List the symptoms of poor indoor air quality.
3. Perform an inspection/evaluation of a building’s structure and equipment for potential causes of poor indoor air quality.
4. Identify the causes and corrective actions used to remedy common indoor air problems.
5. Identify the HVAC equipment and accessories that are used to sense, control, and/or enhance indoor air quality.
6. Use selected test instruments to measure or monitor the quality of indoor air.
7. Clean HVAC air system ductwork and components.

Performance Tasks

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

1. Use selected radon monitors and/or test kits.
2. Perform a building indoor air quality (IAQ) inspection/evaluation.
3. Make air measurements using each of the following:
   - Carbon dioxide (CO₂) detector/sensor
   - Carbon monoxide (CO) detector/sensor
   - Volatile organic compound (VOC) detector/sensor
   - Combustion analyzer
4. Use a manufacturer’s humidifier capacity chart to find the humidifier capacity needed for various building types and sizes.
5. Use a manufacturer’s portable dehumidifier capacity chart to find the dehumidifier capacity needed for various building types and sizes.
6. Clean and inspect ductwork using one or more approved methods:
   - Contact vacuum
   - Air washing
   - Power brushing

Materials and Equipment

Multimedia projector and screen
Computer
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Copy of ASHRAE Standard 62.1-2007, Ventilation for Acceptable Indoor Air Quality

Manufacturer’s operation and service literature for demonstration equipment
Radon monitors and/or test kits
Access to a building to be IAQ inspected/surveyed
Checklists for IAQ evaluation
Set of building plans and specifications for the specific building to be IAQ inspected/surveyed
Manufacturers’ humidifier and dehumidifier capacity charts

continued
Access to a commercial or industrial facility with operating HVAC systems incorporating one or more of the following:
- Air handler units
- Unit ventilators
- Mechanical filters
  - Conventional
  - Extended surface
  - Electrostatic permanent
- Steel/aluminum mesh
- Bag-type
- Box
- Close-pleated rigid
- HEPA

Adsorption filters
- Electronic and nonelectronic air cleaners
- Humidifiers
  - Wetted-element
  - Atomizing
  - Infrared
  - Steam
- Portable dehumidifiers

Portable or stationary gas detectors and analyzers, including:
- Carbon dioxide detectors
- Carbon monoxide detectors
- VOC sensors/detectors
- Combustion analyzers
- Other gas detectors

Access to a building with a radon control subslab depressurization system
- Ultraviolet light air purification equipment

Duct cleaning equipment, including:
- Portable HEPA-filtered vacuuming equipment
- Power brushing, air washing, and power whip equipment
- Borescopes
- Black and white and/or color video cameras and portable videocassette recorder

Copies of the Quick Quiz*
Module Examinations**
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. Trainees will be required to use radon monitors and/or test kits, perform building IAQ inspection/evaluation, use gas detectors and combustion analyzers to make air measurements, and clean and inspect ductwork.

**Additional Resources**

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


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 2 1/2 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 *Indoor Air Quality*. 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.

<table>
<thead>
<tr>
<th>Topic</th>
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<tbody>
<tr>
<td><strong>Session I. Introduction to Indoor Air Quality (IAQ)</strong></td>
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<tr>
<td>A. Introduction</td>
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<tr>
<td>B. Long-Term and Short-Term Effects of Poor IAQ</td>
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<tr>
<td>C. Good Indoor Air Quality</td>
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<tr>
<td>D. Sources of Building Contaminants</td>
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<tr>
<td>1. Building Construction</td>
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<td>2. Human Occupancy</td>
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<tr>
<td>3. Building Materials and Furnishings</td>
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<tr>
<td>4. HVAC and Other Building Equipment</td>
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<tr>
<td>5. Cleaning Compounds and Pesticides</td>
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<tr>
<td>6. Contaminant Sources Located Outside the Building</td>
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<tr>
<td>E. Laboratory</td>
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<tr>
<td>Trainees use selected radon monitors and/or test kits. This laboratory corresponds to Performance Task 1.</td>
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</table>

| **Session II. Elements of a Building IAQ Inspection Survey** | |
| A. Elements of a Building IAQ Inspection Survey | |
| 1. Problem Description | |
| 2. Site Visit and Building Walk-Through | |
| 3. Building HVAC Equipment and Ventilation System Inspection | |
| 4. Air Sampling and Testing for Specific Contaminants | |
| 5. Interpreting Test Results and Corrective Actions | |
| B. Laboratory | |
| Trainees perform a building indoor air quality (IAQ) inspection/evaluation. This laboratory corresponds to Performance Task 2. | |

| **Session III. Achieving Acceptable Indoor Air Quality; IAQ and Energy-Efficient Systems and Equipment** | |
| A. Achieving Acceptable Indoor Air Quality | |
| 1. Initial Building Design | |
| 2. Ventilation Control | |
| 3. Thermal Comfort Control | |
| 4. Controlling Chemical Contaminants | |
| 5. Controlling Microbial Contaminants | |
| B. IAQ and Energy-Efficient Systems and Equipment | |
| 1. Automated Building Management Systems | |
| 2. Air Handling Units | |
| 3. Unit Ventilators | |
| 4. Air Filtration Equipment | |
| 5. Humidifiers and Dehumidifiers | |
| 6. Ozone Generators | |
| 7. Ultraviolet Light Air Purification Systems | |
C. Laboratory
Trainees use manufacturers’ capacity charts to find the humidifier and
dehumidifier capacities needed for various building types and sizes. This
laboratory corresponds to Performance Tasks 4 and 5.

Session IV. Gas Detectors and Analyzers
A. Gas Detectors and Analyzers
1. Carbon Dioxide Detectors
2. Carbon Monoxide Detectors
3. Volatile Organic Compound Sensors
4. Other Gas Detectors/Analyzers

B. Laboratory
Trainees make air measurements using selected detectors/sensors and
combustion analyzers. This laboratory corresponds to Performance Task 3.

Session V. Duct Cleaning
A. Duct Cleaning
1. Duct Cleaning Equipment
2. Duct Cleaning Methods

B. Laboratory
Trainees clean and inspect ductwork using one or more approved methods.
This laboratory corresponds to Performance Task 6.

Session VI. IAQ and Forced-Air Duct Systems; HVAC Contractor Liability;
Review and Testing
A. IAQ and Forced-Air Duct Systems
1. Supply and Return Duct Leaks
2. Sealing Air Duct Leaks

B. HVAC Contractor Liability

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.
Module Overview

Alternative heating and cooling systems are being employed for the purpose of reducing energy consumption and its associated impact on the environment. This module introduces several of these alternative systems.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Fundamentals of Weatherization; Weatherization Technician Level One; and Building Auditor Level Two*, Modules 03102-07, 03107-07, 03108-07, 03202-07, 03203-07, 03407-09, 03404-09, and 03403-09.

Objectives

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

1. Describe alternative technologies for heating, including:
   - In-floor
   - Direct-fired makeup unit (DFMU)
   - Solar
   - Air turnover
   - Corn or wood pellet burners
   - Waste oil/multi-fuel
   - Fireplace inserts
2. Describe alternative technologies for cooling, including:
   - Ductless system (DX/hydronic)
   - Computer room
   - Chilled beams
   - Multi-zone

Performance Tasks

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

Materials and Equipment

Multimedia projector and screen
*Building Auditor Level Two* PowerPoint® Presentation Slides
Computer
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper

Appropriate personal protective equipment
Samples of wood pellets and shelled corn
Section of Type HT vent
Examples of brushes used to clean wood-burning appliances
Copies of the Quick Quiz*
Module Examinations**

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

http://warmair.net

### 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 *Alternative Heating and Cooling Systems*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
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<tbody>
<tr>
<td><strong>Session I. Introduction; Alternative Heating Methods and Systems; Solid Fuel Appliances</strong></td>
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<tr>
<td>A. Introduction</td>
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<tr>
<td>B. Alternative Heating Methods and Systems</td>
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<tr>
<td>C. Solid Fuel Appliances</td>
<td></td>
</tr>
<tr>
<td>1. Wood-Burning Stoves</td>
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<tr>
<td>2. Wood-Burning Furnaces</td>
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<td><strong>Session II. Waste Oil Heaters; Geothermal and Water-Source Heat Pumps; Solar Heating Systems; In-Floor Radiant Heating Systems; Direct-Fired Makeup Units</strong></td>
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<td>E. Direct-Fired Makeup Units</td>
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Session III. Alternative Cooling Methods and Systems; Ductless Split Systems; Computer Rack Cooling Systems; Valance Cooling Systems; Chilled-Beam Cooling Systems

A. Alternative Cooling Methods and Systems

B. Ductless Split Systems
   1. Condensing Units
   2. Air Handlers
   3. Multiple Ductless Split Systems
   4. Installation and Service
   5. Chilled-Water Ductless Split Systems

C. Computer Room Cooling Systems
   1. Raised-Floor Cooling Systems
   2. Free-Standing Air Handlers
   3. Liquid Chillers
   4. Cooled Equipment Enclosures
   5. Spot Coolers

D. Valance Cooling Systems

E. Chilled-Beam Cooling Systems
   1. Passive Chilled-Beam Systems
   2. Active Chilled-Beam Systems

Session IV. Evaporative Coolers; Alternative Energy-Saving Systems and Devices; Air Turnover Systems; Review and Testing

A. Evaporative Coolers

B. Alternative Energy-Saving Systems and Devices
   1. Heat Pump Water Heaters
   2. Waste Heat Water Heaters
   3. Evaporative Pre-Coolers

C. Air Turnover Systems

D. Review

E. 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.
Module Overview

This module shows trainees how to perform a building audit. This crucial step must be done prior to weatherizing the home. The building audit finds areas in the home where energy is being lost or wasted. Once these areas are known, the auditor produces a work order that guides the work crew so that an effective weatherization of the home can take place.

Prerequisites

Before you begin this module, it is recommended that you successfully complete Fundamentals of Weatherization; Weatherization Technician Level One; and Building Auditor Level Two, Modules 03102-07, 03107-07, 03108-07, 03202-07, 03203-07, 03407-09, 03404-09, 03403-09, and 03409-09.

Objectives

Upon completion of this module, the trainee will be able to do the following:
1. Interview homeowners and educate them about how they can save energy in their homes.
2. Describe what is typically checked during a visual inspection of the home.
3. Explain lead-safe work practices.
4. Inspect and evaluate the building envelope and HVAC equipment.
5. Perform the following diagnostic tests:
   - Blower door test
   - Pressure pan test
   - Burner efficiency test
   - Carbon monoxide (CO) test
   - Draft test
   - Spillage test
6. Define baseload energy use and analyze usage of the various devices that contribute to the baseload.
7. Fill out the various forms and reports that building auditors must prepare before, during, and after an audit.

Performance Tasks

Under the supervision of the instructor, the trainee should be able to do the following:
1. Perform the following diagnostic tests:
   - Blower door test
   - Pressure pan test
   - Burner efficiency test
   - Carbon monoxide (CO) test
   - Draft test
   - Spillage test
2. Complete a building audit checklist and prepare a work order with material costs for the weatherization crew.
3. Use approved computer software to prepare a post-weatherization report showing energy savings resulting from the weatherization.
Materials and Equipment

Multimedia projector and screen
Building Auditor Level Two
  PowerPoint® Presentation Slides
Computer
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Renovate Right pamphlets
Blower door test apparatus with manometers
Blower door instruction manual
Pressure pan accessory for blower door
Combustion efficiency test kit
Carbon monoxide (CO) tester
Access to various appliances for testing
Infrared camera
Draft gauge
Nontoxic smoke generator
Blank building audit checklists
Blank weatherization work orders
Weatherization Assistant software
Lead paint test kits
Samples of compact fluorescent lamps
Samples of LED lamps
DOE-approved cost-benefit analysis software
Portable electric drill
Assorted drill bits
Assorted screwdrivers
Assorted wrenches
Assorted pliers
Step ladder
Flashlight
Inspection mirror
Trade Terms Quiz*
Module Examinations**
Performance Profile Sheets**

* 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. Trainees may be exposed to hazardous materials, such as lead paint, that requires special protective equipment. Make sure that all trainees are briefed on appropriate safety procedures.

Additional Resources

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

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 42½ hours are suggested to cover *Performing a Building Audit*. You will need to adjust the time required for 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.

<table>
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<th>Topic</th>
<th>Planned Time</th>
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<td>A. Introduction</td>
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<td>B. Safety</td>
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<td>2. Other Hazardous Materials and Conditions</td>
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<td>A. Visual Inspection of the Home</td>
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<td><strong>Sessions III–V. Combustion Safety Testing</strong></td>
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<td>A. Combustion Safety Testing</td>
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<td>1. Carbon Monoxide (CO) Testing</td>
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<tr>
<td>2. Checking Flue Gas Spillage, Vent Draft Pressure, and CO Levels in Natural-Draft Appliances</td>
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<td>B. Laboratory</td>
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<tr>
<td>Have trainees practice the various combustion safety testing procedures, such as burner efficiency tests and carbon monoxide tests. This laboratory corresponds to Performance Task 1.</td>
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<td><strong>Sessions VI–IX. Evaluating Other HVAC Equipment; Finding Building Air Leaks</strong></td>
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<td>A. Evaluating Other HVAC Equipment</td>
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<td>B. Finding Building Air Leaks</td>
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<tr>
<td>1. Whole-House Blower Door Testing</td>
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<td>C. Laboratory</td>
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<td>Have trainees practice performing a whole-house blower door test to determine building tightness. This laboratory corresponds to Performance Task 1.</td>
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<td><strong>Sessions X–XIII. Zone Leakage Tests</strong></td>
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<td>A. Zone Leakage Tests</td>
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<td>1. Room Pressure Difference Tests</td>
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<td>B. Laboratory</td>
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<tr>
<td>Have trainees practice using a thermal imaging camera to find air leaks in barriers and building cavities. This laboratory corresponds to Performance Task 1.</td>
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<td>C. Zone Leakage Tests</td>
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<tr>
<td>1. Finding Leaks in Air Ducts</td>
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<td>2. Post-Weatherization Testing</td>
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<td>D. Laboratory</td>
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<tr>
<td>Have trainees practice using a blower door pressure pan accessory to find leaks in air ducts. This laboratory corresponds to Performance Task 1.</td>
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</table>
Sessions XIV–XV. Reducing the Baseload
   A. Reducing the Baseload
       1. Appliances
       2. Lighting
       3. Building Auditor as Teacher
   B. Laboratory
      Have trainees complete a building audit checklist and prepare a work order
      with material costs for the weatherization crew. This laboratory corresponds to
      Performance Task 2.

Session XVI. Building Audit Reports
   A. Building Audit Reports
   B. Laboratory
      Have trainees use approved computer software to prepare a post-weatherization
      report showing energy savings resulting from the weatherization. This laboratory
      corresponds to Performance Task 3.

Session XVII. 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.