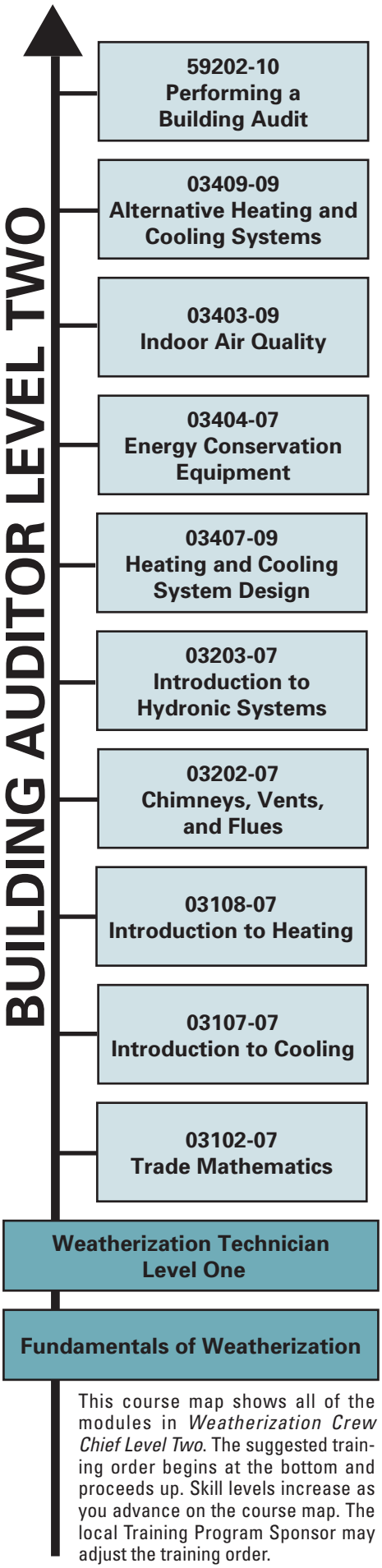
COMPETENCIES, OBJECTIVES, AND PERFORMANCE TASKS



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.

Trade Mathematics
Annotated Instructor's Guide

Module 03102-07

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
  (ISBN 978-0-13-257682-6)
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.

Fundamentals of Mechanical and Electrical Mathematics, Latest Edition. Upper Saddle River, NJ: Prentice Hall Publishing.

Teaching Time For This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 10 hours are suggested to cover *Trade Mathematics.*

Topic	**Planned Time**
Session I. Introduction; Metric System	
A. Introduction	_____
B. Metric Units	_____
C. Length, Area, and Volume	_____
D. Mass Versus Weight	_____
E. Pressure and Acceleration	_____
F. Temperature Scales	_____
Session II. Scientific Notation; Powers and Roots; Algebra	
A. Scientific Notation	_____
B. Powers and Roots	_____
C. Introduction to Algebra	_____
Session III. Geometry; Right Triangles	
A. Introduction to Geometry	_____
B. Working with Right Triangles	_____
Session IV Converting Units; Review and Testing	
A. Converting Decimal Feet to Feet and Inches and Vice Versa	_____
B. Module Review	_____
C. 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.	

Introduction to Cooling
Annotated Instructor's Guide

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
(ISBN 978-0-13-257682-6)
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.

Air Conditioning Systems, Principles, Equipment, and Service, Latest Edition. Upper Saddle River, NJ: Prentice Hall.

Basic Refrigeration (Slides and Student Handbook), Latest Edition. York, PA:York International Corporation, Publications Distribution Center.

General Training Air Conditioning (Fundamentals)–GTAC-I, Latest Edition. Syracuse, NY: Carrier Corporation, Literature Services.

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.

Topic	**Planned Time**
Sessions I and II. Fundamentals of Cooling	
A. Introduction	_____
B. Heat	_____
C. Heat Transfer	_____
D. Pressure	_____
E. Instruments Used to Measure Temperature and Pressure	_____
F. Laboratory	_____
Trainees practice measuring temperatures in an operating air conditioning system. This laboratory corresponds to Performance Task 1.	
Session III. Mechanical Refrigeration System	
A. System Components	_____
B. Refrigeration Cycle	_____
Session IV. Refrigerants	
A. Trade Names	_____
B. Ammonia	_____
C. Fluorocarbon Refrigerants	_____
D. Refrigerant Containers	_____
E. Identifying Refrigerants	_____
F. Laboratory	_____
Have trainees practice identifying refrigerants. This laboratory corresponds to Performance Task 2.	
G. Refrigerant Safety Precautions	_____

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

Introduction to Heating
Annotated Instructor's Guide

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
Building Auditor Level Two
PowerPoint® Presentation Slides
(ISBN 978-0-13-257682-6)
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.

Fundamentals of Gas Heating, Latest Edition. Tyler, TX: The Trane Company.

General Training—Heating (GTH), Latest Edition. Syracuse, NY: Carrier Corporation.

Heating, Ventilating, and Air Conditioning Fundamentals, Latest Edition. Upper Saddle River, NJ: 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 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.

Topic	**Planned Time**
Session I. Fundamentals of Heating	
A. Introduction	_____
B. Heat Transfer	_____
C. Temperature and Heat Measurement	_____
D. Combustion	_____
Session II. Forced-Air Furnaces	
A. Types	_____
B. Heat Exchangers	_____
C. Condensing Furnaces	_____
D Fans, Motors, Air Filters, and Blowers	_____
E. Humidifiers	_____
F. Installation	_____
G. Laboratory 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.

Chimneys, Vents, and Flues Annotated Instructor's Guide

Module 03202-07

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.
9. Adjust a thermostat heat anticipator.

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
PowerPoint® Presentation Slides
(ISBN 978-0-13-257682-6)
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.

Mid-Efficiency Furnace Installation Awareness. Latest Edition. Syracuse, NY: Carrier Corporation.

National Fuel Gas Code (NFPA 54/ANSI/Z223.1). 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 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.

Topic	**Planned Time**
Session I. Introduction to Chimneys and Venting Requirements	
A. Introduction	_____
B. Combustion	_____
C. Flue Gases	_____
D. Furnace Venting	_____
E. Vent System Components	_____
F. Natural-Draft Furnaces	_____
G. Induced-Draft Furnaces	_____
H. Laboratory Have trainees practice measuring the temperature and determining the temperature rise. This laboratory corresponds to Performance Task 1.	_____
I. Laboratory Have trainees practice adjusting the thermostat anticipator. This laboratory corresponds to Performance Task 2.	_____

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.

Introduction to Hydronic Systems Annotated Instructor's Guide

Module 03203-07

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.
9. Calculate heating water flow rates.
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
  (ISBN 978-0-13-257682-6)
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)

Venturi and orifice-type flow meters
Two-way and three-way valves
Assorted hot-water terminals, including:
  Convectors
  Baseboard and finned-tube radiators
  Unit heaters
  Heating coils
  Shell-and-tube plate heat exchangers
Tankless water heaters
Indirect water heaters
Manufacturers' instructions for safety relief valves
Manufacturers' literature on expansion/compression tanks
Manufacturers' literature on circulating pumps
Copies of the Quick Quizzes*
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. 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.

ASHRAE Handbook — HVAC Systems and Equipment, 2004. Atlanta, GA: American Society of Heating and Air Conditioning Engineers, Inc.

ASHRAE Handbook — HVAC Applications, 2007. Atlanta, GA: American Society of Heating and Air Conditioning Engineers, Inc.

HVAC Systems, 1992. Samuel C. Monger. Englewood Cliffs, NJ: 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 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.

Topic	**Planned Time**
Session I. Introduction to Hot-Water Heating System Components and Boilers	
A. Introduction	_____
B. Water System Terms	_____
C. Hot-Water Heating Systems	_____
D. Hot-Water Boilers	_____
E. Safety Controls	_____
F. Laboratory Have trainees practice demonstrating safety precautions when working on a boiler. This laboratory corresponds to Performance Task 1.	_____
G. Laboratory Have trainees practice safely performing selected operating procedures on a boiler. This laboratory corresponds to Performance Task 3.	_____

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.

Heating and Cooling System Design Annotated Instructor's Guide

Module 03407-09

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
Building Auditor Level Two
PowerPoint® Presentation Slides
(ISBN 978-0-13-257682-6)
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
Samples of foil- and/or vinyl-backed fiberglass duct insulation
Examples of building floor plans and/or distribution system layouts
Examples of heating and cooling load estimate forms
Manufacturer's product literature for cooling equipment, furnaces, and heat pumps
Examples of friction loss charts
Operating air distribution duct system
Examples of air distribution system fans and blowers
Duct design calculators
Air diffusers, registers, and grilles
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.

Additional Resources

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

Air Distribution System Selection. York, PA: International Corporation.

HVAC Duct Construction Standards – Metal and Flexible. Chantilly, VA: Sheet Metal and Air Conditioning Contractors National Association (SMACNA).

Manual D, Duct Design for Residential Winter and Summer Air Conditioning. Washington, DC: Air Conditioning Contractors of America (ACCA).

Manual G, Selection of Distribution Systems. Washington, DC: Air Conditioning Contractors of America (ACCA).

Manual J, Load Calculation for Residential Winter and Summer Air Conditioning. Washington, DC: Air Conditioning Contractors of America (ACCA).

Manual N, Load Calculation for Commercial Winter and Summer Air Conditioning. Washington, DC: Air Conditioning Contractors of America (ACCA).

Residential Air System Design. Syracuse, NY: Carrier Corporation.

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.

Topic **Planned Time**

Session I. Introduction; Overview of the Design Process; Building Evaluation/Survey; Load Estimating I

A. Introduction _____
B. Overview of the Design Process _____
C. Building Evaluation/Survey _____
D. Load Estimating _____
   1. Heat Transfer _____
   2. Heat Gain and Loss _____

Session II. Load Estimating II

A. Load Estimating _____
   1. Cooling and Heating Load Factors _____

Session III. Load Estimating III

A. Load Estimating _____
   1. Preparing the Load Estimate _____
   2. Load Estimating Software _____

Session IV. Laboratory

A. Laboratory _____

   Have trainees develop a list of factors that affect heating and cooling loads. This laboratory corresponds to Performance Task 1.

B. Laboratory _____

   Have trainees develop a floor plan that contains all the information needed to perform a load estimate. This laboratory corresponds to Performance Task 2.

Session V. Laboratory

A. Laboratory _____

   Have trainees prepare a load estimate based on their floor plan. This laboratory corresponds to Performance Task 3.

Session VI. Equipment Selection

A. Equipment Selection _____
   1. Cooling Equipment Selection _____
   2. Heating Equipment Selection _____
   3. Heat Pump Selection _____
B. Laboratory _____

   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.

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.

Energy Conservation Equipment Annotated Instructor's Guide

Module 03404-09

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
Building Auditor Level Two
PowerPoint® Presentation Slides
(ISBN 978-0-13-257682-6)
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.

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

HVAC Systems Design Handbook. Blue Ridge Summit, PA: TAB Books, Inc.

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.

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

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.

Indoor Air Quality
Annotated Instructor's Guide

Module 03403-09

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 (CO_2) 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
Building Auditor Level Two
PowerPoint® Presentation Slides
(ISBN 978-0-13-257682-6)
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.

Building Air Quality, a Guide for Building Owners and Facility Managers, Latest Edition. Washington, DC: U.S. Environmental Protection Agency.

Indoor Air Quality, Latest Edition. Chantilly, VA: Sheet Metal and Air Conditioning Contractors National Association (SMACNA).

Indoor Air Quality in the Building Environment. Troy, MI: Business News Publishing Company.

ACR 2006, Assessment, Cleaning, and Restoration of HVAC Systems, Latest Edition. Washington, DC: National Air Duct Cleaners 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 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.

Topic **Planned Time**

Session I. Introduction to Indoor Air Quality (IAQ)

A. Introduction _____
B. Long-Term and Short-Term Effects of Poor IAQ _____
C. Good Indoor Air Quality _____
D. Sources of Building Contaminants _____
   1. Building Construction _____
   2. Human Occupancy _____
   3. Building Materials and Furnishings _____
   4. HVAC and Other Building Equipment _____
   5. Cleaning Compounds and Pesticides _____
   6. Contaminant Sources Located Outside the Building _____
E. Laboratory _____

   Trainees use selected radon monitors and/or test kits. This laboratory corresponds to Performance Task 1.

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
(ISBN 978-0-13-257682-6)
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.

Additional Resources

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

http://warmair.net

http://www.servicemagic.com/article.show.Think-Green-when-it-Comes-to-Residential-Heating.15397.html

Teaching Time For This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 10 hours are suggested to cover *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.

Topic	**Planned Time**
Session I. Introduction; Alternative Heating Methods and Systems; Solid Fuel Appliances	
A. Introduction	_____
B. Alternative Heating Methods and Systems	_____
C. Solid Fuel Appliances	_____
1. Wood-Burning Stoves	_____
2. Wood-Burning Furnaces	_____
3. Wood-Burning Boilers	_____
4. Installation and Maintenance	_____
Session II. Waste Oil Heaters; Geothermal and Water-Source Heat Pumps; Solar Heating Systems; In-Floor Radiant Heating Systems; Direct-Fired Makeup Units	
A. Waste Oil Heaters	_____
1. Waste Oil Heating Issues	_____
B. Geothermal and Water-Source Heat Pumps	_____
1. Ground-Source Heat Pumps	_____
2. Water-Source Heat Pumps	_____
C. Solar Heating Systems	_____
1. Passive Solar Heating Systems	_____
2. Active Solar Heating Systems	_____
D. In-Floor Radiant Heating Systems	_____
1. Electric Radiant Heating Systems	_____
2. Radiant Hydronic Heating Systems	_____
E. Direct-Fired Makeup Units	_____

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.

Performing a Building Audit
Annotated Instructor's Guide

Module 59202-10

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
(ISBN 978-0-13-257682-6)
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.

Consumer Guide to Home Energy Savings: Save Money, Save the Earth. Washington, DC: American Council for an Energy-Efficient Economy (ACEEE).

Residential Energy: Cost Savings and Comfort for Existing Buildings, 5th Edition. Upper Saddle River, NJ: Prentice Hall.

The Homeowner's Handbook to Energy Efficiency: A Guide to Big and Small Improvements. Helena, MT: Saturn Resource Management, Inc.

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 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.

Topic	Planned Time
Session I. Introduction; Safety	
A. Introduction	_____
B. Safety	_____
1. Lead-Safe Work Practices	_____
2. Other Hazardous Materials and Conditions	_____
Session II. Visual Inspection of the Home	
A. Visual Inspection of the Home	_____
Sessions III–V. Combustion Safety Testing	
A. Combustion Safety Testing	_____
1. Carbon Monoxide (CO) Testing	_____
2. Checking Flue Gas Spillage, Vent Draft Pressure, and CO Levels in Natural-Draft Appliances	_____
B. Laboratory	_____
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.	
Sessions VI–IX. Evaluating Other HVAC Equipment; Finding Building Air Leaks	
A. Evaluating Other HVAC Equipment	_____
B. Finding Building Air Leaks	_____
1. Whole-House Blower Door Testing	_____
C. Laboratory	_____
Have trainees practice performing a whole-house blower door test to determine building tightness. This laboratory corresponds to Performance Task 1.	
Sessions X–XIII. Zone Leakage Tests	
A. Zone Leakage Tests	_____
1. Room Pressure Difference Tests	_____
B. Laboratory	_____
Have trainees practice using a thermal imaging camera to find air leaks in barriers and building cavities. This laboratory corresponds to Performance Task 1.	
C. Zone Leakage Tests	
1. Finding Leaks in Air Ducts	_____
2. Post-Weatherization Testing	_____
D. Laboratory	_____
Have trainees practice using a blower door pressure pan accessory to find leaks in air ducts. This laboratory corresponds to Performance Task 1.	

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.