MODULE OVERVIEW

This module covers the techniques for reading and understanding various types of construction drawings, specifications, and other related documents. Emphasis is placed on the types of drawings and specifications that are commonly used by those in the HVAC trade and other closely-related trades. The procedures and documents involved in an HVAC equipment and material takeoff are also covered.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum; HVAC Level One; HVAC Level Two; and HVAC Level Three.

OBJECTIVES

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

1. Read HVAC drawings and architect’s plans and explain their relationships.
2. Compare mechanical plans with the actual installation of duct and pipe runs, fittings, and sections.
3. Interpret specification documents and apply them to the plans.
4. Interpret shop drawings and apply them to the plans and specifications.
5. Describe a submittal, its derivation, routing, and makeup.
6. Develop a field set of as-built drawings.
7. Identify the steps required for transferring design information to component production.
8. Identify, develop, and complete takeoff sheets.
9. List and classify materials most commonly used in HVAC systems.
10. Complete takeoff procedures for HVAC systems.

PERFORMANCE TASKS

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

1. Identify and interpret a site plan drawing.
2. Identify and interpret the following on an architectural drawing:
   - Floor plans and details
   - Elevations
   - Foundation plan
   - Reflected ceiling plan
3. Identify and interpret the following on a plumbing plan drawing:
   - Sanitary plumbing plans
   - Domestic water plumbing plans
   - Isometric views
   - Riser diagrams
   - Schedules
   - Specification references
   - Legends
4. Identify and interpret the following on a mechanical plan drawing:
   - Hot- and chilled-water coil piping
   - HVAC piping
   - Chiller piping/installation
   - Refrigeration piping schematics
   - Air handling unit installation/connecting ductwork
   - Hot- and chilled-water flow diagrams
   - Schedules
   - Specification references
   - Legends

continued
5. Identify and interpret the following on an electrical plan drawing:
   - Riser diagrams
   - Schedules
   - Specification references
   - Legends
6. Prepare a request for information (RFI) form.
7. Identify and interpret the information given in the specifications pertaining to a construction project.
8. Interpret all types of HVAC-related shop drawings.
9. Mark up HVAC mechanical plans to show as-built modifications.
10. Perform an HVAC equipment and material takeoff and prepare the takeoff forms.
11. Prepare building coordination drawings that show the composite installation of HVAC equipment relative to the equipment installed by other trades, such as the electrical and plumbing trades.

**MATERIALS AND EQUIPMENT LIST**

| Overhead projector and screen | Cut sheets/lists |
| Transparencies                | HVAC equipment catalogs |
| Blank acetate sheets          | Equipment submittals |
| Transparency pens             | Complete set of as-built plans (drawings) for a local construction project |
| Whiteboard/chalkboard        | Various takeoff sheets |
| Markers/chalk                 | Drafting instruments |
| Pencils and scratch paper     | Drafting supplies |
| Appropriate personal protective equipment | Drafting symbol template |
| Complete set of drawings for a local construction project | Takeoff tools and materials including: |
| Various site plans            |   - Air devices and equipment takeoff sheets |
| Examples of floor, foundation, and reflected ceiling plans and elevation drawings |   - Piping and accessories takeoff sheets |
| Drawings showing schedules    |   - Ductwork takeoff sheets |
| Various detail drawings       |   - Colored pencils |
| Section drawings              |   - Electronic wheel scalers |
| Plumbing plan drawings        |   - Metallic tape |
| Mechanical plan drawings      |   - Architect’s drafting scales |
| Electrical plan drawings      |   - Straightedges |
| Complete specifications for a local construction project |   - Automatic mechanical counters |
| Request for information (RFI) forms |   - Adding machines or calculators |
| Shop drawings                 |   - Magnifying glasses |
| Coordination drawings         | HVAC-related manufacturers’ catalogs |
|                                 | HVAC-related technical books and manuals |
|                                 | Copies of the Quick Quiz* |
|                                 | Module Examinations** |
|                                 | Performance Profile Sheets** |

* Located in the back of this module
**Located in the Test Booklet

**SAFETY CONSIDERATIONS**

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Trainees may be required to visit a construction site.
**ADDITIONAL RESOURCES**

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

- *Reading Plans and Elevations*, NCCER Carpentry Curriculum.

**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 *Construction Drawings and Specifications*. 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>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session I. Introduction; Reading Drawings</strong></td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Reading Drawings</td>
<td></td>
</tr>
<tr>
<td>C. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have trainees practice interpreting a site plan drawing. This laboratory corresponds to Performance Task 1.</td>
<td></td>
</tr>
<tr>
<td>D. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have trainees practice interpreting architectural drawings. This laboratory corresponds to Performance Task 2.</td>
<td></td>
</tr>
<tr>
<td><strong>Sessions II and III. Reading Plumbing Plans and Mechanical Plans</strong></td>
<td></td>
</tr>
<tr>
<td>A. Reading Plumbing Plans</td>
<td></td>
</tr>
<tr>
<td>B. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have trainees practice interpreting plumbing plan drawings. This laboratory corresponds to Performance Task 3.</td>
<td></td>
</tr>
<tr>
<td>C. Reading Mechanical Plans</td>
<td></td>
</tr>
<tr>
<td>D. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have trainees practice interpreting mechanical plan drawings. This laboratory corresponds to Performance Task 4.</td>
<td></td>
</tr>
<tr>
<td><strong>Session IV. Reading Electrical Plans</strong></td>
<td></td>
</tr>
<tr>
<td>A. Reading Electrical Plans</td>
<td></td>
</tr>
<tr>
<td>B. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have trainees practice interpreting electrical plan drawings. This laboratory corresponds to Performance Task 5.</td>
<td></td>
</tr>
<tr>
<td><strong>Session V. Request for Information Forms; Specifications</strong></td>
<td></td>
</tr>
<tr>
<td>A. Request for Information Forms</td>
<td></td>
</tr>
<tr>
<td>B. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have trainees prepare a request for information (RFI) form. This laboratory corresponds to Performance Task 6.</td>
<td></td>
</tr>
</tbody>
</table>
C. Specifications
   Have trainees practice interpreting the information given in the specifications pertaining to a construction project. This laboratory corresponds to Performance Task 7.

Sessions VI and VII. Shop Drawings; Submittals
A. Shop Drawings
   1. Cut Lists
   2. General Procedure
B. Laboratory
   Have trainees prepare building coordination drawings that show the composite installation of HVAC equipment relative to the equipment installed by other trades. This laboratory corresponds to Performance Task 11.
C. Laboratory
   Have trainees practice interpreting all types of HVAC-related shop drawings. This laboratory corresponds to Performance Task 8.
D. Submittals

Session VIII. As-Built Drawings
A. As-Built Drawings
B. Laboratory
   Have trainees mark up an HVAC mechanical plan to show as-built modifications. This laboratory corresponds to Performance Task 9.

Session IX. Takeoffs
A. Takeoffs
B. Takeoff Tools and Materials
C. Selecting Equipment and Materials
D. Takeoff Procedures
E. Laboratory
   Have trainees perform an HVAC equipment and material takeoff and prepare the takeoff forms. This laboratory corresponds to Performance Task 10.
F. Building Codes

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

This module builds on the information previously studied in the Level One module, *Air Distribution Systems*. Among the subjects covered in this module is psychrometrics, and trainees will be introduced to the psychrometric chart and its use in determining the various properties of air. The procedures, equipment, and instrumentation used for testing, adjusting, and balancing air distribution systems are also covered.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum; HVAC Level One; HVAC Level Two; HVAC Level Three; and HVAC Level Four*, Module 03401-09.

Objectives

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

1. Explain the gas laws (Dalton, Boyle, and Charles) used when dealing with air and its properties.
2. Explain the fan and pump laws.
3. Use a psychrometric chart to evaluate air properties and changes in air properties.
4. Explain the principles involved in the balancing of air and water distribution systems.
5. Define common terms used by manufacturers when describing grilles, registers, and diffusers.
6. Identify and use the tools and instruments needed to balance air distribution systems.
7. Balance an air distribution system.
8. Change the speed of an air distribution system supply fan.

Performance Tasks

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

1. Select and properly use test instruments for balancing air distribution systems.
2. Balance a selected air system:
   - Measure fan and fan motor rpm.
   - Measure supply and return duct static pressures.
   - Use fan curve charts.
   - Adjust supply fan speed to provide higher or lower air quantities.
   - Measure airflow at air supply outlets.
   - Adjust dampers in branch supply ducts and at air terminals and diffusers.
   - Prepare system balancing report forms.
3. Balance an air distribution system using the thermometer method.
4. Measure the temperature rise and drop across ducted heating and cooling equipment, respectively.
MATERIALS AND EQUIPMENT LIST

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Air distribution system component manufacturers’ catalogs
Plans and specifications for selected building air distribution systems
Psychrometric chart
Operating air distribution system
Tachometers
Sling psychrometer
Electronic hygrometer
Clamp-on ammeters
Multimeters
Differential pressure gauge

Manometers (as available)
U-tube
Inclined
Inclined vertical
Electronic
Pitot tubes
Static pressure tips
Velometers/anemometers (as available)
Rotating vane
Swinging vane
Hot wire
Flow hood
Air volume balancer
Digital thermometers
Optional blowers and fans and related manufacturers’ fan curve charts
Samples of system balancing report forms
Copies of the Quick Quiz*
Module Examinations**
Performance Profile Sheets**

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Trainees will be required to balance air distribution systems and perform supply air fan adjustments.

ADDITIONAL RESOURCES

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


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 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 20 hours are suggested to cover System Balancing. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session I. Introduction; Air Properties; Psychrometrics</strong></td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Air Properties</td>
<td></td>
</tr>
<tr>
<td>1. Atmospheric Pressure and Gauge Pressure</td>
<td></td>
</tr>
<tr>
<td>2. Temperature, Pressure, and Volume Relationships</td>
<td></td>
</tr>
<tr>
<td>C. Psychrometrics</td>
<td></td>
</tr>
<tr>
<td>1. Dry Air</td>
<td></td>
</tr>
<tr>
<td>2. Humidity</td>
<td></td>
</tr>
<tr>
<td>3. Dew point</td>
<td></td>
</tr>
<tr>
<td>4. Enthalpy</td>
<td></td>
</tr>
<tr>
<td>D. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have trainees use sling psychometers and/or electronic hygrometers to measure dry-bulb and wet-bulb temperatures and relative humidity.</td>
<td></td>
</tr>
<tr>
<td><strong>Session II. Psychrometric Chart</strong></td>
<td></td>
</tr>
<tr>
<td>A. Psychrometric Chart</td>
<td></td>
</tr>
<tr>
<td>1. Psychrometric Chart Layout</td>
<td></td>
</tr>
<tr>
<td>2. Use of the Psychrometric Chart</td>
<td></td>
</tr>
<tr>
<td>B. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have trainees use a psychrometric chart to find unknown properties of air based on measured dry-bulb and wet-bulb temperatures.</td>
<td></td>
</tr>
<tr>
<td><strong>Session III. Air Balance</strong></td>
<td></td>
</tr>
<tr>
<td>A. Air Balance</td>
<td></td>
</tr>
<tr>
<td>1. Air Balance Terminology</td>
<td></td>
</tr>
<tr>
<td>a. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have trainees calibrate and use a manometer and pitot tube to make pressure, velocity pressure, and total pressure measurements in a duct system.</td>
<td></td>
</tr>
<tr>
<td>2. Air System Measuring Instruments</td>
<td></td>
</tr>
<tr>
<td>a. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have trainees calibrate and properly use velometers and anemometers to make airflow measurements at selected air system grilles and registers. This laboratory corresponds to Performance Task 1.</td>
<td></td>
</tr>
<tr>
<td>3. Air System Balancing Considerations</td>
<td></td>
</tr>
<tr>
<td>a. Airflow</td>
<td></td>
</tr>
<tr>
<td>b. Air Weight</td>
<td></td>
</tr>
</tbody>
</table>
Session IV. Air System Balancing Procedures I
A. Air System Balancing Procedures
   1. Pre-Balance Checks
      a. Laboratory
         Have trainees perform pre-balance checks on an air distribution system.
         This laboratory corresponds to Performance Task 2.
   2. Duct System Balancing: Mains
      a. Laboratory
         Have trainees balance the mains in a selected air system and then
         record measured balancing data on selected system balance reporting
         forms. This laboratory corresponds to Performance Task 2.
   3. Terminal Balancing
      a. Laboratory
         Have trainees balance the terminals in a selected air system and then
         record measured balancing data on selected system balance reporting
         forms. This laboratory corresponds to Performance Task 2.

Session V. Air System Balancing Procedures II
A. Air System Balancing Procedures
   1. Mixed Air System Adjustment
   2. Balancing Dual-Duct Systems
   3. Balancing Induction Systems
   4. Measuring Temperature Rise
      a. Laboratory
         Have trainees measure the temperature rise across ducted heating
         equipment. This laboratory corresponds to Performance Task 4.
   5. Measuring Temperature Drop
      a. Laboratory
         Have trainees measure the temperature drop across ducted cooling
         equipment. This laboratory corresponds to Performance Task 4.

Session VI. Air System Balancing Procedures III
A. Balancing by Thermometer
B. Laboratory
   1. Have trainees balance an air system for cooling using the thermometer
      method. This laboratory corresponds to Performance Task 3.
   2. Have trainees balance an air system using the thermometer and
      velocity meter method. This laboratory corresponds to Performance
      Task 3.

Session VII. Supply Air Fan Adjustments
A. Supply Air Fan Adjustments
   1. Fan Laws
      a. Laboratory
         Have trainees measure fan and fan motor rpm. This laboratory corres-
         ponds to Performance Task 2.
   2. Fan Curve Charts
      a. Laboratory
         Have trainees use a fan curve chart to find the value of an unknown
         fan characteristic when the values of any two of the three fan character-
         istics are known. This laboratory corresponds to Performance Task 2.
3. Changing the Speed of the Fan
   a. Laboratory
      Have trainees change the speed of a belt-driven fan with a fan motor that
      has a variable pitch pulley. For a fixed-drive pulley, have trainees calculate
      new pulley diameters to achieve specified speed changes. This laboratory
      corresponds to Performance Task 2.

Session VIII. Review and Testing
   A. Review
   B. Module Examination
      1. Trainees must score 70% or higher to receive recognition from NCCER.
      2. Record the testing results on Craft Training Report Form 200, and submit the
         results to the Training Program Sponsor.
   C. Performance Testing
      1. Trainees must perform each task to the satisfaction of the instructor to receive
         recognition from NCCER. If applicable, proficiency noted during laboratory
         exercises can be used to satisfy the Performance Testing requirements.
      2. Record the testing results on Craft Training Report Form 200, and submit the
         results to the Training Program Sponsor.
MODULE OVERVIEW

This module 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.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum; HVAC Level One; HVAC Level Two; HVAC Level Three; and HVAC Level Four, Modules 03401-09 and 03402-09.

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 LIST

- Overhead projector and screen
- Transparencies
- Blank acetate sheets
- Transparency pens
- Whiteboard/chalkboard
- Markers/chalk
- Pencils and scratch paper
- Appropriate personal protective equipment

continued
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. Trainees may be required to visit facilities and/or construction sites. Ensure that trainees are briefed on site safety procedures.

ADDITIONAL RESOURCES

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


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.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session I. Introduction to Indoor Air Quality (IAQ)</strong></td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Long-Term and Short-Term Effects of Poor IAQ</td>
<td></td>
</tr>
<tr>
<td>C. Good Indoor Air Quality</td>
<td></td>
</tr>
<tr>
<td>D. Sources of Building Contaminants</td>
<td></td>
</tr>
<tr>
<td>1. Building Construction</td>
<td></td>
</tr>
<tr>
<td>2. Human Occupancy</td>
<td></td>
</tr>
<tr>
<td>3. Building Materials and Furnishings</td>
<td></td>
</tr>
<tr>
<td>4. HVAC and Other Building Equipment</td>
<td></td>
</tr>
<tr>
<td>5. Cleaning Compounds and Pesticides</td>
<td></td>
</tr>
<tr>
<td>6. Contaminant Sources Located Outside the Building</td>
<td></td>
</tr>
<tr>
<td>E. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have trainees use selected radon monitors and/or test kits. This laboratory corresponds to Performance Task 1.</td>
<td></td>
</tr>
<tr>
<td><strong>Session II. Elements of a Building IAQ Inspection Survey</strong></td>
<td></td>
</tr>
<tr>
<td>A. Elements of a Building IAQ Inspection Survey</td>
<td></td>
</tr>
<tr>
<td>1. Problem Description</td>
<td></td>
</tr>
<tr>
<td>2. Site Visit and Building Walk-Through</td>
<td></td>
</tr>
<tr>
<td>3. Building HVAC Equipment and Ventilation System Inspection</td>
<td></td>
</tr>
<tr>
<td>4. Air Sampling and Testing for Specific Contaminants</td>
<td></td>
</tr>
<tr>
<td>5. Interpreting Test Results and Corrective Actions</td>
<td></td>
</tr>
<tr>
<td>B. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have trainees perform a building indoor air quality (IAQ) inspection/evaluation. This laboratory corresponds to Performance Task 2.</td>
<td></td>
</tr>
<tr>
<td><strong>Session III. Achieving Acceptable Indoor Air Quality; IAQ and Energy-Efficient Systems and Equipment</strong></td>
<td></td>
</tr>
<tr>
<td>A. Achieving Acceptable Indoor Air Quality</td>
<td></td>
</tr>
<tr>
<td>1. Initial Building Design</td>
<td></td>
</tr>
<tr>
<td>2. Ventilation Control</td>
<td></td>
</tr>
<tr>
<td>3. Thermal Comfort Control</td>
<td></td>
</tr>
<tr>
<td>4. Controlling Chemical Contaminants</td>
<td></td>
</tr>
<tr>
<td>5. Controlling Microbial Contaminants</td>
<td></td>
</tr>
<tr>
<td>B. IAQ and Energy-Efficient Systems and Equipment</td>
<td></td>
</tr>
<tr>
<td>1. Automated Building Management Systems</td>
<td></td>
</tr>
<tr>
<td>2. Air Handling Units</td>
<td></td>
</tr>
<tr>
<td>3. Unit Ventilators</td>
<td></td>
</tr>
<tr>
<td>4. Air Filtration Equipment</td>
<td></td>
</tr>
<tr>
<td>5. Humidifiers and Dehumidifiers</td>
<td></td>
</tr>
<tr>
<td>6. Ozone Generators</td>
<td></td>
</tr>
<tr>
<td>7. Ultraviolet Light Air Purification Systems</td>
<td></td>
</tr>
</tbody>
</table>
C. Laboratory
Have 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
Have 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
Have 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
This module covers various heat recovery/reclaim devices and other energy conservation equipment. It includes information on their operation as well as maintenance procedures.

PREREQUISITES
Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum; HVAC Level One; HVAC Level Two; HVAC Level Three; and HVAC Level Four, Modules 03401-09 through 03403-09.

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 LIST

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective 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
Manufacturer’s operation and service literature for demonstration equipment
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
**Located in the Test Booklet
SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Trainees will be required to operate selected energy conversion equipment. Ensure that trainees are briefed on site safety procedures.

ADDITIONAL RESOURCES

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


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>
</tr>
</thead>
<tbody>
<tr>
<td>Session I. Introduction; Heat Recovery/Reclaim Methods and Equipment</td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Heat Recovery/Reclaim Methods and Equipment</td>
<td></td>
</tr>
<tr>
<td>1. Energy and Heat Recovery Ventilators</td>
<td></td>
</tr>
<tr>
<td>2. Fixed-Plate and Rotary Air-to-Air Heat Exchangers</td>
<td></td>
</tr>
<tr>
<td>3. Condenser Heat Recovery Systems</td>
<td></td>
</tr>
<tr>
<td>4. Coil Energy Recovery Loops</td>
<td></td>
</tr>
<tr>
<td>5. Heat Pipe Heat Exchangers</td>
<td></td>
</tr>
<tr>
<td>6. Thermosiphon Heat Exchangers</td>
<td></td>
</tr>
<tr>
<td>7. Twin Tower Enthalpy Recovery Loops</td>
<td></td>
</tr>
<tr>
<td>Session II. Economizers; Heat Recovery in Steam Systems</td>
<td></td>
</tr>
<tr>
<td>A. Economizers</td>
<td></td>
</tr>
<tr>
<td>1. Air-side Economizers</td>
<td></td>
</tr>
<tr>
<td>2. Water-side Economizers</td>
<td></td>
</tr>
<tr>
<td>B. Heat Recovery in Steam Systems</td>
<td></td>
</tr>
<tr>
<td>1. Flash Steam (Flash Tank) Heat Recovery</td>
<td></td>
</tr>
<tr>
<td>2. Flue Gas Heat Recovery System</td>
<td></td>
</tr>
<tr>
<td>3. Blowdown and Heat Recovery System</td>
<td></td>
</tr>
<tr>
<td>C. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have trainees adjust an economizer for the proper setting in a local area. This laboratory corresponds to Performance Task 1.</td>
<td></td>
</tr>
<tr>
<td>Session III. Electric Utility Energy Demand Reduction Systems; Food Processing Cooling Water Recovery System</td>
<td></td>
</tr>
<tr>
<td>A. Electric Utility Energy Demand Reduction Systems</td>
<td></td>
</tr>
<tr>
<td>1. Off-Peak Utility Usage</td>
<td></td>
</tr>
<tr>
<td>B. Food Processing Cooling Water Recovery System</td>
<td></td>
</tr>
</tbody>
</table>
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 Craft Training Report Form 200, and submit the results to the Training Program Sponsor.

C. Performance Testing
   1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
   2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.
MODULE OVERVIEW
This module explains how computers and microprocessor controls are used to manage zoned HVAC systems in residential and commercial buildings locally and through computer networks. This module also covers the installation of building management systems and related components.

PREREQUISITES
Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum; HVAC Level One; HVAC Level Two; HVAC Level Three; and HVAC Level Four, Modules 03401-09 through 03404-09.

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

1. Identify the major components of a building management system and describe how they fit together.
2. Operate a basic direct digital controller.
3. List the types of information available on a typical front-end computer screen for a building management system.
4. List the typical steps required to install a building management system.
5. Demonstrate how to install typical sensors, actuators, power wiring, and communication wiring.

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

1. Program an electronic thermostat.
2. Interpret operating data received at the central control computer of a building management system.
3. Under the supervision of the instructor, select and modify operating parameters for a building management system.
4. Interpret basic diagnostic and test data provided by a building management system.

MATERIALS AND EQUIPMENT LIST

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overhead projector and screen</td>
<td>Programmable electronic thermostats</td>
</tr>
<tr>
<td>Transparencies</td>
<td>Selection of automatic zone dampers</td>
</tr>
<tr>
<td>Blank acetate sheets</td>
<td>Battery-powered zone controller</td>
</tr>
<tr>
<td>Transparency pens</td>
<td>Operating building management system</td>
</tr>
<tr>
<td>Whiteboard/chalkboard</td>
<td>Copies of the Quick Quiz*</td>
</tr>
<tr>
<td>Markers/chalk</td>
<td>Module Examinations**</td>
</tr>
<tr>
<td>Pencils and scratch paper</td>
<td>Performance Profile Sheets**</td>
</tr>
</tbody>
</table>

* Located in the back of this module

**Located in the Test Booklet

SAFETY CONSIDERATIONS
Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. This module may require trainees to visit a site that has a BMS in operation. Ensure that trainees are briefed on site safety policies prior to any site visits.
**ADDITIONAL RESOURCES**

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


**TEACHING TIME FOR THIS MODULE**

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 17½ hours are suggested to cover *Building Management 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.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session I. Introduction; Basic Digital Controller; DDC Network Types</strong></td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Basic Digital Controller</td>
<td></td>
</tr>
<tr>
<td>1. Control Point Classification</td>
<td></td>
</tr>
<tr>
<td>2. Input and Output Devices</td>
<td></td>
</tr>
<tr>
<td>3. Closed Control Loop</td>
<td></td>
</tr>
<tr>
<td>4. Control Algorithms</td>
<td></td>
</tr>
<tr>
<td>C. DDC Network Types</td>
<td></td>
</tr>
<tr>
<td>1. Polling Networks</td>
<td></td>
</tr>
<tr>
<td>2. Peer-to-Peer Networks</td>
<td></td>
</tr>
<tr>
<td><strong>Session II. Building Management System Architecture</strong></td>
<td></td>
</tr>
<tr>
<td>A. Packaged HVAC Systems</td>
<td></td>
</tr>
<tr>
<td>B. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have trainees program an electronic thermostat. This laboratory corresponds to Performance Task 1.</td>
<td></td>
</tr>
<tr>
<td>C. Applied HVAC Systems</td>
<td></td>
</tr>
<tr>
<td>D. Building Management Functions</td>
<td></td>
</tr>
<tr>
<td><strong>Sessions III and IV. User Interfaces; Interoperability; Interpreting Front-End Software</strong></td>
<td></td>
</tr>
<tr>
<td>A. User Interfaces</td>
<td></td>
</tr>
<tr>
<td>B. Interoperability</td>
<td></td>
</tr>
<tr>
<td>1. BACnet</td>
<td></td>
</tr>
<tr>
<td>2. LON Technologies</td>
<td></td>
</tr>
<tr>
<td>3. Modbus</td>
<td></td>
</tr>
<tr>
<td>4. Hypertext Transfer Protocol</td>
<td></td>
</tr>
<tr>
<td>5. Web Browser System Integration</td>
<td></td>
</tr>
<tr>
<td>6. The Future of Interoperability</td>
<td></td>
</tr>
</tbody>
</table>
C. Interpreting Front-End Software
   1. Sign-On/Off and Operator Management
   2. Database Management
   3. Graphical Interface
   4. Alarm Management
   5. Report Management

D. Laboratory
   Have trainees access and interpret status reports, diagnostics, and other basic operating data received at the central control computer of a building management system. This laboratory corresponds to Performance Task 2.

Session V. Installation
A. Sensor Installation
B. Control Panel Installation
C. Running Sensor, Power, and Communication Wiring
D. Controller Programming
E. Controller Installation and Wiring Termination
F. Central Computer Installation and Programming
G. Modem Programming
H. Web Page Server Programming
I. Laboratory
   Under your supervision, have trainees select and modify operating parameters for a building management system. This laboratory corresponds to Performance Task 3.
J. Laboratory
   Have trainees interpret basic diagnostic and test data provided by a building management system. This laboratory corresponds to Performance Task 4.

Session VI. System Control Strategies
A. VVT Control Sequence
B. VAV Control Sequence
C. Night-Time Free Cooling
D. Demand-Control Ventilation
E. Humidity Control
F. Building Pressurization
G. Smoke Control
H. Interoperability Strategies

Session VII. Review and Testing
A. Review
B. Module Examination
   1. Trainees must score 70% or higher to receive recognition from NCCER.
   2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.
C. Performance Testing
   1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
   2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.
MODULE OVERVIEW

This module covers procedures for the startup and shutdown of hot-water and steam-heating systems, chilled-water systems, and forced-air distribution systems. Emphasis is on startup after initial equipment installation or after an extended period of shutdown. Procedures to prepare these systems for extended periods of shutdown are also included.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum; HVAC Level One; HVAC Level Two; HVAC Level Three; and HVAC Level Four, Modules 03401-09 through 03405-09.

OBJECTIVES

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

1. Prepare a boiler for dry storage.
2. Prepare a boiler for wet storage.
3. Clean, start up, and shut down a steam boiler.
4. Clean, start up, and shut down a hot-water boiler.
5. Start up and shut down a reciprocating liquid chiller and related water system.
6. Start up and shut down a selected centrifugal or screw liquid chiller and related water system.
7. Start up and shut down an air handler and related forced-air distribution system.
8. Test compressor oil for acid contamination.
9. Add or remove oil from a semi-hermetic or open reciprocating compressor.
10. Inspect and clean shell and tube condensers/evaporators and other water-type heat exchangers.

PERFORMANCE TASKS

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

1. Develop a checklist for shutting down a steam boiler and preparing it for dry storage.
2. Develop a checklist for shutting down a steam boiler and preparing it for wet storage.
3. Develop a checklist for starting up a steam (or hot-water) boiler and preparing it for normal operation.
4. Start up a reciprocating chiller and prepare it for normal operation.
5. Shut down a reciprocating chiller and chilled-water system.
6. Shut down a cooling tower and prepare it for an extended period of shutdown.
7. Develop a checklist for starting up a centrifugal (or screw) chiller and preparing it for normal operation.
8. Develop a checklist for shutting down a centrifugal (or screw) chiller and preparing it for an extended shutdown.
9. Start up an air handling unit and its related air distribution system and prepare it for normal operation.
10. Shut down an air handling unit and its related air distribution system and prepare it for an extended shutdown.
11. Remove and charge oil from and into a compressor.
SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Trainees will perform procedures for the startup and shutdown of a chilled-water system and an air-handling unit. They will also shut down a cooling tower and charge oil into and remove oil from a compressor. Ensure that they are briefed on appropriate safety procedures.

ADDITIONAL RESOURCES

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


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.

MATERIALS AND EQUIPMENT LIST

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Manufacturer’s operation and service literature for all demonstration equipment
Water analysis test kits
Samples of high-temperature bonding mortar
Samples of anti-corrosive materials
Samples of desiccants
Acid and moisture test kits
Water treatment chemicals (as recommended by the equipment manufacturer)
Refrigerant oil (as recommended by the equipment manufacturer)
Lockout/tagout lock and tags

HVAC systems and equipment:
Steam boiler and related water system
Hot-water boiler and related water system
Reciprocating chiller and related water system
Centrifugal (or screw) chiller with water-cooled condenser and related cooling tower
Air handling unit/air distribution system
Packaged year-round air conditioning unit/air distribution system
HVAC technician’s tool set
Multimeters (VOMs/DMMs)
Clamp-on ammeters
Gauge manifold sets and hoses
Electronic leak detectors
Electronic thermometers
Tube cleaning equipment and brushes
Copies of the Quick Quiz*
Module Examinations**
Performance Profile Sheets**

* Located in the back of this module
**Located in the Test Booklet
This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 22 1/2 hours are suggested to cover System Startup and Shutdown. 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>
</tr>
</thead>
<tbody>
<tr>
<td>Session I. Introduction; Steam/Hot-Water Boilers and Systems I</td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Steam/Hot-Water Boilers and Systems</td>
<td></td>
</tr>
<tr>
<td>1. Shutdown</td>
<td></td>
</tr>
<tr>
<td>C. Laboratory</td>
<td>Have trainees develop checklists for shutting down a steam boiler and preparing it for both wet and dry storage. This laboratory corresponds to Performance Tasks 1 and 2.</td>
</tr>
</tbody>
</table>

| Session II. Steam/Hot-Water Boilers and Systems II |   |
| A. Steam/Hot-Water Boilers and Systems |   |
| 1. Steam Boiler System Startup for Normal Operation |   |
| 2. Hot-Water Boiler Startup |   |
| 3. Boiler Cleaning Prior to Startup for Normal Operation |   |
| B. Laboratory | Have trainees develop a checklist for starting up a steam (or hot-water) boiler and preparing it for normal operation. This laboratory corresponds to Performance Task 3. |

| Session III. Reciprocating Chillers and Water Systems |   |
| A. Reciprocating Chillers and Water Systems |   |
| 1. Startup |   |
| 2. Shutdown |   |
| B. Laboratory | Have trainees start up a reciprocating chiller and prepare it for normal operation. This laboratory corresponds to Performance Task 4. |
| C. Laboratory | Have trainees shut down a reciprocating chiller and chilled-water system. This laboratory corresponds to Performance Task 5. |

| Session IV. Centrifugal Chillers and Water Systems; Screw Chillers and Water Systems |   |
| A. Centrifugal Chillers and Water Systems |   |
| 1. Startup |   |
| 2. Normal Shutdown |   |
| 3. Extended Shutdown |   |
| B. Screw Chillers and Water Systems |   |
| C. Laboratory | Have trainees develop a checklist for starting up a centrifugal (or screw) chiller and preparing it for normal operation. This laboratory corresponds to Performance Task 7. |
| D. Laboratory | Have trainees develop a checklist for shutting down a centrifugal (or screw) chiller and preparing it for an extended shutdown. This laboratory corresponds to Performance Task 8. |
Session V. Cooling Tower Water Systems
A. Cooling Tower Water Systems
   1. Startup
   2. Periodic Maintenance After Startup
   3. Winter Operation
   4. Shutdown
B. Laboratory
   Have trainees shut down a cooling tower and prepare it for an extended period of shutdown. This laboratory corresponds to Performance Task 6.

Session VI. Air Handling Unit/Air Distribution System
A. Air Handling Unit/Air Distribution System
   1. Startup
   2. Shutdown
B. Laboratory
   Have trainees start up an air handling unit and its related air distribution system and prepare it for normal operation. This laboratory corresponds to Performance Task 9.
C. Laboratory
   Have trainees shut down an air handling unit and its related air distribution system and prepare it for an extended shutdown. This laboratory corresponds to Performance Task 10.

Session VII. Packaged Year-Round Air Conditioning Units
A. Packaged Year-Round Air Conditioning Units
   1. Startup
   2. Shutdown
B. Laboratory
   Have trainees start up and shut down a packaged year-round air conditioning unit and its related air distribution system.

Session VIII. Post-Shutdown Maintenance
A. Post-Shutdown Maintenance
   1. Oil Charging/Removal in a Semi-Hermetic or Open Reciprocating Compressor
   2. Inspecting and Cleaning Shell and Tube Condensers and Evaporators (Coolers)
   3. Inspecting and Cleaning Heat Exchangers
B. Laboratory
   Have trainees remove and charge oil from and into a compressor. This laboratory corresponds to Performance Task 11.

Session IX. Review and Testing
A. Review
B. Module Examination
   1. Trainees must score 70% or higher to receive recognition from NCCER.
   2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.
C. Performance Testing
   1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
   2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.
MODULE OVERVIEW

This module 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

Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum; HVAC Level One; HVAC Level Two; HVAC Level Three; and HVAC Level Four, Modules 03401-09 through 03406-09.

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.
SAFETY CONSIDERATIONS

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

ADDITIONAL RESOURCES

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


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


MATERIALS AND EQUIPMENT LIST

| Overhead projector and screen | Samples of foil- and/or vinyl-backed fiberglass duct insulation |
| Transparencies | Examples of building floor plans and/or distribution system layouts |
| Blank acetate sheets | Examples of heating and cooling load estimate forms |
| Transparency pens | Manufacturer’s product literature for cooling equipment, furnaces, and heat pumps |
| Whiteboard/chalkboard | Examples of friction loss charts |
| Markers/chalk | Operating air distribution duct system |
| Pencils and scratch paper | Examples of air distribution system fans and blowers |
| Appropriate personal protective equipment | Duct design calculators |
| ACCA Manual J (one copy for each trainee, if possible) | Air diffusers, registers, and grilles |
| Load estimating software | Copies of the Quick Quiz* |
| Metal duct sections of various sizes and shapes | Module Examinations** |
| Metal duct installation fasteners and attaching hardware | Performance Profile Sheets** |
| Ductboard sections of various sizes and shapes | |
| Ductboard installation materials and attaching hardware | |

* Located in the back of this module

**Located in the Test Booklet
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>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session I. Introduction; Overview of the Design Process</strong></td>
<td></td>
</tr>
<tr>
<td>Building Evaluation/Survey</td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Overview of the Design Process</td>
<td></td>
</tr>
<tr>
<td>C. Building Evaluation/Survey</td>
<td></td>
</tr>
<tr>
<td><strong>Sessions II-V. Load Estimating</strong></td>
<td></td>
</tr>
<tr>
<td>A. Heat Transfer</td>
<td></td>
</tr>
<tr>
<td>B. Heat Gain and Loss</td>
<td></td>
</tr>
<tr>
<td>C. Cooling and Heating Load Factors</td>
<td></td>
</tr>
<tr>
<td>1. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have trainees develop a list of factors that affect heating and cooling loads. This laboratory corresponds to Performance Task 1.</td>
<td></td>
</tr>
<tr>
<td>D. Preparing the Load Estimate</td>
<td></td>
</tr>
<tr>
<td>1. Laboratory</td>
<td></td>
</tr>
<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>
<td></td>
</tr>
<tr>
<td>2. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have trainees prepare a load estimate based on their floor plan. This laboratory corresponds to Performance Task 3.</td>
<td></td>
</tr>
<tr>
<td>E. Load Estimating Software</td>
<td></td>
</tr>
<tr>
<td><strong>Session VI. Equipment Selection</strong></td>
<td></td>
</tr>
<tr>
<td>A. Equipment Selection</td>
<td></td>
</tr>
<tr>
<td>1. Cooling Equipment Selection</td>
<td></td>
</tr>
<tr>
<td>2. Heating Equipment Selection</td>
<td></td>
</tr>
<tr>
<td>3. Heat Pump Selection</td>
<td></td>
</tr>
<tr>
<td>B. Laboratory</td>
<td></td>
</tr>
<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>
<td></td>
</tr>
</tbody>
</table>
Sessions VII-VIII. Air Distribution System Duct Design

A. Duct System Basics

B. Air Distribution Duct Systems

C. Duct System Components

D. Duct System Design
   1. 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.
   2. 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.
   3. 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.
   4. 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.

E. Other Duct System Design Considerations

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 Craft Training Report Form 200, and submit the results to the Training Program Sponsor.

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

This module expands on the refrigeration system coverage provided in the HVAC Level Three module Retail Refrigeration Systems. It covers large-scale refrigeration systems such as those found in supermarkets, cold storage facilities, packing houses, and food processing plants.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum; HVAC Level One; HVAC Level Two; HVAC Level Three; and HVAC Level Four, Modules 03401-09 through 03407-09.

OBJECTIVES

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

1. Identify different types of refrigerated coolers and display cases and describe each one’s common application.
2. Compare the basic components used in commercial/industrial refrigeration systems with those used in retail refrigeration systems.
3. Identify single, multiple, and satellite compressor systems. Describe the applications, installation considerations, and advantages and disadvantages of each type.
4. Identify packaged condensing units and unit coolers. Describe their applications, operation, and installation considerations.
5. Identify two-stage compressors and explain their operation and applications.
6. Identify the various accessories used in commercial refrigeration systems. Explain why each is used and where it should be installed in the system.
7. Identify the various refrigeration control devices. Explain the purpose of each type and how it works.
8. Compare the components used in ammonia systems with those used in halocarbon-based refrigerant systems.

PERFORMANCE TASKS

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

1. Install a packaged condensing unit and/or individual air-cooled condenser in a refrigeration system.
2. Install a packaged unit cooler and/or individual evaporator in a refrigeration system.
3. Install two to three selected refrigeration system accessories.
4. From a selection provided by the instructor, identify the following control devices commonly used in refrigeration systems:
   - Crankcase pressure regulator
   - Evaporator pressure regulator
   - Condenser head pressure regulator
   - Hot gas bypass regulator
   - Compressor cylinder unloader
   - Solenoid-controlled unloader
MATERIALS AND EQUIPMENT LIST

Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Appropriate personal protective equipment
Refrigeration packaged condensing unit
Refrigeration evaporator or unit cooler
Refrigeration system control devices, including:
  - Crankcase pressure regulator
  - Evaporator pressure regulator
  - Condenser head pressure regulator
  - Hot gas bypass regulator
  - Compressor cylinder unloader
  - Solenoid-controlled unloader
Capacity control devices

Refrigeration system accessories, including:
  - Filter-drier with replacement cartridge
  - Sightglass/moisture-liquid indicator
  - Suction line accumulator
  - Crankcase heater
  - Oil separator
  - Receiver
  - Service valves
  - Fusible plug
  - Relief valve
  - Relief manifold
  - Check valve
  - Muffler
  - Vibration isolator
  - Defrost devices
  - Defrost time clock / timer
  - Copies of the Quick Quiz*
  - Module Examination**
  - Performance Profile Sheets**

* Located in the back of this module
**Located in the Test Booklet

SAFETY CONSIDERATIONS

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

ADDITIONAL RESOURCES

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

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 22½ hours are suggested to cover Commercial and Industrial Refrigeration 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.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Planned Time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session I. Introduction; Refrigeration and the Preservation of Food Products; Refrigerated Transport Units</strong></td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Refrigeration and the Preservation of Food Products</td>
<td></td>
</tr>
<tr>
<td>1. Cold Storage</td>
<td></td>
</tr>
<tr>
<td>2. Commercial Freezing Methods</td>
<td></td>
</tr>
<tr>
<td>C. Refrigerated Transport Units</td>
<td></td>
</tr>
<tr>
<td>1. Refrigerated Shipboard Containers</td>
<td></td>
</tr>
<tr>
<td>2. Trailer and Truck Units</td>
<td></td>
</tr>
<tr>
<td>3. Refrigerated Railcars</td>
<td></td>
</tr>
<tr>
<td><strong>Sessions II–V. Refrigeration Systems and Components; Accessories</strong></td>
<td></td>
</tr>
<tr>
<td>A. Refrigeration Systems and Components</td>
<td></td>
</tr>
<tr>
<td>1. Compressors</td>
<td></td>
</tr>
<tr>
<td>2. Condensers</td>
<td></td>
</tr>
<tr>
<td>a. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have trainees install a packaged condensing unit or individual air-cooled condenser in a refrigeration system. This laboratory corresponds to Performance Task 1.</td>
<td></td>
</tr>
<tr>
<td>3. Evaporators</td>
<td></td>
</tr>
<tr>
<td>a. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have trainees install a packaged unit cooler or individual evaporator in a refrigeration system. This laboratory corresponds to Performance Task 2.</td>
<td></td>
</tr>
<tr>
<td>4. Display Cases</td>
<td></td>
</tr>
<tr>
<td>5. Accessories</td>
<td></td>
</tr>
<tr>
<td>a. Laboratory</td>
<td></td>
</tr>
<tr>
<td>Have trainees install two or three selected refrigeration system accessories. This laboratory corresponds to Performance Task 3.</td>
<td></td>
</tr>
<tr>
<td><strong>Session VI. Refrigeration System Control Devices, Part I</strong></td>
<td></td>
</tr>
<tr>
<td>A. Crankcase Pressure Regulating Valves</td>
<td></td>
</tr>
<tr>
<td>B. Evaporator Pressure Regulating Valves</td>
<td></td>
</tr>
<tr>
<td>C. Air-Cooled Condenser Pressure Regulator</td>
<td></td>
</tr>
<tr>
<td>D. Bypass Control Valves</td>
<td></td>
</tr>
<tr>
<td>E. Capacity Control Devices</td>
<td></td>
</tr>
</tbody>
</table>
Session VII. Refrigeration System Control Devices II
A. Pump-Down Control
B. Defrost Systems
C. Laboratory
Selecting items from the list below, have trainees identify control devices commonly used in refrigeration systems. This laboratory corresponds to Performance Task 4.
- Crankcase pressure regulator
- Evaporator pressure regulator
- Condenser head pressure regulator
- Hot gas bypass regulator
- Compressor cylinder unloader
- Solenoid-controlled unloader

Session VIII. Ammonia Refrigeration Systems; Secondary Coolants
A. Ammonia Refrigeration Systems
B. Secondary Coolants

Session IX. Review and Testing
A. Review
B. Module Examination
1. Trainees must score 70% or higher to receive recognition from NCCER.
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.
C. Performance Testing
1. Trainees must perform each task to the satisfaction of the instructor to receive recognition from NCCER. If applicable, proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.
2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.
MODULE OVERVIEW

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 Core Curriculum, HVAC Level One; HVAC Level Two; HVAC Level Three; and HVAC Level Four, Modules 03401-09 through 03408-09.

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 LIST

| Overhead projector and screen | Appropriate personal protective equipment |
| Transparencies | Samples of wood pellets and shelled corn |
| Blank acetate sheets | Section of Type HT vent |
| Transparency pens | Examples of brushes used to clean wood-burning appliances |
| Whiteboard/chalkboard | Copies of the Quick Quiz* |
| Markers/chalk | Module Examination** |
| Pencils and scratch paper | |

* Located in the back of this module
** Located in the Test Booklet

SAFETY CONSIDERATIONS

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

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

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>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session I. Introduction; Alternative Heating Methods and Systems;</strong></td>
<td></td>
</tr>
<tr>
<td>Solid Fuel Appliances</td>
<td></td>
</tr>
<tr>
<td>A. Introduction</td>
<td></td>
</tr>
<tr>
<td>B. Alternative Heating Methods and Systems</td>
<td></td>
</tr>
<tr>
<td>C. Solid Fuel Appliances</td>
<td></td>
</tr>
<tr>
<td>1. Wood-Burning Stoves</td>
<td></td>
</tr>
<tr>
<td>2. Wood-Burning Furnaces</td>
<td></td>
</tr>
<tr>
<td>3. Wood-Burning Boilers</td>
<td></td>
</tr>
<tr>
<td>4. Installation and Maintenance</td>
<td></td>
</tr>
<tr>
<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>
<td></td>
</tr>
<tr>
<td>A. Waste Oil Heaters</td>
<td></td>
</tr>
<tr>
<td>1. Waste Oil Heating Issues</td>
<td></td>
</tr>
<tr>
<td>B. Geothermal and Water-Source Heat Pumps</td>
<td></td>
</tr>
<tr>
<td>1. Ground-Source Heat Pumps</td>
<td></td>
</tr>
<tr>
<td>2. Water-Source Heat Pumps</td>
<td></td>
</tr>
<tr>
<td>C. Solar Heating Systems</td>
<td></td>
</tr>
<tr>
<td>1. Passive Solar Heating Systems</td>
<td></td>
</tr>
<tr>
<td>2. Active Solar Heating Systems</td>
<td></td>
</tr>
<tr>
<td>D. In-Floor Radiant Heating Systems</td>
<td></td>
</tr>
<tr>
<td>1. Electric Radiant Heating Systems</td>
<td></td>
</tr>
<tr>
<td>2. Radiant Hydronic Heating Systems</td>
<td></td>
</tr>
<tr>
<td>E. Direct-Fired Makeup Units</td>
<td></td>
</tr>
</tbody>
</table>
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 Craft Training Report Form 200, and submit the results to the Training Program Sponsor.
MODULE OVERVIEW
This module explains many of the skills needed to become an effective supervisor. Issues covered include those related to leadership, gender and culture, problem solving/decision making, and safety.

PREREQUISITES
Prior to training with this module, it is recommended that the trainee shall have successfully completed Core Curriculum; HVAC Level One; HVAC Level Two; HVAC Level Three; and HVAC Level Four, Modules 03401-09 through 03409-09.

OBJECTIVES
Upon completion of this module, the trainee will be able to do the following:
1. Describe the skills necessary to be a supervisor.
2. List the characteristics and behavior of effective leaders, as well as the different leadership styles.
3. Explain the difference between problem solving and decision making.
4. Describe ways to deal with common leadership problems, such as absenteeism and turnover.
5. Identify a supervisor’s safety responsibilities.
6. Describe the signals of substance abuse.
7. List the essential parts of an accident investigation.

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

MATERIALS AND EQUIPMENT LIST
Overhead projector and screen
Transparencies
Blank acetate sheets
Transparency pens
Whiteboard/chalkboard
Markers/chalk
Pencils and scratch paper
Module Examination*

*Located in the Test Booklet
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 Supervisory Skills*. 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>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Session I. Introduction to Supervision; Becoming a Leader</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Session II. Gender and Cultural Issues</strong></td>
<td></td>
</tr>
<tr>
<td>A. Communication Styles of Men and Women</td>
<td></td>
</tr>
<tr>
<td>B. Language Barriers</td>
<td></td>
</tr>
<tr>
<td>C. Cultural Differences</td>
<td></td>
</tr>
<tr>
<td>D. Sexual Harassment</td>
<td></td>
</tr>
<tr>
<td>E. Gender and Minority Discrimination</td>
<td></td>
</tr>
<tr>
<td><strong>Session III. Problem Solving and Decision Making</strong></td>
<td></td>
</tr>
<tr>
<td>A. Types of Decisions</td>
<td></td>
</tr>
<tr>
<td>B. Formal Problem-Solving Techniques</td>
<td></td>
</tr>
<tr>
<td>C. Dealing with Leadership Problems</td>
<td></td>
</tr>
<tr>
<td><strong>Session IV. Supervisors and Safety; Supervisor Involvement in Safety</strong></td>
<td></td>
</tr>
<tr>
<td>A. Supervisors and Safety</td>
<td></td>
</tr>
<tr>
<td>1. Safety Responsibilities, Programs, and Policies/Procedures</td>
<td></td>
</tr>
<tr>
<td>2. Hazard Identification and Safety Training</td>
<td></td>
</tr>
<tr>
<td>B. Supervisor Involvement in Safety</td>
<td></td>
</tr>
<tr>
<td>1. Safety Meetings and Inspections</td>
<td></td>
</tr>
<tr>
<td>2. Substance Abuse</td>
<td></td>
</tr>
<tr>
<td>3. Accident Investigation</td>
<td></td>
</tr>
<tr>
<td><strong>Session V. Review and Testing</strong></td>
<td></td>
</tr>
<tr>
<td>A. Module Review</td>
<td></td>
</tr>
<tr>
<td>B. Module Examination</td>
<td></td>
</tr>
<tr>
<td>1. Trainees must score 70% or higher to receive recognition from NCCER.</td>
<td></td>
</tr>
<tr>
<td>2. Record the testing results on Craft Training Report Form 200, and submit the results to the Training Program Sponsor.</td>
<td></td>
</tr>
</tbody>
</table>