Lesson Plans for Module 03201

COMMERCIAL AIRSIDE SYSTEMS

Module 03201 introduces the air distribution systems used in commercial structures such as schools and office buildings that are divided into comfort heating and cooling zones. The module covers the various types of systems, as well as the air terminals and air source equipment used in these systems. Accessories commonly used with commercial systems are also covered.

Objectives

Learning Objective 1
- Describe basic commercial airside systems and their operating characteristics.
  a. Describe the typical operating characteristics of a commercial airside system.
  b. Describe the purpose and function of ventilation and exhaust systems.

Learning Objective 2
- Describe various approaches used in commercial air distribution design.
  a. Describe single-zone constant volume system operation.
  b. Describe multi-zone constant volume system operation.
  c. Describe variable volume, variable temperature (VVT) system operation.
  d. Describe variable air volume (VAV) system operation.

Learning Objective 3
- Describe common air terminal operation and related air delivery devices.
  a. Explain the basic operation of VVT and single-duct VAV terminal devices.
  b. Explain the basic operation of fan-powered VAV terminals.
  c. Identify various styles of commercial grilles and registers.

Learning Objective 4
- Identify the characteristics and components of various airflow sources.
  a. Describe the various forms and components of packaged systems.
  b. Describe the various forms and components of air handling units.
  c. Describe the purpose and function of economizers.
  d. Describe common accessories used with commercial airside systems.

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

Recommended Teaching Time: 12.5 hours

The sections in this Lesson Plan (LP) correspond to the sections in the Trainee Guide module. While planning class times, review the objectives, content, and Lesson Plan outline for the sections you plan to teach. Allow sufficient time for demonstrations, laboratories, field trips, and testing, as well as administrative tasks and periodic breaks.

It is advisable to assign the reading of the module sections prior to the classroom instruction. Additional homework may be assigned to support the learning objectives.

Gather the required equipment, materials, visual aids, and answer keys. Using your access code, download the PowerPoint® presentations and Performance Sheets for this module from NCCER’s Instructor Resource Center at www.nccerirc.com. For information and updates about accessing the Module Examinations, visit www.ncce.org/testing. The passing score for submission into NCCER’s Registry is 70% or above for the Module Exam.

If there are Performance Tasks, performance testing may be administered at any suitable time. Performance Tasks are graded pass/fail. Complete the Performance Profile Sheet for each trainee and submit the results to your Training Program Sponsor through the Registry system.

Instructional Methods
Research has shown that varying instructional methods periodically throughout class sessions helps to engage and hold trainees’ attention. The PowerPoint® presentations that you received with this Lesson Plan is keyed to the sections of the Trainee Guide indicated below and has been designed for use with this Lesson Plan.
**Safety Considerations**

Safety must be emphasized at all times to ensure that trainees always wear the proper PPE, follow safe practices, and give due respect to unseen hazards.

**Classroom Equipment and Materials**

- Whiteboard/chalkboard
- Markers/chalk
- Pencils and paper
- PowerPoint® Presentations for Module 03201

**Equipment and Materials for Laboratories and Performance Testing**

- DVD player
- LCD projector and screen
- Computer
- Module Examinations

**Additional Resources**

This module presents thorough resources for task training. The following reference material is recommended for further study.

- *Central Station Air Handlers (TDP-611)*. Syracuse, NY: Carrier Corporation

There are a number of online resources available for trainees who would like more information on HVAC commercial air distribution systems and their applications. A search for additional information may be assigned as homework to interested trainees.

There may be suitable videos available online. However, instructors should view them in advance to ensure their suitability. Appropriate videos can provide teachable moments in both proper and improper work processes and behaviors. Be prepared to stop the videos at appropriate times to point out and discuss both proper and improper conduct and techniques.

Instructors are also encouraged to locate additional audiovisual aids available on the internet, make personal videos, and take photos related to the HVACR trade and add them to the PowerPoint® presentations throughout the program.
Overview

Before an air distribution system is manufactured, mechanical engineers make calculations, work through options, and often negotiate with other engineers in other specialties to produce the plans. Value engineering—comparing projected costs to the return on investment—is also a significant factor. Understanding principles of airflow will help craftworkers better appreciate the design process and recognize why systems are designed as they are.

This module explains how airflow is affected by duct size, shape, and material of construction. Features such as turning vanes that increase the efficiency of airflow in an elbow, minimize turbulence, and ensure the best possible airflow are explored. Trainees are provided with the necessary knowledge to fabricate and install systems from a performance perspective and learn why this is important to building owners and their occupants.

Learning Objective 1

Successful completion of this module prepares trainees to:

Explain how duct pressure relates to airflow and describe the air distribution system design process.

a. Identify and describe the pressures relevant to air distribution systems.
b. Describe the relationship between airflow and fan performance.
c. Describe the process of sizing duct using the equal friction method.
d. Identify factors related to diffuser selection.

Learning Objective 2

Successful completion of this module prepares trainees to:

State common design standards that apply to various duct fittings.

a. State common design standards that apply to transitions.
b. State common design standards that apply to offsets and ells.
Performance Tasks

This is a knowledge-based module; no Performance Tasks are required for module completion.
Recommended Teaching Time: 22.5 hours

Classroom Equipment and Materials

• Whiteboard and markers
• Pencils and paper
• PowerPoint® Presentations for Module 04303
• A variety of standard marker sizes
• Poster board
• Flip chart
• LCD projector and screen
• Computer with Internet access
• Module Review answer key
• Module Examinations
Overview

Construction drawings and documents govern the way a project is accomplished. Using these documents will not only guide the construction process and outline the required results, but it is also useful in the preparation of equipment schedules, material takeoffs, and craft scheduling. This module explains how to put knowledge of construction drawings and documents to work as a sheet metal fabricator or installer, emphasizing the ways in which they usually interact with the drawings.

Learning Objective 1

Successful completion of this module prepares trainees to:

Explain how to take measurements on scale drawings.

a. Explain how to use an architect’s scale.
b. Explain how to use an engineer’s scale and a metric scale.

Learning Objective 2

Successful completion of this module prepares trainees to:

Explain how to read and use various construction drawings and documents.

a. Explain the initial approach to viewing a set of drawings.
b. Describe shop drawings and their purpose.
c. Describe schedules and their purpose.
d. Describe the Request for Information (RFI) and how it is prepared.
e. Explain the importance of building codes to the design process.

Learning Objective 3

Successful completion of this module prepares trainees to:

Describe the takeoff process and how it is performed.
a. Identify and describe the tools and materials used in a takeoff process.
b. Explain how to conduct a takeoff.

**Performance Tasks**

1. Using an architect's scale, determine the actual dimensions of a given drawing component.
2. Perform an equipment and material takeoff and prepare the takeoff forms.

Recommended Teaching Time: 30 hours

**Classroom Equipment and Materials**

- Whiteboard and markers
- Pencils and paper
- PowerPoint® Presentations for Module 04308
- A variety of standard marker sizes
- Poster board
- Flip chart
- LCD projector and screen
- Computer with Internet access
- Module Review answer key
- Module Examinations

**Performance Task 1**

- Architect's scale
- Appropriate, instructor-provided drawings, at scale
- Performance Profile Sheets

**Performance Task 2**

- Instructor-provided drawings with materials and equipment specifications as needed
- Takeoff sheets as needed for the takeoff requested (duct, air distribution devices, etc.)
- Colored pencils
- Mechanical counters
- Drawing scales
- Calculators
- Magnifying glasses (if required for drawing)
• Performance Profile Sheets
Overview

Plans, specifications, and submittals are documents that describe in exact detail how a building is to be constructed and the required characteristics of the materials used. The specifications document outlines instructions and standards for how the work is to be performed, while submittals specify the equipment to be installed, and both must be followed closely. It is critical that the various trades on site coordinate their work with one another prior to the beginning of construction. It is also important to coordinate the order in which things are installed so that one trade’s work does not hinder access for another trade that will be working later in the same space. This module will cover how the specifications and submittal documents are applied when accomplishing work for a specific job.

Learning Objective 1

Successful completion of this module prepares trainees to:
Describe the use of specifications and submittals in construction projects.

a. Describe specifications and their purpose.
b. Describe submittals and their purpose.

Performance Tasks

1. Compare and analyze equipment specifications and several submittals to determine if one or more items meet the specifications.

Recommended Teaching Time: 20 hours

Classroom Equipment and Materials

- Whiteboard and markers
- Pencils and paper
- PowerPoint® Presentations for Module 04305
- A variety of standard marker sizes
- Poster board
• Flip chart
• LCD projector and screen
• Computer with Internet access
• Module Review answer key
• Module Examinations

**Performance Task 1**

• Equipment specifications, such as those for inline or rooftop exhaust fans, for a project

• A variety of submittal sheets for the chosen equipment, with some meeting the specifications and others that do not

• Performance Profile sheets
04402
Air Testing and Balancing
Sheet Metal

Overview
Even when a forced-air comfort system is properly installed and operating, the air must be properly distributed to the spaces. Therefore, after the system is installed and running, the air must be properly balanced. This process requires a deep understanding of airflow fundamentals and the ability to use specialized test instruments to measure air pressures, velocity, and volume.

Learning Objective 1
Successful completion of this module prepares trainees to:
Describe the air balancing process and identify the required tools and instruments.

a. Describe air balancing and define common terminology.
b. Identify the tools and instruments used in air balancing.
c. Describe the fan laws and explain how to make changes to the supply air volume.

Learning Objective 2
Successful completion of this module prepares trainees to:
Explain how to leak test and balance an air distribution system.

a. Describe how to conduct air leakage testing.
b. Describe the steps to take prior to beginning an air balancing task.
c. Explain how to measure and balance system and terminal airflow.

Performance Tasks
1. Measure airflow at grilles and diffusers.
2. Adjust dampers in branch supply ducts and at air terminals to balance airflow.

Recommended Teaching Time: 30 hours
Classroom Equipment and Materials

- Whiteboard and markers
- Pencils and paper
- PowerPoint® Presentations for Module 04402
- A variety of standard marker sizes
- Poster board
- Flip chart
- LCD projector and screen
- Computer with Internet access
- Module Review answer key
- Module Examinations

Performance Tasks 1 and 2

- Appropriate PPE
- Air velocity measuring instruments, as needed for the application
- Air-volume measuring instruments, as needed for the application
- Construction plans or schematic layout of the HVAC system (or section thereof) to be evaluated
- Performance Profile sheets
Module 19202 describes the fiberglass blanket insulation used for ductwork and provides instructions for applying fiberglass duct blanket.

### Objectives

**Learning Objective 1**
- Describe the use of fiberglass blanket to insulate air ducts.
  - a. Describe the design and construction of fiberglass blanket.
  - b. Describe the installation methods for fiberglass blanket on air ducts.

### Performance Tasks

**Performance Task 1 (Learning Objective 1)**
- Cut and install two pieces of fiberglass blanket insulation on ductwork using the staple stitch method and seal the butt laps with tape.

**Performance Task 2 (Learning Objective 1)**
- Seal butt laps on fiberglass blanket insulation using mastic.

**Performance Task 3 (Learning Objective 1)**
- Seal butt laps on fiberglass blanket insulation using adhesive.

**Performance Task 4 (Learning Objective 1)**
- Insulate a section of ductwork that includes a run-out.

### Recommended Teaching Time: 7.5 hours

This Lesson Plan (LP) is divided into sections that correspond to the sections in the Trainee Guide module. As you plan your class times, review the objectives, content, and lesson plan outline for the section you plan to teach. Allow sufficient class time for demonstrations, laboratories, field trips, and testing. Each class period should also include time for administrative tasks and periodic breaks.

Be sure to gather the required equipment, materials, visual aids, and answer keys. Using your access code, download the PowerPoint® presentations and Performance Sheets for this module from NCCER’s Instructor Resource Center at [www.nccerirc.com](http://www.nccerirc.com).

It is advisable to assign the reading of a module section prior to the classroom instruction. The Section Review and Module Review questions may be assigned as homework. At their discretion, instructors may assign additional homework to meet the teaching objectives.

Performance Testing may be administered at any suitable time in the course of the module training. Tasks are graded pass/fail. Trainee performance and proficiency during practice sessions that meets or exceeds the standards for a task can be accepted as Performance Task completion. Complete the Performance Profile Sheet for each trainee.

For information and updates about accessing the Module Examinations, visit [www.nccer.org/testing](http://www.nccer.org/testing). The passing score for submission into NCCER’s Registry is 70% or above for the Module Exam. Record the testing results for each trainee on the Registration of Training Modules form and submit the form to the Training Program Sponsor.
Safety Considerations

Safety must be emphasized at all times. Trainees should be carefully observed to ensure that they wear the proper PPE, follow safe practices, and give due respect to unseen hazards. Any deficiencies must be corrected to ensure future trainee safety. All practice sessions and Performance Tasks must be completed under your direct supervision.

When trainees are exposed to insulating materials, they must wear the proper protective clothing and respiratory equipment.

Caution must be exercised when handling and using tools such as staple guns and cutting tools.

Classroom Equipment and Materials

- Whiteboard
- Markers
- Pencils and paper
- LCD projector and screen
- DVD player or a computer with a DVD drive
- PowerPoint® presentation for Module 19202
- Computer with Internet access
- Examples of fiberglass blanket insulation (duct wrap) with different jacketing:
  - FSK
  - ASJ
  - Vinyl
- Duct tape
- Adhesive
- Mastic
- Module Review answer key
- Module Examinations

Laboratories and Performance Testing

Appropriate PPE to include the following:

- Safety glasses
- Work gloves
- Nuisance dust respiratory protection as designated by the instructor or training facility provider
- Proper footwear as designated by the instructor or training facility provider
- Hearing protection as designated by the instructor or training facility provider
- Hard hat as designated by the instructor or training facility provider
- Access to rectangular and round ducting (or mockups)

- Fiberglass blanket insulation (duct wrap)
- Approved duct tape
- Adhesive
- Mastic
- Staple gun (flared stapler)
- Staples
- Copies of Performance Profile Sheets

Additional Resources

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

- National Insulation Association (NIA) website offers resources for products and training. www.insulation.org.

There are a number of online resources available for trainees who would like more information on blanket insulation. A search for additional information may be assigned as homework to interested trainees.

Instructors should view any videos that may be identified in the lesson plan before using them to ensure their suitability. The videos can provide teachable moments in both proper and improper work processes and behaviors. Be prepared to stop the videos at appropriate times to point out and discuss both proper and improper conduct and techniques.

Instructors are encouraged to locate additional audiovisual aids available on the Internet, make personal videos, and take still pictures related to the subject matter and add them to the presentations throughout the program.
Module 19203 discusses the use of fiberglass board insulation for air distribution ducting. Trainees will learn about the characteristics of fiberglass board insulation and how to install it on ductwork using a variety of methods. Trainees will also be introduced to the attachment of weld pins.

### Objectives

**Learning Objective 1**
- Describe fiberglass board insulation and explain how it is installed on air ducts.
  - a. Describe the design and construction of fiberglass board insulation.
  - b. Explain how to install fiberglass board insulation on air ducts.

### Performance Tasks

- **Performance Task 1 (Learning Objective 1)**
  - Apply insulation weld pins to ductwork.
- **Performance Task 2 (Learning Objective 1)**
  - Apply fiberglass board insulation to straight duct and seal all joints with tape.
- **Performance Task 3 (Learning Objective 1)**
  - Kerf, lay out, and install board insulation for a rectangular branch duct.

### Recommended Teaching Time: 20 hours

This Lesson Plan (LP) is divided into sections that correspond to the sections in the Trainee Guide module. As you plan your class times, review the objectives, content, and lesson plan outline for the section you plan to teach. Allow sufficient class time for demonstrations, laboratories, field trips, and testing. Each class period should also include time for administrative tasks and periodic breaks.

Be sure to gather the required equipment, materials, visual aids, and answer keys. Using your access code, download the PowerPoint® presentations and Performance Sheets for this module from NCCER’s Instructor Resource Center at [www.nccerirc.com](http://www.nccerirc.com).

It is advisable to assign the reading of a module section prior to the classroom instruction. The Section Review and Module Review questions may be assigned as homework. At their discretion, instructors may assign additional homework to meet the teaching objectives.

Performance Testing may be administered at any suitable time in the course of the module training. Tasks are graded pass/fail. Trainee performance and proficiency during practice sessions that meets or exceeds the standards for a task can be accepted as Performance Task completion. Complete the Performance Profile Sheet for each trainee.

For information and updates about accessing the Module Examinations, visit [www.nccer.org/testing](http://www.nccer.org/testing). The passing score for submission into NCCER’s Registry is 70% or above for the Module Exam. Record the testing results for each trainee on the Registration of Training Modules form and submit the form to the Training Program Sponsor.
Appropriate PPE as designated by the instructor or training facility provider, including the following:
- Safety glasses with side shields
- Work gloves
- Long-sleeved shirt of heavy material
- Proper footwear
- Hearing protection
- Hard hat
- Face shield
- Adhesive insulation pins and clips
- Approved duct tape
- Construction T-squares

Elevated cutting surfaces
- Insulation adhesive and applicators
- Kerfing (V-groove) tools
- Markers (e.g., Sharpie™)
- Pin welding control unit and cables
- Pin welding guns with appropriate collets
- Rolls of pipe and tank fiberglass insulation
- Sharp utility knives
- Sheets of fiberglass board insulation
- Tape measures
- Weld pins and clips
- Performance Profile Sheets

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


The following websites offer resources for products and training:
- National Insulation Association (NIA). [www.insulation.org](http://www.insulation.org)
- Midwest Fasteners, Inc. (YouTube® Channel). [www.youtube.com](http://www.youtube.com)

There are many online resources available for trainees who would like more information on board insulation. A search for additional information may be assigned as homework to interested trainees.

Instructors should view any videos that may be identified in the Lesson Plan before using them to ensure their suitability. The videos can provide teachable moments in both proper and improper work processes and behaviors. Be prepared to stop the videos at appropriate times to point out and discuss both proper and improper conduct and techniques.

Instructors are encouraged to locate additional audiovisual aids available on the Internet, make personal videos, and take still pictures related to the subject matter and add them to the presentations throughout the program.