Trade Math Two

Annotated Instructor's Guide

Module 04201-08

MODULE OVERVIEW

This module reviews the formulas used to solve many construction specification problems. Trainees will learn the basic principles of applied math and will practice solving measurement, percentage, and proportion problems using mathematical formulas.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Sheet Metal Level One*.

OBJECTIVES

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

1. Apply mathematical formulas to solve problems.
2. Solve problems sequentially with simple equations.
3. Solve linear, circular, and angle measurement problems.
4. Solve percentage problems.
5. Define and solve ratio and proportion problems.
6. Use a protractor, a vernier caliper, and a micrometer.
7. Calculate selected seam allowances.
8. Demonstrate competence in solving selected field measuring problems.
9. Apply standard rules and practice for solving selected field measurement problems.

PERFORMANCE TASKS

This is a knowledge-based module—there is no performance testing.

MATERIALS AND EQUIPMENT LIST

Transparencies
Markers/chalk
Blank acetate sheets
Transparency pens
Overhead projector and screen
Whiteboard/chalkboard
Pencils and paper
Appropriate personal protective equipment
Copies of your local code
English ruler
Metric ruler
Sections of cut pipe
Calculator
Protractor
Sheets of unlined paper
Micrometers
Vernier calipers
Test pieces of fixed sizes to measure using micrometers and vernier calipers
Module Examinations*

*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. Ensure that they are briefed on shop 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.

Algebra and Trigonometry, Third Edition. 2008. Judith Beecher et al. Boston, MA: Addison-Wesley Longman, Inc.

Applied Construction Math: A Novel Approach. 2006. National Center for Construction Education and Research. Upper Saddle River, NJ: Prentice Hall.

Basic Math, Algebra, and Geometry with Applications. 2004. Cheryl Cleaves and Margie Hobbs. Upper Saddle River, NJ: Prentice Hall.

Math on Call: A Mathematics Handbook. 2004. Andrew Kaplan et al. Wilmington, MA: Great Source Education Group.

Math the Easy Way, 1988. Anthony Prindle. Hauppauge, NY: Barron's Educational Series.

Math to Build On, 1993. Johnny and Margaret Hamilton. Clinton, NC: Construction Trades Press.

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 20 hours are suggested to cover *Trade Math Two.* You will need to adjust the time required for hands-on activity and testing based on your class size and resources.

Topic	**Planned Time**
Session I. Formulas and Symbols	
A. Fractions Refresher	_____
B. Sequence of Operations	_____
C. Coefficients	_____
D. Solving Simple Equations	_____
Session II. Linear Measure	
A. Study Problems: Linear Conversions	_____
B. Study Problems: Circles and Arcs	_____
Session III. Angle Measure and Percentages	
A. Study Problems: Angle Measure	_____
B. Study Problems: Percentage of a Number	_____
C. Study Problems: Solving for Percent	_____
Session IV. Ratio and Proportion	
A. Study Problems: Ratio, Direct Proportion, and Indirect Proportion	_____
B. Mean Proportional	_____
C. Compound Ratios and Proportions	_____
D. Mixture Proportions	_____

Session V. Trigonometry; Protractors

A. Complementary Angles _____
B. Functions _____
C. The Protractor _____
D. Measuring Angles _____
E. Constructing Angles _____

Session VI. Seam Allowance, Part One

A. Single Hem _____
B. Double Hem _____
C. Lap Seam _____
D. Grooved Lock Seam _____
E. Riveted Lap Seam _____

Session VII. Seam Allowance, Part Two

A. Dovetailed Seam _____
B. Burred Bottom Seam _____
C. Set-In Bottom Seam _____
D. Body and Bottom Allowances _____
E. Pittsburgh Lock Seam _____
F. Bend Allowances _____

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.

Plans and Specifications
Annotated Instructor's Guide

Module 04202-08

MODULE OVERVIEW

This module provides an overview of the different types of plans and specifications. Trainees will learn how to tell one type of plan from another; to interpret project information using the lines and symbols in the drawings; and to read section, elevation, and detail drawings.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Sheet Metal Level One; Sheet Metal Level Two*, Module 04201-08.

OBJECTIVES

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

1. Read selected plans to interpret project information.
2. Read and interpret section, elevation, and detail drawings.
3. Read specifications for information about selected parts of a construction job.

PERFORMANCE TASKS

This is a knowledge-based module—there is no performance testing.

MATERIALS AND EQUIPMENT LIST

Transparencies

Markers/chalk

Overhead projector and screen

Whiteboard/chalkboard

Blank acetate sheets

Transparency pens

Pencils and paper

Appropriate personal protective equipment

Copies of your local code

Several sets of commercial blueprints

Sample schedule

Drawing plans provided with this module:
- Civil plans
- Architectural plans
- Mechanical plans
- Structural plans
- Plumbing plans
- Electrical plans

Sample shop drawing and the mechanical drawing on which it is based

Sample submittals

Sample as-built drawing and its original mechanical or shop drawing

Module Examinations*

* 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. Ensure that they are briefed on shop 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.

Sheet Metal Shop Drawings, 1971. Howard Bretz, New York, NY: Industrial Press Inc.

Blueprint Reading for Construction, Second Edition. 2004. James A.S. Fatzinger. Upper Saddle River, NJ: Prentice Hall.

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 20 hours are suggested to cover *Plans and Specifications.* You will need to adjust the time required for hands-on activity and testing based on your class size and resources.

Topic	**Planned Time**
Session I. Introduction to Plans and Specifications	
A. Introduction	_____
B. Working with Plans	_____
Session II. Plans, Part One	
A. Civil Plan	_____
B. Architectural Plan	_____
Session III. Plans, Part Two	
A. Mechanical Plan	_____
B. Structural Plan	_____
Session IV. Plans, Part Three	
A. Plumbing Plan	_____
B. Electrical Plan	_____
Session V. Specifications and Shop Drawings	
A. Specifications	_____
B. Shop Drawings	_____
Session VI. Submittals; As-Built Drawings; Introduction to Exercises	
A. Submittals	_____
B. As-Built Drawings	_____
C. Exercise 1: Title Page	_____
Session VII. Exercises, Part One	
A. Site Survey and Site Plan	_____
B. Architectural Plans	_____
C. Structural Plans	_____

Session VIII. Exercises, Part Two; Review and Testing

A. Mechanical Plans _____

B. Review _____

C. Module Examination _____

1. Trainees must score 70% of 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.

Fabrication Two – Radial Line Development
Annotated Instructor's Guide

Module 04203-08

MODULE OVERVIEW

This module discusses the principles of radial line development. Trainees will learn how to lay out and fabricate selected sheet metal fittings and perform related tasks.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Sheet Metal Level One; Sheet Metal Level Two*, Modules 04201-08 and 04202-08.

OBJECTIVES

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

1. Describe the principles of radial line development used to determine layouts for sheet metal fittings.
2. Use the principles of radial line development for the layout of selected sheet metal fittings.
3. Layout and fabricate selected sheet metal fittings.

PERFORMANCE TASKS

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

1. Lay out and fabricate 7 of these 12 fittings:
   - Rectangular weather cap*
   - Symmetrical tapered duct
   - Roof pitch stack flange*
   - Cone-shaped exhaust weather cap*
   - Roof peak gravity ventilator
   - Round duct intersecting a tape
   - Tapered offset duct
   - Two-way Y-branch
   - Off-center tapered duct
   - Square-to-square tapered duct
   - Shoe tee intersecting a taper on center
   - 90-degree tapered elbow

*Note: Trainees will use these fabricated fittings in Sheet Metal Level Three, *Advanced Architectural Sheet Metal.*

MATERIALS AND EQUIPMENT LIST

Transparencies

Markers/chalk

Blank acetate sheets

Transparency pens

Overhead projector and screen

Whiteboard/chalkboard

Pencils and paper

Appropriate personal protective equipment

Copies of your local code

Sample pictorial views, elevation, and plan views

Sample pattern drawings

Layout tools, including:
- Scratch awls
- Pencils and felt-tipped markers
- Straightedge
- Flat steel square and combination square
- Prick punch and center punch
- Dividers
- Trammel points
- Marking gauge
- French curves
- Circumference rule
- ¼-inch tape measure

(*continued*)

Appropriate gauge and sufficient quantity of sheet metal

Several fittings that include dimension errors

Sheet metal brake

Sheet metal shear

Whitney hand (lever) punch

Beading, crimping, turning, slip-roll forming, and burring machines

Ring and circle shears

Bar folder

Gas welding equipment

Arc welder

Bench plate and stakes

Electric spot welder

Hand seamer

C-clamps and parallel clamps

Sheet metal hammer and mallet

Sheet metal snips

Chisel

Rivet set and hand groover

Drill bits and drill

Files

Hacksaw

Screwdrivers, wrenches, and pliers

Module Examinations*

Performance Profile Sheets*

*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 requires trainees to work with hand and power tools. Ensure that they are briefed on shop 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.

Today's 40 Most Frequently Used Fittings. Richard S. Budzig. Chicago, IL: Practical Publications.

Ultimate Sheet Metal Fabrication. Tim Remus. Stillwater, MN: Wolfgang Publications.

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 55 hours are suggested to cover *Fabrication Two – Radial Line Development.* You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	**Planned Time**
Session I. Introduction to Radial Line Development	
A. Introduction	_____
B. Radial Line Development Principles	_____
Session II. Radial Line Development Safety	
A. General Safety Rules	_____
Session III. Radial Line Development Tasks	
A. Overview of Tasks	_____
B. Layout Tools	_____
C. Fabrication Equipment	_____

Session IV. Task 1: Rectangular Weather Cap

A. Rectangular Weather Cap Layout and Fabrication _____

B. Laboratory _____

Trainees practice laying out and fabricating a rectangular weather cap. This laboratory corresponds to Performance Task 1.

Session V. Task 2: Symmetrical Tapered Duct

A. Symmetrical Tapered Duct Layout and Fabrication _____

B. Laboratory _____

Trainees practice laying out and fabricating a symmetrical tapered duct. This laboratory corresponds to Performance Task 1.

Session VI. Task 3: Roof Pitch Stack Flange, Part One

A. Elevation or Side View _____

B. Half Plan View _____

C. Pattern Stretchout _____

Session VII. Task 3: Roof Pitch Stack Flange, Part Two

A. Flange and Collar Layout _____

B. Laboratory _____

Trainees practice laying out and fabricating a roof pitch stack flange. This laboratory corresponds to Performance Task 1.

Session VIII. Task 4: Exhaust Weather Cap, Part One

A. Constructing the Drawings _____

B. Layout Overview _____

Session IX. Task 4: Exhaust Weather Cap, Part Two

A. Exhaust Weather Cap Layout and Fabrication _____

B. Laboratory _____

Trainees practice laying out and fabricating an exhaust weather cap. This laboratory corresponds to Performance Task 1.

Session X. Task 5: Roof Peak Gravity Ventilator, Part One

A. Elevation and Plan Views _____

B. One-half Taper Stack Stretchout _____

Session XI. Task 5: Roof Peak Gravity Ventilator, Part Two

A. Roof Peak Gravity Layout and Fabrication _____

B. Laboratory _____

Trainees practice laying out and fabricating a roof peak gravity ventilator. This laboratory corresponds to Performance Task 1.

Session XII. Task 6: Pipe Intersecting a Taper, Part One

A. Working View _____

B. Half End View _____

Session XIII. Task 6: Pipe Intersecting a Taper, Part Two

A. Pipe Intersecting a Taper Layout and Fabrication _____

B. Laboratory _____

Trainees practice laying out and fabricating a pipe intersecting a taper. This laboratory corresponds to Performance Task 1.

Session XIV. Task 7: Tapered Offset Duct

A. Tapered Offset Duct Layout and Fabrication _____

B. Laboratory _____

Trainees practice laying out and fabricating a tapered offset duct. This laboratory corresponds to Performance Task 1.

Session XV. Task 8: Two-Way Y-Branch

A. Two-Way Y-Branch Layout and Fabrication _____

B. Laboratory _____

Trainees practice laying out and fabricating a two-way Y-branch. This laboratory corresponds to Performance Task 1.

Session XVI. Task 9: Off-Center Tapered Duct

A. Off-Center Tapered Duct Layout and Fabrication _____

B. Laboratory _____

Trainees practice laying out and fabricating a off-center tapered duct. This laboratory corresponds to Performance Task 1.

Session XVII. Task 10: Square-to-Square Tapered Duct

A. Square-to-Square Tapered Duct Layout and Fabrication _____

B. Laboratory _____

Trainees practice laying out and fabricating a square-to-square tapered duct. This laboratory corresponds to Performance Task 1.

Session XVIII. Task 11: Shoe Tee Intersecting a Taper on Center, Part One

A. Elevation View _____

B. Working Drawing _____

Session XIX. Task 11: Shoe Tee Intersecting a Taper on Center, Part Two

A. Shoe Tee Intersecting a Taper on Center Layout and Fabrication _____

B. Laboratory _____

Trainees practice laying out and fabricating a shoe tee intersecting a taper on center. This laboratory corresponds to Performance Task 1.

Session XX. Task 12: 90-Degree Tapered Elbow, Part One

A. Elevation View _____

B. Working Drawing _____

Session XXI. Task 12: 90-Degree Tapered Elbow, Part Two

A. 90-Degree Tapered Elbow Layout and Fabrication _____

B. Laboratory _____

Trainees practice laying out and fabricating a 90-degree tapered elbow. This laboratory corresponds to Performance Task 1.

Session XXII. 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 the 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.

Sheet Metal Duct Fabrication Standards
Annotated Instructor's Guide

Module 04204-08

MODULE OVERVIEW

This module discusses the effect of operating pressure on the design of a duct system, as well as the standards, codes, and ordinances that govern sheet metal duct fabrication. Trainees will learn how to use reference charts and tables to determine requirements for working on sheet metal duct.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Sheet Metal Level One; Sheet Metal Level Two*, Modules 04201-08 through 04203-08.

OBJECTIVES

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

1. Explain the effect of operating pressure on the design of a duct system.
2. Locate standards for selected topics, fittings, or components.
3. Define the difference between standards and codes or ordinances.
4. Determine sealing requirements for a selected ductrun by using reference charts and tables.
5. Determine minimum gauge requirements for a selected ductrun by using reference charts and tables.
6. Determine minimum connector and reinforcing requirements for selected ductruns by using reference charts and tables.
7. Describe the purpose of a tie rod and determine when a tie rod is optional or mandatory by using reference charts and tables.
8. Identify the different types of acceptable longitudinal seams, including applications and any limitations.

PERFORMANCE TASKS

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

1. Using the example of shop standards located in the module, locate various standards for rectangular ducts in various instructor-specified pressure classes.
2. Using the example of shop standards located in the module, use tables, figures, and notes to determine correct hanger sizes and spacings to solve a duct hanger problem supplied by your instructor.

MATERIALS AND EQUIPMENT LIST

Transparencies

Markers/chalk

Blank acetate sheets

Transparency pens

Overhead projector and screen

Whiteboard/chalkboard

Pencils and paper

Appropriate personal protective equipment

Copies of, or samples from, several organizations' standards

Copies of your local code

Copies of or samples from SMACNA's *HVAC Duct Construction Standards—Metal and Flexible*, third edition, 2005, or similar standards publication from NAIMA or another association.

A variety of standard transverse connectors and proprietary connectors

A variety of longitudinal seams

Module Examinations*

Performance Profile Sheets*

*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. Ensure that they are briefed on shop 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.

HVAC Duct Construction Standards—Metal and Flexible, Third Edition, 2005. Chantilly, VA: Sheet Metal and Air Conditioning Contractors National Association, Inc.

International Building Code, 2000. Falls Church, VA: International Code Council.

International Mechanical Code, 2000. Falls Church, VA: International Code Council.

Uniform Building Code, 1997. Whittier, CA: International Conference of Building Officials.

Uniform Mechanical Code, 2000. Walnut, CA: International Association of Plumbing and Mechanical Officials.

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

Topic	**Planned Time**
Session I. Duct Fabrication Codes and Standards	
A. Building Codes	_____
B. Industry Standards	_____
C. SMACNA Standards	_____
Session II. Ductwork Performance, Part One	
A. Operating Pressure	_____
B. Air Leakage	_____
C. Laboratory	_____
Trainees practice locating standards for rectangular duct. This laboratory corresponds to Performance Task 1.	
D. Duct Gauge	_____
E. Spacing and Rigidity for Connectors	_____
Session III. Ductwork Performance, Part Two; Review and Testing	
A. Standard Transverse Connectors	_____
B. Longitudinal Seams	_____
C. Shop Standards	_____
D. Laboratory	_____
Trainees practice using shop standards to determine correct hanger sizes and spacing. This laboratory corresponds to Performance Task 2.	

E. Review _____

F. 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.

G. 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.

Air Properties and Distribution
Annotated Instructor's Guide

Module 04205-08

MODULE OVERVIEW

This module explains how the gas laws are used when making calculations about air properties and how the properties of air relate to each other. Trainees will learn how to use instruments that measure temperature and humidity, air pressure, and air velocity in air distribution systems, and how to make basic measurements in these systems.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Sheet Metal Level One; Sheet Metal Level Two*, Modules 04201-08 through 04204-08.

OBJECTIVES

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

1. Explain the gas laws (Dalton's, Boyle's, and Charles's) used when dealing with air and its properties and explain how the properties of air relate to one another.
2. Use a psychrometric chart to evaluate air properties and changes in air properties.
3. Explain the differences between propeller and centrifugal fans and blowers.
4. Recognize the instruments used to make measurements in air systems and explain the use of each instrument.
5. Make basic temperature, air pressure, and velocity measurements in an air distribution system.
6. Explain the three fan laws.

PERFORMANCE TASKS

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

1. Perform two of the following tasks:
   - Use a manometer to measure ESP (external static pressure).
   - Use a sling psychrometer to calculate relative humidity.
   - Use a flow hood to measure air volume out of a grille or diffuser.

MATERIALS AND EQUIPMENT LIST

Transparencies
Markers/chalk
Blank acetate sheets
Transparency pens
Overhead projector and screen
Whiteboard/chalkboard
Pencils and paper
Appropriate personal protective equipment
Copies of your local code
Calculators
Dry- and wet-bulb thermometers
Sample psychrometric charts
Samples of manufacturers' fan curve charts
Digital and analog electronic thermometers
Sling, squeeze-bulb, and battery-operated psychrometers
Different types of manometers
Copies of the Practice Problems*
Module Examinations**
Performance Profile Sheets**

* Located at 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. Ensure that they are briefed on shop 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.

Air Conditioning: Home and Commercial, Fourth edition. 1986. Edwin P. Anderson. New York, NY: Macmillan Publishing Company.

Air Conditioning Principles and Systems, Third edition. 1998. Edward G. Pita. Upper Saddle River, NJ: Prentice-Hall.

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 15 hours are suggested to cover *Air Properties and Distribution.* You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	**Planned Time**
Session I. Introduction; Air Pressure; Gas Laws	
A. Introduction	_____
B. Air Pressure Scales and Gauges	_____
C. Pressure, Temperature, and Volume Relationships	_____
1. Gas Laws	_____
Session II. Psychrometry; The Psychrometric Chart	
A. Dry Air	_____
B. Humidity and Relative Humidity	_____
C. Dew Point	_____
D. Enthalpy	_____
E. Scales on the Psychrometric Chart	_____
F. Using the Psychrometric Chart	_____
Session III. The Air Distribution System	
A. Airflow in Ductwork	_____
B. Air Velocity and Volume in Ductwork	_____
C. Pressures in Ductwork	_____
D. Air Distribution in a Cooling System	_____
Session IV. Blowers, Fans, and Fan Laws	
A. Belt-Drive and Direct-Drive Blowers	_____
B. Centrifugal Blowers	_____
C. Propeller Fans	_____
D. Duct Fans	_____
E. Fan Laws	_____

Session V. Measurement Instruments

A. Temperature and Humidity _____

B. Laboratory _____

Trainees practice using a sling psychrometer. This laboratory corresponds to Performance Task 1.

C. Air Pressure _____

D. Laboratory _____

Trainees practice using a manometer. This laboratory corresponds to Performance Task 1.

E. Air Velocity _____

F. Laboratory _____

Trainees practice using a flow hood. This laboratory corresponds to Performance Task 1.

Session VI. Review and Testing

A. Review _____

B. Module Examination _____

1. Trainees must score 70% of 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.

Bend Allowances
Annotated Instructor's Guide

Module 04206-08

MODULE OVERVIEW

This module discusses the factors that influence bend allowances. Trainees will learn how to perform the calculations necessary to determine proper bend allowances and how to lay out and fabricate bend allowances according to those calculations.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Sheet Metal Level One; Sheet Metal Level Two*, Modules 04201-08 through 04205-08.

OBJECTIVES

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

1. Describe the factors that influence bend allowances on sheet metal blanks.
2. Perform the calculations necessary for determining proper bend allowances on selected sheet metal problems.
3. Apply bend allowance calculations to lay out and fabricate a mating hat channel.
4. Determine bend allowances on selected sheet metal problems.

PERFORMANCE TASKS

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

1. Perform bend allowance calculations with the use of tables and charts:
   - Empirical formula
   - Geometrical formula
   - Approximate method
2. Lay out and fabricate a mating hat channel.

MATERIALS AND EQUIPMENT LIST

Transparencies
Markers/chalk
Blank acetate sheets
Transparency pens
Overhead projector and screen
Whiteboard/chalkboard
Pencils and paper
Appropriate personal protective equipment
Copies of your local code
Bent sheet metal that shows tensile stress, compression stress, and a neutral axis
Metal coat hanger
Calculator
Scriber
Straightedge
Combination square
Felt-tipped marker
Hand punch and prick punch
Sheet metal hammer
Mallet
Screwdriver and pliers
Drill and drill bits
Reamer
¼-inch tape measure
Circumference rule
Sheet metal gauge
Sheet metal snips
Shearing, bending, and forming machines
Module Examinations*
Performance Profile Sheets*

*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 requires trainees to work with hand and power tools. Ensure that they are briefed on shop 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.

Machinery's Handbook, 25th Edition, 1996. New York, NY: Industrial Press, Inc., pp 1246-1251.

Press Brake Technology: A Guide to Precision Sheet Metal Bending, 1997. Steve D. Benson. Dearborn, MI: Society of Manufacturing Engineers.

www.solidworks.com

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 5 hours are suggested to cover *Bend Allowances.* You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic **Planned Time**

Session I. Bend Shapes; Bend Allowances; Stretchout; Linear Measure, Part One

A. Introduction _____
B. Bend Shapes _____
C. Approximate Bend Allowance _____
D. Precision Bend Allowance _____
E. Stretchout Development _____
F. Reference Lines _____
G. Task 1: Calculating Bend Allowances _____
H. Laboratory _____

Trainees practice calculating bend allowances. This laboratory corresponds to Performance Task 1.

Session II. Linear Measure, Part Two; Review and Testing

A. Task 2: Mating Hat Channel _____
B. Laboratory _____

Trainees practice laying out and fabricating a mating hat channel. This laboratory corresponds to Performance Task 2.

C. Review _____
D. Module Examination _____
   1. Trainees must score 70% of 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.
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 introduces the tools and materials used in soldering. Trainees will learn how to safely and properly use soldering tools and materials in a variety of tasks.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Sheet Metal Level One; Sheet Metal Level Two*, Modules 04201-08 through 04206-08.

OBJECTIVES

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

1. Identify soldering tools and materials.
2. Safely and properly use soldering tools and materials in selected tasks.

PERFORMANCE TASKS

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

1. Clean and shape a soldering iron.
2. Tin a soldering iron.
3. Tack solder to hold two pieces in a selected position.
4. Solder a lap seam in the flat position.
5. Pre-tin a seam.
6. Sweat and solder a grooved locked seam.
7. Solder a bottom seam on a round container.

MATERIALS AND EQUIPMENT LIST

Transparencies

Markers/chalk

Blank acetate sheets

Transparency pens

Overhead projector and screen

Whiteboard/chalkboard

Pencils and paper

Appropriate personal protective equipment

Copies of your local code

A variety of solders, including:
- Bar solder
- Pig solder
- Cake solder
- Paste solder
- Foil, sheet, or ribbon solder
- Segment or drop solder
- Solid or cored wire solder
- Wire or bar 50/50 tin-lead solder

Material safety data sheets (MSDS) for solder and flux

A variety of soldering irons, including:
- Light-duty iron
- Medium-duty iron
- Heavy-duty iron
- Temperature-controlled iron
- Transformer pencil iron
- Soldering gun

Soldering iron tips, including:
- Copper
- Iron-plated with a coated shank
- Iron-plated with a stainless steel shank
- Calorized

Supplies to clean metal surfaces, including:
- Acid swab or brush
- Approved cleaning solvents
- Hydrochloric acid and sulfuric acid
- Abrasive cleaning materials
- Soap, water, clean cloths

Materials for surface preparation, including:
- Course-cut flat file and fine file
- File, metal scraper, or stainless steel wire brush
- Emery cloth or sandpaper
- Sal ammoniac block

(*continued*)

Materials to apply flux to a joint, including:
- Soldering flux
- Stainless steel flux
- Metal joint
- Fiber brush or swab

Samples of joints, including:
- T
- Lap
- Flush lap
- Flat lock seam
- Grooved lock seam

Soldering furnace

14-ounce ball peen or setting hammer

Number-three hand groover

Rivet set and six 1¼-inch pop rivets

Sheet metal hammer

Drill with ⅛-inch drill bit

Center punch

Metal scribe

Combination square

Vise

Anvil

Hand seamer

Transite, wood, or other insulated-backing sheet material

Nails or clamps

Sheet metal to be formed and soldered, including:
- Six pieces of 2" × 6" galvanized iron, 24-gauge
- Two pieces of 2½" × 6" galvanized iron, 24-gauge
- Two pieces of 2⅜" × 6" galvanized iron, 24-gauge or lighter
- Two pieces of 2" × 6" aluminum sheet, .025-inch thick

Round container, soldered with solder beads

Metal for soldering a 8" × 8" × 8" pan (galvanized iron, galvanized steel, aluminum, stainless steel)

Metal for soldering a drain (galvanized iron, galvanized steel, aluminum, stainless steel)

Drains

Module Examinations*

Performance Profile Sheets*

*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 requires trainees to work with hand and power tools, as well as acids and other potentially hazardous materials. Ensure that they are briefed on shop 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.

Principles of Soldering and Brazing, 1992. Giles Humpston et al. Materials Park, OH: ASTM International. ASTM International, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania, USA.

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

Topic	**Planned Time**
Session I. Introduction; Types of Solder; Flux	
A. Introduction	_____
B. Types of Solder	_____
C. Flux	_____
Session II. Soldering Irons; Soldering Process	
A. Soldering Irons	_____
B. The Soldering Process	_____
C. Laboratory	_____
Trainees practice sheet metal cleaning methods.	
Session III. Joint Design; Safety	
A. Joint Design	_____
B. Safety	_____
Session IV. Practice Tasks, Part One	
A. Task 1: Preparing a Soldering Iron	_____
B. Laboratory	_____
Trainees practice cleaning, shaping, and tinning a soldering iron. This laboratory corresponds to Performance Tasks 1 and 2.	
C. Task 2: Flat Lap Seam	_____
D. Laboratory	_____
Trainees practice tack soldering a horizontal lap seam. This laboratory corresponds to Performance Tasks 3 and 4.	
E. Task 3: Vertical Lap Seam	_____
F. Laboratory	_____
Trainees practice pre-tinning a seam. This laboratory corresponds to Performance Task 5.	
Session V. Practice Tasks, Part Two	
A. Task 4: Grooved Lock Seam	_____
B. Laboratory	_____
Trainees practice sweating and soldering a grooved lock seam. This laboratory corresponds to Performance Task 6.	
C. Task 5: Riveted Seam	_____
D. Laboratory	_____
Trainees practice soldering a riveted seam.	
E. Task 6: Soldering a Bottom Seam	_____
F. Laboratory	_____
Trainees practice soldering a bottom seam on a round container. This laboratory corresponds to Performance Task 7.	

Session VI. Practice Tasks, Part Three; Review and Testing

A. Task 7: Soldering Aluminum _____

B. Laboratory _____

Trainees practice soldering aluminum.

C. Task 8: Soldering Stainless Steel _____

D. Laboratory _____

Trainees practice soldering stainless steel.

E. Review _____

F. Module Examination _____

1. Trainees must score 70% of 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.

G. 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.

Basic Piping Practices
Annotated Instructor's Guide

Module 04208-08

MODULE OVERVIEW

This module introduces basic piping practices, including methods for measuring, cutting, and joining selected pipe. Trainees will learn about pipe materials and their applications, as well as about the common types of fittings.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Sheet Metal Level One; Sheet Metal Level Two*, Modules 04201-08 through 04207-08.

OBJECTIVES

Upon completion of this module, the trainees will be able to:

1. Measure, cut, and join selected types of pipe.
2. Describe the materials from which pipe is made.
3. List some of the applications for selected pipe materials.
4. Describe the common types of pipe fittings, hangers, and supports.

PERFORMANCE TASKS

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

1. Make a solvent-welded PVC joint.
2. Cut and thread a ½-inch-diameter by 8-inch-long pipe nipple within ⅛-inch tolerance.

MATERIALS AND EQUIPMENT LIST

Transparencies
Markers/chalk
Blank acetate sheets
Transparency pens
Overhead projector and screen
Whiteboard/chalkboard
Pencils and paper
Appropriate personal protective equipment
Copies of your local code
Several sections of pipe, including:
  Threaded metal pipe
    – threaded pipe with fitting on one end
    – threaded pipe with fittings on both ends
  Sections of cut metal pipe with burrs
  Sections of metal pipe for tube cutting
  Unthreaded metal and plastic pipe
Tools for measuring sections of pipe
Tube cutter
Pipe reamers
Hacksaw and miter box
Pipe dies and stock
Pipe-threading machines
Oil and rags
Joint compound
Teflon® tape
Manufacturer's instructions for solvent cements
Materials to join grooved pipe, including:
  Manufacturer's instructions
  Lubricant
  Grooved pipe
  Gasket
  Necessary tools to tighten the nuts
Sample pipe fittings, including:
  Tees
  Elbows
  Unions
  Couplings
  Nipples
  Crosses
  Plugs and caps
  Bushings
Module Examinations*
Performance Profile Sheets*

*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 requires trainees to work with hand and power tools, as well as with solvents and welding processes. Ensure that they are briefed on shop 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.

Pocket Guide to Flanges, Fittings, and Piping Data, 1999. R.R. Lee. Houston, TX: Professional Publishing Company.

Practical Shielded Metal-Arc Welding, 1997. Mike Gellerman. Upper Saddle River, NJ: Prentice Hall.

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 7½ hours are suggested to cover *Basic Piping Practices.* You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	**Planned Time**
Session I. Pipe Measuring, Cutting, Threading; Safety	
A. Measuring Pipe	_____
B. Laboratory Trainees practice measuring pipe.	_____
C. Cutting and Reaming Pipe	_____
D. Laboratory Trainees practice cutting and reaming pipe.	_____
E. Threading Pipe	_____
F. Laboratory Trainees practice cutting and threading pipe. This laboratory corresponds to Performance Task 2.	_____
G. Pipe Joining Safety	_____
Session II. Pipe Joining Methods; Pipe Materials; Fittings	
A. Pipe Joining Methods	_____
B. Laboratory Trainees practice making solvent-welded joints. This laboratory corresponds to Performance Task 1.	_____
C. Pipe Materials	_____
D. Pipe Fittings	_____

Session III. Pipe Hangers and Supports; Review and Testing

A. Pipe Hangers and Supports _____

B. Review _____

C. Module Examination _____

1. Trainees must score 70% of 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.

D. 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.

Fiberglass Duct
Annotated Instructor's Guide

Module 04209-08

MODULE OVERVIEW

This module reviews the types of fiberglass duct and describes layout, fabrication, and closure methods for fiberglass duct. Trainees will learn how to fabricate, hang, support, and repair fiberglass duct modules and fittings.

PREREQUISITES

Please refer to the Course Map in the Trainee Module. Prior to training with this module, it is recommended that the trainee shall have successfully completed the following: *Core Curriculum; Sheet Metal Level One; Sheet Metal Level Two*, Modules 04201-08 through 04208-08.

OBJECTIVES

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

1. Identify types of fiberglass duct.
2. Demonstrate fiberglass duct layout and fabrication methods.
3. Demonstrate the various closure methods for sealing fiberglass duct.
4. Fabricate selected duct modules and fittings using the appropriate tools.
5. Demonstrate hanging and support methods for fiberglass duct.
6. Repair major and minor damage to fiberglass duct.

PERFORMANCE TASKS

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

1. Lay out fiberglass duct.
2. Fabricate fiberglass duct using at least two of the following methods:
   - Centerline method
   - Guide edge method
   - Machine fabrication
3. Seal fiberglass duct using at least two of the following methods:
   - Pressure-sensitive tape
   - Heat-activated tape
   - Mastic and glass fabric tape
4. Fabricate selected duct modules and fittings using the appropriate tools.
5. Hang and support fiberglass ducts.
6. Repair major and minor damage to fiberglass duct.

MATERIALS AND EQUIPMENT LIST

Transparencies
Markers/chalk
Whiteboard/chalkboard
Overhead projector and screen
Blank acetate sheets
Transparency pens
Pencils and paper
Appropriate personal protective equipment
Copies of your local code
Calculators
Television/VCR
NAIMA's free video, *Play it Smart, Play it Safe*

Sections of fiberglass duct, including:
  Rigid duct board
  Rigid round duct
  Flexible round duct
  Damaged duct
Flexible duct board
Pieces of duct board that show the standard tooling and reverse tooling setup
Insulation knife
Peeler knife
Round hole cutter

(continued)

Duct layout squares and transition tools
Heat sealing irons
Grooving tools (hand or machine)
Oil-free, lint-free cloth
Vane hole cutter
Rule
Measuring tape
Straightedge
Squaring tool
Staple gun and outward clinching staples
Pressure-sensitive tape, heat-activated tape, mastic, and glass fabric tape
Plastic tape rubbing tool
Male and female hand shiplap tools
Fine tooth saw
Miter box
Sheet metal sleeves and elbows
Metal reducers
Sheet metal collars (spin-in and dovetail)
Foam insulating sealant
Closure straps
FasLoop™ bending tools
14" horseshoe nippers or carpenter's pincers
Wire cutters
12-gauge galvanized steel wire
Galvanized steel washers
– 2½-inch-square by .028-inch-thick
– 2½-inch-square by .020-inch-thick
Turning vanes, including rail-mounted vanes
Module Examinations*
Performance Profile Sheets*

*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 requires trainees to work with hand and power tools. Ensure that they are briefed on shop 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. This is optional material for continued education rather than for task training.

Energy Efficient Design of New Low-Rise Residential Buildings, 1992. In *National Voluntary Consensus Standard.* ANSI/ASHRAE.

Environmental Protection Agency Web site, www.epa.gov, *Biocontaminant Control,* www.epa.gov/appcdwww/iembo/biocontam.htm, reviewed March 2008.

Environmental Protection Agency Web site, www.epa.gov, "Should You Have the Air Ducts in Your Home Cleaned" Indoor Environments Division, EPA-402-K-97-002, October 1997, www.epa.gov/iaq/pubs/airduct.html, reviewed March 2008.

Fibrous Glass Duct Construction Standard, Fourth edition, 2001. Alexandria, VA: North American Insulation Manufacturers Association.

Fibrous Glass Duct Construction Standard, Third edition, 1993. Alexandria, VA: North American Insulation Manufacturers Association.

Fibrous Glass Residential Duct Construction Standard, Third Edition, 2002. Alexandria, VA: North American Insulation Manufacturers Association. Available at: www.naima.org/pages/resources/library/pdf/AH119.PDF.

NFPA 90A: Standard for the Installation of Air Conditioning and Ventilating Systems, 2002. Quincy, MA: National Fire Protection Association.

Standard for Closure Systems for Use with Rigid Air Ducts and Air Connectors, UL 181A, Third Edition, 2005. Northbrook, IL: Underwriters Laboratories, Inc.

Standard for Closure Systems for Use with Flexible Air Ducts and Air Connectors, UL 181B, Second Edition, 2005. Northbrook, IL: Underwriters Laboratories, Inc.

Standard for the Installation of Air Conditioning and Ventilating Systems, 1999. Quincy, MA: National Fire Protection Association.

Working With Fiber Glass, Rock Wool, and Slag Wool Products, 2001. Alexandria, VA: North American Insulation Manufacturers Association.

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 20 hours are suggested to cover *Fiberglass Duct.* You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories often correspond to Performance Tasks, the proficiency of the trainees may be noted during these exercises for Performance Testing purposes.

Topic	**Planned Time**
Session I Introduction; Fiberglass Duct; Extended Plenum Supply System	
A. Introduction	_____
B. Fiberglass Duct	_____
C. Extended Plenum Supply System	_____
Session II. Cutting and Forming Duct Board	
A. Hand Grooving Tools	_____
B. Machine Grooving Tools	_____
C. Other Tools	_____
D. Centerline Fabrication Method	_____
E. Laboratory	_____
Trainees practice laying out fiberglass duct and using the centerline hand fabrication method. This laboratory corresponds to Performance Tasks 1 and 2.	
F. Guide Edge Fabrication Method	_____
F. Laboratory	_____
Trainees practice using the guide edge hand fabrication method. This laboratory corresponds to Performance Task 2.	
G. Machine Fabrication	_____
H. Laboratory	_____
Trainees practice using the machine fabrication method. This laboratory corresponds to Performance Task 2.	
Session III. Closure Systems; Fabrication and Joining; Ten-Sided Duct	
A. Joints with and without Staple Flaps	_____
B. Applying Pressure-Sensitive Tape	_____
C. Laboratory	_____
Trainees practice applying pressure-sensitive tape. This laboratory corresponds to Performance Task 3.	
D. Applying Heat-Activated Tape	_____
E. Laboratory	_____
Trainees practice applying heat-activated tape. This laboratory corresponds to Performance Task 3.	
F. Applying Mastic and Glass Fabric Tape	_____
G. Laboratory	_____
Trainees practice applying mastic and glass fabric tape. This laboratory corresponds to Performance Task 3.	
H. Fabricating and Joining a Duct Module	_____
I. Laboratory	_____
Trainees practice fabricating a duct module. This laboratory corresponds to Performance Task 4.	
J. Ten-Sided Duct	_____

Session IV. Connecting Duct Board to Sheet Metal; Fabrication, Part One

A. Connecting Duct Board to Sheet Metal _____
B. Elbows, Offsets, and Turning Vanes Fabrication _____
C. Tees, Transitions, and Tap-Ins Fabrication _____
D. Laboratory _____

Trainees practice fabricating fittings. This laboratory corresponds to Performance Task 4.

E. End Caps _____
F. Laboratory _____

Trainees practice fabricating end caps. This laboratory corresponds to Performance Task 4.

Session V. Fabrication, Part Two; Flexible Connections; Hangers and Supports

A. Dampers _____
B. Sleeved Accessory Mounting _____
C. Registers or Grilles _____
D. Flexible Round Duct Connections _____
E. Hangers and Supports _____
F. Laboratory _____

Trainees practice hanging and supporting fiberglass duct. This laboratory corresponds to Performance Task 5.

Session VI. Reinforcement, Part One

A. Tie Rod Reinforcement _____
B. Channel Reinforcement _____
C. Reinforcing Fittings: 90-Degree Elbows _____
D. Reinforcing Fittings: Branch Connections _____
E. Reinforcing Fittings: Tees _____
F. Reinforcing Fittings: Offsets _____

Session VII. Reinforcement, Part Two; Repairing Damage

A. Reinforcing Fittings: Transitions _____
B. Reinforcing Access Doors _____
C. Reinforcing End Caps _____
D. Repairing Minor Damage _____
E. Laboratory _____

Trainees practice repairing minor damage to facing material. This laboratory corresponds to Performance Task 6.

F. Repairing Major Damage _____
G. Laboratory _____

Trainees practice repairing major damage to fiberglass duct. This laboratory corresponds to Performance Task 6.

Session VII. Review and Testing

A. Review _____
B. Module Examination _____
   1. Trainees must score 70% of 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.