MODULE OVERVIEW

This module introduces trainees to math concepts they will use on the job, including weights and measures, area and volume, temperature, pressure, and force. The module also reviews the six simple machines.

PREREQUISITES

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

OBJECTIVES

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

1. Identify the weights and measures used in the English and metric systems.
2. Describe how to calculate area and volume.
3. Describe the practical applications of area and volume calculations in plumbing.
4. Explain the concepts of temperature and pressure and how they apply to plumbing installations.
5. Explain the functions and applications of six simple machines: inclined plane, lever, pulley, wedge, screw, and wheel and axle.

PERFORMANCE TASKS

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

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

Copies of your local code

Sketch paper

English ruler, yardstick, gallon jug, measuring cup, and hand weights

Water

Calculators

String and ruler

Liquid, bimetallic, and electrical thermometers

Examples of an inclined plane, lever, pulley, wedge, screw, and wheel and axle

Wrench

Doorstop

Drill bit

Valve with a wheel handle

Section of pipe, friction caps, water, hairdryer or blowtorch (optional)

TV/VCR (optional)

Explosion Danger Lurks videotape (optional)

Two 4-inch pipes of different diameters, caps for the bottom end of each (optional)

Assorted blocks, levers, wheels, and twine (optional)

Module Examinations*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.Located in the Test Booklet.

SAFETY CONSIDERATIONS

Remind trainees that safety considerations apply in any construction activity conducted at a work site—including measuring and making calculations. Ensure that they 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.

Code Check Plumbing: A Field Guide to Plumbing, 2000. Michael Casey, Douglas Hansen, and Redwood Kardon. Newton, CT: Taunton Press.

Explosion Danger Lurks [Videotape], ca. 1955. Watts Regulator Company. North Andover, MA: Watts Regulator Company.

Math to Build On: A Book for Those Who Build, 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 17 ½ hours are suggested to cover *Applied Math*. 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—Weights and Measures	
A. The English System	_____
B. The Metric (SI) System	_____
C. Converting Measurements	_____
Session II. Measuring Area	
A. Measuring the Area of a Rectangle	_____
B. Measuring the Area of a Right Triangle	_____
C. Measuring the Area of a Circle	_____
D. Area Calculations in Plumbing	_____
Session III. Measuring Volume	
A. Measuring the Volume of a Rectangular Prism	_____
B. Measuring the Volume of a Right Triangular Prism	_____
C. Measuring the Volume of a Cylinder	_____
D. Volume Calculations in Plumbing	_____
Session IV. Temperature	
A. Thermometers	_____
B. Thermal Expansion	_____
C. Protecting Pipes From Freezing	_____
Session V. Pressure	
A. Water Hammer	_____
B. Head	_____
C. Calculating Pressure on Test Plugs	_____
D. Temperature and Pressure in Water Heaters	_____

Session VI. Simple Machines, Part One

A. Inclined Planes _____
B. Levers _____
C. Pulleys _____
D. Wedges _____

Session VII. Simple Machines, Part Two

A. Screws _____
B. Wheels and Axles _____
C. The Worksheet _____
D. Review _____
E. Module Examination _____

1. Trainees must score 70 percent 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.

Sizing Water Supply Piping
Annotated Instructor's Guide

Module 02302-06

MODULE OVERVIEW

This module reviews how to size water supply systems. Trainees will learn how to calculate system requirements and demand, estimate developed lengths, and calculate pressure drops. Trainees will also review the various factors that can reduce efficiency in water supply piping.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Plumbing Level One*; *Plumbing Level Two*; *Plumbing Level Three*, Module 02301-06.

OBJECTIVES

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

1. Calculate pressure drops in a water supply system.
2. Size pipe for different acceptable flow rates.
3. Explain the difference between and advantages of a continuous-flow system and an intermittent-flow system.
4. Identify fixtures with high flow rates.
5. Explain how friction and flow impact a water supply system.
6. Lay out a water supply system.
7. Calculate developed lengths of branches for a given water supply system.
8. Calculate flow rates for high flow rate fixtures.

PERFORMANCE TASKS

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

1. Using design information provided by the instructor, lay out a water supply system.
2. Using design information provided by the instructor, calculate developed lengths of branches for a given water supply system.

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

Copies of your local code

Calculators

Bucket of water

Basin

Copies of blueprints that include plumbing drawings

Copies of *Table 1* (optional)

Copies of two of the standards cited in your local code (optional)

Isometric drawings of a water supply piping system (optional)

Copies of Quick Quiz** (optional)

Module Examinations*

Performance Profile Sheet*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

**Located at the end of this module.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Emphasize the importance of following all safety precautions and of paying close attention to limits for water temperature and pressure.

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.

Code Check Plumbing: A Field Guide to Plumbing, 2000. Redwood Kardon, Michael Casey, and Douglas Hansen. Newtown, CT: Taunton Press.

Plumbers and Pipefitters Handbook, 1996. William J. Hornung. Englewood Cliffs, NJ: Prentice Hall College Division.

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 *Sizing Water Supply Piping*. 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. Factors Affecting Water Supply Piping, Part One	
A. Temperature	_____
B. Density	_____
C. Viscosity	_____
D. Types of Flow	_____
Session II. Factors Affecting Water Supply Piping, Part Two	
A. Friction and Efficiency	_____
B. Calculating Equivalent Lengths	_____
Session III. Laying Out the Water Supply System, Part One	
A. Calculating Flow Rates	_____
B. Determining System Pressure	_____
Session IV. Laying Out the Water Supply System, Part Two	
A. Water Supply Fixture Units	_____
B. Intermittent and Continuous Demand	_____
C. Maximum Probable Flow	_____
D. Developed Length	_____
E. Performance Testing (Task 1)	_____
Session V. Sizing Water Supply Piping, Part One	
A. Calculating Minimum Acceptable Pressure	_____
B. Determining Correct Pipe Size	_____
C. Subtracting Total Pressure Loss From the Minimum Pressure	_____

Session VI. Sizing Water Supply Piping, Part Two

A. Sizing the System Using Trial Pipe Size _____

B. Calculating Friction Loss _____

Session VII. Sizing Water Supply Piping, Part Three

A. Review of Sizing Technique _____

B. The Worksheet _____

C. Review _____

D. Module Examination _____

1. Trainees must score 70 percent 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 (Task 2) _____

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.

Potable Water Treatment
Annotated Instructor's Guide

Module 02303-06

MODULE OVERVIEW

This module explains how to disinfect, filter, and soften water supply systems. Trainees will learn how to troubleshoot water supply problems, flush out visible contaminants from a plumbing system, and disinfect a potable water plumbing system.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Plumbing Level One*; *Plumbing Level Two*; *Plumbing Level Three*, Modules 02301-06 and 02302-06.

OBJECTIVES

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

1. Flush out visible contaminants from plumbing systems.
2. Disinfect a potable water plumbing system.
3. Identify common water problems and identify the basic equipment to solve them.
4. Practice methods used to soften water.
5. Analyze and measure water-conditioning problems.
6. Install water-conditioning equipment.

PERFORMANCE TASKS

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

1. Flush out visible contaminants from a plumbing system.
2. Disinfect a potable water plumbing system.
3. Identify the basic equipment necessary to solve specific water quality problems.
4. Install water-conditioning equipment.

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
Copies of your local code
Microscope
Assorted slides prepared with drops of water
Samples of liquid and solid chlorine
Diaphragm pump chlorinator
Injector chlorinator
Tablet chlorinator
Mechanical filter
Neutralizing filter
Oxidizing filter
Oxidizing agent
Alum
Test kit for iron contamination with appropriate water samples
Test kit for acidity with appropriate water samples
Copies of Quick Quiz** (optional)
Module Examinations*
Performance Profile Sheets*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

**Located at the end of this module.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Emphasize the importance of following all safety precautions and procedures when working with chemicals such as chlorine.

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.

Basic Principles of Water Treatment. Cliff Morelli. Littleton, CO: Tall Oaks Publishing.

Practical Principles of Ion Exchange Water Treatment. Dean L. Owens. Littleton, CO: Tall Oaks Publishing.

TEACHING TIME FOR THIS MODULE

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 15 hours are suggested to cover *Potable Water Treatment*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories and Teaching Tips activities 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. Water Supply Disinfection Methods, Part One	
A. Introduction to Water Supply Treatment	_____
B. Overview of Disinfection Methods	
C. Diaphragm Pump Chlorinators	_____
Session II. Water Supply Disinfection Methods, Part Two	
A. Injector Chlorinators	_____
B. Tablet Chlorinators	_____
C. Pasteurization Systems	_____
D. Ultraviolet Light Systems	_____
E. Performance Testing (Task 2)	_____
Session III. Water Supply Filtration and Softening Methods, Part One	
A. Sources of Contamination	_____
B. Removing Contaminants from Water Supply Systems	_____
C. Performance Testing (Task 1)	_____
D. Municipal Water Treatment	_____
E. Ion Exchange Systems	_____
Session IV. Water Supply Filtration and Softening Methods, Part Two	
A. Filtration Systems	_____
B. Precipitation Systems	_____
C. Reverse Osmosis Systems	_____
D. Distillation Systems	_____
E. Performance Testing (Task 4)	_____

Session V. Troubleshooting Water Supply Problems, Part One

A. Hardness _____
B. Discoloration _____
C. Acidity _____

Session VI. Troubleshooting Water Supply Problems, Part Two

A. Foul Odors and Flavors _____
B. Turbidity _____
C. Laboratory – trainees practice troubleshooting water supply problems. This laboratory corresponds to Performance Task 3. _____
D. Review _____
E. Module Examination _____
   1. Trainees must score 70 percent 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.
F. 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.

Backflow Preventers
Annotated Instructor's Guide

Module 02304-06

MODULE OVERVIEW

The module introduces the principles and hazards of backflow and reviews the six basic backflow prevention devices. It also covers how to install common types of backflow preventers.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Plumbing Level One*; *Plumbing Level Two*; *Plumbing Level Three*, Modules 02301-06 through 02303-06.

OBJECTIVES

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

1. Explain the principle of backflow due to back siphonage or back pressure.
2. Explain the hazards of backflow and demonstrate the importance of backflow preventers.
3. Identify and explain the applications of the six basic backflow prevention devices.
4. Install common types of backflow preventers.

PERFORMANCE TASK

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

1. Install common types of backflow preventers.

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

Copies of your local code

Appropriate tools for assembling and disassembling various types of backflow preventers

Various types of backflow preventers with manufacturer's instructions, including:

- Atmospheric vacuum breaker (AVB)
- Pressure-type vacuum breaker (PVB)
- Double-check valve assembly (DCV)
- Dual-check valve backflow preventer (DC)
- Reduced-pressure zone principle backflow preventer (RPZ)

Copies of Quick Quiz** (optional)

Module Examinations*

Performance Profile Sheets*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

**Located at the end of this module.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Emphasize the importance of following all safety precautions and procedures when installing backflow preventers. Point out that only certified personnel may test backflow preventers.

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.

Backflow Prevention: Theory and Practice, 1990. Robin L. Ritland. Dubuque, IA: Kendall/Hunt Publishing Company.

Manual of Cross-Connection Control, Ninth Edition, 1993. Foundation for Cross-Connection Control and Hydraulic Research. Los Angeles, CA: University of Southern California.

Recommended Practice for Backflow Prevention and Cross-Connection Control, Second Edition, 1990. Denver, CO: American Water Works 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 *Backflow Preventers*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Trainee proficiency noted during laboratory exercises can be used to satisfy the Performance Testing requirements.

Topic	**Planned Time**
Session I. Principles of Backflow and Cross-Connections	
A. Back Pressure	_____
B. Back Siphonage	_____
Session II. Types of Backflow Preventers, Part One	
A. Overview of Backflow Preventers	_____
B. Air Gaps	_____
Session III. Types of Backflow Preventers, Part Two	
A. Atmospheric Vacuum Breakers	_____
Session IV. Types of Backflow Preventers, Part Three	
A. Pressure-Type Vacuum Breakers	_____
Session V. Types of Backflow Preventers, Part Four	
A. Dual-Check Vacuum Breakers	_____
B. Double-Check Valve Backflow Preventers	_____
Session VI. Types of Backflow Preventers, Part Five	
A. Reduced-Pressure Zone Principle Backflow Preventers	_____
Session VII. Specialty Backflow Preventers	
A. Intermediate Atmospheric Vent Vacuum Breakers	_____
B. In-Line Vacuum Breakers	_____
Session VIII. Backflow Preventer Testing	
A. Requirements for Backflow Preventer Testing and Servicing	_____
B. Review	_____
C. Module Examination	_____
1. Trainees must score 70 percent 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.	

D. Performance Testing (Task 1) _____

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.

Types of Venting
Annotated Instructor's Guide

Module 02305-06

MODULE OVERVIEW

This module reviews the different types of vents that can be installed in a drain, waste, and vent (DWV) system. Trainees will learn how to design, construct, and install different vent configurations.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Plumbing Level One*; *Plumbing Level Two*; *Plumbing Level Three*, Modules 02301-06 through 02304-06.

OBJECTIVES

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

1. Describe the scientific principles of venting.
2. Design vent systems according to local code requirements.
3. Sketch the different types of vents.
4. Construct given vent configurations.
5. Install the different types of vents correctly.
6. Select correct fittings for vents.

PERFORMANCE TASK

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

1. Install different types of vents.

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

Copies of your local code

Straw, glass, and container for water

Selections from a model code other than the one on which your local code is based

Access to several computers with Internet connections (optional)

Copies of Quick Quiz** (optional)

Module Examinations*

Performance Profile Sheets*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

**Located at the end of this module.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Emphasize the importance of following all safety precautions and procedures when installing vents. Ensure that trainees understand that significant plumbing problems and significant health hazards to the public may result if venting systems are not properly installed.

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.

Estimator's Man-Hour Manual on Heating, Air Conditioning, Ventilating, and Plumbing, 1978. John S. Page. Woburn, MA: Gulf Professional Publishing Company.

Planning Drain, Waste & Vent Systems, 1990. Howard C. Massey. Carlsbad, CA: Craftsman Book Company.

Plumbers and Pipefitters Handbook, 1996. William J. Hornung. Englewood Cliffs, NJ: Prentice Hall College Division.

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 *Types of Venting*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Trainee proficiency noted during laboratory and Teaching Tip exercises can be used to satisfy the Performance Testing requirements.

Topic	**Planned Time**
Session I. Understanding Vents and Vent Installation	
A. Introduction to Vents	_____
B. How Vents Work	_____
C. Designing a Vent Installation	_____
Session II. Vent System Components and Grading	
A. Components of a Vent System	_____
B. Vent Grades	_____
Session III. Types of Vents, Part One	
A. Overview	_____
B. Individual Vents	_____
Session IV. Types of Vents, Part Two	
A. Common Vents	_____
B. Battery Venting	_____
Session V. Types of Vents, Part Three	
A. Wet Vents	_____
Session VI. Types of Vents, Part Four	
A. Air Admittance Vents	_____
Session VII. Types of Vents, Part Five	
A. Relief Vents	_____
Session VIII. Types of Vents, Part Six	
A. Sovent® Vent Systems	_____
B. Review	_____
C. Module Examination	_____
1. Trainees must score 70 percent 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.	

D. Performance Testing (Task 1)

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.

Sizing DWV and Storm Systems
Annotated Instructor's Guide

Module 02306-06

MODULE OVERVIEW

This module explains how to calculate drainage fixture units for waste systems. Trainees will learn how to size drain, waste, and vent (DWV) systems; storm drainage systems; and roof storage and drainage systems.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Plumbing Level One*; *Plumbing Level Two*; *Plumbing Level Three*, Modules 02301-06 through 02305-06.

OBJECTIVES

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

1. Calculate drainage fixture units for waste systems.
2. Size building drains and sewers.
3. Size a vent system.
4. Identify and size special kinds of waste and vent systems.
5. Size roof drainage systems.

PERFORMANCE TASKS

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

1. Calculate drainage fixture units for a plumbing system.
2. Size branch lines for plumbing fixtures.
3. Size waste stacks.
4. Size building drains and sewers.
5. Size vents according to local code.
6. Determine annual rainfall and 10-, 25-, 50-, and 100-year expectations.
7. Calculate the surface area of a roof for storm system sizing.
8. Size conventional roof drainage systems for storm water removal.

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
Copies of your local code
Calculators
Module Examinations*
Performance Profile Sheets*

*~ Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment. Emphasize the importance of following all safety precautions and procedures when installing DWV and storm drainage systems. Especially remind them of the dangers of inadequate trenching when working with underground pipe and equipment. Note that significant public health and substantial plumbing problems may result from incorrect installation.

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.

Code Check Plumbing: A Field Guide to Plumbing. Redwood Kardon, Michael Casey, and Douglas Hansen. Newtown, CT: Taunton Press.

Planning Drain, Waste & Vent Systems. Howard C. Massey. Carlsbad, CA: Craftsman Book Company.

Water, Sanitary, and Waste Services for Buildings. Alan F. E. Wise and J. A. Swaffield. Boston, MA: Addison-Wesley.

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 *Sizing DWV and Storm Systems*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories and Teaching Tips 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 Sizing Drain, Waste, and Vent (DWV) Systems	
A. Introduction	_____
B. Calculating Drainage Fixture Units	_____
C. Laboratory – Trainees practice calculating DFUs for fixture groups. This laboratory corresponds to Performance Task 1.	_____
Session II. Sizing Drains	
A. Exceptions and Limitations	_____
B. Sizing Building Drains and Sewers	_____
C. Laboratory – Trainees practice calculating the size of building drains and sewers. This laboratory corresponds to Performance Task 4.	_____
D. Performance Testing (Tasks 2 and 3)	_____
Session III. Sizing Vents, Part One	
A. Main Vents	_____
B. Individual Vents	_____
Session IV. Sizing Vents, Part Two	
A. Common Vents	_____
B. Wet Vents	_____
C. Relief Vents	_____
D. Battery Vents	_____
Session V. Sizing Vents, Part Three	
A. Sump Vents	_____
B. Combination Drain and Vent Systems	_____
C. Performance Testing (Task 5)	_____
Session VI. Sizing Storm Drainage Systems, Part One	
A. Rainfall Conversion	_____
B. Performance Testing (Task 6)	_____

Session VII. Sizing Storm Drainage Systems, Part Two

A. Sizing Conventional Roof Drainage Systems _____

B. Sizing Controlled-Flow Roof Drainage Systems _____

C. Sizing Secondary Roof Drains

D. Laboratory – Trainees practice sizing roof storage and drainage systems. This laboratory corresponds to Performance Tasks 7 and 8. _____

Session VIII. Sizing Storm Drainage Systems, Part Three

A. Sizing Above-Grade and Below-Grade Drainage Systems _____

B. Review _____

C. Module Examination _____

1. Trainees must score 70 percent 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.

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.

Sewage Pumps and Sump Pumps
Annotated Instructor's Guide

Module 02307-06

MODULE OVERVIEW

This module introduces the plumbing trainee to the components, operation, and functions of sewage and sump pumps. Trainees also learn how to size, install, troubleshoot, and repair sewage and storm water removal systems.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Plumbing Level One*; *Plumbing Level Two*; *Plumbing Level Three*, Modules 02301-06 through 02306-06.

OBJECTIVES

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

1. Explain the functions, components, and operation of sewage and sump pumps.
2. Size a storm water sump by calculating the runoff from paved and unpaved land surfaces.
3. Size a sewage sump by calculating the sewage flow from a structure.
4. Install and adjust sensors, switches, and alarms in sewage and sump pumps.
5. Troubleshoot and repair sewage and sump pumps.
6. Using a detailed drawing, identify system components.
7. Install a sump pump.
8. Find local applicable code requirements for installation and use.

PERFORMANCE TASKS

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

1. Install and adjust sensors, switches, and alarms in sewage and sump pumps.
2. Using a detailed drawing provided by the instructor, identify system components.
3. Install a sump pump.
4. Troubleshoot and repair sewage and sump pumps.

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
Copies of your local code
Calculators
Small sewage or storm water pump
Copies of Quick Quiz**
Module Examinations*
Performance Profile Sheets*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

**Located at the end of this module.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Emphasize the importance of following all safety precautions and procedures—especially those concerning trenching—while installing and repairing sewage pumps and sump pumps underground. Urge them to wear personal protective equipment that is appropriate for specific tasks and work spaces.

ADDITIONAL RESOURCES

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

Planning Drain, Waste & Vent Systems, 1993. Howard C. Massey. Carlsbad, CA: Craftsman Book Company.

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 *Sewage Pumps and Sump Pumps*. 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. Sewage Removal Systems, Part One	
A. Introduction and Overview	_____
B. Sewage Removal Systems	_____
C. Sewage Pumps	_____
Session II. Sewage Removal Systems, Part Two	
A. Centrifugal Pumps	_____
B. Pneumatic Ejectors	_____
Session III. Sewage Removal Systems, Part Three	
A. Sewage Sumps	_____
B. Controls	_____
Session IV. Storm Water Removal Systems, Part One	
A. Overview	_____
B. Storm Water Pumps	_____
Session V. Storm Water Removal Systems, Part Two	
A. Storm Water Sumps	_____
B. Controls	_____
C. Performance Testing (Tasks 1, 2, and 3)	_____
Session VI. Troubleshooting and Repairing Sewage and Storm Water Removal Systems, Part One	
A. Troubleshooting Electrical Problems	_____
B. Troubleshooting Mechanical Problems	_____
Session VII. Troubleshooting and Repairing Sewage and Storm Water Removal Systems, Part Two	
A. Replacing Sewage and Storm Water Pumps	_____
B. Review	_____
C. Module Examination	_____

1. Trainees must score 70 percent 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.

D. Performance Testing (Task 4) _____

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.

Corrosive-Resistant Waste Piping
Annotated Instructor's Guide

Module 02308-06

MODULE OVERVIEW

This module discusses corrosive wastes and reviews related safety issues and hazard communications. Trainees will learn how to determine when corrosive-resistant waste piping needs to be installed, as well as how to correctly select and properly connect different types of piping.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Plumbing Level One*; *Plumbing Level Two*; *Plumbing Level Three*, Modules 02301-06 through 02307-06.

OBJECTIVES

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

1. Discuss corrosive wastes and explain where they are found.
2. Discuss common types of materials used for corrosive-resistant waste piping.
3. Explain the methods of joining corrosive-resistant waste piping.
4. Discuss safety issues and hazard communications.

PERFORMANCE TASKS

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

1. Determine when corrosive-resistant waste piping needs to be installed.
2. Connect three different types of corrosive-resistant waste piping using proper techniques and materials.

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

Copies of your local code

Glass pipe cutter

Manufacturers' catalogs for plastic pipe

Sections of pipe materials used for corrosive waste, including:

- Borosilicate glass pipe, both beaded and plain end
- Plastic pipe
- Stainless steel pipe
- Silicon cast-iron pipe, both hub-and-spigot and no-hub styles

Appropriate materials and tools to join the various types of piping, such as:

- Couplings for borosilicate glass pipe
- Several clean cloths
- Water
- Adhesives specific to the types of plastic pipe
- Ratchet wrenches
- Fusion fittings and equipment
- Mechanical joints

Color version of the NFPA diamond

Copies of *NFPA Standard 704*

Several sample MSDSs

Module Examinations*

Performance Profile Sheets*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

SAFETY CONSIDERATIONS

Ensure that the trainees are equipped with appropriate personal protective equipment. Tell trainees to take special heed of all safety precautions and procedures, including appropriate personal protective equipment, when they may come into contact with corrosive waste. Piping materials for such waste may also require special handling.

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.

Corrosion-Resistant Piping Systems. Philip A. Schweitzer. New York: Marcel Dekker, Inc.

Hazard Communication Made Easy: A Checklist Approach to OSHA Compliance. Sean M. Nelson and John R. Grubbs. Rockville, MD: ABS Group, Government Institutes.

Water, Sanitary, and Waste Services for Buildings. Alan F. E. Wise and J. A. Swaffield. Boston, MA: Addison-Wesley.

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 *Corrosive-Resistant Waste Piping*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources. Because laboratories and Teaching Tips 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 Materials for Corrosive Wastes	
A. Types of Corrosive Wastes	_____
B. Performance Testing	_____
C. Borosilicate Glass Pipe	_____
D. Plastic Pipe	_____
E. Silicon Cast-Iron Pipe	_____
F. Stainless Steel Pipe	_____
G. Laboratory – Trainees practice selecting correct corrosive-resistant pipe. This laboratory corresponds to Performance Task 1.	_____
Session II. Installing Corrosive-Resistant Waste Piping	
A. Borosilicate Glass Pipe	_____
B. Plastic Pipe	_____
C. Silicon Cast-Iron Pipe	_____
D. Stainless Steel Pipe	_____
E. Acid Dilution and Neutralization Sumps	_____
F. Laboratory – Trainees practice installing corrosive-resistant waste piping systems. This laboratory corresponds to Performance Task 2.	_____
Session III. Hazard Communication	
A. HazCom Labels	_____
B. Material Safety Data Sheets	_____
C. Worker Training	_____
D. Review	_____

E. Module Examination _____

1. Trainees must score 70 percent 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.

F. 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.

Compressed Air
Annotated Instructor's Guide

Module 02309-06

MODULE OVERVIEW

This module explains the principles of compressed air systems and how to install these systems, their components, and their accessories. Trainees will learn how to determine friction loss in a compressed air piping system and how to troubleshoot and install air lines on air compressor systems.

PREREQUISITES

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Core Curriculum*; *Plumbing Level One*; *Plumbing Level Two*; *Plumbing Level Three*, Modules 02301-06 through 02308-06.

OBJECTIVES

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

1. Identify components of compressed air systems.
2. Discuss the installation of compressed air systems and their components and accessories.
3. Describe the applications of compressed air systems.
4. Identify the different methods of conditioning compressed air.
5. Identify the types, functions, and capacities of different air compressor systems.
6. Identify the safety issues related to compressed air systems.
7. Install a basic compressed air system.

PERFORMANCE TASKS

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

1. Install a basic compressed air system.
2. Identify components of compressed air systems.

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

Copies of your local code

Calculators

Examples of equipment that use compressed air

A variety of devices that reduce noise and vibration, including:

- Intake silencers
- Flexible metal hoses
- Shock absorbing mounts

Air throttle valve, air pressure regulator, and lubricator

Copies of Quick Quiz**

Module Examinations*

Performance Profile Sheets*

* Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

**Located at the end of this module.

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.

Compressed Air Systems: A Guidebook on Energy and Cost Savings. E. M. Talbot. Lilburn, GA: Fairmont Press.

Pneumatic Handbook. Antony Barber. New York: Elsevier Science.

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 *Compressed Air*. 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 Compressed Air Systems	
A. Working Safely with Compressed Air	_____
B. Principles of Compressed Air Systems	_____
1. Properties of Air	_____
2. Measuring Air Pressure	_____
Session II. Components of Compressed Air Systems, Part One	
A. Air Compressors	_____
B. Aftercoolers and Air Dryers	_____
Session III. Components of Compressed Air Systems, Part Two	
A. Piping	_____
B. Controls	_____
Session IV. Installing and Maintaining Compressed Air Systems	
A. Installing Compressed Air Systems	_____
B. Compressed Air System Maintenance	_____
C. Review	_____
D. Module Examination	_____
1. Trainees must score 70 percent 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 (Tasks 1 and 2)	_____
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.	