Module 02301-14 introduces trainees to math concepts they will use on the job, including weights and measures, area and volume, temperature, pressure, and force. It also describes the six simple machines: inclined planes, levers, pulleys, wedges, screws, and wheels and axles.

**Objectives**

**Learning Objective 1**
- Identify the weights and measures used in the English and metric systems.
  a. Explain the English system of weights and measures.
  b. Explain the metric system of weights and measures.
  c. Explain how to convert measurements.

**Learning Objective 2**
- Describe how to measure area and volume.
  a. Describe how to measure area.
  b. Describe how to measure volume.

**Learning Objective 3**
- Describe the practical applications of area and volume in plumbing.
  a. Describe how to perform area calculations in plumbing.
  b. Describe how to perform volume calculations in plumbing.
  c. Describe how to perform load calculations.

**Learning Objective 4**
- Explain the concepts of temperature and pressure and how they apply to plumbing installations.
  a. Explain the concept of temperature and how it applies to plumbing installations.
  b. Explain the concepts of pressure and force and how they apply to plumbing installations.

**Learning Objective 5**
- Explain the functions and applications of six simple machines: inclined plane, lever, pulley, wedge, screw, and wheel and axle.
  a. Explain how inclined planes work.
  b. Explain how levers work.
  c. Explain how pulleys work.
  d. Explain how wedges work.
  e. Explain how screws work.
  f. Explain how wheels and axles work.

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

**Teaching Time: 17.5 hours**
(Seven 2.5-hour Classroom sessions)

Session time may be adjusted to accommodate your class size, schedule, and teaching style.

**Prerequisites**
-Core Curriculum, Plumbing Level One, and Plumbing Level Two.

**Before You Begin**
As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the Module Examinations from [www.nccerirc.com](http://www.nccerirc.com). The passing score for submission into NCCER's Registry is 70 percent or above for the Module Examination.
Safety Considerations
Safety is paramount in the plumbing trade, and safe habits and practices must be emphasized whenever possible.

Classroom Equipment and Materials
- Whiteboard/chalkboard
- Markers/chalk
- Pencils and paper
- Calculator
- *Plumbing Level Three* PowerPoint® Presentation Slides
- Computer
- Copies of the Module Examination
- Vendor-supplied videos/DVDs showing simple machines (optional)
- TV/DVD player

Equipment and Materials for Laboratories and Performance Testing
- Lab scale
- Chisels
- Cold water
- Hot water
- Ice
- Infrared thermometer
- Liquid thermometer
- Bimetal thermometer
- Construction drawings
- Roof plan
- Manufacturer catalogs and brochures for plumbers
- Pulleys
- Rope
- Screws
- Tape measure
- Water hammer arrestor
- Weights

Additional Resources and References
This module presents thorough resources for task training. The following resource material is suggested for further study:


There are a number of online resources available for trainees who would like more information on the use of applied math in the plumbing industry. A search for additional information may be assigned as homework to interested trainees.
The lesson plan for this module is divided into seven 2.5-hour sessions. Each session includes 10 minutes for administrative tasks and one 10-minute break.

**SESSION ONE**

Session One introduces weights and measures.
1. Show Session One PowerPoint® presentation slides.
2. Discuss the English system of weights and measures.
3. Discuss the metric system of weights and measures.
4. Discuss and demonstrate how to convert measurements.

**SESSION TWO**

Session Two introduces area calculations.
1. Show Session Two PowerPoint® presentation slides.
2. Discuss and demonstrate how to calculate rectangular area.
3. Discuss and demonstrate how to calculate triangular area.
4. Discuss and demonstrate how to calculate circular area.

**SESSION THREE**

Session Three introduces volume calculations.
1. Show Session Three PowerPoint® presentation slides.
2. Discuss and demonstrate how to calculate volume for a rectangular prism.
3. Discuss and demonstrate how to calculate volume for a right triangular prism.
4. Discuss and demonstrate how to calculate volume for a cylinder.

**SESSION FOUR**

Session Four introduces area and volume in plumbing.
1. Show Session Four PowerPoint® presentation slides.
2. Identify and discuss plumbing applications in which area calculations are required.
3. Identify and discuss plumbing applications in which volume calculations are required.
4. Discuss and demonstrate load calculations for pipe and fittings.
**Session Outline for Module 02301-14**

**APPLIED MATH**

---

**Session Five**

Session Five introduces temperature and pressure.

1. Show Session Five PowerPoint® presentation slides.
2. Explain why the concepts of temperature, pressure, and force are important as related to plumbing systems.
3. Discuss different temperature scales and how to convert between each scale.
4. Explain the concept of thermal expansion.
5. Discuss how water pressure is affected by height.

---

**Session Six**

Session Six introduces simple machines.

1. Show Session Six PowerPoint® presentation slides.
2. Identify the six simple machines and how each works.
3. Describe applications for each simple machine.

---

**Session Seven**

Session Seven is a review and testing session. Have trainees complete the module Review Questions and Trade Terms Quiz. (Alternatively, these may be assigned as homework at the end of Session Six.) Answer any questions that trainees may have.

1. Have trainees complete the Module Examination.
2. Record the testing results on Training Report Form 200 and submit the report to your Training Program Sponsor.
### Materials Checklist for Module 02301-14, Applied Math

<table>
<thead>
<tr>
<th>Equipment and Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personal protective equipment:</strong></td>
</tr>
<tr>
<td>None Required</td>
</tr>
<tr>
<td>Calculator</td>
</tr>
<tr>
<td>Chisels</td>
</tr>
<tr>
<td>Lab scale</td>
</tr>
<tr>
<td>Construction drawings</td>
</tr>
<tr>
<td>Copies of the Module Examination</td>
</tr>
<tr>
<td>Manufacturer catalogs and brochures for plumbers</td>
</tr>
<tr>
<td>Roof plan</td>
</tr>
<tr>
<td><strong>Plumbing Level Three</strong></td>
</tr>
<tr>
<td><strong>PowerPoint® Presentation Slides</strong></td>
</tr>
<tr>
<td>Cold water</td>
</tr>
<tr>
<td>Water hammer arrestor</td>
</tr>
<tr>
<td>Whiteboard/chalkboard</td>
</tr>
<tr>
<td>Hot water</td>
</tr>
<tr>
<td>Rope</td>
</tr>
<tr>
<td>Markers/chalk</td>
</tr>
<tr>
<td>Ice</td>
</tr>
<tr>
<td>Screws</td>
</tr>
<tr>
<td>Pencils and paper</td>
</tr>
<tr>
<td>Infared thermometer</td>
</tr>
<tr>
<td>Tape measure</td>
</tr>
<tr>
<td>Computer</td>
</tr>
<tr>
<td>Liquid thermometer</td>
</tr>
<tr>
<td>Weights</td>
</tr>
<tr>
<td>Vendor-supplied videos/DVDs showing simple machines (optional)</td>
</tr>
<tr>
<td>Bimetal thermometer</td>
</tr>
<tr>
<td>Pulleys</td>
</tr>
<tr>
<td>TV/DVD player</td>
</tr>
</tbody>
</table>

To the extent possible, provide a selection of the tools listed for each session; alternatively, photos may be used to teach tool identification.
Module 02312-14 describes techniques for sizing water supply systems, including calculating system requirements and demand, developed lengths, and pressure drops. The module also introduces the different types of backflow prevention devices and discusses how they work, where they are used, and how they are installed.

**Objectives**

**Learning Objective 1**
- Determine the factors that affect the sizing of water supply systems.
  a. Determine how temperature and density affect water supply systems.
  b. Determine how flow and friction affect water supply systems.

**Learning Objective 2**
- Size a given water supply system for different acceptable flow rates and calculate pressure drops in a given water system.
  a. Determine how to establish system requirements for a given water supply system.
  b. Determine how to calculate demand for a given water supply system.
  c. Determine the correct pipe size based on system and supply pressures in a given water supply system.
  d. Determine how to calculate system losses in a given water supply system.

**Learning Objective 3**
- Describe the six basic backflow-prevention devices and the hazards they are designed to prevent.
  a. Describe the principle of backflow due to back siphonage and back pressure.
  b. Describe when and how to install air gaps.
  c. Describe when and how to install atmospheric vacuum breakers.
  d. Describe when and how to install pressure-type vacuum breakers.
  e. Describe when and how to install dual-check valve backflow preventer assemblies.
  f. Describe when and how to install double-check valve assemblies.
  g. Describe when and how to install reduced-pressure zone principle backflow preventer assemblies.
  h. Describe when and how to install specialty backflow preventers.
  i. Describe when and how to troubleshoot and repair backflow preventers.

**Performance Tasks**

**Performance Task 1 (Learning Objective 2)**
- Using design information provided by the instructor, lay out a water supply system and calculate developed lengths of branches.

**Performance Task 2 (Learning Objective 3)**
- Install common types of backflow preventers.

**Teaching Time: 30 hours**
(Twelve 2.5-hour Classroom Sessions)
Session time may be adjusted to accommodate your class size, schedule, and teaching style.

**Prerequisites**
*Core Curriculum, Plumbing Level One and Plumbing Level Two.*

**Before You Begin**
As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the Module Examinations and Performance Profile Sheets from [www.nccerirc.com](http://www.nccerirc.com). The passing score for submission into NCCER’s Registry is 70 percent or above for the Module Examination; performance testing is graded pass or fail.
Safety Considerations

Safety is paramount in the plumbing trade, and safe habits and practices must be emphasized whenever possible. Performance Tasks must be completed under your supervision. Each trainee must use required PPE and follow safe tool practices and procedures.

Classroom Equipment and Materials

- Whiteboard/chalkboard
- Markers/chalk
- Pencils and paper
- Plumbing Level Three PowerPoint® Presentation Slides
- LCD projector and screen
- Computer
- Copies of the Module Examination and Performance Profile Sheets
- Vendor-supplied videos/DVDs showing backflow preventers (optional)
- TV/DVD player

Equipment and Materials for Laboratories and Performance Testing

- Appropriate Personal Protective Equipment:
  - Eye protection
  - Work boots
  - Gloves
  - Hard hat
- Assortment of pipe, fittings, and tools for the following:
  - Vacuum breaker installation
  - RPZ installation and servicing
  - Installation of backflow preventers with intermediate atmospheric vents and in-line vacuum breakers
  - Atmospheric vacuum breaker (AVB)
  - Backflow preventers with intermediate atmospheric vents
  - Clear plastic pipe or borosilicate glass pipe
  - Fittings/valves for the plastic or glass pipe
  - Double-check valves (DCVs)
  - Dual-check valve backflow preventer assemblies (DC)
  - Hose connection vacuum breaker
  - In-line vacuum breakers
  - Reduced-pressure zone principle backflow preventer assembly (RPZ)
  - Pressure-reducing valve

- Pressure-type vacuum breaker
- Construction drawings for a small residence
- International Plumbing Code®
- International Residential Code®, Appendix P
- Local plumbing code
- Manufacturer catalogs for dual-check valve backflow preventer assemblies (DCs) and double-check valves (DCVs)
- Manufacturer catalogs for vacuum breakers and specialty vacuum breakers
- Operator’s manual for a backflow preventer test kit
- Product specifications for various fixtures
- Manufacturer instructions for testing an RPZ
- Manufacturer literature for backflow preventers
- Metal container (open type) for heating water
- Heat source (such as cook stove)
- Lab scale
- One cubic foot of water
- Thermometer
- Water hose
Additional Resources and References

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


*Plumbing Level One*. 2012. Alachua, FL: NCCER.


There are a number of online resources available for trainees who would like more information on sizing and protecting the water supply system. A search for additional information may be assigned as homework to interested trainees.
Session Outline for 02312-14

SIZING AND PROTECTING THE WATER SUPPLY SYSTEM

The lesson plan for this module is divided into twelve 2.5-hour sessions. Each session includes 10 minutes for administrative tasks and one 10-minute break.

**SESSION ONE**
Session One introduces factors affecting water supply system sizing.
1. Show Session One PowerPoint® presentation slides.
2. Identify the factors that affect sizing of the water supply system.
3. Discuss the effects on water when it is heated.
4. Discuss the types of flow that occur in a piping system.

**SESSION TWO**
Session Two introduces methods used to determine water supply system requirements.
1. Show Session Two PowerPoint® presentation slides.
2. Discuss the factors to consider when installing a water supply system.
3. Provide an overview of how water supply system requirements are determined.

**SESSION THREE**
Session Three introduces procedures for calculating water supply system demand.
1. Show Session Three PowerPoint® presentation slides.
2. Discuss the term *demand* and explain how demand is determined.
3. Demonstrate how fixture demand is determined.
4. Explain how water supply fixture units (WFSUs) are converted to gallons per minute (gpm).

**SESSION FOUR**
Session Four introduces how pipe size for a water supply system is determined.
1. Show Session Four PowerPoint® presentation slides.
2. Provide an overview of the procedure used to size the piping for a water supply system.
3. Explain and demonstrate how to properly size the pipe for a small residence.
4. Discuss the concept of pressure drop and identify possible reasons for pressure to drop in a water supply system.

**SESSION FIVE**
Session Five introduces procedures for calculating water supply system losses.
1. Show Session Five PowerPoint® presentation slides.
2. Explain how pressure losses are calculated for a water supply system.
3. Demonstrate how to lay out a water supply system and calculate the developed lengths of the branches.

**SESSION SIX**
Session Six introduces the concept of backflow.
1. Show Session Six PowerPoint® presentation slides.
2. Discuss the importance of backflow prevention in a water supply system.
3. Discuss the two types of backflow in a water supply system and identify possible scenarios that can cause backflow.
4. Identify various types of backflow preventers and discuss factors to consider before installing a backflow preventer.
### Session Seven

Session Seven introduces air gaps and vacuum breakers.

1. Show Session Seven PowerPoint® presentation slides.
2. Discuss the use of air gaps and note the code requirements for air gaps.
3. Demonstrate the proper installation of an air gap.
4. Discuss the use of atmospheric vacuum breakers (AVBs) and demonstrate the proper installation of an AVB.
5. Discuss the use of a hose connection vacuum breaker and demonstrate the proper installation of them.
6. Discuss the use of pressure-type vacuum breakers (PVBs) and demonstrate the proper installation of a PVB.

### Session Eight

Session Eight introduces dual-check valves and double-check valve assemblies.

1. Show Session Eight PowerPoint® presentation slides.
2. Discuss the use of a dual-check valve backflow preventer assemblies (DC) and demonstrate the proper installation of them.
3. Discuss the use of a double-check valve backflow preventer assemblies (DCVs) and demonstrate the proper installation of them.

### Session Nine

Session Nine introduces reduced-pressure zone principle backflow preventer assemblies (RPZ).

1. Show Session Nine PowerPoint® presentation slides.
2. Discuss the use of an RPZ and demonstrate the proper installation of them.

### Session Ten

Session Ten introduces specialty backflow preventers.

1. Show Session Ten PowerPoint® presentation slides.
2. Discuss the use of backflow preventers with an atmospheric vent and demonstrate the proper installation of them.
3. Discuss the use of in-line vacuum breakers and demonstrate the proper installation of them.

### Session Eleven

Session Eleven introduces testing and repair of backflow preventers.

1. Show Session Eleven PowerPoint® presentation slides.
2. Explain that the local plumbing code specifies testing and servicing requirements for backflow preventers.
3. Discuss and demonstrate repairs and servicing needs that may be required by RPZs.

### Session Twelve

Session Twelve is a review and testing session. Have trainees complete the module Review Questions and Trade Terms Quiz. (Alternatively, these may be assigned as homework at the end of Session Eleven.) Answer any questions that trainees may have.

1. Have trainees complete the Module Examination. Any outstanding performance testing must be completed during this session.
2. Record the testing results on Training Report Form 200 and submit the report to your Training Program Sponsor.
### Materials Checklist for Module 02312-14, Sizing and Protecting the Water Supply System

<table>
<thead>
<tr>
<th>Equipment and Materials</th>
<th>Personal protective equipment:</th>
<th>Assortment of pipe, fittings, and tools for the following:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Eye protection</td>
<td>Vacuum breaker installation</td>
</tr>
<tr>
<td></td>
<td>Work boots</td>
<td>RPZ installation and servicing</td>
</tr>
<tr>
<td></td>
<td>Gloves</td>
<td>Installation of backflow preventers with intermediate atmospheric vents and in-line vacuum breakers</td>
</tr>
<tr>
<td></td>
<td>Hard hat</td>
<td>Atmospheric vacuum breaker (AVB)</td>
</tr>
<tr>
<td></td>
<td>Whiteboard/chalkboard</td>
<td>Backflow preventers with intermediate atmospheric vents</td>
</tr>
<tr>
<td></td>
<td>Markers/chalk</td>
<td>Clear plastic pipe or borosilicate glass pipe</td>
</tr>
<tr>
<td></td>
<td>Pencils and paper</td>
<td>Fittings/valves for the plastic or glass pipe</td>
</tr>
<tr>
<td></td>
<td><em>Plumbing Level Three</em></td>
<td>Double-check valves (DCVs)</td>
</tr>
<tr>
<td></td>
<td>Computer</td>
<td>Dual-check valve backflow preventer assemblies (DC)</td>
</tr>
<tr>
<td></td>
<td>LCD projector and screen</td>
<td>Hose connection vacuum breaker</td>
</tr>
<tr>
<td></td>
<td>Copies of the Module</td>
<td>In-line vacuum breakers</td>
</tr>
<tr>
<td></td>
<td>Examination and Performance</td>
<td>Heat source (such as cook stove)</td>
</tr>
<tr>
<td></td>
<td>Profile Sheets</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vendor-supplied videos/DVDs</td>
<td>Reduced-pressure zone principle backflow preventer assembly (RPZ)</td>
</tr>
<tr>
<td></td>
<td>showing backflow preventers</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>(optional)</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TV/DVD player</td>
<td>Pressure-reducing valve</td>
</tr>
<tr>
<td></td>
<td></td>
<td>One cubic foot of water</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pressure-type vacuum breaker</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thermometer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water hose</td>
</tr>
</tbody>
</table>

To the extent possible, and as required for performance testing, provide a selection of the tools listed for each session; alternatively, photos may be used to teach tool identification.
Module 02303-14 describes how to disinfect, filter, and soften water supply systems, including how to troubleshoot water supply problems, flush out visible contaminants from a plumbing system, and disinfect a potable water plumbing system.

Objectives

Learning Objective 1

- Identify the methods for disinfecting the water supply and determine the sources of contamination they address.
  a. Determine when and how to install chlorinators.
  b. Determine when and how to install pasteurization systems.
  c. Determine when and how to install ultraviolet-light systems.

Learning Objective 2

- Identify the methods for filtering and softening the water supply and determine the sources of contamination they address.
  a. Explain how municipal water treatment systems work.
  b. Determine when and how to install ion-exchange systems.
  c. Determine when and how to install filtration systems.
  d. Determine when and how to install precipitation systems.
  e. Determine when and how to install reverse-osmosis systems.
  f. Determine when and how to install distillation systems.

Learning Objective 3

- Determine how to troubleshoot water supply problems caused by contamination.
  a. Determine how to troubleshoot problems caused by hardness.
  b. Determine how to troubleshoot problems caused by discoloration.
  c. Determine how to troubleshoot problems caused by acidity.
  d. Determine how to troubleshoot problems caused by foul odors and flavors.
  e. Determine how to troubleshoot problems caused by turbidity.

Performance Tasks

Performance Task 1 (Learning Objective 1)

- Flush out visible contaminants from a plumbing system.

Performance Task 2 (Learning Objective 2)

- Install a reverse-osmosis system.

Performance Task 3 (Learning Objective 3)

- Identify the basic equipment necessary to solve specific water quality problems.

Teaching Time: 15 hours

(Six 2.5-hour Classroom Sessions)

Session time may be adjusted to accommodate your class size, schedule, and teaching style.

Prerequisites

Core Curriculum, Plumbing Level One, and Plumbing Level Two.

Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the Module Examinations and Performance Profile Sheets from www.nccerirc.com. The passing score for submission into NCCER’s Registry is 70 percent or above for the Module Examination; performance testing is graded pass or fail.
**Safety Considerations**

This module requires that trainees work with potentially hazardous chemicals such as chlorine. Safety is paramount in the plumbing trade, and safe habits and practices must be emphasized whenever possible. Performance Tasks must be completed under your supervision. Each trainee must use required PPE and follow safe tool practices and procedures.

**Classroom Equipment and Materials**

- Whiteboard/chalkboard
- Markers/chalk
- Pencils and paper
- *Plumbing Level Three PowerPoint® Presentation Slides*
- Computer
- Copies of the Module Examination and Performance Profile Sheets
- Vendor-supplied videos/DVDs showing how to disinfect, filter, and soften water supply systems *(optional)*
- TV/DVD player

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

- Appropriate Personal Protective Equipment:
  - Hard hat
  - Eye protection
  - Gloves
- Fitting or length of pipe contaminated by scale
- Section of copper or brass pipe that has been damaged by acidity
- Soap solution
- Acid test kits
- Ultraviolet lamps
- Home distiller unit
- Mechanical, neutralizing, and oxidizing filters
- Osmosis filters
- Portable water softeners with the manufacturer’s instructions, and appropriate chlorine for disinfecting them
- Tools required to assemble and disassemble portable water softeners
- Reverse-osmosis systems with the manufacturer’s instructions
- Tools required to install a reverse-osmosis system
- Containers filled with water, including mineral-enriched water and iron-rich water
- Copies of a variety of water-conditioning equipment manuals
- Small, empty containers
- Heat sources such as Bunsen burners
- Liquid droppers
- Microscopes
- Pipe and fixtures erected in such a way as to simulate a residential water supply system to which a reverse-osmosis system will be connected
- Samples of a sulfurous material
- Alum
- Absorptive material, such as sponges
- Adsorptive material, such as activated carbon
- Samples of an oxidizing agent
- Diatomaceous earth
- Liquid and solid chlorine
- Soda ash
- Several slides prepared with drops of water
- Test kits for iron contamination

**Additional Resources and References**

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

- “Distillation for Home Water Treatment.” Purdue University Cooperative Extension Service. [www.extension.purdue.edu](http://www.extension.purdue.edu)
- “Treatment Systems for Household Water Supplies: Distillation.” University of Minnesota Extension. [www.extension.umn.edu](http://www.extension.umn.edu)

There are a number of online resources available for trainees who would like more information on potable water supply treatment. A search for additional information may be assigned as homework to interested trainees.
Session Outline for Module 02303-14

Potable Water Supply Treatment

The lesson plan for this module is divided into six 2.5-hour sessions. Each session includes 10 minutes for administrative tasks and one 10-minute break.

**Session One**

Session One introduces the principles of water supply disinfection, including instruction on determining when and how to install chlorinators, pasteurization systems, and ultraviolet-light systems.

1. Show Session One PowerPoint® presentation slides.
2. Explain how water is made safe through disinfection, filtration, and softening.
3. Explain the process of pasteurization. Discuss applications for which pasteurization systems are not suitable.
4. Review and discuss how ultraviolet light kills bacteria and viruses in water.

**Session Two**

Session Two introduces the principles of water supply filtration and softening, including an explanation of municipal water treatment systems and instruction on determining when and how to install ion-exchange systems.

1. Show Session Two PowerPoint® presentation slides.
2. Explain how to install a water filter unit in a basement, a crawl space, and a slab-on-grade foundation.
3. Review how the process of ion exchange removes mineral ions from hard water.

**Session Three**

Session Three continues the overview of water supply filtration and softening, including instruction on determining when and how to install filtration, precipitation, reverse-osmosis, and distillation systems.

1. Show Session Three PowerPoint® presentation slides.
2. Explain the difference between adsorption and absorption. Give examples of each principle in action.
3. Explain how the addition of a precipitation step in the filtration process can remove extremely fine particles and certain chemicals that may be able to pass through filters.
4. Review the chemical process of osmosis and explain how it can be used to filter out harmful materials in water.
5. Explain how distillation removes contaminants by converting water to steam and back to water again.

**Session Four**

Session Four introduces techniques for troubleshooting problems caused by contamination, specifically those caused by hardness and discoloration.

1. Show Session Four PowerPoint® presentation slides.
2. Explain the causes and symptoms of water supply problems associated with hardness and discuss how to treat them.
3. Explain the causes and symptoms of water supply problems associated with discoloration and discuss how to treat them.
Session Outline for Module 02303-14

**POTABLE WATER SUPPLY TREATMENT**

### Session Five

Session Five continues the overview of techniques for troubleshooting problems caused by contamination, specifically those caused by acidity, foul odors and flavors, and turbidity.

1. Show Session Five PowerPoint® presentation slides.
2. Explain the causes and symptoms of water supply problems associated with acidity and discuss how to treat them.
3. Explain the causes and symptoms of water supply problems associated with foul odors and flavors and discuss how to treat them.
4. Explain the causes and symptoms of water supply problems associated with turbidity and discuss how to treat them.

### Session Six

Session Six is a review and testing session. Have trainees complete the module Review Questions and Trade Terms Quiz. (Alternatively, these may be assigned as homework at the end of Session Five.) Answer any questions that trainees may have.

1. Have trainees complete the Module Examination. Any outstanding performance testing must be completed during this session.
2. Record the testing results on Training Report Form 200 and submit the report to your Training Program Sponsor.
## Materials Checklist for Module 02303-14, Potable Water Supply Treatment

<table>
<thead>
<tr>
<th>Equipment and Materials</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personal protective equipment:</strong></td>
<td>Fitting or length of pipe contaminated by scale</td>
</tr>
<tr>
<td>Hard hat</td>
<td>Section of copper or brass pipe that has been damaged by acidity</td>
</tr>
<tr>
<td>Eye protection</td>
<td>Soap solution</td>
</tr>
<tr>
<td>Gloves</td>
<td>Acid test kits</td>
</tr>
<tr>
<td>Whiteboard/chalkboard</td>
<td>Ultraviolet lamps</td>
</tr>
<tr>
<td>Markers/chalk</td>
<td>Home distiller unit</td>
</tr>
<tr>
<td>Pencils and paper</td>
<td>Mechanical, neutralizing, and oxidizing filters</td>
</tr>
<tr>
<td><strong>Plumbing Level Three PowerPoint® Presentation Slides</strong></td>
<td>Osmosis filters</td>
</tr>
<tr>
<td>Computer</td>
<td>Portable water softeners with the manufacturer’s instructions, and appropriate chlorine for disinfecting them</td>
</tr>
<tr>
<td>Copies of the Module Examination and Performance Profile Sheets</td>
<td>Tools required to assemble and disassemble portable water softeners</td>
</tr>
<tr>
<td>Vendor-supplied videos/DVDs showing how to disinfect, filter, and soften water supply systems (optional)</td>
<td>Reverse-osmosis systems with the manufacturer’s instructions</td>
</tr>
<tr>
<td>TV/DVD player</td>
<td>Tools required to install a reverse-osmosis system</td>
</tr>
<tr>
<td></td>
<td>Containers filled with water, including mineral-enriched water and iron-rich water</td>
</tr>
<tr>
<td></td>
<td>Copies of a variety of water-conditioning equipment manuals</td>
</tr>
<tr>
<td></td>
<td>Test kits for iron contamination</td>
</tr>
</tbody>
</table>

To the extent possible, and as required for performance testing, provide a selection of the tools listed for each session; alternatively, photos may be used to teach tool identification.
Module 02305-14 describes the different types of vents that can be installed in a DWV system and how they work. The module also teaches design and installation techniques.

### Objectives

#### Learning Objective 1
- Describe the principles and components of vent systems and their code requirements.
  - a. Describe the principles of venting.
  - b. Describe the components of a vent system.
  - c. Describe how to grade vents properly.

#### Learning Objective 2
- Describe the different types of vent systems that plumbers install.
  - a. Describe the characteristics and requirements of individual and common vents.
  - b. Describe the characteristics and requirements of battery vents.
  - c. Describe the characteristics and requirements of wet vents.
  - d. Describe the characteristics and requirements of air admittance and island vents.
  - e. Describe the characteristics and requirements of relief and Sovent® vents.

### Performance Tasks

#### Performance Task 1 (Learning Objective 2)
- Install different types of vents.

### Teaching Time: 20 hours
(Eight 2.5-hour Classroom Sessions)
Session time may be adjusted to accommodate your class size, schedule, and teaching style.

### Prerequisites

Core Curriculum, Plumbing Level One, and Plumbing Level Two.

### Before You Begin
As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans, and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the Module Examinations and Performance Profile Sheets from [www.nccerirc.com](http://www.nccerirc.com). The passing score for submission into NCCER’s Registry is 70 percent or above for the Module Examination; performance testing is graded pass or fail.
**Classroom Equipment and Materials**
- Whiteboard/chalkboard
- Markers/chalk
- Pencils and paper
- *Plumbing Level Three* PowerPoint® Presentation Slides
- LCD projector and screen
- Computer
- Copies of the Module Examination and Performance Profile Sheets
- Vendor-supplied videos/DVDs showing types of venting *(optional)*
- TV/DVD player

**Equipment and Materials for Laboratories and Performance Testing**
- Appropriate Personal Protective Equipment:
  - Gloves
  - Hard hat
  - Eye protection
  - Hearing protection
  - Safety shoes
  - Respiratory protection
  - Length of DWV pipe
  - Set of plumbing drawings
  - Set of residential drawings
  - Air admittance vents

**Safety Considerations**
This module requires that trainees install different types of vents. Safety is paramount in the plumbing trade and safe habits and practices must be emphasized whenever possible. Performance Tasks must be completed under your supervision. Each trainee must use required PPE and follow safe tool practices and procedures.

**Additional Resources and References**
This module presents thorough resources for task training. The following resource material is suggested for further study:


There are a number of online resources available for trainees who would like more information on types of venting. A search for additional information may be assigned as homework to interested trainees.
Session Outline for Module 02305-14

Types of Venting

The lesson plan for this module is divided into eight 2.5-hour sessions. Each session includes 10 minutes for administrative tasks and one 10-minute break.

**Session One**

Session One introduces the principles and components of venting systems.
1. Show Session One PowerPoint® presentation slides.
2. Explain the principles of venting systems. Include a discussion about the principles of air pressure.
3. Describe the components of a vent system and how to grade vents properly.

**Session Two**

Session Two introduces the components of a vent system and how to grade vents.
1. Show Session Two PowerPoint® presentation slides.
2. Describe the components of a vent system. Clarify the difference between a stack vent and a vent stack.
3. Explain how to grade vents; emphasize the importance of knowing the code.

**Session Three**

Session Three introduces the different types of vent systems, including individual and common vents.
1. Show Session Three PowerPoint® presentation slides.
2. Describe the characteristics and requirements of individual vents.
3. Describe the characteristics and requirements of common vents.

**Session Four**

Session Four introduces battery vents.
1. Show Session Four PowerPoint® presentation slides.
2. Describe the characteristics and requirements of battery vents.
3. Discuss the importance of knowing the local applicable code before installing a battery vent.

**Session Five**

Session Five introduces wet vents.
1. Show Session Five PowerPoint® presentation slides.
2. Describe the characteristics and requirements of wet vents.
3. Discuss the importance of knowing the local applicable code to determine wet vent sizing and placement.

**Session Six**

Session Six introduces air admittance and island vents.
1. Show Session Six PowerPoint® presentation slides.
2. Describe the characteristics and requirements of air admittance vents; explain the principles of air pressure within this system. Clarify the difference between the two different types of air admittance vents. Emphasize the importance of knowing the code requirements for air admittance vents.
3. Describe the characteristics and requirements of island vents. Emphasize the importance of knowing the code requirements for island fixtures.
**SESSION SEVEN**

Session Seven introduces relief vents and the Sovent® vent system.

1. Show Session Seven PowerPoint® presentation slides.

2. Describe the characteristics and requirements of relief vents. Review the local applicable code for details about installing relief vents.

3. Describe the characteristics and requirements of the Sovent® vent system. Review the local applicable code for the proper procedure for installing the Sovent® vent system.

**SESSION EIGHT**

Session Eight is a review and testing session.

Have trainees complete the module Review Questions and Trade Terms Quiz. (Alternatively, these may be assigned as homework at the end of Session Seven.) Answer any questions that trainees may have.

1. Have trainees complete the Module Examination. Any outstanding performance testing must be completed during this session.

2. Record the testing results on Training Report Form 200, and submit the report to your Training Program Sponsor.
Materials Checklist for Module 02305-14, Types of Venting

<table>
<thead>
<tr>
<th>Equipment and Materials</th>
<th>Length of DWV pipe</th>
<th>Clear plastic bottle with a hole in the bottom</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personal protective equipment:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gloves</td>
<td>Set of plumbing drawings</td>
<td>Copies of the local applicable code</td>
</tr>
<tr>
<td>Hard hat</td>
<td>Set of residential drawings</td>
<td>Copies of the manufacturer’s guide for Sovent System</td>
</tr>
<tr>
<td>Eye protection</td>
<td>Air admittance vents</td>
<td>Stations with an assortment of plumbing fixtures, DWV pipe, fittings, and the tools to assemble and join them</td>
</tr>
<tr>
<td>Safety shoes</td>
<td>Clear bowl for water</td>
<td>Sovent® pipe and fittings</td>
</tr>
<tr>
<td>Respiratory protection</td>
<td>Water</td>
<td></td>
</tr>
<tr>
<td>Hearing protection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whiteboard/chalkboard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Markers/chalk</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pencils and paper</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Plumbing Level Three</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PowerPoint® Presentation Slides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LCD projector and screen</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copies of the Module Examination and Performance Profile Sheets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vendor-supplied videos/DVDs showing types of venting (optional)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TV/DVD player</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

To the extent possible, and as required for performance testing, provide a selection of the tools listed for each session; alternatively, photos may be used to teach tool identification.
Module 02306-14 describes how to calculate drainage fixture units for waste systems. The text also reviews how to size drain, waste, and vent (DWV) systems, storm drainage systems, and roof storage and drainage systems.

### Objectives

**Learning Objective 1**
- Describe how to size drain, waste, and vent systems.
  - a. Describe how to size drains.
  - b. Describe how to size vents.

**Learning Objective 2**
- Describe how to size storm drainage systems.
  - a. Describe how to calculate rainfall conversions.
  - b. Describe how to size roof storage and drainage systems.
  - c. Describe how to size above-grade and below-grade drainage systems.

### Performance Tasks

**Performance Task 1 (Learning Objective 1)**
- Calculate drainage fixture units for a plumbing system.

**Performance Task 2 (Learning Objective 1)**
- Size branch lines for plumbing fixtures.

**Performance Task 3 (Learning Objective 1)**
- Size waste stacks.

**Performance Task 4 (Learning Objective 1)**
- Size building drains and sewers.

**Performance Task 5 (Learning Objective 1)**
- Size vents according to local code.

**Performance Task 6 (Learning Objective 2)**
- Determine annual rainfall and 10-, 25-, 50-, and 100-year averages per your local code.

**Performance Task 7 (Learning Objective 2)**
- Calculate the surface area of a roof for storm-system sizing.

**Performance Task 8 (Learning Objective 2)**
- Size conventional roof drainage systems for storm-water removal.

### Teaching Time: 20 hours
(Eight 2.5-hour Classroom Sessions)

Session time may be adjusted to accommodate your class size, schedule, and teaching style.

### Prerequisites

*Core Curriculum, Plumbing Level One, and Plumbing Level Two.*

### Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the Module Examinations and Performance Profile Sheets from [www.nccerirc.com](http://www.nccerirc.com). The passing score for submission into NCCER’s Registry is 70 percent or above for the Module Examination; performance testing is graded pass or fail.
**Safety Considerations**

Safety is paramount in the plumbing trade, and safe habits and practices must be emphasized whenever possible. Performance Tasks must be completed under your supervision. Each trainee must use required PPE and follow safe tool practices and procedures.

---

**Classroom Equipment and Materials**

- Whiteboard/chalkboard
- Markers/chalk
- Pencils and paper
- *Plumbing Level Three* PowerPoint® Presentation Slides
- LCD projector and screen
- Computer
- Internet access
- Copies of the Module Examination and Performance Profile Sheets
- Vendor-supplied videos/DVDs showing sizing DWV and storm systems (optional)
- TV/DVD player

---

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

- Circuit and relief vents
- Common vents and vertical drains of various sizes
- Copies of the local plumbing code
- Diagram of a fixture group
- Fittings
- Fixture drains of various sizes
- Manufacturers’ information on siphonic roof drain systems
- Rainfall maps
- Various individual vents
- Various main vents
- Vent stack
- Drainage stack
- Waste line

---

**Additional Resources and References**

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


There are a number of online resources available for trainees who would like more information on sizing DWV and storm systems. A search for additional information may be assigned as homework to interested trainees.
The lesson plan for this module is divided into eight 2.5-hour sessions. Each session includes 10 minutes for administrative tasks and one 10-minute break.

**SESSION ONE**
Session One introduces how to size building drains and sewers.
1. Show Session One PowerPoint® presentation slides.
2. Discuss the purpose of DFUs and the variables used to determine DFUs.
3. Explain the sizing process for DWV systems.
4. Explain how building drains and sewers are sized, and discuss considerations that must be taken into account.

**SESSIONS TWO THROUGH FOUR**
Sessions Two through Four introduce how to size different types of vents.
1. Show Sessions Two, Three, and Four PowerPoint® presentation slides.
2. Explain the process of calculating the diameter of a vent stack or stack vent.
3. Discuss the purpose of and common sizing requirements for main vents and individual vents.
4. Discuss how common vents are used.
5. Explain how to determine the correct pipe size for a wet vent.
6. Discuss the purpose of relief vents and review when it is necessary to use a relief vent.
7. Discuss the purpose and setup of a battery of fixtures.
8. Review how to use the local code to determine correct sizes and lengths of sump vents.
9. Discuss the purpose and setup of a combination drain-and-vent system.

**SESSION FIVE**
Session Five introduces how to calculate rainfall conversions.
1. Show Session Five PowerPoint® presentation slides.
2. Discuss the three methods of retaining and disposing of stormwater and explain how an appropriate method is chosen.
3. Discuss the tools used to determine rainfall probabilities.
4. Explain how to size a drainage system using storm estimates for 10-, 25-, 50-, and 100-year periods.

**SESSION SIX**
Session Six introduces how to size roof storage and drainage systems, including conventional, siphonic, and secondary roof drainage systems.
1. Show Session Six PowerPoint® presentation slides.
2. Discuss the differences between conventional and controlled-flow roof drainage systems.
3. Discuss the characteristics and common specifications for a conventional roof drainage system.
4. Explain the physics involved in siphonic roof drain systems.
5. Discuss the characteristics and purpose of secondary roof drains.
Session Outline for Module 02306-14
Sizing DWV and Storm Systems

**SESSION SEVEN**

Session Seven introduces sizing above-grade and below-grade drainage systems.

1. Show Session Seven PowerPoint® presentation slides.
2. Discuss the concepts of ponding and permeability.
3. Discuss the types of pipe materials allowed by the IPC.

**SESSION EIGHT**

Session Eight is a review and testing session. Have trainees complete the module Review Questions and Trade Terms Quiz. (Alternatively, these may be assigned as homework at the end of Session Seven.) Answer any questions that trainees may have.

1. Have trainees complete the Module Examination. Any outstanding performance testing must be completed during this session.
2. Record the testing results on Training Report Form 200 and submit the report to your Training Program Sponsor.
| Equipment and Materials                              | Personal protective equipment: | Circuit and relief vents | Various main vents | None Required | Diagram of a fixture group | Various individual vents | Whiteboard/chalkboard | Fittings | Waste line | Markers/chalk | Fixture drains of various sizes | Pencils and paper | Rainfall maps | Plumbing Level Three | PowerPoint® Presentation Slides | Common vents and vertical drains of various sizes | Computer | Drainage stack | Internet access | Vent stack | LCD projector and screen | Copies of the local plumbing code | Copies of the Module Examination and Performance Profile Sheets | Manufacturers’ information on siphonic roof drain systems | Vendor-supplied videos/DVDs showing sizing DWV and storm systems *(optional)* | TV/DVD player |

To the extent possible, and as required for performance testing, provide a selection of the tools listed for each session; alternatively, photos may be used to teach tool identification.
Lesson Plans for Module 02307-14

SEWAGE PUMPS AND SUMP PUMPS

Module 02307-14 describes the installation, diagnosis, and repair of pumps, controls, and sumps in sewage and stormwater removal systems.

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Performance Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Learning Objective 1</strong>&lt;br&gt;• Describe the components of sewage and stormwater removal systems and explain how to size and install them.&lt;br&gt;  a. Describe sewage pumps and sumps, and explain how to size and install them.&lt;br&gt;  b. Describe stormwater pumps and sumps, and explain how to size and install them.&lt;br&gt;  c. Describe sewage and stormwater pump controls, and explain how they work.&lt;br&gt;&lt;br&gt;<strong>Learning Objective 2</strong>&lt;br&gt;• Explain how to troubleshoot and repair sewage and stormwater removal systems.&lt;br&gt;  a. Explain how to troubleshoot electrical problems.&lt;br&gt;  b. Explain how to troubleshoot mechanical problems.&lt;br&gt;  c. Explain how to replace pumps.</td>
<td><strong>Performance Task 1 (Learning Objective 1)</strong>&lt;br&gt;• Using a detailed drawing provided by the instructor, identify system components.&lt;br&gt;<strong>Performance Task 2 (Learning Objective 1)</strong>&lt;br&gt;• Install a sump pump.&lt;br&gt;<strong>Performance Task 3 (Learning Objective 1)</strong>&lt;br&gt;• Install and adjust sensors, switches, and alarms in sewage and sump pumps.&lt;br&gt;<strong>Performance Task 4 (Learning Objective 2)</strong>&lt;br&gt;• Troubleshoot sewage and sump pumps.</td>
</tr>
</tbody>
</table>

**Teaching Time: 12.5 hours**<br>(Five 2.5-hour Classroom Sessions)<br>Session time may be adjusted to accommodate your class size, schedule, and teaching style.

**Prerequisites**<br>*Core Curriculum*, *Plumbing Level One*, and *Plumbing Level Two*.

**Before You Begin**<br>As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the Module Examinations and Performance Profile Sheets from [www.nccerirc.com](http://www.nccerirc.com). The passing score for submission into NCCER’s Registry is 70 percent or above for the Module Examination; performance testing is graded pass or fail.
**Safety Considerations**
This module requires that trainees work with materials and equipment that are designed to handle untreated sewage and gaseous wastes and stormwater runoff, potentially work under confined-space conditions, and perform electrical work. Safety is paramount in the plumbing trade, and safe habits and practices must be emphasized whenever possible. Performance Tasks must be completed under your supervision. Each trainee must use required PPE and follow safe tool practices and procedures.

**Classroom Equipment and Materials**
- Whiteboard/chalkboard
- Markers/chalk
- Pencils and paper
- Plumbing Level Three PowerPoint® Presentation Slides
- LCD projector and screen
- Computer
- Copies of the Module Examination and Performance Profile Sheets
- Vendor-supplied videos/DVDs showing how to install and service sewage and stormwater pumps (optional)
- TV/DVD player

**Equipment and Materials for Laboratories and Performance Testing**
- Appropriate Personal Protective Equipment:
  - Eye protection
  - Gloves
  - Hard hat
  - Hearing protection
  - Respiratory protection
  - Work boots
- A device that makes noise, such as an alarm clock, wind-up bell, or a battery-powered radio
- An airtight chamber attached to an air pump
- Candle
- Check valve designed for use with centrifugal sewage pumps
- Copies of the local applicable code
- Electric pump motor
- Impeller from a submersible pump
- Preassembled sewage or stormwater pump system
- Rubber diaphragm exhaust valve from a pneumatic ejector
- Set of burned-out bearings from a water-lubricated pump
- Sewage or stormwater sump fitted with a float switch
- Tools for assembling, disassembling, and installing sewage pumps
- Tools for assembling, disassembling, and installing stormwater pumps
- Variety of analog and digital switches, including float, pressure float, mercury float, and probe analog switches, and laser, field effect sensor, and radar digital switches
- Variety of centrifugal sump pumps
- Variety of controls for sewage and sump pumps, such as sensors and alarms, with the manufacturer’s installation instructions
- Variety of gate and check valves designed for use on stormwater pump discharge lines
- Variety of sewage and sump pumps that have electrical and mechanical problems
- Variety of sewage pumps, including centrifugal pumps and pneumatic ejectors, with manufacturer’s installation and servicing instructions
- Variety of stormwater pumps, with manufacturer’s installation and servicing instructions

**Additional Resources and References**
This module presents thorough resources for task training. The following resource material is suggested for further study:


There are a number of online resources available for trainees who would like more information on the installation, diagnosis, and repair of pumps, controls, and sumps in sewage and stormwater removal systems. A search for additional information may be assigned as homework to interested trainees.
The lesson plan for this module is divided into five 2.5-hour sessions. Each session includes 10 minutes for administrative tasks and one 10-minute break.

**SESSION ONE**
Session One introduces the components and applications of sewage pumps and sumps and explains how to size and install them.

1. Show Session One PowerPoint® presentation slides.
2. Provide a broad overview of the components of sewage and stormwater removal systems.
3. Introduce the process of sizing and installing sewage pumps.
4. Discuss general considerations for sizing and installing sewage sumps.

**SESSION TWO**
Session Two introduces the components and applications of stormwater pumps and sumps and explains how to size and install them.

1. Show Session Two PowerPoint® presentation slides.
2. Provide an overview of the requirements for sizing and installing stormwater pumps.
3. Review the applications for stormwater sumps.

**SESSION THREE**
Session Three introduces the switches and other controls used in sewage and stormwater removal systems.

1. Show Session Three PowerPoint® presentation slides.
2. Discuss the critical role played by switches and other controls in sewage and stormwater removal systems.
3. Discuss the purpose and types of other pump controls and alarms.

**SESSION FOUR**
Session Four introduces troubleshooting and repair techniques for sewage and stormwater removal systems.

1. Show Session Four PowerPoint® presentation slides.
2. Review electrical problems common to sump and stormwater pumps and explain how to troubleshoot and repair them.
3. Review mechanical problems common to sump and stormwater pumps and explain how to troubleshoot and repair them.
4. Discuss the circumstances in which sewage and stormwater pumps need to be replaced.

**SESSION FIVE**
Session Five is a review and testing session. Have trainees complete the module Review Questions and Trade Terms Quiz. (Alternatively, these may be assigned as homework at the end of Session Four.) Answer any questions that trainees may have.

1. Have trainees complete the Module Examination. Any outstanding performance testing must be completed during this session.
2. Record the testing results on Training Report Form 200 and submit the report to your Training Program Sponsor.
## Materials Checklist for Module 02307-14, Sewage Pumps and Sump Pumps

<table>
<thead>
<tr>
<th>Equipment and Materials</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Personal protective equipment:</strong></td>
<td></td>
</tr>
<tr>
<td>Eye protection</td>
<td>Candle</td>
</tr>
<tr>
<td>Gloves</td>
<td>Copies of the local applicable code</td>
</tr>
<tr>
<td>Hard hat</td>
<td>Impeller from a submersible pump</td>
</tr>
<tr>
<td>Hearing protection</td>
<td>Rubber diaphragm exhaust valve from a pneumatic ejector</td>
</tr>
<tr>
<td>Respiratory protection</td>
<td>Sewage or stormwater sump fitted with a float switch</td>
</tr>
<tr>
<td>Work boots</td>
<td>An airtight chamber attached to an air pump</td>
</tr>
<tr>
<td>Whiteboard/chalkboard</td>
<td>Variety of gate and check valves designed for use on stormwater pump discharge lines</td>
</tr>
<tr>
<td>Markers/chalk</td>
<td>Tools for assembling, disassembling, and installing sewage pumps</td>
</tr>
<tr>
<td>Pencils and paper</td>
<td>Variety of analog and digital switches, including float, pressure float, mercury float, and probe analog switches, and laser, field effect sensor, and radar digital switches</td>
</tr>
</tbody>
</table>

**Plumbing Level Three**

*PowerPoint® Presentation Slides*  
*Computer*  
*Copies of the Module Examination and Performance Profile Sheets*  
*Vendor-supplied videos/DVDs showing how to install and service sewage and stormwater pumps (optional)*  
*TV/DVD player*

To the extent possible, and as required for performance testing, provide a selection of the tools listed for each session; alternatively, photos may be used to teach tool identification.
**Lesson Plans for Module 02308-14**

**CORROSIVE-RESISTANT WASTE PIPING**

Module 02308-14 describes the types of corrosive wastes that are commonly found in residential and commercial applications, reviews related safety issues and hazard communications, discusses the various types of piping materials used to handle corrosive wastes, and reviews how to correctly select and properly connect different types of corrosive-resistant waste piping.

### Objectives

**Learning Objective 1**
- Identify corrosive wastes and handle them safely.
  - a. Identify the different types of corrosive waste.
  - b. Identify the safety issues and hazard communication systems related to working with corrosive-resistant waste.

**Learning Objective 2**
- Explain how to join and install different types of corrosive-resistant waste piping.
  - a. Explain how to join and install borosilicate glass pipe.
  - b. Explain how to join and install plastic pipe.
  - c. Explain how to join and install silicon cast-iron pipe.
  - d. Explain how to join and install stainless steel pipe.
  - e. Explain how to install acid dilution and neutralization sumps.

### Performance Tasks

**Performance Task 1 (Learning Objective 1)**
- Identify the circumstances in which corrosive-resistant waste piping should be installed.

**Performance Task 2 (Learning Objective 2)**
- Identify the neutralizing agents of an acid.

**Performance Task 3 (Learning Objective 2)**
- Connect three different types of corrosive-resistant waste piping using proper techniques and materials.

### Teaching Time: 7.5 hours

(Three 2.5-hour Classroom Sessions)

Session time may be adjusted to accommodate your class size, schedule, and teaching style.

### Prerequisites

Core Curriculum, Plumbing Level One, and Plumbing Level Two.

### Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the Module Examinations and Performance Profile Sheets from [www.nccerirc.com](http://www.nccerirc.com). The passing score for submission into NCCER’s Registry is 70 percent or above for the Module Examination; performance testing is graded pass or fail.
Safety Considerations
This module requires that trainees be familiar with the hazards caused by corrosive chemicals and identify and wear appropriate personal protective equipment when cutting, joining, and installing borosilicate glass, plastic, silicon cast-iron, and stainless steel pipe. Safety is paramount in the plumbing trade, and safe habits and practices must be emphasized whenever possible. Performance Tasks must be completed under your supervision. Each trainee must use required PPE and follow safe tool practices and procedures.

Classroom Equipment and Materials
- Whiteboard/chalkboard
- Markers/chalk
- Pencils and paper
- *Plumbing Level Three PowerPoint® Presentation Slides*
- LCD projector and screen
- Computer
- Copies of the Module Examination and Performance Profile Sheets
- Vendor-supplied videos/DVDs showing the various types of corrosive wastes and how to correctly select and properly connect different types of piping (optional)
- TV/DVD player

Equipment and Materials for Laboratories and Performance Testing
- Appropriate Personal Protective Equipment:
  - Eye protection
  - Hand protection
  - Hard hat
  - Welding gloves
  - Welding goggles
- A Globally Harmonized System of Classification and Labeling of Chemicals (GHS) label (color version)
- Assorted Uniform Laboratory Hazard Signage (ULHS) pictographs
- Assortment of ferritic, austenitic, martensitic, and duplex stainless steel pipe
- Assortment of fusion equipment
- Assortment of fusion fittings
- Assortment of manufacturers’ catalogs for plastic corrosive-resistant waste pipe
- Assortment of mechanical joints
- Borosilicate glass pipe cutter
- Cold chisels
- Copies of a company HazCom program
- Copies of a comprehensive list of laboratory hazards
- Copies of safety data sheets (SDSs) for a variety of materials
- Examples of padded hangers used for borosilicate glass pipe
- Floor drain
- Lengths of no-hub and hub-and-spigot silicon cast-iron pipe
- Lengths of plain- and beaded-end borosilicate glass pipe
- Lengths of plastic pipe
- Lengths of standard stainless steel pipe for water supply and drain, waste, and vent (DWV) systems
- Lengths of thermoplastic pipe
- List of residential and commercial wastes that includes both corrosive and non-corrosive wastes
- Materials used to join corrosive-resistant waste piping materials
- Mechanical and hydraulic spring-loaded pipe cutters
- Neoprene gaskets used to join hub-and-spigot silicon cast-iron pipe
- Samples of borosilicate glass pipe couplings
- Samples of neutralizing agents
- Samples of stainless steel piping or fittings that show effects of chemical corrosion
- Sections of pipe for corrosive-resistant waste piping materials
- Equipment needed to weld stainless steel piping

Additional Resources and References
This module presents thorough resources for task training. The following resource material is suggested for further study:


There are a number of online resources available for trainees who would like more information on corrosive-resistant waste piping. A search for additional information may be assigned as homework to interested trainees.
Session Outline for Module 02308-14
CORROSIVE-RESISTANT WASTE PIPING

The lesson plan for this module is divided into three 2.5-hour sessions. Each session includes 10 minutes for administrative tasks and one 10-minute break.

**SESSION ONE**

Session One introduces the various types of corrosive waste and the safety issues and hazard communication systems used when working with corrosive waste.

1. Show Session One PowerPoint® presentation slides.
2. Discuss the different types of corrosive wastes, and explain why systems must be designed to handle them. Note the EPA's definition of corrosive waste. Discuss problems that result from corrosive waste.
3. Discuss the elements of a hazard communications (HazCom) program that are required by law.

**SESSION TWO**

Session Two introduces the materials, tools, and procedures for joining and installing different types of corrosive-resistant waste piping systems.

1. Show Session Two PowerPoint® presentation slides.
2. Discuss why borosilicate glass pipe is suitable for handling wastes at extreme temperatures.
3. Review the advantages of using plastic pipe for corrosive waste drainage.
4. Discuss the use of silicon cast-iron pipe in corrosive waste systems, and review the techniques used to cut and join it.
5. Review the four types of stainless steel alloys for corrosive-resistant waste piping and discuss the applications of each.
6. Review the procedures for diluting, treating, and neutralizing corrosive liquids before allowing them to be discharged into a drainage system.

**SESSION THREE**

Session Three is a review and testing session. Have trainees complete the module Review Questions and Trade Terms Quiz. (Alternatively, these may be assigned as homework at the end of Session Two.) Answer any questions that trainees may have.

1. Have trainees complete the Module Examination. Any outstanding performance testing must be completed during this session.
2. Record the testing results on Training Report Form 200 and submit the report to your Training Program Sponsor.
### Materials Checklist for Module 02308-14, Corrosive-Resistant Waste Piping

<table>
<thead>
<tr>
<th>Equipment and Materials</th>
<th>Assortment of fusion fittings</th>
<th>Borosilicate glass pipe cutter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assortment of ferritic, austenitic, martensitic, and duplex stainless steel pipe</td>
<td>Assortment of manufacturers’ catalogs for plastic corrosive-resistant waste pipe</td>
<td></td>
</tr>
<tr>
<td>Vendor-supplied videos/DVDs showing the various types of corrosive wastes and how to correctly select and properly connect different types of piping</td>
<td>Lengths of standard stainless steel pipe for water supply and drain, waste, and vent (DWV) systems</td>
<td>List of residential and commercial wastes that includes both corrosive and non-corrosive wastes</td>
</tr>
<tr>
<td>Computer</td>
<td>Materials used to join corrosive-resistant waste piping materials</td>
<td>Neoprene gaskets used to join hub-and-spigot silicon cast-iron pipe</td>
</tr>
<tr>
<td>LCD projector and screen</td>
<td>Sections of pipe for corrosive-resistant waste piping materials</td>
<td>Samples of stainless steel piping or fittings that show effects of chemical corrosion</td>
</tr>
<tr>
<td>Copies of the Module Examination and Performance Profile Sheets</td>
<td>Assortment of ferritic, austenitic, martensitic, and duplex stainless steel pipe</td>
<td>Assortment of manufacturers’ catalogs for plastic corrosive-resistant waste pipe</td>
</tr>
<tr>
<td>Assorted Uniform Laboratory Hazard Signage (ULHS) pictographs</td>
<td>A Globally Harmonized System of Classification and Labeling of Chemicals (GHS) label (color version)</td>
<td>Copies of safety data sheets (SDSs) for a variety of materials</td>
</tr>
<tr>
<td>Markers/chalk</td>
<td>Mechanical and hydraulic spring-loaded pipe cutters</td>
<td>Samples of borosilicate glass pipe couplings</td>
</tr>
<tr>
<td>Whiteboard/chalkboard</td>
<td>Copies of a company HazCom program</td>
<td>Copies of a comprehensive list of laboratory hazards</td>
</tr>
<tr>
<td>Welding goggles</td>
<td>Assortment of fusion equipment</td>
<td>Assortment of mechanical joints</td>
</tr>
<tr>
<td>Welding gloves</td>
<td>Examples of padded hangers used for borosilicate glass pipe</td>
<td>Assortment of mechanical joints</td>
</tr>
<tr>
<td>Hard hat</td>
<td>Samples of neutralizing agents</td>
<td>Lengths of plain- and beaded-end borosilicate glass pipe</td>
</tr>
<tr>
<td>Hand protection</td>
<td>Lengths of plastic pipe</td>
<td>Lengths of thermoplastic pipe</td>
</tr>
<tr>
<td>Eye protection</td>
<td>Cold chisels</td>
<td>Floor drain</td>
</tr>
<tr>
<td>Personal protective equipment:</td>
<td>Assortment of fusion fittings</td>
<td>Borosilicate glass pipe cutter</td>
</tr>
</tbody>
</table>

To the extent possible, and as required for performance testing, provide a selection of the tools listed for each session; alternatively, photos may be used to teach tool identification.
Module 02309-14 explains the principles of compressed-air systems and describes their components and accessories, reviews safety issues related to compressed-air systems, and introduces trainees to the installation procedures for compressed-air systems.

### Objectives

**Learning Objective 1**
- Explain the types, functions, and capacities of different compressed-air systems.
  a. Explain the properties of air.
  b. Explain how to measure air pressure.

**Learning Objective 2**
- Identify the different methods of conditioning compressed air.
  a. Describe how aftercoolers are used to condition compressed air.
  b. Describe how air dryers are used to condition compressed air.

**Learning Objective 3**
- Identify the safety issues related to compressed-air systems.
  a. Explain the safety issues related to high temperature and high air pressure.
  b. Explain the safety issues related to installing, repairing, and servicing compressed-air systems.

**Learning Objective 4**
- Explain how to install a basic compressed-air system.
  a. Identify the components of compressed-air systems.
  b. Describe the steps required for installing a compressed-air system.

### Teaching Time: 10 hours

(Four 2.5-hour Classroom Sessions)

Session time may be adjusted to accommodate your class size, schedule, and teaching style.

### Prerequisites

*Core Curriculum, Plumbing Level One, and Plumbing Level Two.*

### Before You Begin

As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the Module Examinations and Performance Profile Sheets from [www.nccerirc.com](http://www.nccerirc.com). The passing score for submission into NCCER’s Registry is 70 percent or above for the Module Examination; performance testing is graded pass or fail.
**Classroom Equipment and Materials**

- Whiteboard/chalkboard
- Markers/chalk
- Pencils and paper
- *Plumbing Level Three PowerPoint® Presentation Slides*
- LCD projector and screen
- Computer
- Copies of the Module Examination and Performance Profile Sheets
- Vendor-supplied videos/DVDs showing aspects of compressed-air system design and installation *(optional)*
- TV/DVD player

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

- Appropriate Personal Protective Equipment:
  - Eye protection
  - Gloves
  - Hard hat
  - Hearing protection
  - Respiratory protection
  - Work boots
- A quarter
- Air-receiver relief valve
- Assortment of compressed-air distribution system controls, including shutoff valves, air-pressure regulators, and lubricators
- Assortment of compressed-air system controls, including stop/start controls, throttles, constant-speed controls, part load controls, and sequencing controls
- Assortment of compressed-air tools, such as air hammers or saws, and the manufacturer’s operating instructions for them
- Assortment of couplings and hose fittings in various thread sizes, including fittings attached to lengths of hose
- Assortment of portable air compressors and their operating instructions
- Assortment of whip checks
- Containers filled with a desiccant material
- Containers filled with water
- Copies of Compressed Air Challenge Fact Sheet #7, “Compressed Air System Leaks”
- Copies of newspaper, magazine, or online articles related to compressed-air safety issues
- Copies of the local applicable code
- Damp tissue
- Empty two-liter plastic soda bottle, with lid
- Flexible hose
- Flexible metal hose
- Freezer
- Intake silencer
- Manual blowdown valve or automatic drain valve
- PTFE tape or other manufacturer-approved sealant
- Section of threaded pipe used for compressed-air tools and equipment
- Variety of air compressors

---

**Safety Considerations**

This module requires that trainees work with sources of compressed air as well as tools and equipment that operate using compressed air. Safety is paramount in the plumbing trade, and safe habits and practices must be emphasized whenever possible. Performance Tasks must be completed under your supervision. Each trainee must use required PPE and follow safe tool practices and procedures.
Additional Resources and References
This module presents thorough resources for task training. The following resource material is suggested for further study:


*Improving Compressed Air System Performance*. Vienna, VA: Resource Dynamics Corporation for Compressed Air Challenge. [compressedairchallenge.org](http://compressedairchallenge.org)


There are a number of online resources available for trainees who would like more information on compressed-air systems. A search for additional information may be assigned as homework to interested trainees.
The lesson plan for this module is divided into four 2.5-hour sessions. Each session includes 10 minutes for administrative tasks and one 10-minute break.

**SESSION ONE**

Session One introduces trainees to the various types, functions, and capacities of compressed-air systems and to the techniques used to condition compressed air.

1. Show Session One PowerPoint® presentation slides.
2. Review and discuss the principles of pneumatics and the properties of air.
3. Discuss the various methods used to measure air pressure.
4. Review the different methods of conditioning compressed air.
5. Explain how aftercoolers condition compressed air.
6. Explain how air dryers condition compressed air.

**SESSION TWO**

Session Two covers compressed-air system safety.

1. Show Session Two PowerPoint® presentation slides.
2. Discuss the safety issues related to high temperature and high air pressure in compressed-air systems.
3. Explain the safety requirements that should be observed when installing, repairing, and servicing compressed-air systems.

**SESSION THREE**

Session Three introduces the techniques for installing compressed-air systems and their components.

1. Show Session Three PowerPoint® presentation slides.
2. Identify the various components of compressed-air systems.
3. Explain how air compressors work.
4. Explain the requirements for pipe in compressed-air systems.
5. Explain how hoses and couplings work in compressed-air systems.
6. Explain the various controls in compressed-air systems.
7. Discuss how to install a compressed-air system.

**SESSION FOUR**

Session Four is a review and testing session. Have trainees complete the module Review Questions and Trade Terms Quiz. (Alternatively, these may be assigned as homework at the end of Session Three.) Answer any questions that trainees may have.

1. Have trainees complete the Module Examination. Any outstanding performance testing must be completed during this session.
2. Record the testing results on Training Report Form 200 and submit the report to your Training Program Sponsor.
<table>
<thead>
<tr>
<th>Personal protective equipment:</th>
<th>Equipment and Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>A quarter</td>
<td>Flexible hose</td>
</tr>
<tr>
<td>Air-receiver relief valve</td>
<td>Flexible metal hose</td>
</tr>
<tr>
<td>Assortment of whip checks</td>
<td>Freezer</td>
</tr>
<tr>
<td>Containers filled with water</td>
<td>Intake silencer</td>
</tr>
<tr>
<td>Damp tissue</td>
<td>Variety of air compressors</td>
</tr>
<tr>
<td>Empty two-liter plastic soda bottle, with lid</td>
<td>Manual blowdown valve or automatic drain valve</td>
</tr>
<tr>
<td>PTFE tape or other manufacturer-approved sealant</td>
<td>Containers filled with a desiccant material</td>
</tr>
<tr>
<td>Copies of the local applicable code</td>
<td>Section of threaded pipe used for compressed-air tools and equipment</td>
</tr>
<tr>
<td>Assortment of portable air compressors and their operating instructions</td>
<td>Copies of Compressed Air Challenge Fact Sheet #7, “Compressed Air System Leaks”</td>
</tr>
<tr>
<td>Assortment of compressed-air tools, such as air hammers or saws, and the manufacturer’s operating instructions for them</td>
<td>Assortment of couplings and hose fittings in various thread sizes, including fittings attached to lengths of hose</td>
</tr>
<tr>
<td>Assortment of compressed-air system controls, including stop/start controls, throttles, constant-speed controls, part load controls, and sequencing controls</td>
<td>Assortment of compressed-air distribution system controls, including shutoff valves, air-pressure regulators, and lubricators</td>
</tr>
<tr>
<td>Copies of newspaper, magazine, or online articles related to compressed-air safety issues</td>
<td></td>
</tr>
</tbody>
</table>

To the extent possible, and as required for performance testing, provide a selection of the tools listed for each session; alternatively, photos may be used to teach tool identification.
Module 02311-14 describes how to troubleshoot and repair problems with water supply and DWV systems and fixtures, and how to observe safety and etiquette standards while on service calls.

Objectives

Learning Objective 1
- Recognize and observe standards of safety and etiquette when making service calls to residential and commercial facilities.
  a. Observe safety on service calls.
  b. Observe etiquette on service calls.

Learning Objective 2
- Explain how to troubleshoot and repair problems with water supply systems.
  a. Explain how to troubleshoot and repair leaks.
  b. Explain how to troubleshoot and repair frozen pipes.
  c. Explain how to troubleshoot and repair water pressure problems.
  d. Explain how to troubleshoot and repair water quality problems.
  e. Explain how to troubleshoot and repair water flow-rate problems.
  f. Explain how to troubleshoot and repair underground pipes.
  g. Explain how to diagnose cross-connections.

Learning Objective 3
- Explain how to troubleshoot and repair problems with fixtures and appliances.
  a. Identify common repair and maintenance requirements and procedures for fixtures, valves, and faucets.
  b. Explain how to troubleshoot and repair water heaters.
  c. Explain how to troubleshoot, repair, and replace tubs, showers, and water closets.
  d. Explain how to troubleshoot and repair other fixtures and appliances.

Learning Objective 4
- Explain how to troubleshoot and repair problems with DWV systems.
  a. Explain how to troubleshoot and address blockages.
  b. Explain how to troubleshoot and correct odor problems.

Performance Tasks

Performance Task 1 (Learning Objective 2)
- Troubleshoot and repair problems with water supply systems.

Performance Task 2 (Learning Objective 3)
- Troubleshoot and repair problems with fixtures, valves, and faucets using the proper tools and replacement parts.

Performance Task 3 (Learning Objective 3)
- Use manufacturer’s instructions to disassemble and re-assemble a valve.

Performance Task 4 (Learning Objective 3)
- Troubleshoot and repair problems with water heaters.

Performance Task 5 (Learning Objective 4)
- Troubleshoot and repair problems with DWV systems.

Teaching Time: 27.5 hours
(Eleven 2.5-hour Classroom Sessions)
Session time may be adjusted to accommodate your class size, schedule, and teaching style.

Prerequisites
Core Curriculum, Plumbing Level One, and Plumbing Level Two.

Before You Begin
As you prepare for each session, allow sufficient time to review the course objectives, content, visual aids (including the PowerPoint® presentation), and these lesson plans and to gather the required equipment and materials. Consider time required for demonstrations, laboratories, field trips, and testing.

Using your access code, download the Module Examinations and Performance Profile Sheets from www.nccerirc.com. The passing score for submission into NCCER’s Registry is 70 percent or above for the Module Examination; performance testing is graded pass or fail.
### Safety Considerations

This module requires that trainees work with fixtures and fittings that are designed for use in conditions where toxic, flammable, and biohazardous materials may be present. Safety is paramount in the plumbing trade, and safe habits and practices must be emphasized whenever possible. Performance Tasks must be completed under your supervision. Each trainee must use required PPE and follow safe tool practices and procedures.

### Classroom Equipment and Materials

- Whiteboard/chalkboard
- Markers/chalk
- Pencils and paper
- PowerPoint® Presentation Slides
- LCD projector and screen
- Computer
- Copies of the Module Examination and Performance Profile Sheets
- Vendor-supplied videos/DVDs showing how to troubleshoot and repair problems with water supply and DWV systems and fixtures and how to observe safety and etiquette standards while on service calls (optional)
- TV/DVD player

### Equipment and Materials for Laboratories and Performance Testing

#### Appropriate Personal Protective Equipment:
- Gloves
- Hard hat
- Eye protection
- Hearing protection
- Work boots
- Respiratory protection

#### Cartridge pullers
- Compression faucets
- Containers of sealant liquid used in waterless urinals
- Copies of articles from print or online magazines about service call etiquette
- Copies of installation manuals for a variety of electric and gas water heaters
- Copies of or excerpts from NFPA 99, Health Care Facilities Code
- Copies of or extracts of Chapter 10 of the latest edition of the International Plumbing Code®
- Copies of the local applicable code
- Copies of the manufacturer's instructions for a zeolite system
- Copies of the Safe Drinking Water Act
- Domestic food-waste disposer
- Drain-cleaning glove
- Drills
- Drum trap
- Dust mask and a respirator used in confined spaces
- Fiberglass tubs or shower stalls
- Float-controlled valve assemblies
- Frost-free wall hydrant
- Frost-free yard hydrant
- Gas-fired and electric water heaters (one of these will need to be filled for the Wrap Up exercise)
- Hammers or mallets
- Kitchen sinks mounted on cabinets, with related piping
- Lockout/tagout device
- Manufacturer's instructions for the filled water heater
- Mini tube cutter
- Oil of peppermint
- One or more immersion elements
- One or more sacrificial anodes
- Penetrating oil
- Pipe, teakettle, or other metal object affected by hard-water deposits

#### Lengths of blocked DWV pipe

#### Lengths of DWV pipe showing evidence of corrosion due to rust, electrolysis, and galvanic corrosion

#### Lengths of pipe of various materials, including copper tube

#### Augers, drum machines, rodders, and jetters

#### Cartridge, rotating-ball, ceramic-disc, and touch faucets

#### Examples of damaged plastic and metal water supply pipe

#### Electronic controls for faucets

#### Faucet water filters

#### Fixture traps fitted with trap primers

#### Flow restrictors

#### Globe and gate valves (including some that have been blocked with broken screws)

#### Manual and sensor flushometers

#### Waterless urinals

#### Float-controlled, tank flush, balancing, and T/P valves

#### Pipe insulation

#### Press fittings and pressing tools

#### Examples of sewage removal systems

#### Examples of sinks or lavatories with clogged drains

#### Water supply fittings with various defects

#### Assortment of water supply pipe

#### Backflow preventers, including one designed to be installed on a lawn sprinkler supply line

#### Bladder tank pressure switch

#### Cartridge filters used in waterless urinals

#### Cartridge pullers

#### Compression faucets

#### Containers of sealant liquid used in waterless urinals

#### Copies of articles from print or online magazines about service call etiquette

#### Copies of installation manuals for a variety of electric and gas water heaters

#### Copies of or excerpts from NFPA 99, Health Care Facilities Code

#### Copies of or extracts of Chapter 10 of the latest edition of the International Plumbing Code®

#### Copies of the local applicable code

#### Copies of the manufacturer's instructions for a zeolite system

#### Copies of the Safe Drinking Water Act

#### Domestic food-waste disposer

#### Drain-cleaning glove

#### Drills

#### Drum trap

#### Dust mask and a respirator used in confined spaces

#### Fiberglass tubs or shower stalls

#### Float-controlled valve assemblies

#### Frost-free wall hydrant

#### Frost-free yard hydrant

#### Gas-fired and electric water heaters (one of these will need to be filled for the Wrap Up exercise)

#### Hammers or mallets

#### Kitchen sinks mounted on cabinets, with related piping

#### Lockout/tagout device

#### Manufacturer's instructions for the filled water heater

#### Mini tube cutter

#### Oil of peppermint

#### One or more immersion elements

#### One or more sacrificial anodes

#### Penetrating oil

#### Pipe, teakettle, or other metal object affected by hard-water deposits
Plungers
Pump
Removable seat wrenches
Repair kits for manual and sensor flushometers
Reseating tools
Rolls of electric heat tape
Sample of resin from a zeolite system
Sample section of a hypothetical DWV system, including bends, joints, and fittings, with at least one hidden leak
Schrader valve

Screw extractors
Section of cellulose acetate membrane from a reverse-osmosis filtration system
Site plans for a variety of residential and commercial buildings
Stations with flooring
Tee tap wrenches
Temporary pipe clamp
Tools and equipment required to drain a water heater
Tools for installing float-controlled valve assemblies
Tools to install flow restrictors
Tools, equipment, and materials required to make temporary and permanent repairs to pipe
Trap primer installed on a fixture trap
Warm water
Water closets
Water hammer arrester
Water heater stand
Water heater thermostat
Water supply system pump
Wet mortar

Additional Resources and References
This module presents thorough resources for task training. The following resource material is suggested for further study:


There are a number of online resources available for trainees who would like more information on troubleshooting and repairing problems with water supply and DWV systems and fixtures, and observing safety and etiquette standards while on service calls. A search for additional information may be assigned as homework to interested trainees.
The lesson plan for this module is divided into eleven 2.5-hour sessions. Each session includes 10 minutes for administrative tasks and one 10-minute break.

**SESSION ONE**

Session One introduces trainees to service call safety and etiquette.

1. Show Session One PowerPoint® presentation slides.
2. Review the elements of service call safety.
3. Review residential and commercial service call etiquette.

**SESSION TWO**

Session Two introduces trainees to the repair of leaking and frozen pipes.

1. Show Session Two PowerPoint® presentation slides.
2. Discuss the common causes of leaks and the techniques for troubleshooting and repairing them.
3. Discuss how to repair leaks along a fitting.
4. Review how to make temporary repairs along a length of pipe.
5. Discuss the common causes of frozen pipes and the techniques for troubleshooting and repairing them.

**SESSION THREE**

Session Three introduces trainees to the repair of problems with water pressure and quality.

1. Show Session Three PowerPoint® presentation slides.
2. Review and discuss common water pressure problems and how to repair them.
3. Discuss how to troubleshoot and repair problems associated with low water pressure, high water pressure, and bladder tanks.
4. Discuss how to troubleshoot and repair water quality problems caused by hard-water deposits and small particles and organisms.

**SESSION FOUR**

Session Four introduces trainees to techniques for troubleshooting and repairing water flow-rate problems, underground pipes, and cross-connections.

1. Show Session Four PowerPoint® presentation slides.
2. Review the methods for troubleshooting and repairing water flow-rate problems.
3. Discuss the requirements for troubleshooting and repairing underground pipes.
4. Review the hazards posed by cross-connection and how to diagnose and remedy cross-connections in water supply systems.
5. Discuss how to diagnose and service cross-connections in medical gas and vacuum systems.

**SESSIONS FIVE AND SIX**

Sessions Five and Six introduce trainees to the procedures for troubleshooting and repairing fixtures, valves, and faucets.

1. Show Sessions Five and Six PowerPoint® presentation slides.
2. Identify common repair and maintenance requirements and procedures for globe valves; gate valves; flushometers; waterless urinals; float-controlled and tank flush valves; and balancing and T/P valves.
3. Identify common repair and maintenance requirements and procedures for cartridge and rotating-ball faucets; ceramic-disc and touch faucets; and faucet water filters and electronic controls.
## Session Outline for Module 02311-14

**Service Plumbing**

### Session Seven

Session Seven introduces trainees to techniques for troubleshooting and repairing water heaters.

1. Show Session Seven PowerPoint® presentation slides.
2. Review the procedures for draining a water heater.
3. Review common water heater problems and their solutions.
4. Review how to replace a water heater.
5. Review the process of replacing an immersion element in an electric water heater.

### Sessions Nine and Ten

Session Nine and Ten introduce trainees to techniques for troubleshooting and repairing blockages and odor problems in DWV systems.

1. Show Sessions Nine and Ten PowerPoint® presentation slides.
2. Discuss how to troubleshoot and address blockages in drains and traps and in vents and restaurants.
3. Discuss how to troubleshoot and correct odor problems in DWV systems.
4. Review the use of the smoke and peppermint tests in a DWV system.

### Session Eleven

Session Eleven is a review and testing session. Have trainees complete the module Review Questions and Trade Terms Quiz. (Alternatively, these may be assigned as homework at the end of Session Ten.) Answer any questions that trainees may have.

1. Have trainees complete the Module Examination. Any outstanding performance testing must be completed during this session.
2. Record the testing results on Training Report Form 200, and submit the report to your Training Program Sponsor.

---

### Session Eight

Session Eight introduces trainees to techniques for troubleshooting and repairing tubs, showers, water closets, domestic dishwashers, and lawn sprinklers.

1. Show Session Eight PowerPoint® presentation slides.
2. Review the techniques for troubleshooting, repairing, and replacing tubs, showers, and water closets.
3. Explain how to troubleshoot and replace domestic dishwashers.
4. Explain how to troubleshoot and repair problems with lawn sprinklers.
<table>
<thead>
<tr>
<th>Equipment and Materials</th>
<th>Personal protective equipment:</th>
<th>Backflow preventer</th>
<th>Schrader valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gloves</td>
<td>Bladder tank pressure switch</td>
<td>Temporary pipe clamp</td>
<td></td>
</tr>
<tr>
<td>Hard hat</td>
<td>Drain-cleaning glove</td>
<td>Water hammer arrester</td>
<td></td>
</tr>
<tr>
<td>Eye protection</td>
<td>Drum trap</td>
<td>Water heater stand</td>
<td></td>
</tr>
<tr>
<td>Hearing protection</td>
<td>Frost-free wall hydrant</td>
<td>Water heater thermostat</td>
<td></td>
</tr>
<tr>
<td>Work boots</td>
<td>Frost-free yard hydrant</td>
<td>Water supply system pump</td>
<td></td>
</tr>
<tr>
<td>Respiratory protection</td>
<td>Lockout/tagout device</td>
<td>Cartridge pullers</td>
<td></td>
</tr>
<tr>
<td>Whiteboard/chalkboard</td>
<td>Mini tube cutter</td>
<td>Compression faucets</td>
<td></td>
</tr>
<tr>
<td>Markers/chalk</td>
<td>Hammers or mallets</td>
<td>Oil of peppermint</td>
<td></td>
</tr>
<tr>
<td>Pencils and paper</td>
<td>Penetrating oil</td>
<td>Plungers</td>
<td></td>
</tr>
<tr>
<td><strong>Plumbing Level Three PowerPoint® Presentation Slides</strong></td>
<td>Backflow preventer, including</td>
<td>A pipe, teakettle, or other metal object affected by hard-water deposits</td>
<td></td>
</tr>
<tr>
<td></td>
<td>one designed to be installed</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>on a lawn sprinkler supply</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>line</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LCD projector and screen</td>
<td>Pump</td>
<td>Warm water</td>
<td></td>
</tr>
<tr>
<td>Computer</td>
<td>Removable seat wrenches</td>
<td>Reseating tools</td>
<td></td>
</tr>
<tr>
<td>Copies of the Module Examination and Performance Profile</td>
<td>An assortment of cartridge,</td>
<td>Examples of damaged plastic and metal water supply pipe</td>
<td></td>
</tr>
<tr>
<td></td>
<td>rotating-ball, ceramic-disc,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>and touch faucets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vendor-supplied videos/DVDs showing how to troubleshoot</td>
<td>Assorted lengths of DWV pipe</td>
<td>A sample section of a hypothetical DWV system, including bends, joints, and fittings, with at least one hidden leak</td>
<td></td>
</tr>
<tr>
<td>and repair problems with water supply and DWV systems and</td>
<td>showing evidence of corrosion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fixtures, and/or how to observe safety and etiquette</td>
<td>due to rust, electrolysism,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>standards while on service calls (optional)</td>
<td>and galvanic corrosion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TV/DVD player</td>
<td>Water closets</td>
<td>Wet mortar</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fixture traps fitted with trap primers</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Manual and sensor flushometers</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cartridge filters used in</td>
<td>Examples of sewage removal systems</td>
<td></td>
</tr>
<tr>
<td></td>
<td>waterless urinals</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Examples of sinks or lavatories with clogged drains</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Examples of sinks or lavatories with clogged drains</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water supply fittings with</td>
<td>An assortment of water supply pipe</td>
<td></td>
</tr>
<tr>
<td></td>
<td>various defects</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lengths of blocked DWV pipe</td>
<td>Containers of sealant liquid used in waterless urinals</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Copies of or excerpts from</td>
<td>Copies of or extracts of Chapter 10 of the latest edition of the International Plumbing Code®</td>
<td></td>
</tr>
<tr>
<td></td>
<td>NFPA 99, Health Care Facilities Code</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Copies of the local applicable code</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kitchen sinks mounted on</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>cabinets, with related piping</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rolls of electric heat tape</td>
<td>Screw extractors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stations with flooring</td>
<td>Tee tap wrenches</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Drills</td>
<td>Fiberglass tubs or shower stalls</td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td>Description</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copies of installation manuals for a variety of electric and gas water heaters</td>
<td>Lengths of pipe of various materials, including copper tube</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The tools, equipment, and materials required to make temporary and permanent repairs to pipe</td>
<td>Gas-fired and electric water heaters (one of these will need to be filled for the Wrap Up exercise)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pipe insulation</td>
<td>Press fittings and pressing tools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site plans for a variety of residential and commercial buildings</td>
<td>Tools and equipment required to drain a water heater</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electronic controls for faucets</td>
<td>Faucet water filters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repair kits for manual and sensor flushometers</td>
<td>Copies of the Safe Drinking Water Act</td>
<td></td>
<td></td>
</tr>
<tr>
<td>An assortment of augers, drum machines, rodders, and jetters</td>
<td>Dust mask and a respirator used in confined spaces</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A sample of resin from a zeolite system</td>
<td>Trap primer installed on a fixture trap</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tools to install flow restrictors</td>
<td>Float-controlled valve assemblies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Globe and gate valves (including some that have been blocked with broken screws)</td>
<td>Section of cellulose acetate membrane from a reverse-osmosis filtration system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Domestic food-waste disposer</td>
<td>One or more sacrificial anodes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The manufacturer’s instructions for the filled water heater</td>
<td>Copies of the manufacturer’s instructions for a zeolite system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tools for installing float-controlled valve assemblies</td>
<td>One or more immersion elements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waterless urinals</td>
<td>Flow restrictors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Float-controlled, tank flush, balancing, and T/P valves</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

To the extent possible, and as required for performance testing, provide a selection of the tools listed for each session; alternatively, photos may be used to teach tool identification.