

# Plumbing Standards and Skills

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## Health & Safety Standards

### Standard 1: Safety and Health in a Plumbing Environment

Students will be able to demonstrate health and safety in a construction environment, including the management of tools and equipment, use of personal protective equipment, and workspace ergonomics.

* Aligned Industry Recognized Credentials: OSHA10 – Construction

#### Skills:

1. Safely use and store hand tools, power tools, and ladders according to OSHA standards.
2. Appropriately document and communicate safety risks and equipment maintenance needs.
3. Select and use personal protective equipment, including safe use and maintenance of fall protection according to current industry and OSHA standards.
4. Describe OSHA 10 Construction standards and explain their relevance to plumbing.
5. Demonstrate compliance with each of the standards in Subpart Q of OSHA 10 General Industry Standards (1910.252-1910.255) related to welding, cutting, and brazing.
6. Comply with appropriate fire protection regulations, local permit regulations, and state/federal regulations (OSHA, Hot Work, National Fire Protection Association, 527CMR.100).
7. Describe and demonstrate methods of safely using acetylene and other gases.
8. Describe and demonstrate methods of safely working with sewage and contaminated soil.
9. Describe and demonstrate basic safety procedures that apply to ladder safety.
10. Describe and apply regulations for working in confined space.

## Technical & Integrated Academic Standards

### Standard 2: Plumbing in Society

Students will be able to explain the importance of plumbing in communities and describe the advancement of plumbing in society.

#### Skills:

1. Explain the historical and modern-day developments of plumbing.
2. Describe the impact of plumbing on the health, safety, and advancement of society.
3. Identify the regulatory codes, standards, and licensing/certification requirements for the modern plumbing industry.
4. Identify and describe career opportunities in the field of plumbing.
5. Describe the concept of apprenticeship models and the professional and licensure requirements of the plumbing industry.
6. Identify career opportunities available in the plumbing industry.
7. Identify and define jurisdictional boundaries of utilities, fire department, and local inspectors.

### Standard 3: Print Reading

Students will be able to identify, interpret, and design technical drawings and blueprints.

* Aligned Industry Recognized Credentials: Credit toward Massachusetts Plumbing License

#### Skills:

1. Understand terms, abbreviations, symbols, and line types of technical drawings and blueprints.
2. Design plumbing, gas, and hydronic technical drawings and blueprints utilizing Computer Aided Drafting equipment.
3. Describe the basic layout of a set of prints, as well as the importance of the accompanying job specifications document.
4. Interpret and follow drawing dimensions.
5. Convert measurements from a print using an architect’s scale.
6. Define and interpret floor plans, elevations, sections, details, ceiling plans, and finish schedules.
7. Explain and implement estimating methods in pricing jobs using drawings/prints and permit applications.
8. Describe, develop, and complete material quantity takeoff lists.
9. Explain how state and/or local code requirements apply to prints.

### Standard 4: Standard Plumbing Techniques

Students will be able to utilize techniques in measuring, cutting, reaming, supporting, and joining pipes made of common plumbing materials, including steel, copper, cast iron, plastic, corrugated stainless steel (CSST), and flue systems.

* Aligned Industry Recognized Credentials: Credit toward Massachusetts Plumbing License

#### Skills:

1. Identify the names, classifications, and sizing of fittings of common plumbing materials.
2. Identify the appropriate material for a project, create a material list, and assemble the project to the specified dimensions while aligning to state regulation and code.
3. Demonstrate techniques in measuring, cutting, reaming, supporting, and joining steel pipe and fittings.
4. Identify the common types and schedules of steel pipe and fittings.
5. Identify the names, classification, and sizing of fittings used with steel pipe.
6. Measure, cut, ream, support, and join steel pipe in all sizes using pipe dies.
7. Measure, cut, ream, support, and join steel pipe using the rolled groove method.
8. Measure, cut, ream, support, and join steel pipe using mechanical press technology.
9. Demonstrate techniques in measuring, cutting, reaming, supporting, and joining copper tubing and fittings.
10. Identify the common types and schedules of copper tubing and fittings.
11. Identify the names, classification, and sizing of fittings used with copper tubing.
12. Measure, cut, ream, support, and join copper tubing for solder, braze, compression, roll groove, mechanical press technology, push-to-connect, and flare type fittings.
13. Demonstrate techniques in measuring, cutting, and joining cast iron pipe and fittings.
14. Identify the common types and schedules of cast iron pipe and fittings.
15. Identify the names, classifications, and sizing of fittings used with cast iron pipe.
16. Accurately measure, cut, support, and join cast iron pipe for lead & oakum, no-hub, and resilient gasket type fittings, (if pouring lead joints, OSHA safety standards must be in place).
17. Demonstrate techniques in measuring, cutting, reaming, and joining plastic pipe & fittings.
18. Identify the common types and schedules of plastic pipe and fittings.
19. Identify the names, classifications, and sizing of fittings used with plastic pipe and fittings.
20. Accurately measure, cut, ream, support, and join plastic pipe, utilizing solvent weld, heat fusion, PEX joining methods, and compression type fittings.
21. Demonstrate techniques in measuring, cutting, and joining CSST (Corrugated Stainless-Steel Tubing) and fittings.
22. Identify the common types of CSST and fittings.
23. Identify the names, classifications, and sizing of fittings used with tubing.
24. Measure, cut, support, and join CSST tubing for a gas installation.
25. Demonstrate techniques in measuring, cutting, and joining flue systems.
26. Identify the common types of flue systems.
27. Identify the names and classifications of fittings used with flue systems.
28. Design and size a flue system referencing the NFPA 54 and NFPA 58.
29. Measure, cut, support, connect, and install flue systems.

### Standard 5: Water Supplies and Massachusetts Plumbing Code

Students will be able to identify the major components and functions of public and private water supply systems utilizing the Massachusetts State Plumbing Code.

* Aligned Industry Recognized Credentials: Credit toward Massachusetts Plumbing License

#### Skills:

1. Define features and regulations of water supply systems as described in the state code.
2. Identify pipe and fitting materials allowed on water supply systems as described in the state code.
3. Identify the major components of a public and private water supply system and describe the function of each component.
4. Design and size a potable water system referencing the Massachusetts State Plumbing Code.
5. Install a water piping system according to the Massachusetts State Plumbing Code.
6. Test a water supply system according to the Massachusetts State Plumbing Code.
7. Identify methods of protecting the potable water system as described in the Massachusetts State Plumbing Code.
8. Identify means of producing hot water and the protection of these systems as described in the Massachusetts State Plumbing Code.

### Standard 6: Drainage, Waste, and Venting Systems

Students will be able to identify the fundamental components and proper techniques to design and install drainage, waste and vent piping systems utilizing the Massachusetts State Plumbing Code.

* Aligned Industry Recognized Credentials: Credit toward Massachusetts Plumbing License

#### Skills:

1. Identify proper materials used in venting, waste, and drainage systems.
2. Identify common types and patterns of drainage, waste, and venting systems.
3. Describe how waste moves from a fixture through the drainage system to the environment.
4. Identify the major components of a drainage system and describe their functions.
5. Identify types and parts of traps; describe the operation and function of traps; and how they lose their seals.
6. Identify proper drainage pattern fittings that are allowed to be used for a sanitary waste system.
7. Install a waste system according to the Massachusetts State Plumbing Code.
8. Design and size a sanitary waste system according to the Massachusetts State Plumbing Code.
9. Test sanitary waste according to the Massachusetts State Plumbing Code.
10. Identify and describe the parts and sizing of an indirect waste pipe system.
11. Identify and define special waste systems as described in the Massachusetts State Code.
12. Identify and define pipe and fitting materials allowed on DWV systems as described in the Massachusetts State Plumbing Code.
13. Define and demonstrate the fundamentals of venting a plumbing system.
14. Define and demonstrate the scientific principles of venting.
15. Identify the following types of venting: individual vent, common vent, stack vent, wet vent, bow vent, continuous waste and vent, battery (circuit and loop), and future vent.
16. Size a venting system according to the Massachusetts State Plumbing Code.
17. Identify pipe and fitting materials allowed on venting systems described by the Massachusetts State Plumbing Code.
18. Identify the major components of a public and private drainage system and describe the function of each component.
19. Demonstrate techniques in sizing and installing roof and area drains.
20. Size a roof or area drain using the tables supplied from the Massachusetts State Plumbing Code.
21. Set the elevation of a floor or area drain using a surveyor’s level, laser, or transit.

### Standard 7: Diagnosis and Troubleshooting

Students will be able to install, troubleshoot and service common plumbing systems, including plumbing fixtures, washing, and drying machines, dishwashers, faucets, food waste grinders, appliances, and hydronic equipment.

* Aligned Industry Recognized Credentials: Credit toward Massachusetts Plumbing License

#### Skills:

1. Diagnose problems of common valves, appliances, and fixtures.
2. Select the appropriate materials to troubleshoot and service common machines and appliances.
3. Dismantle and reassemble common fixtures, appliances, and machines.
4. Demonstrate techniques in selecting and installing plumbing fixtures.
5. Read and interpret manufacturer fixture roughing in sheets.
6. Identify the types and styles of plumbing fixtures.
7. Describe the procedures for the installation and maintenance of plumbing fixtures.
8. Describe the operation and assembly of flushometers, ballcocks, and water closet discharge systems.
9. Describe the types, assembly, and repair of shower valves.
10. List the reasons for installing anti-scald shower valves.
11. Install and repair faucets.
12. Install dishwashers.
13. Install food waste grinders.
14. Install laundry/washing machine connections.
15. Install, service, and maintain Hydronic Equipment.
16. Demonstrate techniques in servicing a plumbing system.
17. Diagnose water supply problems.
18. Identify water quality problems.
19. Identify and service various types of valves.
20. Identify and define different types of corrosion and their effects on piping services.
21. Troubleshoot and repair water supply problems.
22. Troubleshoot and repair drainage problems.

### Standard 8: Fuel Gas Systems

Students will be able to identify the fundamental components and proper techniques to troubleshoot and install fuel gas systems utilizing the Massachusetts State Fuel Gas Code.

* Aligned Industry Recognized Credentials: Credit toward Massachusetts Plumbing License

#### Skills:

1. Identify components of fuel gas systems.
2. Describe potential hazards of fuel gas systems and follow safety precautions.
3. Design piping and venting systems for a fuel gas system.
4. Connect common appliances to a fuel gas system.
5. Troubleshoot and repair common issues with fuel gas systems.
6. Demonstrate techniques in sizing and installing fuel gas systems.
7. Identify the components of fuel gas systems (natural and LP) and describe the function of each component.
8. Identify the physical properties of natural and LP gases.
9. Apply the Massachusetts State Fuel Gas Code in the installation and venting of fuel gas systems.
10. Design and size all piping in a fuel gas and venting system using the Massachusetts State Fuel Gas Code.
11. Diagnose and repair problems with the fuel gas system and its connected appliances.
12. Adjust and maintain fuel gas systems and its connected appliances.

## Employability Standards

### Standard 9: Employability Skills

Students will understand and demonstrate the roles of professional communication, critical thinking, problem solving, professionalism, teamwork, and collaboration within the context of plumbing careers.

#### Skills:

1. Demonstrate the impact of communication skills on the success of a plumbing system installation.
2. Describe appropriate methods of communication for internal and external stakeholders.
3. Evaluate the impact of poor communication by plumbers on the safety of a job site.
4. Troubleshoot a project plan to find mistargeted or extraneous work that does not contribute to the ultimate objectives of the project.
5. Build a team-based project plan that results in a successful plumbing system installation and that includes recruiting teammates and assigning roles for a project.
6. Examine the role of a Plumber in society, particularly in terms of its significance for employability and career opportunities.

## Entrepreneurship Standards

### Standard 10: Entrepreneurship

Students will be able to describe opportunities for entrepreneurship and be able to evaluate the value proposition of business ownership in the plumbing field.

#### Skills:

1. Understand and be able to explain the needs of a startup plumbing services company (including initial equipment and staffing needs, a marketing/business development plan, and a basic revenue management strategy).
2. Describe the concept of professional networking and demonstrate personal introductions and an “elevator speech” appropriate for other plumbers, contractors, developers, and other potential business partners.
3. Evaluate the licensing, regulatory and tax implications of self-employment and business ownership as a plumber compared to W-2 employment.

## Digital Literacy Standards

### Standard 11: Digital Literacy

Students will be able to demonstrate the use of common software and information technology in a modern plumbing environment.

#### Skills:

1. Describe the use of online resources in licensing and professional development as a plumber.
2. Demonstrate the use of a common ticketing/case management system for plumbing services.
3. Demonstrate the use of common scheduling, resource management, and customer relationship software systems.
4. Understand where to find online resources that support effective plumbing work and how to be a safe and ethical consumer and creator of digital content.
5. Apply strategies for using digital tools and technology to drive business and commerce.

## Sample Performance Tasks

### Standard 1: Safety and Health in a Plumbing Environment

Students will be able to demonstrate health and safety in a construction environment, including the management of tools and equipment, use of personal protective equipment, and workspace ergonomics.

* Aligned Industry Recognized Credentials: OSHA10 – Construction

#### Sample Performance Tasks:

* Students will participate in daily/weekly “Toolbox Safety Talks” and pass a written and performance test for all shop tools and equipment before using them.

### Standard 2: Plumbing in Society

Students will be able to explain the importance of plumbing in communities and describe the advancement of plumbing in society.

#### Sample Performance Tasks:

* The student will construct a table indicating the progression of career paths in the Plumbing and Piping Industry.

### Standard 3: Print Reading

Students will be able to identify, interpret and design technical drawings and blueprints.

* Aligned Industry Recognized Credentials: Credit toward Massachusetts Plumbing License

#### Sample Performance Tasks:

* Students will perform shop/job site projects/work from appropriate sets of prints/drawings.
* Student will develop a material quantity takeoff for a given project/job.
* Students will develop a cost estimate for materials and from material quantity takeoff for a given project/job.
* Student will prepare an application for an appropriate plumbing/gas permit.

### Standard 4: Standard Plumbing Techniques

Students will be able to utilize techniques in measuring, cutting, reaming, supporting, and joining pipes made of common plumbing materials, including steel, copper, cast iron, plastic, corrugated stainless steel (CSST), and flue systems.

* Aligned Industry Recognized Credentials: Credit toward Massachusetts Plumbing License

#### Sample Performance Tasks:

* The student will select the appropriate materials for a given project and write a material list, assemble the project to the specified dimensions, and pressure test the project.
* The student will select the appropriate materials for a given project and write a material list, assemble the project to the specified dimensions, and pressure test the project.
* The student will select the correct material for the project and write a material list, assemble the project to correct dimensions and pressure test the project.
* The student will select the appropriate materials for a given project and write a materials list, assemble the project to the specified dimensions and pressure test the project.
* The student will select the correct material for the project and write a material list, assemble the project to correct dimensions and pressure test the project.
* Student will explain flue system installation limitations.

### Standard 5: Water Supplies and Massachusetts Plumbing Code

Students will be able to identify the major components and functions of public and private water supply systems utilizing the Massachusetts State Plumbing Code.

* Aligned Industry Recognized Credentials: Credit toward Massachusetts Plumbing License

#### Sample Performance Tasks:

* + - Student will identify the major components of a public and private water supply system and describe the function of each component.

### Standard 6: Drainage, Waste, and Venting Systems

Students will be able to identify the fundamental components and proper techniques to design and install drainage, waste, and vent piping systems utilizing the Massachusetts State Plumbing Code.

* Aligned Industry Recognized Credentials: Credit toward Massachusetts Plumbing License

#### Sample Performance Tasks:

* Identify the major components of a public and private drainage system and describe the function of each component.
* The student will identify the major components of a designated vent system and describe its function. Size, install, and test the vent system in accordance with the Massachusetts State Plumbing Code.
* The student will size and install a roof drain according to Massachusetts State Plumbing Code using cast iron no hub pipe.

### Standard 7: Diagnosis and Troubleshooting

Students will be able to install, troubleshoot and service common plumbing systems, including plumbing fixtures, washing, and drying machines, dishwashers, faucets, food waste grinders, appliances, and hydronic equipment.

* Aligned Industry Recognized Credentials: Credit toward Massachusetts Plumbing License

#### Sample Performance Tasks:

* The student will install a bathroom fixture group consisting of a water closet, lavatory, and tub & shower combination, laundry connection, and a kitchen group consisting of a kitchen sink, food waste grinders, and dishwasher.
* Given several different types of valves the student will dismantle each, identify the major parts and reassemble each to working condition.

### Standard 8: Fuel Gas Systems

Students will be able to identify the fundamental components and proper techniques to troubleshoot and install fuel gas systems utilizing the Massachusetts State Fuel Gas Code.

* Aligned Industry Recognized Credentials: Credit toward Massachusetts Plumbing License

#### Sample Performance Tasks:

* The student will identify the major component of a gas piping system and describe the function of each component.