



# PLUMBING 46.0503.00

## TECHNICAL STANDARDS

Arizona's CTE Plumbing Program Technical Standards are adopted from the National Center for Construction Education Research (NCCER) the leading provider of construction education for industry and career and technical education programs. The Arizona Career and Technical Education Quality Commission, the validating authority for the Arizona Skills Standards Assessment System, approved this adoption on May 14, 2024.

Note: Arizona's Professional Skills are taught as an integral part of the Plumbing program.

**The Technical Skills Assessment for Plumbing is available SY 2025-2026.**

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### STANDARD 1.0 INVESTIGATE THE PLUMBING PROFESSION

- 1.1 Trace the history of plumbing systems from as early as 2900 BC to the 20<sup>th</sup> century
- 1.2 Describe plumbing as a system and a business practice and its influence on modern society
- 1.3 Describe the responsibilities of plumbers (e.g., install and maintain safe, reliable plumbing systems)
- 1.4 Identify skills and personal characteristics needed to be a successful plumber (i.e. skilled at working with hands, ability to use precise measuring and testing tools to solve complex problems, can read and interpret construction drawings, able to understand and apply legal standards, etc.)
- 1.5 Identify plumbing specialties (career opportunities) in commercial and residential settings
- 1.6 Describe plumbing codes and licenses
- 1.7 Explain an apprentice versus a journey plumber
- 1.8 Identify industry-recognized credentials for plumbers

### STANDARD 2.0 APPLY PLUMBING RULES AND SAFETY REGULATIONS

- 2.1 Identify plumbing hazards that can lead to serious accidents or injuries (e.g., unsafe practices, unsafe acts, and unsafe conditions)
- 2.2 Explore direct and indirect cost or delays, increased expenses, and loss of life due to accidents
- 2.3 Describe the proper use and care of personal protective equipment (i.e., hard hats, eye and face protection, gloves, safety shoes, hearing protection, proper clothing, etc.)
- 2.4 Describe OSHA and other state and national regulations and programs designed to reduce safety risks and workplace injuries (i.e., proper use of fall protection equipment, proper use of respiratory protection, proper clothing and grooming, the HazCom training on labels and SDSs, worksite emergency response plan, etc.)
- 2.5 Use, maintain, and store hand tools and power tools appropriately
- 2.6 Identify methods used to establish work zone safety (i.e., danger signs, caution signs, information signs, safety instruction signs, barricades and barriers)
- 2.7 Describe safety precautions associated with various work areas (e.g., confined spaces, underground work, lockout/tagout procedure, and jobsite safeguards and emergency response procedures)

### STANDARD 3.0 PERFORM BASIC MATHEMATICAL CALCULATIONS

- 3.1 Demonstrate mathematical operations using whole numbers
- 3.2 Demonstrate mathematical operations using fractions
- 3.3 Demonstrate mathematical operations using decimals
- 3.4 Demonstrate mathematical conversions
- 3.5 Describe the metric system
- 3.6 Demonstrate the use of squares and square roots
- 3.7 Explain how pipe is measured (e.g., end to end, end to center, center to center, end to face, face to face, and face to throat)
- 3.8 Calculate pipe lengths
- 3.9 Recognize how different types of math are used on the job

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## **STANDARD 4.0 READ AND INTERPRET PLUMBING DRAWINGS**

- 4.1 Differentiate types of drawings used to install plumbing systems [e.g., pictorial drawings, schematic diagrams, orthographic drawings, and plumbing-specific drawings (e.g., submittal fixture drawings, exploded views, and cutaways)]
- 4.2 Identify elements of a drawing set (e.g., title sheet, site plan, foundation plan, floor plan, elevation drawings, electrical drawings, HVAC/mechanical drawings, plumbing drawings, and coordination drawings)
- 4.3 Identify components of a drawing (e.g., title blocks and revision blocks, section and detail drawings, schedules, notes, abbreviations, and legends)
- 4.4 Explain how to scale and dimension a drawing
- 4.5 Identify symbols used in construction drawings
- 4.6 Explain the role of construction documents in plumbing
- 4.7 Sketch orthographic and isometric drawings
- 4.8 Illustrate methods for measuring pipe length using a variety of tables and illustrations
- 4.9 Read a plumbing drawing including codes, specifications, and building information

## **STANDARD 5.0 DEMONSTRATE TECHNIQUES TO MEASURE, CUT, JOIN, AND SUPPORT PLASTIC PIPE AND FITTINGS**

- 5.1 Identify types of plastic pipe and their uses (e.g., ABS, PVC, CPVC, PEX, and PB)
- 5.2 Describe sizing and labeling of plastic pipe
- 5.3 Describe different types of fittings used on plastic pipe
- 5.4 Identify storage and handling requirements for plastic pipe
- 5.5 Describe how to measure and cut plastic pipe
- 5.6 Describe how to join PVC and CPVC pipe
- 5.7 Describe the installation procedures for PVC bell-and-spigot pipe
- 5.8 Describe the methods for joining PEX and PE tubing
- 5.9 Describe hangers and fasteners used to support pipe
- 5.10 Describe the protection of plastic pipes in concealed locations
- 5.11 Explain methods of pressure testing plastic pipe
- 5.12 Select the correct types of material for plastic piping systems
- 5.13 Identify types of fittings and valves and their uses related to plastic pipes
- 5.14 Select appropriate PPE equipment for working with plastic piping
- 5.15 Measure, cut, and join plastic piping
- 5.16 Select the correct support and spacing for the application for plastic pipes

## **STANDARD 6.0 DEMONSTRATE TECHNIQUES TO MEASURE, CUT, JOIN, AND SUPPORT COPPER TUBE AND FITTINGS**

- 6.1 Identify types of copper tube and their sizes
- 6.2 Describe sizing and labeling of copper tube
- 6.3 Describe different types of fittings and valves used on copper tube
- 6.4 Identify storage and handling requirements for copper tube
- 6.5 Explain the tools and methods used to measure copper tube
- 6.6 Explain the tools and methods used to cut copper tube
- 6.7 Describe the tools and methods used to bend copper tube
- 6.8 Describe the different methods used to join copper tube
- 6.9 Describe the hangers and fasteners used to support copper tube
- 6.10 Explain the insulation requirements for copper tube
- 6.11 Explain methods of pressure testing copper tube systems
- 6.12 Select correct types of materials for copper tube systems
- 6.13 Identify types of fittings and valves and their uses related to copper tubes
- 6.14 Select appropriate PPE equipment for working with copper tubes
- 6.15 Measure, cut, and join copper tube

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6.16 Select the correct support and spacing for the application for copper tubes

## **STANDARD 7.0 DEMONSTRATE TECHNIQUES TO MEASURE, CUT, AND JOIN CAST IRON PIPE AND FITTINGS**

- 7.1 Describe types of cast iron pipe and how they are sized and labeled (e.g., hub-and-spigot pipe and no-hub pipe)
- 7.2 Identify cast iron fittings and their applications (e.g., bends, branches, reducers, and traps)
- 7.3 Explain tools and methods used to measure, cut, and join cast iron pipe
- 7.4 Describe how to join hub-and-spigot and no-hub pipe
- 7.5 Describe how to support horizontal and vertical pipe runs
- 7.6 Explain how to install and test cast iron pipe
- 7.7 Select correct materials for cast iron piping systems
- 7.8 Identify fittings and their uses related to cast iron pipes
- 7.9 Select PPE equipment for cast iron pipe
- 7.9 Measure, cut, and join cast iron pipe
- 7.10 Select support and spacing for the application related to pipes and fittings

## **STANDARD 8.0 DEMONSTRATE TECHNIQUES TO MEASURE, CUT, AND JOIN STEEL PIPE AND FITTINGS**

- 8.1 Describe sources, applicable material standards, and storage and handling of steel pipe
- 8.2 Explain methods used to identify pipe threads
- 8.3 Describe different types of fittings and valves used on steel pipe
- 8.4 Explain tools and methods used to measure and cut steel pipe
- 8.5 Describe how to join threaded pipe
- 8.6 Describe how to join grooved pipe
- 8.7 Explain tools and methods used to install corrugated stainless steel tubing (CSST) pipe
- 8.8 Describe hangers and fasteners used to support steel pipe
- 8.9 Explain how to support vertical and horizontal piping runs
- 8.10 Measure, cut, and join steel piping

## **STANDARD 9.0 EXPLAIN THE OPERATION OF FIXTURES AND FAUCETS**

- 9.1 Identify and describe materials used in making plumbing fixtures (i.e., vitreous china, porcelain enamel, cast iron, steel, stainless steel, plastics, etc.)
- 9.2 Identify and describe common bathroom fixtures (e.g., sinks and laboratories, bathtubs, and shower stalls)
- 9.3 Explain the operating principles of water closets and urinals/bidets
- 9.4 Identify and describe common kitchen fixtures (i.e., food waste disposers, dishwashers, etc.)
- 9.5 Identify and describe other common plumbing fixtures (i.e., laundry trays, service sinks and mop basins, drinking fountains, etc.)
- 9.6 Describe compression and non-compression faucets
- 9.7 Describe kitchen and bathroom fixture faucets
- 9.8 Describe utility faucets
- 9.9 Describe basic tools for installing and servicing fixtures and faucets (e.g., basin wrench, basket strainer wrench, crescent wrench, seat wrench, shower valve socket wrench, and spud wrench)

## **STANDARD 10.0 EXPLAIN THE DRAIN, WASTE, AND VENT (DWV) SYSTEM**

- 10.1 Describe how DWV systems remove liquids and solid waste safely and effectively
- 10.2 Identify DWV components (i.e., pipes, drains, traps, vents, etc.)
- 10.3 Identify types and parts of traps (e.g., P-trap and S-trap)
- 10.4 Describe trap installation requirements and challenges (i.e., loss of trap seal, etc)
- 10.5 Identify DWV fittings and their applications (i.e., vents, bends, cleanouts, tees, etc.)
- 10.6 Identify sewer and waste disposal systems and components
- 10.7 Explain how plumbing codes affect the construction of DWV systems
- 10.8 Describe how plumbers connect DWV components to municipal and private sewer systems
- 10.9 Sketch an isometric drawing of a simple DWV system and label its components

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## **STANDARD 11.0 EXPLAIN WATER DISTRIBUTION SYSTEMS**

- 11.1 Describe water sources (e.g., wells, reservoirs, lakes, and streams)
- 11.2 Explain water treatment processes (e.g., how the water supply is treated for chemicals and other contaminants and disinfected for microorganisms that may cause disease and illness)
- 11.3 Describe water distribution systems (e.g., via service line from private supply and via service line from a public water main)
- 11.4 Describe the purpose of backflow preventers (e.g., testing to ensure adequate flow and pressure and flushing to remove sediment from the distribution pipes)
- 11.5 Identify types of valves used in water distribution systems (e.g., gate, globe, angle, ball, check, pressure regulator, supply stop valve, temperature and pressure, and tempering valves)
- 11.6 Identify major components of a building water system and describe how to determine proper placement
- 11.7 Explain requirements for sizing main supply lines
- 11.8 Sketch an isometric drawing of a simple water distribution system and label its components