Arkansas CTE

Plumbing: Grades 9, 10, 11, 12

Adopted 2007

Practicing Safety on the Plumbing Site

1.1 Define terminology related to hazardous materials

1. Use terms appropriately in context 1.1.1

1.2 Identify the chemical risks associated with plumbing occupations, referencing Material Safety Data Sheets

1. Prepare a list of common chemical hazards associated with the plumbing occupation (e.g., primers, acids, cement, flux, and pipe joint compound, as well as others listed on MSDS). 1.2.1

Introduction to Plumbing

2.1 Define terminology related to safety in plumbing

1. Use terms appropriately in context 2.1.1

2.2 Outline the historical development of plumbing

1. Relate the historical landmarks in the development of the plumbing trade, beginning with its origins (4000 B.C.) 2.2.1
2. Relate the impact of Roman aqueducts on features of modern plumbing systems 2.2.2
3. Discuss sanitation problems of the Middle Ages 2.2.3
4. Discuss the development of modern sanitation systems 2.2.4

2.3 Describe the importance of plumbers in modern society

1. Depict ways that plumbing relates to sanitation and public health 2.3.1
2. Demonstrate how improper plumbing and sanitation impacts environmental quality 2.3.2

2.4 Identify the functions of water supply systems

1. Discuss the importance of clean water and its relationship to human health and life span 2.4.1
2. Explain ways a residential water supply system can be contaminated 2.4.2

2.5 Identify the functions of sewage treatment systems

1. Describe the components in a residential sewage disposal system 2.5.1
2. Discuss environmental impacts of improper sewage discharge 2.5.2

Using Math in Plumbing

3.1 Define terminology related to math application in plumbing

1. Use terms appropriately in context 3.1.1

3.2 Identify various pipe dimensions and measurements

1. Demonstrate the ability to read a rule accurately to within +/- 1/32 inch 3.2.1
2. Show how to measure a pipe end-to-end, center-to-center, and face-to-face 3.2.2
3. Determine methods of sizing and specifying various types of pipe used in plumbing 3.2.3

3.3 Select mathematical calculations related to plumbing, using feet and inches as the units of measure

1. Solve various mathematical calculations, using feet and inches 3.3.1
2. Perform various addition, subtraction, and conversion problems applicable to plumbing scenarios 3.3.2

3.4 Identify area and volume related to plumbing

1. Calculate the area of various shaped spaces 3.4.1
2. Calculate the volume of various shaped spaces 3.4.2
3. Calculate the volume of liquid that a round or square tank can hold 3.4.3

3.5 Explain the concept of fitting allowance

1. Discuss reasons for fitting allowances used in plumbing 3.5.1
2. Calculate the fitting allowance for various plumbing fittings 3.5.2

Interpreting Plumbing Construction Drawings

4.1 Define terminology related to interpreting plumbing construction drawings

1. Use terms appropriately in context 4.1.1

4.2 Identify specific plumbing fixtures depicted on plumbing construction drawings

1. Use standard fixtures on a residential construction drawing 4.2.1
2. Use standard fixtures on a commercial construction drawing 4.2.2

4.3 Select items to create a fitting/material list

1. Construct a fitting/material list from construction drawings 4.3.1
2. Use the correct size pipe and fittings necessary to connect fixtures based on construction drawings 4.3.2
3. Verify that plumbing fixture clearances meet code standards 4.3.3
4. Calculate the cost of plumbing materials for various rooms or jobs 4.3.4

4.4 Identify isometric plumbing drawings

1. Explain notes and dimensions used on isometric plumbing drawings 4.4.1
2. Identify fixture and material symbols used on isometric plumbing drawings 4.4.2
3. Compare isometric plans to floor plans and other construction drawings 4.4.3

Identifying Tools Used in Plumbing

5.1 Define terminology related to identifying tools used in the plumbing industry

1. Use terms appropriately in context 5.1.1

5.2 Identify hand tools used in plumbing

1. Demonstrate the uses for common hand tools in the plumbing industry 5.2.1
2. Demonstrate the uses for specialized hand tools in the plumbing industry 5.2.2
3. Use proper hand tools for specific tasks in the plumbing industry 5.2.3

5.3 Select power tools used in plumbing

1. Demonstrate the uses for common power tools in the plumbing industry 5.3.1
2. Demonstrate uses for specialized power tools in the plumbing industry 5.3.2
3. Use proper power tools for specific tasks in the plumbing industry 5.3.3

Cutting and Joining Pipe

6.1 Define terminology related to cutting and joining pipe

1. Use terms appropriately in context 6.1.1

6.2 Describe cutting a cast iron pipe

1. Cut cast iron pipe to length within +/- 1/16 inches 6.2.1
2. Demonstrate techniques to cut cast iron pipe square in a manner that prevents crushing 6.2.2

6.3 Explain cutting and deburring copper tubing

1. Demonstrate cutting copper tubing with a tubing cutter to correct length within +/- 1/16 inches 6.3.1
2. Use a deburring tool on copper tubing according to industry guidelines 6.3.2

6.4 Describe cutting plastic pipe with a PVC/ABS saw or approved cutter

1. Demonstrate cutting PVC/ABS pipe with approved cutting tool with end square and to correct length within +/- 1/16 inches 6.4.1
2. Cut a pipe with a hacksaw with end square and to correct length within +/- 1/16 inches 6.4.2
3. Deburr PVC/ABS pipe 6.4.3

6.5 Explain the purpose of cutting and reaming steel pipe

1. Demonstrate cutting steel pipe to proper length within +/- 1/16 inches, using hand pipe cutters 6.5.1
2. Demonstrate cutting steel pipe to proper length within +/- 1/16 inches, using power pipe cutters 6.5.2
3. Discuss reaming steel pipe according to industry guidelines 6.5.3

6.6 Describe how to join cast iron pipe using rubber-type seal and no-hub connectors

1. Align cast iron pipe to receive connector 6.6.1
2. Check to ensure band and seal are aligned prior to tightening connector 6.6.2
3. Check to ensure no-hub connector is torqued according to plumbing code 6.6.3

6.7 Label a copper pipe (tubing) assembly with solder joints

1. Clean pipe using sandpaper or a wire brush 6.7.1
2. Apply flux with brush to fittings and pipe 6.7.2
3. Apply heat for solder according to industry guidelines 6.7.3
4. Apply solder to joint according to industry guidelines 6.7.4
5. Test piping assembly for leaks 6.7.5
6. Wipe excess flux from joint after assembly cools 6.7.6

6.8 Describe joining plastic pipe (tubing) to fittings using solvent method

1. Use various primer, cement, and solvent types for various piping materials 6.8.1
2. Apply primer/cement/solvent to pipe and fittings according to industry guidelines 6.8.2
3. Demonstrate inserting pipe and assembling joints according to industry guidelines 6.8.3
4. Test pipe assembly for leaks 6.8.4

6.9 Describe how to join copper pipe (tubing) using compression fittings

1. Use various compression fittings for copper pipe 6.9.1
2. Clean compression fittings and pipe according to industry guidelines 6.9.2
3. Tighten compression fittings according to manufacturer's specifications 6.9.3
4. Test piping assembly for leaks 6.9.4

6.10 Outline how to join copper pipe (tubing) to fittings using flare method

1. Select appropriate flare fitting for use on copper pipe `6.10.1`
2. Use a flaring tool and block to prepare a flare joint on copper pipe `6.10.2`
3. Clean fitting and pipe for a flare joint according to industry guidelines `6.10.3`
4. Tighten flare fitting according to manufacturer's specifications `6.10.4`
5. Test pipe assembly for leaks `6.10.5`

6.11 Explain how to join plastic pipe (tubing) to fittings using crimp ring method

1. Determine tools to use with crimp ring method of joining plastic pipe `6.11.1`
2. Discuss uses for crimp ring fittings for copper pipe `6.11.2`
3. Clean fittings and pipe according to industry guidelines `6.11.3`
4. Install crimp ring according to manufacturer's specifications `6.11.4`
5. Test pipe assembly for leaks `6.11.5`

6.12 Describe how to join plastic pipe (tubing) to fittings using clamp/insert fittings method

1. Determine tools to use with clamp/insert fitting method `6.12.1`
2. Discuss uses for clamp/insert fitting for copper pipe `6.12.2`
3. Clean clamp/insert fittings and pipe according to industry guidelines `6.12.3`
4. Install clamp/insert fitting according to manufacturer's specifications `6.12.4`
5. Test pipe assembly for leaks `6.12.5`

6.13 State how to join pipe with flexible sleeve couplings

1. Clean fitting and pipe to receive flexible sleeve couplings according to industry guidelines `6.13.1`
2. Discuss uses for flexible sleeve couplings for copper pipe `6.13.2`
3. Install and torque flexible sleeve couplings according to industry guidelines `6.13.3`
4. Test pipe assembly for leaks `6.13.4`

6.14 Explain how to thread steel pipe with power-driven thread cutter

1. Set up and install dies for threading steel pipe with power-driven thread cutter `6.14.1`
2. Apply correct procedure to produce pipe with typical threads `6.14.2`
3. Clean and deburr threads on steel pipe threaded with power-driven thread cutter `6.14.3`

6.15 Outline how to thread steel pipe using hand thread cutter and oilers

1. Demonstrate setting up and installing dies for threading steel pipe with hand thread cutter and oiler 6.15.1
2. Create a pipe with typical threads 6.15.2
3. Clean and deburr threads on steel pipe threaded with hand thread cutter and oilers 6.15.3

6.16 Name the steps involved in joining pipe of dissimilar materials

1. Discuss methods and situations to connect pipe of dissimilar materials 6.16.1
2. Join pipe of dissimilar materials 6.16.2
3. Test pipe assembly for leaks 6.16.3

Supporting and Hanging Pipe

7.1 Define terminology related to supporting and hanging pipe

1. Use terms appropriately in context 7.1.1

7.2 Identify types of anchors and straps for commercial plumbing applications

1. Use various types of anchors and straps used in attaching and hanging plumbing (including expansion anchors, inserts, Red Head anchors, clevis hangers, split-ring hangers, beam clamps, riser clamps, wire hooks, perforated straps, and tube straps) 7.2.1
2. Explain plumbing code requirements associated with the use of hangers and anchors 7.2.2

7.3 Label parts used to install backing and ledger supports for plumbing fixtures

1. Cut back and ledger to correct size, using appropriate material to fit snugly in space 7.3.1
2. Install backing and ledger supports properly positioned and level 7.3.2
3. Check assembly for solid attachment to frame of structure 7.3.3

7.4 Describe the installation of pressure pipe, using various supports, including wire pipe hooks, tube talon, or tube straps

1. Discuss reasons for spacing guidelines with various hangers 7.4.1
2. Install space hangers according to manufacturer's guidelines for a specific application 7.4.2
3. Install pressure pipe, using various supports 7.4.3

7.5 Match DWV (drainage, waste, and vent) pipe with various types of supports (e.g., perforated strap, pipe hooks, and riser clamps)

1. Discuss reasons for accurate grade (slope) for DWV pipe 7.5.1
2. Use grade DWV pipe according to code and industry guidelines 7.5.2
3. Install appropriate supports for DWV pipe 7.5.3

7.6 Describe the correct installation of pipe sleeves through a concrete or masonry wall

1. Install a pipe sleeve through a concrete or masonry wall 7.6.1
2. Correctly caulk a pipe sleeve 7.6.2

Installing Waste and Soil Pipes

8.1 Define terminology related to the installation of waste and soil pipes

1. Use terms appropriately in context 8.1.1

8.2 Outline a procedure for roughing-in a DWV (drainage, waste, and vent) pipe assembly of PVC/ABS piping

1. Discuss the elements in a DWV system to include water closet, lavatory, bathtub, shower, kitchen or bar sink, and washing machine 8.2.1
2. Rough-in a DWV pipe assembly for kitchen, bathroom, or laundry room installation 8.2.2

8.3 Describe how to calculate and set waste and soil pipes

1. Calculate slope for plumbing runs 8.3.1
2. Discuss techniques and instruments used for setting level and slope for waste and soil pipe 8.3.2
3. Install waste and soil pipes according to measurements for level and slope in accordance with plumbing code 8.3.3

8.4 Describe how to install a water closet flange

1. Lay out the measurements for installation of a water closet flange 8.4.1
2. Inspect pipe layout in accordance with plumbing code, manufacturer's specifications blueprints, and ADA (Americans with Disabilities Act) 8.4.2

8.5 Explain the purpose of a back flow valve

1. Determine situations in which back flow prevention devices should be used 8.5.1
2. Describe the purpose for a back flow valve 8.5.2
3. Discuss installation techniques for a back flow valve 8.5.3
4. Discuss the consequences of faulty installation of a back flow valve 8.5.4

8.6 Describe how a drainage system standing water/air leak test works

1. Water/air leak test a drainage system according to the plumbing code 8.6.1
2. Perform a drainage system water/air leak test according to industry guidelines 8.6.2

Components of a Water Distribution System

9.1 Define terminology related to the components of a water distribution system

1. Use terms appropriately in context 9.1.1

9.2 Describe procedures and materials used to install a building's water service

1. Discuss the components in a building's water service 9.2.1
2. Use procedures for installing a building's water meter 9.2.2
3. Identify various types of main shutoff valves (e.g., gate, ball, butterfly) 9.2.3
4. Use procedures for installing main shutoff valves for a building 9.2.4
5. Explain advantages of various types of main shutoff valves 9.2.5
6. Shut off and turn on the water supply to a building 9.2.6

9.3 Describe the installation of a water distribution system

1. Demonstrate installation procedures for hard-drawn copper, CPVC (chlorinated polyvinyl chloride), and PEX (cross-linked polyethylene) components in a water distribution system 9.3.1
2. Install water system components according to construction drawings, manufacturer's specifications, and plumbing code 9.3.2
3. Lay out pipe for a residential water distribution system 9.3.3
4. Rough-in water supply components for a washing machine, lavatory, kitchen sink, tank-type water closet, and a bathtub or shower 9.3.4

9.4 Explain how air pressure and water pressure tests are conducted

1. Discuss procedures for an air pressure leak test of a pipe assembly 9.4.1
2. Discuss procedures for a water pressure leak test of a pipe assembly 9.4.2
3. Perform an air pressure leak test on a pipe assembly 9.4.3
4. Perform a water pressure leak test on a pipe assembly 9.4.4

9.5 Describe how to insulate water supply lines

1. Discuss various insulating materials designed for water supply lines 9.5.1
2. Demonstrate procedures for installing various insulating materials on water supply lines 9.5.2
3. Discuss advantages and disadvantages of pipe insulating materials 9.5.3
4. Insulate a water supply line 9.5.4

9.6 List examples of nail guard protection for pipe

1. Mark locations where nail guards should be installed for plumbing protection 9.6.1
2. Determine size requirements for various nail guard installations 9.6.2
3. Install nail guards 9.6.3

Installing Plumbing Fixtures and Equipment

10.1 Define terminology related to installing plumbing fixtures and equipment

1. Use terms appropriately in context 10.1.1

10.2 Outline how to install and trim out a lavatory

1. Discuss procedures for installing a wall-hung lavatory `10.2.1`
2. Install a countertop lavatory `10.2.2`
3. Install a lavatory fixture and faucet `10.2.3`
4. Inspect a lavatory installation to ensure it is secure, level, and plumb `10.2.4`
5. Install the water supply to a lavatory, and check for leaks `10.2.5`

10.3 Describe how to install and trim out a kitchen sink

1. Discuss procedures for installing a double kitchen sink `10.3.1`
2. Measure and verify the cutout for a sink is correct for size of sink unit `10.3.2`
3. Install a kitchen sink fixture and kitchen faucet according to manufacturer's specifications `10.3.3`
4. Perform inspection to verify sink is level `10.3.4`
5. Verify solid fit and appropriate seal at rim and countertop `10.3.5`

10.4 Explain how to install and trim out a water closet

1. Discuss procedures for installing a water closet `10.4.1`
2. Install a water closet fixture `10.4.2`
3. Install water control mechanisms for a water closet `10.4.3`
4. Inspect to verify installation is secure, level, and plumb `10.4.4`
5. Inspect to verify water closet wax ring has been installed correctly `10.4.5`
6. Demonstrate how to install a water supply to water closet, and check for leaks `10.4.6`

10.5 Describe installation of a garbage disposal

1. Discuss the installation procedures of a garbage disposal in a kitchen sink `10.5.1`
2. Install a garbage disposal, and check for leaks according to manufacturer's specifications `10.5.2`

10.6 Outline how to install an automatic dishwasher

1. Discuss how to set the dishwasher in the cabinet space, plumb and trim, and verify attachment of dishwasher to cabinet `10.6.1`
2. Install dishwasher drain according to installation instructions and plumbing code `10.6.2`
3. Install a water supply to dishwasher according to installation instructions and plumbing code `10.6.3`
4. Inspect cabinet installation, water supply, and drain for leaks `10.6.4`

10.7 Describe installation of a water heater

1. Discuss code considerations for installation of an electric water heater `10.7.1`
2. Discuss code considerations for installation of a natural gas water heater `10.7.2`
3. Install an electric water heater `10.7.3`
4. Install a natural gas water heater `10.7.4`
5. Inspect plumbing installation for leaks and appropriate water supply `10.7.5`

10.8 Describe how to trim out a tub and shower valve

1. Discuss the installation of a tub and shower valve `10.8.1`
2. Install a tub and shower valve `10.8.2`
3. Inspect to verify valve installation is straight, neat, and to manufacturer's specifications `10.8.3`
4. Inspect installation for leaks and appropriate water supply `10.8.4`

10.9 Outline installation of an outside water faucet

1. Discuss installation of an outside water `10.9.1`
2. Inspect installation for leaks and appropriate water supply `10.9.2`

Servicing and Repairing Plumbing Fixtures and Equipment

11.1 Define terminology related to servicing and repairing plumbing fixtures and equipment

1. Use terms appropriately in context `11.1.1`

11.2 Describe how to replace and adjust water control mechanisms for a water closet

1. Discuss procedures to replace water control mechanisms in a water closet `11.2.1`
2. Replace a water control mechanism `11.2.2`
3. Adjust the water control mechanisms `11.2.3`
4. Inspect installation for leaks, and verify proper function of water control mechanisms `11.2.4`

11.3 Outline replacement of a water closet flush valve

1. Discuss the removal and installation of a water closet flush valve `11.3.1`
2. Remove and install a water closet flush valve `11.3.2`
3. Replace a water closet tank gasket `11.3.3`
4. Inspect installation for leaks and appropriate water supply `11.3.4`

11.4 Identify how to troubleshoot, repair, or replace automatic flushing devices

1. Inspect to verify correct operation of an automatic flushing device `11.4.1`
2. Service an automatic flushing device `11.4.2`
3. Install an automatic flushing device in an existing fixture `11.4.3`

11.5 Describe how to operate a plumbing drain auger

1. Discuss how to operate a plumbing drain auger `11.5.1`
2. Use an auger to clean a drain `11.5.2`

11.6 Describe how to remove and replace a fixture trap

1. Discuss the procedure for removing and replacing a plumbing fixture trap `11.6.1`
2. Remove and replace a plumbing fixture trap `11.6.2`
3. Set a trap level with respect to seal `11.6.3`
4. Inspect installation for leaks `11.6.4`

11.7 Explain the repair or replacement of a washer-type faucet

1. Remove and replace a washer in a washer-type faucet `11.7.1`
2. Replace a washer-type faucet `11.7.2`
3. Check installation for leaks and appropriate water supply `11.7.3`

11.8 Describe repair or replacement of washerless faucets

1. Discuss removal and replacement of a washerless faucet (e.g., ball type, cartridge type, or ceramic disk type) `11.8.1`
2. Remove and replace a ball, cartridge, or disk in a washerless faucet `11.8.2`
3. Remove and replace a washerless faucet `11.8.3`
4. Inspect installation for leaks and appropriate water supply `11.8.4`

11.9 Describe how to repair or replace a shower diverter valve

1. Remove and replace a shower diverter valve `11.9.1`
2. Inspect installation for leaks and appropriate water supply `11.9.2`

11.10 Explain how to replace a bathtub waste and overflow pipe

1. Remove and replace a bathtub waste and overflow pipe `11.10.1`
2. Inspect installation for leaks `11.10.2`

11.11 Describe how to replace a bathtub shower arm and shower head

1. Replace a bathtub shower arm and shower head `11.11.1`
2. Inspect installation for leaks and appropriate water supply `11.11.2`

11.12 State standard troubleshooting problems pertaining to a garbage disposal

1. Discuss troubleshooting a garbage disposal `11.12.1`
2. Discuss causes for failure of garbage disposals `11.12.2`
3. Remove and replace a garbage disposal `11.12.3`

11.13 Describe key troubleshooting areas when determining whether to repair/replace a gas or electric water heater

1. Discuss the causes for failure of electric water heaters `11.13.1`
2. Explain the causes for failure of gas water heaters `11.13.2`
3. Troubleshoot water heater malfunctions, i.e., failure to heat, no pilot light, leaks, thermostat control `11.13.3`
4. Remove and replace a gas water heater `11.13.4`
5. Remove and replace an electric water heater `11.13.5`
6. Remove and replace gas or electric water heater `11.13.6`

11.14 Describe how to thaw frozen water pipes

1. Discuss safe procedures for thawing frozen water pipes `11.14.1`
2. Thaw frozen pipes using standard cautionary steps `11.14.2`

11.15 Identify procedures to install a plumbing repair coupling

1. Explain situations in which plumbing repair couplings may be used `11.15.1`
2. Install a plumbing repair coupling `11.15.2`
3. Inspect installation for leaks `11.15.3`

Career and Technical Student Organizations (SkillsUSA/HOSA)

12.1 Define terminology related to student organizations

1. Use terms appropriately in context `12.1.1`

12.2 Outline a self-assessment, and identify individual learning styles

1. Show individual strengths `12.2.1`
2. Show areas in need of improvement `12.2.2`

12.3 Describe self-motivation techniques, and establish short-term goals

1. Prepare a list of short-term goals `12.3.1`
2. Discuss ways to change or improve lifestyle, appearance, and behavior `12.3.2`

12.4 Give examples of individual time-management skills

1. Prepare and maintain a time journal `12.4.1`
2. Outline ways to improve time-management skills `12.4.2`

12.5 Predict future occupations

1. Research the Internet to explore career opportunities in specified fields of study 12.5.1
2. Prepare a presentation on a specified career area 12.5.2

12.6 Identify the customer

1. Differentiate between external and internal customers 12.6.1
2. Identify factors that contribute to poor customer relationships 12.6.2

12.7 Identify the benefits of doing a community service project

1. Outline ways to become involved in the community 12.7.1
2. Develop a community service project 12.7.2

12.8 Describe effective communication with others

1. Note personal barriers to listening 12.8.1
2. Relate a personal plan to overcome barriers to listening 12.8.2

12.9 Give locations for a shadowing activity

1. Summarize and relate an experience of job shadowing activity 12.9.1

12.10 Identify the components of an employment portfolio

1. Present parts of a portfolio 12.10.1
2. Compile a personal employment portfolio for an interview 12.10.2

12.11 List proficiency in program competencies

1. Construct an interpersonal competency assessment 12.11.1

12.12 Describe how to measure/modify short-term goals

1. Discuss how to pursue short-term goals 12.12.1

12.13 Identify stress sources

1. Prepare a list of personal stress sources 12.13.1
2. Outline techniques to cope with individual sources of stress 12.13.2

12.14 Identify characteristics of a positive image

1. List behaviors and traits that lead to a positive image 12.14.1
2. Note behaviors and traits that lead to a negative image 12.14.2

12.15 Describe how team skills can be applied to a group project

1. Form a team to develop a class project 12.15.1

12.16 Outline how to observe and critique a meeting

1. Attend a formal meeting held in the community 12.16.1
2. Prepare a critique of the meeting attended 12.16.2

12.17 List business meeting skills

1. Relate the basic rules required to ensure an orderly and business-like meeting 12.17.1
2. Demonstrate with role-playing appropriate meeting skills 12.17.2

12.18 Outline a survey for employment opportunities

1. Compile information on a particular employment opportunity of interest 12.18.1
2. Perform an Internet search of a specific career area 12.18.2

12.19 Select a professional journal for review, and develop a three-to five-minute presentation

1. Prepare a presentation on the content, purpose, and distribution of a particular professional journal 12.19.1

12.20 Identify customer expectations

1. List customer expectations 12.20.1
2. Discover the consequences of unmet customer expectations 12.20.2

12.21 List parts of a job application

1. Prepare a job application from various businesses in the community 12.21.1
2. Demonstrate a mock job interview 12.21.2

12.22 Outline your employment portfolio

1. Construct a personal employment portfolio 12.22.1

12.23 Identify supervisory and management roles in an organization

1. Prepare an organizational chart 12.23.1
2. Outline the responsibilities of managers and supervisors 12.23.2

12.24 Outline safety issues

1. Research safety issues within a given career area 12.24.1