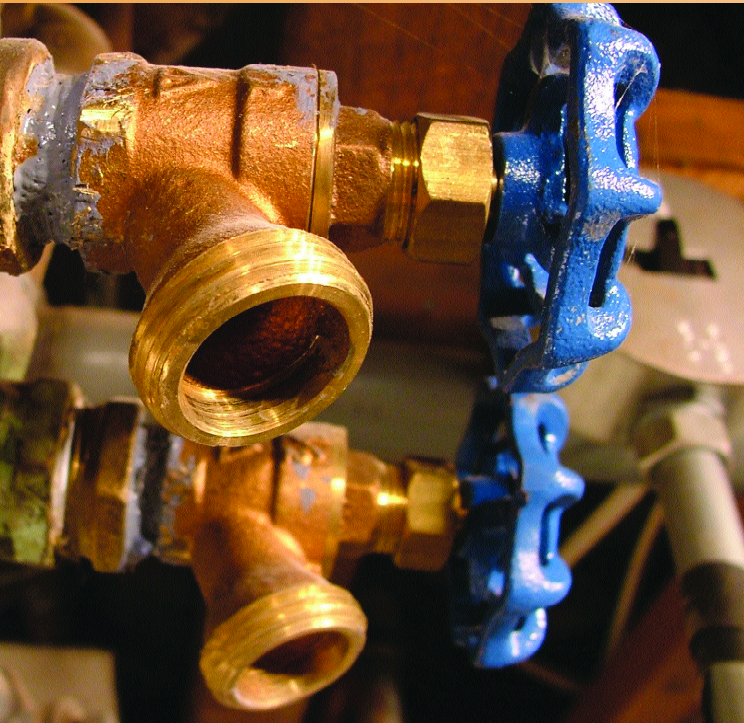


Tools of the Trade



Inside the Plumber's Toolbox

SHOPWARE

Instructor's Guide

Introduction

This Teacher's Guide provides information to help you get the most out of *Inside the Plumber's Toolbox*, part of the *Tools of the Trade* series. The contents of this guide will allow you to prepare your students before they use the program, assist them as they navigate through the program, and present follow-up activities to reinforce the program's key learning points.

Tools of the Trade is a 6-part series of programs that present inventories of the most common and most basic tools used in specific trades. Each program opens the trade's "toolbox" so students can delve into its basic tools and materials, including their purpose and proper usage. Students will view brief demonstrations of rudimentary tasks with the tools, and gain an understanding of safety precautions, code concerns, and industry tips, if applicable.

Inside the Plumber's Toolbox is a 32-minute video targeted to students (vocational students, in particular) in grades 9-12. Its content is appropriate to such curriculum areas as Technology Education, Trade, and Industrial Education. The information presented in the *Tools of the Trade* series could also be presented in vocational/technical schools or "Do it Yourself" adult education courses.

The *Tools of the Trade* series consists of the following titles:

- *Inside the Plumber's Toolbox*
- *Inside the Carpenter's Toolbox*
- *Inside the Mason's Toolbox*
- *Inside the Welder's Toolbox*
- *Inside the Automotive Mechanic's Toolbox*
- *Inside the Electrician's Toolbox*

Learning Objectives

After watching this program, students will be able to:

- Identify and understand the differences between each basic plumbing tool and material.
- Explain the benefits of each tool and the types of plumbing jobs for which it should be used.
- Demonstrate the proper use of each tool.
- Understand the different types of piping (copper, plastic, cast iron, and galvanized).
- Recognize proper plumbing safety precautions (e.g., checking state and local codes before starting any project, locating shutoff valves, wearing safety equipment, etc.).

Educational Standards

This program correlates with the following standards:

- The competency standards for Core Curriculum and Carpentry from the National Center for Construction Education & Research;
- The National Apprenticeship Standards for Plumbing and Steamfitting-Pipefitting, developed by the National Joint Plumbing Apprenticeship and Journeyman Training Committee and the National Joint Steamfitter-Pipefitter Apprenticeship Committee, together with the Department of Labor;
- The standards of Essential Knowledge and Skills for Trade and Industrial Education—Construction-Maintenance Systems, High School, for the State of Texas
- The standards of Technology Education—Tools, Resources, and Technological Processes, for the State of New York

- Standard 2.0 Career Cluster: Architecture and Construction Careers in designing, planning, managing, building and maintaining the built environment. (Competency Standards for Core Curriculum and Carpentry from the National Center for Construction Education & Research.)
- The student knows the employability characteristics of a successful worker in the modern workplace, and demonstrates ability to identify employment opportunities, including entrepreneurship, and preparation requirements for the piping trades and plumbing. (Texas State Standards on Piping Trades and Plumbing: Essential Knowledge and Skills for Trade and Industrial Education—Construction-Maintenance Systems, High School.)
- The student knows the function and application of the tools, equipment, technologies, and materials used in piping trades and plumbing. The student can safely use hand and power tools and equipment commonly employed in piping trades and plumbing; properly handle and dispose of humanly and/or environmentally hazardous materials used in piping trades and plumbing; and demonstrate knowledge of new and emerging technologies that may affect piping trades and plumbing. (Texas State Standards on Piping Trades and Plumbing: Essential Knowledge and Skills for Trade and Industrial Education—Construction-Maintenance Systems, High School.)
- The student applies the concepts and skills of the trade to simulated and actual work situations. The student can: fabricate, assemble, install, and maintain metallic and nonmetallic pipe and piping systems; install and maintain pneumatic and hydraulic controls and piping; and apply the essential knowledge and skills in piping trades and plumbing to work-based learning experiences including, but not limited to, cooperative education, job shadowing, mentoring, and apprenticeship training. (Texas State Standards on Piping Trades and Plumbing: Essential Knowledge and Skills for Trade and Industrial Education—Construction-Maintenance Systems, High School.)
- The student applies technological knowledge and skills to design, construct, use, and evaluate products and systems to satisfy human and environmental needs; uses a variety of materials and energy sources to construct things; understands the importance of safety and ease of use in selecting tools and resources for a specific purpose; and develops basic skills in the use of hand tools. (New York State Standards on Technology Education: Tools, Resources, and Technological Processes.)

ASME Plumbing Standards

- A112.4.2: 2003 Water Closet Personal Hygiene Devices
- A112.4.3: R2004 - Plastic Fittings for Connecting Water Closets to the Sanitary Drainage System
- A112.18.1: 2005 - Plumbing Fixture Fittings
- A112.18.2: 2005 - Plumbing Waste Fittings
- A112.3.4: R2004 - Macerating Toilet Systems and Related Components
- A112.19.6: 1995 - Hydraulic Requirements for Water Closets, Urinals

Program Summary

Given the wide range of trades in the world today, the *Tools of the Trade* series is a welcome addition to the Shopware brand. Its overview and demonstration of the basic tools used in each trade help lay the foundation of understanding for the trades, and pique student interest in developing “do it yourself” practical knowledge that can also lead to plumbing as a possible career choice.

The first title in the series, *Inside the Plumber’s Toolbox*, presents the common tools of the industry—from the most basic, such as the plunger and pipe wrench, to the mandatory items such as pliers, wrenches, cut-

ting and joining tools, washers, and pipe cements. It also shows specialty tools used for each type of pipe. The program introduces the tools in the context of the plumbing system to ensure that the correct tools are used for the different types of pipes.

Main Topics

Topic 1: Introduction

The program's host, Alan Pratt, introduces viewers to a plumbing system and its two main systems—the fresh potable water supply system and the drainage-waste-vent (DWV) system.

Topic 2: Types of Pipes

The viewer is familiarized with a full range of pipe materials. Both water supply and wastewater pipes are discussed, as well as pipe fittings.

Topic 3: Inside the Plumber's Toolbox

In this section, after a brief review of key safety precautions for plumbing tools, the plumber's toolbox is opened to reveal the tools and materials for safety and cleanliness, measurements, leaky faucets, clogs, grasping/loosening/tightening, and cutting pipes and tubing.

Topic 4: Copper Tools and Materials

The proper techniques for safely cutting and sweating a copper pipe, and joining copper pipe with a compression fitting, are demonstrated.

Topic 5: Plastic Tools and Materials

The viewer learns how to measure, cut, clean, align and test, and glue ABS and PVC pipe.

Topic 6: Cast Iron Tools and Materials

In this section, cast iron specialty tools and materials are highlighted during the process of fitting a no-hub cast iron pipe.

Topic 7: Wrap-Up

Alan offers some closing remarks on the program and on how to learn more about kickstarting a career in plumbing.

Fast Facts

- The earliest plumbing fixtures—including flush toilets—date back nearly 6,000 years to ancient India, Egypt, and Crete. Pipes were usually made of clay or copper. Later, the Romans used lead pipes in their public baths to provide fresh water and drainage. Wooden pipes made from hollowed-out logs were used during the colonial era in Boston.
- Lead pipes were installed until the 1920s and lead solder was used until the 1980s. Due to the toxicity of lead, nearly all modern manufactured plumbing products and materials are lead-free.
- Cast iron was the material of choice through the 1960s because it was durable, easily cut and joined, and resisted corrosion; but it fell out of favor because it could also break easily, was a very heavy material to work with, and hard to install. As a result, cast iron pipe is less likely to be stocked at a local hardware store or home center.

- There are two types of cast iron—hub (also called bell-and-spigot or hub-and-spigot) and no-hub—both of which refer to type of fittings used with the pipe. No-hub cast iron is now the industry standard, and is used when making repairs to hub cast iron.
- Rigid copper comes in various color-coded classes, or thicknesses. Green "Type K" is the heaviest and thickest, and is used to connect the water meter to the water main. Blue "Type L" is standard and medium-thick. It is used for underground piping and water lines. Red "Type M" is lightest and thinnest. It is used for inside piping, mostly for hydronic heating lines. And yellow "Type DWV" is used for above-ground DWV piping only.
- Although PVC and ABS can be mechanically joined, codes do not allow the two types to be glued directly together at any time.
- A sink plunger has a flat rim designed to fit over a sink or shower opening to form a seal, while a toilet plunger has an interior flange designed to fit into the bottom of a toilet bowl to form a seal. This flange can be flipped up inside the toilet plunger, which then enables it to be used as a sink plunger, as well.
- Wrenches should only be used on nuts and steel pipes, which are joined by tightening and turning; they should not be used on copper or plastic, which are joined by solder and glue.
- Before cutting any "live" water pipes, it must be ensured that the water supply valve is off, and the house's highest and lowest faucets are open to drain the water lines.
- A plumber must first serve as a plumber's helper or apprentice and carry tools, supply the plumber with materials, cut pipes and threads, and make minor fittings. The period of apprenticeship is dependent upon the worker's ability and upon local conditions, and may last from two to four years. The plumber's helper acts as an assistant until he or she has fully demonstrated an ability to install plumbing, when the apprentice can then attain the rank of journeyman plumber. Duties will then include the installation and repair of all plumbing and fixtures, running and connecting pipes, wiping joints, and connecting traps, vents, etc.

Vocabulary Terms

ABS (acrylonitrile butadiene styrene): Rigid black plastic pipe used only for drain lines.

adaptor: A fitting that joins different types of pipe together, e.g., ABS to cast iron pipe.

adjustable open-end wrench: A wrench having fixed, open jaws on one or both ends.

apprentice: A person who works for another in order to learn a trade.

basin wrench: A plumbing tool for removing and installing sink faucets. It has a long handle that reaches up from under a sink to turn nuts on fittings and faucets. The hinged jaw repositions itself after each turn. Its long handle with spring tension pipe-gripping jaws at the end allows a plumber to reach up to grip pipe nipples or tighten or loosen nuts in tight, hard-to-reach areas.

black steel pipes: Pipes used to transport gas in the home.

capillary action: Also called capillarity or capillary attraction, it is a manifestation of surface tension by which the portion of the surface of a liquid coming in contact with a solid is elevated or depressed, depending on the adhesive or cohesive properties of the liquid.

cast iron: An alloy of iron, carbon, and other elements, cast as a soft and strong, or as a hard and brittle, iron, depending on the mixture and methods of molding. There are two types of cast iron—hub (also called bell-and-spigot or hub-and-spigot) and no-hub—both of which refer to type of fittings used with the pipe. No-hub cast iron is the industry standard.

copper pipe: Often called copper tubing, it is available in two types—hard or rigid copper (called drawn temper copper) and flexible or soft copper (called annealed temper copper).

coupling: A fitting that joins two pieces of pipe.

CPVC (chlorinated polyvinyl chloride): A substance used to make rigid plastic pipes used in water supply systems, where code permits.

drainage-waste-vent system (DWV system): The system of plumbing pipes used in the removal of liquid and solid waste from a building.

dry-fit: Holding a pipe in its fitting to make sure it fits.

elbow: A pipe fitting with two openings that changes the direction of the line. Also called an ell, it comes in a variety of angles, from 22 1/2° to 90°.

emery cloth: An abrasive cloth used for polishing and cleaning metal.

fall/flow: The proper slope or pitch of a pipe for adequate drainage.

fitting: A device used to split or join a number of pipes together. An elbow changes the line's direction. A coupling joins two straight sections of pipe. A bushing reduces the size of fitting openings. A reducer does the same thing, but for pipe openings. A union attaches two pipe pieces together with a locking nut. A branched fitting starts or unites pipe branches with the main line, and can be in the shape of a "Tee (T)" (used to deliver water under pressure) or a "Tee-Wye (TY)" or "Wye (Y)" (used to transport waste without clogging at a turn in a single- or double-combination fitting). A pipe nipple is a short piece of pipe that is threaded on both ends. A transition fitting joins copper tube with plastic tube or galvanized steel pipe. While a flared fitting requires specialized tools and tends to be used for outdoor use, a compression fitting is used in the home mostly for fixture supply lines.

fixture: In plumbing, the device that provides a supply of water and/or its disposal, e.g., sinks, tubs, toilets.

flame guard: A piece of flame-resistant material that protects from direct exposure to flames.

flux compound: An acidic paste that helps two pieces of pipe fuse by chemically cleaning the pipe and acting as a flow agent.

folding rule: Also called a zigzag rule, it is a ruler composed of light strips of wood joined by rivets so as to be foldable, all the opening and closing parts being in parallel planes. In plumbing, it is used to measure pipe lengths.

galvanized steel pipe: A pipe made of galvanized steel, which is widely used in applications where rust resistance is needed. Galvanized steel pipe is threaded and connected with threaded fittings.

hacksaw: A saw consisting of a tough, fine-toothed blade stretched taut in a frame, used for cutting metal.

journeyman: A person who has fully served an apprenticeship in a trade or craft and is a qualified worker in another's employ.

makeup distance: When measuring pipe, it is the distance between two fittings plus the depth of the fittings themselves, since the pipe extends all the way into them.

mechanical engineering: The branch of engineering that encompasses the generation and application of heat and mechanical power and the design, production, and use of machines and tools.

metal burr: A rough edge or area remaining on material after it has been cut.

no-hub coupling: A device for no-hub cast iron pipe that consists of a neoprene gasket, a stainless steel shield, and a worm-drive band clamp, which compresses the gasket around the cast iron pipe.

O-ring: A flat ring made of rubber or plastic, used as a gasket on washerless faucets.

PB: Polybutylene, a substance used to make flexible plastic tubing used in water supply systems where allowed by code.

PEX: Cross-linked polyethylene, a substance used to create tubing commonly used for hydronic radiant floor heat, but increasingly also used for water supply lines.

pipe fitter: A person who installs and repairs pipe systems.

pipe hanger: A device on which pipes are hung that supports the pipes and provides vibration isolation.

pipe joint compound: Also known as pipe dope, it is a non-separating thread sealant compound designed to seal threaded connections against leakage due to internal pressure.

pipe layer: One who lays conducting pipes in the ground, as for water, gas, etc.

pipe-thread tape: Sealing tape used for joining pipes. Pipe-thread tape makes it easy to drive the male pipe deeper by allowing the threads to slip past one another, while filling minute gaps to prevent seepage. It also makes it easier to disassemble a joint later, if need be, by reducing the tendency of some types of pipe threads to stick together over time.

pipe vise: A clamp for holding pipe that is to be cut or threaded. Two types of vises are yoke vises and chain vises.

pipe wrench: A tool having two toothed jaws, one fixed and the other free to grip pipes and other tubular objects when the tool is turned in one direction only.

plastic pipes: There are two types of plastic pipes used for water supply—rigid plastic (called chlorinated polyvinyl chloride [CPVC]), and flexible plastic (called cross-linked polyethylene [PEX]). For wastewater, rigid plastic polyvinyl chloride (PVC) and acrylonitrile butadiene styrene (ABS) are the most popular types of DWV plastic plumbing pipes.

plastic shears or scissors: Shears used to cut thinner pipes and both flexible and rigid plastic tubes.

plumber's pliers: Also known as water-pump pliers or tongue-and-groove pliers, it is a tool with jaws that can expand wide enough to get around pipes of all sizes, exposing serrated teeth that provide great grip, and an offset head that allows more torque for turning a pipe than average conventional pliers.

plumber's putty: A pliable, popular putty used to seal joints between drain pieces and fixture surfaces.

plunger: Also nicknamed a plumber's helper, a plunger is available in two versions: toilet and sink. A sink plunger has a flat rim designed to fit over a sink or shower opening to form a seal, while a toilet plunger has an interior flange designed to fit into the bottom of a toilet bowl to form a seal. This flange can be flipped up inside the toilet plunger, which then enables it to be used as a sink plunger.

primer: A first coat or layer as a base in a fitting when gluing PVC pipe.

propane torch: Portable, hand-held torch which consists of a bottle containing pressurized propane gas with a screwed-on burner nozzle. The nozzle is used to direct the burning gas, when it is ignited, to be used for soldering, brazing, etc.

PVC (polyvinyl chloride): A rigid white or cream-colored plastic pipe used in non-pressure systems, such as waste and vent systems.

reamer: A tool for enlarging holes and for removing metal burrs from the inside of pipes.

reducer: A fitting that connects pipes of different sizes.

rigid copper: A kind of pipe is available in various color-coded classes (thicknesses): Type K, Type L, and Type M for water supply, and Type DWV for transporting wastewater.

riser: A vertical assembly of fittings and pipes that distributes water upward.

round file: A tool used to smooth rough edges.

rubber seats: A type of rubber gasket used for washerless faucets.

rubber washers: A type of rubber gasket used for compression faucets.

run: A complete or secondary section of pipe that extends from supply to fixture or drain to stack.

sandpaper: Strong paper coated with a layer of sand or other abrasive, used for smoothing or polishing.

sanitary fitting: A fitting that joins the assorted pipes in a drain, waste, and vent system, designed to allow solid material to pass through without clogging.

sawzall: A handheld reciprocating saw that can be used to cut cast iron pipe.

septic system: A buried concrete septic tank that holds the solid waste from a home's plumbing waste drains, and a septic drain field, that distributes the waste water to the ground where it disperses through the soil or evaporates. The septic tank operates by decomposing solid waste through a variety of bacteria.

shutoff valve: Located near the beginning of the incoming line, it is a device that controls the flow of water into a building.

snapper: Also called a snap cutter, it is a tool used to cut cast iron. The tool is wrapped around a pipe and uses its ratcheting action to systematically constrict the pipe until the two halves of the pipe snap apart.

soapstone marker: A marker available at welding supply stores that produces a white line that can be seen, but easily wiped off.

soil stack: The largest vertical drain line to which all branch waste lines connect; carries waste to the sewer line.

solder: A metal alloy that is melted to join or mend metal surfaces; also, the act of melting solder into the joint.

solvent cement: A cement used to join plastic pipes.

steamfitter: A person who installs the piping for heating systems.

stop valve: A valve that controls the flow of water to an individual fixture, allowing water supply to be stopped to one fixture without affecting the water supply to other fixtures.

striker or spark lighter: A device used to light a propane torch.

swage: The process of reducing, tapering, or bending. Tubing can be swaged more easily than pipe.

sweating: The process of joining copper pipes by soldering them together at fittings.

tee: A T-shaped fitting with three openings used to create branch lines.

thread-cutting oil: Oil that is specially formulated to give sharp, clean threads and extend die life on a threading machine.

threader: A threading machine used to thread galvanized pipe.

threading handle: Also called the stock, it is the handle of a threader.

toilet auger: A toilet auger is a plumbing snake inside a protective tube that has a bent end, used to unclog a toilet when a toilet plunger is not successful.

torch: A portable apparatus that produces a very hot flame by the combustion of gases, used to melt solder when joining pipes.

torque wrench: A wrench that has a gauge that indicates the amount of torque being applied.

trap: The curved section of a fixture drain line, designed to hold water, thus preventing sewer gases from entering the house.

union: A three-piece fitting that joins two sections of pipe, but allows them to be disconnected without cutting the pipe. Used primarily with steel pipes, but never in a DWV system.

vent stack: The upper portion of the soil stack above the topmost fixture through which gases and odors escape.

water filter: A filter used to remove impurities from the water supply.

water main: A main pipe or conduit in a system for conveying water.

water meter: A device for measuring and registering the quantity of water that passes through a pipe or other outlet.

water softener: Any of a group of substances that when added to water containing calcium and magnesium ions cause the ions to change their usual properties: used in the purification of water for the laboratory, and for giving water more efficient sudsing ability with soap.

wye: A Y-shaped fitting with three openings used to create branch lines.

Pre-Program Discussion Questions

1. What is the purpose of a plumbing system, and what does it comprise?
2. Can you name the primary materials used for the pipes in a plumbing system?
3. What safety precautions do you think should be kept in mind when working on or with pipes, and why?
4. Looking at the pipes in your home, can you identify which pipes are for water supply and which are for drainage or waste?
5. Do you know where the main shutoff valve is in your house, and why it is important?

Post-Program Discussion Questions

1. How do the pipes in a fresh water supply system differ from those used in a DWV system?
2. Describe how water travels into, through, and out of a home's plumbing system.
3. What are the various types of copper pipes available, and what are they used for? What kinds of plastic pipes are available, and what are they used for?
4. How does the process differ for joining each pipe type?
5. What tool should you use to cut copper pipe? Plastic pipe? Cast iron pipe?

Individual Student Projects

- Ask each student to design his or her own plumbing system, including both the fresh water supply and the DWV systems. A diagram should be included that details every facet of each system, including fixtures, equipment, system components, and pipe types.
- In small groups, practice cutting each pipe type with its appropriate cutting tool. Then, have each student write a paper that addresses each tool and cutting process, and the advantages and disadvantages of each tool.
- Have each student research what plumbing tools he or she currently has at home, then write a paper about how each tool can be used, and what tools would still need to be purchased to complete an ideal plumber's toolbox.

Group Activities

- Ask your students to write down a list of questions they would ask a builder or plumbing designer regarding the process of designing a plumbing system for a new home. Then, if possible, arrange to meet with one or more new home builders in the area with an on-site field trip, so the students can see first-hand the plumbing installation and/or plans and get the answers to their questions from the experts.
 - Divide the class into groups. Have each group practice joining copper pipe, both by sweating and by using a compression fitting. Ensure that the group tests to see if one seal is better, and why; then discuss the results, as a class.
 - Discuss, as a class, the use of each of the following fittings, its use as a supply and/or DWV fitting, and the kind(s) of pipe it joins:
 - Bushing
 - Coupling
 - Elbow
 - Pipe nipple
 - Reducer
 - Tee
 - Transition
 - TY
 - Y
 - Union
- Then, design a small pipe system that would use all of the fittings, and create a poster of the resulting system.

Internet Activities

- Using the Internet and library books, ask your students to research any plumbing innovations or industry technologies in the last few years (e.g., remote video inspection systems and pipe cameras). Then, ask each student to write a research paper or create a presentation of his or her findings, as well as any ideas or inventions of his or her own for how plumbing tools can be improved for future plumbers.
- Research the local plumbing codes in your area. Which kinds of plastic pipe can be used, and which, if any, are prohibited, and why? If possible, cite examples from local construction jobs of new homes.
- Investigate the kinds of plumbing tools that are available for purchase from various retailers, e.g., your local hardware store, a larger home center, and a plumbing specialty e-store on the Internet. What plumbing tools are available in one outlet that are not available in the others? Why do you think that is so? Write a paper that discusses your findings.

Assessment Questions

- Q1:** Which of the following is a correct statement about copper pipe? Select all that apply.
- a) It can rust and get clogged with mineral deposits.
 - b) It is easy to handle and install.
 - c) It is more dependable than plastic.
 - d) It is cheaper than plastic.
- Q2:** Water supply lines in a home can be made of which of the following? Select all correct answers.
- a) Cast iron
 - b) Copper
 - c) Plastic
 - d) Galvanized steel
- Q3:** For what purpose are black steel pipes used?
- Q4:** What is the make-up distance of a copper pipe which is 10" long, where the left fitting is 1" and the other fitting is 2"?
- a) 10"
 - b) 11"
 - c) 12"
 - d) 13"
- Q5:** Joining copper pipe using solder is called _____. Soldering copper pipe relies on a process called _____.
- Q6:** Choose either "ABS" or "PVC": If you are gluing _____ pipe, spread a layer of primer around the end of the pipe and a light layer all the way into the fitting, down to the shoulder. If you are gluing _____ pipe, no primer is needed.
- Q7:** True or False: ABS can only be used for cold water, NOT for hot water.
- Q8:** True or False: When inserting a pipe into a fitting, the fitting screws on clockwise.
- Q9:** Match each tool with its corresponding description.
- | | |
|-------------------------------|-------------------|
| a) Adjustable open-end wrench | b) Basin wrench |
| c) O-rings and rubber seats | d) Pipe wrench |
| e) Plumber's pliers | f) Rubber washers |
- 1) The tool's jaws can expand wide enough to get around pipes of all sizes, exposing serrated teeth that provide great grip
 - 2) Mostly used as a specialty tool for steel pipes, but also good in a pinch for getting to some difficult nuts
 - 3) Its smooth jaws are made to fit small nuts, bolts, and square and hexagonal fittings
 - 4) Used as gaskets for washerless faucets
 - 5) Its long handle with spring tension pipe-gripping jaws allows you to reach up to grip pipe nipples or tighten/loosen nuts in tight, hard-to-reach areas
 - 6) Used as gaskets for compression faucets
- Q10:** Which of the following may be used when joining copper pipes?
- a) Flared fitting
 - b) Flux compound
 - c) Compression fitting
 - d) Solder

Assessment Questions Answer Key

Q1: Which of the following is a correct statement about copper pipe? Select all that apply.

- a) It can rust and get clogged with mineral deposits.
- b) It is easy to handle and install.
- c) It is more dependable than plastic.
- d) It is cheaper than plastic.

A1: *The correct answers are (b) and (c). Copper actually resists rust, is easy to handle and install, and is more dependable than plastic. But it is expensive and may cost up to three times more than plastic pipes.*

Q2: Water supply lines in a home can be made of which of the following? Select all correct answers.

- a) Cast iron
- b) Copper
- c) Plastic
- d) Galvanized steel

A2: *The correct answers are (b), (c), and (d). Copper and plastic are used in water supply lines, and galvanized steel can be found in older homes. Cast iron is not used in water supply.*

Q3: For what purpose are black steel pipes used?

A3: *Black steel pipes are not used for water; rather, they are used for transporting gas.*

Q4: What is the make-up distance of a copper pipe which is 10" long, where the left fitting is 1" and the other fitting is 2"?

- a) 10"
- b) 11"
- c) 12"
- d) 13"

A4: *The correct answer is (d). The make-up distance includes the depth of both fittings plus the length of the pipe.*

Q5: Joining copper pipe using solder is called _____. Soldering copper pipe relies on a process called _____.

A5: *Joining copper pipe using solder is called **sweating**. Soldering copper pipe relies on a process called **capillary action**.*

Q6: Choose either "ABS" or "PVC": If you are gluing _____ pipe, spread a layer of primer around the end of the pipe and a light layer all the way into the fitting, down to the shoulder. If you are gluing _____ pipe, no primer is needed.

A6: *If you are gluing PVC pipe, spread a layer of primer around the end of the pipe and a light layer all the way into the fitting, down to the shoulder. If you are gluing ABS pipe, no primer is needed.*

Q7: True or False: ABS can only be used for cold water, NOT for hot water.

A7: *This statement is false. PVC can only be used for cold water; ABS can be used for both.*

Q8: True or False: When inserting a pipe into a fitting, the fitting screws on clockwise.

A8: *This statement is true.*

Q9: Match each tool with its corresponding description.

- a) Adjustable open-end wrench
- b) Basin wrench
- c) O-rings and rubber seats
- d) Pipe wrench
- e) Plumber's pliers
- f) Rubber washers

- 1) The tool's jaws can expand wide enough to get around pipes of all sizes, exposing serrated teeth that provide great grip
- 2) Mostly used as a specialty tool for steel pipes, but also good in a pinch for getting to some difficult nuts
- 3) Its smooth jaws are made to fit small nuts, bolts, and square and hexagonal fittings
- 4) Used as gaskets for washerless faucets
- 5) Its long handle with spring tension pipe-gripping jaws allows you to reach up to grip pipe nipples or tighten/loosen nuts in tight, hard-to-reach areas.
- 6) Used as gaskets for compression faucets

A9: 1e; 2d; 3a; 4c; 5b; 6f

Q10: Which of the following may be used when joining copper pipes?

- a) Flared fitting
- b) Flux compound
- c) Compression fitting
- d) Solder

A10: All of these may be used in the process of joining copper.

Additional Resources

Plumbing Manufacturers Institute

www.pmihome.org

The American Society of Plumbing Engineers

www.aspe.org

Plumbing-Heating-Cooling Contractors Association

www.phccweb.org

International Association of Plumbing and Mechanical Officials

www.iapmo.org

Easy2 DIY: Plumbing Basics

www.easy2diy.com (click on "Plumbing")

World Plumbing Council

www.worldplumbing.org

ToolBase Services

www.toolbase.org

International Code Council

www.iccsafe.org

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Plumbing: Rough-in and Final

- VHS/DVD/Digital On-Demand
- Preview clip online (search on 31963)
- Closed captioned
- Includes viewable/printable teacher's guide
- Correlates to the Competencies and Objectives of the National Center for Construction Education & Research
- Order #31963 (English)
- Order #36050 (Spanish narration with English subtitles and English narration with Spanish subtitles)

Looks at plumbing in its two construction phases: rough-in, or initial installation, and final. Details of water systems and drainage, waste, and venting (DWV) systems are examined, as well as tools commonly used. From the series *Building Trades II*. A Shopware Production. (19 minutes) © 2004.

Residential Plumbing

- VHS/DVD/Digital On-Demand
- Preview clip online (search on 26211)
- Includes viewable/printable teacher's guide
- Correlates to national and state standards
- Order #26211
- Order #36063 (Spanish narration with English subtitles and English narration with Spanish subtitles)

Our in-house narrator works with a professional plumber. We find out what it takes to design the plumbing service, and how to install pipes, faucets, drains, sinks, bathtubs, and showers. Shawn shows us how to rough in the pipes, cut holes in the floor, sweat copper pipes, and bond PVC pipes. An extremely instructive how-to video. From the series *Residential Construction*. A Shopware Production. (14 minutes) © 2000.

Mechanical Inspection: Electrical, Plumbing, and Heating

- VHS/DVD-R/Digital On-Demand
- Preview clip online (search on 30516)
- Closed captioned
- Includes viewable/printable teacher's guide
- Order #30516

In this video, viewers are shown three of the key areas to inspect when buying a home—the electrical service, plumbing, and the heating system. Beginning in the basement, our home inspector, Alex Welsh, closely checks the electrical service. He reviews the condition of the fuse box or circuit breaker box to ensure that it is properly assembled and that there are no loose connections or frayed wires. While in the basement, he also checks out the water heater and the heating source. There are many different types of heating systems; here the focus is on gas furnaces and boilers and the particular issues they present. There is also a special feature on state-of-the-art furnaces. As the home inspector roams the house, he also checks plumbing joints for dryness, fit, and safety, as well as looking for evidence of asbestos. A comprehensive review of modern septic systems is also included. Each home style is featured for the distinctive elements and potential problems it presents. From the series *The Home Inspector*. (21 minutes) © 2003.

Basic Plumbing Systems: Residential

- VHS
- Order #19219

By utilizing CAD diagrams, students view a typical residential layout for the hot and cold water supply lines, drain system, and the vent system. An actual construction site is utilized to demonstrate the rough-in plumbing stage where only the water supply lines and drains have been installed. The stub-out stage is also shown. The finish stage gives a brief look at the final installation of all plumbing fixtures. (14 minutes) © 1994.

Basic Plumbing Practices

- VHS
- 3-part series
- Order #24774

Demonstrates proper procedures for measuring, cutting, and fitting various plumbing materials. Each program examines the special considerations for using each type of material, and safety precautions for all plumbing applications. Includes *Steel Pipe and Material Combination; Copper Pipe; Plastic Pipe*. (29 to 40 minutes each) © 1994.

Plumbing

- VHS/DVD-R
- Order #26085

Watch basic plumbing installation for residential and commercial construction, including pipe fitting and bathroom fixtures. From the series *Building Trades*. A Meridian Production. (14 minutes) © 1992.

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