TVET CERTIFICATE III in PLUMBING

DOMESTIC PLUMBING WORKS

CSTPW301

Prepare domestic plumbing works

Competence

Credits: 10

Learning hours: 100

Sector: Construction

Sub-sector: Plumbing

Module Note Issue date: June, 2020

Purpose statement

This is core module, which describes the skills, knowledge and attitude to be acquired by a trainee to use and maintain tool, materials and equipment for plumbing works at the construction site in respect to the standards.

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Learning Unit 1 – Use tools

LO 1.1 –Handle tools

- Content/Topic 1 Introduction on handling tools

Plumbing Tools

In plumbing, as in other skilled trades, the plumber's ability and knowledge is closely tied to the tools used. Good tools in the hands of the skillful plumber turn out quality work. Poorly maintained or ill-adapted tools in the hands of the same plumber cannot produce the same quality of work.

Classification of plumbing tools

Class	Examples	General use of tool
1.Measuring tools	-tape measure, ruler, try-square, protractor	Measuring length, width and angles
2.Marking tools	Pencil, center punch, compass and dividers	Marking on pipes where you want to cut
3.cutting tools	Hacksaw, pipe cutter, utility knife, die,	Used to cut the pipe into two parts
4.Fixing and holding tools	Pipe vise, pipe wrench, spanner, adjustable spanners, pliers, screw driver, hammer…	Those tools are used for fixing and holing as well as tightening
5.Aligning and checking tools	Spirit level, plumb bob	Tools used for aligning and checking both horizontal levels and vertical level, except plumb bob which is aimed to check vertical levels

		only
6.Smoothing tools	Files, reamer	Used to smooth the pipes, and removing burrs
7.Swagging tools	Flaring tools	
8.Special tools	Core hammer drill, power threading machine, hydraulic bending machine	

- Content/Topic 2 Techniques of lifting and handling tools

Hazards and Human Factors:

Strains, sprains, hernias, fractures, bruises, and lacerations may result from poor manual material handling and lifting practices. Lifting, carrying, dropping, and lowering are the common physical acts responsible for injuries. Many strains are the direct result of improper lifting techniques, lifting with no assistance, or failure to use required and available manual material handling equipment.

Manual Handling.

Influencing factors when manually lifting materials include the size, shape, and weight of the object to be lifted (and distance to be moved). Proper lifting techniques are as important as the weight of the object to be lifted. Heavy weights or awkward positions may require mechanical assistance or team lifting to be used.

Lifting and Carrying.

There are several variables, which influence the ability of people to manually handle and lift materials. Physical capabilities of individuals and variables in the work environment need consideration. Proper consideration and knowledge of limitations and the use of correct lifting and carrying techniques will reduce the possibility of injury.

Training.

Department Heads, Managers and Supervisors must train personnel who regularly perform manual lifting duties. Supervisors will ensure their personnel receive thorough instructions on the proper techniques to use and what PPE is required.

Minimizing Manual Material Handling Hazards:

Engineering Controls. A preferred method of minimizing the risk of manual lifting is the use of engineering controls such as employing mechanical assists to decrease the force, the repetition, distance of travel, and frequency of the manual handling activities. Some examples might include employing scissor tables, elevators, conveyors, and gravity chutes.

Proper Lifting Methods.

No single technique for preventing injury during lifting and material handling has been discovered despite numerous research efforts. The best prevention strategy is to ensure workstations are properly designed, loads are manageable in both size and weight distribution, the frequency and duration of lifting are not excessively stressful, and workers can demonstrate knowledge of proper techniques for material handling. There are three basic methods of lifting, that is, straight back-bent knees, free style, and kinetic

Manual lifting

Content/Topic 3 Safety in the workplace

A safe work environment is a productive one. No matter the size or type of the business, procedures for safety in the workplace are a necessity for all staff. Safety measures protect employees as well as equipment and business property. Avoiding or minimizing injuries and damage to equipment and facilities will result in fewer expenses and more profit for a business.

Workplace Safety Policies

Each business should have a safety policy in place, created either by management or in a joint effort between management and staff. Every employee has a role in carrying out the safety policies. A safety handbook should be created identifying safety issues and spelling out consequences of not following the appropriate safety procedures

Importance of Safety Training

Training is necessary so that employees will know the importance of safety and how to practice safety in the workplaces. Depending on the type of equipment used, the training may be required by a federal mandate. For example, any workplace that operates a forklift must provide training for employees for its safe operation. Training can come from outside experts hired to teach classes or employees specially trained to perform safety instruction.

Workplace Safety Equipment

Appropriate personal protective equipment (PPE) must be available to anyone who comes in contact with a potential work safety hazard. This can include **hard hats, protective eyewear,**

earplugs, shoes, gloves and **clothing.** Even an office worker who delivers a message to a work area near a potential safety hazard must put on the appropriate PPE.

Benefits of Workplace Safety

Safety in the workplace results in fewer accidents, which results in fewer costs for worker's compensation, less down time for employees, and less retraining time for workers otherwise needed to replace an injured worker. Avoiding damage to equipment will result in fewer repair costs. Worker performance is improved when workers know how to prevent injuries and have confidence in management's active role in protecting their safety.

LO 1.2 – select and use tools

- Content/Topic 1 Identification of plumbing tools

COMMONLY USED TOOLS

Simple plumbing jobs will ordinarily require only a few tools. However, to perform all operations that are part of plumbing work would require a considerable number of various types of tools. This unit will consider the tools most frequently used.

Some of the tools are needed in several sizes. In such cases, you will find guidelines for selecting the proper size for the job.

Measuring and layout tools

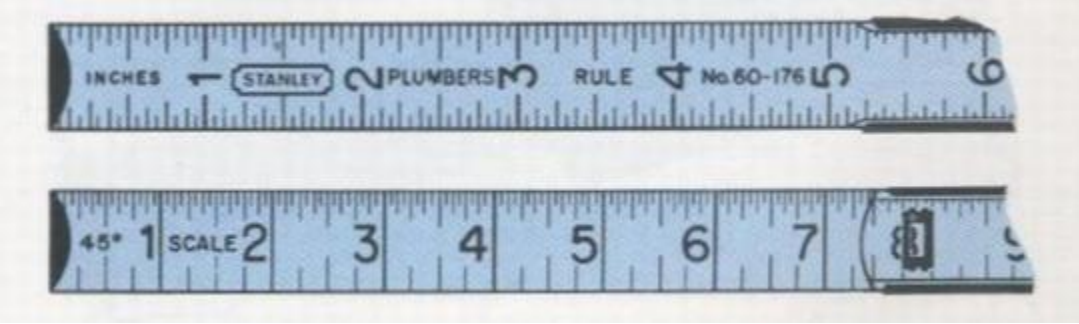
Instruments that measure length, height, diameter, levelness, or plumb are classified as **measuring tools**. Those that are used to produce accurate lines, circles or any other marking are called **layout tools**. *Plumbing dimensions must be accurate within fractions of an inch and the instruments must be capable of such accuracy over distances of several feet.* Tools the plumber will use include: rules, tapes, squares, levels, transits, plumb bobs, chalk lines, compasses, and dividers.

RULES

The folding wood rule in Fig. 1-1 is equipped with a metal sliding extension. This can be used to take accurate internal measurements.

Folding wood rule can be carried in a pocket where it is always handy. It is sometimes called a “zigzag” or extension rule.

(Lufkin Div., Cooper Tools)



Plumbers’ folding rule. The side with vertical inch markings is shown at top. A 45˚scale is shown at bottom.

TAPES

Many plumbers carry a steer tape measure, for its convenience. Since many of these rules retract into their case at the push of a button, they can be quickly put away with one hand.

Frequently, steel tapes in 25, 50, and 100 foot lengths are desirable for locating terminal points for pipe or for measuring the length of pipe required for long runs. Generally, the plumber prefers the 100 foot size because of its greater capacity. Some steel tapes are marked in both English and metric. Metric tapes are produced in 10, 15, 20, 25, and 50 meter lengths.

A tape measure

A metal clip on the back of the case permits the tape to be attached to a belt.

This 100 foot steel tape is useful for measuring long runs of pipe.

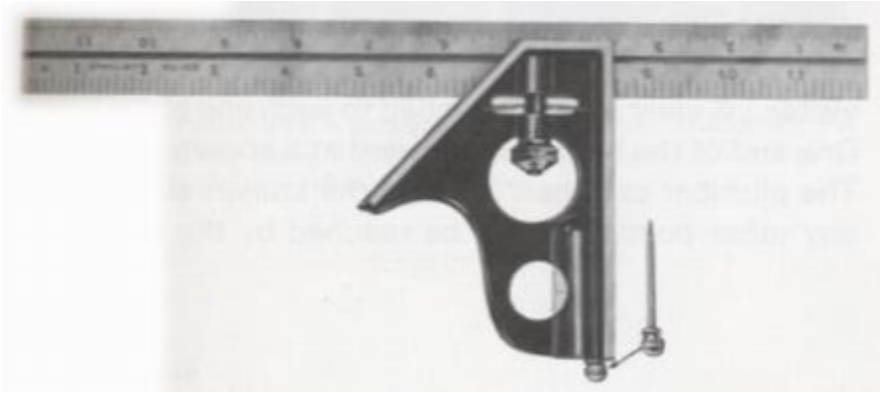
SQUARES

Plumbers will find some type of square useful in these situations:

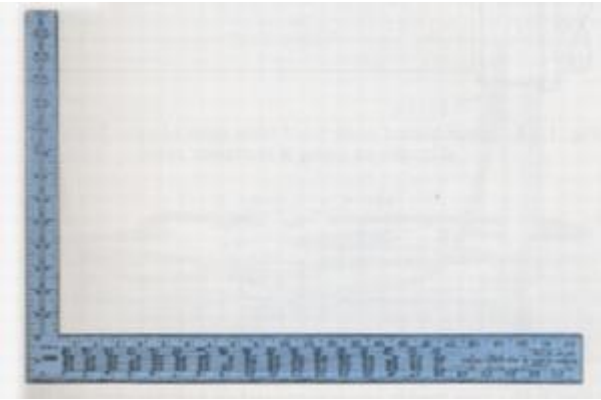
- When locating the position of fixtures.

- When marking framing members for cuts that will permit plumbing installation.

Try square has 6 inch metal blade and metal or wood stock.



Combination square has sliding head and scribe for marking metal. (Stanley Tools)

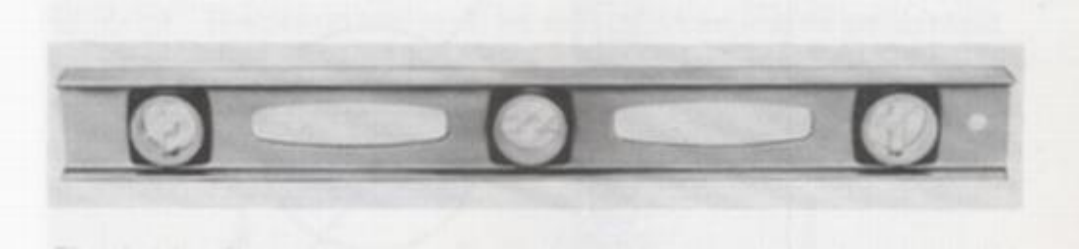


Framing square is used for measuring, squaring, and marking cuts to be made on walls and partition.

ALIGNMENT TOOLS

When installing pipe and plumbing fixtures, it is frequently necessary to determine if the part is **plumb** (vertical) or **level** (horizontal). Several tools are used for these purposes.

The **level**, is used to check both positions.



General purpose level should have three vials. Bubble in appropriate vial centers when part being checked is level or plumb.

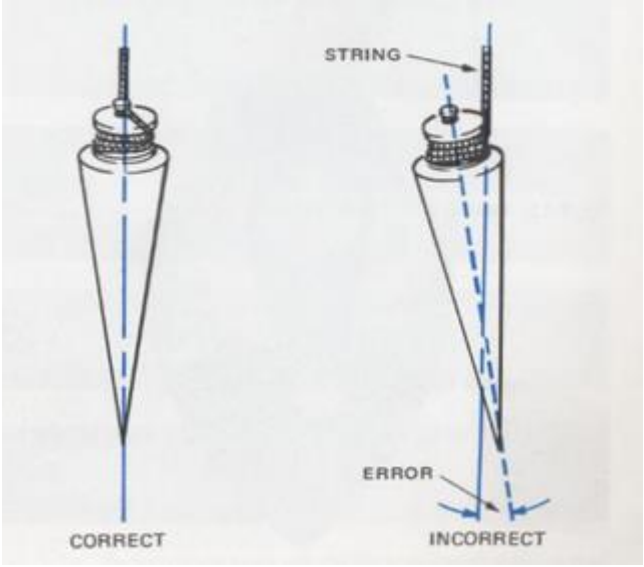
PLUMB BOB

The plumber can accurately locate the center of vertical runs of pipe and transfer this point from one floor level to another with a **plumb bob**, Fig. 1- 9. Although the plumb bob is a simple tool, it must be made with care if it is to function accurately.

COMPASS AND DIVIDER

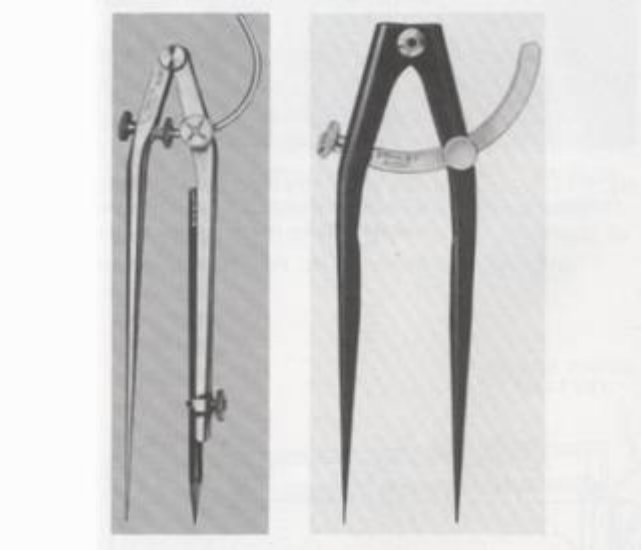
Laying out circles and arcs requires a compass or divider, Fig. 1-11. There is a difference in these tools. The **compass** has a pencil in one leg, whereas, the **divider** has two metal points.

The plumb bob must be well balanced and its string must be attached at exact top center.



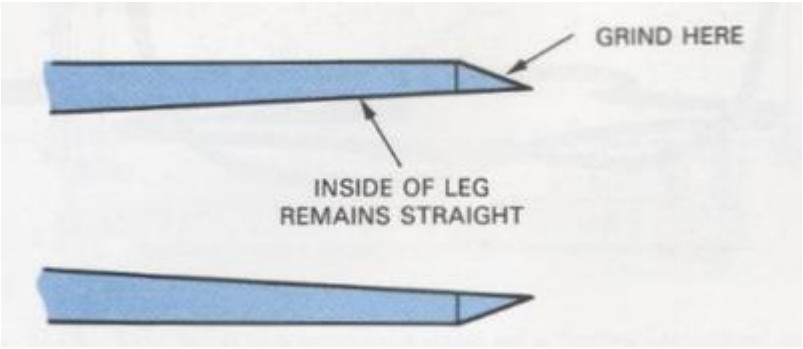
Plumb bob

If string is incorrectly attached to plumb bob, the point will be deflected and reading will be inaccurate.



Compass and divider

Left. Compass is preferred for marking soft or light-colored surfaces. Right. Dividers have two sharp metal points. They are used for marking hard and smooth surfaces such as metal.

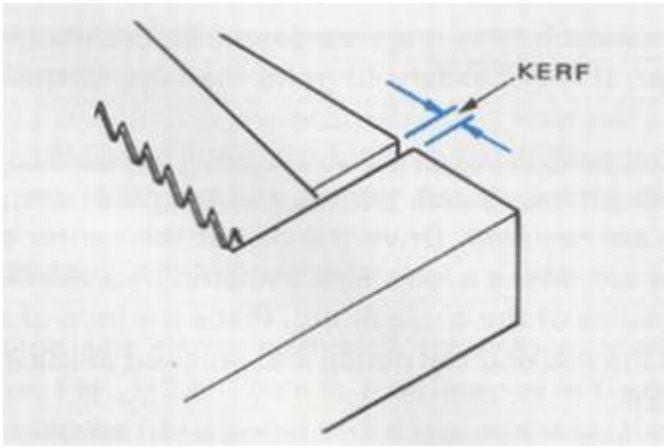


To preserve their accuracy, dividers should be sharpened only on the outside of the legs.

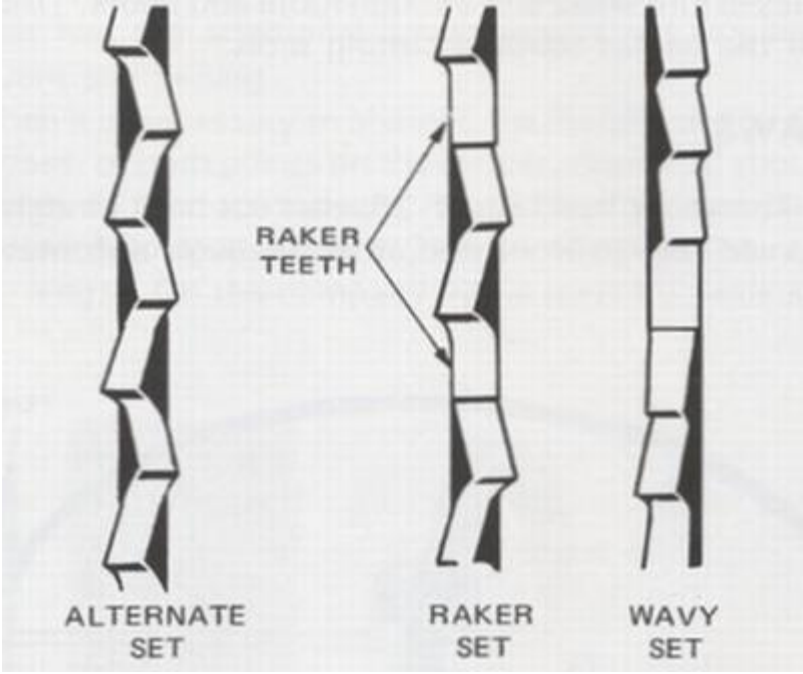
Hacksaws, are the all-purpose tool for cutting metal. Plumbers keep them in their tool box for occasional use in cutting galvanized and black iron pipe. However, this is not usually recommended. It is very difficult to produce a square cut and crooked cuts are hard to thread. Should it be necessary to use the hacksaw, install the correct blade. This will improve the quality of the work and lengthen the life of the blade.

Hacksaw frame with a D-handle design. (Stanley Tools)

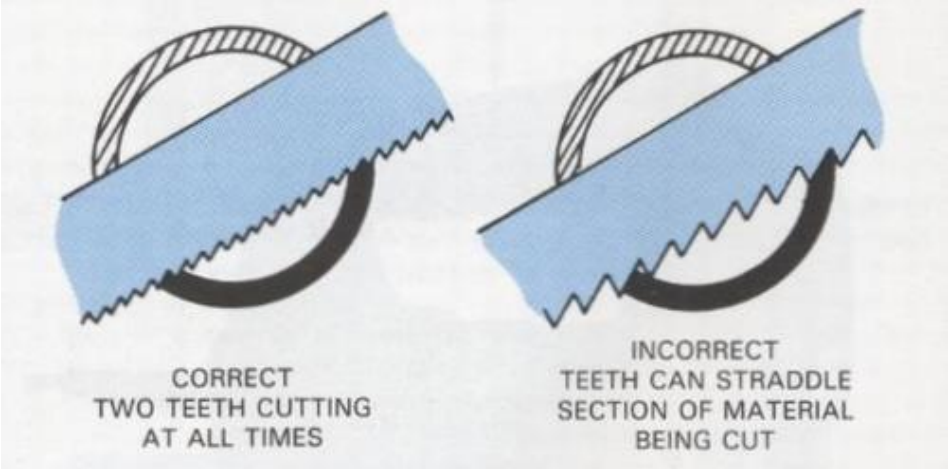
Section of hacksaw blade shows how teeth are pitched forward for better cutting.



Kerf made by hacksaw blade should be cut from the scrap part of stock.



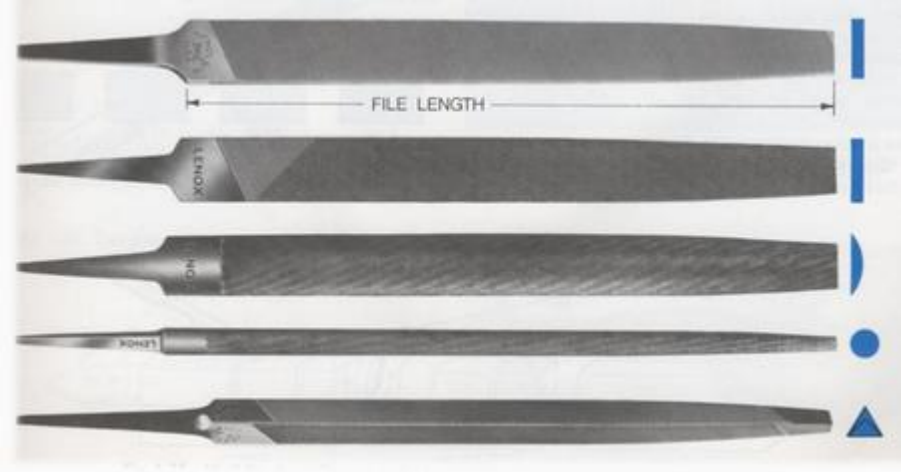
Teeth on all hacksaw blades are bent at a slight angle off vertical. This enables the blade to produce a cut wide enough so that the rest of the blade does not bind or break. In the alternate set, every other tooth is bent at the same angle.



The correct hacksaw blade should be selected for the material being cut. Teeth at right are too coarse for the thin material.

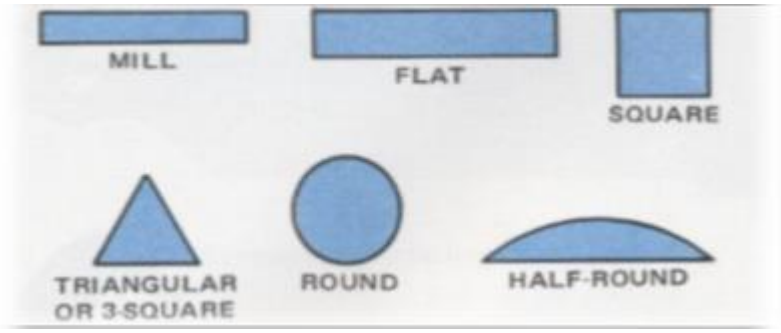
FILES

Another class of tool with cutting teeth is **files**, Fig. 1-18. White they have a cutting action, their purpose is to remove small quantities of wood or metal while shaping and smoothing the material. Files have many different shapes, lengths, types of teeth, and degrees of coarseness.

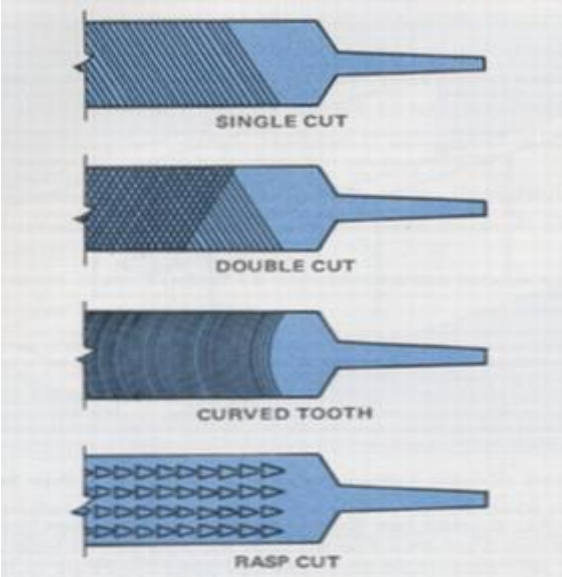


All of the above files are useful in plumbing. Length is measured from heel to point.

Figure below shows the most common cross-sectional shapes. The shape selected will depend on the contour the user wishes to produce on the filed surface. For example, flat or convex (bulging) surfaces require a flat or mill file.



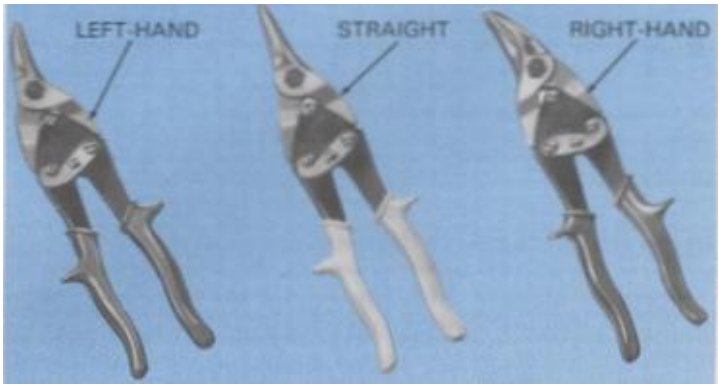
Sections show various shapes of files a plumber may use. A contour may be selected to fit the surface being filed.



Files can also be identified by the kinds of teeth.

AVIATION SNIPS

Aviation snips are useful for cutting sheet metal, the compound lever-action of the snips makes cutting relatively easy. Aviation snips are available in right, left, and straight cut designs.

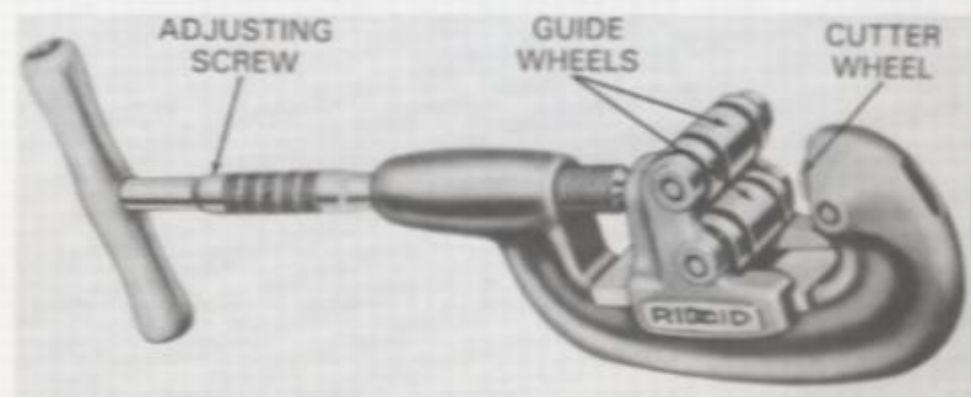


Aviation snips are manufactured in three styles.

PIPE CUTTERS

A more sophisticated tool is the **pipe cutter** shown in Fig. 1-22. It has four movable parts, including a cutter wheel, two guide wheels, and an adjusting screw. Used properly, it remains

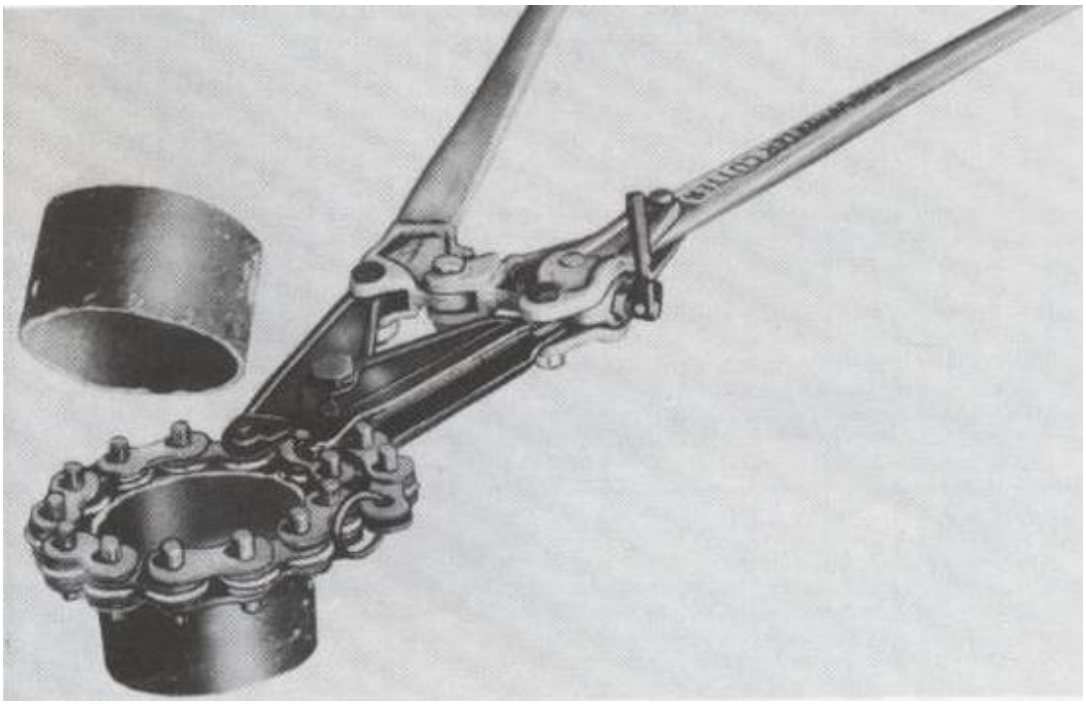
serviceable for a long time. However, the cutter wheel will eventually need to be replaced. A dulled cutter tends to crush rather than cut the pipe. A slight amount of lubricating oil applied to the screw and the cutting wheel should be a part of the preventive maintenance.



The pipe cutter has a threaded handle that moves the guide wheels tightly against the pipe being cut. This action helps the cutter wheel bite into and cut the metal.

SOIL PIPE CUTTER

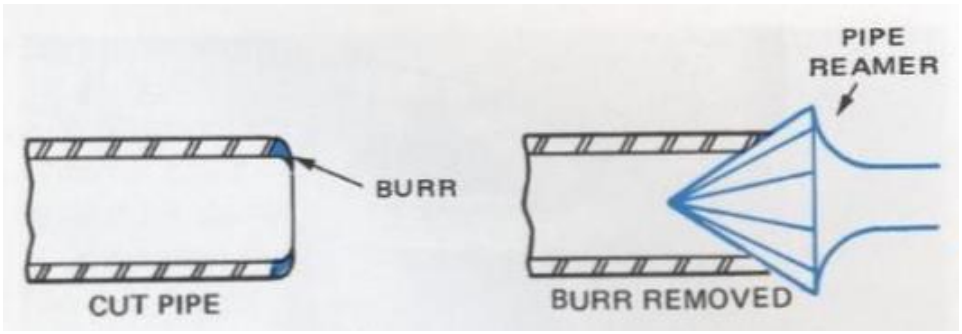
The soil **pipe cutter** is similar to the pipe cutter. It is much faster than the chisel in cutting cast iron pipe. As the chain is drawn tight and the tool rotated slowly, the cutters are forced into the walls of the pipe forcing it to break cleanly.



Soil pipe cutter has cutting roller at every link.

REAMING AND THREADING TOOLS

Reaming the end of a pipe removes the burr formed inside when the pipe is cut. This operation is shown in Figure below, If not removed, the burr collects deposits that obstruct the flow of water. A pipe reamer, does this job well.

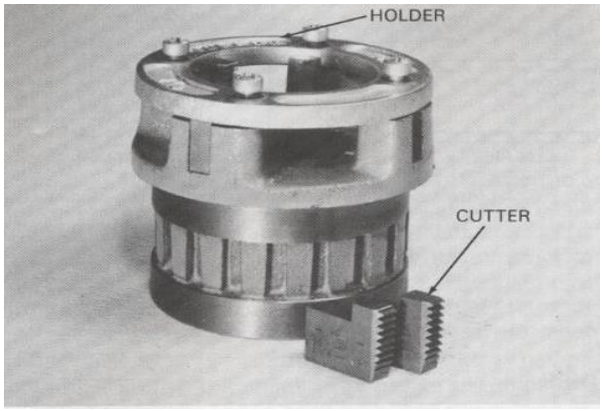


Cutters are on tapered face of the burring reamer. The reamer can be used on any size pipe.

Burring reamer shown has spiraling cutters.

DIES

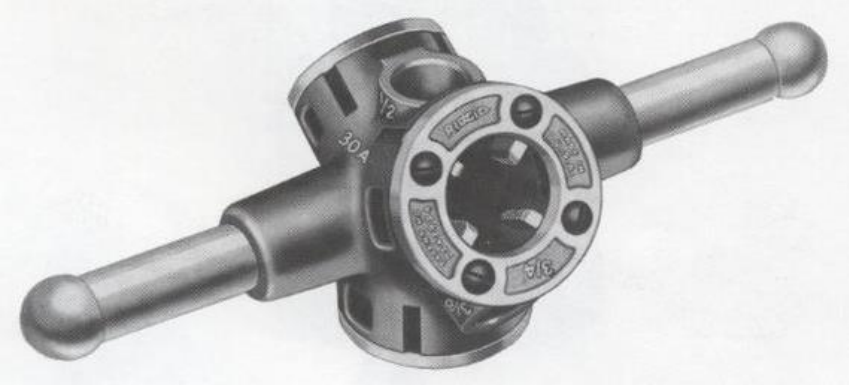
Before galvanized pipe can be assembled in the plumbing system, the ends of the pipe may need to be threaded. For this job, the plumber needs special dies. Pipe dies, cut correctly tapered threads for each of the standard pipe sizes.



Pipe die consists of holder and cutters.

DIE STOCKS

Die stocks, are required to turn the dies. The ratchet-style die stock is preferred because it permits the worker to use body weight to rotate the die while standing to one side of the pipe.



A three-way pipe die and stock permits three diameters of pipe to be threaded with a single tool.

TOOLS FOR ASSEMBLING AND HOLDING

The plumbers' toolbox must include a variety of wrenches. Wrenches are used to turn pipes, fittings, and fasteners found in today's plumbing systems.

WRENCHES

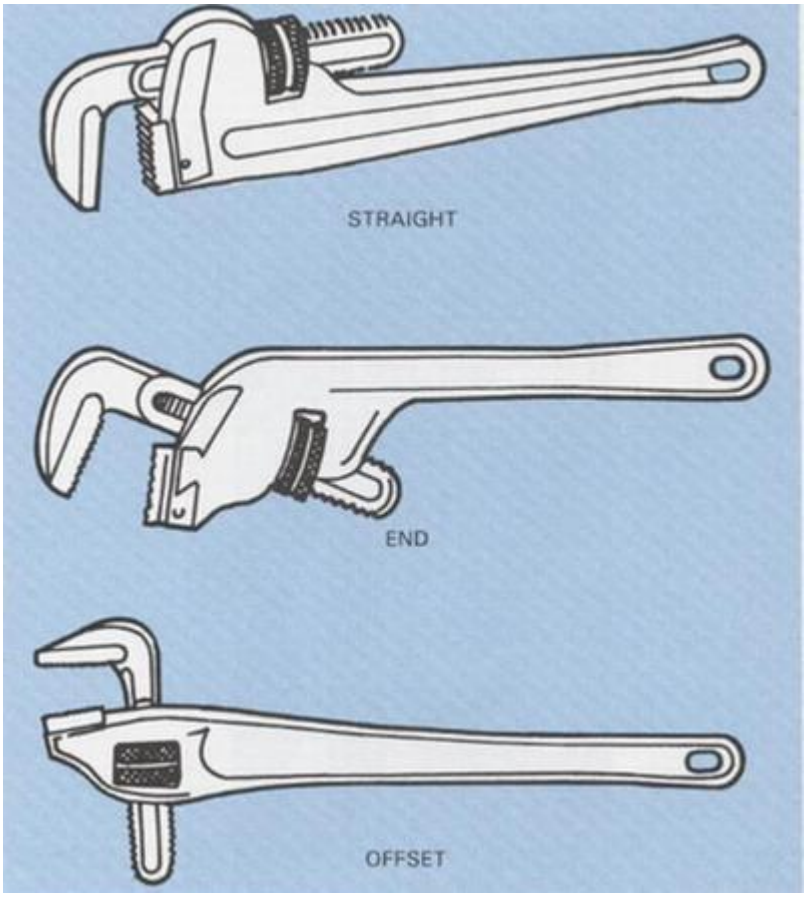
Some pipe wrenches must grip finished surfaces that would be ruined by jaw marks. Others must hold pipes in circumstances where only sharp jaws will do the job.

Pipe wrench

A **pipe wrench,** is used to hold or turn threaded pipe during assembly. Pipe wrenches are manufactured in three basic designs: straight, end, and offset. The straight pipe wrench is used most often. The end and offset pipe wrenches are valuable when working in close quarters. At least two pipe wrenches will be required. Figure below indicates the pipe wrench lengths most suitable for various size pipes. Jaws should be adjusted so that the teeth will grip the pipe firmly

without crushing it. Fig. 1-32 indicates the correct method of attaching the wrench so that it will grip the pipe or fitting.

Oil should be applied to the adjustment nut at regular intervals to prevent rusting. The ability of the pipe wrench to grip pipe is directly related to the condition of the teeth. Cleaning the teeth and sharpening them with a three-square (triangular) file can restore some wrenches to usefulness.

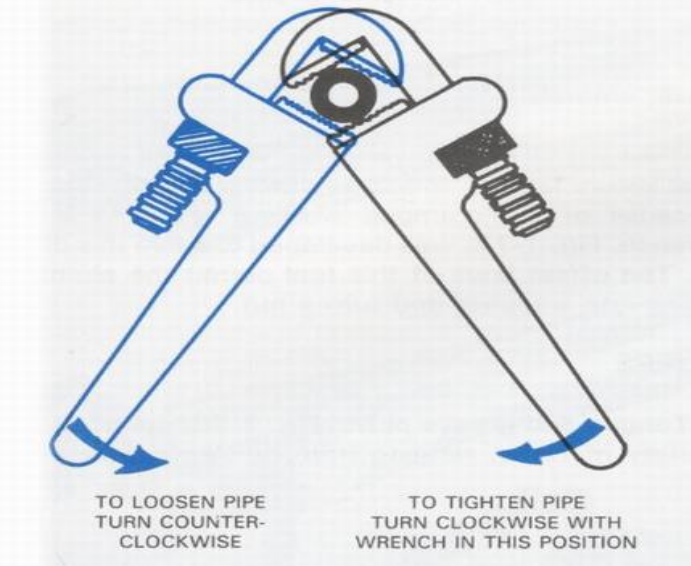


Pipe wrench has heavy toothed jaws for gripping pipe.

TABLE OF PIPE WRENCHES
SIZES AND CAPACITIES

WRENCH LENGTH (INCHES)	PIPE DIAMETER (INCHES)	WRENCH CAPACITY (INCHES)
6	1/8 - 1/4	3/4
8	1/8 - 1/2	1
10	1/2 - 3/4	1 1/2
12	3/4 - 1	2
14	1 - 1 1/2	2
18	1 1/2 - 2	2 1/2

Use this guide for selecting the right wrench for the job.



Open side of jaws should face in same direction as the force exerted on the handle.

Chain wrench

Where diameters of more than 2 inches are involved, it is common practice to use a **chain wrench,** to hold or rotate the pipe during assembly. Chain wrenches can be used on larger pipe, and they require less space around the pipe than pipe wrenches.

Chain wrench is used on large diameter pipe.

Strap wrench

A **strap wrench** can be used to assemble chrome plated or other finished pipe. The teeth of a pipe wrench would damage such surfaces.

Often pipe fittings, valves, and plumbing fixtures have hex (six-sided) or square shoulders that permit the use of a monkey wrench, open end wrench, or adjustable wrench. The monkey wrench, Fig. 1-35, looks like a pipe wrench but is different in two significant ways:

1. The jaws are smooth.

2. There is no provision for the jaws to tighten on the part being turned as pressure is applied to the wrench.

The **monkey wrench** is only useful for turning or holding objects that have flats. Many people choose another wrench because of its size and frequent difficulty in adjusting it to hold properly.

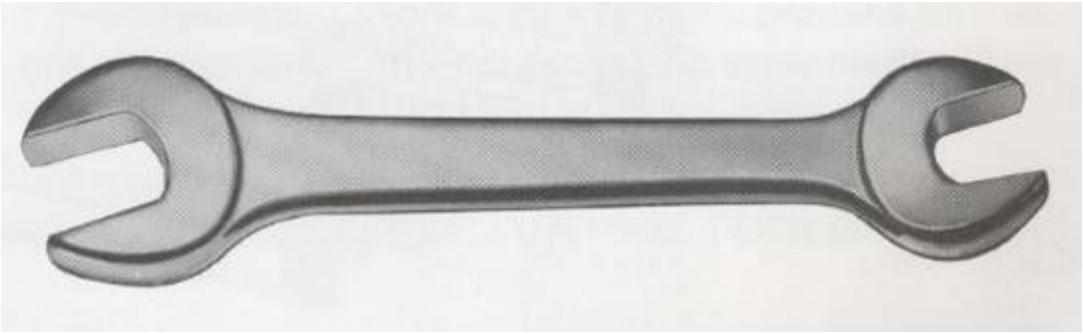
The strap portion of a strap wrench needs to be coated with rosin to prevent slipping on smooth-surfaced pipe.

A monkey wrench is like a pipe wrench with smooth jaws.

(Diamond Tool and Horseshoe Co.)

Open end wrenches

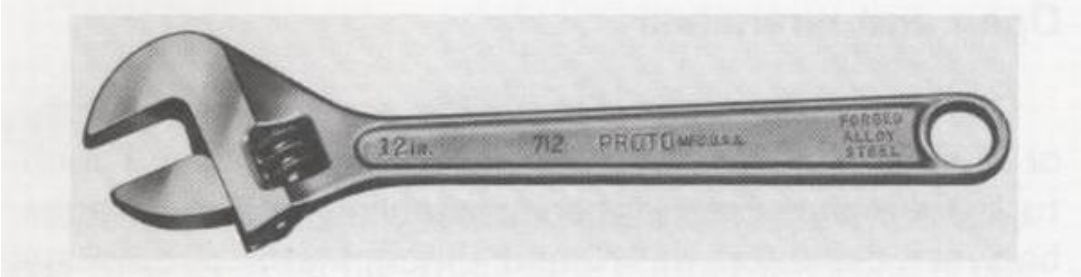
Open end wrenches, below are sold individually or in sets. The plumber will find the sizes from 1 inch to 1 3/4 inches useful when assembling pipe and fittings between diameters of 1/2and 1 inch. Metric sizes range from 6 mm to 32 mm in increments of 1 mm. Since the jaws of these wrenches are fixed, they are less likely to slip off a nut.



Open end wrench is less likely to slip off the nut than adjustable jawed tool.

Adjustable wrenches

Adjustable wrenches, Fig. 1-37, are very popular since they can replace several different sizes of open end wrenches. They hold better on nuts and will fit into more places than the monkey wrench.

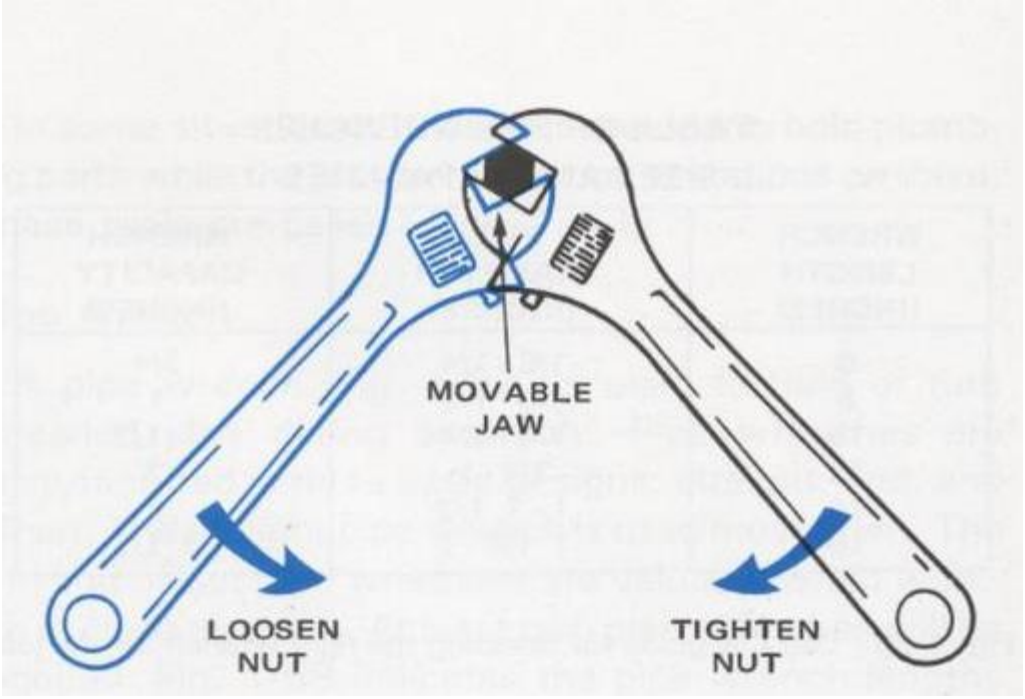


Adjustable wrench handle nuts of all sizes up to its capacity.

SIZE AND CAPACITY OF ADJUSTABLE WRENCHES

SIZE (INCHES)	CAPACITY (INCHES)
4	1/2
6	3/4
8	15/16
10	1 1/8
12	1 5/16
15	1 11/16
18	2 1/2
24	2 1/2

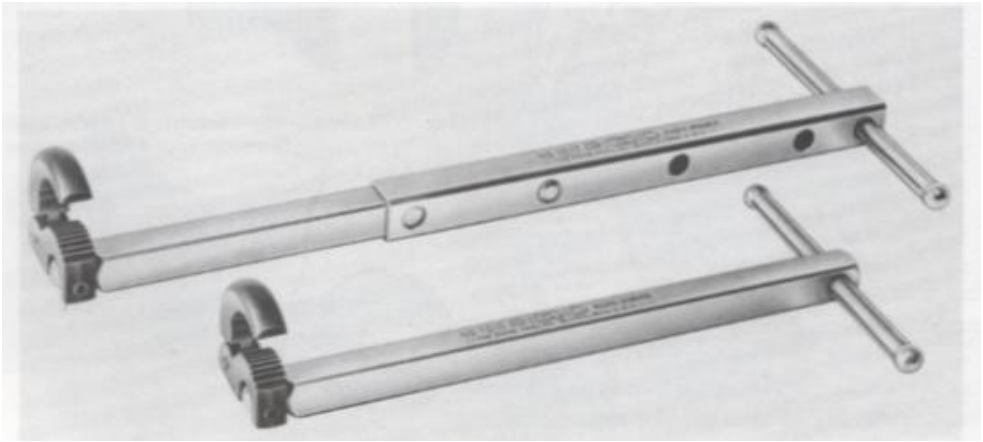
Adjustable wrenches will adjust to sizes listed.



Placing adjustable wrench on nut properly will prevent damage to the jaws.

Basin wrench

It is hard to use conventional wrenches on the nuts that secure faucets and some other plumbing equipment because of the cramped working space. The **basin wrench**, Fig. 1 -40, was developed to solve this difficulty. The offset jaws of this tool permit the plumber to reach into a recess and turn a nut.



Basin wrench can fit into small recesses to turn nuts.

PLIERS

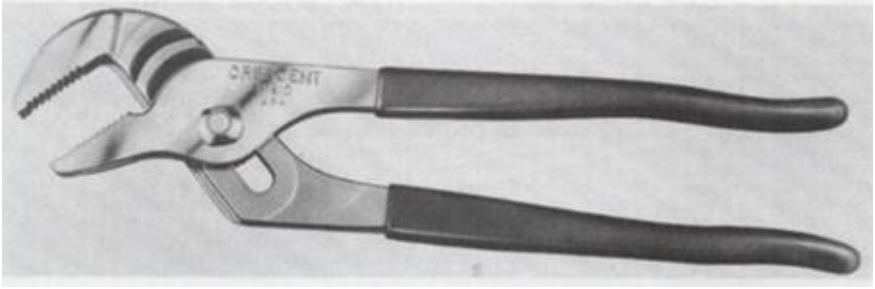
Tongue-and-groove pliers, are useful for a variety of tasks, ranging from holding copper fittings while soldering to assembly and disassembly operations. The plastic-coated handles allow you to use pliers comfortably for extended periods of time. Do not use pliers on finished plumbing parts where the teeth in the jaws might make unsightly marks.

Locking pliers, are a multipurpose tool frequently used when taking apart old plumbing fixtures. Since tremendous clamping pressure can be exerted with this tool, it is often possible to hold or turn an object on that the square or hex shoulders have worn away. **HAMMERS**

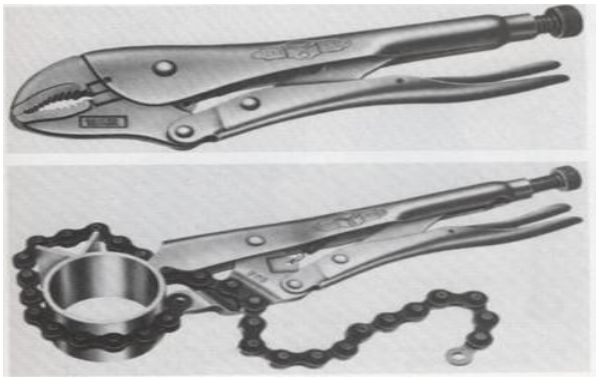
Two types of hammers should be included in the plumber's list of tools. The **carpenter's hammer,** is used for driving or pulling nails and for tapping a wood chisel. The head is made of forged, hardened, and tempered steel. The claw may be straight or curved; *the face may* be bell-shaped or plain.

A **ball pein hammer,** is often used for driving a cold chisel or a punch. Sizes are available in 4, 6, 8, and 12 ounce as well as 1, 1 1/2, and 2 pounds. For heavier work the 12 ounce or 1 1/2 pound is suitable. Lighter work is best done with a 4 or 6 ounce hammer.

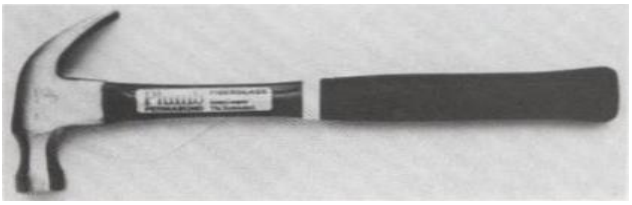
There are other fastening tools occasionally useful to a plumber. Because of their special nature, they will be considered only in the units that relate to their use.



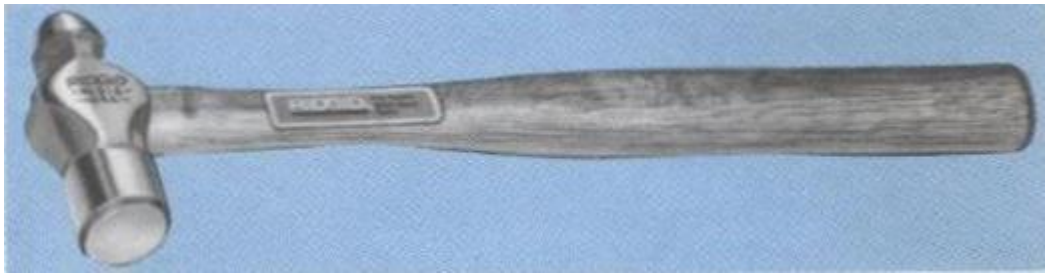
Tongue-and-groove pliers are a useful general-purpose tool.



Locking pliers exert extraordinary clamping pressure.(American Tool Co. Inc)



The curved claw carpenter's hammer is handy for a variety of tasks.



The ball pein hammer is particularly useful for driving punches and chisels.

SCREWDRIVERS

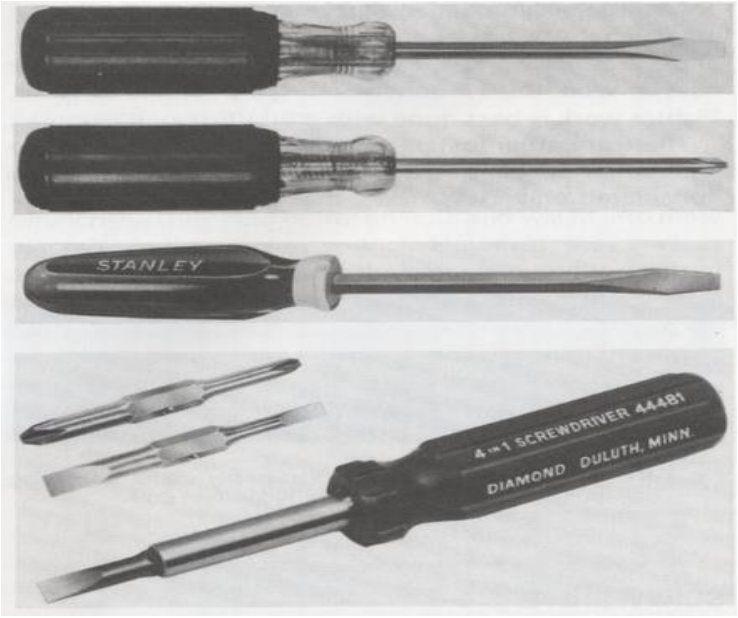
Several sizes and types of screwdrivers are used by a plumber, Fig. 1-45. Two or three small- or medium-sized straight and Phillips screwdrivers are essential.

A **4-in-l screwdriver** generally has two straight and two Phillips blades. This screwdriver is convenient to carry; however, it may not be suitable for all tasks because the shank is larger in diameter than the smaller blades.

VISES

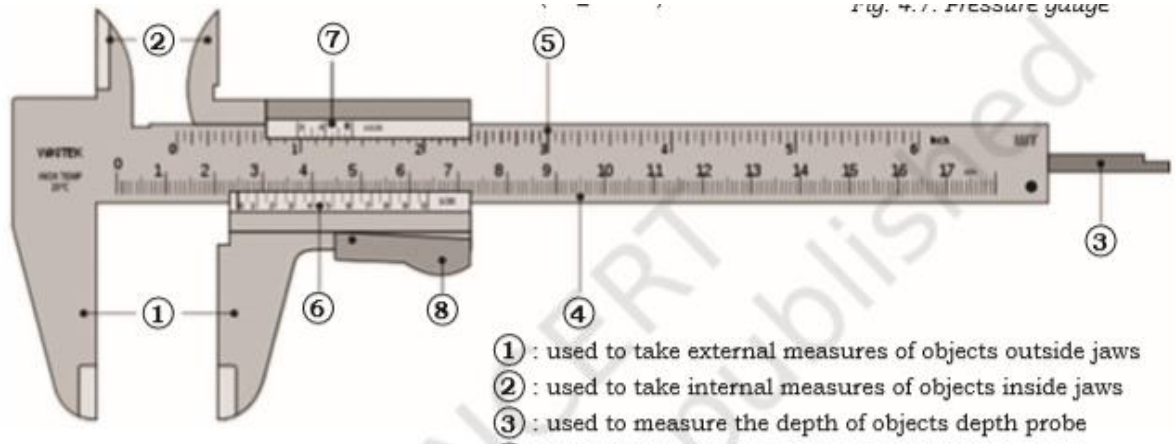
The **pipe vise,** Fig. 1-46, is the most commonly used holding device. Its hardened jaws permit it to firmly grip the pipe preventing the pipe from turning. Since the jaws tend to leave marks, their use is generally limited to work on pipe that will not be exposed in the finished structure.

A **chain-type pipe vise,** Fig. 1-47, is also available. It serves the same purpose as the conventional pipe vise.



Straight blade and Phillips screwdrivers in several sizes are a necessary part of the plumber's Tools

Vernier caliper



① : used to take external measures of objects outside jaws
② : used to take internal measures of objects inside jaws
③ : used to measure the depth of objects depth probe
④ : (cm) Main scale
⑤ : (inch) Main scale
⑥ : (cm) Vernier
⑦ : (inch) Vernier
⑧ : used to block movable part retainer

Fig. 4.8: Vernier calliper and its parts

- Content/Topic 2 Proper Use of hand and machine tools

Hand tool, any of the implements used by craftspersons in manual operation such as chopping, chiseling, sawing, filling, or foring. Complementary tools, often needed as auxiliaries to shaping tools, include such implements as the hammer for nailing and the vise for holding.

Today people are still becoming injured, sick or killed as a result of hazards around machinery and equipment in every industry. There are numerous potential hazards around machinery and equipment. Safety Hazards

● Contact with Moving Parts

● Contact with Electricity, Heat, Fire, Cold, Other Energies

● Contact with Pressurized Gas or Liquid

Where you feed materials into the machine: loading, cleaning.

● Where the machine cuts, turns, drills, shapes, punches, or moves in any way: cleaning and maintenance, trouble shooting and repair, adjusting, setting up.

● At the gears, wheels, cylinders, belts, rollers, chains, cables, sprockets, cams: cleaning and maintenance, trouble shooting and repair, adjusting, setting up.

- Content /Topic 3 Proper Use of power tools

Safety Precautions to Take Before Using Power Tools

Without power tools, we would be unable to complete many of the construction projects that occur throughout the country on a daily basis. It is important though, that all people are extremely cautious when using these tools because they have the ability to cause serious injuries. Taking the time to implement some safety precautions can help to minimize the potential damages and may keep the handler and anyone nearby safe.

Power tool safety may seem like common sense, but without spending a few minutes reviewing your familiarity with each tool and ensuring that you have properly set up the area you will be working in, you may be putting yourself in danger. Safety precautions that you should consider taking before using a power tool include:

Read the instruction manuals and warning. Power tools come with safety information that is relevant to the handling of the equipment. If the information is unavailable, discuss how to use the tool with someone who is familiar with the device.

Five basic safety rules can help prevent hazards associated with the use of hand and power tools:

- Keep all tools in good condition with regular maintenance.
- Use the right tool for the job.
- Examine each tool for damage before use and do not use damaged tools.
- Operate tools according to the manufacturers' instructions.
- Provide and use properly the right personal protective equipment.

Learning Unit 2 –Use of equipment

LO 2.1 – Handle equipment

- Content/Topic 1 Introduction on handling tools and equipment

Manual handling causes over a third of all workplace injuries. These include work-related musculoskeletal disorders (MSDs) such as pain and injuries to arms, legs and joints, and repetitive strain injuries of various sorts.

The term manual handling covers a wide variety of activities including lifting, lowering, pushing, pulling and carrying. If any of these tasks are not carried out appropriately there is a risk of injury.

Why is dealing with manual handling important?

Manual handling injuries can have serious implications for the employer and the person who has been injured. They can occur almost anywhere in the workplace and heavy manual labour, awkward postures, repetitive movements of arms, legs and back or previous/existing injury can increase the risk.

What do I have to do?

To help prevent manual handling injuries in the workplace, you should avoid such tasks as far as possible. However, where it is not possible to avoid handling a load, employers must look at the risks of that task and put sensible health and safety measures in place to prevent and avoid injury.

For any lifting activity

Always take into account**:**

- individual capability
- the nature of the load
- environmental conditions
- training
- work organization

If you need to lift something manually

- Reduce the amount of twisting, stooping and reaching
- Avoid lifting from floor level or above shoulder height, especially heavy loads
- Adjust storage areas to minimise the need to carry out such movements
- Consider how you can minimise carrying distances
- Assess the weight to be carried and whether the worker can move the load safely or needs any help – maybe the load can be broken down to smaller, lighter components

If you need to use lifting equipment

- Consider whether you can use a lifting aid, such as a forklift truck, electric or hand-powered hoist, or a conveyor
- Think about storage as part of the delivery process – maybe heavy items could be delivered directly, or closer, to the storage area
- Reduce carrying distances where possible

- Content/Topic 2 Techniques of lifting and handling equipment

OBJECTIVE

To prevent back injuries by utilizing safe lifting methods. By adopting the lifting techniques in this pamphlet, and avoiding known hazards, employees can prevent back injuries from occurring.

Good handling technique for lifting

There are some simple things to do before and during the lift/carry:

- Remove obstructions from the route.
- For a long lift, plan to rest the load midway on a table or bench to change grip.

- Keep the load close to the waist. The load should be kept close to the body for as long as possible while lifting.
- Keep the heaviest side of the load next to the body.
- Adopt a stable position and make sure your feet are apart, with one leg slightly forward to maintain balance

SAFE LIFTING TECHNIQUES

There are eight steps to performing a lift in a safe manner:

1. Size up the load.

2. Plan the job.

3. Establish a base support.

4. Bend your knees.

5. Get a good grip

6. Keep the load close

7. Lift with your legs.

8. Pivot; don't twist.

SIZE UP THE LOAD

Always assess the object before lifting it. Make sure the load is stable and balanced. Carefully and slowly, put force against the object to determine its weight. IF IT IS TOO HEAVY, GET HELP!

PLAN THE JOB

Plan a route that is free of tripping and slipping hazards. Ensure that the planned route allows for easy travel. Know where the object will be unloaded and plan for rest stop if necessary. Think through the lift -lift the load in your mind. Face the object you are about to lift and, if possible, face the direction you want to go. DO NOT TWIST YOUR BODY.

ESTABLISH BASE OF SUPPORT

Make sure you have a firm footing. Keep your feet at least shoulder width apart. A staggered stance, with one foot slightly behind the other, often helps provide a firm base of support.

BEND YOUR KNEES

Bend at your knees, not at your waist. Bend or squat down as far as necessary using your legs and not your back. Tuck your chin in toward your chest. This will help keep your back straight. In this position, your knees are bent and your back is straight form your hips to your shoulders, as if you were in a sitting position.

GET A GOOD GRIP

Place your hands at opposite sides of the object. Grip the load firmly, using your whole hand, not just your fingers. Pull your elbows in close to your body.

KEEP THE LOAD CLOSE

Keep the load close to your body. The closer it is to your spine, the less force it exerts on your back. Maintain the natural curve of your lower back. Keep your back upright. Whether you are lifting or putting down a load, do not add the weight of your body to the load. 10 POUNDS AT ARMS LENGTH IS LIKE LIFTING 100 POUNDS.

LIFT WITH YOUR LEGS

Lift with your legs to allow your body's powerful leg muscles to do the work. Flex your knees and hips, not your back.

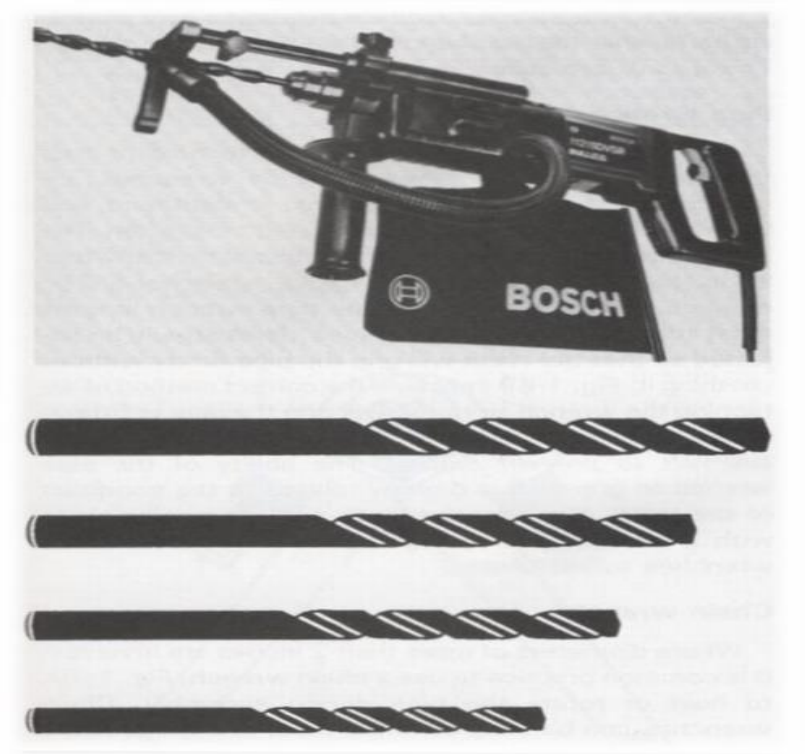
LO 2.2 – Select and use equipment

- Content/Topic 1 Identification of plumbing equipment

The different types of plumbing equipment include personal **hand tools**, consumable materials, and power tools and equipment for the shop or workplace. The simplest set of tools that you may have for basic plumbing jobs include an adjustable wrench, fire-resistant cloth, hacksaw, **pipe wrench**, pliers, plunger, **propane** torch, and safety glasses.

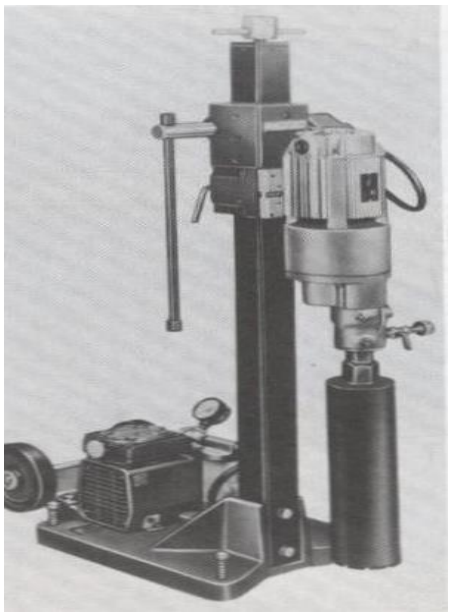
These tools can be used to do basic work, such as unclogging a drain, changing a faucet or **soldering** two pipes together. More complex plumbing equipment may be required to do more complicated jobs.

A **rotary hammer drill**, Fig. 1-24, is an effective means of drilling holes in concrete and masonry. The hammering action breaks the dense material and the rotating bit removes the chips.

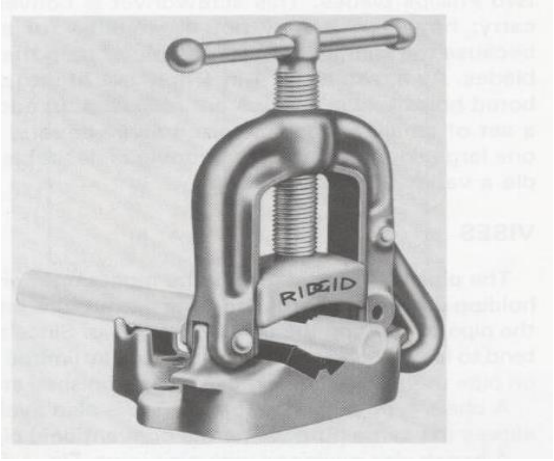


Rotary hammer drills are useful when drilling holes for masonry and concrete anchors. A variety of bits are available.

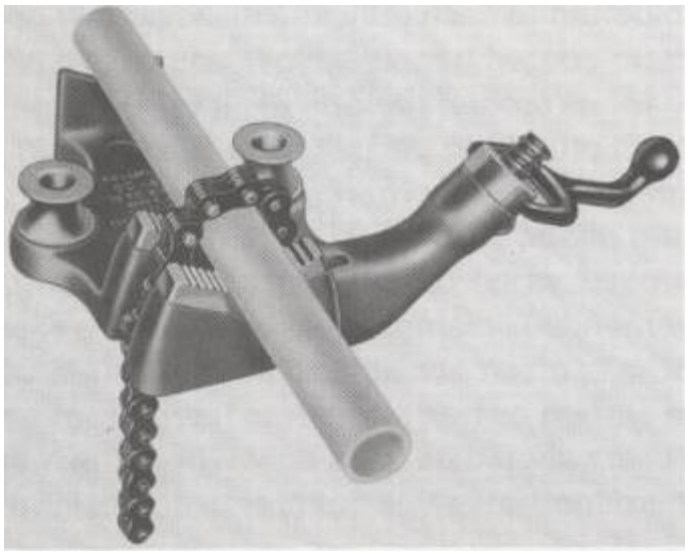
When it is necessary to drill large diameter holes through steel reinforced concrete, **diamond core drilling equipment** is used, Fig. 1- 25 Diamond core drills can drill to a depth of 14 inches in diameters from 3/4 inch to 14 inches. Core drilling rigs are held in position by vacuum plates mounted at the base of the machine.



Diamond core drills are used to drill large holes in concrete.



Pipe vise holds pipe for other operations being performed.



Chain-type vise serves same purpose as regular pipe vise.

- Content/Topic 2 Use of power machines

To prevent hazards associated with the use of power tools, workers should observe the following general precautions: Never carry a tool by the cord or hose.

Never yank the cord or the hose to disconnect it from the receptacle

Machinery Safety Guidelines

1. Get trained on each machine before using.

2. Follow instruction manuals.

3. Select the appropriate machine/tool for the job.

4. Use required PPE and guards.

5. Set up before starting. Change dull blades, clamp work, secure bits, and remove chuck keys.

6. Make sure operating controls are clearly labeled and easy to reach.

7. Turn off machinery when unattended.

Causes of accidents while working with machinery

• Loose clothing, hair, jewelry being caught in moving parts.

• Materials ejected from the machine when it is operational.

• Inadvertent starting of the machine.

• Slipping and falling into an unguarded nip.

• Contact with sharp edges, e.g., cutting blade.

• Making adjustments while the machine is operational.

• Unauthorized operation of machines.

• Lack of preventive maintenance.

Learning Unit 3 – Join other types of pipes

LO 3.1 – Join PVC pipes

- Content/Topic 1 Discussion on different methods of joining PVC pipes

Commonly methods used to join PVC pipes are sited and discussed below;

1. **Ring joint :** A Ring Type Joint Flange is a type of flange that uses a metal ring that sits in a hexagonal groove as a gasket to seal the flange pair. The flanges seal when the bolts are tightened and the gasket is compressed into the groove making a metal to metal seal. An RTJ flange usually has a raised face with the groove machined into the face of the flange. The raised face doesn't serve as a way to contain the pressure.

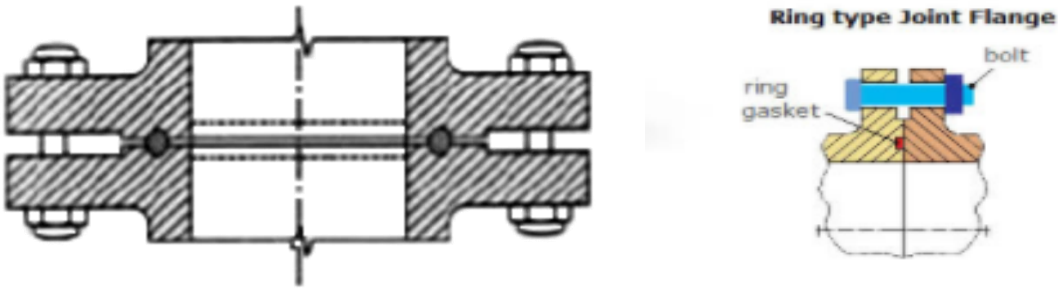


Figure: Ring type joint flange

2. **solvent-weld joint:**
   A pipe joint made by spreading a cement on two plastic surfaces to be joined. The ceme nt reacts chemically with these surfaces, thereby dissolving the material. Then these tw o surfaces are placed in contact; a solid joint is formed when hardening takes place.

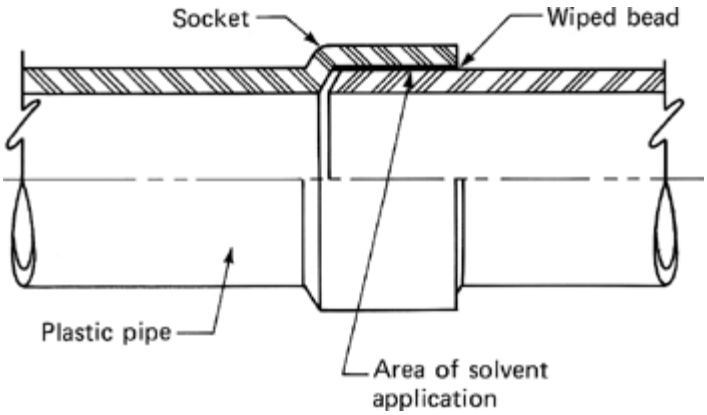


figure :solvent-weld joint

3. Threaded fittings

Types of Threaded Joints

Threaded joints are specified below for the way a joint is made, or for its purpose.

Direct joints

The component parts to be joined have internal or external thread and are directly screwed together. No additional fastening elements are needed.

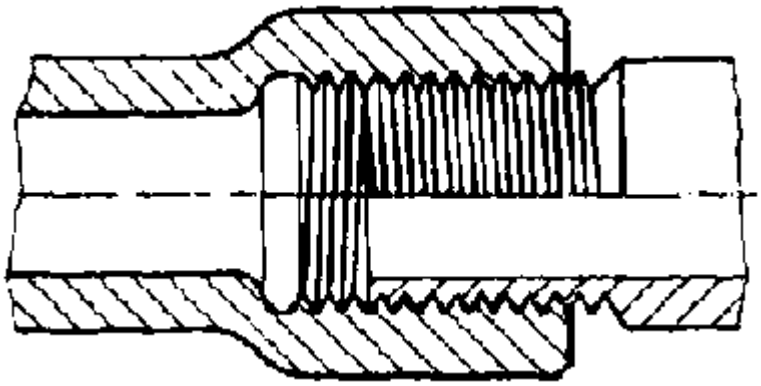


Figure. Direct joint

Indirect joints

The component parts to be joined are held together by standardized components, i.e. bolts, screws and nuts. Locking devices and washers may be used additionally.

Where a component part has a female thread, the joint may be made without a nut. The walls of the work-piece must be sufficiently thick for this kind of joint.

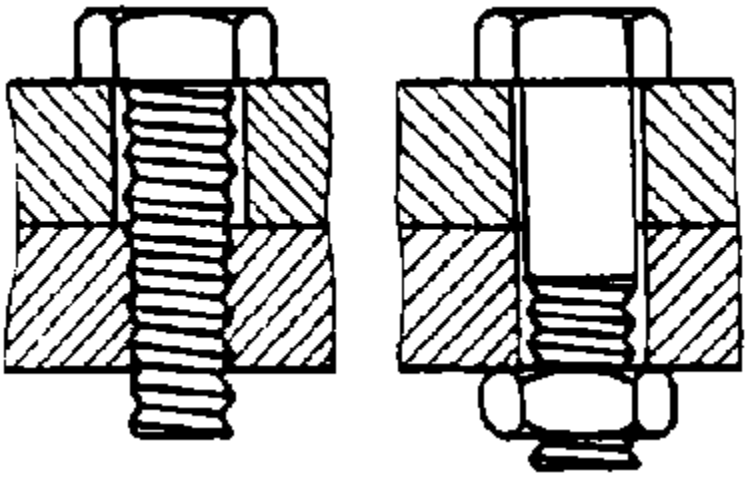


Figure. Indirect joint

Fastening joints

The component parts are to be joined directly or indirectly only for the purpose of connecting them. The vee-thread, ISO metric vee-thread or Whitworth thread, are the preferred types of thread. Both threads are self-retaining.

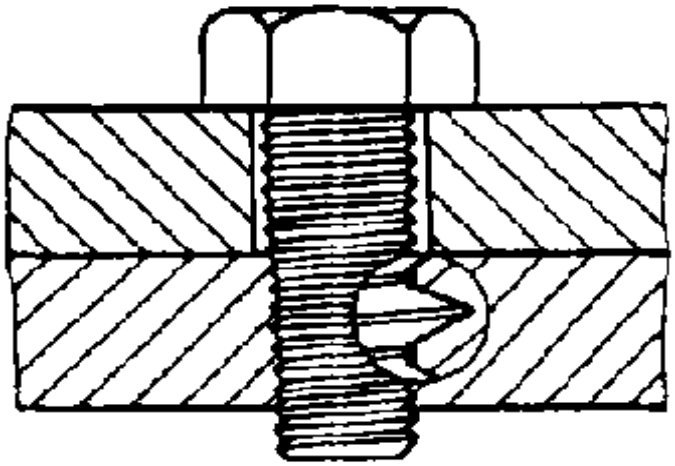


Figure . Screwed joint for fastening purpose

Adjustable joints

The component parts are joined for the purpose of connecting them and transmitting movements or forces. The preferred types of thread are round thread, acme standard screw thread or saw-tooth thread.

These are less self-retaining.

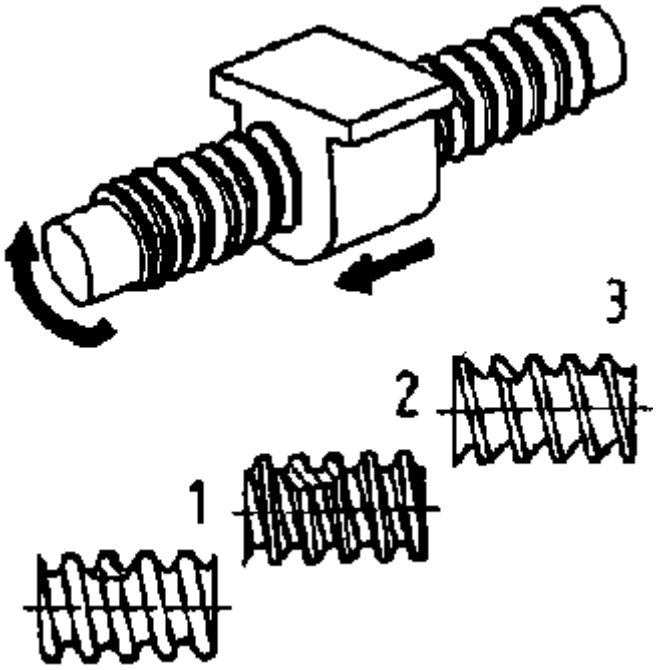


Figure. Adjustable joint

Advantages of threaded joint

1. Threaded joints are detachable joints which help to joint different parts together easily as well as remove or separate from each other.
2. Threaded joints are reliable
3. Threads joints can be used in any position vertical, horizontal or inclined because threaded joints are self locking.
4. Threads are easy or simple in manufacturing hence they are cost effective.
5. Threaded joints are used in various sizes from small size to large size.
6. Threaded joint components are standardized like screw, bolt and nut.
7. Threaded joining process is simple to use.

Disadvantages of threaded joint

1. Threaded joint parts are subjected to stress concentration near to hole which causes to failure of joint parts.

4. **Use fusion**

Heat fusion (sometimes-called **heat welding**, **butt welding** or simply **fusion**) is a welding process used to join two different pieces of a thermoplastic. This process involves heating both pieces simultaneously and pressing them together. The two pieces then cool together and form a permanent bond. When done properly, the two pieces become indistinguishable from each other.

Cutting PVC pipes

While cutting PVC plastic pipes either, a plastic tubing cutter or a hacksaw can be used. Cuts must be straight to ensure watertight joint. PVC plastic are joined with plastic fitting and solvent glue. Use solvent glue that is made for the type of plastic pipe you are installing.

Solvent glue hardens in about 30seconds, so test-fit all plastic pipes and fittings before gluing the first joint some solvent glues, called “all-purpose” or “universal” solvents, may be used on all types of plastic pipe. For best results, the surfaces of plastic pipes And fittings should be dulled with emery cloth and liquid primer before they are joined. Liquid solvent glues and primers are toxic and flammable. Provide adequate ventilation when fitting Plastics, and store the products away from any source of heat.

Tools & Materials needed:

- Tape measure
- Felt-tipped pen
- Tubing cutter or hacksaw
- Utility knife
- Channel-type pliers
- Gloves
- Plastic pipe
- Fittings
- Emery cloth
- Plastic pipe primer
- Solvent glue
- Rag
- Petroleum jell

Cutting Process

- Prepare the materials and tools according to drawings.
- Join PVC pipes using fittings or glue.
- Check the joints for leakage

Find the length of plastic pipe needed by measuring between the bottoms of the fitting sockets (fittings shown in cutaway).Mark the length on the pipe with a felt-tipped pen.

Tools for cutting PVC pipes

1.Plastic tubing cutters do a fast, neat job of cutting. You‟ll probably have to go to a professional plumbing supply store to find one, however. They are not interchangeable with metal tubing cutters.

2.**The best cutting tool for plastic pipe** is a power miter saw with a fine tooth woodworking blade or plastic-specific blade.

3. **A ratcheting plastic-pipe cutter** can cut smaller diameter PVC.

Process of joining PVC pipes

1) Remove rough burrs on cut ends of plastic pipe, using an utility knife.
2) Test-fit all pipes and fittings. Pipes should fit tightly against the bottom of the fitting sockets
3) Mark the depth of the fitting sockets on the pipes.
4) Apply a light coat of plastic pipe primer to the ends of the pipes and to the insides of the fitting sockets.
5) Solvent-glue each joint by applying a thick coat of solvent glue to the end of the pipe.
6) Quickly position the pipe and fitting so that the alignment marks are offset by about 2".
7) Spread solvent by twisting the pipe until the marks are aligned
8) Wipe away excess solvent glue with a rag. Do not disturb the joint for 30 minutes after gluing.

Solvent welding is a chemical bonding process used to Permanently join PVC pipes and fittings.

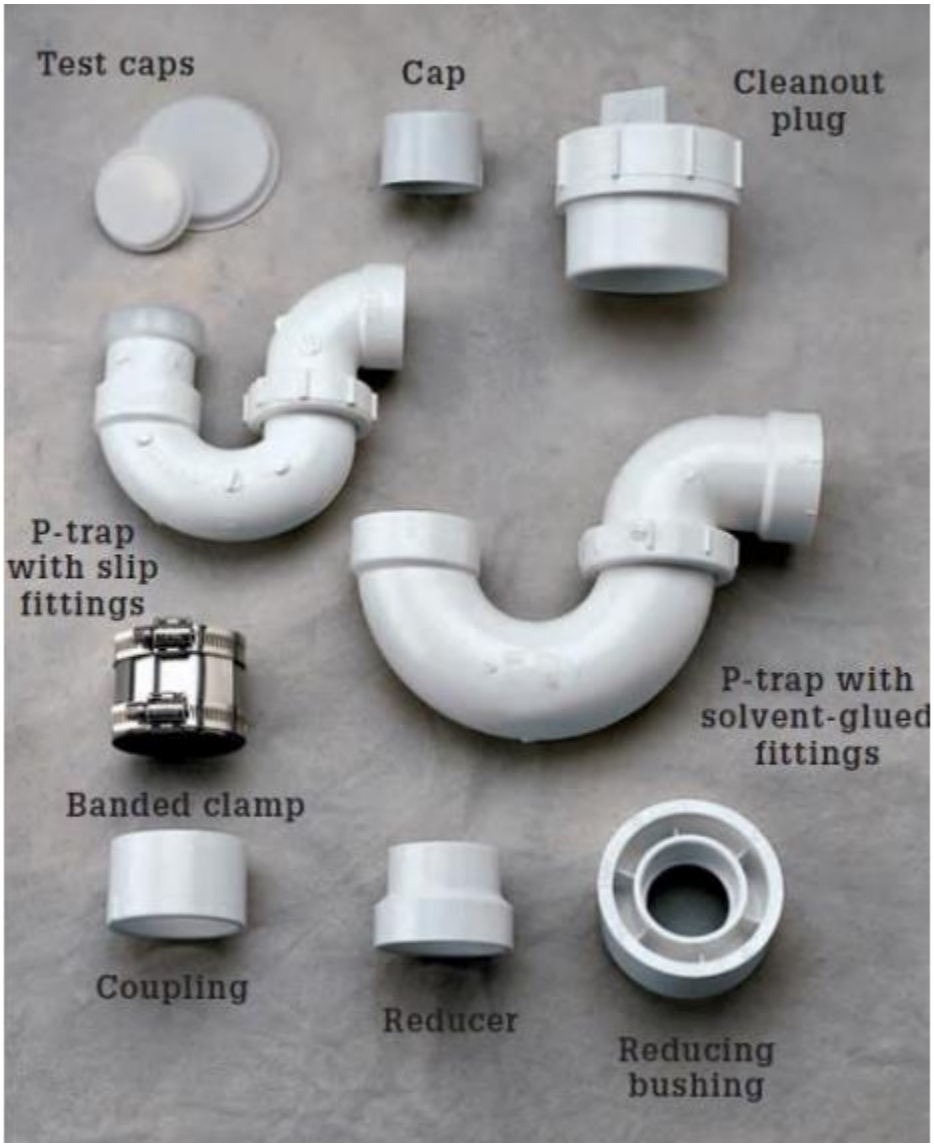
Different fittings used to join PVC pipes

Drain, waste, and vent pipe fittings Drain, waste, and vent (DWV) is the system for removing water from a house. Fittings for drain, waste, and vent pipes are available in many configurations, with openings ranging from 11⁄4"to 4" in diameter. When planning your project, buy plentiful numbers of DWV and water supply fittings from a reputable retailer with a good return policy. It is much more efficient to return leftover materials after you complete your project than it is to interrupt your work each time you need to shop for a missing fitting. Below are DWV available in various shapes and sizes:

PVC Fittings

Different PVC fittings

Different PVC fittings



Different PVC fittings

LO 3.2 – Join copper pipes

- Content/Topic 1 Discuss on different methods of joining copper pipes

Copper pipes joining

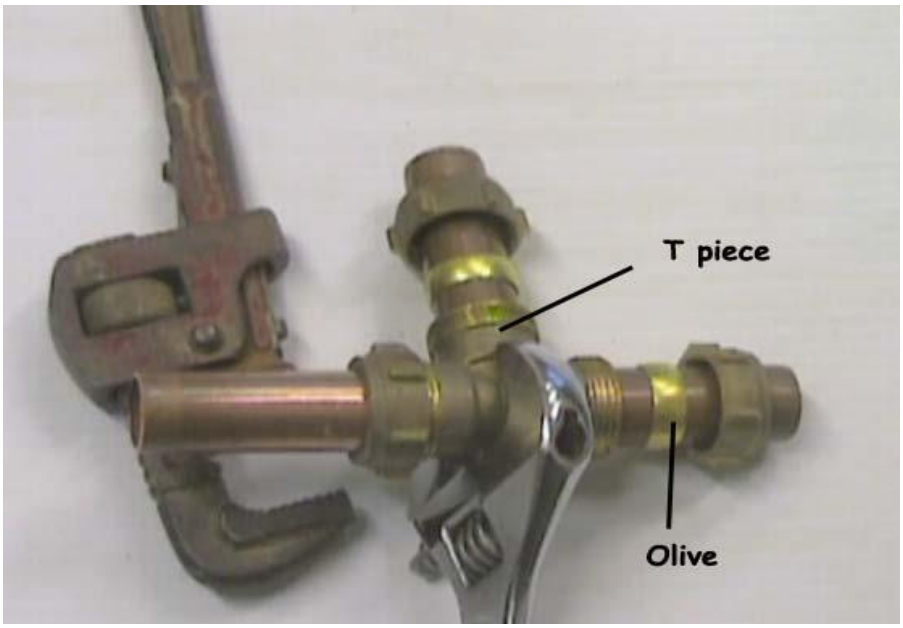
Copper is the ideal material for water supply pipes. It resists corrosion and has smooth surfaces that provide good water flow. Copper pipe is manufactured in rigid and flexible forms Rigid copper, sometimes called hard copper, is approved for home water supply systems by all local codes. It comes in three wall-thickness grades:

Types M, L, and K. Type M is the thin nest, the least expensive, and a good choice for do-it-yourself home plumbing.

Different methods of joining copper pipes:

- Compression joints: A compression joint is one which uses a fitting to join two or more pipes by compressing a small brass ring, known as an olive, between the fitting and the pipe.

Compression joints should never be over tightened as the pipe can kink making it impossible to seal.



Compression T Junction

Capillary joints : Capillary joints are used to join sections of copper pipe in plumbing and heating systems. Unlike a compression joint, which uses the force exerted on a small ring of copper by tightening a nut to seal the connection, capillary joints rely on a seal of molten and then cooled solder.

The solder is inserted into the joint (either at manufacture, or by the person installing the pipe), heated and then allowed to cool, hopefully creating a perfect seal.

Figure: Capillary joint

- Brazing **joints: Brazing** is a metal-joining process in which two or more metal items are joined together by melting and flowing a filler metal into the joint, the filler metal having a lower melting point than the adjoining metal.

Brazing differs from welding in that it does not involve melting the work pieces and from soldering in using higher temperatures for a similar process, while also requiring much more closely fitted parts than when soldering.

Brazing practice

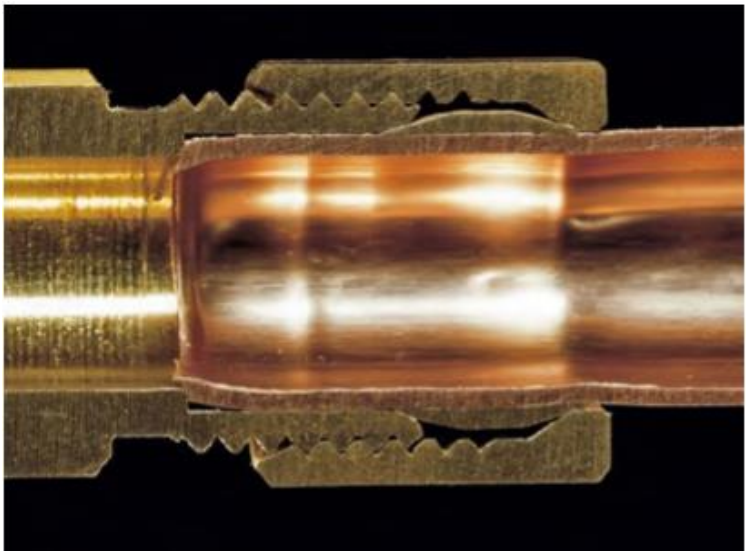
Joining with Soldered fittings, also called sweat Fittings, often are used to join copper pipes. Correctly, soldered fittings are strong and trouble-free. Copper pipe can also be joined with compression fittings or flare fittings.

Soldered joint

Use caution when soldering copper. Pipes and fittings become very hot and must be allowed to cool before handling Prevent accidents by shutting off propane torch immediately after use. Make sure valve is closed completely.

Joining with Compression Fittings

Compression fittings are used to make connections that may need to be taken apart. Compression fittings are easy to disconnect and are often used to install supply tubes and fixture shutoff valves. Use compression fittings in places where it is unsafe or difficult to solder, such as in crawl spaces. Compression fittings are used most often with flexible copper pipe. Flexible copper is soft enough to allow the compression ring to seat snugly, creating a watertight seal. Compression fittings also may be used to make connections with Type M rigid copper pipe.



Compression fittings

Types of compression fittings:
There are two basic types of compression fitting:

- **Type-A or non-manipulative fitting:** These fittings are easy to install and do not require any modifications to the tubing. Type-A compression fittings are also known as olive and can be installed using an ordinary wrench for tightening the surrounding nut. These fittings are usually used for water connections.
- **Type-B or manipulative fittings:** Installation of Type-B fittings require flaring or belling the tubing. In order to remove this type of fitting, a specialized pulling tool is often used for siding the nut and olive away from the pipe or tube. The type-B fitting is mostly used for gas lines.

Parts of a Compression Fitting:
The pipe compression fittings consist of three parts:

a. Compression nut
b. Compression ring or inner ring or "olive", and
c. Compression seat

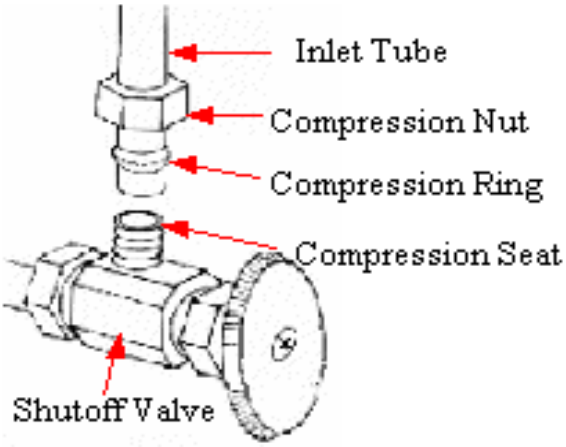


Figure: Parts of compression fittings

Joining two Copper Pipes with a compression union fitting

1) Slide compression nuts and rings over the ends of pipes. Place a threaded union between the pipes.

2) Apply a layer of pipe joint compound or Teflon tape to the union‟s threads, then screw compression nuts onto the union.

3) Hold the center of the union fitting with an adjustable wrench and use another wrench to tighten each compression nut one complete turn. Turn on the water. If the fitting leaks, tighten the nuts gently.

Fittings used

SOLDER JOINT FITTINGS

There are two types of solder fittings for copper pipe:

1. Wrought copper fittings: Are made from copper tubing cut and shaped as required.

2. Cast solder fittings: Wrought fittings are easy to recognize because of their thin walls and smooth exterior. They are also heavier and have a rougher surface. Cast solder fittings are available in a greater variety of shapes and perform the same functions as do similar fittings in cast iron because are designated the same way and fit the various pipe sizes.

Figure below shows Copper pressure fittings (may be wrought or cast).

Figure below shows Special copper fittings to connect copper to galvanized pipe and fittings

Flared Fitting Flared fittings are used to connect soft copper gas supply pipes to a threaded nipple: either on a gas appliance or another fitting. The key to success using a flared fitting is making a perfectly flared end in the tubing with a flaring tool. Flaring tools can be purchased at most hardware stores. Make sure the brass flared fitting you purchase matches the diameter of the soft copper tubing you are using. Handle the soft copper gently and avoid overtightening the flaring tool, which can cause the copper tube to crack Tools & materials for making flared fitting: Flaring tool

- Soft, flexible copper tubing
- Brass flare nut
- Channel-type pliers
- Tubing cutter

How to make a flared fitting**?**

1. Cut the end of the soft copper tubing with a tubing cutter and deburr the ends. Slide the brass flare nut over the cut end, with the threaded female end facing out.

2. Select the correct outside diameter setting on the flaring tool base strip and then insert the tubing end into the opening. Clamp the base shut tightly

3. Orient the flaring cone in the reamer over the open end of the tubing and tighten the flaring tool until the cone is seated fully in the tubing end, causing it to flare out.

4. Remove the tool and inspect the flared tube end, making sure there are no cracks and the nut fits cleanly against the flared tube end. Attach the nut to the threaded nipple and tighten to make the joint. Test for leaks.

How to Attach Supply Tubes to Fixture Shutoff Valves with Compression Fittings

1) Bend flexible copper supply tube and mark to length. Include 1⁄2" for portion that will fit inside valve. Cut tube.

2) Slide the compression nut and then the compression ring over the end of the pipe. The threads of the nut should face the valve.

3) Apply a small amount of pipe joint compound to the threads. This lubricates the threads.

4) Insert the end of the pipe into the fitting so it fits flush against the bottom of the fitting socket.

5) Slide the compression ring and nut against the threads of the valve. Hand tighten the nut onto the valve

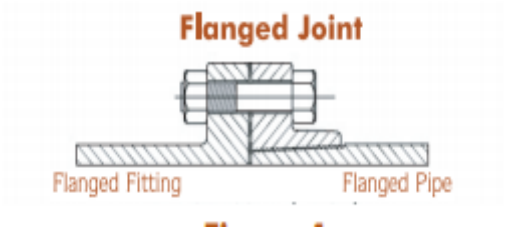
6) Tighten the compression nut with adjustable wrenches. Do not overtighten. Turn on the water and watch for leaks. If the fitting leaks, tighten the nut gently.

LO 3.3 –Join cast and ductile iron

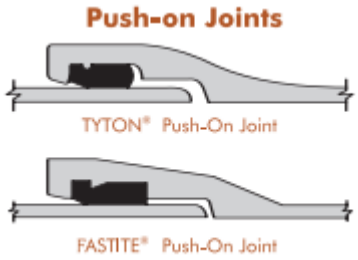
- Content/Topic 1 Different methods of joining ductile and cast iron pipes

Methods of joining:

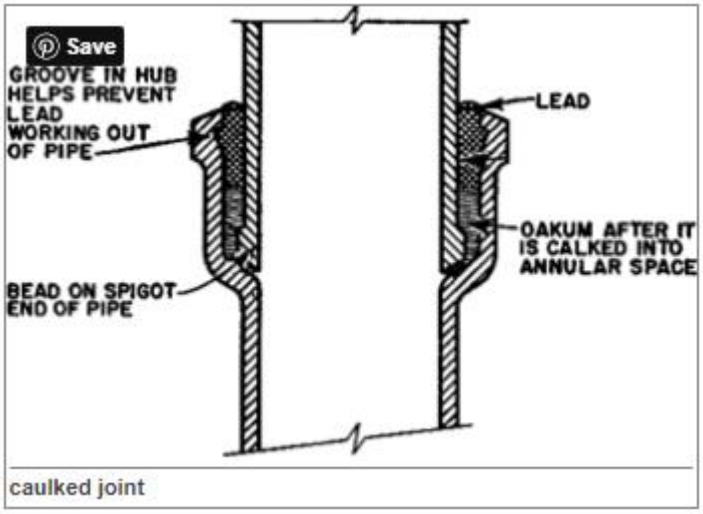
- ✔ Flange joints in above ground : Although the flanged joint's first recorded application was more than 550 years ago, improved joints of this type are still used for many aboveground plant installations and other specialized applications.



✔ Ring push-on (Socket and spigot) : The most popular, quickest, and easiest-to-assemble joint for Ductile Iron pipe and fittings in underground applications is the push-on joint. This joint consists of a single rubber gasket placed in a groove inside the socket at the bell end of the pipe. After lubricating the joint in accordance with the manufacturer's instructions, the beveled end of the pipe is pushed past the gasket.

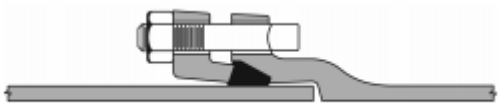


✔ Caulked joint: A type of joint used for cast-iron pipe having hub-and-spigot ends. After the spigot-end of one pipe is placed inside the hub-end of the other, a rope of oakum or hemp is packed into the annular space around the spigot end until the packing is about 1 inch (2.5 cm) below the top. Then molten lead is poured into the annular space on top of the rope. Finally, the lead is pounded farther into the joint with a caulking iron.



✔ Mechanical Joint: The mechanical joint has standardized dimensions as specified in ANSI/AWWA C111/A21.11 "Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings." The joint has four parts: a flange cast with a

bell; a rubber gasket that fits in the bell socket; a gland, or follower ring, to compress the gasket; and tee head bolts and nuts for tightening the joint



Mechanical joint

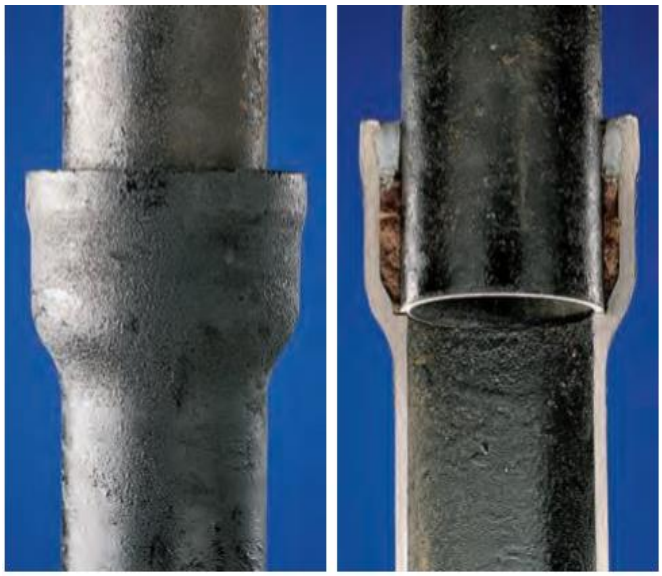
Cast iron pipes joining

Cast iron pipe often is found in older homes, where it is used for large DWV pipes, especially the main stack and sewer service lines. It can be identified by its dark color, rough surface, and large size. Cast iron pipes in home drains usually are 3" or more in diameter. Cast-iron pipes may rust through or hubbed fittings (below) may leak. If your house is more than 30 years old, you may find it necessary to replace a cast-iron pipe or joint. Cast iron is heavy and difficult to cut and fit. For this reason, leaky cast-iron pipe usually is replaced with PVC of the same diameter. PVC can be joined to cast iron easily, using a banded coupling . Snap cutters are the traditional tool of choice for cutting cast iron but today‟s variablespeed reciprocating saws do the job easily and safely. Use a long metal-cutting blade and set the saw at low speed. Wear eye and ear protection when cutting cast iron pipe

Cast-iron pipe was used almost exclusively for drain systems until the introduction of heavy-duty PVC drain pipes. It is tough to work with and in most cases, replacing it makes sense.

Other methods of joining Cast iron pipes

Hubbed fittings (shown cutaway, left) were used to join cast iron pipe. Hubbed pipe has a straight end and a flared end. The straight end of one pipe fits inside the hub of the next pipe. In the old days, joints were sealed with packing material (oakum) and lead. Repair leaky joints by cutting out the entire hubbed fitting and replacing with plastic pipe.



Hubbed fittings

Banded couplings may be used to replace leaky cast iron with a PVC or ABS plastic pipe. The new plastic pipe is connected to the remaining cast-iron pipe with a banded coupling. Banded coupling has a neoprene sleeve that seals the joint. Pipes are held together with stainless steel bands and screw clamps.

Banded couplings

LO 3.4 – Join steel pipes

- Content/Topic Methods of joining steel pipes

Methods of joining:

Threaded joint: Threaded joints are detachable joints of two or more component parts either directly connected with each other or by standardized fasteners, i.e. bolts, nuts and screws.

Threaded joints are made:

- To keep the component parts of the detachable joint in a desired position,

- To provide the force required to produce a joint and maintain this force for the intended period.,

- To transmit motions and forces of component parts.

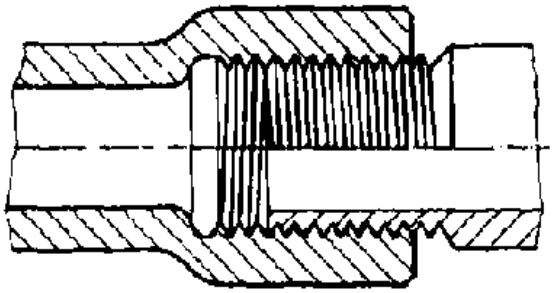
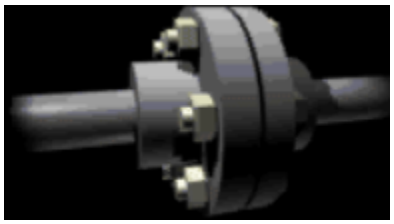


Figure: threaded direct joint

- Coupling joint : A **coupling** is a device used to connect two shafts together at their ends for the purpose of transmitting power. The primary purpose of couplings is to join two pieces of rotating equipment while permitting some degree of misalignment or end movement or both.



Rotating coupling

- Arc Welding: A **welding joint** is a point or edge where two or more pieces of metal or plastic are joined together. They are formed by welding two or more workpieces (metal or plastic) according to a particular geometry. There are five types of joints referred to by the American Welding Society: butt, corner, edge, lap, and tee. These configurations may have various configurations at the joint where actual welding can occur.

Arc welding joint

Joining process

- Prepare the materials and tools.
- Cut threads.
- Apply sealant.
- Fix and tighten the fittings. Don‟t over tighten
- Check for leakage

Needed equipment and tools

Hacksaw, Pipe cutter, threading machine, pipe wrench, Steel ruler, Pipe vice, Square ruler

Steel pipes joining

Steel pipes are most of the time joined using:

Threaded joint where tapered threads are cut into the end of the pipe segment, sealant is applied in the form of thread seal tape also known as PTFE (Teflon tape) and is then threaded into corresponding threaded fitting using pipe wrench.

Compression joints the fitting is designed to enable steel pipes to be joined without threading. Made of malleable iron, they use locking rings and seals, which are tightened onto the pipe. They can be used on water and gas supplies, and although more expensive than threaded joints, they do save time on installation.

Joining process:

- Prepare the materials and tools, according to the drawing.
- Bend and thread the pipes.
- Joining with threaded fittings provided.

- Check the dimension.

Different Fittings used to join steel pipes

Malleable iron fittings

Malleable iron fittings are produced by annealing (softening) cast iron. This process produces a fitting the will withstand more bending, pounding and intern pressure than ordinary cast iron.

Two types of iron fittings are manufactured:

1. Pressure fittings,

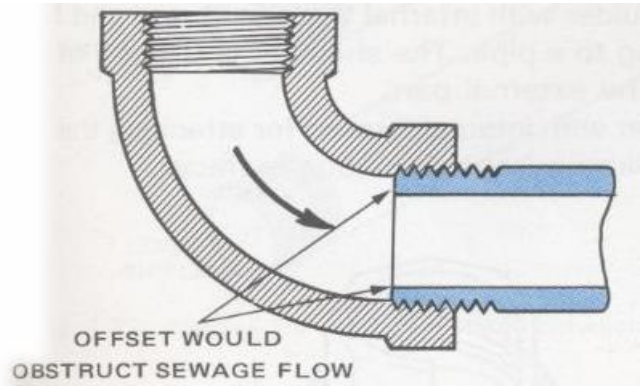
2. Drainage fittings,

Drainage fittings are different from pressure fitting in several ways:

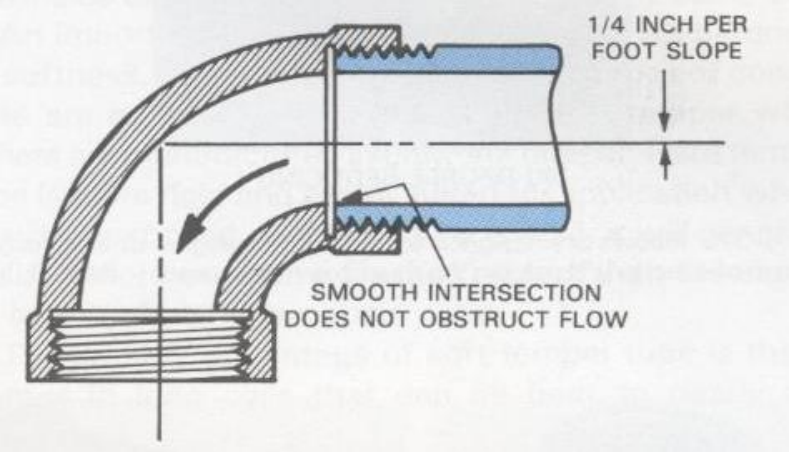
- The insides of drainage fittings are smooth and shape for easy flow.
- Shoulders are recessed so that an unbroken contour is formed when pipes are screwed into the fitting.
- Drainage fittings are designed so that a horizontal line entering them will have a fall of 1/4 inch per foot.

Only drainage fittings should be used on drainage piping. Either pressure or drainage fittings may be used for installing water, gas, or air went lines.

Both drainage and pressure fittings are produced many shapes and sizes. Because drainage lines are never less than 1 1/4 inch diameter, drainage fittings are not available in sizes less than 1 1/4 inch. However, the basic shapes of the fittings are the same for both type and they will, therefore, be discussed together.



Pressure fittings are suitable for air, gas, and water lines but not for drainage.



Drainage fittings are required on all drainage lines.

ELBOWS

Elbows are used to change the direction of a pipeline. They are also called "Ls" or "ells." Several types elbows are shown

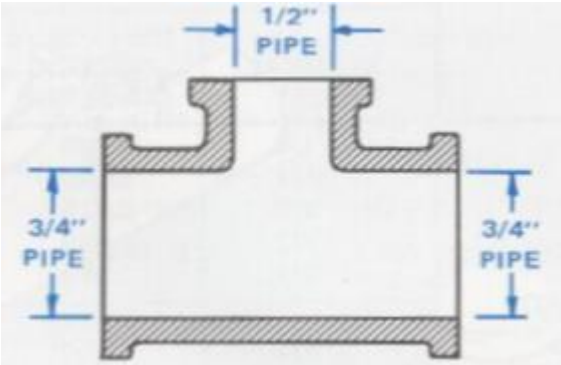
The **drop elbow** or **drop ear** elbow permits attaching the pipeline to the building frame. It is frequently use at the last joint before the pipe comes through the wall to be attached to a fixture.

Elbows are designed for either a 45-degree or a 90-degree change of direction. These are the most commonly used.

FITTINGS

The **T**, is used to make branches at 90˚angles to the main pipe. When all three outlets are the same size, the T is specified as that size. For example, a 1 inch T will connect three 1 inch pipes. When the outlets are not all the same size, the fitting is called a reducing T. A reducing T is specified by giving the run (straight through) dimension followed by the side outlet (branch) dimension. For example, a 3/4 x 1/2 T has 3/4 inch openings on the main and a 1/2 inch branch outlet, A 1 x 3/4 x 1/2 T has a 1 inch and a 3/4 inch outlet on the main and a 1/2 inch branch outlet.

Branch lines are connected to main lines with T fittings like these.

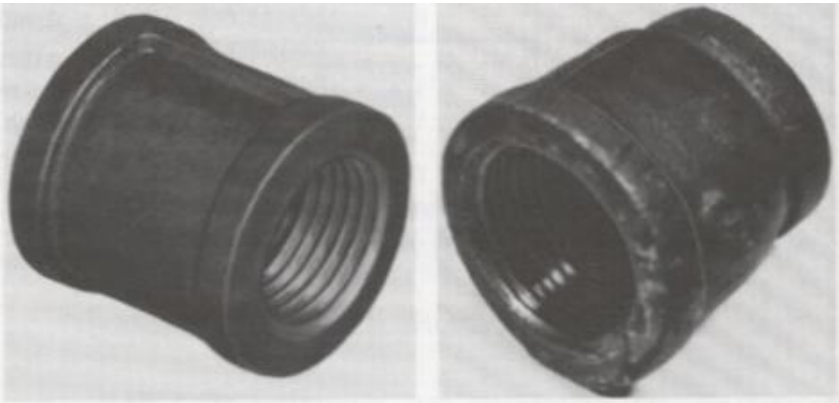


Reducing Ts are specified by the size of the opening on the main followed by the size of the branch opening. T shown is 3/4 x 1/2.

COUPLINGS

Couplings, Fig. 2-23, are short fittings with internal threads at both ends. They are used to connect lengths of pipe on straight runs. Reducing couplings are used to connect pipes of different sizes and are specified by the

diameter of each opening. For example, a 1/2 x 3/4 coupling has a 1/2 inch opening at one end and a 3/4 inch opening at the other end.



Couplings connect two pipes of equal or unequal sizes.

UNIONS

Since all pipes are right-hand threaded, it would be impossible to assemble or disassemble the last length of threaded pipe without a **union**. See Fig. 2-24.

A union can be installed or removed from the system without disturbing other fittings. It consists of three parts:

1. A shoulder with internal threads at one end for attaching to a pipe. The shoulder is

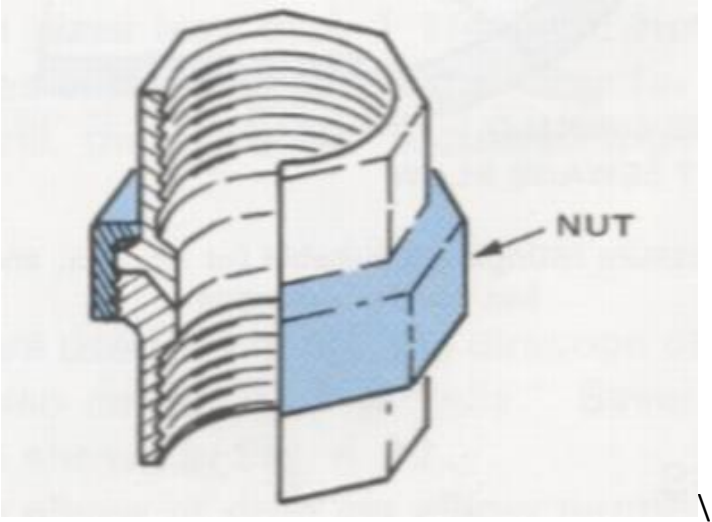
Shaped to mate with the external part.

2. A collar with internal threads for attaching the other two parts over their mating surfaces.

3. A piece with external threads for the collar and mating surface for the shoulder at one end, and internal threads at the other end for attaching to a pipe.

In some designs, the shoulder and the external threaded piece, have a machined spherical joint that provides a watertight seal when the collar is securely tightened.

Dielectric unions are installed when copper and iron pipe are joined. This prevents galvanic corrosion that may destroy the pipe or fitting.



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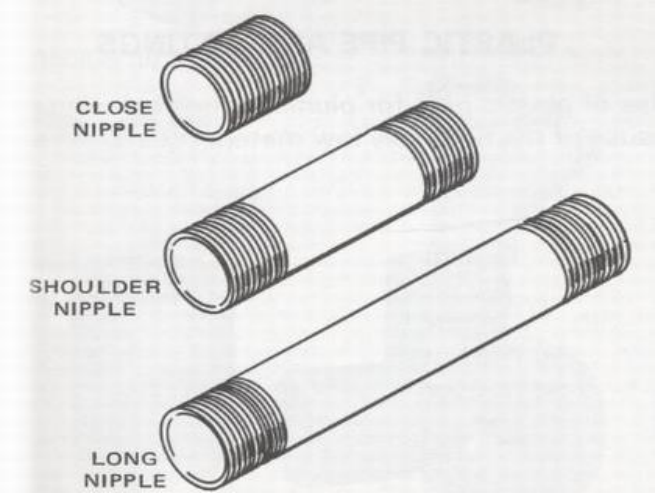
Union fitting

Unions are much alike but may have different shaped joint surfaces. In the spherical type, the end of one part is shaped like a ball with a hole in it. The end of the other part is shaped to fit over it and the two are held together securely by the threaded collar.

NIPPLES

Nipples, are pieces of pipe, 12 inches or less in length threaded on both ends. They are used to join two fittings that are close together. These should be purchased because it is difficult to thread short pieces of pipe with conventional plumbing tools. Do not attempt to make them.

Nipples are specified by diameter and length, Fig. 2-25. A close nipple is threaded along its entire length. Shoulder nipples have a short portion of unthreaded pipe. Length of a pipe nipple is determined by measuring from end to end.



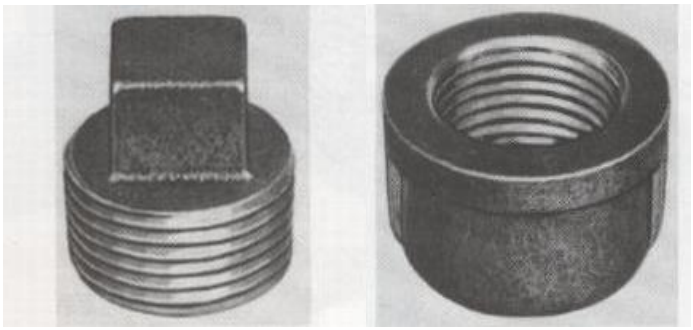
Nipples are short connectors between fittings

Other malleable iron fittings

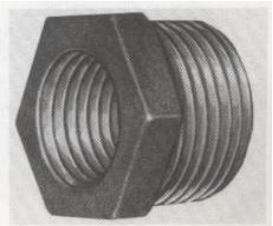
Pipe plugs, have external threads and are used to close openings in other fittings.

Pipe **caps**, have internal threads and are used to close the end of a pipe or a pipe nipple.

A **bushing**, has external threads on the outside and internal threads inside. It is used to connect a pipe to a larger size fitting.



Plugs close openings in fittings. Caps close ends of pipes.



A bushing takes up the difference in diameter when a smaller pipe must be connected to a larger fitting.

Learning Unit 4 – Check condition of tools and equipment

LO 4.1 – Store tools and equipment

- Content/Topic 1 Introduction on storing tools and equipment

Hazardous material is identified for separate storage, transport and handling by authorised persons.

Materials, including flammable liquid and material, gases, bulk liquids and petroleum products are stored in their allocated areas and identified bins and containers according to workplace requirements.

Hazardous materials are transported and handled according to regulatory requirements, including appropriate signage, markings and safety precautions.

Environment is protected through correct storage and handling of materials.

Store your plumbing tools with care

Make sure each tool type has a separate compartment in your toolbox, as this will help to stop them coming into contact with others that could damage them. Some tools may even have their own special storage instructions like torque wrenches, which need to be loosened at the spring to prevent weakening so be sure to abide by these.

Clean your plumbing tools after every use

Enclosed storage spaces, like garages and basements, can have humidity issues that might cause wear to your kit. If you must keep them in this type of environment, invest in a dehumidifier, silica gel packs, or rust collectors and anti-rust liners.

While most of your kit will only require a quick wipe down, most hand tools which look a bit dirty can be cleaned in minutes by dunking them in a bowl of hot soapy water followed by a thorough dry.

For tools like toilet plungers, create a mix of detergent and bleach in the toilet bowl and swirl the plunger round for a minute or two. Do keep this separate from the rest of your tools though as there's no guarantee that all of the bacteria will be gone after this regime.

- Content/Topic 2 The Best condition of tools and equipment

The EHP (Environment Health
Practice) is responsible for making sure that all tools and equipment are well organised and maintained in good working condition. T hey should be stored in a separate secure place so that they are safe and easy to find.

This is usually best done in a place, which is separate from the office.

Lost tools are expensive to replace and much time can be wasted if they are not available and ready to use when needed.

It is usual for those who have responsibility for looking after tools, equipment and materials to keep an inventory (list) of these thing s.

The EHP should check off the inventory regularly and if any items have been loaned out and not returned, he/she must get them bac k. Breakages and losses and materials which have been used up should be reported to the community council administration and re quests made to replace them.

It is a good idea to have a tool box equipped with the necessary plumbing tools and materials (washers, thread tape, O-rings) ready to be picked up and taken to a job.

LO 4.2 – Apply safety requirements of tools and equipments

- Content/Topic 1 Checking of actual condition of tools and equipment

Hand tools inspection processes

Every manufacturer knows the importance of providing quality product to each consumer worldwide. If consumers like the product, it is safe to expect that the consumer would be a repeat-customer. In order to obtain high quality products all the time, it is very important to perform different tests and inspection process to ensure product reliability, safety and ease of use.

This article will cover the standard inspection processes being done on various hand tools available in the market today:

pre-production inspection

The purpose of this inspection process is to verify that all of the needed tools for hand tool production are free from any damage, defects or any loose joints to ensure proper and consistent production when the operation starts. Any devices that show any defects should be repaired or replaced as soon as possible to avoid the risks of creating defective products.

Raw materials inspection

The purpose of this inspection process is to thoroughly inspect and verify that all of the needed materials for molding, hardening, cooling, and assembling are in complete and good order to ensure that all of the materials to be used are free from any damages or defects prior to initiating the production process. Any component that is proven to show defects will be labeled “defective” and will be re-assigned to a different queue for repairs or refurbishment.

Assembly inspection

The purpose of this inspection process is to verify that all of the specifications under the assembly queue meet the initial requirements in order for it to be considered in the next production queue. Items that have the

following will be labeled as “defective” and will be reassigned to a different queue according to its defective state.

Defective list:

- Deformations (for steel-based tools)
- Visual damage
- Loose components
- Pre-production anomalies

Coating inspection

The purpose of this inspection process is to verify that all of the hand tools that require metal coating are properly coated evenly on all the needed surface of the hand tool to ensure that all of the products in need of coating are properly checked. Each hand tool that has missed spots during the coating process will be re-coated to save on production time.

Visual inspection

The purpose of this inspection process is to thoroughly inspect all of the hand tools, regardless of the type, for any visible damages, dents, cracks, chips, or any known production anomalies to ensure that all of the hand tools on the queue are ready for the next set of inspection processes. Should there be any items that show poor craftsmanship and functionality, these will be labeled “defective” and should be reconfigured to pass the quality control and safety guidelines.

Weight and measurement inspection

The purpose of this inspection process is to accurately measure the different hand tools under the same category to ensure that all of the tools are uniform in height, weight, size and diameter. This process is important to assure the right number of components used under the same queue is in check.

For the actual measurements, each hand tool will undergo a machine that will accurately measure each dimension of the hand tool to ensure proper ergonometric features that is both safe and reliable for everyday use (if applicable). Any hand tool that have a different specification as provided will be labeled as “defective” and will be re-assessed accordingly.

Hands on/quality control inspection

The purpose of this inspection process is to thoroughly test and inspect the behaviors of the different hand tools when being used to raise awareness of how certain items can break and cause unwanted accidents. Each hand tool will be inspected and tested using different sets of tests that would fit the hand tool on the current queue.

- Content/topic 2 monitor safety precaution on the workplace

Workplace hazards can take many forms, from a sprained ankle caused by a bundle of cords on the ground to a severed finger on a construction site.

No matter how dangerous the accident, workplace hazards can and should be avoided at all costs.

There are several different categories of workplace hazards, including safety hazards, biological hazards, physical hazards, ergonomic hazards, chemical hazards, and work organization hazards.

Safety hazards

Safety hazards include things like spills, falls, machinery, electrical, and space hazards. Safety hazards are probably the easiest to avoid at work. Typically, there are documented safety codes for every business to ensure it is being run smoothly and safely. Making sure these codes are being strictly followed is the job of the managerial staff, but each employee should be paying attention to them as well.

Biological hazards

Often, people think only certain kinds of businesses work with hazardous biological materials, like jobs involving animals, plant matter, and chemicals. But the truth is, biological hazards can be present in any business, whether it's a hospital, lab, or office.

For example, if you work in an older building that hasn't recently been renovated, there is a chance that you could experience asbestos exposure from the old insulation in the walls. Asbestos is not an easy thing to spot if you don't know what you're looking for, so it can be very precarious.

Chemicals like asbestos can make you very sick. Certain chemicals commonly found in the workplace like mold, fungi, and bacteria can lead to extremely severe symptoms if not treated quickly.

Business owners have the large responsibility of caring for the health and safety of all of their employees. If you get sick at work because of hazardous materials, that is certainly not your fault, though such risks can be evaded if employees followed safety guidelines established in their manuals.

Physical hazards

These types of hazards are caused by direct exposure to factors within the space or environment that can be harmful to your body. These hazards vary from moderate to quite severe

Learning Unit 5 – Perform elementary maintenance of tools and equipments

LO 5.1 – Tight loosened part

- Content/Topic 1 Discussion on different parts of tools and equipment
  - Removable parts
  - Fixed parts

Power tools and other machines are designed for long life, but each requires some **care** and **maintenance** to meet its life expectancy. Properly storing power tools, performing maintenance as needed, and replacing machine parts will extend a tool's life to its full **potential** and deliver more **value** to its owner. We offer some general tips and guidelines below for extending the life of any machine or power tool. **Proper Storage** Our **three guidelines** for tool storage are:

1. Store tools in an area protected from the elements (like moisture).

2. Store tools in a clean and organized space.

3. Store tools in a well-ventilated area.

LO 5.2 – Maintain tools and equipment

- Content/Topic 1 Different types of maintenance

  - ✔ Cleaning
  - ✔ Repair
  - ✔ Replace

Care and Maintenance Before being stored, most power tools can use a little cleaning and a couple of quick checks for damage or other problems. Here's some maintenance tips for keeping those tools in good shape:

- Use a toothbrush and a soft cloth to wipe debris from power tool casings before storage.

Cleaning power tool

- If available, use an air compressor to clean out power tool vents. A little air will go a long way. When a machine or tool can breathe more, it will run cooler and wear more slowly.

- Lubricate power tool parts that need to be lubricated. Following instructions in the tool's user manual will help here.

- Check the parts that hold a tool together, screws, and other fasteners. Tighten up anything that might have been shaken loose during operation.

- Electrical cords should be checked with each use of a power tool. A bad power cord can be dangerous and should be replaced before the tool is used again.
- Keep blades and other cutting accessories sharp. Check bits and other accessories for wear and damage.
- Follow any other maintenance guidelines for a tool or machine explained in its user manual.

Preventive Maintenance

Preventive maintenance is aimed at catching and fixing problems before they happen. It is most commonly carried out in the form of regular inspections, usually occurring multiple times per year.
When you inspect a system or a piece of technology, carefully check for all signs of wear, tear or imminent breakdown. Replace damaged parts immediately. This will prevent having to go into “crisis mode” if something breaks unexpectedly.

The primary benefit of preventive maintenance is that it can eliminate unplanned shutdown time as you will ideally catch problems before they occur.

Condition-Based Maintenance

Condition-based maintenance is sometimes considered to be a more advanced alternative to preventive maintenance. Rather than being inspected according to a schedule, machines and systems are carefully observed for changes that could indicate upcoming failure.
With condition-based maintenance, technicians observe the system running and identify variables that could affect functioning, like temperature, vibration speed, power, the presence or absence of moisture, and more.

Another strategy within condition-based maintenance is predictive maintenance.

Predictive Maintenance

Predictive maintenance refers to a specific type of condition-based maintenance in which systems are constantly observed via sensor devices. These devices are attached to components of the system and feed constant, real-time data to software. The software then interprets this data and warns maintenance technicians of approaching danger.
Predictive maintenance is generally considered to be the most advanced and intensive type of maintenance. This is because there is a lot of data to interpret – and the sensor devices themselves need to be regularly maintained and checked.

Corrective Maintenance

Corrective maintenance is initiated when a problem is discovered while working on another work order. With corrective maintenance issues are caught ‘just in time'.
For example, during a scheduled maintenance check or while fixing another issue, a maintenance technician notices that a pipe in a HVAC system is not working as it should. Corrective maintenance is then scheduled for a future date where the problem is repaired or replaced.

Because corrective maintenance issues are found ‘just in time’, it reduces emergency repairs and increases employee safety.

Predetermined Maintenance

Unlike other styles, predetermined maintenance is carried out using rules and suggestions created by the original manufacturer, rather than the maintenance team. These suggestions are based on experiments and gathered data.
The manufacturer provides statistics and guidelines, usually when the equipment is first purchased and will include data providing the average lifespan of both the entire system and its various parts. The manufacturer will suggest how often parts should be inspected, serviced and replaced.

Relying solely on a predetermined schedule may risk system failures as technicians may not be able to anticipate problems. It can also cause multi-family maintenance teams to replace parts too early, resulting in additional costs. Additionally, predetermined maintenance does not guarantee that a system will not break down since the program is based on statistics and not the actual state of the equipment.

Gaining Maintenance Knowledge with Interplay Learning

Regardless of the type of maintenance strategies your team utilizes, different areas of a multi-family building must be regularly serviced in order to avoid costly repairs or extended downtime. In much the same way, the knowledge and skills of your maintenance technicians must be regularly maintained and updated so that they don't fall behind.
You can avoid that problem with ongoing property maintenance training provided by Interplay Learning’s online course catalogs. Interplay’s digital training approach uses 3D and virtual reality (VR) based technology to create hands-on lessons and simulations which can be practiced by technicians from absolutely anywhere.

Reference(s):

1. Plumbing (Steve Muscroft): First published 2005
2. Pipelines for Water Conveyance and Drainage (Edited by Roger W. Beieler, P.E): Copyright © 2013 by the American Society of Civil Engineers
3. www.techknow.org.uk
4. www.sciencea-z.com