Plumbing

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CHAPTERS:

“Man, an ingenious assembly of portable plumbing.”

- Christopher Morley

CHAPTER

ONE

INTRODUCTION

I don't want to bore you with the story how we came to write this book. It's just a intention to provide a good resources for CTEVT and other technical students. I hope with our efforts and your help this book will grow and become a dear for all learners.

We're extremely interested in your feedback. The online version of this book will let you comment on any part of the book, and discuss it with other readers. We'll do our best to read all the comments posted there, and to respond to as many as possible. If you prefer email, please drop us a line at binary.science98@gmail.com. Either way, we'd love to hear from you! We're glad you're here, and we hope you find Carpentry as exciting, fun, and useful as we do.

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CHAPTER

TWO

CHAPTER 1: INTRODUCTION OF PLUMBING

2.1 History of plumbing

Plumbing originate from Latin word plumbum, which means lead. Plumbing can be defined as a system used in buildings to distribute water and gas and also for disposal of sewage with the help of pipes and fixtures. The word sewage came from the French word essouier, which means to drain. We are surrounded by plumbing everywhere maybe it in our schools, houses, streets, fields, oceans, industries and so on. But from where the practice of plumbing actually start chronologically?

There are evidence of plumbing practice by ancient civilizations like Indus valley ,Greek, Roman, Chinese and Persians. Archaeologists discovered the first water pipes made of stones and other materials in the Indus River in India, dating back to 4000-3000 B.C. Similarly, around 2500 B.C. Harappan civilization start using sitting toilets, public and private bathrooms, elaborate underground waste-water drainage systems and water supply systems. Egyptians started using copper pipes for irrigation and home uses. Romans (500 B.C. - 455 A.D.) developed complex plumbing systems that encompasses aqueducts, underground sewers, public baths, lead and bronze pipelines, and marble fixtures.

In modern day, Sir John Harrington built a flush toilet for Queen Elizabeth I who was her Godson in 1596. However, the first patent for flushing toilet was issued to Alexander Cummings in 1775. In 1644 A.D., King Louis XIV of France ordered the construction of cast-iron as main plumbing line which was used along with other metals like copper until 1966. Due to shortage of metals after wartime, non-metallic and plastic pipelining starts to boom in plumbing. In 1804, Philadelphia of U.S.A became the first city to entirely use cast-iron pipes for their water supply systems. The English Regency shower with nozzle was introduced in 1810 A.D. .In 1829, the Tremont Hotel of Boston became the first hotel to have indoor plumbing with eight water closets. Likewise, Chicago adopted comprehensive sewage system in 1885 A.D.. Modern plumbing revolutionized after Thomas Crapper patented his valve-and-siphon design in 1891 A.D. .Toilet paper and brushes were invented by an American Joseph Gayetty and Addis Brush company in 1857 and 1930 respectively. Also, the elevated water tank and sensor-flushing toilets became available in 1910 and 1986 respectively. Finally, the World Plumbing Council (WPC) in 2000 was formed with aim to achieve the best possible plumbing for the world through growth and development of the world's plumbing industries. However, there are plumbing standard according to the nations for different purposes like Floor and Trench Drains, Ceramic plumbing fixtures, enameled cast iron/steel plumbing fixtures, Roof, Deck and Balcony Drains and so on.

2.2 Importance of plumbing

As we know plumbing links application systems like a house with supply systems like a water reservoir and drainage system like a wastewater treatment plant separately. There are lots of benefits that makes it important to opt for plumbing which are discussed below:

a) Plumbing ensures us safe delivery of water in our residents, fields and other places.

b) Plumbing helps us to deliver water, oil and gases over long distance in short time. For example, Druzhba pipeline that transports oil across Europe.

c) Plumbing industry has grown as a big economic importance since it provides job opportunities and livelihoods for many.

d) Plumbing manufacturers working together with health organization can enhance human quality of life.

e) Plumbing brings comfort and beauty into our houses and lives. For instance, private bathrooms, fountains, and kitchen serves their best purposes for our comfort, ease and beauty.

f) Modern plumbing products comes along with sensors which helps us to save our energy and resources (gas, water etc.) both.

g) Plumbing can be used to supply the water to the regions affected with natural calamities like earthquake and drought and regions with shortage of water.

h) Plumbing helps to minimize the diseases with proper drainage systems. For example, All the sewage from homes, hospitals as well as street is properly channeled to sewage treatment plant without exposing the threat to public and environment.

i) Plumbing are used extensively in industries and entertainment sectors like waterparks and swimming pools due to its safety and reliability.

2.3 Plumbing and sanitary

Plumbing can be related to any system that conveys liquids or gas from one location to another for various applications. A plumbing system is composed of two basic subsystems – Supply system and drainage system. One brings the useable stuffs like water while other throws out the unusable stuffs like wastewater. It uses basic laws of nature like gravity and pressure for its working.

2.3.1 1) Supply System

The water entering the home is under pressure which makes it easy to travel upstairs or significant height else we need to use motors for generating pressure. This system also includes a valve that stops the flow of water incase of plumbing emergency like leaks and reconstruction. This system supplies the water to bathroom, toilet, garden and water or gas to kitchen.

2.3.2 2) Drainage System

Drainage systems are all angled downward hence gravity pulls down all the waste materials. As if it appears simple, the drainage system is complex which encompasses components like vents, traps and clean outs. The vents allow air to enter through drainage pipes to regulate water flow else water gets collected in the traps.

A sanitary sewer or foul sewer is an underground pipe for transporting sewages from houses, public places and commercial buildings to treatment facilities or disposal where it is filtered, treated and discharged.

There are different types of sewers which are as follows:

a) Conventional gravity sewers

b) Force mains

c) Effluent sewer

d) Simplified sewer

e) Vacuum sewer

** (Pics of manhole cover, plant, tunnel etc.)**

We should not confuse between sanitary sewer and storm sewer. The storm sewer is an underground pipeline system or open ditches designed to carry water during rainfall and other drainages and discharged into rivers or other surface water bodies without treatment. It is not designed to carry sewage and other hazardous wastes. So, we should not pour chemicals, motor oils, paints other household items which could poison fish, birds and other wildlife finding its ways into drinking water supplies.

2.4 Scope of plumbing

1. **General**

   a) Work

   b) Quality standards

   c) Submittals

   d) Preconstruction and preparation

2. Materials
    a) Sanitary sewer pipes
    b) Water service
    c) Gas supply
    d) Water heater
    e) Plumbing fixtures
    f) Cabinets, lavatory vanities and countertops
    g) Materials delivery and storage
3. **Construction and Installation**
    a) General installation
    b) Repair, replace or install fixtures
    c) Installation of cabinets, lavatory, countertops etc.
    d) Repair and cleanup

2.5 What's Next

chapter2

CHAPTER

THREE

CHAPTER 2: PLUMBER'S HAND TOOLS

3.1 Pipe wrench of size 12", 9", and up to 18" long

Pipe wrench are classified by the length of the handle. They can be available in any size from 3 inches up to 48 inches or larger. It has teeth and jaw made up of steel while body could be aluminum or steel. It is adjusted with the help of rings and springs for different radius.

Fig. 1: Figure 2-1. Pipe wrench

3.2 Pair of footprints

Warning: Not available

3.3 Stocks and dies, up to 2” diameter, replacement of cutters

To connect two or more pipes while plumbing we need to create threading in pipes so that they connect as a single pipeline. For that we need die stock and dies.

A diestock is an equipment which helps us to create uniform threads on different types of screws, bolts and pipes. It is a framework as shown in figure that provides space to insert cutting tools called dies. Also, it helps to makes sure the amount of pressure applied throughout the thread cutting process remain uniform.

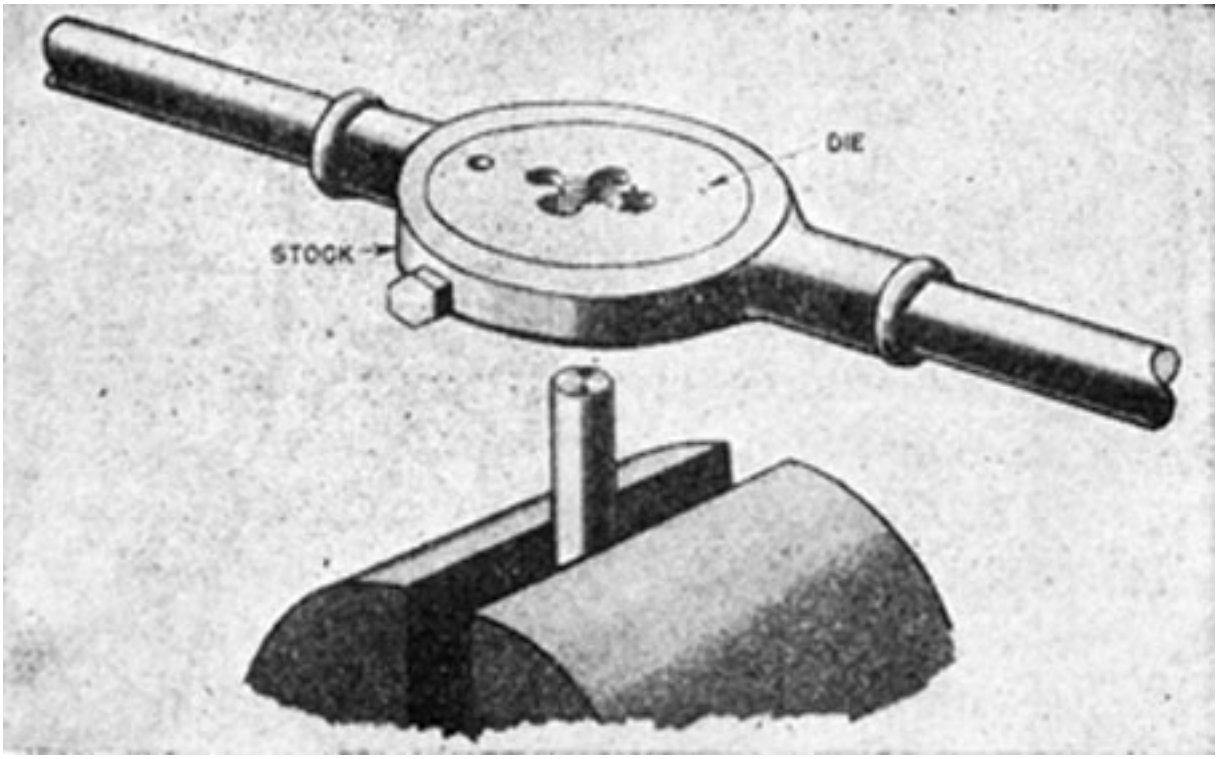


Fig. 2: Figure 2-2 a) Stock

A die is a razor sharp which can cut into the metal of cylindrical materials, like screw or pipe facing with relative ease.

3.4 Wrench chain

It is a type of wrench with chain and adjustable handle where chain wraps around a cylindrical material to tighten or loosen its grip. Handle is turned anticlockwise to grip and unscrew the filter. It may be either a strap-type wrench or a socket.

Fig. 3: Figure 2-2 b) Dies

Fig. 4: Figure 2-3. Wrench chain

3.5 Hack's saw frame and blade

A hacksaw is a fine-toothed saw which is made for cutting metals and other materials like wood and plastic. It consists of a frame and a blade. Common hacksaw are hand saws with C-shaped frame that holds blade under tension.

Similarly, hacksaw blades has fine tooth pointing in forward direction with fourteen to thirty-two teeth per inch (TPI) and measuring 10 to 12 inches. There are varieties of hacksaw available for different uses like panel hacksaw, junior hacksaw and power hacksaw.

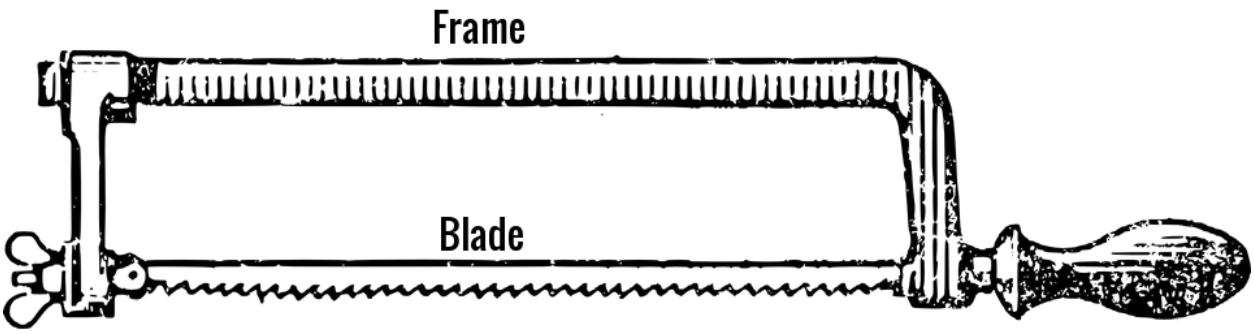


Fig. 5: Figure 2-4. Hacksaw

3.6 Measuring tape

It is important to know the diameter of the pipe you are working with because a hot top saddle or a pipe fitting must fit exactly onto the pipe. Similarly, to measure the length of pipe we need retractable steel tape.

Fig. 6: Figure 2-5. Measuring tape

3.7 Soldering iron

A soldering iron is a hand tool used to join two workpieces by supplying heat to melt filler material that flow into joint. It consists of metal tip and insulated handle shown in figure. It is commonly used for repairs, assembly and installation. It can be electrically powered or gas to heat up the metal tip.

Fig. 7: Figure 2-6. Soldering iron

3.8 Tin snips

Tin snips or tinner snips are type of snips which are mainly used for cutting tin and other sheet metal surface. It has long handle and short blades with extra wide jaws made up of drop forged carbon steel as shown in figure. It has two main types according to which tin snips are cut: straight- pattern and duckbill pattern. Straight pattern is best for straight cuts and gentle curves while duckbill-pattern snips (or trojan-pattern snips) are best for cutting any curves like circles or wave like structures.

Fig. 8: Figure 2-7 a) Curve tin snip

Fig. 9: Figure 2-7 b) Straight tin snip

3.9 Rasp

Rasp is a hand tool with coarse teeth used to scrape or abrade the material surface. Rasp can be of different types like Flat mill, half-round second-cut, flat wood rasp and half-round wood rasp. Flat mill rasp smooths edges and sharpens blades while flat wood rasp is used to smoothen wood, leather, soft metals and soft plastics. Similarly, half-round second-cut smooths inside surface of pipes or holes and half round wood rasp is ideal for use on wood and soft materials like plastics.

Fig. 10: Figure 2-8. Rasp

3.10 Caulking iron

Caulking iron or making iron are used for packing or putting the Cotton or Oakum into the seam between the planks especially in ship building and in leaded cast iron pipe joints. In pipe joints oakum (a rope like substance made from jute, tar and Bentonite clay) is packed into the joints using a yarning iron. Oakum swells when its moist and makes a tight joint. Melted lead is poured into the joint covering the oakum and when lead cools down we tighten the lead using caulking iron. Caulking irons are used to hammer the lead into the recessed end of the pipe joint which makes a sturdy permanent seal.

Fig. 11: Figure 2-9 Caulking iron

3.11 Adjustable wrench up to 12” long

Adjustable wrench or crescent wrench has gripping faces of the jaws displaced to a 15-degree angle relative to the tool’s handle. It comes to handy when you have to work with various diameter of pipes repeatedly. Gripping section of wrench can be adjusted in size to fit a range of nuts, bolts, or fittings that have flat sides using roller or ring available within wrench as shown in figure. You must always position the adjustable wrench as the force pushes against the fixed jaw. It comes in several sizes and 10-inch wrench is commonly used for general purposes.

3.12 Claw hammers /Ball peen hammer/Claw hammer

Claw hammers comes in two forms : two-piece hammer and single-piece hammer. Two piece hammer consists of a head connected to a handle which is made of hickory and single-piece claw hammer is a continuous mass of metal with head and handle.

A claw hammer is a hammer having a head with two sides. The one face is a flat surface meant for tapping the nails and manipulating chisels. The other side of the head is the claw that is mainly used for removing nails.

Ball peen hammer or engineer’s hammer is a type of hammer that has one end of its head shaped in a hemisphere called peen and used in working metal like beating metals. The rounded face is effective for shaping metal without leaving hammer marks.

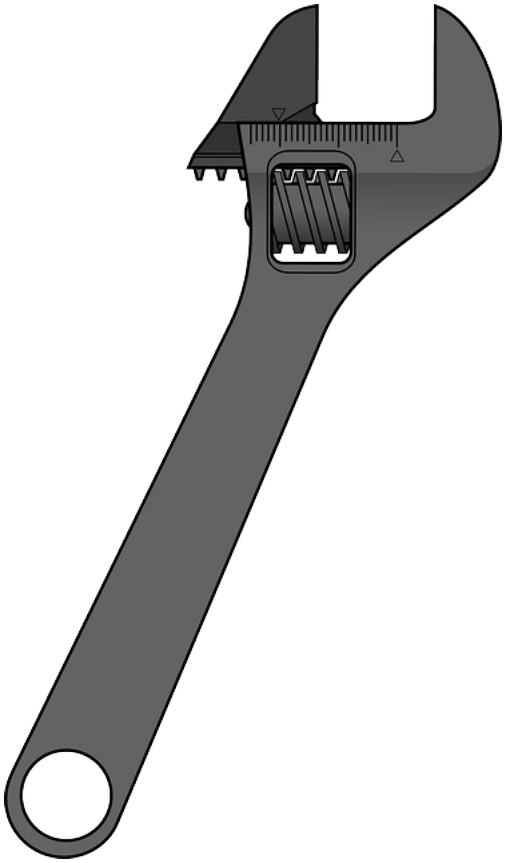


Fig. 12: Figure 2-10. Adjustable wrench

Fig. 13: Figure 2-11. Claw hammer

Fig. 14: Figure 2-12 Ball peen hammer

3.13 Pipe cutter-use and care adjustment of cutting wheels

It has always been acknowledged that the best way to cut pipe is by using pipe cutter because this method assures the pipe is cut squarely, accurately and quickly. Pipe cutter are available in different sizes. Use depends on pipe size, material and situations. Figure shows the pipe cutter when its components are separated and combined.

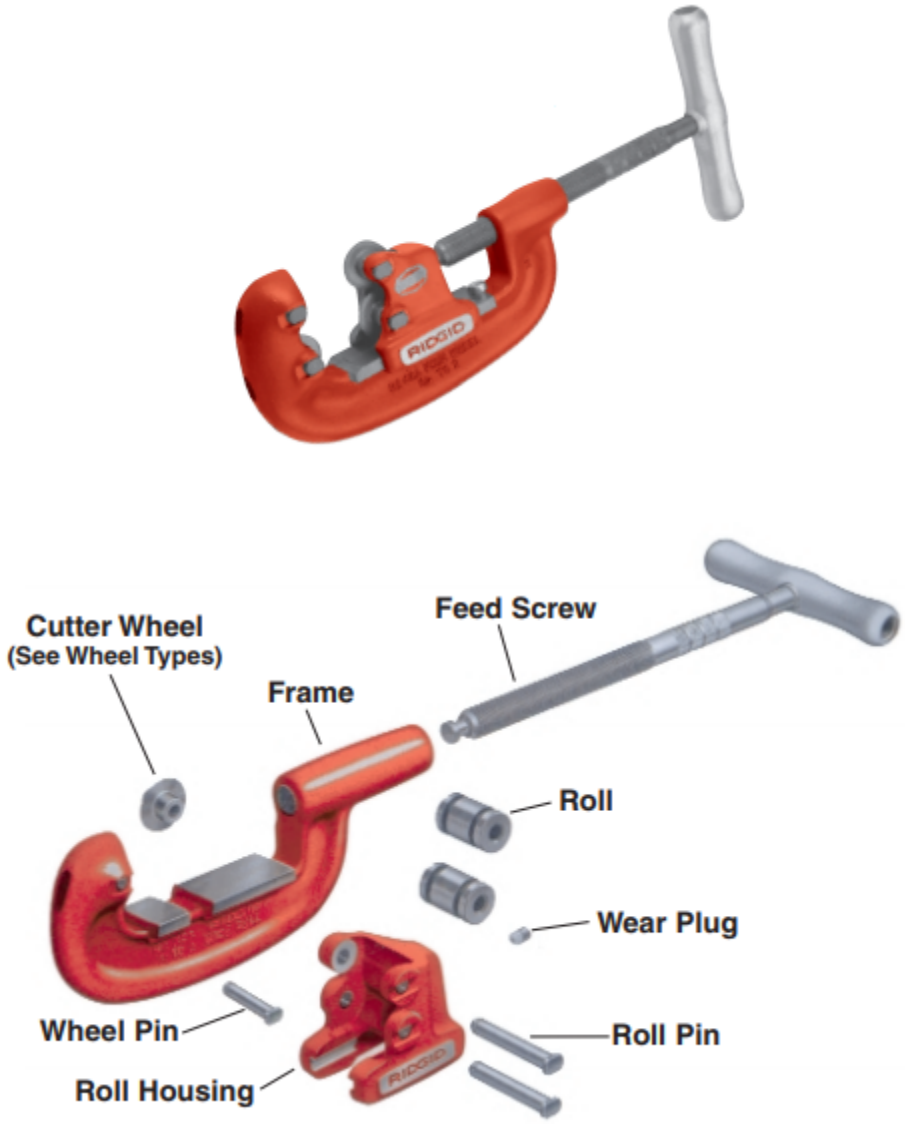


Fig. 15: Figure 2-13 Pipe cutter

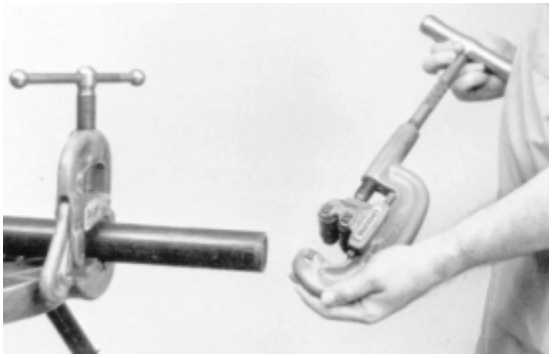
3.13.1 1) Select the Correct cutter

To get maximum performance from a tool, one should always ensure that the correct model of pipe cutter has been selected for the job else it may result in serious injury and damage to the tool and workpiece.

3.13.2 2) Adjustment of cutting wheel

Always ensure that when selecting the cutter, the cutting wheel is of the type suited to – the cutter being used and the material to be cut.

Always inspect the cutter wheel before being used to see that it is not blunt or damaged in any way.

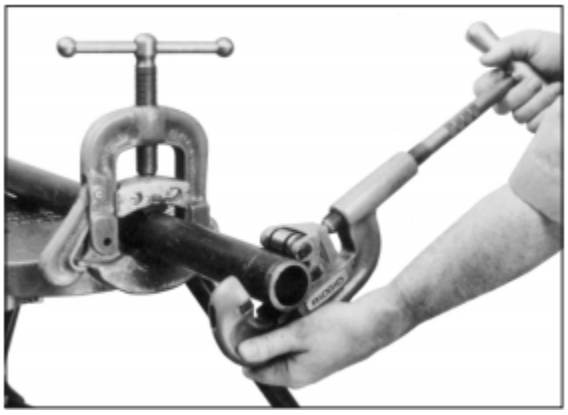


3.13.3 3) Mounting the cutter on the pipe

Open the cutter by turning the feed handle counter clockwise direction and place the cutter on the pipe with great care so that the rollers are in contact with the pipe. Then, turn the screw handle clockwise until the cutter wheel contacts the pipe.

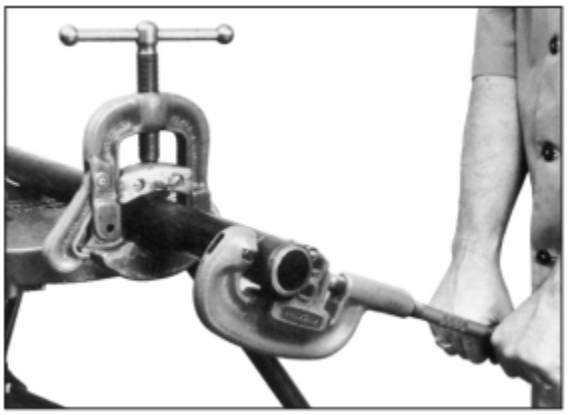
3.13.4 4) True Tracking

After cutter wheel is in contact with the pipe, slowly turn the feed screw ¼ of a turn and rotate the cutter through 360° so that the wheel cuts a light groove. Check this groove if it "tracks" into the original starting groove. If it does, the result will be a good cut else it will not cut. If the cutter does not track, the cutter wheel might be damaged and should be replaced.



3.13.5 5) The cut

Having ensure a "true track", tight the feed screw turning a quarter and rotate the cutter around the pipe progressively tightening the screw at each turn until the pipe is cut. Do not force the cutter wheel into the pipe which may result in damage and shortening the life of the cutter wheel.



Following are the steps for proper maintenance of pipe cutters:

a) Always clean the tools correctly after each jobs using cleaning agent and wire brush to clean the feed screw, rollers and cutter wheel.

b) Always ensure that the feed screw, slide, rollers and cutter wheels are well lubricated using suitable lubricating oil.

c) Inspect the all the components of pipe cutters frequently and examine for proper tracking and cutter wheel sharpness.

d) Always store correctly. For example, hang cutter in a warm dry area.

3.14 Drilling machine and its bits

Drilling machine is commonly used tool for making holes in plastic plugs, pipes, marble or stone tiles and stone or brick walls as well as woods. It works on electric power and some drilling machines for normal uses are also chargeable. Drilling machine has different components as shown in figure.

Drilling bits of different diameters are available like 1, 0.5, 2, 3, 4 etc. Bits used for drilling walls and marble differs from bits used for drilling wood and iron materials. Drilling bits with specific details of its structure and types are given below in figure. Chuck has sockets to hold drill bits of various sizes according to our job. Drilling machine have switch of forward and reverse option which helps to rotate it in both directions. It also has a selector switch to be selected in case of drilling at wall, wood and iron.

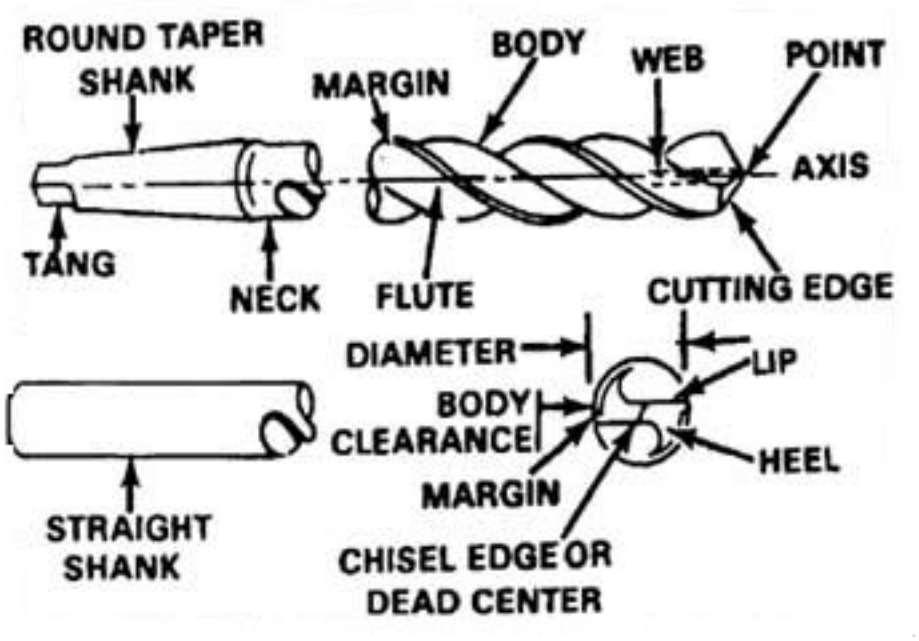


Fig. 16: Figure 2-17 a) Drilling bit

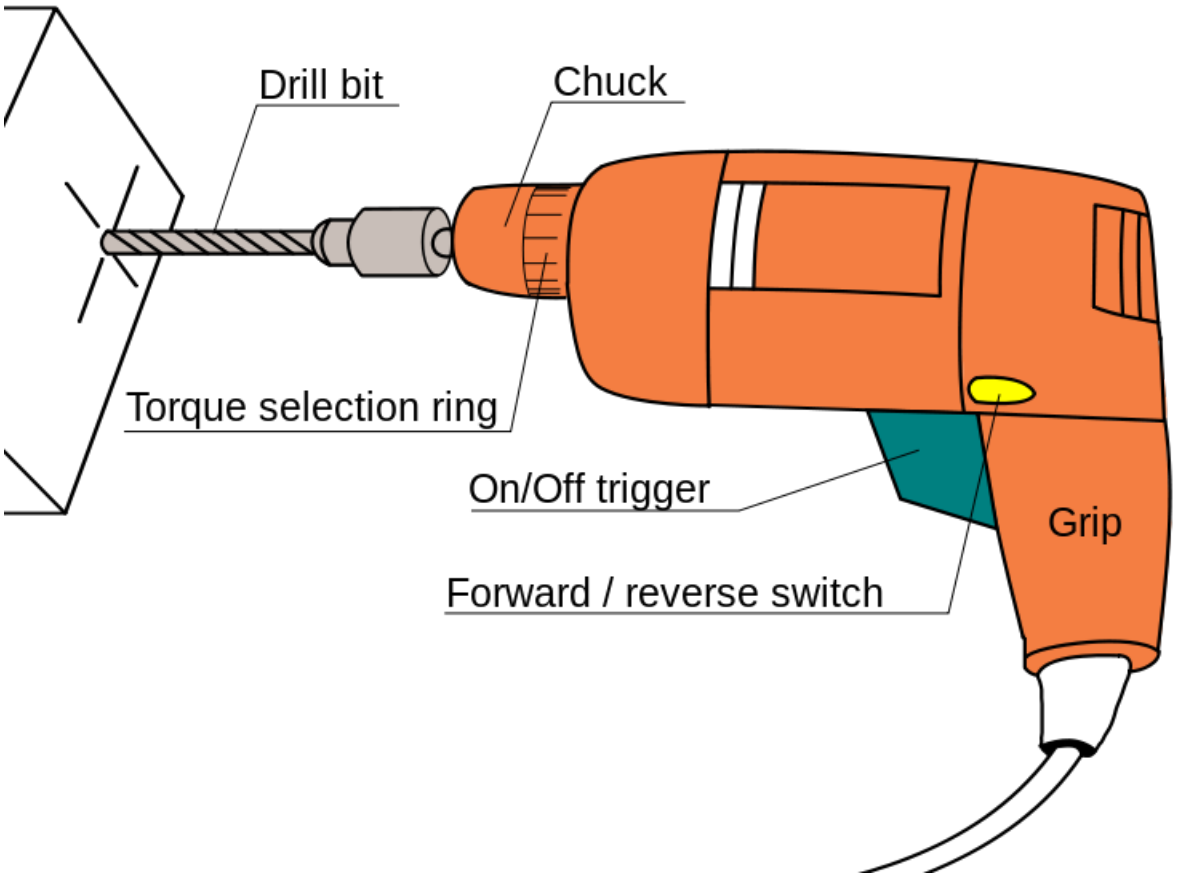


Fig. 17: Figure 2-17 b) Drilling machine

3.15 Pipe vise

Pipe vice is used for holding pipes for cutting or threading purposes. It is mainly made of steel and is available in different sizes like 25, 50, 100, 150mm. You should be very careful while tightening the pipes in pipe vice which may result in damage of pipes.

Fig. 18: Figure 2-18. Pipe vise

3.16 Bench vice

Bench vice is used for holding pipes for cutting or threading purposes. It is mainly made of steel and is available in different sizes from 100 to150mm. It should not be used as base for hammering.

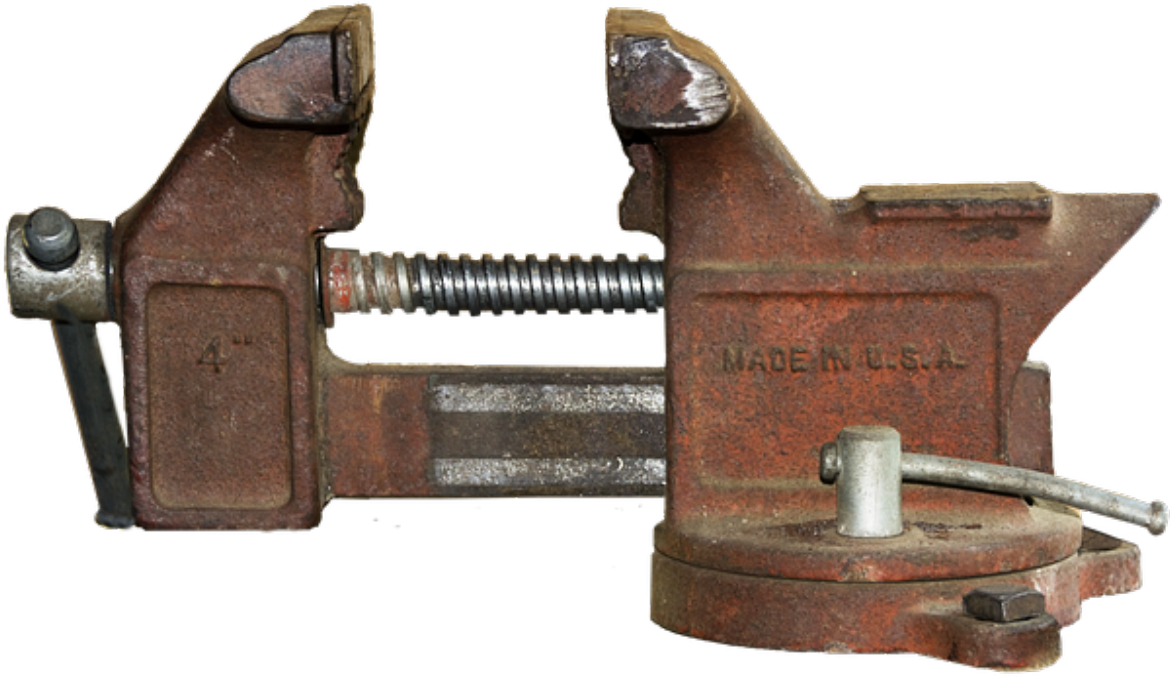


Fig. 19: Figure 2-19. Bench vice

3.17 Spanners of various size

Spanners are made of steel and its different sizes are available to suit different purposes. They are used for tightening and loosening bolts, nuts and screws.

Fig. 20: Figure 2-20. Spanners of various size

3.18 Folding rules metallic/steel

The folding rule comes to handy when you had to measure frequently but laboriously. The individual folding rules are connected by spring-loaded joints which locked into place. The folding rules available are wooden folding rule, plastic folding rule and metallic folding rule.

Fig. 21: Figure 2-21. Folding rules

3.19 Try square, Vernier caliper joining elements: - Nuts, bolts, washer, pins, screws and rivets and jute/pipe tape and lead

3.19.1 Try square

Try square is a woodworking or a metalworking tool for marking and measuring workpiece. Its primary work is to measure the right angle (90 degrees) of corners accurately. And to try a surface means to check its straightness or correspondence relative to an adjoining surface. It is found in size 15 cm, 20 cm, 30 cm etc. We should avoid oily surfaces while measuring with try square.

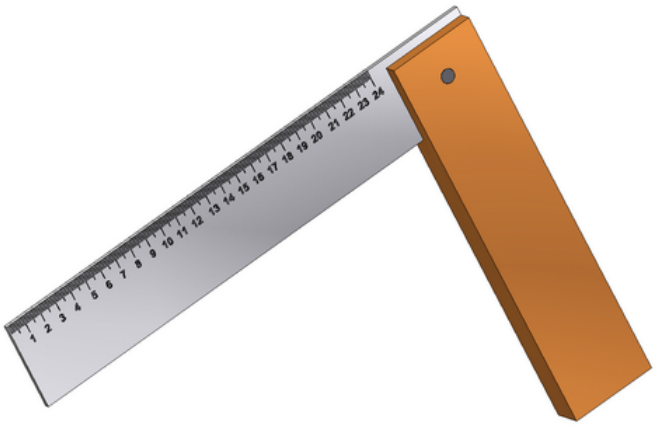


Fig. 22: Figure 2-22. Try square

3.19.2 Vernier caliper

Vernier caliper is an instrument that measures internal or external dimensions and distances. It helps in making more precise measurements than other regular rulers. Before measuring, close the jaws and faces to zero out the reading so that we get a precise measurement otherwise you will have to correct for the zero error. For measuring any length, compare the 0 line of the Vernier scale with the main scale. Then check the division that coincides with the graduated or main scale and add the first reading with the third reading by multiplying.

A scale cannot measure objects which are smaller than 1mm, but a Vernier caliper can measure up to 1mm.

Vernier caliper measures different joining elements which are briefly describe below:

Nut

Nut is a perforated block usually of metal that has an internal screw thread and used on a bolt or screw for tightening or holding something. It is available in different size and shapes as shown in figure.

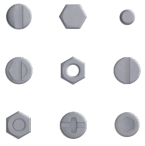


Fig. 24: Figure 2-23 b) Nut

Bolt

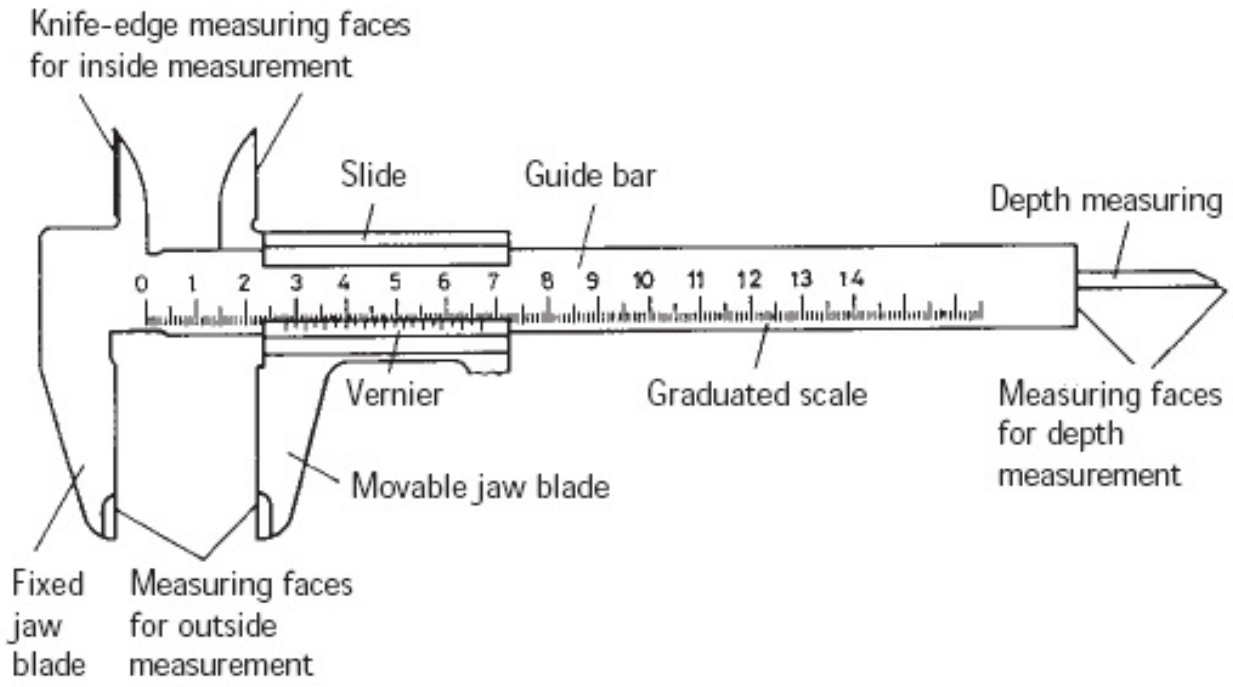


Fig. 23: Figure 2-23 a) Vernier caliper

Bolts is a metal rod or pin for fastening object together that usually has a head at one end and a screw thread at the other end is secured by a nut.

Fig. 25: Figure 2-23 c) Bolts

Washer

Washer is a flat thin ring, or a perforated plate used in joints or assemblies to ensure tightness, prevent leakage or relieve friction.

Fig. 26: Figure 2-23 d) Washer

Screw

Screw is a nail-shaped or rod-shaped piece with a spiral groove with slotted head designed to be inserted into material by rotation usually with the help of screwdriver. It is one of the simple machines and is used for fastening pieces of solid material together.

Fig. 27: Figure 2-23 e) Screw

3.19.3 Rivets

Rivets are metal pin for passing through holes in two or more plates or pieces to hold them together, usually made with a head at one end, the other end being hammered into head after insertion. Rivets are inserted with the help of hammer or riveting machine. For example, bridge components are connected together with the help of rivet joints.

Fig. 28: Figure 2-24. Rivets

3.19.4 Jute/pipe tape

Jute/pipe tape are wrapped around the outer threads of pipe before two pipes are connected as one. This tape is used for stopping leakage and other mishaps. This tape is use because of its anti-corrosive and moisture resistant nature.

Fig. 29: Figure 2-25. Jute/pipe tape

3.20 What's Next

chapter3

CHAPTER

FOUR

CHAPTER 3: GALVANIZED PIPE FITTINGS/PVC FITTINGS

Previously, Lead pipes was the common choice to transport water. As a solution to lead poisoning, builders began to use galvanized steel pipes and fitting alternative to lead. Steel pipes are dipped into molten zinc for galvanization. This zinc coating prevents pipe from corrosion and rust. Galvanized pipes are beneficial because of its cheaper price than copper and more durable than plastic. Also, it has wider diameter to allow more water through compared to copper. Its drawback is the internal corrosion that builds up along the interior of the pipe over time due to reaction of minerals in the water, with zinc.

Similarly, PVC stands for polyvinyl chloride and it has become a common replacement for metal piping. It's a white plastic pipe commonly used for plumbing and drainage. PVC fittings are beneficial because of its strength, durability, easy installation and low cost.

A fitting is a connector that connects straight pipe or tubing sections, adapt to different sizes or shapes for various purposes.

Fig. 1: Figure 3-1. a) GI pipe and fitting b) PVC pipe and fitting

4.1 G.I pipe nipples

A nipple is a fitting, with short piece of pipe with outer surface thread (or male pipe thread) on both ends for connecting other two fittings. A nipple with continuous uninterrupted threading is called close nipple and is unscrewed by nipple wrench while normal nipple can be unscrewed by pipe wrench. And other types of nipples are illustrated in given figure.

4.2 G.I elbows

The pipe is bent to form an elbow. There are issues with bends since the thickness at the bend radius reduces as we bend the pipe. Sharp bends normally called elbows. Bends usually have a minimum bending radius of 1.5 times pipe radius (R). If this bending radius is less than 1.5R, it is called elbow. The most common bending radii in the industry are 1.5R, 3R and 4.5R.

An elbow is used in a pipe supply to change the direction of pipe usually a 90° or 45° angle. When two ends of elbow has different size then it is known as a reducing elbow.

Fig. 2: Figure 3-2. G.I pipe nipples

Fig. 3: Figure 3-3. G.I elbows

4.3 G.I tee

It is a component of plumbing system with one inlet and two outlets arranged at 90° which is in T shape. It can be use to divide flow of one main inlet into two outlets or combine two inlet flows into single outlet. If all the three sides of Tee-fitting has same size then it is called equal tee otherwise it is called unequal tee.

Fig. 4: Figure 3-4. G.I tee

4.4 G.I cross

GI cross fitting contains 4 opening in 4 directions. These types of fitting generates more stress on pipe as the temperature changes, because they are located at center point of four connections.

Fig. 5: Figure 3-5. G.I cross

4.5 G.I reducing elbow

A reducer is used to change the pipe size to meet hydraulic flow requirement of the system. With the help of reducing elbow you can increase or decrease the flow of water supply in water supply system.

Fig. 6: Figure 3-6. G.I reducing elbow

4.6 G.I sockets

G.I sockets is a fitting, with short piece of pipe with inner surface thread (or female pipe thread) on both ends for connecting other two fittings. The opening of sockets matches the outer diameter of a pipe or tube which are to be connected.

Fig. 7: Figure 3-7. G.I sockets

4.7 G.I reducing sockets

G.I reducing sockets is a socket which reduces the flow size from larger to smaller or vice-versa.

Fig. 8: Figure 3-8. G.I reducing sockets

4.8 G.I lock nut

Warning: Not available

4.9 G.I plugs and caps

A **Plug** is a plumbing component which is used to close pipe opening during inspection and repairs. Plugs with male threads are generally available.

A **Cap** is a type of pipe fitting which works similar to plug i.e. to close the pipe, but it has female threads instead of male threads. It can be available in different materials like rubber, copper, steel, plastics etc.

Fig. 9: Figure 3-9. G.I plugs and caps

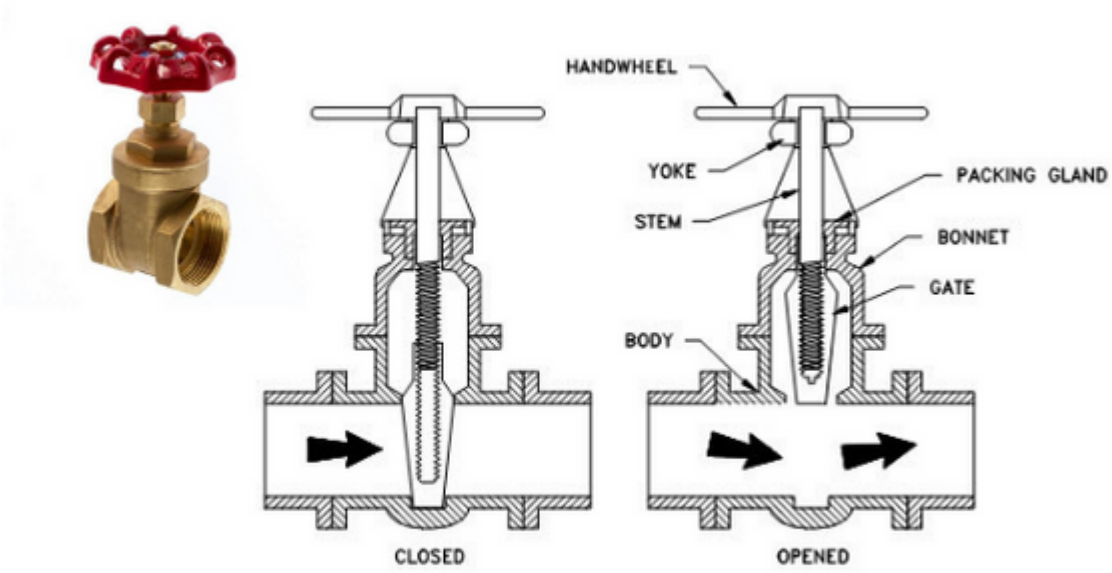
4.10 Flange unions (Gasket) (review needed)

A **coupling** is used to connect the pipes of same diameter. It is useful if the pipe is broken or leakage occurs. There are two types of coupling available- slip coupling and compression coupling. Slip coupling fix long length damage pipes while compression coupling is regular coupling.

A **union** is a type of fitting which also connects two pipes, but we can disconnect union of two pipes whenever we need. It consists of nut, male and female ended threads.

4.11 G.I gate valve (heavy and light)

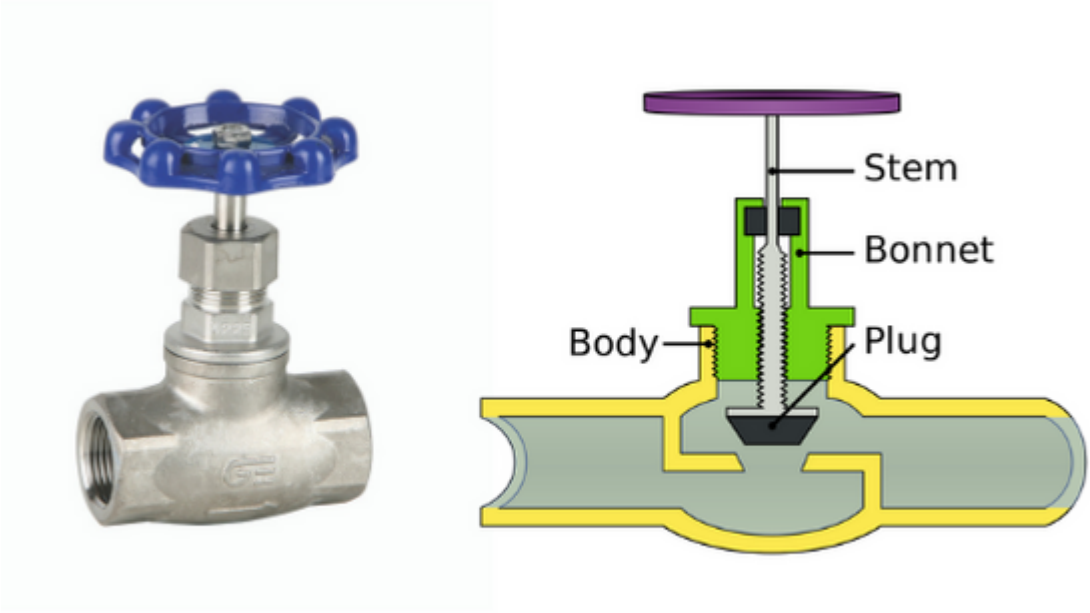
Valves are components of plumbing system which stops or regulates the flow of liquid or gas in its path. Different types of valves are available according to their applications like gate vale, glove valve, check valve, diaphragm valve, butterfly valve, ball valve, foot valve etc.



`Gate valve` is normally used for isolation application where fully close or fully open position is required. This kind of valves are best suited for place where frequent opening and closing is done.

4.12 Foot valve/Glove valve

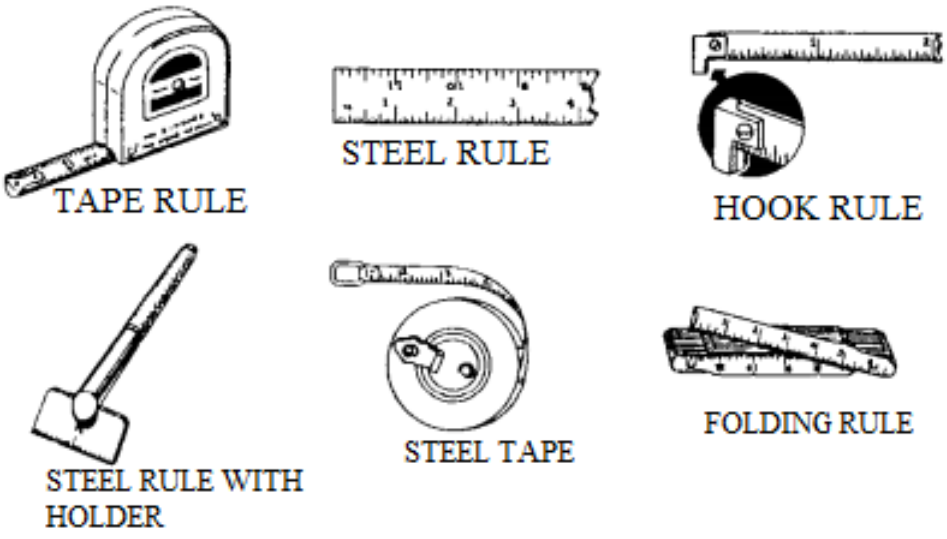
Glove valve is used in high pressure stream and water line. It can be used for throttling purpose and where shutoff is required. Also, it can be employed in isolation and regulation jobs.



Foot valve are used to prime up the centrifugal pump which helps to maintain hydraulic pressure to keep the water flow in accordance with the given configurations. It is made of PVC plastic or stainless steel.

4.13 Pipe tape

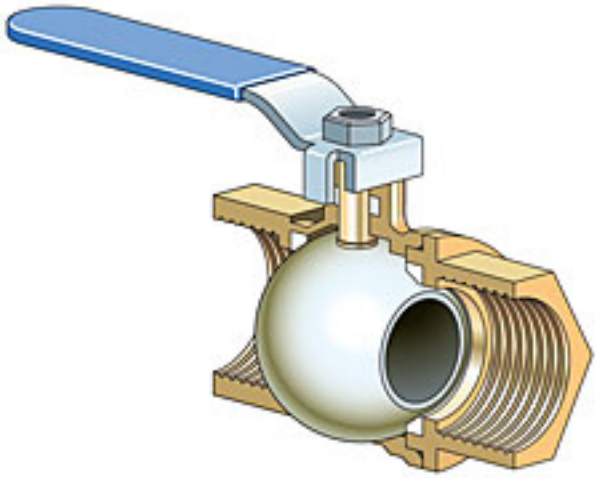
Given figure illustrates some of the commonly used pipe tapes. Steel or wooden straightedge is the most common and simplest measuring tool. This rule is usually 6 or 12 inches long. The thinner the rule is, the easier it is to measure accurately with it, because the division marks are closer to the work to be measured.

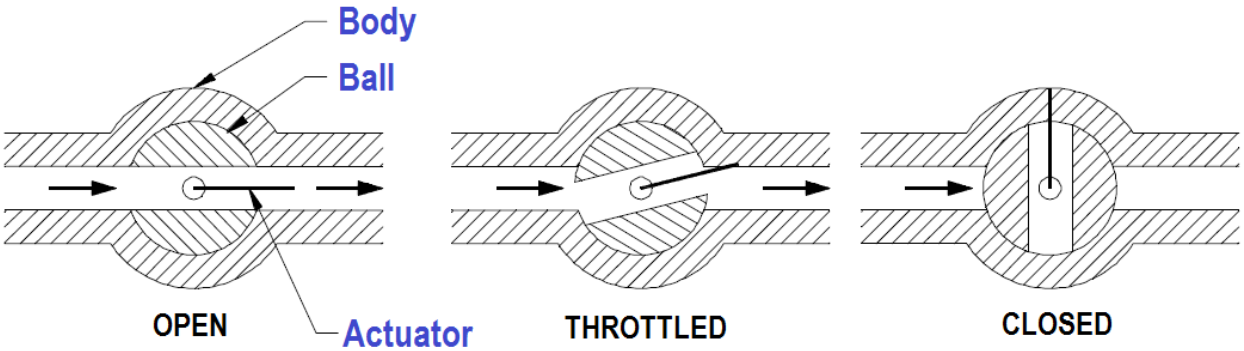


Some common types of tapes

4.14 Float valve or ball valve

A **ball valve** is one type of quarter turn valve which have a ball placed in a passageway through which fluid flows. The ball has a hole through it by which valve is opened and closed. To pass the fluid in same direction, ball must be positioned as the passageway. When the ball is positioned as hole is perpendicular to the passageway then valve is closed, and fluid cannot pass through.




Body
Ball
Actuator
OPEN
THROTTLED
CLOSED

4.15 What's Next

chapter4

CHAPTER

FIVE

CHAPTER 4: PIPE THREADING TO DIMENSION

5.1 Fixing pipe to pipe vice

A pipe vise is an apparatus which enables a pipe to be held tightly for different jobs like cutting, threading or welding. To fix the pipe to pipe vice you should follow the following steps carefully:

Step1: Preparation Find the flat and levelled surface like high worktable to place the pipe vice. Attach pipe vice firmly in the edge of worktable, so that you have more space to work with.

Step 2: Opening the pipe vice If T-handle at the top is screwed all the way down, then loosen it by turning it counter-clockwise. After that, open up the teeth in the middle where the pipe will go. Now, lift the lever to open the pipe vise sideways where pipe will be installed.

Step 3: Insert the pipe Insert the pipe into the slot in the middle, setting it on the curved base.

Step 4: Secure the pipe Finally, close the lever on the side and tighten the T-handle on top which locks the pipe firmly. After pipe vise is secure make sure that the pipe level is not misaligned.

5.2 Measuring pipe to millimeter

While performing maintenance and repair tasks in plumbing system, you must take accurate measurements during inspection, to determine the remaining service life of particular item or to make replacements according to required standard.

5.2.1 Outside pipe diameters

It is necessary to know how to take this measurement because outer diameter is only given sometimes in pipe specifications.

1. To measure outside diameter of a pipe, you should use rigid rule like wooden rule as shown in figure below.
2. Place the scale above the pipe with one end as stop using thumb as in figure.
3. Then, swing the rule through the arc with one end at your thumb and take maximum reading at the other side of the pipe.

5.2.2 Inside pipe diameters

1. You must hold the rule by just resting one end or rule in one side of the pipe as shown in figure.
2. Then, with one end held in place, swing the rule through the arc and take maximum reading of diameter across the inside distance.
3. This measurement is satisfactory for appropriate inside measurement.

5.2.3 Pipe circumferences

1. Take a flexible type of rule (or string that will be later matched to any rule) that will conform to the shape of pipe.
2. Remove labeling or other material wrapped around the pipe.
3. Wrap the tape squarely around the axis of the pipe to ensure that the measurement will not be more than the main body of the rule as shown in given figure
4. Read the measurement in the tape.

Once you have found the circumference, use the chart below to find your pipe size

1. **For copper pipe or PEX tubing**

Table 1: `Copper pipe or PEX tubing sizes`

2.5” (70 mm) :	3/4 pipe
3.53 (90mm) :	1 pipe
4.32 (110mm) :	1 1/4 pipe
5.10 (130mm) :	1 1/2 pipe

2. **For Steel pipe or PVC plastic pipe**

Table 2: `Steel pipe or PVC plastic pipe sizes`

3.25” (83 mm) :	3/4 pipe
4.00 (102 mm) :	1 pipe
5.00 (127mm) :	1 1/4 pipe
6.00 (150mm) :	1 1/2 pipe

3. **For Polyethylene pipe**

Table 3: `Polyethylene pipe sizes`

2.96-3.33” (70-85 mm) :	3/4 pipe
3.74-4.24 (95-108mm) :	1 pipe
4.90-5.57 (124-141mm) :	1 1/4 pipe
5.70-6.28 (145-160mm) :	1 1/2 pipe

5.2.4 Length of pipe

To measure the normal length of any pipe you can use tape rule or steel tape.

1. Place the hook tab on one end of pipe as grip and stretch the tape.
2. Pull out the tape or rule over the pipe parallel to it and read the measurement carefully.

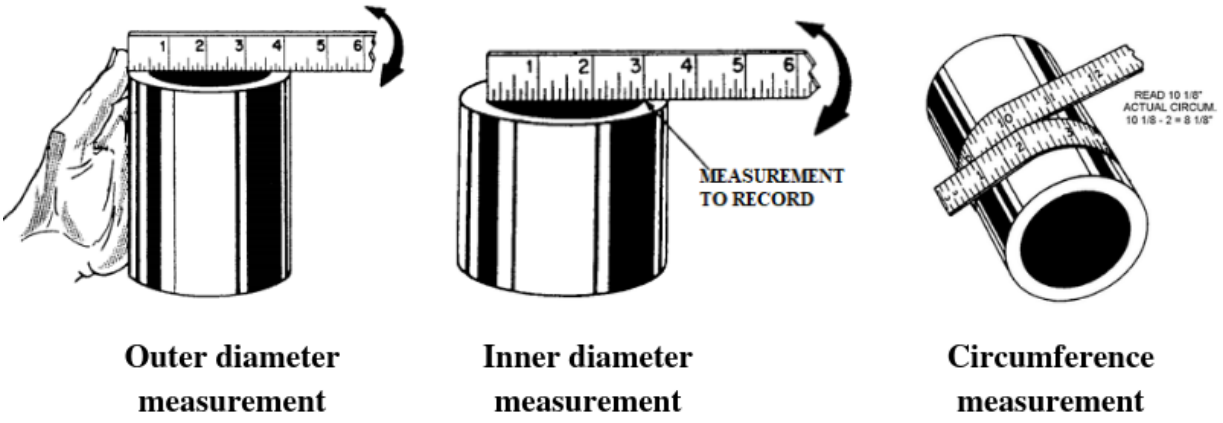


Fig. 1: Figure 4-1. Measuring the diameter of a pipe

5.3 Measuring methods

Where exact measurements are required, use a micrometer caliper which allow you to measure within one ten-thousandth (0.0001) of an inch accurately. Similarly, when extreme preciseness is not main concern, a common tape rule will do most. Some measuring methods are given below:

5.3.1 1) Using common rule or thread

To measure with common rule, hold the rule with its edge on the surface of the object to be measured which will eliminate parallax and other errors. Read the measurement at the graduation that coincides with the distance to be measured.

5.3.2 2) Using caliper

A caliper helps to measure the distance between two opposite sides of an object. With the help of caliper, you can directly measure the diameter of pipe. It can be used in two different ways. Either the caliper is set to the dimension of the work or pipe and the dimension is transferred to a scale, or the caliper is set on a scale and work or pipe is machined until it matches with the dimension set up on the caliper. You should not use caliper to measure a work that is revolving in a machine.

Inside caliper measure the distance between two surfaces as well as internal size of an object. For instance, it is used to measure internal diameter of a pipe.

Outside caliper measures the dimension which are inaccessible. For instance, to measure the thickness of the bottom of a cup outside caliper is used.

Hermaphrodite caliper or oddleg caliper has one leg bent inward and one straight leg ending in a sharp point. It is used for scribing lines at a specified distance from a flat or curved surface.

We can even combine various inside and outside as per the requirements. For example, a combination of firm-joint caliper. Similarly, we can use digital caliber for precise measurements. Vernier caliper, dial caliber and micrometer caliper are also available for our various jobs.

Transferring measurements from one caliper to another

To transfer the measurement from one spring caliper to another follow the following steps:

a) Hold the caliper as shown in figure given below.

b) Carefully adjust the size of caliber so that the two-lower leg of one caliber is extended to contact with the other steady caliber's legs.

c) Calibers should be held lightly. If there is a slight drag, then caliber is not at handled properly.

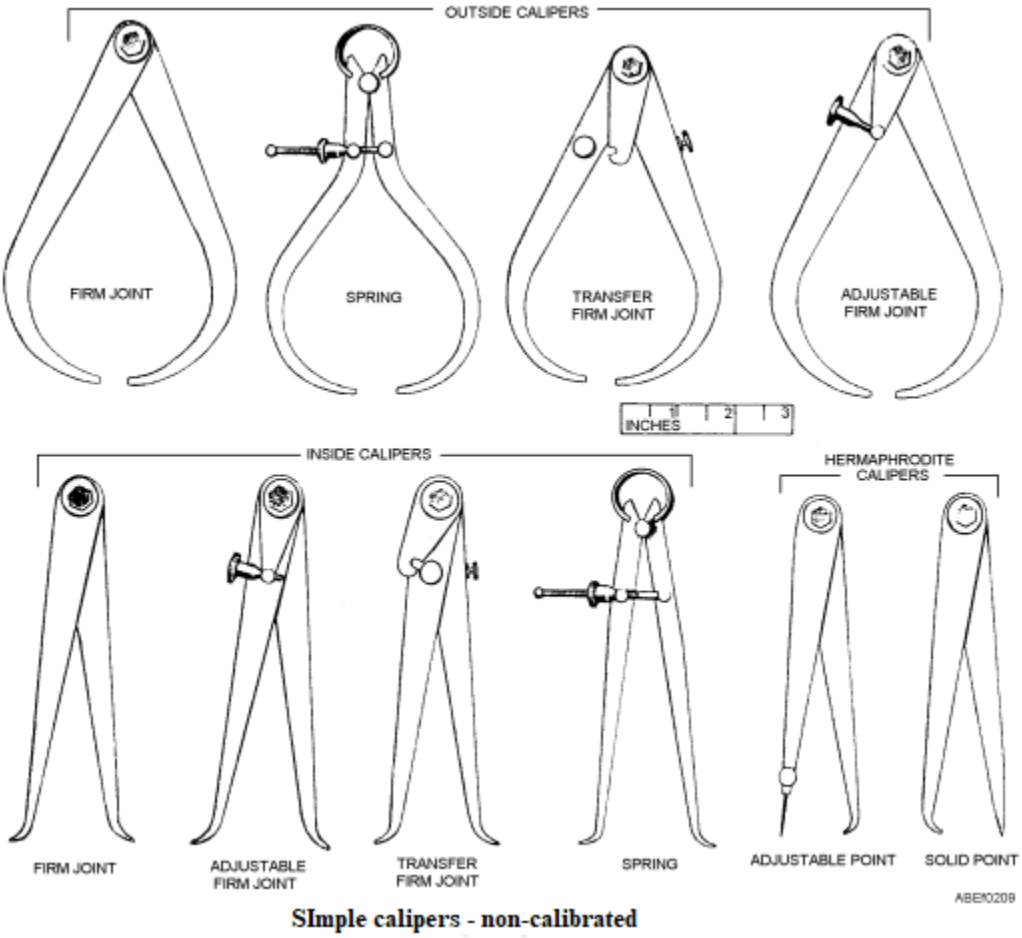
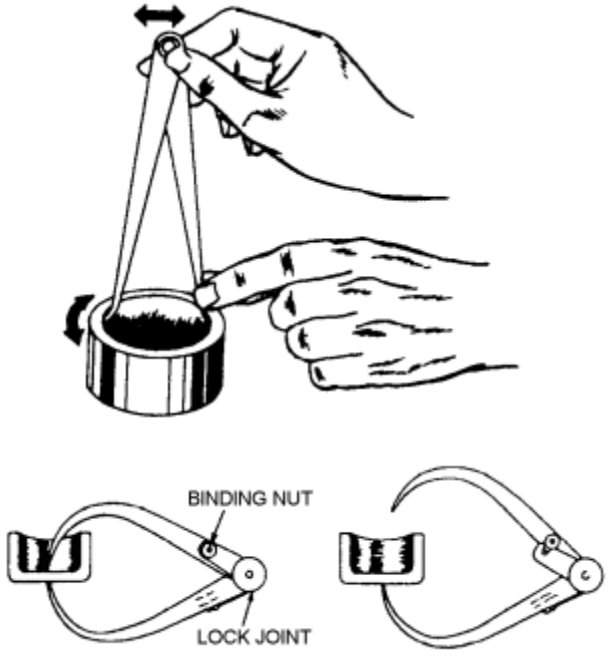
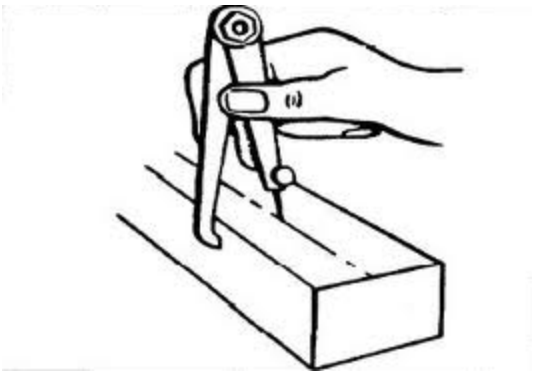
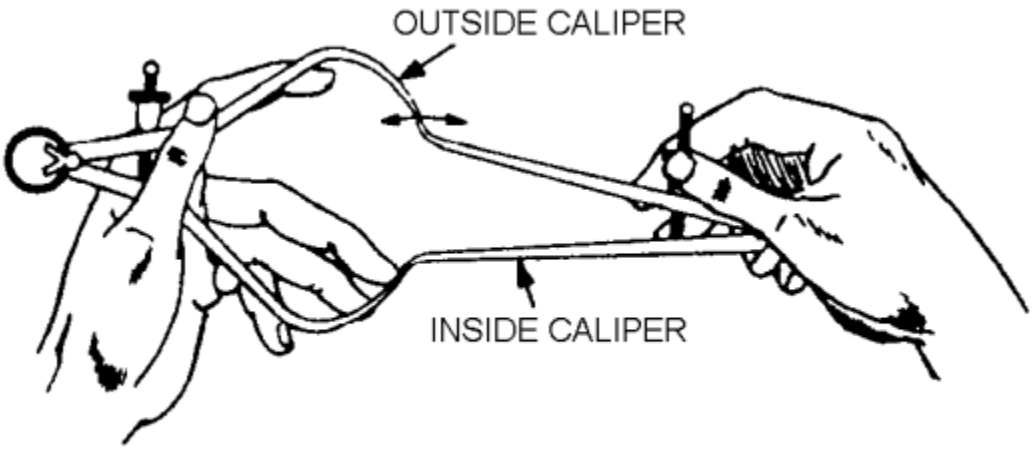


Fig. 2: Figure 4-2a. Calipers





d) Figure shown below is the measurement transfer instance from outside caliper to an inside caliper. Left hand holds the outside caliper firmly while right hand changes the size of inside caliper until legs of the opposite caliper meets exactly as in figure.



Transferring a measurement from an outside to an inside caliper

5.3.3 3) Using micrometer

It is also an caliper and is commonly called as micrometers or simply mikes mostly used where preciseness is main concern like military, industries and research. There are three types of micrometer: inside micrometer, outside micrometer and the depth micrometer. Outside micrometer measures outside dimension, inside micrometer measures inside diameter of a cylinder or a hole and depth diameter measures the depth of a hole or recess. Figure given below shows a micrometer with its components. Procedure of measuring cylindrical works is not in the scope of this book.

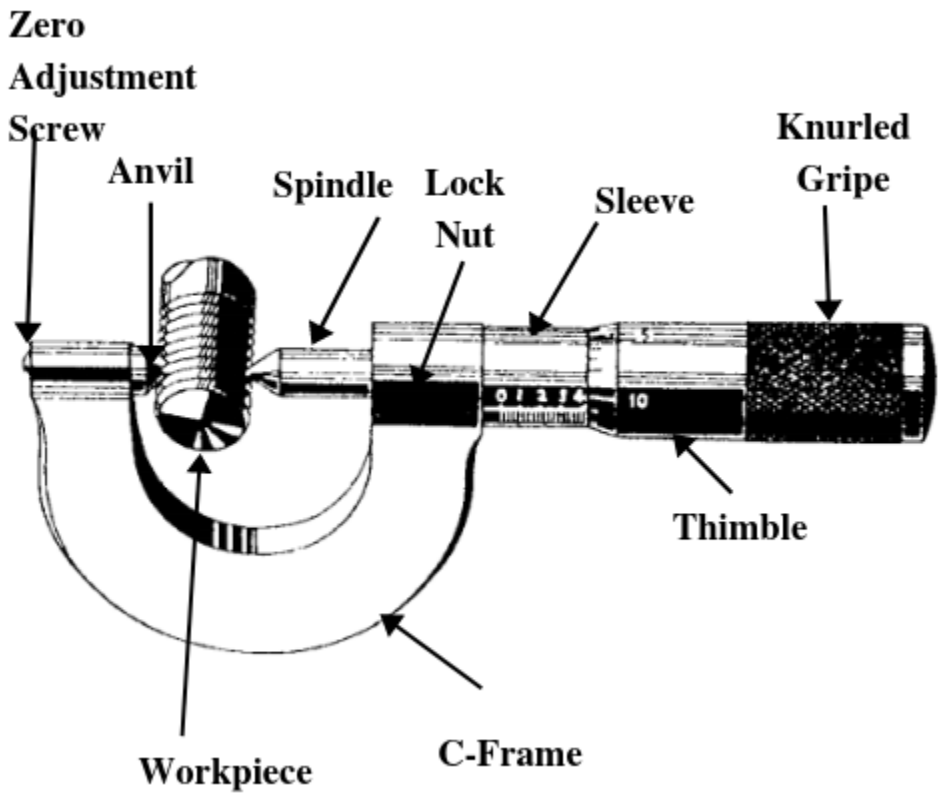


Fig. 3: Figure 4-3. A micrometer

5.4 Die holding/threading methods

A die set is used to cut threads onto a cylindrical like bolt with male threads. Following are the steps to be followed while holding the die

1. Choose the die according to your requirement: solid dies cut nominal thread form and depth while adjustable dies is used for achieving different classes of thread.
2. Rod or workpiece should be of correct diameter for perfect threading which should be either slightly smaller or slightly bigger than die.
3. Now, place the die inside the space in diestock with great care.

A pipe thread is a spiral ridge on the end of a pipe which enables pipes to be joined together. There are two pipe threading standards and they are:

1. **The British Standard Pipe Thread (BSP)**
2. **The American National Thread (NPT)**

Also, there are pipe threading equipment which are required for threading process which are:

1. `Hand held threading handle`
2. `Threading dies and taps`
3. `Hand held threading machine`
4. `Threading oils`
5. `Sealing tape`
6. `Threading sealants` (used for sealing threaded joints.)

Tap and die are tools used for screw threads. Tap is used to for female threads while taps are used to form male threads. There are different ways of making threads like metal cutting, molding and rolling as shown in figure below.

Following are the methods for creating threads in metal workpiece:

1. Using dies

a) Determine the number of threads per inch (TPI) required and select the dies accordingly.

b) Select the hard-enough dies for the metal you are trying to work with.

c) Check the die in diestock, if it is not in fit condition (i.e. wear out) replace it with another die else continue.

d) Lubricate the threading workpiece or cylindrical rod with light machine oil to prevent dies from becoming overheated.

e) Place the workpiece into a vise to hold it firmly so that it won't rotate when diestock is turned over it.

f) Place the die over the workpiece and hold it horizontally.

g) Press steadily on the front of the die head and turn it slowly.

h) Turn the handle of the die clockwise half a turn at a time, and then back it off a bit in order to eject the metal chips.

i) Apply the machine oil or threading oil while threading.

j) Ensure that the die is always kept perpendicular to the pipe to ensure the thread is even and square.

k) After the dies have been run down the required length of thread, reverse the die head in opposite direction carefully so that threads are not damaged.

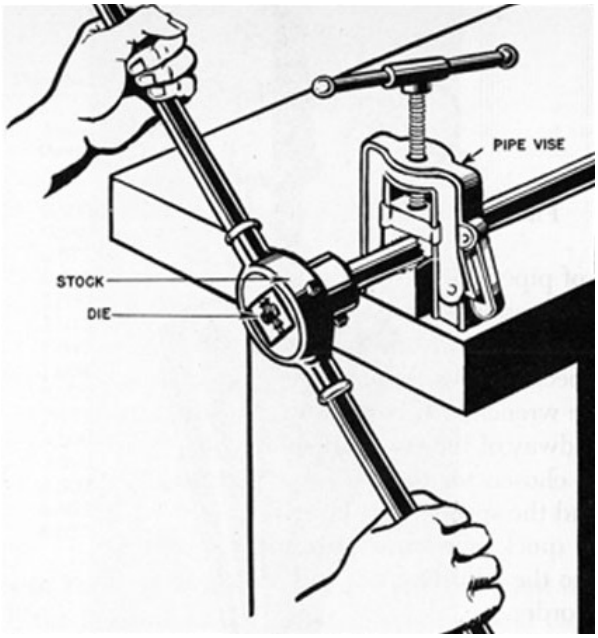
l) Remove the pipe from the vice, stand it on the end and tap to remove unnecessary metal chips from pipe.

m) Clean the pipe with cloth or soft rag to remove oil with care since thread are sharp.

n) Clean the die and diestock after use so that oil and metal do not damage machine for future use.

2. Using taps

a) Determine the number of threads per inch (TPI) required and select the taps accordingly.



b) Select the hard-enough taps for the metal you are trying to work with.

c) Select the tap wrench according to tap you are using. While using a small tap, try to obtain and use a corresponding small tap wrench.

d) Check the tap in tap wrench, if it is not in fit condition (i.e. wear out) replace it with another tap otherwise continue.

e) Mount your workpiece firmly in vice.

f) You should make sure you can invert your workpiece easily to remove chips.

g) Drill the straight hole in the correct diameter and avoid lateral force.

h) Lubricate while threading by applying the machine oil or threading oil.

i) Back off regularly to release chips.

j) Proceed slowly and calmly.

k) After the taper have been run down the required length of thread, reverse the tap head in opposite direction carefully so that threads are not damaged.

l) Remove the pipe from the vice, stand it on the end and tap to remove unnecessary metal chips from pipe.

m) Insert the correct size reamer inside the pipe to ensure any sharp burrs are removed from inside of the pipe.

n) Clean the pipe with cloth or soft rag to remove oil with care since thread are sharp.

o) Clean the tap and tap wrench after use so that oil and metal do not damage machine for future use.

Fig. 4: Figure 4-4 a) Tapping process

Fig. 5: Figure 4-4 b) Tap wrench with tapes

There are various methods and applications for making threads which are

1. `Thread turning`
2. `Thread milling`
3. `Thread tapping`
4. `Thread whirling`
5. `Grinding`

5.5 Die checking/cleaning/oiling

Before operating on pipe and after the completion of job threading die should be checked carefully for iron chips which could damage the life of die in long run. And, ensure that die is hold tight in diestock.

Cleaning should be done while threading by inverting the workpiece to drop the waste particles. And more importantly, once threading is done in workpiece, take a soft cloth and remove the lubricant from the pipe. Be careful while doing so since the freshly cut threads are sharp.

Suitable lubricant is essential for tapping and threading operations for following reasons:

1. To keep threading dies or taps and the workpiece at a stable temperature which improves thread quality.
2. Maximize the life of dies and taps by lubricating the working edge and reducing die ware.
3. Reduces threading torque and speeds the metal removal process.
4. Prevents machined or newly made threads and threading dies/tapes from rust.

For example, petroleum based is used for steel and aluminum.

5.6 Die tightening and loosing/fixing cutter

Die nuts, also known as rethreading dies, are dies made for cleaning up damaged threads. Chasing is the process of repairing damaged threads.

Warning: Not available

5.7 Checking accurate threading and its sharpness

In order to maintain the dimension of threaded workpiece within the specified size, tools used, and process applied like lubrications and sharpness of cutting edges are essential. The fundamental factors which controls the accuracy of thread are as follows:

1) **Angle:** The `angle` between of thread is the angle included between the sides of the thread, measured in an axial plane.

2) **Half angle of thread:** The angle included between side of the thread and the normal (90 degrees), measured in an axial plane.

3) **Lead:** The distance a screw thread advances axially in one turn.

4) **Major diameter:** The largest diameter of the thread of the screw or nut.

5) **Minor diameter:** The smallest diameter of the thread of the screw or nut.

6) **Pitch diameter:** It is known by checking the reference table for the proper pitch diameter limits for the desired fit.

7) **Thread** form by the form and position of the tool.

Note: The number of threads per inch of a bolt or screw may be determined by using a screw pitch gage

5.8 Doing loosen the die fixing the pipe to die and repeat the threading twice for sharpness

Warning: Not available

5.9 What's Next

chapter5

CHAPTER

SIX

CHAPTER 5: ASSEMBLING THE THREADED PIPE TO FITTINGS WITH PIPE TAPE AS PER DRAWING

Once pipes and fittings are threaded as per requirements, you need to connect pipes with the help of fittings so that a path for the flow of fluids or gases is created. There are many national and international standards for pipe threads while two commonly adopted standards are NPT and BSPT. Parts with matching threads performs better because it makes the join stronger and leakage free. However, it is not always the case, therefore pipe tape or sealants are used as common practice to make pipe joints tighter.

6.1 Visualization of drawing in detail

Warning: Not available

6.2 Collecting the fittings (allocate all fitting stuffs)

After correctly measuring the pipe size all the required fitting is to be collected. There are various fittings available as shown below. Collect the fitting according to your work requirement.

6.3 Collecting the threaded pipes in position

Upon collecting fittings required to join threaded pipes, it is necessary for collecting the threaded pipes which are to be joined. Then position the pipes in such way that one end which is to be joined is held free and other side is hold firmly.

Warning: Not available

6.4 Fixing the fittings with pipe tape to pipe in position (wrap the tape around pipe and join)

1) Clean the male threads at the end of the pipe with soft cloth or rag.

2) Place the end of pipe tape on the second thread from the end of the pipe and hold it with a finger or thumb.

3) Tightly wrap the tape around the pipe in the direction towards the direction of threads to conform tape to shape of threads.

4) With the pipe tape or sealing material in place, hand tighten the pipe and fittings as a joint.

5) Then, using pipe wrench, one on the pipe and one on the fitting, tighten one and a half more turn or tighten with conscience.

6) Use pipe clips at regular intervals to support the pipe so that it does not sag because Steel or galvanized pipes are heavy, and it must be well supported.

6.5 Checking the tightness/testing pipe joints

Warning: verify if joined pipe is working wee (not available)

It is extremely important to test all joints for leakage and other malfunctions. So that undesired mishaps like leak and burst would not occur later. Given below are the guides which are to be strictly followed checking tightness:

1) Create a solution mixing a bit of water with dish detergent.

2) Then, take a soft brush and coat the solution all over the joints.

3) Run the flow of fluid or gas in the pipe through joined section.

4) Any bubbles produced indicates a leak. Then, shut off the gas or fluid, retighten the joint and retest.

5) If any bubbles do not appear. Then, all is well.

There are various pipe joints tests which are listed below:

6.5.1 1. Hydrotest for pipe fittings

Hydrotests are not required for pipe fittings unless specifically requested by client. Depending on the system specification

- Hydrostatic test
- Pneumatic test

6.5.2 2. Proof test

To ensure the design of pipe fitting, meet all the accepted standard and code requirements burst test is performed. In this test a pipe and fittings are joined to prepare a dummy pipe spool. This dummy pipe spool is then pressurized to pre-define calculated burst test pressure. If the joint along with fittings withstand the test, then the pipe joint is considered safe for use.

6.5.3 3. Non-destructive test

Any of the following non-destructive testing are performed on finished fitting to ensure the soundness of the product.

- Ultrasonic
- Magnetic particle test
- Liquid penetrant test
- Positive material identification

6.5.4 4. Destructive test

Destructive test are performed to check the strength of the body and join of the pipe.

- Burst test
- Tensile test
- Impact test
- Hardness test

6.5.5 5. Special test

Special tests are carried out on fittings to confirm its ability to confirm its ability to withstand in corrosive environments. T

- Ferrite
- Intergranular corrosion test
- Hydrogen induced cracking
- Sulfide stress corrosion cracking and so on

6.5.6 6. Visual Inspection

It is conducted on fittings to check any surface imperfections. Joints is checked for any visible surface imperfections such as die marks, porosity, undercuts and dents. Acceptance of joint is as per applicable standard.

6.6 Adjusting measurement

Warning: Not available

6.7 Marking, laying, using chalk line to wall/floor/ceiling

Pipe laying usually outside work, laying pipe underground, installing piping systems in buildings, aeroplanes or ships. When it comes to the question of marking and laying, chalk line is the common answer. Chalk line is nothing, but a line drawn with chalk.

1) Fill the chalk box about half full of powdered chalk. Tap the chalk box occasionally to settle the chalk.

2) Mark the points in floor/wall/ceiling through which chalk line must be passed through

3) Hook one end of string and stretch the string tight so it crosses directly over the marks drawn by you.

4) Reach out the farthest straight distance as required and grab the string between your forefinger and thumb.

5) To draw the straight chalk line, lift the string straight up about 4 inch and release it. The snap of chalked thread leaves the line printed on floor which we call the chalk line.

6) To draw long lines accurately, use a helper or a hook on both ends to hold the thread. Then, press down on the string about midway between the ends with your thumb. Lift and snap the string on one side and similarly on other side. It helps us to prevent from unnecessary double lines.

7) Once marking with chalk line finishes, start with the pipe laying process by laying the pipe wherever the mark has been made by chalk line.

6.8 Accurate pipe cutting with margin of necessary threads to pipe

We need to have accurate size of pipe while laying the pipe in the system.

For example, suppose you are laying the pipe in floor. And you need another pipe of 45 cm to take it to the required destination. Let fitter (female threading) that connects the pipe is of 15 cm with 5 cm threading on both ends. So, you need to cover 35 cm more distance. You need to cut 40 cm (35cm + 5cm) pipe allocating 5 cm for making necessary threads.

Warning: (Pic need to be created)

6.9 Fixing pipe to pipe vice

A pipe vice has serrated jaws to grip the pipe and prevent it from turning. While selecting a plumber's vice, it is important to consider how securely the pipe is in the vice. Yoke vice, combination vice and chain vice are different vice used in plumbing. The given figure is a York vice which is common choice among plumbers.

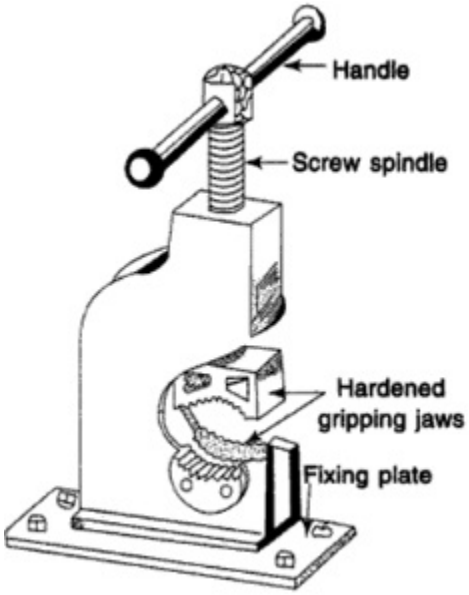


Fig. 1: Figure 5-1. Pipe vice

Warning: Not complete

6.10 Positioning techniques

Warning: (related to placing pipe parallelly)

6.11 What's Next

chapter6

CHAPTER

SEVEN

CHAPTER 6: MAKING UP H.D.P FITTINGS

7.1 Definition of HDP pipe and fittings

HDP corrugated pipes are the most flexible, long lasting and sturdy pipes made from polyethylene, a tough material that can withstand high chemical and environmental stress. It is also called HDPE pipe. HDP stands for High Density Polyethylene. It is widely used in supplying water and wiring, water supply, sewage and drainage purposes.

Fig. 1: Figure 6-1. HDP pipes and fittings

There are many properties which makes HDP pipes and fittings superior than other thermoplastic polyethylene and some are:

1) It is resistant to weather conditions

2) HDPE Pipe High resistance to tearing and pressure

3) It is having high resistance to stress cracking.

4) It has corrosion resistance

5) Easy and reliable assembly of HDP pipes.

6) It has reduced flow noise compared to metal pipes.

7) It is good for thermal insulation.

8) It is non-toxic or hygienically safe.

9) It is suitable for radioactive waste.

7.2 Collecting hot plate with power

Hot plates are used for welding or joining thermoplastics. Hot plate welding is a thermal welding process where a heated plate is placed against the two surfaces to be joined in order to melt them. Then, the hot plate is removed, and the surfaces are brought together and merge with great pressure. This simple technique makes strong joints and used in pipe welding.

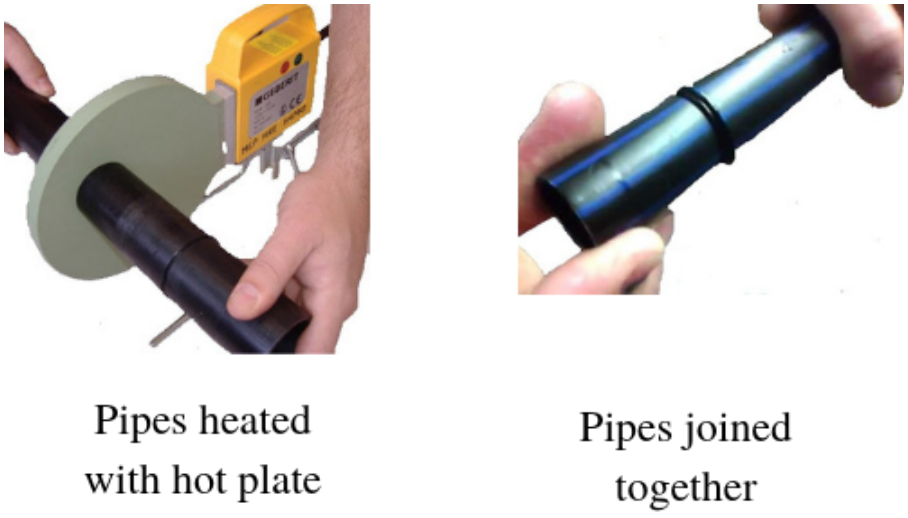


Fig. 2: Figure 6-2. Collecting hot plate with power

7.3 Collecting HDP pipe with necessary diameters

HDP pipes comes with different diameter sizes. Pipes used for normal uses are of size 16 mm up to 250 mm outer diameter avail

- HDPE pipes
- HDPE pipe/fitting with equal diameter of first pipe

Once all these things are collected, the welding process can be started.

Sometimes you need to increase or decrease the flow of fluid inside pipe then you have to use pipes with varied diameters along with necessary fittings (reducers).

7.4 Using miter box cutting pipe to 90°

1) Using a tape measure and a marking tool such as a pencil, mark around the pipe to cut the pipe.

2) Line up your cut mark you made on the miter saw throat plate

3) Secure the pipe to the miter saw table with clamps to the miter saw fence. Avoid to use your hands

4) Switch on the switch trigger and slowly bring the miter saw arm down into and through the pipe.

5) Once miter saw go through the pipe the release the switch trigger.

6) Wait until blade stops spinning and after the blade stops remove the pipe.

7.5 Clean, trim and weld the two halves of pipe to form 90° elbow (L)

Use of handsaw or miter saw creates burrs due to motion of blades. These small bits from pipe need to be removed or cleaned because it can scratch and makes mess while handling pipes. It can be cleaned by following ways:

1) Take a burr cleaning tool which has a tapered cone that spins back and forth motion inside the pipe to remove the burrs

2) Use a sharp knife and run it along the inside edge of the piece.

3) Use a heavy grade sandpaper and run it along the interior of the pipe.

After cleaning is done, trimming need to be performed which is to cut the end of the pipe. Chamfer the pipe end for sizes 1¼" inch diameter and larger.

To weld the two pipe pieces in L shape following steps can be followed:

1) Clean the end of the pipe and the matching inside surface of the fitting.

2) Square and prepare the pipe or trim the pipe end.

3) Hold both the pipes and fitting with proper mechanical equipment.

4) Heat both the external surface of the pipe end and the internal surface of the socket fitting up to recommended fusion temperature.

5) After the pipe starts melting, insert the pipe end into the socket.

6) Hold pipe and socket in place until the joint cools.

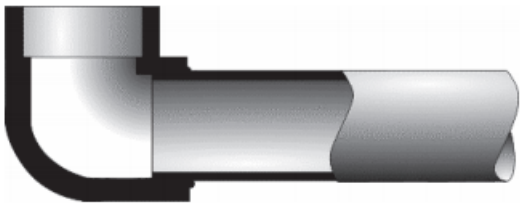


Fig. 3: Figure 6-2. Application of elbow

7.6 Making Tee

To make a Tee or T joint following procedures can be followed carefully:

1) Initially, take necessary tools and equipment like a straight HDP pipe, wooden saw, steel scale, pe file, hot plate, knife and meter box.

2) Then, cut a pipe in three pieces with 45 degrees each accurately using different pipe cutting techniques.

3) Perform cleaning and trimming if necessary.

4) Heat ends of two pipes with 45 angles in hot plate.

5) Join those ends such that an elbow or L joint and allow it to cool.

6) Now, cut the elbow with 45 degree as in figure 2.

7) Heat the angled part of elbow and angled third pipe in hot plate.

8) Join the both heated parts such that Tee or T joint and allow it to cool.

Warning: (Fig not avl)

7.7 Making Wyes (Y)

The procedural steps for making Y joint are as follows:

7.8 What's Next

chapter7

CHAPTER

EIGHT

CHAPTER 7: BAR BENDING WORKS

8.1 Straight making bars methods

To bring the metal back into the proper shape you need to employ some metal straightening methods. Some methods for doing so are

8.1.1 1) Heat straightening

Heat straightening involves applying controlled heat to a deformed part of steel in heating and cooling cycles until the metal gradually straightens. Metals are not to that point when they go molecular changes. The stress added to the heated metal must not surpass the yield stress of the metal in the heated condition, which is the point at which metal deforms into an undesired shape.

Welding torches are common source of heat for heat straightening.

8.1.2 2) Hot mechanical straightening

It is like heat straightening process except it straightens the metal beyond the yield stress. It straightens the metal quickly but can causes unwanted consequences like metal degradation, fractures, wrinkles and buckles.

8.1.3 3) Hot working

It is like hot mechanical straightening, except the metal is heated to the point where the metal might undergo molecular changes. This method of metal straightening is even faster, but causes more unpredictability like increased brittleness, cramps, wrinkles, change in molecular structure and so on.

8.1.4 4) Screw presses

Screw presses are devices that drive a ram into the bent metal through force generated by a screw. Hand-screw presses and hydraulic presses to straighten bent sections and to remove dents from metal sheets. The screw press has weights attached to the handle that helps the press maintain momentum during operation.

8.1.5 5) Fastening devices

In this method metals are heated using fabricators. Metal to be strengthen is placed on the straightening plate or an anvil. Tools like tongs, vices and clamps holds the metal in place so the fabricator can move a part of metal until it straighten.

8.1.6 6) Pipe straightening

When straightening pipes, fabricators sometimes fill the pipes with fine-grained sand and close the ends of the pipes. Then the fabricators heat the pipe and straighten it. The sand prevents the pipe section from developing more deformation.

8.2 Bar tying methods

Proper tying is necessary to maintain bar position. Wire used for tying reinforcing bars is usually gage black, soft-annealed wire. The various methods of bar tying are used for securing reinforcing bars. Much of the tying is done on flat, horizontal formwork such as floor slabs. Some methods are given below and well-illustrated in the figure.

8.3 Categories of bars, e.g. Mild steel bar, T.O.R steel bar and TORKARI bars

Categories of bars used for reinforcement are as follows:

8.3.1 1) Carbon steel bar

This type of bar is commonly used bar for all types of construction works. It corrodes more easily than other types of bars, so it is wise not to use it in the environments with high humidity.

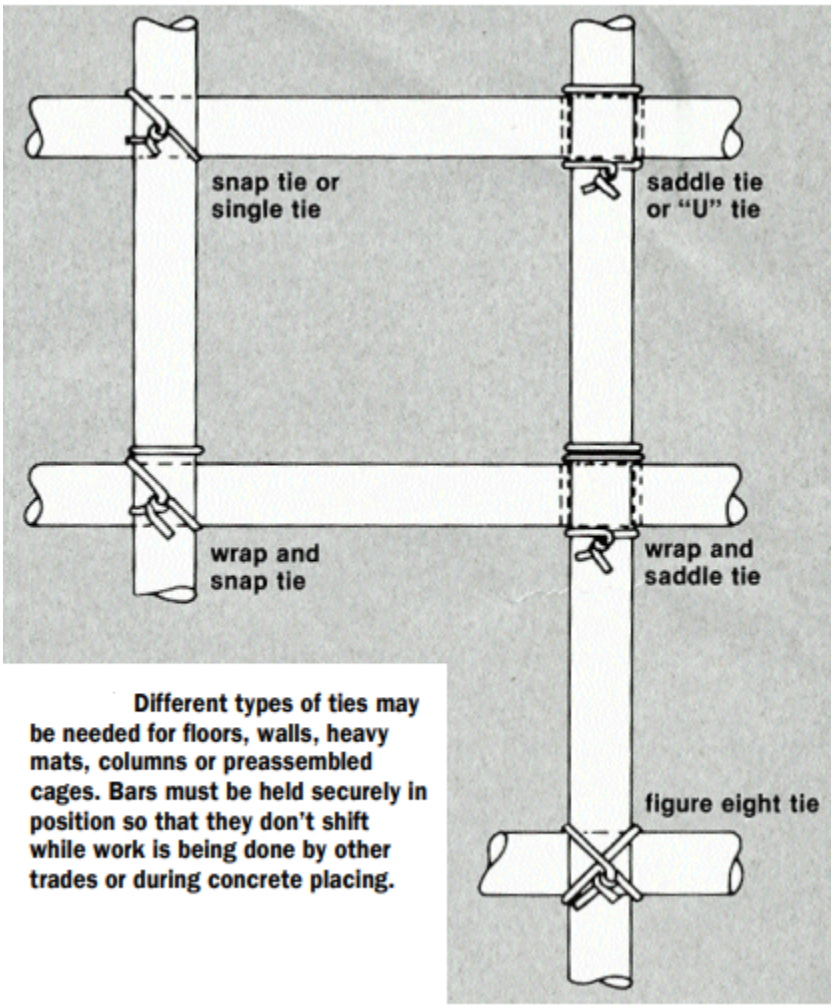


Fig. 1: Figure 7-1. Different types of ties

- Snap tie or single tie
- Wrap and snap tie
- Wrap and saddle tie
- U tie or saddle tie
- Figure eight tie
- Nailhead tie
- Double-strand single tie

8.3.2 2) THREAD-O-RING steel bar

One of the many uses of T.O.R bars is as a purge and equalization fitting during plugging operations on pipelines and plant piping.

8.3.3 3) TORKARI bars

TORKARI is mostly used as reinforcement bar for the concrete in construction works. It is cost effective, weldable and high bending ability.

8.3.4 4) Welded wire fabric

It is used in walls and structural floor slabs like road pavement, drainage structures and small concrete canals.

8.3.5 5) Sheet-Metal Reinforcement

It is commonly used in floor slabs, stairs and roof construction. It is composed of annealed sheet steel pieces bent into corrugations of about one-sixteenth of an inch deep with holes punched at regular spacing

8.3.6 6) Epoxy-Coated Rebars

These type of rebars are costly and are used in areas with contact to salt water.

8.3.7 7) European Rebars

These rebars are made up of manganese so they are flexible to bend. They are not used in areas prone to extreme weather condition like earthquakes, hurricanes and other. It is relatively cheaper.

8.3.8 8) Stainless Steel Rebars

It can be used as a cost-effective solution in areas subjected to corrosion problems or where repair is difficult.

8.3.9 9) Galvanized Rebars

These rebars are the ideal solution to the environments prone to corrosion. It is costly than other rebars.

8.3.10 10) Expanded Metal or Wire Mesh Rebars

These rebars are used as reinforcement in areas where considerable thickness of plaster is required, or to reinforce light concrete construction. It can be used on sidewalks or walkable surfaces that don't receive high load charges.

8.3.11 11) Glass-Fiber-Reinforced-Polymer (GFRP) Rebars

It is highly expensive rebar which is up to 10 times more cost than epoxy-coated rebars. It will not corrode under any tough environmental situations.

8.4 Making L(Hook) procedure to Hook making die and bench

Warning: Not available

8.5 Making 45 degrees crank procedure

Crank bar or bent up bars are provided in slabs or column at the ends of the supports. Those slabs have to deal with two types

1. The positive moment developed at mid of the span
2. The negative moment developed at the supports

There are two main types of RCC slabs

1) One way slab

Main reinforcement is provided in only one direction.

2) Two way slab

Main reinforcement is provided in both the direction.

The procedure to make 45 degrees crank procedure are as follows:

1) The place where slabs are placed is called shuttering. You have to place shuttering oil over there.

2) Place the beam on two ends of the shuttering such that when a hypotenuse is drawn from L/4 distance (from selected beam's side) to top of selected beam, it makes an 45° as shown in figure.

3) Place the main bar and supporting bar in slab and create one way or two-way slab as per your requirement

4) Place the supporting bar above main bar on L/4 distance from both ends of the slab as shown in figure.

5) Use the necessary bar bending tools and bend main bar alternately in 45° as in figure.

6) Make main bar hook to hook the main bar with beam.

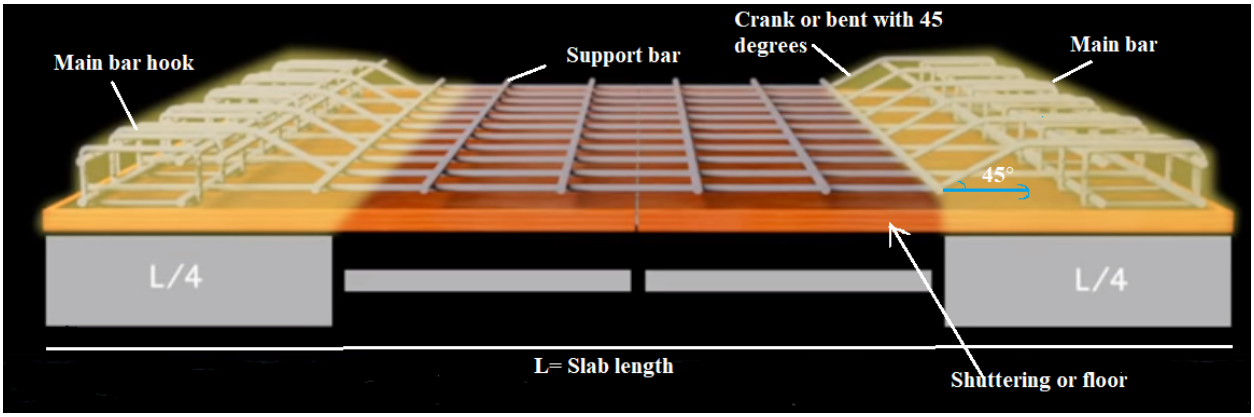


Fig. 2: Figure 7-2. 45 degrees crank

8.6 Making chair to fix reinforcement methods

Chair-like Steel rebar support is a metal building parts for concrete rod reinforcing. It is also known as support chair, rebar stool and reinforcing steel bar stool. It is used to hold the reinforcement or steel pipes in position when the concrete is poured to strengthen the concrete structure.

Following steps need to be followed to make chairs while fixing reinforcement:

1) Take low carbon steel or medium carbon steel as chair making material

2) Measure the required height of chair, length of chair's seat which holds the reinforcement

3) Mark on the rod according to the measurement for bending purposes

4) Bent the rod with different bending techniques into the structure as shown in figure.

5) You can make two-legged chair or four-legged chair based on your requirement.

6) For four-legged chair you need to weld two two-legged chairs of slightly different leg length.

7) You can further bend the lower end of chairs for supporting lower slab or use plates as in figure according to reinforcement requirements.

8) And treat the bottom part of chair leg with plastic coating, plastic caps or iron scraps.

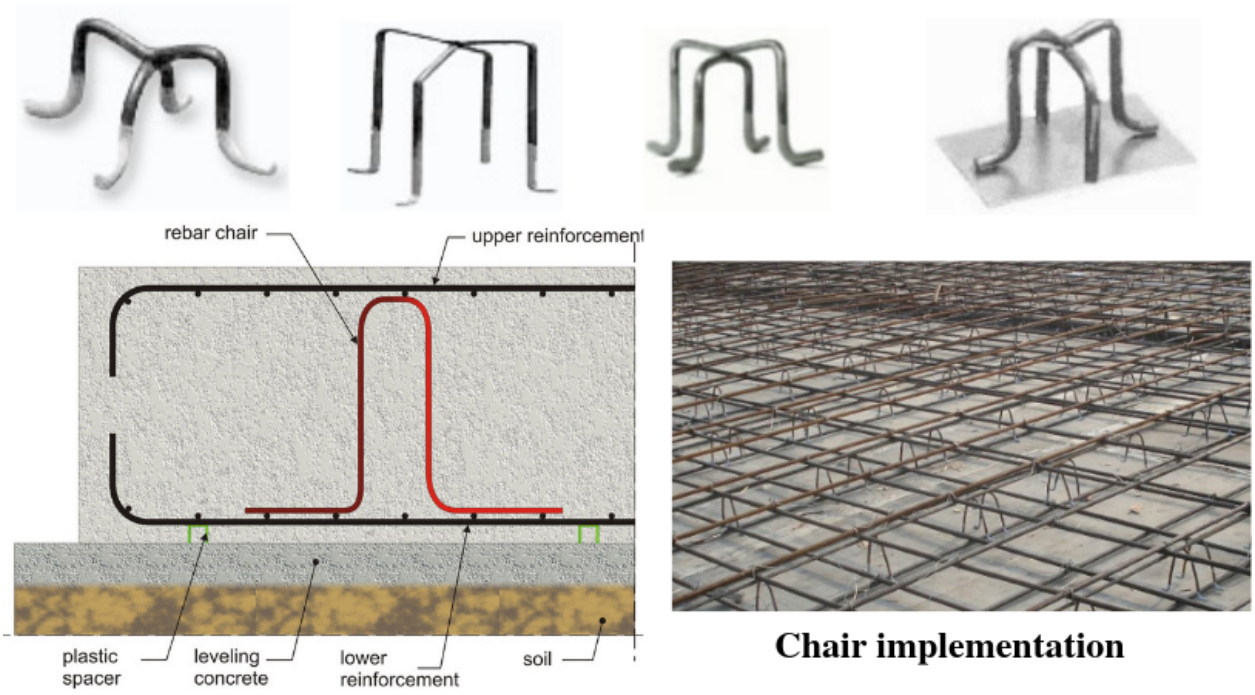


Fig. 3: Figure 7-3. Making of chair to fix reinforcement methods

8.7 Making overlaps to steel bars

Steel is the best material for reinforcing concrete because the properties of expansion for both steel and concrete are approximately the same i.e., they will expand and contract at an almost equal rate. Steel is used in tension and concrete is used in compression. Therefore, there are steel bars in the bottom of a beam where tension is greatest and little steel in the top of a beam where compression is greatest. For steel to handle the tension, you need to arrange the bars overlapping so that the bars transfer the force. To do so we can

- Weld the bars
- Lap the bars
- Couple the bars

Lapping bar means the process of overlapping the bars by some distance, so that they transfer the force from one point to another by passing stress through the concrete.

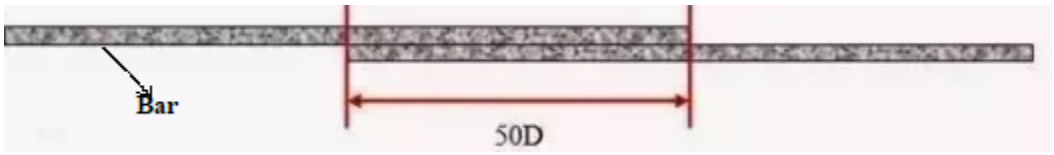


Fig. 4: Steel lapping formula for lap length = 50 X Diameter

Lap length is calculated as follows: If a you have a bar of 10mm diameter the lap length is 500mm (50 X 10).

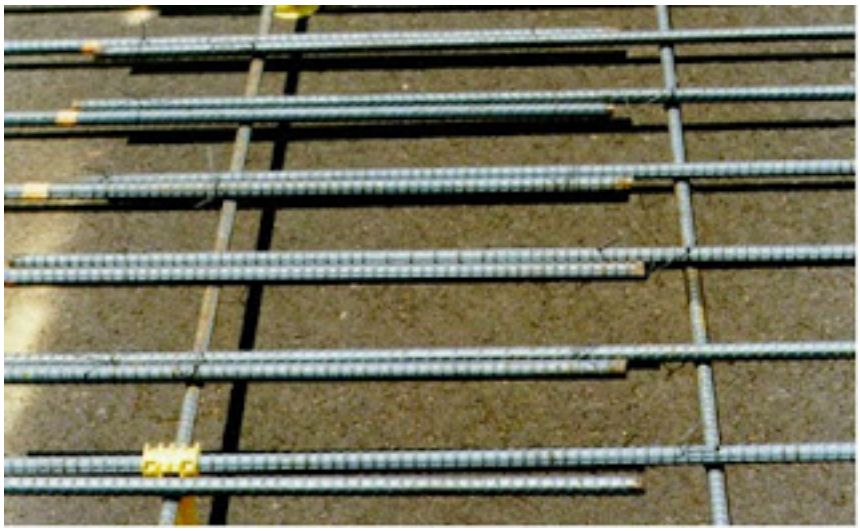


Fig. 5: Figure 7-4. Lapping of bar

8.8 What's Next

chapter8

CHAPTER

NINE

CHAPTER 8: FIXING OR FASTENING RODS TO WIRE

9.1 Single knot tying to slab methods

1. Select the proper annealed steel wire to tie rebar.

2. Prepare the area where the slab is to be made

3. Place the rebars in one-way or two-way slab formation as required

4. Wrap the wire around the joint (where two rebars intersects) from any of the four sides.

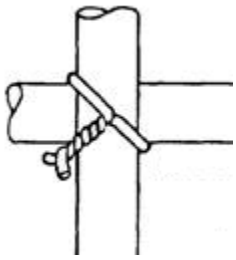
5. Make sure two rebars are in contact.

6. Bring the both ends of tying wire straight and push both ends in opposite direction

7. Twist the wire couple of turns using pliers for effective ties

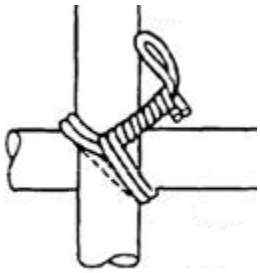
8. Snap the wire or cut the wire fr| om the long end of the wire.

9. Twist both ends of wire downward.



9.2 Double knot tying to slab methods

This tie is a variation of the simple tie. It is especially favored for heavy work



Warning: Not complete

9.3 Tying to beam methods

Warning: Not complete

9.4 Tying to column methods

Colum is the vertical support which is free from all sides which takes the load of beam or slab and transfers the load to the ground. Column can be known as the skeleton of a pillar. It is constructed using steel bars and concrete.

The process of tying to the column are given below:

1. Measure the length of column you required and cut the rod with same length in four pieces.

2. Also, cut two pieces of strong bar with length greater than twice the size of column's breadth.

3. Select a leveled surface and place four stands of equal length in the ground as if they form two parallel lines of length slightly less than the column.

4. Place small bars on top of stands and tie them as shown in figure.

5. Now, prepare the rectangularly bended ties or stirrups as shown in figure.

6. Place a single long rod on top of stands on one side.

7. Insert the required number of ties into that rod.

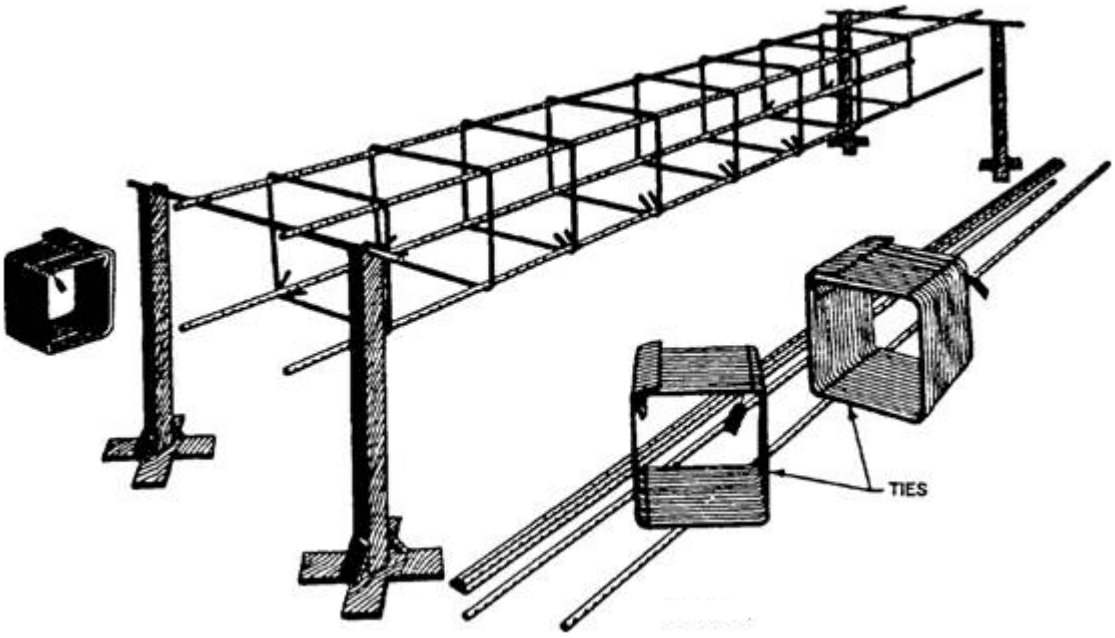
8. Then, insert another long rod through the ties and place above the small rods supported by stands. Ensure that both rods have same length outside the support rods kept in stands.

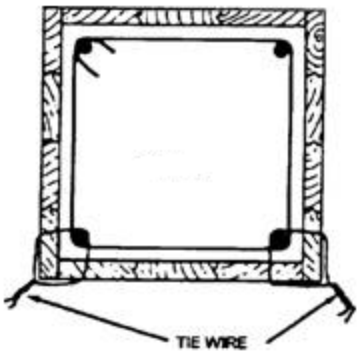
9. Mark the position where ties to be placed in one of the rods.

10. Once ties are arranged in their proper placed, knot both the ties and rod with different tying methods as required as shown in figure.

11. Again, insert third rod through all the ties and make sure it hangs freely only on aid of ties positioning exactly below the long rod above. Tie this rod in the corner of ties in all positions.

12. Repeat same process for the fourth rod and column structure is prepared as shown in figure.





Method of holding column steel in plain

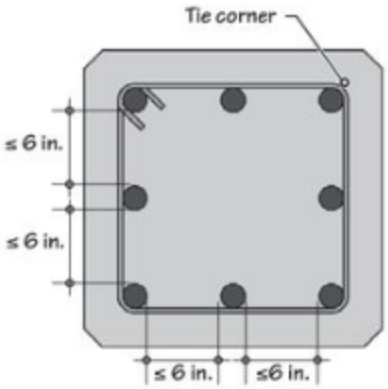
9.5 Checking tightness of stirrups to main bar loops

Warning: Not available

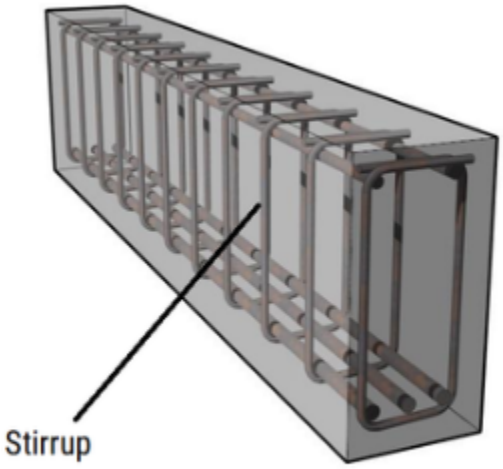
9.6 Making stirrups or rings

Stirrups are the structures made from steel pipes in different shapes of polygons or circles to wrap around top and bottom bars of beams and columns. It helps to prevent columns and beams from buckling.

The process of making stirrups or rings are as follows:



(a) Tie arrangement in a square column with 8 longitudinal bars and one tie set. This arrangement can only be used if the clear space between a supported and an unsupported longitudinal bar is less than or equal to 6 in.



Beam with stirrups

9.7 What's next?

This will be the end of our journery. To dive deep in the plumbing field there are lots of resouces available...

CHAPTER

TEN

INDICES AND TABLES

- genindex
- modindex
- search

10.1 Our Help

If you have any trouble please email at binary.science01@hotmail.com

10.1.1 Your help

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