NATURAL RESOURCES CONSERVATION AND DEVELOPMENT

Level-II

Learning Guide-69

Unit of Competence: Assist Operation and Maintenance of Irrigation and Drainage

Module Title: Assisting Operation and Maintenance Of Irrigation and Drainage

LG Code: AGR NRC2 M15 L05-LG-69

TTLM Code: AGR NRC2 M15 TTLM 0919v1

LO5: Lower and position pipes & clean up

Instruction Sheet	Learning Guide #69

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Laying and consolidating bedding materials
- installing/ lowering Pipes
- installing Pipe joints and fittings
- Backfilling Pipes
- clearing and removing unwanted materials

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, **upon completion of this Learning Guide, you will be able to**:

- Lay and consolidate bedding materials
- install/ lower Pipes
- install Pipe joints and fittings
- Back filling Pipes
- clear and removing unwanted materials

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3 Sheet 4 and Sheet 5”.
4. Accomplish the “Self-check 1, Self-check 2, Self-check 3, Self-check 4 and Self-check 5” **in page -2, 9, 26, 29 and 31** respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2” **in page -32.**
6. Do the “LAP test” **in page – 33**(if you are ready).

Information Sheet-1	Laying and consolidating bedding materials

1.1 Laying and Bedding the Pipe

Plastic pipe conduits complete with fittings and other related appurtenances shall be installed to the lines and grades shown on the drawings. The pipe shall be firmly and uniformly bedded throughout its entire length, to the depth and in the manner specified on the drawings. Bedding material, if necessary, shall be placed and spread in uniform layers and in such a manner as to fill the trench so there are no unfilled spaces (air pockets) below the pipe. Holes shall be dug in the bedding at belled couplings and other fittings to permit the body of the pipe to be in contact with the bedding along its entire length. Figure 4 illustrates a bell hole. Blocking or mounding beneath the pipe shall not be used to bring the pipe to the final grade.

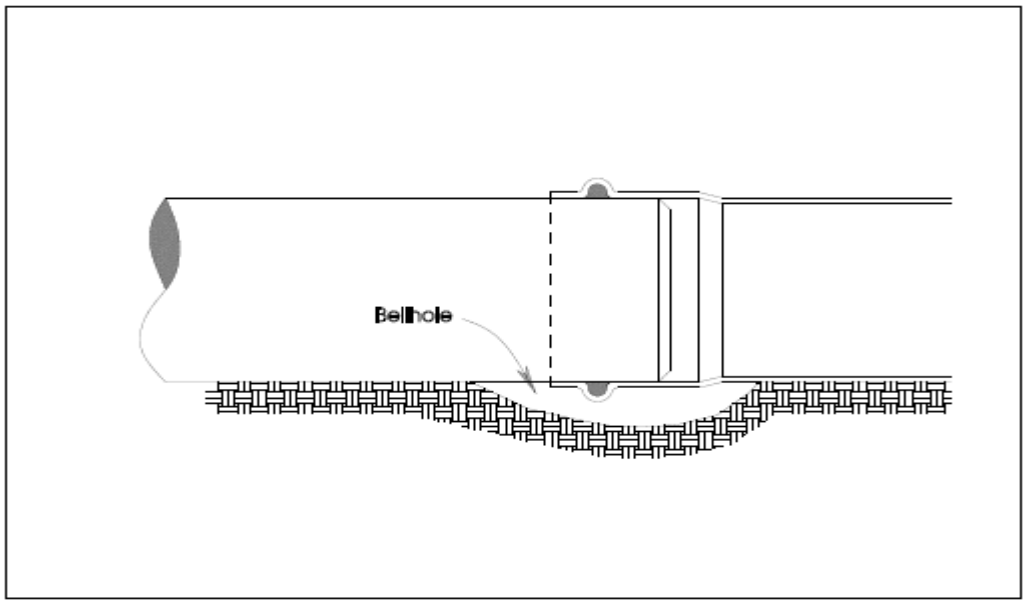


Fig. 1 Bell hole in bedding.

The pipe and the couplings shall be free of foreign material when assembled. At the termination of pipe laying, the open end(s) of the pipeline shall be closed off by a suitable cover or plug until laying operations are resumed.

Care shall be taken to prevent permanent distortion and damage when handling the pipe. To minimize stresses and movement due to expansion and contraction, the pipe shall be allowed to come within a few degrees of the temperature it will have after it is completely covered before placing the backfill, other than the backfill needed for shading, or before connecting the pipe to other facilities.

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. How should you Laying and Bedding the Pipe?(10pts)

Note: **Satisfactory rating 10 points** **Unsatisfactory - below 10 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-2	Installing/ lowering Pipes

2.1 installing/ lowering Pipes

Installing an in-ground irrigation system in your yard lets you program when your yard gets water and makes watering plants less time-consuming. A key component of setting up a system is properly installing irrigation pipe in the ground. If not installed correctly, you could experience pressure loss or other problems that reduce the coverage and efficiency of your irrigation system. Proper installation requires planning and care, but pays off in efficiency and consistent water pressure.

To install irrigation pipes, following actions can be included:-

1. Clearing of the new field e.g. removing bushes, trees
2. Terrain rehabilitation of dongas, anthills, dips etc.
3. Land preparation (liming, ripping, ridging)
4. Pegging out of new blocks
5. Ordering materials according to design plan
6. Digging trenches
7. Laying of main and sub main-lines
8. Laying of laterals and emitters
9. Flushing of system
10. Irrigating and system testing
11. Planting of the crop

Things You Will Need to install pipes are:-

- ✓ Spray paint or chalk-based marking spray
- ✓ Trenching shovel
- ✓ Mechanical trencher (optional)
- ✓ Carpenter's level
- ✓ PVC pipe
- ✓ PVC pipe cutter
- ✓ PVC pipe fittings
- ✓ PVC pipe joint primer and adhesive
- ✓ Drill
- ✓ Measuring tape
- ✓ Sprinkler heads
- ✓ Drip irrigation units or other external system components
- ✓ Grass seed (optional)

Hand loading should be executed by at least two men. It is recommended that the weight carried by one man should not exceed 30 kg. Pipes weighing up to 175 kg can be lowered by means of two ropes. The ropes must be anchored to stakes as indicated in figure 2.

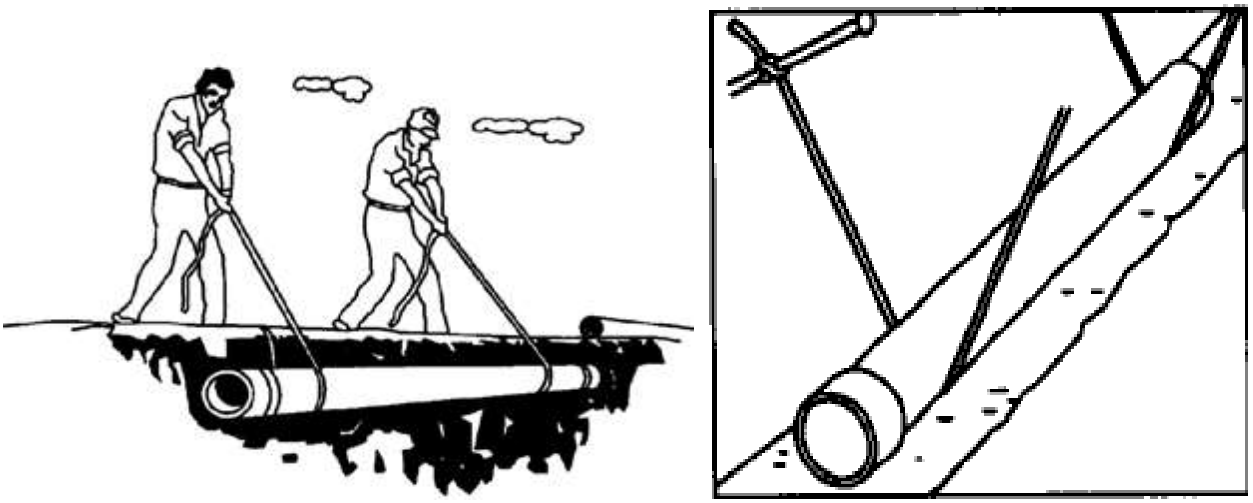


Fig 2: Lowering with ropes

Mechanical lowering is used for larger diameter pipes, especially when combined with pipe assembly in the trench. Two straps or slings can be used from an excavator boom if no separate lifting equipment is available.

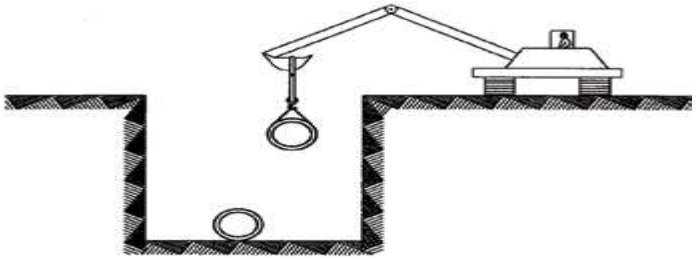


Fig 3: Mechanical lowering with excavator

On an irrigation design plan symbols or different colors are used to depict the various pipes, valves and other features. Usually, a key is provided with the symbols and their meaning.

What does the following notations means?

110/6-80	Pipe with nominal diameter of 110mm, class 6, 80m in length
25/3-150	Pipe with nominal diameter of 25mm, class 3, 150m in length

Describe how you would demarcate a trench and discuss the requirements for a trench in terms of dimensions.

The center of the trench can be pegged with pegs about 50m to 100m apart. Tie a wire or a rope to the pegs to draw a line between them, and use ordinary lime to mark out the line of the trench. When the trenches are dug, the chalk line must be in the center of the trench.

Trenches are dug about 400mm to 600mm wide, depending on the size of the pipe. Trenches are usually about 600mm deep. Trenches for pipes that go through lands and roads, such as mainlines and sub-mainlines, should be 1,000mm deep. Trenches for mother lines can be a bit shallower, at about 400mm.

Describe how to install different types of pipes, bends and end caps.

Pipes are installed in trenches as follows:

- ✓ Before installing pipes in trenches, ensure that the trenches are free of stones and sharp edges.
- ✓ Asbestos cement pipes and large PVC pipes must be laid on a bed of sand.
- ✓ Place the first pipe into the trench and secure it by backfilling the trench near the ends of the pipe.
- ✓ Place a collar over the end of the pipe. Make sure that the collar and the end of the next pipe is clean.
- ✓ Lubricate the inside of the collar and the end of the next pipe with pipe lubricant. Do not use oil because this will cause the rubbers to perish.
- ✓ Insert the end of the second pipe into the collar.
- ✓ Place a wooden block against the open end of the second pipe and tap the block with a hammer to force the pipe into the collar. The force that is required depends on the size of the pipe.
- ✓ Drive the pipe up to where the depth is marked on the pipe. Take care not to pinch the rubbers.
- ✓ If the pipe refuses to go into the collar, remove the pipe and inspect the collar as the rubbers may have shifted.
- ✓ Ensure that there are no foreign objects inside the pipes that can cause blockages in the irrigation system.
- ✓ As the pipes are laid they can be backfilled near the edges. Joints must be left open at first to check for leaks.

General steps to install pipes are:

1. Mark the path of your pipes in your yard using spray paint. Check the plan for your irrigation system, making corrections to reduce the number of bends and turns in the pipe because each bend will reduce water pressure slightly.
2. Dig a trench approximately 6 to 12 inches deep along your marked lines using a trenching shovel or mechanical trencher. Although they're more work, deeper trenches provide better protection against freezing or other pipe damage. Dig trenches for your main irrigation lines first, then come back and dig the trenches for branches off the main lines.

3. Check the grade of your trenches, digging portions of them out with a trenching shovel to create a level trench bottom. If the trenches aren't level, you may lose water pressure within your pipes.
4. Lay out the pipes beside the trenches, cutting them with a pipe cutter, as needed and installing fittings to create branches or turns. Apply a joint primer compound and adhesive to the pipe and inside the fittings during assembly to join them together.
5. Drill holes in the pipes, as needed, to connect sprinkler heads to according to the spacing on your installation plan. Depending on the specific pipes you use and whether your installation plan was created by an irrigation supply company, the pipes may have pre-drilled holes.
6. Connect the main line pipes to your irrigation system's valve manifold, the valve and backflow prevention system that connects to the water supply and any pumps included in the system. Each main pipe should connect to the outlet on one of the manifold valves.
7. Continue placing your irrigation pipes in the trenches, working out from the manifold and orienting them so the holes for sprinkler head connections face up.
8. Connect the hoses attached to the sprinkler heads to the holes in your pipe, pressing the heads into the soil so they are at ground level while the system is unpressurized. Connect any additional system components, such as drip irrigation units, for your garden or flower beds that connect to one of the main line branches.
9. Turn on the irrigation system to test it, checking for any sprinkler heads that don't function properly or signs of leaks. Leave the system running for a few minutes to ensure the pipes can handle sustained water pressure, and then turn it off.
10. Fill in the trenches, the cover them with sod or sow grass seed to match the rest of your yard.






Fig.4 Different Images of pipe installation (Source: https://www.shutterstock.com › search › irrigation pipe)

Pump and filter bank installation is a specialized job that should be carried out by a competent contractor. Inline filters can however be installed very easily.

The filter is attached to risers so that it is above ground. At the bottom end of the risers are riser outlet bends which are spigot formed to slide over the pipe. At the back of each riser leg, a Y-standard is hammered into and tied down on to the riser to keep the leg from popping out. The valve clusters are installed in the same way.

Grommets are installed by sawing a hole in the mother line, and inserting a rubber ring into the hole.

The ring has a groove that fits into the sides of the pipe. The coupling is inserted into the lateral and then pushed into the rubber ring. There is also another type of grommet that is pushed into the hole and the retaining nut on the grommet is tightened.

Nylon couplings and reducers are pushed into the poly pipe. No clamps are needed as long as the working pressure is within limits.

Micros have a tube that is fitted with a barb and drippers have the barb and drippers onto them. A hole is punched in to the poly pipe and the barb inserted into the hole.

Describe the testing of the irrigation system.

The various components of the irrigation system are tested as they are installed, and the performance of the entire system is tested once the installation is complete.

As the pipes are laid and flushed, joints are inspected for leaks. Once the pipes are partially backfilled with the joints exposed, the system is slowly brought up to working pressure. The

blocks that are grouped in operations are opened. Pressure readings are taken before and after the valves, and these are compared with the values noted on the irrigation design plan in the Pressure and Flow at Nodes table. If the readings are not correct, it may be an indication of wrong pipe size, incorrect hydraulic valve settings, or pump or filter malfunction.

Hydraulic valves are calibrated at this time. The pressure gauge is inserted downstream after the valve and the valve is opened. Note the pressure reading. Once the pipes in the block are filled, the valve is switched to automatic. If the pressure reading drops, the screw on the pilot is turned slowly in a clockwise direction. If the pressure rises, the screw on the pilot is turned anticlockwise. The process is repeated by adjusting the pilot, checking the pressure again after a while, and adjusting the pilot again if necessary.

Once the hydraulic valves have been calibrated, the pressures in the lateral lines can be checked.

Check the pressure at the end of each lateral which should be close to the pressure that the valve is set at. Alternatively, each lateral can be assessed visually and the pressure of the laterals measured that appears to have a different distribution pattern than the other lines.

Emitter delivery can also be checked to see if it corresponds with the irrigation plan. Place the emitter in a suitable container. After a while (1 to 30 minutes), remove the container and measure the amount of water. Calculate the emitter delivery per hour. When this test is done with a representative sample of at least 25 points over the whole block, the CU (Coefficient of Uniformity) can be calculated. If the CU is 90% or above the uniformity is good.

After this test is done and the system has been operating for a couple of days, inspect joints for leaks. If no leaks are found, the trenches can be backfilled completely.

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. List down actions that are included during installation of irrigation pipes (5pts)
2. Things/materials you should have to install pipes? (5pts.)
3. What are the General steps to install pipes? (5pts.)

Note: **Satisfactory rating 5 points** **Unsatisfactory - below 5 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-3	Installing Pipe joints and fittings

3.1 Installing Pipe joints and fittings

Irrigation system installations consist of various pipes, fittings, valves and other equipment depending on the kind of system and the type of installation. Most installations have the same structure, and thus a relatively small range of equipment can meet the requirements of a whole region.

3.1.1 Pipe Fittings

Pipe fittings are an important component of the plumbing system. In plumbing, many types of fixtures are joined with the help of various types of material as per the requirement. Fittings are fixed in the plumbing system to join straight pipes or any section of tubes. We can say that the water-supply fittings like elbow, tee, socket, reducer, etc., are fitted to change the direction of flow, distribute the water supply from the main pipe to other pipes of equal size or lower size, etc.

Any part used in connection with water supply, distribution, measurement, controlling, use and disposal of water is known as a pipe fitting (Fig. 5).

Fig. 5: Pipe fittings

Type of Fittings

- ✓ Collar
- ✓ Elbow
- ✓ Gasket
- ✓ Union
- ✓ Reducer
- ✓ Tee
- ✓ Nipple
- ✓ Trap

Collar

While joining two pipes in the same length, collar is used. Collar is fitted in the end of pipe (Fig. 5.3).

Fig. 6: Collars

Elbow

It is installed at the time of joining two pipes. With the help of an elbow, the direction of liquid is changed. Normally a 45° or 90° elbow is used. When the two sides of pipes differ in size, an elbow of reducing size is used. This is called reducing type elbow or reducer type elbow. Elbows are categorized as follows.

Long Radius (LR) Elbows

Here, the radius is 1.5 times the diameter of pipe.

Short Radius (LR) Elbows

In this, the radius is 1.0 times the diameter of pipe.

90° Elbow

This is used when the change in direction required is 90° (Fig. 7).

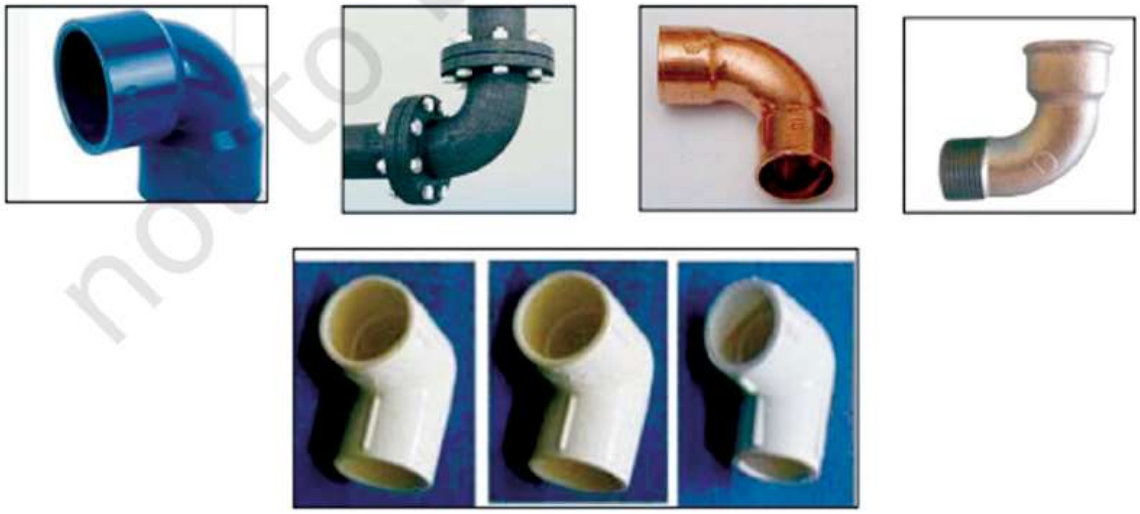


Fig. 7: Bend 90°

45° Elbow

This is used when the change in direction required is 45° (Fig. 8).

Fig. 8: Bend 45°

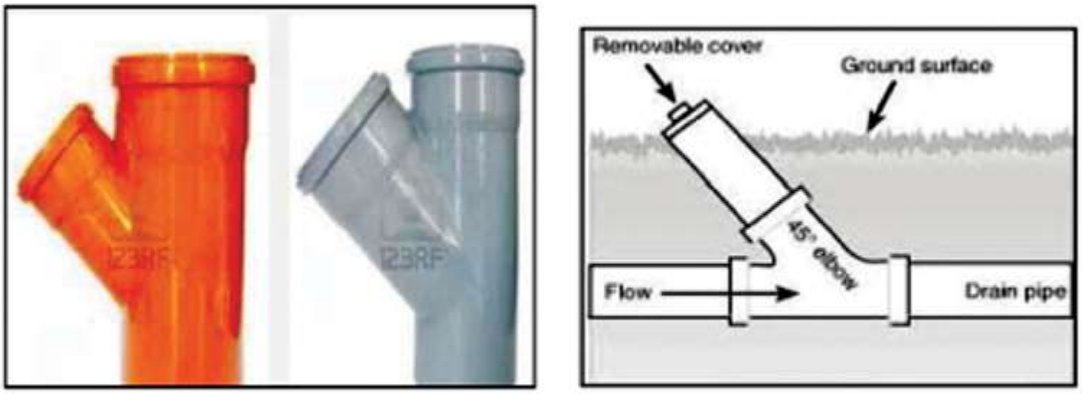


Fig. 9: Y-T Joint

Fig. 10: Double Y-T Joint-1

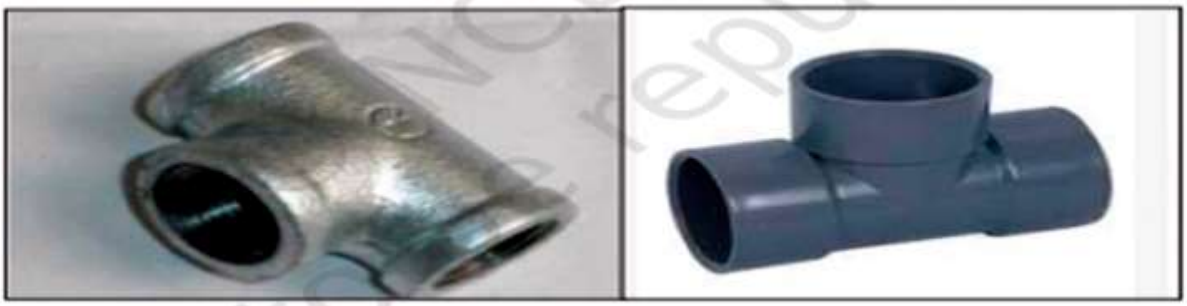


Fig. 11: Double Y-T Joint-2

Fig. 12: T Trap

Gasket

They are mechanical seals, generally ring-shaped type and fitted for sealing flange joints. A flange joint is a plate or ring to form a rim at the end of a pipe when fastened to the pipe. Gaskets are made as per by construction, materials and features. Important gaskets used are non-metallic, spiral-wound and ring-joint type (Fig. 13).

Fig. 13: Gasket

Union

When two ends of pipes are joined, the pipe fitting used is called union. A union is made of three parts namely a nut, a male end and a female end. The male and female ends are assembled with the support of the nuts, and necessary pressure is made to connect the joint. Since the pairing ends of the union are interchangeable, the union can be changed easily in a short time (Fig. 14).

Fig. 14: Union

Reducer

It is used to connect pipes of different diameters. A reducer may be of various types like reducer tee, reducer elbow and reducer socket (Fig. 15).

Fig. 15: Reducers

Tee

It is an important fitting with a side outlet at 900 to the run of the pipe. Tees connect pipes of various diameters and help in changing the direction of water or material in a pipe. Tees are made in various sizes like equal or unequal. The equal tee is most commonly used (Figs. 16 –18).

Fig. 16: Single tee socket

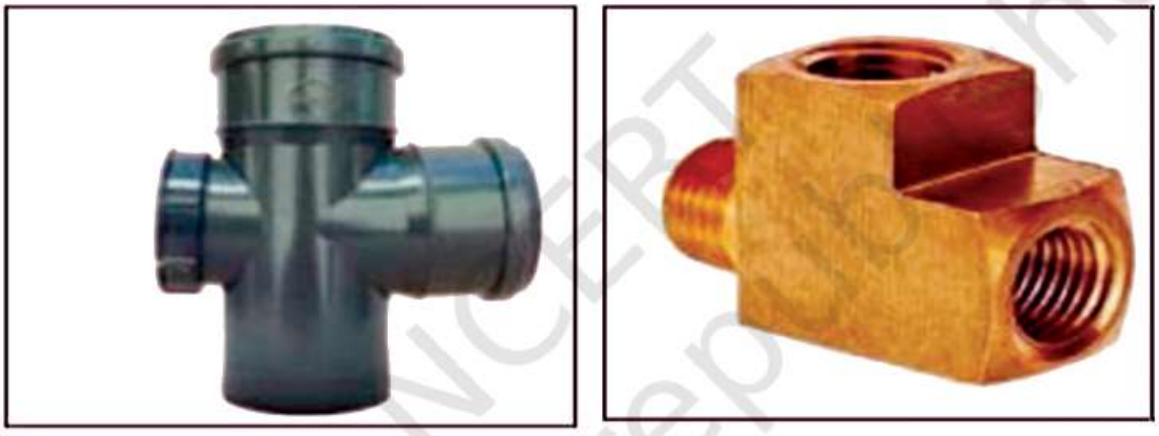


Fig. 17: Single tee socket

Fig. 18: Double tee socket

Nipple

It is a piece of pipe having thread at both sides, and could be used for short extension of plumbing lines. It can also be used for connecting two fittings within small distance (Fig. 19).

Fig. 19: Nipple

Trap

It is a fitting in a P, U, S or J-shaped type (Fig. 20). Traps are fitted near a plumbing fixture. The trap bend is fitted to prevent sewer gases from entering the building. If the gases are inserted back into home, then it could lead to people inhaling foul smell, which could cause illnesses. It could even explode.

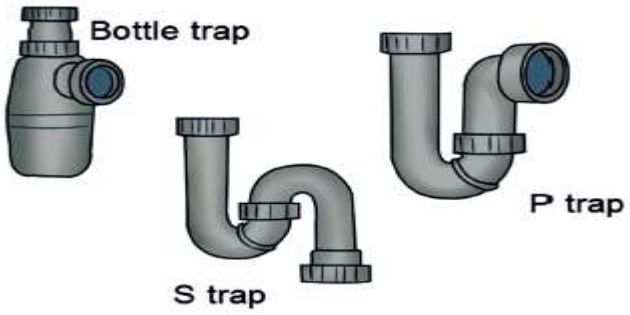


Fig. 20: Trap

Cross

When four pipes are joined, a cross is formed. It is also called a cross branch line or a four-way fitting (Fig. 21). This fitting has three outlets and one inlet. Cross fittings may deteriorate when temperatures change, because cross fitting is made at the center of the four connection points.

Fig. 21: Cross

Offset

When an assembly of fittings on a pipeline makes one section of pipe out of line and parallel to a second section, then it is known as an offset (Fig. 22).

Fig. 22: Offset

3.1.2 Pipe Joints

Pipes are connected with the help of joints. A variety of joints are used in an assembly of pipes. Connecting two or more pipes together is called a fitting. Various types of joints could be used in a pipe as per the requirement. Joints are also used for multiple pipe connections, and are an important component of the plumbing system. Generally, the pipe joint fitted can easily sustain the pressure created in the pipe.

Types of pipe joints

Various types of pipe joints are as follows.

1. Threaded joint
2. Welded joint (butt welded, socket welded)
3. Brazed joint
4. Soldered joint
5. Grooved joint
6. Flanged joint
7. Compression joint

Threaded joint

When pipes are joined by screwing in threads which are provided in the pipe, it is called a threaded joint. In this joint, one of the pipes has internal threads whereas the other pipe has threads externally. The threads are also made in various pipes like PVC, CI pipes, copper pipes and GI pipes, etc. (Fig. 5.20).

Threaded joints are used from 6 mm diameter to 300 mm diameter pipes.

Fig. 22: Threaded joint

Welded joints (Butt-welded joints)

It is one of the most common methods of joining pipes used in large infrastructure like commercial, institutional and industrial systems. Cost of material are low, but the labour costs are more due to the non-availability of trained welders and fitters (Fig. 23).

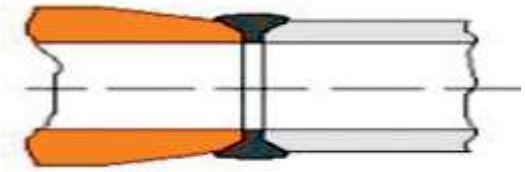


Fig. 23: Welded joint

Socket-welded joints

These are used when there is a high chance of leakage in the joints. Pipes are joined as putting one into other and welded around the joint, as shown in Fig. 24. Pipes having different diameters are suitable for this type of a joint. Socket-welded joint gives good results as compared to other joints.

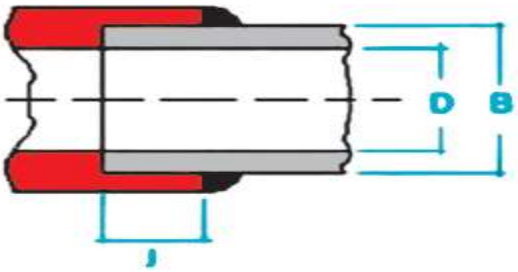


Fig. 24: Socket-welded joint

Brazed joints

When pipes are joined with the help of molten filler material at above 840°C, it is called brazing. Brazing is done for connecting copper pipes or copper alloy pipes. It is important to note that the melting point of the parent material (pipe material) should be higher than the filler material. Brazed joints have less mechanical strength, and are preferred in case of moderate temperatures (Fig. 25).

Fig.25: Brazing

Soldered joints

Soldering and brazing are similar activities. In soldering, the filler material melts below 840oC. With the help of soldering, copper and copper alloy pipes are joined. During soldering, flux or metal joining material is used to prevent oxidation due to the flame. Soldered joints are suitable for low temperature areas and have low mechanical strength (Fig. 26 and Fig. 27).

Fig. 26: Brazed and soldered joint

Fig. 27: Solder joint

Grooved joints

When two pipes are joined together by making grooves (narrow cuts or depression) at the end of pipes with the help of sockets or couplings, such joints are called grooved joints. Due to the ease of assembly of the grooved joints, the labour cost is less. The piping system can

be easily uninstalled and reinstalled frequently for maintenance (Fig. 28). These are mostly used for fire protection.

Fig. 28: Grooved joint

Flanged joints

This joint is commonly used for joining pipes in pumping stations, filter plants, hydraulic laboratories and boiler houses, etc. (Fig. 29). These joints are preferred due to easy process of assembly and disassembly, however these connections are costly. These joints can be disassembled and re-assembled when required. A pipe has flanged ends on both sides of the pipe length. Both the ends of pipes are joined at a proper level near one another. A hard rubber washer is placed between flanges and bolted. Flanges are generally fixed to the pipe by welding or threading. In certain cases, a flange-type joint is also called a lap joint. It may also be made by forging the process and machining the pipe end. There is no leakage in flanged joints even after rapid temperature fluctuations.

Fig. 29: Flanged joints

Compression joints

These are applied to join the pipe without any preparations. The cost of installation of these joints is very economical. The pipes having plain ends are joined by fixing fittings at their ends, and such a joint is called a compression joint. The pipe ends are joined with threaded fittings or couplings. Joints are placed properly to check the flow pressure, otherwise, leakage may occur. These fittings are manufactured from different types of material. Selection of fittings is done as per requirement (Fig. 30).

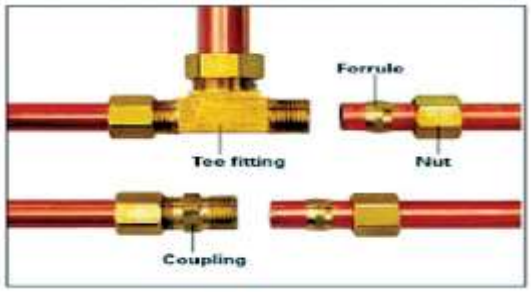


Fig. 30: Compression joints

Valves

For proper functioning of the pipeline, valves made of iron or brass are used in the water-supply mains. Valves stop or control the flow of fluid like liquid, gas, condensate, etc. These are classified according to their usage like isolation, throttling and non-return corrector. Various types of valves are manufactured depending upon their use and type of construction.

Sluice valve

It is fitted at an important place like at the entrance of a pipe. It may be the start of a new pipe from a tank, or a number of branches from the tank. This valve isolates the water-supply, as and when required. The sluice valve is specified by the pipe bore (diameter) of the water-way. The standard sizes are 50 mm, 65 mm, 80 mm, 100 mm, 150 mm, 200 mm, 250 mm and 300 mm (Fig. 31).

Fig. 31: Sluice valve

Scour valve

This valve is provided at the lower level in a pipeline, so that such sections can be supplied and drained for maintenance purpose. The water is distributed into natural drains. It is basically a sluice valve and the very nature of its use has created the difference in the name (Fig. 32).

Fig. 32: Scour valve

Air valve

It is fitted to release the air automatically when the pipe is filled with water. This valve also permits entry of air when the pipe is drained. This valve is fixed at the end of a communication pipe and controls or stops the supply of water. This valve is specified by the standard bore (diameter) of the socket or pipe outlet, to which it is fitted. The standard sizes are 8 mm, 10 mm, 15 mm, 20 mm, 25 mm, 32 mm, 40 mm and 50 mm (Fig. 33).

The body components and washer plate are made of cast brass or leaded tin bronze. The washers are made from fibre, leather, rubber or nylon. This valve is available in two types: internally threaded and externally threaded.

Fig. 33: Air valve

Gate valve

It is used for starting or stopping flow. For a straight-line flow of fluid, minimum flow restriction can also be done with gate valve. In service, these valves are generally either fully open or fully closed. These valves are used for various types of liquids and make a tight seal when closed.

Fig. 34: Split taper non-rising gate valve

Types of gate valve

Gate valves have gates of wedge type, solid or split type, or gate of double disc or parallel type. The movement of the gate shall be by the internal or external screw on the spindle. The

spindle, which controls the flow of a liquid, can be of the rising or non-rising type. See Fig. 34 and Fig. 35.

Fig. 35: Rising spindle split wedge gate valve

Parallel slide valve

It has two discs without spreading mechanism which slides between the two parallel body seats. The activation of the valve discs is by the internal and the external screw on the spindle and the spindle may be of the rising or non-rising type (Fig. 35).

Fig. 36: Parallel slide valve

Angle valve

It is used to control the movement of a fluid like liquids, gases, fluidised solids, or slurries by opening, closing or partially obstructing various pathways. This type of a valve generally has a round body, in which the body ends are fitted at right angles with each other and the disc moves up and down. The valve is moved to action by the internal or external screw on the spindle. The spindle may be of the rising or non-rising type. See Fig. 38 and Fig. 39).

Fig. 38: Angle valve-1

Fig. 39: Angle valve-2

Check valve or non-return valve

It is a valve which permits (fluid) water to move in one direction but checks all the returning flow. It is operated by the pressure above, having no external means of control (Fig. 40).

Fig. 40: Check valve or non-return

Ferrule

It is used for connecting a service pipe to the water main. It is usually made of non-ferrous metal and screwed to the main pipe (Figs. 41-44).

Fig. 41: Ferrule

Fig. 42: Swing check

Fig. 43: Horizontal check

Fig. 44: Vertical check

Foot valve

It is a valve used in the pump. It is also called check valve, as it makes sure that the pump is ready to use. If the pump is off, then the foot valve keeps enough fluid in the pump to ensure that it can start again. In a well, the foot valve will be between the water surface and the pump. In a water intake system, the foot valve will be at the end of the water intake line. The foot valve has a strainer on the outside which prevents obstructions also (Fig. 45).

Fig.45: Foot valve

Float valve

It is used for stopping water when the water tank or flush toilet is filled, so that it stops overflowing. When the water level rises, the float also rises; once it rises to a pre-set level, the water level forces the lever to close the valve and stops the water flow. A float valve is a fitting used for filling water tanks as well as flush toilets (Fig. 46).

Fig. 46: Float valve

Filter: The filter ensures that clean water enters the system. There are different types of filters - screen, media and disc. Different sizes of filters are available depending on the flow rate of water in the system.

Fig.47 **Filter**

Generally, Irrigation equipment can be divided into:

- ✓ pipes;
- ✓ pipe connector fittings;
- ✓ flow control devices;
- ✓ filters;
- ✓ fertigation equipment;
- ✓ water emitters;
- ✓ automation equipment;
- ✓ operation equipment;
- ✓ water-lifting device

The main characteristics of the irrigation equipment are:

- ✓ Material, e.g. galvanized steel, rigid PVC, etc.;
- ✓ Size, i.e. the nominal diameter (DN) of the ISO metric range in millimeters (16–160 mm) and/or of the BSP threaded range in inches (–4 inches);
- ✓ Type of joint, e.g. threaded, quick coupling, solvent welded, etc.;
- ✓ working pressure PN (nominal pressure) or PR (pressure rating) in bars, e.g. 6.0 bars;
- ✓ National and/or international standards conformed to, e.g. DIN, ISO, BS, ASTM, EN.

All PP connector fittings are also available with one or both ends threaded (Fig. 48).

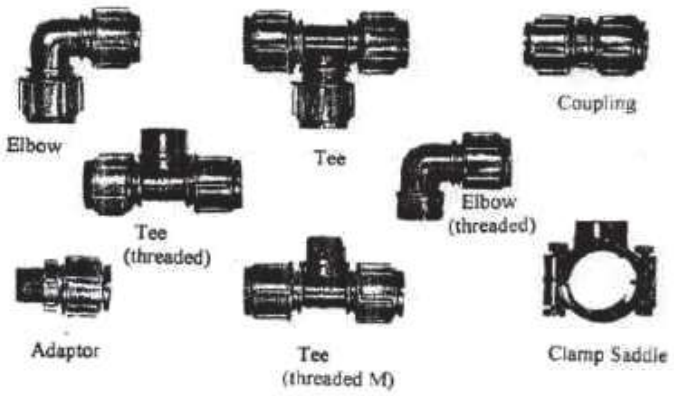


Fig. 48 Polypropylene fittings compression type

Self-Check -3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Which of the following fittings is used to connect two pipes with each other? (5pts.)

(a) Tee (b) Connector (c) Elbow (d) All of the above

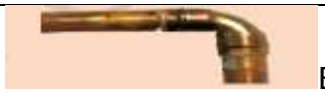
2. Which of the following fittings is used to connect four pipes? (5pts.)

(a) Offset (b) Union (c) Cross (d) Reducer

3. The valve which avoids both overflow and back flow of water is_____. (5pts.)

(a) float valve (b) angle valve (c) foot valve (d) check valve

Matching(each 5pts)

Column-A	Column-B
1. Nipple	 A
2. Ferrule	 B
3. Soldered joint	 C
4. Foot valve	 D

Note: **Satisfactory rating - 35 points** **Unsatisfactory - below 35 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet - 4	Backfilling Pipes

4.1 Backfilling Pipes

Either water packing or hand or mechanical methods may be used for backfill consolidation for pipes. All pipelines with a pressure rating of less than 80 psi shall be filled with water prior to backfilling for either method.

4.1.1 Initial Backfill

When water packing, the pipeline shall be filled with water and maintained near design working pressure during backfilling. The initial backfill, before wetting, shall be of sufficient depth to insure complete coverage of the pipe after consolidation occurs. Water packing is accomplished by adding enough water to diked reaches of the trench to saturate the initial backfill thoroughly without excessive pooling. After the initial fill is saturated, the pipeline shall remain full until after final back filling. The water packed backfill shall be allowed to dry until firm enough to walk on before final backfill is begun.

If hand or mechanical methods of backfill are used, the initial backfill shall be placed in layers and compacted around and above the pipe to the soil density required to provide adequate lateral support to the pipe. Compaction by hand or by hand-directed mechanical means shall be accomplished in lifts not to exceed 6 inches for all pipe sizes. The initial backfill shall be compacted firmly and evenly around and above the pipe to provide adequate lateral support, free from voids, to the pipe. The pipe shall not be displaced, deformed, or damaged by the backfilling operation.

The initial backfill shall be soil or granular material that is free from rocks, gravel, and frozen material larger than 0.75 inch or earth clods greater than 2 inches in diameter and shall be installed to an elevation no less than 6 inches above the top of the pipe (refer to Figure 2 below).

The degree of compaction for all pipe sizes shall be such that lateral deflection of the pipe sidewalls will be minimal. Unless special compaction requirements are noted on the drawings, or water packing methods are used, the initial backfill material shall be compacted firmly to achieve a soil density at least equal to the density of the undisturbed side walls of the trench.

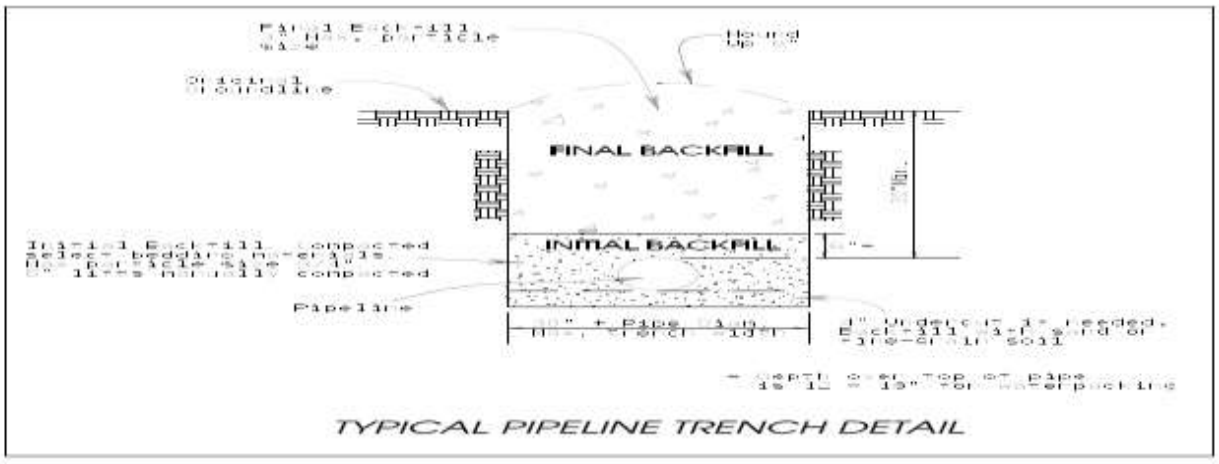


Fig.2 Trench detail

4.1.2 Final Backfill

Unless otherwise shown on the drawings, the final backfill material within 6 inches of the top of the pipe to the top of the trench shall be free of rocks, frozen clods or other debris larger than 3 inch in diameter. The material shall be placed and spread in approximately uniform layers so there are no unfilled spaces in the backfill. Rolling equipment or heavy tampers shall not be used to consolidate the final backfill until after the minimum depth of cover has been placed, or where the pipe has a wall thickness less than that of DR or SDR 41. Final backfill may be mounded over the top of the trench above ground level, but in no case shall the final backfill be lower than the natural ground along the top of the trench. All special backfilling requirements of the pipe manufacturer shall be met.

Self-Check -4	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What are the two types of backfilling? (5 points)

Note: **Satisfactory rating - 5 points** **Unsatisfactory – below 5 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-5	clearing and removing unwanted materials

5.1. Clearing and removing unwanted materials

The job site shall be kept in a neat, clean, and orderly condition at all times during the installation process. All scrap and excess materials are to be regularly removed from the site and not buried with the pipes. Laying pipe and backfilling shall be continuous so that the amount of open trench at the end of each work day is minimized.

Irrigation work sites are expected to be clean, tidy, comfortable, good and well maintained to create conducive environment for work.

Generally, Waste /unwanted materials may include, but not limited to:

- ✓ Unused construction and excavated materials
- ✓ Plant debris
- ✓ Litter and broken components
- ✓ Waste may be removed to designated areas for recycling, reuse, and return to the manufacturer or disposal
- ✓ Plant-based material may be mulched or composted
- ✓ Plastic, metal, paper-based materials may be recycled, re-used, returned to the manufacturer, or disposed of according to enterprise work procedures

Self-Check -5	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. List down the kind of unwanted materials? (5 pts.)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - belo5 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Operation Sheet -1	Preparation of a list of fittings available in your college

Material Required

1. Different types of fitting
2. Notebook
3. Pen

Procedure

1. Identify the fittings available in your college.
2. Prepare a list of the identified fitting items seen
3. Note down the fitting items and their use

Operation Sheet -2	Practicing of joining irrigation pipe

Material Required

1. Joints
2. Pipe
3. Tools

Procedure

1. Collect the pipe joints, pipes and tools
2. Identify the components
3. Collect the joints
4. Join the pipe with the help of proper pipe joining tools

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 4:30 hour.

Task 1. Prepare a list of fittings available in your college

Task 2. Join the pipe

Task 3. Store tools and equipment according to 3s standard.

Reference

Directorate Vocational Education andTraining. 1994. *Building Maintenance*. DVET, Mumbai.

Indian Plumbing Skills Council. 2014. *Plumber General Helper.* IPSC.

Pandey, Krishna Chandra.1999. *Building Material Textbook for Class XI.* PSSCIVE, NCERT, New Delhi.

Shah, Charanjit S. 1998. *Water Supply and Sanitation*. Galgotia Publishing Company, New Delhi.

Shah, M.G., C.M. Kale and S.Y. Patki. 2012. *Building Drawing with an Integrated Approach to Build Environment*. Tata McGraw-Hill Publishing Company Limited, New Delhi.

Websites

1. https://www.e-education.psu.edu › marcellus › node
2. https://www.thebalancesmb.com › ... › Design › New Specifications
3. https://www.apa.com.au › about-apa › our-projects › pipeline-construction...
4. https://www.sciencedirect.com › topics › earth-and-planetary-sciences › pipe...
5. https://napcopipe.com › sites › default › files › media › MU-IG-022-CA-E...
6. https://plasticpipe.org › pdf › chapter09