Agricultural TVET College

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Small Scale Irrigation Development

Level III

MODEL TTLM

Learning Guide #06

Unit of Competence: Operate pressurized irrigation systems

Module Title: Operating pressurized irrigation systems

LG Code: AGR SSI3 M06LO1-LO3

TTLM Code: AGR SSI3 TTLM06 1218V$_1$

Nominal Duration: 90 Hours

Instruction Sheet	Learning Guide 06

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

- Perform pre-start checks for pressurized irrigation system
- Startup and inspecting system
- Shut down system based upon irrigation indicators

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:-

- Checks of water, power, fuel and lubricants ensure that all are made available and the control system is operational.
- Pumps are primed, if necessary, and valves and controls are open or closed.
- Pressure and flow testing equipment are calibrated and available as required.
- Other pre-start system checks are carried out.
- Start up sequence is implemented in accordance with operations manual.
- All malfunctions, leaks and blockages are corrected or repaired immediately and reported.
- Pressure at the head works and control valves is within design specifications and water is distributed evenly with minimal wastage and run-off.
- Water is applied for sufficient time to the required soil moisture levels in accordance with irrigation schedule.
- System components are shut down and drained in sequence.
- Drainage and treatment systems are checked.
- Irrigation activities are recorded and reported

Learning Activities

1. **Read the specific objectives of this Learning Guide.**
2. **Read the information written in the "Information Sheet"**
3. **Accomplish the "Self-check".**
4. **If you earned a satisfactory evaluation proceed to the next "Information Sheet". However, if your rating is unsatisfactory, see your facilitator for further instructions or go back to Learning Activity.**
5. **Submit your accomplished Self-check. This will form part of your training portfolio.**
6. **Read and Practice "Operation Sheets".**
7. **If you think you are ready proceed to "Job Sheet".**
8. **Request you facilitator to observe your demonstration of the exercises and give you feedback.**

Introduction

The application of improved irrigation methods and techniques on small farms is expanding rapidly as a result of the increasing demand for higher irrigation efficiency, improved utilization of water and intensification and diversification of production.

A pressure piped irrigation system is a network installation consisting of pipes, fittings and other devices properly designed and installed to supply water under pressure from the source of the water to the irrigable area.

In irrigated crop production, farmers depend on irrigation to supplement rainfall to supply the water requirements of the crop. Proper operation and maintenance ensures that an irrigation system performs optimally. Before an inspection can be done you need to understand the components of an irrigation system

A basic pressurized irrigation system consists of at least the following components (Fig. 1):

- Water-lifting devices or pump;
- Pipes (mains, sub mains, laterals);
- pipe connector fittings;
- flow control devices (valves, flow meter, pressure regulator);
- filters;
- fertigation equipment;
- water emitters;
- automation equipment (timer, remote control (electric) valves, the controller and the field wiring)
- operation equipments (moisture sensor such as tensiometers)

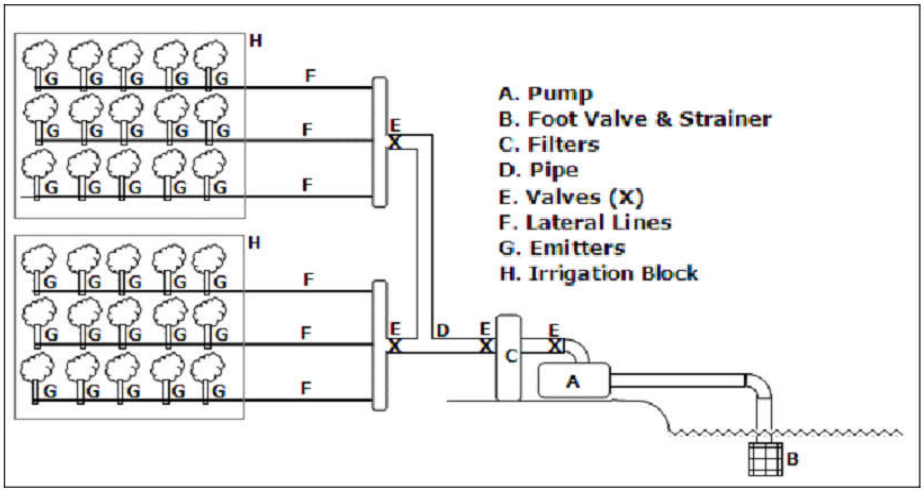

Figure1: Pressurized irrigation system components

a. Pumps

Almost all irrigation systems, except gravity feed systems, rely on pumps to pump water to the field blocks or orchards and supply pressure to the emitters to work properly. The pump moves, or

displaces, water by sucking water from the source, such as a river, dam, reservoir, etc., and propelling in through the irrigation system.

Pumps come in a wide range of shapes, sizes and types, such as centrifugal, submersible, and positive displacement pumps. They are driven by either diesel engines or electrical motors. The most commonly used pumps are single and multi stage centrifugal pumps driven by electrical motors as electricity is generally significantly more cost effective than diesel. Single stage pumps have only one stage containing a single impeller, while multi stage pumps have two or more stages and delivers higher pressures where required.

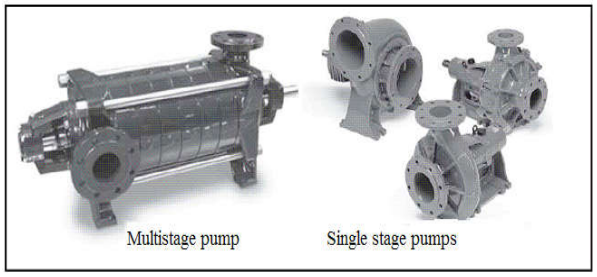

Figure 2: Single and multistage pumps

Pumps consist of various components, including the motor that drives the pump, the suction and delivery pipes, and various valves. Figure 3 shows the various components of a standard pump.

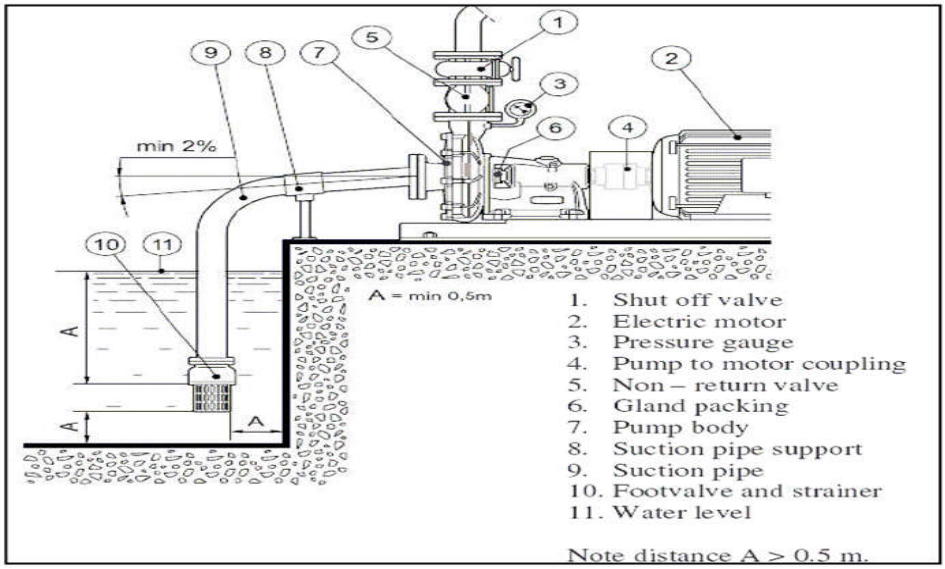

Figure 3: Various components of a standard pump

b. Pipes

The pipeline channels water between points, such as from the water-source to the pump, from the pump to the main lines and from the main lines to the crops.

A wide range of pipes is available and used on farms. For main and sub-main lines PVC and steel pipes are normally used. In some older installations, asbestos-cement pipes are still in use. These pipes are unsuitable where acid is introduced into the irrigation water for fertigation purposes.

Polyethylene pipe (black plastic pipe) is mostly used for lateral lines, which is the name of pipelines that deliver water to the crops.

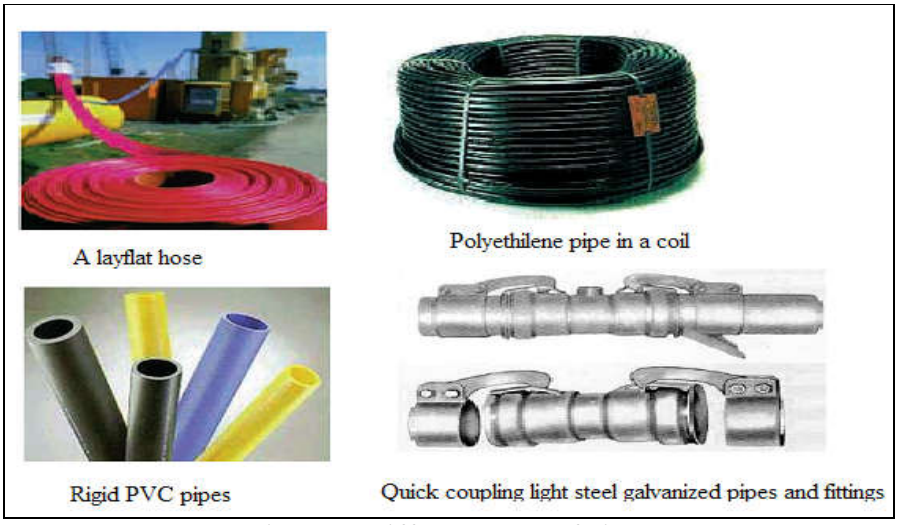

Figure 4. Different types of pipes

c. Flow control devices/valves

Any device installed in a fluid supply system, in order to ensure that the fluid reaches the desired destination, at the proper time, in the required amount (the flow rate), and under the right pressure, is called a control appliance. Valves control the flow of water by opening or closing, thereby allowing water through or cutting it off. Various types of valves are used such as:

- Gate and butterfly valves are used to open or close a pipeline;
- Pressure control valves are used to regulate pressure and flow rate;
- Non-return valves are used to prevent the reverse flow of water when the pump is switched off;
- Air and vacuum valves are used to expel air in the pipeline and to prevent a vacuum from forming after a line is closed or the pump is switched off

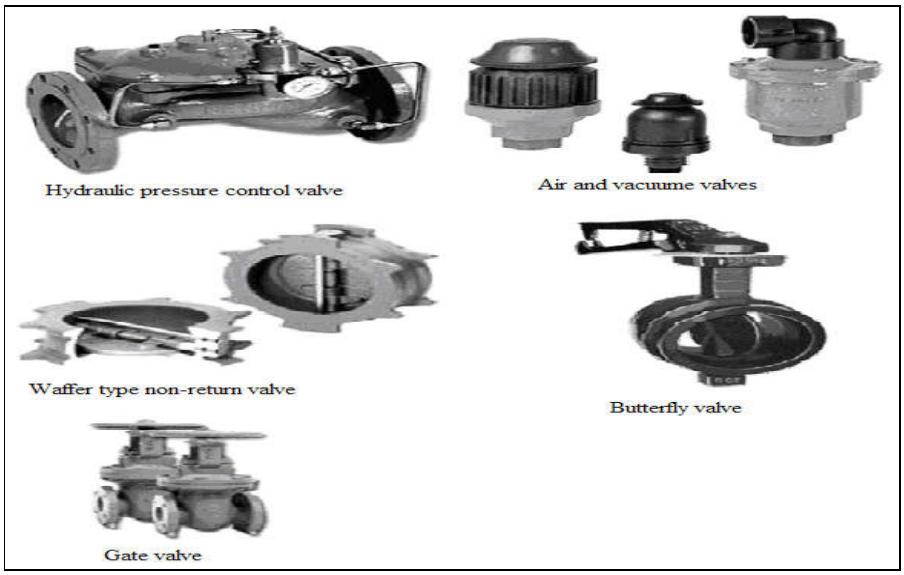

Figure 5: Examples of Various Types of Valves

d. Filters

The filtration of the irrigation water is essential in order to avoid blockage damage to the micro-irrigation emitters. The type of filter used depends on the kind of impurities contained in the water and the degree of filtration required on the emitters. Their size should be the most economical with the lowest friction losses ranging from 0.3-0.5 bars. Various types of filters are used, most commonly sand, disc and screen-type filters.

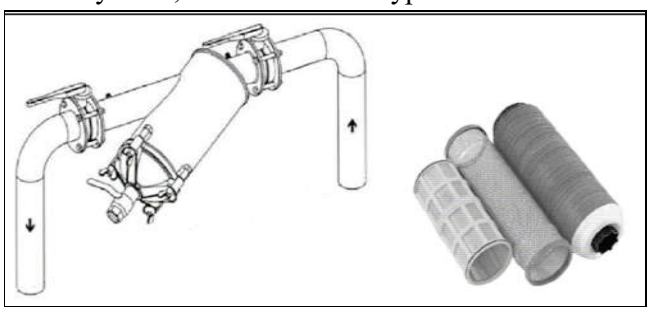

Figure 6: Inline Filter with Screen (left) and Screen and Disc Cartridges for Inline Filters (right).

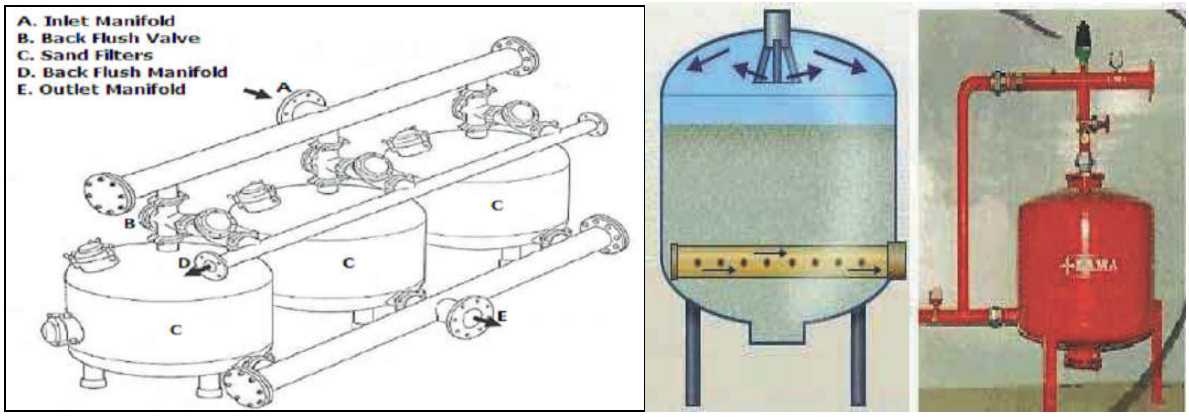

Figure 7. Sand Filter Bank

e. Fertigation equipment

Fertilizers are applied with the irrigation water through the system using special devices called fertilizer injectors installed at the head control. There are three main types of fertilizer injectors: closed tank, Venturi type and piston pump. All of them are water driven by the operating pressure of the system.

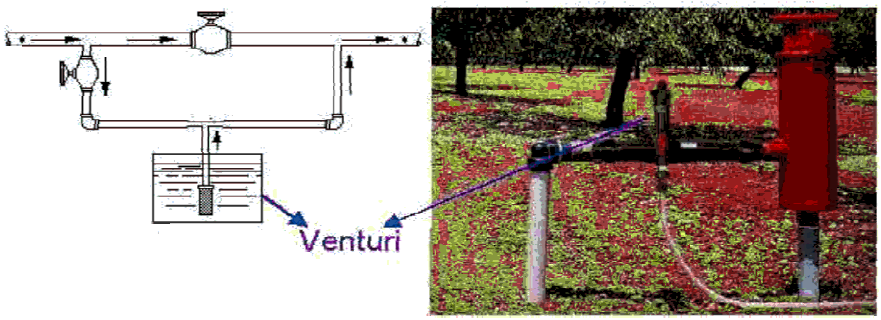

FIGURE 8. Scheme and photograph of a Ventury type fertilizer

f. Emitters

The water emitters specify the kind of system and in most cases the type of installation. Fitted on the laterals at frequent spaces, they deliver water to the plants in the form of a rain jet, spray, mist, small stream, fountain or continuous drops. All kinds and types of emitters in use now are of the small orifice-nozzle, vortex or long-path labyrinth types. Thus, the flow in the water emitters is turbulent. Some drip emitters of laminar flow used in the past are no longer available.

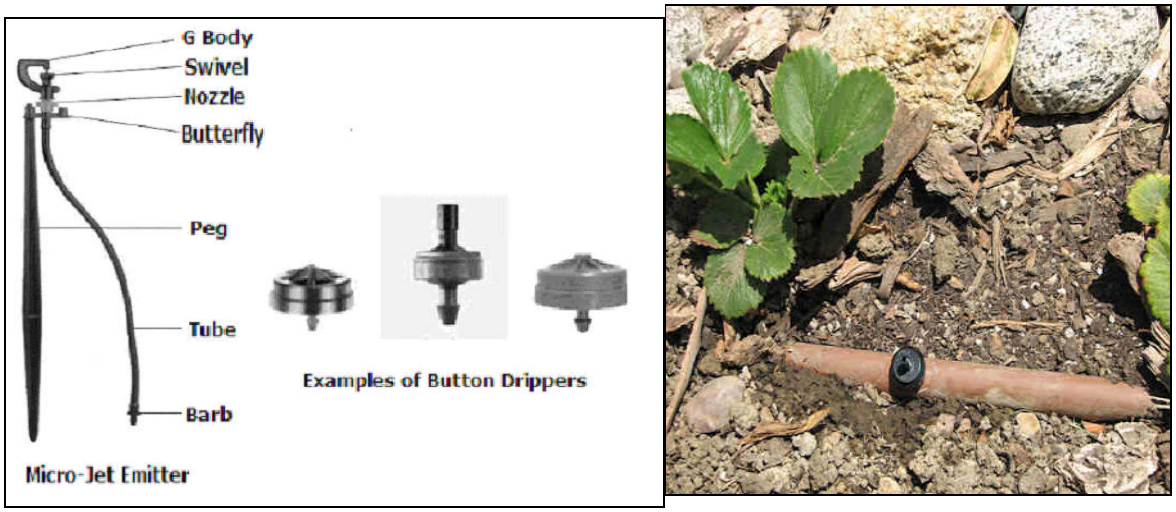

Figure 9: Micro-Sprayers and Drippers

1.1. Checking the water, power, fuel and lubricants of the system

There will always be pre-start checks that you need to make on your irrigation system. Checks of water, power, fuel and lubricants must be made to ensure that all are available and the control system is functional. Pumps will need to be primed as necessary and valves and controls are opened and closed as directed.

Checking and cleaning components

The various components of the irrigation system must be checked before the system is started. Never start the pump system to check that it is working properly, as damage may be caused to a component. A visual check of the various components is essential.

I. Check water availability

It is very important to ensure that there is enough water in the supply source, such as the river, canal, dam, pit, etc., before the pump is started. If there is not enough water in the water source the pump will suck air, which will cause cavitation, which is very destructive and can cause damage to the pump.

Cavitation is one of the greatest dangers to the pump. Cavitation can be caused by:

- The water level in the water source being too low;
- Water being lost through leakages in the suction pipe or one of its connections; or
- The filter in the inlet system being blocked or dirty;
- Defective valves that do no open properly.

All of these factors must be checked carefully as part of the pre-start-up procedure. Note that cavitation can also occur when the pump sucks air because of not being properly primed. Make sure the pump is primed properly.

Cavitation will only become evident once the pump is running, when it will show symptoms such as loss of pressure, excess noise and vibration and the pump body becoming warm. If this occurs, the pump must be switched off immediately.

Make a visual inspection of the water level before starting the pump. The water level must be above the minimum water level mark, which should be marked by the irrigation manager. If the water level is near or below this mark, do not start the pump.

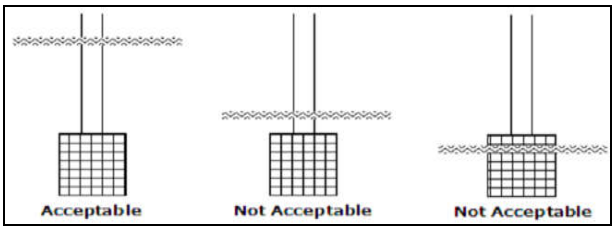

Figure10: Acceptable Water Levels at the Suction Pipe

If crops are irrigated from a borehole, a water level switch inside the borehole will prevent the pump from starting.

II. Power/ Motor and pump working characteristics

Most pump installations are equipped with the following gauges:

- The amp meter is located on the electrical panel and measures the current that is used;
- The volt meter is located on the electrical panel and gives a reading of the voltage, e.g. 400V;
- The pressure gauge is located on the delivery pipe and gives a reading of the pressure in kPa or Bar;
- The flow meter is installed on the delivery pipe and measures the flow in cubic meters (m^3). Mechanical flow meters have a dial gauge on the meter, while electronic flow meters have a digital readout in a special panel.

Although all pump stations will not necessarily have volt and flow meters, it should at least be equipped with an amp meter and pressure gauge.

The normal readings, or norms, differ from pump to pump. The supervisor or manager should give the norms for amps, volts, pressure and flow. Actual readings are compared with the norms to establish whether the pump and motor are running optimally, and to assist with determining the

pump and motor characteristics. For example if **Amps motor = Amps normal** this is the normal operating condition for the pump. Note that the pressure and flow readings will also be normal.

III. Pump

- Pumps and motors run on bearings that need lubrication by either grease or oil. Failing to lubricate the pump and motor can result in a serious damage.

- Bearings that are lubricated by oil have a dipstick that indicates the oil level. Before the pump is started, remove the dipstick and check the oil level. The oil level should be between the minimum (Min) and Max) marks.
- Where pumps and motors are fitted with grease nipples, the pump and motor must be greased regularly.
- Grease the bearing with a grease gun until the old grease is expelled from the casing. Clean the nipple before greasing and wipe off the old grease with a rag. Beware of over-greasing electrical motors, as the excess grease can end up inside the motor windings and cause the motor to burn out. Make sure grease is clean, free of grit and sand, and of the right type.

In addition, the following checks must be made before starting the pump:

- Check for excessive water inside the pump house. If excessive water is found, try to establish where the water is coming from.
- Check the oil levels.
- Inspect the pump for leaks at flanges and leaks on the pump body. Flanges are the metal discs on the pipes that are bolted down on to the pump. A gasket is inserted between the two flanges and leakage can occur if the gasket is worn or if the flanges are not properly tightened.
- Inspect the gland packing around the pump shaft. The gland packing is the seal at the pump shaft and seals of the water inside the pump.
- Check the rubber coupling at the pump and motor shaft for signs of wear and cracks.
- Check for loose mounting bolts, which are used to attach the pump to the platform.
- Turn the pump with your hand to ensure that it rotates freely.
- Check that the motor is not wet.
- Check that the starter panel is not wet.
- Check for signs of vandalism, e.g. forced entry, missing cables, broken panels and mountings.

IV. Filters

Filters are used to remove solids and other debris from irrigation water. There is a filter, called a suction filter in the suction pipe before the water enters the pump. There are also filters in the delivery pipe after the pump. It is important to ensure that the filters are working properly, otherwise:

- ✓ Pump failure can occur due to blockage of the impeller. This will happen if the suction strainer is broken or missing;
- ✓ Pipes or emitters can be blocked by debris or other solids.

The suction strainer is under water and can be checked only by removing it. This is done once a year or on instruction from the manager. At these times, inspect the strainer for damage and blockages, and clean if needed.

Perform the following checks on the filters before starting up the pump system.

- Check the filter valves.
- Check that the filter lids are bolted or clamped down.
- Check the lid-seal or rubber ring for cracks.
- Check flanges for leaks. If the filter is fitted with hydraulic valves, check the small inline filter and clean if necessary.

If the filters in the filter bank after the pump delivery are dirty, there will be a pressure loss in the field. This can only be assessed when the pump is running. Filter-banks are cleaned by back-flushing them with the pump running.

V. Valves

For manual valves, being gate and butterfly valves, check the following:

- ✓ Check the valves manually to see if they open and close as they should.
- ✓ On gate valves, check whether the spindle rises or drops, as this can be indication of a broken thrust washer, in which case the valve will not open or close.
- ✓ Check if the spindle keeps on rotating. This indicates a stripped nut, in which case the valve will not open or close.
- ✓ Check for leaks at the gland packing, spindle seal, flanges and casing.
- ✓ Check for signs of vandalism, such as a missing wheel or vandalized parts.

For hydraulic valves check the following:

- ➢ Check to see if the 3-way valve is able to turn between open, close and auto, and return it to original setting.
- ➢ Check the rest of the valve for damage to the tubing, fittings, solenoids and wires.

VI. Other components

The following should also be checked, preferably while the system is operating:

- Check that emitters are fully open and unblock if otherwise. Do not damage emitter during unblocking.
- Check for leaks in the laterals and other pipelines and report immediately when found.

1.2. Priming pumps and opening or closing valves and controls

Priming pumps

Priming means to fill the pump with water so that all air is expelled. If the pump is not primed, it will not be able draw water from the water source, which will result in cavitation. If the pump is fully primed, it will be able to draw and pump water. Centrifugal pumps must be fully primed in order to work properly.

To check whether the pump is primed, open the cock valve on the delivery side of the pump. This is a small valve that is used to expel air and to check whether the pump is full of water. If water

squirts form the valve, the pump is primed, but if no water is present, the pump still has to be primed.

There are various methods that can be used to prime a pump. To prime a pump that is below the water level, for example a pump at the bottom of the dam wall, simply open the cock valve and keep it open until all the air has escaped and only water squirts out. Once the cock valve has been closed again, the pump is primed.

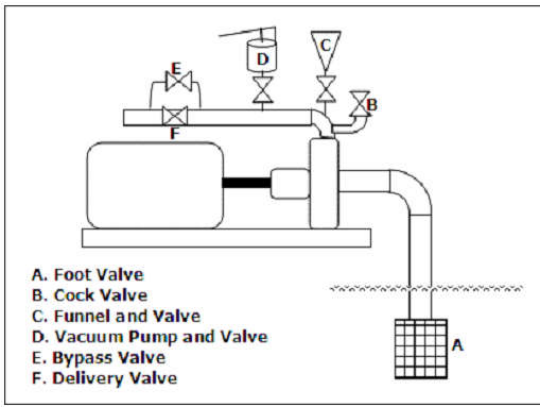

Figure 11. A Pump with Different Configurations for Priming

If the pump is above the water level, the pump can be primed using the funnel, the vacuum pump or the line pressure.

To prime the pump using the funnel:

Ensure that the delivery valve is closed;

- Open the valve below the funnel;
- Pour water into the funnel using a bucket. The water go into the pump and the air will be expelled through the funnel;
- Continue to fill the pump until the funnel is brimming with water and no more air is expelled;
- The pump is now primed and the valve below the funnel can be closed.

To prime the pump using the vacuum pump:

- Ensure that the delivery valve and all other valves are closed;
- Open the valve below the vacuum pump;
- Use the handle of the vacuum pump to pump all the air out;
- The pump is now primed and the valve below the vacuum pump can be closed.

When the main line is filled with water, the line pressure can be used to prime the pump. If a non-return valve is fitted at the delivery valve, the bypass valve as well the cock valve must be opened. Air will blow from the cock valve. When water squirts from the cock valve, the pump is primed and the cock and bypass valves can be closed.
In some instances the pump won't prime, which could be due to either a leak on the suction pipe or a faulty foot valve. Report such an incident immediately to the supervisor or manager.

1.3. Calibrating pressure and flow testing equipment

To set the flow rate for an irrigation block, the pressure needs to be adjusted by opening or closing the valve. To reduce the pressure, close the valve more, and to increase the pressure, open the valve more. All valves under water pressure must always be opened and closed very slowly to prevent water hammer and the resulting damage.

Regulating infield valve pressure

It is very important that the pressure on infield valves is regulated properly and set to the required levels, as the pressure determines the flow rate for the irrigation block. If the pressure is too low, too little water will be delivered to the crops, resulting in water-stress that can impact negatively on the yield. If the pressure is too high, too much water will be delivered to the crops, which not only will result in water wastage, but also tend to make emitters mist. Misting causes emitters to spray water into the rows between the crops, and not on the root-zone.

The correct pressure levels for infield valves are determined and prescribed by the irrigation manager or supervisor. The supervisor or manager will also set the pilot valves that are used on hydraulic valves, and no other person should be allowed to adjust the settings.

Infield valves are located on valve risers or valve clusters. Usually, these risers consist of riser pipes, a valve (hydraulic, gate, butterfly) and either hydromatics or pressure points. A hydromatic is type of quick coupler that is used for pressure readings.

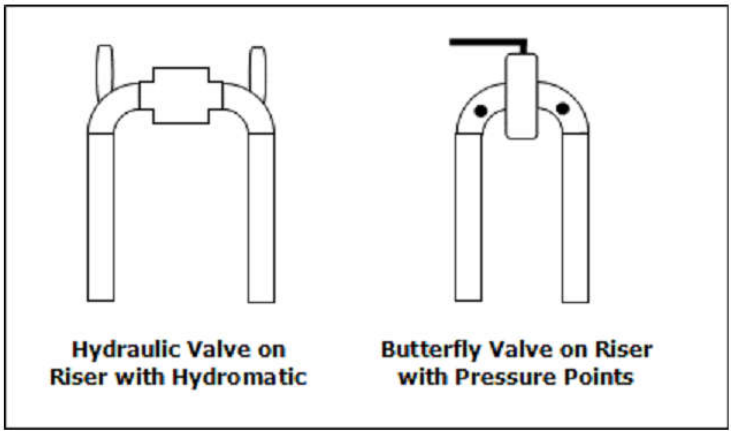

Figure 12. Examples of Valve Risers

The hydromatic and pressure points are used to measure the pressure. To measure the pressure using the hydromatic:

- Fit a pressure gauge to a pipette, which fits into the hydromatic, and not to be confused with a pipette that it used in chemistry
- Insert the pipette with the gauge into the hydromatic
- Make sure the latch on the pipette locks on to the hydromatic
- The pressure will register on the gauge
- To release the pipette, push it down, unlock the latch and remove it

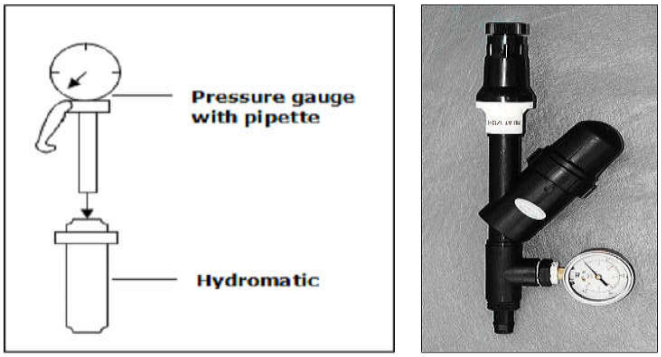

Figure 13. Example of Pipette and Hydromatic

To use the pressure point, the gauge must be fitted with a special needle. To take a pressure reading:

- ✓ Insert the needle carefully into the pressure point, as carelessness can damage the silicon nipple inside the pressure point.
- ✓ The pressure will register on the gauge.
- ✓ Remove the gauge by simply pulling the needle out of the pressure point. Be careful when inserting the needle.

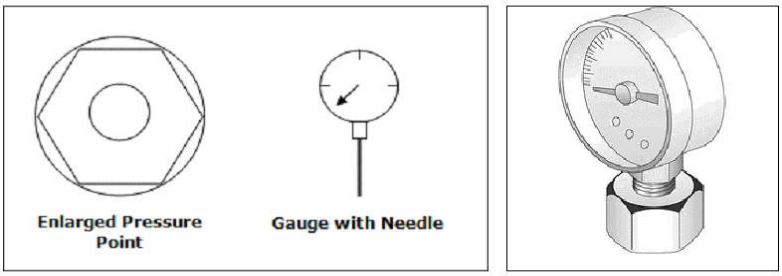

Figure 14. Pressure point and gauge with needle

Where a hydraulic valve is used, the pilot valve is set to regulate the pressure for the irrigation block. It is good practice to take a reading once the valve is open and the pressure is stable, around 10-20 minutes after opening. The norm is 1.8 to 2.3bar where micro emitters are used, but can vary depending on the characteristics of the block. It is however important to note that if the pilot valve is set to for example 2bar, the reading should not be lower than 1.8bar or higher than 2.2bar, which is a 10% tolerance. If the reading is outside this range, it must be reported to the supervisor or manager.

Where a gate or butterfly valve is used, the pressure must be set manually. Insert the gauge into the riser and open the valve slowly. Once the lateral lines in the block have filled with water and the pressure has stabilised, regulate the pressure by turning the wheel, thereby opening and closing the valve. If the required pressure is for example 2bar, and the reading on the gauge is 1.7bar, open the valve slowly until the pressure is 2bar. If the reading is 2.3bar, close the valve slowly until the reading is 2bar.

1.4. Carrying out other pre-start system checks

- Pumps run when they should
- Controllers work
- Air vents actually let air out and keep water in
- Try out the fertilizer injector without fertilizer
- Check that pressure gauges on the filters are accurate

Self-Check 1	Written Test

Name: _____ Date: _____
Directions: Answer all the questions listed below.

1. What will happen if you do not grease or oil the pump and motor? (2points)
.....
.....
.....
2. Complete: The oil level must be between the _____ mark and _____ mark. (2points)

3. What should you do when the oil is discolored? (1pint)
.....
.....
.....
4. Describe where the water level should be. (2points)
.....
.....
.....
5. Describe what will happen if you start the pump and the water level is too low. (3point)
.....
.....
.....
6. Name the five main components of an irrigation system and describe their main functions.(5pts)
a.
b.
c.
d.
e.
7. Give two reasons why filters must work properly. (2points)
.....
.....
.....
8. Describe how you would check to see if the pump is primed. (5points)
.....
.....
.....

Note: satisfactory Rating-22 and above pts. Unsatisfactory Rating-below 22 pts.
You can ask your teacher for the copy of the correct answers

Information sheet 2	Starting up and inspecting system

2.1. Implementing start up sequence

Steps to be followed for System Startup

a. **Run the well pump for a few minutes** discharging the water somewhere other than the irrigation system before sending water to the filter. Over the winter, sand or other particulates may have collected in the water around the pump. Discharge of this material as a "plug" will cause problems for the filter.
b. **Inspect the filter(s).** For sand media filters, consider whether it is time to replace the media. For screen filters, check for holes in the screen and general wear and tear on and around the screens. Damage may be due to sand from the well and should be addressed.
c. Close all submain valves. **Open mainline** flush valves and run the system until discharge water runs clear for 5 minutes.
d. Close the mainline flush valves and **open submain** valves with flush manifolds open to clear the submains of debris.
e. **Flush the submains** until the water at the end of the laterals runs clear. If there is not enough pressure and velocity to maintain a strong flow, consider flushing a few lines at a time. Close the submains.
f. **Close the flush manifolds** on lateral ends.
g. **Operate the system until it is fully pressurized** and all air is discharged block by block as it was designed.
h. Starting from the well, check the system for leaks and necessary repairs.
i. Check each individual row for missing emitters or other damage.
j. Make sure to check drip risers and any other parts of the system which are above ground for damage.
k. If you make repairs, be sure to re-flush the lines after leaks are repaired.
l. Check pressures at key points in the system with gauges and adjust all pressure regulators and pressure-regulating valves as necessary.
m. **Check on other system components**:

- Pumps run when they should
- Controllers work
- Air vents actually let air out and keep water in
- Try out the fertilizer injector without fertilizer
- Check that pressure gauges on the filters are accurate

2.2. Correcting or repairing, and reporting all malfunctions, leaks and blockages

Using defective tools and equipment can be very dangerous and costly. It is good practice to learn to be sensitive to the tools and equipment you use. Usually there is a symptom before a breakdown or problem occurs, for example a pump will make noise or vibrate if something is wrong, or the secondary filters will need cleaning within a shorter period of time, because something is wrong

with the primary filter. It is very important that worn, defective tools and equipment be reported to the manager. Any unusual events or problems must also be reported to the manager.

2.3. Distributing water evenly

Knowing your irrigation systems application uniformity is critical to make certain that the water you are applying is spread evenly across the growing zone. If your application is uniform then the depth of water you have applied over the entire area should be about the same. With that in mind, a uniform water application is essential for crops to maximize their efficiency of water use and to conserve water by avoiding over application.

Many factors can be involved in why an overhead irrigation system in a nursery has poor uniformity they include:

1. Improper selection of the delivery system piping (diameters either too small or too large).
2. Incorrect sprinkler heads and nozzles.
3. Poor overlap by sprinklers.
4. Pumping system not sized correctly for the system.
5. Effects of wind on the sprinkler distribution of water.
6. Wear and age of the system causing changes in volume of water emitted through nozzles.
7. Nozzles become clogged.

Generally speaking, if the Distribution Uniformity (DU) is poor then some plants in a zone will be under watered and others will be overwatered. Improperly watered plants will show poor growth and increased pest problems. Also dry or water logged media or soils will reduce fertilizer uptake by the plants.

Items Needed to Conduct Irrigation Uniformity Checks

1. Catch cans (straight sided) minimum of 16.
2. Ruler to measure depth in catch can.
3. Clock or stop watch to time irrigation application.
4. Pitot tube on pressure gauge to check nozzle pressure.
5. Paper and pencil to record data collected.

2.3.1. Checking water pressure

Pressure and flow testing equipment may need to be calibrated. Refer to enterprise procedures and the operator's manuals for other pre-start checks that need to be undertaken.

With respect to filters, pipes and other components, regular inspection, identification and sealing of leaks is necessary in order to maintain the designed pressures and water delivery to the crop.

Periodic opening of the end of the lateral to check for impurities on the inside wall can identify the presence of bacteria slime and measures can then be taken to avoid the clogging of the emitters.

Checking pressure and flow

Pressure checks at the filtering system help to decide on the frequency of cleaning the filters. Additionally, pressure checks at critical points of the system (inlet of block and end of lateral) help to identify possible leaks or pipe breakages or blockage in the system.

A water meter or a flow meter, located after the filters, can assist in checking the proper operation of the system. If the flow rate is higher than the designed flow, it is an indication of pipe breakage or the end of a number of laterals being open. On the other hand, if the flow is lower than envisaged, it is a sign of clogging in the system, reduced performance of the pump, or overloaded filters.

2.3.2. Checking control valves

Opening and closing pressure control valves

Pressure control valves are hydraulic valves fitted with a pilot valve and is used to regulate pressure and flow. The pilot valve is a device that regulates the pressure inside the hydraulic valves. These valves are controlled by a 3-way valve. The 3-way valve is marked Open, Close and Auto. To open the pressure, simply turn the dial to open and to close the valve, turn the dial to close.

Possible problems

After a pump is started in the morning, it must be monitored during the day to ensure that it is running smoothly. Always check the perimeter and working characteristics of the pump. Also pay attention to vibration, noise, leaks, burst pipes, smoke, sparks, fire, etc. Switch off the pump immediately if any of this should occur.

Infield valves

Hydraulic, gate or butterfly valves are used as infield valves. While gate valves are opened and closed using a wheel. To open a gate valve, turn the wheel anticlockwise and to close the valve, turn the wheel clockwise.

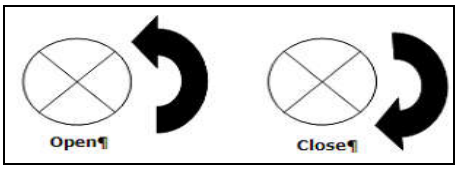

Figure 15: Opening and closing direction for gate valves.

Butterfly valves are equipped with a handle. To open the valve, turn the handle until it is in line with the pipe. To close the valve, turn the handle until it is perpendicular to the pipe. Some butterfly valves are equipped with a wheel and dial. When the wheel is turned, the dial indicates if it is opening or closing.

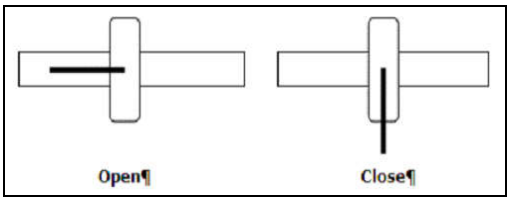

Figure 16: Opening and closing positions for butterfly valves

To set the flow rate for an irrigation block, the pressure needs to be adjusted by opening or closing the valve. To reduce the pressure, close the valve more, and to increase the pressure, open the valve more. All valves under water pressure must always be opened and closed very slowly to prevent water hammer and the resulting damage.

2.3.3. Checking filter operation

Using the pressure gauge, the pressure differential between the inlet and outlet is recorded daily. As the filters remove water impurities the pressure differential increases. If left unchecked, the load inside the filter will consume unreasonable levels of pressure, resulting in the substantial reduction of the pressure available for the operation of the system. In extreme cases, this results in water stress to the crop. The maximum pressure drop across a sand media filter should not exceed 7 m and it is preferable to range from 3-5 m. For screen and disc filters, the pressure drop should not exceed 2-3 m.

When the level of pressure drop reaches the above limits, the filters should be cleaned. In the case of screen and disc filters, they are opened and, using a hose from the outlet of the sand media filter, cleaned manually. Sand media filters are designed to be cleaned through the back-wash process, whereby clean water from the outlet of one unit is diverted to the lower part of the second unit, lifting up the sand media and flushing out the impurities.

2.3.4. Checking water distribution.

Irrigation should be applied as evenly as possible to ensure a uniform crop response. Variable applications lead to over-watering of some areas in an effort to ensure that other parts receive an adequate amount; this in itself can also lead to lower crop yield and poorer quality, as well as creating surface water ponding and possible run-off problems.

Uniformity is very difficult to measure visually, so can easily be overlooked. However, application uniformity should be checked periodically to identify any spatial variability that may have arisen since the last check. Then the set up (e.g. lane spacing, etc.) and operation (e.g. water pressure) of the system can be checked, and improvements made as necessary.

Uniformity is influenced by three main factors:
1. Correct operation of equipment (pressure, trajectory & sector angle)
2. Lane spacing – the area of wetted overlap (how far the water is being 'thrown')
3. Local weather conditions, including wind speed and direction during irrigation

Checking water distribution

- Check in the field using 5 liter catch cans, spaced at 3 m intervals across the full wetted area, and covering the overlap of adjacent pulls. Measurements of the volume of water collected at each point can then be plotted to show the areas of non-uniformity on a graphical image.

- A value called the Coefficient of Uniformity (CU) is calculated from these measurements. The larger the figure, the more even the application - though much higher than 90% would not be expected in the field.

Self-Check 2	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

1. Describe the steps you should follow to startup pressurized irrigation systems. (5 points)
2. How do you check the functionality filters? (3 points)
3. How do you check even distribution of water throughout the field? (3 points)
4. Describe how you would check to see the pressure and flow rate of the system. (4 points)

Note: satisfactory Rating-15 and above points. Unsatisfactory Rating-below 15 points

You can ask your teacher for the copy of the correct answers

Information sheet 3	Shut down system based upon irrigation indicators

3.1 Applying water optimally considering the environments and weather conditions

Environmental considerations include: efficient operation of the system to conserve water by identifying and repairing leaks, avoidance of over watering, and even distribution of water to targeted areas with minimal wastage and run-off.

Weather consideration includes the climate condition of area includes temperature, rainfall, wind speed, humidity, etc

The time lag between shut down and end of watering is determined to minimize run-off and ensure deep percolation. Once irrigations activities have been completed, the system components should be shut down in sequence in accordance with the manufacturer's and enterprise procedures. This sequence will be different for each system and will depend on the type of water control devices your enterprise uses.

3.2 Shutting down and draining System components in sequence

The system components may vary according to brand and supplier and may include pumps, tensiometers, probe tubes, flow meter, catch cans, pressure gauge, computer and/or other scheduling devices, recycling equipment and spray equipment.

Line flushing:-Particulate matter not removed by filters accumulates in irrigation pipes and laterals. Chemical precipitation may occur inside pipelines after the irrigation system shuts down. Suspended materials will be carried with the irrigation water, but as the water velocity decreases near the end of lines, particles will settle. If these sediments are allowed to build up, they will eventually plug emitters.

- ✓ Periodically flush the entire irrigation pipe system (mainlines, sub mains, headers, manifolds and lateral lines).
- ✓ Manually flush lateral lines by opening only a few at a time. The desired flushing water velocity to remove larger and denser particles is 1 to 2 ft/sec.
- ✓ Determine flushing velocity by measuring the volume of water flowing from an open lateral for 1 minute.
- ✓ Examine the flushed material to get an idea of potential plugging problems. Hold a plastic sheet, nylon sock, or jar at the end of the lateral line to catch the first bit of debris as it leaves the pipe.
- ✓ Determine future flushing frequency based on the amount of material that flushes out:
  - o Increase the flushing interval if only a small amount of suspended particles are flushed from the pipe.
  - o Reduce the flushing interval if large amounts of material are flushed.
- ✓ After fertilizer is injected, run the system long enough to wash it out of the irrigation system. If chlorine is injected, this extra run time is not necessary.
- ✓ Occasionally irrigation pipes must be cut for maintenance or repairs.

Prevent plastic cuttings or shavings from plugging emitters:

- Use tube cutters rather than saws for repairs.
- If a saw must be used, clean and flush the repaired section before reconnecting it to the irrigation system.

Shut-Down

✓ Close the delivery valve slowly, preventing water hammer.

✓ As soon as the valve is closed, switch off the pump.

Note that just before shutting down the pump is an ideal time to take pressure readings on the filter bank and to back-flush the filters.

✓ If the plant has 'auto' controls, operate an automatic shut down. Check that all sequencing and any special shut down requirements are operated satisfactorily;

✓ if the plant is arranged for manual control, proceed through the correct relevant sequence to shut the complete plant down; observe whether all automatic or safety features are operated satisfactorily; and

✓ In either case above note whether anything abnormal occurs during the shut down cycle (such as noise, vibration, or unexpected pressure variation).

3.3 Checking drainage and treatment systems

Checking the drain system treatment is used to prevent emitter/spray plugging. Preventing emitter plugging is best accomplished by continuous or intermittent water treatment with organic or inorganic chemicals that are able to:

- prevent biological growths,
- prevent precipitation reactions, or
- Dissolve scale deposited on the inside surfaces of tubing and emitters.

Preventative treatments greatly reduce the need for system flushing. Water treatment chemicals vary widely in stability, mode of action, corrosiveness, safety of use, dosage, and cost.

a. Biocides

Chlorination is the most widely used chemical irrigation water treatment to prevent biological emitter plugging. Chlorine injected into irrigation water kills microorganisms like algae and bacteria. These organisms are most commonly found in surface water, but they may also be present in ground water.

b. Acidification

- Add acid to irrigation water to help prevent emitter plugging:
  - ✓ Lowering the water pH can enhance the effectiveness of chlorine.
  - ✓ The pH-lowering power of acid can prevent precipitation of solid compounds, particularly calcium carbonate (CaCO3).
  - ✓ Citric acid has prevented iron scale formation when continuously injected at 25 ppm.
- Neutralize 80% of the bases (carbonates and bicarbonates) in the water to eliminate carbonate precipitation.
- Typical acids that can be injected to neutralize carbonates:
  - ✓ Sulfuric acid
  - ✓ Muriatic (hydrochloric) acid
  - ✓ Phosphoric acid

3.4 Recording and reporting Irrigation activities.

Regardless of whether your extension sector uses pressurized irrigation systems you need to record the activities associated with each irrigation activity. Irrigation activities recorded include water used, time of shutdown, malfunctions, blockages, leaks and other faults requiring repair during the operation of the pressurized irrigation systems.

The minimum information you need to record includes:

specific activities of each member of the irrigation operation process and the hours for each the irrigation start and finish time the water storage levels for pressurized irrigation systems recommendations for service and maintenance activities monitoring activities used to determine the amount of irrigation required data collection process, including those used to test the levels of soil moisture, plant/crop condition and climatic data including rainfall, air temperature, frost risk other information such as water quality. This information may be recorded electronically or manually using a log book. It may also be appropriate to use graphs or charts to record some of the information.

Self-Check 3	**Written Test**

Name: _____ **Date:** _____

Directions: Answer all the questions listed below.

1. Write the advantage Environmental considerations and allowing for weather conditions to the applied water to the crops? (5 points)
2. Describe line flushing and shutdown of based on the operation of pressurized irrigation systems? (5points)
3. Write the sequences of shutdown? (5points)
4. How to prevent emitter/spray plugging? (5 points)
5. Write the advantage of Recording and reporting of Irrigation activities? (5points)

Note: satisfactory Rating-25 and above pts. Unsatisfactory Rating-below25 pts

You can ask your teacher for the copy of the correct answers

Operation Sheet 1	Perform pre-start checks for operating pressurized irrigation system

Objective: To perform pre-start checks for operating pressurized irrigation system.

Materials, Tools and equipments used

- ✓ Pump
- ✓ Drip set
- ✓ Sprinkler set
- ✓ Pressure gauge
- ✓ Spray equipments
- ✓ Catch canes
- ✓ Probe tube
- ✓ Tensiometeres

- ✓ Flow meter
- ✓ Oil, diesels, water etc.

Procedures

The following procedures should be taken into account to perform pre-start checks for operate pressurized irrigation system:

- ✓ Visually inspect all wiring for damage and condensation
- ✓ Turn off main switch before opening any cabinets for electrical systems.
- ✓ Clean and inspect pump stations
- ✓ Check for any sign of shorting, burnt cables, hot terminals
- ✓ Test priming system and control system
- ✓ Inspect suction and discharge piping for corrosion and leaks
- ✓ Assessing water availability
- ✓ cleaning the pump, filters and valves
- ✓ checking oil level land fuel

Operation Sheet 2	Start up and inspect system

Objective: To perform Start up and inspect system for operating pressurized irrigation system.

Materials, Tools and equipments used

- ✓ Pump
- ✓ Drip set
- ✓ Sprinkler set
- ✓ Pressure gauge
- ✓ Spray equipments
- ✓ Catch canes
- ✓ Probe tube
- ✓ Tensiometeres
- ✓ Flow meter
- ✓ Oil, diesels, water etc.

Procedures

The following procedures should be taken into account to Start up sequences and inspection for operate pressurized irrigation system:

- ✓ Inspect suction and discharge piping for corrosion and leaks
- ✓ Fully close and open all valves to ensure they are still functioning.
- ✓ Ensure air valve on discharge is functioning and sealing
- ✓ On systems drawing from a water source below the pump, ensure the suction assembly rises to the pump flange i.e. ensure there is no high point above the pump flange, this includes the fitting bolted to the pump flange
- ✓ Ensure system is primed / priming pump or system working if applicable
- ✓ Run the pump
- ✓ Check pressure gauges are working, replace as necessary
- ✓ Check it runs up to pressure – note pressure

- ✓ Check for leaks around pump station and from the pump mechanical seal or gland packing
- ✓ Test and control systems like discharge measurements
- ✓ Check water meter is functioning
- ✓ Drive the mainline ,sub main lines, lateral lines and check for leaks and damage
- ✓ Check air valves
- ✓ Check that emitters are fully open and closed

LAP Test/ Job Sheet	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions:

1. You are required to perform the following activity:

- Request your teacher to arrange materials, tools and equipments used in operating pressurized irrigation work, in order to handle materials and equipment.
- Checking of water, power, fuel and lubricants
- Priming pump systems
- Measuring flow rates
- Checking water pressure
- Checking control valves
- Checking filter operation
- Checking water distribution
- Repairing all damaged pipes
- Shutdown the system components
- Request your teacher for evaluation and feedback.