# LEARNER GUIDE

# Crop Production: Irrigation

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# Learning Unit 1

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| **Unit Standard** | |
| **116414** | **Develop suitable irrigation systems** |
| **Specific Outcomes** | |

SO1: Select an appropriate irrigation system

SO2: Efficiently and cost effectively manage an extended irrigation operation.

SO3: Implement appropriate task related technology in the irrigated agricultural environment (scheduling/monitoring, adaptation of scheduling programmes, etc.) in variable water availability scenarios.

SO4: Manage appropriate seasonal/year irrigation related work programmes with reference to crop water requirement, crop value, area irrigated and water availability and water quality.

SO5: Recommend a safety, servicing and replacement policy of all irrigation systems with reference to expenditure implications.

SO6: Ensure that all irrigation practices are environmentally sensitive (e.g. Eurepgap and related Agreement compliant), specifically in terms of water extractions and return flows.

| **CCFO's** | | |
|---|---|---|
| Identifying | Communicating | Collecting |
| Working | Demonstrating | Science |
| Organise | Contributing | |

## IRRIGATION SYSTEMS

Irrigation is an artificial application of water to the soil. It is used to assist in the growing of agricultural crops, maintenance of landscapes, and revegetation of disturbed soils in dry areas and during periods of inadequate rainfall. Additionally, irrigation also has a few other uses in crop production, which include protecting plants against frost, suppressing weed growing in grain fields[2] and helping in preventing soil consolidation.

In contrast, agriculture that relies only on direct rainfall is referred to as rain-fed or dryland farming. Irrigation systems are also used for dust suppression, disposal of sewage, and in mining. Irrigation is often studied together with drainage, which is the natural or artificial removal of surface and sub-surface water from a given area.

## TYPES OF IRRIGATION

Various types of irrigation techniques differ in how the water obtained from the source is distributed within the field. In general, the goal is to supply the entire field uniformly with water, so that each plant has the amount of water it needs, neither too much nor too little. The modern methods are efficient enough to achieve this goal.

### SURFACE IRRIGATION

In surface irrigation systems, water moves over and across the land by simple gravity flow to wet it and to infiltrate into the soil. Surface irrigation can be subdivided into furrow, border strip or basin irrigation. It is often called **flood irrigation** when the irrigation results in flooding or near flooding of the cultivated land. Historically, this has been the most common method of irrigating agricultural land.

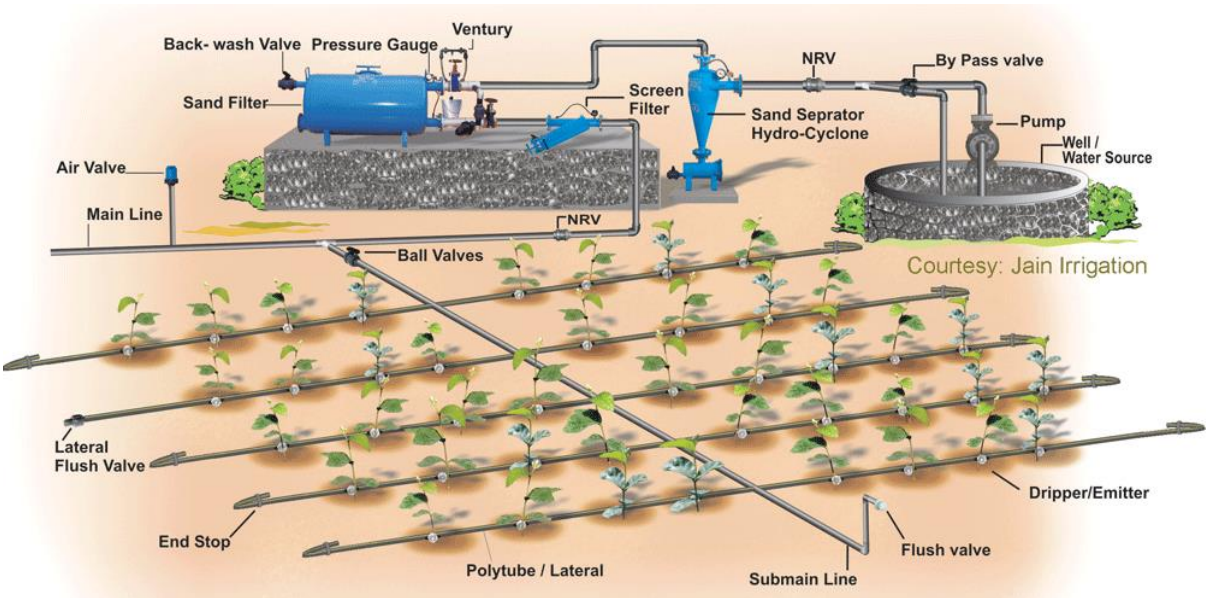
Where water levels from the irrigation source permit, the levels are controlled by dikes, usually plugged by soil. This is often seen in terraced rice fields (rice paddies), where the method is used to flood or control the level of water in each distinct field. In some cases, the water is pumped, or lifted by human or animal power to the level of the land.

## LOCALIZED IRRIGATION

Localized irrigation is a system where water is distributed under low pressure through a piped network, in a pre-determined pattern, and applied as a small discharge to each plant or adjacent to it. Drip irrigation, spray or micro-sprinkler irrigation and bubbler irrigation belong to this category of irrigation methods.

## DRIP IRRIGATION

Drip irrigation, also known as trickle irrigation, functions as its name suggests. Water is delivered at or near the root zone of plants, drop by drop. This method can be the most water-efficient method of irrigation, if managed properly, since evaporation and runoff are minimized. In modern agriculture, drip irrigation is often combined with plastic mulch, further reducing evaporation, and is also the means of delivery of fertilizer. The process is known as *fertigation*.




*Drip Irrigation Layout and its parts*

Deep percolation, where water moves below the root zone, can occur if a drip system is operated for too long of a duration or if the delivery rate is too high. Drip irrigation methods range from very high-tech and computerized to low-tech and labour-intensive. Lower water pressures are usually needed than for most other types of systems, except for low energy centre pivot systems and surface irrigation systems, and the system can be designed for uniformity throughout a field or for precise water delivery to individual plants in a landscape containing a mix of plant species.

Although it is difficult to regulate pressure on steep slopes, pressure compensating emitters are available, so the field does not have to be level. High-tech solutions involve precisely calibrated emitters located along lines of tubing that extend from a computerized set of valves. Both pressure regulation and filtration to remove particles are important. The tubes are usually black (or buried under soil or mulch) to prevent the growth of algae and to protect the polyethylene from degradation due to ultraviolet light. But drip irrigation can also be as low-tech as a porous clay vessel sunk into the soil and occasionally filled from a hose or bucket.

Subsurface drip irrigation has been used successfully on lawns, but it is more expensive than a more traditional sprinkler system. Surface drip systems are not cost-effective (or aesthetically pleasing) for lawns and golf courses. In the past one of the main disadvantages of the subsurface drip irrigation (SDI) systems, when used for turf, was the fact of having to install the plastic lines very close to each other in the ground, therefore disrupting the turf grass area. Recent technology developments on drip installers place the line underground and covers the slit, leaving no soil exposed.

## SPRINKLER IRRIGATION

*Sprinkler irrigation*

In sprinkler or overhead irrigation, water is piped to one or more central locations within the field and distributed by overhead high-pressure sprinklers or guns. A system utilizing sprinklers, sprays, or guns mounted overhead on permanently installed risers is often referred to as a *solid-set* irrigation system. Higher pressure sprinklers that rotate are called *rotors* and are driven by a ball drive, gear drive, or impact mechanism.

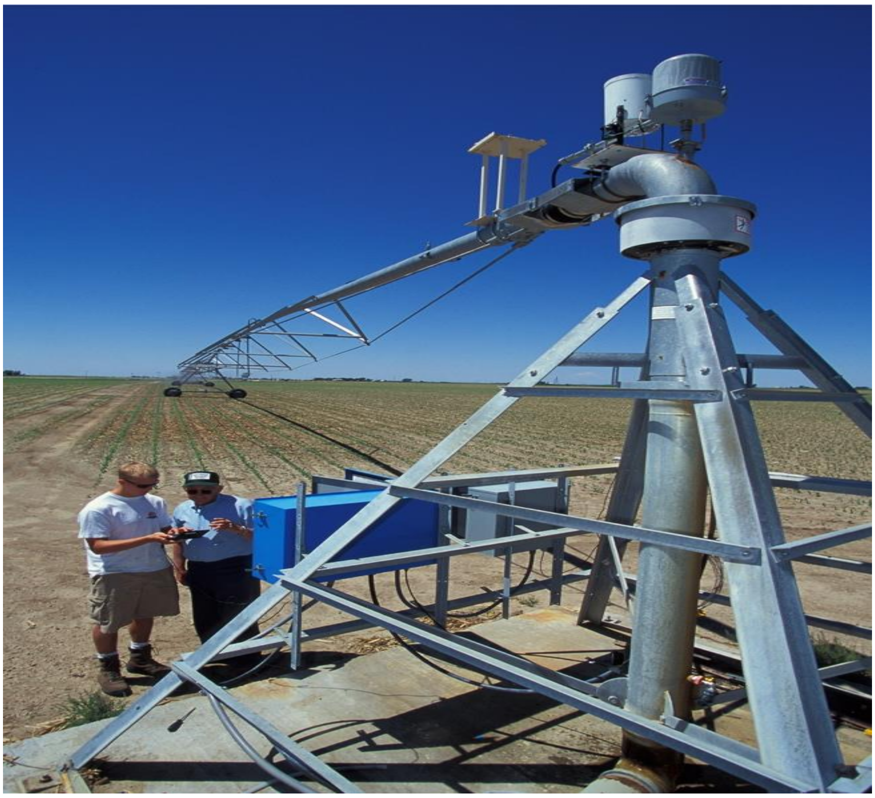
Rotors can be designed to rotate in a full or partial circle. Guns are like rotors, except that they generally operate at very high pressures of 40 to 130 lbf/in² (275 to 900 kPa) and flows of 50 to 1200 US gal/min (3 to 76 L/s), usually with nozzle diameters in the range of 0.5 to 1.9 inches (10 to 50 mm). Guns are used not only for irrigation, but also for industrial applications such as dust suppression and logging.

*A travelling sprinkler*

Sprinklers can also be mounted on moving platforms connected to the water source by a hose. Automatically moving wheeled systems known as *travelling sprinklers* may irrigate areas such as small farms, sports fields, parks, pastures, and cemeteries unattended. Most of these utilize a length of polyethylene tubing wound on a steel drum. As the tubing is wound on the drum powered by the irrigation water or a small gas engine, the sprinkler is pulled across the field. When the sprinkler arrives back at the reel the system shuts off. This type of system is known to most people as a "water reel" travelling irrigation sprinkler and they are used extensively for dust suppression, irrigation, and land application of waste water. Other travellers use a flat rubber hose that is dragged along behind while the sprinkler platform is pulled by a cable. These cable-type travellers are old technology and their use is limited in today's modern irrigation projects.

## CENTER PIVOT IRRIGATION

*A small centre pivot system from beginning to end*



*The hub of a centre-pivot irrigation system*

*Rotator style pivot applicator sprinkler.*

Centre pivot irrigation is a form of sprinkler irrigation consisting of several segments of pipe (usually galvanized steel or aluminium) joined together and supported by trusses, mounted on wheeled towers with sprinklers positioned along its length. The system moves in a circular pattern and is fed with water from the pivot point at the centre of the arc. These systems are found and used in all parts of the nation and allow irrigation of all types of terrain. Newer irrigations have drops as shown in the image that follows.

*Centre pivot with drop sprinklers.*

*Wheel line irrigation system*

## LATERAL MOVE (SIDE ROLL, WHEEL LINE) IRRIGATION

A series of pipes, each with a wheel of about 1.5 m diameter permanently affixed to its midpoint and sprinklers along its length, are coupled together at one edge of a field. Water is supplied at one end using a large hose. After sufficient water has been applied, the hose is removed and the remaining assembly rotated either by hand or with a purpose-built mechanism, so that the sprinklers move 10 m across the field.

The hose is reconnected. The process is repeated until the opposite edge of the field is reached. This system is less expensive to install than a centre pivot, but much more labour intensive to operate, and it is limited in the amount of water it can carry. Most systems utilize 4 or 5-inch (130 mm) diameter aluminium pipe. One feature of a lateral move system is that it consists of sections that can be easily disconnected. They are most often used for small or oddly shaped fields, such as those found in hilly or mountainous regions, or in regions where labour is inexpensive.

## SUB-IRRIGATION

Sub irrigation also sometimes called *seepage irrigation* has been used for many years in field crops in areas with high water tables. It is a method of artificially raising the water table to allow the soil to be moistened from below the plants' root zone. Often those systems are located on permanent grasslands in lowlands or river valleys and combined with drainage infrastructure. A system of pumping stations, canals, weirs and gates allows it to increase or decrease the water level in a network of ditches and thereby control the water table.

Sub-irrigation is also used in commercial greenhouse production, usually for potted plants. Water is delivered from below, absorbed upwards, and the excess collected for recycling. Typically, a solution of water and nutrients floods a container or flows through a trough for a short period of time, 10–20 minutes, and is then pumped back into a holding tank for reuse. Sub-irrigation in greenhouses requires sophisticated, expensive equipment and management. Advantages are water and nutrient conservation, and labour-saving through lowered system maintenance and automation. It is similar in principle and action to subsurface drip irrigation.

## MANUAL IRRIGATION USING BUCKETS OR WATERING CANS

These systems have low requirements for infrastructure and technical equipment but need high labour inputs. Irrigation using watering cans is to be found for example in peri-urban agriculture around large cities in some African countries.

- ***Automatic, non-electric irrigation using buckets and ropes***

Besides the common manual watering by bucket, an automated, natural version of this also exist. Using plain polyester ropes combined with a prepared ground mixture can be used to water plants from a vessel filled with water.

The ground mixture would need to be made depending on the plant itself, yet would mostly consist of black potting soil, vermiculite and perlite. This system would (with certain crops) allow to save expenses as it does not consume any electricity and only little water (unlike sprinklers, water timers,). However, it may only be used with certain crops (probably mostly larger crops that do not need a humid environment; perhaps e.g. paprika).

- ***Irrigation using water condensed from humid air***

In countries where at night, humid air sweeps the countryside, water can be obtained from the humid air by condensation onto cold surfaces.

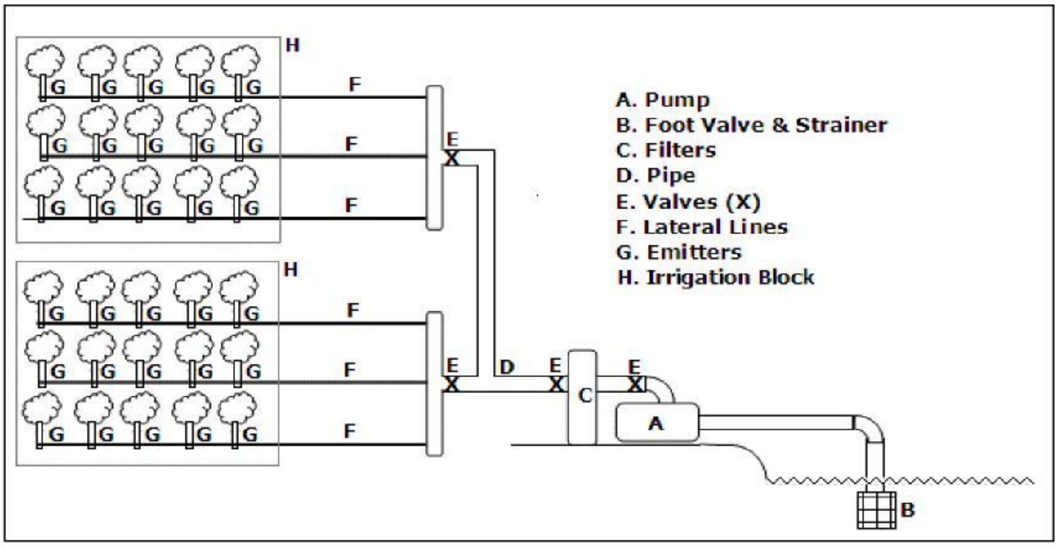
# COMPONENTS OF AN IRRIGATION SYSTEM

## Introduction

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

## The irrigation system

A basic irrigation system consists of the following components:

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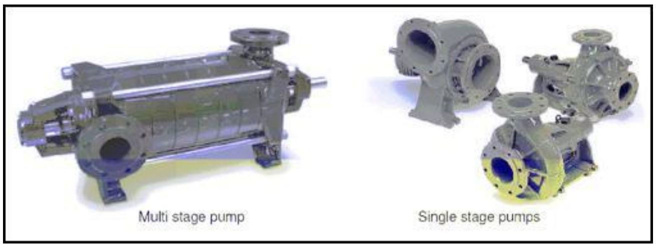
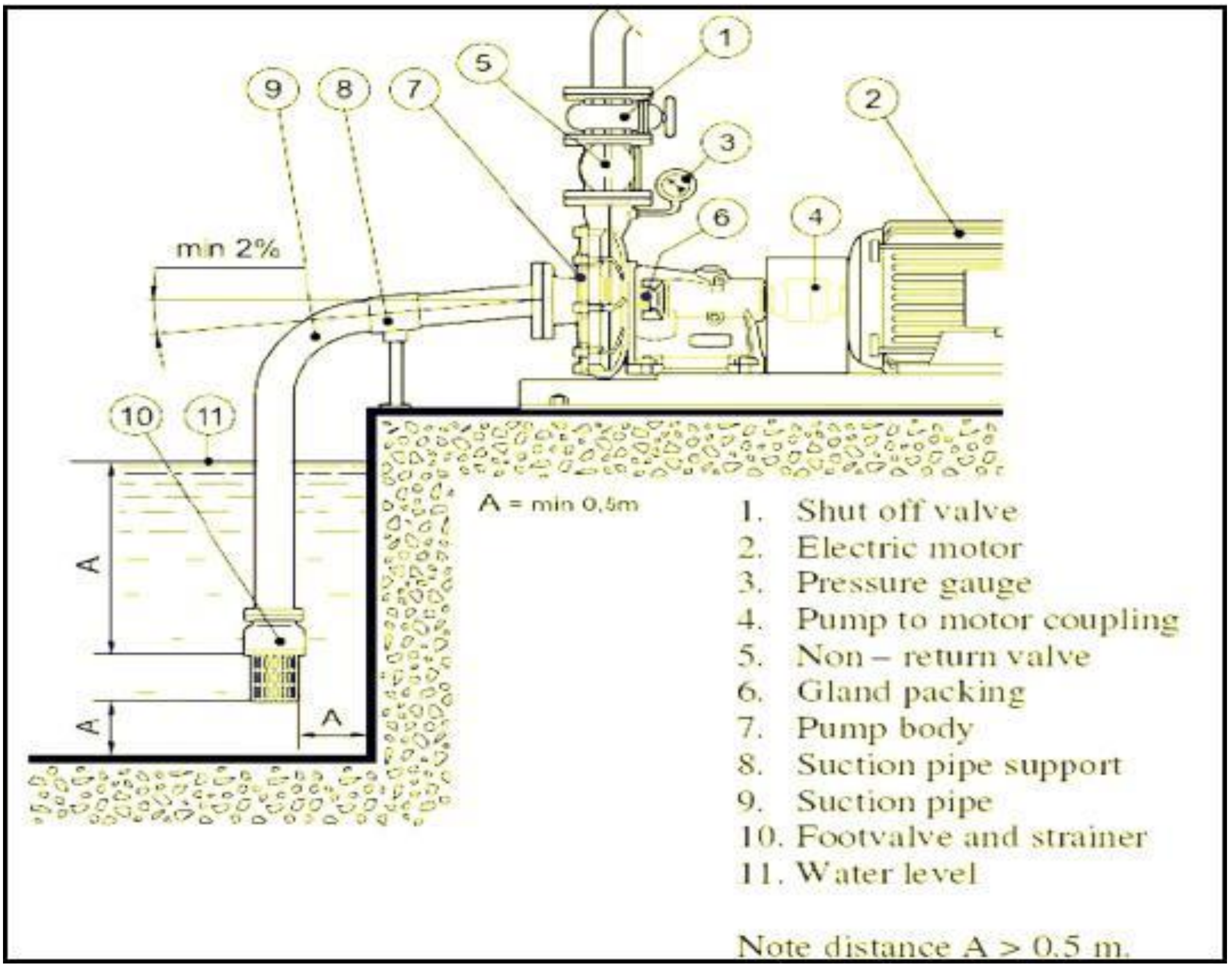
## Pumps




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.

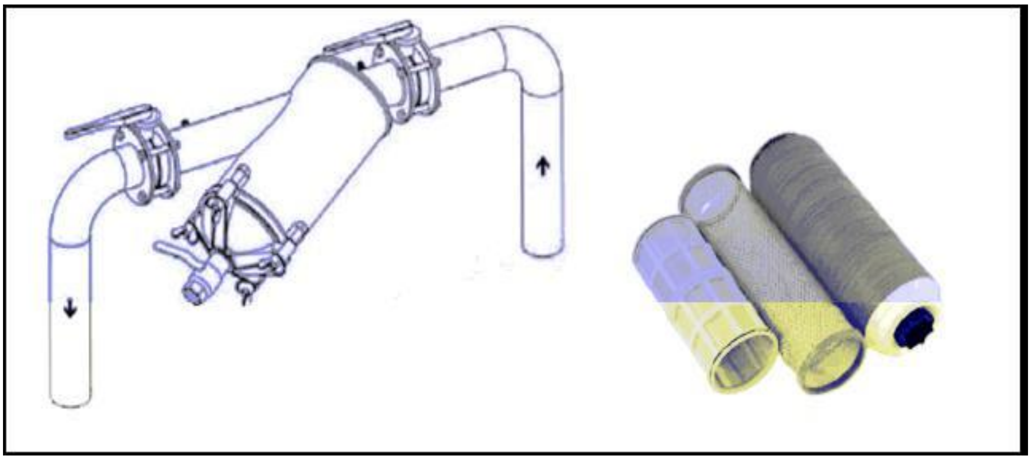
Pumps come in a wide range of shapes, sizes and types, such as centrifugal, submersible, and positive displacement pumps. They are driven by either diesel engines or electrical motors. The most commonly used pumps are single and multi-stage centrifugal pumps driven by electrical motors as electricity 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

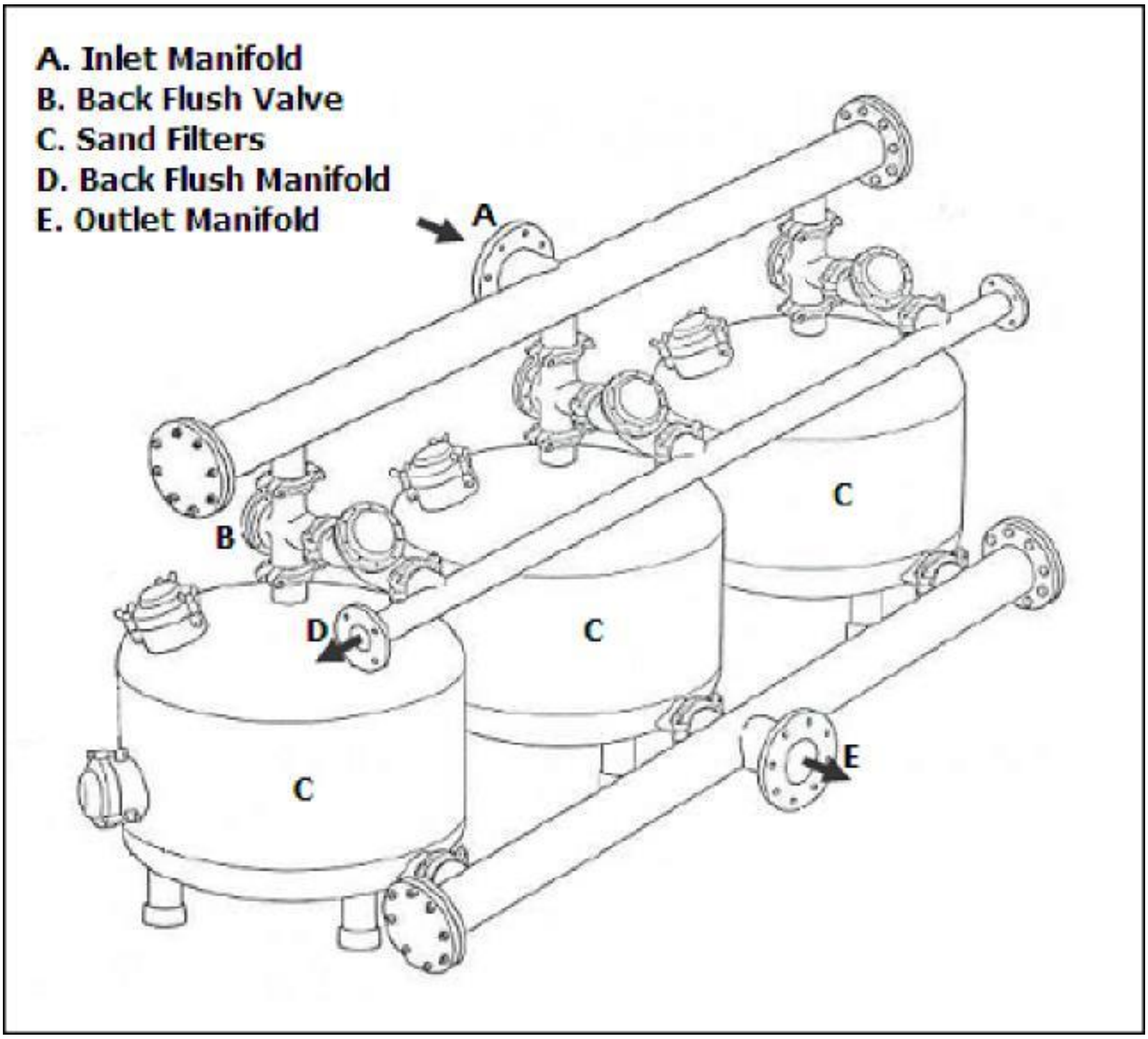
Pumps consist of various components, including the motor that drives the pump, the suction and delivery pipes, and various valves. The Figure shows the various components of a standard pump.




## Filters

Filters clean and remove impurities from water that can block emitters. Various types of filters are used, most commonly sand, disc and screen-type filters.




A. Inlet Manifold
B. Back Flush Valve
C. Sand Filters
D. Back Flush Manifold
E. Outlet Manifold
A
B
C
C
C
D
E

## 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 mainlines to the crops.

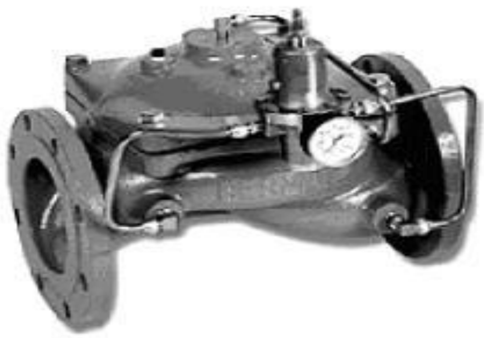
A wide range of pipes is available and used on farms. For main and sub-main lines u-PVC and steel pipes are normally used. In some older installations, asbestos-cement pipes are still in use. These pipes are unsuitable where acid is introduced into the irrigation water for fertigation purposes.

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

## Valves

Valves control the flow of water by opening or closing, thereby allowing water through or cutting it off. Various types of valves are used.

- **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.



Hydraulic Pressure Control Valve

Air and Vacuum Valves

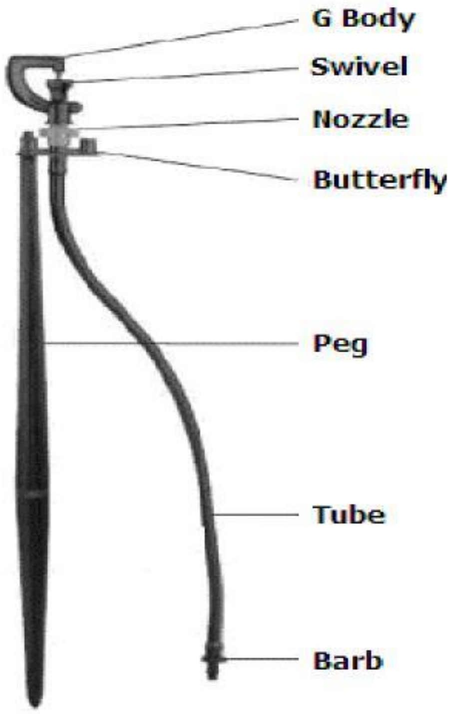
Waffer Type Non-Return Valve

Butterfly Valve

Gate Valves

## Emitters

Emitters are placed in lateral lines and apply water to individual crops in a uniform and efficient manner. Examples of emitters are micro-sprayers, drippers and sprinklers.




Micro-Jet Emitter

Examples of Button Drippers

## Pre-start-up inspection

Before starting up the irrigation system, a number of pre-start-up checks must be performed, being:

- Assessing water availability.
- Checking and cleaning the pump, filters and valves

### *Assessing 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.

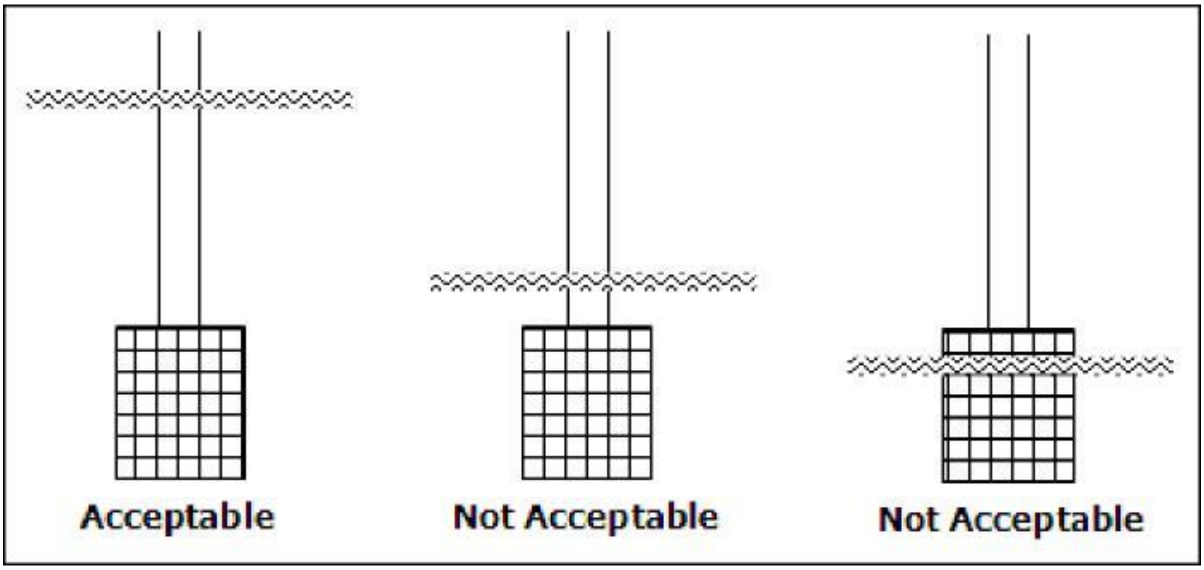
Cavitation is one of the greatest dangers to the pump. Cavitation can be caused by:

- 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. If the water level is too low to start the pump, or if water levels fell below the minimum water level mark while the pump was running, report it to the irrigation manager or supervisor



The Figure above gives an indication of what constitutes an acceptable water level. The picture in the middle is unacceptable, because even though the water level is above the intake, the pump will suck air as soon as it is started and the water level drops.

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

***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.

## 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 maximum (*Max*) marks. If the oil level is above the *Max* or below the *Min* marks, report it immediately to the manager. In addition, visually check that the oil is clear. If the oil is milky, grey or black, report it immediately to the manager before starting the pump.

Where pumps and motors are fitted with grease nipples, the pump and motor must be greased regularly. Consult the manager for the intervals, as they vary between different makes of pumps and motors. Note however that some motors are fitted with sealed bearings that must not be greased.

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 additional, 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

## 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.

## Valves

For hydraulic valves check the following:

- Check to see if the 3-way valve can 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.

## 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.

## Reporting on the pre-start-up inspection

A pre-start-up checklist should be used to record the findings of the pre-start-up procedure. When the pre-start-up checklist has been completed it is handed to the supervisor or manager and matters that require urgent attention is reported verbally to the supervisor.

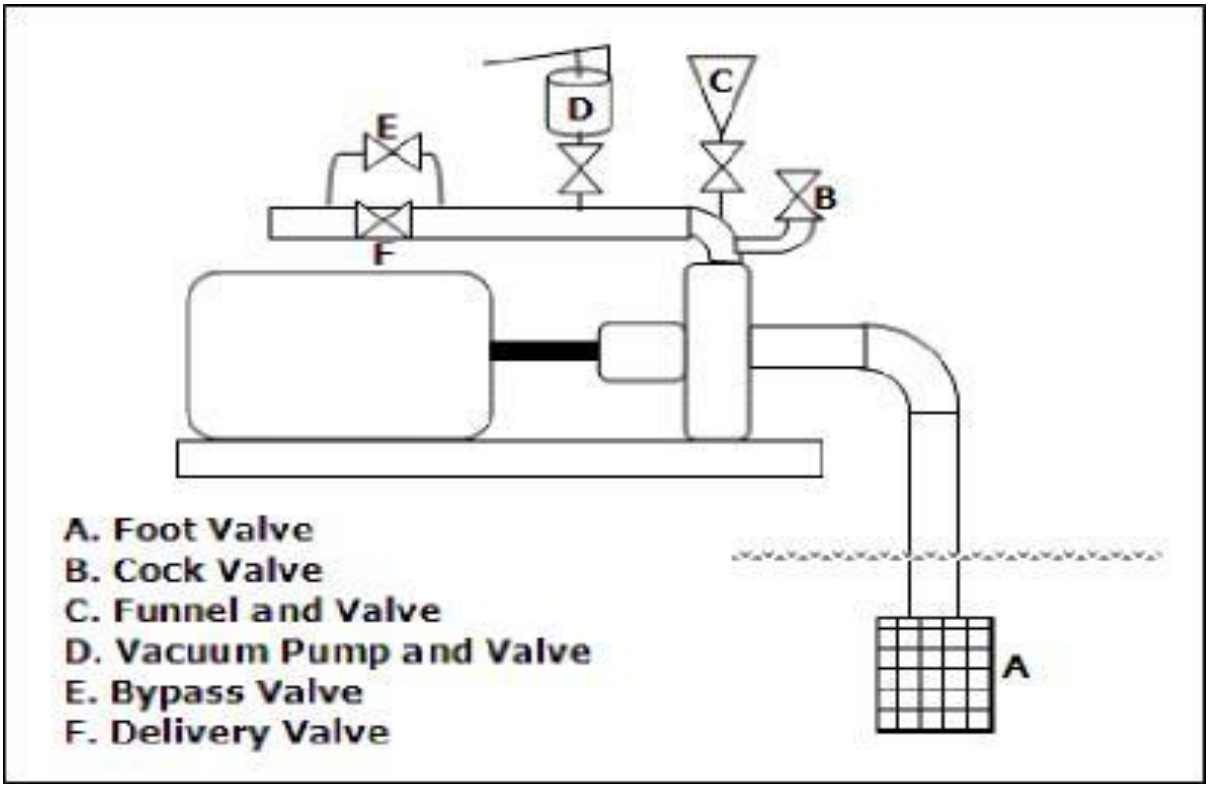
## Priming pumps

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.




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.

# PERFORM START-UP AND SHUT DOWN PROCEDURES

## Starting up and shutting down pumps

Proper starting and shutting down of pumps will ensure that the pump will operate optimally for a long time.

It is **very important that the delivery valve must be closed** before the pump is started or shut down. If the delivery valve is open during start-up, the pump will need more energy to start, resulting in a bigger electricity bill. If the pump is shut down with an open valve, water hammer can occur, which can damage the internal parts of the pump. Note that some pump installations are equipped with automated hydraulic valves. These valves open and close automatically when the pump is switched on and off.

### Starting up

- Perform the pre-start-up inspection.
- Check that the pump is properly primed
- Close the delivery valve.
- Start the pump by pushing the start button and remain at the panel until the pump runs smoothly (10-20 seconds). If any unusual noise or vibration occurs, immediately press the stop button.
- If the pump runs normally, open the delivery valve **slowly**.

### Shutting 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.

### 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.

## 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*. To regulate the pressure, or for other automated functions, turn the dial to *Auto*. Keep in mind that turning the dial to open could burst a pipe because of high pressure. The pilot should be adjusted by the supervisor or manager. Some valves are fitted with pressure points. See section 6 of this chapter for more information on the use of these pressure points.

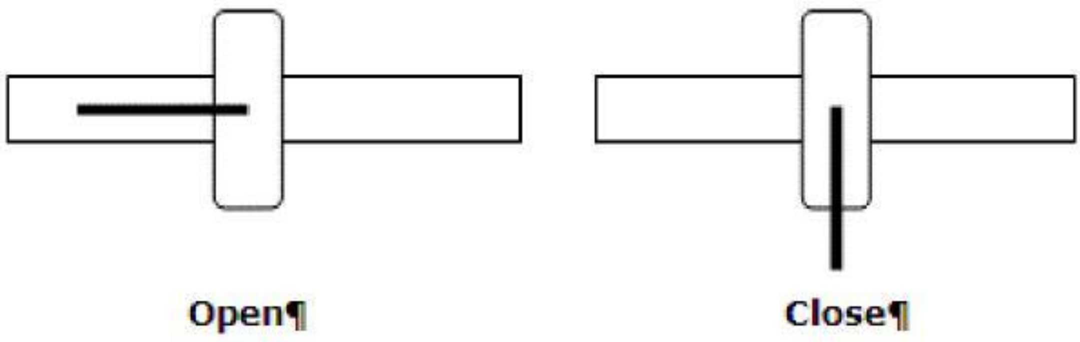
### Possible problems

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 as described in previous sections. Also pay attention to vibration, noise, leaks, burst pipes, smoke, sparks, fire, etc. Switch off the pump immediately if any of this should occur and report it to the supervisor or manager.

## Infield valves

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

**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.




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. See section 6 for the measuring and regulating of the pressure.

### 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.

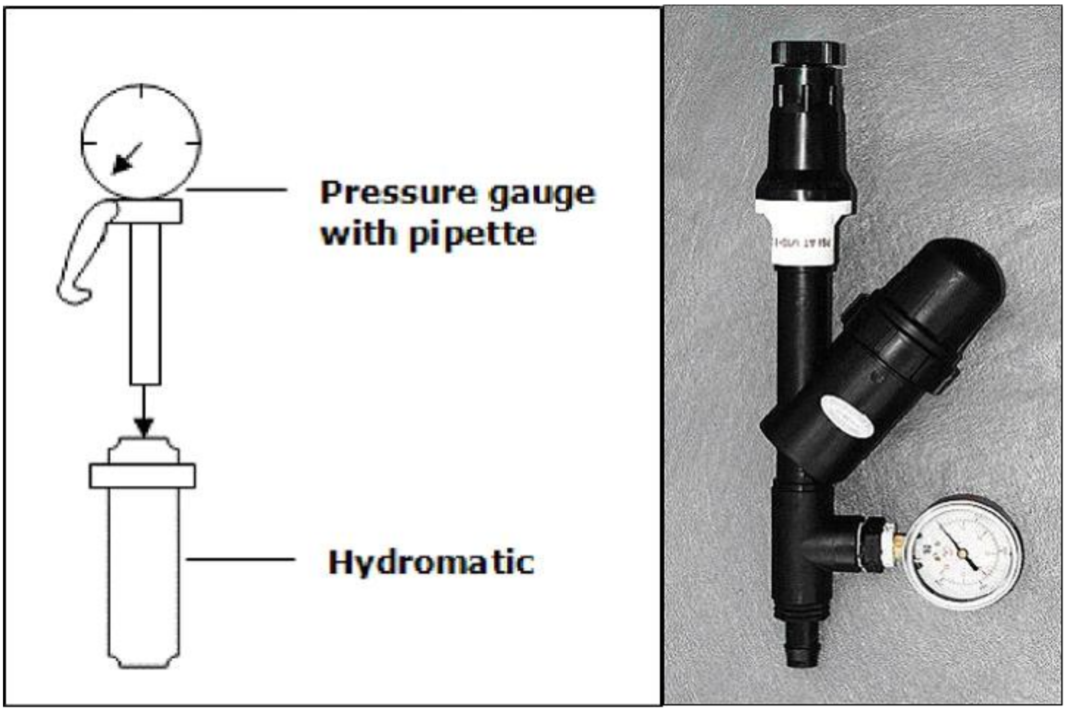
The correct pressure levels for infield valves are determined and prescribed by the irrigation manager or supervisor. The supervisor or manager will also set the pilot valves that are used on hydraulic valves, and no other person should be allowed to adjust the settings.

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.

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

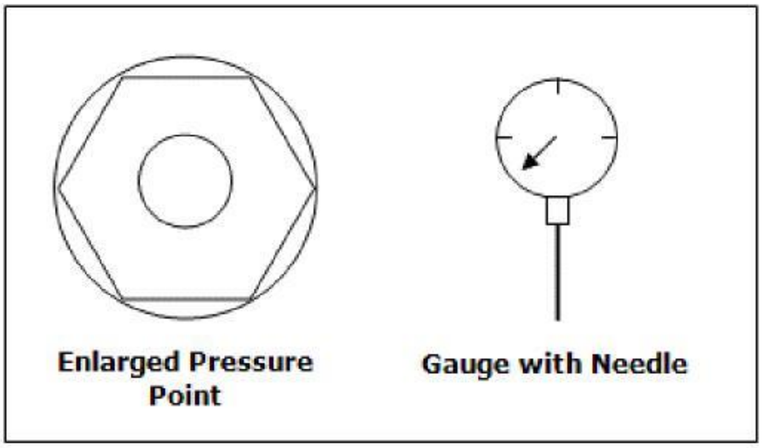
- Insert the pipette with the gauge into the hydromatic
- Make sure the latch on the pipette locks on to the hydromatic
- The pressure will register on the gauge
- To release the pipette, push it down, unlock the latch and remove it

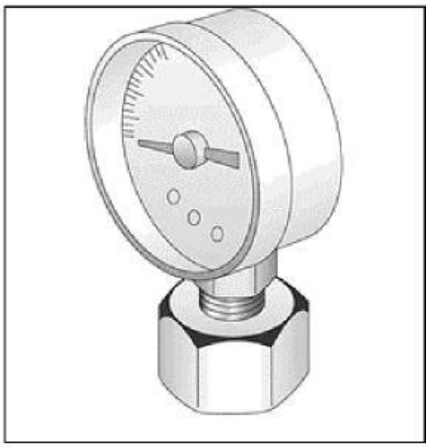



*Example of Pipette and Hydromatic*

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.





*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 practise 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 2.3 bar 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 2 bar, the reading should not be lower than 1.8 bar or higher than 2.2 bar, 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 2 bar, and the reading on the gauge is 1.7 bar, open the valve slowly until the pressure is 2 bar. If the reading is 2.3 bar, close the valve slowly until the reading is 2 bar.

## Measuring infield filter pressure

In some irrigation systems, secondary inline filters are fitted. Using the same techniques as for the valves, measure the pressure upstream, being before the filter, and downstream, and being after the filter. The difference between the two readings should not be more than 0.5 bar.

If the inline filters are in a bank, i.e. two or more filters are in parallel, the filters can be back-flushed. After back-flushing, take a pressure reading again. If the difference is still greater than 0.5 bar.

- Close the filter inlet valve
- Remove the filter lid
- Remove the elements from the filter
- Clean it with a brush (see the manual for the specific filter)
- Re-insert the elements
- Replace the filter lid
- Open the inlet valve

Take a pressure reading again. If the difference is still larger than 0.5 bar, report this to the supervisor or manager.

# IRRIGATE CROP ACCORDING TO GIVEN GUIDELINES

## Monitoring irrigation quality

In crop production, it is important to have a uniform irrigation pattern in all blocks. The entire root-zone must be wetted uniformly. Regular quality checks on the system are essential to ensure that the prescribed standards are maintained.

While a block is being irrigated, a visual inspection must be done, focussing on the following:

- **Leaks** – Any leak, large or small, must be repaired immediately using a suitable joint or fitting. Leaks that cannot be repaired must be reported immediately to the supervisor or manager. Close the infield valve that controls the flow to the irrigation block in case of a large leak or a burst pipe.

- **Dry Spots** – While irrigating, one should always be on the lookout for dry spots. Determine the cause of the dry spot, which may be a clogged micro or dripper, or a faulty spreader. If the micro is blocked, remove the micro from the peg, remove the head and clean the nozzle. If a dripper is blocked, tap the dripper with your finger. If it stays clogged, report it to the supervisor or manager. Never use a sharp object to unclogged the dripper as this will damage or puncture the dripper. Dry spots can also occur due to swivels that remain stationary, spreaders that spray skew or micros that have fallen over. Make sure that the peg is upright that the spreader sprays in the right direction and pattern, and that the swivels are turning.

- **Overlapping** – Most irrigation systems have a small degree of overlapping. Be on the lookout for excessive overlapping on the one side of a crop and a dry spot on the other. Move the emitter more to the centre. Overlapping can also occur when the radius of the spreader or spinner increases, due to pressure being too high, which may coincide with misting. Check the pressure, make the necessary adjustment, and report the matter to the manager.

- **Over- and under-irrigation** – Too much water is just as bad for crops as too little water. Be attentive to large puddles and runoff forming, which may be an indication of over-irrigation. Check that the pressure is not too high, and that the stand-time is not too long. Under-irrigation will cause crops to wilt. Check that the pressure is not too low and that the stand-time is not too short.

## Irrigation scheduling

Irrigation scheduling determines the amount of time (stand-time) and water that each block receives, and also indicates the time allowed to change the valves. Scheduling varies between seasons according to the phenology of the crop.

The irrigation schedule is determined and prescribed by the irrigation manager. Keeping to the irrigation schedule ensures that irrigation is effective.

Remember that the stand-time and the time required to open valves vary between seasons and between farms. It is important to open the valve of the specified block at the right time, and to close it at the right time. Failing to do so will affect the crop negatively.

## Monitoring operational parameters

Operational parameters are the parameters within which the irrigation system should operate to ensure that it functions effectively. These parameters include operating pressures, stand-times and the quality checks as set out in section 1 of this chapter.

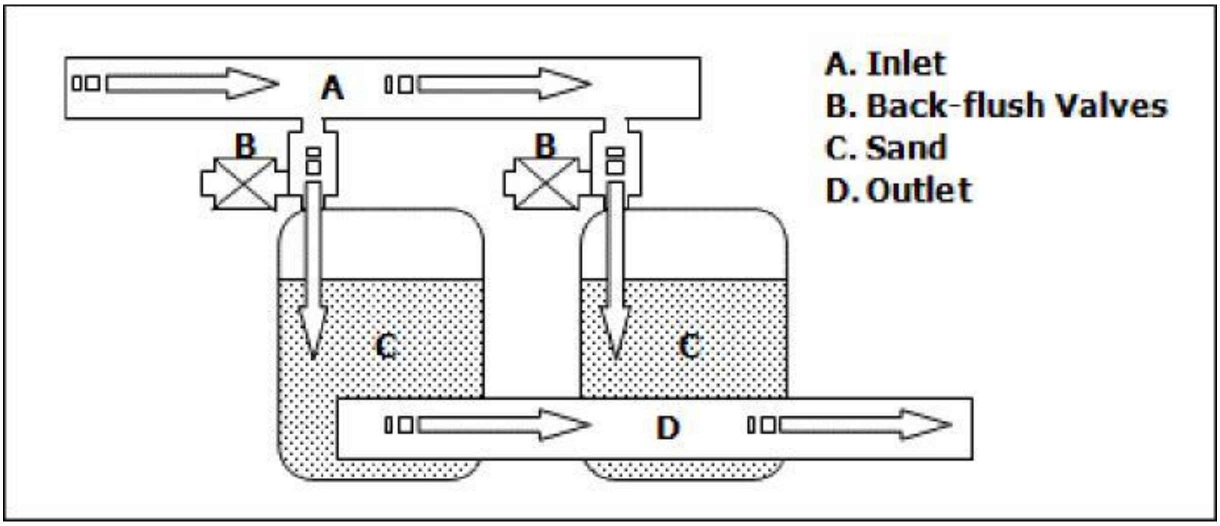
During irrigation, these parameters must be monitored and recorded. Recordkeeping of these parameters is important, as this helps the manager to manage the irrigation effectively and to detect possible problems early.

# CARE AND MAINTENANCE OF EQUIPMENT AND TOOLS USED DURING IRRIGATION

## Flushing and cleaning filters

Primary filters are usually in banks and can be either sand or disc filters.

Filters in banks are back-flushed using hydraulic valves. In a sand filter, water enters through the inlet and is filtered through the sand during normal operation with back-flush valves closed. The clean water exits through the outlet and the dirt and impurities stay trapped in the sand. The more the filter is used, the dirtier the sand will become.



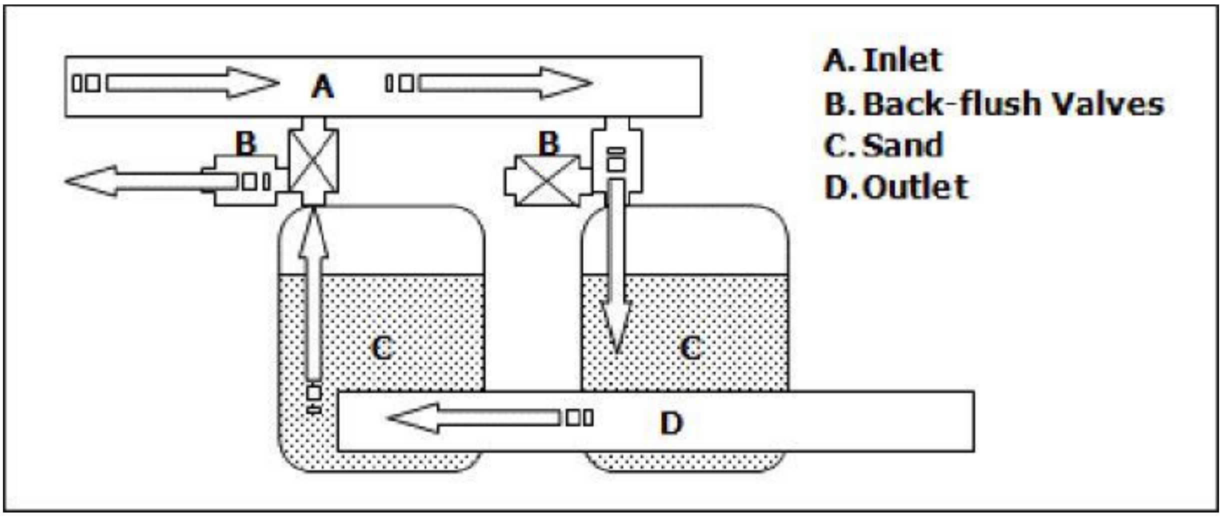

*Normal Filtration in Sand Filter*

If the sand has become dirty to a point where water cannot pass through it easily any longer, a pressure differential between the in- and outlet of greater than 0.5bar occur. The filter needs to be back-flushed.

If filters are not back-flushed regularly in the prescribed manner, dirt will accumulate in the filter, causing holes in the sand. The accumulated dirt causes irregular flow inside the filter. This irregular flow blow holes inside the sand. The water will move through the holes and not the sand, meaning that the water will not be filtered properly.

Filters are flushed up to five times a day or even more, depending on the water quality. It is good practice to also flush the filter once a week with the main valve closed. This will create extra pressure to flush out the filter. Once a month the filter lid must be opened and the inside inspected. Remember not to do this while the filter is under pressure. Check that the sand is loose and not caked. Caked sand will not break up during back flush, so the dirt stays inside the filter. If the sand is caked, report it to the manager.

The filters in the bank are flushed one at a time. During the back-flush, the inlet of the filter is closed, and the back-flush valve is opened. Clean water from the other filter flows back through the filter that is being flushed. The dirt is washed out with the waste water. The filter must be flushed for no less than 60 seconds. If the water is brown and muddy, it is a good indication that the filter is doing its job. Flushing must continue until the water is clear.




*Back-flushing of Sand Filter*

Disc filters use discs to filter water instead of sand. If the filters are in a bank, they can be back-flushed in the same manner as sand filters. If the filter is a single inline type, it can be cleaned by removing the filter element or cartridge, as follows:

- Loosen the filter element.
- Remove the individual discs.
- Scrub each disc with a brush and water.
- Replace in the same way and with the same amount in the filter element.
- Reinsert the filter element into the filter.
- Close the lid.

The filter elements are removed and cleaned on a weekly to monthly basis, depending on water quality.

## Pipeline maintenance

Leaks in pipes, connections and flanges must be repaired as soon as they are detected. Basic repair and replacement items must be kept on the farm for this purpose.

It is important to flush the mother-lines and lateral lines regularly. The intervals between flushing vary depending on the season, being weekly in mid-summer and monthly in winter. Proper flushing reduces emitter blockage and forms an essential part of the maintenance program. The supervisor or manager will prescribe the appropriate flushing interval.

## Tool Maintenance

Proper care and maintenance of tools prolongs their lifespan and will help to ensure that they work properly. Follow these guidelines:

- **Hand Tools** includes pliers, spanners, screwdrivers, spades and any other hand tools. After use, wash, clean and dry the tools if required, otherwise wipe them with a rag. Regularly following this procedure will prevent rusting. When tools are dry and clean, store them in the proper place that prevents theft and accidents.
- **Pressure Gauges** – Keep gauges away from high temperatures and protect them from bumps and shocks. If the gauge is filled with fluid, keep it $^{3}/_{4}$ full of glycerine. Never use a low-pressure gauge to measure high pressure as this will damage the gauge and make it inaccurate.
- **Grease Guns and Oil Cans** – Keep grease guns and oil cans free of sand and grit. Always wipe the tip of the grease gun before use to remove any sand or grit. Wipe off excess grease and oil after use, and after filling the cans.

Tools must be stored in a shed or an enclosed area that can be locked. This prevents theft of tools. A system must be in place to ensure that tools are returned after being used. It is helpful to have designated areas for the different tools marked on a board, to which the tools can be returned. This not only keeps the tool shed tidy but allows one to see at a glance if a tool is missing.

## Reporting

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.

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