AGRICULTURALTVET COLLEGE

SMALL SCALE IRRIGATION DEVELOPMENT LEVEL-II

Model TTLM

Learning Guide #07

Unit of Competence: Maintaining Pressurized Irrigation Systems

Module Title: Maintaining Pressurized Irrigation Systems

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Nominal Duration: 35 Hours

Instruction Sheet	Learning Guide 07

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

- Carry out pre- and post-season maintenance
- Carry out periodic and routine maintenance activities on pressurized irrigation
- Record and report maintenance activities

Thisguidewillalsoassistyoutoattainthelearningoutcomestatedinthecoverpage.Specifically, upon Completion of this Learning Guide, you will be able to: –

- ✓ Prepare equipment for pre-season effective operation
- ✓ Flush, cleaning, closing down and maintaining system post-season
- ✓ Dismantle, loading, transporting and storing equipment
- ✓ Carry out all maintenance activities (gender and environment)
- ✓ Service mechanical equipment.
- ✓ Flush and cleaning supply and distribution systems with sprinklers and drip line
- ✓ Replace and cleaning outlets, strainers, pump screens and filters
- ✓ Inspect and recording system visually for leaks, faults and dry areas
- ✓ Maintain operation area in a clean and safe condition
- ✓ Carry out system maintenance at scheduled time
- ✓ Inspect parts for wear or blockage and reporting or replacing
- ✓ Reassemble and replacing outlet removed , cleaned and damaged
- ✓ Record all damage and blockage
- ✓ Record and reporting damage or faulty pumps, valves, electrical components
- ✓ Record and reporting all routine maintenance activities

Learning Activities

1. Read the specific objectives of this Learning Guide.
2. Read the information written in the "Information Sheets.
3. Accomplish the" Self-check" at the end of each learning outcomes.

4. IfyouearnedasatisfactoryevaluationproceedtothenextInformationSheet.However,if your rating is unsatisfactory, see your teacher for further instructions or go back to the Learning Activity.
5. Submit your accomplished Self-check. This will form part of your training portfolio
6. Follow the steps and procedure list on the operation sheet
7. Do the "LAP test" and Request your teacher to evaluate your performance

Information Sheet 1	Carrying out pre- and post-season maintenance

1.1 Pre-season preparation of equipment for effective operation

Maintaining pressurized irrigation systems: is one most effective ways to reduce wasted water, reduce pollution from run-off and over-irrigation, and improve plant health by applying the correct amount of water where it can be utilized by the landscape. **Pre-season** irrigation maintenance is as it sounds - maintenance that occurs prior to the start of a new season. A pressurized irrigation system provides water to garden beds, lawn areas, nursery, etc. All of these areas have different types of plants and different watering requirements. The system has therefore been designed to efficiently distribute water for these different needs. Pressurized irrigation system needs to be maintained prior to the new season starting.

The basics of irrigation maintenance are:

- ✓ Inspect the controller and make sure it's plugged in and functioning:
- ✓ Update the time and date
- ✓ Check the connection on all of the wires – make sure that rain, wind, or soil moisture sensors are connected
- ✓ Replace the back-up battery
- ✓ Change the schedule to reflect the current season and irrigation needs of the landscape
- ✓ Turn on each zone and look for system damage

- Preparing pre-season pressurized irrigation equipment

Table 1.1 checking of pre-season pressurized irrigation equipment

No.	Equipment	check	No.	Equipment	Check
1	Safety	Pump switch is tagged/locked	8	Main lines	✓ Main lines undamaged ✓ Tapping saddles/ connections secure
2	Water supply	Checks completed	9	Sprinkler	. Each nozzle for correct size and not worn, not blocked . Moving sprinkler parts free
3	Pump	✓ Clean inside and out, flow meter and pressure gauge serviceable	10	Flexible connecting pipe	Flexible, not cracking or split
4	Filtration	✓ Rings/screens clean with no holes ✓ Pressure gauges in good condition	11	Headwork	For leaks
5	Control valve	Operational with ease	12	System pressure	All off-take pressures correct
6	Off-take	Hydrants secure	13	Pipe network	✓ For leaks along mains

					✓ Laterals flush clear
7	Flushing points	Flushing points accessible	14	Connecting pipe	Not leaking

In all piped systems the main component parts are:

- ✓ The control station (head control unit);
- ✓ The mains and sub mains (pipelines);
- ✓ The hydrants;
- ✓ The manifolds (feeder pipelines);
- ✓ The laterals (irrigating pipelines) with the emitters.

Note: all the above listed component parts should be checked weather they are functional or not if they are not functional replace by functional parts

- **Before placing the System into service each season, check the following:**

Visual Inspection: Make a visual check of all bolts in the System making sure something has not become loose during the idle period. When the System has been newly installed, all the bolts should be checked with an end wrench to make sure they have been tightened by the erection crew. One loose bolt may cause serious structural damages. Check the electrical boxes and wiring of the System to make sure the Ground Wires are secured and rodents or insects have not damaged the Systems' mechanisms.

Flushing/Draining the System: Place the Disconnect Switch in the "OFF" position. Only water is required for this procedure – the System does not need to move. DO NOT start the flushing procedure while the System is under water pressure. Removing Sand Trap Caps while the System is under pressure can cause personal injury or death! Remove the Sand Trap Cap and pump water through the System. This will flush out any foreign material that might plug the Sprinkler Heads or Sprinkler Valves. This is particularly important on newly installed Systems, because of possible straw, dirt or any other material may be accumulated in the pipe during

erection. After the Sand Trap Cap is back in place, pump water through the System and check the Sprinklers for proper operation. The arc travel of the End Gun should be set as the diagrams show on page 16 of the owner's manual. Also, check the System water pressure to see if it is operating at the proper pressure. If the water pressure has fallen, may need adjustment or repair, or after time, the Sprinkler Head nozzles may be worn. Repair or replace any worn or damaged sprinklers, pressure regulators, or fittings. These problems will reduce the uniformity of water application and should be corrected. If a Sprinkler Nozzle is replaced, make sure the new one is the same size. After flushing the System, check the function of the Low Pressure Drains by pushing each one upward in a rotating motion. Low Pressure Drains are located on the bottom side of each Hook Joint, the Last Tower Top and on the End Boom Pipe.

Lubrication: Grease fittings are located on the Power Tower Cart (Lateral Move only), Pivot Point (8), at any optional Steel U-joints (1 each), and on any Towable Gearboxes (2 each). These fittings should be greased with good quality grease. Check the oil level in the center Drive and **Wheel Gearboxes**. Water condenses in the Gearboxes and should be drained. The water may be drained by loosening the drain plug on the bottom. When the plug is removed, if there is any water, it will be the first to drain out. Do not overfill any of these Gearboxes! Overfilling may result in seal damage. NOTE: Refer to the Reinke Wheel Gearbox Maintenance Section.

Switches: Main Control Panel Switches should be cycled and checked for proper System operation. All automatic controls such as Auto-Stop, End Gun, Tower Auto-Stop and Tower Auto-Reverse should be cycled to check for proper operation. Consult your Reinke Dealer or authorized Service Technician for assistance.

Booster Pump: If a Booster pump is installed on your System, it should be inspected for proper operation. A second person should be located near the End Boom. Turn the Percent Timer to zero and with power to the System, press the Start Button. When the System is at normal operating pressure, turn the End Gun Switch to the ON position and check the phasing of the Booster Pump. When viewing from above, the pump shaft should be turning in a clockwise direction when running. Operating the pump backward can damage the pump. When the End

Gun switch is OFF, the Booster Pump should be OFF. If the phasing needs to be changed, contact Service Person.

Tires: Tire pressure should be maintained according to the chart in the owner's manual. Also, inspect the Tires for impending problems (cuts, breaks, etc.).

Generators: If your System utilizes Generator Belts, check them for proper tension and wear. Before starting the Engine, remove any rodent nests from the Engine Fan Cover. The Generator Pulley may initially be rotated either direction to generate power. *Caution. If the Generator rotation is ever reversed later, the System will be out-of-phase.* Call your Dealer or Service Person to correct the phasing problem if you plan to operate the Generator while rotating it in the opposite direction.

NOTE: The Generator warranty requires that all Combustion Engines coupled to a Generator, driving the System, must have a Governor, a Tachometer, and a Safety Load Meter. The Generator and System controls will be damaged by over or under Engine speeding.

There are a few things that we need to do.

1. **Inspection:** check that all parts are in good working order. This includes the sprinkler heads, pipes and valves.
2. **Fix:** find out how to fix problems that you may find in your inspection and determine the types of equipment you would need to fix them.
3. **Assist:** help a new employee to decommission some equipment including parts of an in ground irrigation system; aluminum snap lock system; dripper system and bayonet sprinklers.

There are some fairly common problems that are picked up in a pre-season check of gardens. Things like valve boxes and sprinklers getting covered by mulch and vegetation; sprinkler heads can sometimes get blocked by dirt or ants; and damage to the poly pipe or sprinklers are also not uncommon.

The process for fixing them is to:

1. Find them.
2. Write their position on an irrigation plan.
3. Write up an irrigation fault report for each.
4. Fix them.

General:

- Do a general cleaning of hull, deck and topsides using a mild detergent
- Make sure drains and scuppers are clear
- Put on a good coat of wax
- Clean and polish metal with a good metal polish
- Clean teak and oil
- Clean windows and hatches
- Clean canvas, bimini and dodger
- Clean interior including bilges
- Check spare parts and tools and replace as necessary
- Make sure registration is current and onboard
- Check and replace wiper blades if necessary

Hull

- Check for hull abrasions, scratches, gouges, etc. and repair
- Check and replace zincs
- Check for blisters and refinish is necessary
- Check rub rails
- Check swim platform and/or ladder
- Inspect and test trim tabs
- Check shaft, cutlass bearing, strut and prop
- Check rudder and fittings
- Touch up or replace antifouling paint

Deck, fittings, safety equipment:

- Check stanchion, pulpits and lifelines for integrity
- Check ground tackle, lines, fenders, etc.
- Check chain plates and cleats

- Check hull/deck joint
- Check deck, windows, and port lights for leaks
- Inspect anchor windlass and lubricate
- Clean and grease winches
- Check and lubricate blocks, pad eyes, etc.
- Check dinghy, and life raft

Below decks:

- Check, test and lubricate sea cocks
- Check condition of hoses and clamps
- Make sure below waterline hoses are double clamped
- Check bilges pumps for automatic and manual operation
- Check for oil in bilges
- Check limber holes and make sure they are clear of debris

Electrical system and components:

- Check battery water level
- Check/recharge batteries
- Check terminals for corrosion, clean and lubricate
- Check bonding system
- Inspect all wiring for wear and chafe
- Test all gauges for operability
- Check shore power and charger
- Check for spare fuses
- Check all lighting fixtures (including navigation lights) and make sure you have spare bulbs
- Check all electronics for proper operation
- Inspect antennas

Required and recommended equipment:

- Sound signaling device
- Check distress signals and expiration date
- Check Pfds
- Inspect life rings and cushions
- Check fire extinguishers and recharge if necessary
- Check and adjust compass
- Check navigation lights

- Check charts and replace as necessary
- Check radar reflector
- Check and replace first aid supplies
- Check bailer and hand pump

Inboard engine(s):

- Change oil & filters - have spare onboard
- Check and change fuel filters - have spares onboard
- Check and change engine zincs
- Check cooling system change coolant as necessary - have extra onboard
- Record engine maintenance log, especially date & hours of last oil changes
- Check belts for tension
- Check transmission fluid
- Check and clean backfire flame arrestor
- Check impeller
- Check and clean water strainer
- Check bilge blower

Head system:

- Checked for smooth operation - lubricate and clean as necessary
- If equipped with treatment system, have chemicals on hand
- Y-valve operation checked, valve labeled & secured

Water system:

- Flush water tank
- Check water system and pump for leaks and proper operation
- Check hot water tank working on both AC and engines
- Check for tank cap keys on board
- Check and clean shower sump pump screens

Galley:

- Fill propane tank, check electric & manual valves, check storage box vent to make sure it is clear
- Check refrigerator, clean and freshen, operate on AC and DC
- Clean stove, check that all burners and oven are working
- Check microwave, if fitted

Outboard motor:

- Replace spark plugs
- Check plug wires for wear
- Check prop for nicks and bends
- Change/fill gear lube
- Inspect fuel lines, primer bulb and tank for leaks
- Lubricate and spray moveable parts

Trailer:

- Check for current registration
- Check rollers and pads
- Check and lubricate wheel bearings
- Clean and lubricate winch
- Lubricate tongue jack and wheel
- Test lights and electrical connections
- Check tire pressure and condition
- Check brakes (if equipped)
- Check safety chains
- Check tongue lock

Sails:

- Check general condition
- Look for wear and chafing
- Check battens and batten pockets
- Check all sail attachments
- Inspect bolt rope

Mast and rigging:

- Check mast and spreaders for corrosion or damage
- Inspect spreader boots and shrouds
- Inspect rivets and screw connections for corrosion
- Check reefing points and reefing gear
- Clean sail track
- Check rigging, turnbuckles and clevis pins for wear and corrosion
- Inspect stays for fraying and "fish hooks"
- Check forestay and backstay connections
- Check masthead fitting and pulleys
- Check and lubricate roller furling
- Check halyards and consider replacing or swapping end for end
- Tape turnbuckles, cotter pins, and spreaders

It is suggested that we add three more items to the spring checklist. They are as follows:

1. Lubricate stuffing boxes, shaft and rudder logs
2. Empty water separator filters
3. Shock the drinking water tank. Barry suggests pool shock not bleach. Pool shock breaks down in a few days and then can be flushed out.

1.2 Maintainingpost-season of pressurized irrigation equipment

- **Centrifugal pumps**
  - ✓ Drain all the water from pump and connecting pipelines.
  - ✓ Where possible, remove suction lines and store them.
  - ✓ Cover shaft and any exposed metal and all oil or grease lubricated bearings with protective lubricant.
  - ✓ Loosen ‘v’ belt or flat belt drive and insert piece of greaseproof paper between belts and pulley.

- ✓ Loosen packing gland.
- ✓ Clean debris and any other material from impeller and volute.

➢ **Internal combustion engines**

- ✓ Run engine to thoroughly warm up oil in the crankcase; stop engine and drain crankcase oil; replace drain plug and refill crankcase with high-grade engine oil; start engine and run slowly for two minutes to complete oil distribution on all surfaces.
- ✓ Stop engine; remove all spark plugs; pour 60 ml of engine oil into each spark plug hole; with ignition switch off, crank engine for several revolutions to distribute oil over the cylinder walls and valve mechanism; replace spark plugs.
- ✓ Drain oil from crankcase; drain cooling system and close drain cocks; drain all fuel from tank, lines and carburetor bowl; replace all plugs and close drain cock.
- ✓ Lubricate all accessories and seal all openings airtight, including air cleaner inlet, exhaust outlet, and crankcase breather tube, with weatherproof masking tape.
- ✓ Check oil filler cap, gas tank and radiator cap.
- ✓ Spray all accessories and electrical equipment with suitable insulating compound.
- ✓ Insert a strip of greaseproof paper under the 'v' belt pulley.
- ✓ Remove battery and store fully charged.
- ✓ Where the engine is in the open, cover with waterproof material.

➢ **Electric motors**

- ✓ Ensure that all bearings are well lubricated.
- ✓ Cover motor to protect against rodents, insects and dust, but provide ventilation.
- ✓ Lock control box in 'off' position and cover with a canvas where exposed in the open to protect against moisture and dust.

1.2.1 Cleaning of post season pressurized irrigation system

Drip irrigation systems are a necessary part of any modern greenhouse facility. The simplest drip irrigation system includes pressure regulator, filter, tubing and emitters (drippers). It provides a controlled and uniform distribution of water and nutrients between plants located along the

irrigation line. However, emitters are prone to clogging from deposits of calcium carbonate, algae or bacteria, so irrigation lines require maintenance for better and longer service.

The drip system filter should be checked every day and cleaned if necessary. Disc and screen filters are available on the market. The preference should be given to disc filters, as they are more resistant to clogging and easier to clean through back flushing. Check lines for leaks.

A pH higher than 6.0, and high EC may lead to precipitation of calcium and magnesium salts, which will clog the emitters. Precipitates may build up to the end of the season even when precautions have been taken. Partially clogged emitters may still conduct feeding solution, but they will distribute nutrients unevenly among the plants. Therefore, the lines should be flushed with acid at the end of each season to remove build-up.

Nitric acid is a most efficient solubilize although sulphuric and phosphoric acids can be used too. Flushing lines for one hour with pH 4.5 solution is usually effective enough. However, you can leave the solution overnight if you have a particularly tough precipitate build up. Flush the lines with water afterward. Avoid precipitate build-up through preventive measures rather than drastically eliminating it at the end of the season.

Mineral precipitates are relatively easy to remove compared to the organic slime formed by bacteria and algae. The preventive measure would be injections of chlorine or commercial bacterial control agents. Use 2 ppm chlorine daily to "rinse" at the end of irrigation cycle and 30 ppm if slime becomes a problem.

If there is already a lot of algae and bacteria growing in the pipeline, emitters can be plugged worse when the slime begins to break off and gets carried downstream. Therefore, it is very important to flush the lines extensively before irrigating again. Automatic valves flushing several liters of the feeding solution at the end of each irrigation cycle are not expensive and can be installed at the end of each dripline. This will prevent any build-up of particles or slime at the end of drip lines. To eliminate all microorganisms in your irrigation system; at the end of growing period inject sulphuric acid (pH 5) through one injector and 50 ppm chlorine through a second injector downstream from the sulphuric acid injection leave the solution overnight and flush it out the next morning.

1.3. Dismantling, loading, transporting and storing equipment requiring storage

Before loading and transporting irrigation equipment, it is necessary to dismantle properly, so that it can be easily packed and get ready for transportation .Material handling equipment (MHE) is used for the movement and storage of material within a facility or at a site. Material handling equipment can be classified into the following five major categories:

Transport Equipment.Equipment used to move material from one location to another (e.g., between workplaces, between a loading dock and a storage area, etc.). The major subcategories of transport equipment are conveyors, cranes, and industrial trucks. Material can also be transported manually using no equipment.

Positioning Equipment.Equipment used to handle material at a single location so that it is in the correct position for subsequent handling, machining, transport, or storage. Unlike transport equipment, positioning equipment is usually used for handling at a single workplace. Material can also be positioned manually using no equipment.

Unit Load Formation Equipment.Equipment used to restrict materials so that they maintain their integrity when handled a single load during transport and for storage. If materials are self-restraining (e.g., a single part or interlocking parts), then they can be formed into a unit load with no equipment.

Storage Equipment. Equipment used for holding or buffering materials over a period of time. Some storage equipment may include the transport of materials. If materials are block stacked directly on the floor, then no storage equipment is required.

Identification and Control Equipment. Equipment used to collect and communicate the information that is used to coordinate the flow of materials within a facility and between a facility and its suppliers and customers. The identification of materials and associated control can be performed manually with no specialized equipment.

Transporting and stacking large equipment's has caused numerous injuries to and deaths of operators of the machinery and people near the scene of operations. Many accidents occur when

equipment's topple off the forks of a front-end loader and strike the operator. Accidents can be avoided by using suitable equipment for the job and by taking care when using the equipment.

- **Equipment Handling Attachments**

It's important to use only properly designed and constructed mechanical handling equipment, for example a loader, lift truck or rough terrain handler, with a proprietary handling attachment to ensure the equipment is secure from movement during lifting. Ensure your machinery is properly maintained.

- **Safety in Handling and Transporting**

The equipment has to be purposely designed to secure the equipment's or to restrain it that it cannot fall when raised. Where possible, avoid using parts and attachments not purpose-built for the particular model of front-end loader you are using. Any modifications made to existing equipment must be purposely designed and the work should be carried out by qualified persons.

Self-Check 1	**Written Test**

Name: _____ **Date:** _____

Directions: **Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers**

1. How to handle pressurized irrigation components? 5pts
2. Define visual inspection pressurized irrigation system? 5pts
3. Discuss about maintenance of post season irrigation system? 5pts

Note: **Satisfactory rating –7.5points and above Unsatisfactory - below 7.5 points**

You can ask your teacher for the copy of the correct answer.

Operation sheet-1	**Investigate surveying tools, material and equipment**

Objectives: To check pressurized irrigation system.

Procedure:

1. Close the PPE
2. Identify component of pressurized irrigation system
3. Check weather functional or not
4. Replace the nonfunctional component
5. Maintain preseason and postseason pressurized irrigation system

LAP Test1	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions:

1. You are required to perform any of the following:

1.1 Request your teacher to arrange for you to visit the nearby pressurized irrigation system. You should identify component or equipment of pressurized irr. system

1.2 Request a set of pressurized irrigation component, then perform the following tasks in front of your teacher

1. Identify component of pressurized irrigation system
2. check weather functional or not
3. Replace the nonfunctional component
4. Maintain preseason and postseason pressurized irrigation system

1.3 Request your teacher for evaluation and feedback

Information Sheet-2	Carrying out routine maintenance activities on pressurized irrigation delivery systems

2.1 Carrying out maintenance activities

Regular maintenance is essential to keep equipment, machines and the work environment safe and reliable. Lack of maintenance or inadequate maintenance can lead to dangerous situations,

accidents and health problems. Maintenance is a high-risk activity with some of the hazards resulting from the nature of the work. Maintenance is carried out in all sectors and all workplaces. Therefore, maintenance workers are more likely than other employees to be exposed to various hazards.

According to the European Standard EN 13306, maintenance concerns the "combination of all technical, administrative and managerial actions during the life cycle of an item intended to retain it in, or restore it to, a state in which it can perform the required function".

Maintenance is a generic term for variety of tasks in very different types of sectors and all kinds of working environments. Maintenance activities include:

- ✓ Inspection
- ✓ testing
- ✓ measurement
- ✓ replacement
- ✓ adjustment
- ✓ repair
- ✓ upkeep
- ✓ fault detection
- ✓ replacement of parts
- ✓ servicing
- ✓ lubrication,
- ✓ cleaning

Maintenance is critical to ensure continuous productivity, to produce products of high quality and to keep company's competitiveness. But it also has an impact on occupational safety and health. Firstly, good maintenance is essential to keep machines and work environment safe and reliable. Secondly, maintenance itself is a high-risk activity and it has to be performed in a safe way, with appropriate protection of maintenance workers and other people present in the workplace.

Maintenance recommendations are based on industry standards and experience in reclamation facilities. However, equipment and situations vary greatly, and sound engineering and

management judgment must be exercised when applying these recommendations. Maintenance activities are generally classified as follow:

Operation and maintenance of irrigation systems

An Operation and Maintenance plan shall be prepared for landowner or operator use. The plan shall provide specific instructions for operating and maintaining facilities to ensure they function properly. The plan shall include the following provisions:

- Periodic cleaning and regarding of water storage facilities to maintain functionality.
- Periodic inspection, removal of debris, and repair if needed of trash racks and inlet and outlet structures to assure proper operation.
- Routine maintenance of mechanical components in accordance with manufacturer recommendations.
- Periodic inspection and maintenance of embankments and earth spillways to repair damage or control erosion and undesirable vegetation.
- Periodic removal of sediment from traps or storage facilities to maintain design capacity and efficiency.
- Periodic Inspection or testing of all pipelines and pumping plant components and appurtenances, as applicable.
- Routine maintenance of mechanical components in accordance with manufacturer recommendations.
- Periodic inspection and maintenance of embankments and earth spillways to repair damage or control erosion and undesirable vegetation.
- Periodic removal of sediment from traps or storage facilities to maintain design capacity and efficiency.
- Periodic Inspection or testing of all pipelines and pumping plant components and appurtenances, as applicable.

Maintenance activities can be more easily undertaken in the off-season, as during this period, labor from the farming community is normally plentiful. Furthermore, if farmers are engaged in maintenance work on their own land for their own benefit, they' are more likely to work

willingly. Also, operational personnel are more free at that time of the year and can be engaged to supervise or execute part of the maintenance work themselves

2.2. Servicing mechanical equipment

The Maintenance Service is entrusted with the overall responsibility for keeping the irrigation and drainage systems working in a satisfactory manner, within the limitations imposed by the initial design.

Similarly to the Operation Service, the main functions to be undertaken are:

- Planning the maintenance activities.
- Implementing the maintenance activities planned and those unforeseen;
- Monitoring the above mentioned activities.

A Maintenance Service requires data for good planning which can be obtained by regular monitoring. Without reliable data on costs for the different units of work and on productivity no realistic planning can be done. Later in this text, productivity data are given for machinery and manpower engaged in maintenance operations. They will be helpful when planning and costing activities if no better data are available, but a project should endeavor to have its own data based on the specific conditions of the area.

Maintenance of Pumps

Pump is a machine that converts mechanical energy into fluid energy, the fluid being incompressible. Maintenance is done on the machine in order to improve system reliability.

Maintenance may be:

- Preventive Predictive (Conditional Monitoring)⎪ Periodic⎪
- Break down
- RCM

Pump major components:

- Shaft
- Impeller
- Wear Rings
- Stuffing Box
- Diffuser Casing

- Bearings

Inspection during Maintenance:

- Pump Impeller.
- Mechanical Seal.
- Gland Packing.
- Shaft Sleeve.
- Relieve Valve.
- Pump Element (PD).

Periodical maintenance for pumping unit may include changing

- Engine oil
- Replacing the oil filter
- Replacing the air cleaner
- Checking battery water level
- Pre-cleaner
- Gear box oil
- Cooling
- System/water
- Fuel
- Battery charge and fuel tank
- Greasing the pump jack shaft and bearings and
- Flushing (de-silting) the pump.

Centre control tower maintenance may include

- Greasing head of pivot and all gearboxes
- Checking tire pressure and
- Cleaning electrical controls of authorized components.

There may be environmental considerations relating to the servicing of mechanical equipment such as disposal of oils/grease and used parts.

2.3. Flushing and cleaning supply and distribution systems

A properly operated and maintained pressurized/sprinkler irrigation system is an asset to the farm. This irrigation system was designed and installed to apply irrigation water to meet the water requirements of the crops. The 10-year design life of this system can be assured and usually increased by developing and carrying out a good operation and maintenance program.

This practice will require performance of periodic maintenance and also require operational items to maintain satisfactory performance. A good operation and maintenance program includes:

- Only operate the system when needed to furnish water for plant growth, for salt management, or to store moisture within the rooting depth of the plant. Monitor crops regularly, noting areas of moisture stress, and repair or adjust system operation as needed.
- Operate the system at the pressure, discharge rate, speed, duration and frequency as designed. Periodically examine each sprinkler and spray head, etc., for proper operation. Clean plugged nozzles, and replace if defective and worn. Use shank end of steel drill bits to check diameters.
- Promptly repair all leaks in delivery facilities by replacing valves, fittings, gaskets, and worn or damaged parts.
- During non-seasonal use, place appurtenances in an area where it they will not be damaged but are secure, if necessary.
- Maintain all screens, filters, valves, timers and other electrical and mechanical equipment in good operating condition, following manufacturer's recommendations. Drain and protect from freezing, as necessary.
- Eradicate or otherwise remove all rodents and/or burrowing animals that have or can potentially damage any part of the delivery, or application facilities. Immediately repair any damage caused by their activity.
- Immediately repair any vandalism, and vehicular or livestock damage. Do not allow livestock near equipment during operation.

Here are some tips how to maintain the system;

- Observing and if necessary cleaning the water tank before every irrigation as well as possible.

- Filling the tank only when it is clean.
- Observing and if necessary cleaning the filter before every irrigation and if necessary during irrigation.
- Checking for clogged drippers and replacing them by in-line drippers. (Or using connectors to connect pipe section of 10 cm with dripper.)
- Opening the drip laterals and flushing it after the last irrigation and before the next first irrigation.
- In case of leakage, fixing the leaking fitting or replacing it.

Flushing this method consists of pumping water under pressure into the distribution systems, thus removing the dirt by jet action. It can be done with a high pressure nozzle (80-100 atmosphere) delivered from a farm tractor of about 40 hp, or with a low pressure nozzle (20 atmosphere) delivered from a movable motor; 1000 m/day of tile drain can be cleaned with this machine. Its disadvantage is that it only removes a small portion of the silt and in sandy soils there is the risk of sand entering the pipes. With this method drains of up to 350 m can be cleaned.

Flushing the Transmitter Water Lines

Contaminants such as solder, soldering or brazing flux, oils, metal chips or burrs, and possibly Teflon sealing tape, can frequently be found in new transmitter waterlines. When the water lines are first installed, these contaminants must be flushed and cleaned from the system before the device and magnets are connected. The cleaning procedures in the transmitter manual should also be followed.

- Before cleaning the transmitter closed circulating water system,
- Disconnect the device and magnet, then
- Add jumper hoses between the input and output of the klystron and electromagnet water lines.
- Disconnect or bypass the pump motor.
- Fill the system with hot tap water.
- Open drain in transmitter cabinet and flush for 15 minutes or until clean.
- Separately flush water lines between tank and pump with hot tap water until clean.

- Connect all water lines and fill system with hot tap water and non-sudsing detergent. Trisodium phosphate is recommended; follow product directions.
- Operate water system with hot tap water for 30 minutes. An immersion heater may be used to maintain hot water.
- Drain and flush system with hot tap water for 30 minutes.
- Remove and clean filter element.
- Refill water system with tap water (ambient temperature).
- Operate water system.

Maintain water level while draining and flushing system until no detergent, foam, or foreign objects or particles are visible in drained or filter element. To test for detergents in water, use small glass test tube, drain sample of water into test tube and allow sitting for 5 minutes. To generate foam, vigorously shake test tube for 15 seconds and allow standing 15 seconds. A completely foam-free surface indicates no foam-producing impurities. Refer to the foaming test instructions in AEB-26.

Cleaning Water Lines

If there is heavy scaling on the Vapotron collector and/or blocked water passages, consult CPI for cleaning recommendations.

Chlorine present in tap water is harmful to the klystron water passages. Thorough flushing with deionizer water will remove all traces of chlorine. Never use tap water for final refill or for makeup water.

Other cleanliness issues

The sight glass and float of the water-flow indicators must also be kept clean to achieve efficient system operation. The water-flow indicators usually become contaminated during use, and this contamination collects on the sight glass and float, making the readouts difficult to see. If too much contamination is present on the glass and float, they may stick and produce an erroneous reading. The detergent and cleaning solutions may not remove all of this contamination. If this is the case, the flow meter must be removed and cleaned and the glass surface brushed.

Flushing Physical Contaminants

The filter on the drip irrigation system should be checked during or after each operating period, and cleaned if necessary. Cleaning frequency can be determined by installing a pressure gauge on the inlet and outlet sides of the filter. When the pressure loss through the filter exceeds 5-7 psi, it is time to clean the filter. A clogged cartridge filter should be replaced. A clogged screen or disc filter can be cleaned with a stiff-bristle brush or by soaking in water. Sand filters need to be back-flushed according to manufacturer's recommendations.

Since normal filtration only traps larger particles, fine silt and clay particles entering a drip irrigation system will settle as the water velocity decreases at the ends of the manifolds and laterals. Periodic flushing will remove this buildup, which would otherwise clog the emitters. Flush the main lines first, with all the manifold valves closed. Then flush each manifold one-at-a-time. Finally, flush the laterals, opening only as many ends at a time that will sustain adequate pressure for flushing. In all cases, flush long enough to observe clear water running out of the ends of the pipes for at least two minutes.

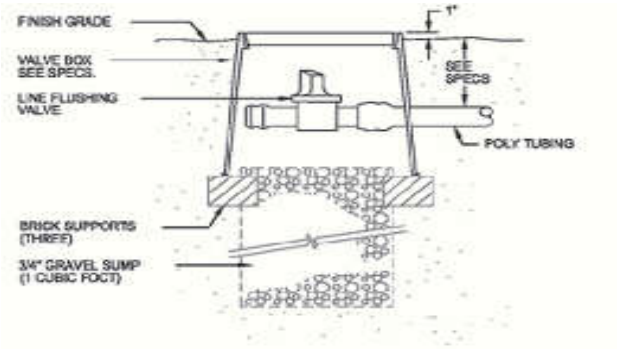


Figure 2.1 manual flushing

In any new installation the system should be flushed completely before the drippers are installed to prevent blockages at the first use and also flushed again immediately after drippers have been installed to flush out any polythene fragments or any other potential blockage material.

Procedure

- The mainline should be flushed with sub mains and laterals closed for at least 2 minutes or until clean water is flowing.
- The sub mains are next with the water being discharged from the end of the sub main until clean water is discharging.

- The laterals should be then flushed plot by plot for at least 2 minutes and until clean water is discharging.

2.4. Cleaning and replacing out lets, strainers, pump screens and filters

Checking Your System

The first step in cleaning and maintaining your drip irrigation system is performing a visual inspection. You'll want to look carefully at your system and make sure that nothing is out of place or looking worn. Worn tubing could be leaking over areas you wouldn't want it to, resulting in a big waste of water.

Fig 2.2. Simple checking up of system

Tubing Lines

Fig 2.3 checks for tubing line

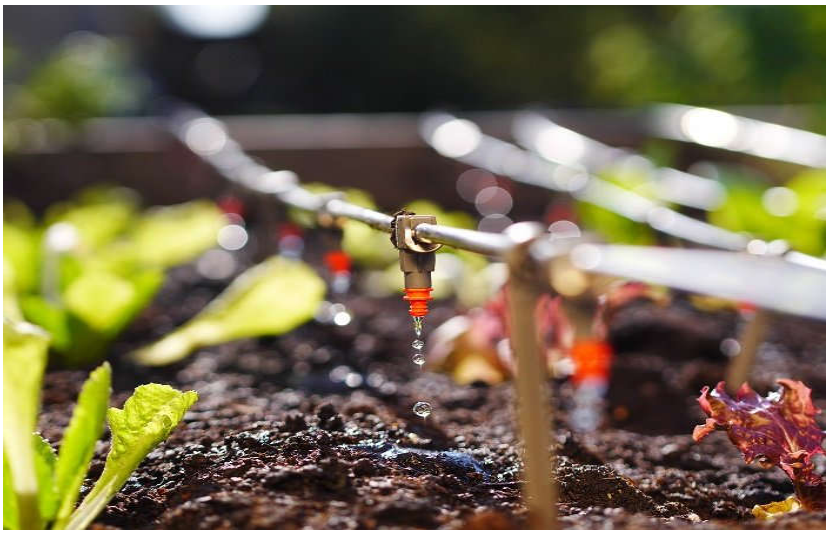
Of course, it may be easier to just run your hand along the tubing to identify any existing cracks or leaks. Once you find one, you'll either want to repair or replace that section of tubing. This decision will ultimately depend on the size of the leak, your particular setup, and your personal preference. Keep in mind that even the smallest leaks can result in a large amount of water loss over time if left untreated.

You may find that your tubes are being slimed from algae and bacteria in your system. This can be rather annoying and can eventually create clogs in your lines. Luckily, there are commercial bacteria and algae control agents you can add to your system that will help you eliminate this issue. A daily rinse of chlorine is another good option, but you'll only want to use about two parts per million at the end of each irrigation cycle. Alternatively, you can add an automatic valve to your drip lines that flushes the entire system out at the end of each irrigation cycle and reduces the amount of slime buildup inside.

Filter

You'll also want to check your system's filter and clean it if necessary. If you currently have screen filters, and you're finding that they're clogging and hard to clean, it may be time to invest in some disc filters. Disc filters are better at filtering water, harder to clog, and can be back flushed for easy cleaning.

Emitters



2.4 showing emitter

Depending on your water supply (and anything you add to your water nutrient-wise), your emitters may be getting clogged with magnesium and calcium salts. Even if your emitters are only partially clogged, they can still create problems by unevenly distributing nutrients and water throughout the irrigation system. Rinse them out to the best of your ability, but bad build-up problems will usually require a more serious cleaning something you should usually do near the end of the growing season. One helpful tip on clearing up emitters is to soak them in a vinegar-based solution.

End-of-the-Season System Flushing

Flushing the lines can help clear out the buildup of unwanted material in them like bacteria and residual calcium salts. Use an acid to flush your lines out at the end of the growing season. Flush the lines with your acid of choice for about an hour. Afterward, flush the lines with water to clear out any of the remaining acid solution. If you find that the lines still look rough with buildup, you can leave the acid solution in them overnight for an extra good soaking. This flushing should take care of all the microorganisms and particulate buildup in your system.

In case of an emergency, there must be some system for easy communication between the pump house operator and the officer in charge - either telephone or signal or runner.

Here are some tips how to maintain the system;

- Observing and if necessary cleaning the water tank before every irrigation as well as possible. Filling the tank only when it is clean.
- Observing and if necessary cleaning the filter before every irrigation and if necessary during irrigation.
- Checking for clogged drippers and replacing them by in-line drippers. (Or using connectors to connect pipe section of 10 cm with dripper.)
- Opening the drip laterals and flushing it after the last irrigation and before the next first irrigation. In case of leakage, fixing the leaking fitting or replacing it.

2.5. Visually inspecting system for leaks, operating faults and dry areas and recording observations in the maintenance book.

Visually Inspection checks that all parts are in good working order. This includes the sprinkler heads, pipes and valves**.** Irrigation systems require checking the system for smooth running and making free of damage, leaks and blockages in channels, drains and outlets.

Leaks

Leaks are the easiest problems to locate and correct. A drop in system pressure usually indicates a leak. Leaks at fitting unions can often be fixed by tightening the fitting. However, a fitting may need to be disassembled and cleaned prior to tightening to remove particulates or buffer residues. If this does not correct the leak, it is best to replace the fitting. Leaks at other locations such as detector cells, pump heads and injection valves may require rebuilding or replacing seals. Check the instrument manual or contact the manufacturer for service.

The following questions will help you inspect an irrigation system and correct many of the problems you find. The result should be substantial water savings for you and your community. Note that some communities, water utilities, and businesses offer landscape water audits for those who want this service.

Step 1. Examine the condition and type of irrigation heads. Make regular checks for damaged or missing spray heads and leaking lines. Are there heads that spray a hard surface or that leave part of the landscape without water? Are any nozzles clogged? Are irrigation heads buried by surrounding grass or other plant growth? Twist to raise or if necessary dig out and reposition heads on flexible risers (swing pipe), or add a threaded riser to raise heads on inflexible risers to grade level.

What types of heads are installed? Spray heads deliver the same amount of water in 1/3 the time of rotors. Rotor heads are well suited to irrigating large turf areas and are rated more efficient than spray heads. Set a zone with rotor heads to run three times the number of minutes of a spray head zone if the same amount of water is required on the two landscape locations. The heads on one zone should all be of the same type. Replace different heads so all the heads within the same zone match.

Step 2.Is the area level or on a slope? Slopes and berms are hard to water efficiently because the water applied naturally runs off. Nozzles with a lower precipitation rate may be required on

slopes in addition to using cycle and soak applications. Adjust run times on the controller accordingly.

Step 3.Evaluate dry spots: Dry spots may be caused by poor coverage if irrigation heads have been installed too far apart or not in a recommended square or triangle pattern. Other causes can be low system water pressure, a plugged nozzle or a south, west or windy exposure.

Step 4.Evaluate wet spots: Wet areas may be due to normal system drainage—draining of water to the lowest point (head) in a zone after the zone shuts off. Wet spots could also be present in north-facing exposures or shaded areas that are over-irrigated. However, a leaky valve that causes constant seepage out to the heads is like a dripping indoor faucet. Open the valve box and either replace worn diaphragms in the solenoid valves, or with sealed units, replace the entire valve.

Step 5. Is the exposure full sun, shade, southwest slope, or something else? Adjust run times on the controller accordingly. A shady or northern exposure will likely require 1/2 the water of a level, sunny landscape. A south or west-facing slope may require two times the water of a level landscape area that is in full sun.

Step 6. What type of plants is being grown? Group plants with similar water requirements together and water appropriately. Established borders of medium to low water-using shrubs require less irrigation than bluegrass turf or a vegetable garden.

Step 7. Calculate precipitation rates and determine run times to set the controller. If you are unsure or need to confirm the manufacturer's ratings of how much water spray heads deliver per hour (precipitation rate), follow these steps. Place four identical, straight-sided cans between irrigation heads in a zone. Operate the zone for 15 minutes. Pour water from three of the cans into the fourth. Use a rule and measure, in inches, the depth of water collected in can four. Because each can represents 15 minutes or one-quarter hour of collection time, the total water in the fourth can represents four times 15 minutes or one hour of collection. Therefore, the water measured in can four is the sprinkler precipitation rate in inches per hour for that zone. To convert precipitation rates to minutes of run time for a zone, divide the water you want to apply in inches (ET) by the precipitation rate calculated in inches per hour, and multiply by 60 minutes per hour. The result is the run time in minutes for setting the controller.

$$\text{Sprinkler run time (in minutes)} = \frac{\text{Water you want to apply (in inches)}}{\text{Precipitation rate (in inches per hour)}} \times 60 \text{ (minutes per hour)}$$

2.6. Maintain operation area clean and safe condition

Site maintenance

- The job site shall be kept in a neat, clean, and orderly condition at all times during the Installation process.
- all scrap and excess materials are to be regularly removed from the site and not buried in trenches.

- Trenching, laying pipe and backfilling shall be continuous so that the amount of open trench at the end of each work day is minimized. Any open trench or other excavations shall be Barricaded and marked with high visibility flagging tape.
- This standard requires that installations covered shall be maintained in good working order in clean conditions accordance with the installer's instructions and ohs procedure.
- This means regular maintenance of the installation should be carried out, to ensure, in particular, the safety and reliability of the installation.
- Also the access and the associated environment shall be maintained in good working order in accordance with the installer instructions. According to this standard the installer of a drainage structure should provide the instructions for the owner of the enterprise and the maintenance organization detailing maintenance requirements according to the enterprise after completion of the installation, and as a result of a risk assessment.
- These instructions should be written in a manner that can be easily understood by compete maintenance persons and should take account of:
- The specifications and the intended use of the installation (type of installation, performance, type of goods to be transported, type of users, etc.);

- The environment in which the installation and its components are installed (weather conditions, vandalism, etc.); any restriction of use;
- The result of the risk assessment for every working area and for every task to be undertaken;
- The specific maintenance instructions provided by the manufacturer of safety components;
- In case of components other than safety components, where maintenance is necessary, the maintenance instructions provided by the manufacturer of these components. keep culverts, ditches and bridges clear to ensure proper drainage.

2.7. Carrying out system maintenance at scheduled time

The long-term operation of the irrigation installation depends upon simple maintenance carried out by the farmer. The periodic servicing of pumping plants and the repair of special devices (filters, injector, etc.) is carried out by trained maintenance and repair personnel. Maintenance is carried out during a period of non-use to prepare the system:

a) For the off-season shut-down; and

b) For use before the next season. All equipment requires a certain amount of care in handling for storage and maintenance. For every installation there is a procedure which concerns various aspects of the distribution network and the pumping unit.

Maintenance timetable for a new irrigation system

- ✓ Flush the piping - main line, sub-mains and distribution pipes.
- ✓ Flush the dripper lines.
- ✓ Check actual flow rate and working pressure for each irrigation shift (when the system is active for at least half an hour).
- ✓ Compare the data collected to the data supplied with the system (planned). The tolerance should not be greater than ±5%.

- **Once a week**

✓ Check actual flow rate and working pressure for each irrigation shift under regular operating conditions (i.e., when the system is active for at least half an hour and stabilized).

✓ Compare the data collected to the benchmark data.

✓ Check that the water reaches the ends of all the dripper lines.

✓ Check the pressure differential across the filters.

✓ A well-planned filtration system should lose 0.2 - 0.3 bar (when the filtration system is clean). If the pressure differential exceeds 0.8 bar (11.6 PSI), check the filter/s and their controller for faults.

- **Once a month**

✓ Check the pump's flow rate and pressure at its outlet.

✓ Flush the dripper lines. (A higher or lower frequency may be required, depending on the type and quality of the water.)

✓ If the filtration system is automatic, initiate flushing of the filter/s and check that all the components work as planned.

✓ If pressure-regulating valves are installed, check the pressure at the outlet of each one of them and compare these figures with the benchmark data.

- **Once a growing season:** In some cases the following need to be performed twice or three times in a growing season, depending on the type and quality of the water used.

✓ Check all the valves in the system.

✓ Check the level of dirt in the system (carbonates, algae and salt sedimentation).

✓ Check for occurrence of dripper clogging.

✓ Flush the piping - main line, sub-mains and distribution pipes.

✓ If necessary, inject hydrogen peroxide and/or acids as required.

- **At the end of the growing season**

✓ Inject chemicals for the maintenance and flushing of the main line, the sub-main lines, the distribution pipes and the dripper lines.

✓ Flush the dripper lines.

- ✓ Prepare the system for the inactive period between the growing seasons.

Proper maintenance of an irrigation system involves having a working knowledge of the functionality of the basic components that are common in all systems. This knowledge can be directed toward detecting and preventing problems associated with improperly functioning systems, thus preventing deterioration of landscapes. Irrigation work involves the maintenance and repair of all the components of the irrigation system. The scope of work includes, but is not limited to, the point of connection, piping system, electrical system and the sprinkler heads that apply water to the landscape area.

Drip irrigation system maintenance: Drip/low-volume irrigation system maintenance is more necessary, time consuming, and involved than maintenance of conventional sprinkler systems. The primary reasons are that sprinkler heads are more visible than drip emitters, (and associated problems are more apparent) and that drip systems have some additional components not normally installed on sprinkler systems .but contrary to popular belief, drip systems can be relatively trouble free for many years, particularly if certain maintenance checks and steps are performed periodically, and especially at the beginning and end of each season.

The first component to check is the filter:-which is normally found at the beginning of the system, right after the control valve. Filters are often neglected and never cleaned. With the system valve closed, unscrew the filter cover and remove, inspect, and if necessary clean the screen or disk element with a brush or hose. If the screen element is damaged it should be replaced, preferably with one with a stainless steel screen.

Flush out the lateral lines on a regular basis:-to do so, open the system control valve and unscrew the flush cap (or other end closure fitting) at the end of the ½" or ¾" poly tubing. Let the water run at full volume for a minute or two, making sure the water runs clear. If multiple line ends are present on a single system, flush them out one at a time.

Flushing the lines:- leave the system running, and walk the entire drip zone line, and check each emitter (if visible) and/or micro-sprinkler for leaks, clogs, and correct flow. Clogged or malfunctioning emitters should be replaced with emitters with the same flow rate. Clogged or

damaged micro-sprinklers are easier to check, and can sometimes be removed, flushed and re-installed. Check all compression or insert fittings for leaks and replace with the appropriate size if necessary. Sub-surface emitters are not visible but verify that there are no gaps in the wetted area on the soil surface. A pressure regulator installed on the system:- make sure it is functioning by installing a pressure gauge at the end of the line and checking the dynamic pressure. If the pressure is above the regulators limit, the regulator should be repaired or replaced.

Sprinkler system inspection, maintenance and testing requirements

- ✓ The owner or the owner's agent shall be responsible for carrying out inspection, maintenance and testing procedures of the sprinkler system.
- ✓ Sprinkler control valves shall not be closed in the event of a fire until the fire is extinguished or is considered to be under control by other means as determined by the fire department.
- ✓ Sprinklers shall be protected by acceptable sprinkler guards where there is a possibility of mechanical damage.
- ✓ Where operations require the temporary shutting down of sprinkler protection, such operations shall be programmed by the contractor working on the system to enable completion in the shortest possible time and protection restored as promptly as possible. The fire department shall be notified of such work
- ✓ Records shall be kept of all tests and service of each system and this record shall be retained for 2 years for
- ✓ Examination by the authority having jurisdiction.
- ✓ Do not paint sprinklers.

Inspection maintenance and testing shall conform Monthly inspection & testing responsibility: owner/occupant

- All valves controlling the sprinkler system water supply shall be inspected to ensure that they are locked in the open position.

- A water flow alarm test shall be performed using the alarm test valve. (Alarms should sound within 10 – 20 seconds of opening the valve). Prior notification of such tests shall be given to all parties who could be affected by the alarm.

Annual inspection & testing responsibility: qualified personnel

- ✓ Sprinklers shall be inspected for damage, corrosion or accumulations of grease, paint, or other deposits and shall be replaced where such conditions would impair the operation of the sprinkler system.
- ✓ At least one main drain test shall be conducted to ensure that the water supply available to the sprinkler system has not deteriorated.
- ✓ Where an electric fire pump is installed the pump shall be tested at full rated capacity.

Maintenance procedures

- ✓ Inspect all control valves. Visually inspect all the valves to be sure they are in the fully open position. All control valves should have a lock and chain to prevent accidental closure.
- ✓ Inspect all sprinklers. The sprinklers placed throughout your home should be visually inspected to determine if any of the following exist: 1) obstruction to spray. Make sure there is no storage items placed too close to the sprinkler which would affect the spray in the event of afire.
- ✓ Painted sprinklers damaged sprinklers. If any sprinkler has been damaged or painted it shall be replaced immediately. Once the test valve is closed, the alarm will stop. Some systems are equipped with an automatic water booster pump. The test method described above remains the same, except that the pump will start and stop automatically, the same as the alarm.

2.8. Parts are inspected for wear or blockage and reported or replaced

The following components should be inspected for wear and blockage:

- ➢ Flush mains, sub mains, manifolds and laterals.
- ➢ Inspect for possible damage to the network and repair it.
- ➢ Open fully and drain completely all valves.

- Remove dirt, corrosion and other foreign material from the component parts.
- Check emitters for possible clogging, damage, wear and signs of deterioration, and replace where necessary.
- Store all emitters in a dry clean place on shelves away from fertilizers, chemicals, oil, grease and lubricants.
- Examine the condition of air and check valves.
- Flush and drain filtration and fertilizer injection equipment.
- Clean all filter elements.
- Check condition of gaskets and seals; remove, clean and store in a dry place.
- Retrieve all portable plastic tubes by rolling them up in coils; store properly.
- Inspect all portable metal pipes for any kind of damage and consult suppliers for repair; store properly away from power lines and wiring.
- Drain completely all pipes left in the open.

How do I receive replacement parts/components?

Maintenance personnel involved in irrigation maintenance are responsible for ordering all replacement parts. The engineer must approve the ordered parts before they are bought, and determine whether the contractor will pay.

Replacement of original parts: Replacement of irrigation system components must be made with materials of the same manufacturer and model as the original equipment. Substitutions of materials other than the original equipment brand will be approved only when the original equipment has been discontinued and is no longer available for purchase at any location. The substituted component must be completely compatible with the original and must be approved in advance by the engineer. All repairs to the system shall Be identical to the original installation unless otherwise approved in advance by the engineer. All replacement parts must have the same output and coverage specifications as the previous equipment.

Changes to existing irrigation system: If changes to the irrigation system components will result in lower future maintenance costs, less frequent breakage, or an increase in public safety, you may request authorization from the engineer. As you prepare for another humid summer,

make sure that your drip irrigation system can handle the heat. Just like sprinkler systems, drip irrigation systems need regular maintenance in order to work properly. Without consistent care, drip irrigation systems can break down and prevent water from reaching your yard. The primary goal of our irrigation services is to provide a continuously improving irrigation system for your home and landscape. Flushing The Drip Irrigation System – If your drip irrigation system has a clogged emitter, your irrigation specialist may flush the entire system to remove the blockage. By turning on the drip irrigation system and obstructing the emitter, your specialist will use water pressure to unclog the broken part. Changing Emitters – After flushing the system, your specialist will be able to tell which emitters need to be repaired. If the emitter can't be cleaned, your irrigation specialist may remove the entire emitter and swap it with a new part. Checking Water Pressure – If your irrigation specialist thinks that there might be a leak in your drip irrigation system, they will check the water pressure to make sure your system is functioning properly. Replacing Broken Tubes – If there is a crack or permanent kink in your drip irrigation system, your irrigation specialist will replace the broken tubes with new tubing.

What are the components of a typical irrigation system is maintained?

An efficient irrigation system consists of a carefully engineered assembly of pipes, valves, sprinkler heads, electrical wires and other hardware. There are main components that are involved with all automatic sprinkler systems currently in use. The types and functions of these components are discussed below:

Sprinkler heads: Usually, the sprinkler heads in a watering zone are uniformly spaced long the lateral piping system (laterals). Each sprinkler delivers a metered amount of water over a part of the entire zone. It is essential that each zone has the same type of sprinkler heads on it because each type of sprinkler head has a specific rate of application. If different types of sprinklers are placed on the same lateral, the distribution will be uneven and dry and/or wet spots will develop.

Risers are fixed heads mounted on pipes projecting out of the ground. Since they are permanently installed above the height of surrounding plants, they can appear unsightly, create a hazard or be subject to damage; for example, from mowers. They are best suited for planting

beds or other non-traffic areas. When the water is turned off, they retract, allowing mowers to pass over them. In addition to spray head patterns mentioned above:

Spray nozzles are also available in special patterns for long, narrow strips of grass, such as in narrow medians and between sidewalk and street.

Drip tubing and **piping** are thin-walled poly tubing, 1/8-1 inch in diameter that supply water to emitters or microsprays (see below).

Emitters are devices that drip water at a slow rate. Output for drip Emitters is measured in gallons per hour (gph) with discharge rates generally ranging from 1/2-2 gph. Emitters are typically installed in a location that delivers water to the base of plants. On sloping terrain they should be placed on the uphill side of the area to be watered.

How do I detect and repair a break in the mainline: A break in a mainline normally will result in a high rate of water loss at the location of the break. Sometimes the breaks are not visible. What you should take notice of are wet areas that are present all the time. This may be an indication of a break or small leak. These problems should be taken care of immediately as they will eventually turn into the"high rate of water loss" mentioned earlier.

Mainline breaks require that water be shut off at the poc(point of connection)

- Place locater flag at area of break.
- Turn off water at poc.
- Dig a trench to a depth exposing break. Most mainlines are 18 to 24 inches deep. Remove soil to provide adequate work space around and under the pipe and break. (see note in lateral repair section.)
- Allow any water in the trench to drain and clean any loose soil from around the break.
- Use an approved pipe repair device (see below).
- Check for any leaks and repeat the process if leaks are found.
- Back fill trench, compact the soil by puddling (applying water to the top of the backfill), jetting (injecting water below the surface of backfill) or tamping (compacting soil with some type of compaction device).

This may have to be done in several lifts (layers), depending on the depth of excavation. For mainline pipe sizes larger than 2", do not use quick-fix repair couplings as they are not able to handle the water pressure spikes due to water hammer in larger systems. Knock-on couplings and mechanical type couplings are to be used in these situations. For repair of mainlines larger than 2" follow the instructions below: pvc repair couplings slip x spigot telescopic quick-fix. Made of high impact pvc type ii material in one-piece cylinder to avoid leaks; no solvent

Weld necessary. Includes an internal, high quality, self-lubricating epdm o-ring for long life and smooth movement.

How do I detect and repair a break in the lateral line

Breaks in a lateral will not be evident until the control valve of that zone is activated and water begins to flow through the lateral lines to the sprinkler heads. Many lateral line breaks occur at the connection to sprinkler heads. Laterals may be repaired any time the zone is not activated; or, if actively running, the water can be temporarily shut off at the control valve by closing the flow control.

Remember: If the flow control is closed to make repair, return it to the proper position (adjusted to the flow demand of the zone) after the repair is complete. If the break is located between sprinkler heads, use the same procedures as for a broken mainline.

Lateral repair checklist

- Locate the break.
- If the sprinklers are on, wait until they go off or close flow control on control valve.
- Excavate a hole large enough to have room to reach around the pipe in all directions (see note below) and around the break.
- Using the appropriate size quick-fix, make the cuts on either side of the break and complete repair as per the instructions on how to use a quick-fix.
- Let glue set up and remove the nozzles on the sprinkler heads downstream from the break.

- Activate the zone from the controller or by using the manual bleed on the remote control valve.
- Let water flush from the open sprinkler heads for a few minutes to remove any debris from the lines.
- Check for leaks around the repair before turning water off and filling hole.
- Replace sprinkler nozzles and test the zone one more time

Excavating for irrigation repair

When excavating for irrigation repair it is very important that the hole you dig is large enough so that you have lots of room to get your hands around the pipe. The other concern is that you have a large enough sump below the pipe so that any excess water and mud is not able to go into the cut pipe. The size of the hole will be different depending on the size of the pipe. Another consideration is that you will need enough room for the repair device that you are installing. One tip is that the area you uncover should be at least three times the size of all of the pieces you are replacing. For example, if the repair coupling and piece of pipe you are replacing amount to 12 inches, then you should have at least 36 inches (3 ft.) Of pipe uncovered, and at least 6-8 inches around(top, sides and bottom) the pipe. Keep in mind that all of these dimensions will increase as the pipe gets larger as you prepare for another humid summer, make sure that your drip irrigation system can handle the heat. Just like sprinkler systems, drip irrigation systems need regular maintenance in order to work properly.

Reassembling and replacing outlet removed, cleaned and damaged

During maintenance of pressurized irrigation system firstly we are expected to inspect for damaged, worn out and clogged area of our components before replacing and reassembling the components.

The general procedure for cleaning and replacing the outlets and damage parts are as follow

- ✓ Inspect for possible damage to the network and repair it.
- ✓ Flush mains, sub mains, manifolds and laterals.
- ✓ Open fully and drain completely all valves.

- ✓ Remove dirt, corrosion and other foreign material from the component parts.
- ✓ Check emitters for possible clogging, damage, wear and signs of deterioration, and replace where necessary.
- ✓ Store all emitters in a dry clean place on shelves away from fertilizers, chemicals, oil, grease and lubricants.
- ✓ Examine the condition of air and check valves.
- ✓ Flush and drain filtration and fertilizer injection equipment.
- ✓ Clean all filter elements.
- ✓ Check condition of gaskets and seals; remove, clean and store in a dry place.
- ✓ Retrieve all portable plastic tubes by rolling them up in coils; store properly.
- ✓ Inspect all portable metal pipes for any kind of damage and consult suppliers for repair; store properly away from power lines and wiring.
- ✓ Drain completely all pipes left in the open.

How to maintain and clean the out lets in drip irrigation system

Insert plugs into all the emitters: Emitters are the holes in the tubing of your drip system. Your system should have come with plastic black or green plugs that fit inside of the emitter holes. Press the plugs into the emitters along the length of the tubing. Unscrew the cap at the end of the mainline if it isn't removed already so that water can flow out of it freely. Plugging up the emitters will increase the water pressure and help loosen clogs. If you lost the plugs that came with your system, you can purchase new ones through the system's manufacturer or you can purchase 3rd party drip irrigation plugs online.

Turn the system on to flush it: Turn the handle for your system to the on position. The water should freely flow through the tubing and out of the end of the mainline, flushing out clogs and obstructions. It's normal for the water to be brown initially.

Examine the water for dirt or bacteria buildup: The water should run clear after about 10 seconds. If the water does not run clear and looks brown, you most likely have bacterial buildup in your system. Flushing the system with hydrochloric or phosphoric acid can remove these

buildups. No water should be coming out of the emitters during this time if you plugged them all up correctly.

Close the main line and remove the caps from all emitters. Screw the plug into the end of the mainline and remove the caps that you inserted into the emitters. Turn the system back on and take notice of any emitters that aren't dripping water

Thick wall drip hose: is a robust variation of a drip tape. It can be a plain hose and use point source emitters attached to the outside of the lateral or distribution line at a variable spacing. Thick wall hose is also made with internal emitters, molded or glued together at equal spacing within the distribution line as thin wall tape. The working pressure is higher, it ranges from 20 to 40 psi).The drip hose can be laid on the ground, above ground or buried for vineyards and pecan orchards. For vineyards a single hose per plant row is almost universal, it is installed 1 foot above ground, for other orchards like pecans two buried hoses may be necessary.

Subsurface drip and micro-sprinklers irrigation: for vineyards and orchards are becoming more popular. Micro-sprinklers are mini-sprays, micro-sprays, jets, or spinners. The emitters operate by throwing water through the air in predetermined patterns. Micro-sprinklers can be installed as a movable system, using external emitters or spinner heads individually connected to the lateral pipe line, with spaghetti tubing and mounted on a support, for young trees. Micro-sprinklers can be a solid set system, using emitters or spinner heads installed on a permanent PVC pipe riser connected to a manifold line. The flow rate of micro-sprinkler emitters vary to cover large areas, it ranges from 3 to 30 gph depending on the orifice size and line pressure.

How to maintain and clean the out lets in sprinkler irrigation system

Broken equipment why is this a problem? Broken equipment allows water to leak out of the system. Leaking water is not being efficiently applied to the landscape and results in runoff. Runoff won't keep your landscape healthy, though you still pay for it on your water bill.

How do you fix broken equipment: Most broken heads can be easily repaired? Dig up the existing head and replace it with a new one. Repairing broken valves lateral, and main lines

require more finesse. Only homeowners who feel very comfortable with their system should attempt these repairs. If they don't feel comfortable- they should call a certified contractor

Blocked Heads Blocked heads occur for a variety of reasons Overgrowth of vegetation Changes to landscape and not sprinkler system poorly placed heads

Why is this problem? Water is not reaching the intended area and can lead to uneven spray patter and brown grass.

How to Fix Blocked Heads: Trim back overgrows vegetation. Move the head with blocked spray pattern to a better location. If the area is not suited for watering by a sprinkler head, consider replacing the turf with water-conserving plants. Install heads with check valves to eliminate water loss from the system, and prevent excess wear on the system pipes. Several types and brands of heads come with pre-installed check valves. If a check valve is necessary, simply replace the whole head. Inappropriate nozzle/ spray pattern.

Clogged Nozzle: A clogged nozzle is caused be debris in the system getting stuck in the nozzle or the filter of a spray head. Clogs may be caused by dirt, sand, roots, plastic, etc. Clogged heads can cause uneven distribution of water resulting in brown spots.

How to Fix: Make sure system is off Screw the nozzle off of the spray head. Be sure to hold onto the stem of the head or clamp it to prevent it from dropping back into the body of the head. Take the filter out of the stem and wash out any debris in the filter or the nozzle. Put the clean filter back into the stem and screw the nozzle back on. Adjust the spray pattern to ensure that water is spraying onto the turf.

Overspray: Overspray is caused when sprinkler heads are improperly adjusted, and are set to spray on surfaces not requiring irrigation. These areas could be sidewalks, driveways, mulch or rock beds, or even fences. Overspray results in runoff and thus excessive water waste. Non-point source pollution

Maintenance of in-field systems

- Repair leakages along the service lines, hydrants and repair them promptly;

- Replace the missing, damaged control valves;
- Ensure that loose connections are tightened;
- Flush the system at the beginning of the irrigation;
- Clean the clogged nozzles;
- Replace non performing accessories e.g. springs, clips, seals, bed head arm;
- Broken or missing sprinkler head must be replaced;
- Align the misaligned heads: use the manufacturers manual to align;
- Reposition the sprinkler heads and fasten the tripods;

Note: Periodic inspection of supply lines, mechanical equipment and other accessories should be made throughout the irrigation season.

Maintenance of pipe network for repair and replace

- Regular flushing out of the pipe system by opening all washouts and end caps.
- Repair leakages and bursts promptly. It is recommended to remove a short length of pipeline on each side of the damage since the defects may be extended. If in doubt, replace the whole length of pipe;
- Replace the missing, damaged or vandalized pipes;
- Tighten the leaking joint and replace the damaged coupling/fittings. Avoid over tightening of steel couplers and must be protected against corrosion; Repair damaged thrust/anchor block and replace vandalized or damaged posts;
- Set the pressure as per the design and replace damaged pressure regulating devices;
- Repair damaged chamber covers and frame.

Note: precaution should be taken when repairing bursts under dirty conditions to ensure that Pipe and joint surfaces are clean throughout the operation

Maintenance of irrigation schemes

- Clean all valves regularly for blockage and repair all worn out parts;
- Grease bolts and other movable joints;
- Tighten the bolts;

- Bolts and nuts should be cleaned, greased and replaced if damaged or worn out;
- Flush the pressure reducing valves by pulling the easing lever up;
- Remove and clean strainers on diaphragm type valves;
- Repair any damage on the chamber walls, covers and frames.

Outlets /Sprinkler Heads maintenance:

- Missing or broken heads? (Replace heads with the same type of head.)
- Heads Clogged? (Remove the head and clean the filter or replace with the same type of head.)
- Heads tilted, spraying in the wrong directing, or too far in or above the ground? (Adjust or replace.)
- Leaking Water? (Replace a leaky valve in the valve box or check for a drainage problem.)
- Misdirected or blocked spray pattern? (Remove vegetation, trim grass, trees or shrubs, or other obstructions or consider raising the heads.)
- Spraying sidewalk, deck, building driveway or street? (Adjust the heads to stay within the planting area.)

Controller:

- Is the cabinet or space holding the controller clean? (Clean out cobwebs, dirt, debris, or ants.
- Is a new battery needed? (Consider replacing seasonally.)
- Is time/day showing correctly? (Reprogram)
- Is the controller programmed for the appropriate season? (Generally, plants need less water in the winter and mature plants need less water than newly installed plants. Refer to the seasonal watering schedule provided by your irrigator.)
- Is the controller programmed for any water conservation measures that may be in effect from your water purveyor? (Adjust program if needed.)

Drip/Micro Irrigation:

- Emitters connected to flex line.
- Ensure proper operation of operation of automatic flush valves.

- Service filter strainer periodically
- Flex line connected to riser.
- Micro adjustment nozzle connected to flex line and nozzle intact.
- Confirm operational pressures.
- Backflow Prevention Devices:

Self-Check 2	**Written Test**

Name: _____ Date: _____

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. Write some of the maintenance activities carried out in a pressurized irrigation system? (5pts.)
2. Write how you could flush and clean supply and distribution systems? (5 pts.)
3. List the steps you use to inspect for leaks, operating faults and dry areas? (10pts.)
4. Clearly list cleaning and flushing procedure of pressurized irrigation systems. (5 pts)
5. Write the procedures of servicing mechanical equipments. (5 pts)

Note: Satisfactory rating - 15 points and above Unsatisfactory - below 15 points

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

Operation sheet-2	**Carrying out routine maintenance activities on pressurized irrigation delivery systems**

Objective: Carry out routine maintenance on pressurized irrigation

Purpose: - A pressurized irrigation system is a system that relies on water pressure for the system to work. If the system is connected to the pressurized water main (mains pressure) no

pump is needed, however, if the water source is not pressurized, then a pump will be needed to pressurize the system.

Equipment, Tools and Materials:

Pipes, tubes, water emitting devices, flow control equipment, installation tools, fittings and accessories, engine oil, replacing the oil filter, replacing the air cleaner, checking battery water level, pre-cleaner, gear box oil, cooling system/water, fuel, battery charge and fuel tank, greasing the pump jack shaft and bearings, and flushing (de-silting) the pump.

Conditions: If the system is connected to the pressurized water main (mains pressure) no pump is needed, however, if the water source is not pressurized, then a pump will be needed to pressurize the system.

Procedure:

- Prepare maintenance plan
- Use appropriate PPE's
- Inspect the system and check functional and non-functional components
- Identify the clogged, broken and worn out components
- Visually Inspecting system for leaks, faults and dry areas
- Periodic cleaning and regarding of water storage facilities to maintain functionality.
- Periodic inspection, removal of debris, and repair if needed of trash racks and inlet and outlet structures to assure proper operation.
- Periodically inspect and maintain mechanical components in accordance with manufacturer recommendations.
- Periodic removal of sediment from traps or storage facilities to maintain design capacity and efficiency.
- Periodic Inspection or testing of all pipelines and pumping plant components and appurtenances, as applicable.
- Release all end caps / flush valves to clean the system of dirt
- Check pressure and discharge and ensure all emitters are working
- Repair and replace the worn out outlets and other components

Precaution:

Before maintaining the system be sure that you use appropriate PPE's. Care should be taken so that dirt, sand etc. does not enter into the pipes while making maintenance.

Quality Criteria:

At the completion of the project, should inspect for blockage, leaks, clogging, and worn out parts in irrigation pipes and connections ensure that all components are operating at their proper flow rate, and ensure all trenches have been properly covered.

LAP Test/ Job Sheet	**Practical Demonstration**

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions:

You are required to perform the following:

Request a set of different activities in maintenance of pressurized irrigation systems and then perform the following task in front of your trainer:

- Prepare well plan for maintenance of pressurized irrigation components
- Identify the worn out, broken and clogged components
- Maintain the system according to the manual in front of your teacher

Information Sheet-3	**Recording and reporting maintenance activities**

3.1. Recording and locating damage and blockage caused by pests and vermin

Leaking valves or pipes: Leaks can occur as a result of weather damage (freezing and thawing), damage from shovels and other sharp tools, vandalism, tree roots, and normal aging of the system. Leaks from valves and pipes may be large and very obvious. Smaller leaks may not

show up immediately and will require some detective work. Replace or repair damaged valves and pipes.

Broken or missing heads: Damage can occur to sprinkler heads from lawn mowers, vandalism, improperly installed heads, and normal wear and tear. Replace damaged or missing heads immediately. Installing heads on swing pipe allows the head to "float" in the soil and reduces the damage that can result from lawn mowers and other heavy objects.

Clogged nozzles: Clogged nozzles occur as a result of debris entering the irrigation system, a dirty water source, and normal wear and tear. Flush system at the beginning of the irrigation system, install screens on sprinkler heads, replace clogged nozzles, and improve system filtration.

Seal leaks: Over time, dirt and debris can wear out the wiper seal resulting in leaks around the top of the spray head. If the spray head consists of a single unit the entire head must be replaced; with some spray heads it is possible to screw off the top of the sprinkler head and replace.

Sunken heads: It is not uncommon for sprinkler heads to settle over time. Even when the soil is packed around them during, the weight of lawn mowers and other heavy equipment on wet turf can cause the heads to settle. Grass clipping, soil, and other debris can build up around heads resulting in a head that doesn't clear the grass adequately and disrupts the spray pattern. Current best management practices call for higher mowing heights – older systems may have been designed for shorter turf. Heads can be raised by using taller sprinkler bodies, or installing risers. Cutting turf away from heads is another solution but must be seasonally.

Tilted heads: Lawn mowers and wet soil can cause newly installed sprinkler heads to tilt resulting in uneven coverage. If possible install the sprinkler head on swing pipe and move the head out of the line of mowers and other equipment that may cause the head to settle or shift. Otherwise reposition the head and pack the soil around it carefully.

3.1.1 Record System Data Monthly

One of the best ways to identify worn components such as sprinklers, pumps, or irrigation systems is to keep good records. Recording the outlet pressure, flow rate, hours of operation, and energy use each month provides an excellent means of evaluating pump and motor performance and identifying changes. The pivot should be in the same position each time the operating

pressure is recorded since the pump will produce different outlet pressures depending on whether it's facing uphill or downhill. Also, systems that do not have pressure regulators to maintain sprinkler pressure will have different flow rates. Compare the current flow rate and pressure to last year's and the years before.

- ✓ **The reports shall include:**
    - specification of the quantity of each of the principal damage and blockage caused by pests and vermin ,
    - specification of the quantity of each of the principal location and the section of the system affected
    - a summary of licensee disposal unit survey and maintenance activities,
    - a summary, by waste class, of activities and quantities disposed of,
    - any instances in which observed site characteristics were significantly different from those described in the application for a license; and
    - Any other information the Commission may require.

3.2. Recording and reporting damage or faulty pumps, valves, electrical components and

All routine maintenance

Damaged or faulty pumps, valves, electrical components, etc in irrigation systems should be recorded and reported to the supervisor. Maintenance and repair to these damaged parts should also be carried as soon as possible to avoid leakage and water losses.

The record of damaged or faulty pumps, valves, electrical components may also be stored in electronic media with the capability for producing legible, accurate, and complete records during the required retention period. Records such as letters, drawings, specifications, must include all pertinent information such as stamps, initials, and signatures.

Most commonly, slower re-prime can be attributed to excessive face clearance. If this is not the cause of your slowdown, check the following:

- Is the seal leaking?
- Is all hardware at gaskets tight?

- Is the cutwater section of the volute badly worn?

Is the re-circulating port clogged: A maximum vacuum check can be performed to determine the location of the problem? Fill the pump with the minimum amount of water than what the volute casing normally retains for re-priming. To do so, simply remove the suction flap valve, priming the volute casing and energizing the pump. After the pump achieves dynamic operation, turn the pump off and allow the liquid in the pump to return to the sump.

Whatever product remains in the volute casing is the minimum left for a re-prime cycle. Install a vacuum gauge on the suction side of the pump and close a valve in the suction line outboard of the gauge. If there are no valves in the suction line, a solid gasket without an inside diameter hole may be installed in a pipe joint to create a "valve" effect. Energize the pump and inspect the vacuum gauge. The pump will pull a vacuum against the closed valve or solid gasket. This reading is the equivalent to the pump's lift capabilities. If a vacuum gauge calibrated in inches of mercury (Hg) is used, multiply that reading by 1.13 to convert to feet of water.

The pump is making excessive noise: If your pump sounds like a bunch of marbles rattling in a can, this may be an indication of cavitation - and could be caused by a suction lift that's too high, a suction hose that's too long, plugged or has a collapsed lining, a clogged strainer, a combination of any of these, or perhaps a problem on the discharge side of the pump.

Failing bearings can also cause excessive noise. Noise should be qualified as mechanical or hydraulic noise. Run the pump briefly without water. If the noise is no longer present, it is of a hydraulic nature. If the noise is present after removing the product, then it's mechanical. Again, a quality set of gauge readings will direct your attention to the problem side of the system if the noise is deemed to be a hydraulic noise.

The pump is clogging frequently: If a pump's suction check valve is clogged, the strainer may be too large or too small, or face clearance could be too wide. Alternatively, the strainer may be stuck in mud, plugging the suction side.

The pump is overheating: In this case, very likely, the flow of liquid into or out of the pump is being restricted. Improper impeller clearance could be slowing re-priming, the suction strainer or recirculation port in the volute casing may be clogged or the pump's ability to handle air through an air release line, air release valve or open ended discharge line may be obstructed. Never open

a hot pump. Allow the pump to cool to the touch prior to opening. Even after cooling, there may be lingering pressure inside the volute casing.

The reports on damaged or faulty pumps, valves, electrical components shall include:

- specification of the quantity of each of the principal damage and blockage
- specification of the quantity of each of the principal location and the section of the system affected
- a summary of maintenance activities,
- a summary, by waste class, of activities and quantities disposed of,
- any instances in which observed site characteristics were significantly different from those described in the application for a license; and
- any other information the Commission may require

3.2.1 Recording and reporting all routine maintenance activities

Routine maintenance: the following works are to be carried out annually: cleaning of canal from silt, vegetation, and landslides; filling dams with earth; repair of small damages of canals, flumes, structures, buildings, and other facilities. Preventive repair is a variety of routine maintenance which provides for regular cleaning of certain sections of canals and berms (banquettes) from soil and vegetation, liquidation of burrowing animals' galleries, ice scabbling from structures, tightening of structures' bolted joints, arrangement of heating works, cleaning of structures from garbage, removal of floating objects, lubrication of bearings, etc. This repair is executed without stopping the operation of the irrigation system.

The record on routine maintenance activities of pressurized irrigation systems includes at least the following operations:

- a record on light deforestation on the system
- a record weed control in the canal section
- a record on seeding grass in the canal section
- a record on maintenance of flow gauges and other measuring devices

- a record on removal of silt
- a record on maintenance of pumping stations where water cannot be evacuated by gravity.

After completing the records, a report has to be submitted to authorize personnel for corrective measures.

Self-Check 3	**Written Test**

Name: _____ **Date:** _____

Directions: **Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers**

1. List the damage and blockage caused by pests and vermin? 10pts
2. Define routine maintenance of pressurized irrigation system? 5pts

Note: **Satisfactory rating –7.5 points and above Unsatisfactory - below 7.5 points**

You can ask your teacher for the copy of the correct answer.

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