Agricultural TVET College

Small Scale Irrigation Development

Level II

MODEL TTLM

Learning Guide #10

Unit of Competence: Maintain Small Motorized and Manual Irrigation Pump

Module Title: Maintaining Small Motorized and Manual Irrigation Pump

LG Code: AGR SSI2 10 0816

TTLM Code: AGR SSI2 10M TTLM 1218V_2

Nominal Duration: 30 Hours

Instruction Sheet # 1	**Unit**	**Maintain Small Motorized and Manual Irrigation Pump**
	Module	**Maintain Small Motorized and Manual Irrigation Pump**
	LO#1-4	

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

- Carry out pre- and post-seasonal periodic maintenance
- Carry out routine maintenance activities on small motorized and manual irrigation pump
- Maintain system components
- Record and report maintenance activities

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

- Inspect, repair and replace simple pump components
- Carry out maintenance activities under routine supervision.
- Apply OHS procedures relating to drainage system maintenance.
- Carry out pre- and post-season maintenance record and report maintenance observations and activities

Learning Activities

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

8. **Request you facilitator to observe your demonstration of the exercises and give you feedback.**

Information sheet # 1	**Unit**	**Maintain Small Motorized and Manual Irrigation Pump**
	Module	**Maintain Small Motorized and Manual Irrigation Pump**
	LO#1	**Carry out pre- and post-seasonal periodic maintenance**

Introduction

Maintenance is one of the most important tasks to be performed by pump operators and owners to ensure proper functioning and longevity of their equipment. Every irrigation system needs regular maintenance in order to run efficiently and reliably. Poorly maintained systems waste energy and money, and are prone to breakdowns that cause crop losses and yield reductions. Maintenance is required to:

- ✓ Keep the pump system in top operation condition at all times.
- ✓ To obtain the longest life and greatest use of the system is facilitates by providing adequate maintenance and replacements.
- ✓ To achieve the above two objectives at the lower possible cost.

Maintenance includes Routine tasks carried out throughout the irrigation season and Periodic service, repair and overhaul of pump and motor.

Routine or regular maintenance is small maintenance work that is done on a regular basis can be done by individual persons working on his own.

Periodic maintenance is work that is carried out periodically, say once a season or once a month. This work will be too big individual persons to do and will be done by a group of persons working together.

Maintenance involves the following activities:

- ✓ Identification and quantification of maintenance needs through regular inspections.
- ✓ Costing of maintenance needs.
- ✓ Categorizations and pritorisation of maintenance requirements.
- ✓ Implementation of maintenance
- ✓ Supervision and inspection of maintenance work

1.1. Preparing pre-season equipments for effective operation

Pre-season maintenance is maintenance activity done before starting operation of pump system for new season. It can allow the grower to realize the full benefits of irrigation system.

Before you begin operating the pump system each year, you should prepare your pump system for the new season.

Before placing the system into service each season, it is necessary to check components of the pump system. Pre-season maintenance may include Checking, inspecting and servicing pumps operation.

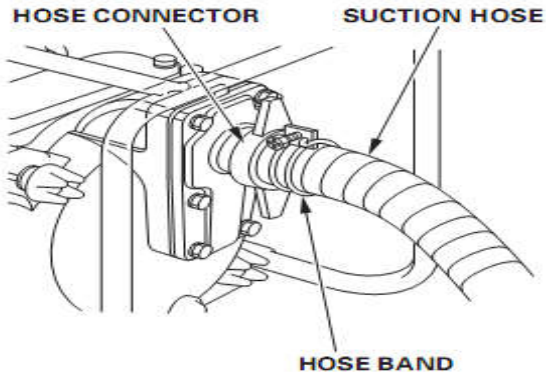
A. Diesel or Gasoline operated pumps

1. <u>Connect the suction hose.</u>

Use commercially available hose, hose connector, and hose bands. The suction hose must be of reinforced, non collapsible construction. Suction hose length should not be longer than necessary, as pump performance is best when the pump is not far above the water level. Self-priming time is also proportional to hose length. The strainer that is provided with the pump should be attached to the end of the suction hose with a band, as shown.

CAUTION: Always install the strainer on the end of the suction hose before pumping. The strainer will exclude debris that can cause clogging or impeller damage.

NOTE: Tighten the hose connector and bands to prevent air leakage and loss of suction. A loosely connected suction hose will reduce pump performance and self-priming ability.

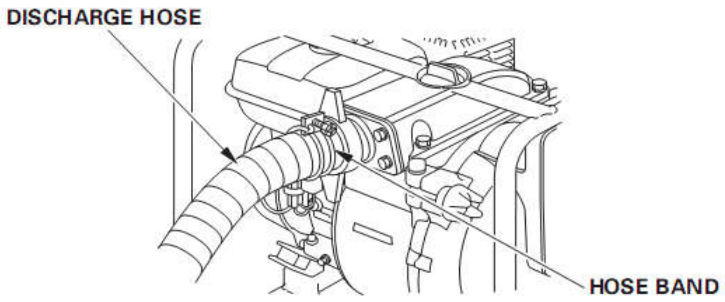


EQUIPMENT PARTS	Type C	Type UD, DE
HOSE CLAMP RING	X	○
HOSE COUPLING	X	○
HOSE COUPLING PACKING	X	○
HOSE BAND	○	○
STRAINER Type C Type UD, DE	○	○

2. <u>Connect the discharge hose.</u>

Use a commercially available hose, hose connector, and hose band. A short, large-diameter hose is most efficient. Long or small-diameter hose increases fluid friction and reduces pump output.

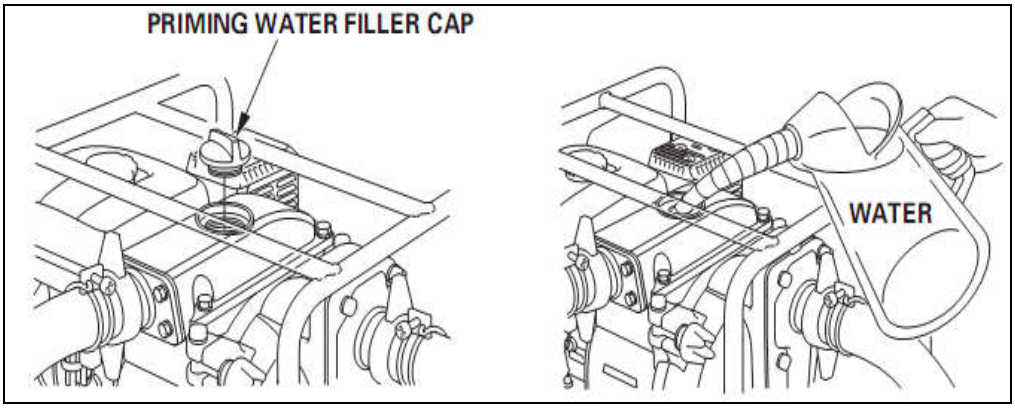
NOTE:
Tighten the hose band securely to prevent the hose from disconnecting under high pressure.



3. <u>Check the priming water</u>.

The pump chamber should be primed with full of water before operating.

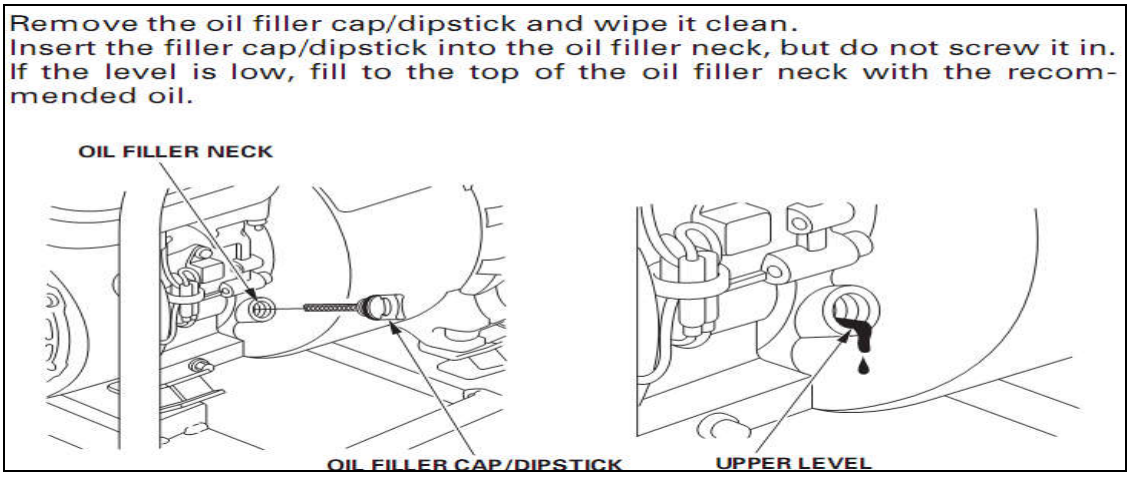
CAUTION: Never attempt to operate the pump without priming water or the pump will overheat. Extended dry operation will destroy the pump seal. If the unit has been operated dry, stop the engine immediately and allow the pump to cool before adding priming water.



4. <u>Check the engine oil level.</u>

Use only the oil recommended by the manufacturer. Tag each engine with a label identifying the proper oil. SAE 10W-40 is recommended for general, all-temperature use.

Remove the oil filler cap/dipstick and wipe it clean.
Insert the filler cap/dipstick into the oil filler neck, but do not screw it in.
If the level is low, fill to the top of the oil filler neck with the recommended oil.



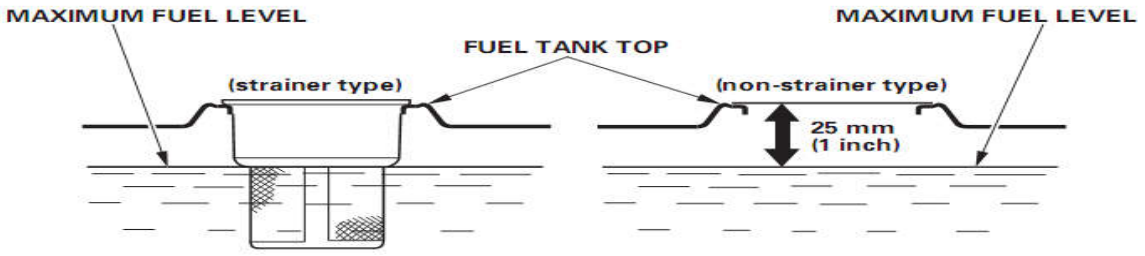
5. Check the fuel level.

Fuel: Check fuel level in tank. Do not over fill tank. Use fresh, clean automotive fuel.

Note: do not fill fuel tank when engine is running.

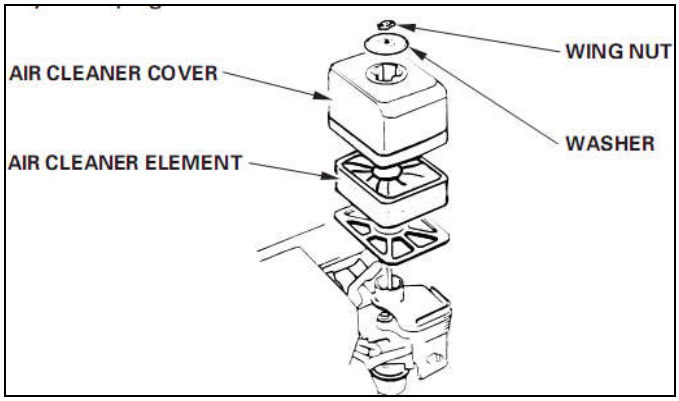
Never use stale or contaminated gasoline or an oil/gasoline mixture. Avoid getting dirt, dust or water in the fuel tank.

With the engine stopped and on a level surface, remove the fuel tank cap and check the fuel level.
Refill the tank if the fuel level is low.
Do not fill the fuel tank completely. Fill tank to approximately 25 mm (1 inch) below the top of the fuel tank to allow for fuel expansion. If may be necessary to lower the fuel level depending on operating conditions.
After refueling, make sure the tank cap is closed properly and securely.



6. Check the air cleaner element.

Remove the wing nut, washer and air cleaner cover. Check the element for dirt or obstruction. Clean the element if necessary.



CAUTION: Never run the engine without the air cleaner. Rapid engine wear will result from contaminants, such as dust and dirt, being drawn through the carburetor, into the engine.

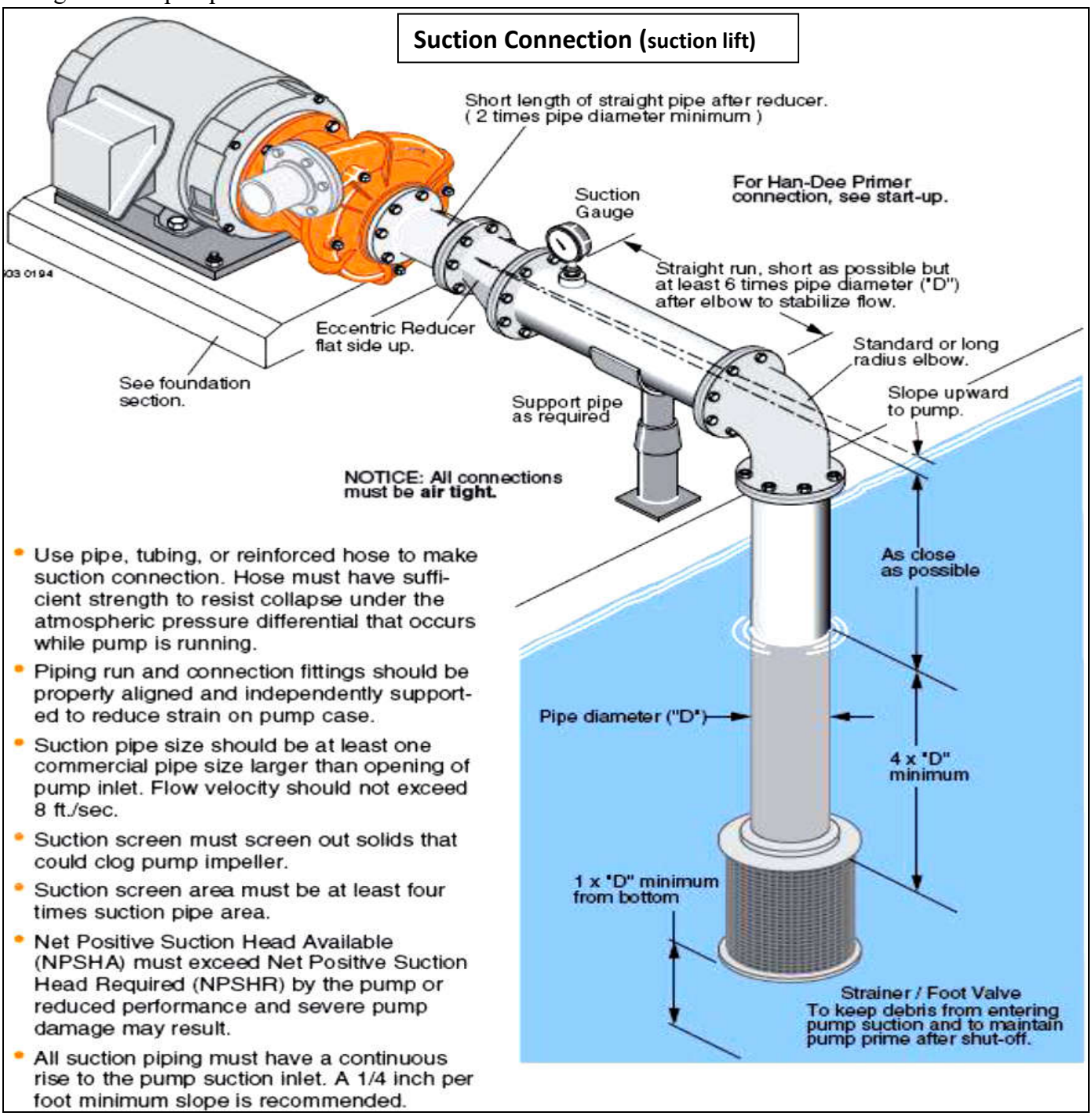
7. Start-up

Once all the checks and procedures described above have been carried out, start the pump. Conduct a visual and audio check of the pump (in particular, listen for the presence of any "suspicious" noises).

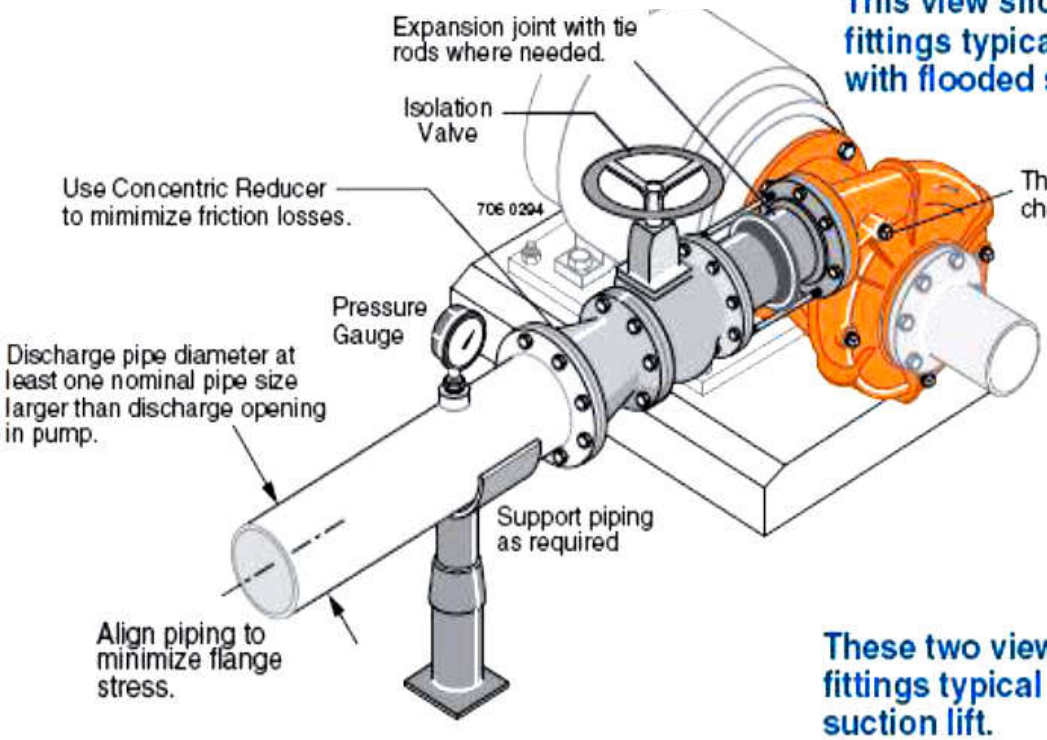
B. Suction and delivery connection of electrical operated pumps

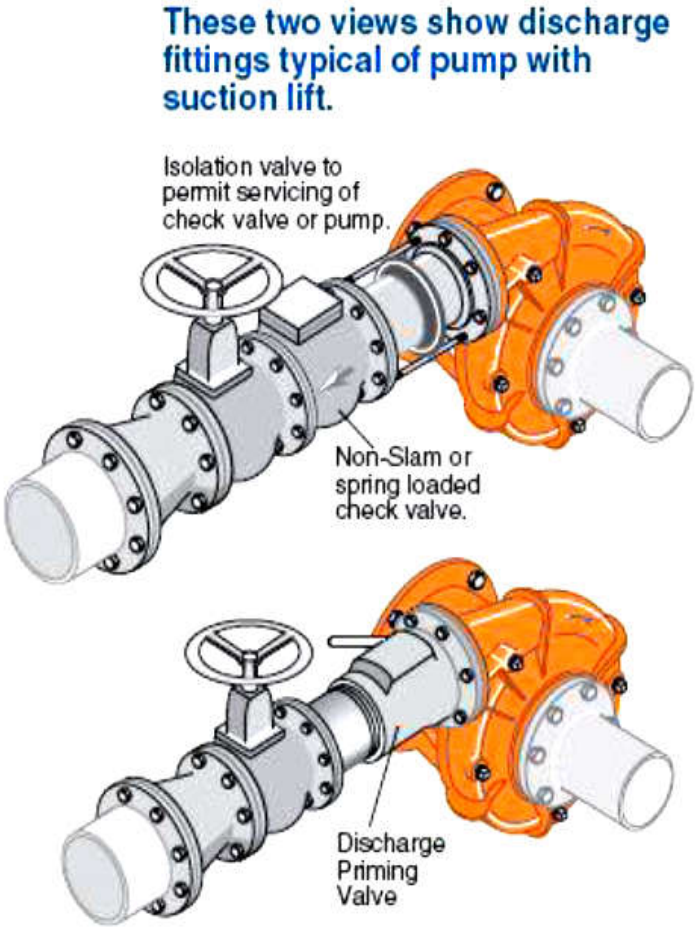
Installing and priming a pump

To prime a self-priming pump, all air must be vacated from the pump casing. To vacate the air, remove the priming plug from the pump casing and fill the casing with water. Return plug into casing and start pump.



Discharge connection (Delivery)





- Use pipe, tubing, or reinforced hose to make discharge connection. Material selected must have sufficient strength for operating pressures.
- Discharge pipe should be sized so that flow velocity is below 8 ft./sec.
- Use only non-slamming check valves to prevent hydraulic shock (water hammer).
- Use gate, ball, or butterfly valve for isolation. Valve should be full open during operation.
- Maintain proper pipe size throughout discharge system, using as few elbows and tees as possible to keep friction loss to a minimum.
- Install pressure gauge after reducer as shown to check operating pressure.

1.2. Flushing, cleaning, closing down and maintaining system post-season

Post-season maintenance is the maintenance activity done after the completion of irrigation works or after completion of irrigation operation season.

Activities undertaken during post-season maintenance may includes Draining and flushing diesel tanks of diesel sediments, treating and flushing the system, capping open pipes on fixed systems, and covering fixed systems to protect from environmental degradation.

Maintain pumps and all system components in virtually new condition to avoid efficiency loss. Wear is a significant cause of decreased pump efficiency. Bearings must be properly lubricated and replaced before they fail. Shaft seals also require consistent maintenance to avoid premature mechanical failures. Most important is the renewal of internal wearing ring clearance and the smoothness of impeller and casing waterways.

Equipment Cleaning - It is important to clean all equipment during and especially at the end of each work day. Thorough flushing of pumps, tanks, and hoses with clean water is a necessary standard procedure for both health and safety of personnel as well as equipment care and longevity.

1.3. Storage requirement of equipment

Short Term Storage (Less than 6 Months)

It is preferable to store the material under a shelter in its original package to protect it from adverse weather conditions. In condensing atmospheres, follow the long term storage procedure.

Long Term Storage (Longer than 6 Months)

The primary consideration in storage of pump equipment is to prevent corrosion of external and internal components. This corrosion is caused by natural circulation of air as temperature of the surroundings change from day to night, day to day, and from season to season. It is not practical to prevent this circulation which carries water vapor and other corrosive gasses, so it is necessary to protect internal and external surfaces from their effects to the greatest extent possible.

The equipment is to be stored in a shelter; protected from direct exposure to weather. The prepared equipment should be covered with a plastic sheet or a tarpaulin, but in a manner which will allow air circulation and prevent capture of moisture. Equipment should be stored 12 inches or more above the ground.

Pump Drive

1. Remove motor and flood the gearbox compartment with a high grade lubricating oil/rust preventative such as Mobile Oil Corporation product. Fill the compartment completely to minimize air space and water vapor condensation. After storage, drain this material and refill the equipment with the recommended lubricant for equipment commissioning.
2. Brush all unpainted metal surfaces with multipurpose grease. Store these unattached.

Electrical Equipment

1. Motors should be prepared in the manner prescribed by their manufacturer. If information is not available, dismount and store motors as indicated in step 3 below.
2. Dismount electrical equipment (including motors) from the pump.
3. For all electrical equipment, place packets of Vapor Phase Corrosion Inhibitor (VPCI) inside of the enclosure, then place the entire enclosure, with additional packets, inside a plastic bag. Seal the bag tightly.

Dismantling the pump

a. Loosen and remove all the bolts from volute, then pull out the volute cover

b. Remove the impeller lock-nut

c. Pull out the impeller, using puller if necessary

d. Remove flange coupling, use puller if necessary

e. Remove mechanical seal. Be sure to measure first the correct distance of mechanical seal from the other end of the shaft before pulling it out. *N.B. ensure that lubricants (e.g. grease, oil) are removed before removing casing*

f. Remove the bolts on the casing covers; pull out the shaft with bearings from the housing

g. Pull out the bearing from the shaft using the bearing puller

Transportation guidelines

Pump handling

WARNING: Dropping, rolling or tipping units, or applying other shock loads, can cause property damage and personal injury. Ensure that the unit is properly supported and secure during lifting and handling.

CAUTION: Risk of injury or equipment damage from use of inadequate lifting devices. Ensure lifting devices (such as chains, straps, forklifts, cranes, etc.) are rated to sufficient capacity.

Lifting methods

WARNING:

- Risk of serious personal injury or equipment damage. Proper lifting practices are critical to safe transport of heavy equipment. Ensure that practices used are in compliance with all applicable regulations and standards.
- Safe lifting points are specifically identified in this manual. It is critical to lift the equipment only at these points. Integral lifting eyes or eye bolts on pump and motor components are intended for use in lifting the individual components only.
- Lifting and handling heavy equipment poses a crush hazard. Use caution during lifting and handling and wear appropriate Personal Protective Equipment (PPE, such as steel-toed shoes, gloves, etc.) at all times. Seek assistance if necessary.

Table 1: Methods

Pump type	Lifting method
A bare pump without lifting handles	Use a suitable sling attached properly to solid points like the casing, the flanges, or the frames.
A bare pump with lifting handles	Lift the pump by the handles.
A base-mounted pump	Use slings under the pump casing and the drive unit, or under the base rails.

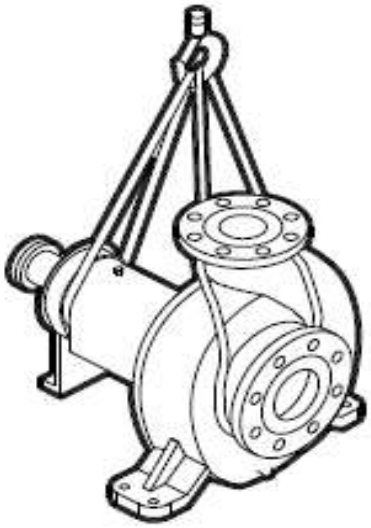
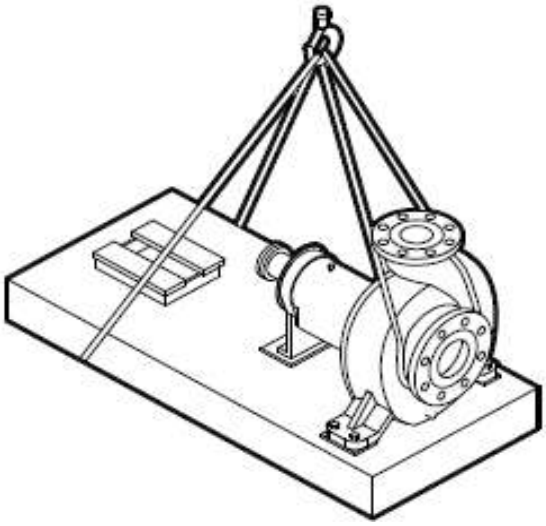


Figure: Example of a proper lifting method



NOTICE: Do not use this method to lift a Polyshield ANSI Combo with the pump and motor mounted. These items are not designed to handle the heavy weight of the Polyshield system. Doing so may result in equipment damage.

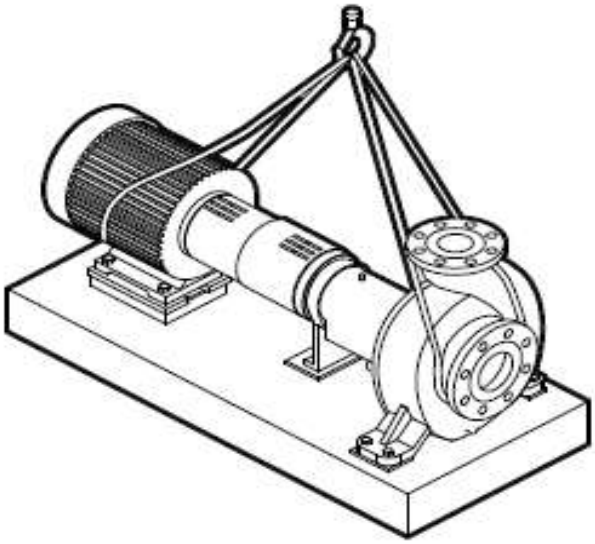


Figure: Example of a proper lifting method

NOTICE: Do not use this method to lift a Polyshield ANSI Combo with the pump and motor mounted. These items are not designed to handle the heavy weight of the Polyshield system. Doing so may result in equipment damage.

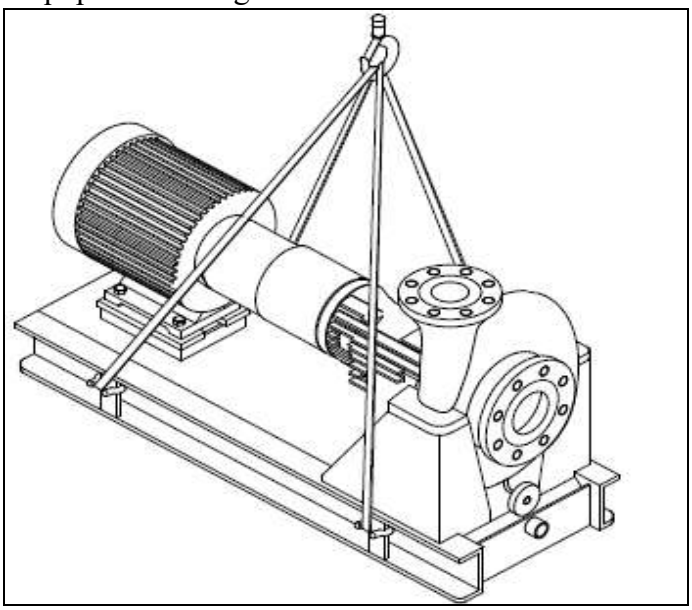


Figure: Example of a proper lifting method

NOTICE: When lifting a unit for which a strap cannot be secured at the suction flange, secure the strap through the frame/frame adapter. Securing at the frame adapter will prevent slipping of the strap and possible equipment damage.

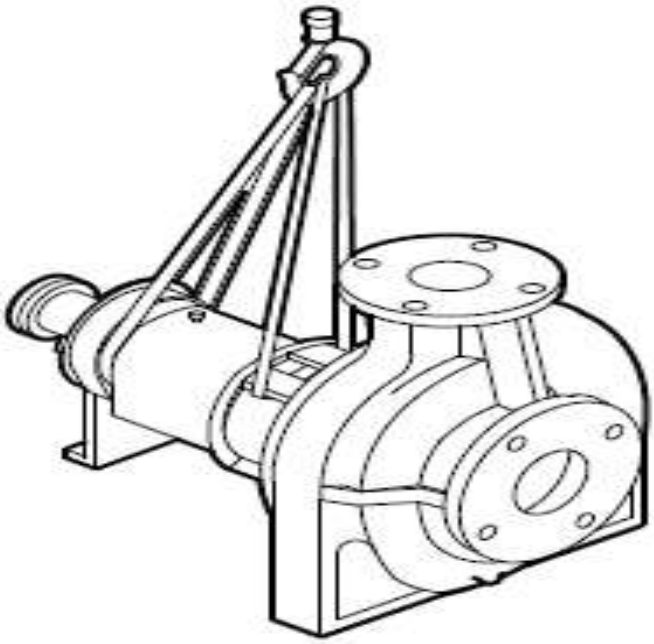


Figure: Example of a proper lifting method with a strap secured around the frame adapter

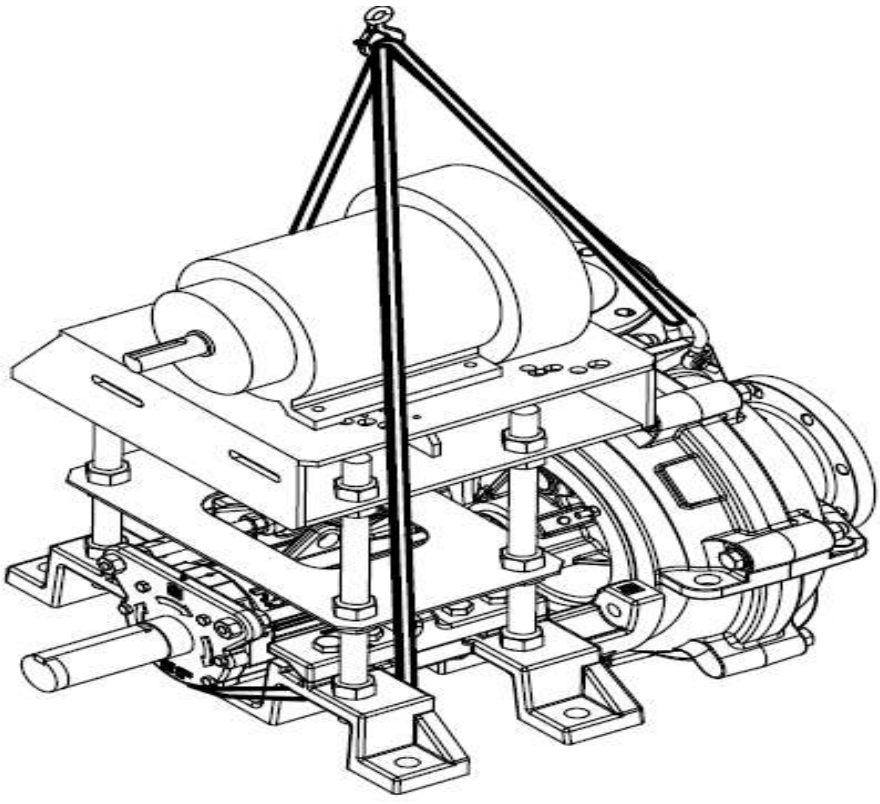


Figure: Example of offset overhead motor mount pump proper lifting method

Pump storage requirements

Storage requirements depend on the amount of time that you store the unit. The normal packaging is designed only to protect the unit during shipping.

Length of time in storage	Storage requirements
Upon receipt/short-term (less than six months)	• Store in a covered and dry location. • Store the unit free from dirt and vibrations.
Long-term (more than six months)	• Store in a covered and dry location. • Store the unit free from heat, dirt, and vibrations. • Rotate the shaft by hand several times at least every three months.

Treat bearing and machined surfaces so that they are well preserved. Refer to drive unit and coupling manufacturers for their long-term storage procedures.

Self-Check 1	**Written Test**

Name: _____ **Date:** _____

Directions: ***Answer all the questions listed below.***

1. What is maintenance means and its advantage ?(5pt)
2. What is periodic maintenance means?(5pt)
3. Write the difference between pre-and post-season maintenance activities of small motorized and manual irrigation pump?(5pt)
4. Write the basic types of small motorized and manual irrigation pump?(5pt)
5. Write the ways of storage requirement of pump?(5pt)

Note: **Satisfactory rating – 25 points** **Unsatisfactory – below 25 points**

INFORMATION SHEET # 2	**Unit**	**Maintain Small Motorized and Manual Irrigation Pump**
	Module	**Maintain Small Motorized and Manual Irrigation Pump**
	LO#2	**Carry out routine maintenance activities on small motorized and manual irrigation pump**

2.1 Carrying out all maintenance activities

Caution: The recommendations below are not comprehensive and may not be correct for all systems.
Consult your owner's manual for recommended maintenance procedures and always follow the manufacturer's instructions if they differ from the ones in this guidebook.

i. Maintaining Engine Air System

Always replaces disposable air filter with new ones. Cleaning can distort the filter and allow more dirt to enter.

Maintenance Tasks:

- At season startup, clean and re- ll the lter bath in oil-bath air cleaners and reassemble the air cleaner.
- Periodically brush blockage off the screen if the air induction system is equipped with a pre-screener.
- Change the air filter when the service indicator signals that it's time to change it:
- Turn off engine before changing air filter.
- Wipe the outside of the cover and housing with a damp cloth and remove the cover.
- If cover is dented or warped, replace it.
- Use extreme care when removing the filter to prevent dirt from falling into the intake duct. Use a clean damp cloth to wipe inside of filter housing.
- Install new air filter.

ii. Engine Electrical System

If you have a natural gas engine, be aware that natural gas has a higher octane value than automotive gasoline. You can increase engine efficiency and reduce fuel consumption by setting the ignition timing to take advantage of the higher octane. Consult the engine manufacturer for recommendations on how to do this.

Maintenance Tasks

At season startup:

- Inspect breaker points for wear and replace if needed.
- Set the gap or dwell angle and lubricate the rotor.
- Check timing and adjust if necessary.
- Clean all connecting terminals; cover with protectors.
- Spray silicone on electrically operated safety switches and ignition system to prevent corrosion.

Twice a year:

- ☞ In engines that have them, clean and re-gap spark plugs or replace with plugs in the recommended heat range.
- ☞ Check all terminals and electrical connections for tightness and corrosion, and spray with corrosion inhibitor (NOT grease).
- ☞ Remove the distributor cap and lubricate governor weights with silicone (NOT oil).

iii. Engine Oil and Lubrication

Have a sample of engine oil analyzed for contaminants, which signal abnormal wear. Intervals between analyses will depend on the engine, and analysis may be cost-effective only for larger engines. Equipment dealers should know where the oil can be analyzed and how often this should be done. Use only the oil recommended by the manufacturer. Tag each engine with a label identifying the proper oil.

Maintenance Tasks:

Twice a year:

- ☞ If the engine was not protected during shutdown, or if the oil has not been changed within the last year, change the crankcase oil and oil filter.
- ☞ Lubricate all engine accessories such as the driveshaft and U-joints.

iv. Engine Fuel and Coolant

Maintenance Tasks

Twice a year;

- ☞ Remove and clean or replace the fuel filter.
- ☞ Periodically check that fuel tank cap and oil filter cap are on tight and that gaskets aren't cracked.
- ☞ Periodically check that the fluid level and degree of coolant protection are adequate.
- ☞ Check that the radiator cap is on tight and that gaskets aren't cracked.

v. Servicing Impeller and Wear Rings

If you suspect that your pump impeller is clogged or damaged, or that the wear rings are worn, you can dismantle the pump. This will take some work and is best done in the shop. Or have a qualified pump repair shop undertake this procedure. Always follow the directions in the manufacturer's manual, if available, instead of the following simplified directions.

- ☞ Remove suction cover or volute case.

- ☞ Remove debris from impeller and volute.
- ☞ Remove pebbles lodged between vanes.
- ☞ Check wear at the impeller eye and vanes.
- ☞ If worn, repair or replace the impeller.
- ☞ Re-machine or replace wear ring if clearance is greater than 1/32 inch per side. Replace suction cover or volute. Use a new gasket.

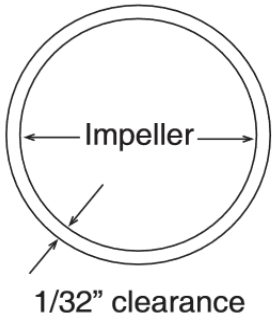
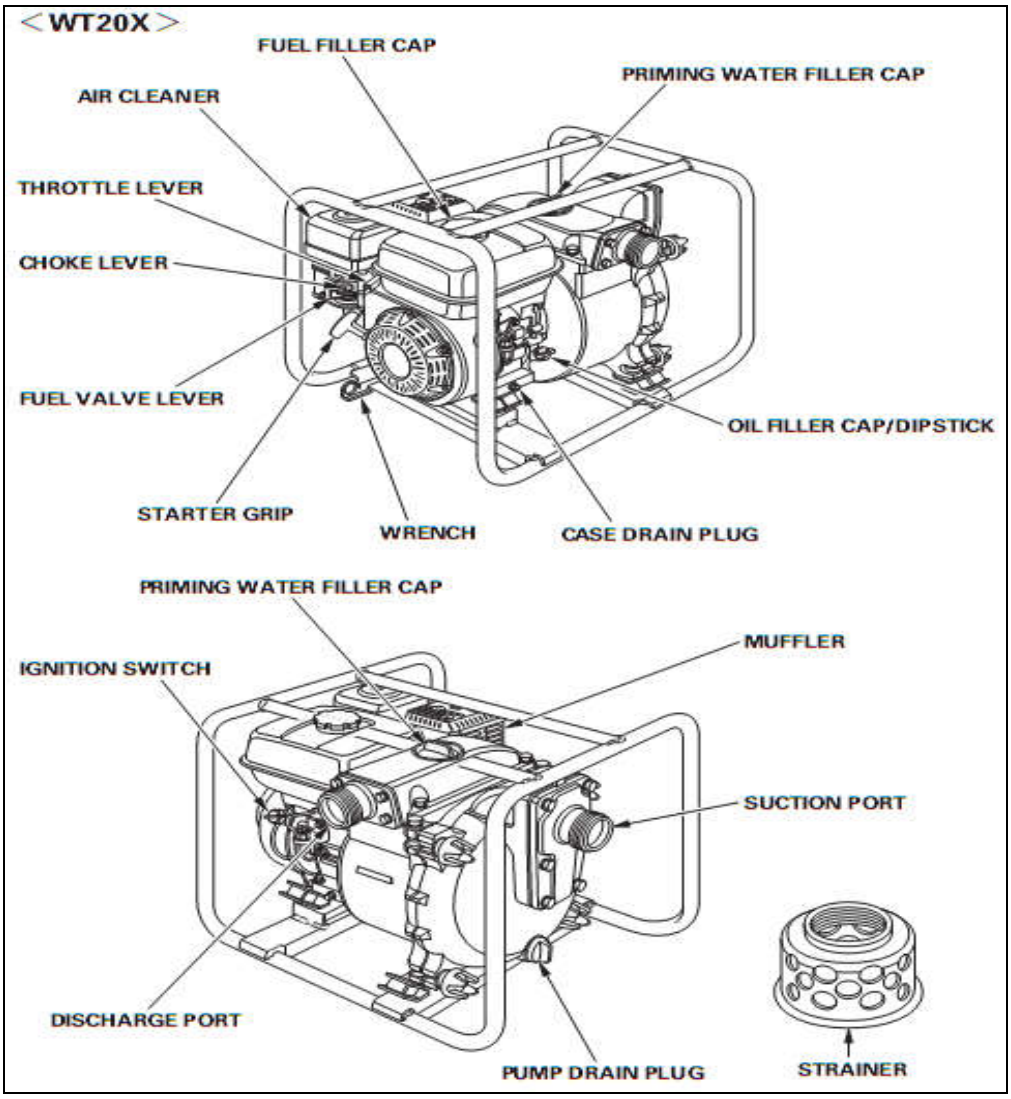


Figure: Impeller Eye and Wear Ring

2.2. Servicing mechanical equipment

I. Motorized water pump (Petrol Engine Type)

Components and control locations (see figure below)

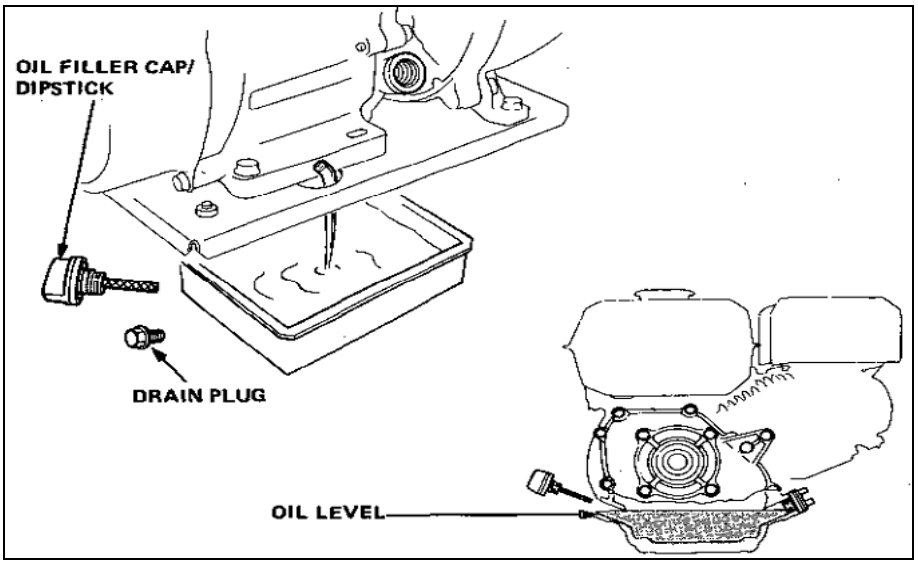


A. ***Changing oil***

Drain the oil while the engine is still warm to assure rapid and complete draining.

1. Remove the oil filler cap and the drain plug, then drain the oil.
2. Reinstall the drain plug and tighten securely...
3. Refill with the recommended oil to the specified level.

Oil capacity: 0.6p (0.63 us qt)



B. Air cleaner service

A dirty air cleaner will restrict air flow to the carburetor. To prevent carburetor malfunction, service the air cleaner regularly. Service more frequently when operating the pump in extremely dusty areas.

WARNIG Never use gasoline or low flash point solvents for cleaning the air cleaner element. A fire or explosion could result.

CAUTION: Never run the pump without the air cleaner. Rapid engine wear will result from contaminants, such as dust and dirt being drawn through the carburetor, into the engine.

1. Unscrew the wing nut, remove the air cleaner cover and remove the foam element.
2. Wash the element in a non-flammable or high flash point solvent and dry it thoroughly.
3. Soak the element in clean engine oil and squeeze out the excess oil.
4. Reinstall the air cleaner element and the cover.

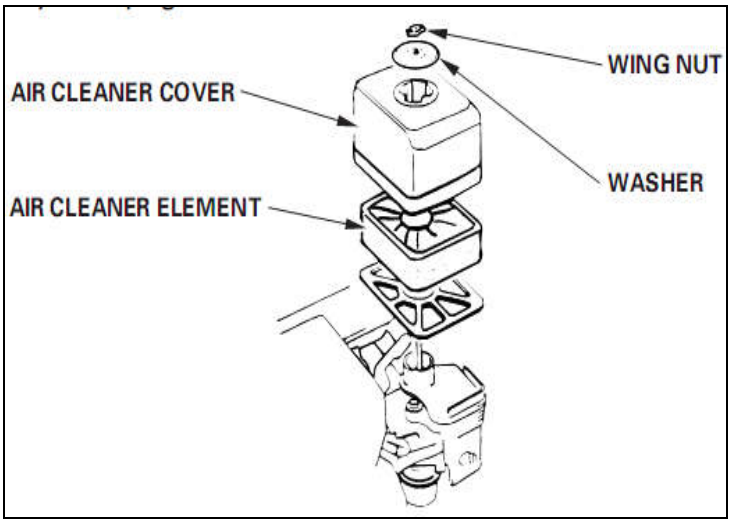


Figure: Air cleaner

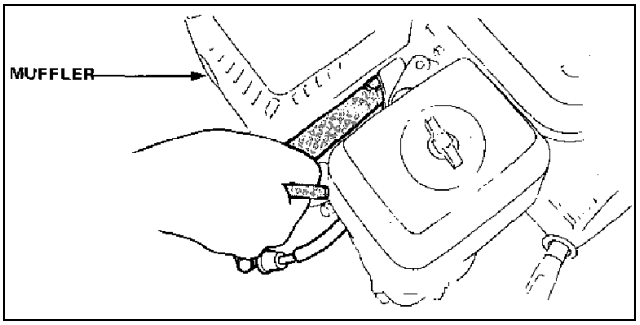
C. *Spark plug service*

Recommended spark plug: BPRGES (NGK) , W20EPR-U (ND) .To ensure proper engine operation, the spark plug must be properly gapped and free of deposits.

Steps;

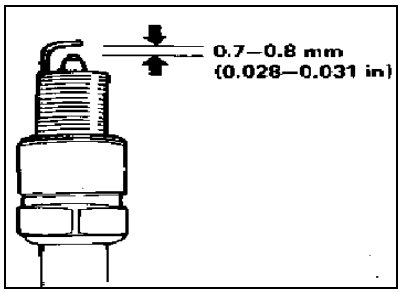
1. Remove the spark plug.

WARNIG: If the engine has been running, the muffler will be very hot. Be careful not to touch the muffler,

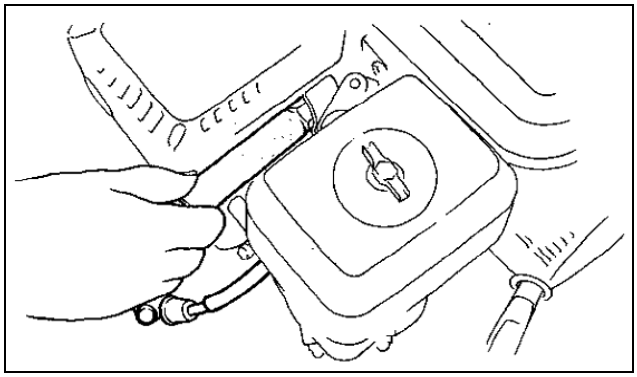


2. Visually inspect the spark plug. Discard it if the insulator is cracked or chipped. Clean the spark plug with a wire brush if it is to be reused.

3. Measure the plug gap with a feeler gauge. The gap should be 0.7-0.8 mm (0.028-0.031 in). Correct as necessary by bending the side electrode.



4. Thread the plug in by hand to prevent cross-threading.



5. Tighten a new spark plug l/2 turn with the wrench to compress the washer. If you are reusing a plug, it should only take l/8-1/4 turn after the plug seats.

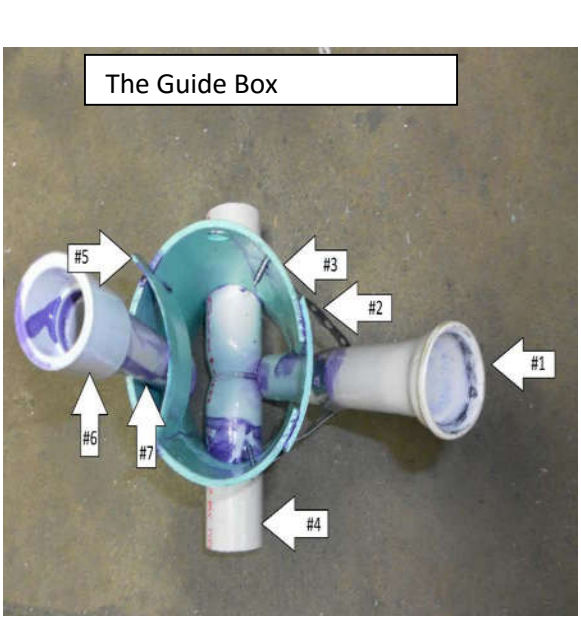
CAUTION: The spark plug must be securely tightened. An improperly tightened plug can become very hot and damage the engine. Spark plugs which have an improper heat range may cause engine damage.

II. MANUAL WATER PUMPS

A. Maintenance for Rope Pump

The only part of the pump requiring maintenance would be the rotating rim, gears and handles. On a monthly basis these parts should be inspected for fatigue and grease applied to help reduce friction and make the turning of these components easier. Also keep a look out for any rust which can be fixed by sanding and repainting.

Little to no maintenance is required on the guide box. All PVC components of the guide box will have a usable lifespan of 8-10 years. After this 10 year period, a new guide box should be constructed and installed. During the guide box's usable lifespan of 8-10 years, all glued components should be checked for security and placement on a yearly basis. If any components are loose or have shifted, reinforce and secure using additional PVC cement or bracing. If the rising piping is ever replaced or repaired, check the guide box as it attached to the bottom of the rising pipe. Perform any repairs or replacement if necessary.



Throughout the use of your new rope pump some routine maintenance may need to be performed. However due to the simplicity of the pump very little maintenance is required.

1. Due to the friction involved, wear and tear might be seen in the rope and seals. Special attention should be paid to the rope during each use for fraying or any areas of damage. Polypropylene ropes should be replaced on a yearly basis or until signs of wear appear. When the rope is replaced, it is recommended to also put new seals on, especially the rubber part.

To replace the rope:

a) The original rope must be cut

b) Tie one end of the old rope (still in the well) to the pump structure

c) Tie the other end of the old rope to the new replacement rope

d) Tie the other end of the new rope to the pump structure as well (this is a safety measure so the rope does not get pulled all the way through).

e) The new rope needs to be tied to the old one and fed around the bottom guide box by pulling the old rope (the end tied to the pump structure) until the new rope comes out and both ends are visible.

f) The new rope should then carefully be untied from the pump structure and from the old rope.

g) Now the replacement rope can have its free ends tied together with enough tension to stay on the drive wheel.

h) With this new rope, new seals should be applied.

2. Damaged seals will only slightly affect the overall performance of the pump and shouldn't be a concern to the average user. Seals cannot effectively be replaced individually. Users can replace the rope and put on new seals if bad seals are hurting the pump performance.

3. All rotating parts at the head of the pump should be cared for using grease in any high friction areas - like the handle and the bearings in the wheel. This will make it easier for the user to pump water and turn the drive wheel.

1. Operation

Functioning and life time of the pump will be increased when care is taken during operation of the pump.

Guidelines:

- Only rotate the pump clockwise, never turn the pump reverse direction.
- Always use the pumping lock when pumping is stopped.
- Don't let very small children operate the pump. If the handle slips out of their fingers, the pump will turn in backwards direction and the handle could hurt the children.
- Don't operate the pump with more than one person at the time. Avoid children hanging on the handle.

2 .Regular maintenance

Regular maintenance is necessary to keep the pump in good shape and guarantee along running time.

Tasks are:

- Checking the tension of the rope and adjusting when needed.
- Lubricating the bushings every 2 weeks or when the bushings are running dry.

If the bushings start to make a shrieking noise oiling is URGENTLY needed. Add a few drops of NEW motor oil. (In case motor oil is not available, cooking oil can be used for emergency) Use a clean stick to apply the oil, NOT with your fingers and remember:

Old oil contains iron particles and dirt, and will sand the inside of the bushings, reaching the opposite effect. Don't use too much oil at the time to prevent leaking into the well. Carryout repairs when needed.

3. Potential repairs

• Replacement of the rope.

Pistons usually last about twice as long as the rope. When the rope shows a lot of damage, the rope should be changed preferably before it breaks. Tie the new rope (with the pistons) to the old rope (be sure pistons are running in the right direction) and pass it through the tubing. It is not necessary to take out the tubing.

• Replacement of pistons

- ✓ The pistons should be changed, when the user has noted a reduction output.
- ✓ Before changing the pistons, check the clearance in a piece of riser main to check whether a reduced output is due to worn-out pistons.

• Painting

To avoid corrosion, it is essential to paint parts again that start corroding.

- Clean the parts with a steel brush and roughen it with sand paper.
- Then apply anticorrosive primer paint, and when it's completely dry, finish it with paint. Allow the paint to dry in the shade, NOT in the sun.

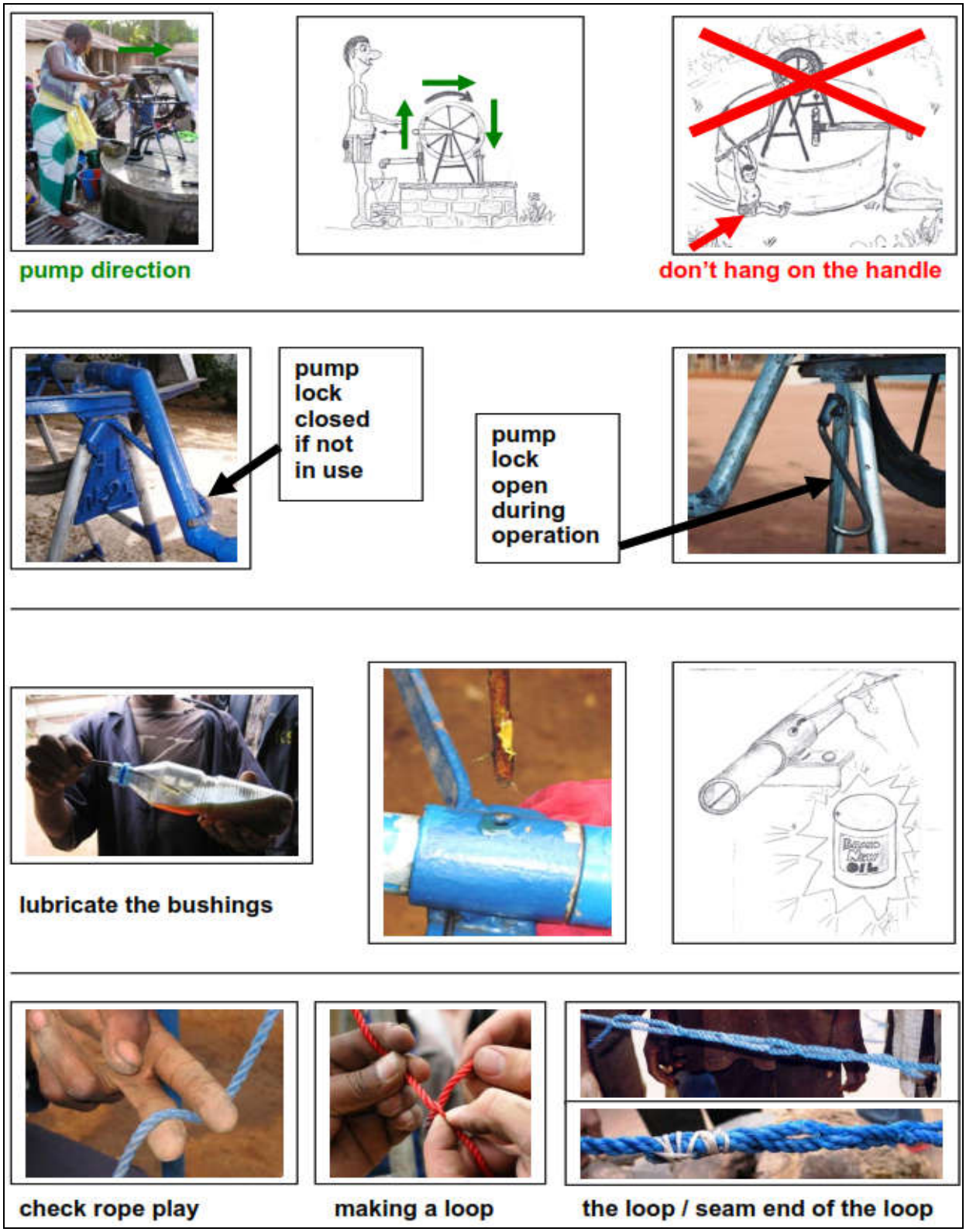
• The bushings

If bushings are worn out, dismantle and replace them. (If properly oiled, bushes last for 10 years or more!)

• PVC tubing

- ❖ If a pump is placed in direct sunlight, the ultra-violet rays will affect the PVC parts, causing cracks. (To prolong life of PVC, paint it!)
- ❖ If the well contains fine sand, the sand will wear out PVC parts as well. In case wear is excessive, replace tubing.

Operation and Maintenance sheet (See picture below)



Rope pump technical checklist

Date of visit:	.....	
Name technician:	.....	
Pump number:	nr.....	,produced by.....
User(s)		
Name owner:	_____	
Name of area:	_____	
Number of users:	_____	
Comments of users:	_____	
Pump		
Installation date:	_____	,installed by.....
		Comments
Water level:	_____	dry / wet season
Well depth:	_____	
Well type:	hand dug well / tube well	.....
Well cover:	concrete / open / other:	.....
Piston size:	PE / rubber	size: .....
Piston quality:	OK / cracks / holes / all present /	.....
Rope quality:	OK / warn out / broken /	.....
Rope tension:	OK / loose / tight /	.....
Rope connection:	OK /	.....
Grip on wheel:	OK / slipping /	.....
PVC		
T-piece:	OK / broken / clean / dirty /	.....
Reducer:	OK / broken / clean / dirty /	.....
Riser main:	OK / broken / clean / dirty /	.....
Flares:	OK / broken / clean / dirty /	.....
Structure		
Welding:	OK / broken /	.....
Painting:	OK / come off /	.....
Rust:	Yes / no / little / much	Place: .....
Axle:	OK / damaged	Wall thickness: .....
Bushing:	OK / damaged	Wall thickness: .....
Handle (grip):	OK / PVC broken /	.....
Grip lock:	wrong direction / right direction	.....
Height of handle:	OK / too height / too low /	.....
Wheel:	OK / damaged /	.....
Pumping		
Pumping:	easy / difficult / resistance /	.....
Guide box:	OK / clean / dirty / rusty /	.....
Water discharge:	OK / very little /	Turbidity: high / low / clear .....
Problems:	_____	
Actions taken:	.....	

TECHNICAL MONITORING SHEET FOR VILLAGE TEST RPS

for monitoring by a technical (project) person

Name of technician: Teshome Tefera

Monitoring date: 10 / 4/ 2014

LOCATION

Woreda name:	Meskan	Kebele :	Yetebon
Village name:	Mamija	Pump model nr:	1 / 2 / 3 A / 4 / 5 / 6
Owner (full name):	Zeleke Degaga	Mobile nr. owner:	0924719863
Static water level:	3.76M	Measuring time:	

GENERAL INFO (only once during installation)

Installation date: 22 / 12 / 2013

GPS (North):		GPS (East):	
Diameter of the well:	0.7M	Depth of the well:	6.83M

TECHNICAL CHECKS yes / no if not correct, please explain !

Rope, pistons and PVC

- Is the rope tension still correct? yes / no too loose / too tight / broken
- Is the rope connection still correct? yes / no
- Is the rope still centered in the PVC pipe? yes / no *Because Kids have broken the raiser men clamp so the rope is not centered so that I re weld it by keeping the center*
- Do you observe any wear on the rope? yes / no
- Do you observe any wear on the pistons? yes / no
- Do you observe any wear on PVC parts? yes / no
- Any other observations:

Pump structure

- Are all bolts and nuts still present and tight? yes / no In economy type there is no bolt and nut
- Do you observe any broken welds? yes / raisin men holder clamp is broken according of t user told me kids wear playing on it during their absence and broken
- Is there any corrosion on pump parts? yes / no
- Do you observe any wear on the bushings? yes / no
- Do you observe any wear on the axle? yes / no

B. Maintenance and Repair of Treadle Pump

The pressure pump pistons have leather seals which must be wetted prior to use, otherwise they will not provide a good seal and the pump will be difficult to prime. It is reported that the pump is very hard to operate, due to the tight fit of the leather seals; two operators are often needed at the same time for pumping.

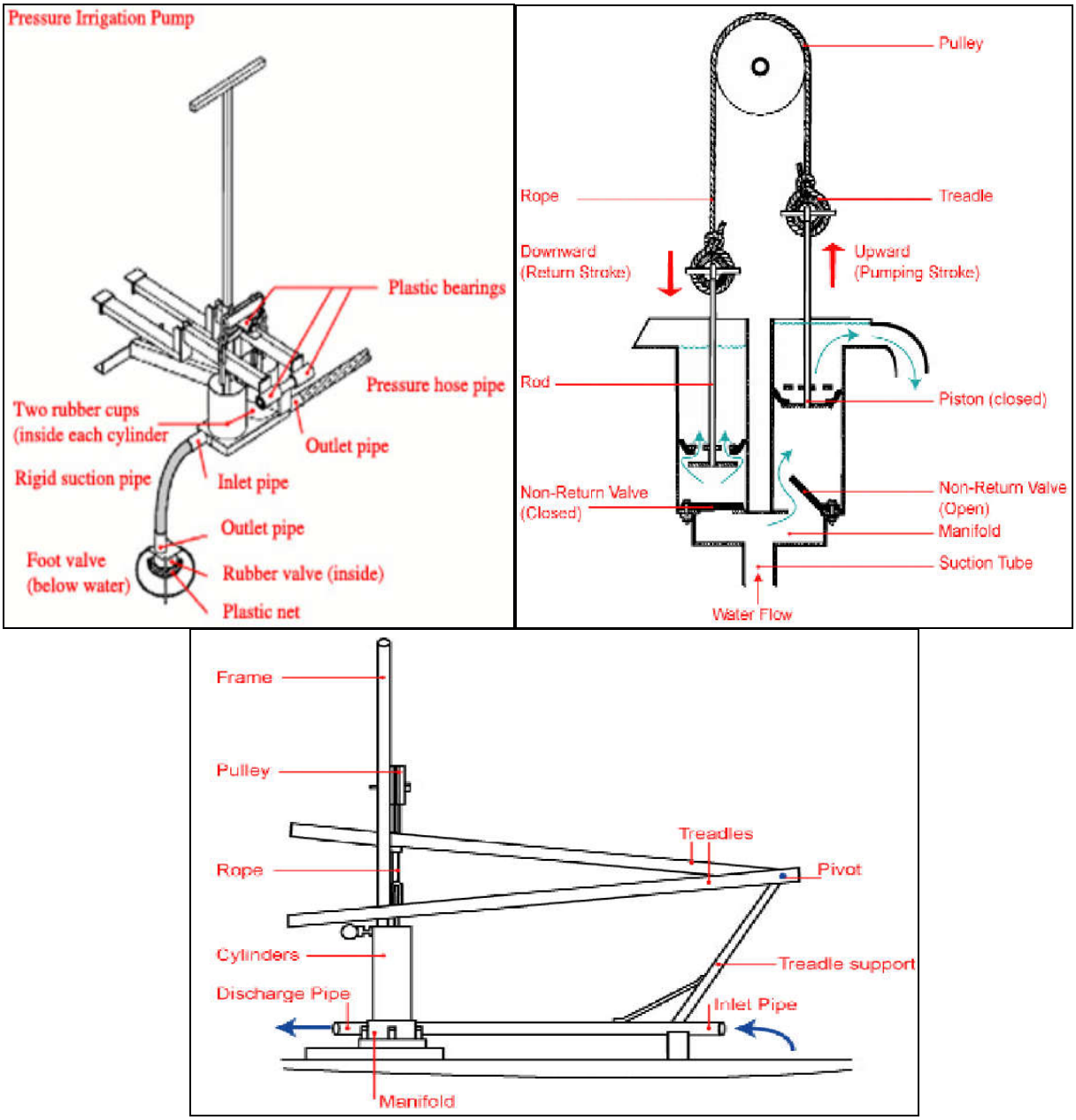


Figure: Treadle pump operating principles

Treadle pumps are easily maintained and repaired by the average user. The pump head can last up to seven years, the rubber cups between 3 and 24 months, depending on how they are used. Non-return valves can last as long as the pump. The only movable part on it – the rubber flap – may be replaced as necessary. It can be made at village level using a cut-out from a bicycle or motor-vehicle tyre inner tube.

Rubber cups wear out easily if used to pump dirty and muddy/sandy water. Use of a strainer made of mosquito wire mesh is recommended at the intake. The rubber cups and foot valves should be thoroughly cleaned in water after use. Storage of the pump should be in shade in a safe place where thieves cannot steal it.

Experience shows that the nylon pulley rope often breaks but this is the easiest part to replace at village level. Farmers often use cattle hide to make a strap as a replacement. When treadles or the pulley break, farmers can find wood from the bush and replace the treadles easily by following the design length and slots from the old one.

Treadle Maintenance

If a treadle breaks than all you have to do is disconnect it from the pivot points, the wood blocks on the rod at the back of the pump, and from the pistons and simply reconnect a new board.

Seal maintenance:

1. Lubricate the piston seals with vegetable shortening (such as Crisco) or vegetable oil.

2. After using the pump, removing the pistons from the cylinders will help the cylinders dry and prevent rot. However, doing this may allow the lower seal to flare out and make it difficult to put the pistons back in the cylinder. One solution would be to remove the piston almost completely from the cylinder, leaving the very bottom of the bottom seal in the top of the cylinder. This will allow the seals to dry but make sure the bottom seal holds its shape.

3. The seals may eventually begin to rot. When the seal rots, it will need to be replaced. Customers should be able to manufacture replacements by attaching a wet leather disc to the piston (in the position of the top seal), and forcing it into the cylinder as though the pump is about to be used.

Cylinder Maintenance:

The one way valve flaps may eventually become worn or break. A new flap could easily be cut from an old inner tube or other scrap of thin rubber. The plug of the water chamber can be unscrewed for easy access. Broken Elbows can be repaired with PVC primer and cement.

2.3. Flushing and cleaning Small motorized and manual irrigation pump components

If the engine has been running, allow it to cool for at least half an hour before cleaning. Clean all exterior surfaces, touch up any damaged paint, and coat other areas that may rust with a light film of oil.

NOTICE

- Using a garden hose or pressure washing equipment can force water into the air cleaner or muffler opening. Water in the air cleaner will soak the air filter, and water that passes through the air filter or muffler can enter the cylinder, causing damage.
- Water contacting a hot engine can cause damage. If the engine has been running, allow it to cool for at least half an hour before washing.
- If the engine coolant is water, drain and refill the cooling system with water, a rust inhibitor, and antifreeze.
- Drain all fuel from the tank and lines and shut off the fuel valve.

2.4. Inspecting and recording small motorized and manual irrigation pump operating faults

There are certain procedures that are recommended by pump manufactures before any pump start-up. Some of the pre-start-up inspections recommended immediately after pump installation are checking for correct pump-motor wiring connections, valve connections, shaft and gland clearance. It has to be remembered that starting a pump dry will cause seizing or destructive wear between the pump components. Therefore, pumps that are not self-priming or those with a positive suction lift should be primed before they are started. Different manufacturers also have specific instructions for pump shut down after operation. These have to be adhered to strictly.

Operation sheet # 3	**Unit**	**Maintain Small Motorized and Manual Irrigation Pump**
	Module	**Maintain Small Motorized and Manual Irrigation Pump**
	LO#3	**Carry out routine maintenance activities on small motorized and manual irrigation pump**

Project title:-Perform all routine maintenance of small motorized and manual irrigation pumps
Materials, tools and equipments: petrol operated centrifugal pump, Kerosene, oil, water, different types of wrenches, working bench, clothes, PPES etc.

Objective: to enable the trainees carryout the required maintenance tasks to make the pump operational.

Procedures*:*

- Drain the oil while the engine is still warm to assure rapid and complete draining.
- Remove the oil filler cap and the drain plug, then drain the oil.
- Reinstall the drain plug and tighten securely...
- Refill with the recommended oil to the specified level.
- Unscrew the wing nut, remove the air cleaner cover and remove the foam element.
- Wash the element in a non-flammable or high flash point solvent and dry it thoroughly.
- Soak the element in clean engine oil and squeeze out the excess oil.
- Reinstall the air cleaner element and the cover.
- Remove the spark plug.
- Visually inspect the spark plug. Discard it if the insulator is cracked or chipped.
- Clean the spark plug with a wire brush if it is to be reused.
- Measure the plug gap with a feeler gauge.
- Thread the plug in by hand to prevent cross-threading.
- Tighten a new spark plug l/2 turn with the wrench to compress the washer.

Information sheet # 3	**Unit**	**Maintain Small Motorized and Manual Irrigation Pump**
	Module	**Maintain Small Motorized and Manual Irrigation Pump**
	LO#3	**Maintain system components**

3.1: Carrying out system maintenance at scheduled time:

3.1.1: Preventive Maintenance Task List:

Once all of the equipment and components have been itemized and the manufacturer's literature has been collected, it is time to develop the comprehensive list of preventive maintenance tasks and to schedule them.

Working systematically through each component of the facility, and remembering to address additional areas such as building and grounds maintenance, all preventive maintenance tasks must be identified and a frequency for scheduling should be assigned.

While many of the preventive maintenance tasks can be determined by the review of manufacturer's literature, other tasks can be identified based on the experience of the operations staff and the guidance derived from outside sources.

Appropriate maintenance schedule and procedure need to be prescribed for all electrical and mechanical pumps and equipment based on;

- Manufacturers' recommendations,
- Characteristics of the equipment,
- Site and environment conditions i.e. temperature, humidity, dust condition, etc.

The maintenance schedule also needs to be reviewed and revised in the light of experience and analysis of failures and breakdown at the pumping station.

The preventive maintenance schedule shall detail the maintenance to be carried out at regular intervals i.e. daily, monthly, quarterly, half yearly, annually etc. or operation hours. The schedule shall also include inspections and tests to be performed at appropriate interval or periodicity. Example of maintenance schedule (see table below).

ITEM (Perform at every indicated month or operating hour interval, whichever comes first.) / REGULAR SERVICE PERIOD (3)			Each use	First month or 20 Hrs.	Every 3 months or 50 Hrs.	Every 6 months or 100 Hrs.	Every year or 300 Hrs.
•	Engine oil	Check level	○				
		Change		○		○	
•	Engine oil filter	Replace					○ or 200 Hrs
•	Air filter	Check	○				
		Clean			○ (1)		
		Replace					○*
•	Spark plug	Clean-Readjust				○	
		Replace					○
	Spark arrester (optional part)	Clean				○	
•	Idle speed	Check-adjust					○ (2)
•	Valve clearance	Check-Readjust					○ (2)
•	Fuel filter	Check				○	
		Replace					○ (2)
•	Fuel line	Check	Every 2 years (Replace if necessary) (2)				

3.2. Inspecting components and reporting or replacing operating faults

Make a habit of checking that the engine is securely bolted to its platform; mounting bolts can vibrate loose. Regularly check coolant, oil levels, fuel, and fan belts. If coolant or oil is down, check lines for leakage. On diesel engines, check injectors and fuel lines for leaks.

3.2.1 Inspecting signs of trouble.

If any of the following are observed during pump operation, it is an indication that the pump requires specialist mechanical attention:

- Oil, fuel and water leakage
- Leakage from stuffing box or mechanical seal
- Changes in sound while pump is running
- immediate changes in bearing temperature, overheating, burning smell
- Abnormal color of exhaust smoke (i.e. black, dark blue or white smoke)
- Abnormal noise and vibrations
- In addition to the daily checks and ‘in-operation’ observations, there are other checks that are done less frequently, at longer intervals of time…

3.2.2: Monthly inspection

Inspection Tasks:

- Check free movement of the gland of the stuffing box; check gland packing and replace if necessary
- Clean and apply oil to the gland bolts
- Inspect the mechanical seal for wear and replace if necessary
- Check condition of bearing oil and top up if necessary
- Seasonal inspection for pump
- Check impeller for pitting or any other signs of wear. Check impeller clearance
- Check interior of pump (volute, casing and diffuser) for pitting, erosion and rough surface
- Check and change oil in seal and motor housing

3.2.3: Undertaking seasonal inspection

- Check stuffing box, glands, lantern ring, mechanical seal and rectify if necessary
- Check condition of gaskets; replace if needed to prevent water leaks
- Assess vibration level with instruments if available; otherwise rely on manual observation and assessment
- Seasonal inspection for motor pump
- Clean the bearing housing and examine it for signs of wear, grooving etc.
- Clean and flush the bearings with kerosene and check them for signs of corrosion, wear and scratches. Immediately after cleaning, the bearings should be coated with oil or grease to prevent accumulation of dirt or moisture
- Check and correct the alignment of the pump and the motor drive. The pump and motor should be decoupled while correcting the alignment
- Examine shaft sleeves for wear or scour and necessary rectification. (If shaft sleeves are not used, the shaft at gland packing's should be examined for wear)
- Grease all moving parts of motor to control corrosion
- Clean calamine in exhaust pipe
- Control, adjust or replace the carburetor (petrol engine) or injectors (diesel engine)
- Check the level and quality of the battery electrolyte

3.2.4: Reporting or replacing operating faults

3.2.4.1 Record of operations and observations

Ideally, a log book should be maintained to record details such as:

- Timings when the pump is started, operated and stopped
- Task for which pump was used, with some indication of intake water level and distance of discharge delivery point
- Quantity of fuel and oil used
- Date, time and nature of any variance or unusual events observed during pump operation and what follow-up action was taken

3.2.4.2 Under taking possible remedial for pump faults and failure

The following signs and symptoms of pump malfunction are provided with a possible corrective/remedial action;

Symptoms of pump malfunction	Possible causes	Corrective action
1. Pump stops working after a while	Air leakage in the suction pipe	Repair and replace
	Excessive suction lift	Reduce length of suction line; Move pump to a lower position if possible
	Insufficient water at suction inlet	Submerge inlet lower into the water
	Blocked suction inlet or strainer	Unblock and clean
	Collapsed suction hose	Repair or replace
	Mechanical seal or packing drawing air into pump	Replace seal
	Obstruction in pump casing or impeller	Locate and unblock; Repair
	Blocked or punctured delivery hose	Remove source of blockage; Repair or replace hose
	Clogged water seal passages	Unclog
	Lack of fuel	Check fuel level; refuel
2. Pump does not deliver water	Insufficient priming; casing and suction pipe are not completely filled with water	Prime the pump; fill pump casing and suction pipe
	Excessive discharge pressure	Partially closed valve or other obstruction in the discharge

		line; Open valve; Remove block
	Delivery head too high	Check delivery lift and friction loss; Check for bends in delivery pipe
	Suction lift too high or suction pipe too small or too long, causing excessive friction loss	Move the pump to a lower position if possible; Adjust length and size of suction hose
	Suction pipe or suction entry screen blocked	Unblock, clean or replace screen
	Suction line or valve is closed	Open
	Foot valve or check valve is leaking	Replace valve
	Mechanical seal leaking	Replace mechanical seal
	Clogged impeller passages	Clean impeller
	Loss of suction pressure	Check for ruptured suction line; Repair or replace pipe
	Leakage of air into pump casing	Repair, replace
3. Pump vibrates and is very noisy	Impeller clogged, eroded, unbalanced or damaged	Replace impeller; watch out for abrasive suspended solids in pumped water
	Worn motor bearings	Replace bearings
	Suction lift too high	Lower suction lift, install foot valve and prime
	Misaligned pump and motor	Correctly align
	Loss of discharge head pressure or an obstruction in the suction line -- Cavitation	Temporarily minimize damage by throttling the discharge gate valve until the cause can be found and corrected
4. Loss of suction	Suction lift too high	Lower suction lift, install foot valve and prime
	Air leak in suction line	Repair and replace
	Clogged foot valve or strainer	Unclog
	Defective foot valve	Replace
	Defective priming hose on suction pipe	Replace
5. Motor overheats and shuts off	Operation of the pump beyond its rated capacity; motor speed too high	Respect pump operational guidelines
	Poor shaft alignment, bent shaft, excessively tight stuffing box packing, worn wearing rings	Repair and replace
	Impeller is rubbing against pump case or not turning freely due to obstruction	Dismantle pump, unclog or replace the impeller
	Cavitation	Don't re-start pump till cause

		is identified and corrected
6. Excessive fuel/oil consumption	Pump running too fast	Do not exceed permitted operating limits
	Stuffing boxes too tight, wearing rings worn	Repair and replace
	Discharge pressure higher than calculated	Adjust operating regime
	Incorrect lubrication of driver	Use recommended lubricants
	Pumping elements rubbing and binding from misalignment	Inspect and repair

3.3 Maintaining operation area

Working area safety

Description

It is your responsibility to work safely to protect yourself from injuries and any other accidents. You must exercise positive efforts to do this both for your own sake, and for the sake of your family, your colleagues, and your company. Accidents can be caused by human factors, physical factors, or a combination of both.

- **Accidents due to human factors:-** Accidents that are caused by improper use of a machine or tool, by wearing inappropriate clothes, carelessness of the technician, etc.
- **Accidents due to physical factors:-** Those resulting from a malfunction of a machine or tool, lack of integrity of a safety device or poor working environment.

Therefore, you must make it a routine practice to correct hazardous elements in your work place to prevent accidents.

Work clothes - What to Wear for Safety in Work

Work wears

- Select work wear, which is strong and fits well for ease in work. Avoid work wear with exposed belts, buckles and buttons, which can cause damage to vehicles during work.
- Have a clean work wear when at work, as oil and dirt on your clothing will spoil customers' vehicle.

Work shoes

Choose proper footwear for working. It is dangerous to wear sandals or any other type of footwear that slips easily. It is recommended to use with non-slip soles and hardened toecaps.

Work gloves

When lifting heavy items or removing hot exhausts pipes or similar objects, it is advisable to wear gloves, but it is not necessary to make a rule of wearing them for ordinary maintenance work.

Safe and tidy work-workshop rules

In the working area

- Always keep the place where you work clean. When a job is finished, everything should be replaced neatly in order
- Keep your work area clean, and wastes should be disposed.
- The repair shop for engine, transmission and alignment units, etc., should be kept clean at all times.
- Do not leave things, even temporarily exits where they may obstruct people or cars going in and out.
- Do not leave tools and parts on the floor where you, or anyone else, might trip over them. Make a habit of putting them on a workbench or work stand.
- Clean up any spilled fuel, oil or grease immediately to prevent yourself or others from slipping on the floor.

Use of tools and equipment

- Electrical, hydraulic and compressed air equipment can cause serious injury if incorrectly used.
- Dust and chips should be removed from machinery and equipment such as grinders and drilling tools after use to keep them clean.
- Tools should be cleaned after finishing a job, checked item by item, and stored in the tool box.
- Remove dirt and oil from special service tools (SST), testers, gages etc., and put them away neatly in the correct places.

Fire prevention- necessary precautions

- Besides being familiar with the fire alarm system, all workers should co-operate in putting out fires. To do this, they should know where the fire extinguishers are located and how to use them.
- Rags socked with gasoline and oil may sometimes ignite by spontaneous ignition that they should be disposed of in a metal container fitted with a cover.
- Do not use an open flame in the vicinity of stored oil and parts-washing equipment containing flammable liquids.
- Never use open flames or create sparks in the vicinity of batteries being changed, as they give off explosive gas which could ignites.
- Never bring fuel or cleaning solvents into the workshop except when necessary, and use a special container that can be sealed.
- Do not dispose of combustible waste oils, gasoline, etc., into sewage as they can cause a fire within the sewage system. They should always be disposed in a drain tank or an appropriate container.

- Do not start the engines of vehicles with leaks in the fuel system until repairs have been completed.
- **DO NOT SMOKE** except in authorized areas, and be sure to extinguish cigarettes in an ashtray.

Self check #2	**Unit**	**Maintain Small Motorized and Manual Irrigation Pump**
	Module	**Maintain Small Motorized and Manual Irrigation Pump**
	LO#3	**Maintain system components**

Name: _____ **Date:** _____

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

1. What are the main causes of accidents during pump maintenance? (4 pts)

   ……
   ……..
   ……
   ……..

2. What are the factors which are used to set us an appropriate maintenance schedule (6 pts)

   ……
   ……..
   ……
   ……..

3. Give the corrective action for the possible causes of pump symptom (10 points)

POSSIBLE CAUSES	**CORRECTIVE ACTION**
Pump running too fast	
Stuffing boxes too tight, wearing rings worn	_ _
Discharge pressure higher than calculated	_ _
Incorrect lubrication of driver	_ _
Pumping elements rubbing and binding from misalignment	_ _

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

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

Operation sheet #2	**Unit**	**Maintain Small Motorized and Manual Irrigation Pump**
	Module	**Maintain Small Motorized and Manual Irrigation Pump**
	LO#3	**Maintain system components**

Project title: <u>Maintaining Pump Components</u>

➢ **Objectives:** To know the critical procedures of maintaining irrigation pumps.

Tools, equipment and resources required:

- Toolset
- Motorized pump with full accessories

Procedures:

- Preparing the necessary toolsets
- Preparing the pump to be maintained in an appropriate area
- Un tighten and dissemble the basic parts
- Assemble the basic components of the pump

Precaution:

- Be take care the risk of physical and tool accidents.

Quality Criteria:

- ✓ Maintain the working area properly
- ✓ Clean and store the equipments properly.

Information sheet # 4	**Unit**	**Observe and Report on Weather**
	Module	**Observing and Reporting on Weather**
	LO#4	**Record and report maintenance activities**

4.1. Recording all damage and blockage caused by pests and vermin

The efficiency of filter drains can be seriously impaired by the formation of a silt crust, with or without vegetation growth, and pest/small animals on the top of the filter material(foot valve), or by the accumulation of trapped silt in the lower layers. The efficiency of fin/narrow filter drains can be seriously impaired by the accumulation of trapped silt in the lower layers.

Records must be kept indicating which maintenance tasks have been performed and when. This is helpful for two reasons. First, it is imperative to verify the completion of each maintenance task. If for some reason a particular maintenance task is not performed at its scheduled time, then that must be documented to ensure that it is rescheduled as soon as possible. Second, to schedule future maintenance activities or to verify the condition of certain equipment, it is always helpful to be able to refer back to the record of past maintenance performed.

Destructive animals or insects: small animals or insects that harm people, livestock, property, or crops and are difficult to control, e.g. rats, weasels, fleas, or cockroaches

4.2. Recording and reporting damage or faulty pumps and components

The maintenance recordkeeping system must be kept current so that a complete maintenance history of each piece of equipment is available at all times. This is important for planning and conducting an ongoing maintenance program. Regular maintenance and emergency maintenance must be well documented, as should special work done during overhauls and replacement.

4.3. Recording and reporting all routine maintenance activities

Using defective tools and equipment can be very dangerous and costly. It is good practice to learn to be sensitive to the tools and equipment you use. Usually there is a symptom before a breakdown or problem occurs, for example a pump will make noise or vibrate if something is wrong, or the secondary filters will need cleaning within a shorter period of time, because something is wrong with the primary filter. It is very important that worn, defective tools and equipment be reported to the manager. Any unusual events or problems must also be reported to the manager.

Table: Sample record sheet

No.	Components	Damage & blockage type	Degree of damage & blockage	Cause	Location	Section of the system affected	Date of detection	Action taken	Effect of maintenance action	Cost	Remark
1											
2											
3											
4											
5											

Prepared by: Name_____ **Signature:** _____ **Date:**

Operation sheet #3	**Unit**	**Observe and Report on Weather**
	Module	**Observing and Reporting on Weather**
	LO#4	**Record and report maintenance activities**

Project title: Record and report maintenance observation activities

- **Objectives:** To undertake record and report faulty or damaged parts of irrigation pump.

Tools, equipment and resources required:

- Paper
- Pen
- Pencil
- Clipboard

Procedures:

- Use the following table as a sample format

No.	Components	Damage & blockage type	Degree of damage & blockage	Cause	Location	Section of the system affected	Date of detection	Action taken	Effect of maintenance action	Cost	Remark
1											
2											

Lap Test	**Practical Demonstration**

Name: _____ Date: _____

Time started:_____ Time finished:____

Instructions:

☞ You are required to perform the following activity:

- ✓ Task_1: Select the necessary tools and equipments:
- ✓ Task_2: perform flushing and cleaning of pumps
- ✓ Task_3: Conduct the maintenance activities according to instructions.
- ✓ Task_4: Carryout pre-season and post-season pump maintenance work
- ✓ Task_5: Clean, store and maintain tools and equipments.
- ✓ Task_6: Clean and maintain working area.
- ✓ Task_7: Record and report observed faults and damaged parts