

Session 1 – Introduction, training objectives and pre-training evaluation



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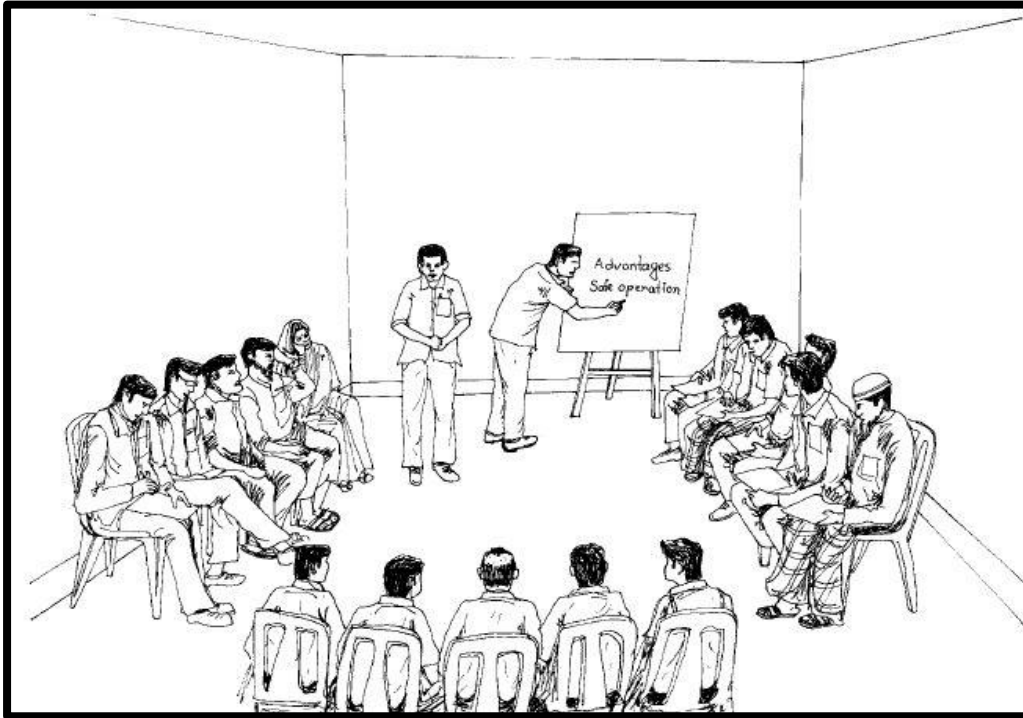
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What do you expect to learn from this training?



- In groups, discuss what you think you'll learn today.
- Choose one of the participants to speak for the group.
- Take Notes.

Today's sessions

- 1. Introduction, training objectives and pre-training evaluation**
- 2. Introduction to the axial flow pump and mixed flow pump**
- 3. Major parts of the axial and mixed flow pumps**
- 4. Common causes of axial and mixed flow pump failure and breakdown and their potential solutions**

Today's sessions

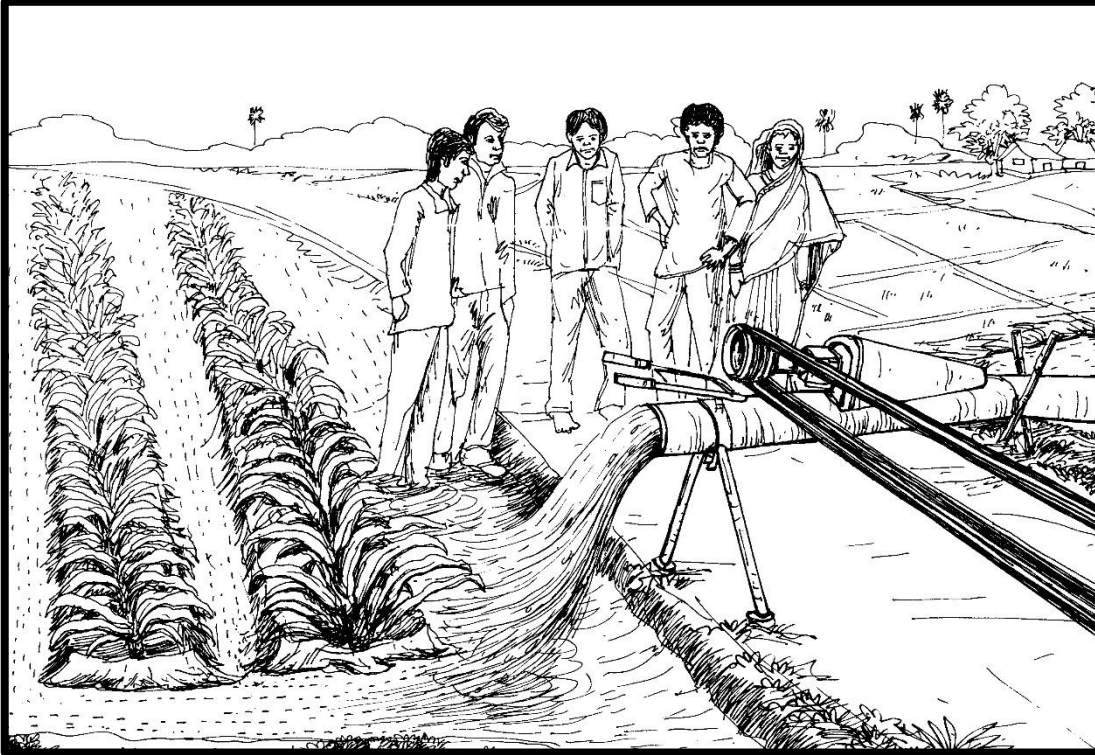
- 5. Common causes of axial and mixed flow pump failure and breakdown – practical troubleshooting)**
- 6. Review of key messages, post-training evaluation and close of training**

What kind of training is this?

This is participatory training, so:

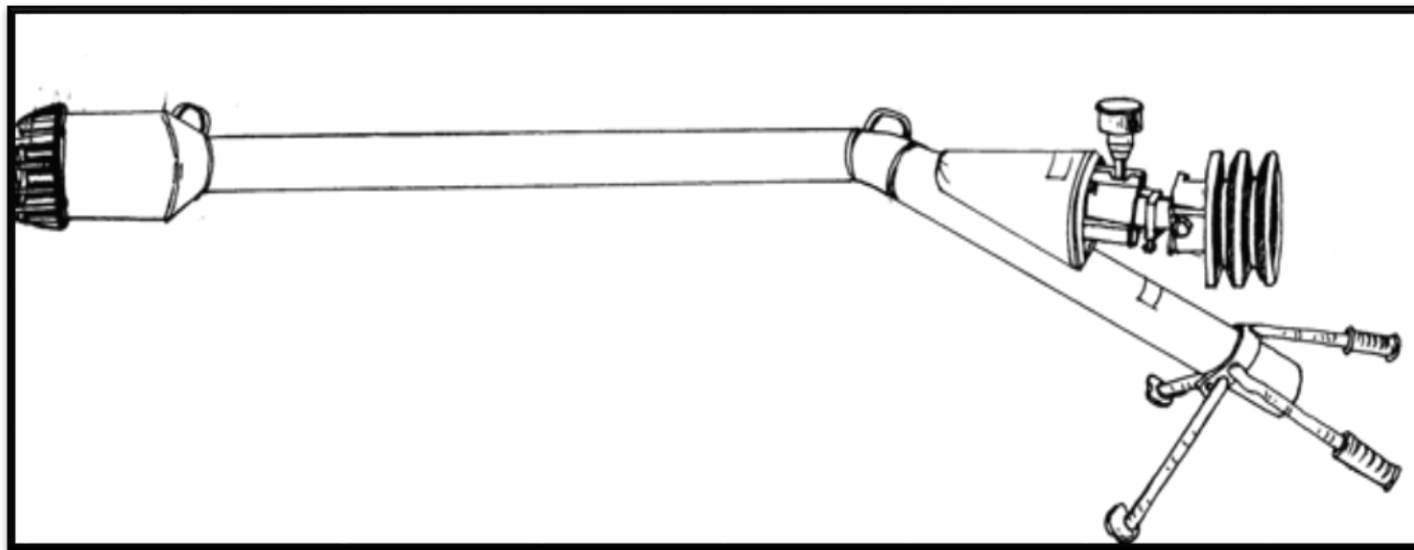
- **Ask questions and speak.**
- **Learn by experience – run irrigation pumps yourself and learn how to operate them.**
- **Learn by discussing each topic with your group.**

- **Speak up when the facilitator asks questions – and ask questions yourself. This way we can learn from each other.**
- **Feel free to ask questions and to contribute your knowledge!**



- **Make sure you get time to practice how to set up and operate the pump.**
- **Have fun!**

Please enjoy this training!



Session 2 – Introduction to the axial flow pump and mixed flow pump



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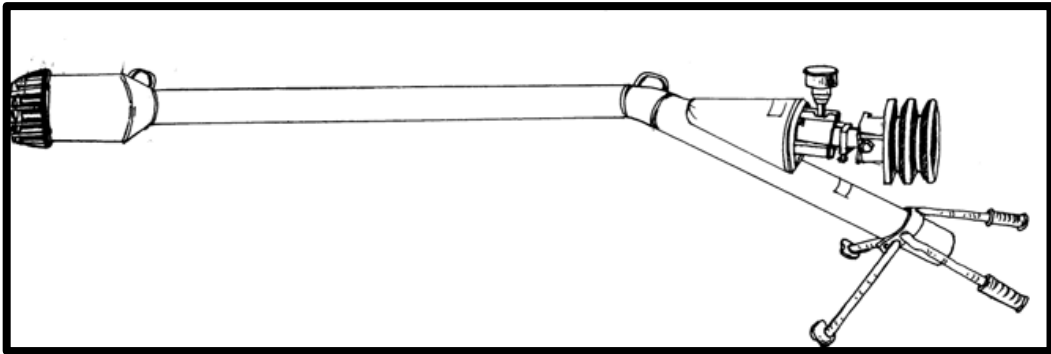


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What is an axial flow pump?



- **An axial flow pump (AFP) is a pump driven by**
 - (1) a shaft encased in a long pipe, and**
 - (2) an impeller (this is a reverse directed propeller – like on a boat – which is powered by a diesel engine or electric motor).**

- **A mixed flow pump has a ‘bell’ at the end, where water is sucked into the pump. The impeller is usually larger than the diameter of the conduit pipe in which the shaft is encased.**
- **Axial and mixed flow pumps were developed by innovative farmers in Vietnam and Thailand in the 1960s and are now common throughout Southeast Asia.**

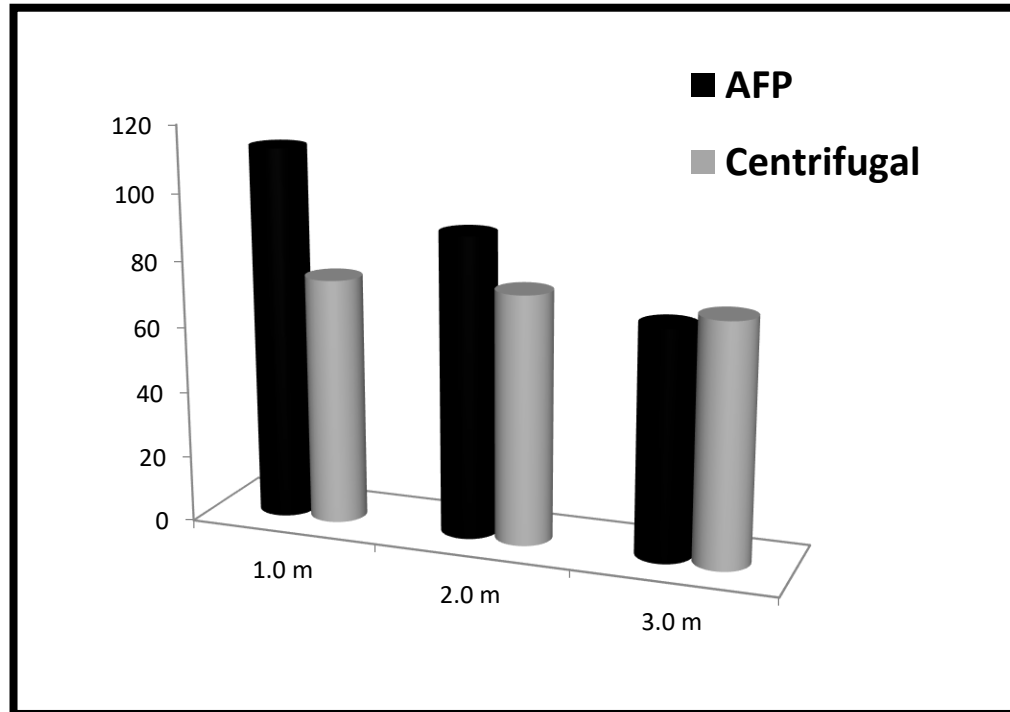
- **Both pumps are known as ‘propeller pumps’ – because the impeller works much like a boat propeller.**
- **To run either an axial or mixed flow pump, a two-wheeled tractor or a diesel engine of 12-16 HP is usually necessary, unless engines are directly coupled. However, these are rare in South Asia.**

- **Using these pumps to irrigate farmers' fields can be profitable – for the pump owner and for the farmer too!**

Differences between the AFP/MFP and the centrifugal pump

Criteria	AFP/MFP	Centrifugal pump ²³
Capacity	high	low
Frictional loss	low	high
Operating cost	low	high
Power transmission	high efficiency	low efficiency
Operating time required	less	more
Manufacture	easy to fabricate	difficult to fabricate
Fuel consumption	low	high
Water lifting height	up to about 3 m (and fuel efficient)	over 3 m (but with low fuel efficiency when lift < 3m)

Advantages of the AFP

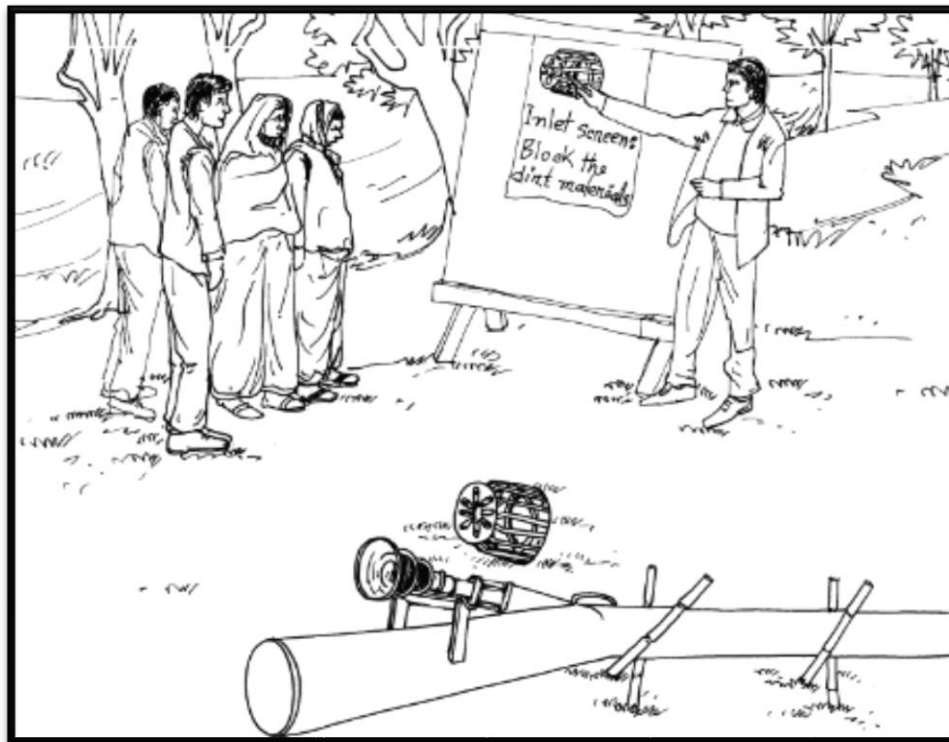


Early experiments show that:

- **At 1 m lift, the AFP is 51% more fuel efficient than the centrifugal pump.**

- **At 2 m lift, the AFP is 21 % more fuel efficient than the centrifugal pump.**
- **At 3 m lift, the AFP discharges more water but the fuel cost is higher.**

Mixed flow pumps can provide increased lift height. Experiments are under way to determine the best engineering approach to developing highly fuel efficient MFPs.



Session 3 – Major parts of the axial or mixed flow pump and their functions



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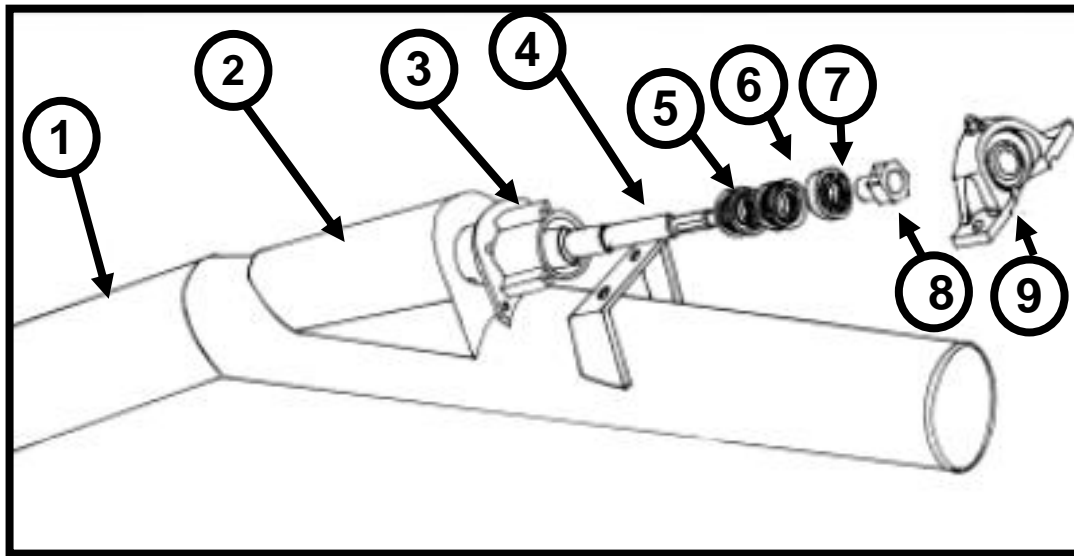
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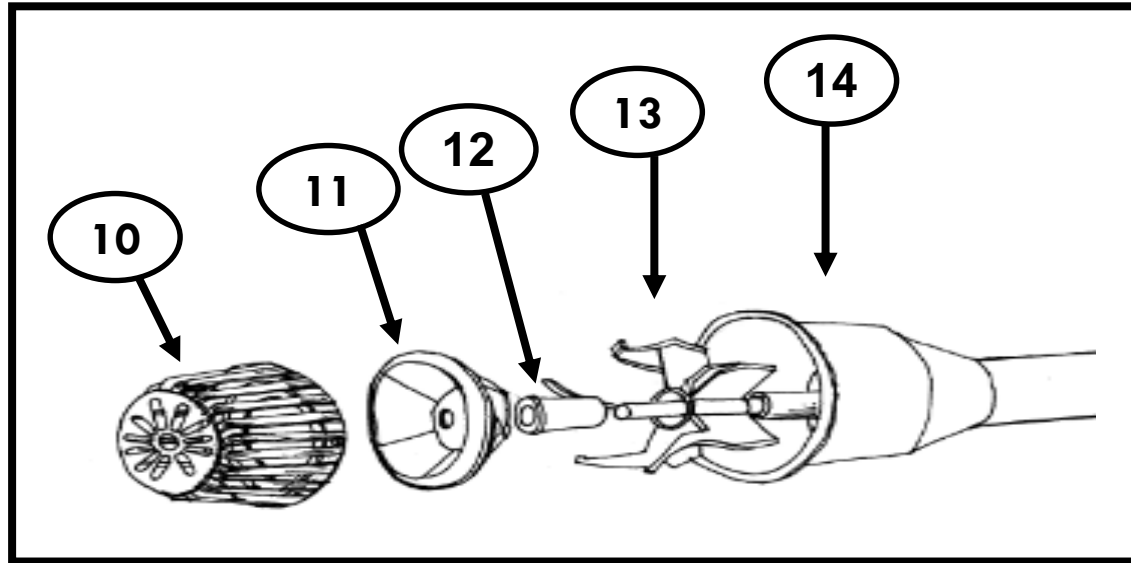
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Major parts of the axial flow pump and their functions



- | | |
|---------------------------|----------------------------|
| 1. Pipe column | 6. Ball bearing |
| 2. Bearing house mount | 7. Additional ball bearing |
| 3. Bearing housing | 8. Shaft collar |
| 4. Inlet side drive shaft | 9. Mounted bearing |
| 5. Thrust bearing | |



10. Inlet screen

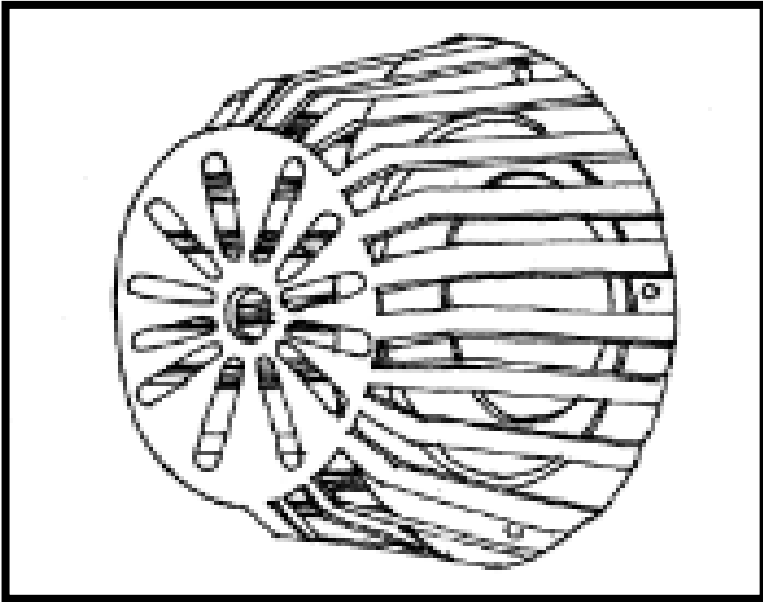
11. Impeller

12. Suction end bushing

13. Suction end stator

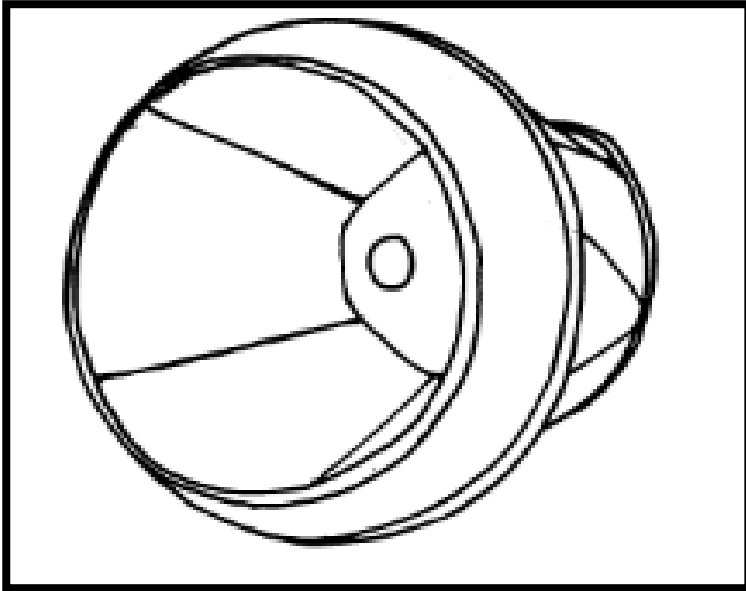
14. Suction bell

The inlet screen



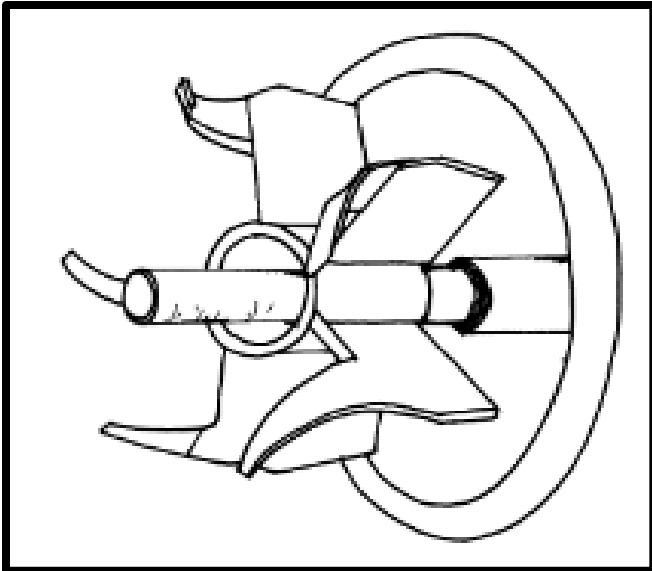
Prevents dirt and other stray materials from getting into the pump from the canal, pond or river that the water is pumped from.

The impeller

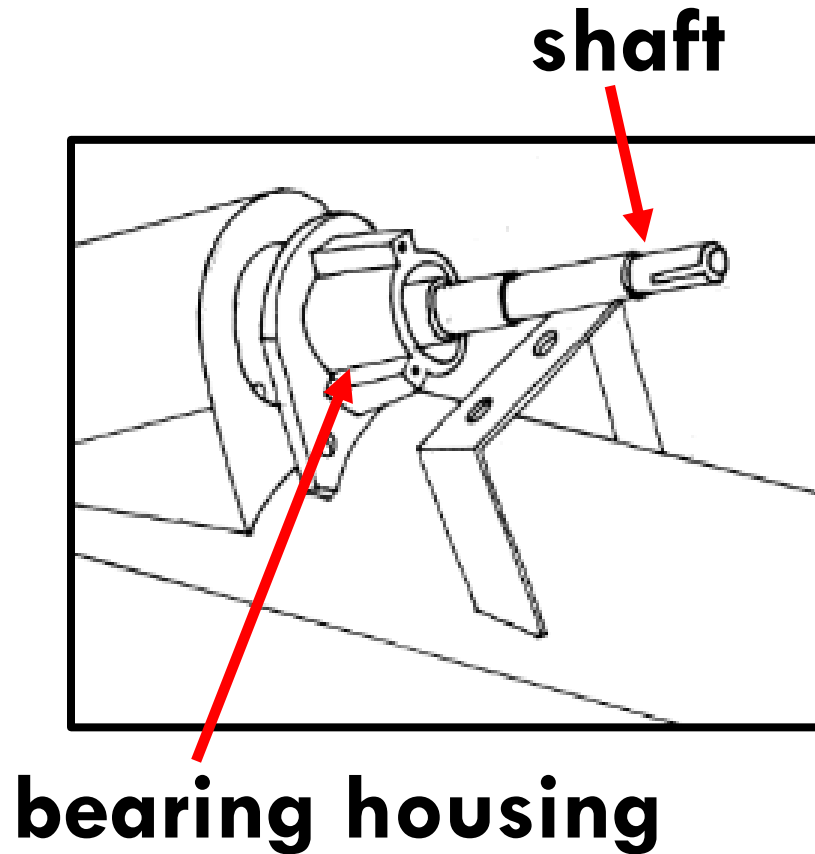


Pumps/pushes water upward through the pipe or conduit.

The suction end stator



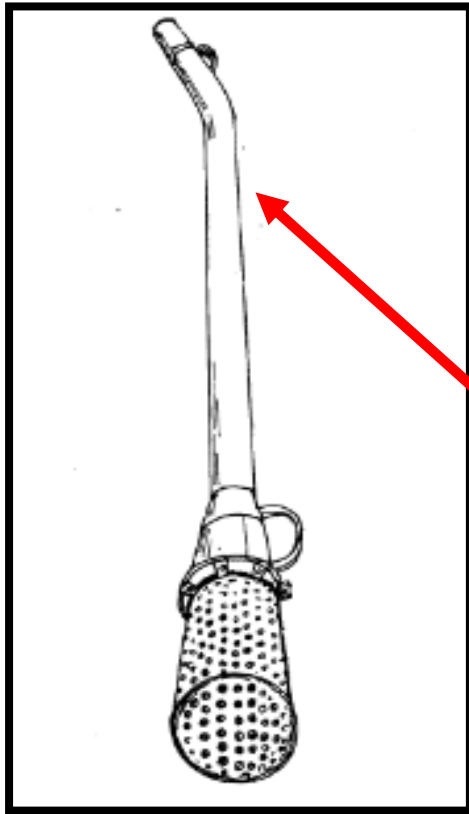
Straightens water flow and reduces turbulence.



**The driving shaft
Drives the impeller**

**The bearing housing
Holds the bearings**

The pipe/conduit

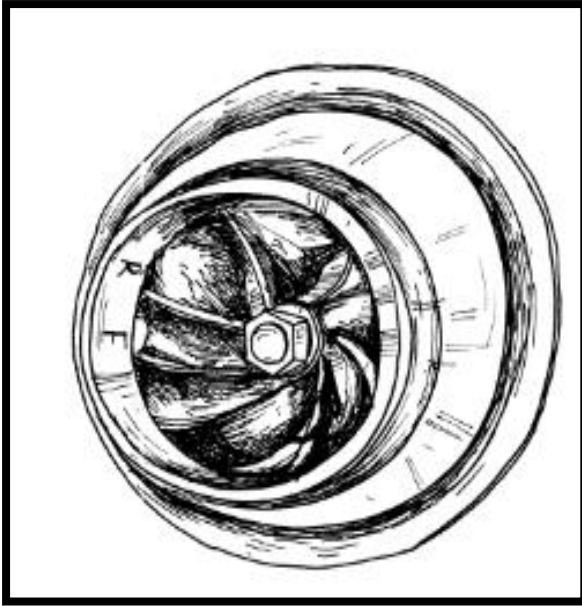


pipe

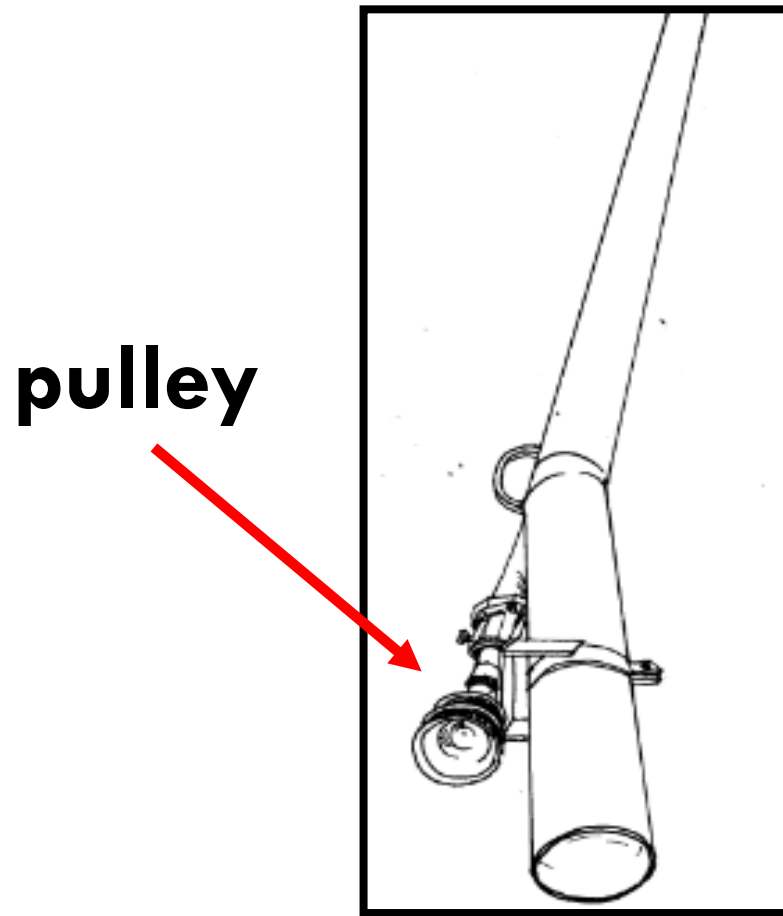
Transfers the water pumped by the impeller until delivery.

Note: this pump is an AFP (not MFP) because it does not have a 'bell' shape at the end of the pump from where water is drawn.

The bushing



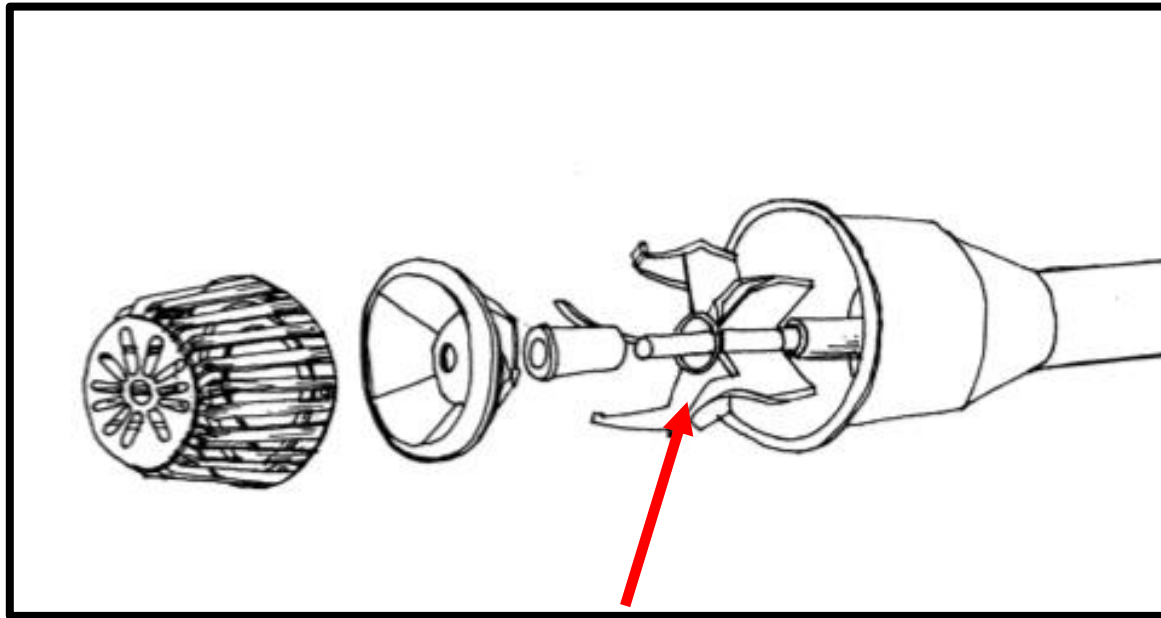
Holds the impeller and shaft in place



The pulley

Drives the shaft to rotate the impeller (powered by an engine)

The diffuser vane



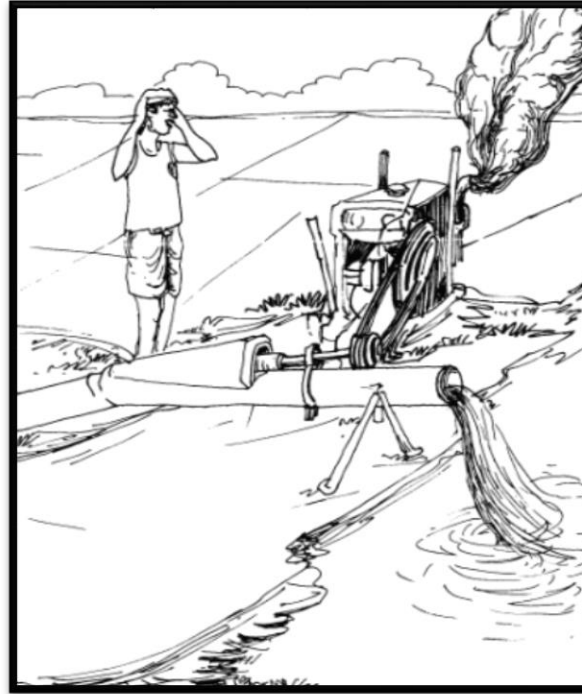
diffuser vane

**Straightens the water
after it is transferred
by the impeller into
the conduit pipe**

Review of Key messages

- **The axial pump and the mixed flow pump are very similar.**
- **Axial flow pumps have smaller impellers – these fits inside the conduit pipe.**
- **The mixed flow pumps has larger which is wider than the conduit pipe. It delivers more water than an axial flow pump.**

Name of part	Functions
Inlet screen	Blocks dirt and other stray materials from getting into the pump from the canal, pond or river where water is pumped from
Impeller	Pumps/pushes water upward through the pipe or conduit
Driving shaft	Drives the impeller, which pushes water up the pump
Pipe or conduit	Holds the water pumped by the impeller until delivery
Bearing housing	Hold the bearings
Bushing	Works like a bearing and holds the shaft in place
Pulley	Drives the shaft (powered from an engine)
Diffuser vane	Straighten the water flow and reduces turbulence



Session 4 – Common causes of failure and breakdown of the axial flow pump and mixed flow pump (potential solutions)



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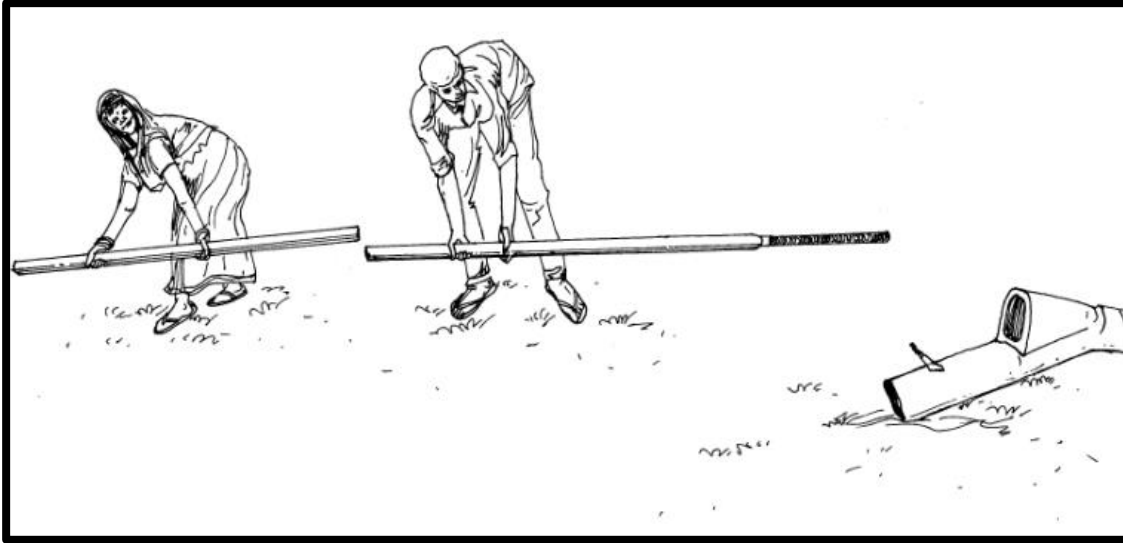
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Problem 1: the pump shaft breaks



Symptoms:

**Abnormal sounds from
the pump or no water
discharge**

Causes:

- (1) over-running the pump**
- (2) excessively high water lift height**
- (3) faulty shaft**

Effects:

Complete pump failure (meaning that the pump cannot be used)

Spare parts required:

Shaft

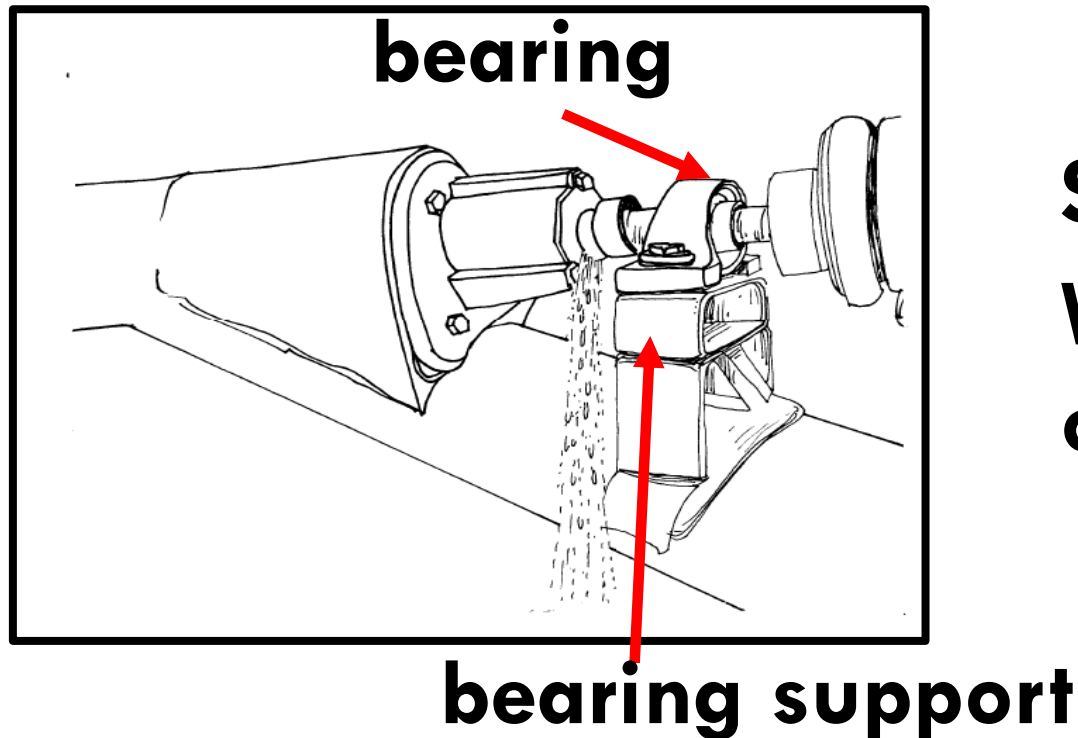
Where to get or make/repair spare parts:

collect new one from a dealer or make another one with a new pipe

Tools required:

dual wrench, adjustable wrench, screwdriver, hammer and puller

Problem 2: water leakage during pumping due to faulty oil seal



Symptoms:

**Water leakage from the base
of oil seal**

Cause(s):

- (1) tearing or loosening of the oil seal**
- (2) loosening of nuts and bolts**
- (3) bent shaft**

Effects:

- (1) water gets into the bearing and causes bearing damage**
- (2) reduction of water discharge/efficiency**
- (3) increased fuel cost**

Solution:

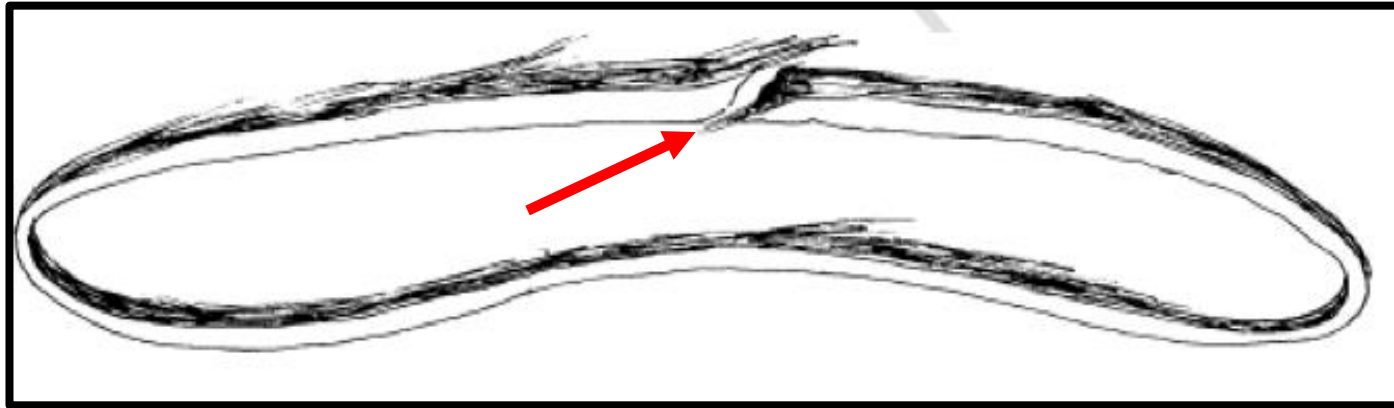
- (1) straighten the shaft**
- (2) replace oil seal**
- (3) tighten nut-bolts**
- (4) replace bearing support**
- (5) replace faulty bearings**

Spare parts required:
oil seal, bearings

Where to get spare parts:
shop deals with
pump/engine spare parts

Tools required:
dual wrench,
adjustable wrench,
screwdriver

Problem 3: the transmission V-belt rips



Symptoms:

The v-belt connecting the engine to the pump cracks or tears

Causes:

- (1) misalignment of the engine and pump and pulleys**
- (2) engine speed too high**
- (3) the pump pulley is too close to the engine**
- (4) the surface of the pulley is rough, wearing away the belt**
- (5) the V-belt is old**

Effects:

- (1) belt slippage**
- (2) reduction of discharge**
- (3) increase of cost**
- (4) the pump fails**

Prevention:

- (1) align the pulley correctly in a straight line with the pump**
- (2) use a large belt if water level is too low**
- (3) file the pulley until smooth**

Solution:

replace the belt (full set)

Tools required:

file or sand/glass paper

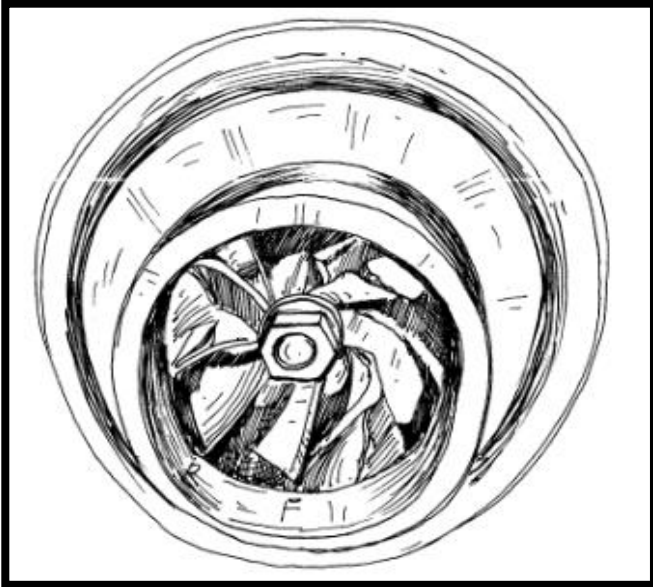
Spare parts required:

V-belt

Where to get spare part:

**shop dealing in
pump/engine spare parts**

Problem 4: pump impeller breaks



Symptoms:

Low discharge of water, abnormal vibration of the pump, lack of water flow

Cause:

Foreign objects or dirt are sucked into the pump, breaking the blades or causing their disruption

Effects:

- (1) reduced discharge due to partial break of blade(s)**
- (2) zero discharge due to complete break of blade(s)**

Solution:

- (1) repair the blade(s), and/or**
- (2) replace the impeller**

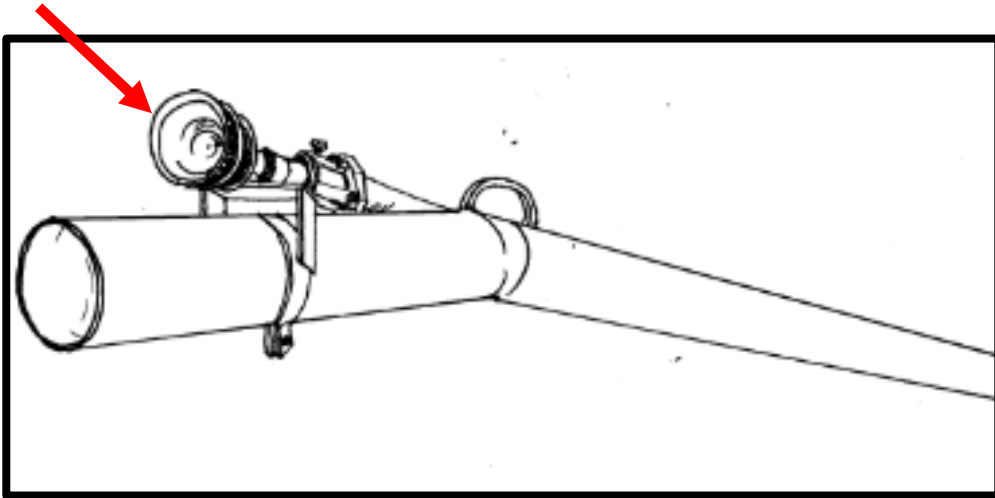
Spare parts required:

Impeller

**Where to get or make/repair spare parts:
purchase new impeller from dealer or repair/have new
blade(s) prepared at a local workshop**

**Tools required:
dual wrench and adjustable wrench**

Problem 5: pump pulley worn out



Symptoms:

these can be felt by touching the pulley – it will be out of shape, or show gouges or similar defects.

Causes:

- (1) loose V-belt**
- (2) rough surface of pump pulley**

Effects:

the V-belt tears

Spare parts required:

new V-belt, or new pulley (if the deterioration of the pulley is severe)

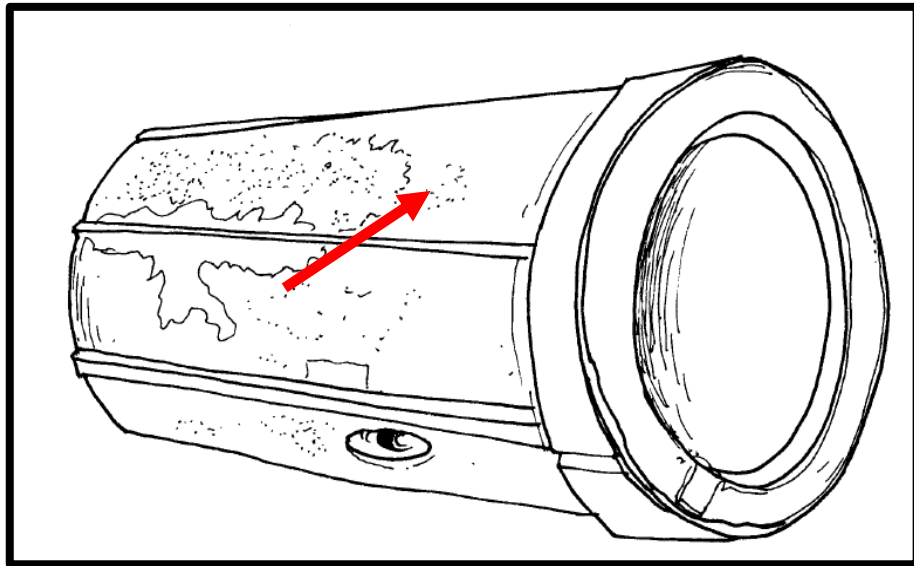
Where to get spare parts:

at a shop dealing in pump/engine spare parts

Tools required:

file or sand/glass paper, wrenches

Problem 6: damage to shaft bushing due to deposition of sand in the pump



Symptoms:
excessive vibration of the pump, faulty shaft

Causes:

- (1) the impeller is too close (less than 0.6 m) to the bottom of the canal, pond or river, and/or**
- (2) running the pump in muddy or sandy water**

Effects:

- (1) the shaft bends/breaks, and/or**
- (2) bushing rips**

Prevention:

- (1) always place the impeller at least 0.2 m (or never less than 0.3 m) above the bottom of the water body you are pumping from**
- (2) never run the pump in muddy or sandy water**

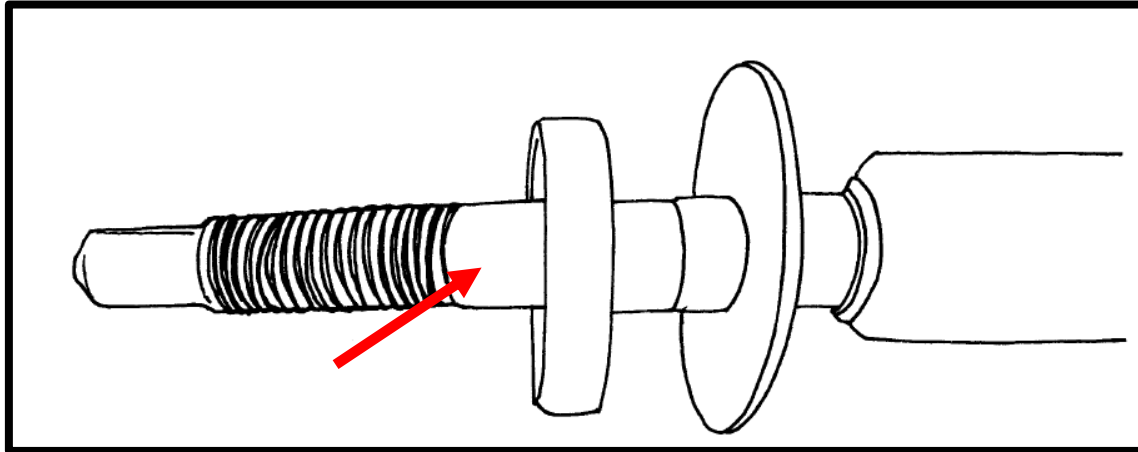
Spare parts required:

bushing

**Where to get or make/repair spare parts:
purchase new one from dealer or repair/have a new
one made at a local workshop**

**Tools required:
dual wrench, adjustable wrench**

Problem 7: shaft bearing(s) fail



Symptoms:
Noise, overheating
bearing (s)

Causes:

- (1) misalignment of the shaft**
- (2) old bearing (s)**

Effects:

- (1) power loss**
- (2) reduction in discharge**

Solution:

Replace faulty bearing (s)

**Spare parts required:
bearing(s)**

Where to get spare parts:

at a shop dealing with pump/engine spare parts

Tools required:

**dual wrench, adjustable wrench, screw driver, hammer,
puller and chisel**

Problem 7: shaft bearing(s) fail



Symptom:
black smoke comes from the engine during operation

Causes:

- (1) engine speed is too high**
- (2) water lift height is too high**
- (3) engine size/horse power is too small for the
AFP/MFP being used**
- (4) engine is old or overloaded**

Effect:

damage can be caused to the engine

Solution:

- (1) reduce engine speed**
- (2) pump water within the suggested range of water lift heights**
- (3) select correct engine or pump**

Review of key messages, post-training evaluation and close of training

Session 5



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- **What are major parts of an axial or mixed flow pump and their functions?**
- **What are major causes of failure and breakdown of the axial/mixed flow pump?**
- **What is the solution if the pump shaft breaks or bends?**

- **Where can you collect new impellers?**
- **What is the best solution if there is water leakage from the pipe or pump?**
- **How do you prevent the transmission belt ripping?
How do you deal with it when it rips?**