# Pump efficiency

## Surface electric

**Inefficient pumping is costly and common. Conducting a pumping efficiency test as part of an overall irrigation system audit can highlight problem areas and save money.**

**Pumping inefficiency can stem from one or more of the following:**

- **Wrong pump type** for the job (pump duty).
- **Worn pump components**.
- **Incorrect wiring** of the motor.
- **Wrong size pump** for the job (pump duty).
- **Insufficient water supply**

These problems can easily occur when there have been changes to the irrigation area or application method since the pump was originally commissioned.

Pump efficiency is a measurement of how well a pump converts power input into water output (delivery) and is represented as a percentage.

**Pump Efficiency = Water Power Output ÷ Electrical Power Input**

The pump must provide sufficient head pressure to compensate for all friction losses, and enable the water outlet (nozzle, emitter etc) located at the highest point in the irrigation block to operate efficiently.

**Pump efficiency of 70 to 85% should be achievable. An acceptable minimum is 65%.**

**To measure the efficiency of an electric bore pump** you will need to find and record the following information:

| | |
|---|---|
| Pump | |
| Make and model | |
| Size | |
| Type of pump | |
| Motor specifications (e.g. HP/kW, RPM) | |
| Drive system (e.g. flat belt, gear) | |

## Calculate water power output

The water power output of the system is the amount of work the pump is required to do in providing adequate pressure at the discharge end.

**Water Power Output = Gravity** (0.98) **x Total dynamic head** (TDH) **x Water discharge** (Q)

## Total Dynamic Head

To calculate the total dynamic head (TDH) required for the system, you will need to measure and add together the:

- static lift
- suction line friction (Fs)
- discharge friction (Fd)

**Static lift** – for a centrifugal pump positioned above the water source, measure the vertical height between the water surface and the centre line of the pump in metres.

OR use a vacuum pressure gauge on the suction side of the pump to measure static lift + suction friction.

**Suction line friction** – is dependent upon the length and size of the pipe from the water to the pump, the foot valve and also the flow rate. Use the friction loss calculator on the National Pump and Energy website to estimate suction line friction loss. https://www.nationalpump.com.au/calculators/friction-loss-calculator/ Record the result in metres.

**Pump operating pressure** – this is measured using a suitably-sized gauge, installed as close as possible to the pump on the discharge side. Convert the reading to metres.

- To convert psi to metres of head, multiply by 0.70284
- To convert kPa to metres of head, multiply by 0.10194.

**Discharge friction** – Similar to column friction, measure the friction losses in the delivery mainlines using the calculator on the National Pump and Energy website (see above).

**Add these four readings (in metres) together to give the Total Dynamic Head.**

## Water discharge (Q)

Next, measure the water discharge in litres per second. The best way to do this is using a water meter positioned on the discharge side according to design specifications. To measure flow rate, time how long it takes, in seconds, for 1000 litres to travel through the water meter. For example, 1000 litres ÷ 92 seconds = 10.9 litre/sec.

If the water meter is installed some distance from the pump site, check all hydrants for leaks.

# Electrical power input

**Power input = Electrical consumption** (kW) **x Motor efficiency** (Me) **x Drive factor** (Df)

**Electrical consumption** – Calculate the kW based on the time taken for meter discs to rotate a specific number of revolutions and taking into account the meter constant, or the difference between two readings (say 20 minutes apart) on a digital meter.

**Motor efficiency** – Refer to the motor specifications to determine the decimal factor to use.

As a guide:

- 10 to 22 kW motor efficiency factor = 0.88
- 22 to 55 kW motor efficiency factor = 0.90
- 55 to 75 kW motor efficiency factor = 0.92

**Drive factor** – The type of motor drive on the pump determines drive loss.

Use the relevant factor for your motor:

- Flat belt drive factor = 0.88
- V-belt drive factor = 0.93
- Gear drive factor = 0.95

## Next Steps

**Water Power Output = Gravity** (0.98) **x Total dynamic head** (TDH) **x Water discharge** (Q)

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**Power input = Electrical consumption** (kW) **x Motor efficiency** (Me) **x Drive factor** (Df)

=

**Pump Efficiency = Water Power Output ÷ Electrical Power Input**

=

**Pump efficiency of 70 to 85% should be achievable. An acceptable minimum is 65%.**

Compare your findings to the pump curve from an irrigation supplier or the manufacturer that matches your pump's specifications.

If your pump performance is not within the acceptable range, seek advice from a pump and irrigation

## Resources

Basics of Sugarcane Irrigation Systems Handbook, Module 4 – Basics of hydraulics

Basics of Sugarcane Irrigation Systems Handbook, Module 5 – Pumps and pumping

National Pump and Energy website: https://www.nationalpump.com.au/calculators/friction-loss-calculator/

Information Sheet – Reading pump curves