Irrigation Energy Quick Test

Delivery System Efficiency Worksheet

What is the Irrigation Quick Test about?

The purpose of this Irrigation Quick Test is to determine the energy efficiency of the headworks and pipelines feeding the irrigation system. See also the guidelines for fuller explanation of the steps.

If findings are unexpected, or suggest low performance, consider getting professional advice.

When should testing be done?

Complete the efficiency test when commissioning a new system and after any major changes to the pumping or irrigation systems. It should also be repeated as part of annual maintenance.

Make sure the system operation is 'typical' when you test, so your results are meaningful.

What needs to be done?

1. Gather information about the system
2. Record the data on the worksheet
3. Work out answers using the worksheet calculations
4. Compare your results with target values

What equipment will you need?

- This worksheet and the guide
- Pressure gauge
- Vacuum (suction) gauge
- Tape measure
- Pen or pencil

Field measurements

- Water meter readings
- Elevation at water level, pump, mainline entry and mainline exit
- Pressure readings at pump inlet and outlet
- Pressure readings at mainline entry and exit

The more accurate your input values, the more accurate your results. Take care reading pressure and determining elevation changes. Use good equipment in good order.

If you don't already have pressure and suction gauges in place, it may take a little setting up the first time you do this testing. Next time, your equipment will already be in place.

What is acceptable?

Note:

In this Guideline, elevations in metres are converted to kilopascals (kPa) using specific gravity (SG). The standard factor is SG = 9.8, but if your measurements are less than 95% accurate, you could just multiply metres by 10 to get kilopascals.

Headworks Efficiency

Basic headworks including water meter, clean filters and gate valves, but excluding pressure control valves

- Maximum friction headloss < 30 kPa

Intake side / Suction Line

- Maximum intake suction < 60 kPa
- Maximum suction velocity < 1.5 m/s (where pipe sizes are not determined by pressure variation or velocity requirements)

Hydraulic (Mainline) Efficiency

- Mainline friction loss < 100 kPa (unless there is need to burn off pressure, such as in gravity supplied systems).

- Mainline friction loss 4 - 12 kPa/100m pipe

Situation: Max Velocity

< 150 mm diameter pipe

- open end, controlled start & stop < 3.0 m/s
- uncontrolled start and stop < 1.5 m/s

>150 mm diameter pipe

- open ended, controlled start & stop < 2.0 m/s
- uncontrolled start and stop < 1.0 m/s

Prepared with funding from EECA, the Energy Efficiency and Conservation Authority

Worksheet for IRRIG8Quick Delivery System Efficiency Test

Enter elevations, pressures and other data and complete the Calculations as directed
Enter information using the measurement units (e.g. kilopascals or metres) specified
to ensure calculated answers have the correct units.
Compare your results with standard recommendations

Table A: Headworks Inlet Efficiency

Inlet-side Efficiency

a	Water surface elevation when operating – include drawdown (m)	
b	Pump inlet elevation (m)	
c	Change in elevation head (kPa) *[(b – a) x SG]*	
d	Water intake pressure (kPa)	
e	Pump inlet pressure (kPa)	
f	Change in pressure head (kPa) *[d – e]*	
g	Friction headloss (kPa) *[f – c]*	

Outlet-side Efficiency

h	Pump outlet elevation (m)	
j	Mainline entry elevation (m)	
k	Change head (kPa) *[(h – g) x SG]*	
m	Pump outlet pressure (kPa)	
n	Pressure at mainline entry (kPa)	
p	Change in pressure head (kPa) *[m – n]*	
q	Friction headloss (kPa) *[p – k]*	

Total Headworks Efficiency

r	Total friction headloss (kPa) *[g + q]*	
s	Total pressure head (kPa) *[f + p]*	
t	Headworks Efficiency *[(s – r) / s] x 100*	

Excess Energy Cost

u	Excess headworks friction loss (kPa) *[r – 30]*	
w	Excess system friction ratio *[u / s]*	
y	Annual Energy Cost ($ pa) From Pump Efficiency Quick Test	
z	Annual energy loss cost $ pa *[w x y]*	

Table B: Mainline Efficiency

a	Mainline entry elevation (m)	
b	Mainline exit elevation (m)	
c	Change in elevation head (kPa) *[(b – a) x SG]*	
d	Mainline entry pressure (kPa)	
e	Mainline exit pressure (kPa)	
f	Change in head (kPa) *[d – e]*	
g	Friction headloss (kPa) *[f – c]*	
h	Excess mainline friction (kPa) *[100 - g]*	
j	Mainline length (m)	
k	Friction loss (kPa/100m) *[g / j x 100]*	
m	Excess mainline friction (kPa/100m) *[12 - k]*	

Excess Energy Cost

n	Excess mainline friction loss (kPa) *[greater of h or m]*	
p	Excess system friction ratio *[n / f]*	
q	Annual Energy Cost ($ pa) From Pump Efficiency Test	
r	Annual energy loss cost $ pa *[p x q]*	

Table C: Pipe Velocities

a	System flow rate (m^3/hr)	
b	Intake pipe internal diameter (mm)	
c	Intake pipe section area (m2) *[3.14 x (b / 2000) ^{2}]*	
d	Intake pipe velocity (m/s) *[(a / 3600) / c]*	
e	Excess intake velocity (m/s)	
f	Mainline internal diameter (mm)	
g	Mainline section area (m2) [3.14 x (f / 2000) ^{2}]	
h	Mainline velocity (m/s) *[(a / 3600) / g]*	
j	Standard velocity max for conditions (m/s)	
k	Relative velocity (m/s) *[h - j]*	

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