Pumps and pressure in irrigation systems

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SD Farm and Nursery Expo 11/4/2021

Flowrate per acre

Avocado spaced 18’ x 22’
110 trees per acre
Two 1 gph emitters per tree
So each acre takes 220 gph or 3.6 gpm/acre

RAIN BIRD

20JH

1/2" 13mm Full Circle, Brass Impact Sprinkler

- Durable brass die-cast arm
- Stainless steel springs and fulcrum pin
- Corrosion and grit resistant

Features

Straight Bore Nozzle (SBN-1) Performance*

psi @ Nozzle	NOZZLE SIZE (Stream Height: 6 ft.) 7/64" Rad. (ft.)	7/64" Flow (gpm)	1/8" Rad. (ft.)	1/8" Flow (gpm)	9/64" Rad. (ft.)	9/64" Flow (gpm)	5/32" Rad. (ft.)	5/32" Flow (gpm)
35	38	2.05	38	2.68	39	3.39	39	4.19
40	38	2.19	39	2.86	40	3.62	39	4.47
45	39	2.32	39	3.03	40	3.84	40	4.73
50	39	2.45	39	3.20	40	4.05	40	5.00
55	39	2.57	40	3.35	40	4.24	40	5.23
60	39	2.68	40	3.50	41	4.43	41	5.47

There are 50 sprinkler heads per acre
and each puts out 3 gpm.
So each acre takes 150 gpm.

You need an irrigation schedule and irrigation sets should cover the same area

Block	Area
1	0.9
2	0.33
3	0.4
4	0.5
5	0.63
6	0.61
7	0.74

Irrigation sets		
Block	Area, acres	Flowrate, gpm
1	0.9	
3	0.4	
Total	**1.3**	**195**
5	0.63	
7	0.74	
Total	**1.37**	**205**
6	0.61	
4	0.5	
2	0.33	
Total	**1.44**	**216**

There are 50 sprinkler heads per acre and each puts out 3 gpm.
So each acre takes 150 gpm,
Or 150 gpm/acre

If you irrigate less area, the pressure will increase

Block	Area
1	0.9
2	0.33
3	0.4
4	0.5
5	0.63
6	0.61
7	0.74

Irrigation sets

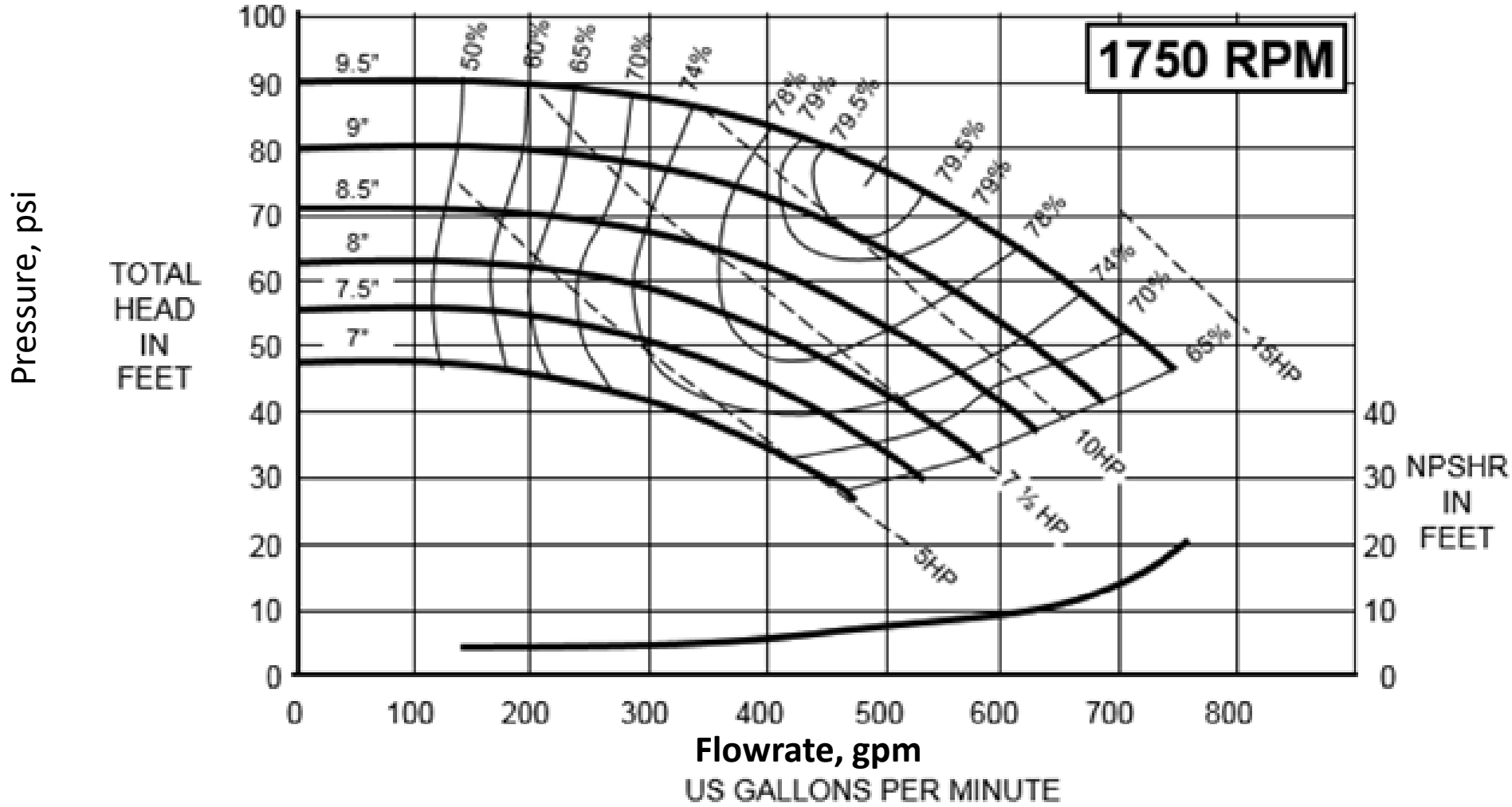
Block	Area	gpm
1	0.9	
Total	**0.9**	**135**
3	0.4	
4	0.5	
Total	**0.9**	**135**
6	0.61	
2	0.33	
Total	**0.94**	**141**
5	**0.63**	**94**
7	**0.74**	**111**

If you irrigate with smaller sets, the flowrate required from the pump is smaller

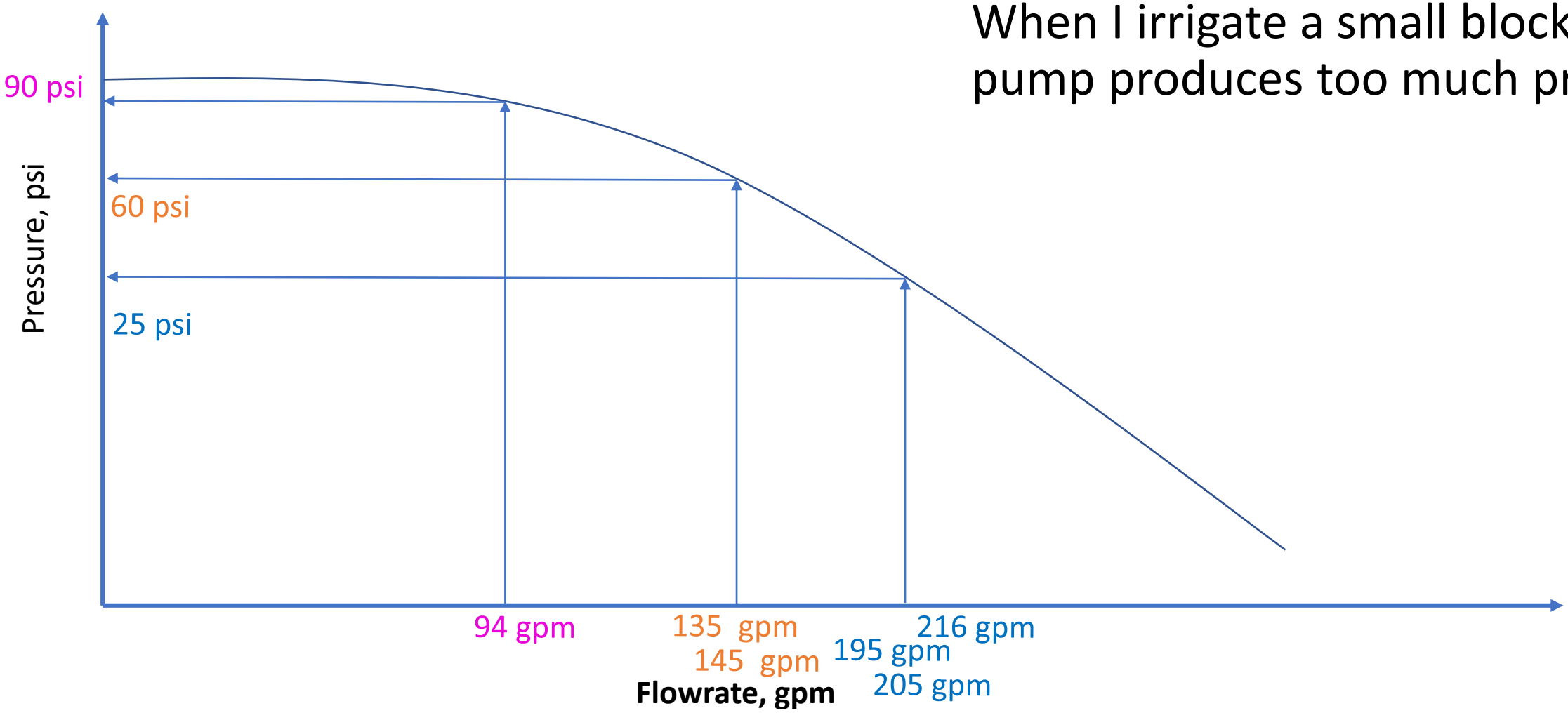
Pump performance curve

The pump can only operate at a point on this curve

If you increase the flowrate, the pressure drops and vice versa



Pump performance curve



When I irrigate a small block, the pump produces too much pressure

How much pressure do you need?

Drip system

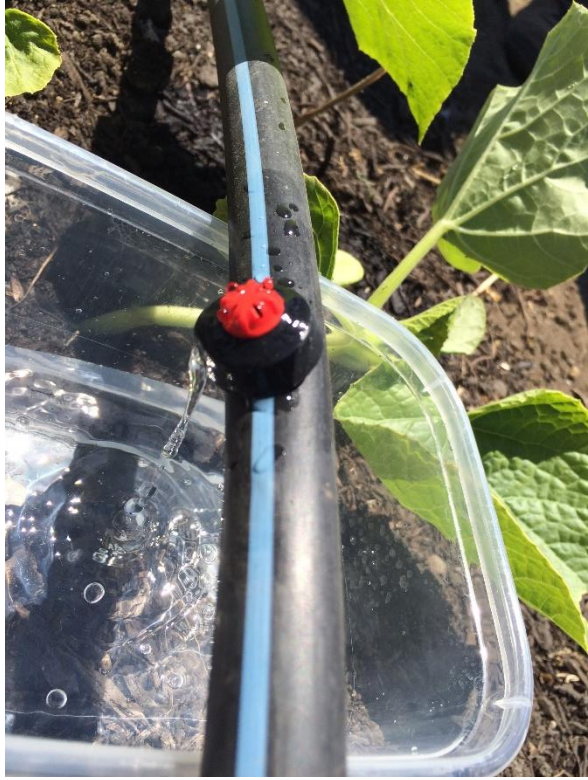
A. 8 to 12 psi
B. 20 to 30 psi
C. 50 to 60 psi
D. Above 60 psi

Micro-Sprinkler system

A. 8 to 12 psi
B. 20 to 30 psi
C. 50 to 60 psi
D. Above 60 psi

Impact Sprinkler system

A. 8 to 12 psi
B. 20 to 30 psi
C. 50 to 60 psi
D. Above 60 psi



If water moves, the pressure drops.

Elevation:

2.31 ft = 1 psi or

1 ft = 0.43 psi

Friction: If water moves, the pressure drops.

More pressure losses if:

- Longer pipe
- Smaller diameter
- Larger flowrate
- Rougher pipe surface (old iron pipes)

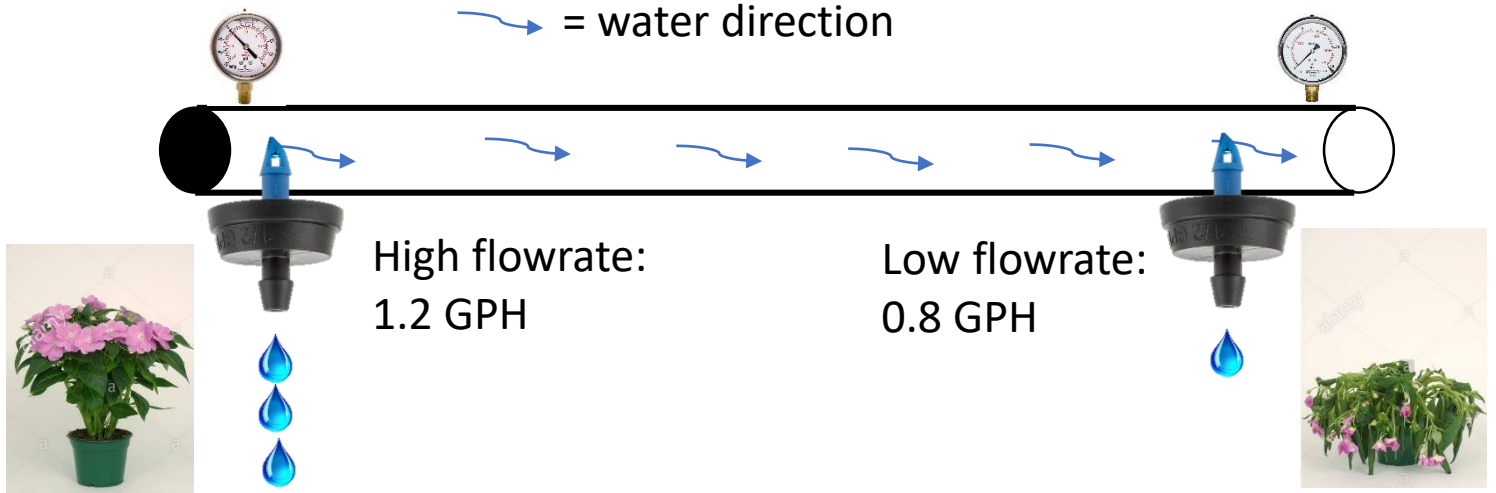
Pressure distribution uniformity

The flowrate is how much volume is discharged in a time. The flowrate is dependent on pressure

Nominal flowrate is rated at 10 psi

High pressure: 15 psi

Low pressure: 6 psi



Pressure compensating are not sensitive to water pressure differences.

If the pressure is too high at one block:

Pressure regulators

Manually adjust valves: “throttling”

This solution works but it’s a waste of energy!


Dwyer
ON
OFF
UNITS
ZERO


Dwyer
ON
OFF
UNITS
ZERO

Pressure regulators

Fixed

Adjustable ~$600 - 1000

PRU

PRU – Ultra High Flow

Ideal for installations requiring ultra high flows and accurate zone control.

Applications: Commercial Turf, Drip, Nursery, Agricultural Solid Set, Effluent and Industrial Mining Applications.

Features

- The compact size makes it convenient for use in a valve box
- Corrosion resistant materials that can withstand harsh water conditions and chemicals
- Very low hysteresis and friction loss
- Large flow path resists plugging

Specifications | Literature | FAQ

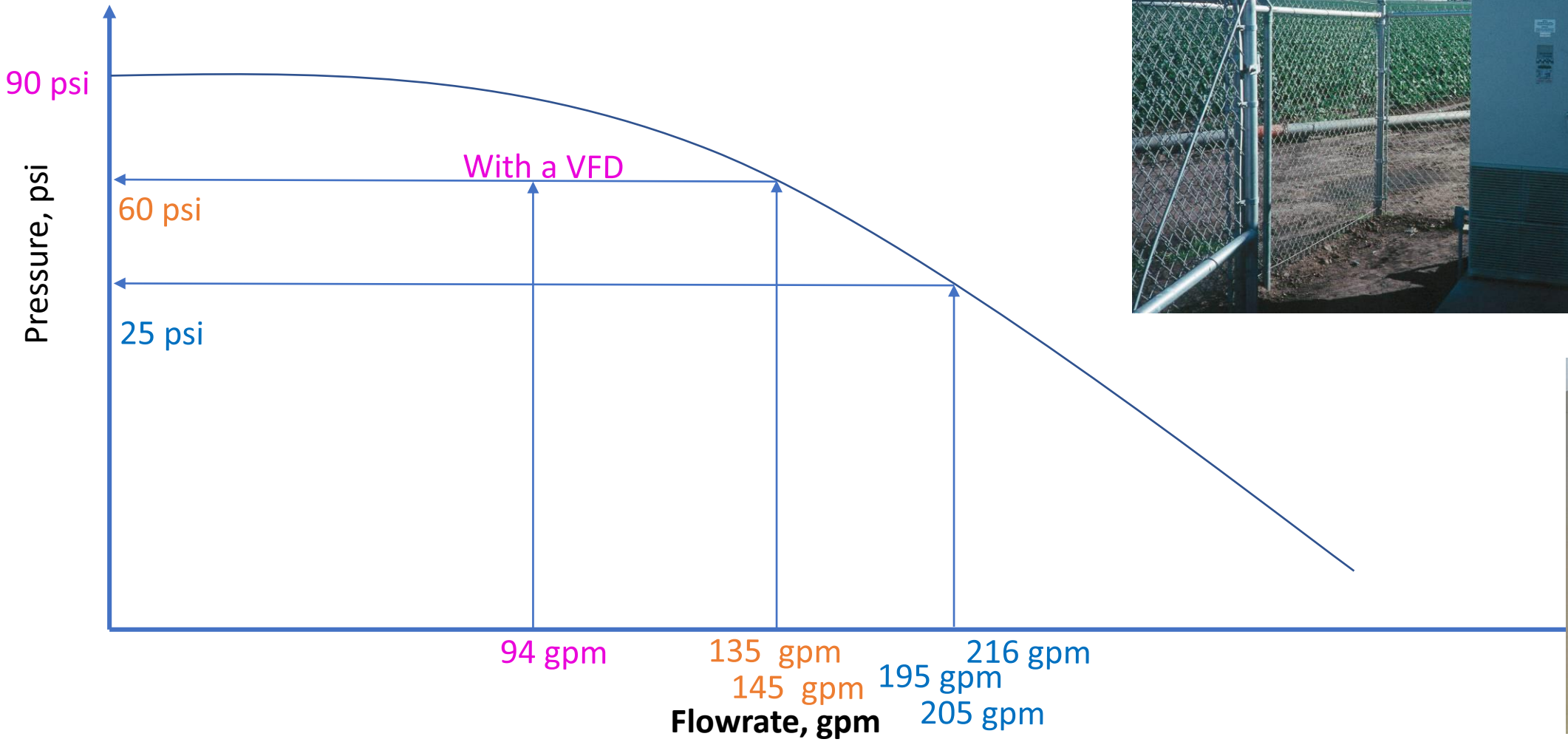
Model #	Flow Range	Preset Operating Pressure	Maximum Inlet Pressure	Inlet Sizes	Outlet Sizes
PRU-	20 - 100 gpm (4543 - 22713 L/hr)	10 psi (0.69 bar)	90 psi (6.20 bar)	2" F NPT, 2" F BSPT	2" F NPT, 2" F BSPT
PRU-15	20 - 100 gpm (4543 - 22713 L/hr)	15 psi (1.03 bar)	95 psi (6.55 bar)	2" F NPT, 2" F BSPT	2" F NPT, 2" F BSPT
PRU-20	20 - 100 gpm (4543 - 22713 L/hr)	20 psi (1.38 bar)	100 psi (6.89 bar)	2" F NPT, 2" F BSPT	2" F NPT, 2" F BSPT
PRU-25	20 - 100 gpm (4543 - 22713 L/hr)	25 psi (1.72 bar)	105 psi (7.24 bar)	2" F NPT, 2" F BSPT	2" F NPT, 2" F BSPT
PRU-30	20 - 100 gpm (4543 - 22713 L/hr)	30 psi (2.07 bar)	110 psi (7.58 bar)	2" F NPT, 2" F BSPT	2" F NPT, 2" F BSPT
PRU-40	20 - 100 gpm (4543 - 22713 L/hr)	40 psi (2.76 bar)	120 psi (8.27 bar)	2" F NPT, 2" F BSPT	2" F NPT, 2" F BSPT

… but pressure regulators and choking a valve to burn pressure are wastes of energy.

The paradox is that we spend money for the pump to produce energy and then we burn that same energy with a pressure regulator

A Variable Frequency Drive (VFD) solves this problem

A better solution is a VFD, that allows you to select a pressure/flowrate point below the curve

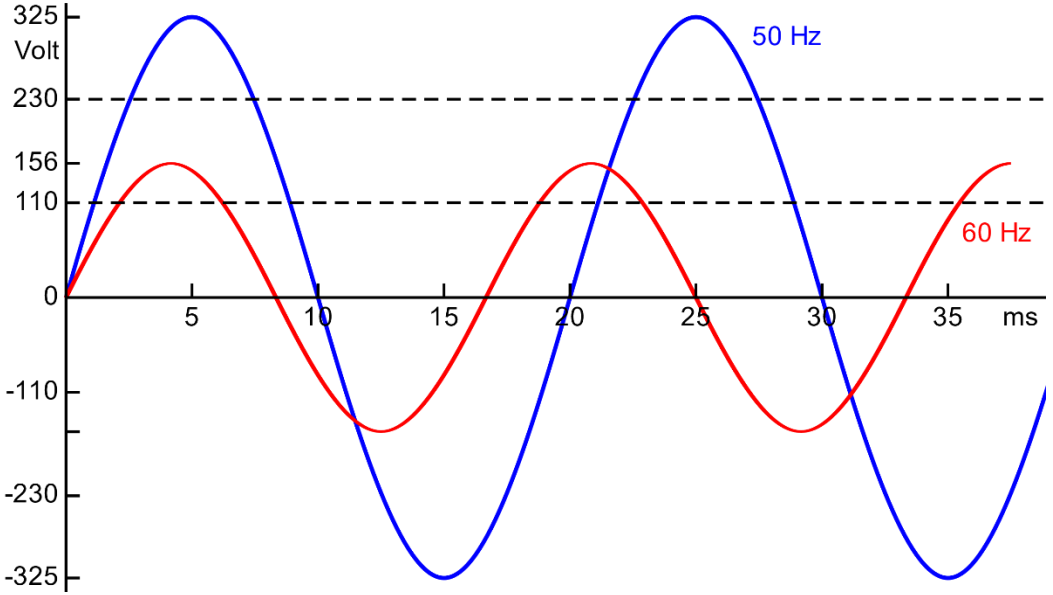


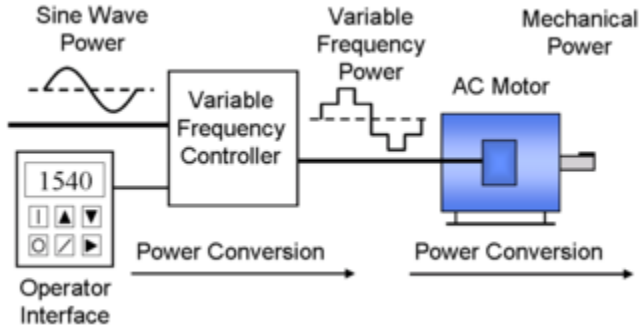
Pumps driven by electric motors can spin only at a set RPM given by the electricity frequency and motor construction (# of poles)

The result is that the pump can only operate at a point on the performance curve shown earlier

A VFD is a panel with electronics that controls the electricity that goes to your pump motor

It can change the frequency of the electricity so your pump can spin slower and operate at any point below the curve





VFDs are mostly useful when:

Irrigating odd shaped blocks or in annual cropping systems
Annual production systems with rotations
Using different irrigation methods
Slopes - differences in elevation
To be economical the VFD needs to be operated a number of hours per year

Thank you!

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Please complete the evaluation!

https://surveys.ucanr.edu/survey.cfm?surveynumber=33281