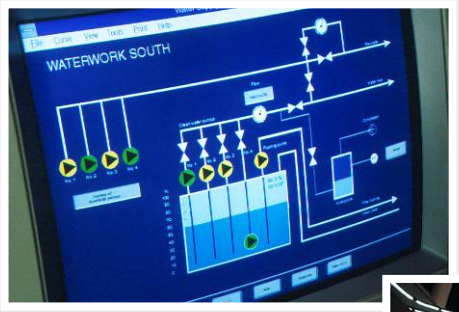
BCGWA 2017 CONFERENCE
KAMLOOPS, BC

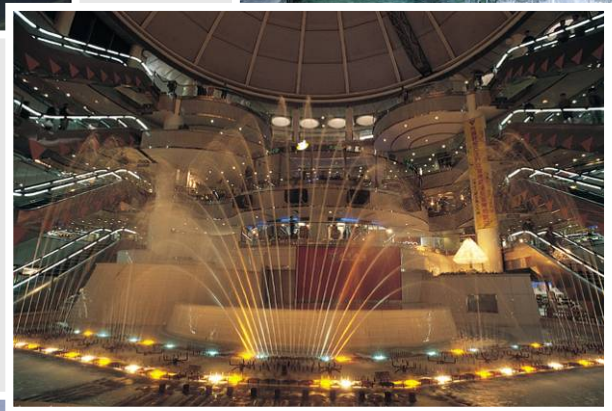
Submersible Well Pumps

Operation, Selection and Application

Rod Parker

Applications

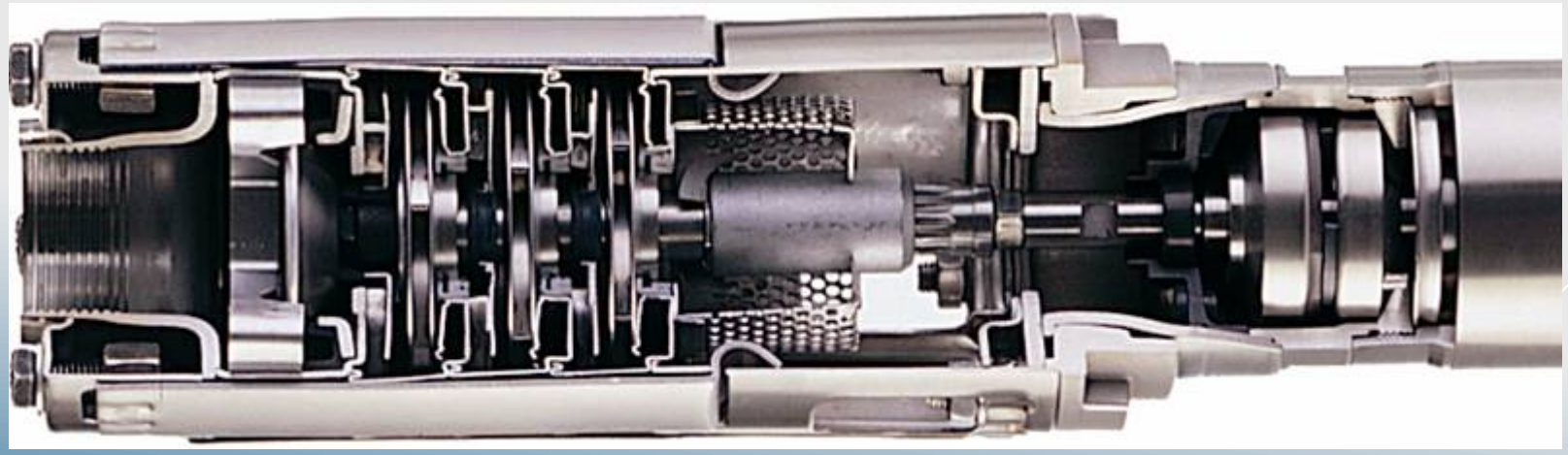




- General water supply
- Irrigation
- Fountains
- Pressure boosting
- Offshore
- Mining
- Dewatering

POSITIVE DISPLACEMENT VS CENTRIFUGAL

Helical rotor or progressive cavity pump

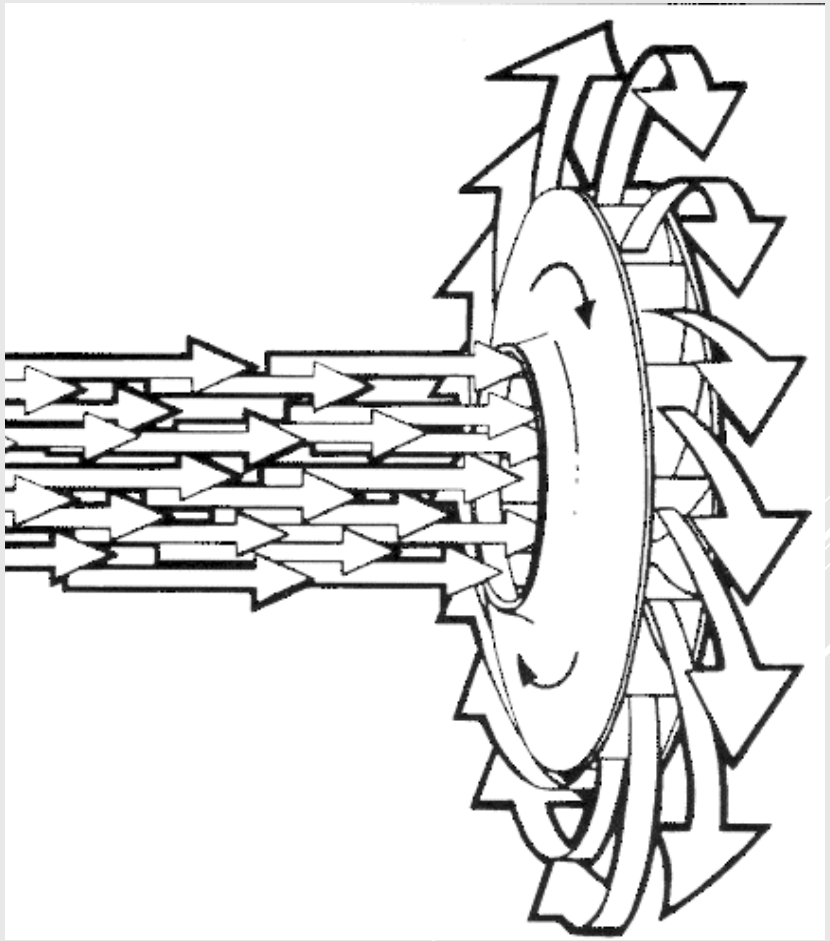


Other types:
Piston
Diaphragm
Gear

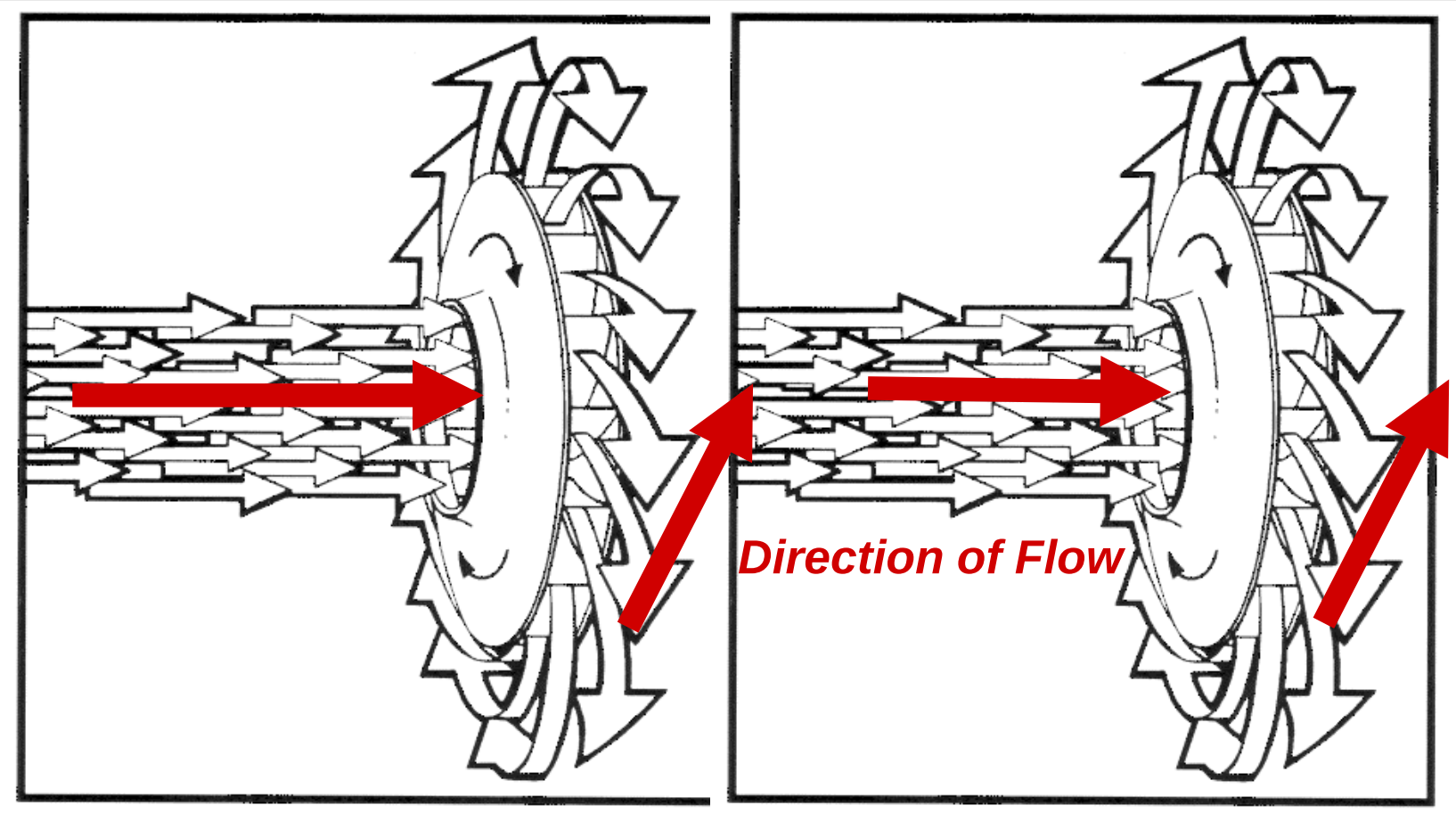
CENTRIFUGAL PUMPS

- This machine consists of an *IMPELLER* rotating within a case (diffuser).

- Liquid which is directed into the center of the rotating impeller is picked up
- by the impeller's
- vanes and accelerated
- to a higher velocity by the
- rotation of the impeller and discharged by
- *CENTRIFUGAL FORCE* into the case (diffuser).

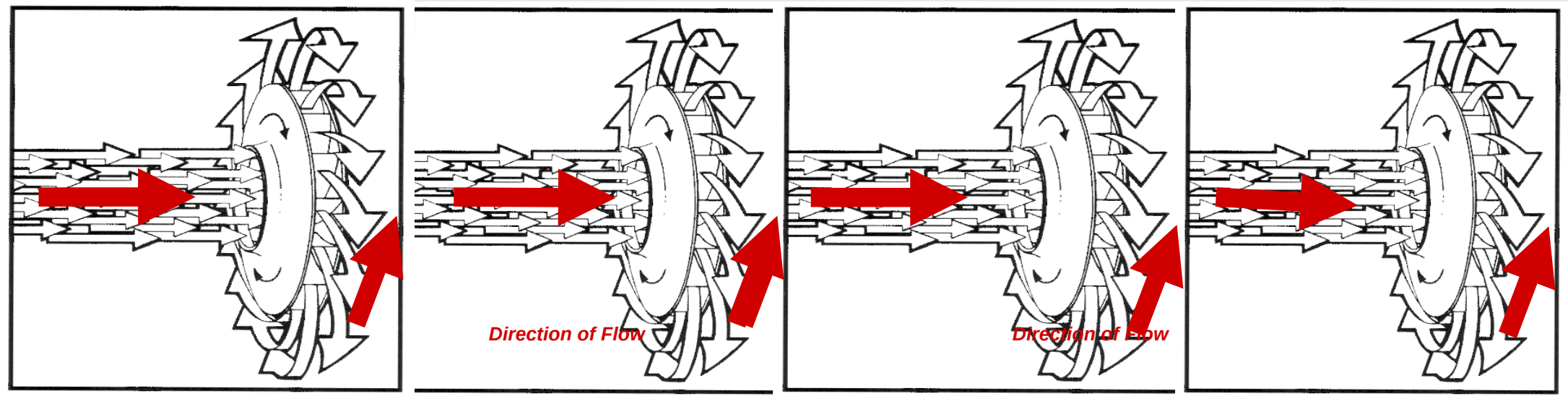


TWO IMPELLERS IN SERIES



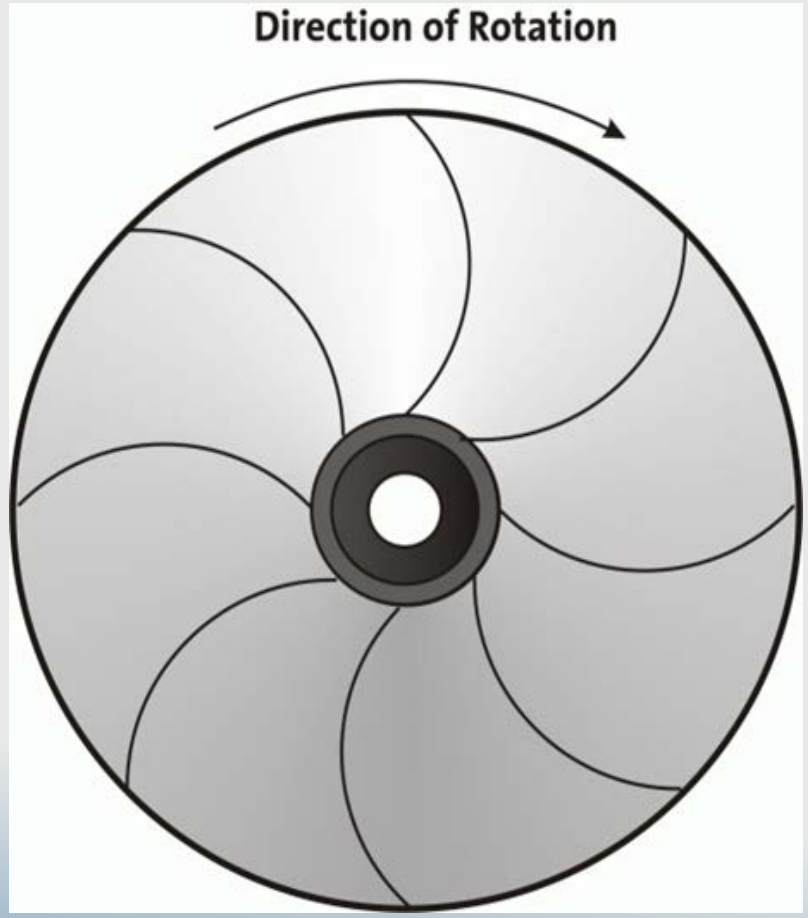
- Twice the pressure
- Same amount of water

MULTIPLE IMPELLERS IN SERIES



- Placing impellers in series increases the amount of head produced
- The head produced = # of impellers x head of one impeller

IMPELLER DIRECTION OF ROTATION



Parts of a pump

Wet end/pump end

Motor

Discharge fitting

Check valve

Impeller

Strap

Chamber

Shaft

Cable guard

Water intake

Submersible Motors

Specifications:

Diameter

Voltage and phase

Horsepower – rated by output power

service factor 1.15 +

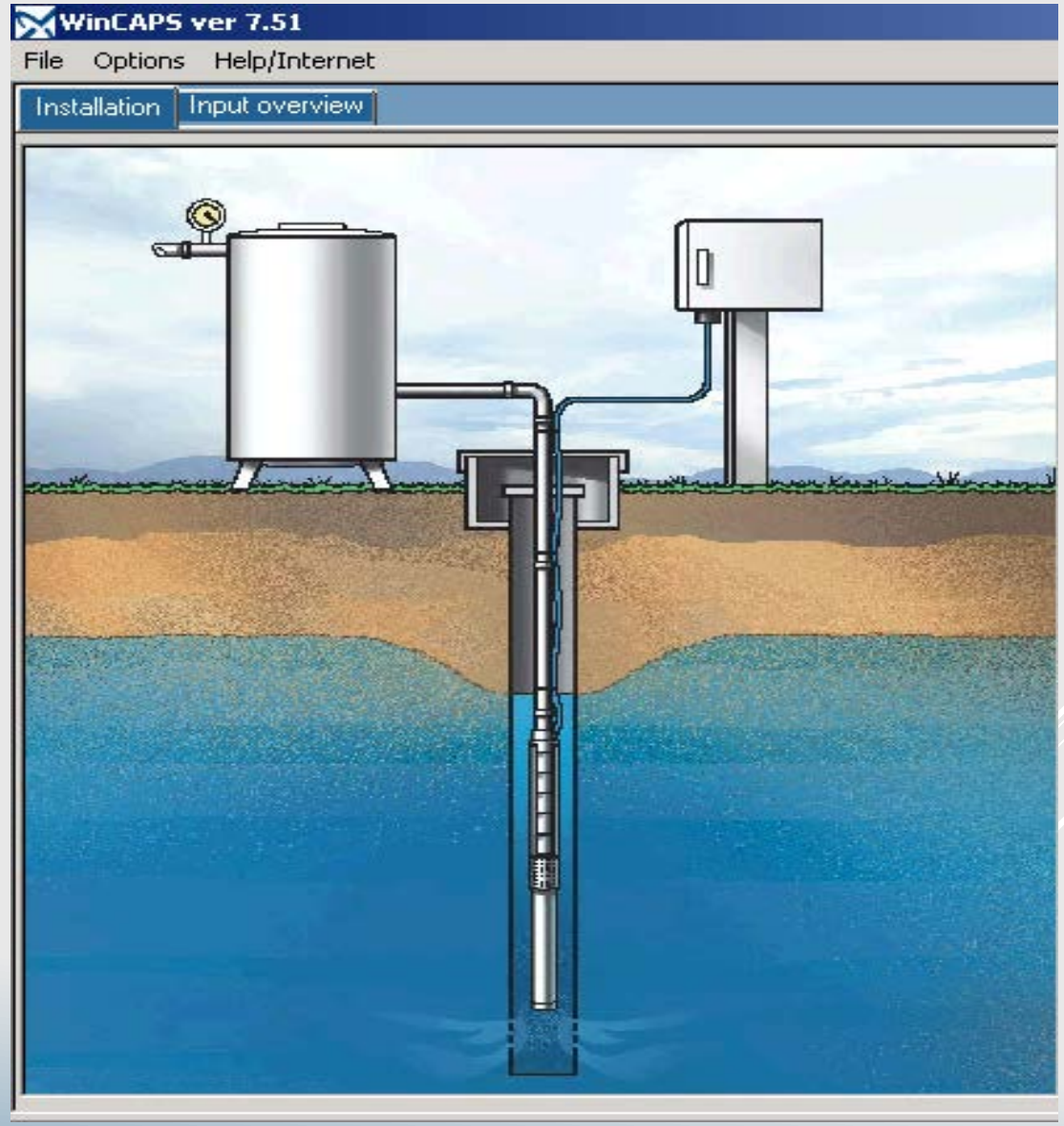
2 and 3 wire for smaller hp, 1 phase

3 wire, 3 phase

Temperature range

Mitchell / Kingsbury style Thrust Bearing

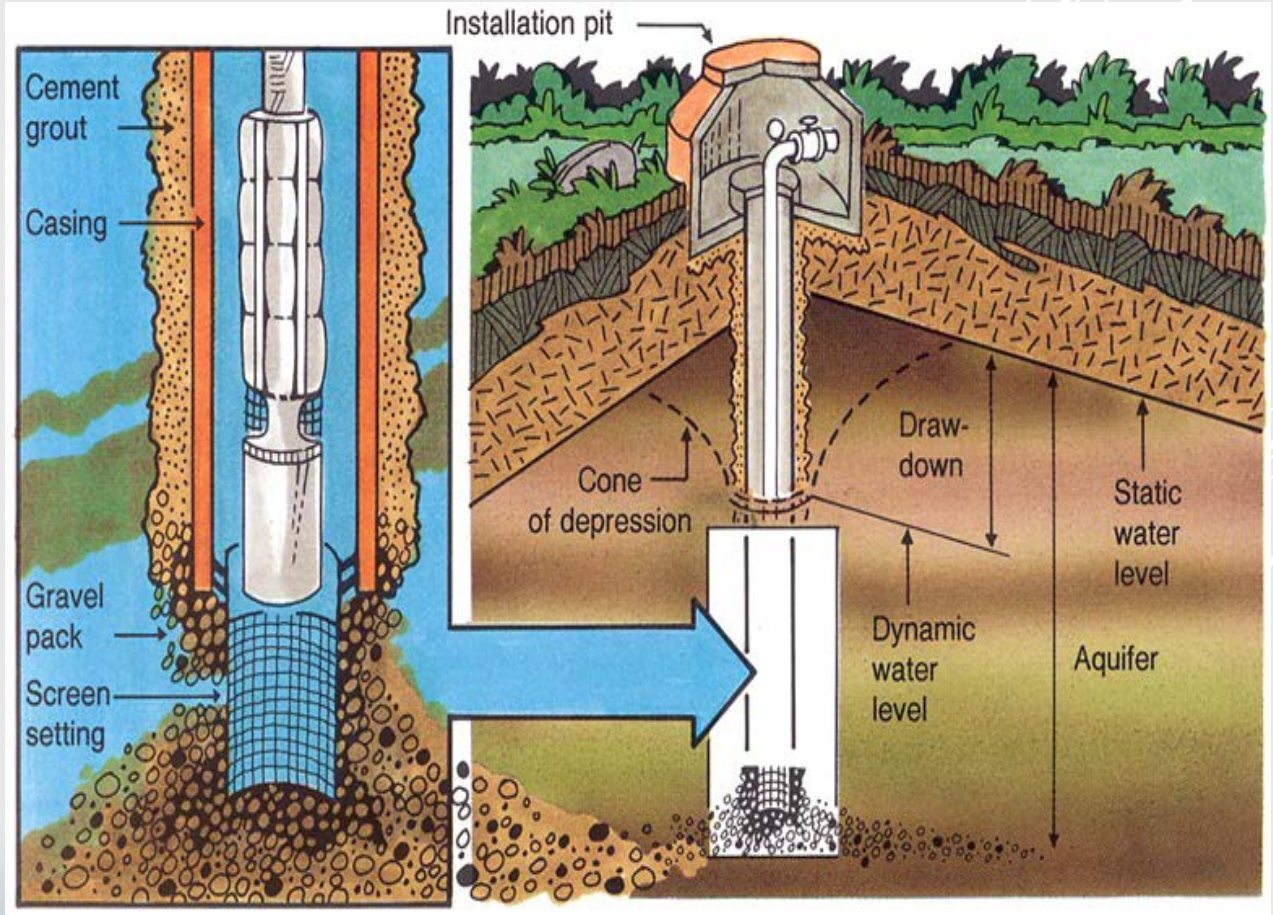
- How does the conventional groundwater system operate?

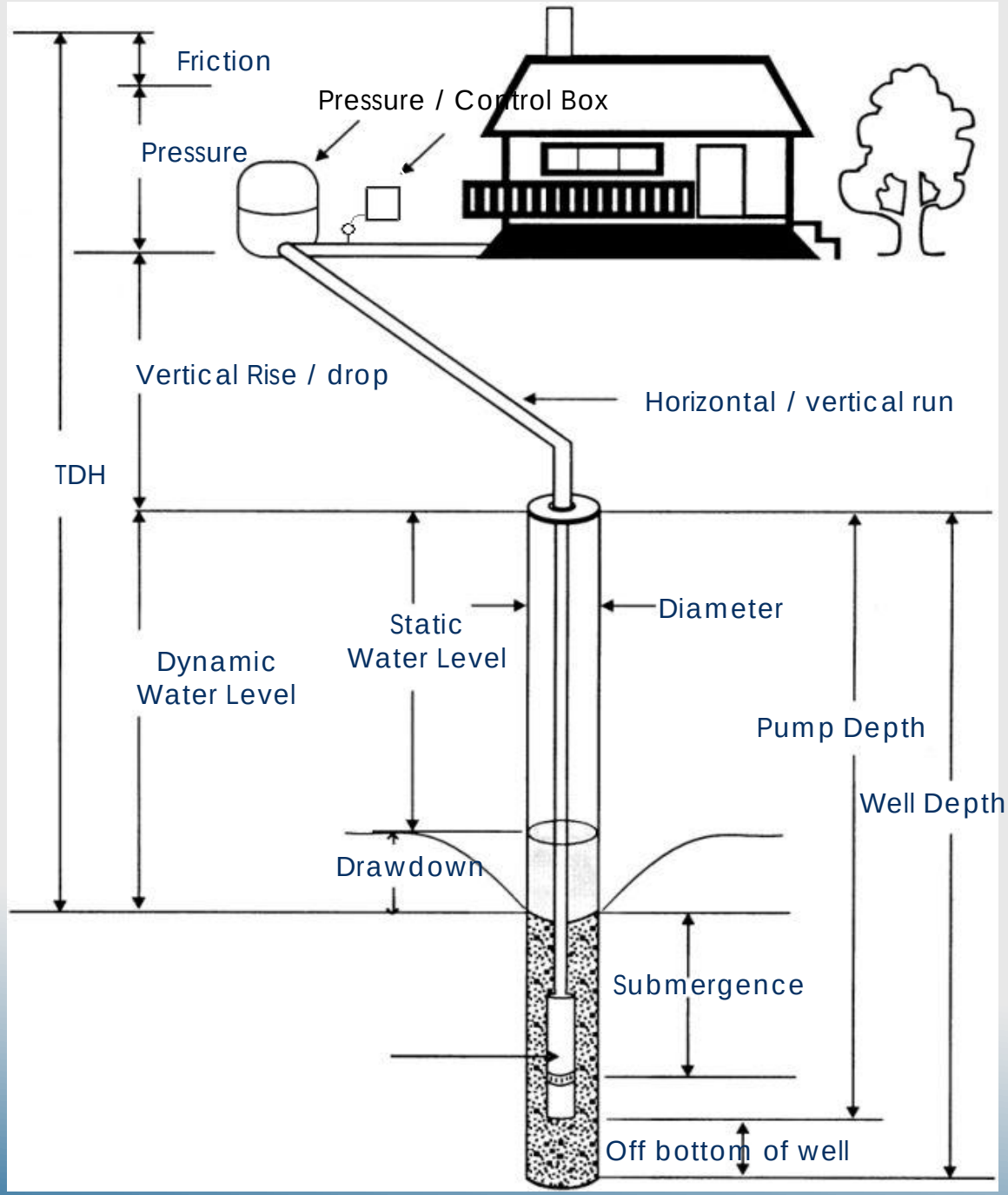


Submersible Pump Sizing

Application Considerations:

1. Recovery rate of well (yield)
2. Required flow
3. Total head (required of system)
4. Well diameter
5. Voltage supply
6. Maximum ambient fluid and air temperatures




Friction
Pressure / Control Box
Pressure
Vertical Rise / drop
Horizontal / vertical run
TDH
Diameter
Static
Water Level
Dynamic
Water Level
Pump Depth
Well Depth
Drawdown
Submergence
Off bottom of well

WHAT DO WE NEED?

- Required flow. Example: 25 gpm

- Centrifugal pumps are not rated in developed pressure (P), but rather in developed head.

- Total Dynamic Head (TDH) is found by adding:
  - Elevation (feet) Example: 300 ft
  - Pressure (psi) 60 psi
  - Friction loss (feet) to be calculated

WHAT IS A ‘FOOT OF HEAD’?

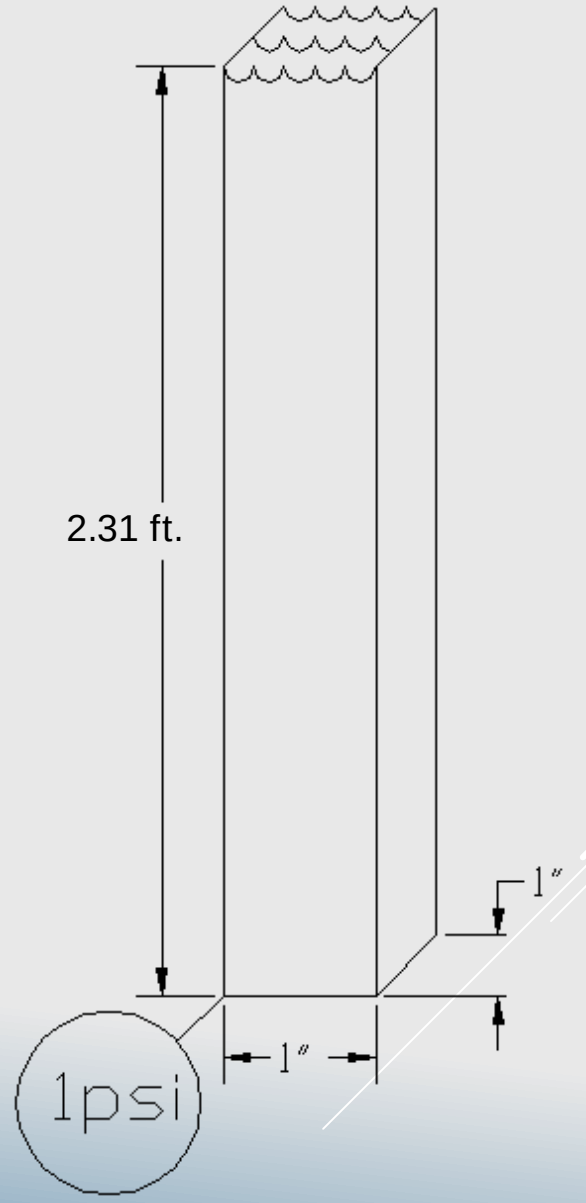
1 lb of water fits in a 1”x1”x27.7” tube, and

27.7” = 2.31 feet

1 foot of water = .433psi

1psi = 2.31 ft head

Example: 60 psi x 2.31 = 139 ft



FRICTION HEAD

Desc of Ftgs	Qty of Ftgs		Value Equiv of Pipe Ea		Equiv Lgth
Gate valve	2	X	2	=	4
Check valve	3	X	13	=	26
Std. 90°	6	X	4	=	24
Tee	2	X	3	=	6
	Ftgs Equiv Lgth		Actual Pipe Lgth		Total Equiv Lgth
	60 ft	+	300 V+150 H = 450 ft.	=	510 ft.
	Total Equiv Lgth		Loss per 100 Ft		Total Friction Loss
	510 ft.	X	4.5	=	23 ft.

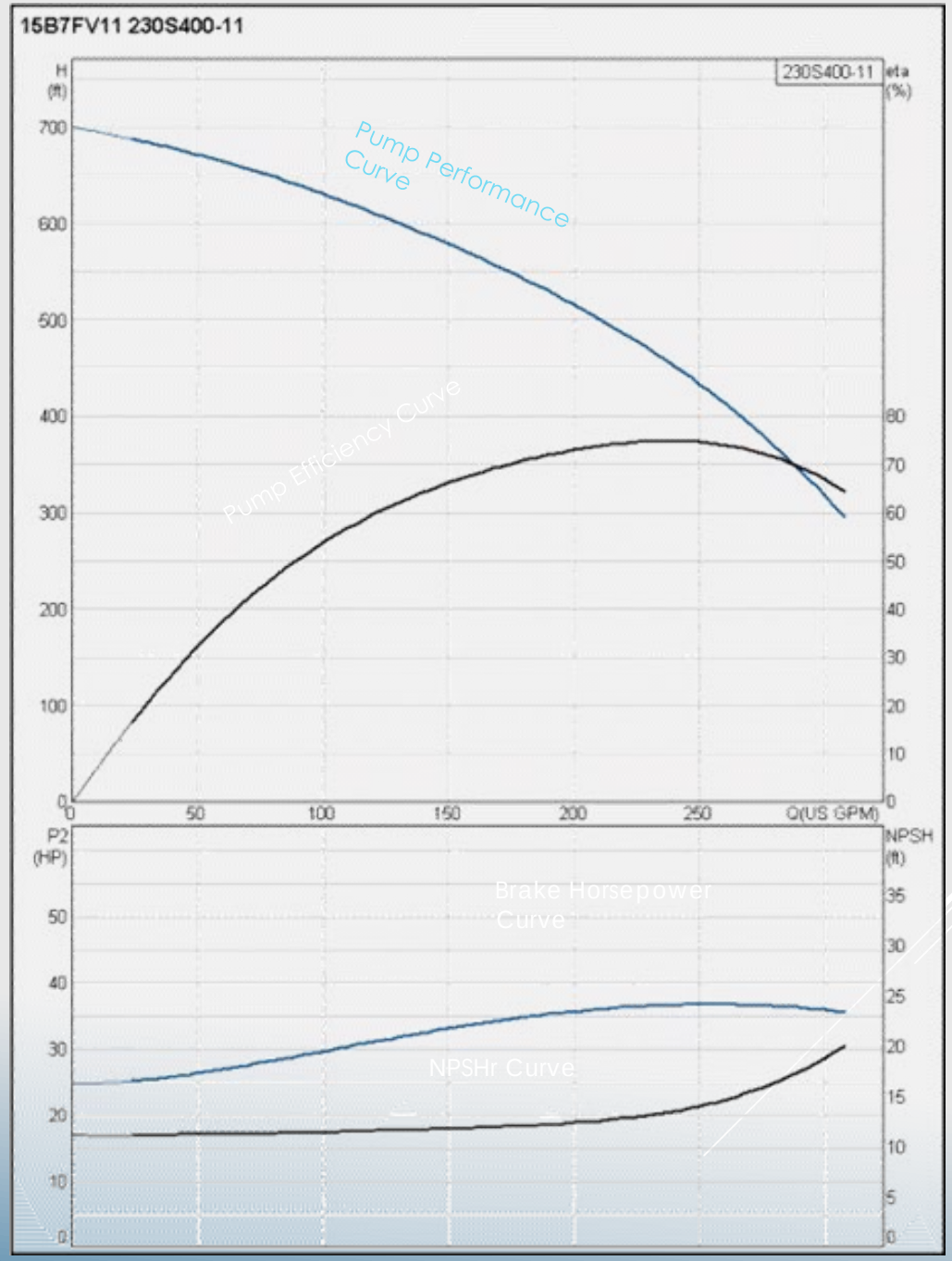
In this example we are sizing for 25 GPM through 1.5” Sch 40 steel pipe

SELECTION EXERCISE

- Desired flow: **25 GPM**
  1. Static water level: 250 ft
  2. Drawdown: 20 ft
  3. Elevation (above grade): 30 ft
  4. 40/60 Pressure switch setting in feet: 116 ft (60 x 2.31)
  5. Friction loss: 23 ft

- Total Dynamic Head = **439 feet**
- Pumps selected:

TYPICAL PUMP CURVE FORMAT



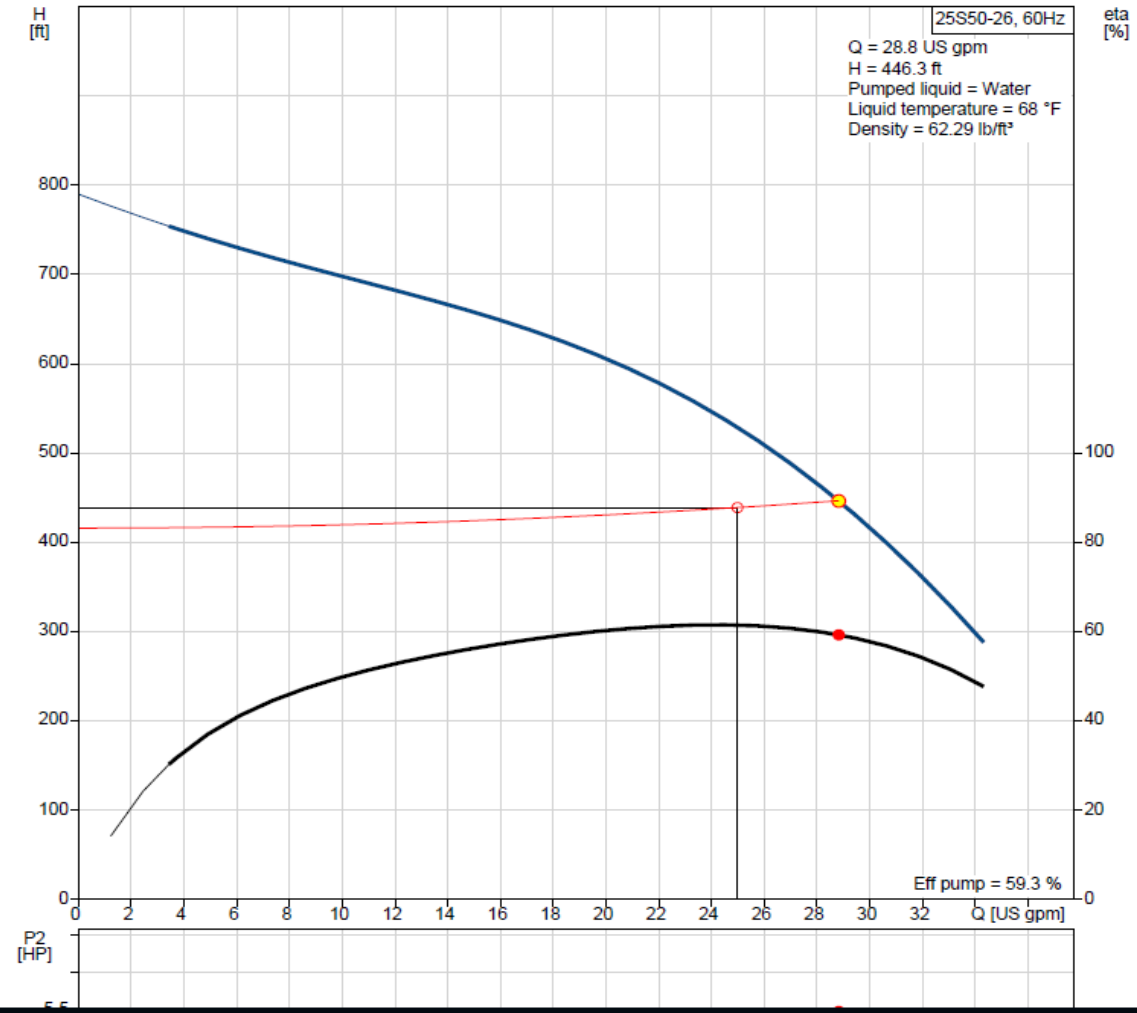
Pump runs where pump curve and system curve meet.

GRUNDFOS

Company name:
Created by:
Phone:

Date: 2/22/2017

05010026 25S50-26 60 Hz



25S50-26

Duty point:
25 gpm at 439 ft

Actual performance:
28.8 gpm at 446 ft

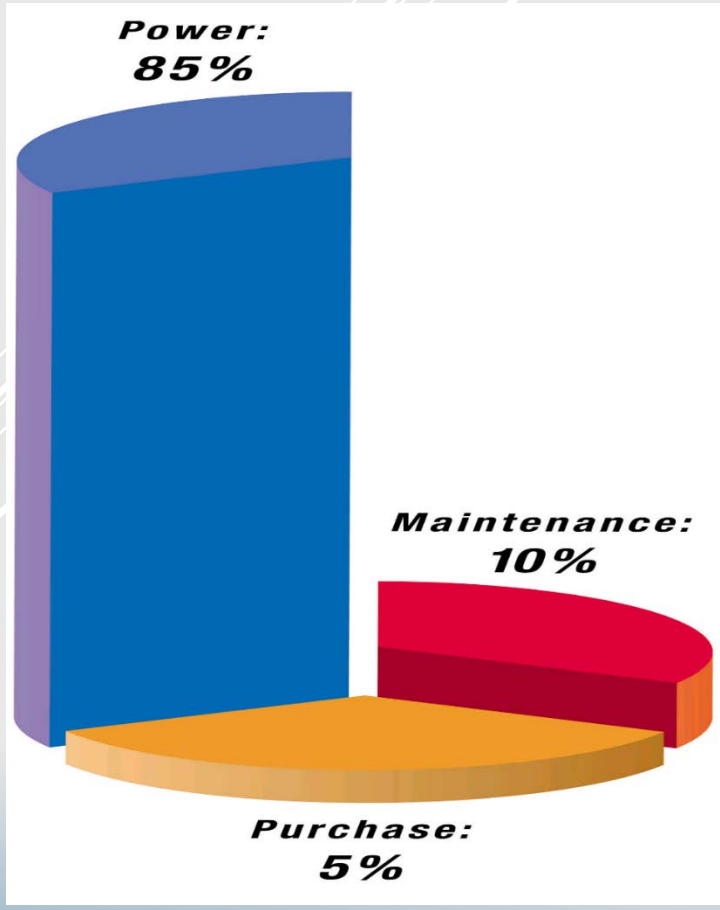
WHY VARIABLE SPEED DRIVES?

Speed control:

- Constant pressure
- Built in motor protection

Reduced energy consumption

Extended motor life

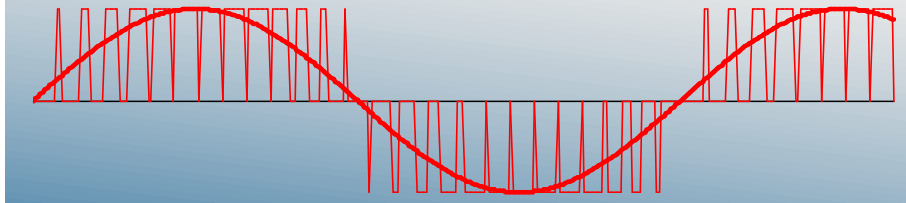


CONSTANT PRESSURE PUMP SYSTEMS

- Electronic approach

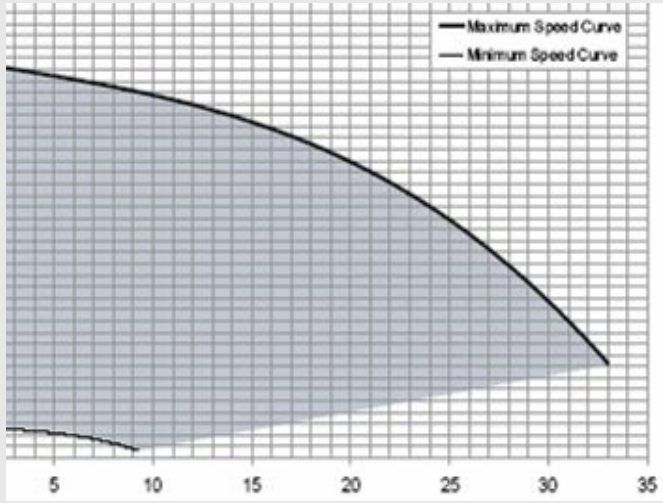
Non-integrated VFD
With induction motor

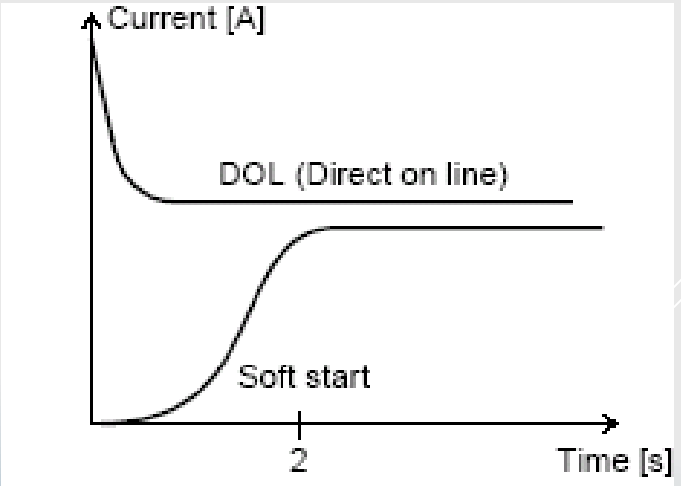
Integrated VFD



CONSTANT PRESSURE PUMP SYSTEMS

- **Common features in both integrated & non-integrated systems include:**
  - **Variable speed pump performance**
  - **Soft start**
  - **High starting TQ**
  - **Pressure sensing feedback**
  - **Small tank**
  - **Pump & motor protection**
    - Dry run
    - Overload
    - Over/Under voltage
  - **Pump diagnostics**
    - Actual Pressure
    - Alarm logs
    - Number of starts
    - Hours of operation

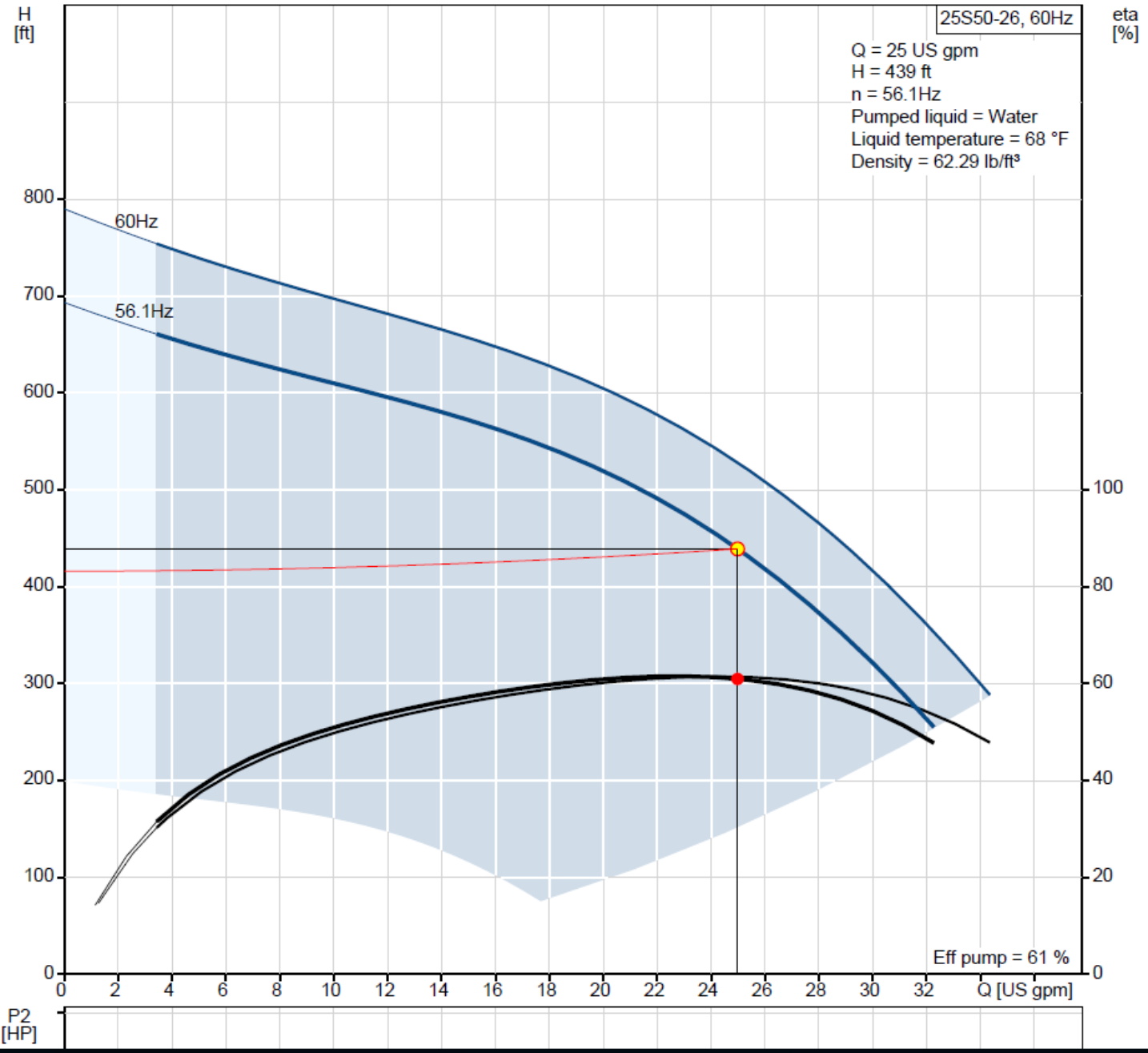




Variable
Frequency
Drive

Date: 2/22/2017

05010026 25S50-26 60 Hz



VFD USE

- Don’t exceed the rated frequency.
- The minimum operating frequency is half the rated frequency.
- Maximum ramp time must be one second to 30 Hz.
- Ensure that cooling needs are met at rated frequency.

Submersible Motors

Selection:

Horsepower: What is required by selected pump end?

Diameter: how big is the well casing?

Electrical supply: Voltage and phase of available?

Motor configuration: 2 or 3 wire for smaller hp, 1 phase
3 wire, 3 phase (required for VFD use)

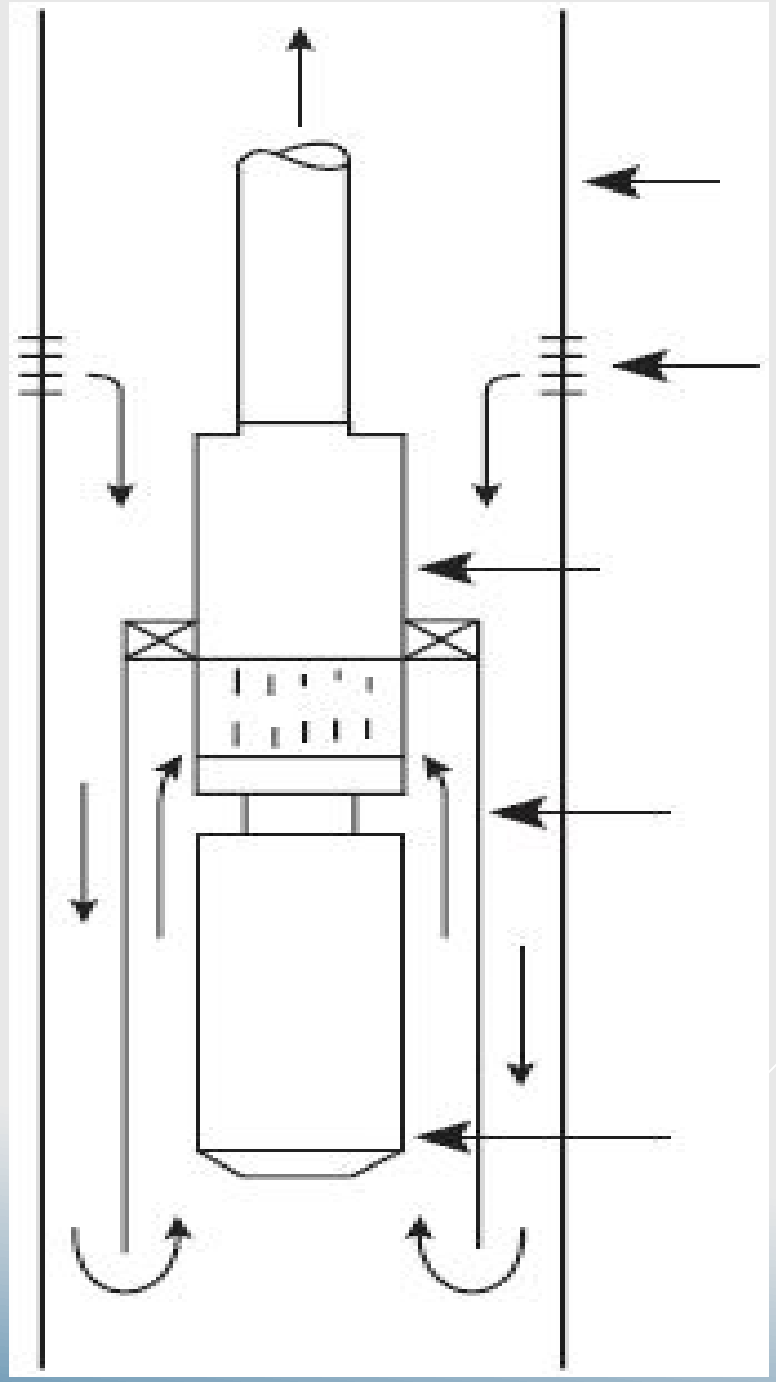
Temperature range: Higher temp. range or de-rate motor

Flow velocity across motor surface: min. 0.25 fps for 4”
min. 0.50 fps for 6”,8”, 10”

FLOW SLEEVE

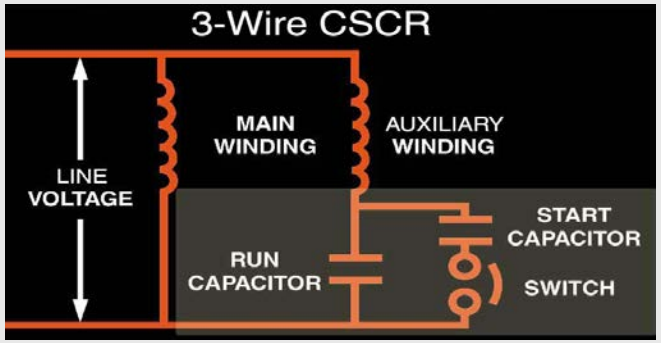
Required for cooling

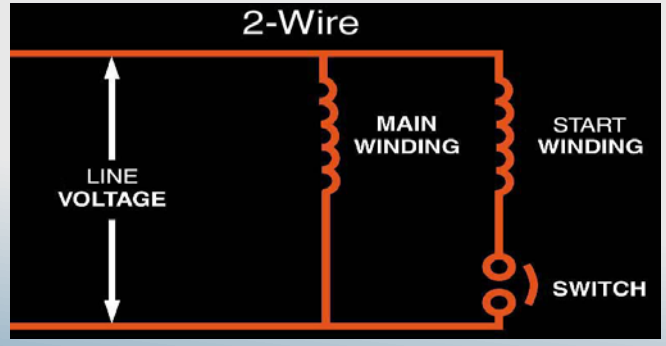
Rule of thumb; required where well casing is more than 2” larger than motor diameter
Or
In tank/cistern

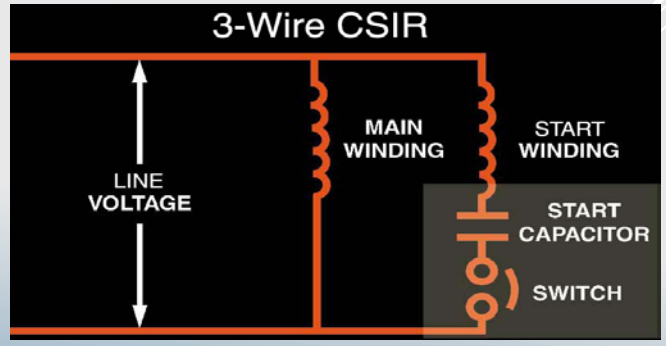


WHAT IS THE DIFFERENCE BETWEEN 2 & 3 WIRE 1 PHASE MOTORS?

- 2 wire Resistance start, induction run, (split phase)
- 3 wire CSIR – Capacitor start, induction run
- 3 wire CSCR – Capacitor start, capacitor run
- 3 wire PSC – like CSCR without start capacitor and switch







QUESTIONS