PUMPS & MOTORS

101

BY: JAY ZAFFINO
ROTATING EQUIPMENT S.M.E.

BURNS McDONNELL SM

PDH

DID YOU ENROLL?

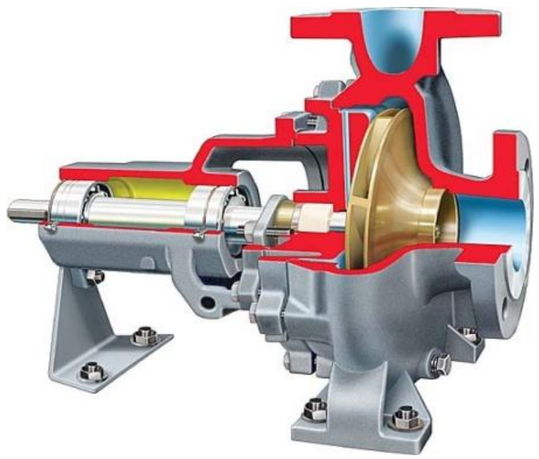
BURNS McDONNELL℠

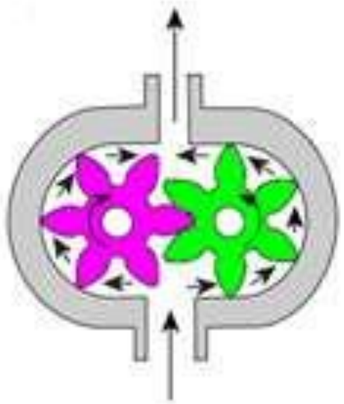
Jay Zaffino, P.E.

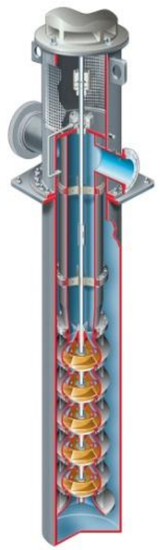
- Rotating Equipment Engineer
- Penn State University
- 29 years in Rotating Equipment
- OEMs & Refinery
- P.E. in TX, OK, IL, PA, WI, CA and LA
- Vibration Analyst II
- Lubrication Analyst II
- One Lucky Guy

Pump Types

- Positive Displacement
  - Rotary
  - Reciprocating
  - Screw
- Centrifugal

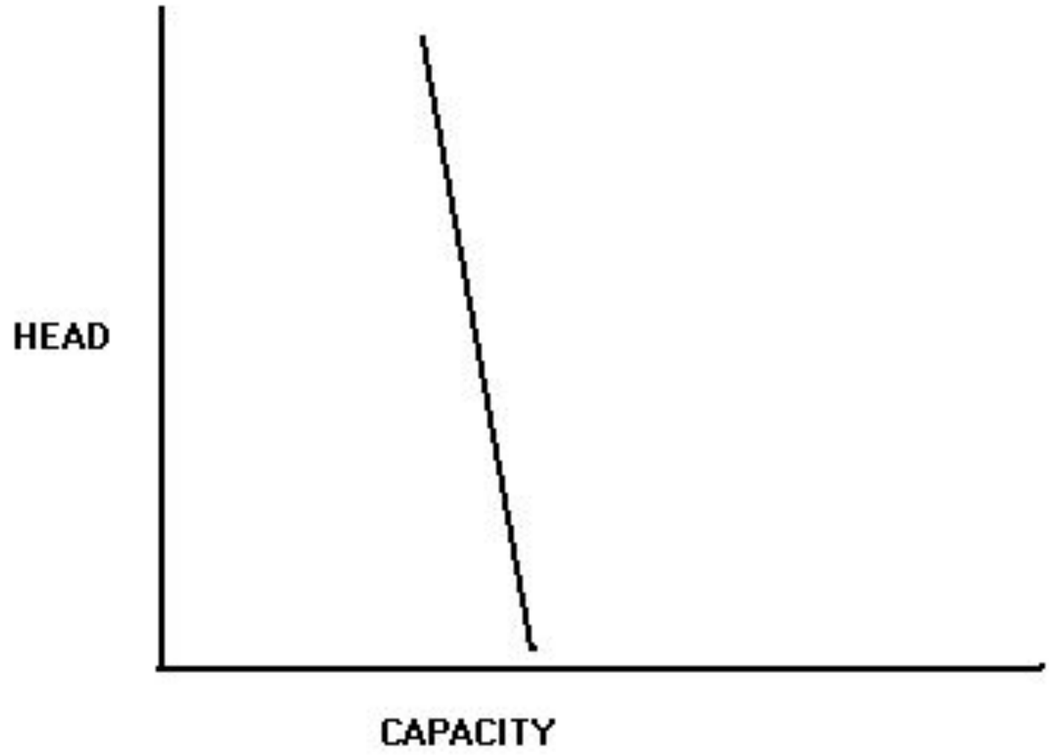




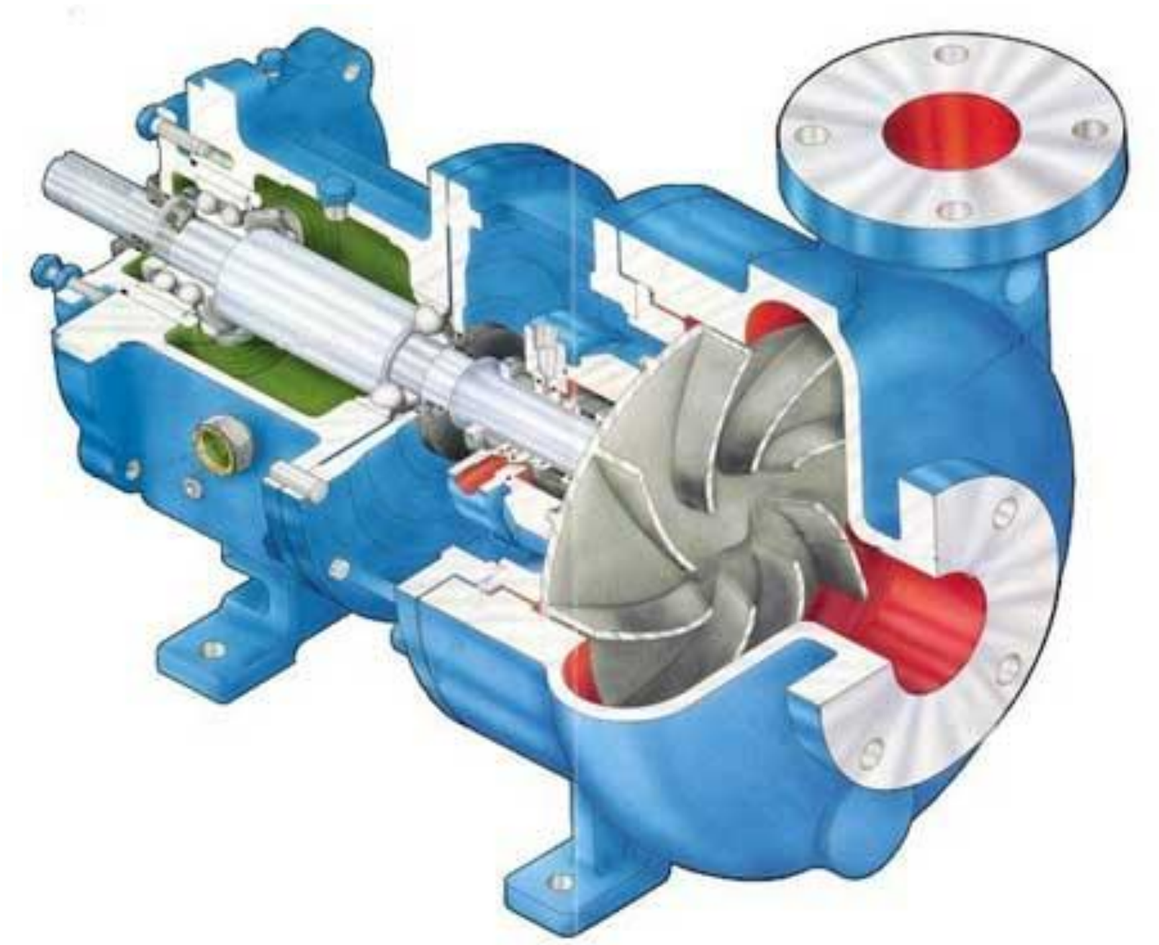


Positive Displacement Pumps

- The capacity of a positive displacement pump, will remain almost constant as long as the pump speed is not altered.
- With a higher speed the pump delivers more flow.
- The maximum head is determined by the strength of the pump casing and the horsepower available

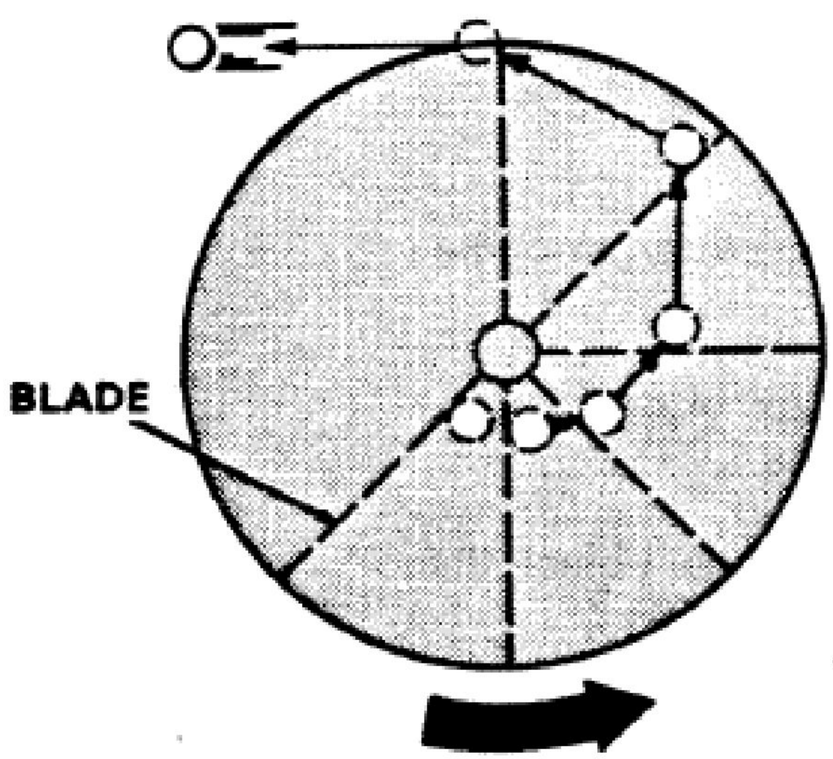


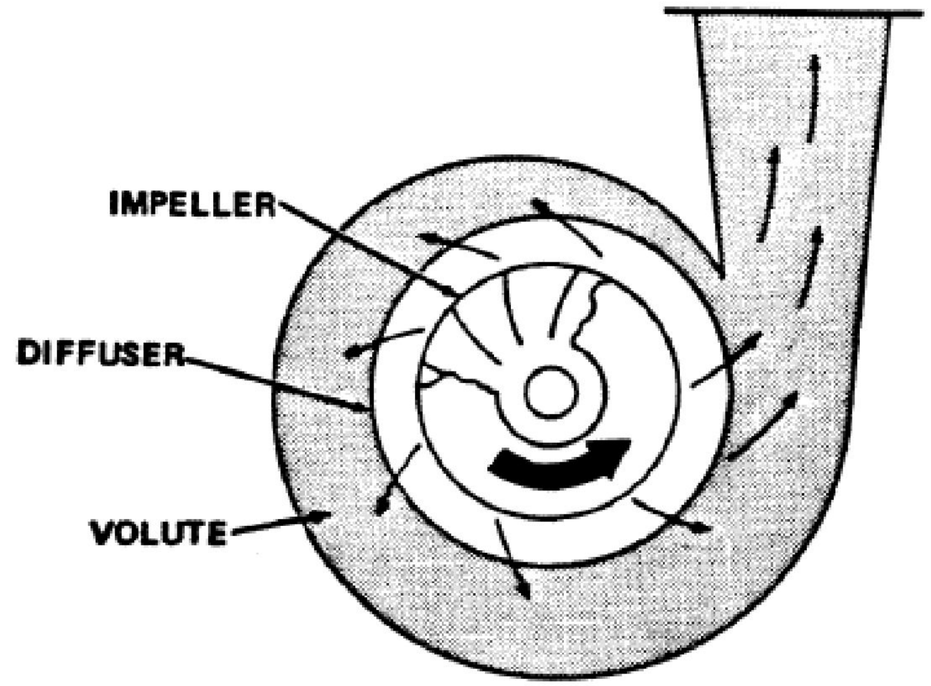
Centrifugal Pumps Making Pressure



- The liquid enters the pump
- This impeller increases the speed (velocity) of the liquid through centrifugal force.
- This pushes the liquid out to the volute or diffuser.
- The larger volume of the volute slows the liquid.

Centrifugal Pumps Making Pressure



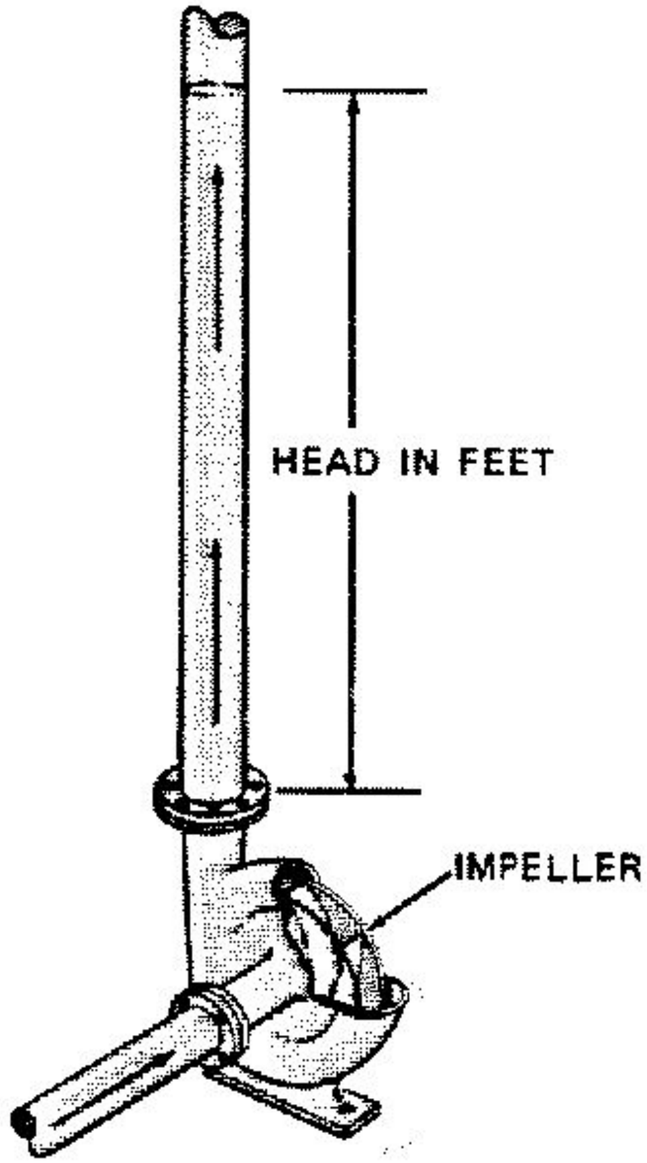


Centrifugal Pumps Making Pressure

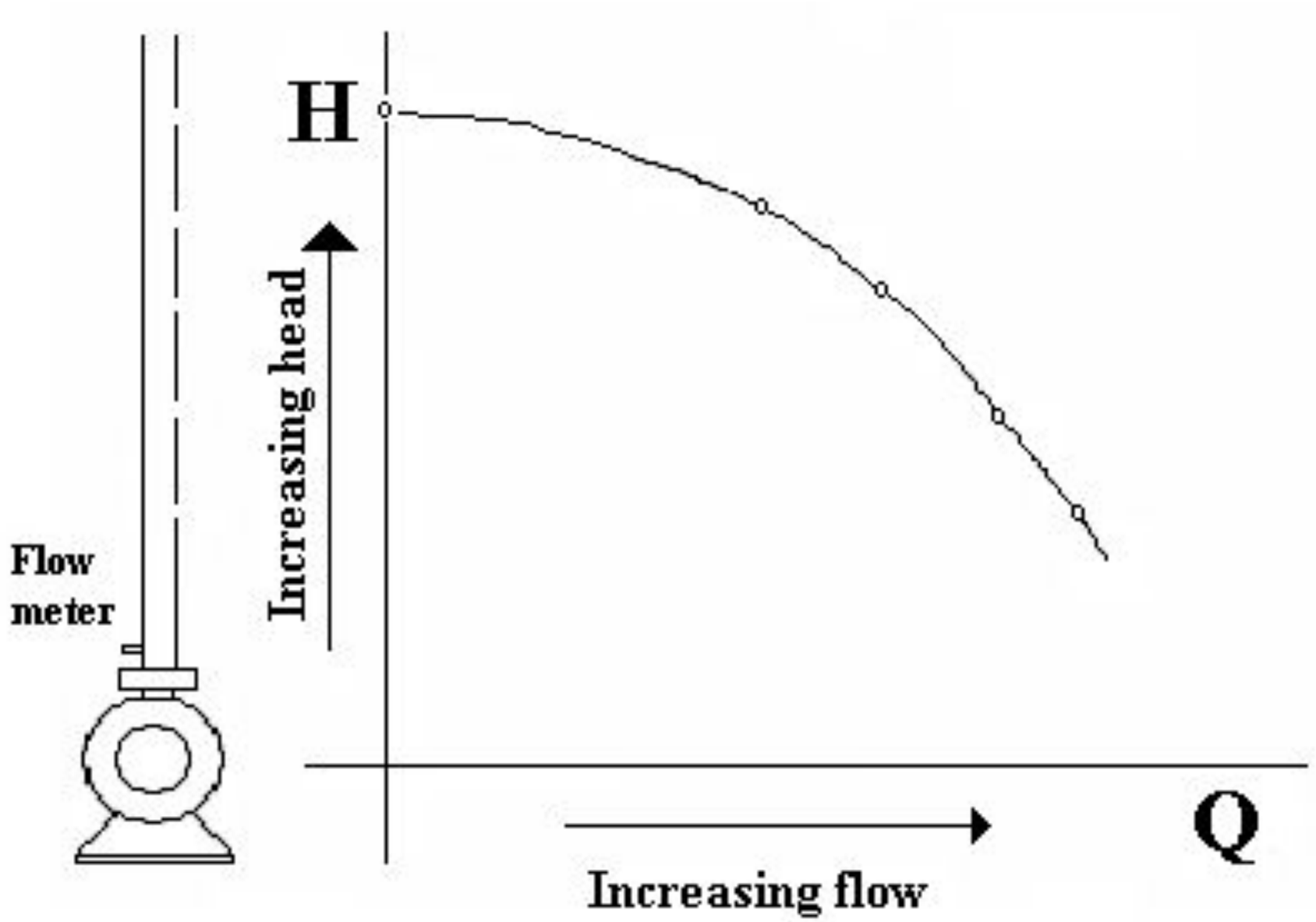
- My College Roommate, Mr. Bernoulli, stated that energy can neither be created nor destroyed. It can only be changed.
- When the volute slows the fluid, the energy of the speed is changed to pressure

Head

- The pump moves the liquid to certain height in a column
- The height the liquid is moved to, is the same no matter the liquid



Centrifugal Pump Curves

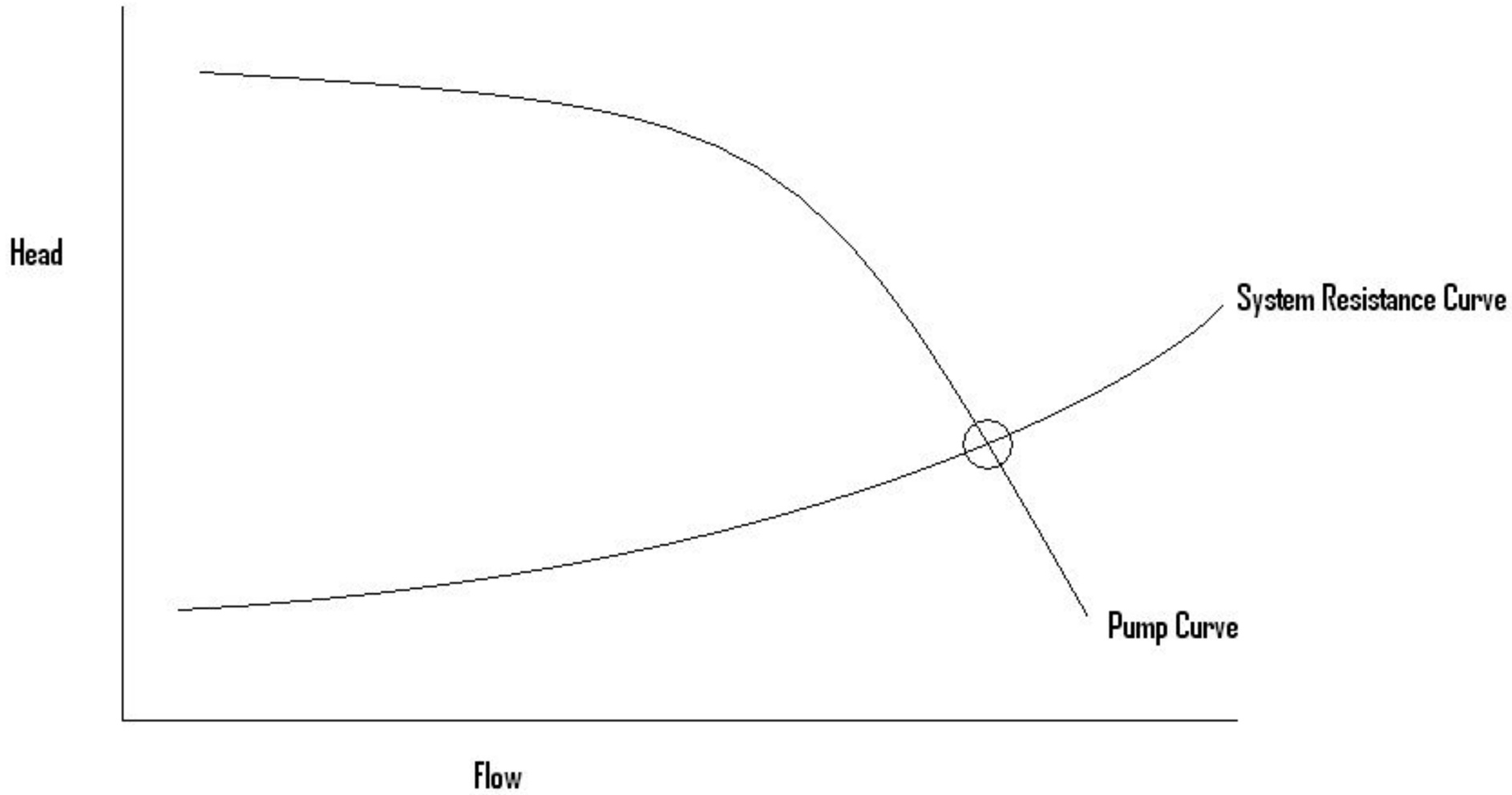


System Resistance

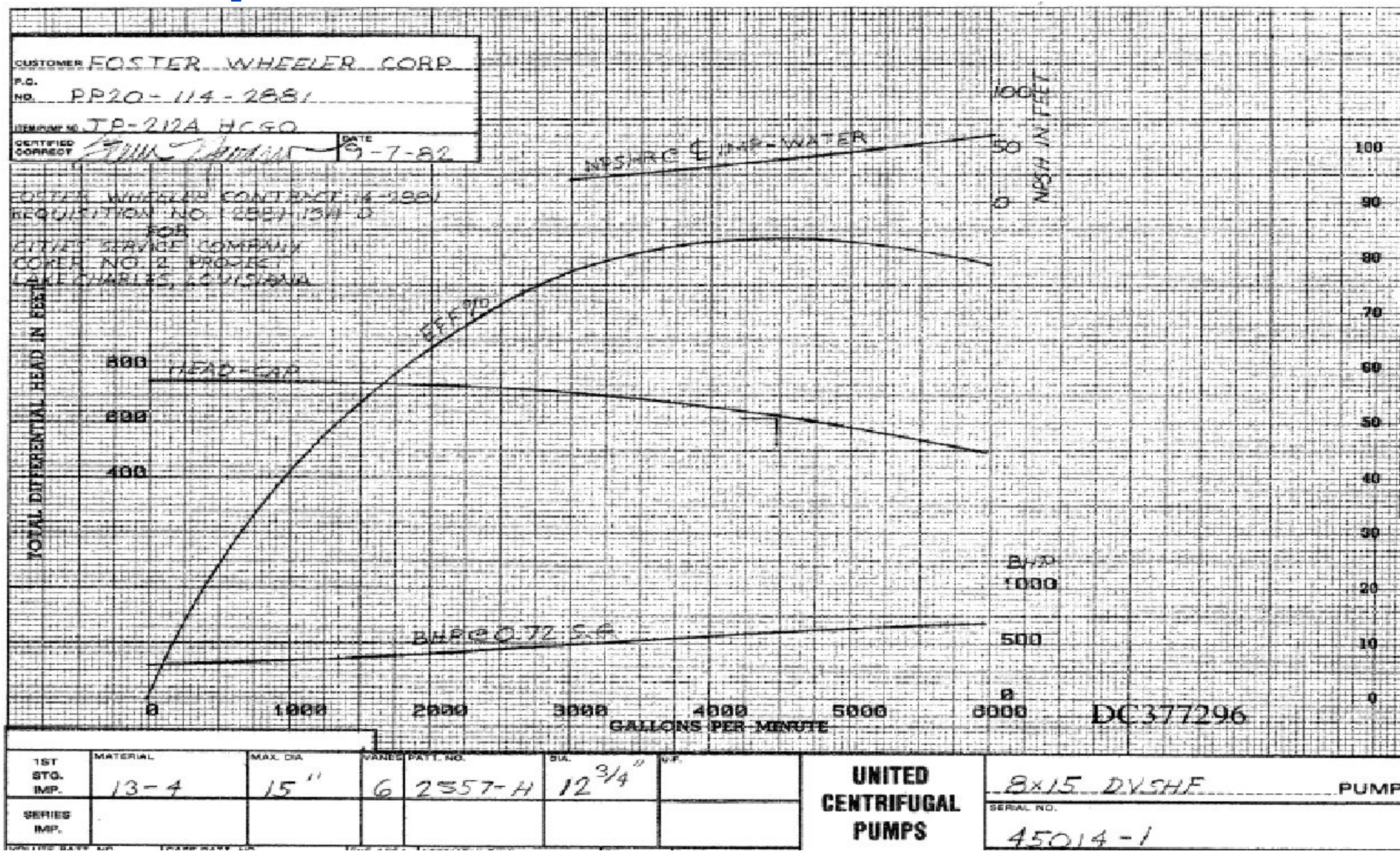
- Getting the fluid to and from the pump is a “System” of piping, valves, tanks, etc.
- This system also operates on a curve (System Resistance Curve)
- The pump operates where the System resistance curve crosses the pump performance curve

System Resistance

System Resistance

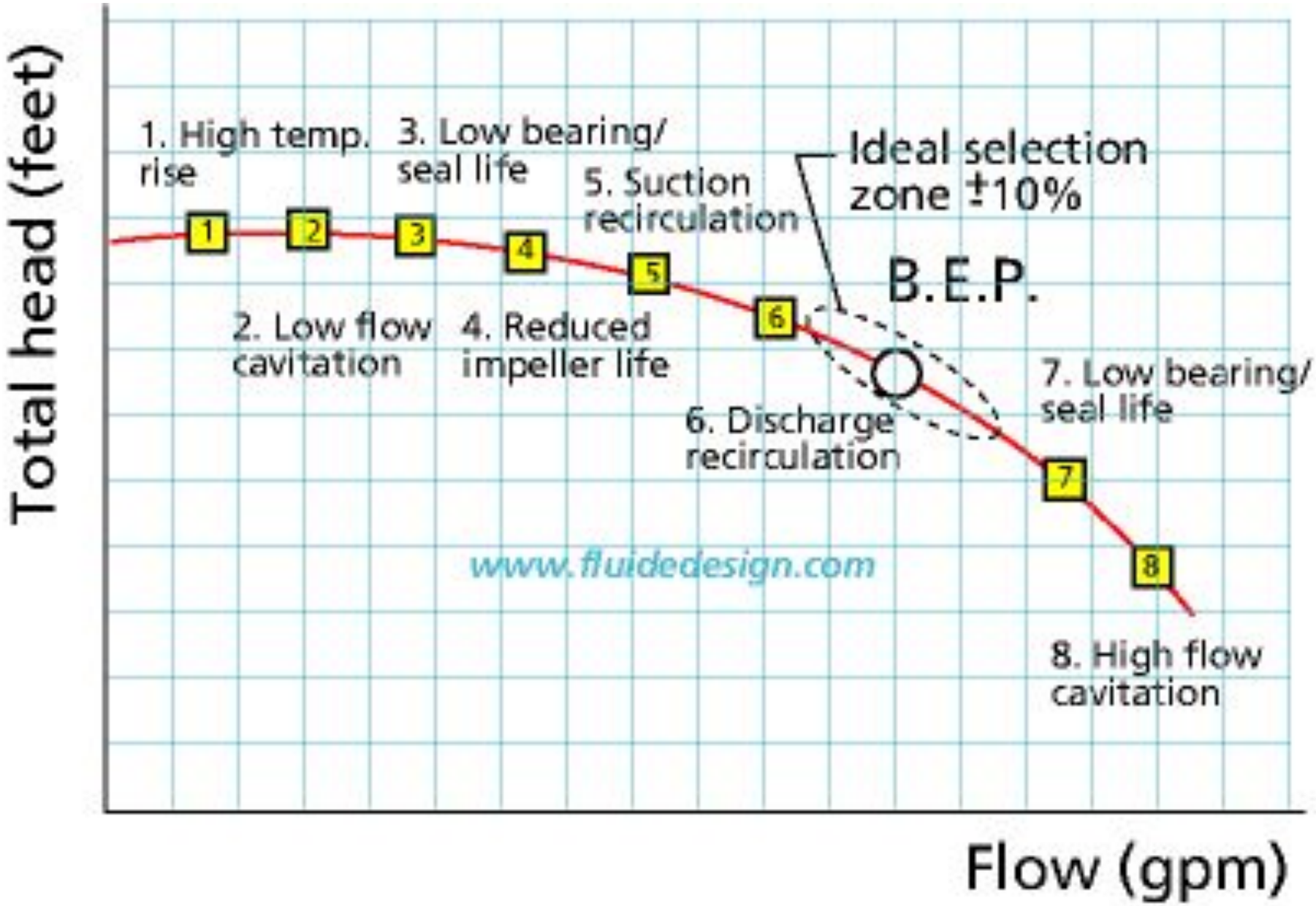


Horsepower



CUSTOMER FOSTER WHEELER CORP
P.O. NO. PP20-114-2881
ITEM/PUMP NO. JP-212A HCGO
CERTIFIED CORRECT
DATE 9-7-82
NPSHRC ℄ IMP - WATER
NPSH IN FEET
100
50
0
EFF %
HEAD-CAP
BHP @ 0.72 S.G.
TOTAL DIFFERENTIAL HEAD IN FEET
800
600
400
BHP
1000
500
0
EFFICIENCY IN PERCENT
100
90
80
70
60
50
40
30
20
10
0
0
1000
2000
3000
4000
5000
6000
GALLONS PER MINUTE
DC377296
1ST STG. IMP.
MATERIAL 13-4
MAX. DIA. 15"
VANES 6
PATT. NO. 2357-H
DIA. 12 3/4"
SERIES IMP.
UNITED CENTRIFUGAL PUMPS
8x15 DVSHF PUMP
SERIAL NO. 45014-1

Pump Operating Point vs. Pump Reliability



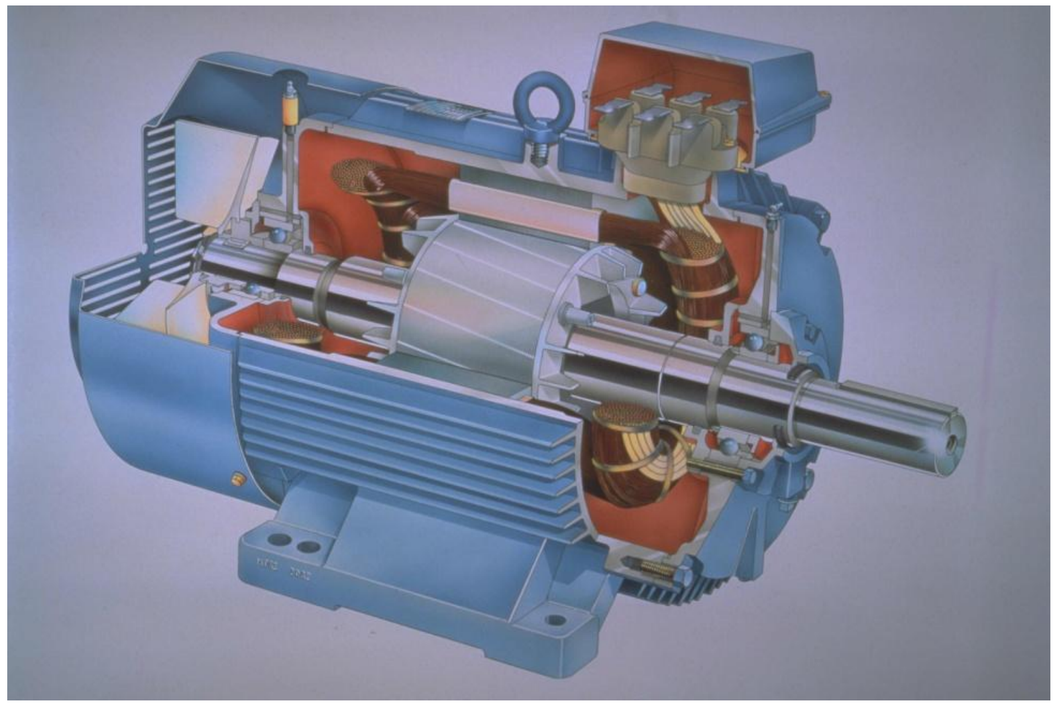
Motor Sizing

- API 610
  - 7.1.1 The driver shall be sized to meet the maximum specified operating conditions…
  - 7.1.4 Motors shall have nameplate power ratings, excluding the service factor (if any), at least equal to the percentages of power at the pump rated conditions given in table 12…

Motor nameplate rating		Percentage of rated pump power
kW	hp	%
<22	<30	125
22 to 55	30 to 75	115
>55	>75	110

Enclosures and Cooling

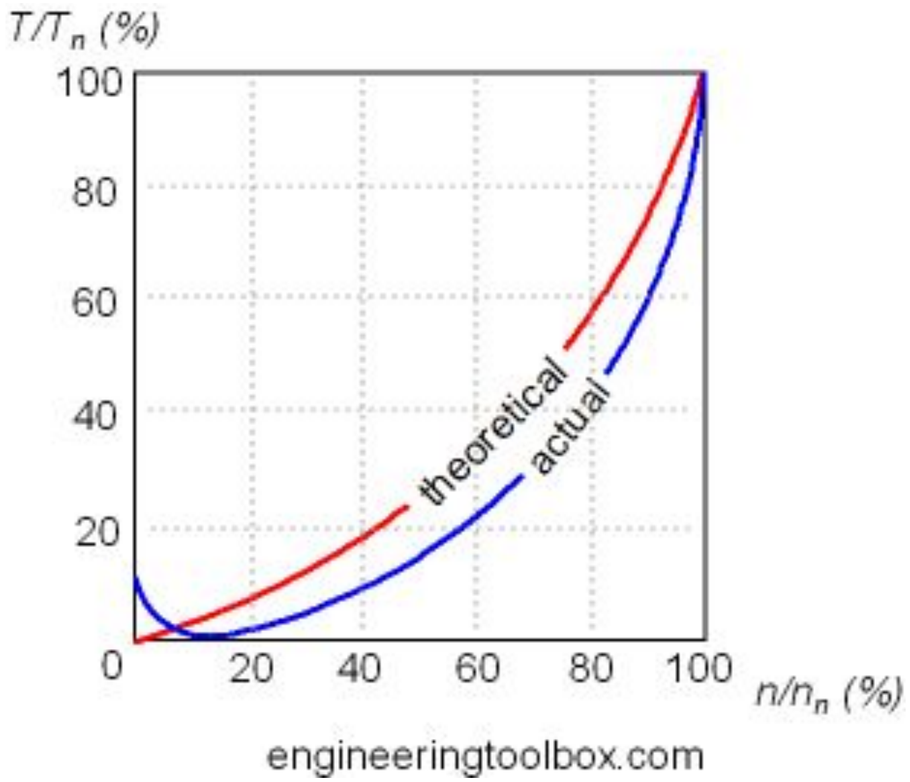
TEFC



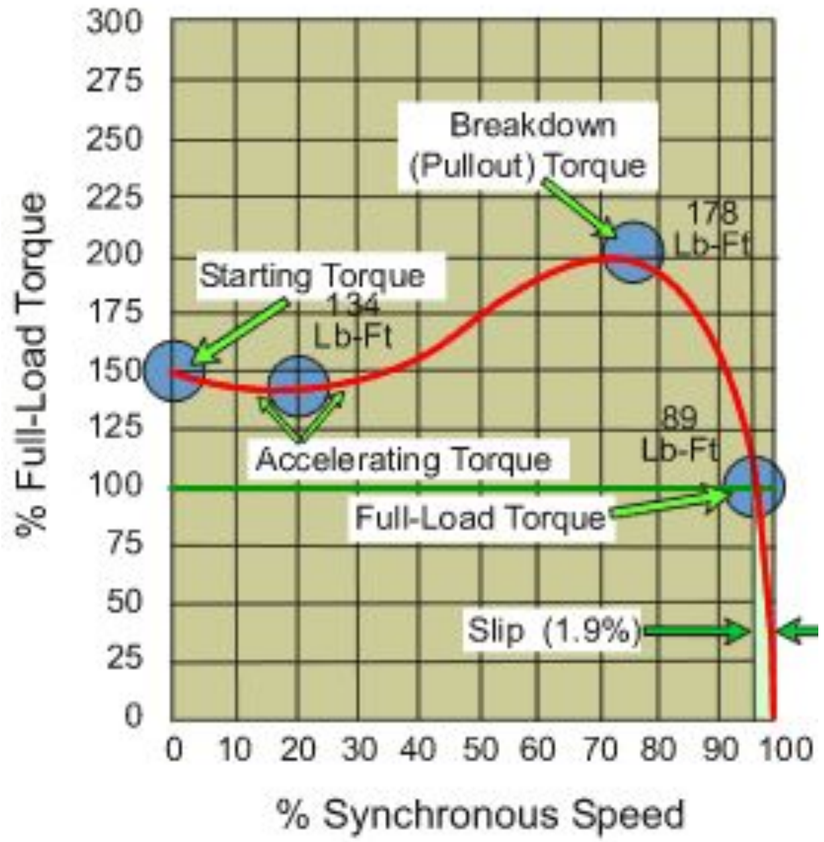
WP II

Speed Torque Curves

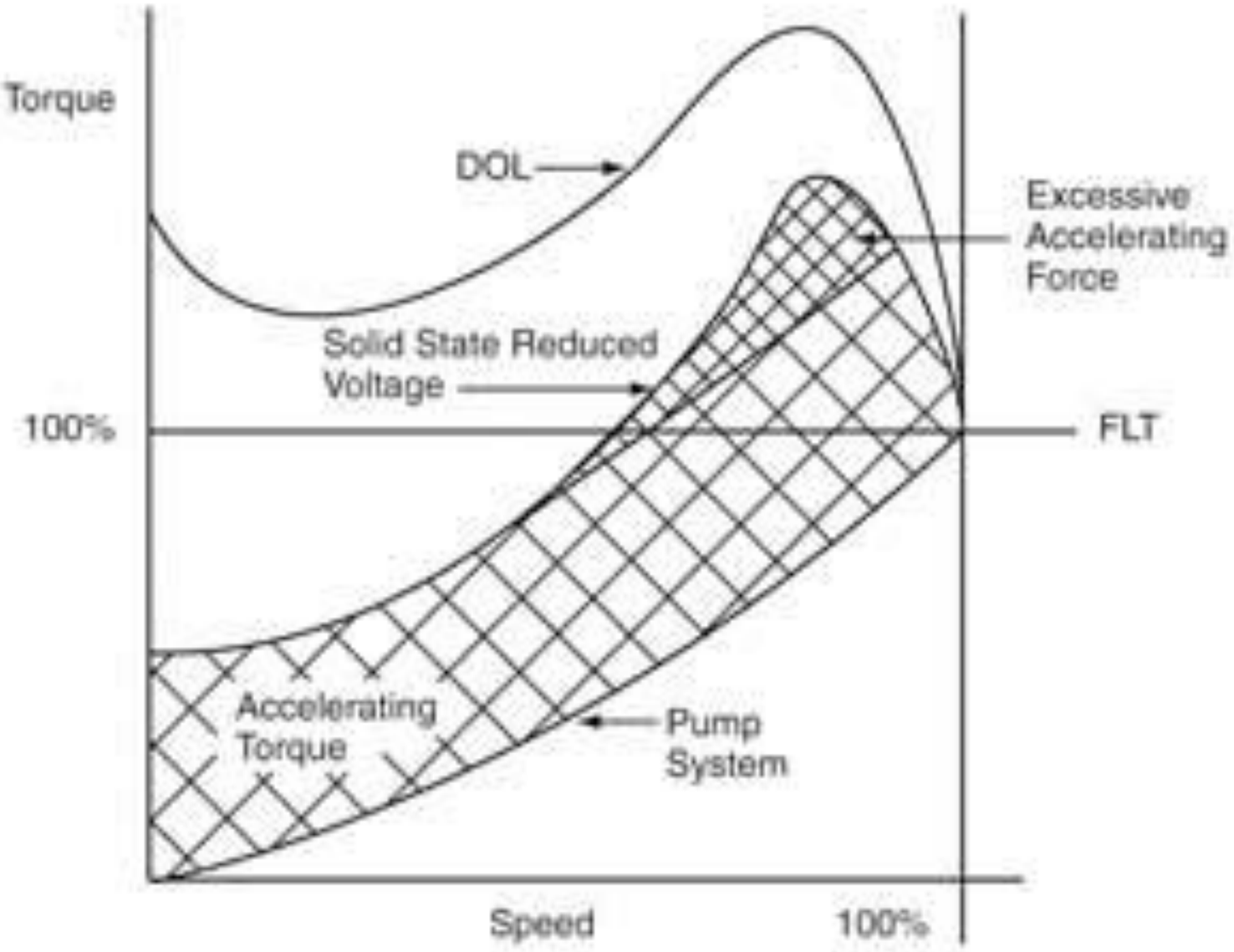
Centrifugal Pump



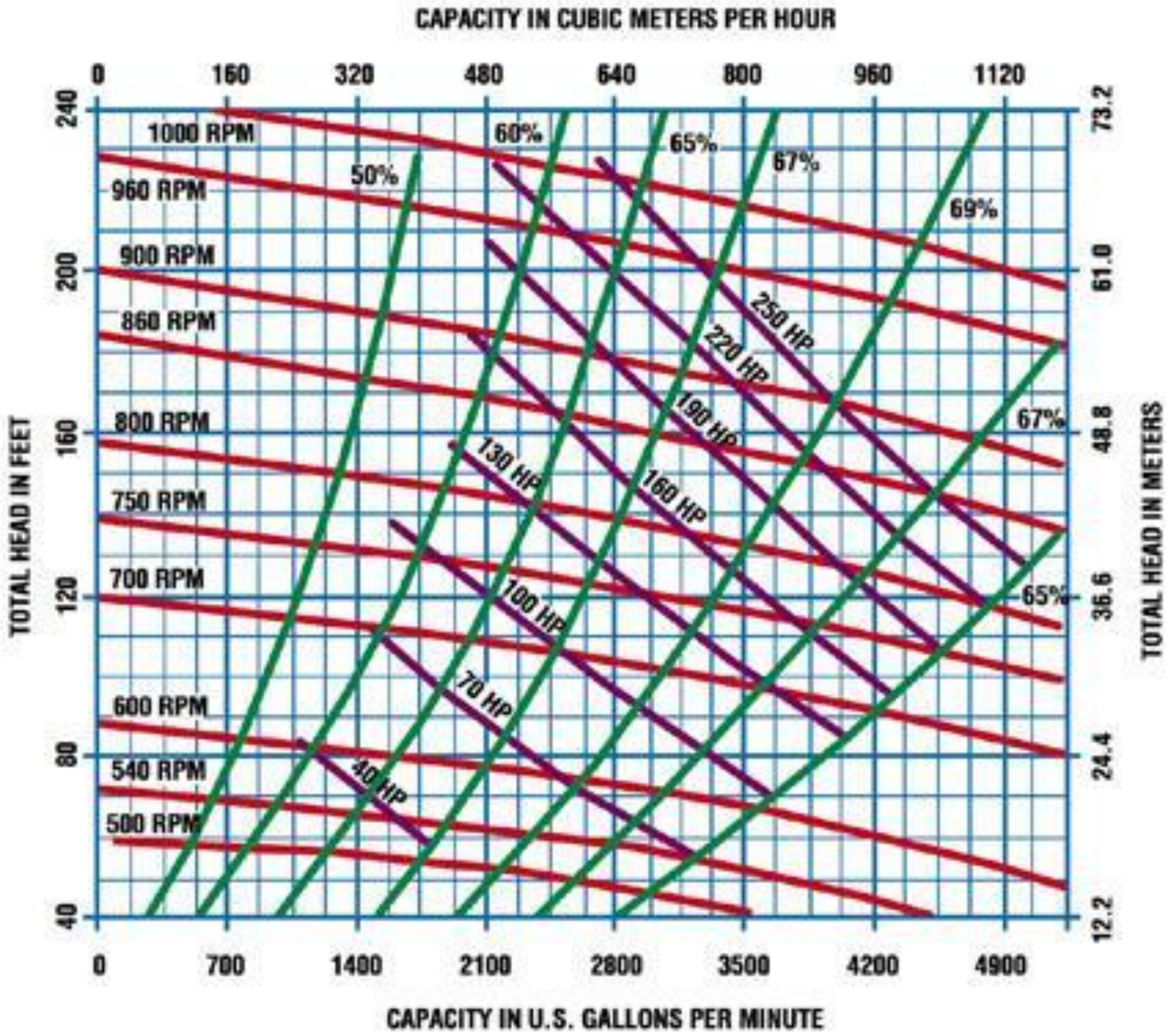
Motor



Acceleration Torque



Variable Speed (VFD)

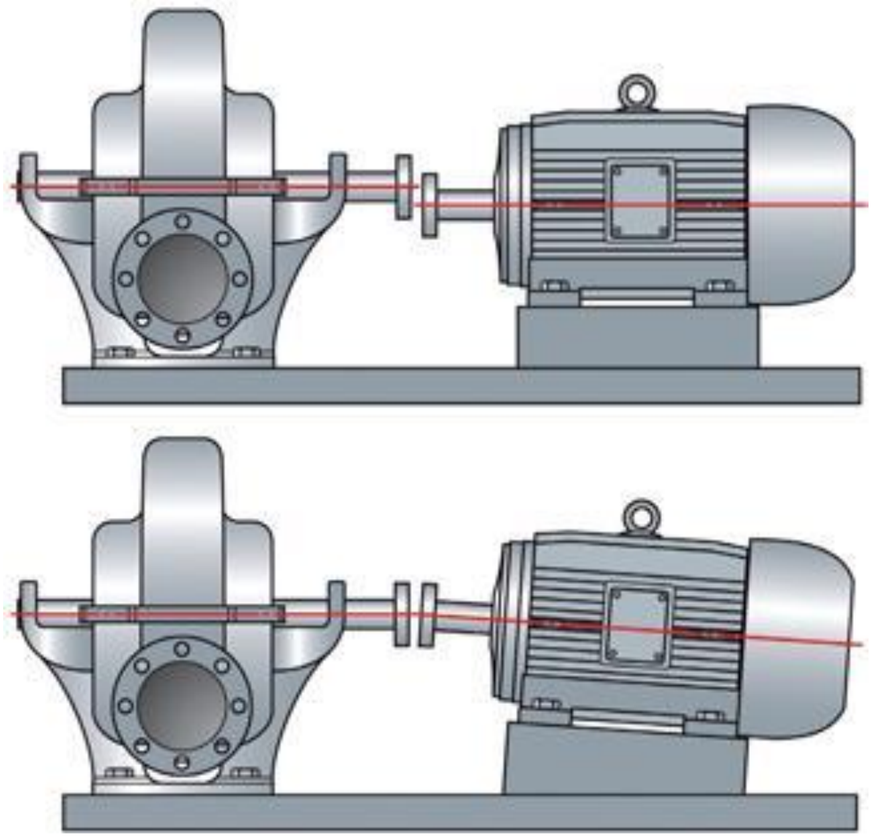


Mounting Motors

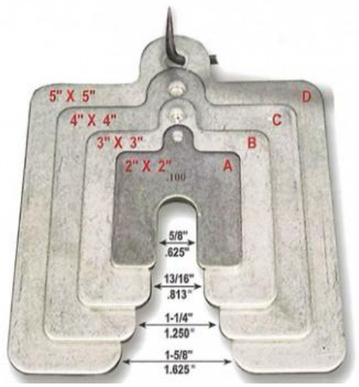
- Four points mounted flat, rigid machined surface
- Stiff enough to handle operating loads
- Grout between steel base and concrete
- Check for soft foot
- Consider thermal growth

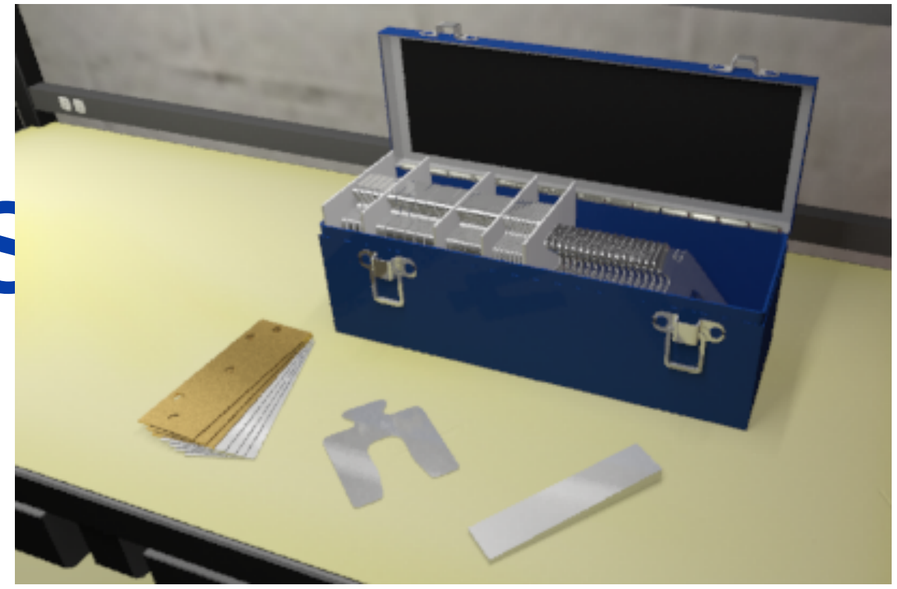
What is Shaft Misalignment?

In broad terms, shaft misalignment occurs with the centerlines of rotation of two or more machinery shafts are not in line with each other.



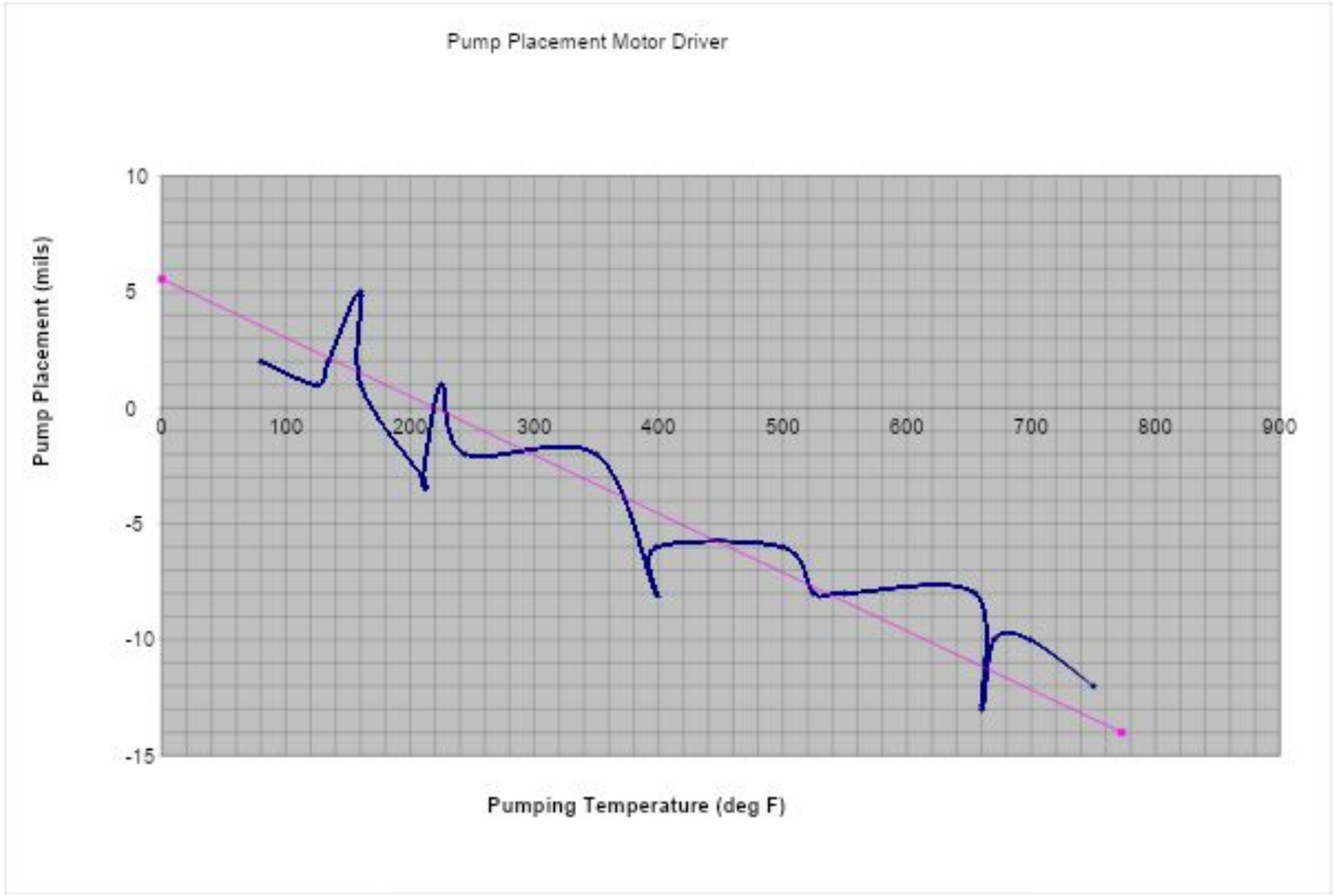
Vertical Adjustments





Soft Foot

Thermal Growth



Couplings

Greased Gear-type

Dry Disc-type

Bearings

Rolling Element

Sleeve Bearings

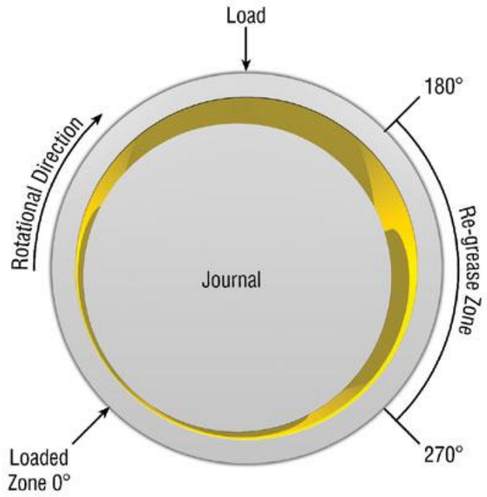
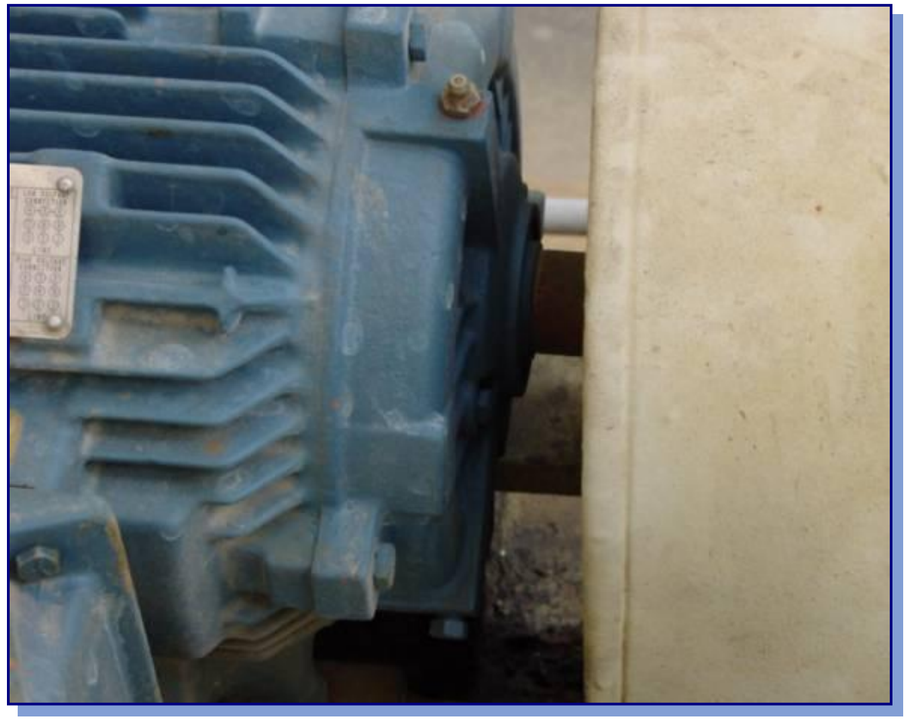
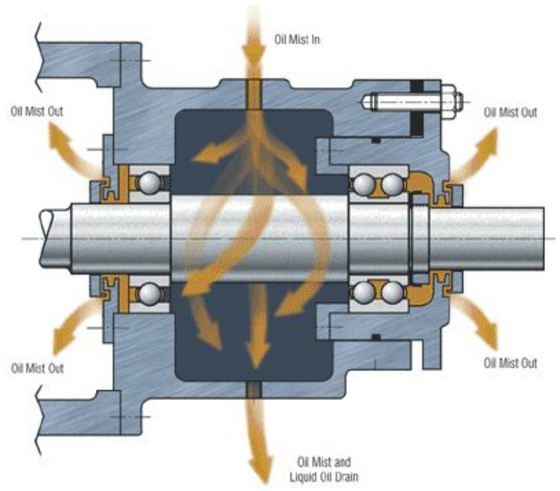


Figure 5

Lubrication

- Grease
  - Greased for life
  - Periodic grease
- Wet Sump (oil ring)
- Oil Flooded
- Forced lube
- Oil Mist
  - Pure Mist
  - Purge Mist





Maximizing Motor Life

- Proper motor design for type of pump driven
- Adequately sized to handle loads
- Proper enclosure to protect the motor from the environment
- Proper installation, alignment, system tuning
- Adequately designed and maintained bearing lubrication system

Don’t Do This!