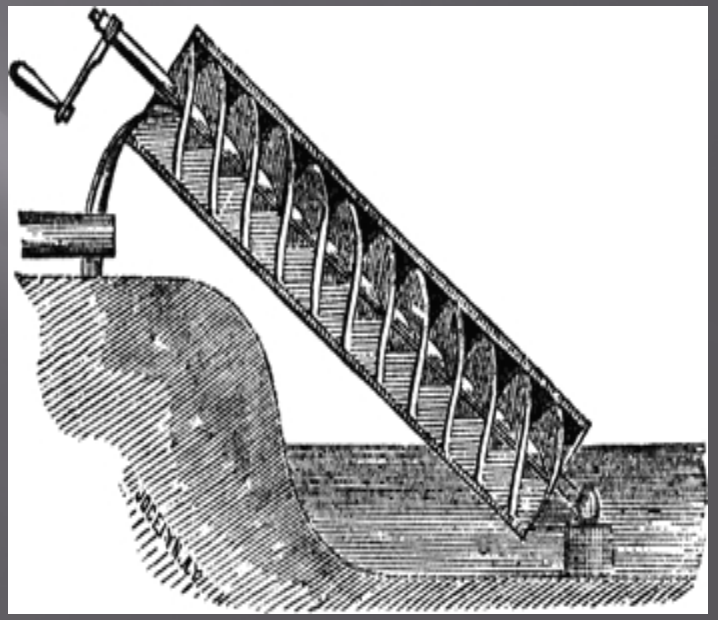
BEHIND PUMP VIBRATIONS

The reasons pumps shake

The First Pumps

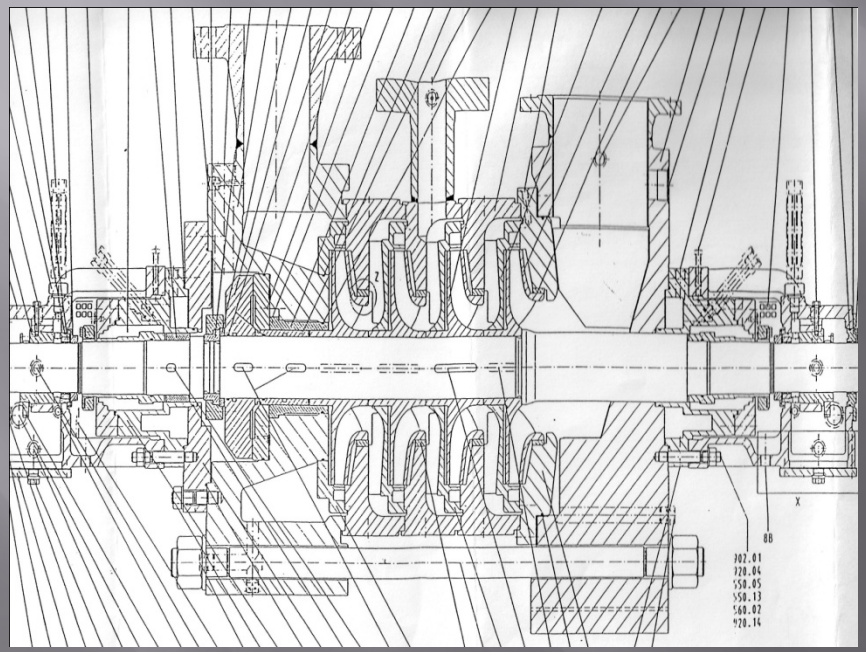
SWIPE PUMP

ARCHIMEDES SCREW

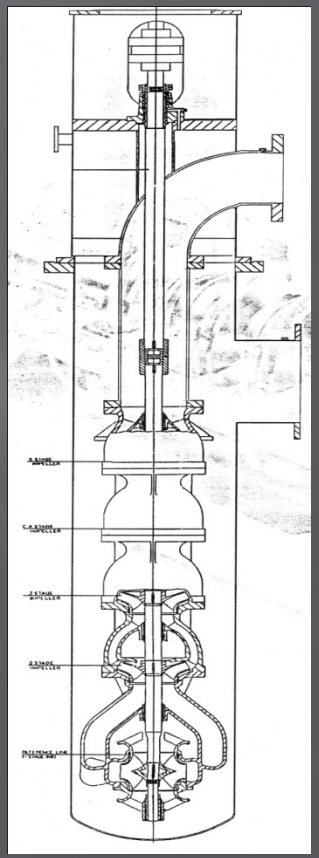


Today's Pumps

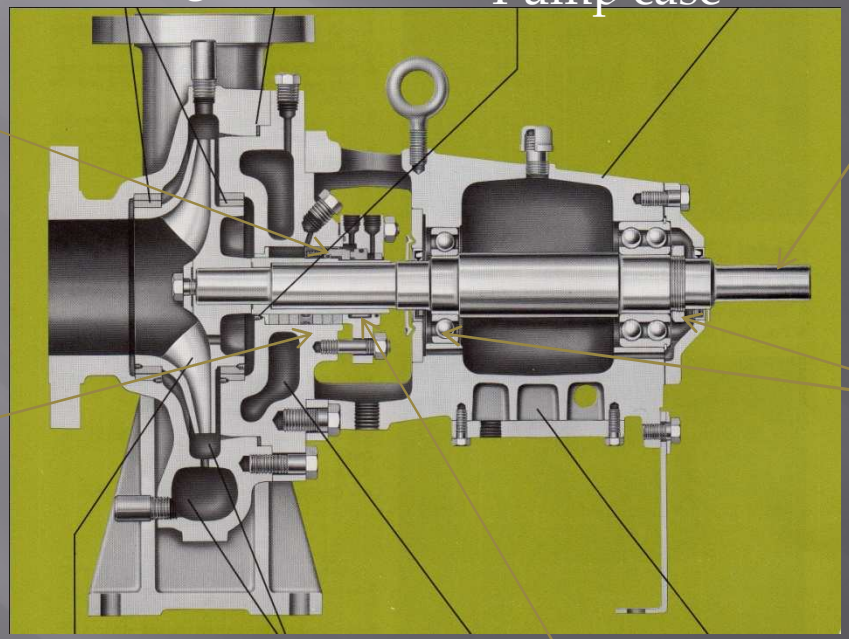
MULTISTAGE HORIZONTALS



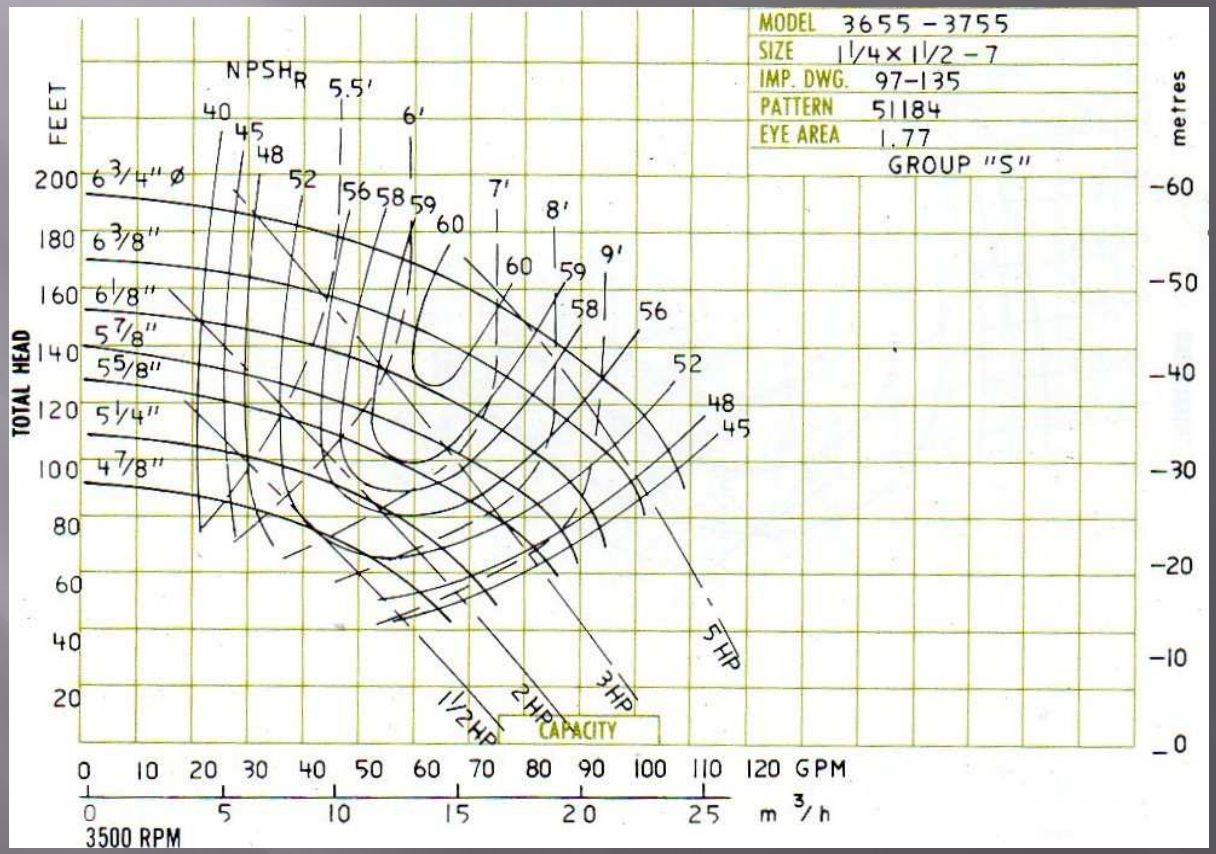
MULTISTAGE VERTICALS



Pump Components



Pump Curve


MODEL 3655 - 3755
SIZE 1 1/4 x 1 1/2 - 7
IMP. DWG. 97-135
PATTERN 51184
EYE AREA 1.77
GROUP "S"
NPSHR
FEET
TOTAL HEAD
metres
6 3/4" ø
6 3/8"
6 1/8"
5 7/8"
5 5/8"
5 1/4"
4 7/8"
CAPACITY
1 1/2HP
2HP
3HP
5HP
0 10 20 30 40 50 60 70 80 90 100 110 120 GPM
0 5 10 15 20 25 m 3/h
3500 RPM

Vibration

- Inbalance, Bent shaft (1x RPM)
- Misalignment (2xRPM)
- Vane Pass (# of impeller vanes x RPM)
- Cavitation (Raised Floor)
- Rubbing (.5x RPM)
- Looseness (multiples of RPM)
- Roller Bearing Damage (high frequencies)
- High Axial (Off design operations)

Inbalance, Bent shaft (1x RPM)

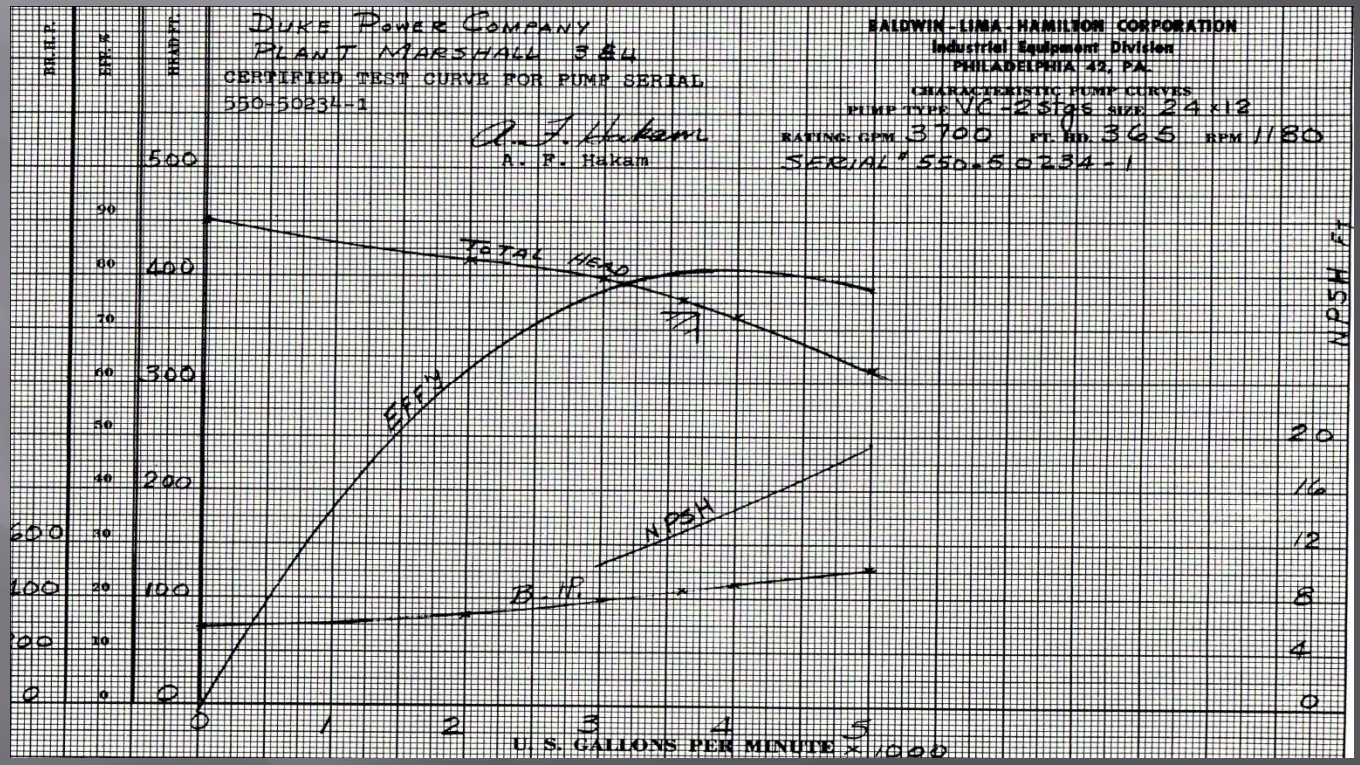
Common Causes

- Wear
- Inadequate balance criteria
- Inadequate shaft TIR criteria
- Improper shaft materials
- Rotor grab

Inbalance, Bent shaft (1x RPM)

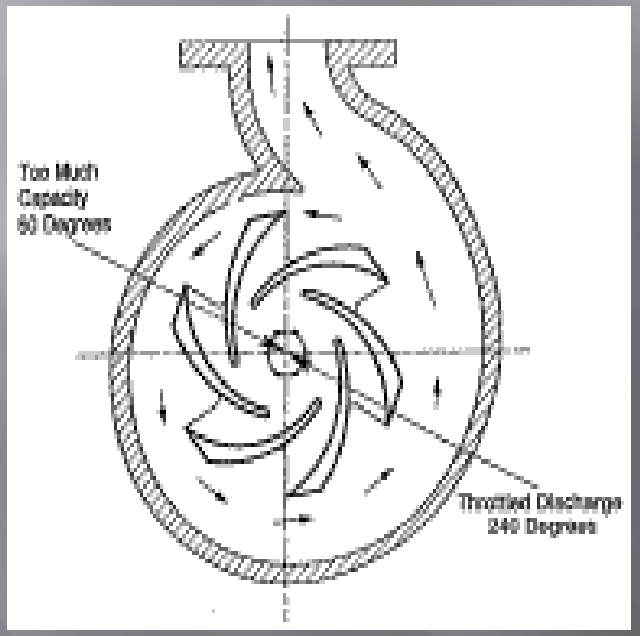
Operational Cause

- Off flow operation

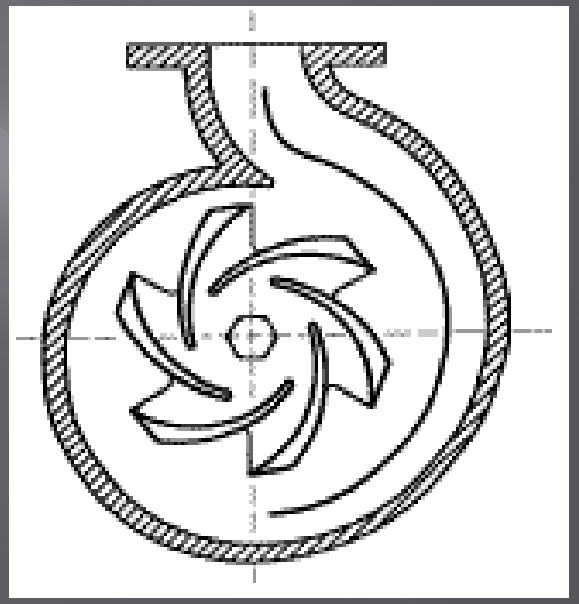


Volute Designs

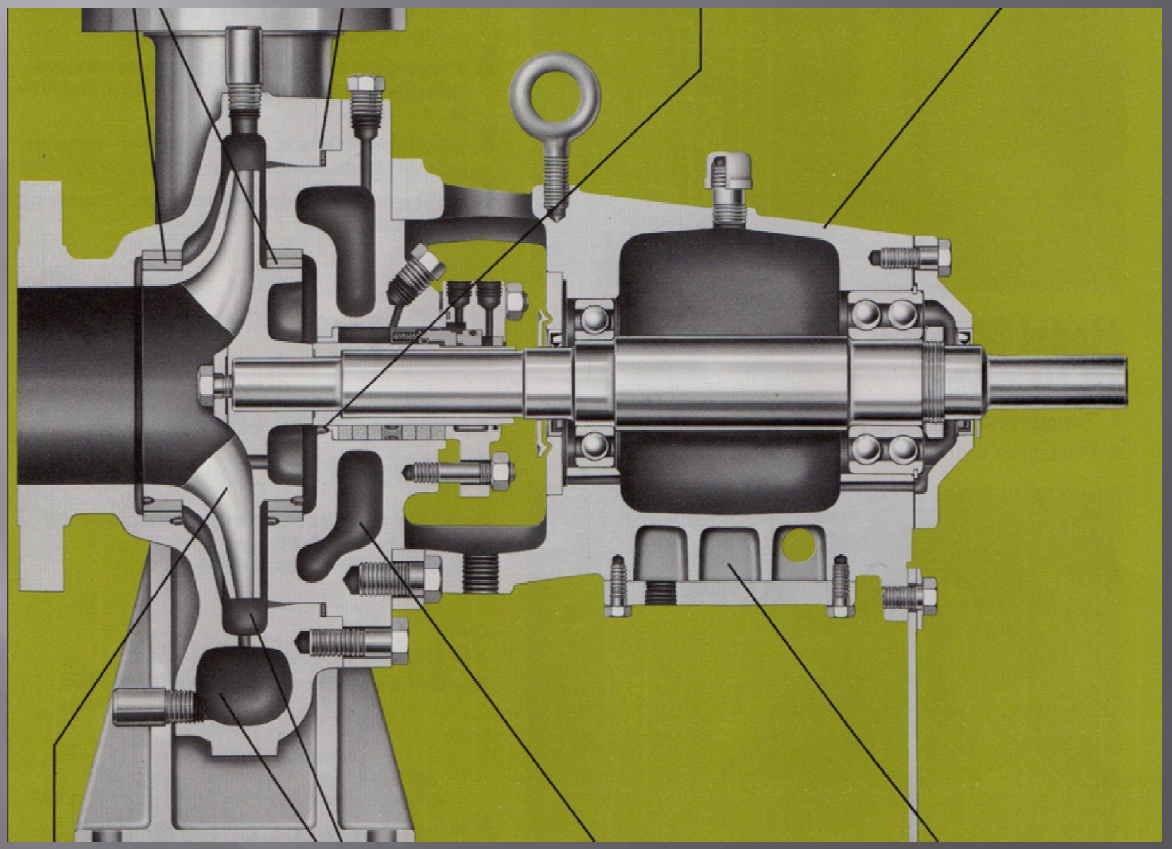
SINGLE VOLUTE



TWIN VOLUTE



Radial Forces

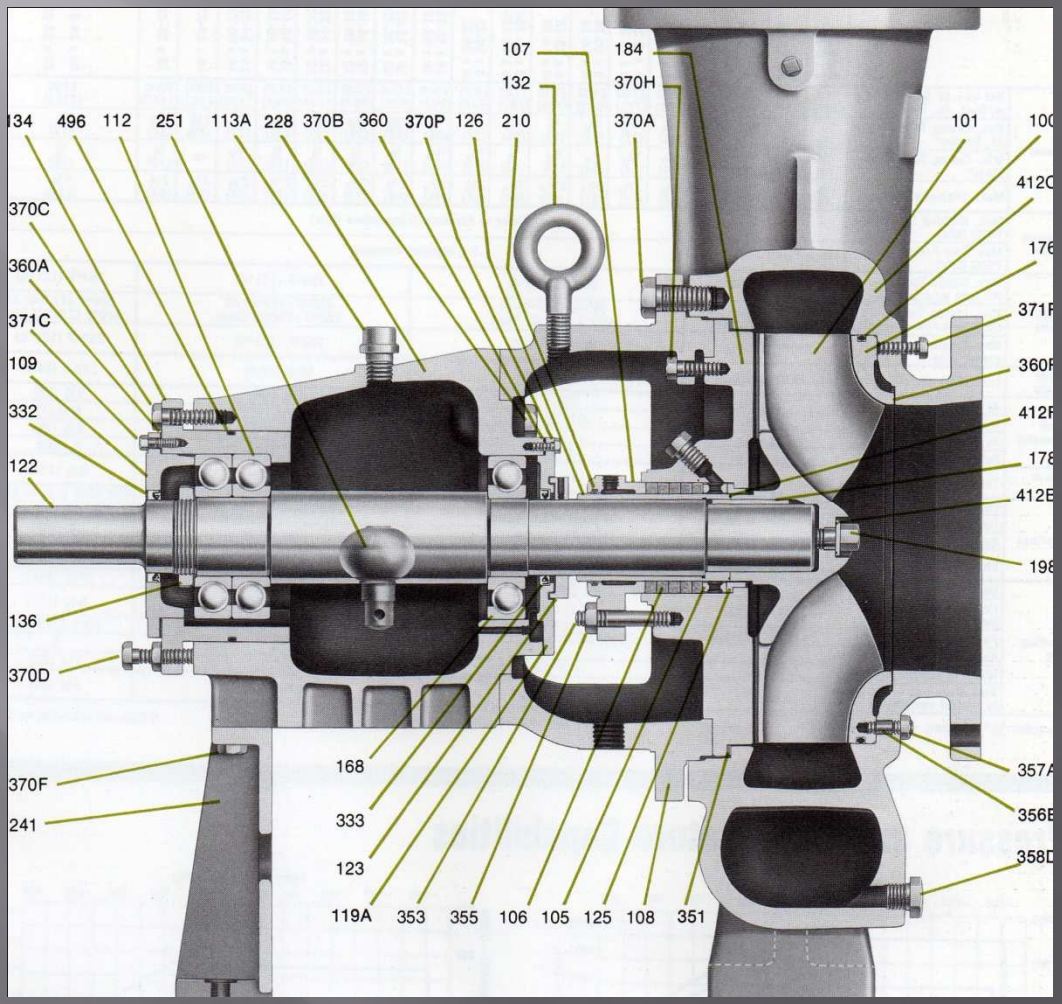


Misalignment (2xRPM)

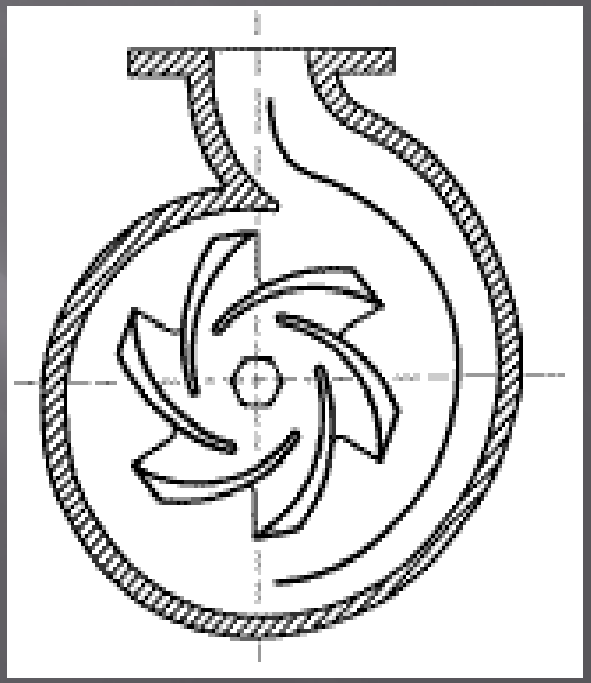
Common Causes

- Inadequate alignment procedures
- Thermal growth
- Pipe loading
- Inadequate base-plates and grouting

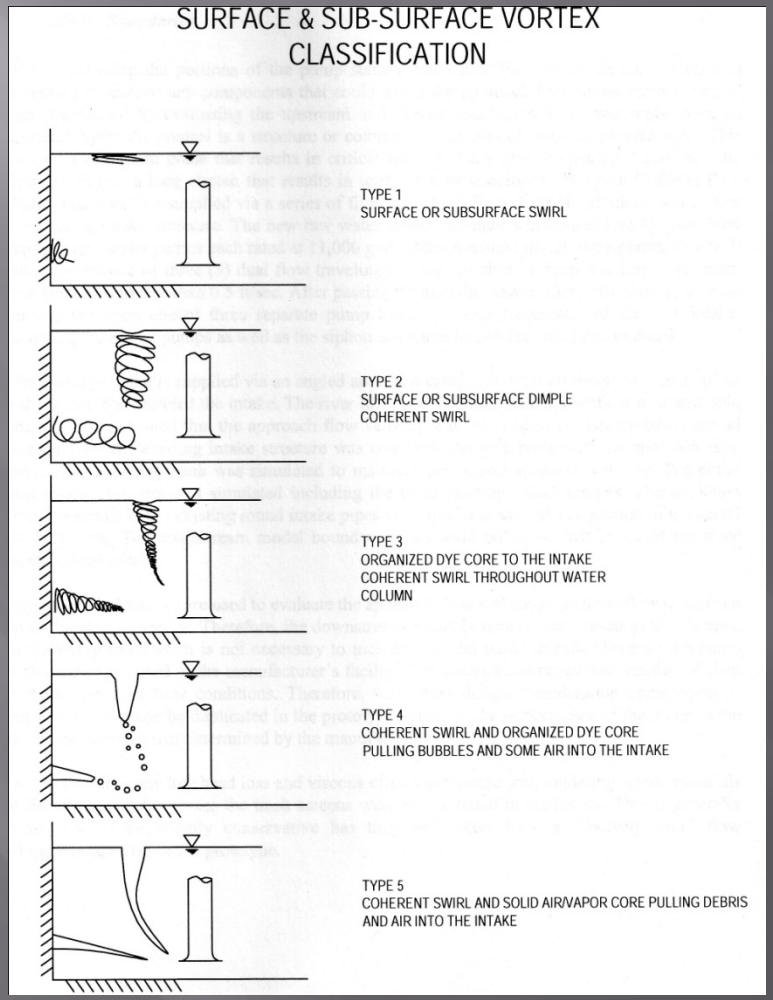
Misalignment



Vane Pass (# of impeller vanes x RPM)



Vertical Vane Pass



Bernoulli's Equation

- $P_1/rg+v_1^2/2g+z_1=P_2/rg+v_2^2/2g+z_2+h+w-q$
- Bernoulli's equation equates the energy at two points in time
- It's important's in this class is how it relates pressure and velocity

BE Example

- Assuming a particle of water entering an impeller. Time one will be in the suction line and time two will be as it enters the impeller.
- $P_1/rg+v_1^2/2g+\cancel{z1}=P2/rg+v_2^2/2g+\cancel{z_2}+\cancel{h}+\cancel{w}-\cancel{q}$
- Leaving $P_1/V_1^2=P_2/V_2^2$ or $P_1/P_2=(V_1/V_2)^2$
- There fore as velocity increases pressure drops by the square

Cavitation (Raised Floor)

- There are two primary types of cavitation and they are caused by very different conditions and in different areas of the impeller. They are both accompanied by a sound similar to the pump trying to pump marbles

Low NPSH Caviation

- This is the cavitation most of think about when they hear the term. It is caused by too low suction pressure to at the suction of the impeller such that when the impeller inlet vane hits the liquid it momentarily drops below the vapor pressure . This damage is found on the visible side of the inlet vane usually in the root or spread across the inlet vane. This type of cavitation is usually more severe in high flow condition, as the inlet velocity of the fluid increases.

Low NPSH Caviation

Recirculation Cavitation

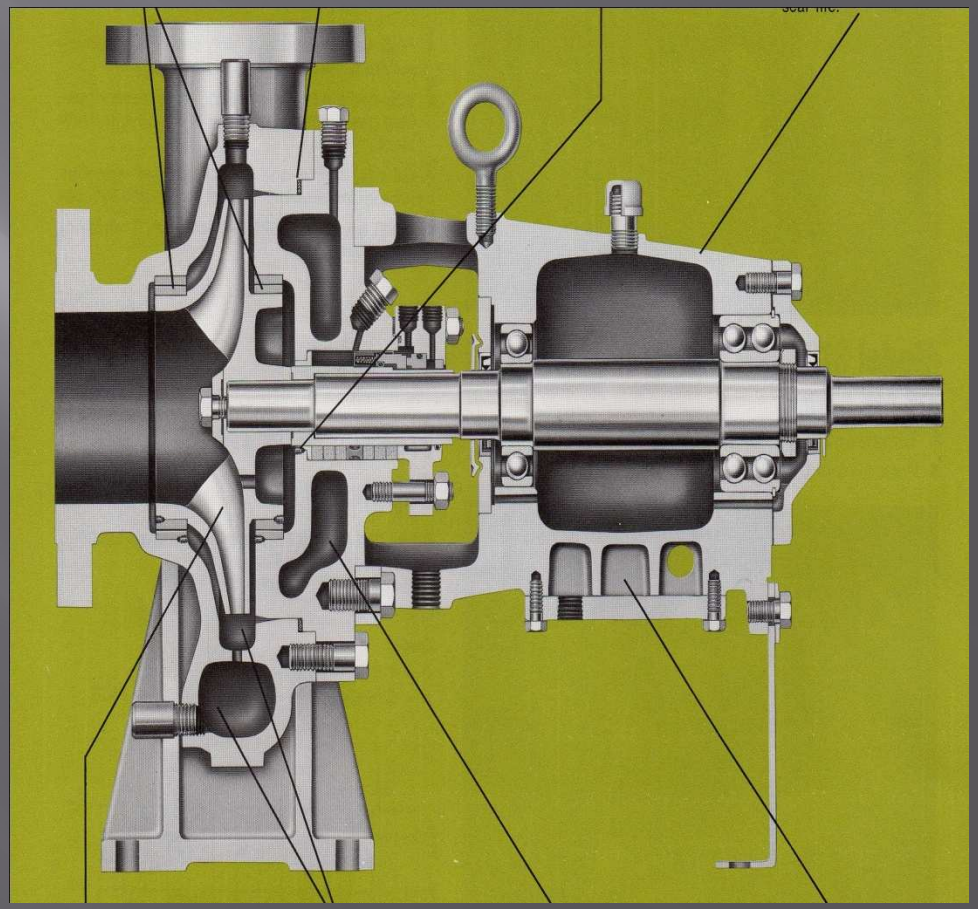
- Recirculation Cavitation is found at low flow conditions. This type of cavitation is due to turbulents in the impeller caused by liquid trapped in the impeller with no place to go due to the reduced flow. The damage for this cavitation is found on the back side of the impeller inlet vane and is sometimes missed until holes are found in the vanes.

Recirculation Cavitation

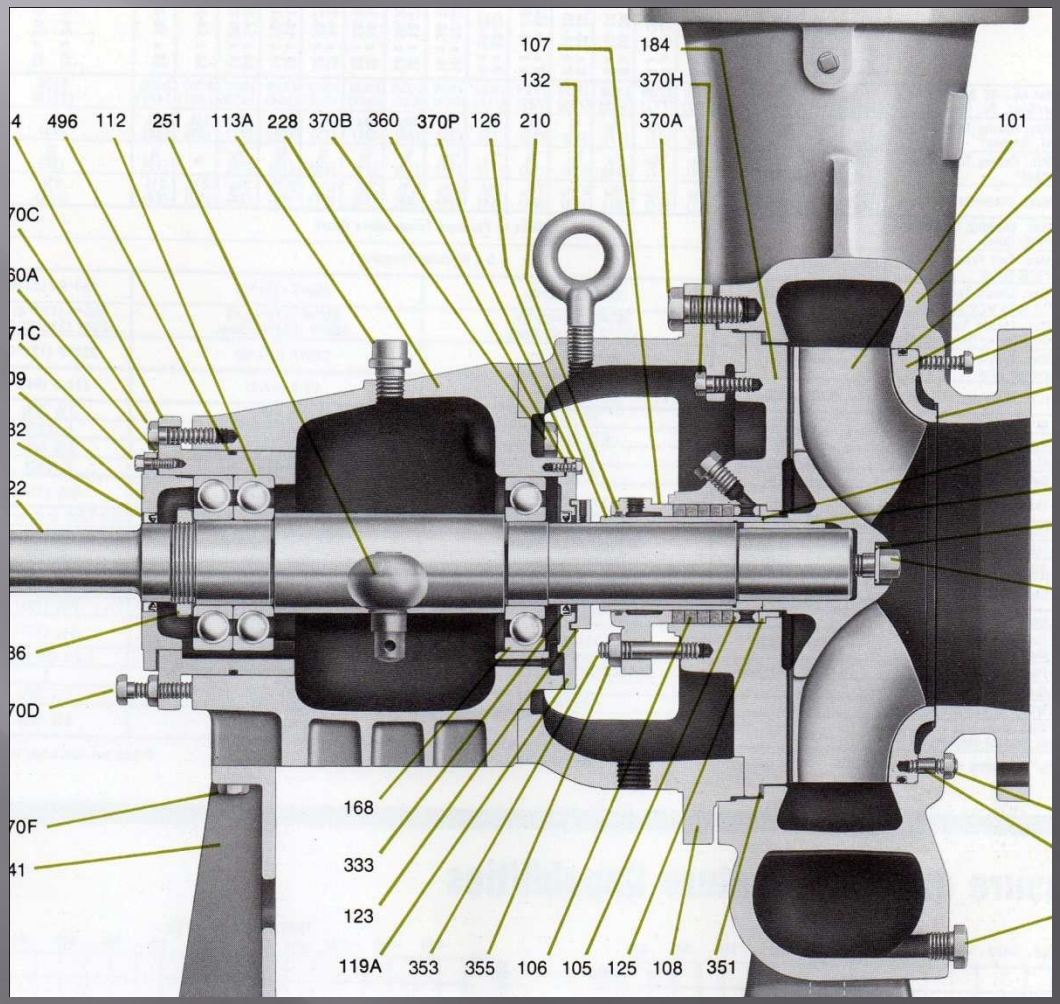
Rubbing (.5x RPM)

Common Causes

- Improper installation
- Misalignment
- Pipe strain



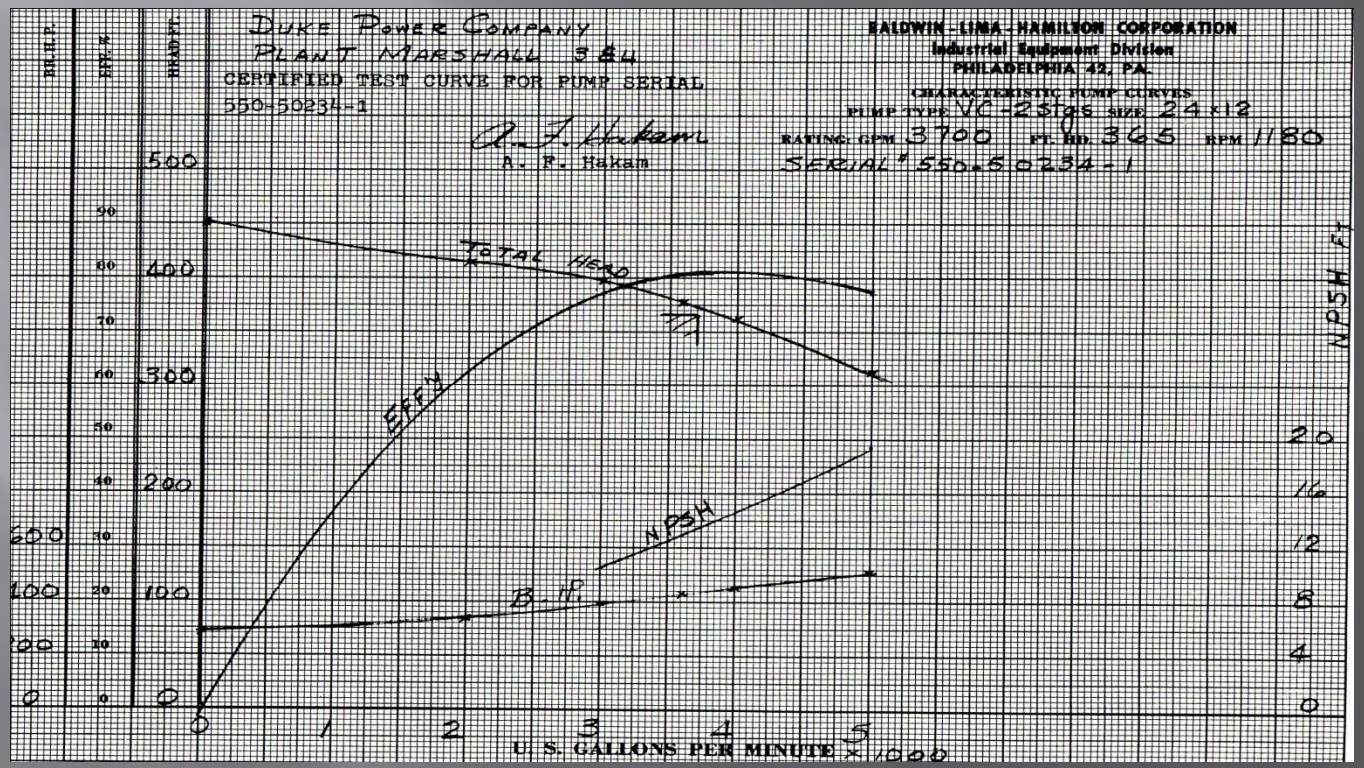
Looseness


107
184
132
370H
4
496
112
251
113A
228
370B
360
370P
126
210
370A
101
70C
60A
71C
09
32
22
36
70D
70F
41
168
333
123
119A
353
355
106
105
125
108
351

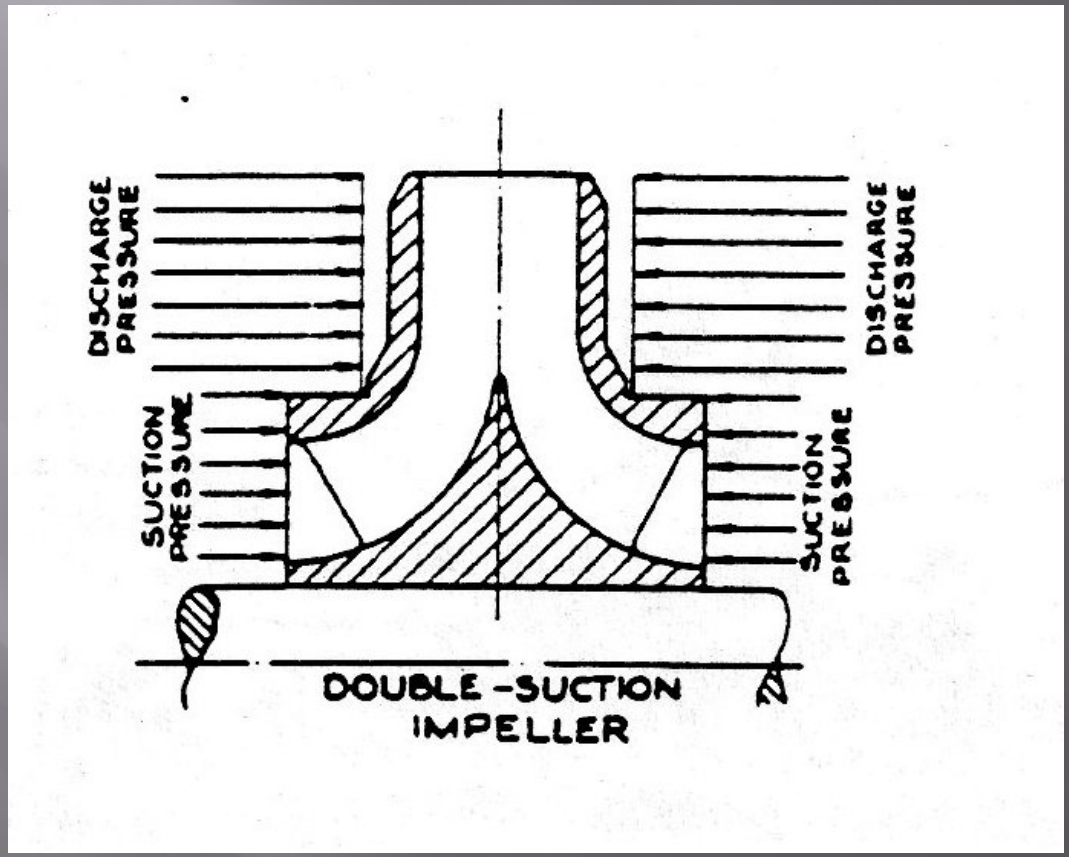
Roller Bearing Damage (high frequencies)

- Improper installation
- Reusing bearings
- Improper lubrication
- Defective new bearings

High Axial


DUKE POWER COMPANY
PLANT MARSHALL 3 & 4
CERTIFIED TEST CURVE FOR PUMP SERIAL
550-50234-1
A. F. Hakam
BALDWIN-LIMA-HAMILTON CORPORATION
Industrial Equipment Division
PHILADELPHIA 42, PA.
CHARACTERISTIC PUMP CURVES
PUMP TYPE VC-23fgs SIZE 24 x 12
RATING: GPM 3700 FT. HD. 365 RPM 1180
SERIAL # 550-50234-1
TOTAL HEAD
EFF %
B.H.P.
NPSH
U. S. GALLONS PER MINUTE x 1000
NPSH Ft.

Hydraulic Balance



High Axial

Understanding Why?

- Knowing why certain types of vibration are present can help you know how serious the problem is and how it can be resolved.

Any Questions?

Pumps