Selecting Pumps for Ultimate Owner Satisfaction
(Advanced Pumping and Selection)

There is a fundamental shift in the way we design, construct, maintain and operate a building being driven by ASHRAE Standards becoming code, DOE Efficiency Mandates and Hydraulic Institute piping guidelines. The Owners are expecting us to still provide pumping systems that satisfy their demands for the Best LCC Pump Life Expectance, the best System Efficiency Operating Cost and other needs.

This presentation will examine a few of the key design decisions and their impact on the owner’s true requirements.

Happy Pumps make Happy Owners

What is Important to Owner Satisfaction

- Best First Cost and Life Cycle Cost
- Best System Comfort and Operating Cost
- Pump Station Piping and Foot Print

The Pump Types Per ASHRAE & DOE

- ESCC End suction close Couple Single Stage
- IL Inline End suction close Couple
- ESFM End suction frame mounted on Base Plate
- VTS submersible turbine
- DSBM Double Suction Base mounted Horizontal or Vertical Split case
- Single Stage
- ILSCDS Inline Split Coupler Double Suction Over hung impeller single stage


Third Party Guidelines Best Practice

- ASHRAE HANDBOOK and 90.1
- Hydraulic Institute Guide lines
- DOE Department of Energy
The Pump Types Per ASHRAE & DOE

- No one pump type is best for the owner’s satisfaction in all applications. A detailed study of piping connections, installed pump piping footprint, LCC pump life, and installed pump station head loss is required.
- First cost is controlled by casing size and single or double suction style pump.

Pump Life Expectancy For Life Cycle cost

ASHRAE 2015 HANDBOOK

Typical Pump Lifetimes By DOE

DOE defines “equipment lifetime” as the age when a pump is retired from service. DOE consulted with market experts to establish typical pump lifetimes by class of equipment. The average life time by equipment class as published by DOE is:

- **ESCC** End suction close Couple
  - ESCC 1800 11 years
  - ESCC 3600 11 years
- **IL** inline
  - IL 1800 16 years
  - IL 3600 13 years
- **ESFM** End suction frame mounted
  - ESFM 1800 23 years
  - ESFM 3600 20 years
- **VTS** submersible turbine
  - VTS 3000 11 years

Allowable Vibration and Pump Life

Hydraulic Institute 9.6.4-2000

- 10 hp to 100 hp

- End Suction Foot Mounted Single Stage: .125 to .175 in/sec rms unfiltered
- Vertical-Inline Separately Coupled: .125 to .175 in/sec rms unfiltered
- Between Bearing Horizontal Split Case: .15 to .20 in/sec rms unfiltered

Between Bearings HSC Double Suction Can Tolerate More Vibration

These Vibration Values are to be used as a general owner acceptance guide.

What is Important to Owner Satisfaction

Best First Cost and Life Cycle Cost

Best System Comfort and Operating Cost

Pump Station Piping and Foot Print
Basic Pump Affinity Laws

- Pump Head Loss Calculations
  1. ASHRAE 90.1-2010 & 90.1-2013
  2. Open Versus Close Systems
  3. Constant Fixed and Variable Head
- Pump Curve Review

Brake Horsepower

Brake Horsepower (Bhp) = the power required for pumps to circulate water through a hydronic system

For water:

\[ Bhp = \frac{GPM \times \Delta h}{3960 \times E_p} \]

Pump Affinity Laws

- VFD - Speed Change
  \[ GPM_2 = GPM_1 \times \left( \frac{N_2}{N_1} \right)^2 \]
  \[ h_2 = h_1 \times \left( \frac{N_2}{N_1} \right)^2 \]
  \[ bh_{p2} = bh_{p1} \times \left( \frac{N_2}{N_1} \right)^3 \]

- Impeller Diameter Change
  \[ GPM_2 = GPM_1 \times \left( \frac{D_2}{D_1} \right)^2 \]
  \[ h_2 = h_1 \times \left( \frac{D_2}{D_1} \right)^2 \]
  \[ bh_{p2} = bh_{p1} \times \left( \frac{D_2}{D_1} \right)^3 \]

“100% Variable Head Loss”

12.5% BHP in theory at 50% flow
Only when no control valves

Extremely hard to find in the real world

Theoretical Savings - 100% Variable Flow

- Basic Pump Affinity Laws
- Pump Head Loss Calculations
  1. ASHRAE 90.1-2013
  2. Open Versus Close Systems
  3. Constant Fixed and Variable Head
- Pump Curve Review
Current ASHRAE 90.1 Code Adoptions

CHAPTER 6
HEATING, VENTILATING, AND AIR CONDITIONING
SECTION 6.4
Mandatory Provisions

6.4.2 Load Calculations. Heating and cooling system design loads for the purpose of sizing systems and equipment shall be determined in accordance with ANSI/ASHRAE/ACCA Standard 183-2007, Peak Cooling and Heating Load Calculations in Buildings Except Low-Rise Residential Buildings.

6.4.2.1 Load Calculations. Heating and cooling system design loads for the purpose of sizing systems and equipment shall be determined in accordance with ANSI/ASHRAE/ACCA Standard 183-2007, Peak Cooling and Heating Load Calculations in Buildings Except Low-Rise Residential Buildings.

6.4.2.2 Pump Head. Pump differential pressure (head) for the purpose of sizing pumps shall be determined in accordance with generally accepted engineering standards and handbooks acceptable to the adopting authority. The pressure drop through each device and pipe segment in the critical circuit at design conditions shall be calculated.

- Basic Pump Affinity Laws
- Pump Head Loss Calculations
  1. ASHRAE 90.1-2010 & 90.1-2013
  2. Constant Fixed and Variable Head
- Pump Curve Review

Variable Head Loss Ratio

Pump Head Calculation

Pump Curve Review

Variable Head + Constant Fixed Head = Total Head

52 ft + 28 ft = 80 ft
**Real World V/S Curves**

- **Efficiency changes 50% and Below**
- **Minimum speed**

**System Curve Review**
1. Constant Fixed Head and Variable Head
2. Constant Volume and Variable Volume
3. Pump Selection Guidelines ASHRAE
4. Efficiency Islands and Load Profiles

**Pump Selection Examples**
1. Condenser Water Pump Selection and BEP with VSD
2. Variable Volume Pump Sections and Efficiency Islands
   - Energy Savings Old Versus New Pumps

**What happens to **minimum pump speed** as you increase minimum control head, fixed head, or differential pressure set point?**

**Flow, GPM**

**Total Pump Head 70 ft**
- Control Head 30 ft
- Minimum Speed 60%

**Total Pump Head 70 ft**
- Control Head 50 ft
- Minimum Speed 75%

**Variable Head**
**Fixed Head**

**Piping Head Loss**

**Flow, GPM**
Possible Consequences of Oversizing Critical Circuit

What can happen to VFD pump flow & efficiency at 100% flow when you over head a pump and actual operating design point is far right of BEP?

Variable Head

Real World V/S Curves

Variable Speed Drive will not fix the problem!

Real World V/S Curve Owner Problem

Large University Chilled Water Plant Condenser Water Pumps

Specified Right of BEP at 3,000 gpm at 100 ft head and 89% Efficient with 100 HP VFDs to allow Balancing.

Actual pump head required was 60 ft and VFD will not fix Pump Cavitation and falling Off the Pump Curve at 75 ft head at reduced rpm.

Owner hired another Consulting Engineer to explain why the pump discharged balance valves were throttled with the VFDs?

Minimum Wasted Energy is $16,500 per year for ever! Who pays?

The owner paid for 100 HP pumps and 100 HP VFDs. Smaller 60 HP Pumps and 60 HP VFDs will work fine! Who pays?

Owners are getting Smarter

• Control Curve Review
  1. Fixed Head and Variable Head
  2. Constant Volume and Variable Volume
  3. Pump Selection Guidelines ASHRAE
  4. Efficiency Islands and Load Profiles

• Pump Selection Examples
  1. Condenser Water Pump Selection and BEP with VSD
  2. Variable Volume Pump Sections and Efficiency Islands
     • Energy Savings Old Versus New Pumps
ASHRAE Recommendation

"selection limits of 66% to 115% of flow at the BEP are suggested"

"Where possible, pumps should be chosen to operate to the left of the BEP because the pressure in the actual system may be less than design due to overstated data for pipe friction and for other equipment. Otherwise, the pump operates at a higher flow and possibly in the turbulent region."

-- 2016 ASHRAE Systems and Equipment Handbook, p 44.11

Should we consider selecting pumps at full design flow to the right of BEP to maximize variable flow system efficiency?

(Must have accurate pump head calculations)

(Do Not Overheat)

Two 50% parallel selected pumps may have a higher system efficiency and provide 75% plus standby

Pump Efficiency is the highest at the maximum size impeller Diameter and reduced rpm using VFD kw limiting. Caution if you need constant motor speed standby limit the impeller size To be non-over loading at synchronous speed. Check motor torque.

As the load changes, control valves change the system curve and the operating point moves to a new point on the pump curve

-- 2016 ASHRAE Systems and Equipment Handbook, p 44.11

AHRI 550/590 Standard

IPLV Load Profile

AHRI 550/590-2015 Standard

"IPLV" Chiller Efficiency

[Integrated Part Load Value]

<table>
<thead>
<tr>
<th>Chiller Load</th>
<th>Weighting</th>
<th>Condenser Temp °F</th>
<th>kw/Ton</th>
<th>Run-Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>1%</td>
<td>85</td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>75%</td>
<td>42%</td>
<td>75</td>
<td></td>
<td>B</td>
</tr>
<tr>
<td>50%</td>
<td>45%</td>
<td>65</td>
<td></td>
<td>C</td>
</tr>
<tr>
<td>25%</td>
<td>12%</td>
<td>65</td>
<td></td>
<td>D</td>
</tr>
</tbody>
</table>

IPLV = \[\frac{1}{\text{A}^{1\%} \cdot \text{B}^{42\%} \cdot \text{C}^{45\%} \cdot \text{D}^{12\%}}\]

expressed in kw/Ton

Note: Lower Condenser Water Temperature at Part Load

AHRI 550/590 Standard

"IPLV" Pump Efficiency - Load Profile

(Integrated Part Load Value)

Based on 30% constant fixed head

<table>
<thead>
<tr>
<th>HVAC Load</th>
<th>Weighting</th>
<th>Pump Flow Rate</th>
<th>Pump Eff</th>
<th>Run-Point</th>
<th>Pump Efficiency</th>
<th>Operating Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>1%</td>
<td>100%</td>
<td></td>
<td>A</td>
<td>B</td>
<td></td>
</tr>
<tr>
<td>75%</td>
<td>42%</td>
<td>75%</td>
<td>75%</td>
<td>B</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>50%</td>
<td>45%</td>
<td>50%</td>
<td>50%</td>
<td>C</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>25%</td>
<td>12%</td>
<td>25%</td>
<td>25%</td>
<td>D</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Pump PLEV = \[\frac{1}{\text{A}^{1\%} \cdot \text{B}^{42\%} \cdot \text{C}^{45\%} \cdot \text{D}^{12\%}}\]

expressed in blended efficiency

Note: Assume pump flow rates match % load

AHRI 550/590 Standard

"IPLV" Pump Efficiency - Load Profile

(Integrated Part Load Value)
• System Curve Review
  1. Fixed Head and Variable Head
  2. Constant Volume and Variable Volume
  3. Pump Selection Guidelines ASHRAE
  4. Efficiency Islands and Load Profiles
  5. Pump Annual Operating Cost

Pump Annual Operating Cost

<table>
<thead>
<tr>
<th>Load</th>
<th>Hours</th>
<th>Flow GPM</th>
<th>Head Feet</th>
<th>GPM</th>
<th>BHP</th>
<th>EM</th>
<th>kWHR</th>
<th>Cost/day</th>
<th>Water Use LF</th>
</tr>
</thead>
<tbody>
<tr>
<td>25%</td>
<td>2.89</td>
<td>1.002</td>
<td>0.46</td>
<td>851</td>
<td>85.4</td>
<td>7.29</td>
<td>8.51</td>
<td>10.1</td>
<td>84.35</td>
</tr>
<tr>
<td>50%</td>
<td>12.23</td>
<td>1.003</td>
<td>0.46</td>
<td>851</td>
<td>85.4</td>
<td>7.29</td>
<td>8.51</td>
<td>10.1</td>
<td>84.35</td>
</tr>
<tr>
<td>75%</td>
<td>19.94</td>
<td>1.003</td>
<td>0.46</td>
<td>851</td>
<td>85.4</td>
<td>7.29</td>
<td>8.51</td>
<td>10.1</td>
<td>84.35</td>
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<td>7.29</td>
<td>8.51</td>
<td>10.1</td>
<td>84.35</td>
</tr>
</tbody>
</table>

Pump PLEV = 84.6%

“100% Variable Head”

“30 Feet Constant Head”

Who is going to pay the difference

Owners are getting smarter

Pump PLEV = 88.5%

$4,444.78

Pump PLEV = 84.6%
Variable-Speed Pumping Control Strategies

Outline of Presentation

ASHRAE 90.1 and Variable Speed Pumping
Control Curve and Control Area Review
Variable Speed Curve Control Strategies
  • Pump Head Control
  • Full System Flow Sensor
  • Sensorless
Variable Speed Area Control Strategies
  • Remote DP
  • Remote DP with valve position reset

Summary

HEATING, VENTILATING, AND AIR CONDITIONING

6.5.4.1 Hydronic Variable Flow Systems.

HVAC pumping systems having a total pump system power exceeding 10 hp that include control valves designed to modulate or step open and close as a function of load shall be controlled to achieve pump head, flow, and/or temperature to reduce the pump motor demand of no more than 30% of design wattage at 50% of design system flow. The controls or devices shall be controlled as a function of desired flow or to maintain a minimum required differential pressure. When control valves are utilized on the return side of variable head systems, the control of the pump head and flow shall be reset downward based on valve positions until one valve is nearly wide open.

Exceptions:
  a. Systems where the minimum flow is less than the minimum flow required by the equipment manufacturer for the proper operation of the system.
  b. Systems where the total pump system power is 75 hp or less.

ANSI/ASHRAE/IES Standard 90.1-2013

Our Example System

Control curve for our example system

Variable-Speed Pump Curve Control adjusts pump speed to keep the pump operating on the control curve. To do this, the controller must know where the pump is operating on the pump curve. This can be achieved by sensing RPM along with pump flow, pump head, or pump kW.
Variable Speed Pumping System
Control Area Review

How much pump head does our example system need at 400 gpm?

Answer: It depends on where the load is!

The sun rises in the east and sets in the west. Zone loads will shift with the sun.

If all 400 gpm is through Zone 3, required pump head is 40 feet.

Note that this point is above the control curve. Hydronic systems will need to operate above and below the control curve if exact flow demands are delivered.

How much pump head will this control system generate at 800 gpm?

With Zones 2 and 3 fully loaded, pump head is 54 feet.
Once again, we are operating above the control curve.

We can plot all of these possible operating points and end up with the control area.

The single line Quadratic equation used for Sensorless Control:

\[
Q = \frac{Q_h}{Q} \cdot Q_{\text{min}}
\]

Outline of Presentation

ASHRAE 90.1 and Variable Speed Pumping
Control Curve and Control Area Review
Variable Speed Curve Control Strategies
- Pump Head Control
- Full System Flow Sensor
- Sensorless

Variable Speed Area Control Strategies
- Remote DP
- Remote DP with valve position reset

Summary

There is a unique speed (rpm) for each pump (head) point on the control curve.
Variable Speed Curve Control will operate on the fixed control curve.

Curve Control Pump Control will operate on the fixed control curve.
Outline of Presentation
ASHRAE 90.1 and Variable Speed Pumping
Control Curve and Control Area Review
Variable Speed Curve Control Strategies
  • Pump Head Control
  • Full System Flow Sensor
  • Sensorless
Variable Speed Area Control Strategies
  • Remote DP
  • Remote DP with valve position reset
Summary

There is a unique (rpm) speed for each pump (flow) point on the control curve

Variable Speed Curve Control (with local flow measuring device)

Sensorless Pumping (Curve Control)

Sensorless pumping continuously does the following:
1. Flow calculation (from RPM and HP)
2. Uses this calculated flow to set the new RPM based on the control curve

Sensorless Flow Calculations

With 9" impeller, at 1770 RPM and 20 HP (both read from the VFD), what is our flow?
Sensorless Flow Calculations

With 6.25" impeller, at 1750 RPM and 3 HP (both read from the VFD), what is our flow?

This pump isn't suitable for sensorless pumping in certain flow ranges.

Variable Speed Curve Control (Sensorless)

- Sensorless control head = 25 ft
- No external sensors or wires are needed
- Flow limiters are used

Sensorless pumping continuously does the following:
1. Flow calculation (from RPM and HP)
2. Uses this calculated flow to set the new RPM based on the control curve

A sensorless pump operates on the fixed control curve.

Variable Speed Curve Control adjusts pump speed to keep the pump operating on the estimated fixed control curve. To do this, the controller needs to know where the pump is operating on the pump curve. This can be achieved by sensing RPM along with pump flow, pump head, or pump kW.

The control area of our system is shown in red. Since Curve Control Pump Control operates on the control curve, there will be times when a coil is short of flow. We call this a "miss".
Control Head Creep: The phenomenon of control head increasing in value over months and years in an installed variable-speed pumping system. This can occur when the pump control system underflows coils, causing coil flow "misses".

Someone increases the control head value to fix problems

The control area of our system is shown in red. Since Curve Control Pump Control operates on the control curve, there will be times when a coil is short of flow. We call this a "miss".

Outline of Presentation
ASHRAE 90.1 and Variable Speed Pumping
Control Curve and Control Area Review
Variable Speed Curve Control Strategies
- Pump Head Control
- Full System Flow Sensor
- Sensorless
Variable Speed Area Control Strategies
- Remote DP
- Remote DP with valve position reset
Summary

Sensor with fixed DP setpoint and DP Reset
- Control head is 25 ft (pressure drop of coil, control valve and flow limiter)
- Pump control maintains the control head across DP sensor at all times

ASHRAE’S DEFINITION OF A BALANCED SYSTEM

TERMINOLOGY
Balanced System. A system designed to deliver heat transfer required for occupant comfort or process load at design conditions. A minimum heat transfer of 97% should be provided to the space or load served at design flow. The flow required for minimum heat transfer establishes the system’s flow tolerance. The fluid distribution system should be designed to allow flow to maintain the required tolerance and verify its performance.

2015 ASHRAE Handbook, HVAC Applications
ASHRAE RECOMMENDS
10% FLOW TOLERANCE
FOR 140 HOT WATER
FOR 45 CHILLED WATER
SENSORLESS FIXED
CURVE CONTROL WILL
HAVE MISSES
MR. CREEP IS THE ONLY
WAY TO FIX AND ROBS
YOUR ENERGY SAVINGS
AREA CONTROL REDUCES
MISSES AND SAVES
ENERGY

Suggested Coil Flow Tolerance to maintain
97% Design Heat Transfer

Heating
140 degree supply 30 degree delta T flow tolerance is 10%

Cooling
45 degree supply 12 degree delta T flow tolerance is 10%

ASHRAE HANDBOOK 2016 – Systems and Equipment
page 44.14 Statements on Sensorless
(Predefined Curve Control)

Constant-pressure control is recommended if pressure losses in the distribution and supply systems (pipe, boiler, heat exchanger, etc.) are low.

Proportional pressure control compensates for pressure loss in the distribution and supply systems with a linear approximation, within which stop differential pressure across the control valves is nearly constant, and good control performance is obtained at both full-load and part-load operation.

Variable-differential pressure control can also be achieved by remote feedback from critical locations, if the critical locations can be identified and remote control is an option, this can offer the best potential pump energy savings.

What is Important to Owner Satisfaction

Best First Cost and Life Cycle Cost
Best System Comfort and Operating Cost
Pump Station Piping and Foot Print

The Pump Station

The Pump Station Piping Installed Foot Print
The Pump Station Head Loss
The Actual Required Pumping System Head Loss

HEATING, VENTILATING, AND AIR CONDITIONING
SECTION 6.5
Prescriptive Path

6.5.4.5 Pipe Sizing. All chilled-water and condenser-water piping shall be designed such that the design flow rate in each pipe segment shall not exceed the values listed in Table 6.5.4.5 for the appropriate total annual hours of operation. Pipe size selections for systems that operate under variable flow conditions (e.g., modulating two-way control valves at coils) and that contain variable-speed pump motors are allowed to be made from the “Variable Flow/Variable Speed” column. All others shall be made from the “Other” columns.

Exceptions:

a. Design flow rates exceeding the values in Table 6.5.4.5 are allowed in specific sections of pipe if the pipe in question is not in the critical circuit at design conditions and not predicted to be in the critical circuit during more than 3% of operating hours.

b. Piping systems that have equivalent or lower total pressure drop than the same system constructed with standard weight steel pipe with pipes and fittings sized per Table 6.5.4.5.
CHAPTER 6
HEATING, VENTILATING, AND AIR CONDITIONING

SECTION 6.5
Prescriptive Path

### Maximum Velocity for Pipes

**Maximum Velocity for Pipes over 12 in. Size**

- 2½ fps
- 3 fps
- 4 fps
- 5 fps
- 6 fps
- 8 fps
- 10 fps
- 12 fps
- 180 fps
- 270 fps
- 350 fps
- 410 fps
- 740 fps
- 1200 fps
- 1800 fps
- 2500 fps
- 8.5 fps
- 13.0 fps
- 18 fps
- 27 fps
- 530 fps
- 620 fps
- 1100 fps
- 1800 fps
- 2500 fps
- 3800 fps
- 13.5 fps
- 21 fps
- 40 fps
- 47 fps
- 860 fps
- 1400 fps
- 2000 fps
- 2900 fps
- 9.5 fps
- 13.5 fps
- 21 fps
- 32 fps
- 37 fps
- 680 fps
- 1100 fps
- 1600 fps
- 2300 fps
- 5.0 fps
- 8.0 fps
- 12 fps
- 14 fps
- 21 fps
- 25 fps
- 440 fps
- 700 fps
- 1000 fps
- 1500 fps
- 7.5 fps
- 11.5 fps
- 17.5 fps
- 32 fps
- 37.5 fps
- 680 fps
- 1100 fps
- 1600 fps
- 2300 fps
- 6.0 fps
- 10 fps
- 15 fps
- 25.5 fps
- 44 fps
- 700 fps
- 1000 fps
- 1500 fps

**TABLE 6.5.4.5 Piping System Design Maximum Flow Rate in GPM**

<table>
<thead>
<tr>
<th>Nominal Pipe Size, in.</th>
<th>Operating Hours/Year</th>
<th>Other</th>
<th>Variable Flow/Other</th>
<th>Variable Flow/Variable Speed</th>
<th>Other</th>
<th>Variable Flow/Variable Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 10</td>
<td>≥2000 Hours/Year</td>
<td>0.5</td>
<td>264</td>
<td>457</td>
<td>0.5</td>
<td>264</td>
</tr>
<tr>
<td>≥ 12</td>
<td>≥2000 and &lt;4400 hours</td>
<td>0.5</td>
<td>264</td>
<td>457</td>
<td>0.5</td>
<td>264</td>
</tr>
<tr>
<td>≤ 12</td>
<td>&gt;4400 hours/Year</td>
<td>0.5</td>
<td>264</td>
<td>457</td>
<td>0.5</td>
<td>264</td>
</tr>
</tbody>
</table>

May exceed flow if branch not critical circuit over 30% of hours.

**ENERGY EFFICIENT PUMP STATION DESIGNS FOR YOUR PUMPS**

**SIDE PUMP STATION PIPING CONNECTIONS**

**OVER HEAD PUMP STATION PIPING CONNECTIONS**

**SIZE PIPE AND CALCULATE FITTING PRESSURE DROPS PER ASHRAE 90.1-2010 & 2013 THE CRITICAL CIRCUIT**

**WHAT IS YOUR CHOICE?**

**Calculate the Required Pump Station Head**

When comparing Over Head Pump Station Piping Connections based upon system flow/head there are big consequences without reassessing the system, recalculating pressure drop, additional piping costs, additional footprint, additional operating cost, and the potential for insufficient pump flow.

*Note: ASHRAE 90.1-2010 Requires you to do a detailed pump head loss Calculation and to use minimum pipe sizes based on flow.*

**Over Head Pump Station Piping Connections**

*Basis of Design*

V E OFFERED CHANGE FOR A LOWER FIRST COST SMALLER PUMP AND PIPE

OWNER OPERATING COST PENALTY $4,307 TO $6,584 ANNUALLY FOR EVER

**1.4.2.5.1 Pipe supports/anchors**

Suction and discharge piping must be anchored, supported and restrained near the pump to avoid application of forces and moments to the pump.

**9.6.6.2 Introduction**

Two of the most common detrimental effects from pump piping are the *excessive nozzle* loads that the piping can place on a pump and the *excessive nozzle loads* that unsupported equipment such as valves or vertical in-line pumps can place on the piping.
Double suction pumps centerline plane perpendicular to pump shaft plane do not need suction diffusers

Although ANSI/HI 1.1-1.5 1994 states “For a double suction pump, an elbow whose plane is parallel to the pump shaft should not be used.”

From Hydraulic Institute Standards

Pumps and Flex connectors

- ASHRAE talks about flexible connectors and their purpose in APPLICATIONS SECTION 48.50.
- Flexible pipe connectors (1) provide piping the flexibility to permit isolators to function properly
- Protect equipment from strain caused by misalignment and expansion and contraction of the piping
- Attenuate noise and vibration transmission along the piping

Happy Pumps make Happy Owners

SUMMARY

- Third Party Pump Guidelines Best Practice are ASHRAE, Hydraulic Institute & DOE
- When Calculating Owner Pump LCC use Third Party Pump Life Guidelines
- Default to IPLV or use Actual Load profile & Control head for Owner Operating Cost
- The two Control Strategies are Curve Control and Area Control
- Maximum Control head to meet ASHRAE 90.1 pump energy savings is about 40%
- Sensorless Pump Vendors default to 40% of design submitted head, commissioning critical
- Sensorless better than constant speed with simple loads where flow misses or not critical
- Area Control Strategies can reduce or eliminate misses and save more energy
- Selections of Design Flow right of BEP over headed may fall off the pump curve
- The Pump Station is the Critical circuit use 90.1 Minimum Pipe Size (No Owner Penalty)
- Avoid Excessive Pump Nozzle Loads Cause by Pipe Growth and Pipe Support

Owners are getting Smarter