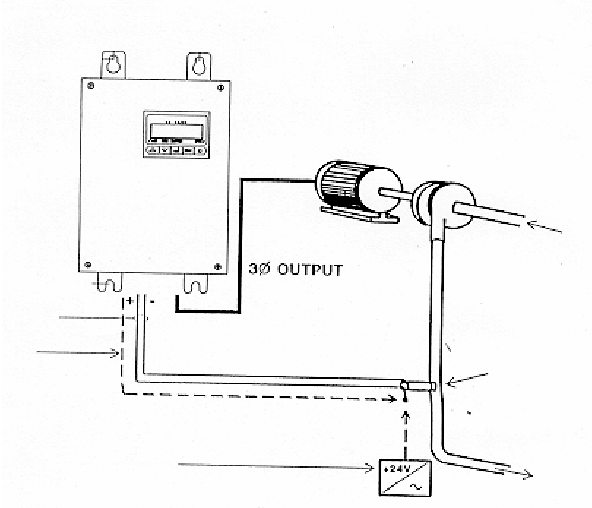
Energy Savings & Payback Guide

For Centrifugal Pumps



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Reference: IM10106 Rev B
Dated: February 2009

Energy Savings

The pumping of liquids consumes enormous quantities of energy, and deserves some thoughtful consideration by those who manage profits and, therefore, desire to save more through energy management. The purpose of this cost justification guide is to provide a practical tool for management by analysing the savings available through variable speed pumping with a Zener AC Drive. Unlike a computer generated payback analysis, this guide allows the user to see where the numbers come from.

Methods of Flow Control

A pump system will be engineered for 100% design flow, but many times could operate with less flow. Let's say that 50% flow is required for one hour. What are the options?

A. 50% could be recirculated (Figure 1).

Energy Cost = 100%

B. Restrict flow with a throttling valve (Figure 2).

Energy Cost = 70%

C. Run the pump only 50% of the time

Energy Cost = 50%

D. Reduce pump speed with Zener AC Drive.

Energy Cost = 25%

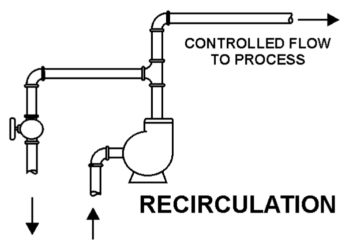


FIGURE 1

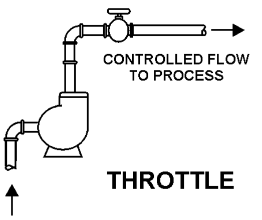


FIGURE 2

Some observations about these methods:

A. Recirculation would be great if energy was free.
B. Throttling valves should not be used on axial flow pumps. They also have limited turn down.
C. Cycling reduces pump and motor life and increases power "demand" charges.
D. The Zener AC Drive has the ability to re size the pump to exact needs through impeller speed control. It also regulates flow much better than a valve and uses the least energy. Does this justify the extra cost?

Figure 3 shows the pump energy required vs. flow for the various methods of flow control. These curves indicate substantial reductions in pump energy through variable speed techniques.

Calculating Payback

When the installed cost of a Zener AC Drive must be justified through energy savings, there are several pieces of information required. The most obvious are:

A. Pump HP (not motor HP).
B. Cost of electricity (including demand and power factor penalties).
C. Installed cost of Zener AC Drive.

Some less obvious are:

D. Hours/year from 0 – 50% flow – Range A Figure 4
E. Hours/year from 50 – 75% flow – Range B Figure 4
F. Hours/year from 75 – 100% flow – Range C Figure 4

Savings in each of the flow ranges indicated in D, E and F, above, are relatively constant in any one range, but are substantially different one range to another. Improved accuracy of payback calculations will result from this estimate of hours/year in each flow range.

Follow the instructions (page 3) to determine payback on your pump system.

Example

A 20 HP pump circulates water through a heat exchanger (no static head) in order to maintain a constant process temperature. The pump runs 16 hours/day, 300 days per year. Manufacturing estimated that flow is controlled by a throttling valve so that 1500 hours are spent in flow range A (0 – 50% flow), 2700 hours in B (50 – 75% flow), and 600 hours in C (75 – 100% flow). According to the pump manufacturer's curves, 100% design flow should only require 12 BHP (brake horsepower at the pump shaft). Power costs are 6c/KWH. From Page 3, the savings index S.I. is

0.77 (1500) + 0.71 (2700) + 0 .62 (600) = 3444

according to footnote 3, the S.I. should be increased by 30% for a system with no static head.①

Revised S.I. = 3444 x 1.3 = 4477

Savings can now be calculated.

0.746 (12)	(0.06)	(4477)	=	($2,405) Savings
HP	$/KWH	S.I.		$/Yr.

Estimated costs were $3,750 and payback in years would be:

$$\text{Payback} = \frac{3750}{2405} = 1.6 \text{ Years}$$

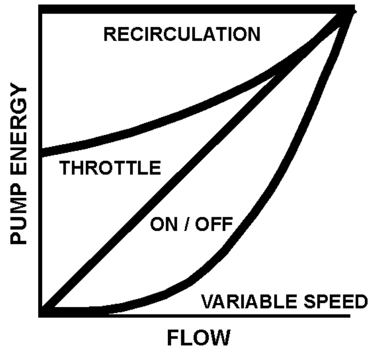
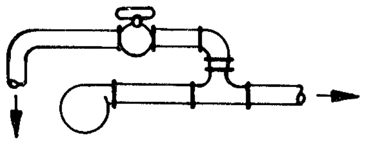
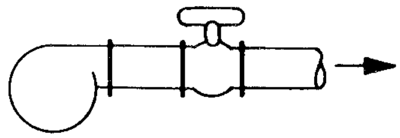
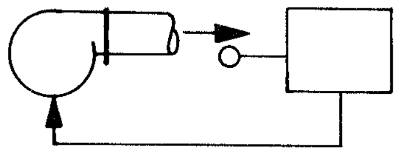


FIGURE 3

COMPARE ZENER AC DRIVE TO YOUR SYSTEM.
FOLLOW THESE FOUR EASY STEPS.

1. Pick your existing system and calculate your savings index (S.I.) based on the hours/year for the required flow range.

HRS A :	hours/year at	0 - 50 % Flow
HRS B :	hours/year at	50 - 75 % Flow
HRS C :	hours/year at	75 - 100 % Flow

BYPASS	THROTTLE	ON/OFF
		
1.51 x ____ HRS A = ____	0.77 x ____ HRS A = ____	0.00 x ____ HRS A = ____
1.25 x ____ HRS B = ____	0.71 x ____ HRS B = ____	0.30 x ____ HRS B = ____
0.85 x ____ HRS C = ____	0.62 x ____ HRS C = ____	0.31 x ____ HRS C = ____
TOTAL ____ S.I.②	TOTAL ____ S.I.③	TOTAL ____ S.I.④

2. Calculate savings/year using this formula:

0.746 x ____ x ____ x ____ x ____

	HP ⑤	$/KWH	S.I.	$/Yr. Savings

3. Estimate Costs

Equipment:	Zener AC Drive, Meters etc	____
Installation:	estimate 8 man hours	____
Consultation Fee:		____
Total Cost		____

4. Calculate Payback

____ ÷ ____ = ____

Total Cost ÷ $/Yr. Savings = Years

① See Page 4 for explanation of static and fiction head.

② This S.I. is for a system with medium static head as a portion of total head. For high static head, reduce S.I. by 20%. For low static head, increase S.I. by 20%.

③ This S.I. is for a system with medium static head as a portion of total head. For high static head, reduce S.I. by 30%. For low static head, increase S.I. by 30%.

④ This S.I. is for a system with medium static head as a portion of total head. Foe high static head, S.I. may equal 0. For low static head, increase S.I. by 100%

⑤ HP is pump HP required for design flow.

Additional Cost Justification

Energy savings alone may justify the installation of a Zener AC Drive, however, there are even more savings to realised through:

1. Reduced mechanical wear and associated maintenance.
2. Reduced power “demand charge” because the motor is started softly with complete lack of inrush current.
3. Improved power factor (0.96).
4. Possible reduction in the amount of liquid that must be conditioned (cooled, heated, purified, etc.)

Development of S.I.

The savings index, S.I., is a calculated number based on savings per year and is derived from the curves in Figure 4. These are typical power vs. flow curves that are based on % power required by a pump to produce design flow. I.e. 10% design flow requires 100% power at the pump input shaft. These curves, and the S.I., are based on a pump which is 20% oversized. Pumps are usually oversized because:

a. Proper flow regulation requires it.
b. Design engineers are conservative.
c. The next smaller pump or impeller was too small.

All curves are based on the use of an AC motor with 90% efficiency at full speed, full load, and typical reductions in efficiency for reduced load.

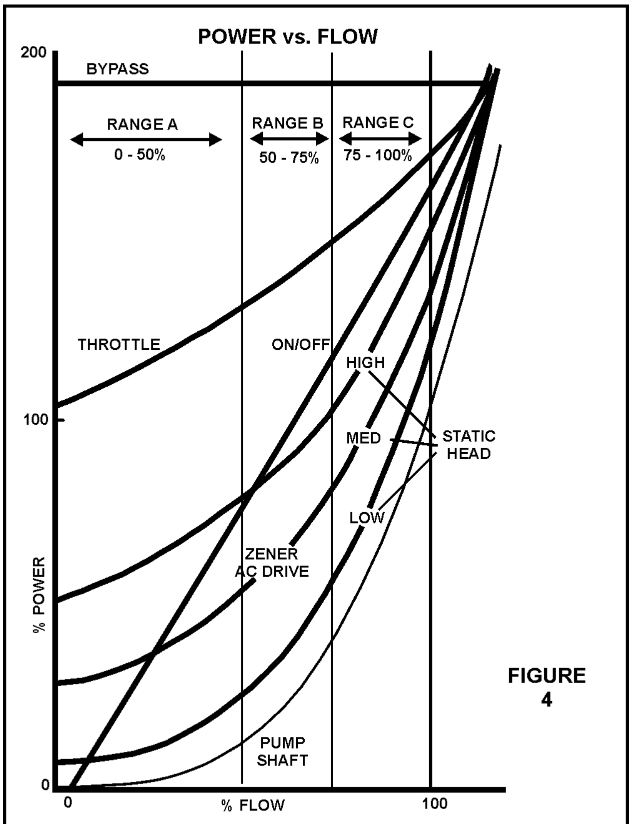


FIGURE 4

Most variable speed justifications consider a pump system with low static head. Actually, the proportion of static to total head has some affect on power vs. flow for variable speed pumps. (See Figure 5). The curves in Figure 4 indicate the range of this effect on the Zener AC Drive curves, and the medium static head curve was used to develop a savings index formula. The savings, in % power, between the Zener AC Drive curve and, for instance, the Throttle curve, were measured at 0, 50, 75 and 100% flow. This allowed calculation of an average saving figure in each flow range, which could be multiplied by the number of hours per year in that flow range. These saving hours per year will increase for a low static head and decrease for a high static head and decrease for a high head as indicated in footnotes 2, 3, and 4.

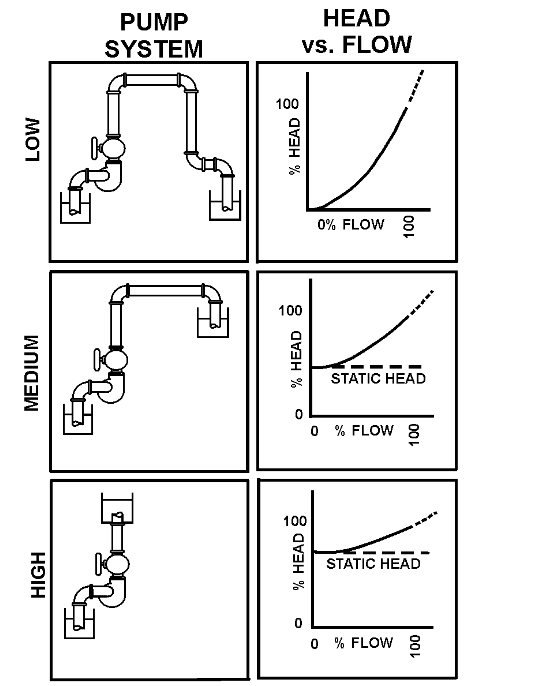


FIGURE 5

The Best

Should you decide to use Zener AC Drive, you can feel assured that you have made the right decision. Not only is variable speed the best method of control, the Zener AC Drive is the very best variable speed choice. Why?

1. Lowest Power Consumption
2. Lowest Installed Cost
3. Least Maintenance (saves wear and tear on the pump too)
4. No inrush current (starting)
5. Highest (near unity) Power Factor
6. Local Sales, Service and Application Specialists

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