# Technical Publication

# Monitor Your Pump for Process Efficiency

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## Monitor Your Pump for Process Efficiency

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**Pumps are all too frequently one of the most overlooked and abused pieces of equipment in process automation, yet nothing moves without them and a process becomes ineffcient when they don't operate properly or completely shutdown. While it is convenient to blame the pump manufacturer, more often than not the process or the surrounding equipment confguration is the problem.**

Optimizing your process for productive operation, including the pump, and protecting the pump against common hazards, are two of the smartest ways that engineers and technicians can help their plant operations. These efforts will improve end-product or batch quality, cut the material costs, eliminate waste and reduce maintenance costs. Taking good care of your pump always delivers a positive payback and there are some simple strategies that can be employed—starting with an analysis of process media fow rates.

### Protecting Your Process

With today's focus on turning plants into 24/7 lean operations, the pumps in most plants are running near capacity to keep up with material through-put objectives and demand in many industries—such as petrochemicals.

One of the most common hazards to effcient pump operation is irregular material fow, which can result in three negative conditions: (1) fow turbulence, (2) low fows, or (3) dry running conditions.

Controlling material fow ensures that pumps operate effciently, moving stock or products with the least possible expenditure of energy while reducing maintenance requirements and extending life.

Failing to control material fow adequately can lead to some unwanted conditions, such as cavitation, or pump bearing failure, or even seal failure. The frst problem— cavitation—can reduce capacity or even cause quality problems. Losing a bearing or a seal can lead to pump shut-down, possibly process line shut-down and the unfavorable conditions could get worse the further you take this type of scenario.

### Analyze The Flow

Protecting your process and pump starts with analyzing the fow to make sure the media is fowing regularly at the pressure required by the pump with a minimum headloss. Any number of process conditions can cause irregular fow, such as turbulence,

*Figure 1: Plant Overview*

temperature changes, unwanted air ingestion, etc. The problems of irregular fows and turbulence, in particular, can be especially challenging to solve because eliminating the root causes are often diffcult to impossible—so you need a workaround strategy.

Nothing can damage a pump faster than the build-up of heat from low fow or dry running conditions, which occurs when liquid fow dramatically slows down or stops fowing altogether through the line or the pump. When the liquid isn't there to provide cooling, the heat can destroy a pump's bearings or seals. If repair is even possible, it is going to be a very expensive proposition. Of course, such dramatic failures also often ruin the material being processed or reduce process line capacity.

### Eliminating Irregular Flows

For proper and effcient operation, pumps require a stable upstream fow profle in the pipeline before liquid enters the pump. Irregular fows often result in cavitation, a condition where cavities form in the liquid at the point of pump suction. A commonly cited industry pump installation guideline suggests at least 10 diameters of unobstructed pipe be placed between the point of pump suction and the frst elbow or other disturbance.

Obstructions and/or corrosion in a pipe can change the velocity of the media and affect its pressure as well.

When plant real estate restrictions result in the placement of elbows, valves or other equipment that are too close to a pump, these other devices can create swirl and velocity profle distortion in the pipeline (as well as pressure changes). These disturbances can result in excess noise and cavitation, resulting in reduced bearing and/or seal life.

An Inline or elbow fow conditioner can be installed upstream from your pump to ensure an optimal fow profle for effcient operation. Isolating the effects of velocity profle distortions, turbulence, swirl and other fow anomalies in your pipeline will result in a repeatable, symmetric, and swirlfree velocity profle with minimal pressure loss. Creating a relatively more benign operating environment helps increase pump life. The conditioned fow stream enters the pump's impeller in a uniform and equally distributed pattern, optimizing pump effciency and extending bearing life while at the same time decreasing noise and cavitation.

When faced with less than ideal piping confgurations, an inline or elbow fow conditioner will eliminate all upstream straight run requirements for pumps, compressors, fow meters and other critical process equipment.

Tab type fow conditioners, such as the Vortab Flow Conditioner, have proved successful in these applications. Other fow conditioning technology choices, including tube bundles, honeycombs, and perforated plates, may also be considered depending upon the specifcs of the application.

The inline or elbow fow conditioner's profle conditioning tabs produce rapid crossstream mixing, forcing higher velocity regions to mix with lower velocity regions. The shape of the resultant velocity profle is "fat" and repeatable regardless of the closecoupled upstream fow disturbances.

Incorporating anti-swirl mechanisms into the design of the fow conditioner eliminates the swirl condition typically seen exiting 90-degree elbows. The result is a fow stream that enters the pump in such a way that it maximizes the effciency of its operation and reduces stress. In addition, the tapered design of the anti-swirl and profle conditioning tabs make them immune to fouling or clogging.

## Pump Flow Monitoring

Eliminating the damage caused by a low fow or a dry running condition can be achieved by installing a point fow switch in the process loop. Combination point fow switches will detect not only a low fow situation, but also detecting a dry running condition. This capability allows the control system or operator to take corrective measures before the bearings of the pumps are overheated and fail.

There are many types of point fow switches available. The FCI® FlexSwitch™ FLT93 Series, with its no moving parts design,

*Figure 2: Vortab Inline and Elbow Flow Conditioners*

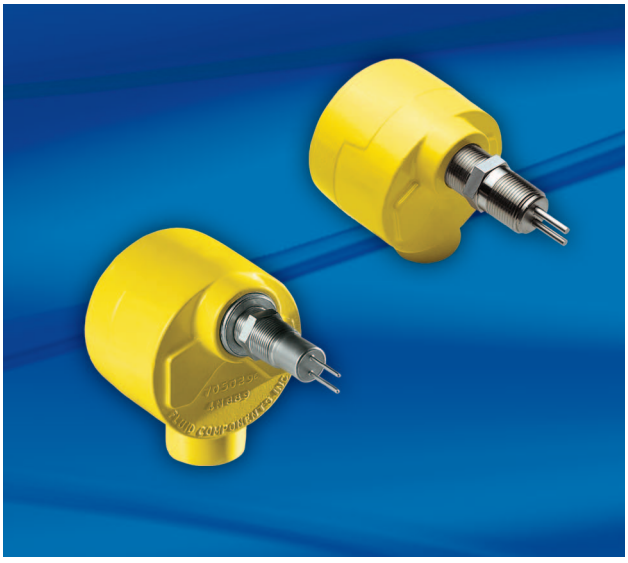

*Figure 3: FLT93 Flow Switch*

offers a highly robust scheme for pump protection with its dual alarm capability.

With Alarm 1, the switch will detect a low fow situation anywhere between 0.01 and 3 feet per second (FPS) (0.003 to 0.9 meters per second MPS). This low fow alarm can be regarded as a pre-warning signal for the control system or operator. The system or operator can then decide to keep the pump running or to shut it down.

If an Alarm 2 occurs because the feed line to the pump is running dry, this condition would be an emergency signal to shut down the pump immediately because the bearings now see gas instead of a liquid as a heat transfer media. In such situations, the temperature of the bearings may rise very fast. Using a fow switch prevents permanent damage to the pump's bearings that will require an overhaul of the pump before more damage occurs.

The FLT fow switch is a dual-function instrument that indicates both fow and temperature, and/or level sensing in a single device. It can be specifed in either insertion or in-line styles for pipe or tube installation. With the FLT, a single switch monitors your direct variable interest, fow, and temperature simultaneously with excellent accuracy and reliability. The dual 6A relay outputs are standard and are assignable to fow, level or temperature.

## Choosing A Flow Switch

In selecting a fow switch for pump protection or any application, the frst step is choosing the appropriate fow technology. There are multiple fow switch sensing technologies available, and the major ones now include:

- Paddle
- Piston
- Thermal Mass
- Pressure
- Magnetic Reed

Each of these technologies have their advantages/disadvantages, depending on the media and your application's requirements. Some may be the only choice in certain media for your application. By looking at these factors, as well as your plant's layout, environmental conditions, maintenance schedules, energy cost and ROI, you will quickly be able to narrow the field to one or two best choices.

## Conclusions

When designing new plants or retrofitting old ones, be sure to consider pump requirements. Optimizing your process with your pumps in mind offers a wide range of benefits: higher capacity, improved quality, lower energy costs, reduced maintenance, increased equipment (pump) life.

One of the most common pump problems is irregular fows caused by turbulence that frequently results when the minimum pipe straight runs required between the point of pump suction and elbows, valves or other equipment are either ignored or pushed to the limits. Inserting a fow conditioner frequently eliminates turbulent fow issues.

Don't forget to protect your pump from accidental low fow or dry running conditions, which can lead to bearing or seal loss requiring expense repairs. Inserting a dual alarm fow switch in your process loop not only protects the pump from damage, but will alert you to a potential problem and let you make adjustments before a shutdown is necessary. ■