



Improve Flow Accuracy and Reduce Costs: Putting Smart Flow Conditioning Practices to Work

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If you need to increase your plant's productivity and reduce its operational costs, focusing on flow measurement can result in significant monetary savings, potential product quality improvements and even a competitive advantage. The accurate measurement of gases, steam, liquids and slurries is critically important in many plants and processes that produce chemicals, energy and power, food/beverages, pharmaceuticals, pulp/paper, water and more.

Unfortunately, the measurement of flow is often an afterthought—especially in many plant expansion, equipment upgrades and retrofit projects. The selection and placement of flow switches and flow meters requires careful advance thought. Choosing the wrong flow sensing technology for your application or placing your flow instrument in the wrong location too closely to pumps or valves can not only eliminate potential cost savings, but frequently results in unnecessary replacement or relocation projects.

Carefully planning for new or upgrade flow instrumentation in your plant, however, offers many advantages:

- Lower initial instrument installation costs and faster start-up
- Decreased energy costs to run burners, boilers, fans or ovens
- Reduced consumption of process gases, such as chlorine or nitrogen
- Lower consumption of process water and wastewater
- Less frequent plant maintenance and equipment replacement

The Problems

In a perfect world, every plant would have an instrumentation engineer on staff who is familiar with all the different flow technologies on the market, has experience applying them in multiple processes or industries, enough budget to buy the best equipment, a great maintenance team to do the installation, etc. You can stop reading if you're working for this company because this article is for the 95 percent of you who make up the real world.

Optimizing your flow instrumentation can be summed up fairly simply with the following four broad guidelines to consider.

- Choose the appropriate flow sensing technology for your process media
- Consider the installation and maintenance requirements in advance
- Be careful about installing other equipment around flow instrumentation
- Consider adding a flow conditioner or flow straightener

Flow Sensing Technology

When selecting a flow instrument, the first consideration should always be the process media to be measured: air, gas, steam, liquid or slurries. Many flow sensing technologies perform best in one or two media, such as gas or liquids. Some will measure slurries—and some won't at all. The industry's major flow sensing technologies now available include:

- Coriolis (Mass)
- Differential Pressure
- Electro Magnetic
- Positive Displacement
- Thermal (Mass)
- Turbine
- Ultrasonic
- Variable Area
- Vortex Shedding

All of these technologies have their advantages and/or disadvantages, depending on your process and plant. Thinking about the process media, as well as your plant's equipment, environmental or other regulations, maintenance schedules, etc., you will be able to narrow the field to one or two best choices.

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Installation Issues

One of the most common problems when installing flow instruments, especially flow meters, is an inadequate straight run upstream and downstream from the instrument. Before specifying any flow meter, you must consult the manufacturer's specification to determine the necessary straight pipe run.

Adding elbows, expansions or reductions, and/or spiral piping in close proximity to instrumentation often further exacerbates the problem of inadequate straight runs. Lots of equipment, not enough space and poor piping layouts—they all work together to alter the process media's tangential, radial and axial velocity vectors. The final result is flow disturbances, including swirl, jetting and velocity profile distortions.

Flow disturbances frequently have a significant impact on the performance of flow meters, pumps and other equipment. For example with flow meters, the irregular flow of process material adversely affects the accuracy and repeatability of many of the most popular flow sensing technologies: differential pressure, turbine, magnetic, thermal, ultrasonic and vortex shedding. Depending on the flow sensing technology, the straight pipe run requirements for flow meters varies—from 10 to 20 or more diameters.

The Solutions

One of the most practical ways to optimize flow meter accuracy and/or compensate for adverse installation conditions is the use of flow conditioners. Through the use of flow conditioners, it is often possible to increase the accuracy and/or repeatability of a flow instrument by 50 percent or more.

For example, thermal mass flow meters with the addition of a flow conditioner can be optimized to perform at +1 percent accuracy instead of their standard +2 percent accuracy. That increase in accurate measurement can result in huge savings in controlling expensive natural gas fed burners for plant boilers over a year's period of time.

There are many types of flow conditioners, including:

- **Honeycomb Vane-Type** conditioners are popular in HVAC or compressed air handling system applications where they provide air flow profile corrections. Many different designs and materials are available.
- **Perforated Plates** are frequently selected for application in natural gas pipelines or other clean gases and liquid applications. They are simple to install and require no spool piece, but they can be prone to clogging in dirty gas.

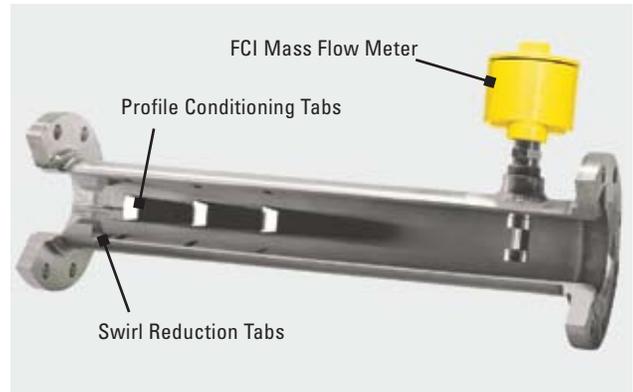


Figure 1. Tab-Type Flow Conditioner with Mass Flow Meter

- **Tab-Type Flow Conditioners** are a good choice in clean or dirty gases and liquids because of the tapered design of their tabs. They provide excellent cross-mixing to remove swirl and correct velocity profiles with minimal pressure-drop.
- **Tube Bundles** and vanes have been used for decades. Tube bundles are effective at removing swirl, but have the tendency to “freeze” the velocity profile and therefore are not as efficient at isolating and correcting flow distortion anomalies.

To choose a flow conditioner, you'll need to follow many of the same guidelines required to specify a flow meter. The process media is especially important. Be sure to consider the viscosity of the process media when selecting a flow conditioner. Some technologies are prone to clogging in slurries, for example, and/or contaminant build-up in dirty gas processes.

Don't forget that in general the more effective flow conditioners are at correcting flow profile distortions, the more pressure drop they may produce. If you're trying to reduce power consumption or pumping costs or you need to speed product throughput, then you'll want to minimize headloss or pressure drop.

For example, one flow conditioning technology that has proven itself effective is the tab-type flow conditioner (Figure 1). In its standard straight tube configuration, the Vortab® Flow Conditioner consists of pipe fitted with a short section of swirl reduction tabs combined with three arrays of profile conditioning tabs. Combining the anti-swirl and profile conditioning tabs created a repeatable, flat velocity profile at the outlet of the pipe.

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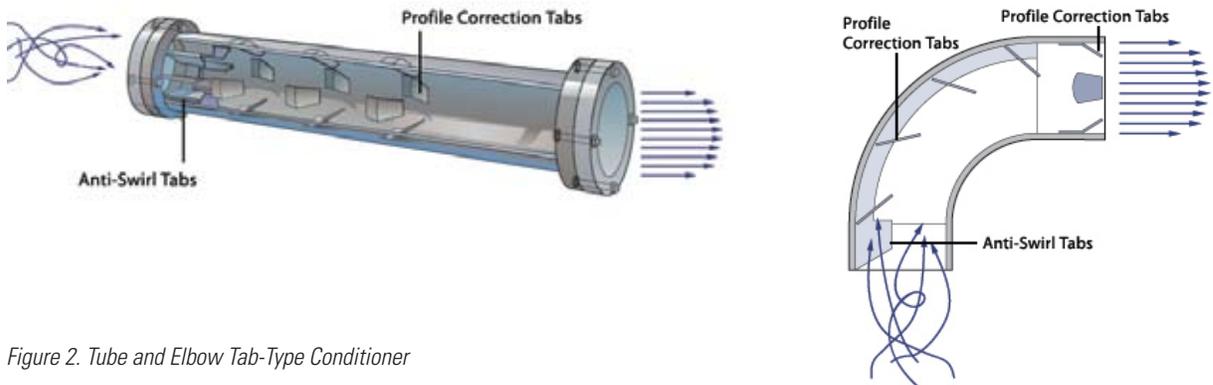


Figure 2. Tube and Elbow Tab-Type Conditioner

An elbow flow conditioner also can be configured with the same tab-type flow conditioning technology (Figure 2).

Many different processes and different types of flow instruments can benefit from the installation of tab type flow conditioners. At an offshore oil pumping station, for example, the process engineering team needed to add a pump to increase capacity. Elbows feeding into the pump consisted of a 20-inch inlet and reduced down to a 12-inch section (Figure 3).

The engineer quickly determined there was no room for the pump's required straight run and no way to expand the platform to accommodate the pipe run. By inserting a tab-type elbow conditioner in the elbow itself, the engineer solved the space problem by ensuring a properly conditioned flow entering the pump at a large cost savings and freed real estate for other possible uses.

At an electric power facility, the plant team needed to add two identical 14-inch centrifugal pumps to feed water into its main boilers. The pump configuration required that the line size drops from 16 inches at the elbow to 14 inches at the pump inlet. These pumps are powered by 350 hp electric motors.

When installing the pumps, it was found that the indoor facility did not have adequate room for an upstream pipe run into the pumps. Note the close proximity of the building's wall in Figure 4. Using a tab-type flow conditioner placed in the elbow compensated for the lack of straight run and provided an equally distributed flow profile entering the pumps.

Conclusions

With thorough advance planning, the selection of the proper flow instrument, by following best practice installation techniques and the addition of flow conditioners where appropriate, you can optimize the performance of flow instruments. In many cases, the simple reduction in flow meter straight pipe run requirements possible with

the use of flow conditioners can save plant real estate, reduce the purchase of pipe material and cut installation costs to accommodate other equipment. Paying careful attention to flow measurement can translate into big plant operational cost savings. ■



Figure 3. Elbows for Offshore Oil Pumping Station



Figure 4. Electric Power Plant Elbow and Pump