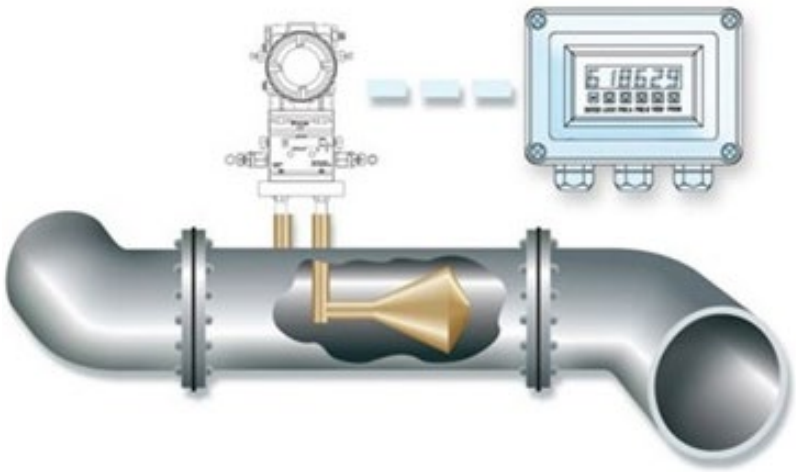
V-Cone Differential-Pressure Meters: Accuracy To Go With The Flow



When space is tight and straight-run piping is at a premium, V-Cone® differential pressure (DP) meters (Figure 1) are an excellent choice — especially where the potential for turbulence raises metering accuracy issues with other conventional meter styles. This article describes how to satisfy some challenging water infrastructure applications with V-Cone meter accuracy at a low permanent pressure loss.

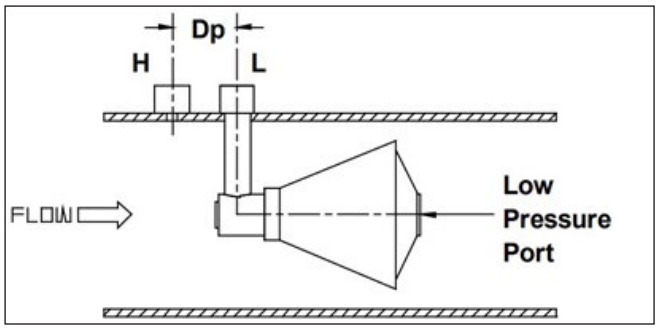


Figure 1. The V-Cone design works on the principle of differential pressure, with high pressure measured through a port in the pipe before the cone and low pressure measured through a port at the back end of the cone. It is based on Bernoulli's theorem for the conservation of energy in a closed pipe.

Turbulence Tolerance

Metering accuracy challenges in water and wastewater applications come from a variety of sources. One is pipeline configuration, where elbows, valves, reducers, headers, and other turbulence-inducing structures can impact reading accuracy. That turbulence needs to be removed by a flow-conditioning device or by long runs of straight, smooth pipe to allow the turbulence to dissipate.

A second challenge is identifying the best technology to measure flow with or without turbulent conditions. The physics behind each technology — mechanical, electromagnetic (mag meter), differential pressure, etc. — plays a role in how that technology reacts to diverse conditions encountered in many water infrastructure environments. For example, unlike orifice plates and other technologies, V-Cone meters exhibit a lower permanent-pressure-loss (Figure 2).

V-Cone meters also deliver + 0.5-percent accuracy over their standard flow range, despite disruptive turbulence or the characteristics of liquid or gas flowing through the pipeline. With up to 40:1 turndown ratio, V-Cone technology can also maintain that accuracy over a broad range of operating conditions to meet variable application requirements.

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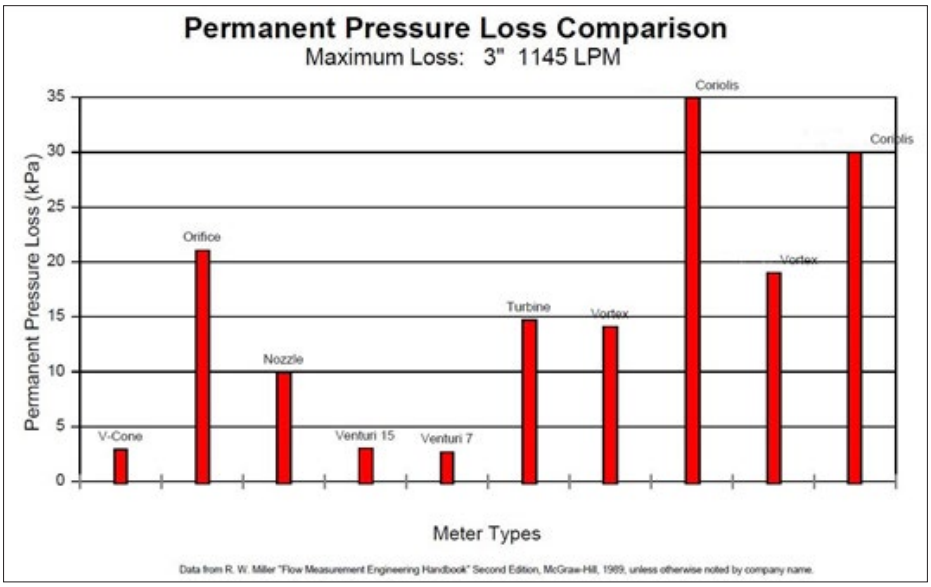
Figure 2. V-Cone meters exhibit low permanent pressure loss as compared to these other types of flow meters.



Space-Saving Accuracy

V-Cone meters are a well-suited option for retrofitting older systems with little to no straight-run pipe and limited space. This is typical for older mag meter replacements or installations of meters where no metering capability currently exists.

In most municipal water applications, the number of straight-run pipe diameters (d) required upstream from a V-Cone meter is minimal (0 to 2d as compared to 20d or 30d for other meter types). A V-Cone meter can be installed directly after an elbow with negligible impact on flow measurement accuracy.

VFD Error Protection

Another area where V-Cone technology offers a better solution than commonly used mag meter technology is in environments running pumps with variable frequency drives (VFDs) for energy efficiency. Because VFDs in water and wastewater treatment plants can generate a tremendous amount of electrical noise, they can interfere with mag meter operation and cause erratic readings. V-Cone sensing technology works on pressure differential instead of an electromagnetic field, so any stray electrical noise flowing through the pipeline has no effect on reading accuracy.

Multi-Pump Compatibility

Any application that experiences inputs from multiple pumps feeding a common header at variable flow rates can generate turbulence, which makes accurate flow measurement a challenge. Examples include discharge points in water treatment plants (WTPs) or booster pump stations in the middle of drinking water distribution systems where there is not enough straight-run piping to neutralize the turbulence's effects on metering accuracy.

These types of challenging applications are ideal for V-Cone meters (Figure 3). The built-in design of the cone smooths out the turbulence, making the differential pressure readings both accurate and consistent.

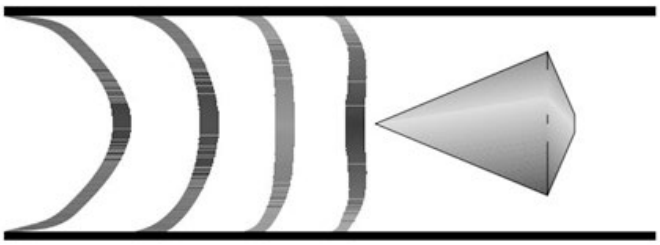


Figure 3. The presence of the V-shaped cone in the pipeline helps to equalize the pressure profile across the width of the pipe, neutralizing the effects of turbulence as the flow approaches and passes around the V-Cone inside the pipe.

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Long-Term Reliability

With only about a 1 percent deviation in the discharge coefficient (Cd) after years of service, the need for recalibration is minimal — as documented in this white paper on long-term V-Cone performance. When required, calibration should be performed in a lab accredited to the ISO/IEC 17025:2005 standard through the National Voluntary Laboratory Accreditation Program (NVLAP) and in a NIST-traceable flow lab.

A Perfect Fit For The Water Space

Because the V-Cone meter design works so well for water-industry applications, some packaged solutions are now being offered to simplify its use in water infrastructures.

- **Pressure Transmitters.** The inclusion of a DP transmitter in a prepackaged configuration enables users to feed V-Cone meter outputs directly to SCADA systems or distributed control systems (DCS) on a plug-and-play basis.

- **Header Compatibility.** Many water treatment applications combine water from different flows at some point in the process. This could be to accommodate multiple pumps running at variable flow rates for energy efficiency, or simply to recombine the outlets from multiple settling tanks or filtration lines. Because flow rates from multiple pipes entering one header can induce turbulence in the system, cone-type meters that are self-conditioning while maintaining high accuracy are highly desirable in these applications.

- **No Moving Parts.** The lack of moving parts within a V-Cone DP meter minimizes opportunities for error, wear, and maintenance.

- **Custom-Construction Options.** Some manufacturers also provide custom attributes to help users match their applications' environments with the most appropriate features.

- **Pressure-Loss Protection.** Cone size can be adjusted to optimize the meter's beta ratio as a means of minimizing permanent pressure loss and its associated energy costs.

- **AWWA Flanges.** V-Cone meters can be provided with this flange design popular within the water industry, as well as with ANSI flanges.

- **Coating Options.** Choices of painted finishes or epoxy coating help end users match meters to their specific application operating environments.

- **Custom Span Lengths.** Customizable V-Cone meters can be provided to replicate the specific dimensions of an existing mag meter that needs to be replaced.

- **Custom Materials.** When V-Cone meters are used beyond traditional water applications, the ability to specify them in a variety of materials — including titanium — helps users accommodate specific requirements. Material sourcing considerations can also apply to projects financed with Clean Water State Revolving Fund (CWSRF) and Drinking Water State Revolving Fund (DWSRF) assistance.

Extending Cone-Type Meter Benefits To Varied Flow Compositions

While V-Cone flow meters are designed primarily for clean water flow, they do tolerate modest amounts of sand, minerals, or minor biological debris. That makes them useful for well water and other types of raw source-water applications. In fact, the V-Cone design even provides a beneficial side effect of immediate, even dispersion in chemical injection applications — e.g., chlorination, pH balancing, anti-corrosion treatments, etc.

Beyond drinking water systems, V-Cone meters can also be used for wastewater effluent that is clear of particulate matter. They can even be sized to provide accurate measurement for measuring digester gas flow with minimal pressure loss. This is important because digester gas applications are low-pressure applications where any amount of permanent loss would be noticeable.

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