

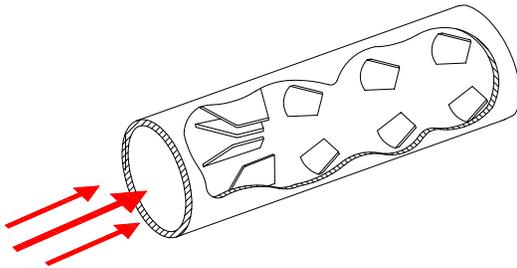


ELBOW Flow Conditioning CONDITIONERS FOR LIQUIDS AND GASES

In Industrial installations, process plants are designed to minimize floor space. Abbreviated floor space can result in inadequate short runs of straight pipe required upstream from pumps, flowmeters, and other critical components used in the process industries. Inadequate lengths of upstream piping, valves, compressors, spiral welded pipe, expansions, reductions, and elbows alter the media's tangential, radial, and axial velocity vectors. These alterations generate swirl, jetting, and velocity profile distortions.

Flow disturbances adversely affect differential pressure, turbine, vortex shedding, ultrasonic, and magnetic flowmeter technologies. Poor piping practices increase flowmeter error, often outside of the specified performance limits of the flowmeter manufacturer. Flow disturbances can induce cavitation and noise in pumps, control valves and other critical process components resulting in excessive wear and damage. Flow disturbances can be reduced or eliminated by the installation of 90° Elbow Flow Conditioners.

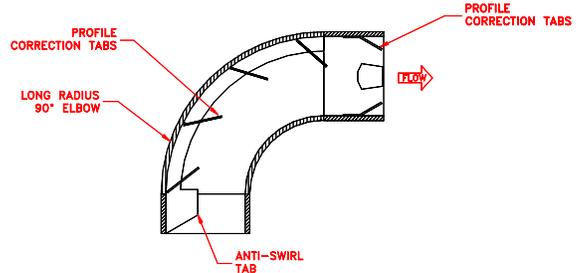
The standard straight tube VORTAB Flow Conditioner's "Tab-Type" technology is laboratory proven and have been used successfully in the field to improve industrial processes and flowmeter accuracy by creating a repeatable, swirl free, flat velocity profile at the outlet of the conditioner.



Standard Straight Tube VORTAB

The elbow flow conditioner was developed using the same proven tab-type flow conditioning technology. Swirl reduction and velocity profile correction occur naturally in long lengths of straight pipe due to diffusion and turbulent mixing. VORTAB's anti-swirl and inclined vortex generating profile correction tabs, projecting

from the inside pipe surface, generate vortices that accelerate and amplify these natural pipe effects.

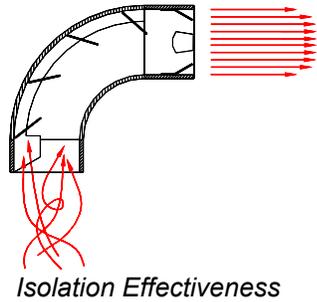


Elbow Flow Conditioner Internals

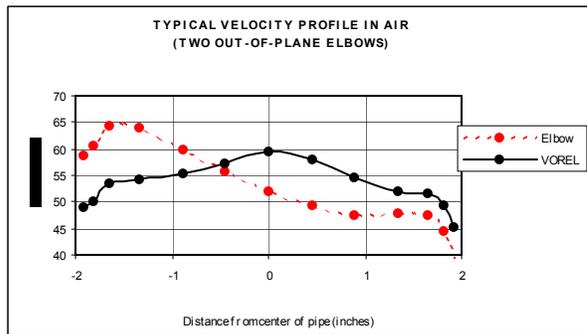
The anti-swirl tab runs along the outer bend of the elbow and four profile correction tabs are attached. The presence of swirl causes vortices to be generated by the anti-swirl tab. These vortices are opposite to the mean swirl circulation and the cancellation of opposing forces aid in reducing swirl entering the elbow.

Located at the outlet are four symmetrically arranged vortex generating profile correction tabs. These four tabs and the four profile correction tabs attached to the anti-swirl tab create counter-rotating vortices, which are formed in the wakes of the profile tab's corners. The tabs also shed transient hairpin-like vortices that move downstream along with the counter-rotating vortices. As hairpin vortices merge, the boundary layer thickens. The media is either expelled into the hairpin vortices or continues to spiral downstream in the counter-rotating vortices. The result is a vigorous cross-stream mixing which rapidly mixes faster velocity streams with slower streams. The mixing quickly produces a homogeneous (i.e., conditioned), reproducible, flat velocity profile without swirl.

The elbow flow conditioner was developed and tested in our state-of-the-art gas, air, and liquid calibration facilities. To validate the design, ball valves, gate valves, out of plane and in plane elbows, and swirl generators were installed at the immediate inlet of the elbow flow conditioner. In all instances, the elbow flow conditioner isolated flow irregularities and conditioned the flow stream into a uniform velocity profile.



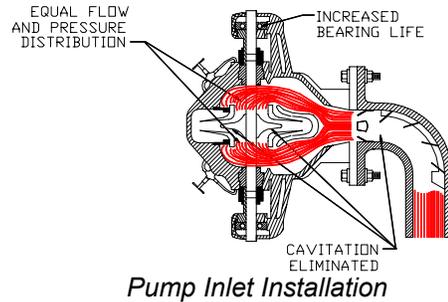
The following graph of velocity profiles generated by two out-of-plane elbows, with and without elbow flow conditioning, is typical of the results obtained from traversing the flow stream.



Velocity Profiles With & Without Elbow Flow Conditioning

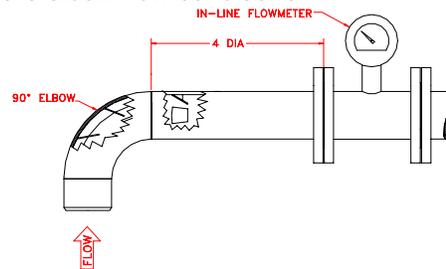
These tab type conditioners have a low-pressure drop and can be used in separated flows and thus are able to operate with very minimal upstream piping. In addition, uneven particulate distributions or temperature stratification are made more uniform through this process. The tapered design of the swirl and profile tabs make it inherently immune to fouling and clogging.

The elbow flow conditioner's ability to isolate flow disturbances, reduce swirl, and develop a repeatable flow profile with minimal pressure loss make it ideal for increasing pump and valve life. The conditioned flow stream enters the pump in a uniform and equally distributed pattern resulting in increased bearing life and decreasing noise and cavitation.



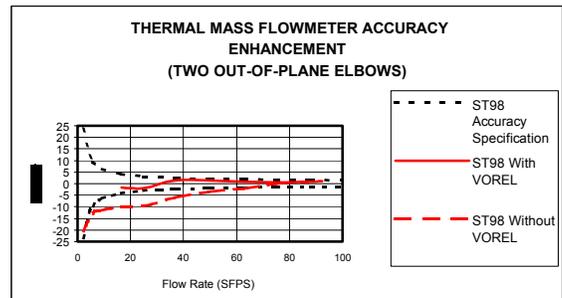
Pump Inlet Installation

Moving the flow conditioner into the elbow enables many flow metering technologies to be installed just four pipe diameters downstream from the elbow flow conditioner.



Flowmeter Installation

In today's flow metering environment, accuracy and repeatability are critical. The VORTAB Elbow ensures accurate and repeatable measurement by eliminating flow distortions that degrade flowmeter performance.



Flowmeter Accuracy VS. Flow Rate

The simple, flexible designs of the VORTAB Elbow and VORTAB Insert Sleeve, Short Run, Meter Run and Field Kit configurations provide a cost effective solution to poor installations for flow meters, control valves, pumps, and other process equipment.

VORTABs provide the most effective flow disturbance isolation, lowest pressure drop, and least affect by fouling of any of the conventional perforated plate, tube, or rotational vane type flow conditioners offered in the market today.