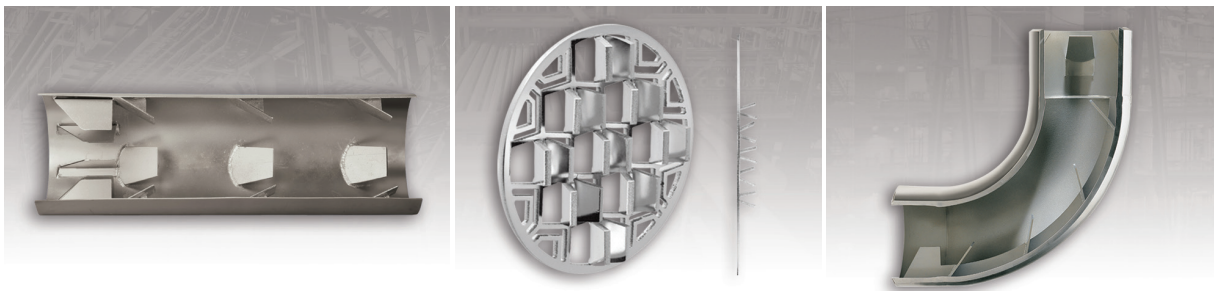
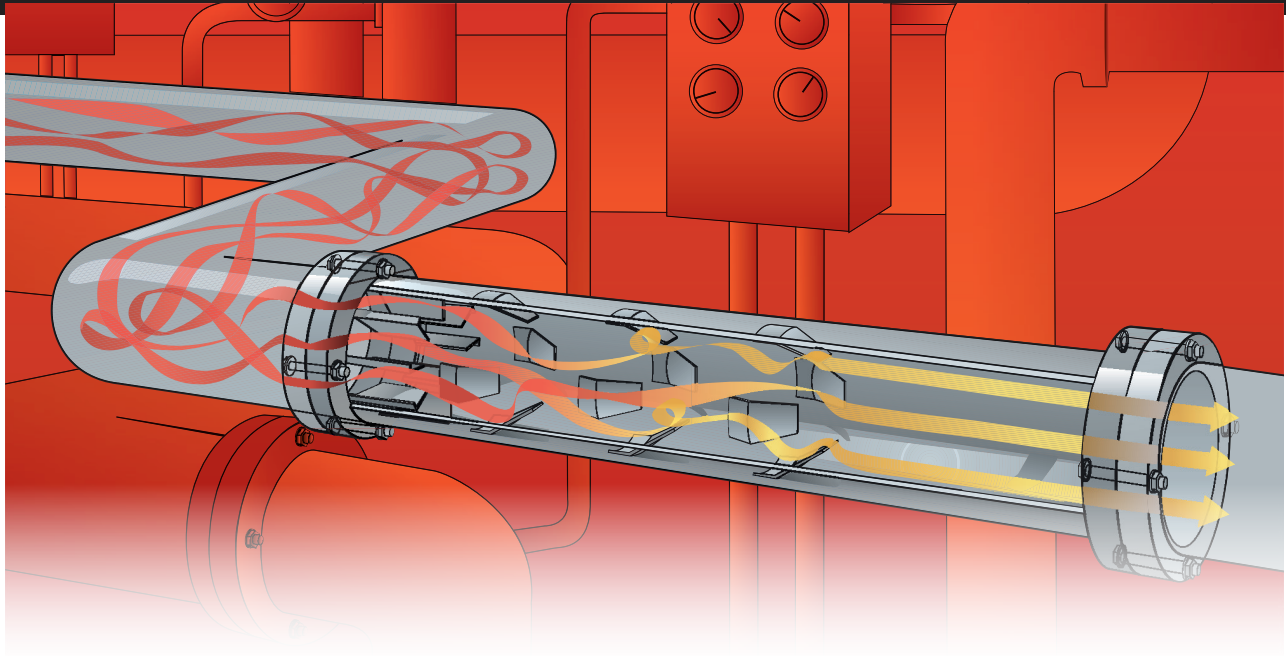




VORTAB[®]
COMPANY

VORTAB[®] FLOW CONDITIONERS

For Flow Meters, Pumps and Other Flow Profile Critical Equipment



- ▶ Reduce flow meter straight-run requirements into just a few diameters
- ▶ Balance pump inlet flow to eliminate premature wear and cavitation
- ▶ Install after elbows, valves, pipe expanders or reducers and other flow disturbances
- ▶ Very low pressure drop technology

► Flow Conditioners and Flow Straighteners

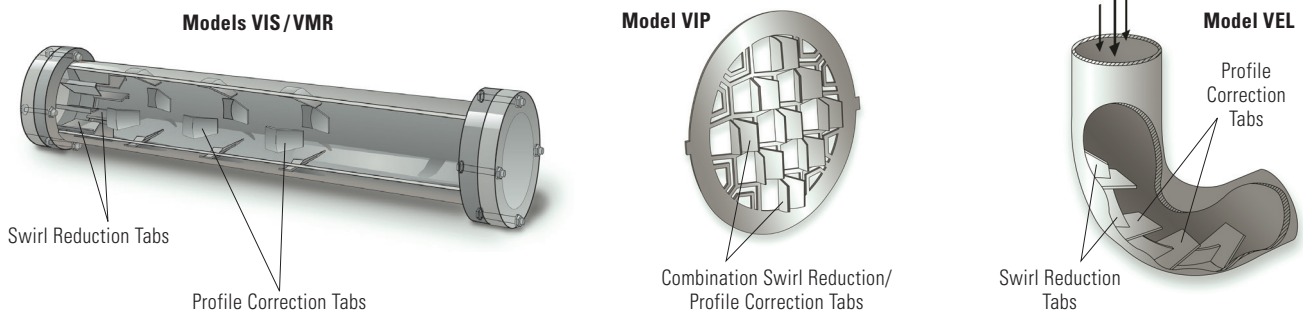
Reducing straight-run requirements for flow meters, pumps and flow profile critical process equipment

Straight-run is required in flow meter and pump installations to overcome the swirl, asymmetrical flow profiles and otherwise un-repeatable flow that is created by elbows, pipe expanders or reducers, valves, dampeners and other disrupters in the process pipe. In process piping systems, finding or adding a suitable amount of straight-run to accommodate the flow meters, pumps and other critical components is often impractical or un-feasible, either technically, economically or both. Flow conditioners, sometimes referred to as flow straighteners, are a practical and cost effective engineering solution to overcome this lack of available straight-run.

► Vortab Flow Conditioners

Vortab flow conditioners were the first and original tab-type flow conditioners patented. They were immediately recognized by the flow engineering community for their unique ability to eliminate both swirl and flow profile distortions, all with a minimum amount of pressure loss (see table, ΔP Equations, on page 4). The Vortab product line includes an extensive selection of configurations, and installation options ensure a Vortab solution matched to your application needs.

Swirl Reduction & Profile Conditioning Tabs – Swirl reduction is achieved by generating small vortices (swirls) opposite the main swirl resulting in swirl degradation. Profile conditioning tabs produce vigorous cross-stream mixing, which rapidly mixes faster velocity regions with slower regions. This mixing quickly produces a homogenous (i.e. conditioned) velocity profile. Combining anti-swirl with profile correction mechanisms also benefit equal distribution of particulates and temperature gradients. Static mixing is another side benefit of all Vortab products.



Vortab flow conditioners eliminate swirl and cross-mix the flow stream to achieve a symmetrical, distortion-free, repeatable flow profile in just three (3) pipe diameters. For installation ease and application optimization, traditional Vortab flow conditioners are available in a complete spool piece pipe section (Models VMR and VSR), an insertion sleeve (Model VIS), or as a weld-in-place kit (Model VFK). Also available, and particularly well suited for pump and compressor applications, is Vortab's exclusive elbow section (Model VEL). With all models, in addition to their low pressure loss, the open tab design is non-fouling and will not trap dirt or be clogged by debris in the flow stream. Traditional Vortab models are for use in air, gas and liquid applications.

Vortab VIP combines the science of tab-type flow conditioning with the installation ease and cost savings of an insertion panel type design. This patented design achieves Vortab performance in a simple flange mount or weld-in-place plate. Standard VIPs are available for pipe sizes 2 inch to 40 inch [51 mm to 1000 mm], and larger with special order. Today, VIP is only available for use in air/gas flow applications. Optimum performance is achieved when VIP is installed 3d downstream of the disturbance and the flow meter installed 3d downstream of the VIP; however, VIP has been successfully installed with less than 3d between the disturbance and the VIP, depending on the type of disturbance and flow rates. The Vortab Company has performed extensive tests at various disturbance-to-VIP distances and can assist you with data and placement tradeoffs in your application. *US Patent Number 9,010,994*

For flow meters

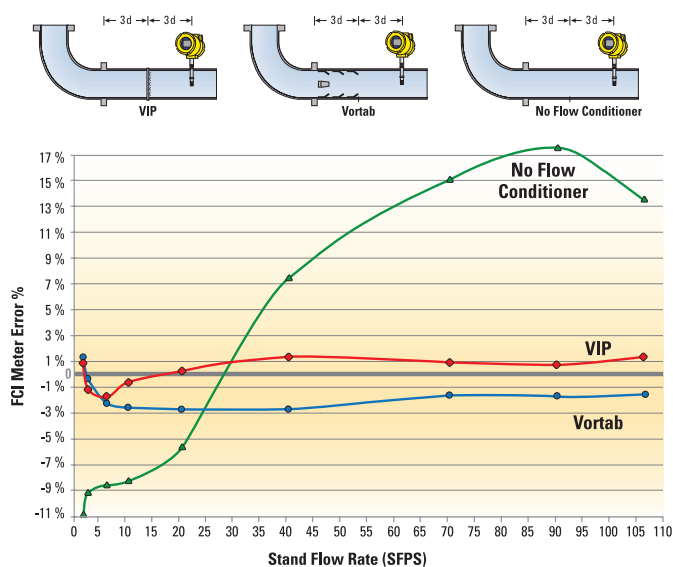
For flow meters to operate accurately and with repeatability, the flow profile at the flow meter must be uniform and repeatable. For many flow meter technologies the specified amount of upstream straight-run required can range from 15 to 40 pipe diameters. Additionally, flow meters with extreme low flow sensing and/or wide turndowns may experience natural changes to flow profile in the "transitional" flow between laminar and turbulent flow.¹

Vortab flow conditioner products are specified for use and successfully applied with flow meter technologies that include ultrasonic, vortex shedding, turbine, thermal dispersion², magnetic tubes, pitot tubes and more. Whenever the amount of pipe straight-run specified for the flow meter exceeds the processes' technical and/or economic limits, or will experience transitional flow profile changes, Vortab flow conditioners can provide a solution. Vortab products can be shipped directly to a job site or flow meter supplier for them to perform a potentially necessary matched system calibration.

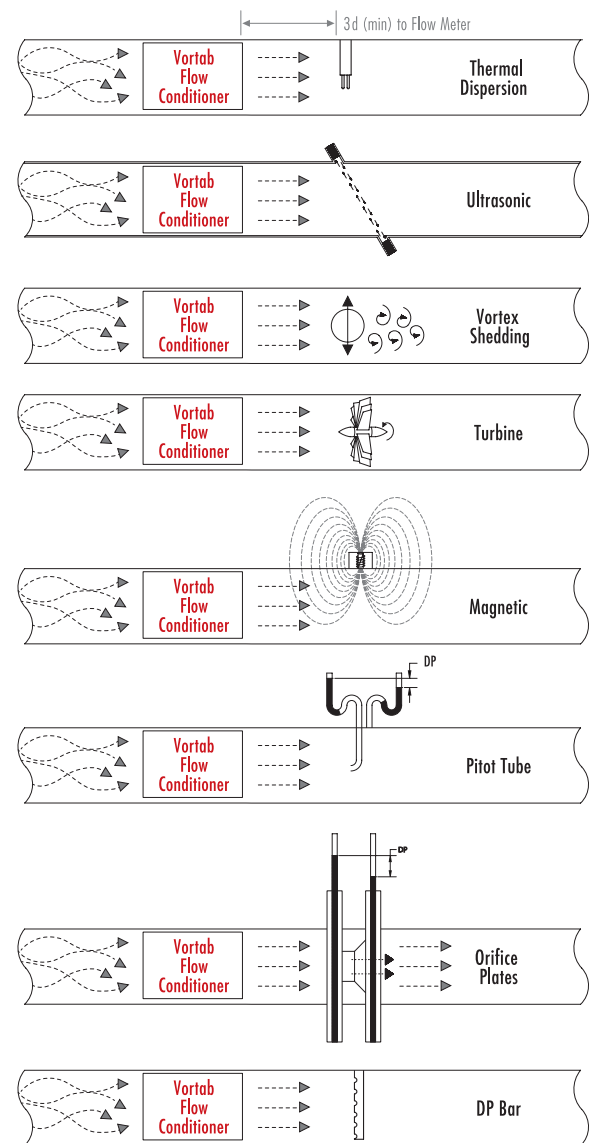
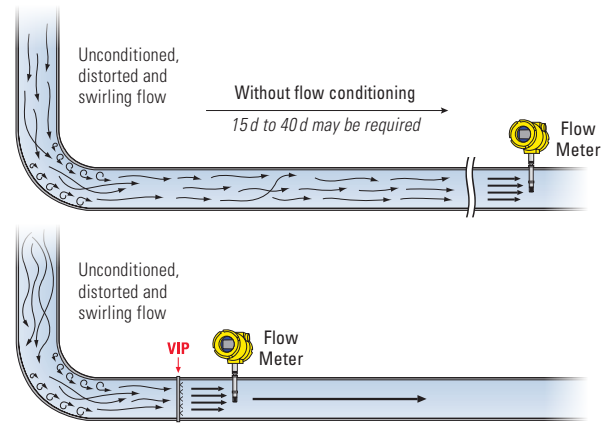
To comply with these straight-run requirements, flow conditioners produce a uniform and repeatable flow profile in much fewer pipe diameters. While there are several flow conditioner technologies and designs which can be considered, engineering must then consider trade-offs in installation ease and cost, straight-run still required by the flow conditioner, ability of the flow meter to be calibration matched to the flow profile created, clean or dirty fluid, ability of the flow conditioner to overcome the specific type of flow disturbance(s) (e.g. swirl, velocity profile distortion) and very important, the amount of pressure drop created. Excessive pressure loss can create unexpected and undesired process re-engineering and, most certainly a proportional increase in energy costs to overcome.

Flow Meter Accuracy Comparison With and Without Flow Conditioner

Flow meter installed 6d from single elbow in 4 inch [100 mm] diameter pipe



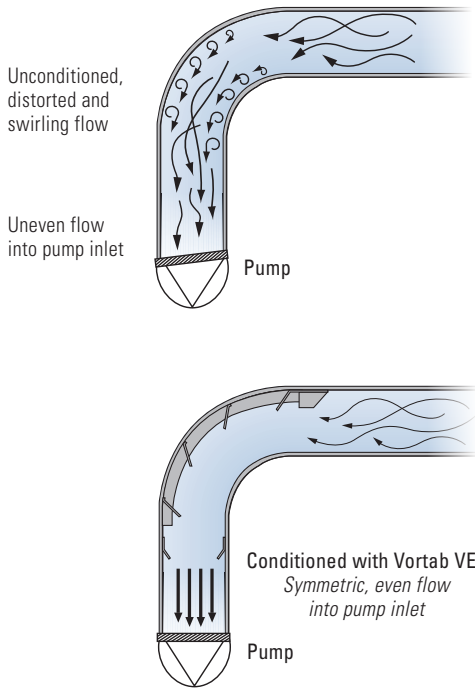
¹ For more information please consult Vortab technical article/white paper "Transitional Flow Effects on Flow Meter Measuring Accuracy," available to download at www.Vortab.com



² Fluid Components International (FCI) is Vortab Company's exclusive partner for use with thermal dispersion technology flow meters; FCI flow meters have been optimally designed for use with Vortab flow conditioners and FCI calibration laboratory will precision match the flow meter calibration to Vortab and Vortab VIP

For pumps, compressors and other flow profile critical equipment

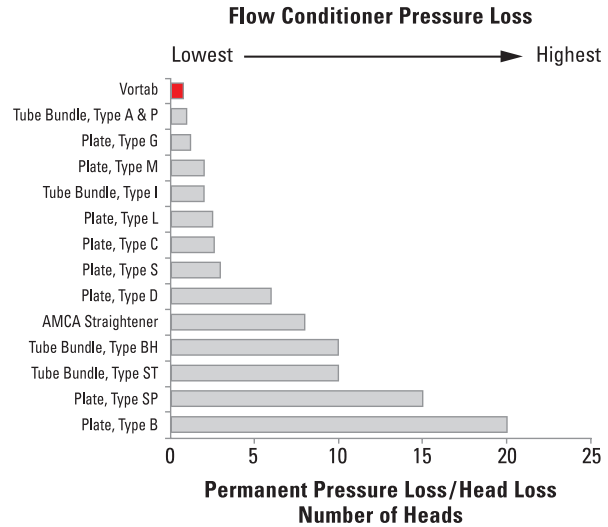
An unequal, imbalanced fluid flow force on the inlet of pumps and other critical process components can result in premature, unexpected and expensive failures. Like flow meters, pump and component manufacturers often require a specified straight-run to achieve a uniform and balanced flow entering the inlet of the pump and system, frequently as condition of their warranty.



Vortab VEL installation at pump inlet

Pressure loss consideration

All flow conditioning technologies will create some pressure drop. Higher pressure drop creates additional engineering issues in the process' design and equipment sizing, and directly results in increased energy cost to overcome it. With Vortab flow conditioners, engineers are assured of the lowest pressure loss solution available.



ΔP Equations

For Air at Standard Conditions (60 °F, 0 psig)

$$\Delta P = A \times \frac{Q^2}{D^4} \text{ or } B \times \frac{M^2}{D^4}$$

For Water

$$\Delta P = C \times \frac{Q^2}{D^4} \text{ or } D \times \frac{M^2}{D^4} \text{ or } E \times \frac{G^2}{D^4}$$

ΔP = pounds per square inch (psi)

Q = volumetric flow rate in cubic feet per minute (cfm)

M = mass flow rate in pounds per hour (lb m/hr)

G = flow rate in gallons per minute (gpm)

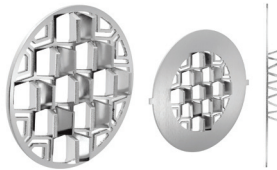
D = inside pipe diameter in inches

Model	VIP	VIS, VMR, VSR, VFK	VEL
A	1.06E-04	1.24E-04	1.86E-04
B	6.06E-06	6.11E-06	9.16E-06
C		9.45E-02	0.142
D		6.75E-09	1.01E-08
E		1.69E-03	2.54E-03

► Vortab Model Summary

Model	VIP	VIS	VMR	VSR	VEL	VFK
Style	Insertion Plate	Insertion Sleeve	Meter Run	Short Meter Run	90° Elbow	Field Kit
Liquids		►	►	►	►	►
Air/Gas	►	►	►	►	►	►
Pipe Sizes Available	2" to 40" [50 mm to 1000 mm]	1" to 48" [25 mm to 1220 mm]	2" to 24" [50 mm to 610 mm]	2" to 24" [50 mm to 610 mm]	1" to 36" [25 mm to 915 mm]	36" to 96" [915 mm to 2440 mm]
Round Pipes	►	►	►	►	►	►
Materials of Construction						
Carbon Steel		►	►	►	►	►
316L Stainless Steel	►	►	►	►	►	►
Hastelloy C-276	*	►	*	*	*	►
Installation/Mounting	Between flanges or weld-in-place	Between flanges or weld-in-place	NPT(M), flanged, butt weld prep	NPT(M), flanged, butt weld prep	NPT(M), flanged, butt weld prep	Weld-in-field

* Special order



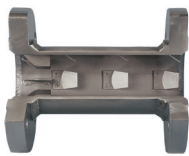
VIP Insertion Plate – Low cost, lightweight, easy to transport and easy to install insertion panel/plate. The panel contains conditioning tabs and strategically engineered cross members. The VIP plate is designed for installation between flanges or weld-in-place. VIP is currently available only for use in air/gas applications. US Patent Number 9,010,994



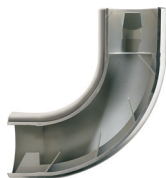
VIS Insertion Sleeve – A 3d long sleeve Vortab flow conditioner designed for inserting within an existing pipe. The sleeve is either tack welded in place or bolted between flanges with optional retaining wafer. Settling distance of 3d is required after the VIS and prior to the flow sensor. Actual inside pipe ID is required upon ordering to ensure correct sizing.



VMR Meter Run – A fully integrated 7d long spool piece section containing 3d of flow conditioners, 3d settling chamber, the optional flow meter tap point and 1d downstream settling distance. Process connection options include flanges, NPT or butt weld prep. The flow element tap options include 3/4 inch NPT(F), 1 inch NPT(F), 1 1/4 inch NPT(F), 1 1/4 inch NPT(M), and 1 1/2 inch flanges. Other process and flow element connections can be provided by special order.



VSR Short Run – A 3d long spool piece section containing just the flow conditioning elements. VSR is used when the installation location has the 3d of settling distance before the flow element. VSR is ideally suited for retrofits and upgrade situations where an installed flow meter is not performing due to a lack of straight-run. Process connection options include flanges, NPT or butt weld prep. Other process connections can be provided by special order.



VEL Elbow – The only true isolating 90° elbow flow conditioner. Can be applied with flow meters and is ideal for use in tight installations with pumps, compressor and other critical process equipment requiring a stable flow profile and applications where an elbow inlet is typical. Process connection options include flanges, NPT or butt weld prep. Other process connections can be provided by special order.

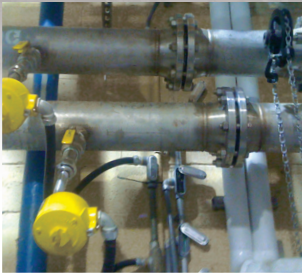


VFK Field Kit – Kit containing Vortab flow conditioning and anti-swirl tabs aligned for on-site fabrication. VFKs are most often specified for use in large existing pipes and ducts at the installation site where a complete Vortab spool piece assembly is too large to transport and handle. VFK is supplied with detailed installation and welding instructions for on-site installers. VFK is available in straight or elbow configurations for pipe or duct sizes 36 inch to 96 inch [915 mm to 2440 mm].

Vortab World Class Calibration and R&D Laboratory

The Vortab Company operates a world class flow calibration laboratory to verify and validate product performance and quality. This laboratory is home to more than 19 NIST traceable flow stands and is certified to meet the stringent standards such as MIL-STD 45662A and ANSI/NCSS Z-540. These flow stands are outfitted with high-speed, precision data acquisition systems and capable of flowing a broad range of fluids over wide flow ranges at various temperature and pressure conditions. Vortab R&D engineers utilize state of the art fluid dynamics and modeling tools such as SolidWorks Flow Simulation to thoroughly tests and prove designs, and assure flow conditioner performance.

When Vortab products are ordered for use with Fluid Components International (FCI) flow meters, these same calibration stands are used to deliver a Vortab+FCI matched precision calibration.



Vortab VMR with flow element installed in optional tap



More than 19 precision flow stands to match NIST traceable fluids, process conditions, flow rates and line sizes specified in your application.

Local Vortab® Representative



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FCI's Quality Management System is ISO9001 and AS9100 certified.