



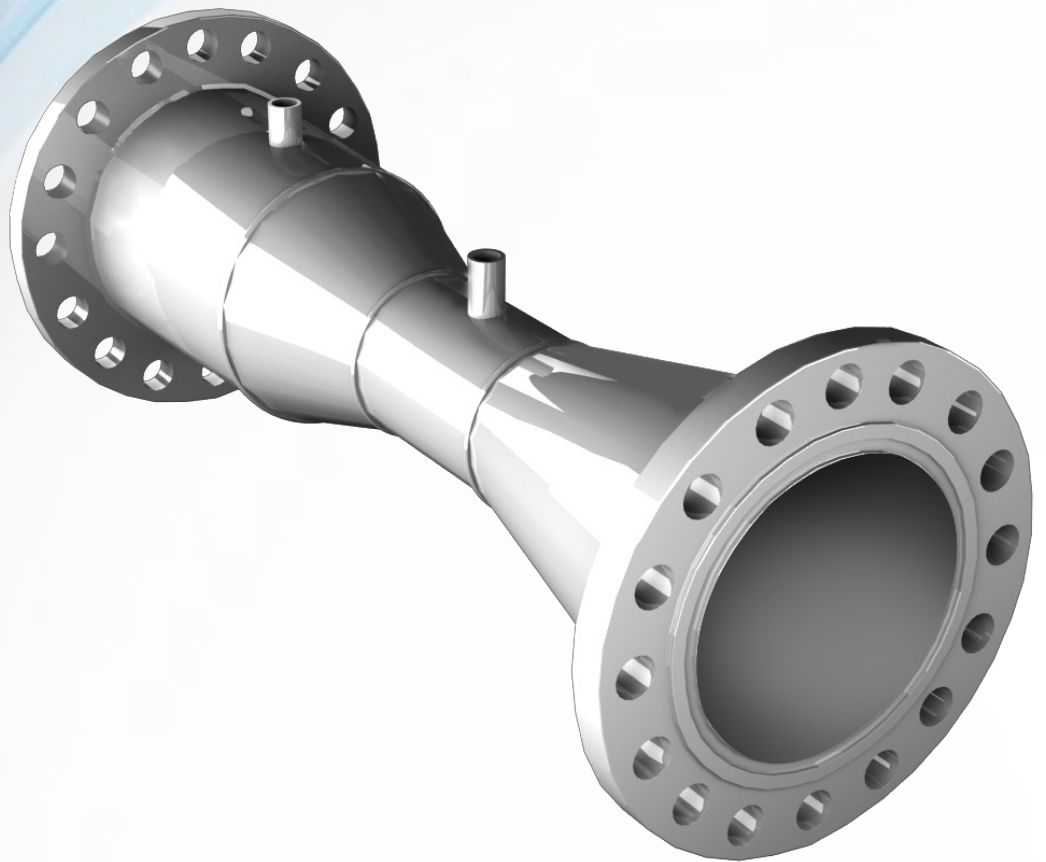
Technology Solutions

TEK-DP 1640A

Venturi Tube Meter



FLOW



Introduction

Tek-DP 1640A Venturi Tube meters are Differential Pressure flow meters designed for the measurement of low viscosity single-phase liquids and gases. The prominent features of Venturi Tube designs include: Low permanent pressure loss, no moving parts, no abrupt flow restrictions and minimal upstream and downstream pipe length requirement.

Venturi Tubes are often used in process applications where low permanent pressure loss is a requirement and also where high performance / accuracy is needed. In the case of highly viscous liquids (>100Cst) Venturi meters have been used within the oil and gas industry however, it is recommended that the Reynolds number operating range (Re_D) is reviewed to make sure that the meter diameter and beta ratio are correctly defined, calibration will be required on most venturi meters for high accuracy use.

Tek-DP 1640A Venturi Tubes are manufactured to ISO standards 5167 Pt 4, with a gradually decreasing convergent upstream nozzle section and a gradually increasing downstream diffuser section.

Due to this characteristic design, Venturi meters have a capability to keep and regain a major part of the line pressure unlike certain other primary low elements. This minimal pressure loss makes Venturi tube meters ideal for applications where a low head loss is required.

Tek-DP 1640A Venturi tubes are available in various models for single phase gas, liquid applications, steam, slurries and wet gas applications they are manufactured with a high level of manufacturing accuracy.

Tek-DP 1640A series also provides consistent accuracy repeatability with maximum pressure recovery, and sustained performance for a variety of applications.

Measurement Principle

A Venturi meter uses a constriction within a pipe (classically an hourglass shape) that varies the flow characteristics of a fluid (either liquid or gas) travelling through the tube. As the fluid velocity in the meter throat is increased there is a consequential drop in pressure (h). Italian scientist Giovanni B Venturi (1746-1822) was the first to observe this phenomenon due to the law of conservation of energy.

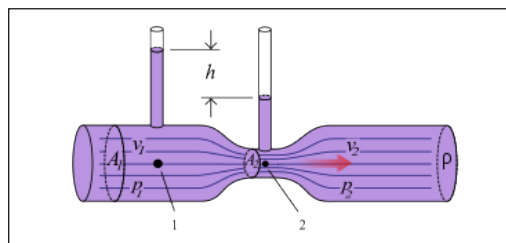


Fig.1 : Venturi Tube Cross-Section

A Pressure drop accompanies an increased flow velocity is fundamental to the laws of fluid dynamics. Swiss mathematician, Daniel Bernoulli, derived the interrelationship between pressure, velocity and other physical properties of flowing fluids in 1738 ! The Venturi meter is a robust and time tested technology.

Daniel Bernoulli described this relationship between the flow rate and differential pressure. (See equation 1.0):

$$\Delta p \propto Q_m^2$$

Equation 1.0

$$Q_m \propto \sqrt{\Delta p}$$

Equation 2.0

For a fluid flowing across a given pipe restriction the differential pressure (Δp) is proportional to the square of the mass flow rate Q_m . Higher flow rates produce higher differential pressure, therefore the mass flow is also proportional to the square root of the Δp ! (See equation 2.0)

Tek-DP 1640A Series Venturi Tubes

Tek-DP 1640A series Venturi Tubes are available in following designs types.

- **Classical Venturi**

The convergent inlet is manufactured as a truncated cone (See Fig.1).



Fig.2 : Classical Venturi

The Classical Venturi is used in gas and fluid flow applications, where low pressure loss is a primary requirement. Classical Venturi Tubes prevent sediment clogging due to the increase in velocity at the meter throat.

- **Nozzle Venturi**

The convergent inlet matches with the structure of the flow nozzle (See Fig.2).

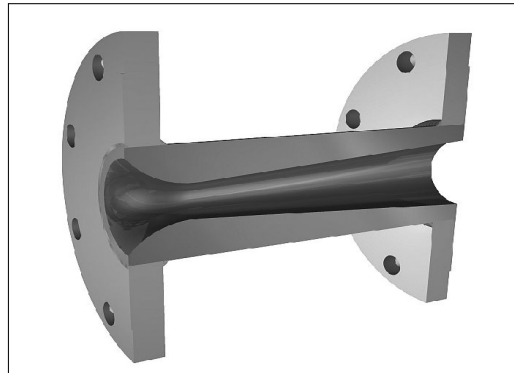


Fig.3 : Venturi Nozzle

The Venturi nozzles are suitable in the measurement of superheated fluid, steam and gas where the pressure gradient is below critical and the flow pattern is steady.

Features

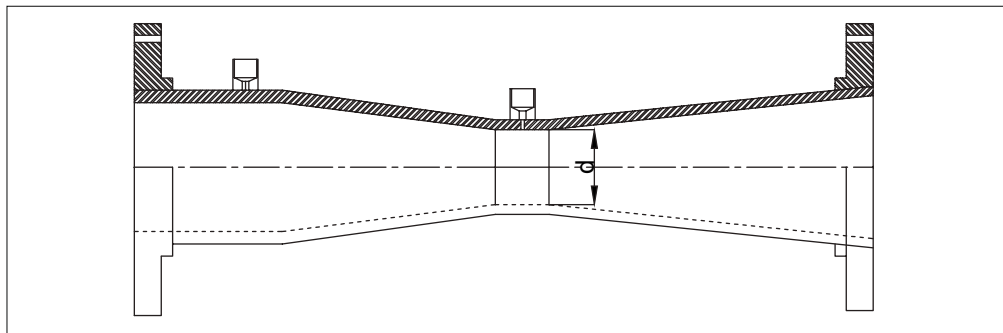
- Designs in accordance with ASME and ISO Standards.
- Durable and optimized design, simple configuration easy to install.
- Suitable for high-pressure, high-velocity, non-viscous, erosive process media.
- Reduced piping cost.
- Highest pressure recovery with lowest permanent pressure loss.
- Accuracy $\leq \pm 0.5$ % of the actual flow rate.
- Repeatability 0.1%.
- Minimal upstream and downstream lengths per ISO standards.
- Available in all pipe sizes and a wide range of materials.

Major Applications

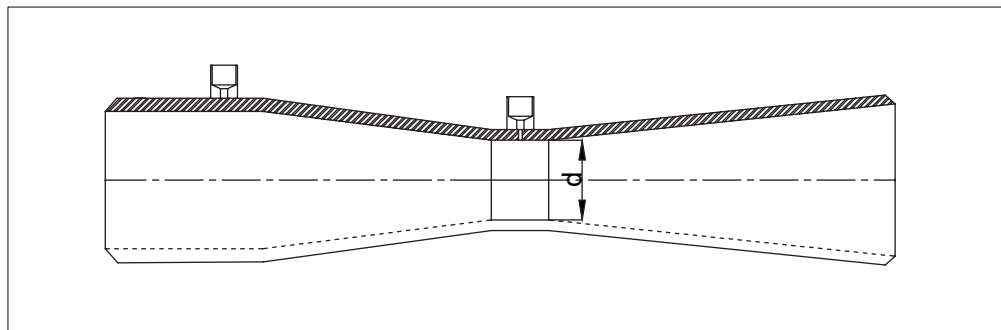
- Water and sewage plants.
- Slurry flows in mining, chemical plants.
- Power Generation.
- Hydrocarbon, Liquid & Gas Processes.
- LNG Trains.
- High Accuracy Custody Transfer, Fiscal and Allocation Flow Metering.
- Compressor Stations.
- Cryogenics.
- Wet Gas Flows and Steam Applications

Venturi Types/Styles

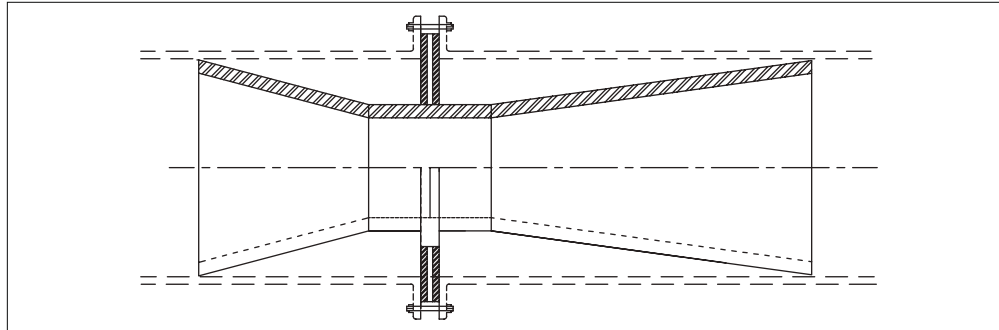
Flanged Type



Weld-in Type



Insertion Type



Specifications

Venturi Meter for normal liquids

Material	All standard materials available
Tap Connections	Two 1/2" NPT per side standard, Flanged, Socket Welded, Butt Welded, Valves
Venturi Tube Sizes	1" to 48", Custom size available on order, Flanged, Socket Welded, Butt Welded Valves
Turn Down Ratio	10:1 Standard
Beta Ratio	Typically, β 0.4 to 0.75
End Connection	#150 - #2500 RF/RTJ, SO/WN Flanges or Beveled ends
Operating Temperature	Standard at -20° to 100° F, optional -40° to 1200° F
Operating Position	Vertical, Horizontal (any orientations for liquids only)
Process products	Liquids, Liquid Hydrocarbons, Cryogenics
Assembly Type	Flange, Weld in, Insertion type

Venturi Meters for wet and dry gas

Material	All standard materials available (See model chart)
Tap Connections	Three 1/2" NPT standard, Flanged end, Socket welded, Butt welded, Valves
Venturi Tube Sizes	1" to 48", Custom size available on order , Flange, Weld in, Insertion type
Turn Down Ratio	10:1 Standard
Beta Ratio	Typically, β 0.4 to 0.75
End Connection	#150 - #2500 RF/RTJ, SO/WN Flanges or Beveled ends
Operating Temperature	Standard at -20° to 100° F, optional -40° to 1200° F
Operating Position	Vertical, Horizontal, Hydrocarbon Wet Gases, Steam, (other orientations available)
Process products	Natural Gases, Steam.
Assembly Type	Flange, Weld in, Insertion type

TekValSys

Tek-Trol Venturi's can be supplied with a unique, Powerful, Industrially Proven, Patented Validation/Diagnostics System (TekValSys). From this system real time DP flow data collection using 2 extra transmitters in conjunction with the base flow meter transmitter offer a complete diagnostic monitoring of how well the venturi meter (or even other DP meters) is performing, this is in real time and can help to streamline field maintenance operations associated with DP metering.

With this option a TekValSys FCA Flow Computer and its on board transmitter reads the normal primary flow data for say the custody flow rate calculations, however the extra 2 a DP transmitter available by TEK-TROL are installed to measure both the recovery pressure and permanent pressure loss during flowing conditions.

This diagnostic operation is called Condition Based Monitoring or Maintenance !

A Unique system allowing meter flow data plus performance data related to the meters health to be transmitted to say SCADA or to be read locally using a secure protocol at the meter location by company operation staff.

TekValSys is a real asset to help keep loss and unaccounted (L&U) values under control and at low level during DP measurement operations.

DP Diagnostic Operation:

- A Downstream Pressure Tap Allows 2 extra DP transmitters (DP's) to be read.
- Existing DP transmitter for base calculations is used in conjunction with 2 extra DP's.
- The Pressure Field Through the Venturi Meter is Monitored in Real time.
- The Diagnostic System Improves the Meters Capability and Viability.
- All 3 DP's are Compared to Confirm Correct Meter and DP Transmitter Operation.
- A Simple Live Diagnostics Plot is Shown in the Control Room or read locally.

Venturi Flow Meter Issues Detectable by TEK-TROL Diagnostics Include:

1. Incorrect Inlet or Throat Diameter Keypad Entry.
2. Two-Phase Flow.
3. Excessive Flow Disturbance Upstream of the Meter.
4. Contamination Build Up Through the Meter.
5. Blocked Impulse Lines.
6. Saturated DP Transmitter.
7. Drifting DP Transmitter.
8. Incorrect Discharge Coefficient Keypad Entry.
9. Incorrectly Spanned DP Transmitter.



Model Chart

Example	Tek-DP 1640A	0050	A	01	A	01	A	03	A	03	A	01	A	MTR	Tek-DP 1640A-0050-A-01-A-01-A-03-A-03-A-01-A-MTR
Series	Tek-DP 1640A														Venturi Tube
Size		0015 0020 0025 0040 0050 0065 0080 0100 0150 0200 0250 0300 0350 0400 0450 0500 0600 0700 0800 0900 1200													1/2" 3/4" 1" 1 1/2" 2" 2 1/2" 3" 4" 6" 8" 10" 12" 14" 16" 18" 20" 24" 28" 32" 36" 48"
Meter Body			A B C D E F G H X												Carbon Steel (Standard) Low Temp CS 304L SS 316L SS Duplex 2205 Duplex 2507 Chromemoly CrMo P11 Chromemoly CrMo P22 Special
Pipe Schedule				01 02 03 04 05 06 07 08 09 10 11 12 13 XX											STD (Standard Pipe SCH) 10S 10 20 30 40S 40 80S 80 120 160 XS XXS Special
Process Connection					A B C D E F G H I W X										Raised Face Slip On Raised Face Weld Neck RTJ Slip On RTJ Weld Neck Hubs API Beveled End Socket NPTF (Upto 3" Only) Wafer Style (Upto 4" Only) Special
Pressure Rating						01 02 03 04 05 06 07 08 09 XX									150# 300# 600# 900# 1500# 2500# NPT (3000#) Socket Beveled End Special

Example	Tek-DP 1640A	0050	A	01	A	01	A	03	A	03	A	01	A	MTR	Tek-DP 1640A-0050-A-01-A-01-A-03-A-03-A-01-A-MTR
Throat Material of Construction							A B C D E F G H X								Carbon Steel Low Temp CS 304L SS 316L SS Duplex 2205 Duplex 2507 Chromemoly CrMo P11 Chromemoly CrMo P22 Special
Pressure Taps Size								01 02 03 04 05 XX							1/4" 3/8" 1/2" 3/4" 1" Special
Pressure Tap Style									A B C D F H V X						3000psi NPT 6000psi NPT 3000psi Socket 6000psi Socket Flanged Hubs Valves Special
Beta										01 02 03 04 05 06 07 XX					0.45 0.50 0.55 0.60 0.65 0.70 0.75 Special
Additional Meter Taps (D/S)											A B C X				None Temperature Tap (3D) Validation/Diagnostic Tap (6D) Special
Flow Transmitters/ Computers												01 02 03 04 05 06 XX			None (Customer Supplied) Tek-Bar 3110 (Liquids) - Smart DP Tek-Bar 3800 (MVT Steam & Compressed Gases) Tek-FC 8000 (Natural Gas - Flow Computer) TekValsys DPRO (Insitu Flow Validation) TekValsys DPRO WFGM (Wet Gas) Special
Calibration													A B C D X		Dry (ISO 5167) Water Air Multiphase Special
Options														MTR MC PMI COC HYD XRT DPT MPT O2C TAG UMR DMR FMR CDE MRB DFT CPC	Material Test Report EN3.1 Material Cert EN2.1 Poistive Material Identification (NDE) Certificate of Conformity Hydro Test X-Ray Dye Penetrant Magnetic Particle Testing O2 Cleaned SS TAG PLATE Upstream Meter Run - 1PC Downstream Meter Run - 1PC Meter Run with Flow Contioner Plates - 2PC Certified Drawing Electronic (As Built) Manufacturing Record Book Dry Film Thickness - Custom Paint Spec Custom Product Code