

## VENTURI TUBE

### KEY FEATURES

- Venturi tube design according to ISO5167-1 & ISO5167-4 or ASME.MFC.3M standards
- Recommended for clean fluids
- Internal pipe diameter : from 50 mm to 1 200 mm
- Reynolds number : from  $2 \cdot 10^5$
- Accuracy : from 0.7% of the max flowrate
- Repeatability of measurement : 0.1%



Rolled welded venturi tube, weld connections



Rolled welded venturi tube, flange connections

### BENEFITS

- Very long life-time product, no drift over time
- Standardized principle : reliability and accuracy of measurement, no need of calibration
  - Suitable for a large range of fluids and process conditions
  - Low permanent pressure drop
- Short upstream and downstream straight lengths



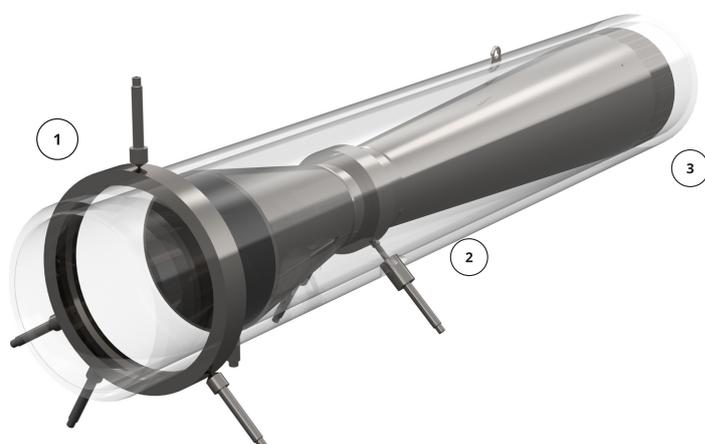
The venturi tube is made up of an entrance cylinder connected to a conical convergent inlet section flowed by a cylindrical throat and a conical divergent outlet section. Due to the fact that a major part of its inlet pressure is regained, the venturi tube is particularly suited for the measurement of flow rates in systems where a low differential pressure is needed.

## STANDARDS & DIRECTIVE

- ISO 5167-1 & ISO 5167-4
- ASME MFC-3M
- Pressure equipment directive PED 2014/68/UE

## DIFFERENT TYPES

- Machined venturi tubes : small sized units, they are machined from a unique bar stock
- Rolled welded venturi tubes : of the largest diameters, they are manufactured from rolled metal sheets welded together
- Venturi tubes "as cast" : they can be made by casting in a sand mould or by other methods which leave a finish on the surface of the convergent section similar to that produced by sand casting. The throat is machined and the junctions between the cylinders and cones are rounded (rounded angles according to standards) to optimise the fluid flow.
- Deltafluid also proposes the rolled welded venturi inserted in a pipe. This assembly has the advantage of balancing the pressure around the venturi: the end of the divergent is not welded to the pipe, which allows the fluid to circulate and fill the space between the venturi and the external pipe. The pressure constraints supported by the venturi are thus much lower (only equivalent to the permanent pressure loss) and the thickness of the venturi can thus be revised downwards.

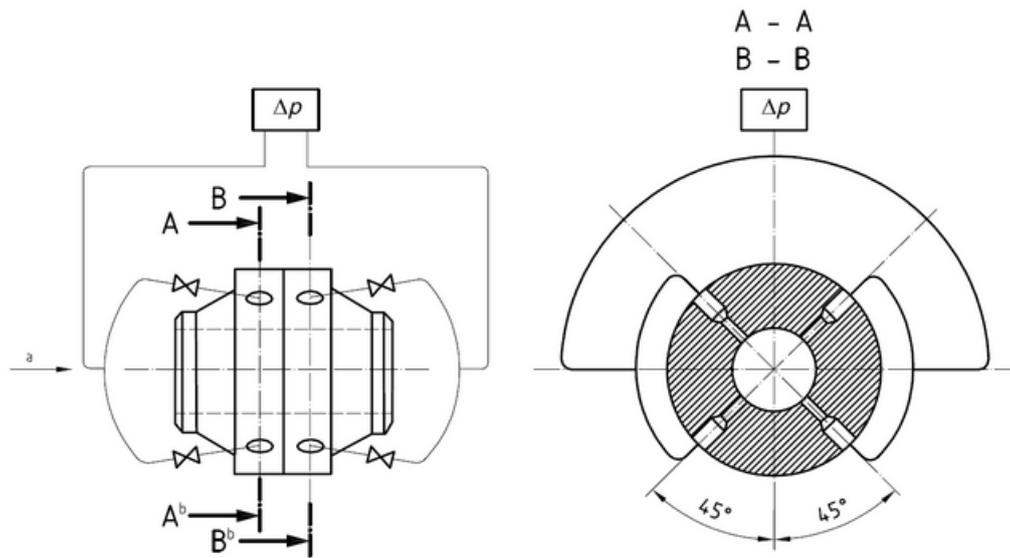


Venturi inserted in a pipe

- ① cylindrical inlet with pressure taps
- ② transparent part: representation of the external pipe
- ③ end of divergent

# PRESSURE TAPS

- Venturi tubes are delivered with integrated pressure taps, one upstream located on the entrance cylinder section and one at the throat.
- The pressure taps can be individual pressure taps located at the surface of the pipe.
- Several pressure taps in the same plane are also authorized; they can be interconnected by annular chambers (see venturi drawings on following pages) or as a "triple T" arrangement with connection of four individual pressure tapplings.



- a Flow
- b Section A-A (upstream) also typical for section B-B (downstream)

Présentation de la disposition en "triple T" issue de la norme ISO 5167-1

- Instrumentation connection types :
  - to screw : NPT, BSP,...
  - to weld : SW, BW (nipple weldolet type),...
  - with flange : flangeolet, flange extension,...

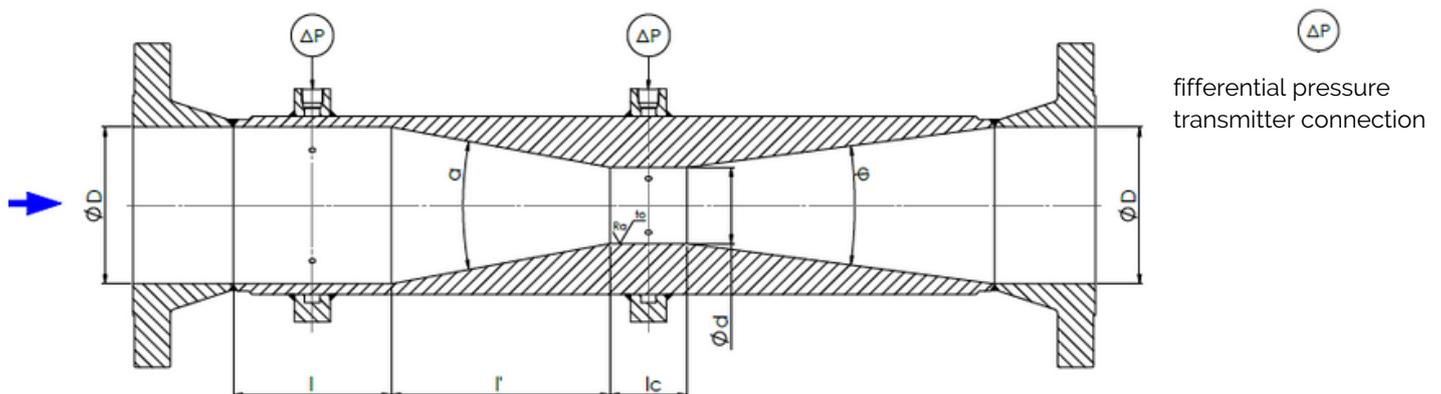
# TECHNICAL CHARACTERISTICS - GENERAL INFO

- Fluid temperature <sup>(1)</sup> : cryogenic to +800°C
- Materials <sup>(2)</sup> : carbon steel, stainless steel, monel, hastelloy, inconel, duplex, super duplex, titanium, tantalum, PVC, PTFE...
- Maximum operating pressure : limited by the flange rating

## TECHNICAL CHARACTERISTICS - MACHINED VENTURI TUBE

- Accuracy : 1 % of the maximum flowrate
- Characteristics according to the standard in force :

		ISO 5167-1&4	ASME MFC-3M
ReD	Reynolds number in the pipe	$ReD > 2.10^5$	$2.10^5 \leq ReD \leq 6.10^6$
D	Inside pipe diameter	$50 \text{ mm} \leq D \leq 250 \text{ mm}$	
$\beta$	d/D	$0.4 \leq \beta \leq 0.75$	$0.3 \leq \beta \leq 0.75$
Ra	Throat roughness	$Ra \leq 10^4 \cdot d$	
	Convergent and entrance cylinder roughness	$Ra \leq 10^4 \cdot d$	
l	Entrance cylinder minimum length	$l = D$	
l'	Inlet convergent length	$l' = 2,7 \cdot (D - d)$	
$\alpha$	Angle of the inlet convergent	$\alpha = 21^\circ \pm 1^\circ$	
lc	Throat length	$lc = d \pm 0,03 \cdot d$	
$\phi$	Angle of the outlet divergent	$7^\circ \leq \phi \leq 15^\circ$	



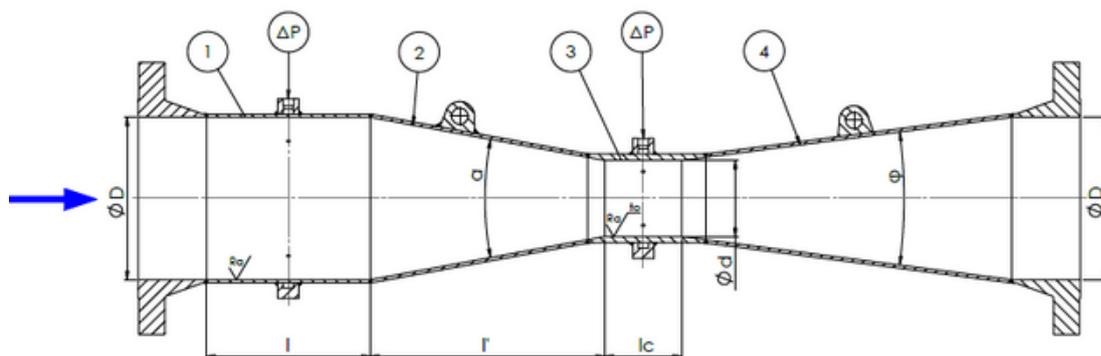
(1) No temperature restriction with remote-mounted transmitter, otherwise +125°C max

(2) For an aggressive fluid, applying a specific coating on the inside surface of the venturi tube can increase the product lifetime

# TECHNICAL CHARACTERISTICS - ROLLED WELDED VENTURI TUBE

- Accuracy : 1,5 % of the maximum flowrate
- Characteristics according to the standard in force :

		ISO 5167-1&4	ASME MFC-3M
ReD	Reynolds number in the pipe	$2 \cdot 10^5 \leq \text{ReD} \leq 2 \cdot 10^6$	$2 \cdot 10^5 \leq \text{ReD} \leq 6 \cdot 10^6$
D	Inside pipe diameter	$200 \text{ mm} \leq D \leq 1200 \text{ mm}$	$100 \text{ mm} \leq D \leq 1200 \text{ mm}$
$\beta$	d/D	$0,4 \leq \beta \leq 0,7$	$0,3 \leq \beta \leq 0,75$
Ra	Throat roughness	$Ra \leq 10^4 \cdot d$	
	Convergent and entrance cylinder roughness	$Ra \leq 5 \cdot 10^4 \cdot D$	
l	Entrance cylinder minimum length	$l = D$	
l'	Inlet convergent length	$l' = 2,7 \cdot (D - d)$	
$\alpha$	Angle of the inlet convergent	$\alpha = 21^\circ \pm 1^\circ$	
lc	Throat length	$lc = d \pm 0,03 \cdot d$	
$\phi$	Angle of the outlet divergent	$7^\circ \leq \phi \leq 15^\circ$	

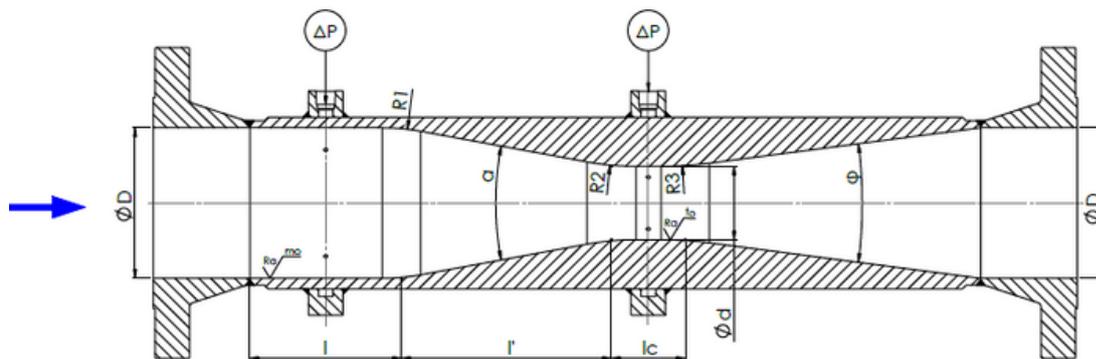


- ① entrance cylinder   
 ② convergent   
 ③ throat   
 ④ divergent   
 ΔP differential pressure transmitter connection

# TECHNICAL CHARACTERISTICS - VENTURI TUBE "AS CAST"

- Accuracy : 0,7 % of the maximum flowrate
- Characteristics according to the standard in force :

		ISO 5167-1&4	ASME MFC-3M
ReD	Reynolds number in the pipe	$2 \cdot 10^5 \leq \text{ReD} \leq 2 \cdot 10^6$	$2 \cdot 10^5 \leq \text{ReD} \leq 6 \cdot 10^6$
D	Inside pipe diameter	$100 \text{ mm} \leq D \leq 800 \text{ mm}$	$100 \text{ mm} \leq D \leq 1200 \text{ mm}$
$\beta$	$d/D$	$0,3 \leq \beta \leq 0,75$	
Ra	Throat roughness	$Ra \leq 10^4 \cdot d$	
	Convergent and entrance cylinder roughness	$Ra \leq 10^4 \cdot D$	
l	Entrance cylinder minimum length	$l = D \text{ ou }^{(3)} (0,25 \cdot D + 250 \text{ mm})$	
l'	Inlet convergent length	$l' = 2,7 \cdot (D - d)$	
$\alpha$	Angle of the inlet convergent	$\alpha = 21^\circ \pm 1^\circ$	
lc	Throat length	$lc = d \pm 0,03 \cdot d$ (longueur minimum = $d/3$ )	
R1	Radius of curvature 1 between the entrance cylinder and the convergent	$R1 = 1,375 \cdot D \pm 0,275 \cdot D$	
R2	Radius of curvature 2 between the convergent and the throat	$R2 = 3,625 \cdot d \pm 0,125 \cdot d$	
R3	Radius of curvature 3 between the throat and the divergent	$5 \cdot d < R3 < 15 \cdot d$	
$\phi$	Angle of the outlet divergent	$7^\circ \leq \phi \leq 15^\circ$	



 differential pressure transmitter connection

(3) Take the lowest of these two values

## MOUNTING ON PIPE

- Mounting between flanges or to be welded (BW)
- Flange types : ISO PN 2,5 to PN 420, ASME 150# to 2500#, API flanges
- Gasket types : flat gasket (spiral wound, graphite, PTFE) or RTJ (soft iron, inox, monel...)
- Piping connection between straight sections according to the standard (variable upstream and downstream straight lengths according to  $\beta$  ( $\beta=d/D$ ) and according to the upstream fittings) - see upstream straight lengths table on page 8
- Alignment venturi tube / pipe:
  - Distance between the centrelines of the upstream pipe and of the venturi tube  $\leq 0,005D$
  - Angular alignment of the venturi tube centreline with respect to the upstream pipe centreline  $< 1^\circ$

# STRAIGHT LENGTHS

- Straight lengths required between venturi tube and fittings
- Values expressed as multiples of D (D = pipe internal diameter)

d/D	UPSTREAM SIDE OF PRIMARY ELEMENT												
	Simple coude à 90°	Two or more 90° bends in the same plane or in different planes		Concentric reducer from 1,33D to D over a length of 2,3D	Concentric expander of 0,67D to D over a length of 2,5D	Concentric reducer of 3D to D over a length of 3,5D	Concentric expander of 0,75D to D over a length of D	Full bore ball valve or gate valve fully open					
	1	2	3	4	5	6	7	8					
0,30	8	3	8	3	4	4	2,5	2,5	2,5				
0,40	8	3	8	3	4	4	2,5	2,5	2,5				
0,50	9	3	10	3	4	5	4	5,5	2,5	2,5	3,5	2,5	
0,60	10	3	10	3	4	6	4	8,5	2,5	3,5	2,5	4,5	2,5
0,70	14	3	18	3	4	7	5	10,5	2,5	5,5	3,5	5,5	3,5
0,75	16	8	22	8	4	7	6	11,5	3,5	6,5	4,5	5,5	3,5

Nota :

The minimum straight lengths required are the lengths between various fittings located upstream of the venturi tube and the venturi tube itself.

Straight lengths shall be measured from the downstream end of the curved portion of the nearest bend or reducer or expander to the upstream pressure tapping plane of the venturi tube.

A thermowell installed upstream of the venturi tube shall not exceed 0,13D in diameter and shall be located at least 4D upstream of the upstream tapping plane of the venturi tube.

For downstream straight lengths, fittings situated at least 4 throat diameters downstream of the throat pressure tapping plane do not affect the accuracy of the measurement.

In the columns, left values give lengths corresponding to zero additional uncertainty (see ISO 5167-1 standard)

Right values give lengths corresponding to 0,5% additional uncertainty (see ISO 5167-1 standard). Empty cells when no available data.

# ACCESSORIES

For flow measurement, we offer a full range of accessories for assembly with venturi tubes.

## ■ Flanges



Flanges with flat gasket face, raised face, large male/female face, tongue/groove face, RTJ-F face

## ■ Transmitter



Differential pressure transmitter, multivariable transmitter

## ■ Manifold



2-way / 3-way / 5-way manifold with or without direct mounting

## ■ Condensation pot



## ■ Valve



## ■ Flow straightener or conditioner



## ■ Fittings



# FURTHER INFORMATION

All the information on the mounting of venturi tubes (and their accessories) such as :

- pressure taps orientation
- mounting of the differential pressure transmitter
- flange tightening

can be found on the IOM notice "User guide - installation, operation and maintenance manual" ref DTF-SMQ-P3-IOM-008 provided on request upon delivery of components.

# ITEM CODES

■ Machined venturi tube : DVU-ND-NP-Face type-Material

DVU	ND	NP	Face type	Material
Nominal diameter - ASME	2" to 10"	150# to 2500#	RF RTJ SEM <sup>(5)</sup> SEF <sup>(5)</sup> DEM <sup>(5)</sup> DEF <sup>(5)</sup>	304L 316L Others
OR				
Nominal diameter - ISO	ND50 to 250	NP2,5 to 400		

■ Rolled welded venturi tube : DVRS-ND-NP-Face type-Material

DVRS	ND	NP	Face type	Material
Nominal diameter - ASME	4" to 48"	150# to 2500#	RF RTJ SEM <sup>(5)</sup> SEF <sup>(5)</sup> DEM <sup>(5)</sup> DEF	304L 316L Others
OR				
Nominal diameter - ISO	ND100 to 1200	NP2,5 to 400		

■ Exemples venturi codes:

- DVU-100-50-RF-316
- DVRS-16-1500-RTJ-316
- DVBF- venturi "as cast" - consult us

(5) Specify large or small male/female face if flanges according to ASME B16-5 standard.



Chemin Les Augas – RD817  
64170 LACQ  
FRANCE



delta64@deltafluid.fr



+33 (0)5 59 30 85 20



www.deltafluid.fr



DELTAFLUID