Venturi Flowmeter
DATASHEET

JUNHO 2013
IntraVenturi
Venturi Tube
Type: IVT

Technical Information
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THE EXPERT IN LEVEL AND FLOW
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1. General Description

Comparing with orifices and flow nozzles, the Venturi tube generally is of a little more complicated structure, requires more material and costs and tends to be larger in size. However, Venturi tubes offer advantages including an extremely low pressure loss, a higher durability and a lower chance of catching a sludge media and sediment than other throttle elements. The Venturi tube is mostly used for measurements of flow wherever a minimal loss of pressure is important.

![Venturi Tube Diagram]

The Intra-Automation Venturi Tube IAVT is designed and manufactured in full compliance with ISO-5167 and ASME MFC-3M standards.

2. Specifications

- Venturi tube type: machined type, welded type, tetragon duct type
- End connection: butt-weld, flanged (slip-on & welding neck)
- β-ratio-range: machined type: β between 0,4 and 0,75 incl., welded type: β between 0,4 and 0,7 incl.
- Options-1: Pressure tapping leading into piezometer ring
- Options-2: Full Jacket or Semi Jacket for Heating or Cooling
3. Drawings

Generally, Venturi tube with a machined convergent can be used in pipes of size between 2” and 10”. However, in the case that the machined type is of large size (8” or 10”), they have disadvantages because of required higher costs due to huge material consume.

4. Intra-Automation Design Standards

- Conical Convergent Angle: 21° ± 1°
- Conical Divergent Angle: 14° ± 1°
- End connection: butt-welds
  flanged connection is available on request as welding-neck or slip-on-type
- Tapping adaptors: ½” NPT
  Others are available on request (i.e. ½” SW, ¾” NPT or SW, etc)
- Tapping Nos: 1 (one) upstream pressure tapping and 1(one) downstream pressure tapping
  There may be used with several sets of pressure tappings on request.
5. Tetragon Duct and Tapless type Venturi

Tetragon Duct

The tetragon is designed and manufactured in order to fit into tetragon duct type piping and the throat have the same area with its throat diameter calculated by ISO-5167, ASME MFC-3M or L.K.SPINK.- standards.

Tapless

The tapless Venturi tube, which has no need of pressure tappings for differential pressure measurement, can be effectively used (with less pressure drop) for flow measurement of a slurry fluid, a fluid with suspensions, or a corrosive fluid. It can also measure a liquid which solidifies at low temperatures, or a liquid which vaporizes at high temperatures.

- max. temperature: -40...+280 °C
- pressure rating: up to JIS 20K RF up to ANSI 300 lb
6. Equations

Equations describing the Venturi-principle:

From the Bernoulli-Equation:

\[ \frac{w_1^2 \rho}{2} + p_1 + \rho g z = \frac{w_2^2 \rho}{2} + p_2 + \rho g z_2 \]

with

\[ z_1 - z_2 = h \]
\[ p_1 - p_2 = \Delta p \]

concludes into

\[ \Delta p + \rho g h = \frac{1}{2} \rho (w_2^2 - w_1^2) = \frac{1}{2} \rho \frac{w_2^2}{w_1^2} 1 - \frac{w_1^2}{w_2^2} \]

based on mass conservation:

\[ w_1 A_1 = w_2 A_2 \]
\[ w_1 = \frac{A_2}{A_1} w_2 \]

the following is additionally valid:

\[ \Delta p + \rho g h = \frac{1}{2} \rho \frac{w_2^2}{1 - \left[ \frac{A_2}{A_1} \right]^2} \]

\[ w_2 = \sqrt{\frac{2(\Delta p + \rho g h)}{\rho \left(1 - \left[ \frac{A_2}{A_1} \right]^2\right)}} \]

So the mass flow in a Venturi pipe is as follows:

\[ m = \rho A_2 w_2 = \rho \frac{A_2}{\sqrt{1 - \left(\frac{A_2}{A_1}\right)^2}} \sqrt{\frac{2}{\rho} (\Delta p + \rho g h)} \]
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