INTERPLANT STANDARD - STEEL INDUSTRY		
IPSS	**SPECIFICATION OF VORTEX TYPE FLOWMETER**	**IPSS: 2-07-102-15**
	No Corresponding IS Exists	Formerly-: *(New Standard)*

0. FOREWORD

0.1 Interplant standardization activity in steel industry is being pursued under the aegis of Steel Authority of India Limited (SAIL). This interplant Standard has been prepared by the Standards committee on Computerization and Automation IPSS 2:7, with the active participation of representatives from the steel plants, other concernd organizations and established manufacturers in the field, and was adopted on May, 2015.

0.2 Interplant Standards on design parameters primarily aim at achieving rationalization and unification of parts and assemblies of process and auxiliary equipment used in steel plants and these are intended to provide guidance to the steel plant engineers, consultants and manufacturers in their design activities.

0.3 Objective:

Objective of this standard on specification of Vortex type flow meter is to give an idea for selection and preparation of specifications for Vortex flow meter for the measurement of fluid flow in steel plant application.

1.0 Scope

This standard covers different parameters which are to be given attentions while selection of **Vortex type flow meters** for its application in steel plants.

2.0 Principle of Measurement:

2.1 Vortex flow meter makes use of the principle called Von Karman effect. According to this, flow will alternately generate vortices when passing through a bluff body in the medium. In a vortex meter, the bluff body is a piece of material with a broad, flat front that extends vertically into the flow stream. Flow velocity is proportional to the frequency of the vortices.

$$\text{Vortex frequency (f)} = \frac{\text{Strouhal number(St) x Flow Velocity (v)}}{\text{Vortex shedder width (d)}}$$

Struohal number and shedder width are the constants for a particular meter. So, Flow velocity is proportional to the vortex frequency. Hence flow rate is calculated by multiplying the area of the pipe line to the velocity of the flow.

2.2 In order to compute the flow rate, vortex flow meter counts the number of vortices generated by the bluff body. Piezoelectric sensor or capacitive sensor or ultrasonic sensors are used to detect the vortices.

3.0 Functional Specifications:

3.1 Service: Liquid, Gas, Steam application

3.2 Line size: Wafer type ½" to 8" , but can go up to 16" .
DN 15 to DN 200.
Flanged ½" to 12"
DN 15 to DN 300

Pipe schedule : Process piping schedule : 10, 40, 80, 160

3.3 Output Signal :

(i) DC 4 – 20 mA Superimposed HART(Latest version).
(ii) Pulse output, (Optional) : 0- 10000 Hz.
(iii) Foundation Field Bus/ Profibus PA

Analog Output Adjustment:

- Engineering units and lower & upper range values are user selectable

3.4 Ambient temperature Limit: Normally - 20˚C to 65˚C.

3.5 Pressure Limit :

Flange style meter :
Rated to ASME B16.5 (ANSI) # 150, #300, #600, #600, #900, #1500
Wafer style meter :
Rated for ASME B16.5 (ANSI) #150, #300, #600

3.6 Self Diagnostic :

i) Fail safe mode should be considered for safety.
ii) Saturation output value should be programmed accordingly.

3.7 Damping and response time:

May be adjusted between 0.2 and 250 sec.
Response time : 3-vortex shedding cycle or 300 ms.

3.8 Low Cut-Off :

Adjustable over entire flow range. Below a selected value, output is driven to 4 mA and zero for pulse output frequency.

4.0 Performance Specifications:

4.1 i) Versatile flow meter provide up to 30:1 turn down ratio.
ii) Capable of withstanding product viscosities as high as 30 Cp or as low as 0.01 Cp for high temperature, high quality steam.
iii) Low permanent pressure loss compared to orifice plate.

4.2 Accuracy :

For liquid , (Rd > 20000), accuracy =± 0.75 % of rate or better.
For Gas and steam, (Rd>20000) accuracy =± 1 % of rate .

4.3 Repeatability: ± 0.2% of actual flow rate.

4.4 Process temperature Effect:

Automatic K-factor correction with user entered process temperature.

4.6 Built in EMI/RFI and Magnetic field Interferences immunity as per EN61326 :

5.0 Physical Specifications:

5.1 Mounting: i) Integral – electronics are mounted on the meter body.

ii) Remote – Electronics may be mounted remotely. Length of cable from meter bidy to electronics must be considered.

5.2 Temperature limitations of integral mountings:

Ambient temperature and process temperature should be considered so that electronics must not expose to temperature exceeding 85˚C.

5.3 Enclosure IP-66

6.0 Selection Guidelines:

6.1 Low flow rates present a problem for vortex meters, because they generate vortices irregularly under low flow conditions

6.2 In some cases, vortex meters requires the use of straightening vanes or straight up stream piping to eliminate distorted flow patterns and swirls. It is required to have upstream straight pipe diameter(D) ranging from 10 D to 40 D depending on disturbances and manufacturer without flow conditioning.

6.3 The accuracy of vortex meter is from medium to high, depending on model and manufacturer. Gas, liquid as well as steam flow meters with vortex principle are in use.

6.4 In addition to their ability to tolerate high process temperature and pressure, vortex meters have wide rangeability. This allows them to measure steam flow at varying velocities.

6.5 Multivariable Vortex: By using information from in-built RTD sensor and Pressure transducer, the flow meter can determine volumetric flow, temperature, pressure, fluid density and compute mass flow. Multivariable vortex flow meter have the capability of measuring mass flow and this makes them attractive, specifically for steam and gas flow measurement.

6.6 For majority of manufacturer, Strouhal number(St) is constant when Reynolds number(Re) is between 20000 to 7000000.

$$\text{Reynold Number (Rd)} = \frac{VD\rho}{\mu}$$

V – Flow velocity, D- Inside diameter of pipe, ρ – density of fluid , µ – Viscosity of fluid.

So for measurable Flow rate, process condition must be within limiting values of Rd and velocity limitations specified by the manufacturer of the flow meter.

Therefore, as long as the Rd falls within limiting range, the vortex frequency is not affected by change in fluid viscosity, density, temperature or pressure, unlike many other meter technologies.

6.7 One perennial problem with vortex flow meter has been susceptibility to vibration error. Vibration in the line can cause a vortex flow meter to falsely generate a vortex signal; or to incorrectly read the existing vortex signal. However, supplier has responded to these issues of surrounding vibration can be taken care by implementing software and electronics, including digital signal processing that will reduce the susceptibility of vortex meters to interference from vibration.

6.8 Minimum Back Pressure :

Following condition that would allow Cavitations, the release of vapour from a liquid, should be avoided.

To prevent cavitations, the minimum back pressure should be

$P = 2.9\ \Delta p + 1.3\ p_v$

or $P = 2.9\ \Delta p + p_v + 0.5$ psia, Use smaller of these two result.

P – Line pressure at five pipe dia downstream of the meter , psia.

Δp – Pressure loss across the meter , psi

p_v - Liquid vapour pressure at operating condition, psia