Schneider Electric Vortex Overview

Javier Lopera, Stephanie Brandenburg - Flow Offer Manager – April 2020

Life Is On Schneider Electric

Agenda

- Vortex Technology
- SE Vortex Portfolio
- Key Features of SE Vortex
- Sanitary Vortex
- Multivariable Vortex
- Applications
- Production Vortex Meter
- Vortex Competitor Comparison
- Software Tools
- Q&A

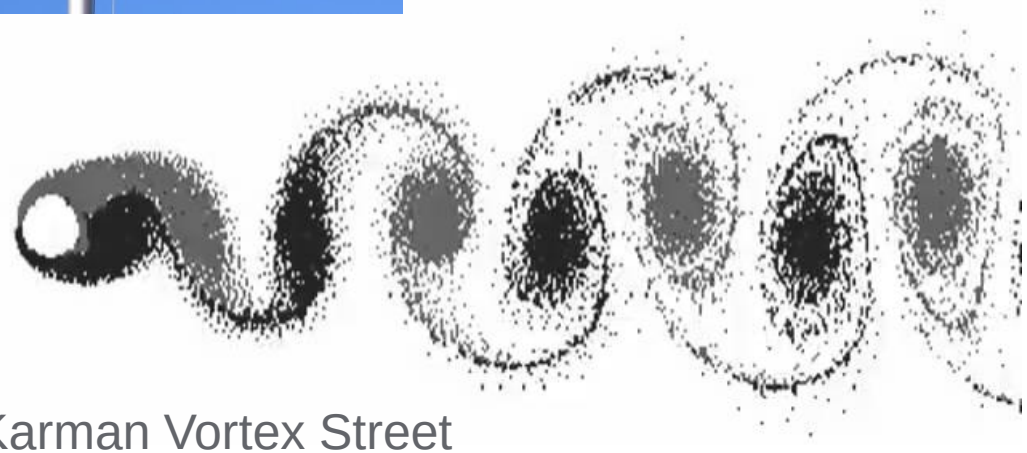
Vortex Technology

When a body is placed in the middle of a turbulent media flow vortexes are formed on both sides, for example a flag waving from a flagpole.

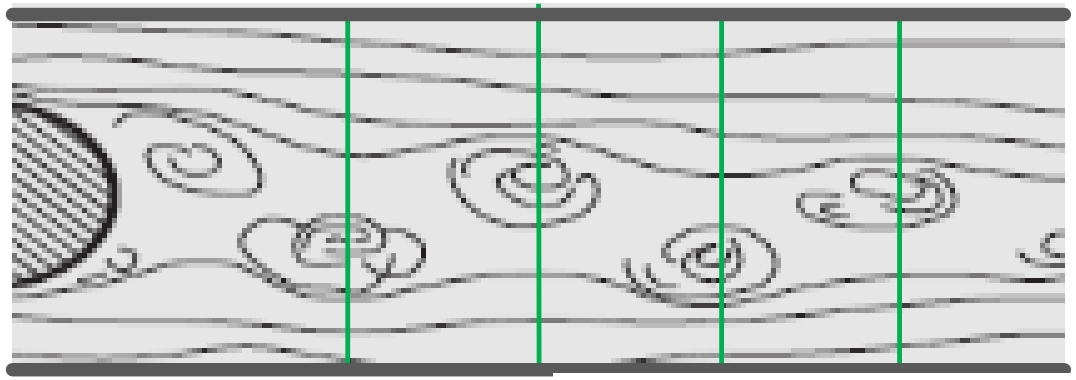
The flagpole acts as a bluff body and vortex shedding occurs.
As the wind speed increases the **rate of vortex** shedding **increases** and causes the flag to wave faster (higher frequency).

That periodic vortexes are shed from each side alternately was discovered by Karman after whom the Karman Vortex Street is named.

Knowing the pipe diameter … every section between the vortexes represents a defined volume, so vortex is a **true volumetric flow measurement.**



Karman Vortex Street



Advantages of Vortex flowmeters

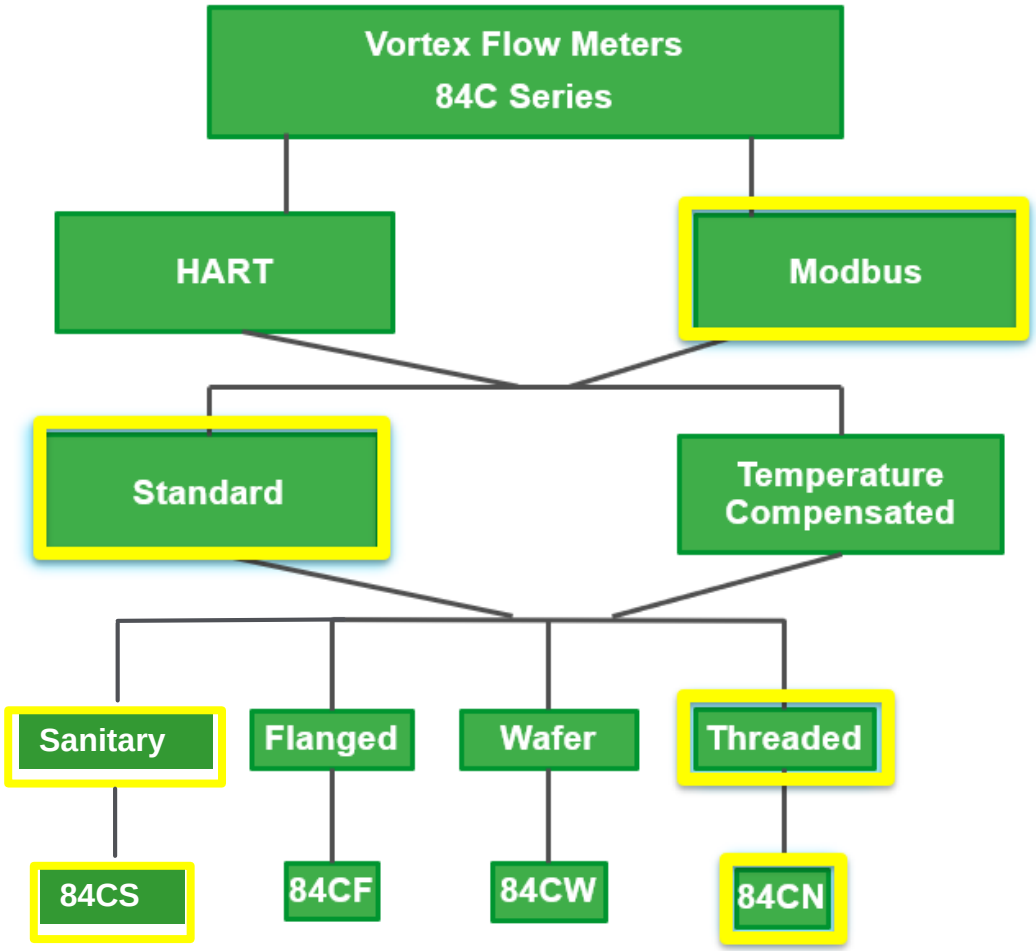
- True **Volumetric** Flow measurement
- **% of Rate** accuracy for better accuracy
- **Low cost of ownership**
  - Economically priced
  - Easy installation
  - Excellent durability and reliability
  - No moving parts = low maintenance cost
  - ½ the permanent pressure loss compared to orifice plate

Wide range of flow measurement
  - 40:1 typical for Liquids
  - 20:1 typical for Gas/Steam

- **Few joints** for fugitive emissions
- **Wide applicability**, from liquid gas to superheated steam
- Multi-Variable sensor provides a Mass-flow measurement.
- Low-cost alternative to Coriolis for liquid measurement.

84C Vortex Series

Best-in Class Vortex Offer



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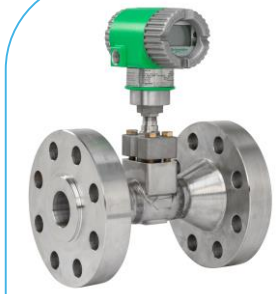
Vortex Portfolio



84CF / 84CW Vortex flowmeter

General purpose

- Accuracy: ±0.5% liquid ; ± 1.0% gas and steam
- Flanged or Wafer end-connection
- 3/4 - 12"; DN15 to DN300

Applications

Oil & Gas	Gas, Liquid or Steam applications
Chemical	De-ionized water
Semi-con	

84CF/84CW Temp.compensated Vortex

Energy and mass meter for Saturated Steam

- Best in class accuracy: ±1.4% mass sat. Steam
- Flanged or Wafer end-connection

Applications

Oil & Gas	Steam injection
Chemical	Utility & process steam distribution
P & P	Coriolis alternative

84CN - NPT Threaded connections

Direct replacement for Turbine

- Male NPT thread, 1" to 2"; DN25 to DN50
- Solar powered option

Applications

Oil & Gas	Upstream O&G
Chemical	Non-potable water supply
Building	Cooling water, Hot water delivery

84CS Sanitary vortex

Hygienic applications

- 3A certified
- Suitable for CIP / SIP process
- 2" to 3"; DN50 to DN80

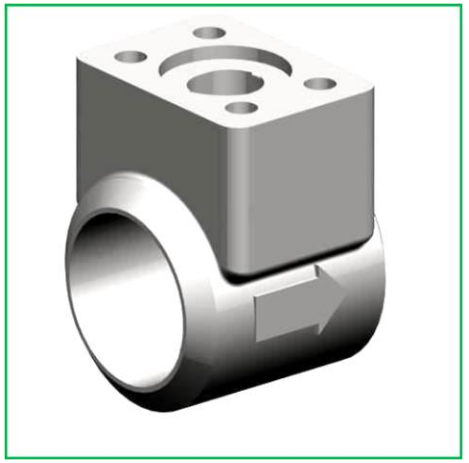
Applications

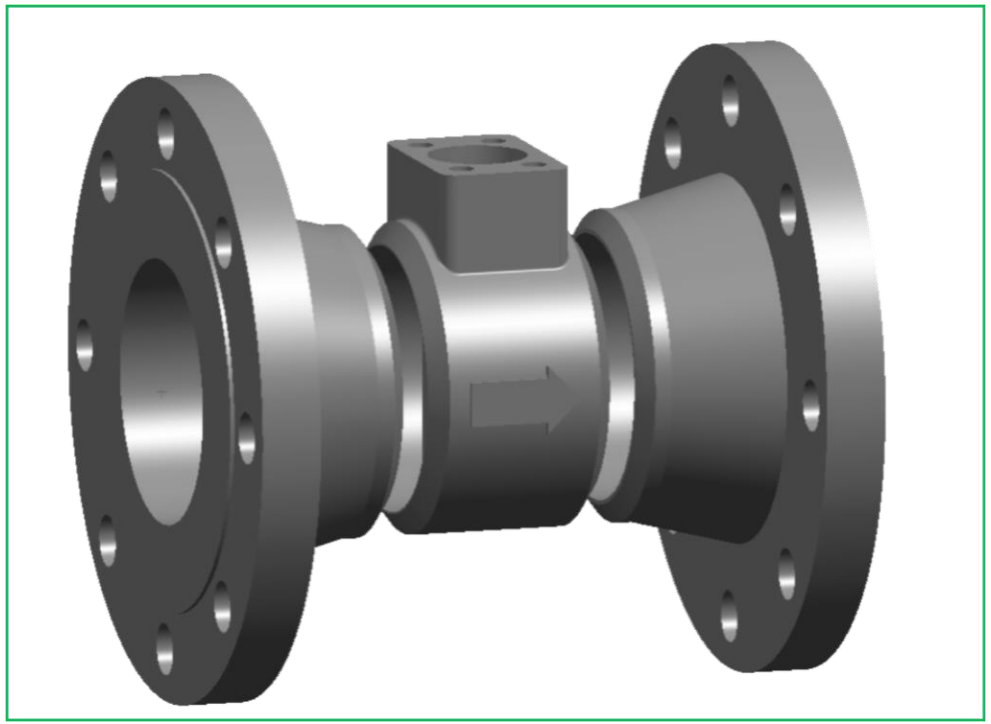
F & B	Milk, bottled water, juices
Pharma	Purified water
	CIP / SIP skid

Vortex Modular Construction

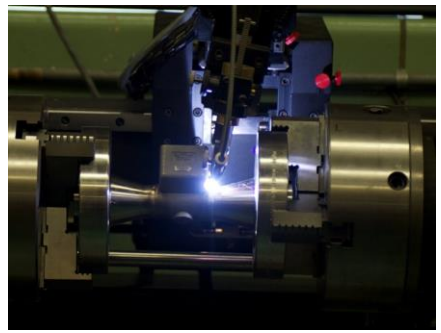
Vortex 84C Platform

- Center body design





- “C” platform is more flexible and cost effective!



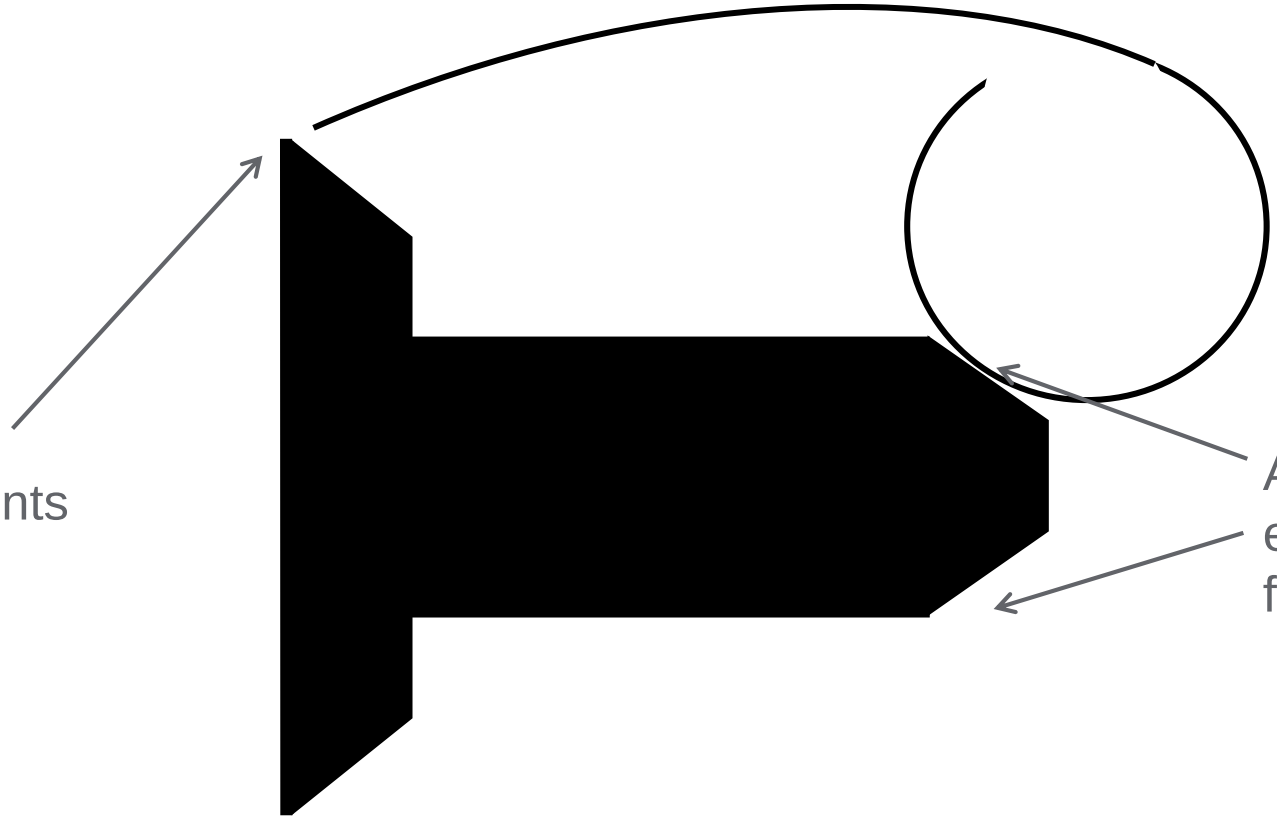
Schneider Electric production plant

Key Features of SE Vortex

1. Unique shedder design
2. Unique sensor with *DirectSense*™ Technology
3. *Active Tuning*™ Algorithms

1. Unique Shedder Design

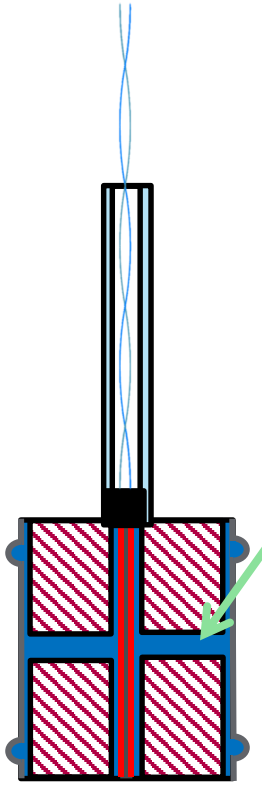
Key Takeaway
Precise design and machining produces



Precise take off points

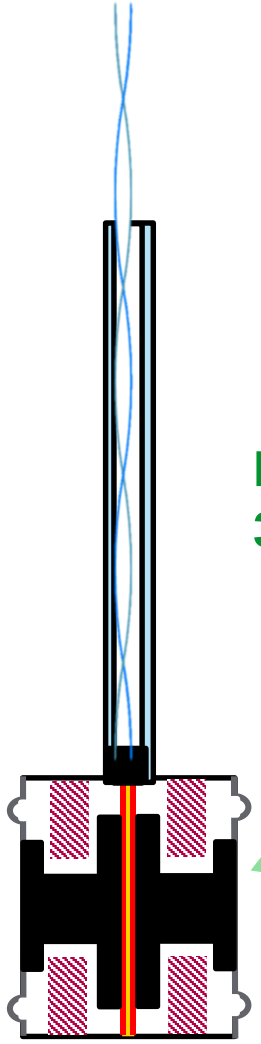
Angled tail for enhanced vortex formation

2. Unique Sensor Design



Fill fluid

Standard sensor
0 to 400 ºF (-20 to 200 ºC)



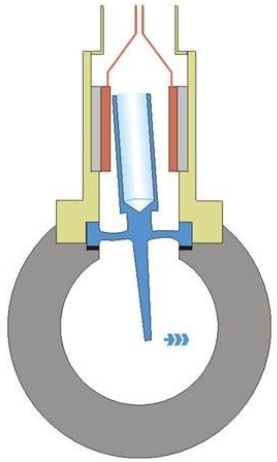
Hi-temp sensor
300 to 800 ºF (151 to 430 ºC)

No Fill fluid

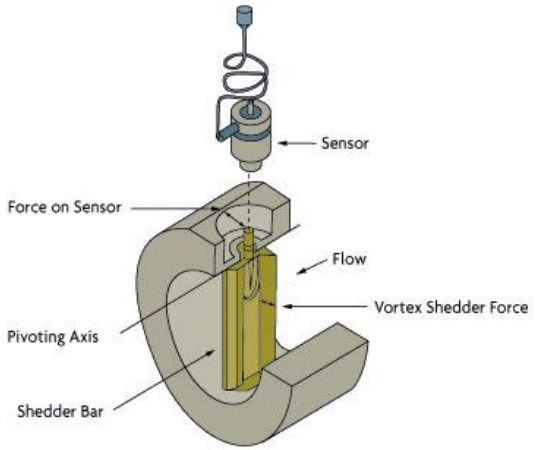
Why DirectSense™ technology is so important ?

- Many vortex meters rely on the **movement of a mechanical "flapper"** to detect vortices and transfer the vortex pulses (loose efficiency in signal strength) to the sensor convert this mechanical into electrical signal. (Endress+Hauser, Emerson, Rosemount, …)
  - **SE Process Instrumentation Vortex Meter are free of moving parts, to reduce wear and increase measurement performance.**

Endress+Hauser

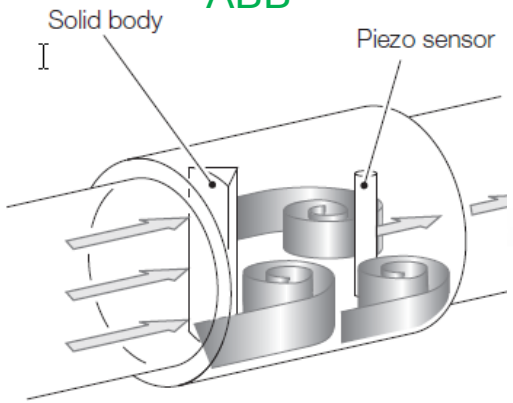


Emerson (Rosemount)

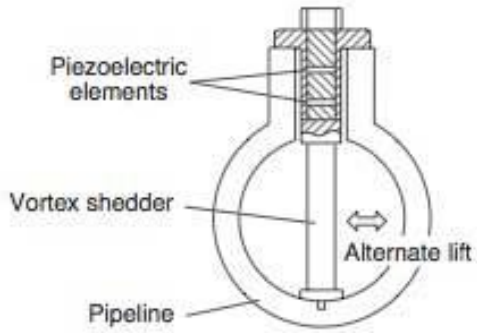


- Some vortex meters detect vortices with a **piezo sensor**, here is the **location of measurement point** very important for the accuracy and rangeability (in the flow or how far away from bluff body). (Schneider Electric, ABB, Yokogawa, …)
  - **DirectSense™ technology incorporates the sensor technology directly into the flow stream, to maximize the vortex pulse strength, rangeability and noise immunity.**

ABB

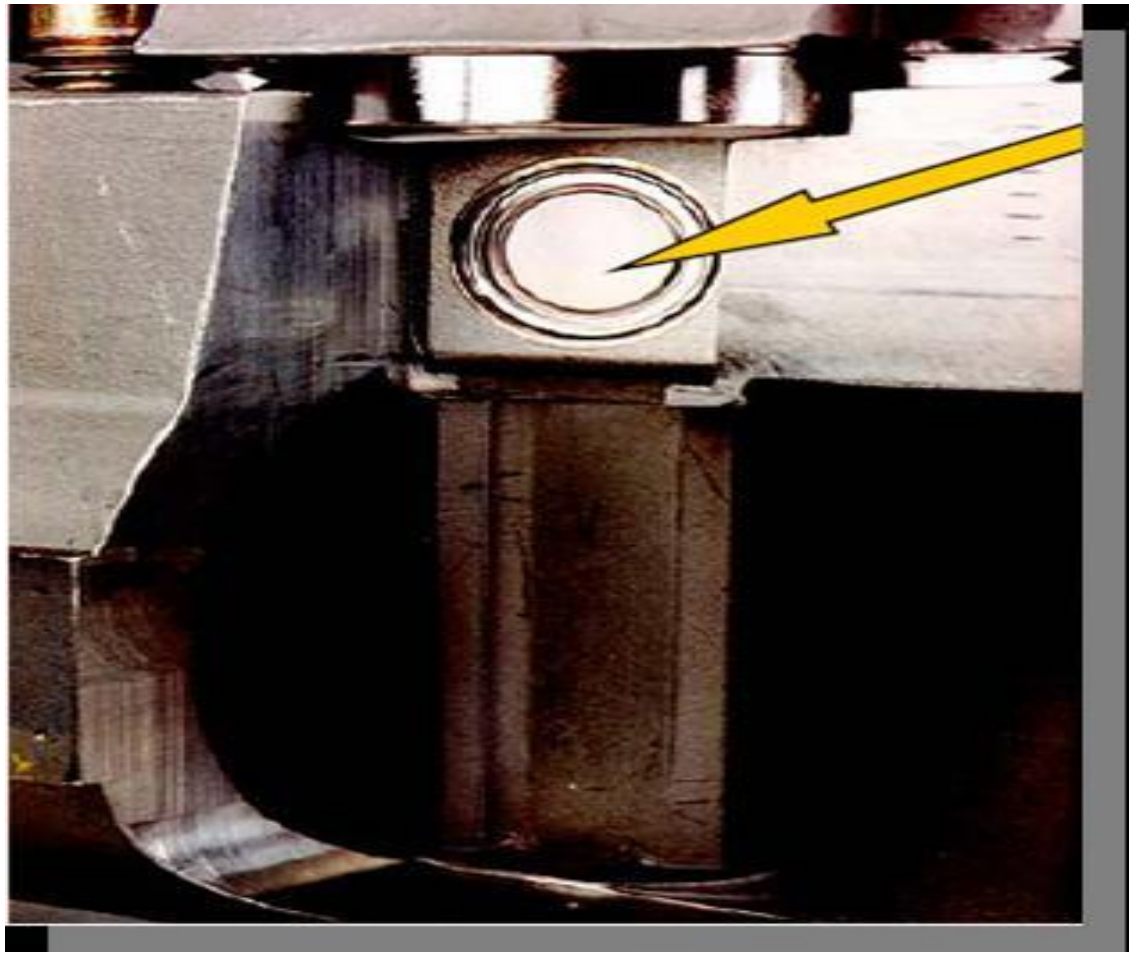


Yokogawa



What is DirectSenseTM technology?

- Unlike most other vortex meters, the **Model 84 has no unreliable mechanical linkage** between process and sensor, and no vibrating shedder bars.
  - Greater sensitivity for **higher accuracy** and **wider flow rate** measurement capability
  - **Less noise** from pipe vibration
  - Large sensing surface, **no clogging**
  - Simpler design for **better reliability**
- **Lifetime sensor warranty***



***Temp. compensated sensor has a 3-year warranty**

3. Schneider Electric's ActiveTuning™ intelligence

- **ActiveTuning™ algorithms** includes a number of electronic features that improve the accuracy of the flow measurement:

1) **Real time Reynolds number (Re) low flow correction** down to Re of 5000
2) **Low Flow Cut-In** (LFCI)
3) **Compensation** for **piping effects**
4) **Adaptive filtering** and **Signal conditioning**

84CS Sanitary Vortex

Sanitary Applications with Vortex

What can we Offer?

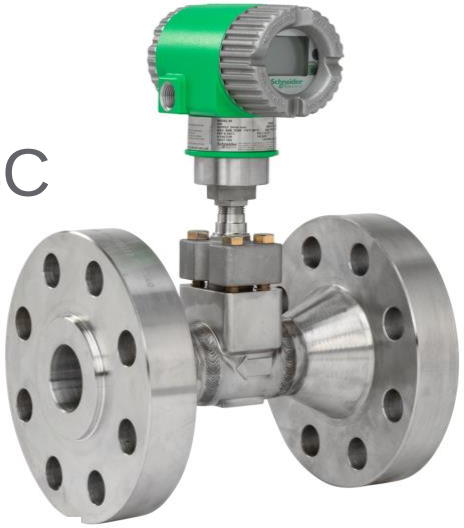
- **Vortex 84CS** = ONLY Sanitary Vortex meter in market
  - Available in 2” and 3” line size
  - 3A Certified design: crevice-free design with NO moving parts
  - Sanitary, Quick-Disconnect fittings

- Clean-in Place construction
- Low-Power consumption (competes vs High-Power Magflow meters)
- Full Suite of Certifications (FM, CSA, ATEX, IECEx…)
- Piezo-electric *Direct Sense™* Technology
- High accuracy
- Maximum temperature 350F (177 C)
- Wide range-ability
- Easy to install and maintain
- No need to re-calibrate

84C Multivariable Vortex

Multivariable Vortex

Vortex Model 84C



Model 84

RTD

Temperature XMTR

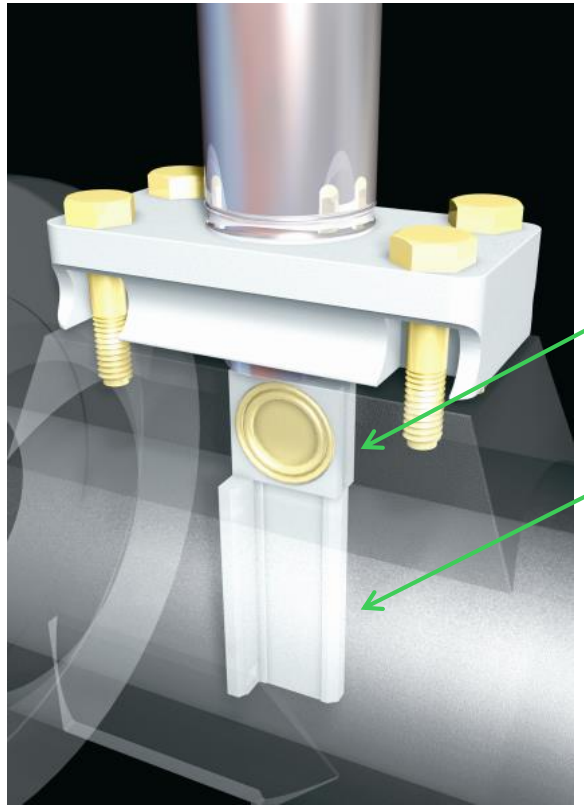
Mass Flow Computer

Temperature Compensated Vortex 84C

- **Vortex 84C** = Vortex 84
  - plus built in **temperature sensor**
  - plus built in **flow computer**
- Provides:
  - Volumetric Flow
  - Temperature
  - Mass Flow
- Built in mass flow computer for:
  - **Saturated Steam** calculation
  - **Superheated Steam** calculation
  - **user defined liquids**
- High accuracy
- Wide range-ability
- Easy to install and maintain
- No need to re-calibrate

Direct Sense™ vortex sensor

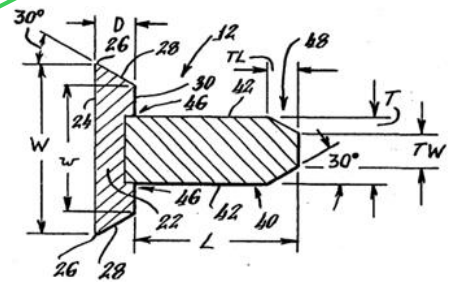
- **Widest flow range**
- **No moving parts**
- **Measuring where Vortexes are generated**



Key Takeaway
Patented integral construction, no additional process penetrations

Direct Sense
Vortex Sensor

Unique bluff body
(aka Shedder bar)



Built in 1000 Ω
4 wire platinum RTD

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Vortex Applications

Vortex Applications

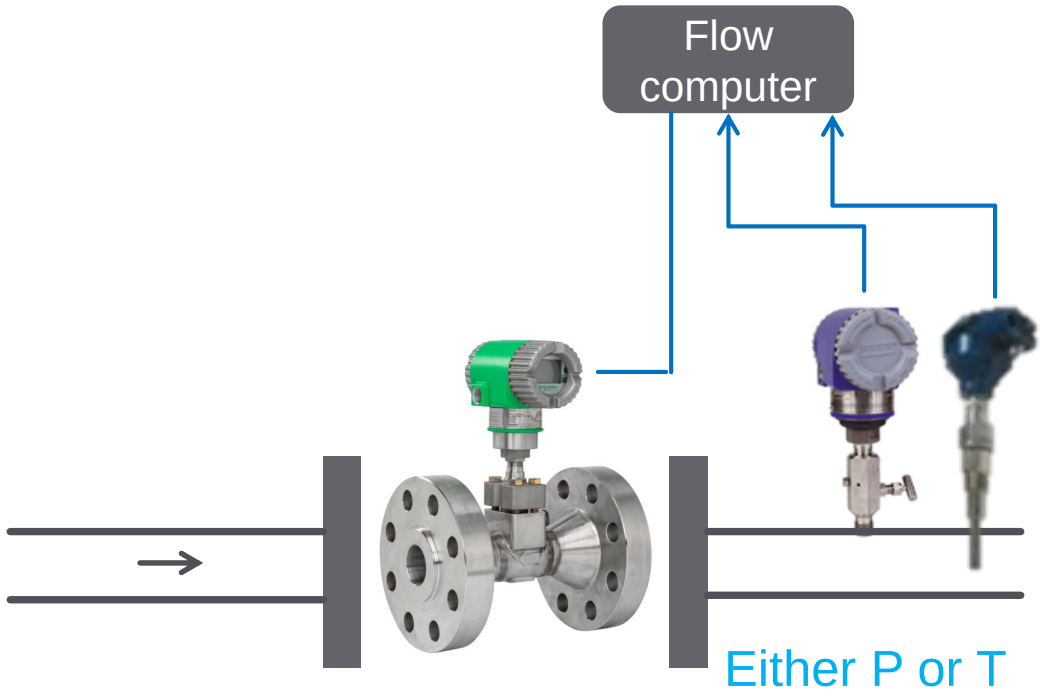
SE Vortex meters are ideal flow meters for:

- Liquid application (clean recommended)
- Sanitary applications (CIP/SIP): food and beverage, pharmaceuticals
- Low Conductivity process (< 5 µS)
- High Temperature and High Pressure applications
- Gas (clean recommended)
- Steam (saturated and superheated)

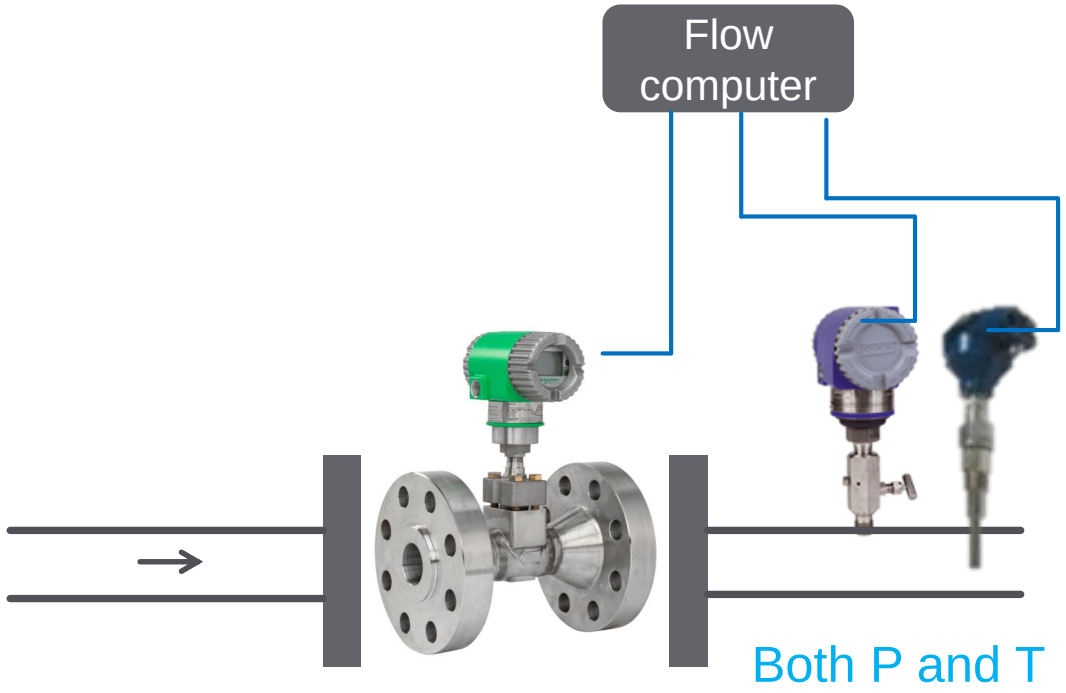
Steam Applications

Vortex Flow Measurement in Steam

Saturated Steam



Superheated Steam



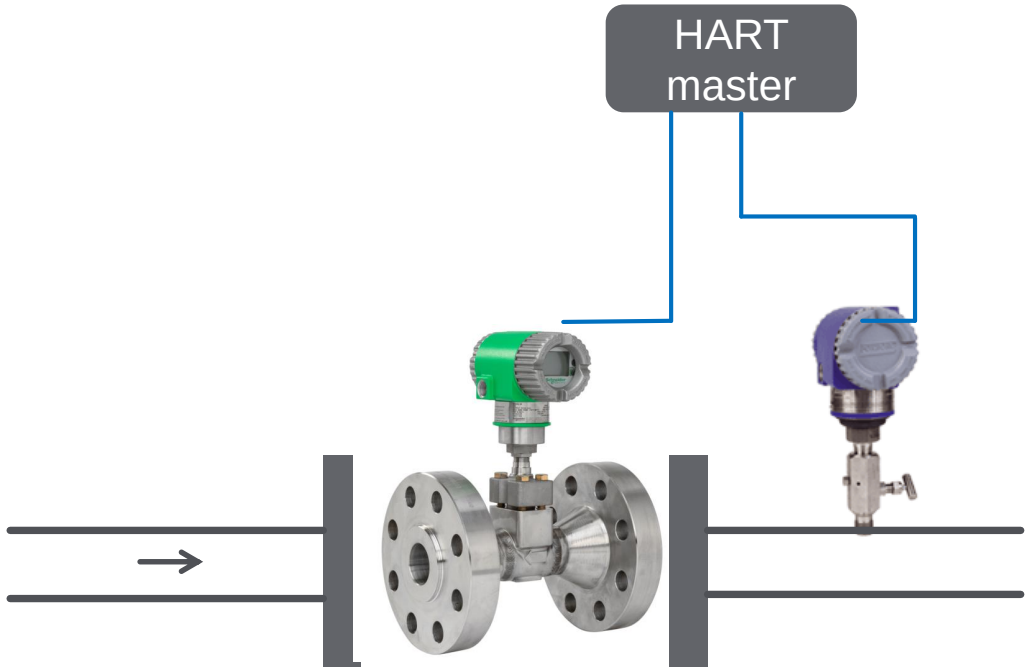
With the 84C!!!

Saturated Steam

Key Takeaway

84C saves the user much money and complexity!!!

Superheated Steam



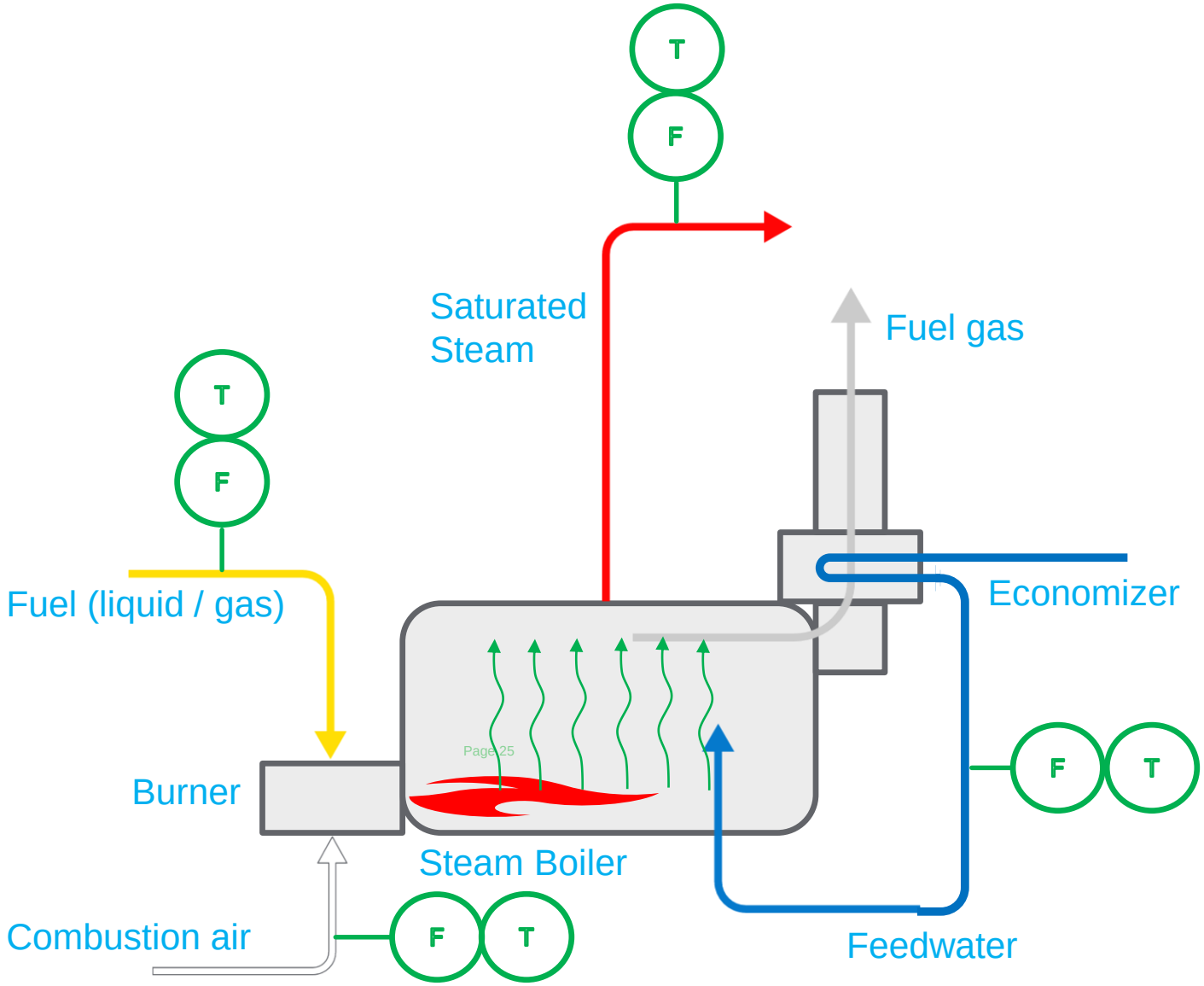
Saturated and Superheated Steam

Why use Vortex for Steam?

- High accuracy … Better manage of energy utilization
- Wide range-ability … Deal with seasonal changes in demand
- Frequency based … Simplifies custody transfer applications
- No moving parts … Reduces maintenance
- No need to re-calibrate … Long service life

- **These all add up to low cost of ownership and increased revenue for your customer !!!**
- **Replace DP flow and old mechanical meters!!**

Vortex in Steam Distribution Applications

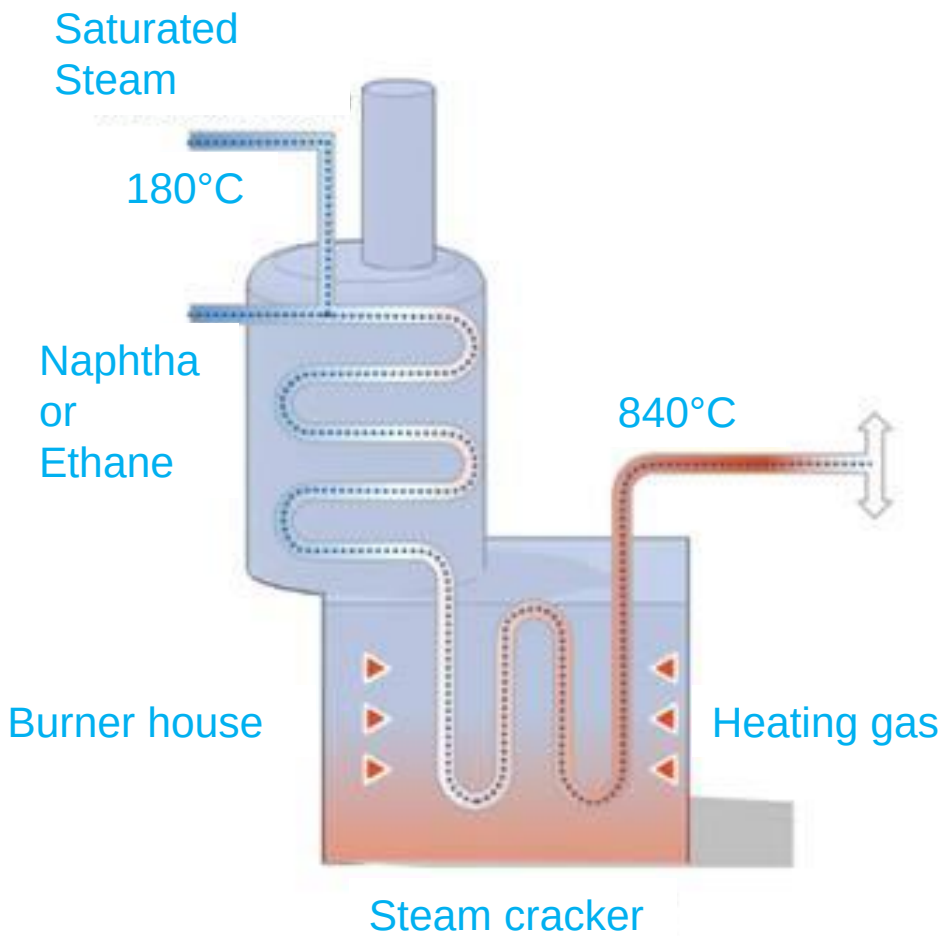


84C platform gives you;

- With temp compensation you can measure **Mass flow** in Saturated steam in Nm³ up to 500°F / 260°C
- With Temp compensation you can measure **Heat Content/ Flow** in J, BTU
- Without temp compensation temp range up to 800°F/ 427°C and up to class 1500 or PN160

Vortex in Refinery Applications

Gas and Steam Measurement

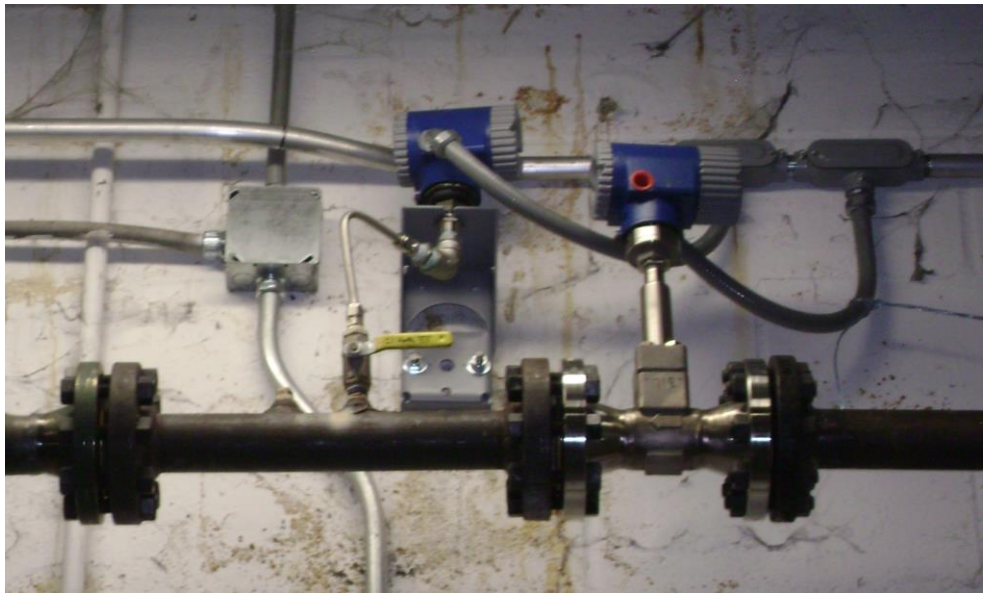


Many Vortex applications in a Refinery, for example;

- On a Steam cracker for injection
- For heating or pre-heating purposes thru heat exchangers
- All kind of Gas measurements as refineries use Hydrogen gas, Oxygen gas, Chlorine gas in their processes
- Vortex can be used as cheaper alternative for Coriolis with external pressure compensation to produce Mass flow numbers

Vortex in Pulp and Paper Application

Application for Saturated Steam Mass flow measurement



Steam is used to heat the drying drums in paper mills all over the world. Our customer is already monitoring the steam pressure, but isn't able to monitor the steam mass flow itself to optimize his steam consumption.

Customer functional specs:

- **Wide measurement range**, due to the large difference in steam consumption for drying in paper mills.
  The seasons provide some issues for a paper mill and the demand for steam is going up and down and the meter needs to measure it all to optimize energy utilization. **(=> FlowExpertPRO**)
- To keep the **cost-of-ownership low** and especially take care of **maintenance budget**.
  The customer was pleased by our meter without moving parts and no need for recalibration.
- **Low installation and commissioning cost**, best without additional engineers.
  Preference is to use own personnel, this provides flexibility scheduling installation/ commissioning.

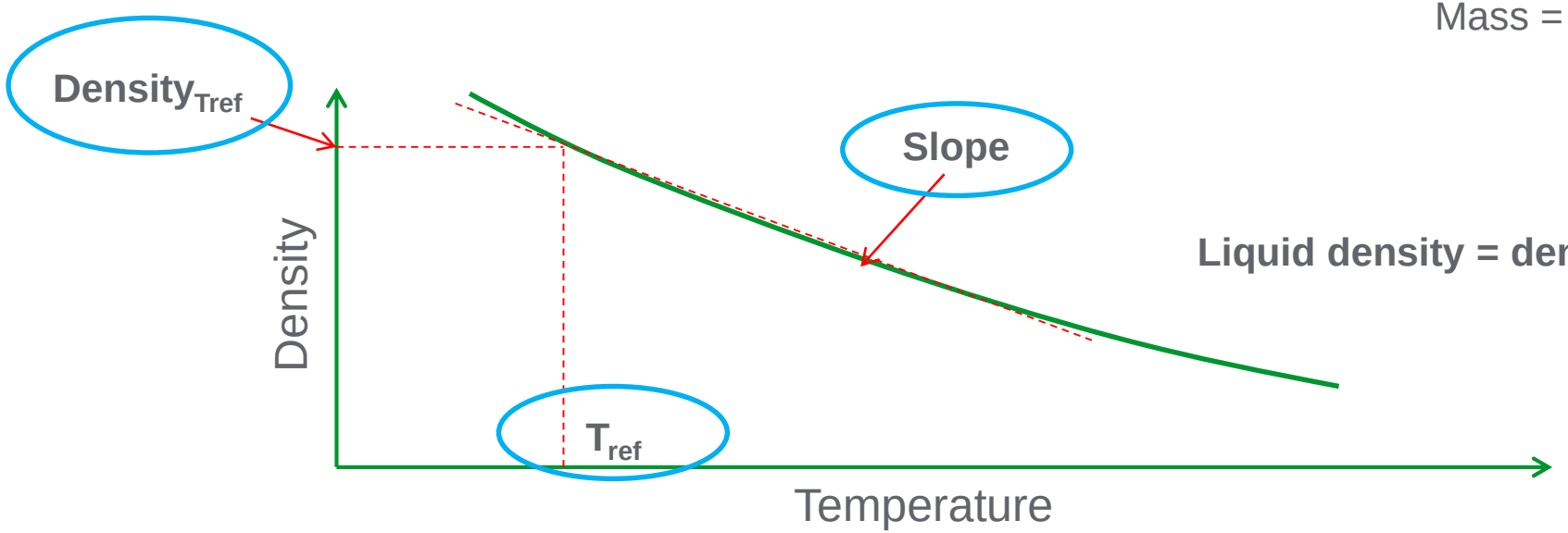
Massflow of User Defined Liquids

Low Cost Liquid Mass Flow Measurement

User defined liquids with temperature compensation

The mass flow of a substance is its volume flow multiplied with density

Mass = Volume x density



Liquid density = density$_{Tref}$ + (Δdensity/Δtemp) x (T-T$_{ref}$)

Slope

Value

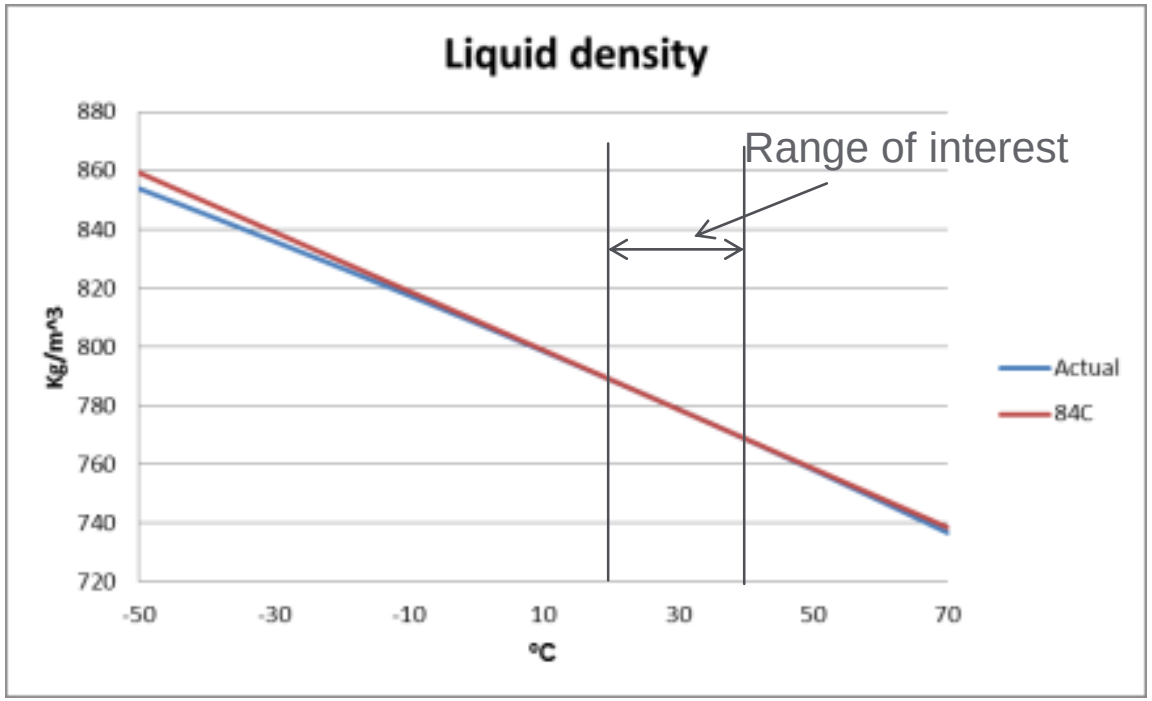
- Much less expensive than Coriolis
  Especially in sizes above 3”
- With good accuracies Typically less than 1%

Mass flow of liquids

Example: Liquid Ethanol

°C	real denisty	calculated density	Error
20	788,89	788,99	0,012%
25	783,92	783,95	0,004%
26	782,93	782,94	0,001%
27	781,93	781,93	0,000%
28	780,92	780,93	0,001%
29	779,92	779,92	0,000%
30	778,91	778,91	0,000%
31	777,91	777,90	-0,001%
32	776,90	776,90	-0,001%
33	775,88	775,89	0,001%
34	774,87	774,88	0,001%
35	773,85	773,87	0,003%
40	768,74	768,84	0,012%

Mass flow of a custom liquid in the range 20 to 40 ºC



Density error = +/- 0.01%

Total mass flow error = +/- 0.50% !

Oil and Gas Applications

NEW- Modbus Communication

Offering

- Modbus RTU (Remote Terminal Unit) mode over 2- wire RS-485 multidrop serial connection
- Explosion-Proof/ Flameproof electrical certifications
- Modbus DTM (with *NEW Easy Configuration WIZARD and Personalities)*

Customer Value

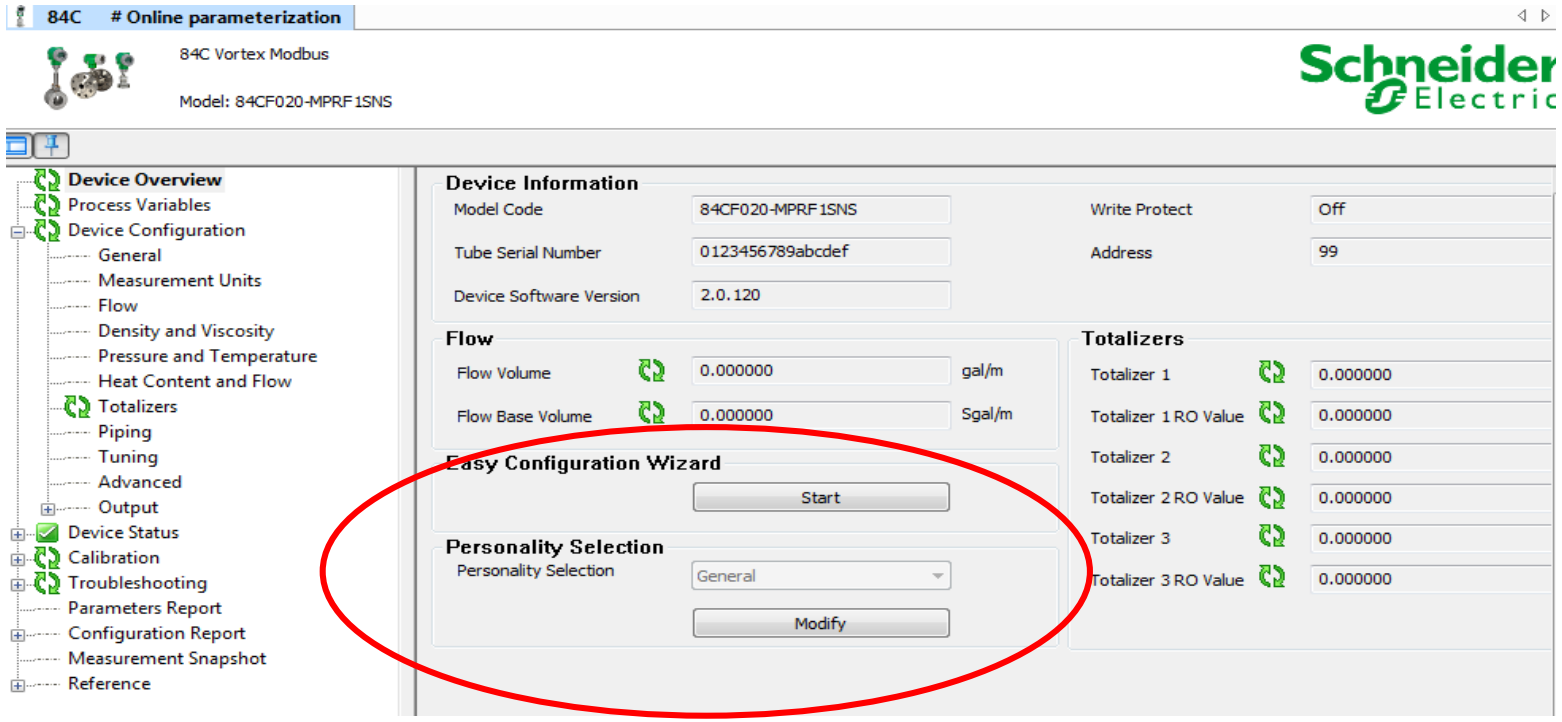
- Preferred Communication protocol for Upstream O&G
- Frees up RTU(cabinet) space vs HART(need adapter)
- Modbus is much faster than HART (Higher update rates)
- Multiple End-connection options: Wafer, Flanged and Threaded (NPT) process connection

Modbus - Low Power

- Low Power* … 180 mW, at 9 Vdc
- One pulse/frequency output and digital Modbus available
- Ideal for SCADA systems
- Doubles battery life/ cuts solar panel requirements in half
- Significantly reduces operating costs

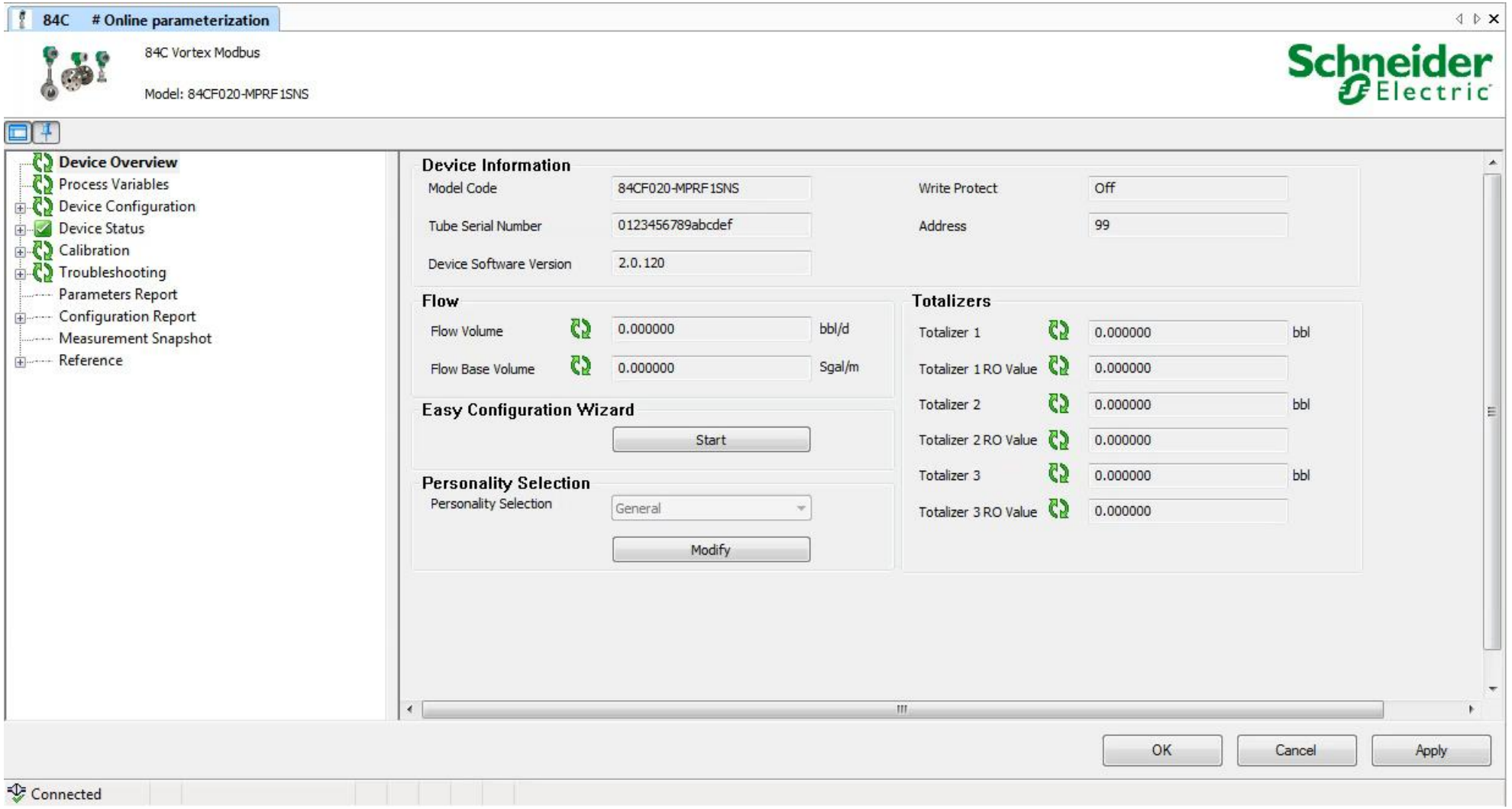
Modbus/HART DTM – Easy 7-Step Configuration Wizard

- Simplification of Configuration, similar to a quick-start with only 7 steps
- Available for “general” or “steam” configuration
- Certified DTM



7-step configuration and the transmitter is up and running

DTM Demonstration



7-step configuration and the transmitter is up and running

Configuration Personalities – Via Modbus/HART DTM or Local Display

- A personality is a pre-configuration that simplifies (or limits) flowmeter settings and measurements available for a specific user application via the Modbus DTM or local display
- For Oil & Gas Applications:
  - A limited set of EGUs are available and ease-of-use menus are provided
  - A single Totalizer is mapped to Volumetric flow
  - The Totalizer EGU matches the Volume Rate EGU. Ex: bbl/d results in a total in barrels
  - If pulse-output is available, it is mapped to Volumetric flow and pre-config
  - For Frequency mode using the user liquid URL of the meter for limiting the max. pulse-out frequency.

EGUs Available

gal/m	gallons per minute
bbl/h	barrels per hour
bbl/d	barrels per day
m3/s	meters cubed per second
m3/d	meter cubed per day

Production Vortex Meter- PVM

Patented and Innovative Software

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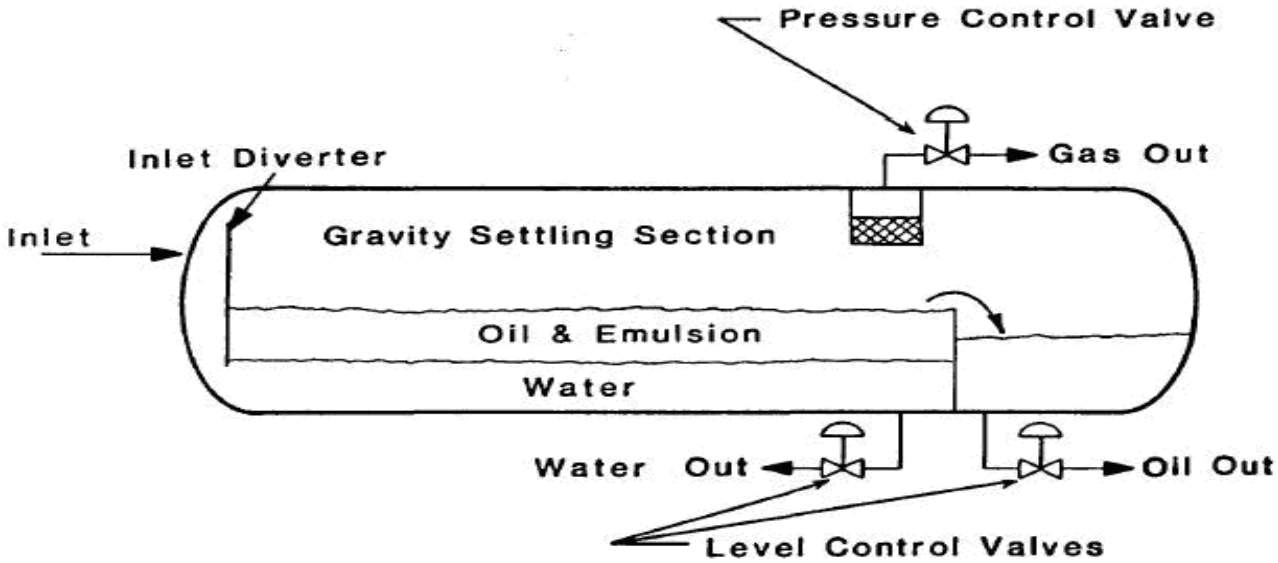
Production Vortex Meter (PVM)

Direct replacement of liquid turbine meters

- Available with all end connections (flanged and wafer)
- Available with standard and low voltage designs
- Available in sizes 1” and 2” (1” and 2” NPT)
- Simplified configuration for O&G
- High flow cut-off feature designed for gas carry under applications on separators (US Patent: 8,576,084)

Pulse output will switch to a very low frequency “heartbeat” when high velocity gas carry under occurs

Typical Oil & Gas Field Separators



Horizontal Separators are commonly used for gas handling applications

Examples of Produced Liquid

Vortex Competitor Comparison

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Vortex Competitor Comparison

	Schneider Electric	Rosemount	Yokogawa	ABB	E&H
Model	**84C Series**	**8800D Series**	**YEWFLO, DY and DYA**	**FSV430 and FSV450**	**200 Series**
Volumetric Liquid accuracy	+/- 0.50% of rate for ALL sizes	+/- 0.65 – 1.0 % of rate	+/-0.75% of rate	+/-0.65% of rate	+/-0.75% of rate
Volumetric Gas accuracy	+/- 1.0% of rate	+/- 1.0% of rate, velocity limited	+/- 1.0% of rate	+/- 0.90% of rate	+/- 1.0% of rate
Massflow Saturated Steam	+/- 1.4% of rate	+/- 2.0% of rate	+/- 2.0% of rate	+/- 2.6% of rate	+/- 1.7% of rate
Line size, Flanged	3/4” to 12” (DN15 to DN300)	1/2” to 12” (DN15 to DN300)	1/2” to 16” (DN15 to DN400)	1/2” to 12” (DN15 to DN300)	1/2” to 12” (DN15 to DN300)
Line size, Wafer	3/4” to 8” (DN15 to DN200)	1/2” to 8” (DN15 to DN200)	1/2” to 4” (DN15 to DN100)	1” to 6” (DN25 to DN150)	1/2” to 6” (DN15 to DN150)
Line size, Threaded	1” and 2” MNPT (DN25 and DN50)	Available	N/A	N/A	N/A
Line size, Sanitary	2” and 3”(DN50 and DN80)	N/A	N/A	N/A	N/A
Dual	*To be added	Yes	Yes	Yes	Yes
Reduced Bore	*Special	Yes	Yes	No	Yes
Operating Pressure	ANSI 1500, PN160	ANSI 1500, PN160, JIS40	ANSI 1500, PN160, JIS40	ANSI 900, PN160	ANSI 1500, PN250
Operating Temperature	0 to 800° F (-20 to 427° C)	-300 to 800° F (-185 to 427° C)	-320 to 842° F (-196 to 450° C)	-67 to 752° F (-55 to 400° C)	-328 to 752° F (-200 to 400° C)
Communication	HART 7, Modbus RTU	HART 7, FF	HART 7, FF	HART 7, Modbus RTU	HART 7, FF, Profibus
Temp. Comp.	Yes, +/- 1°F / 0.56° C	Yes, +/- 2.2°F / 1.2° C	Yes, +/- 0.5% of Value	Yes, +/- 1.8°F / 1.0° C	Yes, +/- 1°F / 0.56° C
Temp. Sensor	RTD, PT1000	Type-N Thermocouple	RTD, PT1000	RTD, PT100	RTD, PT1000
Pressure Comp.	Bring in External	Bring in External	N/A	Bring in External	Integral
Sil2	N/A	Yes	Not published	Yes	Yes

Vortex Tools

Software

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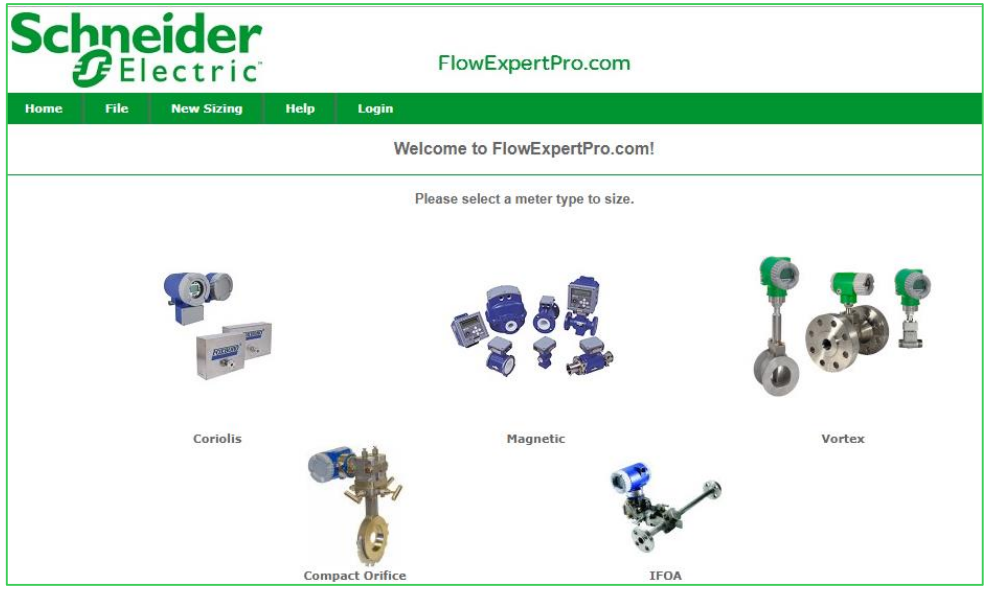
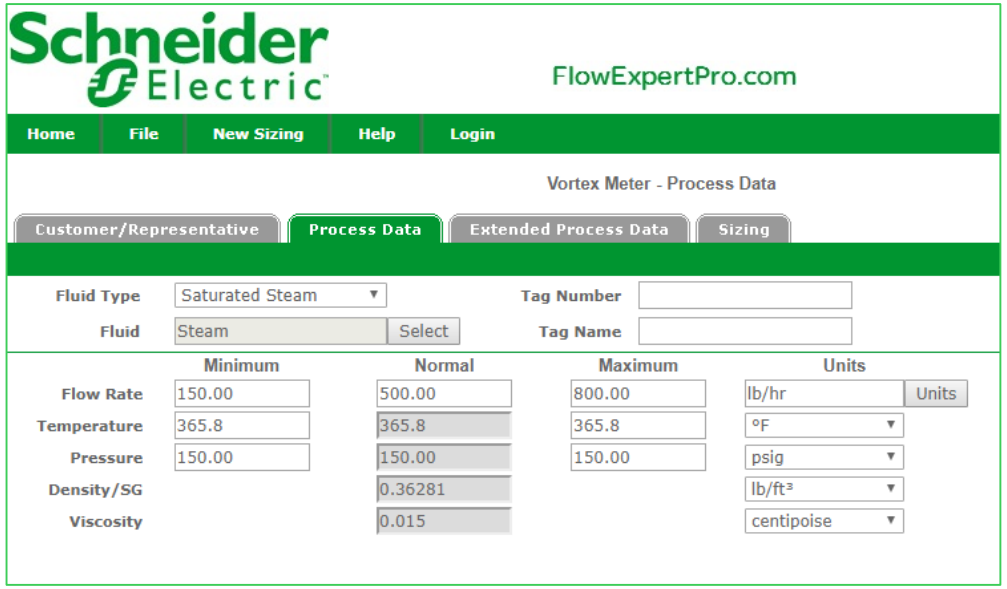
Vortex Sizing Tool





For correct sizing go to **www.Flowexpertpro.com**
(also available as IOS or Android App)

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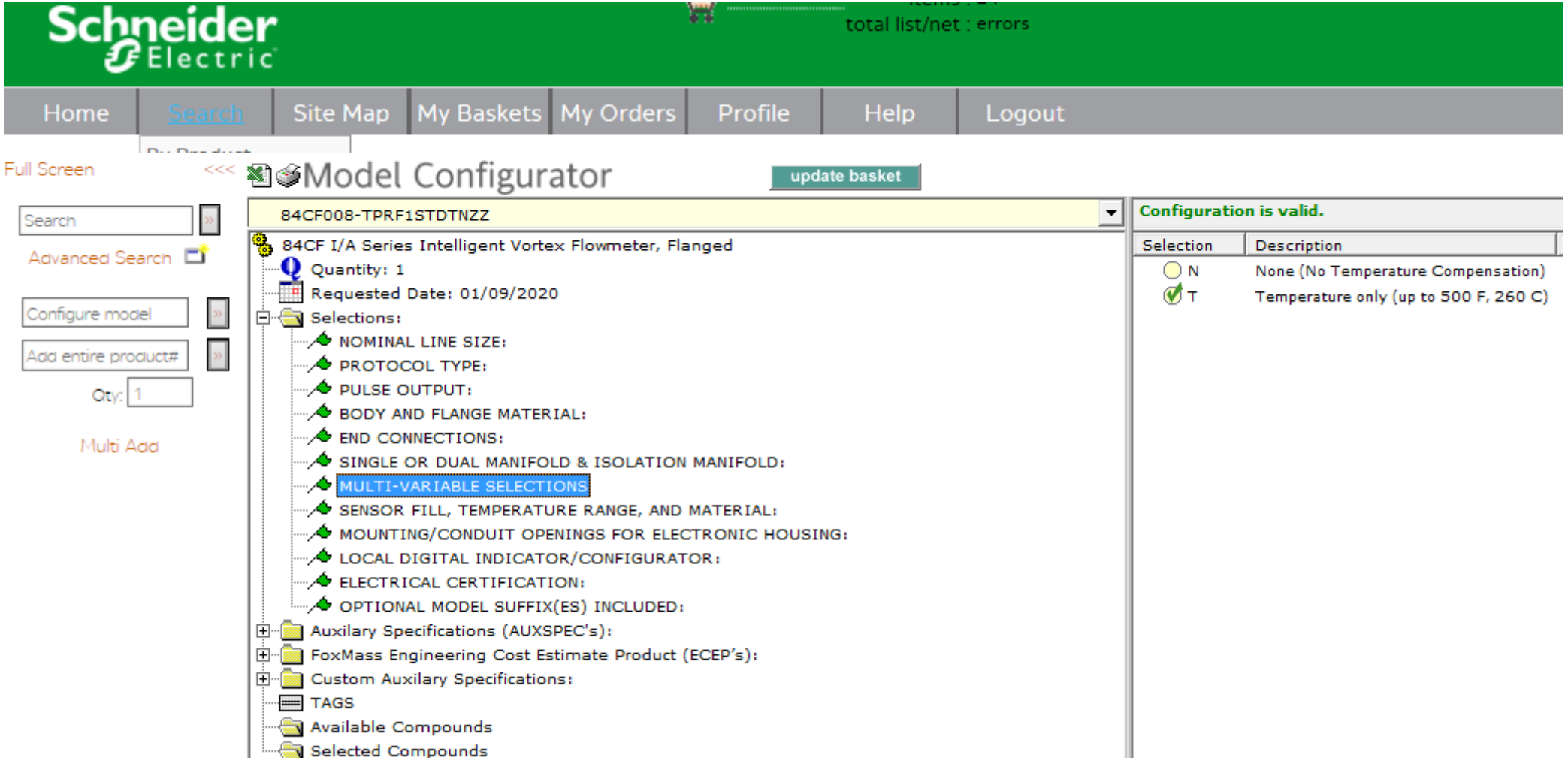

Take Aways

- SE Vortex sensor has **no moving parts, a unique shedder design** and uses ***DirectSense™*** and ***Active Tuning™*** technologies:
- *DirectSense*™ technology places the sensor directly into the flow stream to maximize the vortex pulse strength resulting in **wider rangeability** and **greater noise immunity**
- *ActiveTuning*™ algorithms improve flow measurement **accuracy**

Unique Shedder Design ➔ High accuracy

Direct Sense™ Technology ➔ Wide rangeability

Active Tuning™ Capability ➔ Great stability

No moving parts ➔ reduced maintenance

Now with:

- Modbus Communication
- Modbus DTM
- Configuration Personalities
- Advanced RTU Programming
- NPT threaded Vortex
- Time-in-Service

Questions?

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