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Solution Note

Honeywell

VersaFlow Vortex Meters

Using internal pressure and temperature compensation for improved performance and reduced energy cost

The VersaFlow Vortex meter is the only meter of its type on the market that offers integral temperature compensation standard and the option of integral pressure compensation. These features offer improved system accuracy and can significantly reduce energy costs.

Virtually all industries rely on steam to generate power, heat facilities or clean process lines. Steam efficiency is measured in two basic areas--how effective is the steam production (boiler efficiency) and how effective is the transport of steam throughout the facility (leakage detection and heat loss). The ability to measure pressure and temperature and calculate heat allows the VersaFlow Vortex meter to monitor the production and transfer of steam.

The below diagram illustrates the traditional use of an uncompensated Vortex meter with a separate pressure sensor, temperature sensor and flow computer.

Along with increased potential leak points, you have the total installed cost and accuracy issues to contend with.

Typical installed cost of a 2" Vortex meter in a system is shown:

Vortex Meter—$2500 plus 1.5 hour labor @$ 150/hr

Temperature Sensor—$350 plus 1 hour labor

Pressure Sensor—$650 plus 1 hour labor

Flow Computer to calculate steam flow—$1350 plus 1.5 hour labor

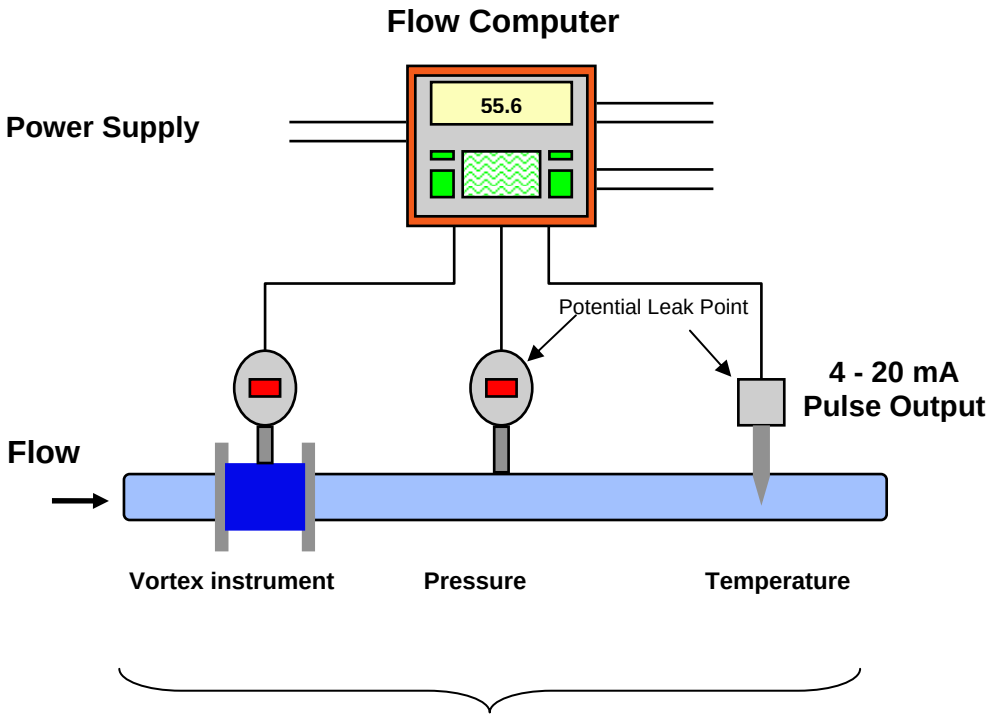
Total Installed Cost: $5600

VersaFlow Vortex with Integral Temperature, Pressure and Steam Calculation: $4800 plus 1.5 hour labor.

Total Installed Cost: $5025

Cost Savings: $575

System accuracy improved from ± 3% to ± 1%



Saturated Steam

In most saturated steam applications the operating temperature and pressure is a known quantity coming off the boiler. Depending on the insulation, as well as leakage in the pipeline, not to mention boiler efficiency, temperature and pressure will not always remain at the ideal levels expected.

Saturated steam has a fixed pressure to temperature relationship. Integral temperature measurement is all that is required. Assuming a constant temperature can lead to errors as shown in the example.

3“ meter			
5911 Kg/hr Saturated steam with a presumed 350 F temperature			
Deg F	Psia	Kg/hr	Error
350	134	5911	
360	152	6680	-13.0%
370	173	7243	-22.5%
380	195	7705	-30.4%
390	219	8186	-38.5%
400	246	8686	-46.9%
340	117	5214	11.8%
330	103	4586	22.4%
320	89	4019	32.0%
310	77	3510	40.6%
300	67	3054	48.3%

A +50 def F change creates a -47% error
A -50 deg F change creates a + 48% error
An integral temperature sensor and integral steam tables in the VersaFlow Vortex meter maintains the 1% accuracy

Superheated Steam

In superheated steam the pressure and temperature are independent. It is recommended that both are tracked. As shown in the example, as temperature changes, even if pressure remains constant the errors can rapidly increase.

3“ meter - 1450 kg/hr Superheated Steam at 350 deg F and 20 psig

Temperature	Flow Output	Error
350	1450	
360	1431.5	1.3%
370	1413.1	2.5%
380	1395.3	3.8%
390	1377.9	5.0%
400	1361	6.1%
410	1344.5	7.3%
420	1328.5	8.4%
430	1312.9	9.5%
440	1297.6	10.5%
450	1282.8	11.5%

Pressure	Flow Output	Error
20	1450	
22	1536	5.9%
24	1620	11.7%
26	1706	17.7%
28	1792	23.6%
30	1878	29.5%
32	1964	35.4%
34	2050	41.4%
36	2136	47.3%
38	2223	53.3%
40	2309	59.2%

A 20 deg F change leads to a 2.5% error
A 50 deg F change leads to a 6% error
A 100 deg F change leads to a 11.5% error
VersaFlow Vortex with integral temperature sensor and integral superheated steam tables maintains the 1% accuracy.
Likewise if pressure shifts even by a couple of psi, the errors start to compound.
A 10% change in pressure creates a 6% meter error
A 50% change in pressure creates a 30% error in reading
VersaFlow Vortex with integral pressure sensor and integral superheated steam tables maintains the 1% accuracy

Cost of a Steam Leak

There are two costs associated with the production of steam. The first is the gas feed to the boiler. Vortex can be used to monitor gas feed to the boiler. The other is in monitoring the efficiency of the steam lines transporting the steam. The major concern, once the line is designed, is the integrity of the pipeline and how much steam is being lost to leakage. VersaFlow Vortex is ideal for this task. By placing a vortex meter at the discharge of the boiler and taking advantage of the integral temperature measurement, you can easily measure the steam being generated. If you have a flow meter on the gas feed line, you can actually monitor boiler efficiency by comparing gas used to the pounds of steam produced (the vortex meter can easily measure in mass flow units because of the temperature compensation). Then by placing another vortex meter at a designated spot further downstream of the boiler you can make the measurement again and compare the flow rate of the steam to what is coming off the boiler. Any reduction in flow not accounted for by any usage points in between is attributable to leakage.

As you can see in the table, even a small leak can cost thousands of dollars a year, not to mention the additional cost to manufacture more steam to compensate. A ½" hole can cost upwards of $50,000 in a year if left unchecked.

Another feature that the VersaFlow Vortex meter can provide is the ability to monitor heat loss. By use of the local display or the HART protocol you can track the temperature and see if there is any extraordinary heat loss from where you measured at the boiler. Heat loss means energy costs, so tracking this can be critical as well.

Cost of Steam Leaks
100 psi steam
Steam Cost: $5.00/1000 lbs

Size of Leak	Lbs Steam Lost per Month	Total Cost per Month	Total Cost per Year
1/8 Inch	52,500	$262.50	$3,150.00
3/16 Inch	117,000	$585.00	$7,020.00
¼ Inch	210,000	$1,050.00	$12,600.00
5/16 Inch	325,000	$1,625.00	$19,500.00
3/8 Inch	470,000	$2,350.00	$28,200.00
7/16 Inch	637,000	$3,185.00	$38,220.00
½ Inch	835,000	$4,175.00	$50,100.00

NOTE: One pound of 100 psi steam contains about 1,200 BTUs.
If the steam is produced at 85% efficiency, the input energy is 1,200 / 85% = 1,411 BTUs per pound. Therefore, 1,000 pounds of steam requires at least 1.4 million BTUs to produce it. (1,411 BTUs per pound x 1,000)
1 MCF of Natural Gas contains 1 million BTUs
Cost to produce 1,000 lbs of steam from natural gas = 1.4 x $ per MCF of Natural Gas
When natural gas costs $7.00 per MCF, 1,000 lbs of steam costs (1.4 x $7) = $9.80
(Source: Armstrong International)

Typical Vortex Meter Applications

- Controlling of steam boiler, superheated and saturated steam measurement
- Burner consumption measurement
- Controlling of compressor capacity, consumption measurement in compressed air networks
- SIP- and CIP-processes in the food, beverage and pharma industries
- Measuring of industrial gases (natural gas, oxygen, nitrogen, hydrogen, argon, etc.)
- Conductive and non conductive liquids < 10 cP (demineralized water, thermo oil, freezing agent, etc.)

More Information
For more information, visit www.honeywell.com/ps or contact your Honeywell account manager.

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