

APPLICATION NEWSLETTER

PROBLEM: Comparison of ΔP Flow Elements

Differential pressure flow elements are still the most often used devices for making flow measurements. As many as 500,000 orifice plates are bought each year; venturis and flow nozzles account for another 100,000 units; and averaging pitot tubes add 50,000 units. Although smaller in unit sales, the averaging pitot tubes (available from Meriam as Accutube flow sensors) are similar in most respects to other differential flow elements, but are significantly lower in total cost.

SOLUTION: All four of the flow elements can be used for liquids, gases or steam. All measure flow on the basis of a square root relationship and thus have a 4:1 turndown ratio. Repeatability is typically 0.1% and accuracy is in the 1% range. Nozzles are often used in steam applications and venturis are preferred for slurries, but for most applications the four elements are comparable.

The advantage of the Accutube, though, is the cost savings. There is a tendency to talk about this advantage in relative terms: as being more energy

efficient and having lower installation cost. This does not adequately describe the magnitude of the savings. An Accutube can reduce costs by over 90%.

The cost comparisons below are for typical water and air applications in a 6" pipe. The only assumptions (other than the actual flow conditions) are that the installation of the Accutube would take one hour and installation of the flanged elements would take four hours - both at a cost of \$50/hour. Also, the energy cost is based on 24 hours/day operation and \$.10/kwh - the average cost for eight mid-west states.

Calculation of the energy cost was done by using a sizing program to find the permanent pressure loss associated with each flow element. This pressure loss was combined with the flow conditions (including a pump efficiency of 80%) to derive the equivalent horsepower needed to overcome the lost pressure; the horsepower was converted to kilowatt hours of energy.

Steam or natural gas applications would show costs somewhere between the water and air examples. Larger pipe sizes would increase both the magnitude and the ratio of cost savings in favor of the Accutube.

	Water				Air			
	Accutube	Orifice	Nozzle	Venturi	Accutube	Orifice	Nozzle	Venturi
Flow Conditions	500 GPM; 50 PSIG; 42 °F				5000 CFM; 50 PSIG; 75 °F			
Beta		.6	.5	.5		.7	.5	.5
Differential	13"	100"	100"	100"	20"	100"	100"	100"
Head Loss	2"	63"	66"	16"	2"	55"	58"	14"
Flow Element	300	100	700	1200	300	100	700	1200
Flange		200	200	200		200	200	200
Initial Cost	<u>300</u>	<u>300</u>	<u>900</u>	<u>1400</u>	<u>300</u>	<u>300</u>	<u>900</u>	<u>1400</u>
Installation	50	200	200	200	50	200	200	200
Installed Cost	<u>350</u>	<u>500</u>	<u>1100</u>	<u>1600</u>	<u>350</u>	<u>500</u>	<u>1100</u>	<u>1600</u>
Annual Energy	12	541	564	136	389	10727	11326	2763
1 Year Cost	<u>\$362</u>	<u>\$1041</u>	<u>\$1664</u>	<u>\$1736</u>	<u>\$739</u>	<u>\$11222</u>	<u>\$12426</u>	<u>\$4363</u>
5 Year Cost	\$410	\$3205	\$3920	\$2280	\$2295	\$54135	\$57730	\$15415

All costs determined on 1993 basis