

DIVA flowmeter for saturated steam flow measurement



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DIVA The Direct-In-line Variable Area Flowmeter . . .

Energy is often treated as an overhead but can represent a considerable part of the cost of production for products and services.

In response to the global Kyoto agreement, many governments are focusing on ways to reduce energy usage and emissions which, together with higher energy costs, is persuading industrial and commercial users to turn to improved energy monitoring techniques.

Saturated steam is an important carrier of energy and consequently is used throughout industry. Companies now recognise the need to measure steam flow. Case studies have shown savings of 5% - 25% are possible when steam flowmeters are used to monitor consumption.

The Spirax Sarco Direct In-line Variable Area flowmeter (DIVA) has been designed as an ideal system for any steam energy management scheme or steam flowmetering application, from monitoring and targeting initiatives to control applications. The contemporary technology and unique operating principle mean it is ideally suited to demanding industrial processes with a low cost of ownership.

The DIVA is an innovative development of the well established family of Spirax Sarco Gilflo flowmeters and the compact ILVA, which have been used in industrial flowmetering applications for more than 25 years.

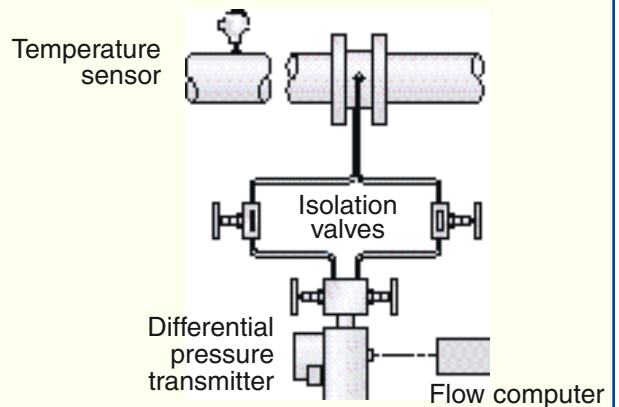
Flowmetering Systems Will:

- Monitor the energy cost of any part of the plant.
- Cost energy as a raw material.
- Identify priority areas for energy savings.
- Enable efficiencies to be calculated for processes or power generation.

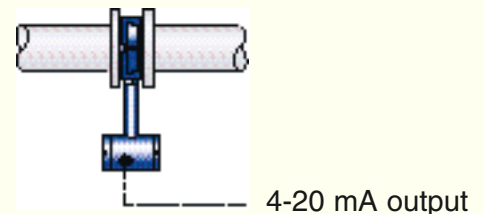
User Benefits

- Wide turndown with excellent system accuracy and repeatability provides accurate readings over a wide range of flows.
- On board electronics automatically compensate for changes in steam density providing accurate mass flow readings irrespective of changes in steam pressure.
- Compact installation requires only 6 pipe diameters upstream and 3 downstream.
- Calibration is factory set enabling simple, menu driven commissioning sequence through the 5 button keypad and integral display.
- Display and outputs available in Mass or Energy, and English or Metric units.
- Reliable, maintenance-free operation provides years of trouble-free, accurate measurement of steam flow.

Traditional System



DIVA System



The DIVA System Will Also:

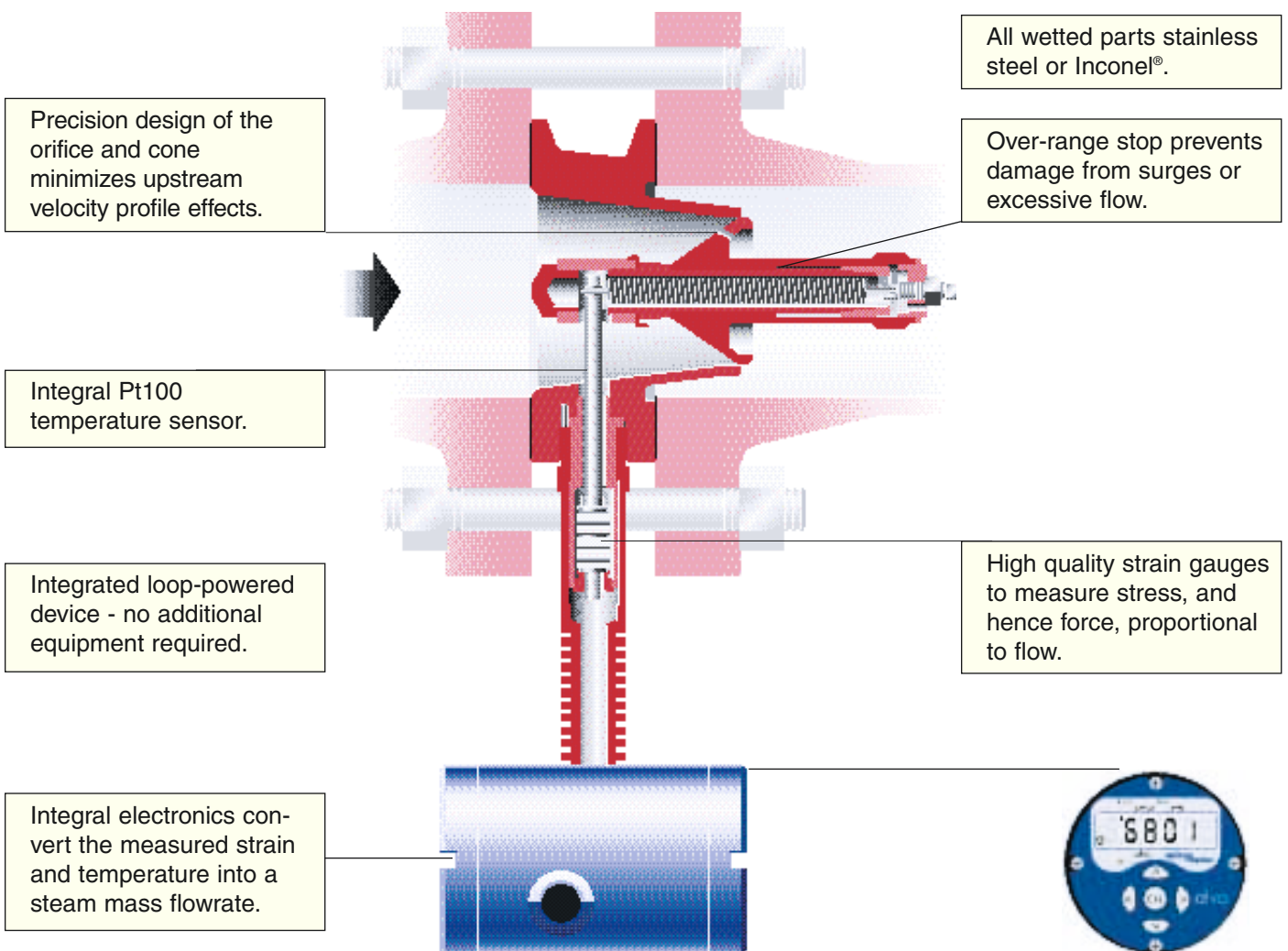
- Provide process control for certain applications.
- Monitor plant trends and identify any deterioration and steam losses.

How The DIVA Flowmeter Operates

The DIVA flowmeter operates on the well established spring loaded variable area (SLVA) principle, where the area of an annular orifice is continuously varied by a precision shaped moving cone. This cone is free to move axially against the resistance of a spring.

However, unlike other SLVA flowmeters, the DIVA does not rely on the measurement of differential pressure drop across the flowmeter to calculate flow, measuring instead the force caused by the deflection of the cone via a series of extremely high quality strain gauges. The higher the flow of steam, the greater the force. This removes the need for expensive differential pressure transmitters, reducing installation costs and potential problems.

The DIVA has an internal temperature sensor which provides full density compensation for saturated steam applications, removing the need for, and expense of additional sensors.

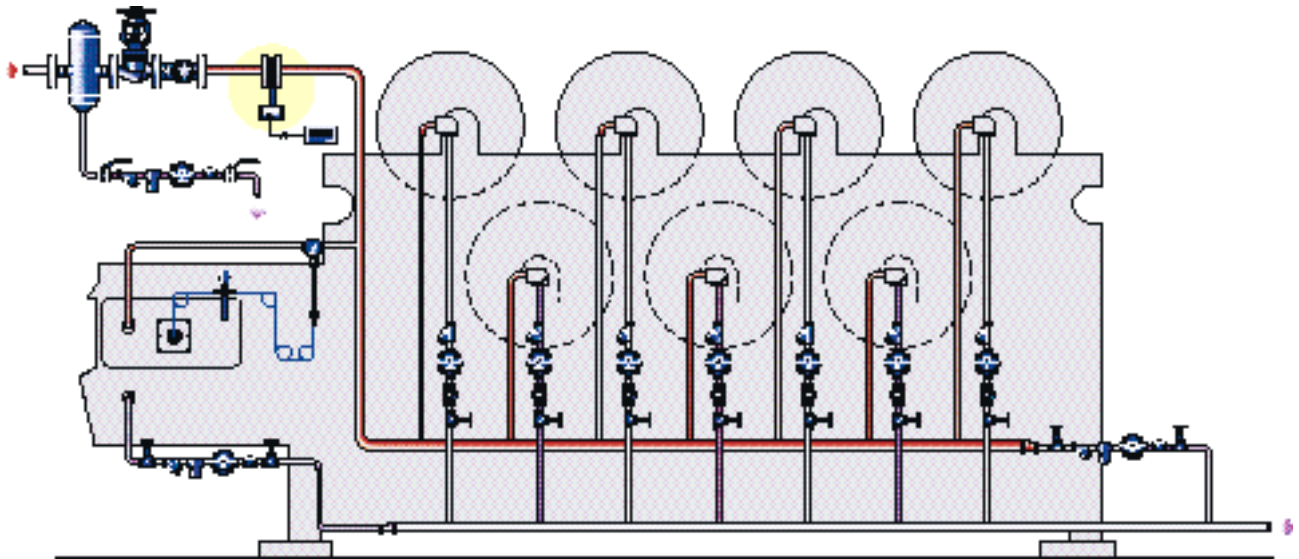


As standard the DIVA is supplied with an easy to use digital commissioning display. All programming is via 5 push buttons using a menu driven commissioning sequence. The display will also report errors detected by the on-board diagnostics program. Flow, temperature, pressure and energy are displayed in metric or imperial units.

... Mass Flow Without The Need For Additional Equipment!

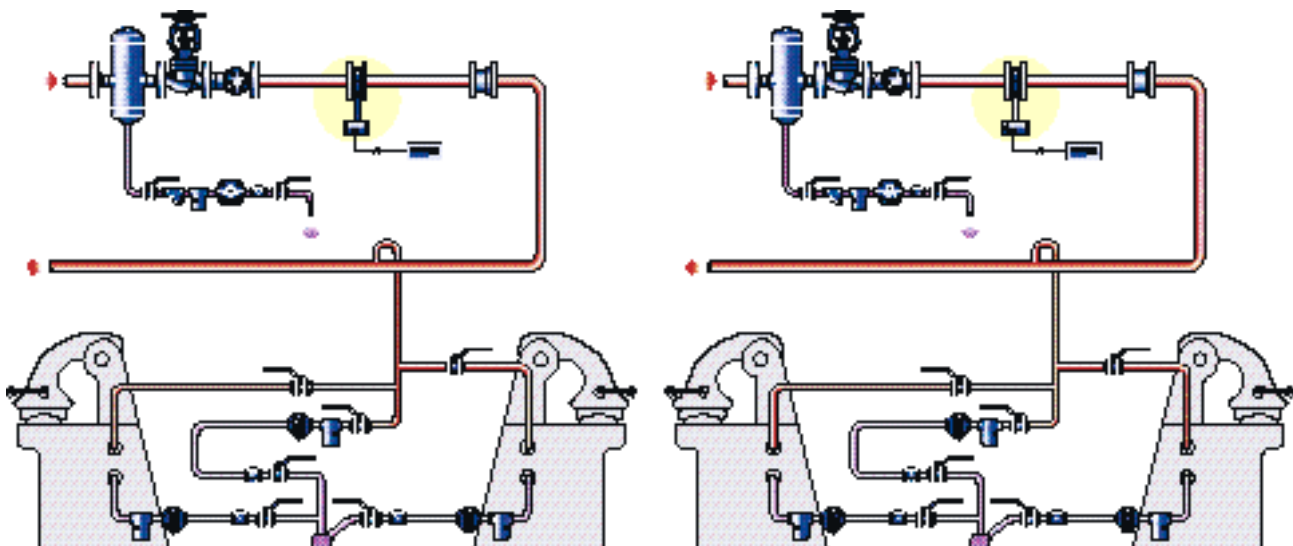
Plant Efficiency

The DIVA can be used to calculate overall plant efficiency, determine when machinery is switched off, when plant is loaded to capacity or when working practices are satisfactory. It will also show the deterioration of plant over time, predicting optimum time for plant cleaning or replacement. It will also establish peak steam usage times or identify sections or items of plant to be major steam users. This may lead to a change in production methods for a more economical use of steam and to ease peak load problems on the boiler plant.



Energy Efficiency

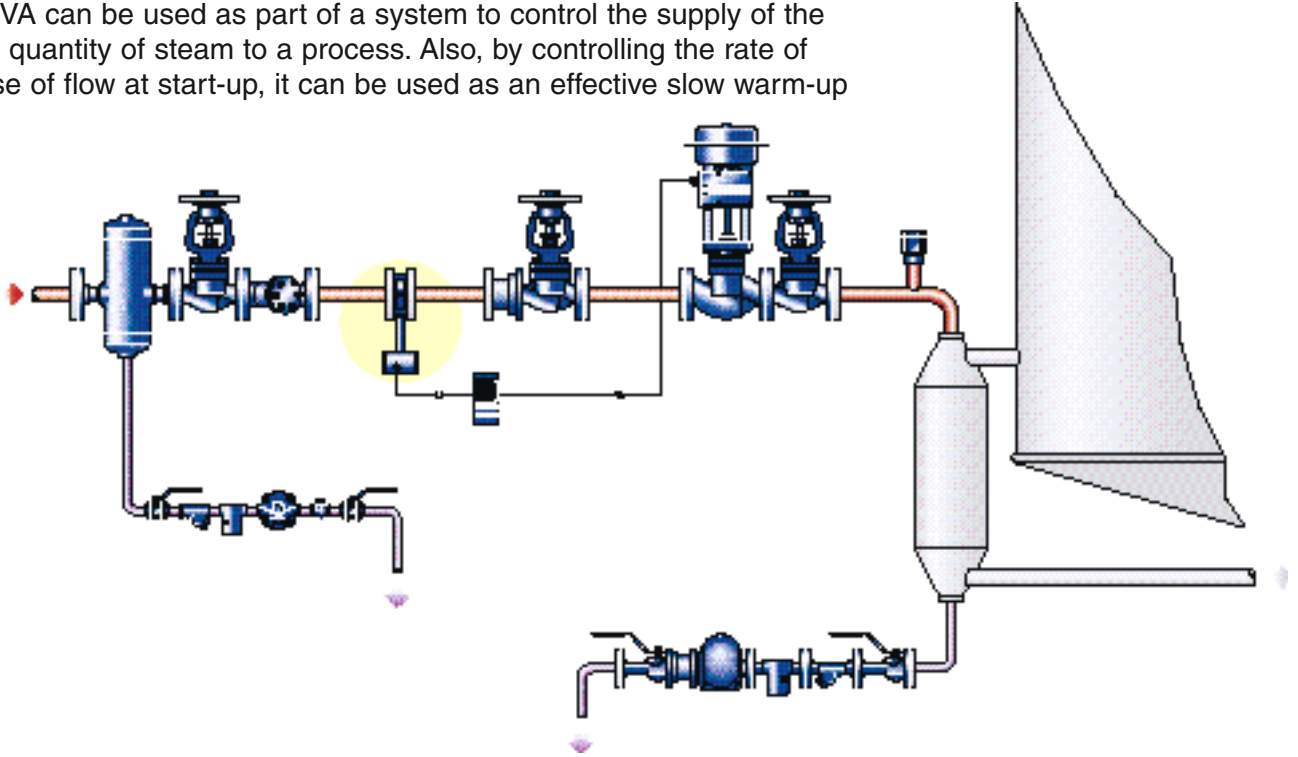
The DIVA can be used to monitor the results of energy saving schemes, such as monitoring and targeting, and to compare the efficiency of one piece of plant with another.



Applications

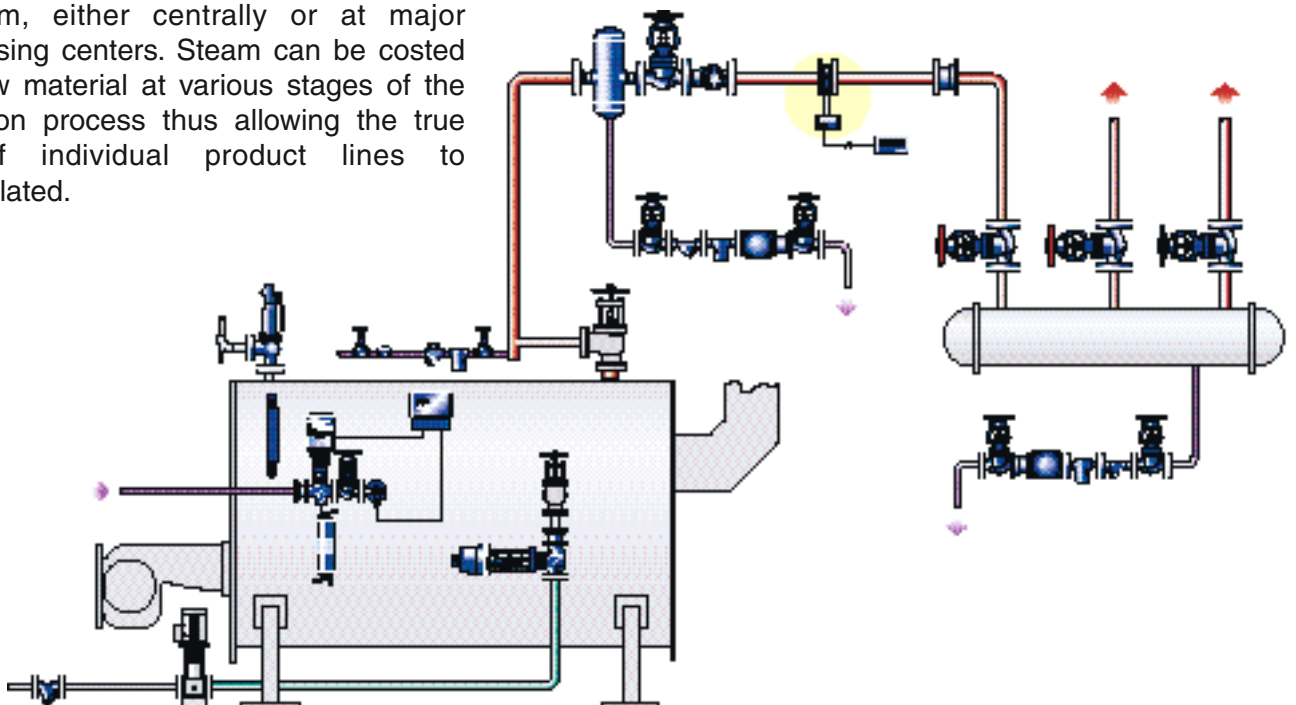
Process Control

The DIVA can be used as part of a system to control the supply of the correct quantity of steam to a process. Also, by controlling the rate of increase of flow at start-up, it can be used as an effective slow warm-up device.



Costing and Custody

The DIVA's high system accuracy and turndown means it is ideally suited to measure the flow of steam, and thus the cost of steam, either centrally or at major steam-using centers. Steam can be costed as a raw material at various stages of the production process thus allowing the true cost of individual product lines to be calculated.



Sizing the DIVA flowmeter for saturated steam - capacities lb/h

Horizontal and Vertically down flow applications

Pressure in psig		14.5	29	43.5	58	72.5	87	101.5	116	130.5	145	159.5	174	188.5	203	217.5	232
2"	Min. flow lb/h	32	39	45	50	55	59	63	66	70	73	76	79	82	85	88	90
	Max. flow lb/h	1048	1395	1670	1905	2113	2304	2477	2637	2793	2938	3076	3207	3330	3452	3576	3684
3"	Min. flow lb/h	70	85	98	109	119	128	137	145	152	160	167	173	179	185	192	197
	Max. flow lb/h	2780	3648	4341	4934	5461	5944	6383	6789	7187	7554	7907	8240	8554	8864	9181	9454
4"	Min. flow lb/h	108	131	151	168	183	197	210	222	234	245	256	266	275	285	294	303
	Max. flow lb/h	4968	6199	7206	8082	8867	9592	10254	10868	11472	12032	12569	13079	13559	14033	14520	14939

Vertically down applications are limited to a maximum flowing pressure of 160 psig

Pressure in psig		246.5	261	275.5	290	304.5	319	333.5	348	362.5	377	391.5	406	420.5	435	449.5	464
2"	Min. flow lb/h	93	96	98	101	103	105	108	110	112	114	116	118	121	123	125	127
	Max. flow lb/h	3808	3904	4008	4117	4223	4321	4419	4520	4609	4701	4790	4881	4969	5052	5138	522
3"	Min. flow lb/h	204	208	214	219	225	230	235	240	245	249	254	258	263	267	272	276
	Max. flow lb/h	9770	10017	10280	10558	10830	11078	11328	11587	11815	12049	12277	12508	12733	12945	13164	13380
4"	Min. flow lb/h	313	320	328	337	345	353	360	368	375	383	390	397	404	410	417	424
	Max. flow lb/h	15426	15805	16210	16638	17058	17440	17826	18226	18578	18938	19291	19649	19996	20324	20662	20996

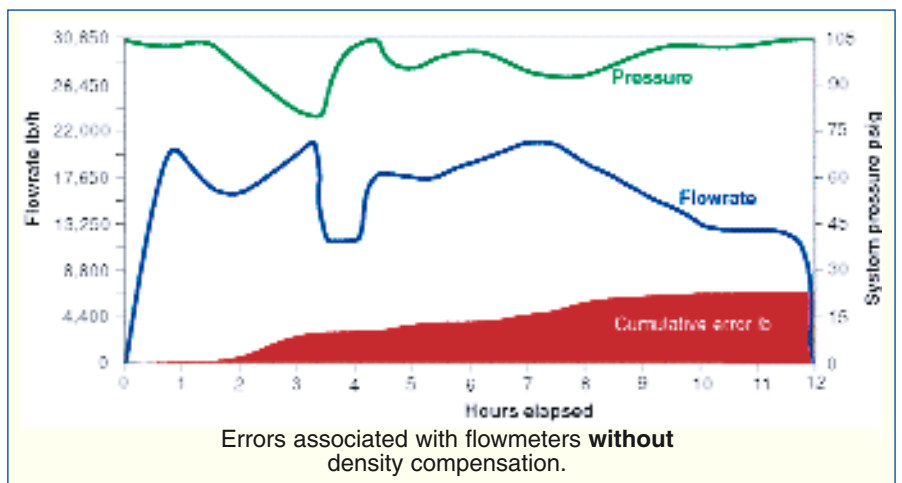
Vertically up flow applications

Pressure in psig		14.5	29	43.5	58	72.5	87	101.5	116	130.5	145	159.5
2"	Min. flow lb/h	35	46	56	63	70	77	83	88	93	98	103
	Max. flow lb/h	1048	1395	1670	1905	2113	2304	2477	2637	2793	2938	3076
3"	Min. flow lb/h	93	122	145	164	182	198	213	226	240	252	264
	Max. flow lb/h	2780	3648	4341	4934	5461	5944	6383	6789	7187	7554	7907
4"	Min. flow lb/h	166	207	240	269	296	320	342	362	382	401	419
	Max. flow lb/h	4968	6199	7206	8082	8867	9592	10254	10868	11472	12032	12569

Density Compensation

It is rare for the pressure in a steam system to remain absolutely constant. Unless this variation is taken into account, flow measurement errors will occur. The integral automatic density compensation provided by the DIVA flowmeter eliminates these errors and ensures accurate flowmetering whatever the steam pressure.

The example shown is for a metering system without density compensation and set at 105 psig. By the end of the day significant errors can arise.



System Uncertainty

The DIVA steam flowmeter has a system uncertainty in accordance with ISO 17025, of:

- $\pm 2\%$ of actual flow to a confidence of 95% (2 standard deviations) over a range of 10% to 100% of maximum rated flow.
- $\pm 0.2\%$ FSD to a confidence of 95% (2 standard deviations) from 2% to 10% of the maximum rated flow.

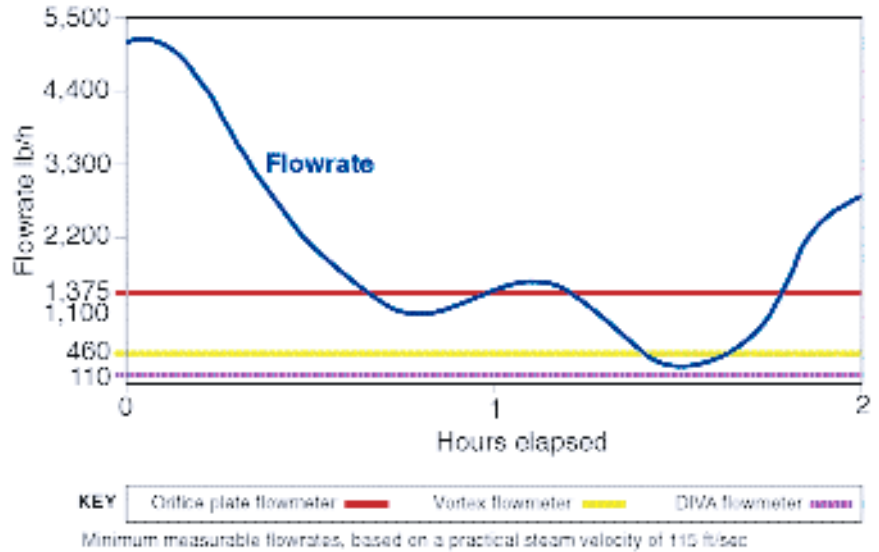
As the DIVA is a self-contained unit the uncertainty quoted is for the complete system. Many flowmeters claim a pipeline unit uncertainty and for a true system uncertainty, the individual uncertainty values of any associated equipment, such as DP cells, need to be taken into account.

The Importance of Turndown

The turndown of a flowmeter is the ratio of the maximum to minimum flowrate over which it will meet its specified performance, or its operational range. The DIVA flowmeter has a high turndown ratio of up to 50:1, i.e. an operational range of up to 98% of its maximum flow.

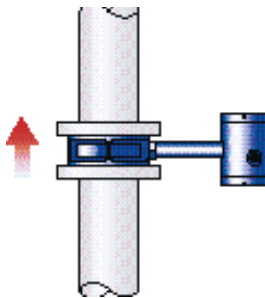
In steam systems, load variations can lead to wide variations in flow, from standing or weekend loads up to the maximum demands of the process. It is essential for the flowmeter to be able to cope with this. The chart compares the minimum flowrates that can be measured for typical flowmeters with a maximum flow of 5,500 lb/h. Flows below the minimum reading will be lost or at best inaccurate.

The DIVA flowmeter can achieve turndown ratios of up to 50:1, ensuring that the flow information gathered is accurate whatever the process conditions.

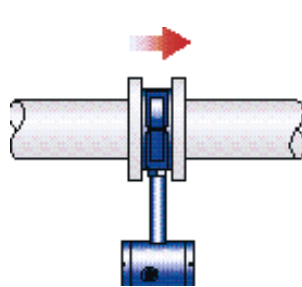


Flow Orientations

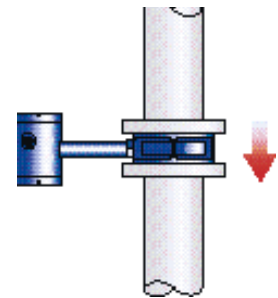
The DIVA can be installed in any of the following orientations:



Flow orientation: vertically upwards
 Turndown up to 30:1
 Pressure limitation 160 psig



Flow orientation: horizontal
 Turndown up to 50:1
 Pressure limitation 464 psig



Flow orientation: vertically downwards
 Turndown up to 50:1
 Pressure limitation 160 psig

Calibration Information

It is important that all flowmeters be calibrated accurately. DIVA flowmeters are calibrated on a high accuracy flow rig at Spirax Sarco's flowmeter manufacturing facility. Designed and built by Spirax Sarco engineers in conjunction with the UK National Engineering Laboratories, the facility ensures that every flowmeter meets the highest possible standards of accuracy.

The all stainless steel calibration rig has a total flow capacity of 5,020 gal/min of water and is capable of calibrating flowmeters of between 2" and 12". Each meter is calibrated against high specification electromagnetic "Master" meters and a gravimetric system, all of which are traceable back to National Standards. Full calibration documentation is supplied as standard with every flowmeter and all flow data is electronically archived for future reference or recalibration.



Flowmeter calibration rig

Technical Data

Operating principle	Spring loaded variable area with strain measurement	
Limiting conditions	Horizontal flow	Maximum operating pressure 464 psig @ 462°F
	Vertical flow	Maximum operating pressure 160 psig @ 370°F
Measurable fluids	Saturated steam	
Sizes available	2", 3", 4"	
Flange specification	Sandwich design for installation between ANSI B 16.5 class 150 or 300 flanges	
Materials of construction	Body and internals	Stainless steel
	Spring	Inconel® X750 (or equivalent)
	Housing	Aluminium HE30
Installation	Below 160 psig - Any flow orientation	Above 160 psig - Horizontal flow lines only
Power supply	Loop powered nominal 24 Vdc	
Turndown	Up to 50:1	
Outputs	4-20 mA (directly proportional to mass flowrate)	
	Pulsed output (per mass unit)	
System uncertainty in accordance with ISO 17025	± 2% of actual flow between 10% and 100% of maximum rated flow	
	± 0.2% of FSD for flows from 2% to 10% of maximum rated flow	
Unrecovered pressure drop	Less than 300" wg at maximum flowrate for the 2" and less than 200" wg for the 3" and 4".	

Associated Equipment

If desired, the DIVA can output a 4-20 mA signal to a Spirax Sarco M700 flow computer for remote indication of flowrate and totals. The M700 provides the loop power for the DIVA and is available with 4-20 mA retransmission or pulsed output (version numbers 1 to 8). See separate literature for details.

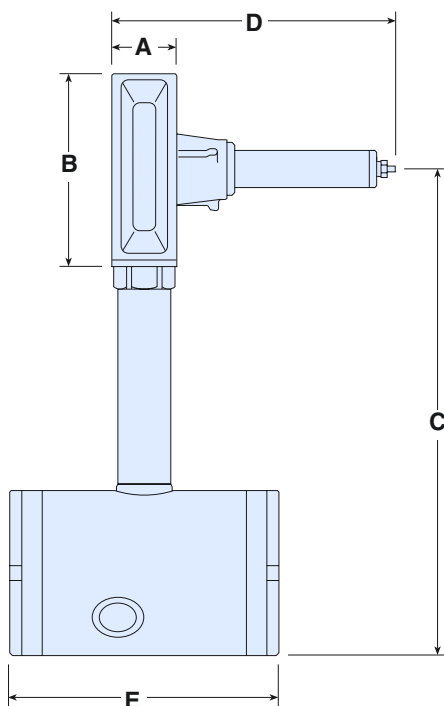
Dimensions/weights (approximate) in inches and lbs

Size	A	B	C	D	E	Weight
2"	1.4	4.1	10.4	6.1	5.7	7.4
3"	1.8	5.4	11.2	5.9	5.7	11.6
4"	2.4	6.4	12.4	8.1	5.7	18.1

How To Order

Example: 1 off Spirax Sarco 4" DIVA flowmeter for installation between ANSI 150 flanges. For use on saturated steam at 145 psig, maximum flow 12,032 lb/hr. Complete with M700 display unit version 3.

In addition to the DIVA flowmeter range, Spirax Sarco can provide flowmeters such as the ILVA for fluids other than steam or higher pressure applications. Please contact us for further details.



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