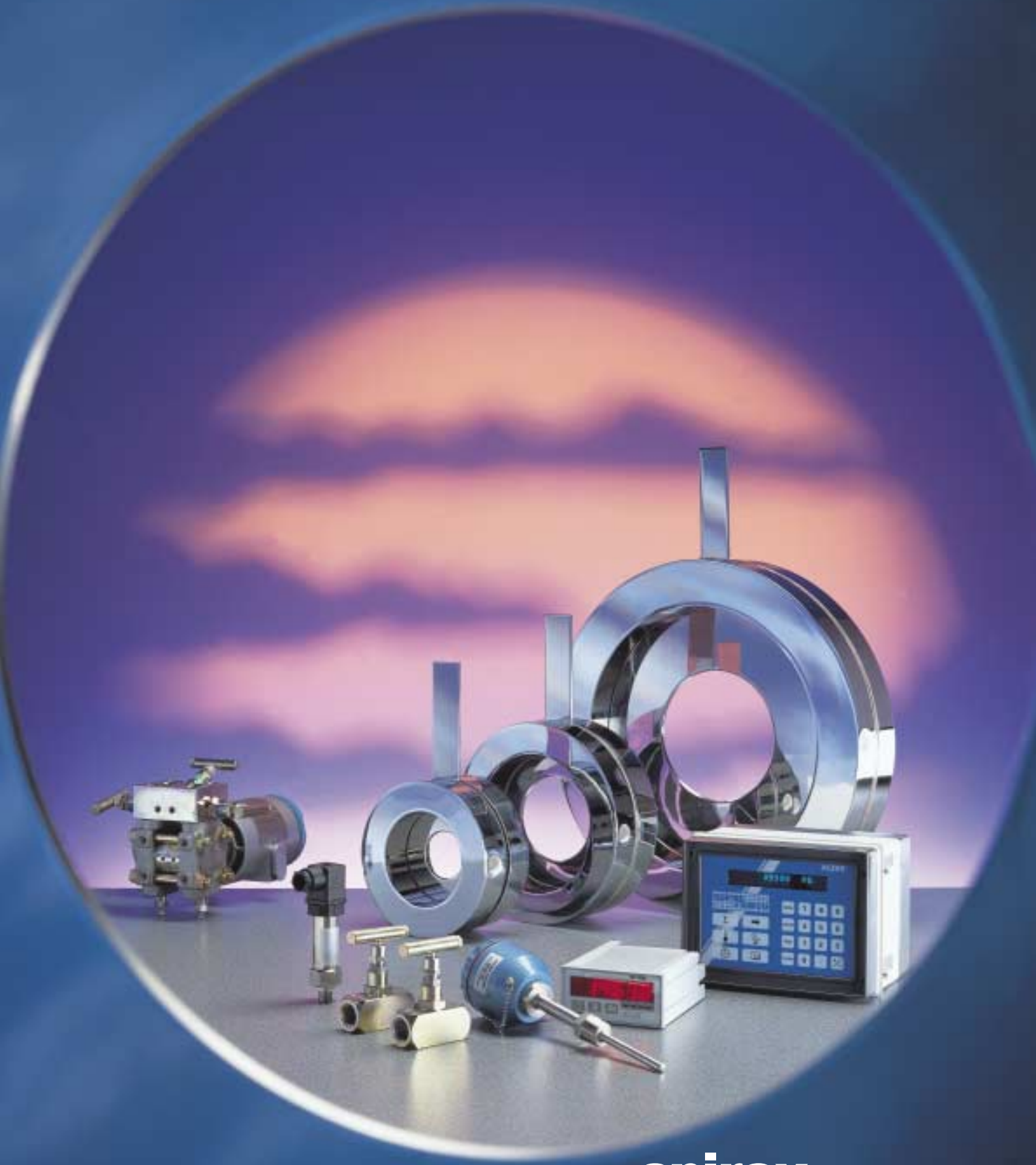
Orifice plate flowmeters

for steam, liquids and gases



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Why measure flow?

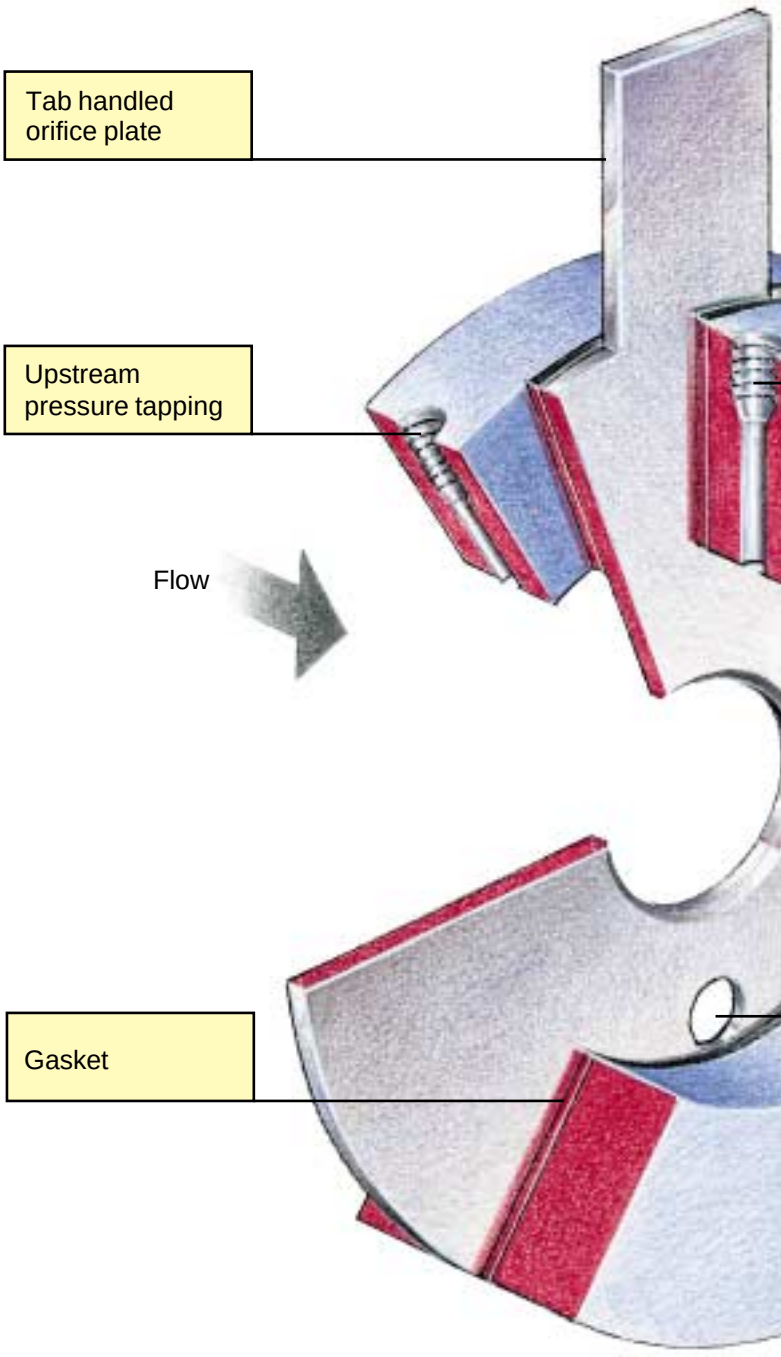
In many of today's industrial processes, it is essential to measure accurately the rate of fluid flow within a system as a whole or in part. This applies equally to gases and liquids (e.g. carbon dioxide, nitrogen, liquors etc.) which are an integral part of the process, or to compressed air, water or steam which are fundamental to plant operation. The installation of any flowmeter can be justified in one of two ways:

1. Process control

Here the flowmeter is used to measure the rate of fluid or energy flow to allow the process to be controlled and so ensure that the end product is of the required quality. A common example of this would be in steam injection systems for the animal feeds industry...too much steam and the product will not pellet...too little steam and the raw materials will not process and may damage the production machinery.

2. Cost allocation

Where energy is used to provide process or space heating, it is fundamental to know where the costs associated with the energy are actually being incurred. Flowmetering allows energy costs to be allocated to a particular product, department or other user this usually resulting in a significant reduction in total energy costs.



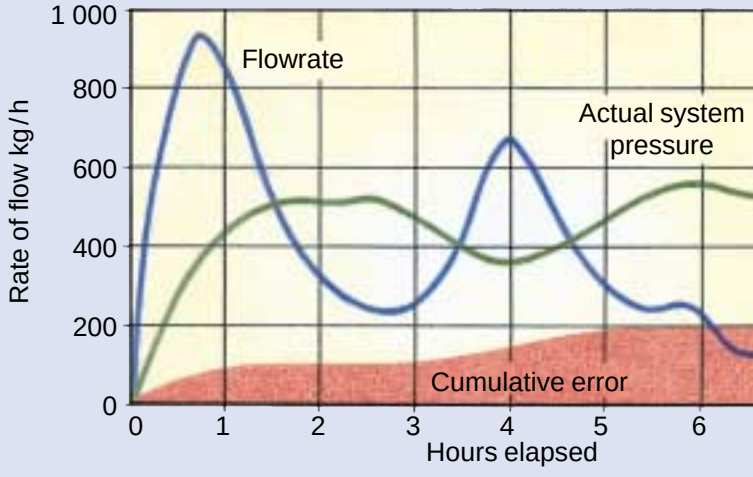
Measuring flow allows you to:-

- Improve process control
- Allocate heating costs
- Identify major energy users
- Monitor the results of process changes
- Check on steam boiler efficiency
- Identify energy patterns through the day
- Provide management information

Lord Kelvin once said:

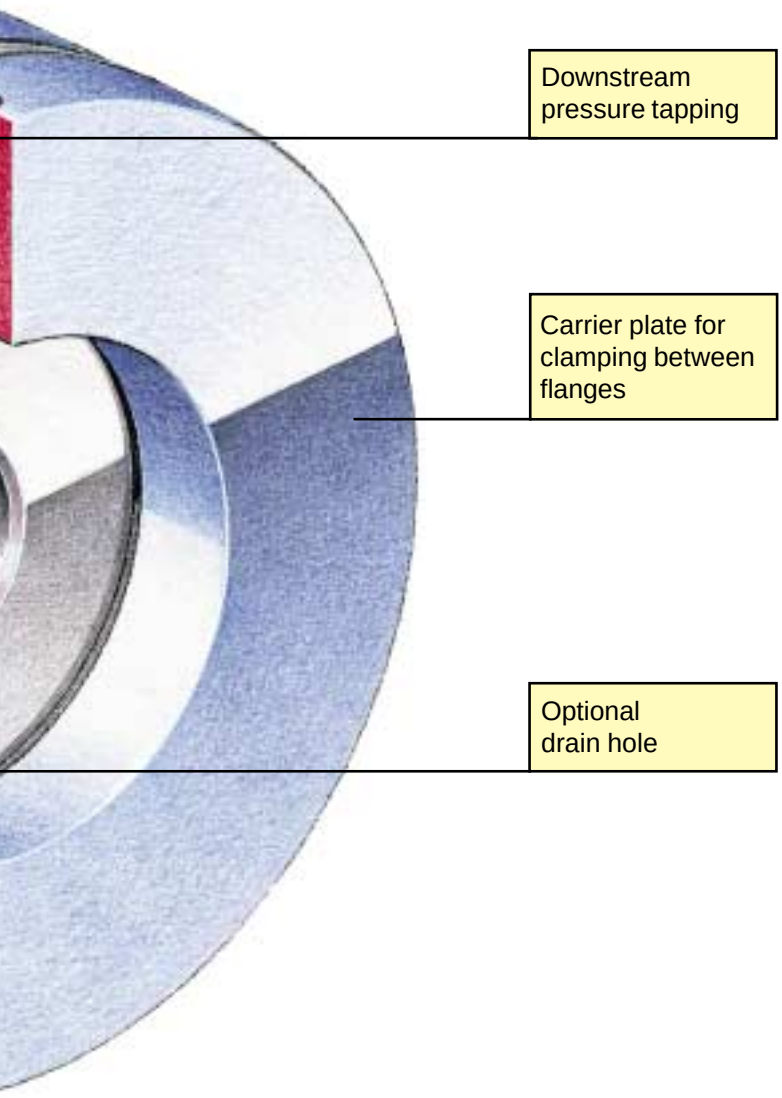
"When you can measure what you are speaking about and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind."

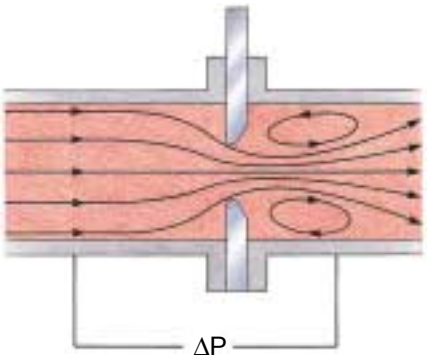
In other words, you cannot manage what you cannot measure and nowhere is that more true than in the measurement of flow.



Why use orifice plates?

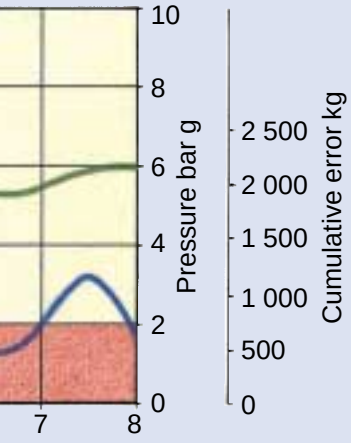
Orifice plates are still the most widely used type of flowmeter in the world today. They offer significant cost benefits over other types of flowmeter, especially in larger line sizes, and have proved to be rugged, effective and reliable over many years. Where a need exists for a rugged, cost effective flowmeter which has a low installation cost and a turndown of not more than 4:1, the orifice plate continues to offer a very competitive solution.





How do orifice plates work ?

An orifice plate installed in a line creates a pressure differential as the fluid flows through it. This differential pressure is measured via impulse lines by a differential pressure transmitter which converts it into an analogue or digital signal which can be processed to provide a display of the instantaneous rate of flow. The relationship between the rate of flow and the differential pressure produced is very well understood and is fully covered by comprehensive national standards. The relevant standards are **BS 1042** and the equivalent **ISO 5167**. One of the principle advantages of orifice plates manufactured and installed following these standards is that they do not require calibration. This means that orifice plates are very cost effective on larger line sizes.



Density compensation

With liquid metering systems, the flowing density is usually fairly constant and relatively simple processing of the output signal from the differential pressure transmitter is usually all that is required.

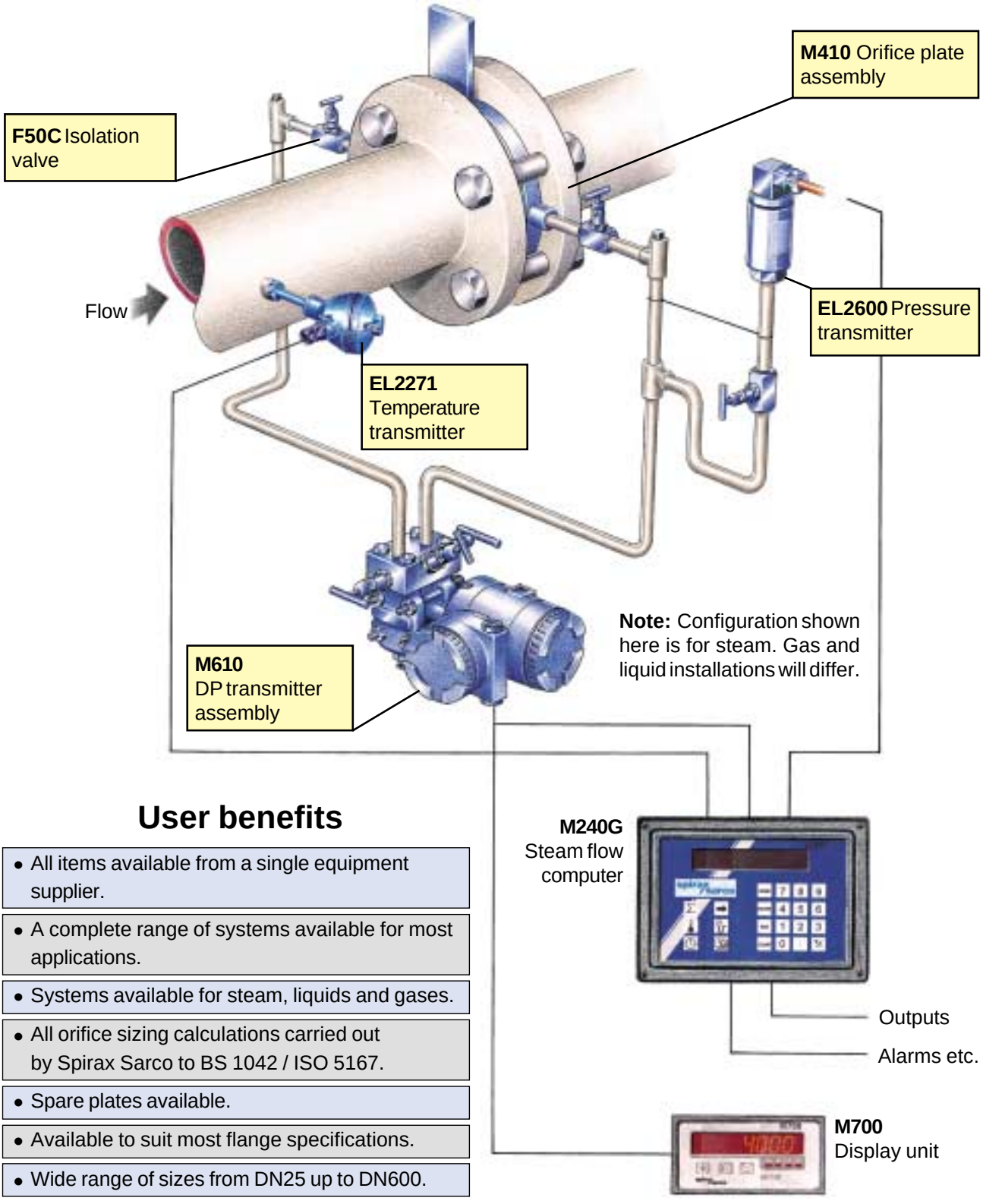
However, it is rare for the pressure in steam systems to remain absolutely constant. Unless this is taken into account, flow measurement errors will occur. By using the automatic density compensation capability of the Spirax Sarco M240G Steam Flow Computer, these errors are completely eliminated allowing accurate steam metering whatever the steam pressure.

Example: A simple non compensated flowmeter is set for 6 bar g. The actual pressure in the system varies through the day and unless this is allowed for, by the end of the day, very significant errors can arise. This is typical of many steam systems.

Spirax Sarco orifice plate flowmeters - the system

Orifice plates are amongst the most simple and easy to use type of flowmeter. However, in order to get the very best out of them, it is essential to ensure that the user specifies a complete system that meets his requirements. All too often, factors such as the need for density compensation are not fully specified by the user with the result that the full potential of the orifice plate primary element is not achieved. Frequently, it is necessary to source items from several different manufacturers and hope that the components will be compatible.

Spirax Sarco has completely eliminated this by introducing a range of orifice plate based flowmetering systems suitable for use on steam, liquids and gases. One of these systems will be ideal for your application. Select the system that is best suited for your needs from the 14 options available then decide on the display you need.....M700 for simple non compensated applications or the M240G steam flow computer for the ultimate in steam flow measurement capability. Spirax Sarco can advise, if necessary, which is the best system for any application.



User benefits

- All items available from a single equipment supplier.
- A complete range of systems available for most applications.
- Systems available for steam, liquids and gases.
- All orifice sizing calculations carried out by Spirax Sarco to BS 1042 / ISO 5167.
- Spare plates available.
- Available to suit most flange specifications.
- Wide range of sizes from DN25 up to DN600.

approach that makes it simple

Step 1

Choose the orifice plate option

		OPTIONS												
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
M410 tab handled orifice plate to BS 1042 / ISO 5167 complete with gaskets ... designed to be clamped between the user's own flanges, this is the simplest option.		●	●			●	●	●	●	●					
Or															
M410 orifice plate, gaskets, carrier ring with the addition of two F50C isolation valves to provide primary isolation.				●	●						●	●	●	●	●

Step 2

Choose the differential pressure transmitter

		OPTIONS												
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
High accuracy **M610** differential pressure transmitter fitted with a three-way manifold for isolation and zero adjustment.			●		●	●	●	●	●	●	●	●	●	●	●

Where pressure and / or temperature varies then it is necessary to compensate for density variations and the following options should be considered:-

Step 3

Choose the pressure transmitter for applications where the line pressure varies

		OPTIONS												
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
EL2600 pressure transmitter.						●			●	●	●			●	●

Step 4

Choose the temperature transmitter for applications where the line temperature varies

		OPTIONS												
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
EL2271 temperature transmitter for line temperatures up to 250°C							●		●			●		●	
Or															
EL2270 temperature sensor and separate **EL2810** temperature transmitter for temperatures above 250°C.								●		●			●		●

Example: **Option 7 would include 1 x M410, 1 x M610, 1 x EL2270 and 1 x EL2810.**

Installation of orifice plate flowmeters

Almost all flowmeters need certain lengths of straight, uninterrupted pipe upstream and downstream of the flowmeter itself, and orifice plates are no exception. As the performance of orifice plates is based on theoretical predictions, the installation is very important and is described in detail in national standards BS 1042 and ISO 5167. The recommened minimum lengths are shown here.

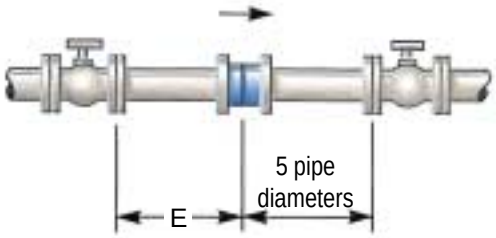
Minimum number of pipeline diameters required upstream of M410 orifice plate.

$$\beta = \frac{\text{d (orifice diameter mm)}}{\text{D (pipe diameter mm)}}$$

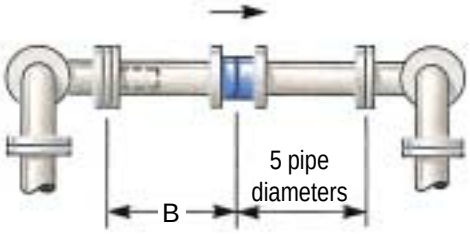
For guidance a β ratio of 0.7 should be used

β	<0.32	0.45	0.55	0.63	0.70	0.77	0.84
A	12	12	13	16	20	27	38
B	15	18	22	28	36	46	57
C	35	38	44	52	63	76	89
E	18	20	23	27	32	40	49
F	10	13	16	22	29	44	56

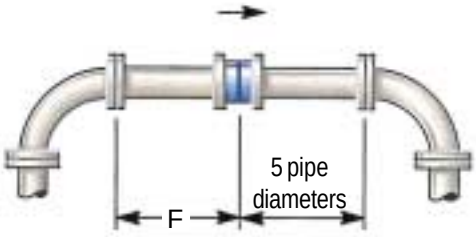
Correct installation is the key to accurate metering !



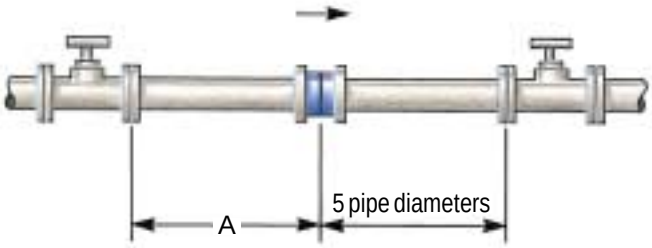
Fully open globe valves



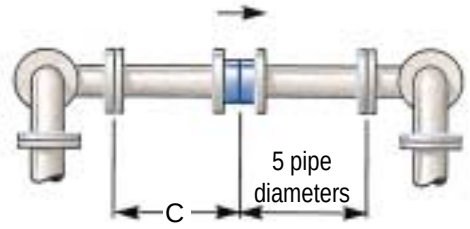
Two bends at right angles with straightening veins



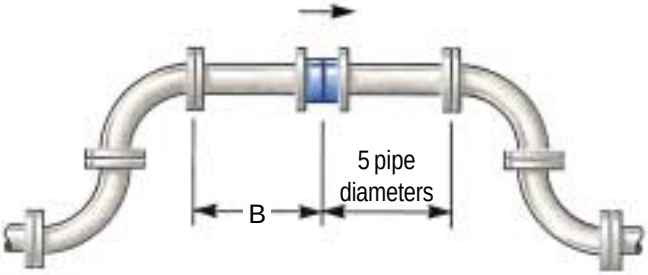
Right angle bends



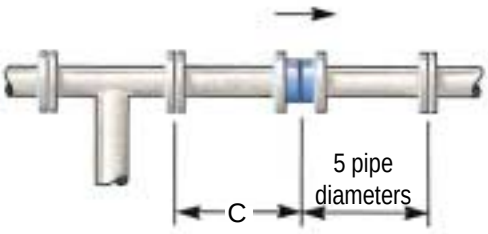
Fully open fullway valve



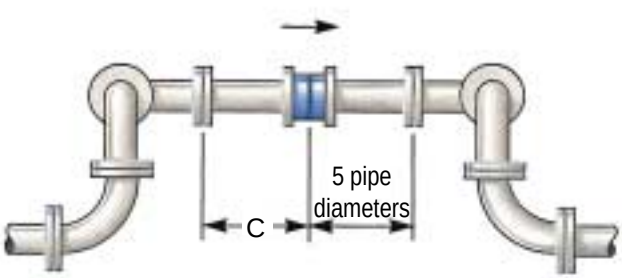
Two bends at right angles



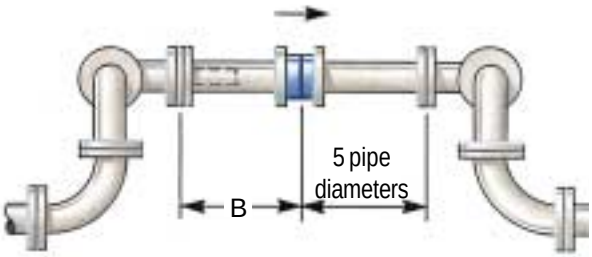
Two right angle bends in same plane



Branches

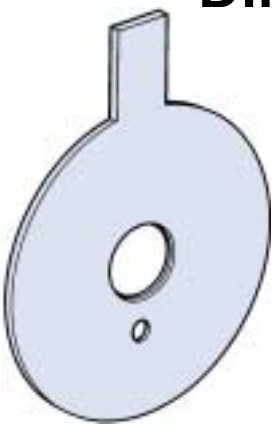


Three bends at right angles



Three bends at right angles with straightening veins

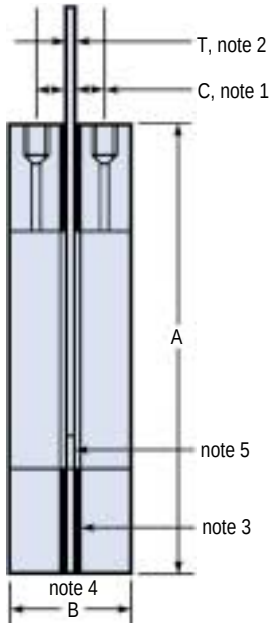
Dimensions (approximate in mm)



M410 Orifice plate

The M410 is available as a tab handled plate that can be located between customers flanges or fitted in its own carrier with integral pressure tappings.

	BS 4504 PN16	BS 4504 PN25	BS 4504 PN40	BS10 Table H	ANSI 150	ANSI 300	ANSI 600	JIS20	KS20	Weight (see note 6)
Size	A	A	A	A	A	A	A	A	A	kg
DN25	73	73	73	71.4	66.7	73.0	73.0	74	74	2.36
DN40	94	94	94	88.9	85.7	95.3	95.3	89	89	3.72
DN50	109	109	109	111.1	104.7	111.1	111.1	104	104	4.91
DN65	129	129	129	130.1	123.8	130.2	130.2	124	124	6.21
DN80	144	144	144	149.2	136.5	149.3	149.3	140	140	7.91
DN100	164	170	170	174.6	174.6	181.0	193.7	165	165	13.75
DN125	194	196	196	215.9	196.9	216.0	241.3	203	203	20.98
DN150	220	226	226	241.3	222.3	250.9	266.7	238	238	23.51
DN200	275	286	293	304.9	279.4	308.0	320.6	383	383	31.25
DN250	331	343	355	358.8	339.7	361.9	400.0	356	356	47.95
DN300	386	403	420	415.9	409.6	422.2	457.1	406	400	58.74
DN350	446	460	477	469.9	450.8	485.7	492.1	450	450	60.20
DN400	498	517	549	527.0	574.3	539.7	565.1	570	570	85.99
DN450	559	567	574	581.0	549.2	596.8	612.7	575	575	94.38
DN500	620	627	631	644.5	606.4	654.0	682.6	630	630	117.69
DN600	737	734	750	749.3	717.5	774.7	790.6	734	734	146.37

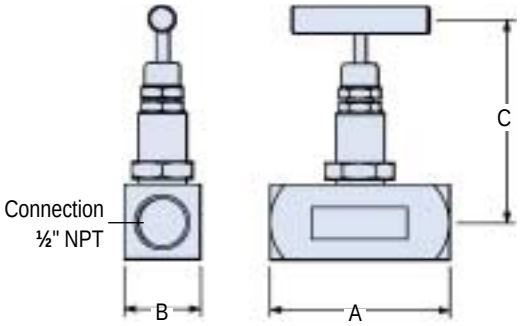


Notes:

1. Dimension C is 25.4 mm for all sizes in line with BS 1042 / ISO 5167.
2. For line sizes DN25 to DN350, orifice plate thickness T is 3 mm, above DN350, T is 6 mm.
3. Gaskets are 1.6 mm thick.
4. For line sizes up to DN350, carrier assembly thickness B is 82 mm, above DN350, B is 85 mm.
5. An optional drain hole that meets BS 1042 can be incorporated if required.
6. Maximum weights shown above are based on ANSI 600 flanges.

F50C Isolation valves

The F50C is a needle type isolation valve designed for primary isolation flowmetering applications for steam and other industrial fluids.



A	B	C	Weight (kg)
66	28	76	0.5

Materials

Body	Passivated zinc plated carbon steel
Seals	Graphoil

Limiting conditions

Maximum operating pressure 413 bar g
Maximum operating temperature 430°C

Technical information

Description

The M410 orifice plate and carrier assembly is a primary flow element consisting of a tab handled square edged orifice plate and optional carrier. The orifice plate is designed and manufactured to meet the requirements of **BS 1042** and **ISO 5167** in all respects and is suitable for measuring the flowrate of most liquids, gases and steam. The tab handled orifice plate can be used:

1) On its own fitted between flanges with pressure tappings in the users pipework or flanges, or;
or
2) Fitted into a carrier with integral flange tappings designed to fit between customer flanges.

Materials

Tab handled orifice plate	BS 1449 S316
Carrier	Passivated zinc plated carbon steel
Gaskets	Exfoilated graphite

Pipe sizes available

DN25, 40, 50, 65, 80, 100, 125, 150, 200, 250, 300, 350, 400, 450, 500, 600

Limiting conditions

The tab handled orifice plate and carrier assembly are suitable for use up to the limiting conditions of the specified flanges.

Accuracy

To BS 1042 and ISO 5167.
The performance of an orifice plate flowmetering system can be greatly influenced by installation variables, so the figures given below are for guidance only:
Accuracy: typically +/- 3 % of actual flow.
(equivalent to +/- 1.5 % full scale deflection at 50 % of rated maximum flow).
Repeatability: typically +/- 0.3 %.
Turndown: typically 4:1.

Connections

Tab handled plates and carriers are available to suit the following flange specifications:
BS 4504 PN16, PN25 and PN40.
BS 10 Table H.
ANSI B 16.5 class 150, 300 and 600.
Japanese Industrial Standard JIS 20.

Pressure tappings

When the tab handled orifice plates are used without the optional carrier, it is the responsibility of the user to provide appropriate presssure tappings in either his flanges or in the upstream and downstream pipework as specified in **BS 1042 / ISO 5167.**

The optional carrier assembly incorporates upstream and downstream pressure tappings threaded ½" NPT. These tappings are 25.4 mm either side of the orifice plate face in line with the requirements of **BS 1042 / ISO 5167.**

For full technical details of associated equipment, see relevant Spirax Sarco literature.
Some of the products shown may not be available in certain markets.

OPLATE

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