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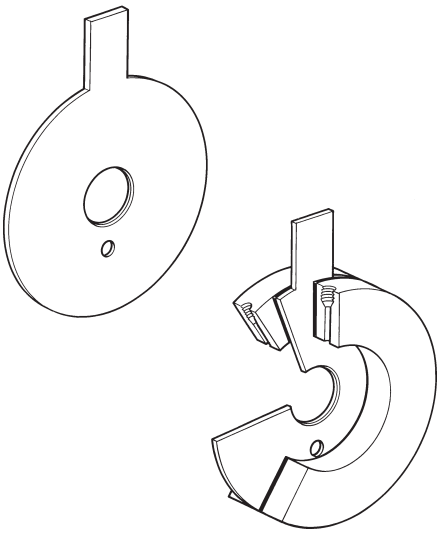
M410 Orifice Plate Assemblies
Installation and Maintenance Instructions



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1. Introduction

The Spirax Sarco Orifice Plate Flowmetering System is designed to meet all the requirements of British Standard BS 1042 and International Standard ISO 5167 for the flowmetering of fluids in closed conduits using a square edged orifice plate. A number of equipment options are available from Spirax Sarco. This document gives technical information and installation details for the M410 Orifice Plate Assembly only.

2. Technical details

2.1 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 British Standard BS 1042 and International Standard Organisation ISO 5167 in all respects and is suitable for the measurement of the rate of flow most liquids, gases and steam. The tab handled orifice plate can be used:

a: on its own fitted between flanges with pressure tappings in the users pipework or flanges.
or
b: fitted into a carrier with integral flange tappings designed to fit between customer flanges.

2.2 Limiting conditions

The pressure and temperature limitations of both the tab handled plate and the carrier assembly are the same as the specified flange ratings.

2.3 Performance

To BS 1042 and ISO 5167.
The performance of an orifice plate metering 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.

2.4 Pipe sizes available

Tab handled plates with or without carriers are available to suit the following pipe sizes:
DN 25, 40, 50, 65, 80, 100, 125, 150, 200, 250, 300, 350, 400, 450, 500, 600.

2.5 Connections

Tab handled plates and carriers are available to suit the following flange specifications:
BS 4504 PN 16, 25, 40.
BS 10 Table H.
ANSI B 16.5 class 150, 300, 600.
Japanese Industrial Standard JIS 20.
Korean Standard KS 20.

2.6 Materials of construction

Tab handled orifice plate: BS 1449 S 316
Carrier: passivated zinc plated carbon steel
Gaskets: exfoliated graphite

2.7 Pressure tappings

When the tab handled orifice plates are installed without the optional carrier, it is the responsibility of the user to provide appropriate pressure tappings in either his flanges or upstream and downstream pipework in line with BS1042/ISO 5167.

The optional carrier assembly incorporates upstream and downstream pressure tappings threaded ½" NPT. These tappings are 25.4mm either side of the orifice plate face in line with the requirements of BS1042 / ISO5167.

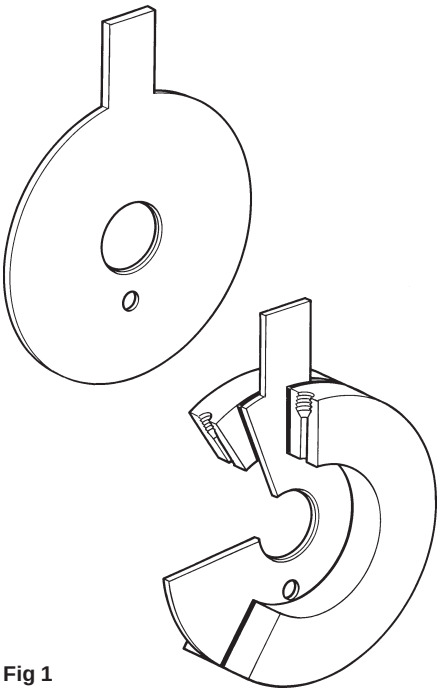

Fig 1

2.8: Dimensions **approximate in millimetres**

DN	BS4504 PN16 A	BS4504 PN25 A	BS4504 PN40 A	BS10 Table H A	ANSI 150 A	ANSI 300 A	ANSI 600 A	JIS 20 A	KS 20 A	Max. Weight kg
25	73	73	73	71.4	66.7	73	73	74	74	2.36
40	94	94	94	88.9	85.7	95.3	95.3	89	89	3.72
50	109	109	109	111.1	104.7	111.1	111.1	104	104	4.91
65	129	129	129	130.1	123.8	130.2	130.2	124	124	6.21
80	144	144	144	149.2	136.5	149.3	149.3	140	140	7.91
100	164	170	170	174.6	174.6	181	193.7	165	165	13.75
125	194	196	196	215.9	196.9	216	241.3	203	203	20.98
150	220	226	226	241.3	222.3	250.9	266.7	238	238	23.51
200	275	286	293	304.9	279.4	308	320.6	383	383	31.25
250	331	343	355	358.8	339.7	361.9	400	356	356	47.95
300	386	403	420	415.9	409.6	422.2	457.1	406	400	58.74
350	446	460	477	469.9	450.8	485.7	492.1	450	450	60.2
400	498	517	549	527	574.3	539.7	565.1	570	570	85.99
450	559	567	574	581	549.2	596.8	612.7	575	575	94.38
500	620	627	631	644.5	606.4	654	682.6	630	630	117.69
600	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 BS1042/ISO5167.
2. For line sizes DN 25 to DN 350, orifice plate thickness T is 3mm, above DN350, T is 6mm.
3. Gaskets are 1.6 mm thick.
4. For line sizes up to DN 350, carrier assembly thickness B is 82mm, above DN 350, B is 85mm.
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.

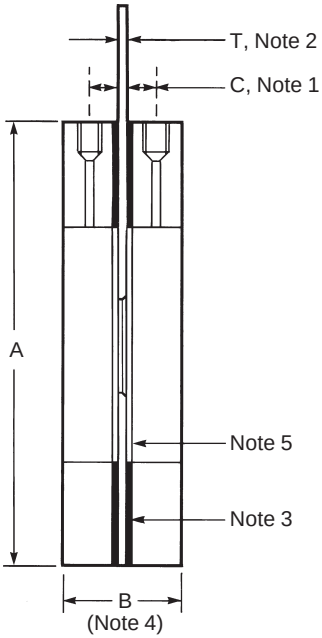

Fig 2

3. Installation requirements

3.1 General installation requirements

The orifice plate (with or without the optional carrier) should be installed between two mating flanges in the pipework.
The following are guidelines for the positioning requirements of the orifice plate assembly. However, for further information please refer to BS 1042 Part 1, Sec 1.1.or ISO 5167.
For liquid metering, the pipe should run full at

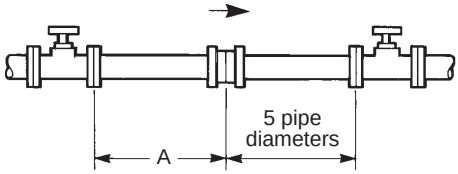

Fig 3a Fully open fulway valve

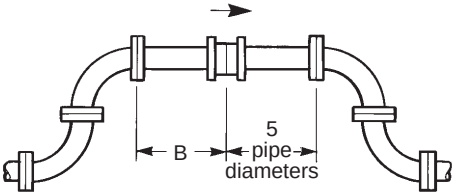

Fig 3b Two angle bends in same pipe

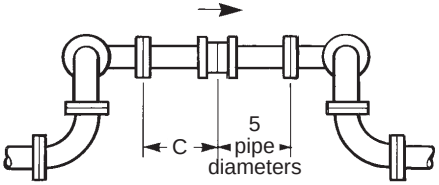

Fig 3c Three bends at right angle

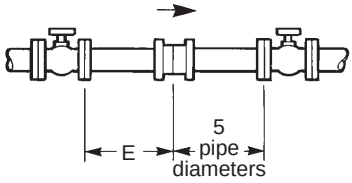

Fig 3d Fully open globe valves

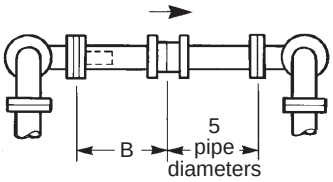

Fig 3e Two bends at right angle with straightening vanes

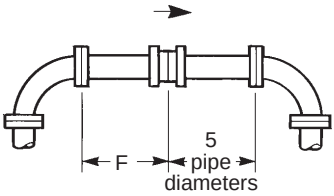

Fig 3f Right angle bends

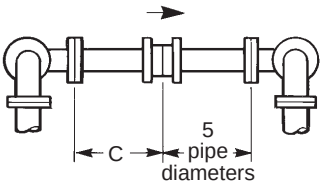

Fig 3g Two bends at right angles

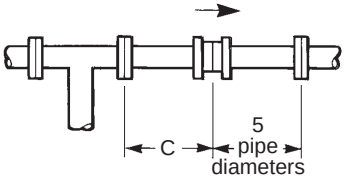

Fig 3h Branches

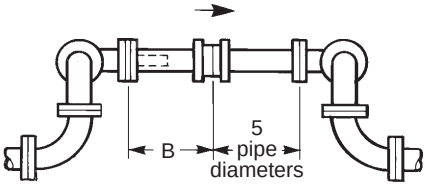

Fig 3j Three bends at right angles with straightening vanes

Minimum number of pipeline diameters required upstream of orifice

$ß = \frac{d}{D}$ where d = orifice diameter (mm)
D = pipe diameter (mm)

ß	<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

the measuring section.
The orifice plate assembly should be fitted between two sections of straight cylindrical pipe of constant cross-sectional area.
The pipe bore shall be circular over the measured length.
The inside surface of the measuring pipe shall be clean and free from scale, pitting and deposits or any other possible source of turbulence. The pipe and pipe flanges should be lagged for steam applications.
The recommended minimum upstream and downstream lengths for optimum accuracy are shown in Fig 3. Shorter lengths can be used although these will reduce the accuracy of the system.
When the pipework is ready for the installation of the orifice plate assembly, remove the assembly from the packing and check the serial number against that supplied on the drawing. As the orifice plate is machined to high tolerances care should be taken when handling to prevent damage.
The orifice plate carrier assembly is held together by tape and this should be checked to ensure that it is secure.

3.2 Installation of the M410 orifice plate assembly

The orifice plate assembly consists of an orifice plate, optional carrier rings with ½ inch NPT tapping and gaskets to fit between the orifice plate and carrier ring, and the carrier ring and the flanges. This assembly is held together by tape.
The orifice plate assembly should be installed between the pipe mating flanges as shown in the diagram below (Fig 4). It is important to ensure that the 45° chamfer should be **downstream**, this will be achieved when the engraving on the tab handle of the orifice plate is facing in the **upstream** direction.
When installed in this way the high pressure tapping in the carrier will be upstream of the orifice plate. Care should be taken to ensure that these are connected to the correct port on the 3-valve manifold on the DP transmitter.
The outside diameter of the orifice plate and carrier assembly is equal to the flange bolt PCD minus the diameter of the bolts to ensure precise centring of the orifice plate in the pipeline, although care should be taken to ensure that the gaskets do not protrude into the measured pipe length. Where a drain hole is present in the orifice plate, ensure that this is positioned at the lowest point to avoid condensate or liquid build-up behind the plate.

3.3 Installation in steam pipelines

The following instructions apply for the layout of the orifice plate and transmitter when steam flow is being measured.
The position of the pressure tappings shall be horizontal or up to 45° above the horizontal.

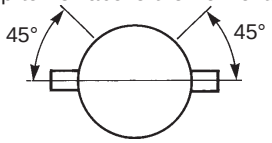

Fig 5 Position of Pressure Tappings for Steam Applications

See figure 5
The DP Transmitter should be installed at a lower position than the orifice plate. The impulse lines should be filled with condensed water to prevent damage to the transmitter. Temperature at the measuring cell should be less than100°C.
The impulse piping should have a minimum fall of 1:20, run over the same route preferably clipped together and unlagged. It should have a minimum O/D of ½" (12.7mm) and be of a suitable pressure and temperature rating for the application.
The impulse piping should follow a route to prevent any elbows where air or non condensable gases could accumulate. This could cause serious errors in the DP Transmitter reading.
The recommended layout of the system can be seen in Fig 6

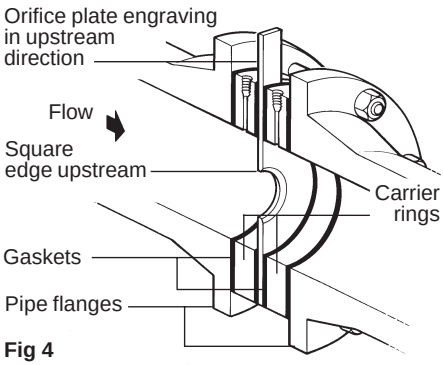

Fig 4

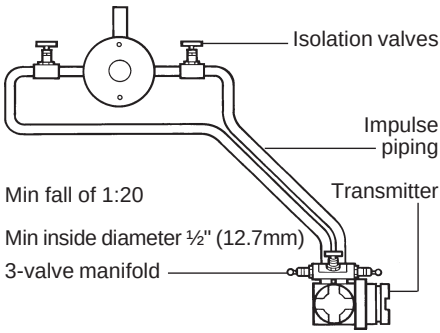

Fig 6 Recommended layout of system

3.4 Installation in gas pipelines

The following instructions apply for the layout of the orifice plate and transmitter when gas flows are being measured.

The position of the pressure tappings shall be vertical or within 45° of the vertical . See figure 7.

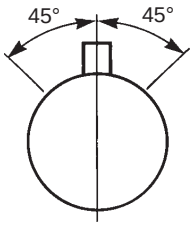

Fig 7 Position of Pressure Tappings for Gas Applications

The transmitter should be installed at a higher position than the orifice plate.

The impulse piping should have a minimum rise of 1:20, and should not contain any elbows where liquid could accumulate causing serious error in the DP Transmitter reading.

The two impulse pipes should follow the same route, preferably clipped together. The impulse piping should have a minimum O/D of ½" (12.7mm) and be of a suitable pressure and temperature rating for the application.

The recommended layout of the system can be seen in Fig 8

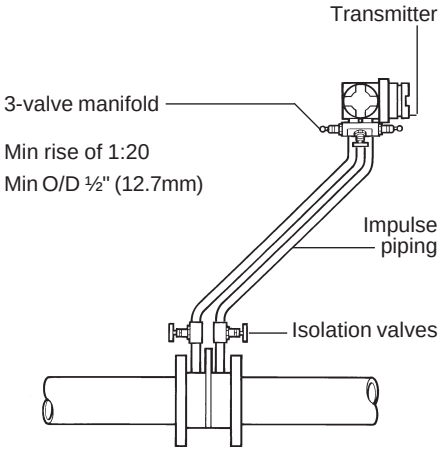

Fig 8 Recommended layout for Gas Applications

3.5 Installation in liquid pipelines

The following instructions apply for the layout of the orifice plate and transmitter when liquid flow is to be measured.

The pressure tappings should be horizontal or up to 45° below the horizontal. They must never be taken off from directly below the orifice plate as any dirt from the pipeline may fall into the impulse piping and either block it or cause a serious error in the transmitter reading. See Fig 9

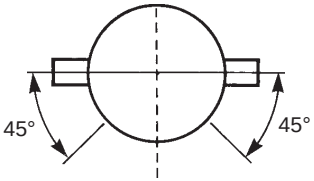

Fig 9 Position of Pressure Tappings for Liquid Measurement

The transmitter should be installed at a lower position than the orifice plate.

The impulse piping should have a minimum fall of 1:20, and should not contain any elbows where air or gases can accumulate as this will cause serious error in the DP Transmitter reading.

The two impulse pipes should follow the same route, preferably clipped together. The impulse piping should have a minimum O/D of ½" (12.7mm) and be of a suitable pressure and temperature rating for the application.

The recommended layout of the system can be seen in Fig 10

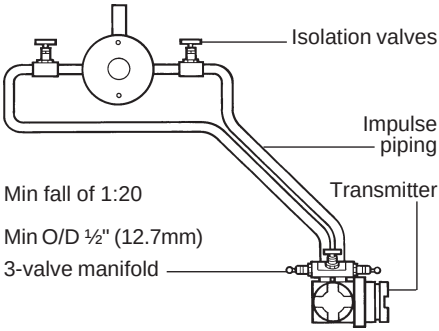

Fig 10 Recommended Layout for Liquid Applications

3.6 Installation in non horizontal pipelines

If the orifice plate is not going to be installed in a horizontal length of process pipework then the following guideline should be followed.
The impulse piping should be set up as shown below in figure 11 The difference in the static head pressure caused by the different layout of the impulse piping can be compensated for using the zero adjustment on the transmitter.

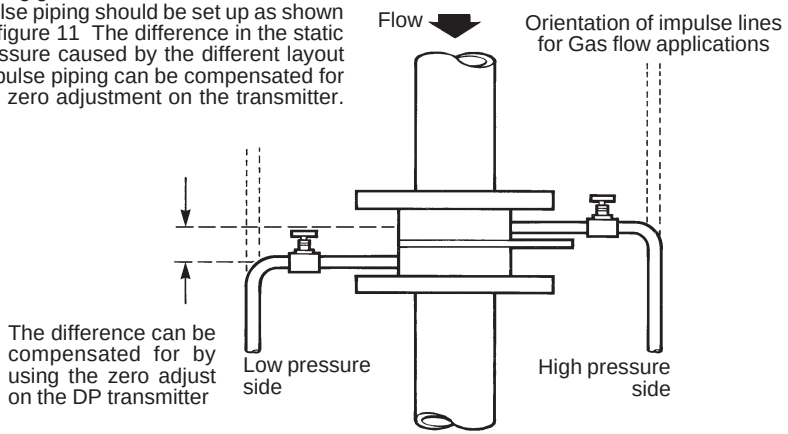

Fig 11 Impulse piping in non horizontal lines