M-Zert
Zertifiziertes QM-System
DIN EN ISO 9001
Zertifikat-Nr. 01017

Orifice Plate and Orifice Flange

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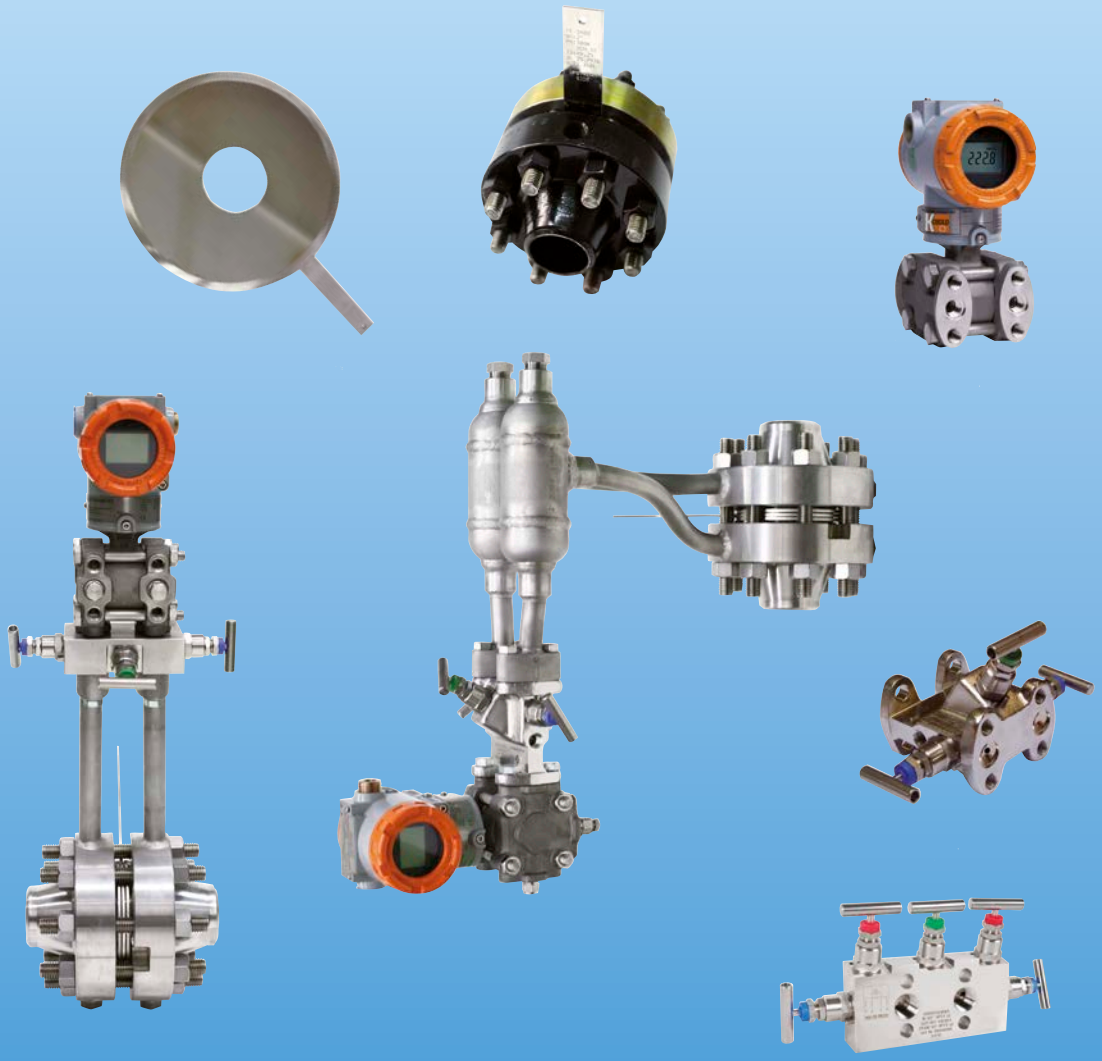
measuring • monitoring • analysing

KPL



- Sizes: DN 50 ... DN 600, 2" ... 24" ASME
- p_{max}: PN 420 or Class 2500; t_{max}: +500 °C (930 °F), higher on request
- Material: stainless steel, carbon steel, others on request

S5

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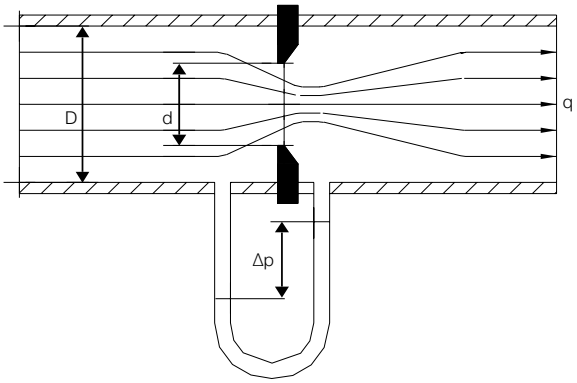
Description

If a pipeline (through which a medium flows) is reduced at a particular point by a cross-sectional constriction, the flow speed of the measured medium is increased at that point. According to Bernoulli's energy equation and the law of continuity, the total flow head (dynamic velocity head and static pressure head) is constant.



The increase in speed at the constriction causes a reduction in the static head. The resulting pressure drop is called the differential pressure head; it is a measure of the flow (volume per unit of time or mass per unit of time).

The flow rate q is given by: $\mathbf{q = c\sqrt{\Delta p}}$

The flow rate (q) is a function of the square-root of the differential pressure head (Δp), where c is the coefficient of flow rate determined by the shape of the differential pressure transducer and the operating data. The pipeline may be constricted with orifice plates.

Fields of application

Orifice primary elements are used for economical and reliable flow measurement of liquids, gases or steam. During measure ment, the medium should be in one pure phase and flow through pipes with circular cross-section running full. DIN EN ISO 5167-2 is not applicable to the measurements of pulsating flow. The orifice plates require little or no maintenance, as there are no moving parts in the measurement stream.

Metering unit design

The entire metering unit comprises of the following:

- **Transmitter**

The transmitter converts the differential pressure signal into a standard output signal. To generate a linear signal, we recommend a differential pressure transmitter with internal square-root extraction, e.g. PAD model.

- **Primary element** (e.g. an orifice with flange tapping, corner tapping or D-D/2 pressure tapping etc.)

- **Orifice Plates (Model KPL-B...)**

The orifice plate with welded handle model KPL-B is supplied with plain raised face for fitting between pipeline flanges. It generates and sustains the differential pressure required for flow measurement. The differential pressure head is tapped in the flange or in the pipeline at a particular distance from the orifice plate. This distance is included in the calculations for the plate. The plates are dimensioned to suit prevailing service conditions. The orifice plates have no mounting rings; they are fitted between pipeline flanges.

The various orifice plate designs depend on application and are summarised below:

Orifice Plates according to DIN EN ISO 5167- 2 Standard

Concentric Orifice Plate (Figure 1)

The essential characteristics are a sharp inlet edge, a cylindrical hole of a specific length and a downstream conically tapered outlet.

The limit of use:
$d > 12.5$ mm
$D < 500$ mm
$0.1 < \beta < 0.75$
$Re > 10^5\ \beta$
Pressure taps only Corner-Taps.

Bidirectional Orifice Plate (Figure 2)

Orifice plates with a cylindrical measuring-plate opening are used for an alternating, bidirectional flow direction or when regulations other than DIN don't specify a bevel.

The limit of use: as for concentric

Quarter Circle Nozzle (Figure 3)

The dimensionless Reynolds number has special significance in the flow throughput measurement and serves to characterize the flow. It is dependent upon the pipeline diameter, the flow rate and the viscosity of the medium. Standard orifice plates cannot be used for small Reynolds numbers (e.g. in the case of oil measurement). Quarter-circle nozzles are used in these cases.

The limit of use:
$d > 15$ mm
$D < 500$ mm
$0.245 < \beta < 0.6$
$Re < 10^5\ \beta$
Pressure taps only Corner-Taps.

Conical Entrance Orifice (Figure 4)

The conical entrance orifice is used for very small Reynolds numbers.

Calculation and designing are based on norm ISO-5167- ISO/TR-15377.

The limit of use:
$d > 6$ mm
$D < 500$ mm
$0.1 < \beta < 0.316$
$80 < Re < 2 \times 10^5\ \beta$
Pressure taps only Corner-Taps.

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Segmental Orifice (Figure 5)

If there are solids or gases in a medium, they could accumulate in front of the orifice and lead to erroneous measurement. The segmented orifices eliminate this disadvantage to a great extent. The measurement cross-section is not circular and concentric, but instead segment shaped. It provides complete clearance in the lower or upper part of the pipe. Existing solids in liquids (aperture at the bottom) or gas bubbles in liquids (aperture at the top) get free flow in the undisturbed part of the pipeline.

Calculation and designing are based on norm ISO-5167- ISO/TR-15377.

The limit of use:
$d > 30$ mm
$100 < D < 350$ mm
$0.3 < \beta < 0.8$
$Re > 10000$
Pressure taps only Flange-Taps.

Excentric Orifice (Figure 6)

If there are solids or gases in a medium, they could accumulate in front of the orifice and lead to erroneous measurement. The segmented orifices eliminate this disadvantage to a great extent. The measurement cross-section is circular and not concentric. It provides complete clearance in the lower or upper part of the pipe. Existing solids in liquids (aperture at the bottom) or gas bubbles in liquids (aperture at the top) get free flow in the undisturbed part of the pipeline.

Calculation and designing are based on norm ISO-5167- ISO/TR-15377.

The limit of use:
$d > 50$ mm
$100 < D < 1000$ mm
$0.46 < \beta < 0.84$
$2 \times 10^5\ \beta^2 < Re < 10^6\ \beta$
Pressure taps only Flange-Taps.

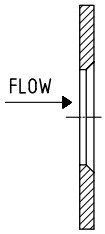


Fig. 1

Fig. 2

Fig. 3

Fig. 4

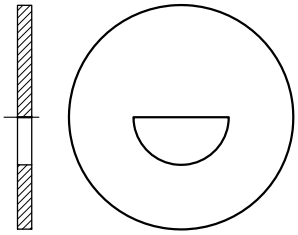


Fig. 5

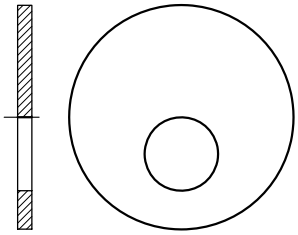
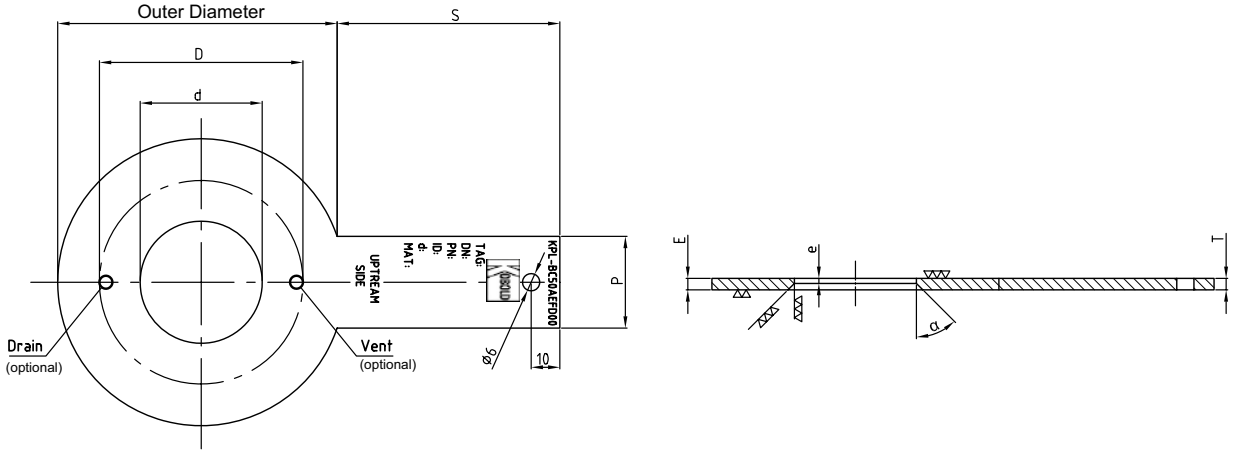


Fig. 6

Design	Bore type	Reynolds No. / Application (approx. numbers)
1	Concentric (standard)	$Re > 5000$ for $0.1 < \beta < 0.56$ $Re > 16000\ \beta^2$ for $\beta > 0.56$
2	Bidirectional	$Re > 5000$ for $0.1 < \beta < 0.56$ $Re > 16000\ \beta^2$ for $\beta > 0.56$
3	Quarter Circle	$500 < Re < 5000$
4	Conical Entrance	$80 < Re < 500$
5	Segmental	$Re > 5000$
6	Excentric	$Re > 5000$ for $0.1 < \beta < 0.56$ $Re > 16000\ \beta^2$ for $\beta > 0.56$

Dimensions (Orifice Plate)



Definitions as per DIN EN ISO 5167

Diameter 'D':

Inner Pipe diameter upstream (or diameter of upstream cylinder in case of classic venturi tube) under process conditions.

Plate Thicknesses 'E' and 'e': as per DIN EN ISO 5167-2

The thickness 'e' of the orifice shall be between 0.005 D and 0.02 D. The difference between the values of 'e' measured at any point on the orifice shall not be greater than 0.001 D.

The thickness 'E' of the plate shall be between 'e' and 0.05 D.

However, when 50 mm ≤ D ≤ 64 mm, a thickness 'E' up to 3.2 mm is acceptable.

If D ≥ 200 mm, the difference between the values of 'E' measured at any point of the plate shall not be greater than 0.001 D.

If D < 200 mm, the difference between the values of 'E' measured at any point of the plate shall not be greater than 0.2 mm.

Orifice diameter (d):

The diameter 'd' shall in all cases be greater than or equal to 12.5 mm. The diameter ratio, β = d/D, shall be always greater than or equal to 0.10 and less than or equal to 0.75. Within these limits, the value of β may be chosen by the user/manufacturer.

Angle of bevel 'α': It should be 45° ±15°

Drain / Vent Hole:

Orifice Plates may also be delivered with drain/vent holes. This option is only available for mounting in horizontal pipes. Outside edge of drain/vent hole is tangent to the inner pipe diameter.

- Vent Hole is used for liquids with gas bubbles
- Drain Hole is used for gases with condensation.
  See orifice plate dimensional drawing for positioning of these holes

Nominal Diameter	E	e	S	P	T
DN 50 (2")	3	1	125	32	3
DN 65 (2½")	3	1.5	125	32	3
DN 80 (3")	3	1.5	125	32	3
DN 100 (4")	3	1.5	125	40	3
DN 150 (6")	3	1.5	140	40	3
DN 200 (8")	6	3.5	140	38	6
DN 250 (10")	6	3.5	140	45	6
DN 300 (12")	6	3.5	140	45	6
DN 350 (14")	6	3.5	140	45	10
DN 400 (16")	10	6	150	45	10
DN 450 (18")	10	6	150	50	10
DN 500 (20")	10	6	150	50	10
DN 600 (24")	12	8	150	50	12

Marking Orifice Plate:
The following data is written on the side facing upstream:

- Tag Nr
- Pipeline nominal size (DN)
- Pressure rating (PN)
- Pipe Inner diameter (D)
- Orifice diameter (d)
- Material
- Upstream side

Recommended Straight Run Requirements:
as per DIN EN ISO 5167-2 (see section “Flow Conditioner”)

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DN	Orifice Plate Outer Diameter (max.) for flanges according to EN 1092-1 Form B1 [mm]						Approx. Weight [kg]					
	PN10	PN16	PN25	PN40	PN63	PN100	PN10	PN16	PN25	PN40	PN63	PN100
50	107	107	107	107	113	119	0.21	0.21	0.21	0.21	0.24	0.27
65	127	127	127	127	138	144	0.3	0.3	0.3	0.3	0.36	0.39
80	142	142	142	142	148	154	0.38	0.38	0.38	0.38	0.41	0.45
100	162	162	168	168	174	180	0.66	0.66	0.71	0.71	0.76	0.91
125	192	192	194	194	210	217	0.92	0.92	0.94	0.94	1.1	1.18
150	218	218	224	224	247	257	1.78	1.78	1.88	1.88	2.29	2.48
200	273	273	284	290	309	324	2.8	2.8	3.03	3.16	3.56	3.94
250	328	329	340	352	364	391	4.04	4.06	4.34	4.56	4.98	5.74
300	378	384	400	417	424	458	5.37	5.54	6.01	6.53	6.75	7.88
350	438	444	457	474	486	512	7.21	7.4	7.84	8.44	8.87	9.85
400	489	495	514	546	543	572	14.97	15.34	16.54	18.66	18.46	20.48
450	539	555	565	571	-	-	18.19	19.28	19.98	20.41	-	-
500	594	617	624	628	657	704	22.09	23.83	24.37	24.69	27.02	31.02
600	695	734	731	747	764	813	36.28	40.47	40.14	41.92	43.84	49.65

Line Size [inch]	Orifice Plate Outer Diameter (max.) for flanges according to ASME B 16.5 and B 16.36* [inch (mm)]					Approx. Weight [kg]				
	300#	600#	900#	1500#	2500#	300#	600#	900#	1500#	2500#
2"	4.375 (111.13)	4.375 (111.13)	5.625 (142.88)	5.625 (142.88)	5.750 (146.5)	0.21	0.21	0.21	0.21	0.24
2½"	5.125 (130.18)	5.125 (130.18)	6.500 (165.1)	6.500 (1165.1)	6.625 (168.28)	0.3	0.3	0.3	0.3	0.36
3"	5.875 (149.23)	5.875 (149.23)	6.625 (168.28)	6.87 (174.6)	7.750 (196.85)	0.38	0.38	0.38	0.38	0.41
4"	7.125 (180.98)	7.625 (193.68)	8.125 (206.38)	8.250 (209.55)	9.25 (234.9)	0.66	0.66	0.71	0.71	0.76
6"	9.875 (250.83)	10.500 (266.7)	11.375 (288.93)	11.125 (282.58)	12.500 (317.5)	1.78	1.78	1.88	1.88	2.29
8"	12.125 (307.98)	12.625 (320.68)	14.125 (358.78)	13.875 (352.43)	15.250 (387.35)	2.8	2.8	3.03	3.16	3.59
10"	14.250 (361.95)	15.750 (400.05)	17.125 (434.98)	17.125 (434.98)	18.750 (476.25)	4.04	4.06	4.34	4.56	4.98
12"	16.625 (422.26)	18.000 (457.2)	19.625 (498.48)	20.500 (520.7)	21.625 (549.28)	5.37	5.54	6.01	6.53	6.75
14"	19.125 (485.78)	19.37 (492.1)	20.500 (520.7)	22.750 (577.85)	-	7.21	7.4	7.84	8.44	8.87
16"	21.250 (539.75)	22.25 (565.15)	22.625 (574.68)	25.250 (641.35)	-	14.97	15.34	16.54	18.66	18.46
18"	23.5 (596.9)	24.12 (612.7)	25.125 (638.2)	27.755 (705.0)	-	18.19	19.28	19.98	20.41	21
20"	25.75 (654.1)	26.87 (682.6)	27.5 (698.5)	29.75 (755.6)	-	22.09	23.83	24.37	24.69	27.02
24"	30.5 (774.7)	31.125 (790.6)	33 (838.2)	35.500 (901.7)	-	36.28	40.47	40.14	41.92	43.84

* only for RF flanges NO RTJ

- **Orifice Flange Union (Model KPL-F…)**

Mechanical construction of the orifice depends also on the type of pressure tapping. Orifice Flange Union comprises of weld-neck flanges for welding in the pipe (flanges with pressure taps) and the exchangeable orifice plate (standard type of pressure tapping). Other types of flanges (slip-on and threaded orifice flanges) and pressure tappings described in DIN EN ISO 5167 such as corner tapping with single bore, corner tapping with annular chamber, Meter Run, D - D/2 tapping and pipe tapping are available on request.

Orifice flanges are widely used in conjunction with orifice plates for measuring the rate of flow of liquids, gases and steam.

Flange tapping (Figure 6)

The accurately positioned pressure taps for connecting the flow measuring instruments are located at a distance of 1" (25.4 mm) before (+) and after (-) the orifice. These built-in taps also reduce field installation labour necessary for welding, drilling and/or tapping pressure taps on the flow line itself. Orifice flanges are provided complete with nuts, bolts, gaskets and plugs for installation. Usually the tapping is realised by a bore through the flange. Standardized measuring flanges are available for flange tapping (EN 1092-1 or ASME B 16.36). The orifice plate is exchangeable. Flange tapping is preferred wherever ASME applies.

Flange tapping is for flanges with raised face, PN 10 ... PN 100 and sizes DN 50 ... DN 600 for flanges according to DIN EN 1092-1 or Cl. 300 ... Cl. 2500 and sizes 2" ... 24" for flanges according to ASME B 16.36 respectively.

D - D/2 tapping (Figure 7)

The tapping connections are fitted in the pipe. Clearance l_1 = D and l_2 = D/2, whereas 'D' is the inner pipe diameter.

Corner tapping (Figure 8)

The pressure is tapped immediately before (+) and after (-) the orifice. It is used when the flange leaf cannot be drilled, e.g. with PN 6, or when pipeline tapping is to be avoided and preferred wherever DIN EN is valid.

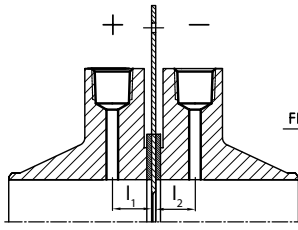

Fig. 6

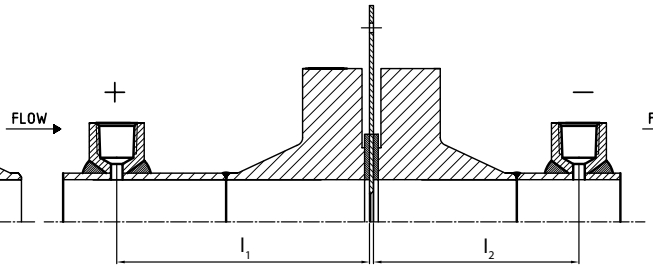

Fig. 7

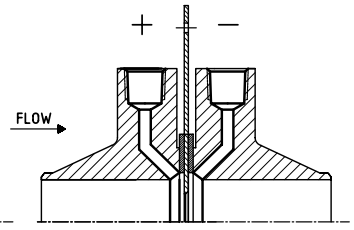

Fig. 8

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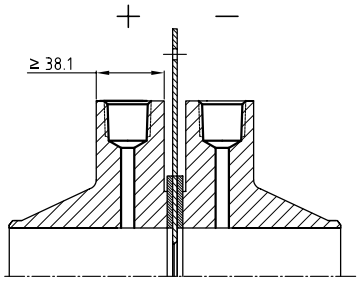
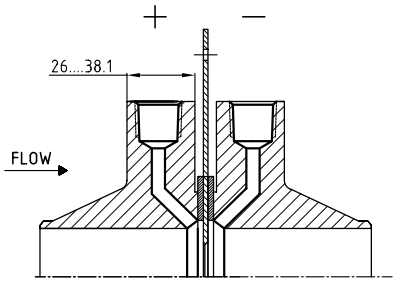
Orifice Flange Union (DIN EN 1092-1 Form B1 flanges, flange or corner tapping)

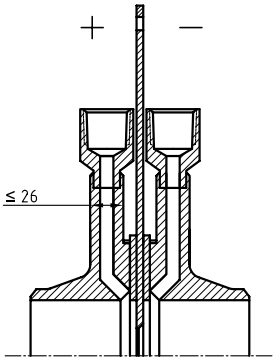
Construction:	DIN EN 1092-1: Orifice plate acc. to DIN EN ISO 5167-2 (standard) completely assembled with flanges, screws and gaskets. Sealing type smooth. Weld neck flange. Orifice calculation according to API (AGA-3) on request
Pressure tap connections:	2 x ½" NPT and 180° apart tappings in each flange are provided as standard, one with a plug. The tap hole diameter is 6.35 mm for DN 50 and DN 65 9.6 mm for DN 80 size and 12.7 mm for DN 100 and larger sizes.
Pressure taps location:	0° (standard). Angle taps according to DIN EN ISO 5167-2 on request.
Sealing surface (orifice plate):	smooth acc. to DIN EN ISO 5167-2



Flange tap



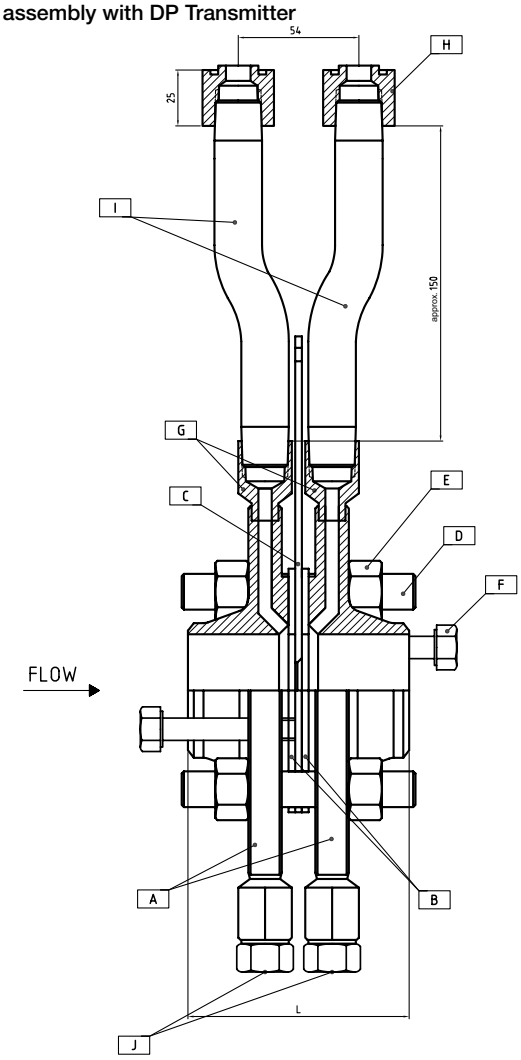
Corner tap



Corner tap with accessories

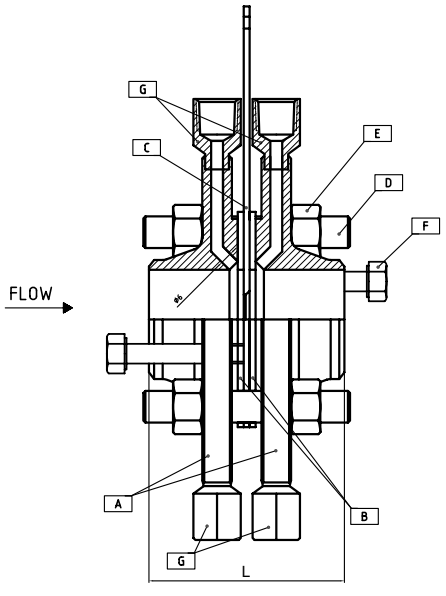
D [mm]	Flanges according to DIN EN 1092-1 Form B1 Type 11 L [mm]						Approx. Weight [kg]					
	PN10	PN16	PN25	PN40	PN63	PN100	PN10	PN16	PN25	PN40	PN63	PN100
50	101	101	107	107	135	148	6.58	6.58	7.24	7.24	11.57	15.51
65	101	101	115	115	147	164	7.76	7.76	10.25	10.25	16.03	22.70
80	111	111	127	127	155	168	10.84	10.84	12.67	12.67	18.41	25.43
100	115	115	141	141	167	192	12.80	12.80	18.41	18.41	26.84	42.37
125	121	121	147	147	187	222	16.55	16.55	25.96	25.96	40.40	63.39
150	121	121	161	161	201	242	22.81	22.81	33.45	33.45	59.41	80.87
200	138	138	174	190	234	274	32.31	34.14	49.82	61.60	99.20	133.34
250	150	154	190	224	264	328	44.55	49.99	69.74	94.46	129.77	205.37
300	150	170	198	244	294	354	51.89	63.43	92.45	131.41	158.71	305.50
350	150	178	214	264	314	392	70.54	90.79	135.25	185.02	253.54	437.85
400	162	188	238	288	338	-	97.44	124.85	185.31	267.77	342.15	-
450	162	184	238	288	-	-	116.31	130.37	225.39	296.43	-	-
500	168	186	268	298	-	-	133.52	195.46	285.35	366.21	-	-
600	184	196	270	320	-	-	186.72	291.41	358.13	597.52	-	-

Example: Orifice Flange Union (DIN EN 1092-1 flanges, corner tapping, with accessories), compact version, prepared for assembly with DP Transmitter



Position	Description	Material
A	Flange DIN EN-1092-1 Type 11 Form B 1	carbon steel or st. steel
B	Gasket spirometalic	spirometalic
C	Orifice plate	1.4404
D	Screw	carbon steel/1.4404
E	Nuts	carbon steel/1.4404
F	Extractor screw	carbon steel/1.4404
G	Pressure Taps x 2 at 180° for flange	1.4404
H	Oval flange	1.4401
I	Nipple	1.4404
J	Plug	carbon steel or st. steel

Example: Orifice Flange Union (DIN EN 1092-1 flanges, corner tapping, with accessories), remote version



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Orifice Flange Union (ASME B16.36 flanges, flange tapping)

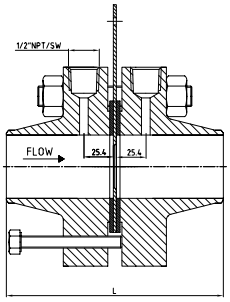
Construction: ASME B 16.36: Orifice plate acc. to DIN EN ISO 5167-2 (standard) completely assembled with flanges, screws, gaskets and extractor screws / locking plugs. Sealing type smooth (RF). Each flange with 2 x outlet taps 180° displaced, weld neck. Orifice calculation according to API (AGA-3) on request.

Pressure tap connections: 2 x ½" NPT and 180° apart tappings in each flange are provided as standard, one with a plug. The tap hole diameter is
¼" for 2" and 2½" size,
⅜" for 3" size,
½" for 4" and larger sizes.

Pressure taps location: 0° (standard). Angle taps according to DIN EN ISO 5167-2 on request.

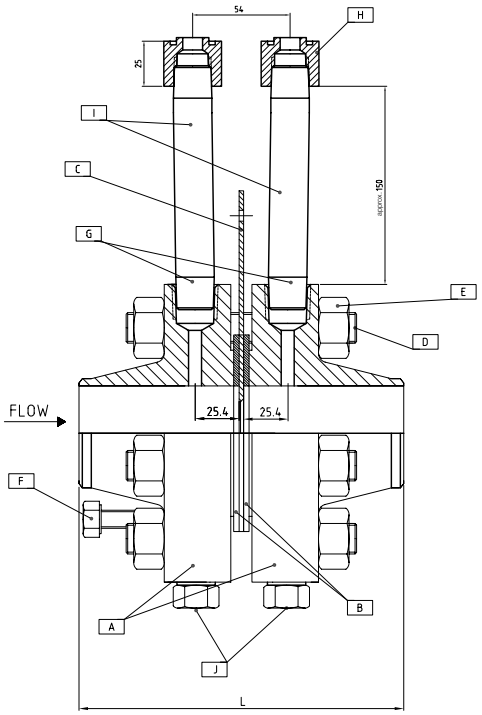
Sealing surface: smooth according to DIN EN ISO 5167-2 (orifice plate)

Example: Orifice Flange Union (ASME B16.36 flanges, flange tapping), remote version



Position	Description	Material
A	Flange ANSI B16.36 WN RF Ra 125-250	Carbon steel or st. steel
B	Gasket spirometalic	spirometalic
C	Orifice plate	1.4404
D	Screw	Carbon steel or st. steel
E	Nuts	Carbon steel or st. steel
F	Extractor screw	Carbon steel or st. steel
G	Pressure Taps x 2 at 180° for flange	1.4404
H	Oval flange	1.4401
I	Nipple	1.4404
J	Plug	Carbon steel or st. steel

Example: Orifice Flange Union (ASME B16.36 flanges, flange tapping), compact version, prepared for assembly with DP Transmitter



D [inch]	Flanges according to ANSI B16.36 L [mm (inch)] (approx.)					Approx. Weight [kg (lbs)]				
	Cl. 300	Cl. 600	Cl. 900	Cl. 1500	Cl. 2500	Cl. 300	Cl. 600	Cl. 900	Cl. 1500	Cl. 2500
2"	182.7 (7.2)	182.7 (7.2)	226.9 (8.9)	226.9 (8.9)	277.7 (10.9)	18.1 (39.9)	18.1 (39.9)	35 (77)	35 (77)	59.6 (131.1)
2½"	188.8 (7.2)	188.8 (7.2)	233 (9.2)	233 (9.2)	309.2 (12.1)	24.2 (53.2)	24.2 (53.2)	50 (110)	50 (110)	74.9 (164.9)
3"	188.8 (7.4)	188.8 (7.4)	226.9 (8.9)	258.4 (10.2)	360 (14.2)	26.7 (58.6)	28.5 (62.8)	40.7 (89.6)	67.2 (147.9)	129.6 (285.2)
4"	194.9 (7.7)	226.9 (8.9)	252.3 (9.9)	271.6 (10.7)	404.7 (15.9)	36.3 (79.9)	51.3 (112.8)	69.1 (152.1)	99.6 (219.1)	203.2 (447.1)
5"	214.2 (8.4)	243.4 (9.6)	277.8 (10.9)	335 (13.2)	-	41.1 (90.5)	80.4 (176.8)	110.5 (243)	175.2 (385.3)	-
6"	211.2 (8.3)	258.4 (10.2)	303.1 (11.9)	366.6 (14.4)	569.8 (22.4)	54.7 (120.4)	104.7 (130.3)	140.3 (308.7)	187.6 (412.7)	523 (1150.7)
8"	236.5 (9.3)	293.4 (11.6)	350.8 (13.8)	452.4 (17.8)	661.7 (26.1)	83.2 (183.1)	153.1 (336.8)	229 (503.8)	348.8 (767.3)	802 (1764.5)
10"	248.7 (9.8)	331.5 (13.1)	395 (15.6)	534.7 (21.1)	864.9 (34.1)	124.7 (274.3)	245.1 (539.3)	329.1 (723.9)	592.9 (1304.4)	1473 (3240.6)
12"	274.1 (10.8)	337.6 (13.3)	427 (16.8)	591.6 (23.3)	953.8 (37.6)	183.4 (403.4)	297.7 (654.9)	414.1 (911)	923.4 (2031.4)	2206.9 (4855.1)
14"	299.8 (11.8)	356.9 (14.1)	452.4 (17.8)	623.6 (24.6)	-	235.7 (518.5)	438 (963.5)	450.2 (990.4)	1071.1 (2356.5)	-
16"	310.2 (12.2)	386.3 (15.2)	462.5 (18.2)	653 (25.7)	-	331.7 (729.7)	601.3 (1322.9)	569.8 (1253.7)	1437 (3161.3)	-
18"	355.6 (13.2)	399 (15.7)	487.9 (19.2)	685 (27)	-	419.9 (923.9)	713.6 (1569.9)	787.8 (1733.2)	1863.8 (4100.4)	-
20"	342.1 (13.5)	411.7 (16.2)	526 (20.7)	741.9 (29.2)	-	499.3 (1098.4)	886.1 (1949.4)	967.4 (2128.2)	2386.9 (5251.1)	-
24"	356.6 (14)	439.1 (17.3)	616.9 (24.3)	845.5 (33.3)	-	708.1 (1557.8)	932.1 (2050.6)	1733.5 (3813.7)	3824.9 (8414.8)	

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Technical Details

Nominal size: DN 50 ... DN 600 or 2" ... 24"

Max. Temperature:

Compact version: +200 °C (liquids/gases)
+300 °C (steam)

Remote version: +500 °C

Max. Pressure: PN 420

Sustained pressure loss: function of orifice ratio d/D
approx. 20 ... 70% of differential pressure head

Orifice diameter 'd': is calculated using the operating data

Materials

Orifice plate: stainless steel 1.4404 (316L)
other materials and coatings on request

Flange: carbon steel (A105)
stainless steel 1.4404 (316L)

Screws/Nuts/Taps: carbon steel or
stainless steel (see table)

Plate Roughness: Ra < 0.8 µm

Installation position: concentric with pipe

Marking: see descripton KPL-B

Materials and Temperature Limits

Part	Material	Temperature Limit
Orifice Plate	St. steel 1.4404 (316L)	-198 °C ... +538 °C (-325 °F ... 1000 °F)
Flanges	Carbon Steel (A105)	-28 °C ... +538 °C (-20 °F ... 1000 °F)
Flanges	St. steel 1.4404 (316L)	-198 °C ... +538 °C (-325 °F ... 1000 °F)
Gasket Spiral Wound Type (standard)	Carbon steel flanges: Carbon Steel outer, Stainless Steel inner, 316L windings with graphite filler Stainless steel flanges: Stainless steel outer, Stainless steel inner, 316L windings with graphite filler	-210 °C ... +538 °C (-350°F ... 1000 °F)
Gasket (optional)	Klinger Sil®	-73 °C ... +371 °C (-100 °F ... 700 °F)
Screws	Carbon steel flanges: Carbon Steel, A193 Grade B7M Stainless steel flanges:Stainless steel 316, A193 Grade B8M	-
Nuts	Carbon steel flanges: Carbon Steel, A194 Gr 2H Stainless steel flanges:Stainless steel 316, A194 Grade 8M	-

* The temperature limits depend on the pressure and the medium.

Measuring ranges

The calculations for the orifice diameter and the different orifice shapes are part of the delivery scope, and are based on DIN EN ISO 5167-2 regulations. Calculations according to API (AGA-3) are available on request.

The Reynolds number, the roughness, and the temperature expansion of the plate and pipeline are used in the calculations for the orifice coefficient and the expansibilty factor.

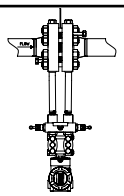
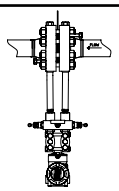
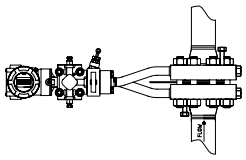
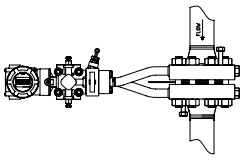
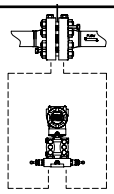
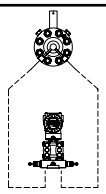
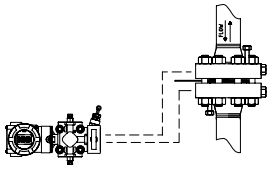
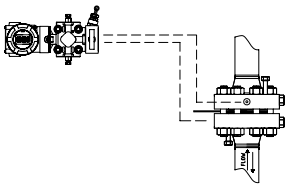
Extensive calculation programs are available for the orifice plate model shapes. A summary of the design data, including the expected pressure loss, are contained on a calculation sheet accompanying every plate supplied.

We require detailed technical data when designing the orifice plate and orifice flange. Kindly fill out the Application Data Sheet (ADS) at the end of this data sheet to inquire.

Design example (for water, 5 °C, d = 0.6xD, measuring range factor 5:1 and flange tapping of differential pressure)

Nominal size	Flow rate [m³/h]	Differential pressure [mbar]	Sustained pressure loss [mbar]	Nominal size	Flow rate [m³/h]	Differential pressure [mbar]	Sustained pressure loss [mbar]
DN 50	1 - 5 2 - 10 5 - 25	1.7 - 44.6 7.0 - 180.3 44.6 - 1134.3	0.7 - 19.4 3.0 - 78.6 19.4 - 496.2	DN 300	80 - 400 100 - 500 170 - 850	9.0 - 226.7 14.0 - 354.4 40.8 - 1025.3	3.9 - 99.7 6.1 - 155.9 17.9 - 451.3
DN 80	5 - 25 8 - 40 12 - 60	6.7 - 173.2 17.5 - 444.7 39.6 - 1002.5	2.9 - 75.8 7.8 - 194.9 17.2 - 439.6	DN 350	100 - 500 150 - 750 220 - 1100	7.8 - 191.3 17.1 - 430.8 36.9 - 927.2	3.3 - 84.1 7.5 - 189.6 16.2 - 408.2
DN 100	9 - 45 12 - 60 18 - 90	9.0 - 230.7 16.2 - 410.7 36.6 - 925.6	3.9 - 101.1 7.0 - 180.1 16.0 - 406.3	DN 400	150 - 750 200 - 1000 300 - 1500	10.0 - 252.5 17.8 - 449.1 40.3 - 1011.1	4.4 - 111.1 7.8 - 197.7 17.7 - 445.2
DN 150	20 - 100 25 - 125 40 - 200	8.9 - 225.8 13.9 - 353.2 35.9 - 905.5	3.8 - 99.1 6.1 - 155.1 16.0 - 406.3	DN 500	230 - 1150 300 - 1500 460 - 2300	9.6 - 243.3 16.4 - 414.6 38.8 - 974.2	4.2 - 107.1 7.2 - 182.3 17.0 - 429.0
DN 200	35 - 175 50 - 250 70 - 350	8.6 - 219.2 17.7 - 447.9 34.9 - 878.7	3.7 - 96.3 7.7 - 7196.9 15.3 - 386.4	DN 600	300 - 1500 400 - 2000 700 - 3500	7.9 - 199.7 14.1 - 355.1 43.4 - 1088.3	3.4 - 87.9 6.2 - 156.4 19.1 - 479.3
DN 250	50 - 250 80 - 400 120 - 600	7.2 - 183.4 18.6 - 470.2 42.1 - 1058.8	3.1 - 80.6 8.1 - 206.8 18.5 - 465.9				

Mounting positions

Medium	Mounting	Flow Pipe arrangement	Flow direction	Possible mounting position
Liquids	Compact	Horizontal	from left	**# L1*** 
			from right	**# L2*** 
		Vertical	up	**# L3*** 
			down	**# L4*** 
	Remote	Horizontal	from left or right	**# L5*** **0° taps** 
				# L6* **angle taps** 
		Vertical	up or down	**# L7*** **0° taps** 
				# L8* **90° taps** 

* Ordering of optional multi-planar flange necessary

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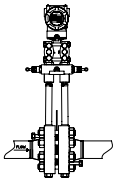
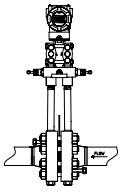
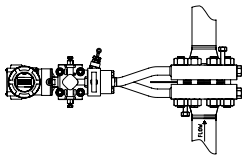
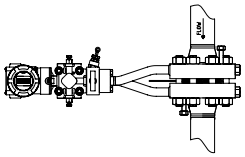
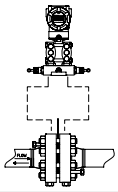
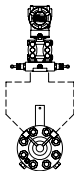
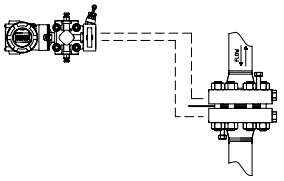
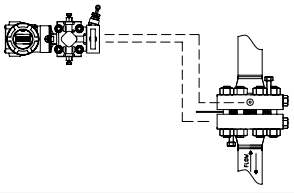
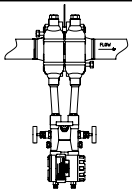
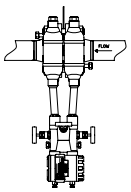
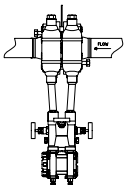
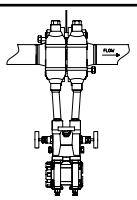
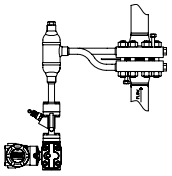
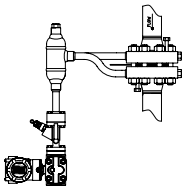
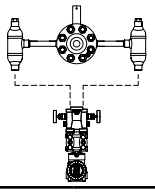
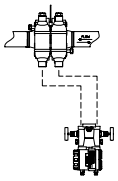
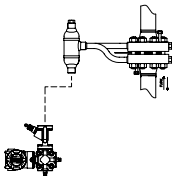
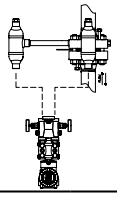
Mounting positions (continuation)

Medium	Mounting	Flow Pipe arrangement	Flow direction	Possible mounting position
Gas	Compact	Horizontal	from left	**# G1*** 
			from right	**# G2*** 
		Vertical	up	**# G3*** 
			down	**# G4*** 
	Remote	Horizontal	from left or right	**# G5*** **0° taps** 
				# G6* **angle taps** 
		Vertical	up or down	**# G7*** **0° taps** 
				# G8* **90° taps** 

* Ordering of optional multi-planar flange necessary

Mounting positions (continuation)

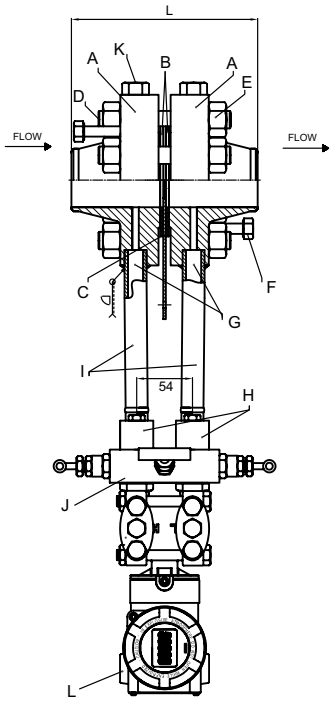
Medium	Mounting	Flow pipe arrangement	Flow direction	Possible mounting position
Steam	Compact	Horizontal	from left or right PAD away from pipe	**# S1** **from left**  **# S2** **from right** 
			from left or right PAD towards pipe	**# S3** **from right**  **# S4** **from left** 
		Vertical	up	**#S5** 
			down	**# S6** 
	Remote	Horizontal	from left or right	**# S7*** **180° taps** 
				# S8 **0° taps** 
		Vertical	up or down	**# S9** **0° taps** 
				# S0* **90° taps** 

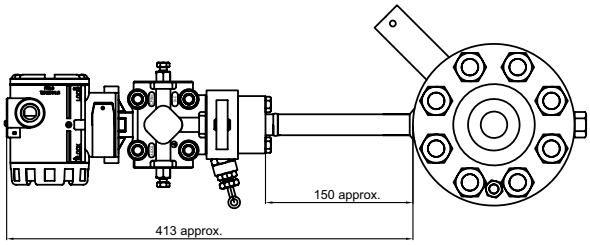
* Ordering of optional multi-planar flange necessary

Mounting positions

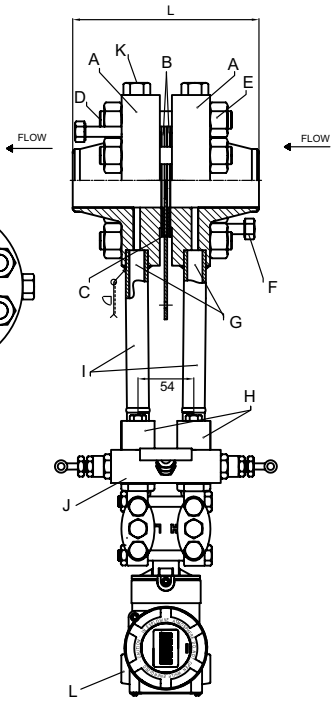
Liquids

Position L1



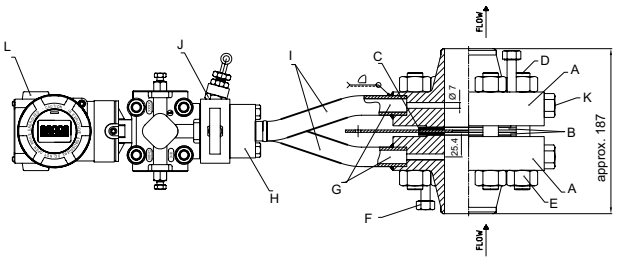


Position L2

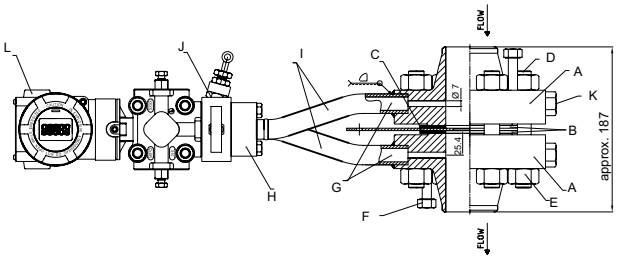


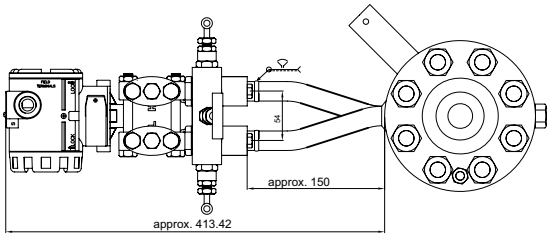
Pos.	Description
A	Flange
B	Gaskets
C	Orifice Plate
D	Screw
E	Nuts
F	Extractor screw
G	Pressure taps x 2 ... 180° for flange
H	Oval flange for connection manifold
I	Nipples
J	Manifold, machined
K	Plugs
L	Differential pressure transmitter PAD

Position L3



Position L4

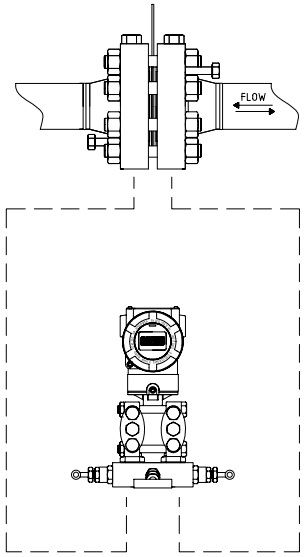




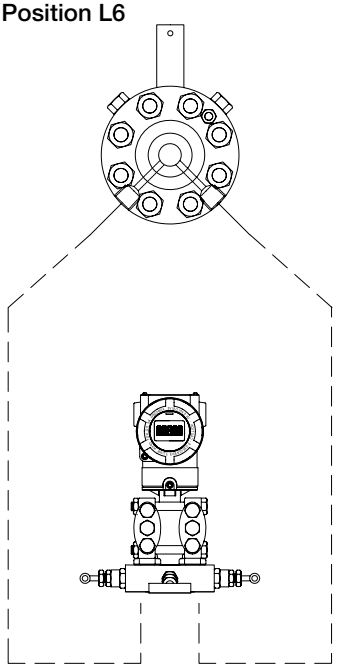
Mounting positions (continuation)

Liquids

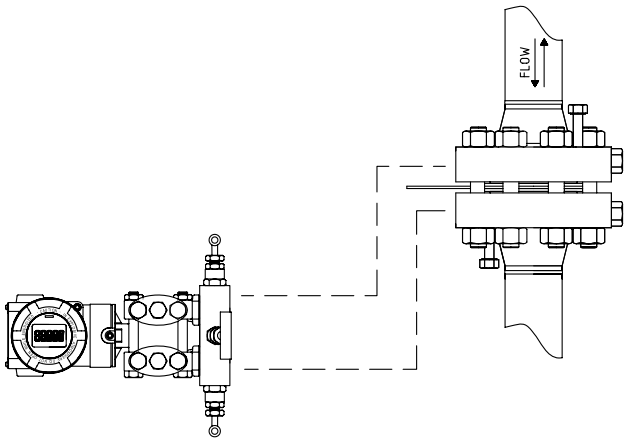
Position L5



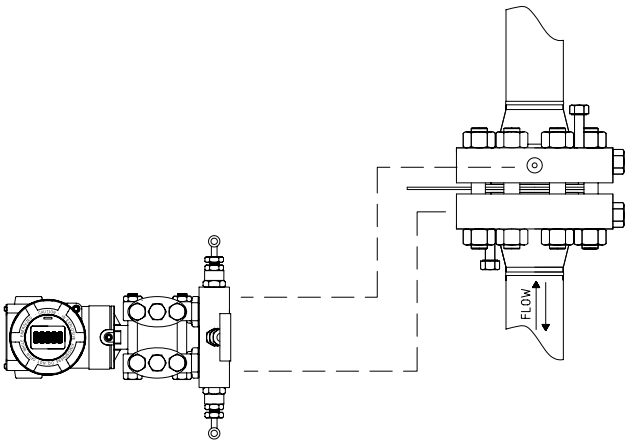
Position L6



Position L7



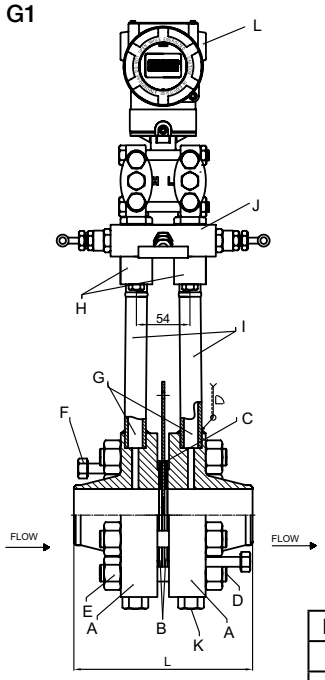
Position L8

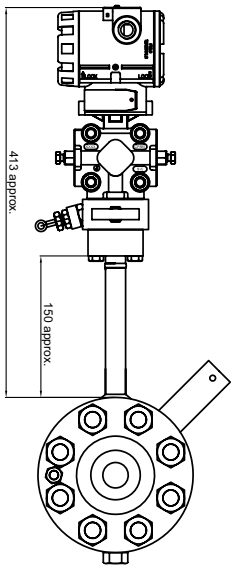


Mounting positions (continuation)

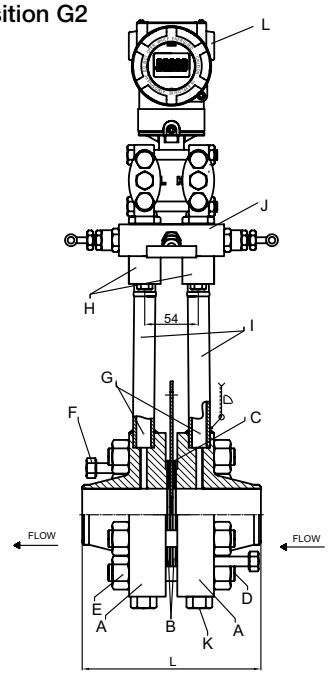
Gases

Position G1



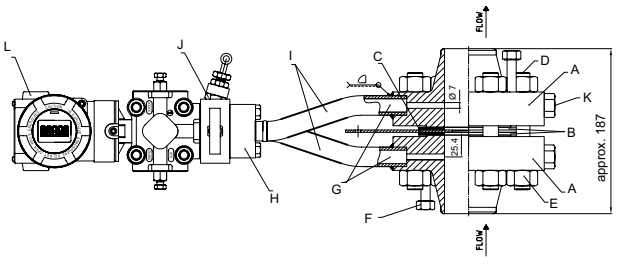


Position G2

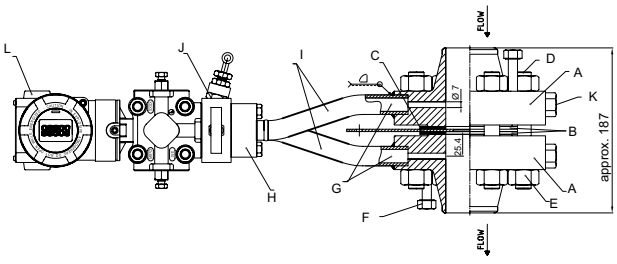


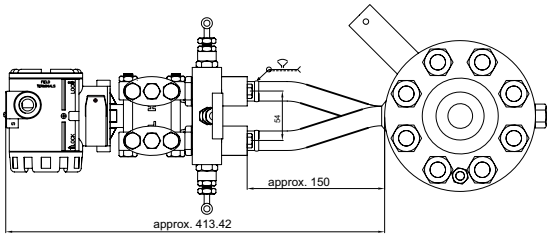
Pos.	Description
A	Flange
B	Gaskets
C	Orifice Plate
D	Screw
E	Nuts
F	Extractor screw
G	Pressure taps x 2 ... 180° for flange
H	Oval flange for connection manifold
I	Nipples
J	Manifold, machined
K	Plugs
L	Differential pressure transmitter PAD

Position G3



Position G4

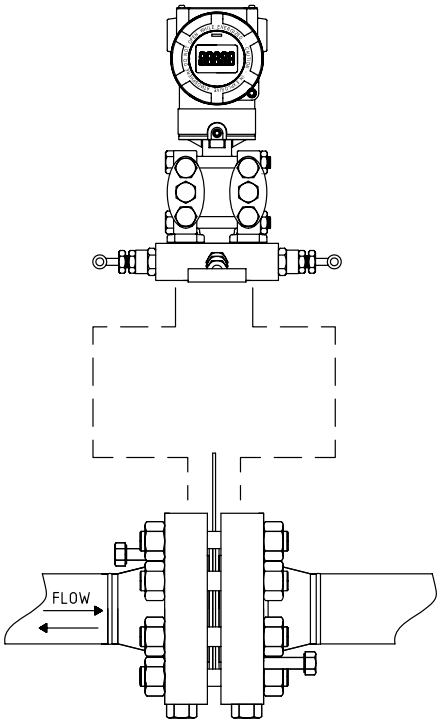




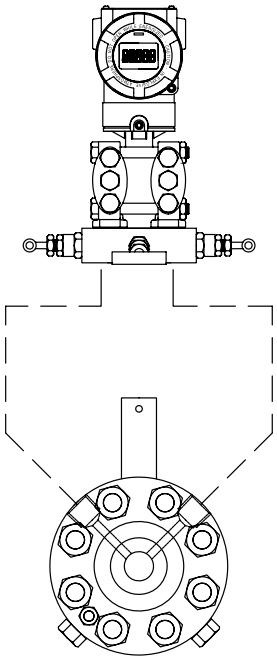
Mounting positions (continuation)

Gases

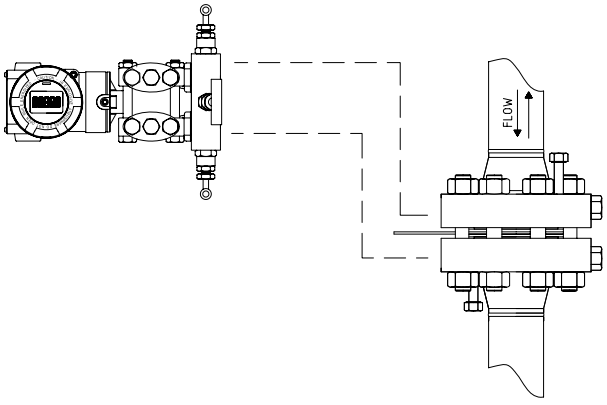
Position G5



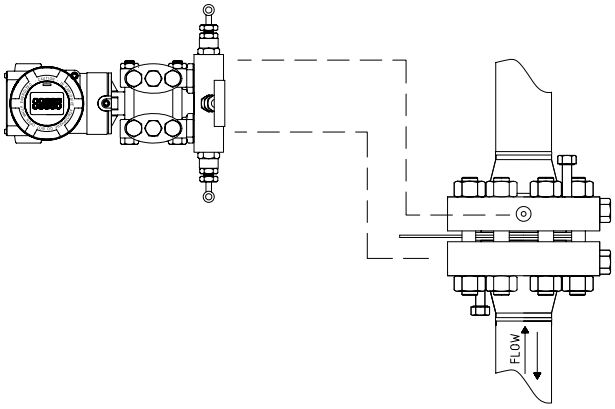
Position G6



Position G7



Position G8

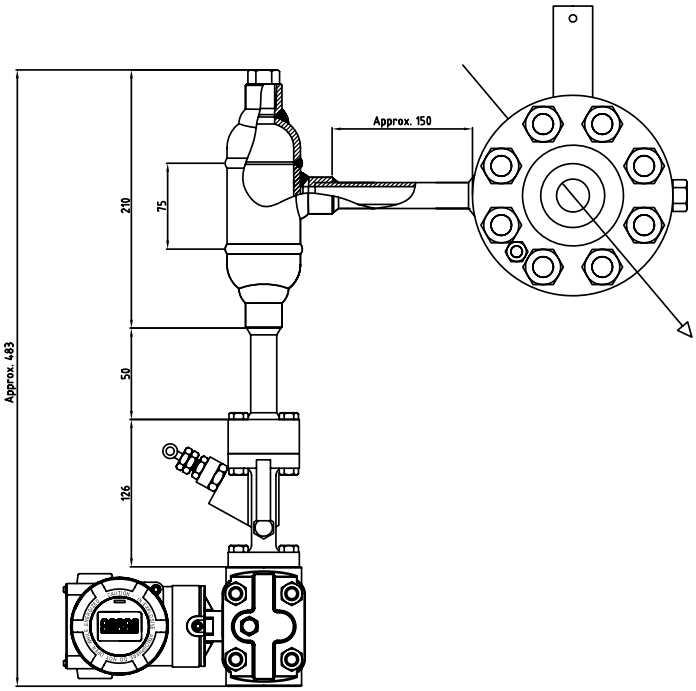


Mounting positions (continuation)

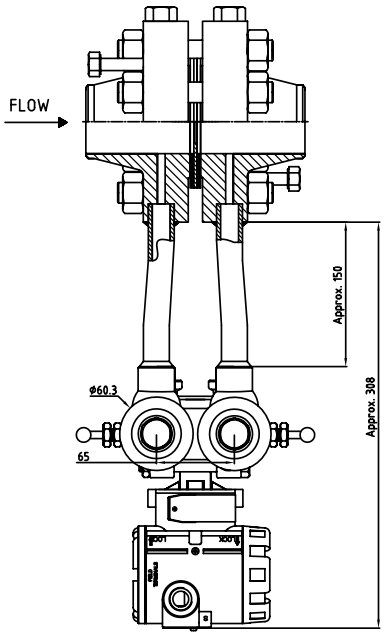
Steam

Position S1

Side View

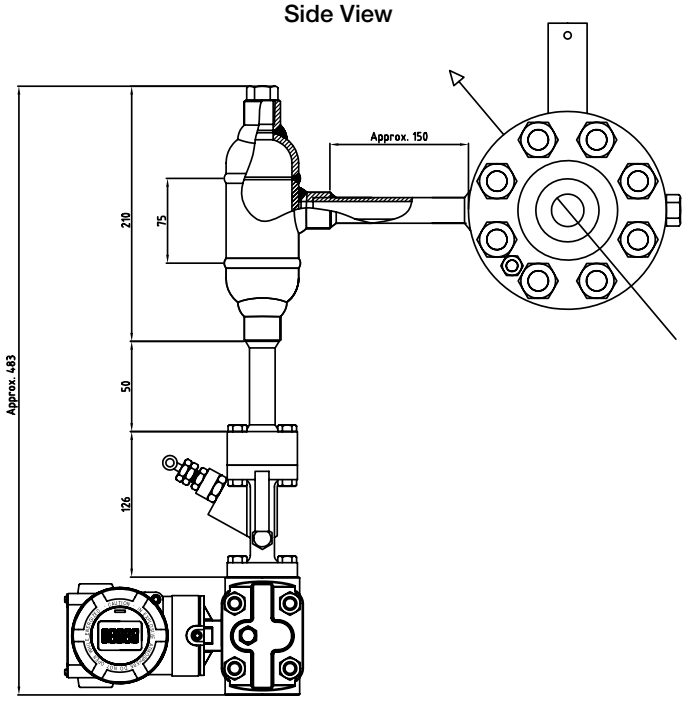


Top View

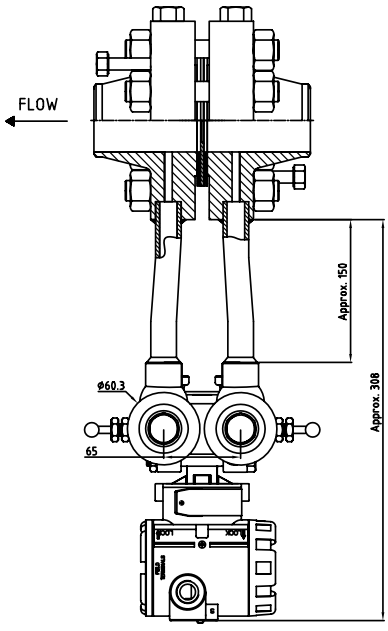


Position S2

Side View



Top View

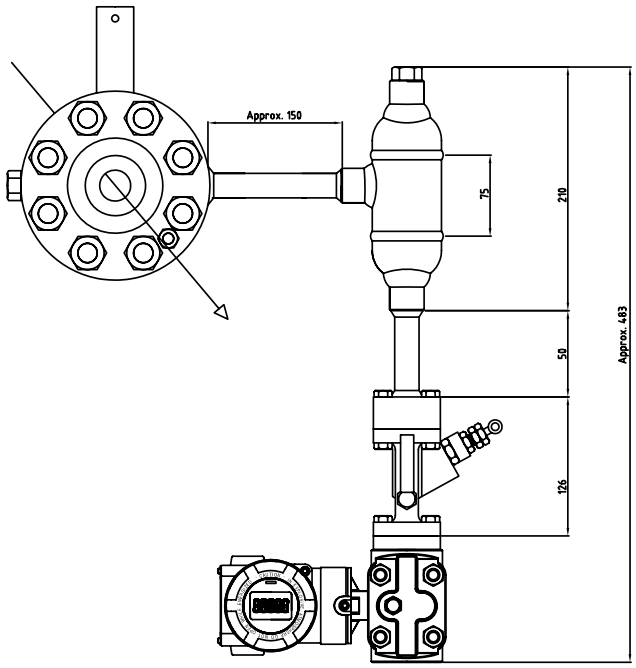


Mounting positions (continuation)

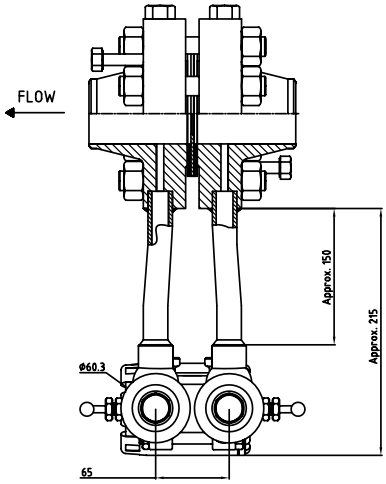
Steam

Position S3

Side View

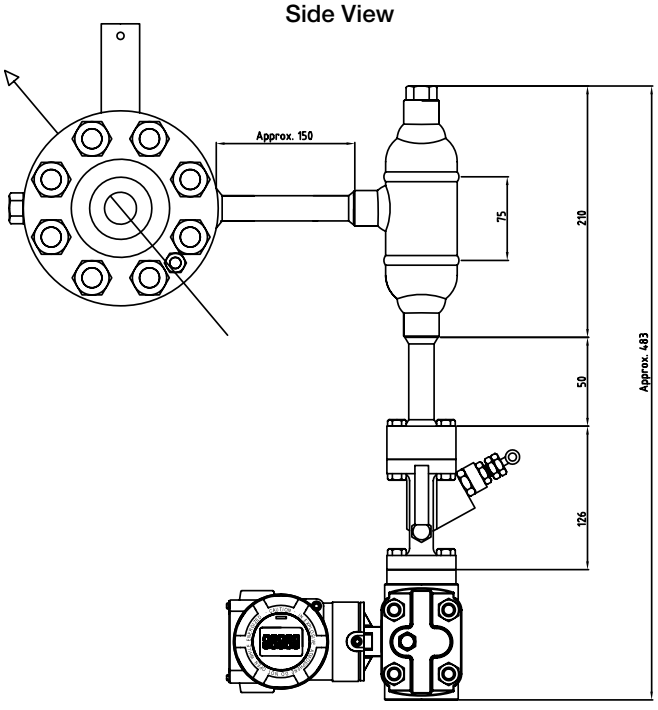


Top View

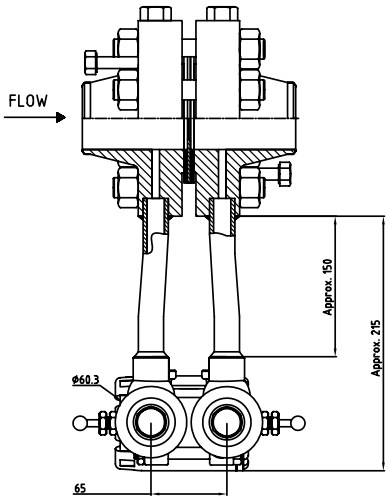


Position S4

Side View

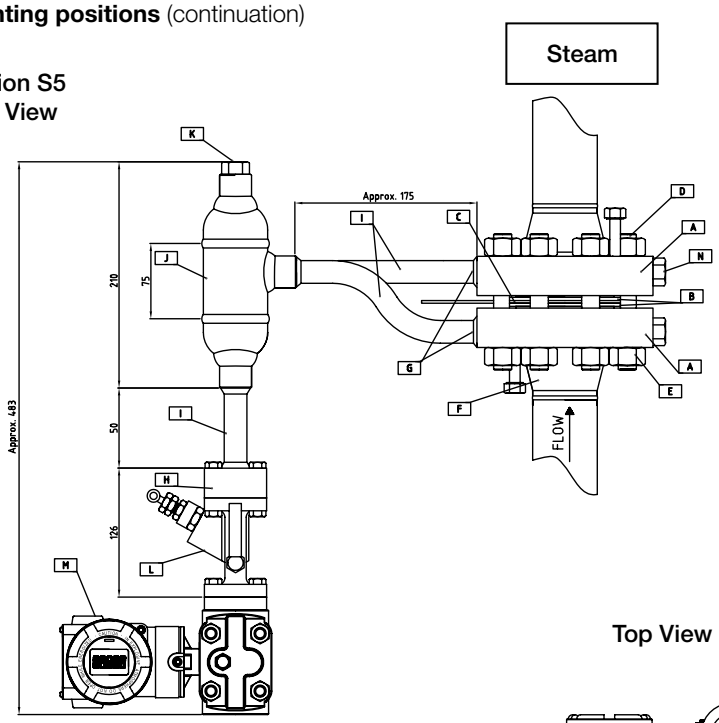


Top View

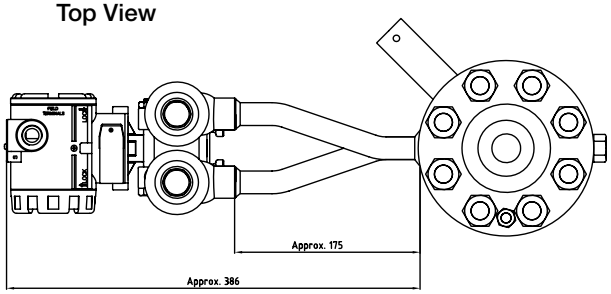


Mounting positions (continuation)

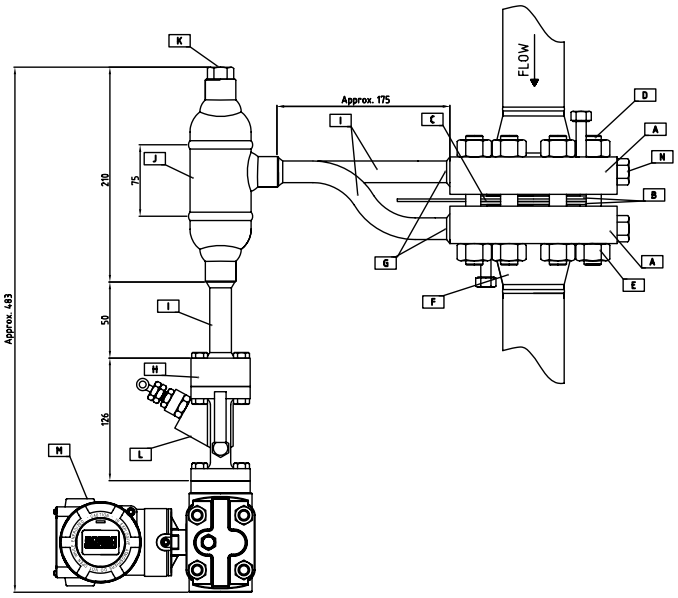
Position S5
Front View



Top View



Position S6
Front View

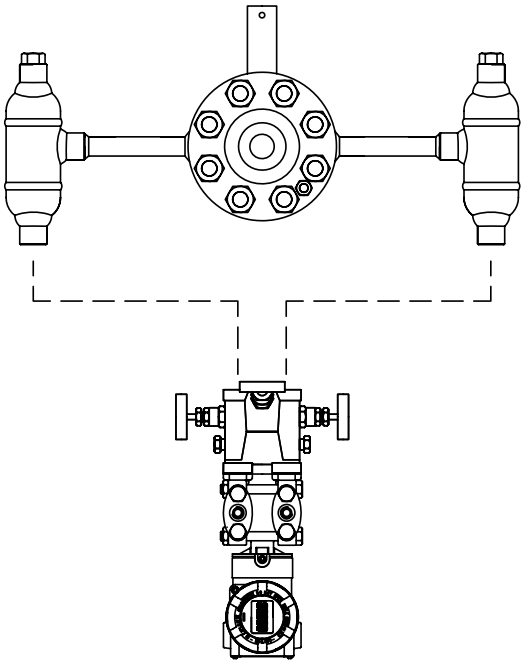


Pos.	Description
A	Flange
B	Gaskets
C	Orifice Plate
D	Screw
E	Nuts
F	Extractor screw
G	Pressure taps x 2 ... 180° for flange
H	Oval flange for connection manifold
I	Nipples
J	Condensate pot
K	Taps
L	Manifold, forged
M	Differential pressure transmitter PAD
N	Taps

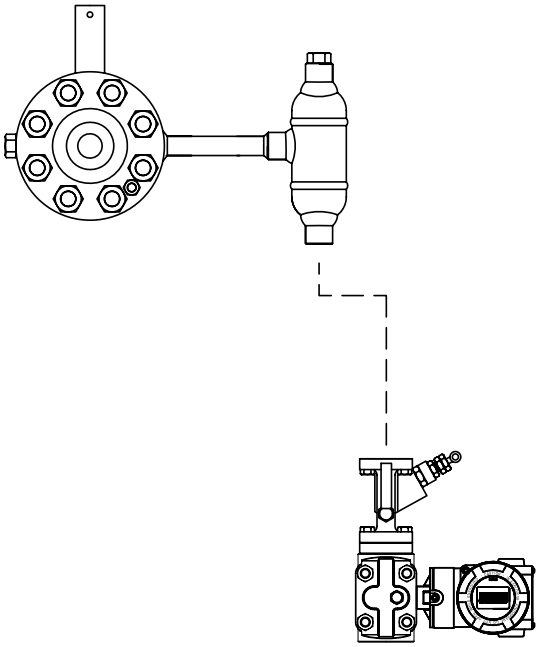
Mounting positions (continuation)

Steam

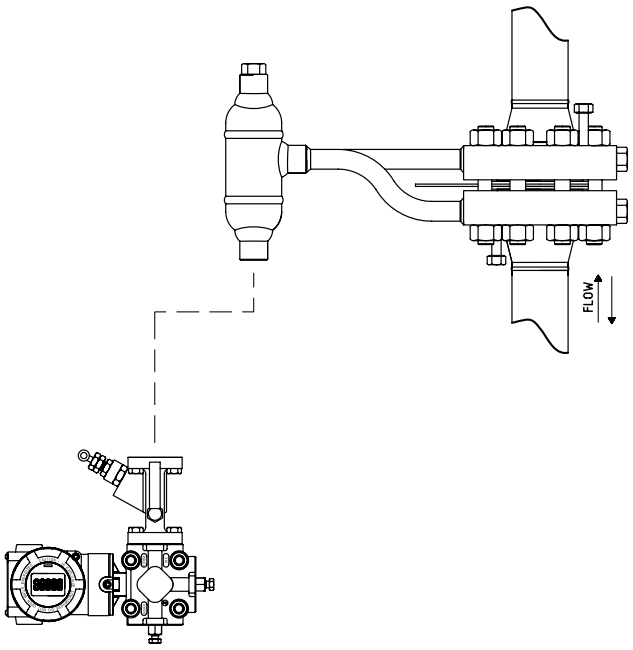
Position S7



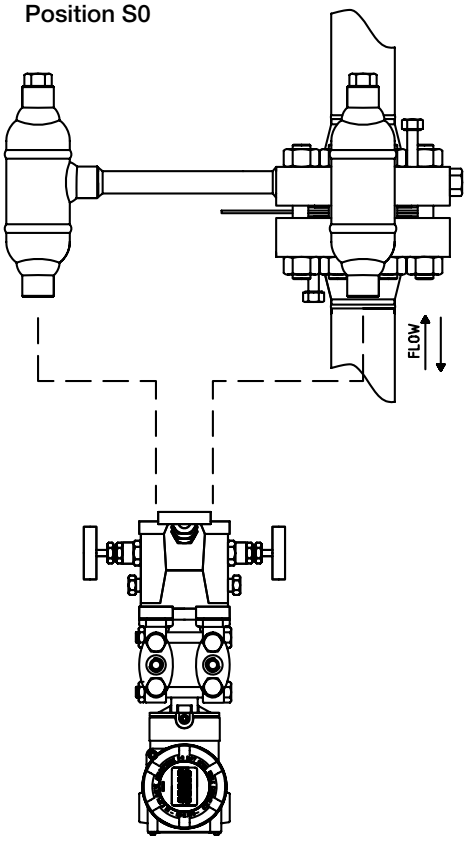
Position S8



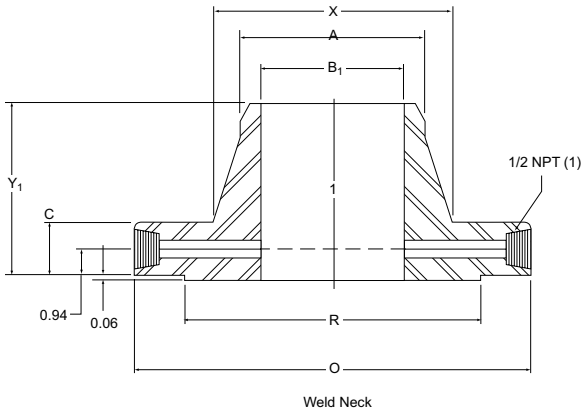
Position S9



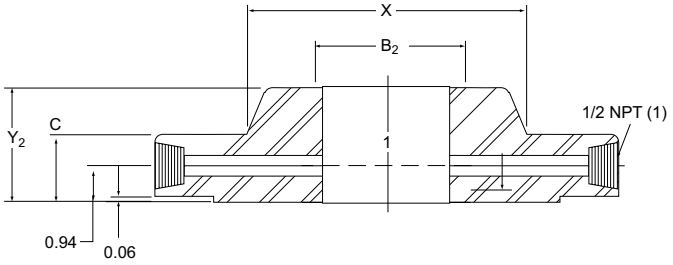
Position S0



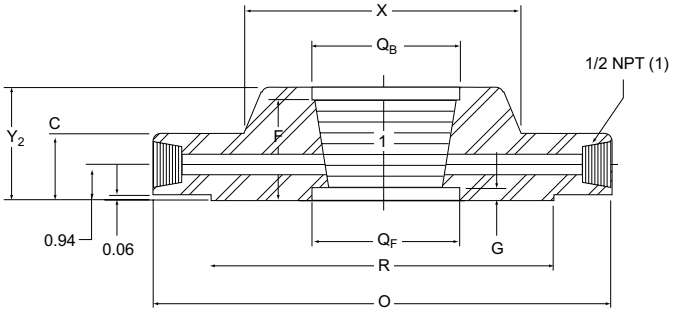
Dimensions in inches
(Weld Neck flange, slip-on and Threaded Orifice Flanges[1)2)] according to ASME B16.36-1996 Class 300)



Weld Neck



Slip-On



Threaded

Nominal Pipe Size [inch]	Outside Ø of raised face R	Outside Ø of flange O	Thickness of flange, min. C	Length through Hub		Ø of Hub X	Hub Ø beginning of Chamfer (W.N.) A	Ø of counterbore		Counterbore depth (from face)		Bore	
				Slip-On and threaded Y_2	Weld Neck Y_1			Back Q_B	Face Q_F	F	G	Slip-On B_2	Weld Neck B_1
1	2.00	4.88	1.50	1.88	3.25	2.12	1.32	1.41	1.30	1.44	0.75	1.36	Threaded flanges are furnished in NPS 1-8 only
1½	2.88	6.12	1.50	1.88	3.38	2.75	1.90	1.99	1.89	1.47	0.72	1.95	
2	3.62	6.50	1.50	1.94	3.38	3.31	2.38	2.50	2.36	1.50	0.69	2.44	
2½	4.12	7.50	1.50	2.00	3.50	3.94	2.88	3.00	2.84	1.75	0.56	2.94	
3	5.00	8.25	1.50	2.06	3.50	4.62	3.50	3.63	3.46	1.81	0.56	3.57	
4	6.19	10.00	1.50	2.12	3.62	5.75	4.50	4.63	4.45	1.88	0.56	4.57	
6	8.50	12.50	1.50	2.12	3.94	8.12	6.63	6.75	6.57	1.88	0.31	6.72	
8	10.62	15.00	1.62	2.44	4.38	10.25	8.63	8.75	8.55	2.19	0.44	8.72	
10	12.75	17.50	1.88	2.62	4.62	12.62	10.75	Bore diameter of weld neck flanges is to be specified by the purchaser				10.88	
12	15.00	20.50	2.00	2.88	5.12	14.75	12.75					12.88	
14	16.25	23.00	2.12	3.00	5.62	16.75	14.00					14.14	
16	18.50	25.50	2.25	3.25	5.75	19.00	16.00					16.16	
18	21.00	28.00	2.38	3.50	6.25	21.00	18.00					18.18	
20	23.00	30.50	2.50	3.75	6.38	23.12	20.00					20.20	
24	27.25	36.00	2.75	4.19	6.62	27.62	24.00					24.25	

Nominal Pipe Size [inch][1)2)]	Ø of Pressure Connection TT	Drilling Template				Bolt Length[3)4)]	
		Bolt Circle	Number of Holes	Ø of Holes	Ø of Bolts	Machine Bolts	Stud Bolts
1	¼	3.50	4	0.69	⅝	4.50	5.00
1 ½	¼	4.50	4	0.81	¾	4.75	5.25
2	¼	5.00	8	0.69	¾	4.50	5.00
2 ½	¼	5.88	8	0.81	¾	4.75	5.25
3	⅛	6.62	8	0.81	¾	4.75	5.25
4	½	7.88	8	0.81	¾	4.75	5.25
6	½	10.62	12	0.88	¾	4.75	5.25
8	½	13.00	12	1.00	⅞	5.00	5.75
10	½	15.25	16	1.12	1	5.75	6.50
12	½	17.75	16	1.25	1 ⅛	6.25	7.00
14	½	20.25	20	1.25	1 ⅛	6.50	7.25
16	½	22.50	20	1.38	1 ¼	7.00	7.75
18	½	24.75	24	1.38	1 ¼	7.25	8.00
20	½	27.00	24	1.38	1 ¼	7.50	8.50
24	½	32.00	24	1.62	1 ½	8.25	9.50

[1)] Weld neck flanges NPS 3 and smaller are identical to Class 600 flanges and may be so marked.
[2)] All other dimensions are in accordance with ASME B16.5.
[3)] Bolt lengths include allowance for orifice and gasket thickness of 0.25 inch for NPS 1 ... 12 and 0.38 inch for NPS 14 ... 24.
[4)] In conformance with ASME B16.5, stud bolt lengths do not include point heights.

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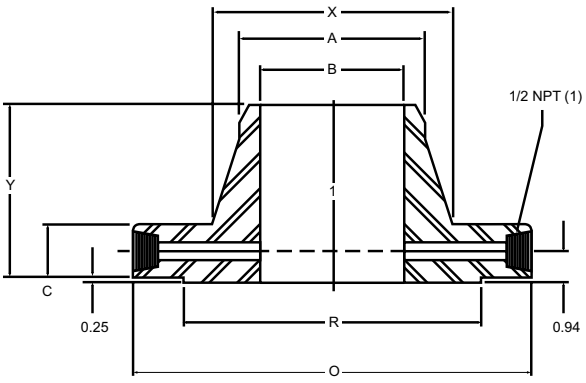
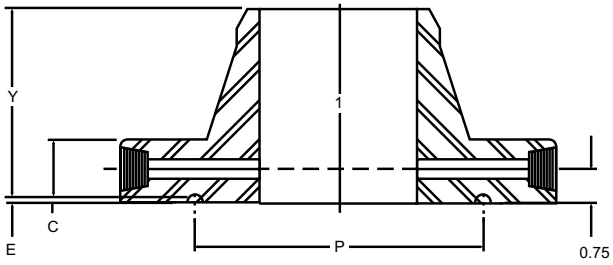
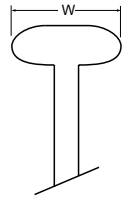
Dimensions in inches
(Weld Neck Orifice Flanges[1)2)] according to ASME B16.36-1996 Class 600)



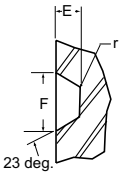
Raised Face



Ring Type Joint



Special One or Two Piece Ring and Orifice Plate Assembly



Groove Detail

Nominal Pipe Size [inch]	Outside Ø of raised face R	Outside Ø of flange O	Thickness of flange, min. C	Length through Hub Y	Height of Raised Face H	Ring Type Joint						Ø of Hub X	Hub Ø Beginning of Chamfer A
						Groove Number	Pitch Diameter P	Groove Depth E	Groove Width F	Radius at Bottom r_{max}	Special Oval Ring Height W		
1	2.00	4.88	1.44	3.19	0.06	R16	2.000	0.250	0.344	0.03	1.00	2.12	1.32
1 ½	2.88	6.12	1.44	3.32	0.06	R20	2.688	0.688	0.344	0.03	1.00	2.75	1.90
2	3.62	6.50	1.44	3.32	0.06	R23	3.250	0.312	0.469	0.03	1.06	3.31	2.38
2 ½	4.12	7.50	1.44	3.44	0.06	R26	4.000	0.312	0.469	0.03	1.06	3.94	2.88
3	5.00	8.25	1.44	3.44	0.06	R31	4.875	0.312	0.469	0.03	1.06	4.62	3.50
4	6.19	10.75	1.50	4.00	0.25	R37	5.875	0.312	0.469	0.03	1.06	6.00	4.50
6	8.50	14.00	1.88	4.62	0.25	R45	8.312	0.312	0.469	0.03	1.06	8.75	6.63
8	10.62	16.50	2.19	5.25	0.25	R49	10.625	0.312	0.469	0.03	1.06	10.75	8.63
10	12.75	20.00	2.50	6.00	0.25	R53	12.750	0.312	0.469	0.03	1.06	13.50	10.75
12	15.00	22.00	2.62	6.12	0.25	R57	15.000	0.312	0.469	0.03	1.06	15.75	12.75
14	16.25	23.75	2.75	6.50	0.25	R61	16.500	0.312	0.469	0.03	1.06	17.00	14.00
16	18.50	27.00	3.00	7.00	0.25	R65	18.500	0.312	0.469	0.03	1.19	19.50	16.00
18	21.00	29.25	3.25	7.25	0.25	R69	21.000	0.312	0.469	0.03	1.19	21.50	18.00
20	23.00	32.00	3.50	7.50	0.25	R73	23.000	0.375	0.531	0.06	1.25	24.00	20.00
24	27.25	37.00	4.00	8.00	0.25	R77	27.250	0.438	0.656	0.06	1.44	28.25	24.00

Nominal Pipe Size [inch][1)2)]	Diameter of Pressure Connection TT	Drilling Template				Bolt Length[3)4)]	
		Bolt Circle	Number of Holes	Ø of Holes	Ø of Bolts	Machine Bolts	Stud Bolts
1	¼	3.50	4	0.69	⅝	4.50	5.00
1½	¼	4.50	4	0.81	¾	4.75	5.25
2	¼	5.00	8	0.69	¾	4.50	5.00
2½	¼	5.88	8	0.81	¾	4.75	5.25
3	⅛	6.62	8	0.81	¾	4.75	5.25
4	½	7.88	8	0.81	¾	4.75	5.25
6	½	10.62	12	0.88	¾	4.75	5.25
8	½	13.00	12	1.00	⅞	5.00	5.75
10	½	15.25	16	1.12	1	5.75	6.50
12	½	17.75	16	1.25	1⅛	6.25	7.00
14	½	20.25	20	1.25	1⅛	6.50	7.25
16	½	22.50	20	1.38	1¼	7.00	7.75
18	½	24.75	24	1.38	1¼	7.25	8.00
20	½	27.00	24	1.38	1¼	7.50	8.50
24	½	32.00	24	1.62	1½	8.25	9.50

[1)] Weld neck flanges NPS 3 and smaller are identical to Class 600 flanges and may be so marked.
[2)] All other dimensions are in accordance with ASME B16.5.
[3)] Bolt lengths include allowance for orifice and gasket thickness of 0.25 inch for NPS 1 ... 12 and 0.38 inch for NPS 14 ... 24.
[4)] In conformance with ASME B16.5, stud bolt lengths do not include point heights.

Note:
Dimensions of Weld Neck Orifice Flanges according to ASME B 16.36-1996 Class 900, Class 1500 and Class 2500 on request.

Dimensions of Pipe Inner Diameter (Info.)

Nominal Pipe size [inch]	Schedule (Standard) [inch]
2	2.067
2½	2.469
3	3.068
4	4.026
6	6.065
8	7.981
10	10.20
12	12.00
14	13.250
16	15.250
18	17.250
20	19.252
24	23.250

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Order Details Orifice Plate (Example: **KPL-B C 50 1 E FN 00**)
(Application Data Sheet should be filled out while ordering)

Model	Type	Bore Type	Line Size[2]	Flange Rating[1][2]
KPL-	**B** = Orifice plate	**C** = Concentric (Standard) **K** = Conical Entrance **Q** = Quarter Circle Nozzle **S** = Segmental **B** = Bidirectional	**50** = DN 50 (2") **65** = DN 65 (2½") **80** = DN 80 (3") **1H** = DN 100 (4") **1F** = DN 150 (6") **2H** = DN 200 (8") **2F** = DN 250 (10") **3H** = DN 300 (12") **3F** = DN 350 (14") **4H** = DN 400 (16") **4F** = DN 450 (18") **5H** = DN 500 (20") **6H** = DN 600 (24") **XX** = special version, to be specified	**A** = ANSI Class 300 RF **B** = ANSI Class 600 RF **C** = ANSI Class 900 RF **D** = ANSI Class 1500 RF **E** = ANSI Class 2500 RF **F** = ANSI Class 300 RTJ **G** = ANSI Class 600 RTJ **H** = ANSI Class 900 RTJ **I** = ANSI Class 1500 RTJ **K** = ANSI Class 2500 RTJ **1** = DN PN16 **2** = DN PN25 **3** = DN PN40 **4** = DN PN63 **5** = DN PN100 **Y** = special version, to be specified

Orifice Material	Pressure Tapping Drain / Vent Hole	Options
E = stainless steel 1.4404 (316L) **Y** = other material, to be specified	**Information regarding tapping needed for orifice plate calculation** **FN** = Orifice flange tapping **FD** = Orifice flange tapping, drain hole **FV** = Orifice flange tapping, vent hole **CN** = Orifice corner tapping **CD** = Orifice corner tapping, drain hole **CV** = Orifice corner tapping, vent hole **DN** = Orifice tapping D+D/2 **DD** = Orifice tapping D+D/2, drain hole **DV** = Orifice tapping D+D/2, vent hole **YY** = special version, to be specified	**00** = without **Optional Certificates** **CF** = Oil and fat free **CO** = Cleaning for oxygen **SF** = Silicone free **MC** = Material Certificate 3.1 according to EN 10204 **NC** = Material according to NACE MR-0175 / ISO 15156 **DG** = Dimensional drawing **YY** = special option, to be specified

[1] Specify inner pipe diameter or alternatively nominal pipe size and pipe schedule
[2] Flange according to DIN EN 1092-1 and ANSI B 16.36

Note: Orifice plate calculation according to DIN EN ISO 5167-2 is standard.
Orifice plate calculation according to API (AGA-3) available on request.

Order Details Orifice Flange with / without Orifice Plate (Example: **KPL-F C 50 1 C FN C 00**)
(Application Data Sheet should be filled out while ordering)

Model[1]	Type	Bore Type	Line Size[2]	Flange Rating[2][3]	Flange material[4]
KPL-	**N** = Orifice flange Union (Weld neck flange) **without** orifice plate	**N** = not applicable (no orifice plate)	**50** = DN50 (2") **65** = DN65 (2½") **80** = DN80 (3") **1H** = DN100 (4") **1F** = DN150 (6") **2H** = DN200 (8") **2F** = DN250 (10") **3H** = DN300 (12") **3F** = DN350 (14") **4H** = DN400 (16") **4F** = DN450 (18") **5H** = DN500 (20") **6H** = DN600 (24")	**A** = ANSI Class 300 RF **B** = ANSI Class 600 RF **C** = ANSI Class 900 RF **D** = ANSI Class 1500 RF **E** = ANSI Class 2500 RF **F** = ANSI Class 300 RTJ **G** = ANSI Class 600 RTJ **H** = ANSI Class 900 RTJ **I** = ANSI Class 1500 RTJ **K** = ANSI Class 2500 RTJ **1** = DN PN16 **2** = DN PN25 **3** = DN PN40 **4** = DN PN63 **5** = DN PN100 **Y** = special version, to be specified	**C** = carbon steel (A105) **E** = stainless steel (316L) **Y** = special version, to be specified
	F = Orifice flange Union (Weld neck flange) **with** orifice plate **Y** = Others (Slip-on flange or threaded orifice flange on request, to be specified in clear text)	**Orifice Plates** **C** = Concentric (Standard) **K** = Conical Entrance **Q** = Quarter Circle Nozzle **S** = Segmental **B** = Bidirectional			

Pressure Tapping Drain / Vent Hole	Version[5] / Taps	Options
FN = Flange tapping **FD** = Flange tapping, drain hole **FV** = Flange tapping, vent hole **CN** = Corner tapping **CD** = Corner tapping, drain hole **CV** = Corner tapping, vent hole **DN** = Orifice tapping D+D/2 **DD** = Orifice tapping D+D/2, drain hole **DV** = Orifice tapping D+D/2, vent hole **YY** = special version, to be specified	**C**[6] = Compact version / 0° and 180° taps (2x flange) ½" NPT female (standard) **K**[6] = Compact version / 0° and 180° taps (2x flange) socket weld ½" (21.3 mm) **R** = Remote version / 0° and 180° taps (2x flange) ½" NPT female (standard) **F** = Remote version / 0° and 180° taps (2x flange) socket weld ½" (21.3 mm) **Y** = special version, to be specified	**00** = without **Optional Certificates** **CF** = Oil and fat free **CO** = Cleaning for oxygen **SF** = Silicone free **MC** = Material Certificate 3.1 according to EN 10204 **NC** = Material according to NACE MR-0175 / ISO 15156 **DG** = Dimensional drawing **YY** = special option, to be specified

[1] Material orifice plate stainless steel 1.4404, others on request
[2] Flange according to DIN EN 1092-1 and ANSI B 16.36, raised face, weld neck as standard
[3] **Specify inner pipe diameter or alternatively nominal pipe size and pipe schedule**
[4] Bolts material is same as flange material
[5] Please consider applicable mounting positions as per your application, and specify the code (see sketch codes on previous pages under caption "Mounting positions").
[6] Compact versions are delivered with the primary element (KPL) mounted together with DP Transmitter, manifold and condensate chambers (when applicable). Please use separate model codes (available at the end of this data sheet) to order these accessories **in addition** to model KPL.

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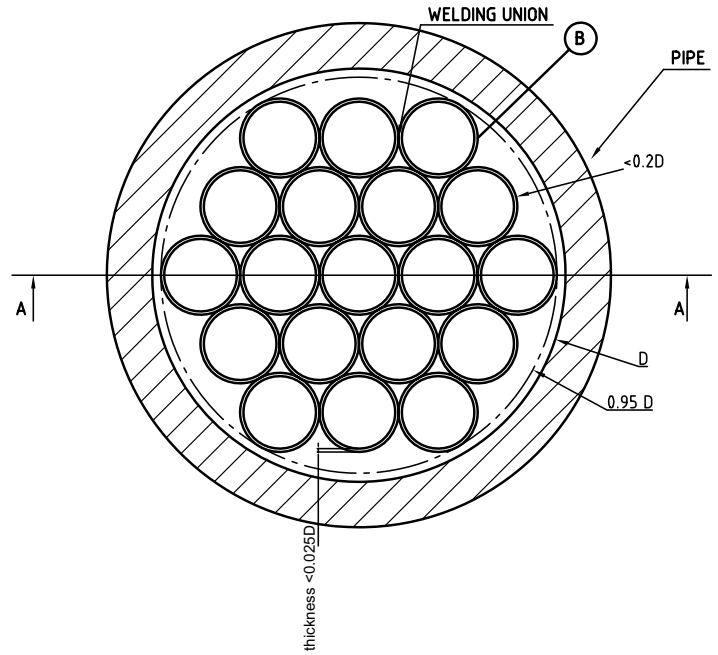
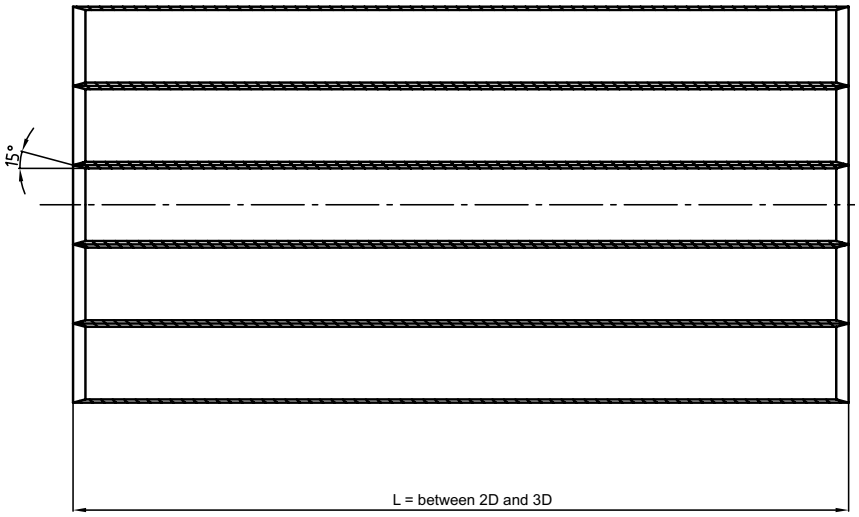
Accessories

Flow straightener

A flow straightener is a device which removes or significantly reduces swirl but may not simultaneously produce the acceptable flow conditions. The 19-tube bundle flow straightener according to DIN EN ISO 5167-2 consists of 19 tubes (marked as "B", see related figure) arranged in a cylindrical pattern.





Flow conditioner

A flow conditioner is a device which, in addition to meeting the requirements of removing or significantly reducing swirl, is desgined to redistributing the velocity profile to produce acceptable flow conditions. The flow conditioner can be used to reduce upstream straight lengths. The ZANKER flow conditioner according to DIN EN ISO 5167-2 plate can be used for $\beta \leq 0.67$ and consists of 32 bored holes arranged in asymmetrical circular pattern.

The approx. dimensions of the holes are a function of the pipe inside diameter 'D' and shall be as follows:

a) a ring of 4 central holes of diameter 0.141 D on a pitch circle diameter of 0.25 D;

b) a ring of 8 holes of diameter 0.139 D on a pitch circle diameter of 0.56 D;

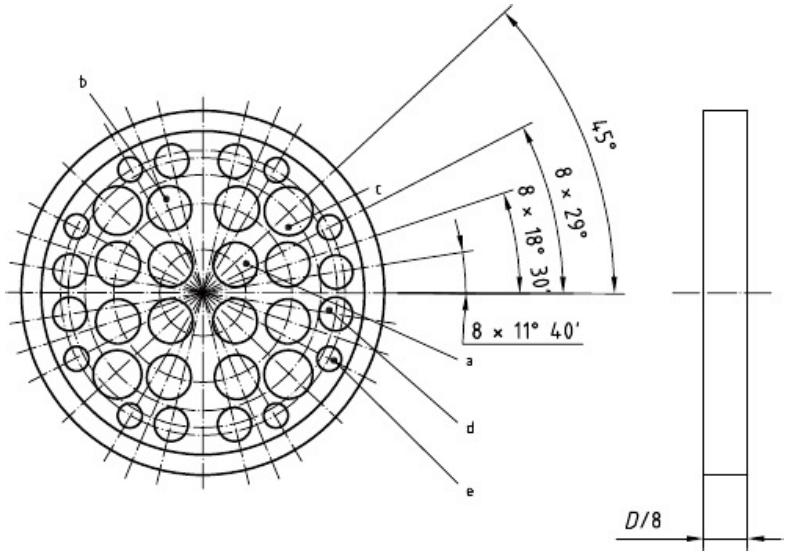
c) a ring of 4 holes of diameter 0.1365 D on a pitch circle diameter of 0.75 D;

d) a ring of 8 holes of diameter 0.110 D on a pitch circle diameter of 0.85 D;

e) a ring of 8 holes of diameter 0.077 D on a pitch circle diameter of 0.90 D.

The perforated plate thickness is D/8. The flange thickness depends on the application; the outer diameter and flange face surfaces depend on the flange type and application.

Pressure loss across the ZANKER flow conditioner plate may



be calculated as:

$\Delta p = 1{,}5 \rho v^2$

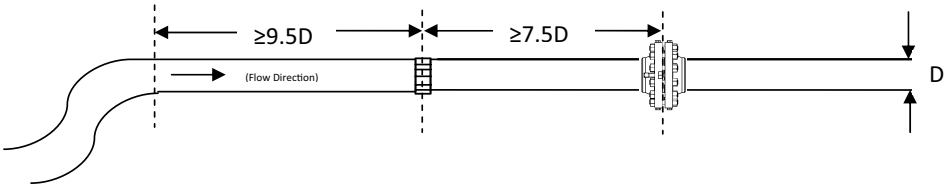
Whereas,

Δp: Pressure loss across the flow conditioner plate (Pa)

ρ: Density of the fluid [kg/m³]

v: Flow velocity [m/s]

The distance between the orifice plate and the nearest upstream fitting, shall be at least equal to 17 D. The ZANKER flow conditioner plate shall be installed so the distance between the downstream face of the conditioner plate and the orifice plate is at least 7.5 D.



Order Details Flow Straightener/Flow Contitioning Plate (Example: **ZUB-FCZ 50 AS MC**)

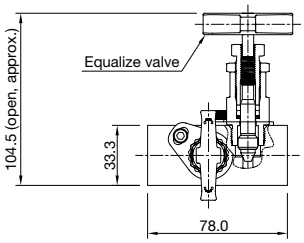
Model	Line Size	Flange Rating, Material	Options
ZUB-FSB... (Flow straightener) **ZUB-FCZ...** (Flow Conditioning Plate)	**50** = DN50 (2") **65** = DN65 (2½") **80** = DN80 (3") **1H** = DN100 (4") **1F** = DN150 (6") **2H** = DN200 (8") **2F** = DN250 (10") **3H** = DN300 (12") **3F** = DN350 (14") **4H** = DN400 (16") **4F** = DN450 (18") **5H** = DN500 (20") **6H** = DN600 (24")	**SS** = ANSI Class 150 RF, 316L **AS** = ANSI Class 300 RF, 316L **BS** = ANSI Class 600 RF, 316L **CS** = ANSI Class 900 RF, 316L **DS** = ANSI Class 1500 RF, 316L **ES** = ANSI Class 2500 RF, 316L **1S** = DN PN16, 316L **2S** = DN PN25, 316L **3S** = DN PN40, 316L **4S** = DN PN63, 316L **5S** = DN PN100, 316L **FS** = ANSI Class 300 RTJ, 316L **GS** = ANSI Class 600 RTJ, 316L **HS** = ANSI Class 900 RTJ, 316L **IS** = ANSI Class 1500 RTJ, 316L **KS** = ANSI Class 2500 RTJ, 316L **XX** = special version, to be specified	**MC** = Material Certificate 3.1 according to EN 10204 **NC** = Material according to NACE MR-0175/ISO 15156 **YY** = special option, to be specified

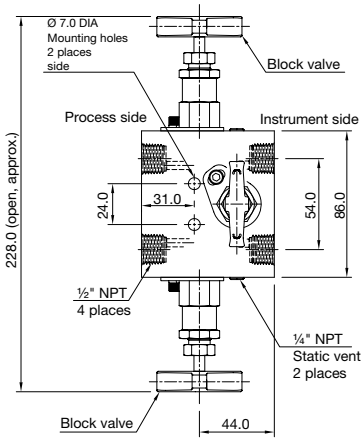
Manifold valves (remote type, machined)

Technical Details

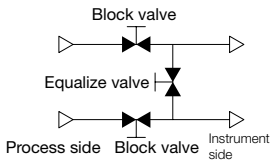
Material: 316SS
Connection and Size: ½" NPT (F)
Pressure rating: 6000 psig at 38 °C (≈410 bar)
Temperature range: -54 °C ... +232 °C

3-way Manifold valve

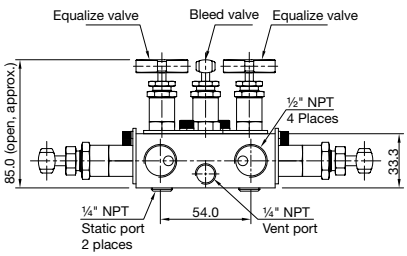


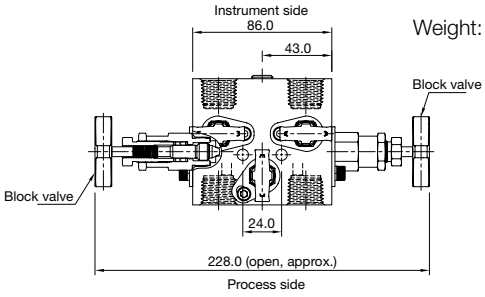


Weight: 2 kg

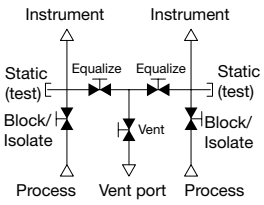


5-way Manifold valve





Weight: 2.2 kg



Order Details

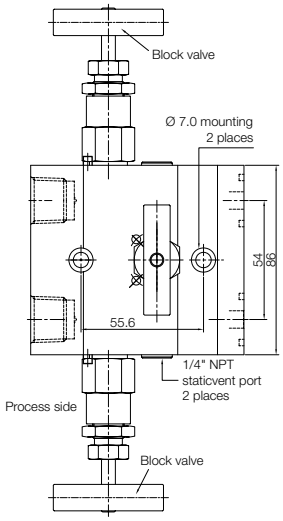
Description	Order number
3-way manifold valve, remote mount, machined	**ZUB-PAD-3WMR**
5-way manifold valve, remote mount, machined	**ZUB-PAD-5WMR**

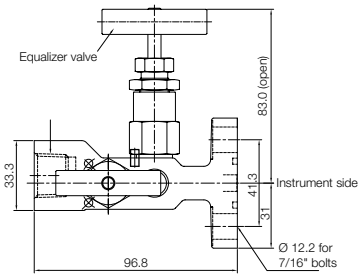
Manifold valves (Direct mount, machined)

Technical Details

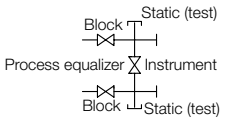
Material: 316SS with PTFE packing
Connection and Size: ½" NPT (F) to flange
Pressure rating: 3000 psig at 232 °C (≈210 bar)
Temperature range: -54 °C ... +232 °C

3-way Manifold valve

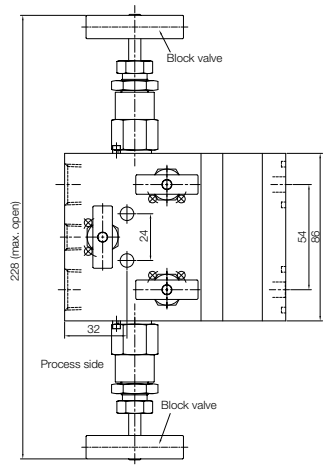


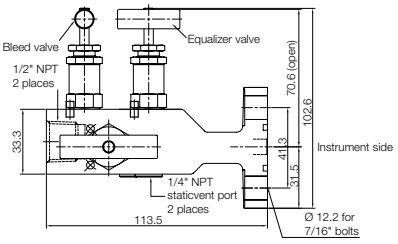


Weight: 1.64 kg

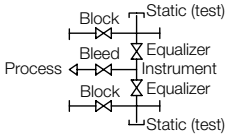


5-way Manifold valve





Weight: 3.1 kg



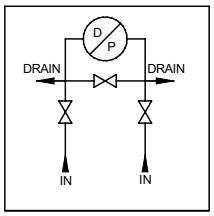
Order Details

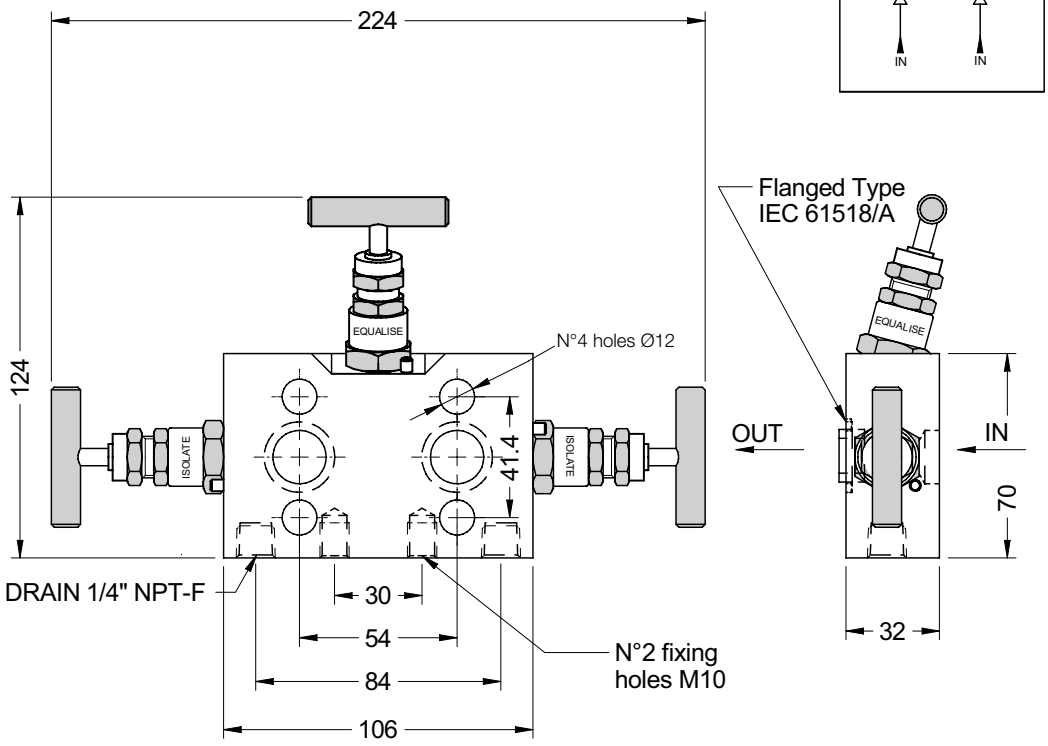
Description	Order number
3-way manifold valve, direct mount, machined	**ZUB-PAD-3WMD**
5-way manifold valve, direct mount, machined	**ZUB-PAD-5WMD**

Manifolds (montage direct, acier usiné)

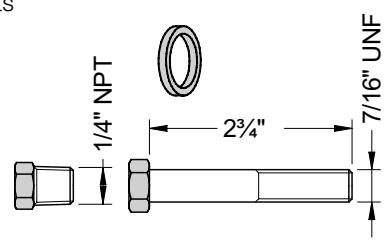
Technical Details
Material: AISI 316L
Pressure rating: 6000 psi
Temperature range: -73 °C ... +210 °C (PTFE packing), standard
-54 °C ... +510 °C (GRAFOIL® packing), on request
Weight: 2.17 kg

3-way Manifold valve
(inlet: flanged / outlet: flanged according to IEC 61518 Type A)





Included accessories:
4 carbon steel screws (stainless steel on request)
2 plugs
2 PTFE gaskets



Order Code: 3151CHHHIBAA (PTFE packing)

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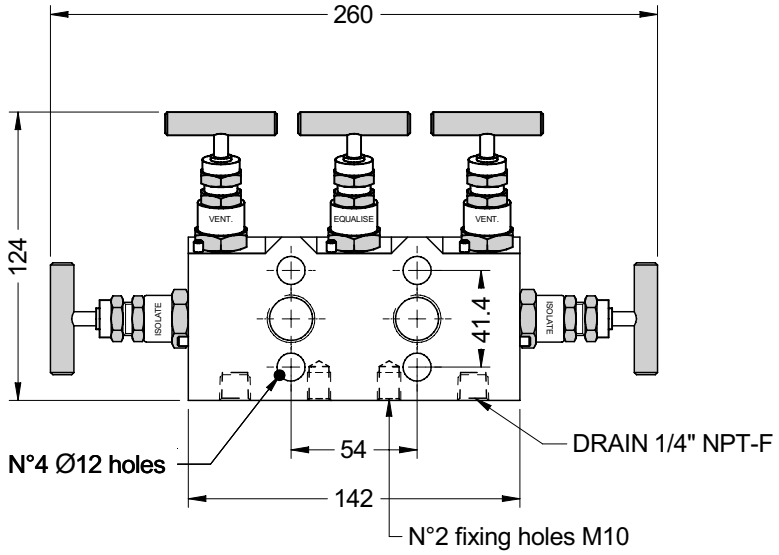
Manifold valves (Direct mount, machined)

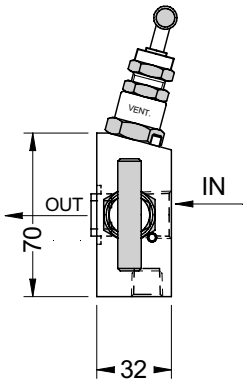
Technical Details

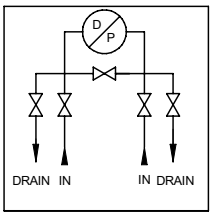
Material: AISI 316L
Pressure rating: 6000 psi
Temperature range: -73 °C ... +210 °C (PTFE packing), standard
-54 °C ... +510 °C (GRAFOIL® packing), on request
Weight: 2.80 kg

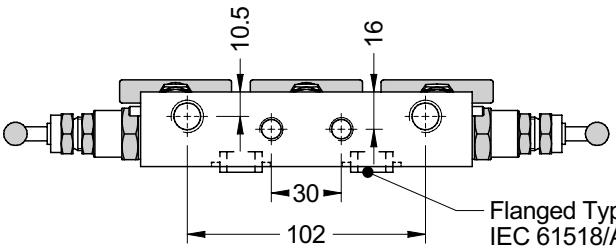
5-way Manifold valve

(inlet: ½" NPT / outlet: flanged according to IEC 61518 Type A)



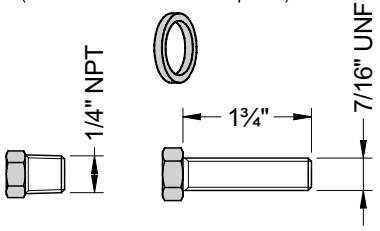






Included accessories:

4 carbon steel screws (stainless steel on request)
2 plugs
2 PTFE gaskets



Order Code: 5050CDAHIBAA (PTFE packing)

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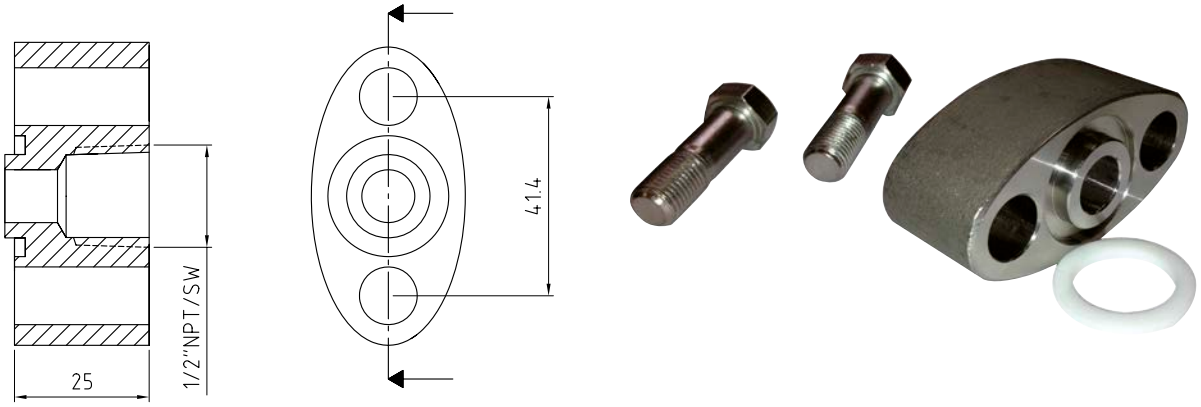
Order Details Mounting brackets

Description	Order number
Angle type bracket for PAD/PAS vertical pipe mounting for PAS vertical pipe mounting for PAD incl. U-Clamp for 2" pipe mounting bracket and 2 x mounting nuts/ washers incl. 4 x mounting screws for PAS incl. 4 x mounting screws for PAD	**ZUB-PAD/PAS-K**
Flat type bracket for PAD/PAS horizontal pipe mounting for PAS vertical pipe mounting for PAD incl. U-Clamp for 2“ pipe mounting bracket and mounting nuts/ washers incl. 4 x mounting bolts and washers for PAS incl. 4 x mounting bolts for PAD	**ZUB-PAD/PAS-L**

Oval Flange (Compact Version)
Dimensions in [mm]



Technical Details
Material: 1.4401 (316 Stainless steel)
Seal: PTFE
Bolts: 2 x mounting screws UNF7/16-20

Order Code: ZUB-PAD-OVF

Condensate Pot (accessory)

Description

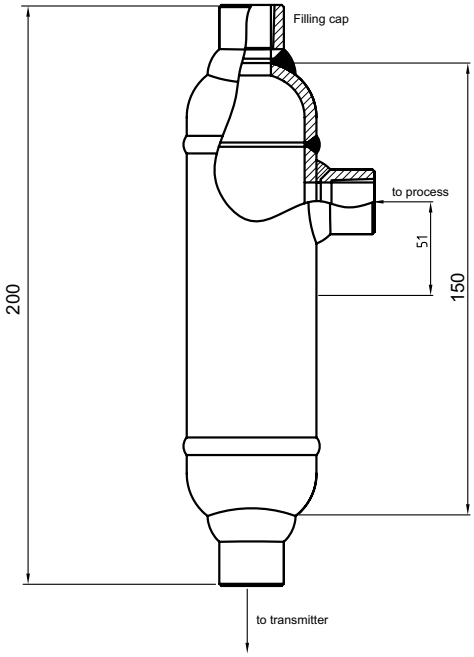
The condensate pots prevent direct contact of hot steam with DP transmitter and ensure that the impulse tubing are always full. Both condensate pots are always at the same level to prevent inaccurate readings. The condensate pots are filled with water before commissioning whereas the water level in the pots is maintained by condensing steam in the process.

Technical Details

Material: steel A105 or stainless steel AISI 316L
Volume: 316 cm^3
Weight: approx. 1.7 kg

Dimension

ASTM A-105 / ASTM AISI 316L



Order Details (Example: **ZUB-CP W 1 C VT**)

Model	Connection input/output	Filling cap	Material / PN	Options
ZUB-CP..	**W** = welding connection 21.3 mm **Y** = other (specify in clear text)	**1** = ½" NPT female with closed plug **Y** = other (specify in clear text)	**C** = steel A105; PN 100 **E** = stainless steel 316L; PN 100 **R** = steel A105; PN 250 **L** = stainless steel 316L; PN 250	**VT** = Visual inspection **LP** = Liquid penetration test **PT** = Pressure test **RT** = Radiographic welding test **UT** = Ultrasonic test **HT** = hardness test **PW*** = Post weld heat treatment **MT** = Magnetic particle test **IT** = Impact test (Resilience) **NC** = Material according to NACE MR-0175/ISO15156 **MC** = Material certificate 3.1 according to EN10204

*not available for material stainless steel

Application Data Sheet (ADS)

ORIFICE PLATE / ORIFICE FLANGE

GENERAL DATA

Customer:
Project:
Order confirmation No.:
Customer P.O. No.:
Calculation Date:
Model No.:
Tag No.:

PRODUCT DESCRIPTION

Orifice Plate Type:	Pressure Tapping Type: Flange tapping ☐ D+D/2 tapping ☐ Corner tapping ☐
Orifice Plate Material: 316L SS	Line Size:
Drain/Vent Diameter:	Wall thickness or Schedule:
Process Connection:	Pipe Outer Dia:
	Pipe Material:

INPUT DATA

Medium name:

Medium state:	Reference Pressure:
Gas ☐ Liquid ☐ Steam ☐	ReferenceTemperature:
Pipe Inner Diameter:	Reference Compressibility:
Operating pressure:	Reference Density:
Operating Temperature:	
Operating Viscosity:	
Isentropic Exponent (Cp/Cv):	
Compressibility at Flow	
Operating Density:	

Flow Values (Mention measuring units)

Minimum:	
Normal:	
Maximum:	(This value is set as Upper Range Value)

CALCULATION DATA (Nominal conditions)

Orifice Bore Size:	Bore Reynolds Number (Normal):
DP at Min. Flow:	Pipe Reynolds Number (Normal):
DP at Normal Flow:	Gas Expansion Factor:
DP at Max. Flow:	**Permanent Pressure Loss**
	at Normal Flow:
Drain/Vent Corr. Factor:	at Max Flow:
Beta:	Velocity at Max. Flow:
Discharge Coefficient:	Minimum Accurate Flow:

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