

FOR SPECIFYING AND PURCHASING ENGINEERS

Orifice plates and assemblies

Orifice plates to ISO 5167-2 and ASME MFC-14M, supplied loose or as flange unions, compact assemblies and small bore meter runs · DN 15 – DN 1200 · ASME Class 150 – 2500

PLATE SIZES	DESIGN CODES	MATERIAL CERTIFICATION
DN 15 – DN 1200	ISO 5167-2 · MFC-14M	EN 10204 3.1

1. Product and variants

An orifice plate is a machined disc that creates a measurable pressure drop in a pipe. Each plate is sized for one line: the bore comes out of a calculation against your flow, pressure, temperature and medium, and is machined to that figure, not picked from a stock list.

Plates are supplied loose, in a flange union, in a compact body, in an orifice fitting or as part of a meter run. The sizing method is the same; the mounting sets the outside diameter and, for fittings and small bore runs, the thickness (Table 1, Section 2.4). Orifice fittings are covered in INK-DS-02 and meter runs in INK-DS-03.

A correctly machined plate is one part of a working measurement: meter tube, tappings, straight lengths, conditioning and instruments count as much. Inkotek states plate geometry and its verification; the installed uncertainty belongs to the whole meter.



Orifice Plate

THE PLATE ON ITS OWN

Paddle or ring type, bored to the calculated diameter, for mounting between flanges, in a fitting or in a carrier.



Orifice Flange Union

PLATE BETWEEN FLANGES

A plate between a matched pair of orifice flanges with radial tappings; supplied with studs, nuts, jack screws and gaskets.



Compact Orifice Assembly

TAPPINGS IN THE BODY

Between the line flanges, or as an integral meter body with its own ends; a direct-mounted transmitter needs no impulse piping.



Small Bore Meter Run

PLATE AND METER TUBE

Orifice element and meter tube designed to ASME MFC-14M; bore, alignment and tappings set in the workshop.

SCOPE OF THE STANDARDS

ISO 5167-2 covers concentric square-edged plates in pipe bores $50 \text{ mm} \leq D \leq 1000 \text{ mm}$, with orifice bore $d \geq 12.5 \text{ mm}$, $0.10 \leq \beta = d/D \leq 0.75$ and pipe Reynolds number from 5000 (higher above $\beta 0.56$ and for flange tappings; 5.3.1). Below $D = 50 \text{ mm}$, and for quadrant edge, conical entrance, eccentric, segmental and multi-hole (conditioning) plates, the basis is ASME MFC-14M, ISO/TR 15377 or flow calibration, as applicable; flange-tapped plates in NPS 2" heavy-wall pipe and above $D = 1000 \text{ mm}$ follow AGA-3.

2. Technical data

2.1 Orifice plate

PROPERTY	VALUE
BORE TYPE	Concentric square-edged: clean single-phase fluids. Quadrant edge, conical entrance: viscous, low Reynolds number. Eccentric, segmental: entrained gas, liquid or solids. Multi-hole (conditioning) plate for shorter straight lengths, on request
LINE SIZE	DN 15 – DN 1200 (½" – 48"), larger on request
PRESSURE RATING	To the line flanges: ASME Class 150 – 2500, EN 1092-1 PN 6 – PN 400, other flange standards
DESIGN STANDARD	ISO 5167-2, β 0.10 – 0.75 with $d \geq 12.5$ mm (5.1.8.1); outside its scope see Sections 1 and 2.4
BORE	Machined to the calculated d within ± 0.02 mm; no diameter more than 0.05 % from the mean (ISO 5167-2:2022, 5.1.8.3; small bore plates: Section 2.4). The measured d is used in the calculation
PLATE THICKNESS	E, e and bevel to ISO 5167-2 (5.1.5 – 5.1.6) for the duty; E not below 2 mm. Fitting plates: Table 1
MEASURING UNCERTAINTY	Stated on the calculation sheet for the duty
PERMANENT PRESSURE LOSS	About 95 % of the differential pressure at β 0.20, 73 % at β 0.50, 45 % at β 0.75 (ISO 5167-2, 5.4.1)

2.2 Orifice flange union

PROPERTY	VALUE
SIZE RANGE	NPS 2" – 24" (DN 50 – DN 600), larger on request; below NPS 2", small bore meter run (Section 2.4)
PRESSURE CLASS	ASME Class 150 – 600 standard; up to Class 2500 special production (Class 2500 to NPS 12"). EN 1092-1: PN 6 – PN 400
FLANGES	In most projects machined from ASME B16.5 flanges to the project's tapping detail; ASME B16.36 orifice flanges (Class 300 – 2500) where the standard detail suits the duty. EN 1092-1 on request
FACING	Raised face or ring type joint; flat face on request. On ASME B16.36 flanges, ring type joint from Class 600. EN 1092-1 facings to order
TAPPINGS	Two per flange, 25.4 mm from each plate face (ISO 5167-2 where $D \geq 50$ mm and the tap hole is below 0.13D and 13 mm, 5.2.2.7; otherwise AGA-3), set for the gasket used; radial, angled on ring type joint flanges where the groove is in the way (ASME B16.36, 9.1). ½" NPT standard, ¼" and ¾" available

2.3 Compact orifice assembly

PROPERTY	VALUE
LINE SIZE	DN 15 – DN 100 (½" – 4"); face to face fixed by the body design, on the installation drawing
FLANGES AND RATING	To the line flanges: ASME B16.5 Class 150 – 2500, EN 1092-1 PN 6 – PN 400 or other standards
DESIGN STANDARD	ISO 5167-2 where $D \geq 50$ mm, β 0.10 – 0.75. Below DN 50: ASME MFC-14M only where the body sits in a meter tube that meets its limits (6.2) and has annular-slot corner taps (6.4.1); otherwise ISO/TR 15377 or flow calibration, as applicable
BORE TYPE	Concentric; multi-hole (conditioning) or quadrant edge on request
TAPPINGS	Corner tappings drilled through the body (ISO 5167-2, from DN 50) or an annular groove in both faces; ¼" NPT, IEC 61518 face for a direct-mounted transmitter, or compression fitting
FLOW CALIBRATION	Line size or Reynolds number at minimum flow outside the standard: calibration sets the uncertainty

2.4 Small bore meter run

PROPERTY	VALUE
CONSTRUCTION	Removable: an orifice ring with annular tappings, clamped between two opposing ASME B16.5 or EN 1092-1 flanges. Permanent: welded meter run
LINE SIZE	NPS ½" – 1½" (DN 15 – DN 40), nominal sizes; the calculation uses the measured bore D
PRESSURE CLASS	ASME Class 150 – 600 standard; up to Class 2500 special production. EN 1092-1: PN 6 – PN 400
DESIGN STANDARD	ASME MFC-14M-2003 (R2018). Calculated: corner taps NPS ½" – 1½", β 0.10 – 0.80; flange taps NPS 1" – 1½", β 0.15 – 0.70; pipe Reynolds number above 1000 (6.3.13, 7.1, 7.2). Flow calibrated: flange taps below NPS 1" and any run outside these limits (7.2, 5.1.1)
PRESSURE TAPPINGS	Corner taps through an annular slot into an annular chamber or carrier ring (6.4.1), or flange taps 25.4 mm from each plate face (6.4.2). A welded run with other tapping geometry is flow calibrated
METER TUBE	Both sections circular and cylindrical within ± 0.025 mm, roughness below $0.25 \mu\text{m}$, no step within 10D upstream (6.2.2, 6.2.4, 6.1.5). Bore — four diameters in each cross-section — and roughness measured and recorded; honed only where the tube as supplied does not meet these limits
ORIFICE PLATE	E 2 – 3.2 mm; e no more than $0.02D$ or $0.125d$, whichever is smaller; bevel $45^\circ \pm 5^\circ$; edge radius no more than $0.0004d$ or 0.0025 mm, whichever is larger; d the mean of four diameters, none more than 0.0076 mm from another; no drain or vent hole (6.3.5 – 6.3.12)
MEASURING UNCERTAINTY	Stated on the calculation sheet; $\pm 0.75\%$ on the discharge coefficient inside the limits above, with the straight lengths of Section 4 (8.1)

3. Materials

PART	MATERIAL
ORIFICE PLATE	316 / 316L or 304 / 304L stainless steel as standard; 316L for low temperature; 321H or 347H for high temperature; duplex (UNS S31803 / S32205), super duplex (UNS S32750), Alloy 400 (UNS N04400), Alloy 625 (UNS N06625) or Alloy C-276 (UNS N10276) for corrosive service; fitting plates 316L (INK-DS-02). Only corrosion and erosion resistant grades, never carbon steel or LF2
ORIFICE FLANGES	To the piping class: A105N carbon as standard; A350 LF2 for low temperature, down to -46°C . A182 F11, F22 or F91 for steam and hot process; F316 stainless. EN 1092-1: P250GH or P245GH; 16Mo3 or 13CrMo4-5 where required. Other grades on request
GASKETS & BOLTING	PTFE, graphite or spiral wound gaskets; A193 B7 / B16 studs, A320 L7 for low temperature. Tap position and stud length are set for the gasket and plate used
COMPACT BODY	Machined from bar or plate, grade set by the flow conditions: most commonly 316 / 316L / 316Ti; other grades to the duty. The plate is usually in the body grade, within the plate grades above
SMALL BORE RUN	Meter tube and spools A106 Gr B carbon or A312 TP316L stainless; flanges and ring A105N or F316, matched to the tube. A333 Gr 6 and A350 LF2 for low temperature. Other grades on request
SOUR SERVICE	Wetted metallic parts to NACE MR0175 / ISO 15156, on request

4. Dimensions

Outside diameter OD and handle dimensions follow the flange standard and rating of the line, or the fitting for fitting plates; union flanges follow ASME B16.5 where machined from it, or ASME B16.36. Plate thickness E, edge thickness e and bevel angle α follow ISO 5167-2 (ASME MFC-14M for small bore plates) and the duty.

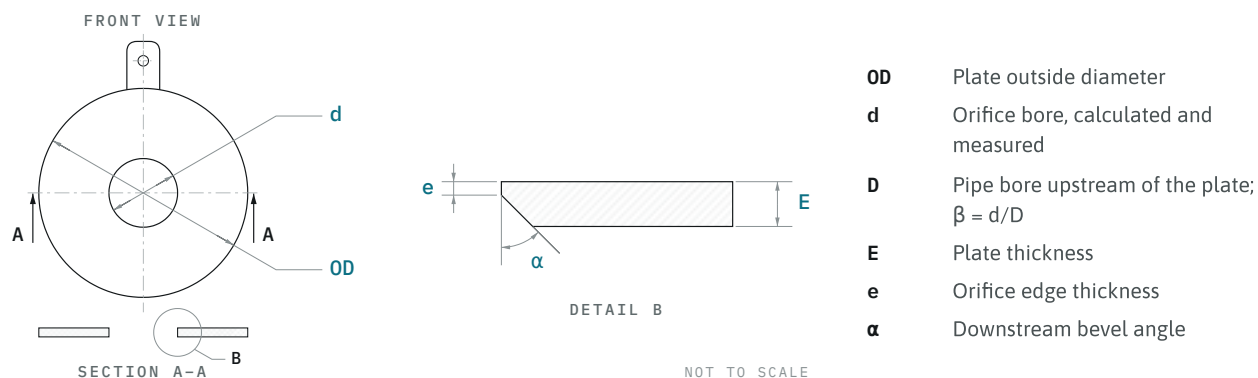


Figure 1 — Orifice plate. Front view, section A-A and detail B; in detail B the flow is from top to bottom. Not to scale.

NPS	DN	E	e	ISO 5167-2, e	ISO 5167-2, E MAX	AGA-3, E MIN – MAX
2"	50	3.2	0.6	0.26 – 1.05 ¹	3.2 ¹	2.92 – 3.30
3"	80	3.2	0.6	0.39 – 1.33	3.33	2.92 – 3.30
4"	100	3.2	1.0	0.51 – 1.75	4.37	2.92 – 3.30
6"	150	4.0	2.0	0.77 – 2.64	6.59	2.92 – 4.14
8"	200	6.0	2.5	1.01 – 3.46	8.65	2.92 – 6.45
10"	250	6.0	3.0	1.27 – 4.32	10.80	2.92 – 8.10
12"	300	8.0	4.0	1.52 – 5.15	12.86	4.45 – 9.63
16"	400	10.0	5.0	1.91 – 6.51	16.27	4.45 – 12.45
20"	500	10.0	5.0	2.41 – 8.16	20.40	6.10 – 12.83
24"	600	12.0	6.0	2.92 – 9.81	24.53	6.10 – 12.83

Table 1 — Plate thickness E and edge thickness e, plates for orifice fittings, mm. One E and e per size for every schedule and pressure class; bevel $\alpha = 45^\circ$ (ISO 5167-2 and AGA-3 Part 2: $45^\circ \pm 15^\circ$, 5.1.6.2; 4.7).

- ISO 5167-2, 5.1.5: e from 0.005D at the thinnest wall to 0.02D at the thickest; E max = 0.05D at the thickest wall. Computed over Sch 40 – Sch 160 (XS – Sch 160 at NPS 20" and 24"). AGA-3 Part 2, Table 3: row of the smallest listed inside diameter. ISO columns: plate geometry only; fitting tap holes: INK-DS-02.
- ¹ Sch 40 only (5.1.5.3: E up to 3.2 mm for $50 \text{ mm} \leq D \leq 64 \text{ mm}$). From Sch 80, $D < 50 \text{ mm}$: outside ISO 5167-2 (5.3.1); AGA-3 applies.
- The tabulated e applies where $e < 0.1d$ (ISO 5167-2, 5.1.5.1) and $e \leq 0.125d$ (AGA-3 Part 2, 4.5); smaller bores take a thinner e within these limits, on the project drawing. NPS 14" and 18": E and e to the same limits, on the project drawing. Flange-mounted plates: E selected for the duty from 2 – 20 mm stock, inside the ISO 5167-2 limits, or AGA-3 Table 3 where AGA-3 applies.

Small bore meter run. Overall length is the meter tube ASME MFC-14M requires — at least 18D upstream and 8D downstream of the plate (6.2.5) — plus any extra upstream run for the fittings ahead (20D – 50D from the plate by fitting and β ; Table 2), at least 10D from the plate to the nearest downstream fitting (Table 2, Note 1) and the process-end preparation. There is no standard length to pick from.

5. Options and configuration

OPTION	CHOICES
PLATE	Paddle or ring type, tab handle, jack screw slots, drain or vent hole (outside the ISO 5167-2 plate geometry; not on small bore plates)
FLANGE UNION BUILD	Standard union · weld-on shut-off valves · valves and condensate pots · orifice flange weldment (union welded into pipe sections, flanged process ends)

OPTION	CHOICES
COMPACT BUILD	Tapping holes · annular tapping groove · integral meter body with threaded, socket weld or flanged ends, transmitter, manifold and valves
SMALL BORE ENDS	Butt-weld, flanged or mixed process ends; drain and vent connections outside the meter tube

6. Quality control and documentation

ITEM	SCOPE
QUALITY SYSTEM	ISO 9001:2015; PED where it applies; welding procedures and NDE to the project specification
PLATE INSPECTION	d is the mean of four diameters at equal angles (ISO 5167-2:2022, 5.1.8.2), measured to 0.005 mm with a calibrated three-point bore gauge, or optically below its range; CMM measurement on request where the order specifies a tighter check. Edge: visual check for $d \geq 25$ mm; contour or optical measurement of the edge radius on request. Below $d = 25$ mm ISO 5167-2 requires that measurement or a flow calibration (5.1.7.2): state which with the order. Small bore plates: Section 2.4
PRESSURE TEST	Hydrostatic test, or pneumatic where the project specifies, on welded builds: orifice flange weldment, small bore meter run, compact assembly with weld ends
DIMENSIONAL REPORT	Bore, thickness, edge, flatness; meter tube bore and roughness; against the approved drawing
MARKING	Marking method to the project. Plate: INLET, tag, serial and job numbers, bore, beta, material and heat number, on the upstream face (on the handle of paddle plates). Flange union: rating and flow direction on the flange. Compact: tag, bore, beta, material, heat number and flow direction, on a welded paddle where one is fitted, otherwise on a stainless nameplate hung with stainless wire. Small bore: tag, d, meter tube D at 20 °C, beta, flow direction, on the body
CERTIFICATES	EN 10204 3.1, heat number carried through to the plate marking; 3.2 on request
DOCUMENTATION	Sizing calculation (bore and beta against the duty, discharge coefficient basis identified), material certificates, dimensional report; pressure test report and calibration certificate where they apply

7. What to send with an enquiry

1. Pipe size, schedule and material
2. Medium and its state, pressure and temperature
3. Minimum, normal and maximum flow
4. Tapping arrangement and differential pressure range
5. Permitted permanent pressure loss
6. Flange standard, rating and facing
7. Available straight run, upstream and downstream
8. Tag numbers, quantity and required documentation

For an assembly, also: **flange union** — build (Section 5); **compact** — build and transmitter interface; **small bore run** — welded or removable, process ends and the length available.

Send the enquiry to info@inkotekenerji.com or through the enquiry form at inkotekenerji.com/en/contact/.

DOCUMENT CONTROL

Ranges are manufacturing capability and are not an offer. Final geometry, materials and documentation are governed by the approved project drawing and the contract.

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