

FOR SPECIFYING AND PURCHASING ENGINEERS

Restriction orifices and attenuation plates

Pressure reducing elements, not for measurement — single and multi-stage restriction orifices, spectacle restriction orifices, attenuation plate sets · DN 15 – DN 1000 · ASME Class 150 – 2500, EN 1092-1 PN 6 – PN 400

LINE SIZES	SIZING CHECKS	MATERIAL CERTIFICATION
DN 15 – DN 1000, higher on request	Cavitation, choking, noise	EN 10204 3.1

1. Product and variants

A restriction orifice takes a known pressure drop out of a line and holds it. It is not a measuring element. Each subcritical stage is sized with the ISO 5167-2 relations for a square-edged orifice, which give the flow, the differential and the pressure recovered after the plate; outside their limits of use (5.3.1, 5.3.2.2) they are extrapolated and the calculation flags it. Choked plates are sized on critical flow. No ISO 5167 conformity is claimed.

The number of stages comes out of the sizing. A liquid stage is kept at or above the cavitation-index limit and short of choking, and a gas stage subcritical; where one plate cannot do that, the drop is split across stages. Flashing — an outlet pressure at or below the vapour pressure — cannot be staged out. Where the project accepts choked flow and its noise, a single plate is sized as a flow-limiting restriction.

No moving parts, no actuator. The plate is inspected whenever the line is opened: cavitation and erosion are what wear a restriction, and the checks in Table 1 are there to limit them.



Single Stage Restriction Orifice Plate

ONE PLATE · FIXED PRESSURE DROP

A paddle plate between the line flanges, raised face or ring-joint, single bore or multi-hole. Used where one plate passes the checks of Table 1, or as a choked flow-limiting plate where the project accepts it.



Multi-Stage Restriction Device

STAGED DROP · CAVITATION AND NOISE CONTROL

Several restrictions in series in one spool. Each stage takes part of the drop, so that no stage passes the cavitation limit or reaches critical flow. Stage plates bolted in and removable.



Spectacle Restriction Orifice

MULTI-HOLE PLATE ONE SIDE · RING THE OTHER

One piece: a multi-hole restriction plate and a ring bored to the pipe, joined across a short web; the ring keeps the flange gap when the restriction is out of the line. Outline to ASME B16.48.



Attenuation Plate Set

MULTI-HOLE SET · DOWNSTREAM OF CONTROL VALVES

Multi-hole plates in series in a short body at a control valve outlet; each stage is sized as an equivalent orifice and laid out as a hole pattern. Flanged, flanged × welded, or wafer body.

2. Technical data

PROPERTY	VALUE
LINE SIZE	NPS ½" – 40" (DN 15 – DN 1000), higher on request
PRESSURE RATING	Plate between flanges: to the line flanges — ASME Class 150 – 2500, EN 1092-1 PN 6 – PN 400; other flange standards and special classes on request. Spools and bodies: to their flanges; butt-weld ends: by pressure design (Section 6)
CONSTRUCTION	Paddle or wafer plate, or spectacle plate, between the line flanges; plate supplied between its own flanges, with gaskets and bolting; wafer body; spool with bolted, removable stage plates
BORE PATTERN	Single bore, or multi-hole: sized on one equivalent bore d and laid out as n holes of diameter d_h
BORE EDGE	Square-edged inlet. Where the plate is thicker than the bore length the ISO 5167-2 relations allow ($e \leq 0.02D$ and $e < 0.1d$), the outlet face is bevelled at $45^\circ \pm 15^\circ$ down to that length (5.1.5, 5.1.6)
STAGES	Set by the sizing calculation — single or multi-stage (Table 1); in a multi-stage device the stages are at least 1D apart
SIZING BASIS	Each stage a square-edged, concentric orifice: flow, differential and permanent pressure loss $\Delta\varpi$ from ISO 5167-2 (C 5.3.2.1, $\Delta\varpi$ 5.4.1); stage outlet = recovered pressure; pressure recovery factor $F_L = \sqrt{(\Delta\varpi/\Delta p)}$, the orifice analogue of the valve liquid pressure recovery factor
PRESSURE LOSS	The design target rather than a by-product: set by the calculation, split across stages where a single plate would cavitate or choke
PLATE THICKNESS	E from the maximum differential the plate can see — start-up, blowdown and depressurising included — checked against permanent deformation to ISO/TR 9464:2023, 5.2.5.1.2.3, Formula (6), on the plate support diameter, with a design yield stress of 100 MPa for stainless steel plates (NOTE 1), or the yield stress at operating temperature where that is lower; not below 2 mm

SERVICE	CHECK	CRITERION
Liquid	Cavitation index $\sigma = (p_1 - p_v)/(p_1 - p_2)$	$\sigma \geq 2.0$, unless the project sets another limit
Liquid	Flashing, choked cavitation	Flashing where $p_2 \leq p_v$; staging cannot avoid it; the outlet pressure is revised or the design made for two-phase flow. Choked where $p_1 - p_2 \geq F_L^2(p_1 - F_F \cdot p_v)$, $F_F = 0.96 - 0.28\sqrt{(p_v/p_c)}$ (IEC 60534-2-1)
Gas, steam	Critical pressure ratio	Choked where $p_2 \leq p_1 - F_L^2(p_1 - p_{vcc})$, $p_{vcc} = p_1 \cdot [2/(\kappa + 1)]^{\kappa/(\kappa - 1)}$ (IEC 60534-8-3:2010, 5.1); beyond it the stage is sized on critical flow from the inlet conditions, with a choked-flow coefficient confirmed by flow simulation (CFD) where the project calls for it. Expansibility from ISO 5167-2, 5.3.2.2; where $\Delta p/p_1 > 0.25$, outside its limit, it is extrapolated and flagged
Gas, steam	Noise	A-weighted sound pressure level 1 m from the downstream pipe wall: IEC 60534-8-3 method applied to each stage as a fixed restriction, levels energy-summed; 85 dB(A) unless the project sets another limit
Multi-stage	Pressure split, stage count	Equal pressure ratio (gas) or equal σ (liquid) per stage; the fewest stages that keep every stage subcritical (gas), or at or above the σ limit and short of choking (liquid)
All	Outlet line	Mach number up to 0.3 (gas); velocity up to about 4.6 m/s (liquid); unless the project sets another limit

Table 1 — Sizing checks, each stage. p_1 , p_2 : stage inlet and recovered outlet pressure ($p_1 - p_2 = \Delta\varpi$, the permanent pressure loss); Δp : differential at the plate tappings; p_v : vapour pressure; p_c : critical pressure; κ : isentropic exponent. Noise is calculated for gas and steam and checked against the limit; the stage count is set by the cavitation and choking checks. Above the limit the calculation points to a heavier downstream wall, acoustic insulation, a larger outlet line or multi-hole plates.

3. Materials

PART	MATERIAL	NOTE
PLATE / ELEMENT	316L, 316, 304 / 304L stainless steel	Standard for water, steam and gas; multi-stage and multi-hole plates from the same grade unless the drop calls for a more resistant grade
CARRIER, HOLDER & FLANGES	A105 carbon, A182 F22 alloy, 16Mo3; A105N, A350 LF2 low temperature, A182 F11, F316 stainless	Matched to the line from the piping class, so the assembly bolts into the existing flange set
HIGH TEMPERATURE SERVICE	A182 F22; F91 / F92, 321H, 347H	Steam blowdown, letdown and hot process lines
ATTENUATION BODY	Carbon or alloy steel matched to the line; hardened alloy steel where the jet bears on the body	Plates in the plate grade above
CORROSION RESISTANT UPGRADE	Duplex (UNS S31803 / S32205), super duplex (UNS S32750), Alloy C-276 (UNS N10276), Alloy 625 (UNS N06625), Alloy 400 (UNS N04400)	Chloride-bearing or acidic media, or where cavitation would open up a stainless bore
GASKETS & BOLTING	Spiral wound, 316 / graphite with carbon steel inner and outer rings; stud bolts, nuts and washers	Where the plate is supplied with its flanges

4. Dimensions

There is no catalogue dimension table: the bore, the hole pattern, the number of stages and their spacing come out of the sizing calculation, and the plate thickness from the differential (Section 2). A paddle plate is drawn to the flange standard and facing; a ring-joint plate carries the ring grooves; a spectacle plate follows the ASME B16.48 outline. Dimensions are issued on the approval drawing once the calculation is agreed. Symbols: D pipe internal diameter; d bore diameter, for a multi-hole plate the equivalent bore; n, d_h number and diameter of the holes in a multi-hole plate; E plate thickness; OD plate outer diameter; N number of stages; s stage spacing, at least 1D; L face-to-face length of a spool, set or assembly. The approved project drawing governs.

5. Options and configuration

OPTION	CHOICES
FACING	To the line flange facing; raised face, ring-joint (grooved) or other
SUPPLY	Plate alone; spectacle plate; plate between its own flanges with gaskets and bolting; wafer body; flanged spool
CHOKED SINGLE STAGE	Gas service, where the project accepts choked flow and its noise
FLOW SIMULATION	Coefficient or hole pattern confirmed by flow simulation (CFD), where the project calls for it
INSPECTION	Positive material identification and penetrant testing where the project specifies

6. Quality control and documentation

ITEM	SCOPE
QUALITY SYSTEM	ISO 9001:2015; PED where it applies
PRESSURE DESIGN	ASME B31.1, B31.3 or EN 13480-3, as specified
WELDING	Welded paddles, spools and bodies: procedures qualified to EN ISO 15614-1 or ASME Section IX; preheat, PWHT and hardness checks where the grade requires them
NDE	To the project specification and the design code: visual, penetrant or magnetic particle, and radiographic or ultrasonic examination, extent as specified

ITEM	SCOPE
PRESSURE TEST	Hydrostatic, or pneumatic where the project specifies, on welded spools and bodies
DIMENSIONAL REPORT	Bore d, or the hole pattern, measured to 0.005 mm with a calibrated three-point bore gauge, or optically below its range; CMM on request. Face roughness, plate thickness, OD and bevel to the project specification
MARKING	Marking method to the project. Plate: INLET, tag, serial and job numbers, size and rating, bore or number of holes, material and heat number, on the handle. Spool or set: tag, serial and job numbers, size and rating and flow direction, on the body
CERTIFICATES	EN 10204 3.1, heat numbers traceable to the marking; 3.2 on request
DOCUMENTATION	Sizing calculation with the cavitation, choking and noise check; approval drawing; material certificates; dimensional report; on welded spools and bodies, WPS and PQR, NDE and pressure test records where the scope of supply calls for them

7. What to send with an enquiry

Every type needs line size and schedule, flange standard and rating, medium, flow rate, upstream pressure and temperature, and the required downstream pressure; for liquids also the vapour pressure and, where known, the critical pressure, for gases the isentropic exponent. Beyond that:

TYPE	ADDITIONAL PROCESS DATA
SINGLE STAGE RESTRICTION ORIFICE PLATE	Allowable sound pressure level 1 m from the downstream pipe wall, and whether choked flow is acceptable or must be avoided
MULTI-STAGE RESTRICTION DEVICE	Allowable noise and cavitation limits, and the face-to-face length available in the line
SPECTACLE RESTRICTION ORIFICE	Flange facing, allowable noise limit, and whether the ring side is bored to the pipe ID
ATTENUATION PLATE SET	Valve type and Cv, distance from the valve outlet, and the allowable sound pressure level at the measuring point

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.

© 2026 İnkotek Enerji Sanayi ve Ticaret Ltd. Şti. · INK-DS-06 Rev 01 · 19 October 2026