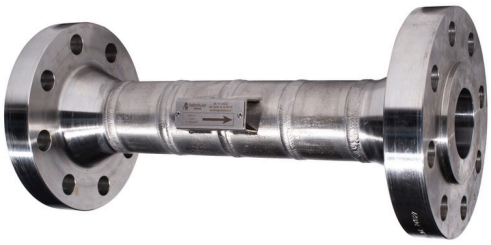
Datasheet

MULTI-STAGE RESTRICTION ORIFICE

FLOW LIMITATION / PRESSURE REGULATION

KEY DATA

- Design according to ISO 5167, ASME MFC-3M or R.W. MILLER standards
- In compliance with the pressure equipment directive PED 2014/68/UE
- Recommended for gas, liquid or steam
- For all types of fluids and all pipe sizes
- Designed with simple hole and/or multi-hole plates if the application requires a reduction in noise level



Multi-stage restriction orifice

BENEFITS

- Suitable when the desired pressure drop cannot be achieved with a single plate
- Prevents cavitation and critical flow issues
- Allows a reduced noise level (multi-orifice plates)
- Simpler, economical and robust design compared to a non-piloted control valve (for the same functionalities)
- Very long life-time of the product (no maintenance)

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MEASURING UP TO YOUR EXPECTATIONS

Restriction orifices are used to reduce the fluid pressure or to restrict the flowrate in a pipe. The pressure drop produced by forcing the flow through the restriction orifice is calculated accurately taking into account all the relevant operating conditions.
If a significant pressure drop must be achieved, a multi-stage restriction orifice may be necessary : the pressure can be reduced in several stages (several plates) to reach the desired value while avoiding cavitation (1) , vibration or excessively high noise levels.

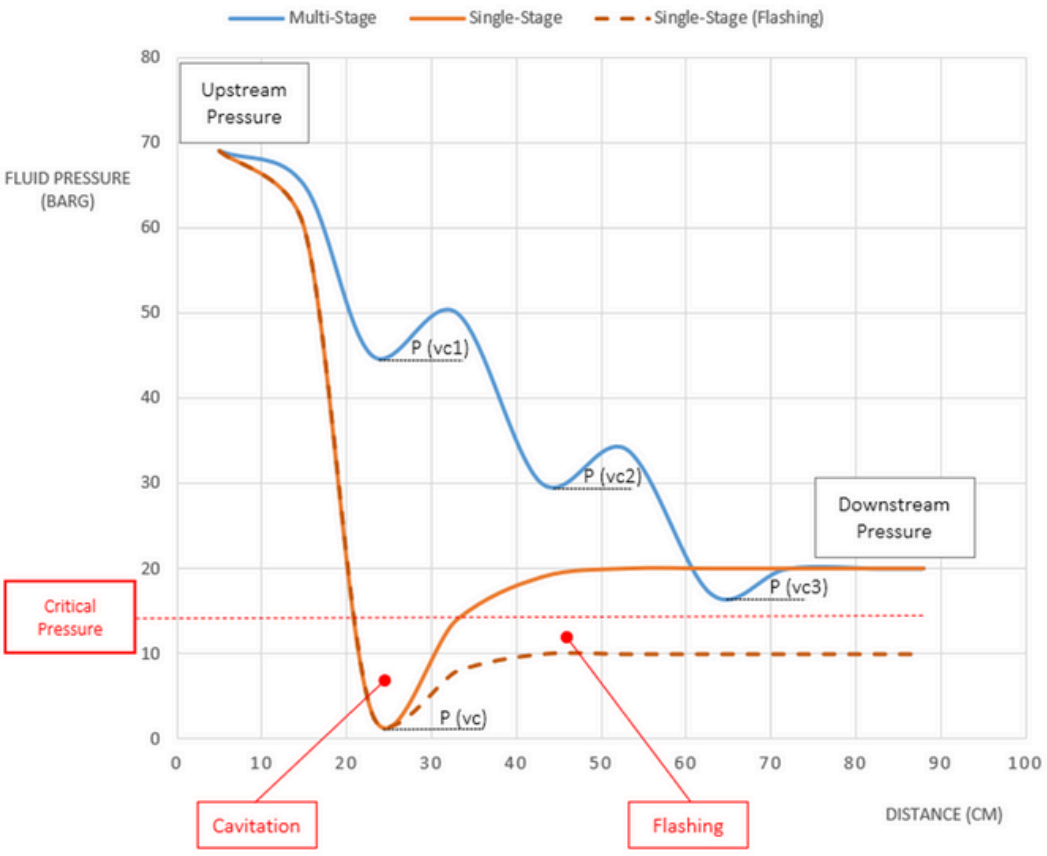


Illustration of multi-stage fluid pressure drop (blue) compared to pressure drop with a single plate (orange).

As illustrated above, the use of a multi-stage restriction orifice eliminates the risk of cavitation, critical flow and flashing, which can damage metal components.

(1) see illustration of cavitation, critical regime and flashing on page 3/7

OPERATING PRINCIPLE

- As passing through the restriction, the fluid pressure decreases as shown in the image below.
  It reaches its minimum value shortly after passing the orifice (P_{min}) then increases again to a stable value (P_2). Thanks to the permanent pressure loss ($\Delta\omega = P_2 - P_1$) generated by turbulence, it is possible to reduce the pressure in a pipe and/or limit a flow rate.

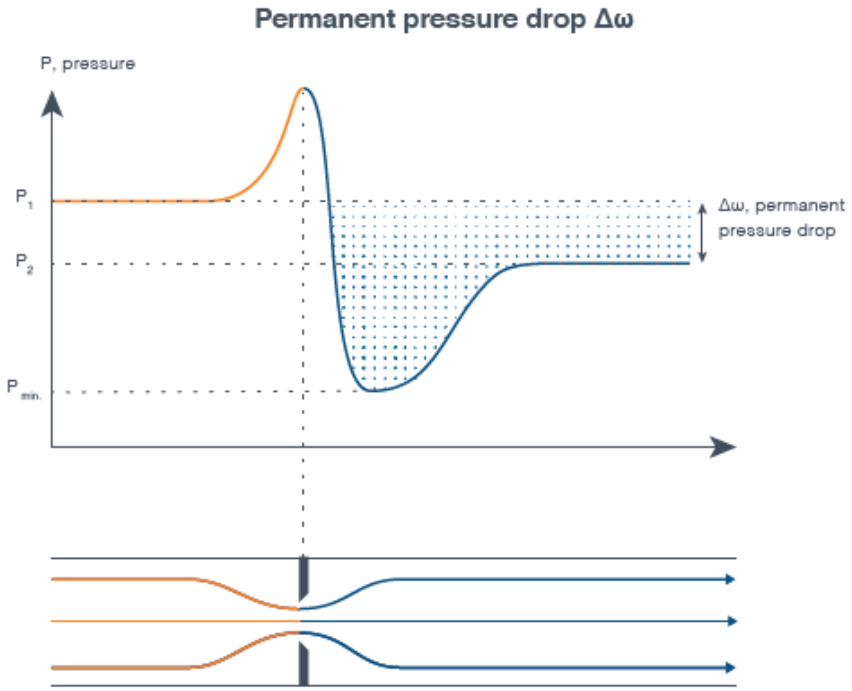


Illustration of the fluid pressure drop when passing the restriction

- With a multi-stage restriction orifice, each stage (each plate) helps reducing part of the pressure. The number of stages is calculated based on the desired total pressure drop to be achieved.
  .

- **Cavitation** (see illustration on page 4/7): in a liquid, cavitation corresponds to the formation of gas bubbles due to a too low local pressure (lower than the vaporization pressure), which can happen when the pressure is droping as the fluid is passing through the restriction (in P_{min}). The implosion of these gas bubbles generates important energy levels and therefore significant noise levels and damages nearby orifices and piping elements.

  To avoid this phenomenon, we calculate the cavitation pressure and size our equipment below this threshold to limit the risk of rapid part deterioration.

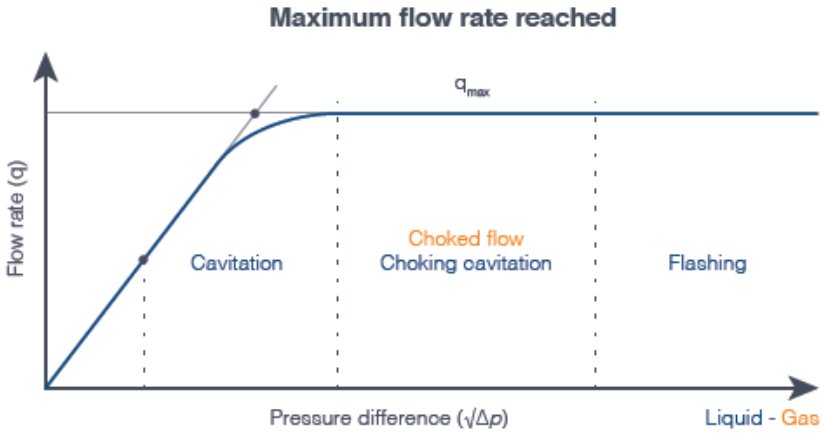


Illustration of cavitation and critical regime of a liquid or gas

- **Critical regime** (see illustration above) : in the vicinity of the restriction, the fluid is accelerated until it reaches its maximum speed at the level of the restriction
  For a gas, sonic conditions can be reached (**choked flow**) : the maximum flow rate is reached, it can no longer increase.
  For a liquid, cavitation can be too important (**choking cavitation**, if pressure loss is too great) and can damage the elements.

  This is the reason why the restriction orifices are sized to limit choked flow or cavitation: we avoid damaging the elements while guaranteeing the maximum pressure drop.

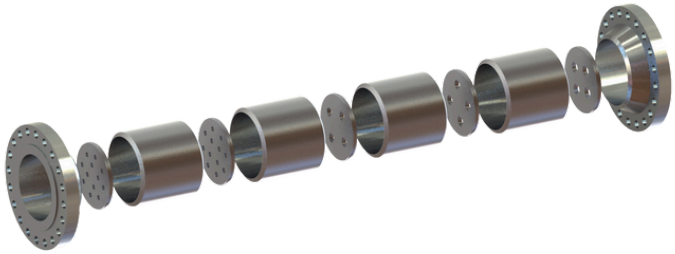
Note: these choked flow conditions are sought in the case of gas flow limitation.

- Our study takes into account the essential operating conditions as well as the particular behaviors of your installation such as **sonic conditions, cavitation or noise level**.

  Multi-stage restriction orifices (with simple hole or/and multi-hole plates) are proposed in order to achieve a significant pressure drop while avoiding premature erosion of the pipe and the plate, cavitation as well as an excessive noise and vibration level.

TECHNICAL CHARACTERISTICS

- Fluid temperature: according to specifications (high temperature possible)
- Fluid type: gas, steam, liquid
- Maximum operating pressure: limited by the flange rating
- Nominal diameters: all pipe sizes
- Materials : carbon steel, stainless steel, monel, hastelloy, inconel, duplex, super duplex, titanium, tantalum, PVC, PTFE...
- Mounting types:
  - RF model to be mounted between flanges with flat or spiral gaskets
  - male/female or tongue/groove models according to EN 1092-1 and EN 1759-1 to be mounted between corresponding flanges
  - restriction orifice in the form of a spool, weld-on mounting or screw-on mounting on the pipe
- Plate thickness: calculated based on the permanent pressure loss generated and the internal diameter of the piping to avoid deformation of the plate during operation
- Number of plates : the calculation of the number of stages is optimized according to the characteristics of the application, each plate allowing the pressure to be reduced as much as possible while avoiding cavitation and critical flow phenomena.



Example of the number of stages (of plates) to be welded

- Noise level: noise level control estimated at 1 m.
  Multi-hole plates are used in order to attenuate the noise level : the greater the number of orifices, the lower the noise generated by the restriction.
  The maximum acceptable noise level depends on the operating conditions and the duration of exposure: consult the corresponding regulations.
  The regulatory framework generally establishes a limit for continuous operation for average daily exposure as well as a maximum impulse noise level for intermittent or emergency operations.
- Cavitation [(2)]: for liquids, the cavitation level is checked for each plate and, in the case of the multi-hole device, all orifices are calculated to avoid cavitation.
  A multi-stage restriction orifice reduces the level of cavitation of the assembly.
- Critical regime[(2)] : the orifices are sized at the critical flow limit for a maximum pressure drop. A mutli-stage restriction orifice is used when the desired pressure drop cannot be achieved with a single plate.

(2) see illustration of cavitation and critical regime on page 4/7

- Thermodynamics: thermodynamics properties of the fluid (such as phase change, temperature, composition and density of the mixture, viscosity, compressibility factor...) are taken into account for the calculation of each stage.

- Please note that the size and number of orifices on different stages may differ, so multi-stage restriction orifices must be installed in the flow direction indicated.

STANDARDS

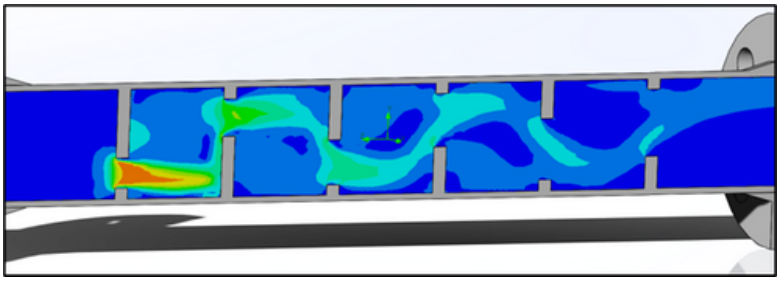
- R.W. MILLER or ISO 5167 or ASME MFC-3M
- Design according to Idel'cik for holes with rounded or bevelled edges on request
- Compliance with the pressure equipment directive PED 2014/68/EU

CONTRUCTION CODES

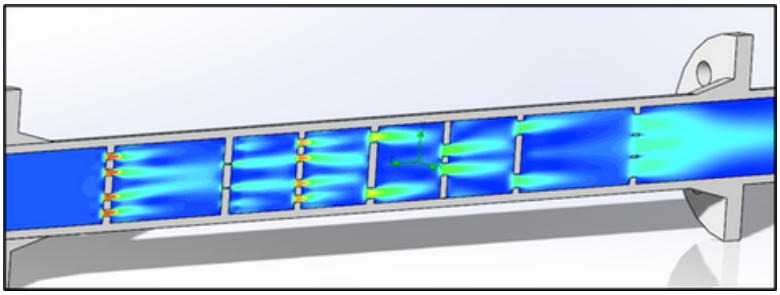
- EN 13480
- ASME B31.3 / B31.1
- CODAP, CODETI...

3D SIMULATION

- For complex applications, possibility f fluid flow simulation (CFD analysis) to optimize the design of the multi-stage restriction orifices and validate analytical calculations.



Fluid velocity with simple orifice plates



Fluid velocity with multi-orifice plates

ITEM CODES

- Multi-stage restriction orifice : DRO-ND-NP-MS-Nb of stages-Face type-Material

DRO	ND (3)	NP	MS	Nb of stages	Face type (5)	Material
Nominal diameter - ASME	1/2'' to 40''	150# to 2500#	MS Multi-stage	Détermined by calculation	RF RTJ SEM (4) SEF (4) DEM (4) DEF (4)	304L 316L Others
OR						
Nominal diameter - ISO	DN15 to 1000	PN2,5 to 400				

- Examples multi-stage restriction orifice codes:

  - DRO-2-300-MS-3-RF-316
  - DRO-3-600-MS-4-RF-MONEL
  - DRO-30-1500-MS-7-RTJF-316

(3) ND standards - beyond, on request

(4) Specify large or small male/female face if flanges according to ASME B16-5 / EN 1092-1 / EN 1759-1 standards

(5) Possibility of mounting in the form of a welded spool (SW) or screwed

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LA MESURE DE VOS EXIGENCES

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