FLOW ELEMENTS

Multistage Restriction Orifice Assembly

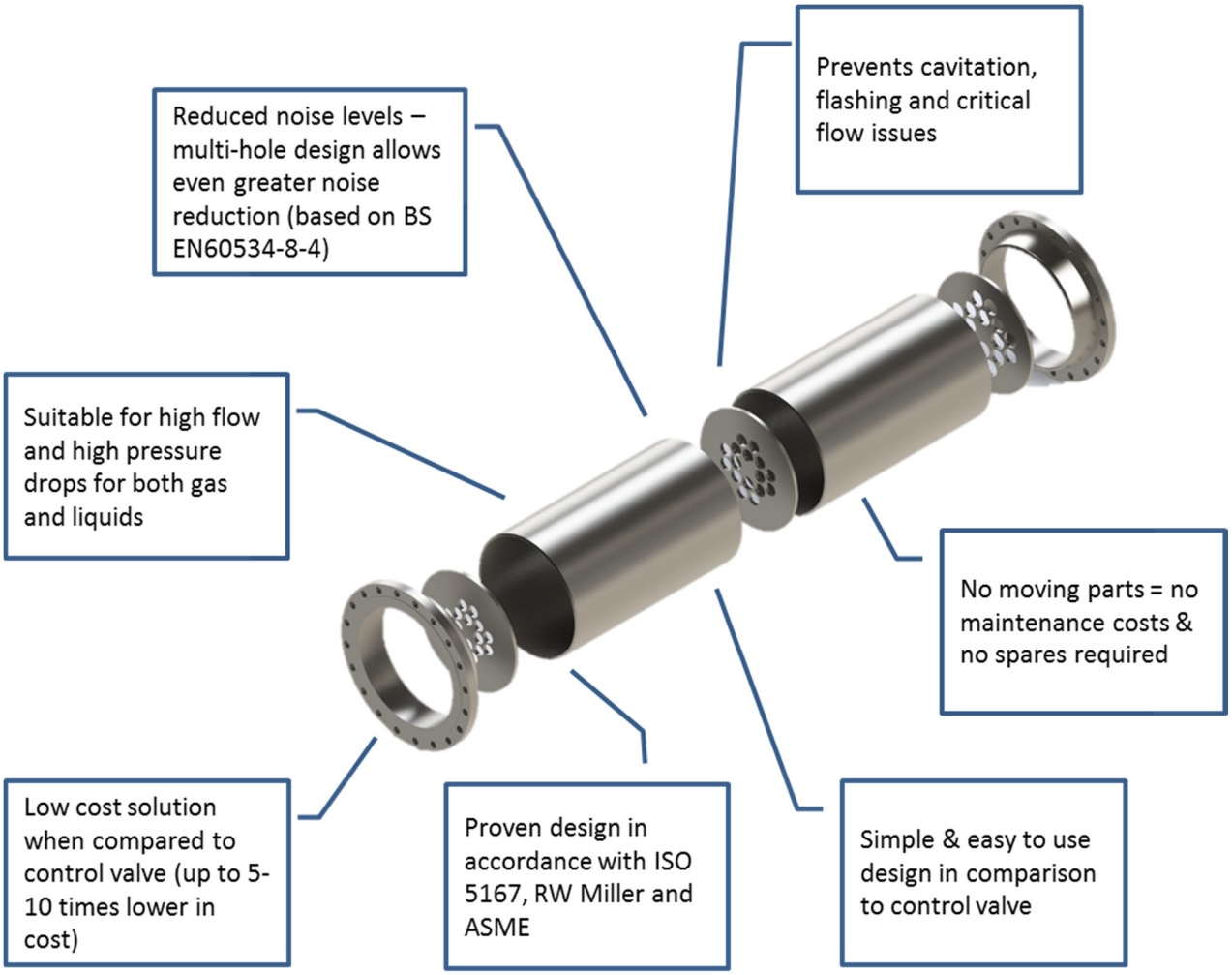
Flow Measurement Excellence

Rototherm is widely recognised as a world leader in the design of restriction orifice assemblies and flow control systems with more than 40 years' experience.

Restriction orifice plates are widely used for managing pressure drops and to control flow rates by restricting flow, regardless of downstream conditions. For high pressure and/or high noise applications, multi-stage restriction orifice assemblies are becoming increasingly common as a proven solution, demonstrating their ability to prevent cavitation, critical flow and flashing from occurring,

Rototherm has built up significant experience and expertise within this area, and have a vast array of installations worldwide on offshore platforms, FPSOs, LNG plants, and mines. Users have selected us based on our design and application knowledge, uncompromising quality, proven project delivery, and industry leading machining and welding capability. Many of the world's leading users within oil & gas production, LNG production and mining, come to Rototherm to ensure the right solution is supplied first time.

MULTI-STAGE RO - KEY FEATURES & BENEFITS



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Product Datasheet

Flow Elements

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Applications

Gas Blowdown

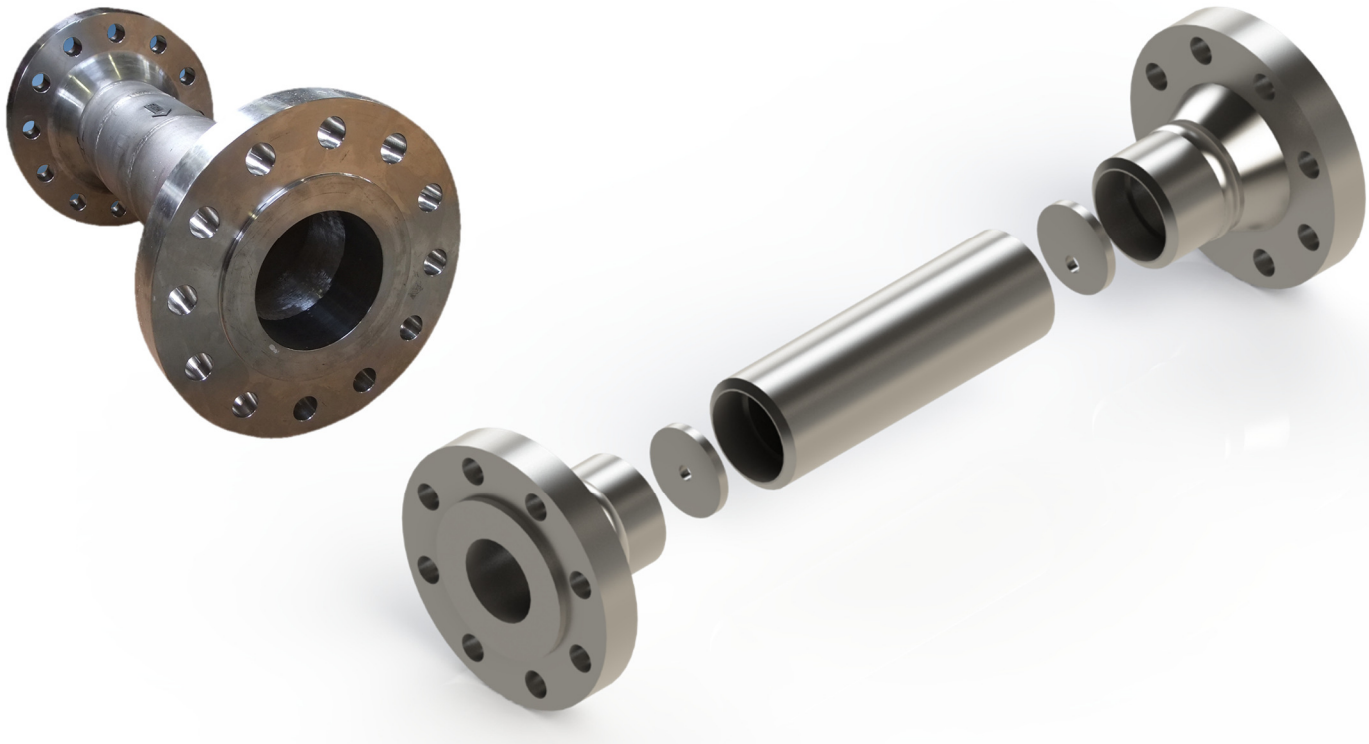
Required typically to reduce pressure down to atmospheric. Increasingly common on offshore platforms where higher pressure drops and flow rates exist and control valves are expensive to install & maintain.
For example, a multistage restriction orifice assembly is installed at the downstream of blow down valves. When blowdown valve opens to release the high pressure on its upstream, the RO at its downstream ensures that the flow is not excessive to overload the flare header. Usually the pressure drop in a blowdown circuit across an RO can be very high.

Gas Blow-by

Typical case is flow of hydrocarbon condensate from high pressure separator. Usually a level control valve controls the level of the high pressure separator. In case of valve failure, the valve needs to open fully to stop separator from overflowing. To stop the downstream systems from overloading due to gas flow, a multistage RO can be used for control. Similar application is seen in the heating medium flow in e.g. boiler, to mitigate effect of heating medium valve fail open position.

Cooling Water Recycling Lines

Common in mining and LNG producing plants, a multi-stage restriction orifice is a cost effective method for managing pressure within the water system. For example, a multistage restriction orifice assembly is used to manage a constant re-circulation flow. The recirculation ensures that cavitation and starvation cannot happen in the pump.



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Restriction orifice plates are traditionally used to reduce pressure by forcing the flow through a restricted bore. The precise pressure drop is produced by accurately calculating the orifice bore and plate thickness required. For high pressure drops (especially high flow), restriction orifice plates are usually unable to meet the pressure drop without issues arising in relation to cavitation, flashing, high noise and vibration.

In these instances, users have two main choices:

1. A control valve, which although has the flexibility of potentially varying flow conditions, is expensive to purchase and maintain due to various moving parts.
2. A multistage restriction orifice assembly which is cost effective and free from maintenance

Rototherm has become a world leader in the niche area of multistage restriction orifice assemblies, which requires great amount of technical understanding and experience within specific applications to ensure the “right” solution is designed and manufactured to meet the pressure drop requirements.

Typically multi-stages are poorly understood due to a lack of understanding of the application, lack of understanding of design requirements for both ISO5167 and limitations of pressure drops in multiple steps.

With significant experience in designing and manufacturing multi-stages for numerous applications such as blow down and water cooling re-cycling systems we have seen pitfalls of poor designs and lack of understanding of process and application. This can lead to costly shutdowns (sometimes unexpectedly) as equipment is replaced due to cavitation/flushing, excessive noise/vibration, or choked flow occurring.

What is Cavitation?

Cavitation is an erosive condition which occurs when the internal pressure of the liquid passing through the orifice falls below its vapour pressure and vapour bubbles form. Further downstream from the orifice the pressure recovers sufficiently to collapse the bubbles with extreme violence. Cavitation calculations are performed during the design stage of a MSRO to calculate cavitation factors at each stage in the orifice assembly.

What is Flashing?

This is similar to cavitation except that the process pressure never recovers sufficiently to collapse the gas bubbles resulting in two phase flow – liquid and gas – downstream of the orifice. Erosion of the pipe work and valves and other instrumentation can occur due to the impact of liquid droplets arrived at high speed in the vapour flow.

What is Choked Flow?

Otherwise known as critical flow, this occurs when too large a pressure drop is attempted across a single orifice plate. When the downstream pressure is less than 53% of the upstream pressure, the flow through the orifice will become sonic, at which point no further increase in flow can be achieved by either increasing the upstream pressure or lowering the downstream pressure. A MSRO will enable staged reductions in pressure to prevent choking from occurring.

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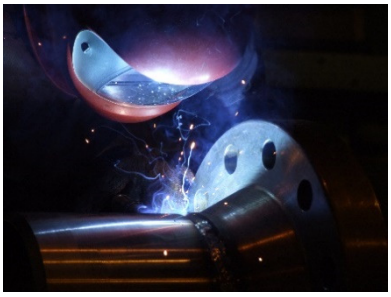
QUALITY & TRUST

Design and Calculation

Each multistage restriction orifice assembly is a bespoke design. We work closely with process engineers to advise what limitations there are in the design of such equipment so that this can be considered as part of the overall system in the plant.

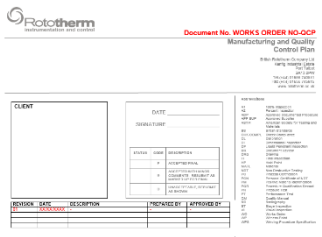
Design & calculations standards:	ISO 5167, RW Miller (Flow Measurement Engineering Handbook), ASME
Noise Calculations:	BS EN 60534-8-4
PED:	97/23/EC
Sizes:	Up to 30”
Pressure Rating:	+2500lbs
Distance between each stage:	2-4 times inner pipe diameter



Manufacture & Assembly

Our in-house machinists and welders are trained to industry leading quality standards, and have experience across a vast array of exotic materials such as hastelloy, monel, duplex stainless steel, Inconel, and others. We are approved suppliers to all leading Oil & Gas producers, miners, and EPCs and our facilities and operators are regularly audited by such users. We are also an approved supplier to the Defence Industry.

ISO9001:2008
FM11958



Quality System, Inspection & Testing

ISO9001:2008
Approved 3rd party endorsed manufacturing and weld procedures
Stringent project quality plans
Experienced project engineers well versed in the high requirements

Testing Services:

- Hydrostatic Pressure Test
- X-Ray (Welds)
- PMI
- Dye Penetrant Inspection
- Ultrasonic examination
- Magnetic Particle Inspection
- Charpy Impact Testing
- Hardness Survey
- Independent 3rd Party Inspection

Typical Documentation Package:

- Bore Calculations
- GA Drawing
- Material Certificate (3.1B, 3,1C)
- Test Certificates (for ITP items)
- Weld Procedures
- PED Statement
- CE Marking
- Certificate of Conformity
- Quality Plan & ITP

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