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Additive Manufacturing Technology for Severe Service valve trim design

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Summary

Severe Service Control Valves

Fluid	Phenomena	Troubles
Gas	High Pressure Drop	Aerodynamic Noise / Vibrations
Gas	Pinlet/Poutlet ratio	Aerodynamic Noise / Vibrations
Liquid	High Pressure Drop	Erosion / Vibration / Hydrodynamic Noise
Liquid	Cavitation	Mechanical Damages / Vibration / Hydrodynamic Noise
Liquid	Flashing	Erosion / Vibration / Hydrodynamic Noise
Gas + Liquid	Wet steam	Erosion
Gas + Liquid	Outgassing	Erosion / Vibrations / Noise
Gas / Liquid	Very high or very low temperatures	Materials Failure
Gas / Liquid	Chemical aggressive fluids	Materials Failure
Gas / Liquid + Solids	Hard Particles	Mechanical Damages / Erosion / Noise

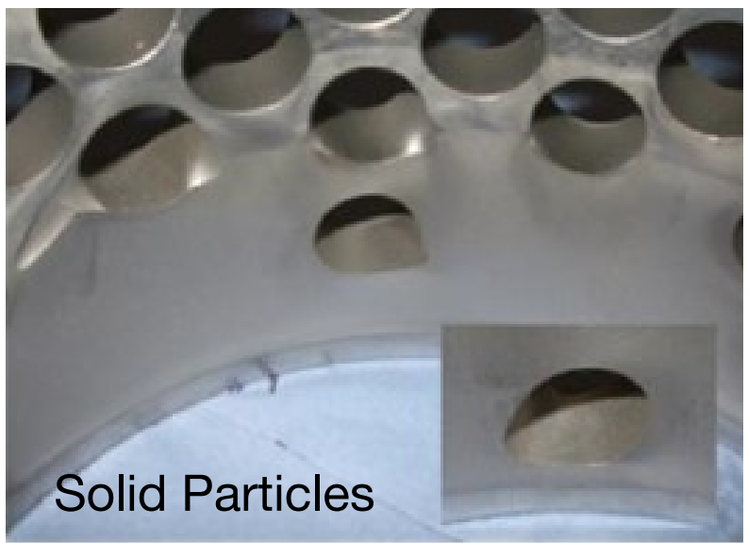
Severe Service Control Valves

High Pressure Drop

Cavitation

Flashing

Vibrations



Solid Particles

Severe Service Control Valves

Cage Trim

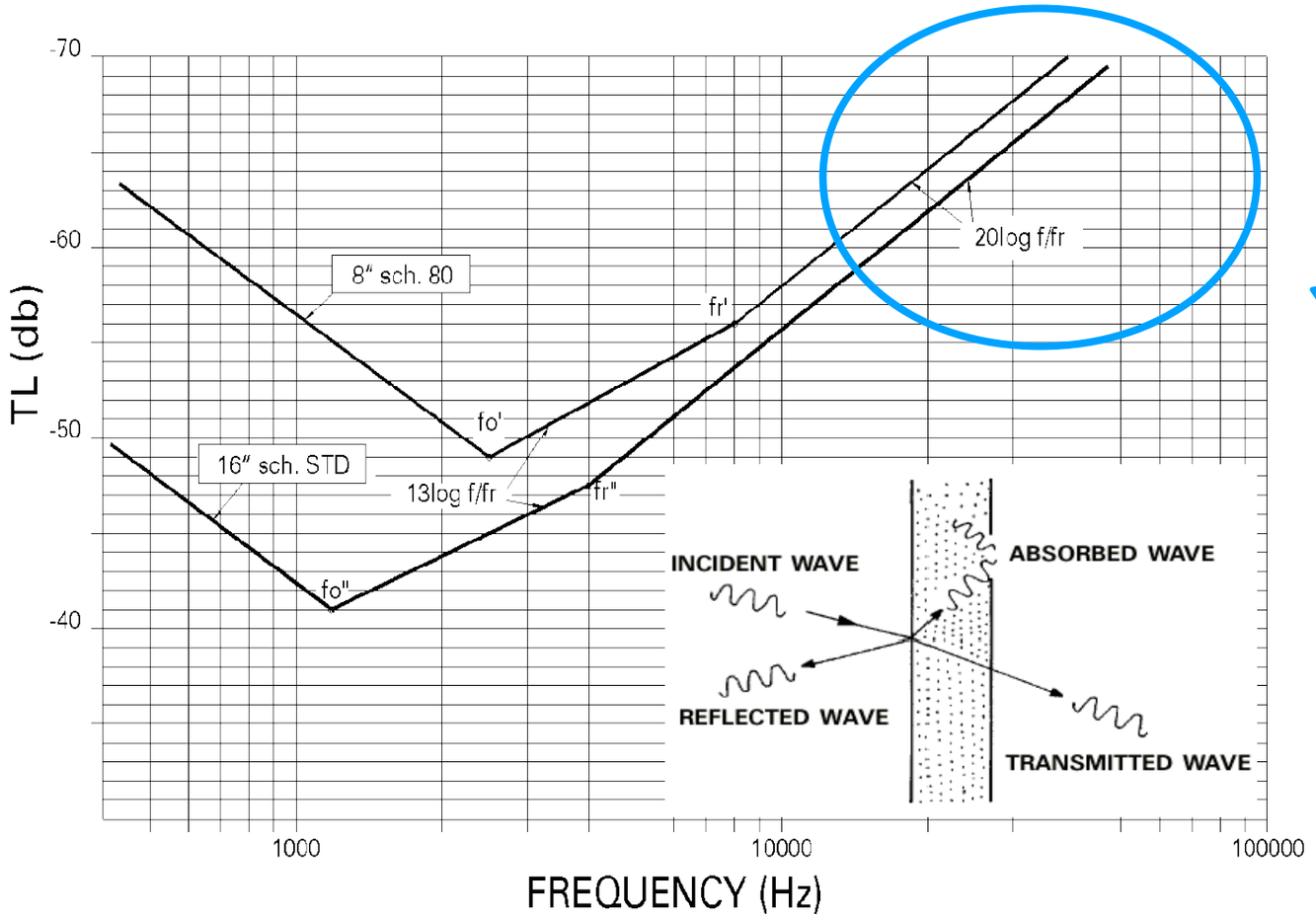
Multi Cage Trim

Fixed Resistor

Multi Stage Trim

Multi Stage Multi Path Labyrinth Trim

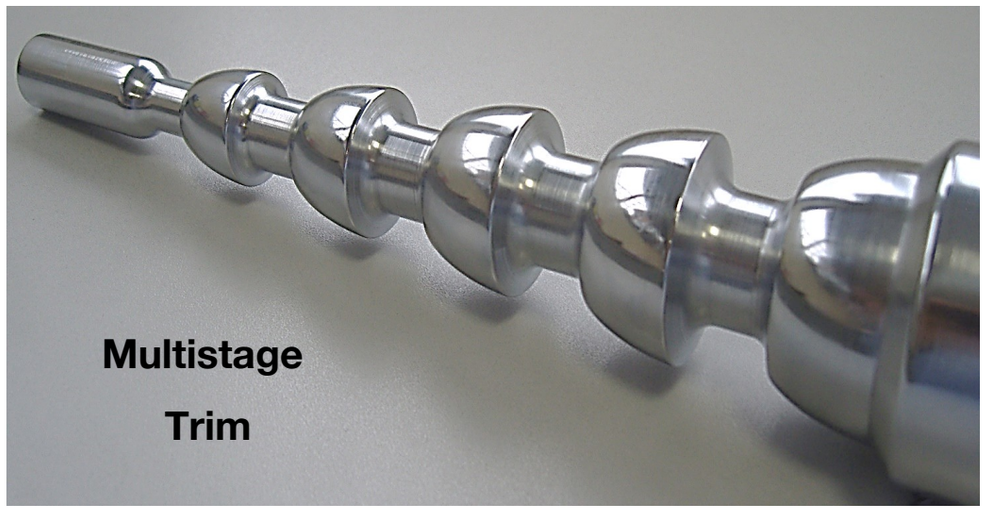
Severe Service on Gas

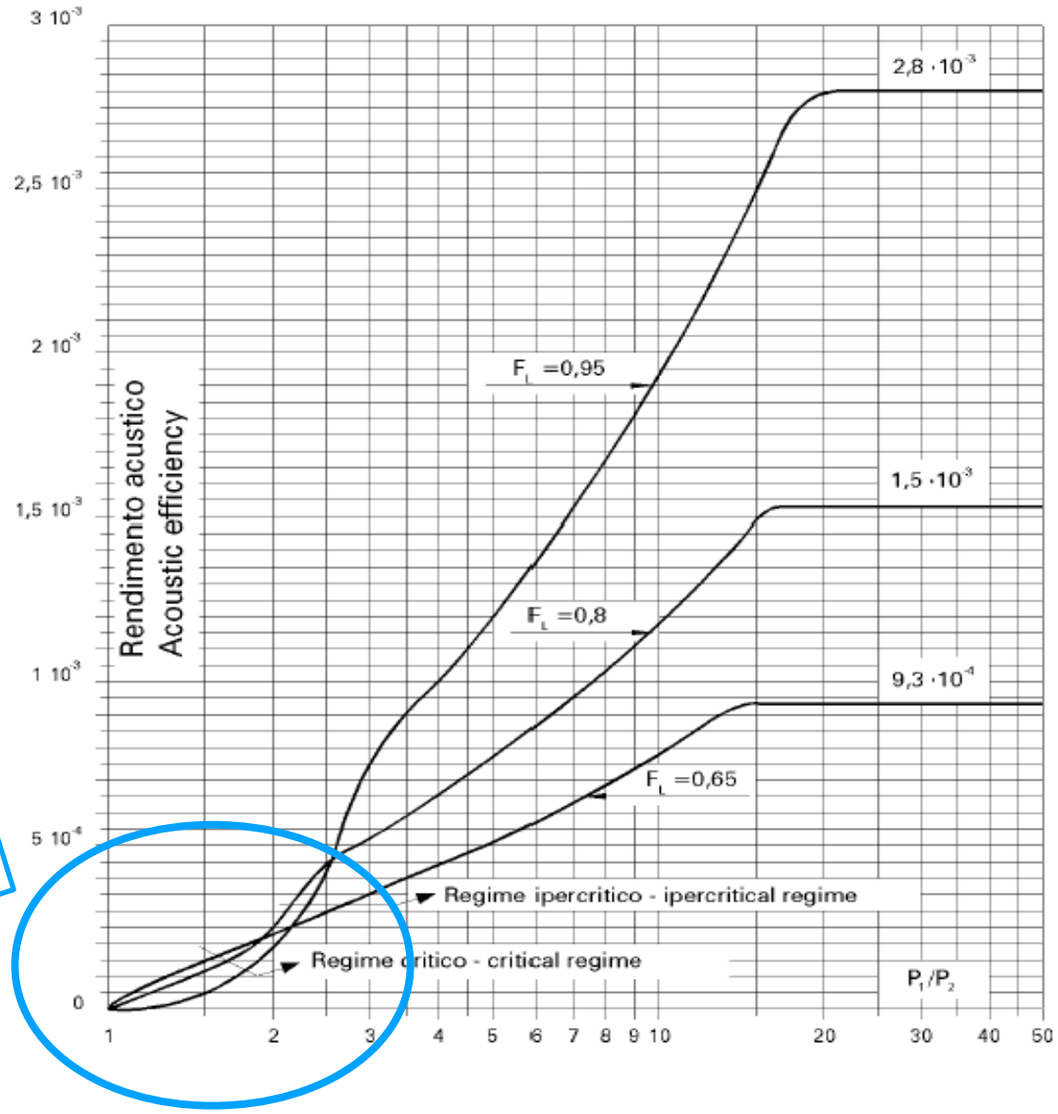


Multipath Trim

Multipath trims split the fluid flow in a large number of small paths in order to produce high frequencies noise that can be significantly reduce by the Transmission Loss across the pipe wall.

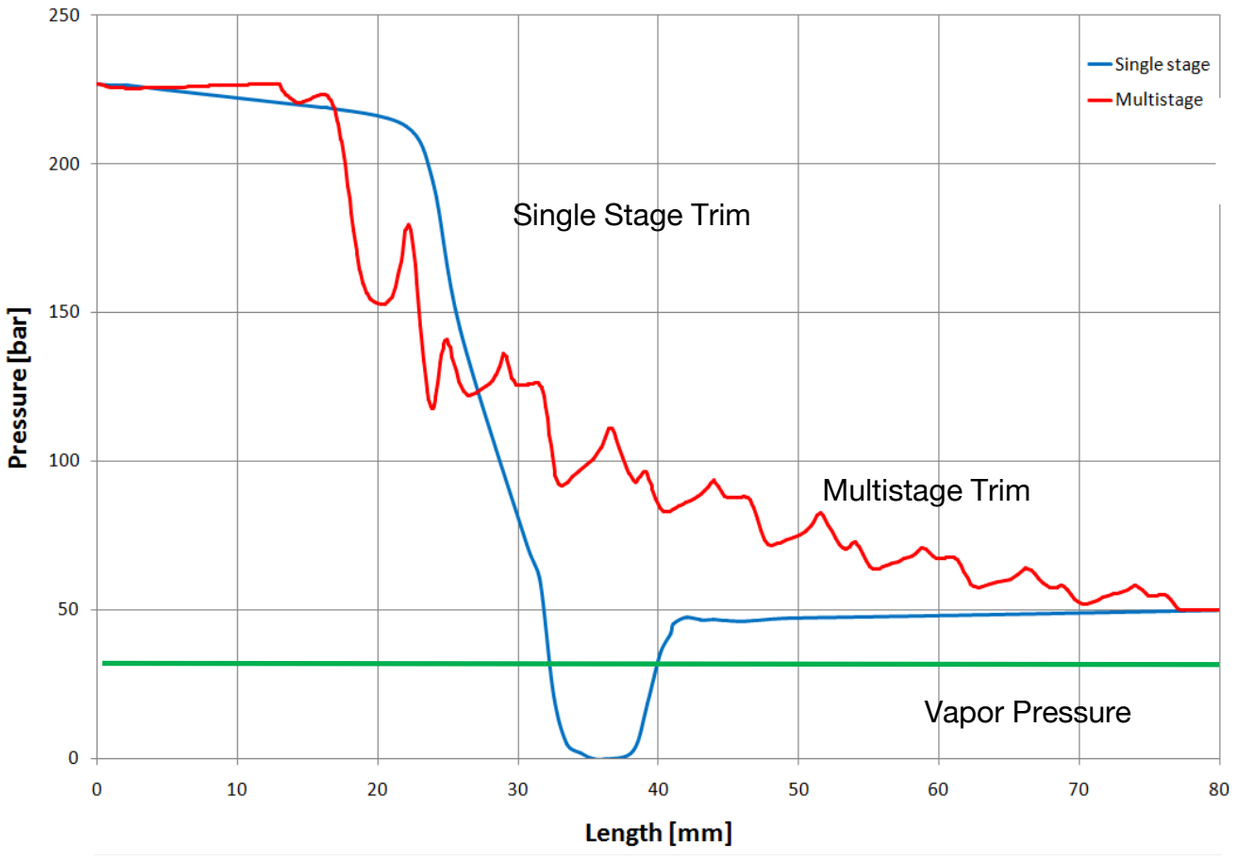
Severe Service on Gas





Multistep trims split the pressure drop in multiple stages in order to reduce the generated acoustic power by limiting the flow regime of each single stage.

Severe Service on Liquid

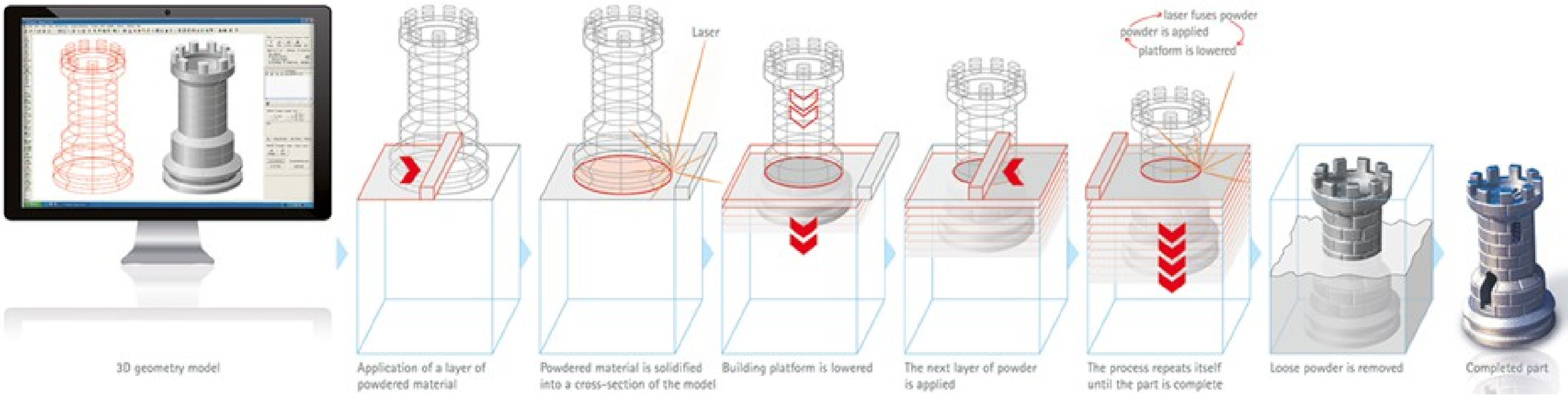


Multistage

Trim

Multistep trims split the pressure drop in multiple stages in order to increase valve FL coefficient, to prevent cavitation, and to limit flow velocity, to reduce erosion phenomena.

Additive Manufacturing

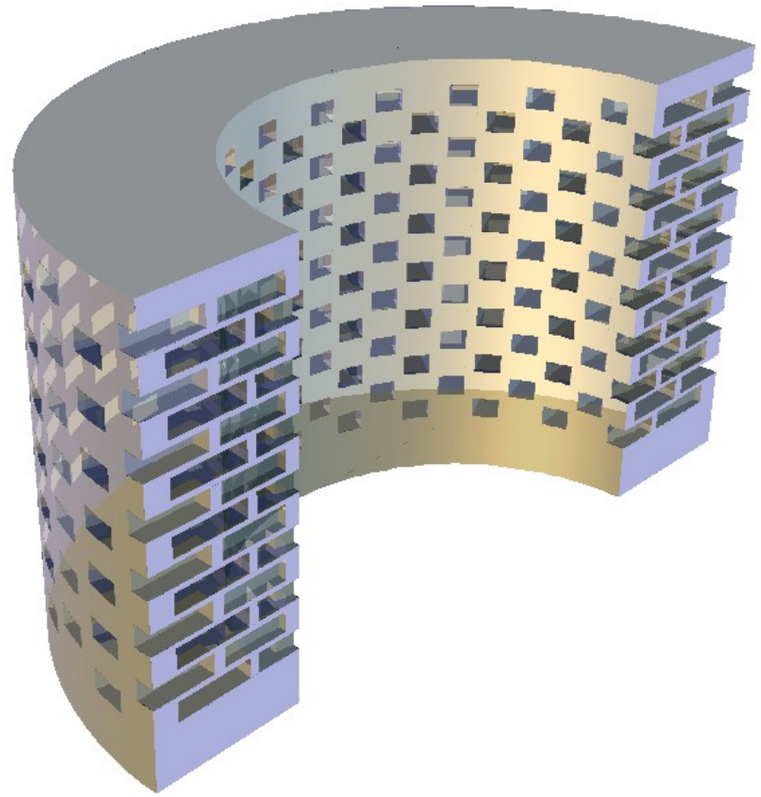


Additive Manufacturing is a process of joining materials to make object from 3D model data, usually layer upon layer, as opposed to subtractive manufacturing methodologies.

[1] ASTM Committee F42 on Additive Manufacturing Technologies, 2012

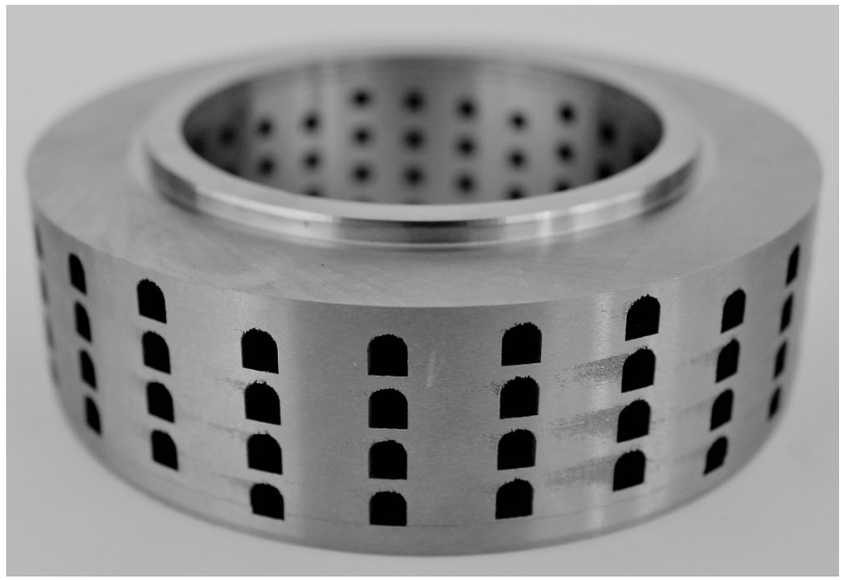
Additive Manufacturing Technology for Severe Service valve trim design

- Multistage – Multipath Concept
- Design customized on application
- No theoretical limits on design
- High Mechanical properties
- Easy made Reverse Engineering and retrofit
- Fast delivery
- Reduced dimensions



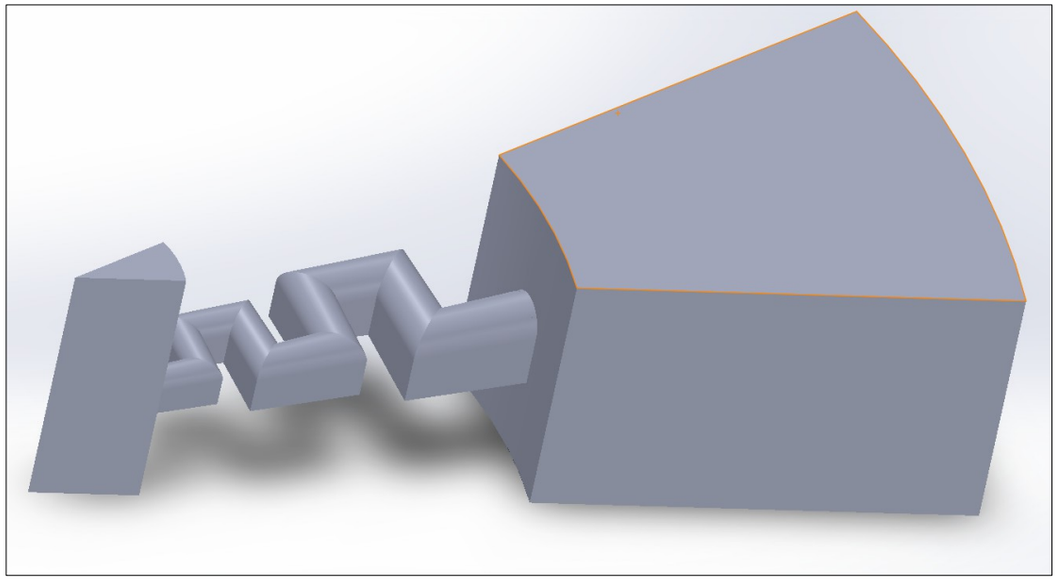
VSI Controls Epsilon Trim

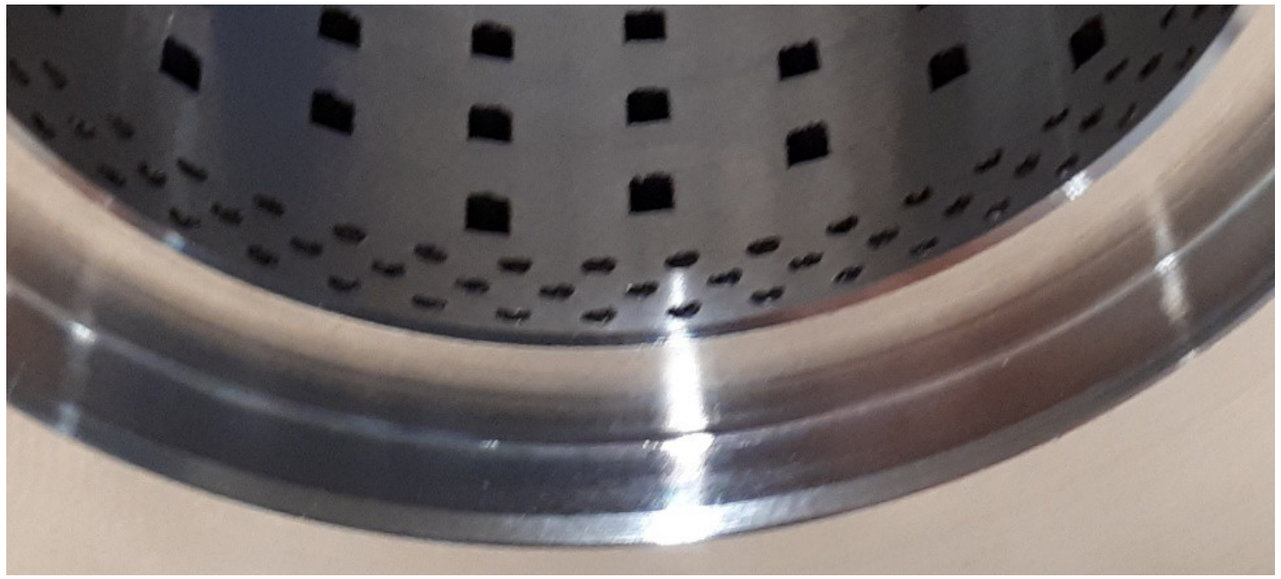
- Multistage – Multipath Labyrinth trim
- Independent channels
- Suitable for Gas or Liquid applications
- Decreasing number of stages and expansion ratio with valve stroke
- Number of stages and expansion ratios customized on application

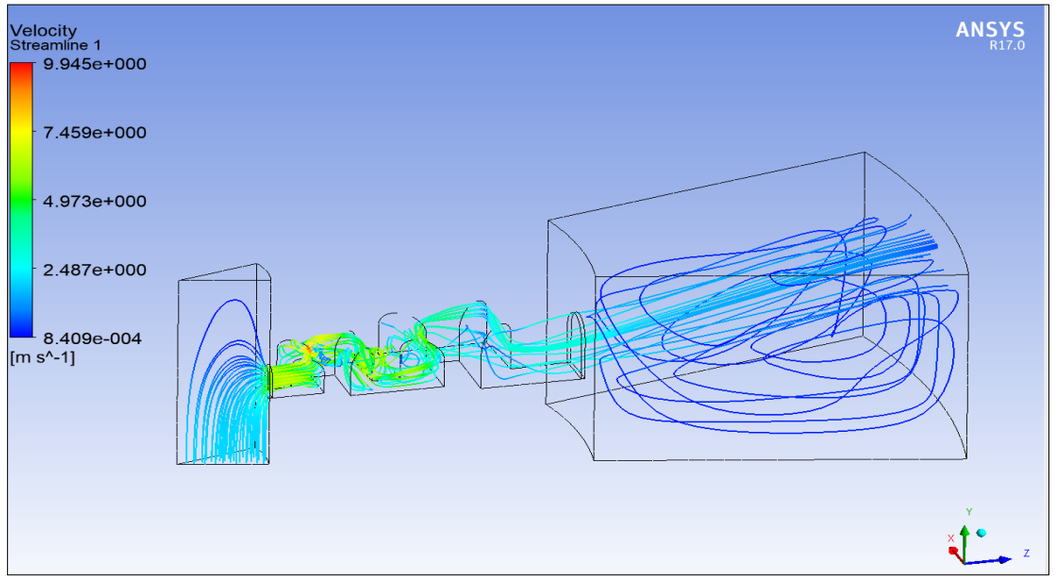


VSI Controls Epsilon Trim

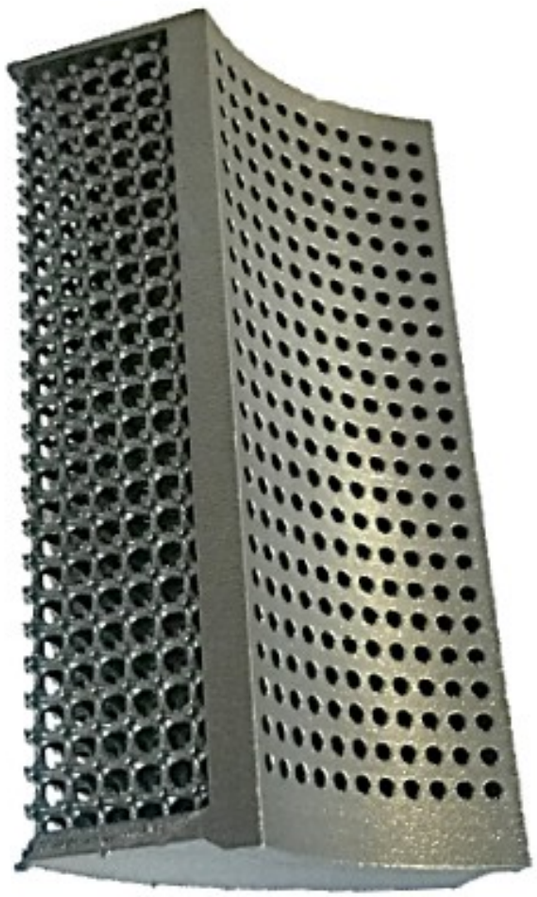
- Fluid dynamic design CFD based
- Centesimal meatus with boundary layer disruption
- P/B or unbalanced trim
- FTO or FTC design
- Inconel Alloy



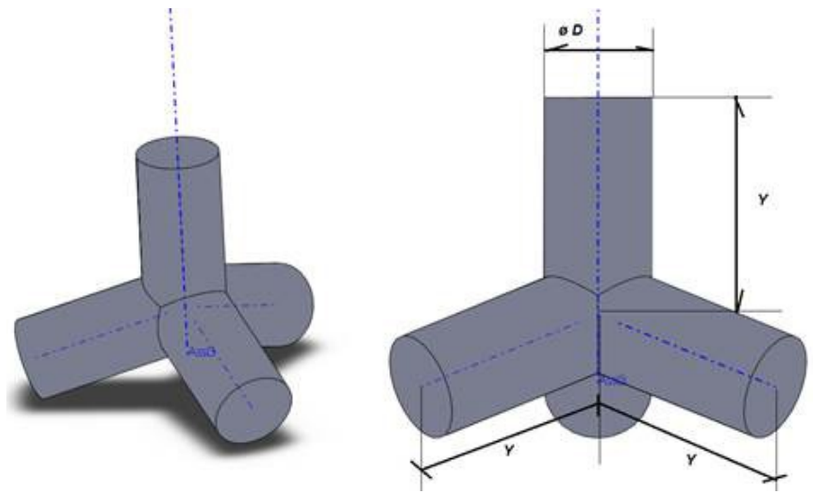


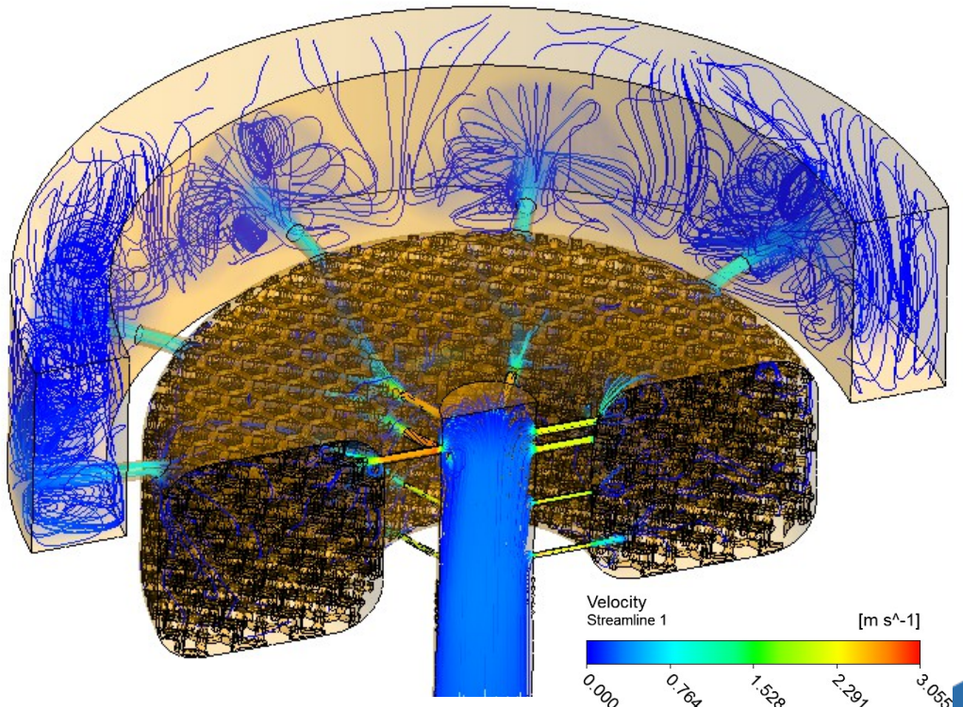


VSI Controls Omicron Trim

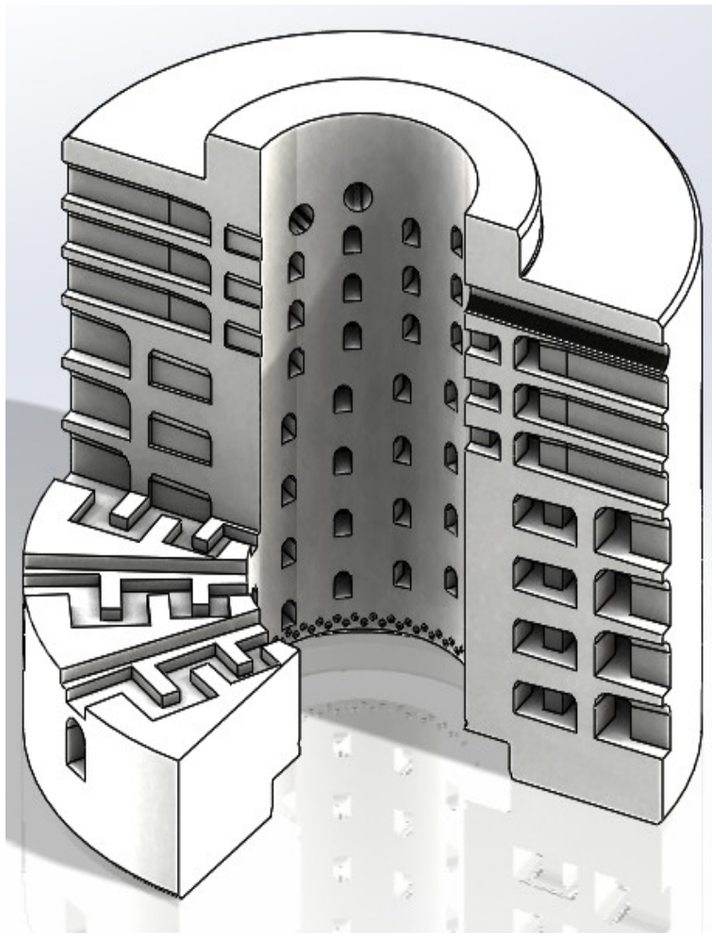


- Multistage – Multipath Labyrinth trim
- Pressure Drop generated by metal grid
- Stochastic concept
- Hundreds of stages of pressure reduction
- Grid dimensions customizable
- Suitable for normal or micro flow

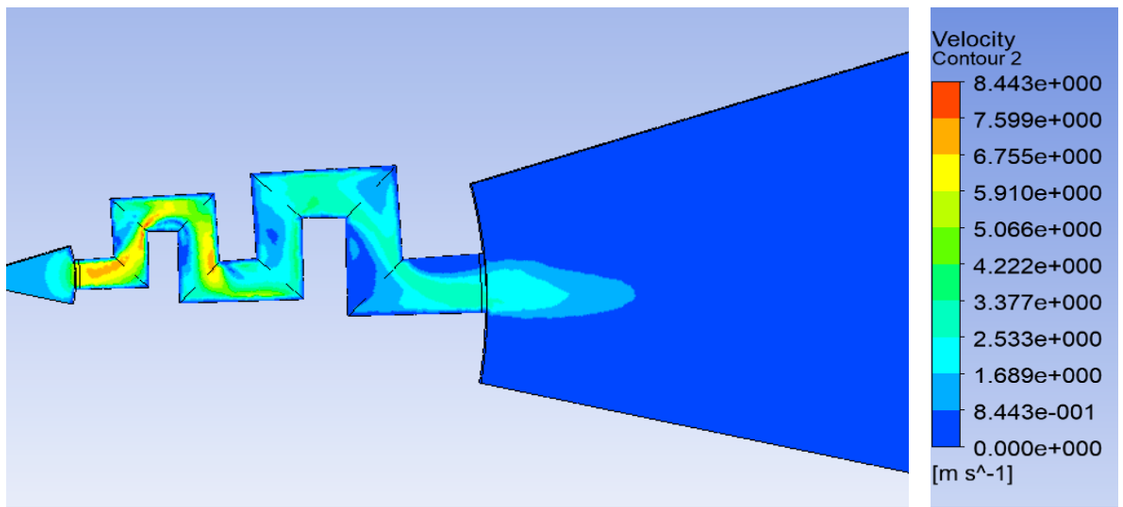




Design

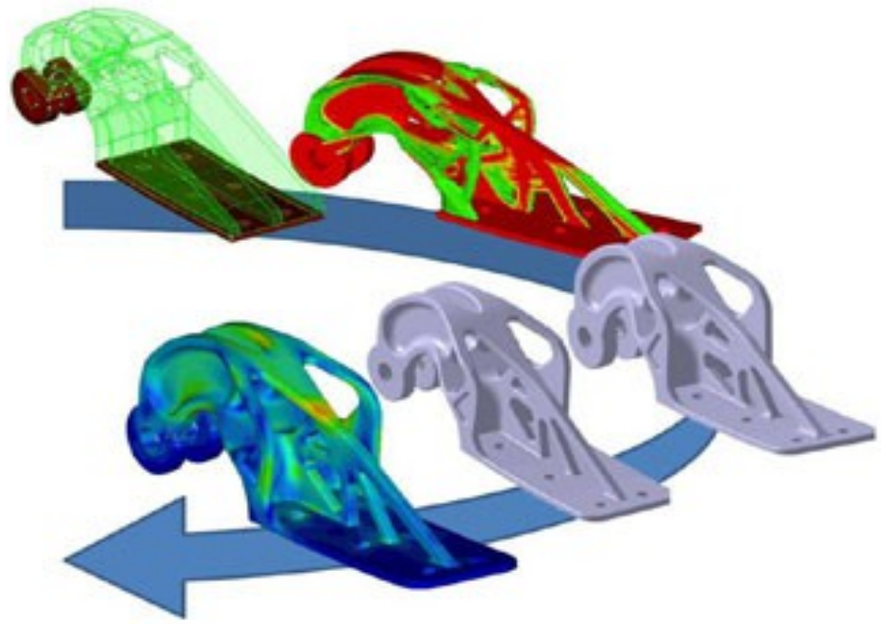


- Fully 3D design
- FEA simulations for fluid-dynamic performances and structural integrity
- Sizing and sound pressure level prediction, according to IEC 60534.
- Hardened materials and superalloys (17-4 PH, Inconel 718, Inconel 625…)



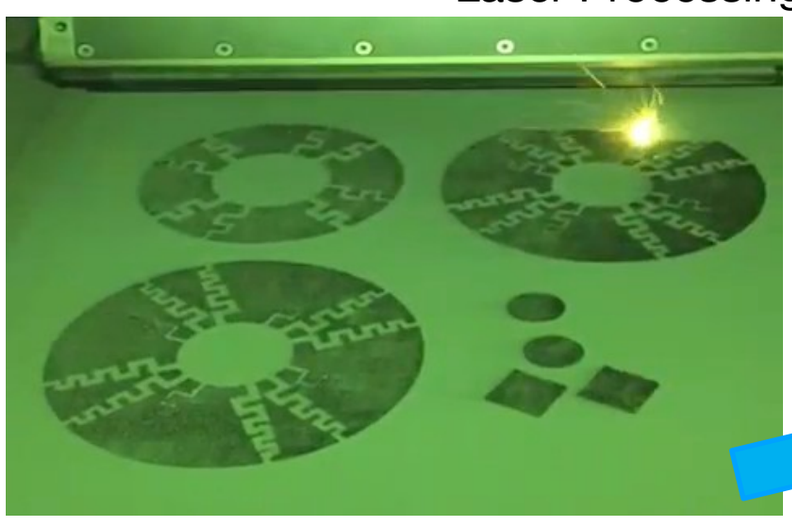
Design

Topological Optimization: a mathematical method that optimizes material layout within a given design space, for a given set of loads, boundary conditions and constraints with the goal of maximizing the performance.

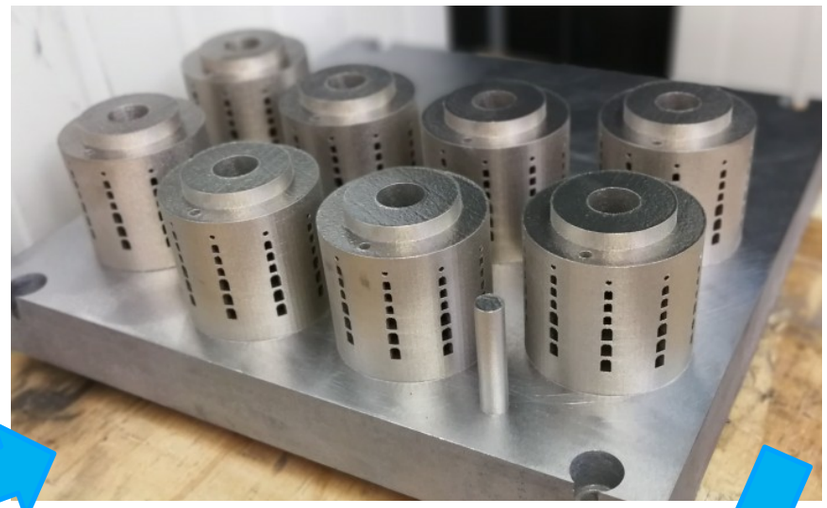


Manufacturing

Laser Processing



Machine removal

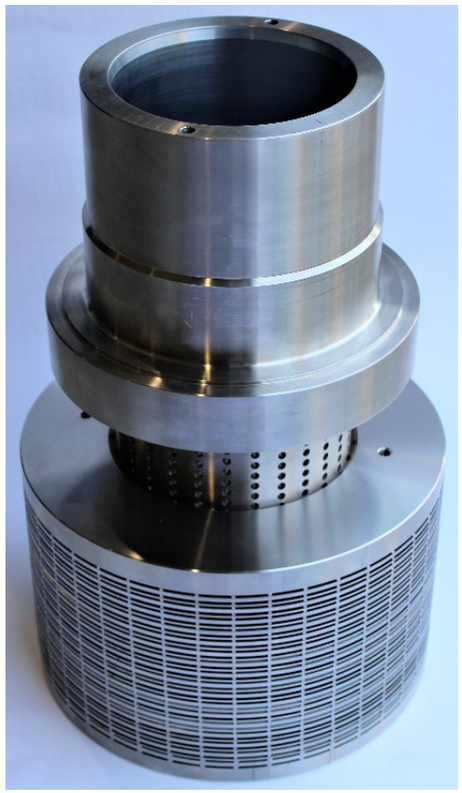


Machining

Wire Cutting

Heat treatment

Technology Comparison



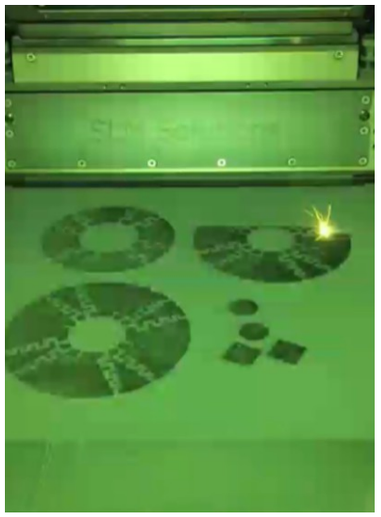
Traditional Technology

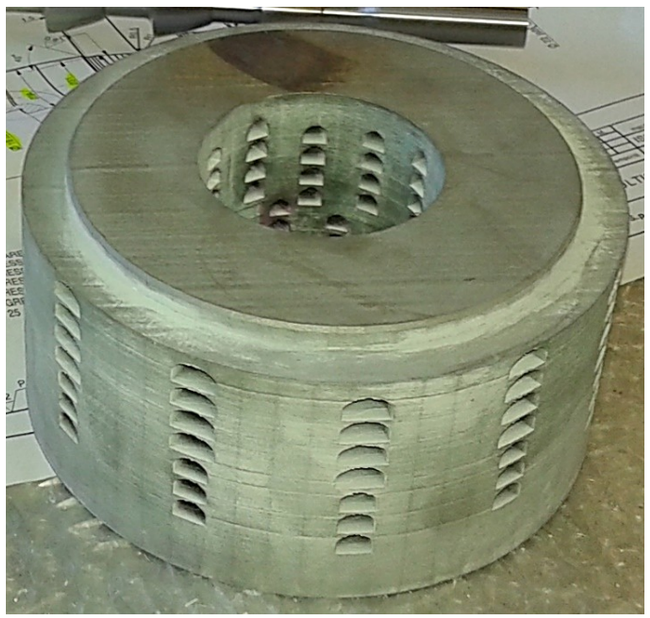
7 kg

78 components

10 weeks standard manufacturing time

Φ 134 mm , h 118 mm





Additive Manufacturing

3,2 kg

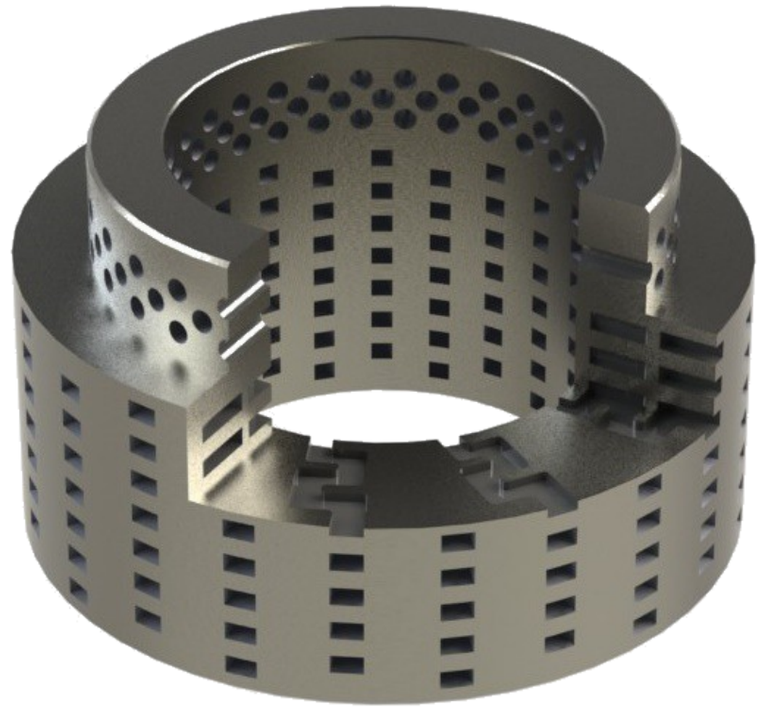
1 component

2 weeks standard manufacturing time

Φ 75 mm , h 73 mm

Conclusions

- No theoretical limits to design
- Highly customizable to the application
- Reduced dimensions
- Suitable for all fluid and process conditions
- High Mechanical properties
- Easy made Reverse Engineering and retrofit
- Fast delivery
- Reduced dimensions



Thank you!

Do you have questions?

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