



ACCELERATING  
INNOVATION

# **Toughest Application Challenges Solved with Severe Service Innovations**

*Session #2-1847*

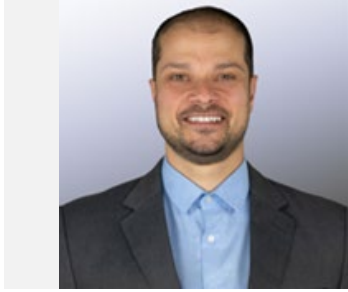
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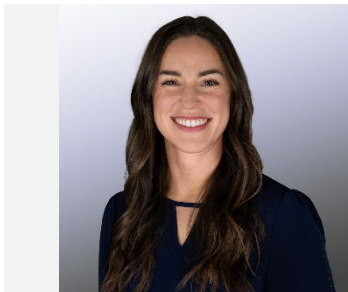
## **Chris Vergos**

Critical Service Specialist, Fisher Inside Sales



## **Justin Goodwin**

Business Development Leader, Fisher Special Products / Emerson



## **Shelby Daniels**

Product Marketing Manager, Fisher NPD / Emerson



Fisher™ Innovation

# Transforming the Way Valves Interact with the World



Intelligent  
Valve Performance



Connected, Intuitive,  
Predictive Valves



Toughest Application  
Challenges Solved



Advancing a  
Sustainable Future

# Toughest Application Challenges Solved

**SHELBY DANIELS**

**What's New in Noise Attenuation**

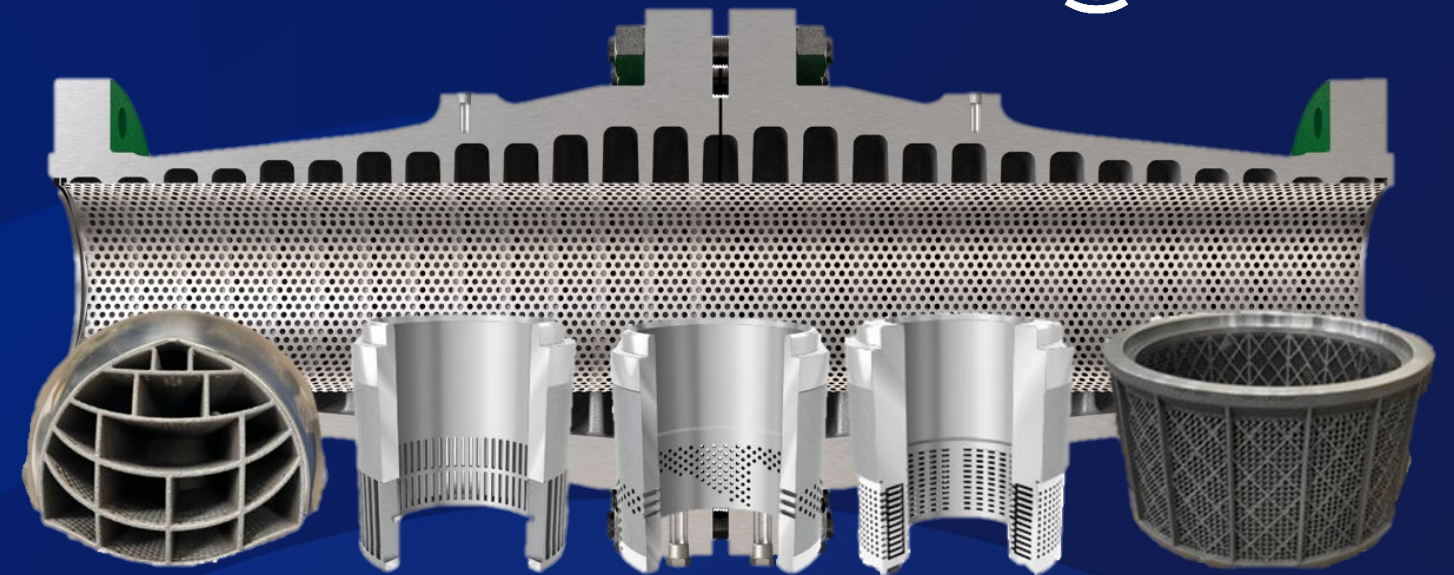
**CHRIS VERGOS**

**Building Upon Our Anti-Cavitation Expertise**

**JUSTIN GOODWIN**

**Custom Engineered Solutions**

# Noise Attenuation Solutions



**Broadest portfolio** of innovative, high-performing noise reduction technologies

Deliver the **most efficient combination** of noise reduction and capacity

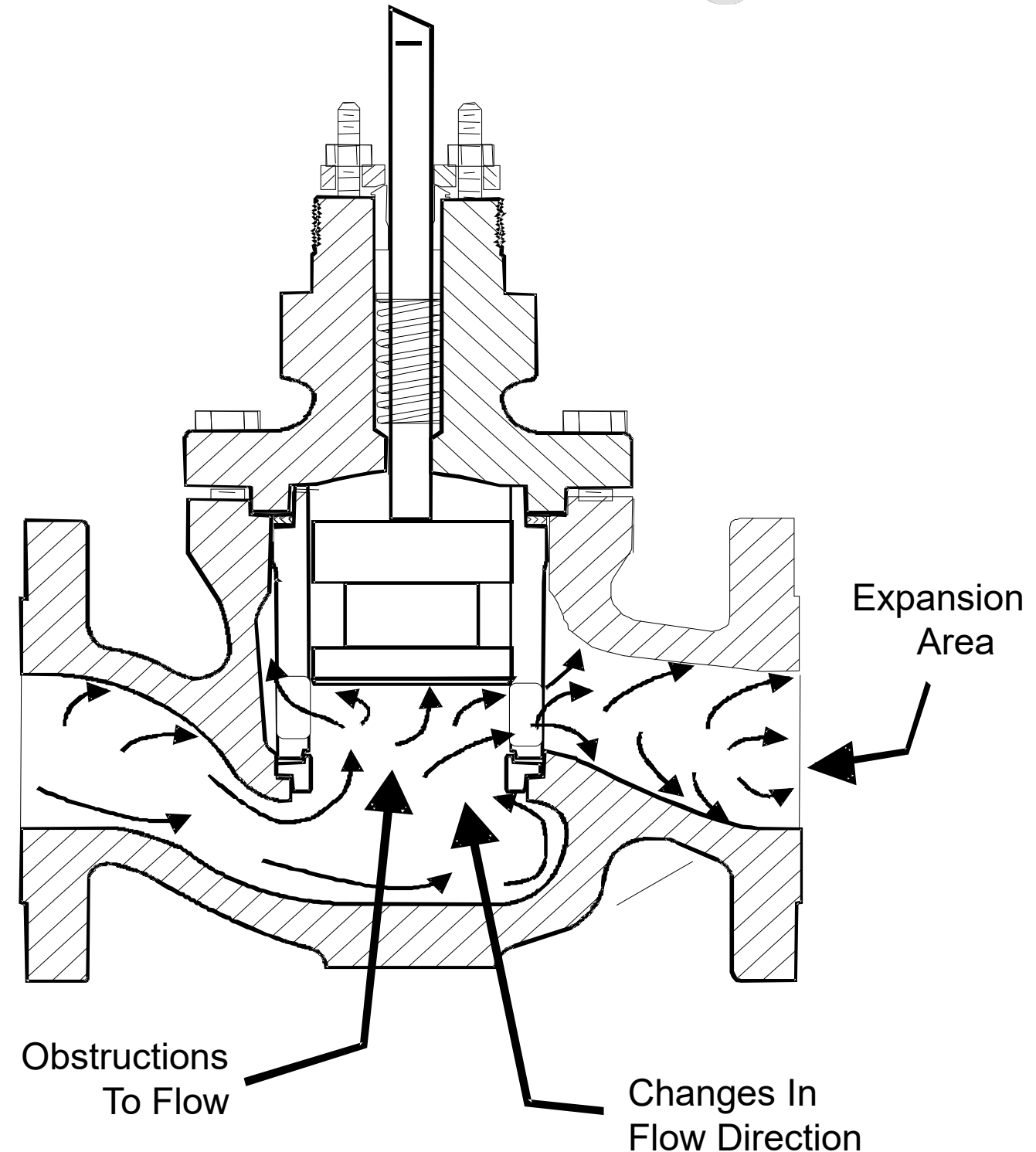
**Continuous product innovation**, first-to-market designs, best-in-class noise suppression

Range of Capacity and Noise Attenuation = A Solution to Any Noise Challenge



# Noise in Control Valves

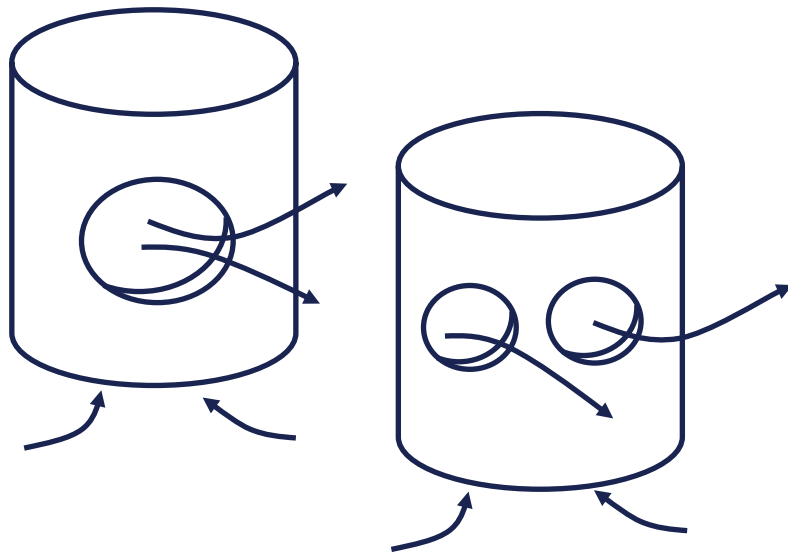
- **Noise is a mixture of a sound waves** of varying amplitude and frequency
- Sound pressure levels are **measured in dBA**
- **Contributors to aerodynamic noise are:**
  - **Turbulence** created in the flow of gas or vapor flows through a control valve and,
  - **Flow path, flow obstructions**, rapid expansion or deceleration of flow, and flow direction changes. For example, the trim and the valve outlet
  - **High pressure drops**
- Turbulence will settle out, but the noise will propagate downstream
- **Options to treat noise at the source:**
  - Proper valve sizing
  - Flow separation and jet separation
  - Shift frequencies out of the audible range



# How Is Noise Addressed in Control Valve Trim Design?

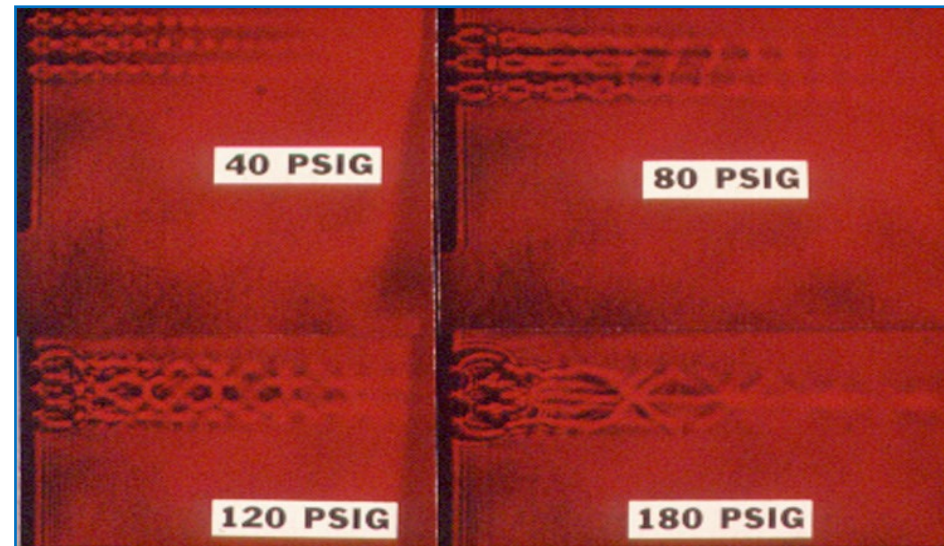
1

**Control Jet Sizes**



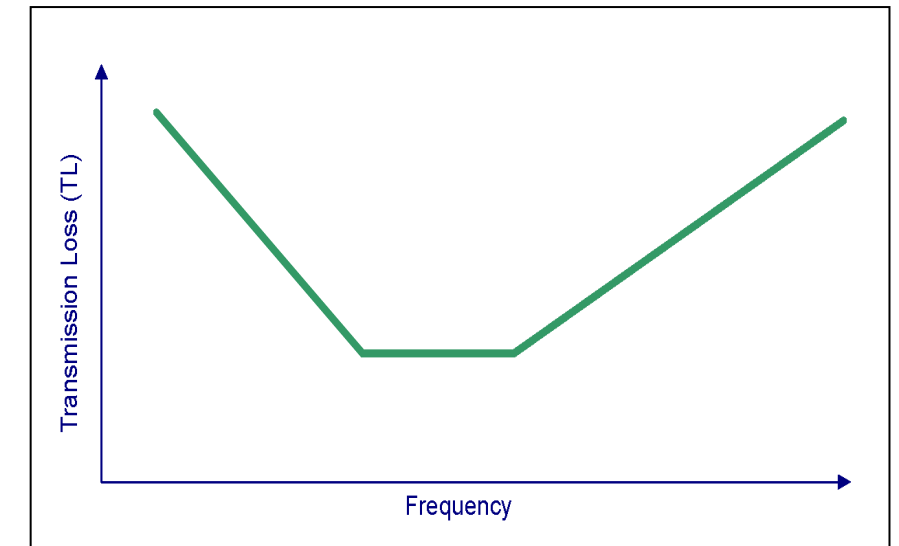
2

**Maintain Jet Independence**



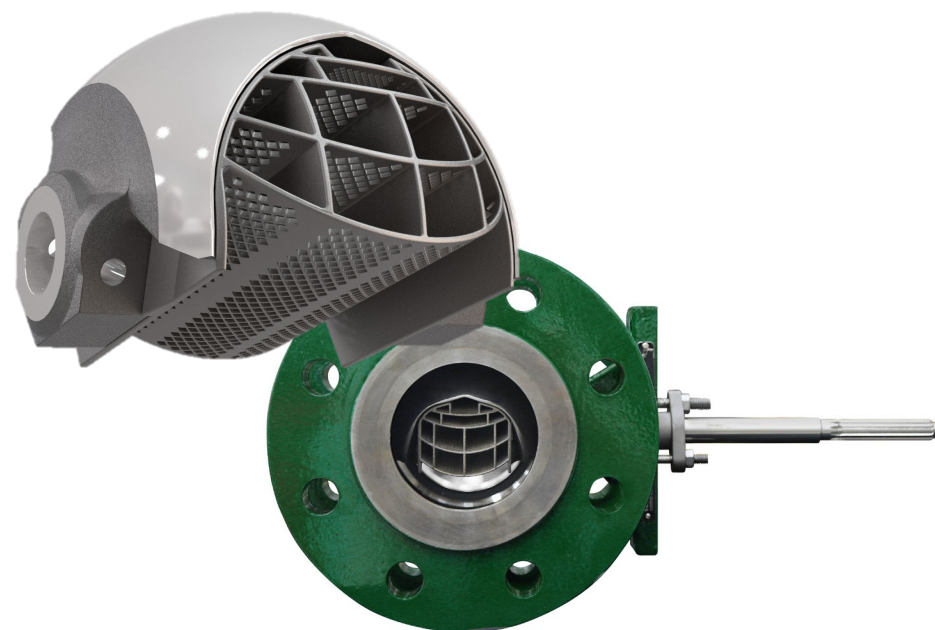
3

**Shift Frequency**



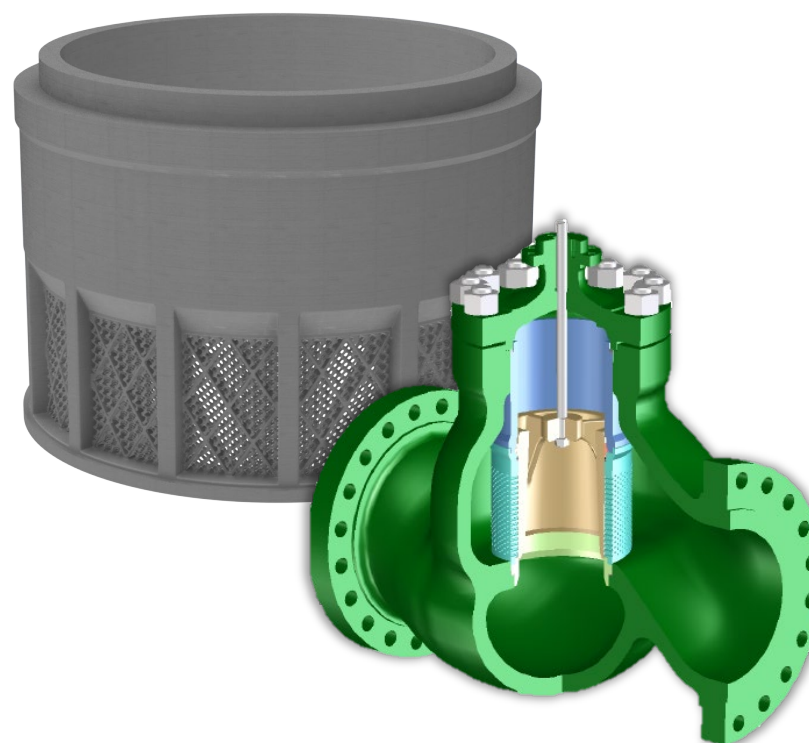
# Next Gen Fisher Whisper Technology

New ROTARY Whisper Trim



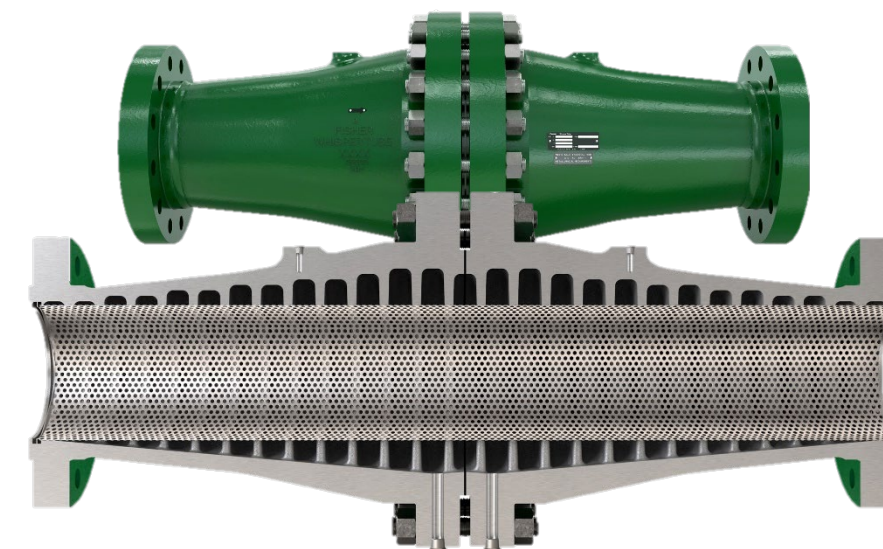
**80% more noise reduction than other rotary valves, as tested**  
*Option to use rotary valves where previously only globe valves would suit*

New GLOBE Whisper Trim



**20% more capacity than other globes without compromising noise attenuation**  
*Use smaller globe valves where previously capacity limited*

New Whisper MODAL ATTENUATOR



**Full bore noise attenuation, with no pressure drop or impact on process**  
*Use anywhere noise attenuation is desired. Can also be paired with other noise solutions.*

**Save Space and Capital without Compromising on Noise Reduction**

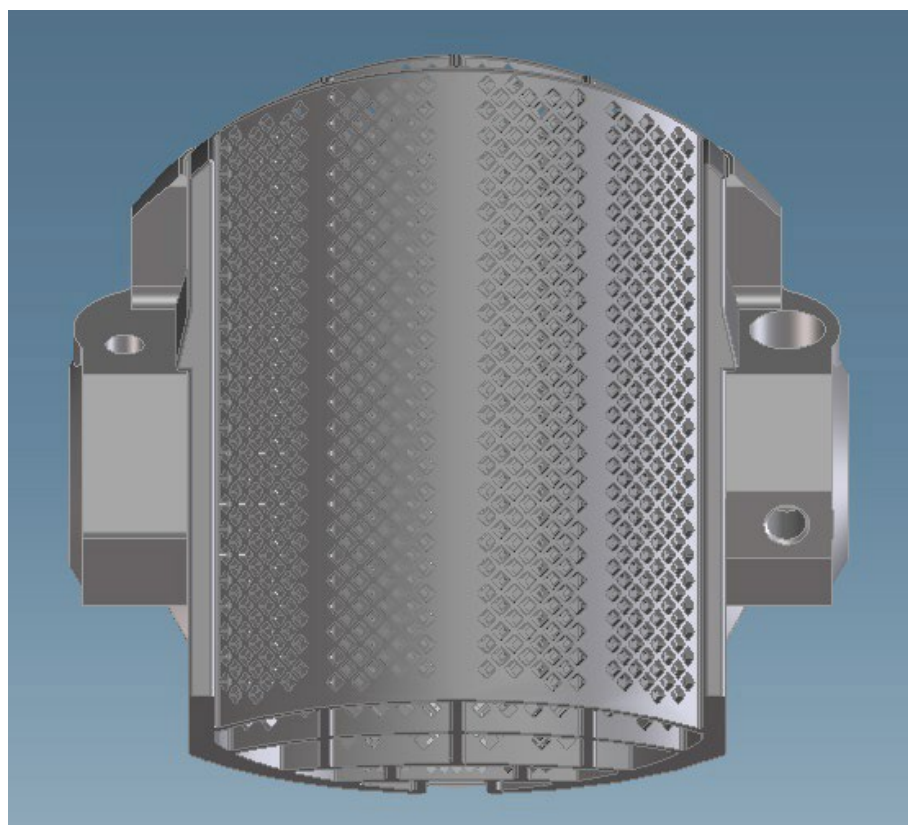
# Next Gen Whisper Technology in Fisher Vee-Balls



Additive manufacturing has unlocked trim geometries which improve our ability to manage flow and shift frequency.

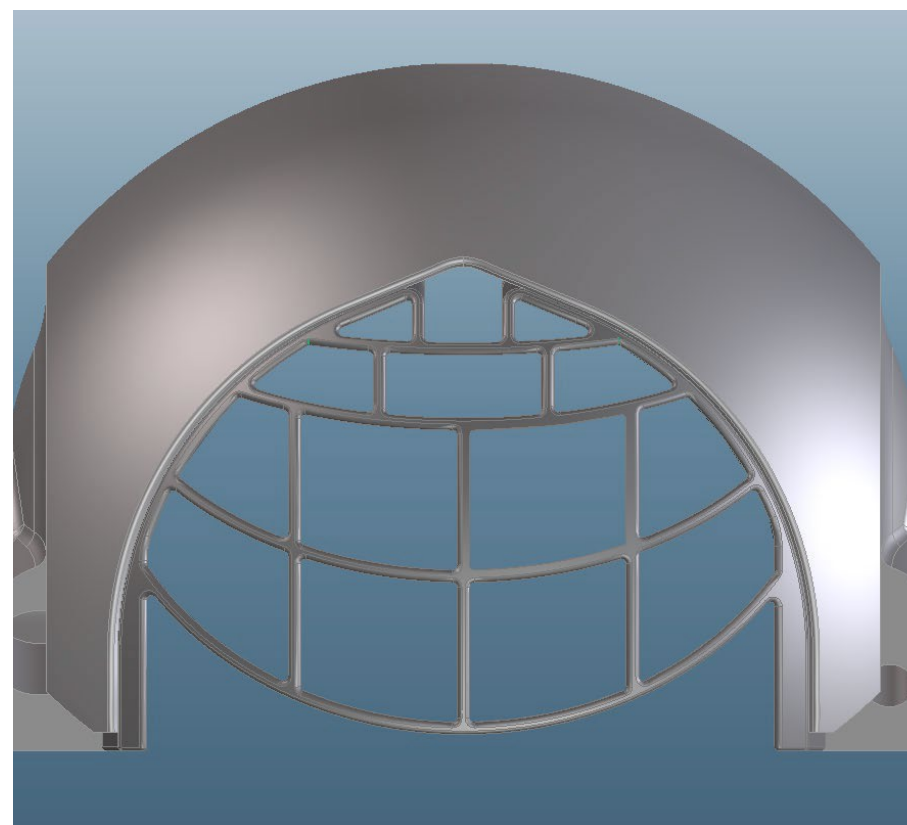
1

Minimal turbulence around the valve trim via improved inlet contour.



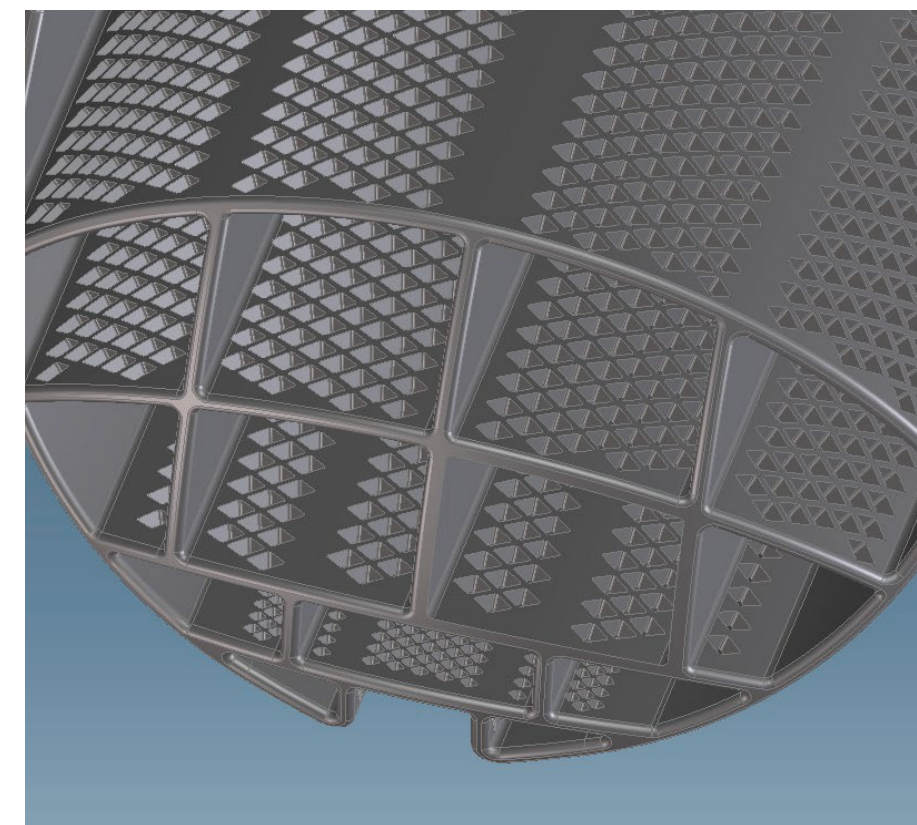
2

Optimized noise control throughout valve rotation with patented elliptical channels



3

Increased noise attenuation with minimal Cv impact by channel and hole enhancements.

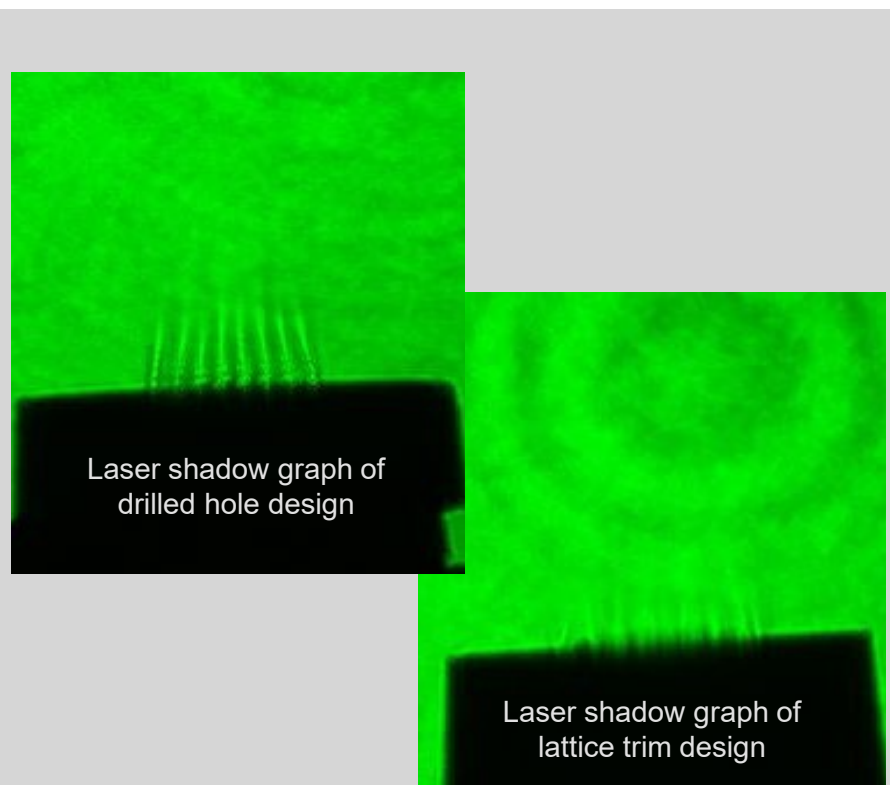


# Next Gen Whisper Technology in Fisher Globes

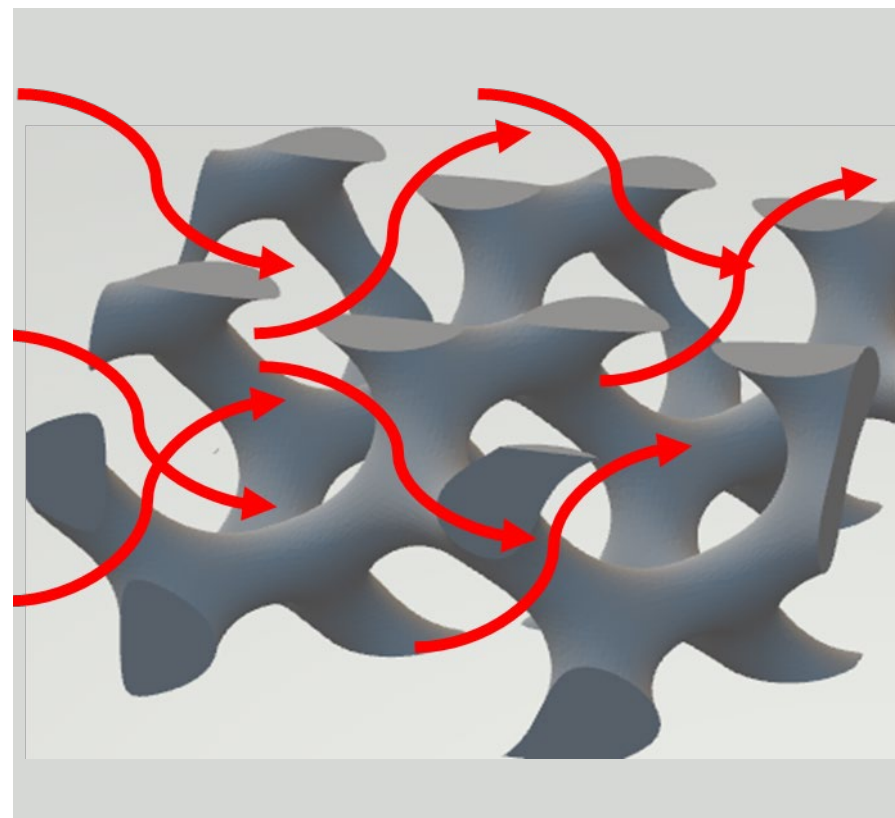


Lattice trim design, made possible by additive manufacturing, enhance our approach to jet management.

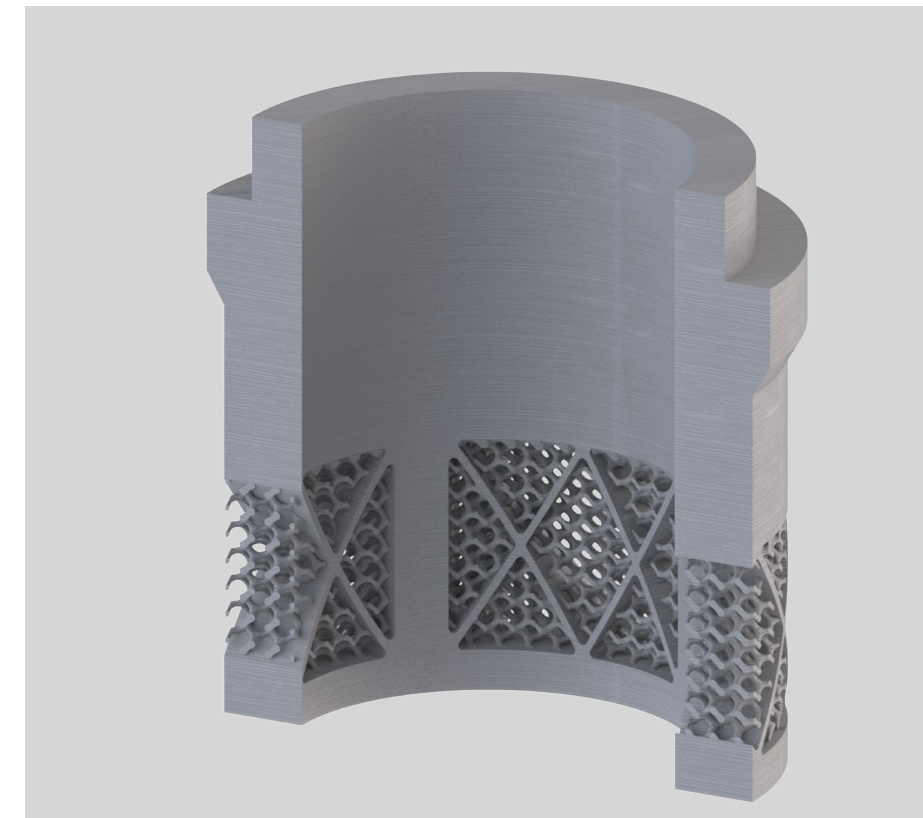
## 1 Dispersed exit flow



## 2 Reduced shear at exit



## 3 No hole spacing increases Capacity



# Fisher WhisperTube Modal Attenuator



Reliably achieve 10 to 15 dBA noise reduction in any compressible fluid application with no pressure drop and no process impacts.

1

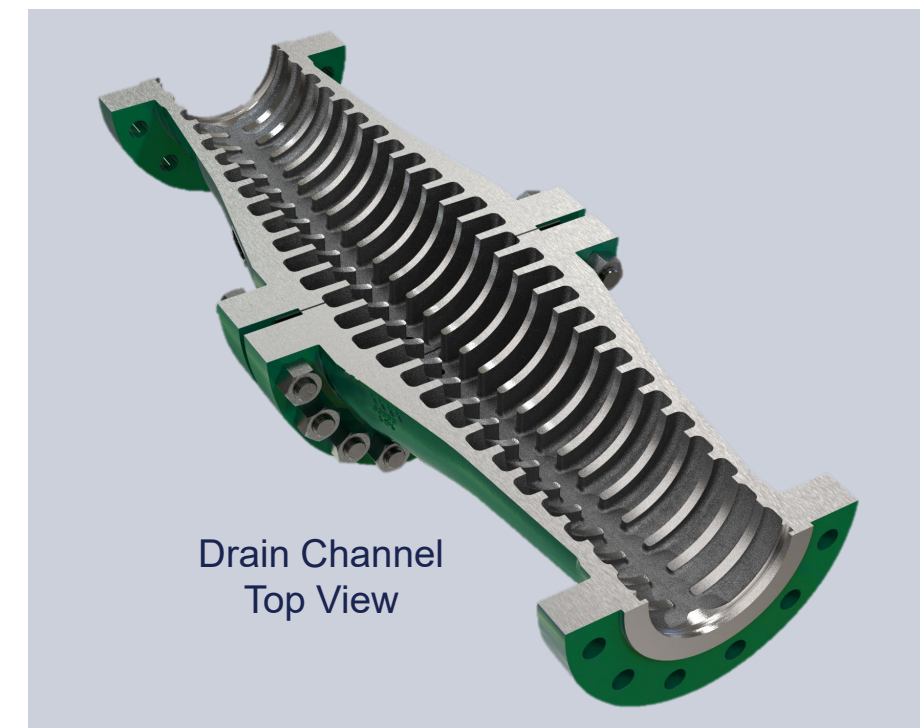
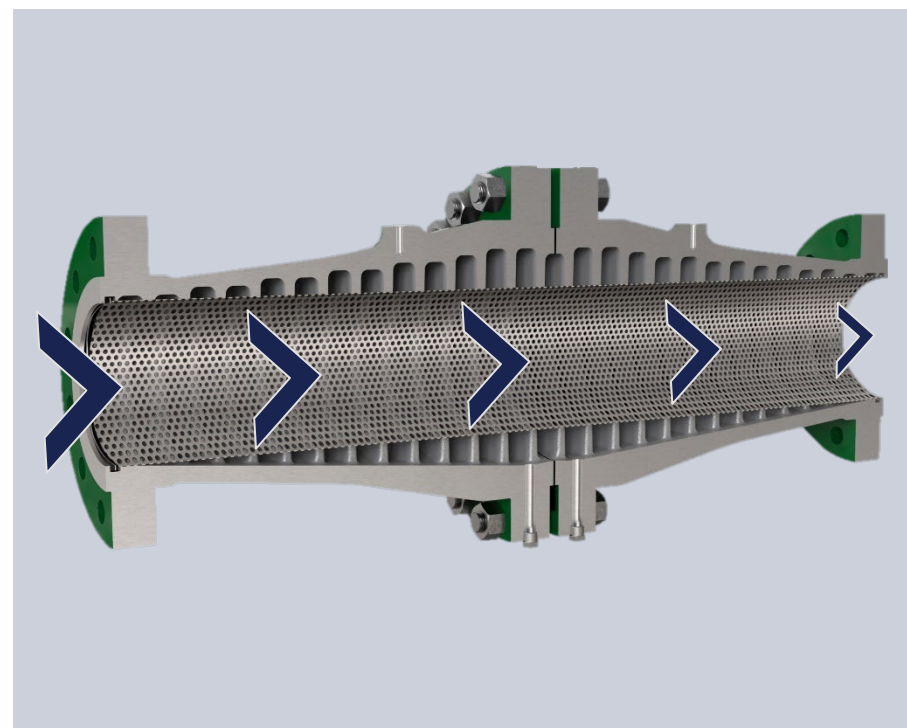
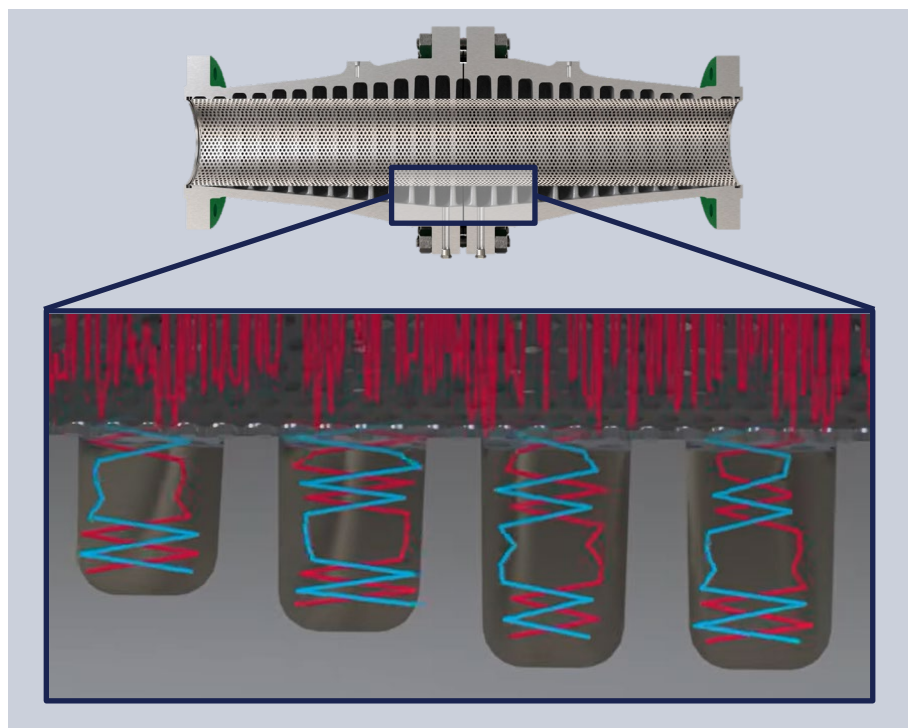
Treat noise via destructive interference in specially engineered acoustic cavities.

2

No process impact through an unobstructed flow path.

3

Resist plugging and buildup with straight through design and integral drain channel.



# Save Space and Capital Without Compromising on Noise Reduction

## Engineering Firm Balances Capacity and Attenuation for Their End User

- Application: Gas treatment skid
- Challenge: Noise not allowed to exceed 80 dBA, but pre-selected noise trim could not meet the capacity requirements
- Solution: NPS 6 **Fisher Vee-Ball with Whisper NXV**
- Smaller footprint and cost than next best solution, an NPS 8 globe valve

## Power Plant Stops Wasting Steam By Leveraging New Noise Solution

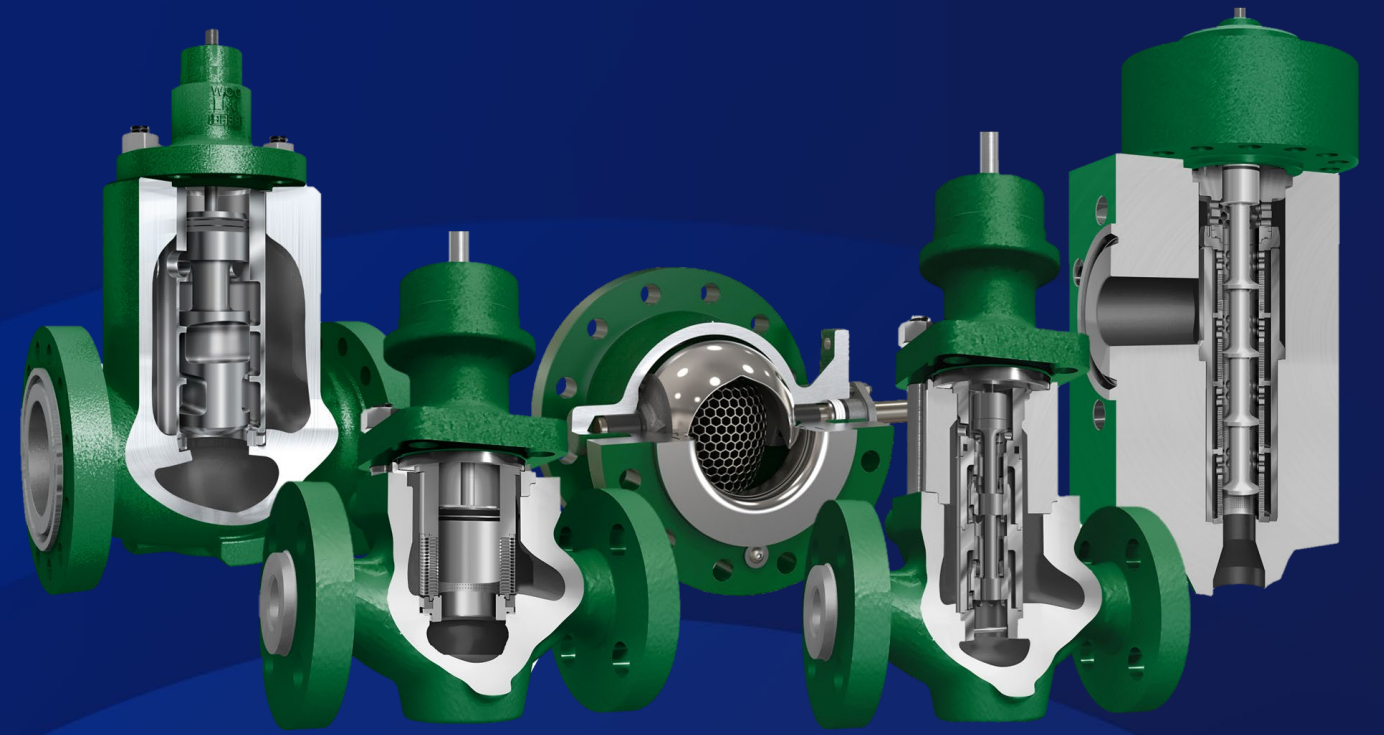
- Application: Cool and reheat steam valve
- Challenge: Low flows causing leakage issues, wasting steam energy and poor downstream control. Vibration from high noise also accelerated damage
- Solution: NPS 4 **Fisher ED with Whisper NXG**
- Change in control range improved accuracy and prevented damage from low flows

## Natural Gas Utility Achieves Unprecedented Noise Reduction

- Application: worker/monitor station with flow rates ranging from 1,100 to 2,500 MCFH at 310+ psid
- Challenge: Customer complaints over non-Emerson ball valves emitting persistent noise up to 100 dBA.
- Solution: Fisher Regulators with Whisper Trim paired with **Fisher WhisperTube**
- New noise level: 82 dBA

**Consider how you can apply the Fisher Whisper portfolio in any noisy application. Contact your local Emerson representative for help with noise audits and application reviews.**

# Anti-Cavitation Solutions



**Comprehensive technology breadth** to solve any cavitating challenge

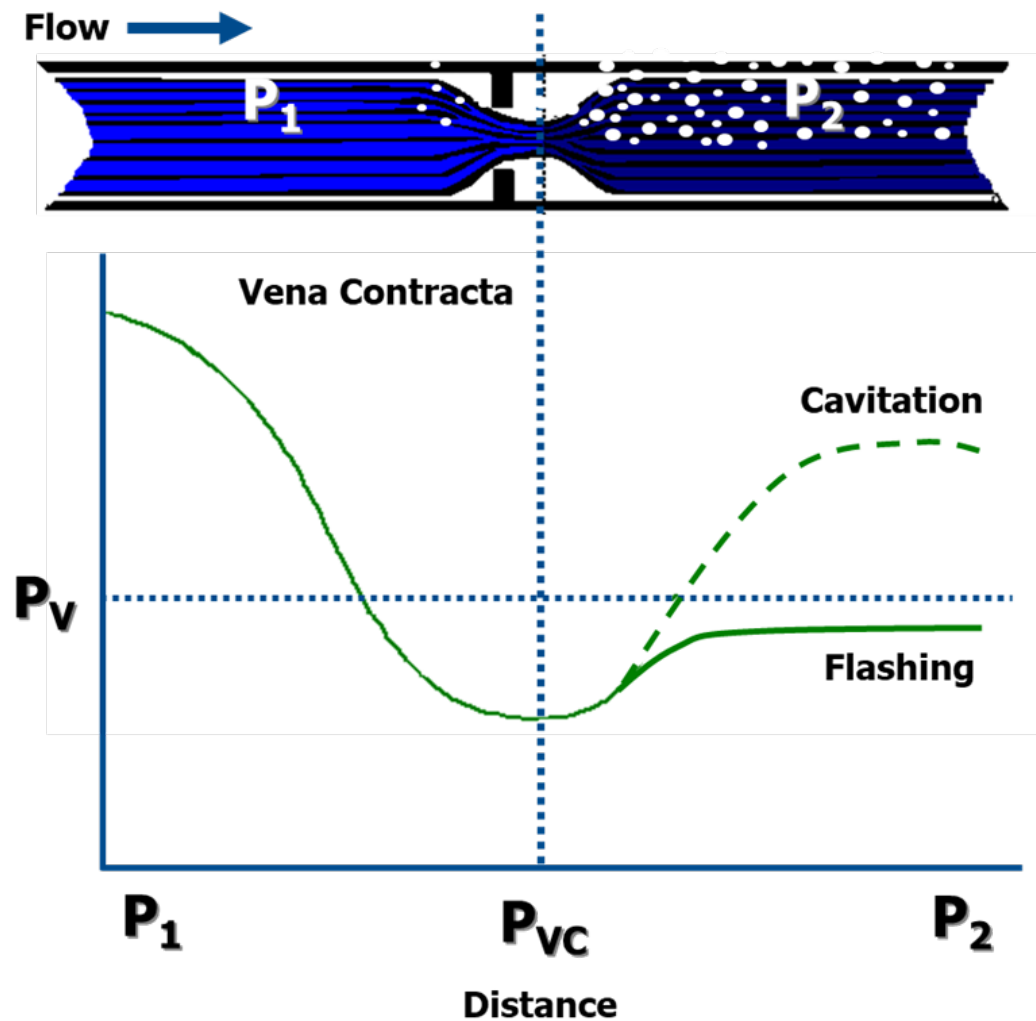
Superior anti-cavitation capabilities through **proven cavitation elimination** methodologies

**Purposeful expansions** and pioneering designs from a history of innovation

Range of Capacity and Pressure Drop = A Solution to Any Cavitating Challenge



# Cavitation in Control Valves



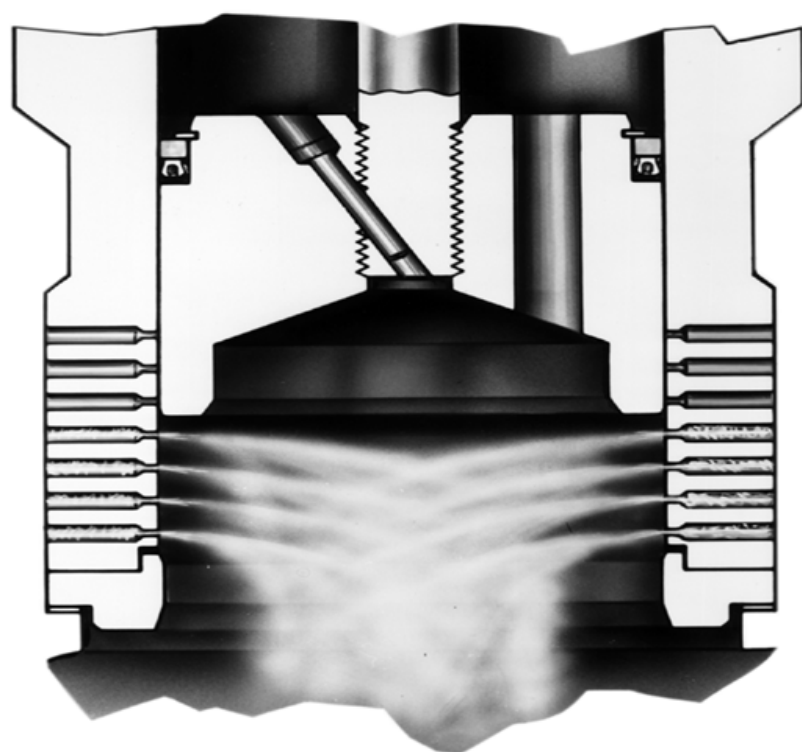
- Rapid phase change
- Liquid-Vapor-Liquid
- As pressure drops through restriction it falls below the vapor pressure and vapor bubbles form. As pressure is recovered, the vapor condenses back to liquid, and high speed destructive micro-jets form
- May also accelerate Erosion/Corrosion
- Hydrodynamic noise and vibration
- Damage appears rough



# How Is Cavitation Addressed in Control Valve Trim Design?

## Isolation

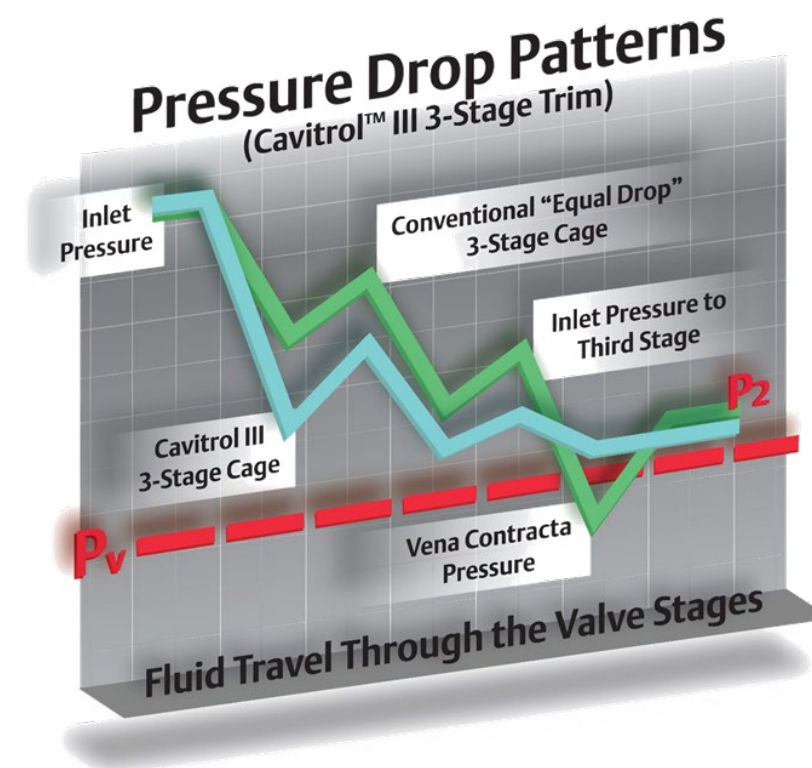
- Isolation merely directs where the cavitation occurs and implements hard / tough materials to withstand the abuse.
- Noise and Vibration are still a concern.



Cavitrol III 1-Stage Trim

## Elimination through Pressure Staging

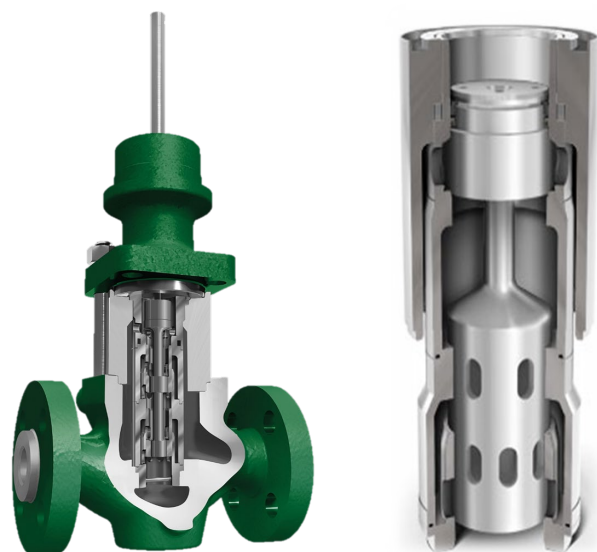
- Reduction / Elimination uses discreet, low recovery pressure stages with engineered recovery zones.
- By reducing or even eliminating cavitation, its associated noise and vibration are also reduced or eliminated.



Cavitrol III 3-Stage Trim

# Fisher Anti-Cavitation Technology

**Globes with Dirty Service  
Anti-Cavitation Trim (DST)**



**Plugging resistance at  
high pressure drops**

*Multi-stage trim designed for applications up to 4200 psid, effective in handling particulate*

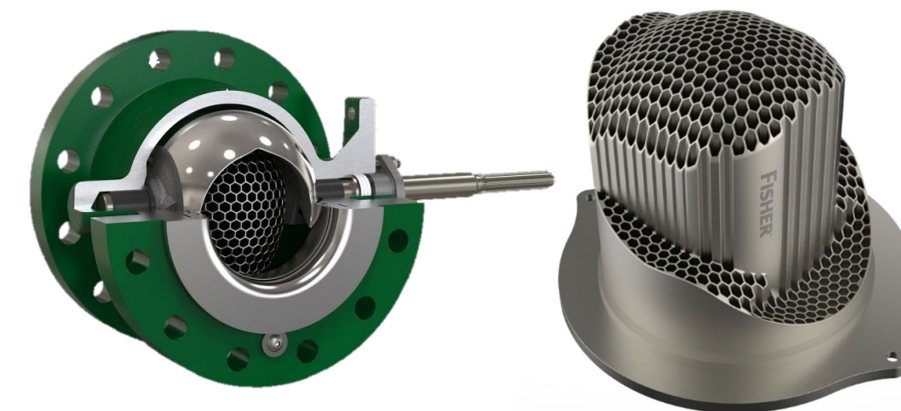
**CAV4 Valve  
with Cavitrol IV trim**



**Serious cavitation protection  
at extreme pressure drops**

*Designed for liquid applications with pressure drops up to 6000+ psid*

**Vee-Balls and e-plugs with  
Cavitrol Hex Trim**



**Isolate cavitation and reduce vibration  
with the throughput of a rotary valve**

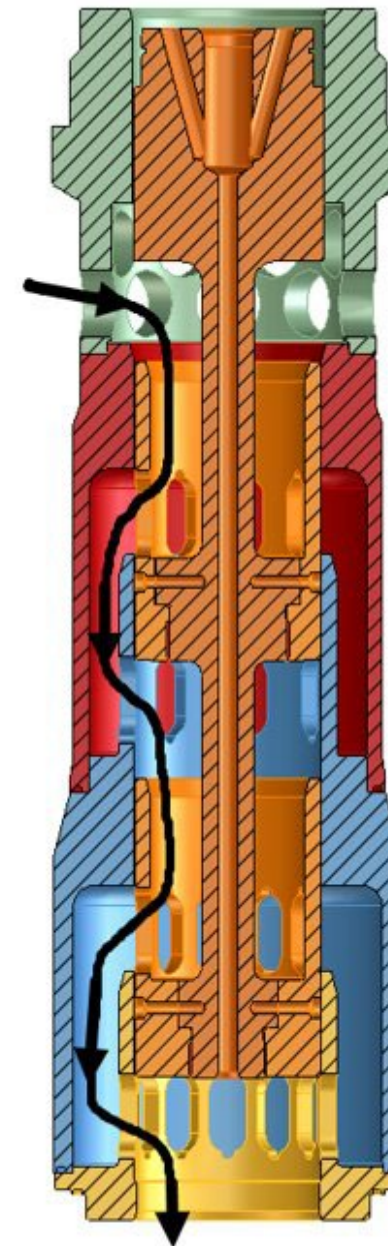
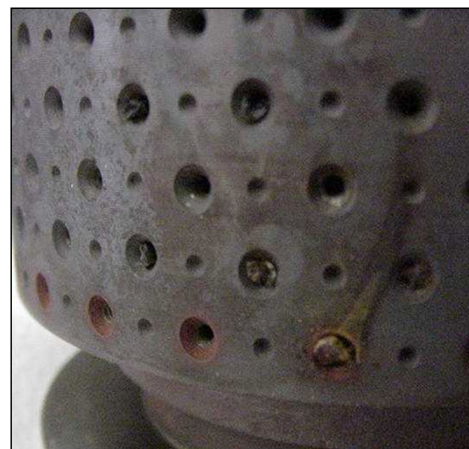
*Manufactured with laser powder bed fusion to with pressure drops up to 250 psid*

**Continuous Expansion and Improvement of Trusted Cavitation Protection**

# DST Trim

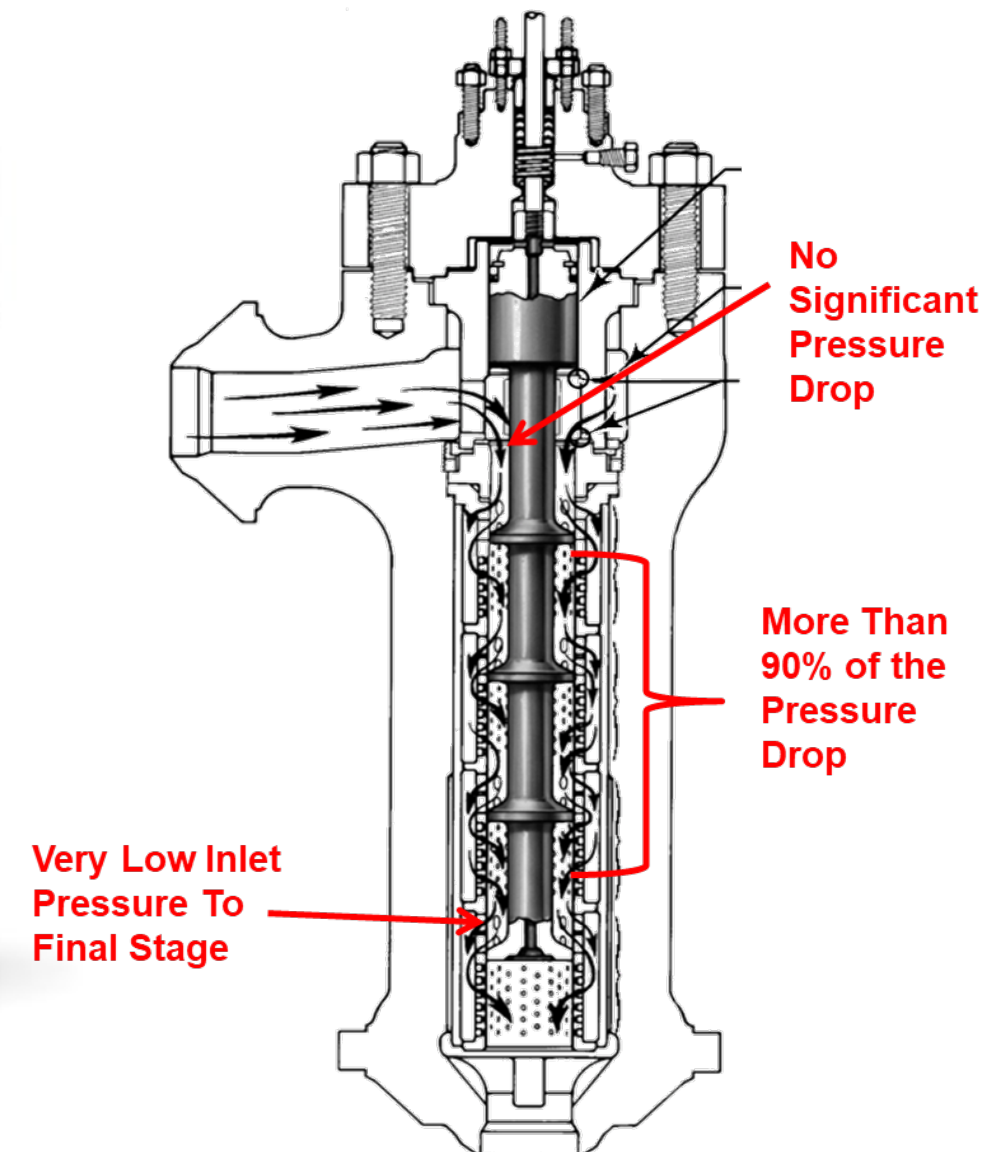
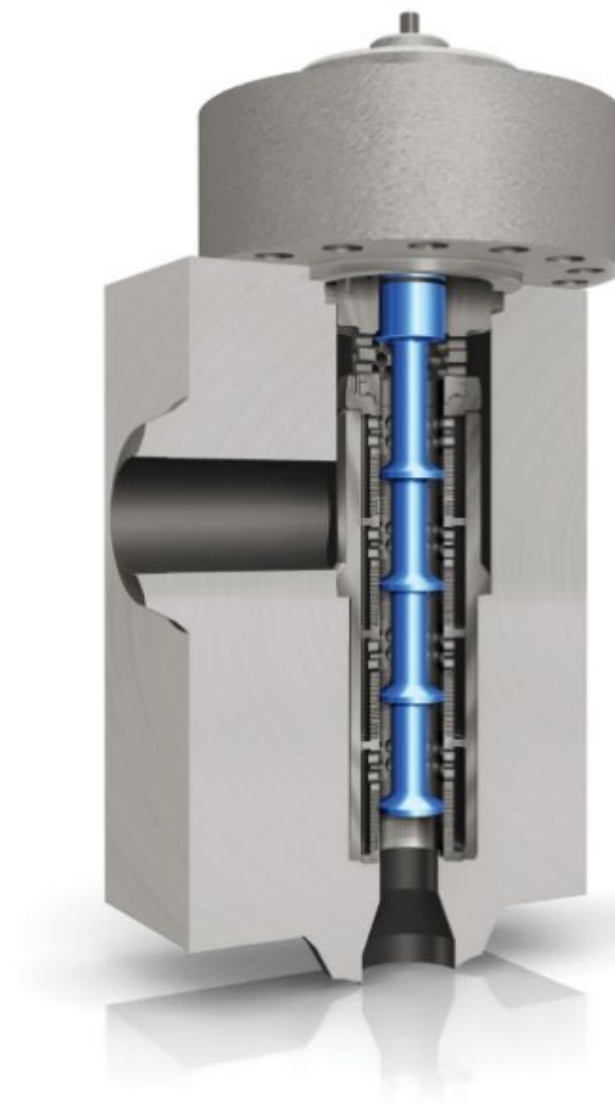
DST trim designed to prevent cavitation up to 4200psid, while passing particulates up to 3/4".

- Combined Axial and Radial Flow
- Large Open Passages
- Multi-Stage
- Protected Seating Surface
- Flow Up or Flow Down
- Fits standard globe or angle bodies
- Many material options
  - Tungsten Carbide option
- Additive option



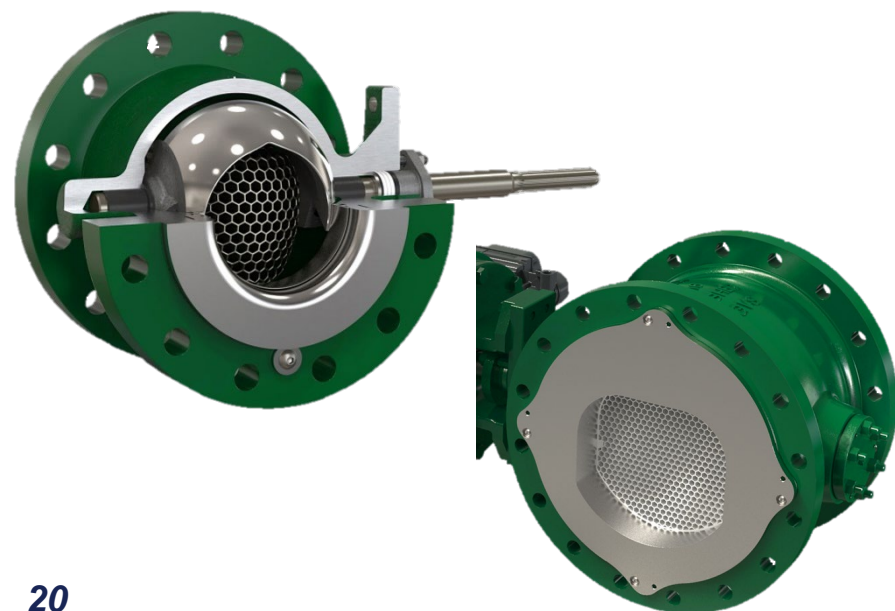
# CAV4

- Designed to eliminate cavitation
- 10000+ psi drop capability
- Protected seat prevents clearance flow erosion
- Available in NPS 2"-6"
- Small holes (.072")
- Special designs available
- Low flow CAV4 construction is available down to minimum operating Cv of 0.1

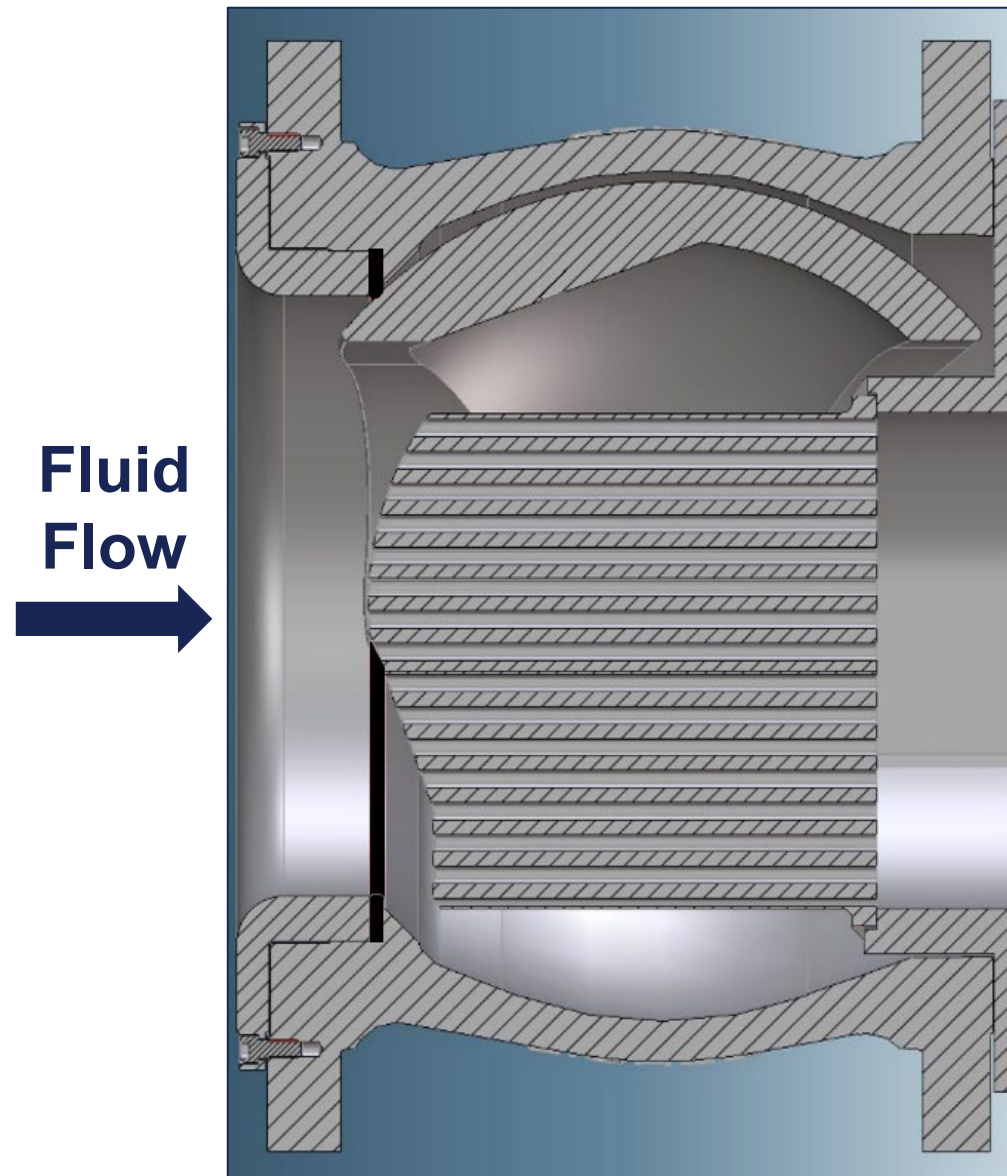


# Cavitrol™ Hex

- Patented design for flanged Vee-Ball™ and CV500 valves
- One-piece array manufactured via laser powder bed fusion
- Attached via tapped holes on the body outlet flange
  - Retrofittable into existing valves



Up to 250 psid, this rotary trim reduces cavitation and noise effects that cause pipeline vibration and damage.



Passages break up flow and manage turbulence through the valve

Pressure loss distributed along the length of the tube bundles

Backpressure helps keep minimum pressure high as possible.

Passable particulate size:  
NPS 4-12 ≈ 0.3" diameter  
NPS 14-20 ≈ 0.4" diameter

# Range of Capacity and Pressure Drop: A Solution to Any Cavitating Challenge

## Refinery increases reliability while reducing maintenance

- Application: Gas Blending Tank Level Control valve
- Challenge: Cavitation and severe vibration accelerated valve and pipeline damage
- Solution: 4" V150 with Cavitrol Hex
- Notes: Erosion and Vibration alleviated

## Coal Powerplant Plugging and Leakage Solved

- Application: Reheat Spray Water Valve
- Challenge: Cage plugging and trim erosion due to cavitation causing temperature control issues
- Solution: 4-Stage DST retrofit within the customer's 2" valve body.
- Notes: The DST trim prevented cavitation and erosion while passing the particulates present in the flowing media.

## Supercritical Power Plant Leakage and Vibration Solved

- Application: Boiler Feed Pump Recirculation
- Challenge: Extreme cavitation erosion, leakage and pipeline vibration which fatigued the DA inlet piping/bolting
- Solution: NPS 6X8" EHT with CAV4 Trim
- Notes: Specific pressure staging prevented cavitation from occurring, which minimized leakage and vibrations.

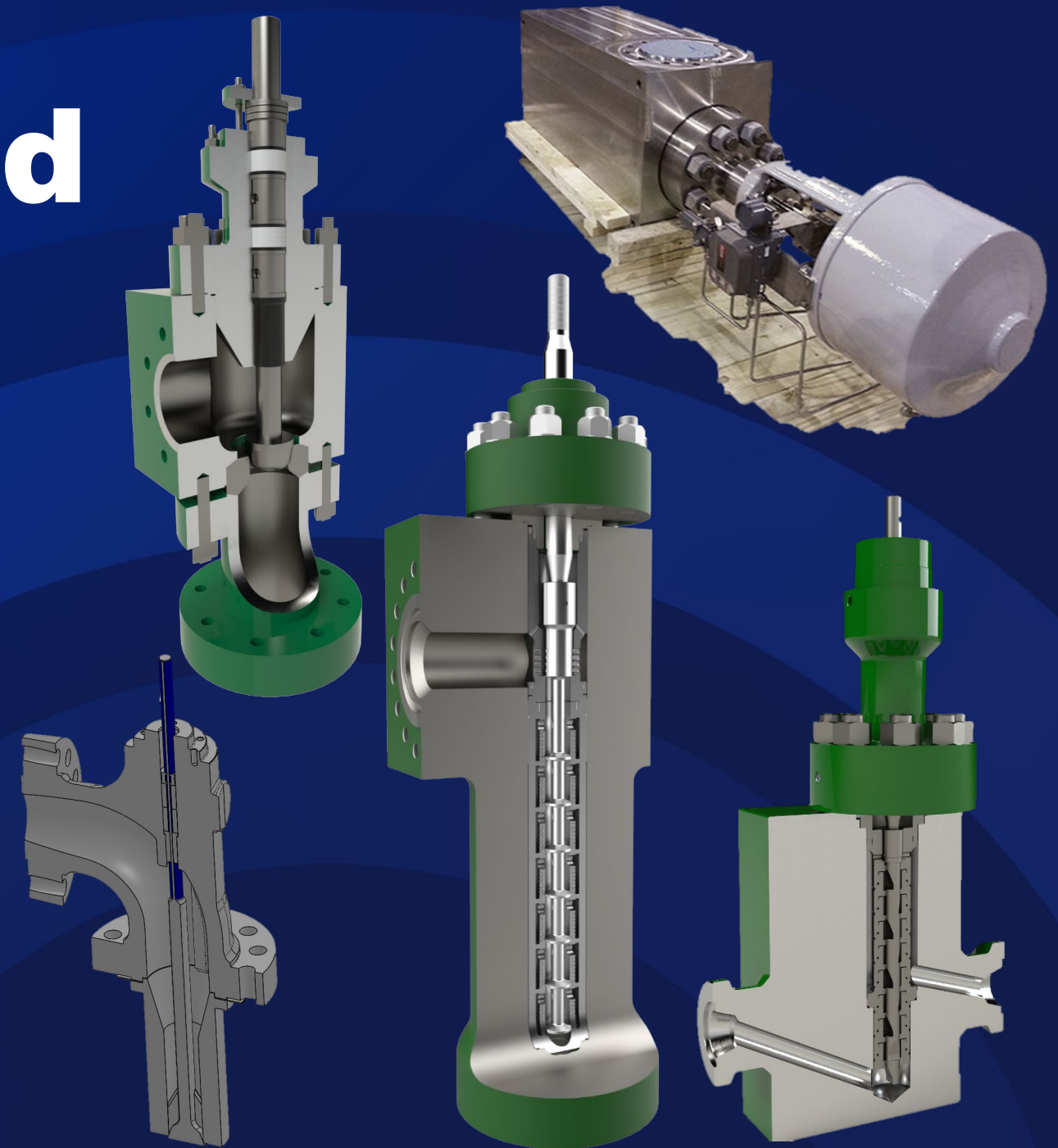
**Consider how you can apply the Fisher Cavitrol portfolio in any cavitating application. Contact your local Emerson representative for help with application reviews.**

# Fisher Custom-Engineered Solutions

**Engineered Solutions** are a large segment of Emerson's Fisher Valve business

**Over 25 design engineers** focused purely on custom-engineered valves

Every day, we design new solutions for the most **critical and challenging applications**



# The Special Products Group: Custom Solutions for Critical Applications

The Specials Product Group has been solving the toughest process control problems for over 30 years

Dirty fluids or  
Entrained  
Particles

Extreme  
Temperatures

Severe  
Cavitation

Special Noise  
Attenuation

Attemperators /  
Desuperheaters

Ultra-high  
Pressures

Outgassing  
and Two-phase  
Applications

Highly Viscous  
Fluids

Erosive Fluids

Highly  
Corrosive Fluids

Many More...

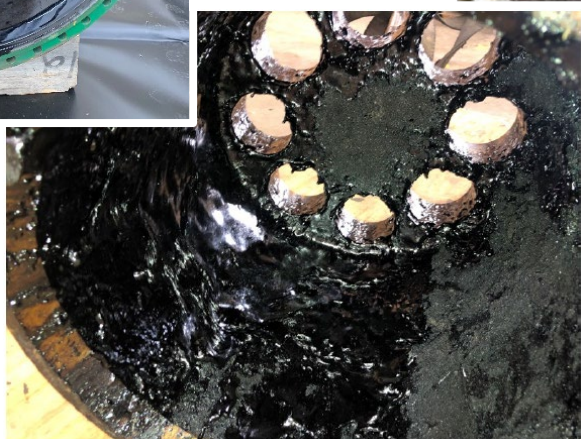
**Need something that's not in our Catalog? This is where it happens!!**

# Special Products Solution Example: Solving a Large Valve Fouling / Sticking Problem

## Problem:

### **42x48 Compressor Anti-Surge Valves Plugging at a Propane Dehydrogenation Facility**

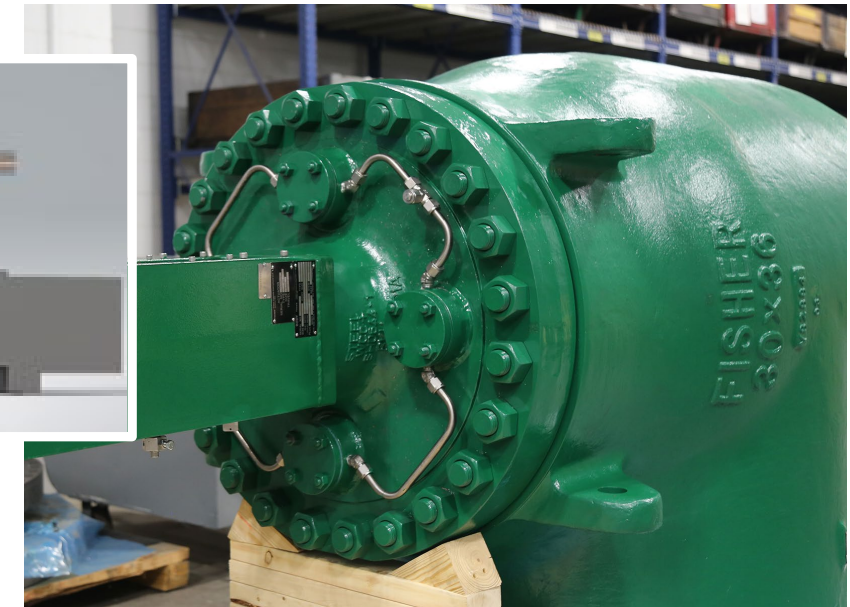
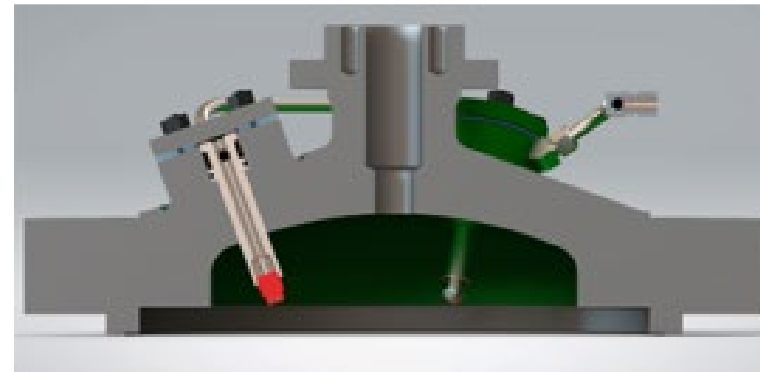
- Entrained dirt and viscous liquids plugging & sticking large, critical valves
- Customer repeatedly had to open the valves, soak trim parts in solvent to clean
- Result was frequent and costly downtime



## Solutions:

### **1. Designed New Bonnets with Integral Solvent Injection Ports & Spray Nozzles**

- Allow solvent to be injected without opening the valve, dissolving build-up remotely
- External access to clean or replace spray nozzles without removing the bonnet



### **2. Custom - Designed Cages with Extra-Large Flow Passages that Still Meet Site Noise Requirements**

- Flow Passages 3 to 4 times larger than original cages

# Boiler Feedwater Valve Printed DST Retrofit Solution

## Problem:

### Plugging and “gear-tooth” damage on Boiler Feedwater Recirculation Valves

- 2x1 Combined Cycle Plant
- NPS 3 with Cavitrol™ III



Example of Particulate  
Plugging Cage



Gear Tooth Effect  
Damage on Plug & Seat



## Solution:

### Customized, 3D Printed Dirty Service Anti-Cavitation Trim (DST)

- Designed to retrofit into existing valve
- Large flow passages to pass any particulate in the flow stream
- Protected seat design that separates the shutoff and the throttling locations of the trim



# Special Products Solution Example: Cavitation Solution on Offshore Oil Platform

## Problem:

### **Cavitation damage & failure of Competitor's Injection Pump Min-Flow Valve**

- Seawater service
- Severe cavitating application: Full pressure drop from 10,400 psi to atmospheric pressure
- Competitor stacked-disc, “multi-turn” trim installed



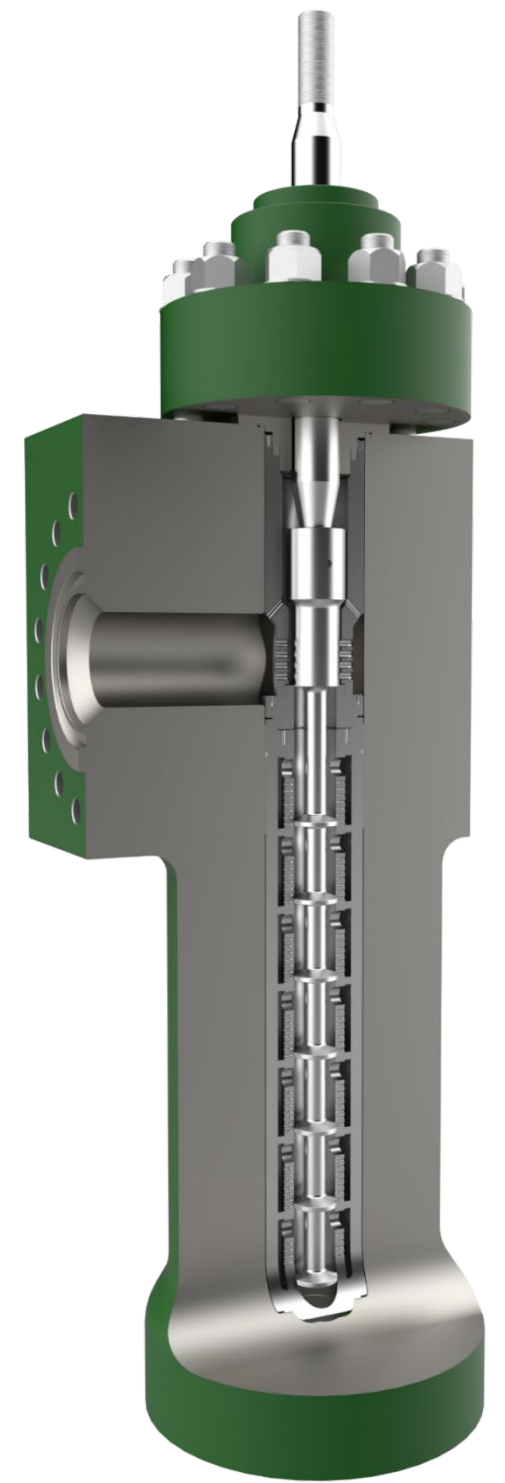
Example of injection pump min flow valve damage



## Solution:

### **Custom-Designed API 15,000-psi-rated CAV4**

- Special design 7-stage trim to handle full 10,400 psi drop
- API 15,000 psi body rating with API Flange connections
- Forged duplex stainless steel block body
- Super Duplex and Inconel 718 trim

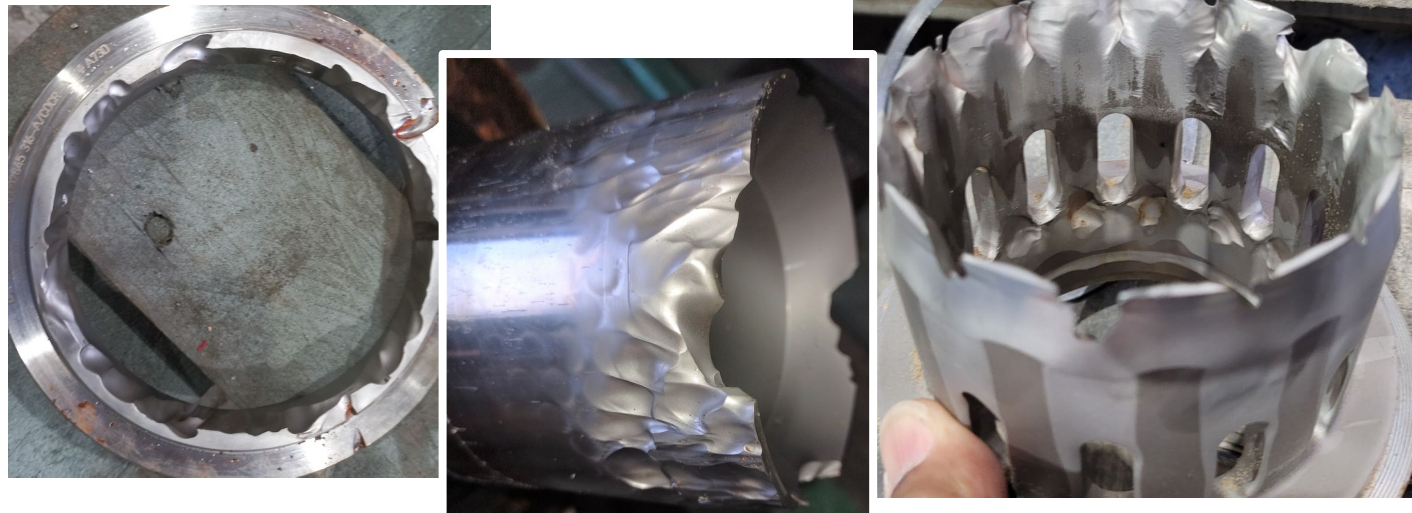


# Special Products Solution Example: Erosion Solutions

## Problem:

### Trim Erosion in Entrained-Particulate Service

- Seawater service with entrained sand



- Hydrocarbon liquid with sand and other particles



## Solution:

### Custom Tungsten Carbide Trim Options

- Tungsten Carbide DST trims
  - All throttling, seating, and internal flow surfaced protected with carbide
- Tungsten Carbide “standard” trims
  - Plugs with carbide seat and guide inserts
  - Seat rings with tungsten carbide seating surface
  - Various cage options, up to and including solid tungsten carbide cages



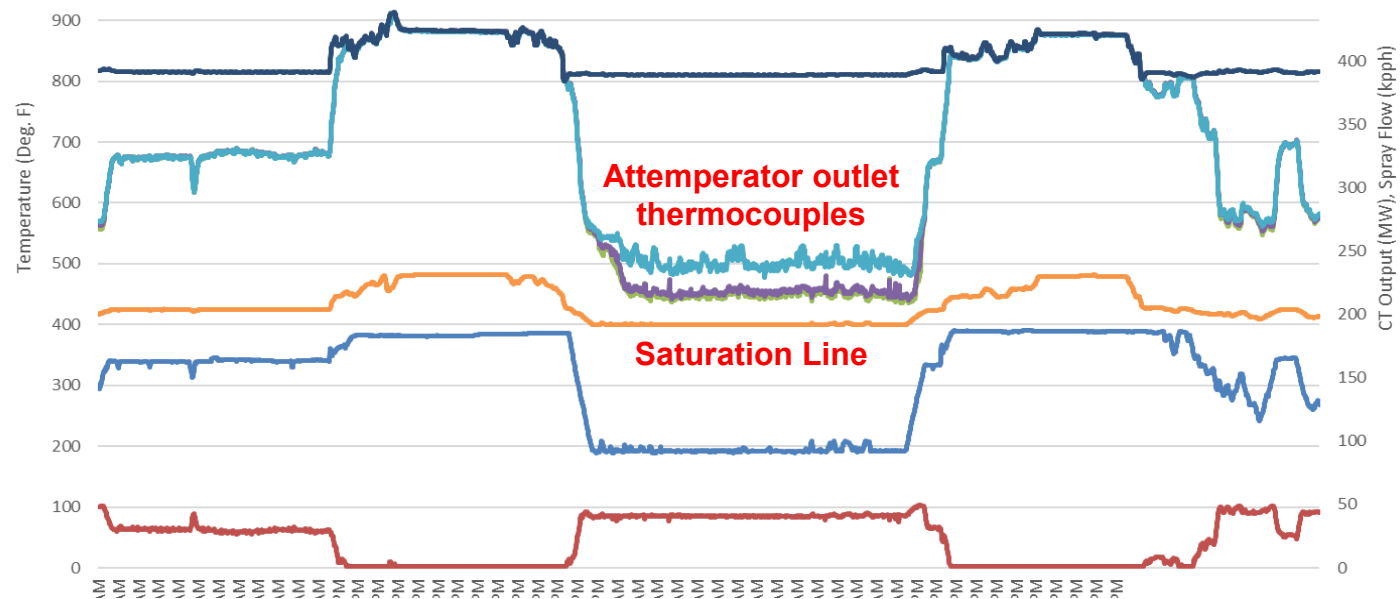
Visit our Special Solutions trade show booth for another example of carbide trim!

# Special Products Solution Example: Attemperator Overspray and Temperature Control Problem

## Problem:

**Low-load plant operation leading to water carry-over, wet thermocouples, risk of pipe damage**

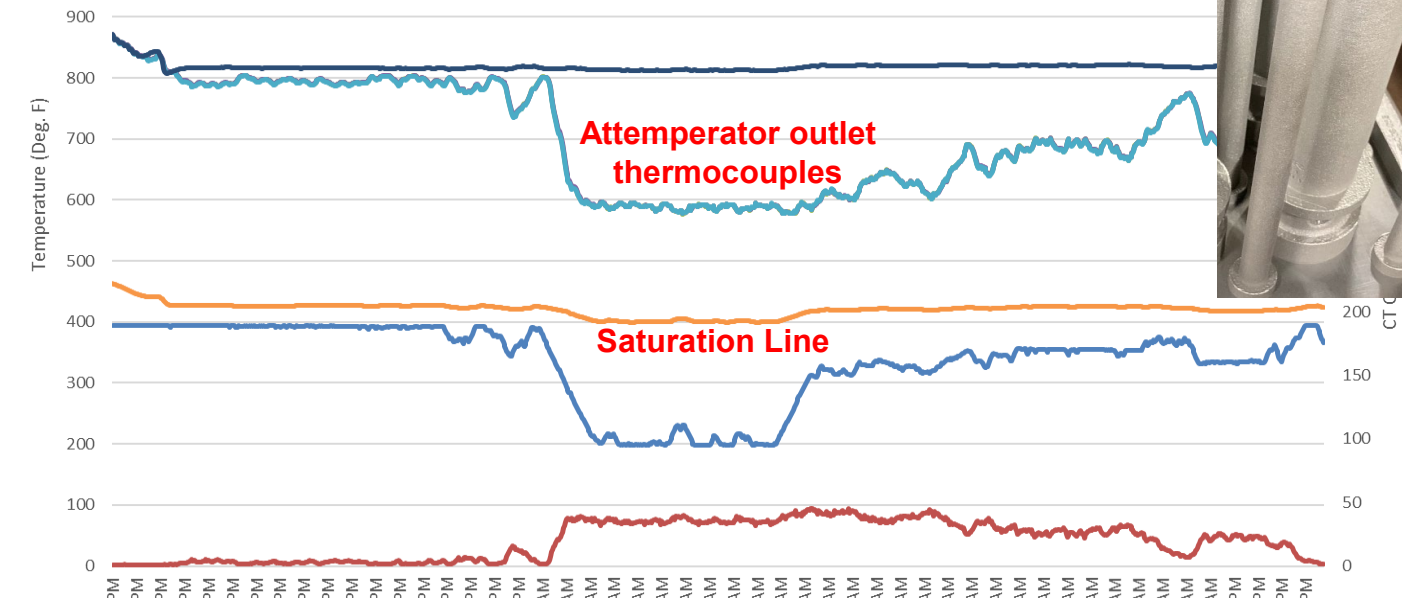
- RH Interstage Attemperator service
- Low CT load overnight meant low steam flow, but high water input requirement
- Traditional spring-loaded nozzles reaching the limits of their operational rangeability



## Solution:

**Utilized Additive Manufacturing to Produce Steam-Atomized, Ring-Style Attemperator Nozzles**

- Complete atomization regardless of water flow, water dP
- Robust nozzle design capable of severe thermal cycling
- Much shorter evaporation distances



Fisher™ Innovation

# Transforming the Way Valves Interact with the World



Intelligent  
Valve Performance



Connected, Intuitive,  
Predictive Valves



Toughest Application  
Challenges Solved



Advancing a  
Sustainable Future

# Toughest Application Challenges Solved

**[2-1194] Control Valve Cavitation - 4 Methods K+S Uses to Extend Control Valve Service Life**

**[2-1291] From Roar to Remedy, Catching Cavitation Early and Stopping it in its Tracks**

**[2-1625] A Sticky Situation: Using Spray Nozzles to Prevent Anti-Surge Valve Fouling**

**[2-1626] Don't Cavitate - Aspirate! Uncommon Solutions to Common Challenges**

**[2-1639] Eliminating Control Valve Erosion – a Journey to a Better Mouse Trap**

**[2-1694] Rapid Resolution of Valve Vibration at Cheniere Energy Corpus Christi Liquefaction**

**[RDM-1850] Flow Controls Roadmap**

**[Exhibit Booth #101] See the technology and meet with severe service SMEs**



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# Thank You