SHARKTOOTH™
Control Valves

Everything you need in a control valve!

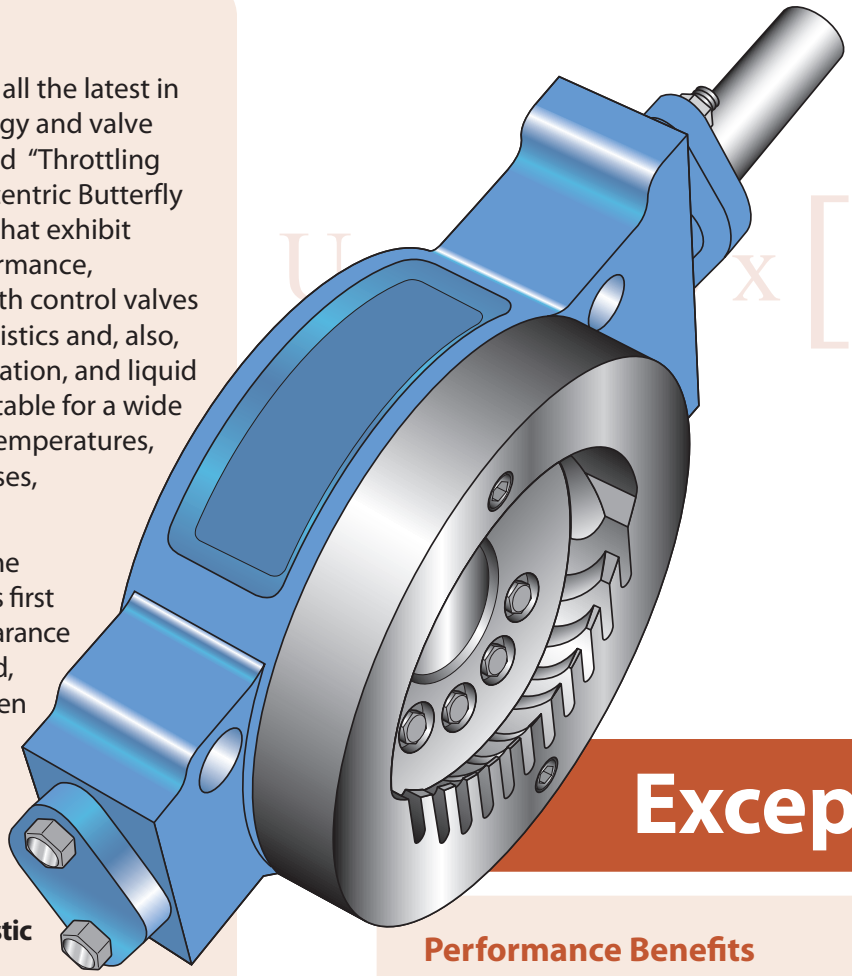
R.M. HEADLEE
VALVES AND CONTROLS

Sharktooth® Control Valve

Sharktooth Control Valves provide all the latest in control valve innovation, technology and valve acoustics. By inserting our patented "Throttling Trim Cartridges" into our Triple Eccentric Butterfly Valves, control valves are created that exhibit significant improvements in performance, simplicity, and economy. Sharktooth control valves have excellent throttling characteristics and, also, provide aerodynamic noise attenuation, and liquid cavitation reductions. They are suitable for a wide range of services from cryogenic temperatures, up to 850° F, including liquids, gasses, and steam.

As the butterfly vane turns within the Throttling Trim Cartridge, the flow is first controlled via the characterized clearance between the disc edge and the solid, tapered portion of the Cartridge; then through the multiple, optimized slots; and, finally, through the additional open area of the valve to provide:

- **Rangeability Exceeding 100:1**
- **An Equal Percentage Characteristic**
- **15dBA Noise Attenuation**
- **Reduced Cavitation**
- **Lower Operating Torque**



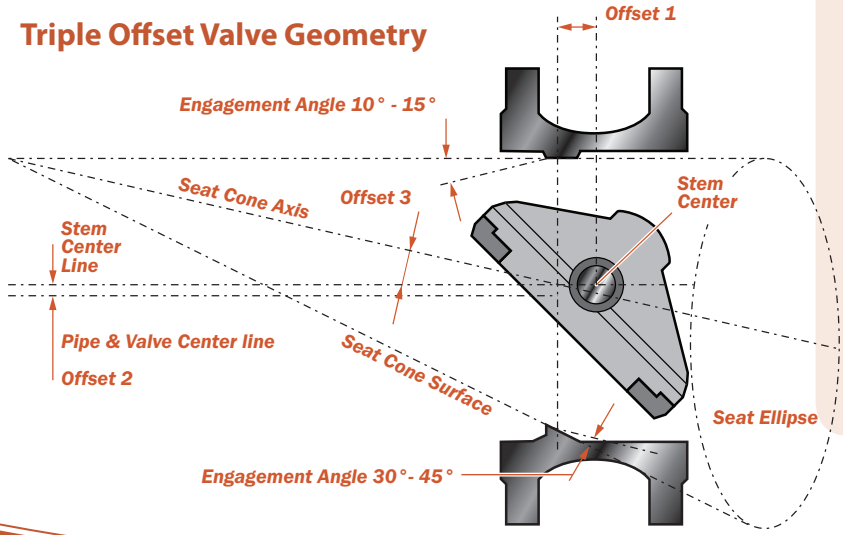
Exceptional

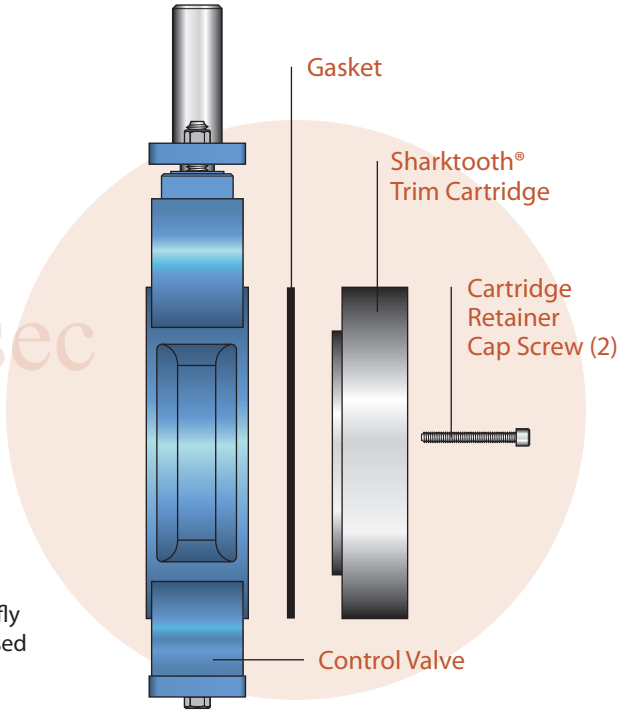
Performance Benefits

- **3" thru 24"***
- **Class: 150 thru 900**
- **Carbon Steel, Stainless Steel, & Exotic Alloys**
- **Metal-to-Metal Seating**
- **Cryogenic to 850° F.**
- **Bidirectional Class IV, V, & VI Shutoff**
- **Firesafe to API 607**
- **Low Running Torques**
- **Stable Control**
- **Light Weight**
- **Compactness**
- **Low Cost of Ownership**
- **Field Replaceable Trim Cartridges**
- **Severe Service Capability**

* = Larger sizes available

Triple Offset Valve Geometry





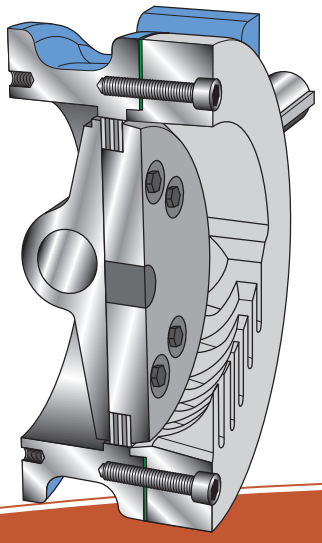
Sharktooth® Throttling Trim Cartridge

The Sharktooth "Throttling Trim Cartridge" is used to turn our Triple-Off-Set Butterfly Valves into excellent throtling control valves. Now, just one style of valve can be used for both on-off, and control applications.

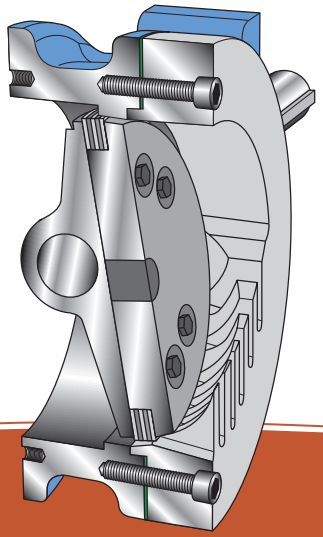
Performance, Simplicity, and Economy!

Sharktooth®... controlling at every angle!

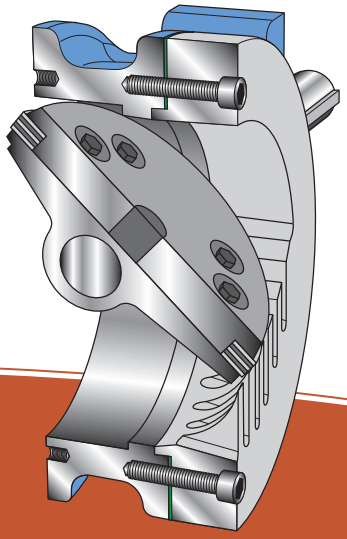
Tight Shut-off



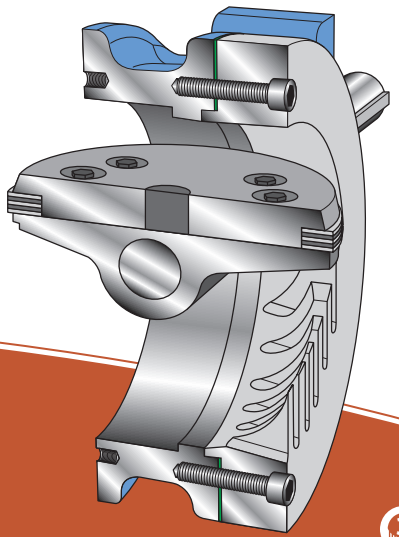
Low Flow



Medium Flow



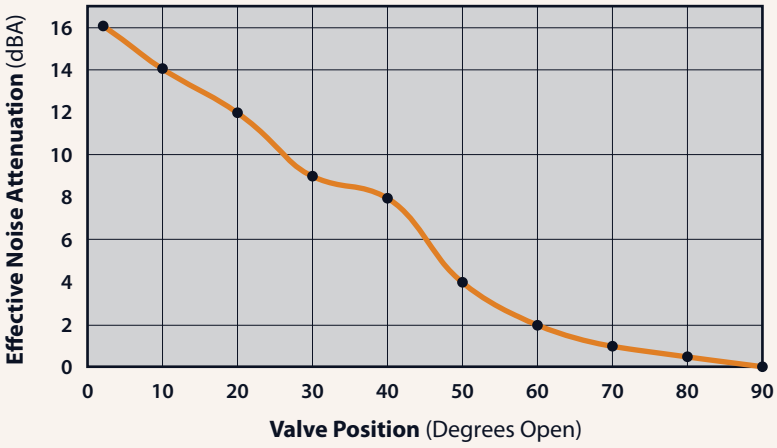
Maximum Flow



Reduces Aerodynamic Noise Up to 15 dBA

As the vane turns within the Sharktooth® Throttling Trim Cartridge, multiple, optimized, throttling slots are gradually exposed to flow. Then, at higher flows, when the vane has cleared the contoured slotted portion of the control cartridge, the resultant lower pressure drop will alleviate any further noise problems.

Noise Attenuation

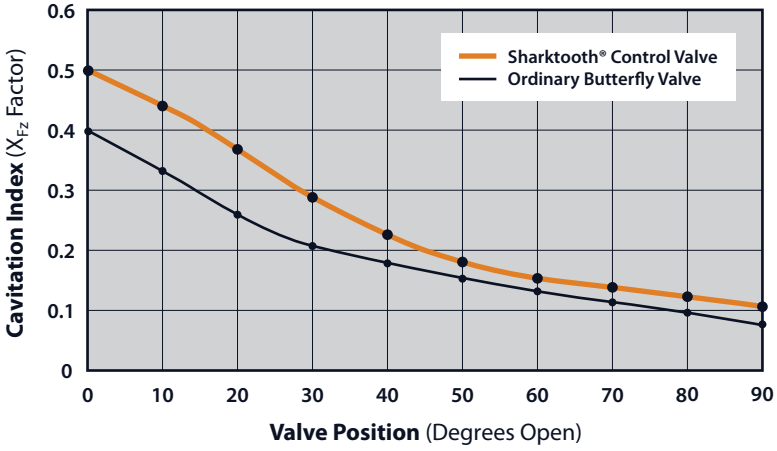


Anti-Cavitation Properties

Sharktooth's® twenty-five percent higher incipient cavitation index allows for higher pressure drops than ordinary butterfly valves, while exhibiting much less noise, cavitation, and damage.

Even if cavitation does occur in higher pressure drop situations, the shorter vapor jets produced by the slots will avoid the damaging effects caused by large vapor jets, referred to as "super cavitation".

Cavitation Reduction

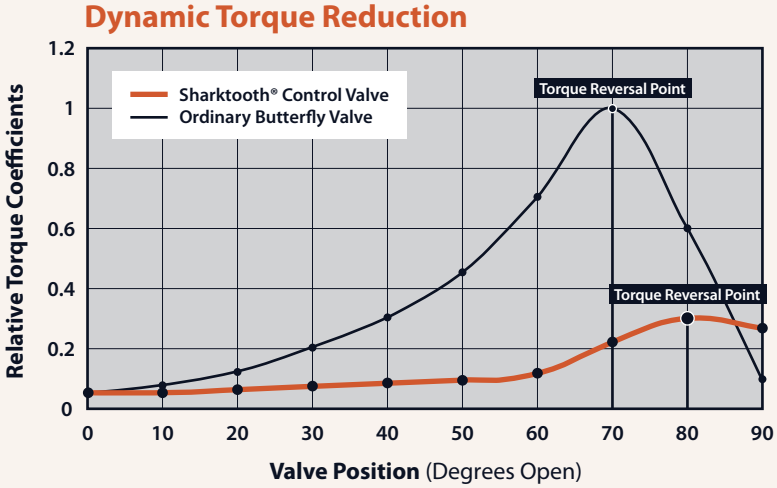


More Control with Less Torque

Sharktooth's® dynamic torque requirements are 60 percent less than ordinary butterfly valves, even at high-end Cv's, thereby providing exceptional stability throughout its control range.

Sharktooth's® Triple Eccentric Metal-to-Metal Seating requires lower breakaway torques than either butterfly or rotary plug control valves and, its extended torque reversal point allows for an expanded range of control.

Dynamic Torque Reduction

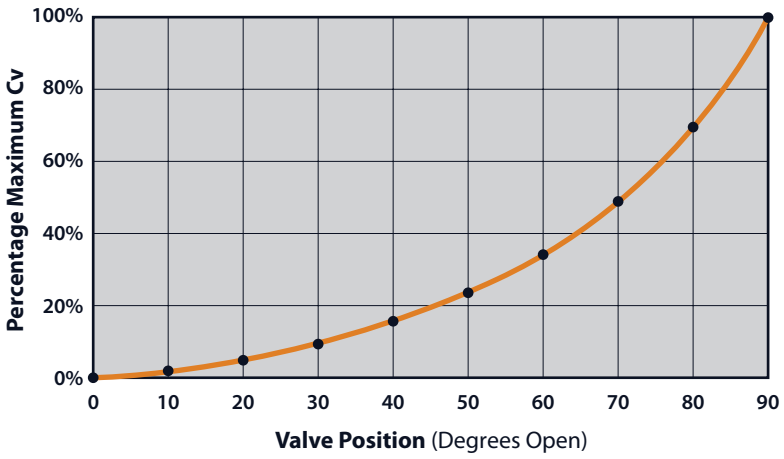


Excellent Control Range

Sharktooth® Control Valves have an effective control range that extends from 1 percent at 5 degrees of travel to 100 percent at 90 degrees of travel.

Its equal percentage flow characteristic fits the vast majority of control loop requirements.

Flow Characteristic



Low to High Flow Capability

The Sharktooth® Throttling Trim Cartridge eliminates the low angle instability inherent in most quarter-turn control valves. For instance, ordinary butterfly valves exhibit poor control at angles of opening that are less than 30 degrees.

Sharktooth® technology greatly extends the control rangeability of our quarter-turn valves to as low as 3 degrees of valve opening while also providing noise attenuation and anti-cavitation benefits.

Notes:
1) Min CV= Minimum Controllable CV
2) Rangeability
- 3″ to 6″ = 100 : 1
- 8″ to 10″= 75 : 1
- 12″ to 16″ = 50 : 1
- 18″ to 24″ = 30 : 1

TOV Cv Comparison with and without Sharktooth®

ANSI 150 & 300						ANSI 600			
Size		Standard TOV		TOV w/Sharktooth		Standard TOV		TOV w/Sharktooth	
(in)	(mm)	Cv @20°	Max Cv	Min Cv	Max CV	Cv @20°	Max Cv	Min Cv	Max Cv
3	75	14	120	1.1	101	14	120	1.1	101
4	100	27	230	1.9	199	25	215	1.9	186
6	150	77	660	7.6	575	77	660	7.6	575
8	200	176	1,500	18	1,325	158	1,350	16	1,192
10	250	281	2,400	30	2,148	241	2,064	25	1,847
12	300	421	3,600	64	3,245	355	3,043	55	2,742
14	350	644	5,500	98	4,915	532	4,550	81	4,066
16	400	889	7,600	136	6,813	750	6,416	115	5,751
18	450	1,205	10,300	309	9,290	1,003	8,576	258	7,735
20	500	1,521	13,000	388	11,667	1,264	10,808	323	9,699
24	600	2,363	20,200	598	17,967	1,966	16,814	498	14,955

Empirically Tested and Proven For:

- Flow Capacity (Cv)
- Rangeability
- Dynamic Torque
- Seating Torque
- Incipient Cavitation
- Noise Attenuation
- Proof of Design

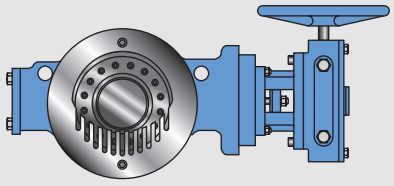
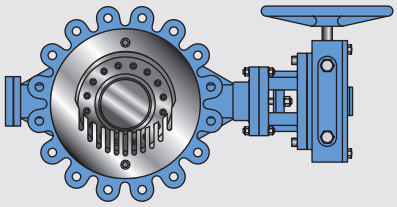
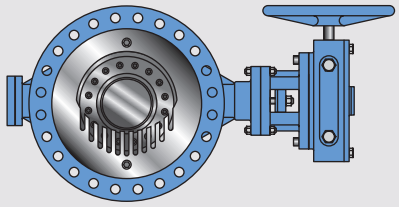
Utah State University Water Research Laboratory
Logan, Utah USA

Valve Sizing Coefficients

Valve Opening	F_L	X_{Fz}	X_T
10°	0.97	0.45	0.58
20°	0.96	0.38	0.57
30°	0.93	0.28	0.56
40°	0.90	0.23	0.55
50°	0.88	0.19	0.54
60°	0.84	0.17	0.53
70°	0.78	0.15	0.51
80°	0.69	0.13	0.48
90°	0.58	0.11	0.44

Note: The above data was substantiated at the Utah State University Water Research Laboratory, Summer 2008.

Standard Product Range

Size		Wafer Type			Lug Type			Raised Face Flanged		
(in)	(mm)	150	300	600	150	300	600	150	300	
3	75	•	•		•	•		•	•	
4	100	•	•	•	•	•	•	•	•	•
6	150	•	•	•	•	•	•	•	•	•
8	200	•	•	•	•	•	•	•	•	•
10	250	•	•	•	•	•	•	•	•	•
12	300	•	•	•	•	•	•	•	•	•
14	350	•	•		•	•		•	•	
16	400	•	•		•	•		•	•	
18	450	•	•		•	•		•	•	
20	500	•	•		•	•		•	•	
24	600	•	•		•	•		•	•	
Body Styles										

Note: *Larger sizes available upon request.*

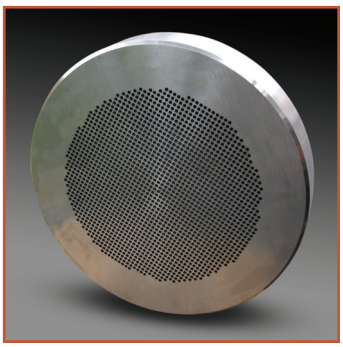
Lug & Wafer Body Face-to-Face Dimensions

Size		ANSI 150						ANSI 300						ANSI 600					
		Valve Body		Sharktooth® Cartridge		Total		Valve Body		Sharktooth® Cartridge		Total		Valve Body		Sharktooth® Cartridge		Total	
in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm
3	75	1.88	47.75	0.65	16.51	2.53	64.26	1.88	47.75	0.65	16.51	2.53	64.26	2.13	54.1	0.65	16.51	2.78	70.61
4	100	2.13	54.10	0.88	22.35	3.01	76.45	2.13	54.10	0.88	22.35	3.01	76.45	2.52	64	0.88	22.35	3.4	86.36
6	150	2.25	57.15	1.31	33.27	3.56	90.42	2.31	58.67	1.31	117.6	3.62	91.95	3.07	77.98	1.31	33.27	4.38	111.25
8	200	2.5	63.5	1.81	45.97	4.31	109.47	2.88	73.15	1.81	45.97	4.69	119.13	4.02	102.11	1.81	45.97	5.83	148.08
10	250	2.81	71.37	2.18	55.37	4.99	126.75	3.25	82.55	2.18	55.37	5.43	137.92	4.61	117.1	2.18	55.37	6.79	172.47
12	300	3.19	81.03	2.69	68.33	5.88	149.35	3.63	92.2	2.69	68.33	6.32	160.53	5.51	139.95	2.69	68.33	8.20	208.28
14	350	3.63	92.2	3.06	77.72	6.69	169.93	4.63	117.6	3.06	77.72	7.69	195.33	6.1	154.9	3.06	77.72	9.16	232.66
16	400	4	101.6	3.5	88.9	7.5	190.5	5.25	133.35	3.5	88.9	8.75	222.25	7.01	178.05	3.5	88.9	10.51	266.95
18	450	*	*	*	*	*	*	*	*	*	*	*	*	7.87	199.9	*	*	*	*
20	500	*	*	*	*	*	*	*	*	*	*	*	*	8.5	215.9	*	*	*	*
24	600	*	*	*	*	*	*	*	*	*	*	*	*	9.13	231.9	*	*	*	*

Note: *Larger sizes available upon request. Dimensions are subject to change without notice. * = Dimensions on application.*

Some Typical Installations

Industry	Application
Steel Mill	12" - 150 Shark + 14" Diffuser, Pump Discharge Flow Control, Water
CoGen Plant	12" - 600 Shark Steam Flow Control
Geothermal Power Gen	12" - 300 Shark w/Electric Actuator Flow Control, Geothermal Water
Steel Mill	14" - 150 Shark, Manual Flow Control Water
Gas Pipline Station	10" - 600 Shark, Flow Control Natural Gas
Geothermal Power Gen	12" - 300 Shark + 16" Diffuser, Freon, Turbo Expander Bypass + Startup
Oil Pipeline	8" - 150 Shark w/ Electro-hydraulic Actuator, Flow Control
Geothermal Heat Transfer	8"- 300 Shark, Flow Control, Freon, Turbo Expander Vent & Bypass
Steel Mill	8" - 150 Shark, Flow Control, Dirty Water to Sump
Major HVAC OEM	3" - 150 Shark, Successful Flow Test Program
Geothermal	8"- 300 Shark/Electric Actuator, Flow Control, Geothermal Water
Salt Cavern Storage	10" - 300 Shark + 12" Diffuser, Flow Control, Brine Well Injection
Snow Making	8" - 300 Shark, Pump Inlet Flow Control - 700 psi Water
Geothermal Power Gen	12" - 150 Shark Steam, Flow Control, Turbine By-Pass
Oilfield Production	6" - 300 Shark, Waste Water Flow Control
Heat Exchanger	12"- 300 Shark, Steam Pressure Control
Paper Mill	10" - 300 Shark, Steam Flow Control
Marine	24" - 150 Shark, Ballast Water Flow Control
Corn Products	8" - 150 Shark, Water Flow Control



Sharktooth® Control Valves are Ideal for Most Applications

By combining the Sharktooth® Throttling Control Cartridge with our Triple Eccentric Butterfly Valves, just one style of valve can be used for both on-off, and control applications. It's the smart choice for today's control systems engineer.

- Oil & Gas Production
- Refining Storage/Transmission
- Electric Power Generation
- Chemicals & Petrochemical
- Textiles
- Pulp & Paper
- Mining & Metals
- Micro-Electronics
- Pharmaceutical & Biotech
- Water Pumping & Transport
- Office Buildings & Hotels
- Water Treatment
- Aircraft, Aerospace, & Military
- Ship Building & Marine

Typical Standard Services

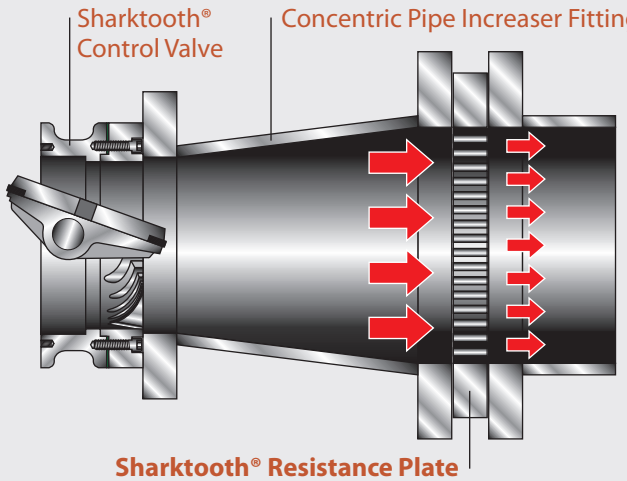
- Pump By-pass Control
- Pressure Reducing
- Back Pressure Control
- Compressor Surge Control
- Flow Control & Balancing
- Ballast Water Flow Control
- Overboard Discharge
- Fire Water Ring Control
- Brine Blowdown
- Jetty Loading Control
- Sea-Water Re-Circulation & Drain
- Cooling Tower Bypass
- Brine Well Injection
- Steam Condensor Inlet
- Steam Venting
- Natural Gas Pressure Control

Typical Severe and Special Services

- Cavitating Liquids
- Noise Reduction in Gas, Steam, & Vapor
- Two Phase Fluids
- Cryogenic Liquids & Gasses
- Fire Safe Shut-off plus Control
- Metal to Metal Tight Shut-off plus Control

Optional Resistance Plates for More Attenuation

When the control valve exit velocity (UV) for gases exceeds 250 ft/sec, the installation of a Resistance Plate to reduce the aerodynamic noise is recommended. Similar use of such plates is advised for high pressure liquids to reduce excessive hydrodynamic noise, or cavitation.



$$U_V = 1120 \times \left[0.02 \times P_1 \times C_V \times \frac{F_L}{D_2^2 \times P_2}\right] \text{ ft/sec}$$

Where: P1 = upstream pressure in psia, P2 = downstream pressure in psia. D2 = valve size, inch. For example: an 8" valve, P1 = 114.5 psia; P2 = 34.5 psia, Cv = 405, FL = 0.9, has an outlet velocity of 421 ft/sec. A resistance plate is required.

Design Optimized by Dr. Hans Baumann

Hans D. Baumann, PhD, P.E. is widely recognized as one of the foremost experts in control valve design and related technologies. His resume represents an unparalleled body of work specializing in control valve development and tactical business evolution. Sharktooth is proud to have Dr. Baumann serve as its primary technology consultant in the design, development and implementation of the Sharktooth® Control Valve technologies. Dr. Baumann is currently the founder and president of HB Services Partners LLC, a premier consultancy to the valve industry.

About Shartooth

The Sharktooth pecializes in the development and integration of innovative valve technologies and we have focused on valve solutions for energy and various process industries for over forty years. The Sharktooth® Control Valve is the first triple eccentric type control valve exclusively designed for process control and throttling purposes.
It was conceived in a collaborative effort between Yeary Controls and Dr. Hans Baumann, a foremost expert in control valve design. The Sharktooth® Control Valve represents the latest in control valve technologies for process control applications.

Automation and Control Systems

RM Headlee Controls offers a complete array of control valve actuators, control instrumentation, and engineered systems to ensure an optimized configuration for your control valve applications.
Our engineering team offers guaranteed solutions that will facilitate implementation of Sharktooth® and other Controls products.

Energy Absorbing Flow Pattern

Flow Laboratory tests verified how individual water jets impinge upon each other at approximately one pipe diameter downstream from the Sharktooth Control Element, thereby converting kinetic energy in the fluid prior to contacting the pipe wall.

For more information, please contact:

R.M. HEADLEE VALVES AND CONTROLS

Represented by: