Becker

a Baker Hughes business

Becker™ T-Ball Control Valve

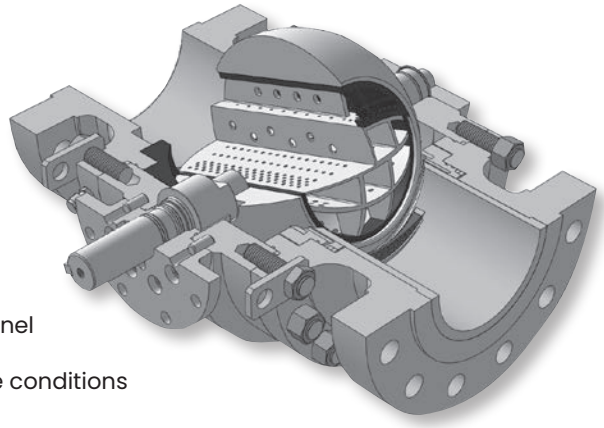
for Natural Gas Applications

Natural gas systems are in the quest for maximum capacity and operational efficiency. As a result of trying to meet increasing market demands, many regulator station designs are exceeding the performance envelope of other control valve manufacturers. When it comes to high demand natural gas regulation requirements, the Becker T-Ball Control Valve series offers a series of valves that can help you to optimize your system's performance.

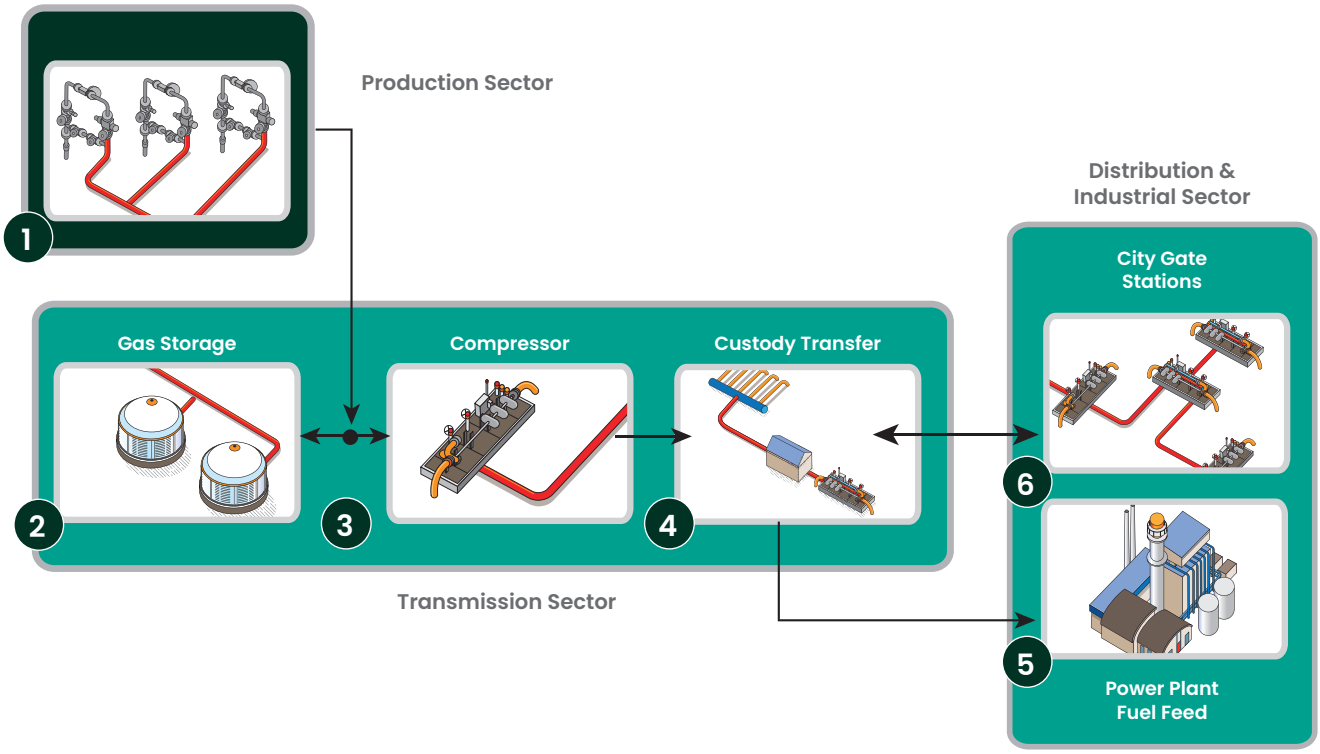
Becker's solution can take on demanding applications that require aggressive noise attenuation, high pressure differentials, large mass flow volumes and extreme precision. In addition, the Becker T-Ball can handle a variety of media from sweet natural gas to multiphase service to corrosive sour gas.

The Becker T-Ball benefits include:

- Decreased station footprint
- Improved system operating efficiency
- Increased reliability and life span
- Reduction of manual operation and maintenance
- Significant decrease in fugitive emissions
- Simpler and safer operating conditions for field personnel
- High Turndown ratio to handle wide variation in service conditions
- Low-Noise trim options to satisfy environmental concerns



Providing exceptional performance, all around



From production to distribution, natural gas requirements vary per application. The Becker patented T-Ball design addresses an extensive range of operating requirements.

				Performance Features Required					
Item	Application	Sector	Control	Aggressive Noise Attenuation	Dirt & Debris Resistance	High Capacity	High Pressure Differential	Wide Flow Range (Turndown)	Bi-Directional Flow
1	Gas Production	Production	PCV	•	•	•	•	•	
2	Gas Storage	Transmission	FCV, PCV	•	•	•	•	•	•
3	Compressor Anti-Surge	Transmission	Surge Control	•	•	•	•	•	
4	Custody Transfer	Transmission	FCV, PCV	•		•	•	•	•
5	City Gate Station	Distribution	FCV, PCV	•		•	•	•	•
6	Power Plant Fuel Gas	Industrial	FCV, PCV	•		•	•	•	

Optimized trim selection

The T-Ball valve can be easily customized by our experienced engineers to suit your specific application requirements. Available in a full range of trim designs (FPCV-T0, QTCV-T1, QTCV-T2, and QTCV-T4), this valve can be configured to meet your precise flow rate and noise attenuation specifications.

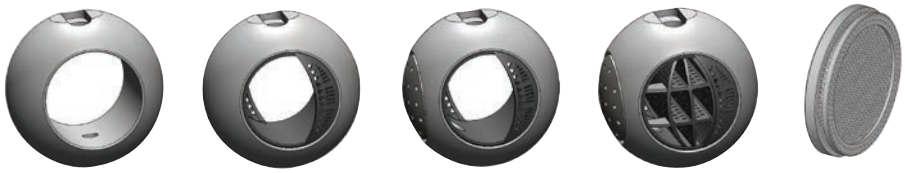
For example, applications that require high mass flow rates, and/or high turndown requirements without the need for noise attenuation are well suited to the conventional full port design of the FPCV-T0 mode.

Applications that require high-pressure differential and aggressive noise attention are ideal for the QTCV-T4 model.

In addition, Baker Hughes offers optional construction materials, including exotic alloys and hardened overlays, that can increase service life and performance in rugged applications.

Trim selection

To help you to optimize performance and durability, the T-Ball valve is offered in a series of noise attenuating trims.:



Becker T-Ball Model	FPCV-T0	QTCV-T1	QTCV-T2	QTCV-T4	*Attenujet™*
Noise Attenuation	Baseline	7 dBa	17 dBa	25 dBa	15 dBa
Turndown Ratio	100:1	200:1	300:1	200:1	-

High capacity and low noise trim

T-Ball Series Capacity (C_V ratings)

Valve Nominal Size		Cv Max			
NPS	DN	FPCV-T0	QTCV-T1	QTCV-T2	QTCV-T4
2	50	260	-	-	-
3	80	550	-	-	-
4	100	975	590	578	300
6	150	2,600	1,398	1,371	673
8	200	5,250	2,148	2,105	1,157
10	250	8,500	3,468	3,399	1,872
12	300	13,900	4,749	4,655	2,696
16	400	22,500	8,222	8,059	4,792
20	500	38,800	12,595	12,346	7,487
24	600	58,000	18,137	17,778	-
30	750	98,000	28,340	27,779	-
36	915	154,000	40,809	40,001	-
42	1,050	249,000	-	-	-

Notes:

- ***Flow Coefficients (Cv) are based upon ISA sizing equation criteria.***
- ***Due to Baker Hughes' dedication to new product development and enhancement data is subject to change. Please check with our engineering department for the most recent data.***

Natural gas applications vary in requirements, the Becker T-Ball series includes a selection of pressure ratings, end connections and trim and body materials.

Product Range	
Size	NPS 2 to NPS 42 50mm to 1050mm
Pressure Ratings	ASME Class 150 to 2500
End Connections	RFFE, RTJ, Weld End
Temperature Range	-60°C to 176°C (-76°F to 349°F)
Materials of Construction	
Body	ASTM A350 LF2 CS[1] ASTM A350 LF3 CS ASTM A350 LF6 CS Duplex Inconnel 625 316 SS 410 SS 17-4PH
Ball and Seat Ring Material	ENP ASTM A350 LF2 CS[1] AISI 4140 Duplex Inconel 625 Tungsten carbide overlay 316 SS 17-4PH
Throttling Trim	17-PH SS1 Duplex
Stem Material	AISI 41401 17-4PH SS 316 SS

1. Indicates standard material construction, alternative material selected on process conditions.

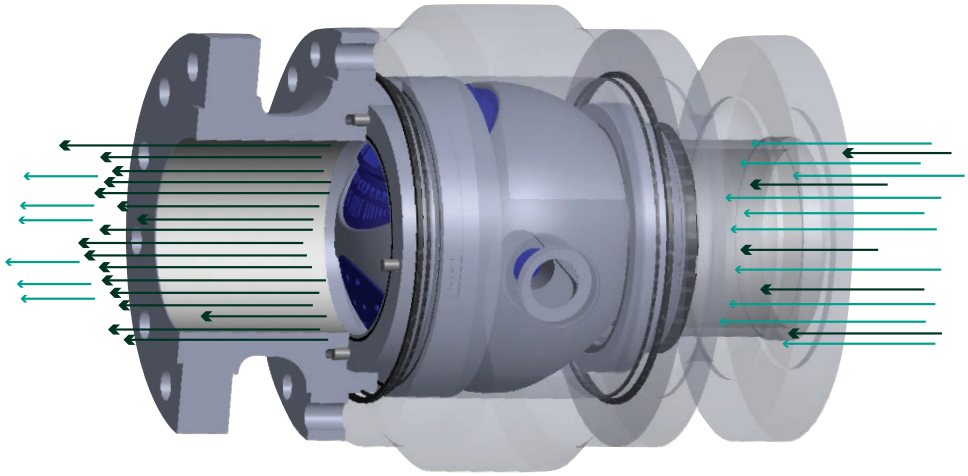
Performance	
Turndown	up to 300:1
Noise Attenuation	up to 25 dBa
Minimum Control Limit	
FPCV-T0	1.0% of Cv
QTCV-T1	0.5% of Cv
QTCV-T2	0.33% of Cv
QTCV-T4	0.5% of Cv
Maximum Control Limit	
FPCV-T0	90% of Cv
QTCV-T1	95% of Cv
QTCV-T2	95% of Cv
QTCV-T4	85% of Cv
Maximum Pressure Differential	
FPCV-T0	Full ASME
QTCV-T1	1,000 psi (69 bar)
QTCV-T2	800 psi (55 bar)
QTCV-T4	1,500 psi (103 bar)
ASME Shut Off Rating	Soft Seat - Tested up to Class VI Metal Seat - Tested up to Class V

Note: Additional and alternative material available upon request. Consult engineering for additional product configurations.

Our products are engineered, built and tested in accordance with the industry's international standards to enhance the quality of our products.

Standard	Description
ASME B16.5	Valve flange dimensions
ASME B16.10	Valve face-to-face/end-to-end dimensions
ASME B16.25	Valve butt weld ends
ASME B16.34	Valve design, test and performance
API6D	Specification for pipeline valves
API 6FA[1]	Specification for fire test for valves
API 607[1]	Fire test for soft-seated quarter-turn valves
CRN[1]	Canadian registration number
NACE MR0175	Petroleum and natural gas industries - Materials for use in H_2S containing environments in oil and gas production
ATEX Dir. 2014/34/EU[1]	Equipment for use in explosive atmospheres
PED 2014/68/EU[1]	EU Pressure Equipment Directive
CU-TR[1]	Russian Gosstandardt Certificate
RTN[1]	Rostekhnadzor
SIL per IEC 61508	Safety integrity level

1. Available upon request.



Superior Flow Capacity
Size for size, the T-Ball design offers superior flow capacity compared to cage style valves. The T-Ball features a control trim design that permits less restriction and greatest capacity when demand requires.

Aggressive Noise Attenuation
A range of trim designs can be implemented to meet operational noise requirements. The multi-stage trim design dissipates kinetic energy by forcing the gas through a series of pressure reducing holes and angles. This frictional path decreases velocity and vibration – providing up to 25 dBa of noise attenuation.

Wide Controllability
Natural gas systems often call for control of a wide range of flow rates. The T-Ball's rotary design offers high turndown ratio up to 300:1 for excellent control range. A wide flow range can be controlled by a single run where cage style valves require multiple runs and valves.

Reduce Emissions
The rotary quarter turn of the T-Ball design provides quick, easy and low impact automation. The constant linear motion forces associated with globe and axial valves can cause damage to stem packing, releasing fugitive emissions. The quarter turn design incorporates pressure seal seating technology that does not require excessive forces to ensure flow shutoff.

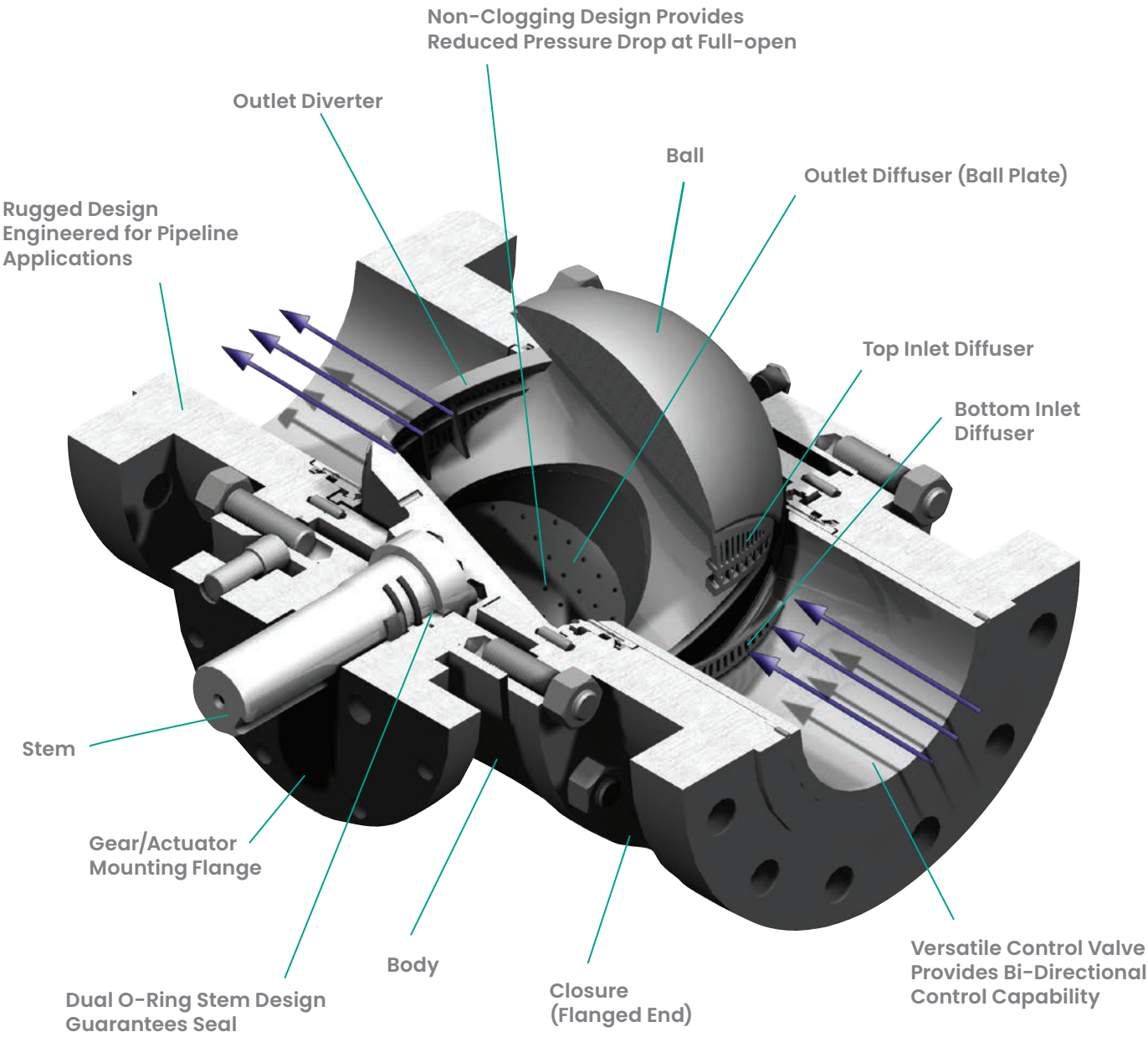
Compact Size
The high capacity T-Ball design allows for the valve to be one or two sizes smaller than cage style valves. Not only does this reduce the station footprint, but less material and resources are required to support the valve.

Bi-Directional Control
T-Ball provides standard bi-directional flow capability without sacrificing control accuracy. This can reduce a system's assets up to 50% – cage style valves may require a valve and supporting materials for each direction.

High Pressure Differential
Through an aggressive multi-stage pressure let down design, the T-Ball is capable of handling pressure differentials over 1500 psid (104 bar). For extremely severe conditions, Tungsten Carbide overlay can be applied to provide further erosion resistance.

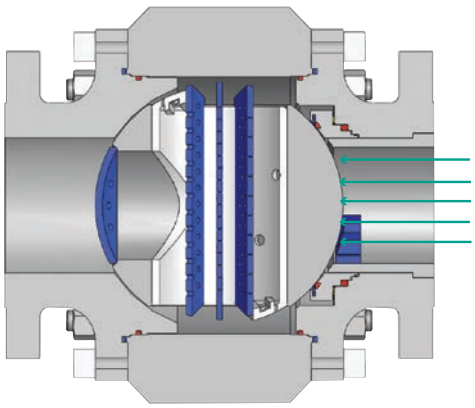
Customized Configurations
Applications vary in service requirements. The T-Ball design can be configured in an array of exotic materials, ASME class ratings, and end connections. Material selection is based on gas composition and process conditions to maximize performance and service life. For the most aggressive applications, metal-to-metal seating is available.

QTCV-T2 T-Ball Cutaway

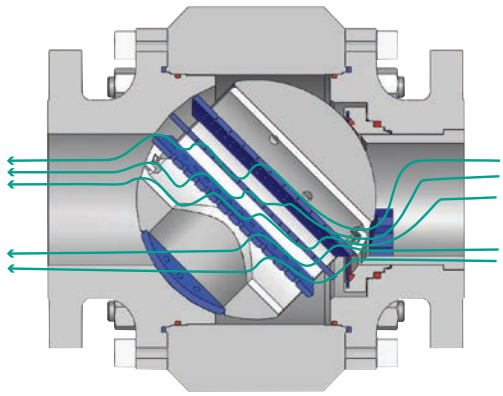


Exceptional noise reduction by design

FULL
CLOSED
0°
TRAVEL



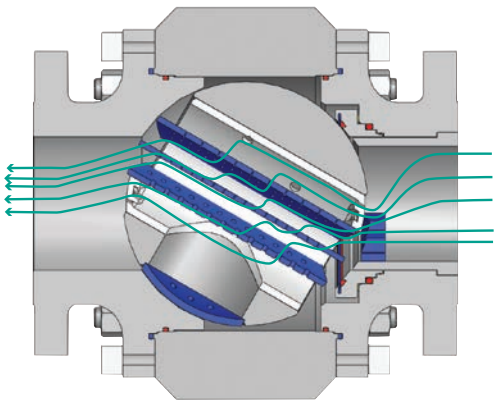
OPEN
30°
TRAVEL



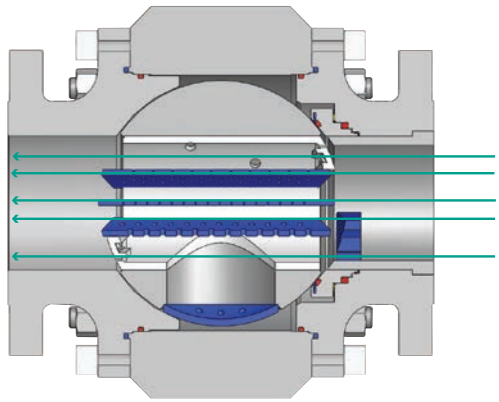
A. **Double Piston Effect Seat** ensures bi-directional flow shutoff up to ASME Class VI in a single seat design

B. **Wide rangeability** provides excellent control during low flow operating conditions

IN
CONTROL
45°
TRAVEL



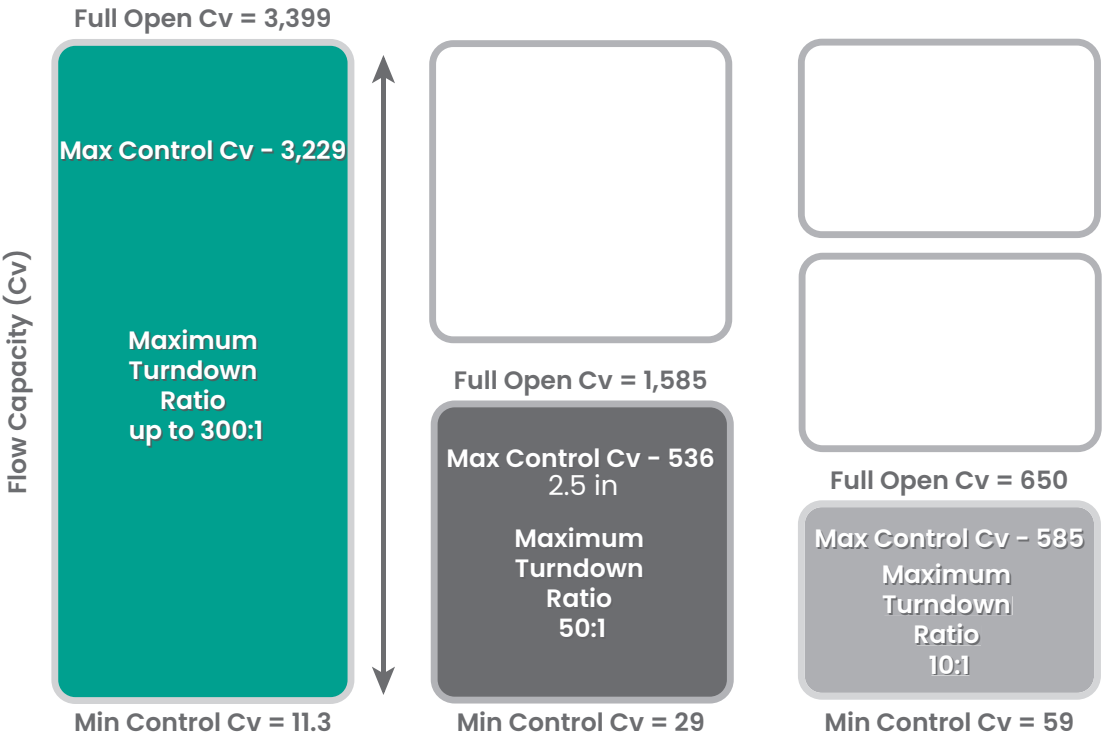
FULL
OPEN
90°
TRAVEL



C. **Maximum noise attenuation** is achieved as the noise attenuator plates are engaged during higher flow rates.

D. **Superior capacity** is crucial when upstream pressure diminishes and flow rates significantly increase, requiring minimum pressure differential

QTCV-T4 trim type shown



To achieve the same capacity as a 10" (250) QTCV-T2, approximately two axial style valves are required or three globe style valves.

Fundamentally, the initial step in control valve selection is calculating the required flow capacity. For globe and axial style valves capacity can be an immediate limitation, resulting in the need to increase size—driving up overall project costs. Compared to these other valve types, size for size, a T-Ball offers the greatest capacity and maximized economy. Its high capacity design offers several unparalleled benefits:

- Less infrastructure to maintain
- Smaller valve and piping
- Excess capacity for additional noise attenuation technologies
- Preparedness for market changes

% Open		T-Ball Model			
		FPCV-T0	QTCV-T1	QTCV-T2	QTCV-T4
10%	Xt	0.45	0.89	0.90	0.90
	FL	0.78	0.94	0.96	0.96
20%	Xt	0.63	0.88	0.89	0.89
	FL	0.85	0.94	0.96	0.96
30%	Xt	0.73	0.88	0.89	0.88
	FL	0.90	0.93	0.95	0.95
40%	Xt	0.78	0.87	0.88	0.87
	FL	0.91	0.92	0.94	0.94
50%	Xt	0.77	0.86	0.87	0.85
	FL	0.88	0.90	0.92	0.93

% Open		T-Ball Model			
		FPCV-T0	QTCV-T1	QTCV-T2	QTCV-T4
60%	Xt	0.68	0.85	0.86	0.82
	FL	0.83	0.88	0.90	0.90
70%	Xt	0.52	0.81	0.82	0.79
	FL	0.79	0.84	0.86	0.87
80%	Xt	0.35	0.77	0.78	0.74
	FL	0.71	0.78	0.80	0.83
90%	Xt	0.22	0.63	0.64	0.65
	FL	0.63	0.69	0.70	0.76
100%	Xt	0.13	0.40	0.41	0.52
	FL	0.53	0.58	0.59	0.67

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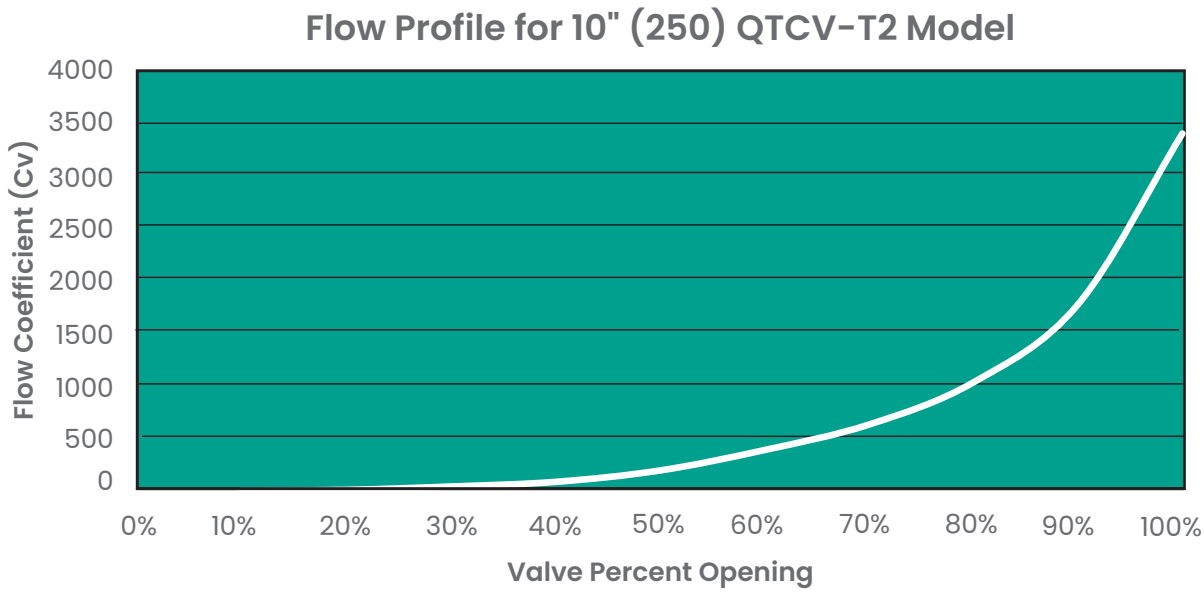


The T-Ball valve's modified equal-percentage flow characteristic combines the benefits of both linear and equal-percentage characteristics, offering excellent control in the low-flow ranges and excellent capacity for high flow. This advanced design enables the valve to meet a large variety of application and control needs.

Original Station Design

Buried Installation Solution

A U.K. city gate station's original design capacity had been far exceeded due to increased market demand. The station not only required additional capacity, but aggressive noise attenuation and the ability to maintain control at low flow volumes. The existing installation incorporated four runs of regulators with large in line silencers. The high capacity and turn down ratio of Becker T-Balls allowed the station to be redesigned to only two buried runs, in turn eliminating silencers.

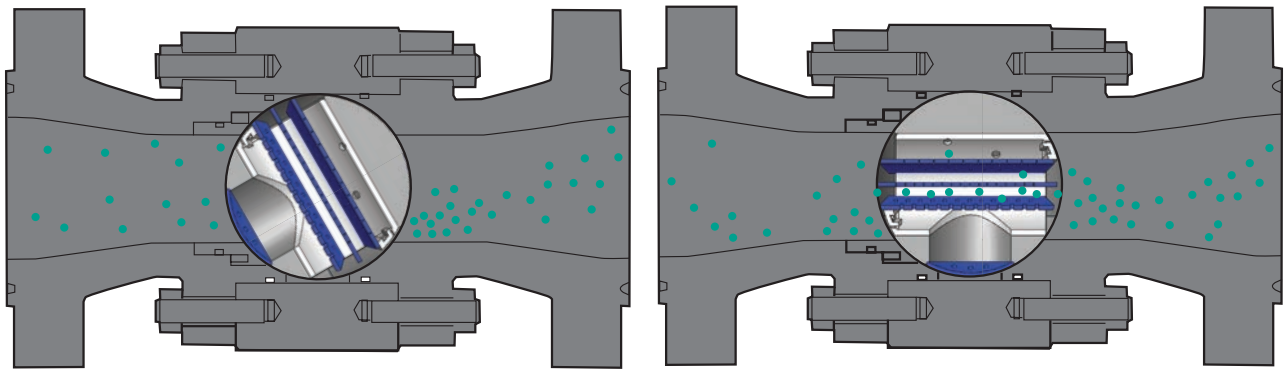
Minimize operational disturbances

It is not uncommon for high velocity concentrated debris, such as sand, to be flowing through the pipeline system. This can create two rapidly destructive problems:

- **Erosion of internal valve components**
- **Clogging build up of debris leading to premature valve failure**

Cage style valves utilize velocity control technologies, such a stacked disks and streamlined paths, to minimize the erosive effects of pipeline debris.
This method only addresses half the problem because the drilled holes in cage style valves are still prone to clogging debris build up.

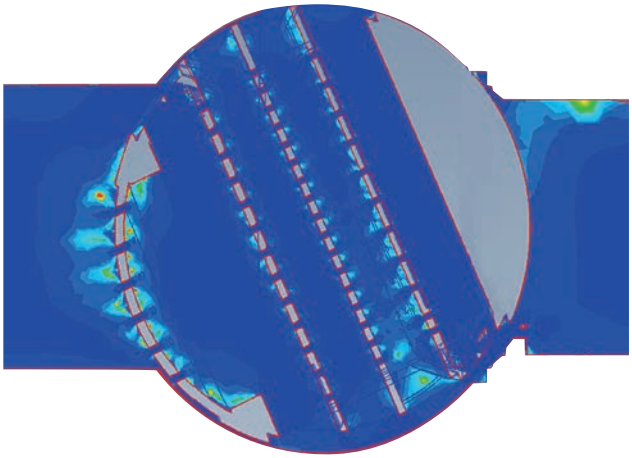
Every year major investments are made in capital and time to maintain and rebuild a station's assets. Over time, the natural gas industry has come to accept the high maintenance and poor service life of cage style valves. With a Becker T-Ball, this is no longer required.



The T-Ball's patented trim not only reduces fluid velocity to combat erosion but it also features a self cleaning non-clogging design. The T-Ball's clean sweep feature allows debris to pass through even a slight opening of the control valve. The rotating element design literally sweeps pipeline debris downstream preventing any debris scouring, build up and clogging. The clean sweep feature reduces unplanned process downtime, adding to your bottom line.

Attack noise at its source

Utilizing remedies that attempt to muffle the noise source might ignore the detrimental and costly damage that can be done to an entire system from excessive vibration. Excessive vibration can result in repeated fatigue failures of piping, control systems, and welds. The T-Ball's multistage design attacks noise at its source–managing vibration and safely protecting your assets.

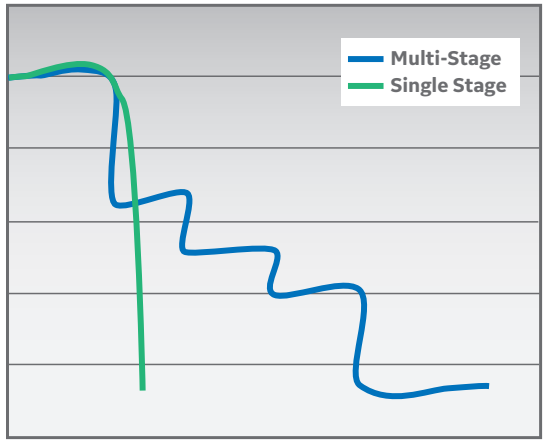


QTCV-T4 Turbulence Intensity

Each of the perforated plates shapes the flow passage to control turbulence, producing a steady flow pattern. There is little fluctuation in turbulent velocity,resulting in greatly-reduced trim vibration and aerodynamic noise.

Applications that require large pressure differentials are especially susceptible to damage, as high velocities are a direct result of pressure reduction. As shown with the QTCV-T4 image above, fluid immediately begins to undergo a series of pressure letdowns as it enters the ball opening through an inlet diffuser. The T-4's innovative multi-stage design maximizes frictional resistance by combining horizontal and vertical perforated plates. Each pressure letdown plate reduces velocity and kinetic energy; the root cause of noise and vibration. Furthermore, the use of progressively increasing hole sizes dissipates energy and prevents excessive velocity.

This concept creates a convoluted flow path which attacks and manages noise and vibration at its source.



Noise Attenuation

A trimmed T-Ball flow pattern is similar to that of a cascading waterfall where water gradually descends over a series of rock steps, reducing kinetic energy and creating the tranquil sound of flowing water. A plunge waterfall, however, could be falling from the same height, but its single drop and high kinetic energy results in a thunderous crashing sound.

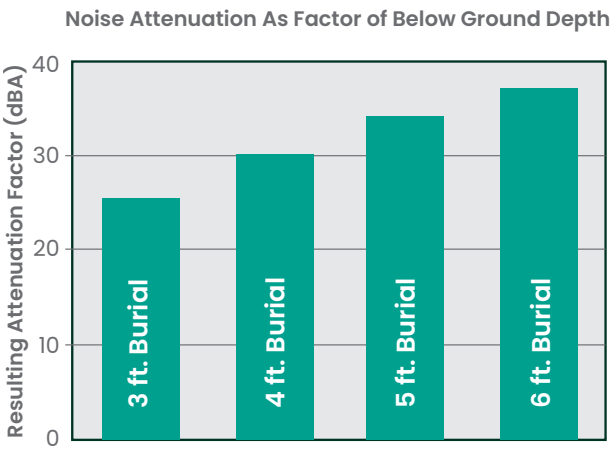
Commitment to the environment

Sustainable and environmentally friendly technology is a continuously growing industry trend. The environmental impact of noise and pollution from natural gas regulating stations is becoming an increasingly important design consideration.

Many methods of handling excessive noise, such as downstream silencers, extra-thick pipe, and enclosure buildings, only offer a partial solution and multiply project costs. Buried installation of T-Ball control valves can easily be configured with a robust extended stem design. This can eliminate ambient noise problems (up to 37 dBa) by the earth's absorption of noise producing vibrations. Due to the T-Ball's inherent non-clogging, low maintenance design, your station is not required to be frequently unearthed and serviced.

Besides enhanced noise control and infrastructure reduction, buried service provides considerable benefits:

- **Ability to handle higher flow volumes**
- **Reduce ambient heat loss**
- **Additional asset security**
- **Safer atmosphere for operating personnel**
- **Compliance with environmental regulations and city ordinances**



Burial depths typically range from 3 ft (1m) to 6 ft (2m) and can provide in excess of 37 dBa of additional noise attenuation.


FLOW

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