

Emergency Shutdown Valve (ESDV)

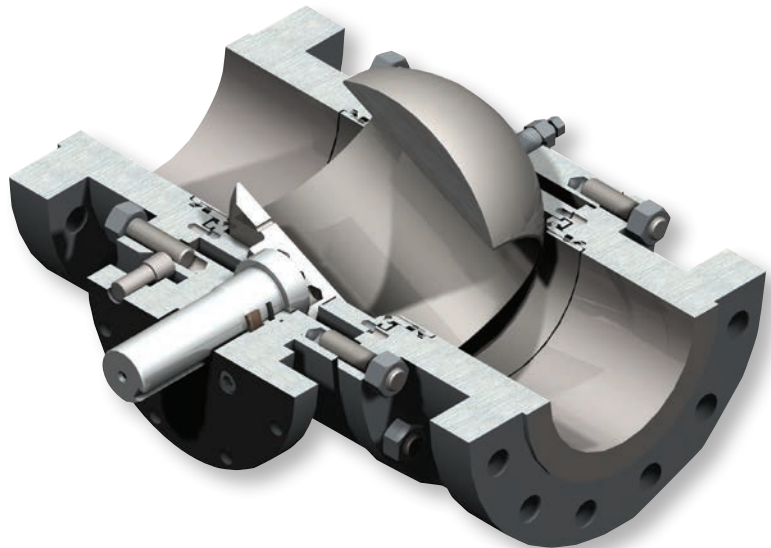
Safety Protection for Natural Gas Transmission Systems and Distribution Networks

The Becker™ Emergency Shutdown Valve (ESDV) from Baker Hughes is well-suited for gas transmission systems, gas distribution networks and industrial gas pressure regulation systems.

Safety within natural gas transmission and distribution systems is key to maintaining reliable operation. The Becker Emergency Shutdown Valve (ESDV) can help protect your employees, equipment, and the environment during dangerous system upsets.

Becker ESDV features are designed for accuracy and dependability

- Trunnion-mounted ball valve
- Fail-safe spring return actuator
- Low emissions design
- Anti-blowout stem configuration
- Fast response time
- Suitable for use in SIL 3 applications



Becker Emergency Shutdown Valve

A full port ball valve's (FPBV's) quarter-turn operation allows the valve to close in less than a second when an emergency situation arises.

Becker Emergency Shutdown Valves Safety Features

- **Tight Shutoff**

With a double-seated design, Becker ESDVs are rated up to ASME Class VI shutoff and provide bubble-tight shutoff.

- **Fire Safe**

In the event of an emergency, your assets may be exposed to fire. All Becker ESDVs are rated to API 6FA Fire Safe.

- **Fast Acting**

Quick response is critical to reducing escalation of hazards. Becker ESDVs can go from full open to full close in less than a second.

- **Manual and Automatic Release Options**

You have flexibility on resumption of system operation after shutdown.

- **Rugged Design**

Designed to withstand shocks and vibrations that could cause false trips, Becker ESDVs help ensure your system is up and running when it needs to be.

- **Customizable Configurations**

Several unique configurations can be engineered to meet your specific application needs.

- **Certified Safety Integrity Level (SIL) per IEC 61508**

The Becker ESDV has been evaluated by an independent third party. Valves from other manufacturers that have not been evaluated rely solely on manufacturers' product claims.

- **Capable of Both Local and Remote Partial Stroke Test**

Users can minimize system disturbances to prevent and diagnose potential operational problems.

How the ESDV Works

The Becker ESDV acts as a safeguard against exceeding setpoint pressure. During normal operation, the valve remains open for an extended period of time—months or sometimes even years. The ESDV must function as called upon during an emergency and manage the situation. In the event that the setpoint is exceeded or power or signal are lost, the valve will close within one second to isolate the flow.

Full Open Position – Normal Operation

The ESDV provides minimal pressure differential when the valve is in full open position. The full bore ball valve virtually acts as a pipe, decreasing process fluid turbulence.



Full Closed Position – Emergency Situation

Setpoint pressure has been exceeded and the ESDV has fully closed, providing bubble-tight shutoff with its double-seated design.

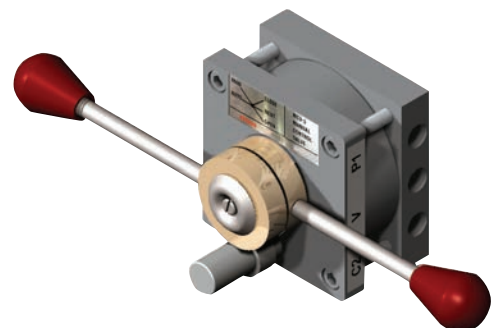


Unlocking Assured by Position Indicator

Once the pressure has been equalized to a safe level, the device can be opened by either:

- Manual reset
- Reaching low set point
- Restoring power

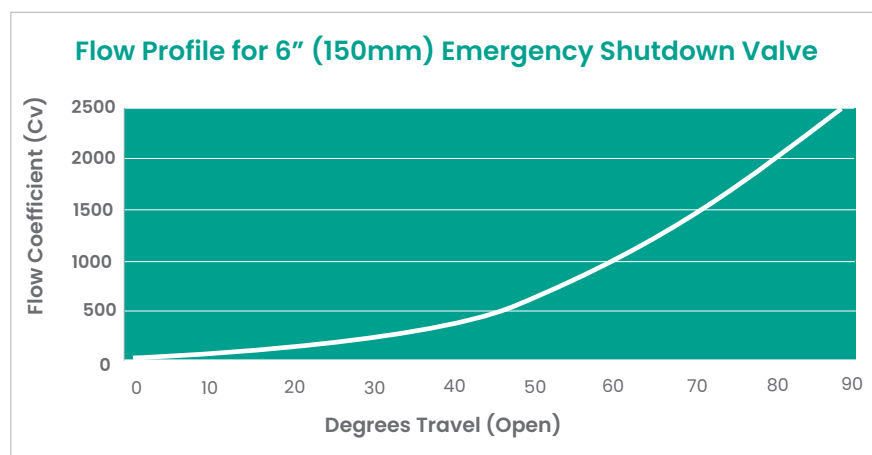
The ESDV comes equipped with an easy-to-read position indicator on the actuator, helping to confirm that the valve has been secured in the full open position.



The Manual Control Valve (MCV) uses a two-handle system and a safety button to provide safe operation.

The emergency shutdown valve is engineered, built and tested with the industry's international standards for product quality.

Product Specifications		Standard	Description
Valve Type	Trunnion mounted full port ball valve	ASME B16.5	Valve flange dimensions
Body Style	Side entry, forged body	ASME B16.10	Valve face-to-face/end-to-end dimensions
Actuator Type	Single-acting, spring return	B16.25	Valve butt weld ends
Instrumentation	Pneumatic or digital	ASME B16.34	Valve design, test & performance
Size Range	NPS 2 – 16 50 mm – 400 mm	API6D	Specification for pipeline valves
Pressure Ratings	ASME Class 150 – 2500	API 6FA	Specification for fire test for valves
Shut Off	Soft seat tested up to Class VI Metal seat – tested up to Class V	API 607	Fire test for soft-seated quarter-turn valves
End Connections	RFFE, RTJ, weld end	CRN	Canadian registration number
Closing Time	< 1 second (depending on size)	NACE MR0175	Petroleum and natural gas Industries – materials for use in H ₂ S containing environments in oil and gas production
Setpoint Accuracy	±0.75%	ATEX	Equipment for use in explosive atmospheres
Temperature Range	–76°F to 349°F –60°C to 176°C	PED	EU Pressure equipment directive
Maximum Pipe Velocity	100 ft/sec 30 m/sec	CU-TR	Russian gosstandart certificate
		RTN	Rostekhnadzor
		SIL	Up to SIL 3 per IEC 61508



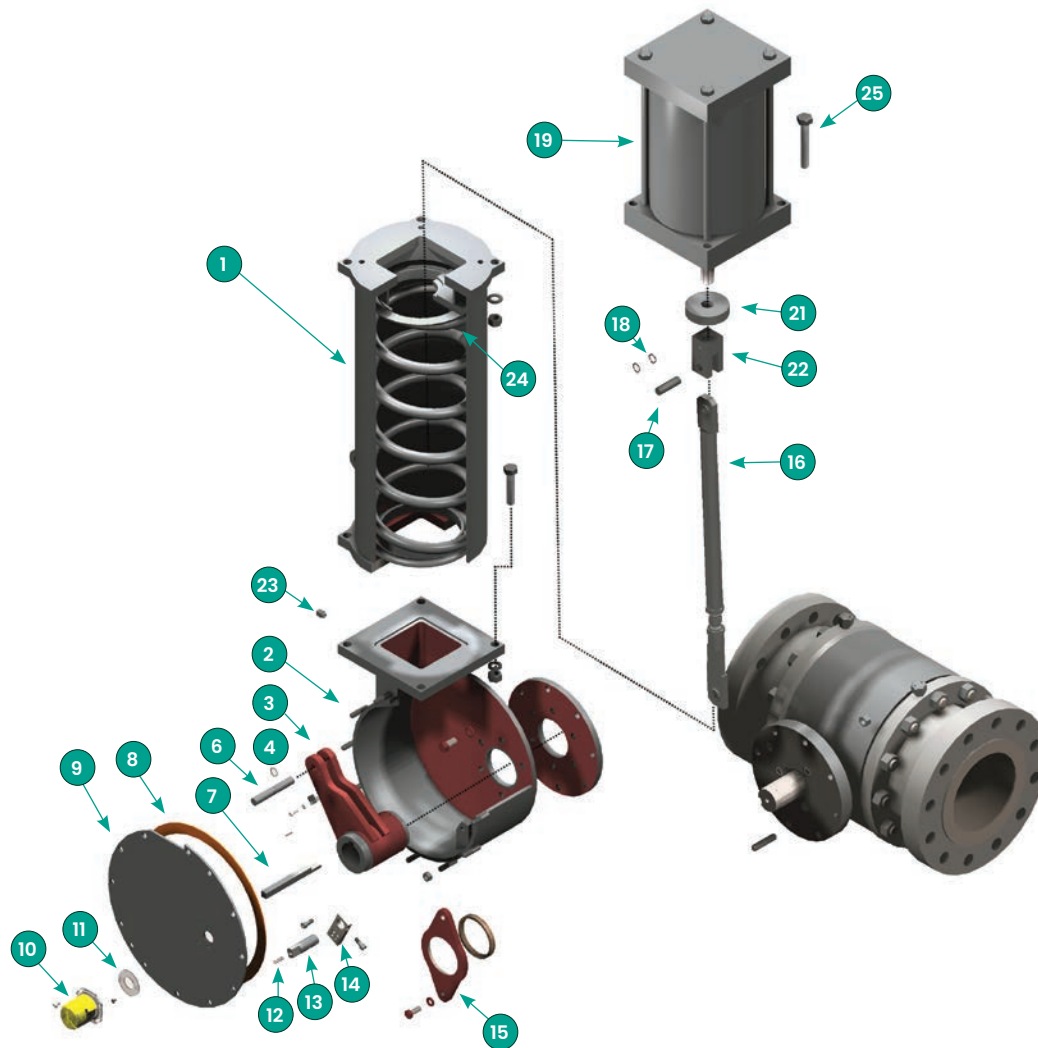
An ESDV must act fast to minimize the effect of a hazardous operating condition. The quarter-turn ball valve design provides an inherently fast operation. Additionally, with its equal percentage flow characteristic (high gain), it not only can close fast but it can significantly decrease the amount of process fluid passing through.

Sizes (DN)		Flow Coefficients ⁽¹⁾	
in.	mm	Cv	Cg
2	50	260	3,269
3	80	550	6,915
4	100	975	12,259
6	150	2,600	32,690
8	200	5,250	66,009
10	250	8,500	106,872
12	300	13,900	174,768
16	400	22,500	282,897

1. Flow coefficients (Cv) based upon ISA sizing equation criteria

Becker Emergency Shutdown Valve (ESDV) can exhibit up to three times more capacity when compared to self-regulating devices and globe- or axial-style valves.

Becker Emergency Shutdown Valve Assembly



Item	Quantity	Description	Material	Item	Quantity	Description	Material
1	1	Spring cartridge	Carbon Steel	14	1	Mounting bracket	Carbon Steel
2	1	Actuator housing	Carbon Steel	15	1	Outboard plate	Carbon Steel w/ Duralon 15
3	1	Torque arm	Carbon Steel	16	1	Adjustable connecting link	Carbon Steel w/ SS Bearings
5	1	Pin clamp	Carbon Steel	17	1	Rod clevis pin	Stress Proof Steel
6	1	Pin clamp	Carbon Steel	18	3	Tru-arc Ring	Carbon Steel
7	1	Torque arm pin	Stress Proof Steel	19	1	Cylinder	Various**
8	1	Gasket	Rubber	21	1	Cylinder rod flange	Carbon Steel
9	1	Cover plate	Carbon Steel	22	1	Rod clevis	Carbon Steel
11	1	Spacer ring	Aluminum	23	1	Housing vent	Plastic
12	1	Spring	Alloy Steel	24	1	Cylinder mtg. nut	Carbon Steel
13	1	Extended stem	Aluminum	25	1	Cylinder mtg. bolt	Carbon Steel



Low Emissions

The Becker VRP-SB-GAP controller measures the process sensing pressure and closes the valve upon reaching high pressure setpoint. It will re-open the valve upon reaching low pressure setpoint. The VRP-SB-GAP controller is able to maintain a control accuracy within $\pm 0.75\%$ of setpoint.

While other pneumatic controllers may continuously vent gas into the atmosphere, the Becker VRP controller features zero steady-state emissions, and when combined with the unique bleed to pressure system (BPS), can eliminate instrumentation emissions.



Smart Technologies

The Becker emergency shutdown valve features the Baker Hughes **Masoneilan™ SVI™ II ESD** smart technology, which was designed using the proven electronic and pneumatic technology from the SVI II AP valve positioner. The SVI II ESD function is designated by a 4–20 mA signal, 0–24 Vdc or a combination of the two.

This device features the following key benefits:

- Captures shutdown events as full-proof test
- Allows continuous HART® communications during a trip
- Executes the valve partial stroke test from any logic server

Reliable: Partial Stroke Test Assured

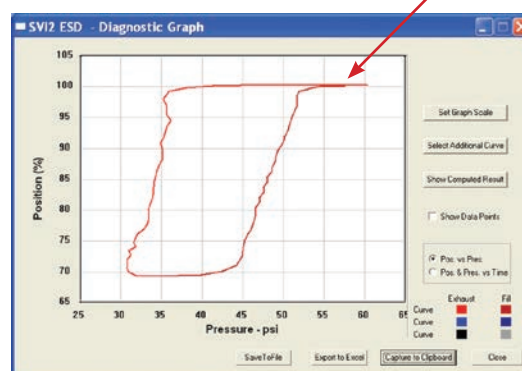
Since the Becker Emergency Shutdown Valve (ESDV) remains open and not in use for prolonged periods, the system's performance and reliability should be checked periodically – but without interrupting operations. Without proper testing, the probability of this component failing when called upon increases over time. Our technology offers test procedures, such as partial stroke testing, an effective and practical method for testing device functionality.

A device that does not have this option is at risk for false trips and potential failure to react when required. Additionally, using devices without this capability may require complete shutdown and the possible removal of equipment from the line. These methods are labor intensive and therefore prone to human error.

Becker's ESDV is capable of both local and remote partial stroke testing through pneumatic or digital configurations. Using a device that can perform partial stroke testing provides the following benefits:

- Eliminates disruptions
- Eliminates need for bypass line
- Improves SIL rating
- Prevents and diagnoses potential problems
- Allows shutoff during testing if emergency signal received

Partial Stroke Test



ESD Partial Signature Data

PST Summary					
	Value		Pass/Fail		
PST Passed Flag	0		Passed		
Friction	4.465		Passed		
Breakout Pressure	4.86		Passed		
Droop	5.795		Passed		
Spring Range	Lower 12.29	Upper 53.355			
Response Time	Exhaust 13.54	Fill 4.91			
View Graph Finish					

Automated Signature Analysis with Pass/Fail

SIL 3 Certified

The complete Becker emergency shutdown valve is rated to Safety Integrity Level 3, or SIL 3. This standard is governed by the International Electrical Committee (IEC). SIL 3 certification validates valve technology has met:

- Risk reduction requirements
- Limitations for random hardware failure
- Quality and engineering procedures to prevent systematic design errors

To achieve a given SIL, the device must have less than the specified probability of dangerous failure and have greater than the specified safe failure fraction. These failure probabilities are calculated by performing a Failure Modes and Effects Analysis (FMEA). The targeted SIL level depends on parameters such as likelihood of an event, device complexity and redundant configurations.

PFD (Probability of Failure on Demand) and RRF (Risk Reduction Factor) for SIL levels set forth in IEC61508 are:

Safety Integrity Level	Average Probability of Failure on Demand (PFD _{AVG})	Risk Reduction Factor (RRF)
SIL 4	$\geq 10^{-5}$ to $< 10^{-4}$	100,000 to 10,000
SIL 3	$\geq 10^{-4}$ to $< 10^{-3}$	10,000 to 1,000
SIL 2	$\geq 10^{-3}$ to $< 10^{-2}$	1,000 to 100
SIL 1	$\geq 10^{-2}$ to $< 10^{-1}$	100 to 10

While risk can never be completely eliminated, using SIL-rated equipment is one means of reducing risk and improving system safety. The SIL calculations provide a third-party statistical evaluation of the unit's long-term reliability and integrity.

All Becker SIL 3-rated emergency shutdown valves come equipped with a safety manual that provides the necessary information to design, install, verify and maintain Safety Instrumented Function (SIF).



