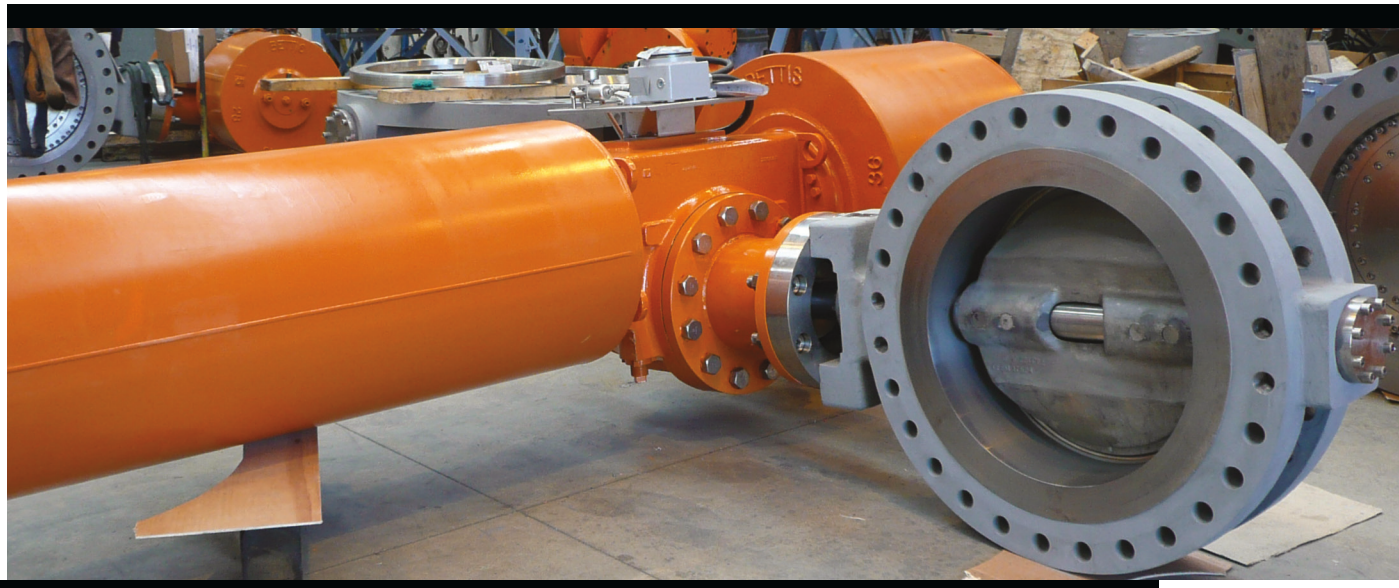
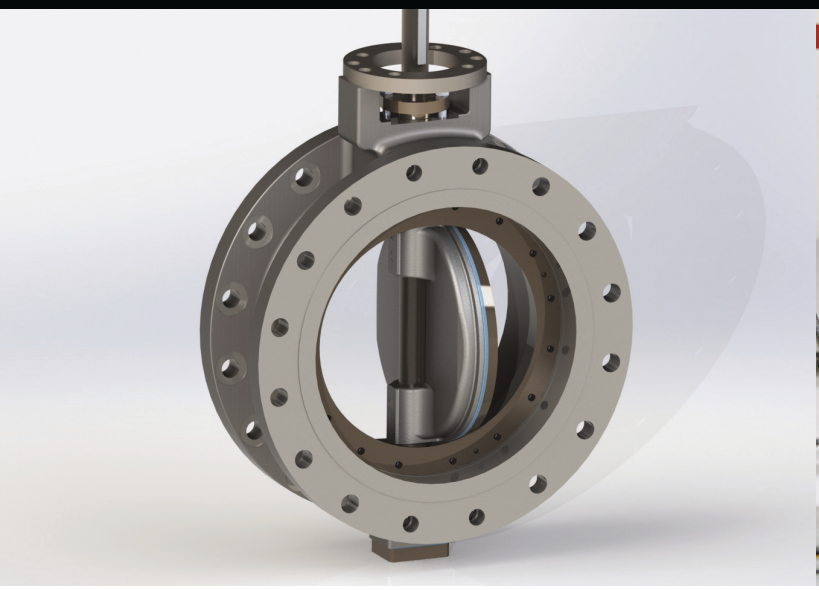
CURTISS-WRIGHT

PermaSeat SP Nuclear Qualified Butterfly Valves



Triple Offset Butterfly Valves

Over 40 Years of Nuclear Experience



Enertech

Enertech, a business unit of Curtiss-Wright Nuclear Division, has been committed to the nuclear power industry since 1967 with the development of the first nuclear qualified hydraulic large bore snubber. Today, Enertech exclusively focuses on providing products and services to the worldwide nuclear power industry including commercial nuclear power plants, NSSS suppliers, A&E's and the U.S. Department of Energy.

Enertech provides the nuclear power industry with one of the largest and most diverse product offerings which includes: valves, actuators, snubbers, instrumentation, and diagnostics and condition monitoring equipment. We have coupled these nuclear qualified products with a team of application and design engineers who can help size and select the best product to exceed the performance and reliability requirements of your application.

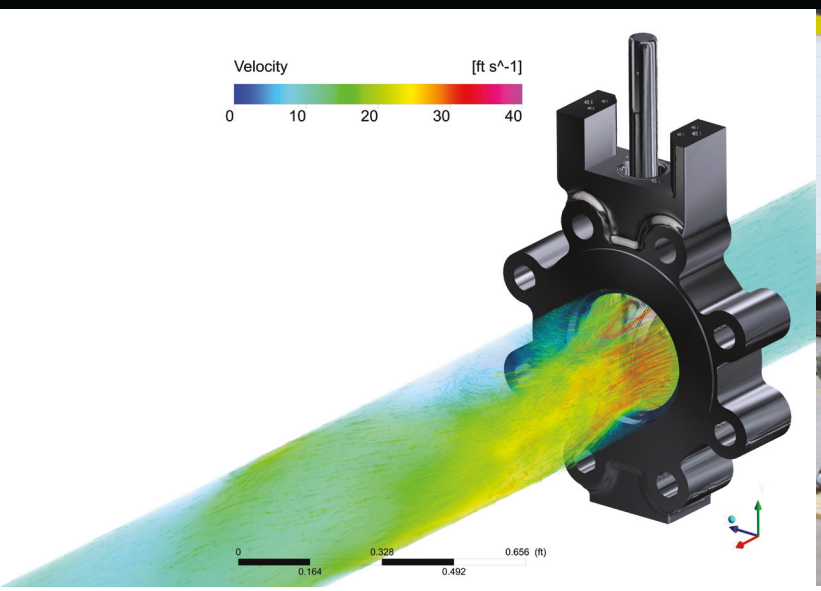
Nuclear Quality Assurance

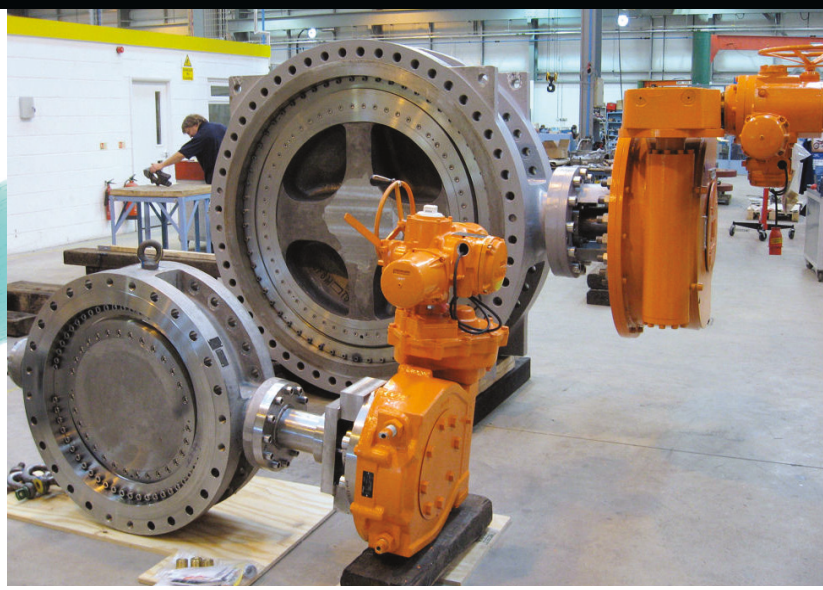
Enertech's extensive certifications demonstrate our firm commitment in complying with the Nuclear Industry's Regulations, Codes, and Standards that provide our valued customers with the most reliable and fully qualified products. Our QA Program has been audited since the early 1990s by the Nuclear Utility Procurement Issues Committee (NUPIC) including observation of the NUPIC Process by the NRC.

PermaSeat SP safety-related and ASME Code butterfly valves are manufactured to the highest quality in accordance with:

- 10CFR50 Appendix B
- ASME N, NR, and NPT Stamps
- ASME Section NQA-1
- ANSI N45.2
- ANSI B16.34
- NRC RG 1.26, 1.28

Activities conducted in accordance with the requirements of the ASME Boiler and Pressure Vessel Code.





Engineering Capabilities

With years of combined nuclear valve experience, we have extensive knowledge in solving industry problems with isolation and throttling valves. Our dedicated nuclear engineering team will listen to your equipment and system challenges and provide an engineering solution that delivers long term reliability.

Analysis and Modeling Capabilities

- State-of-the-art software packages validated according to NQA-1 requirements.
- Finite element analysis modeling
- Structural and flow analysis
- Heat transfer analysis
- Modeling highly complex flows from subsonic to supersonic. Perform failure and root cause analyses and offer solutions to prevent future occurrences.

Actuator Options

Pneumatic

Since 1984, Enertech has partnered with Bettis to provide the industry with qualified pneumatic actuators. Bettis actuators have been successfully used on numerous PermaSeat SP Triple Offset Valves and can meet all PermaSeat SP torque demands.

Electro Hydraulic

Enertech EHO's are fully self-contained electro-hydraulic operators designed for large bore rotary isolation and modulating applications. The actuator is IEEE qualified for both inside and outside containment. The design provides fast acting response in less than five seconds for critical isolation applications and provides post-accident cycling.

Electric

Enertech offers a complete line of motor operated nuclear qualified actuators including the only modulating electric actuator used for valves inside containment. Permaseat SP valves have been used for many years in MOV applications that are subject to 89-10 Regulatory Testing and inspection.

Butterfly Valves

PermaSeat SP

In 1991, Enertech became one of the first nuclear suppliers to introduce Triple Offset Butterfly Valves for safety-related and ASME Code applications. Since then, nearly 700 PermaSeat SP valves have been installed in over 30 nuclear power plants worldwide. With 20 years of nuclear experience and in keeping with our continuous improvement culture, we have enhanced our triple offset design, making it more maintenance friendly and significantly reducing the operating torque of the valve.

These revolutionary improvements resulted in the birth of PermaSeat SP. The PermaSeat SP Triple Offset Butterfly Valve (TOSV) is the only design of its kind that has a field replaceable seal and seat ring. This unique and improved design provides operating torques that are 15% lower than the original design. This allows the reuse of existing actuation when replacing legacy butterfly valves in most cases.

PermaSeat SP valves are installed in a variety of challenging applications that prove the valves' excellent design characteristics in isolation, tight shut-off, and throttling services.

Features

- **Triple Offset Geometry** – Non-rubbing rotation of the segment resulting in less wear, longer life, and tighter shut-off
- **Zero Leakage** – Bi-directional, Class VI shut-off
- **Ease of Maintenance** – Only design that offers a field replaceable seal and seat ring
- **Torque Seated Design** – Able to compensate for temperature and pressure fluctuations
- **Resilient Metal Seat** – Provides repeatable long term sealing performance
- **Flexibility of Design** – Can be designed to the unique requirements of an application
- **Keyed Shaft** – Precision key eliminates backlash and lost motion
- **Non-Galling Design** – Enables a wide variety of material selection
- **Inherently Firesafe Design** – No soft components in construction

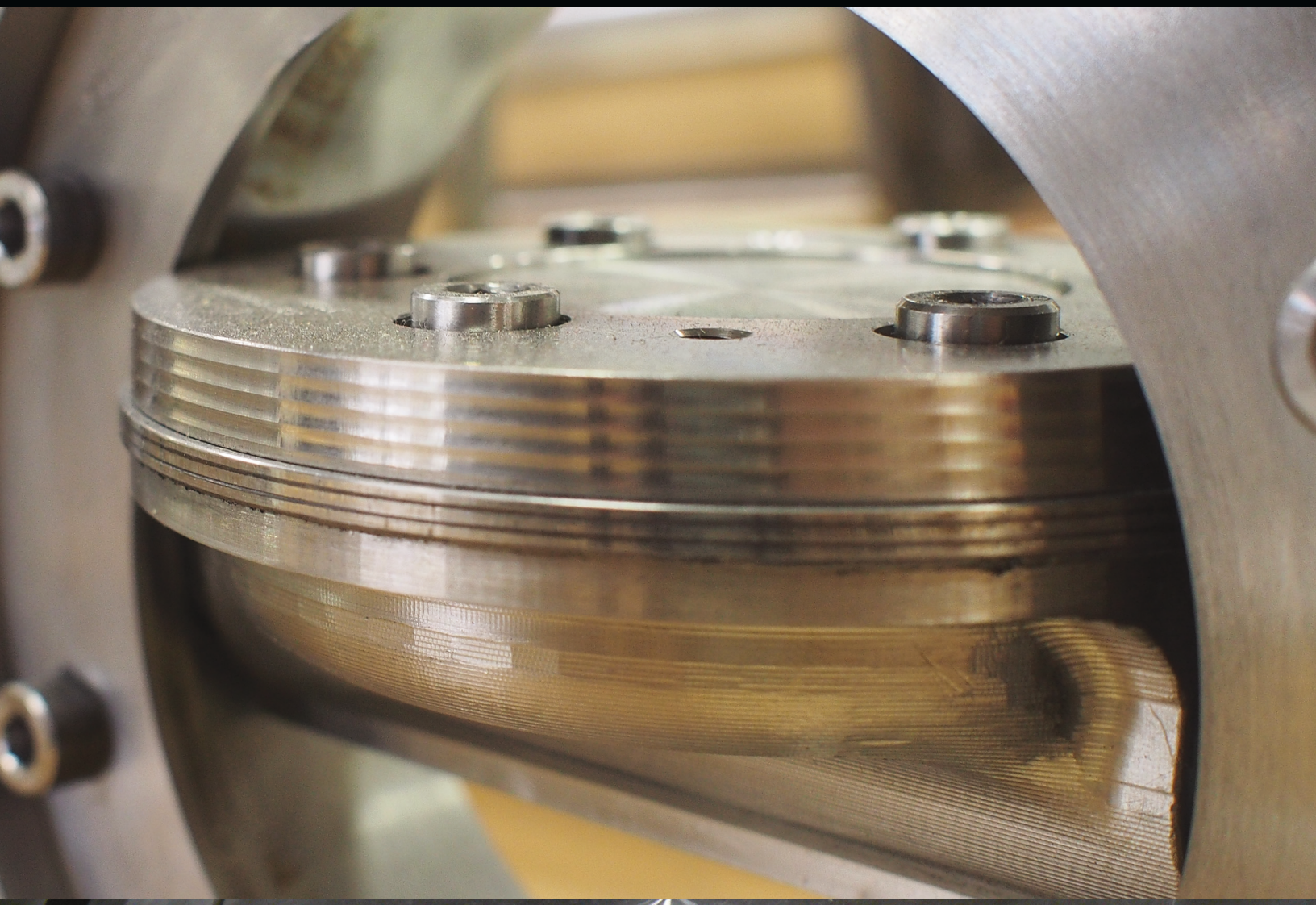
PermaSeat SP Applications

- Service Water Isolation and Flow Control
- Containment Isolation
- Steam Generator Blowdown Isolation
- Component Cooling Water
- Containment Purge/Vent Isolation
- Alt. Decay Heat Removal
- Residual Heat Removal
- Radiation Waste Water Control
- Heater Drain Level Control
- Condensate Polishing Flow Control
- Condensate/Feedwater Loop
- Raw Water Treatment

Specifications

The robust design of the PermaSeat SP metal seated Triple Offset Butterfly Valve has allowed it to operate in both critical isolation and modulating applications. PermaSeat SP offers a full range of sizes from 3" up to 84", pressure ratings up to ANSI Class 2500, and can handle temperatures from -320°F to 1,290°F (-196°C to 699°C).

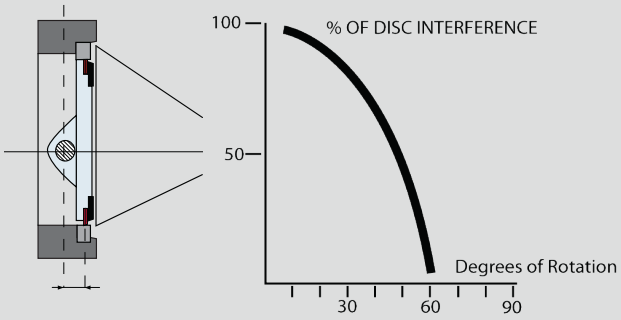
Non-standard face-to-face dimensions can also be accommodated.



Triple Offset Design

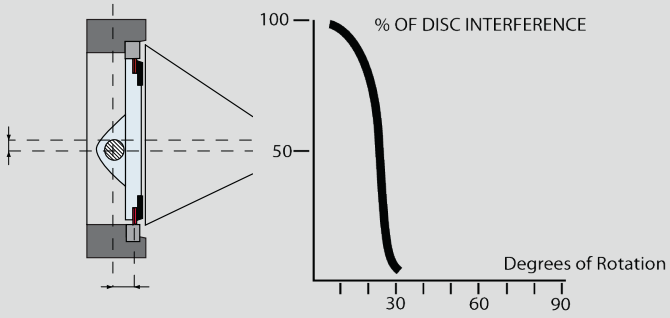
1 Resilient/Single Offset

The shaft centerline is offset away from the centerline of the sealing surface.



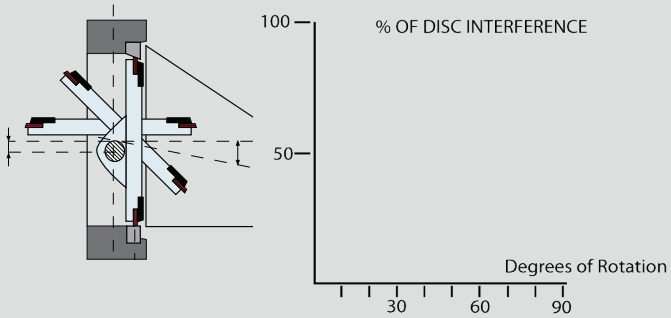
2 Double Offset

The shaft centerline is offset from the pipe/valve centerline to provide the camming action.

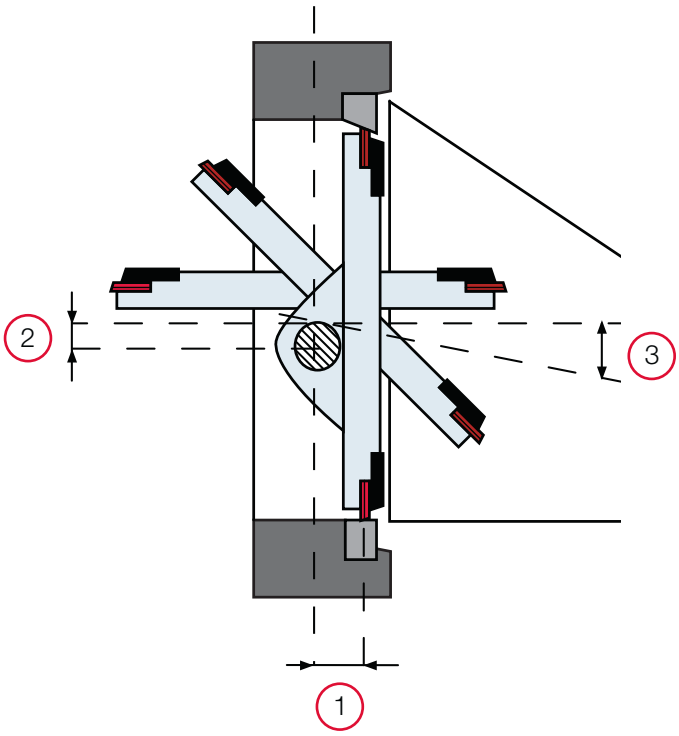


3 Triple Offset

The inclined angle on the conical disc allows for simultaneous engagement of the seal to the seat ring.



- Body
- Replaceable Seat Ring
- Seal Ring Retainer
- Disc/Segment
- Replaceable Laminate Seal (and offset)



Repeatable Tight Shut-off

The PermaSeat SP triple offset geometry is created by offsetting the shaft in two axes, in combination with a tilting cone ellipsoidal segment. This completely removes contact with the seat and seal during the full 90 degree rotation. The laminated seal uses the seat ring as the stopping point, eliminating separate mechanical stops. There is no need for critical settings for disc-to-seat contact to achieve required shut-off. This is particularly beneficial in situations where actuators require several accessories in the control scheme.

When closed, the seat is bi-directionally tight, with zero leakage in both directions. The seat sealing load is torque induced, thus when the disc movement reverses to open, the operating torque quickly reduces. Since there is no rubbing between the seat ring and seal, galling does not occur allowing the same material to be used for both the seal and seat ring.

The PermaSeat SP TOSV has consistently lower operating torques compared to other triple offset designs.

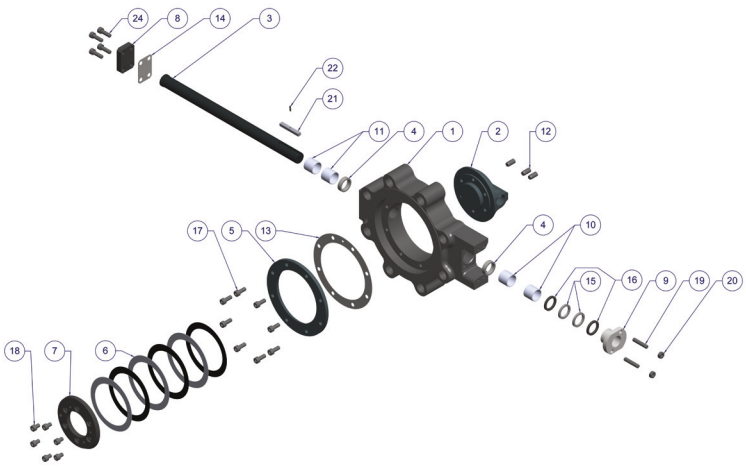
Maintenance Friendly

The PermaSeat SP Triple Offset Butterfly Valve is the only design of its kind with a field replaceable seal and seat ring. There is no need to send the valve back to the OEM, as repair can be conducted on site.

Materials of Construction

Available Materials

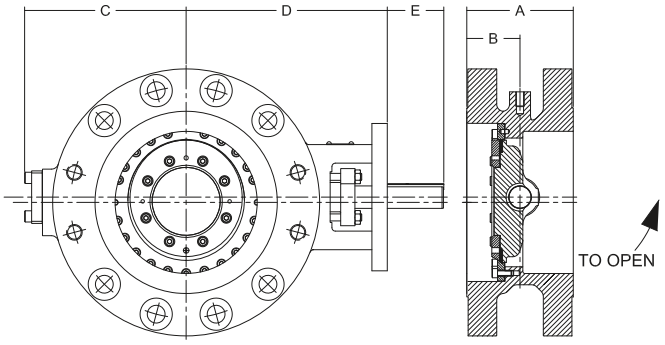
- 300 Series Stainless Steel
- Duplex Stainless Steel
- Carbon Steel
- 6% Moly
- Bronze
- Monel
- Incoloy
- Hastelloy B and C
- Titanium
- Zirconium



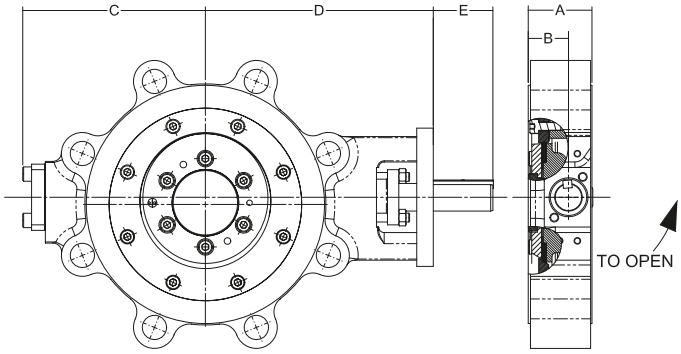
Item	Description	Qty	Material (Carbon Steel Valve)
1	Body	1	Steel ASTM A216 WCB
2	Disc (Segment)	1	Steel ASTM A216 WCB
3	Through Shaft	1	Stainless Steel ASTM A564 Type 630 H110 (17-4ph)
4	Thrust Ring	2	Stainless Steel Type 316/Chrome Plated
5	Seat Ring	1	Stainless Steel Type 316
6	Laminated Seal	1	Stainless Steel Type 316/Supagraph Sheet
7	Clamp Ring	1	Stainless Steel Type 316
8	End Cover	1	Stainless Steel Type 316
9	Gland Plate	1	Stainless Steel Type 316
10	Drive End Bearings	2	Stainless Steel Type 316/Chrome Plated
11	Non Drive End Bearing	2	Stainless Steel Type 316/Chrome Plated
12	Shaft Pin	3	Stainless Steel ASTM A564 Type 630 H110 (17-4ph)
13	Seat Ring Gasket	1	Supagraph Laminated
14	End Cover Gasket	1	Supagraph Laminated
15	Gland Packing	3	Supagraph Passivated P6
16	Gland Packing (Braided)	2	Supagraph Grafpack
17	Seat Ring Screw	4-24	Stainless Steel Grade 304 A2 Class 70
18	Clamp Ring Screw	4-24	Stainless Steel Grade 304 A2 Class 70
19	Gland Plate Stud	2	Stainless Steel Type 316
20	Gland Plate Retaining Nut	2	Stainless Steel Grade 304
21	Key	1	Stainless Steel ASTM A564 Type 630 H1100
22	Rollpin	1	Stainless Steel Grade 304
23	Bearing Protectors	2	Graphoil
24	End Plate Screw	4	Stainless Steel Grade 304 A2 Class 70

ANSI Class 150 Dimensions

Double Flanged Design



Wafer Lugged Design



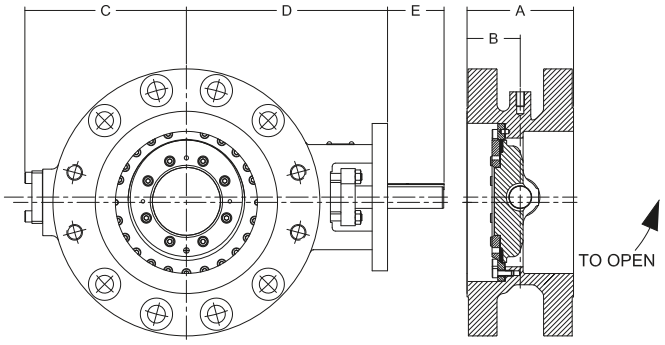
Custom Face-to-Face Dimensions are Available

	Double Flanged Design						Wafer Lugged Design					
Size (in)	Dim. A	Dim. B	Dim. C	Dim. D	Dim. E	Weight (lbs)	Dim. A	Dim. B	Dim. C	Dim. D	Dim. E	Weight (lbs)
3	4.49	2.24	4.92	4.92	4.72	49	1.89	1.14	4.92	4.92	4.72	44
4	4.61	2.50	6.34	5.98	4.72	66	2.13	1.24	6.34	5.98	4.72	62
6	5.51	2.76	6.59	6.97	4.72	84	2.24	1.44	6.61	6.97	4.72	73
8	5.98	2.99	7.95	7.52	5.91	137	2.52	1.63	7.95	7.52	5.91	104
10	6.50	3.25	9.25	9.06	6.30	185	2.80	1.87	9.25	9.06	6.30	176
12	7.01	3.50	11.22	10.63	7.09	269	3.19	1.97	11.22	10.63	7.09	231
14	7.48	3.74	11.30	11.69	7.68	352	3.62	2.30	12.40	11.69	7.68	234
16	8.50	4.25	14.17	11.69	7.68	440	4.02	2.46	14.96	12.80	7.68	407
18	8.74	4.37	15.20	14.02	8.86	495	4.49	2.83	15.20	14.02	8.86	533
20	9.02	4.51	15.83	15.08	8.86	638	5.00	2.97	15.83	15.08	8.86	687
24	10.51	5.26	19.09	18.35	10.83	1023	6.06	3.48	19.09	18.35	10.83	935
26	11.50	5.75	19.09	19.88	10.83	1287	9.02	4.17	19.09	19.88	10.83	1115
28	11.50	5.75	20.28	21.06	10.83	1540	9.02	4.17	20.28	21.06	10.83	1260
30	12.52	6.26	21.46	22.20	11.61	1782	9.02	4.51	23.50	24.41	12.20	1595
32	12.52	6.26	22.83	24.02	11.61	1914	9.02	4.51	23.86	24.41	12.20	1723
34	12.99	6.50	24.02	25.20	12.20	2453	9.49	4.74	24.02	25.20	12.20	2200
36	12.99	6.50	25.00	26.18	12.20	2651	9.49	4.74	25.00	26.18	12.20	2387
38	16.14	8.07	26.38	27.56	12.80	3058	11.81	5.91	26.38	27.56	12.80	2750
40	16.14	8.07	27.36	28.54	12.80	3410	11.81	5.91	27.36	28.54	12.80	3058
42	16.14	8.07	28.54	29.72	12.80	3652	11.81	5.91	28.54	29.72	12.80	3278
44	16.14	8.07	29.53	30.71	12.80	4026	11.81	5.91	29.53	30.71	12.80	3619
46	18.50	9.25	30.71	31.89	13.39	4444	13.78	6.89	30.71	31.89	13.39	3993
48	18.50	9.25	32.09	33.66	13.39	4983	13.78	6.89	32.09	33.66	13.39	4477
50	18.50	9.25	33.27	34.84	13.39	5610	13.78	6.89	33.27	34.84	13.39	5049
52	20.87	10.43	34.06	34.84	13.78	6171	13.78	6.89	34.06	34.84	13.78	5544
54	20.87	10.43	35.43	37.01	13.78	6996	15.35	7.68	35.43	37.01	13.78	6292
56	20.87	10.43	36.81	38.39	14.17	7788	15.35	7.68	36.81	38.39	14.17	7007
58	23.62	11.81	37.99	39.57	14.17	8250	15.35	7.68	37.99	39.57	14.17	7425
60	23.62	11.81	38.98	41.34	14.57	8866	17.32	8.66	38.98	41.34	14.57	7975
64	23.62	11.81	40.75	44.29	14.57	11275	17.32	8.66	40.75	44.29	14.57	10120
72	26.38	13.19	46.06	48.43	14.57	13145	19.29	9.65	46.06	48.43	14.57	11825
80	29.92	14.96	49.02	49.21	15.35	18040	21.26	10.63	49.02	52.17	15.35	16236
84	29.92	14.96	52.76	55.91	15.35	24310	21.26	10.63	52.76	55.91	15.35	21879

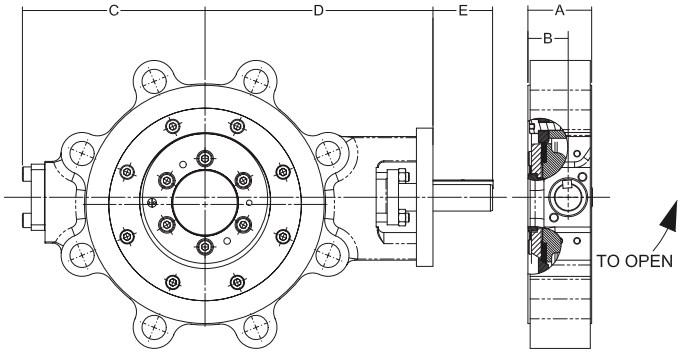
* All dimensions are approximate and subject to change

ANSI Class 300 Dimensions

Double Flanged Design



Wafer Lugged Design

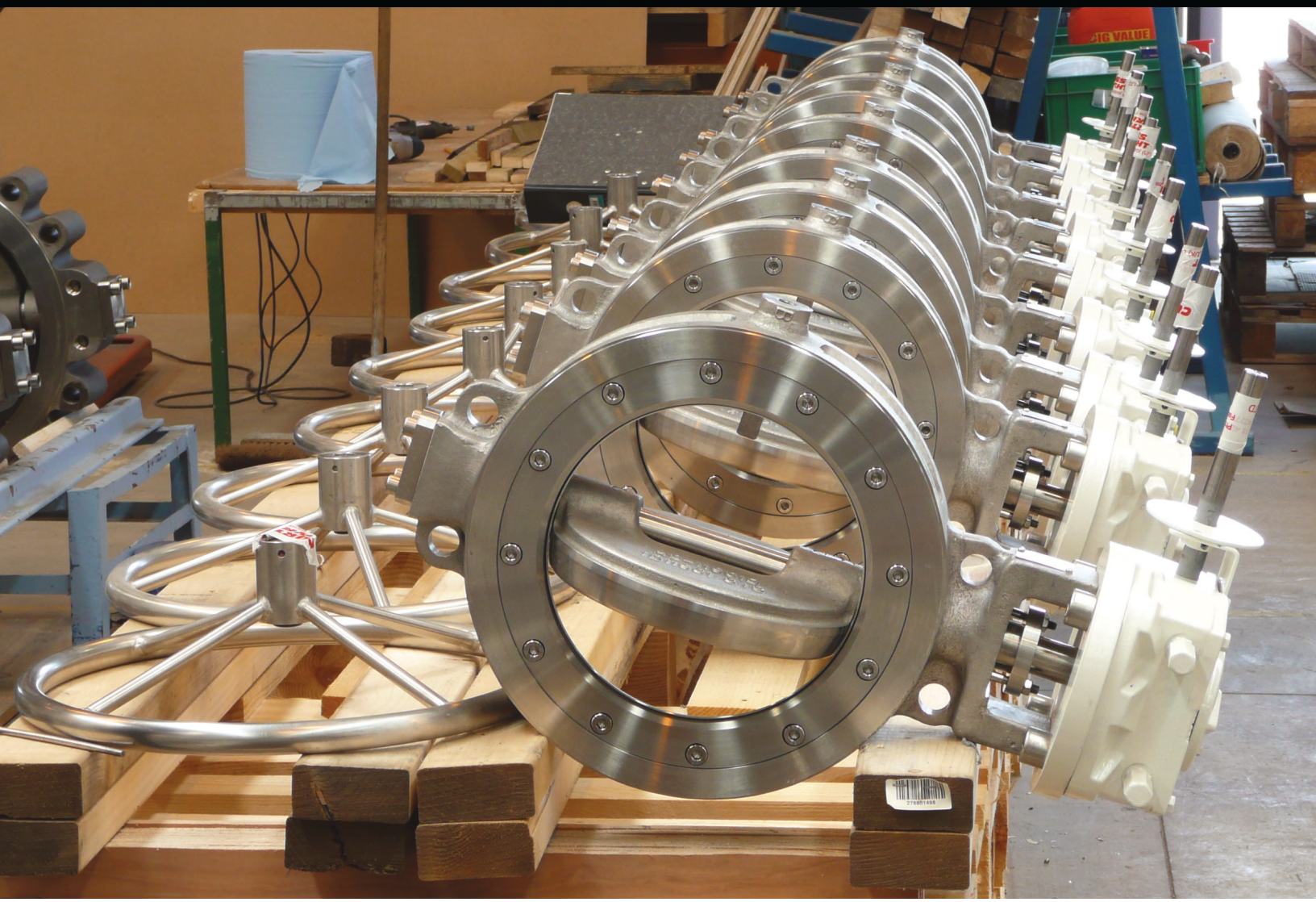


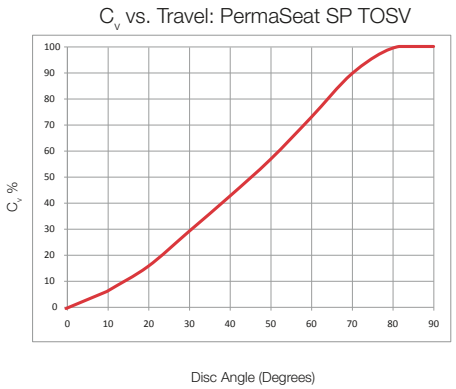
Custom Face-to-Face Dimensions are Available

	Double Flanged Design						Wafer Lugged Design					
Size (in)	Dim. A	Dim. B	Dim. C	Dim. D	Dim. E	Weight (lbs)	Dim. A	Dim. B	Dim. C	Dim. D	Dim. E	Weight (lbs)
3	4.49	2.24	5.12	4.92	4.72	55	1.89	1.14	5.12	4.92	4.72	51
4	5.00	2.50	6.22	5.98	4.72	91	2.13	1.24	6.22	5.98	4.72	73
6	5.51	2.76	7.64	6.97	5.91	128	2.32	1.44	7.62	6.97	5.91	119
8	5.98	2.99	9.06	8.07	7.09	187	2.87	1.63	9.06	8.07	7.09	185
10	6.50	3.25	10.24	9.80	7.68	260	3.27	1.87	11.10	9.80	7.68	275
12	7.01	3.50	12.01	11.61	7.68	385	3.62	1.97	12.28	11.61	7.68	348
14	7.48	3.74	13.07	13.27	8.86	550	4.61	2.30	13.07	13.27	8.86	612
16	8.50	4.25	14.37	14.17	10.24	600	5.24	2.62	15.24	14.17	10.24	808
18	8.74	4.37	16.06	16.02	12.80	869	5.87	2.87	16.97	16.02	12.80	1078
20	9.02	4.51	17.83	17.44	12.80	957	6.26	3.13	18.27	17.44	12.80	1078
24	10.51	5.26	20.47	21.26	14.76	1892	7.13	3.56	21.93	21.26	14.76	1529
26	11.50	5.75	21.06	22.64	14.76	2310	9.02	4.17	22.24	22.64	14.69	1945
28	11.50	5.75	22.83	24.02	14.76	2673	9.02	4.17	22.83	24.02	14.76	2310
30	12.52	6.26	23.82	25.00	15.55	3410	9.02	4.51	25.63	25.39	15.55	2992
32	12.52	6.26	25.00	26.18	15.55	3652	9.49	4.51	26.18	26.38	15.55	3641
34	12.99	6.50	26.18	27.36	15.55	3971	9.49	4.74	26.18	27.36	14.37	3971
36	12.99	6.50	26.18	28.54	15.55	4554	9.49	4.74	27.36	28.54	15.55	4356
38	16.14	8.07	26.38	28.54	15.55	4653	11.81	5.91	27.36	28.54	15.55	5060
40	16.14	8.07	27.36	28.54	16.14	5225	11.81	5.91	27.36	28.54	16.14	5654
42	16.14	8.07	28.54	29.72	16.14	6270	11.81	5.91	28.54	29.72	16.14	6160
44	16.14	8.07	29.53	30.71	16.14	6974	11.81	5.91	29.53	30.71	16.14	6600
46	18.50	9.25	30.71	31.89	16.54	7700	13.78	6.89	30.71	31.89	16.54	7150
48	18.50	9.25	32.09	34.84	16.54	8778	13.78	6.89	32.09	33.66	16.54	7832
50	18.50	9.25	33.27	34.84	16.93	9350	13.78	6.89	33.27	34.84	16.93	8470
52	20.87	10.43	34.06	34.84	16.93	10340	13.78	6.89	34.06	34.84	16.93	9570
54	20.87	10.43	35.43	37.01	16.93	11440	15.35	7.68	35.43	37.01	16.93	11000
56	20.87	10.43	36.81	38.39	17.72	12760	15.35	7.68	36.81	38.39	17.72	12540
58	23.62	11.81	37.99	39.57	17.72	14300	15.35	7.68	37.99	39.57	17.72	13662
60	23.62	11.81	38.98	41.34	18.50	18700	17.32	8.66	38.98	41.34	18.50	14960
64	23.62	11.81	50.59	54.33	18.50	22440	17.32	8.66	50.59	54.33	18.50	19030

* All dimensions are approximate and subject to change

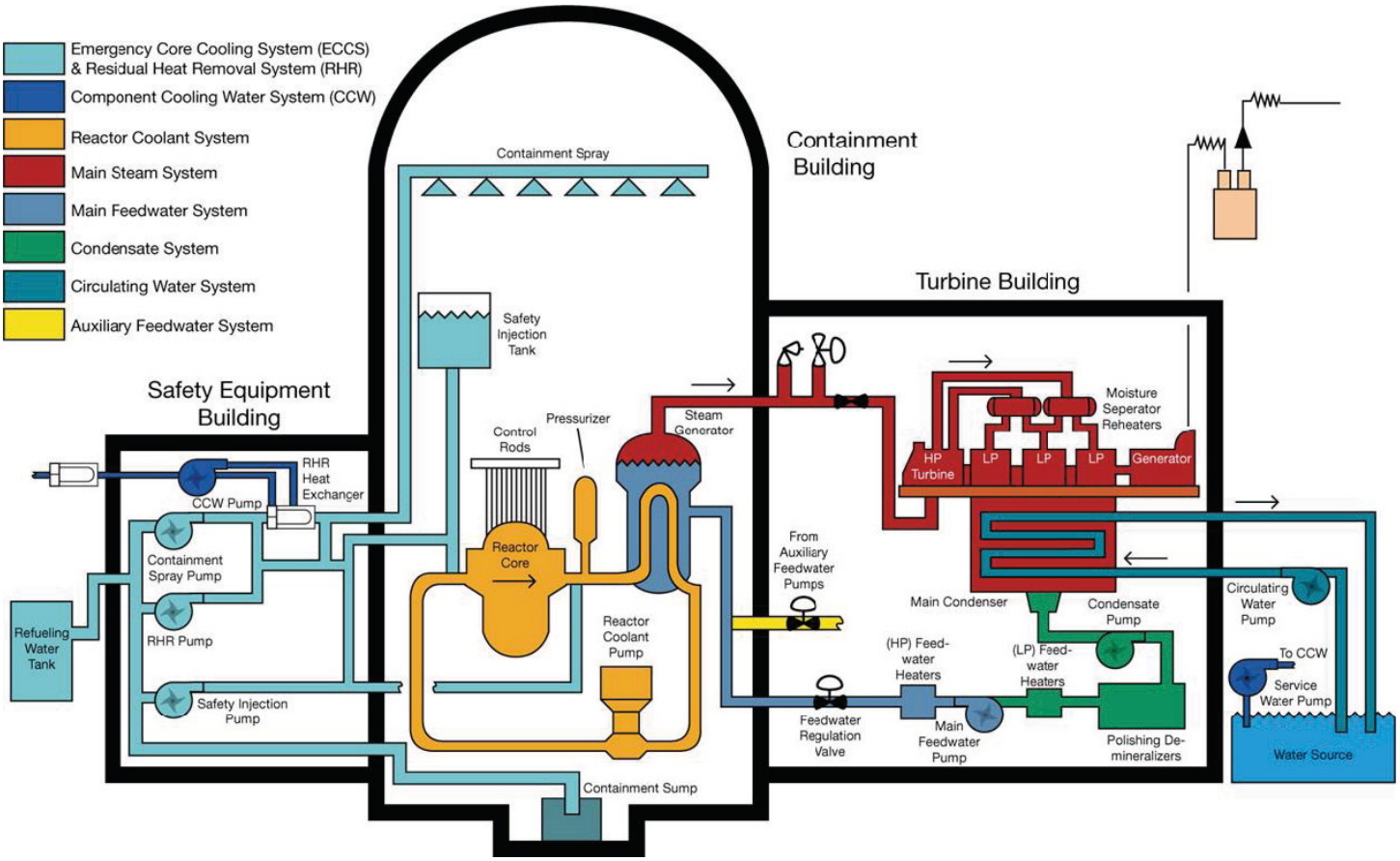
Application Highlights





	Rated C_v																	
ANSI	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	30"	32"	40"	48"	52"	60"	72"
150	96	216	387	1243	1877	3078	4300	6146	7597	10279	16490	21547	33659	45560	66883	79433	97673	152619
300	128	216	504	992	1583	2872	3821	5143	6100	8393	13464	18782	22982	38216				
600		43	159	541	849	1329	1599	1958	2703	3391	6270	11033	13831					

System Reliability



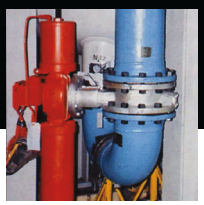
Application Highlight (CCW System)

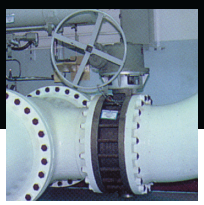
During the construction of a PWR plant in the Midwest, a variety of safety-related rubber lined butterfly valves ranging from 3” to 16” were installed in the Component Cooling Water system (CCW). These valves are used for throttling and also serve an isolation function during outages. Since rubber lined valves are usually not designed for throttling service, the plant has recorded instances of the valve seat actually becoming detached from the body.

The PermaSeat SP Triple Offset Butterfly Valve is specifically designed for both isolation and modulating applications. The PermaSeat SP triple offset geometry is created by offsetting the shaft in two axes, combined with the tilting cone ellipsoidal segment. This completely removes contact with the seat and seal over the full 90 degree movement. There is absolutely no seat to seal interference in our design. Since there is no rubbing between the seat ring and seal, galling does not occur, allowing the same material to be used for both parts. The stainless steel/graphite laminate seat provides repeatable tight shut-off and improvement over a soft seat design.

First in Customer Service to the Global Nuclear Power Industry

Enertech, a business unit of Curtiss-Wright Nuclear Division, is an engineering, manufacturing, distribution and service company committed to providing solutions to meet the unique requirements of the nuclear power industry. Enertech provides integrated system solutions that include advanced valves, actuators, instrumentation, snubbers, diagnostic and test equipment, qualification and dedication services, outage support services, equipment repair, and field service. Whether it's solving chronic component related problems, obsolescence challenges, maintaining and upgrading installed equipment, assisting with plant life extensions or supporting new reactor construction, we have solutions to maximize performance.





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