

BUTTERFLY VALVES



High Performance Butterfly Valves



Sealing principle of “b” eccentric HPBV

Zero Offset:

Concentric valve (zero offset). Disc rotates around the centre axis. Sealing is achieved by the disc deforming the soft seal, resulting in full friction through the full operating cycle.

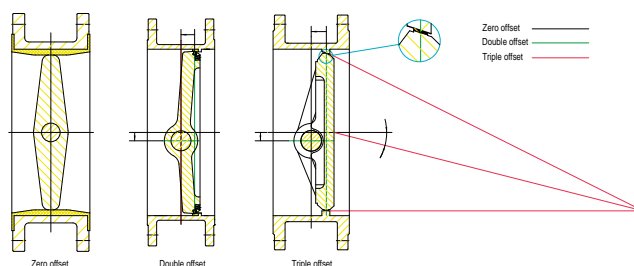
Double Offset:

To allow displacement of the seat, the shaft is offset from the centre line of the disc seat and body seal (offset one), and the centre line of the bore (offset two). This creates a cam action during operation to lift the seat out of the seal resulting in friction during the first 10 degrees of opening and final 10 degrees of closing.

The double-offset disc design allows the disc to move off the seat, reducing break-away torque and seat wear.

Triple Offset:

The third offset is the geometry design of the sealing components, not the shaft position. The sealing components are each machined into an offset conical profile resulting in a right angled cone. This ensures friction free movement throughout its operating cycle. Contact is only made at the final point of closure with the 90° angle acting as a mechanical stop; resulting in no over travel of the disc seat.

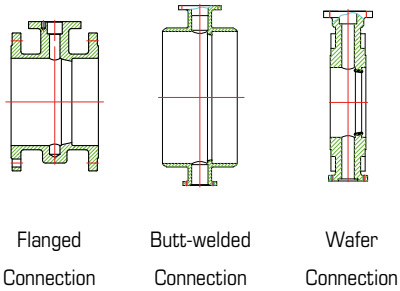


Benefits of a Double / Triple Offset Butterfly Valve

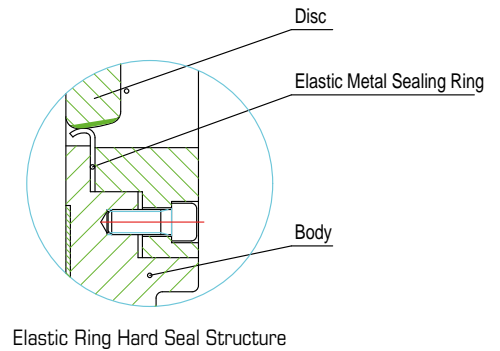
1. The 'cam action' and 'right angled conical sealing' design ensures that the metal sealing components are never in contact until its final degree of closing, resulting in repeatable sealing and a vastly extended valve life
2. Low torques result in low cost of automation.
3. Cavities do not exist between sealing components in comparison to some conventional, concentric valves, therefore eliminating the ingress of particles.
4. Metal to metal sealing is allowing for higher pressure and temperature applications whilst still providing bubble-tight shut off.
5. Ideal for use in controlling or throttling applications.
6. Torque seated resulting in bi-directional, non-pressure aided frictionless seating.

Butterfly valves are used to open and close (seal type) or adjust the medium flow in pipes in the fields of foodstuff, drinks, chemical, industrial water treatment, high-rise constructions, water supply and drainage etc. They are mainly structured as following:

1. Simple structure, small sizes, light weight and low installation dimensions. According to the types of body connection, they are basically classified to wafer-type, lug-type, flanged and butt-welded.

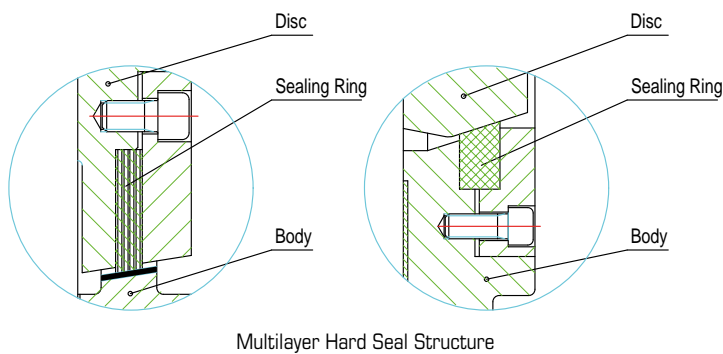


3. Elastic ring hard seal structure (see fig. below) is of the structure of J-type metal sealing ring. It is applicable for double eccentric butterfly valves with a pressure rating \leq Class 300. Provided with fireproof structure to adapt to conditions with great temperature changes it is an outstanding seal, guaranteeing a long service life and minimal maintenance.



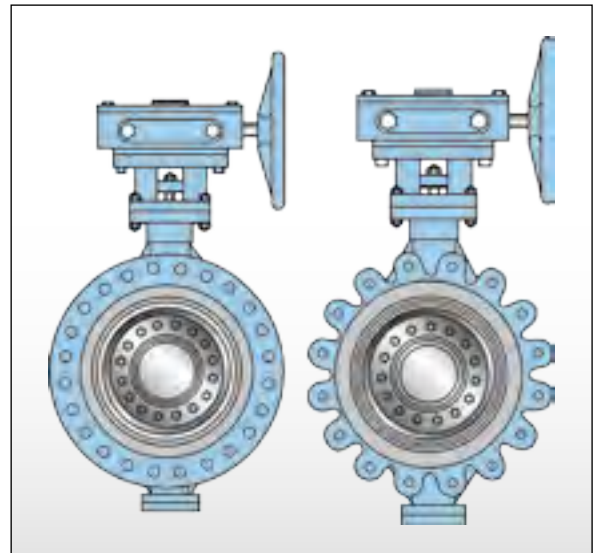
2. Multilayer Hard Seal Structure (See fig. below)

Multilayer hard seal structure is applicable for double and triple eccentric butterfly valves, pressure rating \leq Class 600. Triple eccentric butterfly valve can maintain bidirectional leak-tightness. The multilayer sealing ring is composition of stainless steel and nonmetal material. The nonmetal material can be flexible graphite, PTFE or non asbestos material etc. according to the actual working conditions.

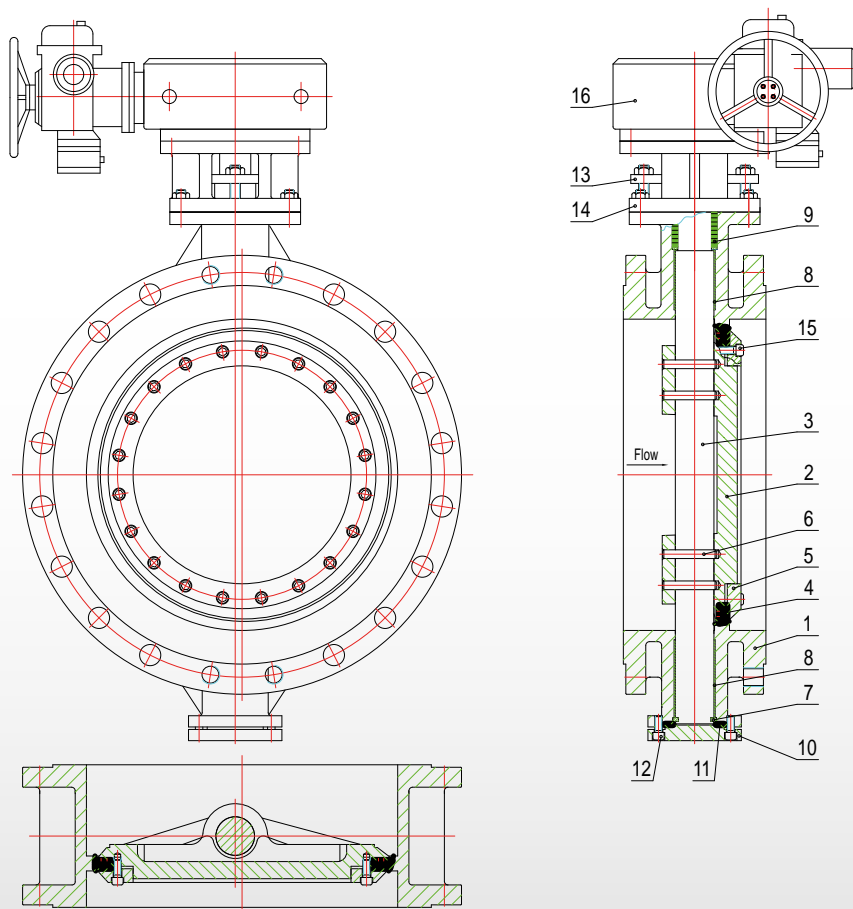


4. Low flow resistance in open position.

5. Low torque, easy and quick operation.



The Triple Offset Geometry

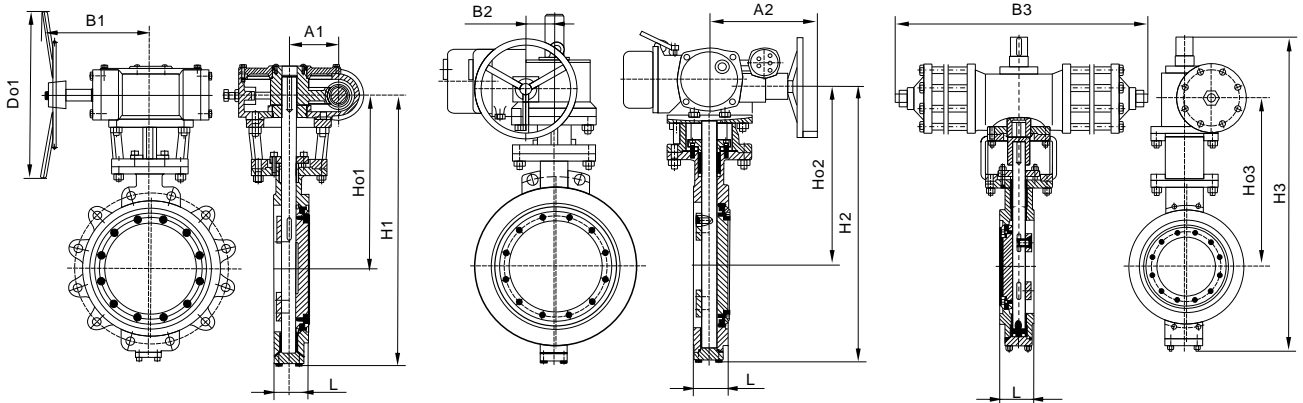


ASTM Material list of Triple Eccentric Seal Butterfly Valves

No.	Part Name	Carbon Steel to ASTM	Stainless Steel to ASTM
1	Body	A216 WCB, A352 LCB	A351 CF3(8), CF3M(8M)
2	Disc	A216 WCB, A352 LCB	A351 CF3(8), CF3M(8M)
3	Stem	A182 F6a, F304	A182 F304(L), F316(L), F51, 17-4PH
4	Sealing Ring	Graphite+304	
5	Retainer Flange	A105, LF2, F6a	A182 F304(L), F316(L)
6	Pin	A276 410, 420	A276 304(L), 316(L), 17-4PH
7	Anti-blow out ring	A182 F6a, F304	A182 F304(L), F316(L), 17-4PH
8	Bearing	PTFE+Bronze, Bronze	
9	Packing	PTFE, (Flexible) Graphite+304	
10	Cover	A105, LF2, F6a	A182 F304(L), F316(L)
11	Gasket	PTFE, (Flexible) Graphite+304	
12	Screw	A193 B7(M), L7(M)	A193 B8(M)
13	Gland Flange	A216 WCB, A352 LCB	A351 CF3(8), CF3M(8M)
14	Yoke	A216 WCB, A352 LCB	A216 WCB, A351 CF3(8), CF3M(8M)
15	Screw	A193 B7(M), L7(M)	A193 B8(M)
16	Actuator	Component	

- Other types of HPBV executions available upon request.
- Please consult certified drawings for final execution.

CTS Series 85, 88 and 98



Worm Gear Driven Lug Butterfly Valve

Electric Operated Wafer Butterfly Valve

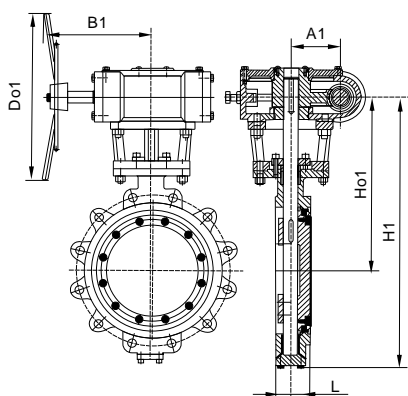
Hydraulic Operated Wafer Butterfly Valve

CLASS 150		Dimensions (mm)													
inch	L	Pneumatically or hydraulically driven			Worm gear					Electrically actuated*				Weight (kg)*	
		H3	Ho3	B3	H1	Ho1	B1	A1	Do1	H2	Ho2	B2	A2	Wafer	Lug
3"	49	-	-	-	320	185	140	63	160	513	263	178	180	9	9
4"	54	-	-	-	342	195	140	63	160	535	282	178	180	11	14
5"	57	-	-	-	365	209	140	63	300	563	293	178	180	15	18
6"	58	-	-	-	415	243	140	63	300	602	322	178	180	17	20
8"	64	690	323	275	510	263	150	84	400	745	296	235	370	25	31
10"	71	750	355	275	567	295	150	84	400	805	325	235	370	40	49
12"	81	955	475	378	665	342	200	108	600	883	365	235	370	61	79
14"	92	1032	513	378	739	385	200	108	600	965	408	235	370	82	107
16"	102	1182	598	530	825	430	240	152	600	1033	443	235	370	123	150
18"	114	1265	635	530	910	469	240	152	800	1120	485	235	370	150	182
20"	127	1335	667	530	990	500	300	168	800	1186	518	235	370	204	253
24"	154	1642	830	680	1210	618	320	192	800	1380	625	235	370	300	398
30"	167	1823	1245	680	1453	875	512	279	400	1583	1005	245	515	454	490
36"	184	2145	1329	860	1775	939	512	279	400	1905	1089	245	515	762	771
40"	217	2235	1488	860	1857	1005	512	279	400	2010	1110	360	540	975	1179
42"	222	2360	1456	860	1980	1086	512	279	400	2120	1216	360	540	1234	1338
46"	254	2445	1505	1080	2070	1110	570	368	600	2175	1260	360	540	1451	1724
48"	254	2535	1564	1080	2165	1194	570	368	600	2235	1324	360	540	1678	1928
54"	305	-	-	-	2382	1477	630	425	800	2412	1503	445	628	2223	2634
60"	333	-	-	-	2684	1617	630	425	800	2699	1687	445	628	2903	3447

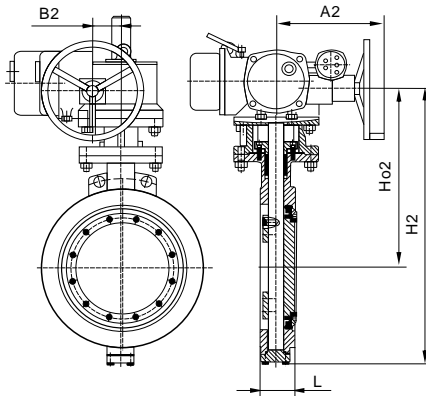
* Note: Actuators and weight dimensions are manufacturer's design.

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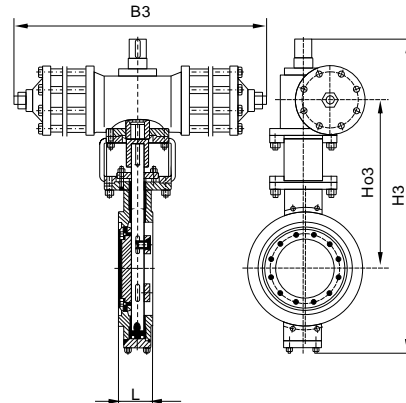
CTS Series 85, 88 and 98



Worm Gear Driven Lug Butterfly Valve



Electric Operated Wafer Butterfly Valve



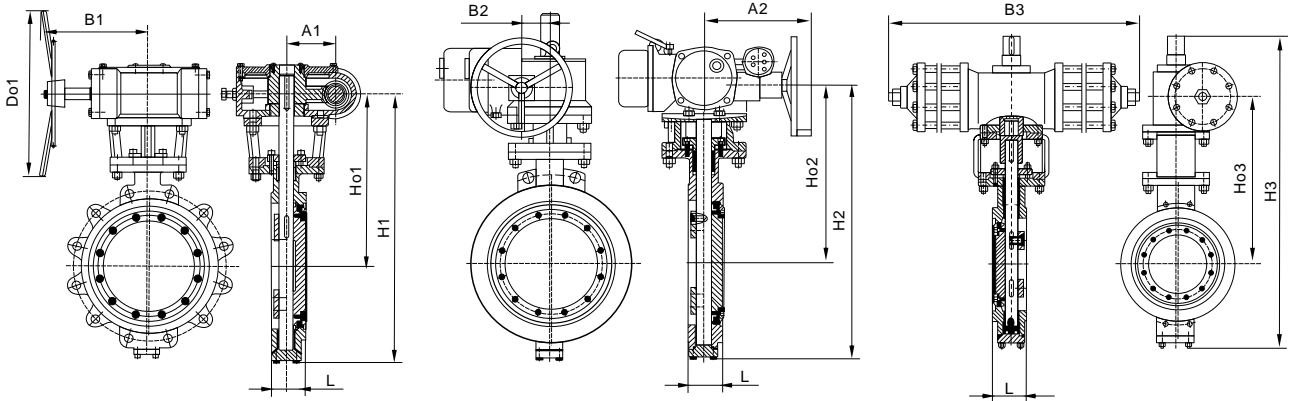
Hydraulic Operated Wafer Butterfly Valve

CLASS 300		Dimensions (mm)													
inch	L	Pneumatically or hydraulically driven			Worm gear					Electrically actuated*				Weight (kg)*	
		H3	Ho3	B3	H1	Ho1	B1	A1	Do1	H2	Ho2	B2	A2	Wafer	Lug
3"	49	-	-	-	320	185	140	63	160	513	263	178	180	13.5	15.5
4"	54	-	-	-	342	195	140	63	160	535	282	178	180	18	21
5"	57	-	-	-	365	209	140	63	300	563	293	178	180	24	28
6"	59	-	-	-	415	243	140	63	300	602	322	178	180	28	34
8"	73	750	368	275	510	263	150	84	400	745	296	235	370	49	60
10"	83	909	442	278	567	295	150	84	400	805	325	235	370	68	88
12"	92	1075	535	530	665	342	200	108	600	883	365	235	370	109	117
14"	117	1158	575	530	739	385	200	108	600	965	408	235	370	186	207
16"	133	1230	610	530	825	430	240	152	600	1033	443	235	370	264	308
18"	149	1462	736	680	910	469	240	152	800	1120	485	235	370	297	408
20"	159	1328	765	680	990	500	300	168	800	1186	518	235	370	363	468
24"	181	-	-	-	1210	618	320	192	800	1380	625	235	370	454	748
30"	254	-	-	-	1937	1180	512	279	600	1516	716	360	540	816	1338
36"	305	-	-	-	2198	1298	570	368	600	1669	794	360	540	1429	2154
42"	324	-	-	-	2318	1358	570	368	600	1914	914	360	540	2155	2427

* Note: Actuators and weight dimensions are manufacturer's design.

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CTS Series 85, 88 and 98



Worm Gear Driven Lug Butterfly Valve

Electric Operated Wafer Butterfly Valve

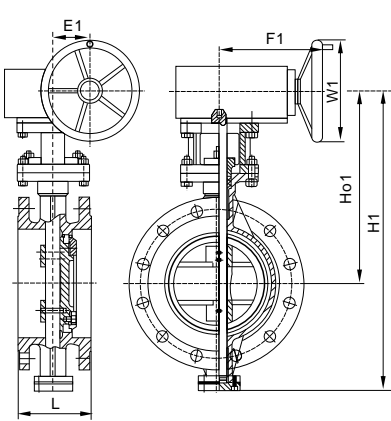
Hydraulic Operated Wafer Butterfly Valve

CLASS 600		Dimensions (mm)													
inch	L	Pneumatically or hydraulically driven			Worm gear					Electrically actuated*				Weight (kg)*	
		H3	Ho3	B3	H1	Ho1	B1	A1	Do1	H2	Ho2	B2	A2	Wafer	Lug
6"	78	-	-	-	415	243	140	63	300	602	322	178	180	45	56
8"	102	750	368	275	510	263	150	84	400	745	296	235	370	70	94
10"	117	909	442	378	567	295	150	84	400	805	325	235	370	103	141
12"	140	1075	535	530	665	342	200	108	600	883	365	235	370	149	201
14"	155	1158	572	530	739	385	200	108	600	965	408	235	370	243	333
16"	178	1230	610	530	825	430	240	152	600	1033	443	235	370	318	401
18"	200	-	-	-	910	469	240	152	800	1120	485	235	370	431	575
20"	216	-	-	-	990	500	300	168	800	1186	518	235	370	472	708
24"	232	-	-	-	1210	618	320	192	800	1380	625	235	370	826	1061

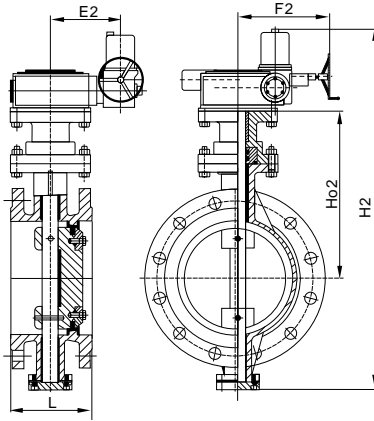
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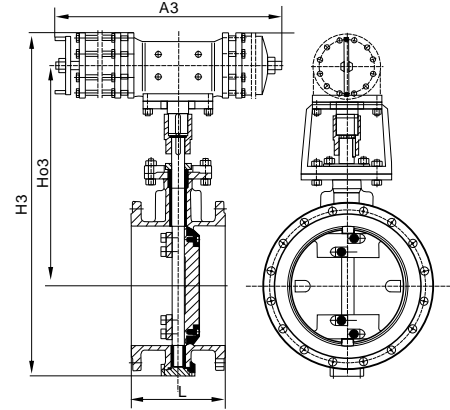
CTS Series 85, 88 and 98



Worm Gear Driven Flanged Butterfly Valve



Electric Operated Flanged Butterfly Valve



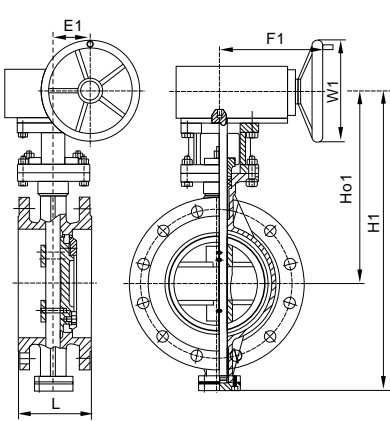
Hydraulic Operated Flanged Butterfly Valve

CLASS 150		Dimensions (mm)												
inch	L	Worm gear					Electrically actuated*				Pneumatically or hydraulically driven			Weight (kg)*
		H1	Ho1	E1	F1	W1	H2	Ho2	E2	F2	H3	Ho3	A3	Worm gear
3"	114	472	350	50	203	203	513	263	180	178	-	-	-	15.4
4"	127	520	386	60	191	203	535	282	180	178	-	-	-	23
5"	140	580	395	60	215	250	563	293	180	178	-	-	-	29
6"	140	653	475	67	289	305	602	322	180	178	-	-	-	33
8"	152	773	565	67	308	460	745	296	370	235	690	323	275	50
10"	165	880	640	86	346	460	805	325	370	235	750	355	275	73
12"	178	989	711	111	403	610	883	365	370	235	955	475	378	108
14"	190	1044	760	60	601	356	965	408	370	235	1032	513	378	143
16"	216	1142	826	60	605	457	1033	443	370	235	1182	598	530	186
18"	222	1228	887	60	652	610	1120	485	370	235	1265	635	530	234
20"	229	1337	959	60	805	762	1186	518	370	235	1335	667	530	277
24"	267	1554	1109	103	763	762	1380	625	370	235	1642	830	680	408
28"	292	1456	956	245	400	315	1587	745	515	245	1711	859	680	653
30"	308	1541	991	310	460	400	1650	777	515	245	1782	910	680	816
32"	318	1611	1036	310	460	400	1717	810	515	245	1856	942	680	914
36"	330	1743	1103	410	480	400	1870	875	540	360	1920	975	680	1157
40"	410	1868	1173	410	480	400	2030	965	540	360	-	-	-	1610
44"	450	1968	1223	410	480	400	2078	1022	540	360	-	-	-	2160
48"	470	2145	1320	520	640	400	2188	1100	540	660	-	-	-	2359
52"	490	2300	1405	520	640	400	2214	1150	565	385	-	-	-	2720
56"	530	2440	1475	520	640	400	2328	1325	565	385	-	-	-	3353
60"	570	2594	1559	450	785	630	2530	1515	565	385	-	-	-	3629

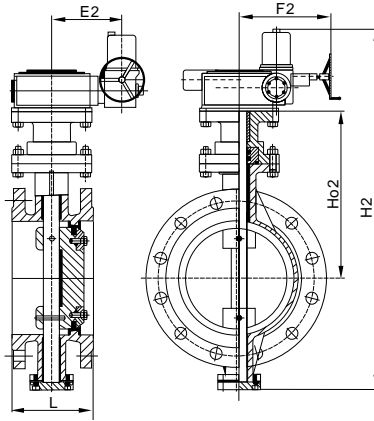
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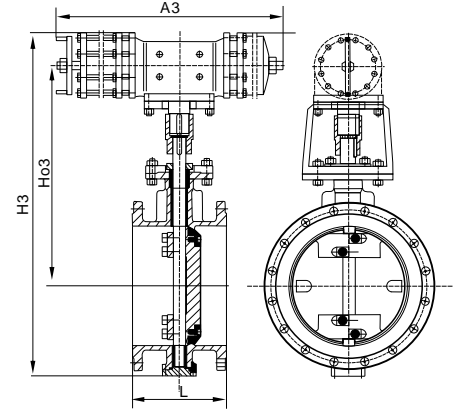
CTS Series 85, 88 and 98



Worm Gear Driven Flanged Butterfly Valve



Electric Operated Flanged Butterfly Valve



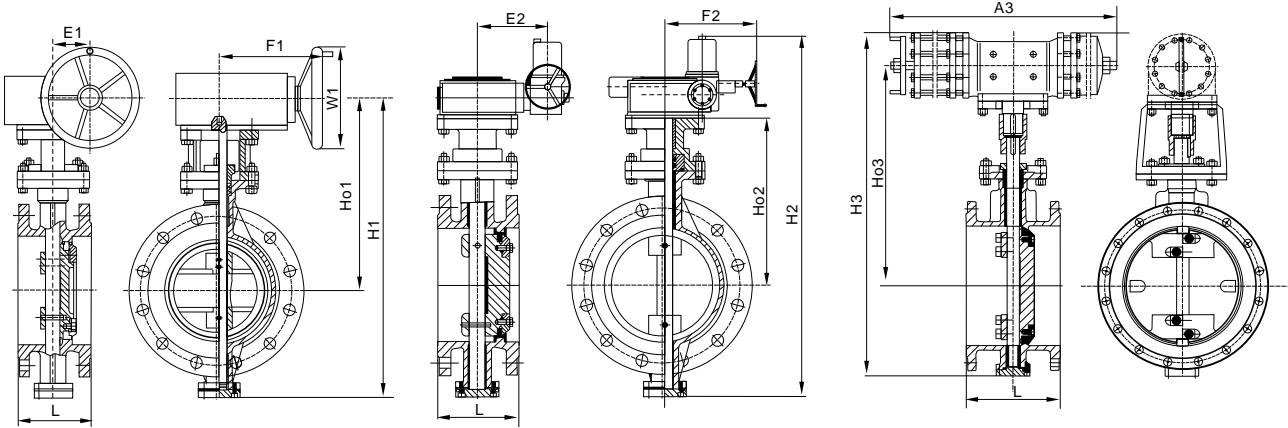
Hydraulic Operated Flanged Butterfly Valve

CLASS 300		Dimensions (mm)												
inch	L	Worm gear					Electrically actuated*				Pneumatically or hydraulically driven			Weight (kg)*
		H1	Ho1	E1	F1	W1	H2	Ho2	E2	F2	H3	Ho3	A3	Worm gear
2"	108	365	237	35	169	152	407	237	180	178	-	-	-	19
3"	114	378	253	73	229	152	530	253	180	178	-	-	-	29
4"	127	421	274	73	229	305	552	274	180	178	-	-	-	39
5"	140	482	312	73	229	305	580	310	180	178	-	-	-	48
6"	140	543	351	108	254	305	610	351	180	178	-	-	-	54
8"	152	628	392	108	254	305	755	392	370	235	750	368	275	84
10"	165	855	480	133	305	610	816	480	370	235	909	442	378	118
12"	178	812	515	133	305	610	912	515	370	235	1075	535	530	170
14"	191	885	555	194	356	610	980	555	370	235	1158	572	530	231
16"	216	951	590	194	356	356	1057	590	370	235	1230	610	530	299
18"	225	1106	636	194	356	356	1140	636	370	235	1462	736	680	390
20"	229	1308	685	194	356	356	1243	685	515	245	1328	765	680	499
24"	267	1445	934	165	686	686	1420	934	817	351	-	-	-	726
28"	292	1495	1039	165	686	686	1812	1039	817	351	-	-	-	1360
30"	292	1535	1060	165	686	686	1906	1060	817	351	-	-	-	1429
32"	318	1575	1120	165	686	686	2021	1120	817	351	-	-	-	1757
36"	330	1605	1190	165	686	686	2327	1190	973	440	-	-	-	2223
40"	410	1755	1234	165	686	686	2451	1234	973	440	-	-	-	2531
42"	430	2100	1385	429	805	903	2515	1385	973	440	-	-	-	2781
44"	450	2175	1436	429	805	903	2565	1436	973	440	-	-	-	2979
48"	470	2303	1570	399	965	903	2697	1570	973	440	-	-	-	3602

* Note: Actuators and weight dimensions are manufacturer's design.

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CTS Series 85, 88 and 98



Worm Gear Driven Flanged Butterfly Valve

Electric Operated Flanged Butterfly Valve

Hydraulic Operated Flanged Butterfly Valve

CLASS 600		Dimensions (mm)												
inch	L	Worm gear					Electrically actuated*				Pneumatically or hydraulically driven			Weight (kg)*
		H1	Ho1	E1	F1	W1	H2	Ho2	E2	F2	H3	Ho3	A3	Worm gear
3"	180	541	414	63	140	250	606	295	180	178	-	-	-	82
4"	190	607	447	63	140	250	650	358	180	178	-	-	-	125
5"	200	680	395	108	200	250	695	371	180	178	-	-	-	165
6"	210	686	490	152	240	315	743	387	180	178	-	-	-	191
8"	230	757	536	168	300	315	1055	417	370	235	-	-	-	247
10"	250	867	641	192	320	315	1172	465	370	235	-	-	-	413
12"	270	1034	727	237	368	400	1392	546	515	245	-	-	-	576
14"	290	1087	757	237	368	400	1475	579	515	245	-	-	-	664
16"	310	1216	825	237	368	400	1557	643	540	360	-	-	-	971
18"	330	1240	840	269	559	400	1625	673	540	360	-	-	-	1119
20"	350	1330	978	350	645	400	1679	701	540	360	-	-	-	1639
24"	390	1583	1070	350	645	400	1834	775	540	360	-	-	-	2082

* Note: Actuators and weight dimensions are manufacturer's design.

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Valve Body Materials

APPENDIX

Material Group	Common Name	Forging Spec	Casting Spec. Equivalent	DIN	Application	
Carbon Steel	CS	A105N	A216-WCB	C22.8 DIN 17243	General non-corrosive service from -20°F (-29°C) to 800°F (427°C)	
Low Temperature Carbon Steel	LTCS	A350-LF2	A352-LC1	TSTE 355 DIN 18103	General non-corrosive service from -50°F (-46°C) to 650°F (340°C), LF2 to 800°F (427°C)	
			A352-LCB			
			A352-LCC			
Low Temperature Alloy Steel	Nickel Steel	A350-LF3	A352-LC3	10Ni14	-150°F (-101°C) to 650°F (340°C)	
Low Alloy Steel	Moly Steel	A182-F1	A217-WC1	15Mo3	Up to 875°F (468°C)	
		A182-F11 cl2	A217-WC6	13CrMo44	Up to 1100°F (593°C)	
	Alloy Steel Chrome Moly	A182-F22 cl3	A217-WC9	10CrMo910	Up to 1100°F (593°C), HP steam	
		A182-F5a	A217-C5	12CrMo195	High temp. refinery service	
		A182-F9	A217-C12	X 12 CrMo 9 1	High temp. erosive refinery service	
		A182-F91	A217-C12A	X 10 CrMoVNB 9 1	High pressure steam	
Stainless Steel	Austenitic S.Steel	A182-F304	A351-CF8	DIN X5CrNi 18 9	0.04% min. carbon for temp. >1000°F (538°C)	
		A182-F304L	A351-CF3	X 2 CrNi 19 11	Up to 800°F (427°C)	
		A182-F304H	A351-CF10	n/a		
		A182-F316	A351-CF8M	DIN X5CrNiMo 18 10	0.04% min. carbon for temp. >1000°F (538°C)	
		A182-F316L	A351-CF3M	X 5 CrNiMo 17 12 2	Up to 800°F (427°C)	
		A182-F316H	A351-CF10M	n/a		
		A182-F316 Ti		X 6 CrNiMoTi 17 12 2	Special grade	
		300 series S.Steel	A182-F321		X 6 CrNiTi 18 10	0.04%min. carbon (grade F321H) and heat treat at 2000°F (1100°C) for service temps. >1000°F (538°C)
			A182-F321H		n/a	
			A182-F347	A351-CF8C	DIN 8556	0.04%min. carbon (grade F347H) and heat treat at 200°F (1100°C) for service temps. >1000°F (538°C)
		A182-F347H		n/a		
		A182-F317L	A351-CG3M*	X2CrNiMo18-16-4		
		Alloy 20	A182-F20*	A351-CN7M**	DIN 1.4500	Service to 600°F (316°C)*
	Duplex 2205	A182-F51		A351-CD3MN	X2CrNiMoN22-5-3	Service to 600°F (316°C) - The original S31803 UNS designation has been supplemented by S32205 which has higher minimum N,CR, and Mo
				A890-J92205*	DIN 10088-1 (95)	
		Super Duplex 2507	A182-F53		A351-CD4MCu*	X2CrNiMoN27-7-4
A890 5A*					DIN 10088-1 (95)	
Super Duplex F55		A182-F55		A995-CD3MWCuN		Service to 600°F (316°C)
Super Austenitic 6Mo	A182-F44		A351-CK3MCuN	X1CrNiMoCuN20-18-7	Service to 600°F (316°C)	
				DIN 10088-1 (95)		
Nickel-Iron Alloy	Incoloy 800	B564-N08800		X10NiCrAlTi32-20	Service to 1000°F (538°C)	
	Incoloy 825	B564-N08825*	A494-CU5MCuC*	DIN 17744	Service to 600°F (316°C) for N02200, 1200°F (648°C) for N02201	
Nickel	Nickel	B160-N02200 (bar)	A494-CZ-100*	NW2200		
Nickel-Copper	Monel 400	B564-N04400	A494-M35-1	DIN 17730		
	Monel 500	B564-N05500*				
Nickel-Alloy	904L	904L*	n/a	Z2 NCDU 25-20		
Nickel Superalloys	Inconel 600	B564-N06600	A494-CY40*	DIN 17742		
	Inconel 625	B564-N06625	A494-CW-6MC*			
	Hastelloy C-276	B564-N10276	A494-CW-2M*	NiMo 16 Cr 15 W		
Titanium	Titanium	B381-Gr2	B367-C2*	Ti 2	Special grade	

* Now discontinued in ANSI B16.34 - 2009.

** Cast CN7M only rated to 150°C, however 'New Alloy 20' grade CN3MCu is available which is to be rated to at least 316°C.

Major Valve Material Groups

FORGED	CAST
CARBON STEEL	
ASTM A105N	ASTM A216 WCB/WCC
ASTM A350 LF2	ASTM A352 LCB/LCC
ALLOY STEEL	
ASTM A350 LF3	ASTM A352 LC3
ASTM A182 F5a	ASTM A217 C5
ASTM A182 F9	ASTM A217 C12
ASTM A182 F11	ASTM A217 WC6
ASTM A182 F22	ASTM A217 WC9
ASTM A182 F91	ASTM A217 C12A
AUSTENITIC STAINLESS STEEL	
ASTM A182 F304/F304L	ASTM A351 CF8/CF3
ASTM A182 F316/F316L	ASTM A351 CF8M/CF3M
ASTM A182 F321	
ASTM A182 F347	ASTM A351 CF8C
ASTM A182 F44 (6MO)	ASTM CK3MCuN
ASTM A182 F20* (ALLOY 2 0)	A351 CN7M
FERRITIC-AUSTENITIC STAINLESS STEEL	
ASTM A182 F51 - UNS S31803 (DUPLX S.S.)	A890 GR.4A*/ A351 C D3MN
ASTM A182 F53 - UNS S32750 (SUPER DUPLX S.S.)	A890 GR.5A*/ A351 C E8MN
ASTM A182 F55 - UNS S32760 (SUPER DUPLX S.S.)	A995 CD3MWCuN/6A
NICKEL ALLOY	
INCONEL 825 - UNS N08825 ASTM B564 - N08825	A484 CU5MCuC*
INCONEL 600 - UNS N06600 ASTM B564 - N06600	A494 CY40*
INCONEL 625 - UNS N06625 ASTM B564 - N06625	A494 CW6MC*
MONEL 400 - UNS N04400 ASTM B564 - N04400	A494 M35-1
TITANIUM	
ASTM B381 GR.F2	ASTM B367 GR.C2
ASTM B381 GR.F3	ASTM B367 GR.C3

* No longer referenced in ANSI B16.34 - 2009.

Valve Trim Materials

APV TRIM CONFIGURATIONS						
API Trim No	Nonimal Trim	Trim code	Stem	Disc/Wedge	Seat	Min. Hardness (Brinell)
1	F6	F6	410 (13Cr)	F6 (13Cr)	410 (13Cr)	250
2	304	304	304 (18Cr-8Ni)	304 (18Cr-8Ni)	304 (18Cr-8Ni)	not specified
3	310	310	(25Cr-20Ni)	310 (25Cr-20Ni)	310 (25Cr-20Ni)	not specified
4	Hard 410	F6-H	410 (13Cr)	F6 (13Cr)	F6 (13Cr)	275
5	410 Full Hard faced	F6-HF	410 (13Cr)	F6+St Gr6 (CoCr Alloy)	410+St Gr6 (CoCr Alloy)	350
5A	410 Full Hard faced	F6-HF	410 (13Cr)	F6+Hardf. NiCr Alloy	410+Hardf. NiCr Alloy	350
6	410 and Ni-Cu	F6-HFS	410 (13Cr)	F6 (13Cr)	Monel 400 ® (NiCu Alloy)	250/175
7	410 and Full Hard	410	410 (13Cr)	F6 (13Cr)	F6 (13Cr) (750 HB)	250/750
8	410 and Hard faced	F6-HFS	410 (13Cr)	F6 (13Cr)	410+St Gr6 (CoCr Alloy)	250/350
8A	410 and Hard faced	F6-HFS	410 (13Cr)	F6 (13Cr)	410+Hardf. NiCr Alloy	250/350
9	Monel	Monel	Monel® (NiCu Alloy)	Monel® (NiCu Alloy)	Monel 400 ® (NiCu Alloy)	not specified
10	316	316	316 (18Cr-Ni-Mo)	316 (18Cr-8Ni-Mo)	316 (18Cr-8Ni-Mo)	not specified
11	Monel and Hard faced	Monel-HFS	Monel® (NiCu Alloy)	Monel® (NiCu Alloy)	Monel 400 ® St Gr6	350
11A	Monel and Hard faced	Monel-HFS	Monel® (NiCu Alloy)	Monel® (NiCu Alloy)	Monel 400 ® Hardf. NiCrA	350
12	316 and Hard faced	316-HFS	316 (18Cr-Ni-Mo)	316 (18Cr-8Ni-Mo)	316+St Gr6	350
12A	316 and Hard faced	316-HFS	316 (18Cr-Ni-Mo)	316 (18Cr-8Ni-Mo)	316 Hardf. NiCr Alloy	350
13	Alloy 20	Alloy 20	Alloy 20 (19Cr-29Ni)	Alloy 20 (19Cr-29Ni)	Alloy 20 (19Cr-29Ni)	not specified
14	Alloy 20 & Hard faced	Alloy 20-HFS	Alloy 20 (19Cr-29Ni)	Alloy 20 (19Cr-29Ni)	Alloy 20 St Gr6	350
14A	Alloy 20 & Hard faced	Alloy 20-HFS	Alloy 20 (19Cr-29Ni)	Alloy 20 (19Cr-29Ni)	Alloy 20 hardf. NiCr Alloy	350
15	304 Full Hard faced	304-HF	304 (18Cr-8Ni-Mo)	304+St Gr6	304+St Gr6	350
16	316 Full Hard faced	316-HF	316 HF (18Cr-8Ni-Mo)	316+St Gr6	316+St Gr6	350
17	347 Full Hard faced	347-HF	347 HF (18Cr-10Ni-Cb)	347+St Gr6	347+St Gr6	350
18	Alloy 20 Full Hard faced	Alloy-HF	Alloy 20 (19Cr-29Ni)	Alloy 20+St Gr6	Alloy 20+St Gr6	350
n/a	Alloy 625	Alloy 625	Alloy 625	Alloy 625	Alloy 625	

TRIM MATERIAL EQUIVALENT GRADES					
TRIM	UNS	TYPE	Grade (forged)	ASTM wrought	DIN
F6	UNS S41000	13Cr	ASTM A182 F6a	A276-410	DIN X12Cr13
304	UNS S30400	18-8 Cr-Ni	ASTM A182 F304	A276-304	DIN X5CrNi 18 10
316	UNS S31600	18-8 Cr-Ni (18-10-2)	ASTM A182 F316	A276-316	DIN X5CrNiMo 18 10
321	UNS S32100	18 Cr-10 Ni-Ti	ASTM A182 F321	A276-321	DIN X6CrNiTi 18 10
347	UNS S34700	18 Cr-10 Ni-Cb	ASTM A182 F347	A276-347	DIN X6CrNiNb 18 10
MONEL®	UNS N04400	67Ni-30Cu	ASTM B564-N04400	B164-N04400	BDIN 17743
ALLOY 20	UNS N08020	28Ni-19Cr-Cu-Mo	ASTM A182-F20*	ASTM B473	DIN 14500
ALLOY 625	UNS N06625	60Ni-22Cr-9Mo-3.5Cb	ASTM B564-N06625	ASTM B564-N06625	DIN 17361
C276	UNS N10276	54Ni-15Cr-16Mo	ASTM B564-N10276	ASTM B574-N10276	DIN NiMo 16 Cr 15 W
17/4PH	UNS S17400	0Cr17Ni4Cu4Nb	ASTM A705 UNS S17400	ASTM A564 UNS S17400	X5CrNiCuNb17-4-4
St. Gr6**	UNS R30006	Co Cr-A	AMS 5894		Stellite(R) Gr6

* No longer referenced in ANSI B16.34 - 2009.

** Hard facing weld overlay.