

# HIGH PERFORMANCE ROTARY CONTROL VALVES

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# KOSO KENT INTROL SUPPLIES A DIVERSE RANGE OF PRECISION -MANUFACTURED CONTROL, CHOKE, AND ROTARY VALVES FOR OIL AND GAS, PETROCHEMICAL AND POWER INDUSTRIES - WORLDWIDE



## TABLE OF CONTENTS

- INTRODUCTION TO KKI'S RANGE OF ROTARY CONTROL VALVES	02
- ROTARY CONTROL VALVE APPLICATIONS	03
- VALVE SELECTION DATA	04
- FIRE WATER PROTECTION SYSTEM	05
- ROTROL - SERIES 63 TO 66	06
- TORQUE REQUIREMENTS	06
- SERIES 63, 64, 65 CLASS 150LB AND 300LB CV TABLES	08
- SERIES 63, 64, 65 CLASS 150LB AND 300LB TORQUE TABLES	11
- SERIES 66 CLASS 150LB AND 300LB CV TABLES	15
- PREVIOUS CUSTOMERS AND PROJECTS	22

# PRODUCT RANGE

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## TOP & BOTTOM-GUIDED CONTROL VALVES

Our range of high-performance top and bottom-guided control valves includes single and double-seated valves suitable for low and high-capacity applications, as well as three-way valves for mixing or splitting flows. Our control valves are designed to facilitate pressure drops at all stages of transportation in the oil, gas and power industries. All valves are refined by our engineers to suit the needs of each application and all service conditions.

## CAGE-GUIDED CONTROL VALVES

The Series 1200/7200 range of cage-guided control valves is KKI's core product. The exceptional valves in this range combine high-integrity features, such as ASME VIII body/bonnet bolting design, a high flow capacity and a wide range of trim designs, from low-noise anti-cavitation to multi-stage trims. These valves are ideally suited to the critical service process control requirements of a wide range of industry applications.

## SURFACE CHOKE VALVES

The KKI Series 73 surface choke valve offers a unique solution for the majority of choke applications in the oil and gas industry. The flexible valve design can incorporate many different trim and body material options to suit differing flow rates and in-service conditions. Thousands of KKI Series 73 surface chokes are installed around the world on projects for some of the world's leading oil and gas production companies.

## ROTARY CONTROL VALVES

The Rotrol range of high-capacity butterfly valves has been developed to overcome the problems associated with control, cavitation and noise in conventional butterfly valve designs. Lighter in weight and more compact than globe valve alternatives, this innovative valve performs especially well in severe-service applications, where pressure drops tend to be high in the controlling position but where high-capacity throughputs at low pressure drops are also required.

## SEVERE SERVICE SOLUTIONS

For more than 45 years, KKI has built up a reputation for delivering valve solutions for the most arduous service conditions. We have developed a range of advanced, high-quality severe service valve solutions for every type of problematic application, from high-pressure, high-temperature environments to sub-zero temperatures. Our valves are designed to combat the effects of cavitation, flashing, erosion, contaminated fluids, corrosion, high velocity, vibration, noise and energy dissipation.

## INSTRUMENTS

KKI offers a wide selection of sophisticated instrumentation to support our comprehensive range of high-performance valves and actuators. The instruments we supply include pneumatic and electro-magnetic positioners, airsets, volume boosters and airlocks. All instruments are specified to deliver optimum performance for the service conditions and specific needs of each application. We also supply proprietary instruments to suit individual customer preferences.

## ACTUATORS

Our range of robust, versatile and reliable pneumatic actuators includes the 'G', 'C' and 'D' Series models. These have been developed to meet the needs of all control valve applications, offering proven design and high reliability. They are used extensively for on-shore, offshore and power installations. In addition, we supply various proprietary actuators – such as electric, electro-hydraulic, pneumatic stepping and hydraulic stepping actuators – to meet customer requirements. All actuators can be supplied with hand-wheels and limit stop features.

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## TOP & BOTTOM-GUIDED CONTROL VALVES

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SINGLE SEATED SERIES 10/71



DOUBLE SEATED SERIES 20



3-WAY MIXING AND DIVERTING SERIES 30



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## CAGE-GUIDED CONTROL VALVES

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SERIES 1200/7200



SERIES 73



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## ROTARY CONTROL VALVES

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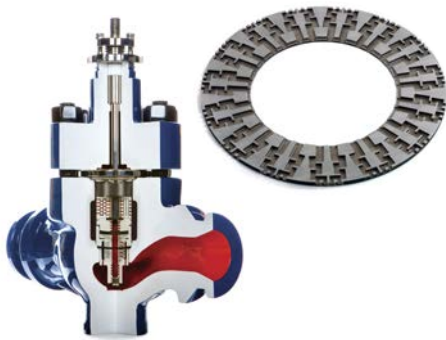
SERIES 60



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## SEVERE SERVICE SOLUTIONS

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## INSTRUMENTS

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## ACTUATORS

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SERIES G



SERIES C



SERIES D





## INTRODUCTION TO THE ROTARY CONTROL VALVE RANGE

At Koso Kent Introl (KKI), innovative design technology and skilled engineering is the motivating force behind the development of the KKI range of high-quality rotary control valves. The rotary valve has been developed by KKI to give a flexible range of valves suitable for a wide range of applications, from benign low pressure drop applications through to some of the most extreme that can be handled by a rotary control valve.

All seated valves have uninterrupted 360-degree seal contact in the closed position due to the offset disc design. With the soft-seated valves having a spring energised and pressure-assisted seal, the valve seating torques are low and seal life is long.

## QUALITY MANUFACTURING

Maintaining the highest standards of quality throughout design, production and customer service is the cornerstone of Koso Kent Introl's philosophy. Our plant is accredited in accordance with Quality Management System ISO 9001 and Environmental Management System ISO 14001. In addition all products, where applicable, conform to ATEX, PED and all other applicable EU Directives and are CE marked accordingly.

The company's standard manufacturing experience includes NACE MR01.75, Norsok, API 6A specifications and individual customer specifications. Our in-house inspection and testing facilities include hardness testing, NDE, PMI, gas and flow testing. Safety is the key element in everything we do, with all employees undergoing both general and specific Health & Safety training.

FIGURE 1. SERIES 66 WITH ROTROL VANE



# ROTARY CONTROL VALVE APPLICATIONS

Rotary control valves have grown in popularity for the process industry in recent years. Rotary control valves get their name from the rotary disc that acts as the control element.

There are several reasons for using the rotary valve:

- More compact than a globe valve.
- Lighter in weight due to the compact design.
- Less expensive than a globe valve.
- Superior seat sealing over globe valves.
- High flow co-efficients.

Our rotary control valves have been designed to comply with all the pressure and temperature ratings as used on a normal butterfly valve. The basic materials of construction satisfy the majority of rotary control valve applications. Surface coatings, overlays and heat treatments are available for steam and arduous service, to provide resistance to wire drawing erosion.

## THE ROTARY CONTROL VALVE CONCEPT

A major disadvantage of conventional butterfly and ball valves when used in throttling applications is the effect of cavitation, which can commence at quite low differential pressure values. This, coupled with high noise emissions, may result in rapid mechanical wear and early failure of the valve components.

To offset these effects, we have developed a rotary control valve with improved performance capability. Rotrol characteristics may be changed by varying the area, number and spacing of the flow orifices. The Rotrol disc has two semi-spherical contours which generate a modified equal percentage flow characteristic and arc to the valve shaft centre line.

The innovative design incorporates a profiled vane which has cowls on its leading and trailing edges. The function of these cowls, which normally cover about one third of the 90° travel, is to split up the flow stream and dissipate the energy created by the pressure drop across the valve. This allows the valve to handle higher pressure drops and higher velocities without the onset of cavitation and noise.

## VALVE TYPES

- Standard Introseal soft-seated valve.
- Rotrol Introseal soft-seated valve.
- Standard Introseal metal-seated valve.
- Rotrol Introseal metal-seated valve.
- Standard Introseal Firesafe valve.
- Rotrol Introseal Firesafe valve.
- Standard Class II control valve.
- Rotrol Class II control valve.

## BODY STYLES AND RATINGS

Wafer, lugged and double flanged connections are all available with body ratings up to ANSI 2500.

## PERFORMANCE

- Elimination of cavitation (Rotrol control valves).
- Can control through 90 degrees (Rotrol control valves).
- Excellent flow control rangeability.
- Low noise performance on both liquid and gas applications (Rotrol control valves).
- Temperature ranges from -196 to +800°C.
- Leakage rates from ASME/ANSI B 16. 104 (ANSI/FCI 70-2) Class II to Class VI.
- Face-to-face dimensions to API 609 for wafer and lugged valves.

## DESIGN FLEXIBILITY

- Can be operated by manual, electric, pneumatic or hydraulic actuators.
- Optional diffuser plates integral on double flanged valves or loose with wafer and lugged valves.
- Full range of body and vane material options, with availability of hard facing.

TABLE 1. VALVE SPECIFICATIONS

SERIES NUMBER	VALVE TYPE	ANSI RATING	DISC CONFIGURATION	BODY STYLE	LEAKAGE CLASS	TEMPERATURE (°C)
63	Introseal soft-seat	150 to 2500	Standard and Rotrol	Wafer, flanged lugged	VI	-196 to +235
64	Introseal metal-seat	150 to 2500	Standard and Rotrol	Wafer, flanged lugged	IV	-196 to +600
65	Introseal Firesafe	150 to 2500	Standard and Rotrol	Wafer, flanged lugged	VI	-196 to +235
66	Control (no seat)	150 to 2500	Standard and Rotrol	Wafer, flanged lugged	II	-196 to +800

## VALVE SELECTION CRITERIA

### SERIES 63 (FIGURE 4.)

For applications where Class IV, V or 100% shut off (Class VI) is required in the closed position on liquids or gases and where control of the flow through the pipeline is required. Can be used on temperatures ranging from  $-196$  to  $+235^{\circ}\text{C}$  and pressures drops up to 100 bar with the correct selection of materials.

### SERIES 64 (FIGURE 5.)

For applications where soft seats are not allowed and only a small leakage (Class IV) is allowed in the closed position or where an elevated temperature or an arduous service means a soft seat is not practical. These valves can also be used as control valves. Temperature ranges from  $-196$  to  $+600^{\circ}\text{C}$  with pressures up to 100 bar. Higher temperatures can be achieved but working conditions are subject to special scrutiny by our engineering department.

### SERIES 65 (FIGURE 6.)

For applications where a 100% shut off is required under normal operating conditions (as Series 63) but in the event of a fire when the soft seat deteriorates, a back-up metal-seat will still maintain the integrity of the valve by only allowing a small leakage past the metal seal in the closed position. This valve will remain operable after a fire until it is safe to remove it and overhaul its seats.

### SERIES 66 (FIGURE 7.)

For applications where leakage in the closed position is not a problem, but where the control of the amount of liquid or gas through the pipeline is paramount. Operating temperature ranges from  $-196$  to  $+800^{\circ}\text{C}$  with the correct selection of materials. Pressure drops of up to 150 bar can be handled. Class II leakage in the closed position is maintained for temperatures up to  $200^{\circ}\text{C}$ . Leak rate increases at temperatures above  $200^{\circ}\text{C}$ .

Please note: Any of the above can be fitted with the standard vane or anti-cavitation vane.

FIGURE 4. SERIES 63 – INTROL SOFT-SEAT DESIGN

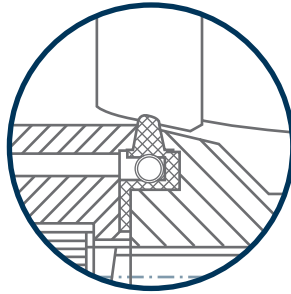


FIGURE 5. SERIES 64 – INTROL METAL-SEAT DESIGN

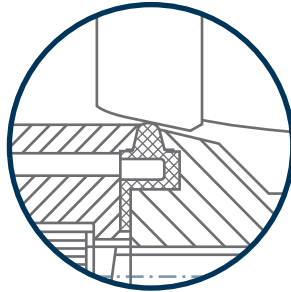
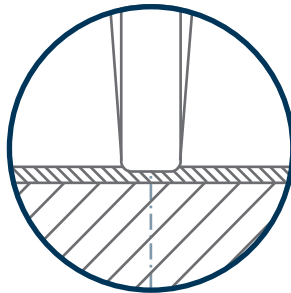


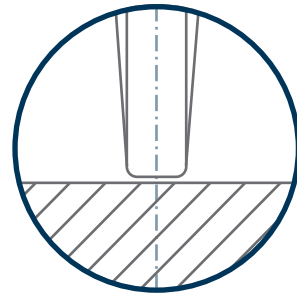
FIGURE 6. SERIES 65 – INTROL FIRESAFE DESIGN



FIGURE 7. SERIES 66 – RUBBER LINED



SERIES 66 – SWING THROUGH DESIGN



**FIRE WATER PROTECTION SYSTEM**

The fire water system on offshore platforms (represented in Figure 8) has proven to provide an extremely onerous duty. KKI became involved in this application when a competitor's butterfly valve suffered severe vibration, resulting in a failure of the system and causing a Health & Safety issue due to the fact that both the sprinkler and deluge system would not function correctly.

On closer inspection of the valve, erosion (resulting from cavitation) of the vane, valve body and seating area was discovered.

On investigation it was noted that the valves were originally specified to be operating with an inlet pressure of 6 bar and a pressure drop of 1 bar. Following installation it was revealed that the operating pressure drop under test conditions was significantly higher. The pressure drop was actually 5 bar and the flow rate had increased from 250 to 340 m<sup>3</sup>/hr. This meant that the existing butterfly valve had a calculated cavitation Index of +2.0 bar, which is classified as 'severe'.

The photograph in Figure 9 shows the type of damage that occurred on this application. The majority of the damage was to the outer edge of the vane, there was also severe cavitation erosion damage to the valve body.

Although it was clear that a larger globe type valve fitted with a low pressure recovery would be suitable for the operating pressures, the operator required a valve that would fit into the existing pipework configuration. KKI provided the Rotrol high-performance butterfly valve as the solution.

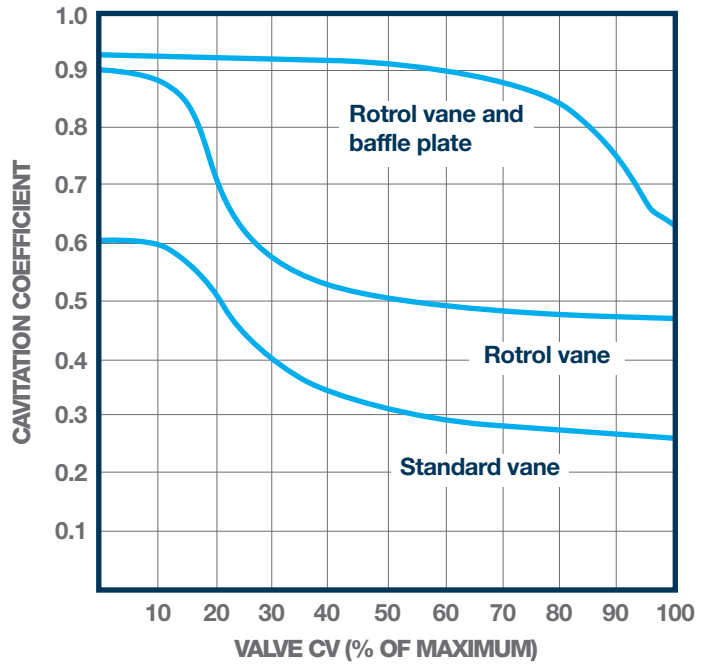
This product had undergone extensive tests both on KKI's water test facility and at Brown Boveri Corporation (Baden) research facility. The special low-recovery vane enables high pressure drops to be handled without the onset of cavitation.

A comparison between the respective pressure recovery characteristics of a standard vane and a Rotrol vane is presented in Figure 10. The Cavitation Index (CI) for the Rotrol valve under the most extreme condition was -0.5 bar. The valve was installed and operated without the previous problems of cavitation and unstable control. This valve is now an accepted solution to what is still an onerous application.

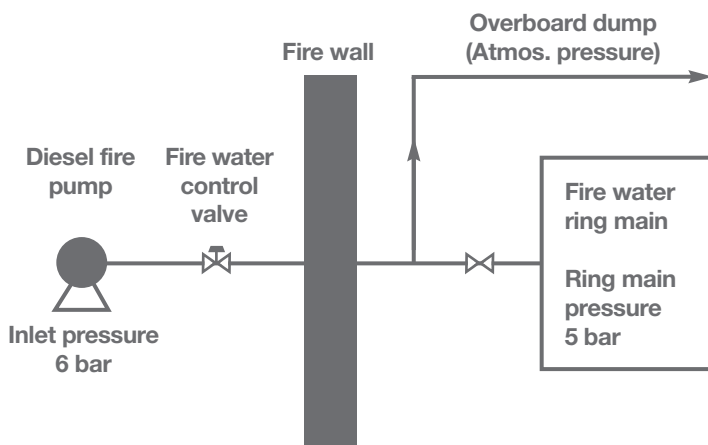
**FIGURE 9. CAVITATION DAMAGE TO BUTTERFLY VALVE**



**FIGURE 10. PRESSURE RECOVERY COMPARISON**



**FIGURE 8. FIRE WATER SYSTEM**



**FIGURE 11. THE ROTROL VALVE**





## ROTROL – SERIES 63 TO 66

The Rotrol butterfly valve range was developed to overcome the problems associated with control, cavitation and noise that would otherwise cause premature mechanical wear and failure of components on conventional butterfly and ball valve designs.

The innovative design, refer to Figure 12, incorporates a profiled vane that has cowls on its leading and trailing edges. The cowls are drilled with a series of holes to allow flow to pass through the cowl. Thus, at low valve openings when the cowls are most effective, the flow passes through these holes, producing smaller turbulence scale and a similar low pressure recovery to that of a cage style trim, refer to Figure 13. This allows the valve to handle higher pressure drops and higher velocities without the onset of cavitation and noise.

This specialised valve performs exceptionally well in severe service applications with its variable resistance trim, where the pressure drop tends to be high in the controlling position but where high capacity throughputs at low pressure drops are also required. For applications that are particularly severe, an integral diffuser pack would be supplied, see Figure 12. The diffuser pack generally consists of one baffle plate fitted into the outlet of the valve body, but can consist of up to three baffle plates for the more extreme applications.

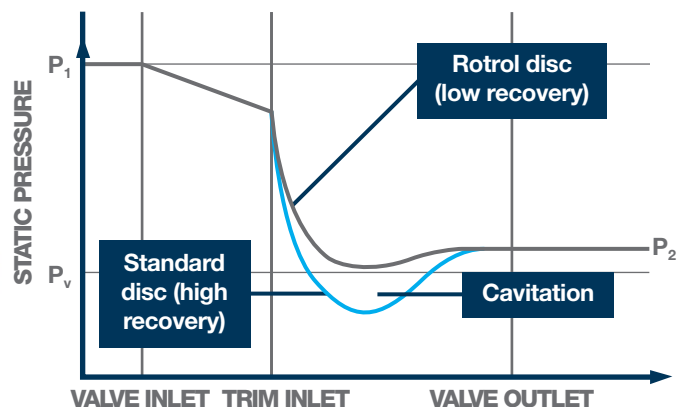
The diffuser pack becomes effective when the flow rate through the valve increases. Thus, as the valve opens beyond 30 degrees and the influence of the cowls on the flow is reduced, the baffle plates start to generate a back pressure.

KKI will consider all valve openings when selecting the Rotrol control valve and diffuser pack, to ensure cavitation is eliminated at all valve openings.

FIGURE 12. ROTROL VALVE WITH OUTPUT BAFFLE PLATE



FIGURE 13. COMPARISON OF PRESSURE RECOVERY BETWEEN



## TORQUE REQUIREMENTS

### TORQUE CHARACTERISTICS

Bearing friction, seal on seat friction, fluid dynamics on the disc and packing box friction are the primary factors in determining the torque requirements for a valve and are described below for convenience.

### BEARING FRICTION

Any pressure drop across the disc places a direct load on the shaft bearings. The projected area of the vane decreases as the valve opens, thus the bearing friction varies from maximum to a minimum as the vane rotates from closed to open.

### SEAL ON SEAT FRICTION (SEATING TORQUE)

Seating torque is created by the interference between the valve vane and the Introseal seal, varies with the contact area and is therefore related to valve size. This torque will only exist in the closed position and does not apply to a valve without a seal.

### FLUID DYNAMIC TORQUE

A rotary control valve vane is only balanced in either the closed or fully open position. In all other positions a dynamic torque is created by the flow velocity over the disc surface. The cowls on the Rotrol disc largely break up this effect and the dynamic torque is much less than a conventional vane.

### PACKING TORQUE

This is the torque required to overcome the tightness of the stuffing box to seal the shaft. This torque varies with the shaft size.

TABLE 2. STANDARD MATERIAL OF CONSTRUCTION FOR SERIES 63

VALVE BODY	CARBON STEEL ASTM A216 WCB	ALUMINIUM /BRONZE	DUPLEX (A895 Gr 4A)
Vane	Stainless Steel ASTM A351 CF8	Monel	Duplex
Shaft	17 - 4PH Stainless Steel	Monel	Duplex
Inboard Bearings	Glacier DU	Aluminium Bronze (Graphite Impregnated)	PTFE
Packing	PTFE Chevrons	PTFE Chevrons	PTFE Chevrons
Packing Follower and Studs	Stainless Steel	Stainless Steel	Duplex
Maximum Temperature	235°C	235°C	235°C

TABLE 3. RECOMMENDED MAXIMUM VELOCITIES FOR LIQUID SERVICE

TRIM	VALVE SIZE		CARBON STEEL		ALLOY STEEL		BRONZE, CU, NI, ALLOY	
	in	mm	ft/s	m/s	ft/s	m/s	ft/s	m/s
Std Vane	4 to 12	100 to 300	25	7.6	25	7.6	15	4.6
	14 to 24	350 to 600	15	4.6	15	4.6	9	2.7
	Above 24	Above 600	10	3	10	3	6	1.8

TABLE 4. RECOMMENDED MAXIMUM VELOCITIES FOR GAS/VAPOUR SERVICE

TRIM DESIGN	VALVE SIZE		MAXIMUM INLET		MAXIMUM OUTLET		MAXIMUM OUTLET MACH. NUMBER FOR REQUIRED NOISE LEVEL		
	in	mm	ft/s	m/s	ft/s	m/s	>95dBA	>90dBA	>85dBA
Std Vane	4 to12	100 to 300	200	61	350	107	0.3	0.2	0.1
	14 to 24	350 to 600	100	30	350	107	0.3	0.2	0.1
	Above 24	Above 600	80	24	350	107	0.3	0.2	0.1

TABLE 5. TYPICAL RANGEABILITY FOR SERIES 63, 64 & 65

VALVE SIZE		STANDARD INTROSEAL		ROTROL INTROSEAL		ROTROL INTROSEAL WITH DIFFUSER PLATE	
in	mm	0 - 60°	0 - 90°	0 - 60°	0 - 90°	0 - 60°	0 - 90°
4 to 10	100 to 250	16	35	19	48	17	34
12 to 18	300 to 450	18	40	21	53	19	39
20 to 36	500 to 900	20	45	23	58	21	44

TABLE 6. TYPICAL RANGEABILITY FOR SERIES 66

VALVE SIZE		STANDARD INTROSEAL		ROTROL INTROSEAL		ROTROL INTROSEAL WITH DIFFUSER PLATE	
in	mm	0 - 60°	0 - 90°	0 - 60°	0 - 90°	0 - 60°	0 - 90°
4 to 10	100 to 250	32	78	19	51	21	38
12 to 18	300 to 450	34	83	21	56	23	43
20 to 36	500 to 900	36	88	23	61	25	48

# SERIES 63, 64, 65 CLASS 150LB AND 300LB CV TABLES

TABLE 7. CV VALUES FOR SERIES 63, 64 & 65 HIGHLIGHT (INTROSEAL SOFT-SEAT, METAL-SEAT AND FIRESAFE)

WAFER, LUGGED AND DOUBLE FLANGED – CLASS 150LB										
VALVE SIZE in mm		ANGLE OF OPENING								
		10	20	30	40	50	60	70	80	90
VALVE SIZE in mm		PERCENTAGE OF 90° CV								
		2.5	6	12	20	31	44	60	82	100
4	100	9	23	45	75	116	165	225	308	375
6	150	28	68	135	225	349	495	675	923	1125
8	200	56	135	270	450	698	990	1350	1845	2250
10	250	89	215	429	715	1108	1573	2145	2932	3575
12	300	133	320	639	1065	1651	2343	3195	4367	5325
14	350	153	366	732	1220	1891	2684	3660	5002	6100
16	400	211	507	1014	1690	2620	3718	5070	6929	8450
18	450	270	648	1296	2160	3348	4752	6480	8856	10800
20	500	338	81	1620	2700	4185	5940	8100	11070	13500
24	600	513	1230	2460	4100	6355	9020	12300	16810	20500
28	700	725	1740	3480	5800	8990	12760	17400	23780	29000
30	750	831	1995	3990	6650	10308	14630	19950	27265	33250
32	800	959	2303	4605	7675	11896	16885	23025	31468	38375
36	900	1197	2873	5745	9575	14841	21065	28725	39258	47875

TABLE 8. CV VALUES FOR SERIES 63, 64 & 65 HIGHLIGHT (INTROSEAL SOFT-SEAT, METAL-SEAT AND FIRESAFE)  
(CV AT 90 = 40% OF STANDARD INTROSEAL VALVE)

WAFER, LUGGED AND DOUBLE FLANGED – CLASS 150LB										
VALVE SIZE in mm		ANGLE OF OPENING								
		10	20	30	40	50	60	70	80	90
VALVE SIZE in mm		PERCENTAGE OF 90° CV								
		1.9	7.7	13	21	33	39	57	86	100
4	100	3	12	20	32	50	59	86	129	150
6	150	9	35	59	95	149	176	257	387	450
8	200	17	69	117	189	297	351	513	774	900
10	250	27	110	186	300	472	558	815	1230	1430
12	300	40	164	277	447	703	831	1214	1832	2130
14	350	46	188	317	512	805	952	1391	2098	2440
16	400	64	260	439	710	1115	1318	1927	2907	3380
18	450	82	333	562	907	1426	1685	2462	3715	4320
20	500	103	416	702	1134	1782	2106	3078	4644	5400
24	600	156	631	1066	1722	2706	3198	4674	7052	8200
28	700	220	893	1508	2436	3828	4524	6612	9976	11600
30	750	253	1024	1729	2793	4389	5187	7581	11438	13300
32	800	292	1182	1996	3224	5066	5987	8750	13201	15350
36	900	364	1475	2490	4022	6320	7469	10916	16469	19150

**TABLE 9. CV VALUES FOR SERIES 63, 64 & 65 HIGHLIGHT VANE (INTROSEAL SOFT-SEAT, METAL-SEAT AND FIRESAFE) WITH INTEGRAL OR LOOSE BAFFLE PLATES (CV AT 90 = 75% OF ROTROL VALVE)**

<b>WAFER, LUGGED AND DOUBLE FLANGED – CLASS 150LB</b>										
<b>VALVE SIZE</b>		<b>ANGLE OF OPENING</b>								
		<b>10</b>	<b>20</b>	<b>30</b>	<b>40</b>	<b>50</b>	<b>60</b>	<b>70</b>	<b>80</b>	<b>90</b>
<b>in</b>	<b>mm</b>	<b>PERCENTAGE OF 90° CV</b>								
		<b>2.5</b>	<b>10.3</b>	<b>17.3</b>	<b>27.7</b>	<b>41.5</b>	<b>48.5</b>	<b>66.5</b>	<b>88.5</b>	<b>100</b>
4	100	3	12	20	31	47	55	75	100	113
6	150	9	35	59	93	140	164	224	299	338
8	200	17	69	117	187	280	327	449	597	675
10	250	27	110	186	297	445	520	713	949	1073
12	300	40	164	277	443	663	775	1062	1414	1598
14	350	46	188	317	507	759	888	1217	1620	1830
16	400	64	260	440	702	1052	1229	1686	2243	2535
18	450	82	333	562	897	1345	1571	2155	2867	3240
20	500	103	416	702	1122	1681	1964	2693	3585	4050
24	600	156	632	1066	1704	2552	2983	4090	5443	6150
28	700	221	893	1509	2410	3611	4220	5786	7700	8700
30	750	253	1024	1730	2763	4140	4838	6633	8828	9975
32	800	292	1182	1996	3189	4778	5584	7656	10189	11513
36	900	364	1475	2490	3978	5960	6966	9551	12711	14363

**TABLE 10. CV VALUES FOR SERIES 63, 64 & 65 HIGHLIGHT (INTROSEAL SOFT-SEAT, METAL-SEAT AND FIRESAFE)**

<b>WAFER, LUGGED AND DOUBLE FLANGED – CLASS 300LB</b>										
<b>VALVE SIZE</b>		<b>ANGLE OF OPENING</b>								
		<b>10</b>	<b>20</b>	<b>30</b>	<b>40</b>	<b>50</b>	<b>60</b>	<b>70</b>	<b>80</b>	<b>90</b>
<b>in</b>	<b>mm</b>	<b>PERCENTAGE OF 90° CV</b>								
		<b>2.5</b>	<b>6</b>	<b>12</b>	<b>20</b>	<b>31</b>	<b>44</b>	<b>60</b>	<b>82</b>	<b>100</b>
4	100	9	23	45	75	116	165	225	308	375
6	150	25	61	122	203	315	447	609	832	1015
8	200	51	122	243	405	628	891	1215	1661	2025
10	250	80	193	386	644	998	1416	1931	2639	3218
12	300	120	288	575	959	1486	2109	2876	3930	4793
14	350	137	329	659	1098	1702	2416	3294	4502	5490
16	400	190	456	913	1521	2358	3346	4563	6236	7605
18	450	236	567	1134	1890	2930	4158	5670	7749	9450
20	500	295	709	1417	2362	3662	5197	7087	9686	11812
24	600	436	1046	2091	3485	5402	7667	10455	14289	17425
28	700	616	1479	2958	4930	7642	10846	14790	20213	24650
30	750	707	1696	3391	5652	8761	12435	16957	23175	28262
32	800	815	1957	3914	6524	10112	14352	19571	26747	32618
36	900	1017	2442	4883	8139	12615	17905	24416	33368	40693

**TABLE 11. CV VALUES FOR SERIES 63, 64 & 65 HIGHLIGHT VANE (INTROSEAL SOFT-SEAT, METAL-SEAT AND FIRESAFE)  
(CV AT 90 = 40% OF ROTROL VALVE)**

<b>WAFER, LUGGED AND DOUBLE FLANGED – CLASS 150LB</b>										
<b>VALVE SIZE</b>		<b>ANGLE OF OPENING</b>								
		<b>10</b>	<b>20</b>	<b>30</b>	<b>40</b>	<b>50</b>	<b>60</b>	<b>70</b>	<b>80</b>	<b>90</b>
<b>in</b>	<b>mm</b>	<b>PERCENTAGE OF 90° CV</b>								
		<b>1.9</b>	<b>7.7</b>	<b>13</b>	<b>21</b>	<b>33</b>	<b>39</b>	<b>57</b>	<b>86</b>	<b>100</b>
4	100	3	12	20	31	47	55	75	100	113
6	150	9	35	59	93	140	164	224	299	338
8	200	17	69	117	187	280	327	449	597	675
10	250	27	110	186	297	445	520	713	949	1073
12	300	40	164	277	443	663	775	1062	1414	1598
14	350	46	188	317	507	759	888	1217	1620	1830
16	400	64	260	440	702	1052	1229	1686	2243	2535
18	450	82	333	562	897	1345	1571	2155	2867	3240
20	500	103	416	702	1122	1681	1964	2693	3585	4050
24	600	156	632	1066	1704	2552	2983	4090	5443	6150
28	700	221	893	1509	2410	3611	4220	5786	7700	8700
30	750	253	1024	1730	2763	4140	4838	6633	8828	9975
32	800	292	1182	1996	3189	4778	5584	7656	10189	11513
36	900	364	1475	2490	3978	5960	6966	9551	12711	14363

**TABLE 12. CV VALUES FOR SERIES 63, 64 & 65 HIGHLIGHT (INTROSEAL SOFT-SEAT, METAL-SEAT AND FIRESAFE)  
WITH INTEGRAL OR LOOSE BAFFLE PLATES (CV AT 90 = 75% OF ROTROL VALVE)**

<b>WAFER, LUGGED AND DOUBLE FLANGED – CLASS 300LB</b>										
<b>VALVE SIZE</b>		<b>ANGLE OF OPENING</b>								
		<b>10</b>	<b>20</b>	<b>30</b>	<b>40</b>	<b>50</b>	<b>60</b>	<b>70</b>	<b>80</b>	<b>90</b>
<b>in</b>	<b>mm</b>	<b>PERCENTAGE OF 90° CV</b>								
		<b>2.5</b>	<b>10.3</b>	<b>17.3</b>	<b>27.7</b>	<b>41.5</b>	<b>47.5</b>	<b>66.5</b>	<b>88.5</b>	<b>100</b>
4	100	3	12	20	31	47	55	75	100	113
6	150	8	31	53	84	126	148	202	269	305
8	200	15	62	105	168	252	295	404	538	608
10	250	24	99	167	267	401	468	642	854	965
12	300	36	148	249	398	597	697	956	1273	1438
14	350	42	169	286	456	684	799	1095	1458	1647
16	400	58	234	396	632	947	1107	1517	2019	2282
18	450	72	291	492	785	1177	1375	1885	2509	2835
20	500	90	364	614	982	1471	1719	2356	3136	3544
24	600	133	537	906	1448	2169	2535	3476	4626	5228
28	700	187	759	1282	2048	3069	3587	4918	6545	7395
30	750	215	871	1470	2349	3519	4112	5638	7504	8479
32	800	248	1005	1697	2711	4061	4746	6507	8660	9785
36	900	309	1254	2117	3382	5066	5921	8118	10804	12208



# SERIES 63, 64, 65 CLASS 150LB AND 300LB TORQUE TABLES

TABLE 14. TORQUE VALUES TO UNSEAT THE VALVE FROM CLOSED POSITION (150LB RATING)

VALVE BORE in	BORE mm	SHAFT	SERIES 63 SOFT SEATED	UNSEATING (Lbs.Ins) SERIES 64 METAL SEATED (UP TO 200°C)	SERIES 65 FIRESAFE	PACKING (Lbs.Ins)	FRICTION (Lbs.Ins)
4	100	0.75	180+(0.9xΔp)	360+(0.9Δp)	225+(1.12xΔp)	74	0.51xΔp
6	150	0.75	264+(1.32xΔp)	520+(1.32xΔp)	330+(1.56xΔp)	74	1.4xΔp
8	200	1	438+(2.19xΔp)	875+(2.19xΔp)	548+(2.74xΔp)	99	3.3xΔp
10	250	1	660+(3.3xΔp)	1950+(4.87xΔp)	825+(4.12xΔp)	99	5.0xΔp
12	300	1.25	1050+(5.05xΔp)	3150+(7.87xΔp)	1312+(6.56xΔp)	124	9.2xΔp
14	350	1.5	1400+(7xΔp)	4200+(10.5xΔp)	1750+(8.75xΔp)	222	15xΔp
16	400	1.5	1920+(9.6xΔp)	5800+(14.5xΔp)	2400+(12xΔp)	222	18.5xΔp
18	450	1.75	2400+(12xΔp)	7200+(18xΔp)	3000+(15xΔp)	259	25.5xΔp
20	500	2	2910+(14.5xΔp)	9000+(22.5xΔp)	3638+(18.20xΔp)	296	40xΔp
24	600	2.25	4400+(22xΔp)	13200+(33xΔp)	5500+(22xΔp) 3	34	67xΔp
28	700	2.5	5750+(28.75xΔp)	17100+(42.75xΔp)	7187+(35.93xΔp)	371	103xΔp
30	750	3	6600+(33xΔp)	19800+(49.5xΔp)	8250+(41.25xΔp)	445	144xΔp
32	800	3	7650+(38.25xΔp)	23000+(57.5xΔp)	9560+(47.8xΔp)	445	165xΔp
36	900	3	9900+(49.5xΔp)	29700+(74.25xΔp)	12375+(61.85xΔp)	445	210xΔp

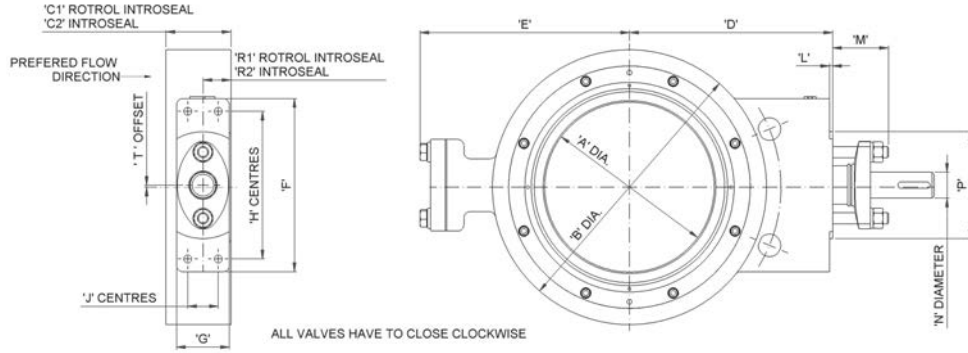
NOTE: Δp (Pressure Drop) in PSI. The torque to open = (Unseating Torque+Packing Torque+Frictional Torque)

TABLE 15. TORQUE VALUES TO UNSEAT THE VALVE FROM CLOSED POSITION (300LB RATING)

VALVE BORE in	BORE mm	SHAFT	SERIES 63 SOFT SEATED	UNSEATING (Lbs.Ins) SERIES 64 METAL SEATED (UP TO 200°C)	SERIES 65 FIRESAFE	PACKING (Lbs.Ins)	FRICTION (Lbs.Ins)
4	100	0.75	180+(0.9xΔp)	360+(0.9xΔp)	225+(1.12xΔp)	74	0.5 1xΔp
6	150	1	264+(1.32xΔp)	520+(1.32xΔp)	330+(1.56xΔp)	99	1.7xΔp
8	200	1.25	438+(2.19xΔp)	875+(2.19xΔp)	548+(2.74xΔp)	124	4.1xΔp
10	250	1.25	660+(3.3xΔp)	1950+(4.87xΔp)	825+(4.12xΔp)	124	6.3xΔp
12	300	1.5	1050+(5.05xΔp)	3150+(7.87xΔp)	1312+(6.56xΔp)	222	11xΔp
14	350	2	1400+(7xΔp)	4200+(10.5xΔp)	1750+(8.75xΔp)	296	20xΔp
16	400	2	1920+(9.6xΔp)	5800+(14.5xΔp)	2400+(12xΔp)	334	24.7xΔp
18	450	2.25	2400+(12xΔp)	7200+(18xΔp)	3000+(15xΔp)	408	36xΔp
20	500	2.75	2910+(14.5xΔp)	9000+(22.5xΔp)	3638+(18.20xΔp)	445	56xΔp
24	600	3	4400+(22xΔp)	13200+(33xΔp)	5500+(22xΔp)	519	89xΔp
28	700	3.5	5750+(28.75xΔp)	17100+(42.75xΔp)	7187+(35.93xΔp)	519	145xΔp
30	750	3.5	6600+(33xΔp)	19800+(49.5xΔp)	8250+(41.25xΔp)	519	168xΔp
32	800	3.5	7650+(38.25xΔp)	23000+(57.5xΔp)	9560+(47.8xΔp)	519	192xΔp
36	900	3.5	9900+(49.5xΔp)	29700+(74.25xΔp)	12375+(61.85xΔp)	519	245xΔp

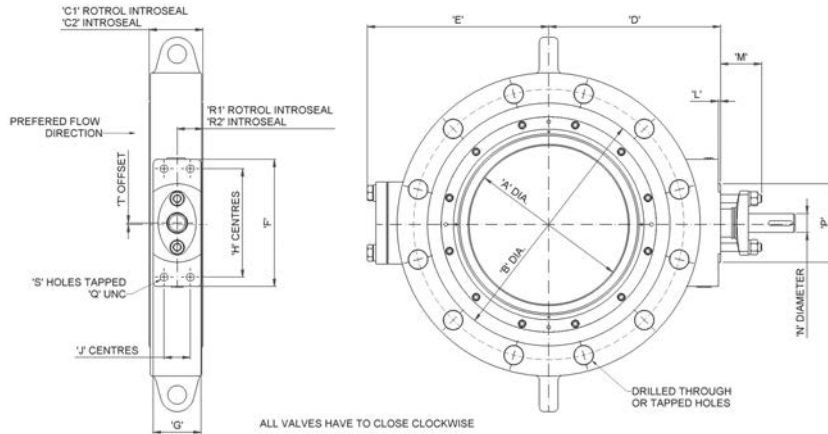
NOTE: Δp (Pressure Drop) in PSI. The torque to open = (Unseating Torque+Packing Torque+Frictional) Conversion: 1 Lbs.Ins = 0.1129Nm 1Nm = 8.85 Lbs.Ins

**DIMENSIONAL DRAWINGS**



**TABLE 16. CLASS 150LB WAFER VALVES (SERIES 63, 64 AND 65)**

VALVE SIZE	DIMENSIONS		DIMENSIONS																	
	in	mm	A	B	C1	C2	D	E	F	G	H	J	L	M	N	P	Q	R1	R2	S
4	100	87	160	60	54	145	145	120	44	100	25	3	45	3/4"	80	3/8"	24.5	24.5	4	1
6	150	138	215	80	59	180	180	150	50	130	30	3	45	3/4"	105	3/8"	26	26	4	1
8	200	188	270	95	64	200	205	170	52	145	30	3	55	1"	105	3/8"	30	27.5	4	2
10	250	238	324	130	72	230	240	170	64	145	35	3	55	1"	105	1/2"	47.5	34.5	4	2
12	300	287	382	145	81	270	270	170	72	145	35	3	55	1 1/4"	105	1/2"	49	37	4	2
14	350	328	426	170	92	308	295	170	80	145	45	3	55	1 1/2"	105	5/8"	62	42	4	2
16	400	365	474	185	102	340	335	170	80	145	45	3	55	1 1/2"	105	5/8"	70	51	4	2
18	450	415	535	210	114	360	365	260	100	210	60	3	60	1 3/4"	170	3/4"	80	57	4	2
20	500	465	590	240	127	395	390	260	100	210	60	3	65	2"	170	3/4"	90	63.5	4	2
24	600	563	695	290	154	480	460	260	125	210	90	3	65	2 1/4"	170	3/4"	110	77	6	2
28	700	665	805	340	165	540	530	260	150	210	100	3	65	2 1/2"	170	1"	136	82.5	6	3
30	750	715	860	365	165	565	550	260	150	210	100	3	65	3"	170	1"	135	79	6	3
32	800	763	920	385	190	600	590	260	150	210	100	3	65	3"	170	1"	144	95	6	3
36	900	863	1028	430	200	655	645	260	150	210	100	3	65	3"	170	1"	165	100	6	3



**TABLE 17. CLASS 150LB LUGGED WAFER VALVES (SERIES 63, 64 AND 65)**

VALVE SIZE	DIMENSIONS		DIMENSIONS																	
	in	mm	A	B	C1	C2	D	E	F	G	H	J	L	M	N	P	Q	R1	R2	S
4	100	87	160	60	54	145	145	120	44	100	25	3	45	3/4"	80	3/8"	24.5	24.5	4	1
6	150	138	215	80	59	180	180	150	50	130	30	3	45	3/4"	105	3/8"	26	26	4	1
8	200	188	270	95	64	200	205	170	52	145	30	3	55	1"	105	3/8"	30	27.5	4	2
10	250	238	324	130	72	230	240	170	64	145	35	3	55	1"	105	1/2"	47.5	34.5	4	2
12	300	287	382	145	81	270	270	170	72	145	35	3	55	1 1/4"	105	1/2"	49	37	4	2
14	350	328	426	170	92	308	295	170	80	145	45	3	55	1 1/2"	105	5/8"	62	42	4	2
16	400	365	474	185	102	340	335	170	80	145	45	3	55	1 1/2"	105	5/8"	70	51	4	2
18	450	415	535	210	114	360	365	260	100	210	60	3	60	1 3/4"	170	3/4"	80	57	4	2
20	500	465	590	-	127	395	390	260	100	210	60	3	65	2"	170	3/4"	90	63.5	4	2
24	600	563	695	-	154	480	460	260	125	210	90	3	65	2 1/4"	170	3/4"	110	77	6	2
28	700	665	805	-	165	540	530	260	150	210	100	3	65	2 1/2"	170	1"	136	82.5	6	3
30	750	715	860	-	165	565	550	260	150	210	100	3	65	3"	170	1"	135	79	6	3
32	800	763	920	-	190	600	590	260	150	210	100	3	65	3"	170	1"	144	95	6	3
36	900	863	1028	-	200	655	645	260	150	210	100	3	65	3"	170	1"	165	100	6	3

Note: Only available to 18" (450mm) for Rotrol Introseals - sizes above that are flanged

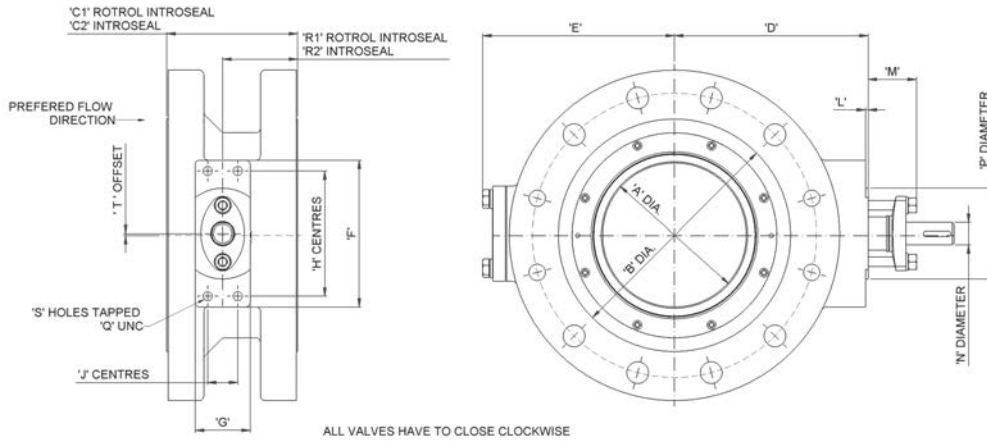


TABLE 18. CLASS 150LB FLANGED VALVES (SERIES 63, 64 AND 65)

VALVE SIZE	DIMENSIONS		DIMENSIONS																		
	in	mm	A	B	C1	C2	D	E	F	G	H	J	L	M	N	P	Q	R1	R2	S	T
4	100	87	1	60	127	127	145	145	120	44	100	25	3	45	3/4"	80	3/8"	77	77	4	1
6	150	138	215	140	140	185	180	150	50	130	30	3	45	3/4"	105	3/8"	86	86	4	1	
8	200	188	270	152	152	200	205	170	52	145	35	3	55	1"	105	3/8"	87	87	4	2	
10	250	238	324	165	165	230	240	170	64	145	35	3	55	1"	105	1/2"	82	82	4	2	
12	300	287	381	178	178	270	270	170	72	145	35	3	55	1 1/4"	105	1/2"	82	82	4	2	
14	350	328	413	190	190	308	295	170	80	145	45	3	55	1 1/2"	105	5/8"	81	81	4	2	
16	400	365	470	223	216	340	335	170	80	145	45	3	55	1 1/2"	105	5/8"	108	108	4	2	
18	450	415	533	250	222	360	365	260	100	210	60	3	60	1 3/4"	170	3/4"	111	111	4	2	
20	500	465	590	265	229	395	390	260	100	210	60	3	65	2"	170	3/4"	115	115	4	2	
24	600	563	692	313	267	480	460	260	125	210	90	3	65	2 1/4"	170	3/4"	134	134	4	2	
28	700	665	801	350	292	540	530	260	150	210	100	3	65	2 1/2"	170	1"	146	146	6	3	
30	750	715	857	380	318	565	550	260	150	210	100	3	65	3"	170	1"	159	159	6	3	
32	800	763	915	400	318	600	590	260	150	210	100	3	65	3"	170	1"	159	159	6	3	
36	900	863	1022	430	330	655	645	260	150	210	100	3	65	3"	170	1"	165	165	6	3	

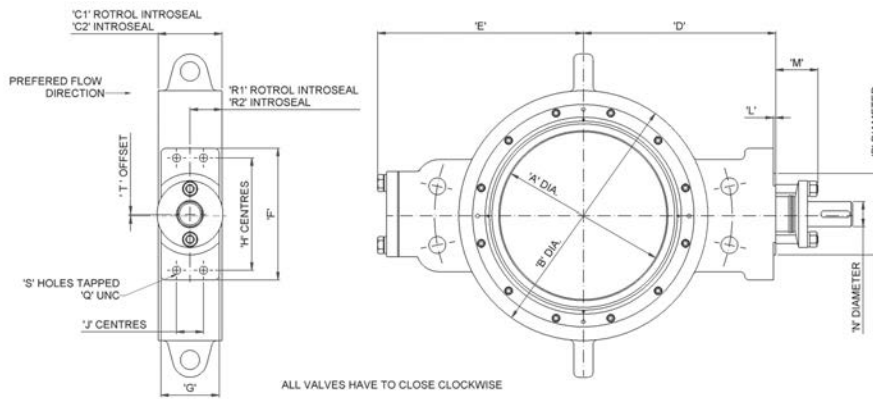
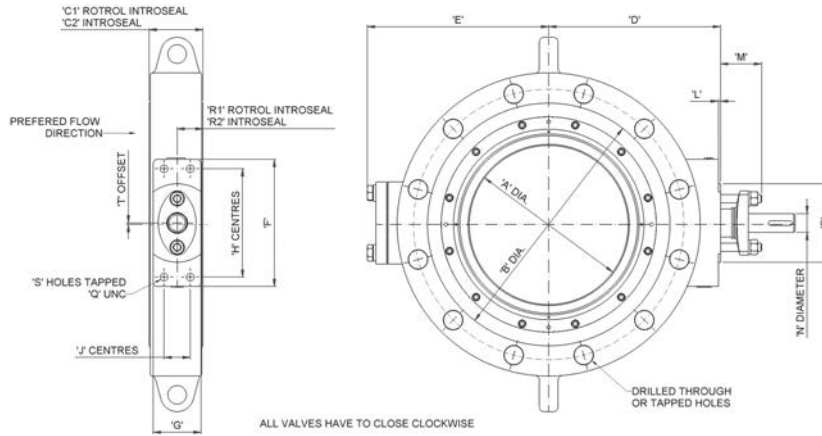


TABLE 19. CLASS 300LB WAFER VALVES (SERIES 63, 64 AND 65)

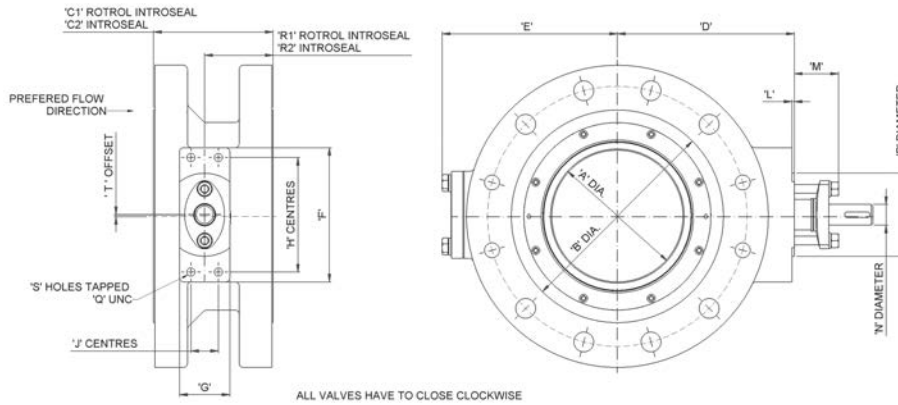
VALVE SIZE	DIMENSIONS		DIMENSIONS																	
	in	mm	A	B	C1	C2	D	E	F	G	H	J	L	M	N	P	Q	R1	R2	S
4	100	87	160	60	54	145	145	120	44	100	25	3	45	3/4"	80	3/8"	24.5	24.5	4	1
6	150	138	216	80	59	185	180	150	50	130	30	3	55	1"	105	3/8"	26	26	4	1
8	200	188	270	100	73	225	220	170	64	145	35	3	55	1 1/4"	105	3/8"	35	36.5	4	2
10	250	238	324	130	83	250	265	170	70	145	35	3	55	1 1/4"	105	1/2"	41.5	45	4	2
12	300	287	382	150	92	285	285	170	80	145	35	3	55	1 1/2"	105	1/2"	50	44	4	2
14	350	328	426	175	117	325	340	250	100	210	60	3	65	2"	170	3/4"	64	59	4	2
16	400	365	474	190	133	350	360	260	100	210	60	3	65	2"	170	3/4"	66.5	66.5	4	2
18	450	415	535	214	149	400	400	260	100	210	60	3	65	2 1/4"	170	3/4"	74.5	74.5	4	2
20	500	465	590	240	159	430	430	260	125	210	90	3	65	2 3/4"	170	3/4"	79.5	79.5	6	2
24	600	563	695	282	181	530	505	260	150	210	100	3	65	3"	170	3/4"	91	91	6	2
28	700	665	805	340	209	595	580	260	150	210	100	3	65	3 1/2"	170	1"	115	104	6	3
30	750	715	860	350	241	625	605	260	150	210	100	3	65	3 1/2"	170	1"	120	120	6	3
32	800	763	920	385	241	650	640	260	150	210	100	3	65	3 1/2"	170	1"	144	120	6	3
36	900	863	1028	440	260	710	700	260	150	210	100	3	65	3 1/2"	170	1"	165	130	6	3



**TABLE 20. CLASS 300LB WAFER LUGGED VALVES (SERIES 63, 64 AND 65)**

VALVE SIZE	DIMENSIONS		DIMENSIONS																	
	in	mm	A	B	C1	C2	D	E	F	G	H	J	L	M	N	P	Q	R1	R2	S
4	100	87	160	60	54	145	145	120	44	100	25	3	45	3/4"	80	3/8"	24.5	24.5	4	1
6	150	138	216	80	59	185	180	150	50	130	30	3	55	1"	105	3/8"	26	26	4	1
8	200	188	270	100	73	225	220	170	64	145	35	3	55	1 1/4"	105	1/2"	35	36.5	4	1
10	250	238	324	128	83	250	265	170	70	145	35	3	55	1 1/4"	105	1/2"	45	45	4	2
12	300	287	381	145	92	285	285	170	80	145	35	3	55	1 1/2"	105	1/2"	49	48	4	2
14	350	328	413	170	117	325	340	260	100	210	60	3	65	2"	170	3/4"	59	59	4	2
16	400	365	470	190	133	350	360	260	100	210	60	3	65	2"	170	3/4"	66.5	66.5	4	2
18	450	415	535	215	149	400	400	260	100	210	60	3	60	2 1/4"	170	3/4"	74.5	74.5	4	2
20	500	465	590	-	159	430	430	260	125	210	90	3	65	2 3/4"	170	3/4"	-	79.5	6	2
24	600	563	692	-	181	530	505	260	150	210	90	3	65	3"	170	3/4"	-	90	6	2
28	700	665	801	-	209	595	580	260	150	210	100	3	65	3 1/2"	170	1"	-	104	6	3
30	750	715	857	-	241	625	605	260	150	210	100	3	65	3 1/2"	170	1"	-	120	6	3
32	800	763	915	-	241	650	640	260	150	210	100	3	65	3 1/2"	170	1"	-	120	6	3
36	900	863	1022	-	260	710	700	260	150	210	100	3	65	3 1/2"	170	1"	-	130	6	3

Note: Only available to 18" 450mm for Rotrol Introseals - sizes above that are flanged



**TABLE 21. CLASS 300LB DOUBLE FLANGED (SERIES 63, 64 AND 65)**

VALVE SIZE	DIMENSIONS		DIMENSIONS																	
	in	mm	A	B	C1	C2	D	E	F	G	H	J	L	M	N	P	Q	R1	R2	S
4	100	87	160	127	127	145	145	120	44	100	25	3	45	3/4"	80	3/8"	77	77	4	1
6	150	138	216	140	140	185	180	150	50	130	30	3	45	1"	105	3/8"	80	80	4	1
8	200	188	270	152	152	225	220	170	64	145	35	3	55	1 1/4"	105	1/2"	87	87	4	2
10	250	238	324	165	165	250	265	170	70	145	35	3	55	1 1/4"	105	1/2"	82	82	4	2
12	300	287	381	178	178	285	285	170	80	145	35	3	55	1 1/2"	105	1/2"	82	82	4	2
14	350	328	413	207	190	325	340	260	100	210	60	3	55	2"	170	3/4"	95	95	4	2
16	400	365	470	231	216	350	360	260	100	210	60	3	55	2"	170	3/4"	108	108	4	2
18	450	415	535	250	222	400	400	260	100	210	60	3	60	2 1/4"	170	3/4"	111	111	4	2
20	500	465	590	275	229	430	430	260	125	210	90	3	65	2 3/4"	170	3/4"	114	114	6	2
24	600	563	692	325	267	530	505	260	150	210	90	3	65	3"	170	3/4"	134	134	6	2
28	700	665	801	371	292	595	570	260	150	210	100	3	65	3 1/2"	170	1"	146	146	6	3
30	750	715	857	390	318	625	605	260	150	210	100	3	65	3 1/2"	170	1"	159	159	6	3
32	800	763	915	400	318	650	640	260	150	210	100	3	65	3 1/2"	170	1"	159	159	6	3
36	900	863	1022	440	330	710	700	260	150	210	100	3	65	3 1/2"	170	1"	165	165	6	3

# SERIES 66 CLASS 150LB AND 300LB CV TABLES

TABLE 22. CV VALUES FOR SERIES 66 HIGHLIGHT (SWING THROUGH CLASS II VALVES)

		WAFER, LUGGED AND DOUBLE FLANGED – CLASS 150LB								
		ANGLE OF OPENING								
		10	20	30	40	50	60	70	80	90
VALVE SIZE in	mm	PERCENTAGE OF 90° CV								
		1.2	4.2	9	16	26	41	64	89	100
4	100	9	30	64	114	185	292	456	634	712
6	150	19	68	145	258	420	662	1034	1437	1615
8	200	34	120	257	456	741	1169	1824	2537	2850
10	250	54	188	402	714	1161	1831	2858	3974	4465
12	300	78	271	581	1034	1680	2649	4134	5749	6460
14	350	97	339	727	1292	2100	3311	5168	7187	8075
16	400	129	451	966	1718	2791	4401	6870	9554	10735
18	450	164	575	1231	2189	3557	5609	8755	12175	13680
20	500	200	698	1496	2660	4323	6816	10640	14796	16625
24	600	291	1017	2180	3876	6299	9932	15504	21560	24225
28	700	396	1385	2967	5274	8571	13516	21098	29339	32965
30	750	456	1596	3420	6080	9880	15580	24320	33820	38000
32	800	523	1831	3924	6977	11337	17878	27907	38808	43605
36	900	667	2334	5002	8892	14450	22786	35568	49462	55575

TABLE 23. CV VALUES FOR SERIES 66 HIGHLIGHT (SWING THROUGH CLASS II VALVES) CV AT 90 = 40% OF STANDARD VALVE)

		WAFER, LUGGED AND DOUBLE FLANGED – CLASS 150LB								
		ANGLE OF OPENING								
		10	20	30	40	50	60	70	80	90
VALVE SIZE in	mm	PERCENTAGE OF 90° CV								
		1.8	5	10	16	25	38	55	80	100
4	100	5	14	28	46	71	108	157	228	285
6	150	12	32	65	103	162	245	355	517	646
8	200	21	57	114	182	285	433	627	912	1140
10	250	32	89	179	286	447	679	982	1429	1786
12	300	47	129	258	413	646	982	1421	2067	2584
14	350	58	162	323	517	808	1227	1777	2584	3230
16	400	77	215	429	687	1074	1632	2362	3435	4294
18	450	98	274	547	876	1368	2079	3010	4378	5472
20	500	120	333	665	1064	1663	2527	3658	5320	6650
24	600	174	485	969	1550	2423	2682	5330	7752	9690
28	700	237	659	1319	2110	3297	5011	7252	10549	13186
30	750	274	760	1520	2432	3800	5776	8360	12160	15200
32	800	314	872	1744	2791	4361	6628	9593	13954	17444
36	900	400	1112	2223	3557	5558	8447	12227	17784	22230



**TABLE 24. CV VALUES FOR SERIES 66 HIGHLIGHT (SWING THROUGH CLASS II VALVES) WITH INTEGRAL OR LOOSE BAFFLE PLATES (CV AT 90 = 65% OF ROTROL VALVE)**

<b>WAFER, LUGGED AND DOUBLE FLANGED – CLASS 150LB</b>										
<b>VALVE SIZE</b>		<b>ANGLE OF OPENING</b>								
		<b>10</b>	<b>20</b>	<b>30</b>	<b>40</b>	<b>50</b>	<b>60</b>	<b>70</b>	<b>80</b>	<b>90</b>
<b>in</b>	<b>mm</b>	<b>PERCENTAGE OF 90° CV</b>								
		<b>2.3</b>	<b>9.2</b>	<b>15</b>	<b>22</b>	<b>37</b>	<b>54</b>	<b>74</b>	<b>94</b>	<b>100</b>
4	100	5	17	28	41	68	100	137	174	185
6	150	10	39	63	92	155	227	311	395	420
8	200	20	68	111	163	274	400	548	697	741
10	250	27	107	174	255	430	627	859	1091	1161
12	300	39	155	252	370	621	907	1243	1579	1680
14	350	48	194	315	462	777	1134	1554	1974	2100
16	400	64	258	419	614	1033	1507	2065	2624	2791
18	450	82	328	534	782	1316	1921	2632	3343	3557
20	500	100	399	648	951	1599	2334	3199	4063	4323
24	600	145	582	945	1386	2330	3401	4661	5921	6299
28	700	198	791	1286	1886	3171	4628	6342	8057	8571
30	750	228	912	1482	2174	3656	5335	7311	9287	9880
32	800	262	1047	1701	2494	4195	6122	8390	10657	11337
36	900	334	1334	2167	3179	5346	7803	10693	13583	14450

**TABLE 25. CV VALUES FOR SERIES 66 HIGHLIGHT (SWING THROUGH CLASS II VALVES)**

<b>WAFER, LUGGED AND DOUBLE FLANGED – CLASS 300LB</b>										
<b>VALVE SIZE</b>		<b>ANGLE OF OPENING</b>								
		<b>10</b>	<b>20</b>	<b>30</b>	<b>40</b>	<b>50</b>	<b>60</b>	<b>70</b>	<b>80</b>	<b>90</b>
<b>in</b>	<b>mm</b>	<b>PERCENTAGE OF 90° CV</b>								
		<b>1.2</b>	<b>4.2</b>	<b>9</b>	<b>16</b>	<b>26</b>	<b>41</b>	<b>64</b>	<b>89</b>	<b>100</b>
4	100	9	30	64	114	185	292	456	634	712
6	150	19	68	145	258	420	662	1034	1437	1615
8	200	31	108	231	410	667	1052	1642	2283	2565
10	250	48	169	362	643	1045	1648	2572	3576	4019
12	300	70	244	523	930	1512	2384	3721	5174	5814
14	350	87	305	654	1163	1890	2980	4651	6468	7268
16	400	116	406	870	1546	2512	3961	6183	8599	9662
18	450	144	503	1077	1915	3112	4908	7661	10653	11970
20	500	175	611	1309	2328	3782	5964	9310	12947	14547
24	600	247	865	1853	3295	5354	8442	13178	18326	20591
28	700	336	1177	2522	4483	7285	11488	17933	24938	28020
30	750	388	1357	2907	5168	8398	13243	20672	28747	32300
32	800	445	1557	3336	5930	9637	15196	23721	32987	37064
36	900	567	1984	4251	7558	12282	19368	30233	42042	47239

TABLE 26. CV VALUES FOR SERIES 66 HIGHLIGHT (SWING THROUGH CLASS II VALVES) CV AT 90 = 40% OF STANDARD VALVE)

WAFER, LUGGED AND DOUBLE FLANGED – CLASS 300LB										
VALVE SIZE in mm		ANGLE OF OPENING								
		10	20	30	40	50	60	70	80	90
PERCENTAGE OF 90° CV		PERCENTAGE OF 90° CV								
		1.8	5	10	16	25	38	55	80	100
4	100	5	14	28	46	71	108	157	228	285
6	150	12	32	65	103	162	245	355	517	646
8	200	18	51	103	164	257	390	564	821	1026
10	250	29	80	161	257	402	611	884	1286	1607
12	300	42	116	233	372	581	884	1279	1860	2326
14	350	52	145	291	465	727	1105	1599	2326	2907
16	400	70	193	386	618	966	1469	2126	3092	3865
18	450	86	239	479	766	1197	1819	2633	3830	4788
20	500	105	291	582	931	1455	2211	3200	4655	5819
24	600	148	412	824	1318	2059	3130	4530	6589	8237
28	700	202	560	1121	1793	2802	4259	6164	8966	11208
30	750	233	646	1292	2067	3230	4910	7106	10336	12920
32	800	267	741	1483	2372	3706	5634	8154	11861	14826
36	900	340	945	1890	3023	4724	7180	10393	15116	18896

TABLE 27. CV VALUES FOR SERIES 66 HIGHLIGHT (SWING THROUGH CLASS II VALVES) WITH INTEGRAL OR LOOSE BAFFLE PLATES (CV AT 90 = 60% OF ROTROL VALVE)

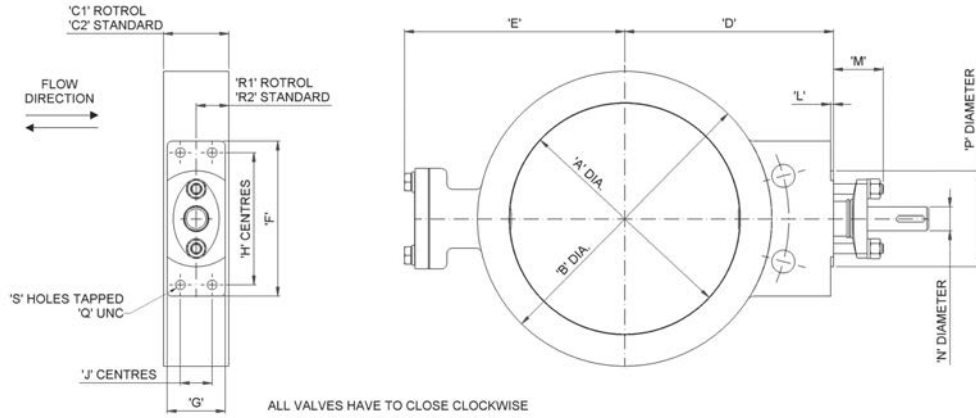
WAFER, LUGGED AND DOUBLE FLANGED – CLASS 300LB										
VALVE SIZE in mm		ANGLE OF OPENING								
		10	20	30	40	50	60	70	80	90
PERCENTAGE OF 90° CV		PERCENTAGE OF 90° CV								
		2.3	9.2	15	22	37	54	74	94	100
4	100	4	16	26	38	63	92	126	161	171
6	150	9	36	58	85	143	209	287	364	388
8	200	14	57	92	135	228	332	456	579	616
10	250	22	89	145	212	357	521	714	907	964
12	300	32	129	209	307	516	753	1033	1312	1395
14	350	40	161	262	384	645	942	1291	1640	1744
16	400	54	214	348	510	858	1252	1716	2180	2319
18	450	66	265	431	632	1063	1551	2126	2700	2873
20	500	81	322	524	768	1292	1885	2654	3282	3491
24	600	114	456	741	1087	1829	2669	3657	4645	4942
28	700	155	621	1009	1479	2488	3631	4976	6321	6725
30	750	179	716	1163	1705	2868	4186	5736	7287	7752
32	800	205	821	1334	1957	3291	4804	6583	8362	8895
36	900	262	1047	1701	2494	4195	6122	8390	10657	11337

TABLE 28. PACKING TORQUE

SHAFT SIZE (in)	0.5	0.75	1	1.25	1.5	1.75	2	2.25	2.5	2.75	3	3.5
TORQUE (Lbs.Ins.)	37	74	99	124	222	259	296	334	371	408	445	519

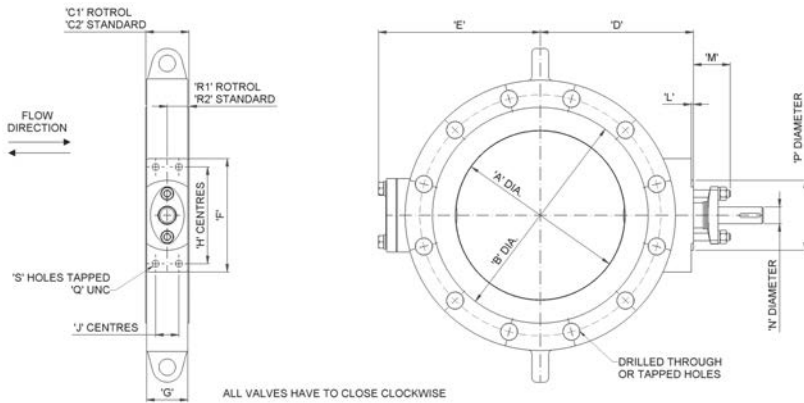


**DIMENSIONAL DRAWINGS**



**TABLE 31. CLASS 150LB WAFER VALVES (SERIES 66)**

VALVE SIZE in	mm	DIMENSIONS		C1	C2	D	E	F	G	H	J	L	M	N	P	Q	R1	R2	S
		A	B																
4	100	102	160	60	54	145	145	120	38	100	25	3	40	1/2"	90	3/8"	30	24.5	4
6	150	152	215	80	59	185	180	150	50	130	30	3	45	3/4"	105	3/8"	40	26	4
8	200	203	270	110	64	200	205	170	52	145	35	3	45	3/4"	105	3/8"	55	27.5	4
10	250	254	324	130	72	230	240	170	64	145	35	3	55	1"	105	1/2"	65	34.5	4
12	300	305	382	164	81	270	270	170	64	145	35	3	55	1"	105	1/2"	82	44	4
14	350	340	426	170	92	308	295	170	80	145	45	3	55	1 1/4"	105	5/8"	85	41.5	4
16	400	390	474	216	102	340	335	170	80	145	45	3	55	1 1/4"	105	5/8"	108	51	4
18	450	440	535	222	114	360	365	260	100	210	60	3	60	1 1/2"	170	3/4"	111	57	4
20	500	490	590	229	127	395	390	260	100	210	60	3	65	1 1/2"	170	3/4"	114.5	63.5	4
24	600	590	695	300	154	480	460	260	125	210	90	3	65	1 3/4"	170	3/4"	150	77	4
28	700	690	805	360	165	540	530	260	150	210	100	3	65	2"	170	1"	180	82.5	6
30	750	740	860	380	165	565	550	260	150	210	100	3	65	2"	170	1"	190	82.5	6
32	800	790	920	400	190	600	590	260	150	210	100	3	65	2 1/2"	170	1"	200	95	6
36	900	890	1027	460	200	655	645	260	150	210	100	3	65	2 1/2"	170	1"	230	100	6



**TABLE 32. CLASS 150LB WAFER LUGGED VALVES (SERIES 66)**

VALVE SIZE in	mm	DIMENSIONS		C1	C2	D	E	F	G	H	J	L	M	N	P	Q	R1	R2	S
		A	B																
4	100	102	160	60	54	145	145	120	44	100	25	3	40	1/2"	90	3/8"	30	24.5	4
6	150	152	215	80	59	185	180	150	50	130	30	3	45	3/4"	105	3/8"	40	26	4
8	200	203	270	110	64	200	205	170	52	145	35	3	45	3/4"	105	3/8"	55	27.5	4
10	250	254	324	130	72	230	240	170	64	145	35	3	55	1"	105	1/2"	65	34.5	4
12	300	305	381	164	81	270	270	170	72	145	35	3	55	1"	105	1/2"	82	44	4
14	350	340	413	170	92	308	295	170	80	145	45	3	55	1 1/4"	105	5/8"	85	41.5	4
16	400	390	474	216	102	340	335	170	80	145	45	3	55	1 1/4"	105	5/8"	108	51	4
18	450	440	533	222	114	360	365	260	100	210	60	3	60	1 1/2"	170	3/4"	111	57	4
20	500	490	590	-	127	395	390	260	100	210	60	3	65	1 1/2"	170	3/4"	-	63.5	4
24	600	590	692	-	154	480	460	260	125	210	90	3	65	1 3/4"	170	3/4"	-	77	4
28	700	690	801	-	165	540	530	260	150	210	100	3	65	2"	170	1"	-	82.5	6
30	750	740	860	-	165	565	550	260	150	210	100	3	65	2"	170	1"	-	82.5	6
32	800	790	915	-	190	600	590	260	150	210	100	3	65	2 1/2"	170	1"	-	95	6
36	900	890	1022	-	200	655	645	260	150	210	100	3	65	2 1/2"	170	1"	-	100	6

Note: Only available to 18" 450mm for Rotrol Introseals – sizes above that are flanged

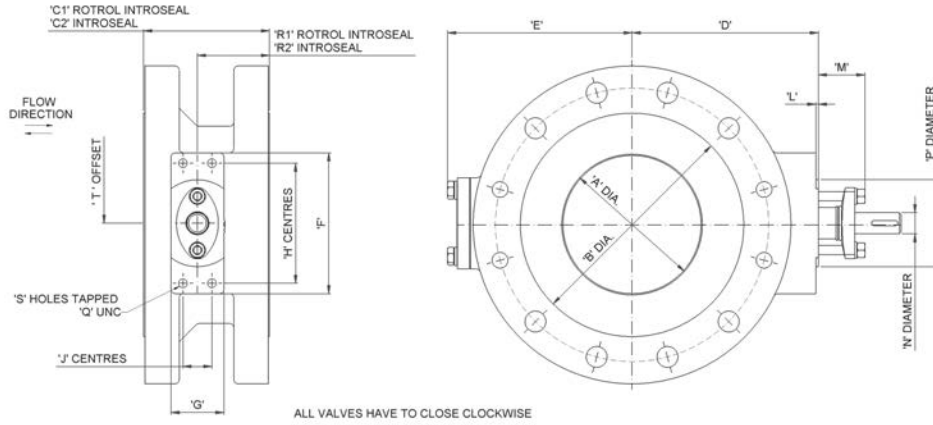


TABLE 33. CLASS 150LB FLANGED VALVES (SERIES 66)

VALVE SIZE in	mm	DIMENSIONS		C1	C2	D	E	F	G	H	J	L	M	N	P	Q	R1	R2	S
		A	B																
4	100	102	160	127	127	145	145	120	44	100	25	3	40	1/2"	90	3/8"	77	77	4
6	150	152	215	140	140	185	180	150	50	130	30	3	45	3/4"	105	3/8"	86	86	4
8	200	203	270	152	152	200	205	170	52	145	35	3	45	3/4"	105	3/8"	87	87	4
10	250	254	324	165	165	230	240	170	64	145	35	3	55	1"	105	1/2"	82	82	4
12	300	305	381	178	178	270	270	170	72	145	35	3	55	1"	105	1/2"	82	82	4
14	350	340	413	190	190	308	295	170	80	145	45	3	55	1 1/4"	105	5/8"	81	81	4
16	400	390	470	216	216	340	335	170	80	145	45	3	55	1 1/4"	105	5/8"	108	108	4
18	450	440	533	222	222	360	365	260	100	210	60	3	60	1 1/2"	170	3/4"	111	111	4
20	500	490	590	229	229	395	390	260	100	210	60	3	65	1 1/2"	170	3/4"	114.5	114.5	4
24	600	590	692	300	267	480	460	260	125	210	90	3	65	1 3/4"	170	3/4"	150	133.5	4
28	700	690	801	360	292	540	530	260	150	210	100	3	65	2"	170	1"	180	146	6
30	750	740	857	380	318	565	550	260	150	210	100	3	65	2"	170	1"	190	159	6
32	800	790	915	400	318	600	590	260	150	210	100	3	65	2 1/2"	170	1"	200	159	6
36	900	890	1022	460	330	655	645	260	150	210	100	3	65	2 1/2"	170	1"	230	159	6

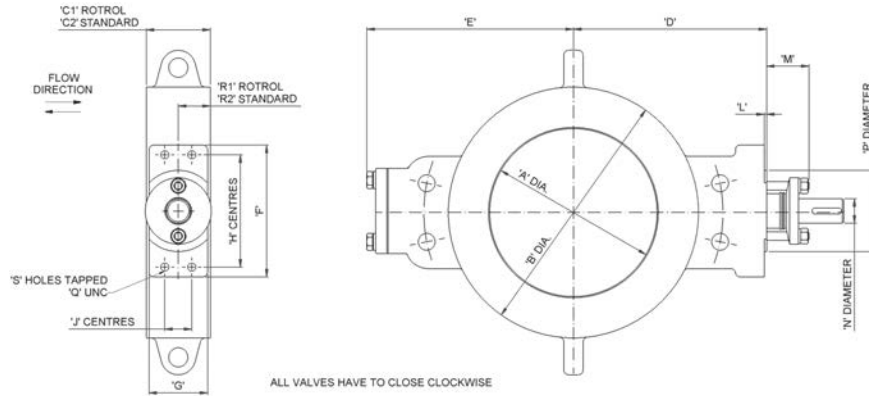


TABLE 34. CLASS 300LB WAFER VALVES (SERIES 66)

VALVE SIZE in	mm	DIMENSIONS		C1	C2	D	E	F	G	H	J	L	M	N	P	Q	R1	R2	S
		A	B																
4	100	102	160	60	54	145	145	120	44	100	25	3	45	3/4"	80	3/8"	30	24.5	4
6	150	152	216	80	59	185	180	150	50	130	30	3	55	1"	105	3/8"	40	26	4
8	200	203	270	110	73	225	220	170	64	145	35	3	55	1"	105	1/2"	55	36.5	4
10	250	254	324	130	83	250	265	170	70	145	35	3	55	1 1/4"	105	1/2"	65	45.5	4
12	300	305	382	164	92	285	285	170	80	145	35	3	55	1 1/2"	105	1/2"	82	48	4
14	350	340	426	170	117	325	340	260	100	210	60	3	65	1 3/4"	170	3/4"	85	58.5	4
16	400	390	474	216	133	350	360	260	100	210	60	3	65	2"	170	3/4"	108	66.5	4
18	450	430	535	222	149	400	400	260	100	210	60	3	65	2 1/4"	170	3/4"	111	74.5	4
20	500	480	590	229	159	430	430	260	125	210	90	3	65	2 1/2"	170	3/4"	114.5	79.5	6
24	600	580	695	300	181	530	505	260	150	210	90	3	65	3"	170	3/4"	150	90.5	6
28	700	685	805	360	209	595	580	260	150	210	100	3	65	3"	170	1"	180	104.5	6
30	750	735	860	380	241	625	605	260	150	210	100	3	65	3"	170	1"	190	120.5	6
32	800	785	920	400	241	650	640	260	150	210	100	3	65	3"	170	1"	200	120.5	6
36	900	985	1027	460	260	710	700	260	150	210	100	3	65	3"	170	1"	230	130	6



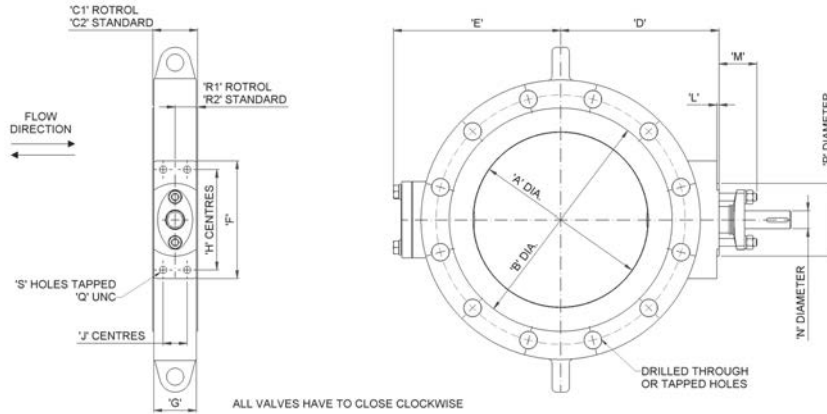


TABLE 35. CLASS 300LB WAFER LUGGED VALVES SERIES 66)

VALVE SIZE in	mm	DIMENSIONS		C1	C2	D	E	F	G	H	J	L	M	N	P	Q	R1	R2	S
		A	B																
4	100	102	160	60	54	145	145	120	44	100	25	3	45	3/4"	90	3/8"	30	24.5	4
6	150	152	216	80	59	185	180	150	50	130	30	3	55	1"	105	3/8"	40	26	4
8	200	203	270	110	73	225	220	170	64	145	35	3	55	1"	105	1/2"	55	36.5	4
10	250	254	324	130	83	250	265	170	70	145	35	3	55	1 1/4"	105	1/2"	65	45.5	4
12	300	305	381	164	92	285	285	170	80	145	35	3	55	1 1/2"	105	1/2"	82	48	4
14	350	340	413	170	117	325	340	260	100	210	60	3	55	1 3/4"	170	3/4"	85	58.5	4
16	400	390	470	216	133	350	360	260	100	210	60	3	65	2"	170	3/4"	108	66.5	4
18	450	430	535	222	149	400	400	260	100	210	60	3	65	2 1/4"	170	3/4"	111	74.5	4
20	500	480	590	-	1599	430	430	260	125	210	90	3	65	2 1/2"	170	3/4"	-	79.5	6
24	600	580	692	-	181	530	505	260	150	210	90	3	65	3"	170	3/4"	-	90.5	6
28	700	685	801	-	209	595	580	260	150	210	100	3	65	3"	170	1"	-	104.5	6
30	750	735	857	-	241	625	605	260	150	210	100	3	65	3"	170	1"	-	120.5	6
32	800	785	915	-	241	650	640	260	150	210	100	3	65	3"	170	1"	-	120.5	6
36	900	885	1022	-	260	710	700	260	150	210	100	3	65	3"	170	1"	-	130	6

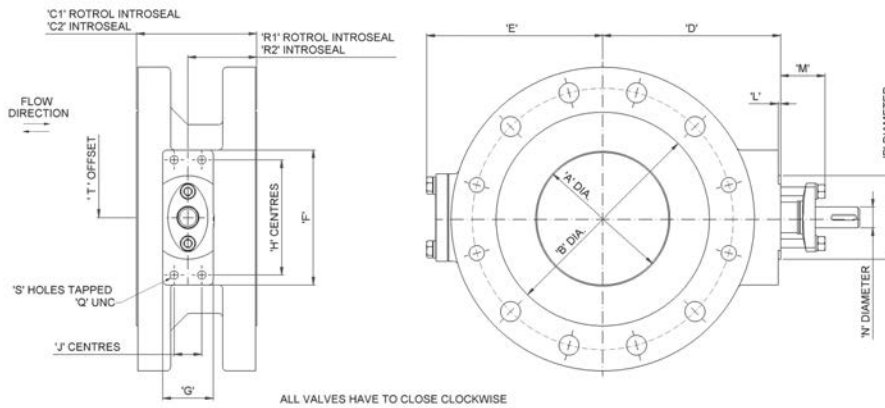


TABLE 36. CLASS 300LB FLANGED VALVES (SERIES 66)

VALVE SIZE in	mm	DIMENSIONS		C1	C2	D	E	F	G	H	J	L	M	N	P	Q	R1	R2	S
		A	B																
4	100	102	160	127	127	145	145	120	44	100	25	3	45	3/4"	90	3/8"	77	77	4
6	150	152	215	140	140	185	180	150	50	130	30	3	55	1"	105	3/8"	80	80	4
8	200	203	270	152	152	225	220	170	64	145	35	3	55	1"	105	1/2"	87	87	4
10	250	254	324	165	165	250	265	170	70	145	35	3	55	1 1/4"	105	1/2"	82	82	4
12	300	305	381	178	178	285	285	170	80	145	35	3	55	1 1/2"	105	1/2"	82	82	4
14	350	340	413	190	190	325	340	260	100	210	60	3	65	1 3/4"	170	3/4"	95	95	4
16	400	390	470	216	216	350	360	260	100	210	60	3	65	2"	170	3/4"	108	108	4
18	450	430	535	222	222	400	400	260	100	210	60	3	65	2 1/4"	170	3/4"	111	111	4
20	500	480	590	229	229	430	430	260	125	210	90	3	65	2 1/2"	170	3/4"	114.5	114.5	6
24	600	580	692	300	267	530	505	260	150	210	90	3	65	3"	170	3/4"	150	133.5	6
28	700	685	801	360	292	595	580	260	150	210	100	3	65	3"	170	1"	180	146	6
30	750	735	857	380	318	625	605	260	150	210	100	3	65	3"	170	1"	190	159	6
32	800	785	915	400	318	650	640	260	150	210	100	3	65	3"	170	1"	200	159	6
36	900	885	1022	460	330	710	700	260	150	210	100	3	65	3"	170	1"	230	165	6

## A SMALL SELECTION OF PREVIOUS CUSTOMER PROJECTS

PROJECT	CUSTOMER	DATE	SERIES	VALVE SIZE	FLANGE RATING	BODY MATERIAL	TRIM STYLE	DESIGN CV	PRESSURE DROP (CLOSED) BAR	DESIGN PRESSURE	DESIGN TEMP (°C)	LINE FLUID	DESTINATION
12180	AZERBAIJAN INTERNATIONAL OPERATIONS	2006	63	18"	Wafer 300	Duplex A890 Gr 4A	Standard Disk	9,450	36	36	45	HC Gas	BP AIOC
12179	AZERBAIJAN INTERNATIONAL OPERATIONS	2006	63	20"	Flanged 150	EN1982-1999 CC33	Rotrol + Baffles	5,400	15	15	70	Seawater	BP AIOC
12190	AIBEL AS	2005	63	10"	Flanged 300	Duplex A995 Gr 4A	Rotrol + Baffles	1,430	11	11	120	Produced water	Maersk Volve Platform
12198	AZERBAIJAN INTERNATIONAL OPERATIONS	2006	63	18"	Wafer 600	Duplex A890 Gr 4A	Standard Disk	8,411	8	80	80	HC Gas	BP AIOC Sangachal II
12284	AIBEL AS	2007	63	16"	Flanged 150	Al/Bronze EN1982-1999 CC33	Rotrol + Baffles	3,380	14	14	50	Seawater	Alvhiem FPSO
12489	AZERBAIJAN INTERNATIONAL OPERATIONS	2007	63	24"	Wafer 600	ASTM A352 LCC	Standard Disk	14,986	55	55	80	HC Gas	BP AIOC Sangachal
12541	SINGLE BUOY MOORINGS	2008	63	8"	Wafer 150	Duplex A995 Gr 4A	Standard Disk	2,250	16	16	130	Gas	Talisman Yme MOPUSTOR
12541	SINGLE BUOY MOORINGS	2008	63	10"	Wafer 150	Super Duplex ASTM A890 Gr6A	Standard Disk	3,575	15	15	85	Seawater	Talisman Yme MOPUSTOR
12544	PETROFAC INTERNATIONAL	2008	63	16"	Wafer 300	Incoloy 825	Rotrol	3,042	35	35	70	Raw Sour Gas	Karachaganak Development
12544	PETROFAC INTERNATIONAL	2008	63	20"	Wafer 600	ASTM A352 LCC	Standard Disk	10,395	70	70	65	Raw Sour Gas	Karachaganak Development
12552	SINGLE BUOY MOORINGS	2008	63	16"	Wafer 300	ASTM A216 WCB	Standard Disk	7,605	30	30	65	Crude Oil	Talisman Yme MOPUSTOR
12566	CBI LUMMUS BV	2008	64	14"	Flanged 300	ASTM A216 WCB	Standard Disk	5,490	34	34	162	Crude Oil	SASREF
20855	THE MAERSK COMPANY	2006	63	10"	Wafer 150	Monel ASTM A94-M35-1	Rotrol	1,430	15	15	60	Seawater	Maersk Oil
20878	PSN LTD	2006	63	18"	Wafer 300	Al/Bronze EN1982-1999 CC33	Standard Disk	3,780	14	14	75	Seawater	Clyde Platform
20931	SHELL UK OIL PRODUCT	2007	64	16"	Wafer 150	ASTM A216 WCB	Standard Disk	3,718	3	3	275	Light Gas Oil	Shell UK
21001	SHELL UK EXPLORATION	2007	66	16"	Wafer 150	ASTM A351 CF8M	Standard Disk	10,735	9.3	9.3	5	Salt Water	Shell UK
21005	TALISMAN ENERGY (UK)	2007	66	8"	Wafer 300	Monel ASTM A94-M35-1	Standard Disk	1,026	19	19	21	Seawater Energy UK	Talisman
21074	APACHE NORTH SEA LIMITED	2007	66	8"	Wafer 150	Monel ASTM A94-M35-1	Standard Disk	1,140	10	10	65	Seawater	Apache North Sea
21101	SHELL UK EXPLORATION	2008	66	12"	Flanged 300	Super Duplex ASTM A890 Gr6A	Rotrol + Baffles	2,326	18.5	18.5	24	Seawater	Shell UK
21455	SHELL UK EXPLORATION	2009	63	12"	Flanged 300	A351 CK 3MCuN	Rotrol + Baffles	2,605	11	11	15	Seawater	Shell UK
21587	O M E as	2009	66	6"	Wafer 900	ASTM A352 LCC	Rotrol	594	114	114	50	Regen Gas	BP Skarv
21636	KARACHAGANAK PETROLEUM	2009	64	8"	Wafer 600	ASTM A352 LCC	Standard Disk	1,964	80	80	100	Sour HC Gas	Karachaganak Development
510003	STATOIL PETROLEUM AS	2007	64	12"	Flanged 600	ASTM A351 CF8M	Standard Disk	4,601	33.5	33.5	385	HC Gas	Statoil Mongstad
510003	STATOIL PETROLEUM AS	2007	64	24"	Flanged 300	ASTM A217 C5	Standard Disk	17,425	10	10	385	HC Gas	Statoil Mongstad
510003	STATOIL PETROLEUM AS	2007	66	28"	Wafer 150	ASTM A216 WCB	Standard Disk	13,186	5	5	54	Seawater	Statoil Mongstad
510004	AKER OFFSHORE PARTNERS	2009	66	20"	Wafer 150	ASTM B367 G2C2	Standard Disk	6,650	15	15	55	Seawater	Statoil Gjoa
510007	STATOIL PETROLEUM AS	2008	64	14"	Wafer 150	ASTM A216 WCB	Standard Disk	6,100	3.5	3.5	110	Air	Statoil Mongstad
510057	FMC KONGSBERG METERING	2009	66	12"	Wafer 300	ASTM A351 CF8M	Standard Disk	5,814	19	19	38	Propane Liquid	Statoil Karsto
520029	STATOIL PETROLEUM AS	2009	63	18"	Flanged 150	ASTM A352 LCC	Rotrol	4,320	19	19	50	Butane	Statoil Mongstad

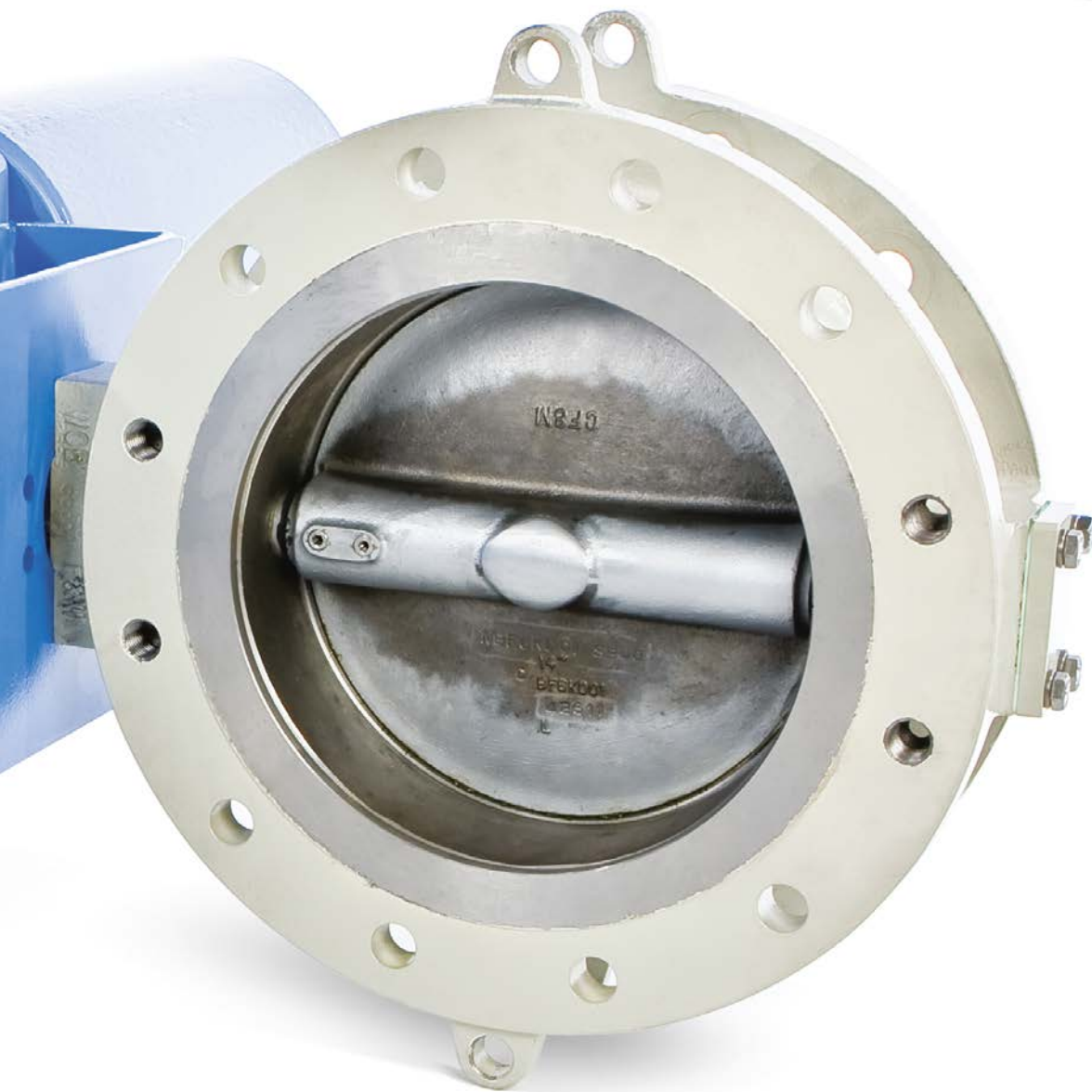
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