CHECK VALVES

TECHNICAL CATALOGUE

(EXTRACT: ENGINEERING DATA)

GOODWIN
INTERNATIONAL LTD

Dual Plate

Axial

www.checkvalves.co.uk

Engineering Data

C_V Pressure Drop Formulae

For Liquids

$$Q = 0.865\, C_V \sqrt{\frac{\Delta P}{G_f}}$$

For Gases

$$Q = 417 C_v P_1 Y \sqrt{\frac{X}{G_g T_1 Z}}$$

Based on ISA-S75.01-1985 for
Fully developed turbulent flow.

Q = Liquid flow rate, m^3/h
Gas flow rate, sm^3/h (@ 1.013 bar and 15.6°C)
C_v = Valve flow coefficient, US gpm
ΔP = Pressure drop, psi
P_1 = Inlet pressure, bar abs.
G_f = Specific gravity of liquid @ 1.013 bar, 15.6°C
G_g = Specific gravity of gas @ 1.013 bar, 15.6°C
T_1 = Inlet temperature, K
Y = Valve Expansion Factor
X = $\Delta P/P_1$
Z = Gas Compressibility Factor
(Ideal Gas = 1)

DUAL PLATE CHECK VALVE FLOW COEFFICIENT (C_V)

ASME 150/300*

Valve Size	C_V
2"	48
3"	150
4"	394
6"	900
8"	1589
10"	3300
12"	3926
14"	5418
16"	8256
18"	10452
20"	14251
24"	26511
26"	30000
28"	33600
30"	38400
32"	48000
36"	55200
40"	84000
42"	96000
48"	107600

*See graphs for C_V values for ASME 600#, 900#, 1500# & 2500#.

AXIAL CHECK VALVE FLOW COEFFICIENT (C_V)

ZB VALVES ALL PRESSURE CLASSES

Valve Size	ZB
1"	24
1¼"	41
1½"	65
2"	103
2½"	181
3"	282
4"	452
5"	725
6"	1071
8"	1966
10"	3163

NK/NB VALVES ASME 150/300

Valve Size	NK	NB
12"	2808	4425
14"	3884	6127
16"	5158	8146
18"	6609	10436
20"	8262	13046
22"	10048	15887
24"	12051	19029
26"	14369	22629
28"	16893	26601
30"	19501	30748

The above tabulated C_V values are for the most commonly used axial valves. For the full range of C_V valves please see the graphs on the following pages or contact Goodwin.

Valve Cracking Pressures

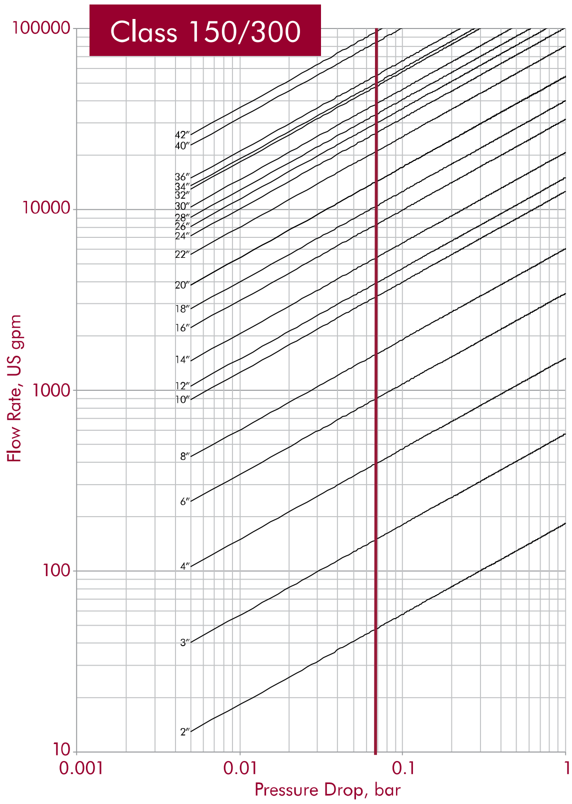
On the initial opening of a check valve, such as at system start-up, the upstream pressure applied by the flow to the front of the plates/disc is required to overcome the force of the spring and any upstream back pressure acting on the back of the plates/disc. The pressure differential at which this happens is known as the "cracking pressure". When the pressure differential exceeds the cracking pressure, the valve plates/disc are "cracked open" from the valve seat and the media can flow.

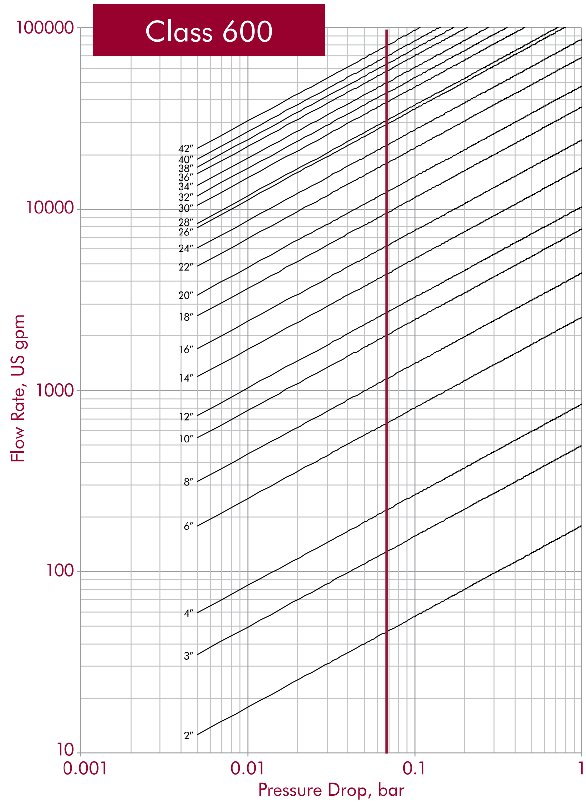
As soon as the plates /disc are cracked open the media cannot sustain a pressure differential and at this point the plates are not kept open by pressure, but by the fluid velocity (see Critical velocity).

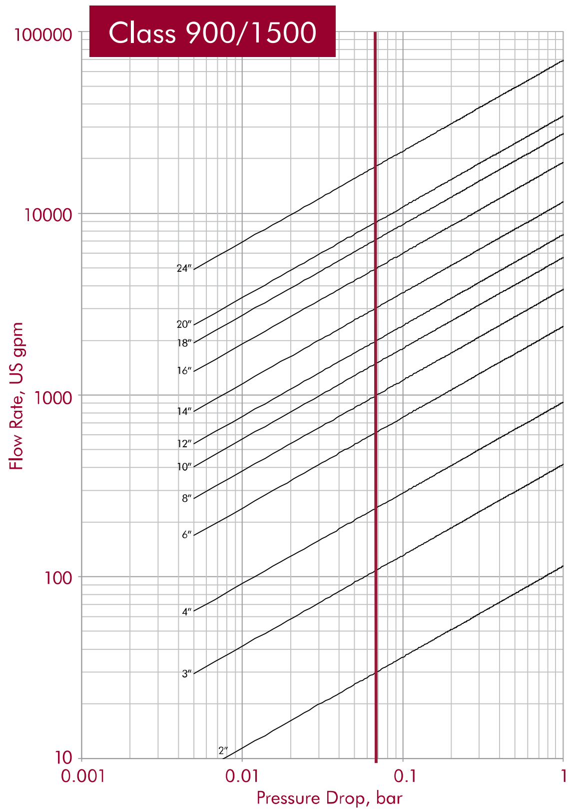
Specific values for cracking pressures at atmospheric conditions can be obtained from Goodwin upon request.

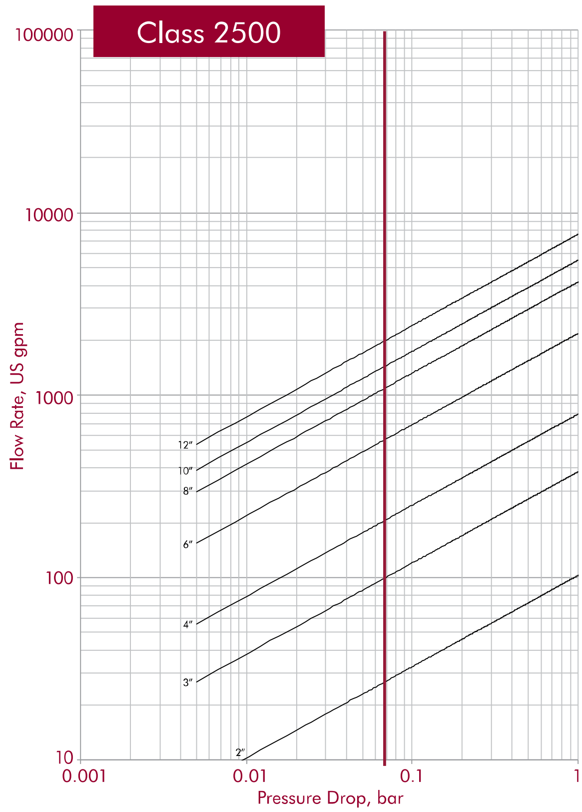
Dual Plate Check Valves

Pressure Loss / Flow Coefficient (C_V)





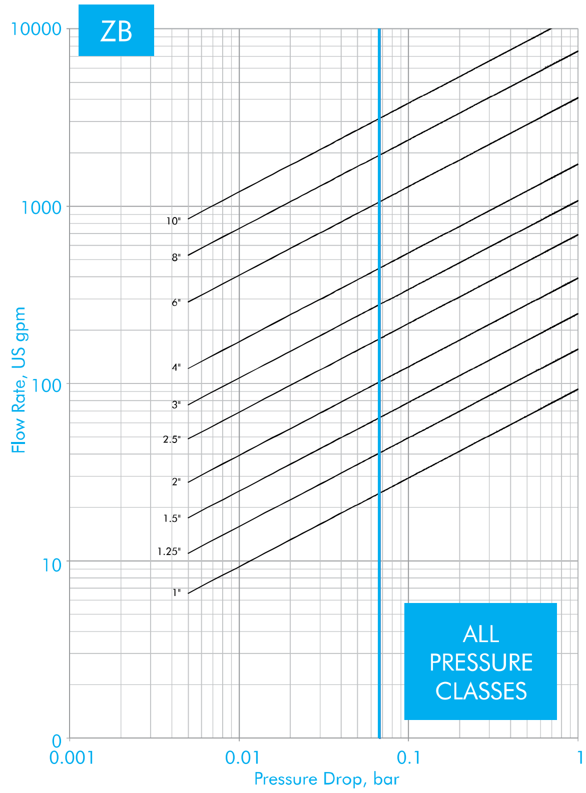


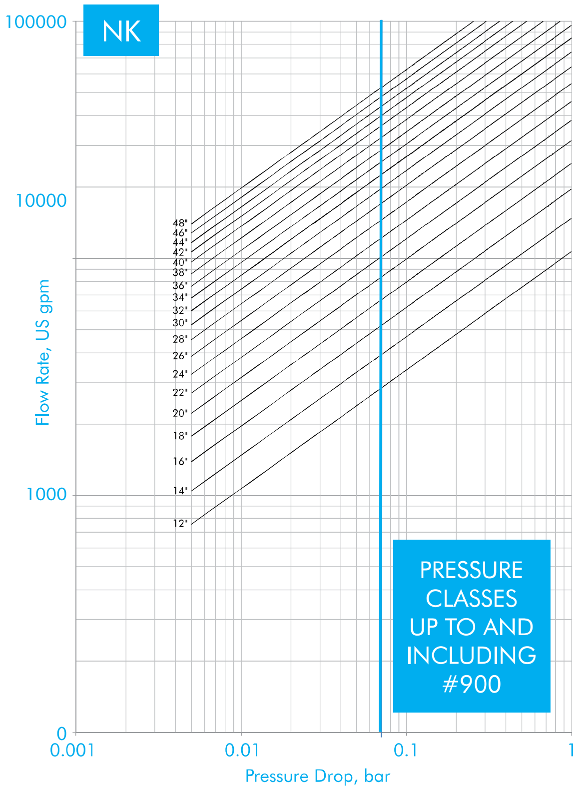


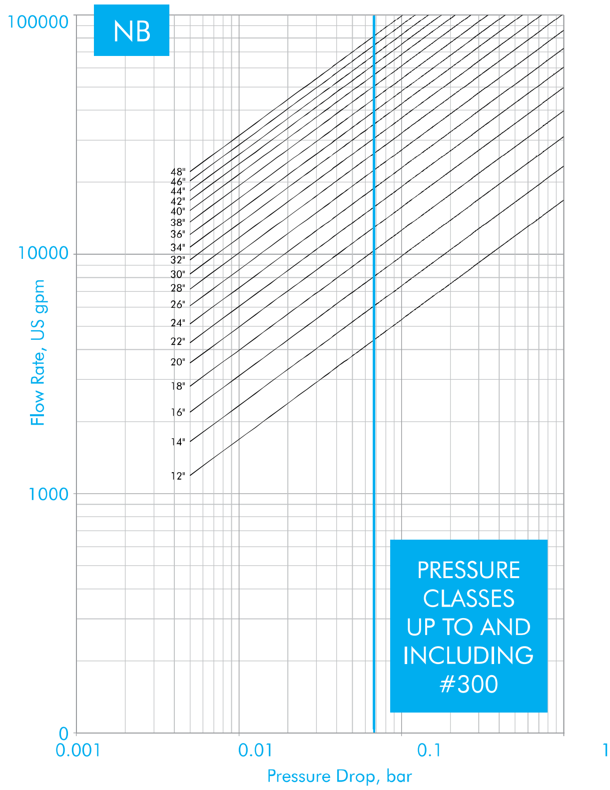
Pressure drop versus flow, as depicted in the above graphs, have been established following tests carried out at Delft Hydraulics Laboratories.

The flow curves do not show the full Goodwin range. Upon request Goodwin can manufacture valves in sizes up to 144″ diameter and in pressure classes up to API 20000.

Axial Check Valves
Pressure Loss / Flow Coefficient (C_V)







Pressure drop versus flow, as depicted in the above graphs, have been established following tests carried out at Delft Hydraulics Laboratories.

The flow curves do not show the full Goodwin range. Upon request Goodwin can manufacture valves in sizes up to 88" diameter and in pressure classes up to API 20000.

Critical Velocity

All check valves should be used in the fully open position. This means that the force provided by the flowing fluid must be greater than the force from the spring(s). This velocity is known as the "Critical Velocity", i.e. that fluid velocity required to keep the plates or disc of a valve fully open.

If the fully open position is not reached any pressure drop calculations would be invalid as the C_V of a valve is determined on the basis of the valve being fully open. With the valve plates or disc only partially open, i.e. the flow velocity being less than the critical velocity of the valve, then a higher pressure drop will exist than would otherwise be calculated.

Goodwin offers a range of spring options requiring different critical velocities to ensure a fully open valve can be selected to suit customer flow data that will be both chatter-free and provide excellent dynamics. All Critical Velocities in the tables are for water. When the fluid is gaseous an energy balance can be applied to convert the media velocity to a water equivalent velocity.

For valves that are installed in a vertical flow up or inclined up position, it must be borne in mind that the fluid velocity must be sufficient to overcome the weight vector of the plates/disc in addition to the Critical Velocity of the spring.

For flow velocities different to those on the right, please consult Goodwin. Other spring strengths are available.

Dual Plate Check Valve Springs

Spring	Critical Velocity
Mini-Torque	1.5 m/s
Low Torque	2.0 m/s
High Torque (Standard)	3.0 m/s
Super Torque	4.4 m/s

Axial Check Valve Springs

Spring	Critical Velocity
#1	1.5 m/s
#2	2.0 m/s
#3	2.5 m/s
#4	3.0 m/s

$$v_{Water,equivalent} = v_{Medium}\sqrt{\frac{\rho_{Medium}}{\rho_{Water}}}$$

Chatter / Flutter

Chatter or flutter will occur when the forward flow is insufficient to fully open the valve plates/disc, i.e. flow through the valve is less than the critical velocity of the valve. Chatter/Flutter will ultimately lead to premature failure of a valve's internal components. A correctly sized check valve should be fully open when operating in forward flow.

To ensure a valve is fully open, the flow through the valve must exceed the 'critical velocity'. The spring must be chosen such that it is weaker than the flow through the valve, otherwise the valve will be only partially open.

Pressure Surge

A check valve closing against a rapidly moving reverse-flowing liquid induces a pressure rise in the downstream region of the line at the moment of closure.

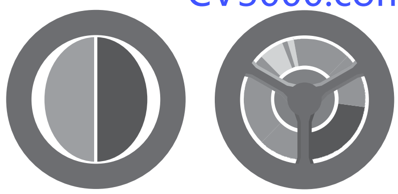
This pressure rise can become large and result in a surge of high pressure moving back down the line as a shock wave.

The magnitude of this pressure was characterised by Joukowsky as:

$$\Delta P_{SURGE} = \frac{\rho \cdot c \cdot v_r}{1 \times 10^5}$$

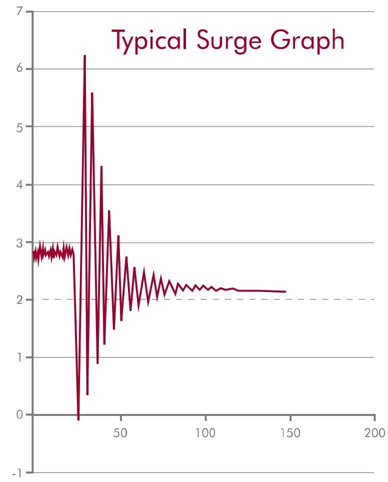
Where ΔP is the maximum surge pressure (bar), r is the media density (kg/m³), c is the celerity (velocity of sound in the line, m/s), v_r is the maximum reverse velocity of the fluid (m/s).

The Phenomenon of Surge



Closing a valve against a moving body of fluid results in pressure pulses. These pulses become stronger as the magnitude of the velocity change increases. A common example of this is when a check valve closes following a pump trip. The pressure pulse can be high and is known as surge or water-hammer.

Whereas surge is the phenomenon of the advancing pressure wave, the term 'slam' relates more specifically to the valve itself, which can be the root cause of the surge. Valve slam occurs after a pump stops when the forward flow decelerates, reverses and accelerates back towards the pump. The check valve must close quickly before the reverse velocity is too high, in order to minimise the surge pressure and protect the line.



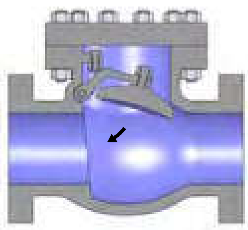
Surge Mitigation

Extensive research has been conducted (Prof. A.R.D. Thorley) into the dynamic response of all types of check valves. It has been found that slam can be reduced by improving the dynamic response of the valve. This is achieved by ensuring that:

- The disc has low inertia and friction
- The travel of the disc is short
- The closure of the disc is assisted with springs

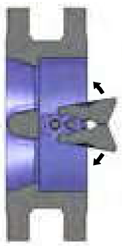
By meeting these requirements, Goodwin provide a range of non-slam check valves to suit up to the most severe of customer requirements.

Swing Check



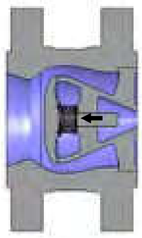
Low Inertia	No
Minimal Travel	No
Mechanical Assistance	No

Dual Plate Check



Low Inertia	Yes
Minimal Travel	No
Mechanical Assistance	Yes

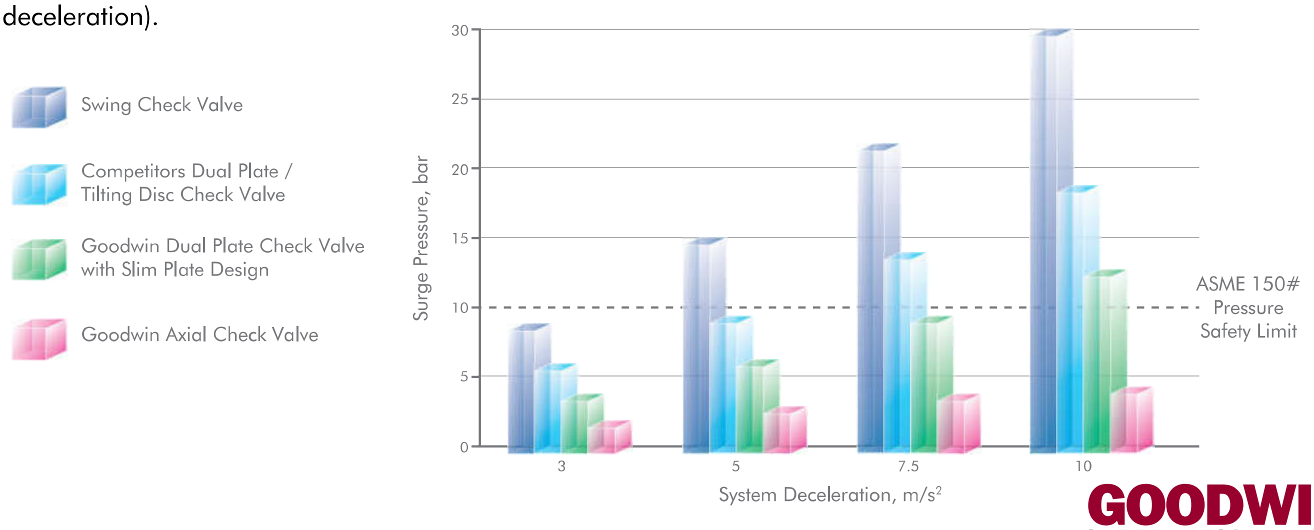
Axial Check



Low Inertia	Yes
Minimal Travel	Yes
Mechanical Assistance	Yes

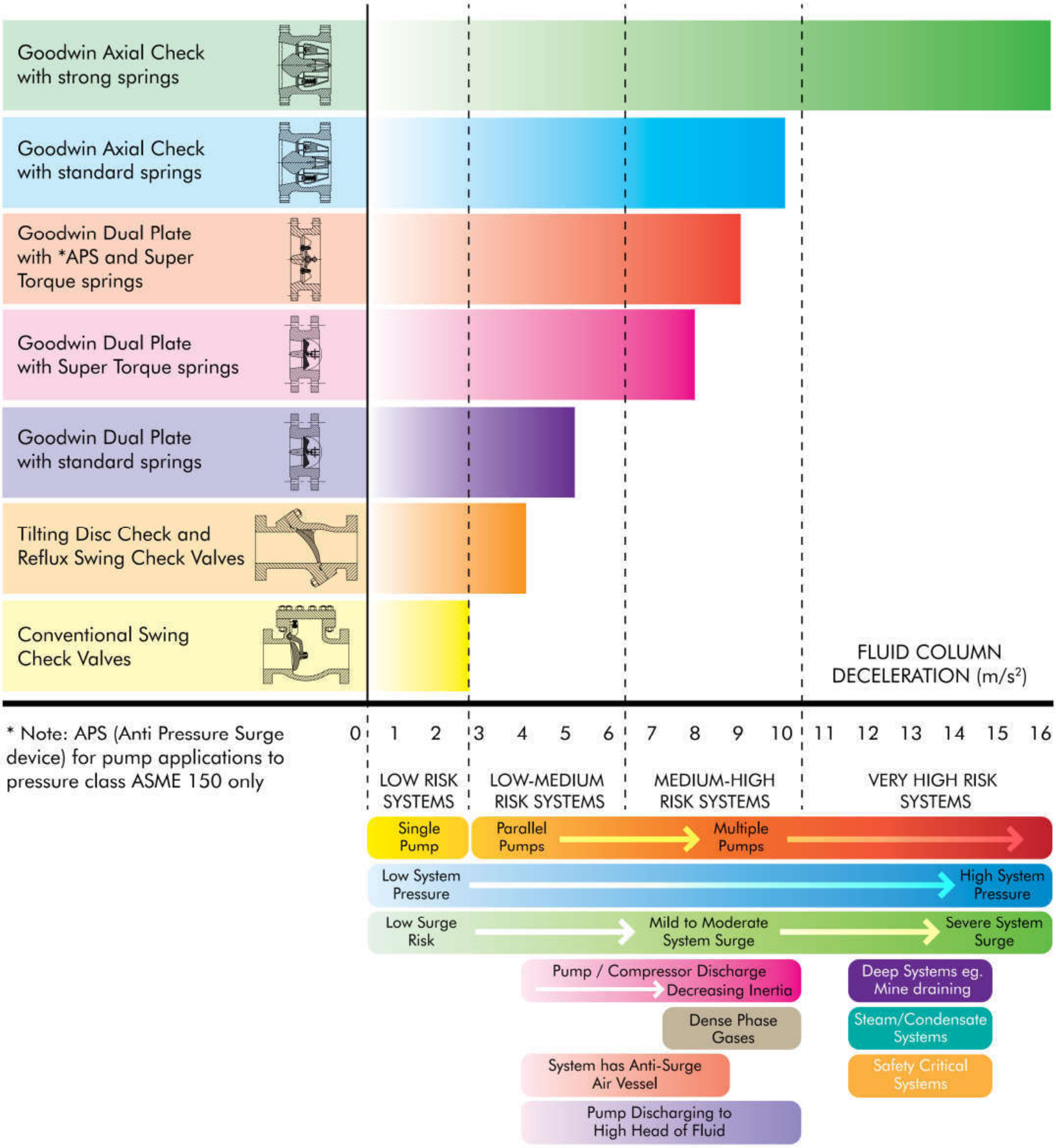
Valve Selection

The magnitude of the surge pressure can be approximated using the Joukowsky equation (See 'Pressure Surge'). A valve can then be selected based upon the severity of the system into which it is installed (how high the system deceleration).



Check Valve Selection based upon System Deceleration Characteristic

Check Valve Types



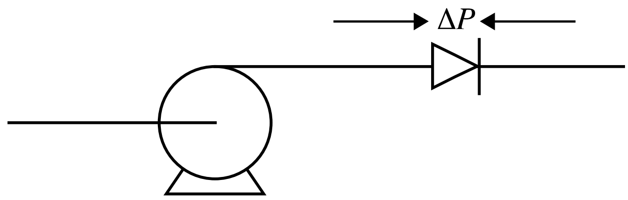
* Note: APS (Anti Pressure Surge device) for pump applications to pressure class ASME 150 only

The above check valve selections and information are for guidance only.
Please consult Goodwin for Check Valve applications.

Total Life Cycle Costs

As fluid passes through a check valve there will be a drop in pressure. To maintain the flow-rate, the pump will need to compensate for this pressure loss by working harder.

Today, energy cost is a prime concern for all plant manufacturers – the below analysis shows why a low pressure drop check valve should be considered for long-term economic benefit.



		SWING CHECK	COMPETITOR DUAL PLATE	GOODWIN DUAL PLATE	GOODWIN AXIAL
Check Valve Size	mm	DN400	DN400	DN400	DN400
ΔP Coefficient	ξ	1.21	1.05	0.81	0.83
Pipe Velocity, v	m/s	3.00	3.00	3.00	3.00
Flow Rate, Q	m^3/s	0.342	0.342	0.342	0.342
Pressure Loss, ΔP	Pa	5551	4817	3716	3807
Pump Power, P	kW	2.5313	2.1966	1.6945	1.7360
Energy Cost /Year	$	2,430	2,109	1,627	1,667
Life Cycle Cost	$	48,600	42,180	32,540	33,340

Area of Sch. 40 DN400 Pipe $=0.1140m^2$

Pipe velocity = Critical velocity (3.0m/s)

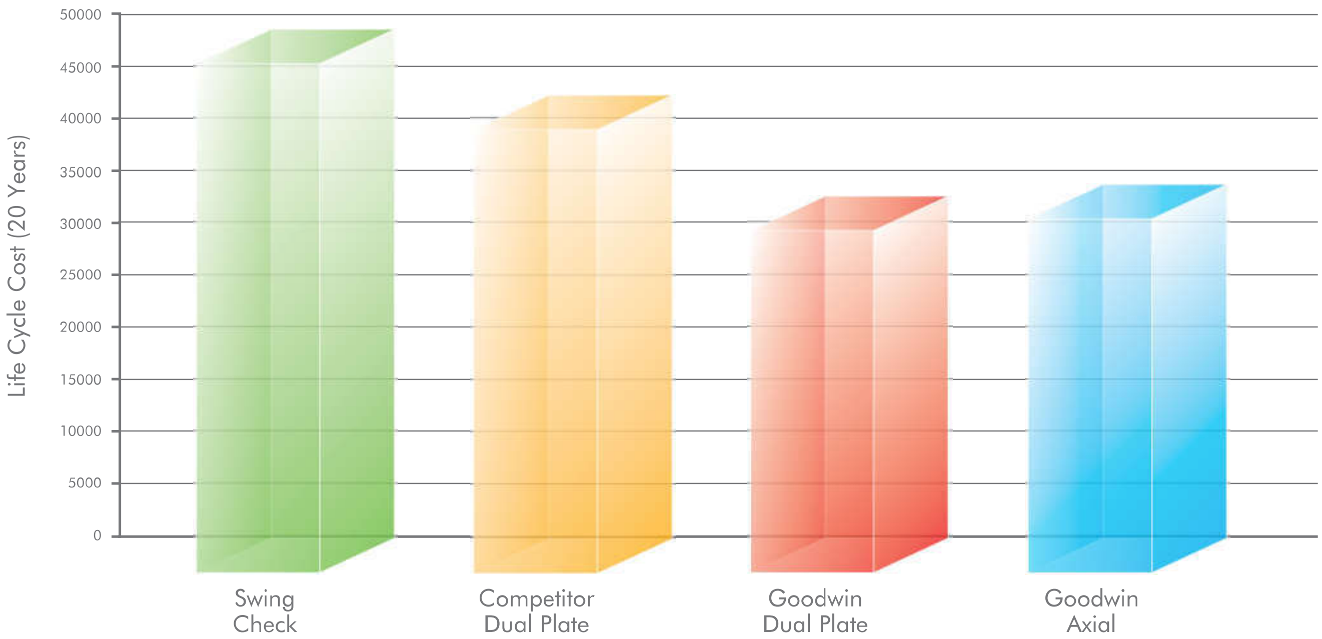
$Q = Av = 0.1140 \times 3.0 = 0.342 m^3/s$

$$\Delta P = \frac{10000 \xi v^2}{2g}$$

$$P = \frac{Q}{1000} \cdot \frac{\Delta P}{\eta}$$ (η = efficiency = 0.75)

Cost = P x Cost/yr x hrs/yr*
= Annual Cost x 20 years

Energy Cost = 0.12 \$/kWh
8000 hrs/year



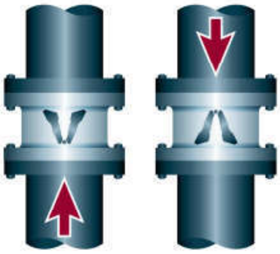
Some swing check valves appear to offer higher Cv values and, therefore, lower pressure losses. However, such pressure losses are only achieved when the valve is 100% open which invariably requires a high fluid velocity – a consequence of which is high system pressure loss. Reducing the flowrate to address this problem causes the valve to partially close resulting in severe valve pressure drop, whereas the Goodwin Dual Plate and Axial Check Valves would still be 100% open and performing well.

With swing check valves other issues arise in high velocity systems - such as slam and water hammer.

Dual Plate Check Valves
Best Practice Valve Installation

Piping components such as pumps, compressors, valves, reducers, bends, elbows create turbulence in a flow stream. To maximise the life of a Dual Plate Check Valve, it should be installed in accordance with industrial best practice i.e. a sufficient distance from turbulence sources to ensure the valve is in fully developed flow. Examples of recommended best practice installation for Dual Plate Check Valves are:

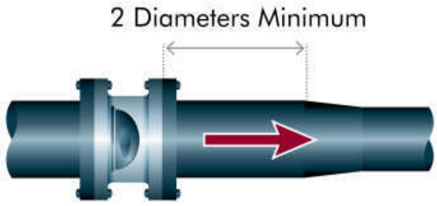
Horizontal Flow

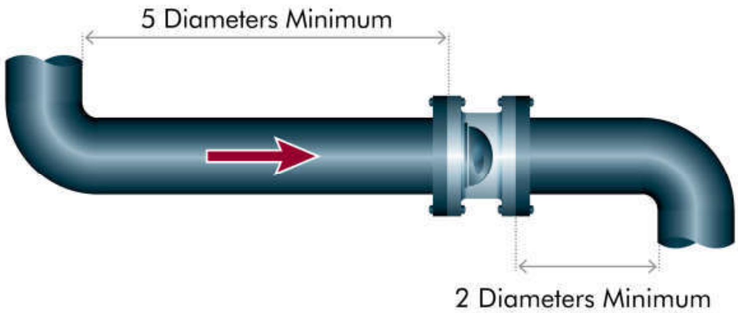


Vertical Flow

Valves (with standard springs) suitable for vertical flow up in sizes to and including 12", and flow down for sizes to and including 8".

For vertical flow in larger valve sizes, please contact Goodwin International with process conditions.



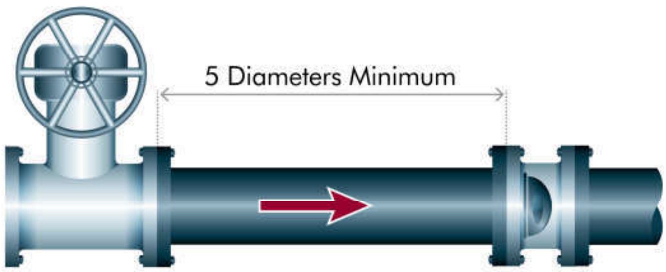


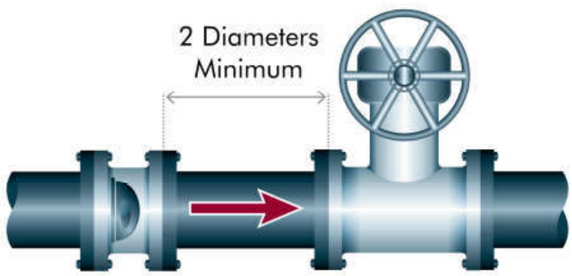
Check Valve should be installed a minimum of 5 diameters downstream of a reducer/ expander or bend to ensure flow at valve is fully developed and turbulence is minimised.

Check Valve should be installed a minimum of 2 diameters upstream of a reducer or bend to avoid choked flow, which would cause the valve to only partially open.

When installed near a throttling valve, the check valve should be installed a minimum of 5 diameters downstream, or 2 diameters upstream, of the throttling valve.

Check Valves can be close coupled upstream or downstream of non-throttling isolation valve (e.g. Full Port Ball Valves). On ball valves, disc clearance must be considered to ensure full operation of the ball valve.





Note: Goodwin Check Valves are not piggable

➔ Indicates direction of flow

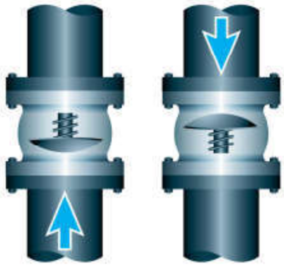
Axial Check Valves

Best Practice Valve Installation

Piping components such as pumps, compressors, valves, reducers, bends, elbows create turbulence in a flow stream. To maximise the life of a Axial Check Valve, it should be installed in accordance with industrial best practice i.e. a sufficient distance from turbulence sources to ensure the valve is in fully developed flow. Examples of recommended best practice installation for Axial Check Valves are:

Horizontal Flow

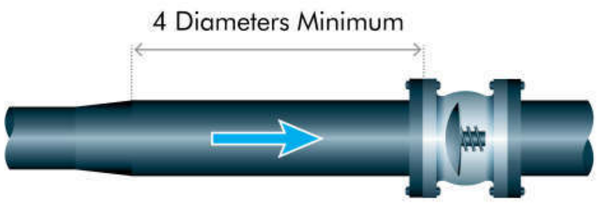
Type Z solid disc shown.
Also applicable to the N type Ring Disc.

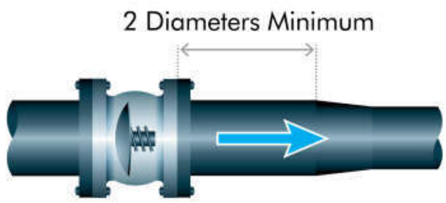


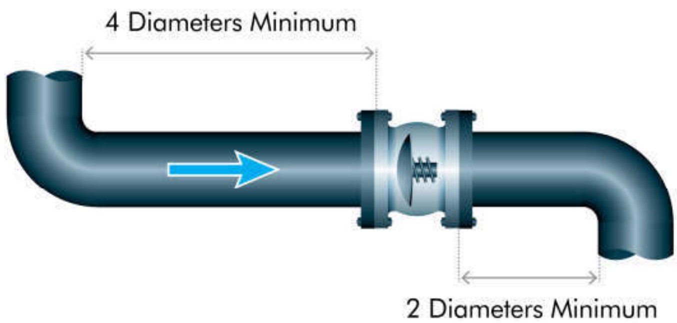
Vertical Flow

Valves suitable for vertical flow up and down.

For vertical flow please contact Goodwin International with process conditions.





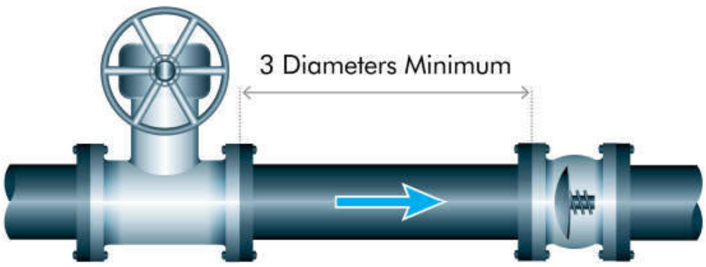


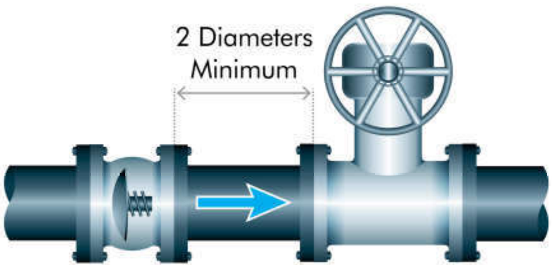
Check Valve should be installed a minimum of 4 diameters downstream of a reducer/ expander or bend to ensure flow at valve is fully developed and turbulence is minimised.

Check Valve should be installed a minimum of 2 diameters upstream of a reducer or bend to avoid choked flow, which would cause the valve to only partially open.

When installed near a throttling valve, the check valve should be installed a minimum of 3 diameters downstream, or 2 diameters upstream, of the throttling valve.

Check Valves can be close coupled upstream or downstream of non-throttling isolation valve (e.g. Full Port Ball Valves).





Note: Goodwin Check Valves are not piggable

Indicates direction of flow

GOODWIN
INTERNATIONAL LTD

Material Specifications

	ASTM GRADE	MATERIAL DESCRIPTION	MIN UTS (Nmm^2)	MIN UTS (ksi)	MIN YIELD (Nmm^2)	MIN YIELD (ksi)	MINIMAL IMPACT (J)	PREn Δ	NOMINAL COMPOSITION C	Cr	Ni	Mo	Cu	N	v	W	Nb
GENERAL PURPOSE	A216 WCB	Carbon Steel	485	70	250	36	-	-	0.23	-	-	-	-	-	-	-	-
	A105	Forged Carbon Steel	485	70	250	36	-	-	0.23	-	-	-	-	-	-	-	-
	B148 C95800	Aluminium Bronze	600	87	250	36	-	-	-	-	4.5	-	79min	-	-	-	-
	A487 4C	Low Alloy Steel	620	90	415	60	-	-	0.20	0.5	0.5	0.25	-	-	-	-	-
LOW TEMP	A352 LCB	Low Temp Carbon Steel	450	65	240	35	27@ -46°C (-50°F)	-	0.23	-	-	-	-	-	-	-	-
	A352 LCC	Low Temp Carbon Steel	485	70	275	40	27@ -46°C (-50°F)	-	0.23	-	-	-	-	-	-	-	-
	A350 LF2	Low Temp Carbon Steel	485	70	250	36	27@ -46°C (-50°F)	-	0.23	-	-	-	-	-	-	-	-
	A352 LC3	Low Temp Alloy Steel	485	70	275	40	27@ -101°C (-150°F)	-	0.10	-	3.5	-	-	-	-	-	-
	A351 CF8M	Cryogenic Stainless Steel	485	70	205	30	80@ -190°C (-320°F)	27	0.08*	19	10	2.50	-	-	-	-	-
	A351 CF3M	Cryogenic Stainless Steel	485	70	205	30	80@ -196°C (-320°F)	27	0.03*	19	10	2.50	-	-	-	-	-
HIGH TEMP	A217 WC6	Chrome Molybdenum Steel	485	70	275	40	-	-	0.10	1.25	-	0.50	-	-	-	-	-
	A217 C5	Chrome Molybdenum Steel	620	90	415	60	-	-	0.10	5.0	-	0.50	-	-	-	-	-
	A217 C12	Chrome Molybdenum Steel	620	90	415	60	-	-	0.10	9.0	-	1.00	-	-	-	-	-
	A217 C12A	Chrome Molybdenum Steel	585	85	415	60		-	0.10	9.0	-	1.0	-	0.05	0.20	-	0.8
	A351 CF8M	Stainless Steel	485	70	205	30	-	27	0.08*	19	10	2.50	-	-	-	-	-
	A351 CF8C	Stainless Steel	485	70	205	30	-	20	0.08*	19	10	0.5*	-	-	-	-	8 x C
HARD WEARING	A217 CA15	Chrome Stainless Steel	620	90	450	65	-	-	0.10	13	-	-	-	-	-	-	-
	A487 CA6NM	Low Temp Chrome Stainless Steel	760	110	515	80	-	-	0.03	13	4.5	0.75	-	-	-	-	-
CORROSION RESISTANT MATERIAL	A351 CF8M	Stainless Steel	495	70	205	30	-	27	0.08*	19	10	2.5	-	-	-	-	-
	A890 4A & A995 4A	Duplex 22% Cr	620	90	415	60	45 @ -40°C (-40°F)	34	0.03*	22	5.5	3	-	0.15	-	-	-
	A890 5A & A995 5A	Super Duplex 25% Cr	690	100	515	75	45 @ -50°C (-58°F)	-	0.03*	25	7.5	4.5	-	0.25	-	-	-
	A890 6A & A995 6A	Super Duplex 25% Cr	725	105	450	65	-	41	0.03*	25	7.5	3.5	0.75	0.25	-	0.75	-
	A351 CK3MCuN	Super Austenitic	550	80	260	38	-	44	0.025*	20	18	6.5	0.75	0.2	-	-	-
	A494-M35-2	Monel	450	65	205	30	-	-	0.35*	-	BAL	-	30	-	-	-	0.5*
	A494 CU5MCuN	High Nickel 825	520	75	240	35	-	-	0.03	21	41	3	2	-	-	-	0.9
	A494 CW-6MC	High Nickel 625	485	70	275	40	-	-	0.03	21	62	9	-	-	-	-	3.5
	A494 CW-12MW	Hastelloy® C276	495	72	275	40	-	-	0.03	16	57	17	-	-	0.35	4	-
	A494 N-7M	Hastelloy® B2	525	76	275	40	-	-	0.03	1*	67	32	-	-	-	-	-
	A494 CX2MW	Hastelloy® C22	550	80	280	45	-	-	0.02*	22	56	13	-	-	0.3	3	-
	B367C2/B348Gr.2	Titanium	345	50	275	40	-	-	0.10*	-	-	-	-	-	-	-	-

* Max
Δ PREn = Pitting Resistance Equivalent number

ASME B16.34 Pressure/Temperature Ratings

Maximum Non-Shock Working Pressure (Standard Class) Bar

Temperature °C	150 A216 WCB / A105	150 A352 LCC	150 A350 LF2	150 A217 WC6	300 A216 WCB / A105	300 A352 LCC	300 A350 LF2	300 A217 WC6	600 A216 WCB / A105	600 A352 LCC	600 A350 LF2	600 A217 WC6
-29 to 38	19.6	19.8	19.6	19.8	51.1	51.7	51.1	51.7	102.1	103.4	102.1	103.4
50	19.2	19.5	19.2	19.5	50.1	51.7	50.1	51.7	100.2	103.4	100.2	103.4
100	17.7	17.7	17.7	17.7	46.6	51.5	46.6	51.5	93.2	103.0	93.2	103.0
150	15.8	15.8	15.8	15.8	45.1	50.2	45.1	49.7	90.2	100.3	90.2	99.5
200	13.8	13.8	13.8	13.8	43.8	48.6	43.8	48.0	87.6	97.2	87.6	95.9
250	12.1	12.1	12.1	12.1	41.9	46.3	41.9	46.3	83.9	92.7	83.9	92.7
300	10.2	10.2	10.2	10.2	39.8	42.9	39.8	42.9	79.6	85.7	79.6	85.7
350	8.4	-	8.4	8.4	37.6	-	37.6	40.3	75.1	-	75.1	80.4
400	6.5	-	6.5	6.5	34.7	-	34.7	36.5	69.4	-	69.4	73.3
450	-	-	-	4.6	-	-	-	33.7	-	-	-	67.7
500	-	-	-	2.8	-	-	-	25.7	-	-	-	51.5
538	-	-	-	1.4	-	-	-	14.9	-	-	-	29.8

Temperature °C	900 A216 WCB / A105	900 A352 LCC	900 A350 LF2	900 A217 WC6	1500 A216 WCB / A105	1500 A352 LCC	1500 A350 LF2	1500 A217 WC6	2500 A216 WCB / A105	2500 A352 LCC	2500 A350 LF2	2500 A217 WC6
-29 to 38	153.2	155.1	153.2	155.1	255.3	258.6	255.3	258.6	425.5	430.9	425.5	430.9
50	150.4	155.1	150.4	155.1	250.6	258.6	250.6	258.6	417.7	430.9	417.7	430.9
100	139.8	154.6	139.8	154.4	233.0	257.6	233.0	257.4	388.3	429.4	388.3	429.0
150	135.2	150.5	135.2	149.2	375.6	250.8	375.6	248.7	320.8	418.1	320.8	414.5
200	131.4	145.8	131.4	143.9	219.0	243.2	219.0	239.8	365.0	405.4	365.0	399.6
250	125.8	139.0	125.8	139.0	209.7	231.8	209.7	231.8	349.5	386.2	349.5	386.2
300	119.5	128.6	119.5	128.6	199.1	214.4	199.1	214.4	331.8	257.1	331.8	357.1
350	112.7	112.7	112.7	120.7	187.8	-	187.8	201.1	313.0	-	313.0	335.3
400	104.2	104.2	104.2	109.8	173.6	-	173.6	183.1	289.3	-	289.3	304.9
450	-	-	-	101.4	-	-	-	169.0	-	-	-	281.8
500	-	-	-	77.2	-	-	-	128.6	-	-	-	214.4
538	-	-	-	44.7	-	-	-	74.5	-	-	-	124.1

Temperature °C	150 A351 CF8M / CF3M	150 A351 CF8C	150 A995 4A A995 6A	150 A494 CW6MC 625 ALLOY*	300 A351 CF8M / CF3M CF3M	300 A351 CF8C	300 A995 4A A995 6A	300 A494 CW6MC 625 ALLOY*	600 A351 CF8M / CF3M A351	600 A351 CF8C	600 A995 4A A995 6A	600 A494 CW6MC 625 ALLOY*
-29 to 38	19.0	19.0	20.0	20.0	49.6	49.6	51.7	51.7	99.3	99.3	103.4	103.4
50	18.4	18.7	19.5	19.5	48.1	48.8	51.7	51.7	96.2	97.5	103.4	103.4
100	16.2	17.4	17.7	17.7	42.2	45.3	50.7	51.5	84.4	90.6	101.3	103.0
150	14.8	15.8	15.8	15.8	38.5	42.5	45.9	50.3	77.0	84.9	91.9	100.3
200	13.7	13.8	13.8	13.8	35.7	39.9	42.7	48.3	71.3	79.9	85.3	96.7
250	12.1	12.1	12.1	12.1	33.4	37.8	40.5	46.3	66.8	75.6	80.9	92.7
300	10.2	10.2	10.2	10.2	31.6	36.1	38.9	42.9	63.2	72.2	77.7	85.7
350	8.4	8.4	-	8.4	30.3	34.8	-	40.3	60.7	69.5	-	80.4
400	6.5	6.5	-	6.5	29.4	33.9	-	36.5	58.9	67.8	-	73.3
450	4.6	4.6	-	4.6	28.8	33.5	-	33.7	57.7	66.9	-	67.7
500	2.8	2.8	-	2.8	28.2	28.2	-	28.2	56.5	56.5	-	56.5
538	1.4	1.4	-	1.4	25.2	25.2	-	25.2	50.0	50.0	-	50.0

Temperature °C	900 A351 CF8M / CF3M	900 A351 CF8C	900 A995 4A A995 6A	900 A494 CW6MC 625 ALLOY*	1500 A351 CF8M / CF3M	1500 A351 CF8C	1500 A995 4A A995 6A	1500 A494 CW6MC 625 ALLOY*	2500 A351 CF8M / CF3M	2500 A351 CF8C	2500 A995 4A A995 6A	2500 A494 CW6MC 625 ALLOY*
-29 to 38	148.9	148.9	155.1	155.1	248.2	248.2	258.6	258.6	413.7	413.7	430.9	430.9
50	144.3	146.3	155.1	155.1	240.6	243.8	258.6	258.6	400.9	406.4	430.9	430.9
100	126.6	135.9	152.0	154.6	211.0	226.5	253.3	257.6	351.6	377.4	422.2	429.4
150	115.5	127.4	137.8	150.6	192.5	212.4	229.6	250.8	320.8	353.9	382.7	418.2
200	107.0	119.8	128.0	145.0	178.3	199.7	213.3	241.7	297.2	332.8	355.4	402.8
250	100.1	113.4	121.4	139.0	166.9	189.1	202.3	231.8	278.1	315.1	337.2	386.2
300	94.9	108.3	116.6	128.6	158.1	180.4	194.3	214.4	263.5	300.7	323.8	357.1
350	91.0	104.3	-	120.7	151.6	173.8	-	201.1	252.7	289.6	-	335.3
400	88.3	101.7	-	109.8	147.2	169.5	-	183.1	245.3	282.6	-	304.9
450	86.5	100.4	-	101.4	144.2	167.3	-	169.0	240.4	278.8	-	281.8
500	84.7	84.7	-	84.7	140.9	140.9	-	140.9	235.0	235.0	-	235.0
538	75.2	75.2	-	75.2	125.5	125.5	-	125.5	208.9	208.9	-	208.9

* Extrapolations from materials with similar CR/NI/MO content

Large Diameter Check Valves

Goodwin specialises in the manufacture of large diameter valves being capable of manufacturing both its Dual Plate Check Valve and the Axial Check Valve in sizes to 144" and 88" respectively in all materials and in all relevant pressure classes.

Applicable Flange Standards

26" - 60": ASME B16.47 Series A
ASME B16.47 Series B

66" - 144": AWWA C207 Class B, D, E & F
(Flat Face flanges)
Taylor Forge (Raised Face flanges)
or
Customer agreed flange design

52" 300# Axial Check Valve Type NKF

Large diameter check valves are utilised throughout the hydrocarbon, energy and process industries in a wide variety of applications. Goodwin Check Valves are in service in applications ranging from potable water and seawater to hydrocarbon gas and LNG in materials such as Carbon Steel, Aluminium Bronze, Duplex Stainless Steel and CF8M Stainless Steel.

Typical Goodwin Large Diameter Check Valve Applications

- Pipelines: Extensive use in the compressor stations and pumping stations of many of the world's cross-country and country-to-country pipelines. Many for the transportation of energy and traversing 1000s of kilometres, by their nature these pipelines are critical - Goodwin Check Valves are selected for their reliability and high performance.

- Ethylene Centrifugal Compressor Trains: Employed on the discharge of each compressor stage, Goodwin Check Valves prevent any potential for backflow to protect compressors against reverse rotation and over pressurisation and the consequent mechanical damage.

- LNG: Especially used within the liquefaction plants, large diameter Goodwin Check Valves are in service at -161°C

84" 150# Dual Plate Check Valve

- Seawater intake line and seawater discharge pumps: Used on the discharge of the pumps, Goodwin Check Valves protect the pumps against reverse rotation and the consequential mechanical damage.

Cryogenic Valves

Goodwin International has its own in-house cryogenic test facility where it is capable of pressure testing at temperatures from ambient temperature down to -196°C.

Cryogenic testing is conducted by immersing the valve in Liquid Nitrogen to cool to the desired temperature which is monitored and recorded at a number of locations on the valve, both internally and externally. Once temperature has stabilised, the pressure test commences using pure Helium (for low temperature testing: Nitrogen or 99% Nitrogen / 1% Helium) as the test medium. Pressure can be increased in increments and seat leakage measured at each increment. Test pressure depends on the rating of the valve and the maximum is limited by the Cold Working Pressure as designated by ASME B16.34.

Seat leakage is measured with calibrated flow meters. Valve Inspection and Test Standard API 598 defines the maximum permissible leakrate with air or inert gas at ambient temperature conditions as 700cc/minute/inch bore diameter. However, for cryogenic service Goodwin manufactures, as standard, both its valves* with a maximum leakrate of 450cc/minute/inch bore diameter (ISO5208 Rate E) with Helium at -196° C. Goodwin has selected this maximum leakrate in response to the requirements of today's LNG plant designers.

Following the seat leak test, valve body integrity is tested whereby the entire body cavity is pressurised and a shell leak detection test carried out using a Mass Spectrometer.

Goodwin has supplied to the majority of the world's most prestigious LNG (Liquefied Natural Gas) projects, particulary to the export liquefaction plants but also to the LNG tanker carriers and the reception/regasification terminals. The vast majority of valves are of 316 Stainless Steel construction for use in Liquefied Natural Gas service at a temperature of -161°C. Additionally, a large number of valves are of LTCS body construction for low temperature service applications.

*On a number of LNG projects, in response to customers' design requirements, Goodwin has supplied its valves to far lower permissible leakrates than the 450 cc/minute/inch bore diameter. With the Goodwin Dual Plate Check Valve, Goodwin's ability to meet these more stringent customer shut-off requirements is achievable due to its unique and patented pressure sensitive plate design.

Cryogenic & High Pressure Gas Testing Facility

Goodwin has over 25 years of in-house cryogenic testing experience. Having its own cryogenic and high pressure gas test facility enables Goodwin to test valves in-house as large as 72" at temperatures down to -196°C and pressures to 15000psig/1035barg.

Typical Test Procedures

BS 6364
Shell SPE 77/200

Acceptance Standards

Seat Leakage: API598 - 700 cc/min/inch bore
ISO 5208 Rate E

Outside Leakage (body): Zero

18" 300# Axial Check Valve Type NKF on Cryogenic Test

70" 150# Dual Plate Check Valve on Cryogenic Test

Certification & Approvals


Certificate of Registration

Goodwin International Limited


Certificate

of Conformity


Certificate of Authority to use the Official API Monogram

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Stoke-on-Trent, Staffordshire

United Kingdom

American Petroleum Institute


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