Goodwin

Market leader in Dual Plate Check Valve quality and design
Retainerless design for fugitive emission control

DUAL PLATE CHECK VALVE TYPES

WAFER TYPE BR

ANSI B16.5
- Flange dims to ANSI B16.5 (MSS-SP44 >24")*
- Face to Face dims to API 594

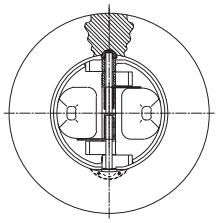
API 605
- Flange dims to API 605**
- Face to Face dims to API 594

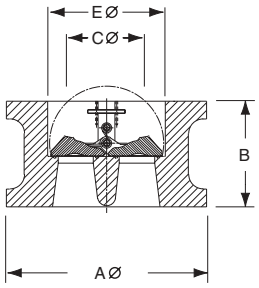
(Retainerless design supplied as standard†)

API 6A
- Flange dims to API 6A
- Face to Face dims to API 6A

API 6D
- Flange dims to ANSI B16.5
- Face to Face dims to API 6D

EXTENDED BODY
- Flange dims to ANSI B16.5



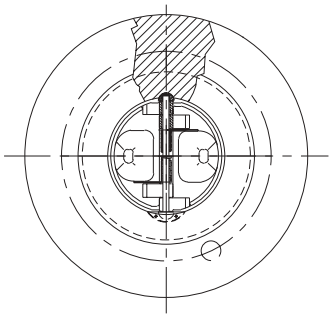


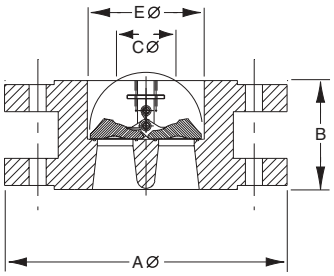
FLANGED TYPE BFR

TYPE BFT
- Threaded Flanged Type also available

FLANGED LUG TYPE
- Flange dims to ANSI B16.5 (MSS-SP44 >24")*
- Face to Face dims to API 594

(Retainerless design supplied as standard†)



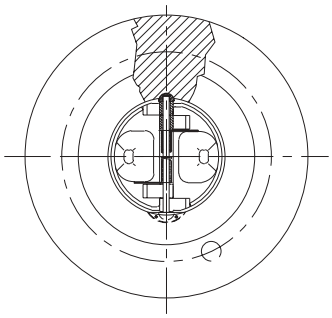


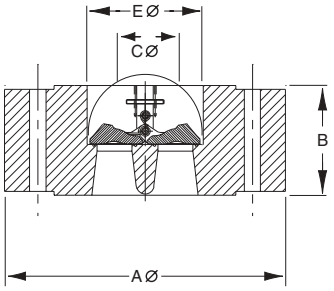
SOLID LUG TYPE BSR

TYPE BTR
- Threaded Lug Type also available

SOLID LUG TYPE
- Flange dims to ANSI B16.5 (MSS-SP44 >24")*
- Face to Face dims to API 594

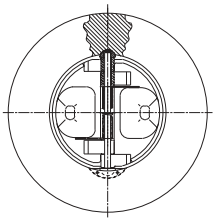
(Retainerless design supplied as standard†)

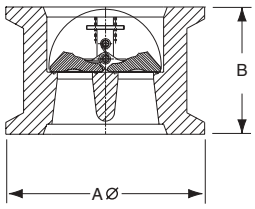




HUB ENDED TYPE BHR

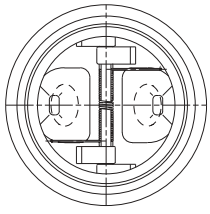
(also available in full bore version - Type BH - with increased face to face dimension)

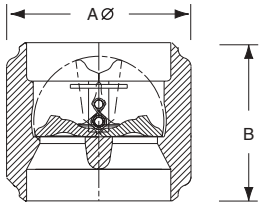




BUTTWELD END TYPE BWR

(Retainerless design supplied as standard†)





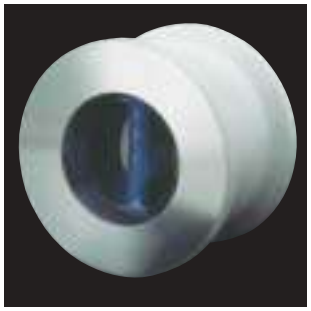
†On occasions, for technical or delivery reasons, Goodwin may offer valves with retainers. In such instances, this will be clearly indicated in the quotation.
*MSS-SP44 now superseded by ANSI B16.47 Series A
**API 605 now superseded by ANSI B16.47 Series B
Δ Outside profile of bodies may differ from those shown above.

TYPE BR
Wafer Retainerless

TYPE BFR
Flanged Retainerless

TYPE BSR
Solid Lug Retainerless

TYPE BHR
Hub-Ended Retainerless



TYPE BWR
Buttweld End Retainerless

Goodwin International Ltd.

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For up to the minute information and to place your enquiries
see our website: http://www.checkvalves.co.uk

Index

TYPICAL CONSTRUCTIONS

CARBON STEEL BODY VALVES — API 600

Seal	Figure No	Body	Plates (1) (8)	Body Seat	Plate Seat	Wetted Parts (2)	Spring (3)	TRIM No.
Metal to metal	CEPPR-YE	A216 WCB/A105	A217 CA15	AS BODY	AS PLATE	410 SS	INCONEL X750®	
Metal overlay	CEEPR-YE	A216 WCB/A105	A217 CA15	410 SS	AS PLATE	410 SS	INCONEL X750®	1
Metal overlay	CEUPR-YE	A216 WCB/A105	A217 CA15	STELLITE 6®	AS PLATE	410 SS	INCONEL X750®	8
Metal overlay	CEUUR-YE	A216 WCB/A105	A217 CA15	STELLITE 6®	STELLITE 6®	410 SS	INCONEL X750®	5
Resilient (4)	CEVPR-YE	A216 WCB/A105	A217 CA15	VITON A®	AS PLATE	410 SS	INCONEL X750®	
Lined (5)	CAXPR/MM	A216 WCB/A105	BS 1400 AB2	CHLOROPRENE®	AS PLATE	MONEL 400®	MONEL K500®	
Metal to metal	OSPPR-YS	A352 LCC/A350 LF2	A351 CF8M	AS BODY	AS PLATE	316 SS	INCONEL X750®	
Metal overlay	OSSPR-YS	A352 LCC/A350 LF2	A351 CF8M	316 SS	AS PLATE	316 SS	INCONEL X750®	10
Metal overlay	OSUPR-YS	A352 LCC/A350 LF2	A351 CF8M	STELLITE 6®	AS PLATE	316 SS	INCONEL X750®	12
Metal overlay	OSUUR-YS	A352 LCC/A350 LF2	A351 CF8M	STELLITE 6®	STELLITE 6®	316 SS	INCONEL X750®	5
Resilient (4)	OSVPR-YS	A352 LCC/A350 LF2	A351 CF8M	VITON A®	AS PLATE	316 SS	INCONEL X750®	

STAINLESS STEEL BODY VALVES — API 600

Seal	Figure No	Body	Plates	Body Seat	Plate Seat	Wetted Parts	Spring (3)	TRIM No.
Metal to metal	SSPPR-YS	A351 CF8M / A182 F316	A351 CF8M	AS BODY	AS PLATE	316 SS	INCONEL X750®	10
Metal overlay	SSUPR-YS	A351 CF8M / A182 F316	A351 CF8M	STELLITE 6®	AS PLATE	316 SS	INCONEL X750®	12
Metal overlay	SSUUR-YS	A351 CF8M / A182 F316	A351 CF8M	STELLITE 6®	STELLITE	316 SS	INCONEL X750®	5
Resilient (4)	SSVPR-YS	A351 CF8M / A182 F316	A351 CF8M	VITON A®	AS PLATE	316 SS	INCONEL X750®	

IRON BODY VALVES

Seal	Figure No	Body (6)	Plates (7) (8)	Body Seat	Plate Seat	Wetted Parts (7)	Spring (7)
Resilient (4)	XANPF-MM	A126 Cl. B	BS 1400 AB2	BUNA N®	AS PLATE	MONEL 400®	MONEL K500®
Lined (5)	XAXPF/MM	A126 Cl. B	BS 1400 AB2	CHLOROPRENE®	AS PLATE	MONEL 400®	MONEL K500®
Resilient (4)	9ANPF-MM	A395	BS 1400 AB2	BUNA N®	AS PLATE	MONEL 400®	MONEL K500®
Resilient (4)	9ANPF-II	A395	BS 1400 AB2	BUNA N®	AS PLATE	INCONEL 625®	INCONEL 625®
Lined (5)	9AXPF-MM	A395	BS 1400 AB2	CHLOROPRENE®	AS PLATE	MONEL 400®	MONEL K500®
Metal to metal	88PPF-SS	A 439 D2	A 439 D2	AS BODY	AS PLATE	316 SS	316 SS
Metal to metal	88PPF-II	A 439 D2	A 439 D2	AS BODY	AS PLATE	INCONEL 625®	INCONEL 625®
Resilient (4)	88NPF-SS	A 439 D2	A 439 D2	BUNA N®	AS PLATE	316 SS	316 SS
Resilient (4)	88NPF-II	A 439 D2	A 439 D2	BUNA N®	AS PLATE	INCONEL 625®	INCONEL 625®
Resilient (4)	8ANPF-II	A 439 D2	BS 1400 AB2	BUNA N®	AS PLATE	INCONEL 625®	INCONEL 625®

ALUMINIUM BRONZE BODY VALVES

Seal	Figure No	Body (8)	Plates (8)	Body Seat	Plate Seat	Wetted Parts (9)	Spring
Metal to metal	AAPPR-MM	BS 1400 AB2	BS 1400 AB2	AS BODY	AS PLATE	MONEL 400®	MONEL K500®
Resilient (4)	AANPR-MM	BS 1400 AB2	BS 1400 AB2	BUNA N®	AS PLATE	MONEL 400®	MONEL K500®

DUPLEX STAINLESS STEEL BODY VALVES

Seal	Figure No	Body	Plates	Body Seat	Plate Seat	Wetted Parts	Spring
Metal to metal	QQPPR-YI	UNS S31803	UNS S31803	AS BODY	AS PLATE	INCONEL 625®	INCONEL X750®
Metal overlay	QQUPR-YI	UNS S31803	UNS S31803	STELLITE 6®	AS PLATE	INCONEL 625®	INCONEL X750®
Resilient (4)	QQWPR-YI	UNS S31803	UNS S31803	VITON B®	AS PLATE	INCONEL 625®	INCONEL X750®

INCONEL STEEL BODY VALVES

Seal	Figure No	Body	Plates	Body Seat	Plate Seat	Wetted Parts	Spring
Metal to metal	IIPPR-II	UNS N06625	UNS N06625	AS BODY	AS PLATE	INCONEL 625®	INCONEL 625®
Metal overlay	IIUPR-II	UNS N06625	UNS N06625	STELLITE 6®	AS PLATE	INCONEL 625®	INCONEL 625®
Inconel clad body (10)	OIIPR/II	A352 LCC	UNS N06625	INCONEL625® CLAD	AS PLATE	INCONEL 625®	INCONEL 625®

TITANIUM BODY VALVES

Seal	Figure No	Body (11)	Plates (11)	Body Seat	Plate Seat	Wetted Parts	Spring
Metal to metal	TTPPR-TT	B348 Gr2 / B381 F2	B348 Gr2 / B381 F2	AS BODY	AS PLATES	B348 Gr2	TITANIUM
Resilient (4)	TTVPT-TT	B348 Gr2 / B381 F2	B348 Gr2 / B381 F2	VITON A®	AS PLATES	B348 Gr2	TITANIUM

See opposite page for applicable notes (1) to (11)

TYPICAL CONSTRUCTIONS

NOTES

(1) If required, CA15/410SS plate material could be substituted with CF8M/316SS
(2) In A216 WCB/A105 Carbon Steel valves, 316SS with 410SS hinge and stop pins is manufacturer's standard wetted parts material
(3) If required, spring material could be substituted with 316SS
(4) Subject to application different resilient materials are available, for example Buna N®, Viton A®, Viton B®, Viton GLT®, Neoprene®, Teflon® (PTFE)
(5) Subject to application different linings are available, for example Chloroprene®, Neoprene®, Chlorobutyl, Rilsan Nylon II®
(6) Cast Iron for sizes 2" to 36" only; Ductile Iron and Ni-Resist Iron for all sizes to 144"
(7) Alternative plate, wetted parts and spring materials are available, for example 316SS, subject to application
(8) Alternative specifications of Aluminium Bronze available on request eg ASTM B148 C95800
(9) In Aluminium Bronze valves, Inconel 625® with Monel 400® hinge and stop pins is manufacturer's standard wetted parts material
(10) Alternative base body materials for Inconel cladding could be used
(11) Alternative Titanium specifications available: B367 C2

STANDARDS DEFINITIONS

API 594 (Extract from Fifth Edition, 1997)

5.3 **Trim**
5.31 The trim includes the following:
a) Body seating surfaces
b) Plate Seating surfaces

5.4 **Internal Wetted Parts**
The term "wetted parts" shall include, but not be limited to, hinges, pins, bolts, bearings, and any other part in contact with the fluid medium other than the body, plates, trim, springs and pipe plugs

API 600 (Extract from Tenth Edition, 1997)

TABLE 3 - Nominal Seating Surface Materials

Name	Trim Number				
	1	5	8	10	12
Plate seating surface	13 Cr (410SS)	Stellite 6®	13 Cr (410SS)	18-8 Cr-Ni (316SS)	18-8 Cr-Ni (316SS)
Body seating surface	13 Cr (410SS)	Stellite 6®	Stellite 6®	18-8 Cr-Ni (316SS)	Stellite 6®

GOODWIN CHECK VALVE FEATURES:

RETAINERLESS
To meet FUGITIVE EMISSIONS control requirements valves are supplied RETAINERLESS as standard, i.e. no threaded plugs in the pressure boundary.This design eliminates the potential leakpath to atmosphere associated with competitors' valves with threaded retaining plugs. The Retainlerless design is ideal on applications where there is a risk of crevice/thread corrosion from either the contained fluid or the environment. Having no threaded retaining plugs in the pressure boundary the Retainlerless design eliminates the associated problems of crevice/thread corrosion.

PRESSURE CLASSES: ANSI 150 TO 2500 LB, API 2000 TO 10,000 LB.

NOMINAL SIZE RANGE

ANSI 150 lb.	**2" to 144"**	Larger diameter valves for the respective pressure classes can be designed and manufactured on request.
ANSI 300 lb.	**2" to 60"**	
ANSI 600 lb.	**2" to 54"**	
ANSI 900 lb.	**2" to 48"**	
ANSI 1500 lb.	**2" to 40"**	
ANSI 2500 lb.	**2" to 24"**	

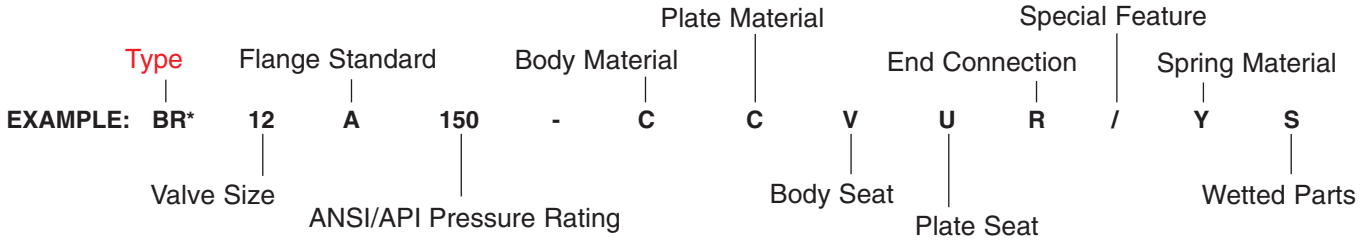
FLANGE STANDARD
Unless otherwise specified in the order text, valves that are to fit between flanges i.e. types BR, BFR and BSR will be supplied to accommodate flanges to ANSI B16.5, 1.5" through 24" and ANSI B16.47 Series A (MSS SP44) for valves larger than 24". Customers requiring the valve to be compatible with ANSI B16.47 Series B (API 605) or other flange standards must request such in the text of their inquiry and order.

SEAT LEAKAGE
A metal-to-metal leakage rate of 1cc/minute/inch diameter can be provided at no extra cost if specified with customer enquiry/order.
(Note: API 598 specifies 3cc/minute/inch diameter with water.)

INDEPENDENT PLATE SUSPENSION
Valves larger than 24" are supplied with independent plate suspension.

PRESSURE EQUIPMENT DIRECTIVE 97/23/EC
Goodwin can manufacture its Dual Plate Check Valves in compliance with the European Pressure Equipment Directive (PED) 97/23/EC to meet customer requirements.

ORDERING INSTRUCTIONS



* 'R' in the valve type code indicates Retainerless.

VALVE TYPE*	
BR	Wafer
BFR (BFT)	Flanged (BFT: Threaded)
BSR (BTR)	Solid Lug (BTR: Threaded)
BHR (R)	Hub Ended Reduced Bore (R)
BHR (F)	Hub Ended Full Bore (F)
BH (F)	Hub Ended Full Bore (F)
BWR (BWA)	Buttweld End
BL	Wafer-Lined
BFL	Flanged-Lined
BSL	Solid Lug-Lined

VALVE SIZE

Inches: For ANSI, AWWA & API standards

Millimetres: For JIS standards and PN ratings

FLANGE STANDARD	
FIG	STANDARD
-	ANSI B16.5
-	ANSI B16.47 Series A (MSS SP 44)
A	ANSI B16.47 Series B (API 605)
D	AWWA C207 Class D
E	AWWA C207 Class E
F	Hub Ended - Full Bore Internals
R	Hub Ended - Reduced Bore Internals
J	JIS 2210

ANSI / API PRESSURE RATINGS	
FIG	PRESSURE RATINGS
015	ANSI 150
030	ANSI 300
060	ANSI 600
090	ANSI 900
150	ANSI 1500
250	ANSI 2500
200	API 2000
300	API 3000
500	API 5000
100	API 10000

BODY AND/OR PLATE MATERIAL

FIG	MATERIAL	SPECIFICATION
C	Carbon Steel	ASTM A105 / A216 WCB
L	Low Temp Carbon Steel	ASTM A352 LCB
O	Low Temp Carbon Steel	ASTM A352 LCC / A350 LF2
D	High Temp Cr Mo Steel	ASTM A217 WC6
N	Low Alloy Steel	ASTM A487 GR 4N
K	Low Alloy Steel	ASTM A487 GR 4C
E	410 Stainless Steel	ASTM A217 CA15
P	5% Cr Steel	ASTM A217 C5
W	9% Cr Steel	ASTM A217 C12
G	Low Temp 13% Cr 4% Ni	ASTM A352 CA6NM
S	316 Stainless Steel	ASTM A182 F316 / A351 CF8M
F	316L Stainless Steel	ASTM A182 F316L / A351 CF3M
Y	347 Stainless Steel (High Temp)	ASTM A351 CF8C
Q	22% Chrome Duplex[1]	J92205 / ASTM A890 4A (WE[1])
R	Ferralium 255-3SC®[2]	(WE[2])
Z	25% Chrome Super Duplex[3]	J93380 / ASTM A890 6A (WE[3])
H	Alloy 825[4]	N08826 / ASTM A494 CU5MCuC (WE[4])
I	Alloy 625[5]	N26625 / ASTM A494 CW6MC (WE[5])
V	Avesta 254 SMO®[6]	J93254 / ASTM A351 CK3MCuN (WE[6])
U	Stellite®	Stellite 6®
T	Titanium	ASTM B367 C2 / B381 F2
J	Hastelloy C276®[7]	ASTM A494 CW12MW (WE[7])
M	Monel	ASTM A494-M35-2
A	Nickel Aluminium Bronze	† BS EN 1982 CC333G / ASTM B148 C95800
1	Chromium Molybdenum Steel	ASTM A217 GR WC9
2	3.5% Nickel Steel	ASTM A352 LC3
3	304 Stainless Steel	ASTM A351 CF8
4	304L Stainless Steel	ASTM A351 CF3
5	Alloy 20	ASTM A351 CN7M
6	317 Stainless Steel	ASTM A351 CG8M
7	Carbon Molybdenum Steel	ASTM A352 LC1
8	Ni-Resist ® Iron	ASTM A439 D2
9	Ductile Iron	ASTM A395
X	To Be Specified	TO BE SPECIFIED

BODY SEAT/PLATE OVERLAY MATERIAL

FIG	MATERIAL	OPERATING TEMP RANGE * °F	°C
P	Same as Body / Plate	As Body / Plate	As Body / Plate
E	410 Stainless Steel	-20 to 1000	-29 to 538
S	316 Stainless Steel	-425 to 1500	-254 to 815
F	316L Stainless Steel	-425 to 850	-254 to 455
G	17-4 PH Stainless Steel	-40 to 800	-40 to 427
M	Monel 400	-321 to 900	-196 to 482
U	Stellite No 6 ®	-450 to 1500	-267 to 815
J	Viton GLT ®	-22 to 400	-30 to 204
V	Viton A®	-40 to 400	-40 to 204
W	Viton B® Anti Explosive Decompression FR58 90	-4 to 392	-20 to 200
N	Buna-N®	-70 to 250	-57 to 121
T	Neoprene®	-40 to 250	-40 to 121
K	Teflon®	-200 to 450	-129 to 232
D	EPDM	-14 to 230	-10 to 110
L	Elast-O-Lion ® 985	-40 to 320	-40 to 160
X	To Be Specified		

END CONNECTION	
FIG	CONNECTION
R	Raised Face 125-250 AARH
S	Stock Finish 250-500 AARH
J	Ring Type Joint
F	Flat Face 125-250 AARH
H	Clamped End
X	To Be Specified
W	Buttweld End

SPECIAL FEATURES	
-	No Special Features
/	To be specified in order and inquiry text
S	Super Torque Spring
L	Low Torque Spring
M	Mini Torque Spring

SPRING MATERIAL		RECOMMENDED MAX TEMP	
FIG	MATERIAL	°F	°C
S	316 Stainless Steel	250	121
Y	Inconel X750®	1000	537
I	Inconel 625®	1000	537
M	Monel K500®	400	204
C	Carpenter 20®		
X	To Be Specified		

WETTED PARTS	
FIG	MATERIAL
S	316 SS
E	410 SS
G	17-4 PH SS
R	Ferralium®
I	Inconel 625®
A	Monel K500®
M	Monel 400®
X	To Be Specified

LINED VALVES

Valves can be supplied with various linings, such as Neoprene®. Chloroprene®. Chlorobutyl and Rilsan Nylon II® (lined valves have retaining plugs).

† Previously BS 1400 AB2

WE - Wrought Equivalents

[1] UNS S31803
[2] UNS S32550
[3] UNS S32760
[4] UNS N08825
[5] UNS N06625
[6] UNS S31254
[7] UNS N10276

* Suitability will depend, in part, on operating temperature range of base material.

MATERIALS AND APPLICATIONS SUITABILITY MATRIX

CLICK HERE TO VIEW

TECHNICAL ADVANTAGES OF SPECIFYING AND

QUALITY ASSURED

The Goodwin Dual Plate Check Valve is designed, manufactured and tested in facilities audited to BS EN ISO 9001. Goodwin's valve shop and foundry have been registered by the British Standards Institute to ISO 9000 series (BS 5750) for over fifteen years. Approval for both companies was first obtained in 1984. The steel foundry, Goodwin Steel Castings Ltd., was the first in Europe to receive such accreditation.

• ISO9001 is equivalent to ANSI / ASQC Q91

CERT No. FM 00343
ISO 9001

Cv FACTORS

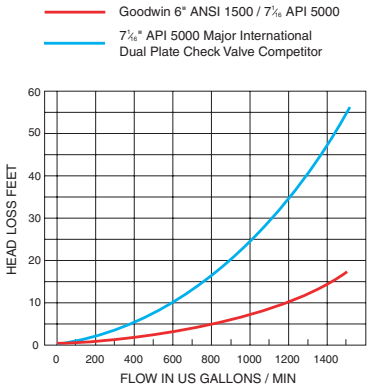


Diagram 1 (Feb. 1994)

From the adjacent graph it can be seen that the pressure drop in the Goodwin high pressure dual plate check valve is substantially less than that of other manufacturers.

This superior performance is achieved by the use of Goodwin's plates (Pat), which through their slim design offer less restriction to flow whilst in the fully open position. Also the plates by having a combination of rigidity in certain areas and flexibility in others make it possible to use larger throat areas in the body, which also contributes to Goodwin's better flow efficiencies, whilst maintaining seat sealing performance.

On conventional dual plate check valves there is typically a 50% reduction in valve throat area between a 150lb valve and a 1500lb valve, whereas there is only around 10% reduction on the Goodwin valve.

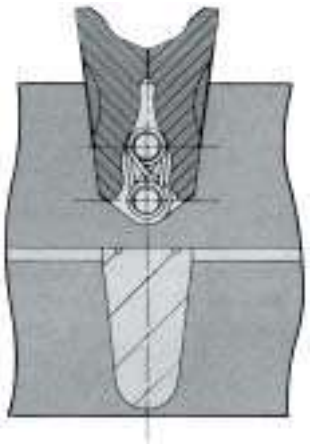
From the FLUENT® computer simulation (see page 41) it can be seen that the pressure drop is caused not only by a reduced flow area in the body, but also by the plates constricting the flow path when in the open position. These constrictions are minimised on the Goodwin valve.

PLATE SHOCK BUMPERS

For many years Goodwin produced wafer check valves with plate shock bumpers located at the extreme edge of the curve of the plate. Goodwin's plate (Pat) now incorporates the plate bumper at the centre of mass of the plate approximately one-third the way in from the curved edge. With the plate bumper at the centre of mass, when the bumper of each plate collides, there is an equal and opposite force acting on the plates which prevents significant bending moments acting on the hinge pin of the plate. Plate bumpers are supplied as standard on all sizes, pressures and types of Goodwin Dual Plate Check Valves.

It is an accepted fact that there will be occasions when the plates do not arrive fully open at the same instance. Clearance on the bumper allow and ensure the plates to hit each other rather than the stop pin. This helps prevent large forces being exerted on the stop pin which could cause damage.

The stop pin has only one purpose, to stop a plate going over top dead centre when reverse flow occurs. If this did occur both plates would be on the same side of the valve leaving one port open, thereby stopping the valve performing its sole function of preventing reverse flow.



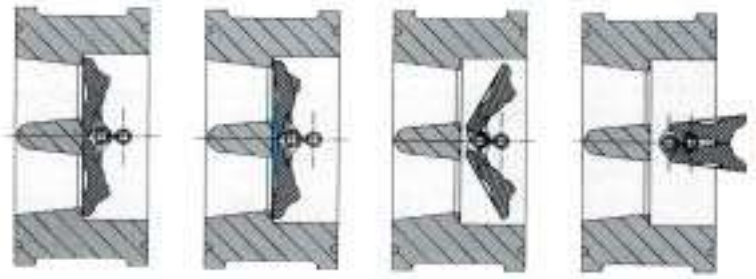
RETAINING PLUGS FOR HUB ENDED VALVES

Retaining plugs have been successfully utilised on check valves for over 30 years. However certain major oil and chemical companies have requested the incorporation of a fire safe sealing element at the lower end of the threaded plugs to prevent corrosion of threads from highly corrosive line media. Hub ended Goodwin valves supplied with retaining plugs accommodate this requirement by having a graphite gasket at the lower end of each retaining plug.

USING GOODWIN DUAL PLATE CHECK VALVES

SEAT LIFE

Increased seat life is obtained by eliminating the problem of the plates dragging on the seat when opening.
Due to the clearance between the plate hinge and the hinge pin the heel of the plate lifts with the initial flow, as the foot of the spring acts beyond the centre of pressure of the plate. As the flow then increases through the valve the plates open without the heels of the plate scuffing the body seat.



INDEPENDENT PLATE CLOSING ACTION

The independent spring action optimises the equal closing rates of each plate especially when friction coefficients are uneven due to one plate resting upon another. The springs have been designed to ensure stresses are kept to a level so that the spring should have a theoretical infinite life. Spring designs utilised in Goodwin valves have undergone accelerated laboratory testing and are proven to be capable of operating without failure over 2,000,000 cycles.

SEAT LEAKAGE - METAL TO METAL SEATS

The dual plate check valve is tested to API 598 which has a metal to metal seat permitted seal leakage of 3 cc/inch of bore/min. This small but significant amount arises because it is more difficult to obtain a perfect seal on a D shaped seat compared to a circular seat. The Goodwin plates (Pat) have been specifically designed to overcome this problem and to be better at sealing than earlier designs, such that near zero leakage can be economically achieved on metal to metal seats. This is particularly useful on high temperature gas applications and cryogenic applications where it is not possible to use resilient seats.

In contrast to other dual plate check valves the seat sealing characteristics of the Goodwin valve does not significantly deteriorate as line pressure increases. This characteristic enables Goodwin to provide dual plate check valves with substantially lower leakage rates than specified in API 598 at no additional costs.

RETAINERLESS DESIGN (Pat)

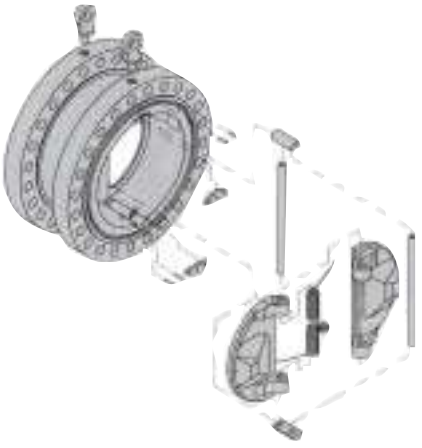
Goodwin was one of the first dual plate check valve manufacturers to offer a retainerless design. This original patented design has now been superseded by a technically superior solution which is available on all types of Goodwin check valve - wafer, flanged, hub-ended and buttweld end. The engineer no longer needs to worry about whether spiral wound gaskets or ring joints are compatible as the Goodwin design accommodates both USA and European sealing elements.

Not only does the retainerless design provide a higher integrity pressure vessel - no screwed plugs, Goodwin's design enables the valve to be disassembled very quickly without the use of force or special tools other than an Allen wrench. The Goodwin Wafer and Flanged design concept is such that it is impossible for the valve to become disassembled in the line and does not utilise any springs or circlips.

With improved machining technology Goodwin are able to offer this superior design as standard at a price equal or less than competitors' valves with retaining plugs.

There is no intrusion into the gasket sealing element surface by the retaining mechanism on Goodwin check valves.

(Pat) = Patented Internationally



CUSTOMERS AND MARKETS

GOODWIN GROUP COMPANIES OVER THE YEARS HAVE SUPPLIED PRODUCTS TO THE FOLLOWING CUSTOMERS AND MARKETS:-

USERS

ADCO
ADMA OPCO
ADNOC
AGIP
AIR PRODUCTS
AMERADA HESS
AMOCO
ARAMCO
ARCO

BAPETCO
BHP
BOC
BOHAI OIL
BP
BRITISH GAS
BRITOIL

CALTEX
CHEVRON
CNPC
CNTIC
CONOCO
CRESCENT

DOW CHEMICAL
DUKE POWER
DUPONT

EASTMAN CHEMICALS
ECOPETROL
EDISON
EGAT
EGPC
ELF
ENI
ENRON
EPMI
EXXON

FINA NESTE
FORMOSA

GAIL
GENERAL ELECTRIC
GENREF
GULF

HYUNDAI

IBN RUSHD
IBN ZAHR
ICI
INDIA OIL CORP
IPCL

KERR MCGEE
KNPC
KOC
KOREA GAS

LAGOVEN
LASMO

MAERSK
MARATHON
MARAVEN
MOBIL
MOSSGAS

NAM
NNPC
NODCO
NORSK HYDRO
NOVA CHEMICALS

OCCIDENTAL
ONGC

PDO
PDVSA
PERTAMINA
PETRONAS
PETROVIETNAM
PHILLIPS
POSCO

QAFAC
QATARGAS
QGPC
QLGC
QUANTUM

RAS LAFFAN LNG CO
RELIANCE
REPSOL
RIYADH WATER

SABIC
SAGA
SAMSUNG
SANTOS
SAUDI METHANOL CO
SHELL
SINOPEC
SONATRACH
SOVEREIGN
STATOIL
SUN OIL

TCPL
TEXACO
TOTAL
TPI

UNOCAL

WOODSIDE

YUKONG

ZADCO

CONTRACTORS

ABB LUMMUS GLOBAL
AIR PRODUCTS
AIR LIQUIDE
AKER
AMEC

BADGER
BANTREL
BECHTEL
BELLELI
BLACK & VEATCH
BOC
BROWN & ROOT

C E HOLT
CHIYODA
CLOUGH
COLT ENGINEERING
COMPRIMO
COSTAIN
CTCI

DAELIM
DAVY JOHN BROWN
DAVY McKEE
DODSAL
EDELEANU
EIL
ENPPI

FLUOR DANIEL
FOSTER WHEELER

GEC ALSTHOM
GROOTINT

HANJUNG
HEEREMA
HITACHI ZOSEN
HYUNDAI

I C F KAISER

JGC
JOHN HOLLAND

KHIC
KTI
KELLOGG BROWN & ROOT
KVAERNER

LARSON & TOUBRO
LINDE
LURGI

M W KELLOGG
MHI
McDERMOTT
MES
MONENCO AGRA

NATCO ENGINEERING
NODECO
NPCC
NUOVO PIGNONE

ODEBRECHT

P T TRIPATRA
PENANG SHIPBUILDING
PROMAN
UMA ENGINEERING
RALPH M. PARSONS
RAYTHEON ENGINEERING

SAIPEM
SAMSUNG
SEMBAWANG ENGINEERING
SHEDDEN UHDE
SIME SEMBAWANG
SNAMPROGETTI
SNC LAVALIN
SPIE CAPAG
STONE AND WEBSTER
STORK PROTECH
SUNKYONG

TECHNICAS REUNIDAS
TECHNIMONT
TECHNIP
TOYO ENGINEERING
TPG
TPL

UHDE

W S NELSON
WILBROS
WIMPEY

DUAL PLATE vs SWING CHECK

ADVANTAGES OF GOODWIN WAFER CHECK VALVE vs SWING CHECK VALVE

		WEIGHT COMPARISON			PRICE COMPARISON		
Valve Size inches	**Valve Rating ANSI**	**Swing Check kg**	**Wafer Check kg**	**Saving over Swing**	**Swing Check US$**	**Wafer Check US$**	**Saving over Swing**
	150#	15	3	80%	78	75	4%
	300#	21	3	86%	90	78	13%
2	600#	28	3	89%	120	85	29%
	900#	68	8	88%	459	102	78%
	1500#	68	8	88%	641	111	83%
	150#	28	6	79%	108	92	14%
	300#	39	8	79%	139	102	26%
3	600#	53	8	85%	183	124	32%
	900#	86	12	86%	580	154	73%
	1500#	120	14	88%	873	169	81%
	150#	44	10	77%	153	120	22%
	300#	70	11	84%	199	125	37%
4	600#	87	13	85%	289	205	29%
	900#	145	19	87%	789	186	76%
	1500#	236	21	91%	1174	203	83%
	150#	76	16	79%	227	181	20%
	300#	130	20	85%	367	216	41%
6	600#	220	36	84%	559	355	36%
	900#	320	54	83%	2414	508	79%
	1500#	545	52	90%	3255	508	84%
	150#	128	36	72%	416	286	31%
	300#	204	40	80%	536	352	34%
8	600#	355	72	80%	895	544	39%
	900#	500	122	76%	4311	810	81%
	1500#	681	116	83%	7458	810	89%
	150#	209	52	75%	562	401	29%
	300#	299	56	81%	784	528	33%
10	600#	665	118	82%	1795	939	48%
	900#	915	196	79%	6105	1459	76%
	1500#	1069	203	81%	10985	1459	87%
	150#	330	97	71%	805	584	27%
	300#	456	98	79%	1121	804	28%
12	600#	820	164	80%	2411	1156	52%
	900#	1342	293	78%	7372	2374	68%
	1500#	2400	373	84%	*	2948	*
	150#	436	123	72%	1372	670	51%
	300#	722	176	76%	1753	1271	27%
14	600#	948	186	80%	2829	1968	30%
	900#	2068	396	81%	*	3036	*
	1500#	2226	484	*	*	3387	*
	150#	571	133	77%	1702	964	43%
	300#	850	207	76%	2351	1687	28%
16	600#	1285	331	74%	3656	3270	11%
	900#	2636	532	80%	*	3896	*
	1500#	3277	587	*	*	4751	*
	150#	660	141	79%	1953	1248	36%
	300#	1028	294	71%	3037	2597	15%
18	600#	1659	394	76%	4377	3865	12%
	900#	2180	611	*	*	4811	*
	1500#	4480	791	*	*	6256	*
	150#	890	215	76%	2564	1535	40%
	300#	1348	363	73%	4042	2852	29%
20	600#	2160	544	75%	7315	4606	37%
	900#	2843	637	*	*	6030	*
	1500#	4835	1275	*	*	8303	*
	150#	1363	358	74%	3687	2010	45%
	300#	1982	521	74%	5572	3895	30%
24	600#	3080	819	73%	9120	6262	31%
	900#	*	1230	*	*	8947	*
	1500#	*	2713	*	*	10974	*
	150#	2318	662	71%	8404	4267	49%
30	300#	3480	952	73%	*	7331	*
	600#	*	1578	*	*	13225	*
	900#	*	1829	*	*	16278	*
	150#	2795	682	76%	*	7388	*
36	300#	4477	1269	72%	*	12328	*
	600#	*	2120	*	*	17282	*
	900#	*	3259	*	*	24137	*
	150#	*	900	*	*	11886	*
40	300#	*	1825	*	*	16320	*
	600#	*	3750	*	*	17368	*
	900#	*	3972	*	*	24874	*

*Data not readily available

The short face-to-face design inherently makes the Goodwin Check Valves lighter and more compact than a swing check valve, leading to ease of installation and lower costs. Typically, the Goodwin Wafer Check Valve is nominally less than one quarter the weight and one quarter the face-to-face of a traditional full-bodied swing check valve.

ILLUSTRATION: 8" ANSI 150#
Swing Check = 282lb / 128kg
Goodwin Wafer Check = 80lb / 36kg

The comparison table illustrates, for carbon steel body, the savings in space and weight that are achieved by specifying Goodwin Wafer Check Valves instead of other manufacturers' swing check valves. Should the valve body material be of Stainless Steel, Duplex Stainless Steel, high nickel alloy or some other high grade material, then the savings that can be made by specifying and using Goodwin Dual Plate Check Valves escalate.

Generally, with the Goodwin Check Valve:

- The larger the valve diameter
- The higher the pressure class
- The higher the grade of material

- **The greater the cost saving**

For new construction projects, check valve costs can be reduced by as much as 70% by utilizing Goodwin Wafer Check Valves instead of traditional flanged full-bodied swing check valves.

FLANGED DUAL PLATE CHECK VALVE vs. SWING CHECK VALVE

Many client company specifications exclude wafer type valves. The Goodwin Flanged Dual Plate Check Valve allows installation in a piping system in a conventional double flanged manner, ie studs and nuts per flange connection. Although higher in price than wafer design it still provides very significant weight, space and cost savings against the traditional swing check valve.

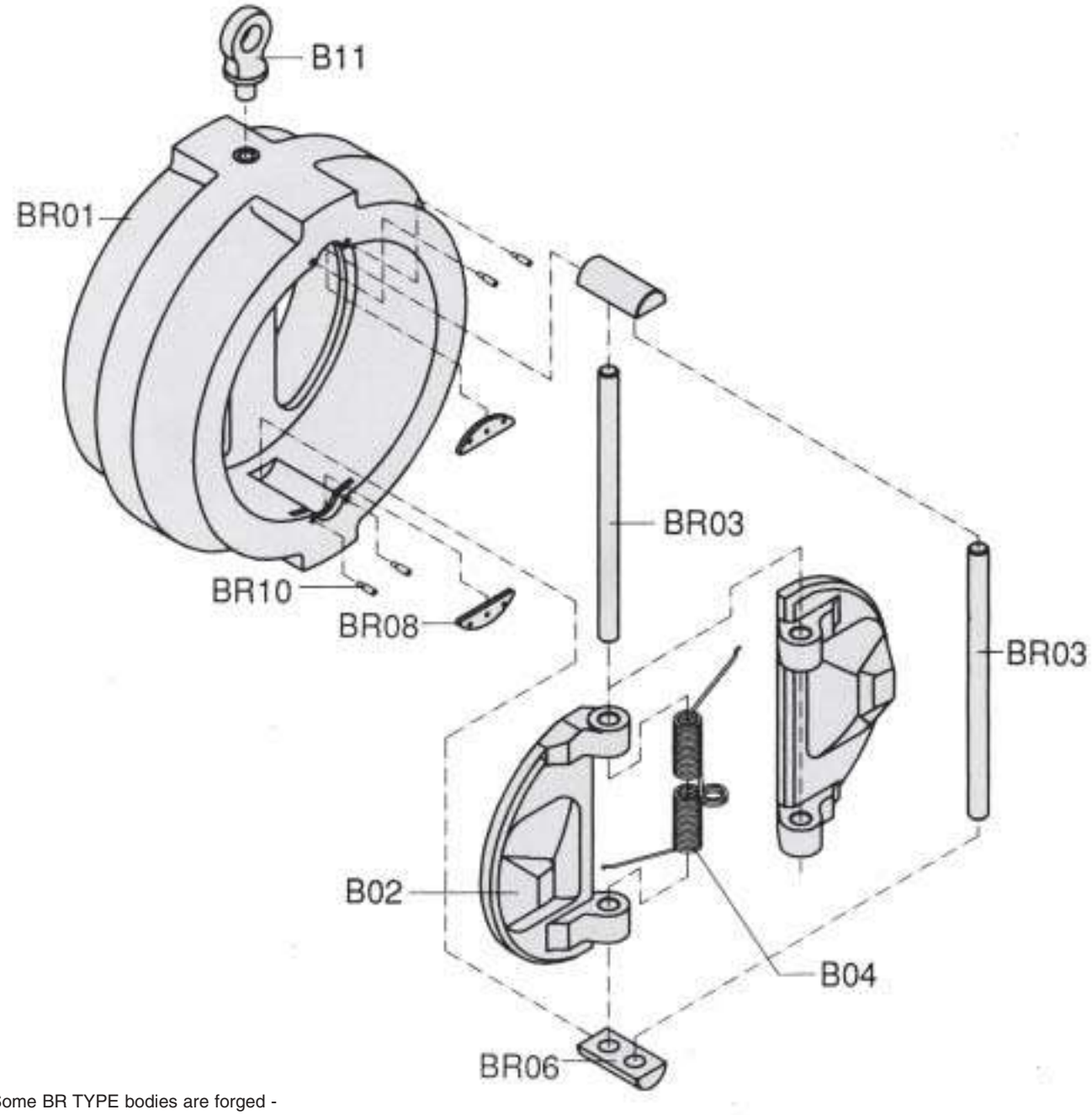
ILLUSTRATION: 24" ANSI 150#
Swing Check = 3000lb / 1363kg
Goodwin Flanged Check = 780lb / 358kg

EXPLODED VIEWS AND SPARE PARTS

WAFER RETAINERLESS — TYPE BR

VALVE COMPONENTS

	BR01	- BODY
*	B02	- PLATE x 2
*	BR03	- HINGE/STOP PIN x 2
*	B04	- SPRING
*	BR06	- CARRIER x 2
*	BR08	- KEEPER PLATE x 2
*	BR10	- DOWEL x 4
†	B11	- EYEBOLT



(Some BR TYPE bodies are forged - as depicted in the exploded view)

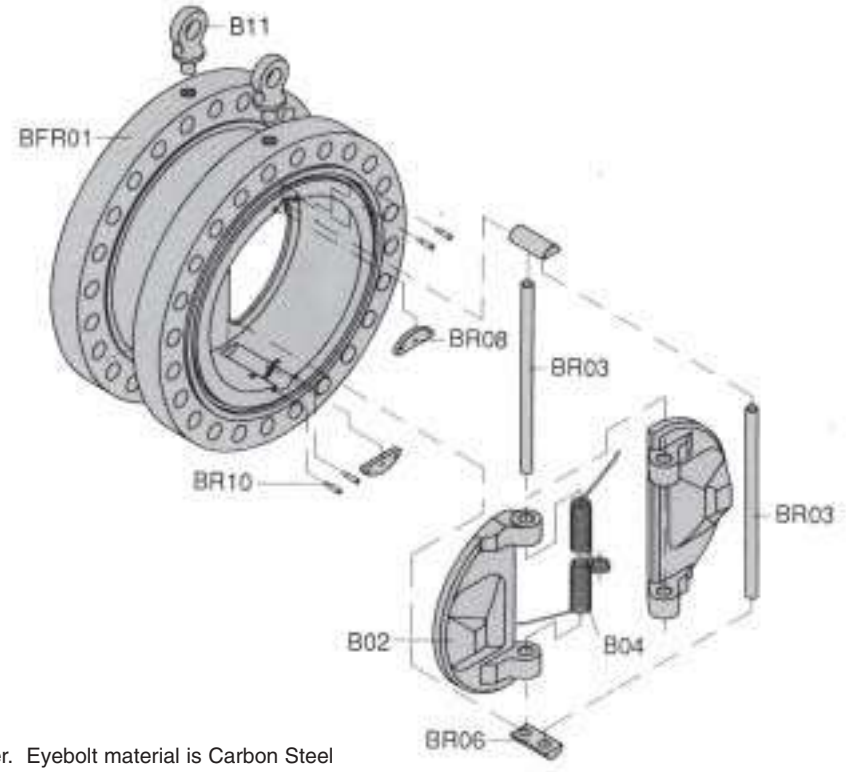
* Spares Available

† 1 eye bolt supplied for valves 6" and larger. Eyebolt material is Carbon Steel

FLANGED RETAINERLESS — TYPE BFR

VALVE COMPONENTS

	BR01	-	BODY
*	B02	-	PLATE x 2
*	BR03	-	HINGE/STOP PIN x 2
*	B04	-	SPRING
*	BR06	-	CARRIER x 2
*	BR08	-	KEEPER PLATE x 2
*	BR10	-	DOWEL x 4
†	B11	-	EYEBOLT x 2



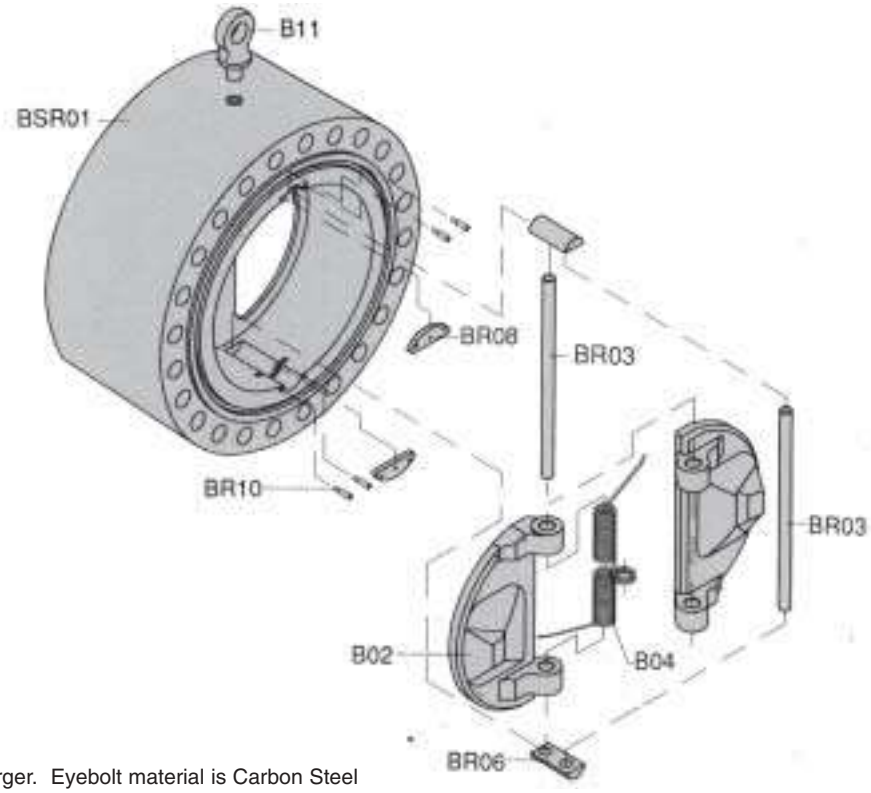
* Spares Available

† 1 eye bolt supplied for valves 6” and larger. Eyebolt material is Carbon Steel

SOLID LUG RETAINERLESS — TYPE BSR

VALVE COMPONENTS

	BR01	-	BODY
*	B02	-	PLATE x 2
*	BR03	-	HINGE/STOP PIN x 2
*	B04	-	SPRING
*	BR06	-	CARRIER x 2
*	BR08	-	KEEPER PLATE x 2
*	BR10	-	DOWEL x 4
†	B11	-	EYEBOLT

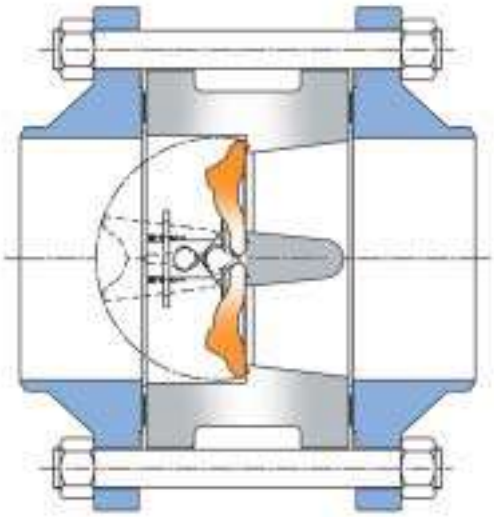


* Spares Available

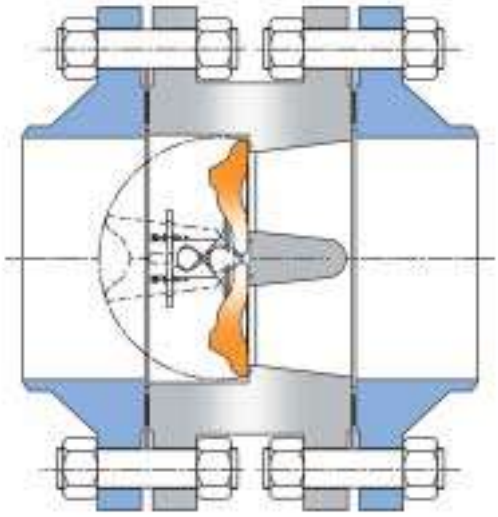
† 1 eye bolt supplied for valves 6” and larger. Eyebolt material is Carbon Steel

INSTALLATION BETWEEN END CONNECTIONS

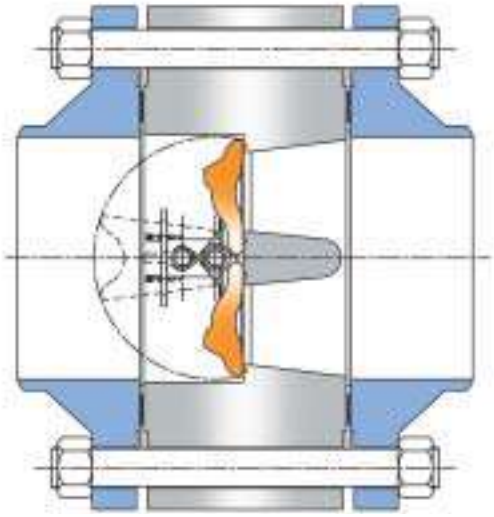
TYPE BR - Wafer



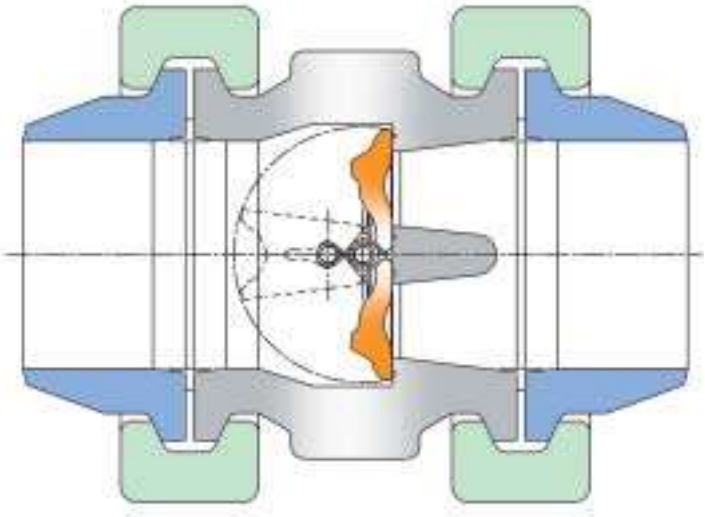
TYPE BFR - Flanged



TYPE BSR - Solid Lug



TYPE BHR - Hub Ended

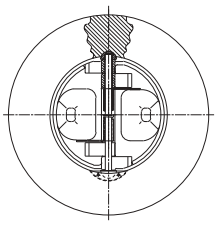


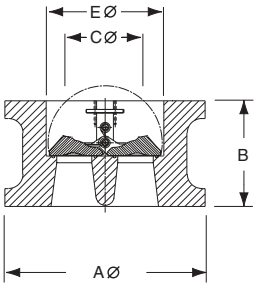
BR, BFR & BSR have face-to-face dimensions to API 594.
BH & BHR face-to-face dimensions to manufacturer's standard.

WAFER TYPE BR

INSTALLATION DIMENSIONS

ANSI B16.5



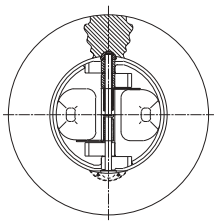


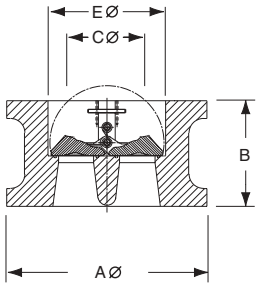
Size	Pressure	End	A Ø	B	C Ø	E Ø	STUD SELECTION			APPROX WT*	
inches	Rating	Facing	inches	inches	inches	inches	No.	Dia	Length	lb	kg
1.5	150	RF	3.375	2	-	1.97	4	0.5	5	4	1.8
(40mm)	300	RF/RJ-20	3.75	2	-	1.97	4	0.75	6.5	4	1.8
	600	RF/RJ-20	3.75	2	-	1.97	4	0.75	6.5	4	1.8
	150	RF	4.125	2.375	-	2.25	4	0.625	6	7	3.2
	300	RF/RJ-23	4.375	2.375	-	2.25	8	0.625	6.875	8	3.2
2	600	RF/RJ-23	4.375	2.375	-	2.25	8	0.625	6.875	8	3.2
(50mm)	900	RF/RJ-24	5.625	2.75	-	2.25	8	0.875	8.75	18	8.2
	1500	RF/RJ-24	5.625	2.75	-	2.25	8	0.875	8.75	18	8.2
	2500	RF/RJ-26	5.75	2.75	-	2.25	8	1	10	29	13.1
2.5	150	RF	4.875	2.625	-	2.94	4	0.625	6.375	11	5
(65mm)	300	RF	5.125	2.625	-	2.94	8	0.75	6.875	13	5
	150	RF	5.375	2.875	2	3.42	4	0.625	7	14	6.4
	300	RF	5.875	2.875	2	3.42	8	0.75	8.125	17	7.7
3	600	RF	5.875	2.875	2	3.42	8	0.75	8.125	17	7.7
(80mm)	900	RF/RJ-31	6.625	3.25	2.375	3.42	8	0.875	9.5	26	11.8
	1500	RF/RJ-35	6.875	3.25	2.375	3.42	8	1.125	10.5	28	12.7
	2500	RF/RJ-32	7.75	3.375	2.375	3.42	8	1.25	12.25	35	15.9
	150	RF	6.875	2.875	3.5	4.45	8	0.625	7	21	9.5
	300	RF	7.125	2.875	3.5	4.45	8	0.75	8.125	23	10.5
4	600	RF/RJ-37	7.625	3.125	3.5	4.45	8	0.875	9.5	28	12.7
(100mm)	900	RF/RJ-37	8.125	4	3.25	4.45	8	1.125	11	42	19.1
	1500	RF/RJ-39	8.25	4	3.25	4.45	8	1.25	12	45	20.5
	2500	RF/RJ-38	9.25	4.125	3.25	4.45	8	1.5	14.625	64	29.1
5	150	RF	7.75	3.375	0	5.875	8	0.75	7.375	28	12.7
(125mm)	300	RF	8.5	3.375	0	5.875	8	0.75	8.125	31	14.1
	150	RF	8.75	3.875	5.5	6.52	8	0.75	8.25	36	16
	300	RF	9.875	3.875	5.5	6.52	12	0.75	9.625	45	20
6	600	RF/RJ-45	10.5	5.375	3.5	6.52	12	1	12.375	80	36
(150mm)	900	RF/RJ-45	11.375	6.25	3.5	6.52	12	1.125	14	119	54
	1500	RF/RJ-46	11.125	6.25	3.5	6.52	12	1.375	16.75	116	52
	2500	RF/RJ-47	12.5	6.25	3.5	6.52	8	2	20.5	154	70
	150	RF	11	5	6.75	8.13	8	0.75	9.75	80	36
	300	RF	12.125	5	6.75	8.13	12	0.875	11.125	88	40
8	600	RF/RJ-49	12.625	6.5	6.625	8.13	12	1.125	14.5	160	72
(200mm)	900	RF/RJ-49	14.125	8.125	5.125	8.13	12	1.375	17.125	271	122
	1500	RF/RJ-50	13.875	8.125	5.125	8.13	12	1.625	20.25	257	116
	2500	RF/RJ-51	15.25	8.125	5.625	8.13	12	2	24	293	132
	150	RF	13.375	5.75	9.25	10.25	12	0.875	11	116	52
	300	RF	14.25	5.75	9.25	10.25	16	1	12.75	124	56
10	600	RF/RJ-53	15.75	8.375	7.875	10.25	16	1.25	17.125	260	118
(250mm)	900	RF/RJ-53	17.125	9.5	7.688	10.25	16	1.375	19	434	196
	1500	RF/RJ-54	17.125	9.75	7.25	10.25	12	1.875	23.5	449	203
	2500	RF/RJ-55	18.75	10	7.5	10.25	12	2.5	30.5	480	217
	150	RF	16.125	7.125	10.25	11.82	12	0.875	12.25	215	97
	300	RF	16.625	7.125	10.25	11.82	16	1.125	14.625	217	98
12	600	RF/RJ-57	18	9	9.125	11.82	20	1.25	18	360	164
(300mm)	900	RF/RJ-57	19.625	11.5	8.125	11.82	20	1.375	21.75	644	293
	1500	RF/RJ-58	20.5	12	8.25	11.82	16	2	27.5	824	373
	2500	RF/RJ-60	21.625	12	8.875	11.82	12	2.75	34.5	870	394

VALVE SIZE	1.5" to 24"	26" to 60"	66" to 144"
FLANGE STANDARD	ANSI B16.5	ANSI B16.47 SERIES A (MSS SP44)	AWWA C207 (CLASS E 275 PSI)

WAFER TYPE BR

INSTALLATION DIMENSIONS





ANSI B16.5 / ANSI B16.47 SERIES A

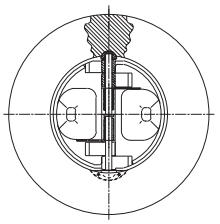
Size	Pressure	End	A Ø	B	C Ø	E Ø	STUD SELECTION			APPROX WT*	
inches	Rating	Facing	inches	inches	inches	inches	No.	Dia	Length	lb	kg
	150	RF	17.75	7.25	11.25	13.34	12	1	13	270	123
14	300	RF	19.125	8.75	11.25	13.34	20	1.125	16.5	390	176
(350mm)	600	RF/RJ-61	19.375	10.75	9.125	13.34	20	1.375	20.25	410	186
	900	RJ/RJ-62	20.5	14	-	13.34	20	1.5	25.5	872	396
	1500	RF/RJ-63	22.75	14	-	13.34	16	2.25	31.5	1068	484
	150	RF	20.25	7.5	13.063	15.25	16	1	13.5	295	133
16	300	RF	21.25	9.125	13	15.25	20	1.25	17.375	458	207
(400mm)	600	RF/RJ-65	22.25	12	13	15.25	20	1.5	22.25	728	331
	900	RF/RJ-66	22.625	15.125	6.375	15.25	20	1.625	27.125	1174	532
	1500	RF/RJ-67	25.25	15.125	6.375	15.25	16	2.5	34.25	1295	587
	150	RF	21.625	8	15.563	17.25	16	1.125	14.5	312	141
18	300	RF	23.5	10.375	15.375	17.25	24	1.25	18.875	650	294
(450mm)	600	RF/RJ-69	24.125	14.25	13	17.25	20	1.625	25.25	870	394
	900	RF/RJ-70	25.125	17.75	9.625	17.25	20	1.875	34.5	1344	611
	1500	RF/RJ-71	27.75	18.438	7.25	17.25	16	2.75	39.75	1745	791
	150	RF	23.875	8.625	17.25	19.19	20	1.125	15.125	472	215
20	300	RF	25.75	11.5	17.25	19.19	24	1.25	20.5	801	363
(500mm)	600	RF/RJ-73	26.875	14.5	17	19.19	24	1.625	26.25	1196	544
	900	RF/RJ-74	27.5	17.75	16	19.19	20	2	32.5	1406	637
	1500	RF/RJ-75	29.75	21	8.25	19.19	16	3	44.25	2812	1275
	150	RF	28.25	8.75	21.125	22.78	20	1.25	16.25	788	358
24	300	RF	30.5	12.5	20.625	22.78	24	1.5	22.75	1150	521
(600mm)	600	RF/RJ-77	31.125	17.25	20.063	22.78	24	1.875	30.75	1802	819
	900	RF/RJ-78	33	19.5	17.5	22.78	20	2.5	38	2713	1230
	1500	RF/RJ-79	35.5	22	15.375	22.78	16	3.5	48.5	5968	2713
	150	RF	30.5	14	23.5	24.78	24	1.25	23.125	1056	680
26	300	RF	32.875	14	23.5	24.78	28	1.625	24.75	1619	735
(650mm)	600	RF/RJ-73	34.125	18	22.75	24.78	28	1.875	31.5	1855	842
	900	RF/RJ-100	34.75	21	22	24.78	20	2.75	38.75	2605	1182
	150	RF	32.75	15	25.5	26.78	28	1.25	24.375	1196	544
28	300	RF	35.375	15	25.5	26.78	28	1.625	26.25	1612	733
(700mm)	600	RF/RJ-94	36	19	24.75	26.78	28	2	33	1916	871
	900	RF/RJ-101	37.25	22.5	24	26.78	20	3	41	3170	1441
	150	RF	34.75	12	25.25	28.93	28	1.25	21	1456	662
30	300	RF	37.5	14.5	25.25	28.93	28	1.75	26.5	2100	952
(750mm)	600	RF/RJ-95	38.25	19.875	23	28.93	28	2	34.125	3472	1578
	900	RF/RJ-102	39.75	25	23	28.93	20	3	44	4024	182
	150	RF	37	14	25.25	30.87	28	1.5	24.625	1556	707
32	300	RF	39.625	16	25.25	30.87	28	1.875	28.75	3597	1635
(800mm)	600	RF/RJ-96	40.25	21	24	30.87	28	2.25	36	3835	1743
	900	RF/RJ-105	42.25	26	24	30.87	20	3.25	46.25	4475	2034
	150	RF	41.25	14.5	25.5	34.04	32	1.5	25.875	1505	682
36	300	RF	44	19	25.5	34.04	32	2	32.5	2799	1269
(900mm)	600	RF/RJ-98	44.5	25	20.75	34.04	28	2.5	45	4664	2120
	900	RF/RJ-105	47.25	28.25	14	34.04	20	3.5	50.75	7183	3259

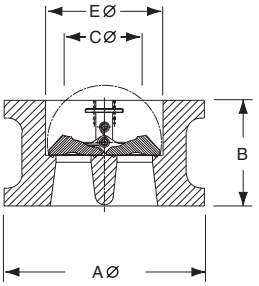
* Weights are for valve only and exclude mating flanges and bolting. † Weight will vary according to corrosion allowance specification.

VALVE SIZE	1.5" to 24"	26" to 60"	66" to 144"
FLANGE STANDARD	ANSI B16.5	ANSI B16.47 SERIES A (MSS SP44)	AWWA C207 (CLASS E 275 PSI)

WAFER TYPE BR

INSTALLATION DIMENSIONS





ANSI B16.47 SERIES A / AWWA C207 CLASS E

Size inches	Pressure Rating	End Facing	A Ø inches	B inches	C Ø inches	E Ø inches	STUD SELECTION No.	Dia	Length	APPROX WT* lb	kg
	150	RF	45.75	17	34.75	38.87	36	1.5	27.375	1980	900
40	300	RF	43.875	21.5	29.5	35.78	32	1.625	35	4015	1825
(1000mm)	600	RF	45.5	26	29.25	35.78	32	2.25	44.25	8250	3750
	900	RF	49.25	30	29	35.78	24	3.5	53.75	8738	3972
	150	RF	48	17	36.813	41.81	36	1.5	28.875	2500	1134
42	300	RF	46	22.375	32.938	39.98	32	1.625	37	5800	2630
(1050mm)	600	RF	48	27.625	25.5	38.26	28	2.5	47.125	6897	3135
	900	RF	51.25	31	23	38.26	24	3.5	59.25	8074	3670
48	150	RF	54.5	20.625	40.813	46.98	44	1.5	33.375	6616	3007
(1200mm)	300	RF	52.125	24.75	38	44.73	32	1.875	40.5	8600	3909
	600	RF	54.75	31	35	44.73	32	2.75	54	9715	4416
54	150	RF	61	23.25	43	50.45	44	1.75	38.25	7097	3225
(1350mm)	300	RF	58.75	28.25	43	50.45	28	2.25	47.25	8532	3878
60	150	RF	67.5	26	47.5	55.97	52	1.75	42	9126	4148
(1500mm)	300	RF	64.75	33	47.5	55.97	32	2.25	53	11863	5392†
66 (1650mm)	150	RF	74.25	31	56.5	65.46	52	1.75	45	16800	7636†
72 (1800mm)	150	RF	80.75	33.5	60.25	71.58	60	1.75	48	18900	8590†
78 (1950mm)	150	RF	87	36.5	65.5	77.7	64	2	52	22522	10237†
84 (2100mm)	150	RF	93.5	41	69	83.32	64	2	57	28111	12777†
90 (2250mm)	150	RF	**	**	**	**	**	**	**	**	**
96 (2400mm)	150	RF	**	**	**	**	**	**	**	**	**
102 (2550mm)	150	RF	**	**	**	**	**	**	**	**	**
108 (2700mm)	150	RF	**	**	**	**	**	**	**	**	**
114 (2850mm)	150	RF	**	**	**	**	**	**	**	**	**
120 (3000mm)	150	RF	**	**	**	**	**	**	**	**	**
126 (3150mm)	150	RF	**	**	**	**	**	**	**	**	**
132 (3300mm)	150	RF	**	**	**	**	**	**	**	**	**
138 (3450mm)	150	RF	**	**	**	**	**	**	**	**	**
144 (3600mm)	150	RF	**	**	**	**	**	**	**	**	**

* Weights are for valve only and exclude mating flanges and bolting

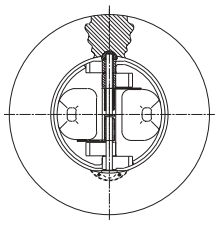
† Weight will vary according to corrosion allowance specification

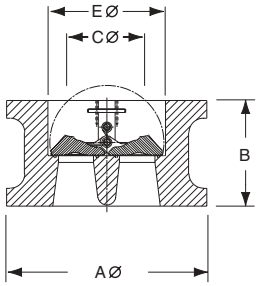
** Apply to Goodwin for details

VALVE SIZE	1.5" to 24"	26" to 60"	66" to 144"
FLANGE STANDARD	ANSI B16.5	ANSI B16.47 SERIES A (MSS SP44)	AWWA C207 (CLASS E 275 PSI)

WAFER TYPE BR

INSTALLATION DIMENSIONS





ANSI B16.47 SERIES B (API 605)

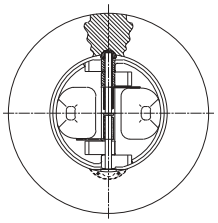
Size inches	Pressure Rating	End Facing	A Ø inches	B inches	C Ø inches	E Ø inches	STUD SELECTION		
							No.	Dia	Length
26	150	RF	28.56	14	23.5	24.78	36	0.75	20
(650mm)	300	RF	30.37	14	23.5	24.78	32	1.25	27.75
28	150	RF	30.56	15	25.5	26.78	40	0.75	21.5
(700mm)	300	RF	32.5	15	25.5	26.78	36	1.25	25.75
30	150	RF	32.56	12	25.375	28.93	44	0.75	18.5
(750mm)	300	RF	34.87	14.5	25.375	28.93	36	1.375	25.75
32	150	RF	34.69	14	25.25	30.87	48	0.75	20.5
(800mm)	300	RF	37	16	25.25	30.87	32	1.5	29.25
36	150	RF	38.87	14.5	29.625	34.04	44	0.875	21.5
(900mm)	300	RF	41.26	19	29.25	34.04	32	1.625	31.5
40	150	RF	43.12	17	34.75	38.78	44	1	24
(1000mm)	300	RF	45.26	21.5	29.5	35.78	40	1.625	34.5
42	150	RF	45.12	17	36.8125	41.81	48	1	25
(1050mm)	300	RF	47.25	22.375	32.8125	39.98	36	1.75	36.5
48	150	RF	51.44	20.625	40.8125	46.98	44	1.125	29.25
(1200mm)	300	RF	53.87	24.75	37.875	44.73	40	1.875	39.75
54	150	RF	57.63	23.25	42.875	50.45	56	1.125	30.5
(1350mm)	300	RF	60.24	28.75	42.875	50.45	48	1.875	43.5
60	150	RF	64.19	26	47.25	55.97	52	1.25	35.25
(1500mm)	300	RF	67.19	33	47.25	55.97	40	2.25	50

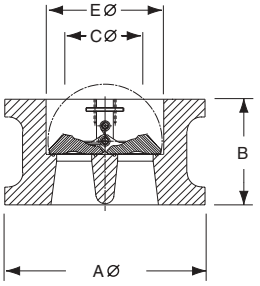
INTERMEDIATE SIZES ARE AVAILABLE TO SPECIAL ORDER
FACE TO FACE DIMENSIONS ARE TO API 594

WAFER TYPE BR

INSTALLATION DIMENSIONS

API 6A †





Size inches	API Rating PSI CWP	End Facing	A Ø inches	B inches	C Ø inches	E Ø inches	STUD SELECTION			APPROX WEIGHT*	
							No.	Dia	Length	lb	kg
	2000	RJ-23	4.375	2.75	-	2.25	8	0.625	8	6	2.72
2 1/16	3000	RJ-24	5.625	2.75	-	2.25	8	0.875	9.25	18	8.16
	5000	RJ-24	5.625	2.75	-	2.25	8	0.875	9.25	18	8.16
	2000	RJ-31	5.875	3.25	2	3.42	8	0.75	9.25	15	6.80
3 1/8	3000	RJ-31	6.625	3.25	2.375	3.42	8	0.875	11.5	28	12.70
	5000	RJ-35	6.875	3.375	2.375	3.42	8	1.125	12	30	13.61
	2000	RJ-37	7.625	4	3.5	4.45	8	0.875	11.5	19	8.62
4 1/16	3000	RJ-37	8.125	4	3.25	4.45	8	1.125	12	45	20.41
	5000	RJ-39	8.25	4.125	3.25	4.45	8	1.125	13	61	27.67
	2000	RJ-45	10.5	6.25	3.5	6.52	12	1	14	70	31.75
7 1/16	3000	RJ-45	11.375	6.25	3.5	6.52	12	1.125	15.25	119	53.98
	5000	RJ-46	11.125	6.25	3.5	6.52	12	1.375	18.375	118	53.52
	2000	RJ-49	12.625	8.125	6.625	8.13	12	1.125	17	143	64.86
9	3000	RJ-49	14.125	8.125	5.125	8.13	12	1.375	18.375	271	122.92
	5000	RJ-50	13.875	8.125	5.125	8.13	12	1.625	21	257	116.57
	2000	RJ-53	15.75	9.5	7.875	10.25	16	1.25	19	249	112.94
11	3000	RJ-53	17.125	9.75	7.688	10.25	16	1.375	20	434	196.86
	5000	RJ-54	17.125	10	7.25	10.25	12	1.875	24.5	449	203.66
13 5/8	2000	RJ-57	18	11.5	9.125	11.82	20	1.25	21.5	308	139.71
	3000	RJ-57	19.625	12	8.125	11.82	20	1.375	23.25	720	326.59

API 10,000 Valves are available upon application

*Weights are for valve only and exclude mating flanges and bolting

† Testing procedure in accordance with API 6A. Allowable leakage rate in accordance with API 598.

TYPE BR to API 6D

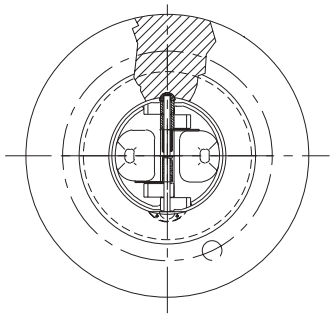
THE INSTALLATION DIMENSIONS
ARE THE SAME AS ANSI VALVES (WAFER TYPE BR)

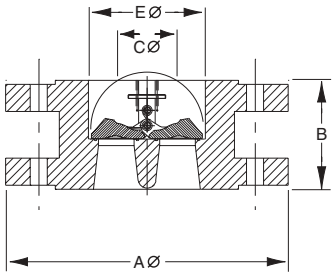
SIZE 2" TO 24" CLASS 150 TO 2500

TESTING PROCEDURE IN ACCORDANCE WITH API 6D,
ALLOWABLE LEAKAGE RATE IN ACCORDANCE WITH API 598.

FLANGED TYPE BFR

INSTALLATION DIMENSIONS





ANSI B16.5 / ANSI B16.47 SERIES A

Size	Pressure	A Ø	B	C Ø	E Ø	STUD SELECTION			APPROX WEIGHT*	
inches	Rating	inches	inches	inches	inches	No.	Dia	Length	lb	kg
8	150	13.5	5	6.75	8.13	8	0.75	4.25	109	49
(200mm)										
10	150	16	5.75	9.25	10.25	12	0.875	5.125	182	82
(250mm)	600	20	8.375	7.875	10.25	16	1.25	8.75	404	183
	900	21.5	9.5	7.688	10.25	16	1.375	9.5	448	203
	150	19	7.125	10.25	11.82	12	0.875	5.5	276	125
12	300	20.5	7.125	10.25	11.82	16	1.125	7.5	338	153
(300mm)	600	22	9	9.125	11.82	20	1.25	9	527	239
	900	24	11.5	8.125	11.82	20	1.375	10.25	767	347
	150	21	7.25	11.25	3.34	12	1	6	318	144
14	300	23	8.75	11.25	13.34	20	1.125	7.75	456	207
(350mm)	600	23.75	10.75	9.125	13.34	20	1.375	9.5	835	378
	900	25.25	14	0	13.34	20	1.5	11.25	1235	560
	150	23.5	7.5	13.063	15.25	16	1	6	388	176
16	300	25.5	9.125	13	15.25	20	1.25	8.25	664	301
(400mm)	600	27	12	13	15.25	20	1.5	10.25	996	451
	900	27.75	15.125	6.375	15.25	20	1.625	11.75	1206	547
	150	25	8	15.563	17.25	16	1.125	6.5	464	210
18	300	28	10.375	15.375	17.25	24	1.25	8.5	862	392
(450mm)	600	29.25	14.25	13	17.25	20	1.625	11	1319	598
	900	31	17.75	9.625	17.25	20	1.875	13.5	1842	835
	150	27.5	8.625	17.25	19.19	20	1.125	7	596	270
20	300	30.5	11.5	17.25	19.19	24	1.25	9	1080	489
(500mm)	600	32	14.5	17	19.19	24	1.625	11.75	1680	762
	900	33.75	17.75	16	19.19	20	2	14.5	3931	1783
	150	32	8.75	21.125	22.78	20	1.25	7.5	1144	520
24	300	36	12.5	20.625	22.78	24	1.5	10.25	1664	756
(600mm)	600	37	17.25	20.063	22.78	24	1.875	13.5	2520	1143
	900	41	19.5	17.5	22.78	20	2.5	18.25	4164	1888
	150	34.25	14	23.5	24.78	24	1.25	9	2215	1007
26	300	38.25	14	23.5	24.78	28	1.625	11	2724	1238
(650mm)	600	40	18	22.75	24.78	28	1.875	14.625	3120	1418
	900	42.75	21	22	24.78	20	2.75	19.125	4380	1991
	150	36.5	15	25.5	26.78	28	1.25	9.25	2255	1025
28	300	40.75	15	25.5	26.78	28	1.625	11.5	2464	1120
(700mm)	600	42.25	19	24.75	26.78	28	2	15.375	3227	1467
	900	46	22.5	24	26.78	20	3	20.5	5337	2426
	150	38.75	12	25.25	28.93	28	1.25	9.5	1745	793
30	300	43	14.5	25.25	28.93	28	1.75	12	3527	1603
(750mm)	600	44.5	19.875	23	28.93	28	2	16	5379	2445
	900	48.5	25	23	28.93	20	3	21.375	6776	3080
	150	41.75	14	25.25	30.87	28	1.5	10.5	5168	2349
32	300	45.25	16	25.25	30.87	28	1.875	12.625	6057	2753
(800mm)	600	47	21	24	30.87	28	2.25	17.125	6457	2935
	900	51.75	26	24	30.87	20	3.25	22.75	7535	3425

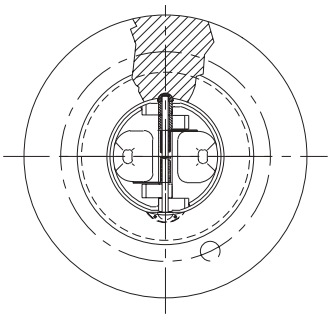
* Weights are for valve only and exclude mating flanges and bolting. † Weight will vary according to corrosion allowance specification.

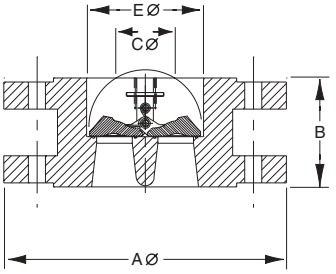
VALVE SIZE	1.5" to 24"	26" to 60"	66" to 144"
FLANGE STANDARD	ANSI B16.5	ANSI B16.47 SERIES A (MSS SP44)	AWWA C207 (CLASS E 275 PSI)

FLANGED TYPE BFR

INSTALLATION DIMENSIONS

ANSI B16.47 SERIES A / AWWA C207 CLASS E





Size inches	Pressure Rating	A Ø inches	B inches	C Ø inches	E Ø inches	STUD SELECTION			APPROX WEIGHT*	
						No. Δ	Dia	Length	lb	kg
	150	46	14.5	25.5	34.04	32	1.5	11.25	2526	1148
36	300	50	19	25.5	34.04	32	2	13.75	4701	2137
(900mm)	600	51.75	25	20.75	34.04	28	2.5	18.75	10417	4735
	900	57.5	28.25	14	34.04	20	3.5	24.875	†	†
	150	50.75	17	34.75	38.87	36	1.5	11.25	3333	1515
40	300	48.75	21.5	29.5	35.78	32	1.625	13.25	6761	3073
(1000mm)	600	52	26	29.25	35.78	32	2.25	18.25	13891	6314
	900	59.5	30	29	35.78	24	3.5	25.625	14714	6688
	150	53	17	36.813	41.81	36	1.5	11.625	4200	1909
42	300	50.75	22.375	32.938	39.98	32	1.625	13.625	9744	4429
(1050mm)	600	55.25	27.625	25.5	38.26	28	2.5	19.5	11612	5278
	900	61.5	31	23	38.26	24	3.5	26.25	†	†
48	150	59.5	20.625	40.813	46.98	44	1.5	12.5	7374	3352
(1200mm)	300	57.75	24.75	38	44.73	32	1.875	15.25	11022	5010
	600	62.75	31	35	44.73	32	2.75	22	13402	6092
54	150	66.25	23.25	43	50.45	44	1.75	14	†	†
(1350mm)	300	65.25	28.25	43	50.45	28	2.25	17.5	†	†
60	150	73	26	47.5	55.97	52	1.75	15	†	†
(1500mm)	300	71.25	33	47.5	55.97	32	2.25	18.375	†	†
66 (1650mm)	150	80	31	56.5	65.46	52	1.75	13	†	†
72 (1800mm)	150	86.5	33.5	60.25	71.58	60	1.75	13.25	†	†
78 (1950mm)	150	93	36.5	65.5	77.7	64	2	14.5	†	†
84 (2100mm)	150	99.75	41	69	83.32	64	2	14.5	†	†
90 - 144 (2250mm-3600mm)	150	**	**	**	**	**	**	**	†	†

* Weights are for valve only and exclude mating flanges and bolting

† Weight will vary according to corrosion allowance specification

Δ Number of studs is per Flange, therefore double the amount for valve installation requirements

** Apply to Goodwin for details

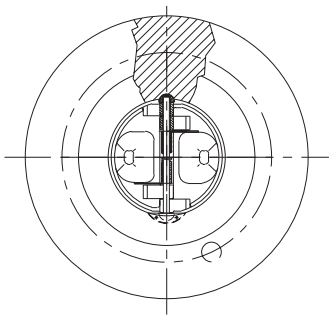
Valves 1.5", 2", 2.5", 3", 4", 5", 6" cannot be supplied in Flanged Type due to insufficient space for the two nuts between the flanges whilst complying with API 594 face to face dimension - therefore refer to the next page as these valves can be supplied as Solid Lug. Alternatively, if flanged type is specifically required in these sizes, dimensions and details for extended face-to-face Type BFR (non-compliant with API 594) can be supplied on request.

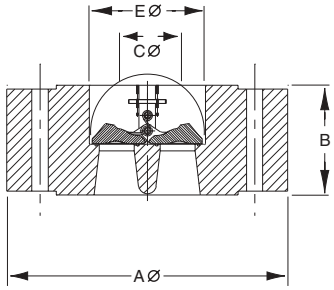
VALVE SIZE	1.5" to 24"	26" to 60"	66" to 144"
FLANGE STANDARD	ANSI B16.5	ANSI B16.47 SERIES A (MSS SP44)	AWWA C207 (CLASS E 275 PSI)

SOLID LUG TYPE BSR

INSTALLATION DIMENSIONS

ANSI B16.5



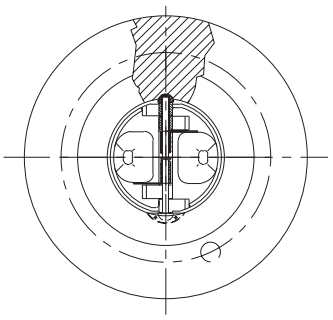


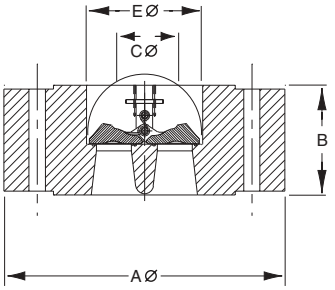
Size	Pressure	A Ø	B	C Ø	E Ø	STUD SELECTION			APPROX WEIGHT*	
inches	Rating	inches	inches	inches	inches	No.	Dia	Length	lb	kg
	150	6	2.375	-	2.25	4	0.625	6	16	7
	300	6.5	2.375	-	2.25	8	0.625	6.875	18	8
2	600	6.5	2.375	-	2.25	8	0.625	6.875	18	8
(50mm)	900	8.5	2.75	-	2.25	8	0.875	8.75	36	16
	1500	8.5	2.75	-	2.25	8	0.875	8.75	36	16
	2500	9.25	2.75	-	2.25	8	1	10	43	19
	150	7.5	2.875	2	3.42	4	0.625	7	28	12
	300	8.25	2.875	2	3.42	8	0.75	8.125	32	14
3	600	8.25	2.875	2	3.42	8	0.75	8.125	32	14
(80mm)	900	9.5	3.25	2.375	3.42	8	0.875	9.5	54	25
	1500	10.5	3.25	2.375	3.42	8	1.125	10.5	64	29
	2500	12	3.375	2.375	3.42	8	1.25	12.25	85	38
	150	9	2.875	3.5	4.45	8	0.625	7	41	19
	300	10	2.875	3.5	4.45	8	0.75	8.125	51	23
4	600	10.75	3.125	3.5	4.45	8	0.875	9.5	66	30
(100mm)	900	11.5	4	3.25	4.45	8	1.125	11	100	45
	1500	12.25	4	3.25	4.45	8	1.25	12	112	51
	2500	14	4.125	3.25	4.45	8	1.5	14.625	152	69
	150	11	3.875	5.5	6.52	8	0.75	8.25	72	32
	300	12.5	3.875	5.5	6.52	12	0.75	9.625	100	45
6	600	14	5.375	3.5	6.52	12	1	12.375	180	81
(150mm)	900	15	6.25	3.5	6.52	12	1.125	14	255	115
	1500	15.5	6.25	3.5	6.52	12	1.375	16.75	264	119
	2500	19	6.25	3.5	6.52	8	2	20.5	406	184
	150	13.5	5	6.75	8.13	8	0.75	9.75	140	63
	300	15	5	6.75	8.13	12	0.875	11.25	172	78
8	600	16.5	6.5	6.625	8.13	12	1.125	14.5	296	134
(200mm)	900	18.5	8.125	5.125	8.13	12	1.375	17.125	480	217
	1500	19	8.125	5.125	8.13	12	1.625	20.25	624	283
	2500	21.75	8.125	5.625	8.13	12	2	24	DOA	DOA
	150	16	5.75	9.25	10.25	12	0.875	11	206	93
	300	17.5	5.75	9.25	10.25	16	1	12.75	254	115
10	600	20	8.375	7.875	10.25	16	1.25	17.125	516	234
(250mm)	900	21.5	9.5	7.688	10.25	16	1.375	19	728	330
	1500	23	9.75	7.25	10.25	12	1.875	23.5	796	361
	2500	26.5	10	7.5	10.25	12	2.5	30.5	1079	489
	150	19	7.125	10.25	11.82	12	0.875	12.25	376	170
	300	20.5	7.125	10.25	11.82	16	1.125	14.625	534	242
12	600	22	9	9.125	11.82	20	1.25	18	672	304
(300mm)	900	24	11.5	8.125	11.82	20	1.375	21.75	1120	509
	1500	26.5	12	8.25	11.82	16	2	27.5	1406	637
	2500	30	12	8.875	11.82	12	2.75	34.5	1647	747
	150	21	7.25	11.25	13.34	12	1	13	440	199
14	300	23	8.75	11.25	13.34	20	1.125	16.5	524	237
(350mm)	600	23.75	10.75	9.125	13.34	20	1.375	20.25	1259	571
	900	25.25	14	0	13.34	20	1.5	25.5	1710	775
	1500	29.5	14	0	13.34	16	2.25	31.5	2419	1097
	150	23.5	7.5	13.063	15.25	16	1	13.5	544	246
16	300	25.5	9.125	13	15.25	20	1.25	17.375	1079	489
(400mm)	600	27	12	13	15.25	20	1.5	22.5	1210	548
	900	27.75	15.125	6.375	15.25	20	1.625	27.125	1344	609
	1500	32.5	15.125	6.375	15.25	16	2.5	34.25	2541	1152

VALVE SIZE	1.5" to 24"	26" to 60"	66" to 144"
FLANGE STANDARD	ANSI B16.5	ANSI B16.47 SERIES A (MSS SP44)	AWWA C207 (CLASS E 275 PSI)

SOLID LUG TYPE BSR

INSTALLATION DIMENSIONS





ANSI B16.5 / ANSI B16.47 SERIES A

Size	Pressure	A Ø	B	C Ø	E Ø	STUD SELECTION			APPROX WEIGHT*	
inches	Rating	inches	inches	inches	inches	No.	Dia	Length	lb	kg
	150	25	8	15.563	17.25	16	1.125	14.5	640	290
18	300	28	10.375	15.375	17.25	24	1.25	18.875	1232	558
(450mm)	600	29.25	14.25	13	17.25	20	1.625	25.25	2378	1078
	900	31	17.75	9.625	17.25	20	1.875	31.5	3198	1450
	1500	36	18.438	7.25	17.25	16	2.75	39.75	3914	1775
	150	27.5	8.625	17.25	19.19	20	1.125	15.125	769	348
20	300	30.5	11.5	17.25	19.19	24	1.25	20.5	1691	766
(500mm)	600	32	14.5	17	19.19	24	1.625	26.25	2861	1297
	900	33.75	17.75	16	19.19	20	2	32.5	4321	1960
	1500	38.75	21	8.25	19.19	16	3	44.25	5898	2675
	150	32	8.75	21.125	22.78	20	1.25	16.25	852	396
24	300	36	12.5	20.625	22.78	24	1.5	22.75	2624	1190
(600mm)	600	37	17.25	20.063	22.78	24	1.875	30.75	3427	1554
	900	41	19.5	17.5	22.78	20	2.5	38	5183	2351
	1500	46	22	15.375	22.78	16	3.5	48.5	7233	3280
	150	34.25	14	23.5	24.78	24	1.25	23.125	2759	1254
26	300	38.25	14	23.5	24.78	28	1.625	24.75	3393	1542
(650mm)	600	40	18	22.75	24.78	28	1.875	31.5	3885	1766
	900	42.75	21	22	24.78	20	2.75	38.75	5454	2479
	150	36.5	15	25.5	26.78	28	1.25	24.375	2807	1276
28	300	40.75	15	25.5	26.78	28	1.625	26.25	3069	1395
(700mm)	600	42.25	19	24.75	26.78	28	2	33	4019	1827
	900	46	22.5	24	26.78	20	3	41	6646	3021
	150	38.75	12	25.25	28.93	28	1.25	21	2171	987
30	300	43	14.5	25.25	28.93	28	1.75	26.5	4391	1996
(750mm)	600	44.5	19.875	23	28.93	28	2	34.125	6699	3045
	900	48.5	25	23	28.93	20	3	44	8437	3835
32	150	41.75	14	29.75	30.87	28	1.5	24.625	6435	2925
(800mm)	300	45.25	16	29.25	30.87	28	1.875	28.75	7542	3428
	900	51.75	26	27.25	30.87	20	3.25	46.25	9383	4265
	150	46	14.5	25.5	34.04	32	1.5	25.875	3146	1430
36	300	50	19	25.5	34.04	32	2	32.5	5854	2661
(900mm)	600	51.75	25	20.75	34.04	28	2.5	45	12971	5896
	900	57.5	28.25	14	34.04	20	3.5	50.75	**	**
	150	50.75	17	34.75	38.87	36	1.5	27.375	4149	1386
40	300	48.75	21.5	29.5	35.78	32	1.625	35	8419	3827
(1000mm)	600	52	26	29.25	35.78	32	2.25	44.25	17296	7862
	900	59.5	30	29	35.78	24	3.5	53.75	18322	8328
	150	53	17	36.813	41.81	36	1.5	28.875	5229	2377
42	300	50.75	22.375	32.938	39.98	32	1.625	37	12133	5515
(1050mm)	600	55.25	27.625	25.5	38.26	28	2.5	47.125	14458	6572
	900	61.5	31	23	38.26	24	3.5	59.25	**	**
48	150	59.5	20.625	40.813	46.98	44	1.5	33.375	9183	4174
(1200mm)	300	57.75	24.75	38	44.73	32	1.875	40.5	13726	6239
	600	62.75	31	35	44.73	32	2.75	54	**	**
54	150	66.25	23.25	43	50.45	44	1.75	38.25	**	**
(1350mm)	300	65.25	28.25	43	50.45	28	2.25	47.25	**	**
60	150	73	26	47.5	55.97	52	1.75	42	**	**
(1500mm)	300	71.25	33	47.5	55.97	32	2.25	53	**	**

* Weights are for valve only and exclude mating flanges and bolting

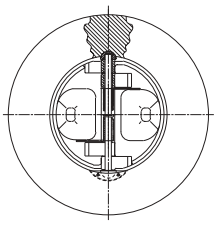
** Apply to Goodwin for details

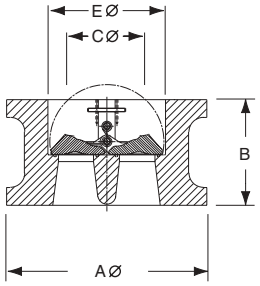
VALVE SIZE	1.5" to 24"	26" to 60"	66" to 144"
FLANGE STANDARD	ANSI B16.5	ANSI B16.47 SERIES A (MSS SP44)	AWWA C207 (CLASS E 275 PSI)

WAFER TYPE BR

INSTALLATION DIMENSIONS

JIS 2210 & KS B1511

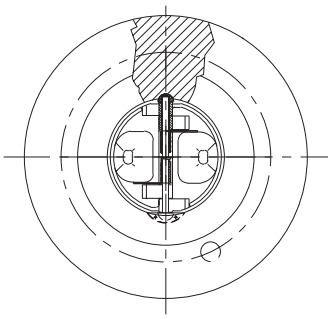


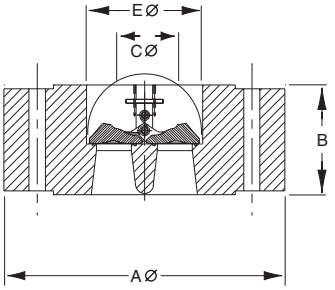


Size inches	Series	End Facing	A Ø (mm)	B (mm)	C Ø (mm)	E Ø (mm)	STUD SELECTION			APPROX WT* kg
							No.	Dia	Length	
1.5	10K	RF	86	50	0	48	4	M16	140	2
(40mm)	20K	RF	86	50	0	48	4	M16	140	2
2	10K	RF	101	60	0	57	4	M16	150	2.5
(50mm)	20K	RF	101	60	0	57	8	M16	150	2.5
2.5	10K	RF	121	67	29	73	4	M16	160	4
(65mm)	20K	RF	121	67	29	73	8	M16	160	4
3	10K	RF	131	73	51	87	8	M16	168	6.5
(80mm)	20K	RF	137	73	51	87	8	M20	180	6.6
4	10K	RF	156	73	89	113	8	M16	165	8.1
(100mm)	20K	RF	162	73	89	113	8	M20	185	8.2
5	10K	RF	187	86	119	141	8	M20	190	12
(125mm)	20K	RF	197	86	119	141	8	M22	200	12.1
6	10K	RF	217	98	140	166	8	M20	205	16
(150mm)	20K	RF	235	98	140	166	12	M22	215	16.2
8	10K	RF	267	127	171	206	12	M20	235	29
(200mm)	20K	RF	279	127	171	206	12	M22	250	29.2
10	10K	RF	330	146	235	260	12	M22	265	48.5
(250mm)	20K	RF	353	146	235	260	12	M24	275	49
12	10K	RF	375	181	260	300	16	M22	300	91
(300mm)	20K	RF	403	181	260	300	16	M24	315	92
14	10K	RF	420	184	285	339	16	M22	305	90
(350mm)	20K	RF	447	222	285	339	16	M30 X 3	375	92
16	10K	RF	483	191	332	387	16	M24	320	125
(400mm)	20K	RF	507	232	332	387	16	M30 X 3	395	127
18	10K	RF	538	203	295	438	20	M24	335	132
(450mm)	20K	RF	572	264	295	438	20	M30 X 3	435	134
20	10K	RF	593	219	438	487	20	M24	350	185
(500mm)	20K	RF	627	292	438	487	20	M30 X 3	465	188
24	10K	RF	697	222	537	579	24	M30	370	285
(600mm)	20K	RF	731	318	537	579	24	M36 X 3	510	289
26	10K	RF	747	356	597	629	24	M30	510	567
(650mm)	20K	RF	802	356	597	629	24	M45 X 3	590	571
28	10K	RF	807	381	648	680	24	M30	535	576
(700mm)	20K	RF	852	381	648	680	24	M45 X 3	625	579
30	10K	RF	867	305	641	734	24	M30	465	442
(750mm)	20K	RF	914	368	641	734	24	M52 X 3	634	447
32	10K	RF	917	356	641	729	28	M30	515	1319
(800mm)	20K	RF	974	406	641	729	24	M52 X 3	680	1325
36	10K	RF	1017	368	648	865	28	M30	530	640
(900mm)	20K	RF	1084	483	648	865	28	M52 X 3	765	647
40 (1000mm)	10K	RF	1121	406	813	909	28	M36	585	855
48 (1200mm)	10K	RF	1341	524	965	1136	32	M36	710	1891
54 (1350mm)	10K	RF	1495	590	1092	1281	36	M42	800	3063
60 (1500mm)	10K	RF	1655	660	1206	1421	40	M42	870	3840

SOLID LUG TYPE BSR
FLANGE TYPE BFR

INSTALLATION DIMENSIONS





JIS 2210 & KS B1511

Size inches	Series	Type	A Ø (mm)	B (mm)	C Ø (mm)	E Ø (mm)	STUD SELECTION No.	STUD SELECTION Dia	STUD SELECTION Length	APPROX WT* kg
2	10K	BSR	155	60	-	57	4	M16	145	6
(50mm)	20K	BSR	155	60	-	57	8	M16	145	6
2.5	10K	BSR	175	67	29	73	4	M16	150	9
(65mm)	20K	BSR	175	67	29	73	8	M16	155	9
3	10K	BSR	185	73	51	87	8	M16	155	10
(80mm)	20K	BSR	200	73	51	87	8	M20	170	11
4	10K	BSR	210	73	89	113	8	M16	155	14
(100mm)	20K	BSR	225	73	89	113	8	M20	175	16
5	10K	BSR	250	86	119	141	8	M20	180	24
(125mm)	20K	BSR	270	86	119	141	8	M22	195	26
6	10K	BSR	280	98	140	166	8	M20	195	28
(150mm)	20K	BSR	305	98	140	166	12	M22	215	30
8	10K	BFR	330	127	171	206	24	M20	105	42
(200mm)	20K	BFR	350	127	171	206	24	M22	125	46
10	10K	BFR	400	146	235	260	24	M22	120	72
(250mm)	20K	BFR	430	146	235	260	24	M24	140	77
12	10K	BFR	445	181	260	300	32	M22	120	113
(300mm)	20K	BFR	480	181	260	300	32	M24	145	118
14	10K	BFR	490	184	285	339	32	M22	125	132
(350mm)	20K	BFR	540	222	285	339	32	M30	160	136
16	10K	BFR	560	191	332	387	32	M24	135	162
(400mm)	20K	BFR	605	232	332	387	32	M30 X 3	165	167
18	10K	BFR	620	203	295	438	40	M24	140	192
(450mm)	20K	BFR	675	264	295	438	40	M30 X 3	170	199
20	10K	BFR	675	219	438	487	40	M24	145	249
(500mm)	20K	BFR	730	292	438	487	40	M30 X 3	190	256
24	10K	BFR	795	222	537	579	48	M30	160	354
(600mm)	20K	BFR	845	318	537	579	48	M36 X 3	200	361
26	10K	BFR	845	356	597	629	48	M30	165	943
(650mm)	20K	BFR	945	356	597	629	48	M45 X 3	225	958
28	10K	BFR	905	381	648	680	48	M30	170	965
(700mm)	20K	BFR	995	381	648	680	48	M45 X 3	230	973
30	10K	BFR	970	305	641	734	48	M30	175	744
(750mm)	20K	BFR	1080	368	641	734	48	M52 X 3	255	753
32	10K	BFR	1020	356	641	729	56	M30	180	2221
(800mm)	20K	BFR	1140	406	641	729	56	M52 X 3	260	2231
36	20K	BFR	1250	483	648	865	56	M52 X 3	270	1090
(900mm)										
40	10K	BFR	1235	406	813	909	56	M36	200	1439
(1000mm)										
48	10K	BFR	1465	524	965	1136	64	M36	220	3184
(1200mm)										
54	10K	BFR	1630	590	1092	1281	72	M42	240	**
(1350mm)										
60	10K	BFR	1795	660	1206	1421	80	M42	250	**
(1500mm)										

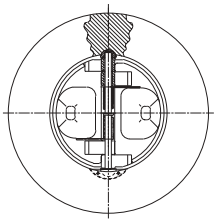
Flanged style standard from 8" (200mm) and larger.
Solid Lug available on request.

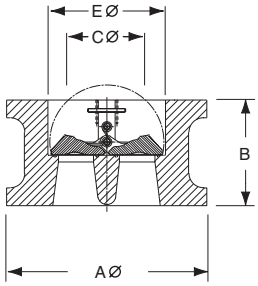
* Weights are for valve only and exclude mating flanges and bolting
**Apply to Goodwin for Details

WAFER TYPE BR

INSTALLATION DIMENSIONS

DIN 2501



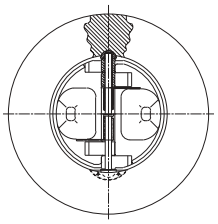


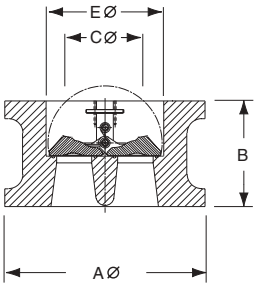
Size mm	Pressure Rating	A Ø (mm)	B (mm)	C Ø (mm)	E Ø (mm)	STUD SELECTION No.	Dia	Length	APPROX WT kg
	PN10	109	60.3	-	57.2	4	M16		3.2
50	PN16	109	60.3	-	57.2	4	M16		3.2
(2")	PN25	109	60.3	-	57.2	4	M16		3.2
	PN40	109	60.3	-	57.2	4	M16		3.2
	PN10	144	73.0	50.8	86.9	8	M16		7.7
80	PN16	144	73.0	50.8	86.9	8	M16		7.7
(3")	PN25	144	73.0	50.8	86.9	8	M16		7.7
	PN40	144	73.0	50.8	86.9	8	M16		7.7
	PN10	164	73.0	88.9	113.0	8	M16		9
100	PN16	164	73.0	88.9	113.0	8	M16		9.5
(4")	PN25	170	73.0	88.9	113.0	8	M20		10
	PN40	170	73.0	88.9	113.0	8	M20		10.5
	PN10	220	98.4	139.7	165.6	8	M20		15.5
150	PN16	220	98.4	139.7	165.6	8	M20		16
(6")	PN25	226	98.4	139.7	165.6	8	M24		19.4
	PN40	226	98.4	139.7	165.6	8	M24		20
	PN10	275	127.0	171.5	206.5	8	M20		35
200	PN16	275	127.0	171.5	206.5	12	M20		36
(8")	PN25	286	127.0	171.5	206.5	12	M24		38
	PN40	293	127.0	171.5	206.5	12	M27		40
	PN10	330	146.1	235.0	260.4	12	M20		51
250	PN16	331	146.1	235.0	260.4	12	M24		52
(10")	PN25	343	146.1	235.0	260.4	12	M27		54
	PN40	355	146.1	235.0	260.4	12	M30		56
	PN10	380	181.0	260.4	300.2	12	M20		94
300	PN16	386	181.0	260.4	300.2	12	M24		97
(12")	PN25	403	181.0	260.4	300.2	16	M27		98
	PN40	420	181.0	260.4	300.2	16	M30		99
	PN10	440	184.2	285.8	338.8	16	M20		122
350	PN16	446	184.2	285.8	338.8	16	M24		123
(14")	PN25	460	222.3	285.8	338.8	16	M30		174
	PN40	477	222.3	285.8	338.8	16	M33		176
	PN10	491	190.5	330.2	387.4	16	M24		131
400	PN16	498	190.5	330.2	387.4	16	M27		133
(16")	PN25	517	231.8	330.2	387.4	16	M33		204
	PN40	549	231.8	330.2	387.4	16	M36		207
	PN10	541	203.2	395.3	438.2	20	M24		141
450	PN16	558	263.5	390.5	438.2	20	M27		284
(18")	PN25	-	-	-	-	-	-		-
	PN40	574	263.5	390.5	438.2	20	M36		294
	PN10	596	219.1	438.2	487.4	20	M24		215
500	PN16	620	292.1	438.2	487.4	20	M30		354
(20')'	PN25	627	292.1	438.2	487.4	20	M33		359
	PN40	631	292.1	438.2	487.4	20	M39		363
	PN10	698	222.3	536.6	578.6	20	M27		358
600	PN16	737	317.5	523.9	578.6	20	M33		518
(24")	PN25	734	317.5	523.9	578.6	20	M36		516
	PN40	750	317.5	523.9	578.6	20	M45		521

WAFER TYPE BR

INSTALLATION DIMENSIONS

BS 4504

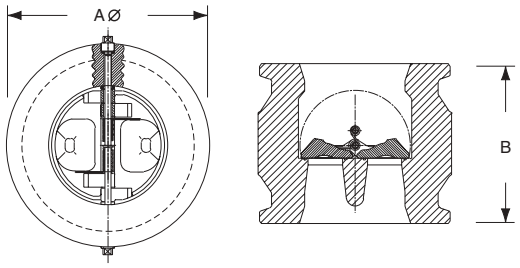




Size inches	Pressure Rating	A ∅ (mm)	B (mm)	C ∅ (mm)	E ∅ (mm)	STUD SELECTION No.	Dia	Length	APPROX WT kg
	PN10	109	60	-	60.3	4	M16	174.6	3.5
2	PN16	109	60	-	60.3	4	M16	174.6	3.5
(50mm)	PN25	109	60	-	60.3	4	M16	174.6	3.5
	PN40	109	60	-	60.3	4	M16	174.6	3.5
	PN10	144	73	54	88.9	8	M16	206.4	6
3	PN16	144	73	54	88.9	8	M16	206.4	6
(80mm)	PN25	144	73	54	88.9	8	M16	206.4	6
	PN40	144	73	54	88.9	8	M16	206.4	6
	PN10	164	73	85.7	114.3	8	M16	206.4	7.5
4	PN16	164	73	85.7	114.3	8	M16	206.4	7.5
(100mm)	PN25	170	73	85.7	114.3	8	M20	241.3	8
	PN40	170	73	85.7	114.3	8	M20	241.3	8
	PN10	220	98	139.7	168.3	8	M20	244.5	16
6	PN16	220	98	139.7	168.3	8	M20	244.5	16
(150mm)	PN25	226	98	139.7	168.3	8	M24	314.3	17.5
	PN40	226	98	139.7	168.3	8	M24	314.3	17.5
	PN10	275	127	187.3	219.1	8	M20	247.6	30
8	PN16	275	127	187.3	219.1	12	M20	285.8	30
(200mm)	PN25	287	127	187.3	219.1	12	M24	285.8	35
	PN40	293	127	187.3	219.1	12	M27	285.8	35
	PN10	330	146	242.9	273.1	12	M20	279.4	50
10	PN16	331	146	242.9	273.1	12	M24	279.4	50
(250mm)	PN25	343	146	242.9	273.1	12	M27	279.4	53
	PN40	355	146	242.9	273.1	12	M30	279.4	53
	PN10	380	181	285.8	323.9	12	M20	311.2	75
12	PN16	386	181	285.8	323.9	12	M24	311.2	75
(300mm)	PN25	403	181	285.8	323.9	16	M27	311.2	80
	PN40	420	181	285.8	323.9	16	M30	311.2	80
	PN10	440	178	314.3	355.6	16	M20	330.2	98
14	PN16	446	178	314.3	355.6	16	M24	330.2	98
(350mm)	PN25	460	222	305	355.6	16	M30	420	140
	PN40	477	222	305	355.6	16	M33	420	140
	PN10	491	191	355.6	406.4	16	M24	615	134
16	PN16	498	191	355.6	406.4	16	M27	640	134
(400mm)	PN25	517	232	358.8	406.4	16	M33	640	210
	PN40	549	305	323.9	406.4	16	M36	755	286
	PN10	541	203	415.9	457.2	20	M24	675	144
18	PN16	558	264	390.5	457.2	20	M27	710	295
(450mm)	PN25	567	264	390.5	457.2	20	M33	745	295
	PN40	574	264	390.5	457.2	20	M36	790	295
	PN10	596	219	466.7	508	20	M24	735	198
20	PN16	620	292	428.6	508	20	M30	785	368
(500mm)	PN25	627	292	428.6	508	20	M33	820	368
	PN40	631	292	428.6	508	20	M39	865	368
	PN10	698	222	568.3	609.6	20	M27	850	307
24	PN16	737	318	539.8	609.6	20	M33	920	525
(600mm)	PN25	734	318	539.8	609.6	20	M36	955	525
	PN40	750	318	539.8	609.6	20	M45	1020	525

HUB ENDED TYPE BH(F)
(Full bore)

INSTALLATION DIMENSIONS



Size inches	Pressure Rating	End Facing	A ∅ inches (2)	B inches (2,5)	APPROX WEIGHT lb	APPROX WEIGHT kg
2	900	Hub	4.375	5.375	20	9
(50mm)	1500	Hub	4.375	5.375	20	9
	2500	Hub	4.625	5.375	20	9
3	900	Hub	5.5	6.25	41	18
(75mm)	1500	Hub	5.875	6.25	45	20
	2500	Hub	6.375	6.25	53	24
4	900	Hub	6.688	8.813	84	38
(100mm)	1500	Hub	7.25	8.813	97	44
	2500	Hub	7.875	8.813	116	52
6	900	Hub	8.188	11	160	72
(150mm)	1500	Hub	10.125	11	244	110
	2500	Hub	11.5	11	315	142
8	900	Hub	11.75	11.625	350	158
(200mm)	1500	Hub	12.875	11.625	419	190
	2500	Hub	14.25	11.625	515	233
10	900	Hub	14.188	14.438	627	284
(250mm)	1500	Hub	15.938	14.438	790	358
	2500	Hub	16.625	14.438	871	395
12	900	Hub	16.625	16.5	994	450
(300mm)	1500	Hub	18.5	16.5	1231	558
	2500	Hub	20.125	16.5	1457	660
14	900	Hub	18.125	19	1365	619
(350mm)	1500	Hub	20	19	1660	752
16	900	Hub	21.125	21	2050	929
(400mm)	1500	Hub	23.25	21	2484	1126
18	900	Hub	23.5	23	2781	1261
(450mm)	1500	Hub	26	23	3402	1543

1. Type BH is supplied with external threaded retainers

2. Full bore Retainerless Type BHR(F), with no external threaded components can be supplied. Dimensions A∅ and B are larger and available on application.

3. Clamps, seal rings and companion hubs are not included with the valve.

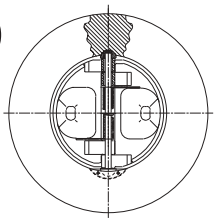
4. Particular make of Hub Ends and Clamp Style must be specified by customer. Relevant technical information should be obtained from the chosen clamp supplier, e.g. Graylok®, Techlok®, Clamplok®.

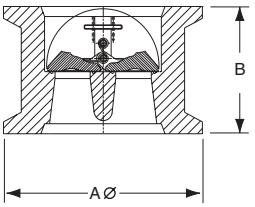
5. Dimension B: These are typical only. Due to the large variety of Hub End sizes and Clamp Styles available the face-to-face dimensions for a given size and rating may vary to maintain ANSI and API design specifications. Please contact Goodwin for details prior to using above data as design criteria.

6. Valve sizes not listed above are available on application, together with customer specified end sizes and types. All valves are rated in accordance with ANSI B 16.34, API 594 and API 598 design and application specifications.

HUB ENDED TYPE BHR(R)
(Reduced bore)

INSTALLATION DIMENSIONS





Size inches	Pressure Rating	End Facing	A Ø inches	B inches (1,4)	APPROX WEIGHT lb	APPROX WEIGHT kg
3	900	Hub	5	4.5	14	6.5
(80mm)	1500	Hub	5	4.5	17	7.5
	2500	Hub	5	4.5	19	8.5
4	900	Hub	6	5	18	8
(100mm)	1500	Hub	6	5	20	9
	2500	Hub	6	5	22	10
6	900	Hub	9.25	6.25	66	30
(150mm)	1500	Hub	9.25	6.25	68	31
	2500	Hub	9.25	6.25	70	32
8	900	Hub	11.5	8.125	152	69
(200mm)	1500	Hub	11.5	8.125	154	70
	2500	Hub	11.5	8.125	156	71
10	900	Hub	13.625	9.75	249	113
(250mm)	1500	Hub	13.625	9.75	251	114
	2500	Hub	13.625	9.75	253	115
12	900	Hub	16	12.5	394	179
(300mm)	1500	Hub	18	12.5	396	180
	2500	Hub	16	12.5	398	181

1. Full Bore Retainerless, Type BHR(F), with no external threaded components, can be supplied. Dimensions AØ and B are larger and available on application.

2. Clamps, seal rings and companion hubs are not included with the valve

3. Particular make of Hub Ends and Clamp Style must be specified by customer. Relevant technical information should be obtained from the chosen clamp supplier, e.g. Graylok®, Techlok®, Clamplok®.

4. Dimension B: These are typical only. Due to the large variety of Hub End sizes and Clamp Styles available the face-to-face dimensions for a given size and rating may vary to maintain ANSI and API design specifications. Please contact Goodwin for details prior to using above data as design criteria.

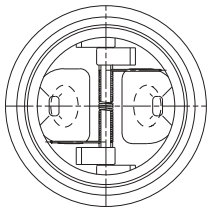
5. Valve sizes not listed above are available on application, together with customer specified end sizes and types. All valves are rated in accordance with ANSI B 16.34, API 594 and API 598 design and application specifications.

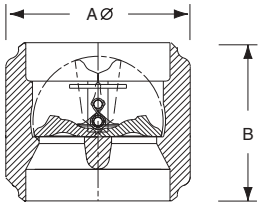
6. Internals designed to suit customer's specified hub-ended bore details.

7. BHR valves have reduced bore internals, usually one size down. Refer to page 35 for Cv valves.

BUTTWELD END TYPE BWR

INSTALLATION DIMENSIONS





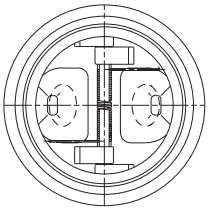
Size inches	Pressure Rating	A Ø		B		APPROX WEIGHT	
		inches	mm	inches	mm	lb	kg
	150	5.097	129.5	4.75	120.7	15.2	6.9
	300	5.097	129.5	4.75	120.7	16.2	7.4
4	600	5.337	135.6	4.75	120.7	18.6	8.5
(100mm)	900	5.777	146.7	6.5	165.1	31	14.1
	1500	6.105	155.1	6.5	165.1	35.9	16.3
	2500	6.685	169.8	6.5	165.1	42.4	19.2
	150	6.625	168.3	5.375	136.5	29.5	13.4
	300	6.625	168.3	5.375	136.5	29.5	13.4
6	600	6.769	171.9	5.375	136.5	32.2	14.6
(150mm)	900	9.008	228.8	8.125	206.4	61.5	27.9
	1500	9.008	228.8	8.125	206.4	80.9	36.7
	2500	9.008	228.8	8.125	206.4	96.2	43.7
	150	8.917	226.5	6	152.4	48.6	22.0
	300	8.917	226.5	6	152.4	55.1	25.0
8	600	9.429	239.5	8.5	215.9	95.6	43.4
(200mm)	900	9.929	252.2	11.5	292.1	151.1	68.5
	1500	11.189	284.2	11.5	292.1	203.4	92.3
	2500	12.309	312.6	11.5	292.1	249.3	113.1
	150	10.75	270.6	7.375	187.3	94.4	42.8
	300	10.75	270.6	7.375	187.3	94.4	42.8
10	600	11.395	289.4	10.313	262.0	170.7	77.5
(250mm)	900	12.035	305.7	10.313	262.0	198.6	90.1
	1500	13.640	346.5	13.625	346.1	351.1	159.3
	2500	14.460	367.3	13.625	346.1	395	179.2
	150	12.971	329.5	8.5	215.9	138.7	62.9
	300	12.971	329.5	8.5	215.9	152.1	69.0
12	600	13.851	351.8	11.5	292.1	256.8	116.5
(300mm)	900	14.671	372.6	12.5	317.5	350.4	159.0
	1500	16.505	419.2	13.75	349.3	516.5	234.3
	2500	14.460	367.3	16.25	412.8	758.4	344.1
	150	14.960	380	10.25	260.4	223.8	101.5
14	300	14.960	380	10.25	260.4	248	112.5
(350mm)	600	15.033	381.8	14	355.6	437.9	198.7
	900	15.033	381.8	14	355.6	508.7	230.8
	1500	16.913	429.6	14	355.6	581.6	263.9
	150	16.745	425.3	12	304.8	321.5	145.9
16	300	16.745	425.3	12	304.8	361.5	164.0
(400mm)	600	17.363	441	15.75	400.1	579.7	263.0
	900	18.483	469.5	15.75	400.1	693.7	314.7
	1500	19.440	493.8	17.25	438.2	956.7	434.1

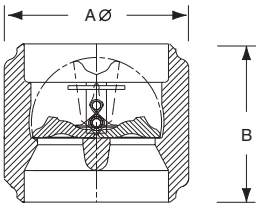
PIPE SCHEDULE

Customer must state pipe schedule at time of enquiry. The nominal bore of the valve will be determined by the pipe schedule selected by the customer and be in accordance with ASME/ANSI B16.25

BUTTWELD END TYPE BWR

INSTALLATION DIMENSIONS





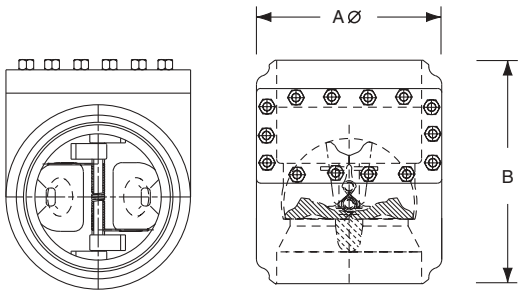
Size inches	Pressure Rating	A Ø		B		APPROX WEIGHT	
		inches	mm	inches	mm	lb	kg
	150	18.715	475.4	13	330.2	417.6	189.5
18	300	18.715	475.4	13	330.2	473.8	215.0
(450mm)	600	19.194	487.5	16.125	409.6	675	306.3
	900	20.454	519.5	17.625	447.7	932.7	423.2
	1500	21.865	555.4	18	457.2	1251.1	567.6
	150	20.735	526.7	15.75	400.1	601.9	273.1
20	300	20.735	526.7	15.75	400.1	688.2	312.3
(500mm)	600	21.255	539.9	19.5	495.3	1015.7	460.9
	900	22.755	578.0	21.5	546.1	1404.6	637.3
	1500	24.475	621.7	21.5	546.1	1884.9	855.2
	150	24	609.6	13.5	342.9	795.8	361.1
24	300	24	609.6	16.5	419.1	1008.4	457.5
(600mm)	600	25.015	635.4	21.5	546.1	1590.2	721.5
	900	26.775	680.1	23.75	603.2	2248.5	1020.2
	1500	29.075	738.5	26	660.4	3087.3	1400.8
	150	28	711.2	14.75	374.7	958.4	434.9
28	300	28.625	727.1	16.5	419.1	1259.5	571.5
(700mm)	600	30.485	774.3	19.25	489	2005	909.7
	900	32.365	822.1	23	584.2	2880.2	1306.8
	150	30	762.0	15.25	387.4	1314	596.2
30	300	30.25	768.4	17	431.8	1575.6	714.9
(750mm)	600	32.25	819.2	20	508	2420.7	1098.3
	900	34.21	868.9	24	609.6	3456.4	1568.2
	150	32	812.8	14.5	368.3	1261.3	572.3
32	300	32.795	833.0	17	431.8	1746.4	792.4
(800mm)	600	34.935	887.3	21	533.4	2957.7	1342.0
	900	37.015	940.2	25	635	4170.8	1892.4
	150	36	914.4	16.5	419.1	2029.6	920.9
36	300	36	914.4	19	482.6	2464	1118.0
(900mm)	600	37.195	944.8	21.75	552.5	3566.9	1618.4
	900	39.495	1003.2	26	660.4	5050.6	2291.6
	150	40	1016.0	18.5	469.9	2766.6	1255.2
40	300	40	1016.0	22.5	571.5	3540.9	1606.6
(1000mm)	600	41.645	1057.8	26	660.4	5279.7	2395.5
	900	44.165	1121.8	29	736.6	7176.8	3256.3
	150	42	1066.8	20	508	3608.1	1637.1
42	300	42	1066.8	23.5	596.9	4435.8	2012.6
(1050mm)	600	43.685	1109.6	26.5	673.1	6036.2	2738.7
	900	46.285	1175.6	30.5	774.7	8302	3766.8
	150	48	1219.2	20.5	520.7	4236.7	1922.3
48	300	48	1219.2	24.5	622.3	7008	3179.7
(1200mm)	600	48	1219.2	27.5	698.5	8196.9	3719.1
	900	48.293	1226.6	29.5	749.3	9199.9	4174.2

PIPE SCHEDULE

Customer must state pipe schedule at time of enquiry. The nominal bore of the valve will be determined by the pipe schedule selected by the customer and be in accordance with ASME/ANSI B16.25

BUTTWELD END WITH ACCESS
TYPE BWA

INSTALLATION DIMENSIONS



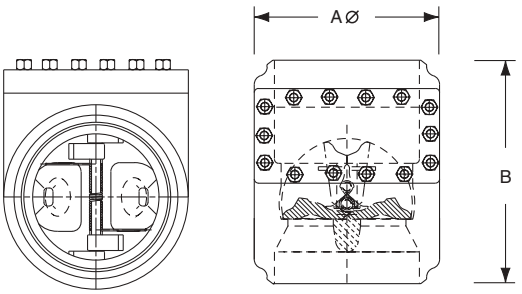
Size inches	Pressure Rating	A Ø		B		APPROX WEIGHT	
		inches	mm	inches	mm	lb	kg
	150	5.097	129.5	12	304.8	46.1	20.9
	300	5.097	129.5	12	304.8	49.1	22.3
4	600	5.337	135.6	12	304.8	56.4	25.6
(100mm)	900	5.777	146.7	14	355.6	82.3	37.3
	1500	6.105	155.1	16	406.4	106	48.2
	2500	6.685	169.8	18	457.2	139	62.9
	150	6.625	168.3	15.9	403.2	102	46.3
	300	6.625	168.3	15.9	403.2	102	46.3
6	600	6.769	171.9	18	457.2	124	56.2
(150mm)	900	9.008	228.8	20	508.0	182	82.7
	1500	9.008	228.8	22	558.8	260	117.8
	2500	9.008	228.8	24	609.6	332	150.8
	150	8.917	226.5	16.5	419.1	158	71.6
	300	8.917	226.5	16.5	419.1	179	81.3
8	600	9.429	239.5	23	584.2	306	139.0
(200mm)	900	9.929	252.2	26	660.4	417	189.2
	1500	11.189	284.2	28	711.2	597	270.9
	2500	12.309	312.6	30	762.0	775	351.6
	150	10.655	270.6	18	457.2	278	125.9
	300	10.655	270.6	18	457.2	278	125.9
10	600	11.395	289.4	28	711.2	549	249.0
(250mm)	900	12.035	305.7	31	787.4	696	315.9
	1500	13.64	346.5	34	863.6	1052	477.2
	2500	14.46	367.3	36	914.4	1241	563.1
	150	12.971	329.5	19.8	501.7	392	177.7
	300	12.971	329.5	19.8	501.7	429	194.8
12	600	13.851	351.8	32	812.8	843	382.5
(300mm)	900	14.671	372.6	36	914.4	1184	537.3
	1500	16.505	419.2	39	990.6	1723	781.8
	2500	14.46	367.3	41	1041.4	2293	1040.3
	150	14.96	380	22.5	571.5	603	273.7
14	300	14.96	380	22.5	571.5	668	303.3
(350mm)	600	15.033	381.8	35	889.0	1314	596.0
	900	15.033	381.8	39	990.6	1671	758.3
	1500	16.913	429.6	42	1066.8	2036	923.6
	150	16.745	425.3	24	609.6	804	364.7
16	300	16.745	425.3	24	609.6	904	410.1
(400mm)	600	17.363	441	39	990.6	1725	782.8
	900	18.483	469.5	43	1092.2	2241	1016.6
	1500	19.44	493.8	47	1193.8	3085	1399.8

PIPE SCHEDULE

Customer must state pipe schedule at time of enquiry. The nominal bore of the valve will be determined by the pipe schedule selected by the customer and be in accordance with ASME/ANSI B16.25

BUTTWELD END WITH ACCESS
TYPE BWA

INSTALLATION DIMENSIONS



Size	Pressure	A ∅		B		APPROX WEIGHT	
inches	Rating	inches	mm	inches	mm	lb	kg
	150	18.715	475.4	26.00	660.4	1044	473.6
18	300	18.715	475.4	26.00	660.4	1185	537.4
(450mm)	600	19.194	487.5	42.00	1066.8	2096	950.9
	900	20.454	519.5	47.00	1193.8	2954	1340.2
	1500	21.865	555.4	51.00	1295.4	4170	1892.1
	150	20.735	526.7	28.00	711.2	1371	622.0
20	300	20.735	526.7	28.00	711.2	1568	711.2
(500mm)	600	21.255	539.9	45.00	1143.0	2852	1294.0
	900	22.755	578	50.00	1270.0	3969	1800.7
	1500	24.475	621.7	54.00	1371.6	5677	2575.6
	150	24	609.6	32.00	812.8	2284	1036.4
24	300	24	609.6	32.00	812.8	2460	1116.1
(600mm)	600	25.015	635.4	47.00	1193.8	4271	1938.1
	900	26.775	680.1	53.00	1346.2	6142	2786.7
	1500	29.075	738.5	56.00	1422.4	8193	3717.4
	150	28	711.2	35.25	895.4	2770	1256.7
28	300	28.625	727.1	35.25	895.4	3321	1506.6
(700mm)	600	30.485	774.3	51.00	1295.4	6315	2865.0
	900	32.365	822.1	57.00	1447.8	8578	3892.1
	150	30	762	36.75	933.5	3823	1734.8
30	300	30.25	768.4	36.75	933.5	4194	1902.8
(750mm)	600	32.25	819.2	53.00	1346.2	7625	3459.7
	900	34.21	868.9	59.00	1498.6	10225	4639.4
	150	32	812.8	38.75	984.3	4001	1815.5
32	300	32.795	833	38.75	984.3	4854	2202.4
(800mm)	600	34.935	887.3	55.00	1397.0	9225	4185.6
	900	37.015	940.2	60.00	1524.0	12095	5487.9
	150	36	914.4	41.50	1054.1	6119	2776.5
36	300	36	914.4	41.50	1054.1	6614	3000.9
(900mm)	600	37.195	944.8	57.00	1447.8	11131	5050.4
	900	39.495	1003.2	61.00	1549.4	14375	6522.2
	150	40	1016	44.50	1130.3	8038	3647.0
40	300	40	1016	44.50	1130.3	8774	3980.8
(1000mm)	600	41.645	1057.8	59.00	1498.6	14621	6633.7
	900	44.165	1121.8	62.00	1574.8	18932	8589.8
	150	42	1066.8	46.00	1168.4	10103	4583.8
42	300	42	1066.8	46.00	1168.4	10901	4945.9
(1050mm)	600	43.685	1109.6	60.00	1524.0	16685	7570.3
	900	46.285	1175.6	63.00	1600.2	21299	9664.0
	150	48	1219.2	50.25	1276.4	12503	5673.0
48	300	48	1219.2	50.25	1276.4	17878	8111.4
(1200mm)	600	48	1219.2	61.00	1549.4	22281	10109.2
	900	48.293	1226.6	64.00	1625.6	24559	11142.9

PIPE SCHEDULE

Customer must state pipe schedule at time of enquiry. The nominal bore of the valve will be determined by the pipe schedule selected by the customer and be in accordance with ASME/ANSI B16.25

CHECK VALVE APPLICATIONS

A check valve is a vital item, installed in support of automatic shutdown valves and safety devices. Its purpose is to prevent and protect against the consequences of unintended reverse flow.

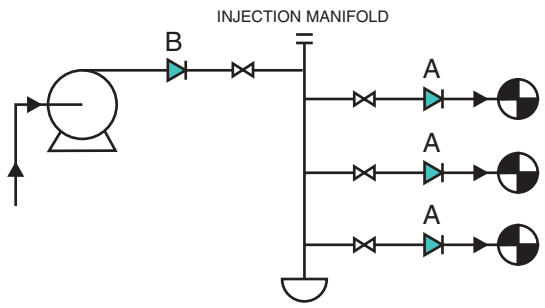
The Goodwin Check Valve provides high integrity first-line defence in the event of unwanted reverse flow and operates in advance of, or in conjunction with safety devices. It is immediately responsive and fast acting in its closure, thereby maximising protection to prevent or minimize the adverse effect of any backflow.

Correct use of the Goodwin Check Valve will give enhanced protection for the safety of personnel, the environment, mechanical equipment, process plant, and against loss of product or production.

Investment in Goodwin Check Valves can protect against significant financial loss that might be caused by unintended reverse flow.

Typical installations where the Goodwin Check Valve might be used are shown below.

WELLHEAD INJECTION LINES



Fluid: Treated Sea Water, Gas, Condensate
Typical Sizes: (A) 4", 6", 8" (B) 12" to 16"
Rating: 900, 1500, 2500, API 5000, API 10000
Typical Materials: LCC, Duplex, SMO 254, ALLOY 825, ALLOY 625
Typical Style: Wafer, Flanged, Solid Lug, Hub Ended.

Purpose:

Valve A: Prevention of backflow into injection line. Valve placed as near as practical to well head to help protect entire line and injection manifold against possible over pressure.

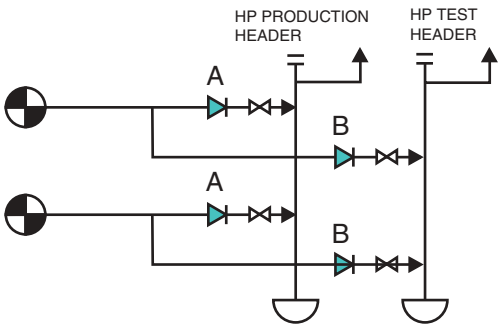
Valve B: Prevention of backflow into pump. Protection against reverse rotation and consequent mechanical damage.

PRODUCTION FLOWLINES

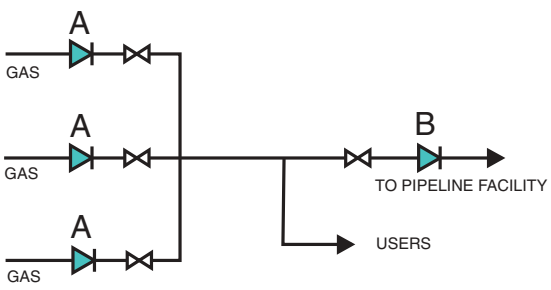
Fluid: Hydrocarbons (Gas, Oil & Condensates)
Typical Sizes: 4", 6", 8", 10"
Typical Pressures: ANSI 1500, 2500
Typical Materials: LCC, CF3MN, Duplex, 825, 625, CF8M
Typical Style: Hub Ended, Flanged, Solid Lug

Purpose:

Valve A: Prevention of backflow into flowline/reservoir.
Valve B: Prevention of backflow from test header to HP Production header.



SALES GAS EXPORT FACILITY



Fluid: Gas
Typical Sizes: (A) 10" to 16" (B) 16" to 36"
Typical Pressures: ANSI 600 and 900
Typical Materials: LCB, LCC, WCB, WCC
Typical Style: Wafer, Flanged

Purpose:

Valve A: Prevention of backflow into any one gas train from operating gas train(s) ensuring gas train separation.

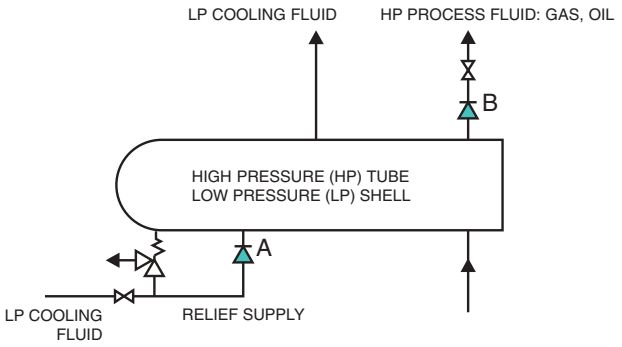
Valve B: Prevention of backflow in the event of process failure or pressure loss. Initial protection against loss of large pipeline inventory.

HEAT EXCHANGER

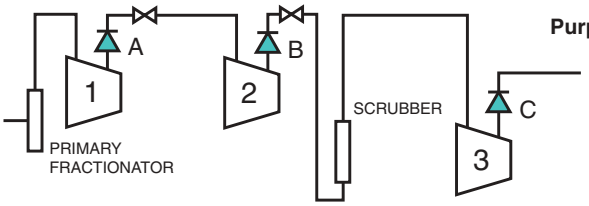
Fluid: Water, Sea Water
Typical Sizes: 6" to 24"
Typical Pressures: ANSI 150
Typical Materials: Al. Br, CS, Duplex, SMo254, Alloy 625
Typical Style: Wafer

Purpose:

Valve A: Prevention of backflow of HP process fluid in LP supply system in event of HP tube rupture. A key component in the protection of the LP system against over pressure and contamination.
Valve B: Prevention of backflow of HP process fluid in event of HP tube rupture. Protection against loss of inventory of HP process fluid.



REFINERY: PROCESS GAS CENTRIFUGAL COMPRESSOR TRAIN



Fluid: Process Gas
Typical Sizes: (A) up to 52" 150: (B) up to 30" 150: (C) up to 18" 300
Typical Materials: WCB
Typical Style: Wafer, Flanged

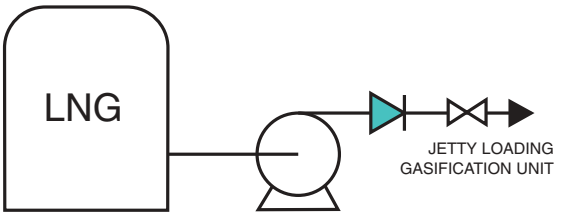
Purpose:

Valve A: Installed on discharge - prevention of backflow through 1st compressor.
Valve B: Installed on discharge - prevention of backflow through 2nd compressor.
Valve C: Installed on discharge - prevention of backflow through 3rd compressor.
Protection against reverse rotation of compressor and consequent mechanical damage and line depressurisation

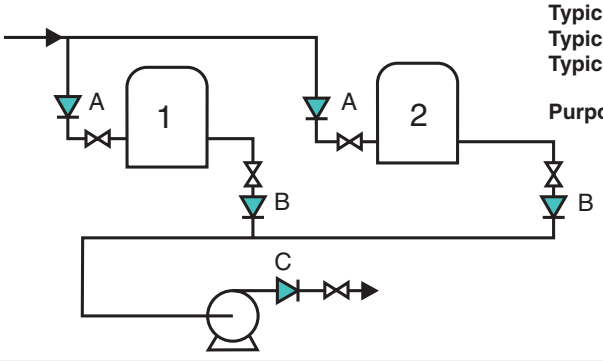
LNG STORAGE

Fluid: LNG @ - 162˚C
Typical Sizes: Up to 24"
Typical Pressures: ANSI 150, 300
Typical Materials: Stainless Steel, CF8M, CF3M
Typical Style: Wafer, Flanged, Solid Lug

Purpose: Prevention of backflow into pump and LNG storage tank. Protection against reverse rotation of pump and over pressure of LNG storage tank.



PRODUCT TANK FARM WITH SHARED LOADING FACILITIES



Fluid: Diesel Oil, Gasoline, Kerosene
Typical Sizes: Up to 42"
Typical Pressures: ANSI 150
Typical Materials: WCB
Typical Style: Wafer, Flanged

Purpose:

Valve A: Prevention of backflow from tanks. Protection against loss of inventory in event of supply line rupture.
Valve A & B: Prevention of cross flow between tanks of different levels. A key component in the protection against over pressurisation, excessive vacuum and contamination.
Valve C: Prevention of backflow into pump. Protection against reverse rotation and consequent mechanical damage. Protection against loss of inventory in event of pump supply line rupture.

TECHNICAL DATA

C_V PRESSURE DROP FORMULA

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

FOR LIQUIDS

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

Q max of ≏0.7 C_V vaporising liquid

$$\sqrt{P_1 - F_f P_v \over G_f}$$

$$W = 63.3\ C_V \sqrt{\Delta P \alpha_1}$$

FOR GASES AND VAPOURS

$$Q = 1360 \times C_V \times P_1 \times Y \times \sqrt{\frac{X}{G_g T_1 Z}}$$

$$W = 19.3 \times Cv \times P_1 \times Y \times \sqrt{\frac{XM}{T_1 Z}}$$

Q = Flow Liquid: US gall per minute
Gas: standard cu.ft per hour

C_V = Valve Co-efficient

ΔP = (P1 - P2) Pressure Drop psi
When $P_2 < \frac{P1}{2}$ let $P_2 = \frac{P1}{2}$

P_1 = Inlet Pressure PSIA

P_2 = Outlet Pressure PSIA

G_f = Specific Gravity of Fluid
eg: water = 1 @ 60ºF, 1 ATM

Gg = Specific Gravity of Gas
eg Air = 1 @ 60ºF, 1 ATM

T_1 = Absolute inlet temperature
(ºF + 460)

W = Flow lb/hour

Y = Expansion factor
(limits between 1 and 0.67)

X = Ratio of pressure drop ΔP to Absolute inlet pressure P_1

Z = Gas compressibility factor
(=1 for an ideal gas)

M = Molecular weight

$\alpha 1$ = Specific weight upstream conditions (lb/ft3)

F_f = Liquid critical pressure ratio factor

$F_f = 0.96 - 0.28 \left(\frac{P_v}{P_c}\right)^{1/2}$

P_v = Absolute vapour pressure of Liquid at inlet temperature in PSIA

P_c = Absolute thermodynamic Critical pressure

VALVE COEFFICIENT ANSI 150/300*

Valve Size	Cv
2"	48
3"	150
4"	394
6"	900
8"	1,589
10"	3,300
12"	3,926
14"	5,418
16"	8,256
18"	10,452
20"	14,251
24"	26,511
26"	30,000
28"	33,600
30"	38,400
32"	48,000
36"	55,200
40"	84,000
42"	96,000
48"	117,600

* See graphs on next page for Cv's ie 600/900, 1500 and 2500 class values.

VALVE SIZE	VALVE CRACKING PRESSURE			
	SUPER TORQUE SPRING (psi)	STANDARD TORQUE SPRING (psi)	LOW TORQUE SPRING (psi)	MINI TORQUE SPRING (psi)
2"	0.511	0.225	0.123	0.050
3"	0.617	0.298	0.110	0.054
4"	0.426	0.165	0.071	0.048
6"	0.353	0.194	0.086	0.043
8"	0.299	0.222	0.118	0.042
10"	0.308	0.231	0.081	0.040
12"	0.275	0.270	0.145	0.040
14"	0.255	0.226	0.086	0.043
16"	0.389	0.243	0.116	0.042
18"	0.320	0.249	0.126	0.041
20"	0.341	0.192	0.093	0.041
24"	0.266	0.207	0.064	0.040

- The Valve Cracking Pressure is the pressure required to lift the plates off the seat. The table above lists the cracking pressure required for a range of Class 150 check valve with Super Torque, Standard Torque, Low Torque and Mini Torque Inconel X750 springs installed. The value of the Cracking Pressure can be varied to suit specific customer requirements by using a different spring.
- The valve spring installed with Goodwin Wafer Check Valves operates as a matched pair of springs providing an independent action on each plate, which ensures synchronous closing.

CRITICAL VELOCITY

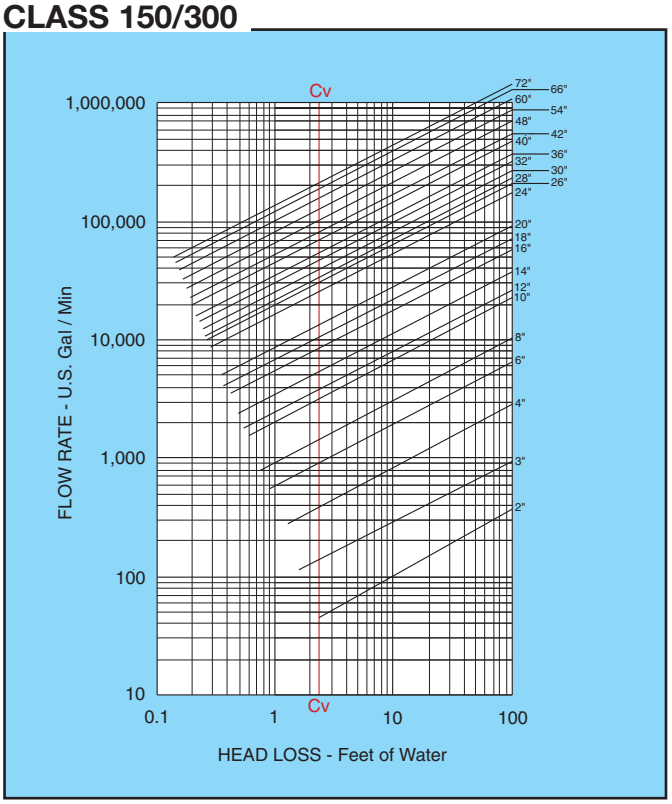
The critical velocity of a valve is that velocity of fluid required to keep the plates of the valve fully open. This condition is important for all check valves. If not reached then any pressure drop calculations would be invalid as the Cv of a valve is calculated on the basis of the valve being in the full open position. With the valve plates only partially open, i.e. the flow velocity being less than the critical velocity of the valve, then a higher pressure drop will exists than would otherwise be calculated.

Goodwin International have designed their valves such that the customer has an option of 4 different spring strengths:

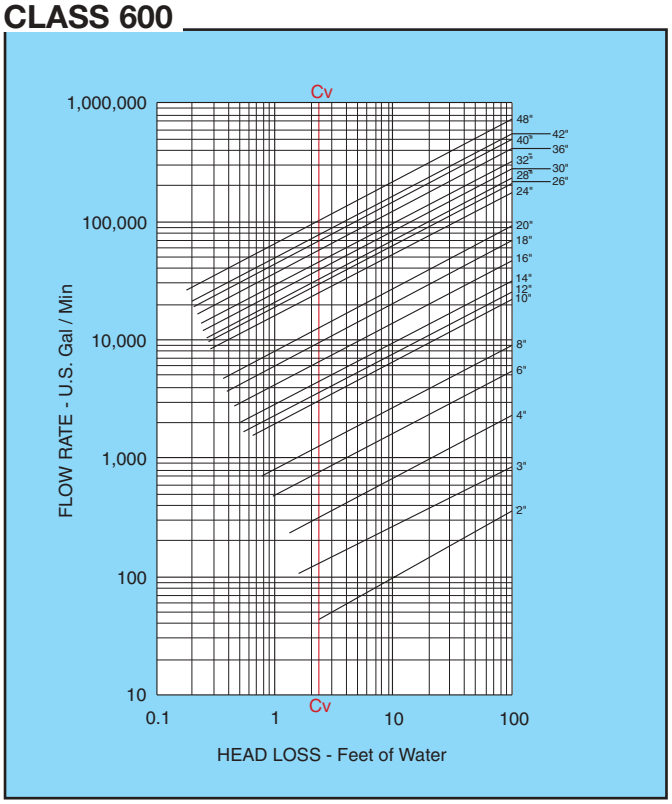
Super torque spring: - this has an average critical velocity in water of 4.4 m/s.
Standard torque spring: - this has an average critical velocity in water of 3 m/s. (This spring fitted as standard unless otherwise specified)
Low torque spring: - this has an average critical velocity in water of 2 m/s.
Mini torque spring: - this has an average critical velocity in water of 1.5 m/s.

HEAD LOSS - FOR WATER AT 60°F

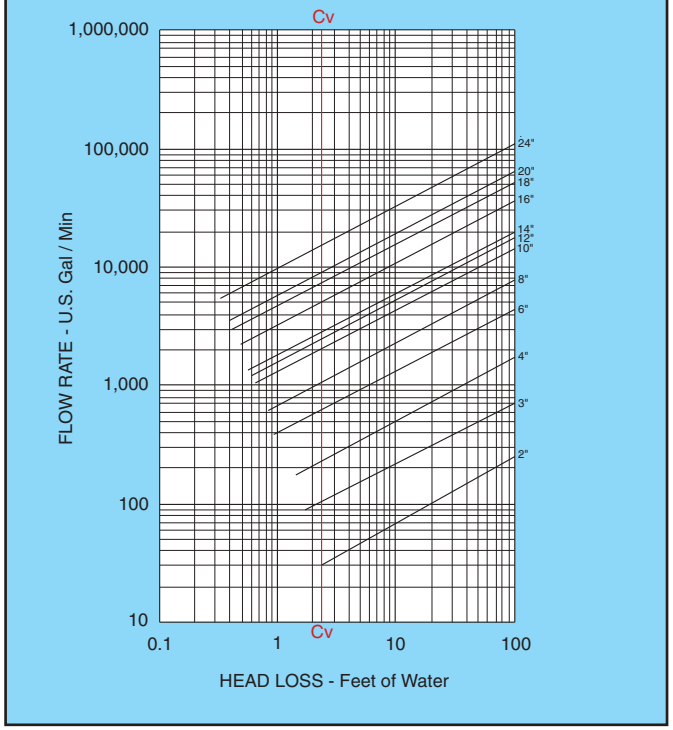
CLASS 150/300



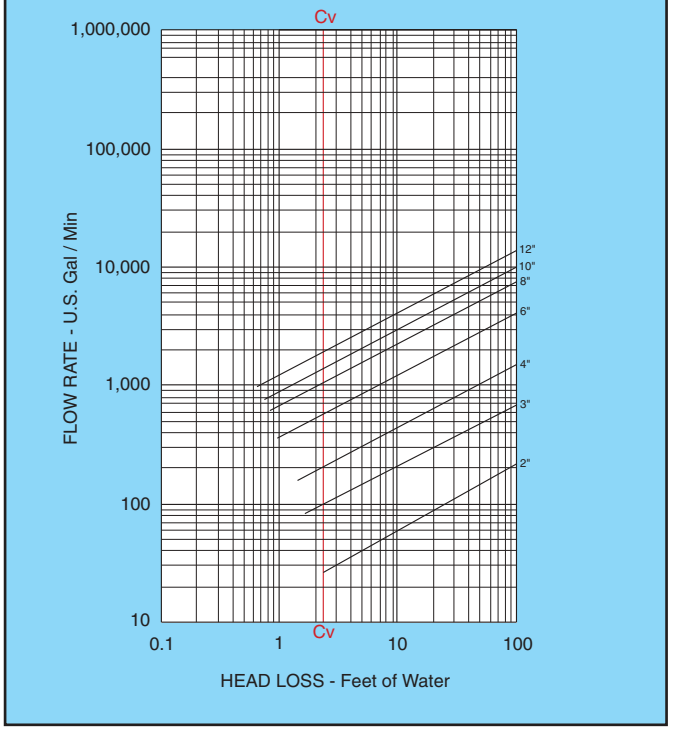
CLASS 600



CLASS 900/1500

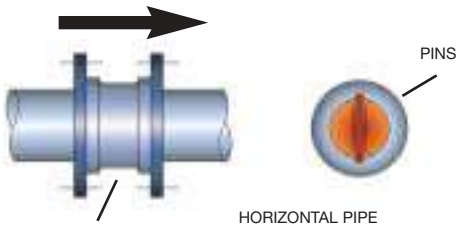


CLASS 2500

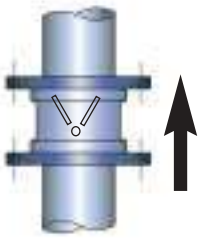


- Valves fitted to larger bore pipes will have lower pressure drops.
- For buttweld end Types BWR & BWA and hub end Type BHR (R) please refer to Goodwin for Cv values.
- Head loss valves versus flow, as depicted in the above graphs, have been established following tests carried out both at Delft Hydraulics Laboratories and from the flow test rig at Goodwin's factory. By combining these test results with area ratios a complete range of test results have been extrapolated.

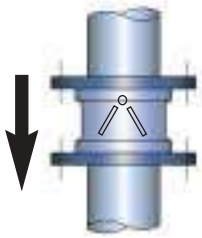
BEST PRACTICE VALVE INSTALLATION



Goodwin Check Valve

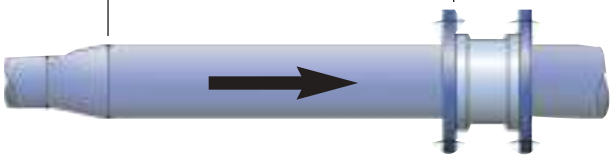


VERTICAL PIPE
WITH FLOW UP

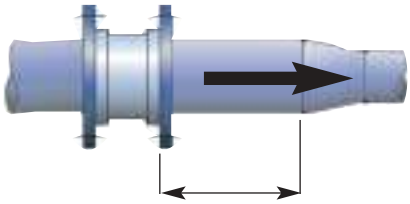


VERTICAL PIPE
WITH FLOW DOWN
UP TO & INCLUDING 8"
WITH STANDARD SPRING

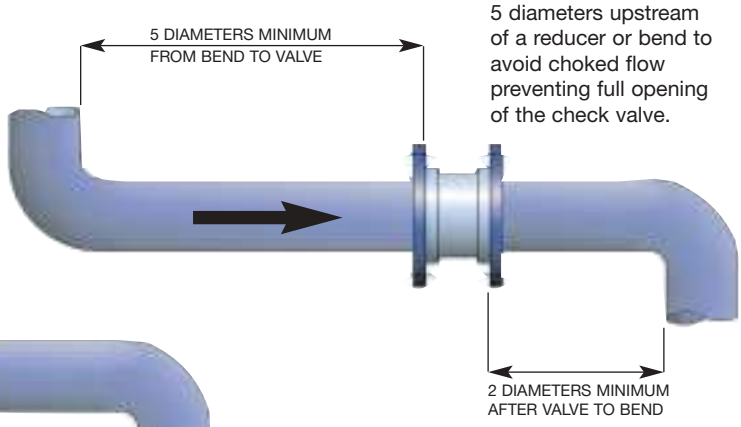
For non-horizontal flow directions, specific system dynamics will be required. Refer to Goodwin.

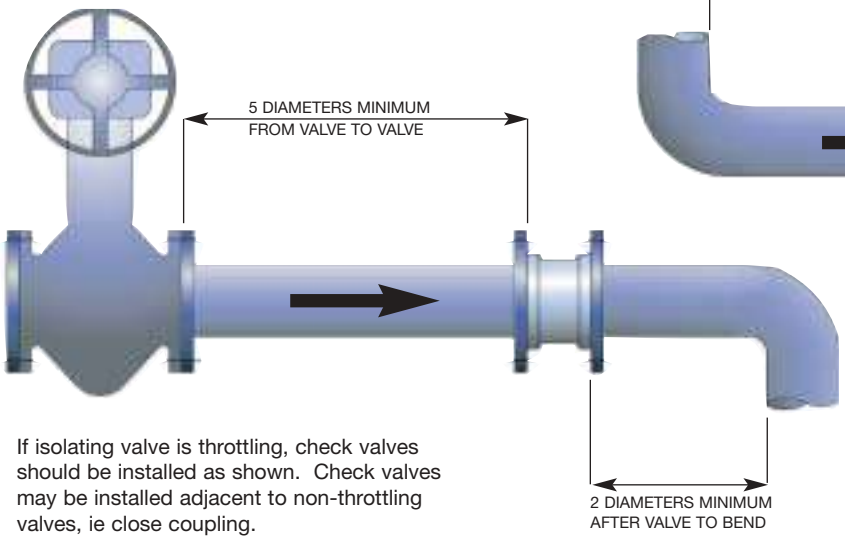


Check valve should be installed a minimum of 5 diameters downstream of a reducer/expander to ensure that the valve is in laminar and not turbulent flow.

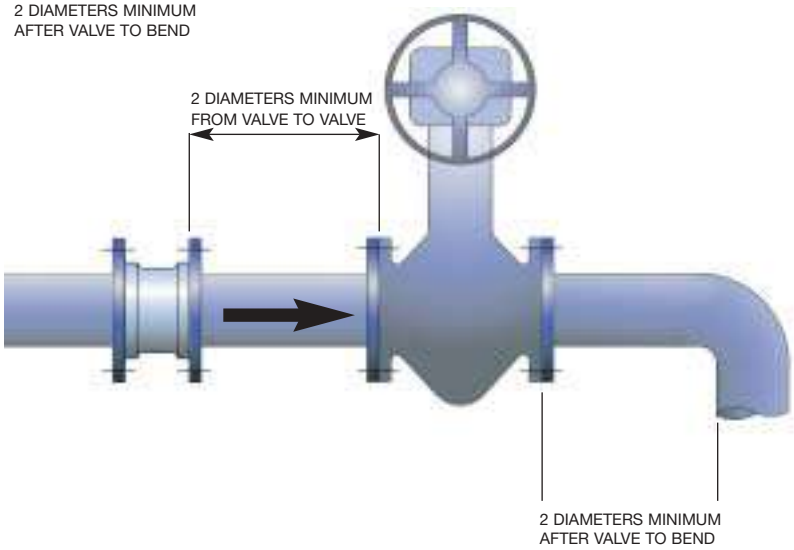


Check valves should be installed a minimum of 5 diameters upstream of a reducer or bend to avoid choked flow preventing full opening of the check valve.





If isolating valve is throttling, check valves should be installed as shown. Check valves may be installed adjacent to non-throttling valves, ie close coupling.



Check valves may be installed on the upstream of isolating valves.
If downstream valve is throttling, clearance as shown should be allowed to ensure full pressure recovery after check valve. Check valves may be installed directly on the inlet to the isolating valve if full port fully open. On ball valves disc clearance must be considered to ensure full operation of the ball valve.

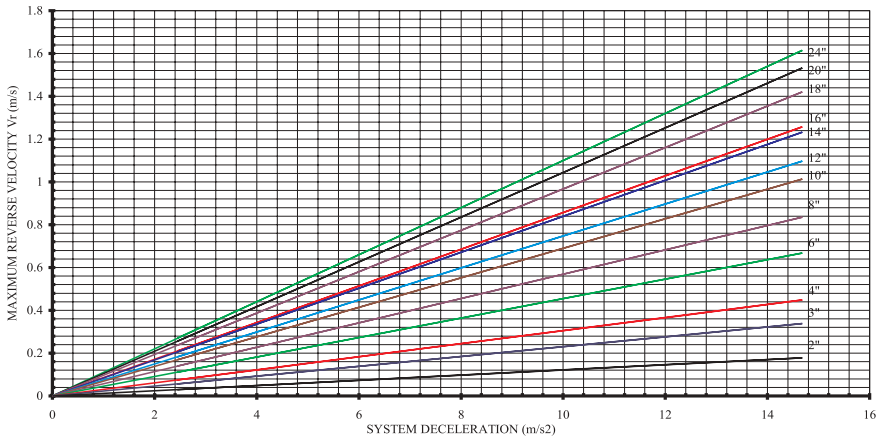
NOTE:
Goodwin check valves are not pigable.

Indicates direction of flow.

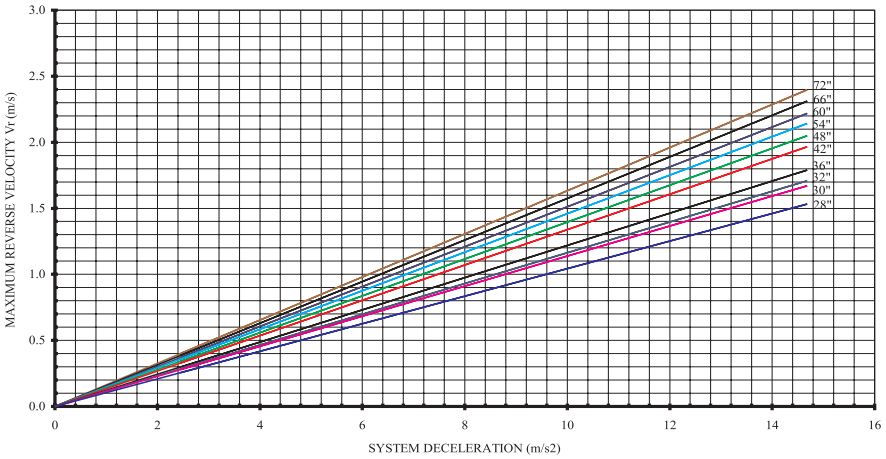
SUPER TORQUE SPRING

DYNAMIC CHARACTERISTICS - FOR WATER AT 60°F

2" to 24" Class 150/300



28" to 72" Class 150/300



◆ 4" – 12" Goodwin Check Valves with Super Torque Springs installed have Dynamic Characteristics similar to, or better than, an equivalent Nozzle Type Non-Slam Check Valve.

◆ 12" and larger Goodwin Check Valves with Super Torque Springs installed have Dynamic Characteristics approximately 20% slower than equivalent Nozzle Type Non-Slam Check Valves but at a fraction of the cost.

◆ Competitors' Dual Plate Check Valves do not exhibit the fast response of the Goodwin Super Torque Valve as they do not have the low weight and low inertia of the slim Goodwin plate design as illustrated on page 41.

◆ Super Torque Springs provide Goodwin Check Valves with good Cv figures. On some sizes Goodwin Check Valves have better Cv values than Nozzle Type Non-Slam Check Valves which cost many times more than Dual Plate Wafer Check Valves.

◆ Maximum Reverse Flow Velocities for a given system deceleration will be reduced for higher pressure Goodwin Check Valves due to the smaller flow area through the valve. This is reflected in a reduced Cv factor as shown on page 36.

◆ Valves are normally supplied with Standard Torque Springs which produce Maximum Reverse Velocities some 30% greater than valves equipped with Super Torque Springs. Customers requiring Super Torque Springs must specify such on their inquiry and order.

◆ The above graphs were produced by extrapolation of results obtained during testing at Delft Hydraulics Laboratory, The Netherlands.

VALVE SIZE (150lb)	VALVE COEFFICIENT (Cv)	
	GOODWIN WAFER CHECK VALVE	TYPICAL NOZZLE CHECK VALVE
6"	900	1250
8"	1589	1800
10"	3300	2800
12"	3926	4000
16"	8256	7500
20"	14251	13000
24"	26511	16100

ANTI PRESSURE SURGE (for ANSI 150lb and 300lb valves)

A DESIGN FOR SEVERE PUMP AND COMPRESSOR APPLICATIONS

In compressor and pump applications where pressure surge and water hammer problems are anticipated, correct check valve selection is critical. Historically, process and piping engineers when confronted with high system decelerations have invariably selected the large size, high weight and, consequently, high cost nozzle check valve. To a lesser extent, the damped swing check valve or swing check valve with bypass is occasionally used in such instances but these, likewise, suffer from high cost, size and weight and are, generally, a maintenance problem.

Goodwin can calculate and determine the dynamic performance of its check valves for given system decelerations. Where the demands of the application are beyond the capabilities of a standard Goodwin check valve, Goodwin will employ its APS# device. The APS device extends the suitability of the Dual Plate Check Valve into those pump and compressor applications which have previously been in the domain of the nozzle check valve.

APS stands for Anti Pressure Surge and is effected in the Goodwin Dual Plate Check Valve by fitting a pressure-sensitive flow-relieving valve in each plate. Essentially, the APS consists of a large piston valve held closed by Belleville washers whose pre-set load will not allow flow through the piston valve from the downstream side of the check valve until the downstream pressure exceeds by 10% the maximum static flow pressure on the downstream side of the valve.

The main function of the APS is not to relieve high pressure but to prevent it from occurring in the first place. It does this by allowing flow which releases excess pressure energy from the downstream side of the valve as the pressure increases on valve closure to the upstream of the valve thereby avoiding the occurrence of full downstream pressure increase. This downstream pressure increase is caused by the instantaneous halt of the column of fluid when the check valve closes and was determined in 1898 by Joukowsky who formulated the equation:

Pressure rise = speed of sound in the fluid line x Vr max x the fluid density
(where Vr max is the maximum reverse velocity of the fluid and is a function of the system deceleration and check valve type.)

Tests carried out at the Delft Hydraulics Laboratory in The Netherlands recorded a 40% reduction in the Joukowsky pressure that would have been seen in any check valve not fitted with APS had the same reverse flow velocity occurred and is little more than is experienced with the nozzle check valve.

The cost effective solution

By utilizing the Dual Plate Check Valve fitted with APS the piping engineer avoids the following problems:

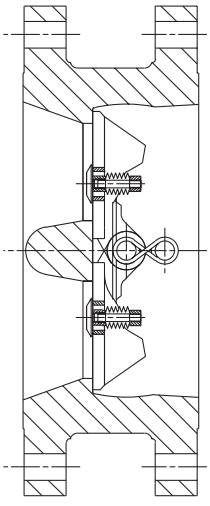
a) The higher pressure drops generally experienced in Nozzle Type Check Valves.
b) The size and weight penalty of the Nozzle and damped Swing Check Valves.
c) The very severe cost penalty (often 250 % to 300 % and more) of the Nozzle and Swing Check Valves.

The APS can be fitted in all Goodwin Check Valves 12" and larger. Goodwin requires the following data to establish if its check valve should be fitted with the APS device to meet the demands of its application:

Valve Size & Pressure Class
Fluid
Phase of fluid – gas or liquid
Flowrate
Fluid Density
Line Operating Pressure
Temperature
Line Velocity
System Deceleration
Downstream pressure in the no flow condition, i.e. when the plates are closed

For further information see the brochure: "Comparative Data" for Goodwin Dual Plate Check Valve fitted with Anti Pressure Surge Device.

Patent applied for.



Schematic of a 32" 150lb Valve with APS.

32" ANSI 150lb Dual Plate Check Valve with APS, as viewed from valve upstream side.

32" ANSI 150lb Dual Plate Check Valve with APS, as viewed from valve downstream side.

CHECK VALVE SELECTION BASED UPON SYSTEM DECELERATION CHARACTERISTIC

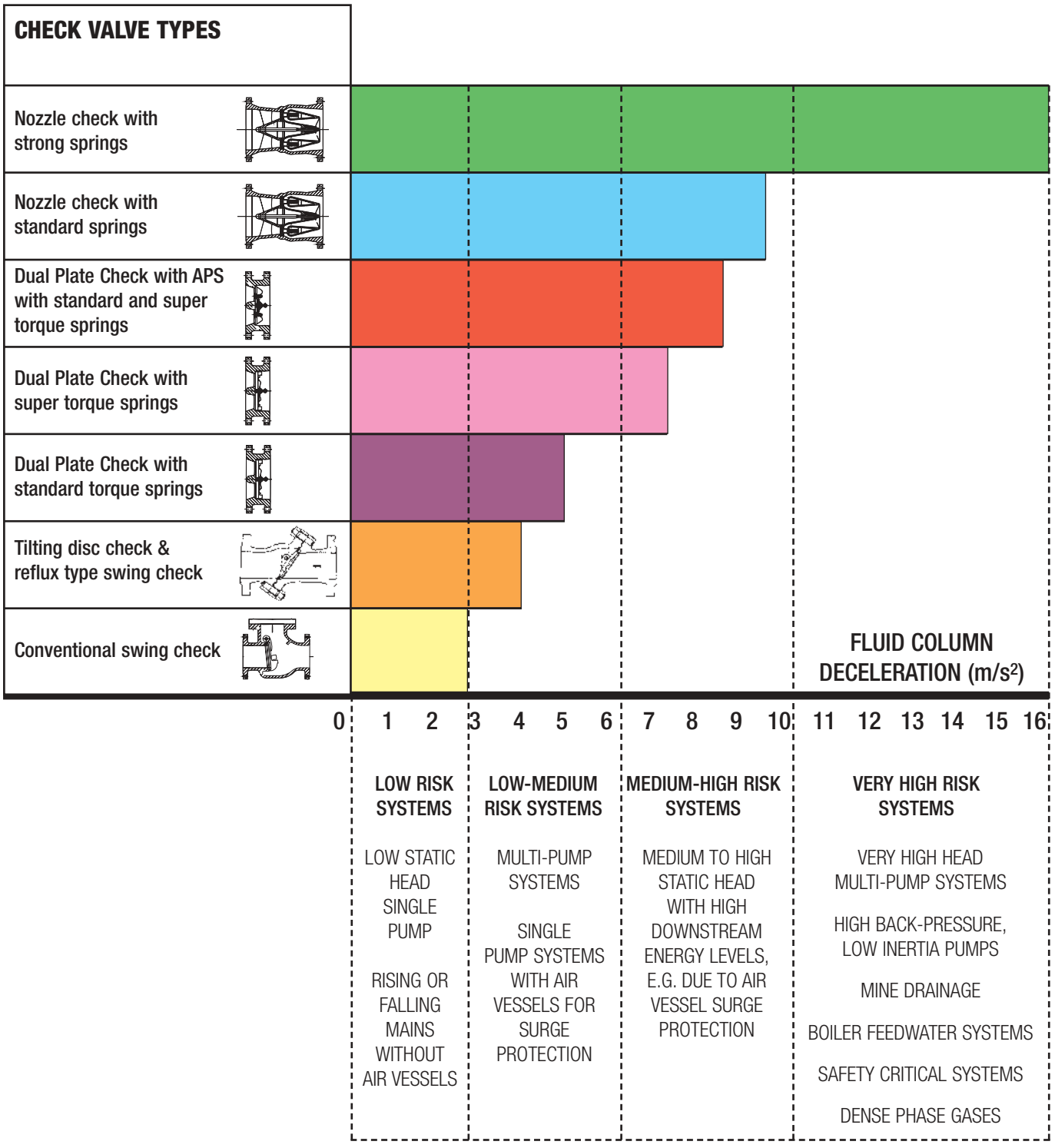
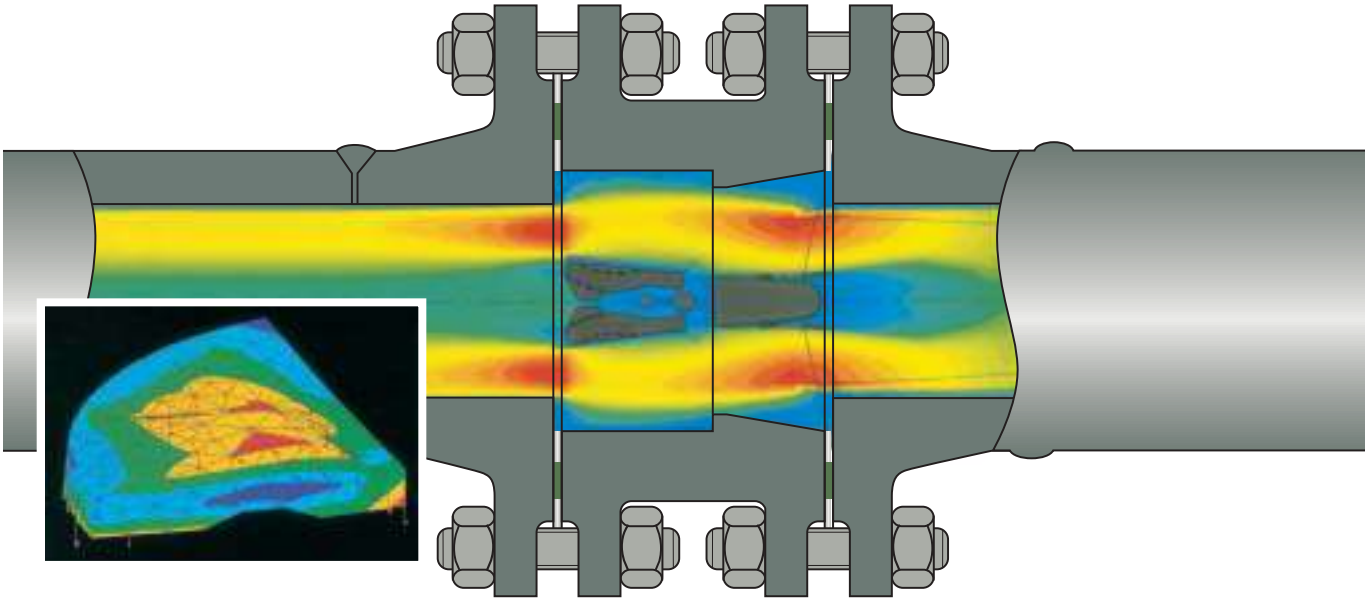


PLATE DESIGN & ATTRIBUTES



By taking advantage of recent advances in computer technology and combining the results of *FLUENT flow modelling and †ANSYS Finite Element Stress Analysis, Goodwin has been able to design a Dual Plate Wafer Check Valve that has a higher performance than had previously been developed.

The Goodwin Valve has a significantly lower pressure drop on high pressure valves than has been achieved before. This improvement has been secured by using a unique plate (Pat) which exhibits differential stiffness, while other areas remain rigid.

The success of this plate design has permitted our designers to maintain almost the same “D” throat area across the pressure range for any given size of valve. For example, when comparing throat areas with those of another leading manufacturer the Goodwin valve was found to have areas as much as 25% greater, giving the obvious benefits of increased flow and lower pressure drop. The benefit of the increased flow area is further enhanced on the outlet side of the valve where the Goodwin slim plates in the fully open position offer dramatically less restriction to flow as depicted in the adjacent photographs.

The Goodwin plate, by virtue of its design, has a lower mass; typically a Goodwin ANSI 2500lb plate weighs less than other suppliers ANSI 300lb plates. This factor decreases both the inertia of the plates and the friction at the plates hinges providing an opportunity to improve the valve response time.

The valve has been tested at Delft Hydraulics Test Laboratories in The Netherlands and independent comparative tests using the Goodwin valve and a valve from another major international Dual Plate Check Valve manufacturer were carried out. The results show that the Goodwin design has a significantly lower pressure drop for a given flow and valve size than the other manufacturer’s valve.

There are vast benefits for users of Goodwin’s design because of its reduction in the operating costs normally associated with energy losses and reduced output in high velocity oil and gas flow line production facilities. The Goodwin valve opens up opportunities for operating companies to develop “best value” solutions for their cost reduction programs.

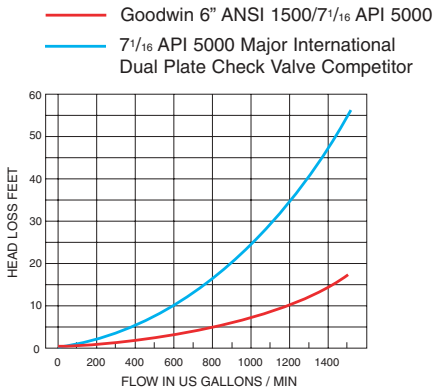
* FLUENT is a registered trademark of Fluent Inc., USA.
† ANSYS is a registered trademark of Swanson Analysis Systems.
(Pat) = Patented Internationally.

Flow area as viewed from bar end.

▲ Goodwin
▼ 6" ANSI 1500/7$^{1}/_{16}$ API 5000

▲ Major Competitor
▼ 6" ANSI 1500

Flow area as viewed through flange on outlet side of valve.



TOTAL LIFE COSTS

Energy savings provided by superior valve design and performance in terms of reduced pressure drop in the valve can exceed the valve original purchase price many times over.

Many valve manufacturers only give Cv values (the water flow at 60˚F in Usgpm at 1 psi drop) for the lower pressure class of valves, eg: ANSI 150 class. This avoids acknowledging higher head losses in their non-optimised designs in the higher pressure classes where, historically, valves have greater resistance to flow due to smaller bores and greater section thickness of internal components.

Goodwin's design pays special attention to the reduction of head loss in higher pressure valves. Operating cost comparisons may be drawn against competitors' valves with a difference in head loss for a given flow.

THEORY

For calculating the savings associated with reduced head loss in a valve:

$$\text{Hydraulic horse power (HP)} = \frac{\text{Head difference (ft) x wt (lb) of liquid per minute}}{33{,}000}$$

$$\text{Hydraulic Power (Kw)} = \text{Hydraulic HP x } 0.746$$

The cost of electricity per KwHr x running period (Hr) = cost saving

An example of this may be seen from Diagram 1 on Page 7, which depicts tests that have been carried out comparing two $7^{1}/_{16}$"API 5000 check valves which demonstrates that at 1000 USgpm there is a head loss difference of 17ft.

Hence: Difference in head =17.0 ft
Flow = 1,000 Usgpm
Weight, if water = 8.338 lb/US gall
Running period = 24 hrs x 365 days/year
Assumes cost of electricity = 5 cents/KwHr

Reduced theoretical running costs by utilising the Goodwin high performance Dual Plate Wafer Check Valve:

$$17 \times 1{,}000 \times 8.338 \times 24 \times 365 \times 0.05 \times \frac{1}{33{,}000} \times 0.746$$

= US$ 1,403 saving per year

PRACTICE

The practical saving is even greater as shown by the graph below with curves for a typical single stage centrifugal pump. The system curve or hydraulic gradient of the piping system will depend upon the pipe friction losses and head losses across components such as check valves.

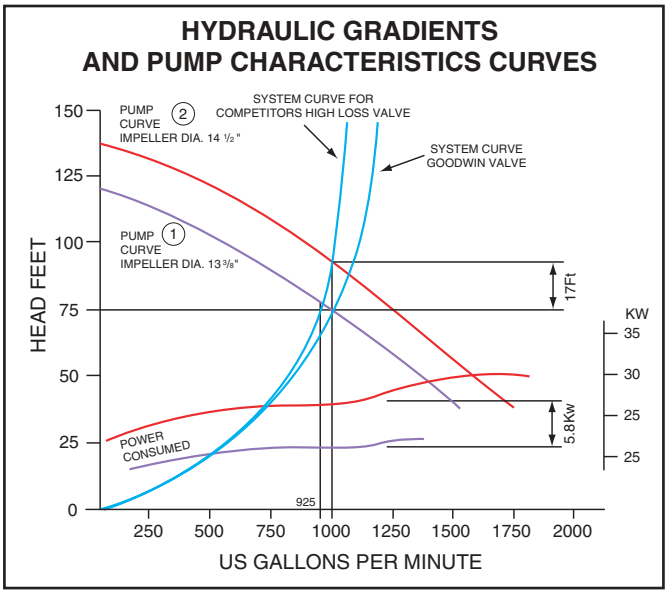
A typical piping system hydraulic gradient with a low head loss check valve is shown by the Goodwin system curve below. The installed pump shown by head/flow curve (1) produced a flow of 1,000 Usgpm corresponding to the system head of 75ft.Had the competitors' high head loss check valve with additional head loss of 17ft been selected, as shown by the high loss valve system curve, it would have been necessary to increase the pump impeller diameter or speed to give a head/flow curve (2) in order to maintain the same flow of 1,000 Usgpm. This would require an extra 5.8 Kw absorbed by the pump motor, having allowed for pump and motor efficiency.

$$\text{Extra electrical motor power (Kw)} = \frac{\text{Hydraulic HP x } 0.746}{\text{Pump efficiency x motor efficiency}}$$

If one takes an arbitrary price of electricity of 5 cents/KwHr over a year, the actual cost is an extra US$ 2,540/year in running costs to produce the desired flow.

Alternatively, if the original pump impeller and speed are unchanged, the flow would drop to 925 USgpm resulting in a loss of 75 Usgpm which, were this crude oil at an arbitrary price of US$ 13/barrel, would represent a loss of revenue of over US$ 30,000/day.

Savings in high flow situations can be substantial and achieved by selecting check valves with lower head loss.



FIRETESTED DUAL PLATE CHECK VALVES

There is an increasing demand by oil company majors for soft seated check valves to be approved and certified firesafe for use in some hydrocarbon service applications. For example, on oil and gas production platforms and in Liquefied Natural Gas (LNG) plants. Two such projects to which Goodwin has supplied where firetest approved and certified designs were mandatory were Amerada Hess' South Arne (Denmark) gas production platform and valves installed in the gas transmission system of the Nigeria LNG (viz. Shell) Bonny Island LNG export facility.

Goodwin International has had firetested by an independent facilty and witnessed by Lloyds Register of Shipping a number of rubber seated valves. The basis of the testing is the valve being subjected to a 30 minute "burn" during which time the soft seat is partially or totally destroyed. During the "burn" and later, after cooling, the leakage across the valve is measured and has to meet specific requirements.

Goodwin is approved and certified firesafe for all sizes in pressure classes ANSI 150 to ANSI 900. The valves tested met the performance requirements stated in the following standards:

BS 6755 Part 2 1987: Testing of Valves
Specification for fire type-testing requirements

API 6FA 2nd Edition 15th February 1994
Specification for Firetest for Valves

API 6FD 1st Edition 15th February 1995
Specification for Fire Test for Check Valves

16" 600 lb BFR Flanged Check Valve undergoing firetest

For a firesafe installation many oil company specifications insist on flanged or solid lug valves in hydrocarbon service. With wafer type valves with exposed long bolting, in the event of fire, these bolts would be subject to direct flame impingement which would then lead to bolt expansion and subsequent "dropping" of the valve. The line fluid would then feed the fire. With solid lug and flanged designs this problem is avoided.

Many companies specify and use wafer type valves in hydrocarbon service preferring, where deemed necessary, to protect the bolting by other means such as bolt shrouds and fireshields.


Score (Europe) Limited

Fire Test Certificate

FIRETEST COVERAGE MATRIX

ANSI RATING /SIZE	150	300	600	900
2"	TEST (Report No 71997-1)		TEST (Report No 71997-2)	
3"	COVERED		COVERED	
4"				
6"	TEST (Report No 71997-3)		TEST (Report No 71997-4)	
8"				
10"	COVERED		COVERED	
12"				
14"	TBC		TBC	
16"	TEST (Report No 71997-5)		TEST (Report No 71552-1)	
AND				
ABOVE	COVERED		COVERED	

LARGE DIAMETER CHECK VALVES

Goodwin specializes in the manufacture of large diameter valves, being capable of manufacturing valves to 144" diameter in all materials and relevant pressure classes.

Applicable Flange Standards

26" – 60": ANSI B16.47 Series A
(superseded MSS-SP 44)
ANSI B16.47 Series B
(superseded API 605)

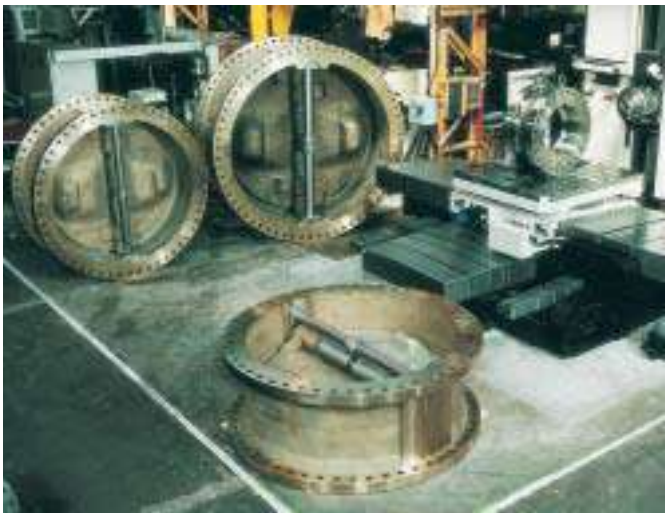
66" – 144": AWWA C207 Class E

With its in-house foundry and pattern shop, Goodwin is able to closely control the quality and integrity of these very large valve castings.

Often the larger valves are supplied into water applications. Typical materials of construction are Ni-Resist Iron; Rubber lined Carbon Steel, Aluminium Bronze, Duplex Stainless Steel and CF8M Stainless Steel. Goodwin can supply these materials and others as listed on page 5.

52" 150lb Dual Plate Check Valve

84" 150 lb valve undergoing hydrotest in Goodwin factory



Two 66" 150 lb and one 84" 150 lb Check Valves in Aluminium Bronze

The two photographs above show valves supplied to Ibn Rushd (SABIC) for the Utilities Plant at its PTA & Aromatics Complex in Yanbu, Saudi Arabia. The 84" is installed on the seawater Intake line and a total of three 66" valves are installed on the seawater discharge pumps.

Many large diameter valves are required in Desalination plants where Goodwin has gained extensive experience. With these plants seawater is converted into potable water. Stagnant seawater poses significant corrosion problems if the correct materials are not selected. Goodwin recommends the use of Inconel 625 spring in both stagnant seawater and oxygenated brine applications.

ANSI PRESSURE / TEMPERATURE RATINGS

MAXIMUM NON-SHOCK PRESSURE TEMPERATURE RATINGS (Standard Class)

Temperature Degrees F	150lb SERIES						300lb SERIES						600lb SERIES						900lb SERIES					
	ASTM A216 WCB	ASTM A105	ASTM A352 LCB	ASTM A352 LCC	ASTM A350 LF2	ASTM A217 WC6	ASTM A216 WCB	ASTM A105	ASTM A352 LCB	ASTM A352 LCC	ASTM A350 LF2	ASTM A217 WC6	ASTM A216 WCB	ASTM A105	ASTM A352 LCB	ASTM A352 LCC	ASTM A350 LF2	ASTM A217 WC6	ASTM A216 WCB	ASTM A105	ASTM A352 LCB	ASTM A352 LCC	ASTM A350 LF2	ASTM A217 WC6
-20 to 100	285	285	265	290	285	290	740	740	695	750	740	750	1480	1480	1390	1500	1480	1500	2220	2220	2085	2250	2220	2250
200	260	260	250	260	260	260	675	675	655	750	675	710	1350	1350	1315	1500	1350	1425	2025	2025	1970	2250	2025	2135
300	230	230	230	230	230	230	655	655	640	730	655	675	1315	1315	1275	1455	1315	1345	1970	1970	1915	2185	1970	2020
400	200	200	200	200	200	200	635	635	620	705	635	660	1270	1270	1235	1410	1270	1315	1900	1900	1850	2115	1900	1975
500	170	170	170	170	170	170	600	600	585	665	600	640	1200	1200	1165	1330	1200	1285	1795	1795	1745	1995	1795	1925
600	140	140	140	140	140	140	550	550	535	605	550	605	1095	1095	1065	1210	1095.0	1210	1640	1640	1600	1815	1640	1815
700	110	110	-	110	-	110	535	535	-	570	-	570	1065	1065	-	1135	-	1135	1600	1600	-	1705	-	1705
800	80	80	-	-	-	80.0	410	410	-	-	-	510	825	825	-	-	-	1015	1235	1235	-	-	-	1525
900	-	-	-	-	-	50	-	-	-	-	-	450	-	-	-	-	-	900	-	-	-	-	-	1350
1000	-	-	-	-	-	20	-	-	-	-	-	225	-	-	-	-	-	445	-	-	-	-	-	670

Pressures in p.s.i

Temperature Degrees F	150lb SERIES						300lb SERIES						600lb SERIES						900lb SERIES					
	ASTM A217 C5	ASTM A217 C12	ASTM A351 CF8M	ASTM A351 CF8C	UNS S31803	ASTM A494 CW6MC 625 ALLOY*	ASTM A217 C5	ASTM A217 C12	ASTM A351 CF8M	ASTM A351 CF8C	UNS S31803	ASTM A494 CW6MC 625 ALLOY*	ASTM A217 C5	ASTM A217 C12	ASTM A351 CF8M	ASTM A351 CF8C	UNS S31803	ASTM A494 CW6MC 625 ALLOY*	ASTM A217 C5	ASTM A217 C12	ASTM A351 CF8M	ASTM A351 CF8C	UNS S31803	ASTM A494 CW6MC 625 ALLOY*
-20 to 100	290	290	275	275	290	261	750	750	720	720	750	675	1500	1500	1440	1440	1500	1350	2250	2250	2160	2160	2250	2025
200	260	260	240	245	260	234	750	750	620	635	720	675	1500	1500	1240	1270	1440	1350	2250	2250	1860	1910	2160	2025
300	230	230	215	225	230	207	730	730	560	590	665	657	1455	1455	1120	1175	1330	1310	2185	2185	1680	1765	1995	1967
400	200	200	195	200	200	180	705	705	515	555	615	635	1410	1410	1030	1110	1230	1269	2115	2115	1540	1665	1845	1904
500	170	170	170	170	170	153	665	665	480	520	575	599	1330	1330	955	1035	1150	1197	1995	1995	1435	1555	1730	1796
600	140	140	140	140	140	126	605	605	450	490	555	545	1210	1210	905	985	1115	1089	1815	1815	1355	1475	1670	1634
700	110	110	110	110	-	99	570	570	430	470	-	513	1135	1135	865	935	-	1022	1705	1705	1295	1405	-	1535
800	80	80	80	80	-	72	500	510	415	455	-	459	995	1015	830	910	-	914.0	1490	1525	1245	1370	-	1373
900	50	50	50	50	-	45	355	450	395	430	-	405	705	900	790	865	-	810	1060	1350	1180	1295	-	1215
1000	20	20	20	20	-	18	190	290	365	365	-	329	385	585	725	725	-	653	575	875	1090	1090	-	981

Pressures in p.s.i

Temperature Degrees F	1500lb SERIES						2500lb SERIES						1500lb SERIES						2500lb SERIES					
	ASTM A217 C5	ASTM A217 C12	ASTM A351 CF8M	ASTM A351 CF8C	UNS S31803	ASTM A494 CW6MC	ASTM A217 C5	ASTM A217 C12	ASTM A351 CF8M	ASTM A351 CF8C	UNS S31803	ASTM A494 CW6MC	ASTM A216 WCB	ASTM A105	ASTM A352 LCB	ASTM A352 LCC	ASTM A350 LF2	ASTM A217 WC6	ASTM A216 WCB	ASTM A105	ASTM A352 LCB	ASTM A352 LCC	ASTM A350 LF2	ASTM A217 WC6
-20 to 100	3750	3750	3600	3600	3750	3375	6250	6250	6000	6000	6250	5625	3705	3705	3470	3750	3705	3750	6170	6170	5785	6250	6170	6250
200	3750	3750	3095	3180	3600	3375	6250	6250	5160	5300	6000	5625	3375	3375	3280	3750	3375	3560	5625	5625	5470	6250	5625	5930
300	3640	3640	2795	2940	3325	3276	6070	6070	4660	4900	5540	5463	3280	3280	3190	3640	3280	3365	5470	5470	5315	6070	5470	5605
400	3530	3530	2570	2770	3070	3177	5880	5880	4280	4620	5120	5292	3170	3170	3085	3530	3170	3290	5280	5280	5145	5880	5280	5485
500	3325	3325	2390	2590	2880	2993	5540	5540	3980	4320	4800	4986	2995	2995	2910	3325	2995	3210	4990	4990	4850	5540	4990	5350
600	3025	3025	2255	2460	2785	2723	5040	5040	3760	4100	4640	4536	2735	2735	2665	3025	2735	3025	4560	4560	4440	5040	4560	5040
700	2840	2840	2160	2340	-	2556	4730	4730	3600	3900	-	4257	2665	2665	-	2840	-	2840	4440	4440	-	4730	-	4730
800	2485	2540	2075	2280	-	2286	4145	4230	3460	3800	-	3807	2060	2060	-	-	-	2540	3430	3430	-	-	-	4230
900	1765	2245	1970	2160	-	2021	2945	3745	3280	3600	-	3371	-	-	-	-	-	2245	-	-	-	-	-	3745
1000	960	1460	1820	1820	-	1638	1600	2430	3030	3030	-	2727	-	-	-	-	-	1115	-	-	-	-	-	1860

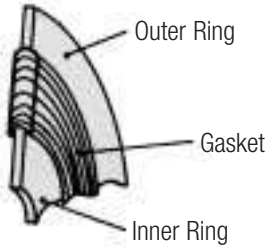
(*) Extrapolations from materials with similar CR/NI/MO content

MATERIAL SPECIFICATIONS

	ASTM GRADE	MATERIAL DESCRIPTION	UNS DESIGNATION	MIN UTS (Nmm2)	(ksi)	MIN YIELD (Nmm2)	(ksi)	TYPICAL IMPACT (J)	PREn†	NOMINAL COMPOSITION C	Cr	Ni	Mo	Cu	N	V	W	Nb
	A126 Cl B	Cast Iron	F12102	214	71	-	-	-	-	-	-	-	-	-	-	-	-	-
GENERAL	A216 WCB	Carbon Steel	J03002	485	70	250	36	-	-	0.23	-	-	-	-	-	-	-	-
PURPOSE	A105	Forged Carbon Steel	K03504	485	70	250	36	-	-	0.23	-	-	-	-	-	-	-	-
	B148 C95800	Aluminium Bronze	C95800	640	93	250	36	-	-	-	-	4.5	-	79min	-	-	-	-
	A487 4N/4C	Low Alloy Steel	J13047	620	90	415	60	-	-	0.20	0.5	0.5	0.25	-	-	-	-	-
	A352 LCB	Low Temp Carbon Steel	J03003	450	65	450	35	27@ -46°C(-50°F)	-	0.23	-	-	-	-	-	-	-	-
	A352 LCC	Low Temp Carbon Steel	J02505	485	70	275	40	27@ -46°C(-50°F)	-	0.23	-	-	-	-	-	-	-	-
LOW	A350 LF2	Low Temp Carbon Steel	K03011	485	70	250	36	27@ -46°C(-50°F)	-	0.23	-	-	-	-	-	-	-	-
TEMP	A352 LC3	Low Temp Alloy Steel	J31550	485	70	275	40	27@ -101°C(-150°F)	-	0.10	-	3.5	-	-	-	-	-	-
	A351 CF8M	Cryogenic Stainless Steel	J92900	485	70	205	30	80@ -190°C(-320°F)	27	0.08*	19	10	2.50	-	-	-	-	-
	A351 CF3M	Cryogenic Stainless Steel	J92800	485	70	205	30	80@ -196°C(-320°F)	27	0.03*	19	10	2.50	-	-	-	-	-
	A217 WC6	Chrome Moly Steel	J12072	485	70	275	40	-	-	0.10	1.25	-	0.50	-	-	-	-	-
HIGH	A217 C5	Chrome Moly Steel	J42045	620	90	415	60	-	-	0.10	5.0	-	0.50	-	-	-	-	-
TEMP	A217 C12	Chrome Moly Steel	J82090	620	90	415	60	-	-	0.10	9.0	-	1.00	-	-	-	-	-
	A351 CF8M	Stainless Steel	J92900	485	70	205	30	-	27	0.08*	19	10	2.50	-	-	-	-	-
	A351 CF8C	Stainless Steel	J92710	485	70	205	30	-	20	0.08*	19	10	0.5*	-	-	-	-	8 x C
	A217 CA15	Chrome Stainless Steel	J91150	620	90	450	65	-	-	0.10	13	-	-	-	-	-	-	-
HARD	A487 CA6NM	Low Temp Chrome	J91540	760	110	515	80	-	-	0.03	13	4.5	0.75	-	-	-	-	-
WEARING		Stainless Steel																
	-	Stellite ® 6 (Plates Only)	W73006	0	70	-	-	-	-	1.20	28	-	-	-	-	-	5	Cobalt
	A351 CF8M	Stainless Steel	J92900 S31600	495	70	205	30	-	27	0.08*	19	10	2.5	-	-	-	-	-
	A890 4A	22% Chrome Duplex	S31803 J92205	620	90	415	60	45 @ -40°C (-40°F)	34	0.03*	22	5.5	3	-	0.15	-	-	-
	-	Ferralium ® 255-3SC	S32550	720	105	450	65	45 @ -40°C (-40°F)	39	0.08*	25	6	3.5	2	0.2	-	-	-
	-	Super Duplex	S32760 J93380	725	105	450	65	-	41	0.03*	25	7.5	3.5	0.75	0.25	-	0.75	-
	A351:CK3MCuN	Super Austenitic	S31254	550	80	260	38	-	44	0.025*	20	18	6.5	0.75	0.2	-	-	-
CORROSION	-	High Nickel 825	N08825	425	62	170	25	-	-	0.03	21	41	3	2	-	-	-	0.9
RESISTANT	A494:CW-6MC	High Nickel 625	N06625	485	70	275	40	-	-	0.03	21	62	9	-	-	-	-	3.5
MATERIAL	A494:CW-12MW	Hastelloy ® C276	N10276	495	72	275	40	-	-	0.03	16	57	17	-	-	0.35	4	-
	A494:N-7M	Hastelloy ® B2	N10665	525	76	275	40	-	-	0.03	1*	67	32	-	-	-	-	-
	A494:CX2MW	Hastelloy® C22	N06022	550	80	280	45	-	-	0.02*	22	56	13	-	-	0.3	3	-
	B367C2/B348G2	Titanium	R50400	345	50	275	40	-	-	0.10*	-	-	-	-	-	-	-	-

†PREn = Pitting Resistance Equivalent number *=max

GASKETS

PRESSURE	FLAT	SPIRAL WOUND	R.T.J.	OPTIONS
ANSI 125lb	✓	-		 SPIRAL WOUND GASKET
ANSI 150lb	✓	✓ †	-	
ANSI 300lb	✓	✓ †	-	
ANSI 600lb	-	✓ †	✓	
ANSI 900lb	-	✓ *	✓	 RING TYPE JOINT
ANSI 1500lb	-	✓ *	✓	
ANSI 2500lb	-	✓ *	✓	
API 6A 3000lb	-	-	✓	 FLAT GASKET
API 6A 5000lb	-	-	✓	
API 6A 10000lb	-	-	✓	

† Inner Ring Optional * Inner ring recommended - Not applicable ✓ Suitable

TYPICAL STANDARDS		
FLAT GASKETS	SPIRAL WOUND	RING TYPE JOINTS
ASME B16.21	API 601 / BS3381	ANSI B16.20 / API 6A

List of gasket suppliers:

Flexitallic Inc.
James Walker & Co. Ltd
Standco Industries Inc.
Houston Manfacturing & Speciality Inc.
National Gasket Co.

VALVE BOLTING*

STUDS

BOLT GRADE INCH	ALLOY TYPE	TYPICAL DUTY	MIN TEMP. °F	MAX TEMP °F	TENSILE STRENGTH T/Inch^2	YIELD STRENGTH 0.2% PROOF STRESS MIN (T/inch^2)	% ELONGATION	HARDNESS HB	LIMITING RULING SECTION (INCH)	NUT GRADES INCH SERIES	CONDITION AND HEAT TREATMENT
-	-	General Purpose	-4	572	26	-	-	-	-	Carbon Steel	-
BL L7	1% Chromium molybdenum steel	General Purpose	-148	752	56 51	47 43	14 14	248/335 223/310	2.5 4	2H 4. 7 or 8 (L4, 7 or 8 with L7 bolts)	Hardened and tempered Harden 1562°F to 1616°F Temper 1112°F min.
B7A	1% Chromium-molybdenum steel (higher mo)	General Purpose	32	842	56	47	13	248/335	4	2H 4. 7 or 8	Hardened and tempered Harden 1562°F to 1652°F OQ Temper 1112°F
B6	12% Chromium steel	Hard wearing General Purpose	32	932	50 42	38 32	15	185/272 223/310	1.5 4	6 or 8 6F or 8F	Hardened and tempered Harden 1742°F to 1868°F OQ or AC. Temper 1112°F min.
B16	1% Chromium-molybdenum-vanadium steel	General Purpose Mid Temp	32	968	56	47	13	248/335	4	4, 7 or 8	Hardened and tempered Harden 1706°F to 1778°F OQ Temper 1112°F
B16A	1% Chromium-molybdenum-vanadium boron steel	General Purpose Mid Temp	32	1049	55	43	13	248/335	4	7 or 8	Hardened and tempered Harden 1778°F to 1868°F OQ or WQ. Temper 1202°F min.
B8 L8 B8X L8X	Austenitic chromium-nickel 18/8 type steel	Cryogenic High Temp	-418	1057	35 56	13.5 45	35 12	183 max. 350 max.	- 0.75	8. 8F 8X, 8FX	Solution treated 1382°F to 2012°F WQ Cold worked after treatment
B8T, L8T B8C, L8C B8TX, L8TX B8CX, L8CX	Stabilized austenitic austenitic chromium-nickel 18/8 type steel	High Temp High Temp High Temp High Temp	-418	1057	35 56	13.5 12	35 12	183 max. 350 max.	- 0.75	8T 8C	Solution treated 1000C to 1100C WQ Cold worked after solution treatment
B8M, L8M B8MX L8MX	Austenitic-chromium-nickel-molybdenum steel	Cryo/High Cryogenic	-418	1112	35 56	13.5 45	35 12	183 max. 350max.	- 0.75	8M	Solution Treated 1832°F to 2012°F WQ Cold worked after treatment
B17B L17B	Precipitation hardening austenitic nickel-chromium steel	Cryogenic	-418	1202	58	38	15	248/341	-	17B	Solution treated and aged 1h at 1778°F to 1814°F OQ or WQ reheat 1328°F for 16h
B8OA L80A	Precipitation hardening nickel-chromium-titanium-aluminium alloy	High Temp	-418	1382	65	40	15	285/360	-	80A	Solution treated and aged 8h at 1916°F AC 16h at 1292°F AC

NUTS

NUT GRADE IDENTIFICATION SYMBOL	ALLOY TYPE	TYPICAL MIN TEMP °F	TYPICAL MAX TEMP °F	TYPICAL CONDITIONS AND HEAT TREATMENT	HARDNESS HB
2H	Carbon Steel	32	842	Hardened and Tempered. Harden 1580°F Temper 752°F min.	248/352
4. L4	Carbon-molybdenum	-148	968	Hardened and Tempered. Harden 1616°F Temper 1022°F min.	248/352
7	1% Chromium-molybdenum steel	32	1067	Hardened and tempered. Harden 1562°F to 1616°F OQ Temper 1112°F min.	248/352
6, 6F	12% Chromium steel molybdenum steel	32	1067	Hardened and tempered. Harden 1796°F to 1832°F OQ or AC Temper 1112°F min.	223/310
8, 8F 8. 8FX	Austenitic-chromium nickel 18/8 type steel	- 418	1067	Solution Treated 1832°F to 2012°F WQ Cold Worked After Solution Treatment	183 m 350 ma
8T 8C 8TX, 8CX	Stabilized Austenitic Chromium-nickel18/8 type steel	- 418	1067	Solution Treated 1832°F to 2012°F WQ Cold Worked After Solution Treatment	183 max 350 max
8M 8MX	Austenitic-chromium nickel molybdenum steel	- 418	1112	Solution Treated 1832°F to 2012°F WQ Cold Worked After Solution Treatment	183 max 350 max
17B	Precipitation Hardening Austenitic Nickel-Chromium steel	- 418	1112	Solution Treated and aged 1hr at 1778°F to 1814°F OQ or WQ. Reheat 1328°F got 16 hrs.	248/341
80A	Precipitation Hardening Nickel-chromium Aluminimum Alloy	- 418	1382	8 hrs at 1976°F AC 16 hrs at 1282°F AC	285/360

*Will not be supplied unless specifically stated on inquiry and order

GOODWIN FACILITIES & RESOURCES

CAD facilities in Goodwin design office

Goodwin's Check Valve manufacturing facilities in Stoke-on-Trent, England, comprise a Steel and Super Nickel alloy foundry (Goodwin Steel Castings) and a well equipped CNC machine shop with full design, fabrication, inspection and test facilities (Goodwin International). The ISO 9001 foundry specialises in producing high integrity pressure vessel castings from a few pounds to 7 tons in weight. The materials cast by the foundry are detailed on page 46 of the catalogue and include carbon and low alloy steels, stainless steels, duplex stainless steels and super nickel alloys such as Hastelloy® and Alloy 625. Goodwin's ability to produce the special alloys is enhanced by their in-house 8 ton AOD refining furnace.

The design, machine and assembly shops cover some 80,000 square feet and are equipped with 14 modern CNC machine tools that are the core of the production and are supplemented by many conventional machine tools.

The test facilities include five hydraulic hydrostatic test rigs, the largest of which has a 2500 ton hydraulic ram and can test valves up to 60". Cryogenic testing is also carried out on site where valves are submerged in liquid nitrogen at -196 degrees centigrade and leak tested with helium gas.

Valve design is carried out using CAD and is verified on computers utilising finite element analysis - ANSYS. Both the foundry and the design, machining, assembly and test facilities are audited by the British Standards Institute and approved to ISO 9001. (Certificate FM343 and FM13182).

Charging Goodwin Steel Castings 8 ton AOD refining vessel

8 ton arc furnace at Goodwin Steel Castings

Three station CNC vertical borer with live spindle and tool changer

2500 ton hydraulic test rig in Goodwin's Assembly bay

Twin Pallet CNC machining centre with 60 tool changer

Four pallet CNC machining centre with auto tool changer

Cryogenic test facility for helium leak testing

CERTIFICATION & TESTING

A Quality Management System accredited by BSI in accordance with ISO 9001 - ANSI/ASQC Q91 - BS 5750 Pt. 1 is maintained

The Standard GOODWIN Check Valve features:-

- Designed, manufactured, assembled and tested in accordance with Quality Assurance System accredited by BSI to BS EN ISO 9001:1994
- Designed and tested to API 594.
- All bodies, plates and trim material are certified to DIN 50049 3.1B(BS EN 10204 3.1.B) as a minimum.
- All new castings are sample approved by dimensional checks (wall thickness etc.) and radiography, 100% coverage to ASTM E446/E186, Level 2 minimum, or ultrasonic testing to ASTM A609, Level "A".
- Surface finish to MSS SP 55 on cast bodies and plates.
- Traceablilty per melt (not batch of ingot) is maintained throughout all manufacturing processes for bodies, plates and trim.
- All valves are hydrostatically tested (Shell and Seat) to API 598 with unique traceability to certification.
- Firetest approved and certified to BS 6755 Pt2, API 6FA & API 6FD for pressure classes ANSI 150lb to ANSI 900lb
- Additional testing to be specified on the inquiry and Purchase Order.

Extensive in-house testing and laboratory facilities are available including:

- Pressure Testing
- Flow Testing
- Low Temperature (-46°C) and cryogenic temperature (-196°C) Pressure Testing
- Helium Leak Testing (Mass Spectrometer)
- Tensile / Bend / Impact / Hardness Testing
- Corrosion Testing
- Metallography
- Magnetic Particle
- Dye Penetrant
- Ultrasonic Examination
- Radiography
- Chemical Analysis
- Alloy Verification
- Finite Element Analysis

Other examination Methods or Acceptance criteria to comply with the customer's own specification may be substituted if agreed with the Company at the time of quotation.

COMPUTER MODELLING

Goodwin Steel Castings model all cast Valve Bodies on their finite element analysis computer. This computer modelling system develops casting feeding and gating designs that will ensure "right first time" production of high integrity castings, when metal is actually poured. The finite element analysis solidification program includes both thermal analysis and X-ray simulation. It is, therefore possible to predict where defects will occur in a given casting, and engineer them out by adjustment of the riser and gating system on the casting.This optimisation process is a feature of Goodwin Steel Castings' Quality Assurance system, accredited by BSI to BS 5750 pt.1 - ISO 9001. Goodwin Steel Castings was the first steel foundry in Europe to develop and be accredited by BSI (British Standards Institute) for a design system, which gives rise to delivered on time, higher integrity castings, at more competitive prices.

RADIOGRAPHY

Radiography is conducted inhouse using 8 MeV Linear Accelerator X-Ray machine with developing and viewing facilities

Method: ASME V Art 2, or BS 4080, or ANSI B16.34 Annex B

Options: 100% of All castings
100% of 10% of castings
Critical Areas* of All castings
Critical Areas* of 10% of castings

Acceptance: ASME VIII Div 1 App 7, BS 5998 or ANSI B16.34 Annex B

*Critical Areas as defined by ANSI B16.34

The Company's operators / interpreters for all forms of Non-Destructive Testing are qualified to SNT Level2

MAGNETIC PARTICLE/ DYE PENETRANT

Method: MPI ASME V Art 7, BS 6702
or ANSI B16.34 Annex C
DPI ASME V Art 6, BS 6443
or ANSI B16.34 Annex D

Options: 1) 100% of ALL castings/forgings
2) 100% of 10% of castings/forgings
3) 100% of all machined surfaces

Acceptance: MPI ASME VIII Div 1 App 7, BS 5998 or ANSI B16.34 Annex C
DPI ASME VIII Div 1 App 7, BS 5998 or ANSI B16.34 Annex D

ULTRASONIC EXAMINATION

Method: ASME V Art 5, or BS 6208, or ANSI B16.34 Annex E

Options: 1) 100% of ALL castings/forgings
2) 100% of 10% of castings/forgings
3) Critical Areas* of All castings/forgings
4) Critical Areas* of 10% castings/forgings

Acceptance: ASME SA 388, BS 6208 or ANSI B16.34 Annex E

*Critical Areas as defined by ANSI B16.34

CORROSION TESTING & METALLOGRAPHY

- Intercrystaline corrosion
- Strauss and Huey tests
- Crevice corrosion
- Pitting Corrosion
- Typical Standards - ASTM G48, A262, G31, G36
- Ferrite counting
- Phase checks
- Graph size/inclusion counts
- Macro and Micro photography
- Typical Standards - ASTM E562, E112, E45

CHEMICAL ANALYSIS

- 24 channel, direct reading spectrograph. Includes determination of the volatile elements such as carbon, sulphur and nitrogen.
- Carbon/Low alloy steels
- Stainless/Duplex/6Mo steels
- Nickel alloys
- Cobalt alloys

CRYOGENIC TESTING

Goodwin International is capable of pressure testing at temperatures from room 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 at a number of locations on the valve, both internally and externally.

Once temperature has stabilised, the pressure test commences using pure Helium or 99% Helium / 1% Nitrogen mix 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 ANSI 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. For cryogenic service Goodwin manufactures, as standard, its valves with a maximum leakrate of 500cc/minute/ inch bore diameter with Helium at -196°C. Goodwin has selected this maximum leakrate in response to the requirements of 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 a number of the world's prestigious LNG (Liquefied Natural Gas) export projects. 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.

Increasingly, engineering contractors and client companies have ever more stringent specifications whereby the degree of shut-off is now much tighter than has previously been demanded of Dual Plate Check Valves. On a number of LNG projects, in response to customers' design requirements, Goodwin has supplied valves to far lower permissible leakrates than the 500cc/minute/inch bore diameter. Goodwin's ability to meet these more stringent customer shut-off requirements is achievable due to Goodwin's unique and patented pressure sensitive plate design.

Cryogenic Test Facility/Explosion Proof Chamber.

Goodwin has over 20 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 6000psig/414barg.

24"ANSI 150lb Check Valve on Cryogenic Test

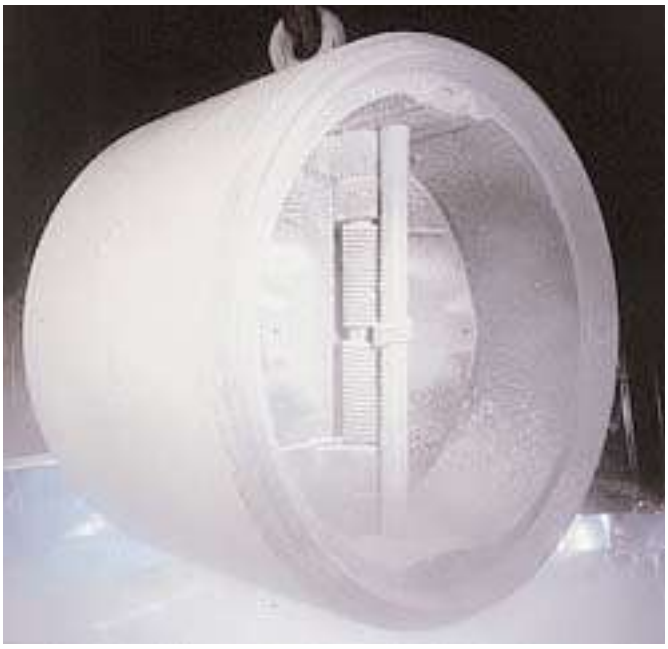
Typical Test Procedures

BS 6364
Shell MESC 77/306

Acceptance Standards

Seat Leakage: API598 - 700 cc/min/inch bore

Outside Leakage (body): Shell MESC 77/306 - zero leakage.



42"ANSI 600# Buttweld end Check Valve after Cryogenic Test with test plates removed.

CERTIFICATION AND APPROVALS

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GCV TEC - 5M - 03