NOREVA GmbH

NOZZLE CHECK VALVES

Technical Catalogue

www.noreva.de

NOREVA
Company History & Overview

The company Noreva GmbH (Non Return Valves) was founded in August 2001 and started with 9 employees who were formerly working for Mannesmann Demag, the inventor of the nozzle check valve 1935.

Noreva has continuously grown and currently has a staff of 55. All of these employees have many years experience with non-slam check valves. With our track record of supply, Noreva has developed an enviable reputation for quality and reliability of product at internationally competitive prices.

Since 2007 Noreva has been part of Goodwin PLC Group.

Noreva is located in the industrial area of Mönchengladbach in Germany. Few valves are sold from stock, the majority of our production is tailor-made to customer specification.

All Noreva non-slam check valves are characterized by non-slam closure, low pressure loss, metal-to-metal sealing and are considered maintenance free.

You will find Noreva check valves all over the world (Average export rate 75%), whether liquid or gaseous fluids, in different applications such as oil pipelines, chemical plants, compressor stations, power plants, water pumping stations, desalination plants, etc.

Noreva GmbH, Moenchengladbach, Germany

Goodwin Steel Castings, Stoke-on-Trent, UK

Goodwin International, Stoke-on-Trent, UK

Contents

NOZZLE CHECK VALVE ADVANTAGES

Energy Saving
Typically, systems are operated at low flow rates to minimise pressure losses and maximise plant efficiencies. To help operators achieve this, Noreva nozzle check valves can be fully open at a flow velocity of 1.5m/s, ensuring minimal pressure drop across the valve.

Non-Slamming
The high economic efficiency of our nozzle check valves is a result of very low pressure losses and the maintenance-free design. Due to short strokes and low moving masses supported by helical springs the valves close slam-free within fractions of seconds.

Maintenance Free
The Noreva Nozzle Check Valve designs use no soft parts. Also as there are no wearing parts, it is considered maintenance free. The springs are sized according to the flow rates to ensure that the valves are in the fully open position during normal use. This minimises cycling of the spring, giving the valves a long design life without regular maintenance.

Horizontal or Vertical
Lightweight discs and spring assisted closure combine to allow the Noreva Nozzle Check Valve to maintain the same high performance regardless of vertical or horizontal installation.

NOREVA, GOODWIN INTERNATIONAL, GOODWIN STEEL CASTINGS

Facilities & Resources

Noreva GmbH's manufacturing plant in Möenchengladbach, Germany, comprises a well equipped manufacturing shop with full design, fabrication, inspection and test facilities. These facilities are complemented by our sister companies Goodwin International Ltd. and Goodwin Steel Castings Ltd. in Stoke-on-Trent, England. Goodwin International comprises a full equipped CNC machine shop and also full design, fabrication, inspection and test facilities. Goodwin Steel Castings is a world class foundry. It was the first steel foundry worldwide to be registered by the British Standards Institution to BS5750 (now BS EN ISO 9001:2008) and is now also accredited to ISO14000:2004 and OHSAS 18000:2007.

Noreva's EN ISO 9001-2008 accredited design, machine, test and assembly bay cover some 7000 m^2. The shop is equipped with conventional machines, the majority of our machining is outsourced to local machine shops.

Valve design is carried out using 3D CAD and is verified utilizing finite element analysis. Our test facilities include 5 hydraulic test rigs for hydrostatic and pneumatic pressure testing. The largest can test valves up to 72".

Noreva has a large conventional liquid coating facility and have just installed and commissioned a state-of-the-art fusion bonded epoxy coating booth to serve the global water market.

Goodwin International

Goodwin International's BS EN ISO 9001-2008 accredited design, machine, test and assembly bays cover some 22,000 m^2. The machine shop is equipped with 36 modern CNC machine tools, including robotic welding, which are the core of the valve production. These are further supplemented by a large number of conventional machine tools.

The test facilities include six hydraulic hydrostatic test rigs, the largest of which has a 2500 tonne 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°C and leak tested with helium gas.

Goodwin Steel Castings

Specialising in producing high integrity pressure vessel castings from a few kilos to 18,000 kg in weight, the materials cast by Goodwin Steel Castings include carbon and low alloy steels, chrome steels, stainless steels, duplex stainless steels and super nickel alloys such as Hastelloy® and Alloy 625. Its ability to produce the special alloys is enhanced by its in-house 10 tonne AOD refining furnace.

CNC vertical lathe

Hydraulic/Pneumatic pressure test bench

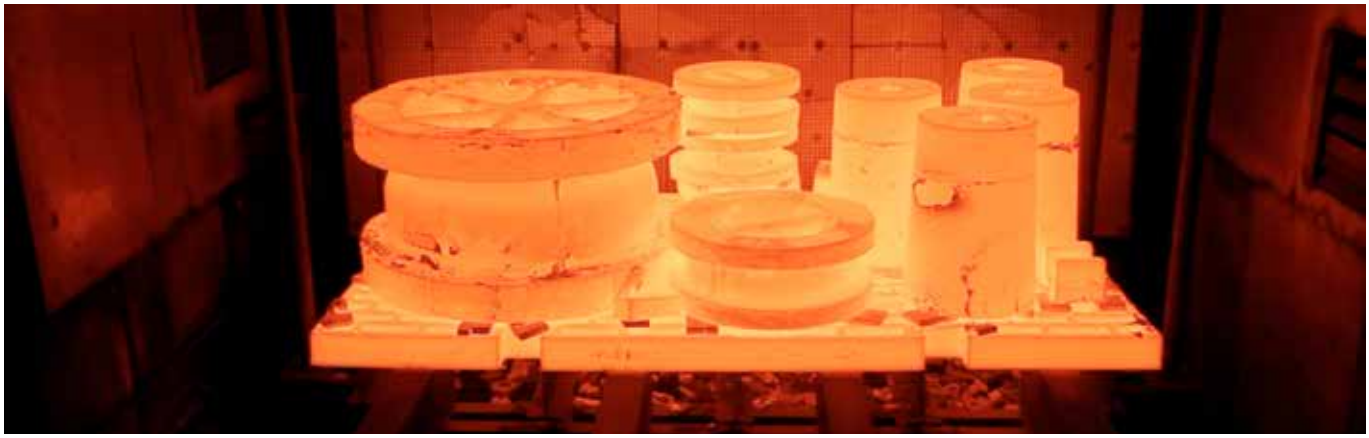
Warehouse

Two station CNC vertical borer with live spindle and tool changer

Cryogenic test facility for helium leak testing

Goodwin Steel Castings models all cast valve bodies using SOLIDWORKS® 3D Modelling. Casting methods are verified, i.e. method verification, using Magmasoft™ software.The Magmasoft™ program includes fluid dynamics, temperature profile, and x-ray simulation to predict where volumetric defects will occur in a given casting. Using this software enables defects to be "engineered out" by developing casting feeding and gating designs to ensure "right first time" production of high integrity castings. This optimisation process is a key feature of Goodwin Steel Castings' Quality Assurance System.

AOD refining allows Goodwin Steel Castings to manufacture castings in a wide range of materials including Carbon, Stainless and Duplex steels and Super Nickel Alloys.



Goodwin Steel Castings have extensive on-site gas fired heat treatment furnaces, with a capacity of 50 tonnes to a temperature of 1,300°C. Cooling can be air, forced air or water quench as shown above.

NOREVA
Certification & Testing

A Quality Management System in accordance with EN ISO 9001:2008 is maintained.

The Standard NOREVA Check Valve features:-

- Designed, manufactured, assembled and tested in accordance with Quality Assurance System EN ISO 9001:2008.
- All bodies and discs certified to EN 10204 3.1 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 components.
- All valves are hydrostatically tested (Shell and Seat) to API 598 with unique traceability to certification.
- Additional testing to be specified on the inquiry and Purchase Order.

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

- Hydrostatic Pressure Testing to 25000 psig (1725 barg)
- High Pressure Gas Testing to 15000 psig (1035 barg)
- Low Temperature (-46°C) and cryogenic temperature (-196°C) Pressure Testing
- High Temperature Pressure Testing to 550°C
- Helium Leak Testing (Mass Spectrometer)
- Tensile / Bend / Impact / Hardness Testing
- Corrosion Testing
- Metallography
- Magnetic Particle
- Dye Penetrant
- Ultrasonic Examination
- Radiography
- Chemical Analysis
- Alloy Verification / Positive Material Identification (PMI)
- Co-ordinate Measuring Machines (CMM)
- Feritscope Verification
- Laser Measurement

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.

Radiography

Radiography is conducted in-group using 9 MeV Linear Accelerator X-Ray machine with developing and viewing facilities.

Method	ASME V Art 2 or ASME B16.34 App 1
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 or ASME B16.34 App 1

*Critical Areas as defined by ASME B16.34

The group's operators for all forms of Non-Destructive Testing are qualified to ASNT Level 2 or PCN Level 2.

Magnetic Particle / Dye Penetrant

Method	MPI to ASME V Art 7 or ASME B16.34 App II DPI to ASME V Art 6 or ASME B16.34 App III
Options	1. 100% of All castings/forgings 2. 100% of 10% of castings/forgings 3. 100% of all machined surfaces
Acceptance	MPI to ASME VIII Div 1 App 7 or ASME B16.34 App II DPI to ASME VIII Div 1 App 7 or ASME B16.34 App III

Magnetic Particle / Dye Penetrant

Ultrasonic Examination

Method	ASME V Art 5 or ASME B16.34 App IV
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 B16.34 App IV

*Critical Areas as defined by ASME B16.34

Ultrasonic Examination

Chemical Analysis

- Routine chemical analysis by one of two optical emission spectrometers: Hilger 28 Channel Spectrometer and ARL 35 channel spectrometer
- Carbon, Sulphur, Nitrogen and Hydrogen determination by a combination of Leco and Eltra combustion analysers
- Oxygen determination by Celox direct measurement
- Portable PMI (Positive Material Identification) by XRF hand held analyser
- Typical material analysed:
  - Carbon/Low Alloy Steels/Chrome Steels
  - Stainless/Duplex/6Mo Steels
  - Nickel alloys
  - Cobalt alloys

Chemical Analysis

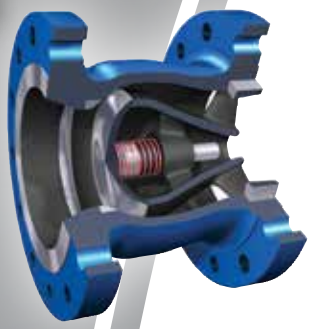
Corrosion Testing & Metallography

- Intercrystalline corrosion
- Strauss and Huey tests
- Crevice corrosion
- Pitting corrosion
- Typical Standards - ASTM G48, A262, G31, G36, A923
- Ferrite counting
- Phase checks
- Grain size/inclusion counts
- Macro and Micro photography
- Typical Standards - ASTM E562, E112, E45

Corrosion Testing & Metallography

NOZZLE CHECK VALVES
Valve Type Specifications

ZB



Type Z

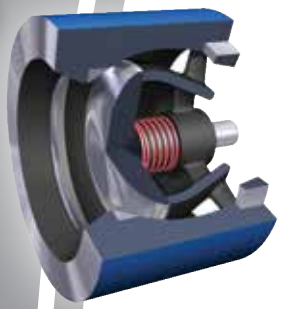
Size range: 1" - 10" (DN 25 - DN 250)
Pressure Class: PN 10 - PN 400, ASME 150 - ASME 4500, API 2000 - API 20000

- Non-slam closure
- Choice of face-to-face length
- Low pressure loss
- Low weight
- Metal sealing
- Maintenance free

The axial design allows for a streamlined flow path around the disc and high pressure recovery, minimising pressure drop across the valve. This efficient design combined with the highly responsive non-slam operation make this valve ideal for high head, critical pump applications.

Type ZB - The ZB is the standard valve for sizes 1" - 10". Its optimum designed aerodynamic flow path through the valve results in very low pressure losses. It is also available with API 6D face-to-face dimensions (ZD).

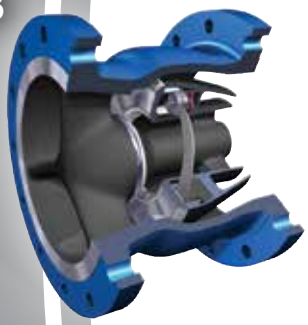
ZS



Type ZS - With a shorter face-to-face (wafer type) than the ZB and where pressure loss across the valve is not such a significant consideration, the ZS is installed where space and weight is at a premium. This type is only available on special request.

The Z range is suitable for all kinds of liquid and gaseous fluids and all installation positions.

NB



Type N

Size range: 12" - 88" (DN 300 - DN 2200)
Pressure Class: PN 10 - PN 400, ASME 150 - ASME 4500, API 2000 - API 20000

- Non-slam closure
- Friction-free valve disc guiding
- Choice of face-to-face length
- Very low pressure loss
- Maintenance free
- Metal sealing
- Low weight

The unique ring disc design ensures that the disc remains light and responsive even in large sizes, which is essential for rapid non-slam closure. Mounted on a multiple spring and radial guide assembly, the disc moves freely without the frictional forces. Combining two ring-shaped annular flow paths with the excellent pressure recovery properties provided by the diffuser, the minimal pressure drop across the Type N valves gives lifetime energy savings when compared to more conventional check valve designs.

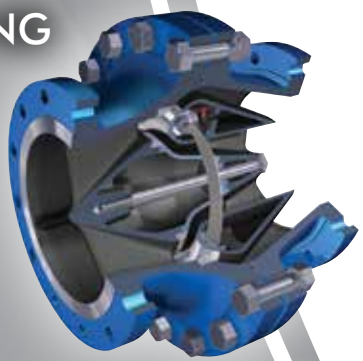
NK

Type NB - The NB is the Noreva standard long face to face for 12" and larger, providing optimum pressure recovery performance and, hence minimum pressure loss. It is also available with API 6D face-to-face dimensions (ND).

Type NK - Providing the customer a shorter face-to-face length and reduced weight, the NK is the Noreva standard lower cost solution where marginally higher pressure drops can be accepted.

The N range is suitable for all kinds of liquid and gaseous fluids and all installation positions.

NG



Type NG

Size range: 12" - 24" (DN 300 - DN 600)
Pressure Class: PN 10 - PN 16

- Non-slam closure
- Friction-free valve disc guiding
- Very low pressure loss
- Maintenance free
- Metal sealing

Pressure recovery is further enhanced within the Type G valve. Whilst using the same Ring Disc format, the Type G valve has a wider, split body design facilitating even greater flow efficiency and throughput performance.

The NG type has been on the world market for more than 70 years. Today they are mainly used by the water industry.

Technical Features & Benefits

Optimised Disc Designs

The Noreva Non-Slam Axial Check valve has two disc designs, depending upon size of valve.

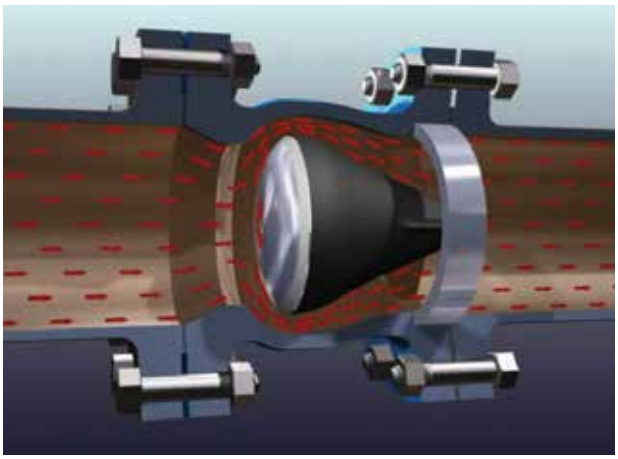
Solid Disc

Available in sizes 1" through to 10", the Noreva Type Z valve is a solid disc and shaft type. The axial design allows for a streamlined flow path around the disc and high pressure recovery, minimising pressure drop across the valve. A short stroke length provides the quick response required by a Non-Slam check valve

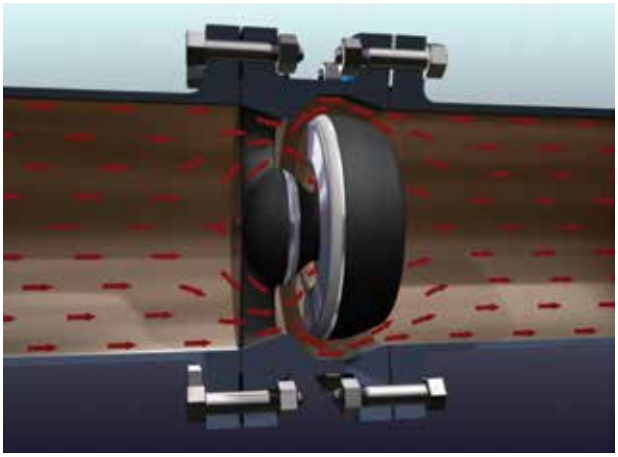
Ring Disc

The Ring Disc design, Type N Valve, in sizes 12" and above ensures that the disc remains light and responsive even in large sizes. Mounted on a multiple helical spring and radial guide assembly , the disc moves freely without any of the frictional forces associated with the solid disc and shaft design.

With a flow path both around and through the centre of the disc the flow capacity of the valve is best in class. Due to the excellent pressure recovery properties of the diffuser, the minimal pressure drop across the valves gives lifetime energy savings when compared to more conventional check valve designs.



Solid Disc Flow Diagram



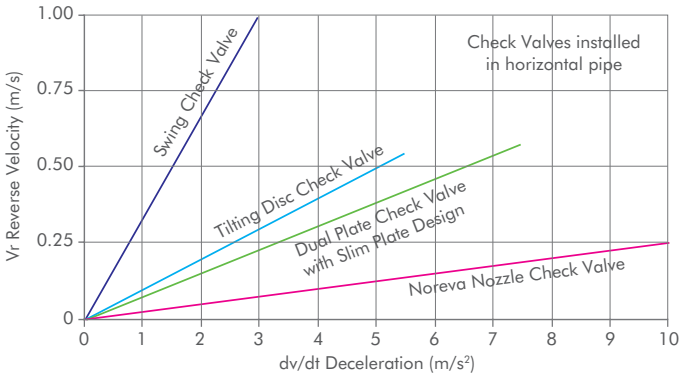
Ring Disc Flow Diagram

Non-Slam: Quick Response

Low weight discs, short stroke lengths and spring assistance combine to ensure that the Axial type check valve responds quickest to change in flow direction.

This fast response ensures reverse velocity cannot build up to a level that can damage pumps, pipes or related equipment. As pressure surges can occur when a valve is closed against a moving body of fluid, the quick closure results in a considerably lower pressure peak than with other types of check valve.

Dynamic Response Curve Comparison



NOZZLE CHECK VALVES
Technical Features & Benefits

Low Pressure Loss

The streamlined internals of the axial check valve range allow for a turbulence free flow path around the disc in the Type Z valve or through and around the disc in the Type N valves.

The high capacity, smooth flow path results in low pressure drop across all of the Axial type valves with exceptionally low pressure drop in the ZB and the NB range.

Low pressure loss can be equated with energy savings in the plant or more throughput, making the axial type valve a competitive check valve solution when considering full lifecycle costs.

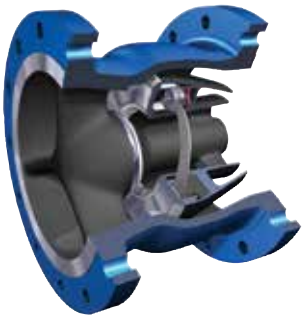
NKF
Standard Short Face-to-Face

Space & Weight Savings

The short face-to-face dimensions of the NK compact design allows for installation in applications where space and weight are at a premium, such as offshore platforms and FPSOs.

The NK type, with its reduced body length and its consequent reduced weight, offers significant cost savings compared with the long pattern NB and ND types. The savings in capital purchase costs are further complimented by low lifecycle cost afforded by the low pressure loss ring disc.

The NK type is Noreva's standard when supplying sizes 12" and larger and is available with Flanged, Wafer, Solid Lug, Hub End and Buttweld End connections.



NBF
Standard Face-to-Face

Choice of Face-to-Face Lengths

The Noreva Axial Check Valves are available in three standard lengths.

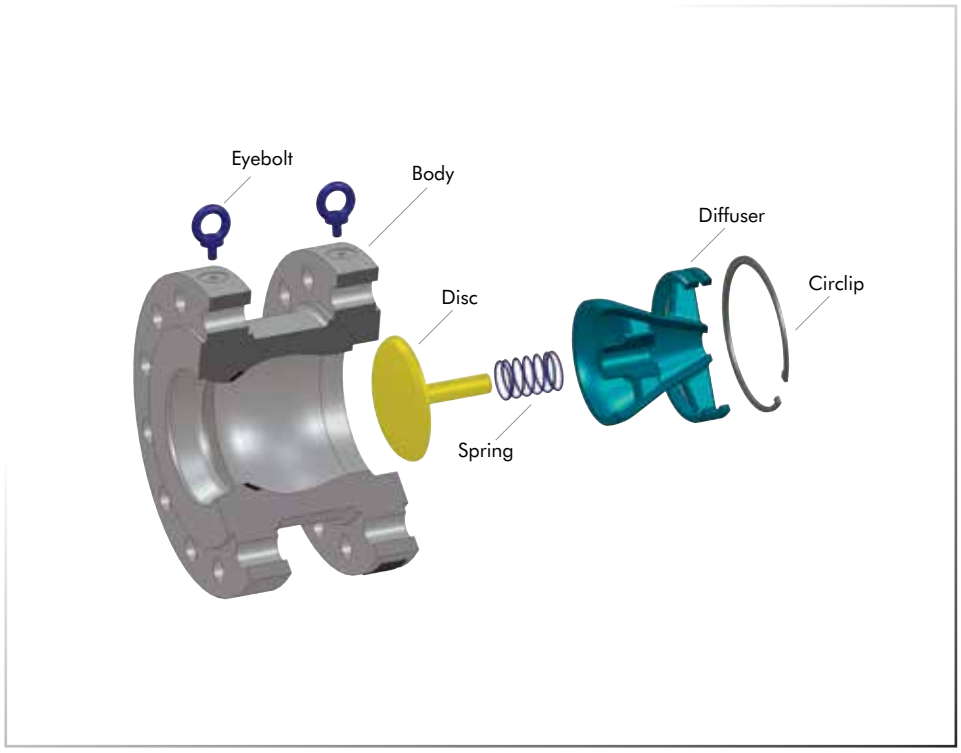
NK, ZS	-	Noreva Standard Compact Face to Face
NG, NB, ZB, ZO	-	Noreva Standard Face to Face
ND, ZD	-	API 6D Face to Face

NDF
API 6D Face-to-Face

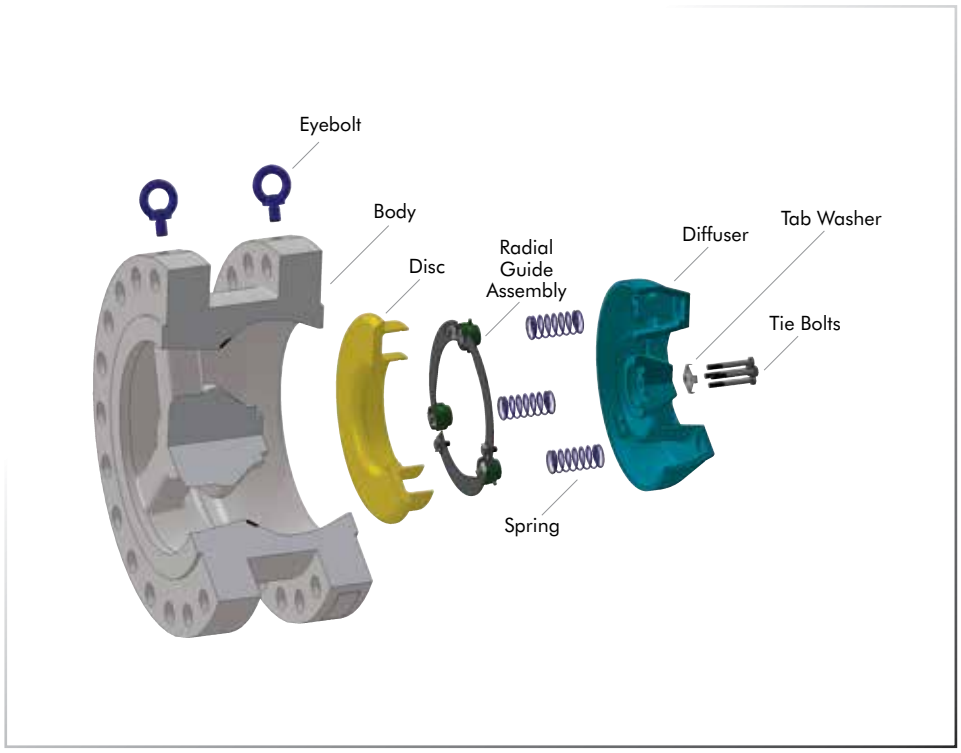
Maintenance Free

The Noreva Axial Check Valve designs use no soft parts and are therefore inherently fire-safe. Also, as there are no wearing parts, it is considered maintenance free. The springs are sized according to the flow rates to ensure that the valves are in the fully open position during normal use. This minimises cycling of the spring, giving the valves a long design life without the need for regular maintenance.

TYPE ZBF & NKF



Type ZBF

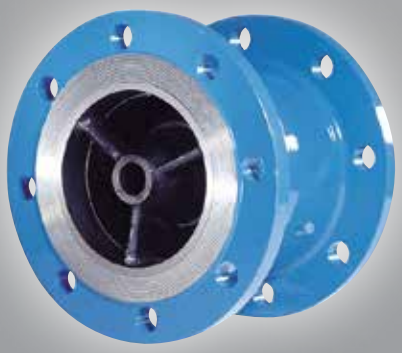


Type NKF

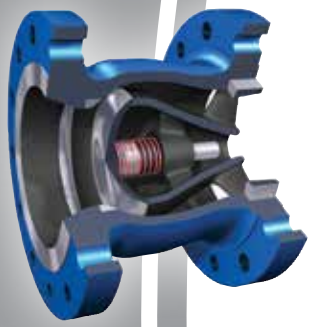
The above two valve designs are Noreva's standard offering for sizes 2" to 10" Type ZBF and 12" and larger Type NKF.

NOREVA GmbH

Solid Disc
Type ZB



Type ZB



The axial design of the ZB and ZD range results in a streamlined flow path around the disc and high pressure recovery, minimising pressure drop across and maximising flow through the valve.

FEATURES
- Non-slam closure
- Very low pressure loss
- Short face-to-face length
- Low weight
- Metal sealing
- Maintenance free design
- Valve design to ASME B16.34

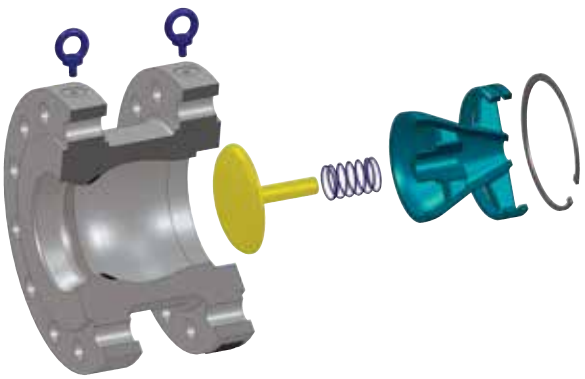
END CONNECTIONS AVAILABLE
- Flanged
- Buttweld
- Hub End

all valves are available with any international flange standard.

TYPE ZB
Noreva Standard Face-to-Face Dimensions (standard valves for sizes 1" to 10")

TYPE ZD
API 6D Face-to-Face Dimensions

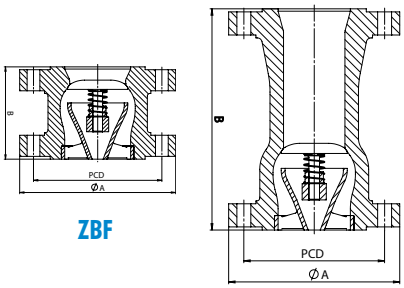
Buttweld and Hub End valve face-to-face dimensions as per Flanged Types. Weights for these types are available upon request.



Type ZB & ZD

Installation Dimensions

Flanges according to ASME B16.5



ZBF

ZDF

Size inches	Pressure Rating ASME	End Facing	A mm	Type ZBF Standard Face-to-Face B mm	Type ZBF Standard Face-to-Face Valve Weight kg	Type ZDF API 6D Face-to-Face B RF mm	Type ZDF API 6D Face-to-Face B RJ mm	Type ZDF API 6D Face-to-Face † Valve Weight kg	FLANGE DETAIL HOLE P.C.D. mm	FLANGE DETAIL HOLE DIA. mm	STUD SELECTION No.	STUD SELECTION DIA. Inches	STUD SELECTION *Length mm
	150	RF	110	100	4	---	---	---	79.4	15.8	4	1/2	85
	300	RF	125	100	4	---	---	---	88.9	19.1	4	5/8	95
1	600	RF/RJ-16	125	100	5	---	---	---	88.9	19.1	4	5/8	100
(25mm)	900	RF/RJ-16	150	150	9	---	---	---	101.6	25.4	4	7/8	140
	1500	RF/RJ-16	150	150	16	---	---	---	101.6	25.4	4	7/8	140
	2500	RF/RJ-18	160	160	28	---	---	---	108.0	25.4	4	7/8	155
	150	RF	115	100	5	---	---	---	88.9	15.8	4	1/2	85
	300	RF	135	100	5	---	---	---	98.4	19.1	4	5/8	100
1¼	600	RF/RJ-18	135	100	9	---	---	---	98.4	19.1	4	5/8	105
(32mm)	900	RF/RJ-18	160	150	11	---	---	---	111.1	25.4	4	7/8	140
	1500	RF/RJ-18	160	150	20	---	---	---	111.1	25.4	4	7/8	140
	2500	RF/RJ-21	185	180	35	---	---	---	130.2	28.6	4	1	165
	150	RF	125	120	7	---	---	---	98.4	15.8	4	1/2	90
	300	RF	155	120	7	---	---	---	114.3	22.2	4	3/4	115
1½	600	RF/RJ-20	155	120	11	---	---	---	114.3	22.2	4	3/4	120
(40mm)	900	RF/RJ-20	180	170	13	---	---	---	123.8	28.6	4	1	155
	1500	RF/RJ-20	180	170	23	---	---	---	123.8	28.6	4	1	155
	2500	RF/RJ-23	205	210	40	---	---	---	146.0	31.8	4	1 1/8	190
	150	RF	152	120	7	203	---	9	120.7	19.1	4	5/8	105
	300	RF	165	120	9	267	---	13	127.0	19.1	8	5/8	110
2	600	RF/RJ-23	165	120	10	292	295	15	127.0	19.1	8	5/8	135
(50mm)	900	RF/RJ-24	216	170	26	368	371	37	165.1	25.4	8	7/8	170
	1500	RF/RJ-24	216	170	26	368	371	37	165.1	25.4	8	7/8	170
	2500	RF/RJ-26	235	210	37	451	454	54	171.4	28.6	8	1	205
	150	RF	180	120	10	216	---	15	139.7	19.1	4	5/8	105
	300	RF	190	150	10	292	---	19	149.2	22.2	8	3/4	120
2½	600	RF/RJ-26	190	150	17	330	333	23	149.2	22.2	8	3/4	130
(65mm)	900	RF/RJ-27	245	190	25	419	422	52	190.5	28.5	8	1	175
	1500	RF/RJ-27	245	190	35	419	422	67	190.5	28.5	8	1	175
	2500	RF/RJ-28	265	240	65	508	514	81	196.8	31.8	8	1 1/8	215
	150	RF	191	120	13	241	---	16	152.4	19.1	4	5/8	110
	300	RF	210	150	18	318	---	26	168.3	22.2	8	3/4	130
3	600	RF/RJ-31	210	150	20	356	359	30	168.3	22.2	8	3/4	155
(80mm)	900	RF/RJ-31	241	190	32	381	384	43	190.5	25.4	8	7/8	170
	1500	RF/RJ-35	267	220	45	470	473	65	203.2	31.8	8	1 1/8	200
	2500	RF/RJ-32	305	270	83	578	584	119	228.6	34.9	8	1 1/4	250
	150	RF	229	140	20	292	---	28	190.5	19.1	8	5/8	110
	300	RF	254	170	31	356	---	41	200.0	22.2	8	3/4	135
4	600	RF/RJ-37	273	170	40	432	435	63	215.9	25.4	8	7/8	175
(100mm)	900	RF/RJ-37	292	210	53	457	460	73	235.0	31.8	8	1 1/8	195
	1500	RF/RJ-39	311	240	69	546	549	107	241.3	34.9	8	1 1/4	220
	2500	RF/RJ-38	356	310	131	673	683	178	273.0	41.3	8	1 1/2	290

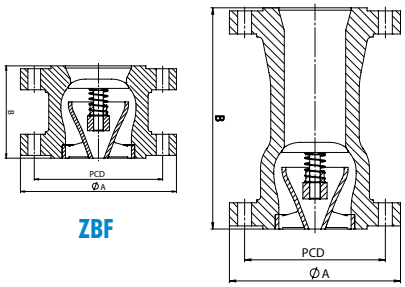
* Where Ring Joint Facing shown in End Facing, Stud lengths based on Ring Joint flange connection.

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

Type ZB & ZD

Installation Dimensions

Flanges according to ASME B16.5



ZBF **ZDF**

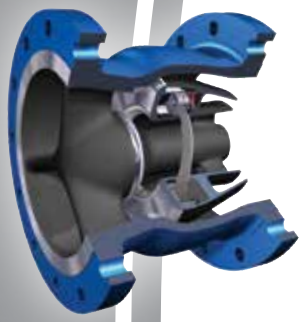
Size inches	Pressure Rating ASME	End Facing	A mm	Type ZBF Standard Face-to-Face B mm	Type ZBF Standard Face-to-Face Valve Weight kg	Type ZDF API 6D Face-to-Face B RF mm	Type ZDF API 6D Face-to-Face B RJ mm	Type ZDF API 6D Face-to-Face † Valve Weight kg	FLANGE DETAIL HOLE P.C.D. mm	FLANGE DETAIL HOLE DIA. mm	STUD SELECTION No.	STUD SELECTION DIA. Inches	STUD SELECTION *Length mm
	150	RF	255	210	31	---	---	---	215.9	22.2	8	3/4	120
	300	RF	280	210	31	---	---	---	235.0	22.2	8	3/4	140
5	600	RF/RJ-41	330	210	55	---	---	---	266.7	28.6	8	1	190
(125mm)	900	RF/RJ-41	350	230	85	---	---	---	279.4	34.9	8	1 1/4	220
	1500	RF/RJ-44	375	310	140	---	---	---	292.1	41.3	8	1 1/2	285
	2500	RF/RJ-42	420	370	225	---	---	---	323.8	47.6	8	1 3/4	335
	150	RF	279	210	38	356	---	44	241.3	22.2	8	3/4	120
	300	RF	318	210	55	445	---	80	269.9	22.2	12	3/4	145
6	600	RF/RJ-45	356	210	82	559	562	137	292.1	28.6	12	1	200
(150mm)	900	RF/RJ-45	381	230	107	610	613	171	317.5	31.8	12	1 1/8	220
	1500	RF/RJ-46	394	310	160	705	711	231	317.5	38.1	12	1 3/8	295
	2500	RF/RJ-47	483	430	324	914	927	487	368.3	54.0	8	2	380
	150	RF	343	280	71	495	---	90	298.5	22.2	8	3/4	125
	300	RF	381	280	91	533	---	120	330.2	25.4	12	7/8	160
8	600	RF/RJ-49	419	280	135	660	664	213	349.2	31.8	12	1 1/8	220
(200mm)	900	RF/RJ-49	470	280	189	737	740	307	393.7	38.1	12	1 3/8	250
	1500	RF/RJ-50	483	350	269	832	841	390	393.7	44.5	12	1 5/8	325
	2500	RF/RJ-51	552	460	480	1022	1038	743	438.2	54.0	12	2	425
	150	RF	406	350	120	622	---	151	362.0	25.4	12	7/8	140
	300	RF	445	350	152	622	---	184	387.4	28.6	16	1	180
10	600	RF/RJ-53	508	350	252	787	791	380	431.8	34.9	16	1 1/4	245
(250mm)	900	RF/RJ-53	546	350	303	838	841	461	469.9	38.1	16	1 3/8	265
	1500	RF/RJ-54	584	400	461	991	1000	710	482.6	50.8	12	1 7/8	370
	2500	RF/RJ-55	673	580	952	1270	1292	1442	539.8	66.7	12	2 1/2	535

* Where Ring Joint Facing shown in End Facing, Stud lengths based on Ring Joint flange connection.

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

Ring Disc
Type NB

Type NB



With its friction free guiding and the aerodynamic flowpath through its two ring shaped flow ports, the NB is “best in class” for speed of response and flow capacity.

FEATURES

- Non-slam closure
- Very low pressure loss
- Friction-free valve disc guiding
- Metal sealing
- Maintenance free design
- Valve design to ASME B16.34

END CONNECTIONS AVAILABLE

- Flanged
- Buttweld
- Hub End
- Compact flange

all valves are available with any international flange standard.

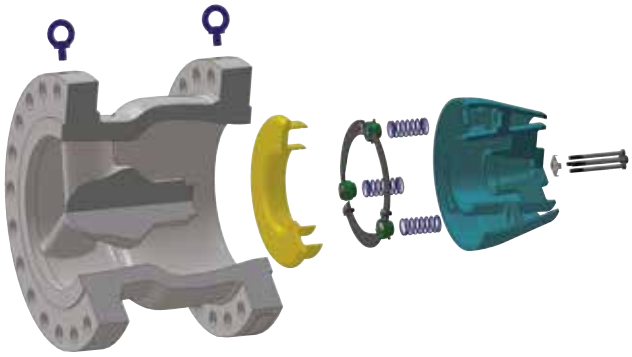
TYPE NB

Noreva Standard Face-to-Face Dimensions (standard face-to-face for - 12" and above)

TYPE ND

API 6D Face-to-Face Dimensions

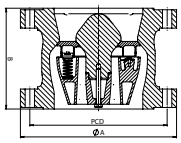
Buttweld and, Hub End valve face to face dimensions as per flanged types. Weights for these types are available upon request.



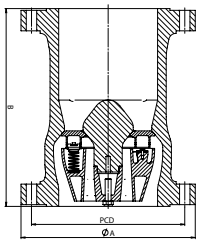
Type NB & ND

Installation Dimensions

Flanges according to ASME B16.5 / ASME B16.47 SERIES A (MSS SP44)



NBF



NDF

Size inches	Pressure Rating ASME	End Facing	A mm	Type NBF Face-to-Face B mm	Type NBF † Valve Weight kg	Type NDF Face-to-Face B RF mm	Type NDF B RJ mm	Type NDF † Valve Weight kg	FLANGE DETAIL HOLE P.C.D. mm	FLANGE DETAIL HOLE DIA. mm	STUD SELECTION No.	STUD SELECTION DIA. Inches	STUD SELECTION *Length mm
	150	RF	483	350	175	699	---	341	431.8	25.4	12	7/8	150
	300	RF	521	350	235	711	---	400	450.8	31.8	16	1 1/8	205
12	600	RF/RJ-57	559	375	310	838	841	623	489.0	34.9	20	1 1/4	255
(300mm)	900	RF/RJ-57	610	340	390	965	968	966	533.4	38.1	20	1 3/8	285
	1500	RF/RJ-58	673	440	650	1130	1146	1638	571.5	54.0	16	2	415
	2500	RF/RJ-60	762	580	1286	1422	1445	2975	619.1	73.0	12	2 3/4	585
	150	RF	533	405	245	787	---	480	476.3	28.6	12	1	165
14	300	RF	584	405	330	838	---	601	514.4	31.8	20	1 1/8	210
(350mm)	600	RF/RJ-61	603	440	410	889	892	819	527.0	38.1	20	1 3/8	265
	900	RF/RJ-62	641	400	510	1029	1038	1211	558.8	41.3	20	1 1/2	310
	1500	RF/RJ-63	749	490	1040	1257	1276	2114	635.0	60.3	16	2 1/4	455
	150	RF	597	455	345	864	---	714	539.8	28.6	16	1	170
16	300	RF	648	455	435	864	---	805	571.5	34.9	20	1 1/4	220
(400mm)	600	RF/RJ-65	686	500	610	991	994	1120	603.2	41.3	20	1 1/2	285
	900	RF/RJ-66	705	470	760	1130	1140	1407	616.0	44.5	20	1 5/8	325
	1500	RF/RJ-67	826	530	1280	1384	1407	1417	704.8	66.7	16	2 1/2	500
	150	RF	635	520	425	978	---	868	577.9	31.8	16	1 1/8	180
18	300	RF	711	520	580	978	---	1036	628.6	34.9	24	1 1/4	230
(450mm)	600	RF/RJ-69	743	565	790	1092	1095	1442	654.0	44.5	20	1 5/8	305
	900	RF/RJ-70	787	530	960	1219	1232	1960	685.8	50.8	20	1 7/8	365
	1500	RF/RJ-71	914	580	1600	1537	1559	3955	774.7	73.0	16	2 3/4	555
	150	RF	699	570	560	978	---	970	635.0	31.8	20	1 1/8	190
20	300	RF	775	570	760	1016	---	1217	685.8	34.9	24	1 1/4	240
(500mm)	600	RF/RJ-73	813	625	1170	1194	1200	1840	723.9	44.5	24	1 5/8	325
	900	RF/RJ-74	857	595	1260	1321	1334	2422	749.3	54.0	20	2	385
	1500	RF/RJ-75	984	655	2100	1664	1686	5124	831.8	79.4	16	3	590
	150	RF	813	685	890	1295	---	1691	749.3	34.9	20	1 1/4	205
24	300	RF	914	685	1240	1346	---	2177	812.8	41.3	24	1 1/2	265
(600mm)	600	RF/RJ-77	940	745	1630	1397	1407	2513	838.2	50.8	24	1 7/8	365
	900	RF/RJ-78	1041	665	1980	1549	1568	3661	901.7	66.7	20	2 1/2	485
	1500	RF/RJ-79	1168	750	3300	1943	1972	8183	990.6	92.1	16	3 1/2	675
	150	RF	927	800	1330	1448	---	1996	863.6	34.9	28	1 1/4	255
28	300	RF	1035	800	1800	1499	---	2860	939.8	44.5	28	1 5/8	305
(700mm)	600	RF/RJ-93	1073	870	2450	1600	1613	4212	965.2	54.0	28	2	405
	900	RF/RJ-100	1168	860	2890	---	---	---	1022.4	79.4	20	3	525
	150	RF	984	855	1590	1524	---	2353	914.4	34.9	28	1 1/4	260
30	300	RF	1092	855	2150	1594	---	3523	997.0	47.6	28	1 3/4	325
(750mm)	600	RF/RJ-95	1130	930	2570	1651	1664	4784	1022.4	54.0	28	2	410
	900	RF/RJ-102	1232	925	3540	---	---	---	1085.8	79.4	20	3	540
	150	RF	1060	910	1990	---	---	---	977.9	41.3	28	1 1/2	290
32	300	RF	1149	910	2200	---	---	---	1054.1	50.8	28	1 7/8	345
(800mm)	600	RF/RJ-96	1194	990	3200	---	---	---	1079.5	60.3	28	2 1/4	430
	900	RF/RJ-103	1314	925	4900	---	---	---	1155.7	85.7	20	3 1/4	570

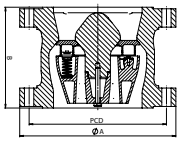
* Where Ring Joint Facing shown in End Facing, Stud lengths based on Ring Joint flange connection.

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

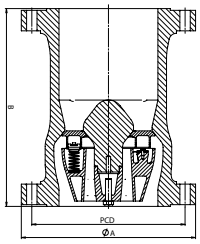
Type NB & ND

Installation Dimensions

Flanges according to ASME B16.47 SERIES A (MSS SP44)



NBF



NDF

Size inches	Pressure Rating ASME	End Facing	A mm	Type NBF B mm	Type NBF † Valve Weight kg	Type NDF B RF mm	Type NDF B RJ mm	Type NDF † Valve Weight kg	FLANGE DETAIL HOLE P.C.D. mm	FLANGE DETAIL HOLE DIA. mm	STUD SELECTION No.	STUD SELECTION DIA. Inches	STUD SELECTION *Length mm
	150	RF	1168	1030	2300	1956	---	3556	1085.8	41.3	32	1 1/2	305
36	300	RF	1270	1030	3100	2083	---	5727	1168.4	54.0	32	2	360
(900mm)	600	RF/RJ-98	1314	1120	4100	2083	---	7261	1193.8	66.7	28	2 1/2	455
	900	RF/RJ-105	1461	1050	5900	---	---	---	1289.0	92.1	20	3 1/2	615
	150	RF	1289	1135	3400	---	---	---	1200.2	41.3	36	1 1/2	305
40	300	RF	1238	1135	3900	---	---	---	1155.7	44.5	32	1 5/8	360
(1000mm)	600	RF	1321	1240	5400	---	---	---	1212.9	60.3	32	2 1/4	490
	900	RF	1511	1185	OA	---	---	---	1339.8	92.1	24	3 1/2	630
	150	RF	1346	1195	3600	---	---	---	1257.3	41.3	36	1 1/2	320
42	300	RF	1289	1195	4100	---	---	---	1206.5	44.5	32	1 5/8	370
(1050mm)	600	RF	1403	1300	5800	---	---	---	1282.7	66.7	28	2 1/2	520
	900	RF	1562	1250	OA	---	---	---	1390.6	92.1	24	3 1/2	650
	150	RF	1511	1365	5200	---	---	---	1422.4	41.3	44	1 1/2	340
48	300	RF	1467	1365	6000	---	---	---	1371.6	50.8	32	1 7/8	410
(1200mm)	600	RF	1594	1485	8800	---	---	---	1460.5	73.0	32	2 3/4	575
	900	RF	1785	1450	OA	---	---	---	1587.5	104.8	24	4	670

Flanges according to ASME B16.47 SERIES B (API 605)

Size inches	Pressure Rating ASME	End Facing	A mm	Type NBF B mm	Type NBF † Valve Weight kg	Type NDF B RF mm	Type NDF B RJ mm	Type NDF † Valve Weight kg	FLANGE DETAIL HOLE P.C.D. mm	FLANGE DETAIL HOLE DIA. mm	STUD SELECTION No.	STUD SELECTION DIA. Inches	STUD SELECTION *Length mm
	150	RF	837	800	1330	1448	---	1775	795.3	22.2	40	3/4	175
28	300	RF	921	800	1800	1499	---	2535	857.2	34.9	36	1 1/4	290
(700mm)	600	RF/RJ-94	953	870	2450	1600	1613	3705	863.6	47.6	28	1 3/4	395
	900	RF/RJ-101	1105	860	2890	---	---	---	971.6	73.0	20	2 3/4	515
	150	RF	887	855	1590	1524	---	2080	846.1	22.2	44	3/4	175
30	300	RF	991	855	2150	1594	---	3250	920.8	38.1	36	1 3/8	305
(750mm)	600	RF/RJ-95	1022	930	2570	1651	1664	4472	927.1	50.8	28	1 7/8	420
	900	RF/RJ-102	1181	925	3540	---	---	---	1035.0	79.4	20	3	545
	150	RF	941	910	1990	---	---	---	900.1	22.2	48	3/4	175
32	300	RF	1054	910	2200	---	---	---	977.9	41.3	32	1 1/2	330
(800mm)	600	RF/RJ-96	1086	990	3200	---	---	---	984.2	54.0	28	2	440
	900	RF/RJ-103	1238	925	4900	---	---	---	1092.2	79.4	20	3	555
	150	RF	1057	1030	2300	1956	---	3062	1009.6	25.4	44	7/8	195
36	300	RF	1172	1030	3100	2083	---	5285	1089.0	44.5	32	1 5/8	340
(900mm)	600	RF/RJ-98	1213	1120	4100	2083	---	6832	1104.9	60.3	28	2 1/4	480
	900	RF/RJ-105	1346	1050	5900	---	---	---	1200.2	79.4	24	3	585
40	150	RF	1175	1135	3400	---	---	---	1120.8	28.6	44	1	210
(1000mm)	300	RF	1273	1135	3900	---	---	---	1190.6	44.5	40	1 5/8	365
42	150	RF	1226	1195	3600	---	---	---	1171.6	28.6	48	1	215
(1050mm)	300	RF	1334	1195	4100	---	---	---	1244.6	47.6	36	1 3/4	375
48	150	RF	1392	1365	5200	---	---	---	1335.1	31.8	44	1 1/8	235
(1200mm)	300	RF	1511	1365	6000	---	---	---	1416.0	50.8	40	1 7/8	400

* Where Ring Joint Facing shown in End Facing, Stud lengths based on Ring Joint flange connection.

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

NOREVA GmbH

Ring Disc
Type NK

Type NK

The NK employs the worldwide proven ring shaped valve disc / radial guide design that ensures the disc remains light and responsive even in large sizes. With a short face-to-face and reduced weight, the compact NK is a lower cost solution to its sister valve the NB.

FEATURES

- Non-slam closure
- Low pressure loss
- Friction-free valve disc guiding
- Metal sealing
- Short face-to-face length
- Low weight
- Maintenance free design
- Valve design to ASME B16.34

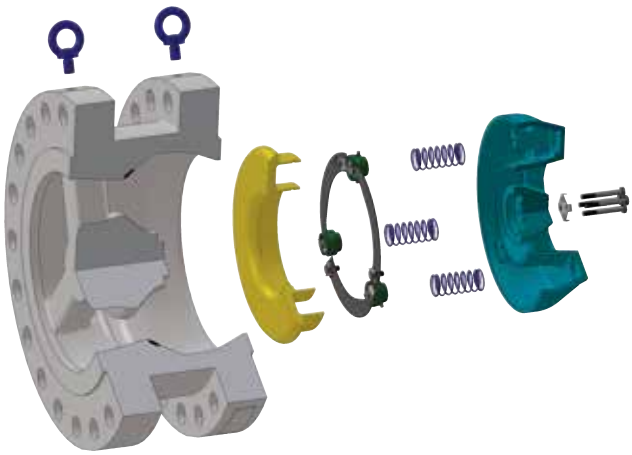
END CONNECTIONS AVAILABLE

- Flanged
- Hub End
- Solid Lug
- Buttweld
- Wafer
- Compact Flange

all valves are available with any international flange standard.

TYPE NK

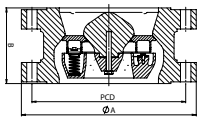
Noreva Compact Face-to-Face Dimensions (standard valves for 12" and above)



Type NK

Installation Dimensions

Flanges according to ASME B16.5 / ASME B16.47 SERIES A



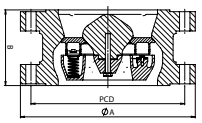
Size inches	Pressure Rating ASME	End Facing	A mm	B mm	Valve Weight kg	FLANGE DETAIL				
						HOLE P.C.D. mm	HOLE DIA. mm	STUD SELECTION		
								No.	DIA. Inches	*Length mm
	150	RF	483	181	105	431.8	25.4	12	7/8	150
	300	RF	521	181	155	450.8	31.8	16	1 1/8	205
12	600	RF/RJ-57	559	229	240	489.0	34.9	20	1 1/4	255
(300mm)	900	RF/RJ-57	610	310	380	533.4	38.1	20	1 3/8	285
	1500	RF/RJ-58	673	450	OA	571.5	54.0	16	2	415
	2500	RF/RJ-60	762	OA	OA	619.1	73.0	12	2 3/4	585
	150	RF	533	222	160	476.3	28.6	12	1	165
14	300	RF	584	222	230	514.4	31.8	20	1 1/8	210
(350mm)	600	RF/RJ-61	603	273	320	527.0	38.1	20	1 3/8	265
	900	RF/RJ-62	641	356	440	558.8	41.3	20	1 1/2	310
	1500	RF/RJ-63	749	500	OA	635.0	60.3	16	2 1/4	455
	150	RF	597	245	230	539.8	28.6	16	1	170
16	300	RF	648	245	340	571.5	34.9	20	1 1/4	220
(400mm)	600	RF/RJ-65	686	305	440	603.2	41.3	20	1 1/2	285
	900	RF/RJ-66	705	384	580	616.0	44.5	20	1 5/8	325
	1500	RF/RJ-67	826	550	OA	704.8	66.7	16	2 1/2	500
	150	RF	635	264	260	577.9	31.8	16	1 1/8	180
18	300	RF	711	264	350	628.6	34.9	24	1 1/4	230
(450mm)	600	RF/RJ-69	743	362	570	654.0	44.5	20	1 5/8	305
	900	RF/RJ-70	787	420	800	685.8	50.8	20	1 7/8	365
	1500	RF/RJ-71	914	610	OA	774.7	73.0	16	2 3/4	555
	150	RF	699	305	350	635.0	31.8	20	1 1/8	190
20	300	RF	775	305	510	685.8	34.9	24	1 1/4	240
(500mm)	600	RF/RJ-73	813	368	740	723.9	44.5	24	1 5/8	325
	900	RF/RJ-74	857	430	900	749.3	54.0	20	2	385
	1500	RF/RJ-75	984	OA	OA	831.8	79.4	16	3	590
	150	RF	813	370	560	749.3	34.9	20	1 1/4	205
24	300	RF	914	370	780	812.8	41.3	24	1 1/2	265
(600mm)	600	RF/RJ-77	940	438	1120	838.2	50.8	24	1 7/8	365
	900	RF/RJ-78	1041	495	1650	901.7	66.7	20	2 1/2	485
	1500	RF/RJ-79	1168	OA	OA	990.6	92.1	16	3 1/2	675
	150	RF	927	430	820	863.6	34.9	28	1 1/4	255
28	300	RF	1035	430	1250	939.8	44.5	28	1 5/8	305
(700mm)	600	RF/RJ-93	1073	480	1600	965.2	54.0	28	2	405
	900	RF/RJ-100	1168	540	2250	1022.4	79.4	20	3	525
	150	RF	984	460	950	914.4	34.9	28	1 1/4	260
30	300	RF	1092	460	1330	997.0	47.6	28	1 3/4	325
(750mm)	600	RF/RJ-95	1130	505	1760	1022.4	54.0	28	2	410
	900	RF/RJ-102	1232	560	2600	1085.8	79.4	20	3	540
	150	RF	1060	500	1090	977.9	41.3	28	1 1/2	290
32	300	RF	1149	500	1500	1054.1	50.8	28	1 7/8	345
(800mm)	600	RF/RJ-96	1194	584	2100	1079.5	60.3	28	2 1/4	430
	900	RF/RJ-103	1314	OA	OA	1155.7	85.7	20	3 1/4	570

* Where Ring Joint Facing shown in End Facing, Stud lengths based on Ring Joint flange connection.

Type NK

Installation Dimensions

Flanges according to ASME B16.5 / ASME B16.47 SERIES A



Size inches	Pressure Rating ASME	End Facing	A mm	B mm	Valve Weight kg	FLANGE DETAIL				
						HOLE P.C.D. mm	HOLE DIA. mm	STUD SELECTION		
								No.	DIA. Inches	*Length mm
	150	RF	1168	560	1600	1085.8	41.3	32	1 1/2	305
36	300	RF	1270	560	2100	1168.4	54.0	32	2	360
(900mm)	600	RF/RJ-98	1314	635	2800	1193.8	66.7	28	2 1/2	455
	900	RF/RJ-105	1461	690	4700	1289.0	92.1	20	3 1/2	615
	150	RF	1289	650	2100	1200.2	41.3	36	1 1/2	320
40	300	RF	1238	650	2120	1155.7	44.5	32	1 5/8	370
(1000mm)	600	RF	1321	820	3200	1212.9	60.3	32	2 1/4	520
	900	RF	1511	970	6400	1339.8	92.1	24	3 1/2	650
	150	RF	1346	670	2500	1257.3	41.3	36	1 1/2	320
42	300	RF	1289	720	2600	1206.5	44.5	32	1 5/8	370
(1050mm)	600	RF	1403	870	4100	1282.7	66.7	28	2 1/2	520
	900	RF	1562	1100	6700	1390.6	92.1	24	3 1/2	650
	150	RF	1511	740	3300	1422.4	41.3	44	1 1/2	340
48	300	RF	1467	840	3600	1371.6	50.8	32	1 7/8	410
(1200mm)	600	RF	1594	970	5850	1460.5	73.0	32	2 3/4	575
	900	RF	1785	1200	8300	1587.5	104.8	24	4	670

* Where Ring Joint Facing shown in End Facing, Stud lengths based on Ring Joint flange connection.

Flanges according to ASME B16.47 SERIES B

Size inches	Pressure Rating ASME	End Facing	A mm	B mm	Valve Weight kg	FLANGE DETAIL				
						HOLE P.C.D. mm	HOLE DIA. mm	STUD SELECTION		
								No.	DIA. Inches	*Length mm
	150	RF	837	430	820	795.3	22.2	40	3/4	175
28	300	RF	921	430	1250	857.2	34.9	36	1 1/4	290
(700mm)	600	RF/RJ-94	953	480	1600	863.6	47.6	28	1 3/4	395
	900	RF/RJ-101	1105	540	2250	971.6	73.0	20	2 3/4	515
	150	RF	887	460	950	846.1	22.2	44	3/4	175
30	300	RF	991	460	1330	920.8	38.1	36	1 3/8	305
(750mm)	600	RF/RJ-95	1022	505	1760	927.1	50.8	28	1 7/8	420
	900	RF/RJ-102	1181	560	2600	1035.0	79.4	20	3	545
	150	RF	941	500	1090	900.1	22.2	48	3/4	175
32	300	RF	1054	500	1500	977.9	41.3	32	1 1/2	330
(800mm)	600	RF/RJ-96	1086	584	2100	984.2	54.0	28	2	440
	900	RF/RJ-103	1238	OA	OA	1092.2	79.4	20	3	555
	150	RF	1057	560	1600	1009.6	25.4	44	7/8	195
36	300	RF	1172	560	2100	1089.0	44.5	32	1 5/8	340
(900mm)	600	RF/RJ-98	1213	635	2800	1104.9	60.3	28	2 1/4	480
	900	RF/RJ-105	1346	690	4700	1200.2	79.4	24	3	585
40	150	RF	1175	650	2100	1120.8	28.6	44	1	210
(1000mm)	300	RF	1273	650	2120	1190.6	44.5	40	1 5/8	365
42	150	RF	1226	670	2500	1171.6	28.6	48	1	215
(1050mm)	300	RF	1334	720	2600	1244.6	47.6	36	1 3/4	375
48	150	RF	1392	740	3300	1335.1	31.8	44	1 1/8	235
(1200mm)	300	RF	1511	840	3600	1416.0	50.8	40	1 7/8	400

* Where Ring Joint Facing shown in End Facing, Stud lengths based on Ring Joint flange connection.

NoReVa GmbH

For Potable Water
Type ZO & NG

Specifically for the potable water market we are still manufacturing two of the best established valve designs, the types ZO and NG. These valves were designed in 1935 and 1955 respectively.

They are available from DN 25 to DN 600 and in pressure classes PN 10 and PN 16.

Type ZO

Type NG

NOZZLE CHECK VALVES

Installation Between End Connections

Flanged
Type ZBF

Flanged
Type NKF

Hub-End
Type ZBH

Hub End
Type NKH

Buttweld End
Type ZBW

Buttweld End
Type NKW

NOZZLE CHECK VALVES

End Connections

Flange Type

In acc. with: EN, ANSI, MSS, API, etc.
Valve Types: ZB, ZD, NK, NB, ND, NG

Welded Ends

In acc. with: EN, ANSI, API, etc.
Valve Types: ZB, ZD, NK, NB, ND

Wafer Type

In acc. with: EN, ANSI, MSS, API, etc.
Valve Types: ZS, NK

Fully Lugged
Wafer Type

In acc. with: EN, ANSI, MSS, API, etc.
Valve Types: ZS, NK

Hub Ends

In acc. with: Grayloc, Techlok, etc.
Valve Types: ZB, ZD, NK, NB, ND

Threaded Ends

In acc. with: EN, ANSI, MSS, API, etc.
Valve Types: ZB, ZD

ENGINEERING DATA

C_V Pressure Drop Formulae

For Liquids

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

For Gases

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

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

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

AXIAL CHECK VALVE FLOW CO-EFFICIENT (C_V)

ZB VALVES
ALL PRESSURE CLASSES

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

NK/NB VALVES
ASME 150/300

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

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

Valve Cracking Pressures

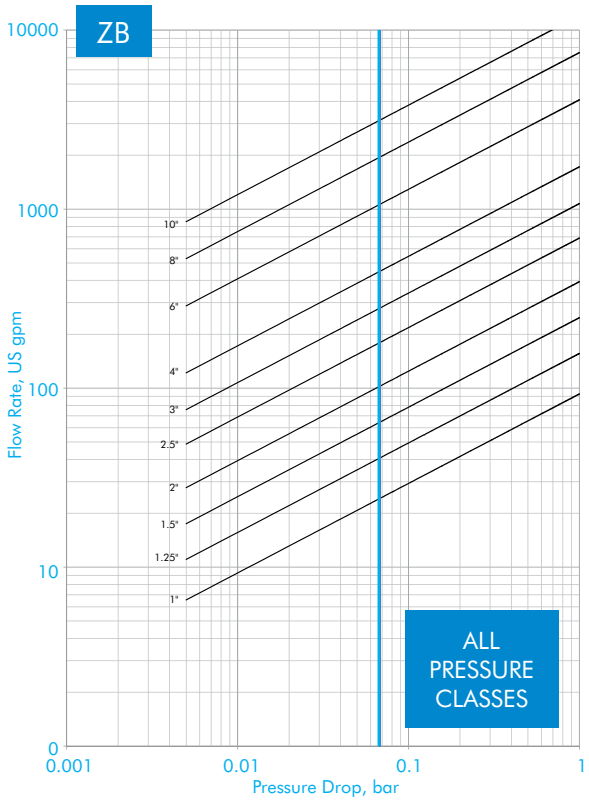
On the initial opening of a check valve, such as at system start-up, the upstream pressure applied by the fluid to the front of the disc is required to overcome the force of the spring and any upstream back pressure acting on the back of the disc. The pressure differential at which this happens is known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

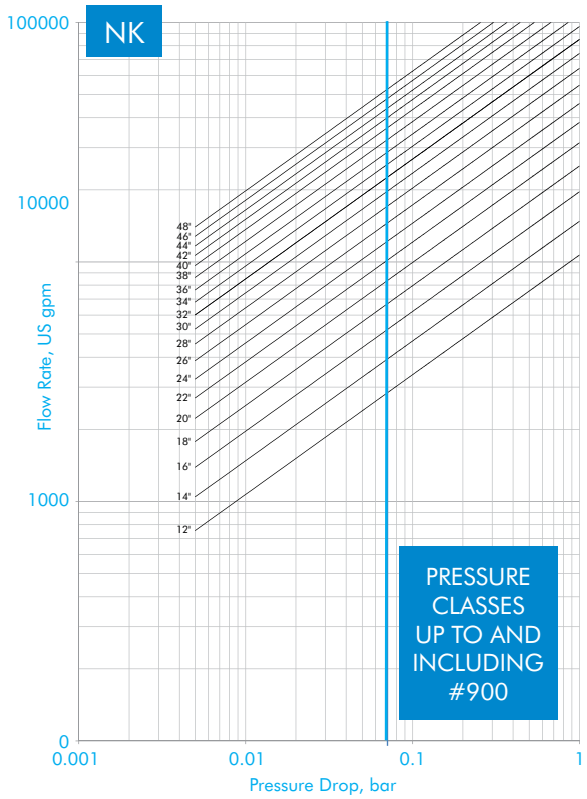
As soon as the disc is cracked open the media cannot sustain a pressure differential and at this point the discs are not kept open by pressure, but by the fluid velocity (see Critical velocity).

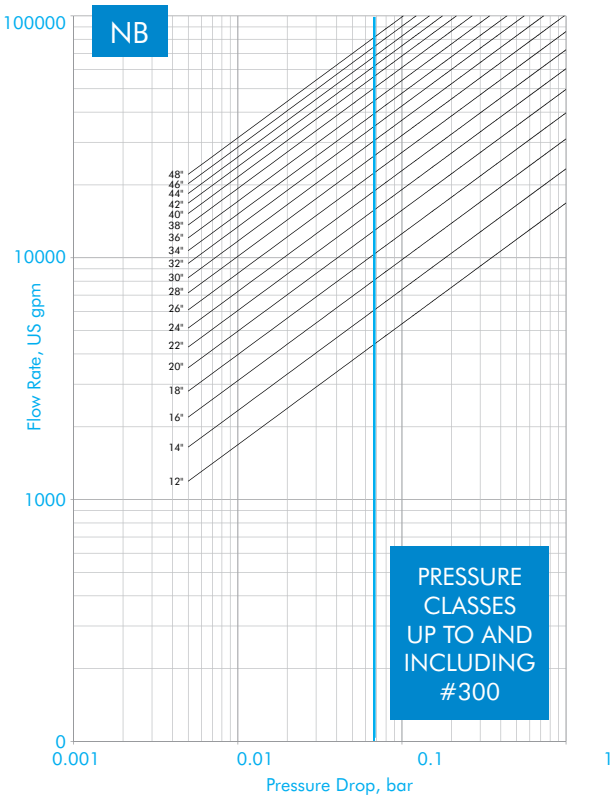
Specific values for cracking pressures at atmospheric conditions can be obtained from Noreva upon request.

ENGINEERING DATA

Pressure Loss / Flow Coefficient (Cv)







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

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

ENGINEERING DATA
Critical Velocity

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

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

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

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

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

Axial Check Valve Springs

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

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

Chatter / Flutter

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

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

Pressure Surge

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

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

The magnitude of this pressure was characterised by Joukowsky as:

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

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

ENGINEERING DATA
The Phenomenon of Surge

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

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

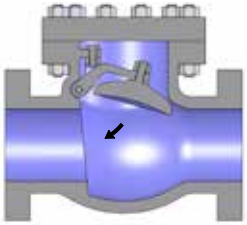
Surge Mitigation

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

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

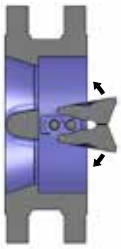
By meeting these requirements, Noreva provide a range of non-slam check valves to suit up to the most severe of customer requirements.

Swing Check



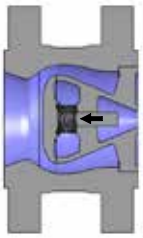
Low Inertia	No
Minimal Travel	No
Spring Assistance	No

Dual Plate Check



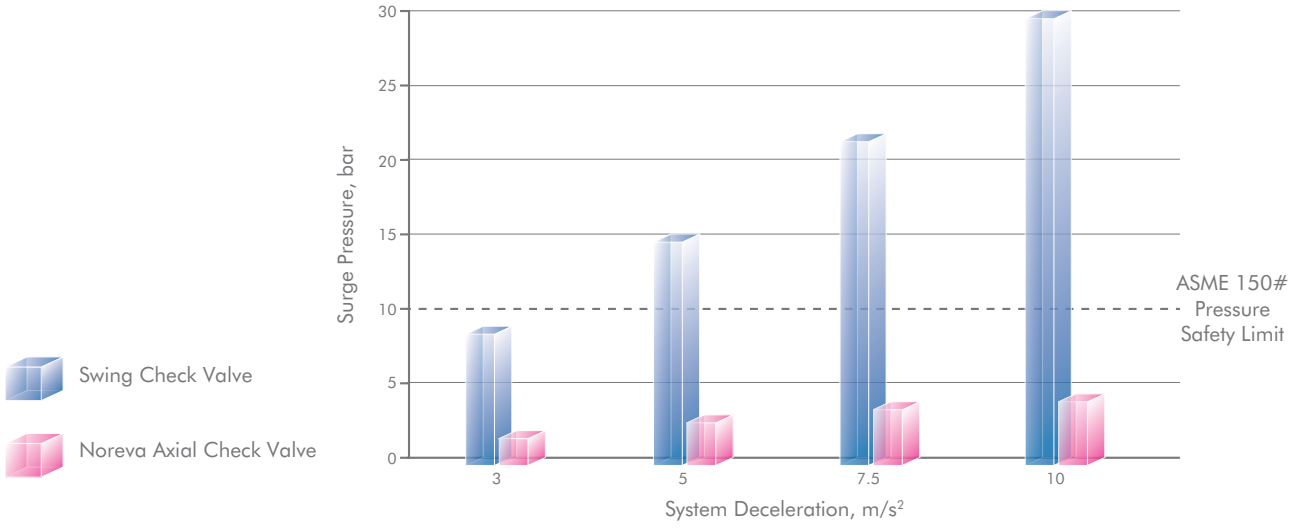
Low Inertia	Yes
Minimal Travel	No
Spring Assistance	Yes

Axial Check



Low Inertia	Yes
Minimal Travel	Yes
Spring Assistance	Yes

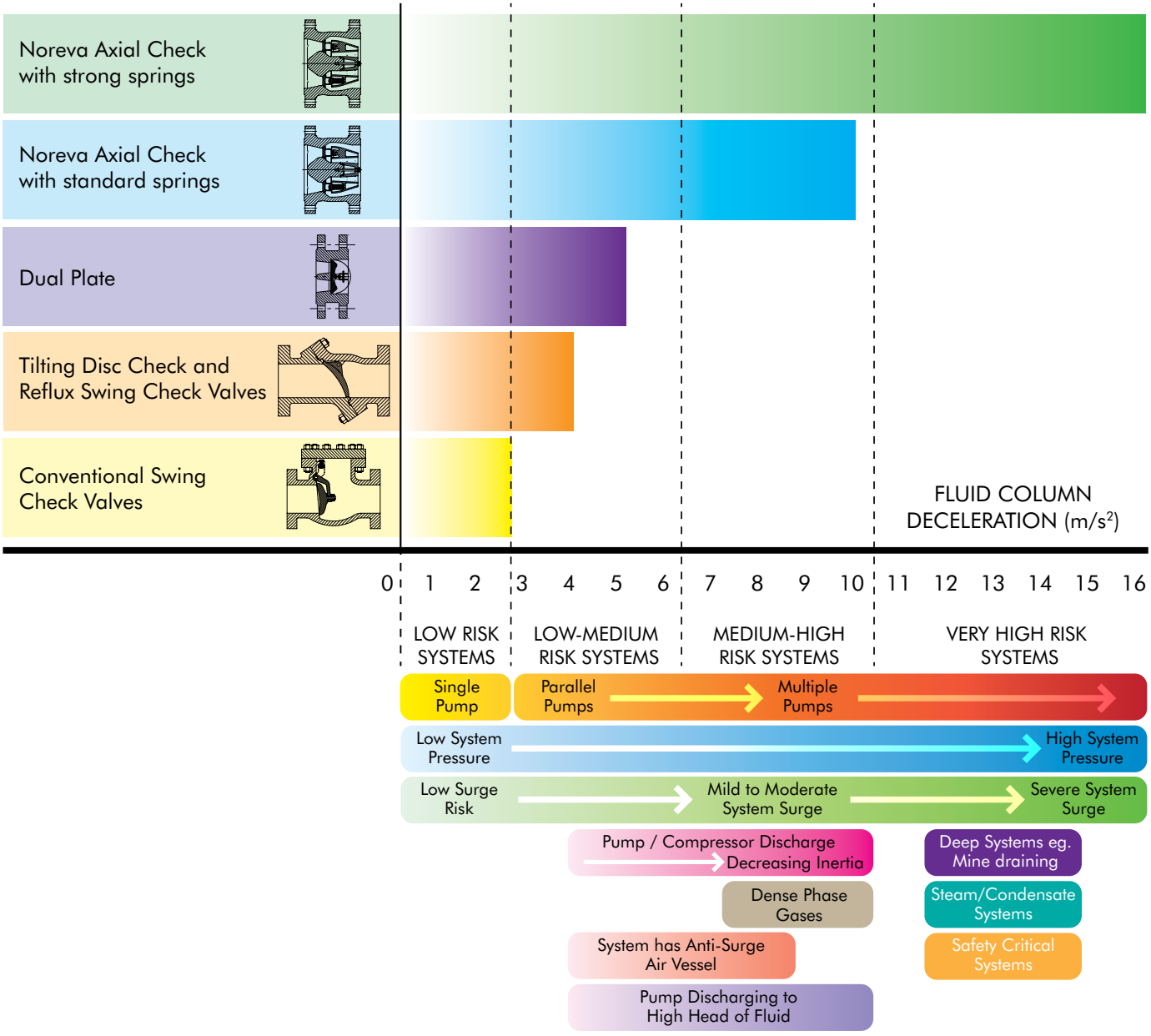
Valve Selection Comparison



ENGINEERING DATA

Check Valve Selection based upon System Deceleration Characteristic

Check Valve Types

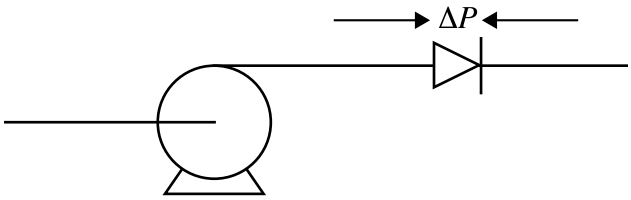


The above check valve selections and information are for guidance only.
Please consult Noreva for Check Valve applications.

ENGINEERING DATA
Total Life Cycle Costs

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

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



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

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

Pipe velocity = Critical velocity (3.0m/s)

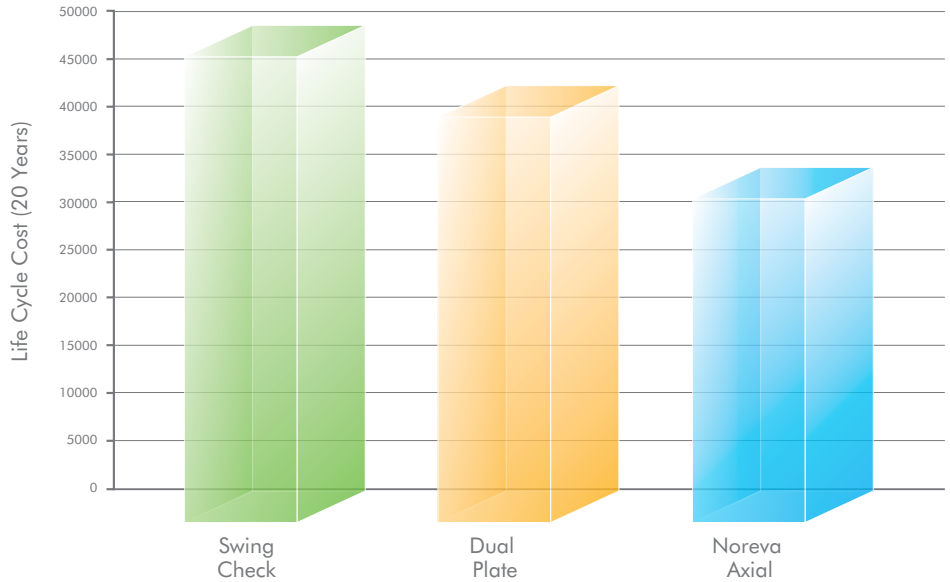
Q = Av = 0.1140 x 3.0 = 0.342m^3/s

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

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

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

Energy Cost = 0.12 $/kWh
8000 hrs/year



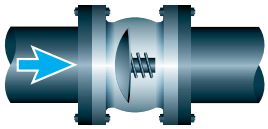
Some swing check valves appear to offer higher Cv values and, therefore, lower pressure losses. However, such pressure losses are only achieved when the valve is 100% open which invariably requires a high fluid velocity – a consequence of which is high system pressure loss. Reducing the flowrate to address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

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

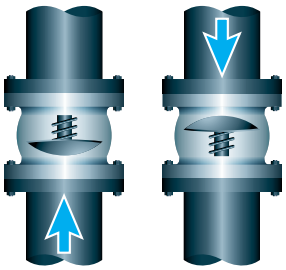
ENGINEERING DATA
Best Practice Valve Installation

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

Horizontal Flow



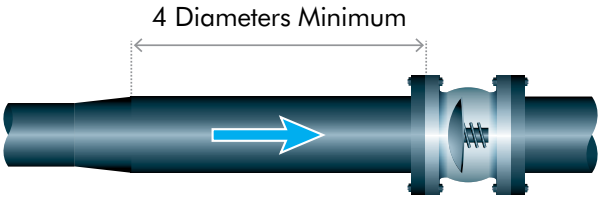
Type Z solid disc shown.
Also applicable to the N type Ring Disc.

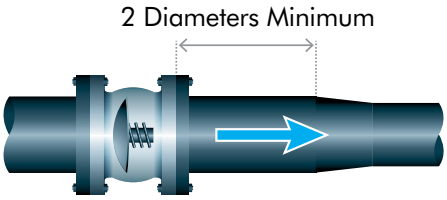


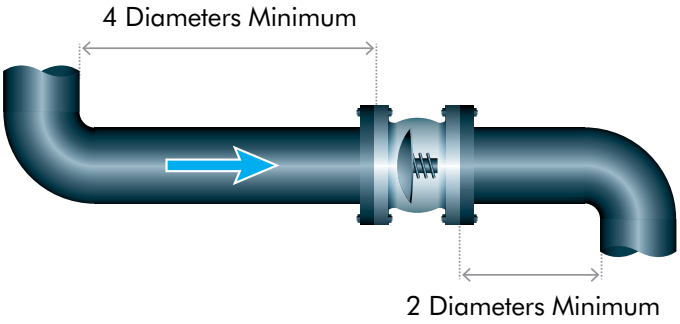
Vertical Flow

Valves suitable for vertical flow up and down.

For vertical flow please contact Noreva with process conditions.





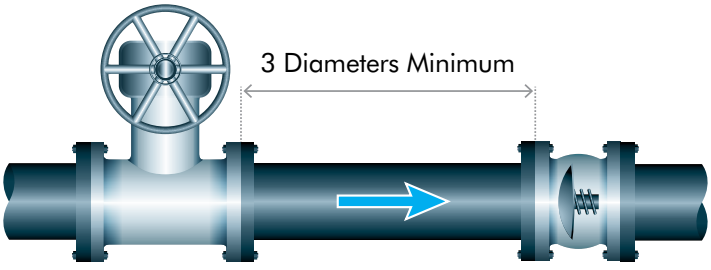


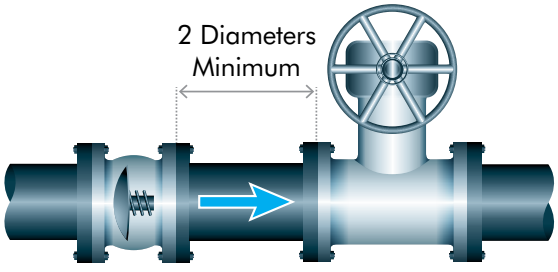
Check Valve should be installed a minimum of 4 diameters downstream of a reducer/ expander or bend to ensure flow at valve is fully developed and turbulence is minimised.

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

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

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





Note: Noreva Check Valves are not piggable

→ Indicates direction of flow

Material Specifications

	ASTM GRADE	MATERIAL DESCRIPTION	MIN UTS (Nmm²)	MIN UTS (ksi)	MIN YIELD (Nmm²)	MIN YIELD (ksi)	MINIMAL IMPACT (J)	PREn Δ	NOMINAL COMPOSITION C	Cr	Ni	Mo	Cu	N	v	W	Nb
GENERAL PURPOSE	A216 WCB	Carbon Steel	485	70	250	36	-	-	0.23	-	-	-	-	-	-	-	-
	A105	Forged Carbon Steel	485	70	250	36	-	-	0.23	-	-	-	-	-	-	-	-
	B148 C95800	Aluminium Bronze	600	87	250	36	-	-	-	-	4.5	-	79min	-	-	-	-
	A487 4C	Low Alloy Steel	620	90	415	60	-	-	0.20	0.5	0.5	0.25	-	-	-	-	-
LOW TEMP	A352 LCB	Low Temp Carbon Steel	450	65	240	35	27@ -46°C (-50°F)	-	0.23	-	-	-	-	-	-	-	-
	A352 LCC	Low Temp Carbon Steel	485	70	275	40	27@ -46°C (-50°F)	-	0.23	-	-	-	-	-	-	-	-
	A350 LF2	Low Temp Carbon Steel	485	70	250	36	27@ -46°C (-50°F)	-	0.23	-	-	-	-	-	-	-	-
	A352 LC3	Low Temp Alloy Steel	485	70	275	40	27@ -101°C (-150°F)	-	0.10	-	3.5	-	-	-	-	-	-
	A351 CF8M	Cryogenic Stainless Steel	485	70	205	30	80@ -190°C (-320°F)	27	0.08*	19	10	2.50	-	-	-	-	-
	A351 CF3M	Cryogenic Stainless Steel	485	70	205	30	80@ -196°C (-320°F)	27	0.03*	19	10	2.50	-	-	-	-	-
HIGH TEMP	A217 WC6	Chrome Molybdenum Steel	485	70	275	40	-	-	0.10	1.25	-	0.50	-	-	-	-	-
	A217 C5	Chrome Molybdenum Steel	620	90	415	60	-	-	0.10	5.0	-	0.50	-	-	-	-	-
	A217 C12	Chrome Molybdenum Steel	620	90	415	60	-	-	0.10	9.0	-	1.00	-	-	-	-	-
	A217 C12A	Chrome Molybdenum Steel	585	85	415	60		-	0.10	9.0	-	1.0	-	0.05	0.20	-	0.8
	A351 CF8M	Stainless Steel	485	70	205	30	-	27	0.08*	19	10	2.50	-	-	-	-	-
	A351 CF8C	Stainless Steel	485	70	205	30	-	20	0.08*	19	10	0.5*	-	-	-	-	8 x C
HARD WEARING	A217 CA15	Chrome Stainless Steel	620	90	450	65	-	-	0.10	13	-	-	-	-	-	-	-
	A487 CA6NM	Low Temp Chrome Stainless Steel	760	110	515	80	-	-	0.03	13	4.5	0.75	-	-	-	-	-
CORROSION RESISTANT MATERIAL	A351 CF8M	Stainless Steel	495	70	205	30	-	27	0.08*	19	10	2.5	-	-	-	-	-
	A890 4A & A995 4A	Duplex 22% Cr	620	90	415	60	45 @ -40°C (-40°F)	34	0.03*	22	5.5	3	-	0.15	-	-	-
	A890 5A & A995 5A	Super Duplex 25% Cr	690	100	515	75	45 @ -50°C (-58°F)	-	0.03*	25	7.5	4.5	-	0.25	-	-	-
	A890 6A & A995 6A	Super Duplex 25% Cr	725	105	450	65	-	41	0.03*	25	7.5	3.5	0.75	0.25	-	0.75	-
	A351 CK3MCuN	Super Austenitic	550	80	260	38	-	44	0.025*	20	18	6.5	0.75	0.2	-	-	-
	A494-M35-2	Monel	450	65	205	30	-	-	0.35*	-	BAL	-	30	-	-	-	0.5*
	A494 CU5MCuN	High Nickel 825	520	75	240	35	-	-	0.03	21	41	3	2	-	-	-	0.9
	A494 CW-6MC	High Nickel 625	485	70	275	40	-	-	0.03	21	62	9	-	-	-	-	3.5
	A494 CW-12MW	Hastelloy® C276	495	72	275	40	-	-	0.03	16	57	17	-	-	0.35	4	-
	A494 N-7M	Hastelloy® B2	525	76	275	40	-	-	0.03	1*	67	32	-	-	-	-	-
	A494 CX2MW	Hastelloy® C22	550	80	280	45	-	-	0.02*	22	56	13	-	-	0.3	3	-
	B367C2/B348Gr.2	Titanium	345	50	275	40	-	-	0.10*	-	-	-	-	-	-	-	-

* Max

Δ PREn = Pitting Resistance Equivalent number

ASME B16.34 Pressure/Temperature Ratings

Maximum Non-Shock Working Pressure (Standard Class) Bar

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

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

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

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

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

ENGINEERING DATA
Large Diameter Check Valves

Noreva specialises in the manufacture of large diameter valves being capable of manufacturing its Axial Check Valve in sizes to 88" in all materials and in all relevant pressure classes.

Applicable Flange Standards

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

66" - 88": ASME/AWWA Class B, D, E & F (Flat Face flanges)
Taylor Forge (Raised Face flanges)
or Customer agreed flange design

68" 300# Nozzle Check Valve Type NBF

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

Typical Noreva Large Diameter Check Valve Applications

- Pipelines: Extensive use in the compressor stations and pumping stations of many of the world's cross-country and country-to-country pipelines. Made for the transportation of energy and traversing 1000s of kilometres, by their nature these pipelines are critical - Noreva Check Valves are selected for their reliability and high performance.
- Ethylene Centrifugal Compressor Trains: Employed on the discharge of each compressor stage, Noreva Check Valves prevent any potential for backflow to protect compressors against reverse rotation and over pressurisation and the consequent mechanical damage.
- LNG: Especially used within the liquefaction plants, large diameter Noreva Check Valves are in service at -161°C

72" 150# Nozzle Check Valve Type NKF

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

ENGINEERING DATA
Cryogenic Valves

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

Seat leakage is measured with calibrated flow meters. Valve Inspection and Test Standard API 598 defines the maximum permissible leakrate with air or inert gas at ambient temperature conditions as 700cc/minute/inch bore diameter.

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.

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

Cryogenic & High Pressure Gas Testing Facility

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

Typical Test Procedures
BS 6364
Shell SPE 77/200

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

Outside Leakage (body): Zero

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

NOZZLE CHECK VALVES Ordering Instructions

EXAMPLE

VALVE TYPE		CONNECTION STYLE	VALVE SIZE			ANSI / API / PN PRESSURE RATING			FLANGE / CONNECTION	END CONNECTION
N	K	F	3	2	i	0	6	0	A	R

VALVE TYPE	
FIG	TYPE
NB	NRV-B
ND	NRV-B (API 6D F/F)
NK	NRV-BK
NP	NRV-B with Position Indicator
ZS	NRV-ZSK
ZB	NRV-ZK
ZD	NRV-ZK (API 6D F/F)
ZO	NRV-Z
ZL	NRV-Z (DIN F/F)
NG	NRV-G
NR	NRV-R
KO	NRV-K
[ ] X	To be Specified

CONNECTION STYLE	
FIG	CONNECTION
F	Flanged
W	Weld End
L	Fully Lugged
O	Wafer
T	Butt Weld + Transition
H	Hub Ended
S	Screwed End
V	Compact Flange
X	To be Specified

VALVE SIZE	
In	ANSI, AWWA,API
mm	JIS & PN Ratings

VALVE SIZE	
API SIZE	FIG
1 13/16 inch	1Xi
2 1/16 inch	2Si
2 9/16 inch	2Xi
4 1/16 inch	4Si
5 1/8 inch	5Ei
7 1/16 inch	7Si
9 inch	09i
11 inch	11i
13 5/8 inch	13x
16 3/4 inch	16x
18 3/4 inch	18x
21 1/4 inch	21Q

VALVE SIZE	
DN SIZE	FIG
14 mm	001
25 mm	002
32 mm	003
40 mm	004
50 mm	005
65 mm	006
80 mm	008
100 mm	010
125 mm	012
150 mm	015
200 mm	020
250 mm	025
300 mm	030
350 mm	035
400 mm	040
450 mm	045
500 mm	050
550 mm	055
600 mm	060
650 mm	065
700 mm	070
750 mm	075
800 mm	080
850 mm	085
900 mm	090
950 mm	095
1000 mm	100
1050 mm	105
1100 mm	110
1150 mm	115
1200 mm	120
1250 mm	125
1300 mm	130
1350 mm	135
1400 mm	140
1450 mm	145
1500 mm	150
1550 mm	155
1600 mm	160
1650 mm	165
1700 mm	170
1800 mm	180
1900 mm	190
1950 mm	195
2000 mm	200
2100 mm	210
2200 mm	220
2400 mm	240

VALVE SIZE	
IN SIZE	FIG
1/2 inch	H1i
1 inch	01i
1 1/4 inch	1Qi
1 1/2 inch	1Hi
2 inch	02i
2 1/2 inch	2Hi
3 inch	03i
4 inch	04i
5 inch	05i
6 inch	06i
8 inch	08i
10 inch	10i
12 inch	12i
14 inch	14i
16 inch	16i
18 inch	18i
20 inch	20i
22 inch	22i
24 inch	24i
26 inch	26i
28 inch	28i
30 inch	30i
32 inch	32i
34 inch	34i
36 inch	36i
38 inch	38i
40 inch	40i
42 inch	42i
44 inch	44i
46 inch	46i
48 inch	48i
50 inch	50i
52 inch	52i
54 inch	54i
56 inch	56i
58 inch	58i
60 inch	60i
62 inch	62i
64 inch	64i
66 inch	66i
68 inch	68i
72 inch	72i
76 inch	76i
78 inch	78i
80 inch	80i
84 inch	84i
88 inch	88i
96 inch	96i

PRESSURE RATING	
ANSI PRESSURE RATING	
FIG	RATING
012	ANSI 125
015	ANSI 150
030	ANSI 300
060	ANSI 600
090	ANSI 900
150	ANSI 1500
250	ANSI 2500
300	API 3000
500	API 5000
100	API 10000

PRESSURE RATING	
PN PRESSURE RATING	
FIG	RATING
P02	PN 2,5
P06	PN 6
P10	PN 10
P14	PN 14
P16	PN 16
P21	PN 21
P25	PN 25
P35	PN 35
P40	PN 40
P48	PN 48
P63	PN 63
P64	PN 64
N10	PN 100
N16	PN 160
N25	PN 250
N32	PN 320
N35	PN 350
N40	PN 400
PXX	Special

FLANGE / CONNECTION	
FIG	STANDARD
A	ASME B16.5 / 16.47 Ser. A / MSS SP-44
F	ASME B16.47 Series B
W	AWWA C207
D	DIN EN 1092-1/2
P	BS 4504
M	BS 1560
K	AS 4087
L	AS 2129
N	NORSOK L-005 / VECTOR
I	API 6A / ISO 10423
B	Butt Weld End to ASME B16.25
E	Butt Weld End to EN 12627
R	Butt Weld End to GL 214-501
G	Grayloc
T	Techlok
C	Screwed / Threaded End
S	SANS 1123
X	To be Specified

END CONNECTION	
FIG	STANDARD
R	Raised Face Rz 16-25 / Form B2
B	Raised Face Rz 16-63 / Form B + B1
J	Ring Groove
F	Flat Face Rz 16-25
A	Flat Face Rz 16-63 / Form A
O	O-Ring Groove / Form H
D	Small/Large Groove / Form D
C	Small/Large Tongue / Form C
E	Small/Large Male / Form E
M	Small/Large Female / Form F
G	O-Ring Vorsprung (Form G)
W	Weld End
H	Hub Ended
V	Compact End
-	N / A
X	To be Specified

BODY / DIFFUSER MATERIAL	BODY SEAT	DISC MATERIAL	DISC SEAT	SPRING MATERIAL	SPRING TORQUE
C	U	S	P	I	2

FIG	MATERIAL	SPECIFICATION
A	Nickel Aluminium Bronze	BS EN 1982 CC333G / ASTM B148 C95800
D	Ductile Iron	ASTM A395 GR 60-40-18
W	German Ductile Iron	EN-GJS-400-15
C	Carbon Steel	ASTM A216 WCB / ASTM A105
P	German Carbon Steel	GP240GH+N (1.0619) / P250GH+N (1.0460)
L	Low Temp Carbon Steel	ASTM A352 LCB [Type: GS-Ck 24 (1.1156)]
O	Low Temp Carbon Steel	"ASTM A352 LCC / ASTM A350 LF2 [Type: G20Mn5+N (1.6220) / P355NH (1.0565)]"
K	Low Alloy Steel	ASTM A487 Grade 4C / AISI 4130 [Type: 25CrMo4 (1.7218)]
E	410 Stainless Steel	"ASTM A217 CA15 / ASTM A182 F6a Class 2 [Type: G-X8CrNi13 (1.4008) / X12Cr13 (1.4006)]"
N	9% Cr Steel	ASTM A217 C12 / ASTM A182 F9
G	Low Temp 13% Cr 4% Ni	ASTM A352 CA6NM
S	316 Stainless Steel	"ASTM A351 CF8M / ASTM A182/A479 F316 [Type: GX5CrNiMo19-11-2 (1.4408) / X5CrNiMo17-12-2 (1.4401)]"
3	German 316Ti Stainless Steel	GX5CrNiMoNb19-11-2 (1.4581) / X6CrNiMoTi17-12-2 (1.4571)
F	316L Stainless Steel	"ASTM A351 CF3M / ASTM A182/A479 F316L [Type: GX2CrNiMo19-11-2 (1.4409) / X2CrNiMo17-12-2 (1.4404)]"
Y	347 St. Steel (High Temp)	"ASTM A351 CF8C / ASTM A182 F321 [Type: X6CrNiTi18-10 (1.4541)]"
Q	22% Chrome Duplex	"ASTM A890/A995 4A / ASTM A182 F51 [Type: GX2CrNiMoN22-5-3 (1.4470) / X2CrNiMoN22-5-3 (1.4462)]"
B	25% Chrome Super Duplex	J93372 / ASTM A995 1B (CD4MCuN) (WE)
R	Ferralium 255-3SC ®	Ferralium
Z	25% Chrome Super Duplex	"ASTM A890/A995 6A / ASTM A182 F55 [Type: X2CrNiMoCuWN25-7-4 (1.4501)]"
H	Alloy 825	"ASTM A494 CU5MCuC / ASTM B564 UNS N08825 [Type: NiCrMo (2.4858)]"
I	Alloy 625	"ASTM A494 CW6MC / ASTM B564 UNS N06625 [Type: NiCr22Mo9Nb (2.4856)]"
V	Avesta 254 SMO ®	ASTM A351 CK3MCuN / ASTM A182 F44
J	Hastelloy C276 ®	ASTM A494 CW12MW (WE)
M	Monel 400	ASTM A494 M35-1 / ASTM B564 UNS N04400
T	Titanium	ASTM B367 C2 / B381 F2 / B384 GR2
U	Stellite ®	Stellite 6
1	Chromium Molybdenum Steel	ASTM A217 GR WC9
2	3.5% Nickel Steel	ASTM A352 LC3
4	431 Stainless Steel	[Type: GX22CrNi17 (1.4059) / AISI 431 [Type: X17CrNi16-2 (1.4057)]
5	Alloy 20	ASTM A351 CN7M
6	317 Stainless Steel	ASTM A351 CG8M
7	Carbon Molybdenum Steel	ASTM A352 LC1 [Type: G18Mo5 (1.5422)]
8	Ni Resist Iron	ASTM A439 D2
9	High Temp CrMo Steel	"ASTM A217 WC6 / ASTM A182 F11 Class 2
X	To Be Specified	To Be Specified

BODY SEAT / DISC SEAT OVERLAY MATERIAL			
FIG	MATERIAL	OPERATING TEMP RANGE	
		°F	°C
P	Same as Body / Disc	Same as Body / Disc	
E	410 Stainless Steel	-20 to 1000	- 29 to 538
S	316 Stainless Steel	-425 to 1000	-254 to 538
F	316L Stainless Steel	-425 to 850	-254 to 455
3	"307 Stainless Steel / G/W 18 8 Mn (1.4370)"	-321 to 1112	-196 to 600
G	17-4 PH	-40 to 800	-40 to 427
I	Inconel 625	-321 to 1500	-196 to 815
M	Monel 400	-321 to 900	-196 to 482
U	Stellite No 6 ®	-450 to 1500	-267 to 815
9	Stellite No 21 ®	-450 to 1500	-267 to 815
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 ®	-22 to 250	-30 to 121
T	Neoprene ®	-40 to 250	-40 to 121
K	Teflone ®	-200 to 450	-129 to 232
D	EPDM	-14 to 230	-10 to 110
L	Lined Body to Specification	100% Internally Lined Body	
X	To be Specified / Seat Ring		

SPRING MATERIAL			
FIG	MATERIAL	RECOMMENDED MAX TEMP	
		°F	°C
S	316 Stainless Steel [Type: X6CrNiMoTi17-12-2 (1.4571) }		
I	Inconel X750 ®	1000	537
T	Inconel 625 ®	1000	537
M	Monel K500 ®	400	204
L	Inconel 718 ®	1022	550
E	Elgiloy	842	450
9	Titanium	662	350
J	Hastelloy	842	450
X	To Be Specified		

SPRING TORQUE		
FIG	STANDARD	VELOCITY
-	Undefined	Undefined
0	Spring No.0	1,0 m/s
1	Spring No.1	1,5 m/s
2	Spring No.2	2,0 m/s
3	Spring No.3	2,5 m/s
4	Spring No.4	3,0 m/s
X	Special	Special

www.noreva.de

NOREVA GmbH
Düsenrückschlagventile, Hocksteiner Weg 56, D - 41189 Moenchengladbach (Germany)
Telephone: +49 (0) 21 66 / 12 686 - 0 **Fax:** +49 (0) 21 66 / 12 686 - 66 **EMail:** info@noreva.de

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