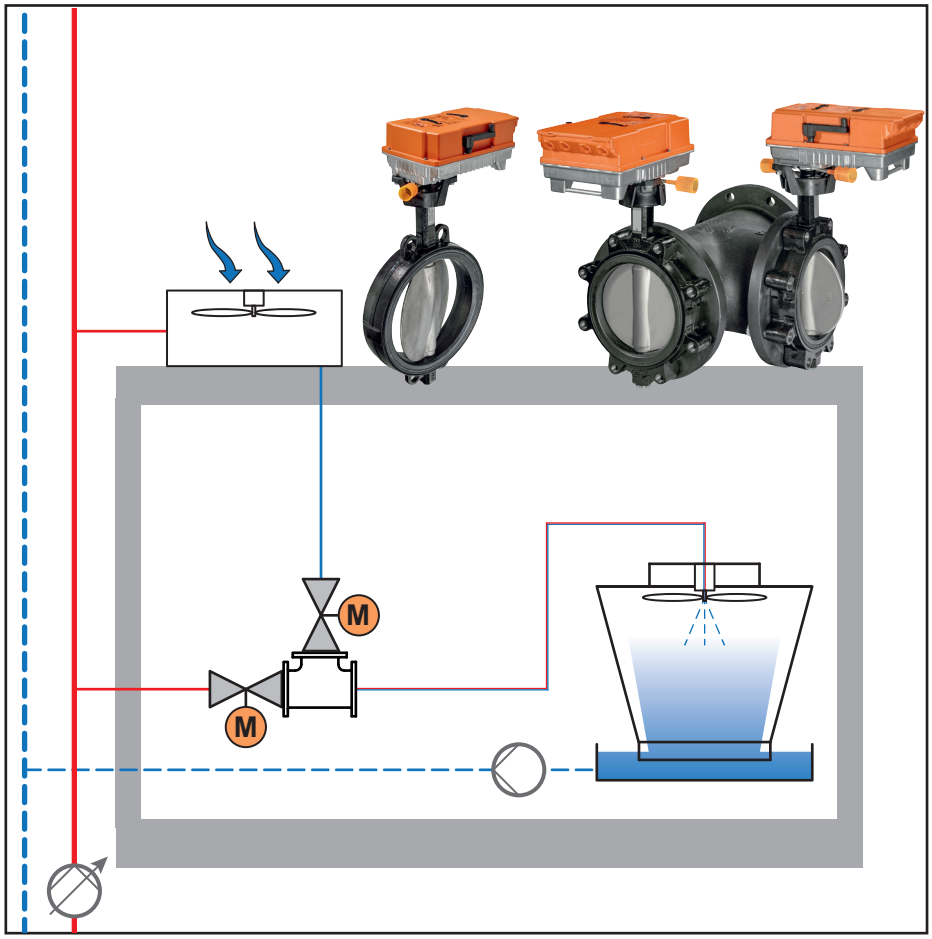


Butterfly valves for open-close, change-over and control applications

Table of Contents

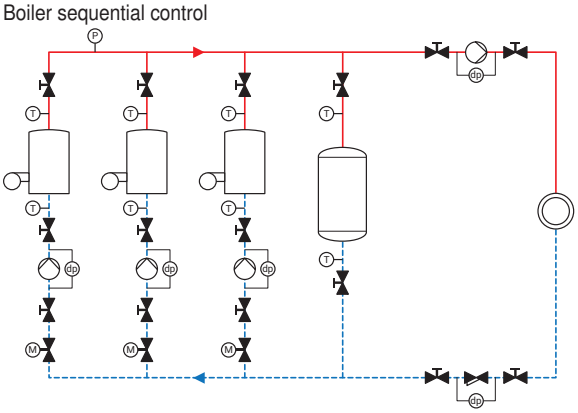
Introduction

Open-close and change-over applications

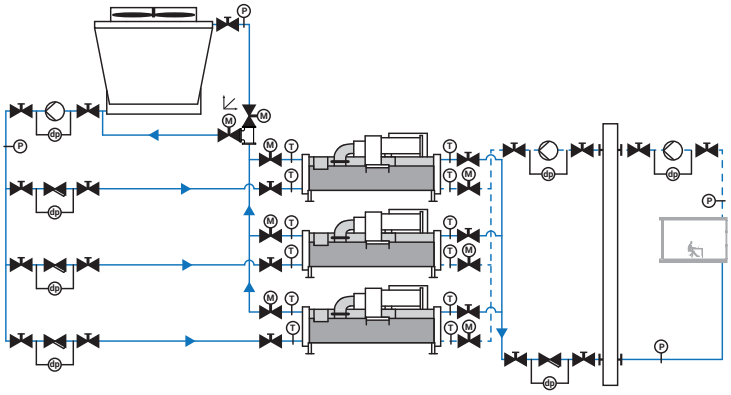
Energy savings and the reduction of the leakages will become even more important in the future. The generation outputs of boilers or chillers are divided up into different performance level categories. Depending on the decline in pressure, the generators will then be switched on or off. The generators will be blocked in order to minimise performance loss. The leakage rate shall be kept as low as possible. The pressure loss shall be low with the valve opened completely. These are prerequisites for minimising the electrical performance of the pumps and thus for lowering operating costs.

Typical applications

Boiler sequential control



Chiller isolation and cooling tower bypass

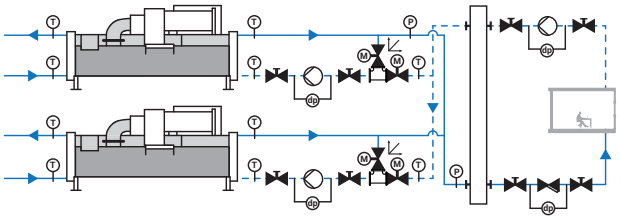


Control applications

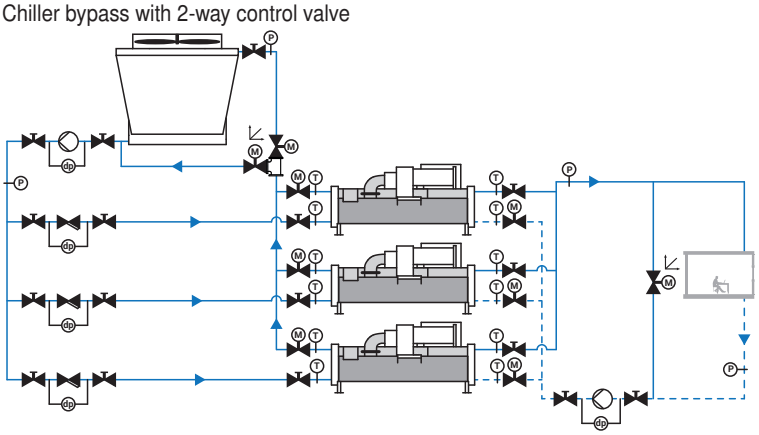
The BELIMO butterfly valves exhibit a nearly equal-percentage characteristic curve in accordance with VDI 2176 for opening angles between 0 % and 60 % and can also be installed in applications with chillers and cooling towers as an inexpensive controlling element.

Typical applications

Chiller start-up circuit



Chiller bypass with 2-way control valve



Introduction

(continued)

Butterfly valves and actuator product range

24 V and 230 V rotary actuators with different functionalities, auxiliary switches, and with or without emergency control function in a variety of torque classes ranging from 20 to 3500 Nm are available for the motorisation of the BELIMO wafer and lug type butterfly valves (DN 25 to 700) for indoor and outdoor applications: SR..A-5, SRF..A-5, SR..P-5, GR..A-5, DR..A-5, DR..A-7, PR.. und SY.. .
The butterfly valves can also be manually operated with lever or worm gear.

Wafer type butterfly valve with lever

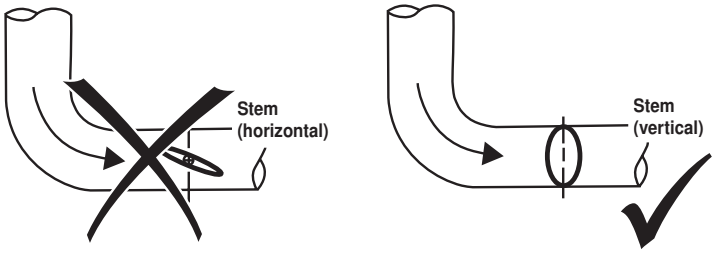
Lug type butterfly valve with worm gear

Lug Type butterfly valve with SR..A-5 actuator

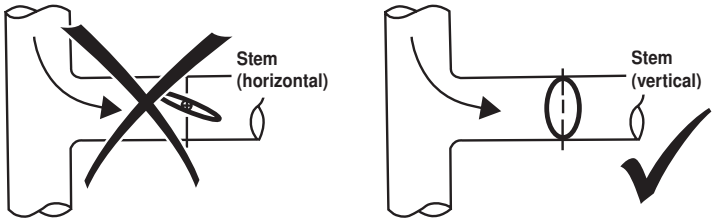
Wafer type butterfly valve with PR.. actuator

Installation

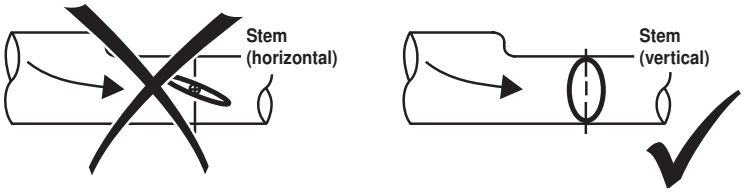
Butterfly valve after a bending



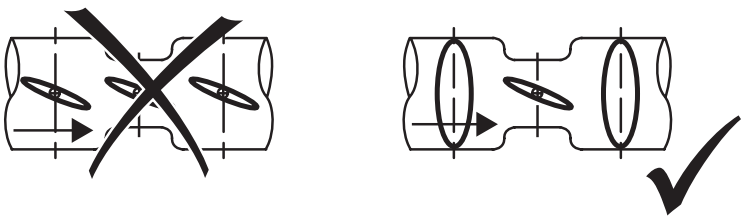
Butterfly valve after a T-piece



Butterfly valve after a pipe reduction



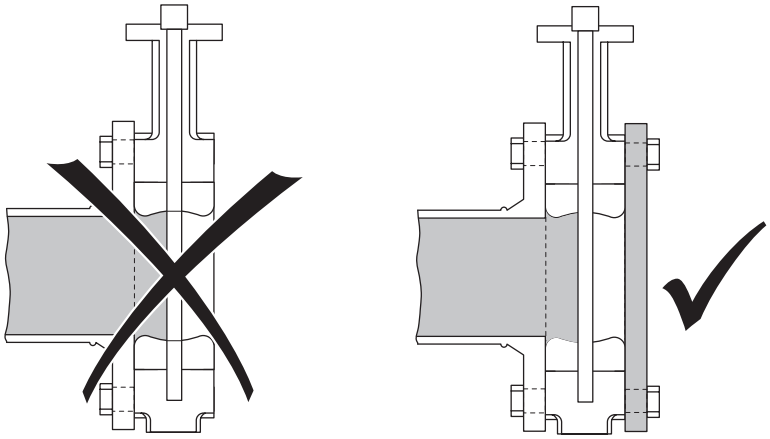
a number of butterfly valves for control applications



Installation *(continued)*

Installation of butterfly valves

as end fitting

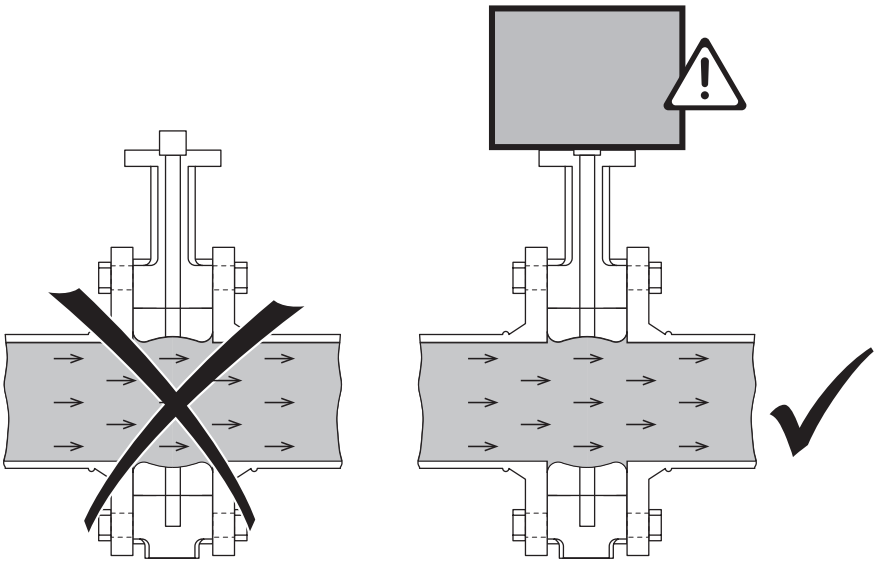


D6..N(L) butterfly valves must be mounted with counter flange in open systems. In case of D6..W(L) butterfly valves, the counter flange must be closed additionally.

Generally speaking, butterfly valves must run through a full cycle at least once per month in order to reduce the breakaway torque.

Important in case of butterfly valves - D6..W(L)

The butterfly valves D6..W and D6..WL shall not be operated without an actuator or worm gear. In the absence of an actuator or worm gear, the butterfly valve might close and cause damage (water hammer).



Project planning

Design

The data, information and limit values listed on the data and installation sheets are to be taken into account and/or complied with, respectively.

Pipeline clearances

The minimum clearances between the pipelines and the walls and ceilings required for project planning depend not only on the valve dimensions but also on the selected actuator and can be found in the data sheets of the valves and actuators.

Design

General information

The open-close and change-over butterfly valves can be used in accordance with the following values:

– The maximum flow speed of 4 m/s may not be exceeded in the valve.
- The valve is to be selected according to the principle "Nominal pipe diameter = Nominal valve diameter" to keep the pressure drop as low as possible.

D6.. + ZD6N-..-combinations

Open-close butterfly valves			Lever	Worm gear 1)
Type	DN [mm]	ζ Zeta value		
D625N(L)	25	0,25	ZD6N-H100	ZD6N-S100
D632N(L)	32	0,55	ZD6N-H100	ZD6N-S100
D640N(L)	40	0,97	ZD6N-H100	ZD6N-S100
D650N(L)	50	1,0	ZD6N-H100	ZD6N-S100
D665N(L)	65	0,99	ZD6N-H100	ZD6N-S100
D680N(L)	80	0,97	ZD6N-H100	ZD6N-S100
D6100N(L)	100	0,59	ZD6N-H100	ZD6N-S100
D6125N(L)	125	0,5	ZD6N-H150	ZD6N-S150
D6150N(L)	150	0,41	ZD6N-H150	ZD6N-S150
D6200W(L)	200	0,53		ZD6N-S150
D6250W(L)	250	0,35		ZD6N-S150
D6300W(L)	300	0,4		ZD6N-S150
D6350N(L)	350	0,23		ZD6N-S350
D6400N(L)	400	0,2		ZD6N-S400
D6450N(L)	450	0,19		ZD6N-S450
D6500N(L)	500	0,17		ZD6N-S500
D6600N(L)	600	0,15		ZD6N-S600
D6700N(L)	700	0,21		ZD6N-S700

1) Worm gears are not suitable for outdoor applications.

Closing and max. differential pressure

DN 25-300

Open-close butterfly valves			Actuators							
			SR..		GR..		DR..		PR..	
Type	DN [mm]	k_vmax [m^3/h]	Δps [kPa]	Δpmax [kPa]	Δps [kPa]	Δpmax [kPa]	Δps [kPa]	Δpmax [kPa]	Δps [kPa]	Δpmax [kPa]
D625N(L)	25	50	1200	300	1200	300	-	-	-	-
D632N(L)	32	55	1200	300	1200	300	-	-	-	-
D640N(L)	40	65	1200	300	1200	300	-	-	-	-
D650N(L)	50	100	1200	300	1200	300	-	-	-	-
D665N(L)	65	170	1200	300	1200	300	-	-	-	-
D680N(L)	80	260	-	-	1200	300	1200	300	-	-
D6100N(L)	100	520	-	-	-	-	1200	300	1200 1)	300
D6125N(L)	125	880	-	-	-	-	1200	300	1200 2)	300
D6150N(L)	150	1400	-	-	-	-	-	-	1200 2)	300
D6200W(L)	200	2200	-	-	-	-	-	-	1400 2)	300
D6250W(L)	250	4200	-	-	-	-	-	-	1400 2)	300
D6300W(L)	300	5700	-	-	-	-	-	-	1400 2)	300

1) ZPR03 Linkage
2) ZPR01 Linkage

Design

(continued)

Closing and max. differential pressure

DN 350-700

Open-close butterfly valves		Actuators											
		SY6		SY7		SY8		SY9		SY10		SY12	
Type	DN [mm]	Δps [kPa]	Δpmax [kPa]	Δps [kPa]	Δpmax [kPa]	Δps [kPa]	Δpmax [kPa]	Δps [kPa]	Δpmax [kPa]	Δps [kPa]	Δpmax [kPa]	Δps [kPa]	Δpmax [kPa]
D6350N(L)	350	600	300	1200 [3]	300	-	-	-	-	-	-	-	-
D6400N(L)	400	600 [4]	300	1200 [5]	300	-	-	-	-	-	-	-	-
D6450N(L)	450	-	-	600 [6]	300	1200 [6]	300	-	-	-	-	-	-
D6500N(L)	500	-	-	-	-	600 [6]	300	1200 [7]	300	-	-	-	-
D6600N(L)	600	-	-	-	-	-	-	-	-	600 [8]	300	1000 [8]	300
D6700N(L)	700	-	-	-	-	-	-	-	-	-	-	200 [9]	200

[3] ZSY-703 Linkage
[4] ZSY-401 Linkage
[5] ZSY-701 Linkage
[6] ZSY-702 Linkage
[7] ZSY-901 Linkage
[8] ZSY-902 Linkage
[9] ZSY-903 Linkage

Design

Flow rate vs. differential pressure

Open-close butterfly valves			Differential pressure Δp_{v100}					
Type	DN [mm]	$k_v$max [m³/h]	0,01 [kPa]	0,1 [kPa]	1 [kPa]	2 [kPa]	3 [kPa]	Flow rate $\dot{V}_{100}$ [m³/h]
D625N(L)	25	50	0,5	1,6	5	7	-	
D632N(L)	32	55	0,6	1,7	5,5	7,8	9,5	
D640N(L)	40	65	0,7	2	6,5	9,2	11,3	
D650N(L)	50	100	1	3,2	10	14,1	17,3	
D665N(L)	65	170	1,7	5,4	17	24	29	
D680N(L)	80	260	2,6	8,2	26	37	45	
D6100N(L)	100	520	5,2	16,4	52	74	90	
D6125N(L)	125	880	8,8	28	88	124	152	
D6150N(L)	150	1400	14	44	140	198	242	
D6200W(L)	200	2200	22	70	220	311	381	
D6250W(L)	250	4200	42	133	420	594	727	
D6300W(L)	300	5700	57	180	570	806	987	
D6350N(L)	350	10300	103	326	1030	1457	-	
D6400N(L)	400	14200	142	449	1420	2008	-	
D6450N(L)	450	18800	188	595	1880	-	-	
D6500N(L)	500	24100	241	762	2410	-	-	
D6600N(L)	600	37300	373	1180	3730	-	-	
D6700N(L)	700	42800	428	1353	4280	-	-	

Type	DN [mm]	$k_v$max [m³/h]	4 [kPa]	5 [kPa]	6 [kPa]	7 [kPa]	8 [kPa]	Flow rate $\dot{V}_{100}$ [m³/h]
D625N(L)	25	50	-	-	-	-	-	
D632N(L)	32	55	11	-	-	-	-	
D640N(L)	40	65	13	14,5	16	17,2	-	
D650N(L)	50	100	20	22	24	26	28	
D665N(L)	65	170	34	38	42	45	48	
D680N(L)	80	260	52	58	64	69	74	
D6100N(L)	100	520	104	116	-	-	-	
D6125N(L)	125	880	176	-	-	-	-	
D6150N(L)	150	1400	280	-	-	-	-	
D6200W(L)	200	2200	440	-	-	-	-	
D6250W(L)	250	4200	-	-	-	-	-	
D6300W(L)	300	5700	-	-	-	-	-	
D6350N(L)	350	10300	-	-	-	-	-	
D6400N(L)	400	14200	-	-	-	-	-	
D6450N(L)	450	18800	-	-	-	-	-	
D6500N(L)	500	24100	-	-	-	-	-	
D6600N(L)	600	37300	-	-	-	-	-	
D6700N(L)	700	42800	-	-	-	-	-	

Formula

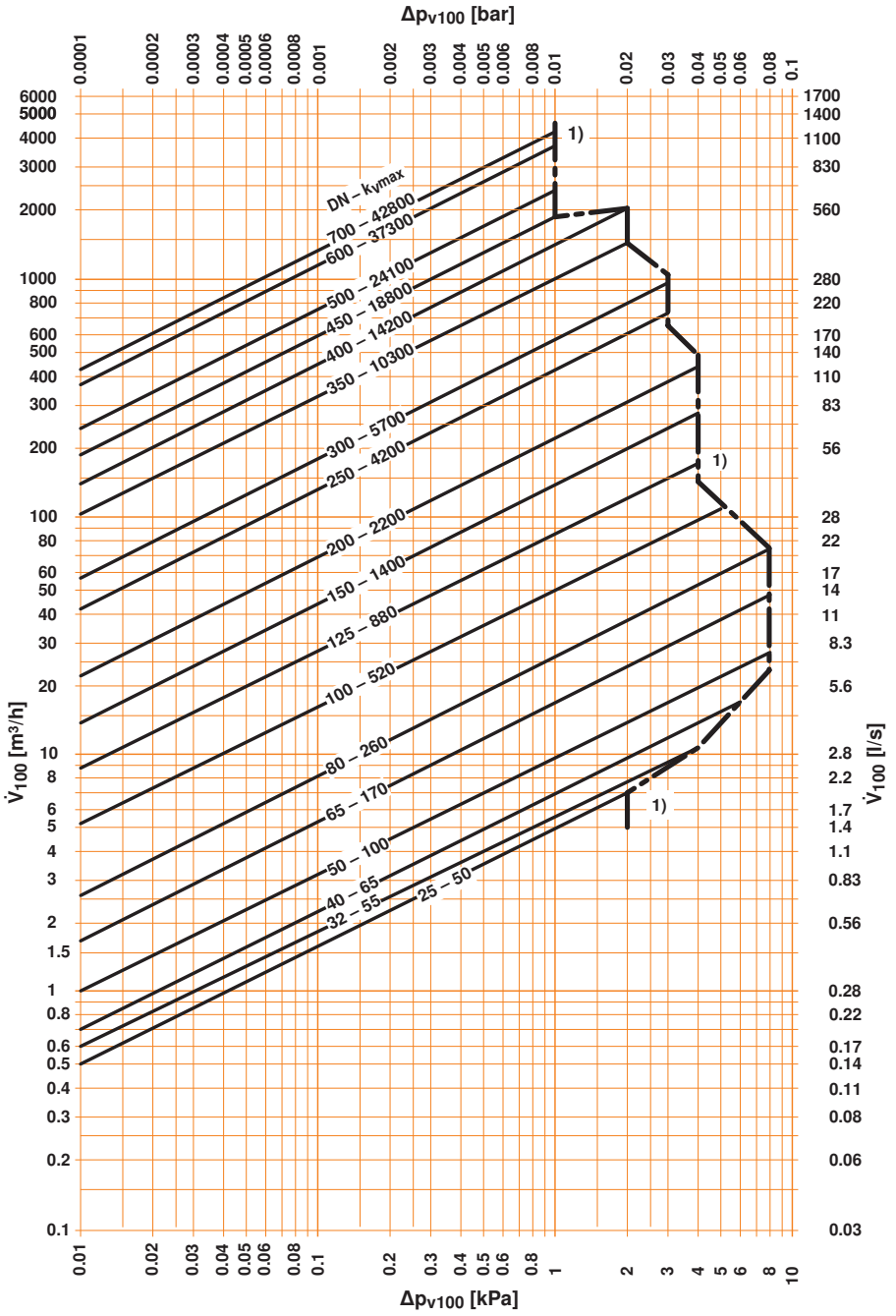
$$\Delta p_{v100} = \left(\frac{\dot{V}_{100}}{k_{v\,max}}\right)^2 \times 100$$

Δp_{v100} [kPa]
$\dot{V}_{100}$ [m³/h]
$k_v$max [m³/h]

Design

(continued)

Pressure drop Δp_{v100} with completely opened valve



Legend

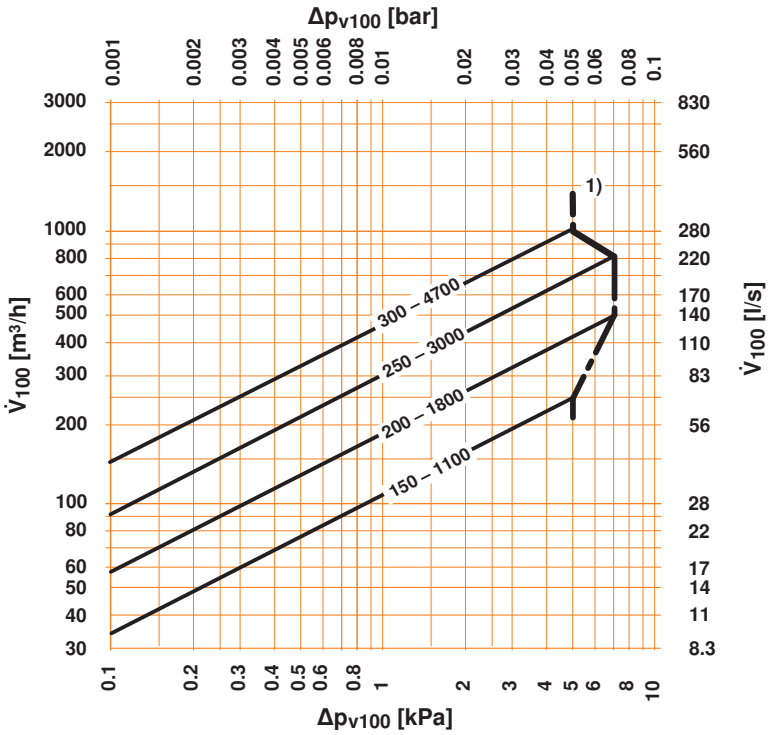
Δp_{v100}	differential pressure with valve completely open
$\dot{V}_{100}$	Nominal flow rate with Δp_{v100}
– · –	Δp_{v100}
1)	The maximum speed in the butterfly valves is 4 m/s

Design

(continued)

Flowrate vs. differential pressure

Change-over butterfly valves			Differential pressure Δp_{v100}						
Type	**DN** [mm]	**$k_v$max** [m^3/h]	**1** [kPa]	**2** [kPa]	**3** [kPa]	**4** [kPa]	**5** [kPa]	**6** [kPa]	**Flow rate $\dot{V}_{100}$** [m^3/h]
D7150NL/BAC	150	1100	110	156	190	220	250	-	
D7200WL/BAC	200	1800	180	255	300	340	380	440	
D7250WL/BAC	250	3000	300	424	500	600	650	700	
D7300WL/BAC	300	4700	470	665	760	890	1000	-	



Legend

Δp_{v100}	differential pressure with valve completely open
$\dot{V}_{100}$	Nominal flow rate with Δp_{v100}
▬ ▪ ▬	Δp_{v100}
1)	The maximum speed in the butterfly valves is 4 m/s

Project planning

Design

The data, information and limit values listed on the D6.. data and installation sheets are to be taken into account and/or complied with respectively.

Pipeline clearances

The minimum clearances between the pipelines and the walls and ceilings required for project planning depend not only on the valve size but also on the selected actuator.

Design

General information

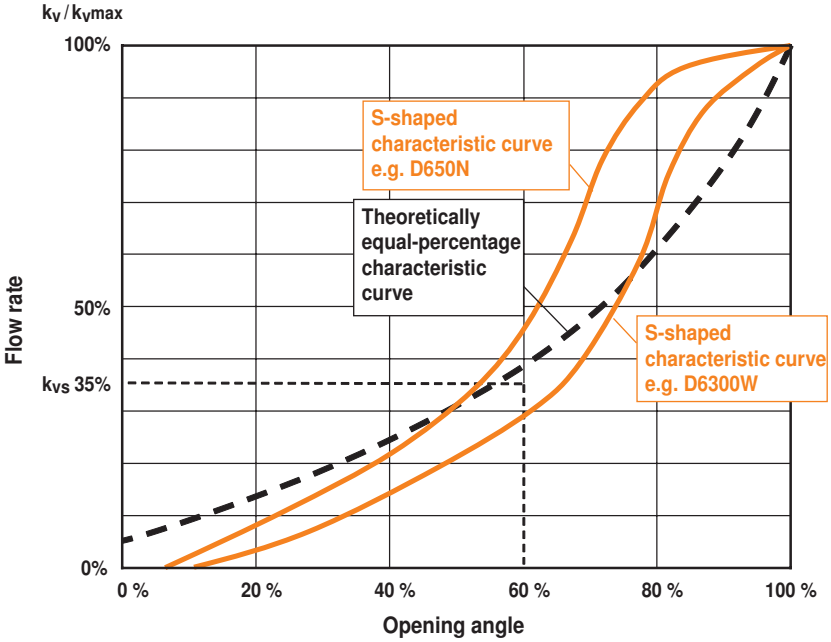
Butterfly valves can be used in control mode when the following values are complied with:
- The maximum flow speed of 4 m/s may not be exceeded in the Control butterfly valve.
- The control butterfly valve is to be selected according to the principle "Nominal pipe diameter ≥ Nominal control butterfly valve diameter". The narrowing of the pipe must be designed in such a way thereby as to ensure optimum flow in order to ensure that the pressure drop is kept as low as possible.
- The maximum differential pressure at flow through the control butterfly valve is 300 kPa (3 bar).

Technical data for control mode

Differential pressure Δp_{v0}: ≤300 kPa with valve cone opening (may not be exceeded)
Differential pressure Δp_{v60}: The values listed in the diff. pressure table must be complied with
Rangeability: >30 (with 60% opening angle)

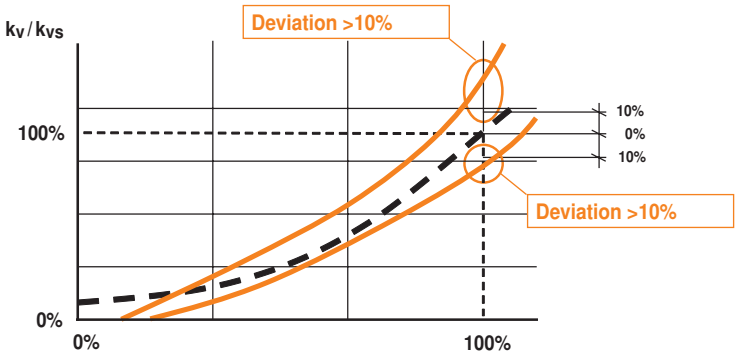
The S-shaped characteristic curve of the butterfly valve does not correspond to the equal percentage characteristic curve pursuant to VDI 2176. It is only in the angle of rotation range between 0 % and 60 % that one can speak of an approximately equal percentage characteristic curve. For an opening angle of 60 %, the kvs corresponds to approximately 35% of the kvmax value for 100 % opening angle.

S-shaped characteristic curve



Definitions $k_{V}max$ and k_{VS}
The flow rate of $k_{V}max$ will ensue when the valve is fully open (100%).
The k_{VS} value designates the flow rate at 60 % opening angle, 1 bar pressure drop and a medium temperature between 5 and 40 °C.

Scaled characteristic curve range



Design *(continued)*

Depending on the desired Kv value, the opening angle for motorising with the PR actuator can be set with a Smartphone by the BELIMO Assistant App via Near Field Communication (NFC) In case of motorising with the SR, GR and DR actuators, the desired angle of rotation range for MF and MP types can be set via PC-Tool MFT-P, as from Version 3.3 (does not apply to SY actuators).

Parameterisation linear characteristic curve

For butterfly valve actuator combinations with the PR actuator, the flow characteristic can be set to linear using the Belimo Assistant App.

Closing and differential pressure

DN 25-300

Control butterfly valves 2-way			Actuators							
			SR..		GR..		DR..		PR..	
Type	DN [mm]	k_{VS} [m^3/h]	Δps [kPa]	Δpmax [kPa]	Δps [kPa]	Δpmax [kPa]	Δps [kPa]	Δpmax [kPa]	Δps [kPa]	Δpmax [kPa]
D625N(L)	25	45	1200	300	1200	300	-	-	-	-
D632N(L)	32	55	1200	300	1200	300	-	-	-	-
D640N(L)	40	70	1200	300	1200	300	-	-	-	-
D650N(L)	50	90	1200	300	1200	300	-	-	-	-
D665N(L)	65	180	1200	300	1200	300	-	-	-	-
D680N(L)	80	300	-	-	1200	300	1200	300	-	-
D6100N(L)	100	580	-	-	-	-	1200	300	1200 [1]	300
D6125N(L)	125	820	-	-	-	-	1200	300	1200 [2]	300
D6150N(L)	150	1600	-	-	-	-	-	-	1200 [2]	300
D6200W(L)	200	2900	-	-	-	-	-	-	1400 [2]	300
D6250W(L)	250	4400	-	-	-	-	-	-	1400 [2]	300
D6300W(L)	300	7300	-	-	-	-	-	-	1400 [2]	300

[1] ZPR03 Linkage
[2] ZPR01 Linkage

Closing and max. differential pressure DN 350-700

[3] ZSY-703 Linkage
[4] ZSY-401 Linkage
[5] ZSY-701 Linkage
[6] ZSY-702 Linkage
[7] ZSY-901 Linkage
[8] ZSY-902 Linkage
[9] ZSY-903 Linkage

Control butterfly valves 2-way		Actuators											
		SY6		SY7		SY8		SY9		SY10		SY12	
Type	DN [mm]	Δps [kPa]	Δpmax [kPa]	Δps [kPa]	Δpmax [kPa]	Δps [kPa]	Δpmax [kPa]	Δps [kPa]	Δpmax [kPa]	Δps [kPa]	Δpmax [kPa]	Δps [kPa]	Δpmax [kPa]
D6350N(L)	350	600	300	1200 [3]	300	-	-	-	-	-	-	-	-
D6400N(L)	400	600 [4]	300	1200 [5]	300	-	-	-	-	-	-	-	-
D6450N(L)	450	-	-	600 [6]	300	1200 [6]	300	-	-	-	-	-	-
D6500N(L)	500	-	-	-	-	600 [6]	300	1200 [7]	300	-	-	-	-
D6600N(L)	600	-	-	-	-	-	-	-	-	600 [8]	300	1000 [8]	300
D6700N(L)	700	-	-	-	-	-	-	-	-	-	-	200 [9]	200

Design

(continued)

Flow rate vs. differential pressure

Control butterfly valves 2-way			Differential pressure Δpv60					
Type	DN [mm]	k_{vs} [m³/h]	5 [kPa]	10 [kPa]	20 [kPa]	30 [kPa]	40 [kPa]	Flow rate $\dot{V}_{60}$ [m³/h]
D625N(L)	25	24	5,4	7,6	-	-	-	
D632N(L)	32	25	5,6	7,9	11,2	-	-	
D640N(L)	40	27	6	8,5	12,1	14,8	17,1	
D650N(L)	50	30	6,7	9,5	13,4	16,4	19	
D665N(L)	65	50	11,2	15,8	22	27	32	
D680N(L)	80	75	16,8	24	34	41	47	
D6100N(L)	100	150	34	47	67	82	95	
D6125N(L)	125	260	58	82	116	142	164	
D6150N(L)	150	400	89	126	179	219	253	
D6200W(L)	200	820	183	259	367	449	-	
D6250W(L)	250	1300	291	411	581	712	-	
D6300W(L)	300	1740	389	550	778	953	-	
D6350N(L)	350	3010	673	952	1346	-	-	
D6400N(L)	400	4140	926	1309	1851	-	-	
D6450N(L)	450	5490	1228	1736	-	-	-	
D6500N(L)	500	7060	1579	2233	-	-	-	
D6600N(L)	600	10900	2437	3447	-	-	-	
D6700N(L)	700	11760	2630	3719	-	-	-	

Type	DN [mm]	k_{vs} [m³/h]	50 [kPa]	60 [kPa]	70 [kPa]	80 [kPa]	90 [kPa]	Flow rate $\dot{V}_{60}$ [m³/h]
D625N(L)	25	24	-	-	-	-	-	
D632N(L)	32	25	-	-	-	-	-	
D640N(L)	40	27	-	-	-	-	-	
D650N(L)	50	30	21	23	25	27	28	
D665N(L)	65	50	35	39	42	45	47	
D680N(L)	80	75	53	58	63	67	71	
D6100N(L)	100	150	106	116	-	-	-	
D6125N(L)	125	260	184	-	-	-	-	
D6150N(L)	150	400	-	-	-	-	-	
D6200W(L)	200	820	-	-	-	-	-	
D6250W(L)	250	1300	-	-	-	-	-	
D6300W(L)	300	1740	-	-	-	-	-	
D6350N(L)	350	3010	-	-	-	-	-	
D6400N(L)	400	4140	-	-	-	-	-	
D6450N(L)	450	5490	-	-	-	-	-	
D6500N(L)	500	7060	-	-	-	-	-	
D6600N(L)	600	10900	-	-	-	-	-	
D6700N(L)	700	11760	-	-	-	-	-	

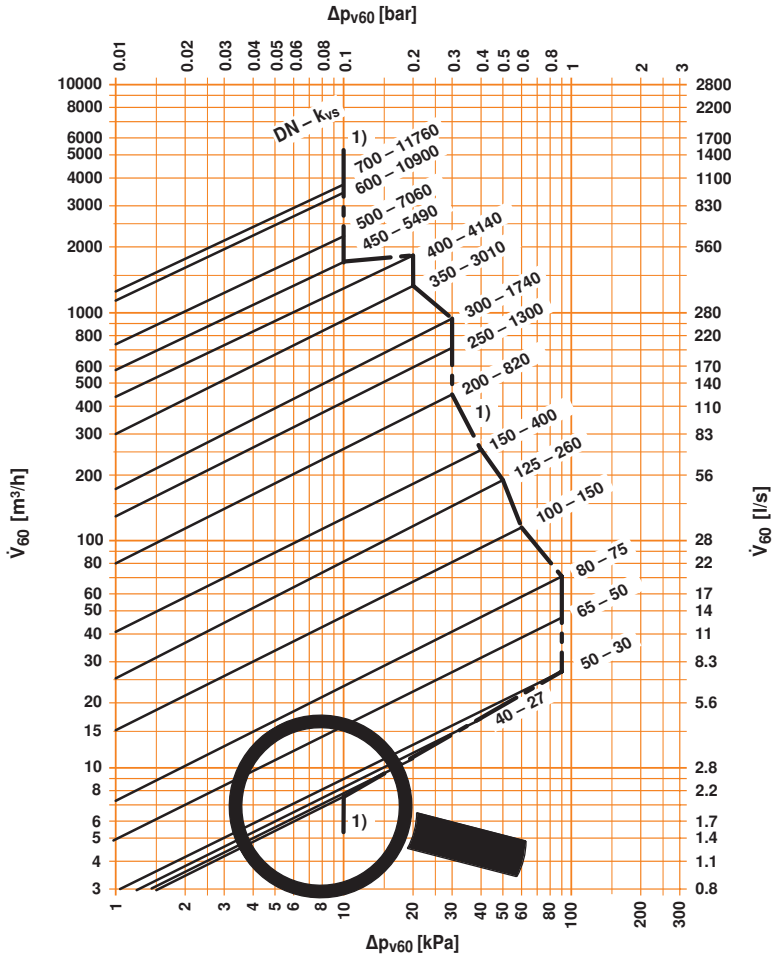
Formula

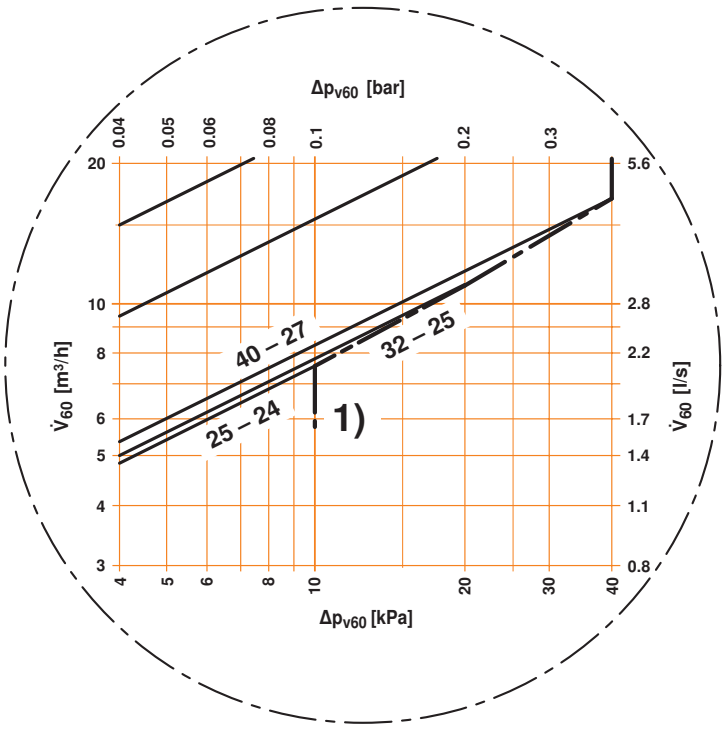
$$\Delta p_{v60} = \left(\frac{\dot{V}_{60}}{k_{vs}} \right)^2 \times 100$$

Δp_{v60}	[kPa]
$\dot{V}_{60}$	[m³/h]
k_{vs}	[m³/h]

Design *(continued)*

Pressure drop Δp_{v60} with 60% opening angle





Legend	
Δp_{v60}	Differential pressure with 60 % valve opening
$\dot{V}_{60}$	Nominal flow rate with Δp_{v60}
▬ · ▬	Δp_{v60}
1)	The maximum speed in the butterfly valves is 4 m/s

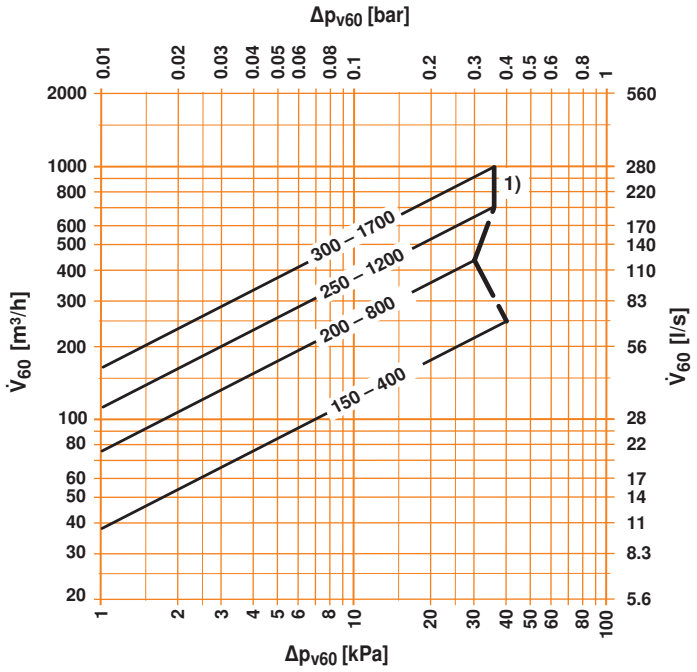
Design

(continued)

Flow rate vs. differential pressure

Control butterfly valves 3-way			Differential pressure Δpv60							
Type	DN [mm]	k_{vs} [m³/h]	5 [kPa]	10 [kPa]	15 [kPa]	20 [kPa]	25 [kPa]	30 [kPa]	35 [kPa]	40 [kPa]
D7150NL/BAC	150	400	90	120	150	175	200	220	235	250
D7200WL/BAC	200	800	180	250	300	360	400	440	-	-
D7250WL/BAC	250	1200	260	370	460	530	600	650	700	-
D7300WL/BAC	300	1700	380	530	660	760	850	925	1000	-

Flow rate $\dot{V}_{60}$ [m³/h]



Legend

Δp_{v60}	Differential pressure with 60 % valve opening
$\dot{V}_{60}$	Nominal flow rate with Δp_{v60}
▬ · ▬	Δp_{v60}
1)	The maximum speed in the butterfly valves is 4 m/s

Definitions

$k_{v}max$ Marking (catalogue value) of butterfly valves: K_v value with valve completely open (100%)

k_v Flow rate factor or flow rate coefficient. The K_v value corresponds to the volumetric flow of water through a valve (in m³/h or l/min) with a differential pressure of 100 kPa (1 bar), a water temperature of 5 ... 40 °C and at a fixed delay angle

k_{vs} k_v value of the valve at 60% degree of opening

Δp_s Closing pressure at which the actuator can still seal the butterfly valve tightly allowing for the appropriate leakage rate

Δp_{v100} Differential pressure with valve completely open

Δp_{v60} Maximum permissible differential pressure in compliance with the flow velocity of 4 m/s at 60 % ◁ valve opening angle

Δp_{v0} Differential pressure at valve cone opening

$\dot{V}_{100}$ Nominal flow rate with Δp_{v100}

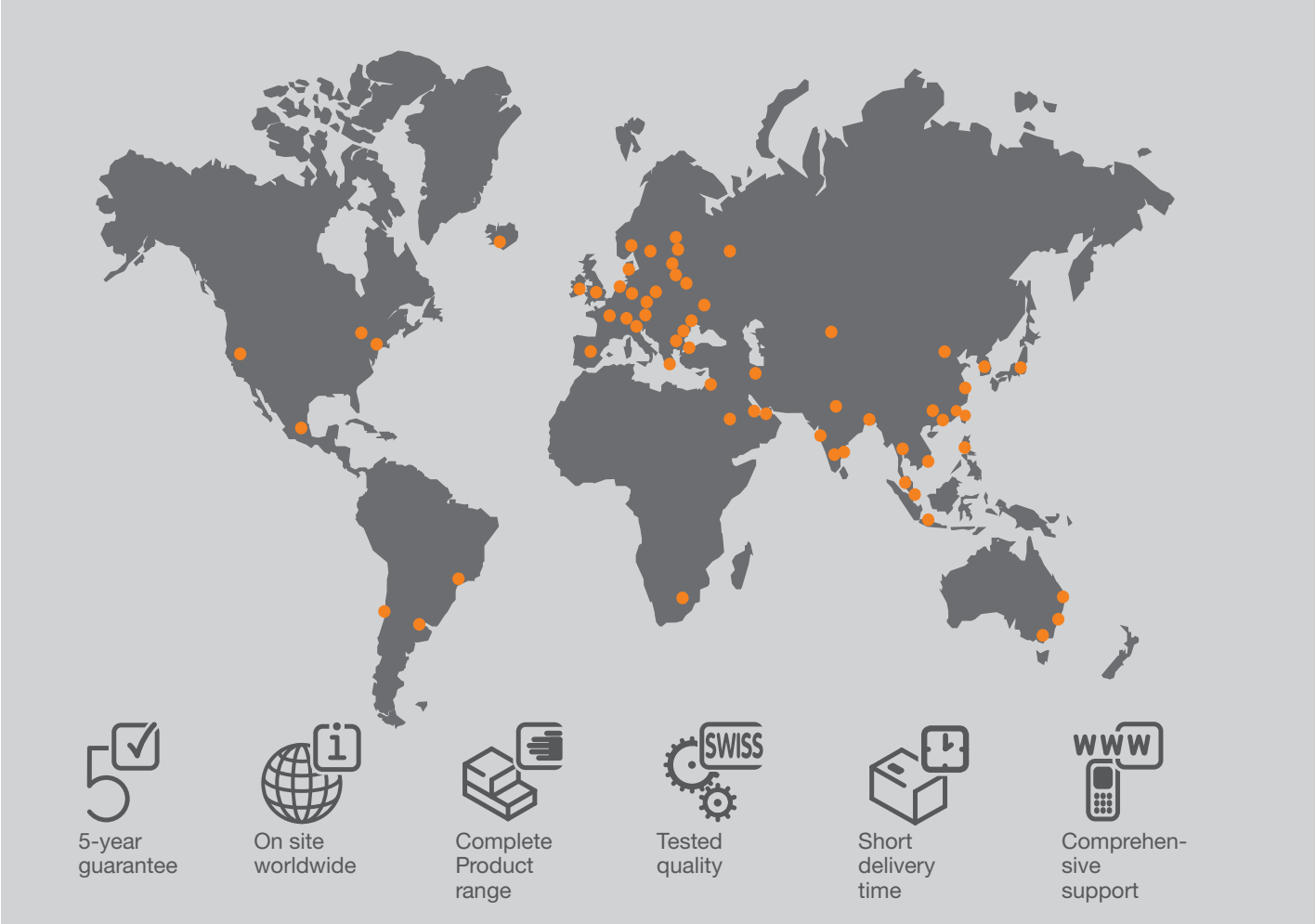
$\dot{V}_{60}$ Nominal flow rate with Δp_{v60}

ζ value Zeta ζ is the coefficient for the pressure loss through the fully opened buttefly valve (100%)

Further documentations

- Overview of Valve-actuator combinations
- Data sheets, butterfly valves and actuators
- Installation instructions for butterfly valves and actuators
- General Notes for project planning

In your vicinity – Everywhere



BELIMO Automation AG
Brunnenbachstrasse 1
CH-8340 Hinwil, Switzerland
Tel. +41 43 843 61 11
Fax +41 43 843 62 68
info@belimo.ch
www.belimo.eu

Belimo worldwide: www.belimo.com