

Series GW control valves

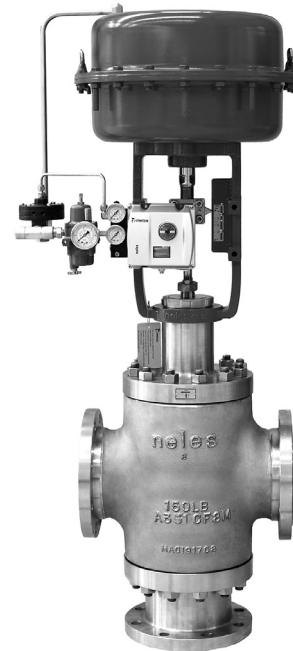
Globe, 3-way mixing & diverting, top and bottom seat guided

Metso's Neles series GW, 3-way top and bottom seat guided globe valves are high performance control valves with the all inherent benefits of linear control valves. The primary application is temperature control. GW design combines the benefits of strong guiding with an unbalanced trim design. The actuator selection is done the same way as single seated valves.

The flow either comes into one side port and is diverted to the other side port and bottom port or it comes into the side and bottom ports and is mixed internally and passed to other side port.

GW standard seat leakage is ANSI B16.104 Class II and optionally Class III.

Standard units are equipped with spring diaphragm or cylinder actuators and ND9000 intelligent valve controllers extended operational life and performance monitoring on-line.



Construction

- Heavy duty guiding with top and bottom seat for stable control
- Both diverting and mixing type available depending on the application
- Wide material selection for different applications
- All trim components removable from the bottom side after removed bottom flange
- Many end connection styles available for different applications
- Extension bonnet design for wide temperature range
- ND9000 digital valve controller with online diagnostics enables performance follow up and predictive maintenance
- Efficient asset management with Metso FieldCare open architecture software and excellent networking Safety and quality
- Rugged one piece body and bottom flange structure to minimize the leak paths
- Strictly tested to ensure specified performance with quality assurance systems in according to ISO 9001
- Certified ISO 15848 fugitive emissions
- Certified CE/PED & ATEX, TSG & EAC (GOST-R)

Accurate control & performance

- ND9000 digital valve controller for auto-calibration and accurate control
- Accurate and sensitive diaphragm and cylinder actuators
- Stable flow control with high rangeability
- Streamline flow passage to secure capacity

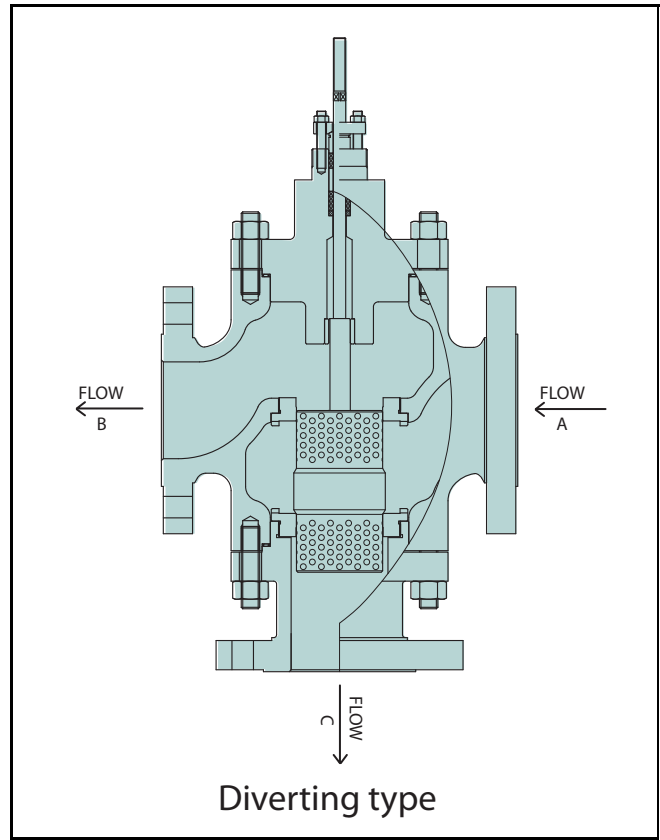
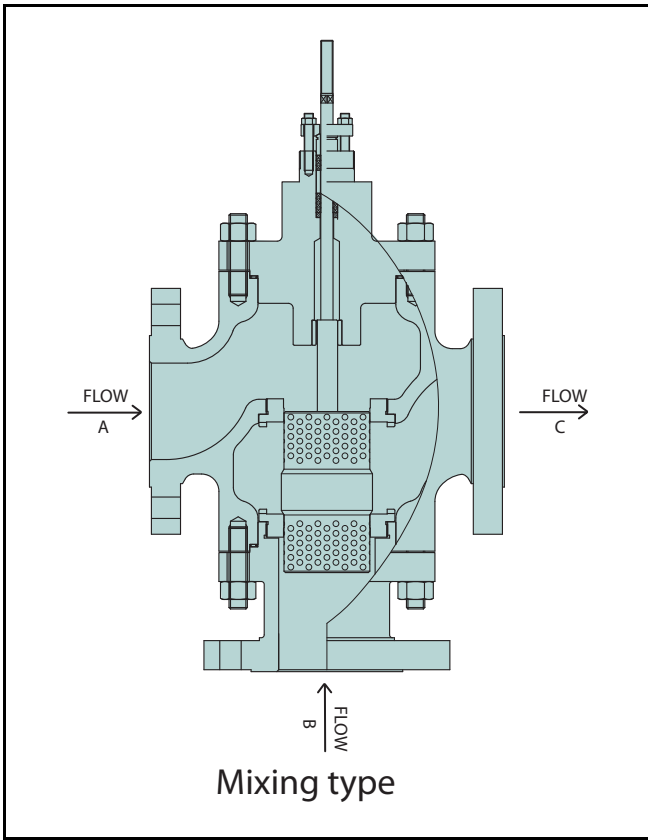
Benefits of GW series applications

- Commonly used in temperature control applications
- Top & bottom seated guiding reduces the vibration of the plug, which could cause valve failure
- Prolonged trim and valve life time
- Stable control of valve and process

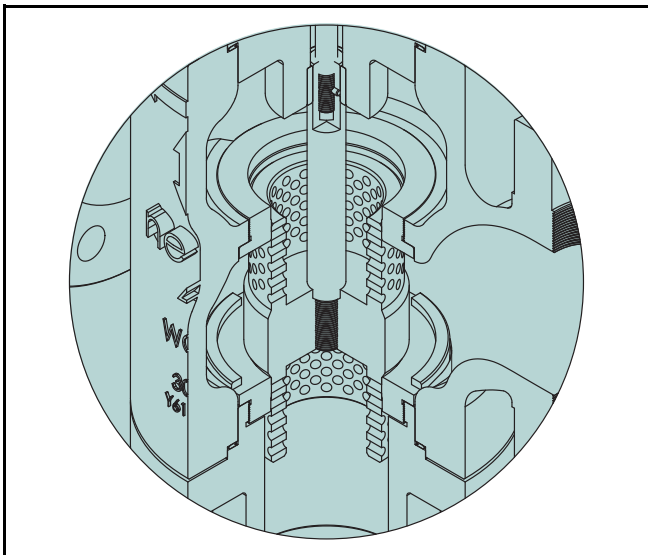
Accessories

A variety of accessories are available including Neles positioners and limit switches, solenoid valves, transducers, relays, boosters and volume tanks and build-in volume chambers etc.

Different flow directions



Standard trim design



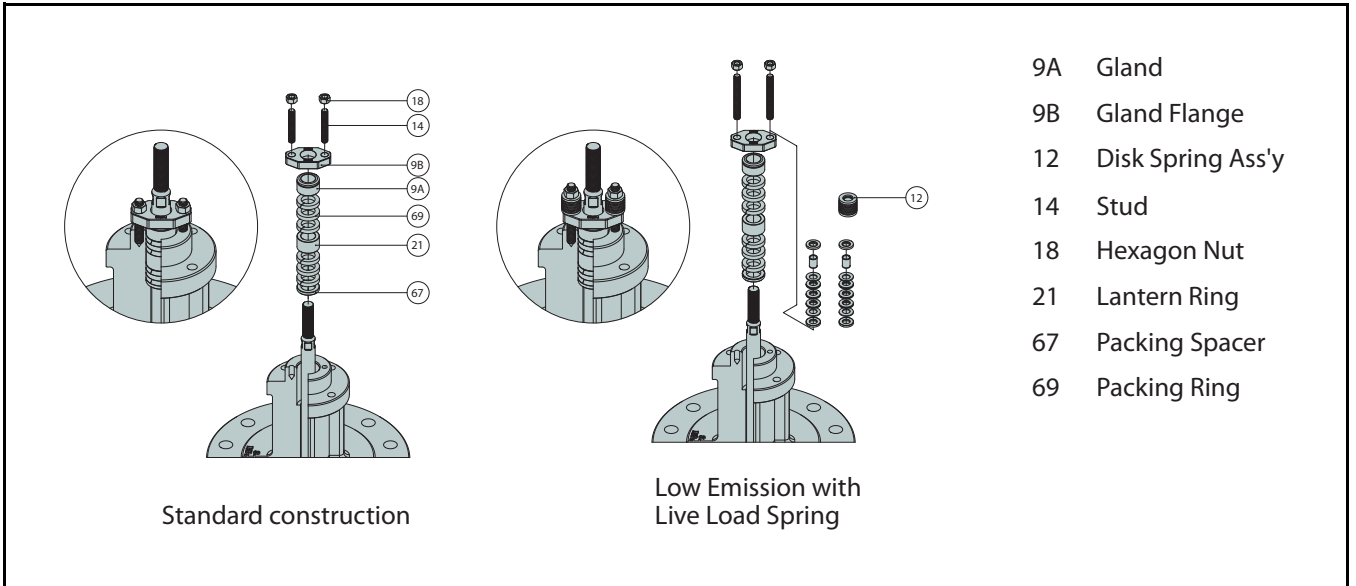
Series GW, Cylindrical plug trim

Series GW, standard cylindrical plug offers a smooth flow profile and heavy duty guiding.

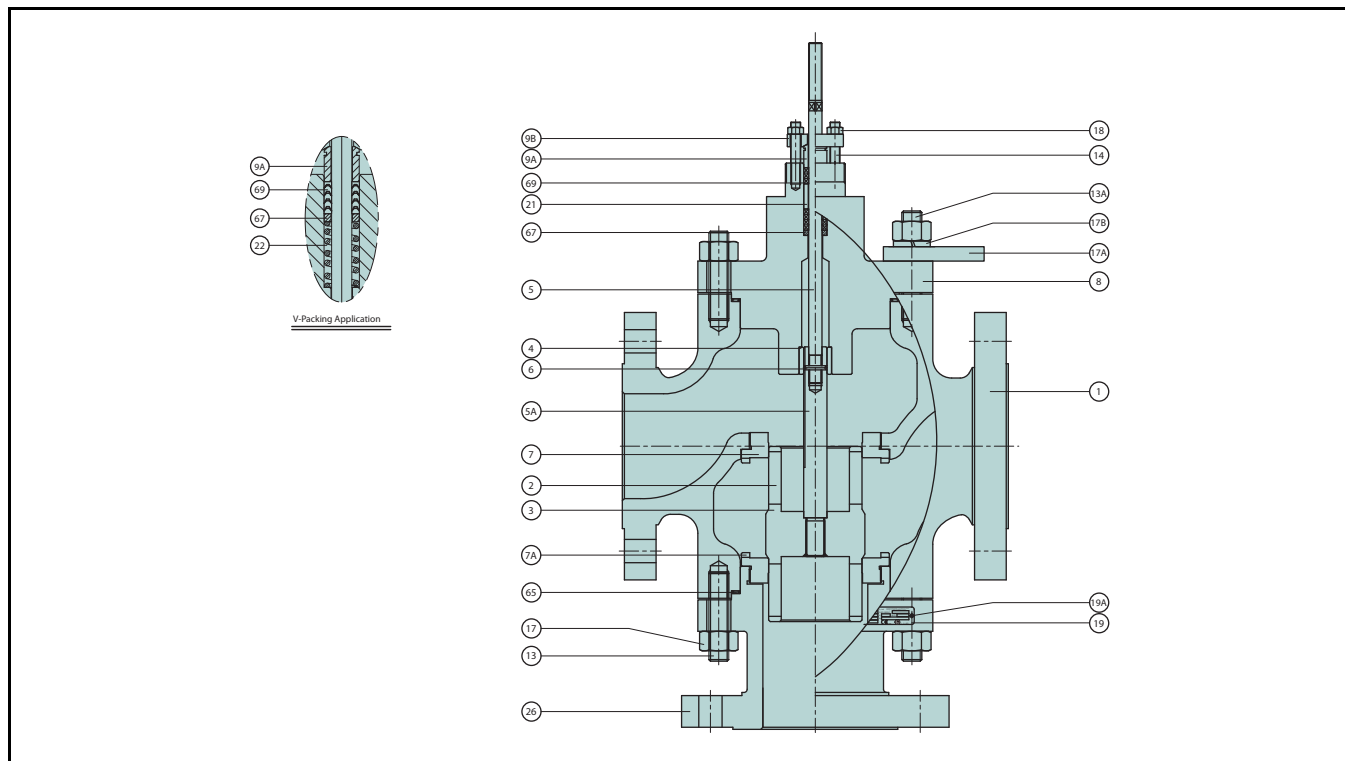
The arrangement of opened small and/or large drilled holes defines the flow path and the flow characteristics of the valve (standard is linear).

The trim design combines benefits of stronger guiding with top and bottom seat rings and the solid cylindrical plug provides strong support to ensure valve alignment.

Packing constructions



GW, Components and materials



Body materials: Carbon steel or Alloy steel

Part no.	Description	Material
1	BODY	A216 WCB / ALLOY STEEL AVAILABLE
2	PLUG SET	410 SS / 630 SS
3*	PLUG	410 STAINLESS STEEL
4	GUIDE BUSHING	440C STAINLESS STEEL
5 / 5A*	STEM	630 STAINLESS STEEL + HCr
6*	PLUG PIN	316 STAINLESS STEEL
7	SEAT RING	410 STAINLESS STEEL
7A	SEAT RING	410 STAINLESS STEEL
8	BONNET	A216 WCB / ALLOY STEEL AVAILABLE
9A	GLAND	304 STAINLESS STEEL
9B	GLAND FLANGE	A351 CF8
13	STUD	A193 Gr.B7
13A	STUD	A193 Gr.B7
14	STUD	A193 Gr.B8
17	HEXAGON NUT	A194 Gr.2H
17A	LIFTING PLATE	JIS G3101-SS400
17B	SPRING WASHER	AISI 304
18	HEXAGON NUT	A194 Gr.8
19	IDNTIFICATION PLAT	E 304 STAINLESS STEEL
19A	RIVET	304 STAINLESS STEEL
21	LANTERN RING	304 STAINLESS STEEL
22	PACKING SPRING	304 STAINLESS STEEL
26	BOTTOM FLANGE	A216 WCB / ALLOY STEEL AVAILABLE
65	BODY GASKET	S/W GASKET, 316 SS + GRAPHITE
67	PACKING SPACER	304 STAINLESS STEEL
69	PACKING RING	PTFE + CARBON FIBER

- Note.
1. Plug/Seat Hard Facing (Cobalt based alloy) is available
 2. Materials description
316 SS : ASTM A276 TP316 or JIS 316 St. Steel
410 SS : ASTM A276 TP410 or JIS 410 St. Steel
420 SS : ASTM A276 TP420 or JIS 420 St. Steel
440C SS : ASTM A276 TP440C ot JIS 440C St. Steel
 3. Above standard materials to be applicable depending on specific service conditions, other optional materials to consult Metso.
 4. Optional materials to meet to requirements of NACE MR 01-75 are available
 5. The materials are subject to change as equivalent depending on detail design
 6. The part no.3* , 5 / 5A* , 6* are delivered as a set with no.2

Body materials: Stainless steel

Part no.	Description	Material
1	BODY	A351 CF8M
2	PLUG SET	316 STAINLESS STEEL
3*	PLUG	316 STAINLESS STEEL
4	GUIDE BUSHING	316 + COBALT BASED ALLOY
5 / 5A*	STEM	316 STAINLESS STEEL + HCr
6*	PLUG PIN	316 STAINLESS STEEL
7	SEAT RING	316 STAINLESS STEEL
7A	SEAT RING	316 STAINLESS STEEL
8	BONNET	A351 CF8M
9A	GLAND	304 STAINLESS STEEL
9B	GLAND FLANGE	A351 CF8
13	STUD	A193 Gr.B8(M)
13A	STUD	A193 Gr.B8(M)
14	STUD	A193 Gr.B8
17	HEXAGON NUT	A193 Gr.8(M)
17A	LIFTING PLATE	JIS G3101-SS400
17B	SPRING WASHER	AISI 304
18	HEXAGON NUT	A193 Gr.B8
19	IDNTIFICATION PLAT	E 304 STAINLESS STEEL
19A	RIVET	304 STAINLESS STEEL
21	LANTERN RING	304 STAINLESS STEEL
22	PACKING SPRING	304 STAINLESS STEEL
26	BOTTOM FLANGE	A351 CF8M
65	BODY GASKET	S/W GASKET, 316 SS + GRAPHITE
67	PACKING SPACER	304 STAINLESS STEEL
69	PACKING RING	PTFE + CARBON FIBER

- Note.
1. Plug/Seat Hard Facing(Cobalt based alloy) is available
 2. Materials description
316 SS : ASTM A276 TP316 or JIS 316 St. Steel
410 SS : ASTM A276 TP410 or JIS 410 St. Steel
420 SS : ASTM A276 TP420 or JIS 420 St. Steel
440C SS : ASTM A276 TP440C ot JIS 440C St. Steel
 3. Above standard materials to be applicable depending on specific service conditions, other optional materials to consult Metso.
 4. Optional materials to meet to requirements of NACE MR 01-75 are available
 5. The materials are subject to change as equivalent depending on detail design
 6. The part no.3* , 5 / 5A* , 6* are delivered as a set with no.2

GW, Applications guide

Temperature range & seat leakage class with different bonnet & seat applications

Valve Size DN / Inch	ASME Rating	Seat Type	Temp. Range (°C)		Seat Leakage class (ANSI B 16.104)	
			Standard Bonnet	Extension Bonnet	Standard	Optional
25 / 1 ~ 250 / 10	150 ~ 600	Metal Seat	-29 ~ +260	-196 ~ +425	II	III

Temperature range with different body and stud/nut materials

Body / Bonnet Application	Stud / Nut Application	Temp. Range (°C)	Sign
Carbon steel (WCB, A105)	ASTM A193-B7 STUD ASTM A194-2H NUT	-29 ~ +425	A
Stainless steel (CF3, CF8, CF3M, CF8M)	ASTM A193-B8 STUD ASTM A194-8 NUT	-196 ~ +425	B
Cr.Mo. Steel (WC6, F11, WC9, F22, C12A, F91)	ASTM A193-B16 STUD ASTM A194-4 NUT	-29 ~ +425	*

* Please contact Metso.

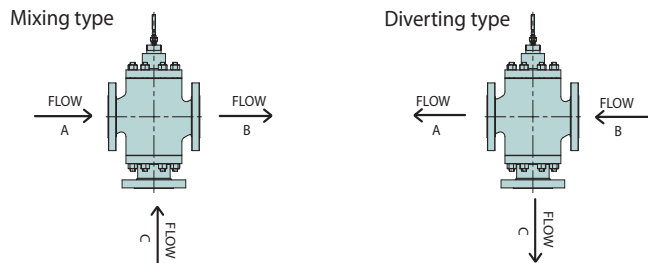
Packing applications

Packing Material	Temp. (°C)	Sign
PTFE Carbon Fiber (Braided TEF + Graphite), standard	-196 ~ +260	G
PTFE V-Ring	-196 ~ +232	T
Graphite (with Mold + Braided)	-196 ~ +400	F
Hi-Graphite (with Mold + Braided)	-196 ~ +425	H
RTFE V-Ring + Metal	-40 ~ +350	M

* Please contact Metso.

Flow Direction

	Flow Positions
Mixing Type (From B and C to A)	Flow to open (for each direction)
Diverting Type (From A to B and C)	Flow to Close (for each direction)



Trim materials

GW, Trim			Temp. Range (°C)	Sign
Plug	Stem	Seat		
410 SS	630 SS + HCr	410 SS	-29 ~ +425	P1XBCS1R1
316 SS	316SS + HCr	316 SS	-196 ~ +425	T6XTCS1T6X
316 SS + Cobalt based	316SS + HCr	316 SS + Cobalt based	-196 ~ +425	T6ATCS1T6A
420 J2	630 SS + HCr	420 J2	-29 ~ +425	*
316 SS	316SS + HCr	316 SS + PTFE	-196 ~ +232	*
630 SS	630 SS + HCr	410 SS	-29 ~ +425	*
Inconel 718	Inconel 718	F91	-29 ~ +425	*
Inconel 625, 718, 750			-196 ~ +425	*

* Please contact Metso.

* Other materials are applicable.

Gasket applications

Body / Bonnet Material	Gasket Material	Temp. Range (°C)	Sign
Carbon steel (WCB, A105)	S/W (Spiral Wound) 316SS + Graphite	-29 ~ +425	S
Stainless steel (CF3, CF8, CF3M, CF8M)	S/W (Spiral Wound) 316SS + Graphite	-196 ~ +425	S
	S/W (Spiral Wound) 316SS + PTFE	-196 ~ +232	L
Cr.Mo. Steel (WC6, F11, WC9, F22, C12A, F91)	S/W (Spiral Wound) 316SS + Graphite + Non Asbestos	-29 ~ +425	H
	S/W (Spiral Wound) 316SS + Graphite + Mica (special Hi-Temp. max 950 °C)		*

Please contact Metso.

GW, Ratings & End Connections

Valve Size DN / Inch	GW, ASME Ratings			
	Class 150 ~ 600			
	RF	RTJ	SW	BW
25 / 1	O	O	O	O
40 / 1-1/2	O	O	O	O
50 / 2	O	O	O	O
80 / 3	O	O		O
100 / 4	O	O		O
150 / 6	O	O		O
200 / 8	O	O		O
250 / 10	O	O		O

* Note

1. RF: Raised Face Flange RTJ: Ring Joint SW: Socket Weld BW: Butt Weld

Rated Cv and Trim Table (Globe, 3-way mixing & diverting, top and bottom seat guided)

Sign	TRIM TYPE	Sign	TRIM CHARACTERISTIC	Sign	Description	RATED Cv								
						Body Size and Stroke								
						1" Srk.	1-1/2" Srk.	2" Srk.	3" Srk.	4" Srk.	6" Srk.	8" Srk.	10" Srk.	
A	Cylindrical plug type	L	Linear	FC	Full capacity	10 (15)	22 (20)	36 (30)	76 (40)	126 (50)	274 (60)	490 (70)	760 (70)	
					1A	1-step reduction	6 (15)	14 (20)	22 (30)	46 (40)	76 (50)	168 (60)	300 (70)	460 (70)
					2A	2-step reduction	4 (15)	10 (20)	14 (30)	28 (40)	46 (50)	100 (60)	180 (70)	280 (70)
					3A	3-step reduction	2 (15)	6 (20)	10 (30)	16 (40)	30 (50)	64 (60)	120 (70)	170 (70)
Y	Special	Y	Special	YY	Special	Contact Metso for Cv details								

* Rated Cv is applied differently depending on the trim type & trim characteristic.

* Available Other flow characteristic.

* (Srk.) means the valve stroke.

* FC: Full Capacity 1A: 1-Step reduced 2A: 2-Step reduced 3A: 3-Step reduced

GW series Cv vs travel

ANSI Class: 150# ~ 600#

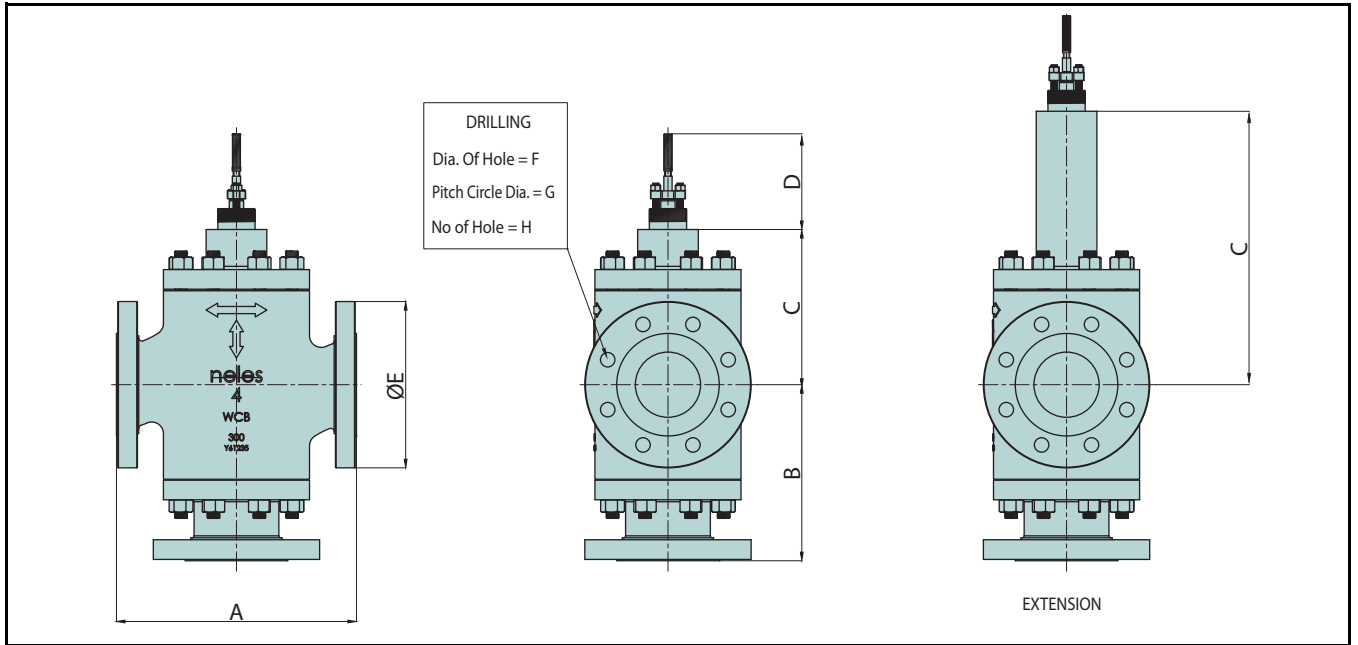
Size: 1" ~ 10"

Flow Characteristic: LINEAR

Valve Travel [%]							10	20	30	40	50	60	70	80	90	100	
F _L							0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Valve Size		Orifice Dia.			Travel		Rated Cv										
Inch	mm	Sign	Inch	mm	Inch	mm											
1	25	FC	1.1	27.0	0.6	15	0.98	1.96	2.94	3.92	4.90	5.88	6.86	7.84	8.82	10	
		1A					0.59	1.18	1.77	2.35	2.94	3.53	4.12	4.71	5.29	6	
		2A					0.39	0.78	1.18	1.57	1.96	2.35	2.74	3.14	3.53	4	
		3A					0.20	0.39	0.59	0.78	0.98	1.18	1.37	1.57	1.76	2	
1-1/2	40	FC	1.5	38.4	0.8	20	2.16	4.32	6.47	8.63	10.78	12.94	15.10	17.25	19.41	22	
		1A					1.37	2.75	4.12	5.49	6.86	8.23	9.61	10.98	12.35	14	
		2A					0.98	1.96	2.94	3.92	4.90	5.88	6.86	7.84	8.82	10	
		3A					0.59	1.18	1.77	2.35	2.94	3.53	4.12	4.71	5.29	6	
2	50	FC	2.0	50.8	1.2	30	3.54	7.06	10.59	14.12	17.65	21.18	24.70	28.23	31.76	36	
		1A					2.16	4.32	6.47	8.63	10.78	12.94	15.10	17.25	19.41	22	
		2A					1.37	2.75	4.12	5.49	6.86	8.23	9.61	10.98	12.35	14	
		3A					0.98	1.96	2.94	3.92	4.90	5.88	6.86	7.84	8.82	10	
3	80	FC	2.6	66.7	1.6	40	7.46	14.91	22.36	29.81	37.26	44.70	52.15	59.60	67.05	76	
		1A					4.52	9.03	13.53	18.04	22.55	27.06	31.57	36.07	40.58	46	
		2A					2.75	5.49	8.24	10.98	13.73	16.47	19.21	21.96	24.70	28	
		3A					1.57	3.14	4.71	6.28	7.84	9.41	10.98	12.55	14.12	16	
4	100	FC	3.5	89.0	2.0	50	12.37	24.72	37.07	49.42	61.77	74.11	86.46	98.81	111.16	126	
		1A					7.46	14.91	22.36	29.81	37.26	44.70	52.15	59.60	67.05	76	
		2A					4.52	9.03	13.53	18.04	22.55	27.06	31.57	36.07	40.58	46	
		3A					2.95	5.89	8.83	11.77	14.71	17.65	20.59	23.53	26.47	30	
6	150	FC	5.3	134.0	2.4	60	26.91	53.76	80.61	107.46	134.31	161.17	188.02	214.87	241.72	274	
		1A					16.50	32.96	49.43	65.89	82.35	98.82	115.28	131.75	148.21	168	
		2A					9.82	19.62	29.42	39.22	49.02	58.82	68.62	78.42	88.22	100	
		3A					6.28	12.56	18.83	25.10	31.37	37.64	43.92	50.19	56.46	64	
8	200	FC	7.0	178.0	2.8	70	48.12	96.14	144.16	192.18	240.20	288.22	336.24	384.26	432.28	490	
		1A					29.46	58.86	88.26	117.66	147.06	176.46	205.86	235.26	264.66	300	
		2A					17.68	35.32	52.96	70.60	88.24	105.88	123.52	141.16	158.80	180	
		3A					11.78	23.54	35.30	47.06	58.82	70.58	82.34	94.10	105.86	120	
10"	250	FC	8.8	224.0	2.8	70	74.63	149.11	223.59	298.07	372.55	447.03	521.51	595.99	670.47	760	
		1A					45.10	90.25	134.33	180.41	225.49	270.57	315.65	360.73	405.81	460	
		2A					27.46	54.94	82.38	109.82	137.26	164.70	192.14	219.58	247.02	280	
		3A					16.68	33.35	50.01	66.67	83.33	99.99	116.65	133.31	149.97	170	

NOTE
 C_v: Valve flow coefficient
 F_L: Liquid pressure recovery factor
 FC: Full Capacity 1A: 1-Step reduced
 2A: 2-Step reduced 3A: 3-Step reduced

Valve dimensions



Dimension (mm)	A			B			C		D	E			F			G			H			Weight (kg)		
	150#	300#	600#	150#	300#	600#	STD	EXT	COMMON	150#	300#	600#	150#	300#	600#	150#	300#	600#	150#	300#	600#	150#	300#	600#
025	184	197	210	160	160	160	130	250	110	110	125	125	15.9	19.1	19.1	79.4	88.9	88.9	4	4	4	20	21	33
040	222	235	251	178	178	178	155	295	110	125	155	155	15.9	22.2	22.2	98.4	114.3	114.3	4	4	4	41	43	50
050	254	267	286	197	197	197	184	295	110	150	165	165	19.1	19.1	19.1	120.7	127	127	4	8	8	57	62	73
080	298	318	337	238	238	238	235	330	115	190	210	210	19.1	22.2	22.2	152.4	168.3	168.3	4	8	8	100	104	113
100	352	368	394	270	270	270	238	380	140	230	255	275	19.1	22.2	25.4	190.5	200	215.9	8	8	8	136	141	156
150	451	473	508	330	330	330	280	430	150	280	320	355	22.2	22.2	28.6	241.3	269.9	292.1	8	12	12	238	249	322
200	543	568	610	410	410	460	375	490	150	345	380	420	22.2	25.4	31.8	298.5	330.2	349.2	8	12	12	351	375	451
250	673	708	752	457	457	490	416	600	150	405	445	510	25.4	28.6	34.9	362	387.4	431.8	12	16	16	779	847	982

Dimension (inch)	A			B			C		D	E			F			G			H			Weight (lbs)		
	150#	300#	600#	150#	300#	600#	STD	EXT	COMMON	150#	300#	600#	150#	300#	600#	150#	300#	600#	150#	300#	600#	150#	300#	600#
1"	7.2	7.8	8.3	6.3	6.3	6.3	5.1	9.8	4.3	4.3	4.9	4.9	0.6	0.8	0.8	3.1	3.5	3.5	4	4	4	44	46	73
1-1/2"	8.7	9.3	9.9	7	7	7	6.1	11.6	4.3	4.9	6.1	6.1	0.6	0.9	0.9	3.9	4.5	4.5	4	4	4	90	95	110
2"	10	10.5	11.3	7.8	7.8	7.8	7.2	11.6	4.3	5.9	6.5	6.5	0.8	0.8	0.8	4.8	5	5	4	8	8	126	137	161
3"	11.7	12.5	13.3	9.4	9.4	9.4	9.3	13	4.5	7.5	8.3	8.3	0.8	0.9	0.9	6	6.6	6.6	4	8	8	221	229	249
4"	13.9	14.5	15.5	10.6	10.6	10.6	9.4	15	5.5	9.1	10	10.8	0.8	0.9	1	7.5	7.9	8.5	8	8	8	300	311	344
6"	17.8	18.6	20	13	13	13	11	16.9	5.9	11	12.6	14	0.9	0.9	1.1	9.5	10.6	11.5	8	12	12	525	549	710
8"	21.4	22.4	24	16.1	16.1	18.1	14.8	19.3	5.9	13.6	15	16.5	0.9	1	1.3	11.8	13	13.7	8	12	12	774	827	994
10"	26.5	27.9	29.6	18	18	19.3	16.4	23.6	5.9	15.9	17.5	20.1	1	1.1	1.4	14.3	15.3	17	12	16	16	1717	1867	2165

NOTE
P.C.D = Pitch Circle Diameter

HOW TO ORDER

Globe 3-Way, Diverting / Mixing type, Series GW

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.
GW	02	C	W	A	J2	X	P1	X	BC	S2	P1	X	S	G	X	S	A	X	A	L	FC

VALVE CONSTRUCTIONS

1.	VALVE SERIES
GW	Globe 3-way, Diverting type

2.	BODY SIZE		
01	1" / DN 25	1H	1-1/2" / DN 40
02	2" / DN 50	03	3" / DN 80
04	4" / DN 100	06	6" / DN 150
08	8" / DN 200	10	10" / DN 250
YY	Special		

3.	PRESSURE RATING	
C	ASME class 150	ASME class 300
Optional Pressure Rating		
F	ASME class 600	Special

4.	END CONNECTION
W	Flanged RF, ASME B16.5
Optional End Connection	
V	Socket welding, ASME B16.11
Q	Butt welding, ASME B16.25
Y	Special

5.	BONNET CONSTRUCTION	
	Bonnet Type	Actuator Connection
A	General	Applicable for VD_25/29/37
B	General	Applicable for VD_48/55
C	General	Applicable for VC_30
D	General	Applicable for VC_40/50/60/70
Optional Bonnet Construction		
E	Extension	Applicable for VD_25/29/37
F	Extension	Applicable for VD_48/55
G	Extension	Applicable for VC_30
H	Extension	Applicable for VC_40/50/60/70
Y	Special	Special

6.	BODY MATERIAL		
J2	A216 gr. WCB	S6	A351 gr. CF8M
Optional Body & Bonnet Material			
S1	A351 gr. CF3M	YY	Special

- Bonnet material is same or equivalent with Body material.

7.	MODEL CODE
X	Model X
B	Model B

TRIM CONSTRUCTIONS

8.	PLUG MATERIAL	
	Material	Description
P1	410 SS	Standard for carbon steel body
T6	316 SS	Standard for stainless steel body
YY	Special	Special materials

9.	PLUG APPLICATION
X	Not applicable
A	Cobalt based alloy
Y	Special

10.	STEM MATERIAL	
	Material	Description
BC	630 SS + HCr	Standard for carbon steel body
TC	316 SS + HCr	Standard for stainless steel body
YY	Special	Special materials

11.	SEAT TYPE
S2	Double metal seat
YY	Special

12.	SEAT MATERIAL	
	Seat	Description
P1	410 SS	Standard for carbon steel body
T6	316 SS	Standard for stainless steel body
YY	Special	Special materials

13.	SEAT APPLICATION
X	Not applicable
A	Cobalt based alloy
Y	Special

OTHERS

14.	PACKING / BELLOWS TYPE
S	General packing
Optional Packing Type	
E	Low emission, Live loaded
L	Live loaded packing
Y	Special

15.	PACKING MATERIAL
G	PTFE + Carbon fiber
F	Graphite (with mold and braided)
Optional Packing Material	
T	PTFE V-Ring
H	Hi-Graphite (with mold + braided)
Y	Special

16.	SEAL RING MATERIAL
X	Not applicable
Y	Special

17.	GASKET MATERIAL
S	S/W gasket type, 316 SS + Graphite for standard
Optional Gasket Material	
H	S/W gasket type, 316 SS + Graphite for high temp.
L	S/W gasket type, 316 SS + PTFE
Y	Special

18.	STUD / NUT MATERIAL
A	A193 gr. B7 / A194 gr. 2H
B	A193 gr. B8 / A194 gr. 8
Optional Bolting Material	
H	A193 gr. B16 / A194 gr. 4
Y	Special

19.	OPTIONS
X	Not applicable
M	Globe 3-Way, Mixing type
Y	Special

* The body, bonnet, trim materials are subject to change as equivalent depending on detail design.

* Please see 'Neles Globe Typecode Instruction' for further options.

TRIM TYPE & RATED Cv

20. Sign	TRIM TYPE	21. Sign	TRIM CHARACTERISTIC	22. Sign	Description	RATED Cv															
						Body Size and Stroke															
						1"	Srk.	1-1/2"	Srk.	2"	Srk.	3"	Srk.	4"	Srk.	6"	Srk.	8"	Srk.	10"	Srk.
A	Cylindrical plug type	L	Linear	FC	Full capacity	10	(15)	22	(20)	36	(30)	76	(40)	126	(50)	274	(60)	490	(70)	760	(70)
			Quick opening	1A	1-Step reduction	6	(15)	14	(20)	22	(30)	46	(40)	76	(50)	168	(60)	300	(70)	460	(70)
				2A	2-Step reduction	4	(15)	10	(20)	14	(30)	28	(40)	46	(50)	100	(60)	180	(70)	280	(70)
				3A	3-Step reduction	2	(15)	6	(20)	10	(30)	16	(40)	30	(50)	64	(60)	120	(70)	170	(70)
Y	Special	Y	Special	YY	Special	Contact Metso for Cv details															

- Rated Cv is different by the trim type and characteristic.
- Srk. & number in the bracket means the valve stroke.