FloWing
Eccentric Rotary Control Valve
Model VFR

OVERVIEW

The eccentric rotary control valve, "FloWing" (model VFR), consists of a straight-through valve body with minimal flow resistance and an open yoke plug with a wing that rotates eccentrically. The FloWing is suitable for applications requiring a large flow capacity and wide rangeability, and for the control of those slurry fluids susceptible to clogging.
Also, the model VFR is able to control the occurrence of cavitation when the liquid is decompressed with high pressure reduction and can decrease the level of noise and vibration. The model VFR can effectively decompress the liquid by inserting a perforated plate (anti-cavitation plate) into the main body outlet side of the valve. Therefore, cold and warm water with a low or medium pressure line or process liquid can be controlled even with a Kc value over 0.55. Furthermore, for the anti-cavitation plate, there are two types: the built-in type and the combined external type (model HRL).

SPECIFICATIONS

Body

Type
Straight-through

Valve size
1, 1½, 2, 3, 4, 6, 8, 10, or 12 in.

Rating
- JIS 10K, 20K, 30K* or 40K*
- ANSI Class 150, 300 or 600*

*Note) *Available only for 1, 1½ and 2 in. valve sizes.*

Connections
Wafer type

Note) For bolt and nut materials and fluid temperatures, refer to Table 1. (The connection bolts and nuts are provided as standard accessories.)

Material
For combinations of valve body, trim materials and fluid temperatures, refer to Table 1.

Bonnet
Integral body type (-60 to 350°C)

Gland type
Bolted gland

Packing/grease
- Without grease….PTFE-inserted asbestos yarn
- With grease……Asbestos yarn or other packings

Note) PTFE: Polytetrafluoroethylene.

Trim

Valve plug
Eccentric rotary open yoke plug with wing

Seat ring
Clamp seat ring

Material
For combinations of valve body, trim materials and fluid temperatures, refer to Table 1.

Actuator

Type
Spring type pneumatic diaphragm actuator (model VR)

Action
Direct or reverse action

Diaphragm
Chloroprene rubber reinforced with nylon fabric

Spring range
70 to 140 kPa {0.7 to 1.4 kgf/cm^2},
98 to 200 kPa {1.0 to 2.0 kgf/cm^2}},
80 to 160 kPa {0.8 to 1.6 kgf/cm^2},
180 to 270 kPa {1.8 to 2.8 kgf/cm^2} (Model VR) or
80 to 240 kPa {0.8 to 2.4 kgf/cm^2} (Model RSA)

Note) Spring range and air supply pressure vary according to nominal size.

Supply pressure
220 to 490 kPa {2.2 to 5.0 kgf/cm^2},

Air connection
Rc¼ internal thread

Ambient temperature
-30°C to 70°C

Maximum diaphragm chamber capacity
- VR1D (R) : 760 cm^3
- PSA2D (R) : 3800 cm^3
- VR3D (R) : 5800 cm^3

Valve action
Direct or reverse action

Positioner (optional)
VPR pneumatic positioner or SVP electro-pneumatic positioner (Refer to their respective specification sheets.)

Auxiliary devices (optional)
Pressure regulator with filter, handwheel, limit switch, solenoid valve, valve position transmitter, volume booster, air lock valve, etc. (Refer to their respective specification sheets and installation drawings.)

Additional specifications (special order)
- Anti-cavitation plate (built-in type)
- Special inspections
  Flow characteristic inspection, material inspection (Material certificate), non-destructive inspection, steam inspection, low temperature inspection
- Flange type
- Copper free treatment
- Oil/water free treatment
- SUS304 atmosphere-exposed nuts and bolts
- Sand-/dust-preventive measures
- Special air connections and joint
- Cold-area use specifications
- Saline damage countermeasures
- Tropical-area use specifications
- Vacuum service
- Yoke material (SCPH12)
- Compliance to the High Pressure Gas Control Law

*Note) *Carbon steel (A216 WCB) is the standard material for yoke used in actuator model RSA.*

Performance

Rated Cv value
Refer to “Cv value and travels” on page 4.

Flow characteristics
Refer to Figure 3.

Inherent rangeability
100 : 1

Permissible differential pressure
Refer to Table 6 and Table 7.

Seat leakage rate
- Metal seat
  IEC6053-4-1999 or JIS B 2007-1993
  Class IV
  Leakage less than 0.01% of maximum valve capacity, or leakage less than 0.001% (optional)
- Soft seat
  IEC6053-4-1999 or JIS B 2007-1993
  Class VI
  Leakage less than 0.00001% of maximum valve capacity.

Hysteresis
Within 1% F.S.

Linearity
Within ± 2% F.S.

Operation speed (from fully closed to fully open)
- VR1D (R) : 3 sec.
- RSA2D (R) : 7 sec.
- VR3D (R) : 21sec.

(Typical values input is changed between 20 and 98 kPa {0.2 and 1.0kgf/cm^2}, with air supply pressure 220 kPa {2.2 kgf/cm^2} for VR1, 340 kPa {3.5 kgf/cm^2} for VR3 or 400 kPa {4.0 kgf/cm^2} for RSA2, using model VPR positioner and pressure regulator with filter, and with no load.)

Face-to-face dimensions
Refer to Figure 4 and Table 8.

External dimensions
Refer to Figure 4 and Table 8.

Weight
Refer to Table 8.

Mounting position
Refer to Figure 6.

Finish
Blue (Munsell 10B5/10) or silver, or other specified colors.

Selection guide for the anti-cavitation specifications

1. Cavitation number (Kc value) will be calculated according to the operation condition.
   The anti-cavitation specification is recommended (select the specification) if the calculated Kc value is over 0.55. It is not applicable for compressible fluid (gas/steam).
   $Kc=\Delta P/(P1-Pv)$
   P1: Valve primary side pressure
   P2: Valve secondary side pressure
   Pv: Saturated vapor pressure of fluid according to inflow side temp. condition
   ΔP=P1-P2: Valve differential pressure
2. Noise control efficiency of the anti-cavitation type.
   The figure below shows differences in the noise occurring based on the structures of the standard type and anti-cavitation type model VFR. Noise that occurs when controlling the flow differs depending on the structures of the valve body and inner valve. The anti-cavitation type model has a maximum noise suppression of 7 dBA.

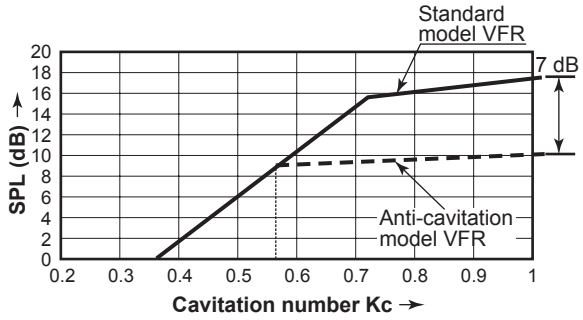


Figure 1 Noise control efficiency (dBA)

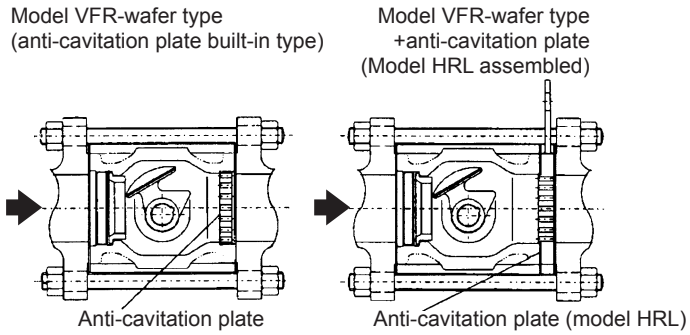


Figure 2

Table 1 Valve body and trim materials, and fluid temperatures (°C)

Components		Material									
Valve body	JIS	SCPH2				SCS13A			SCS14A		
	ASTM	A216WCB				A351 CF8			A351 CF8M		
Trims	Valve plug	SCS24		SCS14 Stellite		SCS14 Stellite			SCS14 Stellite		
	Seat ring	SUS630	SUS316 (*4) PTFE seat	SUS316	SUS316 (*4) PTFE seat	SUS316	SUS316 Stellite	SUS316 (*4) PTFE seat	SUS316	SUS316 Stellite	SUS316 (*4) PTFE seat
	Seat retainer	SUS630	SUS316								
	Brain bearing	SUS440C (*1, *2)				SUS316 Stellite					
	Main bushing	SUS440C (*1, *2)				SUS316 Stellite					
	Valve stem	SUS316 (*2)									
	Key	SUS630				Stellite					
	Spring	SUS316									
	Packing ring	SUS316									
	Packing	V7132Y (PTFE-inserted asbestos packing) *3									
	Packing follower	SUS316									
	Packing flange	SUS304									
	Bolts and nuts for packing flange	SCM3 / SUS304 (For packing)									
	Gasket	Spiral type*5 (Installed between seat ring and seat retainer)									
Temperature range		-5 to 350°C				-60 to 350°C					

*Note) *1: SUS316 Stellite type is used for valves for gas or steam service.*
**2: SUS316 Stellite type is used for valves for thermal medium service.*
**3: T-2200 (Graphite packing) + NP315 (metallic wire-reinforced asbestos packing) is used for valves for thermal medium service.*
**4: SUS316 PTFE seat (glass reinforced) type is applicable to fluid temperatures -30 to 200°C (standard type) or -60 to -31°C (low temperature type)*
**5: Standard SUS316 inorganic paper-filler. (0 to +350°C)*
Oil free specification (normal temp.) SUS316 PTFE filler (-200 to 230°C)
Oil free specification (high temp.) SUS316 graphite filler (+231 to +350°C)

Table 2 Piping bolt and nut materials and applicable fluid temperature ranges

Fluid temperature	Material of bolts	Material of nuts
-25°C to 350°C	SNB7	S45C
-60°C to -30°C	SUS304	SUS304

Cv value and travels

Table 3 Cv values and travels (Standard model VFR)

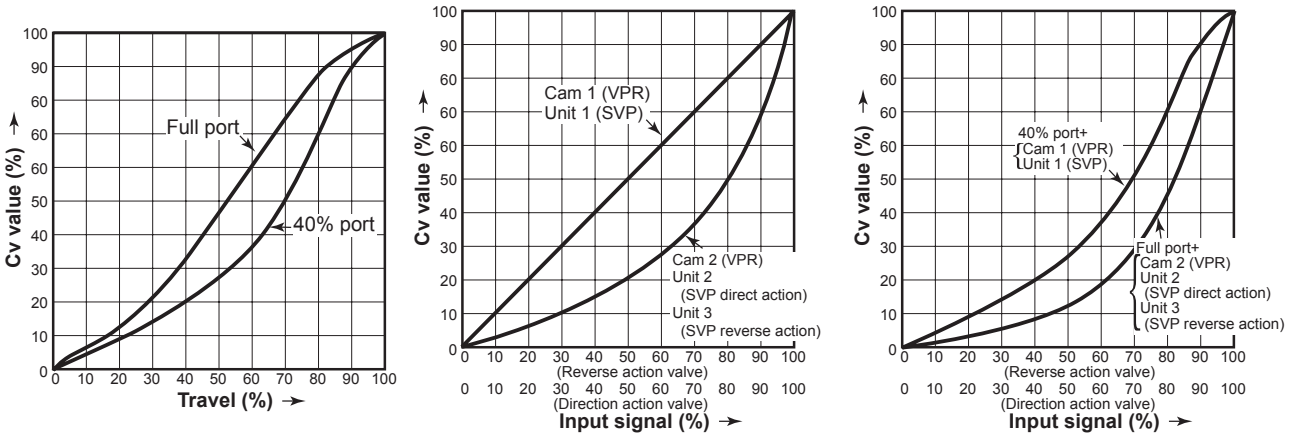
Nominal size (in.)		1	1½	2	3	4	6	8	10	12
Rated Cv value	Full port	14	30	50	150	250	600	1000	1400	1900
	40% port	5.6	12	20	60	100	240	400	560	760
	Rated travel (Rotating angle)	25mm (60°)			38mm (60°)		100mm (60°)			

Table 4 Cv values and travels (Anti-cavitation model VFR)

								Cv value when assembled with model HRL		
Nominal size (in.)		**1**	**1½**	**2**	**3**	**4**	**6**	**8**	**10**	**12**
Rated Cv value	Full port	10	22	35	105	175	420	700	1080	1510
	40% port	4	9	14	42	70	170	280	400	550
	Rated travel (Rotating angle)	25mm (60°)			38mm (60°)		100mm (60°)			

Table 5 Cv values and travels (Anti-cavitation plate model HRL single Cv value) (Formed between the flanges)

Nominal size (in.)		1	1½	2	3	4	6	8	10	12
Rated Cv value	Full port (for model VFR)	12	32	50	140	245	590	980	1700	2480
	40% port (for model VFR)	5.7	13	17	60	105	230	400	570	800



a. Flow characteristics of valve **b. Positioner cam/unit characteristics** **c. Modified flow characteristics**
(Combination of 4 and 6 characteristics)

Figure 3 Flow control characteristics when valve is used in conjunction with positioner cam/unit

Permissible differential pressures

Table 6 Direct action (Air-to-close)

Actuator model No.	Air supply pressure kPa {kgf/cm^2}	Spring range kPa {kgf/cm^2}	Positioner	Differential pressure [by nominal size (inch)] kPa {kgf/cm^2}								
				1	1½	2	3	4	6	8	10	12
VR1D	220 {2.2}	70 to 140 {0.7 to 1.4}	✔	2940 {30.0}	2940 {30.0}	2940 {30.0}	-	-	-	-	-	-
RSA2D	400 {4.0}	80 to 240 {0.8 to 2.4}	✔	-	-	-	2060 {21.0}	2060 {21.0}	-	-	-	-
VR3D	340 {3.5}	80 to 160 {0.8 to 1.6}	✔	-	-	-	-	-	2060 {21.0}	2060 {21.0}	-	-
	490 {5.0}	80 to 160 {0.8 to 1.6}	✔	-	-	-	-	-	-	-	981 {10.0}	780 {8.0}

Table 7 Reverse action (Air-to-open)

Actuator model No.	Air supply pressure kPa {kgf/cm^2}	Spring range kPa {kgf/cm^2}	Positioner	Differential pressure [by nominal size (inch)] kPa {kgf/cm^2}								
				1	1½	2	3	4	6	8	10	12
VR1R	220 {2.2}	70 to 140 {0.7 to 1.4}	✔	2940 {30.0}	2940 {30.0}	2940 {30.0}	-	-	-	-	-	-
RSA2R	400 {4.0}	80 to 240 {0.8 to 2.4}	✔	-	-	-	2060 {21.0}	2060 {21.0}	-	-	-	-
VR3R	340 {3.5}	80 to 160 {0.8 to 1.6}	✔	-	-	-	-	-	1180 {12.0}	-	-	-
	340 {3.5}	180 to 270 {1.8 to 2.8}	✔	-	-	-	-	-	2060 {21.0}	981 {10.0}	490 {5.0}	340 {3.5}

DIMENSIONS

Table 8 Dimensions and weight

(Unit: mm)

Nominal size (inch)	Pressure rating	Actuator model No.	K	A	B	D	E	F	R	P	H	G	M	N	Weight (kg)
1	JIS 10K, 20K, 30K, 40K	VR1D (R)	102	195	40	68	-	-	-	208	220	130	128	23	15
	ANSI 150, 300, 600														
1½	JIS 10K, 20K, 30K, 40K	VR1D (R)	114	201	45	83	-	-	-	208	220	130	128	23	16
	ANSI 150, 300, 600														
2	JIS 10K	VR1D (R)	124	205	49	98	-	-	-	208	220	130	128	23	17
	JIS 20K						22.5	19	60						
	JIS 30K, 40K						22.5	19	64.3						
	ANSI 150						-	-	-						
	ANSI 300, 600						22.5	19	64.3						
3	JIS 10K	RSA2D (R)	165	310	65	128	22.5	19	75	350	295	220	200	35	49
	JIS 20K						22.5	23	80						
	ANSI 150						45	19	76.25						
	ANSI 300						22.5	22	84						
4	JIS 10K	RSA2D (R)	194	315	110	153	22.5	19	87.5	350	295	220	200	35	54
	JIS 20K						22.5	23	92.5						
	ANSI 150						22.5	19	95.25						
	ANSI 300						22.5	22	100						
6	JIS 10K	VR3D (R)	229	420	150	214	22.5	23	120	315	620 (540)	325	360	93	100
	JIS 20K						15	25	130						
	ANSI 150						22.5	22	120.15						
	ANSI 300						22.5	22	135						
8	JIS 10K	VR3D (R)	243	449	180	264	15	23	145	315	615 (535)	330	360	93	125
	JIS 20K						15	25	152.5						
	ANSI 150						22.5	22	149.25						
	ANSI 300						15	25	165						
10	JIS 10K	VR3D (R)	297	510	220	324	15	25	177.5	315	610 (530)	335	360	93	165
	JIS 20K						15	27	190						
	ANSI 150						15	25	181						
	ANSI 300						11.25	29	193.75						
12	JIS 10K	VR3D (R)	338	530	260	369	11.25	25	200	315	605 (525)	340	360	93	185
	JIS 20K						11.25	27	215						
	ANSI 150						15	25	216						
	ANSI 300						11.25	32	225.6						

Note) 1) The face-to-face dimensions comply with S75.04 of ISA, and PMC23.3A of SAMA (Scientific Apparatus Makers Association).

2) The H dimensions enclosed in the parentheses are for the spring range 80 to 160 kPa {0.8 to 1.6 kgf/cm^2}.

3) Face-to-face dimensions of the anti-cavitation specification (built-in type) will not be changed.

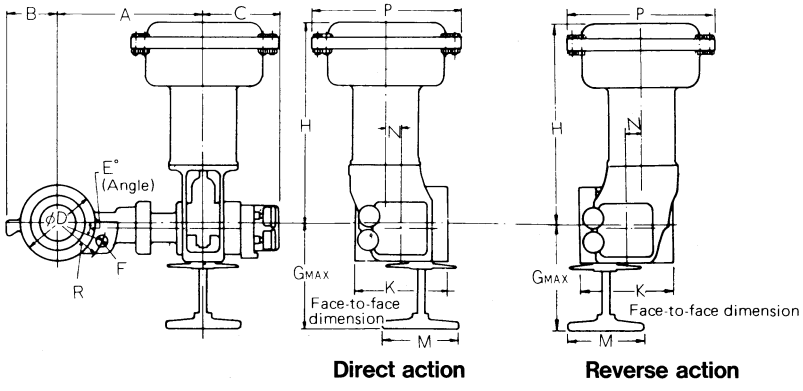


Figure 4 Face-to-face and external dimensions

Table 9 Anti-cavitation plate model HRL: External dimensions and weight

(Unit: mm)

Nominal size (inch)	Pressure rating	ØD	96	T1	T2	H	W	T3	ØF	Weight (kg)	Face-to-face dimensions *1
1	JIS 10K	67	25	10	6	74	20	4	10	0.34	115.2
	JIS 20K	67								0.34	
	JIS 30K, 40K	70								0.36	
	ANSI 150, 300, 600	51								0.22	
1½	JIS 10K	81	40	10	6	74	20	4	10	0.49	127.2
	JIS 20K	81								0.49	
	JIS 30K, 40K	90								0.58	
	ANSI 150, 300, 600	73								0.41	
2	JIS 10K	96	50	10	6	74	20	4	10	0.75	137.2
	JIS 20K	96								0.75	
	JIS 30K, 40K	105								0.86	
	ANSI 150, 300, 600	92								0.7	
3	JIS 10K	127	78	15	6	88	30	6	14	1.8	183.2
	JIS 20K	132								1.8	
	JIS 30K, 40K	---								---	
	ANSI 150, 300, 600	127								1.7	
4	JIS 10K	151	98	15	6	88	30	6	14	2.5	212.2
	JIS 20K	160								2.6	
	JIS 30K, 40K	---								---	
	ANSI 150, 300, 600	157								2.3	
6	JIS 10K	212	149	15	6	114	40	8	20	4.8	247.2
	JIS 20K	230								5.4	
	JIS 30K, 40K	---								---	
	ANSI 150, 300, 600	216								4.7	
8	JIS 10K	262	199	20	10	114	40	8	20	7.2	266.2
	JIS 20K	275								7.4	
	JIS 30K, 40K	---								---	
	ANSI 150, 300, 600	270								6.8	
10	JIS 10K	324	246	20	10	114	40	8	20	14.9	320.2
	JIS 20K	345								11.2	
	JIS 30K, 40K	---								---	
	ANSI 150, 300, 600	324								14.9	
12	JIS 10K	368	296	20	10	114	40	8	20	19.5	361.2
	JIS 20K	395								22.1	
	JIS 30K, 40K	---								---	
	ANSI 150, 300, 600	381								20.7	

*Note) 1) *1 Face-to-face dimensions include the valve main body model VFR and gasket. (3.2mm)*
2) For ANSI 600, JIS30K and JIS40K, only the connection sizes of 1 in. to 2 in. are available.

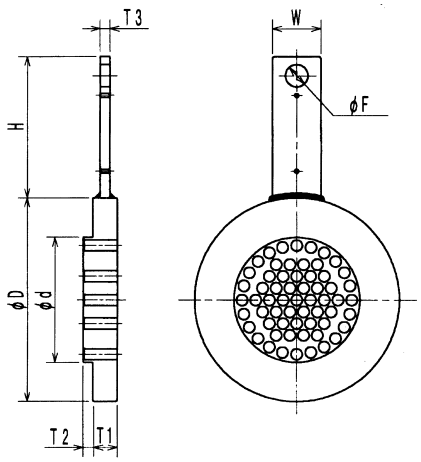
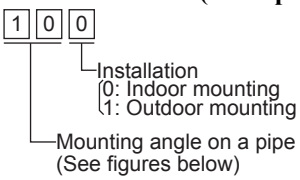
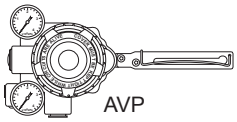
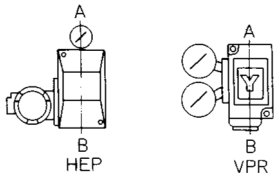


Figure 5

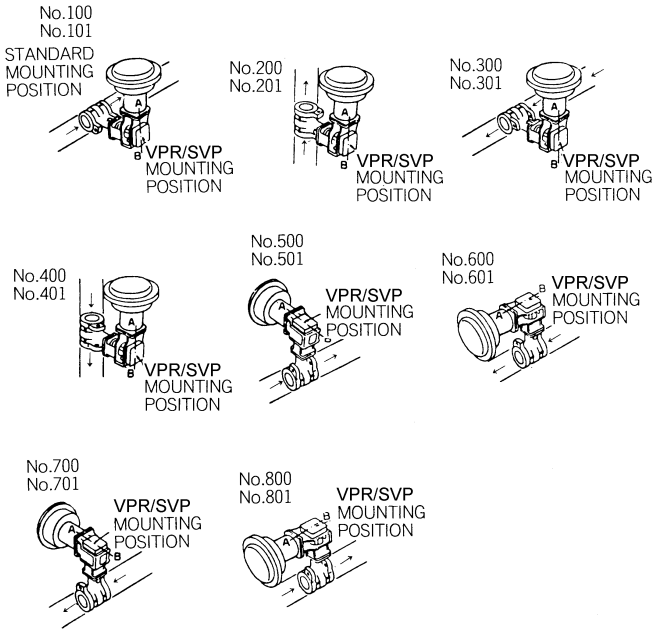
Model number structure (Example)



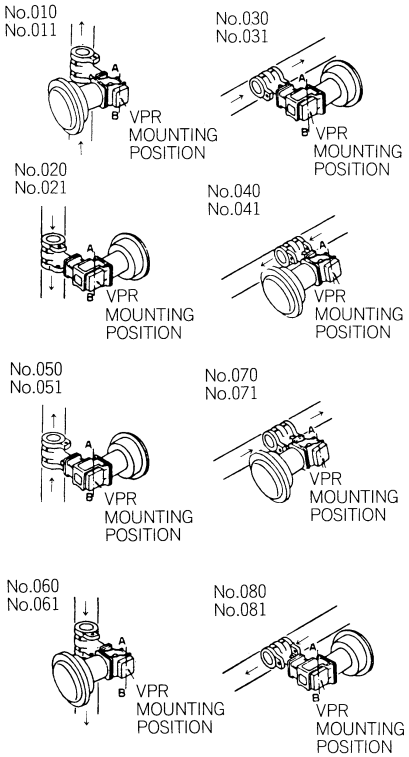




Direction symbol for positioner installation



a. Applicable to both model VPR pneumatic positioner and model SVP electro-pneumatic positioner



b. Applicable to model VPR pneumatic positioner only

Figure 6 Mounting position of valve on process pipes

Note) 1) The pressure regulator with filter is mounted vertically to the ground.
2) Specify mounting positions other than the above standard mounting positions with code number.
3) When installing indoor, weatherproof construction is not needed.
4) When the first 2 digits of the model number, which indicate the mounting angle type, are 50, 60, 70, 80, 01, 02, 03, 04, 05, 06, 07 or 08, weatherproof construction is needed if installing outdoor.
5) When the first 2 digits of the model number, which indicate the mounting angle type, are 10, 20, 30 or 40, weatherproof construction is not required whether it is outdoor or not.

Ordering Information

When ordering, please specify;

1) Model Number: VFR
2) Nominal size X full port or 40% port
3) Rating of valve body
4) Materials of valve body and trims, and necessity of hardening treatment
5) Type of actuator and air supply pressure
6) Valve action (direct or reverse)
7) Accessories (positioner, pressure regulator with filter, etc.)
8) Special requirements for oil / copper free treatment, etc.
9) Name of flow medium
10) Normal flow and maximum flow
11) Pressure of flow medium, upstream and downstream pressure at fully closed and open positions
12) Process fluid temperature and specific gravity
13) Viscosity of flow medium, inclusive or exclusive slurry or flushing
14) Indoor or outdoor usage

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