

INDEX

Search by product name / model No.

Product name	Intro 1
Model No. in alphabetic order	Ending 12

Search by product series

Intro 3
Select from appearance and product overview of each series.

Guide to using CAD data

Intro 7

Website Information

Intro 9

Guide to the model selection system

Intro 10

⚠ Safety Precautions

Intro 17
*For cautions for each product, read the safety precautions for each model series in the text.

Flow characteristics display method Intro 11

Degree of protection Intro 16

CE Marking Ending 2

CKD RoHS compliance Ending 4

ISO9001 / ISO14001 Certification Ending 6

Index (alphabetic order) Ending 12

International unit system (SI units)

Circuit diagram code list

Published on the CKD website.

<https://www.ckd.co.jp/kiki/en/>

Pressure switches

>>> Page 1

Flow rate sensors

>>> Page 219

Flow rate controllers

>>> Page 517

Multi-monitors

>>> Page 577

Product group	Product name	Page
 <p>Electronic pressure switches >>> Page 3</p>	Digital Pressure Sensor PPX	8
	Electronic pressure switch with digital display (Pressure switch) PPD3-S	40
	Electronic pressure switch with digital display PPG-D	60
	Compact electronic pressure switch PPE	72
	Compact electronic pressure switch PPE-□A	80
	Compact electronic pressure switch PPEV-□A	86
	Modular design F.R.L. Digital pressure sensor dedicated for regulator mounting PPR	92
 <p>Air contact/close contact/ cutting tool breakage detection switches >>> Page 97</p>	Digital gap switch GPS3	100
	Contact confirmation switch (gap switch) GPS2	125
	Close contact confirmation switch HPS	152
	Cutting tool breakage detection switch TLPS	180
	Mechanical pressure switch for coolants CPE	210
 <p>Pressure switches for coolants >>> Page 209</p>	Electronic pressure switch for coolants CPD	214
	 <p>Flow rate sensors for air >>> Page 221</p>	Compact flow rate sensor (RAPIFLOW) [®] FSM3
Compact flow rate sensor (RAPIFLOW) [®] Separated display FSM2-D		355
Miniature flow rate sensor for gas RAPIFLOW [®] FSM-X/V/VFM		369
Pneumatic flow rate sensor separated display FLUEREX [®] PFD		403
Karman vortex flow rate sensor FLUEREX [®] WFK2		421
 <p>Flow rate sensors for liquid >>> Page 419</p>	Capacitance electromagnetic flow sensor WFC	447
	Karman vortex flow rate sensor for water FLUEREX [®] WFK3000	465
	Integrated unit for water control WXU	483
	 <p>Flow rate controllers for air >>> Page 517</p>	Compact flow rate controller RAPIFLOW [®] FCM
 <p>Multi-monitors >>> Page 577</p>		Multi-monitors MD

Pressure switches >>> Page 1

Air pressure switches



Listed From Page 3

Pneumatic pressure sensor Electronic pressure switch

Series	Pressure range	Features	Page
PPX	-100 kPa to 1000 kPa	Standard and high-function types are available. Twin display of current pressure and set pressure values. 3-digit digital display	10
PPD3-S	-100 kPa to 980 kPa	Stainless steel diaphragm sensor	42
PPG-D	-101.3 kPa to 100.0 kPa	Size/31 mm Digital pressure sensor	62
PPE	-100 kPa to 1000 kPa	Sensor-amplifier integrated without display. Easy-to-install miniature body	72
PPEV	-100 kPa to 1.0 MPa	Small form factor of 10 mm width, high accuracy and high reliability	86
PPR	-100 kPa to 1.0 MPa	Modular F.R.L. dedicated for regulator mounting	92

Air pressure switches



Listed From Page 97

Pneumatic pressure sensor Contact/close contact/cutting tool breakage detection switch

Series	Detection range	Features	Page
GPS3	0.03 to 0.4mm	Single unit	104
MGPS3	0.03 to 0.4mm	Manifold (2 to 6 stations)	108
UGPS3	0.02 to 0.15mm	Solenoid valve with needle, regulator integrated general purpose unit	110

Series	Orifice size	Features	Page
GPS2	ø0.5, ø0.7	Single unit	126
MGPS2	ø0.5, ø0.7	Manifold (2 to 5 stations)	132
UGPS2	ø0.5, ø0.7	Solenoid valve with needle, regulator integrated general purpose unit	136

Series	Orifice size	Features	Page
HPS	ø0.5, ø0.7, ø1.0	Single unit	154
MHPS	ø0.5, ø0.7, ø1.0	Manifold (2 to 5 stations)	160
UHPS	ø0.5, ø0.7, ø1.0	Solenoid valve with needle, regulator integrated general purpose unit	164

Series	Orifice size	Features	Page
TLPS	ø0.3	Single unit	182
MTLPS	ø0.3	Manifold (2 to 5 stations)	188
UTLPS	ø0.3	Solenoid valve with needle, regulator integrated general purpose unit	192

Pressure switches for coolants



Pressure switches for coolants

Series	Port size	Features	Page
CPE	Rc1/4	Enables a wide pressure setting range of 0.05 to 0.8 MPa for coolant liquid through air	210

Series	Pressure range	Features	Page
CPD	0 to 7 MPa	With sensor amplifier integrated display for coolants and other liquids	214

Flow rate sensor >>> Page 219

Flow rate sensor for air



Listed From Page 221

Flow rate sensor for air Compact flow rate sensor (RAPIFLOW)[®]

Series	Flow range uni-direction/bi-direction	Features	Page
FSM3-□005	0 to 500/-500 to 500 mL/min	High precision High-speed response. Needle valve integrated. Separated display is available. Can be rotated and displayed LCD. Panel mounting is supported. Unrestricted mounting orientation. Variety of fitting variations.	229
FSM3-□010	0 to 1000/-1000 to 1000 mL/min		
FSM3-□020	0 to 2.00/-2.00 to 2.00 L/min		
FSM3-□050	0 to 5.00/-5.00 to 5.00 L/min		
FSM3-□100	0 to 10.00/-10.00 to 10.00 L/min		
FSM3-□200	0 to 20.0/-20.0 to 20.0 L/min		
FSM3-□500	0 to 50.0/-50.0 to 50.0 L/min		
FSM3-□101	0 to 100.0/-100.0 to 100.0 L/min		
FSM3-□201	0 to 200/-200 to 200 L/min		
FSM3-□501	0 to 500/-500 to 500 L/min		
FSM3-□102	0 to 1000/-1000 to 1000 L/min		



Environment-resistant specifications Integrated display/separated display FSM3

Series	Flow range uni-direction/bi-direction	Features	Page
FSM3-□005	0 to 500/-500 to 500 mL/min	Compact flow rate sensor with protection structure equivalent to IP65 while maintaining the features of the FSM3 Series. Optionally, ATEX directive compliant.	323
FSM3-□010	0 to 1000/-1000 to 1000 mL/min		
FSM3-□020	0 to 2.00/-2.00 to 2.00 L/min		
FSM3-□050	0 to 5.00/-5.00 to 5.00 L/min		
FSM3-□100	0 to 10.00/-10.00 to 10.00 L/min		
FSM3-□200	0 to 20.0/-20.0 to 20.0 L/min		
FSM3-□500	0 to 50.0/-50.0 to 50.0 L/min		
FSM3-□101	0 to 100.0/-100.0 to 100.0 L/min		
FSM3-□201	0 to 200/-200 to 200 L/min		
FSM3-□501	0 to 500/-500 to 500 L/min		
FSM3-□102	0 to 1000/-1000 to 1000 L/min		

Separated display FSM2-D

Series	Settable flow rate range	Features	Page
FSM2-D	5, 10, 50, 100, 500, 1000 [mL]	Separated display dedicated for FSM3 Series. When connecting the FSM3 integrated display/separated display, the flow rate range, etc., is automatically recognized.	355
	2, 4, 5, 10, 12, 20, 25, 32, 50, 100, 200, 500, 1000, 1500 [L]		



Series	Flow rate range L/min uni-direction (bi-direction)	Features	Page
FSM-X-A□005	0 to 0.5 (-0.5 to 0.5)	Compact body enabled by separating the sensor head.	372
FSM-X-A□010	0 to 1 (-1 to 1)		
FSM-X-A□050	0 to 5 (-5 to 5)		
FSM-X-A□100	0 to 10 (-10 to 10)		

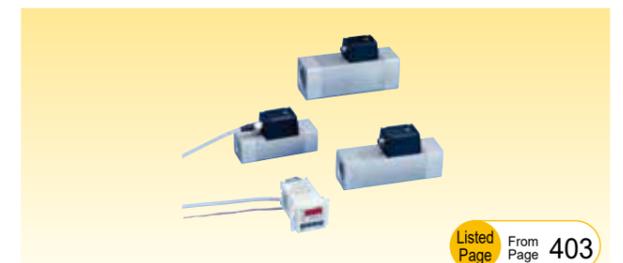
Miniature analog output/switch output FSM-V

Series	Flow rate range L/min	Features	Page
FSM-V-□R0005	-0.05 to +0.05	Easy measurement of forward and reverse flow. Ideal for detection control of vacuum suction and vacuum burst.	378
FSM-V-□R0010	-0.1 to 0.1		
FSM-V-□R0050	-0.5 to 0.5		
FSM-V-□R0100	-1 to 1		
FSM-V-□R0500	-5 to 5		
FSM-V-□R1000	-10 to 10		

Miniature inline filter FSM-VFM

Series	Port size	Features	Page
FSM-VFM	ø1.8, ø4, M5	Inline filter dedicated for miniature and space saving FSM Series	394

Flow rate sensors for air



Listed From Page 403

Flow rate sensor for air Pneumatic flow rate sensors FLUEREX[®]

Series	Flow rate range L/min (normal)	Features	Page
PFD-501	25 to 500	Covers a wide range of flow rates. Compressed air flow rate detection.	406
PFD-102	5 to 50		
PFD-202	100 to 2000		
PFD-402	100 to 200		
PFD-802	400 to 8000		
PFD-163	800 to 16000		

Search by product series

Select from appearance and product overview of each series.

Flow rate sensor >>> Page 219

Flow rate sensor for liquid



Listed From Page 421

Flow rate sensors for liquids

Flow sensors for liquids FLUEREX®

■Karman's vortex

Series	Measured flow rate range	Features	Page
WFK2-005	0.4 to 5 L/min	Wide flow rate measured range IO-Link configuration Equipped with multiple functions enabling various settings	426
WFK2-020	1.6 to 20 L/min		
WFK2-050	4.0 to 50 L/min		
WFK2-100	8.0 to 100 L/min		
WFK2-250	20 to 250 L/min		



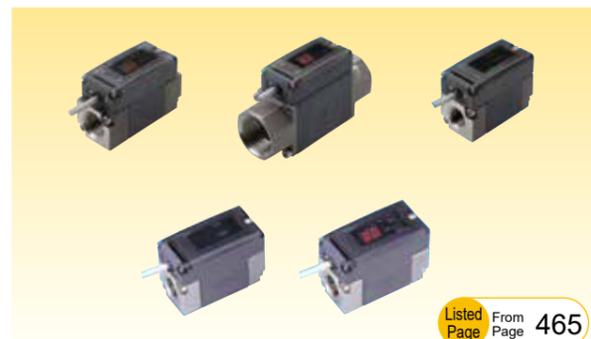
Listed From Page 447

Flow rate sensors for liquid

Capacitance electromagnetic flow sensors

■Capacitance

Series	Measured flow rate range	Features	Page
WFC-150	0.5 to 15 L/min	The Flo-Thru structure is resistant to foreign matter	450
WFC-600	2.0 to 60 L/min		



Listed From Page 465

Flow rate sensors for liquids

Flow rate sensors for water

■Karman's vortex

Series	Measured flow rate range	Features	Page
WFK3000	0.5 to 40, 1.5 to 12 L/min	Compact/device built-in	468



Listed From Page 483

Integrated units for water control

Series	Features	Page
WXU-H	1 Fluid control	486
WXU-HC	1 Fluid control	486
WXU-J	1 Fluid control	492
WXU-P	2 Fluid control	496

Flow rate controllers >>> Page 517

Flow rate controllers for air



Listed From Page 517

Flow rate controllers for air

Compact flow rate controllers RAPIFLOW®

■Standard models

Series	Flow rate range	Features	Page
FCM-9500	0 to 0.5 L/min	Compact, high-speed and multifunctional flow rate controller.	524
FCM-0001	0 to 1 L/min		
FCM-0002	0 to 2 L/min		
FCM-0005	0 to 5 L/min	Compatible fluids are air, nitrogen, argon, oxygen, city gas, methane, propane, hydrogen, helium	524
FCM-0010	0 to 10 L/min		
FCM-0020	0 to 20 L/min		
FCM-0050	0 to 50 L/min		
FCM-0100	0 to 100 L/min		

■Low differential pressure models

Series	Flow rate range	Features	Page
FCM-L9500	0 to 0.5 L/min	Suitable for controlling burner flame or other combustion gases with low supply pressure.	524
FCM-L0001	0 to 1 L/min		
FCM-L0002	0 to 2 L/min		
FCM-L0005	0 to 5 L/min		
FCM-L0010	0 to 10 L/min		

Multi-monitors >>> Page 577



Listed From Page 577

Multi-monitor

■Multi-monitors

Series	Flow rate/pressure range	Features	Page
MD	-100 to 980	For remote monitoring of flow rate and pressure.	580

CKD How to use CAD data

Pneumatic valve manifold specifications and CAD data are easily available on the Web.

Free download!

This is what makes CKD's CAD great!

Comprehensive list of CKD's leading products



Japanese, English, Chinese (Simplified and Traditional), and Korean are supported.

Simultaneous with new product launch

NEW Model No. **AX1R**

ABSODEX



Supports various data formats

- + PDF DataSheet (2D)
- + CAD-DataSheet (3D)
- + SAT File (3D)
- + Solid Edge 2019 (3D)
- + Solid Edge 2023 (3D)
- + Solid Edge 2021 (3D)
- + Solid Edge 2022 (3D)
- + AutoCAD (2D/3D)
- + STEP (AP214/STEP)
- + STEP (AP214/STEP)
- + IFC (3D)
- + JT (3D)
- + TM (3D model/3D)
- + Triangulation (3D/2D)

More than 25 types of 2D and more than 35 types of 3D
Supports PDF and JPEG formats!

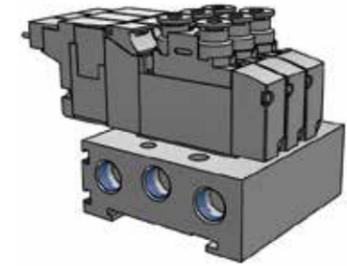
*To use 3D CAD, you must register as a CKD plus member.

Specifications are available



Manifold specifications for pneumatic valves can be prepared and shipped assembled to the customer.

Get CAD data



2D and 3D CAD data available for pneumatic valve manifold assemblies

Specifications and download method of CAD data

CKD plus How to register as a member

STEP 1

From the CKD components product top page, click "New member registration"



STEP 2

Enter your name, company name, contact information, and email address

Registration complete!



Easy registration in 2 STEPS

STEP 1

CKD components product TOP page > Product details page > Click "Manifold specifications sheet"

6 マニホールド仕様書



STEP 2

Select model No.

STEP 3

Create specifications sheet

How to download CAD

STEP 1

Click on "3D CAD" from the product detail page



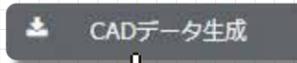
STEP 2

Select model No.

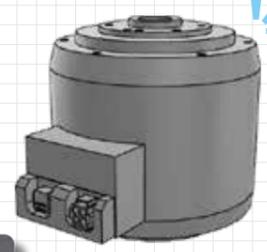
STEP 3

1 Specify CAD format

2 Generate CAD data



Download complete!



STEP 4

Download complete!

- For specifications output, click **仕様出力**.
- If downloading CAD data, click **2D/3D CAD**.

Significantly reduces work time

Website Information

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Please take advantage of it

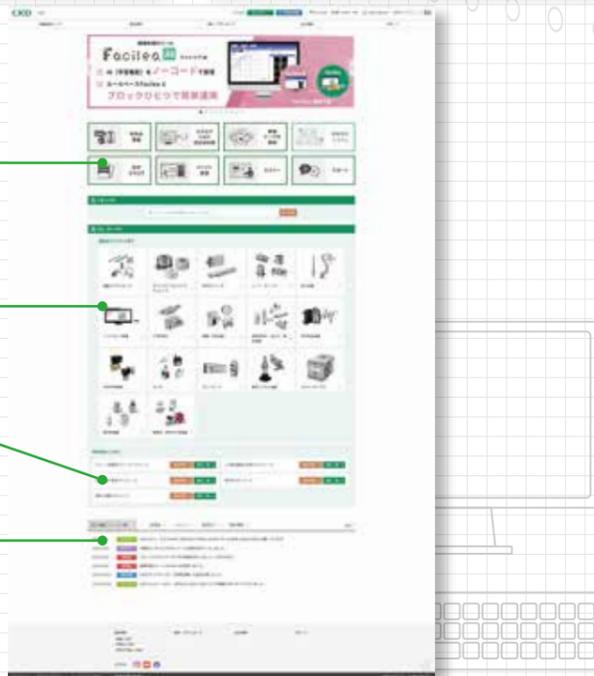
Catalog	CAD	Instruction manual
Maintenance parts	Software	Model selection
FAQ	Technical information	Product Information
Column	Event information	Seminar

You'll find the information you need here

You can find the product you want

Find the right product for each application

Stay up-to-date with the latest news



Various information is provided on each product page



Various information is available according to the products and applications

Guide to the Model Selection System

How to use the Model Selection System

The CKD system supports selection of the following items.
Please use this information when selecting and designing models.

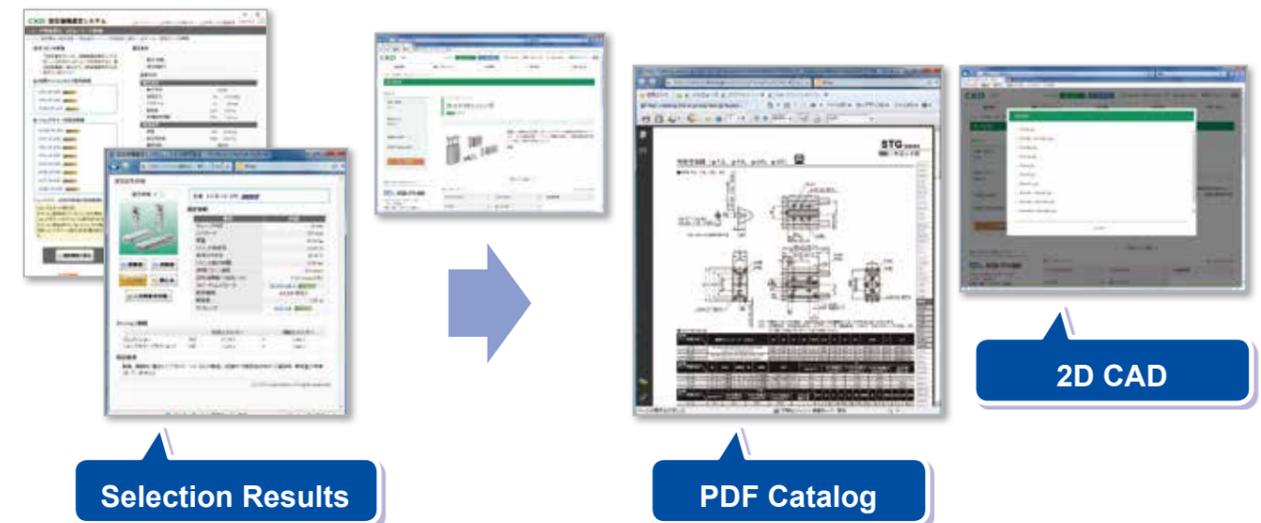
Available on our website

This is a system for selecting products according to the customer's application and working conditions.

<p>Web version Pneumatic components</p>	<p>Download version Mechanical index / Direct drive mode</p>	<p>Web version Electric actuators</p>	<p>Web version Fluid control components</p>
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*Software may not be downloadable due to your security policy. If that is the case, contact CKD.

Linked to PDF catalogs and CAD data from selection results!



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A variety of services such as CKD product catalogs, PDF, CAD data and model selection are available.
Feel free to try it.

<https://www.ckd.co.jp/en/>

How Flow Characteristics are Indicated

1. Flow Characteristics Indication

The catalog specifications indicate the flow rate as follows.

Applicable Components	Indicator	Unit	Standards
Pneumatic Components	JIS compliant indication	C, b	ISO 6358:1989 "Pneumatic fluid power - components using compressible fluids - Determination of flow-rate characteristics" JIS B 8390:2000 (ISO 6358 translation)
	Conventional Display	S Cv	JIS B 8379:1995 "Pneumatic noise reduction device" ANSI (NFPA)T3. 21. 3 R1-2008
Fluid Control Components	JIS compliant indication	Cv Kv	IEC 60534-2-3: 2015 "Industrial Process Control Valves - Part 2: Flow rate - Part 3: Test Procedure" JIS B 2005-2-3: 2004 (IEC 60534-2-3 translation) JIS B 8471: 2004 "Solenoids for water" JIS B 8472: 2008 "Solenoids for steam" JIS B 8473: 2007 "Solenoids for fuel"
	Conventional Display		

2. Pneumatic components descriptions

The flow characteristics of the pneumatic components were conventionally indicated with the effective cross-sectional area S and flow coefficient Cv. However, following JIS revisions (JIS B 8390:2000), these characteristics are now indicated with the sonic conductance C and critical pressure ratio b.

- Sonic conductance C: Value obtained by dividing the passage mass flow of the choked flow component by the product of the upper limit absolute pressure and standard condition density. (sonic conductance) $S \approx 5.0C$ (C enables sizing as before.)
- Critical pressure ratio b: Pressure at which choked flow results if smaller than this value (downstream pressure/upstream pressure (critical pressure ratio))
- Effective cross-sectional area S (mm²): The value of the ideal restricted cross-sectional area without friction or compressed flow, calculated from the pressure changes inside the air tank when the choked flow is released from the components mounted on the air tank.

*Choked flow: Flow at which upstream pressure is higher than downstream pressure, and speeds at components sections reach acoustic velocity. The mass flow rate of the gas is proportional to the upstream pressure and independent of the downstream pressure. (Choked flow)

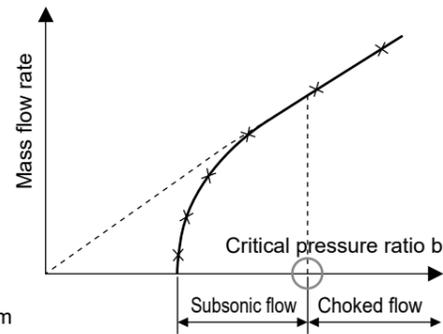


Fig. 1 Mass flow characteristics for upstream pressure

Flow Rate Formula

Depending on the actual unit, they are shown as follows.

• $\frac{P_2}{P_1}$ Choked flow when $\leq b$

$$Q = 600 \times C \times P_1 \times \sqrt{\frac{293}{273 + T}} \dots\dots (1)$$

• $\frac{P_2}{P_1}$ Subsonic flow when $> b$

$$Q = 600 \times C \times P_1 \times \sqrt{1 - \left[\frac{\frac{P_2}{P_1} - b}{1 - b} \right]^2} \times \sqrt{\frac{293}{273 + T}} \dots\dots (2)$$

Q: Flow rate L/min (ANR) in standard condition
C: Sonic conductance [dm³/(s·bar)]
b: Critical pressure ratio
S: Effective cross-sectional area mm²
P₁: Primary side absolute pressure MPa (abs)
P₂: Primary side absolute pressure MPa (abs)
T: Air temperature °C

When calculating with effective cross-sectional area S, substitute value C obtained with $C = S/5$ in the above formula. For subsonic flow, substitute $b = 0.5$ in formula (2).

3. Fluid control components

The flow characteristics of the fluid control components indicated flow coefficients Cv and Av. However, the Av value was eliminated from the control valve flow coefficient with "JIS B 2005-2-3:2004" revisions, so that only Kv and Cv are used. Cv and Kv values are listed for the flow characteristics of the fluid control components.

- Flow coefficient Cv: This is a non-SI control valve flow coefficient, but is used commonly throughout the world. US gal value which indicates 40 to 100°F city water flow rate per minute passing through the valve (device under test) at pressure differential of 1 psi.

$$Cv = Q \sqrt{\frac{\rho}{\rho_w} \cdot \frac{1}{\Delta P}} \dots\dots (3)$$

Cv: Flow coefficient
Q: Flow rate [U.S.gal/min] (1 U.S.gal/min=6,309×10⁻⁵m³/s)
ρ: Fluid density [1b/ft³](1b/ft³=16,018 kg/m³)
ρ_w: Water density of 40°F to 100°F (4°C to 38°C) [1b/ft³]
ΔP: Pressure difference [psi] (1 psi = 6.8948 kPa)

- Flow coefficient Kv: Numerical value expressing the flow rate of drinking water at temperatures from 5 to 40°C flowing through the valve in m³/h when the pressure difference is 1 bar.

$$Kv = Q \sqrt{\frac{1 \times 10^5}{\Delta P} \cdot \frac{\rho}{1000}} \dots\dots (4)$$

Kv: Flow coefficient
Q: Flow rate [m³/h]
ΔP: Pressure difference [Pa]
ρ: Fluid density [kg/m³]

Flow Rate Formula

Depending on the actual unit, they are shown as follows.

●Flow coefficient Cv

For liquids:

$$Q = 45.58 Cv \sqrt{\frac{\Delta P}{G}} \dots\dots (5)$$

For steam:

When $P_2 \leq \frac{P_1}{2}$ $W = \frac{99 Cv P_1}{K} \dots\dots (6)$

When $P_2 > \frac{P_1}{2}$ $W = \frac{198 Cv \sqrt{(P_1 - P_2) P_2}}{K} \dots\dots (7)$

Cv: Flow coefficient
Q: Flow rate [L/min]
ΔP: Pressure difference [MPa]
G: Specific gravity [water G = 1]

Cv: Flow coefficient
W: Flow rate [kg/h]
P₁: Primary side absolute pressure [MPa]
P₂: Secondary side absolute pressure [MPa]
K: (1+0.0013 ts) ts: Superheat (Saturation steam K = 1)

How Flow Characteristics are Indicated

Flow Rate Formula

Depending on the actual unit, they are shown as follows.

●Flow coefficient Kv

For liquids:

$$Q=52.63 Kv \sqrt{\frac{\Delta P}{G}} \dots\dots\dots(8)$$

Kv: Flow coefficient
 Q: Flow rate [L/min]
 ΔP : Pressure difference [MPa]
 G: Specific gravity [water G = 1]

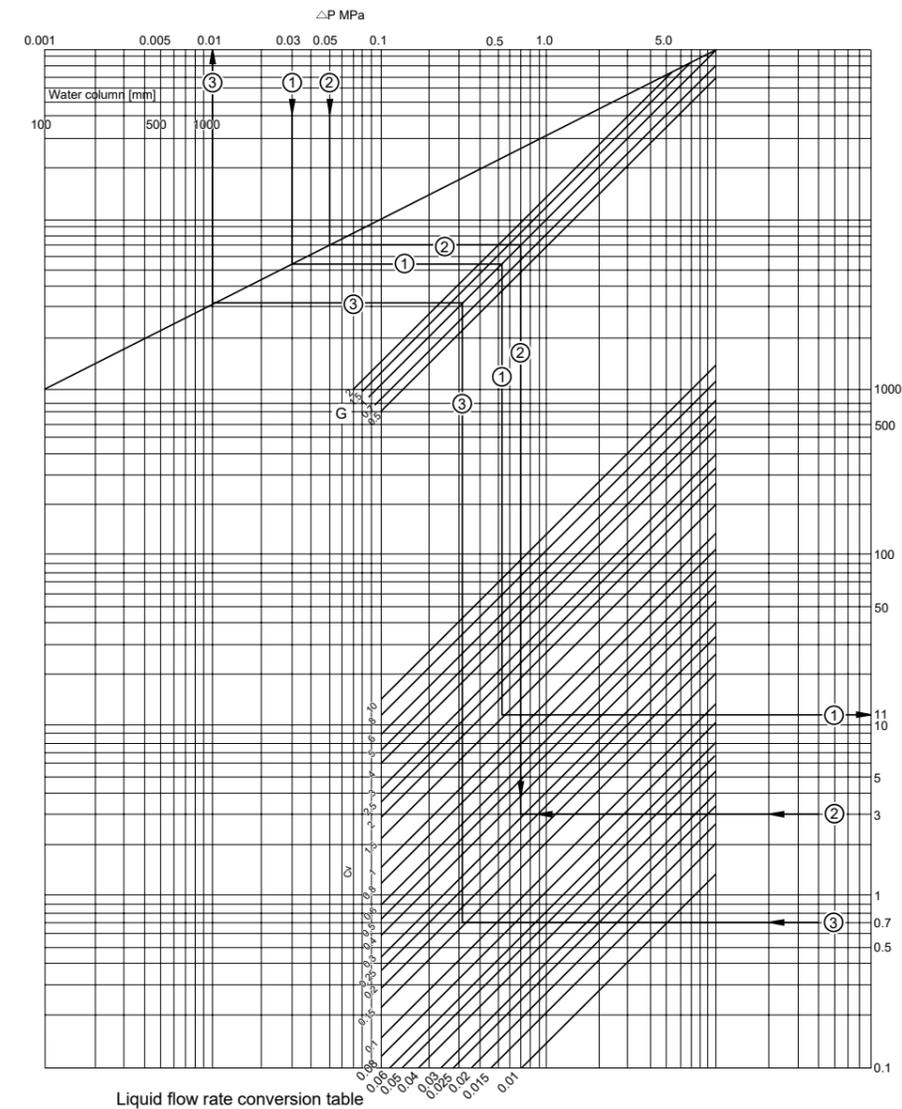
Flow coefficient conversion

$$Kv=0.87 Cv$$

Kv: Numerical value expressing the flow rate of drinking water at a temperature of 5 to 40°C through the valve in m³/h when the pressure difference is 1 bar.
 Cv: Numerical value expressing the flow rate in US gal/min of 60 drinking water temperature flowing through the valve when the pressure difference is 1 lbf/in² (psi)
 The values do not match those of Kv and Cv for air because the test methods are different.

Flow rate conversion table

Water



- Example 1:
 What is the flow rate when water (specific gravity=1) flows through a valve with Cv 1.5 at $\Delta P=0.03$ MPa (P1-P2)
 $Q=11.8$ L/min
 - Example 2:
 Cv value required to flow water (specific gravity=1) at 3 L/min at $\Delta P=0.05$ MPa
 $Cv=0.29$
 - Example 3:
 Pressure loss when water (specific gravity = 1) is passed through a $Cv=0.15$ valve at 0.7 L/min
 $\Delta P=0.01$ MPa
- *1: The table shows Cv up to 10. If this value is exceeded, multiply the Cv and flow rate Q proportionally.
 Example: For a Cv value of 15, this would mean using the 1.5 place and multiplying the flow rate by 10.

Flow rate calculation method

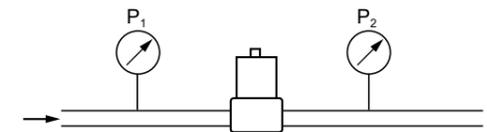
$$Q=52.63 Kv \sqrt{\frac{\Delta P}{G}}$$

Kv: Flow coefficient
 Q: Flow rate [L/min]
 ΔP : Pressure difference [MPa]
 G: Specific gravity [water G = 1]

Flow coefficient conversion
 $Kv=0.87 Cv$

$$Q=45.58 Cv \sqrt{\frac{\Delta P}{G}}$$

Cv: Flow coefficient
 Q: Flow rate [L/min]
 ΔP : Pressure difference [MPa]
 G: Specific gravity [water G = 1]

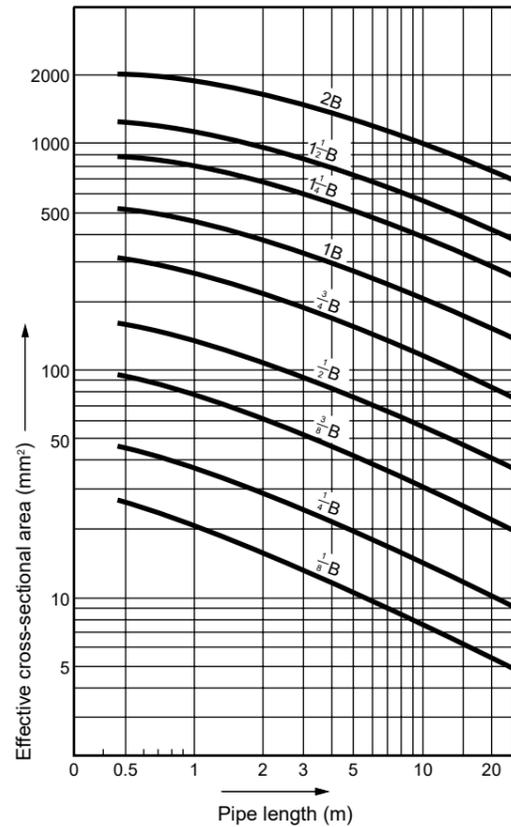


Pressure loss
 ΔP
 $\Delta P=P_1-P_2$

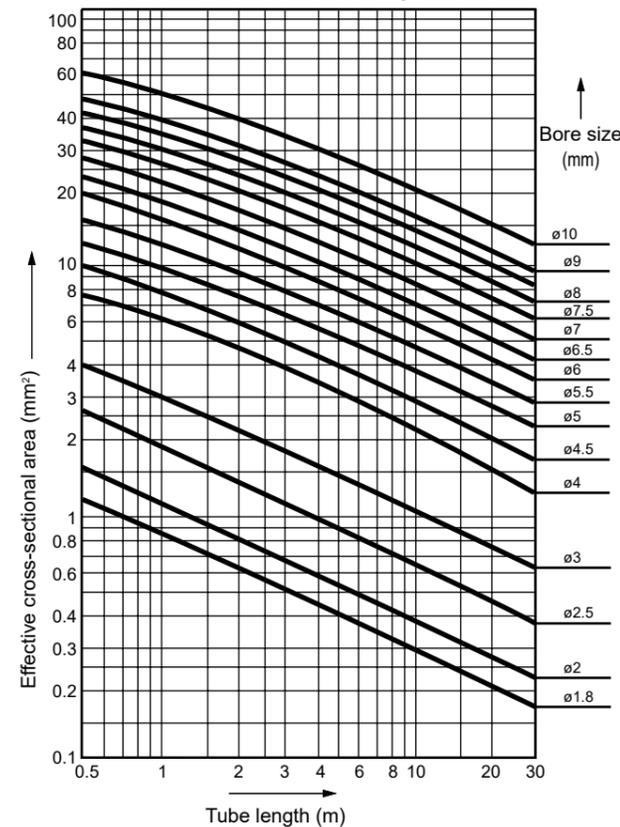
P₁: Upstream pressure [MPa]
 P₂: Downstream pressure [MPa]

Effective cross-sectional area for steel pipes and nylon tubes, and recommended max. flow rate for gas pipes

Effective cross-sectional area of steel pipes



Effective cross-sectional area of nylon tubes



Recommended max. flow rate table of gas tube

Nominal size	1/8B	1/4B	3/8B	1/2B	3/4B	1B	1 1/4B	1 1/2B
Pressure drop MPa (*1)	0.124	0.0707	0.0576	0.0425	0.0276	0.0209	0.0133	0.0105
Inlet pressure MPa	Recommended max. flow rate (L/min)							
0.05	127	244	518	838	1,465	2,460	3,870	5,150
0.1	146	282	598	965	1,690	2,828	4,460	5,950
0.15	163	314	668	1,076	1,885	3,150	4,960	6,630
0.2	179	344	730	1,180	2,060	3,450	5,430	7,280
0.3	206	395	840	1,360	2,375	3,900	6,300	8,400
0.4	230	442	940	1,520	2,660	4,450	7,000	9,360
0.5	252	485	1,030	1,660	2,920	4,875	7,700	10,250
0.6	272	523	1,110	1,800	3,140	5,250	8,300	11,050
0.7	292	558	1,185	1,920	3,350	5,620	8,870	11,800
0.8	308	592	1,260	2,035	3,560	5,970	9,430	12,570
0.9	324	623	1,325	2,140	3,745	6,290	9,900	13,220
1.0	340	654	1,395	2,250	3,930	6,600	10,400	13,880
1.2	370	717	1,510	2,450	4,280	7,150	11,250	15,040
1.4	398	763	1,625	2,624	4,590	7,700	12,100	16,200
1.5	410	790	1,680	2,710	4,740	7,930	12,550	16,780

(*1: Inlet pressure = 0.5 MPa)
Gas tube length: 10 m

(Remarks)

In mainlines with long piping distances, it is necessary to consider the degree of pressure drop that occurs at the end of the mainline when air flows through it. The maximum recommended flow rate means the maximum flow rate that can be recommended within an acceptable pressure drop relative to the pipe length from a practical standpoint. This does not mean that a higher flow is not possible, but rather that the pressure will further decrease if the flow exceeds this value.



Degree of protection

- Degree of Protection
- IEC (International Electrotechnical Commission) Standards (IEC60529)
- JIS C 0920 : 2003

IP-

Protection Characteristic Codes (International Protection)

1st Characteristic No. (degree of protection for foreign solid matter)

1st Characteristic No.	Degree of protection	
0	No protection	
1		Protection against inflow of solids 50 mm and over in diameter
2		Protection against inflow of solids 12.5 mm and over in diameter
3		Protection against inflow of solids 2.5 mm and over in diameter
4		Protection against inflow of solids 1.0 mm and over in diameter
5		No inflow of dust at levels adversely affecting normal device operation or safety
6		No inflow of dust

2nd Characteristic No. (degree of protection for water entry)

2nd Characteristic No.	Degree of protection	
0	No protection	
1		Protection against water dripping No harmful effects from water dripping vertically.
2		Protection against dripping water tilted at an angle of up to 15° Water dripping vertically has no adverse effect when the product is tilted at an angle of up to 15° from its normal position.
3		Protection for watering Water falling as a spray at any angle up to 60° from the vertical has no adverse effect.
4		Protection against splashing water Water splashing against the product from any direction has no adverse effect.
5		Protection against water jets No harmful effects occur even when water is sprayed with nozzles from all directions.
6		Protection against powerful water jets Water projected in powerful jets against the product from any direction has no adverse effect.
7		Protection against immersion Water will not enter the product even when it is immersed in water under defined conditions.
8		Protection against immersion The product can be used for continuous immersion in water.



Safety Precautions

Be sure to read this section before use.

When designing and manufacturing equipment using CKD products, the manufacturer is obligated to ensure that the safety of the mechanism, pneumatic control circuit and/or water control circuit and the system that runs the electrical controls are secured.

It is important to select, use, handle and maintain CKD products appropriately to ensure their safe usage.

Observe warnings and precautions to ensure device safety.

Check that device safety is ensured, and manufacture a safe device.

WARNING

1 This product is designed and manufactured as a general industrial machine part. It must be handled by an operator having sufficient knowledge and experience.

2 Use this product in accordance with specifications.

This product must be used within its stated specifications. In addition, never modify or additionally machine this product. This product is intended for use in general industrial machinery equipment or parts. It is not intended for use outdoors (except for products with outdoor specifications) or for use under the following conditions or environments. (Note that this product can be used when CKD is consulted prior to its usage and the customer consents to CKD product specifications. The customer should provide safety measures to avoid danger in the event of problems.)

- ① Use for applications requiring safety, including nuclear energy, railways, aircraft, marine vessels, vehicles, medical devices, devices or applications in contact with beverages or foodstuffs, amusement devices, emergency cutoff circuits, press machines, brake circuits, or safety devices or applications.
- ② Use for applications where life or assets could be significantly affected, and special safety measures are required.

3 Observe organization standards and regulations, etc., related to the safety of the device design and control, etc. ISO4414, JIS B 8370 (Pneumatic fluid power - General rules and safety requirements for systems and their components) JFPS2008 (Principles for pneumatic cylinder selection and use) Including the High Pressure Gas Safety Act, Industrial Safety and Health Act, other safety rules, organization standards and regulations, etc.

4 Do not handle, pipe, or remove devices before confirming safety.

- ① Inspect and service the machine and devices after confirming safety of the entire system related to this product.
- ② Note that there may be hot or charged sections even after operation is stopped.
- ③ When inspecting or servicing the device, turn OFF the energy source (air supply or water supply), and turn OFF power to the facility. Discharge any compressed air from the system, and pay enough attention to possible water leakage and leakage of electricity.
- ④ When starting or restarting a machine or device that incorporates pneumatic components, make sure to secure system safety, such as pop-out prevention measures.

5 Observe the warnings and cautions on the following pages to prevent accidents.

■ Precautions are ranked as "DANGER", "WARNING", and "CAUTION" in this section.

DANGER: In the case where the product operation is mishandled and/or when the urgency of a dangerous situation is high, it may lead to fatalities or serious injuries.

WARNING: A dangerous situation may occur if handling is mistaken, leading to fatal or serious injuries.

CAUTION: A dangerous situation may occur if handling is mistaken, leading to minor injuries or property damage.

Note that some items indicated with "CAUTION" may lead to serious results depending on the conditions. All items contain important information and must be observed.

Warranty

1 Warranty period

The product specified herein is warranted for one (1) year from the date of delivery to the location specified by the customer.

2 Warranty coverage

If the product specified herein fails for reasons attributable to CKD within the warranty period specified above, CKD will promptly provide a replacement for the faulty product or a part thereof or repair the faulty product at one of CKD's facilities free of charge.

However, following failures are excluded from this warranty:

- 1) Failure caused by handling or use of the product under conditions and in environments not conforming to those stated in the catalog, the Specifications, or the Instruction Manual.
- 2) Failure caused by use of the product exceeding its durability (cycles, distance, time, etc.) or caused by consumable parts.
- 3) Failure not caused by the product.
- 4) Failure caused by use not intended for the product.
- 5) Failure caused by modifications/alterations or repairs not carried out by CKD.
- 6) Failure caused by reasons unforeseen at the level of technology available at the time of delivery.
- 7) Failure caused by acts of nature and disasters beyond control of CKD.

The warranty stated herein covers only the delivered product itself. Any loss or damage induced by failure of the delivered product is excluded from this warranty.

Note: For details on the durability and consumable parts, contact your nearest CKD sales office.

3 Compatibility check

The customer is responsible for confirming the compatibility of CKD products with the customer's systems, machines and equipment.

Precautions for export

1 Security Trade Control

The products in this catalog and their related technologies may require approval before export or provision.

For the sake of maintaining world peace and safety, there may be cases in which approval under the Foreign Exchange and Foreign Trade Control Law is required in advance, depending on the country to where the product or related technology is being exported or provided.

The scope of products and related technologies requiring approval are listed in the Export Trade Control Order Appendix Table 1 or Foreign Exchange Order Appendix Table.

The Export Trade Control Order Appendix Table 1 and Foreign Exchange Order Appendix Table contain the following two types of information.

- "List controls" specified for items 1 to 15
- "Catch-all controls" that do not indicate specifications by item, but restriction by application (Section 16)

Products that require authorization or the range of relevant technology

List control, which is specified in item 1 to 15

Listed in the "Export Trade Control Order Appendix Table 1" or "Foreign Exchange Order Appendix Table"

Catch-all control restricted by application (item 16)

Listed in the "Export Trade Control Order Appendix Table 1" or "Foreign Exchange Order Appendix Table"

An application for approval is received by the Security Export Licensing Division of the Ministry of Economy, Trade and Industry or local bureaus of the Ministry of Economy, Trade and Industry.

2 Products and related technologies in this catalog

The products and related technologies in this catalog are subject to the catch-all control of the Foreign Exchange and Foreign Trade Control Law.

When exporting or providing the products or related technologies in this catalog, ensure that they are not used for arms or weapons.

3 Contact

Contact your local CKD Sales Office for information on the Security Trade Control of products and related technologies in this catalog.

Design / Selection

1. Checking the specifications

⚠ WARNING

- Use the product in the range of conditions specified for the product. The product in this catalog is designed for use only in a compressed air system. Use with pressures or temperatures outside the specifications range may result in damage or operation failure. (Refer to specifications) Contact CKD when using fluids other than those specified in the specifications for each component.

2. Safety Design

⚠ WARNING

- Take measures to prevent physical harm or property damage in the event of breakdown.

⚠ CAUTION

- Understand compressed air features before designing a pneumatic circuit.
 - The same functions as mechanical, hydraulic and electrical methods cannot be anticipated if instantaneous service interruption and holding are required during an emergency stop.
 - Pop-out, air discharge, or leakage due to air compression and expansion may occur.
 - Design the circuit so that compressed air in the system is exhausted.
- Decide on a method of lubricating the pneumatic components, and provide correct maintenance.
 - Is it a lubrication type?

Is it a no-lubrication type?
Specify either of the above for control of lubricant.

- Check for leakage current to avoid malfunction caused by the leakage current.
 - When using a programmable controller, leakage current may cause malfunction.

3. Design by Application

⚠ CAUTION

- Exerts no influence on performance as it uses compressed air and a small amount of leakage is tolerable. Contact CKD if no-leakage is required.

4. Working Environment

⚠ WARNING

- Install the product where it will not be exposed to rain, water or direct sunlight.
- Do not use this product in a corrosive environment. Use in such an environment could lead to damage or operation failure.
- Avoid using this product in environments where ozone is generated. Consult with CKD if ozone is generated in the air supply, as an ozone-resistant series is available.
- If ambient temperature is less than 5°C, moisture in the circuit could freeze and lead to misoperations, etc. Remove moisture to prevent freezing.

⚠ CAUTION

- Confirm before use that the product will withstand the working environment.
 - This product cannot be used in environments where functional obstacles could occur. Such environments include high temperatures, chemical atmospheres, or those where chemical liquids, vibration, moisture, dripping water, coolant or gas are present. Contact CKD if no-leakage is required.

5. Securing of space

⚠ CAUTION

- Secure sufficient space around the pneumatic components for installation, removal, wiring, and piping work.

6. Clearly state in the instruction manual

⚠ CAUTION

- Indicate the maintenance conditions in the device's instruction manual.
 - The product's performance may drop too low to maintain an appropriate safety level depending on usage conditions, working environment and maintenance status. With correct maintenance, the product functions can be used to the fullest.

Mounting, Installation and Adjustment

⚠ CAUTION

1. Mounting

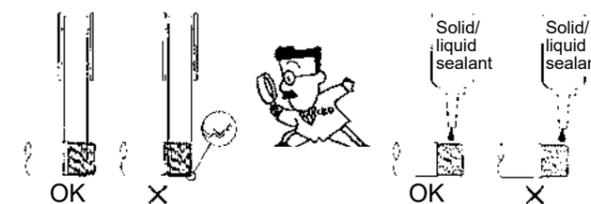
- Do not remove the pneumatic components packaging and the piping port seat cap until just before starting to pipe.
 - If the piping port cap is removed from the piping port before piping work is started, foreign matter could enter the pneumatic component from the piping port and result in faults or faulty operation.
- When mounting a pneumatic components, do not use a mounting method that relies on support from the piping.
- Remove the dust-proof seal of piping port just before starting to pipe.
 - Removing it before starting piping work may cause foreign matter to enter the inside from the piping port, resulting in breakdown malfunction.

2. Pre-operation confirmation

- After connecting the pipes, check pipe connections for air leaks before supplying compressed air.
 - Apply a leakage detection agent on pipe connections with a brush and check for air leaks. Make sure that the leak detection agent does not adhere to the plastic bowl. The plastic bowl could break, which is dangerous.

3. Piping

- When connecting pipes, wrap sealing tape in the opposite direction from the threading, from the inside position to within 2 mm from the pipe end.
 - If sealing tape protrudes from the pipe threads, it could be cut when screwing the bolts in. This could cause the tape to enter the solenoid valve, causing breakdowns.



When using a liquid sealant, make sure that it does not adhere to the plastic bowl. The plastic bowl could break, which is dangerous.

- Check that the piping connected to the pneumatic components is not dislocated due to vibration, looseness, or tension.
 - Piping dislocation is dangerous.
- Observe the following precautions when using nylon or urethane tubes as the piping material.
 - Use flame-resistant tubes or metal steel pipes in an environment where spattering may occur.

- Use a hydraulic hose for common piping for hydraulic and pneumatic specifications.
- When using the standard push-in fitting on the spiral tube, fix the base of the tube with a hose clamp. Rotation may occur, causing a reduction in holding force.
- When using for hot liquids, use a spigot fitting. The push-in fitting cannot be used.

- Connect the piping so that connections are not dislocated by equipment movement, vibration, tension, etc.

- Always flush just before piping pneumatic component.
 - Any foreign matter that has entered the pneumatic components during piping must not enter the valve.

- Tighten pipes with the appropriate torque.
 - The purpose is to prevent air leakage and damage to bolts.
 - First tighten the bolts by hand to ensure that the threads are not damaged, then use a tool.

[Recommended values]

Port thread	Tightening torque N·m
M3	0.3 to 0.6
M5	1 to 1.5
Rc1/8	3 to 5
Rc1/4	6 to 8
Rc3/8	13 to 15
Rc1/2	16 to 18
Rc3/4	19 to 40
Rc1	41 to 70

Note: If a specific tightening torque is recommended for the model, use the torque.



4. Pneumatic source

- Install a pneumatic filter just before the pneumatic component in the circuit.

- When supplying compressed air after connecting pipes, do not suddenly apply high pressure.

- The pipe connection could dislocate causing the pipe to fly off and result in accidents.
- CAUTION: If compressed air is supplied too slowly, sealing pressure may not be generated depending on the internal sealing mechanism of the solenoid valve and may cause air leaks.

- Air Quality

- Use CKD clean air system components appropriate for your application.
- Use compressed air that does not contain oil oxides, tar, carbon, etc., from the air compressor.
- Use compressed air that does not contain solid foreign matter.

⚠ CAUTION

1. Disassembly / Assembly

- Pneumatic components products must be disassembled and assembled by qualified personnel.
 - Personnel involved in this step must have passed the Pneumatic Pressure Skill Test Class 2 or higher.
- Read the relevant product's instruction manual thoroughly and fully familiarize yourself with the work before disassembling or assembling the pneumatic components.
 - Personnel must be fully familiar with pneumatic component structure and operational principles and safety requirements.

2. Maintenance / Inspection

- Be sure to turn power OFF, stop the compressed air supplied, and check that there is no residual pressure before starting maintenance.
 - This is required to ensure safety.