

# Air Flow Controller



Applicable fluid **Dry air, N<sub>2</sub>**

**IP65**



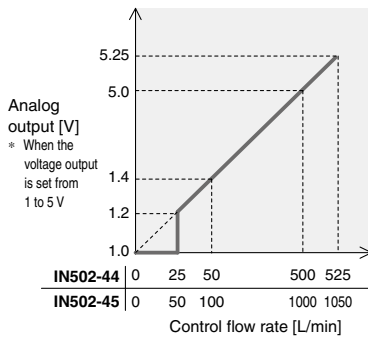
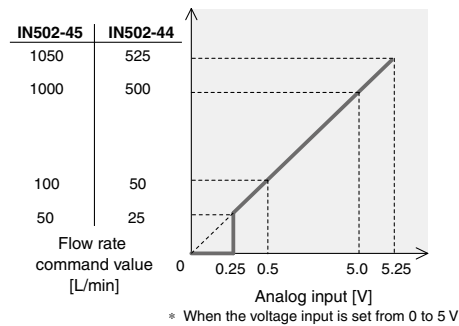
## Automatic flow rate adjustment is possible.

Series	Rated control flow rate range [L/min]			
	50	100	500	1000
IN502-44	50 to 500			
IN502-45		100 to 1000		



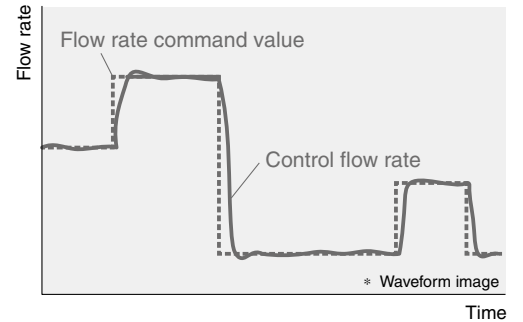
**Control Accuracy ±5% F.S.**

Input signal — Flow rate command value      Control flow rate — Output signal



**Responsiveness 0.5 s or less**

Flow rate control that follows the flow rate command



### 3-screen display

Current control flow rate value (Main screen)

Label (Sub screen/Left side)      Value (Sub screen/Right side)

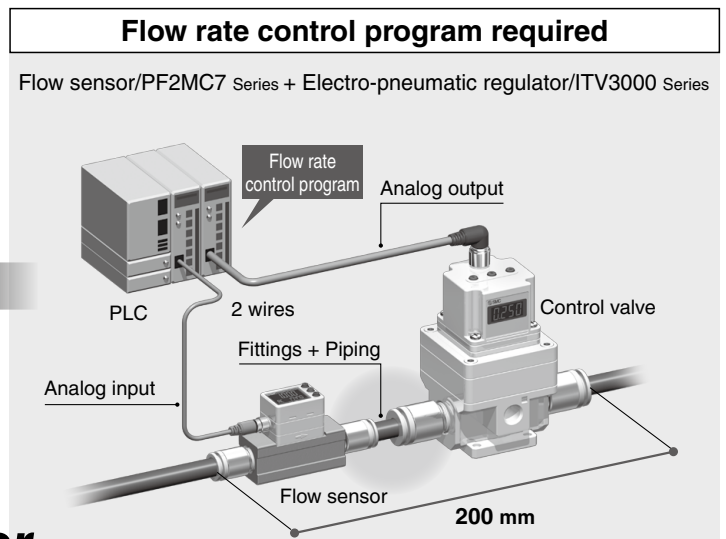
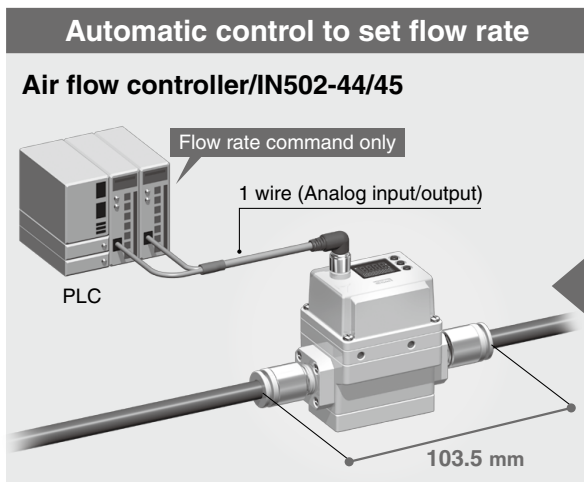
Visualization of settings

- Flow rate command value: 500
- Outlet pressure value: 500 kPa
- Flow rate bottom value: 4.0
- Flow rate peak value: 4.4
- Mode display: Mode 5.0

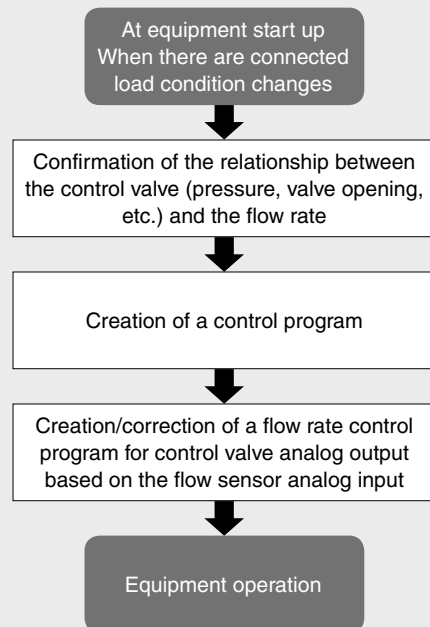
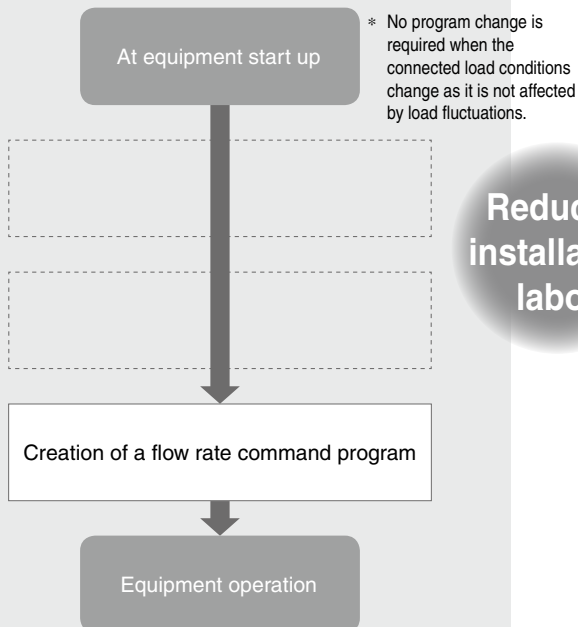
# IN502-44/45



# Space saving/Reduced piping, wiring, and installation labor



## Reduced installation labor



## Reduced effects of load fluctuations

### Changes in connected load conditions

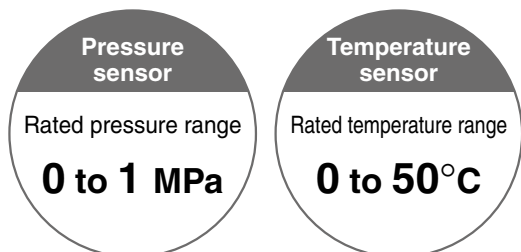
- Control target changes
- Pipe length and pipe bore size changes
- Changes in components, etc.

### The outlet pressure\*1 and fluid temperature\*1 can be measured simultaneously.

\*1 When using IO-Link communication  
\*1 Reference value

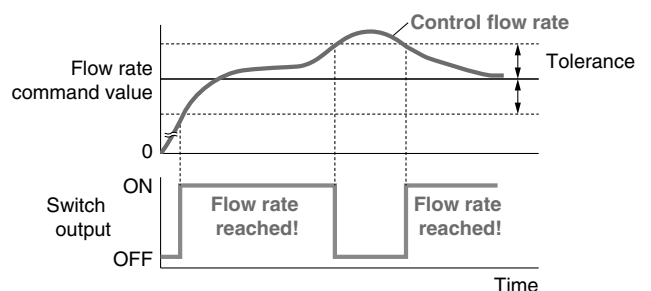
Measurement and output have been made possible by adopting flow rate conversion (differential pressure type) using a pressure sensor and flow rate temperature correction using a temperature sensor.

**p. 6**



### Notifies when the control flow rate command value has been reached

Switch output is performed when the control flow rate falls within the specified allowance with respect to the flow rate command value in the switch output "tolerance mode." (The factory-set tolerance is  $\pm 2\%$  F.S.)

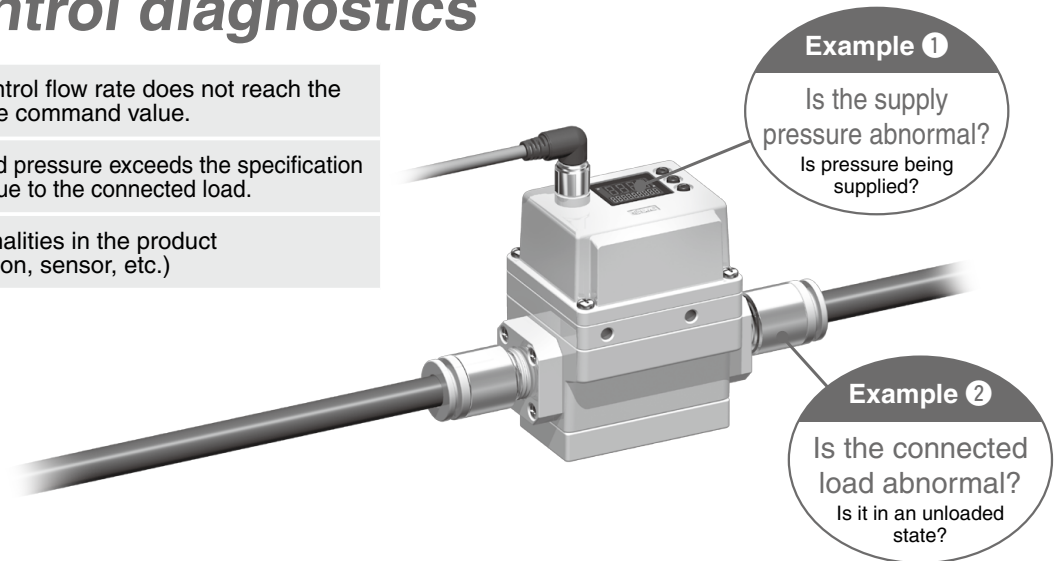


## Various types of grease can be selected.

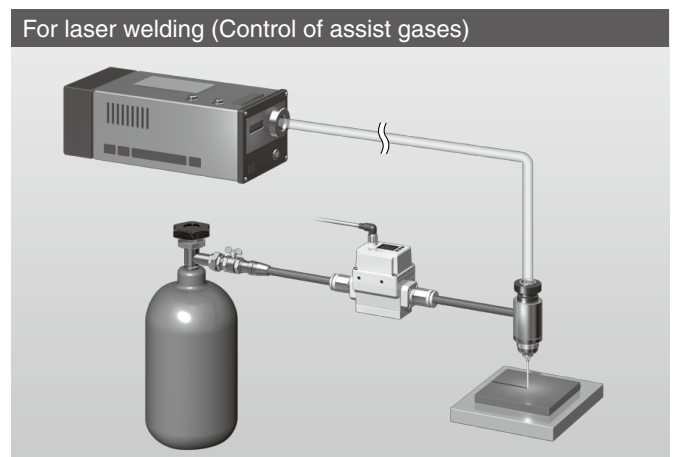
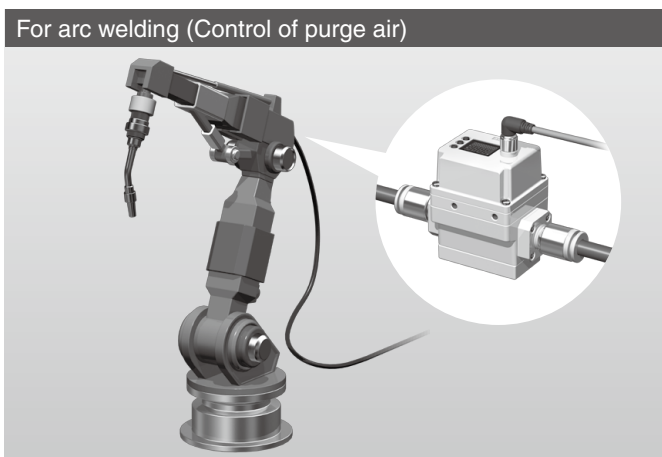
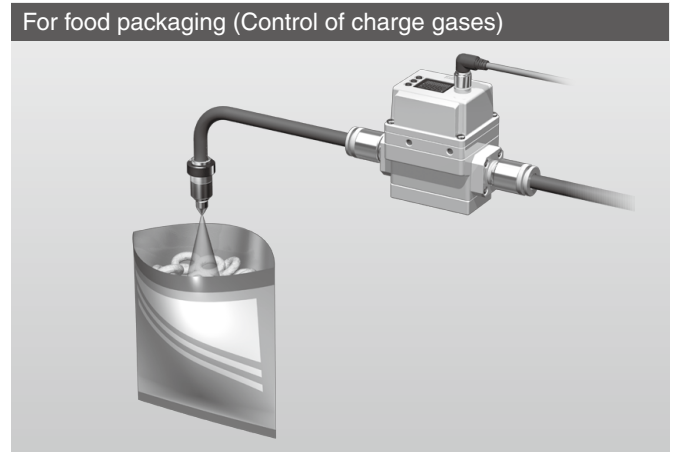
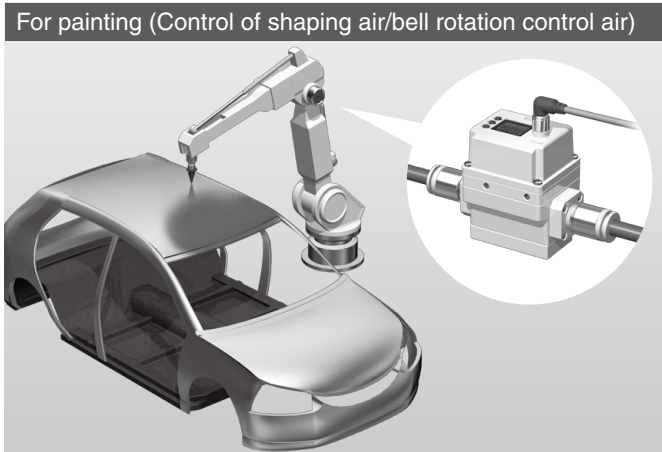
Grease compatible with low dew points	Compatible with low dew point air
White vaseline	Compatible with paint and other coatings
Grease for food	Compatible with NSF H1 grade food grade greases

## Various control diagnostics

Control flow rate unreachable	The control flow rate does not reach the flow rate command value.
Load error	The load pressure exceeds the specification range due to the connected load.
Control error	Abnormalities in the product (operation, sensor, etc.)



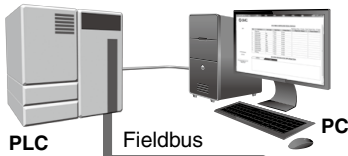
## Applications





IO-Link is an open communication interface technology between the sensor/ actuator and the I/O terminal that is an international standard, IEC61131-9.

## Visualization of operation/equipment status Remote monitoring and control by communication



### Configuration File (IODD File\*1)

- Manufacturer
- Product part no.
- Set value

\*1 IODD File

IODD is an abbreviation of IO Device Description. This file is necessary for setting the device and connecting it to a master. Save the IODD file on the PC to be used to set the device prior to use.

Device settings can be set by the master.

- Threshold value
- Operation mode
- Flow rate command value, etc.

### Read the device data.

- Switch ON/OFF signal and analog data
- Device information: Manufacturer, Product part number, Serial number, etc.
- Normal or abnormal device status
- Cable breakage



IO-Link Master

### Implement diagnostic bits in the process data.

The diagnostic bit in the cyclic process data makes it easy to find problems with the equipment.

It is possible to find problems with the equipment in real time using the cyclic (periodic) data and to monitor such problems in detail with the noncyclic (aperiodic) data.

### Input process data

Bit offset	Item	Note
0	Flow rate SW	0: OFF 1: ON
8	Flow rate diagnosis	0: Normal 1: HHH
9	Pressure diagnosis	0: Normal 1: HHH/LLL
10	Temperature diagnosis	0: Normal 1: Abnormal
11	Output PD	0: Within range 1: Out of range
13	Fixed output	0: Normally 1: Fixed
14	Error	0: Normal 1: Abnormal
15	System error	0: Normal 1: Abnormal
16 to 31	Measured fluid temperature	Unsigned 16 bit
32 to 47	Measured outlet pressure	Unsigned 16 bit
48 to 63	Measured flow rate value	Unsigned 16 bit

### Diagnosis items

- Out of rated flow range
- Pressure display out of range
- Abnormal temperature
- Error diagnosis (Over current, Outside of zero-clear range, Flow rate not reached, Load, Control)
- System error diagnosis (Internal malfunction)

Bit offset	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48
Item	Measured flow rate value: Unsigned 16 bit															
Bit offset	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
Item	Measured outlet pressure: Unsigned 16 bit															
Bit offset	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Item	Measured fluid temperature: Unsigned 16 bit															
Bit offset	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Item	System error	Error	Fixed output	Reservation	Output PD	Temperature diagnosis	Pressure diagnosis	Flow rate diagnosis	Reservation							Flow rate SW

### Output process data

Bit offset	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Item	Flow rate command value: Unsigned 16 bit															

### Displays the output communication status and indicates the presence of communication data



### Operation and Display

Communication with master	IO-Link status indicator light	Status	Screen display*2	Description
Yes	*1	Normal	Operate	Mode oPE Normal communication status (readout of measured value, command) * Output process data valid
			Start up	Mode stRT Normal communication status (readout of measured value) * Output process data invalid
			Preoperate	Mode PrE At the start of communication
No	*1 (Flashing)	Abnormal	Er 15 Version does not match	IO-Link version does not match that of the master. The master uses version 1.0. * The applicable IO-Link version is 1.1.
		Abnormal	Mode oPE Mode stRT Mode PrE Communication disconnection	Normal communication was not received for 1 second or longer.
OFF		SIO mode	Mode S10	General switch output

\*1 In IO-Link mode, the IO-Link indicator is ON or flashes. \*2 When the sub screen is set to Mode

\* "ModE LoC" is displayed when the data storage lock is enabled. (Except for version mismatch or when in SIO mode)

# Air Flow Controller

# IN502-44/45

## How to Order

IN502-44-1A

### Rated control flow rate range

Symbol	Description
44	50 to 500 L/min
45	100 to 1000 L/min

### Grease

Symbol	Description
Nil	Grease compatible with low dew points
A	White vaseline
B	Grease for food

### Specifications

Symbol	Input/Output specification*1	Unit specification	Operation at power-off*5		
1	Analog voltage input/output*2, *3 + Switch output	SI units only	Flow rate zero		
2		With unit selection function			
3	Analog current input/output + Switch output	SI units only		Flow rate retention	
4		With unit selection function			
5	Analog voltage input/output*2, *3 + IO-Link*4/ Switch output	SI units only			Flow rate retention
6		With unit selection function			
7	Analog current input/output + IO-Link*4/ Switch output	SI units only	Flow rate retention		
8		With unit selection function			
9	Analog voltage input/output*2, *3 + Switch output	SI units only		Flow rate retention	
10		With unit selection function			
11	Analog current input/output + Switch output	SI units only			Flow rate retention
12		With unit selection function			
13	Analog voltage input/output*2, *3 + IO-Link*4/ Switch output	SI units only	Flow rate retention		
14		With unit selection function			
15	Analog current input/output + IO-Link*4/ Switch output	SI units only		Flow rate retention	
16		With unit selection function			

\*1 Analog I/O and switch output are I/O for the control flow rate.

\*2 The analog voltage input can be selected from 0 to 5 or 0 to 10 V. The factory setting is 0 to 5 V.

\*3 Either the 1 to 5 or 0 to 10 V button can be pressed to select the analog voltage output. The factory setting is 1 to 5 V.

\*4 The analog input cannot be used in IO-Link mode.

\*5 The operation at power-off, or the operation that is activated when the power supply turns OFF during flow rate control, can be selected via the part number.

Note that when flow rate zero is selected, it is not guaranteed to function as a shut valve. When flow rate retention is selected, it does not guarantee flow rate retention.

### Accessories/Part Nos.

Description	Part no.	Note
Lead wire with M12 connector (Loose wires on 1 side)	EX500-AP010-A	Length: 1 m, Angle
	EX500-AP010-S	Length: 1 m, Straight
	EX500-AP050-A	Length: 5 m, Angle
	EX500-AP050-S	Length: 5 m, Straight
Lead wire with M12 connector (Connectors on both sides)	EX9-AC005-SSPS	Length: 0.5 m, Straight
	EX9-AC010-SSPS	Length: 1 m, Straight
	EX9-AC020-SSPS	Length: 2 m, Straight
	EX9-AC030-SSPS	Length: 3 m, Straight
	EX9-AC050-SSPS	Length: 5 m, Straight
	EX9-AC100-SSPS	Length: 10 m, Straight

\* The lead wire with an M12 connector is not included with the product. Please order it separately.



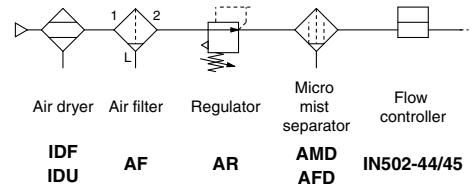
# IN502-44/45

## Specifications

Model		IN502-44	IN502-45	
Fluid	Applicable fluid*1	Air, Nitrogen*13		
	Fluid temperature range	0 to 50°C		
Flow	Rated control flow rate range	50 to 500 L/min	100 to 1000 L/min	
	Set control flow rate range*2	25 to 525 L/min	50 to 1050 L/min	
	Min. set control flow rate unit	1 L/min	1 L/min	
Pressure	Operating pressure range	Supply pressure*3: 1.0 MPa or less		
	Load pressure*4	0.1 to 0.6 MPa (100% F.S. at flow rate)		
	Rated measurement pressure range (Outlet pressure)*12	0.000 to 1.000 MPa		
	Measured pressure range (Outlet pressure)*12	-0.050 to 1.050 MPa		
	Accuracy pressure (Outlet pressure)	±5% F.S. (Reference value)		
	Proof pressure	1.0 MPa		
Temperature*12	Rated measurement temperature range	0 to 50°C		
	Measured temperature range	-20 to 100°C		
	Accuracy temperature*12	±10% F.S. (Reference value)*14		
Electrical	Power supply voltage	24 VDC ±10%		
	Current consumption*5	0.2 A or less		
	Protection	Power supply polarity protection		
Control specification	Control accuracy*7	±5% F.S.		
	Control dead band*6	Flow rate command value: Within ±1% F.S.		
	Temperature characteristics	±5% F.S. (0 to 50°C, 25°C standard)		
	Pressure characteristics	±5% F.S. (Operating pressure range, reference pressure*8 standard)		
Analog output (Control flow rate)	Voltage	Output type: Voltage-output: 1 to 5 V, 0 to 10 V selectable		
	Current	Output type: Current output: 4 to 20 mA		
Analog input (Control flow rate) (SIO mode)	Voltage	Input type: Voltage-input: 0 to 5 V, 0 to 10 V selectable		
	Current	Input type: Current input: 4 to 20 mA		
Switch output (Control flow rate) (SIO mode)	Output type	Select from NPN or PNP open collector.		
	Output mode	Tolerance, Error output, Output OFF		
	Switch operation	Normal output, Reversed output		
	Max. load current	80 mA		
	Max. applied voltage	30 VDC		
	Internal voltage drop	1.5 V or less (at load current of 80 mA)		
Display	Flow	Reference condition	Select from Standard conditions or Normal conditions.	
	Unit*9	L/min, cfm (ft <sup>3</sup> /min)		
	Display range*2	25 to 525 L/min	50 to 1050 L/min	
	Min. display unit	1 L/min		
	Pressure	Unit*10	kPa, MPa, kgf/cm <sup>2</sup> , bar, psi	
	Display range	-50 to 1050 kPa		
	Min. display unit	1 kPa		
	Display method	LCD		
	Number of screens	3-screen display (Main screen, Sub screen x 2)		
	Display color	Main screen: Red/Green, Sub screen: Orange		
Environmental resistance	Number of display digits	Main screen: 4 digits (7 segments) Sub screen (Left): 4 digits (some digits are 11 segments, 7 segments for others) Sub screen (Right): 5 digits (some digits are 11 segments, 7 segments for others)		
	Indicator light	Lights up when switch output is turned ON. OUT1: Orange		
	Enclosure	IP65		
Piping	Withstand voltage	1000 VAC for 1 min between terminals and housing		
	Insulation resistance	50 MΩ or more (500 VDC measured via megohmmeter) between terminals and housing		
	Operating temperature range	Operating: 0 to 50°C, Stored: -10 to 60°C (No condensation)		
	Operating humidity range	Operating/Stored: 35 to 85% RH (No condensation)		
Main materials of parts in contact with fluid	Aluminum alloy, POM, Stainless steel 304, Steel, Brass, Si, NBR, HNBR, FKM			
Standards	CE/UKCA marking			
Weight	Approx. 760 g (Excludes lead wire and M12 connector)			
Communication (IO-Link mode)	IO-Link type	Device		
	IO-Link version	V1.1		
	Communication speed	COM2 (38.4 kbps)		
	Configuration file	IODD file*11		
	Min. cycle time	5.5 ms		
	Process data length	Input Data: 8 bytes, Output Data: 2 bytes		
	On request data communication	Yes		
	Data storage function	Yes		
Event function	Yes			
Vendor ID	131 (0 x 0083)			

\*1 The air quality grade is JIS B 8392-1:2012 [2:6:3] and ISO 8573-1:2010 [2:6:3].

### Example of recommended pneumatic circuit (Compressed air line)



\*2 It changes in conjunction with the setting of the zero cut function. The product's function as a shut valve cannot be guaranteed when the flow rate command value is 0.

\*3 The operating supply pressure range is the pressure range that can be applied to the product inlet side.

\*4 The operating load pressure range is the product outlet pressure range generated by the load connected to the product outlet side.

\*5 When the flow rate command value is 0, the supply current changes momentarily because the internal solenoid valve is driven for 1 s at 30 s intervals.

\*6 Control operation is stopped when the control flow rate is ±1% F.S. of the flow rate command value (control deadband).

\*7 Repeatability: Includes ±2% F.S.

\*8 Supply pressure: 0.6 MPa, Load pressure: 0.1 MPa (100% F.S. flow rate)

\*9 Setting is only possible for models with the unit selection function. When there is no unit selection function, L/min is fixed.

\*10 Setting is only possible for models with the unit selection function. Only MPa or kPa is available for models without this function.

\*11 The configuration file can be downloaded from the SMC website: <https://www.smcworld.com>

\*12 Only when IO-Link communication is used

\*13 When using gases other than the applicable fluids (limited to non-corrosive and non-flammable gases), convert them using the following formula.

$$\text{Gas flow rate} = \text{Flow rate with air} \times \sqrt{\frac{1.293}{\text{Gas density}}}$$

### Conversion example)

If you want argon gas (1.784 [kg/m<sup>3</sup>] (0°C, 1 atm)) to flow at 300 L/min,

$$300 = \text{Flow rate with air} \times \sqrt{\frac{1.293}{1.784}}$$

The flow rate in the air = 352, so when the flow rate command value is set to 352 L/min, the flow rate of the argon gas is controlled to 300 L/min.

### Caution

The flow rates obtained from the above are for reference only and do not guarantee the product specifications. Gases are exhausted from EXH to the outside of the product by controlled operation. Be sure to use the product safely.

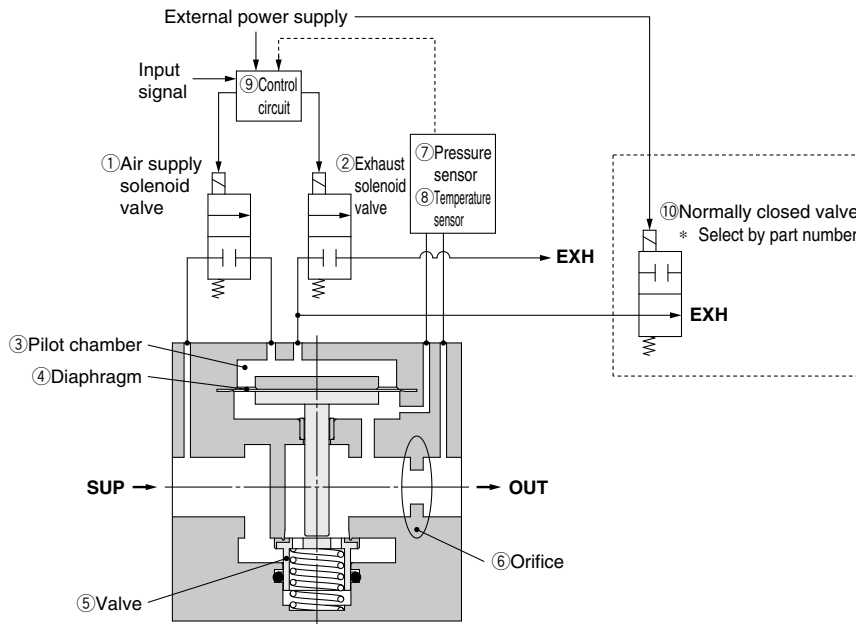
\*14 Errors may occur depending on the ambient temperature. Use this as a guideline.

\* Products with tiny scratches, marks, or display color or brightness variations which do not affect the performance of the product are verified as conforming products.

## Working Principle

When the input signal increases, the air supply solenoid valve ① turns ON, and the exhaust solenoid valve ② turns OFF. For this reason, the supply pressure passes through the air supply solenoid valve ①, fills the pilot chamber ③, and acts on the top surface of the diaphragm ④. As a result, the valve ⑤ interlocked with the diaphragm ④ opens, and the supply pressure flows out from SUP to OUT. This flow rate, the differential pressure generated at the orifice ⑥ and the outlet pressure, is detected by the pressure sensor ⑦ and fed back to the control circuit ⑨. An arbitrary flow rate can always be obtained by activating the control operation until the flow rate corresponding to the input signal is reached.

If you select the flow rate zero type, the pilot chamber ③ pressure will be exhausted by the action of the normally closed valve ⑩, and the main valve ⑤ will close resulting in the flow rate dropping to zero, when the external power supply is disconnected.



## Flow rate conversion using a pressure sensor (differential pressure type)

When installing a conventional thermal type (thermistor, MEMS type) flow rate sensor for gas, responsiveness, the inlet straight pipe length, and the air quality grade needed to be considered. However, the responsiveness can now be improved by converting the detected pressure into flow rate. And the unique detecting method also has made the sensing section more compact. Since this product detects the outlet pressure, control of the flow rate and monitoring of the pressure status can be performed at the same time to control abnormal values.

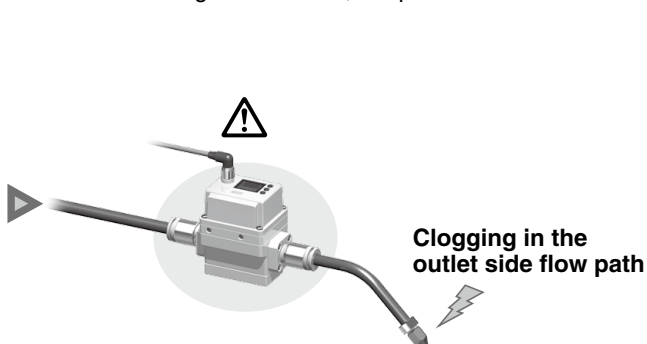
### (Example of outlet pressure status monitoring)

· For the detection of clogging in the outlet side flow path

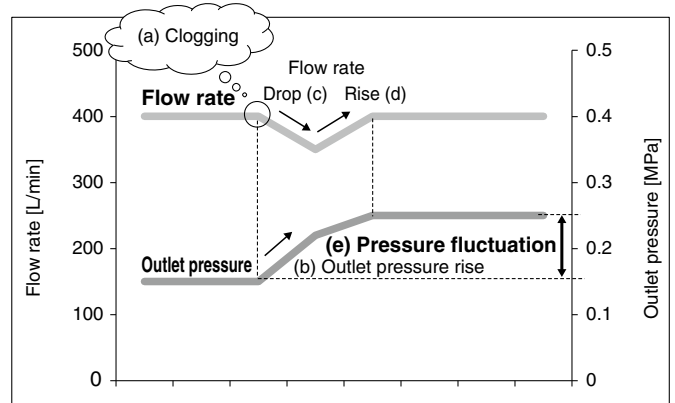
When clogging occurs in the outlet side flow path (a), the outlet pressure rises (b) and the flow rate decreases temporarily (c), but the change is detected and the product operates to return to the pre-clogging flow rate (d).

Therefore, clogging in the outlet flow path can be detected by monitoring such pressure fluctuations (e).

When the blockage is removed, the pressure returns to the initial outlet pressure.



\* If the degree of clogging increases and the set flow rate cannot be reached, an error will occur.

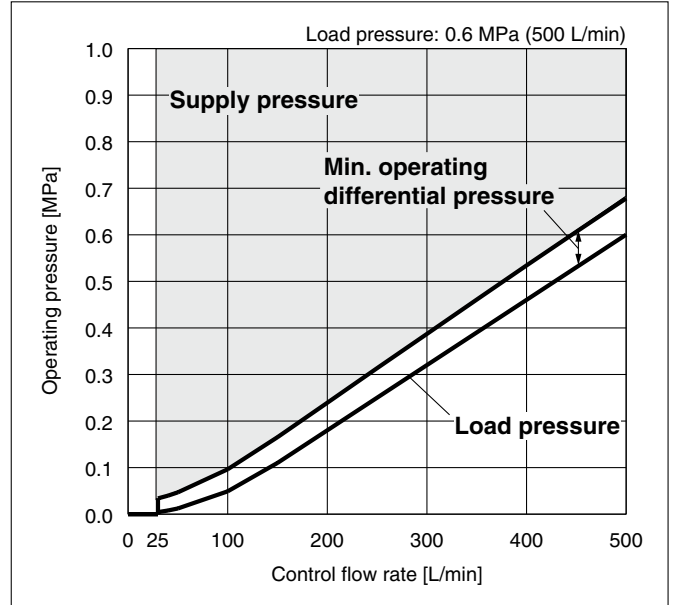
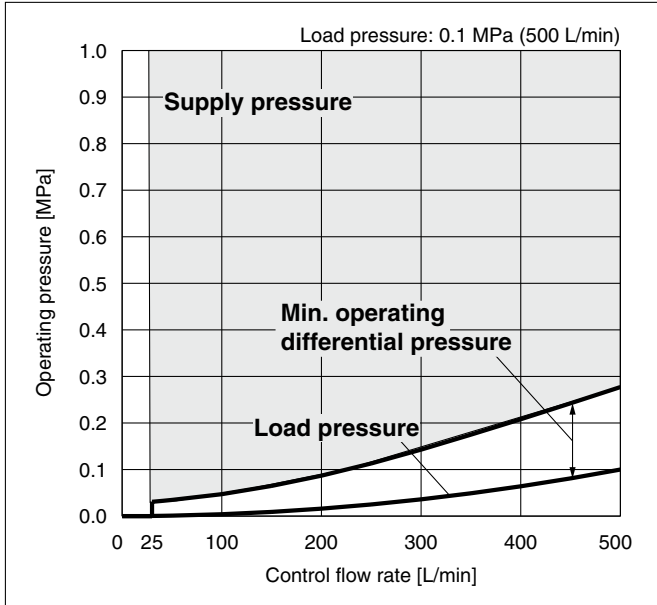


# IN502-44/45

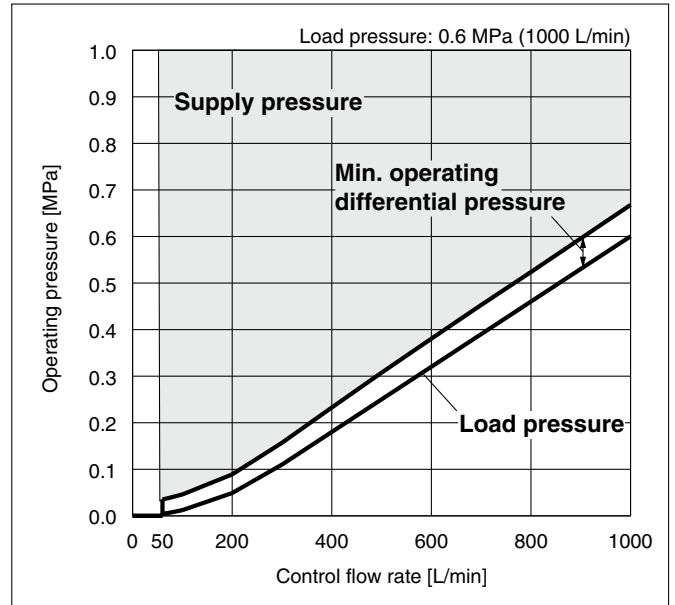
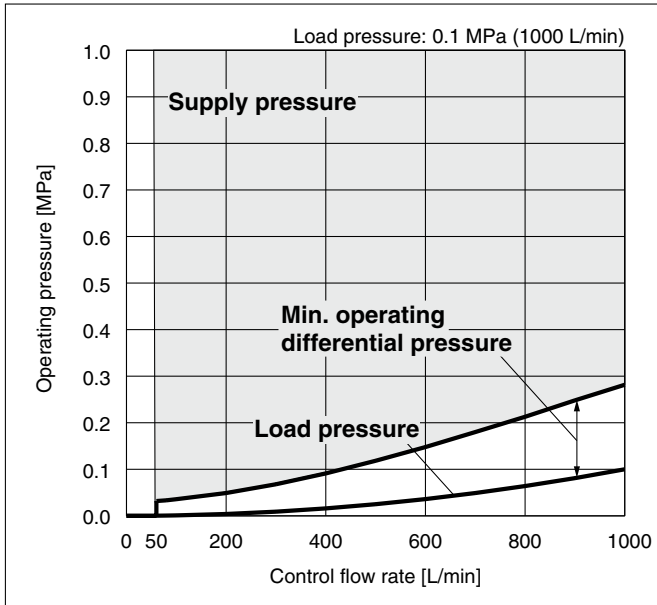
## Relationship between operating pressure and controllable flow rate (reference data)

The data shows the required operating differential pressure and supply pressure for the load pressure conditions. Refer to the graphs below for selection.

### IN502-44



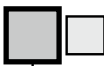
### IN502-45



- \* Use the outlet side pressure display value as a guide for the load pressure.
- \* The min. operating differential pressure is the differential pressure between the supply pressure and the load pressure required for control operation.
- \* The flow rate unit reference in the graph is the value under standard conditions.



## Internal Circuits and Wiring Examples

IN502 – 44/45 – 

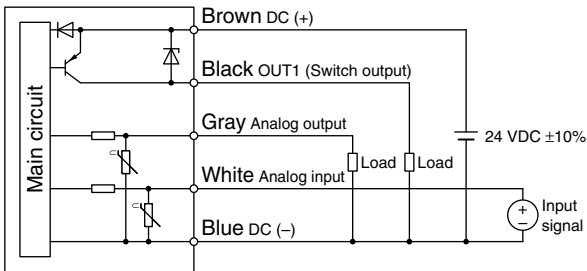
• Output specifications

**1 2 9 10**

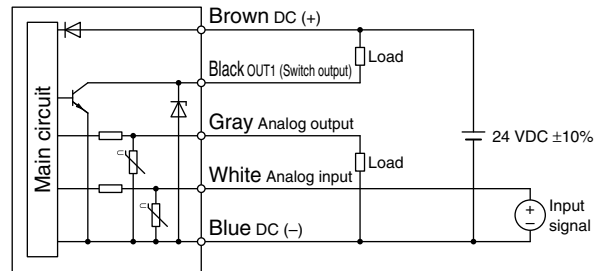
**3 4 11 12**


- Analog voltage input/output + Switch output
- Analog current input/output + Switch output

When PNP open collector is selected



When NPN open collector is selected



IN502 – 44/45 – 

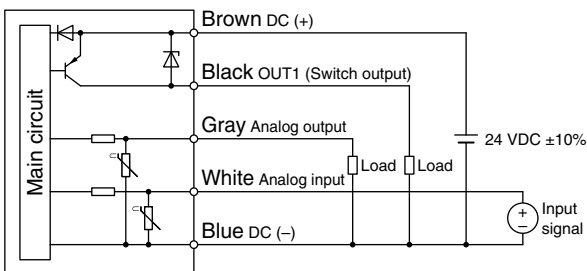
• Output specifications

**5 6 13 14**

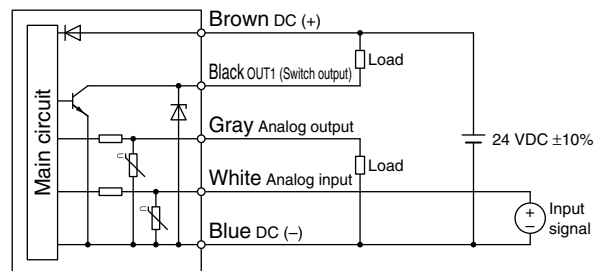
**7 8 15 16**

- Analog voltage input/output + IO-Link/Switch output
- Analog current input/output + IO-Link/Switch output

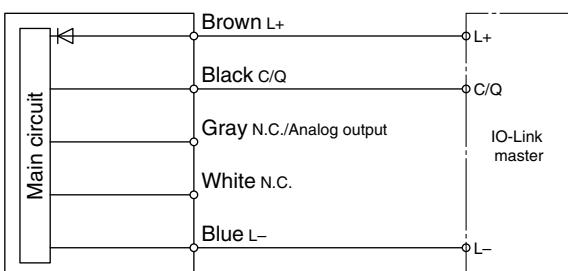
When used as a switch output device  
When PNP open collector is selected



When NPN open collector is selected

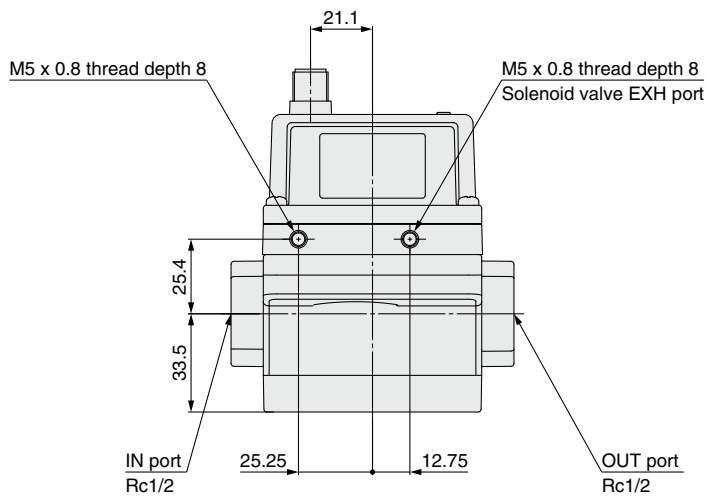
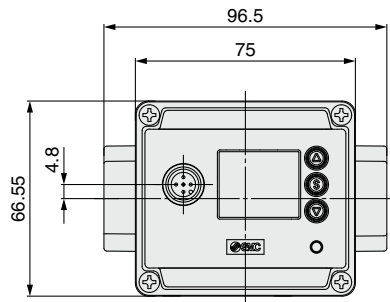


When used as an IO-Link device

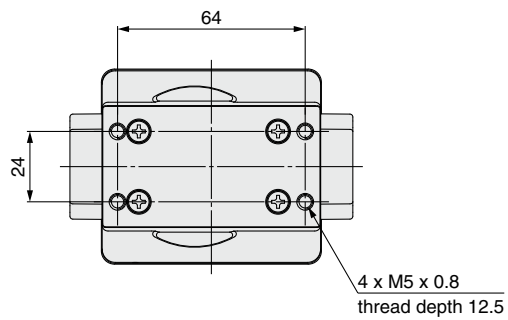


# IN502-44/45

## Dimensions



Flow direction  
→



# IN502-44/45 Accessories

## Lead Wire and M12 Connector (Loose wires on 1 side)

EX500-AP **050** - **S**

• Cable length (L)

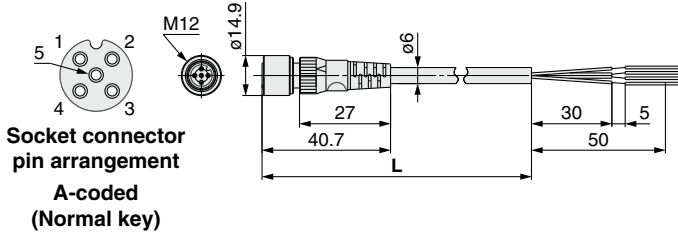
<b>010</b>	1000 mm
<b>050</b>	5000 mm

• Connector specification

<b>S</b>	Straight
<b>A</b>	Angled

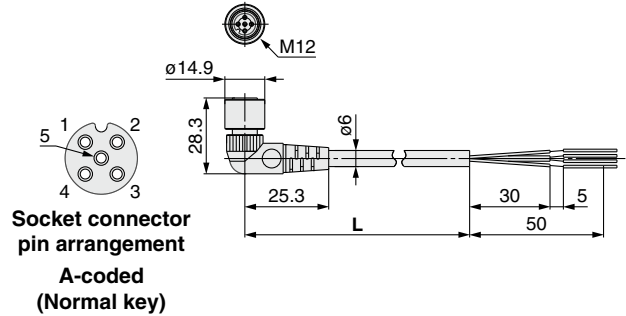


### Straight connector type

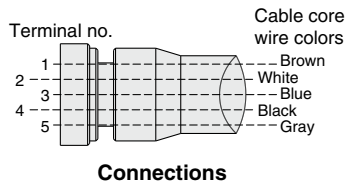


Item	Specifications
<b>Cable O.D.</b>	$\phi 6$ mm
<b>Nominal cross section</b>	$0.3 \text{ mm}^2/\text{AWG22}$
<b>Wire diameter (Including insulator)</b>	1.5 mm
<b>Min. bending radius</b>	40 mm (Fixed)

### Angled connector type



Item	Specifications
<b>Cable O.D.</b>	$\phi 6$ mm
<b>Nominal cross section</b>	$0.3 \text{ mm}^2/\text{AWG22}$
<b>Wire diameter (Including insulator)</b>	1.5 mm
<b>Min. bending radius</b>	40 mm (Fixed)

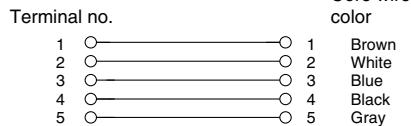
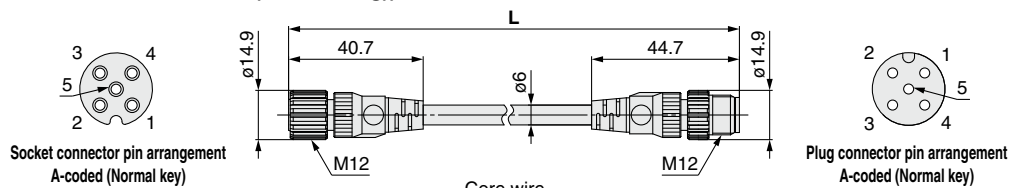


## Lead Wire and M12 Connector (Connector on Both Sides)

EX9-AC **005** -SSPS (With connector on both sides (Socket/Plug))

• Cable length (L)

<b>005</b>	500 mm
<b>010</b>	1000 mm
<b>020</b>	2000 mm
<b>030</b>	3000 mm
<b>050</b>	5000 mm
<b>100</b>	10000 mm



Item	Specifications
<b>Cable O.D.</b>	$\phi 6$ mm
<b>Conductor nominal cross section</b>	$0.3 \text{ mm}^2/\text{AWG22}$
<b>Wire O.D. (Including conductor)</b>	1.5 mm
<b>Min. bending radius (Fixed)</b>	40 mm



# IN502-44/55 / Precautions

Be sure to read this before handling the products.

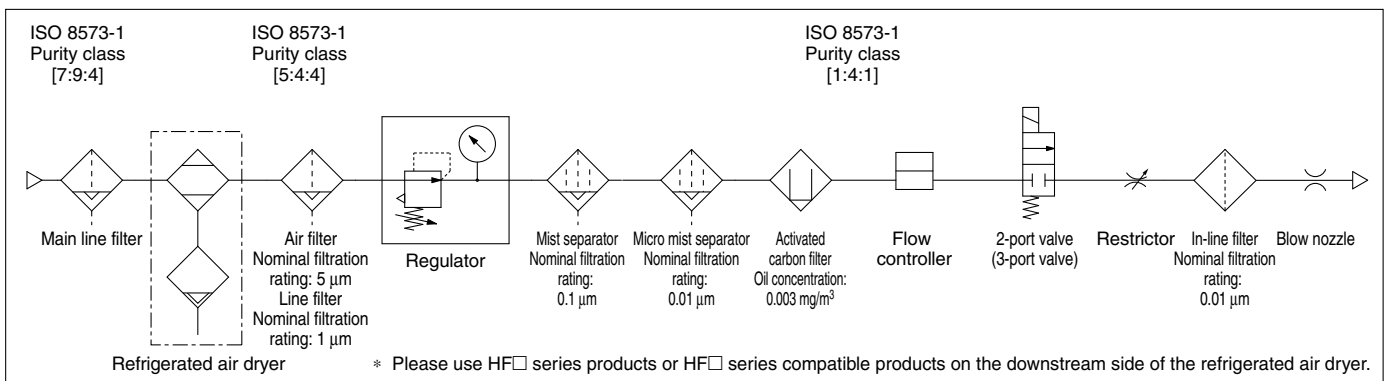
For safety instructions, refer to the “Handling Precautions for SMC Products” and the “Operation Manual” on the SMC website: <https://www.smcworld.com>

## Handling

### Caution

1. When selecting equipment, carefully consider the application, required specifications, and operating conditions (fluid, pressure, flow rate, filtration, and environment), making sure not to exceed the specification range.
2. This product is intended for use in typical manufacturing industry applications. As such, to use the product in applications that may affect the human body directly or indirectly, such as use as a caisson shield, goes against its intended use.
3. When the product is used as an air blower for food, install an appropriate filter to eliminate foreign matter in the compressed air used for air blowing. (Refer to the following example of a pneumatic circuit.)

#### Pneumatic equipment circuit of an air blower for food applications (example)



4. Quality management relating to hygiene for food and medical industry processes is not implemented for this product.

The product is produced on the same line that manufactures other products which use other materials. In rare cases, some residue of these materials may be present.

#### 5. Food Grease used

Fluid contact parts NSF H1 food grade grease

Parts other than fluid contact parts NSF H1 food grade grease or grease which is not NSF H1 grade

6. The grease used for the built-in solenoid valve is not food grade grease.

The solenoid valve exhaust may be discharged from EXH to the outside of the unit. If required, connect a pipe outside the area.

7. Particles are generated from the wear of sliding parts inside the product. When the product is used as an air blower, install an appropriate filter on the outlet of the product to prevent foreign matter from flowing to the downstream side. Be sure to perform regular inspection, element replacement, and maintenance of filters while referring to the operation manual.

8. Flush the piping line before using the product for the first time and after it has been replaced. Also, if piping, etc., is to be connected, flush (air blow) before using the product for the first time in order to reduce the effects of the dust generated from the connection, etc.

Flushing the line is also required to eliminate contamination resulting from the installation of piping lines. Therefore, be sure to flush the line before running the system.

**Safety Instructions** Be sure to read the “Handling Precautions for SMC Products” (M-E03-3) and “Operation Manual” before use.

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Specifications are subject to change without prior notice and any obligation on the part of the manufacturer.