

# Pneumatic Ecosystem v1

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## Overview

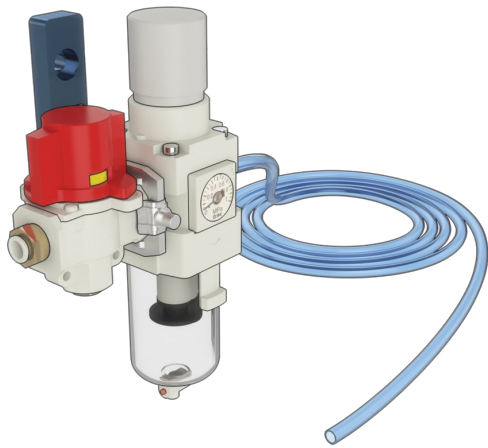
Vention has partnered with SMC, an industry leader in pneumatics, to bring you a series of pneumatic components. These components include an air preparation station complete with a pressure regulator, air filter and manual safety release valve, a manifold that supports up to four independent open-center valves that drive various lengths of double-acting cylinders. The entire system is controlled using Vention's MachineMotion ([CE-CL-005-0003](#)) and IO Expander ([CE-MD-001-0001](#)).

## Applications

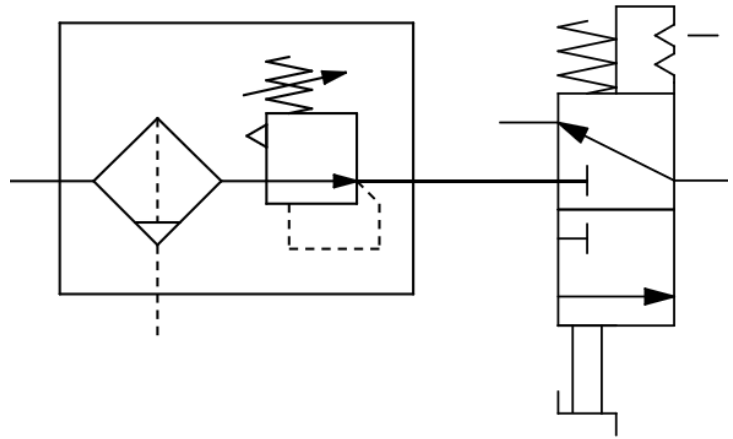
There are several applications for the pneumatic ecosystem, including clamping and guidance systems.

[Browse Open Source Designs](#)

## Air Preparation Station (CA-AP-001-0001)



*Air Preparation Station*

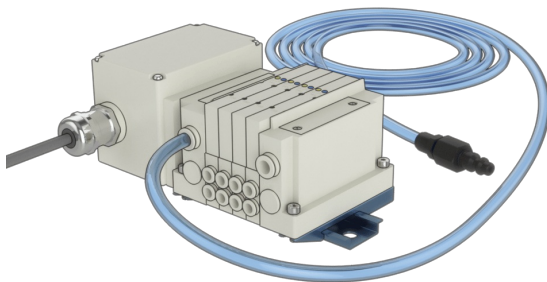


*Symbol*

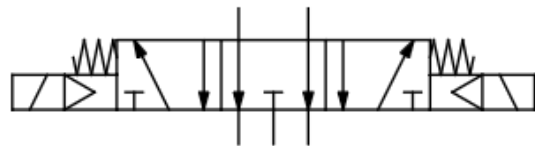
## Specifications

Flow Coefficient $C_v$ (Calculate Flow Rate <a href="#">here</a> )	2.3
Operating Temperature [°C]	-5 to 60
Maximum Operating Pressure [MPa]	1.0
Filter Drain Capacity [ml]	25
Filter Filtration Rating [ $\mu\text{m}$ ]	5
Included Tubing	8mm OD Polyurethane Tubing - 2 meters in length

## Manifold Station with Valves (CA-CO-001-0002/0004)



*Manifold Station with Valves*



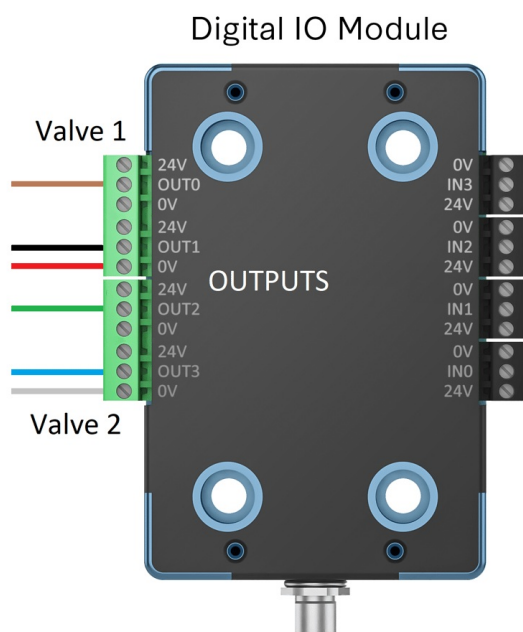
*Valve Symbol*

## Specifications

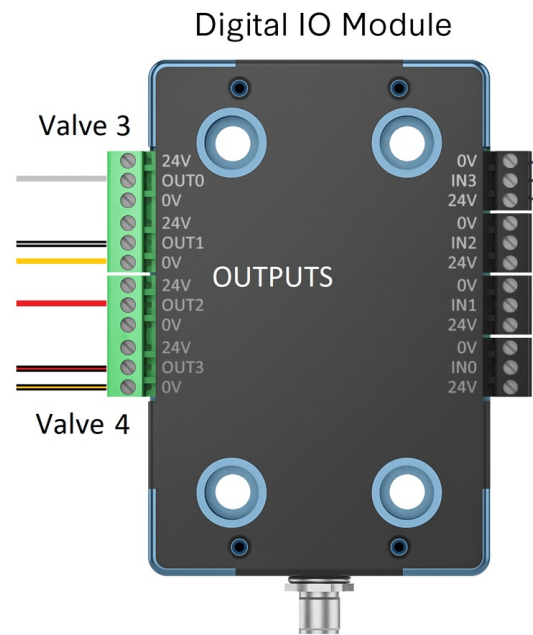
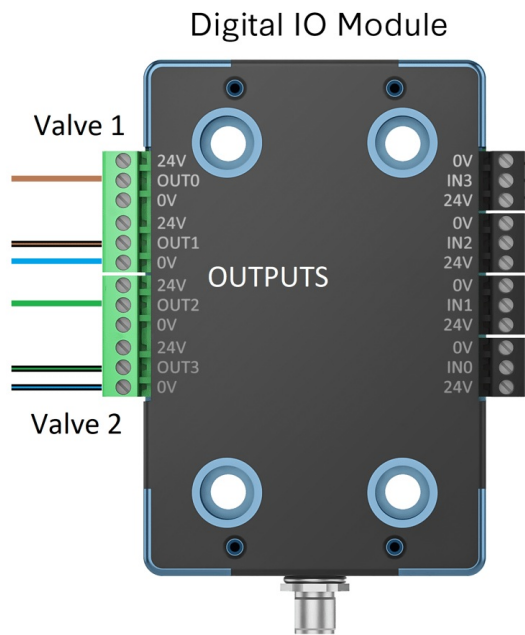
Available Valve Stations	2 and 4
Flow Coefficient C <sub>v</sub> per valve (Calculate Flow Rate <a href="#">here</a> )	0.3
Operating Temperature [°C]	-10 to 50
Maximum Operating Pressure [MPa]	0.7
Minimum Operating Pressure [MPa]	0.2
Control Voltage [V]	24
Maximum Power Consumption [W]	0.35
Enclosure Rating	IP67
Included Tubing	8mm OD Polyurethane Tubing - 2 meters in length with industrial standard male 1/4" quick connector

## Wiring

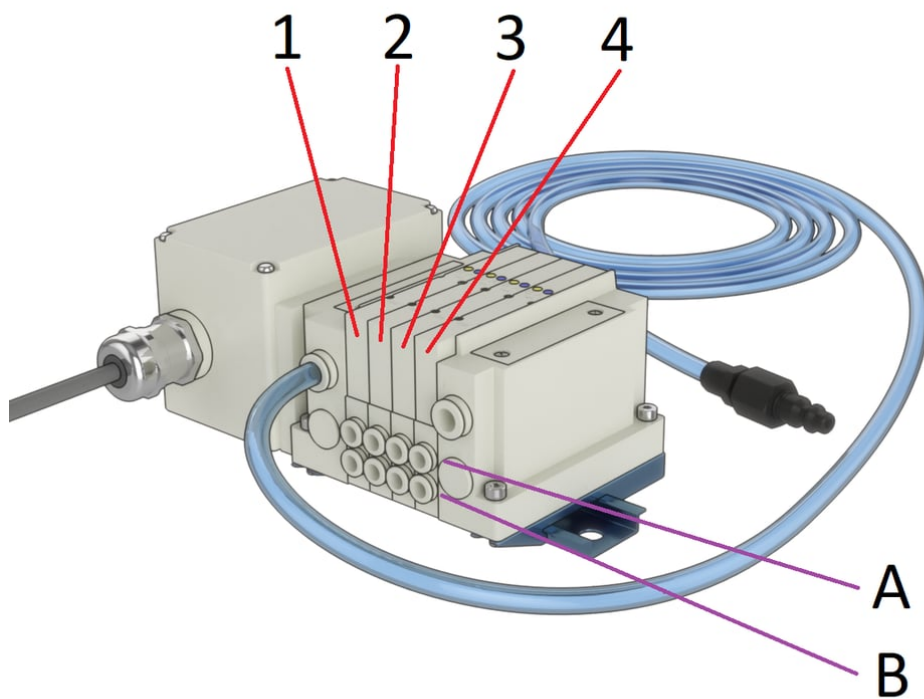
All Manifold Stations come pre-wired using dual output terminal blocks. Each terminal block represents the control of a single valve. Up to 2 valves can be controlled by a single Digital IO Module (CE-MD-001-0001). For a 2-valve Manifold Station (CA-CO-001-0002), it should be wired as follows:



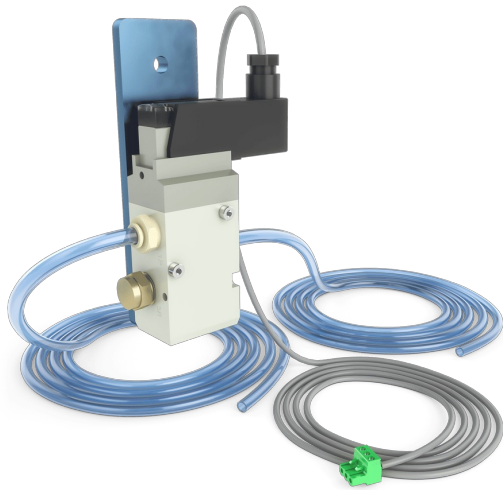
For a 4-valve Manifold Station (CA-CO-001-0004), it should be wired as follows:



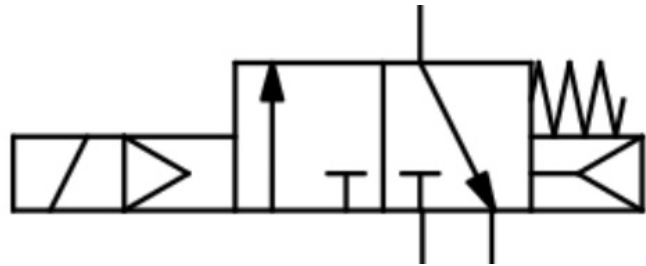
Valve numbering goes as follows on the Manifold station:



On/Off Valve (CE-AR-002-0000)



*On/Off Valve*



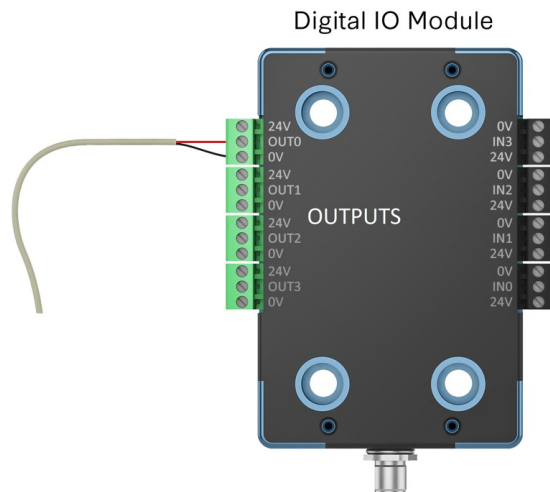
*On/Off Valve Symbol*

## Specifications

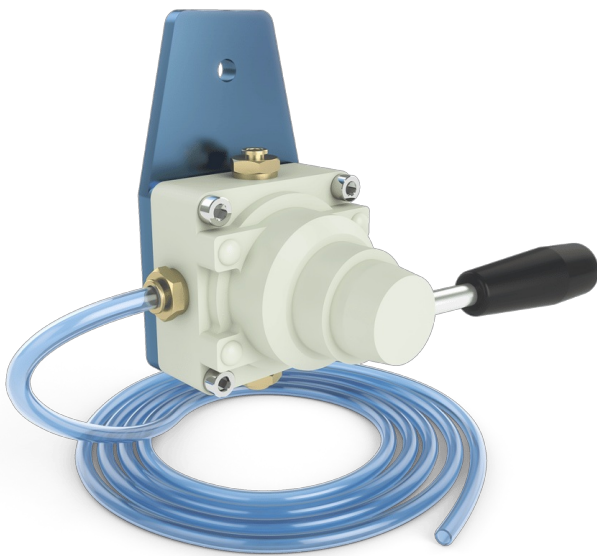
Type of Actuation	Normally Closed (N.C.)
Flow Coefficient $C_v$ (Calculate Flow Rate <a href="#">here</a> )	2.1
Operating Temperature [°C]	-10 to 50
Maximum Operating Pressure [MPa]	0.7
Minimum Operating Pressure [MPa]	0.2
Control Voltage [V]	24
Maximum (Peak) Power Consumption [W]	1.55
Nominal Power Consumption [W]	0.55
Enclosure Rating	IP65
Included Tubing	8mm OD Polyurethane Tubing - 4 meters in length

## Wiring

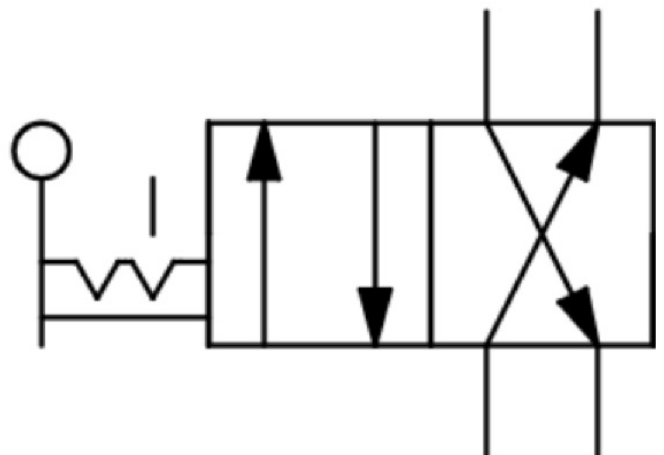
All On/Off Pneumatic Valves come pre-wired to an output terminal block. Up to 4 valves can be controlled by a single Digital IO Module [CE-MD-001-0001](#). It should be wired as follows, the black wire in GND input and the red wire in OUT# output.



## Manual Hand Valve (HW-AR-003-0000)



Manual Hand Valve



Valve Symbol

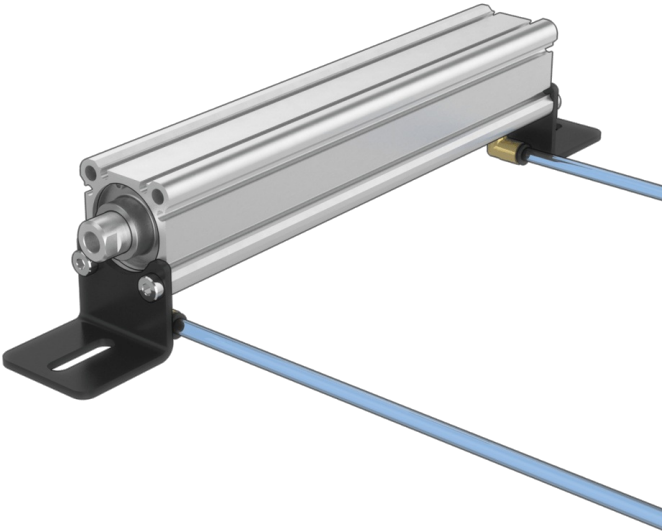
## Specifications

Flow Coefficient $C_v$ per valve (Calculate Flow Rate <a href="#">here</a> )	1.5
Operating Temperature [°C]	-5 to 60
Maximum Operating Pressure [MPa]	1.0
Positions	2
Outlets	6mm OD Push-to-Connect fittings to control Dual-Acting Actuators

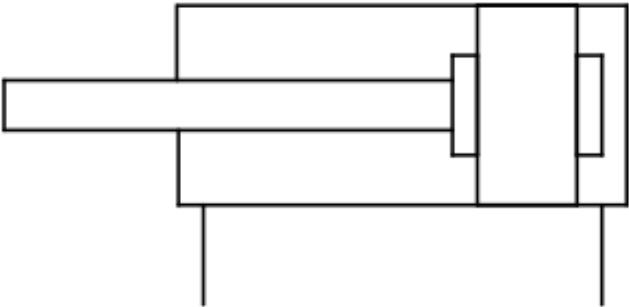
Included Tubing

8mm OD Polyurethane Tubing - 2 meters in length

Non-Guided Actuators (MO-AR-001-0100/0200/0300)



Actuator



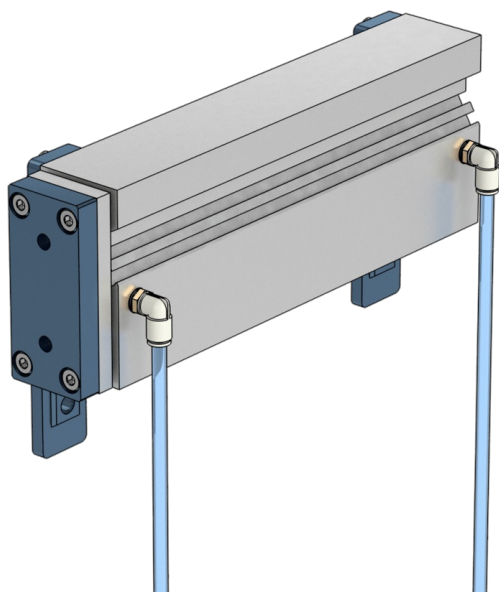
Symbol

Specifications

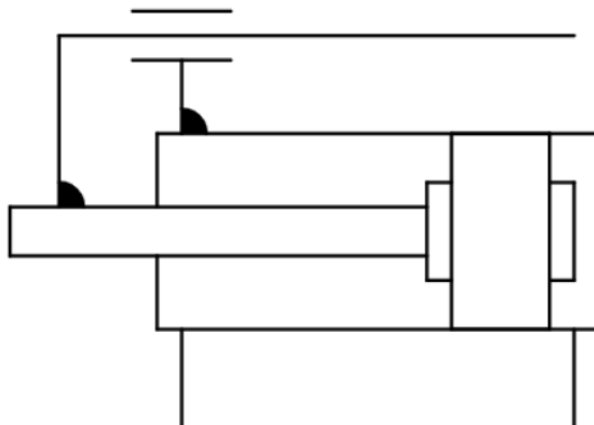
Available Stroke Lengths [mm]	100, 200, 300
Bore Size [mm]	32
Operating Temperature [°C]	-5 to 60
Maximum Operating Pressure [MPa]	1.0
Minimum Operating Pressure [MPa]	0.05
Maximum Radial Load [N]	4
Piston Speed [mm/s]	5 to 500
Included Tubing	6mm OD Polyurethane Tubing - 6 meters in length

The actuator force is a function of its operating pressure. The theoretical output force can be calculated [below](#).

Guided Actuators (MO-AR-002-0100/0200)



**Actuator**



**Symbol**

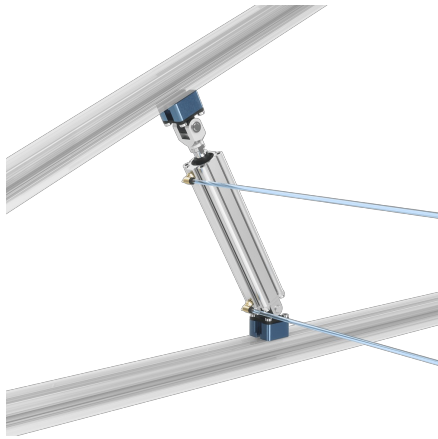
## Specifications

Available Stroke Lengths [mm]	100, 200
Bore Size [mm]	25
Operating Temperature [°C]	-5 to 60
Maximum Operating Pressure [MPa]	1.0
Minimum Operating Pressure [MPa]	0.12
Maximum Radial Load [N]	100mm stroke: 65 200mm stroke: 40
Piston Speed [mm/s]	5 to 500
Included Tubing	6mm OD Polyurethane Tubing - 6 meters in length

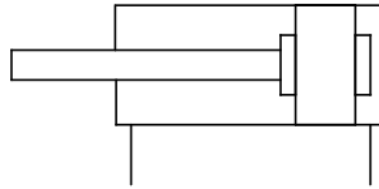
The guide actuator force is a function of its operating pressure. The theoretical output force can be calculated [below](#).

## Pivoting Non-Guided Actuators (MO-AR-003-0100/0200/0300)





**Actuator**



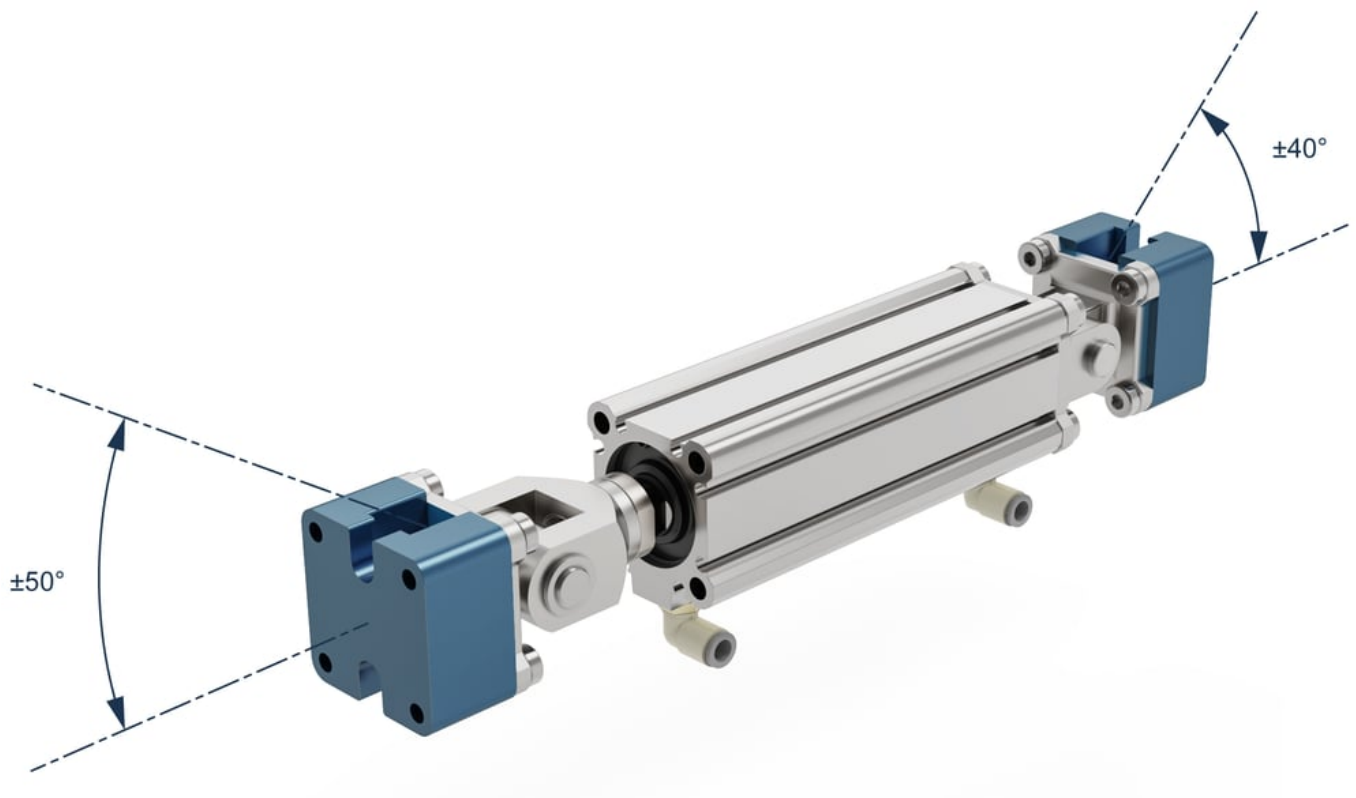
**Symbol**

## Specifications

Available Stroke Lengths [mm]	100, 200, 300
Bore Size [mm]	32
Operating Temperature [°C]	-5 to 60
Maximum Operating Pressure [MPa]	1.0
Minimum Operating Pressure [MPa]	0.05
Maximum Radial Load [N]	4
Piston Speed [mm/s]	5 to 500
Included Tubing	6mm OD Polyurethane Tubing - 6 meters in length

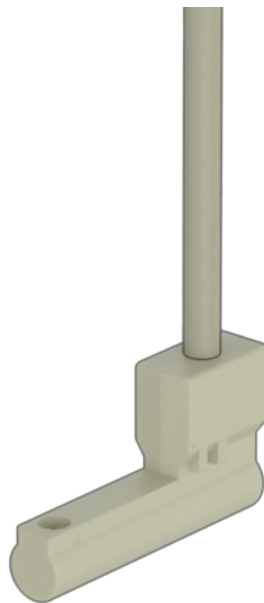
The pivoting non-guided actuator force is a function of its operating pressure. The theoretical output force can be calculated [below](#).

Additionally, the pivoting non-guided cylinders have rotational limitations on both front and back clevis brackets. The front piston clevis mount of the cylinder is limited to a  $\pm 50^\circ$  range of motion, while the back clevis mount is limited to  $\pm 40^\circ$ .

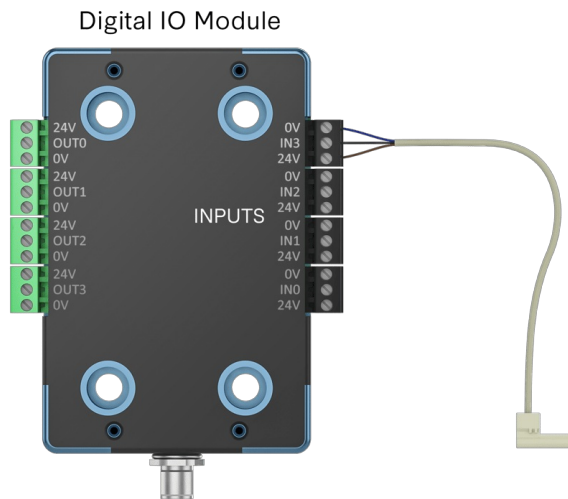


## Position Sensor (CE-SN-008-0001)

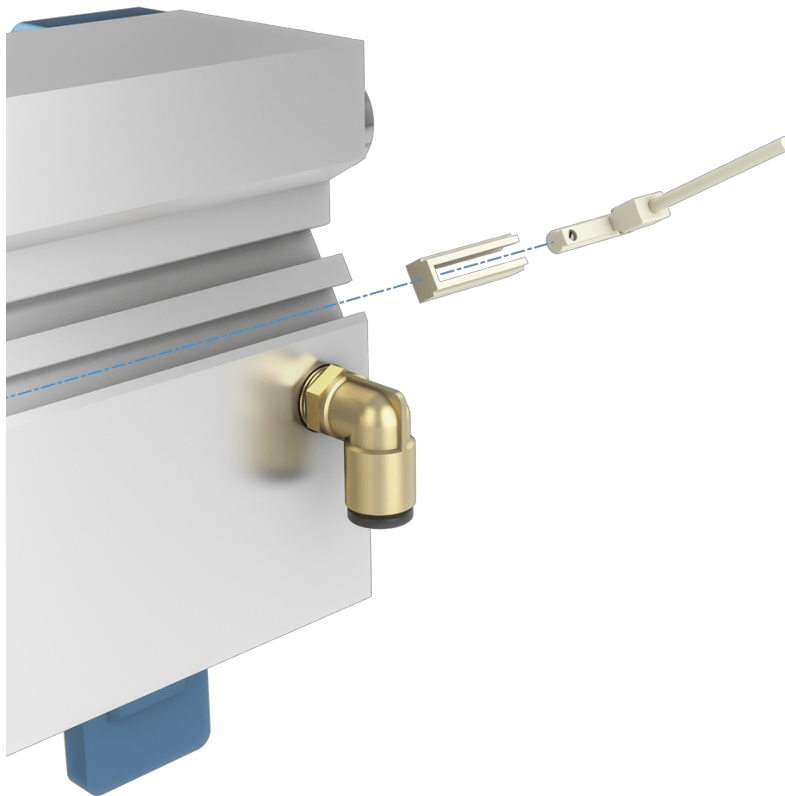
When confirmation of the actuator position is needed, a Normally Closed (N.C.) position sensor ([CE-SN-008-0001](#)) can be easily slid into any groove on the pneumatic actuator and secured in place using a 1mm precision flat screwdriver. It accurately senses the magnetic field of the piston as it passes beneath the sensor and a built in red LED illuminates when turned ON.



Up to 4 position sensors can be easily wired to a single Digital IO Module ([CE-MD-001-0001](#)). It should be wired as follows, the blue wire in GND input, the black wire in IN# input and the brown wire in the 24VDC input.



The guided actuators ([MO-AR-002-0100/0200](#)) require an adapter to properly secure the position sensor in place. An adapter is included with each sensor.



## Accessories

Vention's Pneumatic Ecosystem also includes a variety of accessories for different use cases.

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[6mm to 8mm inline One-touch Fitting](#)



[6mm 90 Degree One-touch Fitting to 1/8in RC with Speed Controller and Indicator](#)



[6mm Wye Splitter One-Touch Fitting](#)



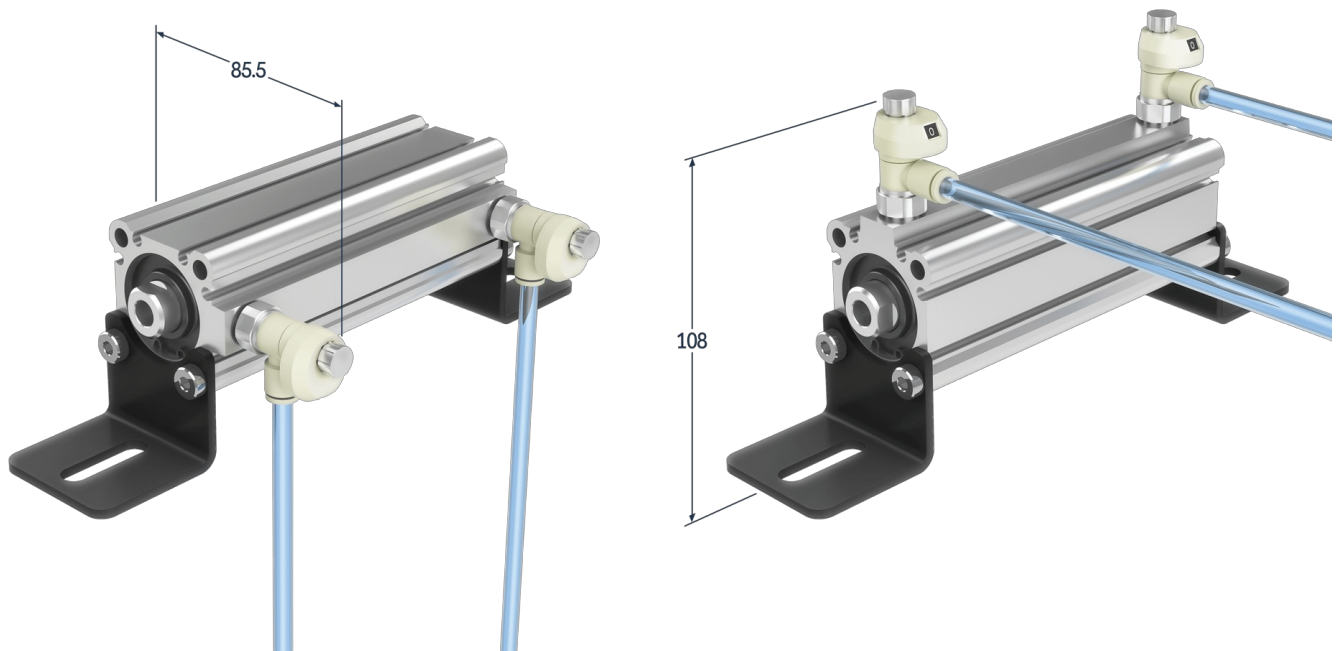
[8mm Wye Splitter One-Touch Fitting](#)



[6mm OD Blue Tubing 5-meter Extension](#)

The [6mm 90 Degree One-touch Fitting to 1/8in RC with Speed Controller](#) features a numeric indicator representing a specific level of flow control for cylinders. This fitting can be used to slow down and control the speed of the push and pull movement of our dual action cylinders. The indicator can be used to synchronize multiple cylinders to the same speed.

**Note:** The speed controller fittings replace the pre-installed 90-degree fittings on all our cylinders. When installing the speed controller fittings, the cylinder must be turned either 90 or 180 degrees with respect to the mounting brackets as the fittings do not fit underneath when mounted. Use an adjustable wrench to properly install the fittings.



## Assembly Instructions

**Note:** All air supply tubes have an **8 mm** outer diameter, whereas all actuator tubes have a **6 mm** outer diameter.

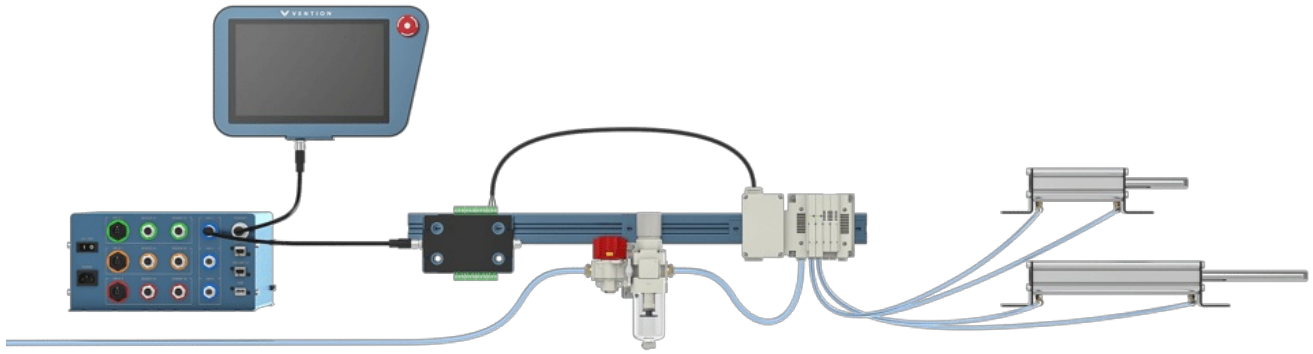
When connecting your pneumatic system:

- Make sure the emergency shutoff valve is turned to the EXH (exhaust) position
- Connect the filter/regulator unit's outlet to the manifold's inlet port using the provided 8 mm tubing
- Connect the unaltered end of the provided supply line to the shutoff valve's inlet
- Attach the provided quick-connect fitting to the supply line, and connect the end of the fitting to your air supply
- If you don't have an air-preparation station, simply connect the unaltered end of the provided supply line to the manifold's inlet

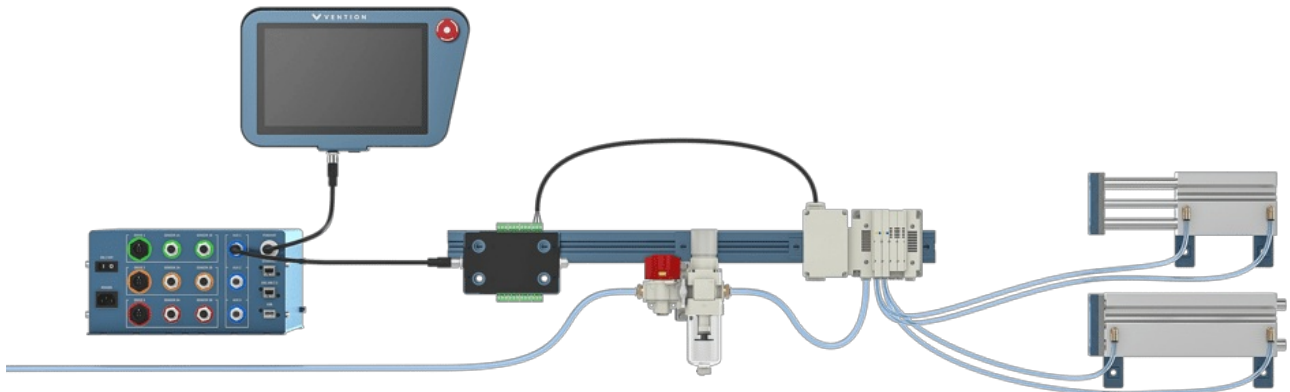
Every valve features two ports which correspond respectively to the actuator's push and pull actions

- Connect the valve ports on the manifold to the actuator ports using the provided 6 mm tubing
- Test the actuator. If the direction of action is the opposite of what is desired, simply swap the tubes using the one-touch fittings

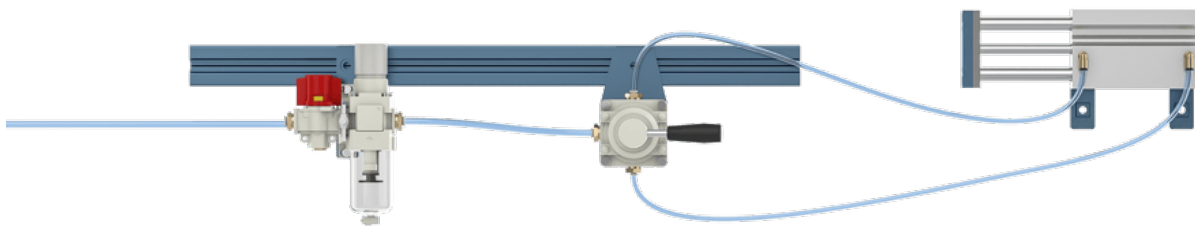
## Non-Guided Cylinder Assembly



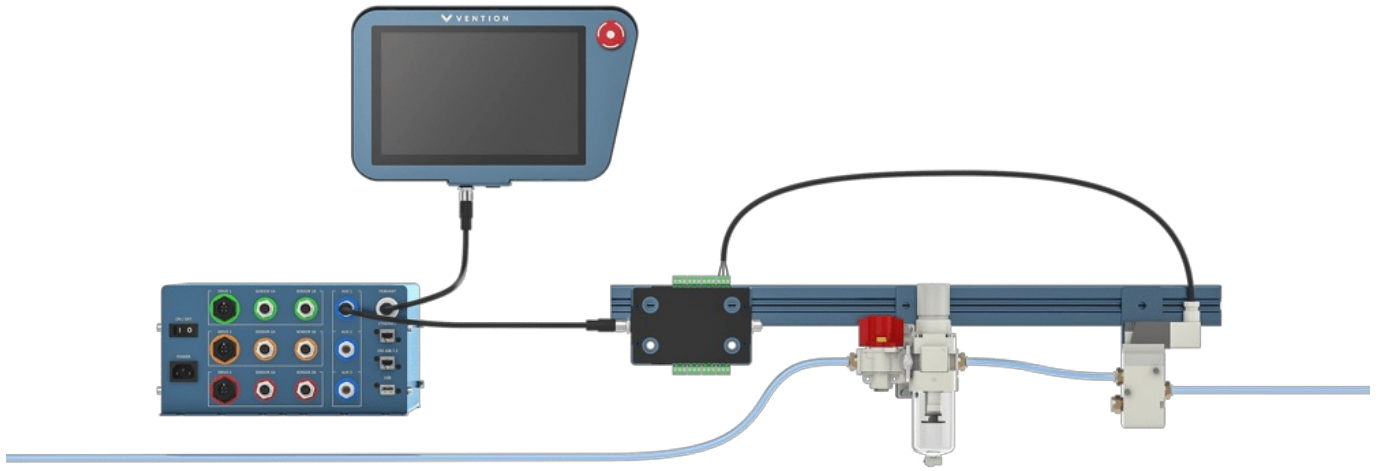
Guided Cylinder Assembly



Manual Valve with Guided Cylinder Assembly



On/Off Valve Assembly



## Actuator Force Calculation

The effective pushing and pulling force of all cylinders can be calculated as follows:

$$F_{push}[N] = P [MPa] \cdot A_{bore}[mm^2] = P [MPa] \cdot \frac{D^2 \cdot \pi}{4} [mm^2]$$

$$F_{pull}[N] = 0.75 \cdot F_{push}[N]$$



Pressure $P$ [MPa]	0.3	0.5	0.7
Non-Guided Cylinder Pushing Force (Out) [N]	241	402	563
Non-Guided Cylinder Pulling Force (In) [N]	181	302	422
Guided Cylinder Pushing Force (Out) [N]	147	246	344
Guided Cylinder Pulling Force (In) [N]	113	189	265

## Flow Rate Calculation

Your system's maximum Flow Rate  $Q_v$  in standard cubic feet per minute (scfm) can be calculated by deviding the Flow Coefficient  $C_v$  by a predetermined conversion factor based on pressure as seen in the table below.

Pressure $P$ [MPa]	0.276 (40 psi)	0.345 (50 psi)	0.412 (60 psi)	0.483 (70 psi)	0.552 (80 psi)	0.621 (90 psi)	0.690 (100 psi)
Conversion Factor	0.0370	0.0312	0.0270	0.0238	0.0212	0.0192	0.0177

When calculating the maximum flow rate, it is important that the lowest  $C_v$  value is used as it is the limiting factor. For example, to determine the maximum flow rate through a system that utilizes an On/Off Valve ([CE-AR-002-0000](#)) and an Air Preparation Station ([CA-AP-001-0001](#)), the lowest  $C_v$  is 2.1. Assuming the system's pressure is set to 0.55 MPa (80 psi), the following calculation must be done:

$$Q_v [scfm] = \frac{C_v}{factor} = \frac{2.1}{0.0212} = 99 scfm$$

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**Note:** This general rule applies at standard air temperature (20°C) and pressure (101.3 kPa or 14.7 psi). It provides an approximation of air flow rate values, not an exact measurement.

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