



# Operation Manual

PRODUCT NAME

3 Port Air Operated Valve

MODEL/ Series/ Product Number

Series: VPA31\*5

**SMC Corporation**

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# Safety Instructions

These safety instructions are intended to prevent hazardous situations and/or equipment damage. These instructions indicate the level of potential hazard with the labels of "Caution," "Warning" or "Danger." They are all important notes for safety and must be followed in addition to International Standards (ISO/IEC)\*1), and other safety regulations.

\*1) ISO 4414: Pneumatic fluid power -- General rules relating to systems.

ISO 4413: Hydraulic fluid power -- General rules relating to systems.

IEC 60204-1: Safety of machinery -- Electrical equipment of machines .(Part 1: General requirements)

ISO 10218: Manipulating industrial robots -Safety.

etc.



## Caution

**Caution** indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.



## Warning

**Warning** indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.



## Danger

**Danger** indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.

## Warning

### **1. The compatibility of the product is the responsibility of the person who designs the equipment or decides its specifications.**

Since the product specified here is used under various operating conditions, its compatibility with specific equipment must be decided by the person who designs the equipment or decides its specifications based on necessary analysis and test results.

The expected performance and safety assurance of the equipment will be the responsibility of the person who has determined its compatibility with the product.

This person should also continuously review all specifications of the product referring to its latest catalog information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.

### **2. Only personnel with appropriate training should operate machinery and equipment.**

The product specified here may become unsafe if handled incorrectly.

The assembly, operation and maintenance of machines or equipment including our products must be performed by an operator who is appropriately trained and experienced.

### **3. Do not service or attempt to remove product and machinery/equipment until safety is confirmed.**

1. The inspection and maintenance of machinery/equipment should only be performed after measures to prevent falling or runaway of the driven objects have been confirmed.

2. When the product is to be removed, confirm that the safety measures as mentioned above are implemented and the power from any appropriate source is cut, and read and understand the specific product precautions of all relevant products carefully.

3. Before machinery/equipment is restarted, take measures to prevent unexpected operation and malfunction.

### **4. Contact SMC beforehand and take special consideration of safety measures if the product is to be used in any of the following conditions.**

1. Conditions and environments outside of the given specifications, or use outdoors or in a place exposed to direct sunlight.

2. Installation on equipment in conjunction with atomic energy, railways, air navigation, space, shipping, vehicles, military, medical treatment, combustion and recreation, or equipment in contact with food and beverages, emergency stop circuits, clutch and brake circuits in press applications, safety equipment or other applications unsuitable for the standard specifications described in the product catalog.

3. An application which could have negative effects on people, property, or animals requiring special safety analysis.

4. Use in an interlock circuit, which requires the provision of double interlock for possible failure by using a mechanical protective function, and periodical checks to confirm proper operation.



# Safety Instructions

## Caution

### **1. The product is provided for use in manufacturing industries.**

The product herein described is basically provided for peaceful use in manufacturing industries.

If considering using the product in other industries, consult SMC beforehand and exchange specifications or a contract if necessary.

If anything is unclear, contact your nearest sales branch.

## **Limited warranty and Disclaimer/Compliance Requirements**

The product used is subject to the following “Limited warranty and Disclaimer” and “Compliance Requirements”.

Read and accept them before using the product.

### **Limited warranty and Disclaimer**

#### **1. The warranty period of the product is 1 year in service or 1.5 years after the product is delivered, whichever is first.\*2)**

Also, the product may have specified durability, running distance or replacement parts. Please consult your nearest sales branch.

#### **2. For any failure or damage reported within the warranty period which is clearly our responsibility, a replacement product or necessary parts will be provided.**

This limited warranty applies only to our product independently, and not to any other damage incurred due to the failure of the product.

#### **3. Prior to using SMC products, please read and understand the warranty terms and disclaimers noted in the specified catalog for the particular products.**

##### **\*2) Vacuum pads are excluded from this 1 year warranty.**

A vacuum pad is a consumable part, so it is warranted for a year after it is delivered.

Also, even within the warranty period, the wear of a product due to the use of the vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty.

### **Compliance Requirements**

#### **1. The use of SMC products with production equipment for the manufacture of weapons of mass destruction(WMD) or any other weapon is strictly prohibited.**

#### **2. The exports of SMC products or technology from one country to another are governed by the relevant security laws and regulation of the countries involved in the transaction. Prior to the shipment of a SMC product to another country, assure that all local rules governing that export are known and followed.**

## Caution

### **SMC products are not intended for use as instruments for legal metrology.**

Measurement instruments that SMC manufactures or sells have not been qualified by type approval tests relevant to the metrology (measurement) laws of each country.

Therefore, SMC products cannot be used for business or certification ordained by the metrology (measurement) laws of each country.



# VPA31\*5 Series Precautions for 3 Port Air Operated Valve ①

Be sure to read before handling.

## Design / Selection

### ⚠ Warning

#### 1. Confirm the specifications.

Products represented in this manual are designed only for use in compressed air systems (including vacuum).

Do not operate at pressures or temperatures, etc., beyond the range of specifications, as this can cause damage or malfunction. (Refer to the specifications.)

Please contact SMC when using a fluid other than compressed air (including vacuum).

We do not guarantee against any damage if the product is used outside of the specification range.

#### 2. Actuator drive

When an actuator, such as a cylinder, is to be driven using a valve, take appropriate measures (cover installation or approach prohibition) to prevent potential danger caused by actuator operation.

#### 3. Holding pressure (including vacuum)

Since the valves are subject to air leakage, they cannot be used for applications such as holding pressure (including vacuum) in a pressure vessel.

#### 4. Not suitable for use as an emergency shutoff valve, etc.

The valves listed in this manual are not designed for safety applications such as an emergency shutoff valve. If the valves are used for the mentioned applications, additional safety measures should be adopted.

#### 5. Release of residual pressure

For maintenance purposes install a system for releasing residual pressure.

#### 6. Operation in a vacuum condition

When a valve is used for switching a vacuum, take measures to install a suction filter or similar to prevent external dust or other foreign matter from entering inside the valve. In addition, at the time of vacuum adsorption, be sure to vacuum at all times. Failure to do so may result in foreign matter sticking to the adsorption pad, or air leakage causing the workpiece to drop.

#### 7. Regarding a vacuum switch valve and a vacuum release valve

If a non-vacuum valve is installed in the middle of piping system having a vacuum, the vacuum condition will not be maintained. Use a valve designed for use under vacuum condition.

#### 8. Ventilation

Provide ventilation when using a valve in a confined area, such as in a closed control panel. For example, install a ventilation opening, etc. in order to prevent pressure from increasing inside of the confined area.

#### 9. Do not disassemble the product or make any modifications, including additional machining.

Doing so may cause human injury and/or an accident.

When the product is disassembled for maintenance, refer to "Overhaul / Cleaning / Addition of grease (VPA31\*5V series: Vacuum Specification)".

## Selection

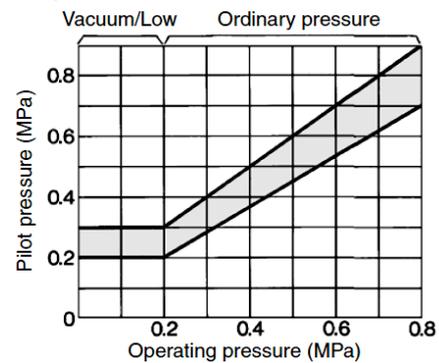
### ⚠ Caution

#### 1. Use in low temperature environments

Valve use is possible to temperature to 0°C. Take appropriate measures to avoid freezing or congealing of drain, water, etc.

#### 2. Pilot air

The pilot port should be pressurized by a compressed air at the specified pressure.



#### 3. Mounting orientation

Mounting orientation is free.

## Mounting

### ⚠ Warning

#### 1. Operation manual

Install the products and operate them only after reading the operation manual carefully and understanding its contents. Also, keep the manual where it can be referred to as necessary.

#### 2. Ensure sufficient space for maintenance activities.

When installing the products, allow access for maintenance.

#### 3. Tighten threads with the proper tightening torque.

When installing the products, follow the listed torque specifications.

#### 4. If air leakage increases or equipment does not operate properly, stop operation.

Check mounting conditions when air and power supplies are connected. Initial function and leakage tests should be performed after installation.

#### 5. Painting and coating

Warnings or specifications printed or affixed to the product should not be erased, removed or covered up.

Please consult with SMC before applying paint to resinous parts, as this may have an adverse effect due to the solvent in the paint.



## VPA31\*5 Series

# Precautions for 3 Port Air Operated Valve ②

Be sure to read before handling.

### Piping

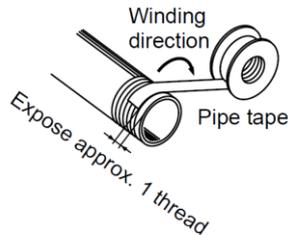
#### ⚠ Caution

##### 1. Preparation before piping

Before piping is connected, it should be thoroughly blown out with air (flushing) or washed to remove chips, cutting oil and other debris from inside the pipe.

##### 2. Wrapping of pipe tape

When screwing piping or fittings into ports, ensure that chips from the pipe threads or sealing material do not enter the piping. Also, if pipe tape is used, leave 1 thread ridges exposed at the end of the threads.



##### 3. Connection of fittings

When screwing fittings into valves, tighten as follows.

#### Tightening Torque for Piping

Connection thread size (R, NPT)	Proper tightening torque (N·m)
1/8	3~5
3/8	15~20
1/2	20~25
3/4	28~30
1	36~38
1 1/4	40~42
1 1/2	48~50
2	48~50

Follow the procedure of the manufacturer when fittings other than SMC is used.

- 1) If the fitting is tightened with excessive torque, a large amount of sealant will seep out. Remove the excess sealant.
- 2) Insufficient tightening may cause seal failure or loosen the threads.
- 3) For reuse
  - (1) Normally, fittings with a sealant can be reused up to 2 to 3 times.
  - (2) To prevent air leakage through the sealant, remove any loose sealant stuck to the fitting by blowing air over the threaded portion.
  - (3) If the sealant no longer provides effective sealing, wind sealing tape over the sealant before reusing. Do not use any form of sealant other than the tape type of sealant.
  - (4) Once the fitting has been tightened, backing it out to its original position often causes the sealant to become defective. Air leakage will occur.

##### 4. Uni thread fittings

- 1) First, tighten the threaded portion by hand, then use a suitable wrench to tighten the hexagonal portion of the body further at wrench tightening angle shown below. For the reference value for the tightening torque, refer to the table below.

#### Connection Female Thread: Rc, NPT, NPTF

Uni thread size	Wrench tightening angle after tightened by hand (deg)	Tightening torque (N·m)
1/8	30 to 60	3 to 5
3/8	15 to 45	14 to 16
1/2	15 to 30	20 to 22

#### Connection Female Thread: G

Uni thread size	Wrench tightening angle after tightened by hand (deg)	Tightening torque (N·m)
1/8	30 to 45	3 to 4
3/8	15 to 30	8 to 9
1/2	15 to 30	14 to 15

- 2) The gasket can be reused up to 6 to 10 times. It can be replaced easily when it has sustained damage. A broken gasket can be removed by holding it and then turning it in the same direction as loosening the thread. If the gasket is difficult to remove, cut it with nippers, etc. In such a case, use caution not to scratch the seat face because the seat face of the fitting's 45° gasket is the sealing face.

##### 5. Piping to products

When piping to a product, refer to the operation manual to avoid mistakes regarding the supply port, etc.

### Lubrication

#### ⚠ Warning

**This is a valve which requires lubrication. Be sure to lubricate it for operation.**

**It may cause problems such as damage and malfunction of the valve if it is not lubricated.**

**A valve of vacuum specification needs overhaul for cleaning and addition of grease because it cannot be lubricated without it. (Refer to page 8.)**

- 1) If a lubricant is used in the system, use class 1 turbine oil (no additive), ISO VG32.
- 2) Please contact SMC regarding class 2 turbine oil (with additives), ISO VG32.

##### Lubrication amount

If too much oil is supplied, the oil will be accumulated in the product, causing malfunction or response delay.

### Air Supply

#### ⚠ Warning

##### 1. Use clean air.

Do not use compressed air that contains chemicals, synthetic oils including organic solvents, salt or corrosive gases, etc., as it can cause damage or malfunction.

#### ⚠ Caution

##### 1. Install an air filter.

Install an air filter upstream near the valve. Select an air filter with a filtration size of 5 μm or smaller.

##### 2. Take measures to ensure air quality, such as by installing an aftercooler, air dryer, or water separator.

Compressed air that contains a large amount of drainage can cause malfunction of pneumatic equipment such as valves. Therefore, take appropriate measures to ensure air quality, such as by providing an aftercooler, air dryer, or water separator.



## VPA31\*5 Series

# Precautions for 3 Port Air Operated Valve ③

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### Air Supply

#### ⚠ Caution

3. **If excessive carbon powder is seen, install a mist separator on the upstream side of the valve.**

If excessive carbon dust is generated by the compressor, it may adhere to the inside of a valve and cause it to malfunction.

For compressed air quality, refer to SMC's Best Pneumatics catalog.

### Operating Environment

#### ⚠ Warning

1. **Do not use in an atmosphere having corrosive gases, chemicals, sea water, water, water steam, or where there is direct contact with any of these .**
2. **Do not use in an environment where flammable gas or explosive gas exists. Usage may cause a fire or explosion. The products do not have an explosion proof construction.**
3. **Do not use in a place subject to heavy vibration and/or shock.**
4. **The valve should not be exposed to prolonged sunlight. Use a protective cover. Note that the valve is not for outdoor use.**
5. **Remove any sources of excessive heat.**
6. **If it is used in an environment where there is possible contact with a waterdrop, oil, weld spatter, etc., exercise preventive measures.**

#### ⚠ Caution

##### (1) Temperature of ambient environment

Use the valve within the range of the ambient temperature specification of each valve. In addition, pay attention when using the valve in environments where the temperature changes drastically.

##### (2) Humidity of ambient environment

If the humidity rises, take measures to prevent the adhesion of water droplets on the valve.

### Maintenance

#### ⚠ Warning

1. **Perform maintenance inspection according to the procedures indicated in the operation manual.**

If handled improperly, malfunction and damage of machinery or equipment may occur.

2. **Removal of equipment, and supply/exhaust of compressed air**

When components are removed, first confirm that measures are in place to prevent workpieces from dropping, run-away equipment, etc. Then, cut off the supply pressure and electric power, and exhaust all compressed air from the system using the residual pressure release function.

When the equipment is operated after remounting or replacement, first confirm that measures are in place to prevent lurching of actuators, etc. Then, confirm that the equipment is operating normally.

3. **Low frequency operation**

Valves should be operated at least once every 30 days to prevent malfunction. (Use caution regarding the air supply.)

4. **If the volume of air leakage increases or the valve does not operate normally, do not use the valve.**

**Perform periodic maintenance on the valve to confirm the operating condition and check for any air leakage.**

#### ⚠ Caution

1. **Drain flushing**

Remove drainage from the air filters regularly.



# VPA31\*5 Series Specific Product Precautions

Be sure to read before handling.

## Other Precautions

### Caution

#### 1. Pressure balance among each port

This valve is pressure-unbalanced type. Operate it within this pressure range:  $IN \geq OUT \geq EXH$ . If not operated in the range, the valve will malfunction.

#### 2. Use as 2 port valve

- 1) Plug EXH port in case of pressure-in and plug IN port in case of vacuum use.
- 2) This valve has slight air leakage and can not be used for such purposes as holding air pressure (including vacuum) in the pressure container.

#### 3. Piping (Vacuum Use)

1) Piping in general:

- |            |   |                  |
|------------|---|------------------|
| EXH port = | Vacuum pump/<br>Blower                                  | } (Suction side) |
| OUT port = | Vacuum pad/<br>Tank                                     | } (Load side)    |
| IN port =  | Plug (2 port valve)<br>Air releasing<br>Air pressure-in |                  |



# VPA31\*5 Series Specific Product Precautions ②

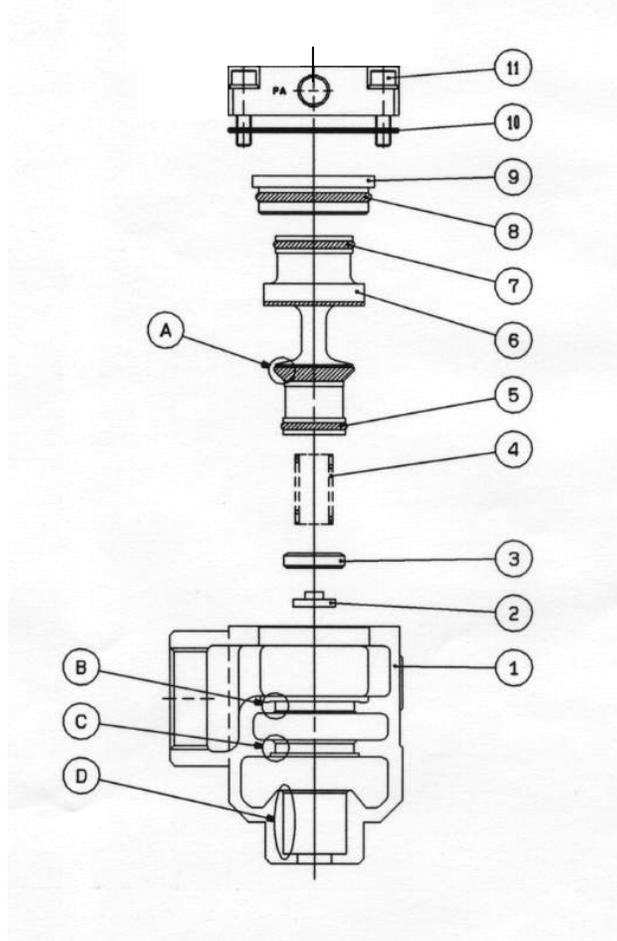
Be sure to read before handling.

## Overhaul, Cleaning, Addition of Grease (VPA31\*5V Series: Vacuum Specification)

### 1) How to overhaul (Remove air supply before starting disassembly.)

Remove the four hexagon socket head cap screws⑪ and take the housing.

The guide ring⑨ can be found on the body, and take it away with a flat head screw driver to take the internal parts away.



### 2) How to add grease

Take the parts off and wipe off the dust adhered on them.

Wipe off the dust inside the body①, too.

Take the O-rings ⑤ and ⑦ in the sliding part off of the spool valve⑥, wipe them to clean and apply grease.

Apply grease to the portion A of the spool valve⑥, internal surface of the guide ring and portions B, C, D of the body①, too.

Note 1) Do not wash the O-ring and the spool valve with organic solvent or such.

Note 2) It is suggested to use the silicone grease "G-40M" made by Shin-Etsu Chemical Co., Ltd.

### 3) Overhaul

1. Insert the element② and the spring washer③ in the direction that the figure shows.

2. Insert the spool valve⑥ and the guide ring⑨ together into the body①.

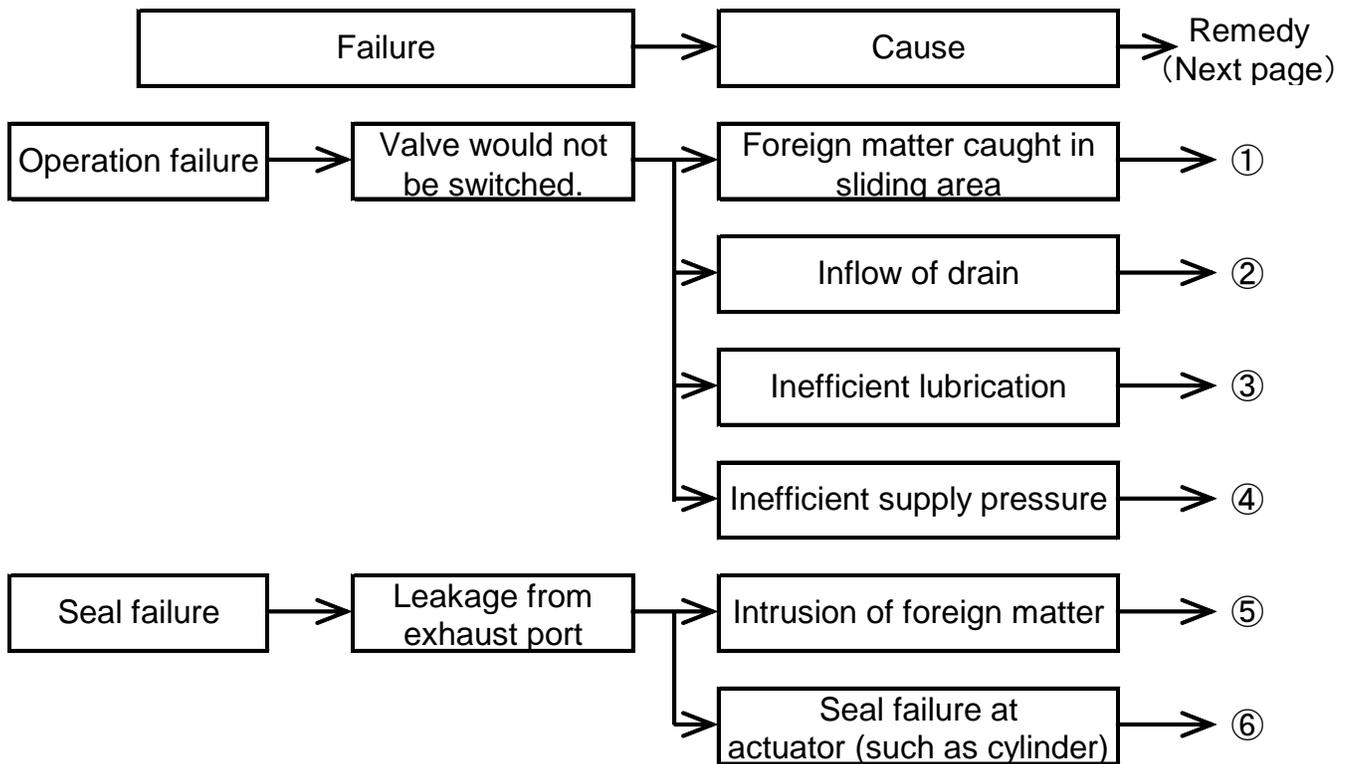
\*Be sure to have a performance inspection and an air leakage test after overhaul of the valve.

Performance deterioration, damage and such caused by overhaul for cleaning are out of SMC's guarantee.

(Contact SMC for repair if it needs to be guaranteed.)

# Trouble shooting

According to the failure, check the cause of the failure from which seems to effect the failure more than the other and devise a countermeasure.



# Remedy

No.	Remedy
①	Replace the valve.
②	- If the lubrication oil was incorrect, remove the oil by air blow and replace the valve.
	Lubricate turbine oil class 1 (ISO VG32) surely after replacing the valve.
	- When a large quantity of drain is given and cannot carry out drain omission surely, install either an auto-drain or a dryer. The valve should be replaced.
③	Check the lubrication amount is correct or not.
④	Check the pressure is within the specified pressure range. Check the pressure is dropped or not when the valve is worked.
⑤	Replace the valve after removing foreign matter in the pipe by such as air blow.
⑥	Fix or replace the actuator.

If no improvement is achieved in spite of the above countermeasure, inside of the valve may have some failure. In this case, stop using the valve immediately.

If any of followings are carried out, inside of the valve may have some failure. In this case, stop using the valve immediately.

1. Oil other than the specified one has been lubricated.
2. Lubrication has been stopped intermediately, or lubrication was suspended temporary.
3. Water splashed directly.
4. Strong impact was given.
5. Foreign matter such as drain and particle invaded.
6. Prohibited way of using the valve which is written at "Precautions" section in this operation manual was carried out excluding above-mentioned.

\* Return us the failure valve in just the state when the failure occurred to the valve.

Revision history	
<input checked="" type="checkbox"/> Renewal	2018.8

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