Doc. No.VP3145-OMM0002-A

Operation Manual

Solenoid Valve

PRODUCT NAME

VP31∗5 Series

MODEL/ Series

SMC Corporation

Contents

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 10218-1992: 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 isdelivered.∗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 govemed 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 goveming that export are known and followed.**

*VP31*5 Series*

Precautions for 3 Port Solenoid 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. Extended periods of continuous energization

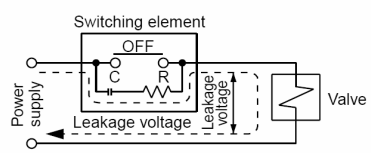
If a valve will be continuously energized for an extended period of time, the temperature of the valve will increase due to the heat generated by the coil.

Selection

⚠ Caution

1. Leakage voltage

When C-R device (surge voltage suppressor) is used for the protection of switching device, the voltage leakage be increased by current passing through the C-R device. Therefore, select a circuit or device suitable to keep residual voltage leakage within the value described below. If the voltage leakage causes recover failure, set up a bleeder resistance in the circuit or device. For further information of the bleeder resistance, contact SMC.



DC coil 5% or less of rated voltage

AC coil 15% or less of rated voltage

2. Continuous energization

If the valve remains energized for long period, switch the valve off at least once a day.

3. Instant energization

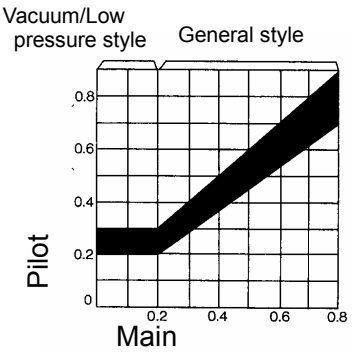
If the valve is to be energized instantly, energizing time (ON) and de-energizing time (OFF) should be both 0.1 sec or more.

4. 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.

5. External pilot type

Use external pilot operated style valve for air blowing applications. Supply compressed air defined by specifications for the port of the external pilot. When the pressure at IN port side drops more than 0.2MPa on switching the valve, the valve will cause operation failure, so use the external pilot type (in case the valve is used with IN port restricted or OUT port opened to the atmosphere or the almost same condition as OUT port).



6. Mounting orientation

Mounting orientation is free.

Precautions for 3 Port Solenoid Valve ②

Be sure to read before handling.

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.

Piping

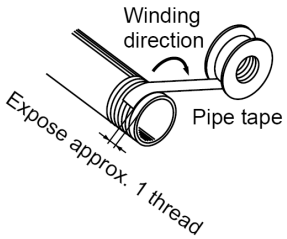
⚠ Caution

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	Proper tightening Proper tightening torque (N·m)
Rc 3/8	22～24
Rc 1/2	28～30
Rc 3/4	28～30
Rc 1	36～38
Rc 1·1/4	40～42
Rc 1·1/2	48～50
Rc 2	48～50

Wiring

⚠ Caution

1. Polarity

No +/- polarity for this solenoid valve

2. Applied voltage

When electric power is connected to a solenoid valve, be careful to apply the proper voltage. Improper voltage may cause malfunction or coil damage.

3. Check the connections.

Check if the connections are correct after completing all wiring.

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 9.)

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.

*VP31*5 Series*

Precautions for 3 Port Solenoid Valve ③

Be sure to read before handling.

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.

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.

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.

7. When the solenoid valve is mounted in a control panel or its energized for a long time, make sure ambient temperatures is within the specification of 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. Manual override operation

When the manual override is operated, connected equipment will be actuated.

Operate after safety is confirmed.

⚠ Caution

1. Drain flushing

Remove drainage from the air filters regularly.

*VP31*5 Series*

Specific Product Precautions ①

Be sure to read before handling.

How to Use DIN Terminal

⚠ Caution

1. Disassembly

1) After loosening the thread (1), then if the cover (4) is pulled in the direction of the thread, the connector will be removed from the body equipment (solenoid, etc.).
2) Pull out the screw (1), then remove the gasket (2a) or (2b).
3) On the bottom part of the terminal block (3), there's a cut-off part (indication of an arrow) (3a). If a small flat head screwdriver is inserted between the opening in the bottom, terminal block (3) will be removed from the cover (4).
4) Remove the cable gland (5) and plain washer (6) and rubber seal (7).

2. Wiring

1) Passing through the cable (8) in the order of cable ground (5), plain washer (6), rubber seal (7), and then insert into the cover (4).
2) Dimensions of the cable (8) are the figure as below. Skin the cable and crimp the crimped terminal (9) to the edges.

Note) Wire power source side cable to No.1 and 2. (No +/- polarity.)

3) Remove the screw with washer (3f) from the bracket (3e). (Loosen in the case of Y-shape type terminal.) As shown in the below figure, mount a crimped terminal (9), and then again tighten the screw (3f).

Note) Tighten within the tightening torque of 0.5N·m+/-15%.

Note: a) It is possible to wire even in the state of bare wire. In that case, loosen the screw with washer (3f) and place a lead wire (3d) into the bracket, and then tighten it once again.

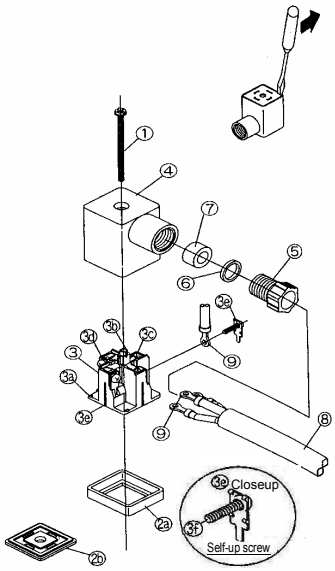
b) Maximum size of crimped terminal (9) is up to 1.25mm^2-3.5 when O terminal. For Y terminal, it is up to 1.25mm^2-4.

c) Cable (8) external: ϕ6 to ϕ12mm

Note) For the one with the external dimension ranged between ϕ9 to ϕ12mm, remove the inside parts of the rubber seal (7) before using.

How to Use DIN Terminal

⚠ Caution



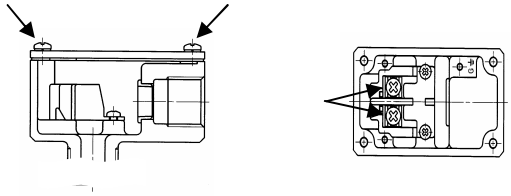
3. Assembly

1) Terminal block (3) connected with cover (4) should be reinstated.
(Push it down until you hear the click sound.)
2) Putting rubber seal (7), plain washer (6), in this order into the cable introducing slit on the cover (4), then further tighten the cable gland (5) securely.
3) By Inserting gasket (2a) or (2b) between the bottom part of the terminal block (3) and a plug on an equipment, screw in (1) on top of the cover (4) and tighten it.
Note1) Tighten within the tightening torque of 0.5N·m+/-20%.
Note2) The orientation of a connector can be changed arbitrarily per 90°, depending on the combination of a cover (4) and a terminal block (3).

How to Wire Conduit Terminal

⚠ Caution

1) Loosen four screws at the terminal box, and removethe lid. (See figure below.)



2) Wire the terminal block in the terminal box with power source side. (See figure on right). The thread size of terminal block is M4.
Note) Tightening torque 0.6+/- 0.06N·m

*VP31*5 Series*

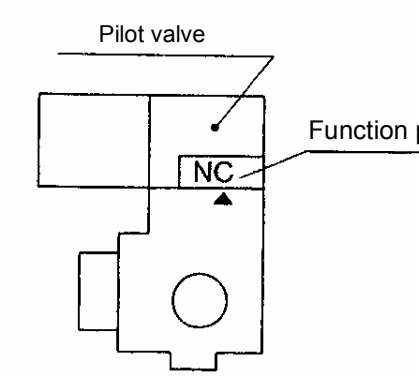
Specific Product Precautions ②

Be sure to read before handling.

N.C./ N.O. Conversion

⚠ Caution

To convert valve oparation from N.C. to N.O or N.O. to N.C., remove the pilot valve, move the function plate along the gascket, both top and bottom until the mark ▲ meets N.C. (N.O.) Please note however, that the N.O. valve functions properly only when the appropriate pressure is applied to the valve.



Light/ Serge Voltage Suppressor

	Grommet (G)	Conduit terminal (T)	DIN terminal (D)
With indicator light (L)	None	Neon bulb, Coil	48 VDC: LED, Coil; 100 VAC: Neon bulb, Coil
Surge voltage suppressor (S)	Varistor, Coil		
With light/surge voltage suppressor (Z)	None	Neon bulb, Varistor, Coil	48 VDC: LED, Varistor, Coil; 100 VAC: Neon bulb, Varistor, Coil

Protection circuit for light/surge voltage suppressor is not the polarity type.

Other Precautions

⚠ Caution

1. Pressure balance among each port

This solenoid valve is pressure-unbalanced type. Operate it within this pressure range: IN ≧ OUT ≧ 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.

Other Precautions

⚠ Caution

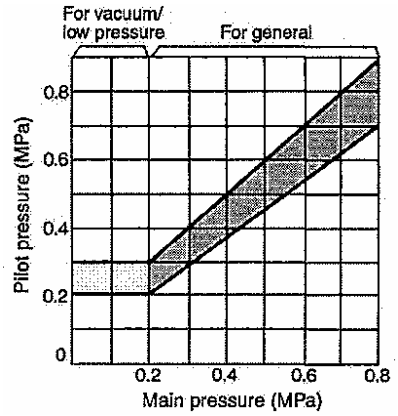
3. External Pilot

Use external pilot model in the following cases.

- Vacuum or low pressure (0.2MPa or less):
  Vacuum/Low pressure type
- Using the valve with supply port external throttle:
  General type
- Air pressure of supply port is slow:
  General type
- Resistance in outlet side is small in case of air blowing or filling an air tank:
  General type

Note 1) Keep external pilot pressure within the pressure range below.

Note 2) Conversion of internal pilot and external pilot can not be done.



4. Piping (Vacuum Use)

1) Piping in general:

EXH port = Vacuum pump/ Blower } (Suction side)

OUT port = Vacuum pad/ Tank } (Load side)
Plug (2 port valve)

IN port = Air releasing
Air pressure-in

2) Following the above piping, vacuum passage is switched between OUT and EXH, therefore, N.C./ N.O. indication on the function plate and switching of the vacuum passage are reversed; N.C. (Normally closed) in vacuum passage are reversed:

”N.C.” indicated on the plate
-N.O. in vacuum passage
(Normally open)
”N.O.” indicated on the plate
-N.C. in vacuum passage
(Normally closed)

*VP31*5 Series*

Specific Product Precautions ③

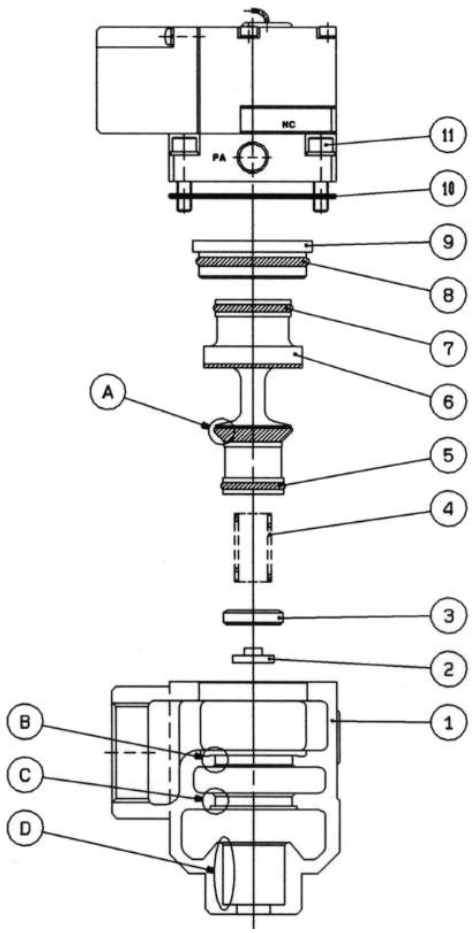
Be sure to read before handling.

Overhaul, Cleaning, Addition of Grease (VP31*5V Series: Vacuum Specification)

1) How to overhaul

Remove the four hexagon socket head cap screws 11 and take the pilot valve off.

The guide ring 9 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 body 1, too.

Take the O-rings 5 and 7 in the sliding part off of the spool valve 6, wipe them to clean and apply grease.

Apply grease to the portion A of the spool valve 1, internal surface of the guide ring and portions B, C, D of the body 1, 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 element 2 and the spring washer 3 in the direction that the figure shows.
2. Insert the spool valve 6 and the guide ring 9 together into the body 1.

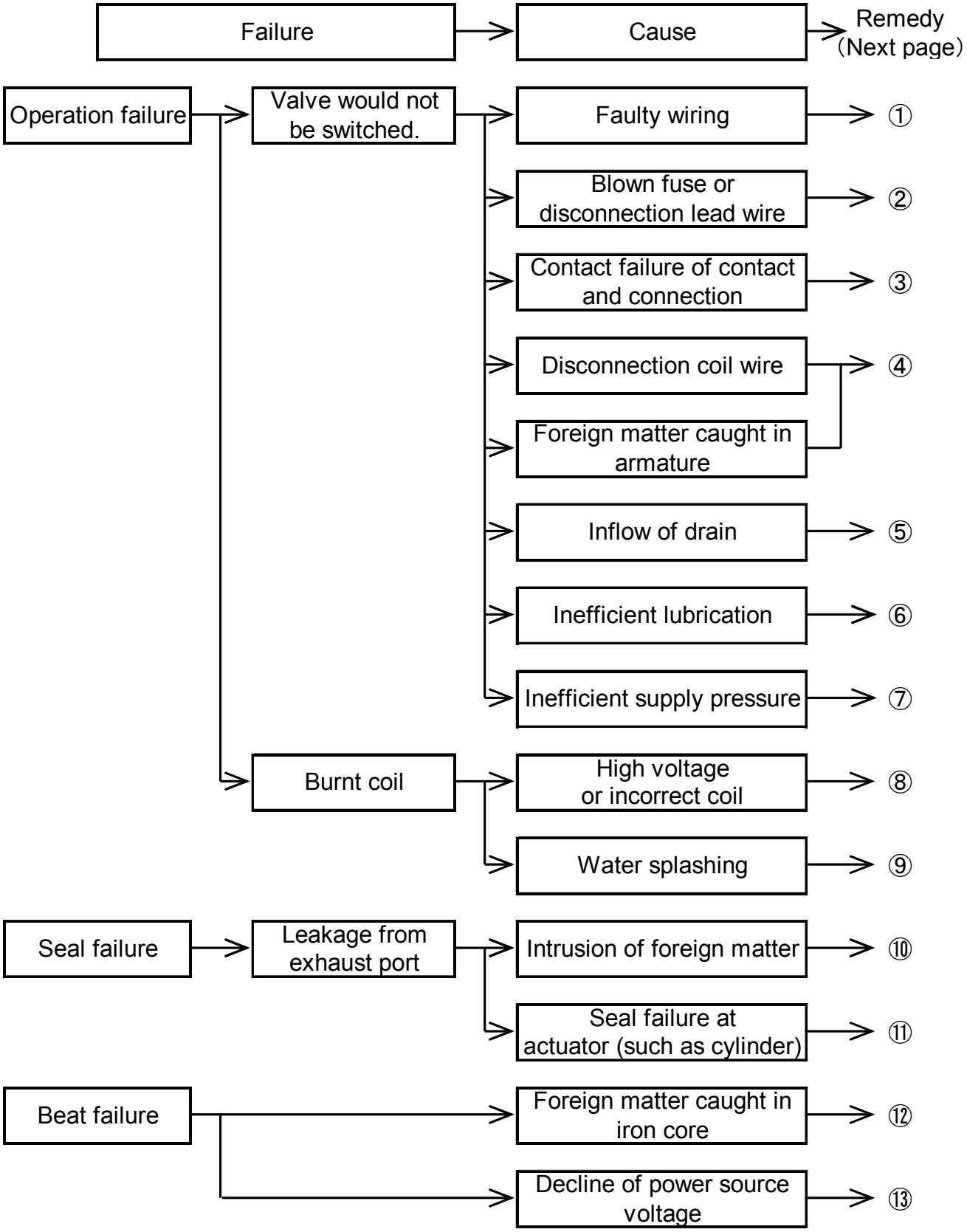
*Be sure to have a performance inspection and an air leakage test after overhaul of the valve.

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	Connect the wires again correctly.
②	Replace the part.
③	Replace the part or connect wires securely.
④	Replace the valve.
⑤	- 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.
⑥	Check the lubrication amount is correct or not.
⑦	Check the pressure is within the specified pressure range. Check the pressure is dropped or not when the valve is worked.
⑧	Check the voltage and replace the valve.
⑨	Protect the valve so that water does not splash the coil. Replace valve.
⑩	Replace the valve after removing foreign matter in the pipe by such as air blow.
⑪	Fix or replace the actuator.
⑫	Replace the valve.
⑬	Adjust the voltage.

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. Voltage out of rated voltage has been used.
2. Oil other than the specified one has been lubricated.
3. Lubrication has been stopped intermediately, or lubrication was suspended temporary.
4. Water splashed directely.
5. Strong impact was given.
6. Foreign matter such as drain and particle invaded.
7. 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	
A Safety Instructions	Po

1st printing: NP

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