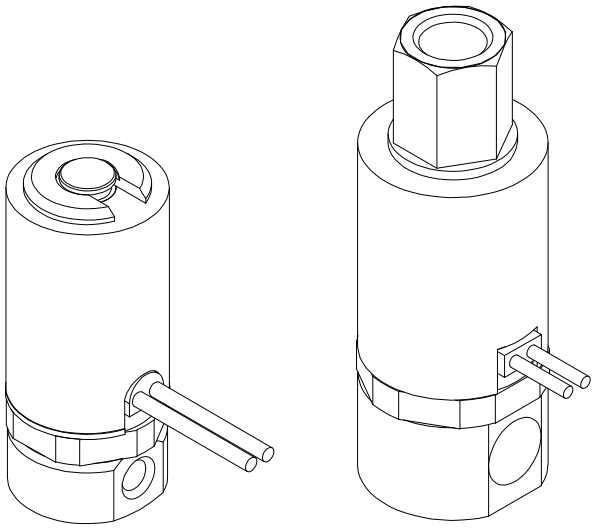
CKD

SM－5530－A

INSTRUCTION MANUAL

Compact direct acting solenoid valve

USB2 Series
USB3 Series
USG2 Series
USG3 Series



- Please read this instruction manual carefully before using this product, particularly the section describing safety.
- Retain this instruction manual with the product for further consultation whenever necessary.

Ver.2
CKD Corporation

Safety precautions

When designing and manufacturing a device using CKD products, the manufacturer is obligated to manufacture a safe product by confirming safety of the system comprising the following items:

- Device mechanism
- Pneumatic or water control circuit
- Electric control that controls the above

It is important to select, use, handle, and maintain the product appropriately to ensure that the CKD product is used safely.
Observe warnings and precautions to ensure device safety.
Check that device safety is ensured, and manufacture a safe device.

⚠ WARNING

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

2. Use this product within its specifications.

This product cannot be used beyond its specifications. Additionally, the product must not be modified or machined.
This product is intended for use in general industrial devices and parts. Use beyond such conditions is not considered. Consult with CKD for details when using the product beyond the unique specification range, outdoors, or in the following conditions or environments. In any case, measures for safety shall be provided when the vavle malfunctions.

① Use for special applications requiring safety including nuclear energy, railroad, aviation, ship, vehicle, medical equipment, equipment or applications coming into contact with beverage or food, amusement equipment, emergency shutoff circuits, press machine, brake circuits, or for safeguard.
② Use for applications where life or assets could be adversely affected, and special safety measures are required.

3. Observe corporate standards and regulations, etc., related to the safety of device design and control, etc.

ISO4414, JIS B 8370 (pneumatic system rules)
JFPS2008 (principles for pneumatic cylinder selection and use)
Including High Pressure Gas Maintenance Law, Occupational Safety and Sanitation Laws, other safety rules, standards and regulations, etc.

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

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

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

■The safety cautions are ranked as "DANGER", "WARNING" and "CAUTION" in this section.

⚠ DANGER : When a dangerous situation may occur if handling is mistaken leading to fatal or serious injuries, or when there is a high degree of emergency to a warning.

⚠ WARNING : When a dangerous situation may occur if handling is mistaken leading to fatal or serious injuries.

⚠ CAUTION : When a dangerous situation may occur if handling is mistaken leading to minor injuries or physical damage.

Note that some items described as "CAUTION" may lead to serious results depending on the situation. In any case, important information that must be observed is explained.

Precautions with regard to guarantee

- **Guarantee period**

The guarantee period of our product shall be one (1) year after it is delivered to the place specified by the customer.

- **Guarantee coverage**

If any failure for which CKD CORPORATION is recognized to be responsible occurs within the above warranty period, a substitute or necessary replacement parts shall be provided free of charge, or the product shall be repaired free of charge at the plant of CKD CORPORATION.

However, the guarantee excludes following cases:

① Defects resulting from operation under conditions beyond those stated in the catalogue or specifications.
② Failure resulting from malfunction of the equipment and/or machine manufactured by other companies.
③ Failure resulting from wrong use of the product.
④ Failure resulting from modification or repairing that CKD CORPORATION is not involved in.
⑤ Failure resulting from causes that could not be foreseen by the technology available at the time of delivery.
⑥ Failure resulting from disaster that CKD is not responsible of.

Guarantee stated here covers only the delivered products. Any other damage resulting from failure of the delivered products is not covered by this guarantee.

- **Confirmation of product compatibility**

Our customer shall be responsible of confirming compatibility of our product used in our customer's system, machinery or device.

【 Contents 】

1. Unpacking

⚠ CAUTION	Do not take off the port protection until just before piping. Otherwise, foreign matter enters the valve and cause malfunction or bad operation.

(1) Check that the model No. shown on the name plate of the product is the same with what you ordered.
(2) Check that the product has no external damages.
(3) When storing the product, keep the product inside the packing box to prevent the intrusion of foreign matter to the valve. Take out the valve when piping.

2. Installation

⚠WARNING	Contact CKD if the product is to be used beyond specifications, or in special applications.

2. 1 Conditions for installation

⚠WARNING	a) Do not splash liquid such as water or lubricating oil. Otherwise, liquid splashed on the coil causes the coil to burn. Protective measure shall be taken against welding spatter. b) The coil generates heat. ・ If the product is to be installed inside a control panel, or if energizing time is long, provide ventilation measures. Temperature around the product will be high. c) The product can not be used in a corrosive or solvent environment. d) Avoid humid environments, since condensation may occur with change in temperature. e) The product cannot be used in an explosive gas atmosphere. f) Use the product away from radiant heat.

(1) Provide appropriate measures to prevent the product from freezing at cold places.
(2) The product cannot be used outdoors. Protective measure shall be taken such as covering, or valve installation inside a panel.
(3) Do not wash the product with water or solvents. Do not paint the product. Resin material used in the product may break down.
(4) Do not use the product under vibration or inertia.

2. 2 Installation method

⚠ CAUTION	a) Read this instruction manual thoroughly and understand the contents before installing the product. b) Always take hold of the body portion when handling and mounting the product. c) Confirm leakage from the piping after installation.

(1) Mounting posture is unrestricted.
However, avoid positioning the coil side down, since foreign matter in the fluid accumulates around the plunger and result in beat sounds and malfunction.

(2) Provide enough space for safe maintenance and troubleshooting work.

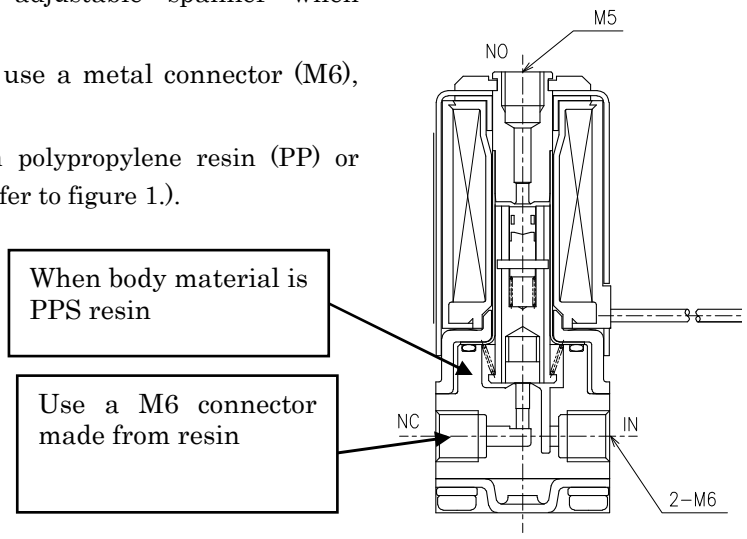
2. 3 Piping method

⚠ CAUTION	a) When piping or re-piping, fix the product. b) Fix and provide appropriate support to the piping, so that the weight and vibration of the piping will not directly be applied to the product. c) When piping is finished and fluid is to be flown, supply pressure gradually. ・If the piping is improper, the piping may disconnect or the fluid may leak.

(1) Cleaning the piping
・Before piping, flush the piping with compressed air 0.3MPa or more to remove foreign material such as dust, metal powder, rust and sealing material.

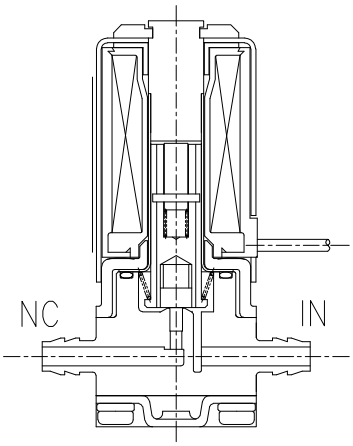
(2) Removal of foreign matter
・Foreign matter such as dust in the fluid causes malfunction and leakage.
To remove foreign matter, attach an appropriate apparatus to the primary side of the product. When the fluid is air, attach a filter 5μm or finer. When the fluid is water, attach a strainer 80 mesh or finer.

(3) Piping
・Make sure that the piping port is correct.
If the supply port is not clear, refer to the product model number and the JIS symbol in the catalogue.
・When piping to the normally open (NO) side Socket for metal body USG3, fix the Socket with a tool such as an adjustable spanner when tightening.
・For resin body types, do not use a metal connector (M6), since it may break the port.
Use a connector made from polypropylene resin (PP) or fluorine resin (PTFE, PFA) (Refer to figure 1.).



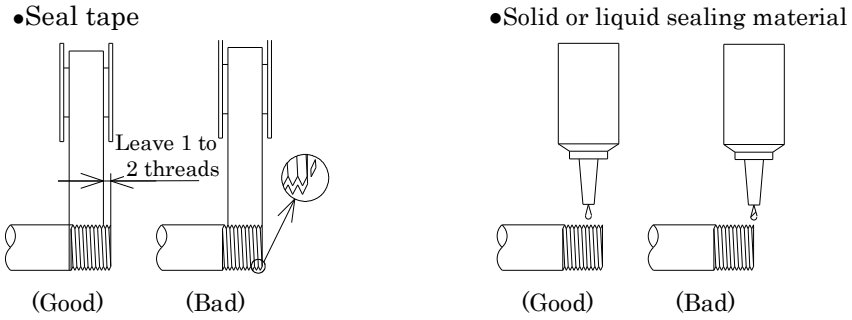
(Figure 1.) Resin body type

・When piping a tube to a barbed joint, be sure to insert the tube straightforward.
Choose tube that has inner diameter around φ4.
Confirm leakage and connection firmness before work, since attaching force (retaining force) differs according to tube material.
Do not apply excessive force such as pull, compression, and bending after piping. External force of 0.2 N・m or more applied to the barbed joint causes leakage or breakage.



(4) Sealing material

・When using sealing material, make sure the sealing material do not enter the piping. Also, make sure there is no external leakage. When taping seal tape to the pipe thread, leave 1 to 2 threads at the tip without taping.
Also, when using liquid sealing material, leave 1 to 2 threads at the tip without sealing material. Do not apply too much sealing material on the thread. Do not apply sealing material to the internal thread (refer to figure 2.).



(Figure 2.) How to apply sealing material

(5) Tightening

・Refer to table 1. for the recommended port tightening torque.

Table 1. Recommended port tightening torque

Body material	Port size	Recommended torque
Copper alloy or stainless steel	M5	1.0 to 1.5 N・m
	Rc1/8	18 to 20 N・m
PPS resin	M6	0.1 to 0.15 N・m

(6) Lubricated or non-lubricated operation

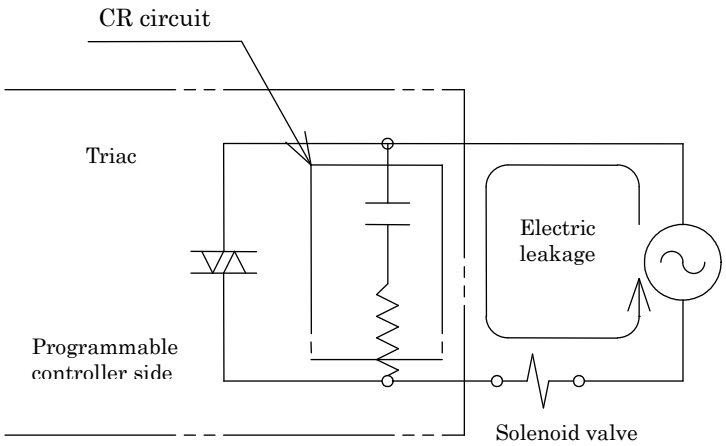
・This product does not require lubrication. Therefore, no lubricator is needed.
If the product is to be lubricated, use turbine oil Class 1, ISO VG32 (#90) or equivalent. Once lubricated, do not stop periodical lubrication.

2. 4 Wiring

⚠ CAUTION	Read this instruction manual thoroughly and understand the contents before wiring the product. ・You need to understand the structure and the operation principle of the solenoid valve. You additionally need knowledge to secure safety.

⚠ CAUTION	a) Confirm the voltage and the alternating or direct current type. b) To prevent unintended operation caused by electric leakage of other control components, confirm electric leakage. ・When using a control circuit such as a programmable controller, the solenoid valve may operate without intention because of the electric leakage from the control components. ・When using this product, keep the electric leakage from other components below the value shown in the table below.

Rated voltage	Electric leakage
DC12V	2mA or less
DC24V	1mA or less
AC100V coil with built-in diode	0.2mA or less
AC200V coil with built-in diode	0.1mA or less



(1) Maintenance of the electric equipment

・To maintain the electric equipment, install a breaker such as a fuse in the control circuit side.

(2) Wiring of the lead wire type

・For wiring, use wire with nominal cross-sectional area 0.5mm^2 or larger. Additionally, take care not to apply too much force on the lead wire.

There is no polarity for DC coils.

3. Pre-operation (post-installation) check

3. 1 Appearance check

⚠WARNING	Stop the flow of the fluid（shut the supply）. Discharge the fluid inside the product.

(1) Push the product by hand and confirm that the product is firmly fixed on the piping.
(2) Confirm that threaded parts such as bolts, nuts and screws are not loose.

3. 2 Leakage check

(1) Confirm leakage at the connection part by applying pressure to the fluid.
We recommend leakage check by the following method:

- Supply compressed air (0.1-0.3 MPa)
- Apply soap water to the portion to check for leakage
- Bubbles will appear if there is any leakage.

3. 3 Electrical check

⚠WARNING	Cut off the electricity. Check while taking serious care to avoid electric shock.

(1) Check the supply voltage.
Voltage variation shall be within 10% of the rated voltage.
Use beyond the allowed variation range will cause malfunction or damage to the coil.
(2) Check insulation resistance
Check the insulation resistance between dead metal parts and uninsulated live parts (such as the tip of the lead wire) that are assembled to the product.
Confirm that insulation resistance is over 100MΩ at DC500V megger.

3. 4 Operation check

(1) Apply rated voltage to the valve and rated pressure to the working fluid. Confirm normal operation of the product.

4. Instructions for proper use

4. 1 Handling precautions

⚠ WARNING	a) Do not use this product as an emergency shut-off valve. ・ This product is not designed as a safety-securing valve, such as an emergency shut-off valve. For such systems, use this valve after providing another method to secure safety. b) Take measures to prevent harm to operators or objects if this product fails. c) Liquid-filled state ・ When conveying a liquid in a circuit, operation may fail if liquid-filled state occurs. This is because pressure rises in the liquid-filled state when temperature rises. Provide an escape valve in the system so that a liquid-filled state circuit is not created. d) Working fluids ・ Do not use this product for fluids other than the working fluids listed in the catalog specifications. ・ Before use, confirm the compatibility of the product and applicable fluid with the Applicable Fluid Check List. ・ Depending on the model, internal parts may wear when the valve operates. Caution is required because wear chips could enter the secondary side of the valve.

⚠ CAUTION	a) Do not touch the coil sections or actuator sections when energized or immediately after energizing. Depending on the product, directly touching these products could cause burns. b) Do not touch the wiring connection sections (bare live part) when energized. There is a risk of electric shock. c) Always use within the maximum working pressure and maximum working pressure differential range.

(1) When carrying the solenoid valve, hold the main body.
Do not carry the valve by the lead wire.

(2) Do not use the product as footings, or place heavy loads on the product.

(3) If the product has not been used for more than a month, the seal rubber and metal at the valve seat may stick and delay operation. Carry out trial run in such cases.

(4) If the 3-port valve (Model: USG) is to be energized continuously, select fluororubber sealing.

(5) If the fluid is dry air or inert gas, number of duration cycles decrease significantly due to abrasion. Please contact us in these cases.

(6) This product cannot be used for vacuum holding. Please contact us if the intended usage is vacuum holding.

(7) Fluid viscosity shall be 50 mm^2/s or less. Otherwise, the product will malfunction.

(8) Refer to “6. Troubleshooting” if any trouble occur.

5. Maintenance

5. 1 Maintenance and inspection

⚠ CAUTION	a) Read this Instruction manual thoroughly and understand the contents well before performing maintenance and inspection. b) Shut off the power supply and release the fluid pressure before performing maintenance.

(1) Regularly inspect the product to ensure optimum performance. Although inspection frequency differs based on the working state, the product should be inspected every half year.

(2) Refer to "3. Pre-operation check" for contents of inspection.

(3) When washing the parts, use a washing agent with low environmental impact, such as a neutral detergent. Note that the rubber parts must be replaced as they could expand.

(4) When not using the product for one or more months after passing water or hot water, completely remove any water or hot water left in the product. Water or hot water residue will cause rust and may lead to operation failure or leaks.

(5) Please contact CKD if there are any unclear points concerning consumable parts.

(6) Beware the clogging of the strainer and filter.

(7) When the product is disassembled and reassembled, tighten the threaded parts with torque shown in Table 2.

Table 2. Recommended tightening torque of threaded parts

Model	Core B	Socket	Cross Recessed Pan Head Machine Screw with Washer
USB2・USG2 Metal body	10 to 22 N・m	—	—
USB3・USG3 Metal body	18 to 32 N・m	4 to 8 N・m	-
USB2・USG2 Resin body	-	-	0.27 to 0.33 N・m
USB3・USG3 Resin body	-	-	0.27 to 0.33 N・m

5. 2 Parts for Maintenance

(1) O ring

Replace when the valve leaks while use, or at disassembly and reassembly.

(2) Plunger Assembly, Spring

Replace when the valve shows abnormality such as leak or malfunction.

6. Troubleshooting

(1) If the solenoid valve does not operate as intended, check according to tables 3. and 4.

Table 3. Cause of malfunction and countermeasures for 2-port valves(Model: USB2, USB3)

State of failure	Cause	Countermeasure
Fluid does not flow	Valve is not energized.	Confirm wiring and fuse, then energize the valve.
	Voltage applied is lower than the allowable voltage range.	Confirm the power supply, and apply rated voltage.
	Applied fluid pressure is too high.	Set pressure within allowable range.
Fluid does not stop flowing	Wrong port is connected to the high pressure side.	Pipe correctly.
	Electricity is not shut off.	Check for leak of electricity. Modify the circuit to cut off electricity completely.
	Plunger does not move because foreign matter is caught in.	Disassemble and remove foreign matter.
Valve leaks externally	Abrasion or flaw of packing and O ring.	Replace parts.
	Core B is loose.	Tighten the Core B.
Valve leaks internally	The valve seat of the Body is worn or damaged.	Replace the product.
	Abrasion or flaw of the sealing side of the rubber parts.	Replace parts.
	Foreign matter caught in the valve seat.	Disassemble and remove foreign matter.

Table 4. Cause of malfunction and countermeasures for 3-port valves(Model: USG2, USG3)

State of failure	Cause	Countermeasure
Fluid does not flow	Valve is not energized.	Confirm wiring and fuse, then energize the valve.
	Voltage applied is lower than the allowable voltage range.	Confirm the power supply, and apply rated voltage.
	Applied fluid pressure is too high.	Set pressure within allowable range.
Fluid does not stop flowing	Wrong port is connected to the high pressure side.	Pipe correctly.
	Electricity is not shut off.	Check for leak of electricity. Modify the circuit to cut off electricity completely.
	Plunger does not move because foreign matter is caught in.	Disassemble and remove foreign matter.
Valve leaks externally	Abrasion or flaw of packing and O ring.	Replace parts.
	Core B or Socket is loose.	Tighten the Core B or Socket.
Valve leaks internally	The valve seat of the Body is worn or damaged.	Replace the product.
	Abrasion or flaw of the sealing side of the rubber parts.	Replace parts.
	Foreign matter caught in the valve seat.	Disassemble and remove foreign matter.

(2) Please contact CKD or your nearest agent for any unclear points.

7. Appropriate disposal

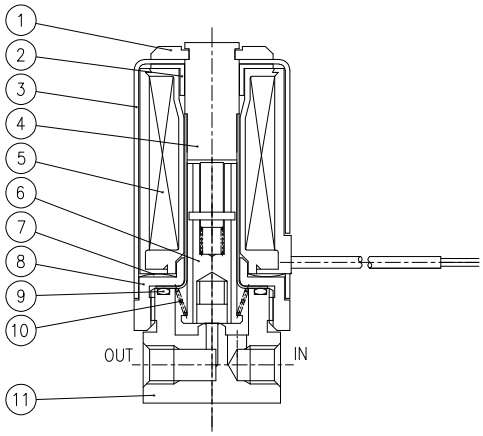
(1) When disposing this product, dispose this product as industrial waste.

(2) This valve series includes coil types that uses lead wires insulated by PVC covering. Do not burn this product at disposal, since deleterious chlorine gas emits when PVC is burned.

8. Internal construction

8. 1 Internal construction of the 2-port valve

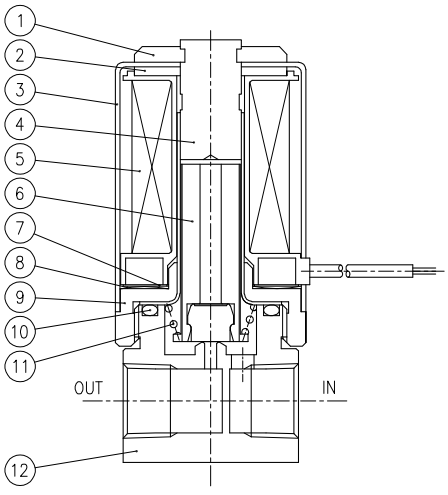
(1) Model: USB2 (Metal body)



No.	Part name	Remarks
①	Clip	
②	Auxiliary Core	
③	Bonnet	
④	Core Assembly	
⑤	Coil Assembly	
⑥	Plunger Assembly	Consumable part
⑦	Waving Washer	
⑧	Core B	
⑨	O ring	Consumable part
⑩	Spring	Consumable part
⑪	Body	

Note) Consumable parts kit is available for replacement.

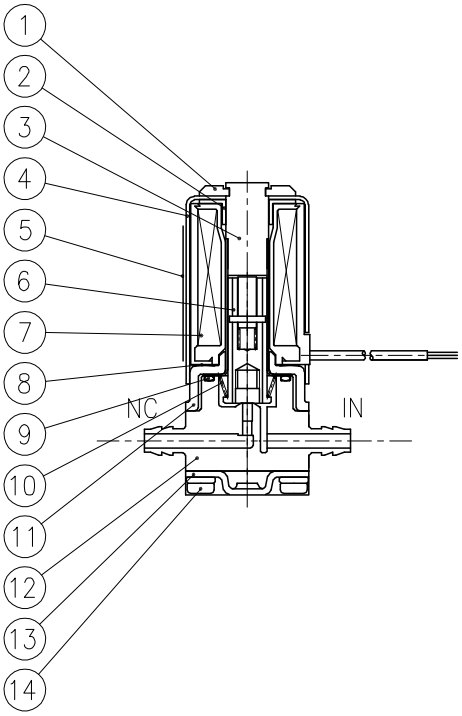
(2) Model: USB3 (Metal body)



No.	Part name	Remarks
①	Clip	
②	Bonnet Piece	
③	Bonnet	
④	Core Assembly	
⑤	Coil Assembly	
⑥	Plunger Assembly	Consumable part
⑦	Insulating Film	
⑧	Waving Washer	
⑨	Core B	
⑩	O ring	Consumable part
⑪	Spring	Consumable part
⑫	Body	

Note) Consumable parts kit is available for replacement.

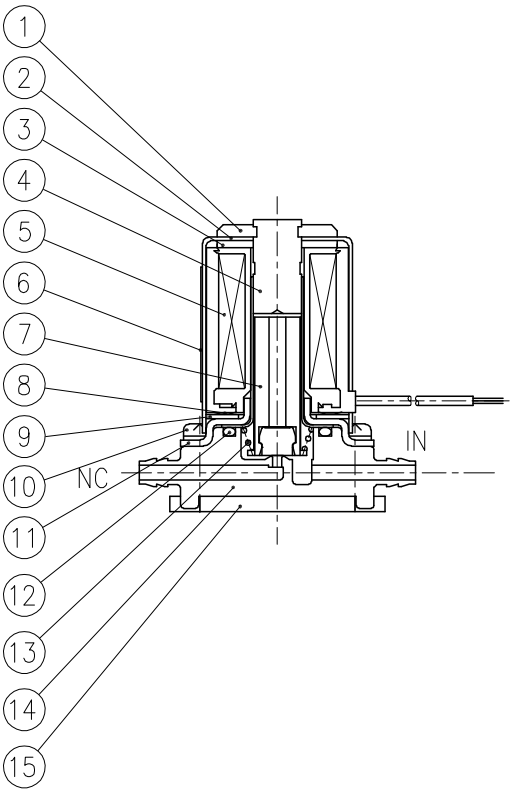
(3) Model : USB2 (Resin body)



No.	Part name	Remarks
①	Clip	
②	Auxiliary Core	
③	Core Assembly	
④	Bonnet	
⑤	Stamp Label	
⑥	Plunger Assembly	Consumable part
⑦	Coil Assembly	
⑧	Waving Washer	
⑨	O ring	Consumable part
⑩	Spring	Consumable part
⑪	Core B	
⑫	Body	
⑬	Body Holding Board	
⑭	Cross Recessed Pan Head Machine Screw with Washer	

Note) Consumable parts kit is available for replacement.

(4) Model : USB3 (Resin body)

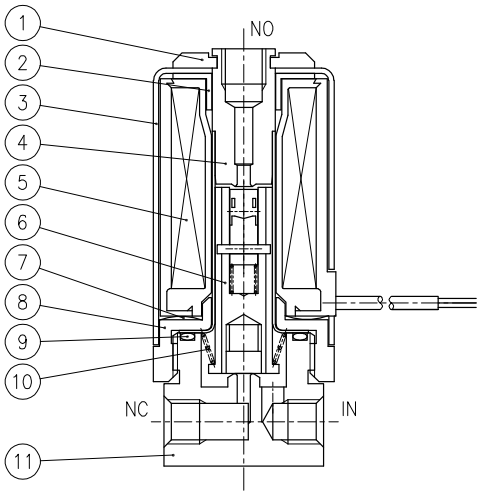


No.	Part name	Remarks
①	Clip	
②	Bonnet	
③	Bonnet Piece	
④	Core Assembly	
⑤	Coil Assembly	
⑥	Stamp Label	
⑦	Plunger Assembly	Consumable part
⑧	Waving Washer	
⑨	Auxiliary Core	
⑩	Cross Recessed Pan Head Machine Screw with Washer	
⑪	Core B	
⑫	O ring	Consumable part
⑬	Spring	Consumable part
⑭	Body	
⑮	Body Holding Board	

Note) Consumable parts kit is available for replacement.

8. 2 Internal construction of the 3-port valve

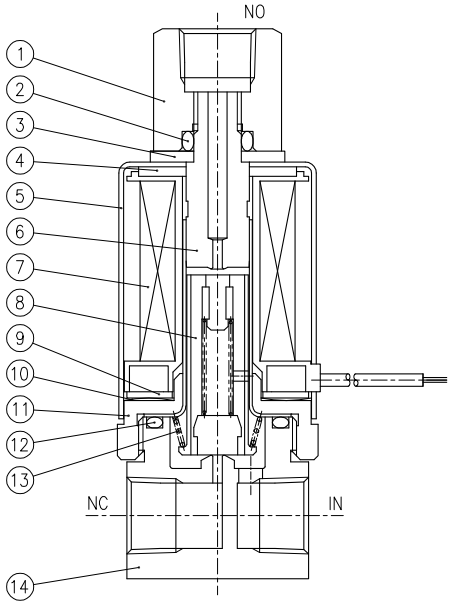
(1) Model: USG2 (Metal body)



No.	Part name	Remarks
①	Clip	
②	Auxiliary Core	
③	Bonnet	
④	Core Assembly	
⑤	Coil Assembly	
⑥	Plunger Assembly	Consumable part
⑦	Waving Washer	
⑧	Core B	
⑨	O ring	Consumable part
⑩	Spring	Consumable part
⑪	Body	

Note) Consumable parts kit is available for replacement.

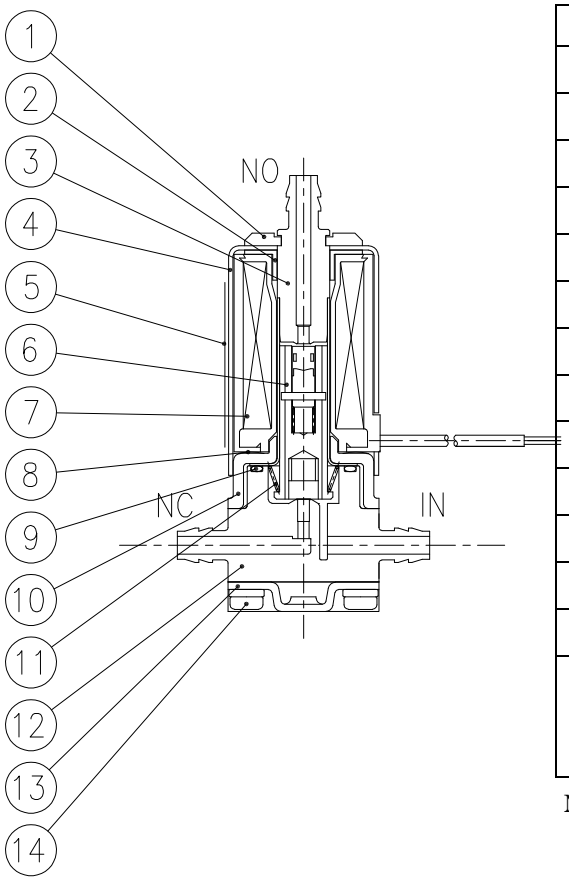
(2) Model: USG3 (Metal body)



No.	Part name	Remarks
①	Socket	
②	O ring	Consumable part
③	Washer	
④	Bonnet Piece	
⑤	Bonnet	
⑥	Core Assembly	
⑦	Coil Assembly	
⑧	Plunger Assembly	Consumable part
⑨	Insulating Film	
⑩	Waving Washer	
⑪	Core B	
⑫	O ring	Consumable part
⑬	Spring	Consumable part
⑭	Body	

Note) Consumable parts kit is available for replacement.

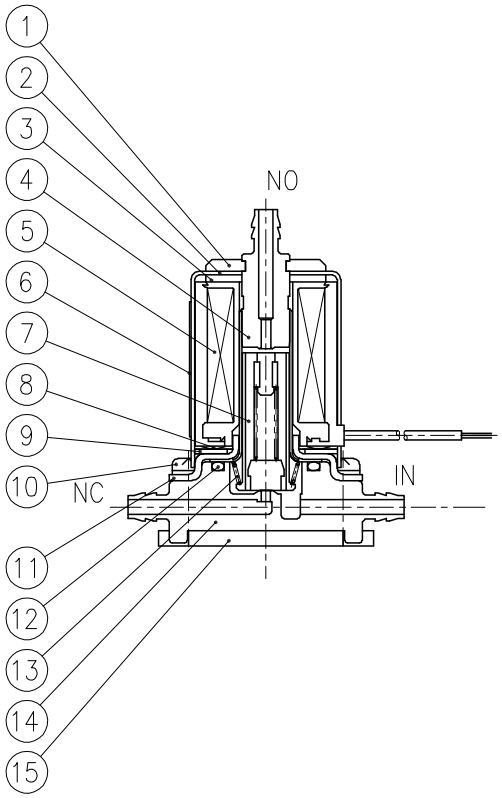
(3) Model: USG2 (Resin body)



No.	Part name	Remarks
①	Clip	
②	Auxiliary Core	
③	Core Assembly	
④	Bonnet	
⑤	Name Plate	
⑥	Plunger Assembly	Consumable part
⑦	Coil Assembly	
⑧	Waving Washer	
⑨	O ring	Consumable part
⑩	Core B	
⑪	Spring	
⑫	Body	
⑬	Body Holding Board	
⑭	Cross Recessed Pan Head Machine Screw with Washer	

Note) Consumable parts kit is available for replacement.

(4) Model: USG3 (Resin body)



No.	Part name	Remarks
①	Clip	
②	Bonnet	
③	Bonnet Piece	
④	Core Assembly	
⑤	Coil Assembly	
⑥	Name Plate	
⑦	Plunger Assembly	Consumable part
⑧	Waving Washer	
⑨	Auxiliary Core	
⑩	Cross Recessed Pan Head Machine Screw with Washer	
⑪	Core B	
⑫	O ring	Consumable part
⑬	Spring	Consumable part
⑭	Body	
⑮	Body Holding Board	

Note) Consumable parts kit is available for replacement.