CKD

Motorized proportional Control Ball Valve

MXBC2 Series

INSTRUCTION MANUAL

SM-50782-A/1

- Read this Instruction Manual before using the product.
- Read the safety notes carefully.
- Keep this Instruction Manual in a safe and convenient place for future reference.

CKD Corporation

PREFACE

Thank you for purchasing CKD's **"MXBC2 Series" motorized proportional control ball valve**.
This Instruction Manual contains basic matters such as installation and usage instructions in order to ensure optimal performance of the product. Please read this Instruction Manual thoroughly and use the product properly.
Keep this Instruction Manual in a safe place and be careful not to lose it.

Product specifications and appearances presented in this Instruction Manual are subject to change without notice.

- The product, which uses control valves such as solenoid valves, motor valves, and air operated valves, is intended for users who have basic knowledge about materials, fluids, piping, and electricity. CKD shall not be responsible for accidents caused by persons who selected or used the product without knowledge or sufficient training with respect to control valves.
- Since there are a wide variety of customer applications, it is impossible for CKD to be aware of all of them. Depending on the application or usage, the product may not be able to exercise its full performance or an accident may occur due to fluid, piping, or other conditions. It is the responsibility of the customer to check the product specifications and decide how the product shall be used in accordance with the application and usage.

SAFETY INFORMATION

When designing and manufacturing any device incorporating the product, the manufacturer has an obligation to ensure that the device is safe. To that end, make sure that the safety of the machine mechanism of the device, the pneumatic or water control circuit, and the electric system that controls such mechanism is ensured.

To ensure the safety of device design and control, observe organization standards, relevant laws and regulations, which include the following:

ISO 4414, JIS B 8370, JFPS 2008 (the latest edition of each standard), the High Pressure Gas Safety Act, the Industrial Safety and Health Act, other safety rules, organization standards, relevant laws and regulations

In order to use our products safely, it is important to select, use, handle, and maintain the products properly.
Observe the warnings and precautions described in this Instruction Manual to ensure device safety.

Although various safety measures have been adopted in the product, customer's improper handling may lead to an accident. To avoid this:

Thoroughly read and understand this Instruction Manual before using the product.

To explicitly indicate the severity and likelihood of a potential harm or damage, precautions are classified into three categories: "DANGER", "WARNING", and "CAUTION".

⚠ **DANGER**	Indicates an imminent hazard. Improper handling will cause death or serious injury to people.
⚠ **WARNING**	Indicates a potential hazard. Improper handling may cause death or serious injury to people.
⚠ **CAUTION**	Indicates a potential hazard. Improper handling may cause injury to people or damage to property.

Precautions classified as "CAUTION" may still lead to serious results depending on the situation.
All precautions are equally important and must be observed.

Other general precautions and tips on using the product are indicated by the following icon.

	Indicates general precautions and tips on using the product.

Precautions on Product Use

⚠ WARNING

The product must be handled by a qualified person who has extensive knowledge and experience.

The product is designed and manufactured as a device or part for general industrial machinery.

Use the product within the specifications.

The product must not be used beyond its specifications. Also, the product must not be modified and additional work on the product must not be performed.
The product is intended for use in devices or parts for general industrial machinery. It is not intended for use outdoors or in the conditions or environment listed below.

- In applications for nuclear power, railroad system, aviation, ship, vehicle, medical equipment, and equipment that directly touches beverage or food.
- For special applications that require safety including amusement equipment, emergency shut-off circuit, press machine, brake circuit, and safety measures.
- For applications where life or properties may be adversely affected and special safety measures are required.
  (Exception is made if the customer consults with CKD prior to use and understands the specifications of the product. However, even in that case, safety measures must be taken to avoid danger in case of a possible failure.)

Do not handle the product or remove pipes and devices until confirming safety.

- Inspect and service the machine and devices after confirming the safety of the entire system. Also, turn off the energy source (air supply or water supply) and power to the relevant facility. Release compressed air and fluid from the system and use extreme care to avoid water or electric leakage.
- Since there may be hot or live parts even after operation has stopped, use extreme care when handling the product or removing pipes and devices.
- When starting or restarting a machine or device that incorporates pneumatic components, make sure that a safety measure (such as a pop-out prevention mechanism) is in place and system safety is secured.

Precautions on Design and Selection

⚠ WARNING

Do not use the product as a valve for ensuring safety such as an emergency shut-off valve.
The product is not designed to be used as a valve for ensuring safety such as an emergency shut-off valve. If using the product for such a system, take appropriate measures in advance to secure safety.

The customer is responsible for checking the specifications of the product and the compatibility with the customer's system when selecting and handling devices.
Incorrect selection and handling of devices may cause problems not only with the product but also with the customer's system.

Precautions on Product Disposal

⚠ CAUTION

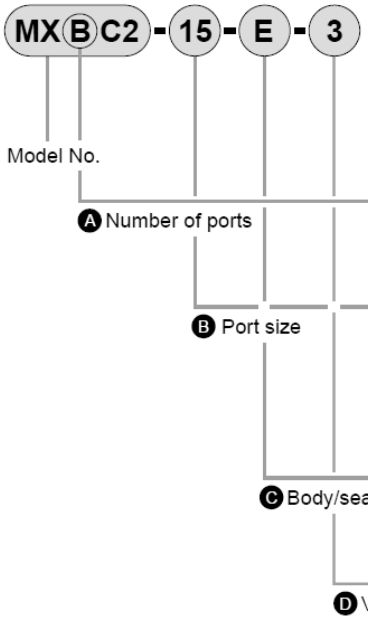
When disposing of the product, comply with laws pertaining to disposal and cleaning of wastes and have an industrial waste disposal company dispose of the product.

CONTENTS

1. PRODUCT OVERVIEW

1.1 Model Number Indication

How to order



Code	Content	Remarks
A Number of ports		
B	2-port	
B Port size		
10	Rc3/8	
15	Rc1/2	
20	Rc3/4	
25	Rc1	
C Body/seat material		
O	Body - bronze/seat - PTFE	
E	Body - stainless steel/seat - PTFE	
D Voltage		
3	24 VDC	

[Example of model No.]

MXBC2-15-E-3

Model: MXBC2

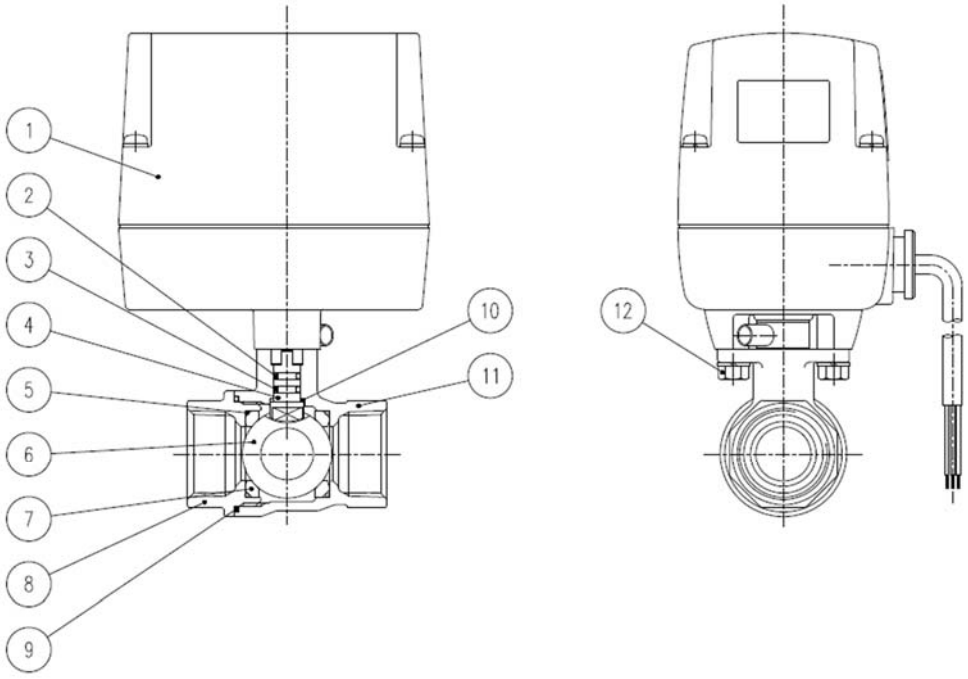
A Number of ports : 2-port valve
B Port size : Rc1/2
C Body/seat material : Body - stainless steel/valve seat - PTFE
D Voltage : 24 VDC

1.2 Specification

Model / Descriptions	MXBC2
Working fluid	Water
Working pressure MPa	0(=0 psi,0 bar) to 1.0 (=150 psi,10 bar)
Proof pressure (water pressure) MPa	2.0(=290 psi,20 bar)
Fluid temperature ℃	0(32°F) to 80 (176°F) (no freezing)
Ambient temperature ℃	-10(14°F) to 50(122°F)
Ambient humidity %	95 or less
Rated voltage	24V DC ±5 % (Ripple P-P 3% or less)
Current consumption (average) mA	750±100
Input signal	0 (4) to 20 mA DC, internal impedance 240 Ω
Resolution	1.3 % or less
Motor load hour rate	Active for 3 sec./off for 5 sec.

Item / Model	Port size	Orifice size (mm)	Cv	Weight (kg)
MXBC2-10	Rc3/8	10	10	2.0
MXBC2-15	Rc1/2	10	6	2.0
MXBC2-20	Rc3/4	15	16	2.2
MXBC2-25	Rc1	20	29	2.3

1.3 Internal structure



PartNo.	Parts name	Q'ty	Material
①	Actuater	1	
②	O-ring	1	NBR (FKM)
③	O-ring	1	FKM
④	Shaft	1	SUS303 (SUS304)
⑤	O-ring	2	FKM
⑥	Valve ball	1	C3771 +Chromium plated (SUS304)
⑦	Ball seat	2	PTFE
⑧	Cap	1	CAC408 (SCS13)
⑨	O-ring ※2	1	FKM
⑩	Spacer ※2	1	PTFE
⑪	Body	1	CAC408 (SCS13)
⑫	Hexagon bolt	2	SWCH

※1 : Materials shown in ( ) are for stainless steel body (E).

※2 : When the body material of the ball valve is bronze (0), there is not O-ring ⑨ and spacer ⑩.

1.4 Operation explanation

This motorized proportional control ball valve（ball valve）can change the opening of a ball valve according to signal inputs from outside.

・Necessary components（See example below）

When in use, the following three components are necessary:

① Motorized proportional control ball valve

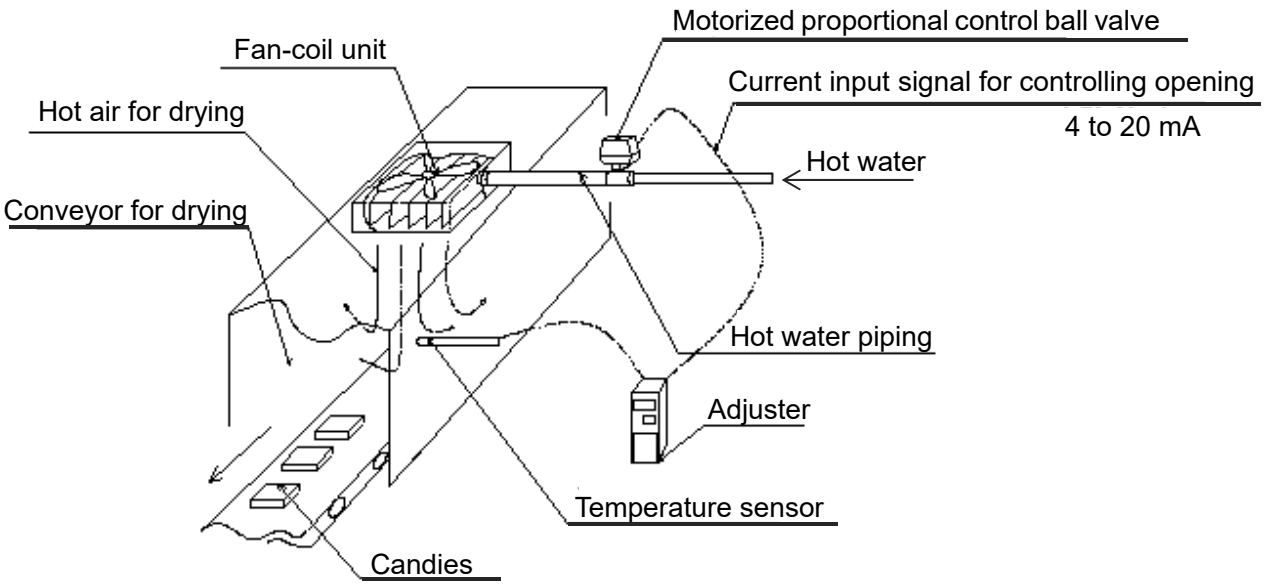
② Control section (Adjustment section) for example; temperature controller, adjuster, and computer.

③ Detecting section (Sensor) for example; temperature measuring resistor, thermocouple, and flow meter.

・Example of actual usage・・・Controlling confectionery drying process using hot water

In this process, the confectionery conveyed by a conveyor is dried using a dryer. Hot water flow rate that flows into the fan coil is controlled by the ball valve. That enables temperature control within the dryer. Confectionery is dried at the best temperature condition.

【Example actual usage】
For controlling confectionery drying with hot water.
Dryer for candies



2. INSTALLATION

2.1 Environment

⚠ WARNING

Consult CKD about the specifications before using the product outside the designated specifications or for special applications.

- If water or cutting oil splashes onto the ball valve directly, it may cause the malfunction.
- You may Install the product outdoors within the International protection rating IPX3 range. Nevertheless, avoid direct sunlight. Consider resin piping also to avoid damage by thunderbolts.

Always hold the body when handling or installing the product.

Do not pull or drop the lead wire.

Do not use this product in an environment in which corrosive gases or explosive gas could encroach the configuration materials.

If there is a risk of freezing, take measures such as draining and keeping warm.

Condensation may occur due to a change in the temperature.

⚠ CAUTION

Remove foreign matter such as dust in the piping.
Install a strainer(80 to 100 mesh) in front of the ball valve.

Secure the product when tightening or piping again.

When piping to the body side, fix the body, and when piping to the cap side, fix the cap.

Be careful not to overtighten the piping.

Refer to the table below for the recommended tightening torque.

- When using in a cold area, take proper measures against freezing.
- The product cannot be used outdoors.Protect the product by installing it inside a cover or a case.
- Do not use the product in an environment where the ball valve subject vibrations or inertia.

2.2 Unpacking

⚠ CAUTION

Do not remove the piping port protector and not take the product out of the plastic bag until just before piping.

If the piping port protector is removed or the product is taken out of the plastic bag before ready to begin piping, foreign matters may enter from the piping ports and cause a failure or malfunction.

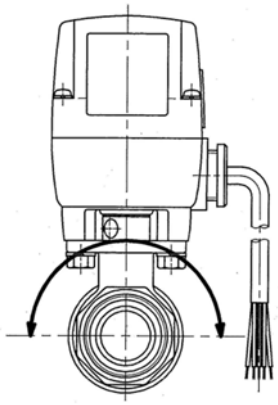
- Check that the model number ordered and the model number indicated on the product are the same.
- Check that the rated voltage is correct.
- Check the exterior of the product for any damage.
- When storing the product, keep it packaged in the individual package box to prevent foreign matters from entering the valve. Take it out of the box when ready begin piping.

2.3 Mounting

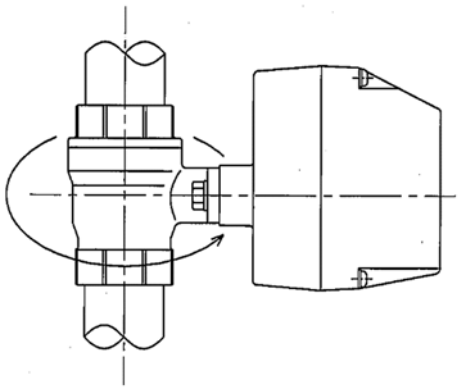
⚠ CAUTION

Thoroughly read and understand this Instruction Manual before mounting the product.
Hold the body firmly when handling and mounting the product.
Check for leakage from the pipes after mounting the product and confirm that the product has been mounted properly.

- Mounting posture should be within ±90° from the actuator section on the upper side.

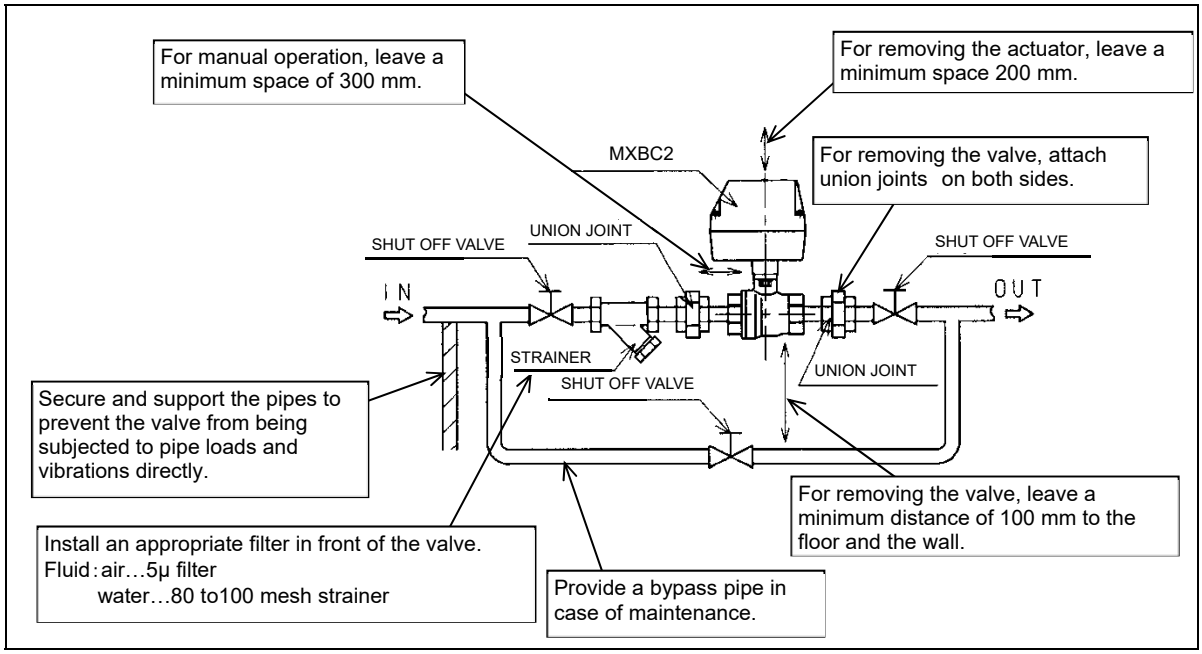


<HORIZON PIPING>



<VERTICAL PIPING>

- Secure sufficient space for working safely during maintenance and troubleshooting.



2.4 Piping

⚠ CAUTION

The manufacturer does not specify the direction to pressurize the ball valve connected to the pipe.

Do not apply force onto the actuator section when piping.

Secure the product when tightening or piping again.

Secure and support the pipes to prevent the valve from being subjected to pipe loads and vibrations directly.

Do not apply high pressure suddenly when supplying fluid for the first time after connecting the pipes.

If the pipes are not secured properly, it may lead to accidents such as a pipe disconnection or a fluid leakage.

■ Pipe cleaning

Before piping, flush wish air of more than 0.3 MPa to remove foreign matters such as dust, metal powder,rust,and seal tape.

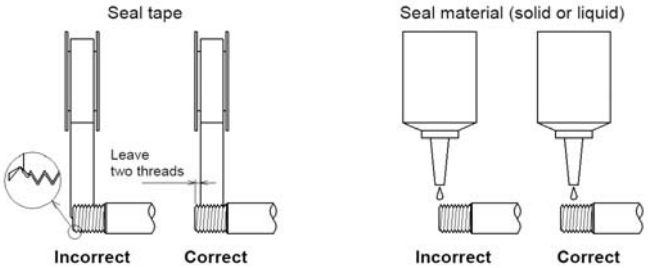
■ Removal of foreign matters

Remove foreign matters such as dust in the fluid to prevent causing an operation fault or leakage.
Install a strainer (80 to 100 mesh) in front of the ball valve.

■ Seal material

Apply a seal tape or seal material to the screw threads leaving two or more threads at the pipe end uncovered or uncoated. If the pipe end is fully covered or coated, a shred of seal tape or residue of seal material may enter inside of the valve and cause a failure.

When using a seal tape, wind it around the screw threads in the direction opposite from the screw threads and press it down with your fingers to attach it firmly.
When using a liquid seal material, be careful not to apply it to resin parts. The resin parts can become damaged and this may lead to a failure or malfunction.
Also, do not apply seal material to the internal threads.



■Tightening

- When piping to the valve, secure the cap or body with a wrench or vise.
- For the pipe tightening torque, refer to the following tables.

Recommended tightening torque

Pipe port size	Recommended tightening torque(N・m)
Rc 3/8	31 to 33
Rc 1/2	41 to 43
Rc 3/4	62 to 65
Rc 1	83 to 86

2.5 Wiring

⚠ WARNING

Thoroughly read and understand this Instruction Manual before working on electrical wiring.
The product must be handled by a person who understands the structure and operation principle of knowledge to secure the safety.

⚠ CAUTION

Check the power supply voltage is 24 V DC.

Check for leakage currents from external control devices to prevent a malfunction.

- ●Bad wiring of power lines result in short circuit accidents. Be sure to wire correctly.
- ●In order to prevent inductive disturbance, use shielded wire for input signal wiring and ensure earthing processing.
- ●Be sure to turn off the power before wiring.
  Before and during work, discharge the static electricity on the human body and tooling equipment and perform work.

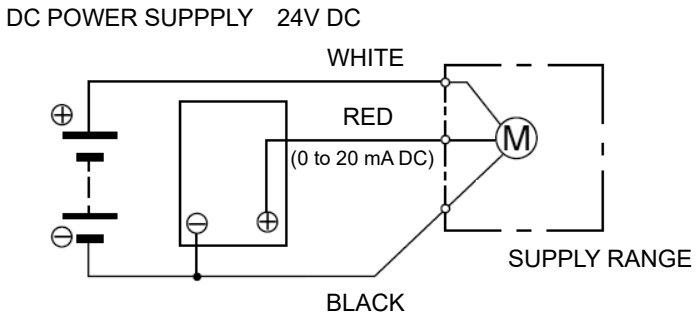
Note the following for power supply.

- ●Choose power supply with enough capacity (capacity around 50 W is recommended).
- ●Do not use a full-wave rectification circuit; it is affected by ripples or zero voltage. Use a stabilized power supply instead.
- ●Variation in power supply ultimately affects the ball valve opening; keep the power supply variation within 24 V DC ±5 %.
- ●Since this product consumes a large amount of current and uses a stepping motor, noise from rush currents and operating currents are inevitable. Therefore, use a noise filter when devices vulnerable to noise, such as computers, are connected to the same power supply.
- ●Use breakers such as fuses for the safety of the electric equipment.
- ●Use a wire of a cross-sectional area of around 0.5 mm^2.
- ●Depending on the wiring method, noise from peripheral devices affect this product. Note the following when wiring this product:
  (1) Use separate lines for the power supply and for signals. Locate them as far apart as possible from each other.
  (2) Do not wire collectively in a single duct.
  (3) Do not route wires near high frequency devices.

<About noise>

Noise cause unexpected problems.
Noise may cause problems such as malfunction and short service life, which affects overall control. Therefore, observe instructions given in several portions in this manual concerning noise countermeasures.

Wiring example



The following table summarizes the wiring method.

Contents of wiring work

Color of motor-operated valve cable.	How to wire.
WHITE	Connect the power supply +24V side.
BLACK	Connect the power supply 0 V (GND) side and control signal 0V (GND) side here.
RED	Connect the 0 (4) to 20 mA, control signal, positive side.

Fix the wiring so that lead wires are not tight.
Connection points should be securely connected and treated for insulation so as to avoid poor connection or poor insulation.

Protection of electric facilities
In order to protect electric facilities, use a circuit breaker such as a fuse in the control circuit.

Wiring of the lead wire type
Use wires with a nominal cross-sectional area of approximately 0.5 mm^2 or more.
In addition, do not subject the lead wires to an excessive force.

3. USAGE

WARNING

Do not use the product as a valve for ensuring safety such as an emergency shut-off valve.
The product is not designed to be used as a valve for ensuring safety such as an emergency shut-off valve. If using the product for such a system, take appropriate measures in advance to secure safety.

Take necessary measures for preventing people and properties from being affected by a failure of the product.

Do not use fluids other than those specified in the Specifications.
Check the compatibility with the working fluid by referring to the checklist of control fluids in the catalog.
If the quality of the working fluid is low, for example if it contains particulates, sludge, and foreign matter, the durability of the ball seat will be significantly reduced. If the ball seat seal performance is lost, the fluid cannot be controlled. Perform maintenance periodically or take proper measures.

Do not use in an explosive atmosphere.

For use in an explosive atmosphere, choose our explosion-proof solenoid valve series.

Fluid temperature

Use within the fluid temperature range listed in the specifications.

Ambient atmosphere

Do not use in a corrosive or component material eroding atmosphere.

Do not use near a heat generating object or in a place receiving radiant heat.

Use within the specified ambient temperature.

For use in cold locations, take appropriate measures to prevent freezing.

Do not touch electrical wiring connections (bare live parts) while the product is energized.
An electric shock may occur.

⚠ CAUTION

Use the product within the specified pressure range.

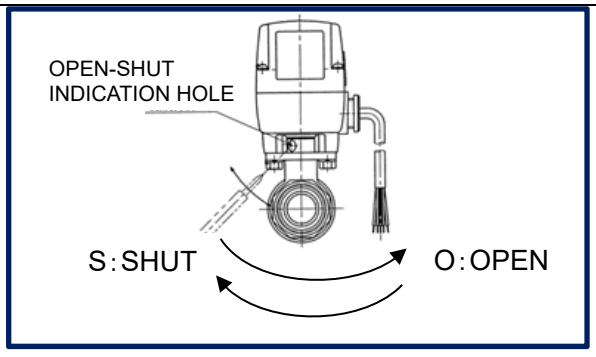
Do not touch the Hood during operation; The Hood is hot due to heat from the motor.
Do not remove the Hood; otherwise, there is a risk of electric shock and burns.

Never perform manual operation except in an emergency such as a power outage or failure.
For manual operation, follow the procedure below.

① Be sure to turn off the power.

② Insert a cross screwdriver (H2 type, No. 2) into the open / close display hole of the intermediate bush and gradually apply force.
Please turn slowly. Turn between S → O and O → S in about 20 seconds.

③ When turning, do not apply a large force suddenly. It may damage the gear.



3.1 Appearance check

⚠ WARNING

Close the main cock and discharge the fluid in the valve before performing an appearance check.

Turn off the power before checking the power and insulation resistance.
Be careful not to get an electric shock while checking.

■If the product is used beyond the voltage fluctuation range, an operation fault or damage to the coil may occur.

■Check the insulation resistance.
Measure the insulation resistance between a non-live metal part mounted to the solenoid valve and a bare live part such as a lead wire.
Check that the insulation resistance is 100 MΩ or more with 500 VDC megger.

■ Operation check

Apply the rated voltage and pressurize the working fluid to check if the solenoid valve performs opening and closing movement properly.

■Proportional control

Input signal

We specified the input signal, which controls the opening, between 4 to 20 mA.
Although the ball valve starts opening around 4 mA, the value is not accurate due to variation among individual products. So, regard the relationship between the input signal and the opening as shown below:

Input signal	Opening
0 mA	Fully closed position
20 mA	Wide open position

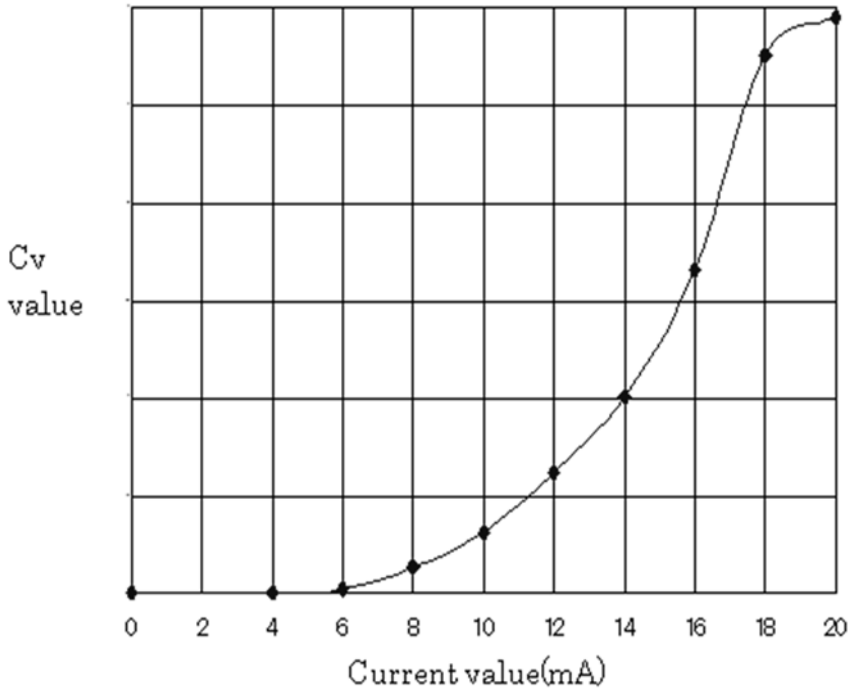
Since the internal impedance is around 240 ohms, voltage necessary to control is around 4.8 V (= 240 ohms x 0.02 A).

■PID control

Most commercially available adjusters have an auto-tuning function capable of PID control. This function provides the best current-carrying timing specifically matched for a control subject. Depending on the subject to control, frequent ball valve movements may be redundant. Auto-tuning eliminates those redundant movements, eliminating redundant energizing and to lowering operation frequency. Be sure to use an adjuster with PID, since PID control is necessary to elongate the durability of the product.

■**Relationship between the input signal and flow rate.**

The relationship between the input signal and the flow rate characteristic (Cv value) is as shown below.



〈Flow rate characteristic〉

However, the characteristic shown above is for reference the characteristic varies to some extent among individual products.

Additionally, portions in the characteristic curve where the valve is near the fully closed and fully open positions are not suitable for practical use. Flow rate differential per one step (minimum change of opening) is large near that portion.

Control will be stable if control is performed around half of the maximum Cv value.

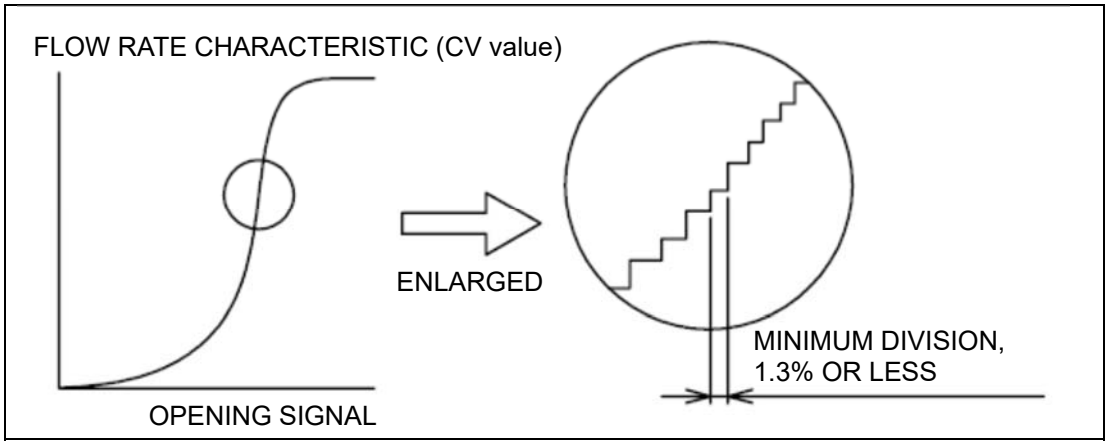
■Resolution.

①Resolution represents the number of divisions of the drive unit (rotation axis).
In the case of this product, the division number from the (Fully closed) to the wide open flow path position only when the input signal rises, or the division from the (Wide open) to the fully closed flow path position Indicates the number.
(1.3% indicates that the wide open channel range is divided 77 from fully closed.)
(It is not a division of the opening degree (flow rate) of the ball valve because it is the division number of the drive rotation axis.)

②When switching input signal from rising to falling, hysteresis occurs about 5 °.
(It is the same also when switching from input signal descent to rising)
Do not use near the edge of the flow path because hysteresis is large and accuracy can not be obtained.

③Regarding resolution, we have variations for each product. (It also has a difference depending on the direction of operation rotation.)
Please do not use it when high precision reproducibility, high precision compatibility for each product is required.

④For stable operation, please use a stable power supply voltage of 24V.
If the power supply voltage fluctuates from 24 V DC or is unstable, stable resolution can not be obtained.



〈Resolution〉

■Basics about electricity

・Consumed current

For this product, most current is consumed in the stepping motor.
The motor, like a coil, has an inductance, so the current and the voltage have different phases with respect to each other. The current does not follow the simple Ohm's law; the current is expressed with a peak value and an average value. While the average value is 750±100 mA, the instantaneous peak current is about 1200 mA (1.2 A). Therefore, we recommend using a stabilized power supply having capacity around 50 W.

・Current input signal

The opening is generally controlled between 4 mA and 20 mA.
The advantage of current control is that it is less affected with voltage noise and the transmission distance.
However, since proportionality between the start-of-opening position and the input signal is hard to establish for ball valves, the fully closed flow path position is set to zero mA.

・Input impedance

At the motor-operated valve side, the control signal is received as a current as described above. However, in the internal circuit, the signal is converted to voltage and processed using comparison operations.

The resistance value used in the conversion to voltage is called the input (internal) impedance. The impedance value of this product is 240 ohms. Therefore, the internal circuit controls voltage between 0.96 V and 4.8 V, calculated as the input current of 4 to 20 mA multiplied by the (internal) impedance of 240 ohms.

・System to be used

We recommend designing the entire system based on PID control rather than on-off control, which is free from redundant actions.

The on-off control results in small step actions, short actuator service life, and other troubles such as overheating of the electric motor.

■Items to be checked

・Internal leakage

The initial leak, 0 cm^3/min by water pressure increases with the lapse of service time. The amount varies widely depending on the angular range used, frequency and pressure, so that it is difficult to be specified. However, if a leak-free function is required, install a fluid flow stop valve in the piping.

・Service durability

The wear parts such as the sealability of the ball valve and the internal gear change greatly depending on the control method (operation frequency).

As an example, in stable operation such as stopping for 10 seconds after 1 second operation, use for around 1 to 1.5 years in a device operating for 8 hours is a standard. Please consider maintenance for long-term use.

・Variations among individual products

Flow rates vary among products that have the same model No., bore, and control signal setting. That is due to variations among individual products.

・Reproducibility (Repeatability).

Although the variation occurs among individual products as described above, for any single piece of the product, the resultant opening amount has reproducibility, without variation, for the same control signal vale. Although a difference occurs in the opening amount depending on the direction of action, opening or closing, repeated actions in one direction produce no difference.

・Controlling signal noise and Power line noise.

Minimize the control signal noise and power line noise as low as possible (For specific measures, see section 2.5).

Noise that come along with the current input control signal directly affects and changes the opening. It excessively increases the energizing frequency.

An excessive increase of the energizing frequency results in a shorter service life and a motor current shutoff by blow of the thermal fuse.

The same results described above applies for power line Noise.

・Generated noise.

The stepping motor rotating the ball valve consumes around 1 A current, which causes a voltage drop or noise in the power line.

To protect noise vulnerable devices such as computers, provide noise preventing means such as a noise filter.

・Voltage drop.

Since changes in the supply voltage are directly affects the opening amount, use a power source that have sufficient capacity (Use a commercially available switching power supply around 50 W).

・Using power from sequencers or the like.

The power source usually provided in sequencers is not suitable for use because capacity is small.

3.2 About actual use

⚠ CAUTION

●**Before installing the product in a system, check the following items during test run.**

Depending on the controlling method, performance may not meet your needs.

Be sure to run tests before installing the product, since it will be difficult to modify the entire system after starting the operation in many cases.

■Turning the power supply on and off

If on and off is controlled from the power source, use terminals, such as relays, that have a large capacity (terminals shall be rated 24 V DC or more, capacity 3 A or more). This is because power source conveys large current.

■Breaker capacity

Fuses and breakers must have a capacity around 5 A.

■Function of thermal protector

A thermal fuse protector protects the actuator motor from burning. The protector shuts the power off temporarily when any trouble occurs, when operation is too frequent, and when the motor is overheated, enabling the motor to cool down and resume operation. Activation of the thermal protector suggests some problems in the system; review the control method and check the ball valve for abnormalities, such as the presence of foreign matter.

■Operating frequency.

Be sure to check the product for the operating frequency, since it affects the durability and stability of the entire system.

To confirm the operating frequency, actually operate the product and watch the movement of the opening-closing indication hole.

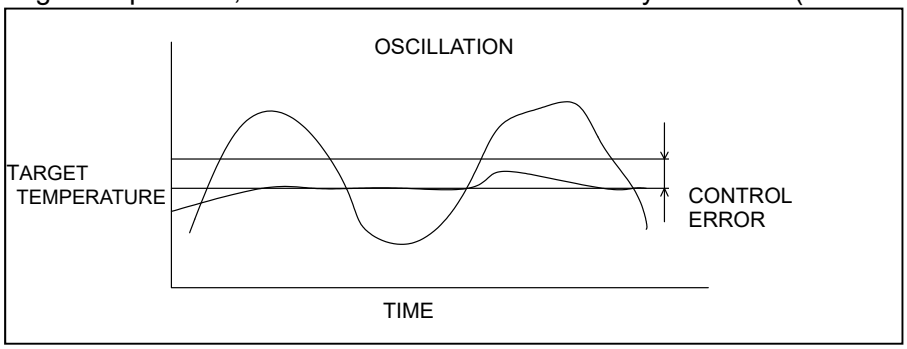
The table below lists precautions. The maximum energizing frequency: three seconds operation, five seconds stop. Observe this strictly. In particular, the ball valve will be energized continuously when the ball valve locks. Stop operation immediately, and remove the problem in such cases.

Note the following points:

Action	Judgment	Remarks
Operate for less than 2 seconds in 10 seconds.	Good	Ideal operation (There may be increase in error depending on conditions.)
The flow path switching operation is continuously performed.	Bad	Even if the control itself is stable and without errors, the frequent ball valve operation causes adverse effects. Revise the adjuster PID factor.

■Stability

By controlling the temperature, confirm the extent of errors with respect to the target temperature, and confirm whether there is any oscillation (fluctuation).



〈State of control〉

- When the actual control oscillates (fluctuates) with respect to the target temperature as shown the flow rate differential at the minimum resolution might be too high. Therefore, check the fluid flow rate and fluid temperature in addition to reviewing the adjuster PID constant.
- The control error results from the imbalance between the heat amount given and heat amount removed (release and absorption of heat). In such a case, check the fluid flow rate and fluid temperature.

■Accuracy

An error is the extent of deviation in temperature control with respect to a target temperature.
The deviation varies with the controlling method. Even with an almost ideal control, the best feasible accuracy will be around ±1 ℃ from the target temperature. Improving the accuracy inevitably requires increase in the operation frequency, resulting in adverse effects such as overheating, blow of the thermal fuse, and a shorter service life. Therefore, set the error range as wide as permissible.

■Examples of suitable and unsuitable controls.

・Suitable, stable control

Temperature control such as heating and cooling, where heat supplied and heat released to the atmosphere is balanced.

・Unsuitable, unstable control.

Precise control such as fine flow rate control and fine pressure control, where control will be unstable and there will be frequent energizing and operating.

■Controlling flow rate, pressure, and temperature

・Flow rate control

Since the resolution is 1.3 percent (about 77 divisions), the flow rate may change excessively in a single step of operation if the pressure is high.
Therefore, fine flow rate control is difficult to attain.

・Pressure control

As in flow rate control, the pressure may change excessively in a single step of operation. Therefore, fine pressure control is difficult to attain.

・Temperature control

Although what is actually controlled is flow rate, the intervening heat exchanger blurs the response to the operation steps. So, resolution has little effect on control.
Therefore, temperature control is the best usage for this product.

Control subject	Judgment	Remarks
Flow rate	Acceptable	Controllable if the pressure is 0.1 MPa or less.
Pressure	Acceptable	Controllable if the pressure is 0.1 MPa or less.
Temperature	Best	Most effective when combined with a temperature controller.

■Response time

Ball rotation torque is generated by the geared motor; the operation time from a fully closed flow path to a fully open flow path is 7 to 9 seconds. This response time must be noted when quick response is required as in the flow rate control. This response time should not be a problem for usage such as temperature control, where slow response is generally accepted.

■Control devices (Temperature controller, Adjuster)

Use of commercially available temperature controllers and adjusters can reduce the system cost while securing favorable functions.
Such temperature controllers have many functions including the automatic tuning function for the PID control, which makes the control efficient. Therefore, control devices are useful in designing a system smallest in size.

■Controlling from computers and microcomputers

When controlling from computers and microcomputers, do not introduce an on-off control to attain a target value; otherwise, service life is adversely affected since the valve will be energized frequently and continuously.

■Choosing sensors

When designing a control system, review the sensors to be used thoroughly.
The sensor characteristics may not be a big problem in temperature control.
However, sensor characteristics greatly affect flow rate control.
Do not use pulse type sensors, since they produce waves in signal values, and make control unstable.

Precautions during control, and items to confirm

■Control initial period

（1）Individual operation

・Correction of incorrect electric wiring is difficult after finishing the system piping. To avoid such a situation, check the wiring for correct control operation by applying current as soon as the wiring is over.

（2）Leakage

・Apply pressure to the working fluid, and check leakage from joints. Recommended checking method: apply soap water to joints, and apply 0.3 to 0.5 MPa air pressure. Bubbles will appear if there is any leakage.

（3）Initial operation

・If needed, check noise from the power line and the signal line with a synchroscope. Also, check whether the operation voltage drops under the allowable range.

・(When the ball valve locks frequently) When continuous energization state or fine motor rotation operation is continuous When the thermal protector is activated and the motor stops, the problem is immediately eliminated and normal operation is obtained Please use it at the frequency of being.

When adjuster and temperature contro-ller are used	Use instruments with an auto-tuning function. Tune while actual load is applied, and arrange an efficient control with less operation frequency (no redundant operation).
When computers and microcomputers are used	Integrate software for PID control in the program to compare target and detected values. (For details, refer to related literature)

4. MAINTENANCE AND INSPECTION

4.1 Periodic Inspection

■Maintenance and inspection

To maintain optimal product conditions, check for the following items at least once in six months.

■Operation

Even if the valve continues to work normally, some parts wear and degrade.
Check the following items:

Sound	Has the sound level increased? Has the sound become uneven?
Heat	Is the actuator surface hotter than 60 degrees Celsius?

Replace the actuator if problems above are found and operation is adversely affected.

■Internal leakage

For proportional flow rate controlled products, the Ball Seat tends to wear unevenly and leak earlier. If wear progresses, the actuator side will also be affected.
Check the internal leakage periodically.
If the leak is a few dozen cm3/min or more, replace the ball valve.

■Check whether the strainer is clogged.

5. TROUBLESHOOTING

5.1 Problems, Causes, and Solutions

If the product does not operate as intended, check the table below for a possible solution.

Problem	Cause	Solution
Valve does not operate.	Full-wave rectification circuit is used.	Change to stabilized power supply (50 W).
	Bad wiring.	Refer to the wiring diagram and check both motor valve side and control side.
	Insufficient power; Voltage drop.	Use power supply with sufficient capacity.
	Foreign matter in the ball valve. Valve seat stuck.	Replace the product.
	Thunderbolt damage, wrong voltage application, bad wiring.	Replace the product.
	Breaker has worked.	Remove the cause of breaker action and apply current again.
	Thermal protector has worked.	Change control method to avoid frequent operations.
	Actuator does not drive.	Replace the Actuator.
Cannot control fluid.	Foreign matter caught in the ball valve.	Replace the product.
	Worn valve seat.	Replace the product.
There is external leakage.	There are abrasions and scratches on O-ring.	Replace the product.
	Cap are loose.	Please retighten.
There is internal leakage.	There are abrasions and scratches on ball seat.	Replace the product.
	Foreign matters are stuck in main valve body.	Clean the inside of the valve.
Unstable operation.	Incorrect PID constant of adjuster.	Set a correct constant for the control subject by auto-tuning.
	Noise in control signal, power line, and from valve.	Use a noise filter.
Large error.	Poor heat radiation, or poor heat absorption.	Correct flow rate and temperature.

If you have any other questions or concerns, contact your nearest CKD sales office or distributor.

6. WARRANTY PROVISIONS

6.1 Warranty Conditions

■ Warranty coverage

If the product specified herein fails for reasons attributable to CKD within the warranty period specified below, CKD will promptly provide a replacement for the faulty product or a part thereof or repair the faulty product at one of CKD's facilities free of charge.
However, following failures are excluded from this warranty:

- Failure caused by handling or use of the product under conditions and in environments not conforming to those stated in the catalog, the Specifications, or this Instruction Manual.
- Failure caused by incorrect use such as careless handling or improper management.
- Failure not caused by the product.
- Failure caused by use not intended for the product.
- Failure caused by modifications/alterations or repairs not carried out by CKD.
- Failure that could have been avoided if the customer's machinery or device, into which the product is incorporated, had functions and structures generally provided in the industry.
- Failure caused by reasons unforeseen at the level of technology available at the time of delivery.
- Failure caused by acts of nature and disasters beyond control of CKD.

The warranty stated herein covers only the delivered product itself. Any loss or damage induced by failure of the delivered product is excluded from this warranty.

■ Confirmation of product compatibility

It is the responsibility of the customer to confirm compatibility of the product with any system, machinery, or device used by the customer.

■ Others

The terms and conditions of this warranty stipulate basic matters.
When the terms and conditions of the warranty described in individual specification drawings or the Specifications are different from those of this warranty, the specification drawings or the Specifications shall have a higher priority.

6.2 Warranty Period

The product is warranted for one (1) year from the date of delivery to the location specified by the customer.