CKD

Active Fine Buffer

AFB-RB Series

INSTRUCTION MANUAL

SM-A05706-A

- 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 **"AFB-RB Series" active fine buffer**. 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 is intended for users who have basic knowledge about materials, piping, electricity, and mechanisms of pneumatic components. CKD shall not be responsible for accidents caused by persons who selected or used the product without knowledge or sufficient training.
- 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 fluid 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 (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.

When using the product for equipment that has great influence on society and on public, take safety measures to protect the equipment in case the motor stops.

Install an emergency stop device or provide an emergency stop circuit so that equipment failures and malfunctions do not adversely affect people and things.

Check the compatibility between the wetted part materials and the working fluid before use.

Observe the ambient temperature described in the Specifications.

Observe the working pressure described in the Specifications.

Use the product within the rated voltage range and the rated current range.

Use compressed air (equivalent to JIS B 8392-1: 2003*) that does not contain solid foreign matters.
Air of poor quality may adversely affect the product characteristics and lead to lower durability.
* Maximum number of solid particles per m^3 by size: 100 of 0.1 ≤ µm <0.5,
1 of 0.5 ≤ µm <1.0,
0 of 1 ≤ µm.

Pressure dew point: + 3 °C or less
Oil concentration: 0.1 mg/m^3 or less

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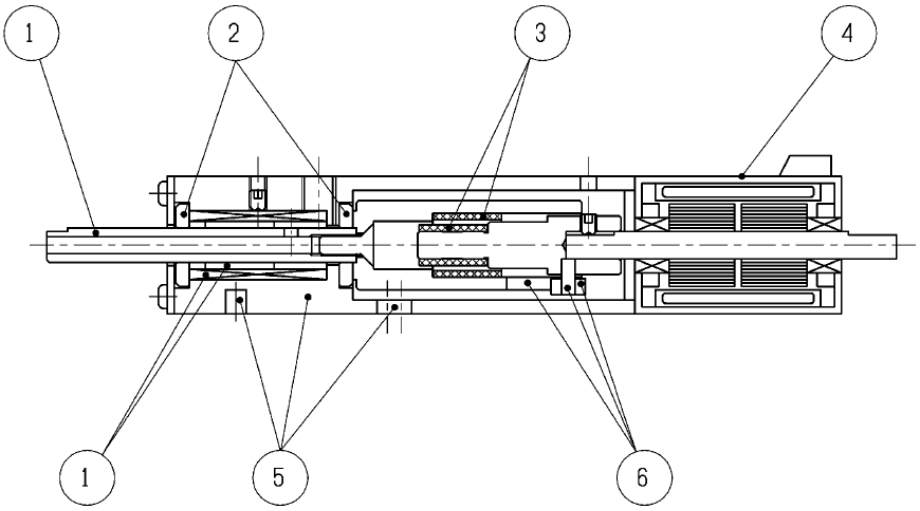
1. PRODUCT OVERVIEW

1.1 Product Features

This product is an actuator that picks and holds a workpiece such as a chip component by vacuum suction, performs θ alignment, and places the workpiece. Features include the following:

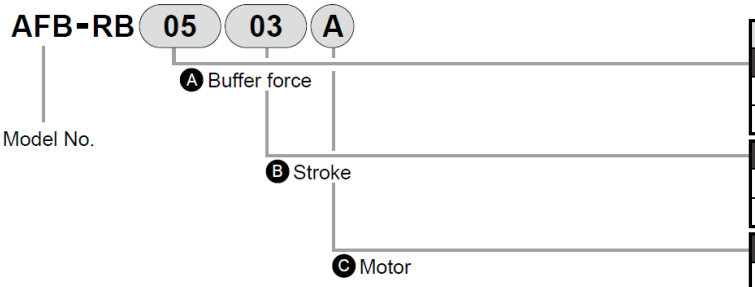
- The product is intended for use in the transfer and mounting of small workpieces such as chip components.
- The pressing force is constant regardless of stroke length since magnetic springs are used.
- This product has low dust generation, long service life, and high performance compared to a product that uses metal springs.
- The built-in ball guide bushing suppresses axial runout due to rotation to a minimum (0.01 mm or less).
- The built-in rotation prevention mechanism prevents loss of synchronization due to overload, which is a phenomenon that is characteristic of magnetic springs.
- Piping and mounting can be done from front surface of the body, ensuring easy handling.
- The product is dimensioned to fit the small motor (20 mm wide) snugly and thus is space saving.

1.2 Part Name



No.	Name	Description
1	Shaft	The shaft end is D-shaped so that a jig can be attached. There is a ball guide bushing in the front part of the body to suppress axial runout of the shaft during rotation.
2	Seal bushing	Since the seal bushings are clearance seals, the shaft can rotate and buffer without any influence. The degree of vacuum suction for holding the workpiece is maintained at the shaft end.
3	Ring magnet	Same magnet is used in CKD's FBU Series. It generates buffer force.
4	Stepping motor	The 2-phase or 5-phase motor manufactured by Oriental Motor Co., Ltd. or the 2-phase motor manufactured by MinebeaMitsumi Inc. can be selected.
5	Body	An aluminum material is used for weight reduction. The mounting surface has a ϕ3 hole and a 3x5 slotted hole for positioning.
6	Pin for preventing loss of synchronization	This is a mechanism for preventing the magnetic springs from losing synchronization during alignment. A small ball bearing rolls along the guide groove so that there is no sliding resistance during buffering.

1.3 Model Number Indication



Symbol	Descriptions
A Buffer force (N)	
05	0.5
10	1.0
B Stroke (mm)	
03	3
06	6
C Motor (manufacturer/type/model No.)	
A	Oriental Motor's 2-phase stepping motor (Motor Model No.: PKP213D05)
B	Oriental Motor's 5-phase stepping motor (Motor Model No.: PK513PB)
C	MinebeaMitsumi's 2-phase stepping motor (Motor Model No.: 08PM-K049BSTDCN)

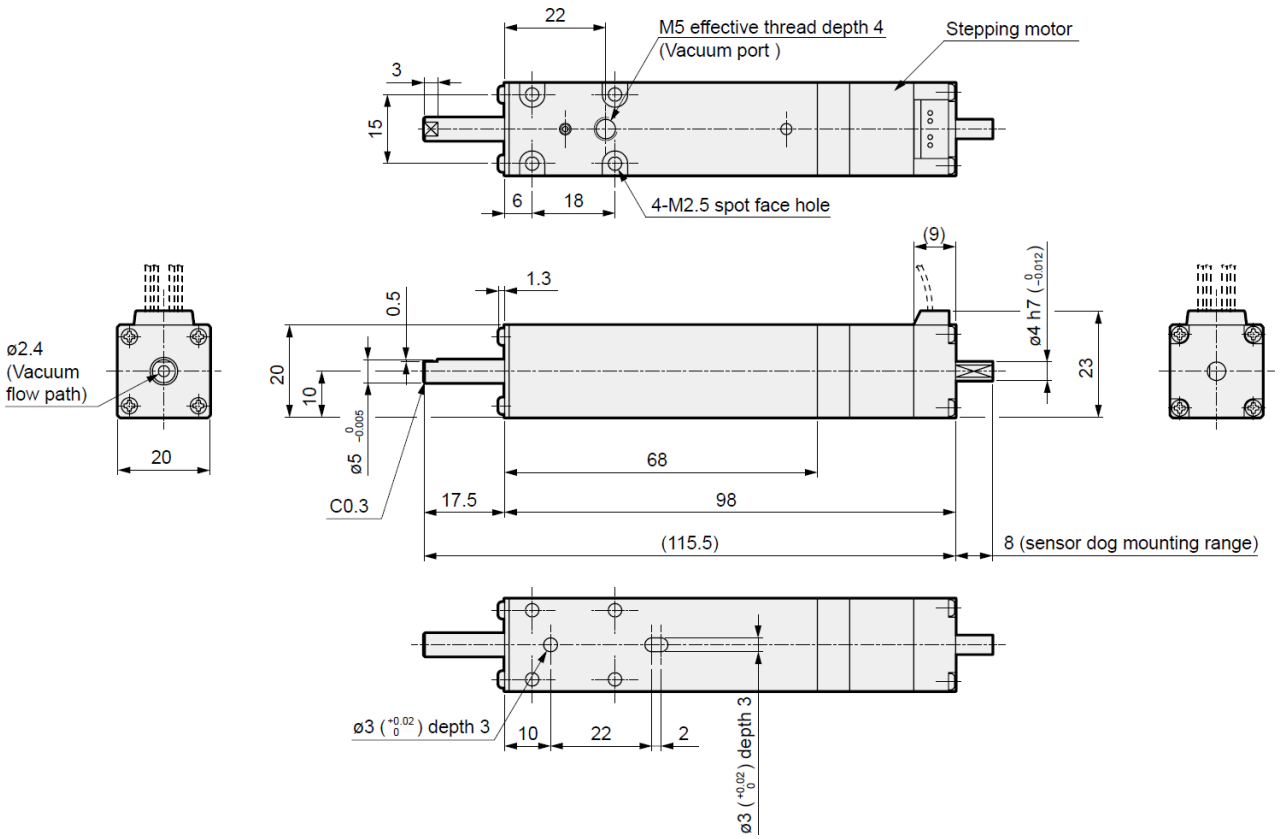
Although the motor is a special order model number for AFB-RB, refer to the above model number to check motor specifications.

1.4 Specifications

Item / Model			AFB-RB
Buffer force		N	0.5 ± 0.2, 1.0 ± 0.2 (selectable)
Buffer force fluctuation Note 1			±15% or less
Stroke length		mm	3, 6 (selectable)
Ambient temperature		°C	10 to 40
Storage ambient temperature		°C	0 to 50 (no condensation)
Rotation runout		mm	0.01
Repeatability Note 2	X, Y	mm	± 0.01
	Z	mm	±0.02
	θ	°	±0.2
Product weight		g	Approximately 120
Mounting orientation Note3			Shaft facing downward
Load capacity		g	50 or less
Moment of inertia of load		kg·m^2	2.45 x 10^{-6} or less
Weight of movable section		g	21
Moment of inertia of movable section		kg·m^2	4.56×10^{-7}
Operating rotational speed		rpm	100 or less

Note 1: This is the fluctuation of the buffer force during stroke operation. It does not indicate that the buffer force is proportional to the stroke length.
Note 2: Repeatability indicates the position to which the shaft returns after buffering.
Note 3: Buffer force takes into consideration the weight of the movable section when the product is used facing downward.
* Holding torque depends on motor specifications.

1.5 Dimensions



1.6 Description of Operation

- The shaft rotates synchronously with the rotation of the stepping motor.
  (The motor driver, controller, and DC power supply for driving the stepping motor are not supplied with the product. They are to be supplied, wired, and controlled by the customer.)
- The shaft has a through hole that leads to the M5 (vacuum port) on the front surface of the body and the workpiece can be held at the shaft end by vacuum suction. This allows the shaft to rotate and buffer while holding the workpiece.
- Applying slight amount of pressure to the vacuum port will allow the workpiece to be released smoothly. Adjust the amount of pressure to apply in accordance with the workpiece weight. Do not apply more than 50 kPa and do not pressurize continuously.
- The pin for preventing loss of synchronization is placed between the fixed shaft and the movable shaft and prevents an external force from rotating the movable shaft. A small ball bearing is press-fitted and bonded to the pin in order to prevent the influence of friction due to rubbing during buffering.
- The shaft can stack workpieces and then press them. The shaft and the movable shaft are structured so that the load is not directly applied to the motor shaft. The press load should not exceed 50 N (about 5 kgf) and the product must not be subjected to impact load.

2. INSTALLATION

⚠ WARNING

Make sure that a qualified person (who fully understands the system and has read this Instruction Manual thoroughly) performs Installation, piping, and wiring.

Incorrect installation and piping may cause problems not only with the product but also with the customer's system and may result in death or serious injury to the user.

⚠ CAUTION

Do not use the product if it may have been dropped or subjected to strong external force.

Install a protection circuit such as a thermal fuse in case of damage to the motor or failure of the circuit.

2.1 Environment

⚠ WARNING

Consider measures for dissipating heat generated from the motor.

Appropriate ventilation or heat dissipation measures must be considered if the product is installed in a control board or needs to be energized for a long period.

- When using the product in cold climates, take proper measures against freezing.
- The product cannot be used outdoors. Protect the product by installing it inside a cover or a case.
- Install the product on a smooth and flat surface with a flatness of 0.01 mm or less.
- Secure sufficient space for working safely during maintenance and troubleshooting.

Do not use the product in an environment where:

- Fluids such as water can splash onto the product
- Condensation can occur due to high humidity and temperature change
- Atmosphere contains explosive gas, inflammable gas, corrosive gas, or solvents
- Atmosphere contains magnetic cutting chips or dust
- There is a heat source in the surrounding area and heat is radiated
- Strong magnetism occurs nearby
- Inflammable materials are nearby
- The product is subjected to vibrations and inertia

2.2 Unpacking

⚠ CAUTION

Unpack the product in a clean and dust-free environment just before installation.
If the product is taken out of the plastic bag before ready to begin installation, foreign matters may enter the product and cause a failure or malfunction.

Do not store the product where water can splash, condensation may occur, or atmosphere contains corrosive gas or fluids.

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

2.3 Mounting

⚠ CAUTION

Hold the body firmly when handling and mounting the product.

Do not put your fingers or objects into the opening of the product.

Do not apply unnecessary force to the shaft, built-in elements, and the motor when attaching a jig to the shaft.

Check for leakage from the pipes after mounting the product and confirm that the product has been mounted properly.

Wipe the mounting surface with ethanol.
Dust and foreign matters may enter and jam the product.

- Mount the product vertically and facing downward.
  The load applied to the workpiece is the total of buffer force and jig weight.
- Mount the product using the counterbore holes for M2.5 provided on the front surface of the body.
  Tighten the hexagon socket head bolts with a tightening torque of 0.4 N·m ± 0.04 N·m.
- There is a ϕ3 hole and a 3x5 slotted hole on the back surface of the body where knock pins can be inserted for positioning. Since the slotted hole is connected to the inside of the product, do not insert pins with a length of 3 mm or more or a diameter of 3 mm or less. Make sure the pin does not come off and enter the inside of the product.

2.4 Piping

⚠ CAUTION

Do not apply stress such as bending, tension, and compression to the body when piping.

Align the length of the tubes so that they are not bent when connecting.
Bent tubes may cause operation faults.

Check that there are no defects such as dust, scratches, and burrs on the seal before tightening the fitting.

Use pipes that are made of corrosion-resistant materials such as nylon tubes and rubber tubes.

Blow air into the pipes to clean the interior and to remove cutting chips and foreign matters before piping.

2.5 Wiring

⚠ WARNING

Turn off the power before wiring.

Do not touch the motor and the actuator while the product is energized.

Do not touch conductive parts such as connection terminals while the product is energized.

For the motor, use a DC power supply with reinforced insulation on its primary and secondary sides.

⚠ CAUTION

Use the motor and the driver in the appropriate combination.

Take proper measures against static electricity when installing the product.
The motor may become damaged due to static electricity.

Do not hold the lead wires when carrying the product.

Do not bend, pull, or pinch the lead wires.

Make sure the motor rotates in the right direction after wiring.

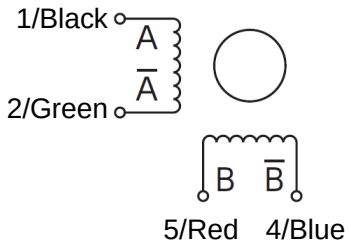
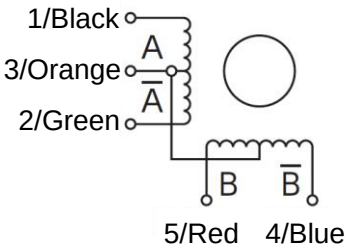
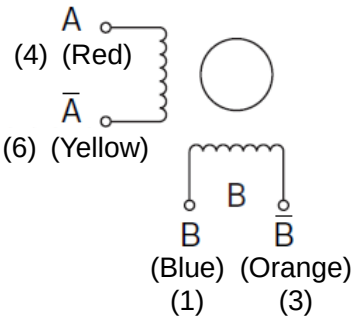
Connect and disconnect the connector by holding the housing so as not to apply force to the lead wires and the terminal.

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.

2.5.1 Motor

Connect the motor according to one of the following diagrams.

2-phase motor manufactured by Oriental Motor	5-phase motor manufactured by Oriental Motor	2-phase motor manufactured by MinebeaMitsumi
Motor model no.: PKP213D05	Motor model no.: PK513PB	Motor model no.: 08PM-K049BSTDCN
		

* The color next to the number indicates the color of the motor lead wire.

- The wiring of the 2-phase motor manufactured by Oriental Motor is drawn out directly from the motor.
- For the 5-phase motor manufactured by Oriental Motor and the 2-phase motor by MinebeaMitsumi, the connection cable must be supplied and wired by the customer.
- For more details and safety instructions concerning the motor, check the latest information on the motor manufacturer's website.
- The motors are double shaft type. The sensor dog or the encoder can be attached to the tail end of the motor shaft.

3. USAGE

3.1 Safety Instructions

⚠ WARNING

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

Turn off the power before moving the product.

Turn off the power when power outage occurs.

⚠ CAUTION

Carry out a test operation before starting an operation if the product has been left unused for a long period.

Do not touch the product during or immediately after operation.

Do not touch the rotating part (the output shaft) during operation.

If an abnormality occurs, immediately stop using the product and turn off the power.

Check for noise and vibrations after mounting the product to the device.
Noise and vibrations may shorten the service life of the product.

Be careful not to let the motor temperature exceed 80 °C after mounting to the device.

Take safety measures, such as designing the device so that the product cannot be touched or attaching a label that warns of hot surface, if the product can become hot.

Do not use external force to move the shaft (the motor shaft) and do not use the product in an application that involves sudden deceleration.

Leave a margin for the load capacity and the operating speed since the product life changes depending on the load capacity, the operating speed, and the environment.

Do not apply any shock to the product from the outside.

Do not damage, pinch, or apply unnecessary tension to the wiring and piping.

Verify the operational takt time and take measures that adjust the timing just before placing the workpiece at the target location.
Depending on the acceleration at which the product descends, force of inertia that exceeds the total of buffer force and jig weight is generated and it may cause the product to operate unintentionally.

Check how the product will be affected before using it in an application where it is moved laterally or vertically at high-G.
The acceleration should not exceed 4G when transferring the workpiece.

3.1.1 Jig

⚠ CAUTION

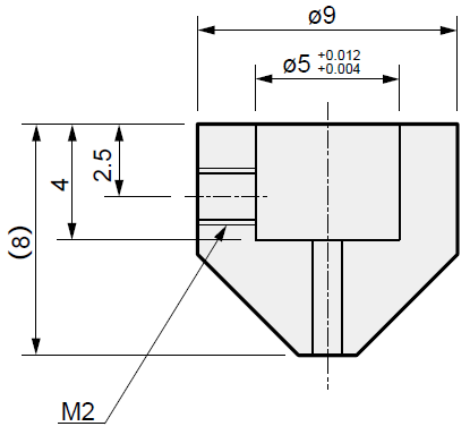
Make sure that the total weight of the jig and the workpiece is within the specifications.
The product may not operate properly when a jig that exceeds the specified weight is attached.

Attach a jig that is balanced and non-eccentric to the shaft.
If the jig is not balanced, the product may not operate properly. It is recommended to use an axisymmetric jig so that the moment of force is not generated during rotation.

Do not apply excessive torque and force to the shaft and the motor shaft when attaching a jig to the shaft end.

Set the moment of inertia of the jig to 2.45 x 10^{-6} kg·m^2 or less.
(Size: ϕ20 x L20; specific gravity: equivalent to iron or stainless steel)

Refer to the figure below when making a jig for attaching to the shaft end.



4. MAINTENANCE AND INSPECTION

⚠ DANGER

Do not disassemble or modify the product.
Disassembling the product will void the warranty.

⚠ WARNING

Secure sufficient space for maintenance and inspection.

Thoroughly read and understand this Instruction Manual before maintenance and inspection.

Turn off the power before maintenance and inspection.

⚠ CAUTION

Plan and conduct daily and periodic inspections so that maintenance can be managed properly.
If maintenance is not properly managed, the product's functions may deteriorate significantly and this may lead to faults (such as short service life, damage, and malfunction) or accidents.

Do not remove the nameplate from the product or erase the printed nameplate contents with organic solvents.

Do not paint the product or clean it with water or solvent.

4.1 Periodic Inspection

In order to use the product under optimum conditions, perform the following periodic inspections once or twice a month.

- Check that the AFB mounting screws and motor mounting screws are not loose.
- Check that there are no abnormal sounds while the product is stopped or operated.
- Check that there are no scratches and abnormal tension on the lead wires and piping tubes.
- Check that there are no scratches and dents on the shaft.
- Check that the power supply voltage is normal.

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
Product does not buffer smoothly.	Lateral load is applied to shaft.	Remove the lateral load.
	Shaft is bent due to external shock load.	Contact your dealer.
	Foreign matters are present in ball guide bush.	Contact your dealer.
Buffer force is unstable.	Foreign matters are present in ball guide bush.	Contact your dealer.
	Mounting screws are loose.	Retighten the screws.
Vacuum suction cannot be performed.	Foreign matters are clogged in hollow hole of shaft.	Contact your dealer.
	Fittings and pipes are loose.	Check the connection of the fittings and the pipes.
Shaft rotation is unstable. Loss of synchronization occurs.	Load attached to shaft is heavy (50 g or more). Jig attached to shaft is eccentric.	Inspect and correct the jig attached to the shaft end.
	Movable shaft and connection thread are loose.	Contact your dealer.
Shaft does not rotate. Motor does not energize.	There is connection failure or disconnection of power supply and motor lead wires.	Check the wiring and the power supply.

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.