



TSUBAKI

POWER CYLINDER

< Eco Series CDS Type >

(LPE025HT·LPE025HK)

(LPE050LT·LPE050LK)

(LPE050HT·LPE050HK)

(LPE100LT·LPE100LK)

Instruction manual

Attention

Make sure that this instruction manual is delivered
to the final user who uses this product.

TSUBAKIMOTO CHAIN CO.

TSUBAKI POWER CYLINDER Eco series CDS Type

Safety Precaution

- You must read this instruction manual and other attached documents prior to use (installation, operation, maintenance, inspection, etc). Understand the equipment and read all instructions thoroughly before installing or operating.
- Keep this manual visible to all users
- Safety precautions in this manual are classified into two categories, “WARNING” and “CAUTION”. These are defined as follows:

	WARNING	Death or serious injury may result from misusing the product without following the instructions.
	CAUTION	Minor or moderate injury, as well as damage to the product may result from misusing the product without following the instructions.

Notice that under “CAUTION” lead to serious results depending on the surrounding situation. Therefore, this section is just as significant as the other, and requires much attention.

 WARNING
<p>< General ></p> <ul style="list-style-type: none"> • Do not handle POWER CYLINDER under live-wire condition. Before starting work, switch off the power supply, otherwise electrical shock may occur. • Transporting, installing, wiring, operating, maintaining and inspecting must be carried out by skilled and professional engineers, to avoid mis-handling, resulting in hazardous situations. • When using with an equipment for transporting human, install a suitable protection device on that equipment for safety purposes. Otherwise an accident resulting in death, injury or damage to the equipment may occur due to accidental falling. • Keep the brake free from water or oil. Weak brake torque may cause accidents such as falling and malfunctioning of the product. • Do not use the POWER CYLINDER in an explosive atmosphere. Explosion, ignition, fire, electrical shock, or damage to the equipment may occur. <p>< Transportation ></p> <ul style="list-style-type: none"> • Do not stand under the product when it is lifted for transportation, otherwise the product may fall and result in death or serious injury. <p>< Wiring ></p> <ul style="list-style-type: none"> • If you do not connect the power cable according to the wiring diagram shown in the terminal or this instruction manual, electrical shock or fire may occur. (In case of no terminal box, insulate terminals completely.) • Do not operate the POWER CYLINDER without the cover of the terminal box. After wiring, fit the cover of the terminal box in place. Failure to do so may result in an electric shock. • Do not bend, pull or pinch the power cable or motor lead wires, otherwise electrical shock may occur. • Make sure you ground the earth terminal to avoid electrical shocks.

< Operation >

- Always supply power as specified on the nameplate, otherwise burnout or fire may occur.
- Do not stand by or touch any rotating portion (manual shaft, etc.) and rod during operation, otherwise injury may occur.
- In case of power failure, make sure the power is off. Otherwise power may come back suddenly and injure a person or damage the equipment.

< Maintenance and safety check >

- When inspecting the product during operation, do not approach or touch any rotating portion(manual shaft, etc.) and rod, otherwise accidents resulting in death or injury may occur.
- When performing an internal inspection, make sure that the motor and all the gears are stopped, and that the inside of the machine is cool enough and well ventilated.
- Set personnel outside of the product to supervise and support the person inspecting inside.
- Internal parts are well lubricated. You must take safety measures to prevent accidents such as slipping.
- Do not operate without placing the safety cover back on. This can cause potentially hazardous situations.



CAUTION

< General >

- Do not use the POWER CYLINDER beyond the capacity of those specified on its name plate or manufacturing specifications. Otherwise electrical shock, injury, damage to the equipment, etc. may occur.
- Do not insert your fingers or other objects in the opening of the POWER CYLINDER, otherwise electrical shock, injury, fire or damage to the equipment may occur.
- Do not use a damaged POWER CYLINDER continuously, otherwise injury, fire, etc. may occur.
- Do not remove the name plate.
- Any remodeling carried out by the customer is not covered by our guarantee and therefore we cannot be held responsible.
- Use within the travel stroke specified. If not, the product can potentially breakdown.

< Upon receipt of the POWER CYLINDER you purchased >

- Make sure the package is in upright position prior to opening.
- Check the POWER CYLINDER you received is exactly what you ordered. If an incorrect product is installed to your equipment, injury, damage to the equipment, etc. may occur.

< Transportation >

- Pay full attention not to drop or overturn the product during transportation. In such cases where the POWER CYLINDER is fitted with lifting rings, check that these rings are fastened securely before use. However, after installing the POWER CYLINDER to another equipment, do not lift the entire equipment by using these lifting rings. Confirm the weight of the POWER CYLINDER with an outline diagram or catalog before lifting. You must not lift the POWER CYLINDER if its weight exceeds the maximum rated weight assigned to the lifting device . This can cause accidents or damage to the equipment or POWER CYLINDER.

< Installation >

- Do not place any flammable objects around the POWER CYLINDER. Otherwise fire may occur.

- Do not place any obstacles which may block the ventilation around the POWER CYLINDER. Otherwise cooling of the POWER CYLINDER becomes less effective and burns or fire may occur due to abnormal overheating.
- Do not climb or hang on to the POWER CYLINDER, otherwise injury may occur.
- In case of operating manually with manual handle, operate without any load. Otherwise injury or damage to the equipment may occur.

< Lubricant >

- When the POWER CYLINDER is used for food processing machinery, etc. avoid contact with the lubricant oil by installing devices such as oil pans. Otherwise oil leaks from the POWER CYLINDER may damage the food products.

< Wiring >

- Make sure that the wiring is correct (RST-UVW) before turning on the power. Wrong wiring can cause injury and breakdown of the equipment.
- Wire according to the general technical standards of electrical installations or those set forth by your company. Otherwise burnout, electrical shock, fire or injury may occur.
- Protection devices are not equipped with the POWER CYLINDER. Installation of the overload protection device is mandatory under the technical standards of Electrical Installations. Installation of other protection devices (such as ground-fault circuit breakers, etc.) in addition to the overload protection device is recommended. Without these devices, damage, electrical shock, fire or injury may occur.
- Before installing the POWER CYLINDER to another machine, check the traveling direction of rod. Incorrect traveling direction may cause injury or damage to the equipment.
- Never use an inverter. This cylinder controls the press contact force by detecting overcurrent with the built-in CDS inside the terminal block and stopping the motor. If an inverter is used, the CDS circuit may be broken.
- Megger testing is prohibited for this cylinder. It may break the built in CDS. Remove all the terminals in the terminal block for megger testing of external circuits.
- Keep the voltage drop of the wiring within 2%. Otherwise the POWER CYLINDER may not start due to voltage drop in case of a long wiring distance.
- When changing rotation direction, stop the motor completely and then reverse. Otherwise forwarding and reversing rotation by plugging may cause damage to the equipment.

< Operation >

- During operation, the surface temperature of the POWER CYLINDER becomes considerably high. Be careful not to touch the POWER CYLINDER, otherwise burn injury may occur.
- Stop the operation immediately when you suspect any problems, otherwise electrical shock, injury or fire may occur.
- Do not exceed the rated maximum load of the material loaded. Otherwise, injury, damage to your equipment or damage to the POWER CYLINDER may occur.

< Maintenance and Safety check >

- The surface temperature of the POWER CYLINDER becomes high. Do not touch with bare hands, otherwise burn injury may occur.
- For abnormal situations, carry out diagnosis according to the instruction manual. Never resume operation until you investigate the cause of the problem.

< Disassembly & assembly >

- In case of malfunction, please return the POWER CYLINDER Disassembly and assembly by the customer may cause electrical shock, injury or fire, etc

< Scrapping >

- Parts used for POWER CYLINDER are RoHS compliant. When scrapping the POWER CYLINDER, dispose as general industrial waste.

Thank you for purchasing Tsubaki POWER CYLINDER Eco Series CDS Type.

This cylinder uses high performance ball screw, and is equipped with a motor with brakes.

In comparison to a conventional electro-mechanical cylinder, high speed and highly frequent operation is possible.

With a spring built in the linear actuating part and the CDS mounted inside the terminal box, over current is detected even when press contact stops or in the case of overload, and the motor is automatically stopped.

The press contact force is retained by the built in spring during stoppage.

Power Cylinder Eco Series CDS Type has superior features compared to pneumatic and hydraulic cylinder or other linear actuators commonly used. This product is both mechanically and electrically sophisticated.

Therefore, careful attention to this manual is essential in order to obtain optimum performance. This operation manual covers everything from how to install to methods of maintenance. Please read carefully and pay special attention to details on inspection, handling, and maintenance. If you have any question in this manual, contact the distributor or our sales office with the information of the name plate.

Contents

1. Upon delivery	---	P. 7
2. Installation	---	P. 7
3. Wiring	---	P. 10
4. Precaution before operation	---	P. 13
5. Characteristics graph		
Frequency of use	---	P. 13
6. General precautions	---	P. 15
7. Maintenance/inspection	---	P. 15
8. Trouble shooting	---	P. 16
9. Warranty	---	P. 17

Caution for handling the products

1. Operation manual

- Deliver this instruction manual to the final customer who uses the Power Cylinder. Read the instruction manual carefully, and use the product properly.
- In case the instruction manual is not at hand, request the distributor where you purchased the product, or our sales office with the information of product name and model number.

2. For safety

- If you suspect danger during operation, take safety precautions immediately, to avoid serious accidents.
- Consider and plan ahead, so that danger will not be a factor, in case the operation becomes abnormal.

3. When performing maintenance or inspection

- Wear proper working clothes and protective equipments (safety device, gloves, shoes, etc.). Make sure the environment is appropriate, before performing maintenance and inspection to avoid secondary disaster.
- Make sure the power is switched off, and the machine has stopped completely before carrying out maintenance and inspection.
- Be careful so that nobody turns the power back on.
- Comply with Ordinance on Labor Safety Law by government.

4. Storage

- Though Power Cylinder is an entirely enclosed structure, store in a dry and well conditioned room indoors to avoid rust.
- In case Power Cylinder is left outdoor with tentative wiring after installing equipment, cover it with vinyl sheet to protect from rain, water, or moisture.
- If it is stored in a place prone to sudden temperature change, dew condensation may cause damage or rust.
- It is dangerous to pour liquid such as water, or place metal pieces inside the product. Do not put any foreign particles inside the Power Cylinder and your equipment.
- Do not store or use in corrosive or flammable atmosphere.
- Do not store or use as disassembled parts, because this can damage the product, and /or cause electrical shock.
- Do not use in a sealed container where heat radiation cannot be expected.
- The Power Cylinder can produce large power when press or pull contact stopping. Do not bring hands, feet and body to the moving parts of the entire equipment including Power Cylinder. Otherwise they can get caught in the machine, and cause hazardous situations.
- Shut down the power source immediately, perform safety procedure, and contact the distributor from whom you purchased the product or our sales office, in case of malfunction (abnormal odor, heat generation, noise and vibration).

1. Upon delivery

1. Confirm that the thrust, speed, stroke, voltage, etc. printed on the nameplate and the accessories (Trunnion column and bellows are attached with the unit) correspond to your requirements.
2. Check whether any part of the product has been damaged during delivery.
3. Check whether the bolts and nuts are fastened securely.

Immediately report on any damage that was found on to the Power Cylinder during shipment to your distributor, or Tsubaki E&M Customer Service center with the information on the nameplate.

2. Installation

Correct installation is essential for an effective long service life of the Power Cylinder.

2-1. Installation site

This Power Cylinder is only for indoor use. Do not use in a hostile environment such as in rain or wind, and wet or vaporous conditions. Ambient temperature is usually 0°C to +40°C.

2-2. Installation direction

In case of Trunnion Mounting, install the Power Cylinder onto your equipment in any direction you wish, unless otherwise specified in the outline drawing. While in case of Flange Mounting (only on LPES040, LPES150), install the Power Cylinder vertically.

2-3. Method of Installation

1) Trunnion Mounting

Do not tighten the frame of Power Cylinder from the outside.

Put grease to the trunnion pins and holes of the trunnion.

Do not apply rotating force to the rod in case of install the end fitting to your equipment. (Use double faced end fitting.)

Put grease to the fitting of I and U type end fixture.

If the main body swing largely when the cylinder operates, consider to use plain bearings or ball-and-roller bearings in the joints.

If the trunion pin or the connecting pin of the front metal fitting are set in the vertical direction (when the cylinder is laid horizontally) and the main body rocks, take proper countermeasures against wear, i.e., fitting a plain bearing on the side of the trunion hole or the end fitting and front metal fitting.

Secure 3 times or more of the rated thrust of Power Cylinder for the strength of customer's equipment and mounting base.

2) Flange mounting

Install the cylinder vertically in case of flange mounting at the tip of the cylinder. In this case, do not swing the cylinder. In addition, do not apply side force to the cylinder unit. For flange installation, screw M6 bolts 12mm and more. Bolt tightening torque for these bolts should be 4.2 to 5.6N · m.

Do not install the cylinder horizontally in flange mounting.

3) Manual operation

Manual operation is available if it is necessary even no power supply.

Remove the release cap at opposite of motor flange and rotate the manual shaft with flat-blade screwdriver.

This is for emergency and initial installation case only due to brakes on.

Make sure that no load is applied to the rod.

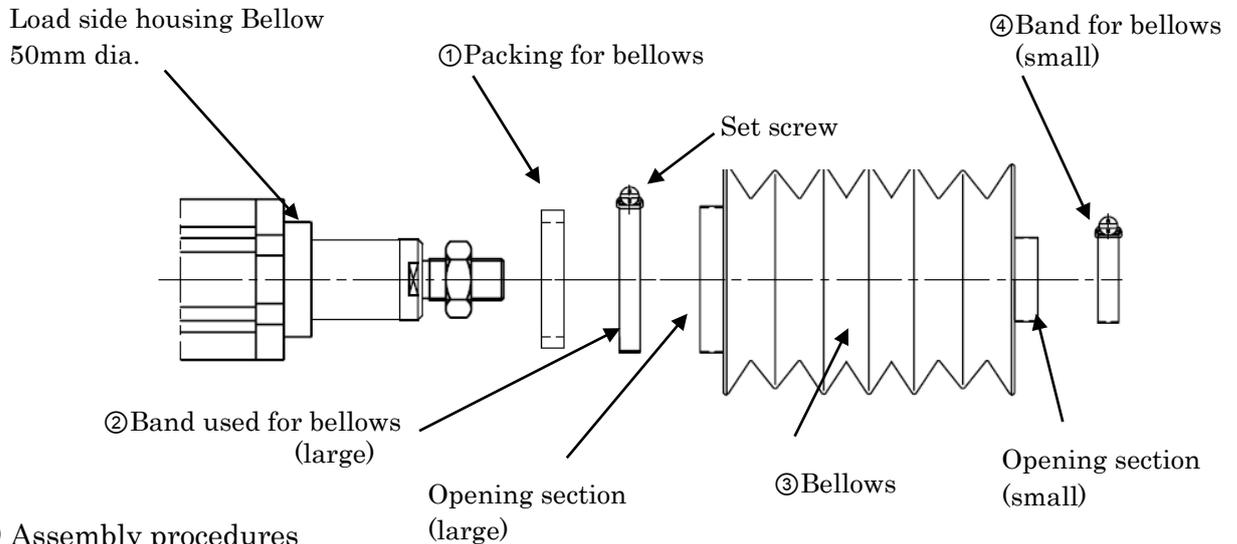
When the main body has a straight shape, turn the shaft clockwise when viewed from the back of the brake motor, and the rod will move backward. Turn it counterclockwise, and the rod will move forward. When the main body has a parallel shape, the rod will move in opposite directions.

- Manual operation necessary torque in the unloaded condition is 2 N·m.(all models)
- The movement of the rod per rotation of the manual handle is shown below.

Model number	Movement length (mm/rotation)
LPE025HT (HK)、LPE050HT (HK)	8.0
LPE050LT (LK)、LPE100LT (LK)	5.0

4) Assembly of bellows (Option)

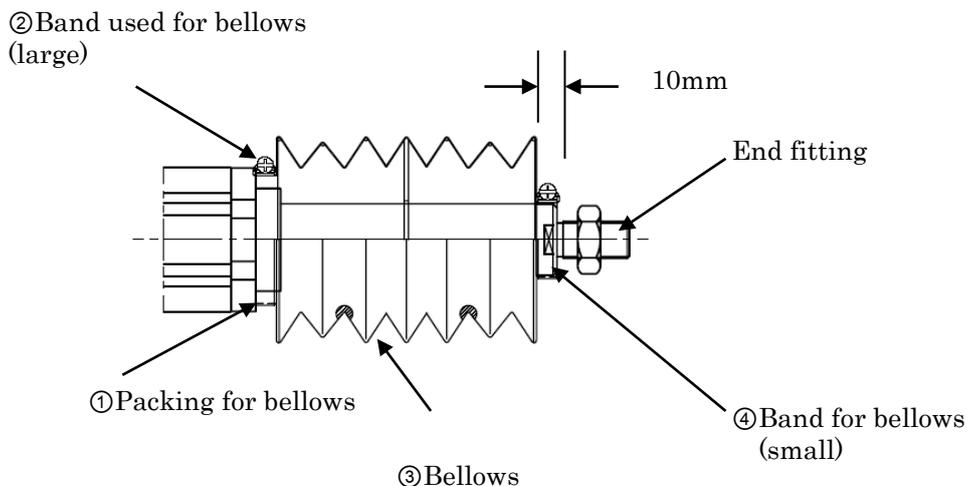
Bellows is included with main unit. Make sure the following parts are bundled.



4-1) Assembly procedures

- 1) Insert ①packing for bellows to the load side housing 50mm dia. portion.
- 2) Insert ③bellows and ②band (large) to the end face of the load side housing along the circumference of packing for bellows.
- 3) Tighten the set screw of bellows band securely by screwdriver. (tightening torque: $3\text{N} \cdot \text{m}$)
- 4) Retract the bellows, and attach the opposite side opening section of the bellows to the 10 mm at root of end fixture, then tighten the set screw with the ④bellows band (small) securely. (tightening torque: $3\text{N} \cdot \text{m}$)

4-2) After assembly



2-4. Setting strokes

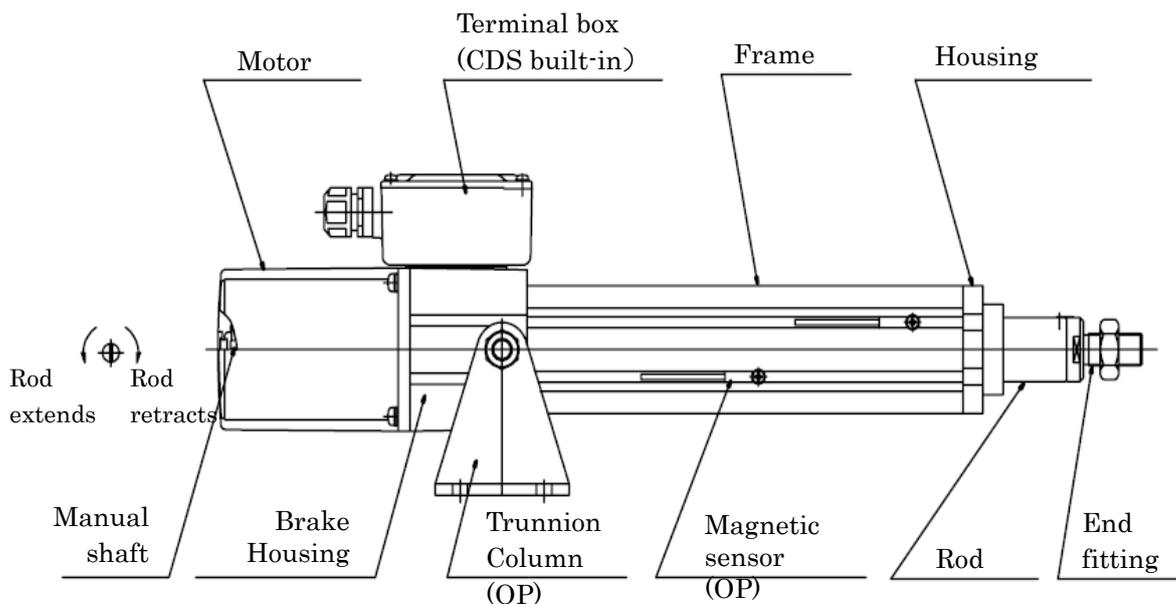
This cylinder automatically stops with the press or pull contact force at the stroke end or when hitting a wall in the middle of a stroke without a stroke adjusting external limit switch.

Press or pull contact stopping is possible at any position in a stroke range, however it can not stop at middle of stroke with stroke adjustment limit switches.

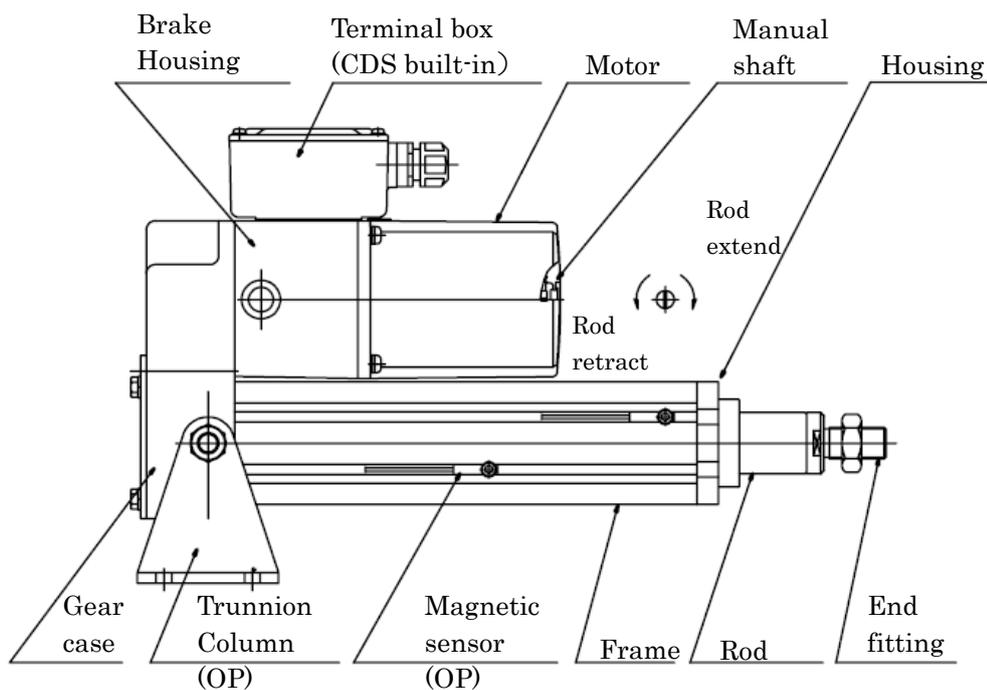
Inching operation should be used initial installation case only due to brakes life shortens.

2-5. A main part name / Approximate mass(kg)

1) Straight type (LPE***T)



2) Parallel type (LPE***K)



3) Approximate mass(kg)

3-1) Straight type

Stroke(mm)	Approximate mass(kg)					
	100	200	300	400	500	600
All models	9	10	11	12	13	14

3-2) Parallel type

Stroke(mm)	Approximate mass(kg)					
	100	200	300	400	500	600
All models	12	13	14	15	16	17

3. Wiring

3-1. Wiring

Perform the wiring work according to the electric equipment technical standard and the regulations of the electric power company. Take care that the voltage drop is not large, since the longer the wiring distance becomes, the more the voltage drop will increase. Generally, you should use electric wire that has proper thickness and length that will not cause the voltage to drop 2% or more. The applicable cable diameter for the gland fitted in the motor terminal box is $\phi 11$ to $\phi 13$. Be sure to use a cable with a diameter in this range.

3-2. Grounding

After installation of the Power Cylinder, ground the motor (Earth work in class 3 or higher).

3-3. Connection of brake motor and forward and backward movements of cylinder

(1) Motor current value • brake current value

Model	Motor current value (A)			Locked rotor current value (A)		
	200V50Hz	200V60Hz	220V60Hz	200V50Hz	200V60Hz	220V60Hz
LPE025HT (HK)	0.6	0.6	0.6	1.0	0.9	1.0
LPE050LT (LK)	0.6	0.6	0.6	1.0	0.9	1.0
LPE050HT (HK)	1.1	1.1	1.1	2.1	1.9	2.1
LPE100LT (LK)	1.2	1.3	1.2	2.1	1.9	2.1

Note: The rated current values and start current values include a brake current value(0.11A).

Motor current value is the motor terminal blocks U's or W's current value so different current value of motor name plate.

Locked rotor current value is current value of press or pull contact stops.

Thermal protector set value is motor current value(not Locked rotor current value) in a standard.

(2) Wire connection

This is operable only by connection of a 3-phase power source.

In this case, the motor stops when press or pull contact stops, however, on-the terminal block electricity is still being conducted. Never fail to cut off the main power source before working with the terminal box open. **(Danger of electrocution)**

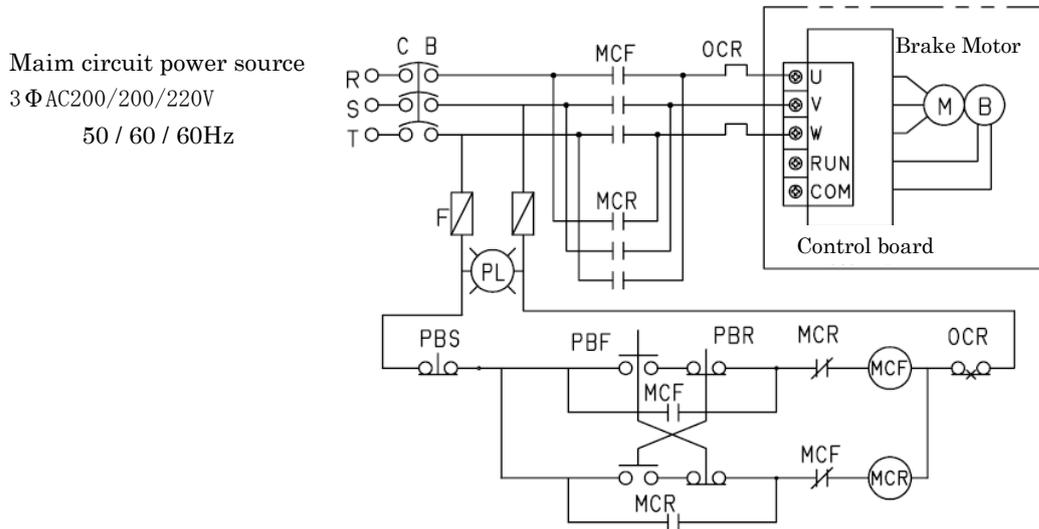


- Basic circuit

This is a single acting circuit diagram. The cylinder extends with the PBF and automatically stops with the press contact force at the stroke end or when hitting a wall in the middle of a stroke, etc. The cylinder retracts with the PBR and stops in the same manner as the extend side. MCF/MCR must be turned OFF with the stop button PBS each time the cylinder automatically stops.

Ensure the change over between extend and retract are at an interval of 0.2 seconds or more.

(Switch signal for extension and retraction may not work at less than 0.2 seconds)



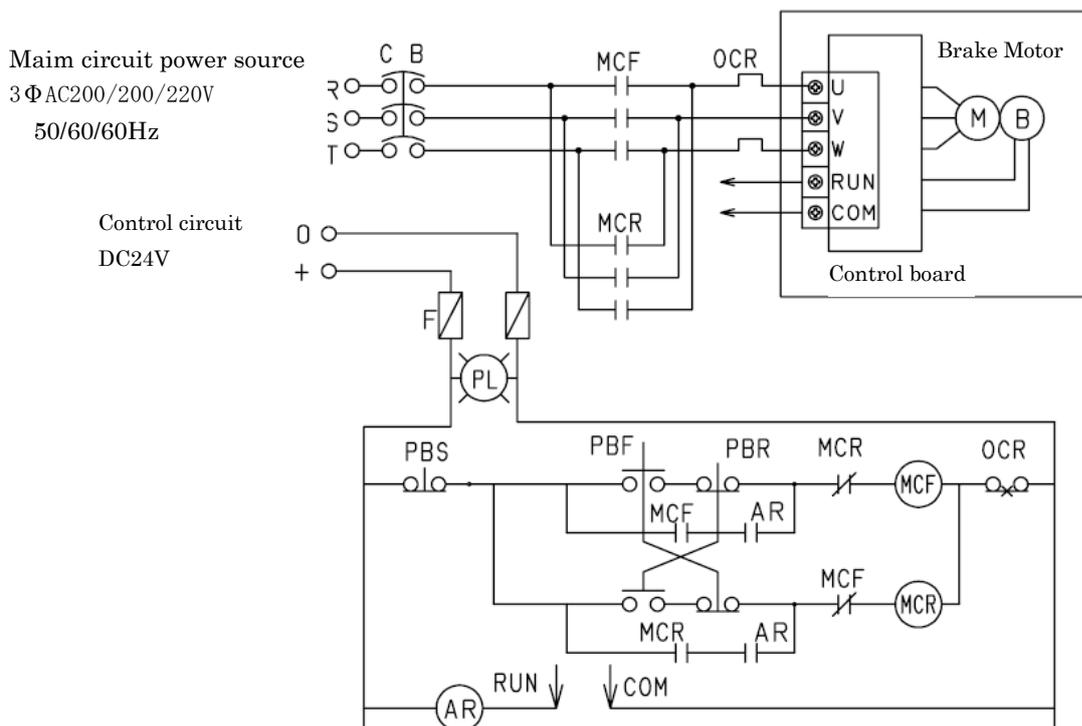
- Reference circuitry (In case of use the Run signal)

Run and COM terminals can take out the output signal of the cylinder action.

MCF (MCR) got cut off automatically after press(pull) contact stop by using an output signal.

(See diagram below)

Ensure the change over between extend and retract are at an interval of 0.2 seconds or more.



Control circuit: DC 24V

RUN output signal: open collector output.

(Longer life of relay contact and direct connection to PLC is possible.)

Open collector output: 50mA maximum 30V DC

Coil current of the relay AR must be 50mA DC or less.

3-4. Wiring of magnetic sensor

Wire the magnetic sensor with a special attention to the following, otherwise the magnetic sensor may be damaged.

(Note: Magnetic sensor is only a sensor to check the position, and is not a sensor to stop at an arbitrary position.)

(1) Do not wire the “+” and “GND” of power source in reverse. (Protection circuit for reverse connection is not included.)

(2) Do not apply over voltage.

Standard magnetic sensor : Max. DC24V and below/ Max. 15mA and below

Magnetic sensor with lamp (LED) (Publication product of catalog)

: Max. DC24V and below/ Max. 12mA and below

(3) Do not wire the power line and control circuit all together.

(4) In case of load which generates surge such as relay, set diode (*1) near by the load. Use a diode with a peak reverse voltage over 400V, average rectified current over 1A.

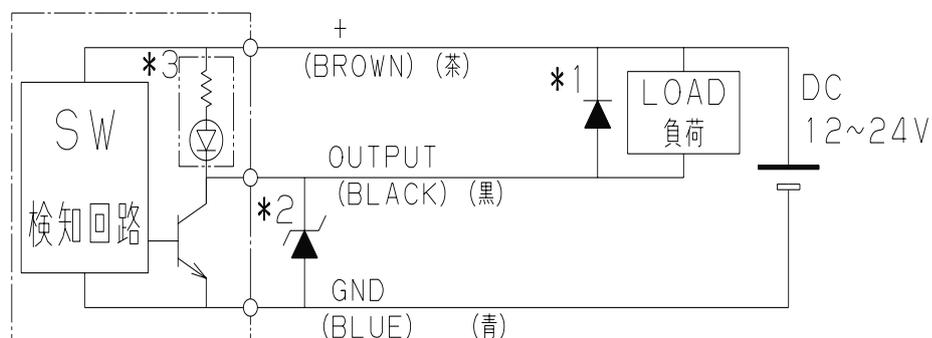
(5) In case of longer wiring than the cable length of magnetic sensor is required, set zener diode (*2) near by the magnetic sensor. Use a zener diode with a zener voltage over 33V, allowable power dissipation over 500mW.

(6) In case of Magnetic sensor with lamp (LED), (*3) is added to the diagram.

Install the magnetic sensors to the appropriate side. If installed on the wrong side of the frame, they do not work properly, even though they can be move in the stroke direction.

In case of special specification, please confirm the final drawing because the type of magnetic sensor might be different.

Diagram for standard magnetic sensor



4. Precaution before operation

4-1. Verification of wiring and power source

Verify there is no wrong wiring, specifically whether motor wiring (rotational direction) is correct. Turn on the power and check by inching. Make sure the forward button works for forward motion, and make sure The cylinder stops with the press contact force at the stroke end or when hitting a wall in the middle of a stroke, and the same for reverse motion.

4-2. Connection with machine/equipment

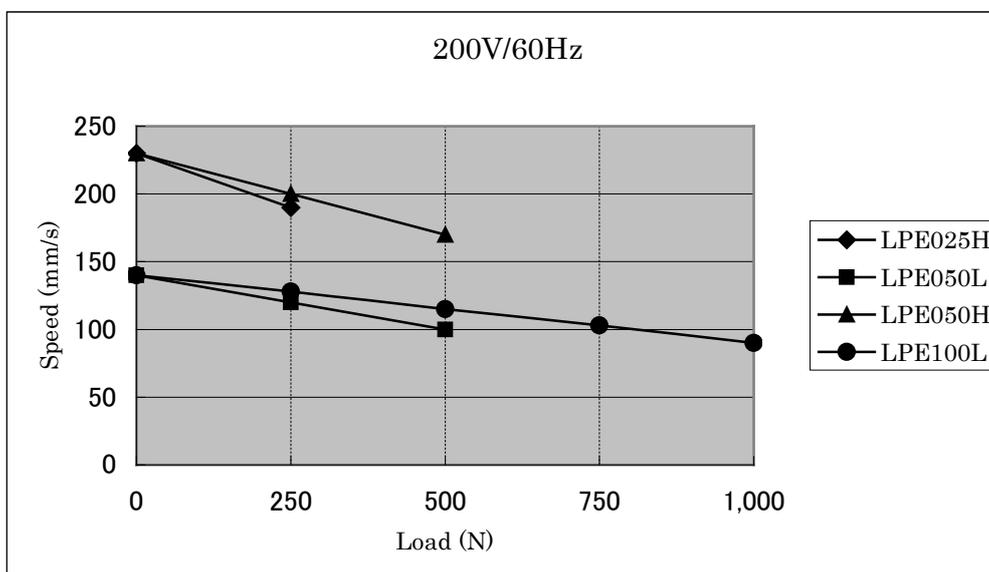
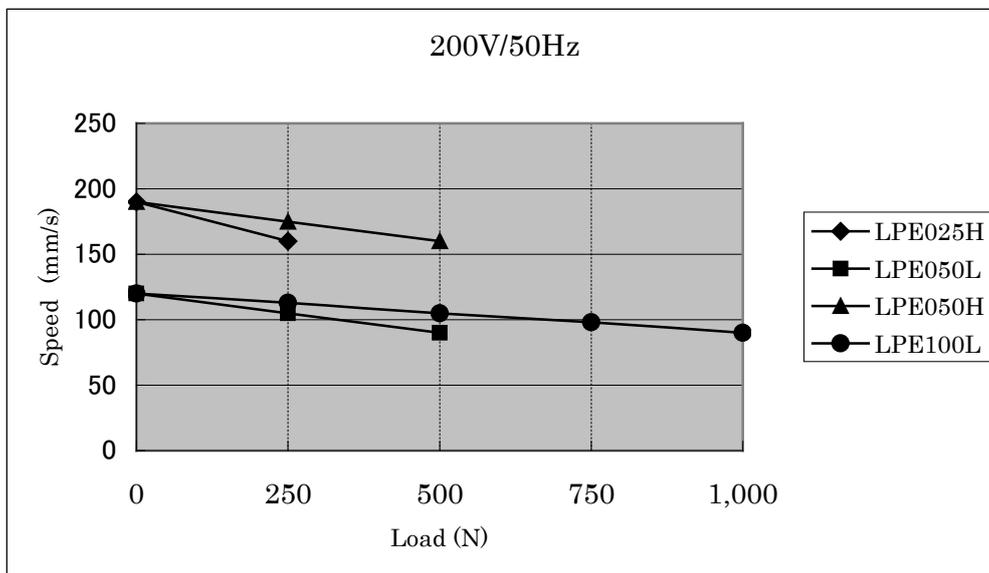
Make sure there is no side force applied to the cylinder rod (force to the axial direction of linkage pin), specifically when it swings at all strokes, check the interference at the end fixture and the other portion. Do not apply the force to bend the rod (lateral load), otherwise it may cause breakage, reduced life or noise.

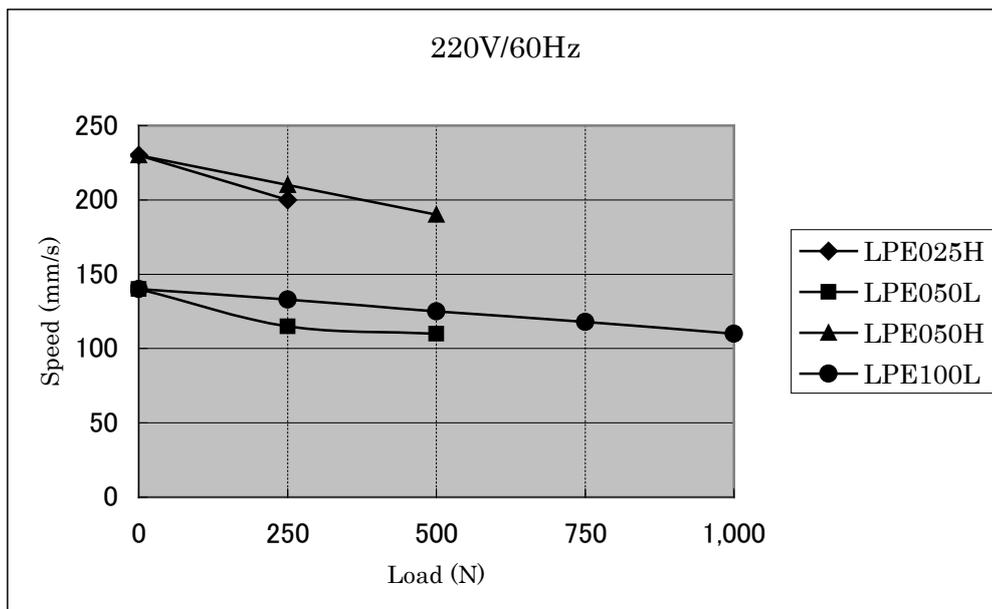
5. Characteristics graph / Frequency of use

5-1. Characteristics graph

Speed varies depending on load, voltage and frequency.

For details, refer to the characteristics diagram.





5-2. Frequency of use

Max. number of start up of Power Cylinder based upon the motor heat generation is shown in Table.

Model	Stroke mm	Number of start up (times/min)			
		Load (N)			
		10	250	500	1000
LPE025H	100	15	12		
	200	15	12		
	300	10	10		
	400	9	5		
	500	8	4		
	600	6	3		
LPE050L	100	15	10		
	200	8	8	5	
	300	5	5	5	
	400	5	5	3	
	500	5	4	2	
	600	4	4	2	
LPE050H	100	15	12	10	
	200	12	10	8	
	300	10	10	6	
	400	9	8	5	
	500	8	7	4	
	600	7	6	3	
LPE100L	100	12	10	8	5
	200	8	8	8	5
	300	5	5	5	4
	400	5	5	5	3
	500	5	5	4	2
	600	4	4	4	2

6. General precaution

6-1. Fluctuation of voltage and frequency

In case the voltage and/ or frequency applied to the motor, are different from specified value, the outcomes may vary. The motor is designed to withstand voltage fluctuation within approximately plus/ minus 10% of the rated voltage and frequency change within approximately plus/ minus 5%. In general, voltage is rather lower than the specified value, and in case the voltage drop is large, the following defects can happen. Consider the voltage drop.

1. Brake is not released and motor cannot start.
2. Starting torque decrease, and it's hard to start up.
3. Less tolerable to overload
4. Overheat

6-2. Load

The following may affect the efficiency of Power Cylinder, have a bad influence for the life of motor or ball screw, and can cause damage to reducer portion, rod or outer tube.

1. Lateral load
Never apply force to bend the rod (lateral load).
2. Load, which strongly impacts the equipment.
3. Over load
4. High inertial loading

Allowable mass in consideration of inertia at time of horizontal drive

Model	LPE025HT LPE025HK	LPE050LT LPE050LK	LPE050HT LPE050HK	LPE100LT LPE100LK
Allowable mass (kg)	50	100	100	200

6-3. Operation upon occurrence of abnormality

If any abnormality is found during operation, immediately stop the operation, and check the cylinder after taking the appropriate measures to prevent lifted objects from falling and other accidents. For example, if the cylinder is kept operating with the motor burnt out, the brake will be released, and the motor output will not be given.

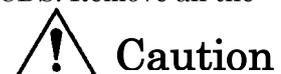
Therefore, a load cannot be supported, which may result in an accident.

7. Maintenance and Inspection

When checking and doing maintenance on the cylinder, turn off the power, and make sure that the cylinder has completely stopped.

Take care that the power is not turned on accidentally. If the main body is disassembled, the Power Cylinder cannot hold a load, which may result in an accident. Remove any load before starting maintenance.

Megger testing is prohibited for this cylinder. It may break the built in CDS. Remove all the terminals in the terminal block for megger testing of external circuits.



Daphne Eponex SR No.2 (Idemitsu Kosan) is applied to the screw shaft of this cylinder at the time of shipment, however, periodic lubrication is required.

On the rod periphery, apply grease so that an oily film does not run out.

8. Trouble shooting

Refer to the following table when trouble happens.

Trouble	Possible Cause	Action
Does not work even if the start button is pressed	1. Wrong wiring of motor, control unit.	Check wiring.
	2. Disconnection of motor starter or wire and lead wire.	Repair and replace.
	3. Failure of the electro-magnetic contactor, control unit.	Repair.
	4. Inertia is too large	Review on equipment design
	5. Breakage of CDS	Repair.
Does not rotate even though the motor sounds like running.	1. Single phase operation.	Check the wiring.
	2. Voltage drop in power source.	Increase power source capacity consider power source size.
	3. Too much stroke of electromagnet of brake.	Adjustment.
	4. Burn out of brake lining.	Replace.
Does not generate specified thrust.	1. Voltage drop in power source.	Increase capacity of power source. Consider power source size.
	2. Bad connection of equipment.	Repair.
Motor is overheated.	1. Excessive load.	Reduce the load, consider the capacity.
	2. Too much frequency.	Consider the capacity.
Damage to the equipment.	1. Impact load.	Repair.
	2. Lateral load.	Repair.
Magnetic sensor does not output signal	1. Wrong wiring	Re-wiring, replacement of sensor
	2. Over voltage	Reset to correct voltage, replacement of sensor

9. Warranty

Tsubaki E&M Co.: hereinafter referred to as "Seller"

Customer: hereinafter referred to as "Buyer"

Goods sold or supplied by Seller to Buyer: hereinafter referred to as "Goods"

9-1. Warranty period without charge

18 months effective the date of shipment or 12 months effective the first use of Goods, including installation of Goods to Buyer's equipment or machines - whichever comes first.

9-2. Warranty coverage

Should any damage or problem with the Goods arise within the warranty period, given that the Goods were operated and maintained under instructions provided in the manual, Seller would repair and replace at no charge once the Goods are returned to Seller. The following are excluded from the warranty.

- 1) Any cost related to removal or re-installation of Goods from the Buyer's equipment or machines to repair or replace parts.
- 2) Cost to transport Buyer's equipment or machines to the Buyer's repair shop.
- 3) Costs to reimburse any profit loss due to any repair or damage and consequential losses caused by the Buyer.

9-3. Warranty with charge

Seller will charge any investigation and repair of Goods caused by:

- 1) Improper installation by failing to follow the instruction manual.
- 2) Insufficient maintenance or improper operation by the Buyer.
- 3) Incorrect installation of Goods into other equipment or machines.
- 4) Structure change of the Goods by any modifications or alterations by the Buyer.
- 5) Any repair by engineers other than the Seller or those designated by the Seller.
- 6) Operation in inappropriate environment not specified in the manual.
- 7) Force Majeure or forces beyond the Seller's control such as natural disaster and injustice done by third party.
- 8) Secondary damage or problem incurred by the Buyer's equipment or machines.
- 9) Defected parts supplied, or specified by the Buyer.
- 10) Incorrect wiring or parameter setting by the Buyer.
- 11) The end of life cycle of the Goods under normal use condition.
- 12) Losses or damages not liable to the Seller

9-4. Dispatch the Seller's engineer

Service to dispatch Seller's engineer for investigation, adjustment or trial testing, etc. of Seller's Goods are at Buyer's expense.

9-5. Others

- In accordance with the policy of Tsubaki E&M Co., the contents of this instruction manual are subject to change without notice.
- We take all possible measures to ensure that there is no error in writing or defect with the contents of this instruction manual.
- We highly appreciate it, if you would let us know any error or defects found in this instruction manual.



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