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TSUBAKI
POWER CYLINDER
< Multi Series >
Instruction Manual
(Ball Screw TYPE)

ATTENTION

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

NOTICE

In the case of special specification, it might be partially different from this instruction manual.
Refer to the attached final drawing for "★" sections.
※The final drawing of standard specification is not attached, so please check the catalog or website as necessary.

Units described herein are SI {Gravitational}.
Figure in { } is for reference.

TSUBAKIMOTO CHAIN CO.

TSUBAKI
POWER CYLINDER Multi-series

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

< General >

- 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 disfunctioning of the product.
- Do not use the standard POWER CYLINDER in an explosive atmosphere. Use explosion-proof type POWER CYLINDER in such environments, otherwise explosion, ignition,fire, electrical shock, or damage to the equipment may occur.

< Transportation >

- Do not stand under the product when it is lifted for transportation, otherwise the product may fall and result in death or serius injury.

< Wiring >

- 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 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 operate while the terminal box cover is removed. After wiring, fix the terminal box cover to its original place, otherwise electrical shock 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.
- Do not remove the cover for internal inspection during operation. This may cause burns due to the splashing of high termperature oil.
- In case of inspecting the tooth on gears and screw while the motor is not running, double check that all the gears and screw are also completely stopped.
- 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 ventulated.
- 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.

< Maintenance and Safety check for brake >

- Do not operate the POWER CYLINDER while the brake is released by manual release bolt, otherwise the equipment may fall over and/or disfunction.
- Before operating, turn the power on and off after stopping the rotation of the driven machine, and check the brake function. Otherwise, accidents may occur.
- After checking or adjusting the brake gap, do not operate the motor without the fan cover. Otherwise it could involve some one in a serious accident and also damage the product.
- When using for a lifting & lowering device, do not release the brake while loaded. This can cause the machine to jerk and drop the material it is carrying, which can lead to major accidents or damage to the equipments.

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 CYLNDER 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 the wiring of the limit switch and the position of the travel stroke are appropriate before operating. Otherwise injury or damage to the equipment may occur.
- Do not touch the terminals when measuring insulation resistance, otherwise electrical shock may occur.
- 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.
- When using star-delta, use an electromagnetic switch on the primary side, and select from 3 contractros.
- When 400V class inverter is used to drive the Motor, install a suppression filter or reactor to the inverter side. Otherwise dielectric breakdown may cause fire or damage to the equipment.
- Do not mistake the starter condenser and the driving condenser. If the starter condenser is used for driving, the condenser will be damaged.
- Do not damage the vinyl cover of the starter condenser, otherwise electrical shock may occur.
- 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.

- When using Power Cylinder with brake, do not supply the electricity to the brake coil continuously while the motor is turned off. Otherwise burnout of the brake coil or fire may occur.

< 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.
- During operation, do not loosen oil plug, otherwise burns may occur due to the splashing of high temperature oil.
- Do not touch the conductive portion of the starter condenser for single phase motor until discharged completely, otherwise electrical shock may occur.
- When changing the rotating direction of single phase motor, except reversible motor, be sure to stop the motor completely then reverse. Otherwise the direction may not be changed and be out of control.
- When used for an elevator or another lifting device, do not release the brake while the load is lifted. Otherwise accidents may occur.

< Maintenance and Safety check >

- Do not touch the terminals when measuring the insulation resistance, otherwise electrical shock may occur.
- In case of changing lubricant, follow the instruction manual. Be sure to use the recommended lubricants, otherwise damage to POWER CYLINDER may occur.
- The surface temperature of the POWER CYLINDER becomes high. Do not touch with bare hands, otherwise burn injury may occur.
- Do not change the lubricant during operation or immediately after stopping the motor, otherwise burn injury may occur.
- When measuring insulation resistance of explosion-proof motors, make sure that it is performed in a non explosive gas or steam atmosphere, otherwise explosion or fire may occur.
- For abnormal situations, carry out diagnosis according to the instruction manual. Never resume operation until you investigate the cause of the problem.
- Where the brake gap exceeds that of the allowed limit, the coil may burn due to bad suction. Damage to the brake plate can also occur, due to the increased impact.

< Disassembly & assembly >

- Repair, disassembly and assembly of the POWER CYLINDER must be handled by specialists, otherwise electrical shock, injury or fire, ect. may occur.

< Scrapping >

- When scrapping the Power Cylinder or disposing the lubricant, dispose as general industrial waste.

Thank you for purchasing Tsubaki Power Cylinder.
Tsubaki Multi Series is a Linear Actuator which has the ability of high speed drive,synchronous motion,and has a wide variation for drive unit.
Tsubaki Multi Series is consisting of high efficiency Ball Screw,Spiral Bevel Gear and Rod,its construction is very simple and compact.
Multiple synchronous motion is available for multiple units by connecting the input shafts with connecting shaft.
In addition,Cradle motion is available when multiple use,because the input shaft is concentric with the center of trunnion mount.
This Tsubaki POWER CYLINDER Multi Series has many excellent features to compare with other actuators,and is built with high rigidity.
For more efficient use,read this instruction manual which describes the procedure of installation and operation in detail,and pay attention to inspection,handling and maintenance.

Contents

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 Low by government.

4. Storage

- Though Power Cylinder is an entirely enclosed structure, store in a dry & 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. 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 receiving the Power Cylinder, check the following.

1. Confirm that the thrust, speed, stroke, voltage, etc. printed on the nameplate and the accessories correspond to your requirements.
2. Check whether any part of the product has been damaged during delivery.
3. Check whether the screws and bolts are fastened securely.

2. Installation

2-1. Storage

Though Power Cylinder is an entirely enclosed structure, store it in a dry and well- conditioned room indoors to avoid rust.

In case Power Cylinder is left outdoors with tentative wiring after installing the equipment, cover it with vinyl sheet to protect from rain and moisture.

★2-2. Installation.

Though Power Cylinder is an entirely enclosed structure, suitable for standard outdoor use, appropriate cover is required at all time in case of snow or thick vapor. For salty wind conditions, changes in the painting method, structure of limit switch and such become necessary.

Ambient temperature is usually –15 ℃～+80℃. (Low temperature may cause poor performance.) When using outside of this range, use an insulation cover.

※ In case of special specification, please confirm the final drawing because use conditions such a use environment or ambient temperature might be different.

★2-3. Direction

Install the Power Cylinder onto your equipment in any direction you wish, unless otherwise specified in the diagram.

※ If the direction is specified on the final drawing, follow the instructions.

2-4. Method of Installation

Use Trunnion mounting.

Do not tighten the outer tube of Power Cylinder from the outside in any mounting method.

★2-5. Prevention of Rod rotation

The rod builds up the rotational force along with the thrust.

Prevent this rotation by using your equipment/ machine.

The rotational torque generated by rod is shown in Table 1.

※In case of the special specification, such as anti-rod rotation might be different from following table, so please confirm the final drawing.

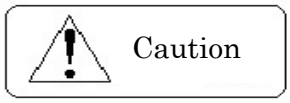
Table 1 Rod rotational torque N・m {kgf・m}

Type	Stroke (mm)	Rod rotational torque	Type	Stroke (mm)	Rod rotational torque
T250	200～600	2.65{0.27)	T6000	500～1500	124 {12.7}
T500	200～800	5.29{0.54}	T8000	500～1500	222 {22.7}
T1000	200～800	14.7 {1.5}			
	1000	11.8 {1.2}	T12000	500～2000	333 {34.0}
T2000	200～800	35.3 {3.6}			
	1000	28.5 {2.9}	T16000	500～2000	665 {68.0}
	1200	22.6 {2.3}			
T4000	200～1200	83.3 {8.5}	T32000	500～2000	1330 {136}
	1500	71.6 {7.3}			

★2-6. Setting strokes (TB type, TC type)

Set the stroke by limit switch (LS). Never operate with only temporary wiring of the motor. Install a limit switch for stroke adjustment at an appropriate position of equipment / machine, where unit does not have limit switches as an option. Make sure the wiring is correct. At the middle of a stroke, stop using the limit switch and move the rod forward for forward motion, and pull the rod backward to reverse.

There is coasting until the cylinder stops completely after the limit switch is activated. Adjust the position of the limit switch by taking coasting into account.



Do not operate the motor, before wiring to LS, it may damage the Power Cylinder. Striker may not activate LS properly if the LS fixing screws are not in correct positon or by suitable tightening torque.

★2-7. Thrust Detection unit (TC type)

A. In case the Thrust Detection unit is used as a safety device

Connect the limit switch for Thrust Detection unit.

Use the limit switch for stroke adjustment (Forward, Reverse) separately.

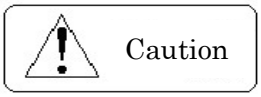
B. In case the Thrust Detection unit is used as a press contact stopping.

Connect the limit switch for Thrust Detection unit.

In case the confirmation of positioning is required, use of limit switch for stroke adjustment is recommended.

Use separate brake power supply for speed M, H. This is also recommended for other speed.

In case the press contact stopping is done on the Power Cylinder side (internal stopping), consider the margin of approximately 10 mm stroke at both ends.



Do not operate the motor, before wiring to Limit Switch for Thrust Detection. It may results the Power Cylinder is broken.

Table 2 Specification of Limit Switches

	Limit Switch for stroke adjustment	Limit Switch for thrust detection unit
Type of Power Cylinder	All type	LPTC250~LPTC16000
Model Number	WLCA2-N or equivalent (OMRON)	V-165-1A5 or equivalent (OMRON)
Capacity	AC 250V 10A (cosϕ=0.4)	AC 250V 10A (cosϕ=0.4)
Contact configuration	NC 11 — 14 NO NC 12 — 13 NO	Forward / Reward Red 3 — 4 Green Black 1 — 5 Yellow White 2 — 6 Brown

※Note: In case of make-to-order product specification, please confirm with issued drawing. Type of LS might be different specification to suite customer application.

3. Selection of drive unit

Use brake with motor to prevent the coasting and reverse action by load,because this Tsubaki POWER CYLINDER Multi Series has extremely high efficiency.
Use brake with 150% of brake torque and quick response type.
Motor selection is wide,I,e.,Variable Speed motor,Gearmotor,DC motor,etc..
Refer to the following formula to calculate motor capacity.

$$T = \frac{W \times L}{2 \times \pi \times \mathrm{R} \times \eta \times 1000} + \frac{\mathrm{T}_0}{100}$$

T :Re*quired input torque* N・m{kgf・m}
W : *Lifting load* N{kgf}
L : *Screw lead* mm
R : *Gear ratio* 2
η : *Overall efficiency* 0．８５５
T_0: *Tare drag torque* N・cm{kgf・cm}

※ η must include efficiency 0.855 of POWER CYLINDER Multi Series itself,then multiple other efficiency of variable/fixed reducer etc..

4..Prevention of overload

Use Torque Limiter Coupling at the output of moter.
Because POWER CYLINDER Multi Series may be broken due to shock load in case of lock condition of one cylinder for multiple use,or LS failure at stroke end.

Setting torque of Torque Limiter Coupling
- Horizontal Drive：Rated torque×1.5
- Vertical Drive：Rated torque×2.0

5. Confirm the following before starting operation

5-1. Wiring and Power source

Check whether the wiring is correct, specifically the relation between the phase of motor (rotational direction) and limit switches for stroke adjustment.
Put the rod at the middle of the stroke, then turn on the power and check by inching. Make sure the forward button works for forward motion, and make sure the limit switch works for stop, and the same for reverse motion.

5-2. Connection to the machine/equipment

Make sure that there is no lateral load to the cylinder rod. In case it swings at all strokes, check the interference at the end fixture and the other portion.

6. General caution

6-1. 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. Overload
2. Restrained load (for axial direction)
   Never keep pushing, pulling when the goods stop.
3. Lateral load
   Never apply force to bend the rod (lateral load).
4. Load, which strongly impacts the equipment.
5. Stop by press contact. (TB type)

6-2. Manual operation

In case the rod is operated manually by manual handle.

6-3. Protector nothing (TB type)

The thrust discovery device does not possess it
It is recommended to use with TSUBAKI Shock Relay as an electrical overload protection device.

6-4. Thrust detection unit (TC type)

Built with dish spring, it detects the thrust load axially. When the load exceeds the preset level, the axial movement of striker activates the limit switch.
Adjustment by limit switch is set when shipping, so no need to adjust.
Note; Limit switch for thrust is set before delivery, so there is no need to disassemble or adjust. In case the LS or striker is moved, cylinder or equipment may be broken due to no activation of limit switch for thrust.

7. Maintenance

★7-1. Grease to the ball screw

Screw shaft, bearing and rod are already filled with grease before shipment, and use as is.
Refer to Table 5 for the periodic cycle of greasing.
After extending the rod to the forward stroke end, inject grease to screw shaft by grease gun through grease port.
Amount of grease per stroke 100mm is approx. 10 to 15g for T250 to T4000, approx. 30 to 50g for T6000 to T16000.
Refer to the following table for recommended grease.
Note: Excessive amount of grease causes trouble.

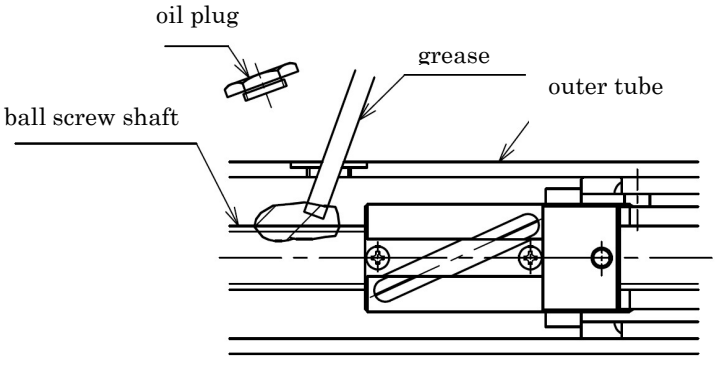


Table 5. Periodic cycle for greasing

Frequency of use	Periodic cycle for greasing
501 to 1000 reciprocates/ day	Every 3 to 6 months
101 to 500 reciprocates/ day	Every 6 to 12 months
10 to 100 reciprocates/ day and less	Every 12 to 18 months

Table 6. Recommended grease

Category	Company	Name
Screw	TSUBAKIMOTO CHAIN	JWGS100G
	IDEMITSU KOSAN	※ 1 Daphne Eponex SR No. 2
	NIPPON GREASE	Niglube EP-2K
	EXXON MOBILE	Mobilux EP No.2
	COSMO OIL LUBRICANTS	Cosmo Grease Dynamax EP No.2
	SHOWA SHELL	Shell Alvania EP Grease2

Note) • ※1 The above greases are filled before shipment.

• When greasing to screw at the timing of table 6, put the same grease to the rod surface to keep the oil film.

• For made-to-order products, confirm the lubricant with final drawing, the filled grease might not be the same as above standard.

★7-2. Grease to gear portion

Gear portion is already greased before shipment. No need to grease this portion.

Following types of grease are used.

Helical, spur gear portion: Idemitsu Daphne Eponex SR No. 1

※In case of the made-to order type, confirm with the final drawing, used grease might not be same as above.

Warranty

TSUBAKIMOTO CHAIN 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”

8-1. 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.

8-2. 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.

8-3. 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

8-4. 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.

8-5. Others

- In accordance with the policy of TSUBAKIMOTO CHAIN 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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