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Toyo Single Axis Series

Installation Manual

VER.E-201401

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1. General Safety Precaution

In order to use TOYO's product safely and correctly, please make sure to read through with correct understanding of the content of the entire manual and the general safety precaution before using or installation of the actuator.

The main purpose of this manual is to prevent personal injury or damage of the actuator and equipment, please follow the instructions listed and take notes on all of the warning and caution.

1-1 Symbol used within the chapter



WARNING

Fail to follow the WARNING instruction may cause severe injury and serious threat endangering the life to the personals around the actuator.



DANGER

Fail to follow the DANGER instruction will cause severe injury and serious threat endangering the life to the personals around the actuator.



CAUTION

Fail to follow the WARNING instruction may cause severe injury to the personals around the actuator and the damage to the actuator or equipment.

It is not possible to list all of the safety measures while operating/installing around the robot. Apart from following the safety instruction, please go through the entire manual to build a full knowledge of the safety rules in order to make correct judgments when around the robot.

1-2 Essential caution items

Particularly important cautions for handling or operating the actuator are described below. In addition, safety information for installation, operation, inspection and maintenance are listed in the related chapter of this manual, please comply the safety measures for safe use of the robot.

a) Automatic operation



DANGER

Severe injury and serious threat endangering the life will occur if impact with moving parts.

- Install a safeguard (protective enclosure), which covers the entire movement range of the actuator, to avoid anyone entering. This is to prevent anyone suffering from injury due to being stuck by moving parts.
- Install a safety interlock that triggers emergency stop when the door or panel is opened.
- Install safeguards so that no entry is allowed except through the door or panel with safety interlocked equipped.
- Stay outside of the safeguard during operation.
- Activate emergency stop before entering the safeguard.

b) Use caution to prevent hand or fingers from being caught by the moving parts.



WARNING

Moving part may cause pinch or crush of hands and fingers, keep hands and fingers away from moving parts.

c) Operation

- Be sure to read through the warning labels and this manual carefully, and make sure you have thoroughly understood the contents before attempting installation and operation of the product.
- A double checking of this chapter before starting to operate the product is always a good idea.
- Please do NOT proceed any actions not being mentioned in the manual.



WARNING

Improper installation or incorrectly operation may cause severe injury and

serious threat endangering the life.

- d) Do not use the product in the environment filled with inflammables or explosives.



WARNING

The product is not designed to operate under the environment where inflammable or explosive substances are present; use of the actuator in such environment might result fire hazard.

- e) Do not use the product in locations with possibly electromagnetic interference.



WARNING

Avoid using the robot in locations subject to electromagnetic interference, electrostatic discharge or radio frequency interference. Malfunctions might otherwise occur.

- f) Use caution when releasing the brake on a vertical axis actuator.



WARNING

The vertical axis will slide down when brake are released, and may cause hazardous situation.

- Use a support to prop the vertical axis before releasing the brake, while emergency stop is activated.
- Be careful not to get caught between the axis and the installing base when releasing the brake to perform direct teaching.

- g) Provide safety measure for end effector (gripper)



WARNING

- End effector must be designed and manufactured so that they create no hazards (for example, a workpiece that comes loose) even if power source (electricity or air pressure) is cut off or power fluctuation occur.
- If there are possible danger that the object hold by the end effector may fly off or drop off, please provide appropriate safety measures, taking the consideration of the object dimension, size, weight, temperature and chemical properties.

h) Use caution when disassemble the motor for vertical axis actuator.



WARNING

The vertical axis will slide down when motor is dissembled, and may cause hazardous situation.

- Use a support to prop the vertical axis before disassembly of the motor, while emergency stop is activated.
- Be careful not to get caught between the vertical axis parts and the installing base.

i) Take the following safety precaution during inspection of controller.



WARNING

- When touching external parts of the controller, such as terminals or connectors, are required for inspection, please make sure to turn off the power switch of the controller and cut off the main power source to prevent possible electrical shock.
- Never touch internal parts of a controller.

j) Please consult with us before dealing with failure or malfunction of actuator.



WARNING

Continue on using a failure or malfunctioned actuator may cause injury to the personals or further damage to the actuator or equipment, please contact your TOYO's sales office or dealer for trouble shooting.

k) The surface of motor and decelerator may get really hot after automatic operation.



WARNING

The surface of the motor and the deceleration gearbox are extremely hot after automatic operation, burns will be caused if touched. Please allow them to cool down if inspection is required. Allow the surface temperature to drop down to reasonable range after power off.

l) Do not remove, alter or damage the warning labels on the actuator.



WARNING

- Removing or altering the warning labels on the actuator may cause accident by others.
- Make sure the warning labels are not blocked or hidden by other equipment or devices.
- Make sure the warning labels are clearly visualized from outside of the safeguard.

m) Electrical grounding



WARNING

Please ground the actuator and the controller to prevent electrostatics or electrical shock.

n) Use correct parameter settings.



WARNING

The actuator must be operated with correct tolerable moment of inertia and acceleration coefficients according to the manipulator tip mass and moment of inertia. If these are not correct, drive unit service life may end prematurely, and damage to actuator parts or may result residual vibration during position.

1-3 Safety function required for the actuator

a) Power overload detection.

When motor overload occurs, the detection activates and cut off servo power.

b) Soft limit sensors

Soft limits can be set on each axis to limit the working envelope in manual operation after return-to-home and during automatic operation.

NOTE. Working envelope is the area limited by soft limits.

c) Mechanical stopper

If the servo power has suddenly been shut off during high-speed operation by emergency stop or safety functions, these mechanical stoppers prevent the axis from exceeding the movement range. No mechanical stopper is provided on the rotating axis.

NOTE. Movement range is the area limited by mechanical stoppers.



WARNING

Axis movement will not stop immediately after servo power supply is cut off by emergency stop or other safety functions.

d) Brake for vertical axis

An electromagnetic brake installation is essential on the vertical axis to prevent sliding down of the axis when servo power is cut off. This brake shall be working when the controller is off, or when the vertical axis servo power is off even with controller is on. The vertical axis brake can be released by means of the programming unit or by commands in the program when controller is on.



WARNING

The vertical axis will slide down when brake are released, and may cause hazardous situation.

- Use a support to prop the vertical axis before releasing the break, while emergency stop is activated.
- Be careful not to get caught between the axis and the installing base when releasing the brake to perform direct teaching.

1-4 Safety measure of the system

Since the actuator is commonly in conjunction with an automated system, danger is more likely to occur from the automated systems instead of from actuator itself. Thus, appropriated safety measure must be taken on the part of the system manufacturer according to the individual system. The system provider shall provide a proper instruction manual for safe and correct operating or service of the system.

1-5 Trial run

After installation, adjustment, inspection or maintenance, follow below procedures to make trial runs.

- a) If a safeguard enclosure has not yet implied after installation of the actuator, rope off or chain off around the movement area of the actuator in place of the safeguard, and observe the following points.
 - Use sturdy, stable posts which will not fall over easily.
 - The rope or chain should be easily visible by everyone around the actuator.
 - Place a sign to keep personal from entering the movement range of the actuator.

- b) Check the following before turn on the controller.
 - If the actuator are securely and correctly installed.
 - If the electrical connection are correctly and properly wired.
 - If other connections such as pressured air supply or grounding connection proper?
 - If the actuator correctly connect to peripheral equipment.
 - Has the safety measure been taken?
 - If the installation location meet the specific environmental requirement.

- c) Check the following after turn on the controller from outside of the safeguard enclosure.
 - If the actuator start and stop as intended, if the operation mode can be selected correctly.
 - If each axis move as intended within the soft limit.
 - If the end effector act as intended.
 - If the signal transmissions to the end effector and peripheral equipment are correct.
 - If emergency stop work.
 - If the teaching and playback function are normal.
 - If the safeguard enclosure and interlock are working as intended.
 - If the actuator move correctly during automatic operation.

1-6 When working inside the safeguard enclosure.

- a) When working inside the safeguard enclosure is required, always turn off the controller and place a clear visual indication showing that the actuator is been adjusted or serviced. This is to prevent others from touching the controller switch or operation panel.
- b) With the following two cases where powering off is not an option:
1. Soft limit settings, please follow the precautions and procedures for each section.
 2. Teaching
When performing teaching inside the safeguard enclosure, comply with the instructions listed below.
 - (1) Before entering the safeguard enclosure.
 - Visual check if there is any hazard inside the safeguard enclosure.
 - Check that that programming unit MPB or DPB operate correctly.
 - Make sure there is no failure within actuator.
 - Double check if emergency stop work correctly.
 - Select teaching mode and prohibit automatic operation.
 - (2) Never enter the movement range of the actuator while inside the safeguard enclosure.

1-7 Automatic operation

- a) Before start, please check the following:
- There is no one inside the safeguard enclosure.
 - The programming unit and tools are in their specified locations.
 - The alarm or the error lamps of the actuator and the equipment has not been triggered.
 - The safeguard enclosure is securely installed with safety interlock active.
- b) Observe the following during automatic operation or in case there are errors occurred.
- After the automatic operation has started, check the operation status and warning lamps to ensure that the actuator is in automatic operation.
 - Never enter the safeguard enclosure while automatic operation is active.
 - In case an error has occurred within the actuator or peripheral equipment, obey the following procedure before entering the safeguard enclosure.
 1. Activate the emergency stop to stop the actuator completely.
 2. Place a sign on the starting switch, indicating that the actuator is been inspected, this is to prevent others from touching the start switch or restart the actuator.

1-8 Adjustment and inspection.

Please do not attempt any installation, adjustment, inspection or maintenance of the actuator unless it is stated within this manual.

Please refer to the following chapters for details.

1-9 Repair and modification.

Please do not attempt any repair, part replacement or modification of the actuator unless it is stated within this manual. The involved actions required qualified technician with professional knowledge and skills, proceed without the knowledge and skills may result hazards.

2. Warranty

Warranty Period

The warranty period is effective for:

- 18 Months (one year and half) after shipment from Taiwan factory.
- 12 Months (one year) after installation.

Whichever period meets first.

Exceptions to warranty

The warranty will not apply in the following cases:

- Fatigue arising due to the passage of time, nature wear or tear occurring during operation (nature fading of painted or plated surfaces, deterioration of parts subjects to wear)
- Consumables.
- Damage due to earthquake, storms, floods, thunderbolts, fire or any other natural or man-made calamities.
- Trouble caused by actions prohibited by this manual.
- Modifications of the product not approved by TOYO or TOYO's sales representative.
- Use of any other than genuine parts or specified lubricant or grease.
- Insufficient or incorrect maintenance or inspection.
- Repair or service done by non-authorized dealer.

In addition, we will be responsible for repairing our own product, but are not responsible for other losses caused by the failure of our product.

Service coverage

We will provide the following service.

- Guide for installation and trial operation.
- Guide for maintenance.
- Guide or training on technical operation and wiring.
- Guide on programming.

3. Part's Name



① Motor end

② Motor Opposite Side

③ Carriage

④ Main Body

⑤ Dust proof cover

⑥ Side cover

⑦ Top Cover

⑧ Coupling cover

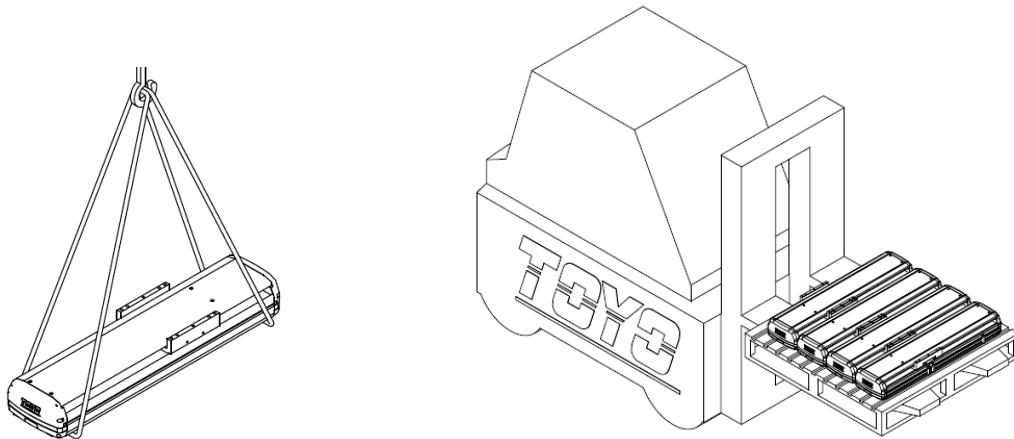
4. Installation

4-1 Transportation

All personal shall bare safety measure while transporting the actuator regardless the method used, proper gears such as safety helmets and gloves shall be equipped. The weight of the product is stated in the specification sheet, please select suitable means to transport.

In case transported by hoists, make sure to use the ropes which can handle the weight. Please also make sure the rope is properly positioned where the product is balanced while lifted.

In case transported by folk lifter or cart, make sure the product is properly positioned to keep its balance and the parts which stands out of the folk or cart will not collide into any other objects.



The following parts of the actuator are not suitable part to apply force for transportation.

- Carriage.
- End plates either sides.
- Top Cover.
- Any cables whether power cable or signal signals, if the motor is installed.

4-2 Installation environment and base requirement

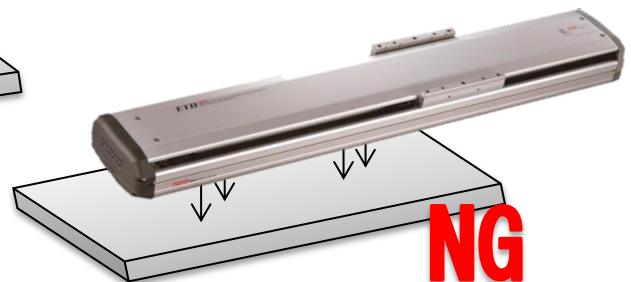
The environmental requirement or restriction for Toyo's actuator is:

Item	ETH	ECH
Surrounding temperature while operating.	0~45°C	0~45°C
Surrounding humidity while operating.	35~85% RH	35~85% RH
Maximum installation height.	0~1000m above sea level.	0~1000m above sea level.
Surrounding	Avoid the following environment: Near water, cutting liquid, dust, metal chips or solvents. Environment filled with corrosive gas or liquid. Environment filled with flammable materials in any forms. Locations where surrounded by electro-magnetic disturbance, statistic or radio-wave emitting. Locations where there are vibration sources nearby or easily collided. Please provide enough space for service.	

Installation base requirement:



OK



NG

Correct installation base

Incorrect installation base

- The installation base should be solid and rigid to sustain the vibration from operation, also must be able to sustain the weight of the actuator plus the working piece.
- The installation base must be even, within the range of $\pm 0.05\text{mm}/500\text{mm}$.
- The installation base must be bigger than the mounting surface, and has

enough mounting holes for screws.




4-3 Driver motor assembly





All assembly shall be done by qualified and experienced technician.

Make sure the power has been turned OFF from power source.

Assembled model: ETH5、ETH6




Ball screw type actuator with direct driven externally assembled motor (BC)

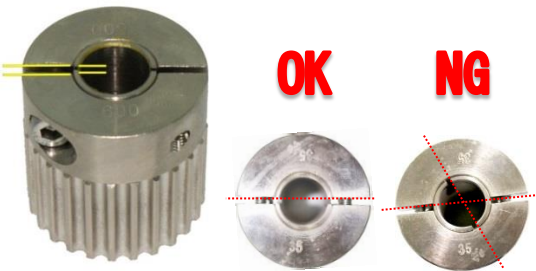
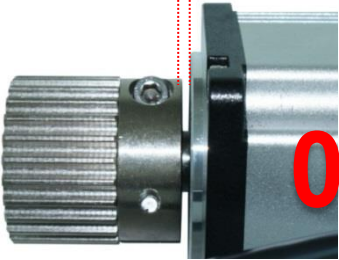

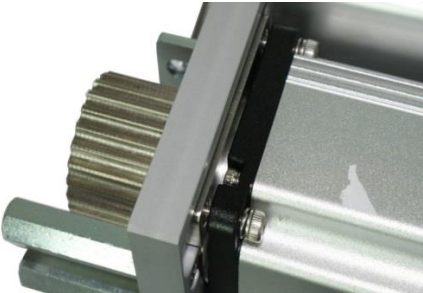
NO	Explanation	Explanation with pictures
1)	Remove the 4 screws on the coupling cover.	
2)	Loose the motor tightening screw on the coupling. In case the coupling is not included, please install one after removal of the coupling cover.	
3)	Assemble the motor onto the actuator.	

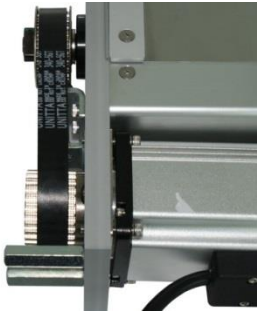

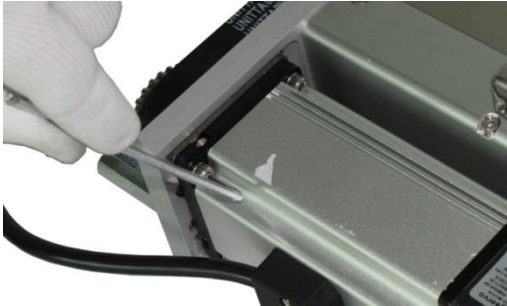


4)	<p>Before apply the mounting screw, make sure the cable outlet direction does not obstruct with surrounding objects upon installation. Also, please apply spring washers to the mounting screws. Tightening the mounting screws.</p>	
5)	<p>Tighten the tighten screws for motor on coupling.</p>	
6)	<p>Screw back the coupling cover.</p>	
7)	<p>Thus, the assembly of direct driven externally assembled motor is finished.</p>	


Assembled models: ETH10、ETH12、ETH13、ETH14、ETH17、ETH22
 ETB5、ETB6

Ball screw type actuator with wrapped around motor:
 Motor on left side (BL) Motor on right side (BR)、
 Motor on lower side (BM)

NO	Explanation	Explanation with pictures
1)	Dissemble the gear cover by removing the 4 mounting screws.	
2)	Dissemble the position fixing plate from the unit for motor installation.	
3)	The wrap around motor type required a belt and a screw-on gear to drive the actuator.	

<p>4)</p>	<p>Before assemble the gear onto the motor, make sure the gap for inner wheel matches the gap from the two clamp-on-piece.</p>	 <p>The image shows a gear on the left with a yellow double-line indicating its inner diameter. To its right are two circular clamp-on pieces. The first is labeled 'OK' and has a red dashed line showing a consistent gap between its inner diameter and the gear's inner diameter. The second is labeled 'NG' and has a red dashed line showing an inconsistent, larger gap.</p>
<p>5)</p>	<p>Make sure once the gear is installed on the motor, there is a small gap between gear and motor.</p>	 <p>The image shows a gear mounted on a motor shaft. A red dashed vertical line indicates a small, uniform gap between the gear's outer teeth and the motor housing. The label 'OK' is in red.</p>
<p>6)</p>	<p>The picture on the right is a bad example as there is no gap between gear and the motor.</p>	 <p>The image shows a gear mounted on a motor shaft. The gear's teeth are in direct contact with the motor housing, with no visible gap. The label 'NG' is in red.</p>
<p>7)</p>	<p>Install the motor with gears onto the unit with the position fixing plates in between, and make sure there are spring washers installed on screws. As belt tension adjustment is required, please do not tighten the screws yet.</p>	 <p>The image shows a gear assembly mounted on a metal frame. Position fixing plates are placed between the gear and the frame. A screw is visible, and the text in the instructions indicates that spring washers should be used and the screw should not be tightened yet.</p>
<p>8)</p>	<p>Insert the belt on the gear which drives the ball screw first. It is usually firstly insert the belt into the gear with the side grip.</p>	 <p>The image shows a hand using a side grip to insert a black timing belt into a gear. The belt is being fed into the gear's teeth from the side.</p>




9)	Insert the other end of the belt into the gear assembled onto motor, make sure to position the belt at the center of the gear.	
10)	Adjust the tension of the belt by turning the screw with the open wrench.	
11)	After the tension of the belt has met the requirement, tighten the mounting screws of the motor.	
12)	Fix the nod on the tension adjustment screw.	
13)	Use a belt tension gauge to confirm if the belt tension is correct. Please refer to 【Table 1】 Ball screw type actuator belt tension meter.	

14)	Resemble the cover with the 4 mountings screw to finish the assembly of the motor.	
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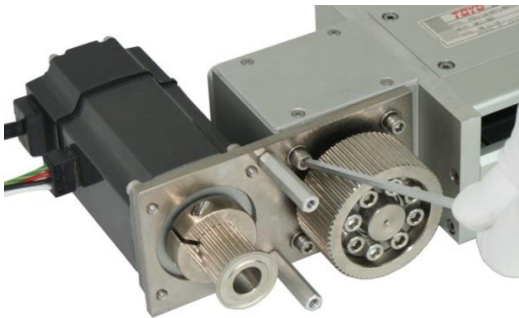

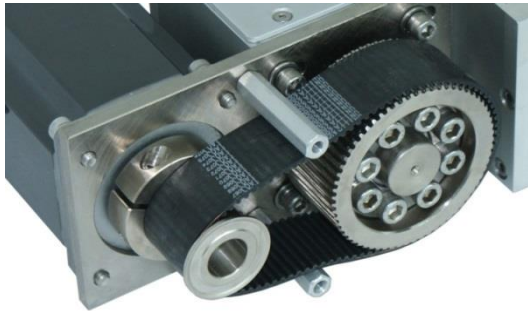
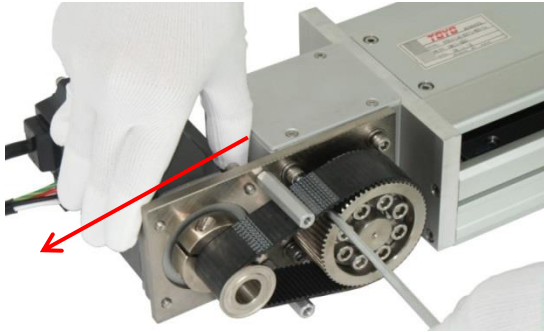

【Table 1】 Ball screw type actuator belt tension meter.


Type	Belt spec.	Tension
ET (C) H 5	3GT-12W-207L	10-15N
ET (C) H 5M	2GT-12W-196L	10-15N
ET (C) H 6	3GT-12W-207L	10-15N
ET (C) H 6M	2GT-12W-196L	10-15N
ET (C) H 10	BL-3GT-15W-336L BR-3GT-15W-252L BM-3GT-15W-273L	46-56N
ET (C) H 12	BL&BR-3GT-15W-300L BM-3GT-15W-273L	46-56N
ETH 13	BL&BR-5GT-15W-340L BM-5GT-15W-275L	55-65N
ET (C) H 14	BL&BR-5GT-15W-340L BM-5GT-15W-275L	55-65N
ET (C) H 17	BL&BR-5GT-20W-420L BM-5GT-20W-340L	95-105N
ET (C) H 22	BL&BR-5GT-20W-L475 BM-5GT-20W-375L	95-105N

Assembled motors : ETB10 、 ETB12 、 ETB14 、 ETB17 、 ETB22
Belt type actuator.

NO	Explanation	Explanation with pictures
1)	Remove the screws for motor mounting.	
2)	Dissemble the gear cover by removing the 2 mounting screws.	
3)	The required components for motor installation are: motor, belt, and gear.	

<p>4)</p>	<p>For three-piece-clamp-on type of gear, before assemble the gear onto the motor, make sure the gap for inner wheel matches the gap from the two clamp-on-piece.</p>	
<p>5)</p>	<p>Make sure once the gear is installed on the motor, there is a small gap between gear and motor.</p>	
<p>6)</p>	<p>The picture on the right is a bad example as there is no gap between gear and the motor.</p>	
<p>7)</p>	<p>Tighten the two screws to fix the position of the gear.</p>	
<p>8)</p>	<p>Install the motor and gear onto the unit. Make sure there are spring washers installed on screws, and also the position of the power outlet of the motor meet the requirement.</p>	

<p>9)</p>	<p>Loose the screws for motor fixing plate will allow movement of motor with gear for belt tension adjustment.</p>	
<p>10)</p>	<p>Insert the belt into the gear with side grip first. In this case, it's the motor side one.</p>	
<p>11)</p>	<p>Install the belt onto both gear.</p>	
<p>12)</p>	<p>Adjust the tension of the belt by moving the motor mounting plate, once the belt reach the correct tension, please tighten the screws for motor mounting plate.</p>	
<p>13)</p>	<p>Use a belt tension gauge to confirm if the belt tension is correct.</p> <p>Please refer to 【Table 2】 belt type actuator belt tension meter.</p>	

14)	Re-assemble the gear cover to finish the assembly of the motor.	
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【Table 2】 belt type actuator belt tension meter.

Type	Opening belt spec	Tension	Belt spec	Tension
ET (C) B 5			2GT-9W	25. 2N
ET (C) B 6			2GT-12W	34. 5N
ET (COB 10	AT5-15W	96N/1000mm	5GT-15W-260L	96N
ET (C) B 14M	AT5-22W	157N/1000mm	3GT-25W-288L	123N
ET (C) B17M	AT5-30W	220N/1000mm	3GT-25W-288L	123N
ET (C) B 22M	AT5-50W	373N/1000mm	5GT-30W-430L	220N

4-4 Installation.

The procedure for installation as follow:

- a) Check screw position on installation surface matches the ones on unit, please refer to the specification sheet.
- b) Remove the side cover or the top cover of the unit.



- c) Move the carriage to ensure all screws are installed.
- d) Tighten all screws to install the unit.



e) Install the covers back to finish installation.

Please note that for ET(C)H5M and ET(C)H6M, the removal for dust proof plate is required, please refer to **5-3 Replacing and adjusting the dust proof plate** for details.

5. Inspection and Maintenance

Periodic inspection and maintenance before operation are required to ensure the safety and lifetime of the product. Please proceed as follow:

- Daily inspections before operation. (Everyday)
- Seasonal inspection and maintenance. (Every three months.)
- Semi-annual inspection and maintenance. (Every six months.)
- Annual inspection and maintenance. (Every twelve months.)

More frequent inspection and maintenance are required with more frequent operation.

5-1 Inspection and maintenance frequency

Inspection : ● Maintenance : ◎

Parts	Daily	Every three month	Every six month	Every twelve month	Check points	Trouble shoot
Cables, power or signal	●				●Checking if there are any part of the cable is damaged.	●Replacement required if damaged.
Ball screw or bearing	●	●◎	●◎	●◎	●Checking if there is any abnormal vibration or noise. ◎Recommended grease: AFEP2 or NSK LG-2	●If there are dirt on the rail, remove and re-apply grease. ●Make sure there are enough grease on the parts.
Dust proof plate	●	●	●	●	●Check if there is any damage ●Check if it is loose.	●Replacement is required if it effects functionality ●Re-adjust the plate if any part of it is loose.
Linear rail	●	●◎	●◎	●◎	●Check if the screw fixing the rails has gone loose. Please refer to 【Table 3】 various parts of screw torque values chart. ●Check if there are noises while slide is moving. ◎Recommended grease: AFEP2 or NSK LG-2	●Tighten if loose. ●If there are dirt on the rail, remove and re-apply grease. ●Make sure there are enough grease on the parts.

Parts	Daily	Every three month	Every six month	Every twelve month	Check points	Trouble shoot
All screws		●	●	●	●Check if any of the screw are loose. Please refer to 【Table 3】 various parts of screw torque values chart.	●Tighten if loose.
Nut				●◎	◎Recommended grease: AFEP2 or NSK LG-2	
Slides	●	●	●◎	●◎	●Check if there are noises while slide is moving. ◎Recommended grease: AFEP2 or NSK LG-2	●If there are dirt on the rail, remove and re-apply grease. ●Make sure there are enough grease on the parts.

【Table 3】 various parts of screw torque values chart.

Screw Size	Torque value (kgf·cm)	Torque value (N·m)
M3	15	1.5
M4	37	3.7
M5	72	7.2
M6	118	11.8
M8	295	29.5
M10	590	59.0

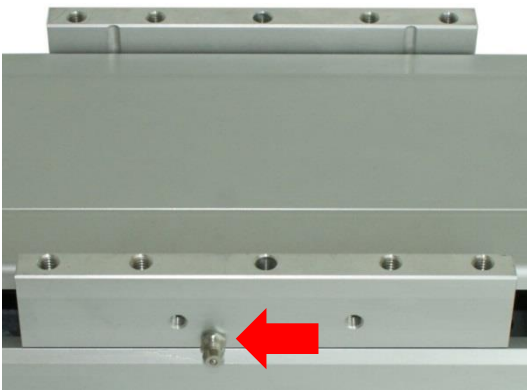
5-2 Applying grease

Make sure to turn off the power before proceeding the following.

Apply the grease periodically.

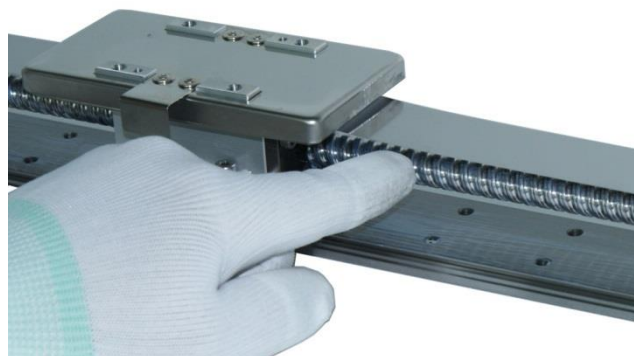
Recommended grease: AFEP2 or NSK LG-2

If the unit is installed with the Toyo patented external grease fitting, which distributes to rail and ball screw if apply grease to the fitting.



If the unit is without Toyo patented external grease fitting, please refer to below:

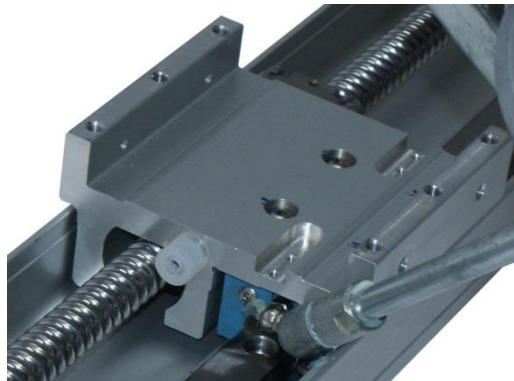
- a) Remove top or side cover.
- b) Apply grease directly to ball screw.



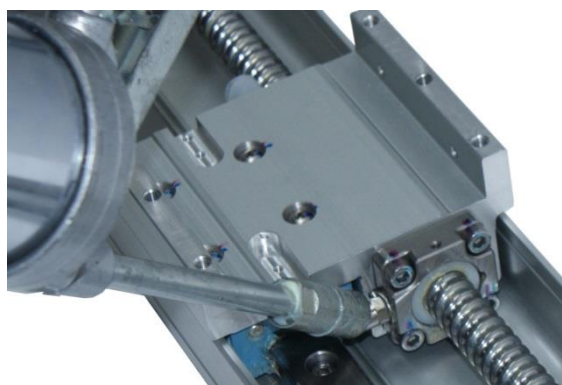
c) Apply grease directly to linear rail.



d) Apply grease to sliders via greasing fitting on slider.



e) Apply grease to nut via greasing fitting on nut.



5-3 Replacing and adjusting the dust proof plate

Make sure to turn off the power before proceeding the following.
To change the dust proof plate:

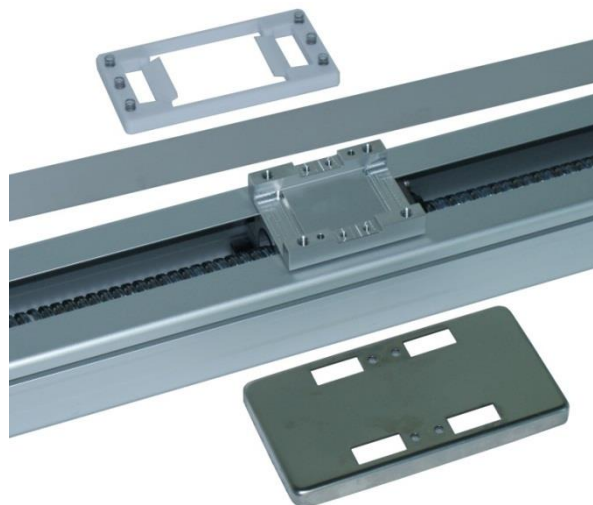
a) Disassemble the carriage cover by removing the 4 screws



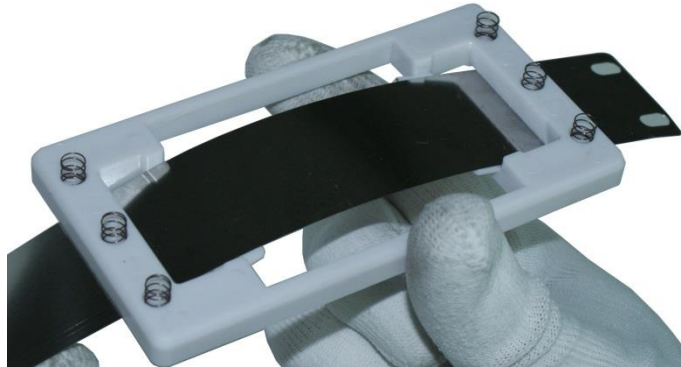
b) Remove the 4 screws which mounts the plate, 2 at each sides of the unit.



c) Disassemble the dust proof plate and the plate holder.



d) Replace the dust proof plate.



e) Reverse the above mentioned steps to re-install the plate and the cover, as adjustment of the plate is required, please do not tighten the screws on both ends yet.

f) After install the cover, pull the plate towards the end by pushing down and push with fingers while tighten the 4 screws at both ends. Please make sure not to apply too much force on the plate or else it will easily cause



deformation of the plate.



Repeating the above steps might be required to tighten the plate.

The plate might be expanded and require tightening after long time of operating. Please follow below steps to adjust the plate.

Make sure to turn off the power before proceeding

- a) Loose but not removing the mounting screws at both end of the plate.
- b) Pull the plate towards the end by pushing down and push with fingers while tighten the 4 screws at both ends. Please make sure not to apply too much force on the plate or else it will easily cause deformation of the plate.

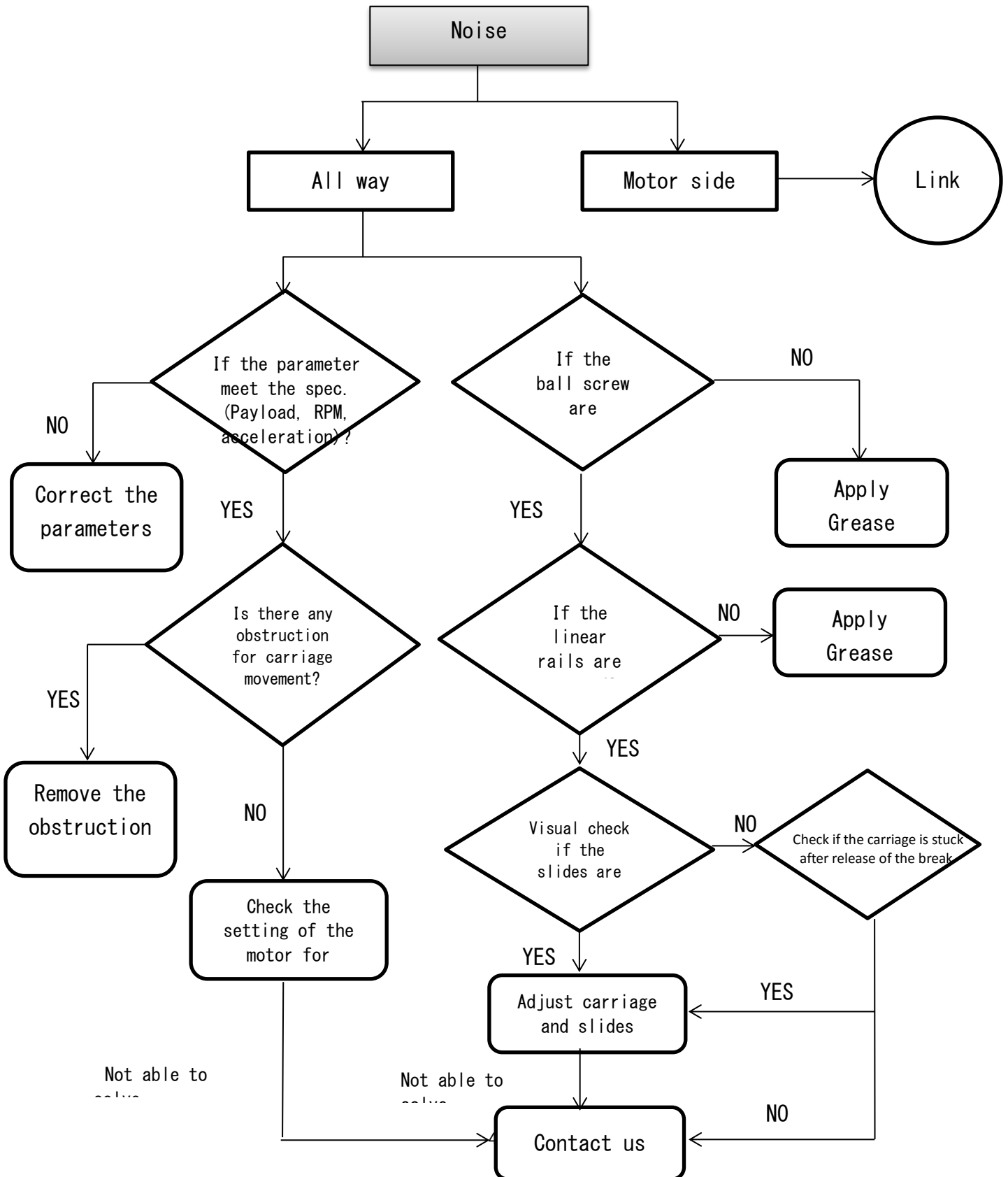
5-4 Consumable

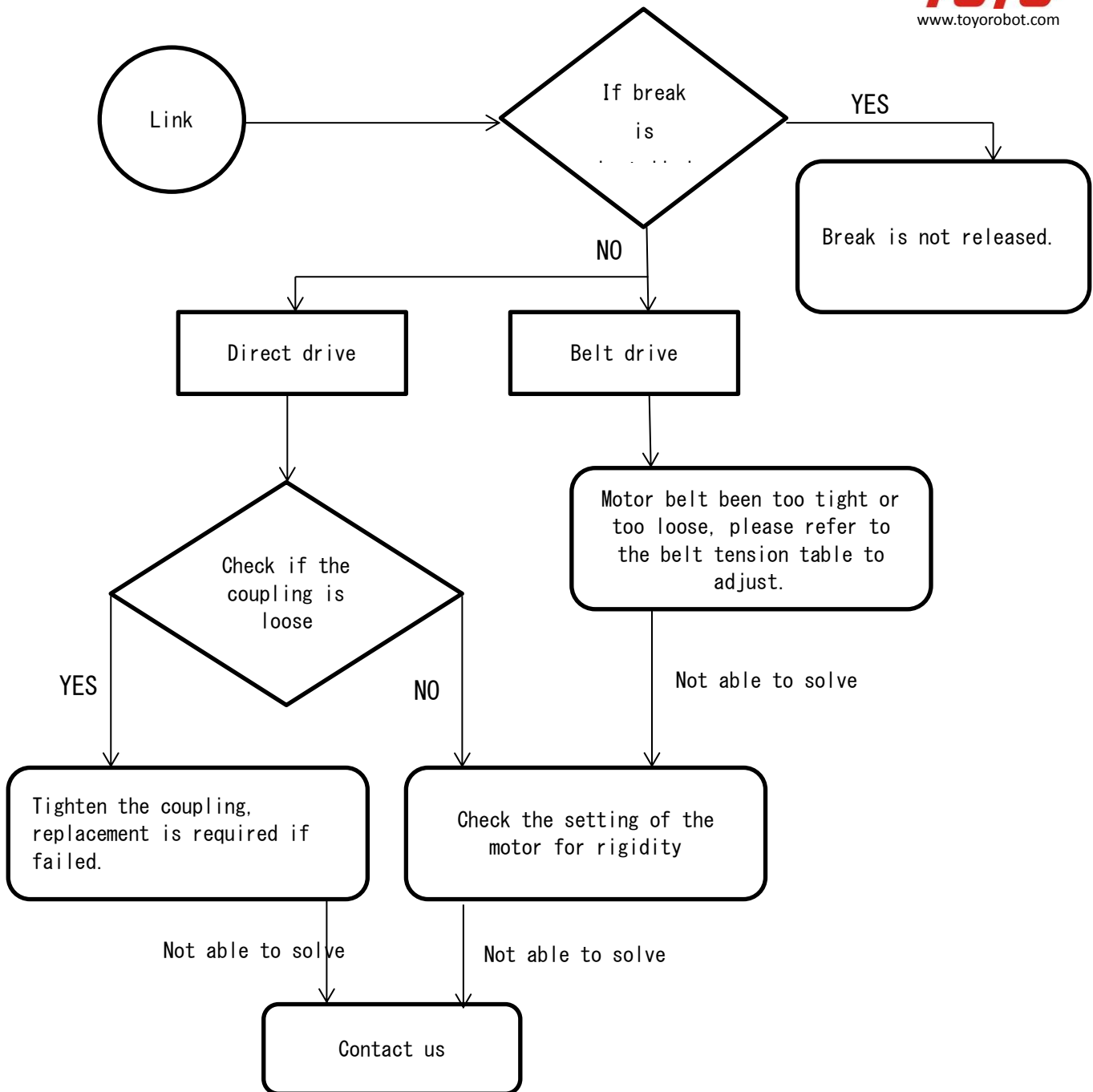
Parts of the actuator will get damaged consumed after certain period of time of operating, please check the status of the following parts during maintenance

Parts	Replacement required when
Sensor	No longer functional.
Dust proof plate	Expended too much or damaged, can be checked visually.
Belt	Broken or ripped.

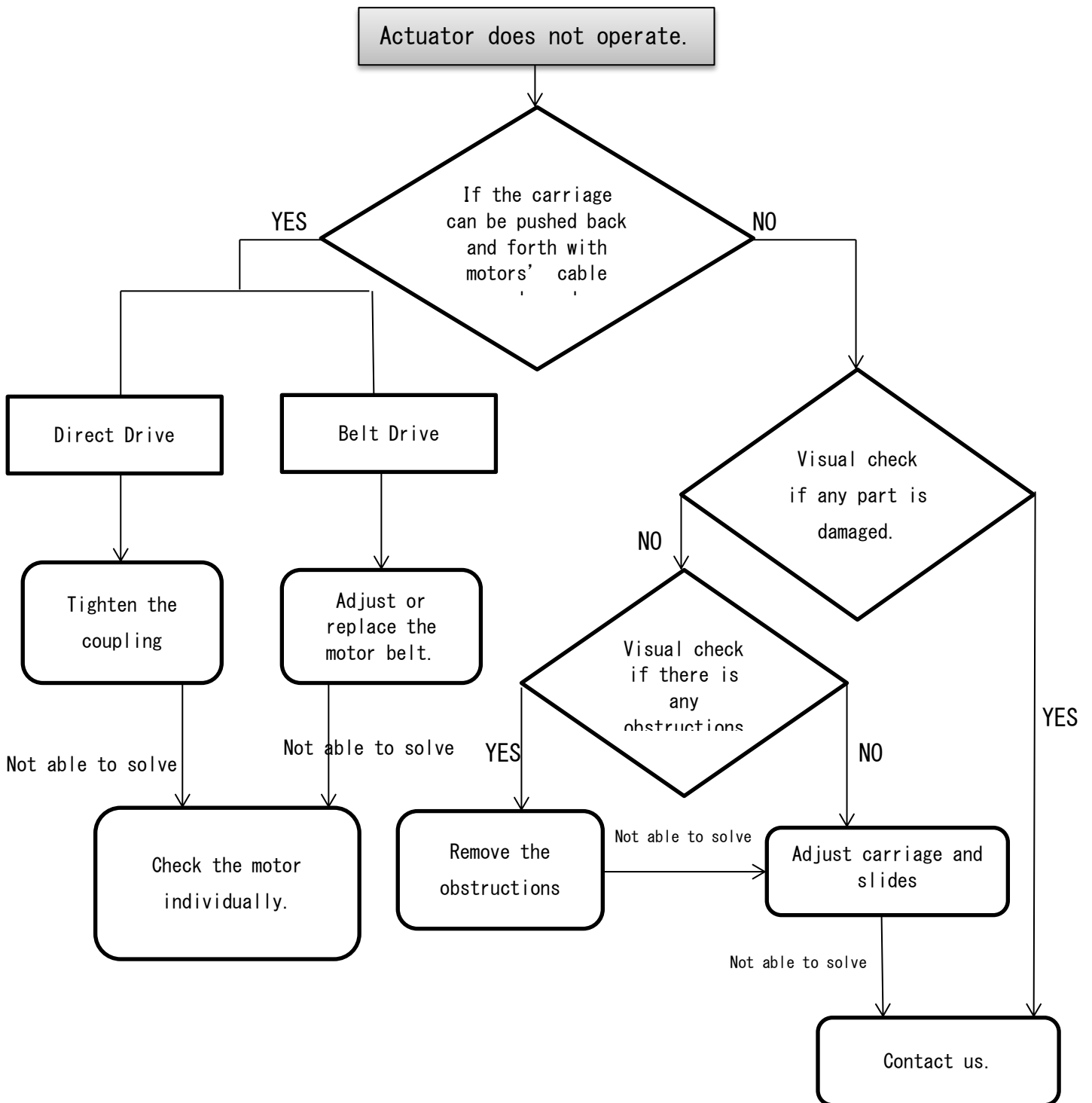
6. Trouble Shooting

6-1 When there is noise during operation





6-2 When actuator does not operate



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