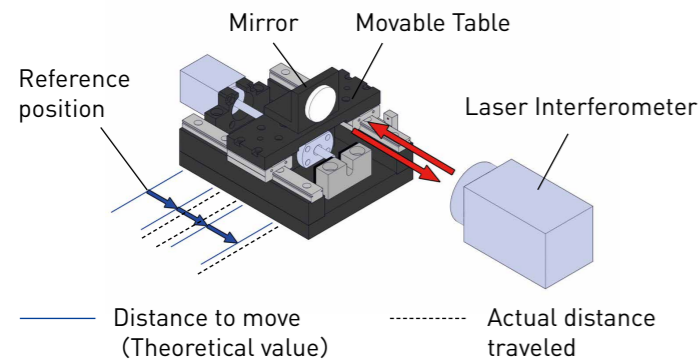


Technical Description of the Actuator products

Accuracy of the Actuator and Measurement method

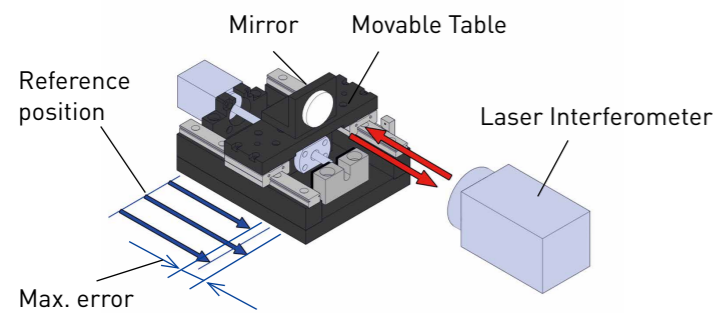
We introduce the method to inspect the positioning related accuracy, and optional inspection (on demand) as below.

[Absolute Positioning Accuracy]



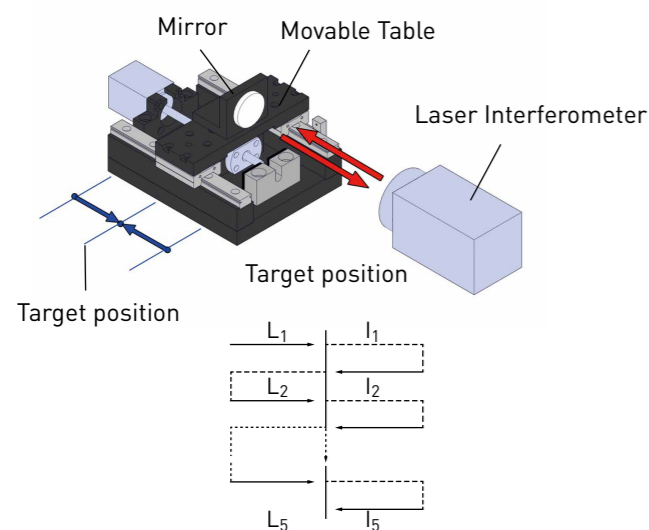
Absolute positioning accuracy is the difference between actual and ideal position in one direction. Measurement is done at several arbitrary points within effective travel range, it should be repeated 5 times under the same points. Maximum difference for each measurement is defined as Absolute Positioning Accuracy.

[Repeatability]



Repeatability is the difference between actual and ideal position at the arbitrary one point from the same direction. 5 times measurements should be conducted at the same point from the same direction. Half of maximum gap of measurement with \pm should be defined as Repeatability.

[Lost Motion]

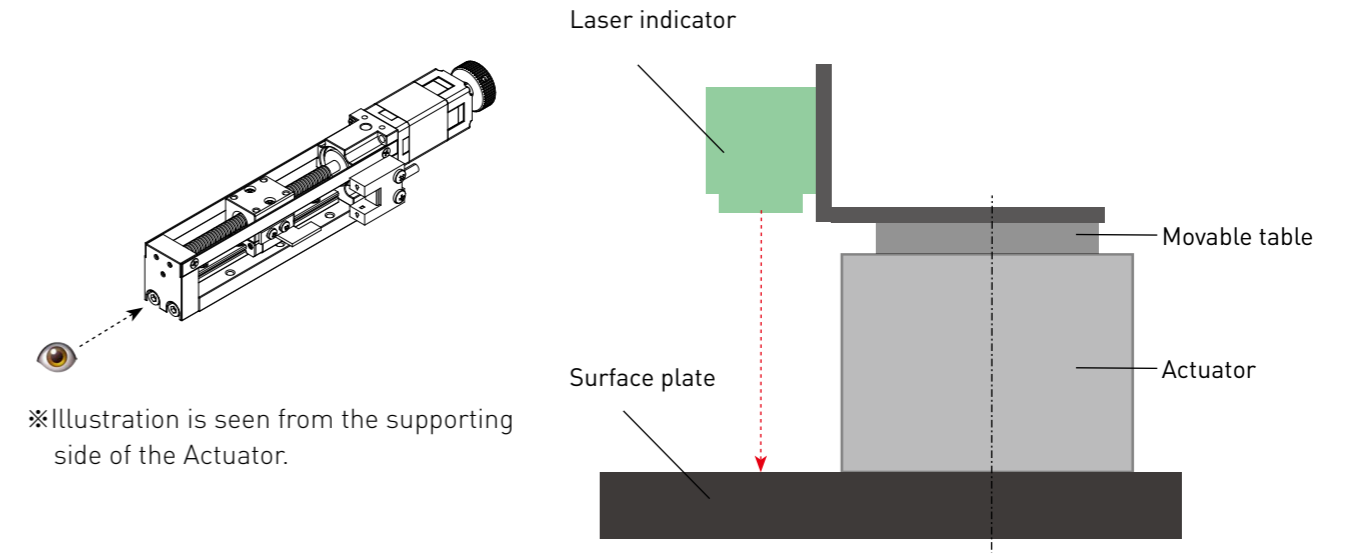


Lost motion is frankly the back and forth positioning error at the arbitrary one point from the different direction. Averaged number of the difference between forward and backward should be obtained for 5 times measurements at the center and both end points. Maximum number from the measurement above is defined as Lost Motion.

[Parallelism]

Applicable for Slider type Actuator

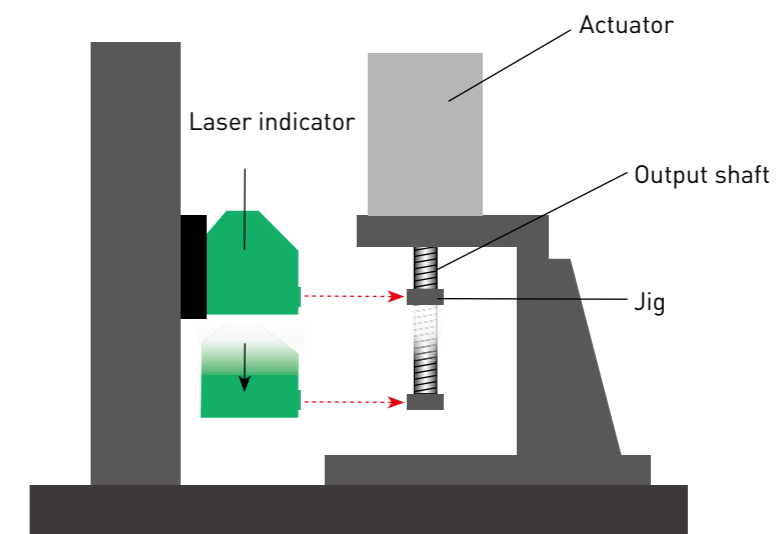
Set the Laser indicator on top of the table of the Actuator which is secured on the surface plate, measure the displacement when moving entire travel range and take the maximum value as Parallelism.



[Straightness]

Applicable for Cylinder type Actuator, Z- θ Actuator

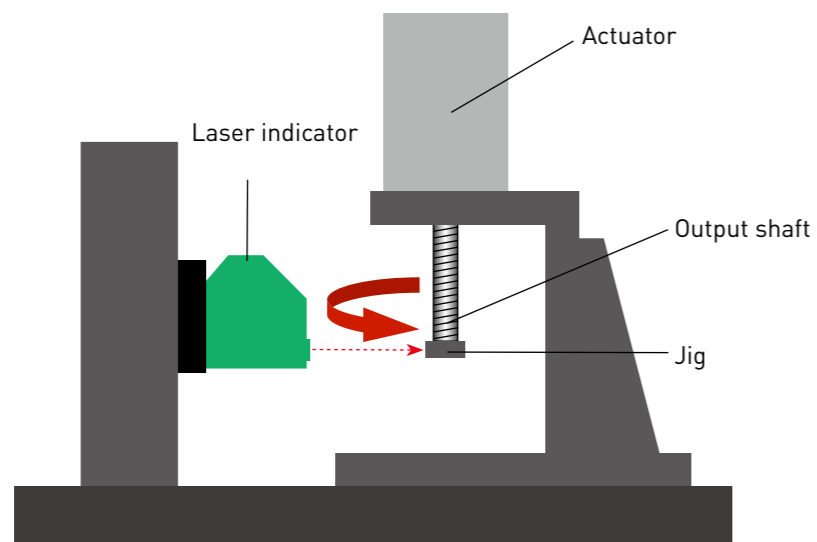
By using the Laser indicator which synchronized with output shaft, reciprocate the shaft from home position one time and inspect the maximum value of difference. Do the same inspection by setting the Actuator at 90 degrees of phase, take the maximum value for both measurement as Straightness.



[Runout of shaft travel end]

Applicable for Z-θ Actuator

Rotate the Shaft at the position which the shaft moved entirely toward the end of travel, the amount of deflection measured by Laser indicator is defined as Runout of shaft travel end. Measurement is done for 360 degrees.



[About optional inspection items with charge]

Parallelism, Straightness, and Runout of Shaft travel end are inspection items that will be charged. Inspection data is packing together in the product with the actual measurement value on the inspection certificate.

[About shipping inspection]

Positioning-related accuracy is executed as shipping inspection, and the Certificate of Inspection shown below is issued for the product that meets the inspection standard. The Certificate of Inspection is shipped with the product.

If you require the actual measured value, we will issue the Inspection Report with charge.

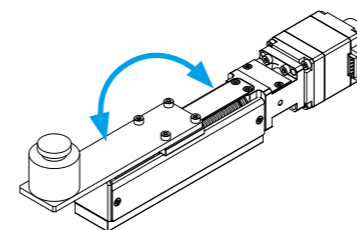
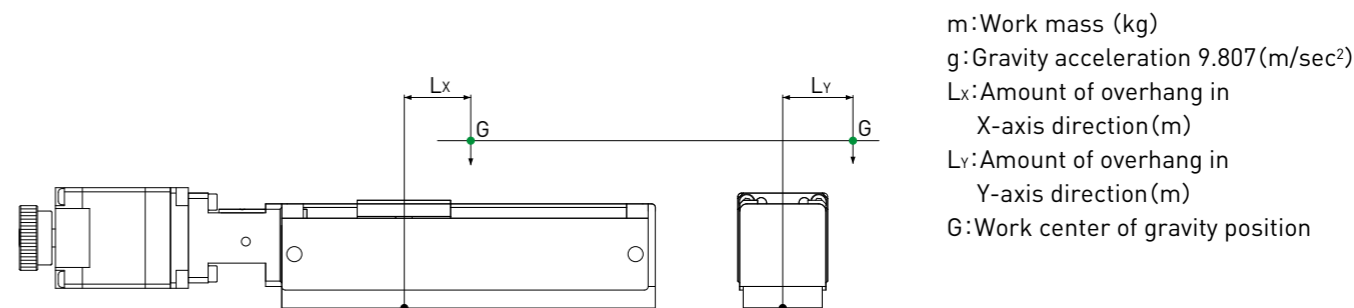


Permissible Moment for the Actuator

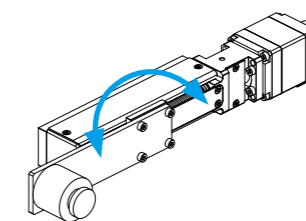
[Permissible Moment of Slider type Actuator]

Momentum Load which is applicable for Slider type Actuator is defined in three (3) directions; Mp (pitching) My(yawing) and Mr (Rolling). KSS is setting the Permissible Moment for each series of the Slider type Actuator.

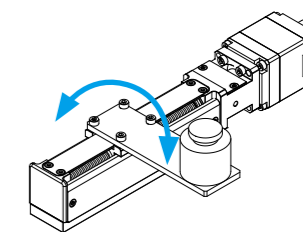
Please apply calculation formula below to calculate the value of Moment of Load under operating condition, make sure not to exceed the value of Permissible Moment shown in the table below. Please note that using the Actuator by exceeding the maximum value in each limit may cause the risk of malfunction or breakage of the product.



Formula for Mp (Pitchng)
Mp=m·g·Lx



Formula for My (Yawing)
My=m·g·Ly



Formula for Mr (Rolling)
Mr=m·g·Lr

Table S-1 : Permissible Moment for Slider type Actuator

Unit: Nm

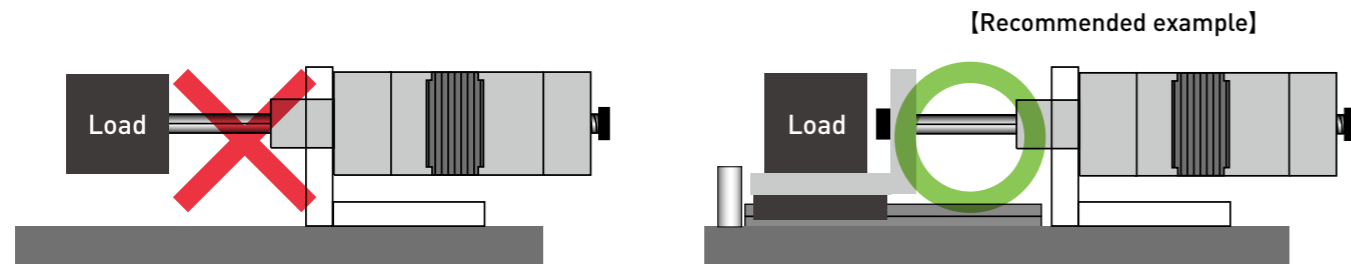
Actuator series	Pitchng (Mp)	Yawing (My)	Rolling (Mr)
Flex Actuator	0.10	0.09	0.23
Compact Actuator NEMA 6 size	0.14	0.12	0.22
MoBo Actuator	0.16	0.10	0.20

Moment Load to the Ball Screw with Ball Spline (BSSP)

Please be careful that Radial or Momentum Load cannot be applied to those products such as BSSP, Z-θ Actuator or Linear Actuator.

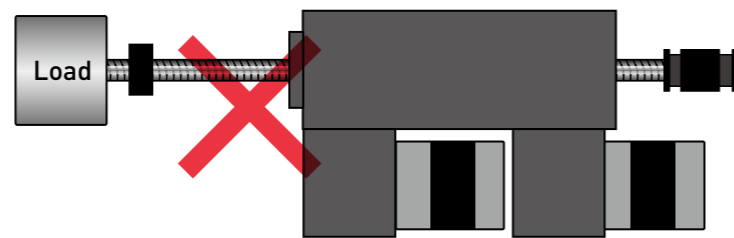
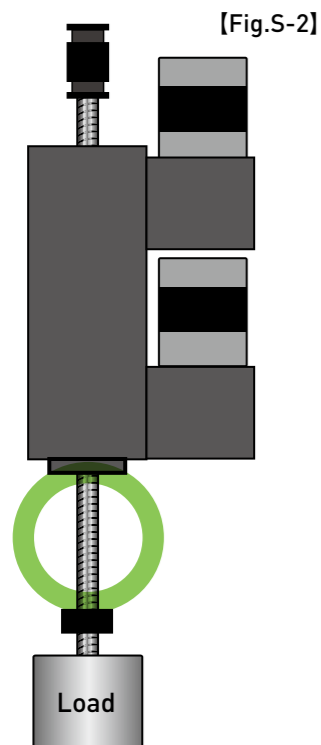
Radial or Momentum Load may affect to Ball Screw's function due to its structure as BSSP, which is Ball Screw and Ball Spline lying on the same axial line. It may cause earlier damage or breakage of the recirculation parts.

Captive type Load applying example



- Do not apply load as illustration shown above left.
- In horizontal position, configure as illustration shown above right as recommended example to apply radial load by Guide rail.

Z-θ Actuator Load applying example



※Illustration above is used Belt-Drive type as example. Please refer to the example and use the same posture for Direct-Drive type and Hybrid-Drive type.

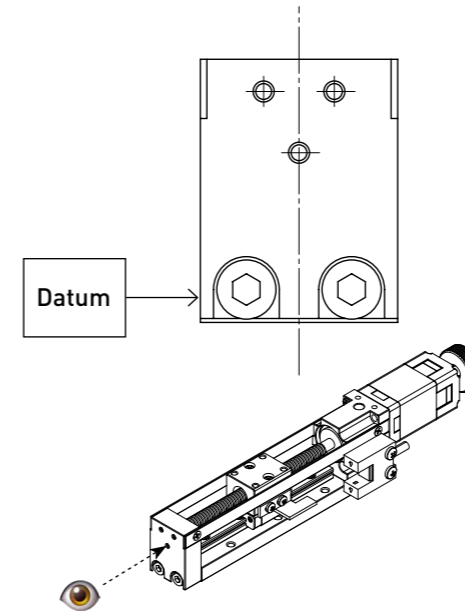
- Radial load cannot be applied on Z-θ Actuator. Please use it in vertical position, as illustrated in Fig.S-2 .
- Do not apply load as Fig.S-3. Radial load will directly apply to Ball Screw and may damage recirculation part of Ball Screw.

Assembling method and precautions for the Actuator

[Datum clamp face of Slider type Actuator]

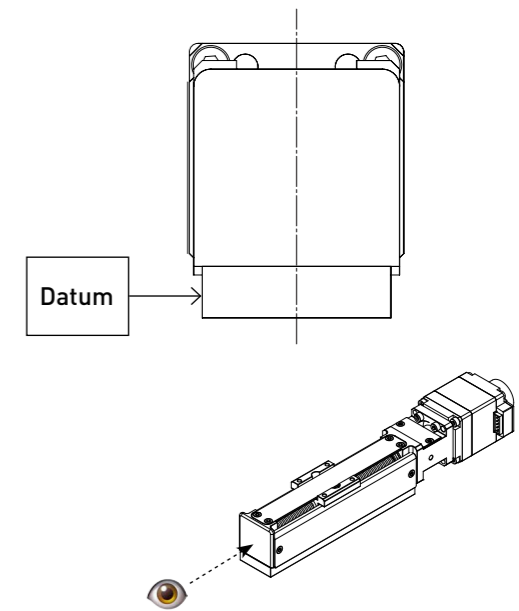
Use the Datum clamp face when assembling the Slider type Actuator to the device.
Note that Datum clamp face does not guarantee parallelism with the movable table.

•Compact Actuator (CAS)



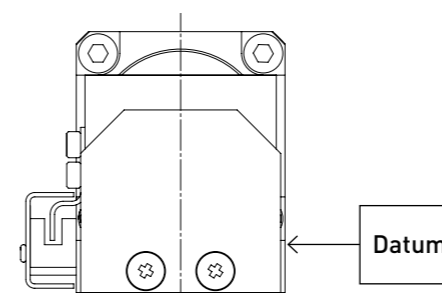
※Illustration is seen from the supporting side of the Actuator.

•Flex Actuator (FAS)

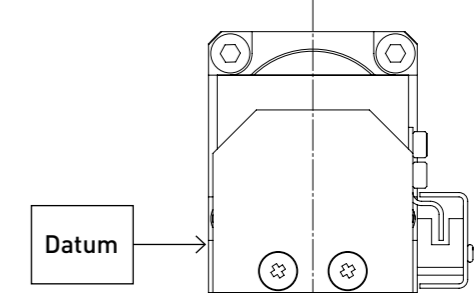


※Illustration is seen from the supporting side of the Actuator.

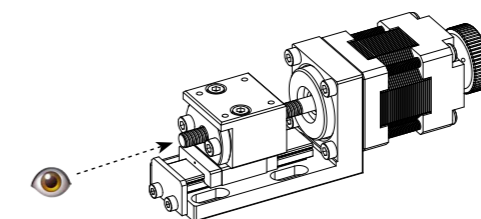
•MoBo Actuator (MAS)



Sensor is in the left position.



Sensor is in the right position.

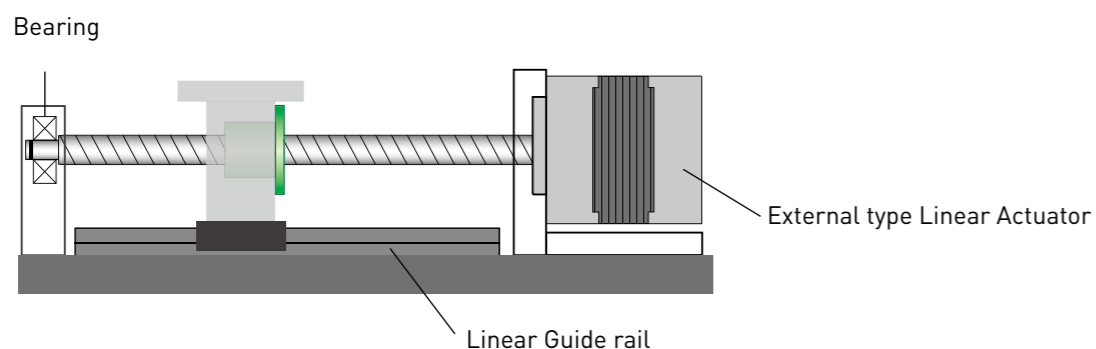


※Illustration is seen from the shaft end of the Actuator.

【Linear Actuator】

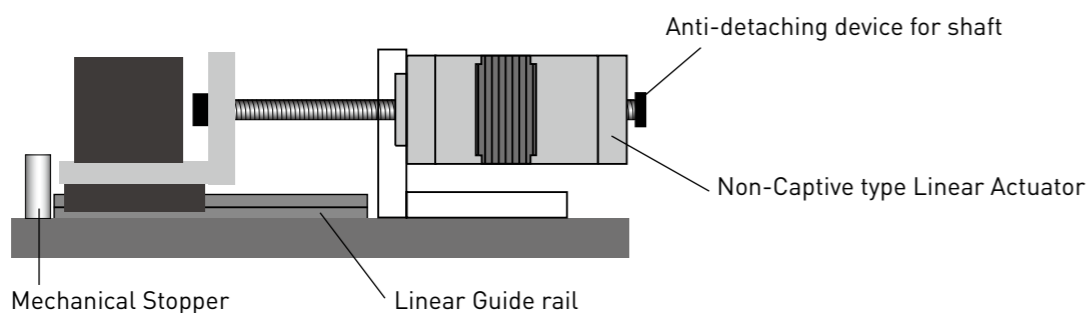
Customer should be careful with assembling and using KSS Actuator due to its compactness and light-weighted design. There are differences of assembling method and precautions depending on each type of Actuator, so please refer to instruction below to assemble and use them properly.

External type Assembling example



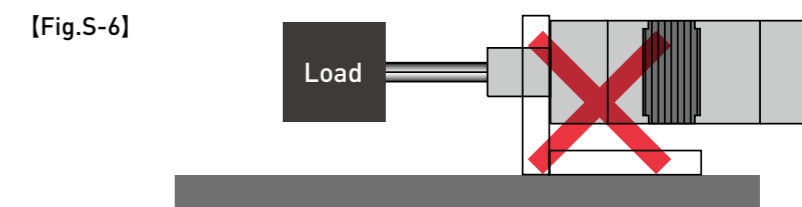
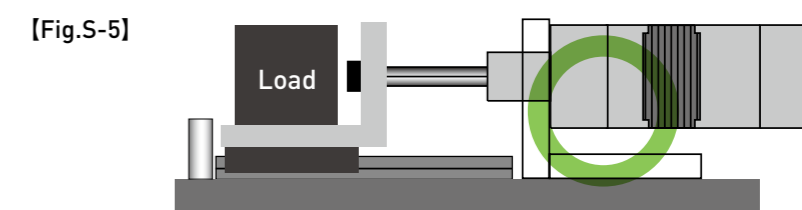
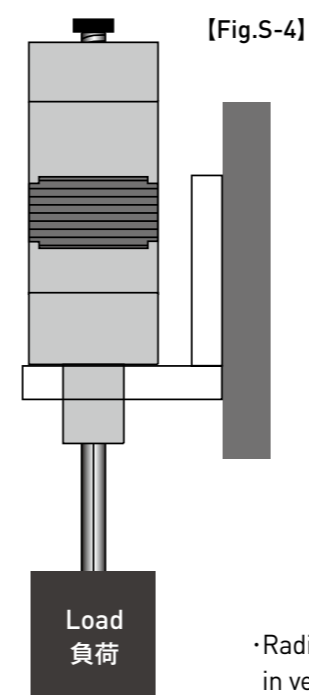
- External type does not have anti-rotating device. External anti-rotating device, such as Linear Guide rail, should be set up when usage.
- Please support journal end by Bearing.

Non-Captive type Assembling example



- Non-Captive type does not have anti-rotating device. External anti-rotating device, such as Linear Guide rail should be set up when usage. In addition, Radial load should be applied on External anti-rotating device.
- Do not use anti-detaching device for shaft as mechanical stopper for linear movement. It may damage the Actuator by excessive force input. Anti-detaching device is for the shaft not to slip out from the Motor. Please set up mechanical stopper outside body like shown in figure above.

Captive type Assembling example

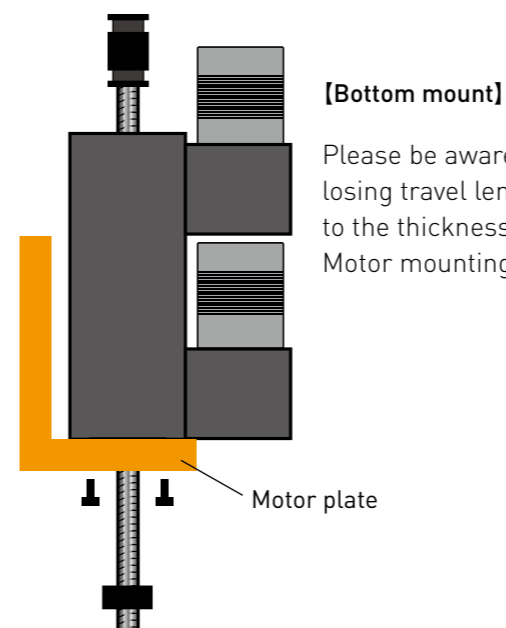


- Radial load cannot be applied on Captive type Linear Actuator. Please use Captive type Actuator in vertical position, as illustrated in Fig.S-4 above.
- In horizontal position, configure as Fig.S-5 as to apply radial load by Guide rail.
- Do not apply load as Fig.S-6. Radial load will directly apply to Ball Screw and may damage recirculation part of Ball Screw.

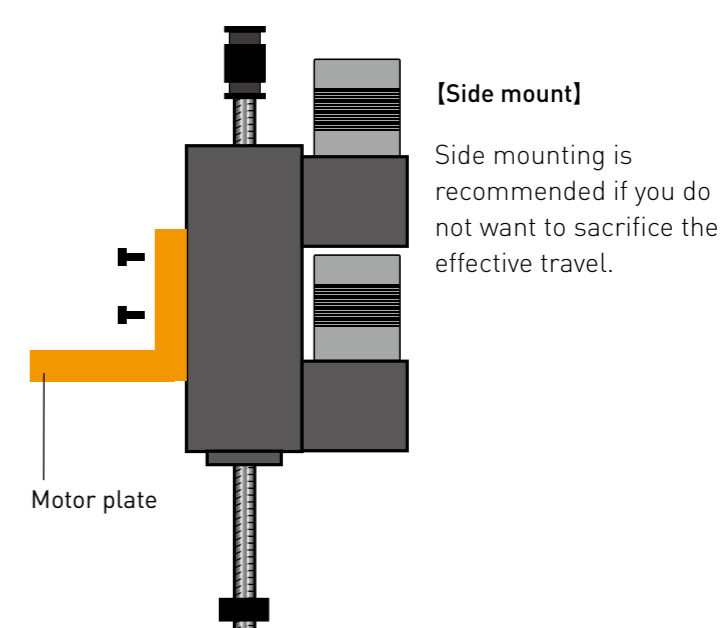
【Precautions for assembling Z-θ Actuator】

When using Z-θ Actuator, movable range may vary depending on the area to be assembled on your unit. Please refer to instruction below to select the best mounting method.

Z-θ Actuator Assembling example



Please be aware of losing travel length due to the thickness of the Motor mounting plate.



Side mounting is recommended if you do not want to sacrifice the effective travel.

Load limit in Vertical Position for Linear Actuator

[Load limit in Vertical Position for External type]

External type Actuator does not require Bearing at fixed side support, therefore the Axial Load will be applied to the inside the Motor directly. So permissible Axial Load is not the same as its Basic Dynamic Load Rating (Ca) of the Ball Screw. It relies on the Motor specifications and may vary depending on each series of Linear Actuator selection. Please use the list below to support your choice for appropriate External Linear Actuator. If you are looking for any Actuators exceeding permissible Axial Load, please contact KSS.

Table S-7 : Load limit in Vertical Position for the External type

Actuator series	Motor size	Load limit in Vertical Position (N)
DMBR	□20 / NEMA08	43
	□28 / NEMA11	150
	□35 / NEMA14	230
	□42 / NEMA17	
2TMB	□42 / NEMA17	300
TMB	□24 / NEMA10	230
	□42 / NEMA17	300
MB	□20 / NEMA08	230
	□24 / NEMA10	
	□42 / NEMA17	300
MMBR	□28 / NEMA11	150
SiMB	□20 / NEMA08	230
	□42 / NEMA17	300

Motor-Attachment

[Flex Actuator]

In order to assemble a Motor other than KSS specified in the Flex Actuator series, it is necessary to have an attachment that matches the mounting dimensions and output shaft length of each Motor manufacturer. The drawings of the Motor attachment which matches each Motor manufacturer are shown below.

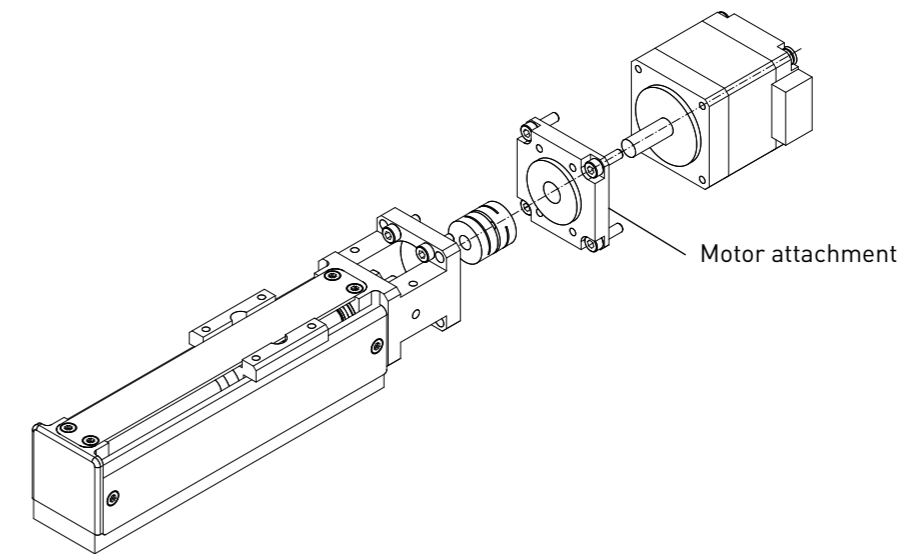
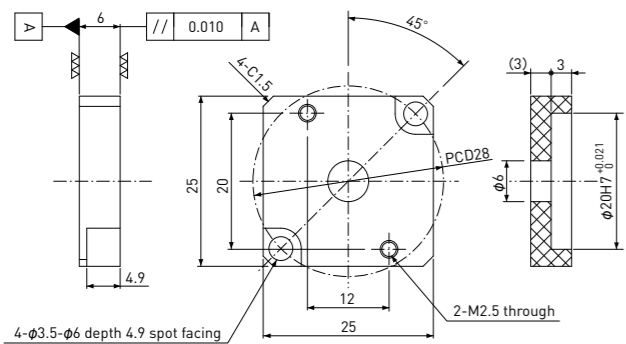


Table S-8 : Motor-Attachment list

Motor manufacturer	Motor Type	Motor Size	Acceptable Motor
Mitsubishi	AC Servo Motor	NEMA 10 □25	HG-AK0 * * *
Yasukawa		NEMA 10 □25	SGMMV-A * *
Oriental Motor	2 Phase Stepping Motor	NEMA 11 □28	PKP2 * *
	5 Phase Stepping Motor	NEMA 11 □28	PKP5 * *
	α Step Motor	NEMA 11 □28	ARM2 * * AZM2 * *
Tamagawa	2 Phase Stepping Motor	NEMA 11 □28	TS3641N1 * E2
	5 Phase Stepping Motor	NEMA 10 □24	TS3664N1 * E2
Sanmei	Stepping Servo Motor	NEMA 11 □28	TS3641N61S02
Moons		NEMA 11 □28	TSM11 * *

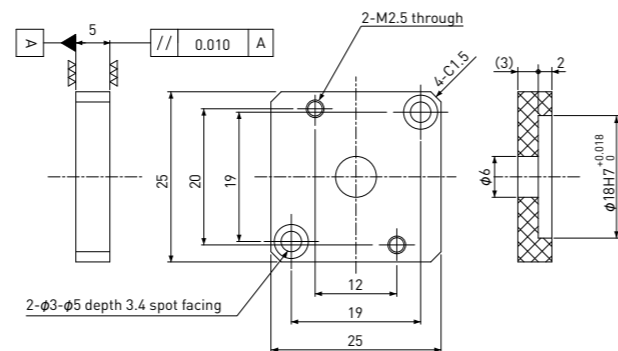
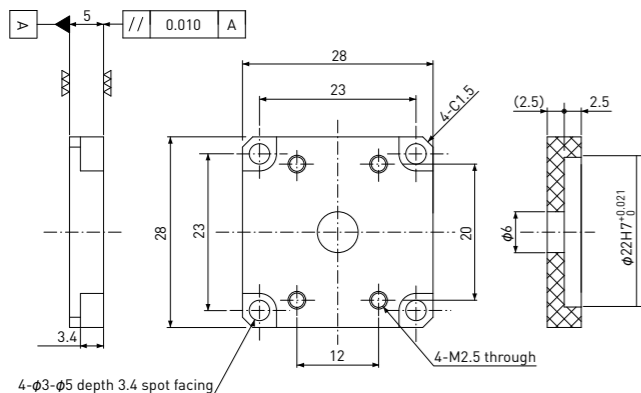
Mitsubishi HG-AK0**
Yasukawa SGMMV-A**



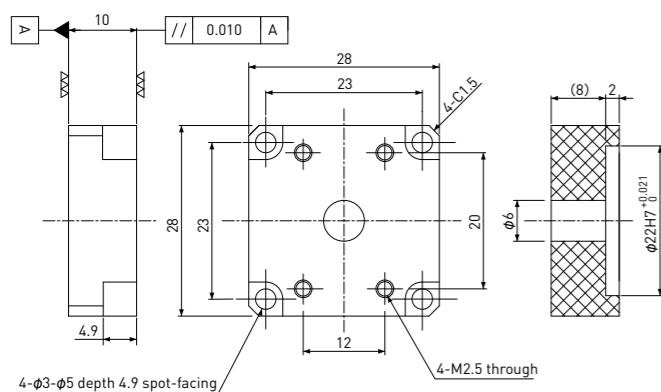
Moons TSM11**

Oriental Motor
PKP2**, PKP5**, ARM2**, AZM2**

Tamagawa TS3664N1*E2



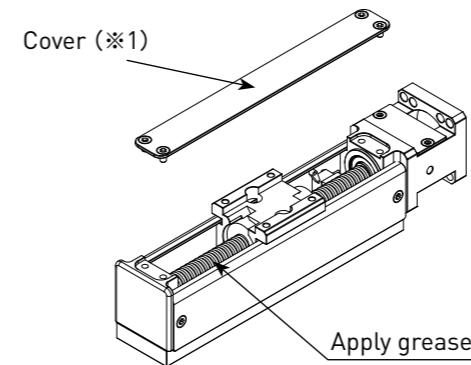
Tamagawa TS3641N*E2, Sanmei TS3641N61S02



Lubricant and Greasing method

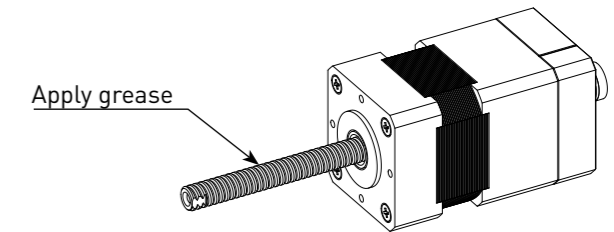
Greasing is required for any KSS Actuators. Maintenance cycle will be depending on your usage and working condition, however in general we recommend that you check the Grease condition in every 3 months, and if required please apply re-Greasing. Please refer to diagram below for how to re-Grease for each Actuator type.

●Slider type (FAS, CAS, MAS)



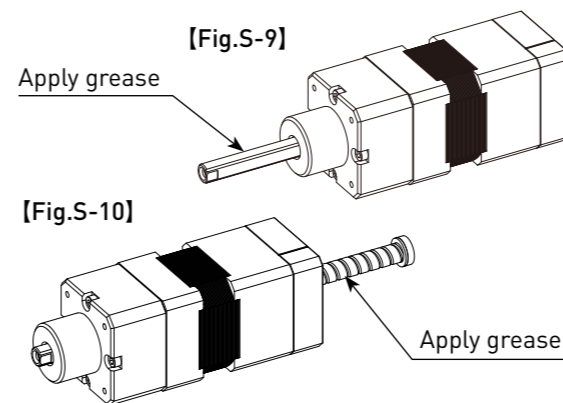
※1) For only FAS
Remove the cover first and expose the shaft before applying the Grease.

●Non-Captive type



The Ball Nut is located on the output-shaft side.
Move the shaft in the direction shown by the illustration and then apply the Grease.

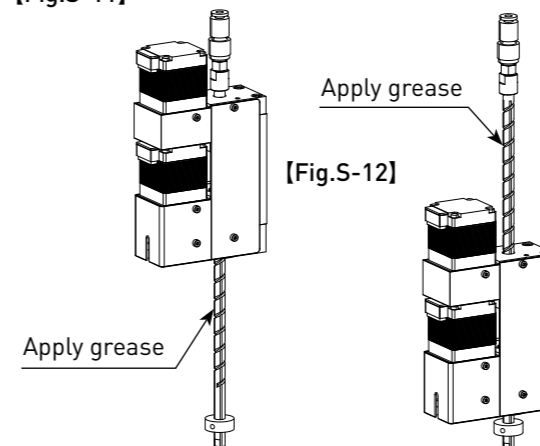
●Captive type



Please follow the procedure below to lubricate both the Ball Spline and the Ball Screw.

- Move the Shaft in the direction shown by the illustration and then apply the Grease (Fig.S-9).
- Applying the Grease for Ball Screw
Move the Shaft in the direction shown by the illustration and then apply the Grease (Fig.S-10).

●Z-θ Actuator [Fig.S-11]



Please follow the procedure below to lubricate both the Ball Spline and the Ball Screw.

- Move the Shaft in the direction shown by the illustration and then apply the Grease (Fig.S-11).
- Applying the Grease for Ball Screw
Move the Shaft in the direction shown by the illustration and then apply the Grease (Fig.S-12).

[Precautions for Grease maintenance]

● Grease maintenance.

If any discoloration (black, brown) are identified in the Grease remaining in the Screw Shaft, please consider that is the appropriate timing for re-Greasing.

● How to wipe off old Grease.

Wipe off old Grease by wiping sheet which is specially designed for wiping oil or Grease.

Note) Do not use the waste clothes which may attract fiber or clothes remaining onto the surface of the Shaft.

Note) Wipe off any debris or foreign particles carefully, they may be attached on the surface of the Shaft.

Move the Ball Nut and wipe off all the remaining Grease as much as possible. Wipe the remaining Grease attached on close to the both edge of the Ball Nut.

● How to apply new Grease.

Apply Grease entirely throughout the Shaft.

Note) Use designated brush, or apply new Grease directly onto the Shaft surface with rubber gloves.

Note) Move the Ball Nut and apply Grease to make sure that the Grease is applied entirely throughout the surface.

Move the Ball Nut throughout the Shaft to apply Grease entirely on the Shaft.

Run the Ball Nut back and forth several times and perform running-in operation.

● Periodic Inspection.

Re-Grease is recommended once every 2~3 months.

If severe discoloration of Grease identified, it is recommended to re-Greasing in a shorter period.

● Precautions.

Please wear rubber gloves when handling the Ball Screw to avoid getting rust.

Please be careful of handling the Ball Screw not to make dents or scars when applying Grease.

Avoid collecting foreign particles onto the Ball Screw.

Do not apply different grease from the time of shipping.

Other technical information**[Free fall]**

Z- θ Actuator does not equip with anti-free fall device.

If free falling is not allowed when use, external anti-free fall device should be set up.

Or choose the Belt Drive type and customize the Motor equipped with Magnetic brake, the Actuator can hold the Shaft even when it powers off.

※**Please note;**

The Motor equipped with Magnetic brake can only be chosen for Belt Drive type Actuator.

It is not available with either Direct-Drive type or Hybrid Drive type Actuator.

For your reference, below table shows the free fall weight for each type of the Actuator.

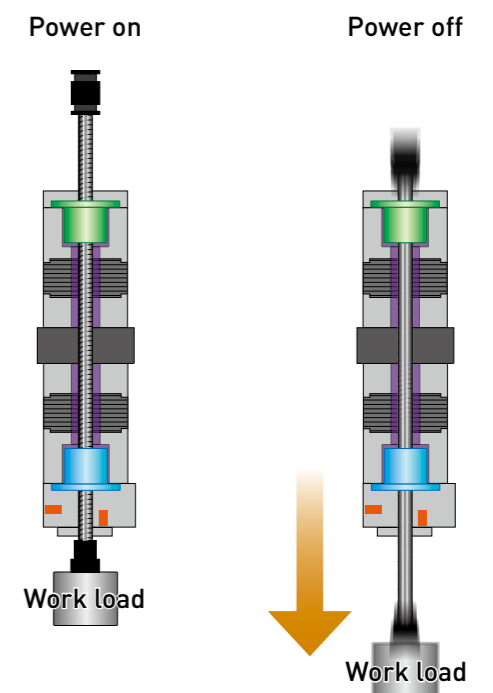
Table S-13 : Free-fall load of Z- θ Actuator

Model	Motor Frame size	Lead	Free-falling load
Direct-Drive type	NEMA11 (□28)	10mm	2N
	NEMA17 (□42)	10mm	5N
Hybrid-Drive type	NEMA10/11 (□25/28)	10mm	3N
Belt-Drive type	NEMA10 (□25)	4mm	18N
	NEMA11 (□28)	10mm	17N
	NEMA14 (□35)	10mm	16N

※**Caution**

Values are not guaranteed number.

Please take them as reference value.

[Example of free falling]

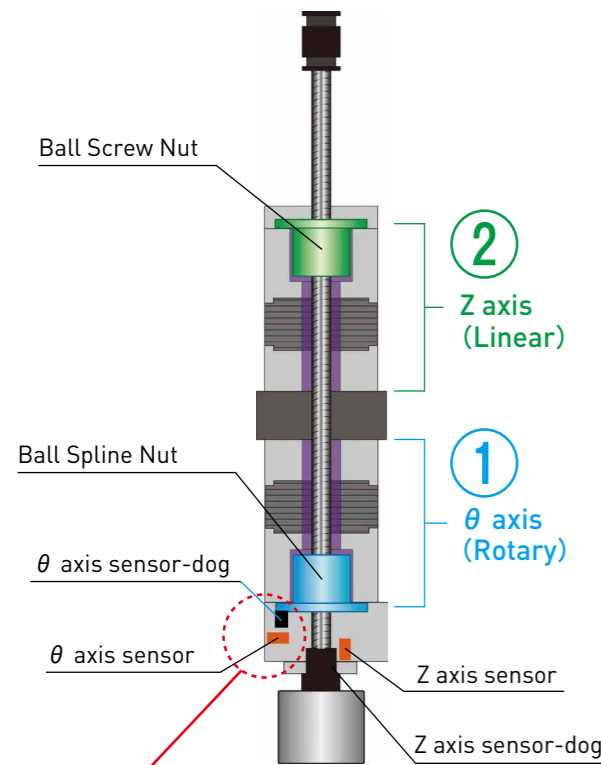
The Shaft can be held by its retention force of the Motor.

The Shaft will free fall once the Actuator turned off, by the loss of retention force from the Motor.

[Home positioning]

In order to apply home positioning, we recommend that θ -axis should be the first, then followed by Z axis. If Z-axis home positioning is first, then zero position may move after θ -axis home positioning. The reason is shown below diagram.

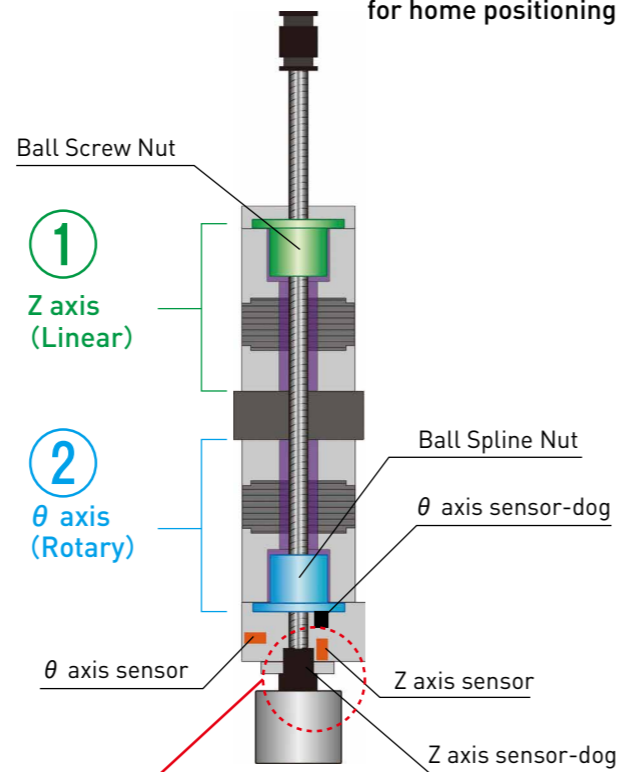
Recommended procedure of home positioning



θ -axis home positioning has been done in zero position. In this situation, Z-axis home positioning should be applied. θ -axis will never move because Ball Spline Nut only plays a role of guide for linear motion.

In case of home positioning for Z axis \rightarrow θ axis

*** Not recommended way for home positioning**



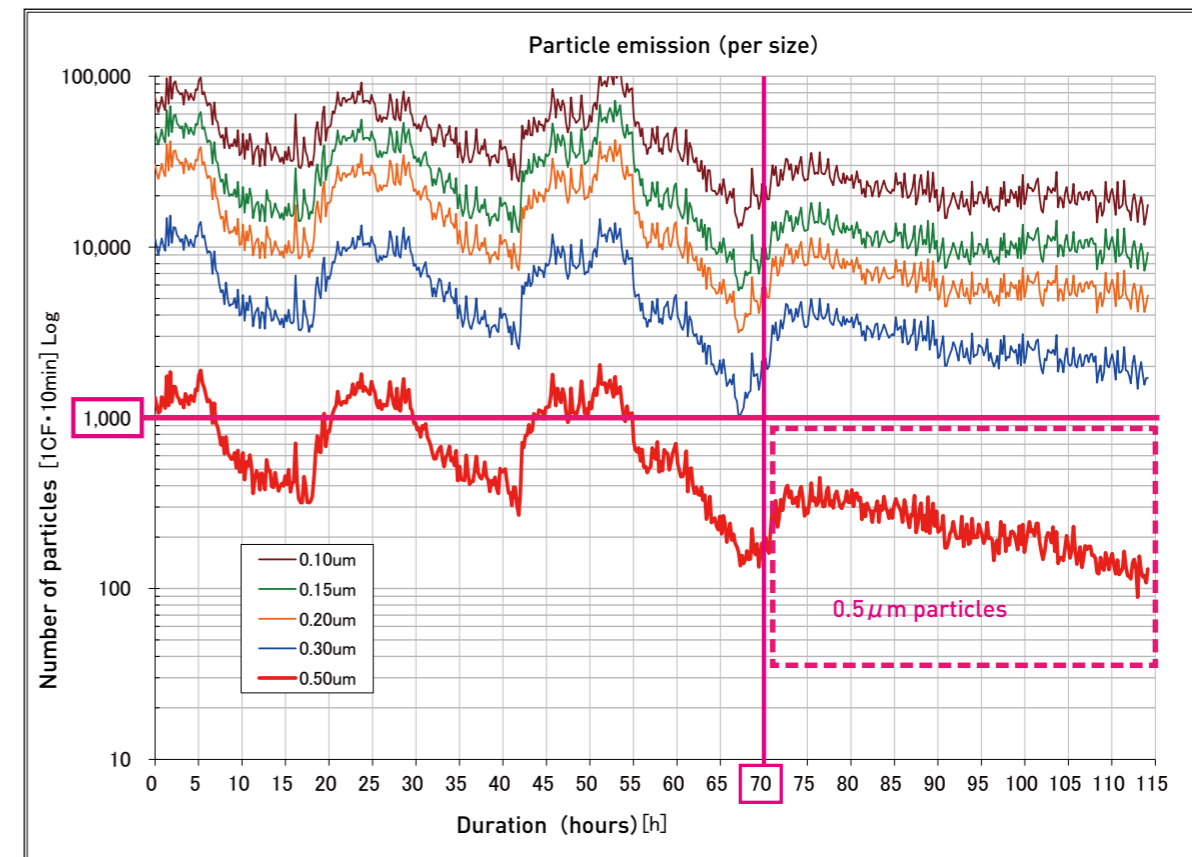
Z-axis home positioning has been done in zero position. In this situation, if θ -axis home positioning is applied. BPPS shaft (Ball Screw with Ball Spline) will move up or down with rotary movement at the same time of CW/CCW home positioning.

[Particle emission of Belt-Drive Actuator]

Z- θ Actuator is not designed for using in clean room facility or environment. Below graph shows the measurement result of dust particle of Belt-Drive Actuator for your example. Please refer to the result below when using our Z- θ Actuator in such facility.

Measurement Condition

- Sample : BDVZ06-G10050N02 (Belt-Drive type)
- Running period : 115 hours
- Speed : Z axis 200mm/sec (Highest spec in Catalogue)
 θ axis 1080°/sec (Highest spec in Catalogue)
- Operating pattern : Spiral moving (Z & θ)
- Load : No loading



※Measurement Method : Followed with FED209D Standard.
 ※Above values are not guaranteed values.
 Please take them as one of the reference data.

[Warranty of Actuator products]

Product warranty is 1 year from the date of shipment. If any defects or malfunctions originated by KSS responsibility, product will be replaced or repaired without any charge. Any defects or malfunctions occurred after warranty period, we will required support with charge.