# Safety Precautions

Be sure to read this section before use.

Refer to Intro Page 73 for general information of the cylinder, and to Intro Page 80 for general information of the cylinder switch.



## Product-specific cautions: Hand Series

## Design/selection

### 1. Common

#### ⚠WARNING

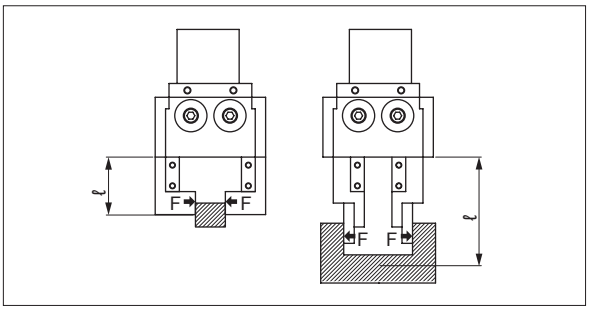
■ If the moving workpiece poses a possible risk to personnel or if fingers could be caught in the master key, etc., install a protective cover, etc.

■ If the circuit pressure drops due to power failure or air source trouble, the gripping force may decrease and the workpiece may fall. Provide position locking measures, etc., so that personnel are not injured or machines damaged.

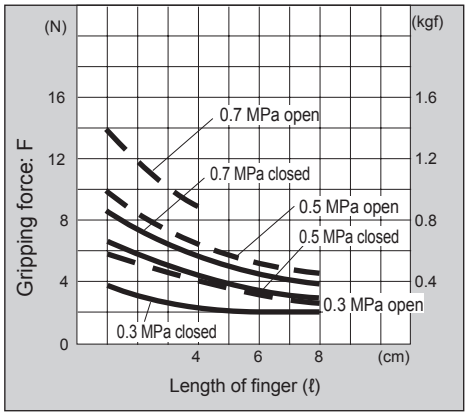
#### ⚠CAUTION

■ Precautions for gripping force

● Gripping force represents the force holding the workpiece, as shown in the figure below.




● Performance data indicates the gripping force of hand at finger length ℓ at a supply pressure of 0.15 to 0.7 MPa.




● To find the gripping force from performance data, if the distance from the attachment to the workpiece center of gravity when manufactured is ℓ, gripping force F is

When ℓ=ℓ1 F = F1

When ℓ=ℓ2 F = F2 Refer to the upper right figure is expressed as above.

● When mounting an L-shaped attachment, select length as shown below.

Example:If the L-shape is 30mm in the finger direction and 30mm at a 90° angle, assume the attachment length is 60mm.

● Length of attachment should be within the numerical value given in the gripping force performance data table of each model.

● Max. working length of attachment should be within the performance data.

Workpiece (weight $W_L$) with the following reference points.

$W_L$x9.8x5<(FxN)[Holding only]

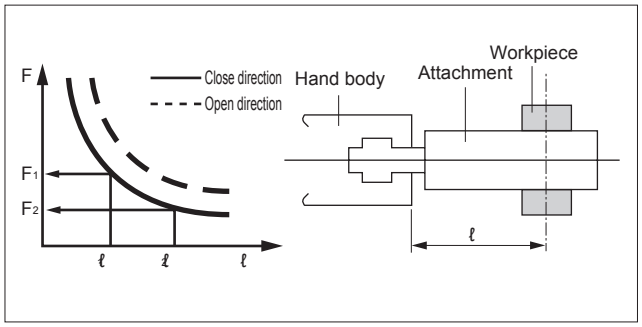
$W_L$x9.8x10<(FxN)[Normal transport]

$W_L$x9.8x20<(FxN)[Sudden accelerated transport]

$W_L$: Weight of workpiece [kg]

F: Gripping force [N]

N: Number of fingers [pcs.]



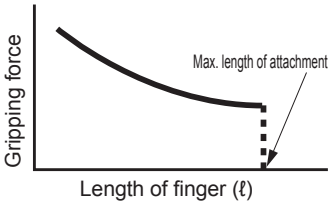

■ Use attachments as short and lightweight as possible. If the attachment is long and heavy, inertia increases when opening and closing. This may cause play in the finger, and adversely affect life due to rapid wear on the finger sliding part.

● Length of attachment should be within the numerical values of performance data.

● The weight of the attachment affects durability, so check that the weight is less than the following value.

W < 1/4H (1 attachment)W: Weight of attachment

H:Weight of Hand product




■ Avoid gripping the workpiece with single acting spring force as much as possible. The gripping force may become unstable, leading to operation failure.

■ With the single acting type, the spring force is minimized near the stroke end (open end for NO, closed end for NC). Due to the structure operated by the spring force, it may not return when operated with a short stroke; take care of the attachment shape so that the workpiece can be

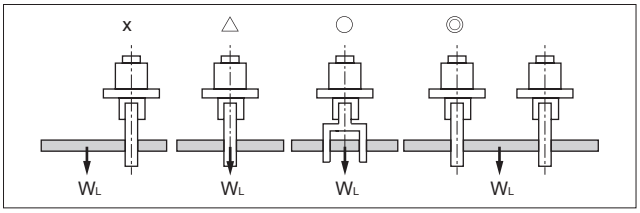
■ The rubber cover is a consumable part. Replace if necessary.

■ Working environment

At cutting, casting, or welding plants, there is a risk of foreign matter, such as cutting fluid, chips, powder and dust, entering the equipment. Use covers and such to prevent this as much as possible. Do not use the equipment under the following environments.

- Exposed to cutting oil (because the sliding section is abraded by abrasive or polishing debris in the liquid)
- When the atmosphere contains organic solvents, chemicals, acids, alkalis, kerosene, etc.
- Exposed to water

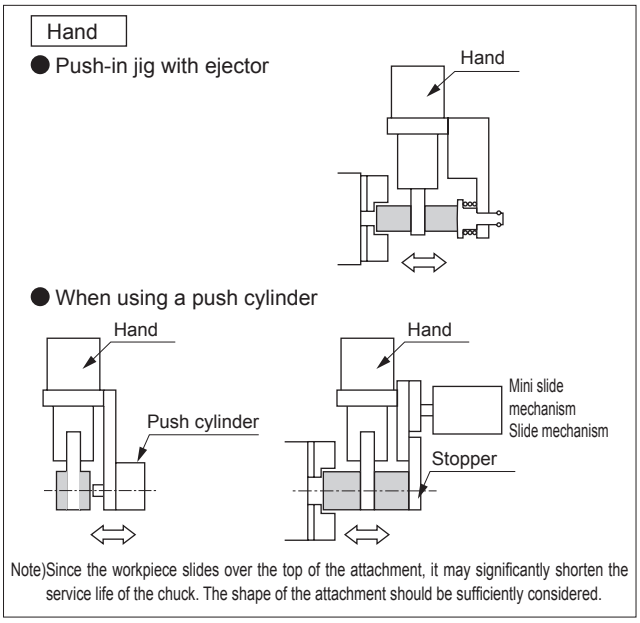
■ When gripping long or large workpieces, stable gripping requires a grip on the center of gravity. Stability is a must when using larger or multiple workpieces as well.




■ Select a model that has sufficient power to grip the workpiece weight.

■ Select a model that has sufficient opening/closing width for the workpiece size.

■ If directly inserting the workpiece into the jig with the hand, consider clearance during design. The hand could be damaged.




Note)Since the workpiece slides over the top of the attachment, it may significantly shorten the service life of the chuck. The shape of the attachment should be sufficiently considered.

■ If the attachment is not rigid enough, the resulting sag could cause the master key to twist or adversely affect operation.

■ Because this product uses a finite orbit linear guide, depending on the usage conditions or the product, the cantilever sliding resistance of the steel ball may increase and the gripping force may decrease. In this case, correct the problem by increasing the working pressure or by inserting a full stroke operation between gripping operations.

■ Adjust the gripper opening/closing speed using the speed controller (sold separately).

When used at high speed, backlash may occur sooner.In addition, the workpiece may vibrate due to shocks in opening/closing, which may lead to erroneous chucking, erroneous insertion of workpieces and poor repeatability.

■ Note that the smoothness of operations of products using crossover rollers (BSA2, BHA, BHG, HKP, BHE) may vary depending on the working status. (Basic performance is not affected.)

## 2. Linear slide cylinder LSH-HP1 Series

■ Condensation (water drops) may occur in the piping in certain conditions if an actuator with small bore size/short stroke is operated at high frequency. Take measures against condensation with a quick exhaust valve, etc.

■ The rubber cover does not ensure reliable air tightness. Due to the structure, there may be a gap between the rubber cover, and the body/fingers. If this raises an issue, please contact us.

## 3. Linear slide cylinder LSHM-HP2 Series

■ Use only a DC safety power supply. Do not connect motors, valves, etc., that generate noise to the power supply used in this device.

■ While wiring, ensure that inductive noise is not applied to the sensor and amplifier and that power lines such as motors do not use the same piping and wiring (through multi-core cables, etc.). Use caution with the inverter power supply and its wiring section as well. (Check that the inverter power frame ground is correctly grounded and noise is released.)

■ Note that noise resistance performance may be adversely affected if the length of the cable is 5 m or greater.

■ Make sure that the cable is wired so that it is free of local bends and tension. Make sure that the cable is free of repeated bends.

■ Make sure that force of 30 N or over is not applied to the M8 connector section.

■ This product cannot be used outdoors or in an atmosphere containing corrosive elements.

## 4. Linear Slide Hand LSH Series

■ When mounting an L-shaped attachment, use within the range on page 1588.

## 5. Shockless LSH-*-C

### ⚠ CAUTION

■ Note that, structurally, the closed side end position cannot be retained if air supply is cut off. When detecting the closed side end by switch, set the switch position with pneumatic pressure applied, as otherwise the position may be out of the detection range.

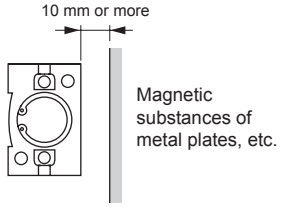
# Mounting, installation and adjustment

## 1. Common

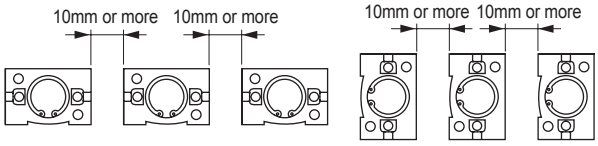
### ⚠CAUTION

■ If a lateral load or load with a large impact is applied to the finger, play or damage could occur. Adjust and check that external force is not applied to the finger.

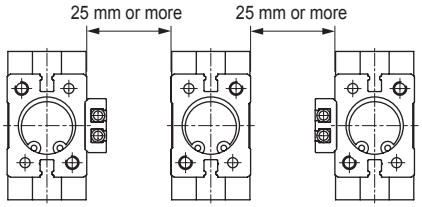
■ The cylinder switch may malfunction if there is a magnetic substance such as a metal plate installed adjacently. Check that a distance of 10 mm is provided from the surface of the cylinders.




■ The cylinder switch may malfunction if cylinders are installed adjacently. Check that the following distances are provided between cylinders.




<LSH-HP series>

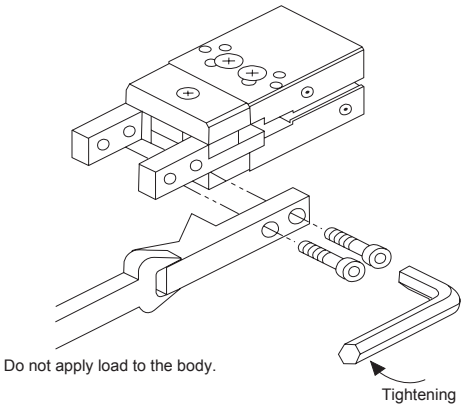



■ Clamping operation is accurate when performed as softly as possible at a low speed. Repeatability is also stable.

■ Regularly grease the sliding section of the finger. Regular replenishment can extend service life further.

■ Installing the attachment

When mounting the attachment to the finger, to prevent any effect on the hand, support with a wrench, etc., when tightening so that the finger is not twisted. We recommend mounting the attachment on the finger outer surface. (Precision suffers on the finger inner surface.)

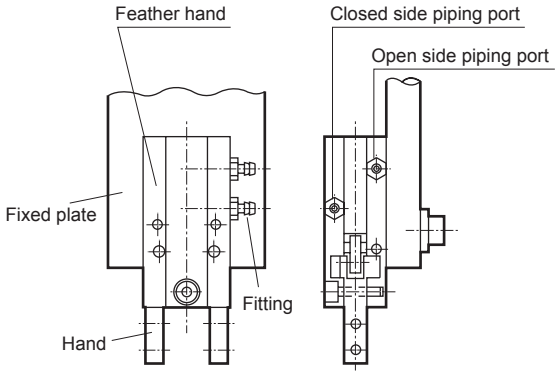



■ Do not retighten or disassemble, other than the screws used for fixing the body and the attachment. This could lead to malfunction.

## 2. Installation

■ Do not cause dents or scratches that may damage flatness or perpendicularity on the body mounting surface or finger.

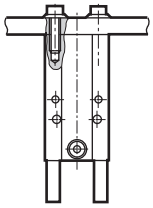
■ If there is a limit to the thickness direction of the FH Series body, the available piping fitting will be limited. Refer to the following fittings.



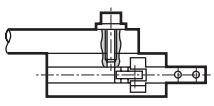

| Model | FH*10 | FH*12 | | FH*16 | FH*20 | FH*25 |
|---|---|---|---|---|---|---|
| Bore size | M3 | | | M5 | | |
| Fitting | Model No. | Applicable O.D. (mm) | Eff. X-sectional area ($mm^2$) | Model No. | Applicable O.D. (mm) | Eff. X-sectional area ($mm^2$) |
| Barbed fitting — Straight FTS | FTS4-M3 | ø3.2/ø4 | 0.4 | FTS4-M5 | ø3.2/ø4 | 2.1 |
| | - | - | - | FTS6-M5 | ø6 | 4.1 |

■ Refer to the following section for FH Series body mounting.

● Top mounting

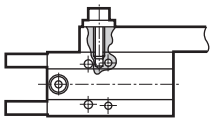


● Front mounting



Note) For types with switch, ensure that the screw insertion depth is less than that in the table below, so that the bolt tip does not press the switch.

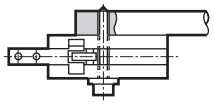
● Side mounting



Note) Ensure that the fixed plate does not contact the finger fulcrum.

| Model | Working bolt size | Max. screw insertion depth (mm) | Recommended tightening torque (N·cm) |
|---|---|---|---|
| FH*10 | M3x0.5 | 4.5 | 70 |
| FH*12 | M3x0.5 | 4.5 | 70 |
| FH*16 | M4x0.7 | 6 | 160 |
| FH*20 | M5x0.8 | 7.5 | 330 |
| FH*25 | M5x0.8 | 12 | 330 |

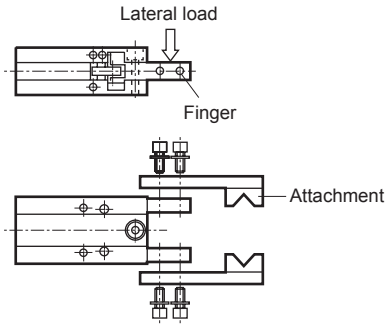
● Use of through hole



| Model | Working bolt size | Recommended tightening torque (N·cm) |
|---|---|---|
| FH*10 | M3x0.5 | 32 |
| FH*12 | M2.5x0.45 | 32 |
| FH*16 | M3x0.5 | 90 |
| FH*20 | M4x0.7 | 210 |
| FH*25 | M4x0.7 | 210 |

Note) Through hole cannot be used when switch is provided.
Note) Ensure that the fixed plate does not contact the finger fulcrum.

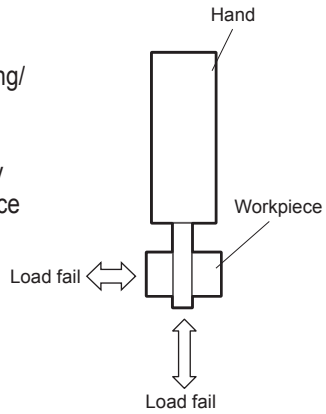
■ When installing the attachment, check that a lateral load is not applied to the finger.




■ Tighten with the following tightening torque when mounting.

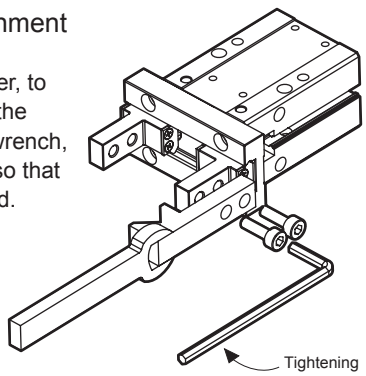
| Thread nominal | M3 | M4 | M5 | M6 | M8 |
|---|---|---|---|---|---|
| Recommended tightening torque (N·m) | 0.59 | 1.4 | 2.8 | 4.8 | 12.0 |

■ Do not apply excessive load to the finger or attachment when attaching/removing or transporting the workpiece. Scratches and dents may occur on the rolling surface of the finger linear guide, possibly causing malfunction.




## 3. Linear Slide Hand LSH-HP1 Series

■ Installing the attachment
When mounting the attachment to the finger, to prevent any effect on the hand, support with a wrench, etc., when tightening so that the finger is not twisted.

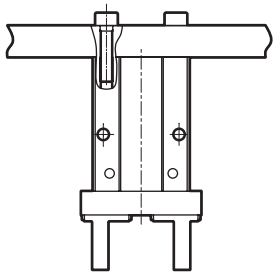



Do not apply load to the body.

| Item | Bolt used | Tightening torque (N·m) |
|---|---|---|
| LSH-*06 | M2.5x0.45 | 0.32 |
| LSH*-*10 | M2.5x0.45 | 0.32 |
| LSH*-*16 | M3x0.5 | 0.59 |
| LSH*-*20 | M4x0.7 | 1.4 |
| LSH*-*25 | M5x0.8 | 2.8 |
| LSH*-*32 | M6x1.0 | 4.9 |

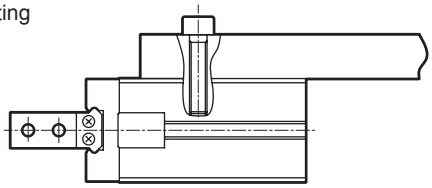
■ Refer to the following section for body mounting.

● Top mounting



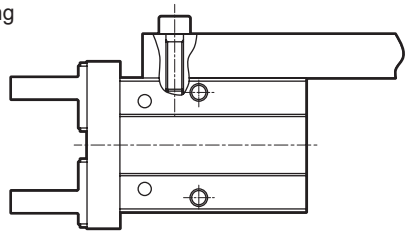
| Item | Bolt used | Tightening torque (N·m) | Max. insertion depth L (mm) |
|---|---|---|---|
| LSH-*06 | M3x0.5 | 0.59 | 4.5 |
| LSH*-*10 | M3x0.5 | 0.88 | 6 |
| LSH*-*16 | M4x0.7 | 2.1 | 8 |
| LSH*-*20 | M5x0.8 | 4.3 | 10 |
| LSH*-*25 | M6x1.0 | 7.3 | 12 |
| LSH-*32 | M6x1.0 | 7.3 | 13 |

● Front mounting



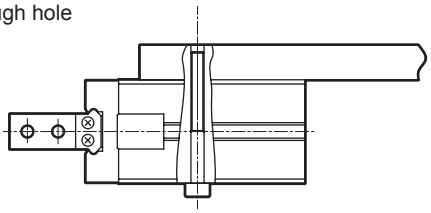
| Item | Bolt used | Tightening torque (N·m) | Max. insertion depth L (mm) |
|---|---|---|---|
| LSH-*06 | M3x0.5 | 0.88 | 10 |
| LSH*-*10 | M3x0.5 | 0.69 | 5 |
| LSH*-*16 | M4x0.7 | 2.1 | 8 |
| LSH*-*20 | M5x0.8 | 4.3 | 10 |
| LSH*-*25 | M6x1.0 | 7.3 | 12 |
| LSH-*32 | M6x1.0 | 7.3 | 13 |

● Side mounting



| Item | Bolt used | Tightening torque (N·m) | Max. insertion depth L (mm) |
|---|---|---|---|
| LSH-*10<br>LSHM-*10 | M3x0.5 | 0.88 | 6 |
| LSHL-*10 | M3x0.5 | 0.78 | 5.5 |
| LSH*-*16 | M4x0.7 | 1.6 | 4.5 |
| LSH*-*20 | M5x0.8 | 3.3 | 8 |
| LSH*-*25 | M6x1.0 | 5.9 | 10 |
| LSH-*32 | M6x1.0 | 5.9 | 10 |

● Use of through hole



| Item | Bolt used | Tightening torque (N·m) |
|---|---|---|
| LSH-*06 | M2.5x0.45 | 0.32 |
| LSH*-*10 | M2.5x0.45 | 0.32 |
| LSH*-*16 | M3x0.5 | 0.88 |
| LSH*-*20 | M4x0.7 | 2.1 |
| LSH*-*25 | M5x0.8 | 4.3 |
| LSH-*32 | M5x0.8 | 4.3 |

Note) Through hole cannot be used when switch is provided.

■ Regularly grease the sliding section of the finger. Regular replenishment can extend service life further.

| Manufacturer | Model No. |
|---|---|
| THK | AFF grease |

## 4. Linear Slide Hand LSHM-HP2 Series

### ⚠CAUTION

■ The zero point adjustment exterior trimmer is equipped with a rubber plug to ensure water resistance. Use it with the plug attached.

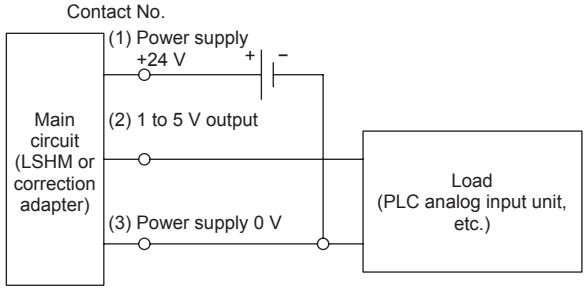
■ To ensure water resistance, do not remove the cap of the correction adapter.

■ To ensure water resistance, securely tighten the M8 screw of the cable.

■ Cable connection

1. Turn power OFF before wiring this product.
2. Do not touch the mating face of the connector with wet hands.
   When wiring, wipe off any moisture adhered to connectors and peripheral parts. Failure to do so may result in insulation failure.
3. Make sure that metal chips or powder do not enter the mating part of the connector.
4. Be sure to tighten the connector fixture (M8) by hand (proper tightening torque: 0.2 Nm). Using a tool such as pliers may cause damage due to excessive load.
   If the tightening force is insufficient, the degree of protection may not be maintained, and loosening may occur due to vibration.

● Connecting the lead wire



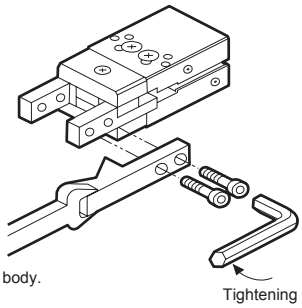

■ Use the combination of LSHM and correction adapter included at shipment.

## 5. Linear Slide Hand LSH Series

### ⚠CAUTION

■ Installing the finger

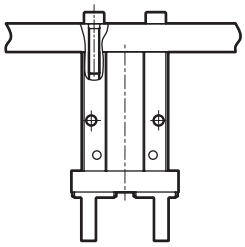
When mounting the attachment to the finger, to prevent any effect on the hand, support with a wrench, etc., when tightening so that the finger is not twisted.




| Item | Bolt used | Tightening torque (N·m) |
|---|---|---|
| LSH-10 | M2.5 x 0.45 | 0.32 |
| LSH-16 | M3 x 0.5 | 0.59 |
| LSH-20 | M4 x 0.7 | 1.4 |
| LSH-25 | M5 x 0.8 | 2.8 |

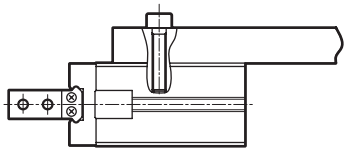
■ Refer to the following section for body mounting.

● Top mounting



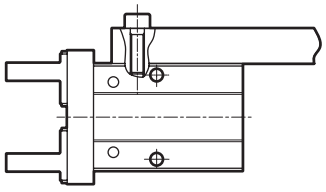
| Item | Bolt used | Tightening torque (N·m) | Max. screw insertion depth L (mm) |
|---|---|---|---|
| LSH-10 | M3 x 0.5 | 0.88 | 6 |
| LSH-16 | M4 x 0.7 | 2.1 | 8 |
| LSH-20 | M5 x 0.8 | 4.3 | 10 |
| LSH-25 | M6 x 1.0 | 7.3 | 12 |

● Front mounting



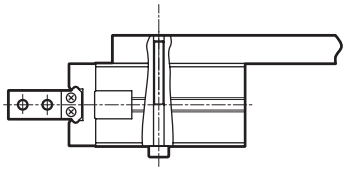
| Item | Bolt used | Tightening torque (N·m) | Max. screw insertion depth L (mm) |
|---|---|---|---|
| LSH-10 | M3 x 0.5 | 0.69 | 5 |
| LSH-16 | M4 x 0.7 | 2.1 | 8 |
| LSH-20 | M5 x 0.8 | 4.3 | 10 |
| LSH-25 | M6 x 1.0 | 7.3 | 12 |

● Side mounting



| Item | Bolt used | Tightening torque (N·m) | Max. screw insertion depth L (mm) |
|---|---|---|---|
| LSH-10 | M3 x 0.5 | 0.88 | 6 |
| LSH-16 | M4 x 0.7 | 1.6 | 4.5 |
| LSH-20 | M5 x 0.8 | 3.3 | 8 |
| LSH-25 | M6 x 1.0 | 5.9 | 10 |

● Through hole mounting



| Item | Bolt used | Tightening torque (N·m) |
|---|---|---|
| LSH-10 | M2.5 x 0.45 | 0.32 |
| LSH-16 | M3 x 0.5 | 0.88 |
| LSH-20 | M4 x 0.7 | 2.1 |
| LSH-25 | M5 x 0.8 | 4.3 |

Note) Through hole mounting is not possible with switch.

■ Do not retighten or disassemble, other than the screws used for fixing the body and attachment. This could lead to malfunction.

# Use/maintenance

## 1. Common

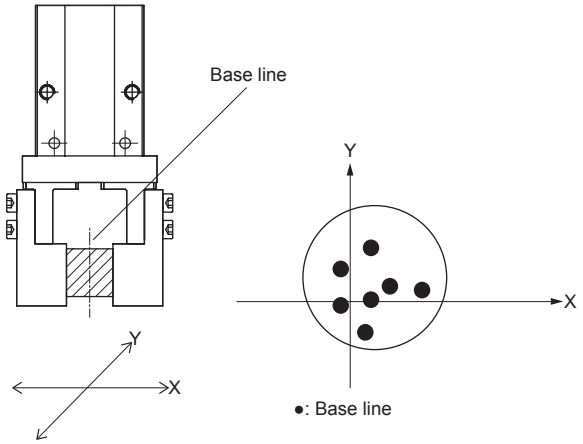
### ⚠ CAUTION

■ Do not disassemble or modify the body.

■ Repeatability

Repeatability here indicates the displacement of the workpiece in the case of repeated clamping and unclamping in the same conditions (hand fixed, same workpiece used: see below).

Conditions
- Workpiece dimensions, shape, weight
- Workpiece transfer position
- Clamp method, length
- Workpiece and workpiece receiving surface resistance
- Fluctuation of gripping force (air pressure), etc.




## 2. Linear Slide Hand LSHM-HP2 Series

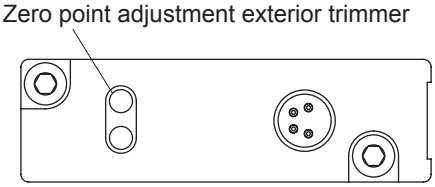
### ⚠ CAUTION

■ Analog output voltage corresponds to the cylinder piston position. The value may fluctuate because of jig deformation and wear, etc., due to use over time. (For the hand, fluctuation is caused by finger opening and closing direction backlash and attachment deformation and wear.)
If the analog output voltage fluctuates, perform fine adjustment using the zero point adjustment exterior trimmer.

Operation procedure
Remove the attachment, etc., close the finger, remove the rubber cap mounted on the zero point adjustment exterior trimmer, rotate the trimmer, and adjust finely until the output voltage is 1 V.
Be sure to reinstall the rubber plug correctly after operation. At this time, make sure water or foreign matter does not enter.

* For models with correction adapter option, keep the correction adapter connected.

Zero point adjustment exterior trimmer



■ Repeatability of analog output

Repeatability here indicates the displacement of the analog output converted to length in the case of repeated clamping and unclamping in the same conditions (hand fixed, same workpiece used: see below).

Conditions
- Workpiece dimensions, shape, weight
- Attachment workpiece gripping position
- Clamp method, length
- Attachment and workpiece contact area resistance
- Fluctuation of gripping force (air pressure)

## 3. Shockless LSH-*-C

### ⚠ CAUTION

■ Because of changes in the cushion stiffness when left for long periods, the stroke may become slightly shorter than the standard value at the low pressure setting. Perform a trial run, such as operating several times and performing back-and-forth operation at high supply pressure.

■ Do not rapidly discharge air from the cylinder after performing low speed operation outside the catalog specifications range.
(Example: Removing piping or coupler, etc.)
Otherwise the rubber-air cushion may fall. Note that the possibility of occurrence of this may increase, especially when the air pressure is high.