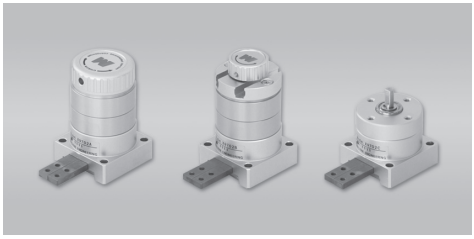
ESCAPEMENT

(Escapement)

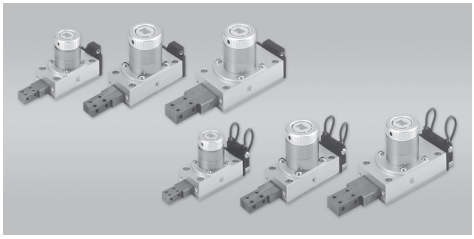
By using escapement, workpieces that are continuously flowing can be easily separated.

Accurate separation and maintaining a correct posture of parts and products are the basis of improving quality of the following operation of correctly grasp, carry, and assemble.
Strong design developed by focusing on the function to endure load from lateral direction and equip high holding power.
Highly reliable component that is essential for FA element that requires high certainty.

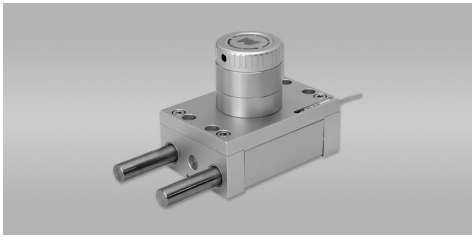
“Automatic assembly starts from accurate separation” .... the process to separate workpiece differs from other automatic assembly work, it does not look like active work process, therefore it is an element that tends to be ignored, at the same time, the well-know fact is that it is the basis of FA. This “accurate separation” becomes the foundation of generating “reliability” of the entire system.
Many FA uses two cylinders and utilize a link to perform “separation work”. We look at the example.
However, such method does not have high reliability and is very insufficient in FA design and construction. Achieve more assured “separation” more easily... based on this thought, MEG <Escapement> was developed as a basic unit of FA.
Please use Escapement useful for design and manufacture of automated assembly system and component.



Micro



Standard



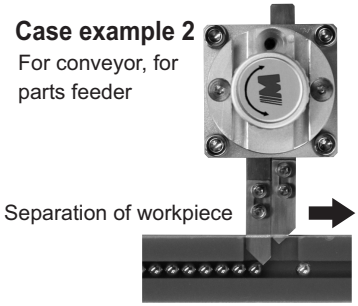
High rigidity

Escapement

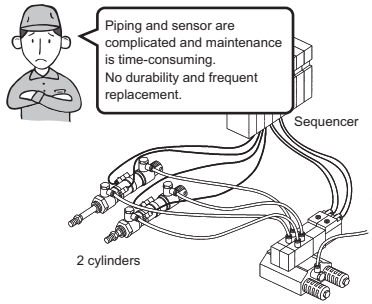
Model selection

Case example 1 For chute

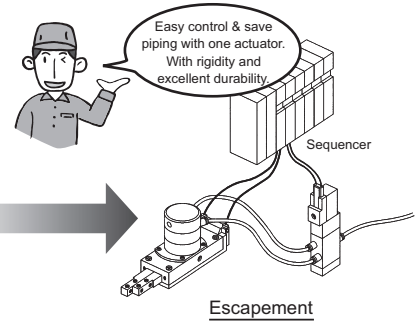
Case example 2
For conveyor, for parts feeder



Up until now



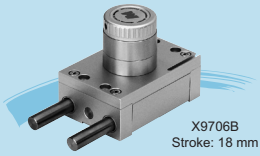
From now



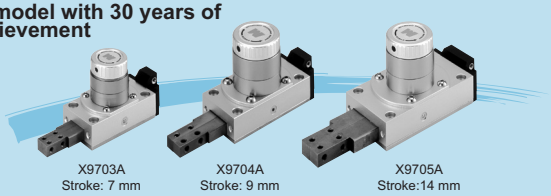
Abundant lineups and wide range of applications

Perfect for small workpiece!

For large workpiece and pallet



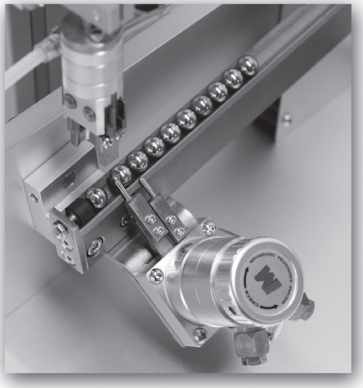
Standard model with 30 years of actual achievement



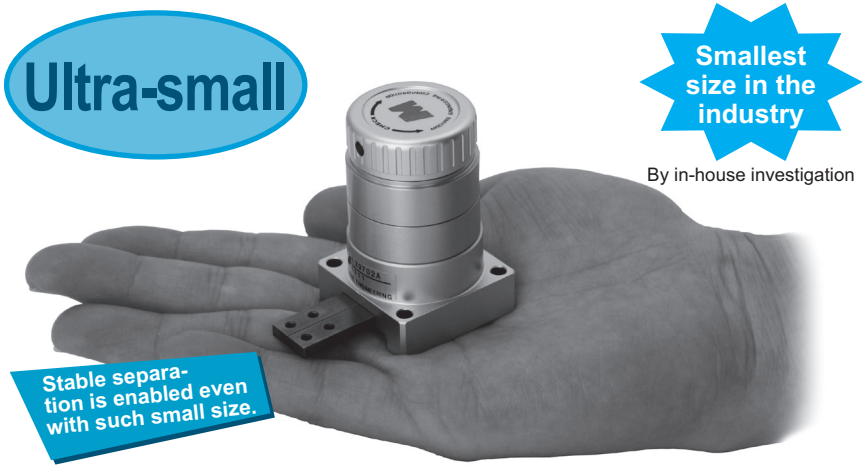
■ Model list

Series	Model No.	Stroke (mm)	Drive: Air	Drive: External	Maximum frequency (cpm)	Mass (g)	Sensor	Manual handle	Page
Micro NEW	X9702A 	5	×		180	106		×	B-4
	X9702B 	5	×		180	106	× (x 2)	×	
	X9702C 	5		×	300	76			
Standard	X9703A 	7	×		40	250	× (x 2)	×	B-10
	X9704A 	9	×		40	400	× (x 2)	×	
	X9705A 	14	×		40	650	× (x 2)	×	
High rigidity	X9706B 	18	×		120	550	× (x 2)	×	B-16

X9702



5 mm stroke even with the ultra-compact type.
Support extensively from minute workpieces such as electronic components and small workpieces.



■ Easy separation of workpiece that is flown in succession

Ultra-small type escapement convenient for separation work at minute parts carrying process. Easy control by accurate separation of two sliders using one actuator. In addition, there is no shock at the movable end due to operation by cam and excellent in durability. Use for planning of each type of labor-saving machine.

■ Three types selectable depending on the application

Basic model
X9702A

Basic model with manual handle.

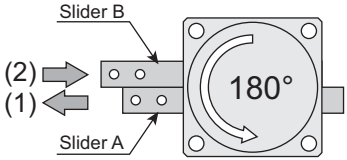
Model with sensor
X9702B

Model with backward movement end check sensor and manual handle.

Connect model
X9702C

This is an external input model. Correspond to air-less environment with motor drive.

■ Independent operation of each slider



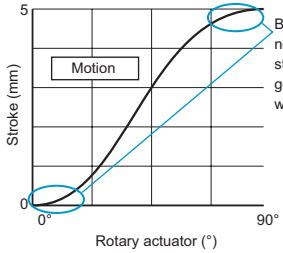
While rotary actuator rotates 180°

(1) Slider A moves forward and stops.

(2) Slider B moves backward and stops.

Accurate separation is enabled because sliders do not move concurrently.

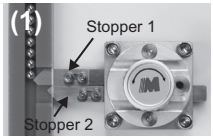
■ Shock-free operation



Because there is no shock at start-up and stop, gentle approach to workpiece.

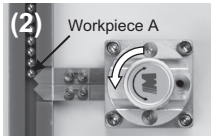
■ Easy adjustment with manual handle

■ Easy control by one actuator



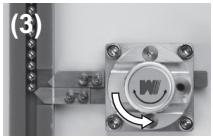
Start position.
Stopper 1 moves forward and workpiece is at a stop.

Solenoid valve a operates.



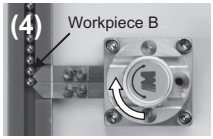
Stopper 2, moves forward.
Take a posture to receive workpiece A.

Solenoid valve a operates.



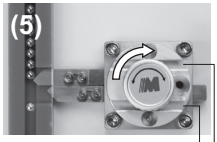
Stopper 1, moves backward.
Receive workpiece A.

Solenoid valve a operates.



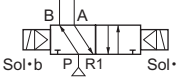
Stopper 1, moves forward.
Stop workpiece after workpiece B.

Solenoid valve b operates.

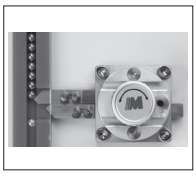


Stopper 2, moves backward.
Return to the start position and workpiece A is separated.

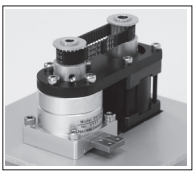
Solenoid valve b operates.



■ Application



Cutout of workpiece on the chute



Drive connect model by stepping motor

X9702

- Accurate separation motion even with small size. Stable separation is enabled over a long period of time with excellent durability.
- Space-saving by two air cylinders configuration. Contribute toward downsizing of the device.
- Easy handling with control by one solenoid valve.
- Connect (external input) type can be used conveniently even in the air-less environment by motor control.
- Slider operation is shock-free. Gentle approach to workpiece.
- Adjustment at starting up the device, position adjustment and maintenance at the production site can be conveniently performed with manual handle.

■ Variations

Model No.	Stroke (mm)	Drive		Retract detection sensor	Manual handle
		Air	External		
X9702A	5	×			×
X9702B	5	×		×	×
X9702C	5		×		

Product number configuration

X9702B-SS-D13L1

Model No.

Code	Product specification
A	Basic model
B	Model with sensor
C	Connect model

Code	Supplied sensor
No code	Without sensor
S	With 1 sensor
SS	With 2 sensors

Code	Sensor specifications
No code	D14L1 (2 conductors 1 m, rearward)
D13L1	D13L1b (3 conductors 1 m, rearward)

* Lead line length of 3 m is also prepared.
  Use “3” for the last number of the code.
  Example: D14L3
* For more information on the sensor, please refer to A-90.

Basic specifications

Product code	X9702A, X9702B	X9702C
Operating method	Air	External input
Stroke	5 mm ±0.2 mm	
Air pressure	0.3 to 0.5 MPa	
Required torque		0.1 N•m
Maximum frequency	180 cpm (From 180° 0.1 sec)	300 cpm
Ambient temperature	5 to 50°C	
Lubrication	Grease filled Non-lubrication specification	
Main body mass	106 g	76 g

* Use X9702C by reciprocating input shaft.
* Use X9702C within input shaft 180°.
  Using with internal mechanical end may shorten the product life.

Sensor specification (backward movement end detection)

Model	Non contact sensor type	
	D13	D14
Power supply voltage	5 to 28 VDC	
Load voltage	28 VDC or smaller	10 to 28 VDC
Loading current	0.1 to 40 mA	5 to 20 mA
Motion time	1 ms or smaller	
Wiring method	PVC 0.15 mm 23 cores	PVC 0.2 mm 22 cores
Protective construction	IP67 (IEC standard), JIS C0920	
Output protection	With	
Indicator light	LED (Light up when it's ON)	
Lead length	1 m	

* For more information on the sensor, please refer to A-90.
* D13 NPN type

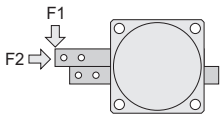
Occurrence thrust

Air pressure (MPa)	Occurrence thrust (N)
0.3	3
0.4	4.5
0.5	6

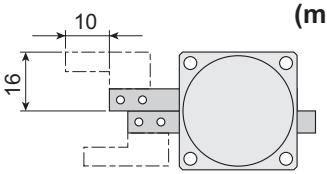
* Load of slider front-back direction.

Allowance load

Code	Allowance load (N)
F1	2
F2	1

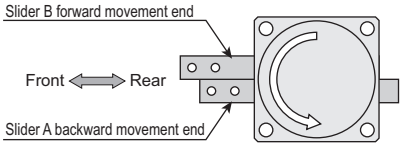


Maximum overhang amount (mm)

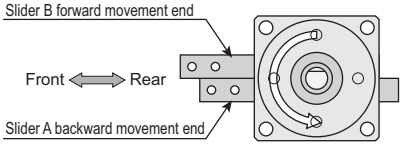


* Height direction is ±5 mm from the center of slider plate thickness.

Slider operation timing diagram

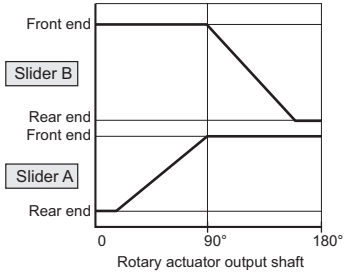


X9702A, X9702B



X9702C

Timing chart

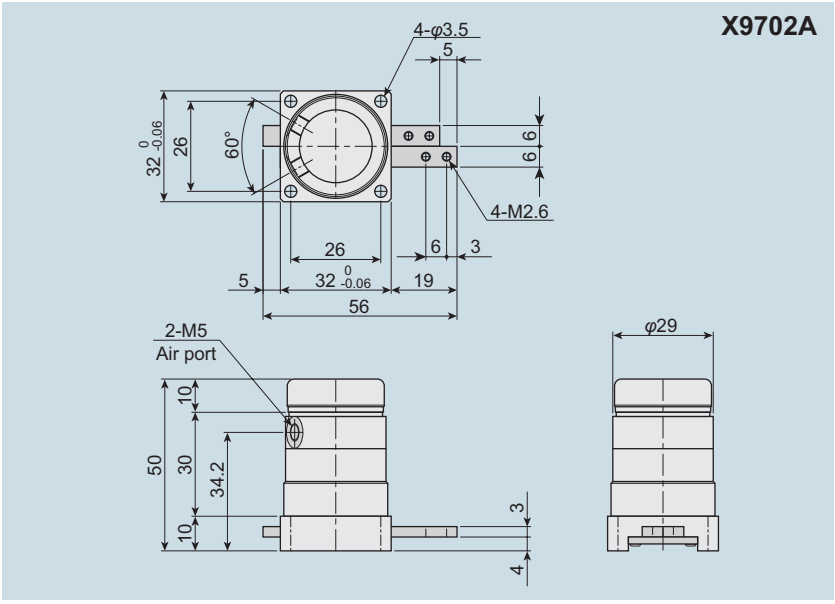


- When rotating X9702C from shaft D cut position, slider A moves forward and then, slider B moves backward.
- When input shaft is rotated 90° as specified in the timing chart, slider A moves forward, and both A and B stopped moving forward. When the shaft is rotated further by 90°, slider B moves backward.

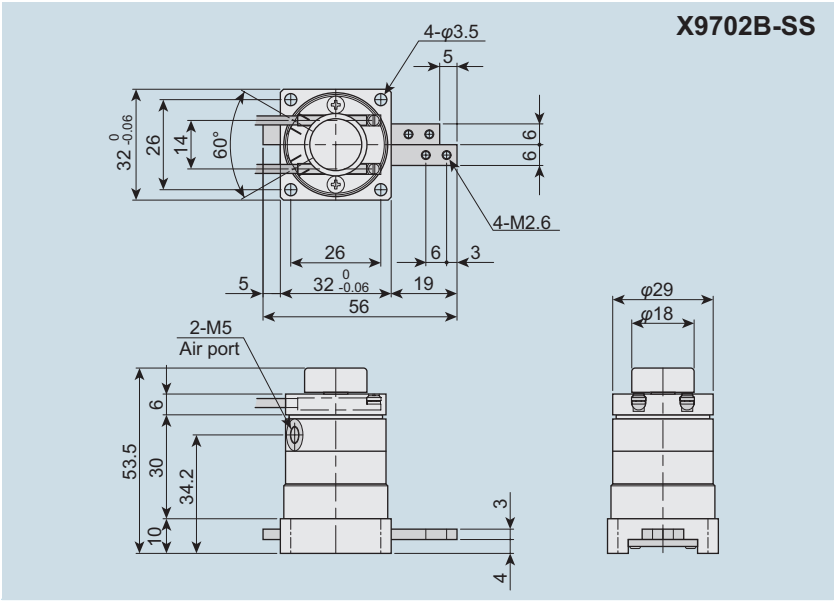
X9702

■ Dimensional drawing (mm)

X9702A



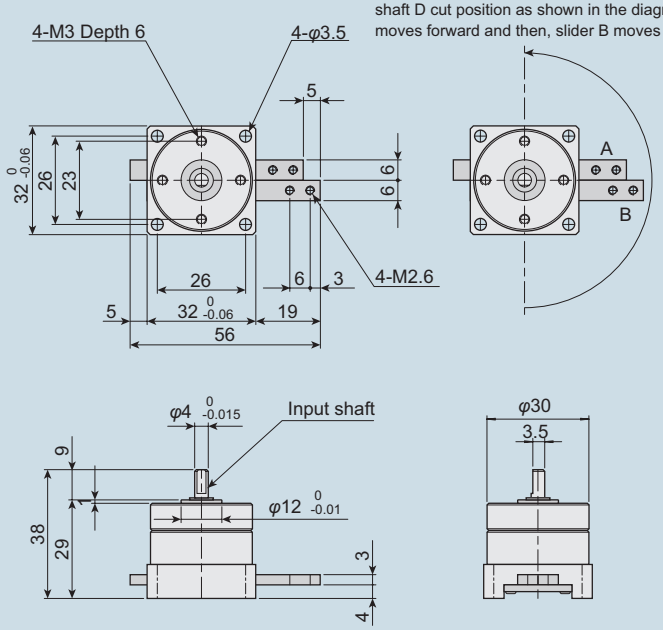
X9702B-SS



(mm)

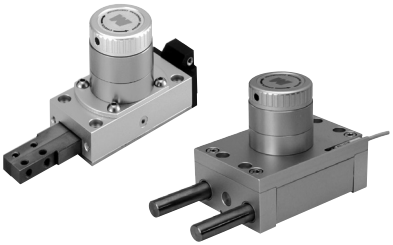
X9702C

When rotating 180° towards the arrow direction from shaft D cut position as shown in the diagram, slider A moves forward and then, slider B moves backward.



X9703A, X9704A, X9705A, X9706B

Two sets of finger tooling are operated by one rotary actuator. Simple mechanical structure generated large holding performance.



The sliding type drives the finger tooling by internally built-in roller and cam for locking, therefore, the characteristic is to be able to obtain strong stopper holding capacity compared to direct use of cylinder and ring type.

Sliding type finger tooling, which is strong at lateral load of workpiece

In order to retain workpiece which constantly pushes from the side, the structure must have strong finger tooling. Devised this <Escapement> with durability and certainty as a basis of the design. Sliders are moved forward and backward alternately by the roller, absorb the shock of the slider motion by the cam for locking. With such sliding type mechanism, stopper load performance is very strong.

Locking mechanism is not overwhelmed by reactive force on the workpiece side.

Robust design without worrying about being overwhelmed by reactive force on the workpiece side by locking cam mechanism.

Excellent finger tooling operation

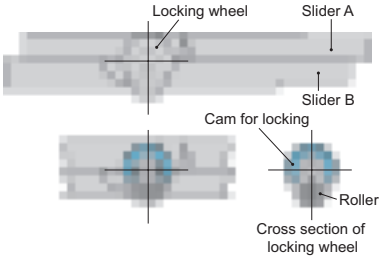
Entry and exit of two finger toolings are operated by each independent motion, therefore, assured [separation] can be performed. Excellent mechanism with no room for timing shift and with high responsiveness. In addition, the characteristic is that parallel operation makes the tooling easy.

Elaborated design for usability

For operation, compact rotary actuator was introduced which enables operation with one valve. Small-size and lightweight Manual installation is possible, and greatly contribute to the downsizing and cost reduction of the entire system.

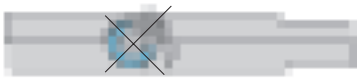
- Type with operation check sensor is available. Sensor detect backward movement end.

(1) Original position

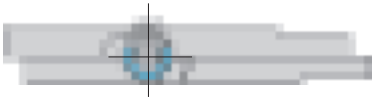


(2) Slider B moves forward. At the state when sliders A and B are locked.

(3) Along with rotation, roller moves backward the slider A. Slider B is held by the cam.

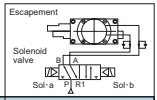


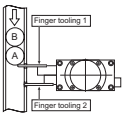
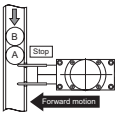
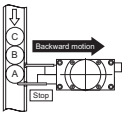
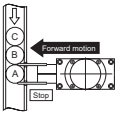
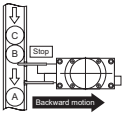
(4) Slider A moves backward. Cam engages with sliders A and B. By this cam mechanism, shock from the slider motion is absorbed.



■ Basic operation

MEG <Escapement> performs such operation.
The characteristic is that two sliders suspend while aligning in parallel at the most advanced position by the operation of 2, and 4. Surely stop the flow of the workpiece and make separation.

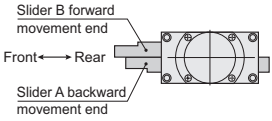


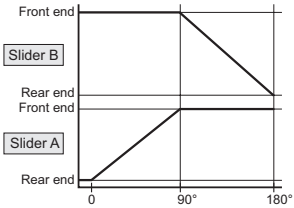
Order	Explanation	Operation	Sol•a conducting	Sol•b conducting
1	Start position. Finger tooling 1 moves forward and workpiece is at a stop.		×	
2	Finger tooling 2 moves forward. Take a posture to receive workpiece A.			×
3	Finger tooling 1 moves backward. Receive workpiece A.			
4	Finger tooling 1 moves forward. Stop workpiece after workpiece B.		×	
5	Finger tooling 2 moves backward. Return to the start position and workpiece A is separated.			

Note) The explanation is given with the example of operation of slider B from forward movement end and slider A from backward movement end.
When the workpiece flow direction becomes opposite, slider A starts from forward movement end and slider B starts from backward movement end.

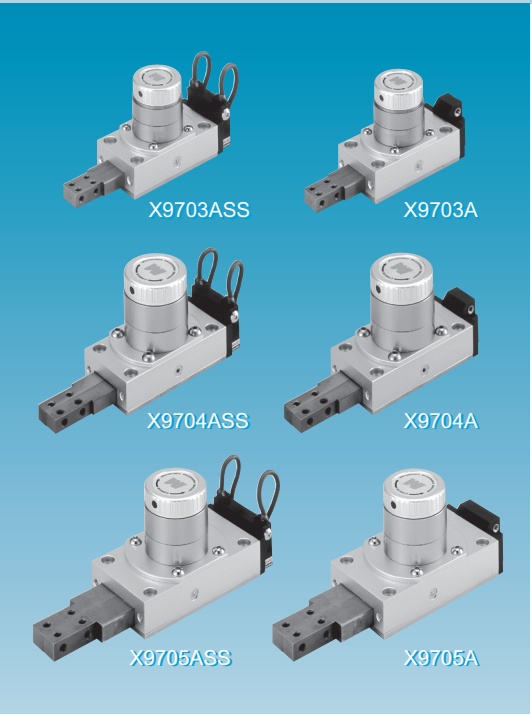
■ Slider operation timing diagram

Slider initial state





X97□□A



- Simplifying and cost reduction of the system is possible as two sliders are operated by one rotary actuator.
- Easy installation with small-size square design.
- Slider is strong at lateral load and easy tooling with square sliding type.
- Excellent at stopper load capacity as slider forward and backward movement ends are locked.

■ Variations

Model No.	Stroke (mm)			Option
	7	9	14	Backward movement detection sensor
X9703A	×			×
X9704A		×		×
X9705A			×	×

Product number configuration

X97[03]A-[SS]

- Model No.
- Stroke
  - 03: 7 mm
  - 04: 9 mm
  - 05:14 mm
- No code: Without sensor
  - S: With 1 sensor
  - SS: With 2 sensors

■ Basic specifications

Operation method	Reciprocating type rotary actuator
Fluid for use	Clean air (Filtered compressed air)
Working pressure range	0.3 to 0.5 MPa
Ambient temperature	5 to 50°C
Lubrication	Non-lubrication
Port size	M5 x 0.8
Maximum frequency of use	40 cycle/minute (when speed is adjusted to the state when slider does not stop by continuous operation)

■ Mass

Model No.	Mass (g)
X9703A	250
X9703A-S	276
X9703A-SS	302
X9704A	400
X9704A-S	426
X9704A-SS	452
X9705A	650
X9705A-S	672
X9705A-SS	702

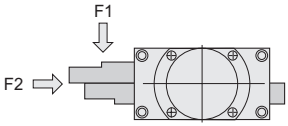
■ Sensor specifications NPN Type

Model	CS101-A
Power supply voltage	12 to 24 VDC ±10% [Ripple (P-P) 10% or less]
Working voltage/current	At 24 VDC, max. 100 mA
Voltage drop	At 24 VDC, max. 1 V
Impact resistance	50G
Vibration resistance	Double amplitude 1.5 mm, 10 to 55 Hz, for 2 hours
Indicator light	LED Light up when it's ON
Working temperature range	-10 to +60°C
Cord length	1.5 m

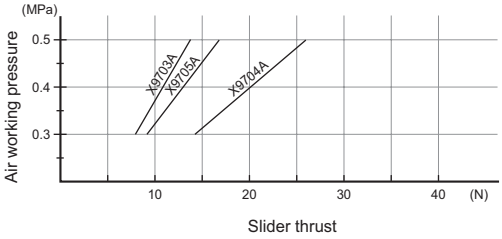
* For more information on the sensor, please refer to A-86.

■ Allowance load (Rough indication value)

Model No.	Allowance load (N)	
	F1 (Lateral direction)	F2 (Axial direction)
X9703A	4.9	4.9
X9704A	6.8	7.8
X9705A	8.8	4.9



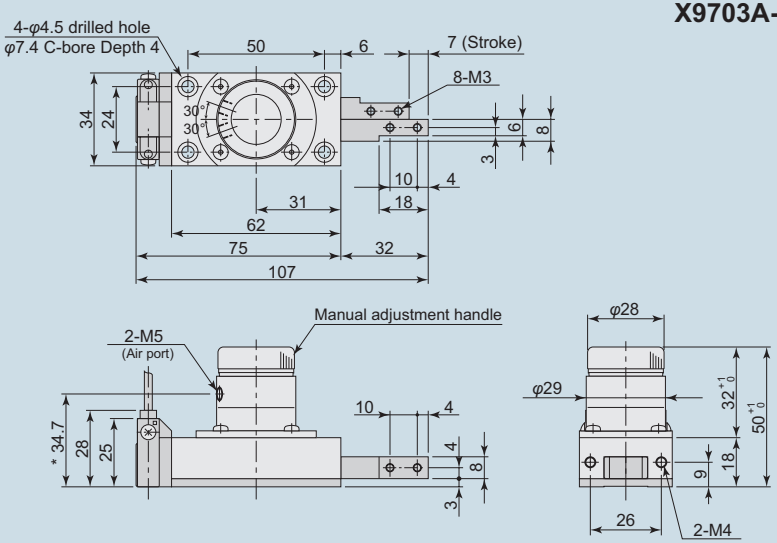
■ Minimum thrust (theoretical value)



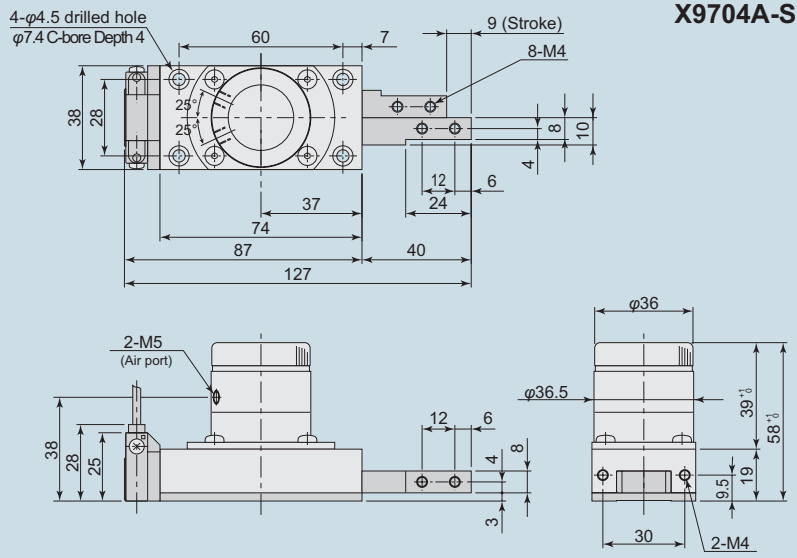
* Indicating the thrust at the slider backward movement position. Theoretically, slider forward movement end becomes infinite thrust in terms of structure.

■ Dimensional drawing (mm)

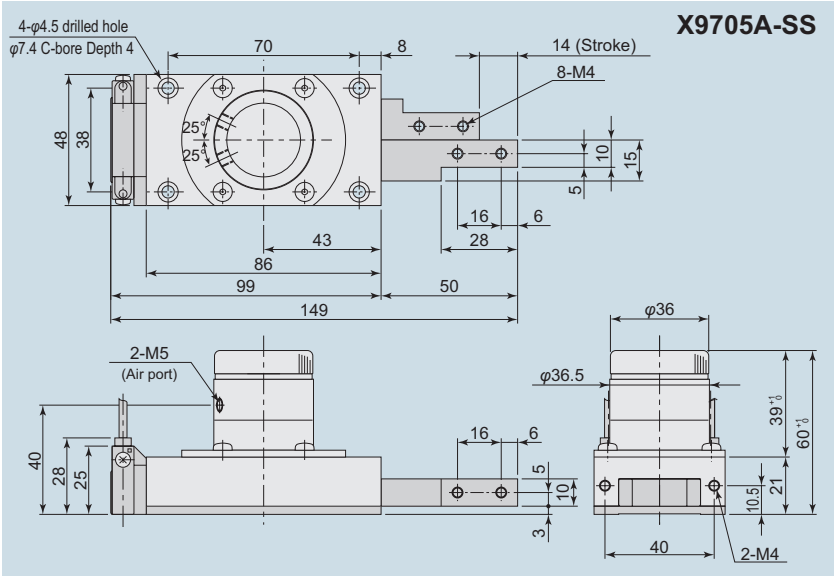
X9703A-SS



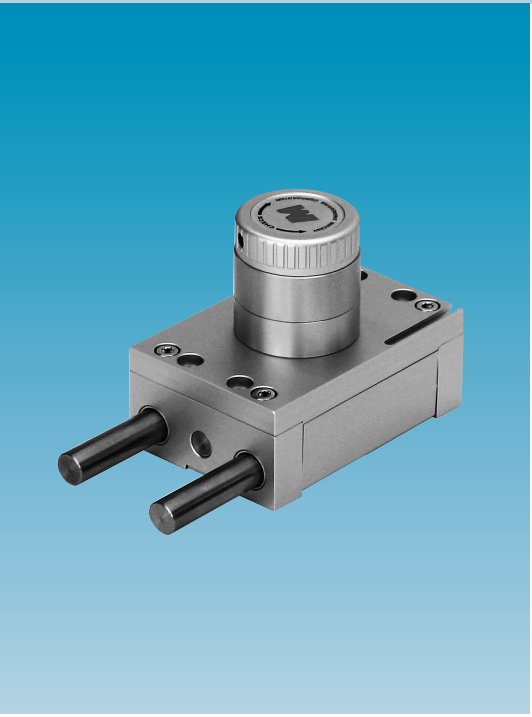
X9704A-SS



(mm)


X9705A-SS
4-φ4.5 drilled hole
φ7.4 C-bore Depth 4
70
8
14 (Stroke)
8-M4
48
38
25°
25°
10
15
5
16
6
43
28
86
99
50
149
φ36
2-M5
(Air port)
φ36.5
40
28
25
16
6
5
10
3
39+1 0
60+1 0
21
10.5
40
2-M4

X9706B



Enabled manual adjustment

Enabled operation of separation manually with handle even without air and electricity. Convenient for position check and maintenance.

Fulfilling installation characteristics

Tap is equipped on the bottom side to enable installation of cap screw from the upper side. Positioning hole on the bottom side.

Excellent in jaw installation

Introduced non-conventional slider round shape. No complicated stopper product by installing stopper with the set collar.

Very energy-saving

Compared to the case when using a large cylinder with φ20, air consumption amount is 1/5 with small rotary actuator.

Small-size and simple

Convenient small-size structure when installing to transfer line.

Also for conveyor pallet

Incorporate the contraption that enable long-term stable separation by long guide of slide part even for a large line pressure with multiple overlapped pallet.

Product number configuration

X9706B - SS - D14L1

Model No.
X9706B

Code	Supplied sensor
No code	Without sensor
S	With 1 sensors
SS	With 2 sensors

Code	Non contact sensor specification
No code	E34L1 (2 conductors 1 m, right angle)
E33L1	E33L1 (3 conductors 1 m, right angle)
D13L1	D13L1 (3 conductors 1 m, rearward)
D14L1	D14L1 (2 conductors 1 m, rearward)

* Lead line length of 3 m is also prepared.
  Use “3” for the last number of the code.
  Example: D14L3
* For more information on the sensor, please refer to A-90.

Basic specifications

Operation method	Rotary actuator	Frequency of use	120 cpm (180° 0.2 sec or more)
Fluid for use	Clean air (Filtered compressed air)	Port size	M5 x 0.8
Stroke	18 mm ±0.5 mm	Lubrication	Non-lubrication
Working pressure range	0.3 to 0.5 MPa	Main body mass	550 g
Ambient temperature	5 to 50°C	Used grease	Cosmo grease, Dynamax

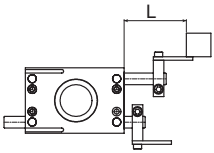
* For more information on the sensor, please refer to A-90.

Allowance load

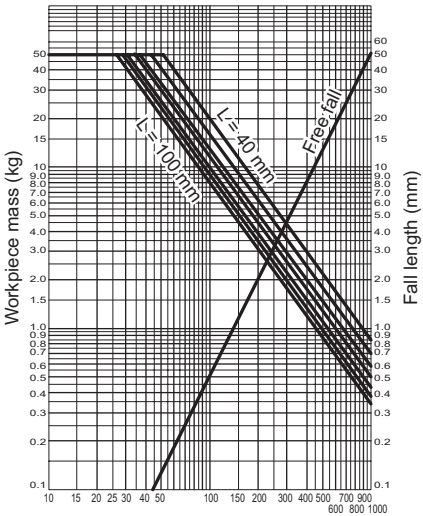
Selection procedure 1 (Selection from shock load)

- When carrying horizontally, connect work speed and work total mass in the graph on the right, and if the line is under the diagonal line (L = **), it is usable.
- For vertical fall, draw a line toward the left from "fall length" and draw a line vertically at the point where it is overlapped with the free fall line. Connect horizontal line of workpiece mass, and if the line is under the diagonal line (L = **) it is usable.

* The interval of L = 40 to L100 line in the graph is at 10 mm interval.



Shock load graph



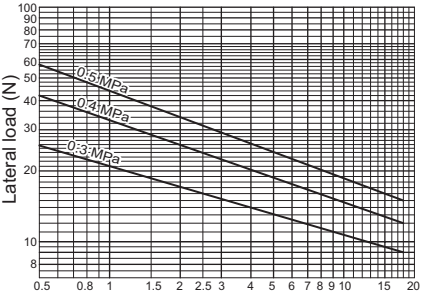
Selection procedure 2 (Selection from lateral load)

1. Obtain lateral load from the following formula.

- When carrying horizontally
  Work total mass x belt friction coefficient x stopper part friction coefficient x safety coefficient (1.5)
- For vertical drop
  Work total mass x stopper part friction coefficient x safety coefficient (1.5)

* Stopper part friction coefficient stands for the contact part of the stopper parts of escapement and workpiece. [Reference value (Dried state): Iron・Iron: 0.2, POM・Iron: 0.25, POM・POM: 0.3]

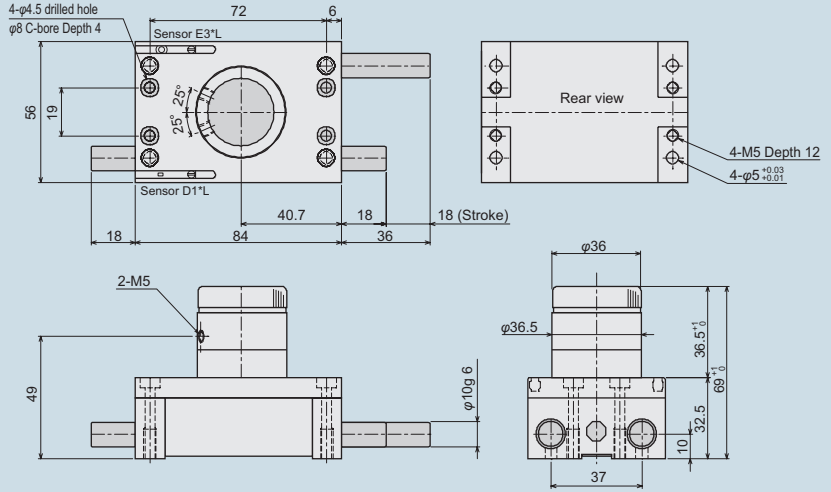
2. In the following graph, draw the obtained lateral load horizontally, draw vertical line at the place where stopper can be taken out from the workpiece, and if the point where the two lines are crossed is below the diagonal line, it is usable.



Tip for selection
Depending on the friction coefficient of the stopper part, the load that can be received changes significantly. Friction coefficient can be reduced by stopper with roller.

X9706B

■ Dimensional drawing (mm)



Precautions

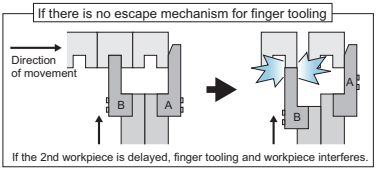
■ Design precautions

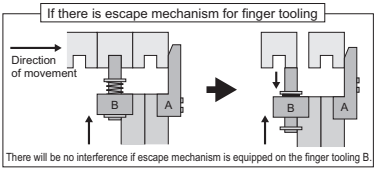
- If inertia of workpiece that hits the finger tooling is larger than production specification, install shock absorber and stopper separately, and take a measure to reduce burden of the lateral load.

- Stroke adjustment by external stopper on the slider forward movement side is not possible. Due to the structure, operation will stop on the way, and the other slider will get stuck.

- At the slider forward movement end, occurrence thrust in the stroke direction becomes theoretically infinite, which leads to damage of the workpiece and product. When there is a risk of interference with workpiece, install escape mechanism to the finger tooling and do not overload the slider.

When finger tooling B gets into the workpiece





- Do not make finger tooling heavier than necessary. If the finger tooling is heavier than necessary, life of the actuator will be shortened.

- Do not overhang the finger tooling from slider more than necessary. Five times of slider thickness or less is appropriate. The use of the product with the attachments overhung may increase abnormal stress in the integrated part due to an unbalanced load, resulting in the failure of the product.
  Refer to B-7 to find the overhang amount of X9702.

- Torsional moment that is added to the shaft (slider) of X9706B must be within 0.4 N•m.

- Use X9702C (external input) by 180° reciprocating. When it is rotated more than 180°, it contacts internal mechanical end (each end + 8° position) and abnormal load will be added. Control within 180° in order to avoid shortening life. In addition, install external stopper for safety to avoid rotating over 180°.

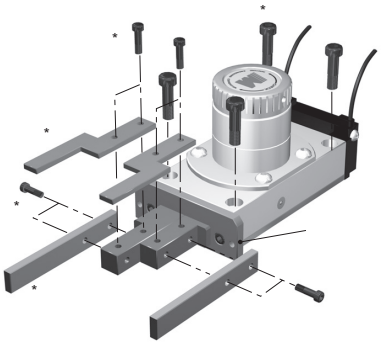
Precautions

■ Mounting precautions

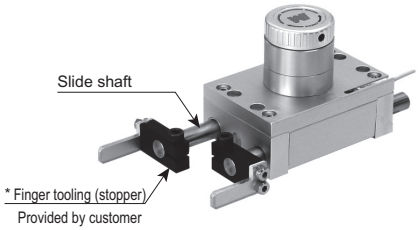
- For the installation, use the mounting hole of the main body.
  Use cap screw for the screw.

- It is recommended to install X97A to the horizontal direction.
  When slider is installed in a vertical direction, dust enters easily between the body of the main unit and the slider, and the inertia may become larger resulting in malfunction and decrease in durability.

- The finger tooling (stopper) is to be provided by customer. Fix X9706B to the shaft by slit-type set collar enables fastening it firmly.



* is to be prepared by customer.



- When installing coupling or pulley, etc. to the input shaft of X9702C, use D cut part processed for the shaft. More assured installation is possible by using a split clamping.

- When installing drive motor, etc. to X9702C, it i possible to use the tap of the main body on the input shaft side.

■ Piping precautions

- Be sure to install speed controller to the piping line and make speed adjustment of the slider. If the product is used with more than necessary speed and air pressure, it will increase impact load and may cause adverse effect on accuracy and service life.

■ Handling precautions

- Before use, read and understand the instruction manual for correct use.

- Escapement is comprised of precision parts. Handle with care to prevent any dent on or deformation of the body.

- Do not disassemble. If this product is disassembled, the functions and performance of the product may not be reproduced.

- When inertia of workpiece that hits the slider is large, install shock absorber or stopper separately.

- Read sensor specifications A-90 to find the detail of the sensor.

How to utilize

■ Escapement can be utilized in the following ways.

- At the preparation work of loading, you would like to accurately [separate] workpiece....

  There will no longer be back pressure from the parts supplied afterward, and loading becomes stable. In addition, for the parts, which tend to tangle or when the parts fit into each other, use this product. Ample assembly work can be performed.

- You would like to [separate] workpiece that is continuously flowing in at regular intervals....

  It is possible to separate parts at regular intervals by repeating the switch of escapement in the same period.

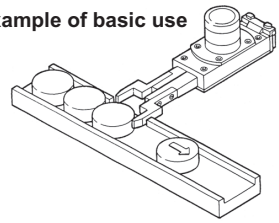
- You would like to resolve clogging due to tortuous chute, etc....

  At the branch where there is a bent part, smooth feeding is possible by sending parts as one part as there is no longer clogging.

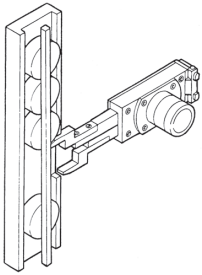
- It is also possible to use as switching of shutter for branch, driving source of intermittent feed by ratchet.

- This product is developed for the purpose of separating workpieces on the parts feeder end, chute, and conveyor, and the product can also be used for the applications as introduced here.

▼ Example of basic use

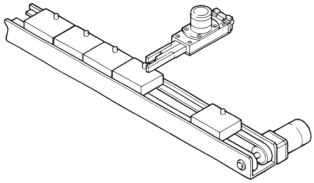


1. Escapement case example at parts feeder. Escapement case on the belt conveyor.

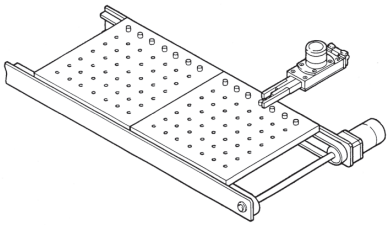


2. Escapement case example at chute.

▼ Application example



3. Escapement case example of pallet at free conveyor.



4. Tray pitch feed case example.

Applications

1. Restriction of applications

This escapement is the product to use as a device to accurately separate workpieces one by one with separation actuator operated using compressed air.

2. Safety precautions

⚠ DANGER

- Do not use the product for the following applications.
  1. Medical devices related to the support and maintenance of human life and body
  2. Mechanisms and machinery used for the purpose of moving and transporting
  3. people
     Important security components of machinery
     This product is not developed or designed for applications that require a high degree of safety. Use of this product for such applications may cause death.
- Do not use the product in a place where hazardous substances such as combustible or flammable substances exist.
  There is a possibility of the product catching fire.
- Never modify the product. Doing so may cause injury due to abnormal operation, electric shock, fire, etc.
- Do not perform improper disassembly/ assembly that affects the product's basic structure, performance, or functions.
- Do not pour water on the product. Pouring water on the product, washing it or using it immersed in water may cause injury due to abnormal operation, electric shock, fire, etc.

⚠ WARNING

- Do not throw the product into the fire. Product may be damaged or poisonous gases may be discharged.

⚠ CAUTION

- Do not apply sudden shocks from outside. Otherwise it may cause damage or injury.
- When mounting the product, ensure reliable retention and securing. Otherwise, fall or abnormal operation of the product may cause injury.
- Do not use this product in places subjected to direct sunlight (ultraviolet light) or dust, iron, iron powder, or in an atmosphere containing organic solvent, phosphate-ester hydraulic oil, sulphurous acid gas, chlorine gas, acids, etc. The product may stop functioning in a short period of time, or the performance may be deteriorated and the lifetime of the product may be significantly reduced.
- Be sure to confirm the safety of the operating range of devices before supplying air to and operating the product. If the air is supplied improperly, there is a risk of injury caused by contact with a movable part.
- Keep away from the operating range of machinery when a product is in operation or ready to operate.
  Failure to do so may result in injury due to unexpected operation of the product.
- Be sure to completely remove the supply of air before performing various tasks such as maintenance, inspection, service, or replacement.

- Use protective covers to prevent the moving parts of machinery from coming in direct contact with human body.

- When working on the product, ensure safety by wearing protective gloves, safety glasses, safety shoes, etc. as required.

- When the product has become unserviceable or unnecessary, dispose of it properly as industrial waste.

- As you incorporate the products into your system, add all safety information to the instruction manual of your system and make sure the operators of the system follow the instructions.
  Be sure to add to the instruction manual all new safety information that needs to be provided as a result of the incorporation.