

# Wide Type Parallel Style Air Gripper

ø10, ø16, ø20, ø25

New

Max. **10%** reduction

585 g → **525 g**  
ø16, Opening/Closing stroke: 30 mm

Weight

Weight reduced by the change of the body shape and internal construction






- Dust resistant option now available.  
(Made to Order: -X85, -X86□)
- Closing width adjusting option now available.  
(Made to Order: -X28)
- Small auto switches can be directly mounted.
  - Mounting brackets are not required. This reduces assembly labor.
  - Direct mounting is possible with the changed groove shape.
  - Solid state auto switch: D-M9□
- Performance and mounting dimensions are interchangeable with the current model.



## 3 Types of Stroke Variations

[mm]

Opening/Closing stroke	Stroke			
	ø10	ø16	ø20	ø25
Short: MHL2-□D 	20	30	40	50
Medium: MHL2-□D1 	40	60	80	100
Long: MHL2-□D2 	60	80	100	120

## MHL2 Series

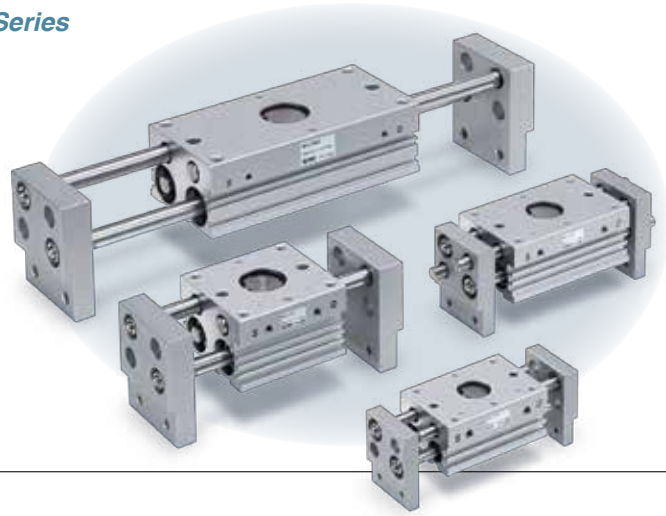


CAT.NAS20-249A

# Lightweight

Lightweight body by changing the body shape

Model	MHL2-□Z	MHL2	Reduction rate [g]
MHL2-10D	280	280	0.0%
MHL2-16D	525	585	10.3%
MHL2-20D	940	1025	8.3%
MHL2-25D	1565	1690	7.4%

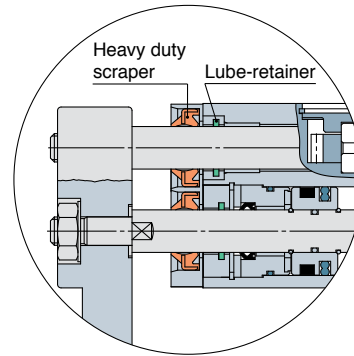
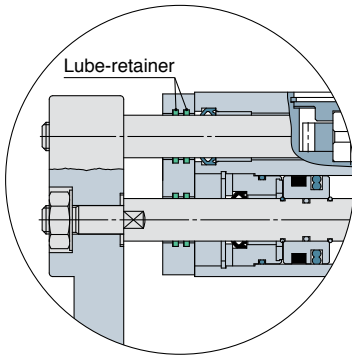


## Built-in dust protection mechanism (Standard)

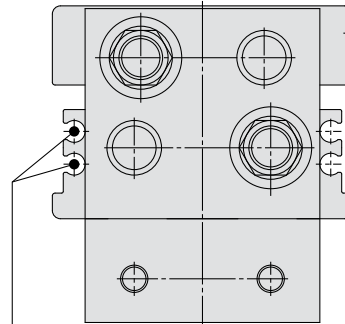
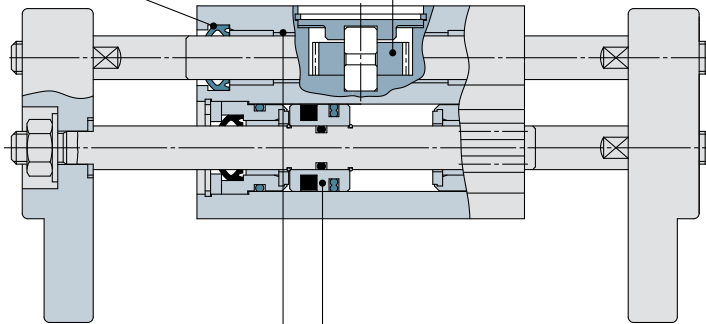
A scraper with a dust lip is adopted for all rod rotating parts.

## Dust resistant option now available. (Made to Order) Pages 19 to 21

- In micro-powder (10 to 100 μm) environments → With double Lube-retainer (-X85)
  - \* Prevents particles and foreign matter from entering the gripper. The Lube-retainer ensures a consistent film of grease, improving gripper endurance.
- In dusty environments → With heavy duty scraper + Lube-retainer (-X86□)
  - \* Applicable for environments containing particles or foreign matter. Grease film is formed on the rod due to the Lube-retainers so that the endurance is improved.
  - \* Seal material can be NBR or fluororubber.



## Fingers synchronized by a rack and pinion mechanism



Double-end type oil-impregnated resin bearings are used for all shafts.

A large amount of gripping force is provided through the use of a double piston mechanism, while maintaining a compact design.

An auto switch can be mounted at 4 locations.

## Series Variations

Series	Action	Bore size [mm]						Made to Order
		10	16	20	25	32	40	
MHL2-□Z	Double acting	●	●	●	●	*1	*1	-X4: Heat resistant 14 to 212°F [-10 to 100°C] -X5: Fluororubber seal (New) -X28: With bolt for adjusting the closing width -X50: Without magnet -X53: Ethylene propylene rubber seal (EPDM) -X63: Fluorine grease -X79: Grease for food processing machines: Fluorine grease -X79A: Grease for food processing machines: Aluminum complex soap base grease (New) -X85: Fine-particle proof specification (MHL2-□Z only) (New) -X86: With heavy duty scraper + Stable lubrication function (Lube-retainer) (NBR seals)(MHL2-□Z only) (New) -X86A: With heavy duty scraper + Stable lubrication function (Lube-retainer) (Fluororubber seals) (MHL2-□Z only)

\*1 For bore size of ø32 and ø40, refer to the **Web Catalog** for the current model.

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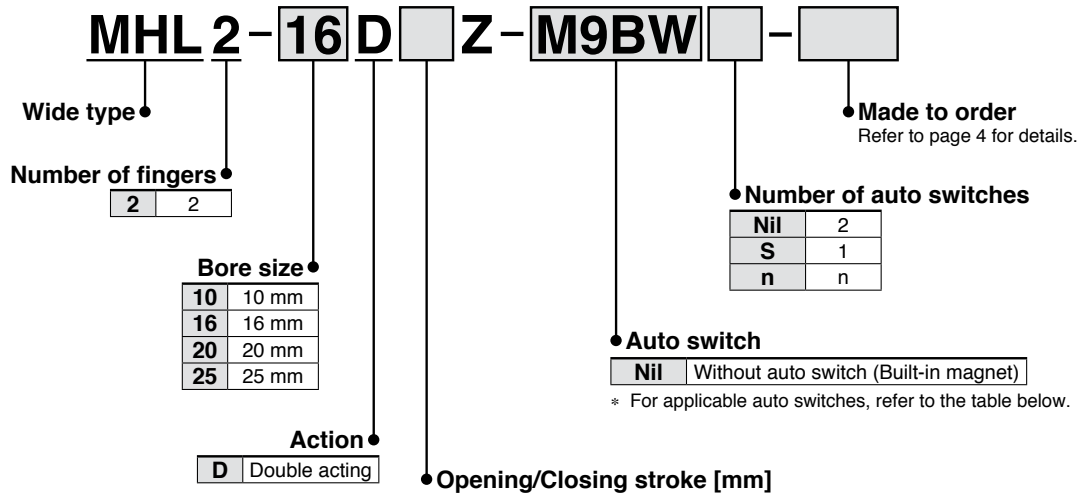





# Wide Type Parallel Style Air Gripper

## MHL2 Series

ø10, ø16, ø20, ø25

### How to Order



	Symbol	ø10	ø16	ø20	ø25
Short: MHL2-□D 	Nil	20	30	40	50
Medium: MHL2-□D1 	1	40	60	80	100
Long: MHL2-□D2 	2	60	80	100	120

### Applicable Auto Switches/Refer to the Web Catalog or Best Pneumatics for further information on auto switches.

Type	Special function	Electrical entry	Indicator light	Wiring (Output)	Load voltage		Auto switch model		Lead wire length [m]*1				Pre-wired connector	Applicable load			
					DC	AC	Perpendicular	In-line	0.5 (Nil)	1 (M)	3 (L)	5 (Z)					
Solid state auto switch	—	Grommet	Yes	3-wire (NPN)	5 V, 12 V	—	M9NV	M9N	●	●	●	○	○	IC circuit	Relay, PLC		
				3-wire (PNP)			M9PV	M9P	●	●	●	○					
				2-wire	M9BV		M9B	●	●	●	○	○					
				3-wire (NPN)	M9NWV		M9NW	●	●	●	○	○					
				3-wire (PNP)	M9PWV		M9PW	●	●	●	○	○					
				2-wire	M9BWV		M9BW	●	●	●	○	○					
	Diagnostic indication (2-color indicator)			Water resistant (2-color indicator)	3-wire (NPN)		5 V, 12 V	M9NAV*2	M9NA*2	○	○	●	○	○		○	IC circuit
					3-wire (PNP)			M9PAV*2	M9PA*2	○	○	●	○	○			
					2-wire		M9BAV*2	M9BA*2	○	○	●	○	○	○			

\*1 Lead wire length symbols: 0.5 m..... Nil (Example) M9NW  
 1 m..... M (Example) M9NWM  
 3 m..... L (Example) M9NWL  
 5 m..... Z (Example) M9NWZ

\*2 Water resistant type auto switches can be mounted on the above models, but SMC cannot guarantee water resistance.

\* Solid state auto switches marked with "○" are produced upon receipt of order.

\* When using the 2-color indicator type, please make the setting so that the indicator is lit in red to ensure the detection at the proper position of the air gripper.

# Wide Type Parallel Style Air Gripper **MHL2 Series**

## Specifications

**Long stroke**  
One unit can handle workpieces with various diameters.

A large amount of gripping force is provided through the use of a double piston mechanism, while maintaining a compact design.

Double-end type oil-impregnated resin bearings are used for all shafts.

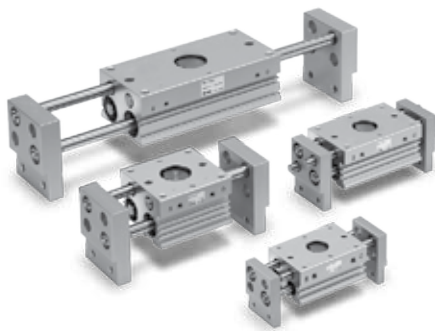
Bore size [mm]	10	16	20	25
Fluid	Air			
Action	Double acting			
Operating pressure psi [MPa]	22 to 87 [0.15 to 0.6]		15 to 87 [0.1 to 0.6]	
Ambient and fluid temperature	14 to 140°F [-10 to 60°C] (No freezing)			
Repeatability	±0.1			
Lubricant	Non-lube			
Effective gripping force lbf [N]*1 at 73 psi [0.5 MPa]	3.15 [14]	10.1 [45]	16.6 [74]	29.5 [131]

\*1 Gripping point distance: 40 mm

## Model/Stroke

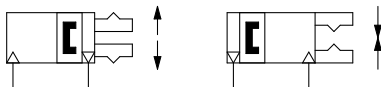
Model	Bore size [mm]	Max. operating frequency [c.p.m]	Opening/Closing stroke [mm] (L2-L1)	Closing width [mm] (L1)	Opening width [mm] (L2)	Weight [g]
MHL2-10DZ	10	60	20	56	76	280
MHL2-10D1Z		40	40	78	118	355
MHL2-10D2Z			60	96	156	430
MHL2-16DZ	16	60	30	68	98	525
MHL2-16D1Z		40	60	110	170	725
MHL2-16D2Z			80	130	210	845
MHL2-20DZ	20	60	40	82	122	940
MHL2-20D1Z		40	80	142	222	1335
MHL2-20D2Z			100	162	262	1520
MHL2-25DZ	25	60	50	100	150	1565
MHL2-25D1Z		40	100	182	282	2295
MHL2-25D2Z			120	200	320	2525

\* The opening/closing width represents the value when gripping the exterior of a workpiece.



### Symbol

Double acting: Internal grip    Double acting: External grip

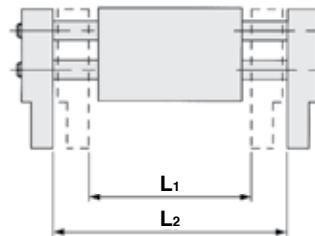


**Made to Order**  
(For details, refer to pages 16 to 21.)

Symbol	Specifications
-X4	Heat resistant (14 to 212°F [-10 to 100°C])
-X5	Fluororubber seal
-X28	With bolt for adjusting the closing width
-X50	Without magnet
-X53	Ethylene propylene rubber seal (EPDM)
-X63	Fluorine grease
-X79	Grease for food processing machines: Fluorine grease
-X79A	Grease for food processing machines: Aluminum complex soap base grease
-X85	Fine-particle proof specification
-X86□	With heavy duty scraper + Stable lubrication function (Lube-retainer) (Seal material: NBR, Fluororubber)

Refer to pages 12 to 14 for cylinders with auto switches.

- Auto Switch Installation Examples and Mounting Positions
- Auto Switch Hysteresis



## ⚠ Specific Product Precautions

Be sure to read this before handling the products. Refer to the back cover for safety instructions. For air gripper and auto switch precautions, refer to the "Handling Precautions for SMC Products" and the "Operation Manual" on the SMC website: <http://www.smcworld.com>

### ⚠ Warning

If a workpiece is hooked onto the attachment, make sure that excessive impact will not be created at the start and the end of the movement. Failure to observe this precaution may result in shifting or dropping the workpiece, which could be dangerous.

# MHL2 Series

## Model Selection

**Step 1** Check the gripping force.

**Step 2** Check the gripping point.

**Step 1** Check the gripping force.

Check the conditions.

Select the model based on the workpiece length.

Calculate the required gripping force.

Select the model from effective gripping force graph.

**Example**

Workpiece form: Length x Width  
200 mm x 20 mm plate

Workpiece mass: 0.3 kg

Gripping point distance R = 70 mm

Operating pressure: 73 psi [0.5 MPa]

Select the appropriate model for a 200 mm long workpiece. (Refer to the Table 1.)  
**MHL2-16D2Z**  
**MHL2-20D1Z, D2Z**  
**MHL2-25D1Z, D2Z**

Guidelines for the selection of the gripper with respect to workpiece mass (Refer to the Effective Gripping Force on page 6.)

- Although conditions differ according to the workpiece shape and the coefficient of friction between the attachments and the workpiece, select a model that can provide a gripping force of 10 to 20 times the workpiece mass, or more.
- Example) For setting the gripping force to be at least 20 times the workpiece mass: Required gripping force =  $0.3 \text{ kg} \times 20 \times 9.8 \text{ m/s}^2 \approx 13.5 \text{ lbf}$  [60 N]
- Further allowance should be provided when great acceleration or impact is expected during workpiece transfer.

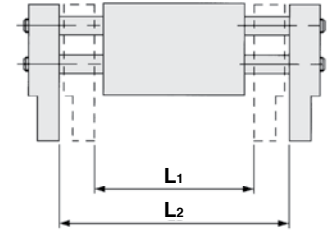
**MHL2-20D $\frac{1}{2}$ Z**

■ When the **MHL2-20D1Z** is selected. A gripping force of 16.4 lbf [73 N] is obtained from the intersection point of gripping point distance R = 70 and a pressure 73 psi [0.5 MPa].

■ The gripping force is 24 times greater than the workpiece mass, and therefore satisfies a gripping force setting value of 20 times or more.

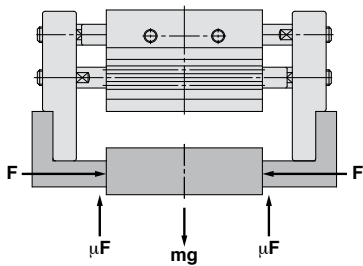
Table 1

Model	Bore size [mm]	Closing width [mm] (L1)	Opening width [mm] (L2)	Model	Bore size [mm]	Closing width [mm] (L1)	Opening width [mm] (L2)
MHL2-10DZ	10	56	76	MHL2-20DZ	20	82	122
MHL2-10D1Z		78	118	MHL2-20D1Z		142	222
MHL2-10D2Z		96	156	MHL2-20D2Z		162	262
MHL2-16DZ	16	68	98	MHL2-25DZ	25	100	150
MHL2-16D1Z		110	170	MHL2-25D1Z		182	282
MHL2-16D2Z		130	210	MHL2-25D2Z		200	320



\* The opening/closing width represents the value when gripping the exterior of a workpiece.

### Calculation of Required Gripping Force



“Gripping force at least 10 to 20 times the workpiece weight”

• The “10 to 20 times or more of the workpiece weight” recommended by SMC is calculated with a margin of “a” = 4, which allows for impacts that occur during normal transportation, etc.

When $\mu = 0.2$	When $\mu = 0.1$
$F = \frac{mg}{2 \times 0.2} \times 4$	$F = \frac{mg}{2 \times 0.1} \times 4$
$= 10 \times mg$	$= 20 \times mg$

10 x Workpiece weight

20 x Workpiece weight

When gripping a workpiece as in the figure to the left, and with the following definitions,

**F** : Gripping force [N]

$\mu$  : Coefficient of friction between the attachments and the workpiece

**m** : Workpiece mass [kg]

**g** : Gravitational acceleration (= 9.8 m/s<sup>2</sup>)

**mg** : Workpiece weight [N]

the conditions under which the workpiece will not drop are

$$2 \times \mu F > mg$$

Number of fingers

and therefore,

$$F > \frac{mg}{2 \times \mu}$$

With “a” representing the margin, “F” is determined by the following formula:

$$F = \frac{mg}{2 \times \mu} \times a$$

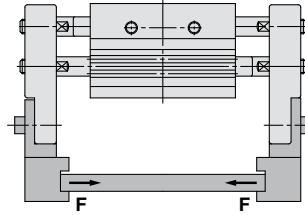
- Even in cases where the coefficient of friction is greater than  $\mu = 0.2$ , for reasons of safety, select a gripping force which is at least 10 to 20 times greater than the workpiece weight, as recommended by SMC.
- If high acceleration or impact forces are encountered during motion, a further margin should be considered.

## Effective Gripping Force

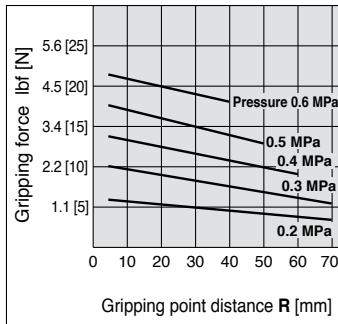
### • Indication of effective gripping force

The gripping force shown in the tables represents the gripping force of one finger when all fingers and attachments are in contact with the work.

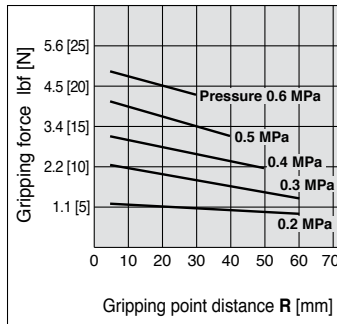
F = One finger thrust.



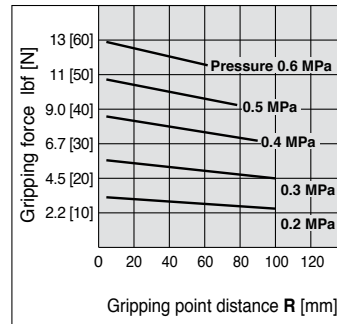
**MHL2-10DZ**



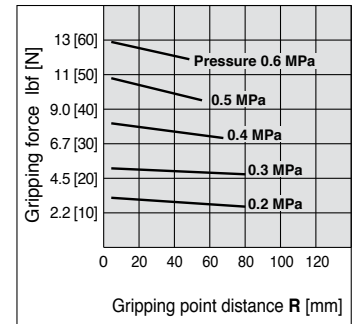
**MHL2-10D<sub>1</sub>Z**



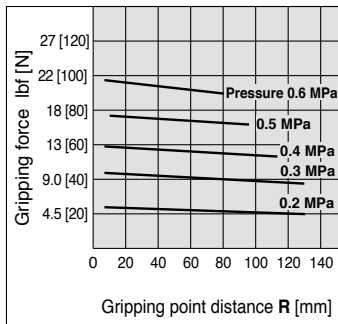
**MHL2-16DZ**



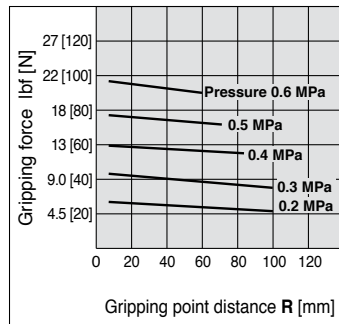
**MHL2-16D<sub>1</sub>Z**



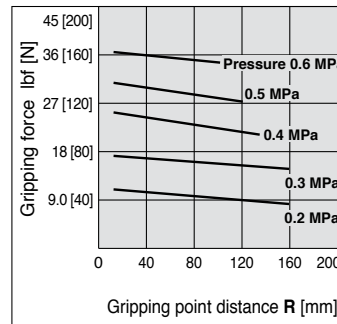
**MHL2-20DZ**



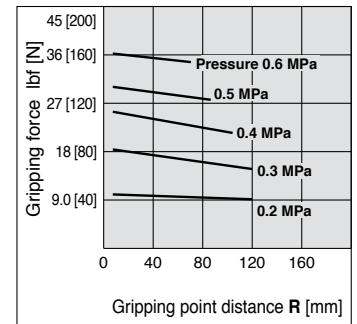
**MHL2-20D<sub>1</sub>Z**



**MHL2-25DZ**



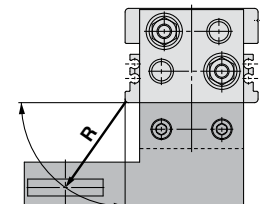
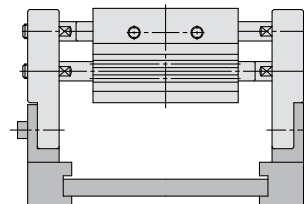
**MHL2-25D<sub>1</sub>Z**



0.6 MPa = 87 psi, 0.5MPa = 73 psi, 0.4 MPa = 58 psi, 0.3 MPa = 44 psi

## Step 2 Check the gripping point.

- The workpiece gripping point distance should be within the gripping force ranges given for each pressure in the effective gripping force graphs above.
- If operated with the workpiece gripping point beyond the indicated ranges, the load that will be applied to the fingers or the guide will become excessively unbalanced. As a result, the fingers could become loosened and adversely affect the service life of the unit.

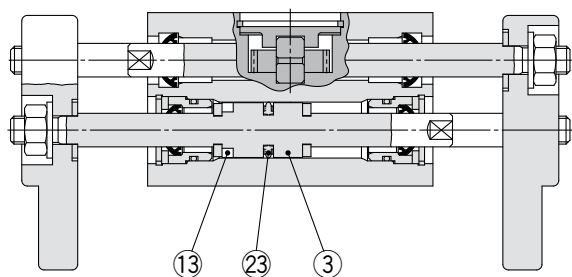


R: Gripping point distance [mm]

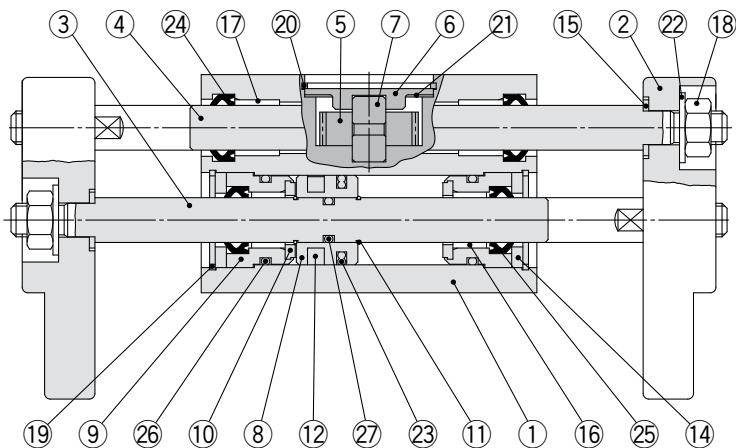
# MHL2 Series

## Construction

ø10



ø16 to ø25



### Component Parts

No.	Description	Material	Note
1	Body	Aluminum alloy	Hard anodized
2	Finger	Aluminum alloy	Hard anodized
3	Piston rod	Stainless steel	
4	Rack	Stainless steel	
5	Pinion	Carbon steel	
6	Pinion cover	Carbon steel	Electroless nickel plating
7	Pinion axis	Stainless steel	
8	Piston	Aluminum alloy	Hard anodized
9	Rod cover	Aluminum alloy	Trivalent chromated
10	Bumper	Urethane rubber	
11	Clip	Stainless steel spring wire	
12	Rubber magnet	Synthetic rubber	
13	Magnet	—	Nickel plating
14	Rod seal cover B	Cold rolled carbon steel sheet	Electroless nickel plating

No.	Description	Material	Note
15	Washer	Stainless steel	
16	Bearing	Oil containing polyacetal	
17	Bearing	Oil containing polyacetal	
18	U nut	Carbon steel	Trivalent chromated
19	Inverted internal retaining ring	Carbon steel	ACP
20	C type retaining ring	Carbon steel	ACP
21	Wave washer	Steel for spring	ACP
22	Conical spring washer	Carbon steel	
23	Piston seal	NBR	
24	Rod seal	NBR	
25	Rod seal	NBR	
26	Gasket	NBR	
27	Gasket	NBR	

### Replacement Parts

Description		MHL2-10□Z	MHL2-16□Z	MHL2-20□Z	MHL2-25□Z	Contents
Seal kit		MHL10-PS	MHL16-PS	MHL20-PS	MHL25-PS	23, 24, 25, 26, 27
Piston assembly	MHL2-□□DZ	MHL-AA1001	MHL-AA1601	MHL-AA2001	MHL-AA2501	ø10: 3, 10, 13, 23 ø16 to ø25: 3, 8, 11, 12, 23, 27
	MHL2-□□D1Z	MHL-AA1002	MHL-AA1602	MHL-AA2002	MHL-AA2502	
	MHL2-□□D2Z	MHL-AA1003	MHL-AA1603	MHL-AA2003	MHL-AA2503	
Rack	MHL2-□□DZ	MHL-AA1004	MHL-AA1604	MHL-AA2004	MHL-AA2504	4
	MHL2-□□D1Z	MHL-AA1005	MHL-AA1605	MHL-AA2005	MHL-AA2505	
	MHL2-□□D2Z	MHL-AA1006	MHL-AA1606	MHL-AA2006	MHL-AA2506	
Rod cover assembly		MHL-AA1007	MHL-AA1607	MHL-AA2007	MHL-AA2507	ø10: 9, 14, 16, 19, 25, 26 ø16 to ø25: 9, 10, 14, 16, 19, 25, 26
Finger assembly		MHL-AA1008	MHL-AA1608	MHL-AA2008	MHL-AA2508	2, 15, 18, 22
Pinion assembly		MHL-AA1009	MHL-AA1609	MHL-AA2009	MHL-AA2509	5, 6, 7, 20, 21
Nut set		MHL-A1017	MHL-A1617	MHL-A2017	MHL-A2517	15, 18, 22
U nut assembly		MHL-A1017A	MHL-A1617A	MHL-A2017A	MHL-A2517A	18, 22

\* Order one finger assembly, pinion assembly, nut set and U nut assembly per unit.

\* For piston assembly and rack, order 2 pieces per unit.

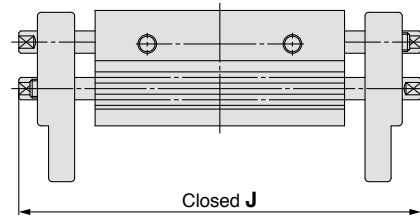
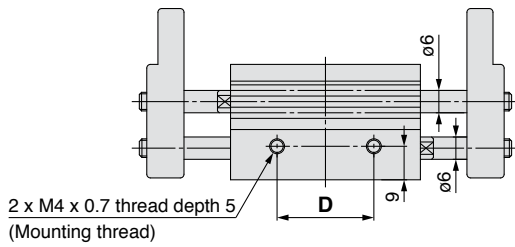
\* For rod cover assembly, order 4 pieces per unit.

\* The seal kit does not include a grease pack. Order it separately. Grease pack part number: GR-S-010 (10 g)/GR-S-020 (20 g)



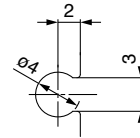
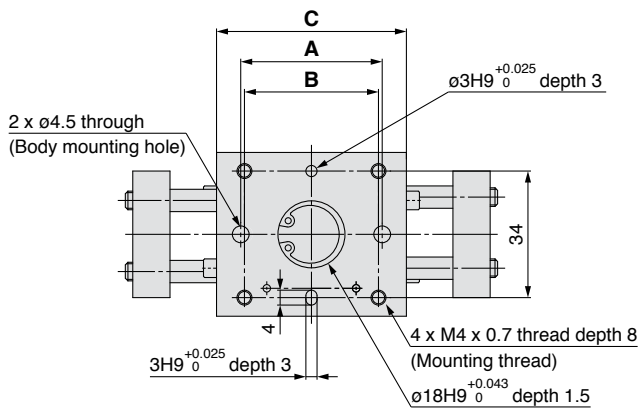
**Dimensions**

**MHL2-10D□Z**

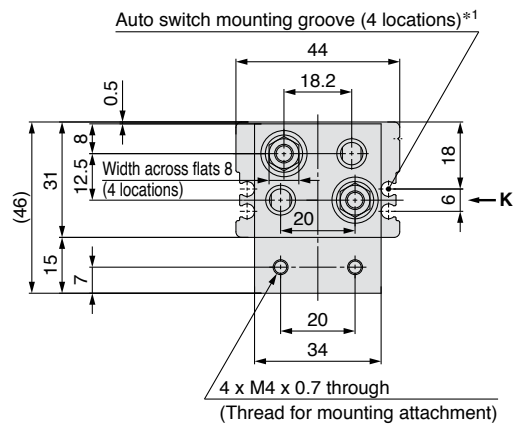
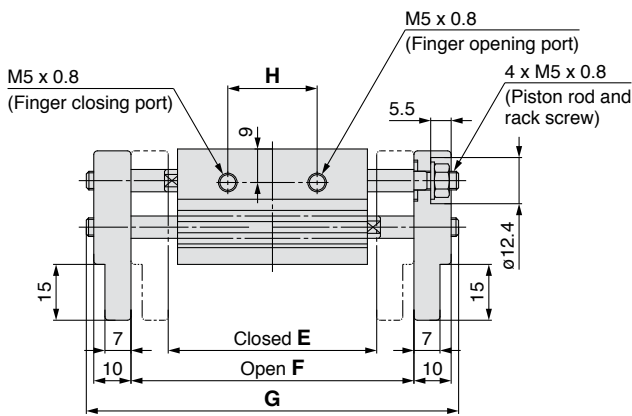


**View K (Fingers closed)**

\* The above figure shows the MHL2-10D1Z/10D2Z.



**\*1 Dimensions of auto switch mounting groove (Enlarged view)**



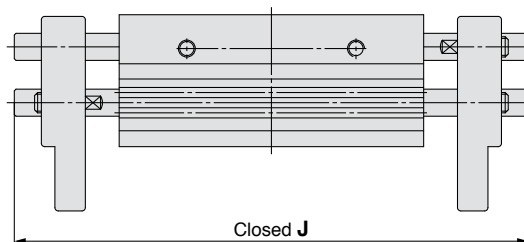
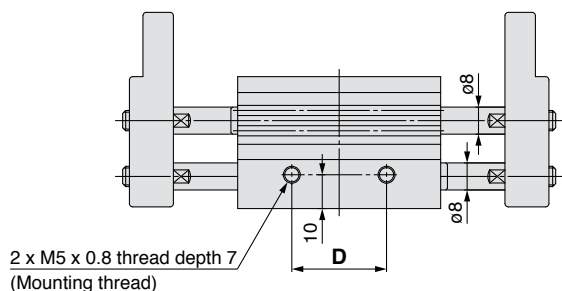
Model	A	B	C	D	E	F	G	H	J
<b>MHL2-10DZ</b>	38	36	51	26	56	76	100	24	80
<b>MHL2-10D1Z</b>	54	52	67	42	78	118	142	39	108
<b>MHL2-10D2Z</b>	72	70	85	60	96	156	180	57	146

\* J dimension is at fully closed.  
 \* D1Z is different from D2Z at finger closed because shaft is ejected from finger end.  
 J dimension is different from the value which is subtracted stroke from G dimension.

# MHL2 Series

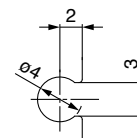
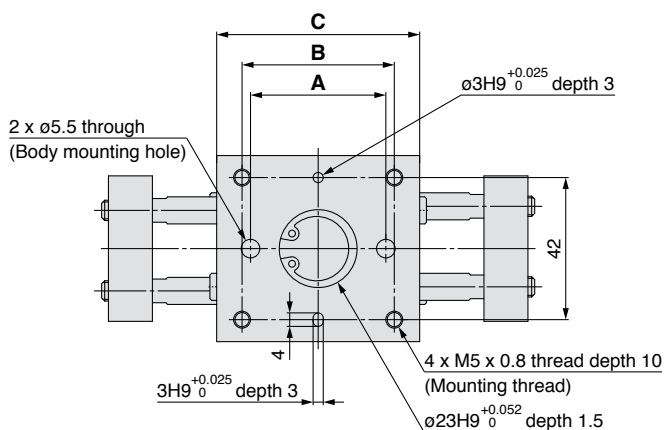
## Dimensions

### MHL2-16D□Z

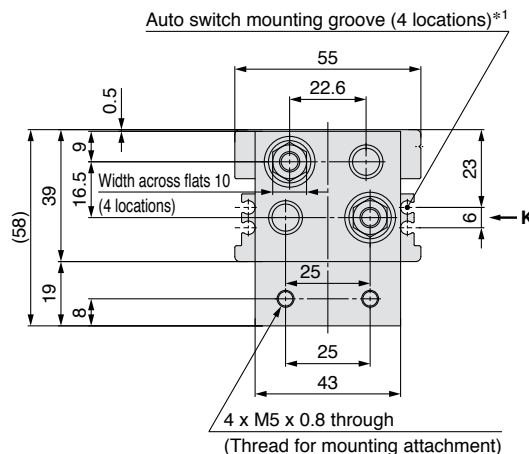
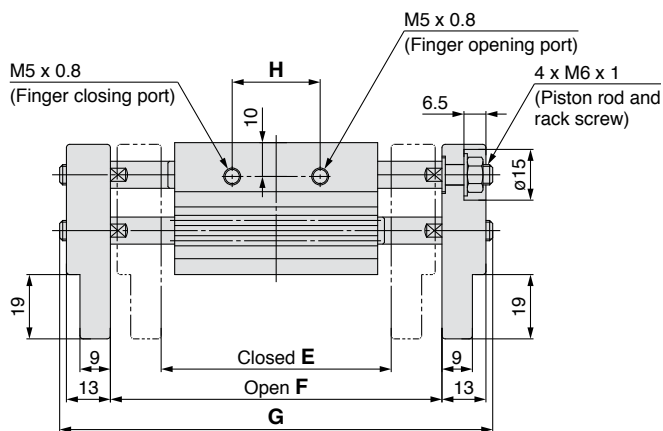


**View K (Fingers closed)**

\* The above figure shows the MHL2-16D1Z/16D2Z.



**\*1 Dimensions of auto switch mounting groove (Enlarged view)**



Model	A	B	C	D	E	F	G	H	J
MHL2-16DZ	40	45	60	28	68	98	128	26	98
MHL2-16D1Z	70	75	90	58	110	170	200	50	152
MHL2-16D2Z	90	95	110	78	130	210	240	70	192

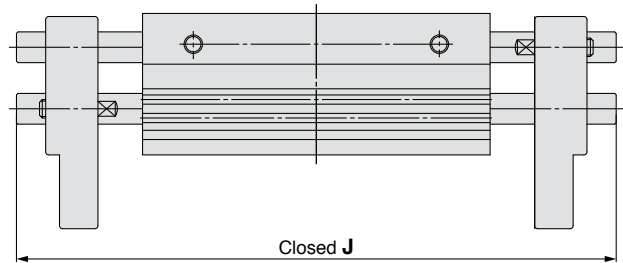
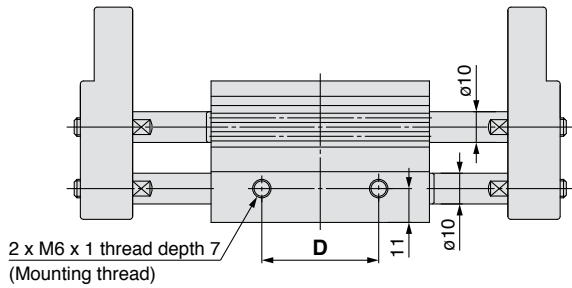
\* J dimension is at fully closed.

\* D1Z is different from D2Z at finger closed because shaft is ejected from finger end.

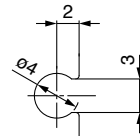
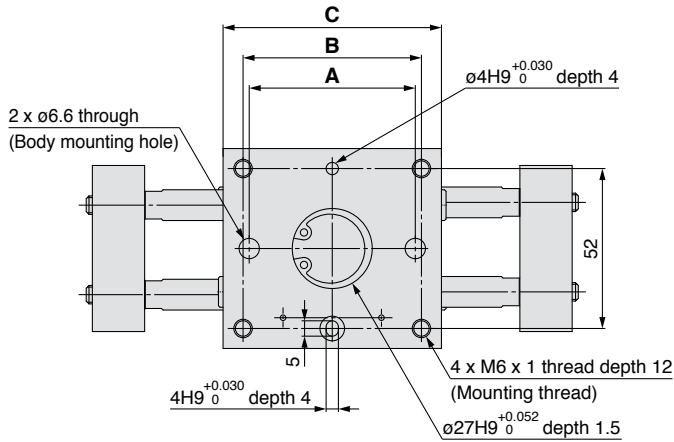
J dimension is different from the value which is subtracted stroke from G dimension.

**Dimensions**

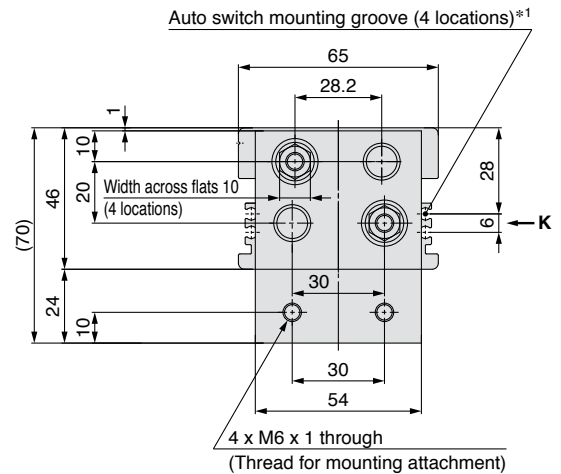
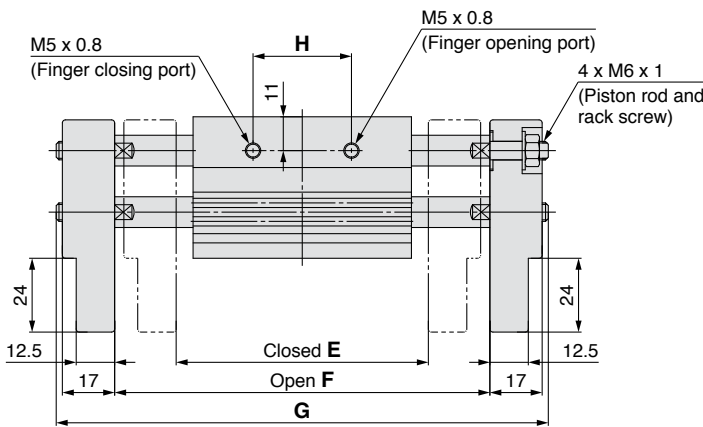
**MHL2-20D□Z**



\* The above figure shows the MHL2-20D1Z/20D2Z.



\*1 Dimensions of auto switch mounting groove (Enlarged view)



Model	A	B	C	D	E	F	G	H	J
MHL2-20DZ	54	58	71	38	82	122	160	32	120
MHL2-20D1Z	96	100	113	80	142	222	260	68	195
MHL2-20D2Z	116	120	133	100	162	262	300	88	235

\* J dimension is at fully closed.

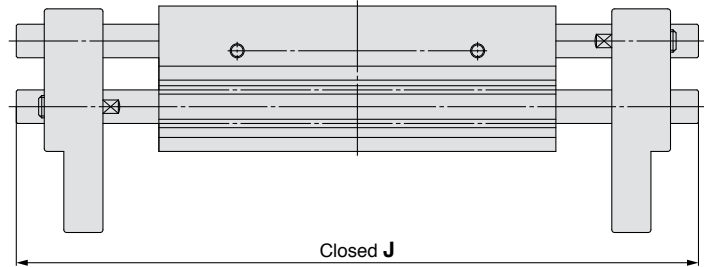
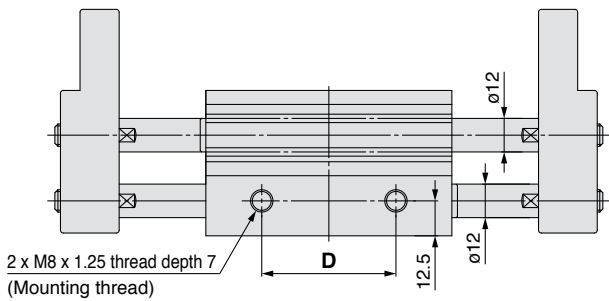
\* D1Z is different from D2Z at finger closed because shaft is ejected from finger end.

J dimension is different from the value which is subtracted stroke from G dimension.

# MHL2 Series

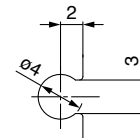
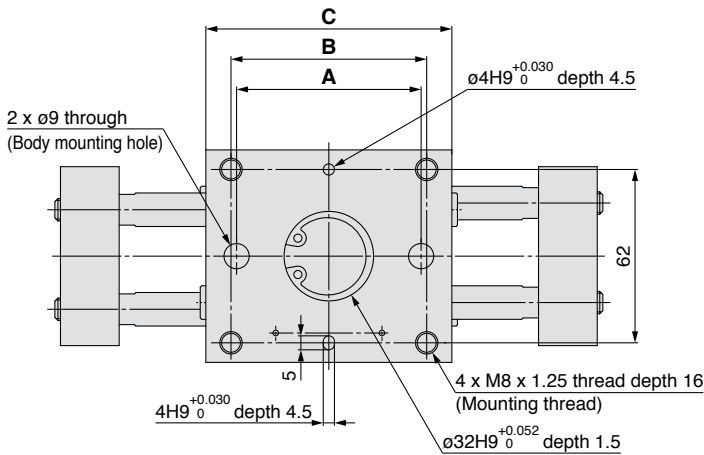
## Dimensions

### MHL2-25D□Z

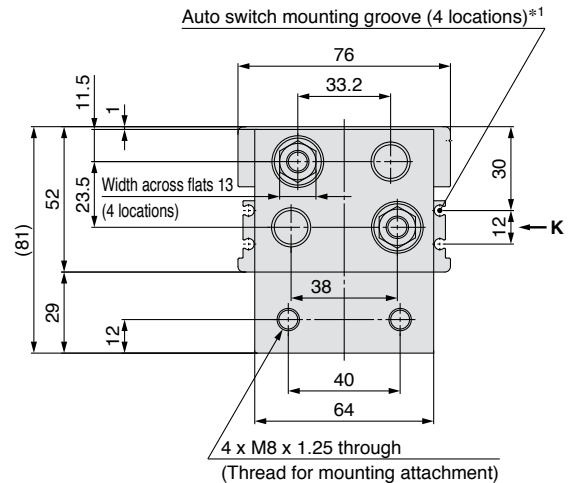
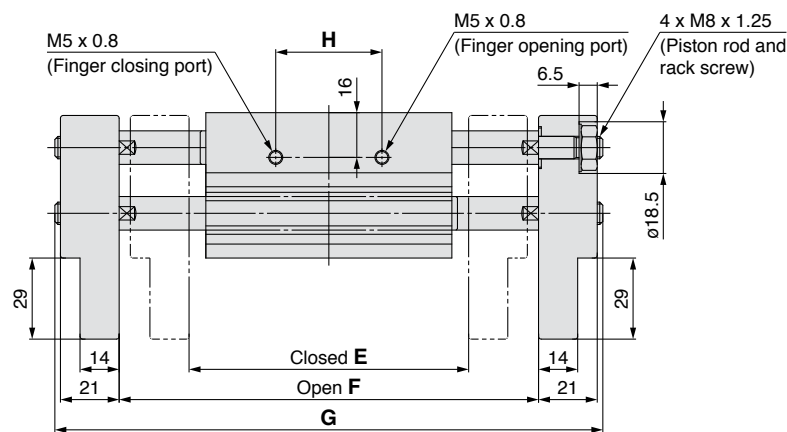


View K (Fingers closed)

\* The above figure shows the MHL2-25D1Z/25D2Z.



\*1 Dimensions of auto switch mounting groove (Enlarged view)



Model	A	B	C	D	E	F	G	H	J
MHL2-25DZ	66	70	88	48	100	150	196	38	146
MHL2-25D1Z	120	124	142	102	182	282	328	86	244
MHL2-25D2Z	138	142	160	120	200	320	366	104	282

\* J dimension is at fully closed.

\* D1Z is different from D2Z at finger closed because shaft is ejected from finger end.

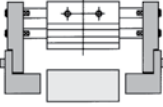

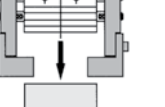

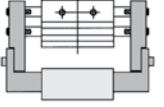
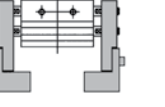
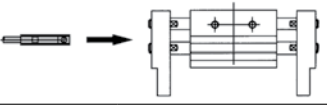
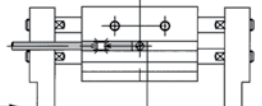
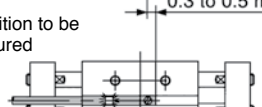
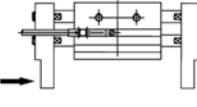
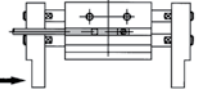
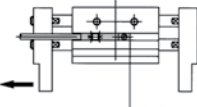
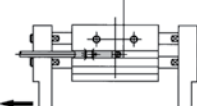
J dimension is different from the value which is subtracted stroke from G dimension.

# MHL2 Series

## Auto Switch Installation Examples and Mounting Positions

Various auto switch applications are possible through different combinations of auto switch quantities and detecting positions.

### 1) Detection when Gripping Exterior of Workpiece

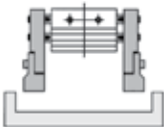
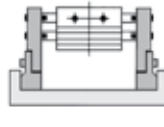
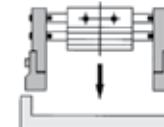
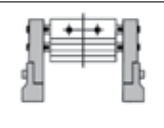
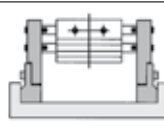
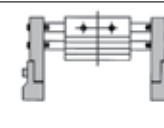

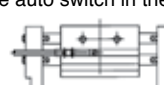
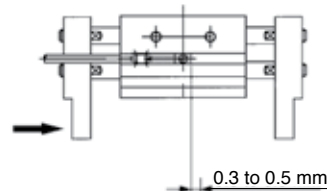
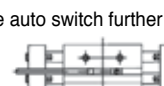
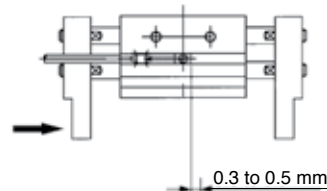
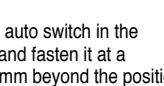
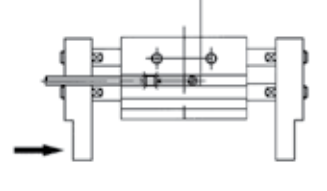

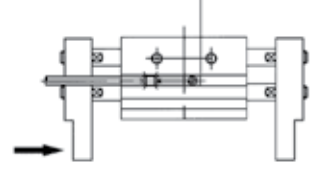

Detection example		① Confirmation of fingers in reset position	② Confirmation of workpiece held	③ Confirmation of workpiece released	
Position to be detected		Position of fingers fully open 	Position when gripping a workpiece 	Position of fingers fully closed 	
Operation of auto switch		When fingers return: Auto switch to turn ON (Light ON)	When gripping a workpiece: Auto switch to turn ON (Light ON)	When a workpiece is not held (Abnormal operation): Auto switch to turn ON (Light ON)	
Detection combinations	One auto switch * One position, any of ①, ② and ③ can be detected.	●	●	●	
	Two auto switches * Two positions of ①, ② and ③ can be detected.	Pattern A	●	—	
		Pattern B	—	●	●
Pattern C	●	—	●		
How to determine auto switch installation position  At no pressure or low pressure, connect the auto switch to a power supply, and follow the directions.		Step 1) Fully open the finger. 	Step 1) Position fingers for gripping a workpiece. 	Step 1) Fully close the fingers. 	
		Step 2) Insert the auto switch into the auto switch mounting groove from the direction of the arrow. 			
		Step 3) Slide the auto switch in the direction of the arrow until the indicator light illuminates and fasten it at a position 0.3 to 0.5 mm in the direction of the arrow beyond the position where the indicator light illuminates.  Position where light turns ON   Position to be secured 	Step 3) Slide the auto switch in the direction of the arrow until the indicator light illuminates. 	Step 4) Slide the auto switch further in the direction of the arrow until the indicator light goes out. 	Step 5) Slide the auto switch in the opposite direction and fasten it at a position 0.3 to 0.5 mm beyond the position where the indicator light illuminates.  Position where light turns ON   Position to be secured 

- \* It is recommended that gripping of a workpiece be performed close to the center of the finger stroke.
- \* When holding a workpiece close at the end of opening/closing stroke of fingers, detecting performance of the combinations listed in the above table may be limited, depending on the hysteresis of an auto switch, etc.

# MHL2 Series Auto Switch Installation Examples and Mounting Positions

Various auto switch applications are possible through different combinations of auto switch quantities and detecting positions.

## 2) Detection when Gripping Interior of Workpiece

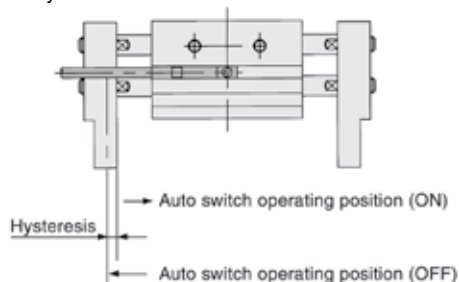
Detection example		① Confirmation of fingers in reset position	② Confirmation of workpiece held	③ Confirmation of workpiece released	
Position to be detected		Position of fingers fully closed 	Position when gripping a workpiece 	Position of fingers fully open 	
Operation of auto switch		When fingers return: Auto switch to turn ON (Light ON)	When gripping a workpiece: Auto switch to turn ON (Light ON)	When a workpiece is not held (Abnormal operation): Auto switch to turn ON (Light ON)	
Detection combinations	One auto switch * One position, any of ①, ② and ③ can be detected.	●	●	●	
	Two autoswitches * Two positions of ①, ② and ③ can be detected.	Pattern A	●	—	
		Pattern B	—	●	●
Pattern C	●	—	●		
How to determine auto switch installation position		Step 1) Fully close the fingers. 	Step 1) Position fingers for gripping a workpiece. 	Step 1) Fully open the fingers. 	
At no pressure or low pressure, connect the auto switch to a power supply, and follow the directions.		Step 2) Insert the auto switch into the auto switch mounting groove from the direction of the arrow. 			
		Step 3) Slide the auto switch in the direction of the arrow until the indicator light illuminates. 	Step 3) Slide the auto switch in the direction of the arrow until the indicator light illuminates and fasten it at a position 0.3 to 0.5 mm in the direction of the arrow beyond the position where the indicator light illuminates. 		
		Step 4) Slide the auto switch further in the direction of the arrow until the indicator light goes out. 	Position where light turns ON 		
		Step 5) Slide the auto switch in the opposite direction and fasten it at a position 0.3 to 0.5 mm beyond the position where the indicator light illuminates. 	Position to be secured 		
		Position where light turns ON 	Position to be secured 		
		Position to be secured 			

\* It is recommended that gripping of a workpiece be performed close to the center of the finger stroke.

\* When holding a workpiece close at the end of opening/closing stroke of fingers, detecting performance of the combinations listed in the above table may be limited, depending on the hysteresis of an auto switch, etc.

## Auto Switch Hysteresis

The auto switch hysteresis is shown in the table. Refer to the table as a guide when setting auto switch positions.



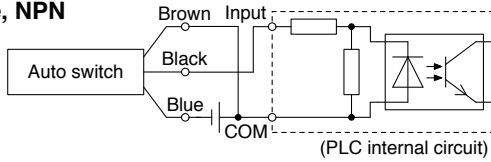
Auto switch model		[mm]
Air gripper model	D-M9□(V) D-M9□W(V) D-M9□A(V)	
MHL2-10D□Z		0.2
MHL2-16D□Z		0.5
MHL2-20D□Z		0.4
MHL2-25D□Z		0.4

# Prior to Use

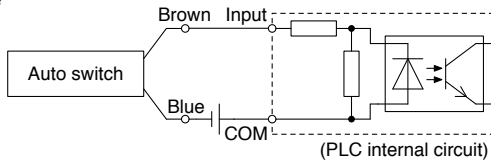
## Auto Switch Connections and Examples

### Sink Input Specifications

#### 3-wire, NPN

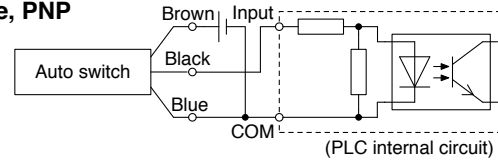


#### 2-wire

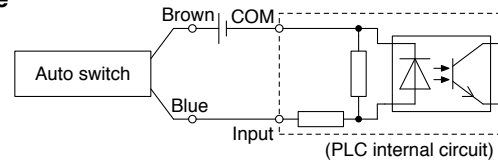


### Source Input Specifications

#### 3-wire, PNP



#### 2-wire



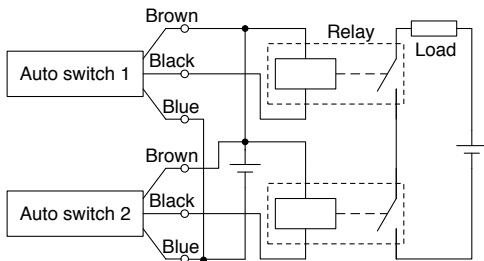
Connect according to the applicable PLC input specifications, as the connection method will vary depending on the PLC input specifications.

### Examples of AND (Series) and OR (Parallel) Connections

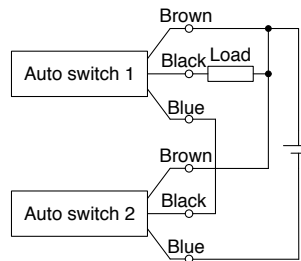
\* When using solid state auto switches, ensure the application is set up so the signals for the first 50 ms are invalid.

#### 3-wire AND connection for NPN output

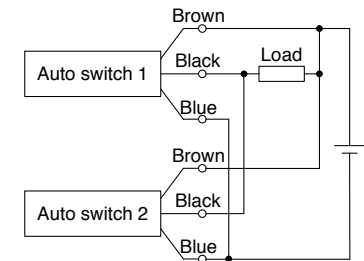
(Using relays)



(Performed with auto switches only)

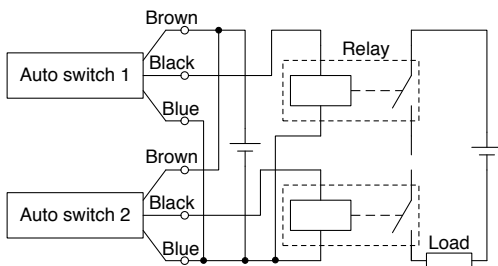


#### 3-wire OR connection for NPN output

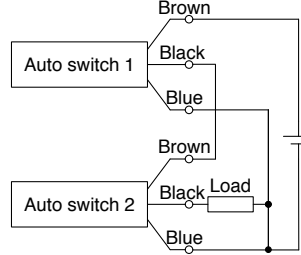


#### 3-wire AND connection for PNP output

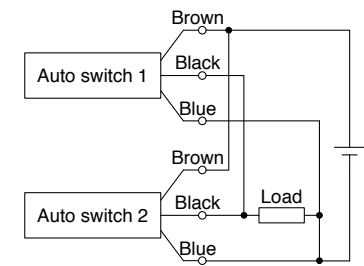
(Using relays)



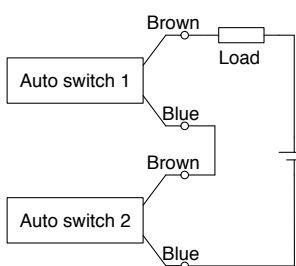
(Performed with auto switches only)



#### 3-wire OR connection for PNP output



#### 2-wire AND connection

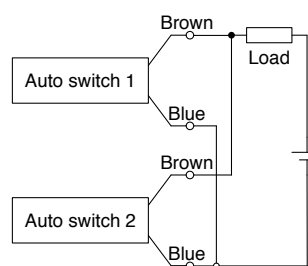


When two auto switches are connected in series, a load may malfunction because the load voltage will decline when in the ON state. The indicator lights will light up when both of the auto switches are in the ON state. Auto switches with a load voltage less than 20 V cannot be used.

$$\begin{aligned} \text{Load voltage at ON} &= \text{Power supply voltage} - \\ &\quad \text{Residual voltage} \times 2 \text{ pcs.} \\ &= 24 \text{ V} - 4 \text{ V} \times 2 \text{ pcs.} \\ &= 16 \text{ V} \end{aligned}$$

Example: Power supply is 24 VDC  
Internal voltage drop in auto switch is 4 V.

#### 2-wire OR connection



(Solid state)  
When two auto switches are connected in parallel, malfunction may occur because the load voltage will increase when in the OFF state.

(Reed)  
Because there is no current leakage, the load voltage will not increase when turned OFF. However, depending on the number of auto switches in the ON state, the indicator lights may sometimes grow dim or not light up, due to the dispersion and reduction of the current flowing to the auto switches.

$$\begin{aligned} \text{Load voltage at OFF} &= \text{Leakage current} \times 2 \text{ pcs.} \times \\ &\quad \text{Load impedance} \\ &= 1 \text{ mA} \times 2 \text{ pcs.} \times 3 \text{ k}\Omega \\ &= 6 \text{ V} \end{aligned}$$

Example: Load impedance is 3 kΩ.  
Leakage current from auto switch is 1 mA.

# *MHL2 Series*

# Made to Order



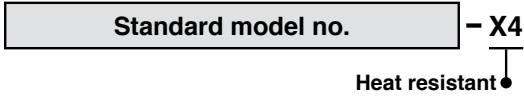
<b>1 -X4</b>	Heat Resistant (14 to 212°F [-10 to 100°C])	Page 16
<b>2 -X5</b>	Fluororubber Seal	Page 16
<b>3 -X28</b>	With Bolt for Adjusting the Closing Width	Page 17
<b>4 -X50</b>	Without Magnet	Page 17
<b>5 -X53</b>	Ethylene Propylene Rubber Seal (EPDM)	Page 17
<b>6 -X63</b>	Fluorine Grease	Page 18
<b>7 -X79</b>	Grease for Food Processing Machines: Fluorine Grease	Page 18
<b>8 -X79A</b>	Grease for Food Processing Machines: Aluminum Complex Soap Base Grease	Page 19
<b>9 -X85</b>	Fine-particle Proof Specification	Page 19
<b>10 -X86</b> <input type="checkbox"/>	With Heavy Duty Scraper + Stable Lubrication Function (Lube-retainer) (Seal Material: NBR, Fluororubber)	Page 21



**1 Heat Resistant (14 to 212°F [-10 to 100°C])**

Seal material and grease have been changed, so that it could be used even at higher temperature up to 212 from 14°F [100 from -10°C].

**How to Order**



- \* Magnet is built-in, but when using an auto switch, the acceptable temperature range becomes 14 to 140°F [-10 to 60°C].
- \* For lubrication, specialized grease GR-F is recommended.

**Specifications**

Ambient temperature range	14 to 212°F [-10°C to 100°C] (No freezing)
Seal material	Fluororubber
Grease	Heat resistant grease (GR-F)
Specifications/dimensions other than the above	Same as standard

**Replacement Parts: Seal Kit**

Seal kit part number
MHL□□-PS-X4

- \* Enter the cylinder bore size into □□ of the seal kit part number. Refer to page 7 for the replacement parts.
- \* The seal kit does not include a grease pack. Order it separately.  
**Grease pack part number: GR-F-005 (5 g)**

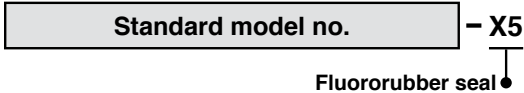
**⚠ Warning**

**Precautions**

Be aware that smoking cigarettes after your hands have come into contact with the grease used for this air gripper can create a gas that is hazardous to humans.

**2 Fluororubber Seal**

**How to Order**



- \* Please contact SMC, since the type of chemical and the operating temperature may not allow the use of this product.
- \* Since the standard type magnet is built-in, please contact SMC for the product's adaptability to the operating environment.

**Specifications**

Seal material	Fluororubber
Specifications/dimensions other than the above	Same as standard

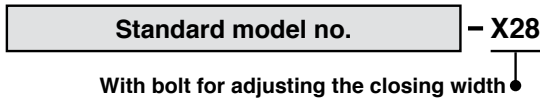
# MHL2 Series

## 3 With Bolt for Adjusting the Closing Width

Symbol  
**-X28**

Finger closing stroke can be fine-tuned by an adjustment bolt.

### How to Order

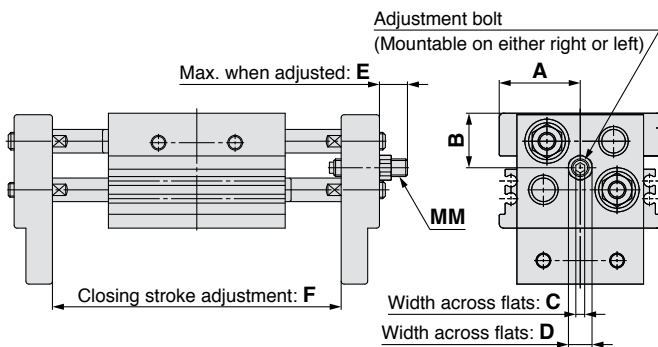


### Specifications

Adjustment range/ Adjustment bolt position	Refer to the dimensions below.
Specifications/dimensions other than the above	Same as standard

\* The bumper at the end of the adjustment bolt is not heat resistant. Combination with high temperature type is only available with a metal stopper.

### Dimensions (The dimensions below are the same as the standard type.)

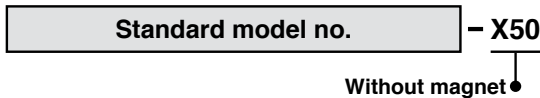


Model	A	B	C	D	E	F	MM
MHL2-10DZ-X28	22	15.5	2.5	7	4	2	M5 x 0.8
MHL2-10D1Z-X28					11	16	
MHL2-10D2Z-X28					11	16	
MHL2-16DZ-X28	27.5	18.5	3	8	9.5	9	M6 x 1
MHL2-16D1Z-X28					13.5	20	
MHL2-16D2Z-X28					13.5	20	
MHL2-20DZ-X28	32.5	21	4	12	7.5	7	M8 x 1
MHL2-20D1Z-X28					8.5	9	
MHL2-20D2Z-X28					8.5	9	
MHL2-25DZ-X28	38	26	5	14	7.5	7	M10 x 1
MHL2-25D1Z-X28				17	15	18	
MHL2-25D2Z-X28				17	15	18	

## 4 Without Magnet

Symbol  
**-X50**

### How to Order



### Specifications

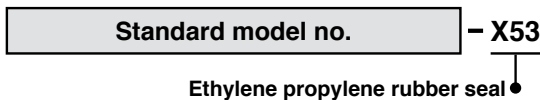
Magnet	None
Specifications/dimensions other than the above	Same as standard

## 5 Ethylene Propylene Rubber Seal (EPDM)

Symbol  
**-X53**

Seal material has been changed to ethylene propylene (EPDM), and grease to fluorine grease.

### How to Order



\* For lubrication, specialized grease GR-F is recommended.  
The grease pack is not included. Order it separately.  
Grease pack part number: GR-F-005 (5 g)

### Specifications

Seal material	Ethylene propylene rubber (EPDM)
Grease	Fluorine grease (GR-F)
Specifications/dimensions other than the above	Same as standard

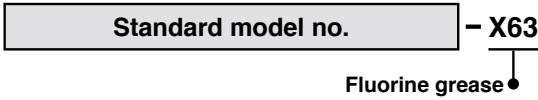
### Warning Precautions

Be aware that smoking cigarettes after your hands have come into contact with the grease used for this air gripper can create a gas that is hazardous to humans.

Symbol  
**-X63**

## 6 Fluorine Grease

### How to Order



### Specifications

Grease	Fluorine grease (GR-F)
Specifications/dimensions other than the above	Same as standard

### ⚠ Warning Precautions

Be aware that smoking cigarettes after your hands have come into contact with the grease used for this air gripper can create a gas that is hazardous to humans.

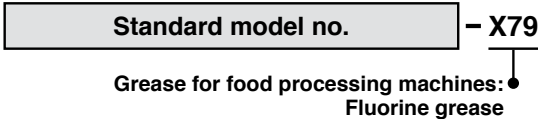
- \* The grease pack is not included. Order it separately.  
Grease pack part number: GR-F-005 (5 g)

Symbol  
**-X79**

## 7 Grease for Food Processing Machines: Fluorine Grease

Use grease for food processing machines (NSF-H1 certified/fluorine grease).

### How to Order



### ⚠ Warning Precautions

Be aware that smoking cigarettes after your hands have come into contact with the grease used for this air gripper can create a gas that is hazardous to humans.

### ⚠ Caution

**Do not use air grippers in a food-related environment.**

<Not installable>

Food zone ..... Food may directly contact with air grippers, and is treated as food products.

<Installable>

Splash zone ..... Food may directly contact with air grippers, but is not treated as food products.

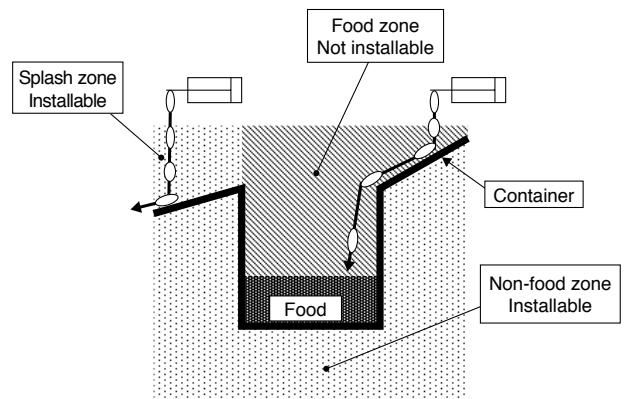
Non-food zone ..... Air grippers do not directly contact food.

- \* For lubrication, specialized grease GR-H is recommended.  
The grease pack is not included. Order it separately.  
Grease pack part number: GR-H-000 (10 g)

### Specifications

Grease	Grease for food processing machines (NSF-H1 certified)/Fluorine grease
Specifications/dimensions other than the above	Same as standard

- \* If the fluorine grease is not applicable to the working environment, use "-X79A."



## 8 Grease for Food Processing Machines: Aluminum Complex Soap Base Grease

Symbol  
**-X79A**

Use grease for food processing machines (NSF-H1 certified).

### How to Order

Standard model no. **- X79A**

Grease for food processing machines:  
Aluminum complex soap base grease

### ⚠ Caution

Do not use air grippers in a food-related environment.

<Not installable>

Food zone ..... Food may directly contact with air grippers, and is treated as food products.

<Installable>

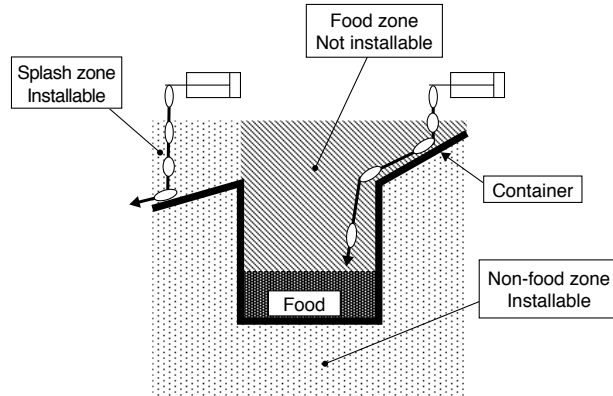
Splash zone ..... Food may directly contact with air grippers, but is not treated as food products.

Non-food zone ..... Air grippers do not directly contact food.

\* For lubrication, specialized grease GR-R is recommended.

### Specifications

Grease	Grease for food processing machines (NSF-H1 certified)/Aluminum complex soap base grease
Specifications/dimensions other than the above	Same as standard



## 9 Fine-particle Proof Specification

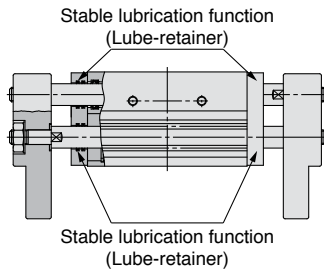
Symbol  
**-X85**

Applicable for environments with flying micro-powder (10 to 100 μm) such as ceramic powder, toner powder, paper powder, and metallic powder (except weld spatter). Grease film is formed on the rod due to the Lube-retainers which maintains lubrication for longer increasing gripper endurance.

### How to Order

Standard model no. **- X85**

Fine-particle proof specification



### Specifications

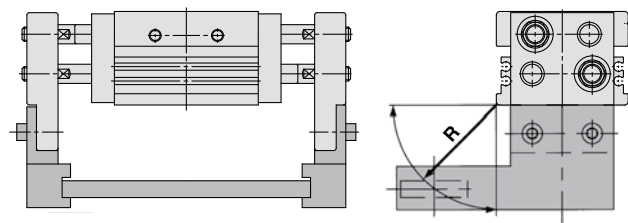
Bore size [mm]	10	16	20	25
Dust prevention method	Stable lubrication function (Lube-retainer) type (8 locations)			
Operating pressure psi [MPa]	58 to 87 [0.4 to 0.6]	44 to 87 [0.3 to 0.6]		
Repeatability	±0.1			
Effective gripping force lbf [N]*1 at 73 psi [0.5 MPa]	3 [14]	10 [45]	17 [74]	29 [131]

\*1 Gripping point distance: 40 mm

Specifications/dimensions other than the above	Same as standard
--	------------------

### Gripping Point

- The workpiece gripping point distance should be within the gripping force ranges given for each pressure in the effective gripping force graphs on the next page.
- If operated with the workpiece gripping point beyond the indicated ranges, the load that will be applied to the fingers or the guide will become excessively unbalanced. As a result, the fingers could become loosened and adversely affect the service life of the unit.



R: Gripping point distance [mm]

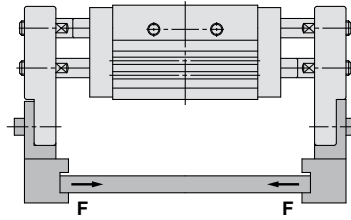
**9 Fine-particle Proof Specification**

**Effective Gripping Force**

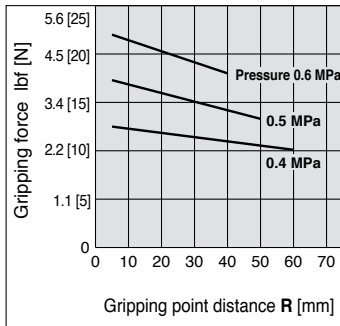
● **Indication of effective gripping force**

The gripping force shown in the tables represents the gripping force of one finger when all fingers and attachments are in contact with the work.

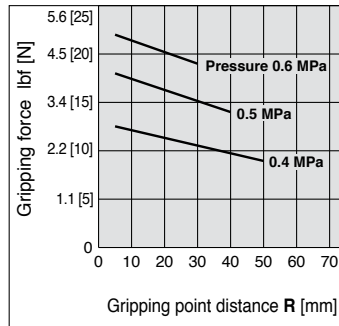
F = One finger thrust.



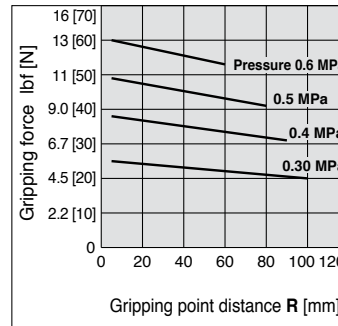
**MHL2-10DZ-X85**



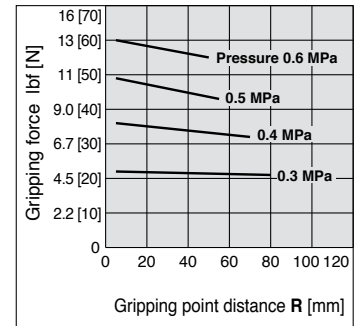
**MHL2-10D<sup>1</sup>/<sub>2</sub>Z-X85**



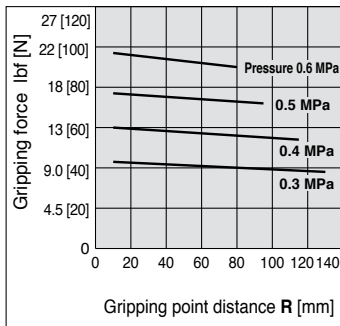
**MHL2-16DZ-X85**



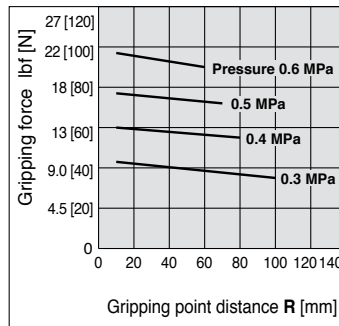
**MHL2-16D<sup>1</sup>/<sub>2</sub>Z-X85**



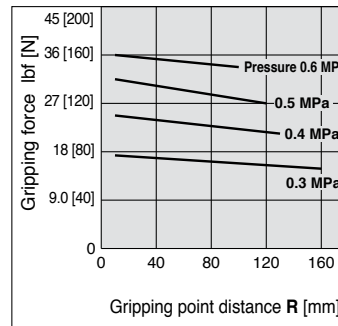
**MHL2-20DZ-X85**



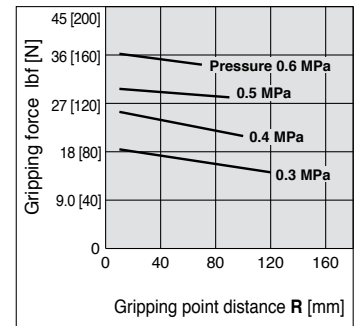
**MHL2-20D<sup>1</sup>/<sub>2</sub>Z-X85**



**MHL2-25DZ-X85**

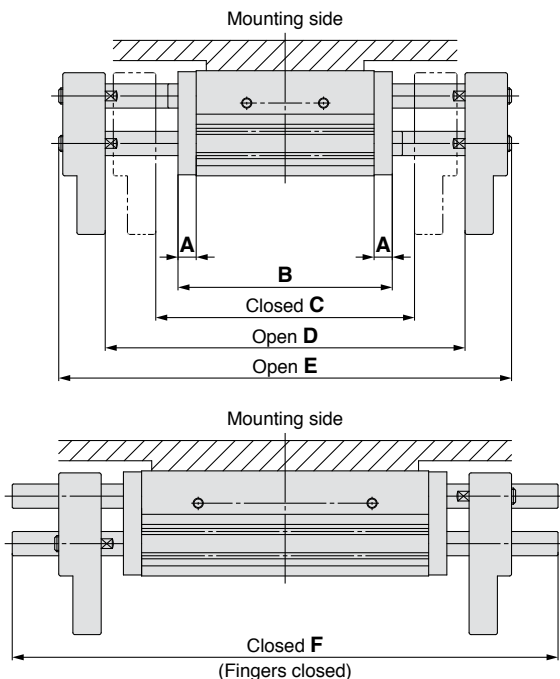


**MHL2-25D<sup>1</sup>/<sub>2</sub>Z-X85**



**Dimensions** (The dimensions below are the same as the standard type.)

0.6 MPa = 87 psi, 0.5MPa = 73 psi, 0.4 MPa = 58 psi, 0.3 MPa = 44 psi



Model	A	B	C	D	E	F	Weight [g]
<b>MHL2-10DZ-X85</b>	8	67	88	108	132	112	350
<b>MHL2-10D1Z-X85</b>	8	83	104	144	168	131	420
<b>MHL2-10D2Z-X85</b>	8	101	122	182	206	169	495
<b>MHL2-16DZ-X85</b>	9.5	79	96	126	156	126	650
<b>MHL2-16D1Z-X85</b>	9.5	109	126	186	216	179	840
<b>MHL2-16D2Z-X85</b>	9.5	129	146	226	256	219	965
<b>MHL2-20DZ-X85</b>	9	89	108	148	186	146	1115
<b>MHL2-20D1Z-X85</b>	9	131	150	230	268	221	1490
<b>MHL2-20D2Z-X85</b>	9	151	170	270	308	261	1675
<b>MHL2-25DZ-X85</b>	9	106	128	178	224	174	1815
<b>MHL2-25D1Z-X85</b>	9	160	182	282	328	270	2500
<b>MHL2-25D2Z-X85</b>	9	178	200	320	366	308	2730

\* Provide clearance between the mounting side and adapter.

# MHL2 Series

Symbol

## 10 With Heavy Duty Scraper + Stable Lubrication Function (Lube-retainer) (Seal Material: NBR, Fluororubber)

**-X86** □

- It is suitable for using cylinders under the environment, where there are much dusts in a surrounding area by using a heavy duty scraper on the wiper ring, or using cylinders under earth and sand exposed to the die-casted equipment, construction machinery, or industrial vehicles. In addition, the stable lubrication function (Lube-retainer) creates grease coating around the rod, which improves lubrication.
- Seal material can be NBR or fluororubber.

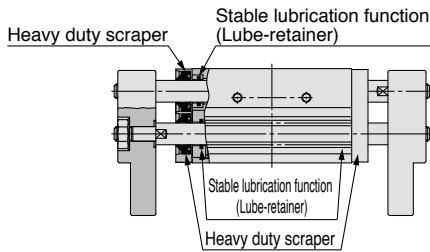
### How to Order

Standard model no. **- X86**

With heavy duty scraper + Stable lubrication function (NBR seals)

Standard model no. **- X86A**

With heavy duty scraper + Stable lubrication function (Fluororubber seals)



### Specifications

Symbol	-X86	-X86A
Bore size [mm]	25	25
Dust prevention method	Heavy duty scraper + Stable lubrication function (Lube-retainer) type (8 locations)	
Heavy duty scraper material	NBR	Fluororubber
Operating pressure psi [MPa]	44 to 87 [0.3 to 0.6]	
Repeatability	±0.1	
Effective gripping force lbf [N] *1 at 73 psi [0.5 MPa]	29.5 [131]	29.5 [131]

\*1 Gripping point distance: 40 mm

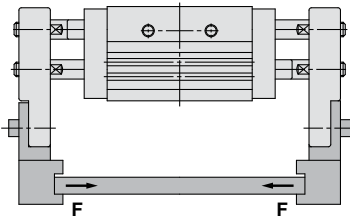
\* For water resistant type, please contact SMC local sales representative.

Specifications/dimensions other than the above	Same as standard
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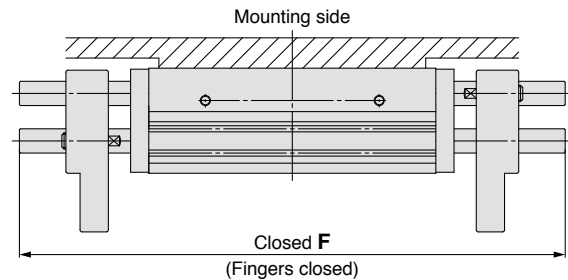
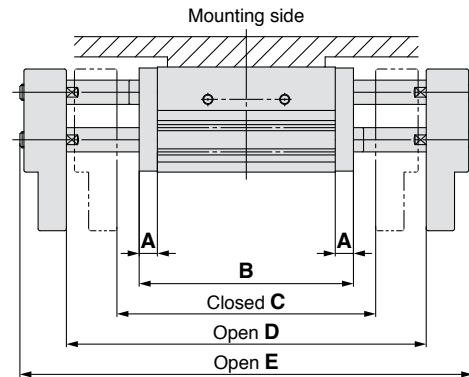
### Effective Gripping Force

#### • Indication of effective gripping force

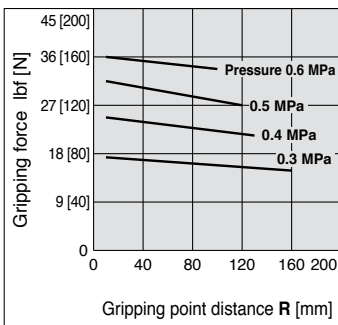
The gripping force shown in the tables represents the gripping force of one finger when all fingers and attachments are in contact with the work. F = One finger thrust.



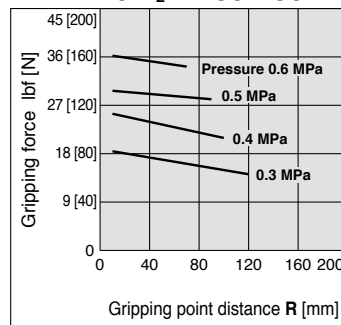
### Dimensions (The dimensions below are the same as the standard type.)



#### MHL2-25DZ-X86/X86A



#### MHL2-25D<sup>1</sup>/<sub>2</sub>Z-X86/X86A



0.6 MPa = 87 psi, 0.5 MPa = 73 psi, 0.4 MPa = 58 psi, 0.3 MPa = 44 psi

Model	A	B	C	D	E	F	Weight [g]
MHL2-25DZ-X86(A)	9	106	128	178	224	174	1835
MHL2-25D1Z-X86(A)	9	160	182	282	328	270	2520
MHL2-25D2Z-X86(A)	9	178	200	320	366	308	2750

\* Provide clearance between the mounting side and adapter.



# MHL2 Series Specific Product Precautions

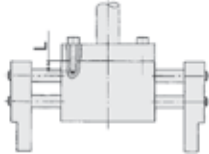
Be sure to read this before handling the products. Refer to the back cover for safety instructions. For air gripper and auto switch precautions, refer to the “Handling Precautions for SMC Products” and the “Operation Manual” on the SMC website: <http://www.smcworld.com>

## How to Mount Air Grippers

Possible to mount from 2 directions.

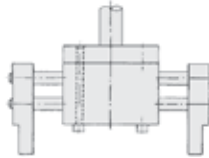
### Axial Mounting

#### • Body tapped



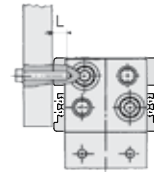
Model	Applicable bolt	Max. tightening torque lbf-ft [N·m]	Max. screw-in depth L [mm]
MHL2-10D□Z	M4 x 0.7	1.5 [2.1]	8
MHL2-16D□Z	M5 x 0.8	3.2 [4.3]	10
MHL2-20D□Z	M6 x 1	5.4 [7.3]	12
MHL2-25D□Z	M8 x 1.25	13.1 [17.7]	16

#### • Body through-hole



Model	Applicable bolt	Max. tightening torque lbf-ft [N·m]
MHL2-10D□Z	M4 x 0.7	1.5 [2.1]
MHL2-16D□Z	M5 x 0.8	3.2 [4.3]
MHL2-20D□Z	M6 x 1	5.4 [7.3]
MHL2-25D□Z	M8 x 1.25	13.1 [17.7]

### Lateral Mounting

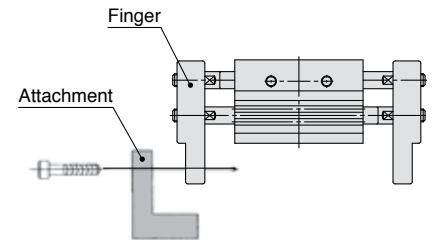


Model	Applicable bolt	Max. tightening torque lbf-ft [N·m]	Max. screw-in depth L [mm]
MHL2-10D□Z	M4 x 0.7	1.0 [1.4]	5
MHL2-16D□Z	M5 x 0.8	2.1 [2.8]	7
MHL2-20D□Z	M6 x 1	3.5 [4.8]	7
MHL2-25D□Z	M8 x 1.25	8.9 [12.0]	7

## How to Mount the Attachment to the Finger


1. Make sure that the piston rod is retracted so as not to apply undue strain on the piston rod while an attachment is being mounted to the finger.
2. Do not scratch or dent the sliding portion of the piston rod. Damage to the bearings or seals may cause air leaks or faulty operation.
3. Refer to the table on the right for the proper tightening torque on the bolt used for securing the attachment to the finger.


Model	Applicable bolt	Max. tightening torque lbf-ft [N·m]
MHL2-10D□Z	M4 x 0.7	1.0 [1.4]
MHL2-16D□Z	M5 x 0.8	2.1 [2.8]
MHL2-20D□Z	M6 x 1	3.5 [4.8]
MHL2-25D□Z	M8 x 1.25	8.9 [12.0]




## Safety Instructions

These safety instructions are intended to prevent hazardous situations and/or equipment damage. These instructions indicate the level of potential hazard with the labels of “Caution,” “Warning” or “Danger.” They are all important notes for safety and must be followed in addition to International Standards (ISO/IEC)\*1), and other safety regulations.

 **Caution:** Caution indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.

 **Warning:** Warning indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.

 **Danger:** Danger indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.

\*1) ISO 4414: Pneumatic fluid power – General rules relating to systems.  
ISO 4413: Hydraulic fluid power – General rules relating to systems.  
IEC 60204-1: Safety of machinery – Electrical equipment of machines.  
(Part 1: General requirements)  
ISO 10218-1: Manipulating industrial robots – Safety.  
etc.

### Warning

#### 1. The compatibility of the product is the responsibility of the person who designs the equipment or decides its specifications.

Since the product specified here is used under various operating conditions, its compatibility with specific equipment must be decided by the person who designs the equipment or decides its specifications based on necessary analysis and test results. The expected performance and safety assurance of the equipment will be the responsibility of the person who has determined its compatibility with the product. This person should also continuously review all specifications of the product referring to its latest catalog information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.

#### 2. Only personnel with appropriate training should operate machinery and equipment.

The product specified here may become unsafe if handled incorrectly. The assembly, operation and maintenance of machines or equipment including our products must be performed by an operator who is appropriately trained and experienced.

#### 3. Do not service or attempt to remove product and machinery/equipment until safety is confirmed.

1. The inspection and maintenance of machinery/equipment should only be performed after measures to prevent falling or runaway of the driven objects have been confirmed.
2. When the product is to be removed, confirm that the safety measures as mentioned above are implemented and the power from any appropriate source is cut, and read and understand the specific product precautions of all relevant products carefully.
3. Before machinery/equipment is restarted, take measures to prevent unexpected operation and malfunction.

#### 4. Contact SMC beforehand and take special consideration of safety measures if the product is to be used in any of the following conditions.

1. Conditions and environments outside of the given specifications, or use outdoors or in a place exposed to direct sunlight.
2. Installation on equipment in conjunction with atomic energy, railways, air navigation, space, shipping, vehicles, military, medical treatment, combustion and recreation, or equipment in contact with food and beverages, emergency stop circuits, clutch and brake circuits in press applications, safety equipment or other applications unsuitable for the standard specifications described in the product catalog.
3. An application which could have negative effects on people, property, or animals requiring special safety analysis.
4. Use in an interlock circuit, which requires the provision of double interlock for possible failure by using a mechanical protective function, and periodical checks to confirm proper operation.

### Caution

#### 1. The product is provided for use in manufacturing industries.

The product herein described is basically provided for peaceful use in manufacturing industries.  
If considering using the product in other industries, consult SMC beforehand and exchange specifications or a contract if necessary.  
If anything is unclear, contact your nearest sales branch.

## Limited warranty and Disclaimer/ Compliance Requirements

The product used is subject to the following “Limited warranty and Disclaimer” and “Compliance Requirements”.  
Read and accept them before using the product.

### Limited warranty and Disclaimer

1. The warranty period of the product is 1 year in service or 1.5 years after the product is delivered, whichever is first.\*2)  
Also, the product may have specified durability, running distance or replacement parts. Please consult your nearest sales branch.
2. For any failure or damage reported within the warranty period which is clearly our responsibility, a replacement product or necessary parts will be provided. This limited warranty applies only to our product independently, and not to any other damage incurred due to the failure of the product.
3. Prior to using SMC products, please read and understand the warranty terms and disclaimers noted in the specified catalog for the particular products.

\*2) **Vacuum pads are excluded from this 1 year warranty.**  
A vacuum pad is a consumable part, so it is warranted for a year after it is delivered. Also, even within the warranty period, the wear of a product due to the use of the vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty.


### Compliance Requirements

1. The use of SMC products with production equipment for the manufacture of weapons of mass destruction (WMD) or any other weapon is strictly prohibited.
2. The exports of SMC products or technology from one country to another are governed by the relevant security laws and regulations of the countries involved in the transaction. Prior to the shipment of a SMC product to another country, assure that all local rules governing that export are known and followed.

### Caution

#### SMC products are not intended for use as instruments for legal metrology.

Measurement instruments that SMC manufactures or sells have not been qualified by type approval tests relevant to the metrology (measurement) laws of each country. Therefore, SMC products cannot be used for business or certification ordained by the metrology (measurement) laws of each country.

 **Safety Instructions** Be sure to read the “Handling Precautions for SMC Products” (M-E03-3) and “Operation Manual” before use.

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