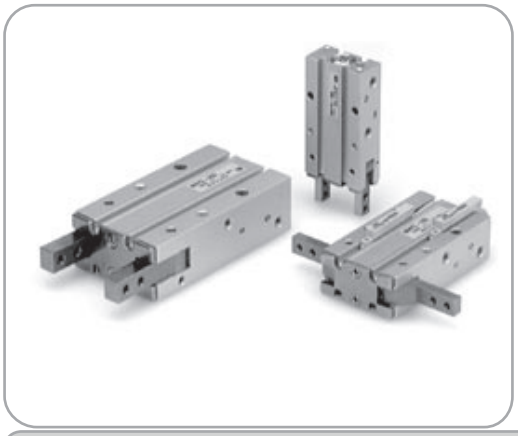
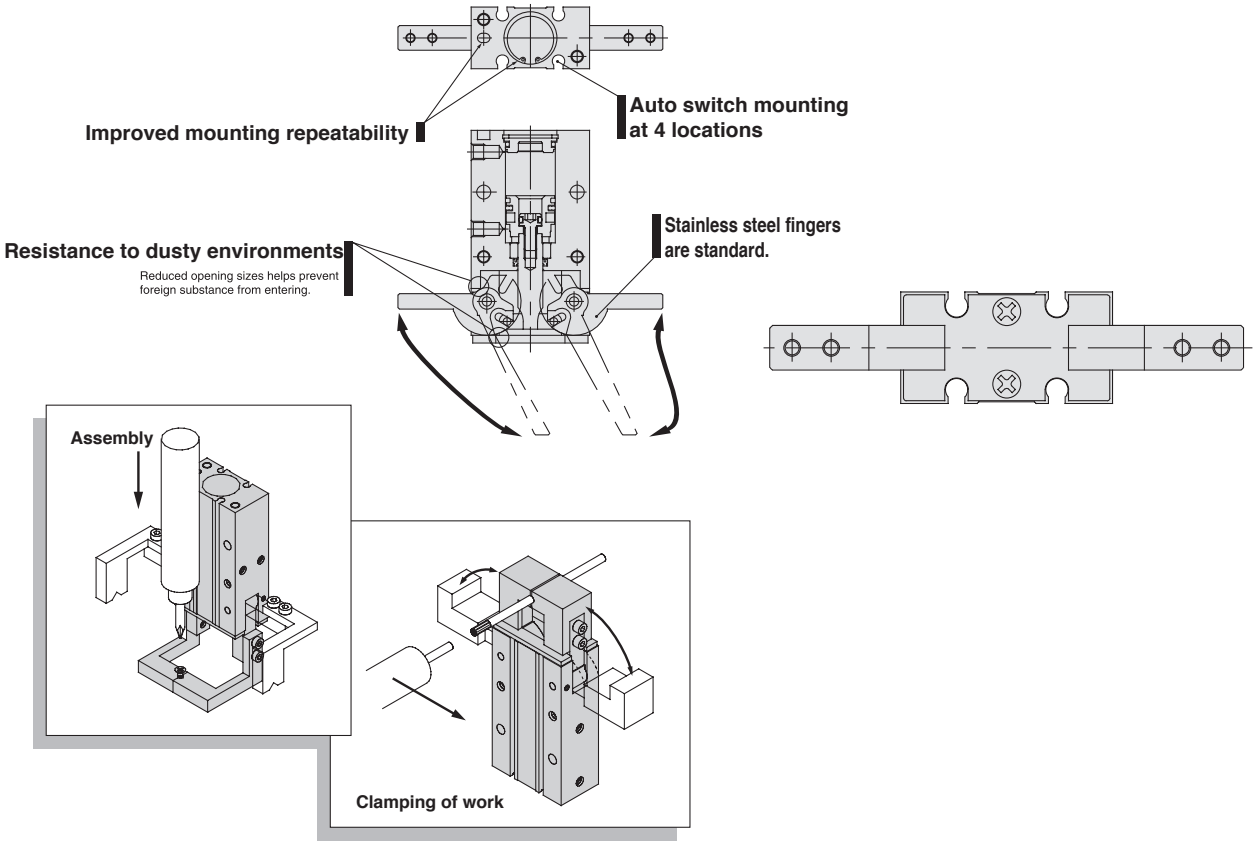
# 180° Angular Gripper Series WHFR

## WHFR Series / Cam Style



Light and compact size in small bore sizes

## Symbol

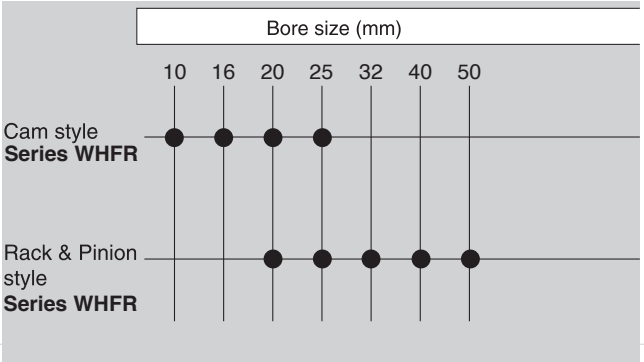



## Model

| Model | Bore size mm | Effective holding moment* Nm | Overall length Lmm | Weight g |
|---|---|---|---|---|
| **WHFR-10D** | 10 | 0.16 | 71 | 70 |
| **WHFR-16D** | 16 | 0.54 | 84 | 150 |
| **WHFR-20D** | 20 | 1.10 | 106 | 320 |
| **WHFR-25D** | 25 | 2.28 | 131 | 560 |

*At pressure of 0.5MPa

## Variation



# How to Select the Applicable Model

## How to Select

### Procedure

**Step 1** Confirm holding force → **Step 2** Confirm holding force → **Step 3** Confirm moment of inertia of attachments

**Step 1 Confirm holding force**

Condition check → Calculation of required holding force → Model selection from the holding force graph

**Example** Work weight: 0.05kg

**Guidelines on model selection according to work weight**

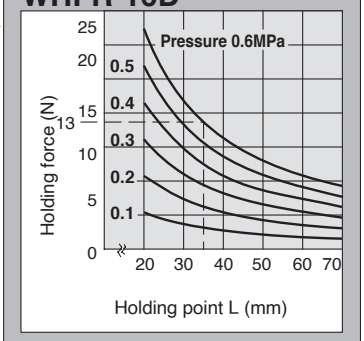
- Although the condition differs according to the coefficient of friction between the attachment and work, select a model that can producea holding force of 10 to 20 times the work weight.
- Further allowance should be provided when great acceleration or impact is expected during work transfer .

Ex.) For setting the holding force to be at least 20 times the work weight;
Required holding force = 0.05kg X 20 X 9.8m/s$^2$
= 10N min.

Holding point L = 35mm

Operating pressure: 0.6MPa

**WHFR-16D**

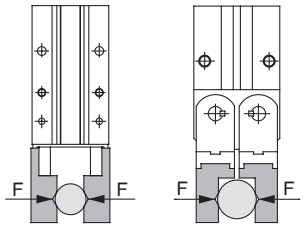



- When MHY2-16D is selected, the holding force is determined to be 13N according to the holding point distance (L = 35mm) and the pressure (0.6MPa).
- The holding force is 26 times the work weight meeting the guideline that holding force should be more than 20 times the set holding force value.

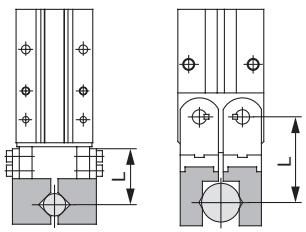
## Effective Holding Force

### Series WHFR Double acting

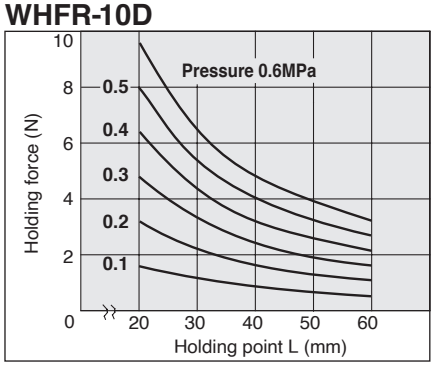
- Indication of effective holding force
  The holding force shown in the tables represents the holding force of one finger when all fingers and attachments are in contact with the work.
  (F: Thrust of one finger)



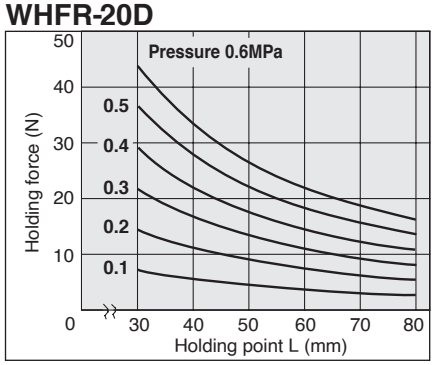

**External hold**



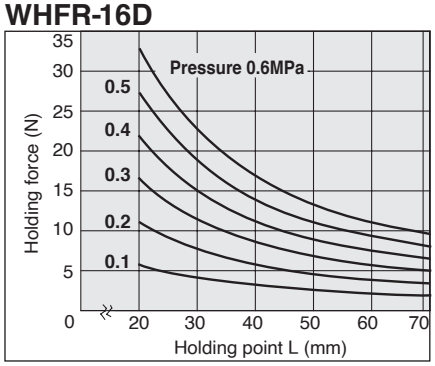

**WHFR-10D**



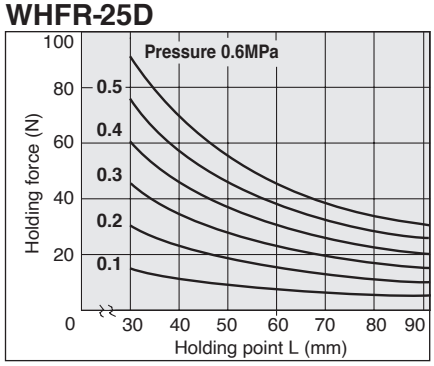

**WHFR-20D**




**WHFR-16D**

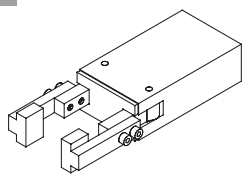



**WHFR-25D**

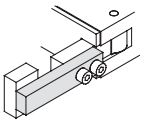


## How to Select the Applicable Model

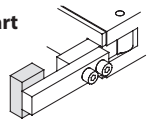
### Step 3 Confirm moment of inertia of attachments



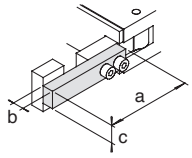
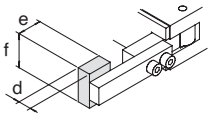
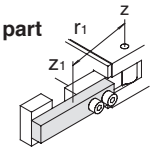
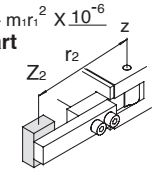
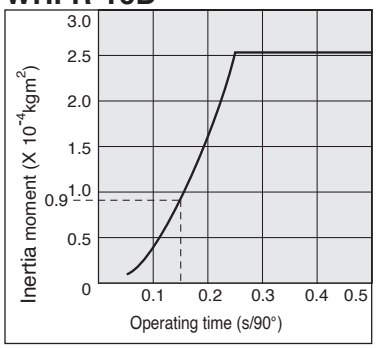
Confirm the moment of inertia for the attachment at one side. Calculate the moment of inertia for A and B separately as shown in the figures on the right.



**A part**



**B part**

| Procedure | Formula | Calculation example |
|---|---|---|
| 1 **Check the operating conditions, dimensions of attachment, etc.** | **A part**<br>  <br><br>**B part**<br>  <br> | Operating model: MHY2-16D<br>Opening time: 0.15s<br>a = 40 (mm)<br>b = 7 (mm)<br>c = 8 (mm)<br>d = 5 (mm)<br>e = 10 (mm)<br>f = 12 (mm) |
| 2 **Calculate the moment of inertia of attachment.** | **A part**<br>  <br><br>Calculation of weight<br>$m_1$ = a X b X c X Specific gravity<br>Moment of inertia around Z1 axis<br>$I_{z1} = \{m_1(a^2 + b^2)/12\} \times \frac{10^{-6}}{*}$<br>Moment of inertia around Z axis<br>$I_A = I_{z1} + m_1 r_1^2 \times \frac{10^{-6}}{*}$<br>**B part**<br>  <br><br>Calculation of weight<br>$m_2$ = d X e X f X Specific gravity<br>Moment of inertia around Z2 axis<br>$I_{z2} = \{m_2(d^2 + e^2)/12\} \times \frac{10^{-6}}{*}$<br>Moment of inertia around Z axis<br>$I_B = I_{z2} + m_2 r_2^2 \times \frac{10^{-6}}{*}$<br>Total moment of inertia<br>$I = I_A + I_B$ (*: constant for unit conversion) | Material of attachment: Aluminum alloy (Specific gravity = 2.7)<br>$r_1$ = 37 (mm)<br>$m_1 = 40 \times 7 \times 8 \times 2.7 \times 10^{-6}$<br>$= 0.006$(kg)<br>$I_{z1} = \{0.006 \times (40^2+7^2)/12\} \times 10^{-6}$<br>$= 0.8 \times 10^{-6}$ (kgm$^2$)<br>$I_A = 0.8 \times 10^{-6} + 0.006 \times 37^2 \times 10^{-6}$<br>$= 9.0 \times 10^{-6}$(kgm$^2$)<br>$r_2$ = 47(mm)<br>$m_2 = 5 \times 10 \times 12 \times 2.7 \times 10^{-6}$<br>$= 0.002$(kg)<br>$I_{z2} = \{0.002 \times (5^2 + 10^2)/12\} \times 10^{-6}$<br>$= 0.02 \times 10^{-6}$ (kgm$^2$)<br>$I_B = 0.02 \times 10^{-6} + 0.002 \times 47^2 \times 10^{-6}$<br>$= 4.4 \times 10^{-6}$ (kgm$^2$)<br>$I = 9.0 \times 10^{-6} + 4.4 \times 10^{-6}$<br>$= 13.4 \times 10^{-6} = 0.13 \times 10^{-4}$ (kgm$^2$) |
| 3 **Determine the allowable moment of iner tia from the graph.** | **WHFR-16D**<br>  <br> | The moment of inertia is determined to be $0.9 \times 10^{-4}$(kgm$^2$) according to the operating time (0.15s) from the graph on the left. |
| 4 **Confirm the moment of inertia of one attachment is within the allowable range.** | Moment of inertia of attachment < Allowable moment of intertia | $0.13 \times 10^{-4}$(kgm$^2$) < $0.9 \times 10^{-4}$(kgm$^2$)<br>Possible to use this model MHY2-16D completely. |

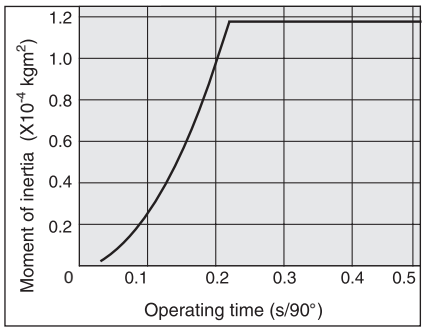
## Symbol

| Symbol | Definition | Unit |
|---|---|---|
| Z | Finger rotation axis | — |
| Z1 | Axis on the centre gravity of A part of attachment and parallel to Z | — |
| Z2 | Axis on the centre gravity of B part of attachment and parallel to Z | — |
| I | Total moment of inertia for attachment | $kgm^2$ |
| $I_{Z1}$ | Inertia moment around the Z1 axis of A part of attachment | $kgm^2$ |
| $I_{Z2}$ | Inertia moment around the Z2 axis of B part of attachment | $kgm^2$ |

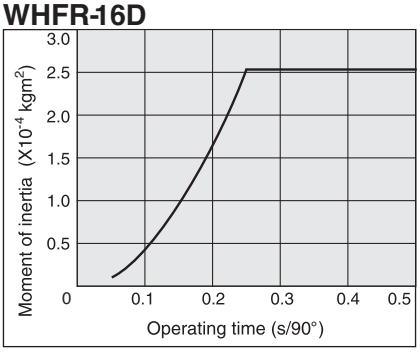
| Symbol | Definition | Unit |
|---|---|---|
| $I_A$ | Moment of inertia around the Z axis of A part of attachment | $kgm^2$ |
| $I_B$ | Moment of inertia around the Z axis of B part of attachment | $kgm^2$ |
| m1 | Weight of A part of attachment | kg |
| m2 | Weight of B part of attachment | kg |
| r1 | Distance between Z and Z1 axis | mm |
| r2 | Distance between Z and Z2 axis | mm |

## Allowable range of inertia moment of attachment

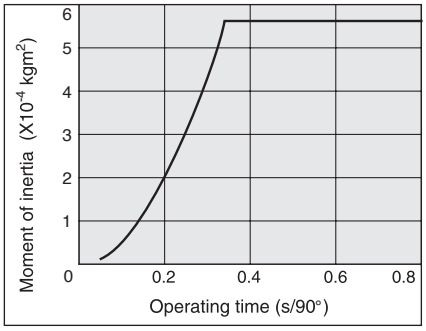
### WHFR-10D



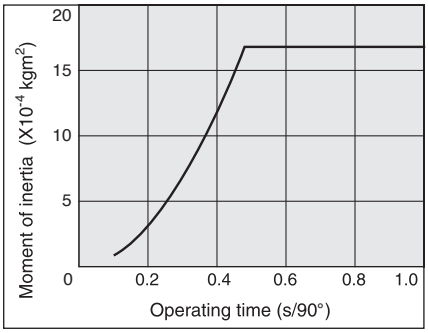

### WHFR-16D



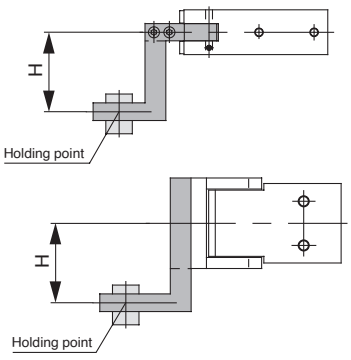

### WHFR-20D



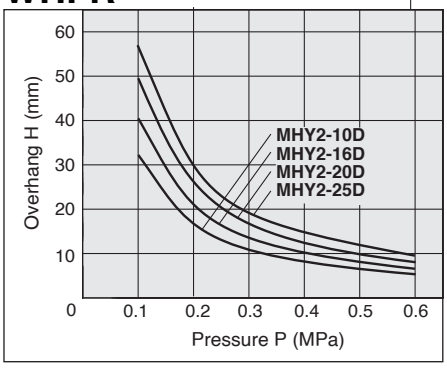

### WHFR-25D




## Step 2 Confirmation of holding point




### WHFR




- Work should be held at a point within the range of overhanging distance (H) for a given pressure indicated in the tables on the right.
- When the work is held at a point outside of the recommended range for a given pressure, it may causes adverse effect on the product life.

## ø10, ø16, ø20,ø25

## How to Order

**WHFR 2 — 16 D 2**

**Number of fingers**

| | |
|---|---|
| 2 | 2 fingers |

**Bore size**

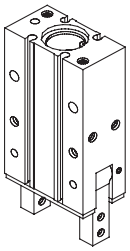
| | |
|---|---|
| 10 | 10mm |
| 16 | 16mm |
| 20 | 20mm |
| 25 | 25mm |

**Action**

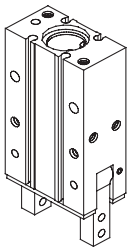
| | |
|---|---|
| D | Double acting |

**Finger option**

–: Standard tap mounting



2: Opening/closing direction through hole



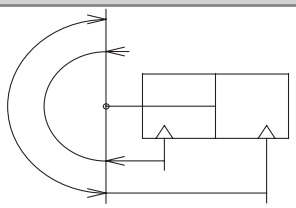
## Specifications

| | |
|---|---|
| **Fluid** | Air |
| **Operating pressure** | 0.1 to 0.6MPa |
| **Ambient and fluid temperature** | –10 to 60°C |
| **Repeatability** | ±0.2mm |
| **Max. operating frequency** | 60c.p.m |
| **Lubrication** | Not required |
| **Action** | Double acting |
| **Auto switch (Optional)** Note) | Solid state switch (3 wire, 2 wire) |

Note) Refer to p. 6-15 for details of auto switch specifications.

## Symbol

**Double acting**



## Model

| Model | Bore size (mm) | Effective holding force (Nm) (1) | Opening angle (Both sides) | | Weight (g) (2) |
|---|---|---|---|---|---|
| | | | Opening side | Closing side | |
| **WHFR-10D** | 10 | 0.16 | 180° | –3° | 70 |
| **WHFR-16D** | 16 | 0.54 | | | 150 |
| **WHFR-20D** | 20 | 1.10 | | | 320 |
| **WHFR-25D** | 25 | 2.28 | | | 560 |

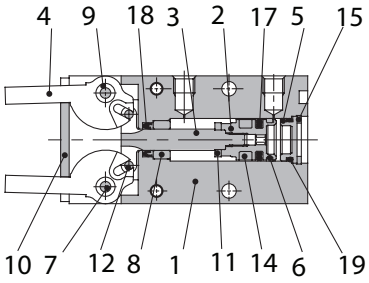
Note 1) At the pressure of 0.5MPa
Note 2) Not including auto switch

- Refer to the "How to Select the Applicable Model" on p.5-244
- Refer to p.5-244 and 5-245 for the details of effective holding force and allowable overhanging distance.

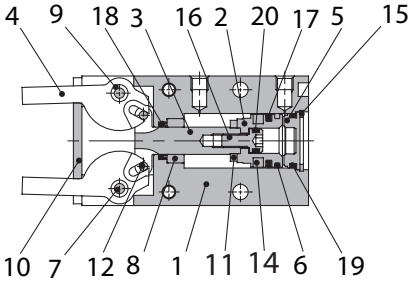
# Construction

## Closed

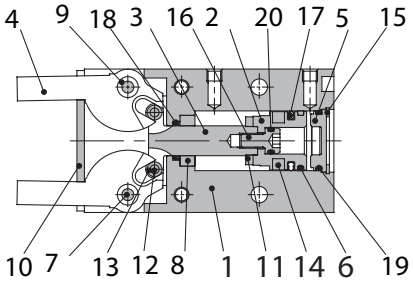
### ø 10



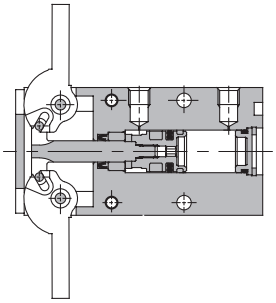

### ø 16

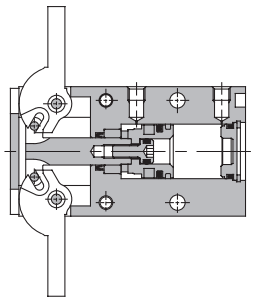


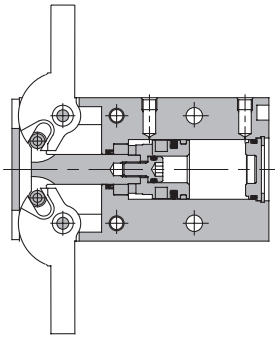

### ø 20, ø 25




## Open







### Component Parts

| No. | Description | Material | Note |
|---|---|---|---|
| 1 | **Body** | Aluminum alloy | Hard anodized |
| 2 | **Piston** | ø10: Stainless steel<br>ø16 to 25: Aluminum alloy | ø16 to 25: Chromated |
| 3 | **Joint** | Stainless steel | Heat treatment |
| 4 | **Finger** | Stainless steel | Heat treatment |
| 5 | **Cap** | Resin | |
| 6 | **Ware ring** | Resin | |
| 7 | **Shaft** | Stainless steel | Nitriding |
| 8 | **Bushing A** | Sintered alloy steel | |

### Component Parts

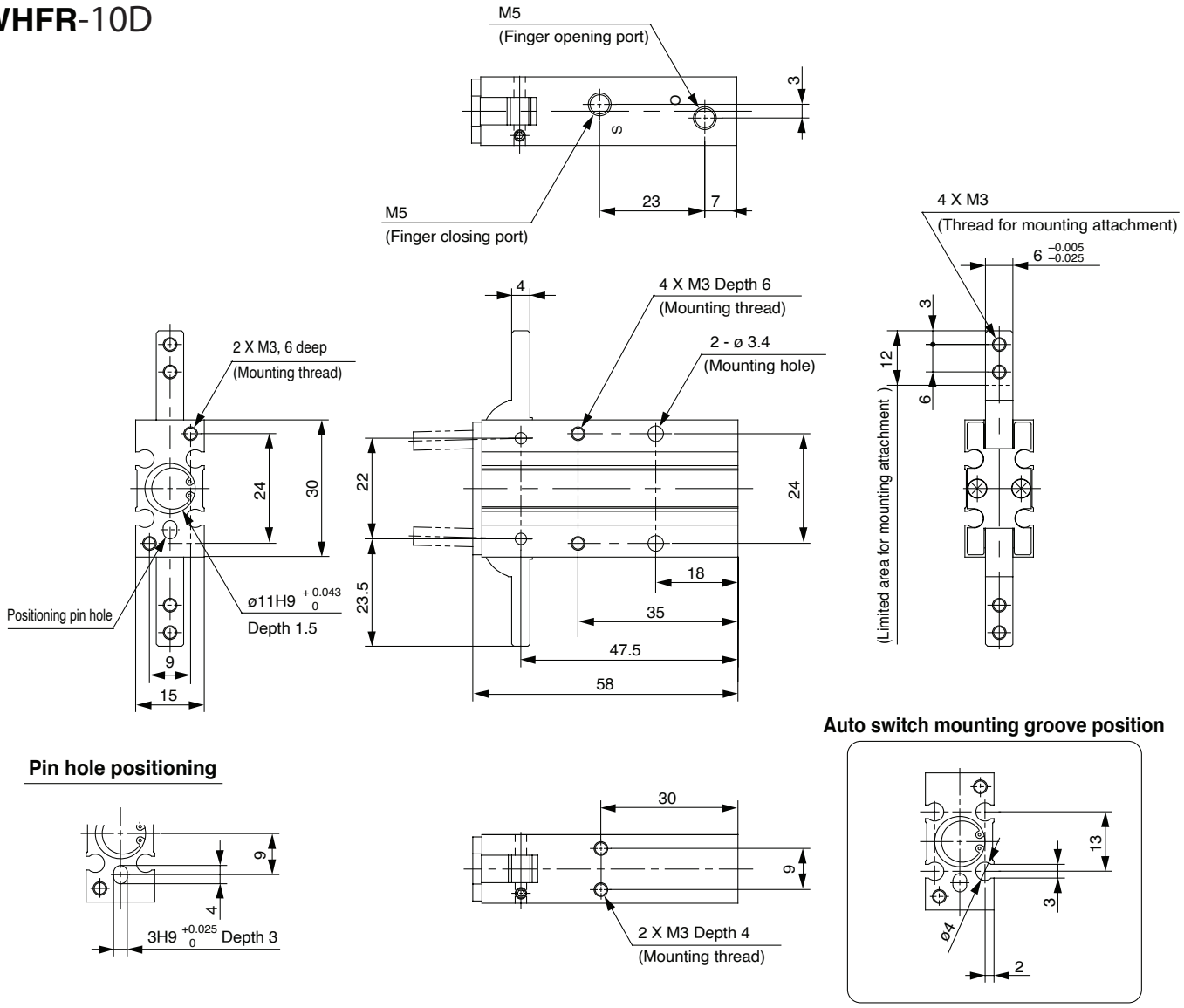
| No. | Description | Material | Note |
|---|---|---|---|
| 9 | **Bushing B** | Sintered alloy steel | |
| 10 | **End plate** | Stainless steel | |
| 11 | **Bumper** | Urethane rubber | |
| 12 | **Cylindrical roller** | High carbon chrome bearing steel | |
| 13 | **Joint roller** | Carbon steel | Nitriding |
| 14 | **Rubber magnet** | Synthetic rubber | |
| 15 | **C-shape snap ring** | Carbon steel | Nickel plated |
| 16 | **Piston bolt** | Stainless steel | |

### Replacement Parts: Seal Kits

| No. | Description | Material | Kit No. | | | |
|---|---|---|---|---|---|---|
| | | | **WHFR10-PS** | **WHFR16-PS** | **WHFR20-PS** | **WHFR25-PS** |
| 17<br>18<br>19<br>20 | **Seal kit** | NBR | WHFR10-PS | WHFR16-PS | WHFR20-PS | WHFR25-PS |

## Dimension

# WHFR-10D




**Auto switch mounting groove position**




**Pin hole positioning**

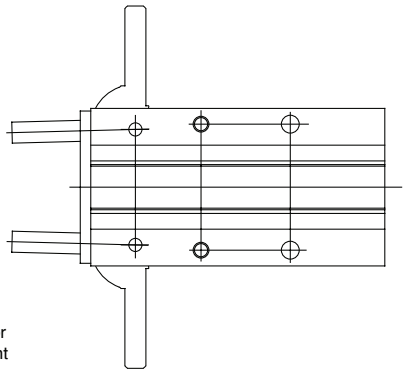


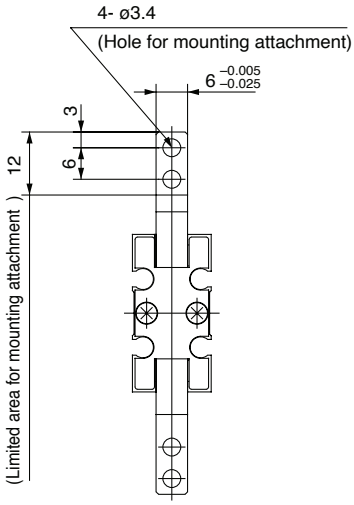




# WHFR-10D2

## Opening/closing direction through hole type

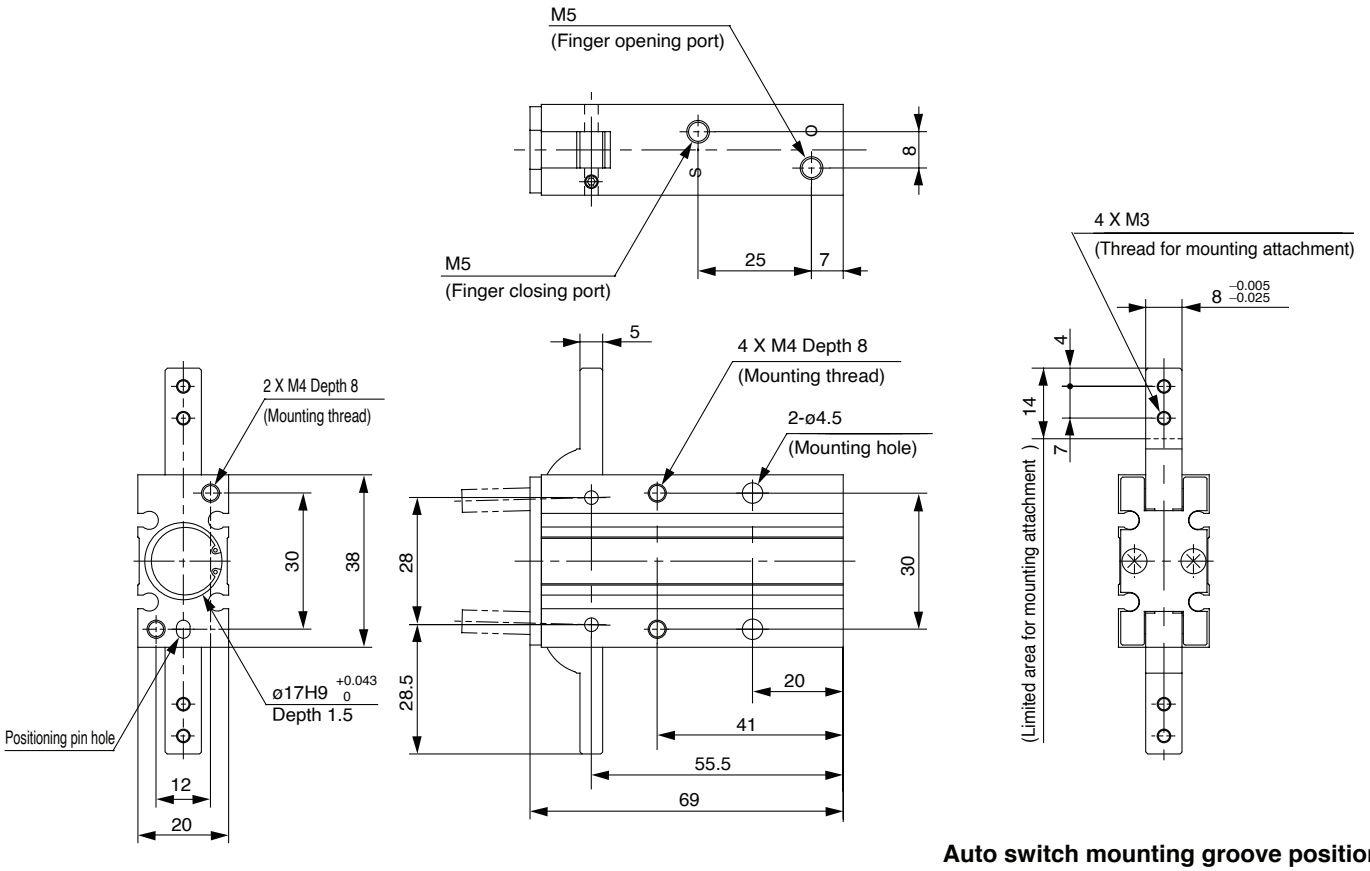




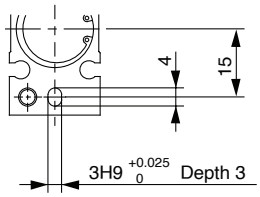

*Do not extend the attachment from limited area for mounting to avoid interference with the attachment or main body.

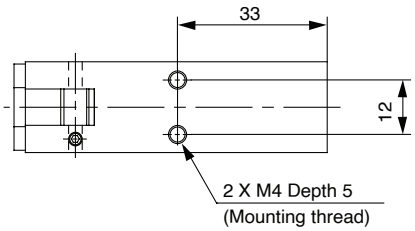
## Dimension

# WHFR-16D

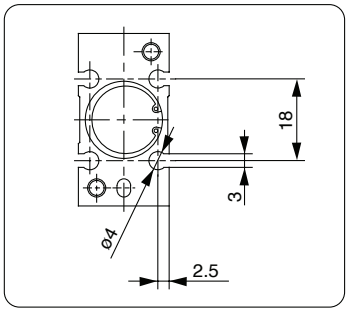



### Pin hole positioning



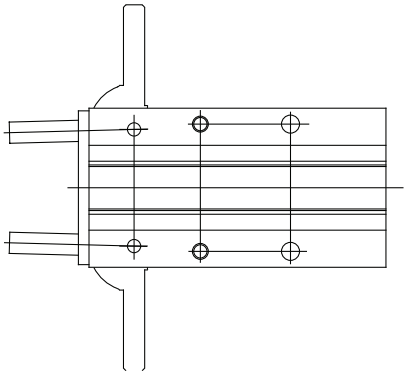



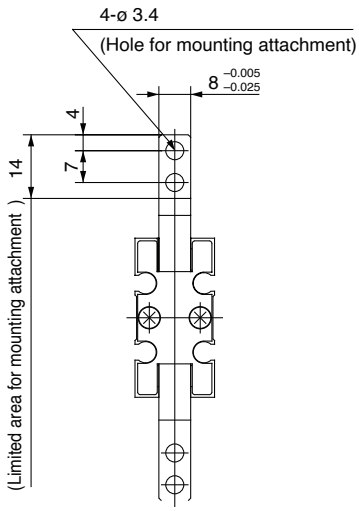

### Auto switch mounting groove position




# WHFR-16D2

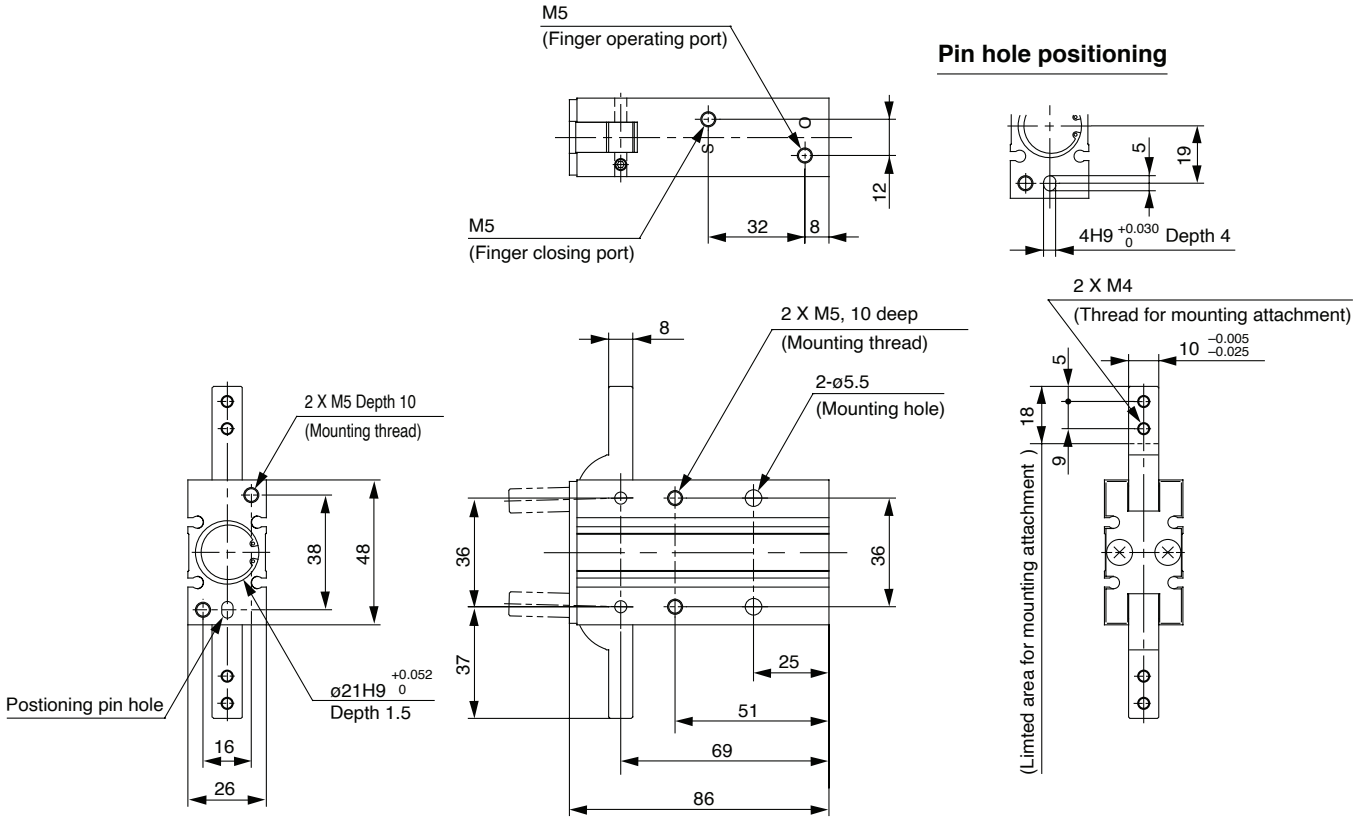
### Opening/closing direction through hole type

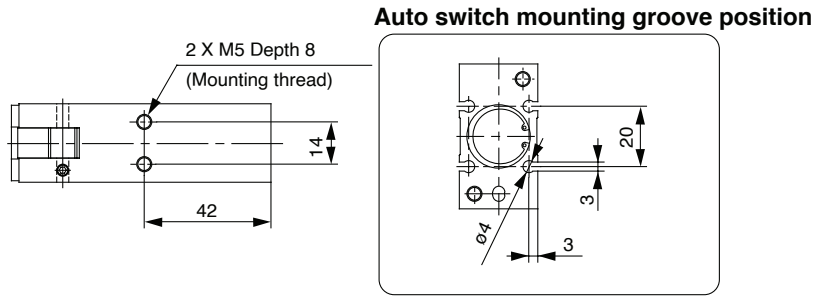





∗Do not extend the attachment from limited area for mounting to avoid interference with the attachment or main body.

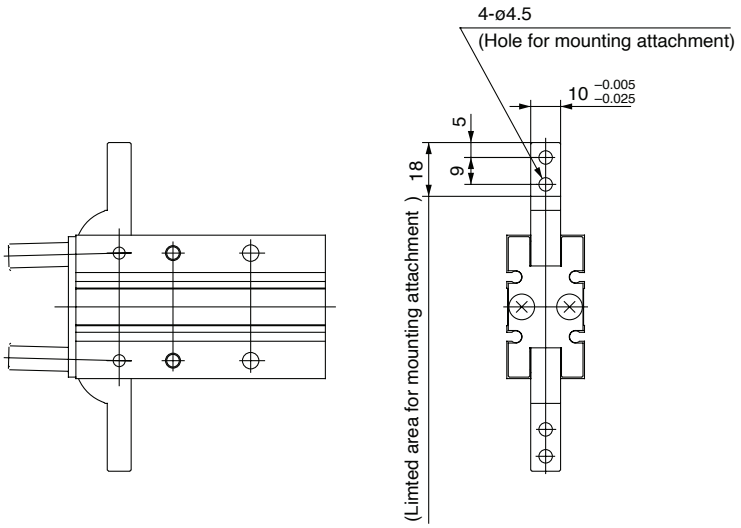
# WHFR-20D



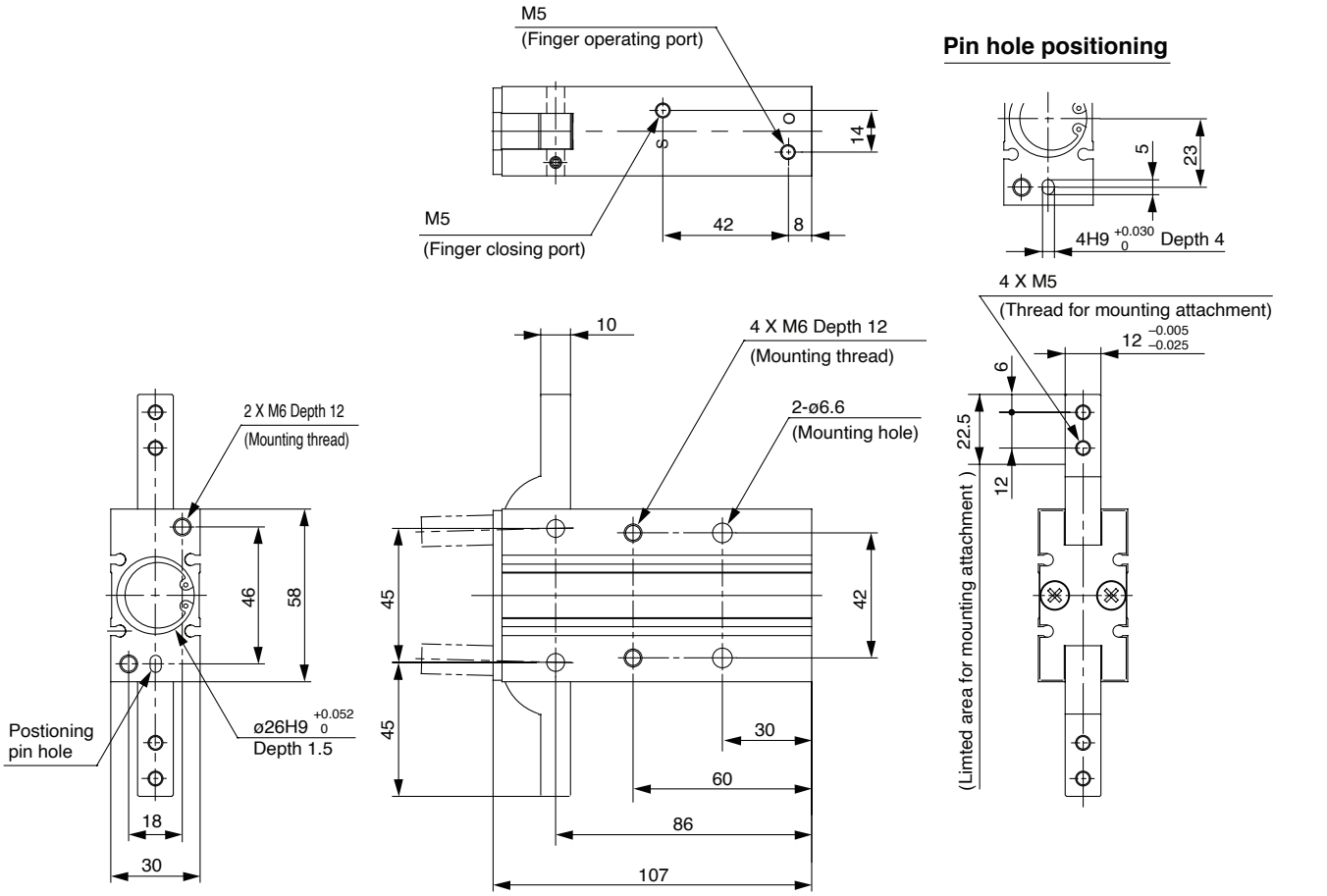

# WHFR-20D2

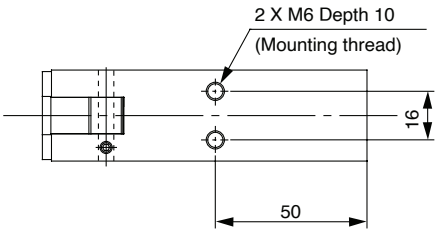
## Opening/closing direction through hole type



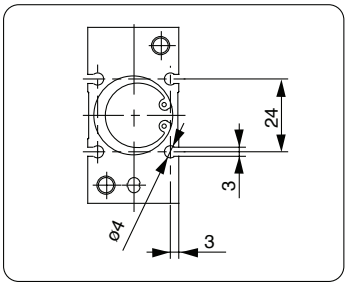

∗ Do not extend the attachment from limited area for mounting to avoid interference with the attachment or main body.

# WHFR-25D



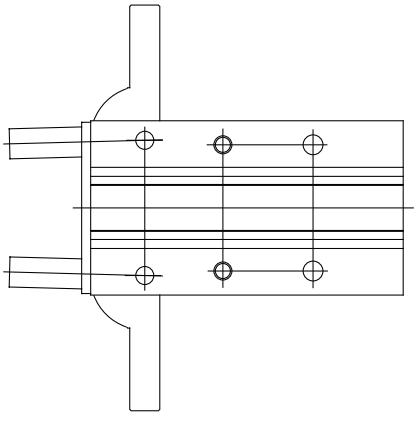



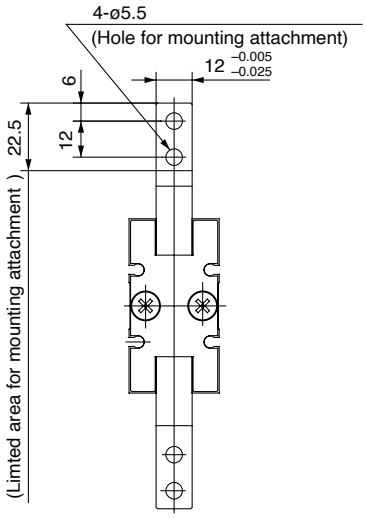

**Auto switch mounting groove position**




# WHFR-25D2

## Opening/closing direction through hole type

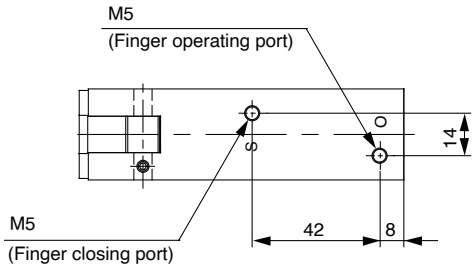




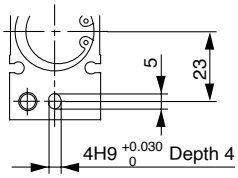

* Do not extend the attachment from limited area for mounting to avoid interference with the attachment or main body.

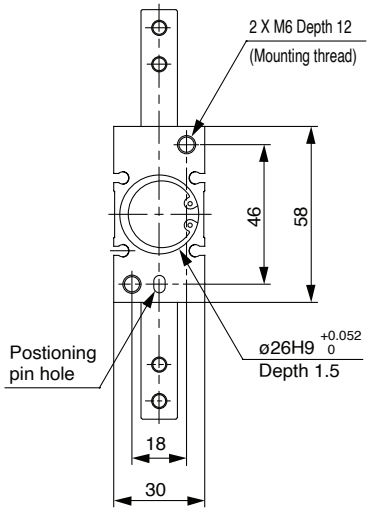
Dimension

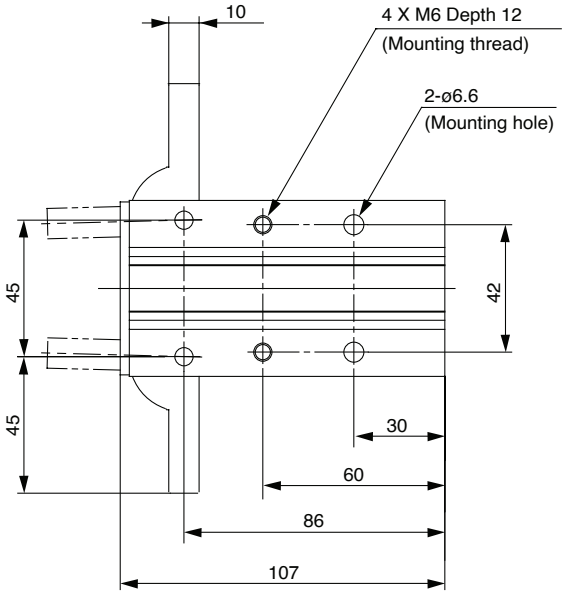
# WHFR-25D

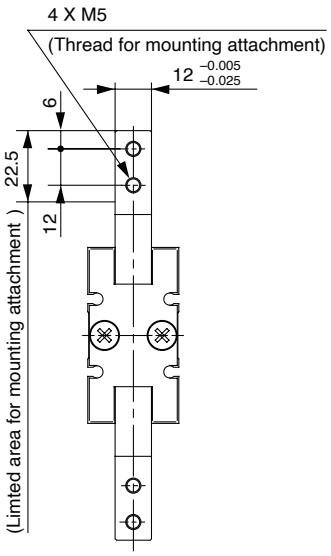


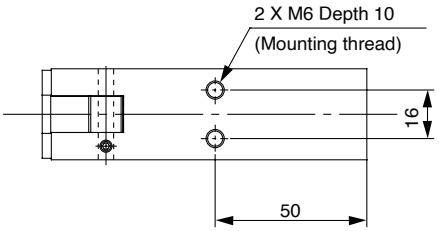

**Pin hole positioning**



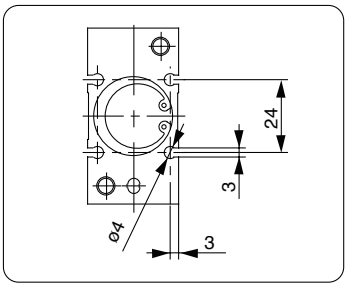



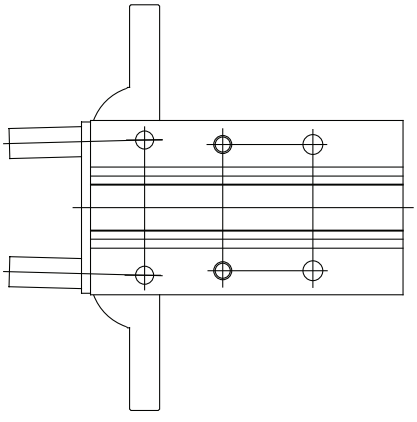



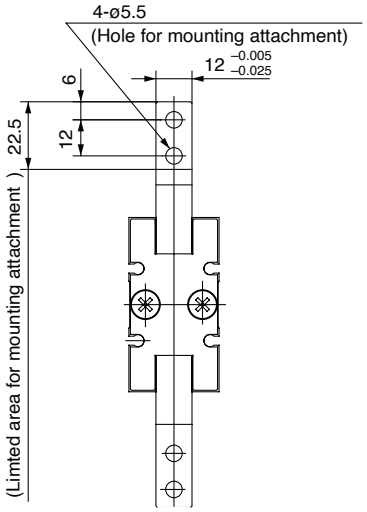

**Auto switch mounting groove position**




# WHFR-25D2

## Opening/closing direction through hole type

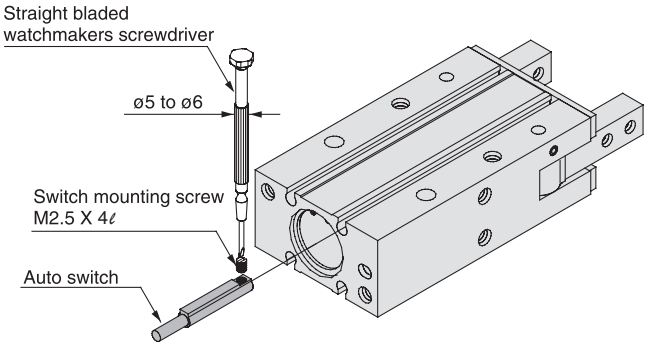





Do not extend the attachment from limited area for mounting to avoid interference with the attachment or main body.

## Setting Method of Auto Switch

To set auto switch, insert the auto switch into the installation groove of the gripper from the direction indicated in the following drawing. After establishing the installation position, tighten the attached switch mounting screw with a straight bladed watchmakers screwdriver.

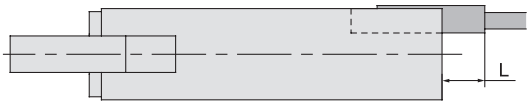



Note) Use a watchmaker screwdrivers with a grip diameter of 5 to 6 mm to tighten the auto switch mounting screw. Use a tightening torque of 0.05 to 0.1 Nm. As a rough guide, tighten the screw an additional 90° after feeling a tighten resistance.

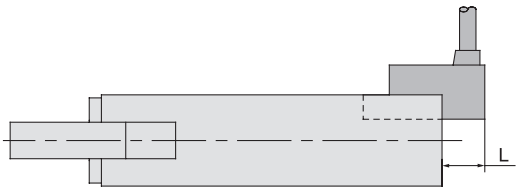
## Projection of Auto Switch From Body Edge

The projection of an auto switch from the edge of the body is shown in the table below. Use the table as a guideline for mounting.

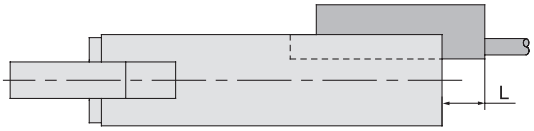
Note) 2 color indicator type and perpendicular entry type protrude in the direction of the lead wire entry.




When auto switch D-M9N is used



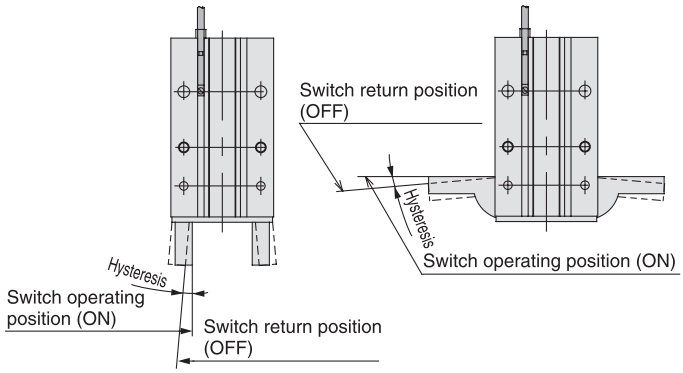

When auto switch D-M9□ V is used




When auto switch D-M9BA is used

## Auto Switch Hysteresis

Auto switch have a differential like a micro swich. Please refer to the following table as a guide when setting auto switch positions.




Max. protrusion of auto switch from edge of body(L) Unit: mm

| Gripper Model No. \ Auto switch model No. | | Protrusion | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | In-line | | | | Perpendicular | | |
| | | D-M9N | D-M9B | D-M9BA | D-M9NW | D-M9NV | D-M9BV | D-M9NWV |
| WHFR-10D | O | — | — | — | — | — | — | — |
| | S | 3 | 8 | 13 | 6 | 1 | 1 | 8 |
| WHFR-16D | O | — | — | — | — | — | — | — |
| | S | 3 | 8 | 13 | 7 | 1 | 1 | 8 |
| WHFR-20D | O | — | — | — | — | — | — | — |
| | S | — | 5 | 10 | 4 | — | — | 5 |
| WHFR-25D | O | — | — | — | — | — | — | — |
| | S | — | 3 | 9 | 3 | — | — | 3 |

| | | D-M9N(V) D-M9B(V) | D-M9NW(V) | | D-M9BA | |
|---|---|---|---|---|---|---|
| | | | Red light at ON | Green light at ON | Red light at ON | Green light at ON |
| WHFR-10D | Finger fully closed | 2° | 2° | 4° | 2° | 3° |
| | Finger fully open | 4° | 4° | 7° | 4° | 5° |
| WHFR-16D | Finger fully closed | 2° | 2° | 4° | 2° | 2° |
| | Finger fully open | 3° | 3° | 6° | 3° | 4° |
| WHFR-20D | Finger fully closed | 2° | 2° | 3° | 2° | 2° |
| | Finger fully open | 3° | 3° | 5° | 3° | 3° |
| WHFR-25D | Finger fully closed | 1° | 1° | 3° | 1° | 2° |
| | Finger fully open | 2° | 2° | 5° | 2° | 3° |