Rotary Actuator
Vane Type
Size: 10, 15, 20, 30, 40

Features a compact body with a built-in angle adjuster unit and auto switch unit (Size: 20, 30, 40)

Overall length
44% shorter
100 mm → 55.6 mm
(Compared with CDRB2BWU, Size 20)

Weight
48% lighter
222 g → 115 g
(Compared with CDRB2BWU, Size 20, Rotating angle 90°)

Weight
48% lighter
222 g → 115 g
(Compared with CDRB2BWU, Size 20, Rotating angle 90°)

Rotation time of 0.5 s/90° is possible.
(CRB2: 0.3 s/90°)
* Excluding size 40

CRB Series
### Overall length

<table>
<thead>
<tr>
<th>Size</th>
<th>CRB</th>
<th>CRB2</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>46</td>
<td>58</td>
</tr>
<tr>
<td>15</td>
<td>54.8</td>
<td>67</td>
</tr>
<tr>
<td>20</td>
<td>55.6</td>
<td>100</td>
</tr>
<tr>
<td>30</td>
<td>70</td>
<td>117.5</td>
</tr>
<tr>
<td>40</td>
<td>84.2</td>
<td>137.2</td>
</tr>
</tbody>
</table>

### Weight

<table>
<thead>
<tr>
<th>Size</th>
<th>CRB</th>
<th>CRB2</th>
<th>Reduction rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>39</td>
<td>42</td>
<td>7%</td>
</tr>
<tr>
<td>15</td>
<td>62</td>
<td>68</td>
<td>9%</td>
</tr>
<tr>
<td>20</td>
<td>115</td>
<td>222</td>
<td>48%</td>
</tr>
<tr>
<td>30</td>
<td>216</td>
<td>387</td>
<td>44%</td>
</tr>
<tr>
<td>40</td>
<td>380</td>
<td>631</td>
<td>40%</td>
</tr>
</tbody>
</table>

Compared with CRB2 (rotating angle 90° with angle adjustment unit and auto switch). (Sizes 10 and 15 compared without angle adjustment unit.)

### Piping, wiring, and angle adjustment

Piping, wiring, and angle adjustment can be performed on the same side for easier mounting.

### Compact solid state auto switch

**D-M9**

### Easy-to-adjust start and end position

Easy-to-adjust start and end position with the angle adjustment bolts (adjustment as standard). Rotating angle: 90°±10° 180°±10° (Size: 20, 30, 40)

### The chamfered position of the shaft

The chamfered position of the shaft can be easily checked using the rotating angle indicator. (Only for CDRB with auto switch)

### Chamfered position of the shaft

### Rotating angle indicator
**Shaft type variations**

* If an auto switch is mounted, choose single shaft (options ① and ⑤).

1. **Single shaft: CRBS**
   - Round shaft
   - Chamfer

2. **Double shaft: CRBW**
   - Round shaft
   - Chamfer

3. **Double shaft: CRBJ**
   - Round shaft
   - Chamfer

4. **Double shaft: CRBK**
   - Round shaft
   - Chamfer

5. **Single shaft: CRBT**
   - Round shaft
   - Chamfer

**Interchangeable mounting**

The mounting pitch and shaft configuration are the same as those for the CRB2.

- Thread for mounting workpiece is interchangeable (6 positions).
- (3 places for size 10)

**Mounting**

<table>
<thead>
<tr>
<th>Mounting type</th>
<th>Standard (Without auto switch)</th>
<th>Standard (With auto switch)</th>
<th>With vertical auto switch unit</th>
<th>With angle adjustment unit</th>
<th>With vertical auto switch unit and angle adjustment unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRB</td>
<td>CRB</td>
<td>CRB-A</td>
<td>CRB-B</td>
<td>CRB-C</td>
<td></td>
</tr>
<tr>
<td>CRB/L52408-A</td>
<td>CRB/L52408-B</td>
<td>CRB/L52408-A</td>
<td>CRB/L52408-B</td>
<td>CRB/L52408-C</td>
<td></td>
</tr>
<tr>
<td>Plate</td>
<td>Plate</td>
<td>Plate</td>
<td>Plate</td>
<td>Plate</td>
<td></td>
</tr>
<tr>
<td>Auto switch</td>
<td>Auto switch</td>
<td>Auto switch</td>
<td>Auto switch</td>
<td>Auto switch</td>
<td></td>
</tr>
<tr>
<td>Vertical auto switch unit</td>
<td>Vertical auto switch unit</td>
<td>Vertical auto switch unit</td>
<td>Vertical auto switch unit</td>
<td>Vertical auto switch unit</td>
<td></td>
</tr>
<tr>
<td>Angle adjustment unit</td>
<td>Angle adjustment unit</td>
<td>Angle adjustment unit</td>
<td>Angle adjustment unit</td>
<td>Angle adjustment unit</td>
<td></td>
</tr>
</tbody>
</table>

* Flange mounting bracket assembly is available as an option. For details, refer to page 36.
- Each of the units below for the CRB2 series can be mounted to the new CRB series.
  - The vertical auto switch unit and angle adjustment unit are the same as those of the CRB2 series. Replacement of just the new CRB body can be done during maintenance.
  - Each of the units for the CRB2 series can be mounted to the new CRB without auto switch (in the case of CRBW).

### Series Variations

<table>
<thead>
<tr>
<th>Model</th>
<th>Type</th>
<th>Applicable auto switch</th>
<th>Vane type</th>
<th>Size</th>
<th>Rotating angle range</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRB</td>
<td>Standard (Without auto switch)</td>
<td>—</td>
<td>Single vane</td>
<td>10</td>
<td>90°±10° (One side ±5°) 180°±10° (One side ±5°) (Sizes 20, 30, and 40 only)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td>90°±10° (One side ±5°) 180°±10° (One side ±5°) (Sizes 20, 30, and 40 only)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20</td>
<td>0 to 85° (90° specification) 0 to 175° (180° specification) (For sizes 10 and 15)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30</td>
<td>0 to 85° (90° specification) 0 to 175° (180° specification) (For sizes 20, 30, and 40)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>40</td>
<td>0 to 85° (90° specification) 0 to 175° (180° specification) (For sizes 20, 30, and 40)</td>
</tr>
<tr>
<td>CDRB</td>
<td>Standard (With auto switch)</td>
<td>D-M9</td>
<td>Single vane</td>
<td>10</td>
<td>90°±10° (One side ±5°) 180°±10° (One side ±5°) (Sizes 20, 30, and 40 only)</td>
</tr>
<tr>
<td>CRB-A</td>
<td>With vertical auto switch unit (CRB2)</td>
<td>Refer to the applicable auto switches shown in the table above.</td>
<td>Single vane</td>
<td>10</td>
<td>90°±10° (One side ±5°) 180°±10° (One side ±5°) (Sizes 20, 30, and 40 only)</td>
</tr>
<tr>
<td>CRB-B</td>
<td>With angle adjustment unit (CRB2)</td>
<td>—</td>
<td>Single vane</td>
<td>10</td>
<td>0 to 85° (90° specification) 0 to 175° (180° specification) (For sizes 10 and 15)</td>
</tr>
<tr>
<td>CRB-C</td>
<td>With vertical auto switch unit (CRB2) With angle adjustment unit (CRB2)</td>
<td>Refer to the applicable auto switches shown in the table above.</td>
<td>Single vane</td>
<td>10</td>
<td>0 to 85° (90° specification) 0 to 175° (180° specification) (For sizes 20, 30, and 40)</td>
</tr>
</tbody>
</table>

Refer to pages 30 and 38 to 41 for details on the angle adjustment method, auto switch mounting, and adjustment.

### Applicable Auto Switches for Vertical Auto Switch Unit

<table>
<thead>
<tr>
<th>Size</th>
<th>Solid state auto switch</th>
<th>Reed auto switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>D-M9(V)</td>
<td>D-97/93A</td>
</tr>
<tr>
<td></td>
<td>D-S99(V)/S9P(V)</td>
<td>D-90/90A</td>
</tr>
<tr>
<td>15</td>
<td>D-M9(V)</td>
<td>D-R73□</td>
</tr>
<tr>
<td></td>
<td>D-S79/S7P</td>
<td>D-R80□</td>
</tr>
<tr>
<td>20</td>
<td>D-M9(V)</td>
<td>D-R73□</td>
</tr>
<tr>
<td></td>
<td>D-S79/S7P</td>
<td>D-R80□</td>
</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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## Selection Procedures

### List of Operating Conditions
- Initially selected models
- Operating pressure [MPa]
- Mounting orientation
- Load type
  - Static load
  - Resistance load
  - Inertial load
- Load dimensions [m]
- Load mass [kg]
- Rotation time [s]
- Rotating angle [rad]

### Calculation of Moment of Inertia

1. Calculate the inertial moment of load.
2. Loads are generated from multiple parts. The inertial moment of each load is calculated, and then totaled.

### Calculation of Required Torque

3. Calculate the required torque for each load type and confirm whether the values fall in the effective torque range.
- Static load ($T_s$)
  - Required torque $T = T_s$
- Resistance load ($T_f$)
  - Required torque $T = T_f \times 3$ to $5$
- Inertial load ($T_a$)
  - Required torque $T = T_a \times 10$

### Confirmation of Rotation Time

5. Confirm whether the time falls in the rotation time adjustment range.

### Calculation of Kinetic Energy

6. Calculate the kinetic energy of the load and confirm whether the energy is below the allowable range.

### Confirmation of Allowable Load

7. Confirm whether the load applied to the product is within the allowable range.

### Calculation of Air Consumption and Required Air Flow Capacity

8. Air consumption and required air flow capacity are calculated when necessary.

### Selection Example

<table>
<thead>
<tr>
<th>Load</th>
<th>Mass</th>
<th>Initial Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.15</td>
<td>$0.055 \text{ N·m}$</td>
</tr>
<tr>
<td>2</td>
<td>0.15</td>
<td>$0.055 \text{ N·m}$</td>
</tr>
</tbody>
</table>

**Initially selected model:** CRBS30-180
**Operating pressure:** 0.4 MPa
**Mounting orientation:** Vertical
**Load type:** Inertial load
**Rotation time:** 0.6 s
**Rotating angle:** $\theta = \pi \text{ rad (180°)}$
1. **Calculation of Moment of Inertia**

The moment of inertia is a value indicating the inertia of a rotating body, and expresses the degree to which the body is difficult to rotate, or difficult to stop. It is necessary to know the moment of inertia of the load in order to determine the value of required torque or kinetic energy when selecting a rotary actuator.

Moving the load with the actuator creates kinetic energy in the load. When stopping the moving load, it is necessary to absorb the kinetic energy of the load with a stopper or a shock absorber. The kinetic energy of the load can be calculated using the formulas shown in Fig. 1 (for linear motion) and Fig. 2 (for rotation motion).

In the case of the kinetic energy for linear motion, the formula (1) shows that when the velocity \( V \) is constant, it is proportional to the mass \( m \). In the case of rotation motion, the formula (2) shows that when the angular velocity \( \omega \) is constant, it is proportional to the moment of inertia.

**Linear motion**

\[
E = \frac{1}{2} \cdot m \cdot V^2 \tag{1}
\]

- \( E \): Kinetic energy
- \( m \): Load mass
- \( V \): Velocity

**Rotation motion**

\[
E = \frac{1}{2} \cdot I \cdot \omega^2 = \frac{1}{2} \cdot m \cdot r^2 \cdot \omega^2 \tag{2}
\]

- \( E \): Kinetic energy
- \( I \): Moment of inertia (= \( m \cdot r^2 \))
- \( \omega \): Angular velocity
- \( m \): Mass
- \( r \): Radius of rotation

As the moment of inertia is proportional to the squares of the mass and the radius of rotation, even when the load mass is the same, the moment of inertia will be squared as the radius of rotation grows bigger. This will create greater kinetic energy, which may result in damage to the product. When there is rotation motion, product selection should be based not on the load mass of the load, but on the moment of inertia.

**Moment of Inertia Formula**

The basic formula for obtaining a moment of inertia is shown below.

\[
I = m \cdot r^2
\]

This formula represents the moment of inertia for the shaft with mass \( m \), which is located at distance \( r \) from the shaft.

For actual loads, the values of the moment of inertia are calculated depending on configurations, as shown below.

⇒ p. 8 Calculation example of moment of inertia
⇒ p. 9 Graph for calculating the moment of inertia

---

### Equation Table of Moment of Inertia

1. **Thin shaft**
   Position of rotational axis: Perpendicular to the shaft through the center of gravity
   \[ I = m \cdot \frac{a^2}{12} \]

2. **Thin rectangular plate**
   Position of rotational axis: Parallel to side \( b \) and through the center of gravity
   \[ I = m \cdot \frac{a^2}{12} \]

3. **Thin rectangular plate (Including rectangular parallelepiped)**
   Position of rotational axis: Perpendicular to the plate through the center of gravity
   \[ I = m \cdot \frac{a^2 + b^2}{12} \]

4. **Round plate (Including column)**
   Position of rotational axis: Through the center axis
   \[ I = m \cdot \frac{r^2}{2} \]

5. **Solid sphere**
   Position of rotational axis: Through the center of diameter
   \[ I = m \cdot \frac{2r^2}{5} \]

6. **Thin round plate**
   Position of rotational axis: Through the center of diameter
   \[ I = m \cdot \frac{r^2}{4} \]

7. **Cylinder**
   Position of rotational axis: Through the center of diameter and gravity
   \[ I = m \cdot \frac{3r^2 + a^2}{12} \]

8. When the rotational axis and load center of gravity are not consistent
   \[ I = K + m \cdot L^2 \]
   \[ K: \text{Moment of inertia around the load center of gravity} \]

9. **Gear transmission**
   1. Find the moment of inertia \( I_B \) for the rotation of shaft (B).
   2. \( I_A \) is converted to the moment of inertia \( I_B \) for the rotation of the shaft (A).
   \[ I_A = \left( \frac{a}{b} \right)^2 \cdot I_B \]
Calculation Example of Moment of Inertia

If the shaft is located at a desired point of the load:

- Obtain the center of gravity of the load as \( I_1 \) and the provisional shaft.

\[ I_1 = m_L \frac{a^2 + b^2}{12} \]

- Obtain the actual moment of inertia \( I_2 \) around the shaft, with the premise that the mass of the load itself is concentrated in the load’s center of gravity point.

\[ I_2 = m_L \]

- Obtain the actual moment of inertia \( I_3 \) around the shaft.

\[ I_3 = m_L \]

\[ m_L = \text{Load mass} \]

\[ L = \text{Distance from the shaft to the load’s center of gravity} \]

Calculation Example

- **Example:**
  - \( m_1 = 0.5 \) kg, \( m_2 = 0.4 \) kg, \( m_3 = 0.2 \) kg
  - \( L = 0.2 \) m, \( \phi D = 0.06 \) m, \( a = 0.06 \) m, \( b = 0.03 \) m

\[ I_1 = 1.5 \times 0.2^2 + 0.06^2 = 0.25 \times 10^{-3} \text{ kg·m}^2 \]

\[ I_2 = 1.5 \times 0.06^2 = 0.375 \times 10^{-3} \text{ kg·m}^2 \]

\[ I_3 = (6.25 + 3.75) \times 10^{-3} = 0.01 \text{ kg·m}^2 \]

\[ I_1 = 0.67 \times 10^{-2} \text{ kg·m}^2 \]

\[ I_2 = 0.13 \times 0.06^2 = 0.03 \times 10^{-3} \text{ kg·m}^2 \]

\[ I_3 = 0.1 \times 0.2^2 = 0.01 \times 10^{-3} \text{ kg·m}^2 \]

\[ I = (1.25 + 0.03) \times 10^{-2} = 1.58 \times 10^{-2} \text{ kg·m}^2 \]

If the load is divided into multiple loads:

- Obtain the moment of inertia of load 1:

\[ I_1 = m_1 \frac{r_1^2}{2} + m_2 \frac{r_2^2}{2} + m_3 \frac{L^2}{2} \]

- Obtain the moment of inertia of load 2:

\[ I_2 = m_3 \frac{r_1^2}{2} + m_4 \frac{r_2^2}{2} \]

- Obtain the actual moment of inertia:

\[ I = I_1 + I_2 \]

\[ m_1 = 2.5 \) kg, \( m_2 = 0.5 \) kg, \( r_1 = 0.1 \) m, \( r_2 = 0.02 \) m, \( L = 0.08 \) m

\[ I_1 = 2.5 \times 0.1^2 + 0.08^2 = 0.33 \times 10^{-2} \text{ kg·m}^2 \]

\[ I_2 = (1.25 + 0.33) \times 10^{-2} = 1.58 \times 10^{-2} \text{ kg·m}^2 \]

If a load is rotated through the gears:

- Obtain the moment of inertia of load 1 around shaft A:

\[ I_1 = m_1 \frac{d_1^2}{2} + m_2 \frac{d_2^2}{2} + m_3 \frac{d_3^2}{2} \]

- Obtain the moment of inertia of load 2 around shaft B:

\[ I_2 = m_4 \frac{d_4^2}{2} \]

- Obtain the actual moment of inertia:

\[ I = I_1 + I_2 \]

\[ m_1 = 2.5 \) kg, \( m_2 = 0.5 \) kg, \( r_1 = 0.1 \) m, \( r_2 = 0.02 \) m, \( L = 0.08 \) m

\[ I_1 = 2.5 \times 0.1^2 + 0.08^2 = 0.33 \times 10^{-2} \text{ kg·m}^2 \]

\[ I_2 = (1.25 + 0.33) \times 10^{-2} = 1.58 \times 10^{-2} \text{ kg·m}^2 \]
Rotary Actuator Model Selection

Graph for Calculating the Moment of Inertia

1. How to read the graph: Only when the dimension of the load is "a" or "r"

[Example] When the load shape is ②, a = 100 mm, and the load mass is 0.1 kg

In Graph (1), the point at which the vertical line of a = 100 mm and the line of the load shape ② intersect indicates that the moment of inertia of the 1 kg mass is 0.83 x 10⁻³ kg·m².

Since the load mass is 0.1 kg, the actual moment of inertia is

0.83 x 10⁻³ x 0.1 = 0.083 x 10⁻³ kg·m²

(Note: If "a" is divided into "a₁a₂", the moment of inertia can be obtained by calculating them separately.)

2. How to read the graph: When the dimension of the load contains both "a" and "b"

[Example] When the load shape is ⑧, a = 200 mm, b = 200 mm, and the load mass is 0.5 kg

In Graph (1), obtain the point at which the vertical line of a = 200 mm and the line of the load shape ⑧ intersect. Move this intersection point to Graph (2), and the point at which it intersects with the curve of b = 200 mm indicates that the moment of inertia of the 1 kg mass is 5.5 x 10⁻³ kg·m².

Since the load mass is 0.5 kg, the actual moment of inertia is

5.5 x 10⁻³ x 0.5 = 2.75 x 10⁻³ kg·m²
2 Calculation of Required Torque

Load Type

The calculation method of required torque varies depending on the load type. Obtain the required torque referring to the table below.

<table>
<thead>
<tr>
<th>Load type</th>
<th>Required torque T = Ts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static load: Ts</td>
<td>When the pressing force is necessary (clamp, etc.)</td>
</tr>
<tr>
<td>Resistance load: Tf</td>
<td>When friction force or gravity is applied to the rotation direction</td>
</tr>
<tr>
<td>Inertial load: Ta</td>
<td>When the load with inertia is rotated</td>
</tr>
</tbody>
</table>

\[
Ts = F \cdot L
\]

Ts: Static load [N·m]
F: Clamp force [N]
L: Distance from the center of rotation to clamp [m]

\[
Tf = m \cdot g \cdot L
\]

Tf: Resistance load [N·m]
m: Load mass [kg]
g: Gravitational acceleration 9.8 [m/s²]
L: Distance from the center of rotation to the gravity or friction force acting point [m]
μ: Coefficient of friction

\[
Ta = I \cdot \omega = I \cdot \frac{\theta}{t^2}
\]

Ta: Inertial load [N·m]
I: Moment of inertia [kg·m²]
ω: Angular acceleration [rad/s²]
θ: Rotating angle [rad]
t: Rotation time [s]

Effective Torque

- Resistance loads ➔ Gravity or friction acts in the rotation direction.
  - Example 1) The axis of rotation is in a horizontal (lateral) direction, and the center of rotation and center of gravity of the load are not the same.
  - Example 2) The load slips against the floor while rotating.
  - The required torque equals the total of the resistance load and inertial load.
    \[
    T = T_f \times (3 \text{ to } 5) + T_a \times 10
    \]

- Non-resistance loads ➔ Gravity or friction does not apply in the rotation direction.
  - Example 1) The axis of rotation is in a perpendicular (vertical) direction.
  - Example 2) The axis of rotation is in a horizontal (lateral) direction, and the center of rotation and center of gravity of the load are the same.
  - The required torque equals the inertial load only.
    \[
    T = T_a \times 10
    \]

3 Confirmation of Rotation Time

Rotation time adjustment range is specified for each product for stable operation. Set the rotation time within the rotation time specified below.

<table>
<thead>
<tr>
<th>Model</th>
<th>Operating pressure [MPa]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.2</td>
</tr>
<tr>
<td>CRB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>15</td>
</tr>
<tr>
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<td>20</td>
</tr>
<tr>
<td></td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>40</td>
</tr>
</tbody>
</table>

If the product is used in a low speed range which is outside the adjustment range, it may cause the stick-slip phenomenon, or the product to stick or stop.
**4 Calculation of Kinetic Energy**

Kinetic energy is generated when the load rotates. Kinetic energy applies on the product at the operating end as inertial force, and may cause the product to damage. In order to avoid this, the value of allowable kinetic energy is determined for each product.

Find the kinetic energy of the load, and verify that it is within the allowable range for the product in use.

### Kinetic Energy

Use the following formula to calculate the kinetic energy of the load.

\[
E = \frac{1}{2} I \omega^2
\]

- \(E\): Kinetic energy [J]
- \(I\): Moment of inertia [kg·m²]
- \(\omega\): Angular velocity [rad/s]

### Angular Velocity

\[
\omega = \frac{2\theta}{t}
\]

- \(\omega\): Angular velocity [rad/s]
- \(\theta\): Rotating angle [rad]
- \(t\): Rotation time [s]

⇒ Below: Allowable kinetic energy and rotation time adjustment range

⇒ p. 12  Moment of inertia and rotation time

To find the rotation time when kinetic energy is within the allowable range for the product, use the following formula.

When the angular velocity is \(\omega = \frac{2\theta}{t}\)

\[
t \geq \sqrt{\frac{2 \cdot I \cdot \omega^2}{E}}
\]

- \(t\): Rotation time [s]
- \(I\): Moment of inertia [kg·m²]
- \(\omega\): Angular velocity [rad/s]
- \(E\): Allowable kinetic energy [J]

### Allowable Kinetic Energy and Rotation Time Adjustment Range

<table>
<thead>
<tr>
<th>Size</th>
<th>Allowable kinetic energy [J]</th>
<th>Adjustable range of rotation time safe in operation [s/90°]</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>0.00015</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>0.001</td>
<td>0.03 to 0.5</td>
</tr>
<tr>
<td>20</td>
<td>0.003</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>0.020</td>
<td>0.04 to 0.5</td>
</tr>
<tr>
<td>40</td>
<td>0.040</td>
<td>0.07 to 0.5</td>
</tr>
</tbody>
</table>

### Calculation Example

**Load form:** Round rod

- Length of a part: 0.12 m
- Rotating angle: 90°
- Length of a part: 0.04 m
- Rotation time: 0.9 s/90°
- Mass of a part (= m1): 0.09 kg
- Mass of a part (= m2): 0.03 kg

**Calculation of Kinetic Energy**

1. Find the angular velocity \(\omega\).

\[
\omega = \frac{2 \theta}{t} = \frac{2 \times 90°}{0.9} = 3.489 \text{ rad/s}
\]

2. Find the moment of inertia \(I\).

\[
I = m_1 \cdot a_1^2 + m_2 \cdot a_2^2 + m_2 \cdot 2r^2
\]

- \(m_1\): Mass of a part (m1) = 0.09 kg
- \(m_2\): Mass of a part (m2) = 0.03 kg
- \(a_1\): Length of a part = 0.12 m
- \(a_2\): Length of a part = 0.04 m
- \(r\): Mass of a part = 0.03 m

\[
I = 0.09 \times 0.12^2 + 0.03 \times 0.04^2 + 0.03 \times 0.03 \times 2 \times 0.03^2
= 4.48 \times 10^{-4} \text{ kg·m}^2
\]

3. Find the kinetic energy \(E\).

\[
E = \frac{1}{2} I \cdot \omega^2 = \frac{1}{2} \times 4.48 \times 10^{-4} \times 3.489^2
= 0.000273 \text{ J}
\]

**Calculation Example**

If the model to be used has been determined, obtain the threshold rotation time in which the rotary actuator can be used in accordance with the allowable kinetic energy of that model.

**Model used:** CRB30

**Allowable kinetic energy:** 0.02 J (Refer to the table above.)

**Load form:** Refer to the figure below.

**Rotating angle:** 90°

\[
I = m_1 \cdot a_1^2 + m_2 \cdot a_1^2 + m_2 \cdot 2r^2
\]

1. Find the moment of inertia.

\[
I = \frac{m_1 \cdot a_1^2}{3} + \frac{m_2 \cdot a_1^2}{3} + \frac{m_2 \cdot 2r^2}{3}
\]

- \(m_1\): Mass of a part (m1)
- \(a_1\): Length of a part
- \(m_2\): Mass of a part (m2)
- \(r\): Mass of a part

2. Find the rotation time.

\[
t \geq \sqrt{\frac{2 \cdot I \cdot \omega^2}{E}}
\]

It is therefore evident that there will be no problem if it is used with a rotation time of less than 0.30 s. However, according to the table above, the maximum value of rotation time for stable operation is 0.5 s. Thus, the rotation time should be within the range of 0.30 ≤ t ≤ 0.50.
Moment of Inertia and Rotation Time

How to read the graph

Example 1) When there are constraints for the moment of inertia of load and rotation time. From “Graph (3)”, to operate at the load moment of inertia $1 \times 10^{-4}$ kg·m² and at the rotation time setting of $0.3 \, ^\circ/90^\circ$, the model will be CRB$30$.

Example 2) When there are constraints for the moment of inertia of load, but not for rotation time. From “Graph (3)”, to operate at the load moment of inertia $1 \times 10^{-5}$ kg·m²:
- CRB$15$ will be $0.22$ to $0.5 \, ^\circ/90^\circ$
- CRB$20$ will be $0.13$ to $0.5 \, ^\circ/90^\circ$

[Remarks] As for the rotation times in “Graph (3)”, the lines in the graph indicate the adjustable speed ranges. If the speed is adjusted towards the low-speed end beyond the range of the line, it could cause the actuator to stick, or, in the case of the vane type, it could stop its operation.

Confirmation of Allowable Load

Provided that a dynamic load is not generated, a load in the axial direction can be applied up to the value that is indicated in the table below. However, applications in which the load is applied directly to the shaft should be avoided as much as possible.

<table>
<thead>
<tr>
<th>Vane Type (Single, Double)</th>
<th>Fsa [N]</th>
<th>Fab [N]</th>
<th>Fr [N]</th>
<th>M [N·m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRB 10</td>
<td>9.8</td>
<td>9.8</td>
<td>14.7</td>
<td>0.13</td>
</tr>
<tr>
<td>CRB 15</td>
<td>9.8</td>
<td>9.8</td>
<td>14.7</td>
<td>0.17</td>
</tr>
<tr>
<td>CRB 20</td>
<td>19.6</td>
<td>19.6</td>
<td>24.5</td>
<td>0.33</td>
</tr>
<tr>
<td>CRB 30</td>
<td>24.5</td>
<td>24.5</td>
<td>29.4</td>
<td>0.42</td>
</tr>
<tr>
<td>CRB 40</td>
<td>40</td>
<td>40</td>
<td>60</td>
<td>1.02</td>
</tr>
</tbody>
</table>
6 Calculation of Air Consumption and Required Air Flow Capacity

Air consumption is the volume of air which is expended by the rotary actuator's reciprocal operation inside the actuator and in the piping between the actuator and the switching valve, etc. This is necessary for selection of a compressor and for calculation of its running cost. Required air volume is the air volume necessary to make a rotary actuator operate at a required speed. It requires calculation when selecting the upstream piping diameter from the switching valve and air line equipment.

To facilitate your calculation, the table below provides the air consumption volume (QCR) that is required each time an individual rotary actuator makes a reciprocal movement.

### 1. Air consumption volume

Formulas:

Regarding QCR, With vane type, use formula (1) because the inner volume varies when ports A and B are pressurized.

\[
Q_{CR} = (V_A + V_B) \times \left( \frac{P + 0.1}{0.1} \right) \times 10^{-3} \quad \text{………………(1)}
\]

For the air consumption in the tube, use formula (2) because the inner volume varies when ports A and B are pressurized.

\[
Q_{CP} = 2 \times a \times L \times \left( \frac{P}{0.1} \right) \times 10^{-6} \quad \text{………………(2)}
\]

\[
Q_c = Q_{CR} + Q_{CP} \quad \text{……………………………(3)}
\]

- \(Q_{CR}\) = Amount of air consumption of rotary actuator \([L \text{ (ANR)}]\)
- \(Q_{CP}\) = Amount of air consumption of tube or piping \([L \text{ (ANR)}]\)
- \(V_A\) = Inner volume of the rotary actuator (when pressurized from A port) \([cm^3]\)
- \(V_B\) = Inner volume of the rotary actuator (when pressurized from B port) \([cm^3]\)
- \(P\) = Operating pressure \([MPa]\)
- \(a\) = Inner sectional area of piping \([mm^2]\)
- \(L\) = Length of piping \([mm]\)
- \(Q_c\) = Amount of air consumption required for one cycle of the rotary actuator \([L \text{ (ANR)}]\)

To select a compressor, it is important to select one that has plenty of margin to accommodate the total air volume that is consumed by the pneumatic actuators that are located downstream. The total air consumption volume is affected by the leakage in the tube, the consumption in the drain valves and pilot valves, as well as by the reduction in air volume due to reduced temperature.

Formulas:

\[
Qc_2 = Q_c \times n \times \text{No. of actuators} \times \text{Safety factor} \quad \text{………………(4)}
\]

- \(Q_c\) = Amount of air from a compressor \([L/min \text{ (ANR)}]\)
- \(n\) = Actuator reciprocations per minute

Safety factor: From 1.5

### 2. Required air flow capacity

Formulas:

\[
Q_r = \left( V_A \times \left( \frac{P + 0.1}{0.1} \right) \times 10^{2} + a \times L \times \left( \frac{P}{0.1} \right) \times 10^{4} \right) \times \frac{60}{t} \quad \text{………………(5)}
\]

\[
Q_r = \left( V_B \times \left( \frac{P + 0.1}{0.1} \right) \times 10^{2} + a \times L \times \left( \frac{P}{0.1} \right) \times 10^{4} \right) \times \frac{60}{t} \quad \text{………………(6)}
\]

- \(Q_r\) = Consumed air volume for rotary actuator \([L/min \text{ (ANR)}]\)
- \(V_A\) = Inner volume of the rotary actuator (when pressurized from A port) \([cm^3]\)
- \(V_B\) = Inner volume of the rotary actuator (when pressurized from B port) \([cm^3]\)
- \(P\) = Operating pressure \([MPa]\)
- \(a\) = Inner sectional area of piping \([mm^2]\)
- \(L\) = Length of piping \([mm]\)
- \(t\) = Total time for rotation \([S]\)

#### Internal Cross Section of Tubing and Steel Tube

<table>
<thead>
<tr>
<th>Nominal</th>
<th>O.D. [mm]</th>
<th>I.D. [mm]</th>
<th>Internal cross section (a) [mm²]</th>
</tr>
</thead>
<tbody>
<tr>
<td>T: 0425</td>
<td>4</td>
<td>2.5</td>
<td>4.9</td>
</tr>
<tr>
<td>T: 0604</td>
<td>6</td>
<td>4</td>
<td>12.6</td>
</tr>
<tr>
<td>TU 0805</td>
<td>8</td>
<td>5</td>
<td>19.6</td>
</tr>
<tr>
<td>T: 0806</td>
<td>8</td>
<td>6</td>
<td>28.3</td>
</tr>
<tr>
<td>1/8B</td>
<td>—</td>
<td>—</td>
<td>6.5</td>
</tr>
<tr>
<td>1075</td>
<td>10</td>
<td>7.5</td>
<td>44.2</td>
</tr>
<tr>
<td>TU 1208</td>
<td>12</td>
<td>8</td>
<td>50.3</td>
</tr>
<tr>
<td>T: 1209</td>
<td>12</td>
<td>9</td>
<td>63.6</td>
</tr>
<tr>
<td>1/4B</td>
<td>—</td>
<td>—</td>
<td>9.2</td>
</tr>
<tr>
<td>TS 1612</td>
<td>16</td>
<td>12</td>
<td>113</td>
</tr>
<tr>
<td>3/8B</td>
<td>—</td>
<td>—</td>
<td>12.7</td>
</tr>
<tr>
<td>T: 1613</td>
<td>16</td>
<td>13</td>
<td>133</td>
</tr>
<tr>
<td>1/2B</td>
<td>—</td>
<td>—</td>
<td>16.1</td>
</tr>
<tr>
<td>3/4B</td>
<td>—</td>
<td>—</td>
<td>204</td>
</tr>
<tr>
<td>1B</td>
<td>—</td>
<td>—</td>
<td>27.6</td>
</tr>
</tbody>
</table>

\(\Rightarrow \) p. 14 Air consumption calculation graph

### Inner Volume and Air Consumption

<table>
<thead>
<tr>
<th>Size</th>
<th>Rotating angle (degree)</th>
<th>Inner volume ([cm^3])</th>
<th>Operating pressure ([MPa])</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Press. (V_A) port</td>
<td>Press. (V_B) port</td>
<td>0.2</td>
</tr>
<tr>
<td>90</td>
<td>0.5</td>
<td>0.8</td>
<td>0.004</td>
</tr>
<tr>
<td>180</td>
<td>1.1</td>
<td>1.1</td>
<td>0.007</td>
</tr>
<tr>
<td>15</td>
<td>Press. (V_A) port</td>
<td>Press. (V_B) port</td>
<td>0.2</td>
</tr>
<tr>
<td>90</td>
<td>1.4</td>
<td>2.1</td>
<td>0.011</td>
</tr>
<tr>
<td>180</td>
<td>2.8</td>
<td>2.8</td>
<td>0.017</td>
</tr>
<tr>
<td>20</td>
<td>Press. (V_A) port</td>
<td>Press. (V_B) port</td>
<td>0.2</td>
</tr>
<tr>
<td>90</td>
<td>3.6</td>
<td>5</td>
<td>0.026</td>
</tr>
<tr>
<td>180</td>
<td>6.5</td>
<td>6.5</td>
<td>0.039</td>
</tr>
<tr>
<td>30</td>
<td>Press. (V_A) port</td>
<td>Press. (V_B) port</td>
<td>0.2</td>
</tr>
<tr>
<td>90</td>
<td>10.1</td>
<td>13.3</td>
<td>0.070</td>
</tr>
<tr>
<td>180</td>
<td>17.4</td>
<td>17.4</td>
<td>0.104</td>
</tr>
<tr>
<td>40</td>
<td>Press. (V_A) port</td>
<td>Press. (V_B) port</td>
<td>0.2</td>
</tr>
<tr>
<td>90</td>
<td>21.9</td>
<td>30</td>
<td>0.156</td>
</tr>
<tr>
<td>180</td>
<td>37.5</td>
<td>37.5</td>
<td>0.225</td>
</tr>
</tbody>
</table>
Rotary Actuator Model Selection

Air Consumption Calculation Graph

**Step 1**
Using Graph (4), air consumption volume of the rotary actuator is obtained. From the point of intersection between the inner volume and the operating pressure (slanted line) and then looking to the side (left side) direction, the air consumption volume for 1 cycle operation of a rotary actuator is obtained.

**Step 2**
Using Graph (5), air consumption volume of tubing or steel tube is obtained.

1. First determine the point of intersection between the operating pressure (slanted line) and the piping length, and then go up the vertical line perpendicularly from there.
2. From the point of intersection of an operating piping tube inside diameter (slanted line), then look to the side (left or right) to obtain the required air consumption volume for piping.

**Step 3**
Total air consumption volume per minute is obtained as follows:

\[
\text{Total air consumption volume} = (\text{Air consumption volume of a rotary actuator} + \text{Tubing or steel tube's air consumption volume}) \times \text{Cycle times per minute} \times \text{Number of rotary actuators}
\]

Example)

When 10 units of a CRBS30-180 are used at a pressure of 0.5 MPa, what is the air consumption of their 5 cycles per minute? (Piping between the actuator and switching valve is a tube with an inside diameter of 6 mm and length of 2 m.)

1. Operating pressure 0.5 MPa → Inner volume of CRBS30-180 17.4 cm³ → Air consumption volume 0.21 L (ANR)
2. Operating pressure 0.5 MPa → Piping length 2 m → Inside diameter 6 mm → Air consumption volume 0.56 L (ANR)
3. Total air consumption volume = (0.21 + 0.56) x 5 x 10 = 38.5 L/min (ANR)

Graph (4) Air Consumption

Graph (5) Air Consumption of Tubing, Steel Tube (1 cycle)

- *Values inside ( ) are inner volume of the supply side when A port is pressurized.*
- *"Piping length" indicates the length of steel tube or tubing which connects rotary actuator and switching valves (solenoid valves, etc.).*
- *Refer to page 13 for the size of tubing and steel tube (inside diameter and outside diameter).*
How to Order

With auto switch

Built-in auto switch magnet

1. **Shaft type**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Shaft type</th>
<th>Shaft-end shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>Single shaft+1</td>
<td>Long shaft, Short shaft</td>
</tr>
<tr>
<td>W</td>
<td>Double shaft</td>
<td>Single flat+2, Single flat</td>
</tr>
<tr>
<td>J</td>
<td>Double shaft</td>
<td>Single flat+1</td>
</tr>
<tr>
<td>K</td>
<td>Double shaft</td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>Single shaft+1</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>Double shaft</td>
<td>For details, refer to page 24.</td>
</tr>
</tbody>
</table>

+1 When an auto switch is mounted to the rotary actuator, only S and T are available.
+2 Size 40 has a parallel key instead of the chamfered position.
+3 J, K, T, and Y are produced upon receipt of order.

2. **Size**

<table>
<thead>
<tr>
<th>Size</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>30</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>90°</td>
<td>90°</td>
<td>180°</td>
<td>180°</td>
<td></td>
</tr>
</tbody>
</table>

3. **Rotating angle**

4. **Auto switch**

<table>
<thead>
<tr>
<th>Name</th>
<th>Without auto switch (Built-in magnet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nil</td>
<td></td>
</tr>
</tbody>
</table>

* For applicable auto switches, refer to the table below.

5. **Lead wire length**

<table>
<thead>
<tr>
<th>Name</th>
<th>Grommet/Lead wire: 0.5 m</th>
<th>Grommet/Lead wire: 1 m</th>
<th>Grommet/Lead wire: 3 m</th>
<th>Grommet/Lead wire: 5 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td></td>
<td>Grommet/Lead wire: 1 m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L</td>
<td></td>
<td>Grommet/Lead wire: 3 m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Z*1</td>
<td></td>
<td>Grommet/Lead wire: 5 m</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

+1 The 5 m lead wire is produced upon receipt of order.

6. **Number of auto switches**

<table>
<thead>
<tr>
<th>Name</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nil</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>1</td>
</tr>
</tbody>
</table>

**Applicable Auto Switches**

Refer to the Web Catalog or Best Pneumatics Catalog for further information on auto switches.

<table>
<thead>
<tr>
<th>Type</th>
<th>Electrical entry</th>
<th>Wiring (Output)</th>
<th>Lead voltage [DC]</th>
<th>Auto switch model</th>
<th>Lead wire type</th>
<th>Lead wire length [m]</th>
<th>Pre-wired connector</th>
<th>Applicable load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid state auto switch</td>
<td>Grommet</td>
<td>3-wire (NPN)</td>
<td>5 V, 12 V</td>
<td>M9N</td>
<td>Oilproof heavy-duty cord</td>
<td>0.5 (Nil), 1 (M), 3 (L), 5 (Z)</td>
<td>IC circuit</td>
<td>Relay, PLC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3-wire (PNP)</td>
<td>2-wire</td>
<td>M9P</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2-wire</td>
<td>12 V</td>
<td>M9B</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Auto switches are shipped together, but not assembled.
* Auto switches marked with “*” are produced upon receipt of order.
Specifications

<table>
<thead>
<tr>
<th>Size</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>30</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotating angle range</td>
<td>90° ± 5°</td>
<td>90° ± 5°</td>
<td>180° ± 5°</td>
<td>180° ± 10°</td>
<td></td>
</tr>
<tr>
<td>Fluid</td>
<td>Air (Non-lube)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proof pressure (MPa)</td>
<td>1.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min. operating pressure (MPa)</td>
<td></td>
<td></td>
<td>0.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rotation time adjustment range (s)</td>
<td>0.03 to 0.5</td>
<td></td>
<td>0.04 to 0.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allowable kinetic energy (J)</td>
<td>0.00015</td>
<td>0.001</td>
<td>0.003</td>
<td>0.02</td>
<td>0.04</td>
</tr>
<tr>
<td>Shaft load</td>
<td>Allowable radial load</td>
<td>15</td>
<td>15</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>Allowable thrust load</td>
<td>10</td>
<td>10</td>
<td>20</td>
<td>25</td>
<td>40</td>
</tr>
<tr>
<td>Port size</td>
<td>M5 x 0.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Symbol

Refer to pages 38 to 41 for actuators with auto switches.

- Auto Switch Proper Mounting Position (at Rotation End Detection)
- Operating Angle and Hysteresis Angle
- Operating Range and Hysteresis
- How to Change the Auto Switch Detecting Position
- Auto Switch Mounting
- Auto Switch Adjustment

Flange mounting bracket assembly is available as an option. For details, refer to page 36.

Chamfered Position and Rotation Range: Top View from Long Shaft Side
Chamfered positions shown below illustrate the conditions of actuators when B port is pressurized.

- Operate within the adjustment range shown below.

Size: 10, 15

Size: 20, 30, 40

- The angle adjusting screw (adjustment bolt) is set at random within the adjustable rotating range. Therefore, it must be re-adjusted to obtain the angle that suits your application. (Refer to page 43.)

Chamfer position when A port is pressurized (when shipped from the factory)
Size: 10, 15, 20, 30, 40
**Inner Volume**

<table>
<thead>
<tr>
<th>Size</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>30</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotating angle</td>
<td>90°</td>
<td>180°</td>
<td>90°</td>
<td>180°</td>
<td>90°</td>
</tr>
<tr>
<td>Inner volume (cm³)</td>
<td>0.8</td>
<td>1.1</td>
<td>2.1</td>
<td>2.8</td>
<td>5</td>
</tr>
</tbody>
</table>

* Values inside ( ) are inner volume of the supply side when A port is pressurized.

**Weight**

<table>
<thead>
<tr>
<th>Size</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>30</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotating angle</td>
<td>90°</td>
<td>180°</td>
<td>90°</td>
<td>180°</td>
<td>90°</td>
</tr>
<tr>
<td>Basic type (S shaft)</td>
<td>26 (27)</td>
<td>25 (26)</td>
<td>46 (47)</td>
<td>45 (46)</td>
<td>107 (110)</td>
</tr>
<tr>
<td>With auto switch</td>
<td>39</td>
<td>38</td>
<td>62</td>
<td>61</td>
<td>115</td>
</tr>
</tbody>
</table>

* ( ): For W shaft

**Effective Output**

*Size 10*

- Effective torque [N·m] vs. Operating pressure [MPa]

*Size 15*

- Effective torque [N·m] vs. Operating pressure [MPa]

*Size 20*

- Effective torque [N·m] vs. Operating pressure [MPa]

*Size 30*

- Effective torque [N·m] vs. Operating pressure [MPa]

*Size 40*

- Effective torque [N·m] vs. Operating pressure [MPa]
Construction: Standard Type (Without Auto Switch)

- Following figures show actuators when B port is pressurized.

Size: 10, 15

For 90°

Size: 20, 30, 40

For 90°

Component Parts

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Material</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Body (A)</td>
<td>Aluminum alloy</td>
<td>Painted</td>
</tr>
<tr>
<td>2</td>
<td>Body (B)</td>
<td>Aluminum alloy</td>
<td>Painted</td>
</tr>
<tr>
<td>3</td>
<td>Vane shaft</td>
<td>Stainless steel</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Stopper</td>
<td>Resin</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Stopper for 90°</td>
<td>Resin</td>
<td>For 90°</td>
</tr>
<tr>
<td>6</td>
<td>Holding rubber</td>
<td>NBR</td>
<td>For 90°</td>
</tr>
<tr>
<td>7</td>
<td>Stopper seal</td>
<td>NBR</td>
<td>Special seal</td>
</tr>
<tr>
<td>8</td>
<td>Back-up ring</td>
<td>Stainless steel</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Bearing</td>
<td>Bearing steel</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>O-ring</td>
<td>NBR</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Hexagon socket head cap screw</td>
<td>Chrome molybdenum steel</td>
<td>Special screw</td>
</tr>
</tbody>
</table>

For 180°

Component Parts

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Material</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Body (A)</td>
<td>Aluminum alloy</td>
<td>Painted</td>
</tr>
<tr>
<td>2</td>
<td>Body (B)</td>
<td>Aluminum alloy</td>
<td>Painted</td>
</tr>
<tr>
<td>3</td>
<td>Vane shaft</td>
<td>Stainless steel</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Stopper</td>
<td>Resin</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Stopper for 90°</td>
<td>Resin</td>
<td>For 90°</td>
</tr>
<tr>
<td>6</td>
<td>Holding rubber</td>
<td>NBR</td>
<td>For 90°</td>
</tr>
<tr>
<td>7</td>
<td>Stopper seal</td>
<td>NBR</td>
<td>Special seal</td>
</tr>
<tr>
<td>8</td>
<td>Back-up ring</td>
<td>Stainless steel</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Bearing</td>
<td>Bearing steel</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>O-ring</td>
<td>NBR</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Hexagon socket head cap screw</td>
<td>Chrome molybdenum steel</td>
<td>Special screw</td>
</tr>
</tbody>
</table>

The material is chrome molybdenum steel for sizes 30 and 40.
**Construction: Standard Type (With Auto Switch)**

- Following figures show actuators when B port is pressurized.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cover</td>
<td>Resin</td>
</tr>
<tr>
<td>2</td>
<td>Magnet holder</td>
<td>Resin</td>
</tr>
<tr>
<td>3</td>
<td>Magnet</td>
<td>Magnetic material</td>
</tr>
<tr>
<td>4</td>
<td>Body C</td>
<td>Resin</td>
</tr>
<tr>
<td>5</td>
<td>Switch plate</td>
<td>Aluminum alloy</td>
</tr>
<tr>
<td>6</td>
<td>Spring pin</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>7</td>
<td>Cross recessed round head screw</td>
<td>1  Chrome molybdenum steel*</td>
</tr>
<tr>
<td>8</td>
<td>Cross recessed round head screw</td>
<td>2  Chrome molybdenum steel*</td>
</tr>
</tbody>
</table>

* The material is stainless steel for sizes 10 and 15.
Dimensions: Standard Type (Without Auto Switch) 10, 15

Single shaft/CRBS
- Following figures show actuators when B port is pressurized.

Double shaft/CRBW

3 mounting holes with the ★ marks are for tightening the actuator and not to be used for external mounting for size 10.

<table>
<thead>
<tr>
<th>Size</th>
<th>A</th>
<th>A2</th>
<th>A3</th>
<th>B</th>
<th>D1(g7)</th>
<th>D2</th>
<th>D3</th>
<th>D4</th>
<th>D5</th>
<th>D6</th>
<th>E1(h9)</th>
<th>E2</th>
<th>E3</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>29</td>
<td>30</td>
<td>37</td>
<td>15</td>
<td>4.0±0.15</td>
<td>14</td>
<td>0.5</td>
<td>9</td>
<td>8</td>
<td>5</td>
<td>9.0±0.036</td>
<td>3</td>
<td>1</td>
<td>12</td>
<td>9.8</td>
<td>M5 x 0.8</td>
<td>3.6</td>
</tr>
<tr>
<td>15</td>
<td>34</td>
<td>39.5</td>
<td>47</td>
<td>20</td>
<td>6.0±0.16</td>
<td>18</td>
<td>0.5</td>
<td>10</td>
<td>9</td>
<td>6</td>
<td>12.0±0.043</td>
<td>4</td>
<td>1.5</td>
<td>14</td>
<td>14.3</td>
<td>M5 x 0.8</td>
<td>7.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size</th>
<th>L</th>
<th>M</th>
<th>P</th>
<th>Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>19.8</td>
<td>14.6</td>
<td>24</td>
<td>M3 x 0.5 depth 6</td>
</tr>
<tr>
<td>15</td>
<td>24</td>
<td>17.1</td>
<td>29</td>
<td>M3 x 0.5 depth 10</td>
</tr>
</tbody>
</table>
CRB Series

Dimensions: Standard Type (Without Auto Switch) 20, 30, 40

Single shaft/CRBS

- Following figures show actuators when B port is pressurized.

For size 40

Parallel key dimensions

A parallel key is used instead of chamfer for size 40.

Double shaft/CRBW

Chamfer

A parallel key is used instead of chamfer for size 40.

Parallel key dimensions

A parallel key is used instead of chamfer for size 40.

2 x F3

L1

B

A2

A1

D3

D1

Chamfer

Chamfer

J1

J2

J3

L

P

Q

Q1

Q2

Q3

J3-dimension is not the dimension at the time of shipment, since its dimension is for adjustment parts.

<table>
<thead>
<tr>
<th>Size</th>
<th>A</th>
<th>B</th>
<th>D1 (g7)</th>
<th>D2</th>
<th>D3</th>
<th>D4</th>
<th>D5</th>
<th>D6</th>
<th>E1 (h9)</th>
<th>E2</th>
<th>E3</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>42</td>
<td>50.5</td>
<td>59.29</td>
<td>20</td>
<td>0.5</td>
<td>10</td>
<td>10</td>
<td>7</td>
<td>14.202</td>
<td>4.5</td>
<td>1.5</td>
<td>13</td>
<td>18.3</td>
<td>M5 x 0.8</td>
</tr>
<tr>
<td>30</td>
<td>50</td>
<td>64</td>
<td>75.40</td>
<td>40</td>
<td>1</td>
<td>12</td>
<td>13</td>
<td>8</td>
<td>16.302</td>
<td>5</td>
<td>2</td>
<td>14</td>
<td>26</td>
<td>M5 x 0.8</td>
</tr>
<tr>
<td>40</td>
<td>63</td>
<td>79.5</td>
<td>90.45</td>
<td>45</td>
<td>1</td>
<td>—</td>
<td>15</td>
<td>9</td>
<td>25.302</td>
<td>6.5</td>
<td>4.5</td>
<td>20</td>
<td>31.1</td>
<td>M5 x 0.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>P</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>16</td>
<td>7.1</td>
<td>27.4</td>
<td>—</td>
<td>28</td>
<td>36</td>
<td>M4 x 0.7 depth 10</td>
</tr>
<tr>
<td>30</td>
<td>19</td>
<td>11.8</td>
<td>32.7</td>
<td>5.5</td>
<td>31.5</td>
<td>43</td>
<td>M5 x 0.8 depth 15</td>
</tr>
<tr>
<td>40</td>
<td>28</td>
<td>15.8</td>
<td>44.1</td>
<td>9.5</td>
<td>40</td>
<td>56</td>
<td>M5 x 0.8 depth 20</td>
</tr>
</tbody>
</table>

For size 40
Dimensions: Standard Type (With Auto Switch) 10, 15

Single shaft/CDRBS

- Following figures show actuators when B port is pressurized.

When auto switches are mounted

<table>
<thead>
<tr>
<th>Size</th>
<th>A</th>
<th>B</th>
<th>D1 (g7)</th>
<th>D2</th>
<th>D3</th>
<th>D4</th>
<th>E1 (h9)</th>
<th>E2</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>K</th>
<th>L</th>
<th>M</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>29</td>
<td>46</td>
<td>32</td>
<td>4</td>
<td>0.015</td>
<td>14</td>
<td>0.5</td>
<td>9</td>
<td>3</td>
<td>12</td>
<td>9.8</td>
<td>M5 x 0.8</td>
<td>3.6</td>
<td>19.8</td>
<td>14.6</td>
</tr>
<tr>
<td>15</td>
<td>34</td>
<td>54.8</td>
<td>36.8</td>
<td>5</td>
<td>0.015</td>
<td>18</td>
<td>0.5</td>
<td>10</td>
<td>4</td>
<td>14</td>
<td>14.3</td>
<td>M5 x 0.8</td>
<td>7.6</td>
<td>24</td>
<td>17.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size</th>
<th>Q</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>M3 x 0.5 depth 6</td>
<td>15</td>
</tr>
<tr>
<td>15</td>
<td>M3 x 0.5 depth 10</td>
<td>19</td>
</tr>
</tbody>
</table>
CRB Series

Dimensions: Standard Type (With Auto Switch) 20, 30, 40

Single shaft/CDRBS

- Following figures show actuators when B port is pressurized.

When auto switches are mounted

Parallel key dimensions

<table>
<thead>
<tr>
<th>Size</th>
<th>A</th>
<th>B</th>
<th>D1(h7)</th>
<th>D2</th>
<th>D3</th>
<th>D4</th>
<th>E1(h9)</th>
<th>E2</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>J1</th>
<th>J2</th>
<th>J3</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>42</td>
<td>55.6</td>
<td>35.6</td>
<td>6</td>
<td>0.04</td>
<td>20</td>
<td>0.5</td>
<td>10</td>
<td>14.5</td>
<td>4.5</td>
<td>13</td>
<td>18.3</td>
<td>16</td>
<td>7.1</td>
<td>27.4</td>
</tr>
<tr>
<td>30</td>
<td>50</td>
<td>70</td>
<td>48</td>
<td>8</td>
<td>0.05</td>
<td>22</td>
<td>1</td>
<td>12</td>
<td>16.5</td>
<td>5</td>
<td>14</td>
<td>26</td>
<td>19</td>
<td>11.8</td>
<td>32.7</td>
</tr>
<tr>
<td>40</td>
<td>63</td>
<td>84.2</td>
<td>54.2</td>
<td>10</td>
<td>0.06</td>
<td>30</td>
<td>—</td>
<td>—</td>
<td>25.5</td>
<td>6.5</td>
<td>20</td>
<td>31.1</td>
<td>28</td>
<td>15.8</td>
<td>44.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size</th>
<th>L</th>
<th>P</th>
<th>Q</th>
<th>S</th>
<th>S1</th>
<th>S2</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>28</td>
<td>36</td>
<td>M4</td>
<td>10</td>
<td>37</td>
<td>28.6</td>
</tr>
<tr>
<td>30</td>
<td>31.5</td>
<td>43</td>
<td>M5</td>
<td>0.8 depth 15</td>
<td>42</td>
<td>40.1</td>
</tr>
<tr>
<td>40</td>
<td>40</td>
<td>56</td>
<td>M5</td>
<td>0.8 depth 20</td>
<td>52</td>
<td>45.2</td>
</tr>
</tbody>
</table>

*1 J3-dimension is not the dimension at the time of shipment, since its dimension is for adjustment parts.
Shaft Type Dimensions (Dimensions other than specified below are the same as the standard type.)

Size: 10, 15
Standard type

With auto switch
Single shaft/CDRB T

Size: 20, 30, 40
Standard type

With auto switch
Single shaft/CDRB T

A parallel key is used instead of chamfer for size 40.

<table>
<thead>
<tr>
<th>Size</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td>15</td>
<td>9</td>
<td>18</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>30</td>
<td>13</td>
<td>22</td>
</tr>
<tr>
<td>40</td>
<td>15</td>
<td>30</td>
</tr>
</tbody>
</table>

* The dimensions of the shaft and chamfer are the same as those of the standard type. Dimensions of parts different from the standard type conform to the general tolerance.
Vane Type Rotary Actuator With Vertical Auto Switch Unit

**CRB□-A Series**

Size: 10, 15, 20, 30, 40

---

### How to Order

**CRB W 30 - 90 - M9B - AM**

1. **Shaft type**
   - **Symbol: W**
   - **Double shaft**
   - **Shaft-end shape:** Single flat

2. **Size**
   - 10
   - 15
   - 20
   - 30
   - 40

3. **Rotating angle**
   - 90°
   - 180°

4. **Auto switch**
   - For applicable auto switches, refer to the table below.

5. **Lead wire length**
   - Nil
   - Grommet/Lead wire: 0.5 m
   - M
   - Connector/Lead wire: 1 m
   - L
   - Connector/Lead wire: 3 m
   - CN
   - Connector/Lead wire: 5 m
   - CL
   - Connector/Lead wire: 3 m
   - Z
   - Grommet/Lead wire: 5 m
   - W
   - Grommet/Lead wire: 1 m

6. **Number of auto switches**
   - Nil: 2
   - S: 1

7. **Auto switch unit**
   - Symbol
   - With vertical auto switch unit (Built-in magnet)
   - Other than the D-M9□(V)

---

### Applicable Auto Switches

- **Refer to the Web Catalog or Best Pneumatics Catalog for further information on auto switches.**

<table>
<thead>
<tr>
<th>Applicable size</th>
<th>Type</th>
<th>Symbol</th>
<th>Electrical entry</th>
<th>Wiring (Output)</th>
<th>Load voltage</th>
<th>Auto switch mode</th>
<th>Lead wire type</th>
<th>Lead wire length [m]</th>
<th>Pre-wired connector</th>
<th>Applicable load</th>
</tr>
</thead>
<tbody>
<tr>
<td>10, 15</td>
<td>Solid state auto switch</td>
<td>Grommet</td>
<td>—</td>
<td>3-wire (NPN)</td>
<td>5 V, 12 V</td>
<td>M9NV M9N</td>
<td>Oilproof heavy-duty cord</td>
<td>24 V</td>
<td>—</td>
<td>Relay, PLC</td>
</tr>
<tr>
<td>10, 15</td>
<td>Reed auto switch</td>
<td>—</td>
<td>No</td>
<td>2-wire</td>
<td>5 V, 12 V</td>
<td>S99V S99</td>
<td>Oilproof heavy-duty cord</td>
<td>—</td>
<td>90</td>
<td>—</td>
</tr>
<tr>
<td>20, 30, 40</td>
<td>Solid state auto switch</td>
<td>Grommet</td>
<td>Yes</td>
<td>3-wire (NPN)</td>
<td>5 V, 12 V</td>
<td>M9NV M9N</td>
<td>Oilproof heavy-duty cord</td>
<td>24 V</td>
<td>—</td>
<td>Relay, PLC</td>
</tr>
<tr>
<td>20, 30, 40</td>
<td>Reed auto switch</td>
<td>—</td>
<td>Yes</td>
<td>2-wire</td>
<td>5 V, 12 V</td>
<td>S99V S99</td>
<td>Oilproof heavy-duty cord</td>
<td>—</td>
<td>90</td>
<td>—</td>
</tr>
</tbody>
</table>

---

* Auto switches are shipped together, but not assembled.

---

Refer to page 37 if the auto switch unit is needed separately.
Vane Type Rotary Actuator
With Vertical Auto Switch Unit

CRB□-A Series

Specifications, rotation range, inner volume, and effective output are the same as those of the standard type. (→ p. 16, 17)

Weight

<table>
<thead>
<tr>
<th>Size</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>30</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotating angle</td>
<td>90°</td>
<td>180°</td>
<td>90°</td>
<td>180°</td>
<td>90°</td>
</tr>
<tr>
<td>Basic type</td>
<td>27</td>
<td>26</td>
<td>47</td>
<td>46</td>
<td>110</td>
</tr>
<tr>
<td>Vertical auto switch unit</td>
<td>15</td>
<td>20</td>
<td>28</td>
<td>38</td>
<td>38</td>
</tr>
</tbody>
</table>

Flange mounting bracket assembly is available as an option. For details, refer to page 36.

Construction: With Vertical Auto Switch Unit

- Components other than those specified below are the same as those found on page 18.

D-M9□

Size: 10, 15

D-S/T99(V) D-S7P D-90/90A
D-S9P(V) D-97/93A D-R73/80□

Size: 20, 30

D-S/T79□

Size: 10, 15

Component Parts

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cover (A)</td>
<td>Resin</td>
</tr>
<tr>
<td>2</td>
<td>Cover (B)</td>
<td>Resin</td>
</tr>
<tr>
<td>3</td>
<td>Magnet lever</td>
<td>Resin</td>
</tr>
<tr>
<td>4</td>
<td>Holding block</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>5</td>
<td>Holding block (B)</td>
<td>Aluminum alloy</td>
</tr>
<tr>
<td>6</td>
<td>Switch block (A)</td>
<td>Resin</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Switch block (B)</td>
<td>Resin</td>
</tr>
<tr>
<td>8</td>
<td>Switch block</td>
<td>Resin</td>
</tr>
<tr>
<td>9</td>
<td>Magnet</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Hexagon socket set screw</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>11</td>
<td>Cross recessed round head screw</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>12</td>
<td>Cross recessed round head screw</td>
<td>Stainless steel</td>
</tr>
</tbody>
</table>

Component Parts

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Cross recessed round head screw</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>14</td>
<td>Cross recessed round head screw</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>15</td>
<td>Rubber cap</td>
<td>NBR</td>
</tr>
<tr>
<td>16</td>
<td>Switch holder</td>
<td>Stainless steel</td>
</tr>
</tbody>
</table>

Flange mounting bracket assembly is available as an option. For details, refer to page 36.

Model Selection

Component Unit

Auto Switch Mounting

CRB□-B/CRB□-C
Dimensions: With Vertical Auto Switch Unit (10, 15)

- Following figures show actuators when B port is pressurized.

3 mounting holes with the ★ marks are for tightening the actuator and not to be used for external mounting for size 10.

A port B port

2 x F3

Auto switch

ø A1 ø E1 ø D1

ø P

ø Y

ø A2 ø C B D2

ø E2

ø F1 F2

D-M9

D-S/T99(V), S9P(V), D-97/93A, 90/90A

1 The angle is 60° when any of the following are used: D-90/90A/97/93A

The angle is 69° when any of the following are used: D-S99(V)/T99(V)/S9P(V)

<table>
<thead>
<tr>
<th>Size</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D1(g7)</th>
<th>D2</th>
<th>D3</th>
<th>D4</th>
<th>E1(h9)</th>
<th>E2</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>K</th>
<th>L</th>
<th>M</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>29</td>
<td>58</td>
<td>15</td>
<td>29</td>
<td>14</td>
<td>0.5</td>
<td>9</td>
<td>9.306</td>
<td>3</td>
<td>12</td>
<td>9.8</td>
<td>5.8 x 0.8</td>
<td>3.6</td>
<td>19.8</td>
<td>14.6</td>
<td>24</td>
</tr>
<tr>
<td>15</td>
<td>34</td>
<td>67</td>
<td>20</td>
<td>29</td>
<td>18</td>
<td>0.5</td>
<td>10</td>
<td>12.304</td>
<td>4</td>
<td>14</td>
<td>14.3</td>
<td>5.8 x 0.8</td>
<td>7.6</td>
<td>24</td>
<td>17.1</td>
<td>29</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size</th>
<th>Q</th>
<th>W</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>M3 x 0.5 depth 6</td>
<td>35</td>
<td>18.5</td>
</tr>
<tr>
<td>15</td>
<td>M3 x 0.5 depth 5</td>
<td>35</td>
<td>18.5</td>
</tr>
</tbody>
</table>
Dimensions: With Vertical Auto Switch Unit (20, 30, 40)

- Following figures show actuators when B port is pressurized.

For size 40

Auto switch ø Y

Parallel key dimensions

<table>
<thead>
<tr>
<th>b(h9)</th>
<th>h(h9)</th>
<th>L1</th>
</tr>
</thead>
<tbody>
<tr>
<td>4−0.030</td>
<td>4−0.030</td>
<td>20</td>
</tr>
</tbody>
</table>

Following table:

<table>
<thead>
<tr>
<th>Size</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D1(g7)</th>
<th>D2</th>
<th>D3</th>
<th>D4</th>
<th>E1(h9)</th>
<th>E2</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>J1</th>
<th>J2</th>
<th>J3</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>42</td>
<td>79</td>
<td>29</td>
<td>30</td>
<td>20</td>
<td>0.5</td>
<td>10</td>
<td>14.3</td>
<td>4.5</td>
<td>13</td>
<td>18.3</td>
<td>M5 x 0.8</td>
<td>16</td>
<td>7.1</td>
<td>27.4</td>
<td>—</td>
</tr>
<tr>
<td>30</td>
<td>50</td>
<td>93</td>
<td>40</td>
<td>31</td>
<td>22</td>
<td>1</td>
<td>12</td>
<td>16.3</td>
<td>5</td>
<td>14</td>
<td>26</td>
<td>M5 x 0.8</td>
<td>19</td>
<td>11.8</td>
<td>32.7</td>
<td>5.5</td>
</tr>
<tr>
<td>40</td>
<td>63</td>
<td>106</td>
<td>45</td>
<td>31</td>
<td>30</td>
<td>—</td>
<td>—</td>
<td>25.5</td>
<td>6.5</td>
<td>20</td>
<td>31.1</td>
<td>M5 x 0.8</td>
<td>28</td>
<td>15.6</td>
<td>44.1</td>
<td>9.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size</th>
<th>L</th>
<th>P</th>
<th>Q</th>
<th>W</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>28</td>
<td>36</td>
<td>M4 x 0.7 depth 7</td>
<td>19.5</td>
<td>25</td>
</tr>
<tr>
<td>30</td>
<td>31.5</td>
<td>43</td>
<td>M5 x 0.8 depth 10</td>
<td>19.5</td>
<td>25</td>
</tr>
<tr>
<td>40</td>
<td>40</td>
<td>56</td>
<td>M5 x 0.8 depth 10</td>
<td>22.5</td>
<td>31</td>
</tr>
</tbody>
</table>
Vane Type Rotary Actuator
With Angle Adjustment Unit/With Vertical Auto Switch Unit and Angle Adjustment Unit

**CRB□-B/CRB□-C Series**
Size: 10, 15, 20, 30, 40

**How to Order**

1. **Shaft type**
   - **Symbol**: Shaft type
   - **Shaft-end shape**: Long shaft, Short shaft

2. **Size**
   - **10**, **15**, **20**, **30**, **40**

3. **Rotating angle**
   - **90°**, **180°**

4. **Auto switch**
   - For applicable auto switches, refer to the table below.

5. **Lead wire length**
   - M: Grommet/Lead wire: 1 m
   - L: Grommet/Lead wire: 3 m
   - CN: Connector/Without lead wire
   - CL: Connector/Lead wire: 3 m
   - Z: Grommet/Lead wire: 5 m

**With angle adjustment unit**
**CRB□-B**

**With vertical auto switch unit and angle adjustment unit**
**CRB□-C**

**Number of auto switches**
- **Nil**: 2
- **S**: 1

**With vertical auto switch unit and angle adjustment unit**

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

<table>
<thead>
<tr>
<th>Applicable size</th>
<th>Type</th>
<th>Spacial position</th>
<th>Electrical entry</th>
<th>Wiring (Output)</th>
<th>Load voltage</th>
<th>Auto switch model</th>
<th>Lead wire type</th>
<th>Lead wire length [m]</th>
<th>Pre-wired connector</th>
<th>Applicable load</th>
</tr>
</thead>
<tbody>
<tr>
<td>For 10, 15</td>
<td>Solid state auto switch</td>
<td>Grommet</td>
<td>Yes</td>
<td>24 V</td>
<td>5 V, 12 V</td>
<td>M9NV M9N</td>
<td>Oilproof heavy-duty cord</td>
<td>90 (M)</td>
<td>● ● ● ○ ○ ○ ○</td>
<td>○ IC circuit</td>
</tr>
<tr>
<td>Reed auto switch</td>
<td>No</td>
<td>2-wire</td>
<td>Yes</td>
<td>12 V</td>
<td>5 V, 12 V</td>
<td>S99V S99</td>
<td>Oilproof heavy-duty cord</td>
<td>90 (M)</td>
<td>● ● ● ○ ○ ○ ○</td>
<td>○ IC circuit</td>
</tr>
<tr>
<td>For 20, 30, 40</td>
<td>Solid state auto switch</td>
<td>Grommet</td>
<td>Yes</td>
<td>24 V</td>
<td>5 V, 12 V</td>
<td>M9NV M9N</td>
<td>Oilproof heavy-duty cord</td>
<td>90 (M)</td>
<td>● ● ● ○ ○ ○ ○</td>
<td>○ IC circuit</td>
</tr>
<tr>
<td>Reed auto switch</td>
<td>Connector</td>
<td>Yes</td>
<td>2-wire</td>
<td>12 V</td>
<td>5 V, 12 V</td>
<td>S99V S99</td>
<td>Oilproof heavy-duty cord</td>
<td>90 (M)</td>
<td>● ● ● ○ ○ ○ ○</td>
<td>○ IC circuit</td>
</tr>
</tbody>
</table>

- **Symbol**
  - **C**: With vertical auto switch unit and angle adjustment unit (Built-in magnet)
  - **CM**: With vertical auto switch unit for D-M9 and angle adjustment unit (Built-in magnet)

- **With vertical auto switch unit**
- **With angle adjustment unit**
- **With vertical auto switch unit and angle adjustment unit**

**Auto switch marked with “v” are produced upon receipt of order.**

* Auto switches are shipped together, but not assembled.
* Auto switches marked with “C” are produced upon receipt of order.

29
### Rotating Angle with Angle Adjustment Unit

- Drawings below are viewed from the long shaft side.
- Chamfered positions illustrate the conditions of actuators when B port is pressurized.
- Operate within the adjustment range.

**Rotating angle with angle adjustment unit**

**Size: 10, 15**

- **For 90°**
  - Adjustment range: 0° to 85°

- **For 180°**
  - Adjustment range: 0° to 175°

**Size: 20, 30, 40**

- **For 90°**

- **For 180°**

The shaded area shows the rotation adjustment range.

**Rotating Angle with Angle Adjustment Unit**

<table>
<thead>
<tr>
<th>Rotating angle (Body)</th>
<th>Size</th>
<th>10</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>90°</td>
<td>0 to 85°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>180°</td>
<td>0 to 175°</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Rotating Angle Adjustment Method**

- The rotating angle can be adjusted by moving the stopper blocks (A) and (B) shown in Fig. 1.
- Fig. 1 shows the default position of the angle adjustment unit.
- Make adjustments when pressure is not being applied.

**Specifications, inner volume, and effective output are the same as those of the standard type.**

(→ p. 16, 17)

### Weight

<table>
<thead>
<tr>
<th>Size</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>30</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotating angle</td>
<td>90°</td>
<td>180°</td>
<td>90°</td>
<td>180°</td>
<td>90°</td>
</tr>
<tr>
<td>Basic type</td>
<td>27</td>
<td>26</td>
<td>47</td>
<td>46</td>
<td>110</td>
</tr>
<tr>
<td>Vertical auto switch unit</td>
<td>15</td>
<td>20</td>
<td>28</td>
<td>38</td>
<td>38</td>
</tr>
<tr>
<td>Angle adjustment unit</td>
<td>30</td>
<td>47</td>
<td>90</td>
<td>150</td>
<td>203</td>
</tr>
</tbody>
</table>

Flange mounting bracket assembly is available as an option.
For details, refer to page 36.
A parallel key is used instead of chamfer for size 40.

### Construction: With Angle Adjustment Unit, With Vertical Auto Switch Unit and Angle Adjustment Unit

- Components other than those specified below are the same as those found on page 18.

<table>
<thead>
<tr>
<th>With angle adjustment unit</th>
<th>With vertical auto switch unit and angle adjustment unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size: 10, 15, 20, 30, 40</td>
<td>Size: 10, 15</td>
</tr>
<tr>
<td>Size: 10</td>
<td>Size: 20, 30, 40</td>
</tr>
</tbody>
</table>

A parallel key is used instead of chamfer for size 40.

#### Component Parts

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Material</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Stopper ring</td>
<td>Aluminum alloy</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Stopper lever</td>
<td>Chrome molybdenum steel</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Lever retainer</td>
<td>Rolled steel</td>
<td>Zinc chromated</td>
</tr>
<tr>
<td>4</td>
<td>Rubber bumper</td>
<td>NBR</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Stopper block</td>
<td>Chrome molybdenum steel</td>
<td>Zinc chromated</td>
</tr>
<tr>
<td>6</td>
<td>Block retainer</td>
<td>Rolled steel</td>
<td>Zinc chromated</td>
</tr>
<tr>
<td>7</td>
<td>Cap</td>
<td>Resin</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Hexagon socket head cap screw</td>
<td>Stainless steel</td>
<td>Special screw</td>
</tr>
<tr>
<td>9</td>
<td>Hexagon socket head cap screw</td>
<td>Stainless steel</td>
<td>Special screw</td>
</tr>
<tr>
<td>10</td>
<td>Hexagon socket head cap screw</td>
<td>Stainless steel</td>
<td>Special screw</td>
</tr>
<tr>
<td>11</td>
<td>Joint</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Hexagon socket set screw</td>
<td>Stainless steel</td>
<td>Hexagon nut will be used for size 10 only.</td>
</tr>
<tr>
<td>13</td>
<td>Hexagon nut</td>
<td>Stainless steel</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Cross recessed round head screw</td>
<td>Stainless steel</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Magnet lever</td>
<td>—</td>
<td></td>
</tr>
</tbody>
</table>
Dimensions: With Angle Adjustment Unit (10, 15)

- Following figures show actuators when B port is pressurized.

3 mounting holes with the ★ marks are for tightening the actuator and not to be used for external mounting for size 10.

### Dimensions (10, 15) [mm]

<table>
<thead>
<tr>
<th>Size</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>C1</th>
<th>D1</th>
<th>D2</th>
<th>D3</th>
<th>D4</th>
<th>E1(h9)</th>
<th>E2</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>K</th>
<th>L</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>29</td>
<td>48.5</td>
<td>15</td>
<td>19.5</td>
<td>3</td>
<td>4.004</td>
<td>0.010</td>
<td>14</td>
<td>0.5</td>
<td>9</td>
<td>9.3</td>
<td>0.636</td>
<td>3</td>
<td>12</td>
<td>9.8</td>
<td>M5 x 0.8</td>
</tr>
<tr>
<td>15</td>
<td>34</td>
<td>59</td>
<td>20</td>
<td>21</td>
<td>3</td>
<td>5.004</td>
<td>0.015</td>
<td>18</td>
<td>0.5</td>
<td>10</td>
<td>12.5</td>
<td>0.443</td>
<td>4</td>
<td>14</td>
<td>14.3</td>
<td>M5 x 0.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size</th>
<th>P</th>
<th>Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>24</td>
<td>M3 x 0.5 depth 6</td>
</tr>
<tr>
<td>15</td>
<td>29</td>
<td>M3 x 0.5 depth 5</td>
</tr>
</tbody>
</table>
CRB□-B Series

Dimensions: With Angle Adjustment Unit (20, 30, 40)

- Following figures show actuators when B port is pressurized.

A parallel key is used instead of chamfer for size 40.

<table>
<thead>
<tr>
<th>Size</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>C1</th>
<th>D1 (g7)</th>
<th>D2</th>
<th>D3</th>
<th>D4</th>
<th>E1 (h9)</th>
<th>E2</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
<th>J1</th>
<th>J2</th>
<th>J3</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>42</td>
<td>74</td>
<td>29</td>
<td>25</td>
<td>4</td>
<td>6</td>
<td>0.043</td>
<td>20</td>
<td>0.5</td>
<td>10</td>
<td>14</td>
<td>4.5</td>
<td>13</td>
<td>18.3</td>
<td>16</td>
<td>7.1</td>
</tr>
<tr>
<td>30</td>
<td>50</td>
<td>91</td>
<td>40</td>
<td>29</td>
<td>4.5</td>
<td>8</td>
<td>0.043</td>
<td>22</td>
<td>1</td>
<td>12</td>
<td>16</td>
<td>5</td>
<td>14</td>
<td>26</td>
<td>19</td>
<td>11.8</td>
</tr>
<tr>
<td>40</td>
<td>63</td>
<td>111.3</td>
<td>45</td>
<td>36.3</td>
<td>5</td>
<td>10</td>
<td>0.043</td>
<td>30</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>6.5</td>
<td>20</td>
<td>31.1</td>
<td>28</td>
<td>15.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size</th>
<th>K</th>
<th>L</th>
<th>P</th>
<th>Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>—</td>
<td>28</td>
<td>36</td>
<td>M4 x 0.7 depth 7</td>
</tr>
<tr>
<td>30</td>
<td>5.5</td>
<td>31.5</td>
<td>43</td>
<td>M5 x 0.8 depth 10</td>
</tr>
<tr>
<td>40</td>
<td>9.5</td>
<td>40</td>
<td>56</td>
<td>M5 x 0.8 depth 10</td>
</tr>
</tbody>
</table>

For size 40

Parallel key dimensions

- Dimensions: With Angle Adjustment Unit (20, 30, 40)

- For size 40

- 2 x F3

- øA1

- øE1

- øD1

- L1

<table>
<thead>
<tr>
<th>b (h9)</th>
<th>h (h9)</th>
<th>L1</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.0 ± 0.030</td>
<td>4.0 ± 0.030</td>
<td>20</td>
</tr>
</tbody>
</table>

- A1 A2 C C1 D1 (g7) D2 D3 D4 E1 (h9) E2 F1 F2 F3 J1 J2 J3

- 33
Dimensions: With Vertical Auto Switch Unit and Angle Adjustment Unit (10, 15)

- Following figures show actuators when B port is pressurized.

![Diagram of Vane Type Rotary Actuator with Vertical Auto Switch Unit and Angle Adjustment Unit]

<table>
<thead>
<tr>
<th>Size</th>
<th>A1</th>
<th>A2</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>K</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>29</td>
<td>74.5</td>
<td>15</td>
<td>45.5</td>
<td>4.5 ±0.04</td>
<td>14</td>
<td>0.5</td>
<td>9</td>
<td>5.5 ±0.06</td>
</tr>
<tr>
<td>15</td>
<td>34</td>
<td>85</td>
<td>20</td>
<td>47</td>
<td>5.5 ±0.04</td>
<td>18</td>
<td>0.5</td>
<td>10</td>
<td>12.5 ±0.043</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size</th>
<th>M</th>
<th>P</th>
<th>Q</th>
<th>W</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>14.6</td>
<td>24</td>
<td>M3 x 0.5 depth 6</td>
<td>35</td>
<td>18.5</td>
</tr>
<tr>
<td>15</td>
<td>17.1</td>
<td>29</td>
<td>M3 x 0.5 depth 5</td>
<td>35</td>
<td>18.5</td>
</tr>
</tbody>
</table>

*1 The angle is 60° when any of the following are used: D-90/90A/97/93A
The angle is 69° when any of the following are used: D-S99(V)/T99(V)/S9P(V)
Dimensions: With Vertical Auto Switch Unit and Angle Adjustment Unit (20, 30, 40)

- Following figures show actuators when B port is pressurized.

A parallel key is used instead of chamfer for size 40.

For size 40

Parallel key dimensions

<table>
<thead>
<tr>
<th>b(h9)</th>
<th>h(h9)</th>
<th>L1</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.5</td>
<td>4.5</td>
<td>20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Size</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>P</th>
<th>Q</th>
<th>W</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>42</td>
<td>100</td>
<td>29</td>
<td>51</td>
<td>6</td>
<td>14.7</td>
<td>4.5</td>
<td>13</td>
<td>18.3</td>
<td>16</td>
<td>7.1</td>
<td>27.4</td>
<td>—</td>
</tr>
<tr>
<td>30</td>
<td>50</td>
<td>117.5</td>
<td>40</td>
<td>55.5</td>
<td>6.2</td>
<td>16.8</td>
<td>5</td>
<td>14</td>
<td>26</td>
<td>19</td>
<td>11.8</td>
<td>32.7</td>
<td>5.5</td>
</tr>
<tr>
<td>40</td>
<td>63</td>
<td>137.2</td>
<td>45</td>
<td>62.2</td>
<td>10.3</td>
<td>25.3</td>
<td>6.5</td>
<td>20</td>
<td>31.1</td>
<td>28</td>
<td>15.8</td>
<td>44.1</td>
<td>9.5</td>
</tr>
</tbody>
</table>
Flange Dimensions/Part Nos.

**Flange assembly for size 10**
Part no.: P211070-2

**Flange assembly for size 15**
Part no.: P211090-2

**Flange assembly for size 20**
Part no.: P211060-2

**Flange assembly for size 30**
Part no.: P211080-2

---

**M3 countersunk head screw (3 pcs.)**

**M4 countersunk head screw (3 pcs.)**

**M5 countersunk head screw (3 pcs.)**

---

**Flange**

**Rotary actuator**

---

**Vane Type Rotary Actuator**

**CRB Series**

---

**Flange Dimensions/Part Nos.**

---

6 x Countersunk head screw for M3 conical seat and through-hole

6 x Countersunk head screw for M5 conical seat and through-hole

6 x Countersunk head screw for M4 conical seat and through-hole
CRB Series Various units can be mounted to a vane type rotary actuator.

**Rotary actuator with vertical auto switch unit**

<table>
<thead>
<tr>
<th>Size</th>
<th>Vertical auto switch unit</th>
<th>Switch block unit</th>
<th>Vertical auto switch unit</th>
<th>Switch block unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>P611070-1M</td>
<td>P811010-8M</td>
<td>P611070-1</td>
<td>P611070-8</td>
</tr>
<tr>
<td>15</td>
<td>P611096-1M</td>
<td>P811090-1</td>
<td>P611090-1</td>
<td>P611070-9</td>
</tr>
<tr>
<td>20</td>
<td>P611060-1M</td>
<td>P811030-8M</td>
<td>P611060-1</td>
<td>P611060-8</td>
</tr>
<tr>
<td>30</td>
<td>P611080-1M</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>P611010-1M</td>
<td>P811010-8M</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Part Number for Vertical Auto Switch Unit**

- The combination of the auto switch unit and angle adjustment unit is available as standard.
- The items marked with ★ are additional parts required for connection (joint unit parts), and the items marked with ◆ are unnecessary.
- Use a unit part number when ordering joint unit separately.

### Part Number for Vertical Auto Switch Unit

<table>
<thead>
<tr>
<th>Size</th>
<th>Vertical auto switch unit</th>
<th>Switch block unit</th>
<th>Vertical auto switch unit</th>
<th>Switch block unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>P611070-1M</td>
<td>P811010-8M</td>
<td>P611070-1</td>
<td>P611070-8</td>
</tr>
<tr>
<td>15</td>
<td>P611096-1M</td>
<td>P811090-1</td>
<td>P611090-1</td>
<td>P611070-9</td>
</tr>
<tr>
<td>20</td>
<td>P611060-1M</td>
<td>P811030-8M</td>
<td>P611060-1</td>
<td>P611060-8</td>
</tr>
<tr>
<td>30</td>
<td>P611080-1M</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>P611010-1M</td>
<td>P811010-8M</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Part Number for Angle Adjustment Unit**

<table>
<thead>
<tr>
<th>Size</th>
<th>Angle adjustment unit</th>
<th>Vertical auto switch unit, Angle adjustment unit</th>
<th>Joint unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>P811010-3</td>
<td>P811010-4</td>
<td>P211070-10</td>
</tr>
<tr>
<td>15</td>
<td>P811020-3</td>
<td>P811020-4</td>
<td>P211090-10</td>
</tr>
<tr>
<td>20</td>
<td>P811030-3</td>
<td>P811030-4</td>
<td>P211060-10</td>
</tr>
<tr>
<td>30</td>
<td>P811040-3</td>
<td>P811040-4</td>
<td>P211080-10</td>
</tr>
<tr>
<td>40</td>
<td>P811050-3</td>
<td>P811050-4</td>
<td>P211010-10</td>
</tr>
</tbody>
</table>
Auto Switch Proper Mounting Position (at Rotation End Detection)

<table>
<thead>
<tr>
<th>Model</th>
<th>Size</th>
<th>Solid state auto switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDRB10, 15</td>
<td>10, 15</td>
<td>A</td>
</tr>
<tr>
<td>CDRB20, 30</td>
<td>20, 30, 40</td>
<td>A</td>
</tr>
</tbody>
</table>

Operating Range and Hysteresis Angle

- Operating range: $\theta_m$
  - The range is between the position where the auto switch turns ON as the magnet inside the auto switch unit moves rotationally and the position where the auto switch turns OFF as the magnet moves rotationally in the same direction.

- Hysteresis range: $\theta_d$
  - The range is between the position where the auto switch turns ON as the magnet inside the auto switch unit moves rotationally and the position where the auto switch turns OFF as the magnet moves rotationally in the opposite direction.

How to Change the Auto Switch Detecting Position

- When setting the detecting position, loosen the cross recessed round head screw a bit and move the auto switch to the preferred position and then tighten again and fix it. At this time, if tightened too much, the screw can become damaged and unable to fix position.
  - Proper tightening torque: 0.4 to 0.6 [N·m]
  - When tightening the cross recessed round head screw, take care that the auto switch does not tilt.

D-M9

<table>
<thead>
<tr>
<th>Size</th>
<th>$\theta_m$: Operating range</th>
<th>$\theta_d$: Hysteresis range</th>
</tr>
</thead>
<tbody>
<tr>
<td>10, 15</td>
<td>170°</td>
<td>20°</td>
</tr>
<tr>
<td>20, 30</td>
<td>100°</td>
<td>15°</td>
</tr>
<tr>
<td>40</td>
<td>86°</td>
<td>10°</td>
</tr>
</tbody>
</table>

D-S/T99(V), S9P(V), S/T79, S7P, D-97/93A, 90/90A, R73/80

<table>
<thead>
<tr>
<th>Size</th>
<th>$\theta_m$: Operating range</th>
<th>$\theta_d$: Hysteresis range</th>
</tr>
</thead>
<tbody>
<tr>
<td>10, 15</td>
<td>170°</td>
<td>20°</td>
</tr>
<tr>
<td>20, 30</td>
<td>100°</td>
<td>15°</td>
</tr>
<tr>
<td>40</td>
<td>86°</td>
<td>10°</td>
</tr>
</tbody>
</table>
Auto Switch Mounting: Sizes 10 to 40 (D-M9\textsuperscript{□})

External view and descriptions of auto switch unit

For sizes 10, 15
1. Auto switch mounting
   Insert the auto switch into the groove of the switch holder.

2. Auto switch securing
   Align the auto switch with the upper surface of the groove on the side of the switch holder, and secure the slotted set screw. (Refer to the enlarged view.)
   - Proper tightening torque: 0.05 to 0.1 [N·m]

3. Switch holder securing
   After the actuated position has been adjusted with the cross recessed round head screw, use the auto switch.
   - When tightening the screw, take care that the auto switch does not tilt.

For sizes 20 to 40
1. Auto switch mounting
   Insert the auto switch into the groove of the switch holder.

2. Auto switch securing
   Align the auto switch with the lower surface of the groove on the side of the switch holder, and secure the slotted set screw. (Refer to the enlarged view.)
   - Proper tightening torque: 0.05 to 0.1 [N·m]

3. Switch holder securing
   After the actuated position has been adjusted with the cross recessed round head screw, use the auto switch.
   - When tightening the screw, take care that the auto switch does not tilt.
Auto Switch Mounting: Sizes 10, 15 (D-S/T99(V), S9P(V), 97/93A, 90/90A)

External view and descriptions of auto switch unit
The following shows the external view and typical descriptions of the auto switch unit.

Solid state auto switch

<<Applicable auto switch>>
3-wire type......D-S99(V), S9P(V)
2-wire type......D-T99(V)

1. Switch block detaching
Remove the cross recessed round head screw (1) to detach the switch block.

2. Auto switch mounting
Secure the auto switch with the cross recessed round head screw (1) and holding block.
Proper tightening torque: 0.4 to 0.6 [N·m]
- Since the holding block moves inside the groove, move it to the mounting position beforehand.
- After the actuated position has been adjusted with the cross recessed round head screw (1), use the auto switch.

Reed auto switch

<<Applicable auto switch>>
D-97/93A (With indicator light)
D-90/90A (Without indicator light)

1. Preparations
Loosen the cross recessed round head screw (2) (About 2 to 3 turns).
- This screw has been secured temporarily at shipment.

2. Auto switch mounting
Insert the auto switch until it is in contact with the switch block hole.
- For the D-97/93A, insert the auto switch in the direction shown in the figure on the right.
- Since the D-90/90A is a round type, it has no directionality.

3. Auto switch securing
Tighten the cross recessed round head screw (2) to secure the auto switch.
Proper tightening torque: 0.4 to 0.6 [N·m]
- After the actuated position has been adjusted with the cross recessed round head screw (1), use the auto switch.
Auto Switch Mounting: Sizes 20 to 40 (D-S/T79□, S7P, R73/80□)

External view and descriptions of auto switch unit

Mounting Procedure

<Applicable auto switch>
Solid state auto switch
D-S79, S7P
D-T79, T79C
Reed auto switch
D-R73, R73C
D-R80, R80C

1. Auto switch mounting
Loosen the cross recessed round head screw (2), and insert the arm of the auto switch.

2. Auto switch securing
Set the auto switch so that it is in contact with the switch block, and tighten the cross recessed round head screw (2).

   ⋆ Proper tightening torque: 0.4 to 0.6 [N·m]

3. Switch holder securing
After the actuated position has been adjusted with the cross recessed round head screw (1), use the auto switch.

   ⋆ Proper tightening torque: 0.4 to 0.6 [N·m]

Auto Switch Adjustment

Rotation range of the output shaft with single flat (key for size 40 only) and auto switch mounting position

<Applicable models/Size: 10, 15, 20, 30, 40>

- Solid-lined curves indicate the rotation range of the output shaft with single flat (key). When the single flat (key) is pointing to the END ① direction, the switch for rotation END ① will operate, and when the single flat (key) is pointing to the END ② direction, the switch for rotation END ② will operate.
- Broken-lined curves indicate the rotation range of the built-in magnet. Operating angle of the switch can be decreased by either moving the switch for rotation END ① clockwise or moving the switch for rotation END ② counterclockwise. Auto switch in the figures on the left is at the most sensitive position.
- Each auto switch unit comes with one right-hand and one left-hand switches.
## Prior to Use

### Auto Switch Connections and Examples

#### Sink Input Specifications

**3-wire, NPN**

![3-wire, NPN Diagram]

**2-wire**

![2-wire Diagram]

#### Source Input Specifications

**3-wire, PNP**

![3-wire, PNP Diagram]

**2-wire**

![2-wire Diagram]

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. Depending on the operating environment, the product may not operate properly.

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

(Using relays)

![3-wire AND connection for NPN output Diagram]

(Performed with auto switches only)

![3-wire OR connection for NPN output Diagram]

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

(Using relays)

![3-wire AND connection for PNP output Diagram]

(Performed with auto switches only)

![3-wire OR connection for PNP output Diagram]

#### 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.

![2-wire AND connection Diagram]

#### 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.

![2-wire OR connection Diagram]

#### Load voltage at ON:

- Power supply voltage – Residual voltage x 2 pcs.
- = 24 V – 4 V x 2 pcs.
- = 16 V

Example: Power supply is 24 VDC

Internal voltage drop in auto switch is 4 V.

#### Load voltage at OFF:

- Leakage current x 2 pcs. x Load impedance
- = 1 mA x 2 pcs. x 3 kΩ
- = 6 V

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

---

* Prior to Use

Auto Switch Connections and Examples

### Sink Input Specifications

**3-wire, NPN**

![3-wire, NPN Diagram]

**2-wire**

![2-wire Diagram]

### Source Input Specifications

**3-wire, PNP**

![3-wire, PNP Diagram]

**2-wire**

![2-wire Diagram]

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. Depending on the operating environment, the product may not operate properly.

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

(Using relays)

![3-wire AND connection for NPN output Diagram]

(Performed with auto switches only)

![3-wire OR connection for NPN output Diagram]

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

(Using relays)

![3-wire AND connection for PNP output Diagram]

(Performed with auto switches only)

![3-wire OR connection for PNP output Diagram]

#### 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.

![2-wire AND connection Diagram]

#### 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.

![2-wire OR connection Diagram]

#### Load voltage at ON:

- Power supply voltage – Residual voltage x 2 pcs.
- = 24 V – 4 V x 2 pcs.
- = 16 V

Example: Power supply is 24 VDC

Internal voltage drop in auto switch is 4 V.

#### Load voltage at OFF:

- Leakage current x 2 pcs. x Load impedance
- = 1 mA x 2 pcs. x 3 kΩ
- = 6 V

Example: Load impedance is 3 kΩ. Leakage current from auto switch is 1 mA.
CRB Series
Specific Product Precautions

Be sure to read this before handling the products. Refer to the back cover for safety instructions. For rotary actuator 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 Loads

To secure the load, select a bolt of an appropriate size from those listed in tables 1 and 2 by taking the shaft’s single flat bearing stress strength into consideration.

Table 1  Directly Fixed with Bolts (Refer to Fig. 1.)

<table>
<thead>
<tr>
<th>Size</th>
<th>Shaft dia.</th>
<th>Bolt size</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>4</td>
<td>M4 or larger</td>
</tr>
<tr>
<td>15</td>
<td>5</td>
<td>M5 or larger</td>
</tr>
<tr>
<td>20</td>
<td>6</td>
<td>M6 or larger</td>
</tr>
<tr>
<td>30</td>
<td>8</td>
<td>M8 or larger</td>
</tr>
</tbody>
</table>

Table 2  Fixed with a Holding Block (Refer to Fig. 2.)

<table>
<thead>
<tr>
<th>Size</th>
<th>Shaft dia.</th>
<th>Bolt size</th>
<th>Plate thickness (t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>4</td>
<td>M3 or larger</td>
<td>2 or wider</td>
</tr>
<tr>
<td>15</td>
<td>5</td>
<td>M4 or larger</td>
<td>2.3 or wider</td>
</tr>
<tr>
<td>20</td>
<td>6</td>
<td>M5 or larger</td>
<td>3.6 or wider</td>
</tr>
<tr>
<td>30</td>
<td>8</td>
<td>M6 or larger</td>
<td>4 or wider</td>
</tr>
</tbody>
</table>

The plate thickness (t) in the table above indicates a reference value when a carbon steel is used. Besides, we do not manufacture a holding block.

Mounting

Refer to the table below when tightening the mounting bolts.

Mounting 1

Body mounting 1 (Body tapped)

<table>
<thead>
<tr>
<th>Size</th>
<th>Bolt</th>
<th>Recommended tightening torque [N·m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>M3</td>
<td>0.63</td>
</tr>
<tr>
<td>15</td>
<td>M3</td>
<td>0.63</td>
</tr>
<tr>
<td>20</td>
<td>M4</td>
<td>1.50</td>
</tr>
<tr>
<td>30</td>
<td>M5</td>
<td>3.0</td>
</tr>
<tr>
<td>40</td>
<td>M5</td>
<td>3.0</td>
</tr>
</tbody>
</table>

Mounting 2

Body mounting 2 (Body through-hole)

<table>
<thead>
<tr>
<th>Size</th>
<th>Bolt</th>
<th>Recommended tightening torque [N·m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>M2.5</td>
<td>0.36</td>
</tr>
<tr>
<td>15</td>
<td>M2.5</td>
<td>0.36</td>
</tr>
<tr>
<td>20</td>
<td>M3</td>
<td>0.63</td>
</tr>
<tr>
<td>30</td>
<td>M4</td>
<td>1.50</td>
</tr>
<tr>
<td>40</td>
<td>M4</td>
<td>1.50</td>
</tr>
</tbody>
</table>

* Refer to the Dimensions for Q1 and Q2 dimensions.

Adjustment

Do not apply a load when adjusting the rotating angle.

Example) For 180 degrees

1. Set the adjustment bolt B while supplying pressure from the A port.
2. Set the adjustment bolt A while supplying pressure from the B port.

Hexagon nut to fix the adjustment bolt

Size 20: 1.5 N·m
Sizes 30, 40: 3 N·m
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.

### Safety Instructions

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

### 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.

#### Safety Instructions

1. **Caution:** 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. **Caution:** 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. **Warning:** 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. **Caution:** 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.

#### Limited Warranty and Disclaimer

**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.

**Exclusion from Warranty**

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. The use of SMC products 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.

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\(^{1}\) 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.