Caution: Before use, be sure to read the “Safety Precautions” on p. 57.

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CAD drawing data catalog is available.
Rotary Actuators Vane Type

RAG Series

Uses angular bearings (except for RAG1), to achieve high precision and high rigidity.

Two different swing angle types are available, 90° and 180°. ±5° adjustment at the end of the swing stroke is possible by adjusting the screwed length of the rubber stopper or shock absorber.

Four different rated torque types are available, 0.1, 0.3, 0.8 and 2.0 N·m [0.07, 0.2, 0.6, 1.5 ft·lbf].

Demonstrates superior load capacity.

<table>
<thead>
<tr>
<th>Allowable load</th>
<th>Model</th>
<th>RAG_1</th>
<th>RAG_2</th>
<th>RAG_8</th>
<th>RAG_20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allowable thrust load W_0 [N·m]</td>
<td>20 (4.5)</td>
<td>60 (13.5)</td>
<td>120 (27.0)</td>
<td>160 (36.0)</td>
<td></td>
</tr>
<tr>
<td>Allowable radial load W_r [N·m]</td>
<td>20 (4.5)</td>
<td>80 (18.0)</td>
<td>100 (22.5)</td>
<td>120 (27.0)</td>
<td></td>
</tr>
<tr>
<td>Allowable moment M [N·m]</td>
<td>0.4 (0.30)</td>
<td>0.9 (0.66)</td>
<td>1.3 (0.96)</td>
<td>3.5 (2.58)</td>
<td></td>
</tr>
</tbody>
</table>

Note: For details of the allowable load, see p.1308, *Handling Instructions and Precautions.*

Four Types of Cushion Mechanisms
Since the rubber stopper and shock absorber use the same sized mounting screw, they are interchangeable (RAG_1 is available with rubber stopper only).

Locating dowel pin holes are available on the table top and main body (3 surfaces).

Piping and swing angle adjustment are possible on one surface.

Embedded type sensor switches are available.

For dimension details, see the Dimensions on p.1321 ~ 1324.
Employs bearings to reduce vibration and deflection, for high precision and high rigidity.

Easy-to-use table type facilitates workpiece mounting.

Compatible with embedded type sensor switches.

---

Application example 1
The vacuum pad lifts a workpiece, while the arm enables offset rotation into place.

Application example 2
Rotating the workpiece, or tightening the screw (applying a thrust load).
Handling Instructions and Precautions

General precautions

Media
1. Use air for the media. For the use of any other media, consult us.
2. Air used for the rotary actuator should be clean air that contains no deteriorated compressor oil, etc. Install an air filter (filtration of a minimum 40 µm) near the rotary actuator or valve to remove collected liquid or dust. In addition, drain the air filter periodically.

Piping
1. In piping connection with the rotary actuators, flush the tube completely (by blowing compressed air) before piping. Intrusion of machining chips, sealing tape, rust, etc., generated during plumbing could result in air leaks and other defective operations.
2. When screwing in piping or fittings to the actuator, tighten to the appropriate tightening torque shown below.

<table>
<thead>
<tr>
<th>Connecting thread</th>
<th>Tightening torque N·cm [in·lbf]</th>
</tr>
</thead>
<tbody>
<tr>
<td>M5×0.8</td>
<td>157 [13.9]</td>
</tr>
</tbody>
</table>

Lubrication
The product can be used without lubrication, if lubrication is required, use Turbine Oil Class 1 (ISO VG32) or equivalent. Avoid using spindle oil or machine oil.

Atmosphere
When using in locations subject to dripping water, dripping oil, etc., use a cover to protect the unit.

Start-up
When starting up operations of a device and the rotary actuator by supplying compressed air rapidly, it could not control the speed due to the construction of the rotary actuator, resulting in damage to the device and rotary actuator. When supplying compressed air to the device and rotary actuator where the air has been exhausted, always ensure that the table is in a secure position and cannot be moved further, paying attention to safety, and then apply air pressure from the connection port of not making move the table, first. For the piping port location and swing direction, see p.1320.
Mounting

1. The mounting surface should be always flat. Twisting or bending during the mounting could result in air leaks or improper operation.
2. Care should be taken that scratches or dents on the rotary actuator's mounting surface may damage its flatness.
3. Take some locking measures when shocks or vibrations might loosen the bolts.
4. For a workpiece mounting, female threads are available for installing the workpiece in place on the table. Always use bolts so that the screw length is less than the depth of the female thread. When mounting the workpiece, tighten the bolts within the range of the tightening torque.
5. Do not let machining chips or dust enter the product through mounting threads in the table-top surface. Machining chips or dust adhering to the internal bearings could lead to defective operation.
6. The rotary actuator RAG series can be mounted in either of the ways shown below. When mounting, ensure that the tightening torque is within the range of allowable torque.

<table>
<thead>
<tr>
<th>Model</th>
<th>Thread size</th>
<th>Thread depth L mm [in.]</th>
<th>Max. tightening torque N·m [ft-lbf]</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAG-1</td>
<td>M4×0.7</td>
<td>6 [0.236]</td>
<td>2.7 [2.0]</td>
</tr>
<tr>
<td>RAG-3</td>
<td>M5×0.8</td>
<td>8 [0.315]</td>
<td>5.4 [4.0]</td>
</tr>
</tbody>
</table>

Caution: When using bolts to mount a workpiece in place on the table, hold either the table or workpiece in place during the operation. Holding the body for tightening will apply excessive moment to the stopper, rubber stopper, and shock absorber, resulting in a change of angle.

<table>
<thead>
<tr>
<th>Model</th>
<th>Mounting method</th>
<th>Thread size</th>
<th>Maximum tightening torque N·m [ft-lbf]</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAG-1</td>
<td>Through hole (pattern A)</td>
<td>M3×0.5</td>
<td>1.14 [0.84]</td>
</tr>
<tr>
<td></td>
<td>Through hole (pattern B)</td>
<td>M4×0.7</td>
<td>2.7 [2.0]</td>
</tr>
<tr>
<td></td>
<td>Main body tapped hole</td>
<td>M4×0.7</td>
<td>1.5 [1.1]</td>
</tr>
<tr>
<td>RAG-3</td>
<td>Through hole (pattern A)</td>
<td>M4×0.7</td>
<td>1.5 [1.1]</td>
</tr>
<tr>
<td></td>
<td>Through hole (pattern B)</td>
<td>M5×0.8</td>
<td>5.4 [4.0]</td>
</tr>
<tr>
<td></td>
<td>Main body tapped hole</td>
<td>M5×0.8</td>
<td>3.0 [2.2]</td>
</tr>
<tr>
<td>RAG-8</td>
<td>Through hole (pattern A)</td>
<td>M5×0.8</td>
<td>5.4 [4.0]</td>
</tr>
<tr>
<td></td>
<td>Through hole (pattern B)</td>
<td>M6×1.0</td>
<td>9.2 [6.8]</td>
</tr>
<tr>
<td></td>
<td>Main body tapped hole</td>
<td>M6×1.0</td>
<td>5.2 [3.8]</td>
</tr>
<tr>
<td>RAG-20</td>
<td>Through hole (pattern A)</td>
<td>M5×0.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Through hole (pattern B)</td>
<td>M6×1.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Main body tapped hole</td>
<td>M6×1.0</td>
<td></td>
</tr>
</tbody>
</table>
**Rubber stopper and shock absorber replacement instructions**

1. When replacing the rubber stopper or shock absorber, refer to the Swing Angle Range and Swing Direction on p.1320 to perform mounting. If the stopper under the table is not in the correct position, it could result in incorrect swing angle or damage. Moreover, never use the rotary actuator with the rubber stopper or shock absorber removed. As noted above, it could lead to incorrect swing angle and will be unable to absorb kinetic energy, resulting in damage to the rotary actuator.

2. Loosen and remove the mounting nut of the rubber stopper or shock absorber. Screw the new rubber stopper or shock absorber into the proper position, and then tighten the mounting nut and secure it in place. When tightening the nut, ensure that the tightening torque is within the range of setting values.

**Swing angle adjustment**

1. The rotary actuators RAG series uses rubber stoppers or shock absorbers for angle adjustment, in the ranges shown on p.1320. For both clockwise and counterclockwise rotation, rotating the rubber stopper or shock absorber to the right (clockwise) will reduce the swing angle. After completing angle adjustment, tighten the nut and secure the rubber stopper or shock absorber in place.

2. Always keep the swing angle within the specified range for use. For the shock absorber, in particular, when the angle between the applied load direction and the center line of the shock absorber exceeds the allowable angle variation, the product could be damaged.

3. The rubber stoppers or shock absorbers are only temporarily tightened at shipping. For actual use, always tighten the nuts to secure the rubber stoppers or shock absorbers in place.

4. When tightening the nut, ensure that the tightening torque is within the range shown below.

<table>
<thead>
<tr>
<th>Model</th>
<th>Nut size</th>
<th>Maximum tightening torque N·m [ft·lb]</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAG 1</td>
<td>M6×0.75</td>
<td>0.85 [0.63]</td>
</tr>
<tr>
<td>RAG 3</td>
<td>M8×0.75</td>
<td>2.45 [1.81]</td>
</tr>
<tr>
<td>RAG 8</td>
<td>M10×1.0</td>
<td>6.37 [4.70]</td>
</tr>
</tbody>
</table>

**Air Consumption**

Air consumption per 1 cycle of the rotary actuator can be found by the following equation.

\[
Q = 2 \times V \times 10^{-3} \times \frac{P + 0.1013}{0.1013}
\]

\[
Q : \text{Air consumption per cycle [liters/cycle (ANR)]}
\]

\[
V : \text{Internal volume \ (cm}^3\text{)}
\]

\[
P : \text{Air pressure \ (MPa)}
\]

<table>
<thead>
<tr>
<th>Model</th>
<th>Internal volume \ 90° \ cm$^3$</th>
<th>Internal volume \ 180° \ cm$^3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAG 1</td>
<td>1.4 [0.085]</td>
<td>1.7 [0.104]</td>
</tr>
<tr>
<td>RAG 3</td>
<td>3.0 [0.183]</td>
<td>3.8 [0.232]</td>
</tr>
<tr>
<td>RAG 8</td>
<td>7.4 [0.451]</td>
<td>9.2 [0.561]</td>
</tr>
<tr>
<td>RAG 20</td>
<td>18.1 [1.104]</td>
<td>22.7 [1.385]</td>
</tr>
</tbody>
</table>
Handling Instructions and Precautions

**Allowable load**

<table>
<thead>
<tr>
<th>Item</th>
<th>Model</th>
<th>RAG 1</th>
<th>RAG 3</th>
<th>RAG 8</th>
<th>RAG 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allowable thrust load ( \text{Ws} ) [lbf]</td>
<td>20[4.5]</td>
<td>60[13.5]</td>
<td>120[27.0]</td>
<td>160[36.0]</td>
<td></td>
</tr>
<tr>
<td>Allowable radial load ( \text{Wn} ) [lbf]</td>
<td>20[4.5]</td>
<td>80[18.0]</td>
<td>120[27.0]</td>
<td>120[27.0]</td>
<td></td>
</tr>
<tr>
<td>Allowable moment ( M ) [N·m [ft·lbf]]</td>
<td>0.4[0.30]</td>
<td>0.9[0.66]</td>
<td>1.3[0.96]</td>
<td>3.5[2.58]</td>
<td></td>
</tr>
</tbody>
</table>

**Effective torque**

- RAG 1
- RAG 3

**Table displacement caused by moment**

In the rotary actuators RAG series, mounting a plate and applying moment on it, and then measure the displacement at 100mm [3.94in.] position from the rotation center.

**Deflection accuracy: Table displacement on 180° swing**

Amount of deflection on the table-top surface

<table>
<thead>
<tr>
<th>Item</th>
<th>Model</th>
<th>RAG 1, 3, 8, 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of deflection on the table-top surface ( \text{mm [in.]} )</td>
<td>0.03 [0.0012]</td>
<td></td>
</tr>
<tr>
<td>Amount of deflection on the table-side surface ( \text{mm [in.]} )</td>
<td>0.03 [0.0012]</td>
<td></td>
</tr>
</tbody>
</table>

The above values are actual measurement values, and are not intended to be guaranteed values.
Selection

Caution: For the load and swing time, follow the below “Model selection procedure” to select within the range of specified values. Moreover, about 80% of the allowable values is recommended to use in applications. By using these values, adverse effects on cylinders and guides can be a minimum.

●Model selection procedure

1. Check the application conditions
   Check the following items ①～④
   ① Swing angle (90° or 180°)
   ② Swing time (s)
   ③ Applied pressure (MPa)
   ④ Workpiece shape and materials
   ⑤ Mounting direction

2. Check the swing time
   Check the swing time in 1—② is within the swing time adjustment range in the specification.

<table>
<thead>
<tr>
<th>Angle</th>
<th>Swing time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA2</td>
<td>0.05~0.25</td>
</tr>
<tr>
<td>RA3</td>
<td>0.05~0.4</td>
</tr>
<tr>
<td>RA6</td>
<td>0.05~0.5</td>
</tr>
<tr>
<td>RA8</td>
<td>0.06~0.6</td>
</tr>
<tr>
<td>RA10</td>
<td>0.1~0.5</td>
</tr>
<tr>
<td>RA11</td>
<td>0.1~0.8</td>
</tr>
<tr>
<td>RA12</td>
<td>0.1~1.0</td>
</tr>
<tr>
<td>RA13</td>
<td>0.12~1.2</td>
</tr>
</tbody>
</table>

Note: The swing time is obtained when using the rubber stopper with no load at 0.5MPa condition.

3. Select torque size (select model)
   Find the torque TA required for rotating the workpiece.

   \[ T_A = I \dot{\omega} K \]

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

   Use the equations on p.1311~1314 to find.

   \( \dot{\omega} \): Uniform angular acceleration (rad/s²)
   \( K \): Marginal coefficient 5
   \( \theta \): Swing angle (rad)
   \( 90° \sim 1.57\text{rad} \)
   \( 180° \sim 3.14\text{rad} \)
   \( t \): Swing time (s)

   Select the model secures the required torque TA by using the applied pressure checked in 1—③, from among the effective torque graph on p.1308.

4. Check the kinetic energy
   If kinetic energy exceeds the allowable energy, the actuator could be damaged. Always select a model so that the energy lies within the allowable energy range. When the kinetic energy is large, use a model with shock absorber (-SS2, -SSR, or -SSL). For the allowable kinetic energy, see Table 1.

   Find the kinetic energy.
   ● With rubber stopper

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

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

   Use the equations on p.1311~1314 to find.

   \( E \): Kinetic energy (J)
   \( I \): Mass moment of inertia (kg·m²)
   \( \omega \): Angular velocity (rad/s)
   \( \theta \): Swing angle (rad)
   \( 90° \sim 1.57\text{rad} \)
   \( 180° \sim 3.14\text{rad} \)
   \( t \): Swing time (s)
   \( E_a \): Allowable energy with rubber stopper

   ... See Table 1.

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

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

   Use the equations on p.1311~1314 to find.

   \( E' \): Kinetic energy [ft-lbf]
   \( I' \): Mass moment of inertia [lbf·ft·sec²]
   \( \omega \): Angular velocity [rad/sec.]
   \( \theta \): Swing angle [rad]
   \( 90° \sim 1.57\text{rad} \)
   \( 180° \sim 3.14\text{rad} \)
   \( t \): Swing time [sec.]
   \( E'a \): Allowable energy with rubber stopper

   ... See Table 1.

   ● Model selection procedure

   1. Check the application conditions
   Check the following items ①～④
   ① Swing angle (90° or 180°)
   ② Swing time (sec.)
   ③ Applied pressure [psi.]
   ④ Workpiece shape and materials
   ⑤ Mounting direction

   2. Check the swing time
   Check the swing time in 1—② is within the swing time adjustment range in the specification.

<table>
<thead>
<tr>
<th>Angle</th>
<th>Swing time (sec.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA2</td>
<td>0.05~0.25</td>
</tr>
<tr>
<td>RA3</td>
<td>0.05~0.4</td>
</tr>
<tr>
<td>RA6</td>
<td>0.05~0.5</td>
</tr>
<tr>
<td>RA8</td>
<td>0.06~0.6</td>
</tr>
<tr>
<td>RA10</td>
<td>0.1~0.5</td>
</tr>
<tr>
<td>RA11</td>
<td>0.1~0.8</td>
</tr>
<tr>
<td>RA12</td>
<td>0.1~1.0</td>
</tr>
<tr>
<td>RA13</td>
<td>0.12~1.2</td>
</tr>
</tbody>
</table>

Note: The swing time is obtained when using the rubber stopper with no load at 73psi. condition.

3. Select torque size (select model)
   Find the torque TA required for rotating the workpiece.

   \[ T_A = I \dot{\omega} K \]

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

   Use the equations on p.1311~1314 to find.

   \( \dot{\omega} \): Uniform angular acceleration [rad/sec²]
   \( K \): Marginal coefficient 5
   \( \theta \): Swing angle [rad]
   \( 90° \sim 1.57\text{rad} \)
   \( 180° \sim 3.14\text{rad} \)
   \( t \): Swing time [sec.]

   Select the model secures the required torque TA by using the applied pressure checked in 1—③, from among the effective torque graph on p.1308.

4. Check the kinetic energy
   If kinetic energy exceeds the allowable energy, the actuator could be damaged. Always select a model so that the energy lies within the allowable energy range. When the kinetic energy is large, use a model with shock absorber (-SS2, -SSR, or -SSL). For the allowable kinetic energy, see Table 1.

   Find the kinetic energy.
   ● With rubber stopper

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

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

   Use the equations on p.1311~1314 to find.

   \( E \): Kinetic energy (J)
   \( I \): Mass moment of inertia [lbf·ft·sec²]
   \( \omega \): Angular velocity [rad/sec.]
   \( \theta \): Swing angle [rad]
   \( 90° \sim 1.57\text{rad} \)
   \( 180° \sim 3.14\text{rad} \)
   \( t \): Swing time [sec.]
   \( E_a \): Allowable energy with rubber stopper

   ... See Table 1.
1. Find the equivalent mass \( m_1 \).

\[
m_1 = \frac{1}{R^2}
\]

2. Find the equivalent mass \( m_2 \).

\[
m_2 = \frac{2XTL}{R^3 + \omega^2}
\]

3. Find the total mass \( m \).

\[
m = m_1 + m_2
\]

4. Find the impact velocity.

\[
V = R \times \omega
\]

5. Find the kinetic energy.

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

6. Judgement whether the unit is usable or not

The unit is usable if it satisfies both 4. Kinetic energy and 5. Load ratio.

\[
E < E_a
\]

Total sum of load ratio \( \leq 1 \)

**Table 1. Allowable energy \( E_a \)**

<table>
<thead>
<tr>
<th>Model</th>
<th>Allowable energy with rubber stopper (J)</th>
<th>Allowable energy with shock absorber (J)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAG_1</td>
<td>0.003</td>
<td></td>
</tr>
<tr>
<td>RAG_3</td>
<td>0.005</td>
<td>0.30</td>
</tr>
<tr>
<td>RAG_8</td>
<td>0.008</td>
<td>0.53</td>
</tr>
<tr>
<td>RAG_20</td>
<td>0.030</td>
<td>1.14</td>
</tr>
</tbody>
</table>

**Fig. 1** R: Distance from the rotation center to the impact point

5. Check the load ratio

Check that the total sum of the load ratio does not exceed 1. For the allowable load, see Table 3 (For the load direction, see the allowable load on p.1308.)

\[
\frac{W_s}{W_{S\text{MAX}}} + \frac{W_r}{W_{R\text{MAX}}} + \frac{M}{M_{\text{MAX}}} \leq 1
\]

**Table 3. Allowable load**

<table>
<thead>
<tr>
<th>Model</th>
<th>Thrust load ( W_s \text{MAX} ) (N)</th>
<th>Radial load ( W_r \text{MAX} ) (N)</th>
<th>Moment ( M_{\text{MAX}} ) (N·m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAG_1</td>
<td>20</td>
<td>20</td>
<td>0.4</td>
</tr>
<tr>
<td>RAG_3</td>
<td>60</td>
<td>80</td>
<td>0.9</td>
</tr>
<tr>
<td>RAG_8</td>
<td>120</td>
<td>120</td>
<td>1.3</td>
</tr>
<tr>
<td>RAG_20</td>
<td>160</td>
<td>120</td>
<td>3.5</td>
</tr>
</tbody>
</table>

6. Judgement whether the unit is usable or not

The unit is usable if it satisfies both 4. Kinetic energy and 5. Load ratio.

\[
E < E_a
\]

Total sum of load ratio \( \leq 1 \)
Diagram for calculating mass moment of inertia
[When the rotation axis passes through the workpiece]

Disk

\[
I = \frac{md^2}{8}
\]

Remark: No particular mounting direction.
Consider separately for sliding use.

Stepped disk

\[
I = \frac{1}{8}\left(md_1^2+m_d^2\right)
\]

Remark: The d2 portion can be negligible when it is much smaller than the d1 portion.

Bar (when the rotation center passes through the edge)

\[
I = \frac{m\ell^2}{3}
\]

Remark: Mounting direction is horizontal.
If the mounting direction is vertical, the swing time will change.

Slender rod

\[
I = \frac{m_1\ell_1^2}{3} + \frac{m_2\ell_2^2}{3}
\]

Remark: Mounting direction is horizontal.
If the mounting direction is vertical, the swing time will change.
### Bar (when the rotation center passes through the center of gravity)

- **Bar length** \( \ell \) (m)
- **Mass** \( m \) (kg)
- **Mass moment of inertia** \( I \) (kg\( \cdot \)m²)
- **Rotating radius** \( \frac{\ell^2}{12} \)

\[
I = \frac{m \ell^2}{12}
\]

### Thin rectangular plate (rectangular solid)

- **Plate length** \( a_1 \) (m)
- **Length of side** \( a_2 \) (m)
- **Length of side** \( b \) (m)
- **Mass** \( m_1, m_2 \) (kg)
- **Mass moment of inertia** \( I \) (kg\( \cdot \)m²)
- **Rotating radius** \( \frac{\ell^2}{12} \)

\[
I = \frac{m_1 (4a_1^2 + b^2) + m_2 (4a_2^2 + b^2)}{12}
\]

### Rectangular parallelepiped

- **Length of sides** \( a \) (m)
- **Length of sides** \( b \) (m)
- **Mass** \( m \) (kg)
- **Mass moment of inertia** \( I \) (kg\( \cdot \)m²)
- **Rotating radius** \( \frac{a^2 + b^2}{12} \)

\[
I = \frac{m (a^2 + b^2)}{12}
\]
Selection

**Concentrated load**

- Shape of concentrated load
- Distance to center of gravity of concentrated load $\ell_1$ (m)
- Length of arm $\ell_2$ (m)
- Mass of concentrated load $m_1$ (kg)
- Mass of arm $m_2$ (kg)

**Mass moment of inertia** $I$ (kg·m²)

$$I = m_1 r^2 + m_2 (\frac{\ell_2}{2})^2$$

Rotating radius: $r$ is calculated according to shape of the concentrated load.

Remark: Mounting direction is horizontal. When $m_2$ is much smaller than $m_1$, calculate as $m_2 = 0$.

**Concentrated load**

- Shape of concentrated load
- Distance to center of gravity of concentrated load $\ell_1$ (ft.)
- Length of arm $\ell_2$ (ft.)
- Weight of concentrated load $w_1$ (lbf.)
- Weight of arm $w_2$ (lbf.)

**Mass moment of inertia** $I$ (lbf·ft·sec²)

$$I = \frac{w_1 \ell_2^2}{32.2} + \frac{w_2 \ell_2^2}{32.2}$$

Rotating radius: $r$ is calculated according to shape of the concentrated load.

Remark: Mounting direction is horizontal. When $w_2$ is much smaller than $w_1$, calculate as $w_2 = 0$.

**Gear**

Equation for calculating the load $J_L$ with respect to rotary actuator axis when transmitted by gears

- Gear Rotary actuator side $a$
  - Load side $b$
  - Inertia moment of load $N\cdot m$

**Mass moment of inertia** $I_a$ (kg·m²)

$$I_a = \left(\frac{a}{b}\right)^2 I_b$$

Remark: If the shapes of the gears are too large, the mass moment of inertia of the gears must be also taken into consideration.
[When the rotation axis is offset from the workpiece]

**Rectangular parallelepiped**
- Length of side: \( h \) (m)
- Distance from rotation axis to the center of load: \( L \) (m)
- Mass: \( m \) (kg)
- Mass moment of inertia \( I \) (kg·m²)
  \[
  I = \frac{m h^2}{12} + mL^2
  \]

**Hollow rectangular parallelepiped**
- Length of side: \( h_1 \) (m), \( h_2 \) (m)
- Distance from rotation axis to the center of load: \( L \) (m)
- Mass: \( m \) (kg)
- Mass moment of inertia \( I \) (kg·m²)
  \[
  I = \frac{m}{12} (h_2^2 + h_1^2) + mL^2
  \]

**Circular cylinder**
- Diameter: \( d \) (m)
- Distance from rotation axis to the center of load: \( L \) (m)
- Mass: \( m \) (kg)
- Mass moment of inertia \( I \) (kg·m²)
  \[
  I = \frac{md^2}{16} + mL^2
  \]

**Hollow circular cylinder**
- Diameter: \( d_1 \) (m), \( d_2 \) (m)
- Distance from rotation axis to the center of load: \( L \) (m)
- Mass: \( m \) (kg)
- Mass moment of inertia \( I \) (kg·m²)
  \[
  I = \frac{m}{16} (d_2^2 + d_1^2) + mL^2
  \]

Remark: Same for cube.

Remark: Cross-section is square only.

Remark: Same for cube.
1. Check the application conditions
   ① Swing angle: 90°
   ② Swing time: 0.4 [sec.]
   ③ Applied pressure: 73 [psi.]
   ④ Workpiece shape: Shown in the above
   Workpiece material
   Rectangular plate: Aluminum alloy (Specific gravity = 2.68 \times 10^3 \text{ kg/m}^3)
   Cube: Steel (Specific gravity = 7.85 \times 10^3 \text{ kg/m}^3)
   ⑤ Mounting direction: Horizontal

2. Check the swing time
   The swing time is 0.5 sec./90°, which means there is no problem in the models larger than RAG_3.

3. Select torque size
   Firstly calculate the mass moment of inertia.

   Rectangular plate
   \[
   m_1=0.05 \times (0.12-0.025) \times 0.01 \times 2.68 \times 10^3 = 0.127 \text{ (kg)}
   \]
   \[
   m_2=0.05 \times 0.025 \times 0.01 \times 2.68 \times 10^3 = 0.034 \text{ (kg)}
   \]
   \[
   I_1=\frac{0.127}{12} \left(4 \times (0.12-0.025)^2+0.05^2\right)+\frac{0.034}{12} \left(4 \times 0.025^2+0.05^2\right)
   \]
   \[
   =0.42 \times 10^{-3} \text{ (kg} \cdot \text{m}^2)\]  

   Cube
   \[
   m_3=0.05 \times 0.05 \times 0.05 \times 7.85 \times 10^3 = 0.981 \text{ (kg)}
   \]
   \[
   I_2=\frac{0.981 \times 0.05^2}{12}+0.981 \times 0.07^2
   \]
   \[
   =5.01 \times 10^{-3} \text{ (kg} \cdot \text{m}^2)\]  

   From ① and ②, the total mass moment of inertia \( I = I_1+I_2 \) is
   \[
   =0.42 \times 10^{-3}+5.01 \times 10^{-3}
   \]
   \[
   =5.43 \times 10^{-3} \text{ (kg} \cdot \text{m}^2)\]  

   According to the given conditions, \( \theta = 90°, t = 0.4 \text{ (s)} \), therefore, the uniform angular acceleration \( \dot{\omega} \) is
   \[
   \dot{\omega} = \frac{2 \times 1.57}{0.4^2} = 19.625 \text{ (rad/s}^2)\]  

   From ③ and ④, the required torque \( T_\alpha \) is
   \[
   T_\alpha=5.43 \times 10^{-3} \times 19.625 \times 5
   \]
   \[
   =0.533 \text{ (N} \cdot \text{m)\]  

   From the Effective torque graph on p.1308, select a model where the torque is more than 0.533 (N\cdot m) at 0.5 MPa.
4. Check the kinetic energy
With rubber stopper
According to the given conditions, $\dot{q}=90^\circ$, $t=0.4\text{ (s)}$ therefore,
$$\omega = \frac{2 \times 1.57}{0.4} = 7.85 \text{ (rad/s)} \cdots \text{(1)}$$
From (1), the kinetic energy $E$ is
$$E = \frac{1}{2} \times 5.43 \times 10^{-3} \times 7.85^2 = 0.167 \text{ (J)} \cdots \text{(2)}$$
0.167 > 0.008, which means the rubber stopper is not sufficient. Therefore, recalculate a case with shock absorber.

With shock absorber
$$w_1 = \frac{2 \times 0.785 \times 0.005}{0.018^3 \times 7.85^2} = 21.84 \text{ (kg)} \cdots \text{(3)}$$
$$m_2 = \frac{2 \times 0.785 \times 0.005}{0.018^3 \times 7.85^2} = 21.84 \text{ (kg)} \cdots \text{(4)}$$
From (3) and (4),
$$m = 16.76 + 21.84 = 38.60 \text{ (kg)} \cdots \text{(5)}$$
$$V = 0.018 \times 7.85 = 0.141 \cdots \text{(6)}$$
From (5) and (6), find the kinetic energy.
$$E = \frac{1}{2} \times 38.6 \times 0.141^2 = 0.384 \text{ (J)}$$
0.384 < 0.53, which means there is no problem in the application with shock absorber.

5. Check the load ratio
[Thrust load]
The total weight is
$$0.034 + 0.127 + 0.981 = 1.142 \text{ (kg)}$$
Therefore,
$$W_S = 1.142 \times 9.8 = 11.192 \text{ (N)} \cdots \text{(1)}$$

[Radial load]
Since no radial load is applied,
$$W_R = 0 \text{ (N)} \cdots \text{(2)}$$

[Moment]
The moment $M_1$ by the rectangular plate is
$$M_1 = (0.034 + 0.127) \times 9.8 \times \frac{0.12 - 0.025}{2} = 0.055 \text{ (N}\cdot\text{m}) \cdots \text{(3)}$$
The moment $M_2$ by the cube is
$$M_2 = 0.981 \times 9.8 \times 0.07 = 0.673 \text{ (N}\cdot\text{m}) \cdots \text{(4)}$$
From (3) and (4), the total moment is
$$M = 0.055 + 0.673 = 0.728 \text{ (N}\cdot\text{m}) \cdots \text{(5)}$$
From (1), (2), and (5), find the load ratio
$$\frac{W_S}{W_{S_{\text{MAX}}}} + \frac{W_R}{W_{R_{\text{MAX}}}} + \frac{M}{M_{\text{MAX}}} = \frac{11.192}{120} + \frac{0}{100} + \frac{0.728}{1.3} = 0.65 < 1.0$$
the load ratio is less than 1.0, and satisfactory.

6. Check the unit specifications
Selection of RAG 8-90-SS2 satisfies both the kinetic energy and load ratio requirements.
## Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation type</td>
<td>RAG-1</td>
</tr>
<tr>
<td>Effective torque</td>
<td>N·m [ft·lbf]</td>
</tr>
<tr>
<td>Media</td>
<td>Air</td>
</tr>
<tr>
<td>Operating pressure with rubber stopper</td>
<td>MPa [psi.]</td>
</tr>
<tr>
<td>Operating pressure with shock absorber</td>
<td></td>
</tr>
<tr>
<td>Cushion with rubber stopper</td>
<td></td>
</tr>
<tr>
<td>Cushion with shock absorber</td>
<td></td>
</tr>
<tr>
<td>Swing angle range 90° type</td>
<td></td>
</tr>
<tr>
<td>Swing angle range 180° type</td>
<td></td>
</tr>
<tr>
<td>Swing angle adjustment range</td>
<td></td>
</tr>
<tr>
<td>Swing time adjustment range</td>
<td></td>
</tr>
<tr>
<td>Allowable energy J [ft·lbf]</td>
<td></td>
</tr>
<tr>
<td>Allowable thrust load N [lbf]</td>
<td></td>
</tr>
<tr>
<td>Allowable radial load N [lbf]</td>
<td></td>
</tr>
<tr>
<td>Allowable moment</td>
<td></td>
</tr>
<tr>
<td>Deflection accuracy mm [in.]</td>
<td>Table-top surface</td>
</tr>
<tr>
<td>Lubrication</td>
<td></td>
</tr>
<tr>
<td>Port size</td>
<td></td>
</tr>
</tbody>
</table>

### Notes:
1. Effective torque is the value when the operating pressure is 0.5 MPa [73 psi].
2. For the swing end position, see p.1320.
3. The swing time adjustment range is the value by using the rubber stopper option, with no load at air pressure of 0.5 MPa [73 psi]. (reference value)
4. The deflection accuracy is an actual measurement value, and is not intended to be a guaranteed value.

## Shock Absorber Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicable model</td>
<td>RAG-3</td>
</tr>
<tr>
<td>Maximum absorption J [ft·lbf]</td>
<td>1.0 [0.74]</td>
</tr>
<tr>
<td>Absorption stroke mm [in.]</td>
<td>5 [0.20]</td>
</tr>
<tr>
<td>Maximum operating frequency cycle/min</td>
<td>60</td>
</tr>
<tr>
<td>Maximum impact speed mm/s [in./sec.]</td>
<td>300 [11.8]</td>
</tr>
<tr>
<td>Angle variation</td>
<td>8° or less</td>
</tr>
<tr>
<td>Operating temperature range °C [°F]</td>
<td>0 ~ 60 [32 ~ 140]</td>
</tr>
</tbody>
</table>

### Caution:
Even if the application is within the shock absorber absorption range, follow also within the rotary actuator RAG series swing time adjustment and allowable energy range.

### Remarks:
1. Do not loosen or remove the small screw on the rear end of the shock absorber. The oil inside will leak out which will fail the function of the shock absorber.
2. The life of the shock absorber may vary from the rotary actuator RAG series depending on its operating conditions.
Order Codes

RAG

- - - - -

Number of sensor switches
1: With 1 sensor switch
2: With 2 sensor switches

Lead wire length
A: 1000mm [39 in.]
B: 3000mm [118 in.]

Sensor switch
Blank: No sensor switch
ZE101: Reed switch type, without indicator lamp
ZE102: Reed switch type, with indicator lamp
ZE201: Reed switch type, without indicator lamp
ZE202: Reed switch type, with indicator lamp
ZE135: 2-lead wires solid state type, with indicator lamp
ZE155: 3-lead wires solid state type, with indicator lamp
ZE235: 2-lead wires solid state type, with indicator lamp
ZE255: 3-lead wires solid state type, with indicator lamp

\*For details of sensor switches, see p.1325.

Angle adjustment
Blank: With rubber stoppers on both sides
SS2: With shock absorbers on both sides
SSR: With shock absorber on the right side (Clockwise rotation end side)
SSL: With shock absorber on the left side (Counterclockwise rotation end side)

Note 3: Figure 1

Nominal torque
1: 0.118N\cdot m [0.087 ft\cdot lb]
3: 0.294N\cdot m [0.217 ft\cdot lb]
8: 0.785N\cdot m [0.579 ft\cdot lb]
20: 1.96N\cdot m [1.45 ft\cdot lb]

Magnet
Blank: No magnet
S: With magnet

Basic model
Rotary actuator RAG series

Additional Parts

- Rubber stopper

CRK

- - - - -

570: For RAG 1-90
588: For RAG 3-90 and RAG 8-90
589: For RAG 20-90

- Shock absorber

KSHAR

- - - - -

5X5-D: For RAG 3-90
5X5-E: For RAG 8-90
6X8-F: For RAG 20-90

Remark: The shock absorber or rubber stopper comes as a set consisting of its body and 1 mounting nut.

Mass

<table>
<thead>
<tr>
<th>Model</th>
<th>Mass [g]</th>
<th>With magnet [g]</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAG 3-90</td>
<td>451 [15.91]</td>
<td>453 [15.98]</td>
</tr>
<tr>
<td>RAG 3-90-SS2</td>
<td>451 [15.91]</td>
<td>453 [15.98]</td>
</tr>
<tr>
<td>RAG 3-90-SSR(L)</td>
<td>451 [15.91]</td>
<td>453 [15.98]</td>
</tr>
<tr>
<td>RAG 3-180</td>
<td>448 [15.80]</td>
<td>449 [15.84]</td>
</tr>
<tr>
<td>RAG 3-180-SS2</td>
<td>448 [15.80]</td>
<td>449 [15.84]</td>
</tr>
<tr>
<td>RAG 3-180-SSR(L)</td>
<td>448 [15.80]</td>
<td>449 [15.84]</td>
</tr>
<tr>
<td>RAG 8-90</td>
<td>641 [22.61]</td>
<td>643 [22.68]</td>
</tr>
<tr>
<td>RAG 8-90-SS2</td>
<td>641 [22.61]</td>
<td>643 [22.68]</td>
</tr>
<tr>
<td>RAG 8-90-SSR(L)</td>
<td>641 [22.61]</td>
<td>643 [22.68]</td>
</tr>
<tr>
<td>RAG 8-180</td>
<td>638 [22.50]</td>
<td>639 [22.54]</td>
</tr>
<tr>
<td>RAG 8-180-SS2</td>
<td>638 [22.50]</td>
<td>639 [22.54]</td>
</tr>
<tr>
<td>RAG 8-180-SSR(L)</td>
<td>638 [22.50]</td>
<td>639 [22.54]</td>
</tr>
<tr>
<td>RAG 20-90-SS2</td>
<td>1030 [36.33]</td>
<td>1032 [36.40]</td>
</tr>
<tr>
<td>RAG 20-90-SSR(L)</td>
<td>1028 [36.32]</td>
<td>1030 [36.33]</td>
</tr>
<tr>
<td>RAG 20-180</td>
<td>1022 [36.05]</td>
<td>1023 [36.08]</td>
</tr>
<tr>
<td>RAG 20-180-SSR(L)</td>
<td>1024 [36.12]</td>
<td>1025 [36.16]</td>
</tr>
</tbody>
</table>

CRK570 4 [0.14]
CRK588 10 [0.35]
CRK589 20 [0.71]
KSHARS×5-D 10 [0.35]
KSHARS×5-E 10 [0.35]
KSHARS×8-F 22 [0.78]

Sensor switch

<table>
<thead>
<tr>
<th>One sensor switch</th>
<th>Lead wire length A [mm]</th>
<th>Lead wire length B [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>15 [0.59]</td>
<td>35 [1.38]</td>
</tr>
</tbody>
</table>
### Major Parts and Materials

<table>
<thead>
<tr>
<th>No.</th>
<th>Parts</th>
<th>Materials</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Body</td>
<td>Aluminum alloy (anodized)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Table</td>
<td>Stainless steel</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Nut</td>
<td>Aluminum alloy (anodized)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Cover</td>
<td>Aluminum alloy (anodized)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Bracket</td>
<td>Stainless steel</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Stopper</td>
<td>Special steel</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Bearing</td>
<td>Steel</td>
<td>RAG[1]: Special bearing RAG[3)--[20]: Angular bearing</td>
</tr>
<tr>
<td>8</td>
<td>Bolt</td>
<td>Stainless steel</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Adjusting bolt</td>
<td>Steel (nickel plated)</td>
<td>Applied only for -SS[]</td>
</tr>
<tr>
<td>10</td>
<td>Bumper</td>
<td>Synthetic rubber (NBR)</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Hexagon nut</td>
<td>Mild steel (zinc plated)</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Shock absorber</td>
<td>—</td>
<td>Applied only for RAG[]</td>
</tr>
<tr>
<td>13</td>
<td>Magnet holder</td>
<td>Aluminum alloy (anodized)</td>
<td>Applied only for RAG[]</td>
</tr>
<tr>
<td>14</td>
<td>Magnet</td>
<td>Plastic magnet</td>
<td>Applied only for RAG[]</td>
</tr>
<tr>
<td>15</td>
<td>Body A</td>
<td>Aluminum alloy (anodized)</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Body B</td>
<td>Aluminum alloy (anodized)</td>
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</tr>
<tr>
<td>17</td>
<td>Vane axis (shaft portion)</td>
<td>Steel (nitrided)</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Vane axis (rotor portion)</td>
<td>Molded plastic</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Vane axis (sealing portion)</td>
<td>Synthetic rubber (NBR)</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Shoe seal</td>
<td>Synthetic rubber (NBR)</td>
<td></td>
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<tr>
<td>21</td>
<td>Shoe</td>
<td>Molded plastic</td>
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</tr>
<tr>
<td>22</td>
<td>Bearing</td>
<td>Sintered oil impregnated alloy</td>
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</tr>
<tr>
<td>23</td>
<td>O-ring</td>
<td>Synthetic rubber (NBR)</td>
<td></td>
</tr>
</tbody>
</table>
Swing Angle Range and Swing Direction

\textbf{90° type}

- Angle adjustment range $\pm 5^\circ$ by adjusting bolt C (shock absorber C)

\textbf{180° type}

- Angle adjustment range $\pm 5^\circ$ by adjusting bolt C (shock absorber C)

Remark: The diagrams show when air is supplied to connection port A for the clockwise rotation, and the table has completed the rotation in the clockwise direction (0° position).
Dimensions of Shock Absorber mm [in.]

<table>
<thead>
<tr>
<th>Model</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
<th>Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>KSHAR5×5—D</td>
<td>M8×0.75</td>
<td>5[0.197]</td>
<td>46[1.811]</td>
<td>4[0.157]</td>
<td>3[0.118]</td>
<td>50[1.969]</td>
<td>7[0.276]</td>
<td>1.2[0.047]</td>
<td>2[0.079]</td>
<td>10[0.394]</td>
<td>1.5[0.059]</td>
<td>10[0.394]</td>
<td></td>
</tr>
<tr>
<td>KSHAR5×5—E</td>
<td>M8×0.75</td>
<td>5[0.197]</td>
<td>46[1.811]</td>
<td>4[0.157]</td>
<td>3[0.118]</td>
<td>50[1.969]</td>
<td>7[0.276]</td>
<td>1.2[0.047]</td>
<td>2[0.079]</td>
<td>10[0.394]</td>
<td>1.5[0.059]</td>
<td>10[0.394]</td>
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</tr>
<tr>
<td>KSHAR6×8—F</td>
<td>M10×1</td>
<td>8[0.315]</td>
<td>6[0.240]</td>
<td>45[1.772]</td>
<td>8[0.315]</td>
<td>4[0.157]</td>
<td>9[0.354]</td>
<td>2[0.079]</td>
<td>3[0.118]</td>
<td>12[0.472]</td>
<td>13[0.547]</td>
<td>8[0.315]</td>
<td></td>
</tr>
</tbody>
</table>

Remark: The drawings show when air is supplied to the connection port for the clockwise rotation, and the table has completed the rotation in the clockwise direction (0° position).
Dimensions mm [in.]

Remark: The drawings show when air is supplied to the connection port for the clockwise rotation, and the table has completed the rotation in the clockwise direction (0° position).

ROTARY ACTUATORS VANE TYPE RAG SERIES
Remark: The drawings show when air is supplied to the connection port for the clockwise rotation, and the table has completed the rotation in the clockwise direction (0° position).
Remark: The drawings show when air is supplied to the connection port for the clockwise rotation, and the table has completed the rotation in the clockwise direction (0° position).
## Order Codes

### RAGS

<table>
<thead>
<tr>
<th>Sensor switch</th>
<th>Lead wire length</th>
<th>Series</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ZE135</strong></td>
<td>1000mm [39in.]</td>
<td>RAGS</td>
</tr>
<tr>
<td><strong>ZE235</strong></td>
<td>1000mm [39in.]</td>
<td>RAGS</td>
</tr>
<tr>
<td><strong>ZE101</strong></td>
<td>3000mm [118in.]</td>
<td>RAGS</td>
</tr>
<tr>
<td><strong>ZE201</strong></td>
<td>3000mm [118in.]</td>
<td>RAGS</td>
</tr>
</tbody>
</table>

- **Solid state type**
- **Reed switch type**
- **with indicator lamp**
- **without indicator lamp**

- **DC10~28V**
- **DC4.5~28V**
- **DC5~28V**
- **DC10~28V**
- **AC85~115V**
- **AC85~115V**

### Lead wire length

- A: 1000mm [39in.]
- B: 3000mm [118in.]

For details of sensor switches, see p.1544.
Moving Sensor Switch

- Loosening the mounting screw allows the sensor switch to be moved along the switch mounting groove on the rotary actuator.
- Tighten the mounting screw with a tightening torque of 0.1 ~ 0.2N•m [0.9 ~ 1.8in-lbf].

When Mounting the Actuators with Sensor Switches in Close Proximity

When mounting the actuators in close proximity, use them at the values shown in the table below, or larger.

<table>
<thead>
<tr>
<th>Item</th>
<th>Model</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating range: £</td>
<td>RAGS1</td>
<td>6°~10°</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RAGS3</td>
<td>5°~9°</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RAGS8</td>
<td>5°~9°</td>
<td>4°~8°</td>
</tr>
<tr>
<td></td>
<td>RAGS20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response differential: C</td>
<td></td>
<td>0.5° or less</td>
<td></td>
</tr>
<tr>
<td>Maximum sensing location [mm]</td>
<td>6mm [0.236in.]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Remark: The above table shows reference values.
Note: This is the length measured from the switch’s opposite end side to the lead wire.

<table>
<thead>
<tr>
<th>Item</th>
<th>Model</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating range: £</td>
<td>RAGS1</td>
<td>13°~20°</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RAGS3</td>
<td>12°~18°</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RAGS8</td>
<td>11°~17°</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RAGS20</td>
<td>8°~15°</td>
<td></td>
</tr>
<tr>
<td>Response differential: C</td>
<td></td>
<td>3° or less</td>
<td></td>
</tr>
<tr>
<td>Maximum sensing location [mm]</td>
<td>10mm [0.394in.]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Remark: The above table shows reference values.
Note: This is the length measured from the switch’s opposite end side to the lead wire.

Sensor Switch Operating Range, Response Differential, and Maximum Sensing Location

- Operating range: £
  Refers to the range of angles as the magnet moves with the vane to switch ON the sensor, and as the magnet moves further in the same direction until the sensor goes OFF again.

- Response Differential: C
  Refers to the angle between the point where the sensor is switched ON as the magnet moves with the vane, and the point where the sensor is turned OFF as the magnet moves in the opposite direction.

<table>
<thead>
<tr>
<th>Solid State Type</th>
<th>Model</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating range: £</td>
<td>RAGS1</td>
<td>52 [2.047]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RAGS3</td>
<td>58 [2.283]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RAGS8</td>
<td>66 [2.598]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RAGS20</td>
<td>76 [2.992]</td>
<td></td>
</tr>
<tr>
<td>Response differential: C</td>
<td></td>
<td>0.5° or less</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reed Switch Type</th>
<th>Model</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating range: £</td>
<td>RAGS1</td>
<td>50 [1.969]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RAGS3</td>
<td>56 [2.205]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RAGS8</td>
<td>66 [2.598]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RAGS20</td>
<td>76 [2.992]</td>
<td></td>
</tr>
<tr>
<td>Response differential: C</td>
<td></td>
<td>3° or less</td>
<td></td>
</tr>
</tbody>
</table>

Remark: The above table shows reference values.
Note: This is the length measured from the switch’s opposite end side to the lead wire.
## Mounting Location of Swing End Detection Sensor Switch

![Diagram of sensor switch with labels A (0° position) and B (90° or 180° position)]

Remark: For the table’s 0°, 90°, and 180° positions, see p.1320.

### Solid State Type

<table>
<thead>
<tr>
<th>Model</th>
<th>90° and 180° types</th>
<th>mm [in.]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>RAGS1</td>
<td>13 [0.512]</td>
<td></td>
</tr>
<tr>
<td>RAGS3</td>
<td>16 [0.630]</td>
<td></td>
</tr>
<tr>
<td>RAGS8</td>
<td>19 [0.748]</td>
<td></td>
</tr>
<tr>
<td>RAGS20</td>
<td>23 [0.906]</td>
<td></td>
</tr>
</tbody>
</table>

### Reed Switch Type

<table>
<thead>
<tr>
<th>Model</th>
<th>90° and 180° types</th>
<th>mm [in.]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>RAGS1</td>
<td>9 [0.354]</td>
<td></td>
</tr>
<tr>
<td>RAGS3</td>
<td>12 [0.472]</td>
<td></td>
</tr>
<tr>
<td>RAGS8</td>
<td>15 [0.591]</td>
<td></td>
</tr>
<tr>
<td>RAGS20</td>
<td>19 [0.748]</td>
<td></td>
</tr>
</tbody>
</table>