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Caution Before use, be sure to read the “Safety Precautions” on p. 57.
Air-operated index table
An air signal and ratchet mechanism ensure that the table rotates at a fixed angle and fixed direction. For operation principles, see p.1331.

Thin, lightweight, compact, and high torque
1.0N·m (0.74ft·lbf) (At operating air pressure 0.5MPa (73psi))

10 times increase of allowable energy
(Compared to the previous model)

Sensor switch for operations check is optional.

Locating dowel pin holes placed on the top of the table and bottom of the body
Two rotation directions:  
Rotation to the right (clockwise),  
Rotation to the left (counterclockwise)  

Note: Will not rotate in reverse direction.  
Three rotation angles: 45°, 60° and 90°

Application example
- Change the orientation of the circuit board and perform soldering.  
  (In combination with Creseed soldering unit)

Indexing table for automatic assembly
- Drilling holes
- Assembling parts
- Soldering
- Loading and unloading
## Operation Principles

Rotary Stage uses air signal and ratchet mechanism to ensure that the table rotates at a fixed angle and fixed direction.

### Process

1. **Completion of table rotation**
   - **Table operation**
     - Table in secured condition.
   - **Ratchet mechanism operation**
     - Knock plate pushes on stopper A to secure the gear in place.
     - Ratchet secures the gear in place.
   - **Piston portion operation**
     - Piston moves to the end of piston rotation side.

2. **Start of piston return**
   - **Table operation**
     - Table in secured condition.
   - **Ratchet mechanism operation**
     - Stopper A secures the gear in place.
     - Ratchet releases the gear, and rotates along with the knock plate.
   - **Piston portion operation**
     - Movement of the piston starts in piston return side.

3. **Completion of piston return**
   - **Table operation**
     - Table in secured condition.
   - **Ratchet mechanism operation**
     - Stopper A secures the gear in place.
     - Ratchet releases the gear.
   - **Piston portion operation**
     - Piston moves to the end of piston return side.

4. **Start of table rotation**
   - **Table operation**
     - Table links with piston portion and rotates.
   - **Ratchet mechanism operation**
     - Ratchet uses stopper B to release stopper A from the gear.
     - Ratchet secures gear in place, and rotates along with the knock plate and gear.
   - **Piston portion operation**
     - Movement of piston starts in its rotation side.

5. **Completion of table rotation**
   - **Table operation**
     - Table rotates for fixed angle, and arrives at secured position.
   - **Ratchet mechanism operation**
     - Knock plate pushes on stopper A to secure the gear in place.
     - Ratchet secures the gear in place.
   - **Piston portion operation**
     - Piston moves to the end of piston rotation side.

- The table is linked to the gear by pin C.
- The ratchet and knock plate are located on the same plate, and move in tandem.
- The ratchet is linked by a connecting shaft to the piston.
- The rotary stage RWT series goes through steps 1→2→3→4→5 above to complete 1 cycle.

### Notes:
1. When operating the Rotary Stage RWT series, always start from the step “1. Completion of table rotation.”
2. If the Rotary Stage RWT series stops while partway through rotation due to a drop in pressure, etc., always start from “3. Completion of piston return.”
3. When connecting the Rotary Stage RWT series to a valve, connect the normally open side to the rotation-side connection port.
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 actuator should be clean air that contains no deteriorated compressor oil, etc. Install an air filter (filtration of a minimum 40 µm) near the actuator or valve to remove collected liquid or dust. In addition, drain the air filter periodically.

Piping
1. Always thoroughly blow off (use compressed air) the tubing before connecting it to the actuator. Entering metal chips, sealing tape, rust, etc., generated during piping work could result in air leaks or other defective operation.
2. When screwing piping or fittings into the actuator, tighten to the appropriate tightening torque shown below.

When starting up operations of a device and the actuator by supplying compressed air rapidly, it could not control the speed due to the construction of the actuator, resulting in damage to the device and actuator. When shutting off compressed air, shut off with the table in a completely rotated state, and check that the stopper has activated. If for some reason the compressed air is shut off while the Rotary Stage is partway through a rotation, apply air pressure through the return side connection port (PB port) and continue applying back pressure in the operation to use. (See the operating principles on p.1331.)

Mounting
1. Horizontal mounting (face up on the table surface) is the only acceptable mounting direction. Any other mounting directions will cause the inner parts to disengage, resulting in damage or defective operation.
2. The mounting surface should always be flat. Twisting or bending during mounting may result in air leaks or improper operation.
3. Care should be taken that scratches or dents on the actuator’s mounting surface may damage its flatness.
4. Take some locking measures when shocks or vibrations might loosen the bolts.
5. For 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. Use of longer bolts than the female thread will interfere with the inner parts, and prevent them from working properly. When mounting the workpiece, tighten the bolts within the range of the tightening torque.

Model Screw size Thread depth L (mm [in.]) Maximum tightening torque (N·m [ft·lbf])
ARWT10 M4×0.7 5 [0.197] 1.50 [1.11]

Caution: When using a bolt to mount the workpiece in place on the table, hold either the table or the workpiece during operation. Holding the body for tightening will apply excessive moment to the stopper or gear, etc., damaging them.

6. When mounting the Rotary Stage RWT series, tighten screws applying torque within the allowable range.

Model Mounting Screw size Maximum tightening torque (N·m [ft·lbf])
ARWT10 Through hole M5×0.8 3.0 [2.2]

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
If using in locations subject to dripping water, dripping oil, etc., use a cover to protect the unit. Also, avoid dew condensation.

Operation
When starting up operations of a device and the actuator by supplying compressed air rapidly, it could not control the speed due to the construction of the actuator, resulting in damage to the device and actuator. When shutting off compressed air, shut off with the table in a completely rotated state, and check that the stopper has activated. If for some reason the compressed air is shut off while the Rotary Stage is partway through a rotation, apply air pressure through the return side connection port (PB port) and continue applying back pressure in the operation to use. (See the operating principles on p.1331.)
Air Flow Rate and Air Consumption

### Finding the air flow rate
(for selecting F.R.L., valves, etc.)

\[
Q_1 = \left[ \frac{6.4 \times 60}{1} \times \frac{P^\prime + 0.1013}{1.013} + 200 \cdot 10^{-3} \right] \times 1 \over 1728
\]

\[
Q_1^\prime = \left[ \frac{0.391 \times 60}{1} \times \frac{P^\prime + 14.696}{14.696} + 12.20 \cdot 10^{-3} \right] \times \frac{1}{1728}
\]

### Finding the air consumption

\[
Q_2 = \left( V \times \frac{P^\prime + 0.1013}{0.1013} + 200 \cdot 10^{-3} \right) \times 10^{-3}
\]

\[
Q_2^\prime = \left( V \times \frac{P^\prime + 14.696}{14.696} + 12.20 \cdot 10^{-3} \right) \times \frac{1}{1728}
\]

#### Thrust load

Top

Bottom

#### Radial load

\[
WR
\]

#### Bending moment

\[
M
\]

### Effective torque

<table>
<thead>
<tr>
<th>Model</th>
<th>Air pressure MPa [psi]</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARWT10</td>
<td>0.2 [29]</td>
</tr>
</tbody>
</table>

\[
N \cdot m [ft \cdot lbf]
\]

<table>
<thead>
<tr>
<th>Model</th>
<th>1.4</th>
<th>1.2</th>
<th>1.0</th>
<th>0.8</th>
<th>0.6</th>
<th>0.4</th>
<th>0.2</th>
<th>0.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARWT10-45</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>ARWT10-60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ARWT10-90</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Rotation time control

For control of rotation time, a sequence control using sensor switches at both stroke ends for detection is recommended. If using timer control, caution should be exercised for the following points:

- For the rotation side, check that the rotation is completed all the way to the end point, and that the stopper positively activates.
- Because no visual check is possible for the return side, set the time to 0.2 second or more, without using a speed controller for adjustment.

Note: One cycle of the Rotary stage consists of movement that returns the device to the return position in preparation for traveling the internal piston by an air signal, and sending the table as far as a fixed angle. For table rotation and piston movement, see p.1331.
Selection

Caution: For the load and rotation 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 the application. 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 Rotation angle (45°, 60° and 90°) and rotation direction (clockwise or counterclockwise rotation).
     ② Rotation time (s)
     ③ Applied pressure (MPa)
     ④ Workpiece shape and materials
     ⑤ Mounting direction (stance)

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

3. Check torque
   - Find the torque $T_a$ required for rotating the work.
     \[
     T_a = I \omega K
     \]
     \[
     \omega = \frac{2 \theta}{t}
     \]
     \[
     K : \text{Marginal coefficient } 5
     \]
     \[
     \theta : \text{Rotation angle (rad)}
     \]
     \[
     45^\circ \rightarrow 0.79 \text{rad}
     \]
     \[
     60^\circ \rightarrow 1.05 \text{rad}
     \]
     \[
     90^\circ \rightarrow 1.57 \text{rad}
     \]
     \[
     t : \text{Rotation time (s)}
     \]
     For the applied pressure checked in ①—④ above, use the effective torque table or graph on p.1333 to check that the required torque $T_a$ is obtained.

4. Check kinetic energy
   - If kinetic energy exceeds the allowable energy, the actuator could be damaged. Always ensure that the energy lies within the allowed level. For the allowable kinetic energy, see Table 1.
     \[
     E = \frac{1}{2} I \omega^2
     \]
     \[
     \omega = \frac{2 \theta}{t}
     \]
     \[
     I : \text{Mass moment of inertia (kg} \cdot \text{m}^2\text{)}
     \]
     \[
     \theta : \text{Uniform angular acceleration (rad/s)}
     \]
     \[
     \omega : \text{Angular velocity (rad/s)}
     \]
     \[
     E < E_a
     \]
     \[
     t : \text{Rotation time (s)}
     \]
     \[
     E_a : \text{Allowable energy}
     \]
     ... See Table 1.

Table 1. Allowable energy $E_a$

<table>
<thead>
<tr>
<th>Model</th>
<th>Allowable energy (J)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARWT10</td>
<td>0.050</td>
</tr>
</tbody>
</table>

Model selection procedure

1. Check the application conditions
   - Check the following items ①～④
     ① Rotation angle (45°, 60° and 90°) and rotation direction (clockwise or counterclockwise rotation).
     ② Rotation time [sec.]
     ③ Applied pressure [psi.]
     ④ Workpiece shape and materials
     ⑤ Mounting direction (stance)

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

3. Check torque
   - Find the torque $T_a$ required for rotating the work.
     \[
     T_a = I \omega K
     \]
     \[
     \omega = \frac{2 \theta}{t}
     \]
     \[
     K : \text{Marginal coefficient } 5
     \]
     \[
     \theta : \text{Rotation angle (rad)}
     \]
     \[
     45^\circ \rightarrow 0.79 \text{rad}
     \]
     \[
     60^\circ \rightarrow 1.05 \text{rad}
     \]
     \[
     90^\circ \rightarrow 1.57 \text{rad}
     \]
     \[
     t : \text{Rotation time [sec.]}\)
     \]
     For the applied pressure checked in ①—④ above, use the effective torque table or graph on p.1333 to check that the required torque $T_a$ is obtained.

4. Check kinetic energy
   - If kinetic energy exceeds the allowable energy, the actuator could be damaged. Always ensure that the energy lies within the allowed level. For the allowable kinetic energy, see Table 1.
     \[
     E = \frac{1}{2} I \omega^2
     \]
     \[
     \omega = \frac{2 \theta}{t}
     \]
     \[
     I : \text{Mass moment of inertia (lb} \cdot \text{ft}^2\text{)}
     \]
     \[
     \theta : \text{Angular velocity (rad/s)}
     \]
     \[
     E < E_a
     \]
     \[
     t : \text{Rotation time [sec.]}\)
     \]
     \[
     E_a : \text{Allowable energy}
     \]
     ... See Table 1.

Table 1. Allowable energy $E_a$

<table>
<thead>
<tr>
<th>Model</th>
<th>Allowable energy [ft-lbf]</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARWT10</td>
<td>0.037</td>
</tr>
</tbody>
</table>
5. Check load ratio
Check that the total sum of the load ratio does not exceed 1.
For the allowable load, see Table 2. (For the load direction, see the allowable load on p.1333.)

\[
\frac{W_S}{W_{S\text{MAX}}} + \frac{M}{M_{\text{MAX}}} \leq 1
\]

Table 2. Allowable load

<table>
<thead>
<tr>
<th>Model</th>
<th>Thrust load $W_{S\text{MAX}}$ (N)</th>
<th>Moment $M_{\text{MAX}}$ (N·m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARWT10</td>
<td>50</td>
<td>1.5</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 $\leq 1$
● Calculation example

If solid circular cylinder workpiece is on the base.

1. Check the application conditions
   ① Rotation angle: 90°
   ② Rotation time: 0.5 (s)
   ③ Applied pressure: 0.5 (MPa)
   ④ Workpiece shape: as shown in the above
     Workpiece materials
     ① Base: Aluminum alloy A5056
       (Specific gravity $\rho = 2.64 \times 10^3 \text{kg/m}^3$)
     ② Solid circular cylinder: Aluminum alloy A5056
       (Specific gravity $\rho = 2.64 \times 10^3 \text{kg/m}^3$)
   ⑤ Mounting direction (stance): Horizontal
     Note: Since the specific gravity can vary depending on the alloy, check
     the specific gravity of the metal being used, and then perform the
     calculation.

2. Check the rotation time
   The rotation time is 0.5s/90°, which is within the range of
   0.2~1.0s/90°, and satisfactory.

3. Check torque
   Firstly calculate the mass moment of inertia.

   Base
   
   \[ m_1 = \frac{\pi}{4} \times 0.08^2 \times 0.01 \times 2.64 \times 10^3 = 0.133 \text{ (kg)} \]
   \[ I_1 = \frac{0.133 \times 0.08^2}{8} = 1.06 \times 10^{-4} \text{ (kg} \cdot \text{m}^2) \] ①

   Solid circular cylinder
   
   \[ m_2 = \frac{\pi}{4} \times 0.03^2 \times 0.02 \times 2.64 \times 10^3 = 0.037 \text{ (kg)} \]
   \[ I_2 = \frac{0.037 \times 0.03^2}{8} + 0.037 \times 0.03^2 = 0.37 \times 10^{-4} \text{ (kg} \cdot \text{m}^2) \] ②

   From ① and ②, the total mass moment of inertia \( I = I_1 + I_2 \)
   \[ = 1.06 \times 10^{-4} + 0.37 \times 10^{-4} = 1.43 \times 10^{-4} \text{ (kg} \cdot \text{m}^2) \] ③

   From the given conditions, \( \theta = 90^\circ, t = 0.5 \text{ (s)} \)
   Therefore, uniform angular acceleration \( \dot{\omega} \) is
   \[ \dot{\omega} = \frac{2 \times 1.57}{0.5} = 12.56 \text{ (rad/s}^2) \] ④

   From ③ and ④, the required torque \( T_A \) is
   \[ T_A = 1.43 \times 10^{-4} \times 12.56 \times 5 = 0.009 \text{ (N} \cdot \text{m}) \] ⑤

   The effective torque at 0.5MPa is 1.0 (N \cdot m), and the torque is
   satisfactory.

1. Check the application conditions
   ① Rotation angle: 90°
   ② Rotation time: 0.5 [sec.]
   ③ Applied pressure: 73 [psi.]
   ④ Workpiece shape: as shown in the above
     Workpiece materials
     ① Base: Aluminum alloy A5056
       [Specific gravity $\rho = 165 \text{lbf/ft}^3$]
     ② Solid circular cylinder: Aluminum alloy A5056
       [Specific gravity $\rho = 165 \text{lbf/ft}^3$]
   ⑤ Mounting direction (stance): Horizontal
     Note: Since the specific gravity can vary depending on the alloy, check
     the specific gravity of the metal being used, and then perform the
     calculation.

2. Check the rotation time
   The rotation time is 0.5sec./90°, which is within the range of
   0.2~1.0sec./90°, and satisfactory.

3. Check torque
   Firstly calculate the mass moment of inertia.

   Base
   
   \[ W_1 = \frac{\pi}{4} \times (1.18)^2 \times (0.082) \times 165 = 0.290 \text{ [lbf.]} \]
   \[ I_1 = \frac{0.290 \times (1.18/12)^2}{8 \times 32.2} = 7.76 \times 10^{-5} \text{ [lbf} \cdot \text{ft} \cdot \text{sec}^2] \] ①

   Solid circular cylinder
   
   \[ W_2 = \frac{\pi}{4} \times (1.18)^2 \times (0.32)^3 \times 165 = 0.082 \text{ [lbf.]} \]
   \[ I_2 = \frac{0.082 \times (1.18/12)^2}{8 \times 32.2} + \frac{0.082 \times (1.18/12)^2}{8 \times 32.2} = 2.77 \times 10^{-5} \text{ [lbf} \cdot \text{ft} \cdot \text{sec}^2] \] ②

   From ① and ②, the total mass moment of inertia \( I' = I_1 + I_2 \)
   \[ = 7.76 \times 10^{-5} + 2.77 \times 10^{-5} = 1.05 \times 10^{-4} \text{ [lbf} \cdot \text{ft} \cdot \text{sec}^2] \] ③

   From the given conditions, \( \theta = 90^\circ, t = 0.5 \text{ [sec.]} \)
   Therefore, uniform angular acceleration \( \dot{\omega} \) is
   \[ \dot{\omega} = \frac{2 \times 1.57}{0.5^2} = 12.56 \text{ [rad} \cdot \text{sec}^2] \] ④

   From ③ and ④, the required torque \( T_A' \) is
   \[ T_A' = 1.05 \times 10^{-4} \times 12.56 \times 5 = 0.0066 \text{ [ft} \cdot \text{lbf}] \] ⑤

   The effective torque at 73psi. is 0.74 [ft \cdot lbf], and the torque is
   satisfactory.
4. Check kinetic energy
From the given conditions, $\theta=90^\circ$, $t=0.5$ (s)
Therefore,
$$\omega = \frac{2 \times 1.57}{0.5} = 6.28 \text{ (rad/s)} \ldots (1)$$
From (1), kinetic energy $E$ is
$$E = \frac{1}{2} \times 1.43 \times 10^{-4} \times 6.28^2 = 0.003 \text{ (J)} \ldots (2)$$
The allowable energy is 0.050 (J), and the kinetic energy is satisfactory.

5. Check load ratio
[Thrust load]
Total mass is
$$0.133 + 0.037 = 0.170 \text{ (kg)}$$
Therefore,
$$W_S = 0.170 \times 9.8 = 1.666 \text{ (N)} \ldots (1)$$

[Moment]
Moment $M_1$ of the base is
$$M_1 = 0.133 \times 9.8 \times 0 = 0 \text{ (N.m)} \ldots (2)$$
Moment $M_2$ of the solid circular cylinder is
$$M_2 = 0.037 \times 9.8 \times 0.03 = 0.011 \text{ (N.m)} \ldots (3)$$
From (2) and (3), the total moment is
$$M = 0 + 0.011 = 0.011 \text{ (N.m)} \ldots (4)$$

From (1) and (4), find the load ratio.
$$\frac{W_S}{W_{S \text{ MAX}}} + \frac{M}{M_{\text{ MAX}}} = \frac{1.666}{50} + \frac{0.011}{1.5} = 0.04 < 1.0$$
The load ratio is less than 1.0, and satisfactory.

6. Judgement whether the unit is usable or not
Since kinetic energy and load ratio are both satisfied, the application is allowable.

4. Check kinetic energy
From the given conditions, $\theta=90^\circ$, $t=0.5$ (sec.)
Therefore,
$$\omega = \frac{2 \times 1.57}{0.5} = 6.28 \text{ (rad/sec.)} \ldots (1)$$
From (1), kinetic energy $E'$ is
$$E' = \frac{1}{2} \times 1.02 \times 10^{-4} \times 6.28^2 = 0.002 \text{ (ft.lbf)} \ldots (2)$$
The allowable energy is 0.037 [ft.lbf], and the kinetic energy is satisfactory.

5. Check load ratio
[Thrust load]
Total weight is
$$0.290 + 0.082 = 0.372 \text{ [lbf.]}$$
Therefore,
$$W_S' = 0.372 \text{ [lbf.]} \ldots (1)$$

[Moment]
Moment $M_1$ of the base is
$$M_1' = 0.290 \times 0 = 0 \text{ [ft.lbf]} \ldots (2)$$
Moment $M_2$ of the solid circular cylinder is
$$M_2' = 0.082 \times \left(\frac{1.18}{12}\right) = 0.008 \text{ [ft.lbf]} \ldots (3)$$
From (2) and (3), the total moment is
$$M' = 0 + 0.008 = 0.008 \text{ [ft.lbf]} \ldots (4)$$
From (1) and (4), find the load ratio.
$$\frac{W_S'}{W_{S \text{ MAX}}'} + \frac{M'}{M_{\text{ MAX}}'} = \frac{0.373}{11.2} + \frac{0.008}{1.1} = 0.04 < 1.0$$
The load ratio is less than 1.0, and satisfactory.

6. Judgement whether the unit is usable or not
Since kinetic energy and load ratio are both satisfied, the application is allowable.
Diagram for calculating mass moment of inertia
[When the rotation axis passes through the workpiece]

### Disk

- **Diameter** \( d \) (m)
- **Mass** \( m \) (kg)
- **Mass moment of inertia** \( I \) (kg \( \cdot \) m\(^2\))
  \[ I = \frac{md^2}{8} \]
- **Rotating radius** \( d^2 / 8 \)

### Stepped disk

- **Diameter** \( d_1 \) (m), \( d_2 \) (m)
- **Mass** \( m_1 \) (kg), \( m_2 \) (kg)
- **Mass moment of inertia** \( I \) (kg \( \cdot \) m\(^2\))
  \[ I = \frac{1}{8}(m_1d_1^2 + m_2d_2^2) \]
- **Rotating radius** \( d_1^2 + d_2^2 / 8 \)

### Bar (rotation center is at the edge)

- **Bar length** \( \ell \) (m)
- **Mass** \( m \) (kg)
- **Mass moment of inertia** \( I \) (kg \( \cdot \) m\(^2\))
  \[ I = \frac{m\ell^2}{3} \]
- **Rotating radius** \( \ell^2 / 3 \)

### Slender rod

- **Rod length** \( \ell_1 \) (m), \( \ell_2 \) (m)
- **Mass** \( m_1 \) (kg), \( m_2 \) (kg)
- **Mass moment of inertia** \( I \) (kg \( \cdot \) m\(^2\))
  \[ I = \frac{m_1\ell_1^2}{3} + \frac{m_2\ell_2^2}{3} \]
- **Rotating radius** \( \ell_1^2 + \ell_2^2 / 3 \)

### Diagrams

1. **Diagram for calculating mass moment of inertia**
2. **Diagram for calculating mass moment of inertia**
3. **Diagram for calculating mass moment of inertia**

Remark: For sliding use, see separate materials.

Remark: The \( d_2 \) portion can be negligible when it is much smaller than the \( d_1 \) portion.
### Bar (rotation center is through the center of gravity)

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

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

- **Bar length** \( \ell \) [ft.]
- **Weight** \( w \) [lbf.]
- **Mass moment of inertia** \( I' \) [lbf \( \cdot \) ft \( \cdot \) sec\(^2\)]
- **Rotating radius**

\[
I' = \frac{w \ell^2}{12 \times 32.2} \quad \frac{\ell^2}{12}
\]

### Thin rectangular plate (rectangular solid)

- **Plate length** \( a_1 \) (m)
- **Length of side** \( a_2 \) (m)
- **Mass** \( m_1 \) (kg)
- **Mass moment of inertia** \( I \) (kg \( \cdot \) m\(^2\))
- **Rotating radius**

\[
I = \frac{m_1}{12} \left(4a_1^3 + b_1^3\right) + \frac{m_2}{12} \left(4a_2^3 + b_2^3\right) \quad \frac{4a_1^3 + b_1^3 + 4a_2^3 + b_2^3}{12}
\]

- **Plate length** \( a_1 \) [ft.]
- **Length of side** \( a_2 \) [ft.]
- **Mass** \( m_1 \) [lbf.]
- **Mass moment of inertia** \( I' \) [lbf \( \cdot \) ft \( \cdot \) sec\(^2\)]
- **Rotating radius**

\[
I' = \frac{w_1}{12 \times 32.2} \left(4a_1^3 + b_1^3\right) + \frac{w_2}{12 \times 32.2} \left(4a_2^3 + b_2^3\right) \quad \frac{4a_1^3 + b_1^3 + 4a_2^3 + b_2^3}{12}
\]

### Rectangular parallelepiped

- **Length of sides** \( a \) (m)
- **Mass** \( m \) (kg)
- **Mass moment of inertia** \( I \) (kg \( \cdot \) m\(^2\))
- **Rotating radius**

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

- **Length of sides** \( a \) [ft.]
- **Mass** \( m \) [lbf.]
- **Mass moment of inertia** \( I' \) [lbf \( \cdot \) ft \( \cdot \) sec\(^2\)]
- **Rotating radius**

\[
I' = \frac{w}{12 \times 32.2} \left(a^2 + b^2\right) \quad \frac{a^2 + b^2}{12}
\]

Remark: For sliding use, see separate materials.
**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)

$$I = m_1 k^2 + m_1 \frac{\ell_1^2}{3} + m_2 \frac{\ell_2^2}{3}$$

Rotating radius: $k^2$ is calculated according to shape of the concentrated load.

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

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

**Gear**

- Gear Rotary Stage side $a$
- Load side $b$
- Inertia moment of load $N·m$

Mass moment of inertia of load with respect to Rotary Stage axis

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

- Gear Rotary Stage side $a$
- Load side $b$
- Inertia moment of load $ft·lb$

Mass moment of inertia of load with respect to Rotary Stage axis

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

Remark: If the shapes of the gears are too large, the mass moment of inertia of the gears must be also taken into consideration.
Selection

[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\(\cdot\)m\(^2\))

\[
I = \frac{m h^2}{12} + mL^2
\]

**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\(\cdot\)m\(^2\))

\[
I = \frac{m}{12} (h_2^2 + h_1^2) + mL^2
\]

**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\(\cdot\)m\(^2\))

\[
I = \frac{md^2}{16} + mL^2
\]

**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\(\cdot\)m\(^2\))

\[
I = \frac{m}{16} (d_2^2 + d_1^2) + mL^2
\]

Remark: Same for cube.

Remark: Cross-section is square only.
## Specifications

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation type</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effective torque[^Note1] N (\cdot) m ([\text{ft} \cdot \text{lbf}])</td>
<td>1.0 [0.74]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Media</td>
<td>Air</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating pressure range MPa ([\text{psi.}])</td>
<td>0.2 ~ 0.6 [29 ~ 87]</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Proof pressure MPa ([\text{psi.}])</td>
<td>0.9 [131]</td>
<td></td>
<td></td>
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<tr>
<td>Operating temperature range °C ([\text{°F}])</td>
<td>0 ~ 60 [32 ~ 140] (Dew condensation prohibited)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Rotation direction</td>
<td>Clockwise</td>
<td>Counter-clockwise</td>
<td>Clockwise</td>
<td>Counter-clockwise</td>
<td>Clockwise</td>
<td>Counter-clockwise</td>
</tr>
<tr>
<td>Rotation angle</td>
<td>45° ± 0.2°</td>
<td>60° ± 0.2°</td>
<td>90° ± 0.2°</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rotation time adjustment [^Note2] s/90°</td>
<td>0.2 ~ 1.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allowable energy ([\text{ft} \cdot \text{lbf}])</td>
<td>0.050 [0.037]</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Allowable thrust load N ([\text{lbf.}])</td>
<td>50 [11.2]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allowable moment N (\cdot) m ([\text{ft} \cdot \text{lbf}])</td>
<td>1.5 [1.1]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lubrication</td>
<td>Not required (If lubrication is required, use Turbine Oil Class 1 [ISO VG32] or equivalent.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Port size</td>
<td>M5×0.8</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

[^Note1]: Effective torque is the value obtained when the pressure is 0.5MPa [73psi].
[^Note2]: The rotation time adjustment range is the value for one complete rotation operating smoothly with applying no load.

### Notes:
1. Effective torque is the value obtained when the pressure is 0.5MPa [73psi].
2. The rotation time adjustment range is the value for one complete rotation operating smoothly with applying no load.

## Mass

<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor switch Assy[^Note3]</td>
<td>30 [1.06]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[^Note3]: Mass for 1 sensor switch Assy set (including 3m [118in.] cable)

## Order Codes

```
ARWT 10 - - -
```

- **Sensor switch Assy**
  - Blank: No sensor switch Assy
  - SW1: With 1 set of sensor switch Assy
  - SW2: With 2 sets of sensor switch Assy

- **Rotation direction**
  - R: Clockwise rotation
  - L: Counter-clockwise rotation

- **Rotation angle (Number of indexing)**
  - 45: 45° (Number of indexing: 8)
  - 60: 60° (Number of indexing: 6)
  - 90: 90° (Number of indexing: 4)

- **Nominal torque**
  - 10: 1.0N \(\cdot\) m [0.74ft \cdot \text{lbf}] (At 0.5MPa [73psi] pressure)

Alpha series
Rotary Stage RWT series
Inner Construction

Major Parts and Materials

<table>
<thead>
<tr>
<th>No.</th>
<th>Parts</th>
<th>Materials</th>
<th>No.</th>
<th>Parts</th>
<th>Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Body A</td>
<td>Aluminum alloy (anodized)</td>
<td>19</td>
<td>Retainer</td>
<td>Plastic</td>
</tr>
<tr>
<td>2</td>
<td>Body B</td>
<td>Aluminum alloy (anodized)</td>
<td>20</td>
<td>Separator</td>
<td>Plastic</td>
</tr>
<tr>
<td>3</td>
<td>Table</td>
<td>Aluminum alloy (anodized)</td>
<td>21</td>
<td>Gear</td>
<td>Steel</td>
</tr>
<tr>
<td>4</td>
<td>Base A</td>
<td>Stainless steel</td>
<td>22</td>
<td>Bumper</td>
<td>Synthetic rubber (Urethane)</td>
</tr>
<tr>
<td>5</td>
<td>Swing plate</td>
<td>Stainless steel</td>
<td>23</td>
<td>Clutch</td>
<td>—</td>
</tr>
<tr>
<td>6</td>
<td>Index plate</td>
<td>Steel</td>
<td>24</td>
<td>Bushing A</td>
<td>Brass</td>
</tr>
<tr>
<td>7</td>
<td>Knock plate</td>
<td>Steel</td>
<td>25</td>
<td>Bushing B</td>
<td>Brass</td>
</tr>
<tr>
<td>8</td>
<td>Cover</td>
<td>Stainless steel</td>
<td>26</td>
<td>Bushing D</td>
<td>Brass</td>
</tr>
<tr>
<td>9</td>
<td>Ratchet</td>
<td>Steel</td>
<td>27</td>
<td>Bushing E</td>
<td>Brass</td>
</tr>
<tr>
<td>10</td>
<td>Cam</td>
<td>Steel</td>
<td>28</td>
<td>Connecting pin</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>11</td>
<td>Pawl</td>
<td>Steel</td>
<td>29</td>
<td>Pin C</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>12</td>
<td>Roller</td>
<td>Steel</td>
<td>30</td>
<td>Nut</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>13</td>
<td>Stopper A</td>
<td>Steel</td>
<td>31</td>
<td>Spring</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>14</td>
<td>Stopper B</td>
<td>Steel</td>
<td>32</td>
<td>Piston seal</td>
<td>Synthetic rubber (NBR)</td>
</tr>
<tr>
<td>15</td>
<td>Stopper C</td>
<td>Steel</td>
<td>33</td>
<td>O-ring</td>
<td>Synthetic rubber (NBR)</td>
</tr>
<tr>
<td>16</td>
<td>Main shaft</td>
<td>Steel</td>
<td>34</td>
<td>Hexagon socket head bolt</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>17</td>
<td>Connecting shaft</td>
<td>Steel</td>
<td>35</td>
<td>Hexagon socket head bolt</td>
<td>Stainless steel</td>
</tr>
</tbody>
</table>

Note: The diagrams show the -R type (clockwise rotation). The -L type (counterclockwise rotation) is left-right symmetry.
Specifications

<table>
<thead>
<tr>
<th>Item</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum detection distance</td>
<td>0.8mm [0.031in.] ±15%</td>
</tr>
<tr>
<td>Stable detection range</td>
<td>0～0.6mm [0～0.024in.]</td>
</tr>
<tr>
<td>Standard detected object</td>
<td>Steel 5×5×11mm [0.20×0.20×0.04 (thickness) in.]</td>
</tr>
<tr>
<td>Response differential (Hysteresis)</td>
<td>15% or less of operating distance</td>
</tr>
<tr>
<td>Repeatability</td>
<td>20 μm or less</td>
</tr>
<tr>
<td>Voltage</td>
<td>12～24V DC ±10%  ( P-P ) 10% or less</td>
</tr>
<tr>
<td>Consumption current</td>
<td>15mA or less</td>
</tr>
<tr>
<td>Output</td>
<td>NPN transistor open collector ( \text{Note 1} )</td>
</tr>
<tr>
<td>Output (operation)</td>
<td>Switches ON upon approach</td>
</tr>
<tr>
<td>Maximum response frequency</td>
<td>1kHz</td>
</tr>
<tr>
<td>Indicator lamp</td>
<td>Red LED (Lights up when output is ON)</td>
</tr>
<tr>
<td>Protective structure</td>
<td>IP67 (IEC), Watertight type (JIS) ( \text{Note 3} )</td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>–25～70°C [-13～158°F], in storage: –25～80°C [-13～176°F]</td>
</tr>
<tr>
<td>Ambient humidity</td>
<td>35～95%RH, in storage: 35～95%RH</td>
</tr>
<tr>
<td>Dielectric strength</td>
<td>AC500V 1 minute ( \text{Note 2} )</td>
</tr>
<tr>
<td>Insulation resistance</td>
<td>5MΩ or more at DC250V megger ( \text{Note 2} )</td>
</tr>
<tr>
<td>Vibration resistance</td>
<td>10～55Hz Total amplitude 1.5mm [0.059in.], 2 hours for each X, Y, and Z direction (De-energized)</td>
</tr>
<tr>
<td>Shock resistance</td>
<td>200m/s² (approx. 20G), 10 times for each X, Y, and Z direction (De-energized)</td>
</tr>
<tr>
<td>Temperature characteristics</td>
<td>Within ±20% of detection distance at 20°C [68°F], in ambient temperature –25～70°C [-13～158°F]</td>
</tr>
<tr>
<td>Voltage characteristics</td>
<td>Within±2% when operating voltage variation is ±10%</td>
</tr>
<tr>
<td>Materials</td>
<td>Case: stainless steel (SUS304), Plastic portion: TPX</td>
</tr>
<tr>
<td>Cable</td>
<td>0.08mm² [1.24×10⁻⁴in²] 3-lead Oil-resistant, heat-resistant, cold-resistant, with cable extension 3m [118in.]</td>
</tr>
<tr>
<td>Mass</td>
<td>Approximately 30g [1.06oz.]</td>
</tr>
</tbody>
</table>

Notes:
1. Maximum detection distance refers to the maximum detection distance for standard detected object.
2. Stable detection range refers to the distance range at which stable detection of a standard detected object is obtained, with consideration for ambient temperature and variations in supply voltage.
3. While protective structure is prescribed the sensor switch including the cable, the end of the cable is not treated to be waterproof, and therefore cannot be a target for protective structure.

For this reason, avoid applications where there is a possibility that water could intrude through the end of the cable.

Use in combinations with devices of the Rotary Stage RWT series only.

The sensor switch Assy (SW-ARWT) is designed to be used in combination with the Rotary Stage RWT series. Use in combination with other actuators could cause abnormal operation.

Order Code

**SW - ARWT**

- **Series**: Alpha series Rotary Stage RWT series
- **Sensor switch Assy (with a holder and a mounting screw)**

---

**Caution**

Do not allow water to intrude here.
Internal Circuit Diagrams

Lead wire color
(Brown) +V
(Black) output

Code:
D: Reverse current protection diode
Z: Zener diode for surge voltage protection
Tr: NPN output transistor

Mounting Sensor Switch

Tighten the mounting pan screw with a tightening torque of 0.63N·m [5.6in·lbf].

Sensor position identification label
S1: For rotation end check
S2: For cylinder return check

Notes:
1. Do not loosen the setscrew. Changing the protruding length from the sensor switch holder could result in damage or defective operations.
2. When re-tightening the setscrew, check the protruding length from the holder, and fasten at a tightening torque of 0.29N·m [2.6in·lbf] ±10% at a direction perpendicular to the indicator lamp.
3. One mounting pan screw (M3 × 0.5 length 8) is included in the sensor switch.