Selection guide of rotary actuator

Step1 Oscillating time check

Use oscillating time withing specified range of the below table. Unit: S

Oscillating angle (°) / Model no.	90	180	270
RRC-8	0.015 to 0.151	0.030 to 0.302	0.045 to 0.452
RRC-32	0.038 to 0.377	0.075 to 0.754	0.113 to 1.131
RRC-63	0.073 to 0.440	0.147 to 0.880	0.220 to 1.320

* Oscillating time on table is time to achieve the end of oscillating after starting movement.

Step2 Size selection

● If clamp, or simple static forces, etc., are necessary.

Static load

(1) Working pressure is determined. P (MPa)
(2) A required force is determined. F (N)
(3) Length of an arm from a rotary actuator is determined. ℓ (m)

➡ Calculation of required torque

$T = F\ell$ (N·m)

➡ (to Determine size)

● To move load

Resistance load

When force (resistance load) caused by fictional force, gravity or other external force is applied.
(1) Working pressure is determined. P (MPa)
(2) A required force is determined. F_R (N)
(3) Length of an arm from a rotary actuator is determined. ℓ (m)

➡ Calculation of resistance torque

$T_R = K \times F_R \times \ell$ (N·m)

K: slack coefficient
If load fluctuation free K = 2
If load fluctuates K = 5
(When resistance torque caused by gravity functions)
if load fluctuates, when K < 5, change of angular speed increases.

⬇

Inertia load

To rotate body.
(1) Oscillating angle /oscillating time and working pressure are determined.
Oscillating angle θ (rad)
Oscillating time t (s)
Working pressure P (MPa)
90° = 1.5708 (rad)
180° = 3.1416 (rad)
270° = 4.7124 (rad)
(2) Calculate load moment of inertia according to load shape and weight. Refer to moment of inertia table for the calculation formula.
I (kg/m²)
(3) Angular acceleration is calculated.
$\alpha = \dfrac{2\theta}{t^2}$ (rad/s²)
θ : Oscillating angle (rad)
t : Oscillating time (s)

➡ Calculation of acceleration torque

$T_A = 5 \times I \times \alpha$ (N·m)

T_A is the required torque to accelete inertia load till set speed.

⬆

Required torque $T = T_R + T_A$ ➡

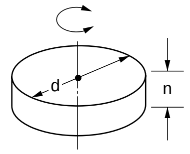
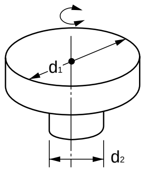
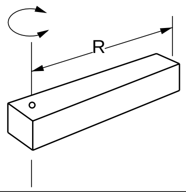
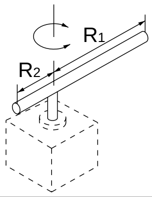
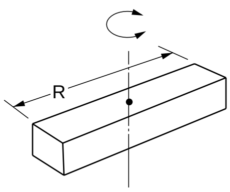
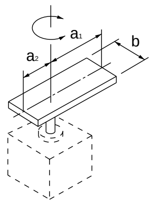
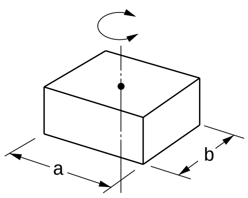
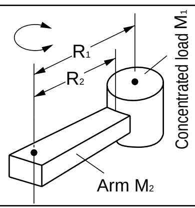
Determine size of rotary actuator according to output torque graph.

Step3 Check of allowable energy

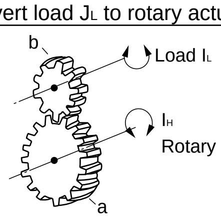
When using an inertial load, keep the load energy to lower than the rotary actuator's allowable energy.
(1) Calculate angular speed $\omega = \dfrac{2\theta}{t}$ (rad/s)
θ : Oscillating angle (rad) t: Oscillating time (s)
(2) Calculation of load inertia energy
$E = 1/2 I\omega^2$ (J)
I: Load moment of inertia (kg/m²)
Check if load inertia energy E to be allowable energy of rotary actuator or less.
When exceeding allowable energy, external shock absorber, etc. is required.

2. Figure for moment of inertia calculation

● When rotary shaft goes through workpiece

Shape	Sketch	Requirements	Moment of inertia I kg/m²	Radius of gyration K_1^2	Remarks
Dial plate		● Diameter d (m) ● Weight M (kg)	$I = \frac{Md^2}{8}$	$\frac{d^2}{8}$	● No installation direction ● When using with sliding, please consult with CKD
Dial plate with step		● Diameter d_1 (m) d_2 (m) ● Weight d_1 section M_1 (kg) d_2 section M_2 (kg)	$I = \frac{1}{8}(M_1d_1^2 + M_2d_2^2)$	$\frac{d_1^2 + d_2^2}{8}$	● Ignore, when d_2 section is extremely small comparing to d_1 section
Bar (center of rotation is an end)		● Bar length R(m) ● Weight M (kg)	$I = \frac{MR^2}{3}$	$\frac{R^2}{3}$	● The installation direction is horizontal ● If vertical installation attitude, oscillating time varies
Thin rod		● Bar length R_1 R_2 ● Weight M_1 M_2	$I = \frac{M_1 \cdot R_1^2}{3} + \frac{M_2 \cdot R_2^2}{3}$	$\frac{R_1^2 + R_2^2}{3}$	● The installation direction is horizontal ● If vertical installation attitude, oscillating time varies
Bar (center of rotation is center of gravity)		● Bar length R(m) ● Weight M (kg)	$I = \frac{MR^2}{12}$	$\frac{R^2}{12}$	● No installation direction
Thin rectangle plate (rectangular parallelepiped)		● Plate length a_1 a_2 ● Length of side b ● Weight M_1 M_2	$I = \frac{M_1}{12}(4a_1^2 + b^2) + \frac{M_2}{12}(4a_2^2 + b^2)$	$\frac{(4a_1^2 + b^2) + (4a_2^2 + b^2)}{12}$	● The installation direction is horizontal ● If vertical installation attitude, oscillating time varies
Lectangular parallelepiped		● Length of side a (m) b (m) ● Weight M (kg)	$I = \frac{M}{12}(a^2 + b^2)$	$\frac{a^2 + b^2}{12}$	● No installation direction ● When using with sliding, please consult with CKD
Concentrated load		● Shape of concentrated load ● Length to center of gravity of concentrated load R_1 (m) ● Arm length R_2 (m) ● Concentrated load weight M_1 (kg) ● Arm weight M_2 (kg)	$I = M_1(R_1^2 + k_1^2) + \frac{M_2R_2^2}{3}$	Calculate k_1^2 according to shape of concentrated load	● The installation direction is horizontal ● When M_2 is extremely small comparing to M_1, may be calculated as $M_2 = 0$

How to convert load J_L to rotary actuator shaft rotation when using with gear

Shape	Sketch	Requirements	Moment of inertia I kg/m²	Radius of gyration K_1^2	Remarks
Gear		● Gear Rotary side (the tooth number) a Load side (the tooth number) b ● Load inertia Moment N·m	Moment of inertia of load rotary shaft rotation $I_H = \left(\frac{a}{b}\right)^2 I_L$		● When shape of gear is increasing, gear moment of inertia should be considered.