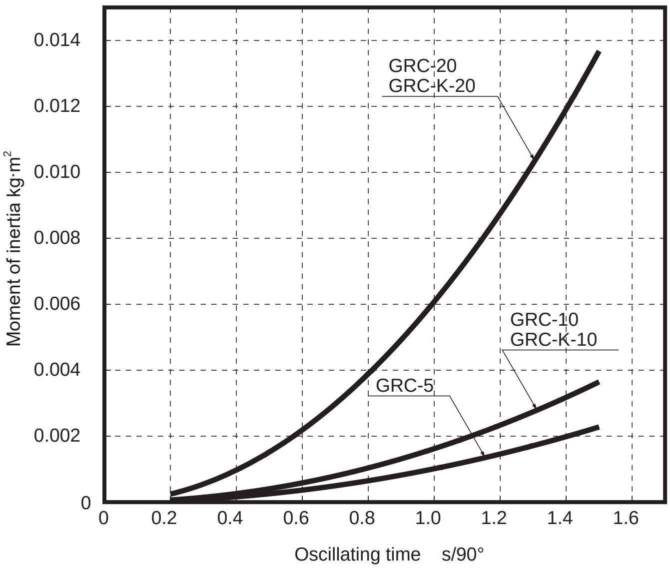
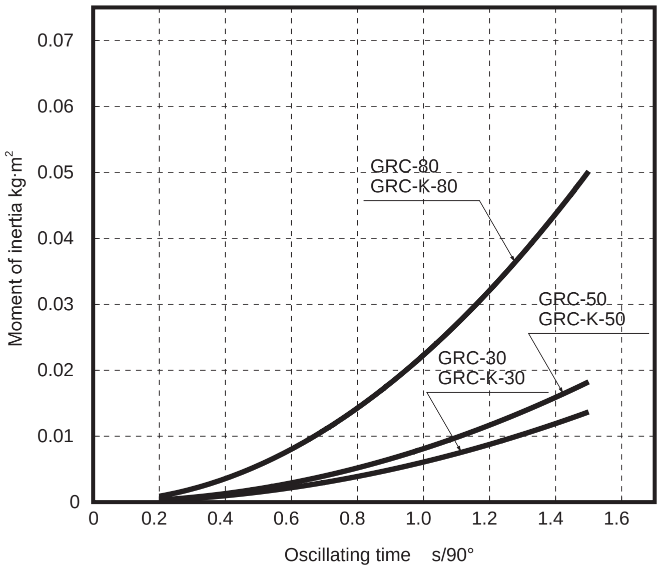
1. Energy absorbing performance and oscillating time

(1) For rubber cushion, the relationship between the moment of inertia and the oscillating time is shown in the diagram below. Always use the product within the lower right range of the graph as the shaft may break otherwise. Refer to this when you select a model.

● Basic high accuracy



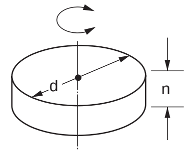
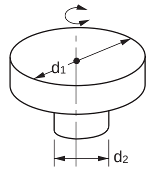
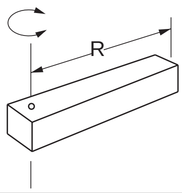
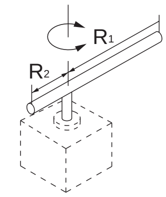
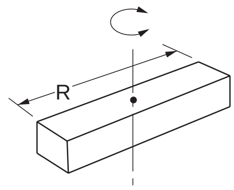
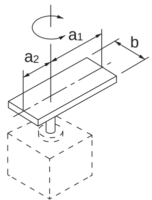
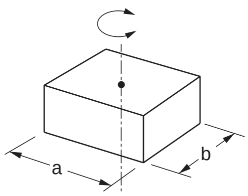
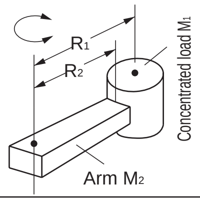
Size 5, 10, 20



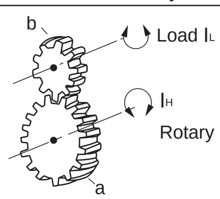
Size 30, 50, 80

2. Figure for moment of inertia calculation

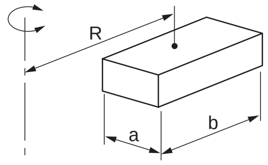
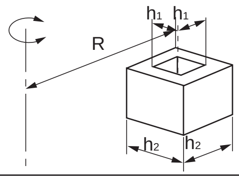
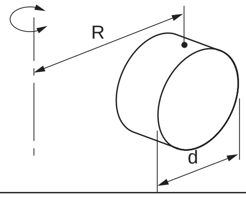
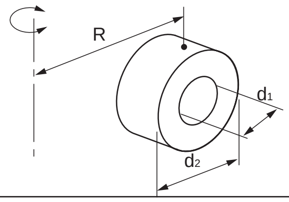
When the rotational axis goes through the workpiece

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 mounting direction ●For sliding use, contact CKD.
Circular stepped plate		● 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 compared to d_1 section.
Bar (center of rotation at end)		● Bar length R (m) ● Weight M (kg)	$I = \frac{MR^2}{3}$	$\frac{R^2}{3}$	● When this is horizontally mounted. ● If this is vertically mounted, the oscillating time changes.
Thin rod		● Bar length R_1, R_2 ● Weight M_1, M_2	$I = \frac{M_1 \cdot R_1^2}{3} + \frac{M_2 \cdot R_2^2}{3}$	$\frac{R_1^2 + R_2^2}{3}$	● When this is horizontally mounted. ● If this is vertically mounted, the oscillating time changes.
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 mounting direction
Thin rectangle plate (rectangular parallelepiped)		● Plate length a_1, a_2 ● Side length b ● Weight M_1, M_2	$I = \frac{M_1}{12}(4a_1^2 + b^2) + \frac{M_2}{12}(4a_2^2 + b^2)$	$\frac{(4a_1^2 + b^2) + (4a_2^2 + b^2)}{12}$	● When this is horizontally mounted. ● If this is vertically mounted, the oscillating time changes.
Rectangular parallelepiped		● Side length a (m), b (m) ● Weight M (kg)	$I = \frac{M}{12}(a^2 + b^2)$	$\frac{a^2 + b^2}{12}$	● No mounting direction ● For sliding use, contact CKD.
Concentrated load		● Shape of concentrated load ● Length to center of gravity of concentrated load R_1 ● 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	● When this is horizontally mounted. ● When M_2 is extremely small compared to M_1, you can assume $M_2 = 0$.

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

Shape	Sketch	Requirements	Moment of inertia I kg·m²	Radius of gyration K_1^2	Remarks
Gear		● Rotary side gear (number of teeth) a Load side gear (number of teeth) 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 the size of the gear wheel is increased, its moment of inertia should be taken into consideration.

● When the rotational axis is off the workpiece

Shape	Sketch	Requirements	Moment of inertia I kg·m^2	Remarks
Rectangular parallelepiped		● Side length a (m) ● Distance from the rotational axis to the load center b (m) R (m) ● Weight M (kg)	$I = \frac{M}{12}(a^2 + b^2) + MR^2$	● Same for cube
Hollow rectangular parallelepiped		● Side length h_1 (m) h_2 (m) ● Distance from the rotational axis to the load center R (m) ● Weight M (kg)	$I = \frac{M}{12}(h_1^2 + h_2^2) + MR^2$	● Cross section is for cube only
Cylinder		● Diameter d (m) ● Distance from the rotational axis to the load center R (m) ● Weight M (kg)	$I = \frac{Md^2}{16} + MR^2$	
Hollow cylinder		● Diameter d_1 (m) d_2 (m) ● Distance from the rotational axis to the load center R (m) ● Weight M (kg)	$I = \frac{M}{16}(d_1^2 + d_2^2) + MR^2$	

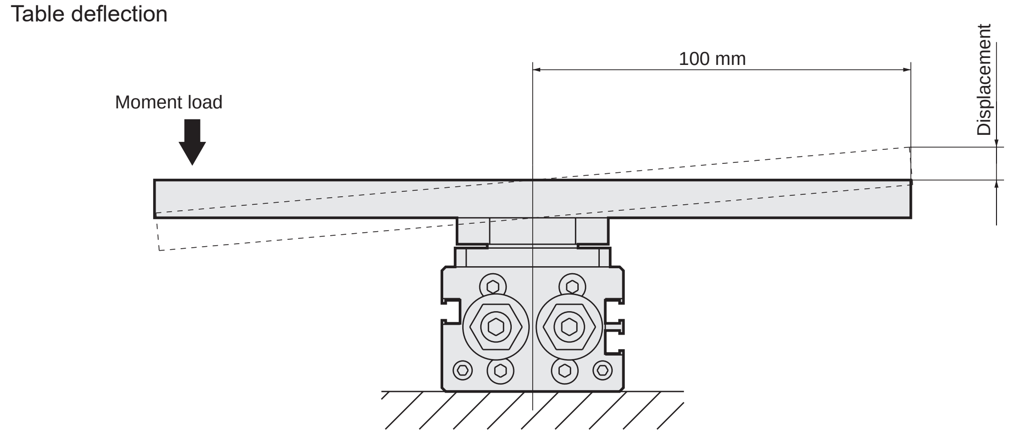
* To find moment of inertia, first convert load, jig, etc., to simple shapes with modeling, then calculate values. For the combined load, calculate each inertial moment and their total.

SCPD3
SCM
SSD2
MDC2
SMG
LCM
LCR
LCG
LCX
STM
STG
STR2
MRL2
GRC
Cylinder switch
MN3E MN4E
4GA/B
M4GA/B
MN4GA/B
F.R (module unit)
Clean F.R
Precision R
Press gauge Diff. press gauge
Electro-pneumatic R
Speed controller
Auxiliary valve
Fitting/ tube
Clean air unit
Pressure sensor
Flow rate sensor
Valve for air blow
Ending

3. Table deflection (reference value)

The displacement (reference value) of the table at 100 mm away from the center of rotation when moment load is applied to GRC is shown below. (It is assumed that the table is stationary and not rotating.)

Measuring method



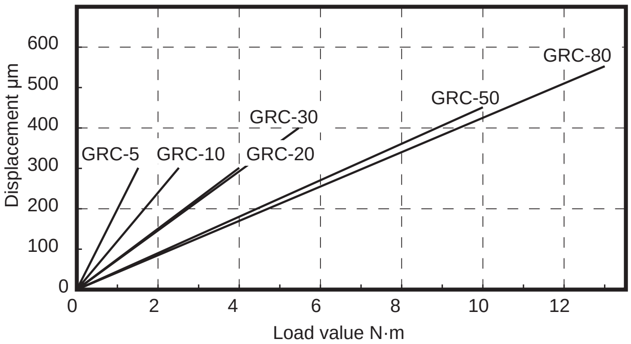


Table deflection of GRC (basic)

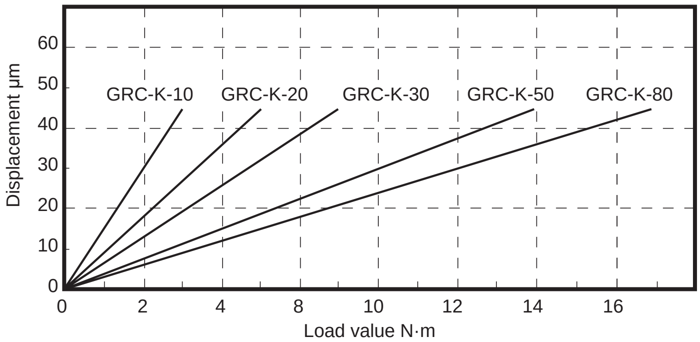
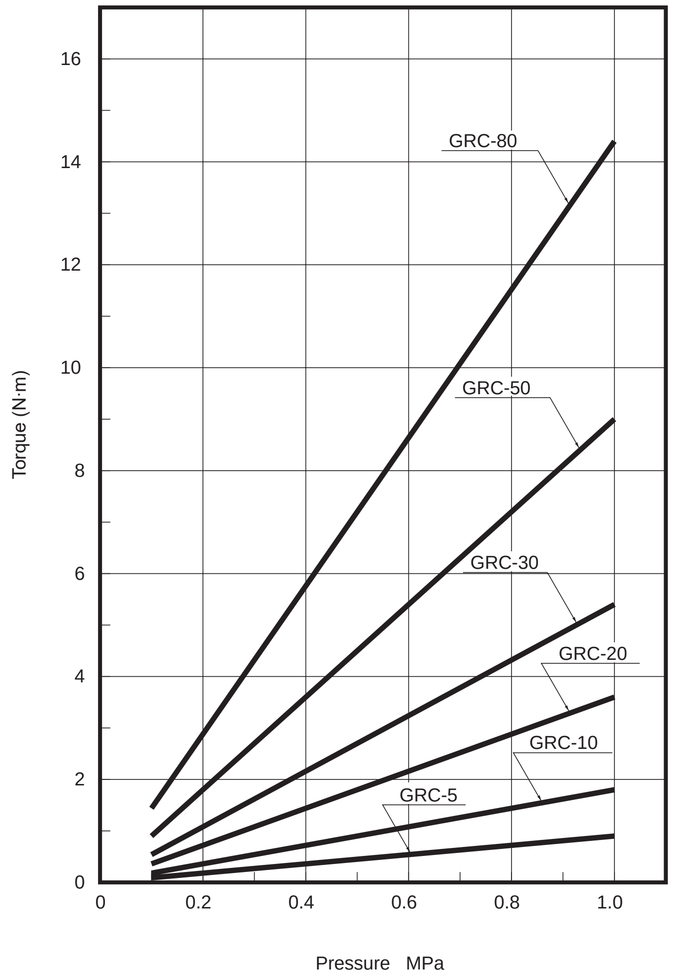


Table deflection of GRC-K (high accuracy)

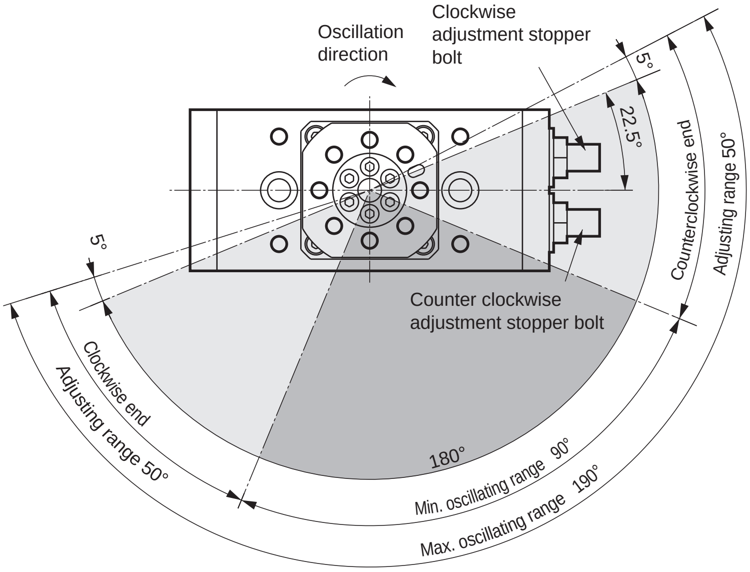
4. Effective torque diagram

Note that the torque at the oscillation end is half of the value in the following graph.

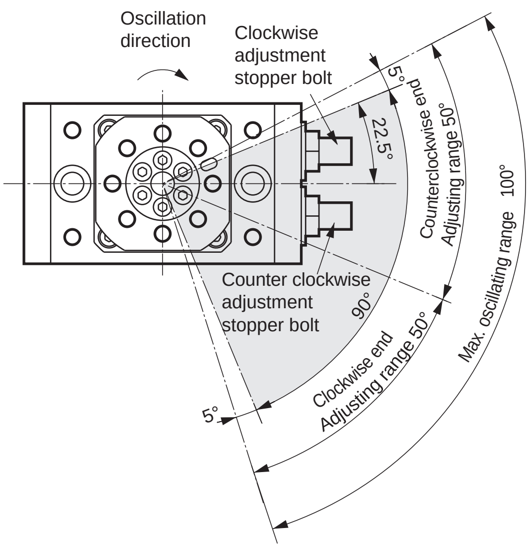


5. Oscillating angle adjustment method

● Basic high accuracy



180° specifications



90° specifications