Gripper Basics

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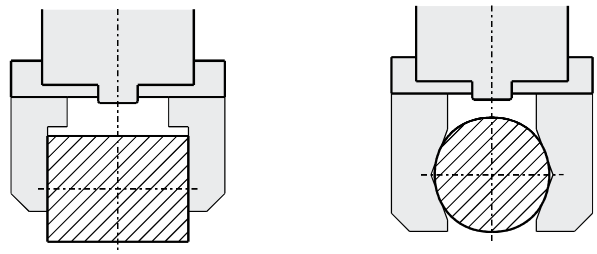
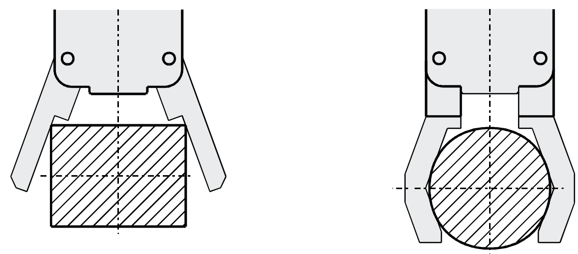
Parallel gripper

The jaws movement is on a straight line.



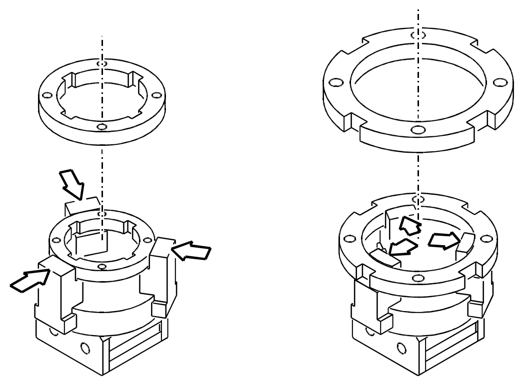
Angular gripper

The jaws are pivoted and move on an angular line with a 10° – 40° angle.



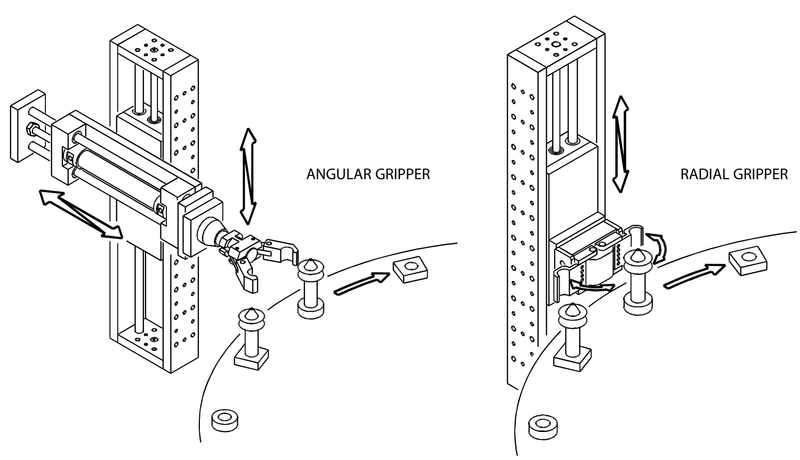
Three jaws gripper

Is generally used to handle loads of cylindrical shapes, maintaing the same axis, even if different diameter parts are being gripped.



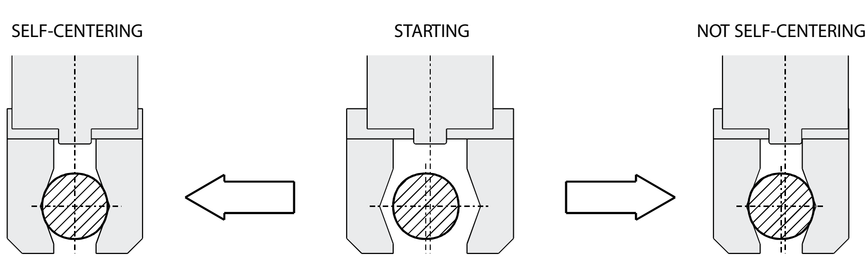
Radial gripper

The jaws move on an angular line with a 90° angle; because of this the moving back can be avoided in order to withdraw the gripping tools from the working plane.



Self-centering

On the pneumatic gripper generally the jaws are symmetrically moved, and because of this, the load is centered.



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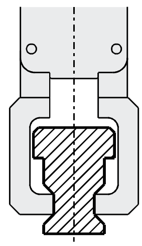
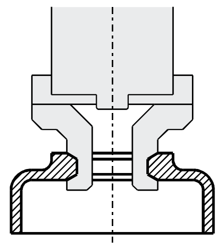
Gripping force

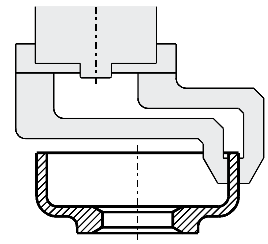
They must be built as short and light as possible, to reach the maximum gripping force, keeping the inertia to a minimum.



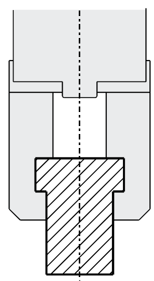
EXTERNAL GRIPPING



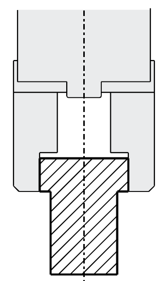
INTERNAL GRIPPING



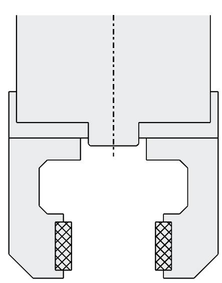
INTERNAL - EXTERNAL GRIPPING



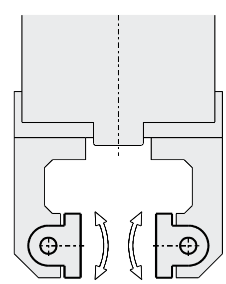
POSITIVE GRIPPING



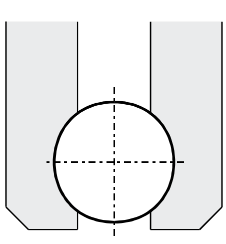
FORCE GRIPPING



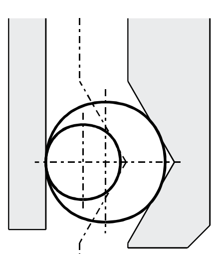
RUBBER



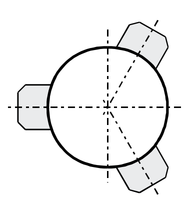
FLOATING HEAD



POSITIVE GRIPPING



3 POINT GRIPPING WITH 2 JAWS

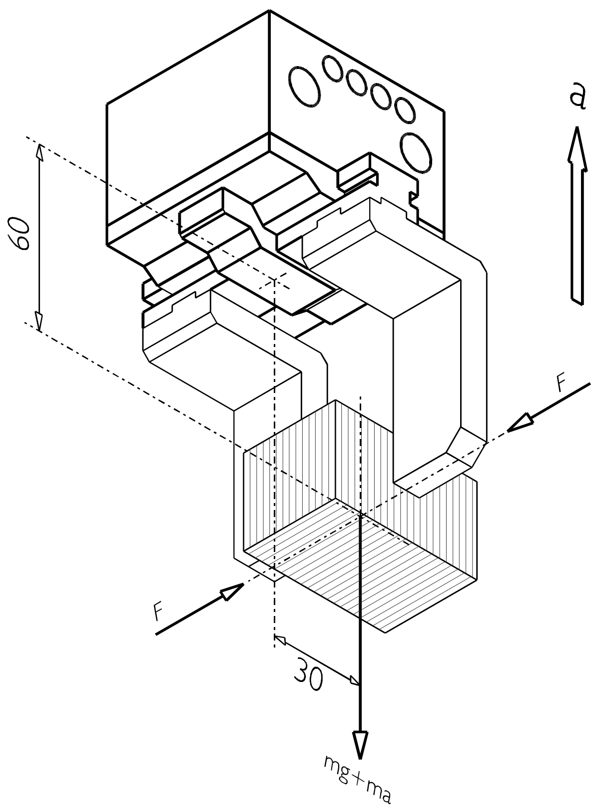


3 POINT GRIPPING WITH 3 JAWS

Gripper Calculation Example

Calculation example:

A 1kg load is to handle as in the figure with a coefficient of friction μ = 0.1.
The gripper, Gimatic MG-0050, moves upward with acceleration $a=4 m/s^2$.
Verify that the safety factor is at least $\eta=1.5$



m = *mass*

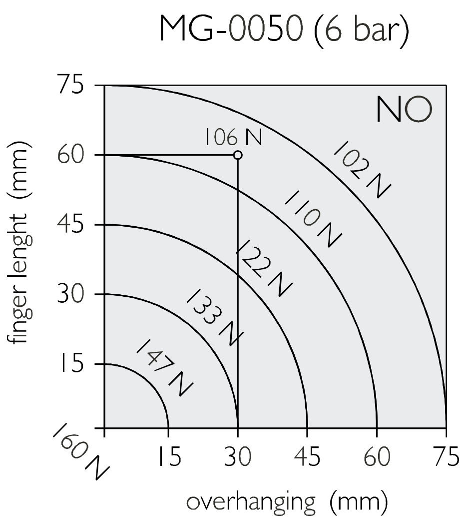
g = *acceleration of gravity*

a = *acceleration of handling*

μ = *coefficient of friction*

η = *safety factor*

m = 1 kg
g = $9.8 \ m/s^2$
a = $4 \ m/s^2$
μ = 0.1
η = 1.5



F = 106N

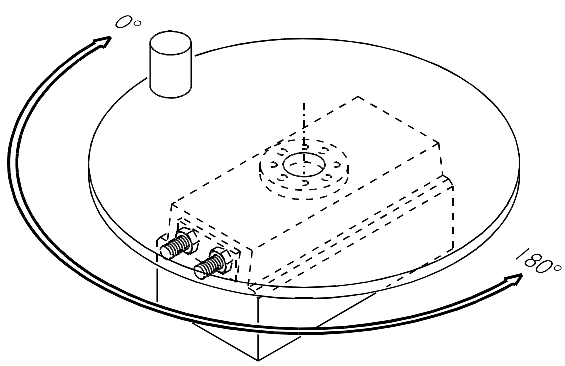
$$\eta m(g+a) = 2\mu F \Longrightarrow$$

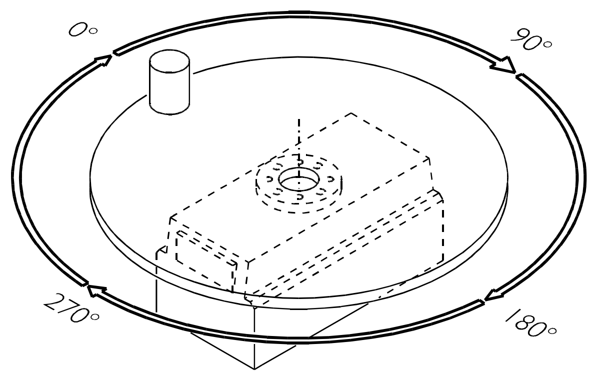
$$\eta = \frac{2\mu F}{m(g+a)} = \frac{2x0,1x106}{1(9,8+4)} = 1,536 \quad \text{OK}$$

Torque Calculations for Rotary Actuators

The rotary units

They convert the linear motion of pneumatic cylinders into rotating intermittent movement of a shaft, on which it is possible to flange the load to rotate.
The rotation can be alternated (swiveling actuator) or keeping the same direction (indexing table).
In the choice of a rotary units the factors to consider are the torque, the kinetic energy and the loads on the pinion.





The torque

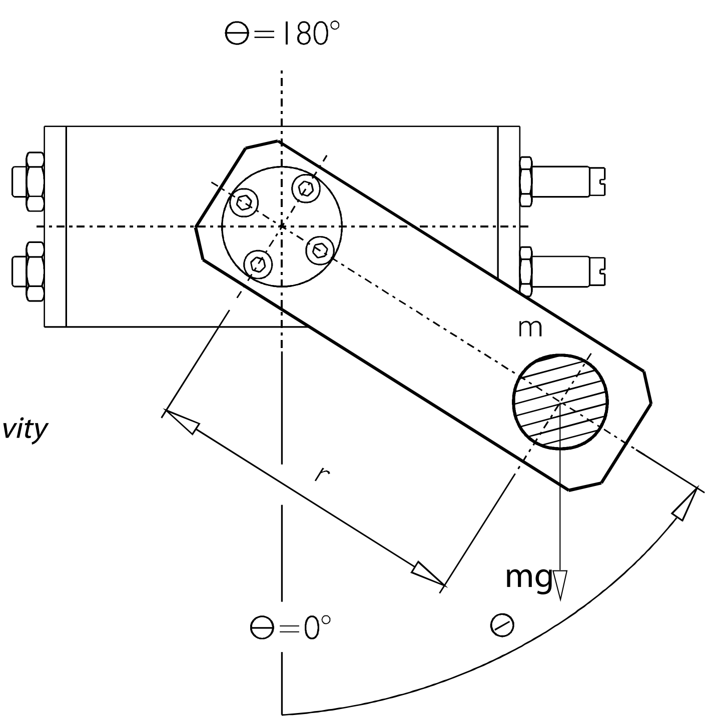
It must be sufficient to counteract the resistant forces, like the gravity of an eccentric mass: C > m g r

C = *torque*

m = *mass*

g = *acceleration of gravity*

r = *eccentricity*



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Kinetic Energy Calculation for Rotary Actuators

Kinetic energy

The kinetic energy, due to the inertia of the rotating masses, must be lower than the maximum admissable value, typical of each rotary unit. Shock-absorbers must be used when the kinetic energy is high.

$$E = \frac{1}{2} J \omega^2_{max} = \frac{1}{2} J \left(2\frac{\theta}{t}\right)^2 = \frac{2J\theta^2}{t^2}$$

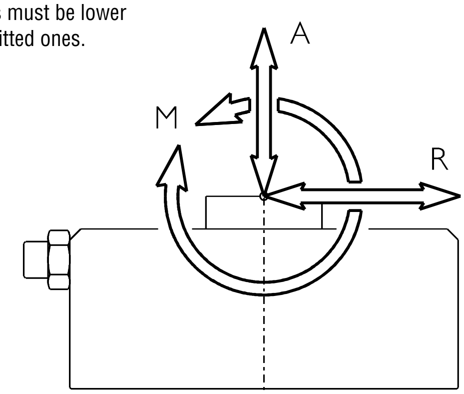
$$E = 0,0006092 \frac{J\alpha^2}{t^2}$$

where:

kinetic energy	E	$\left[\frac{Kg \cdot cm^2}{s^2}\right]$
moment of inertia	J	$[Kg \cdot cm^2]$
maximum angular speed	ω_{max}	$\left[\frac{rad}{s}\right]$
swiveling angle in radiants	θ	[rad]
swiveling angle in degrees	α	[deg]
swiveling time	t	[s]

Loads on the pinion

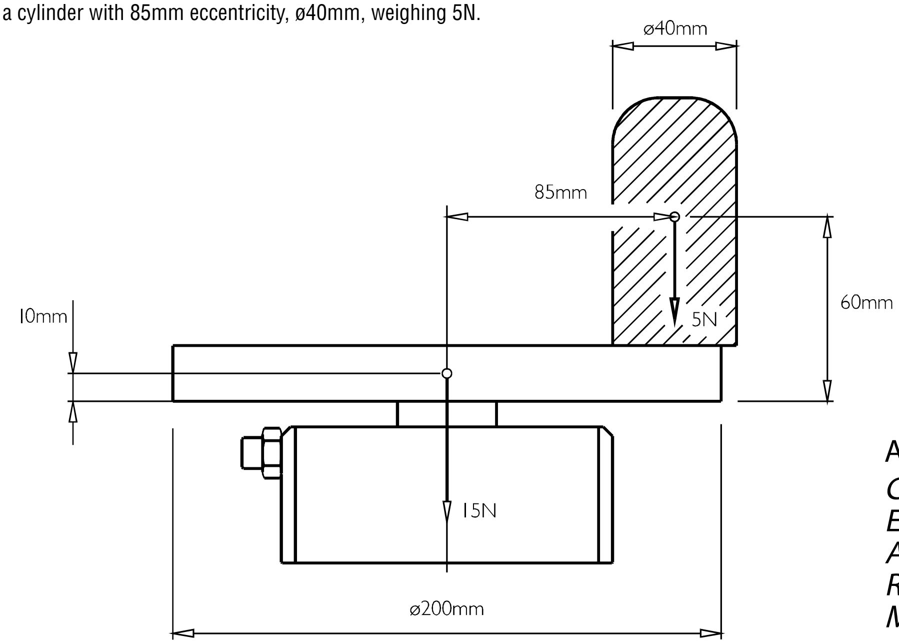
Dynamic and static loads must be lower than the maximum permitted ones.



$A < A_{max}$
$R < R_{max}$
$M < M_{max}$

Calculation example:

Verify the choice of the swiveling unit Gimatic AT-16180-R to rotate 180˚ (π radiants) in 1.4 seconds the masses below the vertical axis of rotation:
a cylinder ø200mm, weighing 15N, centered on the axis of rotation
a cylinder with 85mm eccentricity, ø40mm, weighing 5N.



AT-16180-R :

$C = 1930$ Nmm
$E^{max} = 1600$ Kg cm^2 s^{-2}
$Ad^{max} = 30$ N
$Rd^{max} = 20$ N
$Md^{max} = 0.6$ Nm

$$J = \frac{1}{2} \cdot 1.5kg \cdot (10cm)^2 + \frac{1}{2} \cdot 0.5kg \cdot (2cm)^2 + 0.5kg \cdot (8.5cm)^2 = 112kgcm^2$$

$$E = \frac{2 \cdot 112kgcm^2 \cdot \pi^2}{(1.4s)^2} = 1128kgcm^2s^{-2} < 1600kgcm^2s^{-2} = E_{max}$$

$$Ad = 15N + 5N = 20N < 30N = Ad^{max}$$

$$Rd = 0$$

$$Md = 5N \cdot 85mm = 425Nmm < 0.6Nm = Md^{max}$$

If the axis of rotation were horizontal*:*

$$C_r = 5N \cdot 85mm = 425\ Nmm < 1930\ Nmm = C$$

$$Ad = 0$$

$$Rd = 15N + 5N = 20N = Rd^{max}$$

$$Md = 15N \cdot 10mm + 5N \cdot 60mm = 450Nmm < 0.6\ Nm = Md^{max}$$