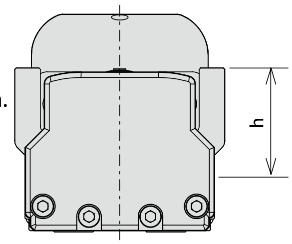
Push Force vs. and Electric Current Limit Correlation Graph

ERC3 Series | Slider Type / Rod Type

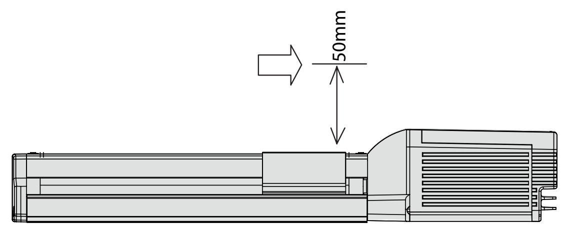
In a push-motion operation, the push force can be used by changing the current-limiting value of the controller over a range of 20% to 70%. The maximum push-force varies depending on the model, so check the required push force from the table below and select an appropriate type meeting the purpose of use.

When using slider type for pressing operation, limit pressing current to prevent anti-moment generated by push force from exceeding 80% of the catalog spec rating for moment (Ma, Mb).
To calculate the moment, use the guide moment action position shown in the figure at the right, and consider the amount of offset at the push force action position.
Be aware that, if excess force above the rated moment is applied, the guide can be damaged and its use life can be shortened. Therefore, carefully set the current with safety in mind.



ERC3
SA5C : h=36.5mm
SA7C : h=46.5mm
ERC3CR/ERC3D
SA5C : h=39mm
SA7C : h=43mm

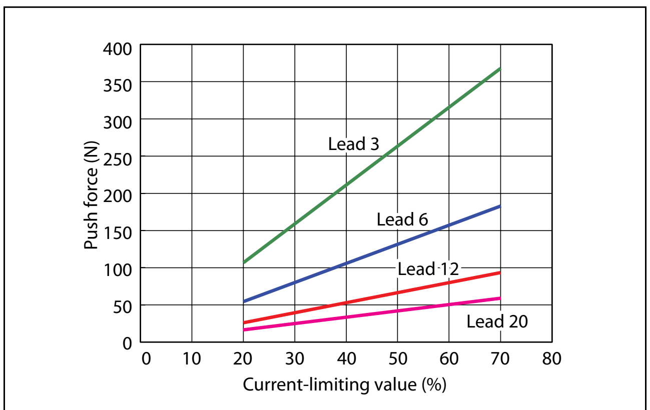
Example of calculation:
With this type, at the position shown in the figure at the right, when there is 100N of pressing
the moment received by the guide is Ma = (46.5 + 50) x 100
= 9650 (N•mm)
= 9.65 (N•m).
The SA7C rated moment is Ma = 15 (N•m)
and 15 x 0.8 = 12 > 9.65, which means it is OK.
Also, when pressing generates moment Mb, use the overhang calculation to similarly confirm that the moment is within 80% of the rated moment.



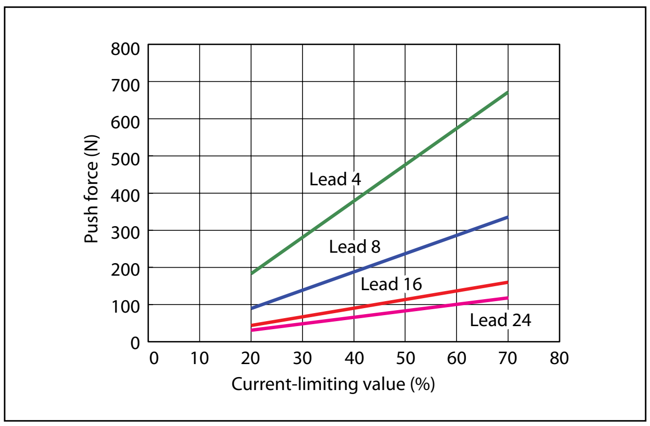
Push Force and Current Limit Correlation Graph

* In the table below, standard figures are shown. Actual figures will differ slightly.

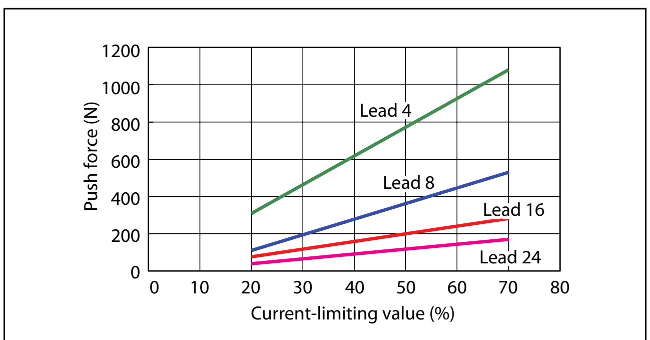
SA5C/RA4C type



SA7C type



RA6C type

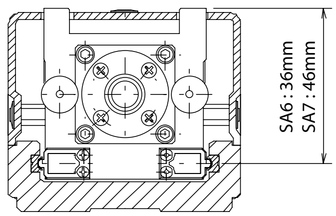


Notes on Use

- The relationship of the push force and the current-limiting value is only a reference, and the graphs may vary slightly from the actual values.
- If the current-limiting value is less than 20%, the push force may vary. Make sure the current-limiting value remains 20% or more.
- The graphs assume a traveling speed of 20 mm/s during push-motion operation.

ERC2 Series | Slider Type / Rod Type

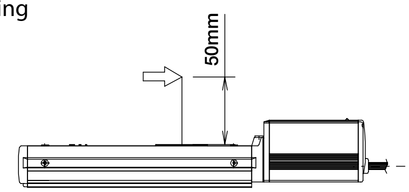
When using slider type for pressing operation, limit pressing current to prevent anti-moment generated by push force from exceeding 80% of the catalog spec rating for moment (Ma, Mb).
To calculate the moment, use the guide moment action position shown in the figure below, and consider the amount of offset at the push force action position.
Be aware that, if excess force above the rated moment is applied, the guide can be damaged and its use life can be shortened.
Therefore, carefully set the current with safety in mind.



Moment operation position

Caution:
Note: The movement speed during pressing is fixed at 20mm/s.

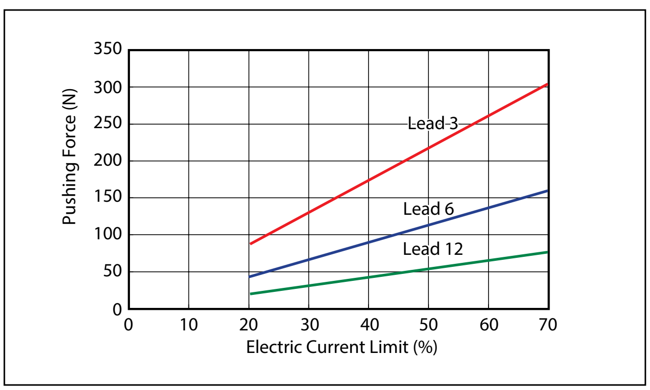
Example of calculation:
With this type, at the position shown in the figure at the right, when there is 100N of pressing the moment received by the guide is Ma = (46 + 50) x 100
= 9600 (N•m)
= 9.6 (N•m).
The SA7C rated moment is Ma = 13.8 (N•m)
and 13.8 x 0.8 = 11.04 > 9.6, which means it is OK.
Also, when pressing generates moment Mb, use the overhang calculation to similarly confirm that the moment is within 80% of the rated moment.



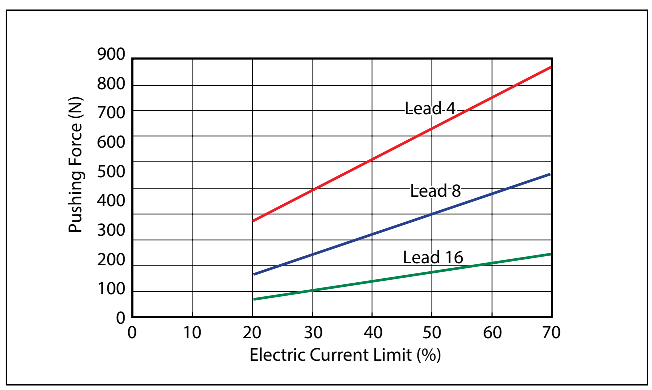
Push Force and Current Limit Correlation Graph

* In the table below, standard figures are shown. Actual figures will differ slightly.

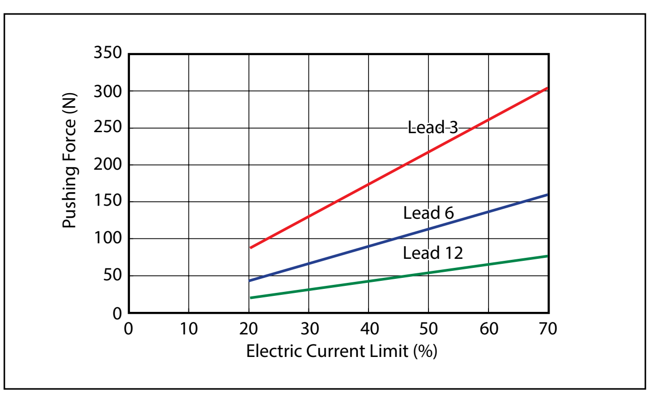
SA6C type



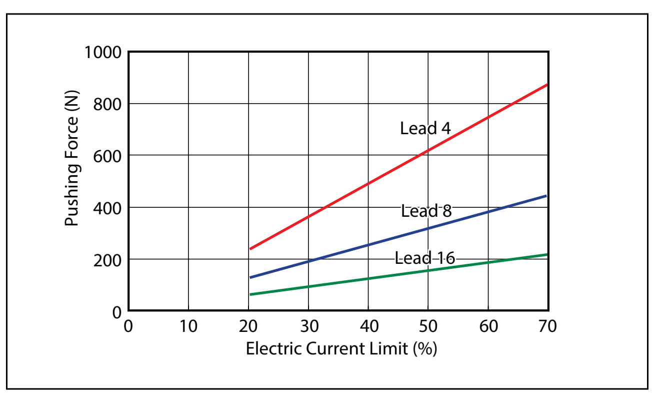
SA7C type



RA6C type



RA7C type

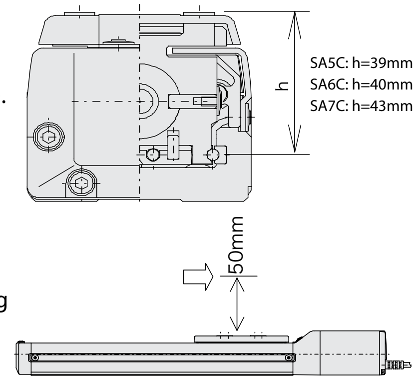


Push Force vs. and Electric Current Limit Correlation Graph

RCP4 Series | Slider Type / Rod Type

In a push-motion operation, the push force can be used by changing the current-limiting value of the controller over a range of 20% to 70%. The maximum push-force varies depending on the model, so check the required push force from the table below and select an appropriate type meeting the purpose of use.

When using slider type for pressing operation, limit pressing current to prevent anti-moment generated by push force from exceeding 80% of the catalog spec rating for moment (Ma, Mb). To calculate the moment, use the guide moment action position shown in the figure at the right, and consider the amount of offset at the push force action position.
Be aware that, if excess force above the rated moment is applied, the guide can be damaged and its use life can be shortened. Therefore, carefully set the current with safety in mind.

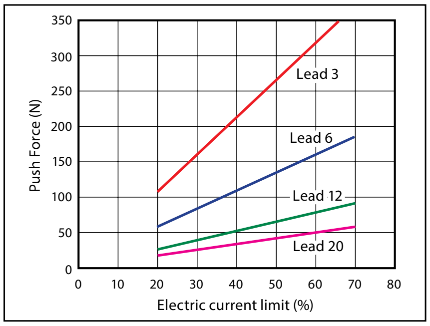


Example of calculation:
With this type, at the position shown in the figure at the right, when there is 100N of pressing the moment received by the guide is Ma = (43 + 50) x 100
= 9300 (N•mm)
= 9.3 (N•m).
The SA7C rated moment is Ma = 13.9 (N•m)
and 13.9 x 0.8 = 11.12 > 9.3, which means it is OK. Also, when pressing generates moment Mb, use the overhang calculation to similarly confirm that the moment is within 80% of the rated moment.

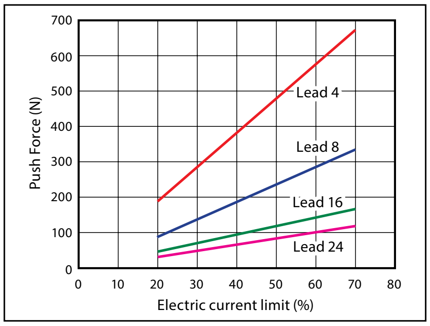
Push Force and Current Limit Correlation Graph

* In the table below, standard figures are shown. Actual figures will differ slightly.

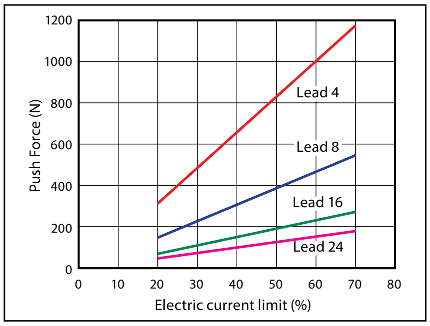
SA5C/SA5R/SA6C/SA6R/RA5C/RA5R type



SA7C/SA7R type



RA6C/RA6R type

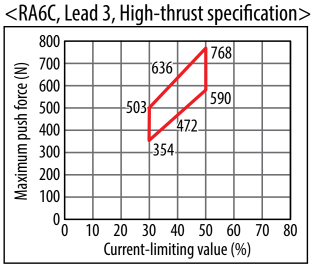


Notes on Use

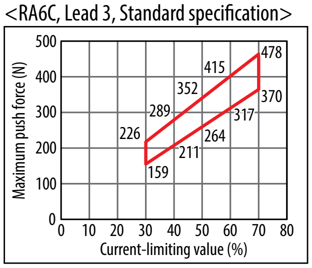
- The relationship of push force and current-limiting value is only a reference, and the graphs may vary slightly from the actual values.
- If the current-limiting value is less than 20%, the push force may vary. Make sure the current-limiting value remains 20% or more.
- The graphs assume a traveling speed of 20mm/s during push-motion operation.

RCP4W-RA6C/RA7C type

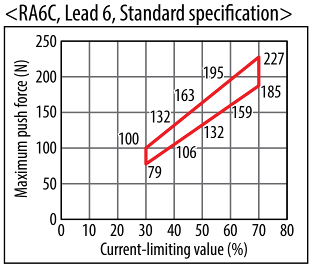
<RA6C, Lead 3, High-thrust specification>



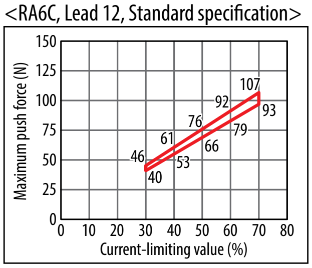
<RA6C, Lead 3, Standard specification>



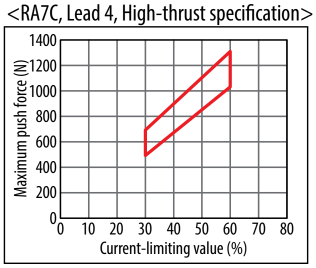
<RA6C, Lead 6, Standard specification>



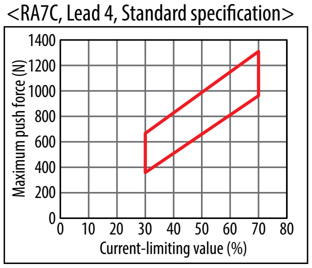
<RA6C, Lead 12, Standard specification>



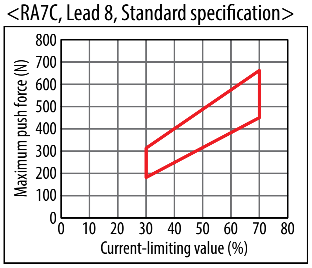
<RA7C, Lead 4, High-thrust specification>



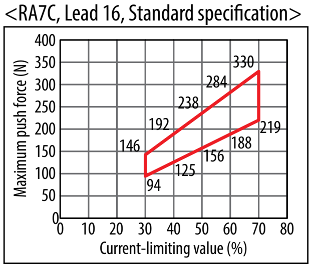
<RA7C, Lead 4, Standard specification>



<RA7C, Lead 8, Standard specification>



<RA7C, Lead 16, Standard specification>



Notes on Use

- The relationship of push force and current-limiting value is only a reference, and the graphs may vary slightly from the actual values.
- If the current-limiting value is less than 20%, the push force may vary. Make sure the current-limiting value remains 20% or more.
- The graphs assume a traveling speed of 20mm/s during push-motion operation. Please be aware that the push force changes as the speed changes.

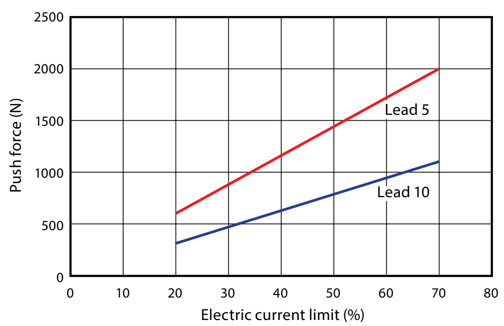
RCP2 Series | High-Thrust Rod Type

You can change the push force exerted by the actuator during push operation, as desired, by changing the electric current limit of the controller. Since the maximum push force varies depending on the model, check the graphs below to identify the necessary push force and select a type that meets your specific purpose.

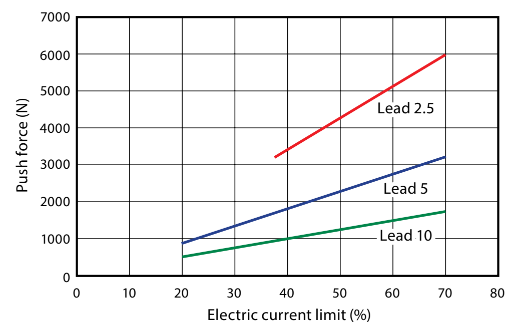
Push Force and Current Limit Correlation Graph

* In the table below, standard figures are shown. Actual figures will differ slightly.

RA8C type



RA10C type



Important

The RCP2-RA8C can perform push operation continuously at electric current limits of up to 60%, but if the electric current limit must be between 60% and 70%, some limitations apply to the operation pattern.
Check the information in "Reference for Selection" below to see if your operation pattern meets the specified conditions.

RCP2-RA8 - Reference for Selection

With the RCP2-RA8, the electric current limit at which the actuator can perform continuous operation is specified as 60% or below in light of heat generation from the motor. If you will be using this actuator to push the work or remain standstill at electric current limits exceeding 60%, the operating torque per cycle must be no more than 60% (2.08 N•m).
Follow the reference for selection below to confirm that your operation pattern meets the specified conditions.

<Operating Conditions>

Condition 1. The actuator does not push the work part or remain for any longer than the time specified for the electric current limit.

Condition 2. The continuous operating torque per cycle is no more than 2.08 N•m.

Condition 3. The actuator does not push the work part or remain standstill at a electric current limit exceeding 60% more than once per cycle.

Condition 1 Pushing/Standstill Time

◎Refer to Table 1/Fig. 1 for the pushing/standstill time.

Table 1 Electric Current Limits and Maximum Times

Electric current limit when pushing/standstill (%)	Maximum time (sec)
70	600
68	850
66	1050
64	1250
62	1500
61	1700
No more than 60	(Continuous operation is possible)

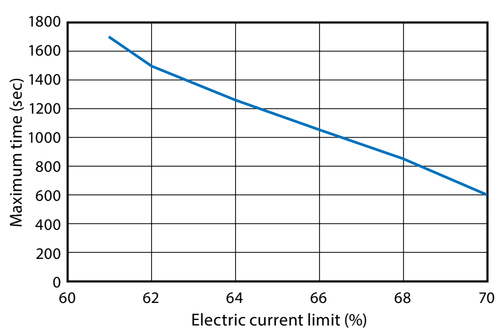


Fig. 1 Electric Current Limit vs. Maximum Time

Push Force vs. and Electric Current Limit Correlation Graph

Condition 2 Continuous Operating Torque

◎Refer to Table 2/Fig. 2 for the pushing/standstill torque.

Table 2 Electric Current Limits and Motor Torques

Electric current limit when pushing/standstill (%)	Motor torque (N•m)
70	2.43
60	2.08
50	1.74
40	1.39
30	1.04

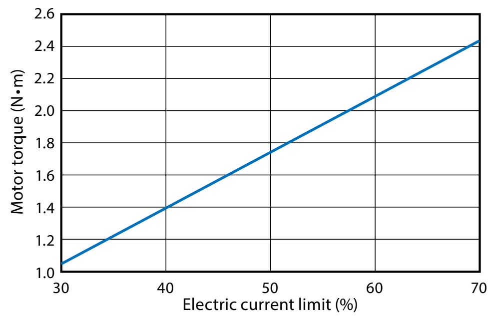
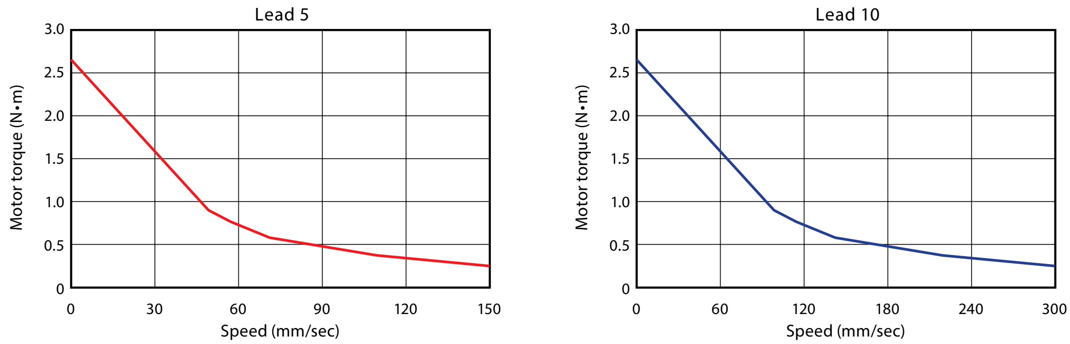


Fig. 2 Electric Current Limit vs. Motor Torque

◎Refer to Fig. 3 for the torque required for constant-speed movement.

◎Refer to Fig. 3 to calculate the motor torque required for acceleration/deceleration by dividing the attained speed by 2.



◎Calculation of continuous operating torque

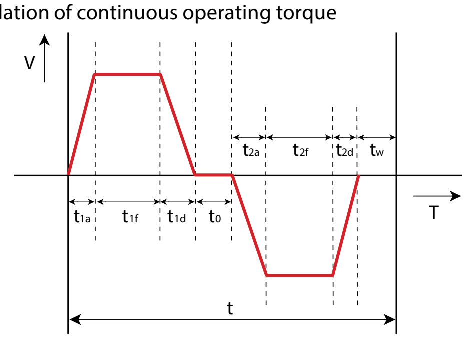


Fig. 4 Change in Actuator Speed Over Time

- t : Operating time per cycle (sec)
- t_{1a} : Acceleration time 1
- t_{1f} : Constant-speed movement time 1
- t_{1d} : Deceleration time 1
- t_0 : Push operation time * Within the scope of Condition 1
- t_{2a} : Acceleration time 2
- t_{2f} : Constant-speed movement time 2
- t_{2d} : Deceleration time 2
- t_w : Wait time

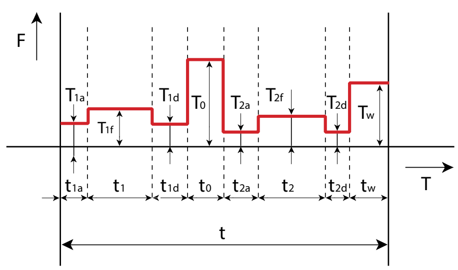


Fig. 5 Change in Torque Over Time

- T_{1a} : Motor torque required for acceleration 1
- T_{1f} : Motor torque required for constant-speed movement 1
- T_{1d} : Motor torque required for deceleration 1
- T_0 : Motor torque required for push operation
- T_{2a} : Motor torque required for acceleration 2
- T_{2f} : Motor torque require d for constant-speed movement 2
- T_{2d} : Motor torque required for deceleration 2
- T_w : Motor torque required for stand-by

$$T_t = \sqrt{\frac{T_{1a}^2 \cdot t_{1a} + T_{1f}^2 \cdot t_{1f} + T_{1d}^2 \cdot t_{1d} + T_0^2 \cdot t_0 + T_{2a}^2 \cdot t_{2a} + T_{2f}^2 \cdot t_{2f} + T_{2d}^2 \cdot t_{2d} + T_w^2 \cdot t_w}{t}} \quad \cdots \text{(Equation 1)}$$

$$T_t \leqq 2.08 \quad \cdots \text{(Equation 2)}$$

Calculation Example

1G = 9.8m/s²

- Let's select an operation pattern according to the selection steps described above.

Operating conditions

- Applicable model : RCP2-RA8 Lead 10
- Speed : 200mm/sec
- Acceleration/deceleration : 1.96m/s² (0.2G)
- Travel distance : 100mm
- Push command value : 70% (1,000N)
- Pushing time : 60 sec
- Electric current limit at standstill : 40%
- Wait time : 36 sec
- Move 100 mm forward and perform push operation, move 100mm backward and wait
- Operation pattern in Fig. 6

The above operation pattern is expressed in the graph shown to the right.

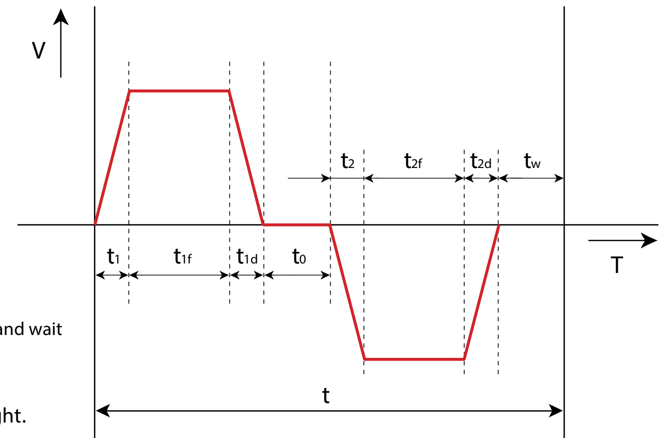


Fig. 6 Operation Pattern

Condition 1 Check the push operation time

From Table 1, the maximum pushing time at the push command value of 70% is 600 sec.
Since the pushing time under this operation pattern is 60 sec, no problem is anticipated in terms pushing time.

Condition 2 Check the continuous operating torque

Check the continuous operating torque
When the operation pattern is assigned to the continuous torque calculation equation (Equation 1):

$$T_t = \sqrt{\frac{T_{1a}^2 \cdot t_{1a} + T_{1f}^2 \cdot t_{1f} + T_{1d}^2 \cdot t_{1d} + T_0^2 \cdot t_0 + T_{2a}^2 \cdot t_{2a} + T_{2f}^2 \cdot t_{2f} + T_{2d}^2 \cdot t_{2d} + T_w^2 \cdot t_w}{t}} \quad \cdots \text{(Equation 1)}$$

Here,
$T_{1a} = t_{1d} = t_{2a} = t_{2d}$ = 0.93 N•m (200 mm/sec / 2 = 100 mm/sec → Find the torque from Fig. 3.)
$T_{1f} = t_{2f}$ = 0.42 N•m (200 mm/sec → Find the torque from Fig. 3.)
T_0 = 2.43 N•m (70% → Find the torque from Table 2.)
T_w = 1.39 N•m (40% → Find the torque from Table 2.)
$t_{1a} = t_{1d} = t_{2a} = t_{2d}$ = 0.2 sec, $t_{1f} = t_{2f}$ = 0.9 sec, t_0 = 60 sec, t_w = 36 sec
Accordingly, the continuous operating torque under the above operation pattern is calculated as follows:

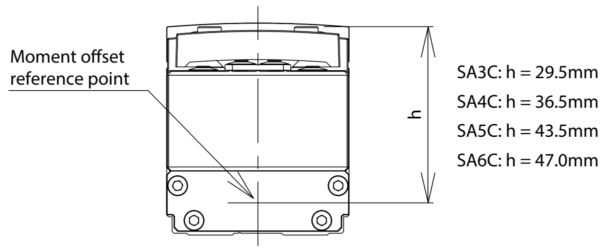
T_t = 2.076

Since (Equation 2) is satisfied, no problem is anticipated in terms of continuous operating torque.

Push Force vs. Electric Current Limit Correlation Graph

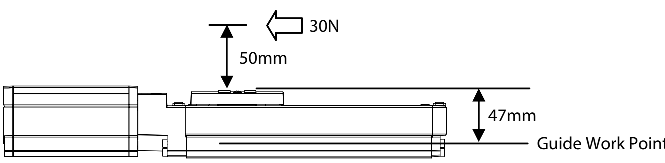
RCP3 Series | Slider Type

When using the slider type for the pressing operation, limit the pressing current to prevent anti-moment generated by push force from exceeding 80% of catalog spec rating for moment (Ma, Mb).
To calculate moment, use the guide moment action position shown in the figure at the right, and consider the amount of offset at the push force action position.
Be aware that, if excess force above the rated moment is applied, the guide can be damaged and its use life can be shortened. Therefore, carefully set the current with safety in mind.



When using slider type for the pressing operation, use setting to ensure that anti-moment generated by push force does not exceed 80% of catalog spec moment tolerance.

Example of calculations:
With the RCP3-SA6C (Lead 12) type, using the position shown in the figure at the right, and pressing at 30N,
the moment received by the guide is Ma = (47 + 50) x 30
= 2910 (N•mm)
= 2.91 (N•m).

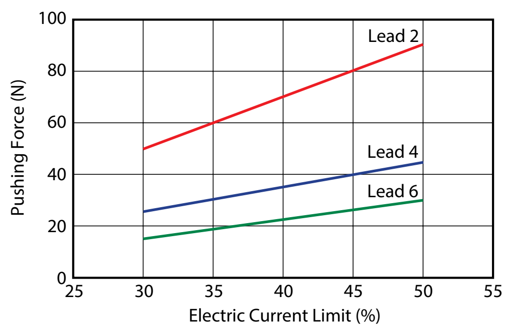


The SA6C allowable load moment (Ma) is 4.31(N•m), 80% of which is 3.448, which is greater than the actual moment load received by the guide (2.91). Therefore, it can be decided that this moment load can be used.

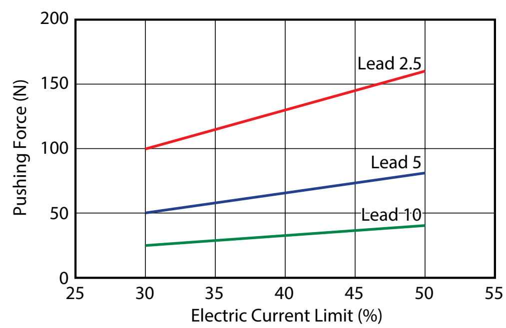
Push Force and Current Limit Correlation Graph

* In the table below, standard figures are shown. Actual figures will differ slightly.

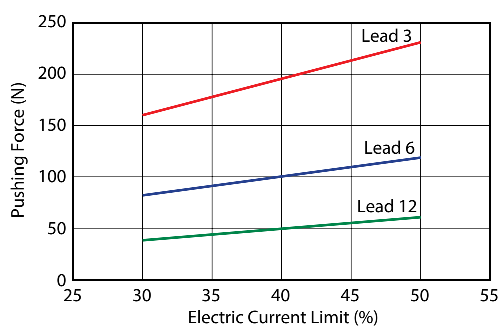
SA3C type



SA4C type

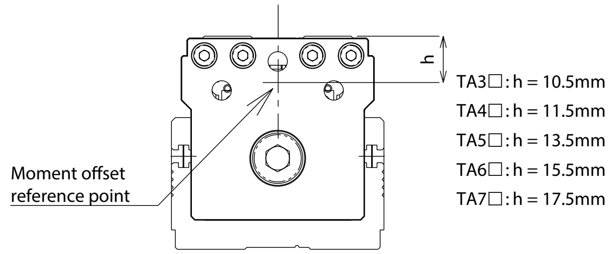


SA5C/SA6C type



RCP3 Series Table Type

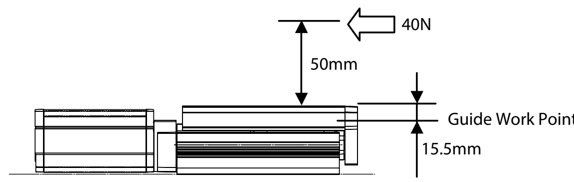
When using the table type for the pressing operation, limit the pressing current to prevent anti-moment generated by push force from exceeding 80% of catalog spec rating for moment (Ma, Mb).
To calculate moment, use the guide moment action position shown in the figure at the right, and consider the amount of offset at the push force action position.
Be aware that, if excess force above the rated moment is applied, the guide can be damaged and its use life can be shortened. Therefore, carefully set the current with safety in mind.



When using a table type for the pressing operation, use setting to ensure that anti-moment generated by the push force does not exceed 80% of catalog spec moment tolerance.

Example of calculations:
With the RCP3-TA6C (Lead 12) type, using the position shown in the figure at the right, and pressing at 40N,
the moment received by the guide is Ma = (15.5 + 50) x 40
= 2620 (N•mm)
= 2.62 (N•m).

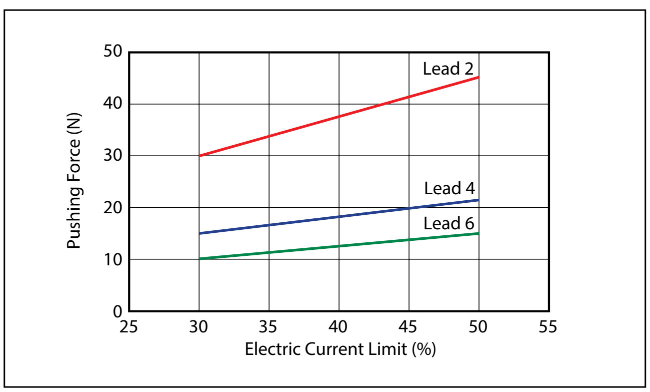
The TA6C allowable load moment (Ma) is 7.26(N•m),
80% of which is 5.968, which is greater than the actual moment load received by
the guide (2.62). Therefore, it can be decided that this moment load can be used.



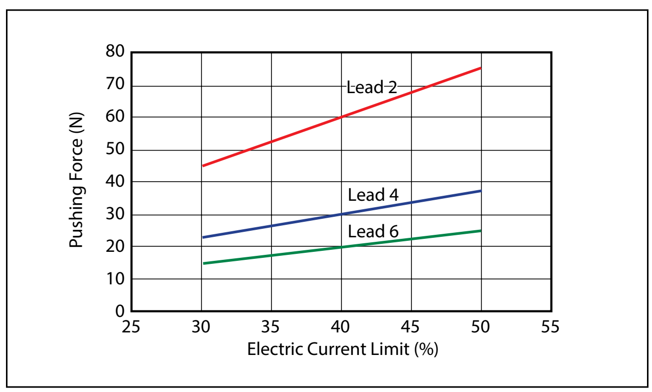
Push Force and Current Limit Correlation Graph

* In the table below, standard figures are shown. Actual figures will differ slightly.

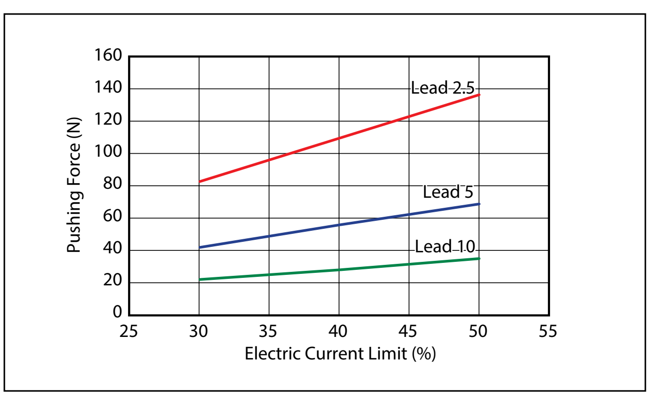
TA3C type



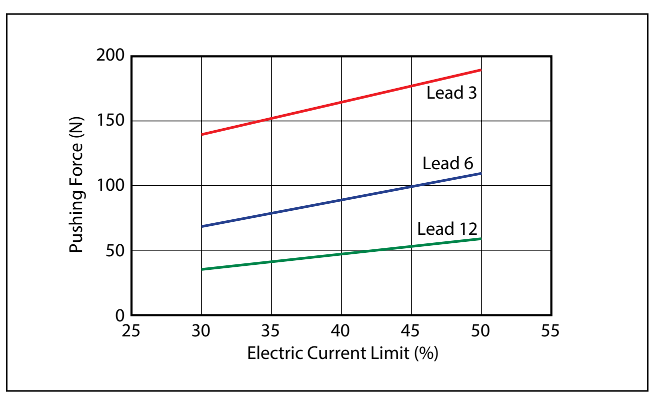
TA4C type



TA5C type



TA6C/TA7C type



Push Force vs. Electric Current Limit Correlation Graph

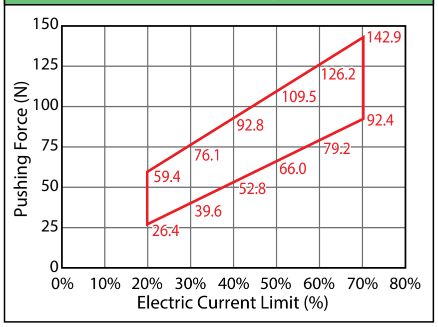
RCP3 Series — Mini Rod Type (RA2AC/RA2BC/RA2AR/RA2BR)

*The specification value is shown within an area indicated by a red line.

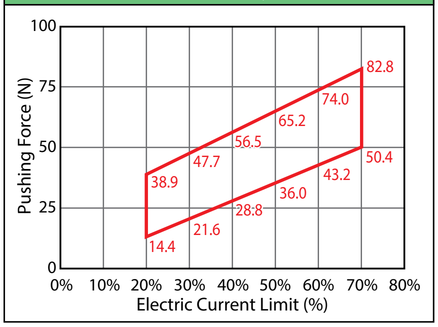
When performing a pressing operation, select a model which has desired push force within an area indicated by the red line in the graph below. (The graph makes allowance for efficiency reduction due to change due to wear.)

Caution:
Movement speed during pressing operation is fixed at 5mm/s.

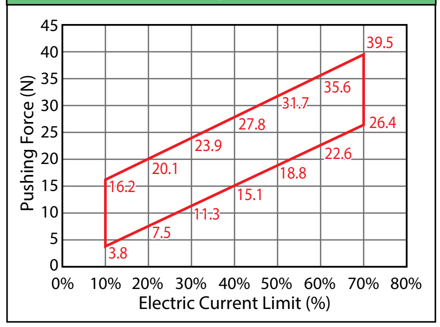
Ball screw high-thrust type <lead 1>



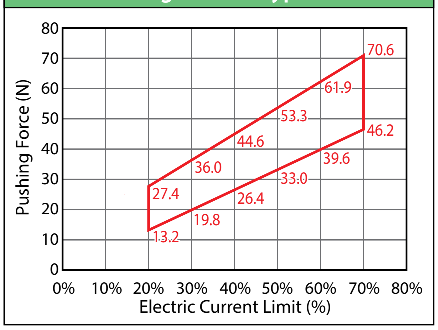
Ball screw standard type <lead 1>



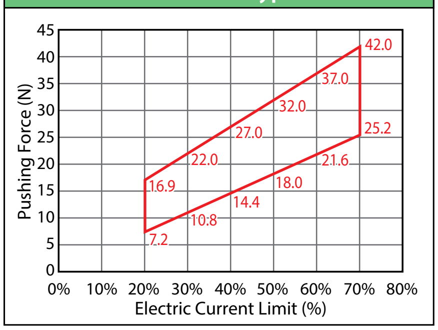
Lead screw type <lead 1>



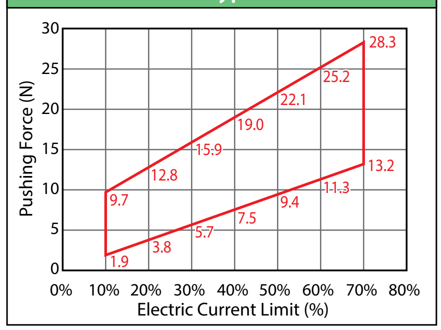
Ball screw high-thrust type <lead 2>



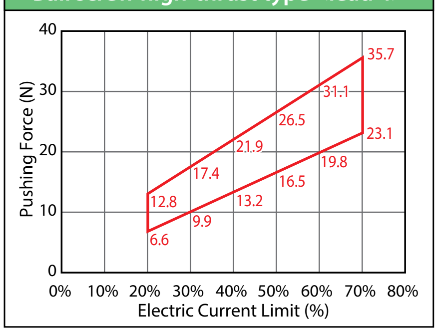
Ball screw standard type <lead 2>



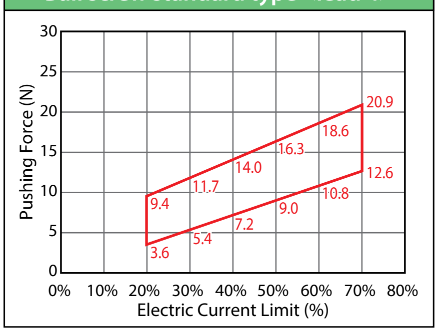
Lead screw type <lead 2>



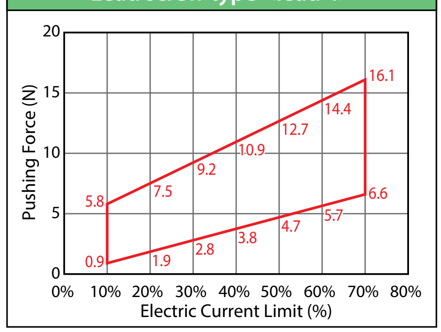
Ball screw high-thrust type <lead 4>



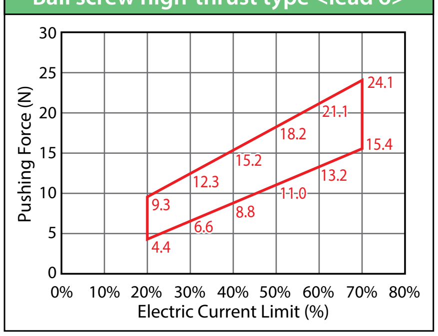
Ball screw standard type <lead 4>



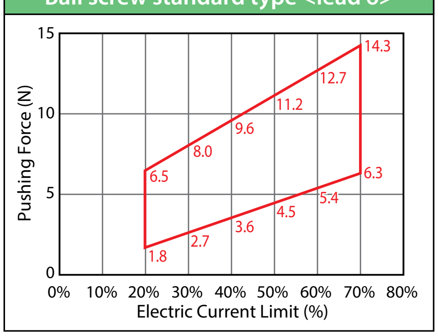
Lead screw type <lead 4>



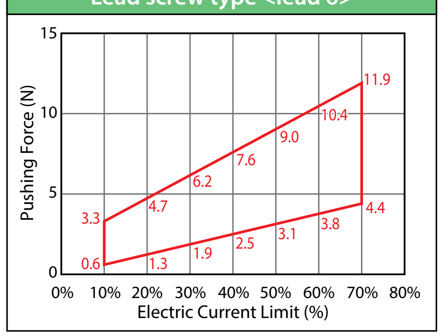
Ball screw high-thrust type <lead 6>



Ball screw standard type <lead 6>

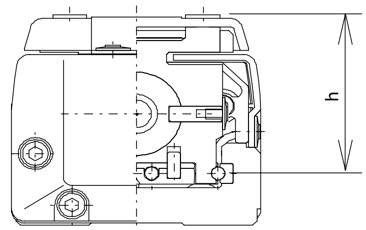


Lead screw type <lead 6>



RCP2 Series Slider Type / Rod Type

When using the slider type for the pressing operation, limit the pressing current to prevent anti-moment generated by the push force from exceeding 80% of the catalog spec rating for moment (Ma, Mb).
To calculate moment, use the guide moment action position shown in the figure at the right, and consider the amount of offset at the push force action position.
Be aware that, if excess force above the rated moment is applied, the guide can be damaged and its use life can be shortened. Therefore, carefully set the current with safety in mind.

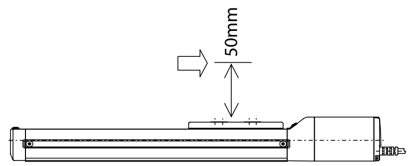


SA5C: h = 39mm
SA6C: h = 40mm
SA7C: h = 43mm
SS7C: h = 36mm
SS8C: h = 48mm

Caution:
- Pressing operations cannot be perfomed for Belt type (BA6/BA7).
- Note: The movement speed during pressing is fixed at 20mm/s.

Example of calculations:
With the RCP2-SS7C type, and using the position in the figure at right for 100N pressing,

the moment received by the guide is Ma = (36 + 50) x 100
= 8600 (N•mm)
= 8.6 (N•m).

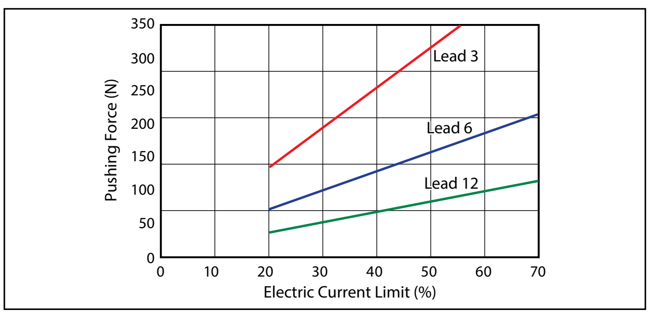


The SS rated moment is Ma = 14.7 (N•m)
and 14.7 x 0.8 = 11.76 > 8.6, which means it is OK.
Also, when pressing generates moment Mb, use the overhang calculation to similarly confirm that the moment is within 80% of the rated moment.

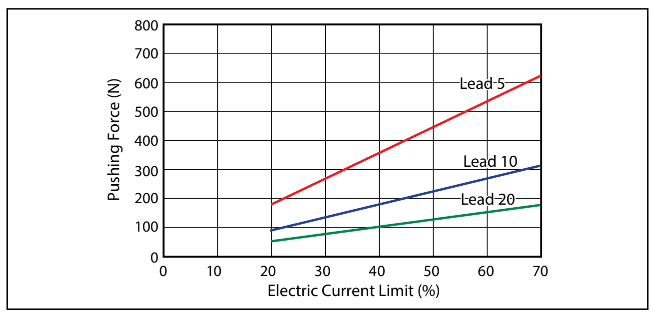
Push Force and Current Limit Correlation Graph

* In the table below, standard figures are shown. Actual figures will differ slightly.

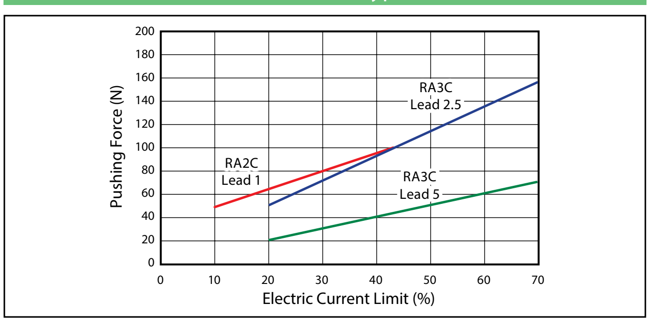
SS7C type



SS8C type

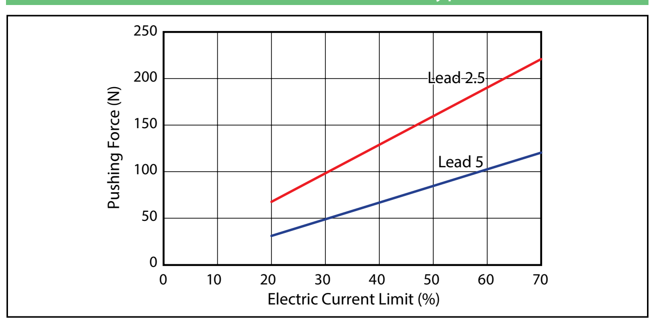


RA2C/RA3C type

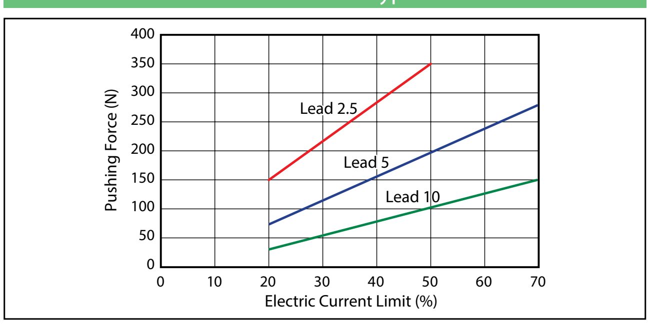


* With the RCS2 models the upper limit of the push force is set according to the stroke. 25.50 stroke: 100N, 75 stroke: 70N, 100 stroke: 55N

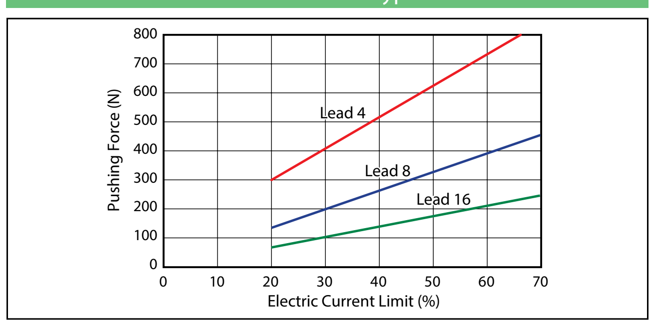
SRA4R/SRGS4R/SRGD4R type



RCP2W-RA4C type



RCP2W-RA6C type



Push Force vs. Electric Current Limit Correlation Graph

RCS2 Series | Rod Ultra-high thrust type

The following three conditions must be met when using this device.
Condition 1: The pushing time must be less than the time determined.
Condition 2: One cycle of continuous thrust must be less than the rated thrust for an ultra-high thrust actuator.
Condition 3: There must be one pushing operation in one cycle.

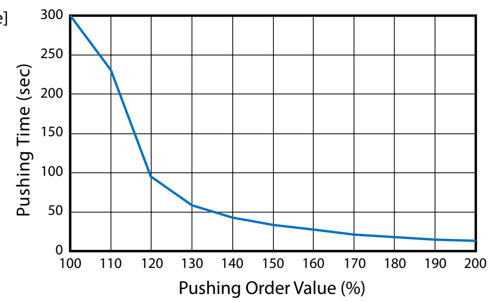
Selection Method

Condition 1. Pushing Time

The maximum pressing time for each pressing order must be determined as shown in the table below. The pressing time used must be less than the tin indicated in the table below.
Actuator malfunction could result if the process is used without adhering to the table below.

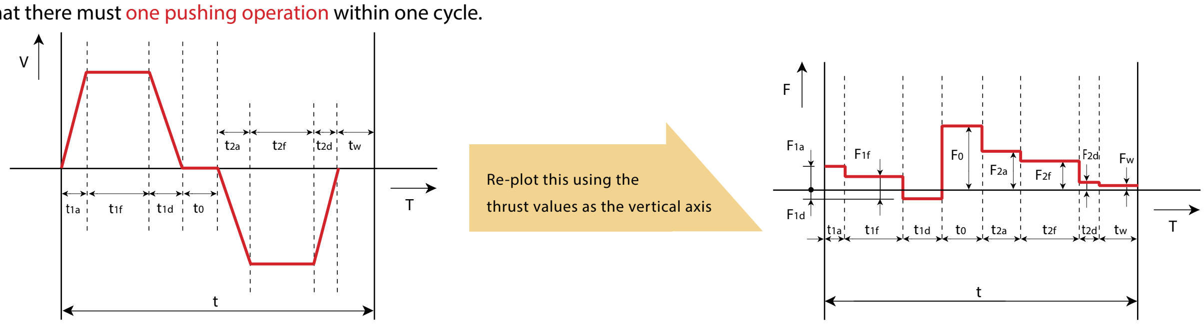
Table 1

Pushing Order Value (%)	Maximum Pushing Time (sec)
70 or less	(Continuous pushing possible)
80~100	300
110	230
120	95
130	58
140	43
150	33
160	27
170	21
180	18
190	15
200	13



Condition 2. Continuous Operation Thrust

Confirm that 1 cycle of continuous operation thrust Ft, based on a consideration of load and duty, is less than that of the rated thrust for a ultra-high-thrust actuator.
Note that there must one pushing operation within one cycle.



t : Operation duration per cycle (s)	t_{2a} : Acceleration duration2
t_{1a} : Acceleration duration1	t_{2f} : Constant speed duration2
t_{1f} : Constant speed duration1	t_{2d} : Deceleration duration2
t_{1d} : Deceleration duration1	t_w : Waiting duration
t_0 : Pushing duration	

F_{1a} : Thrust1 needed for acceleration	F_{2a} : Thrust2 needed for acceleration
F_{1f} : Thrust1 needed for motion at constant speed	F_{2f} : Thrust2 needed for motion at constant speed
F_{1d} : Thrust1 needed for deceleration	F_{2d} : Thrust2 needed for deceleration
F_0 : Thrust needed for pushing	F_w : Thrust needed for waiting

Use the equation below to calculate the continuous operation thrust Ft for one cycle.

$$F_t = \sqrt{\frac{F_{1a}^2 \times t_{1a} + F_{1f}^2 \times t_{1f} + F_{1d}^2 \times t_{1d} + F_0^2 \times t_0 + F_{2a}^2 \times t_{2a} + F_{2f}^2 \times t_{2f} + F_{2d}^2 \times t_{2d} + F_w^2 \times t_w}{t}}$$

*For horizontal use, it is not necessary to calculate the thrust needed for constant speed motion and for waiting.

- Since $F_{1a}/F_{2a}/F_{1d}/F_{2d}$ will change with the direction of motion, use the equations below.

Horizontal use (for both accel./decel.)	$F_{1a} = F_{1d} = F_{2a} = F_{2d} = (M+m) \times d$
Vertical use, downward acceleration	$F_{1a} = (M+m) \times 9.8 - (M+m) \times d$
Vertical use, constant downward speed	$F_{1f} = (M+m) \times 9.8 + \alpha$ (*1)
Vertical use, downward deceleration	$F_{1d} = (M+m) \times 9.8 + (M+m) \times d$
Vertical use, upward acceleration	$F_{2a} = (M+m) \times 9.8 + (M+m) \times d$
Vertical use, constant upward motion	$F_{2f} = (M+m) \times 9.8 + \alpha$ (*1)
Vertical use, upward deceleration	$F_{2d} = (M+m) \times 9.8 - (M+m) \cdot d$
Vertical use, waiting	$F_w = (M+m) \times 9.8$

M : Moveable weight (kg)
m : Loaded weight (kg)
d : Accel./decel. (m/s²)
α : Thrust (taking into account the travel resistance by the external guide.)

*1 If an external guide is attached, it is necessary to consider travel resistance.

Moveable weight for ultra-high thrust actuator: 9kg

- The method of calculating t□a, which is the acceleration duration, will vary for 1 trapezoidal pattern vs. 2 triangular pattern movements.
  Whether a movement pattern is trapezoidal or triangular can be determined by whether the peak speed reached after accelerating over a distance at a specified rate is greater than or less than the specified speed.

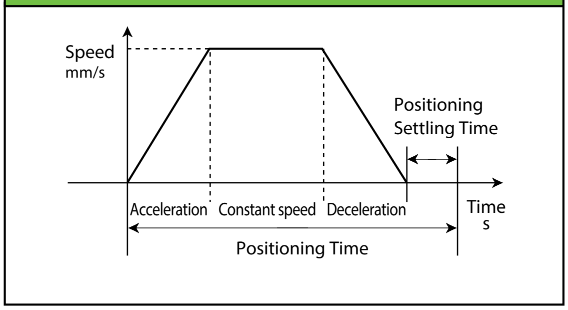
  Peak Speed (Vmax)= $\sqrt{\text{Distance Moved (m)} \times \text{Set Acceleration (m/s}^2\text{)}}$

  Set Speed < Peak Speed → ①Trapezoidal Pattern
  Set Speed > Peak Speed → ②Triangular Pattern

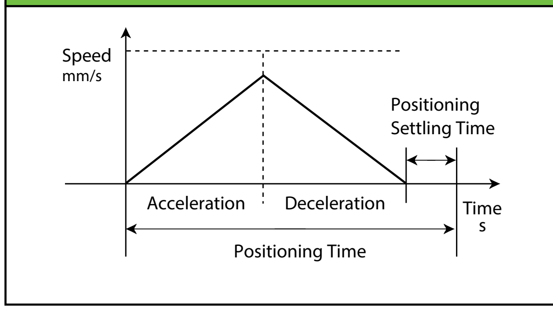
① For trapezoidal pattern,
t□a=Vs/a Vs : Set speed (m/s) a : Ordered acceleration (m/s²)

② For triangular pattern
t□a=Vt/a Vt : Peak speed (m/s) a : Ordered acceleration (m/s²)

① Trapezoidal Pattern



② Triangular Pattern



- t□f is the time taken to move at constant speed. You can calculate this time by computing the distance moved at constant speed.
  t□f= Lc/V Lc : Distance moved at constant speed (m) V : Commanded acceleration (m/s)

  * Distance moved at constant speed = total distance – accelerated distance – decelerated distance Accel./decel. distance = V²/2a

- t□d is the deceleration time. This is the same as the acceleration time, if the magnitude of acceleration and deceleration are the same.
  t□d=V/a V : Set speed (trapezoidal pattern) or Peak speed (triangular pattern)(m/s) a : Commanded deceleration (m/s²)

If the continuous operation thrust Ft by this method is less than the rated thrust, then operation is possible.

Rated thrust for ultra-high thrust actuator with 2.5 lead: 5,100N

Rated thrust for ultra-high thrust actuator with 1.25 lead: 10,200N

Operation is possible if both of the above operating conditions 1 and 2 are met.
If either condition cannot be met, make adjustments such as shortening the pushing operation time or decreasing the duty.

Sample Problem

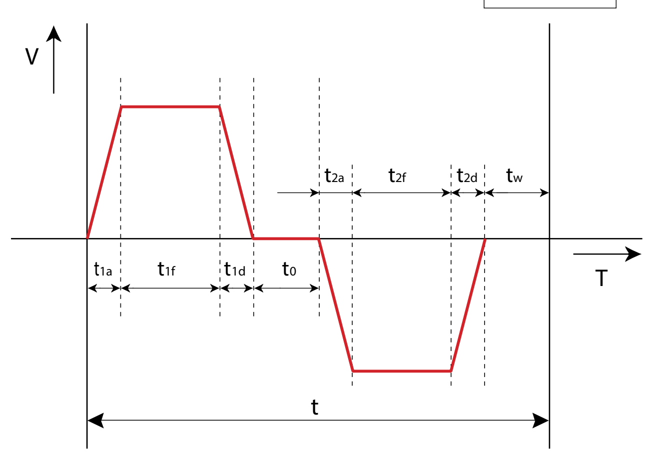
■ Select an operation pattern by using the selection method described above.

Operating Conditions

- Model used : Ultra-high thrust actuator with 1.25 lead
- Mounting orientation : Vertical
- Speed : 62mm/s
- Acceleration : 0.098m/s² (0.01G, same value for deceleration.)
- Distance moved : 50mm
- Payload : 100kg
- Push order value : 200% (2,000kgf)
- Pushing Time : 3 seconds
- Wait time : 2 seconds
- Push down 50mm, then raise 50mm, and finally wait 2 seconds.
  The conditions for downward and upward motions are identical.

Plotting the above operation yields the graph on the right.

1G = 9.8m/s²



Push Force vs. Electric Current Limit Correlation Graph

Using the selection method:

Condition 1. Confirm push operation time

By comparing our push time of 3 seconds with the maximum push time for a push order value of 200%, which is 13 seconds (see Table 1 on page A-83), it is clear that the pressing time is acceptable.

Condition 2. Calculate the continuous operation thrust

Substitute the above operational pattern to the previously mentioned equation for continuous operation thrust.

$$Ft = \sqrt{\frac{F1a^2 \times t_{1a} + F_{1f}^2 \times t_{1f} + F_{1d}^2 \times t_{1d} + F_0^2 \times t_0 + F_{2a}^2 \times t_{2a} + F_{2f}^2 \times t_{2f} + F_{2d}^2 \times t_{2d} + F_w^2 \times t_w}{t}}$$

At this point, by looking at the motion pattern for t1a/t1d/t2a/t2d, the peak speed (Vmax) $= \sqrt{0.05 \times 0.098} \rightarrow 0.07$m/s, which is greater that the set speed, 62mm/s (0.06m/s). Hence this is a trapezoidal pattern.

Hence, $t_{1a}/t1d/t_{2a}/t_{2d} = 0.062 \div 0.098 \rightarrow 0.63$s

Next, calculate t_{1f}/t_{2f}:
Distance moved at constant speed $= 0.05 - \{(0.062 \times 0.062) \div (2 \times 0.098)\} \times 2 \rightarrow 0.011$m, so $t_{1f}/t_{2f} = 0.011 \div 0.062 \rightarrow 0.17$s.

Also, calculating the $F_{1a}/F_{1f}/F_{1d}/F_{2a}/F_{2f}/F_{2d}$ from the equations yields the following:
$F_{1a} = F_{2d} = (9+100) \times 9.8 - (9+100) \times 0.098 \rightarrow 1058$N
$F_{1d} = F_{2a} = (9+100) \times 9.8 + (9+100) \times 0.098 \rightarrow 1079$N
$F_{1f} = F_{2f} = fw = (9+100) \times 9.8 \rightarrow 1068$N

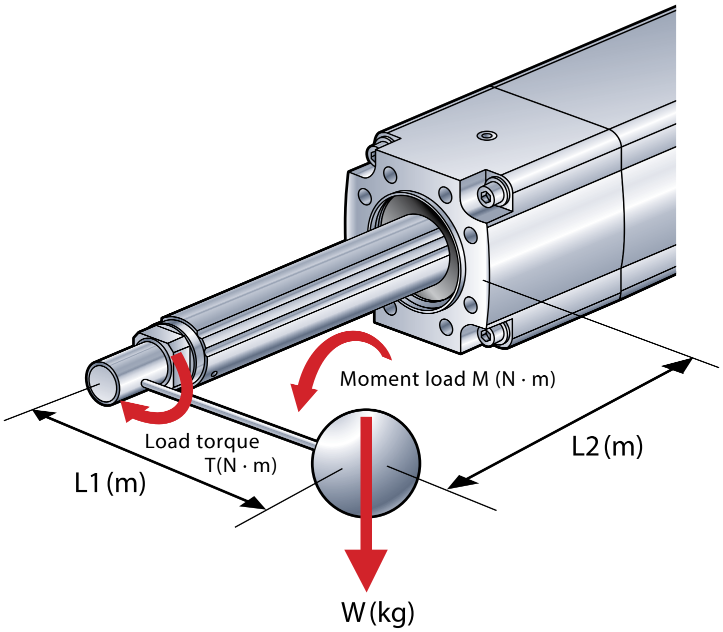
By substituting these values to the continuous operation thrust equation,

$$Ft = \sqrt{\frac{\{(1058 \times 1058) \times 0.63 + (1068 \times 1068) \times 0.17 + (1079 \times 1079) \times 0.63 + (19600 \times 19600) \times 3 + (1079 \times 1079) \times 0.63}{+ (1068 \times 1068) \times 0.17 + (1058 \times 1058) \times 0.63 + (1068 \times 1068) \times 2\} \div (0.63+0.17+0.63+3+0.63+0.17+0.63+2)}} \rightarrow 12113\text{N}$$

Since this exceeds the rated thrust for the 2-ton ultra-thrust actuator, which is 10,200N, operation with this pattern is not possible.

In response, let us increase the wait time. (i.e. decrease the duty)
Recalculating with tw=6.12s(t=12s) will change the thrust to Ft=9,814N, making it operable.

Information on Moment Selection



The ultra-high thrust actuator can apply a load on the rod within the range of conditions calculated below.

M+T ≦ 120 (N · m)
Moment Load M = Wg×L2
Load Torque T = Wg×L1

* g = Gravitational acceleration 9.8
* L1 = Distance from the center of rod to the center of gravity of the work piece
* L2 = Distance from the actuator mounting surface to the center of gravity of the work piece + 0.07

If the above condition is not met, consider installing an external guide, or the like, so that the load is not exerted on the rod.