Brake Dimensioning Type 380.01 _.0 / Type 381._ _ _._ / Type 382.0 _ _.0

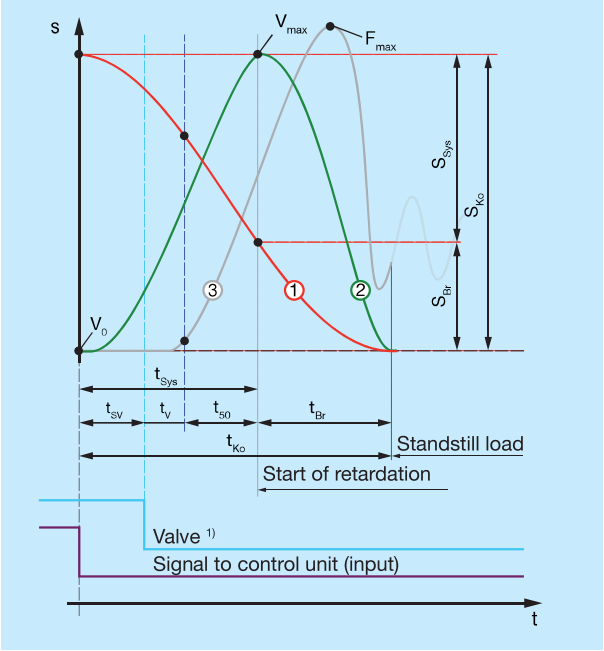

Diagram 1: Switching / Braking Times / Distances

Name

1		**Distance**
2		**Speed**
3		**Axial force**
[]	[°]	Angular position 0° (horizontal) to 90° (vertical)
a_B	[m/s²]	**Acceleration** of the downward-moving load, dependent on the angular position
a_v	[m/s²]	Retardation
g	[m/s²]	Gravitational acceleration (9.81 m/s²)
F_{Br}	[N]	Braking force for dynamic calculation
$F_{erf.}$	[N]	Required holding force
F_{Nenn}	[N]	Nominal holding force (minimum holding force)
F_{NGes}	[N]	Total nominal holding force (one or more brakes)
F_{max}	[N]	Maximum holding force
m	[kg]	Load mass
S_{Br}	[m]	**Braking distance:** Distance from the beginning of the retardation up to the standstill of the load
S_{Sys}	[m]	**System distance:** Distance travelled by the load until the retardation begins.
S_{Ko}	[m]	**Stopping distance:** Distance from the signal interruption up to standstill of the load
t_{50}	[s]	Brake switching time
t_V 1)	[s]	Valve switching time (not applicable for Type 382.0 _ _._)
t_{SV}	[s]	Switching time control unit (signal processing time)
t_{Sys}	[s]	System switching time
t_{Br}	[s]	Brake braking time
t_{Ko}	[s]	**Stopping time:** Time from the signal interruption up to standstill of the load
Q_r	[J]	Friction work per braking action

General

When selecting the brake, the nominal holding force must be greater or equal to the required holding force.

$$F_{Nenn} \geq F_{erf.} \quad [N]$$

Dimensioning for dynamic braking (EMERGENCY STOP)

For safety reasons, at least the weight load of the masses to be held +100 % reserve must be provided.

The larger the ratio of the nominal holding force to the required holding force, the shorter the stopping distance (for the same technical conditions)

The minimum required holding force can be calculated with the following formula:

$$F_{erf.} = \frac{m \times g}{0.5} \quad [N]$$

Dimensioning for static holding (clamping)

For safety reasons, at least the minimum weight load of the masses to be held +20 % reserve must be provided.

The minimum required holding force can be calculated with the following formula:

$$F_{erf.} = \frac{m \times g}{0.8} \quad [N]$$

The stopping distance / stopping time of the load to be braked is strongly dependent on the following influences:

- Switching time control unit (signal processing)
- Switching time of the control valve 1)
- Switching time of the brake
- Cross-section and length of the lines

The larger the sum of the switching times, the later the retardation of the load occurs (due to longer periods of acceleration). The stopping distance / the stopping time becomes longer (with constant holding force).

Please ensure sufficient dimensioning of the components of your system which may be placed under heavy loads during acceleration / retardation as a result of dynamic braking actions.

Name

$Q_{r\,zul.}$	[J]	Permitted friction work per braking action
$Q_{r\,ges.}$	[J]	Total friction work up to wear end (one or more brakes)
V_0	[m/s]	Initial speed
V_{max}	[m/s]	Maximum speed
$Z_{zul.}$		Number of braking actions up to wear end

If you have any questions, please contact *mayr*® power transmission.

1) With the exception of Type 382.0_ _._

Calculation example (dynamic braking)

Data:		
Angular position piston rod	β	= 90° (vertical axis)
Mass	m	= 800 kg
Initial speed	V_0	= 0.5 m/s
Valve switching time	t_V	= 0.016 s
Switching time control system	t_{SV}	= 0.020 s
Existing operating pressure		= 5 bar

1. Pre-selection of braking force

$$F_{erf.} = \frac{m \times g}{0.5} \quad [N]$$

$$F_{erf.} = \frac{800 \times 9.81}{0.5} = \mathbf{15696} \quad [N]$$

Selected: ROBA®-linearstop Size 70, Type 381.12_._

Nominal holding force $\mathbf{F_{Nenn} = 17500\ N}$ at 5 bar operating pressure (from Table "Technical Data")

2. Calculation of the stopping distance /stopping time

Checking the selected brake size

Acceleration of the load

$$a_B = g \times \sin(\beta) = 9.81 \times \sin(90°) = \mathbf{9.81}\ [m/s^2]$$

System distance

$$S_{Sys} = V_0 \times t_{Sys} + a_B \times t_{Sys}^2 \times 0.5 \quad [m]$$

$$S_{Sys} = 0.5 \times 0.096 + 9.81 \times 0.096^2 \times 0.5 = \mathbf{0.093}\ [m]$$

$$t_{Sys} = t_{50} + t_V + t_{SV} = 0.060 + 0.016 + 0.02 = 0.096\ [s]$$

Braking distance

$$S_{Br} = \frac{V_{max}^2}{2 \times \left(\frac{F_{NGes}}{m} - a_B\right)} = \frac{1.44^2}{2 \times 12.065} = \mathbf{0.086}\ [m]$$

$$V_{max} = V_0 + a_B \times t_{Sys} = 0.5 + 9.81 \times 0.096 = 1.44\ [m/s]$$

Stopping distance

$$S_{Ko} = S_{Br} + S_{Sys} = 0.086 + 0.093 = \mathbf{0.179}\ [m]$$

Stopping time

$$t_{Ko} = t_{Br} + t_{Sys} = 0.119 + 0.096 = \mathbf{0.215}\ [s]$$

$$t_{Br} = \frac{V_{max}}{\frac{F_{NGes}}{m} - a_B} = \frac{1.44}{\frac{17500}{800} - 9.81} = 0.119\ [s]$$

Retardation (for system dimensioning)

$$a_v = \frac{F_{NGes} \times 2.5}{m} - g = \frac{17500 \times 2.5}{800} - 9.81 = \mathbf{44.87}\ [m/s^2]$$

$$\text{Load} = \frac{a_v}{g} = \frac{44.87}{9.81} = \mathbf{4.57}\ [g]$$

3. Friction work (Type 381.1_ _._)

Friction work per braking action

$$Q_r = m \times a_B \times S_{Br} + 0.5 \times m \times V_{max}^2 \quad [J]$$

$$Q_r = 800 \times 9.81 \times 0.086 + 0.5 \times 800 \times 1.44^2 \quad [J]$$

$$Q_r = \mathbf{1504}\ (< Q_{r\,zul} = 12948) \quad [J]$$

Number of braking actions up to wear end

$$Z_{zul.} = \frac{Q_{r\,ges}}{Q_r}$$

$$Z_{zul.} = \frac{5.85 \times 10^6}{1504} = \mathbf{3890}\ \text{dynamic braking actions}$$

ROBA®-linearstop hydraulic

Switching time (Type 380.00 _.0) 3)			Size			
			10	20	30	40
Brake switching time	t_{50}	[s]	0.030	0.045	0.055	0.065

ROBA®-linearstop pneumatic

Friction Work and Switching Times (Type 381.1_ _._) 1) 3)			Size					
			20	30	40	60	70	80
Permitted total friction work up to wear end 2)	$Q_{r\,ges.}$	[10^6 J]	0.36	0.75	1.14	3.6	5.85	10.35
Maximum permitted friction work per braking action 2)	$Q_{r\,zul.}$	[J]	579	1049	2097	7361	12948	24708
Brake switching time	t_{50}	[s]	0.037	0.038	0.035	0.050	0.060	0.070

1) For friction work Type 381.0_ _._, please contact *mayr*® power transmission. The switching times also apply for Type 381.0_ _._.
2) For higher friction work / total friction work, please contact *mayr*® power transmission.
3) Switching times are influenced by line length, operating pressure and wear

ROBA®-linearstop electromagnetic

Switching times (Type 382.0_ _._)			Size				
			10	20	40	60	80
Brake switching time	t_{50}	[s]	0.020	0.030	0.030	0.035	0.045