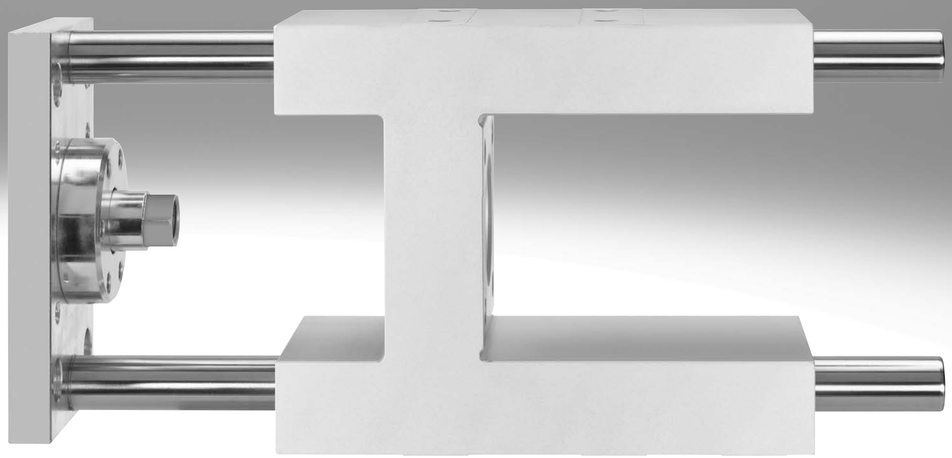
Guide units EAGF, for electric cylinders (calculation example)

FESTO



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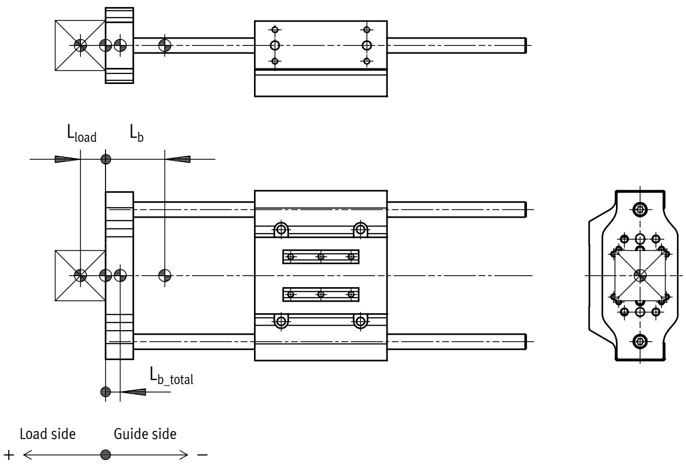
Datasheet

Calculation example



L_b = Centre of gravity of the moving mass of the guide unit
L_{load} = Centre of gravity of payload
L_{b_total} = Centre of gravity of the total moving mass

Length measurements should be provided with plus/minus signs as shown in the figure:
$L_{b\_total} > 0$ = Centre of gravity of the moving mass is on the payload side
$L_{b\_total} < 0$ = Centre of gravity of the moving mass is on the guide side

Assuming:

- Guide unit: EAGF-P2-KF-45-200
- Stroke length: H = 200 mm
- Centre of gravity of payload: L_{load} = 15 mm
- Payload: m_{Load} = 2 kg
- Acceleration: $a_x = a_y = 2\ m/s^2$, $a_z = 0\ m/s^2$

To be determined:

- Loads Fy_{dyn}/Fz_{dyn} and $Mx_{dyn}/My_{dyn}/Mz_{dyn}$
- Functional operation with combined load
- Expected service life

Datasheet

Calculation example

Solution:

Moving mass:

$m_{b\_total} = m_b + m_{load}$ ($m_b = m_{0b} + H \times m_{Hb}$)

From table ➔ page 4

$m_{0b} = 0.342$ kg

$m_{Hb} = 0.0123$ kg/10 mm

$m_b = 0.342$ kg + 200 mm x 0.0123 kg/10 mm = 0.588 kg

$m_{b\_total} = 0.588$ kg + 2 kg = 2.588 kg

m_b = Moving mass of the guide unit

m_{0b} = Moving mass with 0 mm stroke

m_{Hb} = Additional mass per 10 mm stroke

H = Stroke length

Centre of gravity of the moving mass

$$L_{b\_ges} = \frac{L_1 \cdot m_1 + L_b \cdot m_b}{m_{b\_ges}}$$

($L_b = L_{0b} + H \times L_{Hb}$)

From table ➔ page 4

$L_{0b} = 25$ mm

$L_{Hb} = 4.3$ mm/10 mm

$L_b = 25$ mm + 200 mm x 4.3 mm/10 mm = 111 mm

$$L_{b\_ges} = \frac{(+15\ mm) \cdot 2\ kg + (-111\ mm) \cdot 0{,}588\ kg}{2{,}588\ kg} = -14\ mm$$

L_b = Centre of gravity of the moving mass of the guide unit

m_b = Moving mass of the guide unit

L_1 = Centre of gravity of payload

m_1 = Payload

L_{0b} = Centre of gravity of the moving mass with 0 mm stroke

L_{Hb} = Additional centre of gravity of the moving mass per 10 mm stroke

Length measurements should be provided with plus/minus signs as shown in the figure:

$L_{b\_total} > 0$ = Centre of gravity of the moving mass is on the payload side

$L_{b\_total} < 0$ = Centre of gravity of the moving mass is on the guide side

Loads Fy_{dyn}/Fz_{dyn} and $Mx_{dyn}/My_{dyn}/Mz_{dyn}$

$Fy_{dyn} = m_{b\_total} \times a_y = 2.588\ kg \times 2\ m/s^2 = 5\ N$

$Fz_{dyn} = m_{b\_total} \times (g + a_z) = 2.588\ kg \times (9.81\ m/s^2 + 0\ m/s^2) = 25\ N$

From table ➔ page 5

Dimension X = 63 mm

$My_{dyn} = Fz_{dyn}$ x (dimension X + stroke + L_{b_total}) = 25 N x (63 mm + 200 mm + (–14 mm) = 6.3 Nm

$Mz_{dyn} = Fy_{dyn}$ x (dimension X + stroke + L_{b_total}) = 5 N x (63 mm + 200 mm + (–14 mm) = 1.3 Nm

Functional operation with combined load

Max. values from table ➔ page 5

$Fy_{max} = 320$ N

$Fz_{max} = 320$ N

$Mx_{max} = 15$ Nm

$My_{max} = 10$ Nm

$Mz_{max} = 10$ Nm

$$f_v = \frac{|F_{y1}|}{F_{y2}} + \frac{|F_{z1}|}{F_{z2}} + \frac{|M_{x1}|}{M_{x2}} + \frac{|M_{y1}|}{M_{y2}} + \frac{|M_{z1}|}{M_{z2}} \leq 1$$

$$f_v = \frac{5\ N}{320\ N} + \frac{25\ N}{320\ N} + \frac{0\ Nm}{15\ Nm} + \frac{6{,}3\ Nm}{10\ Nm} + \frac{1{,}3\ Nm}{10\ Nm} = 0{,}86 \leq 1$$

F_1/M_1 = dynamic value

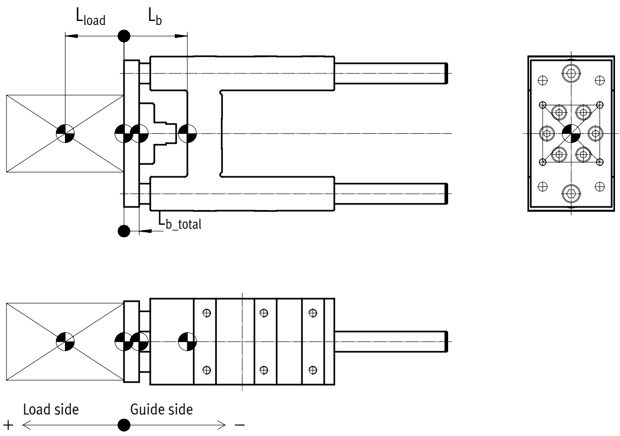
F_2/M_2 = maximum value

Expected service life

$$L = \frac{L_{ref}}{f_v^3} = \frac{5000\ km}{0{,}86^3} = 7930\ km$$

Datasheet

Calculation example



L_b = Centre of gravity of the moving mass of the guide unit
L_{load} = Centre of gravity of payload
L_{b_total} = Centre of gravity of the total moving mass

Length measurements should be provided with plus/minus signs as shown in the figure:
$L_{b\_total} > 0$ = Centre of gravity of the moving mass is on the payload side
$L_{b\_total} < 0$ = Centre of gravity of the moving mass is on the guide side

Assuming:

- Guide unit: EAGF-V2-KF-32-200
- Stroke length: H = 200 mm
- Centre of gravity of payload: L_{load} = 15 mm
- Payload: m_{Load} = 5 kg
- Acceleration: $a_x = a_y = 2$ m/s^2, $a_z = 0$ m/s^2

To be determined:

- Loads Fy_{dyn}/Fz_{dyn} and $Mx_{dyn}/My_{dyn}/Mz_{dyn}$
- Functional operation with combined load
- Expected service life

Datasheet

Calculation example

Solution:

Moving mass:

$m_{b\_total} = m_b + m_{load}$ ($m_b = m_{0b} + H \times m_{Hb}$)

From table ➔ page 10

$m_{0b} = 0.724$ kg

$m_{Hb} = 0.018$ kg/10 mm

$m_b = 0.724$ kg + 200 mm x 0.018 kg/10 mm = 1.084 kg

$m_{b\_total} = 1.084$ kg + 5 kg = 6.084 kg

m_b = Moving mass of the guide unit

m_{0b} = Moving mass with 0 mm stroke

m_{Hb} = Additional mass per 10 mm stroke

H = Stroke length

Centre of gravity of the moving mass

$$L_{b\_ges} = \frac{L_1 \cdot m_1 + L_b \cdot m_b}{m_{b\_ges}}$$

($L_b = L_{0b} + H \times L_{Hb}$)

From table ➔ page 10

$L_{0b} = 30$ mm

$L_{Hb} = 4.1$ mm/10 mm

$L_b = 30$ mm + 200 mm x 4.1 mm/10 mm = 112 mm

$$L_{b\_ges} = \frac{(+15\ mm) \cdot 5kg + (-112\ mm) \cdot 1{,}084kg}{6{,}084\ kg} = -8\ mm$$

L_b = Centre of gravity of the moving mass of the guide unit

m_b = Moving mass of the guide unit

L_1 = Centre of gravity of payload

m_1 = Payload

L_{0b} = Centre of gravity of the moving mass with 0 mm stroke

L_{Hb} = Additional centre of gravity of the moving mass per 10 mm stroke

Length measurements should be provided with plus/minus signs as shown in the figure:

$L_{b\_total} > 0$ = Centre of gravity of the moving mass is on the payload side

$L_{b\_total} < 0$ = Centre of gravity of the moving mass is on the guide side

Loads Fy_{dyn}/Fz_{dyn} and $Mx_{dyn}/My_{dyn}/Mz_{dyn}$

$Fy_{dyn} = m_{b\_total} \times a_y = 6.084\ kg \times 2\ m/s^2 = 12\ N$

$Fz_{dyn} = m_{b\_total} \times (g + a_z) = 6.084\ kg \times (9.81\ m/s^2 + 0\ m/s^2) = 60\ N$

From table ➔ page 11

Dimension X = 83 mm

$My_{dyn} = Fz_{dyn}$ x (dimension X + stroke + L_{b_total}) = 60 N x (83 mm + 200 mm + (–8 mm)) = 16 Nm

$Mz_{dyn} = Fy_{dyn}$ x (dimension X + stroke + L_{b_total}) = 12 N x (83 mm + 200 mm + (–8 mm)) = 3 Nm

Functional operation with combined load

Max. values from table ➔ page 11

$Fy_{max} = 750$ N

$Fz_{max} = 750$ N

$Mx_{max} = 28$ Nm

$My_{max} = 34$ Nm

$Mz_{max} = 34$ Nm

$$f_v = \frac{|F_{y1}|}{F_{y2}} + \frac{|F_{z1}|}{F_{z2}} + \frac{|M_{x1}|}{M_{x2}} + \frac{|M_{y1}|}{M_{y2}} + \frac{|M_{z1}|}{M_{z2}} \leq 1$$

$$f_v = \frac{12\ N}{750\ N} + \frac{60\ N}{750\ N} + \frac{0\ Nm}{28\ Nm} + \frac{16\ Nm}{34\ Nm} + \frac{3\ Nm}{34\ Nm} = 0{,}7 \leq 1$$

F_1/M_1 = dynamic value

F_2/M_2 = maximum value

Expected service life

$$L = \frac{L_{ref}}{f_v^3} = \frac{5000\ km}{0{,}7^3} = 14000\ km$$