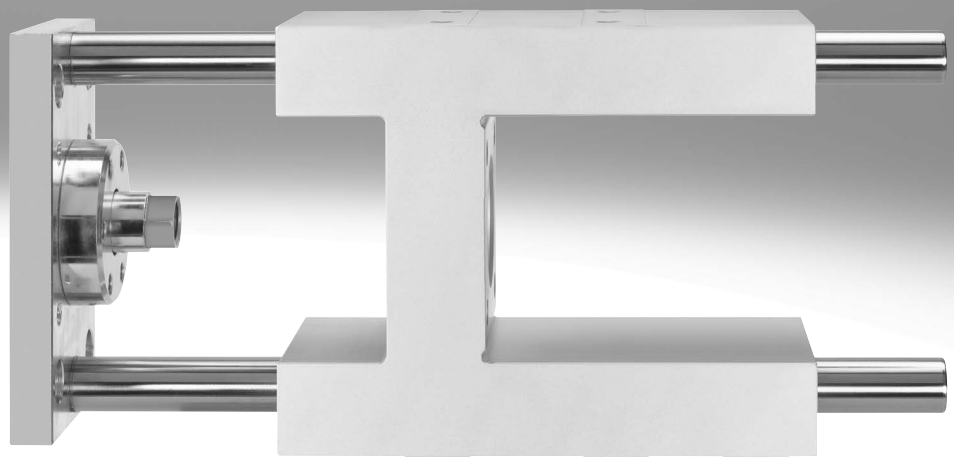
Guide units EAGF, for electric cylinders (calculation example)



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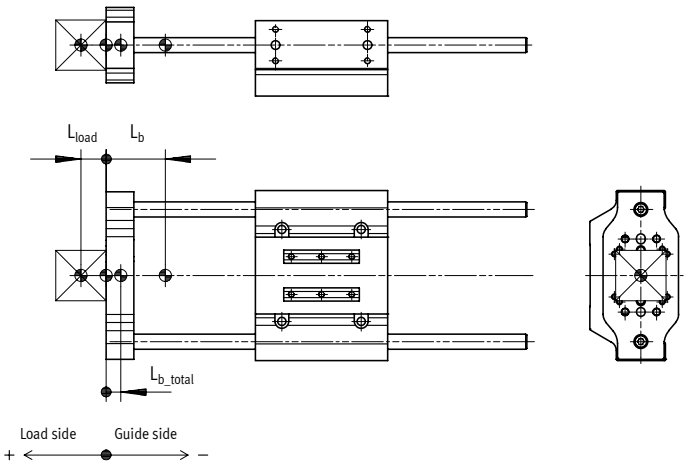
Datasheet

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:

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

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

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

Centre of gravity of the moving mass

$$L_{b\_ges} = \frac{L_1 \cdot m_1 + L_b \cdot m_b}{m_{b\_ges}} \qquad (L_b = L_{0b} + H \times L_{Hb})$$

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

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

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

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

$My_{dyn} = Fz_{dyn} \times (\text{dimension X} + \text{stroke} + L_{b\_total}) = 25\ N \times (63\ mm + 200\ mm + (-14\ mm)) = 6.3\ Nm$
$Mz_{dyn} = Fy_{dyn} \times (\text{dimension X} + \text{stroke} + L_{b\_total}) = 5\ N \times (63\ mm + 200\ mm + (-14\ mm)) = 1.3\ Nm$

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

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

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

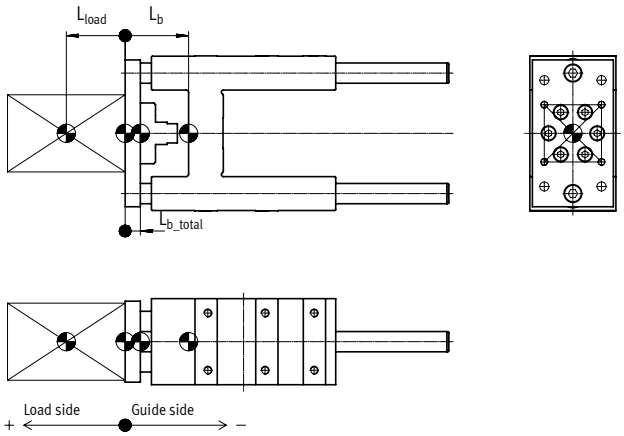
F_1/M_1 = dynamic value
F_2/M_2 = maximum value

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:

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

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

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

Centre of gravity of the moving mass

$$L_{b\_ges} = \frac{L_1 \cdot m_1 + L_b \cdot m_b}{m_{b\_ges}}$$ ($L_b = L_{0b} + H \times L_{Hb}$)

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

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

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

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 x 2 m/s² = 12 N
$Fz_{dyn} = m_{b\_total} \times (g + a_z) = 6.084$ kg x (9.81 m/s² + 0 m/s²) = 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

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