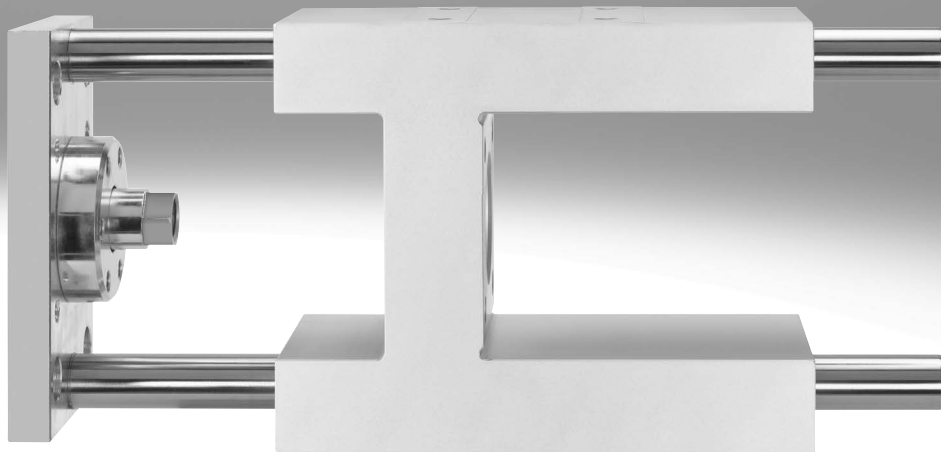


Guide units EAGF, for electric cylinders (calculation example)

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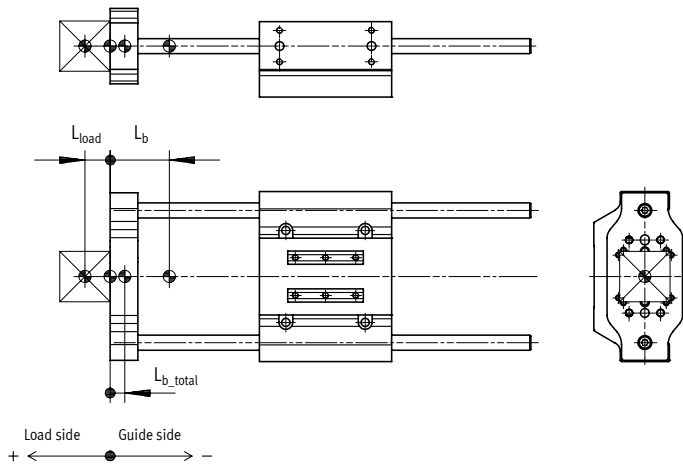
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Datasheet

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/s², $a_z = 0$ m/s²

To be determined:

- Loads F_{y_dyn}/F_{z_dyn} and $M_{x_dyn}/M_{y_dyn}/M_{z_dyn}$
- Functional operation with combined load
- Expected service life

Datasheet

Calculation example

Solution:

Moving mass:

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

From table → page 4

$$m_{0b} = 0.342 \text{ kg}$$

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

$$m_b = 0.342 \text{ kg} + 200 \text{ mm} \times 0.0123 \text{ kg/10 mm} = 0.588 \text{ kg}$$

$$m_{b_total} = 0.588 \text{ kg} + 2 \text{ kg} = 2.588 \text{ kg}$$

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

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

From table → page 4

$$L_{0b} = 25 \text{ mm}$$

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

$$L_b = 25 \text{ mm} + 200 \text{ mm} \times 4.3 \text{ mm/10 mm} = 111 \text{ mm}$$

$$L_{b_ges} = \frac{(+15 \text{ mm}) \cdot 2 \text{ kg} + (-111 \text{ mm}) \cdot 0.588 \text{ kg}}{2.588 \text{ kg}} = -14 \text{ mm}$$

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 F_{y_dyn}/F_{z_dyn} and $M_{x_dyn}/M_{y_dyn}/M_{z_dyn}$

$$F_{y_dyn} = m_{b_total} \times a_y = 2.588 \text{ kg} \times 2 \text{ m/s}^2 = 5 \text{ N}$$

$$F_{z_dyn} = m_{b_total} \times (g + a_z) = 2.588 \text{ kg} \times (9.81 \text{ m/s}^2 + 0 \text{ m/s}^2) = 25 \text{ N}$$

From table → page 5

Dimension X = 63 mm

$$M_{y_dyn} = F_{z_dyn} \times (\text{dimension X} + \text{stroke} + L_{b_total}) = 25 \text{ N} \times (63 \text{ mm} + 200 \text{ mm} + (-14 \text{ mm})) = 6.3 \text{ Nm}$$

$$M_{z_dyn} = F_{y_dyn} \times (\text{dimension X} + \text{stroke} + L_{b_total}) = 5 \text{ N} \times (63 \text{ mm} + 200 \text{ mm} + (-14 \text{ mm})) = 1.3 \text{ Nm}$$

Functional operation with combined load

Max. values from table → page 5

$$F_{y_max} = 320 \text{ N}$$

$$F_{z_max} = 320 \text{ N}$$

$$M_{x_max} = 15 \text{ Nm}$$

$$M_{y_max} = 10 \text{ Nm}$$

$$M_{z_max} = 10 \text{ Nm}$$

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

$$f_v = \frac{5 \text{ N}}{320 \text{ N}} + \frac{25 \text{ N}}{320 \text{ N}} + \frac{0 \text{ Nm}}{15 \text{ Nm}} + \frac{6.3 \text{ Nm}}{10 \text{ Nm}} + \frac{1.3 \text{ Nm}}{10 \text{ Nm}} = 0.86 \leq 1$$

F_1/M_1 = dynamic value

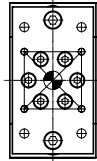
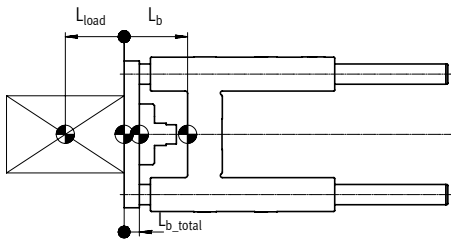
F_2/M_2 = maximum value

Expected service life

$$L = \frac{L_{ref}}{f_v^3} = \frac{5000 \text{ km}}{0.86^3} = 7930 \text{ km}$$

Datasheet

Calculation example



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

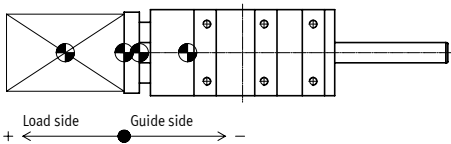
L_{load} = Centre of gravity of payload

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/s², $a_z = 0$ m/s²

To be determined:

- Loads F_{y_dyn}/F_{z_dyn} and $M_{x_dyn}/M_{y_dyn}/M_{z_dyn}$
- Functional operation with combined load
- Expected service life

Datasheet

Calculation example

Solution:

Moving mass:

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

From table → page 10

$$m_{0b} = 0.724 \text{ kg}$$

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

$$m_b = 0.724 \text{ kg} + 200 \text{ mm} \times 0.018 \text{ kg/10 mm} = 1.084 \text{ kg}$$

$$m_{b_total} = 1.084 \text{ kg} + 5 \text{ kg} = 6.084 \text{ kg}$$

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

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

From table → page 10

$$L_{0b} = 30 \text{ mm}$$

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

$$L_b = 30 \text{ mm} + 200 \text{ mm} \times 4.1 \text{ mm/10 mm} = 112 \text{ mm}$$

$$L_{b_ges} = \frac{(+15 \text{ mm}) \cdot 5 \text{ kg} + (-112 \text{ mm}) \cdot 1.084 \text{ kg}}{6.084 \text{ kg}} = -8 \text{ mm}$$

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 F_{y_dyn}/F_{z_dyn} and $M_{x_dyn}/M_{y_dyn}/M_{z_dyn}$

$$F_{y_dyn} = m_{b_total} \times a_y = 6.084 \text{ kg} \times 2 \text{ m/s}^2 = 12 \text{ N}$$

$$F_{z_dyn} = m_{b_total} \times (g + a_z) = 6.084 \text{ kg} \times (9.81 \text{ m/s}^2 + 0 \text{ m/s}^2) = 60 \text{ N}$$

From table → page 11

Dimension X = 83 mm

$$M_{y_dyn} = F_{z_dyn} \times (\text{dimension X} + \text{stroke} + L_{b_total}) = 60 \text{ N} \times (83 \text{ mm} + 200 \text{ mm} + (-8 \text{ mm})) = 16 \text{ Nm}$$

$$M_{z_dyn} = F_{y_dyn} \times (\text{dimension X} + \text{stroke} + L_{b_total}) = 12 \text{ N} \times (83 \text{ mm} + 200 \text{ mm} + (-8 \text{ mm})) = 3 \text{ Nm}$$

Functional operation with combined load

Max. values from table → page 11

$$F_{y_max} = 750 \text{ N}$$

$$F_{z_max} = 750 \text{ N}$$

$$M_{x_max} = 28 \text{ Nm}$$

$$M_{y_max} = 34 \text{ Nm}$$

$$M_{z_max} = 34 \text{ Nm}$$

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

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

F_1/M_1 = dynamic value

F_2/M_2 = maximum value

Expected service life

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