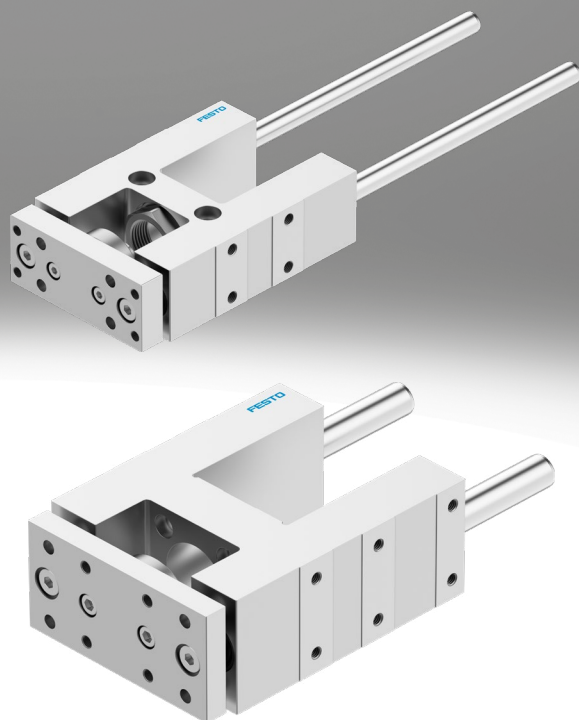


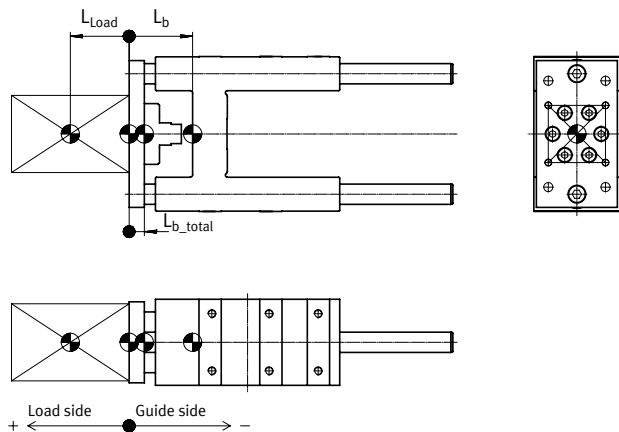
Calculation example for guide units FEN/FENG

FESTO



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

Required:

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

Solution:

Moving mass:

$$m_{b_total} = m_b + m_{Load} \quad (m_b = m_{Ob} + H \times m_{Hb})$$

$$m_{Ob} = 0.483 \text{ kg}$$

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

$$m_b = 0.483 \text{ kg} + 200 \text{ mm} \times 0.018 \text{ kg/10 mm} = 0.843 \text{ kg}$$

$$m_{b_total} = 0.843 \text{ kg} + 5 \text{ kg} = 5.843 \text{ kg}$$

m_b = Moving mass of the guide unit

m_{Ob} = Moving mass with 0 mm stroke

m_{Hb} = Additional mass per 10 mm stroke

H = Stroke length

Centre of gravity of the moving mass

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

$$L_{Ob} = 43 \text{ mm}$$

$$L_{Hb} = 4.5 \text{ mm/10 mm}$$

$$L_b = 43 \text{ mm} + 200 \text{ mm} \times 4.5 \text{ mm/10 mm} = 133 \text{ mm}$$

$$L_{b_ges} = \frac{(+15 \text{ mm}) \cdot 5 \text{ kg} + (-133 \text{ mm}) \cdot 0.843 \text{ kg}}{5.843 \text{ kg}} = -6 \text{ mm}$$

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_{Ob} = 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

Datasheet

Calculation example

Loads $F_{y_{dyn}}/F_{z_{dyn}}$ and $M_{x_{dyn}}/M_{y_{dyn}}/M_{z_{dyn}}$

$$F_{y_{dyn}} = m_{b_total} \times a_y = 5.843 \text{ kg} \times 2 \text{ m/s}^2 = 12 \text{ N}$$

$$F_{z_{dyn}} = m_{b_total} \times (g + a_z) = 5.843 \text{ kg} \times (9.81 \text{ m/s}^2 + 0 \text{ m/s}^2) = 57 \text{ N}$$

Dimension X = 83 mm

$$M_{y_{dyn}} = F_{z_{dyn}} \times (\text{dimension X} + \text{stroke} + L_{b_total}) = 57 \text{ N} \times (83 \text{ mm} + 200 \text{ mm} + (-6 \text{ mm})) = 16 \text{ Nm}$$

$$M_{z_{dyn}} = F_{y_{dyn}} \times (\text{dimension X} + \text{stroke} + L_{b_total}) = 12 \text{ N} \times (83 \text{ mm} + 200 \text{ mm} + (-6 \text{ mm})) = 3 \text{ Nm}$$

Verification of operation with combined load

$$F_{y_{max}} = 750 \text{ N}$$

$$F_{z_{max}} = 750 \text{ N}$$

$$M_{x_{max}} = 28 \text{ Nm}$$

$$M_{y_{max}} = 34 \text{ Nm}$$

$$M_{z_{max}} = 34 \text{ Nm}$$

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

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

F_1/M_1 = dynamic value

F_2/M_2 = maximum value

Expected service life

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