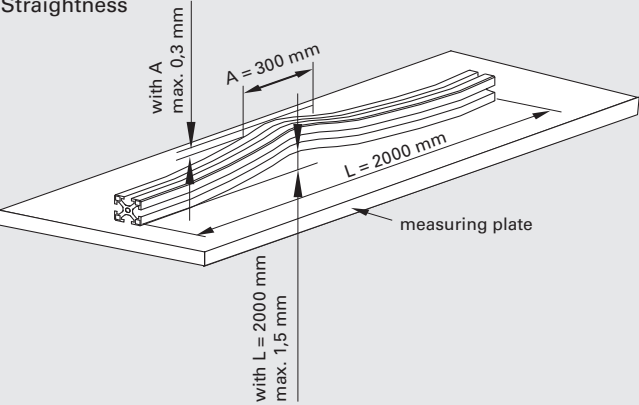
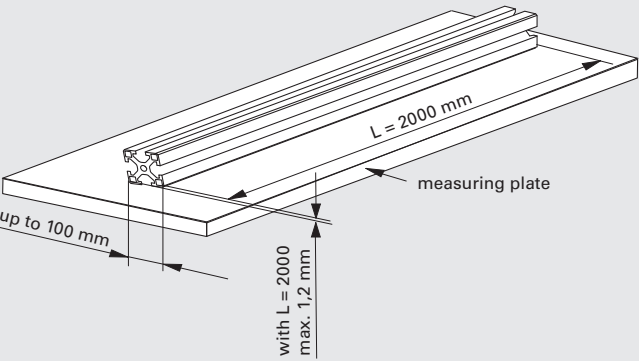


Extrusion Tolerances

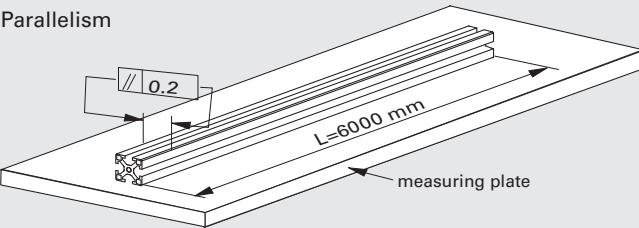
Straightness



Torsion



Parallelism



Technical data – extrusions:

|                                                               |                                                                                                             |
|---------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| Material description:                                         | EN AW-6063 - T66                                                                                            |
| Minimum tensile strength $R_m$<br>(in direction of pressure): | 245 N/mm <sup>2</sup>                                                                                       |
| Yield strength $R_p$ (in direction of pressure):              | 200 N/mm <sup>2</sup>                                                                                       |
| Modulus of elasticity E:                                      | 70000 N/mm <sup>2</sup>                                                                                     |
| Shear Modulus G:                                              | 26000 N/mm <sup>2</sup>                                                                                     |
| Coefficient of linear expansion:                              | $\alpha = 23 \cdot 10^{-6} \text{ 1/K}$                                                                     |
| Brinell hardness:                                             | approx. 70 HB                                                                                               |
| Breaking elongation A5:                                       | 12%                                                                                                         |
| Material density:                                             | 2.7 kg/dm <sup>3</sup>                                                                                      |
| Cutting data:                                                 |                                                                                                             |
| Length tolerance (up to 6000 mm):                             | $\pm 0.2 \text{ mm}$                                                                                        |
| Rectangular accuracy:                                         | up to 50 mm $\pm 0.05 \text{ mm}$<br>up to 100 mm $\pm 0.1 \text{ mm}$<br>up to 200 mm $\pm 0.2 \text{ mm}$ |
| Tolerances for precision extrusions:                          | DIN EN 12020-2                                                                                              |
| Groove tolerance:                                             | 14 $+0.25 / -0 \text{ mm}$                                                                                  |

|                 |                            |                                                                   |
|-----------------|----------------------------|-------------------------------------------------------------------|
| E               | [N/mm <sup>2</sup> ]       | Modulus of elasticity                                             |
| F               | [N]                        | Load                                                              |
| F <sub>G</sub>  | [N]                        | Net weight                                                        |
| f               | [mm]                       | Deflection                                                        |
| L               | [mm]                       | Length                                                            |
| I               | [cm <sup>4</sup> ]         | Moment of inertia (see extrusion data sheets)                     |
| W               | [cm <sup>3</sup> ]         | Section modulus (see extrusion data sheets)                       |
| $\sigma_{max.}$ | [N/mm <sup>2</sup> ]       | Permissible bending stress (recommendation 70 N/mm <sup>2</sup> ) |
| M <sub>t</sub>  | [Nmm]                      | Torque                                                            |
| I <sub>t</sub>  | [cm <sup>4</sup> ]         | Torsional moment of area                                          |
| G               | [26000 N/mm <sup>2</sup> ] | Shear Modulus                                                     |
| $\varphi$       | [°]                        | Rotation angle                                                    |

## Deflection Calculations

Load case example 1



Deflection by force F

$$f = \frac{F \cdot L^3}{3 \cdot E \cdot I \cdot 10^4} \text{ [mm]}$$

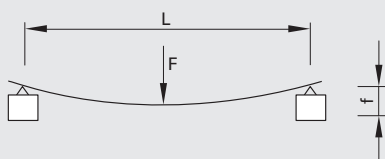
Deflection under own weight

$$f = \frac{F_G \cdot L^3}{8 \cdot E \cdot I \cdot 10^4} \text{ [mm]}$$

Bending stress  $\sigma$  max.

$$\sigma = \frac{F \cdot L}{W \cdot 10^3} \text{ [N/mm}^2\text{]}$$

Load case example 2



$$f = \frac{F \cdot L^3}{48 \cdot E \cdot I \cdot 10^4} \text{ [mm]}$$

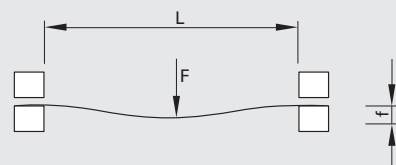
Deflection under own weight

$$f = \frac{5 \cdot F_G \cdot L^3}{384 \cdot E \cdot I \cdot 10^4} \text{ [mm]}$$

Bending stress  $\sigma$  max.

$$\sigma = \frac{F \cdot L}{4 \cdot W \cdot 10^3} \text{ [N/mm}^2\text{]}$$

Load case example 3



$$f = \frac{F \cdot L^3}{192 \cdot E \cdot I \cdot 10^4} \text{ [mm]}$$

Deflection under own weight

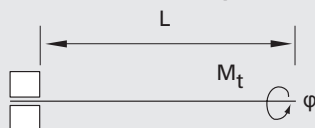
$$f = \frac{F_G \cdot L^3}{384 \cdot E \cdot I \cdot 10^4} \text{ [mm]}$$

Bending stress  $\sigma$  max.

$$\sigma = \frac{F \cdot L}{8 \cdot W \cdot 10^3} \text{ [N/mm}^2\text{]}$$

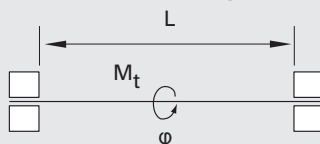
## Torsion Calculations

Load case example 1



$$\Phi = \frac{180^\circ \cdot M_t \cdot L}{\pi \cdot G \cdot I_t \cdot 10^4} \text{ [mm]}$$

Load case example 2



$$\Phi = \frac{180^\circ \cdot M_t \cdot L}{\pi \cdot 4 \cdot G \cdot I_t \cdot 10^4} \text{ [mm]}$$

### Checking the shear stress

The critical factor for failure of an extrusion subject to torsional load is in practice not so much the exceeding of the maximum approved torsional load applied to the extrusion, but rather elastic deformation (torsion). This deformation will affect the functioning of any parts to be assembled onto the extrusion, and so a more torsion-resistant extrusion must be selected, well before the approved maximum values for the torsional load have been reached.

## Standard Screw Drawing

| Code          | Screw designation                                               | ISO standard | DIN standard |
|---------------|-----------------------------------------------------------------|--------------|--------------|
| IBS M_x__     | Socket-head cap screw                                           | ISO 4762     | DIN 912      |
| IBS M_x__NIKO | Socket-head cap screw with flat head                            |              | DIN 6912     |
| SKS M_x__     | Socket-head countersunk screw                                   | ISO 10642    | DIN 7991     |
| LKS M_x__     | Button head cap screw with socket head                          | ISO 7380     |              |
| HKS M_x__     | Hexagon head screw                                              | ISO 4017     | DIN 933      |
| SKM M__       | Hexagonal nut                                                   | ISO 4032     | DIN 934      |
| SKM M__FLA    | Hexagonal nut, flat form                                        | ISO 4035     | DIN 936      |
| BLS M__       | Washer                                                          | ISO 7089     | DIN 125      |
| BLS M__S__    | Washer                                                          |              | DIN 7349     |
| GST M_x__     | Set screw with socket head and conical cup                      | ISO 4026     | DIN 913      |
| GST M_x__SPI  | Set screw with socket head and tip                              | ISO 4027     | DIN 914      |
| GST M_x__FED  | Spring-loaded pressure part with band and hexagonal socket head |              |              |
| BKS _x__      | Countersunk flat head tapping screw                             | ISO 7050     | DIN 7982     |
| PAF _x_x__    | Key                                                             | ISO 773      | DIN 6885     |
| PKS _x__      | Grooved pin                                                     | ISO 8745     | DIN 1472     |
| SIR _x__      | Circlip                                                         |              | DIN 471      |
| SPS _x__      | Clamping pin, lightweight                                       | ISO 13337    | DIN 7346     |