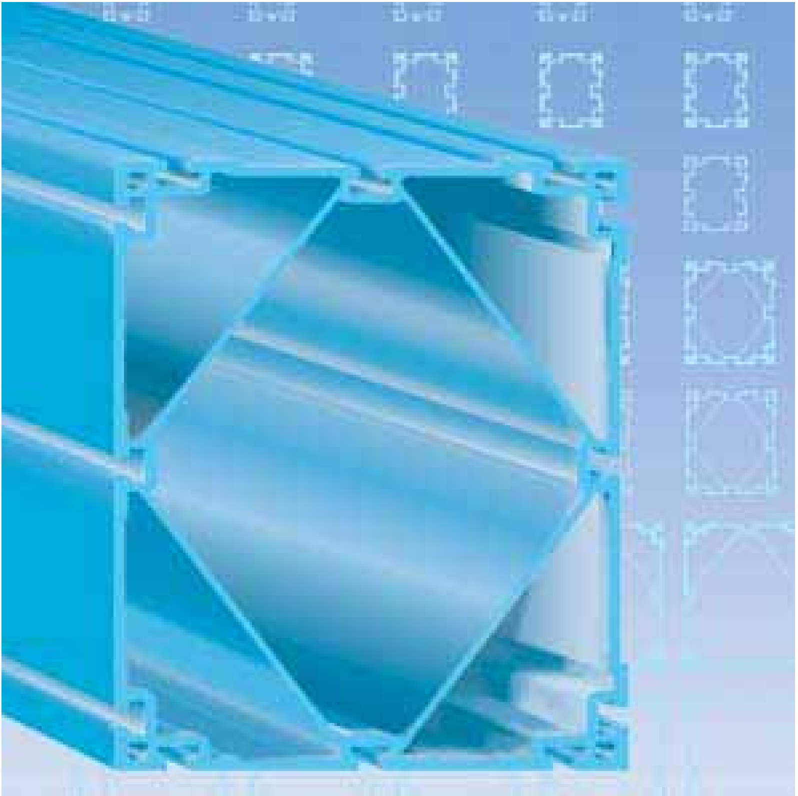

NTS Beam System

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NTS Beam System

With the NTS Beam System Alusuisse Singen has set out on a new course in the semi–fabricated product sector

A flea jumps as far as it does, because there is a very favourable relationship between its mass and the cross sectional area of its muscles. But muscular strength increases only in the diameter squared, mass however increases in the cube.

Therefore, it can be deduced that Elephants cannot jump.

These principles of physics are also valid for the extrusion process. There are physical effects, which are not required to be considered with small presses, that set difficult parameters for large extrusions presses.

For example:

Deformation of the die during the extrusion process normally has no influence on the cross-sectional tolerances of small profiles, however as the diameter of the die increases deformation extends to the fourth power. This affects the ability to maintain the shape of large sections.

Alusuisse Singen is equipped with the largest extrusion press in Europe and has taken on the challenge.

Elephants can indeed jump,

even if only under certain conditions.

Alusuisse Singen manufactures large extrusions with the tolerances of precision profiles – using DIN 17615/3 as a guide. Profiles with tolerances clearly below those of DIN 17615 can also be supplied. This is valid, particularly for straightness, twist and parallelism.

During the manufacture of the profiles, care is taken, that residual stresses are kept to a minimum.

A dimensional data sheet for each section can be supplied, which helps to minimise the customers processing costs, allowing them to be considerably reduced. The dimensional data sheet contains information on the straightness, which is defined as "gravity free", i.e. the measurement is evaluated whereby the influence of the gravity disappears. The conventional method of defining straightness is to place a section on a flat bed table and take measurements. This is not used in this instance. As a result the customer receives more useful information concerning this product.

The NTS beam system has been designed as a universal system. Its features are:

A number of slots, enabling flexibility to fix or mount the beam and a variety of components to it i.e. guide rails.

All other details are waived so that the constructional freedom for the designer is not confined by details, which might eventually restrict the design.

At first glance the profiles appear symmetrical, however this is not the case. In every section there are areas where machining can preferably take place. Two adjacent sides have recessed walls. This assists when machining is required for flatness, whereby the amount of material that needs to be removed can be kept to a minimum.

The internal struts stiffen the profile to a high degree, which has a beneficial effect on the local rigidity.

The NTS beam system is above all a system for small quantities i.e. for the building of special machines and frame work structures, where the development of a special customer section may not be justified (see p. 10).

The profiles are available ex stock and can be cut to length on request. They are sold by the metre. Tolerances are on p. 8.

The profiles can be supplied in 3 tolerance classes, which are as follows:

Tolerance class N (normal)
Based on DIN 1748/4 "fine straightened"

Tolerance class P (precision)
Based on DIN 17615/3 – "Precision Sections manufactured in AlMgSi0,5"

Tolerance class S (special)
Compared with class P, these have substantially tighter tolerances, especially straightness, twist and parallelism. When ordered, class S profiles will be cut from stock lengths based on the given dimensional data sheet.

Surfaces

The surface quality of large profiles can only be compared in a limited way with that of small profiles. However anodising as a protective coat on the surface is possible.

Alusuisse Singen's Department for Application Engineering is always available to offer help.

Remarks

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Our technical advice and recommendations contained in this leaflet are based on reasonable examination. They fall however outside the scope of any contractual obligation and no warranty is expressed or implied.

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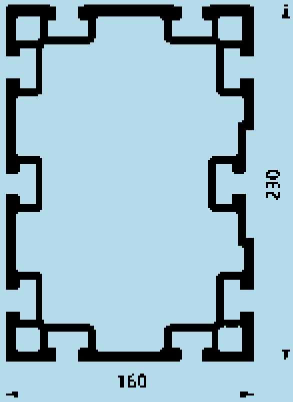
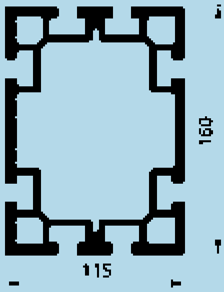
Profile overview

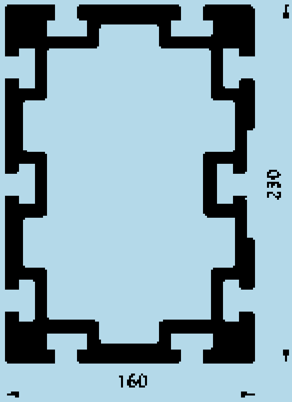
For detailed dimensions, please see the enclosed 1:1 die drawings.



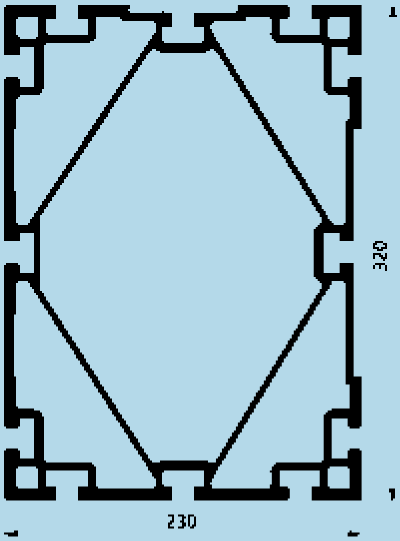
NTS 23x16 l
die No. 41735
G=19,82 kg/m



NTS 16x11,5 l
die No. 41732
G=13,53 kg/m



NTS 23x16 s
die No. 41738
G=29,74 kg/m



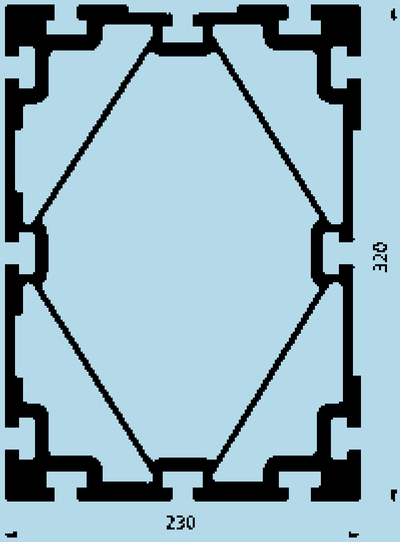
NTS 32x23 l
die No. 41741
G=34,65 kg/m

T-slots:

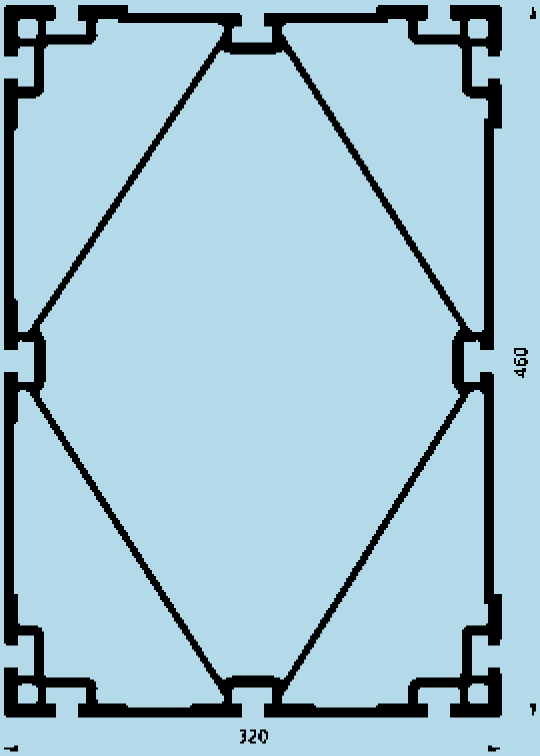
NTS 16x11,5 l:
for DIN M10 T-nuts

NTS 23x16 to 46x32:
for DIN M12 T-nuts

Corner spacings of the edge slot axis:
40 mm

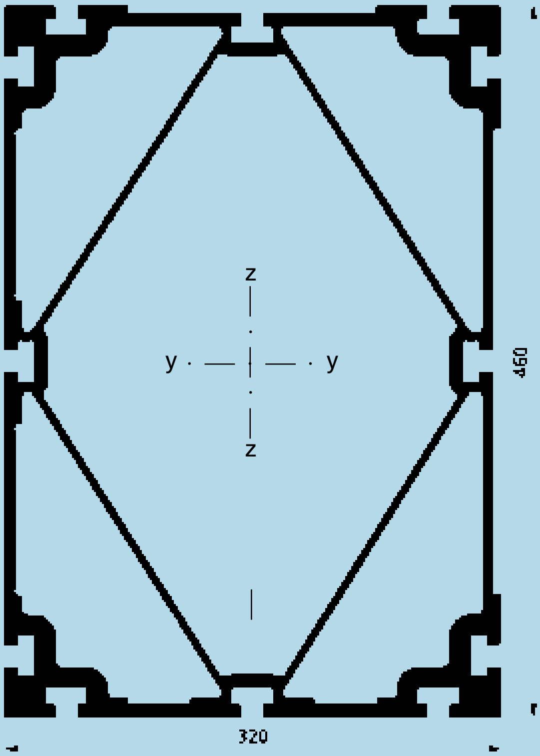


NTS 32x23 s
die No. 41744
G=46,09 kg/m



NTS 46x32 l
die No. 41747
G=51,05 kg/m

Attention:
Profiles are not symmetrical with the exception of 16x11,5 l



NTS 46x32 s
die No. 41750
G=66,78 kg/m

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Basic values for verification

Alloy

AlMgSi0,5 (6060/6063) F22 acc. to DIN 1748.1
(6063 T6 after the changeover to DIN EN 755-2)
$R_m \geq$ 215 N/mm²
$R_{p0,2} \geq$ 160 N/mm²
$A_5 \geq$ 5 % [1)]
HB $\geq$ 70

Permissible stresses acc. to DIN 4113:
(loading case H)
Tension/compression/bending: 95 N/mm²
Shear: 55 N/mm²
Bearing stress for bolts 1: 120 N/mm²
(clearance of bolts $\leq$ 1 mm)
Bearing stress for bolts 2: 145 N/mm²
(clearance of bolts $\leq$ 0,3 mm)
Bearing stress for bolts 3: 125-205 N/mm²
(prestressed bolts)

Physical values

Density ρ: 2,7 g/cm³
Modulus of elasticity E: 70 000 N/mm²
Shear modulus G: 27 000 N/mm²
Poisson's ration ν : 0,33
Coefficient of thermal expansion α : $23{,}5 \cdot 10^{-6}$ 1/K
Specific heat: ≈ 0,9 J/(g K)
Electrical conductivity: 28-35 m/(Ω mm²)

Short-time temperature load (e.g. stovelacquering) without considerable loss of strength (max. 10 %; values are valid for AlMgSi0,5 only)

270° C	8 min
240° C	40 min
220° C	70 min
200° C	~2 h

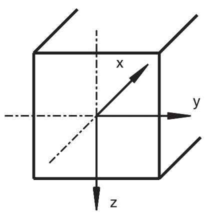
Welding

As with most aluminium alloys the welding heat reduces the strength in the area up to 50 mm from the seam.
With AlMgSi0,5 the following values are defined for the verification of butt welds (in acc. to E-DIN 4113.2):

R_m = 110 N/mm²
$R_{p0,2}$ = 65 N/mm²

Cross section values [2)]:

Section No.	G	A	I_y	W_y	I_z	W_z	I_T	C_M
NTS ...	[kg/m]	[cm²]	[cm⁴]	[cm³]	[cm⁴]	[cm³]	[cm⁴]	[cm⁶]
16x11,5 l	13,53	50,12	1649	206	859	149	526	2472
23x16 l	19,82	73,42	5128	446	2716	336	1865	22370
23x16 s	29,74	110,15	7471	650	3847	473	2769	25850
32x23 l	34,65	128,33	17407	1081	9203	792	8091	51800
32x23 s	46,09	170,71	23619	1460	12225	1047	10882	81930
46x32 l	51,05	189,06	53788	2326	27620	1713	32108	275000
46x32 s	66,78	247,32	74147	3191	35526	2195	40706	920200



Calculation programme DUENQ of Messrs. Dlubal (thin-walled sections) was used for the calculation of torsion constants.
The indicated section moduli are minimum values. Since the axes through the centre of gravity almost coincide with the centre lines, maxW = minW = W can be used for practical design.

[1)] *varying from DIN or EN*
[2)] *Orientation of axes in acc.to DIN 1080*

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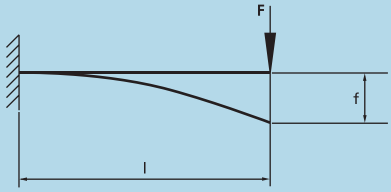
Formulae for design

Cantilever beam

The easiest way to verify cantilever beams for deflection and twist is to use the formulae:

Deflection: $f = \frac{F \cdot l^3}{3 \cdot E \cdot I}$



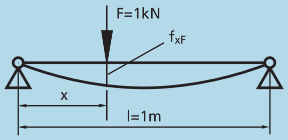
Angle of twist:

$$a = \frac{M_T \cdot l}{G \cdot I_T}[rad] = \frac{M_T \cdot l \cdot 180}{G \cdot I_T \cdot \pi}[°]$$

Beam on two supports

Deflection under point load

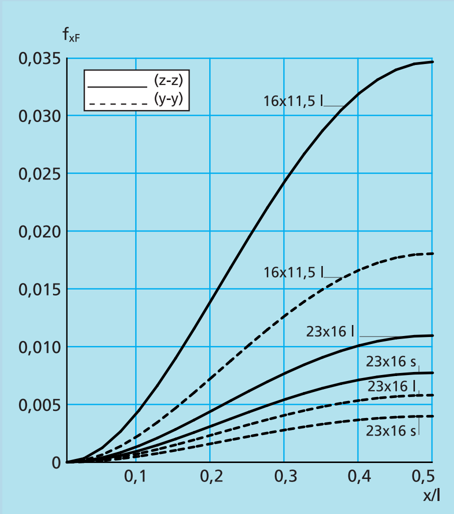
Deflection f_{xF} of point x in mm under unit load F = 1 kN (100 kg) at the point x for a unit span of l = 1 m

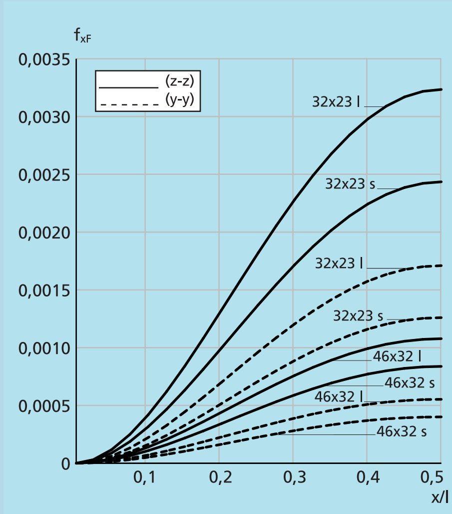


Calculation of general cases:

$f_x = f_{xF} \cdot F \cdot l^3$ [mm]
(with F in kN, l in m)

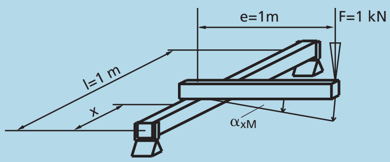
e.g. beam 23x16 l (z-z);
(bending about the weak axis)
l = 8 m, F = 5 kN at x = 3,2 m
=> x/l = 0,4 and $f_{xF} = 0{,}01$
$f_x = 0{,}01 \cdot 5 \cdot 8^3 = 25{,}6$ mm





Twist under torsional moment

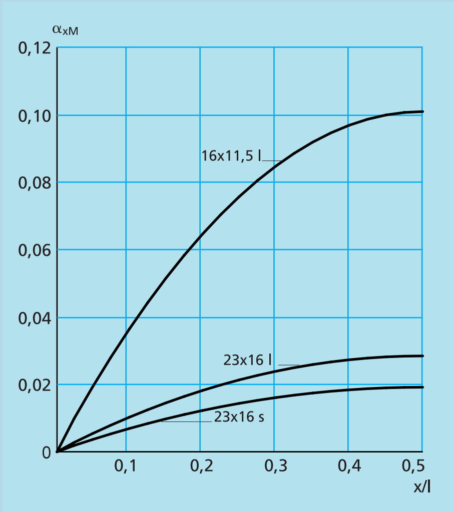
Angle of twist a_{xM} of point x in [°] under unit torsional moment M_T = 1 kNm at the point x for a unit span of l = 1 m.

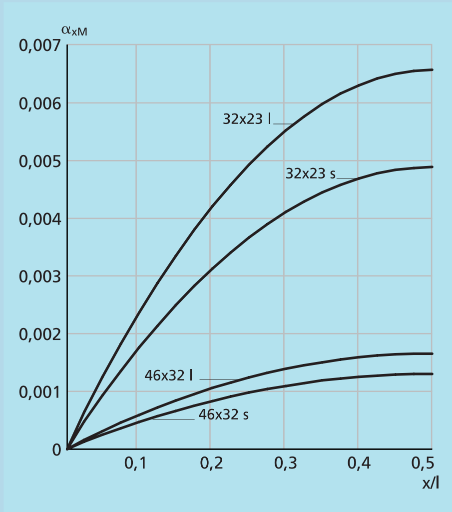


Calculation of general cases:

$\alpha_x = \alpha_{xM} \cdot M_T \cdot l$ [°] or = $\alpha_{xM} \cdot F \cdot e \cdot l$
(with e = lever arm in m,
F in kN, l in m)

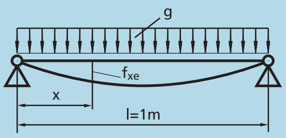
e.g. beam 46x32 l; l = 10 m
F = 7 kN at x = 3,5 m, e = 2 m
=> x/l = 0,35 and $\alpha_{xM} = 0{,}0015$
$\alpha_x = 0{,}0015 \cdot 7 \cdot 2 \cdot 10 = 0{,}21°$





Deflection under dead weight

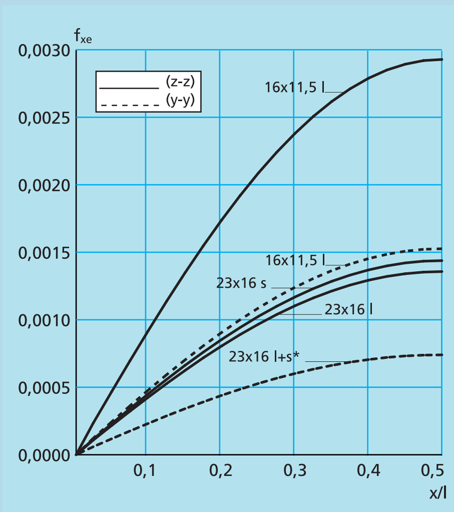
Deflection ordinates f_{xe} in mm under dead weight as a function of point x for a unit span of l = 1 m

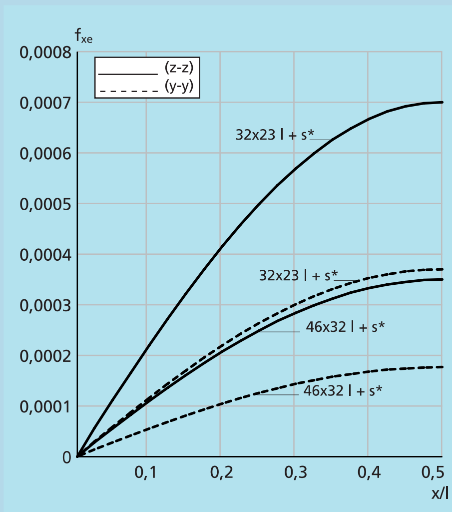


Calculation of general cases:

$f_x = f_{xe} \cdot l^4$ [mm]
(with l in m)

e.g. beam 23x16 l (z-z);
(bending about the weak axis)
l = 8 m, x = 3,2 m
=> x/l = 0,4 and $f_{xe} = 0{,}00128$
$f_x = 0{,}00128 \cdot 8^4 = 5{,}2$ mm





** For these sections the ratio I / G is between variant l and s which is almost identical.*

Formulae for design

Load carrying effect of attached steel parts

If steel parts such as guide rails or toothed racks are connected to the aluminium profiles this often results in a considerable increase of the stiffness/rigidity.

This is the case when the steel parts

a) are the length of the beam
b) are fixed to the aluminium beam with rigid means of connection.

The following calculation method applies:

This is to calculate an I^* which is based on the modulus of elasticity of aluminium as comparative modulus.

An additional assumption is that the axes through the centre of gravity of the aluminium profiles coincide with the respective centre lines (error 1,5 % max.) and that the ratio of the moduli of elasticity E_{St}/E_{Al} is 3.

Δe which is the distance between the new axis through the centre of gravity and the (original) centre line is calculated on the basis of the following formulae:

$$\Delta e = \frac{3\,\Sigma\,(A_{St,i}\cdot e_i)}{(A_{Al} + 3\,\Sigma\,A_{St,i})} \quad \text{or}$$

$$\Delta e = \frac{\Sigma\,(A_i^*\cdot e_i)}{\Sigma\,A_i^*}$$

Therefore the relation

$$I^* = I_{Al} + 3\,\Sigma\,I_{St} + 3\,\Sigma\,(A_{St,i}\cdot(e_i - \Delta e)^2) + A_{Al}\cdot\Delta e^2$$

and in summary

$$I^* = \Sigma\,I_i^* + \Sigma\,(A_i^*\cdot e_i^2) - \Delta e^2\cdot\Sigma\,A_i^*$$

applies to the higher moment of inertia. To calculate the above, please use the table below.

	A_i		A_i^*	e_i ->	$A_i^*\cdot e_i$	e_i^2 ->	$A_i^*\cdot e_i^2$	I_i		I_i^*
Al-beam		x 1 =		0	0	0	0		x 1 =	
Steel sec. 1		x 3 =							x 3 =	
Steel sec. 2		x 3 =							x 3 =	
Steel sec. 3		x 3 =							x 3 =	
Steel sec. 4		x 3 =							x 3 =	
		ΣA_i^* =	①	$\Sigma\,(A_i^*\cdot e_i)$ =	②	$\Sigma\,(A_i^*\cdot e_i^2)$ =	⑤		I_i^* =	⑥
			Δe = ② / ① =		③					
			$\Sigma\,A_i^*\cdot\Delta e^2$ = ①·③² =		④				I^* = ⑤ + ⑥ - ④ =	

Stresses are calculated on the basis of the following formulae:

for Al: $\sigma = M/(I^*/e)$

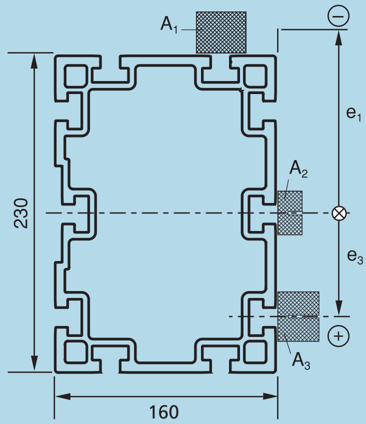
for steel: $\sigma = 3\,M/(I^*/e)$

The shearing force per fixing means between steel and Al-beam is

$$T = \frac{3\,Q\,S}{I^*}\cdot d,$$

with $S = A_{i,St}\cdot(e_i - \Delta e)$ and

d = distance between the fixing means.



Example:
Calculation of the values for NTS 23x16 l with bending about the Y-axis

	b [cm]	h [cm]	A_i [cm²]	e_i [cm]	I_i [cm⁴]
Beam NTS 23x16 l	16	23	73,42	0	5128
Guide rail A_1	5	4	20	-13,5	26,67
Toothed rack A_2	3	5	15	0	31,25
Guide rail A_3	4	5	20	+7,5	41,67

	A_i		A_i^*	e_i ->	$A_i^*\cdot e_i$	e_i^2 ->	$A_i^*\cdot e_i^2$	I_i		I_i^*
Al-beam	73,42	x 1 =	73,42	0	0	0	0	5128	x 1 =	5128
Steel sec. 1	20	x 3 =	60	-13,5	-810	182,25	10935	26,67	x 3 =	80,01
Steel sec. 2	15	x 3 =	45	0	0	0	0	31,25	x 3 =	93,75
Steel sec. 3	20	x 3 =	60	7,5	450	56,25	3375	41,67	x 3 =	125,01
Steel sec. 4		x 3 =							x 3 =	
		ΣA_i^* =	238,42 ①	$\Sigma(A_i^*\cdot e_i)$ =	-360 ②	$\Sigma\,(A_i^*\cdot e_i^2)$ =	14310 ⑤		$\Sigma\,I_i^*$ =	5426,8 ⑥
			Δe = ② / ① =		-1,51 ③					
			$\Sigma A_i^*\cdot\Delta e^2$ = ①·③² =		543,6 ④				I^* = ⑤+⑥ - ④ =	**19193 cm⁴** (≈ **3,7·** I_{Al})

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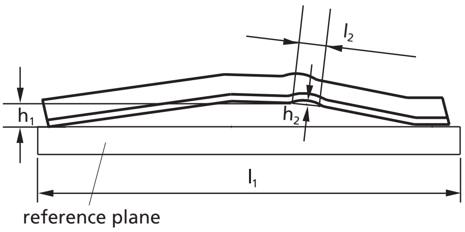
Tolerances

Tolerance class P:

The tolerances are acc. to DIN 17615.3 or analogue values which are linearly extrapolated. Wall thicknesses are acc. to DIN 1748.4. A dimensional data sheet will be issued.

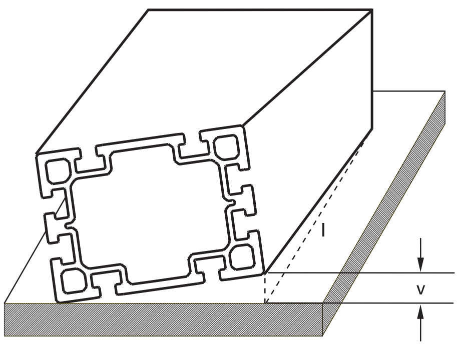
As to the straightness in the longitudinal direction the following applies:



Length l_1	2 m	4 m	6 m	8 m	10 m
max. h_1	1,3	2,2	3,0	4,0	5,0

Definition of short bends in length of l_2
$h_2 \leq 0{,}3$ mm up to $l_2 = 300$ mm und
$h_2 \leq 0{,}7$ mm up to $l_2 = 1000$ mm

For twist v (referring to the wide surface of the profile) the following tolerances are valid as a function of l:



NTS ...	2 m	4 m	6 m	8 m	10 m
16x11,5	1,8	2,6	3,0	-	-
23x16	2,5	3,5	4,0	5,0	6,0
32x23	2,8	4,1	5,0	6,0	7,0
46x32	3,2	4,8	6,0	7,0	8,0

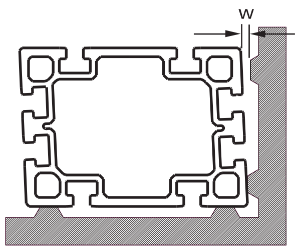
Tolerances on widths and heights:

NTS ...	Width	Height
16x11,5	160 ± 1,0	115 ± 0,6
23x16	230 ± 1,2	160 ± 1,0
32x23	320 ± 1,8	230 ± 1,2
46x32	460 ± 2,4	320 ± 1,8

Tighter tolerances can be kept on the parallelism (equidistance) of adjacent edges. The following tolerances apply as a function of l:

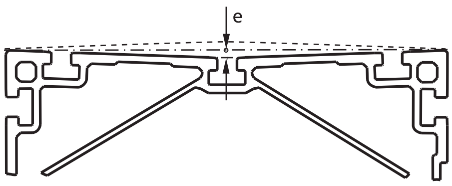
Dim.	2 m	4 m	6 m	8 m	10 m
115	0,3	0,35	0,4	-	-
160	0,35	0,4	0,45	0,5	0,6
230	0,4	0,5	0,6	0,7	0,8
320	0,5	0,6	0,8	1,0	1,2
460	0,7	0,8	1,0	1,2	1,4

As to corner areas the following tolerances on angularity w apply:



NTS ...	Deviation w of the narrow surface
16x11,5	0,8
23x16	0,8
32x23	0,8
46x32	1,2

The tolerances on flatness e of the lateral surfaces (straightness transverse) are shown below:



Dimension	Flatness e
115	± 0,45
160	± 0,65
230	± 0,75
320	± 1,0
460	± 1,4

Tolerance class S:

In general the tolerances indicated for tolerance class P apply. However, smaller tolerance values may be feasible in particular cases. A dimensional data sheet will be issued. The values indicated below are a guide:

Tolerance on straightness in the longitudinal direction:

Length l_1	6 m	10 m
max. h_1	up to 1 mm	up to 2 mm

Tolerance on twist

NTS ...	2 m	4 m	6 m	8 m	10 m
16x11,5	0,3	0,4	0,5	0,6	0,7
23x16	0,4	0,55	0,7	0,85	1,0
32x23	0,6	0,8	1,0	1,25	1,5
46x32	0,9	1,15	1,4	1,7	2,0

Tolerance on parallelism (equidistance)

Dim.	2 m	4 m	6 m	8 m	10 m
115	0,2	0,2	0,2	-	-
160	0,2	0,2	0,2	0,25	0,3
230	0,2	0,25	0,3	0,35	0,4
320	0,25	0,3	0,4	0,5	0,6
460	0,35	0,4	0,5	0,6	0,7

Tolerance on angularity

NTS ...	Deviation w of the narrow surface
16x11,5	0,2
23x16	0,3
32x23	0,4
46x32	0,6

Tolerance on flatness e of the lateral surface (straightness transverse)

Dim.	Flatness e
115	0,3
160	0,4
230	0,55
320	0,7
460	1,0

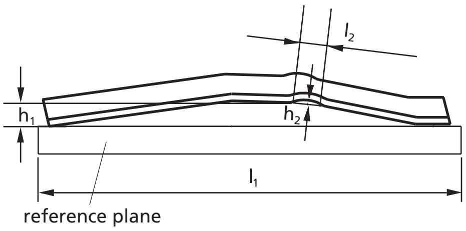
It is not possible to have all minimum values at the same time. Please contact us in time to discuss your special requirements.

Where no unit is indicated values are in mm.

Tolerances

Tolerance class N:
In general the tolerances acc. to DIN 1748.4, "fine straightened" apply with regard to the dimensions of the profiles. No dimensional data sheet will be issued.

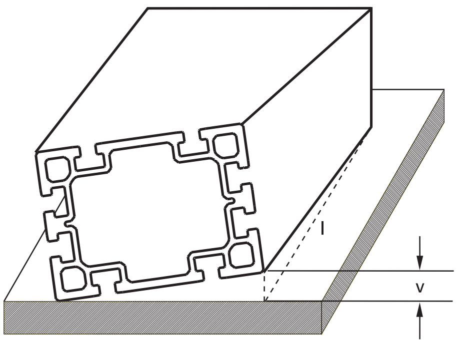
As to the straightness in the longitudinal direction the following applies:



Length l_1	2 m	4 m	6 m	8 m	10 m
max. h_1	2,0	3,5	5,0	7,0	9,0

Definition of short bends in length of l_2
$h_2 \leq 0,3$ mm up to $l_2 = 300$ mm and
$h_2 \leq 1,0$ mm up to $l_2 = 1000$ mm

For twist v (referring to the wide surface of the profile) the following tolerances are valid as a function of l:



NTS ...	2 m	4 m	6 m	8 m	10 m
16x11,5	3,0	3,0	3,0	-	-
23x16	4,0	4,0	4,0	6,0	6,0
32x23	4,0	5,0	5,0	8,0	10,0
46x32	5,0	6,0	6,0	8,0	10,0

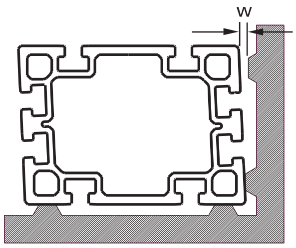
Tolerances on widths and heights:

NTS ...	Width	Height
16x11,5	160± 1,5	115± 1,1
23x16	230± 1,9	160± 1,5
32x23	320± 3,0	230± 1,9
46x32	460± 3,5	320± 3,0

Closer tolerances can be kept on the parallelism (equidistance) of adjacent edges. The following tolerances apply as a function of l:

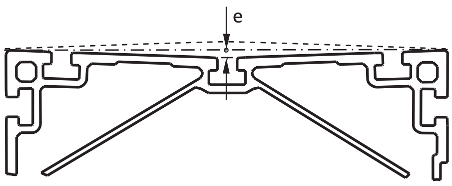
Dim.	2 m	4 m	6 m	8 m	10 m
115	0,4	0,4	0,5	-	-
160	0,5	0,6	0,7	0,8	0,9
230	0,7	0,8	0,9	1,0	1,2
320	0,9	1,0	1,2	1,3	1,6
460	1,1	1,3	1,5	1,8	2,1

As to the corner areas the following tolerances w on angularity apply:



NTS ...	Deviation w of the narrow surface
16x11,5	0,9
23x16	1,3
32x23	1,6
46x32	1,9

The tolerances on flatness e of the lateral surfaces (straightness transvers) are shown below:



Dim.	Flatness e
115	±0,7
160	±0,9
230	±1,2
320	±1,8
460	±2,4

Where no unit is indicated values are in mm

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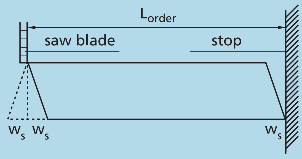
Stock lengths/ Profiles cut to length

Stock lengths
Profile 16x11,5 is available ex stock in lengths of 6 m; all other profiles in lengths of 6 m and 10 m. Other lengths upon request.
Tolerance on length: +200/-0 mm
Always subject to prior agreement.

Profiles cut to length
The profiles are cut with a tolerance t_s which means that the length between the cut (first grip of sawing teeth) and the stop is within the range of this tolerance value.



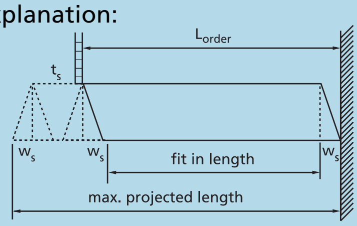
Additionally the cutting angle w_s must be defined. Unless otherwise agreed, this angle is to be $w_s = t_s/2$ (on the basis of the mean profile axis).

Fixed lengths with plus tolerances
The values in mm for t_s are as follows:

NTS ...	up to 5 m	up to 10 m
16x11,5 23x16	6	8
32x23 46x32	8	10

Note: To be able to machine a "precise length L" (parallel at both ends) from a cut-to-length profile, the length to be ordered has to be increased by $2w_s = t_s$.

Explanation:



(On the basis of this definition the projected length of a profile can be max. $L+t_s+3w_s$.)

Length to be ordered:
$L_{order} = L + t_s \ldots\ldots {}^{+t_s}_{-0}$

Example: precise length L 4800 mm; section 23x16 i.e. $t_s = 6$ mm. This results in a length to be ordered of 4806 mm +6/-0.

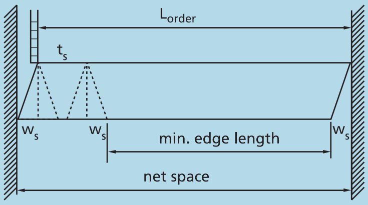
Fixed lengths with minus tolerances

The values in mm for t_s are as follows:

NTS ...	up to 5 m	up to 10 m
16x11,5 23x16	4	6
32x23 46x32	6	8

Note: To obtain the fit in length (i.e. it must be possible to fit the cut-to-length profile between two parallel surfaces at a distance L) the length to be ordered must be reduced by $w_s = t_s/2$ referring to the net space.

Explanation:



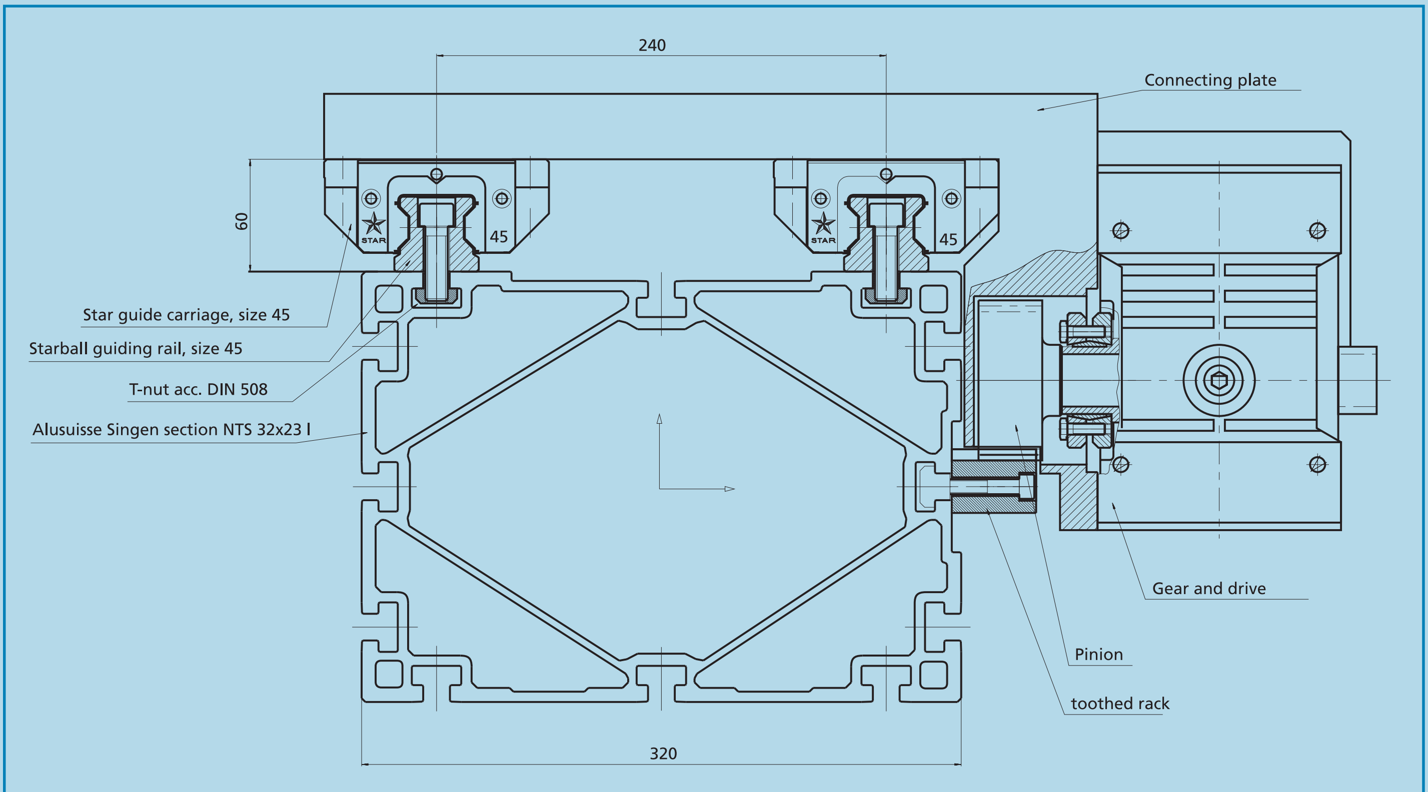
(On the basis of this definition the length of the shortest edge of a profile can be $L\text{-}t_s\text{-}3w_s$.)

Length to be ordered:

$L_{order} = L - t_s/2 \ldots\ldots {}^{+0}_{-t_s}$

Example: Net space 4800 mm, section 23x16 results in t_s = 4 mm and a length to be ordered of 4798 mm +0/-4.

Upon special agreement, profiles can be supplied which are cut with tighter tolerances.



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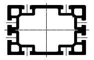
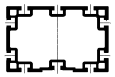
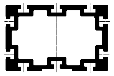
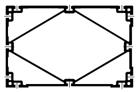
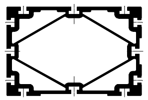
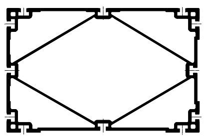
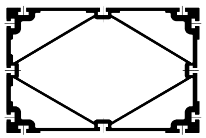
Modified Delivery Terms for NTS Profiles

As of July 2007 the following delivery conditions apply for the NTS profiles: Profiles 41732, 41735, 41738 and 41741 are available from stock, in lengths up to 10 m.
Profiles 41744, 41747 and 41750 are available upon request.

The three tolerance classes N, P, and S are replaced by the consistent tolerances listed below. (They correspond to approx. the previous class "P" tolerance).
A drawing is available upon request with the exact tolerance details.

		TOLERANCES							
	Designation Weight per meter	**Height/ width**	**Parallelism small side**	**Parallelism wide side**	**Straightness including twist**	**Short bends in length**	**Flatness (straightness transverse) small side**	**Flatness (straightness transverse) wide side**	**Angularity**
 41732	**NTS 16x11,5** W=13.5kg	115±0.8 160±1.1	0.5mm/ 10m	0.6mm/ 10m	6.0mm/ 10m	1.0mm/ 2000mm	0.4mm	0.6mm	0.8mm
 41735	**NTS 23x16l** W=19.8kg	160±1.0 230±1.1	0.6mm/ 10m	0.9mm/ 10m	6.5mm/ 10m	1.0mm/ 2000mm	0.6mm	0.8mm	0.9mm
 41738	**NTS 23x16s** W=29.7kg	160+1.1/-0.4 230±1.0	0.3mm/ 3000mm 0.6mm/ 10m	0.8mm/ 10m	7.0mm/ 10m	1.0mm/ 2000mm	0.6mm	0.7mm	0.6mm
 41741	**NTS 32x23l** W=34.7kg	230±0.8 320±1.3	0.8mm/ 10m	1.0mm/ 10m	7.5mm/ 10m	1.2mm/ 2000mm	1.0mm	1.0mm	0.8mm
 41744	**NTS 32x23s** W=46.1kg	230±1.2 320±1.8	1.0mm/ 10m	1.3mm/ 10m	8.0mm /10m	1.2mm/ 2000mm	0.8mm	1.2mm	1.0mm
 41747	**NTS 46x32l** W=51.1kg	320±1.8 460±2.4	1.3mm/ 10m	1.5mm/ 10m	8.5mm/ 10m	1.5mm/ 2000mm	1.8mm	2.4mm	1.9mm
 41750	**NTS 46x32s** W=66.8kg	320±1.8 460±2.4	1.3mm/ 10m	1.5mm/ 10m	9.0mm/ 10m	1.5mm/ 2000mm	1.2mm	1.6mm	1.5mm

The way to your own individual section

In many cases the question will be asked, whether or not it is an advantage to have your own individual section.
The advantages are: a section with optimum shape and weight, so that in the final analysis there are cost saving advantages as well as distinctive design features making the section exclusive.
Necessary concessions: Capital expenditure on a product whose market possibilities cannot be specifically assessed, die costs, minimum quantities, development decisions taken in haste, uncertainty regarding the final shape of the profile.
However these entrepreneurial decisions must be taken. At this stage the argument may be, that when compared with steel, die costs and minimum quantities are not nearly so high for aluminium extrusions and for these reasons many companies have already taken the step of having their own individual section.
The NTS beam system offers the designer alternatives in different situations:
For machines and frameworks that are produced and sold in small quantities.
When it is possible to adapt an existing system to use NTS beams, one saves die costs with the advantages of an individual section.
By starting a new development with NTS beams and changing later to an individual shape, the entrance risk into the market is minimised and the design can be proved.

Alloys

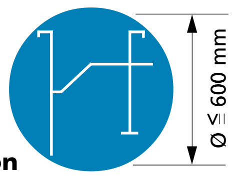
Based on its excellent combination of characteristics alloy AlMgSi0,5 (6060,6063) was chosen for the NTS beam system. Practically all extrusion alloys are heat-treatable alloys. They extrude well, but attain their strength only by heat-treatment which includes quenching.
According to the alloy, quenching must be done with water or with air.
As a rule mechanical engineering requires tight tolerances on the shape and small residual stresses. Therefore air-quenched alloys have the advantage.

Besides AlMgSi0,5 (6060,6063) there is also alloy AlZn4,5Mg1 (7020), which is air-quenchable. The high strength of this alloy would be an additional incentive for many applications. However, it has a higher flow stress, which means it requires larger wall thicknesses, simpler profile shapes and is more expensive. Therefore it is only considered for special cases.
When new sections are being developed, the conclusion is, that AlMgSi0,5 (6060,6063) should be the first alloy to be considered.

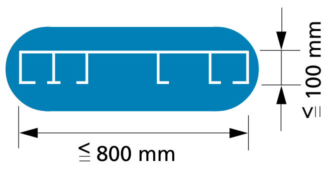
Dimensions

For maximum cross-sectional dimensions the following diagrams illustrate the general limits. These limits are within our manufacturing capabilities. However any borderline section should be discussed at the planning stage with the application engineers at Alusuisse Singen.

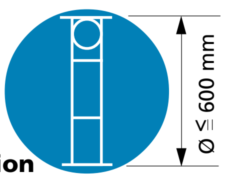
Solid section



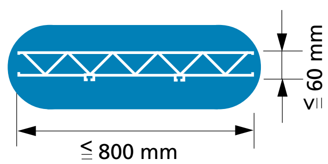
Solid section



Hollow section



Hollow section



Minimum wall thicknesses and weights

There are also factors governing the minimum wall thicknesses and minimum weights, which should not be overlooked.
For AlMgSi0,5 (6060,6063) the following applies:

Circumscr. circle ø [mm]	min. weight [kg/m]	min. wall thickness [mm]
< 40	0,15	1,2
up to 100	0,35	1,8
up to 160	0,7	2,0
up to 200	1,3	2,5
up to 320	3,5	3,0
up to 400	6,0	4,0
> 400	On request	

Tolerances:

DIN 1748/4 is applied in most cases, however, depending on the application DIN 17615/3 can be a basis for design and production. The tolerances stated in this publication can not be taken as a general guideline. For symmetrical sections, which are manufactured in large quantities, relatively small tolerances can be held.
Please feel free to discuss your ideas and plans with us at the planning stage.

The above explanations are valid exclusively for applications similar to the NTS beam system. Alusuisse Singen supplies profiles in a comprehensive range of sizes, alloys and mechanical strength. Data for these possibilities are available on request through brochures or by direct contact.

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