Profile design manual

PURSO®

In this manual

Purso factory and headquarters at Siuro, Nokia.

Expert in aluminium

Purso Oy is an internationally well-known family-owned company with 50 years of experience in the processing aluminium. We manufacture aluminium profiles and profile components for our customers' needs with expertise and accuracy. Purso's aluminium is used on land, at sea and in the air.

Expertise and willingness to serve

- Customised profiles
- Components
- Standard profiles
- Building systems
- Lighting systems
- Transportation system products
- Surface treatment creates a beautiful and durable surface

Billets, or blanks of raw material.

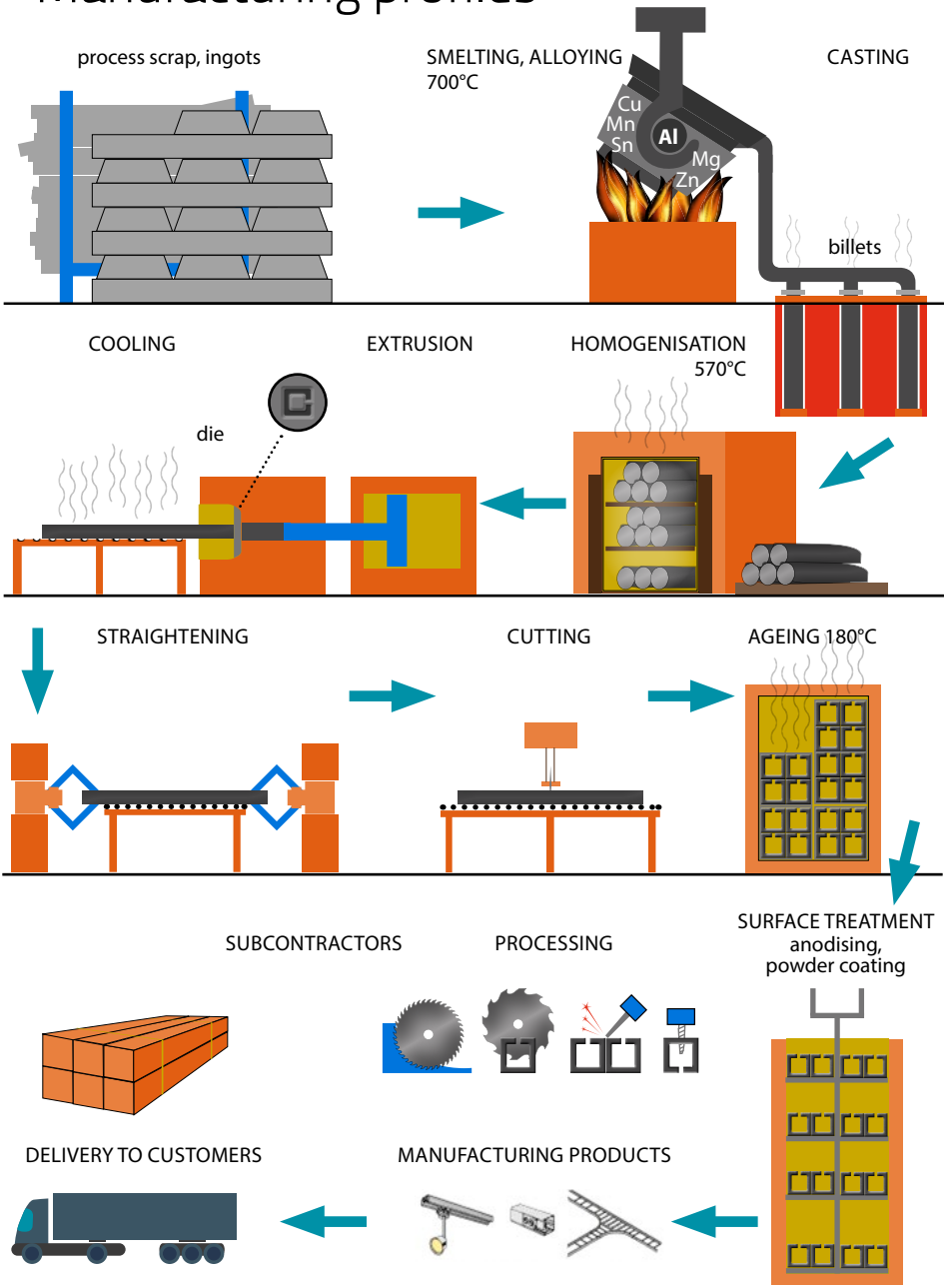
Environmentally friendly aluminium

- Aluminium is the third most common element
- Lightness, strength, service life, corrosion resistance, low maintenance requirements, ability to conduct heat and electricity
- Easy to recycle
- Melting down recycled aluminium requires only five per cent of the energy needed to produce primary aluminium
- Purso Oy uses recycled aluminium in casting high quality extrusion billets in its own smelting plant in Ikaalinen

Certified quality

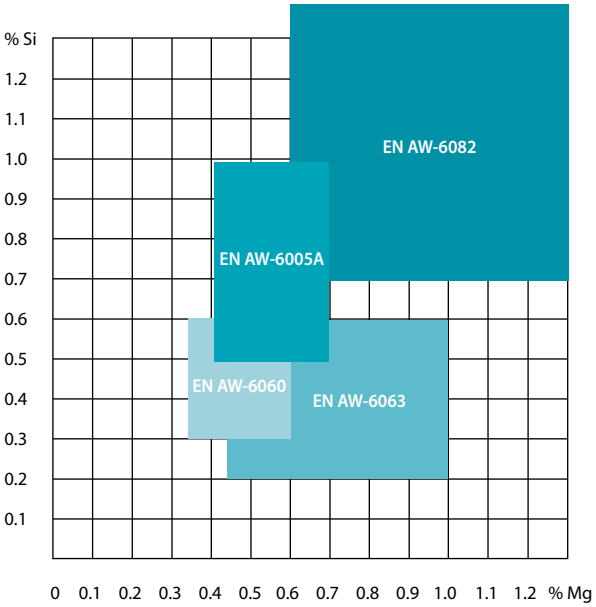
- ISO 9001 quality management system
- ISO 14001 environmental system
- GSB certificate in powder coating
- GostR certificate

Manufacturing profiles



Aluminium alloys used

The silicon and magnesium content affects e.g. tensile properties, surface quality and extrudability.



Aluminium alloys used	
EN AW-6063 EN AW-Al Mg0.7Si	The most common alloy. Excellent tensile properties, very suitable for anodising.
EN AW-6060 EN AW-AlMgSi	Almost the same as alloy 6063, but slightly softer.
EN AW-6005 EN AW-AlSiMg	A harder alloy than 6063. Not very suitable for anodising.
EN AW-6101 EN AW-EAl MgSi	An alloy with good electrical conductivity. The same tensile properties as alloy 6063.
EN AW-6082 EN AW-AlSi1MgMn	Construction alloy. Not very suitable for anodising. The recommended wall thickness is min. 3 mm.

Characteristics of extrusion alloys

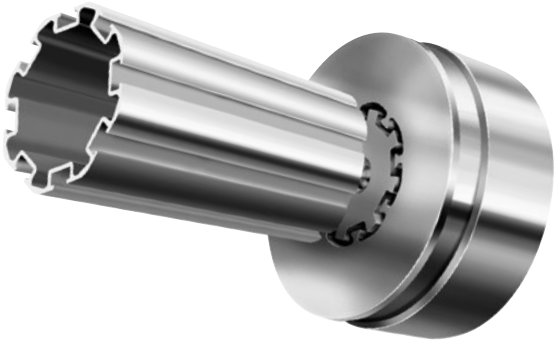
Mechanical, physical and chemical characteristics of aluminium extrusion alloys

Strength requirements

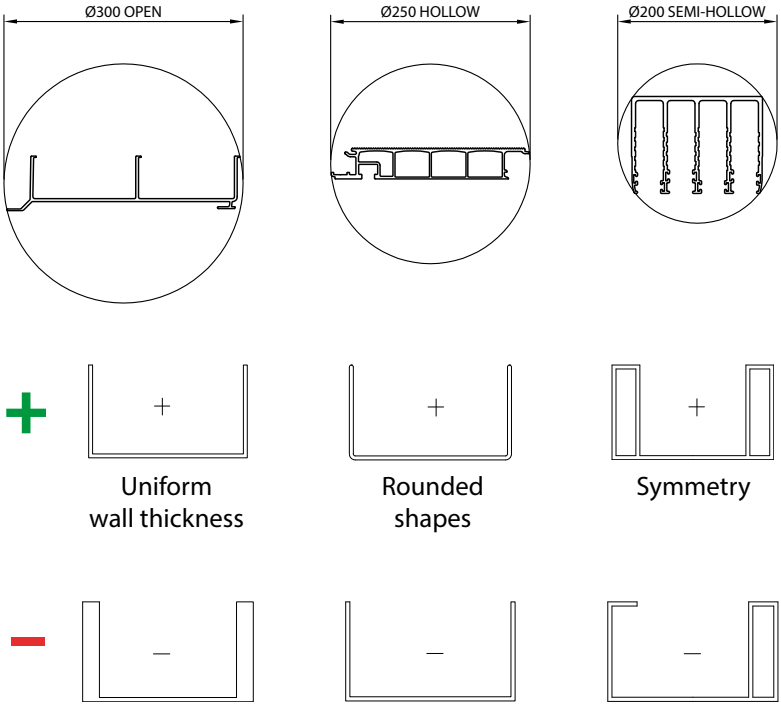
Identifier	**EN AW-6060**				**EN AW-6063**			
Chemical identifier	**EN AW-Al MgSi**				**EN AW-Al Mg0.7Si**			
Temper designations	**T4**	**T5**	**T6**	**T66**	**T4**	**T5**	**T6**	**T66**
Tensile strength R_m (min) MPa (N/mm²)	120	140 - 160	170 - 190	195 - 215	120 - 130	160 - 175	195 - 215	225 - 245
Yield strength $R_{p0.2}$ (min) MPa (N/mm²)	60	100 - 120	140 - 150	150 - 160	65	110 - 130	160 - 170	180 - 200
Elongation A min	16	8	8	8	10–14	7–10	8–10	8–10
($A_{50\%}$ min) PURSO	(14)	(6)	(6)	(6)	(10–12)	(5–6)	(6–8)	(6–8)
Brinell hardness (HBW)	40 - 50	50 - 55	55 - 65	65 - 75	40 - 55	55 - 60	60 - 75	75 - 85
Main alloying elements %	**Si 0.30–0.6 Mg 0.35–0.6**				**Si 0.20–0.6 Mg 0.45–0.9**			
Aluminium content %	**98.5**				**98.5**			
Characteristics	Alloyed, hardenable and extrudable alloy with good tensile properties and good surface quality. Very well suited for anodising.				Alloyed, hardenable and extrudable alloy with good tensile properties and good surface quality. Very well suited for anodising.			
General characteristics	**Modulus of elasticity: 70,000 N/mm²**				**Electrical conductivity: 30–32 Y ≥ MS/m**			

	EN AW-6101A	EN AW-6101B	EN AW-6005A		EN AW-6082		
	EN AW-EAl MgSi(A)	EN AW-EAl MgSi(B)	EN AW-Al SiMg(A)		EN AW-Al Si1MgMn		
	T6	T6	T4	T6	T4	T5	T6
	200	215	180	250 - 270	205	270	270 - 310
	170	160	90	200 - 225	110	230	250 - 260
	10 (8)	8 (6)	15 (13)	8–10 (6–8)	14 (12)	8 (6)	8–10 (6–8)
	65 - 75	65 - 75	55 - 60	80 - 90	60 - 70	75 - 90	90 - 100
	Si 0.30–0.7 Mg 0.40–0.9	**Si 0.30–0.6 Mg 0.35–0.6**	**Si 0.50–0.9 Mg 0.40–0.7**		**Si 0.70–1.3 Mg 0.60–1.2**		
	98.5	**98.5**	**98.0**		**97.5**		
	The same tensile properties as the alloy EN AW-6060 / 6063.	The same tensile properties as the alloy EN AW-6060 / 6063 Good electrical conductivity ≥ 32 MS/m.	An easily hardenable construction alloy with good tensile properties. Not very well suited for anodising or bending.		An easily hardenable construction alloy with excellent tensile properties. Not very well suited for anodising or bending. Larger dimension and shape tolerances than the other alloys.		
	Coefficient of thermal expansion (change in length): 2–100°C 10–6/°C	**Density: 2.70 kg/dm³**	**Electrical conductivity 20°C: 49–55 IACS %**		**Thermal conductivity 20°C: 190–210 W/m°C**		

Dies and extrudability



- Low tool costs
- The profiles are tailored to their purpose
- Functional dies are a prerequisite for successful production



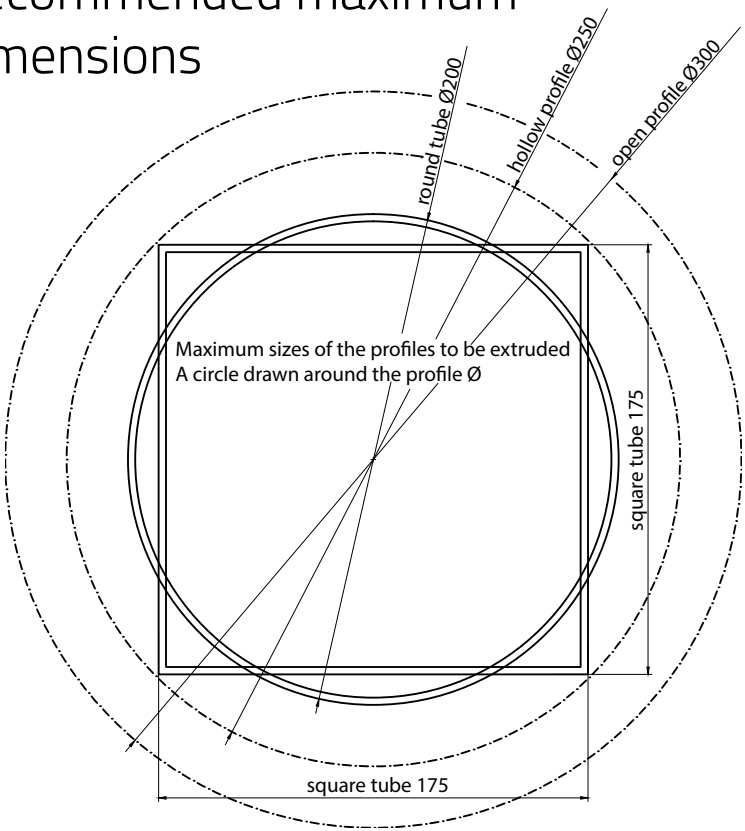
3D modelling

Purso's 3D modelling service enables rapid and cost-effective modelling of the profile shapes before ordering the die. Printing can ensure, for example, the compatibility of the profiles and their functioning in the future product. Modelling speeds up the design process significantly and makes it possible to test different variations without high additional costs.

3D printer

- Tray size: 200 x 200 mm, max. height: 150 mm.
- The material used is ABS plastic, and the colour options are: pale yellow (base colour), white, black, blue and red.
- A 3D model of the object to be printed in an stl file is required.
- The printing speed of the object to be printed depends on the thickness of the printed layers (0.25 or 0.33 mm) as well as the geometry and volume of the object. The accurate printing time for an object can only be found through the printing program.
- Thinner layers of 0.25 mm result in slightly more accurate printing.
- The dimensional accuracy of the printed object is in the range of +/- 0.12–0.25 mm, but it depends of the size of the model. As a whole, a small object will be more accurate than a large one (maximum size).
- If necessary, as many copies of the object can be printed as can fit on the tray.
- It is also possible to carry out unsupervised printing overnight.

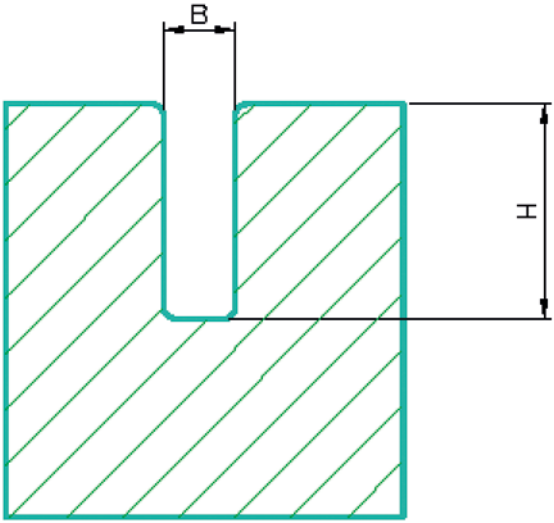
Recommended maximum dimensions



Basic information on profile extrusion	
Maximum profile cross section	200–300 mm (depending on profile type)
Wall thickness	minimum 1.2 mm
Maximum weight	20 kg/m
Minimum weight	~ 0.200 kg/m
Minimum delivery quantity	alloy 6063: 250 kg alloy 6082: 500 kg
Maximum length	16 m
Maximum length, anodised	8.0 m
Maximum length, powder coated	8.0 m
Maximum weight of the profile length	100 kg
Tolerances	SFS-EN 755-3…9 / SFS-EN 12020-1…2

Cavity

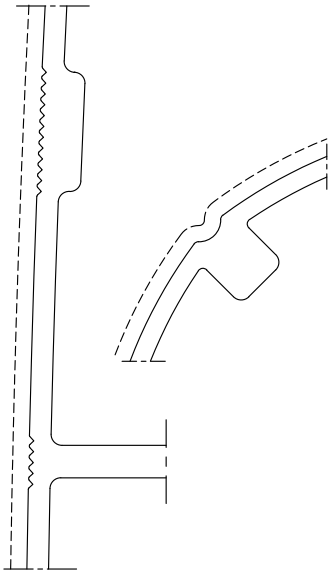
- In design, the width should be taken into account in relation to the depth: 1:3 is a good basic rule.



- The relation of the mouth of the cavity to its depth affects the durability of the extrusion die.

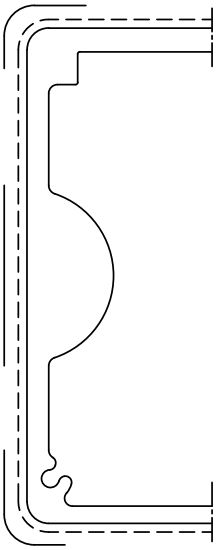
B	max. H:B
1–3	2
3–5	3
5–15	4
15–30	3.5

Taking surface quality into account in design



- Variations in the mass of the profile create visual stripes on the opposite side of the wall.

- The visibility of the extruded profile shapes on the opposite side of the wall can be smoothed out by breaking up the surface shape with grooves, for example.



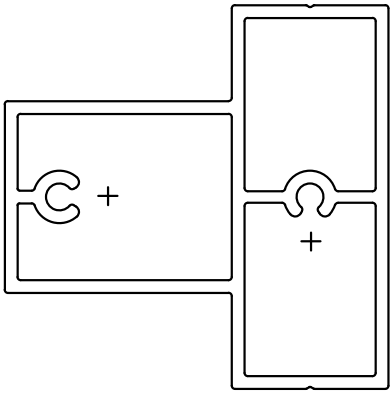
- The most likely locations of thermal lines/-stripes and visual and physical defects due to the extrusion method can be marked in the profile drawings, if necessary.

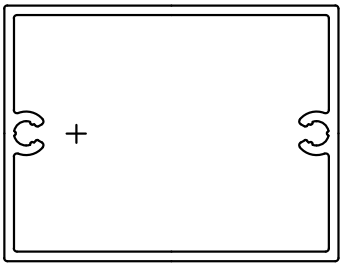
Possible thermal track

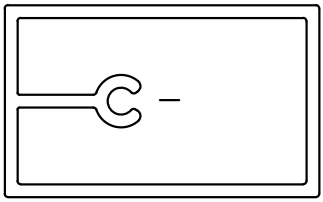
Visible surface

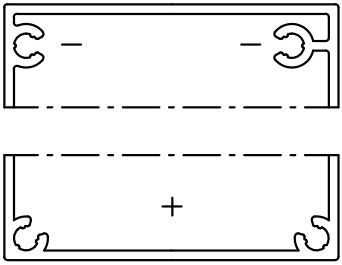
Placement of screw pockets

Examples of screw pocket placements that are recommended/
should be avoided:



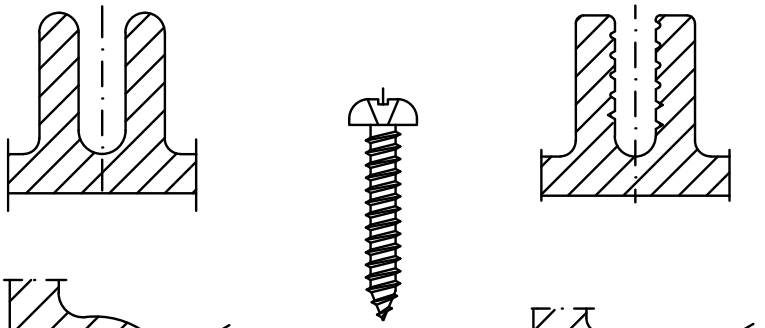


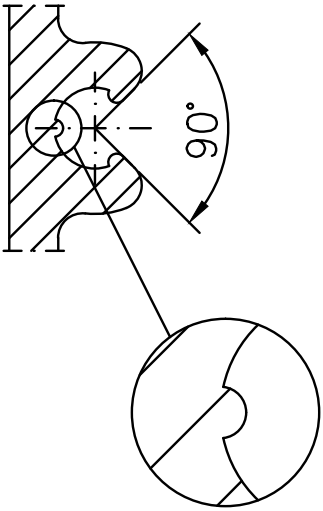




Screw pocket design

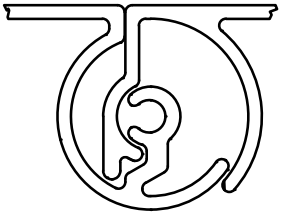
Factors to be taken into account in screw pocket design:

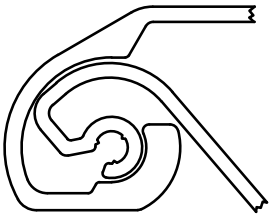


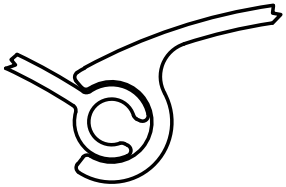


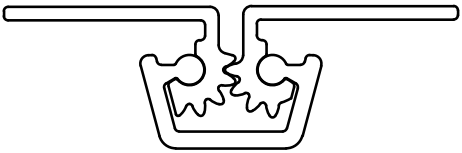
- Nubs located in the screw pocket can improve functionality and compensate the natural variation occurring in the profile.

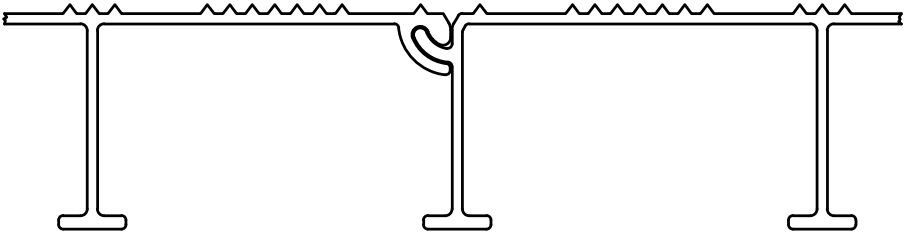
Examples of hinged joints



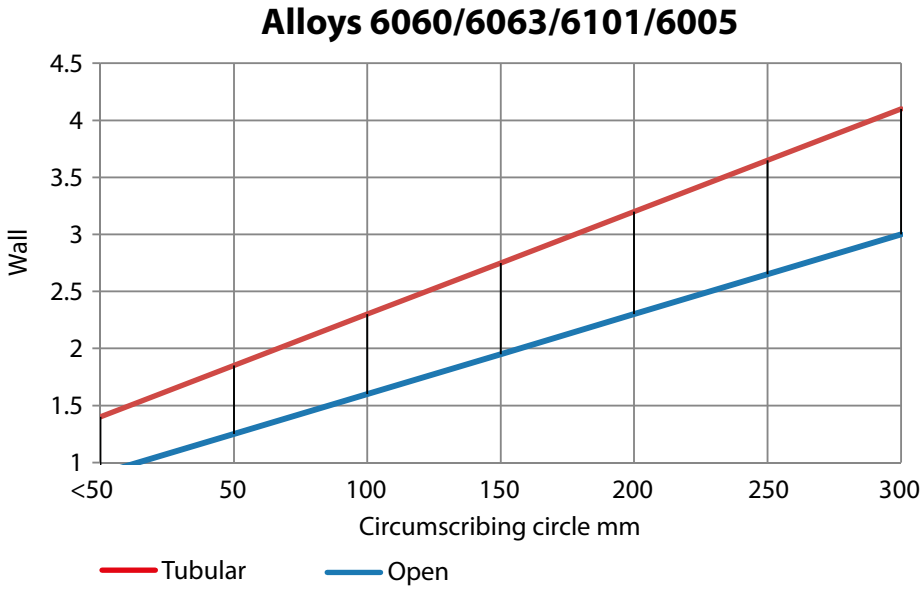


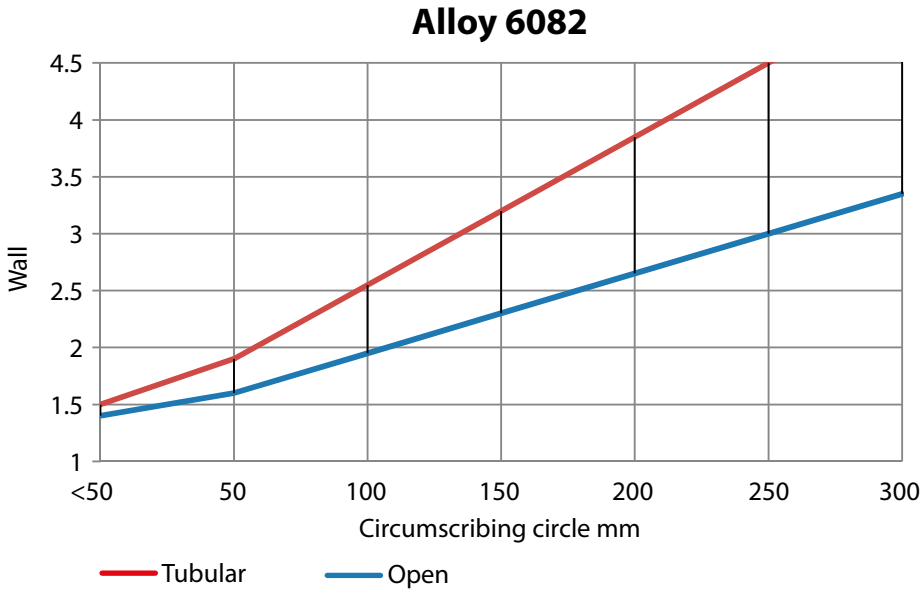




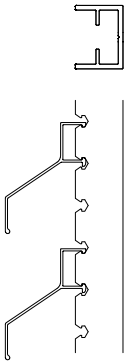


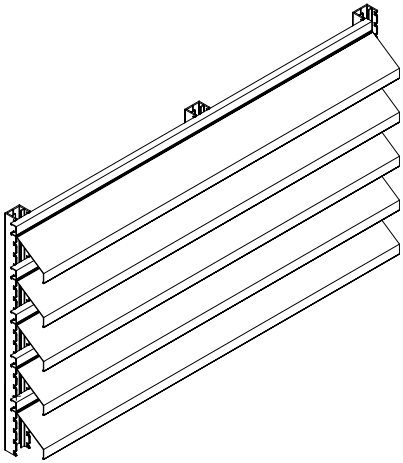
Wall thickness





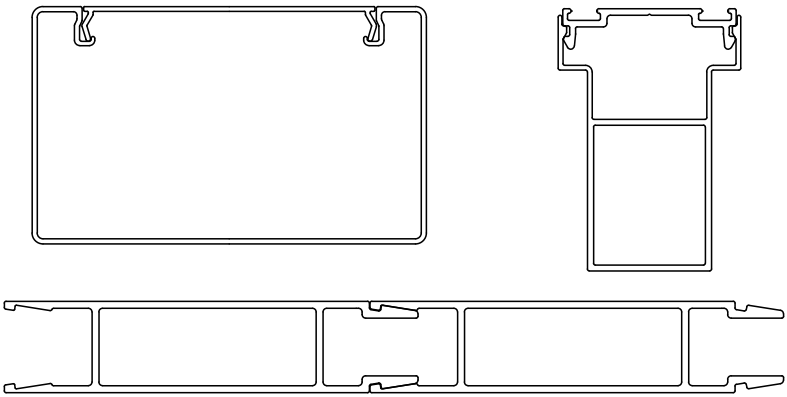
Joints



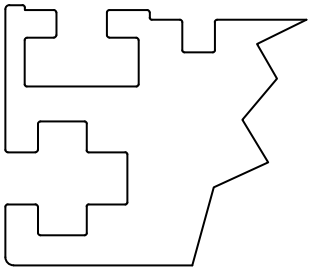


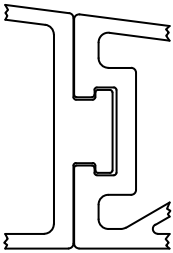
Factors that should be taken into account when designing clip-on joints:

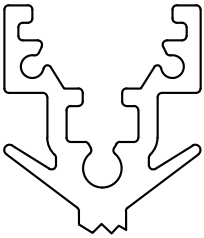
- Surface treatments affect joint function
  - painted and anodised profiles may require different dimensions
- Length of the profiles to be joined
  - straightness and twist tolerances
- Tolerances must preserve functionality
- Information about the counterpart and its tolerances
  (if e.g. a different material/an existing object is involved)

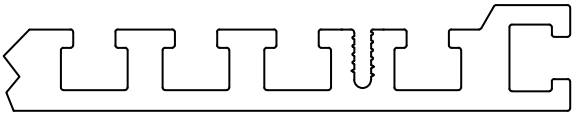


Extrusion can be used to create different types of joints. The profile can be designed with grooves of different shapes that make it possible to join objects or components together.

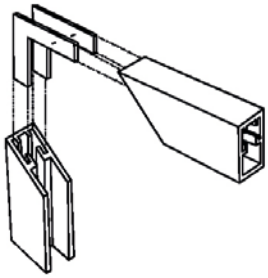


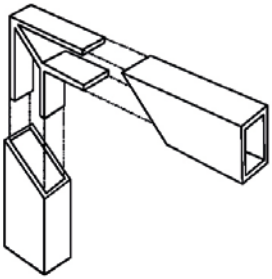






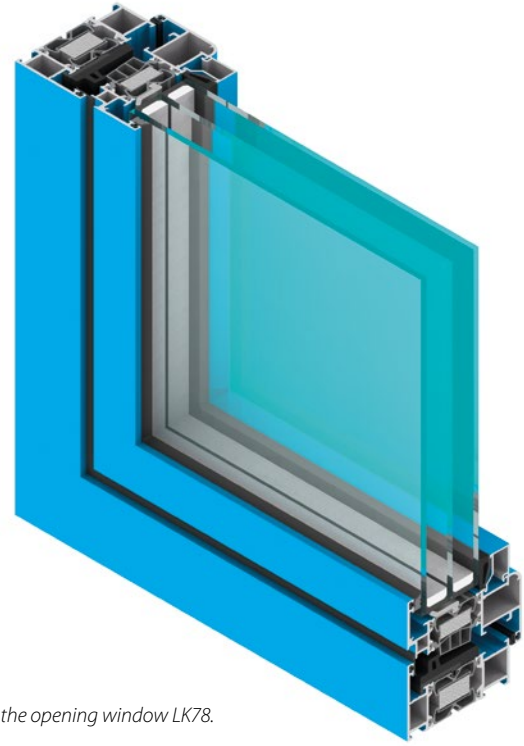
Corner joints





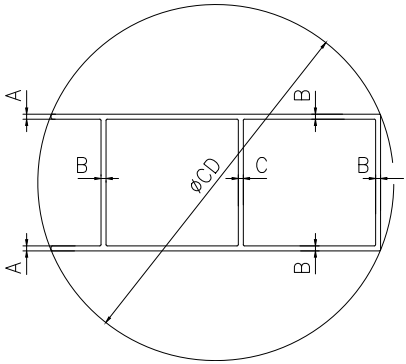
Corner joints can be implemented, for example, with riveted or glued corner pieces or by welding or screwing.

Thermal breaks



Cross section of the opening window LK78.

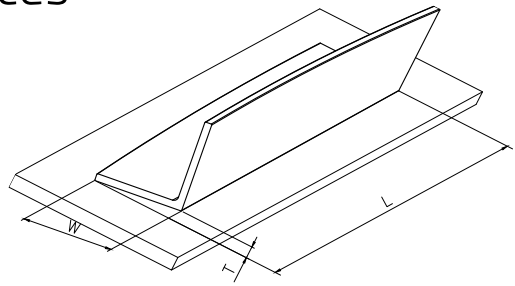
Wall thickness tolerances



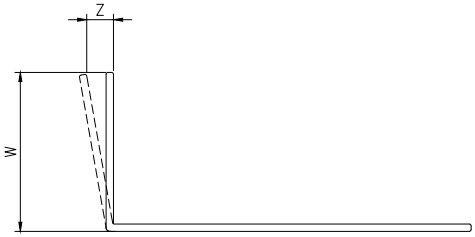
Alloy EN AW-6082						
Nominal wall thickness A, B or C	Wall thickness tolerances, dimensions in mm					
	Wall thickness A circumscribing circle		Wall thickness B circumscribing circle		Wall thickness C circumscribing circle	
over–at maximum	CD≤100	100≤CD≤300	CD≤100	100≤CD≤300	CD≤100	100≤CD≤300
–1.5	± 0.20	± 0.25	± 0.30	± 0.40	± 0.35	± 0.50
1.5–3	± 0.25	± 0.30	± 0.35	± 0.50	± 0.45	± 0.65
3–6	± 0.30	± 0.35	± 0.55	± 0.70	± 0.60	± 0.90
6–10	± 0.35	± 0.45	± 0.75	± 1.00	± 1.00	± 1.30
10–15	± 0.40	± 0.50	± 1.00	± 1.30	± 1.30	± 1.70
15–20	± 0.45	± 0.55	± 1.50	± 1.80	± 1.90	± 1.20
20–30	± 0.50	± 0.60	± 1.80	± 2.20	± 2.20	± 2.70
30–40	± 0.60	± 0.70	-	± 2.50	-	-
40–50	-	± 0.80	-			

Alloys EN-AW6060/6063/6005/6101									
Nominal wall thickness A, B or C	Wall thickness tolerances, dimensions in mm								
	Wall thickness A circumscribing circle			Wall thickness B circumscribing circle			Wall thickness C circumscribing circle		
over–at maximum	CD≤100	100≤CD ≤300	300<CD ≤500	CD≤100	100≤CD ≤300	300<CD ≤500	CD≤100	100≤CD ≤300	300<CD ≤500
–1.5	± 0.15	± 0.20	± 0.25	± 0.20	± 0.30	-	± 0.25	± 0.35	-
1.5–3	± 0.15	± 0.25	± 0.35	± 0.25	± 0.40	± 0.60	± 0.30	± 0.50	± 0.75
3–6	± 0.20	± 0.30	± 0.40	± 0.40	± 0.60	± 0.80	± 0.50	± 0.75	± 1.00
6–10	± 0.25	± 0.35	±0.45	± 0.60	± 0.80	± 1.00	± 0.75	± 1.00	± 1.20
10–15	± 0.30	± 0.40	± 0.50	± 0.80	± 1.00	± 1.20	± 1.00	± 1.20	± 1.50
15–20	± 0.35	± 0.45	± 0.55	± 1.20	± 1.50	± 1.70	± 1.50	± 1.90	± 2.00
20–30	± 0.40	± 0.50	± 0.60	± 1.50	± 1.80	± 2.00	± 1.90	± 2.20	± 2.50
30–40	± 0.45	± 0.60	± 0.70	-	± 2.00	± 2.20	-	± 2.50	± 2.70
40–50	-	± 0.70	± 0.80	-					

Shape tolerances

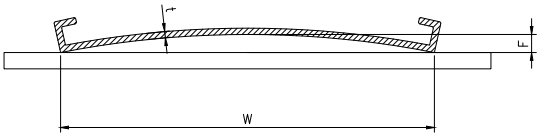


Twist tolerances (mm)			
Width *W*	Twist tolerance *T* for length *L*		
	Dimension for the length of 1,000 mm	For the whole profile length *L*	
over–at maximum		At maximum 6,000	Over 6,000
0–30	1.20	2.50	3.00
30–50	1.50	3.00	4.00
50–100	2.00	3.50	5.00
100–200	2.50	5.00	7.00
200–300	2.50	6.00	8.00

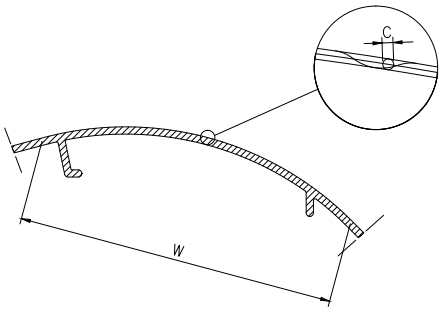


Right angle tolerances (mm)	
Width *W*	Largest permitted deviation *Z*
over–at maximum	
–30	0.40
30–50	0.70
50–80	1.00
80–120	1.40
120–180	2.00
180–240	2.60
240–300	3.10

Shape tolerances



Curvature tolerances (mm)	
Width *W*	Tolerance
over–at maximum	
–30	0.30
30–60	0.50
60–90	0.70
90–120	1.00
120–150	1.20
150–200	1.50
200–250	2.00
250–300	2.50

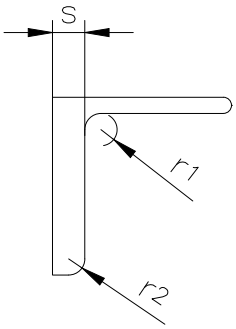


Convexity and concavity tolerances (mm)			
Width *W*	Largest permitted deviation *F*		
	Hollow profiles		Open profiles
over–at maximum	t ≤ 5	t > 5	
–30	0.30	0.20	0.20
30–60	0.40	0.30	0.30
60–100	0.60	0.40	0.40
100–150	0.90	0.60	0.60
150–200	1.20	0.80	0.80
200–300	1.80	1.20	1.20

Corner radii

The following corner radii are recommended for corner design:

Corner radii		
Wall thickness (mm)	Recommended corner radius	
over–up to	r^1	r^2
–2	2	1
2–4	2.5	1.6
4–6	4	2
6–10	6	3
10–20	10	5
20–35	16	10
35–50	20	16



Minimum corner radii to be followed

Due to technical reasons related to manufacturing process, perfectly sharp corners are not possible in practice. Minimum corner radii to be followed:

Minimum corner radii	
Wall thickness (mm)	Sharp inner and outer corner radii
–3	0.5
3–6	0.6
5–10	0.8
10–18	1
18–30	1.2
30–50	1.6

Profile drawing and legend

Both the customer and Purso Oy approve the profile drawing. The most important dimensions and tolerance areas are marked in the image.

REQUIRED INITIAL DATA:

- **Alloys to be used**
- **Temper designation (T4/T5/T6/T66)**
- **Visible surfaces**
- **If possible, an image in .dwg/.dxf format**

Ix = vertical surface moment of inertia

Wx = vertical bending resistance

Iy = horizontal surface moment of inertia

Wy = horizontal bending resistance

f = Full rad = fully rounded

• = radius of rounding marked in the profile drawing

+ = radius of rounding marked in the profile drawing

SB = profile difficulty level (the first letter indicates the profile classification: A = open profile, S = closed profile, P = semi-hollow profile; the second letter indicates the difficulty class: A, B, C, D)

Ref. = the customer's own identifier (no.), if necessary

Øc.a.s. = diameter of a circle drawn around the profile

P.m = perimeter, length of the profile's outer surface

S.a = profile surface area

Surf. Categ. = surface quality category

Kg/m = weight of the profile per metre

Alloy = the aluminium alloy to be used; T5 = temper

Toler. = the tolerances to be used (EN 755-9, EN 12020-2)

Anod. = to be anodised: YES, not anodised: NO

Identif. = identifier: YES; NO

Primary surface --------- = primary visible surface

Secondary surface — - — - — = secondary visible surface, mild roughness and extrusion tracks allowed

Visib. Surf. YES = visible surface, NO = no visible surface

Gen. thickn. = wall thickness

Gen. Rad. = general radii

Straightn. = straightness and the tolerances used

Flatness = flatness and the tolerances used

Torsion = distortion and the tolerances used

Customer no.: = customer number

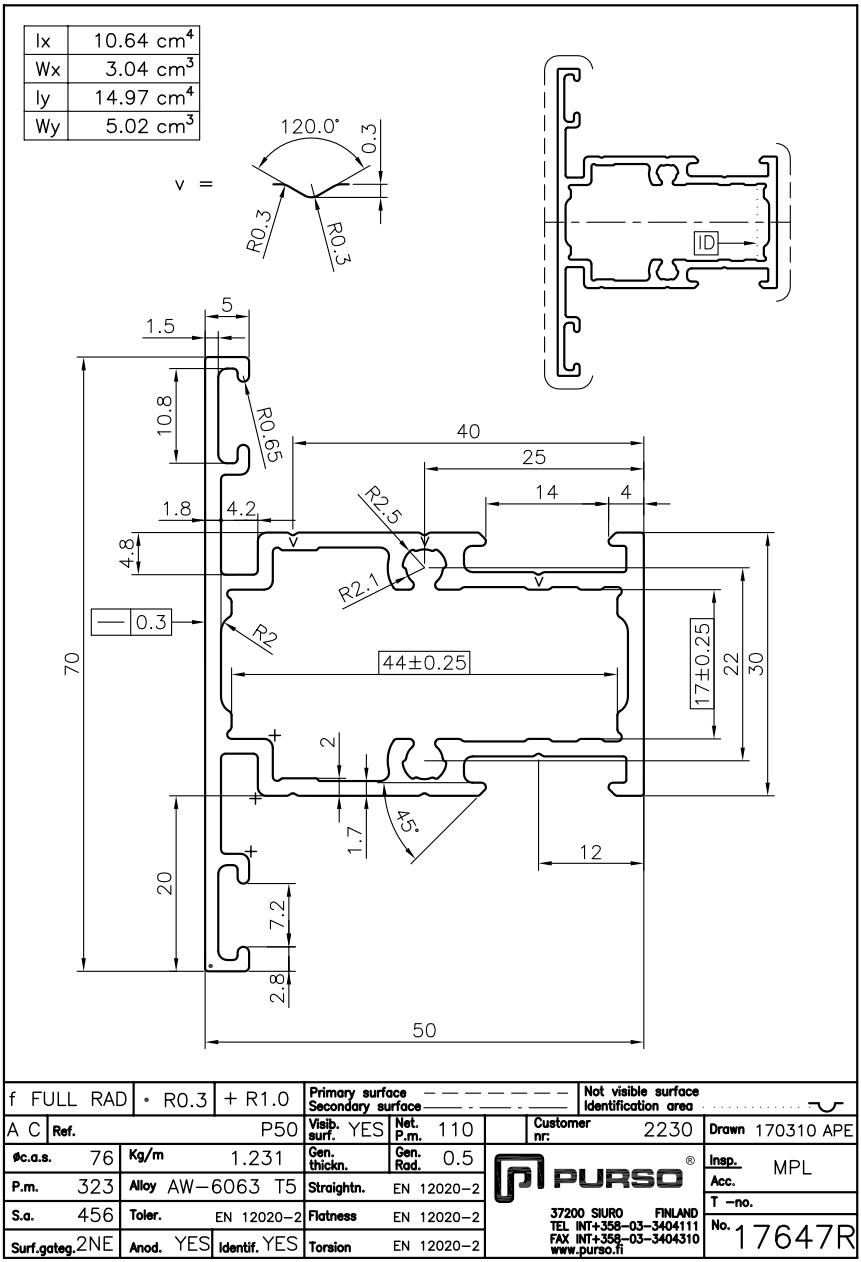
Drawn = creator of the drawing and the date of the drawing

Insp. = inspector

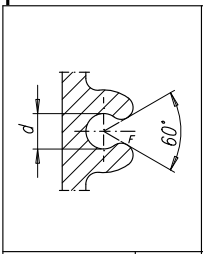
T-no. = profile tender number for the customer

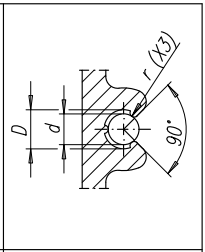
No. = profile number

ID = location of the identifier (area, in which the identifier can be placed)

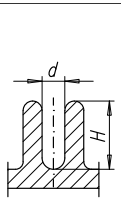


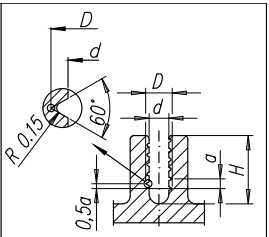
Design schemes for screw grooves and pockets



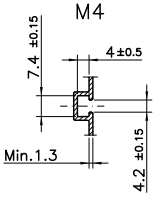


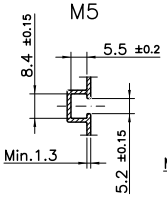
Screw ø	d	D	d	r
2,2	1,9	2,1	1,6	0,25
2,9	2,5	2,7	2,2	0,25
3,5	3,0	3,3	2,6	0,35
(3,9)	3,4	3,7	2,9	0,40
4,2	3,6	4,0	3,0	0,50
4,8	4,2	4,5	3,5	0,50
5,5	4,8	5,2	4,1	0,55
6,3	5,5	6,0	4,8	0,60

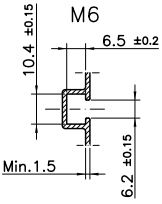


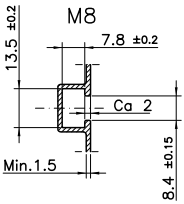


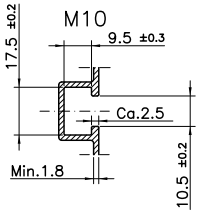
Screw ø	d	H	D	d	a	H
2,2	1,8	5	2,2	1,6	0,79	5
2,9	2,4	7	2,9	2,2	1,06	7
3,5	2,8	8,5	3,5	2,6	1,27	8,5
(3,9)	3,2	9,5	3,9	2,9	1,34	9,5
4,2	3,4	10	4,2	3,0	1,41	10
4,8	4,0	11,5	4,8	3,5	1,59	11,5
5,5	4,6	13,5	5,5	4,1	1,81	13,5
6,3	5,3	16	6,3	4,8	1,81	16

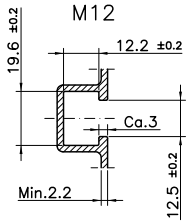


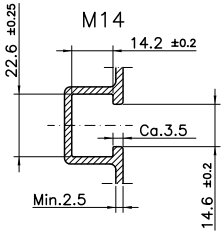


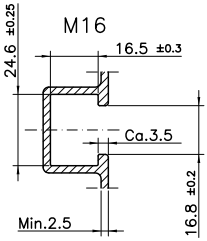


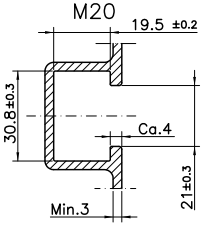


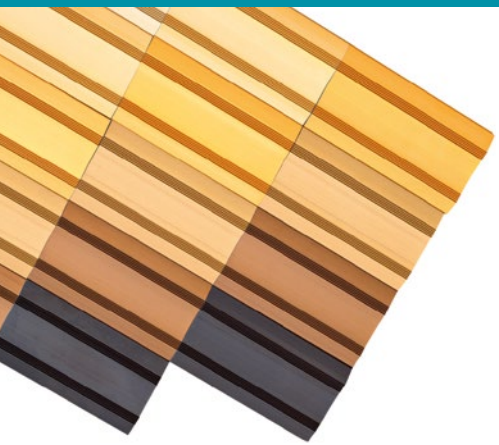






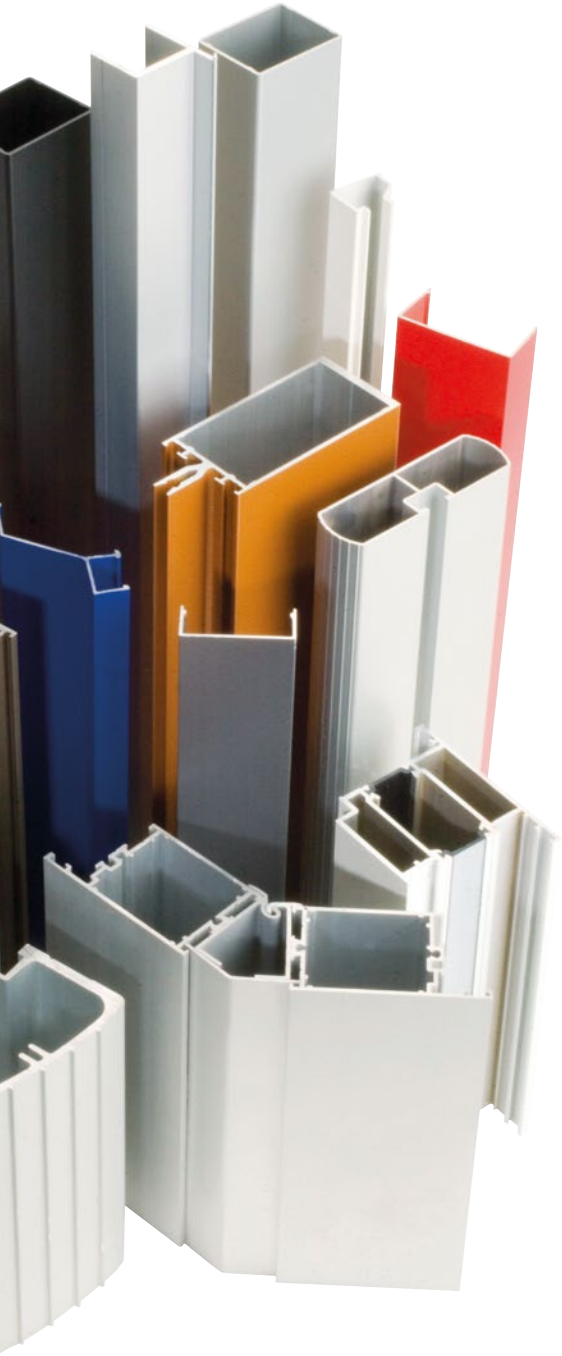






Surface treatments: Anodising

- Anodising forms a protective oxide layer on the surface of the profile. The resulting surface is hard and withstands mechanical wear, with excellent weather resistance. Maximum profile length is 8.0 m.
- Etching with lye in connection with anodising removes a small amount of aluminium from the surface of the profile, which should be taken into account in designing the functional surfaces.



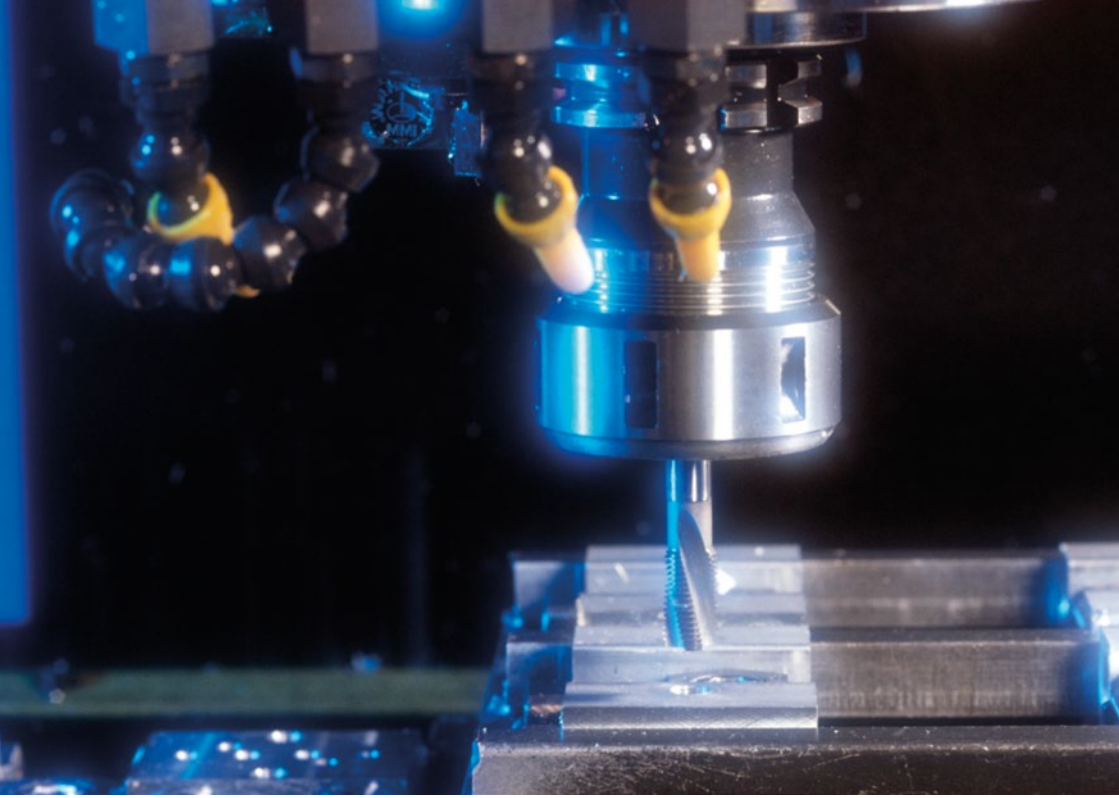
Surface treatments: Powder coating

In powder coating, the RAL colour chart provides over 150 standard colours, but other colours are also possible.

- In powder coating, the paint accumulates in the corners and ends of the profile.
- The design affects the smoothness of the paint layer, which should be taken into account as far as possible already at the design stage.
- The paint layer of a functional surface should be taken into account in designing these shapes (joints and hinges).

Other surface treatment options

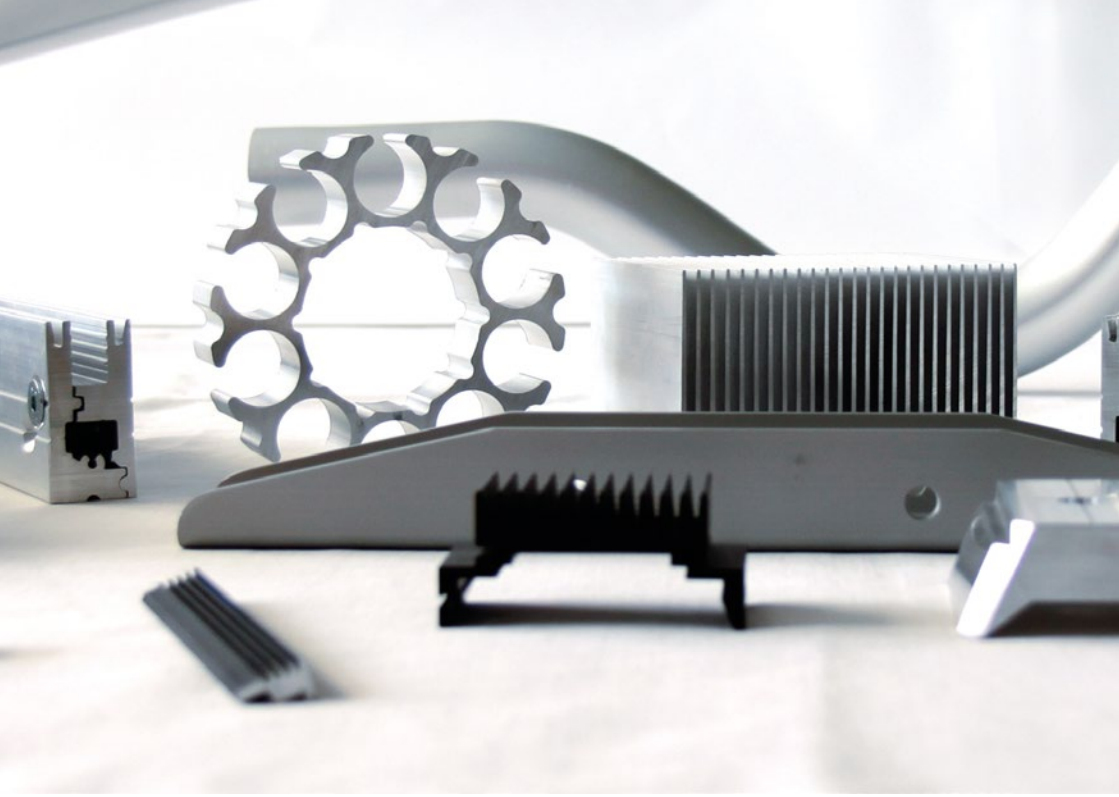
- Tin coating
- Special electrolytic coatings (Surtec)
- Chrome coating
- Galvanising
- Gold and silver coating



Further processing of the profile with a CNC machine

Cutting and processing

- Cutting to fix lengths
- Cutting to frames
- Drilling, milling, threading, punching
- CNC machines with 3, 4 and 5 axes
- Processing lengths for profiles over 10 m



Machining and profile design

When processing steps are known in advance, they must be taken into account already at the profile design stage:

- Working allowances for machined surfaces
- Dimensioning of screw pockets and functional areas taking profile tolerances into account
- Interfaces between profile and machining standards
- Surface treatments: before/after
  (for example, small threads must be protected before anodising)

The dimensioning of bent components cannot fully comply with the most common machining standards.

Common machining tolerances in accordance with the standard DIN ISO 2768-1:

	Permitted deviations from basic measurements (mm)							
Tolerance class	0.5–3	> 3–6	> 6–30	> 30–120	> 120–400	> 400–1000	> 1000–2000	> 2000–4000
f (fine)	± 0.05	± 0.05	± 0.1	± 0.15	± 0.2	± 0.3	± 0.5	-
m (medium)	± 0.1	± 0.1	± 0.2	± 0.3	± 0.5	± 0.8	± 1.2	± 2
c (coarse)	± 0.15	± 0.2	± 0.5	± 0.8	± 1.2	± 2	± 3	± 4
v (very coarse)	-	± 0.5	± 1	± 1.5	± 2.5	± 4	± 6	± 8

	Permitted deviations from basic measurements (mm)		
Tolerance class	0.5–3	> 3–6	> 6
f (fine) m (medium)	± 0.2	± 0.5	± 1
c (coarse) v (very coarse)	± 0.4	± 1	± 2

	Permitted deviations from basic measurements (mm)				
Tolerance class	<10	>10–50	>50–120	>50–400	>400
f (fine) m (medium)	± 1°	± 30′	± 20′	± 10′	± 5′
c (coarse)	± 1° 30′	± 1°	± 30′	± 15′	± 10′
v (very coarse)	± 3°	± 2°	± 1°	± 30′	± 20′

Separate tolerances should be given to nominal measurements under 0.5 mm.

Welding

TIG, MIG and friction stir welding – all of the aluminium alloys we use can be welded.

Bending

When designing the profile, bending the profile should be taken into account. Bending is carried out by programmable bending units. The shape of the object determines the bending method.

Other things to note:

- Temper designation
- Dimensional accuracies
- Bending allowances e.g. in roll bending approx. +500 mm / profile end
- Machining: before/after
- Surface treatment: before/after
- Packing

Purso's general terms (PGT2014)

Term of delivery
FCA Siuro, Incoterms 2010, unless it has been agreed otherwise.

Term of payment
Term of payment according to the agreement.

Packing
The standard package (plastic wrap) is included in the sale price. A separate agreement must be made on any other packing methods.

Drawings
The drawings and models we manufacture are our property, and they may not be copied, handed over or disclosed to a third party without our permission.

Complaints
Any complaints regarding the delivery must be made to Purso within 14 days from receiving the goods, or within 7 days if the matter involves damage that occurred during transport.

Delivery quantity
The minimum extrusion batch for alloys 6063 and 6060 is 250 kg/profile, and for alloys 6082 and 6005 it is min. 500 kg/profile.

An order stated in kilos or metres is considered an approximate value, and the consignment may deviate from what was ordered by plus or minus 10%; however, at least by plus or minus 50 kg (orders of less than 500 kg). When ordering by piece, exceeding the ordered amount by 10% is permitted. A separate agreement must be made on the specific number of pieces.

Tolerances
Normally, tolerances in accordance with SFS-EN 755-9 are applied. Other tolerances may also be applied upon a separate agreement.

Material certificates
Agreement on the material certificates required must be made in connection with the order at the latest.

Delivery lengths
The normal delivery length is 3–8 m. The cutting accuracy is in accordance with SFS-EN 755-9. NOTE! The longest profile cutting length 16 metres.

Anodised and painted profiles
Contact marks remain at the ends and sides of the profiles. If the profile will be anodised later, this must be stated during the order phase.

Storing painted, anodised and untreated profiles
An anodised profile waiting in its transport package for installation or end use is stored protected from rain as well as mechanical damage in a dry area. The profile package must not be wet or exposed to humidity.

Caring for painted, anodised and untreated surfaces
The surfaces are cleaned and inspected at least once every 12 months: Washing with a neutral (pH approx. 5–8) synthetic detergent solution followed by rinsing with clean water at room temperature. Strong basic or alkaline cleaning detergents may not be used either.

Extrusion dies
The customer is responsible for any possible patent violation or design right infringement in profiles that have been ordered in accordance with a model or drawing. The extrusion dies are owned by the seller and they will be destroyed after three (3) years from the last manufacture. Upon a written request by the customer and at the customer's cost, the dies can be stored for a longer period. The customer is not entitled to any compensation for the destroyed dies.

The extrusion dies are only used upon the customer's order. The customer has no other rights to determine what is done with the dies. All of the customer's rights to the extrusion dies will be terminated if the customer enters into reorganisation proceedings or if the customer is declared bankrupt or placed into liquidation.

We cannot give a binding time of delivery for the first delivery of a new product/die because a new extrusion die always requires one or more test runs and possible repairs to ensure its functionality.

Retention of ownership
Purso retains ownership of the products until the customer has paid the purchase price in full. The customer must store the products so that they can be separated from the customer's property.

Force majeure
In addition to the cases listed in the general terms of agreement NL01, the simultaneous breakage of machines or dies as well as possible backup dies in a way that makes it impossible to fulfil the obligations based on the agreement in time is also considered a case of force majeure.

Other terms and conditions
In other respects, we follow the general terms of agreement NL01 regarding deliveries.

PURSO®

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