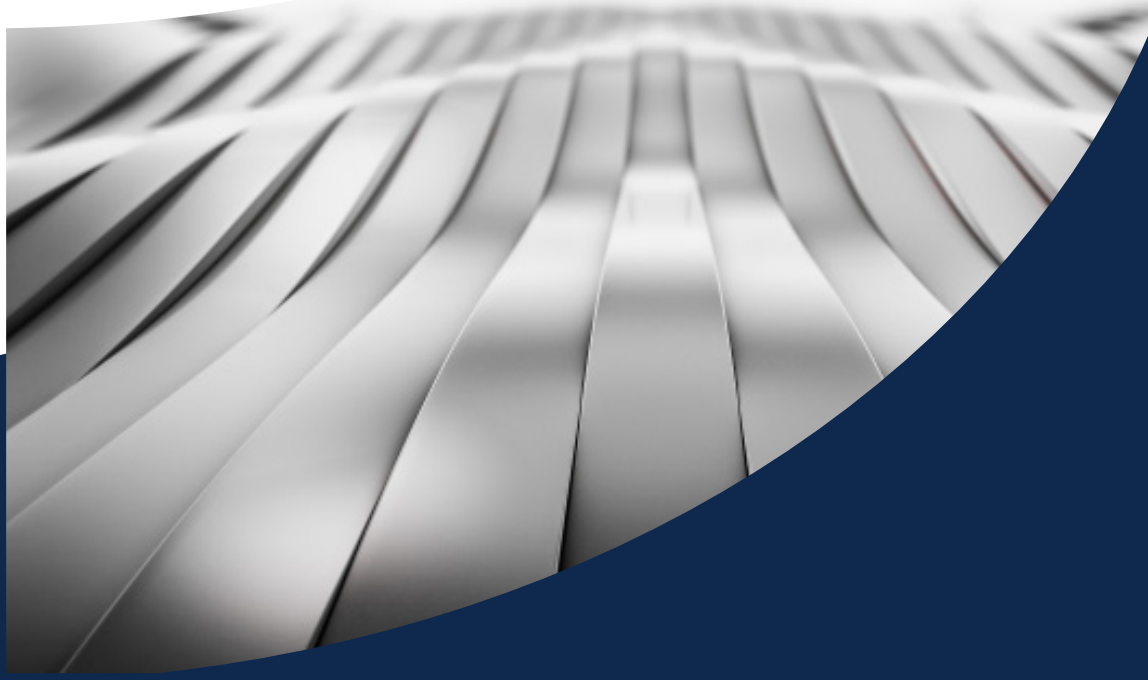
FINAL



The technical manual

of manufacturing capabilities in Final S.A.

www.final.pl

Modern aluminium profiles extrusion plant

The technical manual

of manufacturing capabilities in Final S.A.

FINAL

We Finalize your ideas

Individual and partnership approach to cooperation

Our individual and partnership approach to each Customer is a guarantees of the receive the best product. In order to ensure favorable production capabilities, Final S.A. employees always look forward to optimize the extrusion process. They propose of change the shape or construction of a profile in such a way that ensure the best conditions for its production. Moreover, they minimize the of likelihood occurrence undesirable factors, such as problems with the cross section geometry.

Optimization of the production process

Optimization of the production process also includes the appropriate design of tools for the production of profiles in order to ensure their longest possible service life and as small as possible failure frequency. These features are determined, among others, by the symmetry of the profiles shape and the wall thickness. In the above-mentioned process, the information flow between You and the Final S.A. employees is crucial. The application profile, the method of its further treatment, as well as accurately marked decorative and visible have a significant influence an surfaces, largely affect the correct decisions concerning the tools of construction.

Complete technical support

By offering full technical support to our Customers We present parameters that define our production capabilities in the field of extrusion profiles, shot blasting (sandblasting), anodizing, power coating and fabrication of aluminum profiles.

Our aluminum profiles

Aluminium has been called a „material of great opportunities". It is one of the mostly widely used metal in the world.

Aluminum (Al) belongs to the most widespread elements in the nature.

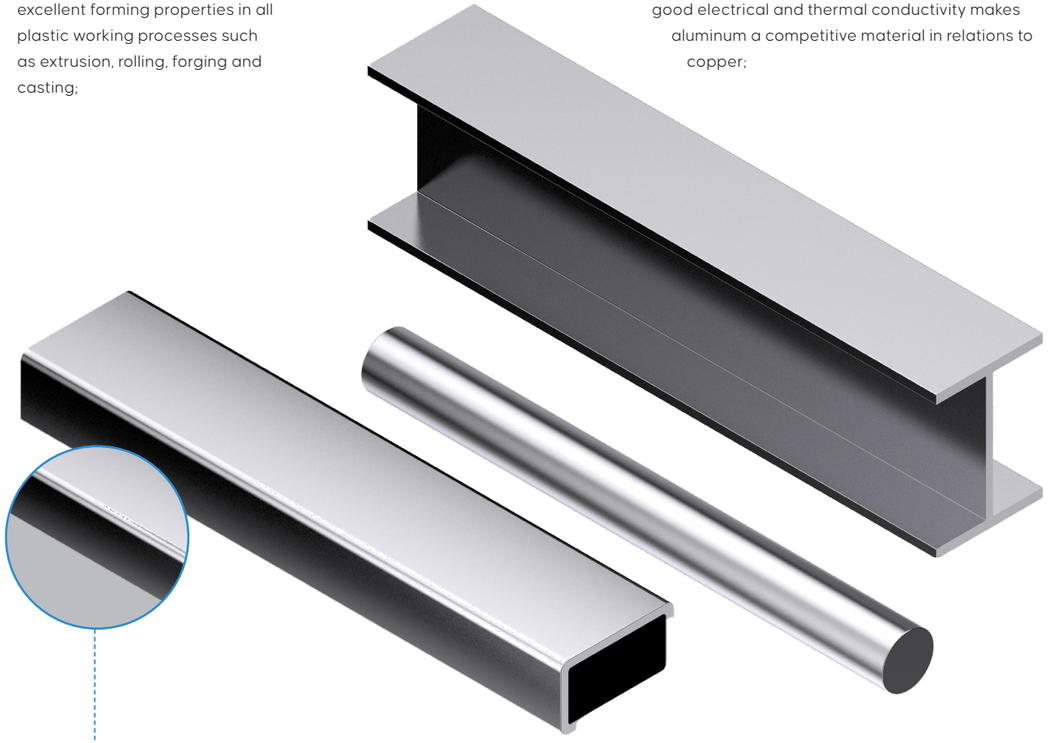
Its content in the Earth's crust is approx. 8% of the total weight of elements, so due to the occurrence it occupies a third place right after oxygen and silicon, while among metals – it occupies the second place after silicon, taking into account the use for construction applications.

Forming

excellent forming properties in all plastic working processes such as extrusion, rolling, forging and casting;

Conductivity

good electrical and thermal conductivity makes aluminum a competitive material in relations to copper;



Strength

low weight of the material and its construction characteristics caused that the designers stated aluminums as an excellent material of new solution;

Corrosion resistance

in the air under atmospheric conditions – it becomes dull by covering with a layer oxide Al_2O_3, which protects the metal against further oxidation;

2,7 kg/dm^3

lightness

density of aluminum is 2,7 kg/dm^3 and it is about three times lower than the density of steel; moreover, very good mechanical properties cause that aluminum is an excellent construction material;

Recycling

this metal can be reused in 100% without losing any properties with remelting. Additionally a very important advantage is its low energy consumption with reprocessing, since with the recycling, 95% of energy needed to produce it from the primary form can be saved.

Construction parameter

i.e. the ratio of strength to specific density for aluminum allows is higher than of the steel;

The extrusion process is one of the basic methods of plastic deformation of non-ferrous metals like aluminium and its alloys.

The extrusion consist in placing the pre-heated aluminium billet into a container, then by high compression force with the use of the stem, extrude the material through an opening in a forming die.

The versatility of this process consists in that, it is possible to apply various alloys and receiving products of complex shapes, thus making it extremely valuable from the point of view of manufacturers of aluminum which supply designers.

In extrusion process like in other methods of metal forming will change not only the shape of the metal, but also causes a change the properties. As a result of the reconstruction of microstructure achieves greater strength and hardness of the material. The extruded aluminium profiles before delivery to the final customer are commonly subjected to heat treatment processes.

The first heat treatment operation is supersaturation and second is aging.

Supersaturation

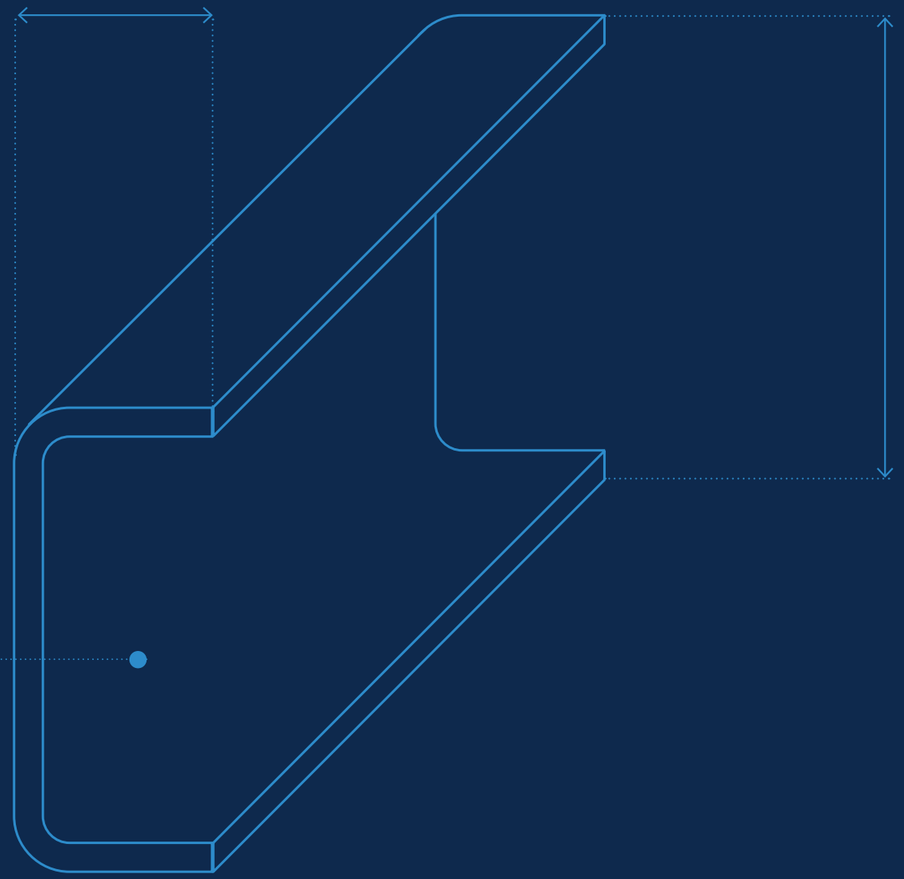
Supersaturation is conducted at the press exit, in temperatures. Supersaturation is carried out of in temperatures above the solvus temperature for the particular alloy, wherein the alloying elements can be completely dissolved, held in elevated temperature and then rapidly cooled up to ambient temperature to retain the alloying elements in the supersaturated solid solution. This heat treatment process decreases mechanical properties and increases plastic properties.

Aging

The second heat treatment operation of hot extruded aluminium profiles is aging process. Conducted aging process after supersaturation determine results of precipitation solid solution the phase (or phases) of appropriate dispersion containing an alloying component, present in solution in excess. If the precipitation occurs under the influence of diffusion in room temperature, then such a process is called naturally aging. However, the precipitation of fine particles can be accelerated by heating up the supersaturated material to elevated temperature below the recrystallization temperature, usually for aluminium alloys close to 200°C and held the products at this temperature for a sufficient time period. Such operation is called artificially aging. This process improved mechanical properties like: hardness, yield strength and tensile strength durability and reduces the plastic properties: elongation.

FINAL

Technical Information



Aluminium alloys

Alloy	Application
1070	Element of equipment in electrical components, chemical equipment, containers, heat exchangers, containers for the food industry, busbars.
6060 /6063	Architectural systems: facades, windows, doors, winter gardens, partition walls, interior equipment, lighting systems, framework systems, ladders, balustrades, fences, heating systems, cooling systems, irrigation systems. Radiators, electronic modules. Constructions, elements and flexible assembly systems for devices and production lines, furniture, office equipment. Sports and recreation equipment. Exhibition and advertising systems, Road transport, railway transport, equipment for extreme sports.
6106	Extruded profiles for various purposes that require the properties higher than 6060/6063 and smaller than alloy 6005.
6005	Elements of load-bearing structures in construction industry, constructions of tent halls, trailer sides, car roof boxes and racks. Railway and bus profiles of structures composed of segments, pylons, platforms, pipelines. Applications in the electrical and mechanical industry. Masts for sailing boats.
6082	Constructions, load-bearing elements and parts for locomotives, railway carriages, passenger cars, trucks and trailers, buses, boats and ships, scaffolding, cranes and heavy constructions, elements of mining equipment, elements of hydraulic systems.

General classification

Series	The main alloying elements
1xxx	Aluminium
2xxx	Al + Cu(Durals)
3xxx	Al + Mn(Alumans)
4xxx	Al + Si(Silumins)
5xxx	Al + Mg(Hydronalium)
6xxx	Al + Mg+Si(Anticorodal)
7xxx	Al + Zn(Constructals)
8xxx	Other alloys

Alloys hardened by heat treatment	Alloys hardened by plastic deformation
2xxx	1xxx
6xxx	3xxx
7xxx	5xxx
8xxx	

Alloys for casting	Alloys for plastic working
5-25% of alloying elements	**up to 5%** of alloying elements

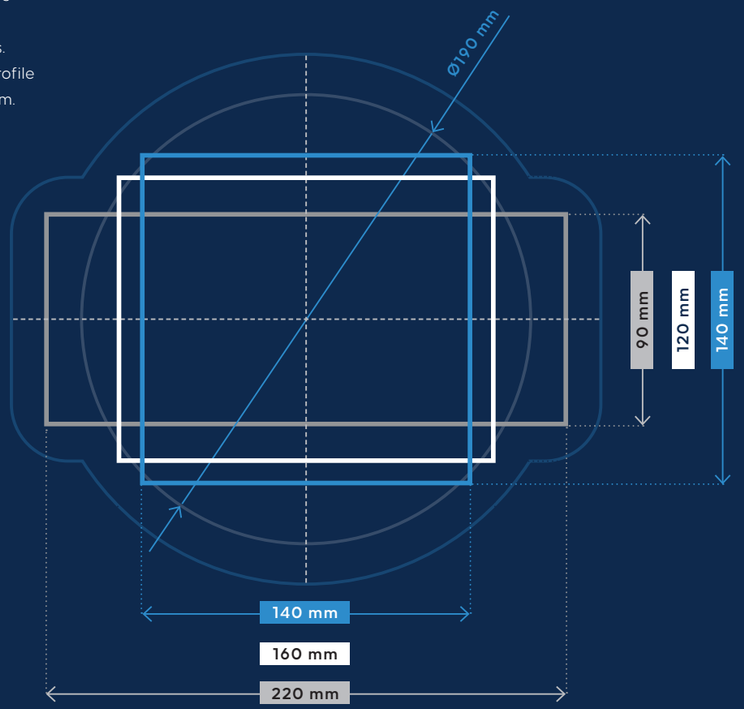
Physical properties – typical values

Alloy	Modulus of elasticity, kN/mm²	Shear modulus, kN/mm²	Linear expansion coefficient, 20-100°C, µ°C⁻¹	Thermal conductivity 20°C, W/(m·K)	Specific heat capacity 0-100°C,J/(kg·K)	Resistivity 20°C, nΩ·m	Conductivity 20°C, % IACS
1070A	69	26	24	235	920	28	62
6060	69	26	23	200	880-900	33	52
6063	69	26	23	200	880-900	33	52
6106	69	26	23	200	880-900	33	52
6005A	69	26	23	200	889-900	33	52
6061	69	25	24	156	896	40	43
6082	69	25	23	180	897	38	46

Maximum size of cross-section

for produced profiles

Radius of circle circumscribed on the profile's cross-section do refers to the maximum sizes of cross-sections for produced profiles. Determination of the maximum sizes for a profile is made on the basis of the following diagram.



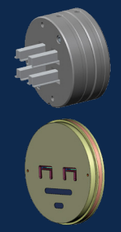
The above diagram is understood as sample dimensions of profiles which can be manufactured in Final S.A. However, all the queries are considered individually and there can be exceptions from this rule.

Construction and shape of a die

Dies for extrusion of aluminum profiles are produced from hot work tool steel number: 1.2343 (WCL) or 1.2344 (WCLV). A opening in a die corresponding to the cross-section of the future profile is made with the use of CNC machining method. In the industry, there are two main types of dies:

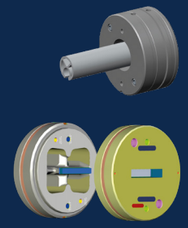
Flat die for the production of solid profiles

Flat dies – a die for such a profile consists of a single flat plate with a opening mapping the shape oe of a required profile, as illustrated in the figure on the right;



Porthole die for the production of hollow profiles

Porthole dies – a dies in this case consists of at least two parts, as shown in the figure on the right. The mandrel part forming the internal shape of a profile, the second part shapes the external section of a profile. The third part can support the die in the extrusion process before deflection.



Comparative Characteristics of Aluminium Alloys / Tempers

Alloy	1070A	6060	6063	6106	6005A	6061	6082
Temper	F	T6	T6	T6	T6	T6	T6
Formability	●●●●	●●	●●	●	●	●	●
Machinability	●	●●	●●	●●●	●●●	●●●	●●●●
Weldability	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●
Decorative Anodizing Response	●	●●●●	●●●●	●●	●●	●	●
General Corrosion Resistance	●●●●	●●●●	●●●●	●●●	●●●	●●●	●●●
Brazeability	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●	●●●●
Typical Conductivity, %IACS	●●●●	●●●	●●●	●●●	●●●	●●	●●
Mechanical Properties	●	●●	●●	●●●	●●●	●●●	●●●●
Surface Quality	●●	●●●●	●●●●	●●●	●●●	●●	●●

●●●● Excellent
●●● Good
●● Fair
● Poor

Diagram of the aluminium profile production process

Technological possibilities for the production of aluminium profiles

FINAL S.A. has four technological lines for hot direct extrusion of aluminum profiles with the pressing force:

Final T1	20 MN	charge diameter 8"
Final T2	16 MN	charge diameter 7"
Final T3	22 MN	charge diameter 8"
Final T4	18 MN	charge diameter 7"

Profiles, which can be produced by the Final S.A., are specified in the following parameters:

Minimum weight:	0,150 kg/m
Maximum weight:	14,00 kg/m

Minimum wall thickness

For technological reasons, it is recommended to use the table below in order to determine the minimum wall thickness. It taking into account the radius of the circumscribed circle and the alloy version. Thicknesses smaller than that listed in the table are very difficult to obtain and require an individual consideration.

Diameter of circumscribed circle d_o [mm]		Recommended minimum wall thicknesses [mm]					
		Solid profiles			Hollow profiles		
Over	Up to	Alloy 6060, 6063	Alloy 6005A, 6106	Alloy 6061, 6082	Alloy 6060, 6063	Alloy 6005A, 6106	Alloy 6061, 6082
0	25	1,0	1,2	2,0	1,2	1,5	2,0
25	50	1,2	1,4	2,2	1,3	1,8	2,2
50	75	1,5	1,7	2,4	1,5	2,0	2,4
75	100	1,7	2,0	2,7	2,0	2,4	2,7
100	150	2,0	3,0	3,0	2,5	3,5	3,0
150	200	2,5	4,0	3,5	3,0	4,5	3,5
200	250	3,0	5,0	4,0	3,5	5,0	4,0
250	300	4,0	5,0	5,0	4,0	5,0	5,0

Chemicial composition according to PN-EN 573-3

Alloy designation	Content of alloying elements [%]				
	Si	Fe	Cu	Mn	Mg
EN AW 1070A	0.20	0.25	0.03	0.03	0.03
EN AW 6060	0.30-0.60	0.10-0.35	0.10	0.10	0.35-0.60
EN AW 6063	0.20-0.60	0.35	0.10	0.10	0.45-0.90
EN AW 6106	0.30-0.60	0.35	0.25	0.05-0.20	0.40-0.80
EN AW 6005A	0.50-0.90	0.35	0.30	0.50	0.40-0.70
EN AW 6061	0.40-0.80	0.70	0.15-0.40	0.15	0.80-1.20
EN AW 6082	0.70-1.30	0.50	0.10	0.40-1.00	0.60-1.20

Temper definition according to PN-EN 515

F	As Fabricated
T4	Solution heat - treated, and naturally aged to a substantially stable condition
T5	Cooled from an elevated temperature shaping process then artificially aged
T6	Solution heat - treated then artificially aged
T64	Solution heat - treated and then artificially in under ageing concitions to improve formability
T66	Solution heat - treated and then artificially aged - mechanical property level higher than T6 achieved through special control of the process

Mechanical properties for profiles

PN-EN 755-2

Alloy	Chemical symbol	Temper		Dimensions, mm	R_m,MPa	$R_{p0,2}$,MPa	A_{50}, %
		EN 515	DIN 1748				
1070A	Al 99,7	F	F6	all	60	23	23
6060	AlMgSi	T4 - extruded: rod/bar, tube, profile	F13	D^a, $S^b \leq 150$, $t \leq 15^c$ $t \leq 25^d$	120	60	14
		T6 - extruded: rod/bar, tube, profile	F18	D^a, $S^b \leq 150$, $t \leq 15^c$, $t \leq 5^d$	190	150	6
		T6 - extruded: profile	F18	$5 < t \leq 25^d$	170	140	6
		T64 - extruded: rod/bar, tube, profile	F19	D^a, $S^b \leq 50$, $t \leq 15^c$	180	120	10
		T66 - extruded: rod/bar, tube	F22	D^a, $S^b \leq 150$, $t \leq 15^c$, $t \leq 5^d$	215	160	6
		T66 - extruded: profile	F22	$5 < t \leq 25^d$	195	150	6
6063	AlMg0,7Si	T4 - extruded: rod/bar, tube, profile	F13	D^a, $S^b \leq 150$, $t \leq 10^c$, $t \leq 25^d$	130	65	12
		T6 - extruded: rod/bar, tube	F22	D^a, $S^b \leq 150$, $t \leq 25^c$	215	170	8
		T6 - extruded: profile	F22	$10 < t \leq 25^d$	195	160	6
		T66 - extruded: rod/bar, tube	F25	D^a, $S^b \leq 150$, $t \leq 25^c$	245	200	8
		T6 - extruded: profile	F25	$10 < t \leq 25^d$	225	180	6
6106	AlMgSiMn	T6	F25	$t \leq 10^d$	250	200	6
6005A	AlSiMg	T6 - extruded: rod/bar	F27	D^a, $S^b \leq 25$	270	225	8
		T6 - extruded: rod/bar	F27	$25 < D^a$, $S^b \leq 50$	270	225	-
		T6 - extruded: rod/bar	F27	$50 < D^a$, $S^b \leq 100$	260	215	-
		T6 - extruded: open profile	F27	$t \leq 5^d$	270	225	6
		T6 - extruded: open profile	F27	$5 < t \leq 10^d$	260	215	6
		T6 - extruded: open profile	F27	$10 < t \leq 25^d$	250	200	6
		T6 - extruded: hollow profile	F27	$t \leq 5^d$	255	215	6
		T6 - extruded: hollow profile	F27	$5 < t \leq 15^d$	250	200	6

PN-EN 755-2

Alloy	Chemical symbol	Temper		Dimensions, mm	R_m,MPa	$R_{p0,2}$,MPa	A_{50}, %
		EN 515	DIN 1748				
6061	AlMg1SiCu	T6 - extruded: rod/bar, tube	F26	D^a, $S^b \leq 200$, $t \leq 5^d$	260	240	6
		T6 - extruded: profile	F26	$t \leq 5^d$	260	240	7
		T6 - extruded: tube, profile	F26	$5 < t \leq 15^d$	260	240	8
6082	AlSi1MgMn	T6 - extruded: rod/bar	F31	D^a, $S^b \leq 20$	295	250	6
		T6 - extruded: rod/bar	F31	$20 < D^a$, $S^b \leq 150$	310	260	-
		T6 - extruded: tube, profile	F31	$t \leq 5^{c, d}$	290	250	6
		T6 - extruded: tube, profile	F31	$5 < t \leq 15^{c, d}$	310	260	8

Tolerances for shape and dimensions for aluminium profiles
In the production of aluminum profiles in FINAL S.A., dimensional tolerances are used on the basis of the standards listed below:

- **EN 755-9:** Aluminum and aluminum alloys – extruded rods, tubs and profiles. Tolerances for shape and dimensions of extruded profiles;
- **EN 12020-2:** Aluminum and aluminum alloys – Profiles extruded from alloys EN AW-6060 and EN AW-6063.

Description of marking for dimensional tolerances specified in tables below:
A - Wall thickness except those enclosing the hollow spaces in hollow profiles;
B - Wall thickness the hollow spaces I hollow profiles except those between two hollow spaces;
C - Wall thickness between two hollow spaces in hollow profiles;
E -The length of the shorter leg of profiles with open ends;
H - All dimensions (except wall thickness) between points on the cross section of the profile or the centres of open screw holes;
CD – diameter of circumscribed circle;
L – fixed length.

All tolerances values are in millimeters (mm).

R_m	Tensile strength in MPa
$R_{p0,2}$	Yield strength in MPa
A_{50}	Elongation measured at the measuring length 50 mm in %
a - D	diameter for round bar
b - S	width across flats for square and hexagonal bar, thickness for rectangular bar
c - t	wall thickness - extruded tube
d - t	wall thickness - extruded profile

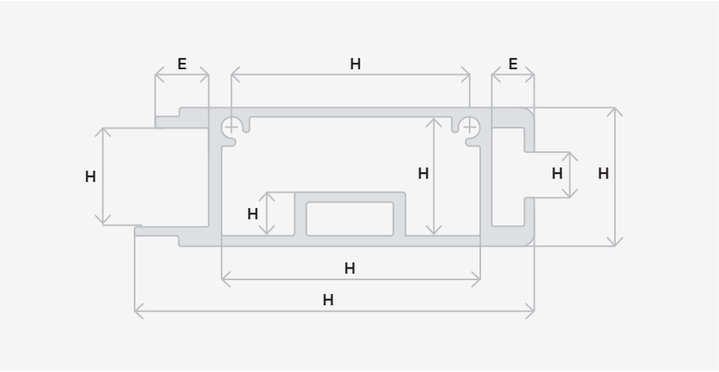
Tolerances on cross-sectional dimensions of solid and hollow profiles

PN-EN 775-9

(values in mm)

Dimension H		Tolerances on H for circumscribing circle CD					
		Alloys Group 1			Alloys Group 2		
Over	Up to and including	CD ≤ 100	100 < CD ≤ 200	200 < CD ≤ 300	CD ≤ 100	100 < CD ≤ 200	200 < CD ≤ 300
-	10	± 0.25	± 0.30	± 0.35	± 0.40	± 0.50	± 0.55
10	25	± 0.30	± 0.40	± 0.50	± 0.50	± 0.70	± 0.80
25	50	± 0.50	± 0.60	± 0.80	± 0.80	± 0.90	± 1.00
50	100	± 0.70	± 0.90	± 1.10	± 1.00	± 1.20	± 1.30
100	150	-	± 1.10	± 1.30	-	± 1.50	± 1.70
150	200	-	± 1.30	± 1.50	-	± 1.90	± 2.20
200	300	-	-	± 1.70	-	-	± 2.50

Definition of dimensions H and E



PN-EN 12020-2

(values in mm)

Dimension H		Tolerances on dimensions (expect open ends)	Tolerances on H (open end)	
Over	Up to and including		E ≤ 60	60 < E ≤ 120[a]
-	10	± 0.15	± 0.15	b
10	15	± 0.20	± 0.20	b
15	30	± 0.25	± 0.25	b
30	45	± 0.30	± 0.30	± 0.45
45	60	± 0.40	± 0.40	± 0.55
60	90	± 0.45	± 0.45	± 0.65
90	120	± 0.60	± 0.60	± 0.80
120	150	± 0.80	± 0.80	± 1.00
150	180	± 1.00	± 1.00	± 1.30
180	240	± 1.20	± 1.20	± 1.50

Dimension E		Additionally, the permissible deviation of dimension H in relation to the dimensions of profiles with free ends
Over	Up to and including	
-	20	± 0.15
20	30	± 0.20
30	40	± 0.25
40	60	± 0.30
60	80	± 0.40
80	100	± 0.45
100	125	± 0.60
125	150	± 0.80
150	180	± 1.00

[a] Tolerances for values E over 120 mm should be subjected to agreements between supplier and subject to agreement purchaser.

[b] Should be agreed between supplier and purchaser.

Tolerances on wall thickness for profiles with a circumscribing circle up to and including 300 mm

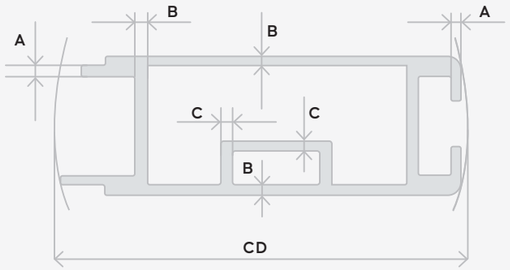
PN-EN 775-9

(values in mm)

Nominal wall thickness A, B or C		Tolerances on wall thickness type A, B or C depend on circumscribing circle											
		Alloy Group 1						Alloy Group 2					
Over	Up to and including	Wall thickness A		Wall thickness B		Wall thickness C		Wall thickness A		Wall thickness B		Wall thickness C	
		Circumscribed circle											
		CD ≤ 100	100 < CD ≤ 300	CD ≤ 100	100 < CD ≤ 300	CD ≤ 100	100 < CD ≤ 300	CD ≤ 100	100 < CD ≤ 300	CD ≤ 100	100 < CD ≤ 300	CD ≤ 100	100 < CD ≤ 300
-	1.50	± 0.15	± 0.25	± 0.20	± 0.30	± 0.25	± 0.35	± 0.20	± 0.25	± 0.30	± 0.40	± 0.35	± 0,50
1,50	3	± 0.15	± 0.25	± 0.25	± 0.40	± 0.30	± 0.50	± 0.25	± 0.30	± 0.35	± 0.50	± 0.45	± 0,65
3	6	± 0.20	± 0.30	± 0.40	± 0.60	± 0.50	± 0.75	± 0.30	± 0.35	± 0.55	± 0.70	± 0.60	± 0,90
6	10	± 0.25	± 0.35	± 0.60	± 0.80	± 0.75	± 1.00	± 0.35	± 0.45	± 0.75	± 1.00	± 1.00	± 1,30
10	15	± 0.30	± 0.40	± 0.80	± 1.00	± 1.00	± 1.20	± 0.40	± 0.50	± 1.00	± 1.30	± 1.30	± 1,70
15	20	± 0.35	± 0.45	± 1.20	± 1.50	± 1.50	± 1.90	± 0.45	± 0.55	± 1.50	± 1.80	± 1.90	± 2,20
20	30	± 0.40	± 0.50	± 1.50	± 1.80	± 1.90	± 2.20	± 0.50	± 0.60	± 1.80	± 2.20	± 2.20	± 2,70
30	40	± 0.45	± 0.60	-	± 2.00	-	± 2.50	± 0.60	± 0.70	-	± 2.50	-	-
40	50	-	± 0.70	-	-	-	-	-	± 0.80	-	-	-	-

[a] for seamless hollow profiles tolerances given for wall thickness C shall apply

Definition of dimensions A, B, C and CD



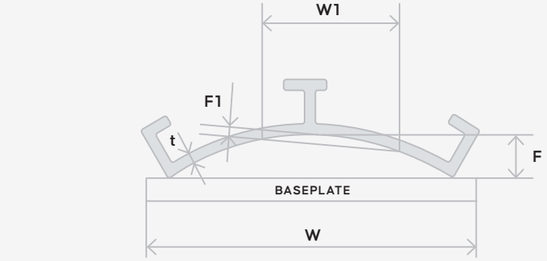
PN-EN 12020-2

(values in mm)

Nominal wall thickness A, B or C		Tolerances for wall thicness			
		Wall thickness A		Wall thickness B or C	
Over	Up to and including	CD ≤ 100	100 < CD ≤ 300	CD ≤ 100	100 < CD ≤ 300
-	2	± 0.15	± 0.20	± 0.20	± 0.30
2	3	± 0.15	± 0.25	± 0.25	± 0.40
3	6	± 0.20	± 0.30	± 0.40	± 0.60
6	10	± 0.25	± 0.35	± 0.60	± 0.80
10	15	± 0.30	± 0.40	± 0.80	± 1.00
15	20	± 0.35	± 0.45	± 1.20	± 1.50
20	30	± 0.40	± 0.50	a	a
30	40	± 0.45	± 0.60	a	a

[a] a shall be subject to agreement betwen supplier and purchaser

Convexity - concavity tolerances



Key:

W	Width
F	deviation
W1	100 mm
F1	local deviation per any 100 mm

PN-EN 775-9

(values in mm)

Width W		Deviation F		
		Hollow profiles*		Solid profiles
Over	Up to and including	Wall thickness t ≤ 5	Wall thickness 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

In the case of solid and hollow profiles with a width W of at least 150 mm, the local deviation F1, shall not exceed 0,07 mm for any 100 mm of width W1.

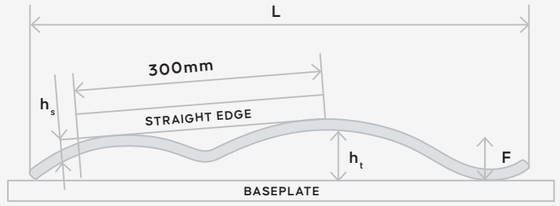
PN-EN 12020-2

(values in mm)

Szerokość W		Maximum allowable deviation F
Over	Up to and including	
-	30	0.20
30	60	0.30
60	100	0.40
100	150	0.50
150	200	0.70
200	250	0.85
250	300	1.00

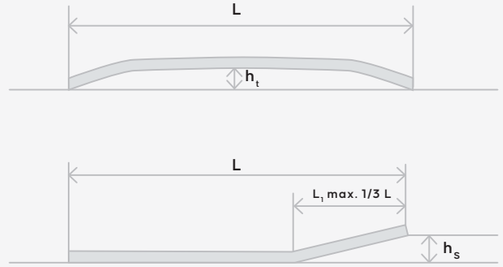
In the case of profiles with a width W over 150 mm, the local deviation F1, shall not exceed 0,50 mm for any width W1 of 100 mm.

Straightness tolerances



PN-EN 755-9

Straightness	Straightness deviation h_t for profiles should not exceed **1,5 mm/m length** (e.g. for the bar of 6 m h_t 9 mm)
	Deviation h_s should not exceed **0,6 mm/300 mm** in length



PN-EN 12020-2

(values in mm)

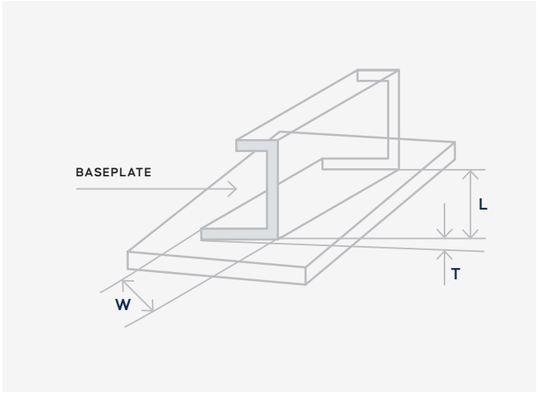
Straightness tolerances h_t for specified length L						
L ≤ 1000	1000 < L≤ 2000	2000 < L≤ 3000	3000 < L≤ 4000	4000 < L≤ 5000	5000 < L≤ 6000	L ≤ 6000
0.70	1.30	1.80	2.20	2.60	3	3.50

Twist tolerances

PN-EN 755-9

(values in mm)

Width W		Twist tolerances T		
		Per 1000[a] of length	On total profile length L	
Over	Up to and including		Over 1000 and to 6000	Over 6000
-	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



Key:

W	width
T	twist tolerance
L	length

[a] Twist tolerances for lengths less than 1 000 mm shall be subject to agreement between supplier and purchaser.

PN-EN 12020-2

(values in mm)

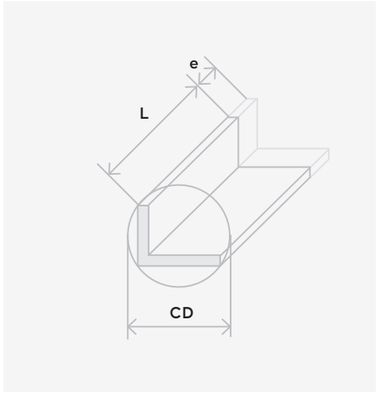
Width W		Straightness tolerances T for specified length L						
Over	Up to and including	L ≤ 1000	1000 < L≤ 2000	2000 < L≤ 3000	3000 < L≤ 4000	4000 < L≤ 5000	5000 < L≤ 6000	L≤ 6000
-	75	1.00	1.20	1.50	1.80	2.00	2.00	Subject to agreement betwen Final and Customer
75	100	1.00	1.20	1.50	2.00	2.20	2.50	
100	125	1.00	1.50	1.80	2.20	2.50	3.00	
125	150	1.20	1.50	1.80	2.20	2.50	3.00	
150	200	1.50	1.80	2.20	2.60	3.00	3.50	
200	350	1.80	2.50	3.00	3.50	4.00	4.50	

Tolerances on fixed length

PN-EN 775-9

(values in mm)

Diameter of circumscribed circle CD		Tolerances on fixed lengths L			
Over	Up to and including	L ≤ 2000	2000 < L≤ 5000	5000 < L≤ 10000	10000 < L≤ 15000
-	100	+5/-0	+7/-0	+10/-0	+16/-0
100	200	+7/-0	+9/-0	+12/-0	+18/-0
200	450	+8/-0	+11/-0	+14/-0	+20/-0



Key:

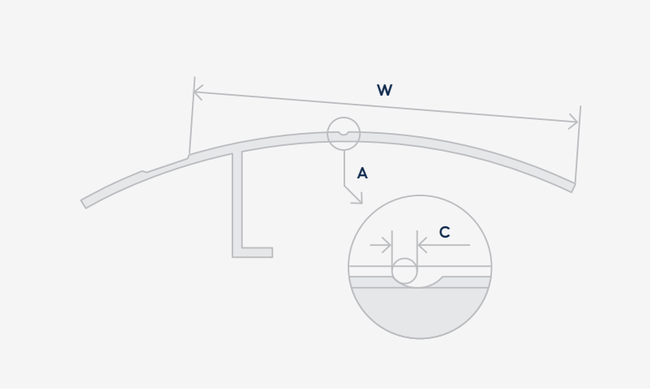
L	length
CD	circumscribed circle

PN-EN 12020-2

(values in mm)

Diameter of circumscribed circle CD		Tolerances on fixed lengths L			
Over	Up to and including	L ≤ 2000	2000 < L≤ 5000	5000 < L≤ 10000	10000 < L≤ 15000
-	100	+5/-0	+7/-0	+10/-0	Subject to agreement betwen Final and Customer
100	200	+7/-0	+9/-0	+12/-0	
200	350	+8/-0	+11/-0	+14/-0	

Contour tolerances



Key:

W	width

PN-EN 755-9

(values in mm)

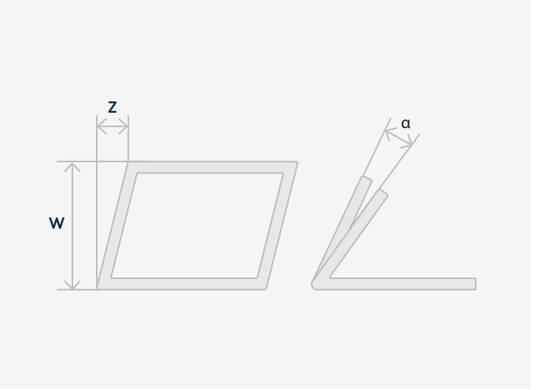
Width W of the contour		Contour tolerance = diameter C of the tolerance circle
Over	Up to and including	
-	30	0.30
30	60	0.50
60	90	0.70
90	120	1.00
120	150	1.20
150	200	1.50
200	250	2.00

PN-EN 12020-2

(values in mm)

Width W of the contour		Contour tolerance = diameter C of the tolerance circle
Over	Up to and including	
-	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

Angularity tolerances



Key:

W	width
Z	deviation from a right angle
α	deviation from a non-right angle

PN-EN 755-9

(values in mm)

Width W		Max allovable deviation Z from a right angle
Powyżej	Up to and including	
-	30	0.40
30	50	0.70
50	80	1.00
80	120	1.40
120	180	2.00
180	240	2.60

The maximum allowable deviation (a) for angles other than a right angle shall be ± 1°.

PN-EN 12020-2

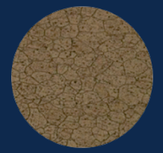
(values in mm)

Szerokość W		Max allovable deviation Z from a right angle
Powyżej	Up to and including	
-	30	0.30
30	50	0.40
50	80	0.50
80	100	0.60
100	120	0.70
120	140	0.80
140	160	0.90
160	180	1.00
180	200	1.20
200	250	1.50

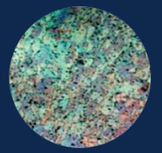
Microstructure of aluminium profiles

The hot-extruded aluminum profiles after the artificially aging heat treatment process are characterized by a fine-grained microstructure. The figures below present images of the profile microstructure in the alloy 6060 and 6082.

Microstructure of profiles in the alloy 6060



Microstructure of profiles in the alloy 6082



Surface of extruded aluminium profiles

Characteristic features of each profile directly after extrusion are visible longitudinal lines resulting from the specificity of the process and impossible to remove in a manner other than by an additional surface treatment. These lines have different degrees of intensity in all classes of surface quality.

The surface quality of extruded aluminum profiles depends among others on, the condition of a tool, construction or aluminum alloy used for the production of profiles. Therefore, the determination: of the application for profiles, their further surface treatment and decorative areas, during the first evaluation of the feasibility of the product in Final S.A. is very important.

	A	B	C	D
	Lack of requirements for surface quality	**Standard surface quality**	**High surface quality**	**Very high surface quality**
Description	Profiles without surface quality requirements, without visible surface; profiles from alloy: EN AW-1070A, EN AW-6061 and EN AW-6082 can only be produced only in this surface class	Profiles with standard surface quality requirements with visible surface	Profiles with high requirements for surface quality, having a decorative surface. A decorative / visible surface around the profile is not possible to obtain	The final length is individually determined with the customer. A decorative surface around the profile is not possible to obtain. Profiles in this class must be anodized. This class can be obtain by surface treatment before (sandblasting) anodizing.
Application examples	Structures, scaffolding, sides and car floors, masts	Structural elements, facades, windows, doors, balustrades, sport gates, ladders, heat sinks, exhibition stands, standard profiles	Furniture, elements of lighting systems, decorative products, finishing elements, decorative profiles	Decorative and profiles, finishing elements for special applications
Surface treatment	mill finished, powder coating, protective anodizing	mill finished, powder coating, anodizing	mill finished, powder coating, decorative anodizing	decorative anodizing
Watching distance	approx. 4 m	approx. 2 m	approx. 1 m	approx. 0,5 m
Aluminium Alloy	1070, 6060, 6063, 6005, 6106, 6061, 6082	6060, 6063, 6005, 6106	6060, 6063	6060 (in T6 temper)
Acceptable defects	eizes and scratches, die design streaks, dents, die lines / colour streaks, waving, pick-ups	light seizes and scratches, light die design streaks, light waving	light die design streaks, light waving, seam welds in the place agreed with the client	seam welds in the place agreed with the client

Aluminium profiles anodizing

As a result of anodizing or anodic oxidation, an oxide layer of high hardness and corrosion resistance is formed on the surface of aluminum.

The initial preparation of the surface for anodizing takes place through 1. dry etching (shot blasting) or 2. alkaline etching (chemical) or a combination of both. The aim is to achieve a satisfactory satin finish on the detail.

Technical conditions for anodizing in Final S.A.

- length: max. 7500 mm,
- colors: C-0 (natural), C-23 (gold), C-31 (stainless steel), C-32 (champagne), C-33 (olive), C-34 (brown), C-35 (black),
- coating thickness: 5-25 µm,
- Typically, trace material attachment to the hanger: from 30 to 50 mm on each side of the detail. For fine (flexible) material, the use of a supporting hanger in the central part is possible.

Before anodizing, all profiles undergo additional pretreatment. The following symbols are used to determine this process:

E0	• The surface is slightly glossy. Scars, scratches, abrasions, lines, and longitudinal streaks that arise during the extrusion of profiles remain visible. The phenomenon of corrosion, previously unseen, now becomes evident. Preliminary processing, etching bath without satin finishing of the surface.
E2	• Preliminary processing - brushing, • Anodizing and sealing of the anodized layer, • As a result of brushing, a uniform, jagged, slightly matte external surface is created. Scars, scratches, and abrasions are partially removed, while the material defect involving the bulging of surface layers along the direction of profile extrusion becomes visible in the form of tears, indentations, and lack of surface continuity after the brushing operation.
E6	• Preliminary processing, etching bath, satin, matte surface. Some defects after the extrusion process may become invisible.
ES	• Shot blasting (dry etching), a uniform matte surface that diffuses light. Masks some defects from the extrusion process. Minimum length of the processed material: 4 m.

The anodizing process takes place in sulfuric acid solutions. Surface finishing of aluminum - decorative and protective.

Powder coating

Powder coaring is connected with the application through special applicators with electrified particles of powder paint on the surface of aluminum profiles, which remain on this surface thanks to the electrostatic forces. The next step of powder coating is the process of heating for powder-coated elements at a temperature of 170-200°C. The effect of this process is melting and polymerization of the powder and consequently the thermosetting of the applied coating.

Coating offered by the Final S.A. is carried out on two technological lines, which are certified by Qualicoat

- horizontal – smaller batches of aluminum profiles (up to 50m^2) and metal sheet, metal flashings and arches are covered on this line,
- Vertical – large batches of aluminum profiles are covered on this line (over 50 m^2),
- coating in RAL colors in all types of gloss and structure,
- standard powder coating thickness - 60 µm.

Technical conditions for powder coating in Final S.A.

Parameters	Vertical line [mm]	Horizontal line [mm]
length	7500	7000
height	150	1700
width	260	370

In the case of powder coating, the proper preparation of the surface is very important. This preparation includes: degreasing, etching and (depending on the line) yellow chromium or chromium-free treatment.

Wood-effect coatings

Final S.A. has in its offer also the covering of aluminum profiles and sheet surfaces with the use of special wood-effect coatings system.

This technology is based on the decoration of profiles with special polyurethane powder paint, and then covering the profiles with a special foil with a selected pattern, which by the action of temperature and pressure is transferred to the profile's surface. The result is aesthetic and durable coating that imitates wood structure.

Technical conditions for wood coatings in Final S.A.

Parameters	Decoral Line - profiles [mm]	Decoral Line - scheet [mm]
length	7200	4000
height	160	-
width	1500	1500

Machining of aluminium profiles

Final S.A. also has the opportunity to provide fabricated final products for its customers. The company can offer the following machining processes within the framework of its machine park:

- drilling,
- milling,
- threading,
- punching,
- precision cutting,
- vibro-abrasive machining,
- assembling and quality control,
- thermal break assembly,
- bending.

Equipment of the fabrication department

The machining offered is carried out using the available machinery, which includes:

- CNC machining centers for fabrication of long profiles,
- automatic CNC cutting machines–angle single and double-head cutting saws,
- mechanical presses,
- device for vibro-abrasive processing,
- thermal break assembly of profiles,
- bending machine.

We carry out projects involving the machining of profiles from as little as 6 mm up to almost 9000 mm in length and with varying dimensions.

Each inquiry is analyzed in terms of possible alternative solutions. This refers mainly to the CNC operation, which can be replaced by a punching operation on the off-center press.

Notes

FINAL

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