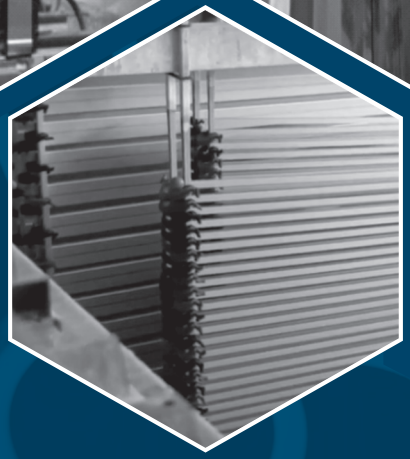


THE TECHNICAL MANUAL OF MANUFACTURING CAPABILITIES IN FINAL S.A.

FINAL

We FINALize your ideas – for this purpose we need to precisely meet your needs.

Our individual and partnership approach to each Customer is a guarantee 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 likelihood of occurrence undesirable factors, such as problems with the cross section geometry.

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 profile application, the method of its further treatment, as well as accurately marked decorative and visible surface have a significant influence at surfaces, largely affect the correct decisions concerning the construction of dies.

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

Aluminum (Al) belongs to the most widespread chemical element 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.

Aluminum has been called a „material of great opportunities". It is one of the most widely used metal in the world. Furthermore, it offers an excellent combination of properties, such as:

- **strength** – low weight of the material and its construction characteristics caused that the designers stated aluminums as an excellent material of new solution;
- **construction parameter** – i.e. the ratio of strength to specific density for aluminum is higher than of the steel;
- **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 a excellent construction material;
- **good electrical and thermal conductivity** – makes aluminum a competitive material in relations to copper;
- **excellent forming properties** in all plastic working processes such as extrusion, rolling, forging and casting;
- **corrosion resistance** – in the air under atmospheric conditions – pasivates by covering with a layer oxide Al_2O_3; which protects the metal against further oxidation;
- **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.

The application of aluminum profiles in the world increase continuously. The new areas of application and new product solutions are being constantly created.

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, the material is extruded through the 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 like in other methods of metal forming, will be 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 - precipitation hardening. The first heat treatment operation is solution treatment and second is aging. Solution treatment is conducted at the press exit, 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 and increases plastic properties. The second heat treatment operation of hot extruded aluminium profiles is aging process. Conducted **aging** process after solution treatment determine results of precipitation hardening, where in 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 natural aging. However, the solution treatment fine particles can be accelerated by heating up the 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 artificial aging. This process improved mechanical properties like: hardness, yield strength, tensile strength, durability and reduces the plastic properties like elongation or necking.

Aluminum alloys – general classification

Series	The main alloying elements
1xxx	Aluminum
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

Heat treatable alloys	Non-heat treatable alloys
Alloys hardened by heat treatment	Alloys hardened by plastic deformation
2xxx	1xxx
4xxx	3xxx
6xxx	5xxx
7xxx	-

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

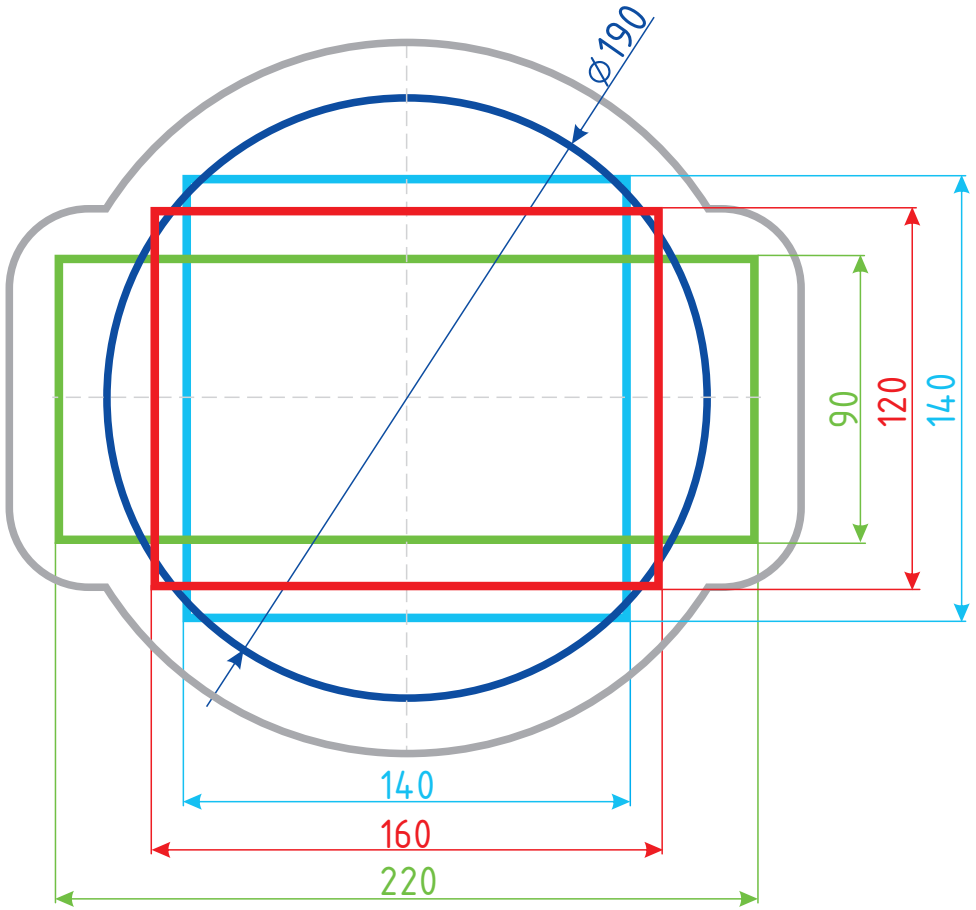
THE APPLICATION EXAMPLES FOR ALUMINIUM ALLOYS

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.
6061	Aircraft and aerospace components, automotive parts, marine fittings, bicycle frames, camera lenses, electrical fittings and connectors, couplings and valves.
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.

Physical properties – typical values							
Alloy	Modulus of elasticity, kN/mm^2	Shear modulus, kN/mm^2	Linear expansion coefficient 20-100°C, $\mu°C^{-1}$	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 EXTRUDED PROFILES

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



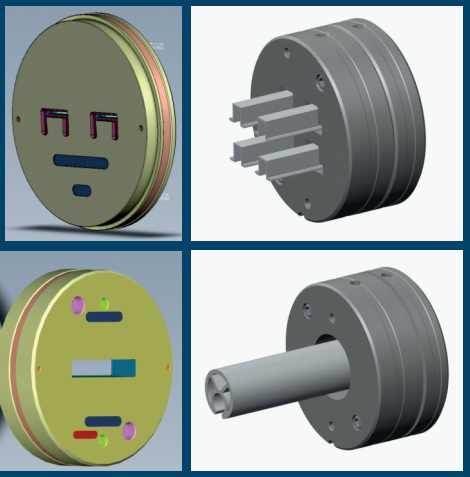
The above diagram is understood as exemplary dimensions of profiles which can be manufactured in Final S.A. However, all the queries are considered individually and there can be exceptions from this rule.
Values in the above diagram are given in millimeters (mm).

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 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.

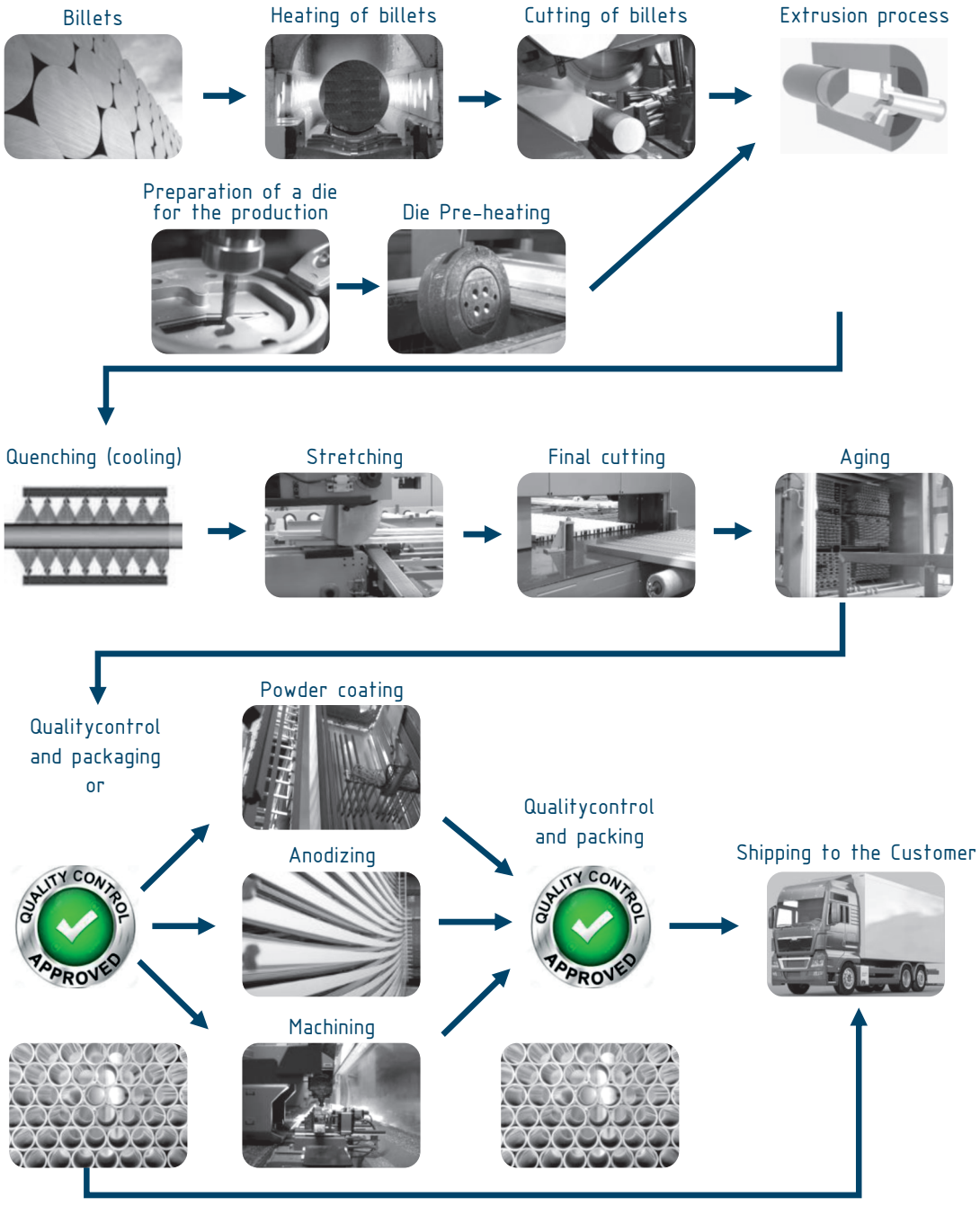


Comparative Characteristics of Aluminium Alloys / Tempers

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

Excellent - ■■■■ Good - ■■■ Fair - ■■ Poor - ■

DIAGRAM OF THE ALUMINUM PROFILE PRODUCTION PROCESS.



TECHNOLOGICAL POSSIBILITIES FOR THE PRODUCTION OF ALUMINUM PROFILES IN FINAL S.A.

FINAL S.A. has four technological lines for hot direct extrusion of aluminum profiles with following main parameters:

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_0 [mm]		Recommended minimum wall thicknesses [mm]					
		Solid profiles			Holow 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

Chemical 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	0.10–0.30	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 underageing 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.

SELECTED MECHANICAL PROPERTIES ACCORDING TO PN-EN 755-2

Alloy	Chemical symbol	TEMPER		Dimensions, mm	R_m, MPa min	$R_{p0,2}$, MPa min	A_{50}, % min
		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, $S^b \le 150$, $t \le 15^c$ $t \le 25^d$	120	60	14
		T6 - extruded: rod/bar, tube, profile	F18	D^a, $S^b \le 150$, $t \le 15^c$, $t \le 5^d$	190	150	6
		T6 - extruded: profile		$5 < t \le 25^d$	170	140	6
		T64 - extruded: rod/bar, tube, profile	F19	D^a, $S^b \le 50$, $t \le 15^c$	180	120	10
		T66 - extruded: rod/bar, tube	F22	D^a, $S^b \le 150$, $t \le 15^c$, $t \le 5^d$	215	160	6
		T66 - extruded: profile		$5 < t \le 25^d$	195	150	6
6063	AlMg0,7Si	T4 - extruded: rod/bar, tube, profile	F13	D^a, $S^b \le 150$, $t \le 10^c$, $t \le 25^d$	130	65	12
		T6 - extruded: rod/bar, tube	F22	D^a, $S^b \le 150$, $t \le 25^c$	215	170	8
		T6 - extruded: profile		$10 < t \le 25^d$	195	160	6
		T66 - extruded: rod/bar, tube	F25	D^a, $S^b \le 150$, $t \le 25^c$	245	200	8
		T66 - extruded: profile		$10 < t \le 25^d$	225	180	6
6106	AlMgSiMn	T6 - extruded: profile	F25	$t \le 10^d$	250	200	6
6005A	AlSiMg	T6 - extruded: rod/bar	F27	D^a, $S^b \le 25$	270	225	8
		T6 - extruded: rod/bar		$25 < D^a$, $S^b \le 50$	270	225	-
		T6 - extruded: rod/bar		$50 < D^a$, $S^b \le 100$	260	215	-
		T6 - extruded: open profile		$t \le 5^d$	270	225	6
		T6 - extruded: open profile		$5 < t \le 10^d$	260	215	6
		T6 - extruded: open profile		$10 < t \le 25^d$	250	200	6
		T6 - extruded: hollow profile		$t \le 5^d$	255	215	6
		T6 - extruded: hollow profile		$5 < t \le 15^d$	250	200	6
6061	AlMg1SiCu	T6 - extruded: rod/bar, tube	F26	D^a, $S^b \le 200$, $t \le 5^d$	260	240	6
		T6 - extruded profile		$t \le 5^d$	260	240	7
		T6 - extruded: tube, profile		$5 < t \le 15^d$	260	240	8
6082	AlSi1MgMn	T6 - extruded: rod/bar	F31	D^a, $S^b \le 20$	295	250	6
		T6 - extruded: rod/bar		$20 < D^a$, $S^b \le 150$	310	260	-
		T6 - extruded: tube, profile		$t \le 5^{c, d}$	290	250	6
		T6 - extruded: tube, profile		$5 < t \le 15^{c, d}$	310	260	8

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 FOR SHAPE AND DIMENSIONS FOR ALUMINIUM PROFILES

In the production of aluminum profiles in FINAL S.A., dimensional tolerances are applied 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 on the following pages:
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 dimensional tolerances on the following pages are in millimeters.

Tolerances on cross-sectional dimensions of solid and hollow profiles

EN 775-9

Dimension in millimeters

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

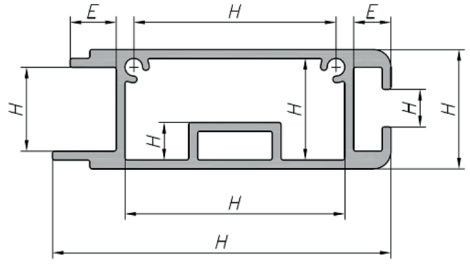
Dimension in millimeters

Dimension E		Additions to the tolerances on H in Table 2 and 3 for dimensions across the ends of open ended profiles
Over	Up to and including	
–	20	–
20	30	± 0.15
30	40	± 0.25
40	60	± 0.40
60	80	± 0.50
80	100	± 0.60
100	125	± 0.80
125	150	± 1.00
150	180	± 1.20
180	210	± 1.40

EN 12020-2

Dimension in millimeters

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



Definition of dimensions H and E

[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

EN 775-9

Dimension in millimeters

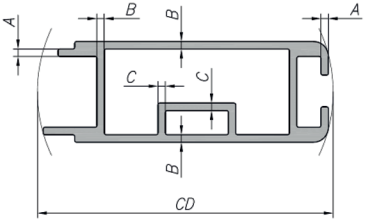
Nominal wall thickeness A, B or C		Tolerances on wall thickness type A, B or C depend on ircumscribing circle						Tolerances on wall thickness type A, B or C depend on ircumscribing circle					
		Alloy Group 1						Alloy Group 2					
Over	Up to and including	Wall thickness A		Wall thickness B*		Wall thickness C		Wall thickness A		Wall thickness B*		Wall thickness C	
		Circumscribed circle		Circumscribed circle		Circumscribed circle		Circumscribed circle		Circumscribed circle		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	–	–	–	–

* for seamless hollow profiles the tolerances given for wall thickeness C shal apply.

EN 12020-2

Dimension in millimeters

Nominal wall thickness A, B or C		Tolerances for wall thickness			
		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



Definition of dimensions A, B, C and CD

a Shall be subject to agreement between supplier and purchaser.

EN 775-9 Dimension in millimeters

Width W		Deviation F		
		Hollow profiles*		Solid profiles
Over	Up to an 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

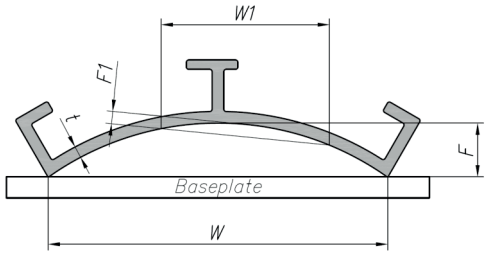
for alloys in Group 2, the specified tolerances shall be multiplied by a factor of 1,4.

* if the profiles has varying wall thickeness in the measurement range, the thinnest wall thickeness shal be used.

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.

EN 12020-2 Dimension in millimeters

Width W		Maximum allowable deviation F
Over	Up to an 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

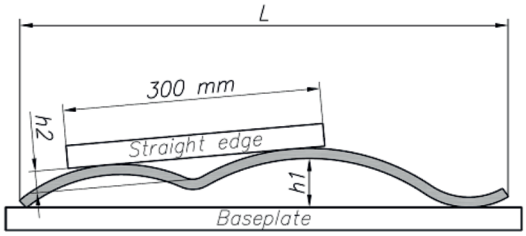


Key:
W – widh
F – deviation
W1 – 100 mm
F1 – local deviation per any 100 mm

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.

PN-EN 755-9

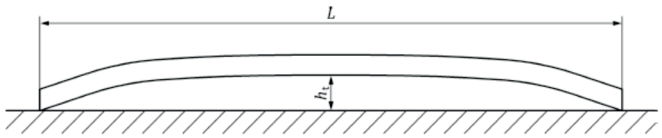
Straightness	Straightness deviation h_t for profiles should not exceed **1,5 mm/m length** (e.g. for the bar of 6 m h_t 9 mm)
	Deviation h_s should not exceed **0,6 mm/300 mm** in length



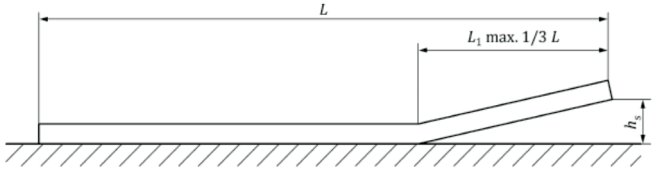
PN-EN 12020-2

Dimension in millimeters

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



Symmetrical deflection



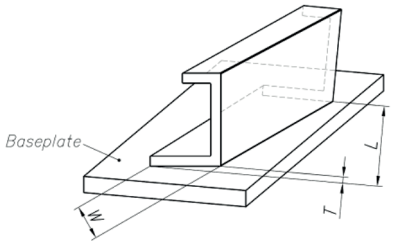
Kink to one side

Twist tolerances

EN 755-9

Dimension in millimeters

Width W		Twist tolerances T for the length L		
Over	Up to and including	Per 1000 of lenght[a]	On total profile length L	
			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 lenghts less than 1 000 mm shall be subject to agreement between supplier and purchser.

EN 12020-2

Dimension in millimeters

Width W		Straightness tolerances h_1 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 between 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	

EN 775-9

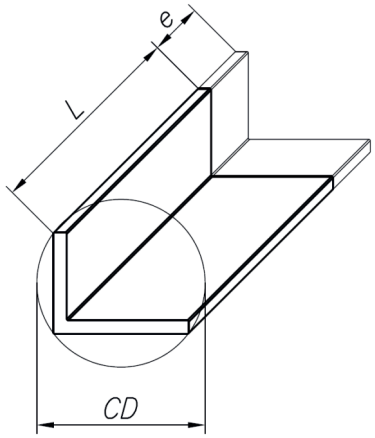
Dimension in millimeters

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

EN 12020-2

Dimension in millimeters

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 between Final and Customer
100	200	+7/-0	+9/-0	+12/-0	
200	350	+8/-0	+11/-0	+14/-0	



Key

L – length

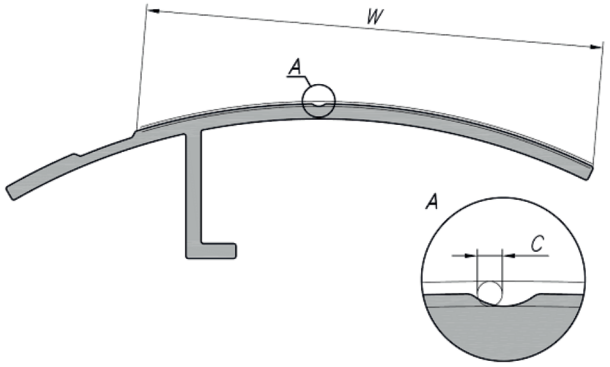
CD - circumscribed circle

EN 755-9 Dimension in millimeters

Width W of the contour		Contoru 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

EN 12020-2 Dimension in millimeters

Width W of the contour		Contoru 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



Key

W – width

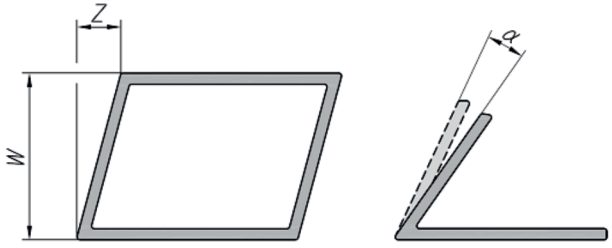
C - contour tolerance

EN 755-9 Dimension in millimeters

Width W		Max Allovable deviation Z from a right angle
Over	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

EN 12020-2 Dimension in millimeters

Width W		Max Allovable deviation Z from a right angle
Over	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



Key

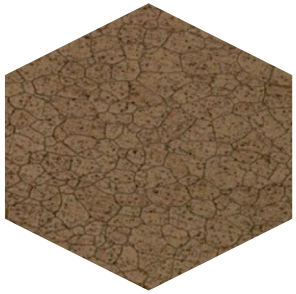
W – width

Z – deviation from a right angle

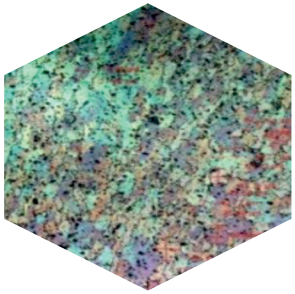
The maximum allowable deviation (α) for angles other than a right angle shall be ± 1 °.

MICROSTRUCTURE OF ALUMINUM 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 ALUMINUM PROFILES

Characteristic features of each profile directly after extrusion are visible longitudinal linesresulting 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, chemical composition 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 deffects	seizes 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
	smaller surface defects that do not affect the application of the product			
Unacceptable deffects	blisters	dents, major waving*, blisters	light seizes and scratches*, dents, major waving*, blisters	scratches*, seizes*, dents*, waving*, light die design streaks*, blisters

* applies to surfaces marked on the technical drawing as visible / decorative

ALUMINUM 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:** maximum 7000 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.
- **surface:** 15-20 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. - main processing
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 coating 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).

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




- Coating in RAL colors, in all types of gloss and structure,
- Standard powder coating thickness - 60 µm.

In the case of powder coating, the proper preparation of the surface is very important. This preparation includes: degreasing, etching and chromium-free treatment.

WOOD-EFFECT COATINGS

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

This technology is basedon 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.

Parameters	Decoral Line – profiles, [mm]	Decoral Line – sheet, [mm]
Length	7200	-
Height	160	4000
Width	1500	1500

MACHINING OF ALUMINUM PROFILES

FINAL S.A. has a possiblity to deliver to its customers products with added value according to customers' request and demand. We can offer following services:

- Drilling
- Milling
- Threading
- Punching
- Precision cutting
- Vibro-abrasive machining
- Assembling
- Thermal break
- Bending
- Deburring
- Special labeling/marking

EQUIPMENT OF THE FABRICATION DEPARTMENT

- 3 axes CNC machining centers
- 4 axes CNC machining centers
- 5 axes CNC machining centers with cutting blade
- automatic cutting center
- double-head cutting saw
- single-head cutting saw
- cleaning machines for small details
- mechanical eccentric press 63T

We machine the profiles starting with lenght from 5 mm up to 9000 mm of different profiles' shapes. Each inquary is veryfied in terms of finding the best possible alternative solutions. Based on gained experience and knowledge we can provide the complex service that will satisfy each customer.

www.final.pl

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