International Mg Society

International Mg Society

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Magnesium and Magnesium Alloys

-- Extruded Profiles for rail transit equipment

Foreword

The International Mg Society (IMS) is a non-profit organization. The purpose of IMS is to promote research, development, and applications of magnesium and its alloys, and to provide an academic exchange platform for all the magnesium scientists and engineers. The president of IMS is Prof. Fusheng Pan. Vice presidents of IMS are Prof. Karl Ulrich Kainer (Germany), Prof. Alan Luo (USA), and Prof. Kwang Seon Shin (Korea).

IMS holds international conferences on magnesium and supports the publication and presentation of scientific results. Journal of Magnesium and Alloys is the official journal for IMS.

IMS standards are prepared by International Magnesium Alloys Advanced Materials Technology Limited (HK, China), the secretariat of the Information Committee on IMS, and prepared by IMS members.

IMS standards are published and served for all parts concerned with Magnesium in the world and are to be modified with help from anybody in the industry chain on magnesium.

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IMS Standards aim to serve the producing, testing, evaluations, and trades of the global magnesium and magnesium alloy industry, offer standard basis for multiple parties in the industrial chain, intensified technical requirements, and simplify negotiation processes. In the preparation of IMS standard, numbers of relevant data are referred, and the essence contents are extracted, then the targeted modifications are carried out according to the actual situation of magnesium industry. This standard is free on trial, and any parties of magnesium chain are sincerely invited to put forward amendments and suggestions for this standard, especially the technical contents. Please provide amendments and reasons, attaching the necessary proof issues, if possible.

Any feedback or questions on this document should be directed to the secretariat of the Information Committee on IMS (Email: international_Mg@163.com)

Introduction

This document classifies the commercially available magnesium and magnesium alloy extruded profiles into a number of grades suitable for rail transit equipment application.

Some of the alloys referenced in this document can be the subject of a patent or of patent applications and their listing herein is not to be construed in any way as the granting of a licence under such patent rights

Magnesium and Magnesium Alloys

-- Extruded Profiles for rail transit equipment

1 Scope

This international standard specifies the chemical composition, mechanical properties, shape and dimensional tolerance, technical conditions for inspection and delivery of magnesium and magnesium alloy extruded profiles for rail transit equipment applications.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced documents (including any amendments) applies.

ISO 3116, *Magnesium and magnesium alloys — Wrought magnesium and magnesium alloys*

ISO 6892-1, *Metallic materials—Tensile testing—Part 1: Method of test at room temperature*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

Profile
Wrought product of uniform cross-section along its whole length, with a cross-section other than wire, rod/bar, tube, sheet or strip, supplied in straight lengths or in coiled form and where the product is long in relation to its cross-sectional dimensions.

Note According to the form of its cross-section, it is called:

a) hollow profile: the cross-section includes either one enclosed void, provided that the cross-section is other than tube, or more than one enclosed void;

b) solid profile: the cross-section does not include any enclosed void.

4 Orders or tenders

The order or tender shall define the product required and shall contain the following details:

a) the type and form of product:

— designation of the magnesium or magnesium alloy;

— form of the product (profile);

b) the metallurgical temper (degree of hardness or heat treatment condition) of the material for delivery and, if different, the metallurgical temper for use;

c) the number of this International Standard or specification number, or, where none exists, properties agreed between the supplier and the purchaser;

d) dimensions and shape of the product (thickness, width, length, diameter); and/or reference to a drawing defining the product;

e) tolerances of the dimensions and form, with reference to the appropriate International Standard;

f) quantity;

g) any requirements for certificates of conformity, test and/or analysis;

h) any special requirements agreed between the supplier and the purchaser (for example drawings).

5 Requirements

5.1 Designation

The alloy designation and temper shall be in conformity with Table 1. If there is any alloy not specified in Table 1, the alloy designation and temper shall be agreed upon between the supplier and purchaser and stated in the order.

Table 1 — Alloy designation and temper of extruded profiles

IMS designation	ISO designation	Temper
IMS-AZ31E	ISO-MgAl3Zn1(A)	F
IMS-AZ40A	ISO-MgAl4Zn	F
IMS-AZ41A	ISO-MgAl4Zn1	F
IMS-AZ61C	ISO-MgAl6Zn1	F
IMS-AZ81B	ISO-MgAl8Zn	F, T5
IMS-M2B	ISO-MgMn2	F
IMS-ZK61C	ISO-MgZn6Zr	F, T5
IMS-ZM21A	ISO-MgZn2Mn1	F
IMS-WE54B	ISO-MgY5RE4Zr	T5, T6
IMS-WE43C	ISO-MgY4RE3Zr1(B)	T5, T6
IMS-VW84A	ISO-MgGd8Y4Zn2	F, T5, T6

5.2 Production and manufacturing processes

Unless otherwise specified in the order, the production and manufacturing processes shall be left to the discretion of the producer. Unless it is explicitly stated otherwise in the order, no obligation shall be placed on the producer to use the same processes for subsequent and similar orders.

5.3 Quality control

The supplier shall be responsible for the performances of all inspection and tests required by the relevant International Standard, specification or customer requests, prior to shipment of the product. If the purchaser wishes to inspect the product at the supplier's works, he shall notify the supplier at the time of placing the order.

5.4 Chemical composition

The chemical composition shall conform to the requirements for the appropriate material given in Table 2, or comply with the requirements specified in ISO 3116.

If the purchaser requires content limits for elements not specified in Table 2 nor in ISO 3116, these limits shall be stated in the order document.

Table 2 — Chemical composition of wrought magnesium and magnesium alloys

Alloy group	Material designation																		
	Symbol	ISO Designation	Element	Mg	Al	Zn	Mn	Gd	Y	RE	Li	Zr	Ca		Si	Fe	Cu	Ni	Others
																			each / total
MgAlZn	IMS-AZ31E	ISO-MgAl3Zn1(A)	min.	Rem.	2.4	0.5	0.15	—	—	—	—	—	—	—	—	—	5	—	— / —
			max.	—	3.6	1.5	0.40								0.10	0.005		0.005	0.05 / 0.30
	IMS-AZ40A	ISO-MgAl4Zn	min.	Rem.	3.0	0.2	0.15	—	—	—	—	—	—	—	—	—	—	—	— / —
			max.	—	4.0	0.8	0.50							0.01Be	0.10	0.05	0.05	0.005	0.01 / 0.30
	IMS-AZ41A	ISO-MgAl4Zn1	min.	Rem.	3.7	0.8	0.30	—	—	—	—	—	—	—	—	—	—	—	— / —
			max.	—	4.7	1.4	0.60							0.01Be	0.10	0.05	0.05	0.005	0.01 / 0.30
	IMS-AZ61C	ISO-MgAl6Zn1	min.	Rem.	5.5	0.5	0.15	—	—	—	—	—	—	—	—	—	—	—	— / —
			max.	—	6.5	1.5	0.40								0.10	0.005	0.05	0.005	0.05 / 0.30
	IMS-AZ80C	ISO-MgAl8Zn	min.	Rem.	7.8	0.20	0.12	—	—	—	—	—	—	—	—	—	—	—	— / —
			max.	—	9.2	0.8	0.40								0.10	0.005	0.05	0.005	0.05 / 0.30
MgMn	IMS-M2B	ISO-MgMn2	min.	Rem.	—	—	1.2	—	—	—	—	—	—	—	—	—	—	—	— / —
			max.	—			20								0.10		0.05	0.01	0.05 / 0.30
MgZnZr	IMS-ZK61C	ISO-MgZn6Zr	min.	Rem.	—	4.8	—	—	—	—	—	0.45	—	—	—	—	—	—	— / —
			max.	—		6.2						0.8							0.05 / 0.30
MgZnMn	IMS-ZM21A	ISO-MgZn2Mn1	min.	Rem.	—	1.75	0.6	—	—	—	—	—	—	—	—	—	—	—	— / —
			max.	—	0.1	2.3	1.3								0.10	0.06	0.10	0.005	0.05 / 0.30
MgYREZr	IMS-WE54B	ISO-MgY5RE4Zr1	min.	Rem.	—	—	—	—	4.75	1.5	—	0.4	—	—	—	—	—	—	— / —
			max.	—		0.20	0.03		5.5	4.0		1.0			0.01	0.01	0.02	0.005	0.01 / 0.30
	IMS-WE43C	ISO-MgY4RE3Zr1(B)	min.	Rem.	—	—	—	—	3.7	2.4	—	0.4	—	—	—	—	—	—	— / —
			max.	—		0.20	0.03		4.3	4.4	0.2	1.0			0.01	0.01	0.02	0.005	0.01 / 0.30
MgGdY	IMS-VW84A	ISO-MgGd8Y4Zn2	min.	Rem.	—	1.0	0.6	7.5	3.5	—	—	—	—	—	—	—	—	—	— / —
			max.	—		2.0	1.0	9.0	5.0						0.05	0.01	0.02	0.005	0.01 / 0.15

5.5 Mechanical properties

The mechanical properties of profiles shall be in conformity with those specified in Table 3. If there is any alloy not specified in Table 3, the mechanical properties shall be in conformity with those specified in ISO 3116 or those agreed upon between the supplier and purchaser and stated in the order.

Table 3 — Mechanical properties of profiles

Alloys	Type	Temper	Dimensions[a]	Tensile strength R_m (N/mm^2) min.	0,2% Proof stress $R_{P0.2}$ (N/mm^2) min.	Elongation A % min.
IMS-AZ31E	SP[b]	F	t≤6.3	240	145	7
			6.3<t≤40	240	150	7
			40<t≤60	235	150	7
			60<t≤130	220	140	7
	HP[c]	F	All	220	110	8
IMS-AZ40A	-	F	t≤130	240	150	5.0
IMS-AZ41A	-	F	t≤130	250	150	5.0
IMS-AZ61C	SP	F	1≤t≤10	260	150	6.0
			10<t≤40	270	170	9.0
			40<t≤65	260	160	9.0
	HP	F	1<t≤10	250	110	7.0
IMS-AZ80C	SP	F	t≤6.3	295	195	9.0
			6.3<t≤40	295	195	8.0
			40<t≤60	295	195	6.0
			60<t≤130	290	185	4.0
	SP	T5	t≤6.3	325	205	4.0
			6.3<t≤60	330	230	4.0
			60<t≤130	310	205	2.0
	HP	F	1≤t≤10	280	180	3.0
IMS-M2B	SP	F	t≤50	230	120	3.0
			50<t≤100	200	120	3.0
	HP	F	t≤2	225	165	2.0
			T > 2	200	145	1.5
IMS-ZK61C	SP	F	t≤50	300	210	5.0
	SP	T5	t≤50	310	230	5.0
	HP	F	All	275	195	5.0

	HP	T5	All	315	260	4.0
IMS-ZM21A	SP	F	t≤10	230	150	8.0
			10<t≤75	245	160	10.0
IMS-WE54B	SP	T5	10<t≤50	250	170	6.0
			50<t≤100	250	160	6.0
	SP	T6	All	250	160	6.0
IMS-WE43C	SP	T5	6.3<t≤50	250	160	4.0
			50<t≤130	240	150	4.0
	SP	T6	6.3<t≤50	250	150	4.0
			50<t≤130	240	140	4.0
IMS-VW84A	SP	F	t≤10	400	290	8.0
			t > 10	350	250	11.0
	HP	F	All	350	250	11.0
	SP	T5	t≤10	500	360	6.0
			t > 10	430	310	3.0
	HP	T5	All	430	310	3.0
	SP	T6	10<t≤65	500	350	8.0
			t > 65	450	280	8.0
	[a] t (mm) = thickness of solid profile; wall thickness of hollow profile. [b] Solid profile. [c] Hollow profile. Notes: The temper shall be in accordance with the symbol, definition and meaning specified in ISO 3116.					

5.6 Surface finish

The products shall be free from defects detrimental to their use. Whilst an operation designed to mask a fault is not permitted, the elimination of a superficial fault is permissible, provided that the dimensional tolerances remain.

5.7 Tolerances on shape and dimensions

The tolerances on the length, cross-sectional dimension, angularity, straightness, flatness, curved cross-section, twist, fillet radii and surface roughness of profiles shall be as follows.

5.7.1 Tolerances on length

If fixed lengths are to be supplied, this shall be stated in the order document. The tolerances on fixed length are given in Table 4.

The length range and the tolerances on the random length shall be subject to agreement between the supplier and purchaser.

Table 4 — Tolerances on fixed length

Unit: mm

Diameter of Circumscribing Circle	Tolerance on fixed length L				
	L≤2000	2000<L≤5000	5000<L≤10000	10000<L≤15000	15000<L≤25000
D≤100	+5	+7	+10	+16	+22
100<D≤200	+7	+9	+12	+18	+24
200<D≤450	+8	+11	+14	+20	+28
450<D≤800	+9	+14	+16	+22	+30
Note: If no fixed length is specified in the order document, profiles may be delivered in random lengths.					

5.7.2 Tolerances on cross-sectional dimensions

Tolerances on cross-sectional dimensions (see Figures 1-3) are specified in Tables 5.

The sectional dimensions shall be A, B, C_e, C_i and D as given in figure 1 and their tolerances shall be as given in table 5. However, as given in figure 2, the tolerances on the sectional dimensions, where the nominal wall thickness of one wall is equal to or greater than three times the thickness of the other wall t shall be upon the agreement between the purchaser and the manufacturer.

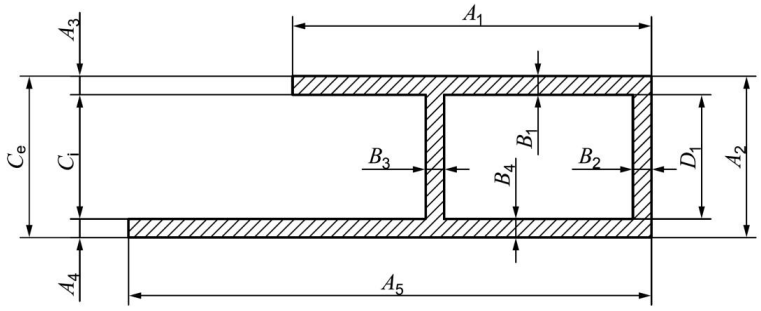


Figure 1 — Cross-sectional dimensions

Key for figure 1:

A_1 to A_5: dimension of metallic part except thickness of wall surface at hollow part (B)

B_1 to B_4: thickness of wall surface at hollow place

C_e and C_i: dimensions of empty space at opening

D_1: dimensions of empty space at hollow place

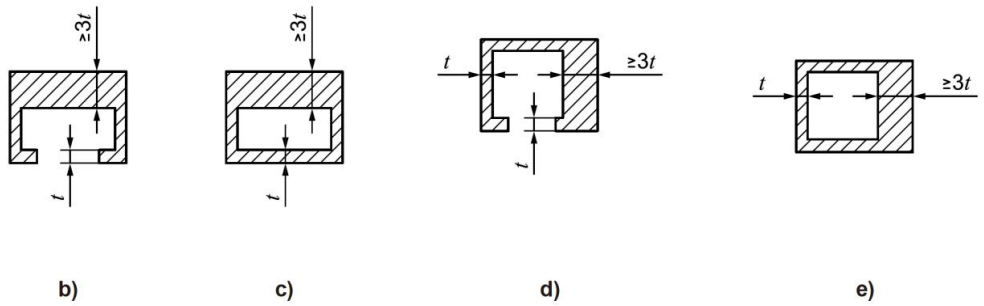


Figure 2 — Cross-sectional dimensions

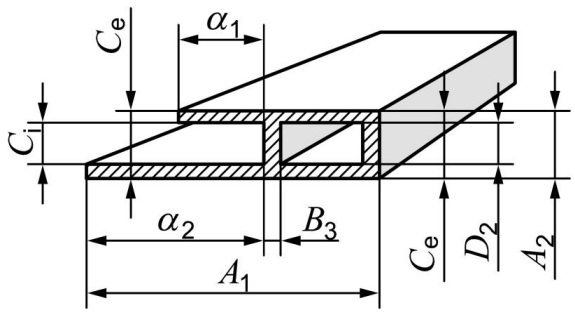


Figure 3 — Cross-sectional dimensions

Key for figure 3:

α_1, α_2: distance between specified point and root of let

Table 5 — Tolerance on cross-sectional dimensions

Unit: mm

Dimension at specified part	Tolerance[a]								
	Metallic part[b, c] (where 75% or more is metal)		Hollow part (where more than 25 % is hollow space, i.e. less then 75 % is metal) C_i or C_e[d]						
	Metallic part other than that in the right column ***A***	Thickness of wall surface at hollow part[e] ***B***	Distance between specified point and root of let α[f]						Tolerances for empty space **D**
			5<α≤15	15<α≤30	30<α≤60	60<α≤100	100<α≤150	150<α≤200	
Circumscribing Circle Size Less than 250 mm in Diameter									
A≤3.20	±0.23	±15%, but ±2.30 max. and ±0.38 min.	±0.33	±0.38	—	—	—	—	±0.38
3.20<*A*≤6.30	±0.27		±0.39	±0.45	±0.51	—	—	—	±0.45
6.30<*A*≤12.50	±0.30		±0.47	±0.51	±0.58	±0.61	—	—	±0.54
12.50<*A*≤20.00	±0.35		±0.53	±0.58	±0.64	±0.67	—	—	±0.62
20.00<*A*≤25.00	±0.38		±0.60	±0.64	±0.70	±0.77	±0.89	—	±0.69
25.00<*A*≤40.00	±0.45		±0.69	±0.73	±0.83	±0.91	±1.0	—	±0.81
40.00<*A*≤50.00	±0.54		±0.79	±0.83	±0.99	±1.1	±1.2	±1.4	±0.90
50.00<*A*≤100.00	±0.92		±1.1	±1.2	±1.5	±1.7	±2.0	±2.3	±1.29
100.00<*A*≤150.00	±1.3		±1.5	±1.6	±2.0	±2.4	±2.8	±3.2	±1.65
150.00<*A*≤200.00	±1.7		±1.8	±2.0	±2.6	±3.0	±3.6	±4.1	±2.03
200.00<*A*≤250.00	±2.1		±2.1	±2.4	±3.2	±3.7	±4.3	±4.9	±2.48
Circumscribing Circle Size Over and Include 250 mm in Diameter									
A≤3.20	±0.54	±20%, but ±3.40 max. and ±0.57 min.	±0.64	±0.69	—	—	—	—	±0.69
3.20<*A*≤6.30	±0.57		±0.67	±0.76	±0.89	—	—	—	±0.72
6.30<*A*≤12.50	±0.62		±0.71	±0.82	±0.95	±1.5	—	—	±0.75
12.50<*A*≤20.00	±0.65		±0.78	±0.93	±1.3	±1.7	—	—	±0.84
20.00<*A*≤25.00	±0.69		±0.81	±1.0	±1.6	±2.0	±2.7	—	±0.87
25.00<*A*≤40.00	±0.72		±0.85	±1.2	±1.9	±2.3	±3.0	—	±0.90
40.00<*A*≤50.00	±0.92		±1.2	±1.5	±2.2	±2.6	±3.3	±4.6	±1.29
50.00<*A*≤100.00	±1.3		±1.6	±1.8	±2.5	±2.9	±3.6	±4.9	±1.65
100.00<*A*≤150.00	±1.7		±1.9	±2.2	±2.9	±3.2	±3.8	±5.2	±2.03

150.00<*A*≤200.00	±2.1		±2.3	±2.5	±3.2	±3.5	±4.1	±5.4	±2.48
200.00<*A*≤250.00	±2.4		±2.6	±2.9	±3.5	±3.8	±4.4	±5.7	±2.85
250.00<*A*≤300.00	±2.8		±3.0	±3.2	±3.8	±4.1	±4.7	±6.0	±3.23
300.00<*A*≤350.00	±3.2		±3.3	±3.6	±4.1	±4.4	±5.0	±6.2	±3.60
350.00<*A*≤400.00	±3.6		±3.7	±3.9	±4.5	±4.7	±5.3	±6.5	±3.98
400.00<*A*≤450.00	±4.0		±4.1	±4.3	±4.8	±5.0	±5.6	±6.8	±4.35
450.00<*A*≤500.00	±4.4		±4.4	±4.6	±5.1	±5.3	±5.9	±7.1	±4.73
500.00<*A*≤550.00	±4.7		±4.8	±4.9	±5.4	±5.6	±6.2	±7.3	±5.10
550.00<*A*≤800.00	±5.1		±5.1	±5.3	±5.7	±5.8	±6.5	±7.6	±5.48

Note:

The circumscribing circle is the smallest circle which encloses entirely the cross-section of the profile. However, this dimension may have to be increased when profiles are subjected to corrections of the uneven thickness or in the case of hollow profiles for which the centre of the circumscribing circle needs to be considered, based on the void. These matters should be confirmed with the supplier beforehand as required.

Notes:

[a] When the dimensional tolerance is not made equal at the plus side and minus side, determine the value in the column corresponding to the centre of allowable range, and use this value as a standard to decide the tolerance.

[b] In the case of angled profiles as shown in Figure 4, the tolerances shall be decided not on the base of the length of dimension X, but on the base of the angle α (see 5.6.3).

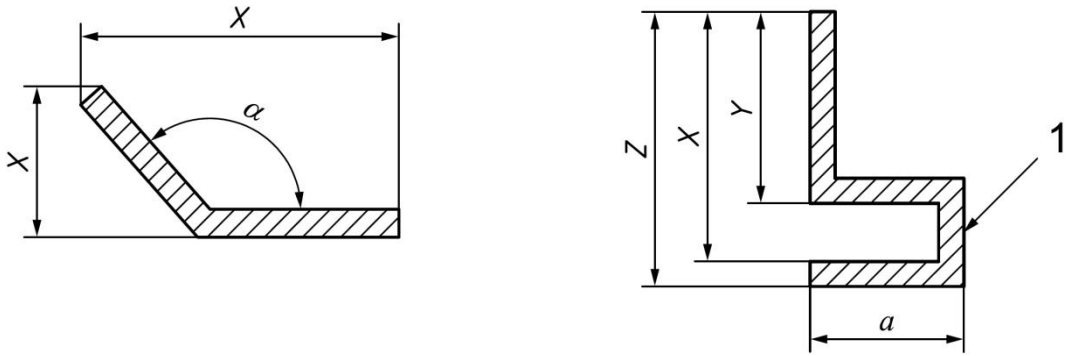


Figure 4 — Cross-sectional dimensions

[c] Even when value Y in Figure 4 is equal to or greater than 75 % of value X, these tolerances are not applied to the dimension X or Z. The tolerances for X and Y

shall conform to the column corresponding to space dimension C_i and C_e depending on the distance a from the reference base.

[e] If the purchaser and the supplier agree, the outside dimension C_e may be specified instead of the inside dimension C_i.

[f] This is applicable when the space volume enveloped with hollow part is 70 mm^2 or larger. If less than 70 $mm^{2,}$ employ column A.

[g] If 5 mm or under, employ column A.

5.7.3 Tolerances on angularity

The deviation from a specified angularity shall be measured as shown in Figures 5 and 6.

The angularity tolerances for right angles shall be as specified in Table 6 as a function of profile width *W*.

Table 6 — Angularity tolerance for right angles

Unit: mm

Width *W*	**Maximum allowable deviation from a right angle** *Z*
W≤30	0.4
30<*W*≤50	0.7
50<*W*≤80	1.0
80<*W*≤120	1.4
120<*W*≤180	2.0
180<*W*≤240	2.6
240<*W*≤300	3.1
300<*W*≤400	3.5

For profiles with a value of *W* which exceeds 400 mm, the tolerance shall be subject to agreement between the supplier and purchaser.

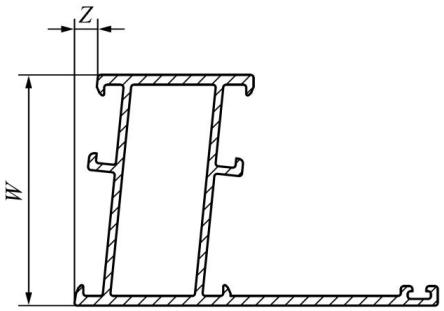


Figure 5 — Measurement of angularity in a right angle

The maximum allowable deviation α in an angle other than a right angle shall be ± 2°. When the tolerances are specified for the plus or the minus side only, the allowable deviation α shall be 4° or -4°.

In the case of unequal side lengths, the tolerance on angularity shall apply to the shorter side of the angle, i.e. it is measured starting from the longer side.

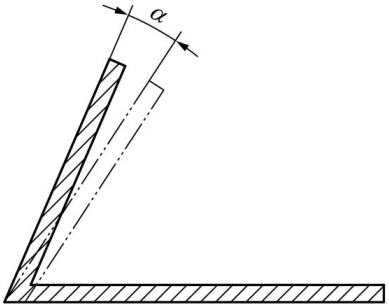


Figure 6 — Measurement of angularity in an angle other than a right angle

5.7.4 Tolerances on straightness

Deviations from straightness h_s and h_t shall be measured as shown in Figure 7 with the profile placed on a horizontal base-plate so that its own mass decreases the deviation.

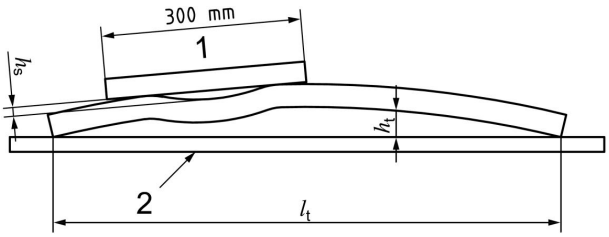


Figure 7 — Measurement of straightness

Key for figure 7:

l_t: total length

h_t: camber of the total length

h_s: camber at arbitrary position

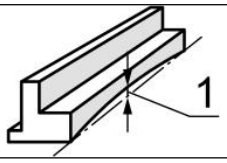
1: ruler

2: flat table

The tolerances on the camber of profiles shall be as given in table 7.

Table 7 — Tolerances on straightness

Unit: mm

Diameter of Circumscribing Circle *D*	**Minimum wall thickness** *t*	**Tolerance** 

		Key: 1: camber	
		h_s for arbitrary length of 1000	h_t for total length
D≤38	t≤2.4	h_s≤6.6	h_t≤6.6×l_t/1000
	t > 2.4	h_s≤2	h_t≤2×l_t/1000
D > 38	All	h_s≤2	h_t≤2×l_t/1000
Note: The tolerance value is obtained when the profile is laid on a flat plate under its own weight so that the camber is minimum.			

5.7.5 Tolerances on flatness

The flatness shall be measured as shown in Figure 8

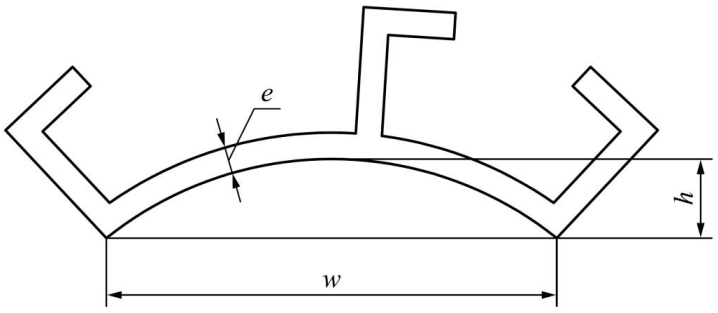


Figure 8 — Measurement of flatness

Key for figure 8:

w: width

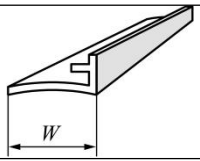
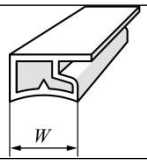
h: flatness

e: thickness

The maximum allowable deviation on flatness for solid and hollow profiles shall be as specified in Table 8.

Table 8 — Tolerances on flatness

Unit: mm

Width *W*	**Tolerance** *h*	
		
	For both solid profile and hollow profile	
	For arbitrary width of 25	For total width W
W≤25	—	*h*≤0.2

$W > 38$	$h \leq 0.2$	$h \leq 0.008 \times W$

5.7.6 Tolerances on curved cross-section

The tolerances for the curved cross-section of profiles shall be applied only when required by the purchaser. If the purchaser does not provide the form board, this item may not be checked.

Tolerances on curved cross-section shall be examined by a form board provided by the purchaser. It shall be measured as shown in Figure 9. The tolerance shall not be more than 1% of arc length.

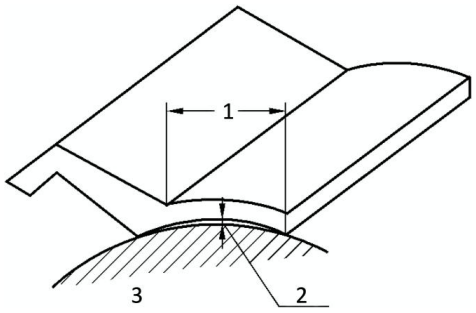


Figure 9 — Measurement of tolerances on curved cross-section

Key for figure 9:

1: arc

2: tolerances on curved cross-section

3: form board

5.7.7 Tolerances on twist

The tolerances on the twist of profiles shall be measured as shown in Figure 10. Placing the profile on a flat base-plate, the profile resting under own mass, and measuring the maximum distance at any point along the length between the bottom surface of profile and the base-plate surface.

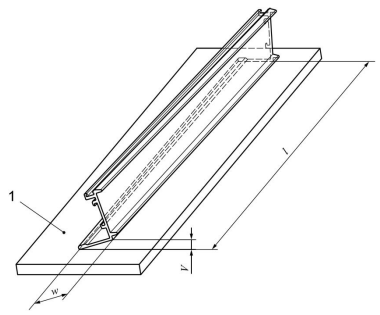


Figure 10 — Measurement of twist

Key for figure 10:

l: whole length

w: width

V: twist

1: flat table

The maximum allowable deviation on twist for profiles shall be as specified in Table 9.

Table 9 — Tolerances on twist

Unit: mm

Diameter of Circumscribing Circle *D*	**Tolerance** [per width (*W*) 1 mm]	
	Per length of 1000	Maximum value for total length
12.5<*D*≤40	0.070	0.140
40<*D*≤80	0.034	0.105
80<*D*≤250	0.026	0.070
D＞250	0.017	0.058

5.7.8 Tolerances on fillet radii

The tolerances on the fillet radii of profiles shall be measured as shown in Figure 11.

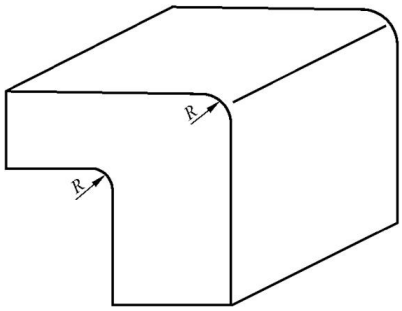


Figure 11 — Measurement of fillet radii

Key for figure 11:

R: fillet radii

The maximum allowable deviation on fillet radii for profiles shall be as specified in Table 10.

Table 10 — Tolerances on fillet radii

Unit: mm

Fillet Radii *R*	Tolerance
$R \leq 1$	±0.40
$1 < R \leq 3$	±0.75
$3 < R \leq 10$	±1.50
$10 < R \leq 25$	±2.00

5.7.9 Tolerances on surface roughness

Roughness of surface of profiles shall not exceed the amount permitted by table 11.

Table 11 — Tolerances on surface roughness

Unit: mm

Wall thickness *t*	Tolerance [Maximum value for allowable depth of defect]
$t \leq 1.65$	0.038
$1.65 < t \leq 3.20$	0.050
$3.20 < t \leq 4.80$	0.065
$4.80 < t \leq 6.30$	0.075
$6.30 < t \leq 12.5$	0.100
$t > 12.5$	0.200

6 Test procedure

6.1 Sampling

6.1.1 Specimens for chemical analysis

The specimens for chemical analysis shall be cast from molten metal samples taken at the time of casting. Their shape and conditions of production (mould design, cooling rate, mass, etc.) shall be so designed that their composition is homogeneous, and be suitable for the method of analysis which is agreed between the supplier and the purchaser.

6.1.2 Specimens for mechanical testing

6.1.2.1 Location and size

Specimens shall be taken from samples in such a way that it is possible to orientate the test pieces in relation to the product, as specified in 6.1.2.2.

The specimens shall be large enough to allow manufacture of sufficient test pieces for the required tests, and for any retests which may be required.

6.1.2.2 Orientation of specimens

Specimens shall generally be taken in the longitudinal direction, unless otherwise agreed upon between the supplier and purchaser and stated in the order.

6.1.2.3 Identification of specimens

Each specimen shall be marked in such a manner that, after removal, it is still possible to identify the product from which it was taken and its location and orientation. If, during the course of subsequent operations, removal of the markings cannot be avoided, new markings shall be made before the originals are removed.

6.1.2.4 Preparation of specimens

Specimens shall be taken from the sample after completion of all the mechanical and heat-treatments that the product has to undergo before delivery, and which may influence the mechanical properties of the metal. In cases where this is not possible, the sample or specimens may be taken at an earlier stage, but they shall be subjected to the same treatment as that to which it is intended to submit the product concerned.

NOTE If the purchaser intends to convert the material to a final temper which is different from the 'as supplied' temper, then additional testing may be requested by the purchaser in order to satisfy himself that the material is capable of meeting the specified properties of the final temper. It is only necessary for the supplier to confirm that selected samples, heat-treated using supplier laboratory conditions, meet the properties specified for the final temper required by the purchaser.

Cutting shall be carried out in such a manner that it does not change the characteristics of the part prepared. Thus, the dimensions of the specimens shall provide an adequate machining allowance to permit removal of the zone affected by cutting.

Specimens shall not be machined or treated in any way by which their mechanical properties may be altered. Any straightening required shall be carried out with great care, preferably by hand.

6.1.2.5 Number of specimens

Unless otherwise specified, the minimum number of specimens shall be as follows:

— for products having a nominal mass up to and including 1 kg per linear metre (1 kg/m), one specimen shall be taken for each lot of 1000 kg or part thereof;

— for products having a nominal mass greater than 1 kg/m up to and including 5 kg/m, one specimen shall be taken for each lot of 2000 kg or part thereof;

— for products having a nominal weight greater than 5 kg/m, one specimen shall be taken for each lot of 3000 kg or part thereof.

Not less than one representative specimen shall be taken from any given inspection or heat-treatment lot.

6.1.3 Test pieces for tensile test

6.1.3.1 Identification of test pieces

Each test piece shall be marked in such a manner that it is possible to identify the inspection lot from which it was taken and, if required, its location and orientation in the product.

If a test piece is marked by stamping, this shall not be in a place or manner which may interfere with subsequent testing.

Where it is not convenient to mark a test piece, an identification tag may be attached. Alternative methods, such as specially designed boxes, may be used for the purpose of test piece identification.

6.1.3.2 Machining

Any machining necessary shall be carried out in such a manner that it does not change the characteristics of the metal in the test piece.

6.1.3.3 Number of test pieces

One test piece shall be taken from each specimen.

The recommended shapes and dimensions for test pieces are specified in ISO 6892-1.

6.1.3.4 Type and location of test pieces

The type of test pieces shall follow table 12.

The location of test pieces shall be agreed between the supplier and the purchaser.

Table 12 — Type of test pieces

Unit: mm

Wall thickness t	**Type of test pieces**
$t \leq 12.5$	Use a rectangular test piece.
$t > 40$	Use a round standard 10 mm diameter test piece.
Note: The test piece shall be prepared such that the fabricated surface is preserved without modification.	

6.2 Test methods

6.2.1 Chemical composition

The determination of the chemical composition of alloys given in table 2 and 3 shall be performed in accordance with relevant International Standards, or other standards as agreed between the supplier and the customer.

6.2.2 Tensile test

Tensile tests shall be carried out in accordance with ISO 6892-1.

6.2.3 Surface finish

Unless otherwise specified, examination of surface appearance shall be carried out, without the assistance of magnifying apparatus, on products before delivery.

For products intended to be anodized, it is recommended that an anodizability test be carried out by the producer on the products before delivery. The frequency and the conditions of the test may be agreed between the producer and customer.

6.2.4 Additional tests

If any other tests are required, they shall be agreed between the supplier and purchaser. These tests shall be carried out in accordance with the relevant International Standards or a method agreed between the supplier and purchaser.

6.3 Retests

6.3.1 Mechanical properties

If any one of the test pieces first selected fails to meet the requirements for the mechanical tests, the following procedure shall be applied:

— if an error is clearly identified, either in the test piece preparation or the test procedure, then the corresponding result shall be disregarded and the testing recommended as initially required;

— if this is not the case, then two further specimens shall be taken from the same inspection lot, one being from the same unit of product from which the original specimen was taken, unless that unit of product has been withdrawn by the supplier. If both test pieces from these additional specimens meet the requirements, the inspection lot which they represent shall be deemed to comply with the requirements of this International Standard.

Should one test piece fail to meet the required limits:

— the inspection lot shall be deemed not to comply with the requirements of this International Standard;

— or, where applicable, the lot may be submitted to additional mechanical or thermal treatment(s) and then retested as a new lot.

6.3.2 Other properties

The retest procedure of other properties shall be agreed upon between the supplier and purchaser.

7 Inspection documents

7.1 General

When requested by the purchaser and agreed upon by the supplier, the supplier shall provide the appropriate inspection documents.

The following documents shall be established on the basis of inspections and tests performed by qualified personnel involved in the manufacturing process and/or belonging to the quality control department.

7.2 Certificate of conformity

The certificate of conformity is a document by which the producer certifies that, according to inspections and results of representative tests, the products for delivery comply with the relevant International Standards and with the additional requirements in the order.

7.3 Test report

The test report is a document by which the producer certifies that the products for delivery comply with the requirements specified in the order.

The document details the results of the current production controls carried out on identical products made using the same methods as the products for delivery but not necessarily on the products for delivery themselves.

The test report shall include:

a) the sample;

b) the International Standard used (including its year of publication);

c) the method used;

d) the result(s), including a reference to the clause which explains how the results were calculated;

e) any unusual features observed;

f) the date of the test.

8 Marking

Marking of products is only undertaken when agreed upon between the supplier and purchaser and stated in the order. This marking shall not adversely affect the final use of the product.

9 Packing

Unless otherwise specified in International Standards relating to special products or specified in the order, the method of packing shall be determined by the supplier who shall take all suitable precautions to ensure that, under the usual conditions or transportation, the products are delivered in a condition suitable for use.

10 Transportation and storage

During transportation, all the products shall be kept clean, dry and away from contamination. Rain and snow shall be kept off to prevent erosion of the packing case. Chemically active substance, dampened materials or inflammable substance shall not be. Loading and unloading should be done with cautious to avoid damage of the packing.

Immediately after receiving, the products should be preserved in dry and clean environment, which is free of corrosive gas, chemical active substance, dampened materials and inflammable substance, and sheltered from rain and snow. Inspection for the erosion should be done within 10 days.

11 Arbitration tests

In cases of dispute concerning conformity with the requirement of this International Standard or specification cited in the order, testing shall be carried out by an arbitrator chosen by mutual agreement between the supplier and purchaser.

The arbitrator’s decision shall be final.

Bibliography

[1] ISO 3116, *Magnesium and magnesium alloys — Wrought magnesium and magnesium alloys*

[2] ISO 6892-1, *Metallic materials—Tensile testing — Part 1: Method of test at room temperature*