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Wrought magnesium and magnesium alloys — Rolled plates and sheets

PROOF/ÉPREUVE

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Contents

Page

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 79, *Light metals and their alloys*, Subcommittee SC 5, *Magnesium and alloys of cast or wrought magnesium*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document classifies the commercially available magnesium and magnesium alloy rolled plates and sheets into a number of grades suitable for the application to which they might be put.

Wrought magnesium and magnesium alloys — Rolled plates and sheets

1 Scope

This document specifies chemical composition, mechanical properties, dimension and shape tolerance, heat treatment and the technical conditions for inspection and delivery of rolled magnesium and magnesium alloy plates and sheets.

It is applicable to rolled magnesium and magnesium alloy plates and sheets.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (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.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
sheet
product that is rectangular in cross-section with nominal thickness less than 6 mm, but not less than 0,20 mm, and with slit, sheared or sawed edges

3.2
plate
product that is rectangular in cross-section and with thickness not less than 6 mm with sheared or sawn edges

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 the product:

   1) designation of the magnesium or magnesium alloy;

   2) form of the product (sheet, plate);

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 document, i.e. ISO 23700, the specification number, or, where none exists, the properties agreed between the supplier and the purchaser;

d) the dimensions and shape of the product (thickness, width, length, diameter of the coil);

e) the tolerances of the dimensions and form, with reference to the appropriate clause or subclause of this document;

f) the quantity;

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

h) any special requirements agreed between the supplier and the purchaser (e.g. drawings).

5 Requirements

5.1 Designation

The following symbols shall be used for temper designation:

— O: annealed;

— H112: strain hardened from working at elevated temperature or from a limited amount of cold work, and for which there are mechanical properties limits;

— H × 4: half hardened (stain hardened to give an ultimate tensile strength approximately midway between that of annealed and H × 8 temper);

— H × 2: quarter hardened (stain hardened to give an ultimate tensile strength approximately midway between that of annealed and H × 4 temper);

— T5: cooled from an elevated temperature shaping process and then artificially aged.

The alloy designation and temper should be as given in Table 1.

Table 1 — Alloy designation and temper

Alloy designation	Alloy symbol	Temper	Thickness mm
MAM61	ISO-MgAl6Mn1	H112	$1 \leq t \leq 5$
MAM91	ISO-MgAl9Mn1	H112	$1 \leq t \leq 5$
MAT11	ISO-MgAl1Sn1	O	$0.5 \leq t \leq 2$
MAT61	ISO-MgAl6Sn1	O	$0.5 \leq t \leq 2$
MAZ31a	ISO-MgAl3Zn1(A)	O, H × 4, H × 2	$0.5 \leq t \leq 25$
MAZ31b	ISO-MgAl3Zn1(B)	O, H112	$0.4 \leq t \leq 70$
MAZ40	ISO-MgAl4Zn	H112	$40 \leq t \leq 70$
MAZ41	ISO-MgAl4Zn1	H112	$10 \leq t \leq 70$
MAZX310	ISO-MgAl3Zn1Ca	O	$0,5 \leq t \leq 1,5$
MAZE310	ISO-MgAl3Zn1RE	O	$0,5 \leq t \leq 1,5$
MVWE751	ISO-MgGd7Y5RE1	T5	$10 \leq t \leq 20$
MVW76	ISO-MgGd7Y6	T5	$12 \leq t \leq 70$
MLAZ931	ISO-MgLi9Al3Zn1	O, H112	$0,5 \leq t \leq 60$
MME20	ISO-MgMn2RE	H112	$10 \leq t \leq 70$
MWE43c	ISO-MgY4RE3Zr(C)	T5	$12 \leq t \leq 70$
MWEK711	ISO-MgY7RE1Zr1	T5	$10 \leq t \leq 20$

Table 1 *(continued)*

Alloy designation	Alloy symbol	Temper	Thickness mm
MZE10	ISO-MgZn1RE	O	$0,5 \leq t \leq 1,5$
MZE20	ISO-MgZn2RE	O	$0,5 \leq t \leq 1,5$
MZM21	ISO-MgZn2Mn1	O, H × 4	$6 \leq t \leq 25$
MZK60	ISO-MgZn6Zr0	H112	$20 \leq t \leq 60$
MZK61	ISO-MgZn6Zr1	T5, H112	$10 \leq t \leq 70$

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 or specification, prior to shipment of the product.

If the purchaser wishes to inspect the product at the supplier's works, he or she 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 to the requirements specified in ISO 3116.

If the purchaser requires content limits for elements not specified in Table 2 or in ISO 3116, these limits shall be stated in the order document.

Table 2 — Chemical composition of rolled magnesium alloy plates and sheets

Alloy group	Material designation		Composition % (mass fraction)																	
	Symbol	Designation	Element	Mg	Al	Zn	Mn	Gd	RE	Li	Zr	Y	Ca	Be	Si	Fe	Cu	Ni	Others each	Others total
MgAlMn	ISO-MgAl6Mn1	MAM61	min.	Rem.	5,0	—	0,50	—	—	—	—	—	—	—	—	—	—	—	—	—
			max.	—	7,0	—	1,50	—	—	—	—	—	—	—	—	—	—	—	0,01	0,30
	ISO-MgAl9Mn1	MAM91	min.	Rem.	8,0	—	0,50	—	—	—	—	—	—	—	—	—	—	—	—	—
			max.	—	10,0	—	1,50	—	—	—	—	—	—	—	—	—	—	—	0,01	0,30
MgAlZn	ISO-MgAl4Zn	MAZ40	min.	Rem.	3,0	0,20	0,15	—	—	—	—	—	—	—	—	—	—	—	—	—
			max.	—	4,0	0,8	0,50	—	—	—	—	—	—	0,01	0,10	0,05	0,05	0,005	0,01	0,30
	ISO-MgAl4Zn1	MAZ41	min.	Rem.	3,7	0,8	0,30	—	—	—	—	—	—	—	—	—	—	—	—	—
			max.	—	4,7	1,4	0,6	—	—	—	—	—	—	0,01	0,10	0,05	0,05	0,005	0,01	0,30
MgAlZn-Ca	ISO-MgAl3Zn-1Ca	MAZX310	min.	Rem.	2,4	0,5	0,15	—	—	—	—	—	0,1	—	—	—	—	—	—	—
			max.	—	3,6	1,5	0,40	—	—	—	—	—	0,3	—	0,1	0,005	0,05	0,005	0,05	0,30
MgAlZn-RE	ISO-MgAl3Zn-1RE	MAZE310	min.	Rem.	2,4	0,5	0,15	—	0,1	—	—	—	—	—	—	—	—	—	—	—
			max.	—	3,6	1,5	0,40	—	0,3	—	—	—	—	—	0,1	0,005	0,05	0,005	0,05	0,30
MgLiAl	ISO-MgLi-9Al3Zn1	MLAZ931	min.	Rem.	2,5	0,5	—	—	—	8,5	—	—	—	—	—	—	—	—	—	—
			max.	—	3,8	1,5	0,05	—	—	9,5	—	—	—	—	0,05	0,01	0,01	0,001	0,02	0,30
MgMnRE	ISO-MgMn2RE	MME20	min.	Rem.	—	—	1,3	—	0,15	—	—	—	—	—	—	—	—	—	—	—
			max.	—	0,20	0,30	2,2	—	0,35	—	—	—	—	0,01	0,10	0,05	0,05	0,007	0,01	0,30
MgZnRE	ISO-MgZn1RE	MZE10	min.	Rem.	—	0,5	0,01	—	0,1	—	—	—	0,1	—	—	—	—	—	—	—
			max.	—	0,05	1,5	0,05	—	0,3	—	—	—	0,3	—	0,05	0,02	0,02	—	0,01	0,10
	ISO-MgZn2RE	MZE20	min.	Rem.	—	1,5	—	—	0,1	—	—	—	0,1	—	—	—	—	—	—	—
			max.	—	0,05	2,5	0,05	—	0,3	—	—	—	0,3	—	0,05	0,02	0,02	—	0,01	0,10
MgZnZr	ISO-MgZn6Zr1	MZK61	min.	Rem.	—	5,0	—	—	—	—	0,30	—	—	—	—	—	—	—	—	—
			max.	—	0,05	6,0	0,10	—	—	—	0,90	—	—	0,01	0,05	0,05	0,05	0,005	0,01	0,30

Key

Rem.: subtract the percentage of all elements except Mg from 100 %.

5.5 Dimensional tolerances

Thickness (t), width (W) and length (L) tolerances shall be in accordance with Table 3. When the tolerance is specified as either all plus or all minus, the value in Table 3 shall be doubled.

When tested with the plate and/or sheet resting on a flat surface against a straight edge, the flatness shall not exceed the appropriate value given in Table 4.

Tolerances for the products exceeding the range of specified value shall be agreed upon by the supplier and the purchaser.

Table 3 — Thickness, width, and length tolerance of sheets and plates (in mm)

Thickness	Thickness tolerance		Width and length tolerance of sheared sheets and plates		Width and length tolerance of sawed sheets and plates				
	Specified width				Specified width and length				
	$W \leq 1\,000$	$1\,000 < W \leq 1\,200$	Width tolerance	Length tolerance	$W, L \leq 800$	$800 < W,L \leq 1\,000$	$1\,000 < W,L \leq 1\,200$	$1\,200 < W,L \leq 2\,000$	$W, L > 2\,000$
$0{,}40 \leq t < 0{,}80$	±0,04	—	±3	±8					
$0{,}80 \leq t < 1{,}00$	±0,05	—	±3	±8					
$1{,}00 \leq t < 1{,}20$	±0,06	±0,08	±3	±8					
$1{,}20 \leq t < 2{,}00$	±0,07	±0,10	±4	±8					
$2{,}00 \leq t < 3{,}00$	±0,10	±0,12	±4	±10					
$3{,}00 \leq t < 4{,}00$	±0,11	±0,15	±5	±10					
$4{,}00 \leq t < 5{,}00$	±0,14	±0,17	±5	±10					
$5{,}00 \leq t < 6{,}00$	±0,17	±0,18	±6	±10					
$6{,}00 \leq t < 8{,}00$	±0,20	±0,20	±7	±10					
$8{,}00 \leq t < 10{,}00$	±0,22	±0,22	±8	±10					
$10{,}00 \leq t < 12{,}00$	±0,25	±0,25	±9	±12					
$12{,}00 \leq t < 20{,}00$	±0,50	±0,50	±10	±16	±4	±5	±6	±7	±8
$20{,}00 \leq t < 26{,}00$	±0,75	±0,75	—	—					
$26{,}00 \leq t < 40{,}00$	±1,00	±1,00	—	—					
$40{,}00 \leq t < 60{,}00$	±1,50	±1,50	—	—					
$60{,}00 \leq t \leq 70{,}00$	±1,90	±1,90	—	—					

Table 4 — Flatness tolerances of sheets and plates (in mm)

Thickness	Flatness of sheets and plates in any 1 000 mm length, maximum		
	Specified width		
	$W \leq 800$	$800 < W \leq 1\,000$	$1\,000 < W$
$0{,}40 \leq t < 2{,}00$	1	2	—
$2{,}00 \leq t < 6{,}00$	2	3	4
$6{,}00 \leq t < 20{,}00$	2	3	5
$20{,}00 \leq t \leq 70{,}00$	3	5	7

5.6 Mechanical properties

The minimum mechanical properties of magnesium alloys sheets and plates in the defined temper conditions shall be as given in Table 5.