Designation: B 90/B 90M – 98

Standard Specification for Magnesium-Alloy Sheet and Plate[1]

This standard is issued under the fixed designation B 90/B 90M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope *

1.1 This specification covers magnesium alloys in sheet and plate form designated as shown in Table 1.

1.2 The values stated in either inch-pound or SI units are to be regarded separately as standards. The SI units are shown in brackets or in separate tables or columns. The values stated in each system are not exact equivalents; therefore, each system must be used independent of the other. Combining values from the two systems may result in nonconformance with the specification.

1.3 Unless the order specifies the "M" specification designation, the material shall be furnished to the inch-pound units.

2. Referenced Documents

2.1 The following documents of the issue in effect on date of material purchase form a part of this specification to the extent referenced herein:

2.2 *ASTM Standards:*

B 275 Practice for Codification of Certain Nonferrous Metals and Alloys, Cast and Wrought[2]

B 296 Practice for Temper Designations of Magnesium Alloys, Cast and Wrought[2]

B 557 Test Methods of Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products[2]

B 557M Test Methods of Tension Testing Wrought and Cast Aluminum- and Magnesium Alloy Products [Metric][2]

B 660 Practices for Packaging/Packing of Aluminum and Magnesium Products[2]

B 661 Practice for Heat Treatment of Magnesium Alloys[2]

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specification[3]

E 35 Test Methods for Chemical Analysis of Magnesium and Magnesium Alloys[4]

E 55 Practice for Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition[4]

2.3 *Federal Standards:*[5]

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)

Fed. Std. No. 184 Identification Marking of Aluminum, Magnesium and Titanium

2.4 *Military Standards:*[5]

MIL-STD-129 Marking for Shipment and Storage

MIL-M-3171 Magnesium Alloy, Processes for Pretreatment and Prevention of Corrosion on

3. Terminology

3.1 *Definitions:*

3.1.1 *plate*—a rolled product rectangular in cross section and form, of thickness 0.250 in., or more, [over 6.30 mm], either sheared or sawed edges.

3.1.2 *sheet*—a rolled product rectangular in cross section and form, of thickness of 0.006 through 0.249 in. [over 0.15 through 6.30 mm] with sheared, slit, or sawed edges.

4. Ordering Information

4.1 Orders for sheet and plate to this specification shall include the following information:

4.1.1 Quantity in pieces, pounds, or [kilograms]

4.1.2 Alloy (Section 5 and Table 1),

4.1.3 Temper (Section 6 and Table 2),

4.1.4 Thickness, width, and length,

4.1.5 Surface treatment (see 8.2),

4.1.6 Whether inspection is required at the manufacturer's works (see 13.1), and

4.1.7 Whether certification of the material by the vendor is required (Section 15).

[1] This specification is under the jurisdiction of ASTM Committee B-7 on Light Metals and Alloys and is the direct responsibility of Subcommittee B07.04 on Magnesium Alloy Cast and Wrought Products.

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[2] *Annual Book of ASTM Standards*, Vol 02.02.

[3] *Annual Book of ASTM Standards*, Vol 14.02.

[4] *Annual Book of ASTM Standards*, Vol 03.05.

[5] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

***A Summary of Changes section appears at the end of this standard.**

TABLE 1 Chemical Composition Limits[A]

NOTE 1—Analysis shall regularly be made only for the elements specifically mentioned in this table. If, however, the presence of other elements is suspected or indicated in amounts greater than the specified limits, further analysis shall be made to determine that these elements are not present in excess of the specified limits.

NOTE 2—The following applies to all specified limits in this table: For purposes of acceptance and rejection, an observed value or a calculated value obtained from analysis should be rounded to the nearest unit in the last right-hand place of figures used in expressing the specified limit.

	Composition %[A]												
	Al	Mn	R.E.	Zn	Zr	Ca	Cu	Fe	Ni	Si	Each	Total	Mg
AZ31B	2.5-3.5	0.20-1.0	. . .	0.6-1.4	. . .	0.04	0.05	0.005	0.005	0.10	. . .	0.30	Remainder

[A] Limits are in weight percent maximum unless shown as a range.

TABLE 2 Tensile Requirements

NOTE 1—For purposes of determining conformance with this specification, each value for tensile strength and yield strength shall be rounded to the nearest 0.1 ksi, and each value for elongation shall be rounded to the nearest 0.5 %, both in accordance with the rounding method of Practice E 29.

Alloy and Temper	Specified Thickness, in.	Tensile Strength, min, ksi	Yield Strength (0.2 % Offset), min, ksi	Elongation in 2 in., or 4 × dia min, %
AZ31B-O	0.016–0.500	32.0[A]	. . .	12
	0.501–2.000	32.0[A]	. . .	10
	2.001–3.000	32.0[A]	. . .	9
AZ31B-H24	0.016–0.249	39.0	29.0	6
	0.250–0.374	38.0	26.0	8
	0.375–0.500	37.0	24.0	8
	0.501–1.000	36.0	22.0	8
	1.001–2.000	34.0	20.0	8
	2.001–3.000	34.0	18.0	8
AZ31B-H26	0.250–0.374	39.0	27.0	6
	0.375–0.500	38.0	26.0	6
	0.501–0.750	37.0	25.0	6
	0.751–1.000	37.0	23.0	6
	1.001–1.500	35.0	22.0	6
	1.501–2.000	35.0	21.0	6

[A] Tensile strength shall be 40.0 ksi max.

5. Chemical Composition

5.1 The sheet and plate shall conform to the chemical requirements in Table 1.

6. Tensile Properties

6.1 The sheet and plate shall conform to the tensile requirements in Table 2 [Table 3] unless other agreement is made

TABLE 3 Tensile Requirements [Metric][A]

Alloy and Temper	Specified Thickness, mm		Tensile Strength, MPa[B]		Yield Strength (0.2 % offset), MPa	Elongation, min %	
	Over	Through	Min	Max	Min	in 50 mm[C]	in 5 × dia ($5.65 \sqrt{A}$)
AZ31B-O	0.40	12.50	221	275	. . .	12	. . .
	12.50	50.00	221	275	. . .	. . .	9
	50.00	80.00	221	275	. . .	. . .	8
AZ31B-H24	0.40	6.30	269	. . .	200	6	. . .
	6.30	10.00	262	. . .	179	8	. . .
	10.00	12.50	255	. . .	165	8	. . .
	12.50	25.00	248	. . .	152	. . .	7
	25.00	50.00	234	. . .	138	. . .	7
	50.00	80.00	234	. . .	124	. . .	7
AZ31B-H26	6.30	10.00	269	. . .	186	6	. . .
	10.00	12.50	262	. . .	179	6	. . .
	12.50	20.00	255	. . .	172	. . .	5
	20.00	25.00	255	. . .	159	. . .	5
	25.00	40.00	241	. . .	152	. . .	5
	40.00	50.00	241	. . .	148	. . .	5

[A] The basis for establishment of mechanical property limits as shown in Appendix X1.

[B] To determine conformance to this specification each value for tensile strength shall be rounded to the nearest 1 MPa and each value for elongation to the nearest 0.5 %, both in accordance with the rounding-off method of Practice E 29.

[C] Elongation in 50 mm apply for thicknesses up through 12.50 mm and in 5 × diameter ($5.65 \sqrt{A}$) for thicknesses over 12.50 mm where *A* is the cross-sectional area of the specimen.

between seller and purchaser. Properties for sizes and tempers not shown in Table 2 [Table 3] shall be as agreed upon by seller and purchaser.

7. Dimensional Tolerances

7.1 Variations from the specified thickness shall not exceed the amounts prescribed in Table 4 [Table 5].

7.2 Variations from the specified width shall not exceed the amounts prescribed in Table 6 [Table 7], Table 8 [Table 9], and Table 10 [Table 11].

7.3 Variations from the specified length shall not exceed the amounts prescribed in Table 12 [Table 13].

7.4 Squareness of sheet and plate shall conform to the requirements of Table 14 [Table 15].

7.5 Flatness of sheet and plate shall conform to the requirements of Table 16 [Table 17].

7.6 Lateral bow of sheet and plate shall conform to the requirements of Table 18 [Table 19] and Table 20 [Table 21].

8. Workmanship, Finish and Appearance

8.1 All sheet and plate shall be commercially flat and free of buckles, shall be free of injurious surface defects, and have a workmanlike finish.

8.2 The sheet or plate shall be supplied in the finish specified by the purchaser. One of the following finishes should be specified:

8.2.1 Mill finish,

8.2.2 Mill finish and oiled,

8.2.3 Chrome pickled, or

8.2.4 Chrome pickled and oiled.

9. Sampling for Chemical Analysis

9.1 *Ingot*—At least one sample shall be taken for each group of ingots of the same alloy poured from the same source of molten metal and analyzed to determine conformance to Table 1. Ingots not conforming shall be rejected.

9.2 *Finished Product*—Unless compliance is established by 9.1, sampling of the finished product shall be according to Method E 55. One sample shall be taken for 4000 lb [1815 kg] or less of material comprising the lot, except that not more than one analysis shall be required per piece.

10. Sampling for Tensile Properties

10.1 *Number of Tests*—One tension test specimen shall be taken from a sheet representing 1000 lb [455 kg] sheet or from a plate representing each 2000 lb [905 kg] of plate of the same alloy, temper, and thickness in the shipment or such other quantity as may be agreed upon by the seller and purchaser.

10.2 *Location of Specimens*—Tension test specimens shall be taken parallel to the direction of rolling. The specimen shall be taken midway between the two plate surfaces for plate in thicknesses of 0.500 through 1.500 in. [12.50 though 40 mm] and midway between the center and the surface of plate over 1.500 in. [40 mm] in thickness.

10.3 *Types of Specimens*—For sheet and plate less than 0.500 in. [12.50 mm] thick, the standard sheet-type specimen shown in Fig. 6 or for plate 0.500 in. [12.5 mm] or over those in Fig. 8 of Test Methods B 557 [Test B 557M] shall be used. If it is necessary to use specimens smaller than the standard specimens, they shall have dimensions proportional to those of Fig. 8 but not less than the following dimensions: reduced

TABLE 4 Thickness Tolerances for Magnesium Flat and Coiled Sheet and Plate[A]

	Thickness tolerance, in. ±						
Specified Thickness, in.	Specified Widths up to 18, incl	Over 18 through 36	Over 36 through 48	Over 48 through 54	Over 54 through 60	Over 60 through 66	Over 66 through 72
0.016–0.028	0.0015	0.002	0.0025	0.0035	0.004	0.004	0.004
0.029–0.036	0.002	0.002	0.0025	0.004	0.005	0.005	0.005
0.037–0.045	0.002	0.0025	0.003	0.004	0.005	0.005	0.005
0.046–0.068	0.0025	0.003	0.004	0.005	0.006	0.006	0.006
0.069–0.076	0.003	0.003	0.004	0.005	0.006	0.006	0.006
0.077–0.096	0.0035	0.0035	0.004	0.005	0.006	0.006	0.006
0.097–0.108	0.004	0.004	0.005	0.005	0.007	0.007	0.007
0.109–0.125	0.0045	0.0045	0.005	0.005	0.007	0.007	0.007
0.126–0.140	0.0045	0.0045	0.005	0.005	0.007	0.010	0.012
0.141–0.172	0.006	0.006	0.008	0.008	0.009	0.012	0.014
0.173–0.203	0.007	0.007	0.010	0.010	0.011	0.014	0.016
0.204–0.249	0.009	0.009	0.011	0.011	0.013	0.016	0.018
0.250–0.320	0.013	0.013	0.013	0.013	0.015	0.018	0.020
0.321–0.438	0.019	0.019	0.019	0.019	0.020	0.020	0.023
0.439–0.625	0.025	0.025	0.025	0.025	0.025	0.025	0.025
0.626–0.875	0.030	0.030	0.030	0.030	0.030	0.030	0.030
0.876–1.125	0.035	0.035	0.035	0.035	0.035	0.035	0.035
1.126–1.375	0.040	0.040	0.040	0.040	0.040	0.040	0.040
1.376–1.625	0.045	0.045	0.045	0.045	0.045	0.045	0.045
1.626–1.875	0.052	0.052	0.052	0.052	0.052	0.052	0.052
1.876–2.250	0.060	0.060	0.060	0.060	0.060	0.060	0.060
2.251–2.750	0.075	0.075	0.075	0.075	0.075	0.075	0.075
2.751–3.000	0.090	0.090	0.090	0.090	0.090	0.090	0.090
3.001–4.000	0.110	0.110	0.110	0.110	0.110	0.110	0.110
4.001–5.000	0.125	0.125	0.125	0.125	0.125	0.125	0.125
5.001–6.000	0.135	0.135	0.135	0.135	0.135	0.135	0.135

[A] When a dimension tolerance is specified other than as an equal bilateral tolerance, the value of the standard tolerance is that applying to the mean of maximum and minimum dimensions permissible under the tolerance.

TABLE 5 Thickness Tolerances for Magnesium Flat and Coiled Sheet and Plate [Metric][A]

Specified Thickness, mm Over Through	Thickness tolerance, mm±						
	Specified Widths up to 450, incl.	Over 450 Through 900	Over 900 Through 1200	Over 1200 Through 1350	Over 1350 Through 1500	Over 1500 Through 1650	Over 1650 Through 1850
0.40–0.70	0.04	0.05	0.06	0.09	0.10	0.10	0.10
0.70–0.90	0.05	0.05	0.06	0.10	0.12	0.12	0.12
0.90–1.15	0.05	0.06	0.07	0.10	0.12	0.12	0.12
1.15–1.70	0.06	0.07	0.10	0.12	0.15	0.15	0.15
1.70–1.90	0.07	0.07	0.10	0.12	0.15	0.15	0.15
1.90–2.40	0.09	0.09	0.10	0.12	0.15	0.15	0.15
2.40–2.76	0.10	0.10	0.12	0.12	0.18	0.18	0.18
2.76–3.17	0.11	0.11	0.12	0.12	0.18	0.18	0.18
3.17–3.55	0.11	0.11	0.12	0.12	0.18	0.25	0.30
3.55–4.35	0.15	0.15	0.20	0.20	0.22	0.30	0.35
4.35–5.15	0.18	0.18	0.25	0.25	0.27	0.35	0.40
5.15–6.30	0.23	0.23	0.28	0.27	0.33	0.40	0.45
6.30–8.00	0.33	0.33	0.33	0.33	0.38	0.45	0.50
8.00–11.10	0.48	0.48	0.48	0.48	0.50	0.50	0.58
11.10–15.75	0.63	0.63	0.63	0.63	0.63	0.63	0.63
15.75–22.20	0.75	0.75	0.75	0.75	0.75	0.75	0.75
22.20–28.50	0.89	0.88	0.88	0.88	0.88	0.88	0.88
28.50–34.90	1.00	1.00	1.00	1.00	1.00	1.00	1.00
34.90–41.25	1.14	1.14	1.14	1.14	1.14	1.14	1.14
41.25–47.60	1.32	1.32	1.32	1.32	1.32	1.32	1.32
47.60–57.15	1.52	1.52	1.52	1.52	1.52	1.52	1.52
57.15–69.85	1.90	1.90	1.90	1.90	1.90	1.90	1.90
69.85–76.20	2.28	2.25	2.25	2.25	2.25	2.25	2.25
76.20–100.00	2.79	2.75	2.75	2.75	2.75	2.75	2.75
100.00–125.00	3.15	3.15	3.15	3.15	3.15	3.15	3.15
125.00–150.00	3.40	3.40	3.40	3.40	3.40	3.40	3.40

[A] When a dimension tolerance is specified other than as an equal bilateral tolerance, the value of the standard tolerance is that applying to the mean of maximum and minimum dimensions permissible under the tolerance.

TABLE 6 Width Tolerances—Magnesium Flat Sheet[A]

Specified Thickness, in.	Width tolerances, in. ±				
	Specified Widths up through 4	Over 4 through 18	Over 18 through 36	Over 36 through 54	Over 54 through 72
0.016–0.064	1/32	1/16	3/32	1/8	5/32
0.065–0.102	1/16	1/16	3/32	1/8	5/32
0.103–0.249	1/8	3/32	1/8	3/16	3/16

[A] 0.016–0.099 sheared to above tolerances.
0.100–0.249 sawed or sheared to above tolerances.

TABLE 7 Width Tolerances, Magnesium Flat Sheet [Metric][A]

Specified Thickness, mm Over Through	Width tolerances, mm±				
	Specified Widths up Through 100	Over 100 Through 450	Over 450 Through 900	Over 900 Through 1350	Over 1350 Through 1850
0.40–1.60	1.0	1.5	2.5	3	4
1.60–2.60	1.5	1.5	2.5	3	4
2.60–6.30	3.0	2.5	3.0	5	5

[A] Over 0.40 through 2.50 sheared to above tolerances. Over 2.50 through 6.30 sawed or sheared to above tolerances.

TABLE 8 Width and Length Tolerances—Magnesium Sawed Flat Plate

Specified Thickness, in.	Tolerances, in. ± specified width[A] or length, in.			
	Up through 10	Over 10 through 48	Over 48 through 84	Over 84
0.250–6.000	3/32	3/16	1/4	5/16

[A] Maximum width = 72 in.

TABLE 9 Width and Length Tolerances, Magnesium Sawed Flat Plate [Metric]

Specified Thickness, mm Over Through	Tolerances, mm ± specified width[A] or length			
	Up Through 250	Over 250 Through 1200	Over 1200 Through 2000	Over 2000
6.30–150.0	2.5	5	6.5	8

[A] Maximum width = 1850 mm.

TABLE 10 Width Tolerances—Magnesium Coiled Sheet

Specified Thickness, in.	Width Tolerances, in. ±				
	Specified Widths up through 6	Over 6 through 12	Over 12 through 24	Over 24 through 48	Over 48 through 60
0.016–0.125	0.010	0.016	1/32	3/64	1/16

section, ¼-in. [41.25 mm] diameter by 1-in. [20.00 mm] gage length; grip ends, ⅜-in. [9.5 mm] diameter; total length, 2⅜in. [60.3 mm] with shouldered ends, 3 in. [76.2 mm] with threaded ends, and 4 in. [101.6 mm] if tested with plain cylindrical ends. If material less than ¾ in. [19.0 mm] in width is tested in full section because the specimens in Fig. 9 cannot be used, the elongation shall not be determined.

11. Methods of Chemical Analysis

11.1 Any suitable method of chemical analysis may be used. In case of dispute, the analysis shall be made by methods given in Methods E 35 or any other standard methods of analysis approved by ASTM unless some other method is agreed upon.

12. Methods of Tension Testing

12.1 *Tension Tests*—The tension tests shall be made in accordance with Test Methods B 557 [B 557M].

NOTE 1—The values obtained for the tensile properties covered by this