Designation: ~~B90/B90M – 15~~ B90/B90M – 21

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

This standard is issued under the fixed designation B90/B90M; 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 U.S. 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.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

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:*[2]

B557 Test Methods for Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products
B557M Test Methods for Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products (Metric)
B660 Practices for Packaging/Packing of Aluminum and Magnesium Products
B666/B666M Practice for Identification Marking of Aluminum and Magnesium Products
B954 Test Method for Analysis of Magnesium and Magnesium Alloys by Atomic Emission Spectrometry
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
E55 Practice for Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition

[1] This specification is under the jurisdiction of ASTM Committee B07 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] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

***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~~
~~ZE10A~~	~~. . .~~	~~. . .~~	~~0.12-0.22~~	~~1.0-1.5~~	~~. . .~~	~~. . .~~	~~. . .~~	~~. . .~~	~~. . .~~	~~. . .~~	~~. . .~~	~~0.30~~	~~Remainder~~

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
ZE10A	. . .	. . .	0.12–0.22	1.0–1.5	. . .	. . .	. . .	. . .	. . .	. . .	. . .	0.30	Remainder

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

2.3 *Federal Standards:*[3]
Fed. Std. No. 123 Marking for Shipment (Civil Agencies)
~~Fed. Std. No. 184 Identification Marking of Aluminum, Magnesium and Titanium~~
2.4 *Military Standards:*[3]
MIL-STD-129 Marking for Shipment and Storage
2.5 *Aerospace Materials Specification:*[4]
AMS-M-3171 Magnesium Alloy, Processes for Pretreatment and Prevention of Corrosion
2.6 *ANSI ~~Standards~~Standards:*[5]
ANSI H35.2 American National Standard Dimensional Tolerances for Aluminum Mill Products
ANSI ~~H32.2 (M)~~H35.2M American National Standard Dimensional Tolerances for Aluminum Mill Products

3. Terminology

3.1 *Definitions:*

3.1.1 *plate, n*—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, n*—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, ~~lbs,~~lbs or ~~[kg]~~[kg],

4.1.2 Alloy (Section 5 and Table 1),

4.1.3 Temper (Section 6 and Table 2),

[3] Available from ~~Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D,~~ DLA Document Services, Building 4/D, 700 Robbins Ave., Philadelphia, PA ~~19111-5098, http://www.dodssp.daps.mil.~~ 19111-5094, http://quicksearch.dla.mil.
[4] Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA ~~15096-0001,~~15096, http://www.sae.org.
[5] Available from ~~Americal~~American National Standards ~~Institute, 11 West 42~~Institute (ANSI), 25 W.~~nd~~ ~~Street,~~ 43rd St., 4th Floor, New York, NY ~~10036.~~10036, http://www.ansi.org.

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 E29.

Alloy and Temper	Specified Thickness, in.	Tensile Strength, min, ksi	Yield Strength (0.2 % Offset), min, ksi	Elongation in 2 in., or ~~4 x dia~~4x dia min, %
~~AZ31B-O~~ AZ31B-O	~~0.016–0.500~~ 0.016–0.500	~~32.0[A]~~ 32.0[A]	~~...~~ ...	~~12~~ 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
ZE10A-O	0.016-0.066	30.0	18.0	15
	0.067-0.250	30.0	15.0	15
	0.251-0.500	29.0	12.0	12

[A] Tensile strength shall be 40.0 ksi max.

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).

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 another agreement is made 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 ANSI ~~H35.2/ANSI 35.2(M)~~ H35.2 [ANSI 35.2M] Table 7.7a.

7.2 Variations from the specified width shall not exceed the amounts prescribed in ANSI ~~35.2/ANSI 35.2(M)~~ 35.2 [ANSI 35.2M] Tables 7.8, ~~7.10~~7.10, and 7.11.

7.3 Variations from the specified length shall not exceed the amounts prescribed in ANSI ~~H35.2/ ANSI H35.2(M)~~35.2 [ANSI 35.2M] Tables 7.9 and 7.10.

7.4 Squareness of sheet and plate shall conform to the requirements of ANSI ~~H35.2/ ANSI H35.2(M)~~35.2 [ANSI 35.2M] Table 7.14.

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 V *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
ZE10A-O	0.41	1.52	207		124	15	
	1.53	6.35	207		103	15	
	6.36	12.7	200		83	12	

[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 E29.
[C] Elongation in 50 mm apply for thicknesses up through 12.50 mm and in 5× diameter (5.65 V *A*) for thicknesses over 12.50 mm where *A* is the cross-sectional area of the specimen.

7.5 Flatness of sheet and plate shall conform to the requirements of Table 4 [Table 5].

7.6 Lateral bow of sheet and plate shall conform to the requirements of ANSI ~~H35.2/ ANSI H35.2(M)~~35.2 [ANSI 35.2M] Tables 7.12 and 7.13.

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,

TABLE 4 Flatness Tolerances—Magnesium Flat Sheet and Plate

Specified Thickness, in.	Maximum Variation from Flat,[A] in.			
	AZ31B (-0 and -H24 tempers) and ZE10A-O		AZ31B (-H26 temper)	
	In any 1 ft[B]	In any 3 ft[B]	In any 1 ft[B]	In any 3 ft[B]
Under 0.126		commercially flat		
0.126–0.250	0.020	0.030	0.020	0.030
0.251–0.500	0.024	0.036	0.025	0.038
0.501–1.000	0.030	0.045	0.050	0.075
1.001–2.000	0.040	0.060	0.050	0.075

[A] As measured with the plate resting on a flat surface, concave side upward, using a straightedge and a feeler gauge, dial gauge, or scale.
[B] Standard measurement is on the 3-ft basis. Widths and lengths less than 3 ft, but more than 1 ft, have tolerances proportionately less than those for 3 ft, but not smaller than for any 1 ft. Widths and lengths less than 1 ft have tolerances proportionately less than those for any 1 ft.

TABLE 5 Flatness Tolerances, Magnesium Flat Sheet and Plate [Metric]

Specified Thickness, mm Over Through	Maximum Variation from Flat[A] mm			
	AZ31B (–O and H24 Tempers)		AZ31B (–H26 Temper)	
	In Any 300 mm[B]	In Any 900 mm[B]	In Any 300 mm[B]	In Any 900 mm[B]
0–3.20				
3.20–6.30	0.50	0.75	0.50	0.75
6.30–12.50	0.60	0.90	0.63	0.95
12.50–25.00	0.75	1.10	1.25	1.90
25.00–50.00	1.00	1.50	1.25	1.90

[A] As measured with the plate resting on a flat surface, concave side upward, using a straightedge and a feeler gauge, dial gauge, or scale.
[B] Standard measurement is on the 900 mm basis. Widths and lengths less than 900 mm but more than 300 mm have tolerances proportionately less than those for 900 mm, 900 mm, but not smaller than for any 300 mm. 300 mm. Widths and lengths less than 300 mm 300 mm have tolerances proportionately less than those for any 300 mm. 300 mm.

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 Practice E55. 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 Figure Fig. 6 of Test Methods B557 [B557M] shall be used, or for plate 0.500 in. [12.5 mm] and over those in Figure Fig. 9 of Test Methods B557 [B557M] shall be used. If it is necessary to use specimens smaller than the standard specimens, they shall have dimensions proportional to those of Figure Fig. 9 of Test Methods B557 [B557M] but not less than the following dimensions: reduced section, ¼-in. [41.25-mm] [41.25 mm] diameter by 1-in. [20.00-mm] [20.00 mm] gauge length; grip ends, ⅜-in. [9.5-mm] [9.5 mm] diameter; total length, 2⅜ in. in. [60.3 mm] with shouldered ends, 3 in. [76.2 mm] [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] [19.0 mm] in width is tested in full section because the specimens in Figure Fig. 9 of Test Methods B557 [B557M] cannot be used, the elongation shall not be determined.