Designation: ~~B26/B26M – 14ε1~~ B26/B26M – 18

Standard Specification for Aluminum-Alloy Sand Castings[1]

This standard is issued under the fixed designation B26/B26M; 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.

~~ε[1] NOTE—Table 1 was updated in February 2015 to include footnotes E, F, and G.~~

1. Scope*

1.1 This specification[2] covers aluminum-alloy sand castings designated as shown in Table 1.

1.2 This specification is for aluminum-alloy sand castings used in general purpose applications. It may not address the mechanical properties, integrity testing, and verification required for highly loaded or safety critical applications.

1.3 Alloy and temper designations are in accordance with ANSI H35.1/H35.1M. ~~Unified Numbering System alloy designations are in accordance with Practice E527.~~

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

1.5 For acceptance criteria for inclusion of new aluminum and aluminum alloys and their properties in this specification, see Annex A1 and Annex A2.

1.6 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard.

1.7 *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~~ safety, health, and ~~health~~environmental practices and determine the applicability of regulatory limitations prior to use.*

1.8 *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:*[3]

B179 Specification for Aluminum Alloys in Ingot and Molten Forms for Castings from All Casting Processes
B275 Practice for Codification of Certain Zinc, Tin and Lead Die Castings
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
B881 Terminology Relating to Aluminum- and Magnesium-Alloy Products
B917/B917M Practice for Heat Treatment of Aluminum-Alloy Castings from All Processes

[1] This specification is under the jurisdiction of ASTM Committee B07 on Light Metals and Alloys and is the direct responsibility of Subcommittee B07.01 on Aluminum Alloy Ingots and Castings.

Current edition approved ~~Oct. 1, 2014~~May 15, 2018. Published ~~October 2014~~June 2018. Originally approved in 1918. Last previous edition approved in ~~2012~~2014 as ~~B26/B26M – 12~~.B26/B26M – 14ε1. DOI: ~~10.1520/B0026_B0026M-14E01~~.10.1520/B0026_B0026M-18.

[2] For ASME Boiler and Pressure Vessel Code applications see related Specification SB-26/SB-26M in Section II of that Code.

[3] 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**

B985 Practice for Sampling Aluminum Ingots, Billets, Castings and Finished or Semi-Finished Wrought Aluminum Products for Compositional Analysis
~~B917/B917M Practice for Heat Treatment of Aluminum-Alloy Castings from All Processes~~
D3951 Practice for Commercial Packaging
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
E34 Test Methods for Chemical Analysis of Aluminum and Aluminum-Base Alloys (Withdrawn 2017)[4]
~~E94~~E94/E94M Guide for Radiographic Examination Using Industrial Radiographic Film
E155 Reference Radiographs for Inspection of Aluminum and Magnesium Castings
~~E165~~E165/E165M Practice for Liquid Penetrant Examination for General Industry
~~E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)~~
E607 Test Method for Atomic Emission Spectrometric Analysis Aluminum Alloys by the Point to Plane Technique Nitrogen Atmosphere (Withdrawn 2011)[4]
E716 Practices for Sampling and Sample Preparation of Aluminum and Aluminum Alloys for Determination of Chemical Composition by Spark Atomic Emission Spectrometry
E1251 Test Method for Analysis of Aluminum and Aluminum Alloys by Spark Atomic Emission Spectrometry
E2422 Digital Reference Images for Inspection of Aluminum Castings
IEEE/ASTM SI 10 Standard for Use of the International System of Units (SI): The Modern Metric System

2.3 *AMS Standard:*[5]
AMS 2771 Heat Treatment of Aluminum Alloy Castings

2.4 *American National Standards:*[6]
H35.1/H35.1(M) Alloy and Temper Designation System for Aluminum

2.5 *Military Standards:*[7]
MIL-STD-129 Marking for Shipment and Storage
MIL-STD-276 Impregnation of Porous Nonferrous Metal Castings
NAVSEA Technical Publication S9074-AR-GIB-010/278

2.6 *Federal Standard:*[7]
Fed. Std. No. 123 Marking for Shipment (Civil Agencies)

2.7 *Aluminum Association Standard:*[6]
Designations and Chemical Composition Limits for Aluminum Alloys in the Form of Castings and Ingot (The Pink Sheets)

2.8 *Other Standards:*[8]
EN 14242 Aluminum and Aluminum ~~Alloys — Chemical Analysis — Inductively~~Alloys—Chemical Analysis—Inductively Coupled Plasma Optical Emission Spectral Analysis

3. Terminology

~~3.1 *Definitions*—Refer to Terminology B881 for definitions of product terms used in this specification.~~

3.1 *Definitions:*
3.1.1 Refer to Terminology B881 for definitions of product terms used in this specification.
~~3.2 *sand casting*—a metal object produced by pouring molten metal into a sand mold and allowing it to solidify.~~

3.2 *Definitions of Terms Specific to This Standard:*
3.2.1 *sand casting, n*—a metal object produced by pouring molten metal into a sand mold and allowing it to solidify.

4. Ordering Information

4.1 Orders for material under this specification shall include the following information (1.4 and 1.5):
4.1.1 This specification designation (which includes the number, year, and revision letter, if applicable),

NOTE 1—For inch-pound application, specify Specification B26 and for metric application specify Specification B26M. Do not mix units.

4.1.2 The quantity in either pieces or pounds [kilograms],
4.1.3 Alloy (Section 7 and Table 1),
4.1.4 Temper (Section 10 and Table 2), and
4.1.5 Applicable drawing or part number,

[4] The last approved version of this historical standard is referenced on www.astm.org.
[5] Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, http://www.sae.org.
[6] Available from Aluminum Association, Inc., ~~1525 Wilson Blvd., Suite 600,~~1400 Crystal Drive Suite 430 Arlington, VA ~~22209, http://www.aluminum.org/bookstore.~~22202 http://www.aluminum.org.
[7] Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://www.dodssp.daps.mil.
[8] Available from European Committee for Standardization (CEN), 36 rue de Stassart, B-1050, Brussels, Belgium, http://www.cenorm.be.

TABLE 1 Chemical Composition Limits

NOTE 1—When single units are shown, these indicate the maximum amounts permitted.

NOTE 2—Analysis shall be made for the elements for which limits are shown in this table.

NOTE 3—The following applies to all specified limits in this table: For purposes of determining conformance to these limits, an observed value or a calculated value obtained from analysis shall be rounded to the nearest unit in the last right-hand place of figures used in expressing the specified limit in accordance with the rounding method of Practice E29.

Alloy		Aluminum	Composition, (Values in Weight Percent)											Others[F]	
ANSI[E]	UNS		Silicon	Iron	Copper	Manganese	Magnesium	Chromium	Nickel	Zinc	Tin	Titanium	Each	Total[G]
201.0	A02010	remainder	0.10	0.15	4.0–5.2	0.20–0.50	0.15–0.55	...	...	...	...	0.15–0.35	0.05[A]	0.10
204.0	A02040	remainder	0.20	0.35	4.2–5.0	0.10	0.15–0.35	...	0.05	0.10	0.05	0.15–0.30	0.05	0.15
242.0	A02420	remainder	0.7	1.0	3.7–4.5	0.35	1.2–1.8	0.25	1.7–2.3	0.35	...	0.25	0.05	0.15
A242.0	A12420	remainder	0.6	0.8	3.7–4.5	0.10	1.2–1.7	0.15–0.25	1.8–2.3	0.10	...	0.07–0.20	0.05	0.15
295.0	A02950	remainder	0.7–1.5	1.0	4.0–5.0	0.35	0.03	...	...	0.35	...	0.25	0.05	0.15
319.0	A03190	remainder	5.5–6.5	1.0	3.0–4.0	0.50	0.10	...	0.35	1.0	...	0.25	...	0.50
328.0	A03280	remainder	7.5–8.5	1.0	1.0–2.0	0.20–0.6	0.20–0.6	0.35	0.25	1.5	...	0.25	...	0.50
355.0	A03550	remainder	4.5–5.5	0.6[B]	1.0–1.5	0.50[B]	0.40–0.6	0.25	...	0.35	...	0.25	0.05	0.15
C355.0	A33550	remainder	4.5–5.5	0.20	1.0–1.5	0.10	0.40–0.6	...	...	0.10	...	0.20	0.05	0.15
356.0	A03560	remainder	6.5–7.5	0.6[B]	0.25	0.35[B]	0.20–0.45	...	...	0.35	...	0.25	0.05	0.15
A356.0	A13560	remainder	6.5–7.5	0.20	0.20	0.10	0.25–0.45	...	...	0.10	...	0.20	0.05	0.15
443.0	A04430	remainder	4.5–6.0	0.8	0.6	0.50	0.05	0.25	...	0.50	...	0.25	...	0.35
B443.0	A24430	remainder	4.5–6.0	0.8	0.15	0.35	0.05	...	...	0.35	...	0.25	0.05	0.15
512.0	A05120	remainder	1.4–2.2	0.6	0.35	0.8	3.5–4.5	0.25	...	0.35	...	0.25	0.05	0.15
514.0	A05140	remainder	0.35	0.50	0.15	0.35	3.5–4.5	...	...	0.15	...	0.25	0.05	0.15
520.0	A05200	remainder	0.25	0.30	0.25	0.15	9.5–10.6	...	...	0.15	...	0.25	0.05	0.15
535.0	A05350	remainder	0.15	0.15	0.05	0.10–0.25	6.2–7.5	...	...	...	...	0.10–0.25	0.05[C]	0.15
705.0	A07050	remainder	0.20	0.8	0.20	0.40–0.6	1.4–1.8	0.20–0.40	...	2.7–3.3	...	0.25	0.05	0.15
707.0	A07070	remainder	0.20	0.8	0.20	0.40–0.6	1.8–2.4	0.20–0.40	...	4.0–4.5	...	0.25	0.05	0.15
710.0[D]	A07100	remainder	0.15	0.50	0.35–0.65	0.05	0.6–0.8	...	...	6.0–7.0	...	0.25	0.05	0.15
712.0[D]	A07120	remainder	0.30	0.50	0.25	0.10	0.50–0.65	0.40–0.6	...	5.0–6.5	...	0.15–0.25	0.05	0.20
713.0	A07130	remainder	0.25	1.1	0.40–1.0	0.6	0.20–0.50	0.35	0.15	7.0–8.0	...	0.25	0.10	0.25
771.0	A07710	remainder	0.15	0.15	0.10	0.10	0.8–1.0	0.06–0.20	...	6.5–7.5	...	0.10–0.20	0.05	0.15
850.0	A08500	remainder	0.7	0.7	0.7–1.3	0.10	0.10	...	0.7–1.3	...	5.5–7.0	0.20	...	0.30

Alloy		Alumi-num	Composition, (Values in Weight Percent)										Others[E]	
ANSI[E]	UNS		Silicon	Iron	Copper	Man-ganese	Magne-sium	Chro-mium	Nickel	Zinc	Tin	Titanium	Each	Total[G]
851.0[D]	A08510	remain-der	2.0–3.0	0.7	0.7–1.3	0.10	0.10	...	0.30–0.7	...	5.5–7.0	0.20	...	0.30
852.0[D]	A08520	remain-der	0.40	0.7	1.7–2.3	0.10	0.6–0.9	...	0.9–1.5	...	5.5–7.0	0.20	...	0.30

TABLE 1 Chemical Composition Limits[A,B,C,D]

Desig.[J]	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ti	Ag	Be	Pb	Sn	Zr	-	FNs	OTHERS[E]		Al Min.
																	Each	Total[F]	
201.0	0.10	0.15	4.0–5.2	0.20–0.50	0.15–0.55	...	...	...	0.15–0.35	0.40–1.0	...	...	...	...	...	...	0.05	0.10	Rem.
204.0	0.20	0.35	4.2–5.0	0.10	0.15–0.35	...	0.05	0.10	0.15–0.30	...	...	...	0.05	...	...	...	0.05	0.15	Rem.
242.0	0.7	1.0	3.5–4.5	0.35	1.2–1.8	0.25	1.7–2.3	0.35	0.25	...	...	...	...	...	...	...	0.05	0.15	Rem.
A242.0	0.6	0.8	3.7–4.5	0.10	1.2–1.7	0.15–0.25	1.8–2.3	0.10	0.07–0.20	...	...	...	...	...	...	...	0.05	0.15	Rem.
295.0	0.7–1.5	1.0	4.0–5.0	0.35	0.03	...	...	0.35	0.25	...	...	...	...	...	...	...	0.05	0.15	Rem.
319.0	5.5–6.5	1.0	3.0–4.0	0.50	0.10	...	0.35	1.0	0.25	...	...	...	...	...	...	...	...	0.50	Rem.
328.0	7.5–8.5	1.0	1.0–2.0	0.20–0.6	0.20–0.6	0.35	0.25	1.5	0.25	...	...	...	...	...	...	...	...	0.50	Rem.
355.0	4.5–5.5	0.6[G]	1.0–1.5	0.50[G]	0.40–0.6	0.25	...	0.35	0.25	...	...	...	...	...	...	...	0.05	0.15	Rem.
C355.0	4.5–5.5	0.20	1.0–1.5	0.10	0.40–0.6	...	...	0.10	0.20	...	...	...	...	...	...	...	0.05	0.15	Rem.
356.0	6.5–7.5	0.6[G]	0.25	0.35[G]	0.20–0.45	...	...	0.35	0.25	...	...	...	...	...	...	...	0.05	0.15	Rem.
A356.0	6.5–7.5	0.20	0.20	0.10	0.25–0.45	...	...	0.10	0.20	...	...	...	...	...	...	...	0.05	0.15	Rem.
443.0	4.5–6.0	0.8	0.6	0.50	0.05	0.25	...	0.50	0.25	...	...	...	...	...	...	...	...	0.35	Rem.
B443.0	4.5–6.0	0.8	0.15	0.35	0.05	...	...	0.35	0.25	...	...	...	...	...	...	...	0.05	0.15	Rem.
512.0	1.4–2.2	0.6	0.35	0.8	3.5–4.5	0.25	...	0.35	0.25	...	...	...	...	...	...	...	0.05	0.15	Rem.
514.0	0.35	0.50	0.15	0.35	3.5–4.5	...	...	0.15	0.25	...	...	...	...	...	...	...	0.05	0.15	Rem.
520.0	0.25	0.30	0.25	0.15	9.5–10.6	...	...	0.15	0.25	...	...	...	...	...	...	...	0.05	0.15	Rem.
535.0	0.15	0.15	0.05	0.10–0.25	6.2–7.5	...	...	...	0.10–0.25	...	0.003–0.007	...	...	...	0.005B	...	0.05	0.15	Rem.
705.0	0.20	0.8	0.20	0.40–0.6	1.4–1.8	0.20–0.40	...	2.7–3.3	0.25	...	...	...	...	...	...	...	0.05	0.15	Rem.
707.0	0.20	0.8	0.20	0.40–0.6	1.8–2.4	0.20–0.40	...	4.0–4.5	0.25	...	...	...	...	...	...	...	0.05	0.15	Rem.
710.0[I]	0.15	0.50	0.35–0.6	0.05	0.6–0.8	...	...	6.0–7.0	0.25	...	...	...	...	...	...	...	0.05	0.15	Rem.
712.0[I]	0.30	0.50	0.25	0.10	0.50–0.65[H]	0.40–0.6	...	5.0–6.5	0.15–0.25	...	...	...	...	...	...	...	0.05	0.20	Rem.
713.0	0.25	1.1	0.40–1.0	0.6	0.20–0.50	0.35	0.15	7.0–8.0	0.25	...	...	...	...	...	...	...	0.10	0.25	Rem.
771.0	0.15	0.15	0.10	0.10	0.8–1.0	0.06–0.20	...	6.5–7.5	0.10–0.20	...	...	...	...	...	...	...	0.05	0.15	Rem.
850.0	0.7	0.7	0.7–1.3	0.10	0.10	...	0.7–1.3	...	0.20	...	...	...	5.5–7.0	...	...	...	...	0.30	Rem.
851.0[I]	2.0–3.0	0.7	0.7–1.3	0.10	0.10	...	0.30–0.7	...	0.20	...	...	...	5.5–7.0	...	...	...	...	0.30	Rem.
852.0[I]	0.40	0.7	1.7–2.3	0.10	0.6–0.9	...	0.9–1.5	...	0.20	...	...	...	5.5–7.0	...	...	...	...	0.30	Rem.

[A] ~~Contains silver 0.40–1.0 %.~~ When single units are shown, they indicate the maximum amounts permitted.

[B] ~~If iron exceeds 0.45 %, manganese content shall not be less than one half of the iron content.~~ Analysis shall be made for the elements for which limits are shown in this table.

[C] ~~Contains beryllium 0.003–0.007 %, boron 0.005 % max.~~

[D] ~~710.0 formerly A712.0, 712.0 formerly D712.0, 851.0 formerly A850.0, 852.0 formerly B850.0.~~

[C] ~~ASTM alloy designations are recorded in~~ The following applies to all specified limits in this table: For purposes of determining conformance to these limits, an observed value or a calculated value obtained from analysis shall be rounded to the nearest unit in the last right-hand place of figures used in expressing the specified limit in accordance with the rounding-off method of Practice ~~B275~~E29.

[D] In case of discrepancy between the values listed in Table 1 and those listed in the "Designations and Composition Limits for Aluminum Alloys in the Form of Castings and Ingot (known as the 'Pink Sheets')", the composition limits registered with the Aluminum Association and published in the "Pink Sheets" should shall be considered the controlling composition.

[E] ~~"Others"~~ "Others" includes listed elements for which no specific limit is shown as well as unlisted metallic elements. The producer may analyze samples for trace elements not specified in the specification. However, such analysis is not required and may not cover all metallic "Others" elements. Should any analysis by the producer or the purchaser establish that an ~~"Others"~~"Others" element exceeds the limit of "Each" or that the aggregate of several "Others" elements exceeds the limit of "Total," the material shall be considered nonconforming.

[F] ~~Other Elements–Total~~ Other Elements—Total shall be the sum of unspecified metallic elements ~~0.010 %~~ 0.010 % or more, rounded to the second decimal before determining the sum.

[G] If iron exceeds 0.45, manganese content shall not be less than one-half iron content.

[H] The Aluminum Association ruling on the number of decimal places to which Mg percent is expressed is exempted for some long standing alloys. See A2.2.6.

[I] 710.0 formerly A712.0, 712.0 formerly D712.0, 851.0 formerly A850.0, 852.0 formerly B850.0.

[J] For a cross reference of current and former alloy designations see the Aluminum Association's "Designations and Composition Limits for Aluminum Alloys in the Form of Castings and Ingot (known as the 'Pink Sheets')".

TABLE 2 Tensile Requirements[A,B] (Inch-Pound Units)

~~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~~Designation[E]	Temper[B,C]	Tensile Strength, min, ksi	Yield Strength (0.2 % offset), min, ksi	Elongation in 2 in. or 4 x diameter, min, %	Typical Brinell ~~Hardness~~ Hardness,[C,D] 500 kgf, ~~10~~10 mm ~~mm~~	
~~ANSI[D]~~	~~UNS~~					
~~201.0~~	~~A02010~~	~~T7~~	~~60.0~~	~~50.0~~	~~3.0~~	~~...~~
201.0	T7	60.0	50.0	3.0	. . .	
~~204.0~~	~~A02040~~	~~T4~~	~~45.0~~	~~28.0~~	~~6.0~~	~~...~~
204.0	T4	45.0	28.0	6.0	. . .	
~~242.0~~	~~A02420~~	~~O[E]~~	~~23.0~~	~~[F]~~	~~[F]~~	~~70~~
242.0	O[F]	23.0	[G]	[G]	70	
		~~T61~~	~~32.0~~	~~20.0~~	~~[F]~~	~~105~~
		T61	32.0	20.0	[G]	105
~~A242.0~~	~~A12420~~	~~T75~~	~~29.0~~	~~[F]~~	~~1.0~~	~~75~~
A242.0	T75	29.0	[G]	1.0	75	
~~295.0~~	~~A02950~~	~~T4~~	~~29.0~~	~~13.0~~	~~6.0~~	~~60~~
295.0	T4	29.0	13.0	6.0	60	
		T6	32.0	20.0	3.0	75
		~~T62~~	~~36.0~~	~~28.0~~	~~[F]~~	~~95~~
		T62	36.0	28.0	[G]	95
		T7	29.0	16.0	3.0	70
~~319.0~~	~~A03190~~	~~F~~	~~23.0~~	~~13.0~~	~~1.5~~	~~70~~
		~~T5~~	~~25.0~~	~~[F]~~	~~[F]~~	~~80~~
		~~T6~~	~~31.0~~	~~20.0~~	~~1.5~~	~~80~~
319.0	F	23.0	13.0	1.5	70	
	T5	25.0	[G]	[G]	80	
	T6	31.0	20.0	1.5	80	
~~328.0~~	~~A03280~~	~~F~~	~~25.0~~	~~14.0~~	~~1.0~~	~~60~~
		~~T6~~	~~34.0~~	~~21.0~~	~~1.0~~	~~80~~
328.0	F	25.0	14.0	1.0	60	
	T6	34.0	21.0	1.0	80	
~~355.0~~	~~A03550~~	~~T6~~	~~32.0~~	~~20.0~~	~~2.0~~	~~80~~
		~~T51~~	~~25.0~~	~~18.0~~	~~[F]~~	~~65~~
		~~T71~~	~~30.0~~	~~22.0~~	~~[F]~~	~~75~~
355.0	T6	32.0	20.0	2.0	80	
	T51	25.0	18.0	[G]	65	
	T71	30.0	22.0	~~G~~	75	
~~C355.0~~	~~A33550~~	~~T6~~	~~36.0~~	~~25.0~~	~~2.5~~	~~...~~
C355.0	T6	36.0	25.0	2.5	. . .	
~~356.0~~	~~A03560~~	~~F~~	~~19.0~~	~~9.5~~	~~2.0~~	~~55~~
356.0	F	19.0	9.5	2.0	55	
		T6	30.0	20.0	3.0	70
		~~T7~~	~~31.0~~	~~[F]~~	~~[F]~~	~~75~~
		T7	31.0	[G]	[G]	75
		~~T51~~	~~23.0~~	~~16.0~~	~~[F]~~	~~60~~
		T51	23.0	16.0	[G]	60
		T71	25.0	18.0	3.0	60
~~A356.0~~	~~A13560~~	~~T6~~	~~34.0~~	~~24.0~~	~~3.5~~	~~80~~
		~~T61~~	~~35.0~~	~~26.0~~	~~1.0~~	~~...~~
A356.0	T6	34.0	24.0	3.5	80	
	T61	35.0	26.0	1.0	. . .	
~~443.0~~	~~A04430~~	~~F~~	~~17.0~~	~~7.0~~	~~3.0~~	~~40~~
443.0	F	17.0	7.0	3.0	40	
~~B443.0~~	~~A24430~~	~~F~~	~~17.0~~	~~6.0~~	~~3.0~~	~~40~~
~~512.0~~	~~A05120~~	~~F~~	~~17.0~~	~~10.0~~	~~...~~	~~50~~
B443.0	F	17.0	6.0	3.0	40	
512.0	F	17.0	10.0	. . .	50	
~~514.0~~	~~A05140~~	~~F~~	~~22.0~~	~~9.0~~	~~6.0~~	~~50~~
514.0	F	22.0	9.0	6.0	50	
~~520.0~~	~~A05200~~	~~T4~~	~~42.0~~	~~22.0~~	~~12.0~~	~~75~~
520.0	T4	42.0	22.0	12.0	75	
~~535.0~~	~~A05350~~	~~F~~	~~35.0~~	~~18.0~~	~~9.0~~	~~70~~
535.0	F	35.0	18.0	9.0	70	
~~705.0~~	~~A07050~~	~~T5~~	~~30.0~~	~~17.0[G]~~	~~5.0~~	~~65~~
705.0	T5	30.0	17.0[H]	5.0	65	
~~707.0~~	~~A07070~~	~~T7~~	~~37.0~~	~~30.0[G]~~	~~1.0~~	~~80~~
707.0	T7	37.0	30.0[H]	1.0	80	
~~710.0[H]~~	~~A07100~~	~~T5~~	~~32.0~~	~~20.0~~	~~2.0~~	~~75~~
710.0[I]	T5	32.0	20.0	2.0	75	
~~712.0[H]~~	~~A07120~~	~~T5~~	~~34.0~~	~~25.0[G]~~	~~4.0~~	~~75~~
712.0[I]	T5	34.0	25.0[H]	4.0	75	
~~713.0~~	~~A07130~~	~~T5~~	~~32.0~~	~~22.0~~	~~3.0~~	~~75~~
713.0	T5	32.0	22.0	3.0	75	

~~Alloy~~Designation[E]	Temper[B,C]	Tensile Strength, min, ksi	Yield Strength (0.2 % offset), min, ksi	Elongation in 2 in. or 4 x diameter, min, %	Typical Brinell ~~Hardness~~ Hardness,[G,D] 500 kgf, ~~10~~10 mm ~~mm~~	
~~ANSI[D]~~	~~UNS~~					
~~771.0~~	~~A07710~~	~~T5~~	~~42.0~~	~~38.0~~	~~1.5~~	~~100~~
771.0	T5	42.0	38.0	1.5	100	
		T51	32.0	27.0	3.0	85
		T52	36.0	30.0	1.5	85
		T6	42.0	35.0	5.0	90
		T71	48.0	45.0	2.0	120
~~850.0~~	~~A08500~~	~~T5~~	~~16.0~~	~~[F]~~	~~5.0~~	~~45~~
850.0	T5	16.0	[G]	5.0	45	
~~851.0[H]~~	~~A08510~~	~~T5~~	~~17.0~~	~~[F]~~	~~3.0~~	~~45~~
851.0[I]	T5	17.0	[G]	3.0	45	
~~852.0[H]~~	~~A08520~~	~~T5~~	~~24.0~~	~~18.0~~	~~[F]~~	~~60~~
852.0[I]	T5	24.0	18.0	[G]	60	

[A] If agreed upon between the manufacturer and the purchaser, other mechanical properties may be obtained by other heat treatments such as annealing, aging, or stress relieving.

[B] 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.

[C] Refer to ANSI H35.1/H35.1M, or both, for description of tempers.

[D] For information only, not required for acceptance.

[E] ASTM alloy designations are recorded in Practice B275.

[F] Formerly designated as ~~222.0-T2 and~~ 242.0-T21.

[G] Not required.

[H] Yield strength to be determined only when specified in the contract or purchase order.

[I] 710.0 formerly A712.0, 712.0 formerly D712.0, 851.0 formerly A850.0, 852.0 formerly B850.0.

4.2 Additionally, orders for material to this specification shall include the following information when required by the purchaser:

4.2.1 Whether chemical analysis and tensile property reports are required (Table 1 and Table 2),

4.2.2 Whether castings or test bars, or both, may be artificially aged for Alloys 705.0-T5, 707.0-T5, 712.0-T5, and 713.0-T5 (10.2) and whether yield strength tests are required for these alloys;

4.2.3 Whether test specimens cut from castings are required in addition to, or instead of, separately cast specimens (Sections 10 and 13);

4.2.4 Whether heat treatment is to be performed in accordance with AMS 2771 (see Section 15),

4.2.5 Whether repairs are permissible (16.1),

4.2.6 Whether inspection is required at the producer's works (Section 18);

4.2.7 Whether certification is required (21.1);

4.2.8 Whether surface requirements shall be checked against observational standards where such standards are established (19.1);

4.2.9 Whether liquid penetrant inspection is required (19.2);

4.2.10 Whether radiographic inspection is required and, if so, the radiographic grade of casting required (19.3, Table 3);

4.2.11 Whether foundry control is required (Section 9); and

4.2.12 Whether Practice B660 applies and, if so, the levels of preservation, packaging, and packing required (~~23.4~~24.4).

5. Quality Assurance

5.1 Unless otherwise specified in the contract or purchase order, the producer shall be responsible for the performance of all inspections and test requirements specified herein. Unless disapproved by the purchaser, the producer may use his own or any other suitable facilities for the performance of the inspection and test requirements specified herein. The purchaser shall have the right to perform any of the inspections and tests set forth in this specification where such inspections are deemed necessary to confirm that the material conforms to prescribed requirements.

6. Manufacture

6.1 The responsibility of furnishing castings that can be laid out and machined to the finished dimensions within the permissible variations specified, as shown on the blueprints or drawings, shall rest with the producer, except where pattern equipment is furnished by the purchaser.

7. Chemical Composition

7.1 The Product shall conform to the chemical composition limits prescribed in Table 1. Conformance shall be determined by the producer by taking samples at the time castings are poured in accordance with Practice E716 and analyzed in accordance with

TABLE 3 Discontinuity-Level Requirements for Aluminum Castings in Accordance with Film Reference Radiographs E155 or Digital Reference Radiographs E2422

Discontinuity	Radiograph	Section Thickness in. [mm]							
		Grade A[A]		Grade B		Grade C		Grade D	
		¼ [6.4]	¾ [19.0]	¼ [6.4]	¾ [19.0]	¼ [6.4]	¾ [19.0]	¼ [6.4]	¾ [19.0]
Gas holes	1.1	none		1	1	2	2	5	5
Gas porosity (round)	1.21	none		1	1	3	3	7	7
Gas porosity (elongated)	1.22	none		1	1	3	4	5	5
Shrinkage cavity	2.1	none		1	[B]	2	[B]	3	[B]
Shrinkage porosity or sponge	2.2	none		1	1	2	2	4	3
Foreign material (less dense material)	3.11	none		1	1	2	2	4	4
Foreign material (more dense material)	3.12	none		1	1	2	1	4	3
Segregation	3.2	none		none		none		none	
~~Cracks~~	~~...~~	~~none~~		~~none~~		~~none~~		~~none~~	
Cracks	...	none		none		none		none	
~~Cold shuts~~	~~...~~	~~none~~		~~none~~		~~none~~		~~none~~	
Cold shuts	...	none		none		none		none	
~~Surface irregularity~~	~~...~~	~~...~~				~~not to exceed drawing tolerance~~			
Surface irregularity	...	. . .				not to exceed drawing tolerance			
~~Core shift~~	~~...~~	~~...~~				~~not to exceed drawing tolerance~~			
Core shift	...	. . .				not to exceed drawing tolerance			

[A] Caution should be exercised in requesting Grade A.
[B] Not available.

Test Methods E607, E1251, or E34, or EN 14242. If the producer has determined the composition of the material during casting, they shall not be required to sample and analyze the finished product.

7.1.1 A sample for determination of chemical composition shall be taken to represent one of the following:

7.1.2 Not more than 4000 lb [2000 kg] of clean castings or a single casting poured from one furnace. ~~The maximum elapsed time between determinations shall be established for each alloy, but in any case the maximum elapsed time shall not exceed 8 h.~~

7.1.3 The maximum elapsed time between determinations shall be established for each alloy, but in any case the maximum elapsed time shall not exceed 8 h.

7.2 If it becomes necessary to analyze castings for conformance to chemical composition limits, the method used to sample castings for the determination of chemical composition shall be in accordance with Practice B985. Analysis shall be performed in accordance with Practice E716, Test Methods E34, E607, or E1251, or EN 14242 (ICP method).

8. Material Requirements—Castings Produced for Governmental and Military Agencies

8.1 Unless otherwise specified, only aluminum alloy conforming to the requirements of Specification B179 or producer's foundry scrap (identified as being made from alloy conforming to Specification B179) shall be used in the remelting furnace from which molten metal is taken for pouring directly into castings. Additions of small amounts of modifiers and grain refining elements or alloys are permitted.

8.1.1 Pure materials, recycled materials, and master alloys may be used to make alloys conforming to this specification, provided chemical analysis can be taken and adjusted to conform to Table 1 prior to pouring any castings.

9. Foundry Control—Castings Produced for Governmental or Military Agencies, or Both

9.1 When specified, castings shall be produced under foundry control approved by the purchaser. Foundry control shall consist of examination of castings by radiographic or other approved methods for determining internal discontinuities until the gating, pouring, and other foundry practices have been established to produce castings meeting the quality standards furnished by the purchaser or agreed upon between the purchaser and the producer. When foundry practices have been so established, the production method shall not be significantly changed without demonstrating to the satisfaction of the purchaser that the change does not adversely affect the quality of the castings. Minor changes in pouring temperature of ±50°F [±28°C] from the established nominal temperature are permissible.

10. Tensile Properties

10.1 The separately cast test specimens representing the castings shall meet the mechanical properties prescribed in Table 2.

10.2 Although Alloys 705.0, 707.0, 712.0, and 713.0 are most frequently used in the naturally aged condition, by agreement between the producer and the purchaser, the castings may be artificially aged to the T5 temper. The producer and the purchaser may also agree to base the acceptance of castings on artificially aged test bars. The conditions of artificial aging shown in Practice B917/B917M shall be employed unless other conditions are accepted by mutual consent.

10.3 When specified, the tensile strength, yield strength, and elongation values of specimens cut from castings shall be not less than 75 % of the tensile and yield strength values and not less than 25 % of the elongation values specified in Table 2 [Table 4].

TABLE 4 Tensile Requirements (SI Units)—[Metric][A,B]

~~NOTE 1—For purposes of determining conformance with this specification, each value for tensile strength and yield strength shall be rounded to the nearest 1 MPa and each value for elongation shall be rounded to the nearest 0.5 %, both in accordance with the rounding method of Practice E29.~~

~~Alloy~~Designation[F]	Temper[B,C]	Tensile Strength, min, MPa[D,K]	Yield Strength[K] (0.2 % offset), min, MPa[D,K]	Elongation in 5× diameter, min %	Typical Brinell Hardness,[E] 500 kgf, 10 mm	
~~ANSI[E]~~	~~UNS~~					
~~201.0~~	~~A02010~~	~~T7~~	~~415~~	~~345~~	~~3.0~~	~~...~~
201.0	T7	415	345	3.0	...	
~~204.0~~	~~A02040~~	~~T4~~	~~310~~	~~195~~	~~6.0~~	~~...~~
204.0	T4	310	195	6.0	...	
~~242.0~~	~~A02420~~	~~O[F]~~	~~160~~	~~[G]~~	~~[G]~~	~~70~~
242.0	O[G]	160	[H]	[H]	70	
		~~T61~~	~~220~~	~~140~~	~~[G]~~	~~105~~
		T61	220	140	[H]	105
~~A242.0~~	~~A12420~~	~~T75~~	~~200~~	~~[G]~~	~~1.0~~	~~75~~
A242.0	T75	200	[H]	1.0	75	
~~295.0~~	~~A02950~~	~~T4~~	~~200~~	~~90~~	~~6.0~~	~~60~~
295.0	T4	200	90	6.0	60	
		T6	220	140	3.0	75
		~~T62~~	~~250~~	~~195~~	~~[G]~~	~~95~~
		T62	250	195	[H]	95
		T7	200	110	3.0	70
~~319.0~~	~~A03190~~	~~F~~	~~160~~	~~90~~	~~1.5~~	~~70~~
319.0	F	160	90	1.5	70	
		~~T5~~	~~170~~	~~[G]~~	~~[G]~~	~~80~~
		T5	170	[H]	[H]	80
		T6	215	140	1.5	80
~~328.0~~	~~A03280~~	~~F~~	~~170~~	~~95~~	~~1.0~~	~~60~~
328.0	F	170	95	1.0	60	
		T6	235	145	1.0	80
~~355.0~~	~~A03550~~	~~T6~~	~~220~~	~~140~~	~~2.0~~	~~80~~
355.0	T6	220	140	2.0	80	
		~~T51~~	~~170~~	~~125~~	~~[G]~~	~~65~~
		T51	170	125	[H]	65
		~~T71~~	~~205~~	~~150~~	~~[G]~~	~~75~~
		T71	205	150	[H]	75
~~C355.0~~	~~A33550~~	~~T6~~	~~250~~	~~170~~	~~2.5~~	~~...~~
C355.0	T6	250	170	2.5	...	
~~356.0~~	~~A03560~~	~~F~~	~~130~~	~~65~~	~~2.0~~	~~55~~
356.0	F	130	65	2.0	55	
		T6	205	140	3.0	70
		~~T7~~	~~215~~	~~[G]~~	~~[G]~~	~~75~~
		T7	215	[H]	[H]	75
		~~T51~~	~~160~~	~~110~~	~~[G]~~	~~60~~
		T51	160	110	[H]	60
		T71	170	125	3.0	60
~~A356.0~~	~~A13560~~	~~T6~~	~~235~~	~~165~~	~~3.5~~	~~80~~
A356.0	T6	235	165	3.5	80	
		~~T61~~	~~245~~	~~180~~	~~1.0~~	~~...~~
		T61	245	180	1.0	...
~~443.0~~	~~A04430~~	~~F~~	~~115~~	~~50~~	~~3.0~~	~~40~~
443.0	F	115	50	3.0	40	
~~B443.0~~	~~A24430~~	~~F~~	~~115~~	~~40~~	~~3.0~~	~~40~~
B443.0	F	115	40	3.0	40	
~~512.0~~	~~A05120~~	~~F~~	~~115~~	~~70~~	~~...~~	~~50~~
512.0	F	115	70	...	50	
~~514.0~~	~~A05140~~	~~F~~	~~150~~	~~60~~	~~6.0~~	~~50~~
514.0	F	150	60	6.0	50	
~~520.0~~	~~A05200~~	~~T4~~	~~290~~	~~150~~	~~12.0~~	~~75~~
520.0	T4	290	150	12.0	75	
~~535.0~~	~~A05350~~	~~F~~	~~240~~	~~125~~	~~9.0~~	~~70~~
535.0	F	240	125	9.0	70	
~~705.0~~	~~A07050~~	~~T5~~	~~205~~	~~115[H]~~	~~5.0~~	~~65~~
705.0	T5	205	115[I]	5.0	65	
~~707.0~~	~~A07070~~	~~T7~~	~~255~~	~~205[H]~~	~~1.0~~	~~80~~
707.0	T7	255	205[I]	1.0	80	
~~710.0[J]~~	~~A07100~~	~~T5~~	~~220~~	~~140~~	~~2.0~~	~~75~~
710.0[J]	T5	220	140	2.0	75	
~~712.0[J]~~	~~A07120~~	~~T5~~	~~235~~	~~170[H]~~	~~4.0~~	~~75~~
712.0[J]	T5	235	170[I]	4.0	75	
~~713.0~~	~~A07130~~	~~T5~~	~~220~~	~~150~~	~~3.0~~	~~75~~
713.0	T5	220	150	3.0	75	
~~771.0~~	~~A07710~~	~~T5~~	~~290~~	~~260~~	~~1.5~~	~~100~~
771.0	T5	290	260	1.5	100	
		T51	220	185	3.0	85

~~Alloy~~Designation[F]	Temper[B,C]	Tensile Strength,[K] min, MPa[D]	Yield Strength[K] (0.2 % offset), min, MPa[D]	Elongation in 5× diameter, min %	Typical Brinell Hardness,[E] 500 kgf, 10 mm	
~~ANSI[E]~~	~~UNS~~					
		T52	250	205	1.5	85
		T6	290	240	5.0	90
		T71	330	310	2.0	120
~~850.0~~	~~A08500~~	~~T5~~	~~110~~	[G]	~~5.0~~	~~45~~
850.0	T5	110	[H]	5.0	45	
~~851.0[I]~~	~~A08510~~	~~T5~~	~~115~~	[G]	~~3.0~~	~~45~~
851.0[J]	T5	115	[H]	3.0	45	
~~852.0[I]~~	~~A08520~~	~~T5~~	~~165~~	~~125~~	[G]	~~60~~
852.0[J]	T5	165	125	[H]	60	

[A] If agreed upon between the manufacturer and the purchaser, other mechanical properties may be obtained by other heat treatments such as annealing, aging, or stress relieving.

[B] ~~Temper designations:~~ For

~~F As fabricated.~~ purposes of

~~O Annealed.~~ determining

~~T1 Cooled from an elevated temperature shaping process and naturally aged to a substantially stable condition.~~ conformance with this specification, each value for tensile strength and yield strength shall be rounded to

~~T4 Solution heat-treated and naturally aged to a substantially stable condition.~~

~~T5 Cooled from an elevated temperature shaping process and then artificially aged.~~

~~T6 Solution heat-treated and then artificially aged.~~

~~T7 Solution heat-treated and stabilized.~~

~~Additional digits, the first of which shall not be zero, may be added to designation T1 through T10 to indicate a variation in treatment that significantly alters the characteristics of the~~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~~product.~~.

[C] Refer to ANSI H35.1/H35.1M, or both, for description of tempers.

[D] For explanation of the SI unit "MPa" see Appendix X2.

[E] For information only, not required for acceptance.

[F] ASTM alloy designations are recorded in Practice B275.

[G] Formerly designated as ~~222.0-T2 and~~ 242.0-T21.

[H] Not required.

[I] ~~Yield~~ Yield strength to be determined only when specified in the contract or purchase order.

[J] ~~710.0~~710.0 formerly A712.0, 712.0 formerly D712.0, 851.0 formerly A850.0, 852.0 formerly B850.0.

[K] 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.

The measurement of the elongation is not required for test specimens cut from castings if 25 % of the specified minimum elongation value published in Table 2 [Table 4] is 0.5 % or less. If grade D quality castings as described in Table 3 are specified, no tensile tests shall be specified nor tensile requirements be met on specimens cut from castings.

11. Workmanship, Finish, and Appearance

11.1 The finished castings shall be uniform in composition and free of blowholes, cracks, shrinks, and other discontinuities except as designated and agreed upon as acceptable by the purchaser.

12. Number of Tests and Retests

12.1 Unless otherwise agreed upon between the purchaser and producer, a minimum of two tension test specimens shall be separately cast and tested to represent the following:

12.1.1 Not more than 4000 lb [2000 kg] of clean castings (gates and risers removed) or a single casting poured from one furnace.

12.1.2 The castings poured continuously from one furnace in not more than eight consecutive hours.

12.2 When tensile properties from castings are to be determined, one per melt-heat combination shall be tested unless otherwise shown on the drawing or specified in the purchase order.

12.3 If any test specimen shows defective machining or flaws, it may be discarded; in which case the purchaser and the producer shall agree upon the selection of another specimen in its stead.

12.4 If the results of the tension tests do not conform to the requirements prescribed in Table 2 [Table 4]; the test bars representative of the castings may be retested in accordance with the replacement tests and retest provisions of Test Methods B557 and B557M, and the results of retests shall conform to the requirements as to mechanical properties specified in Table 2 [Table 4].

13. Specimen Preparation

13.1 The recommended method for casting tension test specimens is shown in Fig. 1 [Fig. 2]. The tension test specimens shall be cast to size in sand without chills in accordance with the dimensions shown in Fig. 1 [Fig. 2]. They shall not be machined prior to test except to adapt the grip ends in such a manner as to ensure axial loading.

~~13.2 The recommended method for casting tension test specimens is shown in Fig. 1 [Fig. 2].~~

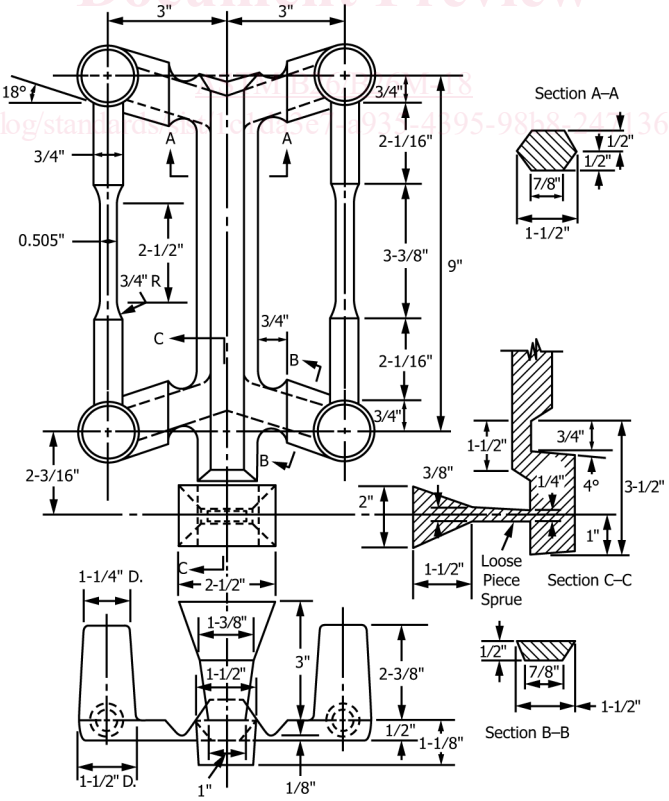
13.2 When properties of castings are to be determined, tension test specimens shall be cut from the locations designated on the drawing, unless otherwise negotiated. If no locations are designated, one or more specimens shall be taken to include locations having significant variation in casting thickness, except that specimens shall not be taken from areas directly under risers. The tension test specimens shall be the standard 0.500-in. [12.5-mm] diameter specimens shown in Fig. 9 of Test Methods B557 and B557M or a round specimen of smaller size proportional to the standard specimen.

	in.	mm
Diameter of reduced section	0.250	6.00
Length of reduced section	1¼	36
Gage length	1.000	30.00
Radius of fillet	3/16	6
Diameter of end section	⅜	9
Overall length:		
With shouldered ends	2⅜	60
With threaded ends	3	75
With plain cylindrical ends	4	100

When necessary, a rectangular specimen may be used proportional to that shown for the 0.500-in. [12.5-mm] wide specimen in Fig. 6 of Test Methods B557 and B557M, but in no case shall its dimensions be less than the following:

	in.	mm
Width of reduced section	¼	6.00
Length of reduced section	1¼	32
Radius of fillet	¼	6
Overall length	4	100
Thickness	0.100	2.50

The specific elongation values shall not apply to tests of rectangular specimens.



NOTE 1—1 in. = 25.4 mm.

FIG. 1 Tension Test Specimen Casting