



Designation: B 221 – 04a

Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes¹

This standard is issued under the fixed designation B 221; 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.

Note—Table 2 was corrected editorially and the year date changed on Oct 5, 2004.

1. Scope*

1.1 This specification² covers aluminum and aluminum-alloy extruded bar, rod, wire, profile, and tube in the aluminum alloys (Note 1) and tempers shown in Table 2.

NOTE 1—Throughout this specification, the use of the term *alloy* in the general sense includes aluminum as well as aluminum alloy.

NOTE 2—For rolled or cold-finished bar and rod refer to Specification B 211, for drawn tube, Specification B 210, for structural pipe and tube, Specification B 429, and for seamless pipe and tube, Specification B 241/B 241M.

1.2 Alloy and temper designations are in accordance with ANSI H35.1. The equivalent Unified Numbering System alloy designations are those of Table 1 preceded by A9; for example, A91100 for Aluminum 1100 in accordance with Practice E 527.

1.3 For acceptance criteria for inclusion of new aluminum and aluminum alloys in this specification, see Annex A2.

1.4 A complete metric companion to B 221 has been developed—B 221M; therefore, no metric equivalents are presented in this specification.

2. Referenced Documents

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

2.2 ASTM Standards:³

B 210 Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes

B 211 Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire

B 241/B 241M Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube

B 429 Specification for Aluminum-Alloy Extruded Structural Pipe and Tube

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

B 594 Practice for Ultrasonic Inspection of Aluminum-Alloy Wrought Products for Aerospace Applications

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

B 666/B 666M Practice for Identification Marking of Aluminum and Magnesium Products

B 807 Practice for Extrusion Press Solution Heat Treatment of Aluminum Alloys

B 881 Terminology Relating to Aluminum- and Magnesium-Alloy Products

B 918 Practice for Heat Treatment of Wrought Aluminum Alloys

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E 34 Test Methods for Chemical Analysis of Aluminum and Aluminum-Base Alloys

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

E 527 Practice for Numbering Metals and Alloys (UNS)

E 607 Test Method for Atomic Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique, Nitrogen Atmosphere

E 716 Practices for Sampling Aluminum and Aluminum Alloys for Spectrochemical Analysis

E 1004 Practice for Determining Electrical Conductivity Using the Electromagnetic (Eddy-Current) Method

E 1251 Test Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Argon Atmosphere, Point-to-Plane, Unipolar Self Initiating Capacitor Discharge

¹ This specification is under the jurisdiction of ASTM Committee B07 on Light Metals and Alloys and is the direct responsibility of Subcommittee B07.03 on Aluminum Alloy Wrought Products.

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² For ASME Boiler and Pressure Vessel Code applications see related Specification SB-221 in Section 11 of this 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.

TABLE 1 Chemical Composition Limits^{A,B,C}

Alloy	Silicon	Iron	Copper	Manga- nese	Magne- sium	Chromium	Zinc	Vanadium	Titanium	Other Elements ^D		Aluminum
										Each	Total ^E	
1060	0.25	0.35	0.05	0.03	0.03	...	0.05	0.05	0.03	0.03	...	99.60 min ^F
1100	0.95 Si + Fe		0.05–0.20	0.05	...	...	0.10	...	...	0.05	0.15	99.00 min ^F
2014	0.50–1.2	0.7	3.9–5.0	0.40–1.2	0.20–0.8	0.10	0.25	...	0.15 ^G	0.05 ^G	0.15	remainder
2024	0.50	0.50	3.8–4.9	0.30–0.9	1.2–1.8	0.10	0.25	...	0.15 ^G	0.05 ^G	0.15	remainder
2219	0.20	0.30	5.8–6.8	0.20–0.40	0.02	...	0.10	0.05–0.15	0.02–0.10	0.05 ^H	0.15 ^H	remainder
3003	0.6	0.7	0.05–0.20	1.0–1.5	...	...	0.10	...	...	0.05	0.15	remainder
Alclad 3003	...	3003 Clad with 7072 alloy			...	...	...	...	...	...	...	...
3004	0.30	0.7	0.25	1.0–1.5	0.8–1.3	...	0.25	...	...	0.05	0.15	remainder
3102	0.40	0.7	0.10	0.05–0.40	...	...	0.30	...	0.10	0.05	0.15	remainder
5052	0.25	0.40	0.10	0.10	2.2–2.8	0.15–0.35	0.10	...	...	0.05	0.15	remainder
5083	0.40	0.40	0.10	0.40–1.0	4.0–4.9	0.05–0.25	0.25	...	0.15	0.05	0.15	remainder
5086	0.40	0.50	0.10	0.20–0.7	3.5–4.5	0.05–0.25	0.25	...	0.15	0.05	0.15	remainder
5154	0.25	0.40	0.10	0.10	3.1–3.9	0.15–0.35	0.20	...	0.20	0.05	0.15	remainder
5454	0.25	0.40	0.10	0.50–1.0	2.4–3.0	0.05–0.20	0.25	...	0.20	0.05	0.15	remainder
5456	0.25	0.40	0.10	0.50–1.0	4.7–5.5	0.05–0.20	0.25	...	0.20	0.05	0.15	remainder
6005	0.6–0.9	0.35	0.10	0.10	0.40–0.6	0.10	0.10	...	0.10	0.05	0.15	remainder
6005A	0.50–0.9	0.35	0.30	0.50 ^I	0.40–0.7	0.30 ^I	0.20	...	0.10	0.05	0.15	remainder
6060	0.30–0.6	0.10–0.30	0.10	0.10	0.35–0.6	0.5	0.15	...	0.10	0.05	0.15	remainder
6061 ^J	0.40–0.8	0.7	0.15–0.40	0.15	0.8–1.2	0.04–0.35	0.25	...	0.15	0.05	0.15	remainder
6063	0.20–0.6	0.35	0.10	0.10	0.45–0.9	0.10	0.10	...	0.10	0.05	0.15	remainder
6066	0.9–1.8	0.50	0.7–1.2	0.6–1.1	0.8–1.4	0.40	0.25	...	0.20	0.05	0.15	remainder
6070	1.0–1.7	0.50	0.15–0.40	0.40–1.0	0.50–1.2	0.10	0.25	...	0.15	0.05	0.15	remainder
6105	0.6–1.0	0.35	0.10	0.10	0.45–0.8	0.10	0.10	...	0.10	0.05	0.15	remainder
6162	0.40–0.8	0.50	0.20	0.10	0.7–1.1	0.10	0.25	...	0.10	0.05	0.15	remainder
6262	0.40–0.8	0.7	0.15–0.40	0.15	0.8–1.2	0.04–0.14	0.25	...	0.15	0.05 ^K	0.15 ^K	remainder
6351	0.7–1.3	0.50	0.10	0.40–0.8	0.40–0.8	...	0.20	...	0.20	0.05	0.15	remainder
6463	0.20–0.6	0.15	0.20	0.05	0.45–0.9	...	0.05	...	...	0.05	0.15	remainder
7005	0.35	0.40	0.10	0.20–0.7	1.0–1.8	0.06–0.20	4.0–5.0	...	0.01–0.06	0.05 ^L	0.15 ^L	remainder
7072 ^M	0.7 Si + Fe		0.10	0.10	0.10	...	0.8–1.3	...	...	...	...	remainder
7075	0.40	0.50	1.2–2.0	0.30	2.1–2.9	0.18–0.28	5.1–6.1	...	0.20 ^N	0.05 ^N	0.15	remainder
7116	0.15	0.30	0.50–1.1	0.05	0.8–1.4	...	4.2–5.2	0.05	0.05	0.05 ^O	0.15	remainder
7129	0.15	0.30	0.50–0.9	0.10	1.3–2.0	0.10	4.2–5.2	0.05	0.05	0.05 ^O	0.15	remainder
7178	0.40	0.50	1.6–2.4	0.30	2.4–3.1	0.18–0.28	6.3–7.3	...	0.20	0.05	0.15	remainder

^A Limits are in weight percent maximum unless shown as a range, or stated otherwise.

^B Analysis shall be made for the elements for which limits are shown in this table.

^C For the purpose 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 the figures used in expressing the specified limit, in accordance with the rounding-off method of Practice E 29.

^D *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* 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.

^E *Other Elements*—Total shall be the sum of unspecified metallic elements 0.010 % or more, rounded to the second decimal before determining the sum.

^F The aluminum content shall be calculated by subtracting from 100.00 % the sum of all metallic elements present in amounts of 0.010 % or more each, rounded to the second decimal before determining the sum.

^G Upon agreement between the purchaser and the producer or supplier, a Zr + Ti limit of 0.20 % max is permitted. Properties in Specification (Table 2) are nto based on the Zirconium and Titanium algorithm.

^H Zirconium, 0.10–0.25 %. The total for other elements does not include zirconium.

^I Manganese plus chromium shall total 0.12–0.50.

^J In 1965 the requirements for 6062 were combined with those for 6061 by revising the minimum chromium from “0.15 %” to “0.04 %.” This action cancelled alloy 6062.

^K Bismuth and lead shall be 0.40–0.7 % each.

^L Zirconium 0.08–0.20 %. The total for other elements does not include zirconium.

^M Composition of cladding alloy applied during the course of manufacture. Samples from finished tube shall not be required to conform to these limits.

^N Upon agreement between the purchaser and the producer or supplier, a Zr + Ti limit of 0.25 % max is permitted. Properties in Specification (Table 2) are nto based on the Zirconium and Titanium algorithm.

^O Gallium 0.03 % max.

G 47 Test Method for Determining Susceptibility to Stress-Corrosion Cracking of 2XXX and 7XXX Aluminum Alloy Products

Method of Test for Exfoliation Corrosion Susceptibility in 7XXX Series Copper-Containing Aluminum Alloys (EXCO Test) (G 34-72)⁴

2.3 *ANSI Standards*:³

H35.1 Alloy and Temper Designation Systems for Aluminum

H35.2 Dimensional Tolerances for Aluminum Mill Products

2.4 *Federal Standard*:⁵

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

2.5 *Military Standard*:⁵

MIL-STD-129 Marking for Shipment and Storage

⁴ The applicable edition in the use of this specification is G 34-72, which is available in the gray pages of the *Annual Book of ASTM Standards*, Vol 02.02.

⁵ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, Attn: NPODS.

2.6 AMS Specification.⁶
AMS 2772 Heat Treatment of Aluminum Alloy Raw Materials
3. Terminology
3.1 Definitions:

Refer to Terminology B 881 for definitions of product terms used in this specification.

⁶ Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001.

TABLE 2 Mechanical Property Limits^{A,B}

NOTE 1—Strength values shown in parentheses are for information only.

Temper	Specified Section or Wall Thickness, in.	Area, in. ²	Tensile Strength, ksi		Yield Strength (0.2 % offset), ksi		Elongation in 2 in. or 4 × Diameter, min, % ^{C,D}						
			min	max	min	max							
Aluminum 1060 ^E													
O	all	all	8.5	14.0	2.5	...	25						
H112	all	all	8.5	...	2.5	...	25						
Aluminum 1100 ^E													
O	all	all	11.0	15.5	3.0	...	25						
H112	all	all	11.0	...	3.0	...	25						
Alloy 2024 ^E													
O	all	all	...	30.0	...	18.0	12						
T4	}	all	50.0	...	35.0	...	12						
T4510 ^F													
T4511 ^F													
T42 ^G	all	all	50.0	...	29.0	...	12						
T6	}	up through 0.499	all	60.0	...	53.0	7						
T6510 ^F													
T6511 ^F													
T6511 ^F													
T62 ^G	}	0.500–0.749	all	64.0	...	58.0	7						
								0.750 and over	up through 25	68.0	...	60.0	7
T62 ^G	}	0.750 and over	all	60.0	...	53.0	7						
								up through 25	60.0	...	53.0	7	
													over 25 through 32	60.0	...	53.0	6
Alloy 2024 ^E													
O	all	all	...	35.0	...	19.0	12						
T3	}	up through 0.249	all	57.0	...	42.0	12 ^H						
								0.250–0.749	all	60.0	...	44.0	12 ^H
								1.500 and over	up through 25	70.0	...	52.0 ^I	10
over 25 through 32	68.0	...	48.0 ^J	8									
T42 ^G	}	up through 0.749	all	57.0	...	38.0	12						
								0.750–1.499	all	57.0	...	38.0	10
								over 25 through 32	57.0	...	38.0	8	
T81	}	0.050–0.249	all	64.0	...	56.0	4						
T8510 ^F													
T8511 ^F													
T8510 ^F	}	0.250–1.499	all	66.0	...	58.0	5						
T8511 ^F													
T8511 ^F	}	1.500 and over	up through 32	66.0	...	58.0	5						
T8511 ^F													
Alloy 2219 ^E													
O	all	all	...	32.0	...	18.0	12						
T31	}	up through 0.499	up through 25	42.0	...	26.0	14						
T3510 ^F													
T3511 ^F	}	0.500–2.999	up through 25	45.0	...	27.0	14						
T3511 ^F													
T62 ^G	}	up through 0.999	up through 25	54.0	...	36.0	6						
								1.000 and over	up through 25	54.0	...	36.0	6
T81	}	up through 2.999	up through 25	58.0	...	42.0	6						
T8510 ^F													
T8511 ^F													
Alloy 3003 ^E													

TABLE 2 *Continued*

Temper	Specified Section or Wall Thickness, in.	Area, in. ²	Tensile Strength, ksi		Yield Strength (0.2 % offset), ksi		Elongation in 2 in. or 4 × Diameter, min, % ^{C,D}
			min	max	min	max	
O	all	all	14.0	19.0	5.0	...	25
H112	all	all	14.0	...	5.0	...	25
Alloy Alclad 3003 ^E							
O	all	all	13.0	18.0	4.5	...	25
H112	all	all	13.0	...	4.5 ^K	...	25
Alloy 3004 ^E							
O	all	all	23.0	29.0	8.5	...	...
Alloy 3102							
H112 ^L	0.028–0.050	all	11.0	18.0	4.0	...	25
Alloy 5052							
O	all	all	25.0	35.0	10.0	...	...
Alloy 5083 ^E							
O	up through 5.000 ^M	up through 32	39.0	51.0	16.0	...	14
H111	up through 5.000 ^M	up through 32	40.0	...	24.0	...	12
H112	up through 5.000 ^M	up through 32	39.0	...	16.0	...	12
Alloy 5086 ^E							
O	up through 5.000 ^M	up through 32	35.0	46.0	14.0	...	14
H111	up through 5.000 ^M	up through 32	36.0	...	21.0	...	12
H112	up through 5.000 ^M	up through 32	35.0	...	14.0	...	12
Alloy 5154							
O	all	all	30.0	41.0	11.0	...	...
H112	all	all	30.0	...	11.0	...	...
Alloy 5454 ^E							
O	up through 5.000 ^M	up through 32	31.0	41.0	12.0	...	14
H111	up through 5.000 ^M	up through 32	33.0	...	19.0	...	12
H112	up through 5.000 ^M	up through 32	31.0	...	12.0	...	12
Alloy 5456 ^E							
O	up through 5.000 ^M	up through 32	41.0	53.0	19.0	...	14
H111	up through 5.000 ^M	up through 32	42.0	...	26.0	...	12
H112	up through 5.000 ^M	up through 32	41.0	...	19.0	...	12
Alloy 6005							
T1	up through 0.500	all	25.0	...	15.0	...	16
T5	up through 0.124	all	38.0	...	35.0	...	8
	0.125–1.000	all	38.0	...	35.0	...	10
Alloy 6005A							
T1	up through 0.249	all	25.0	...	14.5	...	15
T5	up through 0.249	all	38.0	...	31.0	...	7
	0.250–0.999	all	38.0	...	31.0	...	9
T61†	up through 0.249	all	38.0	...	35.0	...	8
	0.250–0.999	all	38.0	...	35.0	...	10
Alloy 6060							
T51	up through 0.125	all	22.0	...	16.0	...	8
Alloy 6061 ^E							
O	all	all	...	22.0	...	16.0	16
T1	up through 0.625	all	26.0	...	14.0	...	16
T4		all	26.0	...	16.0	...	16
T4510 ^F	all	all	26.0	...	16.0	...	16
T4511 ^F		all	26.0	...	16.0	...	16
T42 ^G	all	all	26.0	...	12.0	...	16
T51	up through 0.625	all	35.0	...	30.0	...	8
T6, T62 ^G	up through 0.249	all	38.0	...	35.0	...	8
T6510 ^F		all	38.0	...	35.0	...	10
T6511 ^F	0.250 and over	all	38.0	...	35.0	...	10
Alloy 6063							

TABLE 2 *Continued*

Temper	Specified Section or Wall Thickness, in.	Area, in. ²	Tensile Strength, ksi		Yield Strength (0.2 % offset), ksi		Elongation in 2 in. or 4 × Diameter, min, % ^{C,D}
			min	max	min	max	
O	all	all	...	19.0	...	...	18
T1	{ up through 0.500 0.501–1.000	all	17.0	...	9.0	...	12
		all	16.0	...	8.0	...	12
T4, T42 ^G	{ up through 0.500 0.501–1.000	all	19.0	...	10.0	...	14
		all	18.0	...	9.0	...	14
T5	{ up through 0.500 0.501–1.000	all	22.0	...	16.0	...	8
		all	21.0	...	15.0	...	8
T52	up through 1.000	all	22.0	30.0	16.0	25.0	8
T6, T62 ^G	{ up through 0.124 0.125–1.000	all	30.0	...	25.0	...	8
		all	30.0	...	25.0	...	10
Alloy 6066							
O	all	all	...	29.0	...	18.0	16
T4, T4510, ^F T4511 ^F	all	all	40.0	...	25.0	...	14
T42 ^G	all	all	40.0	...	24.0	...	14
T6, T6510, ^F T6511 ^F	all	all	50.0	...	45.0	...	8
T62 ^G	all	all	50.0	...	42.0	...	8
Alloy 6070							
T6, T62	up through 2.999	up through 32	48.0	...	45.0	...	6
Alloy 6105							
T1	up through 0.500	all	25.0	...	15.0	...	16
T5	{ up through 0.124 0.125–1.000	all	38.0	...	35.0	...	8
		all	38.0	...	35.0	...	10
Alloy 6162							
T5, T5510, ^F T5511 ^F	up thru 1.000	all	37.0	...	34.0	...	7
T6, T6510, ^F T6511 ^F	up thru 0.249	all	38.0	...	35.0	...	8
	0.250–0.499	all	38.0	...	35.0	...	10
Alloy 6262							
T6 T6510 ^F T6511 ^F	{ all	all	38.0	...	35.0	...	10
Alloy 6351							
T1	up through 0.499	up through 20	26.0	...	13.0	...	15
T11	up through 0.749	all	26.0	...	16.0	...	16
T4	up through 0.749	all	32.0	...	19.0	...	16
T5	up through 0.249 0.250–1.000	all	38.0	...	35.0	...	8
		all	38.0	...	35.0	...	10
T51	0.125–1.000	all	36.0	...	33.0	...	10
T54	up through 0.500 up through 0.124	all	30.0	...	20.0	...	10
		all	42.0	...	37.0	...	8
T6	{ 0.125–0.749	all	42.0	...	37.0	...	10
Alloy 6463							
T1	up through 0.500	up through 20	17.0	...	9.0	...	12
T5	up through 0.500	up through 20	22.0	...	16.0	...	8
T6	{ up through 0.124 0.125–0.500	up through 20	30.0	...	25.0	...	8
		up through 20	30.0	...	25.0	...	10
Alloy 7005							
T53	up through 0.750	all	50.0	...	44.0	...	10
Alloy 7075 ^E							
O	all	all	...	40.0	...	24.0	10

TABLE 2 *Continued*

Temper	Specified Section or Wall Thickness, in.	Area, in. ²	Tensile Strength, ksi		Yield Strength (0.2 % offset), ksi		Elongation in 2 in. or 4 × Diameter, min, % ^{C,D}
			min	max	min	max	
T6, T62 ^G T6510 ^F T6511 ^F	up through 0.249 0.250–0.499 0.500–1.499 1.500–2.999 3.000–4.499 4.500–5.000	all	78.0	...	70.0	...	7
		all	81.0	...	73.0	...	7
		all	81.0	...	72.0	...	7
		all	81.0	...	72.0	...	7
		up through 20	81.0	...	71.0	...	7
		over 20 through 32	78.0	...	70.0	...	6
T73 T73510 ^F T73511 ^F	0.062–0.249 0.250–1.499 1.500–2.999 3.000–4.499	up through 20	68.0	...	58.0	...	7
		up through 25	70.0	...	61.0	...	8
		up through 25	69.0	...	59.0	...	8
		up through 20	68.0	...	57.0	...	7
		over 20 through 32	65.0	...	55.0	...	7
T76 T76510 ^F T76511 ^F	up through 0.049 0.050–0.124 0.125–0.249 0.250–0.499 0.500–1.000 1.001–2.000 2.001–3.000 3.001–4.000	all	73.0	...	63.0	...	7
		all	74.0	...	64.0	...	7
		up through 20	74.0	...	64.0	...	7
		up through 20	75.0	...	65.0	...	7
		up through 20	75.0	...	65.0	...	7
		up through 20	75.0	...	65.0	...	7
		up through 20	74.0	...	64.0	...	7
		up through 20	74.0	...	63.0	...	7
Alloy 7116							
T5	0.125–0.500	all	48.0	...	42.0	...	8
Alloy 7129							
T5, T6	up through 0.500	all	55.0	...	49.0	...	9
Alloy 7178 ^E							
O	all	up through 32	...	40.0	...	24.0	10
		up through 0.061	up through 20	82.0	...	76.0	...
T6 T6510 ^F T6511 ^F	0.062–0.249 0.250–1.499 1.500–2.499 2.500–2.999	up through 20	84.0	...	76.0	...	5
		up through 25	87.0	...	78.0	...	5
		up through 25	86.0	...	77.0	...	5
		over 25 through 32	84.0	...	75.0	...	5
		up through 32	82.0	...	71.0	...	5
T62 ^G	up through 0.061 0.062–0.249 0.250–1.499 1.500–2.499 2.500–2.999	up through 20	79.0	...	73.0	...	5
		up through 20	82.0	...	74.0	...	5
		up through 25	86.0	...	77.0	...	5
		up through 25	86.0	...	77.0	...	5
		over 25 through 32	84.0	...	75.0	...	5
		up through 32	82.0	...	71.0	...	5
T76 T76510 ^F T76511 ^F	0.125–0.249 0.250–0.499 0.500–1.000	up through 20	76.0	...	66.0	...	7
		up through 20	77.0	...	67.0	...	7
		up through 20	77.0	...	67.0	...	7

† This value was changed editorially from T6 to T61 in October 2004.

^A The basis for establishment of tensile property limits is shown in Annex A1.

^B To determine conformance to this specification, each value shall be rounded to the nearest 0.1 ksi for strength and nearest 0.5 % for elongation in accordance with the rounding-off-method of Practice E 29.

^C Elongation of full-section and cut-out sheet-type specimens is measured in 2 in. Elongation of cut-out round specimens is measured in 4 × specimen diameter.

^D See 8.1.1 and 8.1.2 for conditions under which measurements are not required.

^E These alloys are also produced in the F temper for which no tensile properties are specified or guaranteed.

^F For stress relieved tempers (T3510, T3511, T4510, T4511, T5510, T5511, T6510, T6511, T73510, T73511, T76510, T76511, T8510, T8511), characteristics and properties other than those specified may differ somewhat from the corresponding characteristics and properties of material in the basic tempers.

^G Material in the T42 and T62 tempers is not available from the material producers.

^H Minimum elongation for tube, 10 %.

^I Minimum yield strength for tube, 48.0 ksi.

^J Minimum yield strength for tube, 46.0 ksi.

^K Yield strength is not applicable in tube.

^L Only in tube form.

^M Properties not applicable to extruded tube over 2.999 in wall thickness.