



Designation: **B221M—13** B221M – 21

Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)¹

This standard is issued under the fixed designation B221M; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

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

1. Scope*

1.1 This specification covers aluminum and aluminum-alloy extruded bars, rods, wires, profiles, and tubes 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 bars and rods refer to Specification B211/B211M, for drawn seamless tube used in pressure applications, Specification B210/B210M, for structural pipe and tube, Specification B429/B429M, and for seamless pipe and tube used in pressure applications, Specification B241/B241M.

NOTE 3— Pipe and tube products listed in this specification are intended for general purpose applications. This specification may not address the manufacturing processes, integrity testing, and verification required for fluid-carrying applications involving pressure. See Specification B210/B210M, B241/B241M, or both as appropriate for seamless pipe and tube used in fluid-carrying applications involving pressure. See Specification B234M, as appropriate, for use in surface condensers, evaporators, and heat exchangers.

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 bars and rods refer to Specification B211M, for drawn seamless tube used in pressure applications, Specification B210M, for structural pipe and tube, Specification B429/B429M, and for seamless pipe and tube used in pressure applications, Specification B241/B241M.

NOTE 3— Pipe and tube products listed in this specification are intended for general purpose applications. This specification may not address the manufacturing processes, integrity testing, and verification required for fluid-carrying applications involving pressure. See Specifications B210M and/or B241/B241M, as appropriate, for seamless pipe and tube used in fluid-carrying applications involving pressure. See Specification B234, as appropriate, for use in surface condensers, evaporators, and heat exchangers.

1.2 Alloy and temper designations are in accordance with ANSI H35.1/H35.1M. 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 E527.

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

1.4 This specification is the metric counterpart of Specification B221.

1.5 The values stated in SI are to be regarded as standard. No other units of measurement are included in this specification.

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

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

NOTE 1—In case of a discrepancy between the values listed in Table 1 and those listed in the “International Alloy Designations and Chemical Composition Limits for Wrought Aluminum and Wrought Aluminum Alloys” (known as the “Teal Sheets”), the composition limits registered with the Aluminum Association and published in the “Teal Sheets” should be considered the controlling composition. The “Teal Sheets” are available at <http://www.aluminum.org/tealsheets>.

Alloy	Silicon	Iron	Copper	Manga- nese	Magne- sium	Chromium	Zinc	Titanium	Vanadium	Other Elements ^D		Aluminum
										Each	Total ^E	
1060	0.25	0.35	0.05	0.03	0.03	...	0.05	0.03	0.05	0.03	...	99.60 min ^F
1100	0.95 Si + Fe		0.05-0.20	0.05	...	...	0.10	...	...	0.05 ^G	0.15	99.00 min ^F
1100 ^G	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 ^H	...	0.05 ^H	0.15	remainder
2014 ^H	0.50-1.2	0.7	3.9-5.0	0.40-1.2	0.20-0.8	0.10	0.25	0.15	...	0.05	0.15	rem
2024	0.50	0.50	3.8-4.9	0.30-0.9	1.2-1.8	0.10	0.25	0.15 ^H	...	0.05 ^H	0.15	remainder
2024 ^H	0.50	0.50	3.8-4.9	0.30-0.9	1.2-1.8	0.10	0.25	0.15	...	0.05	0.15	rem
2219	0.20	0.30	5.8-6.8	0.20-0.40	0.02	...	0.10	0.02-0.10	0.05-0.15	0.05 ^I	0.15 ^I	remainder
2219 ^I	0.20	0.30	5.8-6.8	0.20-0.40	0.02	...	0.10	0.02-0.10	0.05-0.15	0.05	0.15	rem
3003	0.6	0.7	0.05-0.20	1.0-1.5	...	...	0.10	...	...	0.05	0.15	remainder
3003	0.6	0.7	0.05-0.20	1.0-1.5	...	...	0.10	...	...	0.05	0.15	rem
Alclad 3003	...		3003 Clad with 7072 alloy			...	...	...	...	...	...	...
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
3004	0.30	0.7	0.25	1.0-1.5	0.8-1.3	...	0.25	...	...	0.05	0.15	rem
3102	0.40	0.7	0.10	0.05-0.40	...	...	0.30	0.10	...	0.05	0.15	remainder
3102	0.40	0.7	0.10	0.05-0.40	...	...	0.30	0.10	...	0.05	0.15	rem
5052	0.25	0.40	0.10	0.10	2.2-2.8	0.15-0.35	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	rem
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
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	rem
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
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	rem
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
5154 ^G	0.25	0.40	0.10	0.10	3.1-3.9	0.15-0.35	0.20	0.20	...	0.05	0.15	rem
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
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	rem
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
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	rem
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
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	rem
6005A	0.50-0.9	0.35	0.30	0.50 ^J	0.40-0.7	0.30 ^J	0.20	0.10	...	0.05	0.15	remainder
6005A ^J	0.50-0.9	0.35	0.30	0.50	0.40-0.7	0.30	0.20	0.10	...	0.05	0.15	rem
6013	0.6-1.0	0.50	0.6-1.1	0.20-0.8	0.8-1.2	0.10	0.25	0.10	...	0.05	0.15	remainder
6013	0.6-1.0	0.50	0.6-1.1	0.20-0.8	0.8-1.2	0.10	0.25	0.10	...	0.05	0.15	rem
6020 ^K	0.40-0.9	0.50	0.30-0.9	0.35	0.6-1.2	0.15	0.20	0.15	...	0.05	0.15	remainder
6020 ^K	0.40-0.9	0.50	0.30-0.9	0.35	0.6-1.2	0.15	0.20	0.15	...	0.05	0.15	rem
6026 ^L	0.6-1.4	0.7	0.20-0.50	0.20-1.0	0.6-1.2	0.30	0.30	0.20	...	0.05	0.15	rem
6041 ^L	0.50-0.9	0.15-0.7	0.15-0.6	0.05-0.20	0.8-1.2	0.05-0.15	0.25	0.15	...	0.05	0.15	remainder
6041 ^M	0.50-0.9	0.15-0.7	0.15-0.6	0.05-0.20	0.8-1.2	0.05-0.15	0.25	0.15	...	0.05	0.15	rem
6042 ^M	0.50-1.2	0.7	0.20-0.6	0.40	0.7-1.2	0.04-0.35	0.25	0.15	...	0.05	0.15	remainder
6042 ^N	0.50-1.2	0.7	0.20-0.6	0.40	0.7-1.2	0.04-0.35	0.25	0.15	...	0.05	0.15	rem
6060	0.30-0.6	0.10-0.30	0.10	0.10	0.35-0.6	0.05	0.15	0.10	...	0.05	0.15	remainder
6060	0.30-0.6	0.10-0.30	0.10	0.10	0.35-0.6	0.05	0.15	0.10	...	0.05	0.15	rem
6061 ^N	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
6061 ^O	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	rem
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
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	rem
6064 ^P	0.40-0.8	0.7	0.15-0.40	0.15	0.8-1.2	0.05-0.14	0.25	0.15	...	0.05	0.15	remainder
6064 ^P	0.40-0.8	0.7	0.15-0.40	0.15	0.8-1.2	0.05-0.14	0.25	0.15	...	0.05	0.15	rem
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
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	rem
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
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	rem
6082	0.7-1.3	0.50	0.10	0.40-1.0	0.6-1.2	0.25	0.20	0.10	...	0.05	0.15	remainder
6082	0.7-1.3	0.50	0.10	0.40-1.0	0.6-1.2	0.25	0.20	0.10	...	0.05	0.15	rem
6105	0.6-1.0	0.35	0.10	0.15	0.45-0.8	0.10	0.10	0.10	...	0.05	0.15	remainder
6105	0.6-1.0	0.35	0.10	0.15	0.45-0.8	0.10	0.10	0.10	...	0.05	0.15	rem
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
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	rem
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 ^P	0.15 ^P	remainder
6262 ^Q	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	0.15	rem
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
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	rem
6360	0.35-0.8	0.10-0.30	0.15	0.02-0.15	0.25-0.45	0.05	0.10	0.10	...	0.05	0.15	remainder
6360	0.35-0.8	0.10-0.30	0.15	0.02-0.15	0.25-0.45	0.05	0.10	0.10	...	0.05	0.15	rem
6463	0.20-0.6	0.15	0.20	0.05	0.45-0.9	...	0.05	...	...	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	rem
6560	0.30-0.7	0.10-0.30	0.05-0.20	0.20	0.20-0.6	0.05	0.15	0.10	...	0.05	0.15	remainder
6560	0.30-0.7	0.10-0.30	0.05-0.20	0.20	0.20-0.6	0.05	0.15	0.10	...	0.05	0.15	rem

Alloy	Silicon	Iron	Copper	Manganese	Magnesium	Chromium	Zinc	Titanium	Vanadium	Other Elements ^D		Aluminum
										Each	Total ^E	
6560	0.30–0.7	0.10–0.30	0.05–0.20	0.20	0.20–0.6	0.05	0.15	0.10	...	0.05	0.15	rem
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 ^Q	0.15 ^Q	remainder
7005 ^R	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	0.15	rem
7072 ^B	0.7 Si + Fe		0.10	0.10	0.10	...	0.8–1.3	...	...	...	...	remainder
7072 ^S	0.7 Si + Fe		0.10	0.10	0.10	...	0.8–1.3	...	...	...	...	rem
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 ^S	...	0.05 ^S	0.15	remainder
7075 ^T	0.40	0.50	1.2–2.0	0.30	2.1–2.9	0.18–0.28	5.1–6.1	0.20	...	0.05	0.15	rem
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 ^T	0.15	remainder
7116 ^U	0.15	0.30	0.50–1.1	0.05	0.8–1.4	...	4.2–5.2	0.05	0.05	0.05	0.15	rem
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 ^T	0.15	remainder
7129 ^U	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	0.15	rem
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 E29.

^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 Be 0.0003 max for welding electrode, welding rod, and filler wire.

^H 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 not based on the Zirconium and Titanium algorithm.

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

^J Manganese plus chromium shall total 0.12–0.50.

^K Lead 0.05 % max, Tin 0.9–1.50–1.5 %.

^L Bismuth 0.30–0.9 %, Tin 0.35–1.2 %, 0.50–1.5 %, Lead 0.4 % max, Tin 0.05 % max.

^M Bismuth 0.30–0.9 %, Tin 0.35–1.2 %.

^N Bismuth 0.20–0.80, 0.20–0.8 % Lead 0.15–0.40, 0.15–0.40 %.

^O 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.

^P Bismuth 0.50–0.70, 0.50–0.7 %, Lead 0.20–0.40, 0.20–0.4 %.

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

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

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

^T 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 not based on the Zirconium and Titanium algorithm.

^U Gallium 0.03 % max.

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<https://standards.iteh.ai/catalog/standards/sist/1ae96a8c-52ae-437e-975a-19d122380a04/astm-b221m-21>

1.6 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.

TABLE 2 Tensile Property Limits^{A,B}

Temper	Product Type ^C	Specified Section or Wall Thickness, mm		Area, mm ²		Tensile Strength, MPa		Yield Strength (0.2% offset), MPa(0.2%)		Elongation, ^{E,D} %, min		in 50-mm
		all	all	over	incl	over	incl	min	max	min	max	
Aluminum 1060 ^E												
O	Extruded Tube	all	all	all	all	60	95	15	...	25	22	
H112	Extruded Tube	all	all	all	all	60	...	15	...	25	22	
<u>F^D</u>		all	all	...	...	...	...	...	...	...	...
Aluminum 1100 ^E												
O	Extruded Tube	all	all	all	all	75	105	20	...	25	22	
H112	Extruded Tube	all	all	all	all	75	...	20	...	25	22	
<u>F^D</u>		all	all	...	...	...	...	...	...	...	...
Alloy 2014 ^E												
O	Extruded Wire, Rod, Bar, Profiles, and Tube	all	all	all	all	...	205	...	125	12	10	
T4	} Extruded Wire, Rod, Bar, Profiles, and Tube	all	all	all	all	...	345	...	240	...	12	10
T4510 ^F												
T4511 ^F												
T4510 ^E												
T4511 ^E	} Extruded Wire, Rod, Bar, Profiles, and Tube	all	all	all	all	345	...	200	...	12	10	
T42 ^E												
T42 ^G												
T6	} Extruded Wire, Rod, Bar, Profiles, and Tube	all	12.50	all	415	...	365	...	7	6		
T6												
T6510 ^F												
T6511 ^F												
T6510 ^E	12.50	18.00	all	440	...	400	...	...	6			
T6511 ^E		18.00	...	16 000	470	...	415	...	...	6		
T62 ^G	Extruded Wire, Rod, Bar, Profiles, and Tube	}	...	18.00	all	...	415	...	365	...	7	6
			18.00	...	...	16 000	415	...	365	...	...	6
			18.00	...	16 000	20 000	415	...	365	...	...	5
Alloy 2024 ^E												
T62 ^F	} Extruded Wire, Rod, Bar, and Profiles	all	18.00	all	415	...	365	...	7	6		
O												
O			18.00	...	16 000	415	...	365	...	6		
			18.00	...	16 000	20 000	415	...	365	...	5	
F			all	all	...	...	...	...	...	...	...
D					...	...	...	...	...	...	...

TABLE 2 Continued

Temper	Product Type ^C	Specified Section or Wall Thickness, mm		Area, mm ²		Tensile Strength, MPa		Yield Strength (0.2% offset), MPa(0.2%)		Elongation, ^{ED} %, min		in 50-mm
		over	incl	over	incl	over	incl	min	max	min	max	
T3 T3510 ^F T3511 ^F	Extruded Wire, Rod, Bar, and Profiles	...	6.30	all	-	395	...	290	...	12	...	...
		6.30	18.00	all	-	415	...	305	...	12	10	...
		18.00	35.00	all	-	450	...	315	...	...	9	9
		35.00	...	...	16 000	485	...	360	...	...	9	9
		35.00	...	16 000	20 000	470	...	330	...	...	7	7
Alloy 2024												
○		all	all	...	...	240	...	130	12	10		
T3		...	6.30	all	...	395	...	290	12 ^G	...		
T3510 ^E T3511 ^E	18.00	6.30	18.00	all	...	415	...	305	12 ^G	10 ^G		
		35.00	all	...	450	...	315	...	9			
		35.00	...	16 000	20 000	485	...	360 ^H	...	9		
		35.00	...	16 000	20 000	470	...	330 ^I	...	7		
T42		...	18.00	all	...	395	...	260	...	12	10	
_E												
T3 T3510 ^F T3511 ^F	Extruded Tube	...	6.30	all	-	395	...	290	...	10	...	...
		6.30	18.00	all	-	415	...	305	...	10	9	...
		18.00	35.00	all	-	450	...	315	...	...	9	9
		35.00	...	...	16 000	485	...	330	...	...	9	9
		35.00	...	16 000	20 000	470	...	315	...	...	7	7
	18.00	35.00	all	...	395	...	260	...	9			
	35.00	...	...	16 000	395	...	260	...	9			
T42 ^G	Extruded Wire, Rod, Bar, Profiles, and Tube	...	18.00	all	-	395	...	260	...	12	10	...
		18.00	35.00	all	-	395	...	260	...	...	9	9
		35.00	...	...	16 000	395	...	260	...	...	9	9
		35.00	...	16 000	20 000	395	...	260	...	...	7	7
	35.00	...	16 000	20 000	395	...	260	...	7			
T81		...	1.20	6.30	all	440	...	385	...	4	...	...
T8510 ^E		6.30	35.00	all	...	455	...	400	...	5	4	...
T8511 ^E		35.00	...	...	20 000	455	...	400	...	...	4	...
F		all	all	...	...	...	...	...	...	...	...	...
_D												
T81 T8510 ^F T8511 ^F	Extruded Wire, Rod, Bar, Profiles, and Tube	1.20	6.30	all	-	440	...	385	...	4	...	...
		6.30	35.00	all	-	455	...	400	...	5	4	...
		35.00	...	...	20 000	455	...	400	...	...	4	4
Alloy 2219 ^E												
○	Extruded Wire, Rod, Bar, Profiles, and Tube	all	all	...	...	220	...	125	12	10		
T31		...	12.50	...	16 000	290	...	180	...	14	12	

TABLE 2 *Continued*

Temper	Product Type ^C	Specified Section or Wall Thickness, mm		Area, mm ²		Tensile Strength, MPa		Yield Strength (0.2% offset), MPa(0.2%)		Elongation, ^{ED} %, min		in 50-mm ⁵⁰
		over	incl	over	incl	over	incl	min	max	min	max	
T31 T3510 ^F T3511 ^F	Extruded Wire, Rod, Bar, Profiles, and Tube	...	12.50	...	16 000	290	...	180	...	14	12	
		12.50	80.00	...	16 000	310	...	185	12
T3510 ^E	12.50 80.00	...	16 000	310	...	185	...	...	12			
T62 ^E	...	25.00	...	16 000	370	...	250	...	6	5		
T62 ^G	Extruded Wire, Rod, Bar, Profiles, and Tube	...	25.00	...	16 000	370	...	250	...	6	5	
		25.00	20 000	370	...	250	...	...	5			
T81	25.00	...	20 000	370	...	250	...	...	5			
T8510 ^E	...	...	80.00	...	16 000	400	...	290	...	6	5	
T81 T8510 ^F T8511 ^F	Extruded Wire, Rod, Bar, Profiles, and Tube	...	80.00	...	16 000	400	...	290	...	6	5	
	
T8511^E												
Alloy 3003^E												
O	Extruded Wire, Rod, Bar, Profiles, and Tube	all	all	all	95	130	35	...	25	22		
F ^D	...	all	all	...	...	...	...	...	...	...
H112	Extruded Wire, Rod, Bar, and Profiles	all	all	all	95	...	35	...	...	...
Alloy 3003												
O	Extruded Tube	all	all	all	95	130	35	...	25	22		
F ^D	...	all	all	...	...	...	...	...	...	...
Alclad Alloy 3003												
O	Extruded Tube	all	all	all	90	125	30	...	25	...		
O	Extruded Tube	all	all	all	90	125	30	...	25	22		
H112	Extruded Tube	all	all	all	90	...	30 ^L	...	25	...		
H112	Extruded Tube	all	all	all	90	...	30	...	25	22		
Alloy 3004^E												
O	Extruded Tube	all	all	all	160	200	60	...	...	...
F ^D	...	all	all	...	...	...	...	...	...	...
Alloy 3102												
H112 ^K	Extruded Tube	0.70	1.30	all	75	125	30	...	25	...		
H112	Extruded Tube	0.63	1.20	all	75	125	30	...	25	...		
Alloy 5052^E												
O	Extruded Tube	all	all	all	170	240	70	...	...	...
Alloy 5083^E												
O	Extruded Wire, Rod, Bar, and Profiles	...	130.00 ^L	...	20 000	270	350	110	...	14	12	
O	Extruded Wire, Rod, Bar, and Profiles	...	130.00	...	20 000	270	350	110	...	14	12	
H111	Extruded Wire, Rod, Bar, and Profiles	...	130.00 ^L	...	20 000	275	...	165	...	12	10	
H111	Extruded Wire, Rod, Bar, and Profiles	...	130.00	...	20 000	275	...	165	...	12	10	
H112	Extruded Wire, Rod, Bar, and Profiles	...	130.00 ^L	...	20 000	270	...	110	...	12	10	
H112	Extruded Wire, Rod, Bar, and Profiles	...	130.00	...	20 000	270	...	110	...	12	10	
O	Extruded Tube	...	70 ^H	...	20 000	270	350	110	...	14	12	
F ^D	...	all	all	...	...	...	...	...	...	...

TABLE 2 *Continued*

Temper	Product Type ^C	Specified Section or Wall Thickness, mm		Area, mm ²		Tensile Strength, MPa		Yield Strength (0.2% offset), MPa(0.2%)		Elongation, ^{ED} %, min		in 50-mm50
		over	incl	over	incl	over	incl	min	max	min	max	
H111	Extruded Tube	70 ^H	...	20 000	...	20 000	275	...	165	...	12	10
H112	Extruded Tube	70 ^H	...	20 000	...	270	...	110	...	12	10	
Alloy 5086 ^E												
Ø	Extruded Wire, Rod, Bar, and Profiles	...	130.00 ^L	...	20 000	240	315	95	...	14	12	
Ø		...	130.00	...	20 000	240	315	95	...	14	12	
H111	Extruded Wire, Rod, Bar, and Profiles	...	130.00 ^L	...	20 000	250	...	145	...	12	10	
H111		...	130.00	...	20 000	250	...	145	...	12	10	
H112	Extruded Wire, Rod, Bar, and Profiles	...	130.00 ^L	...	20 000	240	...	95	...	12	10	
H112		...	130.00	...	20 000	240	...	95	...	12	10	
Ø	Extruded Tube	70 ^H	...	20 000	...	240	315	95	...	14	12	
F ^D	Extruded Tube	all	all	...	...	...	...	...	...	...	...
H111		70 ^H	...	20 000	250	...	145	...	12	10		
H112	Extruded Tube	70 ^H	...	20 000	...	240	...	95	...	12	10	
Alloy 5154												
Ø	Extruded Wire, Rod, Bar, Profiles, and Tube	all	all	...	...	205	285	75	...	...	...
H112	Extruded Wire, Rod, Bar, Profiles, and Tube	all	all	...	...	205	...	75	...	...	...
Alloy 5454 ^E												
Ø	Extruded Wire, Rod, Bar, and Profiles	...	130.00 ^L	...	20 000	215	285	85	...	14	12	
Ø		...	130.00	...	20 000	215	285	85	...	14	12	
H111	Extruded Wire, Rod, Bar, and Profiles	...	130.00 ^L	...	20 000	230	...	130	...	12	10	
H111		...	130.00	...	20 000	230	...	130	...	12	10	
H112	Extruded Wire, Rod, Bar, and Profiles	...	130.00 ^L	...	20 000	215	...	85	...	12	10	
H112		...	130.00	...	20 000	215	...	85	...	12	10	
Ø	Extruded Tube	70 ^H	...	20 000	...	215	285	85	...	14	12	
H111	Extruded Tube	70 ^H	...	20 000	...	230	...	130	...	12	10	
F ^D	Extruded Tube	all	all	...	...	...	...	...	...	...	...
H112		70 ^H	...	20 000	215	...	85	...	12	10		
Alloy 5456 ^E												
Ø	Extruded Wire, Rod, Bar, and Profiles	...	130.00 ^L	...	20 000	285	365	130	...	14	12	
Ø		...	120.00	...	20 000	285	365	130	...	14	12	
H111	Extruded Wire, Rod, Bar, and Profiles	...	130.00 ^L	...	20 000	290	...	180	...	12	10	
H111		...	120.00	...	20 000	290	...	180	...	12	10	
H112	Extruded Wire, Rod, Bar, and Profiles	...	130.00 ^L	...	20 000	285	...	130	...	12	10	
H112		...	120.00	...	20 000	285	...	130	...	12	10	
Ø	Extruded Tube	70 ^I	...	20 000	...	285	365	130	...	14	12	
H111	Extruded Tube	70 ^I	...	20 000	...	290	...	180	...	12	10	
F ^D	Extruded Tube	all	all	...	...	...	...	...	...	...	...
H112		70 ^I	...	20 000	285	...	130	...	12	10		
Alloy 6005												

TABLE 2 *Continued*

Temper	Product Type ^C	Specified Section or Wall Thickness, mm		Area, mm ²		Tensile Strength, MPa		Yield Strength (0.2% offset), MPa(0.2%)		Elongation, ^{ED} %, min		in 50-mm 50	
		over	incl	over	incl	over	incl	min	max	min	max		
T1	Extruded Wire, Rod, Bar, Profiles, and Tube	...	12.50	all		170	...	105	...	16	14		
T5	Extruded Wire, Rod, Bar, Profiles, and Tube	...	3.20	all	260	...	240	...	8	...	...
T5		...	3.20	all	260	...	240	...	240	...	8	...	9
		-3.20	25.00	all	260	...	240	...	10	9			
Alloy 6005A													
T1	Extruded Wire, Rod, Bar, Profiles, and Tube	...	6.30	all		170	...	100	...	15	...		
T5	Extruded Wire, Rod, Bar, Profiles, and Tube	...	6.30	all	260	...	215	...	7	...	...
		...	6.30	25.00	all	260	...	215	...	9	8		
		-6.30	25.00	all	260	...	215	...	9	8			
T61	Extruded Wire, Rod, Bar, Profiles, and Tube	...	6.30	all	260	...	240	...	240	...	8	...	9
		...	6.30	25.00	all	260	...	240	...	10	...	9	
Alloy 6013													
T61 ^F		...	6.30	all	260	...	240	...	8	...	...
T6, T6511 ^F	Extrusion, Rod, and Seamless Tube	5.00	12.50	all	340	...	315	...	8	...	...
		12.50	20.00	all	340	...	315	...	...	...	7	
		20.00	50.00	all	340	...	310	...	...	...	7	
Alloy 6020													
T6511 ^F	Extruded Rod and Bar	6.30	25.00	all	260	...	240	...	10	9	...		
		...	80.00	160.00	all	260	...	240	...	...	...	9
Alloy 6013													
Alloy 6026													
T6 ^{FE}		5.00	12.50	all	340	...	315	...	8	...	...
T6, T6510, T6511 ^F	Extruded Profiles	5.00	40.00	all	340	...	260	...	6	8			
		12.50	20.00	all	340	...	315	...	...	7		
T6511 ^F	Extruded Tube	20.00	50.00	all	340	...	310	...	...	7		
T6, T6510, T6511 ^F		5.00	12.50	all	340	...	315	...	8	...			
		10.00	30.00	all	340	...	260	...	...	6	8	
		12.50	20.00	all	340	...	315	...	...	7		
FF		20.00	50.00	all	340	...	310	...	...	7		
T6, T6510, T6511 ^F	Extruded Bar, Rod, and Wire	30.00	140.00	all	370	...	300	...	6	8			
		140.00	200.00	all	340	...	250	...	6	8			
		200.00	250.00	all	300	...	200	...	6	8			
Alloy 6020													
T6511 ^F		...	80.00	160.00	all	260	...	240	...	...	...	9
Alloy 6041													
T6 ^M		...	10.00	50.00	all	310	...	275	...	10	9		
T6511 ^{ME}		10.00	50.00	all	310	...	275	...	10	9			
T6, T6511 ^F	Extruded Rod, Bar, and Profiles	10.00	50.00	all	310	...	275	...	10	9			

TABLE 2 *Continued*

Temper	Product Type ^C	Specified Section or Wall Thickness, mm		Area, mm ²		Tensile Strength, MPa		Yield Strength (0.2% offset), MPa(0.2%)		Elongation, ϵ^D , %		in 50-mm
		over	incl	over	incl	over	incl	min	max	min	max	
Alloy 6042												
T5		10.00	12.50	50.00	all	260	290	240	240	10	...	9
T551 ^E		10.00	12.50	all	all	260	...	240	...	10	...	...
T5, T5511 ^F	Extruded Rod, Bar, and Profiles	10.00	12.50	all	all	260	...	240	...	10	...	...
		12.50	50.00	all	all	260	...	240	...	10	...	9
		12.50	50.00	all	all	290	...	240	...	...	...	9
Alloy 6060												
T51	Extruded Profiles	...	3.20	all	all	150	...	110	...	8	...	...
T61	Extruded Profiles	...	3.20	all	all	205	...	170	...	8	...	...
		3.20	25.00	all	all	205	...	170	...	10	...	9
		3.20	25.00	all	all	205	...	170	...	10	...	9
Alloy 6061^E												
O	Extruded Wire, Rod, Bar, Profiles, and Tube	all	all	all	all	...	150	...	110	16	14	...
T1	Extruded Wire, Rod, Bar, Profiles, and Tube	...	16.00	all	all	180	...	95	...	16	14	...
T4 ^E	Extruded Wire, Rod, Bar Profiles, and Tube	...	...	all	all	180	...	110	...	16	14	...
T4510 ^F		all	all	all	all	180	...	110	...	16	14	...
T4511 ^E	all	all	all	all	180	...	110	...	16	14	...	
T42 ^G	Extruded Wire, Rod, Bar, Profiles, and Tube	all	all	all	all	180	...	85	...	16	14	...
T51	Extruded Wire, Rod, Bar, Profiles, and Tube	...	16.00	all	all	240	...	205	...	8	7	...
T6, T62 ^E	Extruded Wire, Rod, Bar, Profiles, and Tube	...	6.30	all	all	260	...	240	...	8	...	...
T6510 ^E		6.30	...	all	all	260	...	240	...	10	9	...
T6511 ^E	all	all	all	all	...	...	...	...	...	...	...	...
T6, T62, T6510 ^F , T6511 ^F	Extruded Wire, Rod, Bar, Profiles and Tube	...	6.30	all	all	260	...	240	...	8	...	...
		6.30	...	all	all	260	...	240	...	10	...	9
Alloy 6063												
O	Extruded Wire, Rod, Bar, Profiles, and Tube	all	all	all	all	...	130	...	...	18	16	...
T1	Extruded Wire, Rod, Bar, Profiles, and Tube	...	12.50	all	all	115	...	60	...	12	10	...
		12.50	25.00	all	all	110	...	55	...	10	10	...
		12.50	25.00	all	all	110	...	55	...	10	10	...
T4, T42 ^E	Extruded Wire, Rod, Bar, Profiles, and Tube	...	12.50	all	all	130	...	70	...	14	12	...
T4, T42 ^G	Extruded Wire, Rod, Bar, Profiles, and Tube	...	12.50	all	all	125	...	60	...	12	12	...
		12.50	25.00	all	all	125	...	60	...	12	12	...
		12.50	25.00	all	all	125	...	60	...	12	12	...

TABLE 2 *Continued*

Temper	Product Type ^C	Specified Section or Wall Thickness, mm		Area, mm ²		Tensile Strength, MPa		Yield Strength (0.2% offset), MPa(0.2%)		Elongation, ^{ED} %, min		in 50-mm
		...	...	over	incl	over	incl	min	max	min	max	
T5	Extruded Wire, Rod, Bar, Profiles, and Tube	...	12.50	all		150	...	110	...	8	7	
		12.50	25.00	all		145	...	105	...	7	7	
		12.50	25.00		145		105		7			
T52	Extruded Wire, Rod, Bar, Profiles, and Tube	...	25.00	all		150	205	110	170	8	7	
T54	Extruded Wire, Rod, Bar, and Profiles	...	3.20	all		225	...	205	...	8	...	
		3.20	12.50	all		225	...	205	...	10	...	
		3.20	12.50		225		205		10			
Alloy 6063 (Continued)												
T6, T62 ^{KE}	Extruded Wire, Rod, Bar, Profiles, and Tube	...	3.20	all		205	...	170	...	8	...	
T6, T62 ^G		...	3.20	all		205	...	170	...	8	...	
		3.20	25.00	all	205		170		10	9		
		3.20	25.00		205		170		10	9		
T65	Extruded Wire, Rod, Bar, and Profiles	...	5.00	all		250	...	230	...	7	...	
Alloy 6064												
T6	Extruded Wire, Rod, Bar, and Profiles	5.00	80.00	all		290	...	260	...	10	9	
T6511 ^F	Extruded Wire, Rod, Bar, and Profiles	5.00	80.00	all		290	...	260	...	10	9	
Alloy 6066												
O	Extruded Wire, Rod, Bar, Profiles, and Tube	all		all		...	200	...	125	16	14	
T4				all		275	...	170	...	14	12	
ASTM B221M-21												
T4, T4510, ^F T4511 ^F	Extruded Wire, Rod, Bar, Profiles, and Tube	all		all		275	...	170	...	14	12	
T4510 ^E		all										
T4511 ^E T42 ^E	Extruded Wire, Rod, Bar, Profiles, and Tube	all		all		275	...	165	...	14	12	
T42 ^G		all		all		275	...	165	...	14	12	
T6				all		345	...	310	...	8	7	
T6, T6510, ^F T6511 ^F	Extruded Wire, Rod, Bar, Profiles, and Tube	all		all		345	...	310	...	8	7	
T6510 ^E		all										
T6511 ^E T62 ^E	Extruded Wire, Rod, Bar, Profiles, and Tube	all		all		345	...	290	...	8	7	
T62 ^G		all		all		345	...	290	...	8	7	
Alloy 6070												
T6, T62 ^E		...	80.00	...	20 000	330	...	310	...	6	5	
T6, T62 ^G	Extruded Wire, Rod, Bar, Profiles, and Tube	...	80.00	...	20 000	330	...	310	...	6	5	
Alloy 6082												

TABLE 2 *Continued*

Temper	Product Type ^C	Specified Section or Wall Thickness, mm		Area, mm ²		Tensile Strength, MPa		Yield Strength (0.2% offset), MPa(0.2%)		Elongation, ϵ^D , %		in 50-mm
		min	max	min	max	min	max	min	max	min	max	
T6		5.00	20.00	all	310	...	260	...	6	8		
T6, T6511 ^F	Extruded Wire, Rod, Bar, and Profiles	5.00	20.00	all	310	...	260	...	6	8		
		20.00	150.00	all	310	...	260	...	8	8		
		150.00	200.00	all	280	...	240	...	8	8		
T6511		20.00	150.00	all	310	...	260	...	8			
T6	Extruded Tube	5.00	25.00	all	310	...	260	...	8	10		
		150.00	200.00	all	280	...	240	...	8			
Alloy 6105												
T4		...	12.5	all	170	...	105	...	16	14		
T1	Extruded Wire, Rod, Bar, Profiles, and Tube	...	12.50	all	170	...	105	...	16	14		
T5		...	3.20	all	250	...	240	...	8	...		
T5	Extruded Wire, Rod, Bar, Profiles, and Tube	...	12.50	all	260	...	240	...	8	7		
		3.20	25.00	all	250	...	240	...	10	9		
T6	Extruded Wire, Rod, Bar, and Profiles	...	12.50	all	260	...	240	...	8	7		
Alloy 6162												
T5,	Extruded Wire, Rod, Bar, Profiles, and Tube	...	25.00	all	255	...	235	...	7	6		
T5, T5510, ^F		...	25.00	all	255	...	235	...	7	6		
T5511 ^F		...	25.00	all	255	...	235	...	7	6		
T5510 ^E		...	25.00	all	255	...	235	...	7	6		
T5511 ^E		...	25.00	all	255	...	235	...	7	6		
T6,	Extruded Wire, Rod, Bar, Profiles, and Tube	...	6.30	all	260	...	240	...	8	...		
		...	6.30	all	260	...	240	...	8	...		
		...	6.30	all	260	...	240	...	8	...		
T6, T6510, ^F	Extruded Wire, Rod, Bar, Profiles, and Tube	...	6.30	all	260	...	240	...	8	...		
T6511 ^F		...	6.30	all	260	...	240	...	8	...		
		...	6.30	all	260	...	240	...	8	...		
T6510 ^E		6.30	12.50	all	260	...	240	...	10	9		
T6511 ^E		6.30	12.50	all	260	...	240	...	10	9		
		6.30	12.50	all	260	...	240	...	10	9		
Alloy 6262												
T6		...	12.50	all	260	...	240	...	10	9		
T6510 ^E		...	12.50	all	260	...	240	...	10	9		
T6, T62, ^G	Extruded Wire, Rod, Bar, Profiles, and Tube	...	20.00	all	13 000	...	180	...	15	13		
T6510, ^F T6511 ^F		...	20.00	all	13 000	...	180	...	15	13		
T6511 ^E		...	20.00	all	13 000	...	180	...	15	13		
Alloy 6351												
T1	Extruded Wire, Rod, Bar, and Profiles	...	12.50	...	13 000	...	180	...	15	13		
T11	Extruded Wire, Rod, Bar, and Profiles	...	20.00	all	13 000	...	180	...	16	14		

TABLE 2 *Continued*

Temper	Product Type ^C	Specified Section or Wall Thickness, mm		Area, mm ²		Tensile Strength, MPa		Yield Strength (0.2% offset), MPa(0.2%)		Elongation, ^{ED} %, min		in 50-mm
		over	incl	over	incl	over	incl	min	max	min	max	
T4	Extruded Wire, Rod, Bar, Profiles, and Tube	...	20.00	all		220	...	130	...	16	14	
T5	Extruded Wire, Rod, Bar, and Profiles	...	6.30	all		260	...	240	...	8	...	
		6.30	25.00	all		260	...	240	...	10	9	
		-6.30	25.00	all		260	...	240	...	10	9	
T51	Extruded Wire, Rod, Bar, and Profiles	-3.20	25.00	...	13 000	250	...	230	...	10	7	
T51		3.20	25.00	...	13 000	250	...	230	...	10	7	
T54	Extruded Wire, Rod, Bar, and Profiles	...	12.50	...	13 000	205	...	140	...	10	9	
T6	Extruded Wire, Rod, Bar, Profiles, and Tube	...	3.20	all		290	...	255	...	8	...	
		3.20	20.00	all		290	...	255	...	10	9	
		-3.20	20.00	all		290	...	255	...	10	9	
Alloy 6360												
T5	Extruded Wire, Rod, Bar, Profiles and Tube	...	6.30	all		150	...	110	...	8	...	
T6	Extruded Wire, Rod, Bar, Profiles, and Tube	...	3.20	all		205	...	170	...	8	...	
		3.20	6.30	all		205	...	170	...	10	...	
		3.20	6.30	all		205	...	170	...	10	...	
Alloy 6463												
T1	Extruded Wire, Rod, Bar, and Profiles	...	12.50	...	13 000	115	...	60	...	12	10	
T5	Extruded Wire, Rod, Bar, and Profiles	...	12.50	...	13 000	150	...	110	...	8	7	
T6, T62 ^E		...	3.20	...	13 000	205	...	170	...	8	...	
T6, T62 ^G	Extruded Wire, Rod, Bar, and Profiles	...	3.20	...	13 000	205	...	170	...	8	...	
		3.20	12.50	...	13 000	205	...	170	...	10	9	
		-3.20	12.50	...	13 000	205	...	170	...	10	9	
Alloy 6560												
T5	Extruded Wire, Rod, Bar, Profiles, and Tube	2.50	3.20	all		150	...	110	...	8	...	
T5		2.50	3.20	all		150	...	110	...	8	...	
T6	Extruded Wire, Rod, Bar, Profiles, and Tube	2.50	3.20	all		205	...	170	...	8	...	
T6		2.50	3.20	all		205	...	170	...	8	...	
Alloy 7005												
T53	Extruded Wire, Rod, Bar, and Profiles		20.00	all		345	...	305	...	10	9	
Alloy 7116												
Alloy 7075 ^E												
T5	Alloy 7129	-3.20	12.50	all		380	...	290	...	8	7	
T5, T6		...	12.50	all		380	...	340	...	9	8	
Alloy 7075												
O	Extruded Wire, Rod, Bar, Profiles, and Tube	all		all		275	...	165	...	10	9	