INTERNATIONAL STANDARD

ISO 6363-2

Second edition
2012-07-15

Wrought aluminium and aluminium alloys — Cold-drawn rods/bars and tubes and wires —

Part 2: Mechanical properties

Aluminium et alliages d'aluminium corroyés — Barres, tubes et fils étirés à froid —

Partie 2: Caractéristiques mécaniques

Reference number
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non–governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 6363-2 was prepared by Technical Committee ISO/TC 79, *Light metals and their alloys*, Subcommittee SC 6, *Wrought aluminium and aluminium alloys*.

This second edition cancels and replaces the first edition (ISO 6363-2:1993) which has been technically revised.

ISO 6363 consists of the following parts, under the general title *Wrought aluminium and aluminium alloys — Cold-drawn rods/bars, tubes and wires*:

— *Part 1: Technical conditions for inspection and delivery*

— *Part 2: Mechanical properties*

— *Part 3: Drawn round bars and wires — Tolerances on form and dimensions (symmetric plus and minus tolerances on diameter)*

— *Part 4: Drawn rectangular bars and wires — Tolerances on form and dimensions*

— *Part 5: Drawn square and hexagonal bars and wires — Tolerances on form and dimensions*

— *Part 6: Drawn round tubes — Tolerances on form and dimensions*

Wrought aluminium and aluminium alloys — Cold-drawn rods/ bars and tubes and wires —

Part 2: Mechanical properties

1 Scope

This part of ISO 6363 specifies the mechanical properties of wrought aluminium and aluminium alloy rods/bars, tubes and wires for general engineering applications (except aeronautical rivets).

It applies to products which are extruded and then cold drawn.

It does not apply to:

— products which are rolled and then cold drawn, including seam-welded tubes;

— forging stock, wire for drawing stock;

— drawn wires for aeronautical application, electrical or welding purposes.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6363-1, *Wrought aluminium and aluminium alloys — Cold-drawn rods/bars, tubes and wires — Part 1: Technical conditions for inspection and delivery*

ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ASTM B557M, *Standard Test Methods for Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6363-1 apply.

4 Tensile testing

For the selection of the specimens and tensile testing, use ISO 6892-1 or ASTM B557M.

5 Mechanical properties

Values for mechanical properties of aluminium and aluminium alloys are given in Tables 1 and 2.

For elongation, two different gauge lengths are used. The choice of the gauge length for elongation measurements (A or A_{50mm}) is at the discretion of the producer, unless otherwise agreed.

NOTE A is the percentage elongation on a gauge length of $5{,}65\sqrt{S_o}$ · A_{50mm} is the percentage elongation on a gauge length of 50 mm.

Test results shall be rounded in accordance with the rules given in Annex A.

Table 1 — Mechanical properties of rods/bars and wires

Alloy	Temper	Dimensions[a]	Tensile strength R_m MPa		0,2 % proof stress $R_{p0,2}$ MPa		Elongation min.	
			min.	max.	min.	max.	A %	A_{50mm} %
1050	O	D or $S \leq 3$	60	100	–	–	–	–
		$3 < D$ or $S \leq 100$	60	100	20	–	–	25
	H14	D or $S \leq 10$	95	–	–	–	–	–
	H18	D or $S \leq 10$	125	–	–	–	–	–
1050A	O	D or $S \leq 30$	60	–	20	–	25	–
	H14	D or $S \leq 30$	100	–	70	–	6	5
	H16	$D \leq 15$ or $S \leq 5$	120	160	105	–	4	3
	H18	D or $S \leq 10$	130	–	110	–	3	–
1070	O	D or $S \leq 3$	55	95	–	–	–	–
		$3 < D$ or $S \leq 100$	55	95	15	–	–	25
	H14	D or $S \leq 10$	85	–	–	–	–	–
	H18	D or $S \leq 10$	120	–	–	–	–	–
1080A	O	$D \leq 20$	–	80	–	–	–	–
	H14	$D \leq 18$	90	–	–	–	–	–
	H18	$D \leq 10$	120	–	–	–	–	–
1098	O	$D \leq 20$	–	70	–	–	–	–
	H14	$D \leq 18$	85	–	–	–	–	–
	H18	$D \leq 10$	115	–	–	–	–	–
1100	O	D or $S \leq 3$	75	110	–	–	–	–
		$3 < D$ or $S \leq 100$	75	110	20	–	22	25
	H14	D or $S \leq 30$	110	–	80[b]	–	5	–
	H18	D or $S \leq 10$	150	–	130[b]	–	3	–
1200	O	D or $S \leq 3$	75	110	–	–	–	–
		$3 < D$ or $S \leq 30$	75	110	30	–	20	25
		$30 < D$ or $S \leq 100$	75	110	20	–	–	25
	H14	D or $S \leq 30$	110	–	80	–	5	–
	H16	$D \leq 15$ or $S \leq 5$	135	170	115		3	3
2007	T3	D or $S \leq 30$	370	–	240	–	7	5
		$30 < D$ or $S \leq 80$	340	–	220	–	6	–
	T351	D or $S \leq 80$	370	–	240	–	5	3
2011	T3	$3 < D$ or $S \leq 38$	310	–	260	–	9	10
		$38 < D$ or $S \leq 50$	295	–	235	–	10	12
		$50 < D$ or $S \leq 80$	280	–	205	–	10	14
	T8	$3 \leq D$ or S ≤ 80	370	–	270	–	8	10
	H13	$D \leq 18$	155	225	–	–	–	–
	H18	$D \leq 10$	240	–	–	–	–	–

Table 1 *(continued)*

Alloy	Temper	Dimensions[a]	Tensile strength R_m MPa		0,2 % proof stress $R_{p0,2}$ MPa		Elongation min.	
			min.	max.	min.	max.	A %	A_{50mm} %
2011A	T3	D or $S \leq 40$	320	–	270	–	10	8
		$40 < D$ or $S \leq 50$	300	–	250	–	10	–
		$50 < D$ or $S \leq 80$	280	–	210	–	10	–
	T8	D or $S \leq 80$	370	–	270	–	8	6
2014	O	$3 \leq D$ or $S \leq 100$	–	245	–	–	–	12
	T3	D or $S \leq 80$	380	–	290	–	8	6
	T351	D or $S \leq 80$	380	–	290	–	6	4
	T4 T42[c] T451	$3 \leq D$ or $S \leq 100$	380	–	220	–	10	16
	T6 T62[d] T651	$3 \leq D$ or $S \leq 100$	450	–	380	–	7	8
2014A	O H111	D or $S \leq 80$	–	240	–	125	12	10
	H13[e]	$D \leq 18$	210	280	–	–	–	–
	H18	$D \leq 10$	295	–	–	–	–	–
	T3	D or $S \leq 80$	380	–	290	–	8	6
	T351	D or $S \leq 80$	380	–	290	–	6	4
	T4 T451	D or $S \leq 100$	380	–	220	–	10	10
	T6	D or $S \leq 50$	440	–	360	–	7	8
	T651	D or $S \leq 100$	450	–	380	–	7	8
2017	O	D or $S \leq 3$	–	245	–	–	–	–
		$3 < D$ or $S \leq 100$	–	245	–	–	–	16
	H13	$3 \leq D$ or $S \leq 10$	205	275	–	–	–	–
	T4	D or $S \leq 3$	380	–	–	–	–	–
	T42[c]	$3 < D$ or $S \leq 100$	380	–	225	–	–	12
2017A	O H111	D or $S \leq 80$	–	240	–	125	12	10
	H13[e]	$D \leq 18$	210	300	–	–	–	–
	H18	$D \leq 10$	315	–	–	–	–	–
	T3	D or $S \leq 80$	400	–	250	–	10	8
	T351	D or $S \leq 80$	400	–	250	–	8	6
	T4	D or $S \leq 50$	380	–	220	–	10	–
	T451	$50 < D$ or $S \leq 100$	390	–	235	–	10	–

Table 1 *(continued)*

Alloy	Temper	Dimensions[a]	Tensile strength R_m MPa		0,2 % proof stress $R_{p0,2}$ MPa		Elongation min.	
			min.	max.	min.	max.	A %	A_{50mm} %
2117	H13[e]	D or $S \leq 18$	170	240	–	–	–	–
	H15	$3 < D$ or $S \leq 10$	195	245	–	–	–	–
	H18	$D \leq 18$	260	–	–	–	–	–
	T4	$3 < D$ or $S \leq 10$	265	–	125	–	–	18
2024	O[f]	D or $S \leq 3$	–	245	–	–	–	–
	H111	$3 < D$ or $S \leq 100$	–	245	–	–	–	16
	H13[e]	$D \leq 18$	230	300	–	–	–	–
	H18	$D \leq 10$	320	–	–	–	–	–
	T3	D or $S \leq 10$	425	–	310	–	10	8
		$10 < D$ or $S \leq 80$	425	–	290	–	9	7
	T351	$12,5 < D$ or $S \leq 100$	425	–	310	–	9	–
	T4	D or $S \leq 3$	425	–	–	–	–	–
	T451	$3 < D$ or $S \leq 12$	425	–	310	–	10	10
		$12 < D$ or $S \leq 100$	425	–	290	–	9	10
	T42[c]	D or $S \leq 3$	430	–	–	–	–	–
		$3 < D$ or $S \leq 100$	430	–	275	–	–	10
	T6	D or $S \leq 80$	425	–	315	–	5	4
	T651	D or $S \leq 80$	425	–	315	–	4	3
	T62[d]	D or $S \leq 3$	410	–	–	–	–	–
		$3 < D$ or $S \leq 100$	410	–	315	–	–	5
	T8	D or $S \leq 80$	455	–	400	–	4	3
	T851	D or $S \leq 80$	455	–	400	–	3	2
2030	T3	D or $S \leq 50$	370	–	250	–	7	–
		$50 < D$ or $S \leq 100$	340	–	210	–	7	–
	T351	D or $S \leq 80$	370	–	240	–	5	3
2219	T851	$10 < D$ or $S \leq 50$	400	–	275	–	3	–
		$50 < D$ or $S \leq 100$	395	–	270	–	3	–
3003	O	D or $S \leq 3$	95	125	–	–	–	–
		$3 < D$ or $S \leq 100$	95	125	35	–	22	25
	H12	D or $S \leq 10$	115	–	80[b]	–	7[b]	–
	H14	D or $S \leq 10$	135	–	110 [b]	–	6[b]	–
	H16	$D \leq 15$ or $S \leq 5$	160	–	130 [b]	–	3[b]	–
	H18	D or $S \leq 10$	180	–	145 [b]	–	2[b]	–
3103	O	D or $S \leq 50$	95	–	35	–	22	19
	H14	D or $S \leq 30$	130	–	90	–	6	4
	H16	$D \leq 15$ or $S \leq 5$	160	195	130	–	4	3
	H18	D or $S \leq 10$	160	–	130	–	4	3

Table 1 *(continued)*

Alloy	Temper	Dimensions[a]	Tensile strength R_m MPa		0,2 % proof stress $R_{p0,2}$ MPa		Elongation min.	
			min.	max.	min.	max.	A %	A_{50mm} %
5005	O H111	$D \leq 80$ or $S \leq 60$	100	145	40	–	18	16
	H14	$D \leq 40$ or $S \leq 10$	140	–	110	–	6	4
	H18	$D \leq 15$ or $S \leq 2$	185	–	155	–	4	2
5005A	O H111	$D \leq 80$ or $S \leq 60$	100	145	40	–	18	16
	H14	$D \leq 40$ or $S \leq 10$	140	–	110	–	6	4
	H18	$D \leq 15$ or $S \leq 2$	185	–	155	–	4	2
5019	O H111	$D \leq 80$ or $S \leq 60$	250	320	110	–	16	14
	H12 H22 H32	$D \leq 40$ or $S \leq 25$	270	350	180	–	8	7
	H14 H24 H34	$D \leq 25$ or $S \leq 10$	300	–	210	–	4	3
5041	O	D or $S \leq 25$	225	–	–	–	–	20
5050	O	D or $S \leq 10$	125	180	–	–	25	22
	H32	D or $S \leq 10$	150	–	–	–	–	–
	H34	D or $S \leq 10$	170	–	–	–	–	–
	H36	D or $S \leq 10$	185	–	–	–	–	–
	H38	D or $S \leq 10$	200	–	–	–	–	–
5051A	O	$D \leq 20$	–	195	–	–	–	–
	H12	$D \leq 18$	170	220	–	–	–	–
	H14	$D \leq 18$	195	245	–	–	–	–
	H18	$D \leq 10$	245	–	–	–	–	–
5052	O	D or $S \leq 3$	170	220	–	–	–	–
	H111	$3 < D$ or $S \leq 100$	170	220	65	–	22	25
	H32	$3 < D$ or $S \leq 10$	215	255	–	–	–	–
	H14	D or $S \leq 3$	235	–	–	–	–	–
		$3 < D$ or $S \leq 30$	235	–	180	–	5	–
	H34	D or $S \leq 3$	235	–	–	–	–	–
		$3 < D$ or $S \leq 30$	235	–	180	–	6[b]	–
	H16 H26 H36	D or $S \leq 15$	250	290	200	–	3	3
	H18	D or $S \leq 10$	270	–	220	–	2	–
	H38	D or $S \leq 10$	270	–	220[b]	–	2[b]	–

Table 1 *(continued)*

Alloy	Temper	Dimensions[a]	Tensile strength R_m MPa		0,2 % proof stress $R_{p0,2}$ MPa		Elongation min.	
			min.	max.	min.	max.	A %	A_{50mm} %
5056	O	D or $S \leq 3$	–	315	–	–	–	–
		$3 < D$ or $S \leq 100$	250	320	110	–	16	20
	H12 H32	D or $S \leq 10$	300	–	–	–	–	–
	H34	D or $S \leq 10$	345	–	–	–	–	–
	H38	D or $S \leq 10$	380	–	–	–	–	–
5083	O	D or $S \leq 3$	275	355	–	–	–	–
		$3 < D$ or $S \leq 100$	275	355	110	–	14	14
	H111	D or $S \leq 50$	270	–	140	–	12	–
	H12	D or $S \leq 30$	300	–	200	–	4	–
5086	O	D or $S \leq 50$	240	–	95	–	16	–
	H12	D or $S \leq 25$	270	–	190	–	4	–
	H32	D or $S \leq 25$	270	–	190	–	5	–
5154	O	D or $S \leq 10$	205	285	75	–	20	16
	H32	D or $S \leq 10$	250	–	–	–	–	–
	H34	D or $S \leq 10$	270	–	–	–	–	–
	H36	D or $S \leq 10$	290	–	–	–	–	–
	H38	D or $S \leq 10$	310	–	–	–	–	–
5251	O H111	$D \leq 80$ or $S \leq 60$	150	200	60	–	17	15
	H14 H24 H34	$D \leq 30$ or $S \leq 5$	200	240	160	–	5	4
	H18 H28 H38	$D \leq 20$ or $S \leq 3$	240	–	200		2	2
5754	O	D or $S \leq 50$	180	–	80	–	16	–
	H14	D or $S \leq 30$	250	–	180	–	4	–
	H34	D or $S \leq 30$	250	–	180	–	5	–
	H18	D or $S \leq 10$	280	–	240	–	2	–
	H38	D or $S \leq 10$	280	–	240	–	3	–
6012	T4[g]	D or $S \leq 80$	200	–	100	–	10	8
	T6[g]	D or $S \leq 80$	310	–	260	–	8	6
6056	H13[d]	$D \leq 18$	160	240	–	–	–	–
	H18	$D \leq 10$	240	–	–	–	–	–
	T39[i]	$D < 6$	400	–	–	–	–	–
	T39[i]	$D \geq 6$	360	–	–	–	–	–
	T4	$D \leq 20$	300	380	–	–	–	–
	T6	$D \leq 20$	400	–	–	–	–	–
	T89[i]	$D < 6$	420	–	–	–	–	–

Table 1 *(continued)*

Alloy	Temper	Dimensions[a]	Tensile strength R_m MPa		0,2 % proof stress $R_{p0,2}$ MPa		Elongation min.	
			min.	max.	min.	max.	A %	A_{50mm} %
6060	T39[i]	$D \geq 6$	220	–	–	–	–	–
	T39[i]	$D < 6$	270	–	–	–	–	–
	T4[g]	D or $S \leq 80$	130	–	65	–	15	13
	T6[g]	D or $S \leq 80$	215	–	160	–	12	10
	T89[i]	$D < 6$	260	–	–	–	–	–
6061	O[f]	D or $S \leq 3$	145	–	–	–	–	–
		$3 < D$ or $S \leq 100$	145	–	–	–	–	18
	H13[h]	$3 \leq D$ or $S \leq 10$	155	205	–	–	–	–
	H18	$D \leq 10$	210	–	–	–	–	–
	T39	$D < 6$	310	–	–	–	–	–
		$6 \leq D$	260	–	–	–	–	–
	T4	D or $S \leq 3$	205	–	–	–	–	–
		$3 < D$ or $S \leq 100$	205	–	110	–	16	18
	T42[c]	D or $S \leq 3$	205	–	–	–	–	–
		$3 < D$ or $S \leq 100$	205	–	95	–	–	18
	T6	D or $S \leq 3$	290	–	–	–	–	–
	T62[d]	$3 < D$ or $S \leq 100$	290	–	240	–	9	10
	T89[i]	$D < 6$	300	–	–	–	–	–
6063	T39[i]	$D \geq 6$	230	–	–	–	–	–
	T39[i]	$D < 6$	280	–	–	–	–	–
	T4[g]	D or $S \leq 80$	150	–	75	–	15	13
	T6[g]	D or $S \leq 80$	220	–	190	–	10	8
	T66[g]	D or $S \leq 80$	230	–	195	–	10	8
	T89[i]	$D < 6$	270	–	–	–	–	–
6063A	O H111	D or $S \leq 80$	–	140	–	–	15	13
	T4[g]	D or $S \leq 80$	150	–	90	–	16	14
	T6[g]	D or $S \leq 80$	230	–	190	–	9	7
6065	T6[g]	$D \leq 120$ or $S \leq 85$	290	–	240	–	10	8
	T8[g]	$D \leq 120$ or $S \leq 85$	345	–	315	–	4	3
	T9[g]	$D \leq 120$ or $S \leq 85$	360	–	330	–	4	3
6082	O	D or $S \leq 80$	–	160	–	110	15	–
	H13[h]	$D \leq 18$	165	225	–	–	–	–
	H18	$D \leq 10$	220	–	–	–	–	–
	T39[i]	$D < 6$	360	–	–	–	–	–
	T39[i]	$6 \leq D$	310	–	–	–	–	–
	T4	D or $S \leq 80$	205	–	110	–	14	–
	T6	D or $S \leq 80$	310	–	255	–	10	–
	T8	D or $S \leq 80$	310	–	260	–	8	–
	T89[i]	$D < 6$	340	–	–	–	–	–

Table 1 *(continued)*

Alloy	Temper	Dimensions[a]	Tensile strength R_m MPa		0,2 % proof stress $R_{p0,2}$ MPa		Elongation min.	
			min.	max.	min.	max.	A %	A_{50mm} %
6181	T4	D or $S \leq 50$	200	–	100	–	15	–
	T6	D or $S \leq 50$	280	–	240	–	8	–
6262	T6	D or $S \leq 100$	290	–	240	–	8	7
	T8[g]	D or $S \leq 50$	345	–	315	–	4	3
	T9	D or $S \leq 50$	360	–	330	–	4	5
		$50 < D$ or $S \leq 80$	345	–	315	–	4	–
6262A	T6[g]	$D \leq 120$ or $S \leq 85$	290	–	240	–	10	8
	T8[g]	$D \leq 120$ or $S \leq 85$	345	–	315	–	4	3
	T9[g]	$D \leq 120$ or $S \leq 85$	360	–	330	–	4	3
7020	T5 T6	D or $S \leq 50$	350	–	280	–	10	–
7022	T6[g]	D or $S \leq 80$	460	–	380	–	8	6
7049A	T6	$D \leq 80$	590	–	500	–	7	–
7075	O[f]	$3 \leq D$ or $S \leq 100$	–	275	–	–	–	10
	H13[h]	$D \leq 18$	230	310	–	–	–	–
	H18	$D \leq 10$	285	–	–	–	–	–
	T6 T62[d] T651	$3 \leq D$ or $S \leq 100$	520	–	460	–	6	7
	T73	D or $S \leq 100$	470	–	385	–	9	7

[a] D (mm) = diameter for round bar.

S (mm) = width across flats for square and hexagonal bar, thickness for rectangular bar.

[b] Guaranteed values agreed upon between the purchaser and the supplier where requested by the purchaser.

[c] The mechanical properties of temper grade T42 shall be applied only where the material of temper grade O has been naturally age-hardened after solution treatment by the purchaser. If the material is cold or hot worked prior to solution treatment by the purchaser, its mechanical properties may be lower than the specified values.

[d] The mechanical properties of temper grade T62 shall be applied only where the material of temper grade O has been artificially age-hardened after solution treatment by the purchaser. If the material is cold or hot worked prior to solution treatment by the purchaser, its mechanical properties may be lower than the specified values.

[e] Mechanical properties shall be tested in T4 temper (alloys 2017A, 2117 and 2024) or T6 temper (alloy 2014A).Testing may also be carried out in T42 temper or T62 temper, instead of T4 or T6 respectively. In this case, the mechanical property limits are those given for the corresponding T4 and T6 tempers.

[f] The material of temper grade O shall be a basis for materials of temper grades T42 or T62. Where requested by the purchaser, the capability to achieve T42 or T62 properties after appropriate heat treatment is demonstrated.

[g] Applicable to those after extrusion followed by controlled cooling at a rate rapid enough to hold constituents in solution.

[h] Mechanical properties shall be tested in T6 temper. Testing may also be carried out in T62 temper, instead of T6. In this case, the mechanical property limits are those given for the corresponding T6 tempers.

[i] For these tempers, the mechanical properties are very dependent on the amount of cold work and, for T89 temper, on the ageing conditions. It is recommended that these characteristics be agreed between the supplier and purchaser. Consequently, typical values of $R_{p0,2}$ and elongation are not given.

Table 2 — Mechanical properties of tubes

Alloy	Temper	Dimensions[a]	Tensile strength R_m MPa		0,2 % proof stress $R_{p0,2}$ MPa		Elongation min.	
			min.	max.	min.	max.	A %	A_{50mm} %
1050	O	$0,4 \le t \le 12$	60	100	–	–	–	–
	H14	$0,4 \le t \le 12$	95	–	–	–	–	–
	H16	$0,4 \le t \le 12$	110	–	–	–	–	–
	H18	$0,4 \le t \le 12$	125	–	–	–	–	–
1050A	O	$0,5 \le t \le 10$	60	95	20	–	25	22
	H14	$0,5 \le t \le 6$	100	—	70	–	6	3
	H16	$t \le 5$	120	160	105	–	4	3
	H18	$0,5 \le t \le 3$	130	—	110		3	2
1070	O	$0,4 \le t \le 12$	55	95	–	–	–	–
	H14	$0,4 \le t \le 12$	85	–	–	–	–	–
	H16	$0,4 \le t \le 12$	95	–	–	–	–	–
	H18	$0,4 \le t \le 12$	120	–	–	–	–	–
1100 1200	O	$0,4 \le t \le 12$	75	110	–	–	–	–
	H14	$0,4 \le t \le 12$	110	–	–	–	–	–
	H16	$0,4 \le t \le 12$	135	–	–	–	–	–
	H18	$0,4 \le t \le 12$	155	–	–	–	–	–
2007	T3	$t \le 20$	370	–	250	–	7	5
	T3510 T3511	$t \le 20$	370	–	240	–	5	3
2011	T3	$0,5 \le t \le 6$	310	–	260	–	10	8
		$6 < t \le 20$	290	–	240	–	8	9
	T8	$0,5 \le t \le 20$	370	–	275	–	8	8
2011A	T3	$t < 5$	310	–	260	–	10	8
		$5 \le t \le 20$	290	–	240	–	8	6
	T8	$t \le 20$	370	–	275	–	8	6
2014	T3	$0,5 \le t \le 10$	380	–	250	–	8	10
2014A	T3510 T3511	$t \le 20$	380	–	290	–	6	4
	T4	$0,5 \le t \le 6$	370	–	205	–	10	9
		$6 < t \le 10$	370	–	205	–	10	10
	T4510 T4511	$t \le 20$	380	–	240	–	10	8
	T6	$0,5 \le t \le 6$	450	–	370	–	6	5
		$6 \le t \le 10$	450	–	370	–	7	7
	T6510 T6511	$t \le 20$	450	–	380	–	6	4
2017	O[b]	$0,6 \le t \le 12$	–	245	–	125	–	17
	T3	$0,6 \le t \le 12$	375	–	215	–	–	13
	T42[c]	$0,6 \le t \le 12$	345	–	195	–	–	13

Table 2 *(continued)*

Alloy	Temper	Dimensions[a]	Tensile strength R_m MPa		0,2 % proof stress $R_{p0,2}$ MPa		Elongation min.	
			min.	max.	min.	max.	A %	A_{50mm} %
2017A	O H111	$t \leq 20$		240	–	125	12	10
	T3	$t \leq 20$	400	–	250	–	10	8
	T3510 T3511	$t \leq 20$	400	–	250	–	8	6
2024	O[b]	$0,6 \leq t \leq 12$	–	215	–	100	–	–
	T3	$0,6 \leq t \leq 1,2$	440	–	295	–	–	12
		$1,2 < t \leq 6,5$	440	–	295	–	–	14
		$6,5 < t \leq 12$	440	–	295	–	–	16
	T42[c]	$0,6 \leq t \leq 1,2$	440	–	275	–	–	12
		$1,2 < t \leq 6,5$	440	–	275	–	–	14
		$6,5 < t \leq 12$	440	–	275	–	–	16
2030	T3	$1 \leq t \leq 6$	370	–	250	–	10	–
		$6 < t \leq 20$	360	–	230	–	8	–
3003 3103 3203	O	$0,4 \leq t \leq 1,2$	95	125	35	–	–	30
		$1,2 < t \leq 6,5$	95	125	35	–	–	35
		$6,5 < t \leq 12$	95	125	35	–	–	–
	H11	$t \leq 17$	105	140	55	–	20	16
	H12	$t \leq 15$	115	150	75	–	14	12
	H13	$t \leq 12$	125	160	95	–	11	8
	H14	$0,4 \leq t \leq 0,6$	135	–	120	–	–	3
		$0,6 < t \leq 1,2$	135	–	120	–	–	5
		$1,2 < t \leq 6,5$	135	–	120	–	–	8
	H15	$t \leq 7$	145	180	120	–	5	4
	H16	$t \leq 5$	160	195	130	–	4	3
	H17	$t \leq 4$	170	205	140	–	3	2
	H18	$0,4 \leq t \leq 0,6$	185	–	165	–	–	2
		$0,6 < t \leq 1,2$	185	–	165	–	–	3
		$1,2 < t \leq 6,5$	185	–	165	–	–	5
5005	O	$0,5 \leq t \leq 10$	100	–	40	–	20	18
	H12	$0,5 \leq t \leq 5$	115	–	80	–	7	4
	H14	$0,5 \leq t \leq 5$	140	–	90	–	6	3
	H18	$0,5 \leq t \leq 1,5$	185	–	155	–	4	2
5005A	O H111	$t \leq 20$	100	145	40	–	18	16
	H14	$t \leq 5$	140	–	110	–	6	4
	H18	$t \leq 3$	185	–	155	–	4	2

Table 2 *(continued)*

Alloy	Temper	Dimensions[a]	Tensile strength R_m MPa		0,2 % proof stress $R_{p0,2}$ MPa		Elongation min.	
			min.	max.	min.	max.	A %	A_{50mm} %
5019	O H111	$t \leq 20$	250	320	110	–	16	14
	H12 H22 H32	$t \leq 10$	270	350	180	–	8	7
	H14 H24 H34	$t \leq 5$	300	380	220	–	4	3
	H16 H26 H36	$t \leq 3$	320	–	260	–	2	2
5049	O H111	$t \leq 20$	180	250	80		17	15
	H11	$t \leq 17$	195	260	100		13	12
	H12	$t \leq 15$	210	270	120	–	10	9
	H13	$t \leq 12$	225	280	140	–	7	6
	H14	$t \leq 10$	240	290	160	–	4	3
	H15	$t \leq 7$	250	300	180	–	3	2
	H16	$t \leq 5$	260	310	200	–	3	2
	H17	$t \leq 4$	270	320	220	–	2	1
	H18	$t \leq 3$	280	–	240	–	2	1
5050	O	$0,5 \leq t \leq 10$	125	165	40	–	19	17
	H32	$0,5 \leq t \leq 10$	150	–	110	–	–	–
	H34	$0,5 \leq t \leq 5$	170	–	140	–	5	3
	H36	$0,5 \leq t \leq 5$	185	–	150	–	–	–
	H38	$0,5 \leq t \leq 1,5$	200	–	165	–	3	2
5052	O	$0,6 \leq t \leq 12$	175	245	70	–	–	–
	H14 H34	$0,6 \leq t \leq 12$	235	–	175	–	–	–
	H18 H38	$0,6 \leq t \leq 6$	275	–	215	–	–	–
5056	O	$0,6 \leq t \leq 12$	–	315	100	–	–	–
	H22[d] H32	$0,6 \leq t \leq 12$	305	–	–	–	–	–
5083	O	$0,6 \leq t \leq 12$	275	355	110	–	–	14
	H22[d] H32	$0,6 \leq t \leq 12$	315	–	235	–	–	5

Table 2 *(continued)*

Alloy	Temper	Dimensions[a]	Tensile strength R_m MPa		0,2 % proof stress $R_{p0,2}$ MPa		Elongation min.	
			min.	max.	min.	max.	A %	A_{50mm} %
5086	O	$0,5 \leq t \leq 10$	240	–	95	–	16	14
	H12	$0,5 \leq t \leq 5$	270	–	190	–	4	3
	H14	$0,5 \leq t \leq 3$	305	–	230	–	3	2
	H32	$0,5 \leq t \leq 5$	270	–	190	–	5	4
	H33	$0,5 \leq t \leq 3$	300	–	230	–	3	2
5154	O	$0,6 \leq t \leq 12$	205	285	75	–	–	–
5154A	O H111	$t \leq 20$	200	260	85	–	16	14
	H14 H24 H34	$t \leq 10$	260	320	200	–	5	4
	H18 H28 H38	$t \leq 5$	310	–	240	–	3	2
5251	O	$0,5 \leq t \leq 10$	150	200	60	–	17	15
	H12	$0,5 \leq t \leq 5$	180	–	110	–	5	4
	H14	$0,5 \leq t \leq 5$	200	–	160	–	4	3
	H16	$0,5 \leq t \leq 1,5$	220	–	180	–	3	2
	H18	$0,5 \leq t \leq 1,5$	235	–	200	–	2	2
5754	O	$0,5 \leq t \leq 10$	180	–	80	–	17	15
	H12	$0,5 \leq t \leq 5$	215	–	140	–	5	4
	H14	$0,5 \leq t \leq 5$	250	–	180	–	4	3
	H34	$0,5 \leq t \leq 5$	250	–	180	–	5	4
6012	T4[e]	$t \leq 20$	200	–	100	–	10	8
	T6[e]	$t \leq 20$	310	–	260	–	8	6
6060	T4	$0,5 \leq t \leq 10$	130	–	65	–	15	–
	T5 T6	$0,5 \leq t \leq 10$	215	–	160	–	12	–
	T8	$0,5 \leq t \leq 10$	215	–	160	–	10	–
6061	O[b]	$0,6 \leq t \leq 12$	–	145	–	100	–	15
	T4	$0,6 \leq t \leq 1,2$	205	–	110	–	–	16
		$1,2 < t \leq 6,5$	205	–	110	–	–	18
		$6,5 < t \leq 12$	205	–	110	–	–	20
	T42[c]	$0,6 \leq t \leq 1,2$	205	–	95	–	–	16
		$1,2 < t \leq 6,5$	205	–	95	–	–	18
		$6,5 < t \leq 12$	205	–	95	–	–	20
	T6 T62[f]	$0,6 \leq t \leq 1,2$	295	–	245	–	10	10
		$1,2 < t \leq 6,5$	295	–	245	–	12	12
		$6,5 < t \leq 12$	295	–	245	–	14	14

Table 2 *(continued)*

Alloy	Temper	Dimensions[a]	Tensile strength R_m MPa		0,2 % proof stress $R_{p0,2}$ MPa		Elongation min.	
			min.	max.	min.	max.	A %	A_{50mm} %
6063	O	$0,6 \leq t \leq 12$	–	125	–	–	–	–
	T4[e]	$t \leq 5$	150	–	75	–	12	10
		$5 < t \leq 20$	150	–	75	–	15	13
	T6	$0,6 \leq t \leq 1,2$	225	–	195	–	–	12
		$1,2 < t \leq 6,5$	225	–	195	–	–	14
		$6,5 < t \leq 12$	225	–	195	–	–	16
	T66[e]	$t \leq 20$	230	–	195	–	10	8
	T83	$0,6 \leq t \leq 12$	225	–	205	–	–	5
	T832[e]	$t \leq 5$	275	–	240	–	5	5
6063A	O H111	$t \leq 20$	–	140	–	–	15	13
	T4[e]	$t \leq 20$	150	–	90	–	16	14
	T6[e]	$t \leq 20$	230	–	190	–	9	7
6082	O	$0,5 \leq t \leq 10$	–	160	–	110	–	–
	T4	$0,5 \leq t \leq 10$	205	–	110	–	14	12
	T6	$0,5 \leq t \leq 5$	310	–	255	–	8	7
	T8	$0,5 \leq t \leq 5$	310	–	240	–	9	8
		$5 < t \leq 10$	310	–	260	–	8	8
6262	T6	$1 \leq t \leq 6$	290	–	240	–	8	7
		$6 < t \leq 10$	290	–	240	–	8	8
	T9	$1 \leq t \leq 10$	330	–	305	–	3	3
7020	T6[e]	$t \leq 20$	350	–	280	–	10	8
7022	T6[e]	$t \leq 20$	460	–	380	–	8	6
7049A	T6	$t \leq 5$	590	–	530	–	6	4
	T6510 T6511	$5 < t \leq 20$	590	–	530	–	7	5

Table 2 *(continued)*

Alloy	Temper	Dimensions[a]	Tensile strength R_m MPa		0,2 % proof stress $R_{p0,2}$ MPa		Elongation min.	
			min.	max.	min.	max.	A %	A_{50mm} %
7075	O[b]	$0,6 \leq t \leq 1,2$	–	275	–	145	–	10
		$1,2 < t \leq 12$	–	275	–	145	–	12
	T6	$0,6 \leq t \leq 6,5$	530	–	460	–	–	8
	T62[f]	$6,5 < t \leq 12$	530	–	460	–	–	9
	T6510 T6511	$t \leq 20$	540	–	485	–	5	4
	T73[e]	$t \leq 20$	455	–	385	–	10	8
	T73510[e] T73511[e]	$t \leq 20$	455	–	385	–	8	6

[a] t (mm) = wall thickness.

[b] The material of temper grade O shall be a basis for materials of temper grades T42 or T62. Where requested by the purchaser, the capability to achieve T42 or T62 properties after appropriate heat treatment is demonstrated.

[c] The mechanical properties of temper grade T42 shall be applied only where the material of temper grade O has been naturally age-hardened after solution treatment by the purchaser. If the material is cold or hot worked prior to solution treatment by the purchaser, its mechanical properties may be lower than the specified values.

[d] For temper grade H22, proof stress shall not apply.

[e] Applicable for those after extrusion followed by controlled cooling at a rate rapid enough to hold constituents in solution.

[f] The mechanical property values of temper grade T62 shall be applied where the purchaser carries out solution heat treatment and subsequent artificial age-hardening treatment for temper grade O. However, where a certain cold working or hot working has been conducted by the purchaser prior to solution heat treatment, the values of mechanical properties may occasionally be lower than the specified limits.

Annex A
(normative)

Rules for rounding

A.1 Rounding of results obtained by inspection and testing

A.1.1 Mechanical and chemical properties

The results of mechanical and chemical tests shall be rounded using either the rules specified in the International Standard specifying the method of test or, if the value obtained contains a larger number of significant figures than the guaranteed value, the generally accepted rules for rounding.

A.1.2 Dimensional characteristics

The results of determinations of dimensions (length, width, thickness, rounding, etc.) and shape (squaring, cambering, straightness, flatness, kinking, circularity, etc.) are not rounded. These shall comply with the specification in the relevant International Standard, taking into account permissible tolerances also given in that International Standard.

A.2 Rounding of determination of compliance

In recording test results, the number representing the result of a test to determine a given property or to determine chemical composition should be expressed to the same number of decimal places as the corresponding number in the relevant International Standard.

The following rules should be used for rounding.

a) Where the figure immediately after the last figure to be retained is less than 5, the last figure to be retained remains unchanged.

b) Where the figure immediately after the last figure to be retained is greater than 5, or equal to 5 and followed by at least one figure other than zero, the last figure to be retained remains unchanged if even and is increased by one if odd.

c) Where the figure immediately after the last figure to be retained is equal to 5 and followed by zeros only, the last figure to be retained remains unchanged if even and is increased by one if odd.

Annex B
(normative)

List of tempers used in Tables 1 and 2

Table B.1 — Description of the tempers used in Tables 1 and 2

Temper	Description
F	As fabricated (no mechanical property limits specified)
O	Annealed — products achieving the required annealed properties after hot forming processes may be designated as O temper
H11	Strain-hardened — 1/8 hard
H111	Annealed and slightly strain-hardened (less than H11) during subsequent operations such as stretching or straightening
H12	Strain-hardened — 1/4 hard
H13	Strain-hardened — 3/8 hard
H14	Strain-hardened — 1/2 hard
H15	Strain-hardened — 5/8 hard
H16	Strain-hardened — 3/4 hard
H17	Strain-hardened — 7/8 hard
H18	Strain-hardened — 4/4 hard (fully hardened)
H22	Strain-hardened and partially annealed — 1/4 hard
H24	Strain-hardened and partially annealed — 1/2 hard
H26	Strain-hardened and partially annealed — 3/4 hard
H28	Strain-hardened and partially annealed — 4/4 hard (fully hardened)
H32	Strain-hardened and stabilized — 1/4 hard
H34	Strain-hardened and stabilized — 1/2 hard
H36	Strain-hardened and stabilized — 3/4 hard
H38	Strain-hardened and stabilized — 4/4 hard (fully hardened)
T3	Solution heat-treated, cold worked and naturally aged
T351	Solution heat-treated, stress-relieved by stretching a controlled amount (permanent set 1 %, to 3 %) and naturally aged. The products receive no further straightening after stretching
T3510	Solution heat-treated, stress-relieved by stretching a controlled amount (permanent set 1 % to 3 %) and naturally aged. The products receive no further straightening after stretching
T3511	Same as T3510 except that minor straightening is allowed after stretching to comply with standard tolerances
T39*	Solution heat-treated and cold worked an appropriate amount to achieve the specified mechanical properties. Cold work may be carried out before or after natural ageing
T4	Solution heat-treated and naturally aged
T42	Solution heat-treated and naturally aged. Applies to test material heat-treated from annealed or F temper or to products heat-treated from any temper by the user
T451	Solution heat-treated, stress-relieved by stretching a controlled amount (permanent set 1 % to 3 %) and naturally aged. The products receive no further straightening after stretching
T4510	Solution heat-treated, stress-relieved by stretching a controlled amount (permanent set 1 % to 3 %) and naturally aged. The products receive no further straightening after stretching
T4511	Same as T4510 except that minor straightening is allowed after stretching to comply with standard tolerances
T5	Cooled from an elevated temperature shaping process and then artificially aged

Table B.1 *(continued)*

Temper	Description
T6	Solution heat-treated and then artificially aged
T62	Solution heat-treated and artificially aged. Applies to test material heat-treated from annealed or F temper or to products heat-treated from any temper by the user
T64*	Solution heat-treated and then artificially aged in underageing conditions (between T6 and T61) to improve formability
T651	Solution heat-treated, stress-relieved by stretching a controlled amount (permanent set 1 % to 3 %) and then artificially aged. The products receive no further straightening after stretching
T6510	Solution heat-treated, stress-relieved by stretching a controlled amount (permanent set 1 % to 3 %) and then artificially aged. The products receive no further straightening after stretching
T6511	Same as T6510 except that minor straightening is allowed after stretching to comply with standard tolerances
T66*	Solution heat-treated and then artificially aged — mechanical property level higher than T6 achieved through special control of the process (6000 series alloys)
T7	Solution heat-treated, and then artificially overaged
T73	Solution heat-treated, and then artificially overaged in order to achieve the best stress corrosion resistance
T73510	Solution heat-treated, stress-relieved by stretching a controlled amount (permanent set 1 % to 3 %) and then artificially overaged in order to achieve the best stress corrosion resistance. The products receive no further straightening after stretching
T73511	Same as T73510 except that minor straightening is allowed after stretching to comply with standard tolerances
T8	Solution heat-treated, cold worked and then artificially aged
T832*	Solution heat-treated, cold worked a controlled specific amount and then artificially aged (applied to 6063 drawn tube)
T851	Solution heat-treated, stress-relieved by stretching a controlled amount (permanent set 1 % to 3 %) and then artificially aged. The products receive no further straightening after stretching
T8510	Solution heat-treated, stress-relieved by stretching a controlled amount (permanent set 1 % to 3 %) and then artificially aged. The products receive no further straightening after stretching
T8511	Same as T8510 except that minor straightening is allowed after stretching to comply with standard tolerances
T89[a]	Solution heat-treated, cold worked an appropriate amount to achieve the specified mechanical properties and then artificially aged
T9	Solution heat-treated, artificially aged and then cold worked

[a] Regional designation quoted from EN 754-2.

Bibliography

[1] ISO 6362-7, *Wrought aluminium and aluminium alloys — Extruded rods/bars, tubes and profiles — Part 7: Chemical composition*

[2] EN 754-2, *Aluminium and aluminium alloys — Cold drawn rod/bar and tube — Part 2: Mechanical properties*

[3] *Registration of International Alloy Designations and Chemical Composition Limits for Wrought Aluminum Alloys (also known as "Teal sheets").* The Aluminum Association, Arlington, VA 22209. Available at: http://www.aluminum.org/tealsheets

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