INTERNATIONAL STANDARD

ISO 6363-2

First edition
1993-10-01

Wrought aluminium and aluminium alloy cold-drawn rods/bars and tubes —

Part 2: Mechanical properties

Barres et tubes étirés à froid en aluminium et alliages d'aluminium corroyés —

Partie 2: Caractéristiques mécaniques

Reference number
ISO 6363-2:1993(E)

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.

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.

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

It cancels and replaces Technical Report ISO/TR 2778:1977 of which it constitutes a technical revision.

ISO 6363 consists of the following parts, under the general title *Wrought aluminium and aluminium alloy cold-drawn rods/bars and tubes*:

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

— *Part 2: Mechanical properties*

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

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

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

NOTE — Part 3, *Drawn round bars — Tolerances on form and dimensions*, will be published later. It is at present published as ISO 5193:1981 and ISO 7274:1981.

Annexes A and B form an integral part of this part of ISO 6363.

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Wrought aluminium and aluminium alloy cold-drawn rods/bars and tubes —

Part 2:
Mechanical properties

1 Scope

In conjunction with ISO 6363-1, this part of ISO 6363 specifies the mechanical properties of cold-drawn wrought aluminium and aluminium alloy rods/bars and tubes for general engineering applications.

It does not apply to electrical conductors.

The chemical composition of these materials is given in ISO 209-1.

The designations of aluminium and aluminium alloys and the temper designations used in this part of ISO 6363 are in accordance with ISO 2092, ISO 2107 and annex B respectively.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 6363. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 6363 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 209-1:1989, *Wrought aluminium and aluminium alloys — Chemical composition and forms of products — Part 1: Chemical composition.*

ISO 2092:1981, *Light metals and their alloys — Code of designation based on chemical symbols.*

ISO 2107:1983, *Aluminium, magnesium and their alloys — Temper designations.*

ISO 3134-3:1985, *Light metals and their alloys — Terms and definitions — Part 3: Wrought products.*

ISO 6363-1:1988, *Wrought aluminium and aluminium alloy cold-drawn rods/bars and tubes — Part 1: Technical conditions for inspection and delivery.*

ISO 6892:1984, *Metallic materials — Tensile testing.*

3 Definitions

For definitions of the terms *rod/bar* and *tube*, see ISO 3134-3.

4 Tensile testing

For the selection of specimens and tensile testing, see ISO 6363-1 which specifies the use of longitudinal test pieces, unless otherwise agreed upon.

For tubes, refer to ISO 6892:1984, annex E.

5 Mechanical properties

Values for mechanical properties of aluminium and aluminium alloys are given in table 1 for rods and bars and in table 2 for tubes. The choice of the gauge length for elongation measurements (A or A_{50}) is at the discretion of the producer, unless otherwise agreed[1].

1) A: Percentage elongation on a gauge length of 5,65 $\sqrt{S_0}$

A_{50}: Percentage elongation on a gauge length of 50 mm

The values are based on machined or cut-out test pieces. For test pieces of full cross-section, A_{50} values must be agreed upon.

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

Table 1 — Mechanical properties of rods/bars

Alloy	Temper[1)]	Dimensions[2)] mm	Tensile strength R_m min. MPa	0,2 % proof stress $R_{p0,2}$ min. MPa	Elongation min. A %	Elongation min. A_{50} %
Al 99,5 (1050A)	0	e ou $D \leqslant 30$	60	20	25	5
	H1D (H14)	e or $D \leqslant 30$	100	70	6	
	H1H (H18)	e or $D \leqslant 10$	130	110	3	
Al 99,0 (1200)	0	e or $D \leqslant 30$	70	30	20	
	H1D (H14)	e or $D \leqslant 30$	110	80	5	
	H1H (H18)	e or $D \leqslant 10$	140	120	3	
Al 99,0Cu (1100)	0	e or $D \leqslant 30$	75	20	22	19
	H1D (H14)	e or $D \leqslant 30$	110	80 [3)]	5	
	H1H (H18)	e or $D \leqslant 10$	150	130 [3)]	3	
Al Mn1 (3103)	0	e or $D \leqslant 50$	95	35	22	19
	H1D (H14)	e or $D \leqslant 30$	130	90	6	4
	H1F (H16)	e or $D \leqslant 10$	160	130	4	3
Al Mn1Cu (3003)	0	e or $D \leqslant 50$	95	35	22	19
	H1B (H12)	e or $D \leqslant 10$	115	80 [3)]	7 [3)]	
	H1D (H14)	e or $D \leqslant 10$	135	110 [3)]	6 [3)]	
	H1F (H16)	e or $D \leqslant 10$	160	130 [3)]	3 [3)]	
	H1H (H18)	e or $D \leqslant 10$	180	145 [3)]	2 [3)]	
Al Mg1,5 (5050)	0	$D \leqslant 10$	125...180 max.		25	22
	H3B (H32)	$D \leqslant 10$	150			
	H3D (H34)	$D \leqslant 10$	170			
	H3F (H36)	$D \leqslant 10$	185			
	H3H (H38)	$D \leqslant 10$	200			
Al Mg2,5 (5052)	0	e or $D \leqslant 50$	170...220 max.	65	22	19
	H1D (H14)	e or $D \leqslant 30$	235	180	5	
	H1H (H18)	e or $D \leqslant 10$	270	220	2	
	H3D (H34)	e or $D \leqslant 30$	235	180	6 [3)]	
	H3H (H38)	e or $D \leqslant 10$	270	220 [3)]	2 [3)]	
Al Mg3 (5754)	0	e or $D \leqslant 50$	180	80	16	
	H1D (H14)	e or $D \leqslant 30$	250	180	4	
	H3D (H34)	e or $D \leqslant 30$	250	180	5	
	H1H (H18)	e or $D \leqslant 10$	280	240	2	
	H3H (H38)	e or $D \leqslant 10$	280	240	3	

Table 1 — *(continued)*

Alloy	Temper[1)]	Dimensions[2)] mm	Tensile strength R_m min. MPa	0,2 % proof stress $R_{p0,2}$ min. MPa	Elongation min. A %	Elongation min. A_{50} %
Al Mg3,5 (5154)	0	e or $D \leqslant 10$	205...285 max.	75	20	16
	H3B (H32)	e or $D \leqslant 10$	250			
	H3D (H34)	e or $D \leqslant 10$	270			
	H3F (H36)	e or $D \leqslant 10$	290			
	H3H (H38)	e or $D \leqslant 10$	310			
Al Mg4 (5086)	0	e or $D \leqslant 50$	240	95	16	
	H1B (H12)	e or $D \leqslant 25$	270	190	4	
	H3B (H32)	e or $D \leqslant 25$	270	190	5	
Al Mg4,5Mn0,7 (5083)	0	e or $D \leqslant 50$	270	110	14	
	– (H111)	e or $D \leqslant 50$	270	140	12	
	H1B (H12)	e or $D \leqslant 30$	300	200	4	
Al Mg5Cr (5056)	0	e or $D \leqslant 50$	250...320 max.[3)]	110 [3)]	16	14
	H3B (H32)	e or $D \leqslant 10$	300			
	H3D (H34)	e or $D \leqslant 10$	345			
	H3H (H38)	e or $D \leqslant 10$	380			
Al Cu4SiMg (2014) et Al Cu4SiMgA (2014A)	TB (T4) or TB51 (T451) [4)]	e or $D \leqslant 100$	380	220	10	10
	TF (T6)	e or $D \leqslant 50$	440	360	7	8
	TF51 (T651) [4)]	e or $D \leqslant 100$	450	380	7	8
Al Cu4MgSiA (2017A)	TB (T4)	e or $D \leqslant 50$	380	220	10	
	TB51 (T451) [4)]	$50 < e$ or $D \leqslant 100$	390	235	10	
Al Cu4Mg1 (2024)	TB (T4)	e or $D \leqslant 12,5$	425	310	10	8
	TB51 (T451) [4)]	$12,5 < e$ or $D \leqslant 100$	425	290	9	
	TD51 (T351) [3)]	$12,5 < e$ or $D \leqslant 100$	425	310	9	
Al Cu4PbMg (2030)	TD (T3)	e or $D \leqslant 50$	370	250	7	
		$50 < e$ or $D \leqslant 100$	340	210	7	
Al Cu6BiPb (2011)	TD (T3)	e or $D \leqslant 40$	310	260	9	
		$40 < e$ or $D \leqslant 50$	295	235	10	
		$50 < e$ or $D \leqslant 80$	280	205	10	12
	TH (T8)	e or $D \leqslant 80$	370	270	8	8
Al Cu6Mn (2219)	TH51 (T851) [4)]	$10 \leqslant e$ or $D \leqslant 50$	400	275	3	
		$50 < e$ or $D \leqslant 100$	395	270	3	
Al Mg1SiCu (6061)	TB (T4)	e or $D \leqslant 80$	205	110	16	18
	TF (T6)	e or $D \leqslant 80$	290	240	9	10

Table 1 — *(concluded)*

Alloy	Temper[1]	Dimensions[2] mm	Tensile strength R_m min. MPa	0,2 % proof stress $R_{p0,2}$ min. MPa	Elongation min. A %	Elongation min. A_{50} %
Al SiMgMn (6082)	0	e or $D \leqslant 80$	160 max.	110 max.	15	
	TB (T4)	e or $D \leqslant 80$	205	110	14	
	TF (T6)	$e \leqslant 80$, $D \leqslant 60$	310	255	10	
	TH (T8)	e or $D \leqslant 80$	310	260	8	
Al SiMg0,8 (6181)	TB (T4)	e or $D \leqslant 50$	200	100	15	
	TF (T6)	e or $D \leqslant 50$	280	240	8	
Al Mg1SiPb (6262)	TF (T6)	e or $D \leqslant 100$	290	240	8	7
	TL (T9)	e or $D \leqslant 50$	360	330	4	5
		$50 < e$ or $D \leqslant 80$	345	315	4	
Al Zn4,5Mg1 (7020)	TE (T5) or TF (T6)	e or $D \leqslant 50$	350	280	10	
Al Zn8MgCu (7049A)	TF (T6)	e or $D \leqslant 80$	590	500	7	
Al Zn5,5MgCu (7075)	TF (T6) or TF51 (T651) [5]	e or $D \leqslant 100$	520	460	6	5
	TM3 (T73) [4]	e or $D \leqslant 100$	470	385	9	7

1) Temper designations in parentheses correspond to the alternative temper system in ISO 2107:1983, clauses 5 and 6.

2) e = thickness or width across flats;

D = diameter.

3) Values guaranteed by special agreement only.

4) Special temper defining stress relieving by controlled stretching (see annex B).

5) TF tempers tend to be susceptible to stress corrosion cracking and to exfoliation corrosion. Where such a risk is unacceptable, TM tempers should be selected, combined with appropriate lot acceptance tests.

Table 2 — Mechanical properties of tubes

Alloy	Temper[1)]	Dimensions[2)] mm	Tensile strength R_m min. MPa	0,2 % proof stress $R_{p0,2}$ min. MPa	Elongation min. A %	Elongation min. A_{50} %
Al 99,5 (1050A)	0	$0,5 \leqslant a \leqslant 10$	60...95 max.	20 [3)]	25	22
	H1D (H14)	$0,5 \leqslant a \leqslant 6$	100	70 [3)]	6	3
	H1H (H18)	$0,5 \leqslant a \leqslant 3$	130	110 [3)]	3	2
Al 99,0 (1200)	0	$0,5 \leqslant a \leqslant 10$	70...105 max.	25 [3)]	20	
	H1D (H14)	$0,5 \leqslant a \leqslant 6$	110	80 [3)]	5	
	H1H (H18)	$0,5 \leqslant a \leqslant 3$	140	120 [3)]	3	
Al 99,0Cu (1100)	0	$0,5 \leqslant a \leqslant 10$	75...105 max.	25 [3)]	20	18
	H1D (H14)	$0,5 \leqslant a \leqslant 6$	110	80 [3)]	5	3
	H1H (H18)	$0,5 \leqslant a \leqslant 3$	145	130	3	2
Al Mn1 (3103)	0	$0,4 \leqslant a \leqslant 10$	95	35	22	19
	H1D (H14)	$0,4 \leqslant a \leqslant 5$	130	90	6	4
	H1F (H16)	$0,4 \leqslant a \leqslant 1,5$	150	130 [3)]	4	3
	H1H (H18)	$0,4 \leqslant a \leqslant 1,5$	170		3	2
Al Mn1Cu (3003)	0	$0,4 \leqslant a \leqslant 6$	95...140 max.	35 [3)]	22	19
		$6 < a \leqslant 10$	95...140 max.	35 [3)]	22	22
	H1D (H14)	$0,4 \leqslant a \leqslant 5$	135	115 [3)]	5	3
	H1F (H16)	$0,4 \leqslant a \leqslant 1,5$	160	130 [3)]	4	3
	H1H (H18)	$0,4 \leqslant a \leqslant 1,5$	180	165 [3)]	3	2
Al Mg1 (5005)	0	$0,5 \leqslant a \leqslant 10$	100	40 [3)]	20	18
	H1B (H12)	$0,5 \leqslant a \leqslant 5$	115	80 [3)]	7	4
	H1D (H14)	$0,5 \leqslant a \leqslant 5$	140	90 [3)]	6	3
	H1H (H18)	$0,5 \leqslant a \leqslant 1,5$	185	155 [3)]	4	2
Al Mg1,5 (5050)	0	$0,5 \leqslant a \leqslant 10$	125...165 max.	40 [3)]	19	17
	H3B (H32)	$0,5 \leqslant a \leqslant 10$	150	110 [3)]		
	H3D (H34)	$0,5 \leqslant a \leqslant 5$	170	140 [3)]	5	3
	H3F (H36)	$0,5 \leqslant a \leqslant 5$	185	150 [3)]		
	H3H (H38)	$0,5 \leqslant a \leqslant 1,5$	200	165 [3)]	3	2
Al Mg2 (5251)	0	$0,5 \leqslant a \leqslant 10$	150...200 max.	60	17	15
	H1B (H12)	$0,5 \leqslant a \leqslant 5$	180	110	5	4
	H1D (H14)	$0,5 \leqslant a \leqslant 5$	200	160	4	3
	H1F (H16)	$0,5 \leqslant a \leqslant 1,5$	220	180	3	2
	H1H (H18)	$0,5 \leqslant a \leqslant 1,5$	235	200	2	2
Al Mg2,5 (5052)	0	$0,5 \leqslant a \leqslant 10$	170...220 max.	65	17	15
	H1D (H14)	$0,5 \leqslant a \leqslant 5$	235	180	4	3
	H1F (H16)	$0,5 \leqslant a \leqslant 1,5$	250	200	3	2
	H1H (H18)	$0,5 \leqslant a \leqslant 1,5$	270	215	2	2
	H3D (H34)	$0,5 \leqslant a \leqslant 5$	235	180	5	4
	H3H (H38)	$0,5 \leqslant a \leqslant 1,5$	270	215	3	3

Table 2 — *(continued)*

Alloy	Temper[1)]	Dimension[2)] mm	Tensile strength R_m min. MPa	0,2 % proof stress $R_{p0,2}$ min. MPa	Elongation min. A %	Elongation min. A_{50} %
Al Mg3 (5754)	0	$0,5 \leqslant a \leqslant 10$	180	80	17	15
	H1B (H12)	$0,5 \leqslant a \leqslant 5$	215	140	5	4
	H1D (H14)	$0,5 \leqslant a \leqslant 5$	250	180	4	3
	H3D (H34)	$0,5 \leqslant a \leqslant 5$	250	180	5	4
Al Mg3,5 (5154) [4)]	0	$0,5 \leqslant a \leqslant 10$	205...285	75	9	8
	H3D (H34)	$0,5 \leqslant a \leqslant 6$	max. 270	200	4	3
	H3H (H38)	$0,5 \leqslant a \leqslant 3$	310	235		
Al Mg4 (5086)	0	$0,5 \leqslant a \leqslant 10$	240	95	16	14
	H1B (H12)	$0,5 \leqslant a \leqslant 5$	270	190	4	3
	H1D (H14)	$0,5 \leqslant a \leqslant 3$	305	230	3	2
	H3B (H32)	$0,5 \leqslant a \leqslant 5$	270	190	5	4
	H3D (H33)	$0,5 \leqslant a \leqslant 3$	300	230	3	2
Al Mg4,5Mn0,7 (5083)	0	$1 \leqslant a \leqslant 6$	270...350	110	12	10
	H1B (H12)	$1 \leqslant a \leqslant 10$	max. 300	235	5	4
Al Mg5Cr (5056)	0	$1 \leqslant a \leqslant 6$	250	110	16	
	H1B (H12)	$1 \leqslant a \leqslant 10$	280	200	6	
	H1D (H14)	$1 \leqslant a \leqslant 6$	355	320		
Al Cu4SiMg (2014) and Al Cu4SiMgA (2014A)	TD (T3)	$0,5 \leqslant a \leqslant 10$	380	250	8	10
	TB (T4)	$0,5 \leqslant a \leqslant 6$	370	205	10	9
		$6 < a \leqslant 10$	370	205	10	10
	TF (T6)	$0,5 \leqslant a \leqslant 6$	450	370	6	5
		$6 < a \leqslant 10$	450	370	7	7
Al Cu4Mg1 (2024)	TD (T3) or TB (T4)	$0,5 \leqslant a \leqslant 6$	440	290	10	8
		$6 < a \leqslant 10$	420	270	10	10
Al Cu4PbMg (2030)	TD (T3)	$1 \leqslant a \leqslant 6$	370	250	10	
		$6 < a \leqslant 20$	360	230	8	
Al Cu6BiPb (2011)	TD (T3)	$0,5 \leqslant a \leqslant 6$	310	260	10	8
		$6 < a \leqslant 20$	290	240	8	9
	TH (T8)	$0,5 \leqslant a \leqslant 20$	370	275	8	8
Al MgSi (6060)	TB (T4)	$0,5 \leqslant a \leqslant 10$	130	65	15	
	TF (T6) or TE (T5)	$0,5 \leqslant a \leqslant 10$	215	160	12	
	TH (T8)	$0,5 \leqslant a \leqslant 10$	215	160	10	

Table 2 — (*concluded*)

Alloy	Temper[1]	Dimension[2] mm	Tensile strength R_m min. MPa	0,2 % proof stress $R_{p0,2}$ min. MPa	Elongation min. A %	Elongation min. A_{50} %
Al Mg0,7Si (6063)	TB (T4)	$0,5 \leqslant a \leqslant 10$	150	70	15	
	TF (T6)	$0,5 \leqslant a \leqslant 10$	220	190	10	
	TH (T8)	$0,5 \leqslant a \leqslant 10$	245	195	8	
Al Mg1SiCu (6061)	TB (T4)	$0,5 \leqslant a \leqslant 6$	205	110	14	14
		$6 < a \leqslant 10$	205	110	16	16
	TF (T6)	$0,5 \leqslant a \leqslant 6$	290	240	8	8
		$6 < a \leqslant 10$	290	240	10	10
Al SiMgMn (6082)	0	$0,5 \leqslant a \leqslant 10$	160 max.	110 max.		
	TB (T4)	$0,5 \leqslant a \leqslant 10$	205	110	14	12
	TF (T6)	$0,5 \leqslant a \leqslant 5$	310	255	8	7
	TH (T8)	$0,5 \leqslant a \leqslant 5$	310	240	9	8
		$5 < a \leqslant 10$	310	260	8	8
Al Mg1SiPb (6262)	TF (T6)	$1 \leqslant a \leqslant 6$	290	240	8	7
		$6 < a \leqslant 10$	290	240	8	8
	TL (T9)	$1 \leqslant a \leqslant 10$	330	305	3	3
Al Zn5,5MgCu (7075)	TF (T6) [5]	$1 \leqslant a \leqslant 6$	520	440	7	6
		$6 < a \leqslant 10$	520	440	7	7
	TM3 (T73) [6]	$1 \leqslant a \leqslant 6$	455	385	8	7
		$6 < a \leqslant 10$	455	385	8	8

1) Temper designations in parentheses correspond to the alternative temper system in ISO 2107:1983, clause 5 and 6.

2) a = wall thickness.

3) Values guaranteed by special agreement only.

4) Also in alloy Al Mg3,5A (5154A).

5) TF tempers tend to be susceptible to stress corrosion cracking and to exfoliation corrosion. Where such a risk is unacceptable, TM tempers should be selected, combined with appropriate lot acceptance tests.

6) Special temper defining stress relieving by controlled stretching (see annex B).