

JIS

JAPANESE INDUSTRIAL STANDARD

Aluminium and Aluminium Alloy Forgings

JIS H 4140—1988

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by

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In the event of any doubt arising,
the original Standard in Japanese is to be final authority.

JAPANESE INDUSTRIAL STANDARD

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Aluminium and Aluminium
Alloy Forgings

H 4140-1988

1. Scope

This Japanese Industrial Standard specifies the die forged or free forged aluminium and aluminium alloy forgings, hereinafter referred to as the "forgings".

Remark: The units and numerical values given in { } in this Standard are based on the International System of Units (SI) and are appended for informative reference.

Further, the traditional units and numerical values accompanied by the SI units and converted values in { } shall be replaced by the units and the numerical values given in the Appendix on January 1, 1991.

2. Grade and Designation

The grade and designation shall be as given in Table 1.

Applicable Standards and Reference Standard: See page 23.

Table 1. Grade and Designation

Grade		Symbol	Informative reference
Alloy No.	Method of manufacture		Characteristics and examples of use
1100	Die forging	A 1100 FD	Excellent in corrosion resistance and hot and cold workability. Memory drum for computer.
1200	Die forging	A 1200 FD	
2014	Die forging	A 2014 FD	High strength and forgeability and ductility. Aircraft parts, car and automobile parts, general structural parts, etc.
	Free forging	A 2014 FH	
2017	Die forging	A 2017 FD	High strength. Aircraft parts, high pressure cylinder for aqualungs, hub material for bicycles, etc.
2018	Die forging	A 2018 FD	Because of excellent forgeability and high temperature strength, used for forgings requiring heat resistance. Cylinder head, piston, VTR cylinder, etc.
2218	Die forging	A 2218 FD	
2219	Die forging	A 2219 FD	High temperature strength and superior both in creep resistance and weldability. Aircraft parts for rocket or the like and others.
	Free forging	A 2219 FH	
2025	Die forging	A 2025 FD	Excellent forgeability and high strength. Propeller, porcelain drum, etc.
	Free forging	A 2025 FH	
2618	Die forging	A 2618 FD	Excellent high temperature strength. Piston, die for molding rubber, general heat-resisting parts, etc.
	Free forging	A 2618 FH	
2 N 01	Die forging	A 2 N 01 FD	Heat resistance and high strength. Hydraulic parts, etc.
	Free forging	A 2 N 01 FH	
4032	Die forging	A 4032 FD	Strength at medium temperatures (about 200°C) is high, thermal expansion coefficient small and abrasive resistance excellent. Piston or the like.
5052	Free forging	A 5052 FH	Intermediate strength alloy and good in corrosion resistance and workability. Aircraft parts or the like.

Table 1 (Continued)

Grade		Symbol	Informative reference
Alloy No.	Method of manufacture		Characteristics and examples of use
5056	Die forging	A 5056 FD	Excellent in corrosion resistance, cutting workability and anodic oxidation processability. Optical instruments and communication apparatus parts, fastener, etc.
5083	Die forging	A 5083 FD	Excellent in corrosion resistance, weldability and mechanical properties at low temperatures. Flange for LNG or the like.
	Free forging	A 5083 FH	
6151	Die forging	A 6151 FD	Strength somewhat higher than 6061, excellent in ductility, toughness and corrosion resistant, and suitable for forgings of complicated forms. Fan wheel of supercharger, wheel for automobile, etc.
	Free forging	A 6151 FH	
6061	Die forging	A 6061 FD	Excellent in ductility, toughness, and corrosion resistance. Rotor for physics and chemistry, automobile wheel, receiver tank, etc.
	Free forging	A 6061 FH	
7050	Die forging	A 7050 FD	Ductility, toughness, and stress resistant corrosion cracking are excellent, and strength for thick article especially excellent. Aircraft parts, high speed rotor, etc.
	Free forging	A 7050 FH	
7075	Die forging	A 7075 FD	Highest strength of all forging alloys. Aircraft parts, parts for marine vessel, automobile parts, etc.
	Free forging	A 7075 FH	
7 N 01	Die forging	A 7 N 01 FD	Alloy for welded construction of high strength and good corrosion resistance. Aircraft parts or the like.
	Free forging	A 7 N 01 FH	

Remark: The designation denoting the temper grade shall be suffixed to the designation of grade given above.

3. Quality

3.1 Appearance The forgings shall have workmanlike finish, unheterogeneity and be free from defects detrimental to practical use, such as blister or flaws.

Further, the forgings shall not be repaired with filler metal or by welding.

3.2 Chemical Composition The chemical composition of the forgings shall be as specified in Table 2.

Table 2. Chemical Composition

Chemical composition %												
Alloy No.	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Zr, Zr+Ti, V	Ti	Other elements (%)	Al
											Each	
1100	Si+Fe 1.0 max.		0.05 to 0.20	0.05 max.	—	—	—	0.10 max.	—	—	0.05 max. 0.15 max.	99.00 min.
1200	Si+Fe 1.0 max.		0.05 max.	0.05 max.	—	—	—	0.10 max.	—	0.05 max.	0.05 max. 0.15 max.	99.00 min.
2014	0.50 to 1.2	0.7 max.	3.9 to 5.0	0.40 to 1.2	0.20 to 0.8	0.10 max.	—	0.25 max.	Zr+Ti 0.20 max.	0.15 max.	0.05 max. 0.15 max.	Remainder
2017	0.20 to 0.8	0.7 max.	3.5 to 4.5	0.40 to 1.0	0.40 to 0.8	0.10 max.	—	0.25 max.	Zr+Ti 0.20 max.	0.15 max.	0.05 max. 0.15 max.	Remainder
2018	0.9 max.	1.0 max.	3.5 to 4.5	0.20 max.	0.45 to 0.9	0.10 max.	1.7 to 2.3	0.25 max.	—	—	0.05 max. 0.15 max.	Remainder
2218	0.9 max.	1.0 max.	3.5 to 4.5	0.20 max.	1.2 to 1.8	0.10 max.	1.7 to 2.3	0.25 max.	—	—	0.05 max. 0.15 max.	Remainder
2219	0.20 max.	0.30 max.	5.8 to 6.8	0.20 to 0.40	0.02 max.	—	—	0.10 max.	Zr 0.10 to 0.25 V 0.05 to 0.15	0.02 to 0.10	0.05 max. 0.15 max.	Remainder
2025	0.50 to 1.2	1.0 max.	3.9 to 5.0	0.40 to 1.2	0.05 max.	0.10 max.	—	0.25 max.	—	0.15 max.	0.05 max. 0.15 max.	Remainder
2618	0.10 to 0.25	0.9 to 1.3	1.9 to 2.7	—	1.3 to 1.8	—	0.9 to 1.2	0.10 max.	—	0.04 to 0.10	0.05 max. 0.15 max.	Remainder
2 N 01	0.50 to 1.3	0.6 to 1.5	1.5 to 2.5	0.20 max.	1.2 to 1.8	—	0.6 to 1.4	0.20 max.	—	0.20 max.	0.05 max. 0.15 max.	Remainder
4032	11.0 to 13.5	1.0 max.	0.50 to 1.3	—	0.8 to 1.3	0.10 max.	0.50 to 1.3	0.25 max.	—	—	0.05 max. 0.15 max.	Remainder
5052	0.25 max.	0.40 max.	0.10 max.	0.10 max.	2.2 to 2.8	0.15 to 0.35	—	0.10 max.	—	—	0.05 max. 0.15 max.	Remainder
5056	0.30 max.	0.40 max.	0.10 max.	0.05 to 0.20	4.5 to 5.6	0.05 to 0.20	—	0.10 max.	—	—	0.05 max. 0.15 max.	Remainder
5083	0.40 max.	0.40 max.	0.10 max.	0.40 to 1.0	4.0 to 4.9	0.05 to 0.25	—	0.25 max.	—	0.15 max.	0.05 max. 0.15 max.	Remainder
6151	0.6 to 1.2	1.0 max.	0.35 max.	0.20 max.	0.45 to 0.8	0.15 to 0.35	—	0.25 max.	—	0.15 max.	0.05 max. 0.15 max.	Remainder
6061	0.40 to 0.8	0.7 max.	0.15 to 0.40	0.15 max.	0.8 to 1.2	0.04 to 0.35	—	0.25 max.	—	0.15 max.	0.05 max. 0.15 max.	Remainder
7050	0.12 max.	0.15 max.	2.0 to 2.6	0.10 max.	1.9 to 2.6	0.04 max.	—	5.7 to 6.7	Zr 0.08 to 0.15	0.06 max.	0.05 max. 0.15 max.	Remainder
7075	0.40 max.	0.50 max.	1.2 to 2.0	0.30 max.	2.1 to 2.9	0.18 to 0.28	—	5.1 to 6.1	Zr+Ti 0.25 max.	0.20 max.	0.05 max. 0.15 max.	Remainder
7 N 01	0.30 max.	0.35 max.	0.20 max.	0.20 to 0.7	1.0 to 2.0	0.30 max.	—	4.0 to 5.0	V 0.10 max., Zr 0.25 max.	0.20 max.	0.05 max. 0.15 max.	Remainder

Note (1) Analysis of other elements shall be conducted only when the existence of the element is anticipated or when, in the course of routine analysis, its quantity shows indications of exceeding the specified value.

3.3 Mechanical Properties of Forgings

3.3.1 Mechanical Properties and Electrical Conductivity of Die Forgings The mechanical properties (tensile strength, proof stress and elongation) and electrical conductivity of the die forgings shall conform to Table 3 (1). However, at the request of the purchaser, Table 3 (2) shall be applied.

The hardness test may substitute the tensile test with the approval of the purchaser. In this case, the Brinell hardness values shall be as specified in Table 3 (3).

Table 3 (1). Mechanical Property (for Test Piece Taken Parallel to Metal Flow by Forging) and Electrical Conductivity of Die Forgings

(Applicable till the end of 1990)

Designation	Temper grade ⁽²⁾	Tensile test					Electrical conductivity IACS %
		Maximum thickness at heat treatment mm	Tensile strength kgf/mm ² {N/mm ² }	Proof stress kgf/mm ² {N/mm ² }	Elongation %		
					Test specimen	Forging	
A 1100 FD A 1200 FD	H 112	100 or under	7.5 { 74} min.	2.5 { 25} min.	25 min.	18 min.	—
A 2014 FD	T 4	100 or under	39 {382} min.	21 {206} min.	16 min.	11 min.	—
	T 6	75 or under	46 {451} min.	39 {382} min.	8 min.	6 min.	—
		Over 75 up to and incl. 100	44 {431} min.	39 {382} min.	8 min.	6 min.	—
A 2017 FD	T 4	100 or under	35 {343} min.	22 {216} min.	14 min.	10 min.	—
A 2018 FD A 2218 FD	T 61	100 or under	39 {382} min.	28 {275} min.	10 min.	7 min.	—
A 2219 FD	T 6	100 or under	41 {402} min.	26.5 {260} min.	10 min.	8 min.	—
A 2025 FD	T 6	100 or under	39 {382} min.	23 {226} min.	16 min.	11 min.	—
A 2618 FD	T 61	100 or under	41 {402} min.	31.5 {309} min.	6 min.	4 min.	—
A 2 N 01 FD	T 6	100 or under	38 {373} min.	30 {294} min.	6 min.	6 min.	—
A 4032 FD	T 6	100 or under	37 {363} min.	30 {294} min.	5 min.	3 min.	—
A 5056 FD	H 112	100 or under	25 {245} min.	12 {118} min.	18 min.	15 min.	—
A 5083 FD	H 112	100 or under	28 {275} min.	13 {127} min.	16 min.	16 min.	—
	O	100 or under	28 {275} min.	12 {118} min.	16 min.	16 min.	—
A 6151 FD	T 6	100 or under	31 {304} min.	26 {255} min.	14 min.	10 min.	—
A 6061 FD	T 6	100 or under	27 {265} min.	25 {245} min.	10 min.	7 min.	—
A 7050 FD	T 74	50 or under	50.5 {495} min.	43.5 {426} min.	10 min.	7 min.	38.0 min. (3)
		Over 50 up to and incl. 100	50 {490} min.	43 {421} min.	10 min.	7 min.	
		Over 100 up to and incl. 130	49.5 {485} min.	42.5 {417} min.	10 min.	7 min.	
		Over 130 up to and incl. 150	49.5 {485} min.	41.5 {407} min.	10 min.	7 min.	
A 7075 FD	T 6	25 or under	53 {520} min.	45 {441} min.	10 min.	7 min.	—
		Over 25 up to and incl. 75	52 {510} min.	44 {431} min.	10 min.	7 min.	
		Over 75 up to and incl. 100	51 {500} min.	44 {431} min.	10 min.	7 min.	
	T 73	75 or under	46 {451} min.	39 {382} min.	10 min.	7 min.	38.0 min. (4)
		Over 75 up to and incl. 100	45 {441} min.	39 {382} min.	10 min.	7 min.	
A 7 N 01 FD	T 6	100 or under	34 {333} min.	28 {275} min.	10 min.	10 min.	—

Notes (2) The temper grade shall be as specified in JIS H 0001.

(3) However, this numerical value shall satisfy the relation:

$$\text{Proof stress kgf/mm}^2 - 0.714 \times \text{electrical conductivity IACS } \% \leq 22.45.$$

(4) In the case where the proof stress is higher than the specified limit by more than 8.5 kgf/mm² {84 N/mm²} and also the electrical conductivity falls in the range of 38.0 or over to and excluding 40.0 %, the test piece shall be heated at 460 to 470°C for at least thirty min, quenched in water, and then within fifteen minutes its electrical conductivity shall be measured again whereby the results obtained shall be at least 6 % lower than the conductivity value before the treatment.

Remark: The mechanical properties of the forging whose dimensions are outside the specified range shall be agreed upon by the parties concerned with acceptance.

Table 3 (2). Mechanical Property (for Test Piece Taken not Parallel to Metal Flow by Forging) and Electrical Conductivity of Die Forgings

(Applicable till the end of 1990)

Designation	Temper grade(2)	Tensile test				Electrical conductivity IACS %
		Maximum thickness at heat treatment mm	Tensile strength kgf/mm ² {N/mm ² }	Proof stress kgf/mm ² {N/mm ² }	Elon-gation % Forging	
A 2014 FD	T 6	25 or under	45 {441} min.	39 {382} min.	3 min.	—
		Over 25 up to and incl. 50	45 {441} min.	39 {382} min.	2 min.	—
		Over 50 up to and incl. 100	44 {431} min.	38 {373} min.	2 min.	—
A 2219 FD	T 6	100 or under	39.5 {387} min.	25.5 {250} min.	4 min.	—
A 2618 FD	T 61	100 or under	39 {382} min.	29.5 {290} min.	4 min.	—
A 2 N 01 FD	T 6	100 or under	35 {343} min.	28 {275} min.	4 min.	—
A 5083 FD	H 112	100 or under	28 {275} min.	11 {108} min.	14 min.	—
	O	100 or under	28 {275} min.	11 {108} min.	14 min.	—
A 6151 FD	T 6	100 or under	31 {304} min.	26 {255} min.	6 min.	—
A 6061 FD	T 6	100 or under	27 {265} min.	25 {245} min.	5 min.	—
A 7050 FD	T 74	50 or under	48 {470} min.	39.5 {387} min.	5 min.	38.0 min. (3)
		Over 50 up to and incl. 100	47 {460} min.	39.5 {387} min.	4 min.	
		Over 100 up to and incl. 130	46.5 {455} min.	38 {373} min.	3 min.	
		Over 130 up to and incl. 150	46.5 {455} min.	38 {373} min.	3 min.	
A 7075 FD	T 6	50 or under	50 {490} min.	43 {422} min.	3 min.	—
		Over 50 up to and incl. 75	49 {481} min.	42 {412} min.	3 min.	
		Over 75 up to and incl. 100	49 {481} min.	42 {412} min.	2 min.	
	T 73	75 or under	44 {431} min.	37 {363} min.	3 min.	38.0 min. (4)
		Over 75 up to and incl. 100	43 {422} min.	37 {363} min.	2 min.	
A 7 N 01 FD	T 6	100 or under	34 {333} min.	28 {275} min.	10 min.	—

Remark: The mechanical properties of the forging whose dimension are outside the specified range shall be as agreed upon by the parties concerned with acceptance.