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Aluminium alloy die castings

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of International Trade and Industry through deliberations at the Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law. Consequently **JIS H 5302** : 1990 is replaced with **JIS H 5302** : 2000.

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In the event of any doubts arising as to the contents, the original JIS is to be the final authority.

Aluminium alloy die castings

Introduction This Japanese Industrial Standard has been prepared based on the second edition of **ISO 3522**, *Cast aluminium alloys—Chemical composition and mechanical properties*, published in 1984, in order to conform the corresponding parts to the International Standard without any modification in the technical contents. This revision has specified all alloys in International Standard which were not included in conventional Japanese Industrial Standard, and these types are classified by their symbols. The items and contents not specified in the corresponding International Standard are supplemented in Japanese Industrial Standard.

1 Scope This Japanese Industrial Standard specifies aluminium alloy die castings (hereafter referred to as "die casting").

Remarks : The International Standard corresponding to this Standard is as follows.

ISO 3522 : 1984 *Cast aluminium alloys—Chemical composition and mechanical properties*

2 Normative references The standards listed in Attached Table 1 contain provisions which, through reference in this Standard, constitute provisions of this Standard. The most recent editions of the standards indicated in the table shall be applied.

3 Classification and symbol Classification and symbol are as shown in Table 1 according to the chemical composition of alloys.

Table 1 Classification and symbol

Classification	Symbol	Informative reference		
		Alloy series	Characteristics of alloy	Serviceable examples
Aluminium alloy die castings Class 1	ADC1	Al-Si series	Corrosion resistance and castability are good, but proof stress is rather low.	Main frame and front panel of automobile; internal pot of automatic bread baker
Aluminium alloy die castings Class 1C	ADC1C (Al-Si12CuFe)	Al-Si series	Corrosion resistance is a little inferior to ADC1. Castability is good, but proof stress is rather low.	
Aluminium alloy die castings Class 2	ADC2 (Al-Si12Fe)	Al-Si series	Corrosion resistance is good next to ADC6, castability is good, and toughness is large.	
Aluminium alloy die castings Class 3	ADC3	Al-Si-Mg series	Impact value and proof stress is high, and corrosion resistance is nearly equal to ADC1, but castability is a little inferior to ADC1.	Automobile wheel cap; crank case of two-wheeled vehicle; bicycle wheel; propeller of outboard motor
Aluminium alloy die castings Class 5	ADC5	Al-Mg series	Corrosion resistance is best, and elongation and impact value are good, but castability is inferior.	Arm of farm machine; propeller of outboard motor; lever and spool of fishing tool
Aluminium alloy die castings Class 6	ADC6	Al-Mg-Mn series	Corrosion resistance is good next to ADC5, and castability is a little better than ADC5.	Hand lever and winker of two-wheeled vehicle; propeller, case, water pump of outboard motor; magnetic disc device
Aluminium alloy die castings Class 7	ADC7 (Al-Si5Fe)	Al-Si series	Toughness, corrosion resistance, and caulking property is better than ADC1, but castability is rather inferior.	
Aluminium alloy die castings Class 8	ADC8 (Al-Si6Cu4Fe)	Al-Si-Cu-Mn series	Strength is better than ADC10, but castability is rather inferior to ADC10.	

Table 1 (concluded)

Classification	Symbol	Informative reference		
		Alloy series	Characteristics of alloy	Serviceable examples
Aluminium alloy die castings Class 10	ADC10	Al-Si-Cu series	Mechanical properties, machinability, and castability are good.	Engine parts of automobile; shock absorber, engine parts, cases of two-wheeled vehicles; cases, cylinder head, cylinder block of farm machine; VTR frame; proper body of camera; motor-driven machine tool; parts for sewing machine; fishing tools; implements for gas supply; floor panel; parts for escalator; and other almost all aluminium parts (except ADC11)
Aluminium alloy die castings Class 10Z	ADC10Z	Al-Si-Cu series	Resistance for casting cracking and corrosion resistance are inferior to ADC10.	
Aluminium alloy die castings Class 11	ADC11 (Al-Si8Cu3Fe)	Al-Si-Cu series	Mechanical properties, machinability, and castability are good, but caulking property is a little inferior to ADC10.	
Aluminium alloy die castings Class 12	ADC12	Al-Si-Cu series	Mechanical properties, machinability, and castability are good.	
Aluminium alloy die castings Class 12Z	ADC12Z	Al-Si-Cu series	Resistance for casting cracking and corrosion resistance are inferior to ADC12.	
Aluminium alloy die castings Class 14	ADC14	Al-Si-Cu-Mg series	Abrasion resistance and fluidity of melt are good, and proof stress is high, but elongation is inferior.	Oil pump body of automobile automatic speed change; insert, housing clutch of two-wheeled vehicle

The symbols in parentheses are for the die castings specified in ISO standard.

4 Quality Quality shall be as follows.

a) The surface is smooth, and free from defects such as harmful cracks and cavities.

b) It shall not be repaired by means of filler or welding. When the defected place is so small that the purchaser recognized to be repairable, it may be repaired.

Moreover, it is permissible to do a leakage-stopping measure with the recognition of purchaser.

c) Chemical compositions are shown in Table 2.

Table 2 Chemical compositions

Unit : %

JIS symbol	ISO symbol	Cu	Si	Mg	Zn	Fe	Mn	Ni	Sn	Pb	Ti	Al
ADC1		1.0 max.	11.0 to 13.0	0.3 max.	0.5 max.	1.3 max.	0.3 max.	0.5 max.	0.1 max.			Remainder
ADC1C	Al-Si12CuFe	1.2 max.	11.0 to 13.5	0.3 max.	0.5 max.	1.3 max.	0.5 max.	0.30 max.	0.1 max.	0.20 max.	0.2 max.	Remainder
ADC2	Al-Si12Fe	0.10 max.	11.0 to 13.5	0.10 max.	0.1 max.	1.3 max.	0.5 max.	0.1 max.	0.05 max.	0.1 max.	0.20 max.	Remainder
ADC3		0.6 max.	9.0 to 10.0	0.4 to 0.6	0.5 max.	1.3 max.	0.3 max.	0.5 max.	0.1 max.			Remainder
ADC5		0.2 max.	0.3 max.	4.0 to 8.5	0.1 max.	1.8 max.	0.3 max.	0.1 max.	0.1 max.			Remainder
ADC6		0.1 max.	1.0 max.	2.5 to 4.0	0.4 max.	0.8 max.	0.4 to 0.6	0.1 max.	0.1 max.			Remainder
ADC7	Al-Si5Fe	0.10 max.	4.5 to 6.0	0.1 max.	0.1 max.	1.3 max.	0.5 max.	0.1 max.	0.1 max.	0.1 max.	0.20 max.	Remainder
ADC8	Al-Si6Cu4Fe	3.0 to 5.0	5.0 to 7.0	0.3 max.	2.0 max.	1.3 max.	0.2 to 0.6	0.3 max.	0.1 max.	0.2 max.	0.2 max.	Remainder
ADC10		2.0 to 4.0	7.5 to 9.5	0.3 max.	1.0 max.	1.3 max.	0.5 max.	0.5 max.	0.2 max.			Remainder
ADC10Z		2.0 to 4.0	7.5 to 9.5	0.3 max.	3.0 max.	1.3 max.	0.5 max.	0.5 max.	0.2 max.			Remainder
ADC11	Al-Si8Cu3Fe	2.5 to 4.0	7.5 to 9.5	0.3 max.	1.2 max.	1.3 max.	0.6 max.	0.5 max.	0.2 max.	0.3 max.	0.2 max.	Remainder
ADC12		1.5 to 3.5	9.6 to 12.0	0.3 max.	1.0 max.	1.3 max.	0.5 max.	0.5 max.	0.2 max.			Remainder
ADC12Z		1.5 to 3.5	9.6 to 12.0	0.3 max.	3.0 max.	1.3 max.	0.5 max.	0.5 max.	0.2 max.			Remainder
ADC14		4.0 to 5.0	16.0 to 18.0	0.45 to 0.65	1.5 max.	1.3 max.	0.5 max.	0.3 max.	0.3 max.			Remainder

5 Shape, dimensions and mass Shape, dimensions, and mass shall follow the drawing or the model. The tolerances on dimensions shall follow the designation by purchaser. Unless otherwise designated, apply the specification in **JIS B 0403**.

6 Material Material shall be that specified in **JIS H 2118**.

7 Test

7.1 Analysis test Analysis test shall follow any one of, **JIS H 1305, JIS H 1306, JIS H 1307, JIS H 1352, JIS H 1353, JIS H 1354, JIS H 1355, JIS H 1356, JIS H 1357, JIS H 1359, JIS H 1360, JIS H 1361**, and **JIS H 1364**.

Analysis test of elements not listed in Table 2 shall conform to the agreement between the parties concerned with delivery.

7.2 Pneumatic pressure and hydraulic pressure test The test by pneumatic pressure and hydraulic pressure shall be carried out by the designation by purchaser.

8 Inspection Carry out the inspection as follows.

a) Inspect the appearance and dimensions, and simultaneously carry out the tests in **7**. The results of the tests shall conform to the requirements given in **4** and **5**.

b) The test sample for analysis shall be taken, unless otherwise specified, from standard analysis sample or die casting.

c) The report of test results shall be submitted to only when there is a request by purchaser.

d) All other general matters than the above shall follow **JIS H 0321**.

9 Marking Marking shall be carried out to indicate the following particulars in adequate manner on a die casting or its package according to the agreement between the parties concerned with delivery.

a) Classification or symbol

b) Manufacture number

c) Name of manufacturer or its abbreviation

Attached Table 1 Normative references

JIS B 0403 *Casting—System of dimensional tolerances and machining allowances*

JIS H 0321 *General rules for inspection of non-ferrous metal materials*

JIS H 1305 *Method for photoelectric emission spectrochemical analysis of aluminium and aluminium alloy*

JIS H 1306 *Methods for atomic absorption spectrometric analysis of aluminium and aluminium alloys*

JIS H 1307 *Methods for inductively coupled plasma emission spectrometric analysis of aluminium and aluminium alloys*

JIS H 1352 *Methods for determination of silicon in aluminium and aluminium alloys*

JIS H 1353 *Methods for determination of iron in aluminium and aluminium alloys*

JIS H 1354 *Methods for determination of copper in aluminium and aluminium alloys*

JIS H 1355 *Methods for determination of manganese in aluminium and aluminium alloys*

JIS H 1356 *Methods for determination of zinc in aluminium and aluminium alloys*

JIS H 1357 *Methods for determination of magnesium in aluminium alloys*

JIS H 1359 *Methods for determination of titanium in aluminium and aluminium alloys*

JIS H 1360 *Methods for determination of nickel in aluminium and aluminium alloys*

JIS H 1361 *Methods for determination of tin in aluminium and aluminium alloys*

JIS H 1364 *Methods for determination of bismuth and lead in aluminium alloy*

JIS H 2118 *Aluminium alloy ingots for die castings*

Related Standard:

JIS Z 8401 *Guide to the rounding of numbers*

Annex (informative)

Properties and serviceable examples of aluminium alloy die castings

This Annex describes the test results carried out on the test pieces that were cut out from as-cast die castings, and does not make a part of this Standard.

1 Mechanical properties Annex Table 1 shows the test results of tensile test and hardness test carried out on the test pieces which were cut out from the die castings used for automobile, gate door, fence, two-wheeled vehicle, electrical appliance, machine, sporting goods, farm machine, construction, ship, implement for gas supply, and others. ADC1 die castings from which samples were cut out count 10 in piece and 7 in class, whose wall thickness was from 1.3 to 16.6 mm. ADC3 die castings count 7 in piece and 7 in class, whose wall thickness 1.2 to 23 mm. ADC5 die castings count 11 in piece and 3 in class, whose wall thickness 2.5 to 10 mm. ADC6 die castings count 7 in piece and 6 in class, whose wall thickness 2 to 11 mm. ADC10 die castings count 12 in piece and 9 in class, whose wall thickness 1.6 to 30 mm. ADC12 die castings count 27 in piece and 11 in class, whose wall thickness 2 to 25 mm. ADC14 die castings count 15 in piece and 9 in class, whose wall thickness 1 to 20 mm. The wall thickness of test pieces, which were cut out from these die castings and submitted to the tensile test, was from 1.2 to 6.8 mm.

The values shown in Annex Table 1 are the values obtained from rarely procured die castings, therefore it is difficult that they are regarded the accurate averages on the die castings of respective ingot. Accordingly, it is recommended to utilize it as a standard for strength on the die casting of respective ingot.

For informative reference, the standard measured values obtained from **ASTM** reference test pieces are shown in the Table.

Annex Table 1 Mechanical properties of test pieces taken from as-cast die castings

Symbols	Tensile test									Hardness test				
	Tensile strength MPa			Proof stress MPa			Elongation %			HB			HRB	
	Average	σ	ASTM	Average	σ	ASTM	Average	σ	ASTM	Average	σ	ASTM	Average	σ
ADC 1	250	46	290	172	22	130	1.7	0.6	3.5	71.2	3.5	72	36.2	5.5
ADC 3	279	48	320	179	35	170	2.7	1.0	3.5	71.4	1.8	76	36.7	2.2
ADC 5	(213)	65	310	(145)	26	190	—	—	5.0	(66.4)	2.4	74	(30.1)	3.7
ADC 6	266	61	280	172	23	—	6.4	3.2	10.0	64.7	2.3	67	27.3	3.9
ADC10	241	34	320	157	18	160	1.5	0.5	3.5	73.6	2.4	83	39.4	3.0
ADC12	228	41	310	154	14	150	1.4	0.8	3.5	74.1	1.5	86	40.0	1.8
ADC14	193	28	320	188	31	250	0.5	0.1	<1	76.8	1.7	108	43.1	2.1

σ : Standard deviation

Remarks 1 The values in parentheses of ADC5 are the measured results obtained from only 3 classes of die castings.

2 The values in **ASTM** column are those quoted from **ASTM** values in Standard DCSM (part for material) of die castings which was published

by the Association of Die Casting in 1994. [The values by **ASTM** mentioned in Standard DCSM (part for material) contain die castings that had no measured results, but the values of these alloys are supplemented with the measured results made by ALCOA.]

The mechanical properties, excepting the value of proof stress, in Annex Table 1 give somewhat lower value than standard measured values on the test piece prepared by **ASTM** standard.

2 Equivalent symbols for ingot Annex Table 2 shows the standard numbers and the equivalent symbols for ingot adopted in other countries which are corresponding to **JIS H 5302**.

Annex Table 2 Equivalent symbols for ingot

JIS (2000)	AA (1996)	ASTM B 85 (1996)	SAE J 452 (1989)	NF A 57-703 (1984)	BS 1490 (1988)	DIN 1725 Part 2 (1986)
ADC1	A413.0	A413.0	A14130	A-S12UY4	—	GD-AlSi12(Cu)
ADC1C	A413.0	A413.0	A14130	A-S12UY4	—	GD-AlSi12(Cu)
ADC 2	—	—	—	A-S12Y4	LM6	GD-AlSi12
ADC 3	A360.0	A360.0	A13600	—	—	GD-AlSi10Mg
ADC 5	518.0	518.0	A05180	—	—	GD-AlMg9
ADC 6	515.0	—	—	—	—	—
ADC 7	C443.0	C443.0	A34430	—	—	—
ADC 8	—	—	—	—	LM21	—
ADC10	D380.0	A380.0	A13800	A-S9U3Y4	—	GD-AlSi9Cu3
ADC10Z	C380.0	A380.0	A13800	A-S9U3ZY4	LM24	—
ADC11	D380.0	—	—	A-S9U3Y4	—	—
ADC12	A383.0	383.0	A03830	—	LM2	—
ADC12Z	A383.0	383.0	A03830	—	LM2	—
ADC14	B390.0	B390.0	A23900	—	LM30	—

Remarks : **DIN 1725** Part 2 is the standard for die castings and ingot in Germany. **SAE J 452** Standard is the alloy standard for overland transportation in **SAE** Standard. **SAE** Standard in Annex Table 2 shows only UNS symbols (Unified Numbering System. "A" is attached at the head of symbol according to the rule of **ASTM E 527**, and followed by 5 digits meaning kind of ingot as specified by Aluminium Association).

3 Examples of serviceable parts Annex Table 3.1 shows the examples of serviceable parts by aluminium alloy die castings by ADC10 and ADC12, and Annex Table 3.2 shows the examples of aluminium alloy die castings except ADC10 and ADC12.

Annex Table 3.1 Examples of serviceable parts

ADC10, ADC12

Use	Examples of parts
Automobile	Water-pump cover, water-outlet pipe, water-inlet housing, water-outlet housing, engine-mount bracket, AC generator housing, airflow-meter housing, oil pan, body of oil pump, oil-seal retainer, oil-pump bracket, cam-shaft bearing cap, carburetor, cylinder block, cylinder-head cover, super charger (housing, rotor), chain cover, distributor housing, valve-rocker arm, fan coupling, fuel-delivery pipe, intake manifold, transmission case, extension housing, piston for air brake, air-compressor housing, AT valve body, car-cooler cylinder block, clutch housing, converter housing, steering-gear housing, starter-motor housing, step for truck, torque-converter stator, wheel cap, alternator bracket, mission-shift fork, rearview mirror
Two-wheeled vehicle	Case for shock absorber, side cover, crank case, crank-case cover, body cylinder, head cylinder, housing-shaft drive, plate brake shoe, plate pressure, housing chain
Snowmobile	Crank case, cylinder, cylinder head
Engine for general use	Cylinder barrel, mission case, connecting rod
Bulldozer	Base, oil filter
Outboard motor	Casing lower, casing up, extension, bottom coupling, oil pan, crank case, cylinder for engine, mission case, bracket
Farm machine	
(Binder)	Case for binding, guide plate for string binding, transmission case, driving case of transportation, gear case for moving
(Tractor)	Case for power taking, transmission case, case for differential gear, clutch housing, case of driving shaft
(Harvester)	Packer arm, transmission case, case for binding, frame for conveyance
(Rice transplanter)	Arm for planting, case for feeding, case for planting, steering-gear case, case for rear shaft of wheel
(Tiller, control machine, power tiller)	Transmission case, rotary case, case for sub-chain
(Walking mower)	Cutter housing, transmission case
(Combined harvester)	Packer-gear case, case of threshing barrel, gear case for exhausting straw, gear case for working drum, transmission case
AV device	VTR frame, VTR cylinder base, VTR camera, mirror body, turntable for stereo, CD pickup.
Computer and related	Base plate, frame for disc driving, light head, platen roll for printer, duplicating machine, drum flange
Telecommunication apparatus	Frame for wireless telephone, satellite broadcasting antenna wave guide, cable joint
Tools in kitchen	Base of electric heater, cock for gas appliances, vaporizing tube for fan heater
Compressor	Connecting rod, head, case, piston
Motor	Housing, bracket, bearing

Annex Table 3.1 (concluded)

ADC10, ADC12

Use	Examples of parts
Reel	Body, drum
Camera	Body, Box for front mirror
Microscope	Arm base, binocular lens barrel, prism holder, prism sheet
Sewing machine	Arm, bed, base, face plate, cover plate, motor cover
Electromotive tool	Cover, case
Cinecamera	Body, holder of lens, lens barrel for eye piece, prism holder
Gas device	Upper and lower case, cover, distributing room, body of cock, shut-off device
Valve for pneumatic pressure	Body, base, cover
Spray gun	Body, body of air gun
Escalator	Cleat, riser, roller boss
Nailing machine	Body, cover
Surveying apparatus	Body of cover
Machine for industry	Front cover, side cover
Oil pressure pump	Bracket
Pipe machine	Base for main shaft, base
Signal	Cover, case

Annex Table 3.2 Examples of serviceable parts

Use	Examples of parts
ADC1	
Automobile	Main frame, front panel
For home bakery	Inner pot
Material of building	Parts for escalator
ADC1C	
ADC2	
ADC3	
Automobile	Wheel cap, engine-mount bracket
Two-wheeled vehicle	Bracket muffler, crank case (upper, lower), bracket, wheel, frame
Bicycle	Wheel
Outboard motor	Propeller
ADC5	
Outboard motor	Propeller, cylinder, impeller
Farm machine	Arm for oscillation, nail holding plate, arm for planting
Fishing tool	Bail-arm lever, crick, spool
ADC6	
Two-wheeled vehicle	Hand lever, winker holder, winker base, foot rest, housing clutch, bracket muffler, piston, crank case, signal lamp
Outboard motor	Propeller, case of water pump, protector bar end
Electronic computer	Device for magnetic disc, carriage
Golf goods	Metal head, sole cover
ADC7	
ADC8	
ADC11	
ADC14	
Automobile	Oil-pump body for automatic transmission, housing, housing of car-cooler compressor, car-cooler cylinder block
Two-wheeled vehicle	Insert, housing clutch

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