SAE International™

SURFACE VEHICLE INFORMATION REPORT

SAE J452

REV. DEC2003

Issued 1934-01
Revised 2003-12

Superseding J452 JAN89

General Information—Chemical Compositions, Mechanical and Physical Properties of SAE Aluminum Casting Alloys

Foreword—This Document has not changed other than to put it into the new SAE Technical Standards Board Format.

1. Scope—The SAE Standards for aluminum casting alloys cover a wide range of castings for general and special use, but do not include all the alloys in commercial use. Over the years, aluminum alloys have been identified by many numbering systems as shown in Table 1. Presently, SAE is recommending the use of the UNS Numbering System to identify these materials. The castings are made principally by sand cast, permanent mold, or die cast methods; however, shell molding, investment casting, plaster cast, and other less common foundry methods may also be used. If the alloys listed do not have the desired characteristics, it is recommended that the manufacturers of aluminum castings be consulted.

2. References

2.1 Applicable Publications—The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated the lastest revision of SAE publications shall apply.

2.1.1 ASTM PUBLICATIONS—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM E 29—Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
ASTM E 34—Test Method for Chemical Analysis of Aluminum and Aluminum Alloys
ASTM E 117—Method for Spectrographic Analysis of Pig Lead by the Point-to-Plane Technique
ASTM B 557—Methods of Tension Testing Wrought and Cast Aluminum and Magnesium Alloy Products

3. Casting Types—General—There are two general types of cast aluminum alloys: nonheat treatable and heat treatable. The nonheat treatable alloys normally are used in the as-cast condition (F), but may be annealed—temper designation (O)—to relieve casting stresses or to reduce the possibility of distortion during machining.

The heat treatable alloys usually are used in a heat treated condition because of the increased strengths resulting from the heat treatment. These treatments generally consist of a high temperature solution treatment, followed by quenching in water, and a low temperature aging treatment (T6).

TO PLACE A DOCUMENT ORDER:
Tel: 877-606-7323 (inside USA and Canada)
Tel: 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: custsvc@sae.org
SAE WEB ADDRESS: http://www.sae.org

TABLE 1—TYPICAL USES OF SAE ALUMINUM CASTING ALLOYS AND SIMILAR SPECIFICATIONS

Alloy Designations			Type of Casting (1)	Similar Specifications			Typical Uses and General Data
UNS	ANSI	Former SAE		ASTM	Federal	AMS	
A02010	201.0	382	S	B26	—	—	Very high strength at room and elevated temperature; good impact strength and ductility; high cost premium casting alloy.
			PM	—	—	4229	
A02060	206.0	—	S	—	—	4237	High tensile and yield strength with moderate ductility; good fracture toughness in T4 temper, structural parts for automotive and aerospace applications.
			PM	—	—	—	
A02080	208.0	380	S	B26	QQ-A-601	—	Manifolds, valve bodies, and similar castings requiring pressure tightness.
			PM	B108	—	—	
A02220	222.0	34	S	B26	QQ-A-601	—	Primarily a piston alloy, but also used for aircooled cylinder heads and valve tappet guides.
			PM	B108	QQ-A-596	—	
A02420	242.0	39	S	B26	QQ-A-601	4222	Used primarily for aircooled cylinder heads, but also for pistons in high performance gasoline engines.
			PM	B108	QQ-A-596	—	
A02950	295.0	38	S	B26	QQ-A-601	4231	General structural castings requiring high strength and shock resistance.
A02960	296.0	—	PM	B108	QQ-A-596	4282	Modification of alloy 295.0 for use in permanent molds.
A03190	319.0	326	S	B26	QQ-A-601	—	General purpose low-cost alloy; good foundry characteristics.
			PM	B108	QQ-A-596	—	
A23190	B319.0	329	S	—	—	—	General purpose alloy similar to 319.0, but with lower ductility and improved machinability.
			PM	—	—	—	
A03280	328.0	327	S	B26	QQ-A-601	—	Similar to alloys 355.0 and 356.0, but lower ductility.
A03320	332.0	332	PM	B108	QQ-A-596	—	Primarily used for automotive and compressor pistons.
A03330	333.0	331	PM	B108	QQ-A-596	—	General purpose low-cost permanent mold alloy used for engine parts, motor housings, flywheel housings, and regulator parts.
A03360	336.0	321	PM	B108	QQ-A-596	—	Piston alloy having low expansion.
A03390	339.0	334	PM	—	—	—	Piston alloy.
A03540	354.0	—	PM	B108	—	—	High strength premium quality casting alloy.
				B686	—	—	
A03550	355.0	322	S	B26	QQ-A-601	4210	General use where high strength, medium ductility, and pressure tightness are required, such as pump bodies and liquid-cooled cylinder heads.
			PM	B108	QQ-A-596	4212	
				—	—	4214	
				—	—	4280	
				—	—	4281	
A33550	C355.0	335	S	B26	QQ-A-601	4215	Similar to alloy 355.0, but has greater ductility.
			PM	B108	QQ-A-596	—	
				B686	—	—	
A03560	356.0	323	S	B26	QQ-A-601	4217	For intricate castings requiring good strength and ductility.
			PM	B108	QQ-A-596	4284	
				—	—	4286	
A13560	A356.0	336	S	B26	QQ-A-601	4218	Similar to alloy 356.0, but has greater ductility.
			PM	B108	QQ-A-596	—	
				B686	—	—	
A03570	357.0	—	S	—	—	—	Similar to alloy A357.0, but has greater ductility.
			PM	B108	QQ-A-596	—	
A13570	A357.0	—	S	—	—	4219	High strength structural alloy with good ductility.
			PM	B108	—	—	
				B686	—	—	
A03590	359.0	—	S	—	—	—	High strength structural alloy with good ductility.
			PM	B108	—	—	

TABLE 1—TYPICAL USES OF SAE ALUMINUM CASTING ALLOYS AND SIMILAR SPECIFICATIONS (CONTINUED)

Alloy Designations			Type of Casting (1)	Similar Specifications			Typical Uses and General Data
UNS	ANSI	Former SAE		ASTM	Federal	AMS	
A03600	360.0	—	D	B85	—	—	Very good casting characteristics; good corrosion resistance; used in place of alloy 413 where higher mechanical properties are required.
A13600	A360.0	309	D	B85	QQ-A-591	4290	Excellent casting characteristics; suited for use in thin-walled or intricate castings produced in cold-chamber casting machine; high corrosion resistance; slightly higher mechanical properties than alloy 360.0.
A03800	380.0	308	D	B85	QQ-A-591	—	Similar to alloy A380.0, but suitable for use in either cold-chamber or gooseneck machines.
A13800	A380.0	306	D	B85	QQ-A-591	4291	Good casting characteristics and fair resistance to corrosion; not especially suited for thin sections; limited to cold-chamber machines.
A03830	383.0	383	D	B85	QQ-A-591	—	Similar to alloy 380.0, but with improved castability.
A03840	384.0	303	D	B85	QQ-A-591	—	General purpose alloy with high fluidity; used for thin-walled castings or castings with large areas.
A03900	390.0	—	D	—	—	—	High wear resistance; used for cylinder blocks, transmission pump and air compressor housings, small engine crankcases, and air conditioner pistons.
A13900	A390.0	—	S	—	—	—	Similar to 390.0, but formulated for sand and permanent mold casting.
			PM	—	—	—	
A23900	B390.0	—	D	—	—	—	Similar to alloy 390.0.
A04130	413	—	D	B85	—	—	Good for large thin-wall die castings, difficult to machine and finish.
A14130	A413.0	305	D	B85	QQ-A-591	—	High corrosion resistance; excellent castability; used for complicated castings with thin sections, also difficult to machine and finish.
A24430	B443.0	35	S	B26	QQ-A-601	—	Used for intricate castings having thin sections; good corrosion resistance; fair strength and good ductility.
			PM	B108	QQ-A-596	—	
A34430	C443.0	304	D	B85	QQ-A-591	—	Good casting characteristics and resistance to corrosion.
A14440	A444.0	—	S	—	—		Good castability; excellent ductility for impact absorption; used for bridge railing posts and turbocharger compressor housings.
A05140	514.0	320	S	B26	QQ-A-601	—	Moderate strength; very high corrosion resistance.
A05200	520.0	324	S	B26	QQ-A-601	4240	High strength structural alloy; requires special foundry and heat treat practice; susceptible to stress corrosion failure.
A05350	535.0	—	S	B26	QQ-A-601	—	Excellent shock and corrosion resistance, dimensional stability, and machinability; used in computer components, frame sections, optical equipment, and applications where stress rupture is a factor.
A07050	705.0	311	S	B26	QQ-A-601	—	High strength general purpose alloy; excellent machinability and dimensional stability; high corrosion resistance; can be anodized.
			PM	B108	QQ-A-596	—	
A07070	707.0	312	S	B26	QQ-A-601	—	Similar to alloy 705.0, but higher strength and lower ductility.
			PM	B108	QQ-A-596	—	
A07100	710.0	313	S	B26	QQ-A-601	—	High strength general purpose alloy similar to alloys 705.0 and 707.0; easily polished.
A07120	712.0	310	S	B26	QQ-A-601	—	General purpose structural castings developing strengths equivalent to alloy 295.0 without requiring heat treatment, but casting characteristics slightly poorer than alloy 295.0.
A07130	713.0	315	S	B26	QQ-A-601	—	Similar to alloy 710.0.
			PM	B108	QQ-A-596	—	

1. S—sand cast; PM—permanent mold; D—die cast.

By aging the solution treated castings at higher temperature to a T7 condition, a product having more stable properties in service at elevated temperatures and less likely to distort during machining is obtained. Occasionally, the artificial aging treatment is omitted and the castings are used in the quenched and naturally aged condition (T4); at other times (especially in castings to be used at elevated temperatures) the solution treatment is omitted and the castings are merely stabilized or aged (T5). This type of thermal treatment provides a limited form of stress relief. Various combinations of properties can be secured by adjusting the thermal treatments, but only the commonly used conditions form a part of the specification.

4. ***Casting Type And Alloys—Selection***—More liberal as-cast dimensional tolerances are employed for sand castings than for permanent mold or die castings. Overall wall thickness and finish stock allowance are usually greater than for permanent mold or die casting. The process has the capability of producing parts with good internal soundness. Newly developed automated high-pressure sand molding methods allow large volume production of sand castings. (Timing to get a new part into production is favorable due to lower tooling time requirements for sand equipment in comparison to the time required for hard molds and dies.)

Permanent mold castings can be cast to close tolerances. For the same chemical composition, they have slightly higher mechanical properties than sand castings. Disposable cores can be used to form both internal or external cavities having pockets or undercuts that will not draw with metal cores. This type casting is called semi-permanent mold. The process has the capability of allowing castings with good internal soundness to be produced.

Semi and permanent mold parts are generally produced by one of two methods: gravity, in which metal is poured into the mold, or low pressure, in which metal is forced into the mold from a sealed furnace by low-pressure air.

The use of die castings for high-volume production of automotive parts has found wide application in this industry. Die castings can be held to much closer tolerances than either sand or permanent mold. The process will permit thinner overall wall thickness and lesser amounts of finish stock thus resulting in a lower weight part. Some holes can be cast within the limitations of the design and part orientation in the die. The surface of die castings is smooth if dies are well maintained, but sometimes can deteriorate with extensive die usage. When surface finishing is required, this characteristic can be advantageous from a cost standpoint.

The uniformity of dimensions, lower weight, and lesser finish stock permits lower costs of finish machining operations. This, coupled with lower as-cast weight, removal of gating with trim dies, high productivity casting rates, and use in the as-cast condition, usually results in die castings having very favorable costs in comparison to parts made by other processes even though tooling costs are more expensive.

Although test bar values for die cast alloys are, in general, high in tensile and yield due to their having been cast with a high chill rate, a lack of internal soundness of castings made from the alloy can result in lower property levels. Injection of metal under high pressures through thin gates which may cause inclusions, solidification phenomena, and actual casting design features unfavorable to producing sound areas, can result in internal defects that reduce considerably the property level of actual parts from that of test bar values. It is extremely important that the producer and the user of die castings cooperate very closely in the design, planning, and try out stages to obtain satisfactory quality in die-cast parts.

5. ***Pattern Design***—In the design of patterns for the production of aluminum alloy sand castings, a shrinkage is usually allowed Table 2A and may vary slightly depending upon the form and size of the casting. Producers of castings should also be consulted concerning the design of the pattern so that the best results may be obtained with the alloy to be used. The information provided in Table 2 is based on a study made by the American Foundrymen's Society.

6. ***Chemical Compositions***—Chemical analysis shall be made in accordance with ASTM E 34, Standard Methods for Chemical Analysis of Aluminum and Aluminum Base Alloys, or any other approved method agreed upon by the manufacturer and the purchaser. The analysis may be made spectrographically, provided that, in case of dispute, the results secured by the ASTM E 34 methods shall be the basis for acceptance.

   For purposes of determining conformance to limits indicated in Table 3, an observed or a calculated value obtained from analysis is rounded off to the nearest unit in the last right-hand place of figures used in expressing the specified limit in accordance with the rounding method of ASTM E 29, Recommended Practices for Indicating Which Places of Figures are to be Considered Significant in Specifying Limiting Values.

7. ***Mechanical And Physical Properties***—The typical physical properties of SAE casting alloys are shown in Table 4. The specified mechanical properties shown in this SAE Information Report are the values that should be obtained from standard test specimens, separately cast under conditions that duplicate, as closely as possible, the conditions of solidification of the casting, and tested without machining, except to adapt the ends to the grips of the testing equipment. The specified properties for sand casting alloys Table 5 are for 1/2 in (12.7 mm) diameter standard test bars cast without chills in green sand molds, and the specified properties for the permanent mold alloys Table 6 are for 1/2 in (12.7 mm) diameter standard test bars cast in a permanent mold. The typical tensile properties given for die casting alloys Table 7 are for 1/4 in (6.4 mm) diameter standard die cast test bars as shown in ASTM B 557, Methods of Tension Testing Wrought and Cast Aluminum and Magnesium Alloy Products.

TABLE 2A—SAE ALUMINUM ALLOY CHARACTERISTICS

Alloy Designations			Foundry Characteristics[1]							
				Pattern Shrinkage Allowance [2]					
UNS	ANSI	SAE	Type of Casting	in/ft	%	Resistance to Hot Cracking[3]	Pressure Tightness	Fluidity[4]	Solidification Shrinkage Tendency[5]
A02010	201.0	382	S	5/32	1.30	4	3	3	4
			PM	(2)	(2)	4	3	3	4
A02060	206.0	—	S	5/32	1.30	4	3	3	4
			PM	(2)	(2)	4	3	3	4
A02080	208:0	380	S	5/32	1.30	4	3	3	3
			PM	(2)	(2)	4	3	3	3
A02220	222.0	34	S	5/32	1.30	3	3	3	3
			PM	(2)	(2)	4	4	3	4
A02420	242.0	39	S	5/32	1.30	4	3	3	4
			PM	(2)	(2)	4	4	3	4
A02950	295.0	38	S	5/32	1.30	4	4	3	3
A02960	296.0	—	PM	(2)	(2)	4	3	3	3
A03190	319.0	326	S	5/32	1.30	2	2	2	2
			PM	(2)	(2)	2	2	2	3
A23190	B319.0	329	S	5/32	1.30	2	2	2	2
			PM	(2)	(2)	2	2	2	2
A03280	328.0	327	S	5/32	1.30	1	1	1	1
A03320	332.0	332	PM	(2)	(2)	1	2	1	2
A03330	333.0	331	PM	(2)	(2)	2	2	1	3
A03360	336.0	321	PM	(2)	(2)	1	2	1	3
A03390	339.0	334	PM	(2)	(2)	1	2	1	2
A03540	354.0	—	PM	(2)	(2)	2	1	1	3
A03550	355.0	322	S	5/32	1.30	1	1	1	1
			PM	(2)	(2)	1	1	2	2
A33550	C355.0	335	S	5/32	1.30	1	1	1	1
			PM	(2)	(2)	1	1	2	2
A03560	356.0	323	S	5/32	1.30	1	1	1	1
			PM	(2)	(2)	1	1	2	1
A13560	A356.0	336	S	5/32	1.30	1	1	1	1
			PM	(2)	(2)	1	1	2	1
A03570	357.0	—	S	5/32	1.30	1	1	1	1
			PM	(2)	(2)	1	1	2	1
A13570	A357.0	—	S	5/32	1.30	1	1	1	1
			PM	(2)	(2)	1	1	2	1
A03590	359.0	—	S	5/32	1.30	2	2	1	2
			PM	(2)	(2)	2	2	2	2
A03600	360.0	—	D	(2)	(2)	1	1	1	—
A13600	A360.0	309	D	(2)	(2)	1	1	1	—
A03800	380.0	308	D	(2)	(2)	1	1	1	—
A13800	A380.0	306	D	(2)	(2)	1	1	1	—

TABLE 2A—SAE ALUMINUM ALLOY CHARACTERISTICS (CONTINUED)

Alloy Designations			Foundry Characteristics[1]							
				Pattern Shrinkage Allowance [2]						
UNS	ANSI	SAE	Type of Casting	in/ft	%	Resistance to Hot Cracking[3]	Pressure Tightness	Fluidity[4]	Solidification Shrinkage Tendency[5]
A03830	383.0	383	D	(2)	(2)	1	1	1	—
A03840	384.0	—	D	(2)	(2)	1	1	1	—
A03900	390.0	—	D	(2)	(2)	3	3	1	—
A13900	A390.0	—	S	5/32	1.30	3	3	1	3
			PM	(2)	(2)	3	3	1	3
A23900	B390.0	—	D	(2)	(2)	3	3	1	—
A04130	413.0	—	D	(2)	(2)	1	2	1	—
A14130	A413.0	305	D			1	2	1	—
A24430	B443.0	35	S	5/32	1.30	1	1	1	1
			PM	(2)	(2)	1	1	1	2
A34430	C443.0	304	D	(2)	(2)	2	3	3	—
A14440	A444.0	—	S	5/32	1.30	4	4	5	—
A05140	514.0	320	S	5/32	1.30	4	5	5	5
A05200	520.0	324	S	1/10	0.83	4	5	4	5
A05350	535.0	—	S	1/10	0.83	3	5	3	4
A07050	705.0	311	S	3/16	1.56	5	3	4	4
A07050	705.0	311	PM	(2)	(2)	5	4	4	5
A07070	707.0	312	S	3/16	1.56	5	3	4	4
			PM	(2)	(2)	5	4	4	5
A07100	710.0	313	S	3/16	1.56	5	3	4	4
A07120	712.0	310	S	3/16	1.56	5	3	4	4
A07130	713.0	315	S	3/16	1.56	5	3	4	4
			PM	(2)	(2)	5	4	4	5

1. 1 indicates best of group; 5 indicates poorest of group.
2. Not applicable to permanent mold and die castings. Allowances are for average sand castings. Shrinkage requirements will vary with intricacy of design and dimensions.
3. Ability of alloy to withstand contraction stresses while cooling through hot-short or brittle temperature range.
4. Ability of liquid alloy to flow readily in mold and fill thin sections.
5. Decrease in volume accompanying freezing of alloy and measure of amount of compensating feed metal required in form of risers.

NOTE: Type of casting: S—sand cast; PM—permanent mold; D—die cast.

TABLE 2B—SAE ALUMINUM ALLOY CHARACTERISTICS

Alloy		Other Characteristics									
UNS	ANSI	Normally Heat Treated	Resistance to Corrosion[1]	Machining[2]	Polishing[3]	Electroplating[4]	Anodized Appearance[5]	Chemical Oxide Coating[6] (Protection)	Strength at Elevated Temperature[7]	Suitability for Welding[8]	Suitability for Brazing[9]
A02010	201.0	Yes	4	1	1	1	2	2	1	4	No
A02060	206.0	Yes	4	1	1	1	2	2	1	4	No
A02080	208.0	Yes	4	3	2	1	3	2	2	4	No
A02220	222.0	Yes	4	1	2	1	3	4	1	4	No
A02420	242.0	Yes	4	2	2	1	3	4	1	4	No
A02950	295.0	Yes	3	2	2	1	2	3	3	3	No
A02960	296.0	Yes	4	3	4	2	4	3	3	2	No
A03190	319.0	Yes	3	3	4	2	4	3	3	2	No
A23190	8319.0	Yes	3	3	4	2	4	3	3	2	No
A03280	328.0	Yes	3	4	5	2	4	2	2	2	No
A03320	332.0	Aged Only	3	3	4	3	5	3	3	2	No
A03330	333.0	Yes	3	2	3	2	4	3	2	3	No
A03360	336.0	Yes	3	4	5	4	5	2	2	2	No
A03390	339.0	Aged Only	3	3	4	3	5	3	3	2	No
A03540	354.0	Yes	3	4	4	2	4	3	2	3	No
A03550	355.0	Yes	3	3	3	1	4	2	2	2	No
A33550	C355.0	Yes	3	3	3	2	4	2	2	2	No
A03560	356.0	Yes	2	4	3	2	4	2	3	1	No
A13560	A356.0	Yes	2	3	3	1	4	2	3	1	No
A03570	357.0	Yes	2	3	3	1	4	2	3	1	No
A13570	A357.0	Yes	2	3	3	1	4	2	3	1	No
A03590	359.0	Yes	2	4	4	2	4	2	2	1	No
A03600	360.0	No	2	4	4	2	4	3	2	3	No
A13600	A360.0	No	3	3	3	1	4	3	2	3	No
A03800	380.0	No	4	3	3	1	4	5	2	4	No
A13800	A380.0	No	4	3	3	1	4	5	2	4	No
A03830	383.0	No	4	3	3	1	4	5	2	4	No
A03840	384.0	No	4	3	3	1	4	5	3	4	No
A03900	390.0	No	3	4	3	—	5	—	1	4	No
A13900	A390.0	Yes	3	4	3	—	5	—	1	4	No
A23900	B390.0	No	3	4	3	—	5	—	1	4	No
A04130	413.0	No	2	4	5	3	5	3	3	3	No
A14130	A413.0	No	3	4	5	3	5	3	3	3	No
A24430	B443.0	No	3	5	5	2	5	2	4	1	Ltd.
A34430	C443.0	No	2	5	5	2	4	3	5	1	No
A14440	A444.0	No	2	4	4	—	4	2	3	1	No

Note: Type of casting: S—sand cast; PM—permanent mold; D—die cast.

TABLE 2B—SAE ALUMINUM ALLOY CHARACTERISTICS (CONTINUED)

Alloy		Other Characteristics									
UNS	ANSI	Normally Heat Treated	Resistance to Corrosion[1]	Machining[2]	Polishing[3]	Electroplating[4]	Anodized Appearance[5]	Chemical Oxide Coating[6] (Protection)	Strength at Elevated Temperature[7]	Suitability for Welding[8]	Suitability for Brazing[9]
A05140	514.0	No	1	1	1	5	1	1	2	4	No
A05200	520.0	Yes	1	1	1	4	1	1	— [10]	5	No
A05350	535.0	Opt	1	1	1	—	1	1	3	4	No
A07050	705.0	Aged Only	2	1	1	3	2	2	5	4	Yes
A07070	707.0	Yes	2	1	1	3	2	2	5	4	Yes
A07100	710.0	Aged only	2	1	1	2	2	3	5	4	Yes
A07120	712.0	Aged Only	2	1	1	2	2	3	5	4	Yes
A07130	713.0	Aged Only	2	1	1	2	2	3	5	4	Yes

Note: Type of casting: S—sand cast; PM—permanent mold; D—die cast.

1. Based on alloy resistance in 5% salt spray test (ASTM B117).
2. Composite rating based on ease of cutting, chip characteristics, quality of finishing, and tool life. Ratings, in the case of heat treatable alloys, based on T6 temper. Other tempers, particularly the annealed temper, may have lower rating.
3. Composite rating based on ease and speed of polishing and quality of finish provided by typical polishing procedure.
4. Ability of casting to take and hold on electroplate applied by present standard methods.
5. Rated on lightness of color, brightness, and uniformity of clear anodized coating applied in sulfuric acid electrolyte.
6. Rated on combined resistance of coating and base alloy to corrosion.
7. Rating based on tensile and yield strengths of temperature up to 500° F (260° C), after prolonged heating at testing temperatures.
8. Based on ability of material to be fusion welded with filler rod of same alloy.
9. Refers to suitability of alloy to withstand brazing temperatures without excessive distortion or melting.
10. Not recommended for service at temperatures exceeding 200 °F (93 °C).

TABLE 3—CHEMICAL COMPOSITIONS OF SAE ALUMINUM CASTING ALLOYS [1]

UNS	ANSI Designation	Former SAE	Product[2]	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Sn	Ti	Others	
														Each	Total
A02010	201.0	382	S,PM	0.10	0.15	4.0–5.2	0.20–0.50	0.15–0.55	—	—	—	—	0.15–0.35	0.05[3]	0.10
A02060	206.0	—	S,PM	0.10	0.15	4.2–5.0	0.20–0.50	0.15–0.35	—	0.05	0.10	0.05	0.15–0.30	0.05	0.15
A02080	208.0	—	S,PM	2.5–3.5	1.2	3.5–4.5	0.50	0.10	—	0.35	1.0	—	0.25	—	0.50
A02220	222.0	34	S,PM	2.0	1.5	9.2–10.7	0.50	0.15–0.35	—	0.50	0.8	—	0.25	—	0.35
A02420	242.0	39	S,PM	0.7	1.0	3.5–4.5	0.35	1.2–1.8	0.25	1.7–2.3	0.35	—	0.25	0.05	0.15
A02950	295.0	38	S	0.7–1.5	1.0	4.0–5.0	0.35	0.03	—	—	0.35	—	0.25	0.05	0.15
A02960	296.0	380	PM	2.0–3.0	1.2	4.0–5.0	0.35	0.05	—	0.35	0.50	—	0.25	—	0.35
A03190	319.0	326	S,PM	5.5–6.5	1.0	3.0–4.0	0.50	0.10	—	0.35	1.0	—	0.25	—	0.50
A23190	B319.0	329	S,PM	5.5–6.5	1.2	3.0–4.0	0.8	0.10–0.50	—	0.50	1.0	—	0.25	—	0.50
A03280	328.0	327	S	7.5–8.5	1.0	1.0–2.0	0.20–0.6	0.20–0.6	0.35	0.25	1.5	—	0.25	—	0.50
A03320	332.0	332	PM	8.5–10.5	1.2	2.0–4.0	0.50	0.50–1.5	—	0.50	1.0	—	0.25	—	0.50
A03330	333.0	331	PM	8.0–10.0	1.0	3.0–4.0	0.50	0.05–0.50	—	0.50	1.0	—	0.25	—	0.50
A03360	336.0	321	PM	11.0–13.0	1.2	0.50–1.5	0.35	0.7–1.3	—	2.0–3.0	0.35	—	0.25	0.05	—
A03390	339.0[4]	334	PM	11.0–13.0	1.2	1.5–3.0	0.50	0.5–1.5	—	0.5–1.5	1.0	—	0.25	—	0.50
A03540	354.0	—	PM	8.6–9.4	0.20	1.6–2.0	0.10	0.40-0.6	—	—	0.10	—	0.20	0.05	0.15
A03550	355.0	322	S,PM	4.5–5.5	0.6[5]	1.0–1.5	0.50[5]	0.40-0.6	0.25	—	0.35	—	0.25	0.05	0.15
A33550	C355.0	335	S,PM	4.5–5.5	0.20	1.0–1.5	0.10	0.40-0.6	—	—	0.10	—	0.20	0.05	0.15
A03560	356.0	323	S,PM	6.5–7.5	0.6[5]	0.25	0.35[5]	0.20-0.45	—	—	0.35	—	0.25	0.05	0.15
A13560	A356.0	336	S,PM	6.5–7.5	0.20	0.20	0.10	0.25–0.45	—	—	0.10	—	0.20	0.05	0.15
A03570	357.0	—	S,PM	6.5–7.5	0.15	0.05	0.03	0.45-0.6	—	—	0.05	—	0.20	0.05	0.15
A13570	A357.0	—	S,PM	6.5–7.5	0.20	0.20	0.10	0.40–0.7	—	—	0.10	—	0.04–0.20	0.05[6]	0.15
A03590	359.0	—	S,PM	8.5–9.5	0.20	0.20	0.10	0.50-0.7	—	—	0.10	—	0.20	0.05	0.15
A03600	360.0	—	D	9.0–10.0	2.0	0.6	0.35	0.40-0.6	—	0.50	0.50	0.15	—	—	0.25
A13500	A360.0	309	D	9.0–10.0	1.3	0.6	0.35	0.40-0.6	—	0.50	0.50	0.15	—	—	0.25
A03800	380.0	308	D	7.5–9.5	2.0	3.0–4.0	0.50	0.10	—	0.50	3.0	0.35	—	—	0.50
A13800	A380.0	306	D	7.5–9.5	1.3	3.0–4.0	0.50	0.10	—	0.50	3.0	0.35	—	—	0.50
A03830	383.0	383	D	9.5–11.5	1.3	2.0–3.0	0.50	0.10	—	0.30	3.0	0.15	—	—	0.50
A03840	384.0	303	D	10.5–12.0	1.3	3.0–4.5	0.50	0.10	—	0.50	3.0	0.35	—	—	0.50
A03900	390.0	—	D	16.0–18.0	1.3	4.0–5.0	0.10	0.45–0.65	—	—	0.10	—	0.20	0.10	0.20
A13900	A390.0	—	S,PM	16.0–18.0	0.50	4.0–5.0	0.10	0.45–0.65	—	—	0.10	—	0.20	0.10	0.20
A23900	B390.0	—	D	16.0–18.0	1.3	4.0–5.0	0.50	0.45–0.65	—	0.10	1.5	—	0.20	0.10	0.20
A04130	413.0	—	D	11.0–13.0	2.0	1.0	0.35	0.10	—	0.50	0.50	0.15	—	—	0.25
A14130	A413.0	305	D	11.0–13.0	1.3	1.0	0.35	0.10	—	0.50	0.50	0.15	—	—	0.25
A24430	B443.0	35[7]	S,PM	4.5–6.0	0.8	0.15	0.35	0.05	—	—	0.35	—	0.25	0.05	0.15
A34430	C443.0	304	D	4.5–6.0	2.0	0.6	0.35	0.10	—	0.50	0.50	0.15	—	—	0.25
A14440	A444.0	I—	S	6.5–7.5	0.20	0.10	0.10	0.05	—	—	0.10	—	0.20	0.05	0.15

TABLE 3—CHEMICAL COMPOSITIONS OF SAE ALUMINUM CASTING ALLOYS [1] (CONTINUED)

UNS	ANSI Designation	Former SAE	Product[2]	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Sn	Ti	Others	
														Each	Total
A05140	514.0	320	S	0.35	0.50	0.15	0.35	3.5–4.5	—	—	0.15	0.15	0.25	0.05	0.15
A05200	520.0	324	S	0.25	0.30	0.25	0.15	9.5–10.6	—	—	0.15	—	0.25	0.05	0.15
A05350	535.0	—	S	0.15	0.15	0.05	0.10–0.25	6.2–7.5	—	—	—	—	0.10–0.25	0.05[8]	0.15
A07050	705.0	311	S,PM	0.20	0.8	0.20	0.40–0.6	1.4–1.8	0.20–0.40	—	2.7–3.3	—	0.25	0.05	0.15
A07070	707.0	312	S,PM	0.20	0.8	0.20	0.40-0.6	1.8–2.4	0.20–0.40	—	4.0–4.5	—	0.25	0.05	0.15
A07100	710.0	313	S	0.15	0.50	0.35–0.65	0.05	0.6–0.8	—	—	6.0–7.0	—	0.25	0.05	0.15
A07120	712.0	310	S	0.30	0.50	0.25	0.10	0.50–0.65	0.40-0.6		5.0–6.5	—	0.15–0.25	0.05	0.20
A07130	713.0	315	S,PM	0.25	1.1	0.4–1.0	0.6	0.20–0.50	0.35	—	7.0–8.0	—	0.25	0.10	0.25

1. Values are maximum except where indicated as a range. Aluminum is the remainder.
2. S—sand cast; PM—permanent mold; D—die cast.
3. Also contains 0.40–1.0% silver.
4. Composition limits differ slightly from those previously listed for former SAE alloy 334.
5. If iron exceeds 0.45%, manganese content shall not be less than one-half the iron content.
6. Also contains 0.04–0.07% beryllium.
7. Former SAE 35 similar to B443.0. Actual former SAE 35 was alloy 443.0 which has been replaced in commercial use by alloy B443.0.
8. Also contains 0.003–0.007% beryllium, 0.002 max. % boron.

TABLE 4—TYPICAL PHYSICAL PROPERTIES OF SAE CASTING ALLOYS

Alloy		Temper	Density		Approximate Melting Range[1]		Elec. Cond. % IACS	Therm. Cond. W/(m · K)	Coeff. of Thermal Expan., x 10^{-6}			
UNS	ANSI		lb/in^2	kg/m^2	°F	°C			68–212 °F per °F	20–100 °C per °C	68–572 °F per °F	20–300 °C per °C
A02010	201.0	T6	0.101	2800	995–1200	535–650	30	121	10.7	19.3	13.7	24.7
		T7	0.101	2800	995–1200	535–650	30	121	10.7	19.3	13.7	24.7
A02060	206.0	T4	0.101	2800	1010–1200	542–650	—	121	10.7	19.3	—	—
A02080	208.0	F	0.101	2800	970–1160	521–627	31	125	12.4	22.3	13.4	24.1
		T4	0.101	2800	970–1160	521–627	—	—	12.4	22.3	13.4	24.1
		T55	0.101	2800	970–1160	521–627	—	—	12.4	22.3	13.4	24.1
		T6	0.101	2800	970–1160	521–627	—	—	12.4	22.3	13.4	24.1
		T7	0.101	2800	970–1160	521–627	—	—	12.4	22.3	13.4	24.1
A02220	222.0	0	0.107	2960	965–1155	518–624	—	—	12.3	22.1	13.1	23.6
		T551	0.107	2960	965–1155	518–624	—	—	12.3	22.1	13.1	23.6
		T61	0.107	2960	965–1155	518–624	33	130	12.3	22.1	13.1	23.6
		T65	0.107	2960	965–1155	518–624	—	—	12.3	22.1	13.1	23.6
A02420	242.0	0	0.102	2820	990–1175	532–635	—	—	12.6	22.7	13.6	24.5
		T571[2]	0.102	2820	990–1175	532–635	34	134	12.6	22.7	13.6	24.5
		T61	0.102	2820	990–1175	532–635	—	—	12.6	22.7	13.6	24.5
		T77	0.102	2820	990–1175	532–635	38	151	12.6	22.7	13.6	24.5
A02950	295.0	T4	0.102	2820	970–1190	521–643	—	138	12.7	22.9	13.8	24.8
		T6	0.102	2820	970–1190	521–643	35	138	12.7	22.9	13.8	24.8
		T62	0.102	2820	970–1190	521–643	—	138	12.7	22.9	13.8	24.8
		T7	0.102	2820	970–1190	521–643	—	—	12.7	22.9	13.8	24.8
A02960	296.0	T4	0.101	2800	970–1170	521–632	—	130	12.2	22.0	13.3	23.9
		T6[2]	0.101	2800	970–1170	521–632	33	130	12.2	22.0	13.3	23.9
		T7	0.101	2800	970–1170	521–632	—	—	12.2	22.0	13.3	23.9
A03190	319.0	F	0.101	2800	960–1120	516–604	27	109	11.9	21.4	12.7	22.9
		T5	0.101	2800	960–1120	516–604	—	—	11.9	21.4	12.7	22.9
		T6	0.101	2800	960–1120	516–604	—	—	11.9	21.4	12.7	22.9
		T61	0.101	2800	960–1120	516–604	—	—	11.9	21.4	12.7	22.9
A23190	B319.0	T5	—	—	—	—	—	—	—	—	—	—
		T6	—	—	—	—	—	—	—	—	—	—
A03280	328.0	F	0.098	2720	1025–1105	552–596	30	121	11.9	21.4	12.9	23.2
		T6	0.098	2720	1025–1105	552–596	—	—	11.9	21.4	12.9	23.2
A03320	332.0	T5[2]	0.100	2770	970–1080	521–582	26	104	11.5	20.7	12.4	22.3
A03330	333.0	F[2]	0.100	2770	960–1085	516–585	26	104	11.4	20.5	12.4	22.3
		T5[2]	0.100	2770	960–1085	516–585	29	117	11.4	20.5	12.4	22.3
		T6[2]	0.100	2770	960–1085	516–585	29	117	11.4	20.5	12.4	22.3
		T7[2]	0.100	2770	960–1085	516–585	35	138	11.4	20.5	12.4	22.3
A03360	336.0	T551[2]	0.098	2720	1000–1050	538–566	29	117	11.0	19.8	12.0	21.6
		T65	0.098	2720	1000–1050	538–566	—	—	11.0	19.8	12.0	21.6
A03390	339.0	T551[2]	0.098	2720	—	—	—	117	—	—	—	—
A03540	354.0	T61	0.098	2720	1000–1105	538–596	32	125	11.6	20.9	12.7	22.9
A03550	355.0	T51	0.098	2720	1015–1150	546–621	43	167	12.4	22.3	13.7	24.7
		T6	0.098	2720	1015–1150	546–621	36	142	12.4	22.3	13.7	24.7
		T62[2]	0.098	2720	1015–1150	546–621	36	142	12.4	22.3	13.7	24.7
		T7	0.098	2720	1015–1150	546–621	42	163	12.4	22.3	13.7	24.7
		T71	0.098	2720	1015–1150	546–621	39	151	12.4	22.3	13.7	24.7

TABLE 4—TYPICAL PHYSICAL PROPERTIES OF SAE CASTING ALLOYS (CONTINUED)

Alloy		Temper	Density		Approximate Melting Range[1]		Elec. Cond. % IACS	Therm. Cond. W/(m · K)	Coeff. of Thermal Expan., x 10^{-6}			
UNS	ANSI		lb/in^2	kg/m^2	°F	°C			68–212 °F per °F	20–100 °C per °C	68–572 °F per °F	20–300 °C per °C
A33550	C355.0	T6	0.098	2720	1015–1150	546–621	36	142	12.4	22.3	13.7	24.7
		T61	0.098	2720	1015–1150	546–621	37	146	12.4	22.3	13.7	24.7
A03560	356.0	F	0.097	2685	1035–1135	557–613	—	—	11.9	21.4	12.9	23.2
		T51	0.097	2685	1035–1135	557–613	43	167	11.9	21.4	12.9	23.2
		T6	0.097	2685	1035–1135	557–613	39	151	11.9	21.4	12.9	23.2
		T7	0.097	2685	1035–1135	557–613	40	155	11.9	21.4	12.9	23.2
		T71	0.097	2685	1035–1135	557–613	—	—	11.9	21.4	12.9	23.2
A13560	A356.0	T6	0.097	2685	1035–1135	557–613	—	—	11.9	21.4	12.9	23.2
		T61	0.097	2685	1035–1135	557–613	39	151	11.9	21.4	12.9	23.2
		T7	0.097	2685	1035–1135	557–613	—	—	11.9	21.4	12.9	23.2
		T71	0.097	2685	1035–1135	557–613	—	—	11.9	21.4	12.9	23.2
A03570	357.0	T6	0.097	2685	1035–1135	557–613	39	151	11.9	21.4	12.9	23.2
A13570	A357.0	T61	0.097	2685	1035–1135	557–613	39	151	11.9	21.4	12.9	23.2
A03590	359.0	T61	0.097	2685	1045–1115	563–602	35	138	11.6	20.9	12.7	22.9
A03600	360.0	F	0.095	2630	1035–1105	557–596	—	—	12.2[3]	22.0[3]	—	—
A13600	A360.0	F	0.095	2630	1035–1105	557–596	29	113	12.2[3]	22.0[3]	—	—
A03800	380.0	F	0.098	2720	1000–1100	538–593	23	96	12.1[3]	21.8[3]	—	—
A13830	A380.0	F	0.098	2720	1000–1100	538–593	—	100	—	—	—	—
A03830	383.0	F	0.098	2720	960–1080	516–582	23	96	11.7[3]	21.1[3]	—	—
A03840	384.0	F	0.098	2720	960–1080	516–582	23	96	11.7[3]	21.1[3]	—	—
A03900	390.0	F	—	—	—	—	—	—	—	—	—	—
A13900	A390.0	T5	0.099	2740	945–1200	507–649	25	134	10.0	18.0	—	—
		T6	0.099	2740	945–1200	507–649	—	—	10.0	18.0	—	—
		T7	0.099	2740	945–1200	507–649	—	—	10.0	18.0	—	—
A23900	B390.0	F	—	—	—	—	—	—	—	—	—	—
A04130	413.0	F	0.096	2660	1065–1080	574–582	—	—	11.9[3]	21.4[3]	—	—
A14130	A413.0	F	0.096	2660	1065–1080	574–582	31	121	11.9[3]	21.4[3]	—	—
A24430	B443.0	F	0.097	2685	1065–1170	574–632	37	146	12.3	22.1	13.4	24.1
A34430	C443.0	F	0.097	2685	1065–1170	574–632	37	142	12.9[3]	23.2[3]	—	—
A14440	A444.0	F	0.095	2635	1065–1145	574–618	41	159	12.1	21.8	13.2	23.8
A05140	514.0	F	0.096	2660	1085–1185	585–640	35	138	13.4	24.1	14.5	26.1
A05200	520.0	T4	0.093	2570	840–1120	449–604	21	88	13.7	24.7	14.8	26.6
A05350	535.0	F	0.095	2635	1020–1165	548–629	23	96	13.1	23.6	14.8	26.6
A07050	705.0	T5	0.100	2770	1105–1180	596–638	25	104	13.1	23.6	14.3	25.7
A07070	707.0	T5	0.100	2770	1085–1165	585–629	25	104	13.2	23.8	14.4	25.9
		T7	0.100	2770	1085–1165	585–629	—	—	13.2	23.8	14.4	25.9
A07100	710.0	T5	0.102	2820	1105–1195	596–646	35	138	13.4	24.1	14.6	26.3
A07120	712.0	T5	0.101	2800	1135–1200	613–649	35	138	13.7	24.7	14.8[4]	26.6[4]
A07130	713.0	T5	0.102	2810	1100–1180	593–638	30	121	13.4[4]	24.1[4]	14.6[4]	26.3[4]

1. The Approximate Melting Range data shown is a practical parameter of the alloy—not concise values. Normal and common composition and process variations can cause deviations from the values given.
2. Chill cast samples; all other samples cast in green sand molds.
3. For die cast alloys, data valid for temperature range of 68–392 °F (20–200 °C).
4. Estimated value.

TABLE 5—MECHANICAL PROPERTY LIMITS OF SAE SAND CASTING ALLOYS[1]

Alloy		Temper	Min. Tensile Strength		Min. Yield Strength (0.2% offset)		Elongation % Min. in 4D	Brinell Hardness[2] (500 kg)
UNS	ANSI		ksi	MPa	ksi	MPa		
A02010	201.0	T6	60.0	415	50.0	345	5.0	115–145
		T7	60.0	415	50.0	345	3.0	115–145
A02060	206.0	T4	40.0	275	24.0	165	8.0	—
A02080	208.0	F	19.0	130	12.0	85	1.5	40–70
		T55	21.0	145	—	—	—	—
A02220	222.0	0	23.0	160	—	—	—	—
		T61	30.0	205	—	—	—	100–130
A02420	242.0	0	23.0	160	—	—	—	—
		T571	29.0	200	—	—	—	—
		T61	32.0	220	20.0	140	—	90–120
		T77	24.0	165	13.0	90	1.0	—
A02950	295.0	T4	29.0	200	13.0	90	6.0	45–75
		T6	32.0	220	20.0	140	3.0	60–90
		T62	36.0	250	28.0	195	—	80–110
		T7	29.0	200	16.0	110	3.0	55–85
A03190	319.0	F	23.0	160	13.0	90	1.5	55–85
		T5	25.0	170	—	—	—	—
		T6	31.0	215	20.0	140	1.5	65–95
A23190	8319.0	T5	26.0[3]	180[3]	—	—	—	—
		T6	32.0[3]	220[3]	21.0[3]	145[3]	1.0[3]	70–100[3]
A03280	328.0	F	25.0	170	14.0	95	1.0	45–75
		T6	34.0	235	21.0	145	1.0	65–95
A03550	355.0	T51	25.0	170	18.0	125	—	50–80
		T6	32.0	220	20.0	140	2.0	65–95
		T7	35.0	240	—	—	—	—
		T71	30.0	205	22.0	150	—	60–90
A33550	C355.0	T6	36.0	250	25.0	170	2.5	—
		T61	36.0[3]	250[3]	30.0[3]	205[3]	1.0[3]	70–100[3]
A03560	356.0	F	19.0	130	—	—	2.0	40–70
		T51	23.0	160	16.0	110	—	45–75
		T6	30.0	205	20.0	140	3.0	55–85
		T7	31.0	215	29.0	200	—	60–90
		T71	25.0	170	18.0	125	3.0	45–75
A13560	A356.0	T6	34.0	235	24.0	165	3.5	55–85
		T7	32.0[3]	220[3]	30[3]	205[3]	—	—
		T71	26.0[3]	180[3]	19.0[3]	130[3]	4.0[3]	—
A03570	357.0	T6 [4]	—	—	—	—	—	—
A13570	A357.0	T6[4]	—	—	—	—	—	—
A03590	359.0	T61[4]	—	—	—	—	—	—
A13900	A390.0	F	26.0[3]	180[3]	26.0[3]	180[3]	—	85–115[3]
		T5	26.0[3]	180[3]	26.0[3]	180[3]	—	85–115[3]
		T6	40.0[3]	275[3]	40.0[3]	275[3]	—	125–155[3]
		T7	36.0[3]	250[3]	36.0[3]	250[3]	—	100–130[3]
B24430	B443.0	F	17.0	115	6.0	40	3.0	25–55

TABLE 5—MECHANICAL PROPERTY LIMITS OF SAE SAND CASTING ALLOYS(1) (CONTINUED)

Alloy		Temper	Min. Tensile Strength		Min. Yield Strength (0.2% offset)		Elongation % Min. in 4D	Brinell Hardness(2) (500 kg)
UNS	ANSI		ksi	MPa	ksi	MPa		
A14440	A444.0	F	18.0(3)	125(3)	7.0(3)	50(3)	8.0(3)	35–65(3)
A05140	514.0	F	22.0	150	9.0	60	6.0	35–65
A05200	520.0	T4	42.0	290	22.0	150	12.0	60–90
A05350	535.0	F	35.0	240	18.0	125	9.0	60–90
A07050	705.0	T5	30.0	205	17.0	115	5.0	50–80
A07070	707.0	T5	33.0	230	22.0	150	2.0	60–90
		T7	37.0	255	30.0	205	1.0	65–95
A07100	710.0	T5	32.0	220	20.0	140	2.0	60–90
A07120	712.0	T5	34.0	235	25.0	170	4.0	60–90
A07130	713.0	T5	32.0	220	22.0	150	3.0	60–90

1. Values represent properties obtained from 0.500 in diameter separetely cast test bars as depicted in Fig. 8 of ASTM B 557, cast in green sand molds, and tested in accordance with the procedures of ASTM B 557.
2. Hardness values are given for information only; not required for acceptance.
3. Preliminary value.
4. Mechanical properties for these alloys are dependent on casting process and heat treat procedures set for individual casting requirements. These alloys have generally been used in premium quality application, and process techniques have not been standardized. Consult individual foundry for applicable property limits.

TABLE 6—MECHANICAL PROPERTY LIMITS OF SAE PERMANENT MOLD CASTING ALLOYS[1]

Alloy		Temper	Min. Tensile Strength		Min. Yield Strength (0.2% offset)		Elongation Min % in 4D	Brinell Hardness[2] (500 kg)
UNS	ANSI		ksi	MPa	ksi	MPa		
A02010	201.0	T6	60.0	415	50.0	345	5.0	115–145
		T7	60.0	415	50.0	345	3.0	115–145
A02060	206.0	T4	40.0[3]	275[3]	24.0[3]	165[3]	8.0[3]	—
A02080	208.0	T4	33.0	230	15.0	105	4.5	60–90
		T6	35.0	240	22.0	150	2.0	75–105
		T7	33.0	230	16.0	110	3.0	65–95
A02220	222.0	T551	30.0	205	—	—	—	100–130
		T65	40.0	275	—	—	—	125–155
A02420	242.0	0	24.0[3]	165[3]	—	—	—	—
		T571	34.0	235	—	—	—	90–120
		T61	40.0	275	—	—	—	95–125
A02960	296.0	T4	33.0	230	15.0	105	4.5	60–90
		T6	35.0	240	—	—	2.0	75–105
		T7	33.0	230	16.0	110	3.0	65–95
A03190	319.0	F	28.0	195	14.0	95	1.5	70–100
		T6	34.0	235	—	—	2.0	75–105
		T61	40.0	275	24.0	165	1.0	80–110
A23190	B319.0	F	29.0[3]	200[3]	15.0[3]	105[3]	1.0[3]	80–110[3]
		T6	36.0[3]	250[3]	—	—	1.0[3]	90–120[3]
A03320	332.0	T5	31.0	215	—	—	—	90–120
A03330	333.0	F	28.0	195	—	—	—	65–100
		T5	30.0	205	—	—	—	70–105
		T6	35.0	240	—	—	—	85–115
		T7	31.0	215	—	—	—	75–105
A03360	336.0	T551	31.0	215	—	—	—	90–120
		T65	40.0	275	—	—	—	110–140
A03390	339.0	T551	31.0	215	—	—	—	—
A03540	354.0	T61	48.0	330	37.0	255	3.0	—
A03550	355.0	T51	27.0	185	—	—	—	60–90
		T6	37.0	255	—	—	1.5	75–105
		T62	42.0	290	—	—	—	90–120
		T7	36.0	250	—	—	—	70–100
		T71	34.0	235	27.0	185	—	65–95
A33550	C355.0	T61	40.0	275	30.0	205	3.0	75–105
A03560	356.0	F	21.0	145	—	—	3.0	40–70
		T51	25.0	170	—	—	—	55–85
		T6	33.0	230	22.0	150	3.0	65–95
		T7	25.0	170	—	—	3.0	60–90
		T71	25.0	170	—	—	3.0	60–90
A13560	A356.0	T6	33.0[3]	230[3]	22.0[3]	150[3]	5.0[3]	65–95
		T61	37.0	255	26.0	180	5.0	70–100
A03570	357.0	T6	45.0	310	—	—	3.0	75–105
A13570	A357.0	T61	45.0	310	36.0	250	3.0	85–115
A03590	359.0	T61	45.0	310	34.0	235	4.0	75–105