

(R) CAST COPPER ALLOYS

Foreword—This Document has also changed to with the new SAE Technical Standards Board Format. References have been added as Section 2.

1. Scope—This standard prescribes the chemical and mechanical requirements for a wide range of copper base casting alloys used in the automotive industry. It is not intended to cover ingot. (ASTM B30 is suggested for this purpose.)

2. References

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

2.1.1 SAE PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J461—Wrought and Cast Copper Alloys

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

ASTM B30—Specification for Copper-Base Alloys in Ingot Form

ASTM B148—Specification for Aluminum-Bronze Castings

ASTM B176—Specification for Copper Alloy Die Castings

ASTM B208—Practice for Preparing Tension Test Specimens for Copper-Base Alloys for Sand, Permanent Mold, Centrifugal, and Continuous Castings

ASTM B271—Specification for Copper-Base Alloy Centrifugal Castings

ASTM B369—Specification for Copper-Nickel Alloy Castings

ASTM B427—Specification for Gear Bronze Alloy Castings

ASTM B505—Specification for Copper-Base Alloy Continuous Castings

ASTM B584—Specification for Copper Alloy Sand Castings for General Applications

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3. **Chemical and Mechanical Properties**—The chemical composition and mechanical properties of products identified by UNS designations shall conform to the limits shown in Tables 1 and 2. Chemical analyses obtained by use of instruments, such as spectrograph, x-ray, and atomic absorption, the copper (%) may be reported as “calculated by difference.” Mechanical property values are applicable to standard specimens (Sand Cast ASTM B208, Centrifugal Cast ASTM B271, Continuous Cast ASTM B505) cast under production conditions used for casting the part(s) identified by the UNS designation. Samples for chemical analysis should be taken from test bars where practical to do so.
4. **Workmanship**—Castings shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage defects or cracks, or other injurious defects.

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TABLE 1—CHEMICAL COMPOSITION OF CAST COPPER ALLOYS⁽¹⁾

Copper Alloy UNS NO. ⁽²⁾	Cu ⁽³⁾	Sn	Pb	Zn ⁽³⁾	Fe	Sb	Ni (Incl. Co)	Mn	As	S	P	Al	Si
C83600	84.0-86.0 ⁽⁴⁾	4.0-6.0	4.0-6.0	4.0-6.0	0.30	0.25	1.0 ⁽⁴⁾	—	—	0.08	0.05 ⁽⁵⁾	0.005	0.005
C83800	82.0-83.8 ⁽⁴⁾	3.3-4.2	5.0-7.0	5.0-8.0	0.30	0.25	1.0 ⁽⁴⁾	—	—	0.08	0.03 ⁽⁵⁾	0.005	0.005
C85200	70.0-74.0	0.7-2.0	1.5-3.8	20.0-27.0	0.6	0.20	1.0	—	—	0.05	0.02	0.005	0.05
C85400	65.0-70.0	0.50-1.5	1.5-3.8	24.0-32.0	0.7	—	1.0	—	—	—	—	0.35	0.05
C85800	57.0 min ⁽⁶⁾	1.5	1.5	31.0-34.0	0.50	0.05	0.50	0.25	0.05	0.05	0.01	0.50	0.25
C86200	60.0-66.0	0.20	0.20	22.0-28.0	2.0-4.0	—	1.0	2.5-5.0	—	—	—	3.0-4.9	—
C86300	60.0-66.0	0.20	0.20	22.0-28.0	2.0-4.0	—	1.0	2.5-5.0	—	—	—	5.0-7.5	—
C86500	55.0-60.0	1.0	0.40	36.0-42.0	0.40-2.0	—	1.0	0.10-1.5	—	—	—	0.50-1.5	—
C87200	89.0 min ⁽⁶⁾	1.0	0.50	5.0	2.5	—	—	1.5	—	—	—	1.5	1.0-5.0
C87400	79.0 min ⁽⁶⁾	—	1.0	12.0-16.0	—	—	—	—	—	—	—	0.8	2.5-4.0
C87500	79.0 min ⁽⁶⁾	—	0.50	12.0-16.0	—	—	—	—	—	—	—	0.5	3.0-5.0
C87800 ⁽⁷⁾	80.0 min ⁽⁸⁾	0.25	0.15	12.0-16.0	0.15	0.05	0.20	0.15	0.05	0.05	0.01	0.15	3.8-4.2
C87900	63.0 min ⁽⁶⁾	0.25	0.25	30.0-60.0	0.40	0.05	0.50	0.15	0.05	0.05	0.01	0.15	0.8-1.2
C90300	86.0-89.0	7.5-9.0	0.30	3.0-5.0	0.20	0.20	1.0 ⁽⁴⁾	—	—	0.05	0.05 ⁽⁵⁾	0.005	0.005
C90500	86.0-89.0 ⁽⁴⁾	9.0-11.0	0.30	1.0-3.0	0.20	0.20	1.0 ⁽⁴⁾	—	—	0.05	0.05 ⁽⁵⁾	0.005	0.005
C90700	88.0-90.0 ⁽⁹⁾	10.0-12.0	0.50	0.50	0.15	0.20	0.50	—	—	0.05	0.30 ⁽⁵⁾	0.005	0.005
C92200	86.0-90.0 ⁽⁴⁾	5.5-6.5	1.0-2.0	3.0-5.0	0.25	0.25	1.0 ⁽⁴⁾	—	—	0.05	0.05 ⁽⁵⁾	0.005	0.005
C92300	85.0-89.0 ⁽⁴⁾	7.5-9.0	0.30-1.0	2.5-5.0	0.25	0.25	1.0 ⁽⁴⁾	—	—	0.05	0.05 ⁽⁵⁾	0.005	0.005
C92500	85.0-88.0	10.0-12.0	1.0-1.5	0.50	0.30	0.25	0.8-1.5	—	—	0.05	0.30 ⁽⁵⁾	0.005	0.005
C92700	86.0-89.0	9.0-11.0	1.0-2.5	0.7	0.20	0.25	1.0	—	—	0.05	0.25 ⁽⁵⁾	0.005	0.005
C92900	82.0-86.0 ⁽⁹⁾	9.0-11.0	2.0-3.2	0.25	0.20	0.25	2.8-4.0	—	—	0.05	0.50 ⁽⁵⁾	0.005	0.005
C93200	81.0-85.0 ⁽⁴⁾	6.3-7.5	6.0-8.0	2.0-4.0	0.20	0.35	1.0 ⁽⁴⁾	—	—	0.08	0.15 ⁽⁵⁾	0.005	0.005
C93500	83.0-86.0 ⁽⁴⁾	4.3-6.0	8.0-11.0	2.0	0.20	0.30	1.0 ⁽⁴⁾	—	—	0.08	0.05 ⁽⁵⁾	0.005	0.005
C93700	78.0-82.0 ⁽⁴⁾	9.0-11.0	8.0-11.0	0.8	0.15 ⁽¹⁰⁾	0.55	1.0 ⁽⁴⁾	—	—	0.08	0.15 ⁽⁵⁾	0.005	0.005
C93800	75.0-79.0 ⁽⁴⁾	6.3-7.5	13.0-16.0	0.8	0.15	0.8	1.0 ⁽⁴⁾	—	—	0.08	0.05 ⁽⁵⁾	0.005	0.005
C94300	68.5-73.5 ⁽⁴⁾	4.5-6.0	22.0-25.0	0.8	0.15	0.8	1.0 ⁽⁴⁾	—	—	0.08	0.05 ⁽⁵⁾	0.005	0.005
C94700	85.0-90.0	4.5-6.0	0.10 ⁽¹¹⁾	1.0-2.5	0.25	0.15	4.5-6.0	0.20	—	0.05	0.05	0.005	0.005
C94800	84.0-89.0	4.5-6.0	0.30-1.0	1.0-2.5	0.25	0.15	4.5-6.0	0.20	—	0.05	0.05	0.005	0.005
C95200	86.0 min ⁽¹²⁾	—	—	—	2.5-4.0	—	—	—	—	—	—	8.5-9.5	—
C95300	86.0 min ⁽¹²⁾	—	—	—	0.8-1.5	—	—	—	—	—	—	9.0-11.0	—
C95400	83.0 min ⁽⁶⁾	—	—	—	3.0-5.0	—	2.5	0.50	—	—	—	10.0-11.5	—

TABLE 1—CHEMICAL COMPOSITION OF CAST COPPER ALLOYS⁽¹⁾ (CONTINUED)

Copper Alloy UNS NO. ⁽²⁾	Cu ⁽³⁾	Sn	Pb	Zn ⁽³⁾	Fe	Sb	Ni (Incl. Co)	Mn	As	S	P	Al	Si
C95500	78.0 min ⁽⁶⁾	—	—	—	3.0-5.0	—	3.0-5.0	3.5	—	—	—	10.0-11.5	—
C95800	79.0 min ⁽⁶⁾	—	0.03	—	3.5-4.5 ⁽¹³⁾	—	4.0-5.0 ⁽¹³⁾	0.8-1.5	—	—	—	8.5-9.5	0.10
C96200	84.5-87.0	—	0.03	—	1.0-1.8	—	9.0-11.0	1.5	—	Nb 1.0	C 0.15	—	0.30

NOTE 1— These specification limits do not preclude the possible presence of other unnamed elements. However, analysis shall regularly be made only for the minor elements listed in the table plus all major elements except one. The major element which is not analyzed shall be determined by difference between the sum of those elements analyzed and 100%. By agreement between producer and consumer, analysis may be required and limits established for elements not specified.

NOTE 2—For welding grades, lead may not exceed 0.01%.

- Percent by mass (weight); maximum, unless shown as a range or minimum.
- Unified Numbering System. For cross reference to SAE, former SAE, ASTM, former ASTM, and former trade names, see SAE Information Report for Wrought and Cast Copper Alloys, SAE J461.
- In reporting chemical analyses by the use of instruments such as spectrograph, X-ray and atomic absorption, copper may be indicated as "remainder." In reporting chemical analyses obtained by wet methods, zinc may be indicated as "remainder" on those alloys with over 2% zinc.
- In determining copper minimum, copper may be calculated at Cu + Ni.
- For continuous castings, phosphorus shall be 1.5% maximum
- Total named elements shall be 99.5% minimum.
- Magnesium requirement is 0.01% maximum.
- Total named elements shall be 99.8% minimum.
- Cu + Sn + Pb + Ni + P shall be 99.5% minimum
- The iron shall be 0.35% maximum when used for steel backed bearings
- The mechanical properties of C94700 (heat treated) may not be attained if the lead content exceeds 0.01%.
- Total named elements shall be 99.0% minimum.
- Iron content shall not exceed nickel content.

TABLE 2—MECHANICAL PROPERTIES OF CAST COPPER ALLOYS

Copper Alloy UNS NO. ⁽¹⁾	SAE Suffix ⁽²⁾⁽³⁾	ASTM Standard No.	Casting Method ⁽³⁾⁽⁴⁾ and Condition	Tensile Strength, min MPa	Tensile Strength, min ksi	Yield Strength, min MPa 0.5% Ext. Under Load	Yield Strength, min ksi 0.5% Ext. Under Load	Elongation min, % in 50 mm (2 in)
C83600	A	B271, B584	Sand, Centrifugal	205	30	95	14	20
C83600	B	B505	Continuous	250	36	130	19	15
C83600	C		Continuous	345	50	170	15	12
C83800	A	B271, B584	Sand, Centrifugal	205	30	90	13	20
C83800	B	B505	Continuous	205	30	95	15	16
C85200		B271, B584	Sand, Centrifugal	240	35	85	12	25
C85400		B271, B584	Sand, Centrifugal	205	30	75	11	20
						0.2% Offset		
C85800		B176	Die ⁽⁵⁾	380	55	205	30	15
C86200		B271, B505, B584	Sand, Centrifugal, Cont.	620	90	310	45	18
C86300	A	B271, B584	Sand, Centrifugal	760	110	415	60	12
C86300	B	B505	Continuous	760	110	425	62	14
C86500	A	B271, B584	Sand, Centrifugal	450	65	170	25	20
C86500	B	B505	Continuous	485	70	170	25	25
						0.5% Ext. Under Load		
C87200		B271, B584	Sand, Centrifugal	310	45	125	18	20
C87400		B271, B584	Sand, Centrifugal	345	50	145	21	18
C87500		B271, B584	Sand, Centrifugal	415	60	165	24	16
						0.2% Offset		
C87800		B176	Die ⁽⁵⁾	585	85	345	50	25
C87900		B176	Die ⁽⁵⁾	485	70	240	35	25
						0.5% Ext. Under Load		
C90300	A	B271, B584	Sand, Centrifugal	275	40	125	18	20
C90300	B	B505	Continuous	305	44	150	22	18
C90500	A	B271, B584	Sand, Centrifugal	275	40	125	18	20
C90500	B	B505	Continuous	305	44	170	25	10
C90700	A		Sand	240	35	125	18	10
C90700	B	B505	Continuous	275	40	170	25	10
C92200	A	B271, B584	Sand, Centrifugal	235	34	110	16	24
C92200	B	B505	Continuous	260	38	130	19	18
C92300	A	B271, B584	Sand, Centrifugal	250	36	110	16	18
C92300	B	B505	Continuous	275	40	130	19	16
C92500	A		Sand	240	35	125	18	10
C92500	B	B505	Continuous	275	40	165	24	10
C92700	A		Sand	240	35	125	18	10
C92700	B	B505	Continuous	260	38	140	20	8
C92900		B427, B505	Sand, Continuous	310	45	170	25	8

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TABLE 2—MECHANICAL PROPERTIES OF CAST COPPER ALLOYS (CONTINUED)

Copper Alloy UNS NO. ⁽¹⁾	SAE Suffix ⁽²⁾⁽³⁾	ASTM Standard No.	Casting Method ⁽³⁾⁽⁴⁾ and Condition	Tensile Strength, min MPa	Tensile Strength, min ksi	Yield Strength, min MPa 0.5% Ext. Under Load	Yield Strength, min ksi 0.5% Ext. Under Load	Elongation min, % in 50 mm (2 in)
C93200	A	B271, B584	Sand, Centrifugal	205	30	95	14	15
C93200	B	B505	Continuous	240	35	140	20	10
C93500	A	B271, B584	Sand, Centrifugal	195	28	85	12	15
C93500	B	B505	Continuous	205	30	110	16	12
C93700	A	B271, B584	Sand, Centrifugal	205	30	85	12	15
C93700	B	B505	Continuous	240	35	140	20	6
C93700	C		Continuous	275	40	170	25	6
C93800	A	B271, B584	Sand, Centrifugal	180	26	95	14	12
C93800	B	B505	Continuous	170	25	110	16	5
C94300	A	B271, B584	Sand, Centrifugal	145	21	—	—	10
C94300	B	B505	Continuous	145	21	95	15	7
C94700	A	B505, B584	Sand, Continuous	310	45	140	20	25
C94700	B	B505, B584	Sand, Continuous (HT)	515	75	345	50	5
C94800		B505, B584	Sand, Continuous	275	40	140	20	20
C95200	A	B148, B271	Sand, Centrifugal	450	65	170	25	20
C95200	B	B505	Continuous	470	68	180	26	20
C95300	A	B148, B271	Sand, Centrifugal	450	65	170	25	20
C95300	B	B505	Continuous	485	70	180	26	25
C95300	C	B148, B271, B505	Sand, Centrifugal, Cont. (HT)	550	80	275	40	12
C95400	A	B148, B271	Sand, Centrifugal	515	75	205	30	12
C95400	B	B505	Continuous	585	85	220	32	12
C95400	C	B148, B271	Sand, Centrifugal (HT)	620	90	310	45	6
C95400	D	B505	Continuous (HT)	655	95	310	45	10
C95500	A	B148, B271	Sand, Centrifugal	620	90	275	40	6
C95500	B	B505	Continuous	655	95	290	42	10
C95500	C	B148, B271	Sand, Centrifugal (HT)	760	110	415	60	5
C95500	D	B505	Continuous (HT)	760	110	425	62	8
C95800	A	B148, B271	Sand, Centrifugal	585	85	240	35	15
C95800	B	B505	Continuous (3)	620	90	260	38	18
C96200		B369	Sand	310	45	170	25	20

1. UNIFIED NUMBERING SYSTEM. For cross reference to SAE, former SAE, former ASTM, and Former trade names, see SAE Information Report for Wrought and Cast Copper Alloys, SAE J461.
2. Suffix symbols may be specified to distinguish between two or more sets of mechanical properties, heat treatment, conditions, etc. as applicable.
3. Most commonly used method of casting is shown for each alloy. However, unless the purchaser specifies the method of casting or the mechanical properties by supplement to the UNS number, the supplier may use any method which will develop the properties indicated.
4. All alloys listed are in the "as cast" condition except those designated as heat treated (HT) and copper alloy UNS No. C95800 which is temper annealed.
5. Mechanical properties shown for die castings are typical, not minimum.