SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 4553B

Issued JUL 1990
Revised DEC 1997

Superseding AMS 4553A

Submitted for recognition as an American National Standard

Brass, Seamless, Tubing
85Cu - 15Zn
Annealed (061)

UNS C23000

1. SCOPE:

1.1 Form:

This specification covers a copper alloy (brass) in the form of seamless tubing.

1.2 Application:

This tubing has been used typically for parts requiring resistance to corrosion by salt, fresh water, salt air, or gases, but usage is not limited to such applications.

1.3 Classification:

Tubing is classified by nominal working pressures as follows:

Type I - Nominal working pressure 100 psi (689 kPa)
Type II - Nominal working pressure 200 psi (1379 kPa)
Type III - Nominal working pressure 300 psi (2068 kPa)
Type IV - Nominal working pressure 450 psi (3103 kPa)

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

QUESTIONS REGARDING THIS DOCUMENT: (412) 772-7154 FAX: (412) 776-0243
TO PLACE A DOCUMENT ORDER: (412) 776-4970 FAX: (412) 776-0790

2.1 SAE Publications:

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

AMS 2223	Tolerances, Copper and Copper Alloy Seamless Tubing
MAM 2223	Tolerances, Metric, Copper and Copper Alloy Seamless Tubing

2.2 ASTM Publications:

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

ASTM B 153	Expansion (Pin Test) of Copper and Copper-Alloy Pipe and Tubing
ASTM B 154	Mercurous Nitrate Test for Copper and Copper Alloys
ASTM B 251	General Requirements for Wrought Seamless Copper and Copper-Alloy Tube
ASTM B 251M	General Requirements for Wrought Seamless Copper and Copper-Alloy Tube (Metric)
ASTM B858M	Determination of Susceptibility to Stress Corrosion Cracking in Copper Alloys Using an Ammonia Vapor Test (Metric)
ASTM E 8	Tension Testing of Metallic Materials
ASTM E 8M	Tension Testing of Metallic Materials (Metric)
ASTM E 243	Electromagnetic (Eddy-Current) Examination of Copper and Copper-Alloy Tubes
ASTM E 478	Chemical Analysis of Copper Alloys

3. TECHNICAL REQUIREMENTS:

3.1 Composition:

Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 478, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - Composition

Element (3.1.1)	min	max
Copper	84.0	86.0
Lead	--	0.05
Iron	--	0.05
Zinc (See 3.1.2)	--	--
Sum of Named Elements (See 3.1.3)	99.8	--

3.1.1 These composition limits do not preclude the presence of other elements. Limits may be established and analysis required for unnamed elements by agreement between the manufacturer or supplier and purchaser.

3.1.2 Zinc may be reported as “remainder”, as the difference between the sum of results for all elements and 100%, or as the result of direct analysis.

3.1.3 When all of the named elements in the table are analyzed, the sum shall be 99.8% minimum, but such determination is not required for routine acceptance of each lot.

3.2 Condition:

Fully recrystallized in the soft annealed (061) temper (See 8.3). Tubing shall be acid cleaned after final annealing when specified.

3.3 Fabrication:

Tubing shall be produced by a seamless process. The external and internal surface finishes shall be produced by any method which will result in surfaces free from laps, folds, tears, and extraneous materials and which show no oxide discoloration. Processing shall not affect limits of wall thickness or corrosion resistance.

3.4 Properties:

Shall conform to the following requirements:

3.4.1 Tensile Properties: Shall be as shown in Table 2, determined in accordance with ASTM E 8 or ASTM E 8M:

TABLE 2 - Minimum Tensile Properties

Property	Value
Tensile Strength	40.0 ksi (276 MPa)
Yield Strength, 0.5% Extension under Load	12.0 ksi (83 MPa)
Elongation in 8 Inches (203.2 mm)	30%

3.4.1.1 Tensile specimens shall be of the full section of tube and shall conform to the requirements of ASTM E 8 or ASTM E 8M, unless limitations of the testing machine preclude the use of such specimen.

3.4.2 Embrittlement: Specimens of tubing, nominally 6 inches (152 mm) in length or twice the diameter, whichever is greater, shall withstand, without cracking, the mercurous nitrate test performed in accordance with ASTM B 154, Procedure A, or the Ammonia Vapor Test in accordance with ASTM B 858M.

3.4.3 Flarability (Expansion Test): Tube specimens shall withstand 20% expansion of the tube original outside diameter, determined in accordance with ASTM B 153.

3.4.4 Hydrostatic Pressure: Tubing shall withstand an internal hydrostatic pressure (P) based on Equation 1, without developing leaks and without an increase in mean diameter of more than 0.2%. The tube need not be tested at a pressure of over 1000 psi (6.90 MPa).

$$P = \frac{2\,St}{D - 0.8t} \qquad \text{(Eq.1)}$$

where:

P = Internal pressure at minimum yield, ksi (MPa)
S = Allowable yield stress (7.0 ksi [48.3 MPa])
t = Wall thickness, inches (mm)
D = Nominal OD, inches (mm)

3.5 Quality:

3.5.1 Visual Imperfections: Tubing, as received by purchaser, shall be uniform in quality and condition and shall have a finish conforming to the best practice for high quality aircraft tubing. It shall be smooth and free from heavy scale, oxide, burrs, seams, tears, grooves, laminations, slivers, pits, and other surface imperfections detrimental to usage of the tubing.

3.5.2 Surface Imperfections: Slight surface imperfections, such as handling marks, straightening marks, light mandrel and die marks, shallow pits, and scale patterns, are acceptable provided the imperfections are removable within tolerances specified for wall thickness.

3.5.3 Cleanliness: Tubing shall be free from grease or other foreign matter. Metallic flakes or particles shall not be collected by a clean white cloth drawn through the bore of a sample tube. Discoloration of the cloth, without the presence of flakes or particles, is acceptable.

3.5.4 Eddy-Current Examination: Tubing, under 2.5 inches (64 mm) in OD, tested in accordance with ASTM E 243 is not acceptable if a discontinuity indication exceeds the discontinuity indication of a single artificial defect as defined in ASTM E 243 and appendix.

3.6 Tolerances:

Shall be as follows:

3.6.1 Diameter, Wall Thickness, and Length: Shall be in accordance with AMS 2223 or MAM 2223.

3.6.2 Weight: For any lot of tubing, the tolerance for overweight shall be 10% maximum. For calculating weight, the density shall be 0.316 pounds per cubic inch (8.75 kg/m^3).

3.7 Sizes and Weights:

Shall be as shown in Tables 3 through 7.

TABLE 3A - Sizes and Weights - Type I Tubing, Inch/Pound Units

Nominal OD Inches	Minimum Wall Thickness Inch	Nominal ID Inches	Nominal Weight Pounds/Foot
2.875	0.065	2.745	2.176
3.500	0.065	3.370	2.660
4.000	0.065	3.870	3.047
4.500	0.065	4.370	3.434
5.563	0.068	5.427	4.451
6.625	0.081	6.463	6.315
8.625	0.105	8.145	10.657
10.750	0.131	10.488	16.573

TABLE 3B - Sizes and Weights - Type I Tubing, SI Units

Nominal OD Millimeters	Minimum Wall Thickness Millimeters	Nominal ID Millimeters	Nominal Weight kg/m
73.02	1.65	69.72	3.24
88.90	1.65	85.60	3.96
101.60	1.65	98.30	4.53
114.30	1.65	111.00	5.11
141.30	1.73	137.85	6.62
168.28	2.06	164.16	9.40
219.08	2.67	206.88	15.86
273.05	3.33	266.40	24.66

TABLE 4A - Sizes and Weights - Type II Tubing, Inch/Pound Units

Nominal OD Inches	Minimum Wall Thickness Inch	Nominal ID Inches	Nominal Weight Pounds/Foot
1.900	0.065	1.770	1.421
2.375	0.065	2.245	1.789
2.875	0.068	2.739	2.274
3.500	0.083	3.334	3.378
4.000	0.095	3.810	4.420
4.500	0.107	4.286	5.600
5.563	0.132	5.299	8.540
6.625	0.158	6.309	12.172
8.625	0.205	8.215	20.563
10.750	0.256	10.238	32.004

TABLE 4B - Sizes and Weights - Type II Tubing, SI Units

Nominal OD Millimeters	Minimum Wall Thickness Millimeters	Nominal ID Millimeters	Nominal Weight kg/m
48.26	1.65	44.96	2.11
60.32	1.65	57.02	2.66
73.02	1.73	69.57	3.38
88.90	2.11	84.68	5.03
101.60	2.41	96.77	6.58
114.30	2.72	108.86	8.33
141.30	3.35	134.59	12.71
168.28	4.01	160.25	18.11
219.08	5.21	208.66	30.60
273.05	6.50	260.04	47.63

TABLE 5A - Sizes and Weights - Type III Tubing, Inch/Pound Units

Nominal OD Inches	Minimum Wall Thickness Inch	Nominal ID Inches	Nominal Weight Pounds/Foot
1.375	0.065	1.245	0.968
1.660	0.065	1.530	1.235
1.900	0.066	1.768	1.442
2.375	0.083	2.209	2.266
2.875	0.100	2.675	3.306
3.500	0.122	3.256	4.910
4.000	0.140	3.720	6.436
4.500	0.157	4.186	8.123
5.563	0.194	5.175	12.408
6.625	0.231	6.163	17.596
8.625	0.301	8.023	29.848
10.750	0.375	10.000	46.349

TABLE 5B - Sizes and Weights - Type III Tubing, SI Units

Nominal OD Millimeters	Minimum Wall Thickness Millimeters	Nominal ID Millimeters	Nominal Weight kg/m
34.92	1.65	31.62	1.44
42.16	1.65	38.86	1.84
48.26	1.68	44.91	2.15
60.32	2.11	56.11	3.37
73.02	2.54	67.94	4.92
88.90	3.10	82.70	7.31
101.60	3.56	94.49	9.58
114.30	3.99	106.32	12.09
141.30	4.93	131.44	18.47
168.28	5.87	156.54	26.19
219.08	7.64	203.78	44.42
273.05	9.52	254.00	68.97

TABLE 6A - Sizes and Weights - Type IV Tubing, Inch/Pound Units

Nominal OD Inches	Minimum Wall Thickness Inch	Nominal ID Inches	Nominal Weight Pounds/Foot
0.405	0.062	0.281	0.253
0.540	0.065	0.410	0.368
0.675	0.065	0.545	0.472
0.840	0.065	0.710	0.600
1.050	0.065	0.920	0.763
1.315	0.066	1.183	0.982
1.660	0.084	1.492	1.577
1.900	0.096	1.709	2.053
2.375	0.120	2.135	3.224
2.875	0.145	2.585	4.716
3.500	0.177	3.146	7.006
4.000	0.202	3.596	9.139
4.500	0.228	4.044	11.603
5.563	0.281	5.001	17.681
6.625	0.335	5.955	25.102
8.625	0.436	7.753	42.534
10.750	0.544	9.662	66.142

TABLE 6B - Sizes and Weights - Type IV Tubing, SI Units

Nominal OD Millimeters	Minimum Wall Thickness Millimeters	Nominal ID Millimeters	Nominal Weight kg/m
10.29	1.57	7.14	0.38
13.72	1.65	10.41	0.55
17.14	1.65	13.84	0.70
21.34	1.65	18.03	0.89
26.67	1.65	23.37	1.14
33.40	1.68	30.05	1.46
42.16	2.13	37.90	2.35
48.26	2.44	43.41	3.06
60.32	3.65	54.23	4.80
73.02	3.68	65.66	7.02
88.90	4.50	79.91	10.43
101.60	5.13	91.34	13.60
114.30	5.79	102.72	17.27
141.30	7.14	127.02	26.31
168.28	8.51	151.26	37.36
219.08	11.07	196.93	63.30
273.05	13.82	245.41	98.43

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The vendor of tubing shall supply all samples for vendor's tests and shall be responsible for the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the tubing conforms to specified requirements.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: The requirements shown in Table 7 are acceptance tests and shall be performed on each lot.