



STANDARD COMPARISON CHART

	C70600			C71500			C44300		
	ASTM B111	ASME SB111	Mil Spec	ASTM B111	ASME SB111	Mil Spec	ASTM B111	ASME SB111	Mil Spec
Chemical Composition	Table 1								
Mechanical Properties	ASME Boiler and Pressure Vessel Code								
Grain Size	0.010-0.045mm								
Marking	Upon Customer request	Upon Customer request	> 1/2" must be marked with manufacture's name, specification #, alloy, temper, and heat number	Upon Customer request	Upon Customer request	> 1/2" must be marked with manufacture's name, specification #, alloy, temper, and heat number	Upon Customer request	Upon Customer request	> 1/2" must be marked with manufacture's name, specification #, alloy, temper, and heat number
Microscopical Exam	Magnification 75 diameters and show uniform and complete recrystallization								
Expansion Test	Shall withstand the expansion shown in Table 2 in accordance with Test Method B153, no cracking or rupture visible to the unaided eye								
Flattening Test	Annealed samples 18" in length shall be slowly flattened by one stroke of a press. A micrometer set at 3 times the wall thickness shall pass freely over the flattened sample. The sample shall not show cracking or rupture to the unaided eye.	Each test specimen shall be flattened in a press at 3 places along the length, each new place to be rotated on its axis approximately one third turn from the last flattened area. Each flattened area shall be at least 2" in length. A flattened test-specimen shall allow a micrometer caliper set at 3 times the wall thickness to pass freely over the flattened area. The flattened areas shall be free of defects.		Annealed samples 18" in length shall be slowly flattened by one stroke of a press. A micrometer set at 3 times the wall thickness shall pass freely over the flattened sample. The sample shall not show cracking or rupture to the unaided eye.	Each test specimen shall be flattened in a press at 3 places along the length, each new place to be rotated on its axis approximately one third turn from the last flattened area. Each flattened area shall be at least 2" in length. A flattened test-specimen shall allow a micrometer caliper set at 3 times the wall thickness to pass freely over the flattened area. The flattened areas shall be free of defects.		Annealed samples 18" in length shall be slowly flattened by one stroke of a press. A micrometer set at 3 times the wall thickness shall pass freely over the flattened sample. The sample shall not show cracking or rupture to the unaided eye.	Each test specimen shall be flattened in a press at 3 places along the length, each new place to be rotated on its axis approximately one third turn from the last flattened area. Each flattened area shall be at least 2" in length. A flattened test-specimen shall allow a micrometer caliper set at 3 times the wall thickness to pass freely over the flattened area. The flattened areas shall be free of defects.	



Tensile test	Table 3								
Mercurous Nitrate Test	N/A	N/A	N/A	N/A	N/A	N/A	The test specimens, cut 6" in length, shall withstand without cracking, an immersion in the standard		
Ammonia Vapor Test	N/A	N/A	N/A	N/A	N/A	N/A	Substitute for Mercurous Nitrate Test. The test specimens, cut 6" in length, shall withstand without cracking, the ammonia vapor test as prescribed in Test Method B 858.	Substitute for Mercurous Nitrate Test. The test specimens, cut 6" in length, shall withstand without cracking, the ammonia vapor test as prescribed in Test Method B 858.	N/A
Eddy Current Test	3Each tube shall be passed through an eddy-current testing unit. Testing shall follow procedures of Practice E 243. The depth of the round-bottom transverse notches and the diameters of the drilled holes in the calibrating tube used to adjust the sensitivity of the test unit are shown in Tables 4 and 5 respectively. Tubes that do not actuate the signaling device shall be considered to conform to the requirements of this test. Tubes causing irrelevant signals because of moisture, soil, and like effects may be reconditioned and retested. Tubes causing irrelevant signals because of visible and identifiable handling marks may be retested by the hydrostatic or pneumatic test. Tubes meeting requirements of either test shall be considered to conform if the tube dimensions are within the prescribed limits.								
Hydrostatic Test	USED AS AN ALTERNATIVE TO EDDY-CURRENT. Mil Spec may require if specified on Purchase Order. Each tube shall stand, without showing evidence of leakage, an internal hydrostatic pressure sufficient to subject the material to a fiber stress of 7000psi, determined by the following equation for thin hollow cylinders under tension. The tube need not be tested at a hydrostatic pressure of 1000psi unless so specified. $P=2St/(D-0.8t)$ where P=hydrostatic pressure, psig t=thickness of tube wall, in. D=outside diameter of the tube, in. S=allowable stress of the material, psi								
Pneumatic Test	USED AS AN ALTERNATIVE TO EDDY-CURRENT. Mil Spec may require if specified on Purchase Order. Each tube shall be subjected to an internal air pressure of 60 psig, min, for 5 s without showing evidence of leakage. The test method used shall permit easy visual detection of any leakage, such as by having the tube under water or by the pressure differential method. Any evidence of leakage shall be cause for rejection.								
Diameter	The outside of the tubes shall not vary from that specified by more than the amounts shown in Table 6 as measured by "go" and "no go" ring gages. Mil Spec must all be on the minus side.								
Wall Thickness	Tubes Ordered to Minimum Wall -- No tube wall at its thinnest point shall be less than the specified wall thickness. The maximum plus deviation from the specified wall at any point shall not exceed twice the values shown in Table 7 Tubes Ordered to Nominal Wall -- The maximum plus and minus deviation from the nominal wall at any point shall not exceed the values shown in table 7. Mil spec is always minimum wall.								
Length	The length of the tubes shall not be less than that specified when measured at a temperature of 20 degrees C, but may exceed the specified value by the amounts given in Table 8.								
Squareness of Cut	The departure from squareness of the end of the tube shall not exceed the following: Up to an incl 5/8=0.01" Over 5/8=0.016"								
Sampling	Lot Size - 600 tubes or 10,000lb or fraction of either, whichever constitutes the greater weight. Portion Size - Sample pieces from two individual lengths of finished product. Samples taken for the purpose of the tests prescribed in the specification shall be selected in a manner that will represent correctly the material furnished and avoid needless destruction of finished material when samples representative of the material are available from other sources.								
Temper	As specified by purchase order								



CHEMICAL COMPOSITION

Table 1 Chemical Requirments

Alloy	Composition %											
	Copper	Tin	Aluminum	Nickel	Lead	Iron	Zinc	Manganese	Arsenic	Antimony	Phosphorus	Chromium
C10100	99.99Min	-	-	-	0.001	-	0.0001Max	-	-	-	0.0003Max	-
C10200	99.95Min	-	-	-	-	-	-	-	-	-	-	-
C10300	99.95Min	-	-	-	-	-	-	-	-	-	0.001-0.005	-
C10800	99.95Min	-	-	-	-	-	-	-	-	-	0.005-0.012	-
C12000	99.90Min	-	-	-	-	-	-	-	-	-	0.004-0.012	-
C12200	99.90Min	-	-	-	-	-	-	-	-	-	0.015-0.040	-
C14200	99.40Min	-	-	-	-	-	-	-	0.15-0.50	-	0.015-0.040	-
C19200	98.7Min	-	-	-	-	0.8-1.2	-	-	-	-	0.01-0.04	-
C23000	84.0-86.0	-	-	-	0.05	0.05Max	Remainder	-	-	-	-	-
C28000	59.0-63.0	-	-	-	0.3	0.07Max	Remainder	-	-	-	-	-
C44300	70.0-73.0	0.9-1.2	-	-	0.07	0.06Max	Remainder	-	0.02-0.06	-	-	-
C44400	70.0-73.0	0.9-1.2	-	-	0.07	0.06Max	Remainder	-	-	0.02-0.10	-	-
C44500	70.0-73.0	0.9-1.2	-	-	0.07	0.06Max	Remainder	-	-	-	0.02-0.10	-
C60800	Remainder	-	5.0-6.5	-	0.1	0.10Max	-	-	0.02-0.35	-	-	-
C61300	Remainder	0.20-0.50	6.0-7.5	0.15Max	0.01	2.0-3.0	0.10Max	0.20Max	-	-	0.015Max	-
C61400	Remainder	-	6.0-8.0	-	0.01	1.5-3.5	0.20Max	1.0Max	-	-	-	-
C68700	76.0-79.0	-	1.8-2.5	-	0.07	0.06Max	Remainder	-	0.02-0.10	-	-	-
C70400	Remainder	-	-	4.8-6.2	0.05	1.3-1.7	1.0Max	0.30-0.8	-	-	-	-
C70600	Remainder	-	-	9.0-11.0	0.05	1.0-1.8	1.0Max	1.0Max	-	-	-	-
C71000	Remainder	-	-	19.0-23.0	0.05	0.50-1.0	1.0Max	1.0Max	-	-	-	-
C71500	Remainder	-	-	29.0-33.0	0.05	0.40-1.0	1.0Max	1.0Max	-	-	-	-
C71640	Remainder	-	-	29.0-32.0	0.05	1.7-2.3	1.0Max	1.5-2.5	-	-	-	-
C72200	Remainder	-	-	15.0-18.0	0.05	0.50-1.0	1.0Max	1.0Max	-	-	-	0.30-0.70



EXPANSION REQUIREMENTS

Table 2 Expansion Requirements			
Temper Designation		Copper Or Copper Alloy Uns No.	Expansion Of Tube Outside Diameter, In Percent Of Original Outside Diameter
Standard	Former		
O61	Annealed	C19200	30
		C23000	20
		C28000	15
		C44300, C44400, C44500	20
		C60800	20
		C61300, C61400	20
		C68700	20
		C70400	30
		C70600	30
		C71000	30
		C71500	30
		C71640	30
		C72200	30
H55	Light-Draw N	C10100, C10200, C10300, C10800, C12000, C12200	20
		C14200	20
		C19200	20
		C70400	20
		C70600	20
		C72200	20
Hr50	Draw N, Stress Relieved	C71500	20
		C71640	20
-	Hard-Draw N, End Annealed	C10100, C10200, C10300, C10800, C12000, C12200, C14200	30



TENSILE REQUIREMENTS

Table 3 Tensile Requirements

Copper Or Copper Alloy Uns No.	Temper Designation		Tensile Strength Min Ksi	Yield Strength Min Ksi	Elongation In 2 In., Min%
	Standard	Former			
C10100, C10200, C10300, C10800, C12000, C12200, C14200	H55	Light-Draw N	36	30	-
C10100, C10200, C10300, C10800, C12000, C12200, C14200	H80	Hard-Draw N	45	40	-
C19200	H55	Light-Draw N	40	35	-
C19200	H80	Hard-Draw N	48	43	-
C19200	O61	Annealed	38	12	-
C23000	O61	Annealed	40	12	-
C28000	O61	Annealed	50	20	-
C44300, C44400, C44500	O61	Annealed	45	15	-
C60800	O61	Annealed	50	19	-
C61300, C61400	O61	Annealed	70	30	-
C68700	O61	Annealed	50	18	-
C70400	O61	Annealed	38	12	-
C70400	H55	Light-Draw N	40	30	-
C70600	O61	Annealed	40	15	-
C70600	H55	Light-Draw N	45	35	-
C71000	O61	Annealed	45	16	-
C71500	O61	Annealed	52	18	-
C71500:					
Wall Thickness Up To 0.048 In., Incl	Hr50	Draw N, Stress-Relieved	72	50	12
Wall Thickness Over 0.048 In.	Hr50	Draw N, Stress-Relieved	72	50	15
C71640	O61	Annealed	63	25	-
C71640	Hr50	Draw N, Stress-Relieved	81	58	-
C72200	O61	Annealed	45	16	-
C72200	H55	Light-Draw N	50	30	-