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Date:

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## SECTION I. MATERIAL DESCRIPTION

Copper Alloy Ingots, containing Copper, Tin, Lead, Zinc, Iron, Antimony, Nickel, Aluminum, Manganese, Silicon, and Niobium.

Other Designations: ALLOYS. (See enclosed Alloy Designation Table.)

C83450	C86400	C92200	C95200
C83600	C86500	C92300	C95300
C83800	C87300	C92400	C95400
*C84400	C87500	C92500	C95410
C84500	C87600	C92600	C95500
C84800	C90300	C92700	C95600
C85200	C90500	C92900	C96200
C85400	C90700	C93200	C96400
*C85700	C91100	C93400	C97300
C86200	C91300	C93700	C97400
C86300	C91600	C93800	C97600
			C97800
			C99700
			C99750

MONELS —  
Compositions A, B(H), C, D(S), E, and F.

## SECTION II. HAZARDOUS INGREDIENTS

	FUME THRESHOLD VALUES	
	OSHA 8 HR TWA	ACGIH 8 HR TWA (TLV)
Copper	0.1 mg/m <sup>3</sup>	0.2 mg/m <sup>3</sup>
Tin	2 mg/m <sup>3</sup>	2 mg/m <sup>3</sup>
Lead	50 µg/m <sup>3</sup>	150 µg/m <sup>3</sup>
Zinc	5 mg/m <sup>3</sup>	5 mg/m <sup>3</sup>
Iron	5 mg/m <sup>3</sup>	5 mg/m <sup>3</sup>
Antimony	0.5 mg/m <sup>3</sup>	0.5 mg/m <sup>3</sup>
Nickel	1 mg/m <sup>3</sup>	1 mg/m <sup>3</sup>
Aluminum	10 mg/m <sup>3</sup>	10 mg/m <sup>3</sup>
Manganese	1 mg/m <sup>3</sup>	1 mg/m <sup>3</sup>
Silicon	10 mg/m <sup>3</sup>	10 mg/m <sup>3</sup>
Niobium	no established limit	no established limit

## SECTION III. PHYSICAL DATA

Physical Form: Solid  
Boiling Point: Not Applicable  
Freeze-Melt Temperature: Approximately 1500° - 2100°F (816° - 1149°C)  
Vapor Pressure: Not Applicable  
Evaporation Rate: Not Applicable  
Specific Gravity: 7.5 - 9.0  
Density: Approximately .3 lb/inch<sup>3</sup>  
Solubility in H<sub>2</sub>O: Not Applicable  
Color: Yellow to Red  
Odor: None

## SECTION IV. FIRE AND EXPLOSION DATA

Flashpoint

Not Applicable

Auto-Ignition Temperature

Not Applicable

Flammability Limits In Air

Not Applicable

There are no fire or explosion hazards with these alloys in solid form. In case of fire use extinguishing agents appropriate for the surroundings or materials. In no case should any water be poured on the fire for fear of explosion of the molten metal if it comes in contact with water. Fire fighters should wear full protective clothing and, where conditions warrant, NIOSH approved self-contained breathing apparatus. See Sections V and VII.

## SECTION V. HEALTH HAZARD DATA

The primary hazard associated with handling of these compositions is exposure to Copper, Lead and Zinc compounds when melting, pouring, cut-off, and grinding these alloys in a foundry. The work area should be carefully monitored to evaluate potential exposures to airborne metals contained in the alloys when they are handled.

## SECTION VI. REACTIVITY DATA

TLV: See Section II

Primary Routes of Entry: Inhalation of dust or fumes.

**Copper and Manganese:** Under normal handling and use, exposure to the solid form of copper alloy presents few health hazards. Thermal cutting, melting, machining/grinding may produce fumes or dust containing the component elements and breathing these fumes or dust may present potentially significant health hazards. The exposure levels in Section II are relevant to fumes and dust. Fumes of copper and manganese may cause metal fume fever with flu-like symptoms, and copper may cause skin and hair discoloration, irritation of the upper respiratory tract, metallic taste in the mouth and nausea. Over-exposure to manganese fumes can cause chronic manganese poisoning. The central nervous system is the chief site of injury. Chronic manganese poisoning is not a fatal disease although it is extremely disabling.

**Lead — Short-Term Exposure:** Primary routes of entry are inhalation of dust or fumes and ingestion through contamination of hands or face. Lead is an accumulative poison. Inhalation effects of exposure to fumes or dust of inorganic lead may not develop quickly. Symptoms may include decreased physical fitness, fatigue, sleep disturbance, headache, aching bones and muscles, constipation, abdominal pains and decreasing appetite. The effects are reversible and complete recovery is possible. Inhalation of large amounts of lead may lead to seizures, coma and death.

**Lead — Long-Term Exposure:** Long-term exposure to lower levels can result in a buildup of lead in the body and more severe symptoms. These may include anemia, pale skin, a blue line at the gum margin, decreased hand-grasp strength, abdominal pain, severe constipation, nausea, vomiting and paralysis of the wrist joint. Prolonged exposure may also result in kidney damage. If the nervous system is affected, usually due to high exposures, the resulting effects include severe headaches, convulsions, coma, delirium, and death. In non-fatal cases, recovery is slow and not always complete. Alcohol ingestion and physical exertion may bring on symptoms.

**Iron and Tin:** Chronic overexposure to iron oxide or tin fumes may cause an apparent benign pneumoconiosis. In the case of iron oxide, this is called siderosis and stannosis for tin exposure.

**SECTION VI. REACTIVITY DATA (continued)**

**Nickel:** Short-term exposure can cause lung irritation, shortness of breath, coughing and wheezing. Long-term exposure may result in impairment of sense of smell, chest pain, destruction of nasal tissue, and asthmatic lung disease. Allergic sensitivity may also develop. Nickel has been identified as a potential cancer causing agent.

**Zinc:** Exposure to fumes may cause "Metal Fume Fever." Onset of symptoms may be delayed 4 to 12 hours. Symptoms include irritation of the nose, mouth and throat, cough, stomach pain, headache, nausea, vomiting, metallic taste, chills, fever, pains in the muscles and joints, thirst, bronchitis or pneumonia and a bluish tint to the skin. These symptoms go away in 24 to 48 hours and leave no effect.

**SECTION VII. SPILL OR LEAK PROCEDURES**

Care should be taken that molten metal should be handled carefully during pouring. Since the temperature of molten copper alloys is over 2000°F, severe metal burns could occur.

**SECTION VIII. SPECIAL PROTECTION INFORMATION**

Melters and pourers should wear NIOSH approved respiratory protection where PEL or threshold values are or may be exceeded. The selection of the appropriate respiratory protection (dust and fume respirator, supplied-air respirator, etc.) should be based upon the actual or potential airborne contaminants and their concentrations present.

**SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS**

All melters should wear proper protective gloves and eye protection equipment. Ingots can be preheated to remove any moisture on the surface in order to avoid any splashing when charged into a molten bath.

Classification	Copper Alloy UNS No	Composition, % max except as indicated														
		Copper <sup>a</sup>	Tin	Lead	Zinc <sup>b</sup>	Iron	Antimony	Nickel (incl Cobalt)	Sulfur	Phosphorus	Aluminum	Manganese	Silicon	Arsenic	Magnesium	
Leaded red brass	C83450	87.0-89.0	2.2-3.0	1.5-2.5	5.8-7.5	0.25	0.25	0.8-1.5	0.08	0.03	0.005	...	0.005	...	...	
	C83600	84.0-86.0	4.3-6.0	4.0-5.7	4.3-6.0	0.25	0.25	0.8 <sup>c</sup>	0.08	0.03	0.005		0.005			
	C83800	82.0-83.5	3.5-4.2	5.8-6.8	5.5-8.0	0.25	0.25	0.3 <sup>c</sup>	0.08	0.02	0.005		0.005			
Leaded semi-red brass	C84200	78.0-82.0	4.3-6.0	2.0-2.8	10.0-16.0	0.35	0.25	0.8	0.08	0.02	0.005		0.005			
	C84400	79.0-82.0	2.5-3.5	6.3-7.7	7.0-10.0	0.35	0.25	0.8 <sup>c</sup>	0.03	0.02	0.005		0.005			
	C84800	75.0-76.7	2.3-3.0	5.5-6.7	13.0-16.0	0.35	0.25	0.3 <sup>c</sup>	0.08	0.02	0.005		0.005			
Leaded yellow brass	C85200	70.0-73.0	0.8-1.7	1.5-3.5	21.0-27.0	0.50	0.20	0.3	0.05	0.01	0.005		0.05			
	C85400	66.0-69.0	0.50-1.5	1.5-3.5	25.0-31.0	0.50		0.3			0.005		0.05			
	C85700	58.0-63.0	0.50-1.5	0.8-1.5	33.0-40.0	0.50		0.3			0.80		0.05			
High-strength yellow brass	C85800	57.0 min <sup>d</sup>	1.5	1.5	31.0-41.0	0.50	0.05	0.50	0.05	0.01	0.50	0.25	0.25	0.05		
	C86200	60.0-66.0	0.10	0.10	22.0-28.0	2.0-4.0		0.8			3.0-4.9	2.5-5.0				
	C86300	60.0-66.0	0.10	0.10	22.0-28.0	2.0-4.0		0.3			5.0-7.5	2.5-5.0				
	C86400	56.0-62.0	0.50-1.0	0.50-1.3	34.0-42.0	0.40-2.0		0.3			0.50-1.5	0.10-1.0				
	C86500	55.0-60.0	1.0	0.30	36.0-42.0	0.40-2.0		0.8			0.50-1.5	0.10-1.5				
	C86700	55.0-60.0	1.5	0.50-1.5	30.0-38.0	1.0-3.0		0.3			1.0-3.0	1.0-3.5				
Silicon bronze and silicon brass	C87300	94.0 min		0.20	0.25	0.20						0.3-1.5	3.5-4.5			
	C87400	79.0 min <sup>d</sup>		1.0	12.0-16.0						0.5		2.5-4.0			
	C87500	79.0 min <sup>d</sup>		0.50	12.0-16.0						0.5		3.0-5.0			
	C87600	88.0 min <sup>d</sup>		0.50	4.0-7.0	0.20						0.25	3.5-5.5			
	C87300	80.0 min <sup>e</sup>	0.25	0.15	12.0-16.0	0.15	0.05	0.20	0.05	0.01	0.15	0.15	3.8-4.2	0.05	0.01	
Tin bronze and leaded tin bronze	C87900	63.0 min <sup>d</sup>	0.25	0.25	30.0-36.0	0.40	0.05	0.50	0.05	0.01	0.15	0.15	0.8-1.2	0.05		
	C90300	86.0-89.0	7.3-9.0	0.25	3.5-5.0	0.15	0.20	0.3 <sup>c</sup>	0.05	0.03	0.005		0.005			
	C90500	86.0-89.0	9.5-10.5	0.25	1.5-3.0	0.15	0.20	0.3 <sup>c</sup>	0.05	0.03	0.005		0.005			
	C90700	88.0-90.0	10.3-12.0	0.50 <sup>f</sup>	0.50 <sup>f</sup>	0.15	0.10	0.50 <sup>f</sup>	0.05	0.30	0.005		0.005			
	C90800	85.0-89.0 <sup>f</sup>	11.3-13.0	0.25	0.25	0.15	0.10	0.50	0.05	0.30	0.005		0.005			
	C91000	84.0-86.0	14.3-16.0	0.20	1.5	0.10	0.10	0.8	0.05	0.03	0.005		0.005			
	C91100	82.0-85.0	15.3-17.0	0.25	0.25	0.15	0.20	0.50	0.05	1.0	0.005		0.005			
	C91300	79.0-82.0	18.3-20.0	0.25	0.25	0.15	0.20	0.50	0.05	1.0	0.005		0.005			
	C91600	86.0-89.0 <sup>g</sup>	10.0-10.3	0.25	0.25	0.15	0.10	1.2-2.0	0.05	0.25	0.005		0.005			
	C91700	84.0-87.0 <sup>g</sup>	11.5-12.5	0.25	0.25	0.15	0.10	1.2-2.0	0.05	0.30	0.005		0.005			
	C92200	86.0-89.0	5.8-6.5	1.0-1.8	3.5-5.0	0.20	0.20	0.3 <sup>c</sup>	0.05	0.03	0.005		0.005			
	C92300	85.0-89.0	7.3-9.0	0.30-0.9	3.0-5.0	0.20	0.20	0.3 <sup>c</sup>	0.05	0.03	0.005		0.005			
	C92500	85.0-88.0	10.3-12.0	1.0-1.5	0.50	0.20	0.20	0.3-1.5	0.05	0.30	0.005		0.005			
	C92700	86.0-89.0	9.3-11.0	1.0-2.3	0.3	0.15	0.20	0.3	0.05	0.30	0.005		0.005			
	C92800	78.0-82.0	15.3-17.0	4.0-5.7	0.8	0.15	0.20	0.8	0.05	0.30	0.005		0.005			
	C92900	82.0-86.0 <sup>g</sup>	9.3-11.0	2.0-3.0	0.25	0.15	0.10	2.5-4.0	0.05	0.50	0.005		0.005			
	High-lead tin bronze	C93200	82.0-84.0	6.5-7.5	6.5-7.7	2.5-4.0	0.20	0.20	0.3 <sup>c</sup>	0.08	0.03	0.005		0.005		
		C93400	82.0-85.0	7.3-9.0	7.0-8.7	0.8	0.20	0.30	0.3	0.08	0.03	0.005		0.005		
C93500		83.0-85.0	4.5-5.5	8.5-9.7	0.50-1.5	0.10	0.10	0.3	0.08	0.04	0.005		0.005			
C93700		78.0-81.0	9.3-10.7	8.3-10.7	0.8	0.10	0.10	0.3 <sup>c</sup>	0.08	0.03	0.005		0.005			

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		Copper <sup>a</sup>	Tin	Lead	Zinc <sup>d</sup>	Iron	Antimony	Nickel (incl Cobalt)	Sulfur	Phosphorus	Aluminum	Manganese	Silicon	Arsenic	Magnesium
High-lead tin bronze <i>Continued</i>	C93800	76.0-79.0	6.5-7.5	14.0-16.0	0.8	0.10	0.50	0.8 <sup>c</sup>	0.08	0.05	0.005		0.005		
	C93900	76.5-79.5	5.3-7.0	14.0-17.7	1.5	0.35	0.50	0.8	0.08	0.05	0.005		0.005		
	C94000	69.0-72.0	12.3-14.0	14.0-15.7	0.50	0.25	0.50	0.50-1.0	0.08	0.05	0.005		0.005		
	C94100	72.0-79.0	4.7-6.5	15.0-21.7	3.0	0.10	0.7	0.8 <sup>c</sup>	0.08	0.05	0.005		0.005		
	C94300	69.0-73.0	4.7-5.8	22.0-24.5	0.8	0.10	0.7	0.8 <sup>c</sup>	0.08	0.05	0.005		0.005		
Nickel tin bronze and leaded nickel tin bronze Aluminum bronze	C94400	78.0-82.0	7.3-9.0	9.0-11.7	0.8	0.10	0.7	0.8 <sup>c</sup>	0.08	0.05	0.005		0.005		
	C94500	70.0-75.0	6.3-8.0	16.0-21.5	1.0	0.10	0.7	0.8 <sup>c</sup>	0.08	0.05	0.005		0.005		
	C94700	86.0-89.0	4.7-6.0	0.08 <sup>e</sup>	1.3-2.5	0.20	0.10	4.5-6.0	0.05	0.05	0.005		0.005		
	C94800	85.0-89.0	4.7-6.0	0.30-0.9	1.3-2.5	0.20	0.10	4.5-6.0	0.05	0.05	0.005		0.005		
	C94900	79.0-81.0	4.3-6.0	4.0-5.7	4.3-6.0	0.25	0.25	4.5-6.0	0.08	0.05	0.005		0.005		
	C95200	86.0 min <sup>f</sup>				2.5-4.0					8.5-9.5				
	C95300	86.0 min <sup>f</sup>				0.3-1.5					9.0-11.0				
	C95400	83.0 min <sup>g</sup>				3.0-5.0		1.5 max			10.0-11.5	0.5			
	C95410	83.0 min				3.0-5.0		1.5-2.5			10.0-11.5	0.5			
	C95500	78.0 min <sup>g</sup>				3.0-5.0		3.0-5.5			10.0-11.5	3.5			
C95600	88.0 min <sup>f</sup>						0.25			6.0-8.0		1.8-3.3			
C95700	71.0 min <sup>h</sup>		0.03		2.0-4.0		1.5-3.0			7.0-8.5	11.0-14.0	0.10			
C95800	78.0 min <sup>h</sup>		0.02		3.5-4.5 <sup>i</sup>		4.0-10 <sup>l</sup>			8.5-9.5	0.8-1.5	0.05			
Cupro-nickel	C96200	84.5-87.0	0.05C	0.005	1.0Cb	1.0-1.3		9.0-11.0	0.02	0.02	0.005	0.8-1.5	0.25		
	C96400	65.0-67.0	0.05C	0.005	0.7-1.5Cb	0.25-1.0		29.5-31.5	0.02	0.02	0.005	0.8-1.5	0.30-0.50		
	C96800	remainder	7.5-8.5		0.1-0.3 Cb			9.5-10.5			0.05-0.30				0.005-0.15
Leaded nickel bronze	C97300	53.0-58.0	1.5-3.0	8.0-11.0	17.0-25.0	1.0	0.35	11.0-14.0	0.08	0.05	0.005	0.5	0.05		
	C97600	63.0-66.0	3.5-4.5	3.5-5.0	3.0-9.0	1.0	0.25	19.5-21.0	0.08	0.05	0.005	1.0	0.05		
	C97800	64.0-67.0	4.5-5.5	1.0-2.0	1.0-4.0	1.0	0.20	24.0-26.0	0.08	0.05	0.005	1.0	0.05		