



# FIELD TESTED. FIELD PROVEN.




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**LEAD-FREE ECO BRASS® INGOTS:**  
The Convergence of Performance,  
Sustainability and Value

**THE PROOF IS HERE.** "Alternatives Assessment Case Study of Lead-Free Brass Alloys for Drinking Water Applications: A Private Report for the California Metals Coalition" dated June 9, 2017 by Peter Sinsheimer, Ph.D., MPH (UCLA) and Marc Edwards, Ph.D. (Virginia Tech)

**ECO BRASS® is the ideal alloy for manufacturers and consumers that require a lead-free, RoHS compliant alloy with high performance, value, and ecological sustainability. An independent, scientific study by UCLA and Virginia Tech confirms that cast components made of  ECO BRASS® used for potable water applications are equal to or superior to the traditional leaded and low-leaded bismuth and silicon alloys.**

**THE STUDY**

A UCLA Report\* was commissioned by the California Metals Coalition on alternative lead-free alloys used in cast products for potable water applications. The study had a dual purpose of conducting a lifecycle-based assessment of the leaded and lead-free alternative alloys, and the study also developed the educational tools to assess the lead-free alternative alloys in a broad range of applications.

\* "Alternatives Assessment Case Study of Lead-Free Brass Alloys for Drinking Water Applications: A Private Report for the California Metals Coalition" dated June 9, 2017 by Peter Sinshmeier, Ph.D., MPH (UCLA) and Marc Edwards, Ph.D. (Virginia Tech)

**DRIVERS FOR THE STUDY**

**Change in legislation:** In 1974, the Safe Drinking Water Act (SDWA) was enacted to ensure safe drinking water for all communities. In 2011, an amendment to the SDWA mandated that leaded brass in potable water supply components had to be phased out entirely in the United States.

**Choices:** The resulting availability of lead-free alternatives meant that supply chain and end users needed beginning-of-life to end-of-life information so a thorough and accurate decision could be made between the different options.

**Model:** Develop an impartial analytical tool that can be used for evaluating alloys outside the study.

**EVALUATION CRITERIA**

An advisory board consisted of two subcommittees: manufacturers and users. These subcommittees decided which performance tests the alloys would go through and how the results should be weighted.

**DATA COLLECTION**

Leaded brass alloy C83600 was chosen as the benchmark alloy for the study because of its performance and its long history of use in cast components for potable water applications. The data was assessed based on a scientific grading system of the lead-free alternative alloys against the benchmark alloy in performance, value and sustainability.

**ALLOY SELECTION**

At the initial 2011 Advisory Board meeting, nine different lead-free alloys were identified as potential candidates for acceptance into the study. Five alloys were selected from this list, two being bismuth alloys: C89833 and C89836, and three were silicon alloys: C87600, C87610, and C87850.

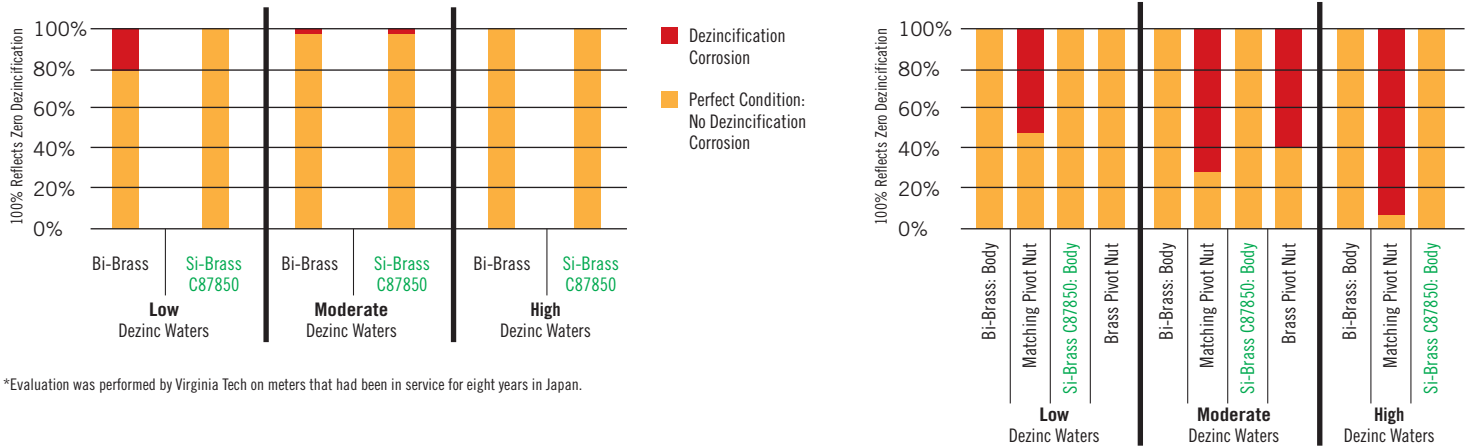
**ALLOYS TESTED**

Alloy	Cu (%)	Pb (%)	Sn (%)	Zn (%)	Si (%)	Bi (%)	P (%)	UTS (ksi)	YS (ksi)	E (%)
<b>C87850*</b>	<b>76</b>			<b>21</b>	<b>3</b>		<b>0.1</b>	<b>59</b>	<b>22</b>	<b>16</b>
C83600*	85	5	5	5				30	14	20
C89833*	89		5	3		2.2		30	14	16
C89836	89.5		5.5	3		2		33	14	20
C87600*	91			5	4			60	30	16
C87610*	92			4	4			45	18	20

\* ASTM B584 (Standard Specifications for Copper Alloy Sand Castings for General Applications) nominal chemistry, minimum mechanical properties

# PERFORMANCE

## Eight Year Water Meter Evaluation\*



\*Evaluation was performed by Virginia Tech on meters that had been in service for eight years in Japan.

## Dezincification Resistance

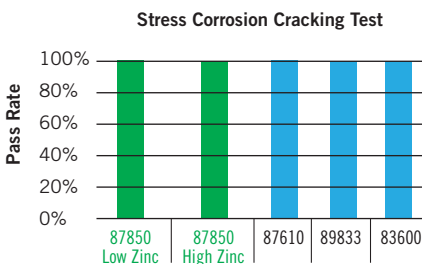
No alloys exhibited dezincification in the ISO6509 test which is used internationally to predict long-term water fitting performance in corrosive drinking water.

\*ISO6509-2 specifies 200µ or less of dezincification for forgings and castings



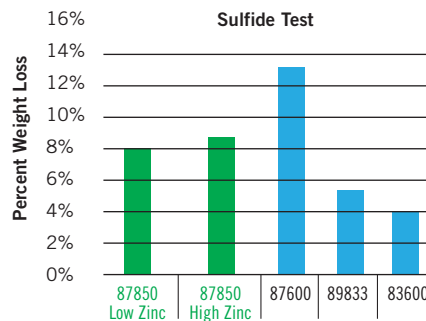
## Stress Corrosion Cracking

All alloys were free from cracking during the ASTM B858 one day and UL1821 ten day tests.



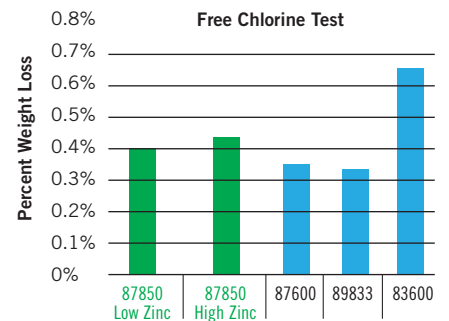
## Underground Corrosion Simulation

All alloys showed sulfide scaling in a chemical environment known to cause corrosion similar to that experienced by underground components.



## Pitting Resistance

All alloys resisted pitting in the high pH, high chloride water of the type that causes pitting failures in copper pipe.



# SUSTAINABILITY

## Abundance Of Chemical Elements In Earth's Crust

The UCLA study reviewed the total life cycle of all the alloys, beginning with availability of chemical elements in the earth's crust through the end of life recyclability, and ability of separating the alloyed elements at end of life.

Element	1= Most Abundant
Silicon	2
Phosphorus	11
Zinc	25
Copper	26
Lead	37
Tin	49
Bismuth	69
Platinum	71

↓  
Least

	LEADED	LEAD-FREE				
	C83600 Red Brass	C89833 Bismuth Brass	C89836 Bismuth Brass	C87850 Silicon Brass	C87600 Silicon Brass	C87610 Silicon Brass
<b>Physical Properties</b>						
Density (lb/in <sup>3</sup> )	0.318	0.317	0.318	→ 0.300	0.300	0.302
Melting Point - Liquid Temp (°F)	1850	1877	1885	1616	1780	1780
Melting Point - Solid Temp (°F)	1570	1454	1580	1571	1580	1510
Freezing Range (°F)	280	423	305	45	270	270
Pour Temp - Light Casting (°F)	2100 -2350	2170	2170	1900 -1960	2000 -2150	2000 -2150
Pour Temp - Heavy Casting (°F)	1951 -2151	2000 -2090	2000 -2090	1830 1850	1900 -2000	1900 -2000
Average Pour Temp (°F)	2138	2108	2108	1885	2013	2013
Superheat (Pour T (°F) - Liquidus (°F))	288	231	231	269	233	233
Machinability (Rating) <sup>2</sup>	84	81	85	70	40	40

## Environmental Impact:

- Lower pour temperatures of Silicon Brass = lower energy and CO<sub>2</sub> emissions
- Silicon Brass results in lower waste generation compared to Bismuth Brass

## Human Health:

- Eliminates lead emissions
- Lower flue dust emissions

Life Cycle Stage	Criteria	Target	Alternative		
		C83600	C89833/ C89836	C87600/ C87610	C87850
Beginning-of-life	Environmental Impact	Benchmark	--	=	=
	Human Health Impact	Benchmark	-	+	+
Alloy Manufacturing	Technical Performance	Benchmark	=	+	+
	Environmental Impact	Benchmark	=	+	+
	Human Health Impact	Benchmark	+	++	++
Component Manufacturing	Technical Performance	Benchmark	-	--	+
	Environmental Impact	Benchmark	+	++	++
	Human Health Impact	Benchmark	+	++	++
Use	Technical Performance	Benchmark	-	=	=
	Environmental Impact	Benchmark	=	=	=
	Human Health Impact	Benchmark	++	++	++
End-of-life	Technical Performance	Benchmark	--	=	=
	Environmental Impact	Benchmark	--	=	=
	Human Health Impact	Benchmark	+	+	+
Cumulative	Environmental Impact	Benchmark	--	+	+

++ MUCH BETTER  
 + BETTER  
 = COMPARABLE  
 - WORSE  
 -- MUCH WORSE

# VALUE

## ECO BRASS® VALUE

Attribute	C87850	C89836	C83600
Copper Content	75-78%	87-91%	84-86%
Density	→ 0.300 lb/in <sup>2</sup>	0.318 lb/in <sup>2</sup>	0.318 lb/in <sup>2</sup>
Melting Point	1616°F	1885°F	1850°F
Energy	0.28 kWh/lb	0.341 kWh/lb	0.325 kWh/lb
Yield	95%	92%	92%
Furnace Refractory Life	2X	1X	1X
Mold Sand Life	3X	1X	1X
Manufacturability With Current Processes	1X	1X	1X

## WHY SHOULD YOU SPECIFY ECO BRASS CASTINGS?

**Key Lead-free ECO BRASS® Characteristics Make The Critical Difference When It Comes To Your Brass Material Selection For Potable Water Components**

**Performance...**ECO BRASS® exhibits high dezincification resistance meaning the parts last as long as the traditional leaded alloys.

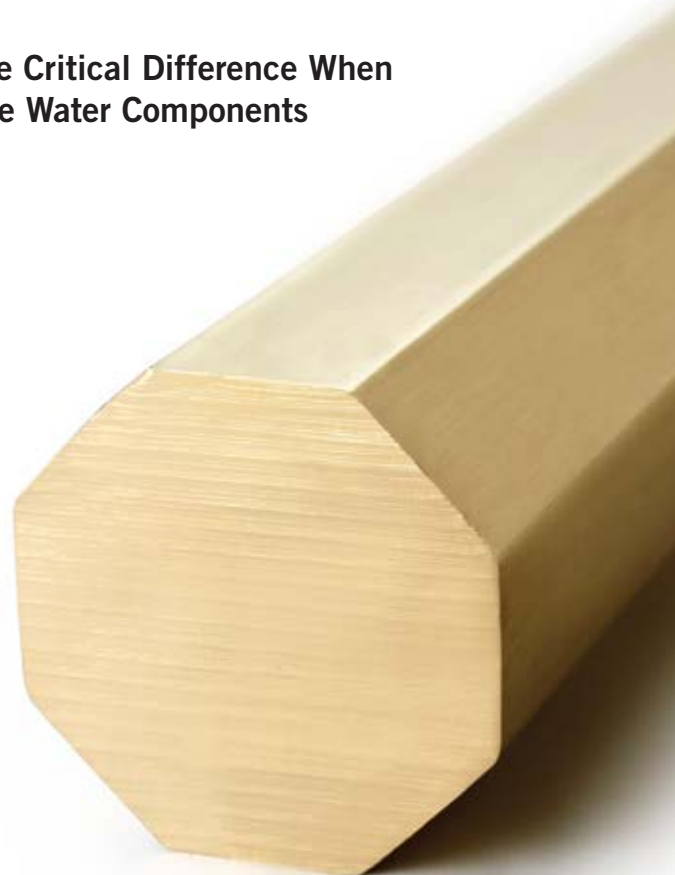
**Sustainability...**from foundry through fabrication ECO BRASS® requires less energy, creates fewer emissions and uses Silicon, which is abundant

**Cost/Value...**ECO BRASS® alloys provide for less waste, easier machining and lower cost than competitive alloys

**Density...**ECO BRASS® is 6% less dense than C89836 and C83600, which saves consumers money

ECO BRASS® can assure you that your lead-free components are in strict compliance with the Safe Drinking Water Act and RoHS regulations. It is manufactured by Chase Brass, one of the world's leading providers of brass products including rod, ingots and forgings for product fabrication. ECO BRASS® ingots are also available from Chase ECO BRASS® partners; California Metal-X and Ingot Metals.

Visit [www.ecobrassingot.com](http://www.ecobrassingot.com) for more information





To Learn More About ECO BRASS, visit  
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