

Master Alloys for the Aluminum & Copper Industries

**Milward**

*Aluminum & Copper Master Alloys*



# Aluminum & Copper Master Alloys

Milward's master alloys enhance the process or improve the performance characteristics of castings for the aluminum and copper industries. Our master alloys are produced in adherence to strict quality control practices utilizing an induction melting and alloying process followed by static mold or direct chill (DC) continuous casting.

Static cast finished products are available in a variety of forms including full or cut waffle ingot and notch bar ingot. Copper-based master alloys are also available in shot, screened and sized to specification, and in bagged shot.

In addition, Milward produces ACU-STIX™, ACU-BAR™ and ACU-COIL™, proprietary lines of precision-extruded alloy products. Select beryllium alloys are offered in rod/coil form. Grain refining and modifying alloys are also available in 3/8" (9.5 mm) rod form.

## Aluminum Alloy Applications

### Grain Refiners

Grain refiners containing titanium (with or without boron) control the structure and dispersion of individual crystals in metals to produce finer grain sized castings. They provide consistent improved mechanical strength and soundness of the casting.

### Modifiers

Usually applied in Silicon-Aluminum, modifiers change micro-structural properties of metal to increase strength, toughness, ductility, and resultant machinability. Milward offers modifier alloys for hypoeutectic Silicon-Aluminum and refiner alloys for hypereutectic Silicon-Aluminum. Strontium is favored where Si concentration is below 12%. Phosphorus-Copper is a highly effective primary refiner for high Si content alloys such as A390.

### Hardeners

Hardener chemical elements change the composition of metal alloys.

### Beryllium-Aluminum

These alloys provide effective control of aluminum melt oxidation by forming a tight protective oxide on the liquid surface. Minimization of oxygen pickup has the concurrent benefit of reducing magnesium oxidation loss common to Mg alloys and high Mg Al alloys.

## Copper Alloy Applications

### Deoxidants

Deoxidants remove oxygen from copper baths to produce a copper bath that is free of dissolved oxygen.

### Alloying Agents

Used as an alloying agent in copper-tin alloys and in high performance electrical conductive alloys, Phosphorus-Copper increases their strength, hardness and elasticity while reducing creep and grain growth.

### Wetting Agents

When added to brazing alloys, Phosphorus-Copper lowers melting temperatures and improves wetting characteristics, resulting in a cleaner, stronger brazed joint. (For more information, request our Phosphorus-Copper product bulletin.)

### Hardeners

Several Milward copper alloys are used to change the composition of metal alloys that require heat treatment to improve strength and wear resistance. These include Iron-Copper, Silicon-Copper, Nickel-Copper, Magnesium-Copper, and Manganese-Copper.

## Milward's Precision Addition™ Products Provide Greater Accuracy & Control

Milward produces a proprietary line of extruded aluminum master alloys that improve precision in your process. All Milward Precision Addition products are controlled to an accuracy of ±5% of weight per unit length.

### ACU-STIX™



ACU-STIX are accurately measured and supplied in exact weights (e.g. 1 oz. = 1"), enabling you to make precise additions. They are available in 2 - 8 oz. pieces and other sizes on request. All shapes are designed to have the same cross-sectional area. Alloys are identified by different shapes.

ACU-STIX are superior to chopped rod because they are more convenient. One piece provides the exact weight addition you need.

ACU-STIX are superior to buttons because their unit weight is more precise and accurate, and they can be supplied in made-to-order units with tight tolerances. ACU-STIX are cleaner (free of oxides) than buttons and compatible in price.

### ACU-BAR™



ACU-BAR is a version of ACU-STIX supplied in 1-lb. and 2-lb. pieces.

### ACU-COIL™



A variety of Milward's aluminum master alloys are available. ACU-COIL coiled rod is supplied in 400 - 1,000 lb. rolls.

# Master Alloys Selection Chart

Aluminum-Based Master Alloys		Precision Addition Family™				Standard Forms				
		Cut Rod	ACU-COIL™	ACU-STIX™	ACU-BAR™	Full Waffle Ingot	Notch Bar Ingot	Cut Waffle Ingot	Shot	Bagged Shot
Grain Refiners		Standard % of Alloying Element								
Titanium Aluminum	6% Ti	●	●	●	●	●		●		
Titanium Aluminum	10% Ti					●		●		
Titanium-Boron Aluminum	3% Ti-1% B	●	●	●	●	●		●		
Titanium-Boron Aluminum	5% Ti-1% B	●	●	●	●	●		●		
Titanium-Boron Aluminum	5% Ti-0.6% B	●	●	●	●	●		●		
Titanium-Boron Aluminum	5% Ti-0.2% B	●	●	●	●	●		●		
Titanium-Boron Aluminum	10% Ti-1% B					●		●		

## Hardeners

Antimony Aluminum	5% Sb					●	●			
Bismuth Aluminum	2 or 8% Bi					●	●			
Chrome Aluminum	10 or 20% Cr					●	●			
Cobalt Aluminum	10 or 20% Co					●	●			
Copper Aluminum	20, 33, 50 or 54% Cu					●	●			
Iron Aluminum	15, 25 or 35% Fe					●	●			
Lead Aluminum	6% Pb					●	●			
Lithium Aluminum	8% Li					●	●			
Magnesium Aluminum	25 or 50% Mg					●	●			
Manganese Aluminum	10, 25 or 50% Mn					●	●			
Nickel Aluminum	20% Ni					●	●			
Silicon Aluminum	20, 36 or 50% Si					●	●			
Vanadium Aluminum	5 or 10% V					●	●			
Zinc Aluminum	50% Zn					●	●			
Zirconium Aluminum	5, 6, 10 or 15% Zr					●	●			

## Modifiers & Special Alloys

Beryllium Aluminum	1, 2.5 or 5% Be	●	●	●	●		●			
Boron Aluminum	3, 4 or 5% B	●	●			●				
Phosphorus Copper	8 or 15% P					●			●	●
Strontium Aluminum	3.5, 10 or 15% Sr	●	●	●	●	●		●		
Strontium-Silicon Aluminum	10% Sr-14% Si					●		●		

## Copper-Based Master Alloys

Aluminum Copper	54, 67 or 80% Al					●	●			
Chrome Copper	5 or 10% Cr					●				
Copper Shot	Pure								●	
Iron Copper	10 to 50% Fe						●		●	
Lithium Copper	2% Li					●	●			
Magnesium Copper	20% Mg						●			
Manganese Copper	30% Mn						●			
Nickel Copper	30 to 50% Ni								●	
Phosphorus Copper	8 to 15% P					●			●	●
Silicon Copper	10 to 30% Si					●				

**Note:** Standard weights and sizes of forms shown on back cover.

## Precision Addition™ Forms



- Cut Extruded Rod** - 3/8" (9.5 mm)  
- 1-oz. (30 g) pieces - approx. 6" (15 cm)  
- 6.5-oz. (200 g) pieces - approx. 40" (1 m)



- ACU-COIL™ Extruded Rod** - 3/8" (9.5 mm)  
- 400-lb. coils (180 kg)  
- 600-lb. coils (275 kg)  
- 1000-lb. coils (450 kg)



- ACU-STIX™ Extruded Rod** - 0.890" (22.5 mm)  
- 2-oz. (50 g) pieces - approx. 2" (5 cm)  
- 4-oz. (100 g) pieces - approx. 4" (10 cm)  
- 6-oz. (150 g) pieces - approx. 6" (15 cm)  
- 8-oz. (200 g) pieces - approx. 8" (20 cm)



- ACU-BAR™ Extruded Rod** - 1.375" (35 mm)  
- 1-lb. (0.5 kg) pieces - approx. 8" (20 cm)  
- 2-lb. (1 kg) pieces - approx. 16" (40 cm)

## Standard Forms



- Aluminum Waffle Ingot** - 16 lbs. (7 kg)  
**Copper Waffle Ingot** - 44 lbs. (20 kg)



- Aluminum Notch-bar Ingot**  
- 15 lbs. (7 kg) and 50 lbs. (22 kg)  
**Copper Bar Ingot** - 40 lbs. (18 kg)



- Aluminum Cut Waffle** - 1 lb. (0.5 kg)



- Shot** - Sized to specification



- Copper** - Bagged Shot  
- 2-oz. (60 g) bags  
- 4-oz. (120 g) bags  
- 6-oz. (180 g) bags

## Packaging & Shipping

Milward master alloys are packaged in steel or fiber drums on pallets, wood or cardboard pallet boxes, and stretch-wrapped on pallets. Most items are available from stock for prompt shipment.

## Supplier of World Class Master Alloys Since 1948

Milward Alloys, Inc., is a manufacturer of hardeners, grain refiners, modifiers and deoxidants for the aluminum and copper melting industries. Milward's master alloys are precisely combined, melted, and packaged additives, made of primary metals and chemicals, designed to satisfy contemporary metallurgical needs.

As a world-class supplier of aluminum- and copper-based master alloys and additives, Milward recognizes that it is of primary importance to anticipate and fulfill the needs of its customers...and to continuously improve by integrating quality, innovation and excellence into our processes, products, service and technology.

## Product Line & Custom Capabilities

In addition to the aluminum and copper master alloys presented herein, Milward produces other precision alloying additives. For free literature and more information, request the specific bulletins below or visit our website ([www.Milward.com](http://www.Milward.com)).

## Phosphorus-Copper

- 15% Phosphorus-Copper: three grades for use as a deoxidant, alloying agent or wetting agent.
- 8% Phosphorus-Copper: one grade for use as a nucleant.

## Custom & Non-Standard Alloy Products

- Technical support in the metallurgical and chemical design of alloys.
- Testing of the metallurgical and chemical composition.
- Prototyping in semi-finished billets or slabs and DC cast semis.
- Full production runs.
- Non-Disclosure Agreements (NDA).
- Wide range of applications - nuclear shielding, ultra-high purity aluminum for marine and aerospace, exotic welding alloys, special alloys for automotive and aerospace, peculiar alloys incorporating curiosity elements, and other specialized functions.

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