**NAVAL BRONZE**
**ALLOY NO. 470**
**UNS/CDA C47000**
AWS A5.8 Class RBCuZn-A
† ASME SFA5.8 RBCuZn-A, QQ-R-571C,
† MIL-R-19631B Type RCuZn-A
MIL-B-7883 QQ-B-650

**DESCRIPTION AND APPLICATIONS**
Washington Alloy Naval Bronze is a 1% tin filler metal used for brazing or oxyacetylene welding of steel, cast iron, malleable iron, copper, bronze and nickel alloys. The addition of tin improves strength and corrosion resistance in the weld deposit. A borax-boric acid flux is generally required. Joint clearances should be 0.002" to 0.005" wide. Preheating may be desirable for some applications. A neutral or slightly oxidizing flame should be used.

**NICKEL BRONZE**
**ALLOY NO. 680**
**UNS/CDA C68000**
† ASME SFA5.8 RBCuZn-B,
† QQ-R-571C, MIL-R-19631B
† Type RCuZn-B

**DESCRIPTION AND APPLICATIONS**
Washington Alloy Nickel Bronze (also referred to as Manganese Bronze) is similar to Naval Bronze, however iron, manganese and nickel have been added to the analysis. The iron and manganese increases the hardness and strength of the weld deposit while nickel ensures uniform distribution of iron in the deposit. Nickel Bronze is primarily used to braze or oxyacetylene weld steel, cast iron, brass and bronze. Also used for building-up wearing surfaces and bearings. Flux required. Use a boric acid or borax commercial flux. A neutral or slightly oxidizing flame should be used. Preheating may be required for some applications.

**LOW FUMING BRONZE ALLOY**
**NO. 681**
**UNS/CDA C68100**
AWS A5.8 Class RBCuZn-C
† ASME SFA5.8 RBCuZn-C,
† QQ-R-571C, MIL-R-19631B
† Type RCuZn-C

**DESCRIPTION AND APPLICATIONS**
Washington Alloy Low Fuming Bronze is a general-purpose oxyacetylene brazing rod used for steel, copper alloys, cast iron, nickel alloys and stainless steel. A balanced chemical analysis of copper and zinc as well as alloying elements of tin, iron, manganese and silicon produce weld deposits with excellent mechanical properties. High strength, ductile and sound weld deposits are easily attained simply by applying a neutral or slightly oxidizing flame. The high silicon content of Washington Alloy Low Fuming Bronze keeps fumes to a minimum. Preheating is required for some applications and bronze brazing flux is required for the bare rods.

* Order as bare or flux-coated.

**NICKEL SILVER ALLOY**
**NO. 773**
**UNS/CDA C77300**
AWS A5.8 Class RBCuZn-D
† ASME SFA5.8 RBCuZn-D,
† QQ-R-571C, MIL-R-19631B
† Type RCuZn-D QQ-B-630 (BCuZn-D)

**DESCRIPTION AND APPLICATIONS**
Washington Alloy Nickel Silver filler metal contains 10% nickel and is used primarily for brazing or oxyacetylene welding of steel or cast iron. The weld deposits of Washington Alloy Nickel Silver have very high tensile strength, good ductility and excellent corrosion resistance. The weld deposits are machinable and work harden when put into service. For this reason Nickel Silver is commonly used for building-up or overlaying worn parts such as gear teeth, bearings and valve seats. It is also used in the matrix of tungsten carbide rods where it acts as a “binder” for the tungsten carbide particles. Excellent for tubular structures. A boric acid or borax flux is required. Preheating may be desired for some applications. A neutral or slightly oxidizing flame is recommended.

* Order as bare or flux-coated.

**SILICONE BRONZE ALLOY**
**NO. 656**
**UNS/CDA C65600**
AWS A5.7 ERCuSi-A
† ASME SFA5.7 ASME
† QQ-R-571C, MIL-R-19631B
† Type RCuSi-A MIL-E-23765/3 (MIL-CuSi)

**DESCRIPTION AND APPLICATIONS**
Washington Alloy Silicon Bronze is a copper-based filler metal containing 3% silicon and small amounts of manganese, tin and zinc. Primarily used for MIG, TIG and oxyacetylene welding of copper, copper-silicon and copper-zinc base metals to themselves and to steel. Excellent for plain- or galvanized steel sheet metal as well as other coated steels. Washington Alloy Silicon Bronze is also used for surfacing areas subjected to corrosion. The oxyacetylene gas flame should be slightly oxidizing. Keep the weld puddle small in order to promote fast solidification and minimize cracking. A high boric acid flux should be used both before and during welding. Preheating is NOT recommended.
DEOX COPPER
ALLOY NO. 189
UNS/CDA 18980
AWS A5.7 Class ERCu
† ASME SFA5.7
† QQ-R-571C, MIL-R-19631B
Type MILRCu-2 MILC-19654
(MILRCu-2)

DESCRIPTION AND APPLICATIONS
Washington Alloy DEOX Copper is a 98% copper filler metal used for MIG, TIG and oxyacetylene welding of copper and copper-alloyed base metals. DEOX Copper contains small amounts of phosphorus and silicon which act as the deoxidizing agents to promote sound weld joints. Washington Alloy DEOX Copper is easy flowing and produces weld deposits that are porosity free, electrically conductive and the color will match that of copper. Excellent for joining copper to mild steel, for overlaying steel and for the fabrication of copper pipes, tanks and copper fittings. The oxyacetylene gas flame must be neutral or slightly oxidizing. Tip size must be one to two sizes larger than the base plate. Preheating should be done only if the part is thick. A boric acid or borax flux is recommended.

PHOS BRONZE A
ALLOY NO. 518
UNS/CDA C51800
AWS A5.7 Class ERCuSn-A
† ASME SFA5.7 ERCuSn-A
† QQ-R-571C, MIL-R-19631B
Type RCuSn-A

DESCRIPTION AND APPLICATIONS
Washington Alloy Phos-Bronze A filler metal is used for MIG and TIG welding of tin-bronze base metals such as 509 to 519 series, for brass and for overlay welding of steel. Phos-Bronze A contains approximately 5% tin and up to 0.35% phosphorus. The tin content increases the wear resistance of the weld deposit while the phosphorus acts as a deoxidizer.

Preheating is recommended.

PHOS BRONZE C
ALLOY NO. 521
UNS/CDA C52100
AWS A5.7 CLASS ERCuSn-C
† ASME SFA5.7 ERCuSn-C,
† MILE-23765/3 (MIL-CuSn-C)

DESCRIPTION AND APPLICATIONS
Washington Alloy Phos-Bronze C filler metal is used quite extensively for surfacing applications. The higher tin (Sn) content (7.0 - 9.0%) gives “PBC” weld deposits greater hardness and higher tensile/yield strength than Phos-Bronze A. “PBC” is commonly used for base metals of similar composition, for joining brass alloys and for joining cast iron to carbon steel. Preheating is recommended.

ALUMINUM BRONZE A-1
ALLOY NO. 610
UNS/CDA C61000
AWS A5.7 Class ERCuAl-A1
† ASME SFA5.7 ERCuAl-A1
QQ-C-450

DESCRIPTION AND APPLICATIONS
Washington Alloy Aluminum Bronze A 1 is an iron-free aluminum bronze filler metal used for MIG and TIG overlay welding of bearing and wear resistant surfaces exposed to corrosive environments such as salt or brackish water and commonly used acids. Aluminum Bronze A-1 is not recommended for joining. Commonly used in steel and pulp mills to overlay tube sheets, valve seats and refineries.

ALUMINUM BRONZE A-2
ALLOY NO. 618
UNS/CDA C61800
AWS A5.7 Class ERCuAl-A2
† ASME SFA5.7 ERCuAl-A2,
† QQ-R-571C, MIL-R-19631B
Type MILRCuAl-A2 MILW-6712
Mil-E-23765/3 (MIL-CuAl-A2)

DESCRIPTION AND APPLICATIONS
Washington Alloy Aluminum Bronze A-2 is an iron-bearing MIG and TIG filler metal used for joining aluminum bronze of similar composition, silicon and manganese bronze, high strength copper-zinc alloys, some copper-nickel alloys, ferrous metals and dissimilar metals. Dissimilar metal combinations would include aluminum bronze to steel and copper to steel. Washington Alloy Aluminum Bronze A-2 is excellent for building-up or overlaying metal for wear and corrosion resistant surfaces. Weld deposits exhibit high mechanical properties, tensile strength, yield strength and hardness. Most common applications would include marine maintenance and repair welding of ship propellers; pump housings, rigging jacks, piston heads, bearings and many overlay or surfacing applications.
ALUMINUM BRONZE
A-3 ALLOY NO. 624
UNS/CDA C62400
AWS A5.7 Class ERCuAl-A3

DESCRIPTION AND APPLICATIONS
Washington Alloy Aluminum Bronze A-3 contains a higher Iron (Fe) content than Aluminum Bronze A-2. The higher Iron content gives “A-3” greater strength when joining aluminum bronze castings of similar composition. “A-3” is often used for piston overlay and bearing surface applications which require higher strength, while maintaining good ductility.

NICKEL-ALUMINUM BRONZE ALLOY
UNS/CDA C63280
AWS A5.7 Class ERCuNiAl
† ASME SFA5.7 ERCuNiAl
† MIL-E-23763/3

DESCRIPTION AND APPLICATIONS
Washington Alloy Nickel-Aluminum Bronze filler metal is used for MIG and TIG welding of cast and wrought nickel-aluminum bronze parts such as ship propellers, where high resistance to corrosion, erosion and cavitation in salt or brackish water is required. Nickel-Aluminum Bronze is a very popular filler metal in offshore technology for such items as seawater desalting, shipbuilding and repair. Also used in the power plant and chemical industry for pumps and tube systems.

MANGANESE-NICKEL-ALUMINUM ALLOY
UNS/CDA C63380
AWS A5.7 CLASS ERCuMnNiAl
† ASME SFA5.7 ERCuMnNiAl
† MIL-E-23765/3

DESCRIPTION AND APPLICATIONS
Washington Alloy Manganese-Nickel-Aluminum Bronze filler metal is designed for MIG and TIG welding or surfacing of cast or wrought base metals of similar analysis. Especially suited for welding ship propellers where resistance to corrosion, erosion and cavitation is required. Manganese-Nickel-Aluminum Bronze is also used for joining or surfacing copper alloys of unalloyed and low alloy steel as well as grey cast iron. Good toughness and hardness.

WASHINGTON ALLOY 67
UNS/CDA C71581
AWS A5.7 Class ERCuNi
† MIL-E-21562 Type MIL-RN67, MIL EN67
† ASME SFA5.7, Class ERCuNi
† QQ-R-571C Mil-R-19631B
Type MILRCuNi Mil-23413 [MIL-67]

DESCRIPTION AND APPLICATIONS
Washington Alloy 67 is a copper-nickel filler metal used for MIG, TIG, oxyacetylene and submerged arc welding of wrought or cast 70/30, 80/20 and 90/10 copper-nickel to themselves or to each other. Excellent for joining copper-nickel alloys to nickel-copper Alloy 400, R-405, K-500 or high nickel alloy 200. Note: Washington Alloy 67 can be used for overlaying on steel, however a barrier layer of Washington Alloy 61 should be used for the first pass when MIG welding. Washington Alloy 60 should be used for the first pass when submerged arc welding.

COPPER BASED MIG & TIG ALLOYS

<table>
<thead>
<tr>
<th>AVAILABLE SIZES AND PACKAGING</th>
<th>MASTER CARTON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package Form (in.) (mm) .023 (0.6) .030 (0.8) .035 (0.9) .045 (1.2) .1/16 (1.6) .3/32 (2.4) .1/8 (3.2) .5/32 (4.0) .3/16 (4.8) .1/4 (6.4) .3/8 (9.5)</td>
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<tr>
<td>2# Spools (4&quot;) x x x x x</td>
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<td>10# Spools (8&quot;) x x x x x</td>
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<td>30# Spools (12&quot;) x x x x x x x</td>
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<tr>
<td>60# Coils x x x x x x x x</td>
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<tr>
<td>* 36” Cut Lengths x x x x x x x</td>
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</tbody>
</table>

**Note: Flux-coated 1/16 (1.6mm) is only available in 18” lengths.
** 10 lb. tubes in a 50 lb. master carton is available upon request.
*** Flag-tagging is also available upon request.

WARNING! Protect yourself and other. Read and understand this information. BRAZING AND SOLDERING ALLOYS AND FLUXES MAY PRODUCE FUMES AND GASES DANGEROUS TO YOUR HEALTH. FLUXES MAY CONTAIN FLUORIDES. FLUXES MAY BURN EYES AND SKIN ON CONTACT AND CAN BE FATAL IF SWALLOWED! Before use, read, understand and follow manufacturer’s instructions. Material Safety Data Sheets (MSDS) and your employer’s safety practices. *Keep head out of fumes. Use enough ventilation and exhaust to keep fumes and gases away from your breathing zone and the general area. *Avoid flux contact with eyes and skin. *Do not take flux internally. *Keep out of reach of children and those unfamiliar with, or unwilling to use safe handling practices. *See American National Standards Z49.1 Safety in Welding and Cutting published by the American Welding Society (AWS), 550 NW LeJeune Rd, PO Box 351040, Miami, FL 33135. OSHA Safety and Health Standards 29 CFR 1910, available from the US Government Printing Office, Superintendent of Document, PO Box 37194 Pittsburgh, PA 15250. MSDS sheets are available from US ALLOY CO Charlotte, NC 28216. on our website at www.weldingwire.com, from your employer or by contacting your supplier.
**COPPER BASED FLUX COATED ELECTRODES**

**RAINIER 3A**
UNS/CDA W60521
AWS A5.6 Class ECuAl-A2
DC Reverse Polarity (Electrode+)
All-Position Phosphor (Tin)
Bronze Electrode for Copper, Steel, Cast Iron and Galvanized Iron

**APPLICATIONS**
Rainier 3A is a multipurpose fluxcoated electrode used for joining heavy sections of steel, cast iron and copper, brass, and bronze. Excellent for overlays on shafts, impellers and propeller blades. Used for building-up bearing journals and frictional wear surfaces on heavier sections. Other uses include ornamental iron, galvanized iron and as a substitute for torch alloys on larger sections.

**FEATURES**
Rainier 3A is specially formulated to be used in any position with a minimum of spatter. Weld deposits are ductile, strong and machinable. Rainier 3A deposits offer good corrosion resistance to salt water and chemicals. Provides a good color match on bronze and will work harden.

**SPECIFICATIONS**
- Tensile strength (psi) ................. Up to 65,000
- Elongation in 2" (%) ................... 45-50
- Brinell Hardness ....................... 85-100
- Machinability .......................... Excellent

**AVAILABLE SIZES AND AMPERAGE**

<table>
<thead>
<tr>
<th>(in.)</th>
<th>3/32</th>
<th>1/8</th>
<th>5/32</th>
<th>3/16</th>
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<tbody>
<tr>
<td>(mm)</td>
<td>2.4</td>
<td>3.2</td>
<td>4.0</td>
<td>4.8</td>
</tr>
<tr>
<td>(Amps)</td>
<td>60-115</td>
<td>100-150</td>
<td>125-200</td>
<td>190-250</td>
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</tbody>
</table>

**PROCEDURES**
Clean the weld area. Bevel edges to a 45° vee. Thin sections generally do not require preheating. However, heavier sections of cast iron and steel should be preheated to 200°F (93°C), phosphor (tin) bronze to 400°F (205°C) and other copper alloys to 700°F (371°C). Maintain the preheat temperature during welding and between passes. Use DC reverse polarity (electrode+). Holding the electrode 90° to the workpiece, maintain a medium arc length and weave slightly. For thicker deposits shorten the arc length and make stringer beads. Allow the part to cool slowly before removing the slag with a chipping hammer and wire brush.

**NOTE:** RAINIER 7A, WHICH MEETS AWS A5.6 CLASS ECUSN-A IS AVAILABLE UPON REQUEST.

**RAINIER 4A**
UNS/CDA W60189
AWS A5.6 Class ECu
DC Reverse Polarity (Electrode+)
High Purity Copper Electrode for Joining Copper and Overlaying Steel

**APPLICATIONS**
Rainier 4A is a copper-cored fluxcoated electrode used to surface, build-up, and fabricate electrolytic tough pitch and oxygen-free copper. Excellent for applications that require high corrosion resistance. Commonly used to overlay steel or to join heavier sections of copper to steel.

**FEATURES**
Rainier 4A produces high purity copper weld deposits. Corrosion resistance and electrical conductivity is excellent. Perfect color match to copper.

**SPECIFICATIONS**
- Tensile strength (psi) ................ Up to 35,000
- Elongation (%) .......................... Approx. 35
- Brinell Hardness ....................... Rockwell F 20-40
- Machinability .......................... Excellent

**AVAILABLE SIZES AND AMPERAGE**

<table>
<thead>
<tr>
<th>(in.)</th>
<th>1/8</th>
<th>5/32</th>
</tr>
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<tbody>
<tr>
<td>(mm)</td>
<td>3.2</td>
<td>4.0</td>
</tr>
<tr>
<td>(Amps)</td>
<td>100-150</td>
<td>125-200</td>
</tr>
</tbody>
</table>

**PROCEDURES**
Clean joint area of all dirt, grease, and oxides. Bevel heavy sections. Porosity free welds on heavy sections can be achieved by preheating and maintaining the preheat temperature during the entire welding operation. Silicon Bronze should not be preheated above 150°F. Pure copper requires a 900°F to 1000°F preheat, while all other copper base alloys require a 500°F to 700°F preheat. Thin sections of steel do not require preheating. However, if the base metal is warmed a lower amperage can be used. Using DC reverse polarity (electrode+) and the largest diameter electrode as possible, maintain a short arc length. Stress and distortion can be avoided by peening each deposit between passes. Allow the part to cool slowly before removing the slag with a chipping hammer and wire brush.

**RAINIER 5A**
UNS/CDA W60614
AWS A5.6 Class ECuAl-A2
DC Reverse Polarity (Electrode+)
Flat Horizontal Positions, Versatile Copper Base Electrode for Joining and Overlaying Copper, Brass, Bronze and Dissimilar Metals.

**APPLICATIONS**
Rainier 5A is a fluxcoated electrode designed for overlays exposed to frictional wear or corrosives such as salt water, alkalies and some acids. Ideal for aluminum bronze, manganese bronze, silicon bronze, bronze to steel and cast iron. Also used on malleable iron, galvanized iron, stainless steel and as a build-up on bearing surfaces. Some common applications are: brake drums, hydraulic pistons, tractor gear housings, paper mill rolls, impellers, motor bases, pickling hooks, ship propellers, mixer arms, yokes, press rams, valve seats, bushings, foundry flasks and bearings.

**FEATURES**
Rainier 5A produces strong, dense, ductile and crack free weld deposits in so many ferrous and nonferrous combinations of dissimilar metals. Weld deposits are extremely tough and will work harder under compressive loads. Overall - an excellent choice.

**SPECIFICATIONS**
- Tensile strength (psi) ................ Up to 100,000
- Yield Strength (psi) .................. Up to 63,000
- Elongation in 2" (%) .................. 24-27
- Brinell hardness ...................... 130-150
- Machinability .......................... Excellent

**AVAILABLE SIZES AND AMPERAGE**

<table>
<thead>
<tr>
<th>(in.)</th>
<th>1/8</th>
<th>5/32</th>
<th>3/16</th>
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<tbody>
<tr>
<td>(mm)</td>
<td>3.2</td>
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<td>4.8</td>
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<tr>
<td>(Amps)</td>
<td>90-120</td>
<td>115-150</td>
<td>140-210</td>
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</tbody>
</table>

**PROCEDURES**
Clean the weld area. Bevel heavy sections. Preheat copper base alloy and heavy sections of steel or cast iron at 250°F to 400°F, depending on the thickness of the part. Use DC reverse polarity (electrode+). Holding the electrode 10-15° off perpendicular, maintain a short arc length and apply thin layers using stringer beads or the weaving technique. Allow the part to cool slowly. Use a chipping hammer and brush to remove slag between passes.
RAINIER 6A
UNS/CDA W60656
AWS A5.6 Class ECuSi
AC-DC Reverse Polarity (Electrode+)
All-Position
AC/DC All Purpose Electrode for “Arc Brazing”
Cast Iron to Steel.

APPLIED JOINING PROCESSES FOR COPPER AND COPPER ALLOYS

E=Ecellent G=Good F=Fair NR=Not Recommended

<table>
<thead>
<tr>
<th>ALLOY</th>
<th>OXYFUEL GAS WELDING</th>
<th>SMAW</th>
<th>GMAW</th>
<th>GTAW</th>
<th>RESISTANCE WELDING</th>
<th>SOLID-STATE WELDING</th>
<th>BRAZING</th>
<th>SOLDERING</th>
<th>ELECTRON BEAM WELDING</th>
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<tbody>
<tr>
<td>ETP Copper</td>
<td>C11000-C11900</td>
<td>NR</td>
<td>F</td>
<td>F</td>
<td>NR</td>
<td>G</td>
<td>E</td>
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<td>NR</td>
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<tr>
<td>Oxygen-Free Copper</td>
<td>C102000</td>
<td>F</td>
<td>NR</td>
<td>G</td>
<td>NR</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>G</td>
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<tr>
<td>Deoxidized Copper</td>
<td>C12000-C123000</td>
<td>G</td>
<td>NR</td>
<td>E</td>
<td>NR</td>
<td>E</td>
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<tr>
<td>Beryllium-Copper</td>
<td>C17000-C17500</td>
<td>NR</td>
<td>F</td>
<td>G</td>
<td>NR</td>
<td>F</td>
<td>G</td>
<td>G</td>
<td>F</td>
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<tr>
<td>Cadmium/Chromium Copper</td>
<td>C16200-C18200</td>
<td>NR</td>
<td>NR</td>
<td>G</td>
<td>NR</td>
<td>F</td>
<td>G</td>
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<tr>
<td>Red Brass - 85%</td>
<td>C23000</td>
<td>F</td>
<td>NR</td>
<td>G</td>
<td>F</td>
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<td>NR</td>
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<tr>
<td>Cartridge Brass - 70%</td>
<td>C26000</td>
<td>F</td>
<td>NR</td>
<td>F</td>
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<tr>
<td>Leaded Brassess</td>
<td>C31400-C38590</td>
<td>NR</td>
<td>NR</td>
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<tr>
<td>Phosphor Bronzes</td>
<td>C50100-C52400</td>
<td>F</td>
<td>F</td>
<td>G</td>
<td>G</td>
<td>G</td>
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<tr>
<td>Copper-Nickel-30%</td>
<td>C71500</td>
<td>F</td>
<td>F</td>
<td>G</td>
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<td>Copper-Nickel-10%</td>
<td>C70600</td>
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<td>Nickel Silvers</td>
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<td>Silicon Bronzes</td>
<td>C65100</td>
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<td>G</td>
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<tr>
<td>Brine II Hardness</td>
<td>60-80</td>
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DESCRIPTION
Washington Alloy 187 is a 70% copper-30% nickel flux-coated electrode designed for welding wrought or cast forms of 70/30, 80/20 and 90/10 copper-nickel alloys. This electrode is also used for many dissimilar applications such as joining nickel-copper Alloy 400, R-405 and K500 or high nickel alloy 200 to the copper-nickel alloys.

APPLICATIONS
The most popular use of Washington Alloy 187 would involve marine applications where it offers excellent resistance to the corrosive effects of salt water. Also used in dissimilar applications such as joining nickel-copper -nickel alloys. This electrode is also used for many applications involving cast iron to steel.

APPLICATIONS
Rainier 6A flux-coated electrodes are used for welding or building up silicon bronze as well as other copper alloys. It is an excellent choice for applications involving cast iron to steel or where the part is exposed to corrosives. Rainier 6A is commonly used on bronze impellers, bronze wear plates, hydraulic piston overlays, track wheels, gears, sprockets and quite often farm implements.

FEATURES
Rainier 6A performs well in any position utilizing AC as well as DC machines. Rainier 6A weld deposits are strong, ductile and crack resistant - even when welding on dirty, oily, burned cast or malleable parts. The high silicon content of this electrode allows it to be used as a welding or brazing electrode.

FEATURES
It is an excellent choice for applications involving cast iron to steel or where the part is exposed to corrosives. Rainier 6A is commonly used on bronze impellers, bronze wear plates, hydraulic piston overlays, track wheels, gears, sprockets and quite often farm implements.

APPLICATIONS
Clean the weld area. Heavier sections should be beveled and preheated up to 500°F depending on the thickness of the part. Thin sections do not require preheating. Maintain a medium arc length and deposit stringer beads in groove or overlay welding and use weave beads for rapid overlays, large areas and for welding ferrous metals. Peen the weld deposit and remove slag between passes.

TYPICAL WELD METAL CHEMISTRY (%)

Si ................0.50 max. Other (total) .....0.50 max.
Fe ...............0.40-0.75 P .................0.020 max.
Mn ..............1.00-2.50 Pb ..................0.02 max.
Ni .............29.0-33.0 Ti ..................0.50 max.

TYPICAL MECHANICAL PROPERTIES OF WELD DEPOSIT (as welded)

Tensile strength (psi) ...........................................50,000 min.
Yield strength (psi) ...........................................20,000 min.
Elongation in 2" (%) ...........................................30
Brine II Hardness .............................................60-80

WELDING POSITIONS
Flat, horizontal, vertical, overhead.

ELECTRON BEAM WELDING

WASHINGTON ALLOY 187
UNS/CDA W60715
AWS/SFA 5.6 Class ECuNi
† MILE-22200/4
Type MiCuNi (70/30)
UNS #W60715

TYPICAL WELD METAL CHEMISTRY (%)

Si ................0.50 max. Other (total) .....0.50 max.
Fe ...............0.40-0.75 P .................0.020 max.
Mn ..............1.00-2.50 Pb ..................0.02 max.
Ni .............29.0-33.0 Ti ..................0.50 max.

ALLOY UNS NO.

<table>
<thead>
<tr>
<th>ALLOY</th>
<th>UN NO</th>
</tr>
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<tbody>
<tr>
<td>Red Brass - 85%</td>
<td>C23000</td>
</tr>
<tr>
<td>Low Brass - 80%</td>
<td>C24000</td>
</tr>
<tr>
<td>Cartridge Brass - 70%</td>
<td>C26000</td>
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<tr>
<td>Leaded Brassess</td>
<td>C31400-C38590</td>
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<tr>
<td>Phosphor Bronzes</td>
<td>C50100-C52400</td>
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<tr>
<td>Copper-Nickel-30%</td>
<td>C71500</td>
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<tr>
<td>Copper-Nickel-10%</td>
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<td>Nickel Silvers</td>
<td>C75200</td>
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<td>Silicon Bronzes</td>
<td>C65100</td>
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<tr>
<td>Brine II Hardness</td>
<td>60-80</td>
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</tbody>
</table>

APPLICABLE JOINING PROCESSES FOR COPPER AND COPPER ALLOYS

E=Ecellent G=Good F=Fair NR=Not Recommended

SPECIFICATIONS

Tensile strength (psi) ........................................... Up to 60,000
Yield strength (psi) ........................................... Up to 42,000
Elongation in 2" (%) ........................................... 52-55
Brinell Hardness ............................................. 80-100
Machinability .................................................. Excellent

AVAILABLE SIZES AND AMPERAGE

(in.) 3/32 1/8 5/32 3/16
(mm) 2.4 3.2 4.0 4.8
(Amps) 40-80 80-125 120-150 140-215

PROCEDURES

Clean the weld area. Heavier sections should be beveled and preheated up to 500°F depending on the thickness of the part. Thin sections do not require preheating. Maintain a medium arc length and deposit stringer beads in groove or overlay welding and use weave beads for rapid overlays, large areas and for welding ferrous metals. Peen the weld deposit and remove slag between passes.

AVAILABLE SIZES AND OPERATING RANGES (DCEP) (DC+)

3/32 (2.4mm) ........................................... 50-75 amps
1/8 (3.2mm) ........................................... 75-110 amps
5/32 (4.0mm) ........................................... 110-145 amps
3/16 (4.8mm) ........................................... 145-185 amps

ELECTRON BEAM WELDING

83821 Copper Technical Brochure.indd   6
6/11/13   3:16 PM
<table>
<thead>
<tr>
<th>COMMON NAME</th>
<th>AWS SPEC. AWS CLASS</th>
<th>APPROX. MELTING TEMPERATURE °F (°C)</th>
<th>AVERAGE AS-WELDED BRINELL HARDNESS</th>
<th>TENSILE STRENGTH MIN PSI (MPA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Naval Bronze</td>
<td>A5.8 RBCuZn-A</td>
<td>1650 (899)</td>
<td>70-90</td>
<td>50,000 (345)</td>
</tr>
<tr>
<td>Nickel Bronze (Manganese Bronze)</td>
<td>A5.8 RBCuZn-B</td>
<td>1620 (882)</td>
<td>80-110</td>
<td>56,000 (386)</td>
</tr>
<tr>
<td>Low Fuming Bronze (LFB or LFBFC)</td>
<td>A5.8 RBCuZn-C</td>
<td>1630 (888)</td>
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<tr>
<td>Nickel Silver</td>
<td>A5.8 RBCuZn-D</td>
<td>1715 (935)</td>
<td>90-110</td>
<td>60,000 (414)</td>
</tr>
<tr>
<td>Silicon Bronze</td>
<td>A5.7 ERCuSi-A</td>
<td>1866 (1019)</td>
<td>80-100</td>
<td>50,000 (345)</td>
</tr>
<tr>
<td>Deox Copper</td>
<td>A5.7 ERCu</td>
<td>1967 (1075)</td>
<td>Rockwell F25</td>
<td>25000 (172)</td>
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<tr>
<td>Phos-Bronze A</td>
<td>A5.7 ERCuSn-A</td>
<td>1922 (1050)</td>
<td>70-85</td>
<td>35,000 (240)</td>
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<tr>
<td>Phos-Bronze C</td>
<td>A5.7 ERCuSn-C</td>
<td>1880 (1026)</td>
<td>68-83</td>
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<tr>
<td>Aluminum Bronze A-1</td>
<td>A5.7 ERCuAl-A1</td>
<td>1898 (1036)</td>
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<td>55,000 (380)</td>
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<tr>
<td>Aluminum Bronze A-2</td>
<td>A5.7 ERCuAl-A2</td>
<td>1904 (1040)</td>
<td>130-150</td>
<td>60,000 (414)</td>
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<tr>
<td>Aluminum Bronze A-3</td>
<td>A5.7 ERCuAl-A3</td>
<td>1925 (1051)</td>
<td>140-180</td>
<td>65,000 (450)</td>
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<tr>
<td>Nickel Aluminum Bronze</td>
<td>A5.7 ERCuNiAI</td>
<td>1930 (1054)</td>
<td>160-200</td>
<td>72,000 (480)</td>
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<tr>
<td>Manganese-Nickel Aluminum Bronze</td>
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<td>1805 (985)</td>
<td>160-200</td>
<td>75,000 (515)</td>
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<tr>
<td>Alloy 67 Copper-Nickel</td>
<td>A5.7 ERCuNi</td>
<td>2260 (1238)</td>
<td>60-80</td>
<td>50,000 (345)</td>
</tr>
</tbody>
</table>

Washington Alloy Co. believes that the information and data contained in this catalog is correct. However, all technical information, data and applications are provided to assist the user in making their own evaluations and decisions and should not be mistaken as expressed or implied warranties. Chemical and mechanical properties are typical or average values that have been obtained by testing and comparing multiple heat or lot numbers of the same material designation. Minimum and Maximum values are noted accordingly and are not intended for specification purposes. Washington Alloy assumes no liability for results or damages incurred from the use or misuse of any information contained herein, in whole or in part, including without limitation, any use in a process not controlled by the seller.
### Suggested Filler Metal Selections for Copper-Based Alloys

<table>
<thead>
<tr>
<th>Copper</th>
<th>Phosphor Bronze</th>
<th>Silicon Bronze</th>
<th>Yellow (Naval) Brass</th>
<th>Manganese Bronze</th>
<th>Navy G</th>
<th>Red Brass</th>
<th>Copper Nickel</th>
<th>Nickel Al Bronze</th>
<th>Low Alloy Steel</th>
<th>Low Carbon Steel</th>
<th>Medium Carbon Steel</th>
<th>High Carbon Steel</th>
<th>Cast Iron</th>
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<tbody>
<tr>
<td>Copper</td>
<td>Deox (1000º)</td>
<td>PHB, Deox (1000º)</td>
<td>SB, PHB, Deox (1000º)</td>
<td>PHB, Deox (1000º)</td>
<td>PHB, Deox (1000º)</td>
<td>AIB-A2, A2 CuNiAl (1000º)</td>
<td>AIB-A2, A2 CuNiAl (1000º)</td>
<td>AIB-A2, A2 (1000º)</td>
<td>AIB-A2, A2 (1000º)</td>
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<tr>
<td>Phosphor Bronze</td>
<td>PHB, Deox (400º)</td>
<td>PHB, SB (150º)</td>
<td>AIB-A2, PHB (600º)</td>
<td>AIB-A2, PHB (600º)</td>
<td>AIB-A2, PHB (600º)</td>
<td>AIB-A2, PHB (600º)</td>
<td>AIB-A2, PHB (600º)</td>
<td>AIB-A2, PHB (600º)</td>
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<tr>
<td>Silicon Bronze</td>
<td>SB (150º)</td>
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<td>AIB-A2, SB (150º)</td>
<td>AIB-A2, SB (150º)</td>
<td>AIB-A2, SB (150º)</td>
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<tr>
<td>Yellow (Naval) Brass</td>
<td>AIB-A2 (600º)</td>
<td>AIB-A2, PHB (600º)</td>
<td>AIB-A2, PHB (600º)</td>
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<td>AIB-A2, PHB (600º)</td>
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<tr>
<td>Manganese Bronze</td>
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<td>AIB-A2, PHB (600º)</td>
<td>AIB-A2, PHB (600º)</td>
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<tr>
<td>Navy G</td>
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<td>AIB-A2, PHB (600º)</td>
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<tr>
<td>Red Brass</td>
<td>AIB-A2, PHB (400º)</td>
<td>AIB-A2, PHB (600º)</td>
<td>AIB-A2, PHB (600º)</td>
<td>AIB-A2, PHB (600º)</td>
<td>AIB-A2, PHB (600º)</td>
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<td>AIB-A2, PHB (600º)</td>
<td>AIB-A2, PHB (600º)</td>
<td>AIB-A2, PHB (600º)</td>
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</tr>
<tr>
<td>Copper Nickel</td>
<td>Copper Nickel (300º)</td>
<td>CuNiAl (300º)</td>
<td>AIB-A2 (400º)</td>
<td>AIB-A2 (400º)</td>
<td>AIB-A2 (400º)</td>
<td>AIB-A2 (400º)</td>
<td>AIB-A2 (400º)</td>
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<tr>
<td>Nickel Aluminum Bronze</td>
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<td>Copper Nickel (600º)</td>
<td>Copper Nickel (600º)</td>
<td>Copper Nickel (600º)</td>
<td>Copper Nickel (600º)</td>
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<td>Copper Nickel (600º)</td>
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</tbody>
</table>

Temperature in parentheses is the recommended preheat and interpass (Fahrenheit) temperature.

Recommended Tungsten Electrodes for GTAW are 2% Thoriated, 2% Ceriated, 2% Lanthanum or E3 (EWG).

**Notes:**
- PHB = Phosphor Bronze
- AIB-A2 = Aluminum Bronze A-2
- Deox = Deoxidized Copper
- CuNiAl = Copper Nickel Aluminum Bronze
- SB = Silicon Bronze
- Alloy 67 = Copper Nickel 67

Washington Alloy has implemented a certified Quality Management System scope in accordance with ISO 9001

### Recommended Welding Amperage

<table>
<thead>
<tr>
<th>Electrode Diameter</th>
<th>Amperes*</th>
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<tbody>
<tr>
<td>SMAW 3/32&quot;</td>
<td>50-110</td>
</tr>
<tr>
<td>GMAW 1/8&quot;</td>
<td>90-160</td>
</tr>
<tr>
<td>GTAW 1/16&quot;</td>
<td>70-120</td>
</tr>
<tr>
<td>DCAR 5/32&quot;</td>
<td>130-180</td>
</tr>
<tr>
<td>DCRP 3/16&quot;</td>
<td>150-225</td>
</tr>
<tr>
<td>DCRF 3/16&quot;</td>
<td>170-230</td>
</tr>
<tr>
<td>SAW 3/32&quot;</td>
<td>20-26</td>
</tr>
<tr>
<td>DCRP 0.035&quot;</td>
<td>20-26</td>
</tr>
<tr>
<td>(Electrode+) 1/16&quot;</td>
<td>29-32</td>
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<tr>
<td>(Electrode-) 1/16&quot;</td>
<td>26-32</td>
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<tr>
<td>Wire Diameter</td>
<td>Amperes*</td>
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<tr>
<td>DCEN</td>
<td>(DCEN)</td>
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<tr>
<td>SMAW</td>
<td>50-110</td>
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<tr>
<td>GMAW</td>
<td>90-160</td>
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<tr>
<td>GTAW</td>
<td>70-120</td>
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<tr>
<td>DCRF 3/32&quot;</td>
<td>130-180</td>
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<tr>
<td>SAW 3/32&quot;</td>
<td>20-26</td>
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<tr>
<td>DCRF 0.035&quot;</td>
<td>20-26</td>
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<tr>
<td>(Electrode+) 1/16&quot;</td>
<td>29-32</td>
</tr>
<tr>
<td>(Electrode-) 1/16&quot;</td>
<td>26-32</td>
</tr>
</tbody>
</table>

*Use low range for iron- or nickel-based alloys; middle range for bronze alloys; high range for copper