### Properties of Metals Used by Mill-Max

**Copper alloy rod and wire for precision-machined pins, receptacles & solder terminals** (RoHS-2 directive 2011/65/EU, exemption 6c) allows up to 4% lead as an alloy agent in copper. All Mill-Max pin materials are:

- **BRASS ALLOYS**: 360 per ASTM B 16, and 385 per ASTM B455
- **PHOSPHOR BRONZE** Alloy 544 (UNS C54400) per ASTM B 139
- **TELLURIUM COPPER** Alloy 145 (UNS C14500) per ASTM B 301
- Spring alloy strip for stamping “multi-finger” spring contacts
- **BERYLLIUM COPPER** Alloy 172 (UNS C17200) per ASTM B 194
- **BERYLLIUM NICKEL** Alloy 360 (UNS N03360)

#### Properties of Brass Alloy 360 ASTM B 16:
- Chemical composition: Cu 63% (max), Pb 3.7% (max), Fe .35% (max), Zn remainder
- Temper as machined: H02/H04
- Yield Strength: 25-45 ksi
- Tensile strength: 57-80 ksi
- Hardness as machined: 80-90 Rockwell B
- After machining, brass parts are often annealed (softened) for subsequent bending, swaging or crimping. A partial anneal down to 60±10 RB is recommended for 90° bends, a full anneal down to 35±15 RB is recommended for pins or terminals that are swaged (riveted) to a circuit board or crimped to a wire.
- Electrical conductivity: 26% IACS *
- Melting point: 1000°C/840°C (liquidus/solidus)

#### Properties of Brass Alloy 385 ASTM B 455:
- Chemical composition: Cu 60% (max), Pb 3.5% (max), Fe .35% (max), Zn remainder
- Temper as machined: H02/H04
- Yield Strength: 16 ksi (min)
- Tensile strength: 48 ksi (min)
- Hardness as machined: 80-90 Rockwell B
- After machining, brass parts are often annealed (softened) for subsequent bending, swaging or crimping. A partial anneal down to 60±10 RB is recommended for 90° bends, a full anneal down to 35±15 RB is recommended for pins or terminals that are swaged (riveted) to a circuit board or crimped to a wire.
- Electrical conductivity: 28% IACS *
- Melting point: 1000°C/840°C (liquidus/solidus)

#### Properties of Phosphor Bronze:
- Used for pins requiring more durability than brass.
- Stock diameters available: .072/.078*
- Chemical composition: Cu 88%, Sn 4%, Zn 4%, Pb 4%
- Temper as machined: H04
- Modulus of elasticity: 15 MPSI
- Tensile strength: 70-80 KSI
- Hardness as machined: 83 Rockwell B
- Density: .321 lbs/in3
- Electrical conductivity: 19% IACS *
- Melting point: 1000°C/930°C (liquidus/solidus)

#### Properties of Tellurium Copper:
- Used for pins requiring a higher current carrying capacity than brass or phosphor bronze.
- Stock diameters available: .079/.093/.125/.156*
- Chemical composition: Cu 99.44%, Te .55%, P .008%
- Temper as machined: H02
- Modulus of elasticity: 17 MPSI
- Tensile strength: 43 KSI
- Hardness as machined: 43 Rockwell B
- Density: .323 lbs/in3
- Electrical conductivity: 93% IACS *
- Thermal conductivity: 91% IACS *
- Melting point: 1075ºC/1051ºC (liquidus/solidus)

#### Properties of Beryllium Copper:
- Chemical composition: Cu 98.1%, Be 1.9%
- Temper as stamped: TD01
- Properties after heat treatment (TH01):
  - Modulus of Elasticity: 19 MPSI
  - Tensile Strength: 175-205 KSI
  - Yield Strength (0.2% offset): 150-185 KSI
  - Elongation: 3-10%
  - Stress Relaxation*: 96% of stress remains after 1,000 hours at 100 ºC, 70% of stress remains after 1,000 hours at 200 ºC
  - Hardness: 36-43 Rockwell C
  - Density: .298 lbs/in3
  - Electrical Conductivity: 22% IACS *
  - Melting point: 980°C/865°C (liquidus/solidus)
- Since BeCu loses its spring properties over time at high temperatures, it is rated for continuous use up to 150ºC. For “down-hole” and “burn-in” applications up to 300ºC, Mill-Max offers nine contacts (#19, #24, #25, #26, #27, #33, #38, #56, #58) made from Beryllium Nickel Alloy 360 (UNS N03360)

#### Properties of Beryllium Nickel:
- Chemical composition: Ni 97.6%, Be 1.9%, Ti 0.5%
- Modulus of Elasticity: 27-30 MPSI
- Tensile Strength: 245 KSI min.
- Yield Strength (0.2% offset): 200 KSI min.
- Elongation: 9% min.
- Hardness: 49 Rockwell C
- Density: .294 lbs/in3
- Electrical Conductivity: 7% IACS *
- Melting point: 1,325°C/1,195°C (liquidus/solidus)

* International Annealed Copper Standard, i.e.: as a % of pure copper.
**Properies of Plastics Used by Mill-Max**

Standard plastics used for catalog products:

**Injection Molded**
- **PCT** Polyester (30% glass filled), High Temp., (black). Flammability rating UL 94 V-O
- **Nylon46** High Temp. (30% glass filled) or (45% glass filled), (black). Flammability rating UL 94 V-O
- **PPS**, High Temp. (40% glass filled), (black). Flammability rating UL 94 V-O

**Machined**
- **G-30** Polyimide/Glass Laminate. .062" thick (natural color, brown). Flammability rating UL 94 HB

### Temperature Comparison of Molded Insulators

<table>
<thead>
<tr>
<th>Material</th>
<th>Heat Deflection Temp. (per ASTM D 648)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCT</td>
<td>529°F (276°C) @ 66 psi</td>
</tr>
<tr>
<td>Nylon 46</td>
<td>554°F (290°C) @ 264 psi</td>
</tr>
<tr>
<td>PPS</td>
<td>&gt;500°F (&gt;260°C) @ 264 psi</td>
</tr>
</tbody>
</table>

Note: Materials with HDT above 446°F (230°C) are considered suitable for “eutectic” reflow soldering. For “lead-free” reflow soldering, choose materials with an HDT above 500°F (260°C).

**PCT is the standard plastic used with RoHS “lead-free” plated pins.**

**Mill-Max Standard Platings (Finishes):**

**Gold** per ASTM B 488, Type 1 (99.7% min. gold),
- Code C (130-200 HK (Knoop hardness)),
- Class (thickness) per customer’s requirements

**Silver** per ASTM B 700, Type 1 (99.9% min. silver),
- Grade B (Bright),
- Class S (anti-tarnish treatment),
- Thickness (7.5μm/300μ") used for solder terminals

**Tin/Lead (93/7)** per ASTM B 545 (Appendix X6.3.2.5 to eliminate whisker growth)
- Class A (2.5μm/100μ")
- or Class B (5μm/200μ")

**Electro-Solder** (60/40) per ASTM B 579, SC2 (8μm/300μ")
- Bright finish (Matte available to order)

**Standard finishes available for RoHS “lead-free” applications:**

**Gold** per ASTM B 488, Type 1 (99.7% min. gold),
- Code C (130-200 HK (Knoop hardness)),
- Class (thickness) per customer’s requirements

**Tin** (100%) per ASTM B 545, Class A (2.5μm/100μ") or
- Class B (5μm/200μ")

Matte finish (With whisker and oxide inhibitors & a nickel underplate)