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**
- ALLOY 360 per ASTM B 16
- PHOSPHOR BRONZE Alloy 544 (UNS C54400) per ASTM B 139
- TELLSURIUM COPPER Alloy 145 (UNS C14500) per ASTM B 301
- BERYLLIUM COPPER Alloy 172 (UNS C17200) per ASTM B 194
- BERYLLIUM NICKEL Alloy 360 (UNS N03360)

Properties of Brass:
- Chemical composition: Cu 61.5%, Zn 35.4%, Pb 3.1%
- Modulus of elasticity: 14 MPSI
- Tensile strength: 70-90 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.
- Density: .307 lbs/in³
- Electrical conductivity: 26% IACS *
- Melting point: 900°C/885°C (liquidus/solidus)

Properties of Phosphor Bronze:
- Used for pins requiring more durability than brass.
- Stock diameters available: .072/.078/.093/.125/.156"
- 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
- 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.
- Density: .321 lbs/in³
- Electrical conductivity: 93% IACS *
- Melting point: 1,000°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
- 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.
- Density: .323 lbs/in³
- Electrical conductivity: 93% IACS *
- Melting point: 1,075°C/1,051°C (liquidus/solidus)

Properties of Beryllium Copper:
- Chemical composition: Cu 99.44%, Te .55%, P .008%
- Temper as machined: H02/H04
- Modulus of elasticity: 34.5 MPSI
- Tensile strength: 125 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.
- Density: .323 lbs/in³
- Electrical conductivity: 19% IACS *
- Melting point: 1,075°C/1,051°C (liquidus/solidus)

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.

**PROPERTIES OF PLASTICS USED BY MILL-MAX**

Standard plastics used for catalog products:
- Injection Molded
  - PCT Polyester, High Temp (Thermx CG933, black)
  - Nylon 46, High Temp (Stanyl TE250F6 (30% glass) or TE250F9 (45% glass), black)
  - PPS, High Temp (Ryton R-4-200)
- Machined
  - G-30 Polyimide/Glass Laminate, .062" thick (natural color, brown)

**TEMPERATURE COMPARISON OF MOLED INSULATORS**

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>BRAND</th>
<th>GRADE</th>
<th>HEAT DEFLECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCT Polyester</td>
<td>Thermx</td>
<td>CG-933</td>
<td>529°F (276°C) @ 66 psi</td>
</tr>
<tr>
<td>Nylon 46</td>
<td>Stanyl</td>
<td>TE250-F6 or F9</td>
<td>554°F (290°C) @ 264 psi</td>
</tr>
<tr>
<td>PPS</td>
<td>Ryton</td>
<td>R-4-200</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).

**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 (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)**

**ALL MILL-MAX PARTS REQUIRE AN UNDERPLATE:**

- Brass parts need a barrier plate to prevent zinc diffusion, 50µ" min. nickel or 100µ" min. copper is recommended by ASTM B 545 and 579. ASTM B 488 also recommends a 50µ" min. nickel barrier plate beneath gold to prevent copper diffusion inherent with all copper alloy products.
- **NICKEL** per ASTM B 689, Type 2 (Bright), Class 1.25 (1.25µm/50µ") or Class 2.5 (2.5µm/100µ")
- **COPPER** per ASTM B 734, Class 2.5 (2.5µm/100µ") or Class 5 (5µm/200µ")