PMX INDUSTRIES, INC.®

*New Dimensions in **Precision Metals**™*

Alloys available in sheet, strip, plate, welded tube and foil forms.

# High Precision Copper Alloys

## For Reliable Cost-Effective Connectors


**PMX Industries**

*New Dimensions in **Precision Metals**™*

5300 Willow Creek Drive SW
Cedar Rapids, IA 52404

Telephone 319-368-7700
Toll Free 800-531-5268
Fax 319-368-7721

Web www.ipmx.com




ISO 9001 ISO/IEC17025:2005

PMX INDUSTRIES, INC.
*New Dimensions in **Precision Metals**™*

# High Precision Copper Alloy Guide

Alloys available in sheet, strip, plate, welded tube and foil forms.

| UNS/CDA Number | - | C11000 | C15100 | C18665 | C19010 | C19002 | 19015 | C19210 | C19400 | C19700 | C22000 | C26000 | C26800 | C27200 | C42200 | C42500 | C64725 | C64750 | C65500 | C70250 | C70260 | C70310 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASTM Spec Number | - | B152 | B747 | - | B422 | B422 | B422 | B465 | B465 | B465 | B36 | B36 | B36 | B36 | B591 | B591 | B422 | B422 | B96-01 | B422 | B422 | - |
| PMX Alloy Number | **XP 5** | **110** | **151** | **MSP 1** | **XP 150** | **19010 M** | **19015M** | **XP 10** | **194** | **197** | **220** | **260** | **268** | **272** | **422** | **425** | **MAX 251C** | **PMC 26** | **655** | **7025** | **7026** | **70310** |
| **Chemistry (nominal)*** | | | | | | | | | | | | | | | | | | | | | | |
| Copper (Cu) (including Ag) | Bal | Bal | Bal | Bal | Bal | Bal | Bal | Bal | Bal | Bal | 90 | 70 | 66 | 63 | 87.5 | 88.5 | 96 | Bal | Bal | Bal | 97.6 | Bal |
| Oxygen (O) | .005 max | .05 max | | | | | | | | | | | | | | | | | | | | |
| Zinc (Zn) | | | | | | | | | 0.12 | | 10 | 30 | 34 | 36 | 11.5 | 9.5 | 1 max | 0.9 max | | | | 2 max |
| Tin (Sn) | | | | | | 0.1 | | | | | | | | | 1 | 2 | .5 max | 0.65 | | | | 1 max |
| Nickel (Ni) | | | | | 1.3 | 1.5 | 1 | | | | | | | | | | 2 | 2 | | 3.2 | 2 | 2.5 |
| Iron (Fe) | | | | | | | | 0.1 | 2.35 | 0.8 | | | | | | | | | | | | 0.1 max |
| Phosphorus (P) | | | | 0.005 | 0.032 | 0.01 | 0.02 | 0.032 | 0.032 | 0.25 | | | | | | | | . | | | | 0.05 max |
| Silicon (Si) | | | | | 0.25 | 0.25 | 0.15 | | | | | | | | | | 0.5 | 0.45 | 3 | 0.65 | 0.4 | 0.6 |
| Zirconium (Zr) | | | 0.1 | | | 0.005 | | | | | | | | | | | | .1 max | | | | 0.005 |
| Magnesium (Mg) | | | | 0.7 | | | 0.02 | | | 0.05 | | | | | | | | .1 max | | 0.15 | | 0.01 max |
| Aluminum (Al) | | | | | | | | | | | | | | | | | | | | | | |
| Manganese (Mn) | | | | | | | | | | | | | | | | | | | 0.9 | | | |

* Nominal chemistry shown for reference, not as specification

| **Physical Properties** | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Density lb/cu. in. @ 68˚ F | 0.323 | 0.323 | 0.323 | 0.323 | 0.322 | 0.322 | 0.322 | 0.323 | 0.322 | 0.319 | 0.318 | 0.308 | 0.306 | 0.305 | 0.318 | 0.317 | 0.317 | 0.322 | 0.308 | 0.318 | 0.319 | 0.320 |
| Modulus of Elasticity x 1000 Ksi ($10^6$ psi) | 17 | 17 | 17 | 17 | 19 | 19 | 18 | 17 | 17 | 17 | 17 | 16 | 15 | 16 | 16 | 16 | 19 | 19 | 15 | 19 | 19 | 19 |
| Electrical Conductivity % I.A.C.S. @ 68˚ F(Annealed) | 99 | 101 | 95 | 63 | 52 | 57 | 80 | 90 | 60 | 80 | 44 | 28 | 27 | 26 | 31 | 28 | 37 | 40 | 7 | 40 | 40 | 38 |
| Thermal Conductivity Btu/sq.ft./ft./hr./˚F @ 68˚ F | 221 | 226 | 208 | 264 | 149 | 150 | 201 | 201 | 150 | 185 | 109 | 70 | 67 | 69 | 75 | 69 | 92 | 95 | 21 | 95 | 9 | 91 |
| Coef. of Thermal Expansion x $10^6$ in./in./˚F (68˚ to 572˚ F) | 9.8 | 9.8 | 9.8 | 9.6 | 9.3 | 9.3 | 9.3 | 9.8 | 9.7 | 9.6 | 10.2 | 11.1 | 11.3 | 11.4 | 10.2 | 10.2 | 9.5 | 9.5 | - | 9.4 | 10 | 9.4 |
| **Tensile Strength** x Ksi (Kgf/mm²=Ksi x .7031) | | | | | | | | | | | | | | | | | | | | | | |
| Annealed (S0XX) (TM00) | 26-33 | 26-33 | 37-42 | 57 | - | - | - | 39-54 | 40-63 | - | 36-43 | 45-61 | 46-61 | 44-54 | 41-49 | 40-50 | - | - | - | 90-110 | 85-95 | 75-90 |
| 1/4 Hard (H01) (TM00S) | 34-42 | 34-42 | 40-45 | 52-65 | - | - | - | 40-55 | - | - | 40-50 | 49-59 | 49-59 | - | 47-57 | 49-59 | - | - | 68 | - | 90-105 | - |
| 1/2 Hard (H02) (TM02) | 37-46 | 37-46 | 43-51 | 61-74 | - | - | 53-63 | 47-60 | 53-63 | 53-63 | 47-57 | 57-67 | 55-65 | 51-64 | 54-65 | 57-69 | 70-93 | - | 78 | 95-120 | 95-105 | 88-103 |
| 3/4 Hard (H03) (TM03) | 41-50 | 41-50 | 47-56 | - | 67-77 | - | - | 52-62 | - | - | 52-62 | 64-74 | 62-72 | 59-71 | 60-72 | 62-74 | - | 77-90 | - | 100-125 | - | - |
| Hard (H04) (TM04) | 43-52 | 43-52 | 53-62 | 69-82 | 71-81 | 72-87 | 60-70 | 56-66 | 60-70 | 60-70 | 57-66 | 71-81 | 68-78 | 70-81 | 67-79 | 70-82 | 87-101 | 87-97 | 89 | - | - | 93-108 |
| Extra Hard (H06) (TM06) | 47-56 | 47-56 | 59-65 | 78-91 | 75-86 | 84-94 | 65-75 | 60-70 | 67-73 | 67-73 | 64-72 | 83-92 | 79-89 | 80-93 | 75-85 | 76-88 | 92-107 | 87 min | 105 | - | - | 98-113 |
| Spring (H08) (TM08) | 50-58 | 50-58 | 64-71 | 85 min | 84 min | 90-101 | 67 min | 64 min | 70-75 | 70-76 | 69-77 | 91-100 | 86-95 | >91 | 82-92 | 84-94 | 101-113 | - | 110 | - | - | 106-125 |
| Extra Spring (H10) | 52 min | 52 min | - | - | - | - | - | 66 min | 73-80 | - | 72-80 | 95-104 | 90-99 | - | 88 min | 92 min | 110 min | - | - | - | - | - |
| **Yield Strength** x Ksi (0.2% offset)(kgf/mm²=Ksi x .7031) Nominal | | | | | | | | | | | | | | | | | | | | | | |
| Annealed (S0XX) (TM00) | 11 | 11 | 8 | - | - | - | - | 30 | 38 | - | 12 | 21 | 23 | <26 | 19 | 17 | - | - | - | 65 min | 65 min | 67 min |
| 1/4 Hard (H01) (TM00S) | 31 | 31 | 35 | 51 | - | - | - | 28 | - | - | 33 | 33 | 34 | - | 38 | 37 | - | - | 62 | - | 75 min | - |
| 1/2 Hard (H02) (TM02) | 37 | 37 | 38 | 62 | - | - | 55 | 52 | 45 | 56 | 47 | 46 | 44 | >24 | 55 | 58 | 69-91 | - | 72 | 85 min | 90-100 | 85 min |
| 3/4 Hard (H03) (TM03) | 43 | 43 | 50 | - | 50 min | - | - | 56 | - | - | 53 | 62 | 53 | >43 | 64 | 64 | - | 68 min | - | 95 min | - | - |
| Hard (H04) (TM04) | 45 | 45 | 56 | 72 | 60 min | 65 min | 62 | 60 | 60 | 61 | 57 | 72 | 57 | >62 | 71 | 72 | 78-100 | 78 min | 82 | - | - | 90 min |
| Extra Hard (H06) (TM06) | 50 | 50 | 60 | 80 | 64 min | 75 min | 66 | 64 | 67 | 68 | 63 | 83 | 67 | >72 | 75 | 79 | 84-106 | 83 min | 99 | - | - | 95 min |
| Spring (H08) (TM08) | 52 | 52 | 66 | 78 min | 74 min | 82 min | - | 62 min | 70 | - | 68 | 86 | 71 | >87 | 82 | 90 | 95-113 | - | 103 | - | - | 105 min |
| Extra Spring (H10) | 54 min | 54 min | - | - | - | - | - | 64 min | 73 min | - | 70 | 90 | 73 | - | 82 min | 87 min | 107 min | - | - | - | - | - |
| **Elongation** (% in 2 inches) Nominal or Indicated | | | | | | | | | | | | | | | | | | | | | | |
| Annealed (S0XX) (TM00) | 35 | 35 | 38 | 25 | - | - | - | 32 | 23 | 20 | 44 | 55 | 53 | >38 | 45 | 48 | - | - | - | 12 | 10 min | 10 min |
| 1/4 Hard (H01) (TM00S) | 23 | 23 | 22 | 15 | - | - | - | 20 | - | - | 27 | 46 | 42 | - | 29 | 38 | - | - | - | - | 6 min | - |
| 1/2 Hard (H02) (TM02) | 20 | 20 | 15 | 10 | - | - | - | 5 | 17 | 17 | 13 | 30 | 31 | >19 | 16 | 20 | 8 | - | - | 9 | 5 min | 8 min |
| 3/4 Hard (H03) (TM03) | 14 | 14 | 8 | - | 12 min | - | - | 4 | - | - | 8 | 16 | 20 | >8 | 7 | 15 | - | 12 min | - | 4 | - | - |
| Hard (H04) (TM04) | 9 | 9 | 4 | 7 | 10 min | 10 min | - | 3 | 7 | 7 | 4 | 10 | 12 | >3 | 4 | 9 | 5 | 8 min | - | - | - | 6 min |
| Extra Hard (H06) (TM06) | 4 | 4 | 2 | 5 | 8 min | 8 min | - | 2 | 4 | 6 | 2 | 4 | 4 | - | 2 | 6 | 3 | 6 min | - | - | - | 5 min |
| Spring (H08) (TM08) | 3 | 3 | 1 min | - | 6 min | 9 min | - | 1 | 2 | 5 | 1 | 1 | 3 | - | 2 | 4 | 2 | - | - | - | - | - |
| Extra Spring (H10) | 3 max | 3 max | - | - | - | 6 min | - | 1 max | 2 max | 1 min | 2 max | 3 max | 2 max | - | 2 max | 2 max | 1 max | - | - | - | - | - |

Dash = Not Applicable

*Other alloys are available. Please provide PMX with your requirements.*
*The above data is for comparative purposes only and is not intended for use as definitive specifications.*

## Copper Alloy Temperature Range

Up to 75˚ C | 105 - 125˚ C | 125 - 150˚ C | 150˚ C Plus


PMX Industries
*New Dimensions in **Precision Metals**™*

5300 Willow Creek Drive SW
Cedar Rapids, IA 52404

Telephone 319-368-7700
Toll Free 800-531-5268
Fax 319-368-7721

Web www.ipmx.com




ISO 9001 ISO/IEC17025:2005

PMX INDUSTRIES, INC.

*New Dimensions in **Precision Metals**™*

# PMX High Precision Copper Alloys and Coatings

Alloys available in sheet, strip, plate, welded tube and foil forms.

## Innovative Cost-Effective Connector Materials

With an emphasis on research and development, we are unmatched in our ability to create customized connector materials for difficult applications. As the demand for increased reliability, increased operating temperatures, and the need to push more power and more signals through less space continues to spiral upwards, the pressure to reduce connector cost and design cycle time are also increasing.

Copper materials and protective coatings from PMX are helping many connector designers meet the rigorous requirements of next generation interconnected devices. Many of our connector customers count on our high conductivity alloys to pass more current through a system with less heat build-up. Where high strength and high conductivity combined with good formability and relability of the contact are critical, we have the ability to develop cost-effective materials that can compete with many of the more expensive beryllium copper alloys. Many of our higher strength alloys offer material substitution opportunities which can reduce overall cost by allowing the connector designer to use thinner materials.

With our wide range of high precision alloys and coatings, we can provide an innovative cost-effective solution that is tailored to your specific requirements.

## Extensive Connector Qualifications

PMX connector alloys are used for interconnection components in automobiles, computers, servers, telecom equipment, networking hardware, high-voltage transmission line hardware, portable digital devices, and safety systems. The connectors, terminals, switches, and contacts that are used in some of these applications have new levels of functionality as a result of our customers forming a strong partnership with PMX technical staff.

Connector designers and manufacturers consistently challenge us to cost-effectively meet their new connector specifications. From connectors to printed circuit boards, to sockets and wiring harnesses, our talented staff is experienced in developing copper alloys to meet high performance interconnection requirements. We know that selection of the best connector material depends on our complete understanding of the application, the operating environment, the expected level of reliability, and the cost constraints.

## Meeting Challenging Connector Requirements

Our approach focuses on careful planning and design backed by engineering expertise in alloy formulation, fabrication, forming and drawing. This is supported by our ISO 9001:2000 quality system and our IEC17025 laboratory certification. PMX understands copper alloy metallurgy and knows that sometimes even minimum processing changes can result in maximum benefits.

We do not use hazardous metals in any of our processes or packaging. PMX copper alloys meet all requirements of the international RoHS lead-free standard. We do not add lead, cadmium, arsenic, or hexavalent chromium to our alloys. We do not compromise on quality.

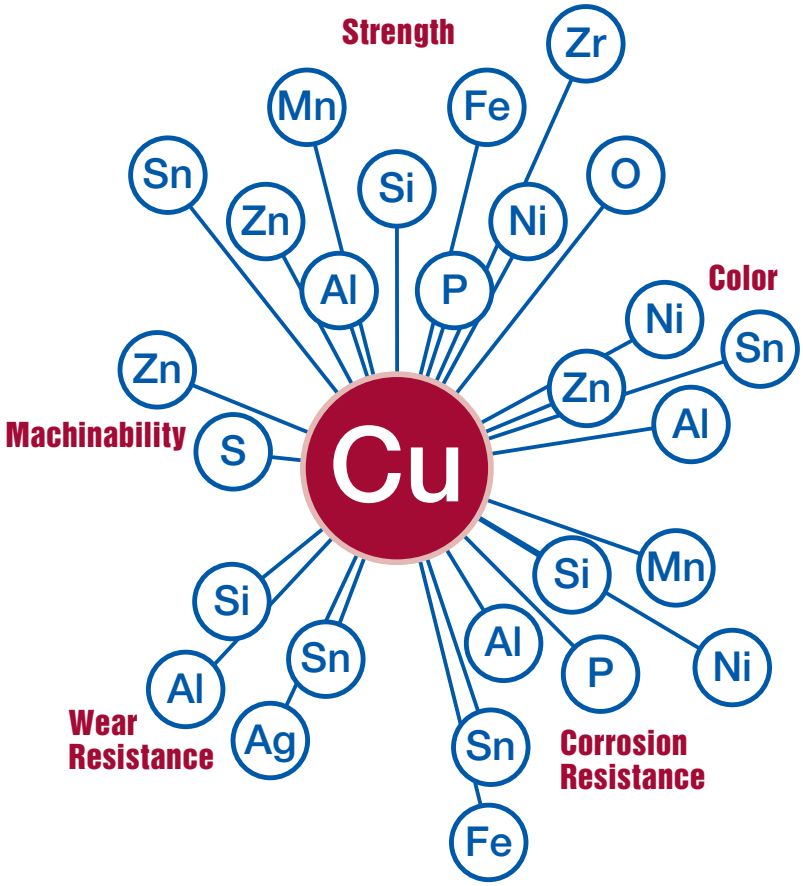
## System Approach to Designing Alloys and Coatings

PMX uses a system approach to creating connector materials and protective coatings. To meet the increased performance requirements of interconnection devices, PMX has developed a comprehensive range of high precision alloys and coatings that are designed to work together to prevent corrosion and deliver a robust, dependable contact. For example, our connector materials and coatings have been used on automotive interconnects to achieve reliable performance during coninuous operation at temperatures of 140˚C.

Our lead-free coatings are developed for specific applications and can be applied as a hot dip, by electrolytic plating or reflow. The hot dip plating chemistry can be based on 100% tin, tin-copper, or a tin-silver alloy. Through secondary steps, we can produce electroplated formulas involving copper, tin, nickel, or gold.

To overcome some of the limitations of ordinary tin coatings, PMX has developed advanced tin coatings which when combined with our copper alloys produce a combination of low insertion force, no whiskering, and high temperature reliability. These protective coatings are cost-effective, corrosion resistant, and provide good solderability.

## Copper Alloy Development




## Put PMX Connector Alloys and Coatings To Work

Let PMX show you how to improve your connectors. Call 800-531-5268 or visit www.ipmx.com to find out how to put our copper alloys and coatings to work on your next project.


**PMX Industries**

*New Dimensions in **Precision Metals**™*

5300 Willow Creek Drive SW
Cedar Rapids, IA 52404

Telephone 319-368-7700
Toll Free 800-531-5268
Fax 319-368-7721

Web www.ipmx.com




ISO 9001 ISO/IEC17025:2005