MATERION

PRODUCT BRIEF

IMPROVE CONNECTIONS WITH ALLOY 174

Engineered to carry high current with lower temperature rise, predictable normal forces and an improved formability to strength ratio, Alloy 174 is specifically designed for applications spanning the computer, electronics, automotive, appliance, electrical/electromechanical, medical and aerospace industries. Since its introduction in 1985, Alloy 174 has established itself as the preferred material in applications where the traditional copper alloys are no longer adequate.

ALLOY 174 COMPOSITION

Alloy 174 fills the performance and cost differential between the lower performance copper alloys, such as brass, and the higher performance beryllium copper alloys. Materions' engineering staff achieved this objective by alloying small quantities of beryllium and cobalt in a copper matrix. The patented chemical composition for Alloy 174 is shown in Figure 1.

ALLOY 174 PROPERTIES

The physical and mechanical properties of Alloy 174 are shown in Figures 2 and 3. Available as mill hardened strip, Alloy 174 conforms to ASTM specification B768 and is manufactured within the quality system requirements of Materion.

Figure 1: Composition

ALLOY	UNS NUMBER	TRADE NAME	Be (%)	Co (%)	Cu
Copper Beryllium	C17410	Alloy 174	0.15 - 0.60	0.35 - 0.60	Balance

Figure 2: Physical Properties

Melting Point (solidus)	1875 °F	1025 °C
Density*	0.318 lb/in^3	8.80 g/cm^3
Specific Gravity	8.80	8.80
Thermal Conductivity*	135 BTU/(ft ·hr·F)	0.56 cal/(cm·sec·C)
Electrical Resistivity*	23.0 ohms·circ mil/ft	3.82 microhm·cm
Electrical Conductivity*		
HT	45% IACS	0.26 megmho/cm
1/2 HT	50% IACS	0.29 megmho/cm
Modulus of Elasticity	20 x 10^6 psi	137,900 N/m^2

*Room temperature

Figure 3: Mechanical Properties

PROPERTY	ALLOY 174 HT		ALLOY 174 1/2 HT	
Ultimate Tensile Strength	110-130 ksi	760-895 N/mm²	95-115 ksi	655-790 N/mm²
Yield Strength (0.2% offset)	100-120 ksi	690-825 N/mm²	80-100 ksi	550-690 N/mm²
Elongation in 2" (50 mm)	7-17%	7-17%	10-20%	10-20%
Hardness	95-102 HRB	230-280 HV	89-98 HRB	180-230 HV
Electrical Conductivity at 68°F (20°C)	45-60%	26-35 m/Ωmm²	50% min IACS	29 m/Ωmm²
Fatigue Strength				
-10⁷ cycles, reversed bending	45-50 ksi	310-345 N/mm²	45-50 ksi	310-345 N/mm²
one way bending	80-85 ksi	550-585 N/mm²	80-85 ksi	550-585 N/mm²
Typical Formability (R/t) 90°				
Longitudinal	1.2		0.5	
Transverse	5.0		0.5	

ALLOY 174 PERFORMANCE

As shown in Figure 4, the performance advantages of Alloy 174 over commonly used copper alloys include a superior resistance to stress relaxation at elevated temperatures, electrical conductivity that is four times greater than the bronzes, enhanced formability for a given strength, and value pricing.

Figure 4: Comparison

PROPERTY	ALLOY 174		C510		C260	
	HT	1/2 HT	S	H	S	H
Ultimate Tensile Strength (ksi)	110-130	95-115	95-110	76-91	95	76
0.2% Yield Strength (ksi)	100-120	80-100	92-108	74-88	86	72
Elongation (%)	7 min.	10 min.	6 max.	11 max.	1 min.	10
Hardness (HRB)	95-102	89-98	88-96	84-93	91	82
Elastic Modulus (x 10⁶ psi)	20	20	16	16	16	16
Conductivity (% IACS)	45-60	50 min.	11	13	28	28
Typical formability (R/t) 90°						
Longitudinal	1.2	0.5	3.0	0.5	1.7	0.9
Transverse	5.0	0.5	8.0	3.0	3.5	1.7
Stress Relaxation Resistance ***Remaining Stress (%) (75% of 0.2% YS) 1000 hrs. at 150°C***	85	80	50	< 50	< 25	20

ALLOY 174

In electrical and electronic products ranging from computers and electrical/electromechanical devices, to automobiles and appliances, current-carrying applications requiring high strength, high conductivity, and superior resistance to stress relaxation are rapidly becoming the norm. These factors, combined with the increasing demand for enhanced product reliability, have triggered changes in contact material specification - changes that have focused attention on the engineered material performance of Alloy 174.

BENEFITS

- Miniaturization
- High temperature applications
- Twice the electrical conductivity of brass
- High repetitive cycle Life
- Easily formed into complex shapes
- Available with tin coatings or precious metal inlays

MINIATURIZATION

The need for more circuit connections in a smaller space can be satisfied using Alloy 174. The material's strength allows it to withstand higher stresses. These higher stresses occur because spring size is reduced, yet spring force is maintained to provide reliable gas-tight contact interfaces.

As the number of circuit pathways increase, connector insertion and withdrawal forces must be managed. Designs using Alloy 174 will have lower insertion and withdrawal forces.

HIGH TEMPERATURE

Applications At high temperatures, Alloy 174 maintains the highest spring force, as compared to other traditional copper alloys (Figures 5 & 6). Applications where in-service temperatures exceed 200° C are using Alloy 174.

Because of this long-term thermal stability, Alloy 174 eliminates the need to overdesign beginning-of-life contact normal forces to compensate for stress loss common in other copper alloys. This will minimize insertion and withdrawal forces.

TWICE THE ELECTRICAL CONDUCTIVITY OF BRASS

With a typical electrical conductivity of 52% IACS, Alloy 174 can carry higher levels of electrical current without generating damaging temperature rises. Substituting Alloy 174 for brass can result in less material usage and reduced heating offering longer and more reliable operating life.

HIGH REPETITIVE CYCLE LIFE

Alloy 174 has excellent fatigue strength making it the material of choice for use in high cycle applications such as switches or relays. In the severe reversed bending mode, Alloy 174 demonstrates cycle life over 100 million operations while stressed to 45 ksi (310 N/mm2).

EASILY FORMED INTO COMPLEX SHAPES

Given the material's high strength level, Alloy 174 has very good forming characteristics. By substituting Alloy 174 for lower strength/performance materials, existing designs have been upgraded without modification to the stamping tool.

AVAILABLE WITH TIN PLATING OR PRECIOUS METAL INLAYS

Alloy 174 is available with surface coatings such as tin plating, solder coating or precious metal inlay. The standard material finish has a stain inhibiting treatment on the surface. This provides a temporary protection against the growth of surface films such as oxides, even in industrial atmospheres (90% relative humidity, 90°F).

STRESS RELAXATION RESISTANCE

The trend toward denser packaging, miniaturization, higher currents, and increased operating temperatures has combined to make a contact material's stress relaxation resistance a critical concern. Materials with low resistance to stress relaxation will lose contact normal force over time. This can lead to increased contact resistance, greater self heating and ultimately failure. The stress relaxation performance of Alloy 174, as it compares with the traditional copper alloys, is shown in Figures 5 and 6.

CONDUCTIVITY

For higher power applications or thermal management of denser packaging, material selection based on electrical and thermal conductivity has assumed primary importance. Since electronic component failure rates increase exponentially with temperature increases, it is important to use materials which minimize temperature rise. The electrical conductivity of Alloy 174 is extremely high for a spring alloy. The alloy's corresponding thermal conductivity is three to five times greater than competitive copper alloys.

FORMABILITY

A comparison of Alloy 174's formability, in relation to other copper alloys, is shown in Figure 4. Alloy 174's 1/2HT temper has excellent forming characteristics in both directions (good-way and bad-way). This allows material substitutions with minimal impact on existing stamping tools.

Figure 5: 150° C Stress Relaxation Resistance Results

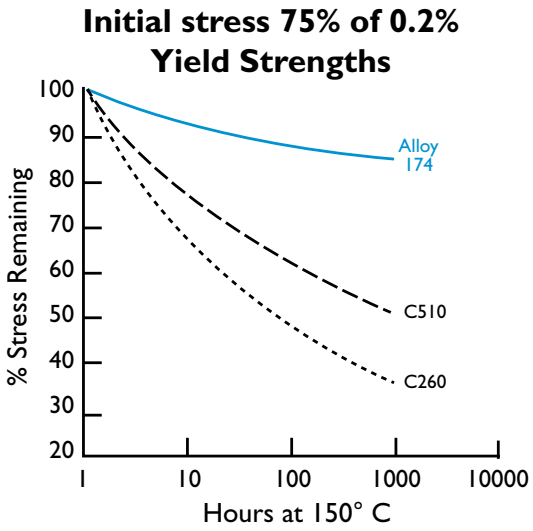
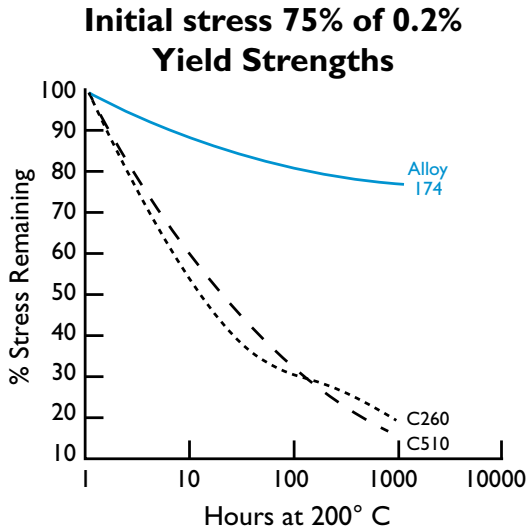


Figure 6: 200° C Stress Relaxation Resistance Results



ABOUT MATERION

Materion Corporation is a global leader in advanced material solutions and services that improve the world. We serve customers in more than 50 countries with operating, service center and major office locations throughout North America, Europe and Asia. Materion Corporation common stock trades on the New York Stock Exchange under the symbol MTRN.

RoHS COMPLIANT

MATERION INTERNATIONAL LOCATIONS

CHINA/HONG KONG
p: +825.2318.1907
brushalloysHK-info@materion.com

CHINA/SHANGHAI
p: +86.21.5237.2328
brushalloysCN-info@materion.com

GERMANY
p: +49.711.830.930
brushalloysDE-info@materion.com

INDIA/PUNE
p: +91.99606.33744
brushalloysIN-info@materion.com

JAPAN
p: +81.33.230.2961
brushalloysJP-info@materion.com

REPUBLIC OF KOREA
p: +82.32.811.2171
brushalloysKR-info@materion.com

SINGAPORE/ASEAN
p: +65.6842.4456
brushalloysSG-info@materion.com

TAIWAN, R.O.C.
p: +886.2.8747.8800 ext. 121
brushalloysTW-info@materion.com

UNITED KINGDOM & IRELAND
p: +44.118.930.3733
brushallousUK-info@materion.com

HEALTH & SAFETY NOTE: Handling copper beryllium in solid form poses no special health risk. Like many industrial materials, beryllium-containing materials may pose a health risk if recommended safe handling practices are not followed. Inhalation of airborne beryllium may cause a serious lung disorder in susceptible individuals. The Occupational Safety and Health Administration (OSHA) has set mandatory limits on occupational respiratory exposures. Read and follow the guidance in the Material Safety Data Sheet (MSDS) before working with this material.

For additional information on safe handling practices or technical data on copper beryllium, contact Materion Brush Performance Alloys, Technical Service Department at 800.375.4205.

MAIN OFFICE
6070 Parkland Boulevard
Mayfield Heights, OH 44124 USA
p: 800.375.4205 +.216.486.4200

www.materion.com/alloy-174

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