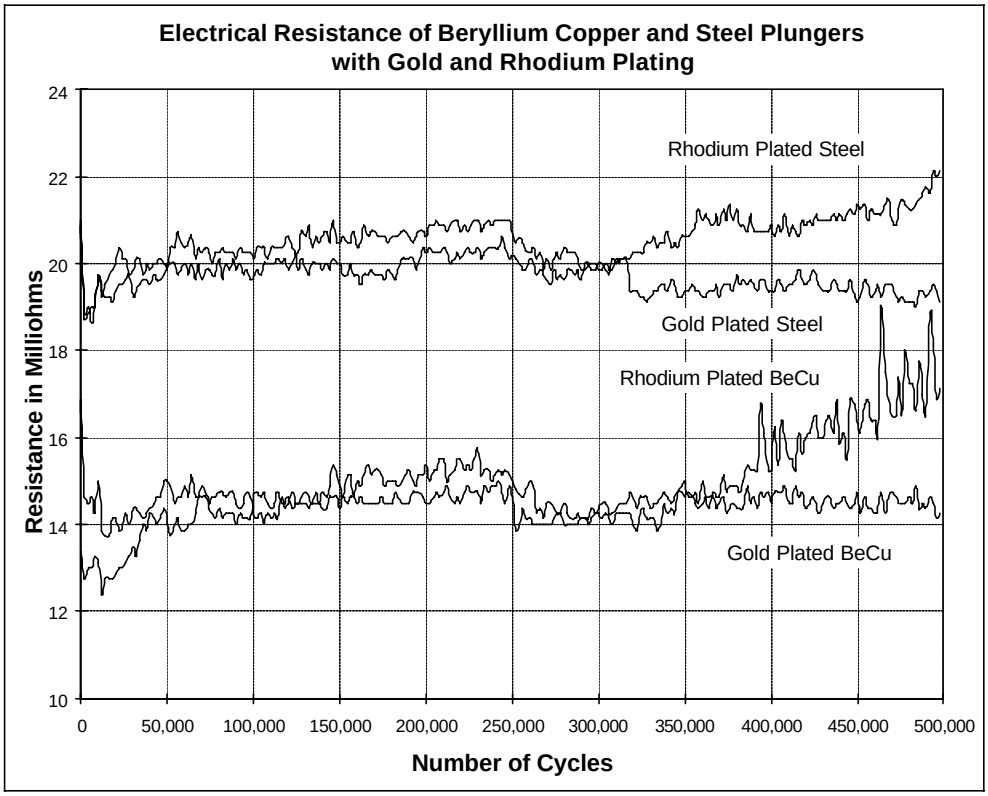
QA Technology Company, Inc.

A p p l i c a t i o n s N o t e

Comparison of Beryllium Copper And Steel Plungers

The graph below compares the electrical performance of 100-25 series probes with beryllium copper and steel plungers with both gold and rhodium plating. Eight probes from each of the four types were cycle tested together.



There is a slight but measurable difference in the average resistance between the two base materials. The steel plungers average 5 or 6 milliohms higher resistance than the equivalent plungers made of BeCu. Note that the bulk electrical resistance of BeCu is .08 microΩ-meters at 20° C, while the steel in QA plungers is .18 microΩ-meters. Although steel has about twice the bulk resistance of BeCu, the difference it makes in probe resistance will not affect the vast majority of test applications.

The hardness of steel plungers typically ranges between 58 and 60 on the Rockwell C scale, versus 38-42 for beryllium copper. Steel plungers will, therefore, remain sharp longer than BeCu plungers, but note that the superior machinability of BeCu means that BeCu plungers generally start out sharper.

The plating change causes no significant difference in electrical resistance. Gold is well known for its excellent properties as an electrical contact material, and rhodium offers similar characteristics as well as increased hardness – at a significantly higher price.
A summary of the average resistance of the four groups appears in the table below.

Part Number	Base Material	Plating	Average Resistance (mW)
100-PRP2508H	BeCu	Gold	14.3
100-PRP2508H-R	BeCu	Rhodium	15.1
100-PRP2508H-S	Steel	Gold	20.0
100-PRP2508H-RS	Steel	Rhodium	20.3

Wear and Electrical Performance Under Sideloading:

In cases of heavy sideloading over many cycles, testing shows virtually no difference in wear between BeCu and steel plungers. Sixteen pieces each of 100-PRP2524S and 100-PRP2524S-S were run for 500,000 cycles at two-thirds travel against a contact surface angled 30º from horizontal. There was no difference in life between BeCu and steel. The photograph at right shows similar plunger shank wear for both materials.

Comparison of two gold-plated BeCu plungers (top) and two steel plungers after running 500,000 cycles against a contact surface angled at 30º. There is no practical difference in plating wear or electrical performance between the two materials.

Electrical resistance was measurably different (again, due to the difference in bulk resistance), but the difference is not significant for most applications. Electrical performance for the sideload test is summarized in the table below. Notice that the 4mΩ difference in average electrical resistance is similar to that found in the preceding cycle test.

Electrical Resistance Summary for 30º sideload over 500,000 cycles				
Plunger Mat'l	Minimum	Maximum	Average	Std. Dev.
BeCu	7mΩ	16	11	1.22
Steel	10	24	15	2.35

Conclusions:

For QA Technology probes, there is no significant difference in electrical resistance or mechanical life between plungers made with beryllium copper versus those made with steel. There is approximately a 5mΩ difference in average electrical resistance, due to the higher bulk resistance of steel. Probe life, even under cases of extreme sideloading, is the same. Steel plungers have a hardness advantage, which will allow delicate tips to remain sharp longer than the equivalent beryllium copper tips in the same application. This is particularly true in cases where plungers are bottomed-out, abraded or otherwise mistreated during use. Beryllium copper, on the other hand, has a cost advantage over steel. For samples, pricing, or point style specifications, please contact QA Technology.