Soldering Palladium Plated Electronic Components

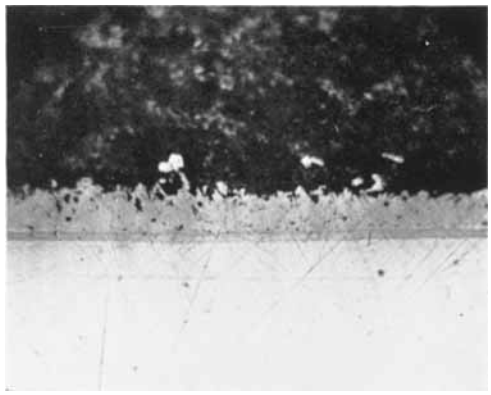
AN INVESTIGATION OF THE RELIABILITY OF JOINTS

The use of gold or palladium plated components to which soldered connections have to be made is now widespread in the electronics industry. Some concern has been expressed from time to time, however, about the reliability of such joints, and the possibilities of failure due to the formation of brittle constituents produced by alloying of the tin and lead in the solder with the gold or palladium of the electrodeposit.

A valuable study of this subject has now been reported by J. Whitfield and A. J Cubbin of the Materials and Processes Laboratory of Automatic Telephone & Electric Co Ltd (*A.T.E. Journal*, 1965, **21**, (1), 2). This investigation shows that the doubts hitherto expressed can be largely discounted in that during normal soldering of tinned copper wire to flat gold-plated tags there was no evidence of unusual crystal formation sufficient to impair the strength of the joint, and that normal soldered joints made to palladium are free from abnormal crystal formation and have adequate joint strengths.

In the experimental work, connector springs as used in production were plated with either gold or palladium to a minimum thickness of 0.0002 inch, and were soldered with 60:40 solder to 0.036 inch diameter tinned soft copper wire, the joints being made approximately $\frac{1}{10}$ square inch. Shear tests were carried out by pulling the wire in a direction parallel to the length of the springs. With gold-plated and also pre-tinned palladium-plated springs, in every case the spring fractured before joint failure could occur.

Palladium is not quite as readily solderable as gold—which is outstanding in this respect—but its solderability is enhanced by pre-tinning and joint strengths comparable to those made with gold were obtained using this technique. Without pre-tinning, joint strengths were still considered to be adequate for most purposes, a conclusion substantiated by field experience.



This photomicrograph shows (top) the tin-lead solder, next the growing palladium alloy layer resulting from 30 seconds in contact with molten solder, then the palladium electrodeposit, and (below) the connector spring. The alloy layer, although having a rough appearance at the solder interface, remains adherent ($\times 1000$)

A further series of experiments involved solder dipping for periods ranging from 1 to 60 seconds. Here extensive alloying of gold was found and acicular and dendritic crystals could be seen throughout the joint under the microscope. Palladium plated springs showed, however, that the palladium had not dissolved in the solder to the extent found with gold, and that the solder layer showed no abnormal crystal formations. Further observations showed that the behaviour of palladium on contact with molten solder is quite different from that of gold. Whereas gold dissolves almost instantaneously, palladium slowly forms a thin alloy layer that thickens pro-

gressively, finally—under extreme conditions of test—becoming detached from the basis metal. During a normal soldering operation, however, very little alloy formation was found, and the authors conclude that negligible brittleness would be expected to be present in a joint.

These conclusions are supported by the company's industrial experience; in a period of almost four years in which some millions of palladium plated spring connections used in telephone equipment and computers have been soldered, no difficulties with joints have been reported. J. E. P.

Continuous Temperature Control in the Blast Furnace

A NEW IMMERSION THERMOCOUPLE

An improved means of controlling the thermal balance of a blast furnace in order to achieve smoother operation and high-quality iron has been developed by K. H. Gee and M. H. Schmidt at Bethlehem Steel Company.

In the course of studies on slag basicity some few years ago, it was found by taking several immersion thermocouple measurements of iron temperatures during each cast that a pattern developed reflecting the condition of the furnace, suggesting that an accurate method of continuous measurement of iron temperature might have operational value. To this end a new design of platinum: rhodium-platinum thermocouple was devised suitable for continuous immersion in the stream of molten iron leaving the furnace. In this construction the couple wires are protected from the metal by an impervious inner ceramic sheath and an outer graphite sheath. Compressed air is used to cool and purge the interior of the thermocouple holder. By means of the usual type of recorder, a chart of the iron temperature is made throughout the duration of a cast.

This instrument has now been in routine use at two of the Bethlehem plants for more than three years and has proved its value as a simple and practical means of control.

Exclusive rights in this thermocouple have been granted by Bethlehem to Electro-Nite Carbon Company of Philadelphia.

The Gee continuous immersion thermocouple in position in the stream of molten iron flowing from a blast furnace in one of the Bethlehem Steel Company's plants