

GENERAL DISCUSSION

MR. F. J. NEWTON.¹—I gather the following conclusions from the presentations of the various papers: In order to have a satisfactory electroplate for exterior exposure, it would be necessary to have a total of 0.003 in. of nickel, preferably deposited in two layers, with buffing on the first layer prior to the deposit of the second coat of nickel. Mr. Nagley of the Bureau of Ships has indicated in his previous discussions that they have not been able to procure articles plated by this method. This would, therefore, leave the industry in the unfortunate position of not being able to procure a satisfactory plate.

In Mr. Sample's presentation, he has indicated that panels which had passed 500-hr salt spray in perfect condition showed very bad corrosion after 14 months' exposure at Kure Beach, N. C. Additional comments by both Mr. Mendizza and Mr. Pinner have indicated the lack of correlation between the salt spray result and field experience, and also the differences between various salt spray boxes. After reviewing these various comments and then observing the corrosion problem exhibited on vehicles which are exposed to road salt and dirt conditions in the city of Detroit, it becomes apparent that the quality and the consistency of plated articles varies from piece to piece when plated by the same

plating source. Perhaps these variables affect the durability both on exposure at exposure stations and in various salt spray boxes.

MR. F. A. LOWENHEIM.²—It has been reported that the galvanic effects between the tin-zinc alloy plate and aluminum are very slight. Since the tin-zinc alloy also has excellent solder-ability, it is quite possible that this plating might go a long way to solving the problem of soldering aluminum.

A MEMBER.—I want to know about research on the effect of movement on coatings, that is, the character of the deposit with respect to movement during plating. It is a very interesting subject. Most plating is done with some movement.

CHAIRMAN W. L. PINNER.³—There was a paper on this subject using ultrasonic vibrations at the 1955 Convention of the American Electroplaters Society. It was published in the booklet that has been heretofore spoken of.

MR. G. GUTZEIT.⁴—We have made some studies concerning the effect of agitation on plating rate in chemical reduction coating, but I believe that the results would possibly be similar in electroplating. The type of agitation used

² Supervisor, Electrochemical Research, Metal and Thermit Corp., Rahway, N. J.

³ Executive Staff Engineer, Houdaille Industries, Inc., Detroit, Mich.

⁴ Associate Director, Research and Development Dept., General American Transportation Corp., East Chicago, Ill.

¹ Manager, Test and Inspection Section, Quality Control Department, Ford Division, Ford Motor Co., Detroit, Mich.

in our experiments was turbulent agitation, produced by a propeller submerged in the plating bath. We found that, as the revolutions of the propellers increased, the plating rate would increase up to a maximum and then decrease very rapidly, giving an asymmetrical curve. This work was done under certain specific conditions and our conclusions apply only to those conditions.

MR. H. J. LAUER⁵ (*by letter*).—We have undertaken an investigation to determine the feasibility and suitability of electroplating an aluminum chassis with a lead-tin alloy (60 per cent tin, 40 per cent lead).

The purpose of lead-tin plating of aluminum alloy is to enhance its solderability characteristics. Aluminum and its alloys are very difficult to solder. This difficulty comes from the great affinity of aluminum for oxygen, which results in the instantaneous formation of an oxide coating. Solder will not bond to aluminum oxide; consequently this coating must be removed before the solder can be made to bond with the underlying aluminum. This oxide film can be removed by various acid and alkaline treatments, but after rinsing, the surface will still have an oxide film that reformed during the treatment. In addition, it is not feasible to mechanically abrade or chemically clean surfaces of aluminum prior to each soldering operation.

A sample chassis was sent to a firm which has developed a successful process for electroplating various types of ferrous and non-ferrous metals, including aluminum with lead-tin solder.

The sample chassis was lead-tin plated by the process owner (Electro Chemical Products Co.) in which 15 min was required to plate a thickness of 0.0005 ± 0.0001 in. In order to determine whether there would be a difference between

buffed and unbuffed surfaces, one half of each section of the chassis was hand buffed. The channel section of the chassis was water dip lacquered, the receiver section was not lacquered. Both sections were then assembled by standard screws and nuts and by soldering. Four wires were soldered to each type surface as follows:

- (a) One wire to a surface as received.
- (b) One wire to a surface buffed.
- (c) One wire to a surface as received and water dip lacquered.
- (d) One wire to a surface buffed and water dip lacquered.

The chassis was then subjected to a standard salt spray test for 50 hr and then examined for corrosion and strength of solder bonds. The inspection showed that:

1. Solderability of all surfaces before and after salt spray was excellent.
2. Strength of all solder bonds was excellent.
3. Surface corrosion products evidenced to a minor degree on inside of channel section only, with trace surface pitting at one end of inside surface of channel. (It is believed that this condition occurred because plating thickness was too thin at these areas.)
4. Water dip lacquer offered little if any protection to coated area, during salt spray test. (Protection from fingerprints during fabrication would be the only advantage of its use.)

About a year later, another corrosion performance test was carried out with a lead-tin plated aluminum electronics chassis in contact with 15 other metals. The plated chassis developed general shallow pitting during corrosion tests whereas a bare 52S aluminum chassis pitted only where other metal couples existed. Plated panels tested earlier did not develop this pitting. Evidently the plating company is troubled by quality variations typical of any new process,

⁵ Electronics Materials Engineer, Bell Aircraft Corp.

and the chassis tested may not represent their best work.

When in contact with nickel-plated brass tube shields, the lead-tin plated chassis developed practically no corrosion. Beneath the plated chassis were several small pits where the steel lock washer had cut through the plating. A bare 52S aluminum sheet, by way of comparison, showed almost continuous pitting in the faying surface beneath the nickel-plated shield to a depth of 0.020 to 0.030 in. into the aluminum. This was about ten times the depth of penetration observed in the plated chassis. The lead-tin plate is cathodic to (or more noble than) the underlying aluminum, so it follows that pinholes and scratches in the plate produced corrosion of the aluminum beneath these defects at a faster rate than if the aluminum were not plated. The plated aluminum had such pits over the entire surface, even the areas remote to other-metal couples. The bare 52S sheets, on the other hand, were not corroded at all, except where other-metals were in contact with it. These general pits in the bare aluminum averaged about 0.003 in. in depth and

0.25 in. wide. While unsightly, they have little effect structurally on the metal. Evidently, the accumulation of corrosion products slowed down the pitting since all pits, even beneath unfavorable metal couples were about the same depth. Tests were run to show the compatibility of the aluminum plating with other metals. Generally, cadmium plate, stainless steel and nickel appeared good in contact with the plated chassis; objectionable, for various reasons, were magnesium, bare copper and brass, and another unplated type 1010 steel. Some pitting occurred on the aluminum sample.

From the above studies, the lead-tin plated aluminum was generally compatible, corrosionwise, with most metals or unplated 52S aluminum, and since the lead-tin plated aluminum solves the problem of the solderability, enabling copper wires to be soft soldered to the chassis easily at any desired spot using rosin flux (such joints showed no corrosion in the 50-hr salt corrosion test) it would appear that the use of lead-tin plated aluminum for electronics chassis poses a great advantage over heavily cadmium plated steel chassis.