

A determination of the rapidity with which lead oxide forms on the surface of solid 70/30 Bell System rosin-core solder

Summary

70/30 Rosin-core lead/tin solder (70% lead/30% tin) kept continuously damp for 30 minutes to one hour with warm salt water to simulate sweat, rapidly formed lead oxide on the surface of the solder. The oxide easily came off in the hands and could not be completely removed even after hand washing in warm water using ordinary household soap.

Introduction

During most of the last century soldering with rosin-core lead solder at a telephone worksite was done with the solder held in one glove-less hand and a soldering iron in the other. Published photographs attest to this.^{1,2} At a work site where hundreds if not thousands of solder joints were being constructed, sometimes under adverse conditions as regards ambient temperature and humidity, the solderer might hold a spool of solder in a warm damp hand for several hours a day.

Ferrous metals will rapidly rust in a warm humid environment. This process is facilitated by the presence of salt. The present experiment was designed to determine if 70/30 lead/tin solder would rapidly “rust”, that is, form a surface oxide in a warm, damp, environment similar to that found in a warm sweaty hand.

The Experiment

A short length of 70/30 rosin-core solder (from the roll of solder pictured on this web site) was rubbed free of oxide with a dry paper towel until the solder was bright and shiny. The solder was then loosely wrapped in a damp paper towel that had been sprinkled with table salt to simulate the salt content of sweat. Every 10 minutes or so the solder was unwrapped, sprinkled with a few grains of salt, lightly moistened with tap water, and then loosely rewrapped. The towel and the solder were kept warm (but not hot) by use of a heat lamp. At the end of 30 minutes the solder was unwrapped and lightly abraded by rubbing it briefly against a patch of clean dry skin. A lead-test indicator solution (sodium sulfide solution, Safety 1st Corp, Chestnut Hill, MA.; confirmed by a Lead Check[®] swab, Homax Products, Bellingham, WA.) was then applied to the skin by means of a cotton swab. Sodium sulfide solution turns dark-brown to black in the presence of lead but is otherwise clear. Lead Check[®] solution turns pink to red in the presence of lead but is otherwise yellow in color. The skin was then cleaned with an abrasive cleaner (Bon Ami[®]). The solder was again rubbed free of oxide and the entire process repeated, but this time over a period of 60 minutes instead of 30.

¹ <http://www.morton.edu/museum/gallery1.htm>

² Bell Laboratories Record, vol 14, no 3, 1935

The Results

Following abrasion of the solder against the skin, application of both the sodium sulfide test solution and the Lead Check[®] solution showed lead to be present on the skin at both 30 and 60 minutes, although more oxide was found to be present at 60 minutes than at 30 minutes.

Discussion

Although lead oxide likely forms over a wide range of temperature and humidity, the present experiment demonstrates that under favorable conditions oxide will form on the surface of 70/30 solid rosin-core solder in as little as 30 minutes. Lead oxide has been shown to be an important cause of occupational lead poisoning.³ When it forms on the surface of molten solder it has been described as “brittle”. When it forms on the surface of solid room temperature 70/30 rosin-core solder, however, lead oxide looks and behaves more like a tarnish, that is, when it is rubbed against the skin it leaves a dirty brown/black stain that stubbornly adheres to the skin. The oxide can only be completely removed by means of an abrasive hand cleaner such as Bon Ami[®]. None of the oxide tarnish appeared to be removed from the hands by simply rinsing them in warm water. Even after washing the hands with liquid soap in warm water some of the tarnish remained. The rapidity with which the oxide forms and the ease with which it is transferred to the bare hand of the solderer, suggests that a solderer’s hands are never free of lead contamination during soldering operations with high-lead solder.

Rosin-core solder was supplied in rolls such as the one pictured on this website. Some of the rolls, like the one pictured, were small enough to fit comfortably in the hand while others, weighing in at 5 pounds, were not. In the latter case several wraps of solder would have been unwound from the roll and then coiled in such a fashion as to allow the solder to be fed easily from one hand.

It would be comforting to believe, if it were true, that a solderer seldom ran his dirty sweaty hands over his trousers, pocket handkerchief, shirt, other areas of his skin, or his hair, and that instead he always promptly and carefully washed his hands in a washroom whenever they were dirty. However given the pressures of the job, the almost continuous presence of lead oxide under the conditions described, as well as Company-sanctioned ignorance about the true dangers of lead, this scenario comforting though it is probably seldom occurred. If this is true then it establishes one means by which lead could have found its way from the work place to the home.

Contact MD@bellsystemleadpoisoning.com with questions or comments.

³ Lead Poisoning; The Recognition of Hazardous Industrial Lead Exposure. The Committee on Lead Poisoning, American Public Health Association, 1942.