Zeroing in on a Lead-Free Solder Database

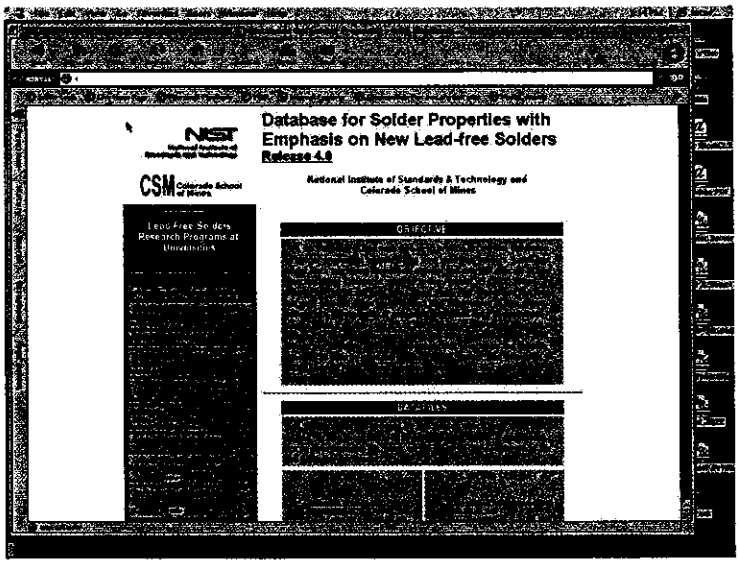
Four scientists assemble the facts on lead-free solders and create a tell-all Web site to share their knowledge

BY THOMAS A. SIEWERT, DAVID R. SMITH, JUAN-CARLOS MADENI, AND STEVEN LIU

The rising interest in lead-free solders creates a need for complete property data on the various lead-free solder compositions. Circuit designers need these data to assess the impact of the transition on product life, and production engineers need these data to determine processing parameters.

Various types of data are available, but they are widely dispersed throughout the literature. One problem with combining data from many sources is that variations in test procedures lead to undesirable scatter.

To improve the sharing of this important information, we developed an online database for solder properties emphasizing new lead-free solders.



Introduction

The worldwide movement in the electronics industry to replace lead-tin eutectic solders with lead-free solders creates a pressing need for property data on the industry's new lead-free solder compositions. While legislated deadlines for the conversion vary from region to region, the multinational companies (who have standardized procedures) are driven by the earliest deadline in their various markets. Some of these companies have completed the conversion and are already shipping lead-free products. Now, the remaining companies need to assess the deadlines for their markets.

Importance of Lead-Free Solder Alloys

Lead-free solder alloys cannot be simply substituted for conventional lead-containing alloys because of differences in their mechanical and physical properties. To use the new lead-free alloys in reliable and enduring products, accurate data must be inserted into the finite-element models of board designs. Also, the production engineers must adapt or replace their production procedures and equipment.

The magnitude of the issue is apparent by the prevalence of lead-free solder articles in industry publications. Journals such as *Circuits Assembly* and *Surface Mount Technology* have dedicated a large fraction of their articles to this issue for the past year or two (Refs. 1, 2). Another measure of the interest in this issue is the large and increasing number of advertisements in the various trade journals for lead-free solders, equipment, and related technology.

A number of organizations recognized the emerging need for these data.

The National Center for Manufacturing Sciences (NCMS) had a group project in the 1990s in which it collected and reported data on a wide variety of existing and emerging lead-free solder alternatives (Ref. 3). This was followed by several group projects in the National Electron-

THOMAS A. SIEWERT (siewert@boulder.nist.gov) *and DAVID R. SMITH are with the National Institute of Standards and Technology, Materials Reliability Division, Boulder, Colo. JUAN-CARLOS MADENI and STEVEN LIU are with the Colorado School of Mines, Golden, Colo.*

ics Manufacturing Initiative (now International Electronics Manufacturing Initiative, iNEMI), in which they worked on issues such as gaps in the solder properties, appropriate rework procedures, and tin whisker formation (Ref. 4).

Developing an Online Database

While these studies were underway, we decided that it would be helpful to collect information on the most popular alloys, and make it widely available. Thus, we developed an online database for solder properties emphasizing the new lead-free solders. This site can be found at *http://www.boulder.nist.gov/div853/lead%20free/solders.html*.

In addition, many research centers at universities are developing and reporting data. The ones that have come to our attention are listed on the solder database Web site. In this growing abundance of disaggregated data on lead-free solders, we saw a continuing opportunity for us to serve as a conduit between the developers of the data and the potential users.

Initially two of us, Siewert and Smith, started to collect and organize data. Traditional literature searches led to the identification of leading researchers and their organizations (universities and research centers) around the world. Then, we could contact these organizations and request more information.

As the amount of data grew and as our work shifted into new areas, we asked Liu and Madeni to help us. They took the tabular data, extended it, and built the Web page that is hosted at NIST and several other sites. While data are always freely transferable, the formatting (tables and figures) are copyrighted by the various publications. Thus, we redrafted the data into new tables and figures. The figures and tables posted on the Web site can be freely shared as they were developed with government funds and so are not subject to copyright.

Production engineers need these data to determine processing parameters.

When the data from different sources were combined, it was found to contain more variation than was expected. We attributed much of this to differences in procedures under which the data were developed. Therefore, we worked with the solder experts on an iNEMI technical interest group to develop a practice guide with some standardized procedures. This guide can be downloaded from *http://www.boulder.nist.gov/div853/Program3_solder.htm*.◆

References

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