

Solders and Soldering, Fourth Edition, by Howard H. Manko. McGraw-Hill, New York, NY, 2001, 519 pp., \$79.95, ISBN: 0 07 134417 9

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The engineering field is blessed to have an endless roster of superlative authors who consistently provide us with excellent reference works. Typically, suitable reviews of these books consist of general overviews followed by chapter-by-chapter accounts of information. However, it is a rare and appropriate occasion when a new work can be immediately used in support of a current issue or challenge. Subsequently, this reviewer had the pleasure of reviewing this book while simultaneously using it to address two work issues: 1. Improving the design of an existing lap joint, and 2. Acquiring raw data for use in the development of an in-house course on lead-free technology. This reviewer is very familiar with Mr. Manko's previous editions. They are used readily as industrial references. Since Mr. Manko's reputation is well-known, this particular review will not provide the traditional outline of information. Rather, this review is based on recent experience in using this book to help resolve and accomplish the aforementioned tasks.

For those readers who are not familiar with this book, Mr. Manko, in all his editions, has produced, perhaps, the industry standard reference on solder technology. His book encompasses all aspects of the technology including solder bond formation, chemistry of fluxes, metallurgy of solder, solder joint design, the soldering process, equipment, cleanliness, hand-soldering, special applications, pastes/preforms, and inspection of solder joints. However, as stated previously, the bulk of this review will be a discussion of the chapters on design and lead-free technology.

Solder joint design is one of many strong sections of the book (comprising the fourth chapter). Manko explains the need for a good joint design. He discusses interaction with the base metal. A good portion of the chapter deals with material selection and rightly so. An explanation is given on the "solder system" and what it is comprised of, i.e., three major components being base metal, soldering flux, and the solder alloy. Manko provides a very useful flow chart for solder joint design which graphically illustrates the three components of the solder system. For this reviewer's particular case in hand, the task consisted of ruggedizing an existing lap joint design. Using the graphics provided in Manko, one can grasp a firm understanding of various types of structural solder joint designs such as the butt joint, scarved joint, lap joint, double lap joint, strapped lap joint and sleeve joint. Manko further

explains the principle of mechanical security. Unlike the previous list of joints, there are techniques to add a strengthening member or technique such as a rivet, peg, or key. For the particular issue at hand, the sleeved approach was selected incorporating a ferruled design improvement. Selection was based, for the most part, on the clear and concise explanation of the design's advantage. Further along in this chapter, Manko provides some detailed accounts of strength calculations for each of these joint types. These guidelines are invaluable to the designer. An abundant amount of information is provided for improvements in other situations. The reader will find this chapter of immense use.

The third chapter contains the section on lead-free technology. It begins with a review of the lead-free legislative issues and the concerns with hazardous materials in the environment. Included are two graphics that compare the mindset between early years and recently regarding the cradle-to-grave concept for materials. In the recent concept, the entire life cycle of a product needs to be addressed including how to dispose of the product when it reaches the end of its useful life. Life cycle considerations greatly influence the design phase of new products and, accordingly, disposal of that product needs to be an important part of the design stroke. Turning to lead-free solders as a means to support a life-cycle approach, Manko presents a "wish list" of the desired properties of new solder alloys. His list contains nine desired comparable (to eutectic tin-lead) characteristics which include 1. Simple "drop-in" capability with comparable material properties, 2. Similar temperature range, 3. Same or better reliability, 4. Equal or lower cost, 5. Comparable with standard surface finishes, 6. Ease of application to work surfaces, 7. Fluxless (and use same standard cleaning procedures), 8. Similar wetting properties, and 9. Stable with minimal intermetallic formation. Explanations/suggestions are provided, in length, for each of these. Finally, Manko provides insight into those non-lead solder alloy groups that have or do not have potential as suitable replacements. He does an excellent job in emphasizing all significant aspects of a suitable replacement alloy. Applicable data is provided on some of the non-lead alloy systems such as bismuth, indium, and silver.

Howard Manko continues to provide a quality reference to the engineering industry. His Fourth Edition of *SOLDERS AND SOLDERING* provides the necessary updates in a changing industry. Generally speaking, his book provides one with all the necessary data and information on solders and its processes. This reviewer has used this edition, as well as the previous editions, as a reliable source for over twenty years. The quality of the graphics, as well as the amount of detail, illustrate his passion for this technology. It is a "must" reference for any engineer working in the electronics industry.

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