

Design for the Environment

Lead-Free Solder Partnership



What Is Design for the Environment?

EPA's Design for the Environment (DfE) Program is a voluntary initiative that forms partnerships with a variety of stakeholder groups in an effort to

- encourage businesses to incorporate environmental concerns, in addition to the traditional criteria of cost and performance, into their decisions, and
- facilitate continuous environmental improvement through effective behavior changes.

To accomplish these goals, the program uses EPA's expertise and leadership to evaluate the human health and environmental risks, performance, and cost of traditional and alternative technologies, materials, and processes. DfE disseminates information on its work to all interested parties and helps businesses implement cleaner alternatives identified through the program. The program has formed cooperative partnerships with the following industries:

- Printed wiring board
- Computer display
- Printing
- Garment and textile care
- Auto refinishing
- Industrial/institutional laundry
- Adhesives
- Chemical formulators

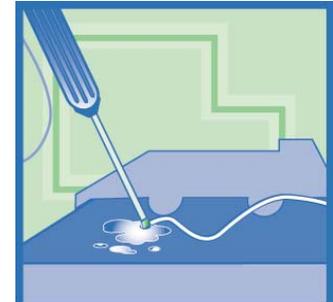
Assessing Life-Cycle Impacts in the Electronics Industry

Why Is the Partnership Evaluating Solders?

Solder comprised of tin and lead is currently a fundamental material joining

electronic components to circuit boards in the assembly of almost every type of electronic product. The electronics industry, however, is facing significant international legislative and market pressures to phase out the use of tin-

lead solders and switch to lead-free alternatives. Such a switch will require dramatic capital expenditures and could have a broad impact on public health and the environment. The electronics industry, as well as public interest and governmental organizations, are concerned about the lack of research to date on the potential environmental effects of the various alternatives to lead-based solder.



Worldwide, over 20 million pounds of tin-lead solder are used annually. Lead, a chemical known to be toxic, can be released into the air and groundwater throughout its life cycle, in processes such as mining, use, waste treatment, and disposal. Once in the environment, lead is persistent (as are all metals) and bioaccumulates in the food chain.

Concerns about potential risks have led to initiatives by several nations to mandate or encourage the electronics industry to replace lead solder with lead-free alternatives. For example, Europe and Japan have pending restrictions on the use of lead. Industry experts estimate that U.S. industry could lose approximately \$240 billion over only three years if the U.S. does not respond to these initiatives quickly and competitively by identifying viable alternative solders that perform well, are cost effective, and pose fewer environmental risks.

Virtually all research about potential substitutes for lead in solder, however, has focused strictly on performance. Although U.S. industry needs to move ahead with alternative products to remain competitive, information about life-cycle impacts and risks of the alternatives is lacking. This has raised concerns for both industry and the public about the possible future business and environmental risks of making a wholesale switch from lead to other metals, without first understanding their life-cycle environmental impacts.



What Are the Partnership's Goals?

To address the information gap on the impacts of leaded and lead-free solders, EPA's Design for the

Environment (DfE) Program has entered into a voluntary partnership with representatives of the electronics industry and other interested parties to evaluate the life-cycle environmental impacts of tin-lead solder and three promising lead-free solder compositions.

Project partners include electronics manufacturers and assemblers, trade associations (the Electronic Industries Alliance and IPC—Association Connecting Electronic Industries), academic and research organizations (e.g., University of Tennessee), and public interest groups (e.g., Silicon Valley Toxics Coalition). The current list of contributing industry partners includes: Agilent, Cookson Electronics, Delphi Delco, Hewlett-Packard, IBM, Intel, Pitney Bowes, Rockwell Collins, Sematech, and Thomson Multimedia. Additional participants are welcome.

Specific goals of the project include:

- evaluating the environmental impacts of tin/lead solder and selected lead-free alternative solders,
- evaluating the effects of lead-free solders on recycling and reclamation at the end of the electronic product life-cycle, and
- assessing the leachability of lead-free solders and their potential environmental effects.

What Work Is Being Conducted by the Partnership?

The partnership is examining life-cycle impacts of tin-lead solder and the

following lead-free solders:

- 99.3% tin and 0.7% copper
- 95.5% tin, 4.0% silver, and 0.5% copper
- 92.3% tin, 3.4% silver, 1.0% copper, and 3.3% bismuth

These specific alternatives were selected by the industry partners because they have shown promising performance as substitutes for tin-lead solder.

Using a **life-cycle assessment (LCA)** approach, the study will generate data to help manufacturers, users, and suppliers of solder to incorporate environmental considerations into their decision-making processes. An LCA examines the full life cycle of a product, and estimates environmental impacts from each of the following life cycle stages:

- Raw material extraction or acquisition and material processing
- Solder manufacture
- Solder application
- End-of-life disposition

The project will generate information that can be used by the electronics industry to select lead-free solders that work well for a given application, and that may have fewer impacts on public health and the environment. The LCA may also identify areas that need further investigation, and help governmental organizations to better manage their electronics purchasing and end-of-life disposition.

Project Milestones

Key milestones in the DfE Lead-Free Solder Partnership include:

- **Complete project scoping:** January 2002
- **Complete draft LCA:** April 2003
- **Publicize results:** July – December 2003

How Can I Get More Information?

To learn more about the DfE Program or the Lead-Free Solder Partnership, contact:

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You can also get more information about the DfE Program, including electronic or hard copies of this fact sheet (**document #EPA 744-F-02-007**) by visiting the Office of Pollution Prevention and Toxics' DfE website at: www.epa.gov/dfc