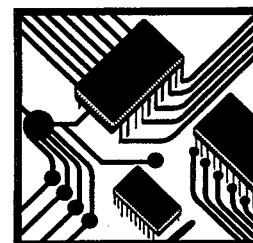




Design for the Environment Printed Wiring Board Project Publications



The Environmental Protection Agency's (EPA's) Design for the Environment (DfE) Program is a voluntary initiative that forms partnerships to encourage businesses to incorporate environmental concerns into the design and redesign of products, processes, and management systems. Publications for the DfE Program's Printed Wiring Board Project are listed in this brochure. Many of these publications can be viewed via the DfE Web site at

www.epa.gov/dfe/pwb. Unless otherwise noted, all of these publications can be ordered through the Pollution Prevention Information Clearinghouse (PPIC) online at www.epa.gov/opptintr/library/ppicdist.htm.

An order form for these materials follows the abstracts. In order to receive your materials, please be sure to fill out all sections of the order form. Publications also can be obtained by placing an order via phone, fax, e-mail, or regular mail at the addresses and numbers listed below:

Pollution Prevention Information Clearinghouse

U.S. Environmental Protection Agency
(7409)
1200 Pennsylvania Ave., NW.
Washington, DC 20460
Hotline: 202 260-1023
Fax: 202 260-4659
E-mail: ppic@epa.gov

National Service Center for Environmental Publications (NSCEP) Clearinghouse

P.O. Box 42419
Cincinnati, OH 45242-2419
Phone: 800 490-9198
Fax: 513 489-8695

Project Summaries

Printed Wiring Board Project Fact Sheet (EPA744-F-99-006)

Provides an overview of the Design for the Environment (DfE) Printed Wiring Board (PWB) Project and the search for viable pollution prevention alternatives in the PWB industry. Also includes information on the project's technical studies, and communication and implementation efforts. 2 pages
December 1999

IPC/DfE Printed Wiring Board Project Publishes Direct Metallization Results and Evaluates Alternative Surface Finishes (EPA742-F-99-021)

A *CircuitTree* article that summarizes the results of the Cleaner Technologies Substitutes Assessment (CTSA) for "making holes conductive" technologies, and describes the CTSA for PWB surface finishes. 4 pages
March 1999

The Design for the Environment Printed Wiring Board Project: A Partnership to Identify Cleaner Technologies (EPA742-F-99-022)

A *Plating and Surface Finishing* article that summarizes the results of the CTSA for "making holes conductive" technologies, and describes the CTSA for PWB surface finishes. 4 pages
January 1999

Design for the Environment Project Releases Direct Metallization Performance Results (EPA742-F-97-007)

A January 1997 *CircuitTree* article that summarizes the methodology and results of the DfE PWB Project performance demonstration for the electroless copper process and six direct metallization technologies. 6 pages
January 1997

EPA and the PWB Industry Team Up on Environmental Assessment of Technologies (EPA742-F-95-015)

A September 1995 *CircuitTree* article that describes EPA's DfE Program and the work conducted with the PWB industry. 3 pages
September 1995

Design for the Environment: A Partnership for a Cleaner Future (EPA742-F-96-018a)

An April 1995 *Printed Circuit Fabrication* article that provides an overview of the DfE Program and describes its work with the PWB industry. 3 pages
April 1995

Reinventing Government Through Common Sense and Design (EPA742-F-95-016)

A February 1995 *CircuitTree* article that discusses EPA's Common Sense Initiative and its applications for the PWB industry. Also provides an overview of the joint IPC and U.S. EPA DfE PWB Project. 2 pages
February 1995

Reference/Technical Reports

Implementing Cleaner Printed Wiring Board Technologies: Surface Finishes (EPA744-R-00-002)

Describes lessons learned and suggestions for implementing and using alternative surface finishes for printed wiring boards. 43 pages
March 2000

Alternative Technologies for Making Holes Conductive: Cleaner Technologies for Printed Wiring Board Manufacturers (EPA744-R-98-002)

Summarizes an analysis of the comparative risk, performance, cost, and natural resource use for technologies that can perform the "making holes conductive" function during printed wiring board manufacturing. Includes the standard electroless copper process and six formaldehyde-free alternatives. 44 pages
September 1998

Printed Wiring Board Cleaner Technologies Substitutes Assessment: Making Holes Conductive, Volumes 1 and 2 (Vol. 1: EPA744-R-98-004a and Vol. 2: EPA744-R-98-004b)

Volume 1 presents a detailed technical analysis of the comparative risk, performance, cost, and natural resource use for technologies that can perform the "making holes conductive" function during PWB manufacturing. Includes the standard electroless copper process and six formaldehyde-free alternatives. Volume 2 contains the appendices cited in Volume 1, including raw data tables.

Vol. 1: 405 pages
Vol. 2: 410 pages
August 1998

Pollution Prevention and Control Technology: Analysis of Updated Survey Results (EPA744-R-98-003)

Analyzes the results of a 1997 survey of pollution prevention and control technologies used by printed wiring board manufacturers, as well as information provided by technology vendors and obtained through a literature search. Contains analysis of production methods and materials; wastewater; pollution prevention and water conservation methods; bath maintenance; recycling and recovery methods; off-site recycling; and end-of-pipe treatment methods. 135 pages
August 1998

Implementing Cleaner Technologies in the Printed Wiring Board Industry: Making Holes Conductive (EPA744-R-97-001)

Describes lessons learned and suggestions for using and implementing the "making holes conductive" alternatives evaluated in the CTSA. Alternative technologies discussed include carbon, graphite, palladium, and conductive polymer methods. 56 pages
February 1997

Making Holes Conductive Performance Testing Results

Describes the "making holes conductive" performance demonstration methodology and results. The results of the demonstration suggest that direct metallization technologies perform at least as well as electroless copper if operated according to specifications. 20 pages
October 1996

Printed Wiring Board Pollution Prevention and Control: Analysis of Survey Results (EPA744-R-95-006)

Presents the results of a 1995 pollution prevention and control survey of PWB manufacturers and describes the state of PWB environmental technology and practices at that time. Includes discussions of production methods and materials; wastewater; pollution prevention and water conservation methods; bath maintenance, recycling, and recovery methods; off-site recycling; and end-of-pipe treatment. 102 pages
September 1995

Printed Wiring Board Industry and Use Cluster Profile (EPA744-R-95-005)

Describes industry demographics, types of products produced, size of the PWB market, and trends in international trade in 1995. Also describes the basic steps in PWB manufacturing, and alternative technologies and processes for each of the major steps. 84 pages
September 1995

Federal Environmental Regulations Affecting the Electronics Industry (EPA744-B-95-001)

Summarizes the 1995 federal Clean Air Act, Clean Water Act, Resource Conservation and Recovery Act (RCRA), Superfund, Community Right-to-Know, and Toxic Substances Control Act requirements that affect the electronics industry. 67 pages
September 1995

Pollution Prevention Case Studies

Printed Wiring Board Case Study #1: Pollution Prevention Work Practices (EPA744-F-95-004)

Provides guidance on planning and implementing a pollution prevention program, and discusses several methods to reduce chemical use, conserve water, recover materials, and reduce copper buildup and sludge generation. 4 pages
July 1995

Printed Wiring Board Case Study #2: On-Site Etchant Regeneration (EPA744-F-95-005)

Describes the economic and environmental advantages of regenerating spent etchant on-site, and provides an overview of the different types of etchant regeneration systems available on the market. Includes system descriptions, product features, availability, and cost savings information. 4 pages
July 1995

Printed Wiring Board Case Study #3: Opportunities for Acid Recovery and Management (EPA744-F-95-009)

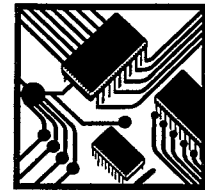
Highlights the pollution prevention efforts of a medium-sized PWB manufacturer. Explains the economic and environmental benefits of acid recovery, microetchant regeneration, and full panel solder strip recycling. 4 pages
October 1995

Printed Wiring Board Case Study #4: Plasma Desmear: A Case Study (EPA744-F-96-003)

Describes the successes enjoyed by a manufacturer of double-sided and multilayer PWBs after implementing plasma desmear technology, and outlines the economic and environmental savings resulting from implementing the process. 4 pages
September 1996



DfE Printed Wiring Board Project Publication Order Form



Complete this form before ordering. Please allow two weeks for delivery. Submit your request to the National Service Center for Environmental Publications (NSCEP), P.O. Box 42419, Cincinnati, OH 45242-2419, Phone: 800 490-9198, Fax: 513 489-8695.

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Affiliation: (please check one)

- Local government State government Federal government
- Faculty; Name of course in which materials will be used _____
type of course: credit noncredit; # of students impacted per semester _____
- Student; major _____
- Business owner/Employer; type of business _____
- Other _____

PRINTED WIRING BOARD PUBLICATIONS

Project Summaries

- Printed Wiring Board Project Fact Sheet (EPA744-F-99-006)
- IPC/DfE Printed Wiring Board Project Publishes Direct Metallization Results and Evaluates Alternative Surface Finishes (EPA742-F-99-021)
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- Design for the Environment: A Partnership for a Cleaner Future (EPA742-F-96-018a)
- Reinventing Government Through Common Sense and Design (EPA742-F-95-016)

Reference/Technical Reports

- Implementing Cleaner Printed Wiring Board Technologies: Surface Finishes (EPA744-R-00-002)
- Alternative Technologies for Making Holes Conductive: Cleaner Technologies for Printed Wiring Board Manufacturers (EPA744-R-98-002)
- Printed Wiring Board Cleaner Technologies Substitutes Assessment: Making Holes Conductive, Volume 1 (EPA744-R-98-004a)
- Printed Wiring Board Cleaner Technologies Substitutes Assessment: Making Holes Conductive, Volume 2 (EPA744-R-98-004b)
- Pollution Prevention and Control Technology: Analysis of Updated Survey Results (EPA744-R-98-003)
- Implementing Cleaner Technologies in the Printed Wiring Board Industry: Making Holes Conductive (EPA744-R-97-001)
- Printed Wiring Board Pollution Prevention and Control: Analysis of Survey Results (EPA744-R-95-006)
- Printed Wiring Board Industry and Use Cluster Profile (EPA744-R-95-005)
- Federal Environmental Regulations Affecting the Electronics Industry (EPA744-B-95-001)

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- Printed Wiring Board Case Study #2: On-Site Etchant Regeneration (EPA744-F-95-005)
- Printed Wiring Board Case Study #3: Opportunities for Acid Recovery and Management (EPA744-F-95-009)
- Printed Wiring Board Case Study #4: Plasma Desmear: A Case Study (EPA744-F-96-003)
- Printed Wiring Board Case Study #5: A Continuous-Flow System for Reusing Microetchant (EPA744-F-96-024)
- Printed Wiring Board Case Study #6: Pollution Prevention Beyond Regulated Materials (EPA744-F-97-006)
- Printed Wiring Board Case Study #7: Identifying Objectives for Your Environmental Management System (EPA744-F-97-009)
- Printed Wiring Board Case Study #8: Building an Environmental Management System: H-R Industries' Experience (EPA744-F-97-010)
- Printed Wiring Board Case Study #9: Flexible Simulation Modeling of PWB Costs (EPA744-F-99-004)

General DfE Information

- EPA Design for the Environment Program Brochure: Partnerships for a Cleaner Future (EPA744-F-96-018)
- CTSA Methodology and Resource Guide (EPA744-R-95-002)

Printed Wiring Board Case Study #5: A Continuous Flow System for Reusing Microetchant (EPA744-F-96-024)

Highlights the experience of a PWB manufacturing facility in implementing a continuous-flow system for reusing sulfuric acid-potassium persulfate microetchant.

4 pages

December 1996

Printed Wiring Board Case Study #6: Pollution Prevention Beyond Regulated Materials (EPA744-F-97-006)

Describes the experience of Tri-Star Technologies, a PWB manufacturer, in implementing pollution prevention measures. These new measures led to both energy and water use reductions, resulting in significant cost savings for the company.

4 pages

May 1997

Printed Wiring Board Case Study #7: Identifying Objectives for Your Environmental Management System (EPA744-F-97-009)

Describes the benefits of initiating an environmental management system (EMS), and describes the process by which a company can identify the environmental aspects of its operations and determine their significance, based on the experiences of H-R Industries, Inc., a PWB manufacturer.

4 pages

December 1997

Printed Wiring Board Case Study #8: Building an Environmental Management System: H-R Industries' Experience (EPA744-F-97-010)

Describes the initial steps taken by a PWB manufacturer (H-R Industries, Inc.) to develop an EMS, shows the similarity between the requirements for ISO 14001 and ISO 9000, and demonstrates

how the ISO 9000 quality system may be used to begin building an ISO 14001 EMS.

4 pages

December 1997

Printing Wiring Board Case Study #9: Flexible Simulation Modeling of PWB Costs (EPA744-F-99-004)

Describes the validation of a flexible model designed to simulate costs of using different technologies for the "making holes conductive" step of PWB manufacturing (e.g., direct metallization processes). The model takes into account environmental costs, such as waste generation and treatment and water and energy use, as well as traditional costs such as capital expenditures, labor, and materials.

4 pages

May 1999

General DfE Information

EPA Design for the Environment Program Brochure: Partnerships for a Cleaner Future (EPA744-F-96-018)

Provides an overview of EPA's DfE Program and includes brief descriptions of the program's goals and projects.

8 panels

September 1996

CTSA Methodology and Resource Guide (EPA744-R-95-002)

Explains the methods and resources required to conduct a Cleaner Technologies Substitutes Assessment (CTSA). CTSA's evaluate the comparative risks, performance, and cost of alternative products, processes, or technologies. The guide breaks the process into 22 modules and describes the goals of each module, skills required, methodologies, information flows, analytical models, published guidance, and data sources.

509 pages

September 1996

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Environmental Protection Agency
United States

