

Sector Specific Technology Transfer Guide

Metal Products Industry

(SIC Groups 344, Fabricated Structural Metal Products, 346, Metal Forging and Stamping, and 347, Metal Services Not Elsewhere Classified)



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This guide was developed to provide an overview of pollution prevention practices and technologies available to the metal products industry. The pollution prevention strategies identified in this guide focus primarily on the reduction of air emissions. The guide has been organized by production processes and the pollution prevention strategies, and categorized by the initial costs of those technologies. Each technology is ranked according to the potential reductions in air emissions resulting from the implementation of those technologies (☼ = a low potential for significant emission reductions, ☼☼☼☼ = the highest potential for significant emission reductions).

Metal Fabrication Operations

Low Cost Pollution Prevention Technologies:

- **Alternative lubricants (☼☼☼)** – Replace oil lubricants used in cold forming operations with a hot lime bath or borax soap to reduce or eliminate the need for cleaning solvents.

Medium Cost Pollution Prevention Technologies:

- **Alternative stamping lubricants (☼☼☼)** – Use stamping lubricants that remain on the part until the annealing process where they can be burned off, reducing or totally eliminating the need for cleaning solvents.

High Cost Pollution Prevention Technologies:

- **Clinching technologies (☼☼☼)** - Replace welding operations with mechanical joining technologies, such as clinching.
- **Laser cutting (☼☼)** – Replace flame or plasma cutting units with lasers.
- **Water cutting (☼☼)** – Replace flame, plasma, or laser cutting units with water jets.
- **Electrical discharge machining (EDM) (☼☼)** – Replace conventional cutting with EDM units.

Cleaning & Degreasing Operations

Low Cost Pollution Prevention Technologies:

- **Low HAP/VOC solvent cleaners (☼☼☼☼)** – Replace traditional solvent cleaners with low HAP/VOC cleaners.
- **Cover open –top vapor degreaser (☼☼☼☼)** - Cover the opening of open-top vapor degreasers during idling and shutdown periods.
- **Keep the spray wand tip below vapor level (☼☼☼☼)** – Make sure that the tip of the spray wand remains below the vapor level during spraying operations.

Medium Cost Pollution Prevention Technologies:

- **Water based cleaning/phosphatizing systems (☼☼☼☼)** – Replace solvent based cleaners with recycled high pressure water-based cleaning/phosphatizing systems to reduce VOCs and HAPs and to enhance performance of water-based and high solids, low VOC paints.
- **Refrigeration coils (☼☼☼☼)** – Modify solvent vapor degreasers by installing refrigeration coils.
- **Increase freeboard ratio (☼☼☼)** - Increase the height of the tank walls to increase the freeboard ratio of vapor degreasing equipment.

High Cost Pollution Prevention Technologies:

- **Electrocleaning systems (☼☼☼☼)** – Clean parts using an anodic or cathodic electrocleaning system in place of convention vapor degreasers.
- **Enclosed hot water parts wash unit (☼☼☼☼)** – Use an enclosed hot water parts wash unit in place of traditional solvent baths for degreasing operations.

Plating Operations

Low Cost Pollution Prevention Technologies:

- **Wetting agents (☼☼☼☼)** – Use a wetting agent to change the surface tension of the plating bath to reduce the fumes generated during the plating process.
- **Poly balls (☼☼☼)** – Use poly balls in baths to reduce evaporation.

Medium Cost Pollution Prevention Technologies:

- **Trivalent chromium (☼☼☼☼)** – Replace hexavalent chromium with trivalent chromium.

High Cost Pollution Prevention Technologies:

- **Automated tank covers (☼☼☼☼)** – Install tank covers that automatically close during the plating operation.

Adhesive Bonding and Sealing Operations

Low Cost Pollution Prevention Technologies:

- **Polyurethane hot melt glues (☼☼☼☼)** – Replace solvent-borne structural glues with polyurethane hot melt glues.
- **Polyvinyl acetate (PVA) glues (☼☼☼☼)** – Replace solvent-borne glues with an aqueous-based PVA glue.
- **Waterborne adhesives (☼☼☼☼)** - Replace solvent-borne adhesives with aqueous-based adhesives.
- **Operator training (☼☼☼)** – Conduct hands-on training sessions in proper spray techniques for employees applying atomized adhesives using manual application processes.
- **Keep all containers closed** (this includes all containers used to store adhesives, solvents, additives, and liquid waste materials) (☼☼) – To reduce air emissions and preserve the chemical properties of the adhesives and glues, instruct all employees to keep containers used to store these materials closed when not in use.

- **Inspect coating storage, transfer, and application equipment (☼)** – On a regular basis, inspect storage container, transfer equipment, and application equipment used to store, transfer or apply solvent-borne adhesives and solvents for leaks or malfunctions.

Medium Cost Pollution Prevention Technologies:

- **Soy-based Adhesives (☼☼☼☼)** – Replace solvent-borne adhesives with soy-based adhesives.
- **High volume low pressure (HVLP) application equipment (☼☼☼)** – Replace conventional atomized spray equipment with HVLP spray equipment.
- **Enclosed spray gun wash systems (☼)** – Use an enclosed gun wash system to clean conventional and HVLP spray application equipment.

High Cost Pollution Prevention Technologies:

- **Roll coat application (☼☼☼☼)** – Replace atomize application equipment with a roll coat application system.
- **Mechanical assembly (☼☼☼☼)** – Replace solvent or adhesive bonding with mechanical means of assembly, such as screws or built-in snaps.

Surface Coating Operations

Low Cost Pollution Prevention Technologies:

- **Operator training (☼☼☼)** – Conducting hands-on training sessions in proper spray techniques for employees applying atomized coatings using manual application processes.
- **Keep all containers closed** (this includes all containers used to store coatings, solvents, additives, and liquid waste materials) (☼) – To reduce air emissions and preserve the chemical properties of the coatings and solvents, instruct all employees to keep containers used to store these materials closed when not in use.
- **Inspect coating storage, transfer, and application equipment (☼)** – On a regular basis, inspect storage container, transfer equipment, and application equipment used to store, transfer or apply solvent-borne coatings and solvents for leaks or malfunctions.
- **Monitoring of coatings defects (☼)** – Track the number of coatings defects, the type of defects detected, and the spraybooth or production line generating the defects. Use this information to determine the source of the defects and take corrective actions to reduce or eliminate future coating defects.

Medium Cost Pollution Prevention Technologies:

- **Waterborne coatings (☼☼☼☼)** – Replace solvent-borne coatings with low-to-no VOC/HAP waterborne coatings.
- **High solids paints and topcoats (☼☼☼)** – Replace low solids solvent-borne coatings with low VOC/HAP high solids coatings.
- **High volume low pressure (HVLP) application equipment (☼☼☼)** – Replace conventional atomized spray equipment with HVLP spray equipment.
- **Enclosed spray gun wash systems (☼)** – Use an enclosed gun wash system to clean conventional and HVLP spray application equipment.
- **Hard pipe system (☼)** – Transfer VOC/HAP containing materials by means of a hard pipe system.

High Cost Pollution Prevention Technologies:

- **Powder coatings** (☼☼☼☼) – Replace solvent-borne coatings with power coatings.
 - **UV curable coatings** (☼☼☼☼) – Replace solvent-borne coatings with UV curable coatings.
 - **Vacuum coating** (☼☼☼☼) - Replace atomized coating systems with a vacuum coating system using waterborne coatings.
 - **Electrostatic application equipment** (☼☼☼☼) – Replace conventional spray equipment with electrostatic application equipment.
 - **Electrodeposition** (☼☼☼☼) = Replace atomized coating application systems with an electrodeposition coating (E-coat) system.
 - **Air-assisted airless application equipment** (☼☼☼) – Replace conventional spray equipment with air-assisted airless application equipment.
 - **Curtain coating** (☼☼☼) - Replace atomized coating equipment with a curtain coating system.
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Links to Additional Information

Metal Fabrication Operations

Alternative Stamping Lubricants:

- EPA Sector Notebook, Fabricated Metal Products:
<http://www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/fabric.html>

Cleaning & Degreasing Operations

Cleaning & Degreasing (General)

- ISSDS Integrated Solvent Substitution Data System. <http://es.epa.gov/issds>
- SAGE Solvent Alternative Guide. <http://es.epa.gov/ssds/ssds.html>
- EPA Sector Notebook, Fabricated Metal Products:
<http://www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/fabric.html>

Gluing & Adhesive Bonding Operations:

Soy-Based Adhesives

- Pacific Northwest Pollution Prevention Resource Center:
www.pprc.org/pprc/pubs/newslets/news0600.html

Glues and Adhesives (General)

- CMTI Case-Study: www.ecn.purdue.edu/CMTI/Technology_Transfer/holiday-rambler

Low-HAP Sealants

- CMTI Case Study: www.ecn.purdue.edu/CMTI/Technology_Transfer/motorveh

Metal Cleaning Operations

Aqueous Cleaning

- CMTI Case-Study: www.ecn.purdue.edu/CMTI/Technology_Transfer/lacayp2
- CMTI Case-Study: www.ecn.purdue.edu/CMTI/Technology_Transfer/pierce
- Solvent Alternatives Guide (SAGE) <http://clean.rti.org/alt.cfm?id=neu&cat=ov>

Metal Cleaning (General)

- Solvent Alternatives Guide (SAGE) <http://clean.rti.org/>

Plating Operations:

Plating Operations (General)

- EPA Sector Notebook, Fabricated Metal Products: <http://www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/fabric.html>
- EPA's Strategic Goals Program: <http://www.strategicgoals.org>
- EPA's Industrial Multimedia, Metal Finishing: http://www.epa.gov/ORD/NRMRL/std/mtb/metal_finishing.htm
- National Metal Finishing Resource Center: <http://www.nmfr.org/>
- North Carolina Division of Pollution Prevention and Environmental Assistance's, Metal Finishing: <http://www.p2pays.org/ref/03/02454.htm>

Surface Coating Operations:

High Solids Coatings

- CMTI Case-Study: www.ecn.purdue.edu/CMTI/Technology_Transfer/innvtech

Waterborne Coatings

- CMTI Case-Study: www.ecn.purdue.edu/CMTI/Technology_Transfer/amlift
- CMTI Case-Study: www.ecn.purdue.edu/CMTI/Technology_Transfer/CO16.htm
- CMTI Case-Study: www.ecn.purdue.edu/CMTI/Technology_Transfer/ITWMICRO
- CMTI Case-Study: www.ecn.purdue.edu/CMTI/Technology_Transfer/PARKANP2

Operator Training

- CMTI Case-Study: www.ecn.purdue.edu/CMTI/Technology_Transfer/amgen

Coatings (General)

- Paint and Coatings Resource Center www.paintcenter.org/
- Coatings Guide™: cage.rti.org/
- North Carolina Division of Pollution Prevention and Environmental Assistance's, Metal Painting and Coating: <http://www.p2pays.org/ref/01/00777/toc.htm>

Additional Sites

- EPA's Enviro\$en\$e <http://es.epa.gov>
- Pollution Prevention Resource Exchange: www.p2rx.org/
- Indiana Clean Manufacturing Technology & Safe Materials Institute: www.ecn.purdue.edu/CMTI/
- IDEM's Office of Pollution Prevention & Technical Assistance: www.in.gov/idem/oppta/
- EPA's Environmental Technology Verification Program: <http://www.epa.gov/etv/index.html>

Summary Table

	Good Pollution Reduction Opportunities →		Best Pollution Reduction Opportunities
<div style="display: flex; flex-direction: column; align-items: center;"> <div>Lowest Cost</div> <div style="margin: 10px 0;">↓</div> <div>Highest Cost</div> </div>	<ul style="list-style-type: none"> Keep containers closed (<i>AS, SC</i>) Inspect storage and application equipment (<i>AS, SC</i>) Monitor coating defects (<i>SC</i>) 	<ul style="list-style-type: none"> Alternative lubricants (<i>MF</i>) Keep vapor degreasing wand below vapor level (<i>CD</i>) Poly balls for plating baths (<i>P</i>) Operator training (<i>AS, SC</i>) 	<ul style="list-style-type: none"> Low HAP/VOC solvent cleaners (<i>CD</i>) Cover open-top vapor degreasers (<i>CD</i>) Plating bath wetting agents (<i>P</i>) Polyurethane hot melt glues (<i>AS</i>) Polyvinyl acetate glues (<i>AS</i>) Water-borne adhesives (<i>AS</i>)
	<ul style="list-style-type: none"> Enclosed spray gun wash system (<i>AS, SC</i>) Hard pipe transfer system (<i>SC</i>) 	<ul style="list-style-type: none"> Alternative stamping lubricants (<i>MF</i>) Increase vapor degreasers freeboard ratio (<i>CD</i>) HVLP application equipment (<i>AS, SC</i>) High solids coatings (<i>SC</i>) 	<ul style="list-style-type: none"> Water-based cleaning/phosphatizing systems (<i>CD</i>) Install refrigeration coils on vapor degreaser (<i>CD</i>) Trivalent chrome (<i>P</i>) Soy-based adhesives (<i>AS</i>) Waterborne coatings (<i>SC</i>)
	<ul style="list-style-type: none"> Laser cutting (<i>MF</i>) Water cutting (<i>MF</i>) EDM (<i>MF</i>) 	<ul style="list-style-type: none"> Mechanical joining (clinching) (<i>MF</i>) Air-assisted airless application equipment (<i>SC</i>) Curtain coating (<i>SC</i>) 	<ul style="list-style-type: none"> Electrocleaning systems (<i>CD</i>) Enclosed hot water parts washers (<i>CD</i>) Automated plating bath covers (<i>P</i>) Roll coat application (<i>AS</i>) Mechanical assembly (<i>AS</i>) Powder coatings (<i>SC</i>) UV curable coatings (<i>SC</i>) Vacuum coating (<i>SC</i>) Electrostatic application equipment (<i>SC</i>) Electrodeposition (<i>SC</i>)

MF - Metal Fabrication Operations

CD - Cleaning and Degreasing Operations

P - Plating Operations

AS – Adhesive Bonding and Sealing Operations

SC - Surface Coating Operations