PRINTING, PUBLISHING AND PACKAGING

THE BASICS OF THE PROCESSES AND POLLUTION PREVENTION TECHNIQUES

by

Gary D. Miller, Director
Printers' National Environmental Assistance Center
and
Assistant Director
Illinois Waste Management and Research Center

November 2, 1997

New Orleans, Louisiana

PRINTING, PUBLISHING AND PACKAGING

THE BASICS OF THE PROCESSES AND POLLUTION PREVENTION TECHNIQUES

Workshop Outline

Introduction and Overview

Size and Scope of the Industry

- Number, economic value and Distribution of Establishments
- Market Share by Type

Process Descriptions

- Screen
- Letterpress
- Flexographic
- Gravure
- Offset Lithographic
- Digital

Ink Formulations

Pollution Prevention Techniques

- Sources of Pollution
  - Air
  - Land
  - Water
- Screen
- Letterpress
- Flexographic
- Gravure
- Offset Lithographic
- Binding and Finishing

Closure, Comments and Questions

Printers' National Environmental Assistance Center

Contact Information:

Debra Kramer CENTER EXPERT
IL Waste Management Research Center
3333 West Arthington Street
Chicago, Illinois 60624
Ph: 773/265-2036
FAX: 773/265-8336

SIZE AND SCOPE

OF THE PRINTING INDUSTRY

Printing Types & Related Trade Organizations

- Lithographic
  - PIA
  - GATF
- Gravure
  - GAA
- Flexographic
  - FTA
- Letterpress
  - PIA
  - GATF
- Screen print
  - SGIA
- Digital Imaging
  - SGIA, GATF, PIA

Other Printing Related Trade Organizations

- Newspaper Association of America
- National Association of Printing Ink Manufacturers
- Tag & Label Manufacturing Institute
- Natl Business Forms Association
- NPES Association for Suppliers of Graphic & Pub Technologies
- National Association of Printers and Lithographers

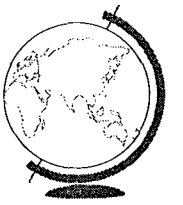
Printing Establishments Census Vs. Industry Data

- U.S. Census in 1987
  - 58,000 firms
  - 62,000 facilities
- PIA 1996 Report to Congress
  - 52,186 firms
- Estimated Actual Number of Facilities
  - Over 100,000

Market Share of the Printing Industry

1996 PIA Report to Congress:

- LITHOGRAPHY 47%
- GRAVURE 18%
- FLEXOGRAPHY 18%
- LETTERPRESS 8%
- SCREEN PRINT 3%
- DIGITAL 6%



Diagram

US Map Depicting Market Share in Each State

Screen Printing Process and Technology

- Posters
- Labels
- Decals
- Signage
- Textiles
- Electronic Circuit Boards

Advantages of Screen Printing

- Surfaces: wood, glass, metal, fabric, cork, etc.
- Any shape or design
- Any thickness
- Any size large or small

Screen Printing Production Rate Improvement

- Development of automatic presses
- Improved dryers
- U.V. Curable Ink
- Rotary Screen

Diagram

Flat bed Screen press

Rotary Screen press

SCREEN PRINTING - Prepress

Screen Making - Frames

- Wood
  - Cedar*
  - Pine
  - * Cedar is preferred - water resistant, light weight
- Metal
  - Aluminum*
  - Steel
  - * Aluminum is preferred - lightweigt, yet sturdy

SCREEN PRINTING - Prepress

Screen Making - Fabric

- Monofilament - single strands
  - graphic arts & other applications
  - easier to clean
- Multi filament - multiple strands (like rope)
  - textile applications
  - ink build up
  - difficult to clean

SCREEN PRINTING - Prepress

Screen Making - Fabric Types

- Silk - multifilament
- Cotton Organide - multifilament
- Nylon - monofilament and multifilament
- Polyester - monofilament and multifilament

Screen Making - Fabric Types
Advantages/Disadvantages

- Silk
  - loses taughtness with frequent use
  - reclaiming chemicals w/ bleach destroy silk
  - silk used for printing art, not commercial
- Cotton-Organdie
  - same disadvantages as silk

Screen Making - Fabric Types
Advantages/Disadvantages (Continued)

- Nylon
  - Good for stretching
  - Compared to polyester, lacks stability
  - Less rigid than polyester
  - Unsuitable for closely registered colors
- Polyester
  - Primary material used in commercial screen printing
  - strong and stable when stretched.

SCREEN PRINTING - Prepress

Screen Making - Screen Mesh

- # of Threads/in2
- fine mesh → thinner ink deposit
- course mesh → thicker ink deposit

SCREEN PRINTING - Prepress

- Emulsion or Stencils
  - Direct Stencil
  - Indirect Stencil

SCREEN PRINTING - Prepress

Direct Stencil - liquid "painted" onto screen

- Most are water soluble
- Wear better than indirect stencils
- Two different types of direct stencil solution
  - Water-resistent stencil solution
  - Solvent resistant stencil solution

SCREEN PRINTING - Prepress

Indirect Stencil - coated acetate film (usually taped into place)

- Produce excellent definition & finer detail
- Best for Water-based ink printing
- More difficult to remove screen mesh
- Two different types of stencil
  - Rubylith
  - Amberlith

SCREEN PRINTING - Prepress

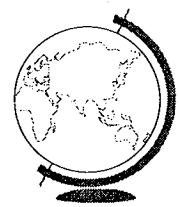
Emulsion Application

- Clean & Degrease Screen Mesh
  - Putting tooth on mesh
- Apply Emulsion/Stencil

SCREEN PRINTING - Prepress

Emulsion Types -

- Water Resistant Emulsions
  - Solvent based ink
  - UV Curable ink
  - Water based ink - w/ chemical curing
- Solvent Resistant Emulsions
  - Water based ink
  - UV Curable Ink



Screen Printing Process Diagram

Screen Printing - Post Press

Screen Reclamation - Why Reclaim Screens?

- Poly fabric costs $10-40/ square yd.
- Annual screen cost $5000-$10,000/yr without reclamation
- Avg monthly fabric cost is $360

Screen Printing - Post Press

Reclaiming screens involves 2-3 steps

1. Remove the ink
2. Remove the emulsion
3. If necessary remove haze or "ghost image"

Screen Printing - Post Press

Wastes from Screen Reclamation Process
(Also see P2 Section)

- Solvent Waste
- Waste Water

Screen Printing Inks

- Solvent Based
- Water Based
- UV Curable
- Water Based Textile
- Plastisol - Textile

Letterpress Printing

- Business Forms
- Business Card
- Letter head
- Proofs

Letterpress Printing Plates

- Cast Metal Type Plates
- Duplicate Plates (almost obsolete)
- Photopolymer Plates

Letterpress Printing Equipment

- Platen
- Flatbed
- Rotary

Letterpress Press Diagram (Platen)

Letterpress Flat-Bed Cylinder Diagram

Letterpress Printing Rotary Diagram

Sheet fed
Web fed

Flexographic Printing

- Flexible Packaging
  - Plastic bags
- Wrappers
  - Candy
- Envelopes
- Newspapers
- Adhesive Tapes
- Labels

Flexographic Printing

- Stack Type
- Central Impression Cylinder
- In-Line

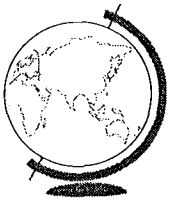


Diagram of Central Impression Flexo Press

Flexographic Plates

- Rubber Plates
- Relief Plates

Flexographic Printing Process

Diagram

Flexographic Print Process

- Ink Roller
- Meter Roller
- Plate Cylinder
- Impression Cylinder

Gravure Printing

- Flexible Packaging
  - Cups
  - Frozen food packages
  - Laundry soap packages
  - Beverage cartons
    - Beer
    - Pop
- Magazines
- Catalogs
- Fooring
- Gift wrap
- Labels
- Currency
- Stamps

Gravure Printing

- Printing Cylinder
- (Rubber Covered) Impression Roller
- Ink Fountain
- Doctor Blade
- Ink Dryer

Gravure Printing

Diagram GRAVURE Print Process

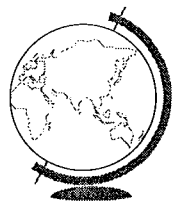
Diagram

Gravure Cylinder

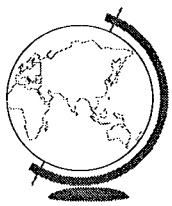
Gravure Prepress

Cylinder Image

- Chemical Etching
- Electromechanically Engraved



Electromechanical Engraving



Gravure Cylinder Cells

Diagram

Gravure Printing

- Doctor Blades
  - Sheer excess ink off surface of plate cylinder
  - Angled to cut through surface of ink
  - Oscillate back and forth to reduce wear

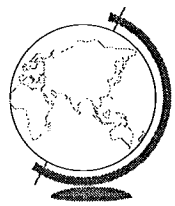
Gravure Printing

- Impression Cylinder
  - Rubber covered steel or aluminum cylinder
  - Holds the substrate next to the plate cylinder
  - Adjusts Tension of Substrate
  - Helps move the substrate through the press

Gravure Printing

Impression Cylinder Coatings:

- Natural Rubber
- Neoprene
- Buna N (Nitrile)
- Polyurethane



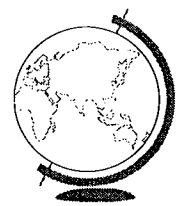
Gravure Process Diagram - AGAIN

Offset Lithographic Printing

- General Commercial Printing
- Quick Printing
- Newspapers
- Books
- Business Forms
- Financial & Legal Documents
- Letterhead
- Business Cards

Offset Lithographic Printing

- Sheet Fed
- Web Fed



Diagram

Offset Printing

Offset Lithographic Printing

- Printing Cylinders:
  - Plate Cylinder
  - Blanket Cylinder
  - Impression Cylinder

Offset Lithographic Printing

- Dampening Roller
- Inking Roller

Lithographic Printing Plates

- Diazo
- Photopolymer
- Silver Halide
- Electrophotographic (Electrostatic)
- Bimetal
- Waterless
- Thermal
- Ablation

Dampening System

- Fountain Solution
  - Direct Feed Continuous Integrated System
  - Direct to Plate

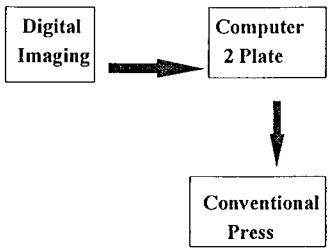
Fountain Solution

- Acts as a water solution for hydrophillic properties
- Applied to Dampening Roller to repel ink in non-image areas
- Helps promote ink drying
- Helps cool the press

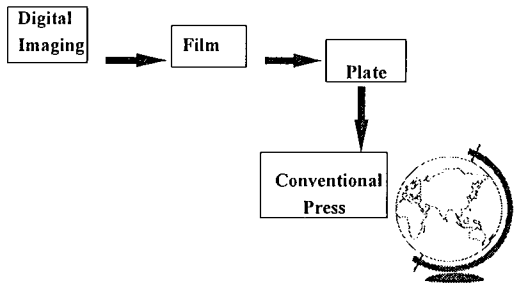
Digital Printing

Digital Imaging → **Digital Press**

Computer 2 Plate (C2P)



Conventional Printing



PrePress

Design

- Conventional
  - Film
  - Contacting
  - Mechanicals
- Digital
  - Electronic File
  - Computer Layout
  - Imagesetting Film

PrePress

- **Proofing**
  - Image is designed and adjusted
  - Color separations created
  - Samples sent to customer to approve color quality and artwork
- **Plates**
  - Film Positives or Negatives are made for each color
  - Film Positive or Negative is transferred onto printing plate

Printing Materials & Samples

- Inks

Ink Types - Emissions

- Solvent based - ⇧ VOC & HAP emissions
- Water based - VOC & HAP emissions (emissions less than solvent based ink)
- UV curable - ⇩ VOC emissions

Screen Printing Inks

Ink Components

- Binders
- Emulsion binders
- Helzarin binders

Screen Printing Inks

- Solvent Based
- Water Based (Graphic Applications)
- UV Cured
- Plastisols (Textile Applications)
- Water Based Textile

Screen Printing Inks

Ink Types - Application - Avg Cost/gal

- Solvent based - Graphic - Avg $25/gal
- Water based - Textile and Graphic - Avg $20/gal
- UV Curable - Graphic - $100/gal
- Plastisol - Textile - $30/gal

Flexographic Inks

- Water Based
- Solvent Based
- UV Curable
  - Typically used for coatings and lacquers

Gravure Inks

- Solvent Based
  - Toluene
  - Alcohol
- Water Based
  - Alcohol
  - Amines (ammonium hydroxide, methanolamine)

Lithographic Inks

- Petroleum Based
- Vegetable Based
  - Soy
  - Linseed
  - Flax seed
- UV & EB Curable
  - Coatings & Lacquers
  - $$$ New Equipment or Modifications
- Heatset

Lithographic UV Inks

- No / Low VOC
- $$$
  - More costly than conventional inks
  - Costly Equipment Modifications on existing presses
  - Costly New Equipment Investment
  - Worker Health & Safety Concerns

Lithographic Electron Beam or EB Inks

- No/Low VOC
- Less Costly than UV Ink
- $$$ Equipment
  - More costly than UV equipment

P2 in Printing

Reducing Waste Generation

Pollution Prevention In Printing

IS:

- Source Reduction
- In-Process Recycling
- Clean Technology
- Raw Material Substitution
- Preventive Maintenance

IS NOT:

- End-of-pipe Technologies
- Pollution Control
- Off-site Waste Recycling
- Out-of-process Waste Recycling

How to Sell P2 to The Printer They Could:

- avoid the rising costs of waste disposal
- save money in other areas such as purchasing of raw materials
- increase printing efficiency
- maintain or increase competitiveness
- decrease long-term liability
- follow state and federal policy guidelines

How to Sell P2 to The Printer (Con't.)

- may reduce present and future regulatory burdens
- improve environmental and workplace conditions
- ensure community safety
- maintain a good corporate image.

Printer P^2 Program Focus

- Source Reduction
- Energy Conservation
- In-Process Recycling
- Process Control

Keys to Effective Process Control

- *Understand* the **conditions** that affect quality
- *Define* the **acceptable ranges**
- *Control* the printing **process** to stay within defined limits

Separation of Wastes Is Essential for Reducing Costs

- Keeping different wastes separated increases potential for recycling/reuse
- Review all waste streams to advise on mixing and disposal methods. Refer to rule re. hazardous waste mixed with a non-haz. waste, the entire mixture must be managed as haz. waste
- Failure to segregate increases waste disposal costs
- Example of poor management: mixing leftover ink with spent hazardous solvent, causing entire mixture to be classified as hazardous waste

VOC Emission Sources from Maintenance

- Parts Cleaner
- Lubricants
- Cleaners

Typical Items for Basic Press Maintenance Checklist

As applicable to type of printing

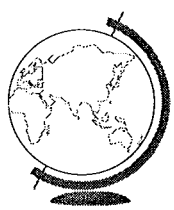
- ✓ Clean dampening fountains
- ✓ Check all dampening rollers and systems
- ✓ Check all roller durometer readings
- ✓ Deep clean and recondition rollers regularly
- ✓ Remove and replace bad rollers as needed
- ✓ Clean and maintain all press cylinders
- ✓ Thoroughly clean squeegees

. . . more . . .

Typical Items for Press Maintenance Checklist (cont..)

As applicable to type of printing

- ✓ Measure and maintain correct gap settings between rollers
- ✓ Keep presses lubricated on daily, weekly, or monthly basis as required
- ✓ Keep press and related area clean and free of hazards
- ✓ Clean and oil vacuum system
- ✓ Perform other press maintenance as recommended by manufacturer



Sources of Pollution from Commercial Printing

✦Air Pollution

Land Pollution

Water Pollution

Air Pollution from Printing

- NOx Emissions:
  - Leads to the Formation of Ozone in the Lower Atmosphere
  - Leads to the Formation of Acid Rain
  - Human Health Hazard, Damages Plants, Animals, etc.

Air Pollution from Printing

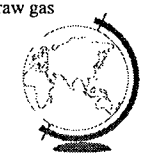
- NOx Emission Sources:
  - Boilers
  - Dryers
  - Oxidative Add-On Control Devices
  - Fuel Combustion Units - Heating

Reduce Air Pollution from Printing

- NOx Emission Reduction:
  - Use Fuel with Little/No Bound Nitrogen
    - 0.1% Bound Nitrogen can produce 200-300 ppm NOx
  - Add Outside Combustion Air to Burner
    - Can reduce NOx by 95% compared to raw gas burner - from 30 to 5-6 ppm

Reduce Air Pollution from Printing

- NOx Emission Reduction:
  - Swirl Combustion Gas
    - Can reduce NOx by 50% compared to raw gas burner
  - Allow Solvent Concentration to Build Up
    - Can reduce NOx by 90% compared to raw gas burner



Reduce Air Pollution from Printing

- NOx Emission Reduction:
  - Water Injection for Larger Systems - Co-Generation
  - Ammonia Injection with Catalytic Reduction to Elemental Nitrogen for Larger Systems.

Air Pollution from Printing

- Particulate Emissions:
  - PM10 Known to Cause Human Health Problems
  - Larger Particles are Irritants
  - Contributes to Visibility Problems
  - Under Certain Circumstances can Cause Explosion

Air Pollution from Printing

- Particulate Emission Sources:
  - Spray powder
  - Folding, Cutting, and Trimming Operations
  - Die Cutting Operations
  - Perfect Binding Operations
  - Bailer / Shredder Equipment

Reduce Particulate Air Pollution from Printing

- Spray Powder
  - Keep Application Amount / Rate to Minimum
  - Exhaust / Removal Systems with Filters - 99% Efficient

Reduce Particulate Air Pollution from Printing

- Cutting / Trimming / Perfect Binding:
  - Keep Equipment Maintained & Knives SHARP
  - Exhaust / Removal System
  - Cyclone - 80-95% Efficient
  - Cyclone with Baghouse - up to 99% Efficient

Air Pollution from Printing

- Ozone Depleting Substance Emissions:
  - Contributes to Thinning of Upper Atmosphere Ozone Layer
  - Some Classified as Air Toxics
  - Classified According to ODS Potential

Air Pollution from Printing

- Ozone Depleting Substance Emission Sources:
  - 1,1,1-Trichloroethane and Carbon Tetrachloride from Inks, Cleaning Solutions, Adhesives, and Propellants
  - Freons from Air Conditioning, Chilling & Cooling Systems
  - Halons from Fire Suppression Systems

Reduce Ozone Depleting Substances from Printing

- Substitute 1,1,1-Trichloroethane and Carbon Tetrachloride with Hydrocarbon Solvents

Reduce Ozone Depleting Substances from Printing

- CFC-11, 12, 113, 114, and R-500
  - Reclaim/Recycle with Proper Equipment
  - Replace with HFC 134a-Requires New Fittings, Filter and Lubricant
  - Replace HCFC-22, But Scheduled for Phase Out in 2020.

Reduce Ozone Depleting Substances from Printing

- Halon 1301 - Fire Extinguishing System
  - Replace with FM2000, FE-13, PFC-410, or Intergen
  - All New Replacements Require Modifications

Reducing Cleaning Solvent Waste

- Use the least amount necessary to do the job
- Use pump cans or squirt bottles to reduce the amount of cleaner used
- Usually better to dampen rag rather that apply solvent directly to press

Reducing Cleaning Solvent Waste

- Do Not Use Cleaning Towels to Line Cleaning Trays
- Use Proper Roller Cleaning Procedure
  - 1/2 At A Time
- Let Ink Run Down As Much As Possible Prior to Cleaning

Choose the Right Cleaners for Your Shop

- Identify all cleaning applications in the shop
- Use the mildest effective cleaner for each task
- Use aggressive, quick-evaporating solvents *only* for tasks requiring their use
- Standardize types of cleaners and cleaning procedures
- Separate different types of used solvents to maximize reuse/recycling possibilities

Questions to Ask When Evaluating Alternative Cleaners

- Will the cleaner product work satisfactorily in my shop?
- What will be necessary for proper storage and disposal of cleaning products?
- What risk does the use of the cleaner pose to employees?

Evaluate New Cleaners' Impacts Prior to Purchase

- Ask for and review a Material Safety Data Sheet (MSDS)
- To reduce air emissions:
  - Select solvents with low volatile organic chemical (VOC) content
  - Opt for lower vapor pressure solvents

... more ...

Evaluate New Cleaners' Impacts Prior to Purchase (cont.)

- To reduce hazardous wastes:
  - Favor cleaners with high flashpoints (above 140°)
  - Minimize purchases of cleaners with hazardous constituents
  - Used solvents may still be hazardous wastes if residues removed by solvent are hazardous
- Require suppliers to take back unused portions of *sample* cleaners

New Cleaners May Require New Operating Procedures

Since most newer cleaning solvents require different cleanup procedures than traditional, quick flash solvents, be sure to provide press operators with thorough instructions on recommended techniques.

P2 - Lithographic Printing

Reducing Ink Costs and Wastes

- Increase accuracy of ink estimating techniques
- Increase use of existing inventory
- Improve ink handling techniques
- Minimize purchase of inks requiring management as hazardous wastes

Managing Ink Inventory to Reduce Wastes

- Keep good records of all existing stock to enable recall and reuse
- Use first in, first out rule
- Consider mixing small quantities of obsolete stock into black to work off versus disposal
  - Readily available software can show how to use existing stock to mix required colors

... more ...

Managing Ink Inventory to Reduce Wastes (cont.)

- Use existing stock whenever possible for in-house jobs
- For jobs where exact color is not critical, offer customer reduced price for use of recycled inks
- If necessary, send waste or obsolete ink to ink recycler for reprocessing

Managing Solvent Waste and Shop Towels or Wipes

- For launderable towels:
  - Wring, drain or centrifuge shop towels to recover solvent prior to laundering
    - Can cut consumption / emissions by 45-70% depending on vapor pressure.
  - Use recovered solvent for dirtiest cleaning operations (e.g., press parts washer)

Managing Solvent Waste and Shop Towels or Wipes

- For disposable towels:
  - Dispose at properly permitted Treatment, Storage & Disposal (TSD) facility

Managing Solvent Waste and Shop Towels or Wipes

- Store used towels and wipes in safety containers with tight fitting lids
- Use false bottoms in cleaning towel drums to collect solution.

Case Study: John Roberts Co.

- Situation
  - Problem with solvents at towel vendor's laundry
  - Laundry asked their major customers and PIM for help in developing effective solutions
  - Roberts was using highly volatile Type Wash for all solvent cleaning
- John Roberts Co.'s Response:
  - Examine solvents used and applications
  - Involve press operators, trade association and solvent supplier in assessing problem and identifying solutions

Case Study: John Roberts Co.

- Found Replacement Solvent
  - Replaced Type Wash with less volatile solvent for majority of cleaning applications
  - **$1800/year savings in solvent purchases**
- Reduced Amount of Solvent Used
- Recovered Solvent for Reuse
  - Installed explosion-proof centrifuge to spin rags
    - recovering 3.5 gal per 220 wipes
    - reused in parts washers to clean press ink trays
    - **Saving $34,000/year on $15,000 investment**
- Employee Involvement and Training was the KEY

Water P2 in Printing

- Recover/Reuse Dehumidifier Condensate Water.
- Recover/Reuse prepress and other process waste water.
- Use dry cleaning methods where possible
- Use closed loop cooling tower system

Water P2 in Printing

- Stormwater Discharge Sources:
  - Outside chemical/product storage
    - Drums Tanks
  - Outside Waste Storage - Dumpster, compactors, containers, skids
  - Loading Dock - Spills, Chemicals, Waste

Water P2 in Printing

- Stormwater Discharge Sources:
  - Rooftop mounted equipment
    - Compressors, A/C
  - Driveways, Vehicle Maintenance, Vehicle Fueling
  - Land Disturbances
    - Construction

Water P2 in Printing

- Stormwater Discharge - Contamination Prevention
  - Enclose In Structure or Building.
  - Construct cover with raised pad or curbing
  - Move inside existing structure
  - Secondary containment.

Water P2 in Printing

- Stormwater Discharge - Prevention:
  - Construct collection system for reuse.
    - Can use for irrigation
  - Construct collection/treatment system
    - Oil/water separator or more elaborate.
  - Use vegetative buffers.
    - Slows velocity and filters discharges

Water P2 in Printing

- Stormwater - Best Management Practices:
  - Good housekeeping and maintenance
  - PM, inspection, equipment maintenance
  - Spill prevention and response procedures.

Water P2 in Printing

- Stormwater - Best Management Practices:
  - Inspection schedules and procedures.
  - Reporting Mechanism for Response
  - Employee Training Program
    - Material Handling, Spill Response, Housekeeping

Water P2 in Printing

- Stormwater - Spill Prevention Checklist:
  - Open, Corroded, Leaking Drums or Other Containers
  - Corroded/Damaged Tanks, Supports, or Valves
  - Torn Bags or Bags Exposed to Rain/Snow

Water P2 in Printing

- Stormwater - Spill Prevention Checklist:
  - Corroded/leaking tanks
  - Leaking/improperly closed valves or fittings.
  - Damaged secondary containment systems.
  - Overloaded, improperly maintained dry chemical conveying systems

Reducing Wastes at Press

- Preventive maintenance
- Reducing make-ready wastes through process control
- Understand and control ink chemistry
- Reduce cleaning solvent toxicity & usage
- Increasing revenues from paper recycling
- Reducing and managing ink wastes

P2 - Screen Printing

Screen Making

- Emulsions
  - No VOC's
  - No HAP's

P2 - Screen Printing

Screen Making

- Clean & Degrease Screen just prior to stencil
  - Stencil lift
  - Scrap screen
  - Advance cleaning ⇨dust/grease can accumulate again

P2 - Screen Printing

Screen Making

- Properly handle & store film
  - Do not expose to any UV source (sun/artificial) prior to use
  - Store in cool dry place
  - Canister tightly sealed
- Handle carefully
  - Avoid creasing film ⇨poor adhesion to mesh

P2 - Screen Printing

Screen making

- Inspect for pin-holes
  - fill in with liquid emulsion
- Carefully monitor screen exposure time
  - Overexposure ⇨Light undercut edge of positive⇨image ill-defined

P2 - Screen Printing

Screen making

- Track UV lamp usage to reduce energy consumption
  - After 1000 hours of use UV lamps lose power
  - Require longer exposures

P2 - Screen Printing

Screen making

- Use correct exposure time
  - refer to film mfr specifications
- Incorrect exposure time results in waste
  - loss of detail & poor definition
  - finished stencil may not adhere properly to screen

P2 - Screen Printing

Screen making

- Reduce developer usage
  - monitor strength of each batch to assure consistency
  - Mix only what is needed for each day
    - H_2O_2 degrades quickly

P2 - Screen Printing

Screen Inks

- Solvent & water based ink
  - Contain VOC's & HAPs
  - No alternatives at this time

P2 - Screen Printing

Water base ink printing on paper

- Use base coat prior to ink apply
  - eliminates ink bleed on paper

P2 - Screen Printing

Ink Management

- Save leftover ink
- Store at optimum temp. and humidity
- Tightly close containers to avoid ink drying out
- Combine small quantities of leftover ink.

P2 - Screen Printing

Ink Waste Disposal

- Eliminate Heavy Metals
- Water based ink waste disposal
- Solvent based ink waste

P2 - Screen Printing

Reclaim Screen

- Poly fabric costs $10-$40 per sq. yard
- Average monthly fabric cost $360.
- Ruined and lack of screen reclamation cost $5000-$10,000 per year.

P2 - Screen Printing

Reduce Screen Reclamation Wastes

- Solvent waste - filter and reuse on site or send off site for distillation
- Waste water - filter particulates and recirculate
  - reclamation chemical consumption

P2 - Screen Printing

Screen cleaning/reclaiming solvents

- Install solvent recovery equipment
  - Size varies from 2-3 gal capacity up to 250 gal capacity
  - Relatively high cost
    - May not be feasible for all printers

P2 - Screen Printing

P2 in Screen Cleaning

- Switch to alternative, lower VOC screen cleaning chemicals
- Clean screens immediately after coming off press.

P2 - Screen Printing

P2 in Screen Cleaning

- Use high pressure spray
  - up to 4000 psi
  - up to 75% reduction emulsion remover

P2 - Screen Printing

P2 in Screen Cleaning (Continued)

- Install Fan type sprayer head
  - maximizes water usage/removal area and reduces cleaning time requirements
- Recycle rinse water
  - Filter suspended solids.

P2 - Screen Printing

P2 in Screen Cleaning

- Use hand held spray bottles to apply emulsion remover
  - Small printers - application of emulsion remover
  - Large printers - small tasks using emulsion remover

P2 - Screen Printing

P2 in Screen Cleaning

- Reduce haze remover consumption
  - Apply the haze remover only to affected areas of screen
  - Clean screens immediately
  - Apply ink degradant before reclamation to prevent "ghost" images

P2 - Screen Printing

Use Retentionable Screen Frames

- Improves printability
- Increases longevity of screen

Flexographic Printing Wastes

Prepress:

- Waste Water
  - Acids
  - Alkalis
  - Solvents
  - Plate Coatings
  - Developers

P2 in Flexographic Printing

Prepress

- Replace chlorinated solvents w/ citrus based solvents used in platemaking.
  - ~100% VOC versus ~25% VOC
  - Citrus based solvents require extra water rinse.

P2 in Flexographic Printing

Prepress - Rubber Plate Making

1st Step of process - Master

- Replace metal engraved masters w/ photopolymer masters
  - Requires equipment and material replacement

P2 in Flexographic Printing

Prepress - Rubber Plate Making

2nd Step of process - Rubber Plate

- Convert to water-washable photopolymer plate making systems
  - nontoxic, noncarcinogenic & noncorrosive

OR

- Replace chemical process w/ laser engraved rubber plates

Both require equipment/material replacement

Flexographic Printing Wastes

Press:

- Waste Paper
- Waste Ink
  - VOC Emssions
  - Inks
- Cleaning Solvent
  - VOC Emissions
  - Hydrocarbons

P2 in Flexographic Printing

Press: Doctor Blades

- Install chambered doctor blade system
  - Controls ink transfer from ink fountain to substrait
  - Encloses inking system
    - reduces or eliminates solvent & amine evaporation

P2 in Flexographic/Gravure Printing

Press: Drying Systems

- Forced Heated Air (convection dryer)
  - uses natural gas or electricity
  - traditional dryer
- Infrared Drying
  - uses electromagnetic radiation & high energy
  - moderate capital cost
  - high operating cost
  - recommend use in conjunction w/ convection

P2 in Flexographic/Gravure Printing

Press: Drying Systems (Continued)

- Radio Frequency
  - High frequency electrical energy
  - High capital cost
  - Moderate operating cost
  - Supplement convection dryers or use in conjunction with IR

P2 in Flexographic Printing

Press: Anilox Rolls

- Ceramic - used with W.B. ink
- Chrome Plated - excess wear
- Laser Engraved - replace chrome plated.
  - Last better than chrome
  - Less wear on doctor blade than chrome

P2 in Flexographic Printing

Press: Anilox roll cleaning

- Use automated system w/ ultrasonic or high pressure liquid cleaning
  - reduces damage to cells
- Investigate new cleaning systems
  - CO2
  - Fine Particle Bombardment - Baking Soda

P2 in Flexographic/Gravure Printing

Press: Install Computerized Ink Mixing

- Advantages
  - Reduced raw material purchase
  - Left-over ink reblended into inks
  - Purchase only what is consumed
- Disadvantages
  - Space requirements
  - Employee requirements
  - Capital investment

P2 in Flexographic/Gravure Printing

Press:

- Reduce evaporative losses/VOC emissions
  - Enclose ink systems
  - Control ink temperature

Reduces evaporative loss of solvents and amines.
Helps maintain viscosity & retain color strength

P2 in Flexographic/Gravure Printing

Press: Water Based Ink Formulation

- Amines are key component
  - Aid in drying process
  - In formulation - aid in the binding of extenders, pigments & water

P2 in Flexographic/Gravure Printing

Press: Switch to Water Based Inks

- WB Ink Drying - 3 Step Process
  - Water evaporates from ink
  - Amines must leave ink to have water resistence
  - Polymer emulsion particles must bind

P2 in Flexographic/Gravure Printing

Press: VOC Reduction

- Solvent Vs. Water based inks:
  - 30-95% VOC to 0.01 to 15% VOC (avg)
- Cleaning Compound w/ Solvent vs. WB ink:
  - 95-100% VOC to 15-85% VOC

P2 in Flexographic/Gravure Printing

Press: Switch to Water Based Inks

- Advantages:
  - Lower VOC Content
  - Crisper, more vibrant colors
  - More stable in high-humidity conditions
  - Use detergent or low VOC cleaners
  - Require less make-up solvent (viscosity)
  - Lower overall cost
  - Waste less toxic

P2 in Flexographic Printing

Press: Switch to Water Based Inks

- Disdvantages:
  - Poor adhesion
  - Poor wet rub
  - Low gloss - requires additives
  - Reduced press speeds
  - Poor dry trapping
  - Prepress - plate films need further development
  - Corrodes inking system (water)

P2 in Flexographic/Gravure Printing

Press: Switch to Water Based Inks

- Cleaning Systems must be converted
  - Install Automatic Wash Equipment
  - Use heated detergent wash
  - Remove all ink
    - Extend life of anilox rollers
    - Extend life of doctor blades

P2 in Flexographic Printing

Press: Overcoming problems with W. B. Inks

- Poor Adhesion
  - Switch to Ceramic Anilox Rolls
  - Use plates which realease ink more readily
  - Prevent excess ink agitation
  - Control temps below 110 F
  - Maintain proper pH

P2 in Flexographic/Gravure Printing

Press: Overcoming problems with W. B. Inks

- Poor Trapping
  - Increase negative pressure on in-between dryers (increase hot air movement)

P2 in Flexographic Printing

Press: Switch to UV Curable Inks/Coatings

Advantages:

- No VOC
- Disadvantages
  - Capital Investment
  - Material Cost
  - Safety Concerns
  - Clean-up Solvent Required

Flexographic Printing Wastes

Post press or Finishing:

- Trim scrap - Waste Paper
- Rubber and Photopolymer Plates
- Metal Die Rule

Reducing Pre-make-ready Wastes

- Keep paper properly stored to avoid web breaks and curling problems during a run
- Use the smallest ink sump available
- Rinse spent ink filters with recovered solvent
- Use electromechanical engraving vs. chemical engraved cylinders

Reducing Make-ready Wastes

- Keep ink filters clean
- Make sure doctor blades are clean & in good condition
- Do your press set-up by the numbers
- Document all the press settings on the job jacket
- Check doctor blade angles
- Check ink viscosity and pH
- Adjust drier temperature as needed

Reducing Wastes at Press

- Use stepped doctor blades vs. conventional doctor blades
- Make sure web break detectors are maintained
- Keep ink fountains closed at all times
- Use additional solvent in inks only as a last resort

Mixing Fountain Ink

- Measure ink and extender carefully
- Measure viscosity
- Measure pH
- Add toners and pH adjusters judiciously
- Match drier temperature to meet supplier recommendations for paper and ink used for job

Improving Ink Handling Techniques

- Filter ink through organdy fabric to remove dried ink or contaminants
- Keep all containers tightly closed
- Properly label, seal and date ink containers
- Seal drums with gaskets
- Record weight and date on container before storing

Managing Waste Inks

- Drain and re-seal empty ink drums and kits
- Re-blend leftover inks from previously opened drums and kits to match requested colors
- Re-use or recycle uncontaminated ink from fountains
- Reduce environmental risk by sending ink waste to proper permitted fuel blending facility rather than to landfill

Tips for Making the Water Based Ink Conversion

- Provide good training for operators
- Involve all your suppliers
- Test your water
  - may need to pretreat water to assure consistent quality

... more ...

Tips for Making the Water Based Ink Conversion (cont.)

- Possible press adjustments
  - Cylinders may need to be re-etched
  - Proper pH levels in inks should be carefully monitored and maintained
  - Slightly slower press speed may be necessary to accommodate drying time
  - Dryers may need to be modified

Achieving Success in Conversion to Water-based Inks

- Use teamwork to develop and implement game plan
- Assure success by briefing and training press crews
- Work through successful conversion of one press at a time
- Transfer and adapt lessons to other presses

Case Study: Gravure Carton Manufacturer

- Situation
  - Previously ink leftover in sumps at the end of a run was combined with cleanup wastes and disposed of as a hazardous waste
  - Shipping out, on average, 5000 gallons/month costing approximately $5750/month in transport and disposal fees

Case Study: Gravure Carton Manufacturer

- Solution
  - Decided to save leftover ink at end of each job
  - Place ink into extender or top lacquer drums, weigh, label, and return to inventory as "fountain ink"
  - Track upcoming jobs using those ink colors, use as start-up ink
  - Subtract fountain ink from job usage records to accurately calculate VOC emissions and ink costs for each job

Case Study: Gravure Carton Manufacturer

- Reuse Leftover Fountain Ink
  - Saved fountain ink at the end of each job for re-use on future runs
  - **$160,000/year savings in ink, solvent, and waste disposal fees.**
- Reduced Amount of Raw Ink, Extender and Solvent Purchased
- Reduced Quantity of Waste Generated by 33%
  - **Saving $45,000/year in waste disposal fees**

P2 - Lithographic Printing

Reducing Waste from Pre-Press Operations

- Manage photographic supplies to prevent spoilage or date expiration
- Use replenishers to extend the lives of developers
- Use non-hazardous platemaking systems
- Minimize VOC content in platemaking chemistries
- Avoid chrome bearing cleaners for film and plate processing equipment
- Use and monitor silver recovery equipment
- Electronic imaging reduces photochemical wastes

P2 - Lithographic Printing

Prepress VOC Emission Sources

- Film Processing, Typesetting, Imagesetting
- Proofing Systems
- Plate Developing Systems
- Miscellaneous - Cleaners, Adhesives

P2 - Lithographic Printing

Prepress VOC Reduction

- Film, Image & Typesetting
  - NO Chemical Substitution Available

P2 - Lithographic Printing

Prepress VOC Reduction

- Proofing Systems:
  - Replace / Substitute With Water-Based System
    - 100% VOC to 5-10% VOC Content
  - Replace With Ink Jet System
    - Less than 1-5% VOC Content
  - Replace With Dry System
    - No Solvents

P2 - Lithographic Printing

Prepress VOC Reduction

- Platemaking Systems:
  - Replace / Substitute with Water-Based System
    - 100% VOC to 5-10% VOC Content.
  - Use equipment with squeegees
    - Can reduce solution dragout by 75%

P2 - Lithographic Printing

Chemical Conservation

- Film Processors:
  - Use automatic mixing equipment
  - Use floating lids on storage containers
  - Use equipment with squeegees - maintain.
    - Can reduce solution drag-out by 75%

P2 - Lithographic Printing

Chemical Conservation

- Film Processors:
  - Install fixer recirculating equipment.
    - Can reduce fixer use by 50%
  - Use chrome-free system cleaners

P2 - Lithographic Printing

Silver Recovery Technology

- Electrodeposition
- Chemical Recovery
- Ion Exchange

P2 - Lithographic Printing

Silver Recovery Technology

- In-line silver recovery can achieve 99% recovery rate.
- Off-Line can achieve 99 % + recovery rate.
  - On-Site - Use Holding Tanks, Metering System, pH adjustment
  - Off-Site - Use Precipitation.

P2 - Lithographic Printing

Silver & Waste Water Reduction

- Silver-Less Films or Dry Films
  - Expensive, Many in Beta Testing
  - Dmax Less than Conventional
  - Dmin Greater than Conventional
  - Compatibility with Conventional Film

P2 - Lithographic Printing

Silver, Film, & Waste Water Reduction

- Direct to Plate Imaging
  - Many in Beta testing for commercial printing
  - Some use dye sensitized photopolymer & alkaline/aqueous developer solutions
  - Some are silver halide-based with or without dye sublimation.
  - Thermally sensitive photopolymer.

P2 - Lithographic Printing

Silver, Film, & Waste Water Reduction

- Direct to Press Imaging
  - Expensive and quality issues.
  - Two use spark erosion technology - waterless.
  - Some use dry toner or liquid toner
  - One uses special ink

Pre-Press Process Control Improves Quality & Reduces Wastes

- Build your job within press capabilities
- Monitor film and plate making exposures and development
- Check all films and plates for errors
- Regularly clean film and plate processors
- Date and properly store all materials
- Change color-viewing lights periodically
- Periodically calibrate all pre-press electronic systems and measuring tools.

P2 - Lithographic Printing

Conserve Water Usage in Pre-Press Area

- Film Processor:
  - Install wash water recirculating equipment
    - Can reduce use by 90%
- Plate Processor:
  - Adjust processor to minimum flow rate.
  - Eliminate non-functional water use
  - Install wash water recirculating equipment
    - Can reduce use by 90%

VOC Emission Sources from Lithographic Presses

- Inks - Ink oils
- Fountain Solutions - Isopropyl Alcohol
- Cleaning Solutions
- Coatings/Tinting
- In-Line Systems - Ink Jet, Adhesive, Fragrance

Practical Waste Reduction in the Lithographic Pressroom

- Preventive maintenance of pressroom equipment
- Reducing make-ready wastes
- Understanding and Controlling Press Chemistry
- Reducing solvents in ink
- Reducing Ink Wastes

P2 - Lithographic Printing

Reducing Make-ready Wastes

- Keep dampening system clean
- Maintain accurate plate-to-press registration
- Do your press set-up by the numbers
- Document the press used and all press settings on the job jacket
- Check impression pressure
- Adjust ink fountain and water fountain settings
- Choose compatible ink and paper

Monitor and Control Quality of Makeup Water

- Inconsistent water quality can affect fountain solution and press performance
- Water needs to have consistent, acceptable pH and conductivity
- May need to treat incoming water
  - Water softening
  - Deionization
  - Reverse osmosis
- Before investing in treatment, test treated samples on your presses

P2 - Lithographic Printing

Water Conservation - Pressroom

- Measure incoming water quality
- Install Automix for fountain solution
- Choose proper concentrate - chrome free

P2 - Lithographic Printing

Water Conservation - Pressroom

- Install filters in dampening system.
  - Can reduce f.s. consumption by 50%
- Install radio frequency units
  - Can reduce consumption by 50%
- Replace with waterless.

P2 - Lithographic Printing

Key Characteristics of Fountain Solution

- pH
  - indicates relative acidity (<7) or alkalinity (>7)
  - most fountain solutions are acidic, but alkaline and neutral solutions are also used
  - pH typically measured with pH pen

  test strips can be used, but less accurate

  . . . more . . .

P2 - Lithographic Printing

Key Characteristics of Fountain Solution (cont.)

- Conductivity
  - indicates ability of solution to pass electrical current
  - rises as additives or impurities increase in fountain solution
  - measure with conductivity meter or pen

P2 - Lithographic Printing

Mixing Fountain Solution

- Measure concentrate and additives carefully
- Measure pH
- Measure conductivity
- Match pH and conductivity to meet supplier recommendations for plate, paper and ink used for job

P2 - Lithographic Printing

Monitor and Control Fountain Solution Quality

- Measure pH and conductivity at least daily
- During a run, pH can either increase or decrease depending on acidity or alkalinity of paper
- Contaminants will increase conductivity

P2 - Lithographic Printing

VOC Reduction from Presses

- Fountain Solutions:
  - Reduce IPA Levels - Extenders
    - 20-25% VOC to 5-15% VOC Content
  - Substitute IPA - Glycol Ethers / Glycols
    - 20-25% VOC to 1-5% VOC Content
  - Substitute Free - Citric Acid / Surfactant
    - 20-25%VOC to 0-1% VOC Content

P2 - Lithographic Printing

VOC Reduction from Presses

- Fountain Solutions:
  - Reduce IPA Levels - Replace Damp. System
    - 20-25% VOC to 5% or Less VOC Content
  - Reduce IPA Levels - Cover Recirculators
    - Reduce Evaporative Loss
  - Reduce IPA Levels - Refrigerate
    - Cut IPA Consumption by 40%

Benefits of Alcohol Substitutes in Fountain

- Richer, brighter colors
- No replenisher needed
- Improved dot quality and reduced dot gain
- Cost savings
- Reduced shop odors
- Reduced fire risks
- Less fountain solution required

Tips for Making the No/Low Alcohol Conversion

- Provide good training for operators
- Involve your suppliers
- Test your water
  - may need to pretreat water to assure consistent quality

... more ...

Tips for Making the No/Low Alcohol Conversion (cont.)

- metering roller durometer should be 18-22 rather than 25-30
- Decrease nip between chrome roller and dampening form roller
- Higher roller speed may be necessary
- Increase nip between chrome roller and metering roller
- Skewing the metering roller works best for some presses and fountain solutions

Achieving Success in Conversion to No/Low Alcohol F.S.

- ✦ Use teamwork to develop and implement game plan
- ✦ Assure success by briefing and training all press operators
- ✦ Work through successful conversion of one press
- ✦ Transfer and adapt lessons to other presses

Reduce Lithographic Ink Waste

- ✦ Remove foreign or dried material from ink surface
- ✦ Cover ink surface w/ wax paper or plastic wrap
- ✦ Properly seal ink cans
- ✦ Seal the lip of can w/ a coating of grease or oil
- ✦ Record date on can

Reduce VOC from Lithographic Presses

- ✦ Inks:
  - – Substitute with Vegetable Oil-Based Inks
    - ♦ 10-25% VOC to 3-7% VOC Content - Sheetfed
    - ♦ 35-45% VOC to 25-30% VOC Content - HSWO
    - ♦ 10-30% VOC to 3-7% VOC Content - NHSWO

Reduce VOC from Lithographic Presses

- ✦ Inks:
  - – Replace With UV/EB Cured Inks:
    - ♦ No VOC Content - 100% Solids.
  - – Capture/Control Devices

Improving Lithographic Ink Handling Techniques

- ✦ Remove any foreign or dried material from surface
- ✦ Cover surface with wax paper or plastic wrap
- ✦ Properly seal and date ink cans
- ✦ Seal can lip with coating of grease or oil
- ✦ Record date on can before storing

Managing Ink Inventory to Reduce Wastes

- Keep good records of all existing stock to enable recall and reuse
- Use first in, first out rule
- Consider mixing small quantities of needed PMS colors from existing, partially used cans of inks
  - Readily available software can show how to use existing stock to mix required colors

... more ...

Managing Ink Inventory to Reduce Wastes (cont.)

- Use existing stock whenever possible for in-house jobs
- For jobs where exact color is not critical, offer customer reduced price for use of leftover ink colors
- Reblend leftovers into "house black"
- If quantities are sufficiently large, consider sending to ink recycler for reprocessing

Managing Lithographic Waste Inks

- Scrape and crush empty ink cans
- Re-blend leftover inks from previously opened cans to match requested PMS colors
- Reblend or recycle uncontaminated ink from fountains into dark ink
- Reduce environmental risk by sending ink waste to proper permitted fuel blending facility rather than to landfill

P2 - Lithographic Printing

Reducing Wastes During Cleanup

- Smart solvent selection and use
- Prudent management of solvent wastes
- Responsible management of towels and wipes
- Reduction and management of ink wastes

P2 - Lithographic Printing

Reducing Wastes During Cleanup

- Cleaning Solutions
  - Reduce VOC Content - New Formulations
    - Vegetable Oils, Fatty Acid Esters, Terpenes, Petroleum - either straight, blended together including water
    - 100% VOC to 0-70% VOC Content
    - Some can be difficult to work with.

P2 - Lithographic Printing

Reducing Wastes During Cleanup

- Cleaning Solutions:
  - Reduce Vapor Pressure
    - 100% VOC-Choose those with Vapor Pressure of 10 mm Hg at 20 C or less. Deemed equivalent to 30% VOC by weight.
    - Can reduce emissions from cleanup solutions by 50% or more.

P2 - Lithographic Printing

Reduce Solvent Washups by Planning Ahead

- Group jobs with similar ink colors
- Run from light colors to dark
- When possible, designate some presses to run certain colors
- If schedules allow, run certain colors on given days

P2 - Lithographic Printing

Reduce Cleaning Solvent Usage

- Use Automatic Blanket Washers
  - Can Reduce Solvent Consumption by 60-70%.
  - Some Systems Can Use 30% by Weight VOC Solutions
- Limitations
  - Can Increase Total Solvent Usage
  - Proper Operator Training is Require

VOC Emission Sources in Binding and Finishing

- Adhesives
- Coatings / Tinting
- Ink Jetting
- Shrink Wrap

Reduce VOC Emissions from Binding & Finishing

- Adhesives
  - Replace with Water-Based
    - From 50-70% VOC to 5-15% VOC Content
  - Replace with Hot-Melts
    - From 50-70% VOC to ~1.5% VOC Content
  - Cover Applicators
  - Capture/Control System.

Reduce VOC from Binding & Finishing

- Coatings
  - Replace with Water-Based
    - From 90-95% VOC to 5-15% VOC Content
  - Replace with UV
  - From 100% VOC to 0% VOC Content

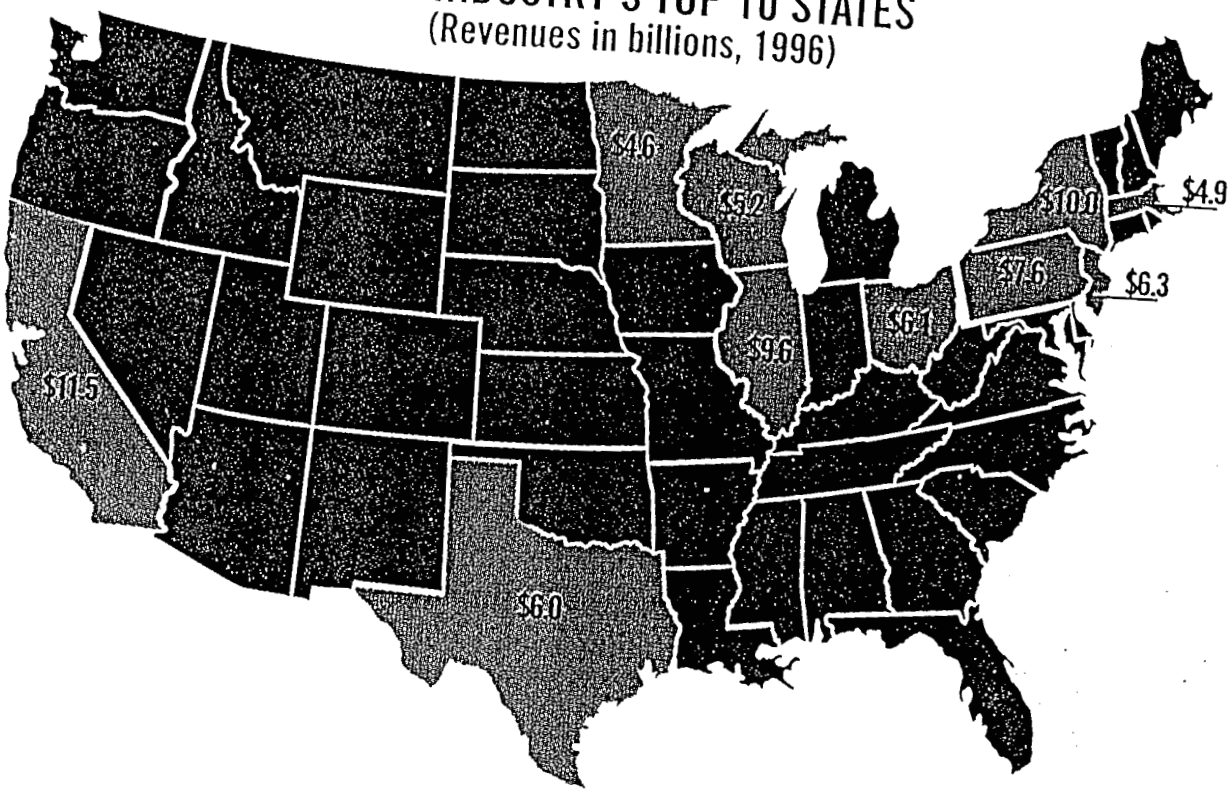
Reduce VOC from Binding & Finishing

- Tinting Solutions
  - Replace with Water-Based Solutions
    - From 90-95% VOC to 5-15% VOC
  - Capture/Control System
  - Purchase Pre-Tinted Paper

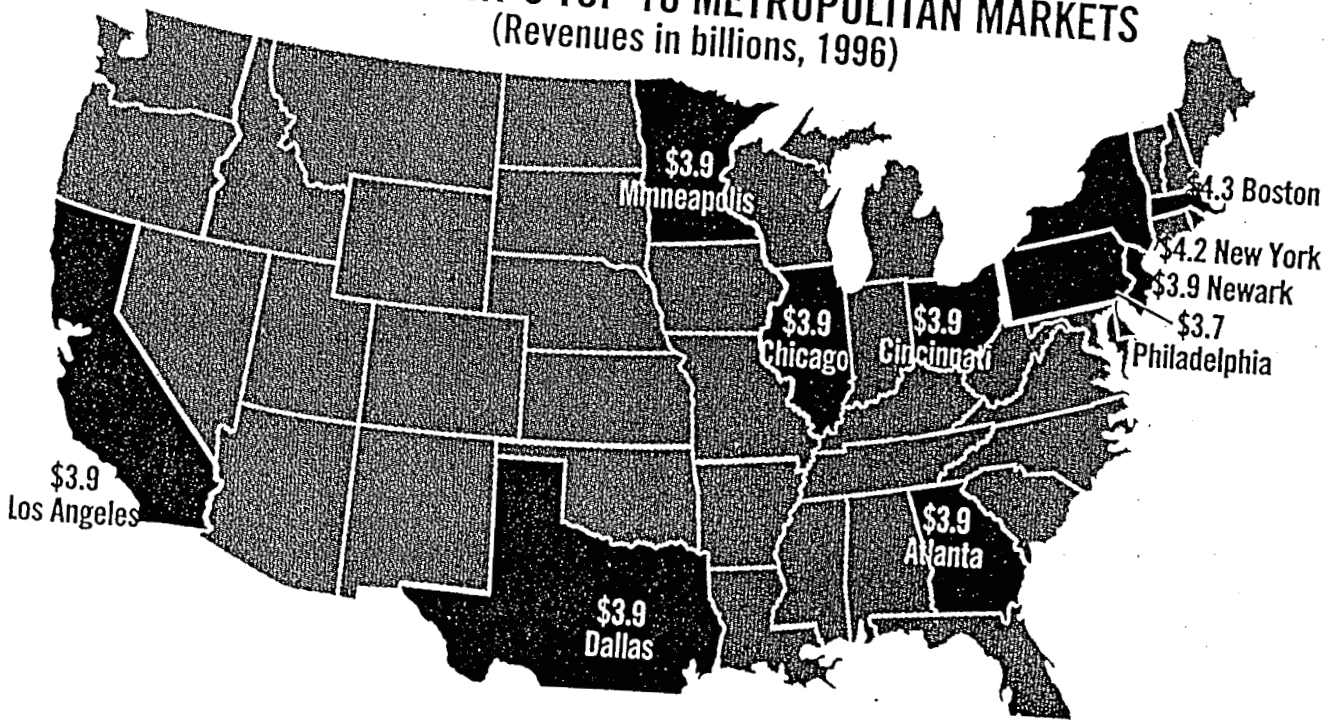
Reduce VOC from Binding & Finishing

- Ink Jet
  - Replace with Water-Based Chemistry
    - From 90% to 5-15% VOC Content
    - Cover Applicators
    - Capture/Control System

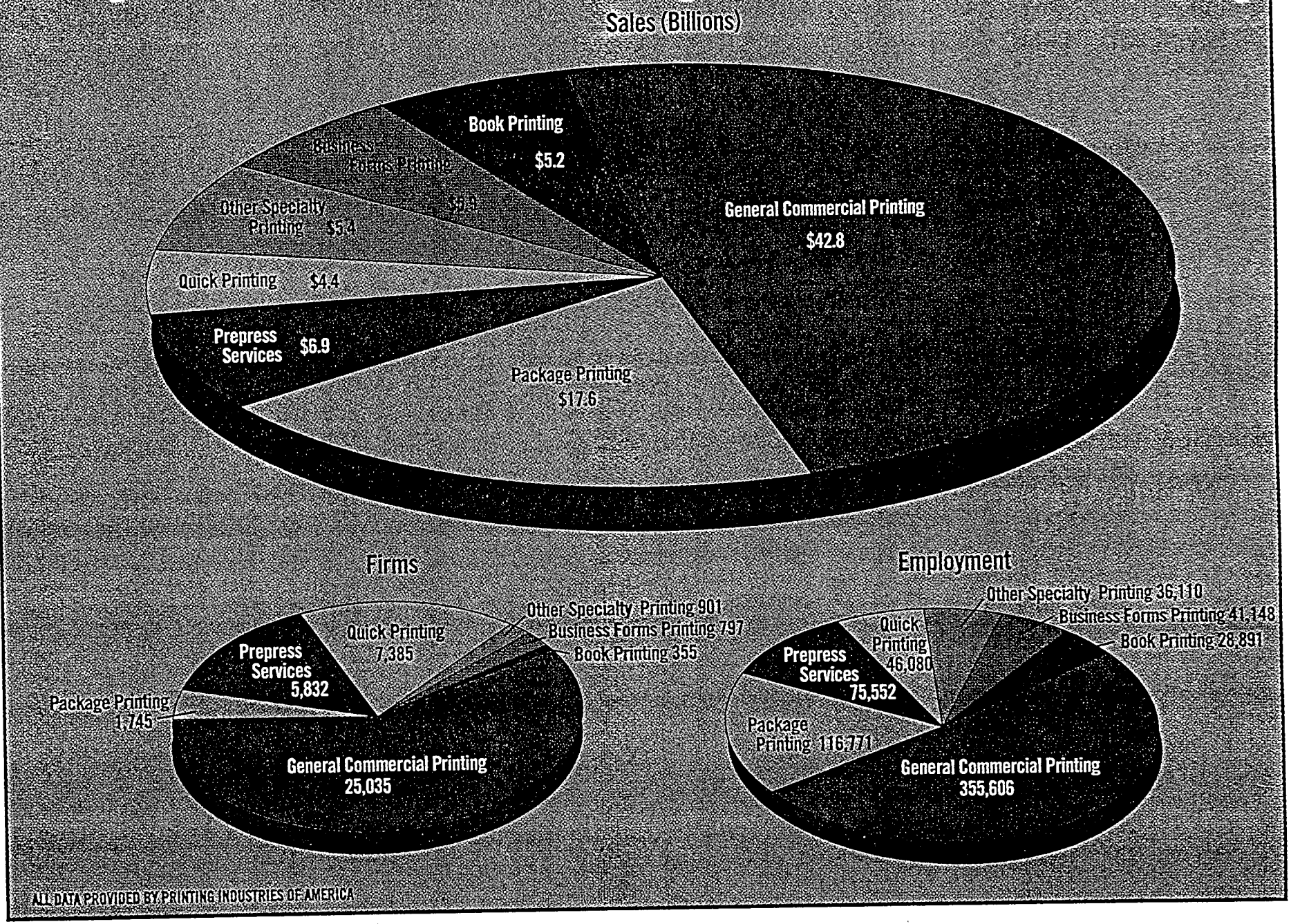
THE INDUSTRY'S TOP 10 STATES
(Revenues in billions, 1996)



THE INDUSTRY'S TOP 10 METROPOLITAN MARKETS
(Revenues in billions, 1996)



TOP MARKET SEGMENTS COMPRISING THE U.S. PRINTING & IMAGING INDUSTRY



ALL DATA PROVIDED BY PRINTING INDUSTRIES OF AMERICA

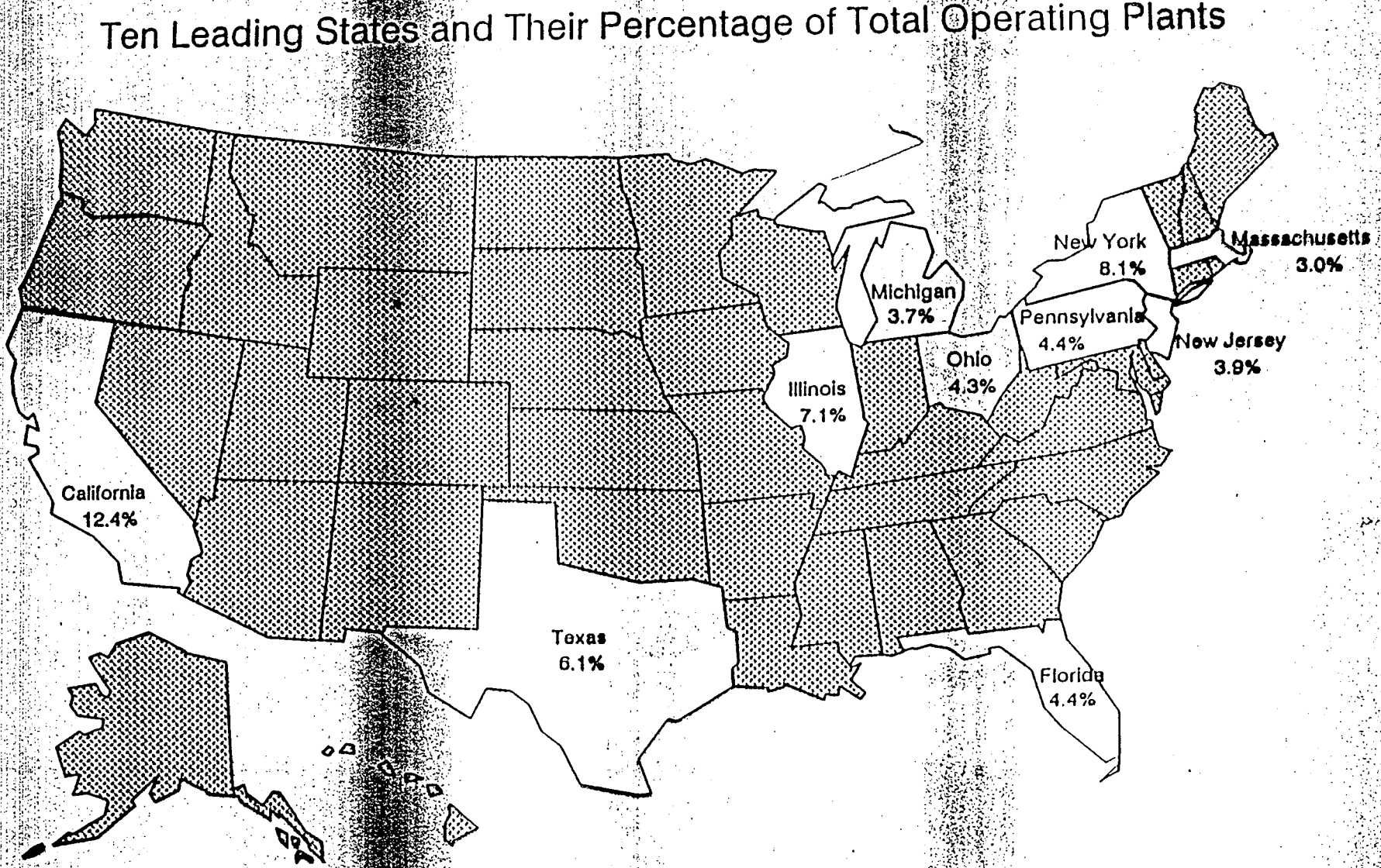


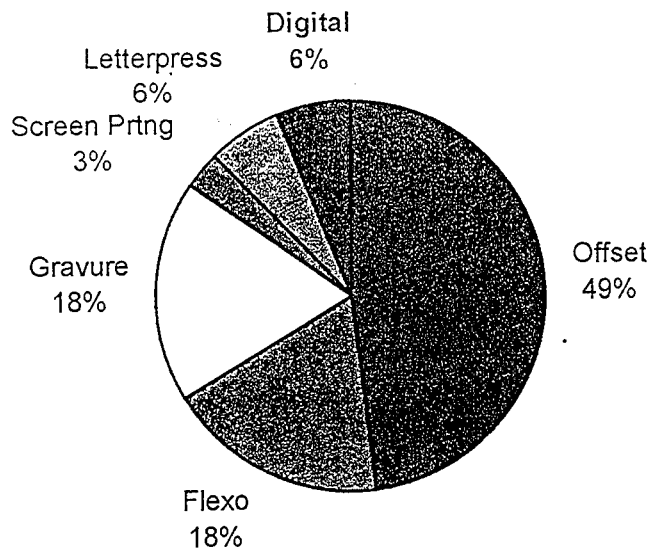
Figure 4. Geographic distribution of printing plants (Source: A.F. Lewis 1991).

APPLICATIONS OF THE MAJOR PRINTING PROCESSES

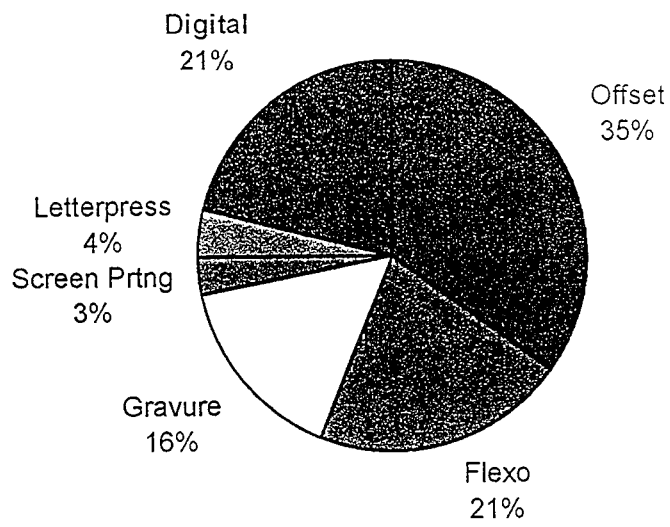
- LITHOGRAPHY
  - Magazines
  - Newspapers
  - Books
  - Envelops
  - Labels and tags
  - Stationery
  - Greeting Cards
  - Advertising
  - Packaging (Folding Paper Boxes)
- FLEXOGRAPHY
  - Packaging
  - Newspapers
  - Magazines
  - Directories
- GRAVURE
  - Packaging
  - Advertising
  - Magazines
  - Bank Notes
  - Stamps
  - Art Books
  - Annual Reports
  - Tissue Products
  - Wall Coverings
  - Films and Laminates
- LETTERPRESS
  - Magazines
  - Newspapers
  - Books
  - Stationery
  - Advertising
- SCREEN
  - Signs
  - Electronics
  - Fine Arts
  - Ceramics and Glass
  - Textiles
  - Decals
  - Nameplates and Panels
  - Containers and Other 3-Dimensional Items
- PLATELESS
  - Short-Run Business Forms
  - Manuals
  - Bar and Batch Codes
  - Tickets
  - Personalized Computer Letters
  - Sweepstakes Mailers
  - Tags
  - Checks

Figure 2. Applications of the Major Printing Processes

Digital Printing Technology is Growing



1995



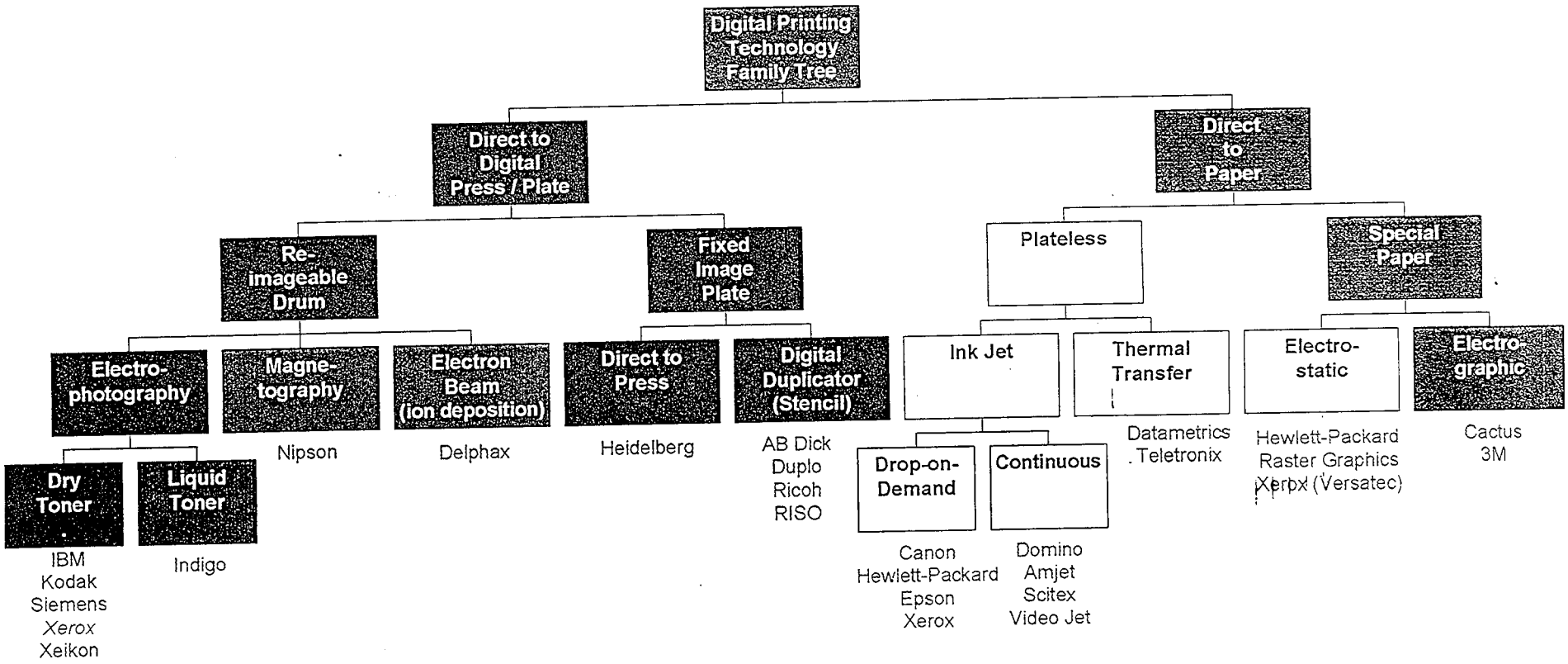
2025

Source: Rochester Institute of Technology

Key Characteristics of Digital Xerography

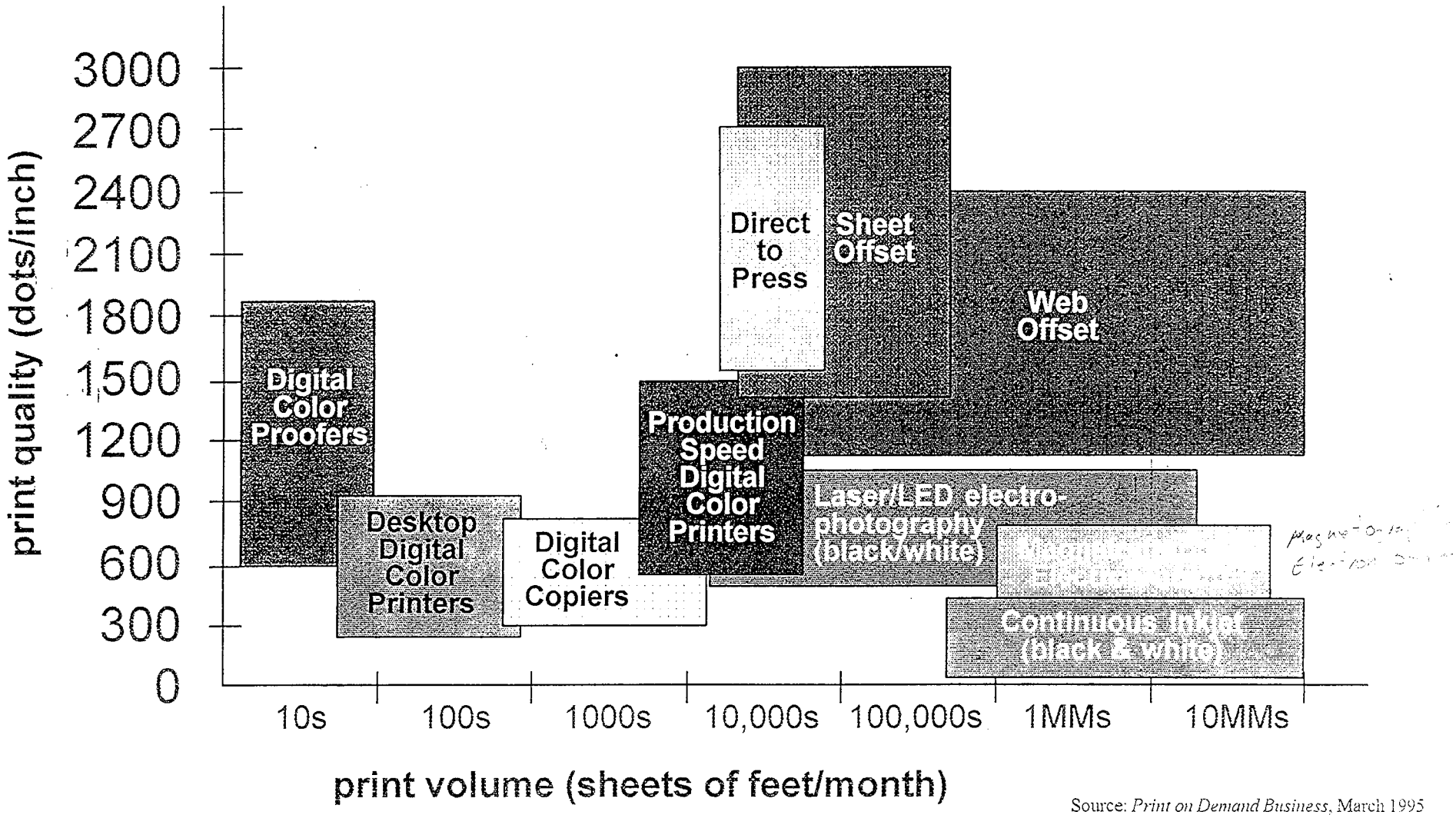
- **Digital Imaging Process**
- **Dry Toner Printing Process**
- **Print on Demand Capability**

Digital Printing Technology Family Tree



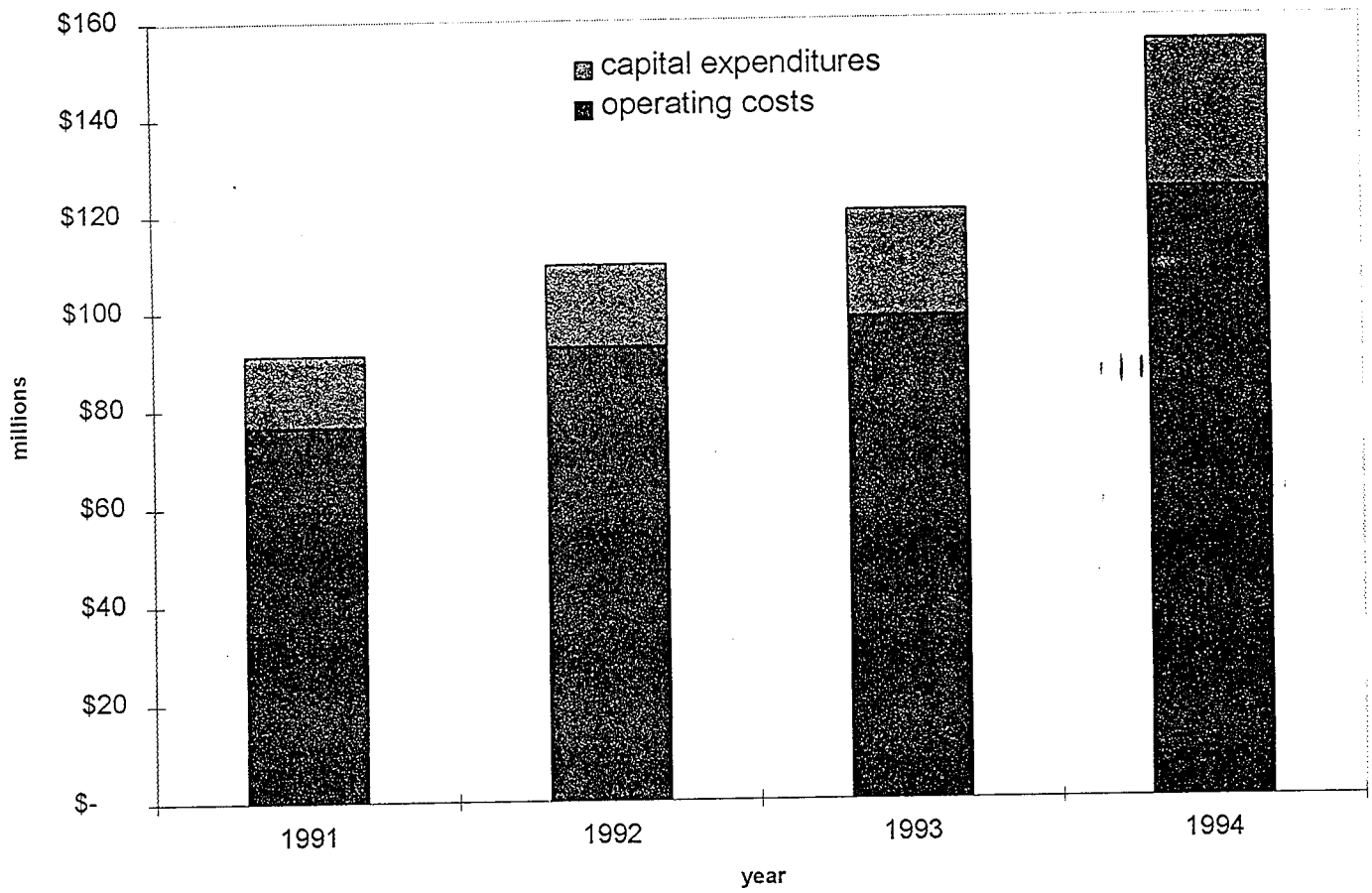
Source: *Print on Demand Business*, March 1995

Spectrum of Printing Technologies



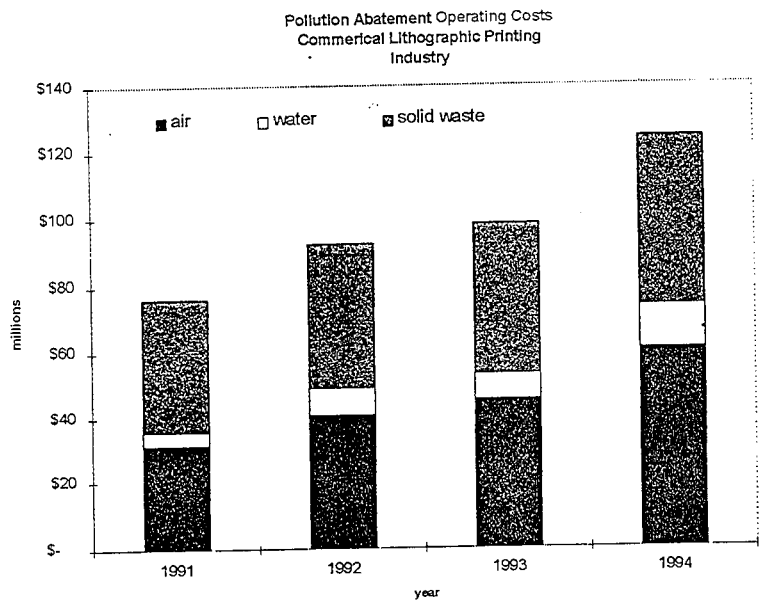
Source: *Print on Demand Business*, March 1995

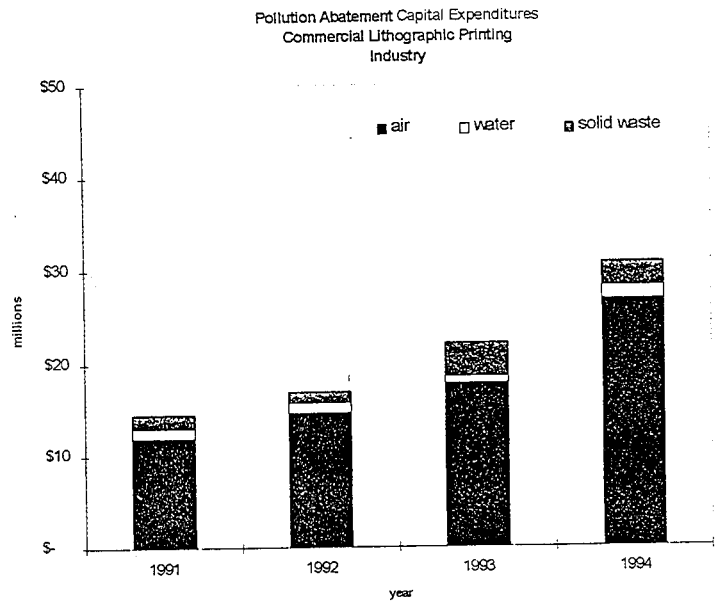
Offset Pollution Abatement Costs Rising



Source: *Pollution Abatement Costs & Expenditures,* U.S. Department of Commerce, Economics & Statistics Administration Bureau of the Census

Air Abatement Most Significant Contribution to Cost Increase





Source: *Pollution Abatement Costs & Expenditures,* U.S. Department of Commerce, Economics & Statistics Administration Bureau of the Census

Digital Xerography Produces Minimal Environmental Impact

No/Minimal:

- Regulatory compliance burden
- Potential environmental liability
- Make-ready & over-run waste

Digital Workflow Translates to Minimal Waste

Traditional Pre-Press for Offset Lithography	Electronic Pre-Press for Offset Lithography	Electronic Pre-press for Digital Xerography
Typesetting	Word Processing	Word Processing
Paste-up	Page Creation	Page Creation
Line Negative	N/A	N/A
Halftone Negative	Scanning	N/A
Film Assembly	Image Assembly	N/A
N/A	Imagesetting	Laserprint/scan or Media/Network Server
Proofing	Proofing	N/A
Platemaking	Platemaking	N/A
Presswork	Presswork	Copier/Printer

Source: Rochester Institute of Technology

Digital Imaging

Eliminates Prepress Materials

Materials

Film/glass cleaner
Equipment cleaner
Film developer
film fixer
Plate developer
Plate finisher/repl.
Image preserver
Color proofing

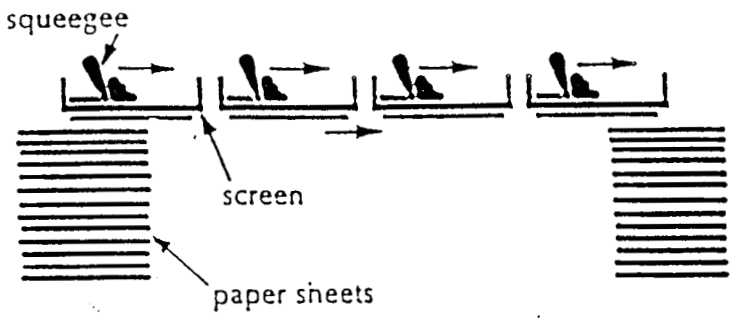
Chemicals

Alcohols: Isopropanol, n-propanol
Chlorinated solvents: 1,1,1-trichloroehane, perchloroethylene
Glycol ethers: 2-butoxy ethanol
Ethylene glycol
Acids/bases: acetic acid, sodium hydroxide, phosphoric acid, sulfosalicyclic acid
Flammable/combustible: acetone, stoddard solvents, alcohols
OTHERS....

Fewer Materials Used in Dry Toner Printing

MATERIAL	CHEMICALS	OFFSET	D/X
ink, varnish	petroleum distillates, vegetable oils, resin, rosin, dryer, pigments containing barium and copper	X	
fountain solution	isopropanol, 2-butoxy ethanol and other glycol ethers, gum arabic, phosphoric acid, ethylene glycol	X	
wash solvent / plate cleaner	aliphatic and aromatic hydrocarbons, mineral spirits, acetone, methylene chloride, xylene, toluene, isopropanol, glycol ethers, vegetable oils, fatty acids, surfactants	X	
glaze remover	toluene, methanol, acetone	X	
plate developer	benzyl, alcohol, diethanoamine, polyvinyl alcohol, ethylene glycol, acetic acid	X	
plate finisher/replenisher	dextrin, mineral spirit, sodium hydroxide, N-methylpyrrolidone, sodium sulfite	X	
image preserver	stoddard solvent, phosphoric acid	X	
color proofing	n-propanol	X	
carrier	steel powder		X
toner	styrene/butadiene copolymer, iron oxide, carbon black		X
dry ink	styrene/butadiene copolymer, iron oxide, carbon black, quaternary ammonium salts		X
fuser shield	polydimethylsiloxane, organo-functional polydimethylsiloxane		X

SCREEN PRESS



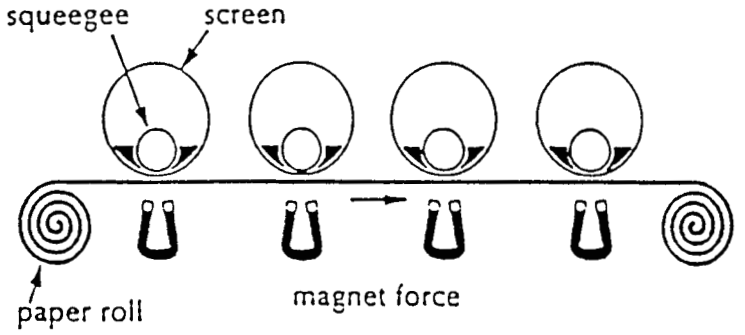
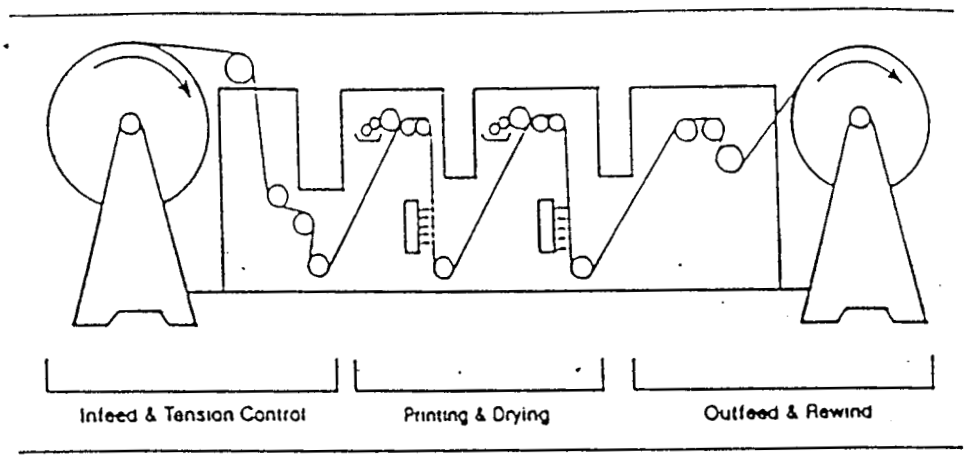


Figure 25. Flat-bed Screen Press (top) and Rotary Screen Press (Source: Field 1980. Reproduced by permission of Ayer Company Publishers, Inc.)

FLEXOGRAPHIC PRESS



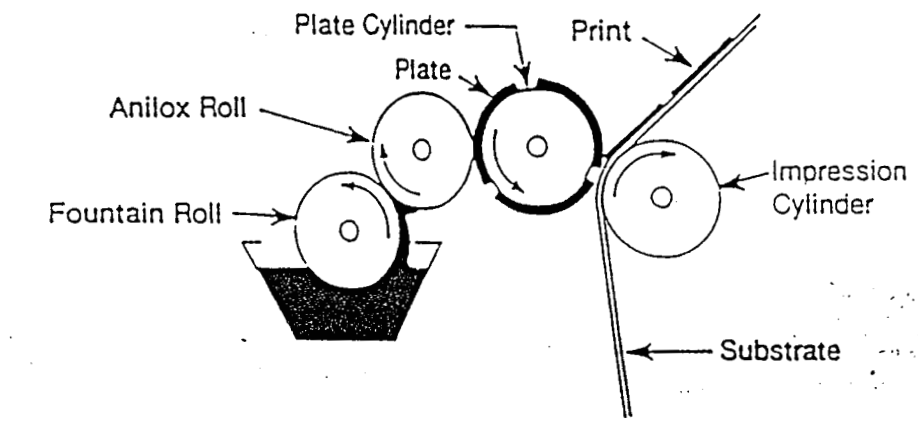


Figure 20. Web-fed Rotary Flexographic Press (top) and Three Roller Ink System (Source: Adams 1988. Reproduced by permission. Printing Technology, 3rd Edition by J. Michael Adams, David D. Faux and Lloyd Reiber, Delmar Publishers, Inc., Albany, New York, Copyright 1988)

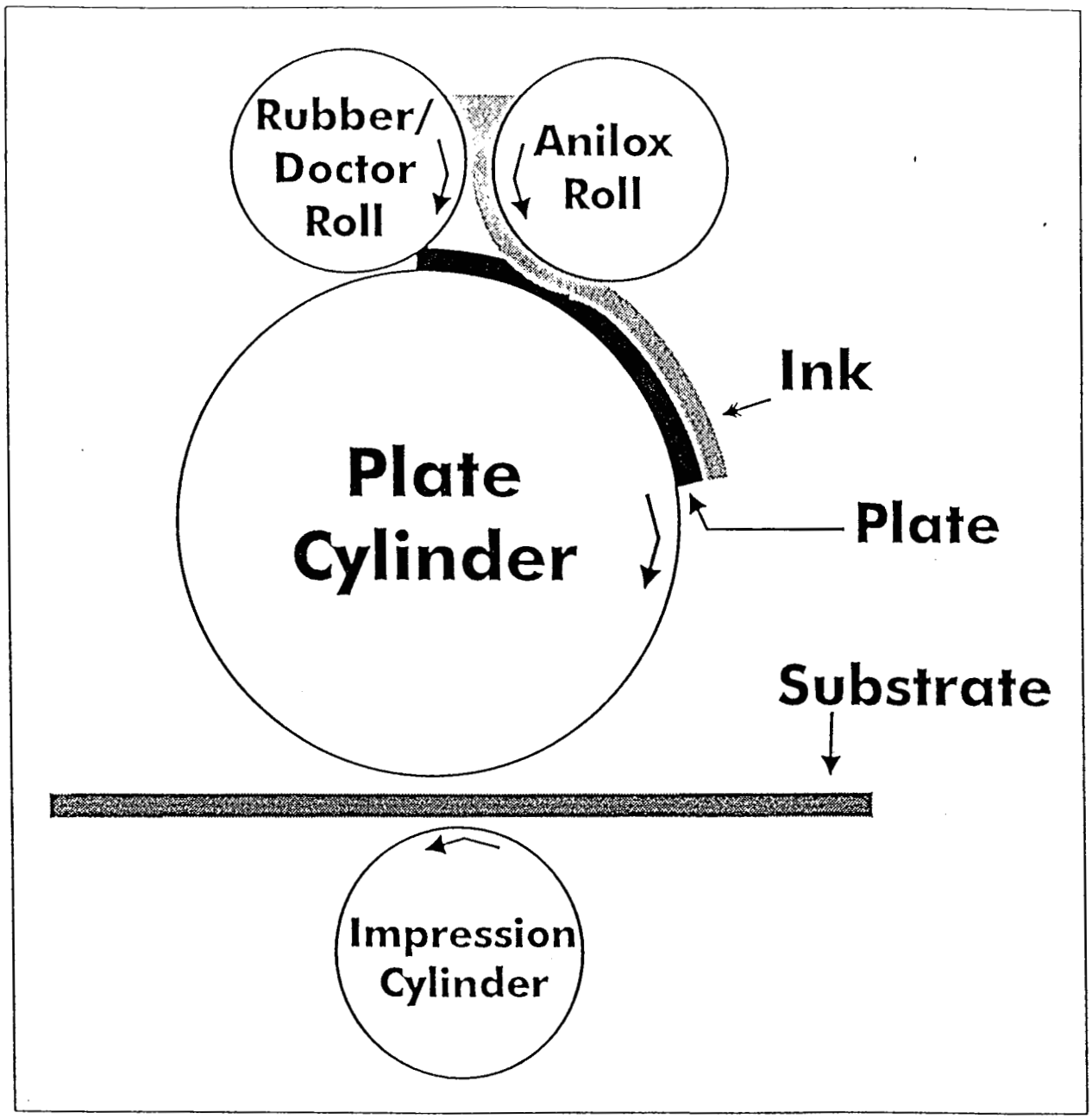
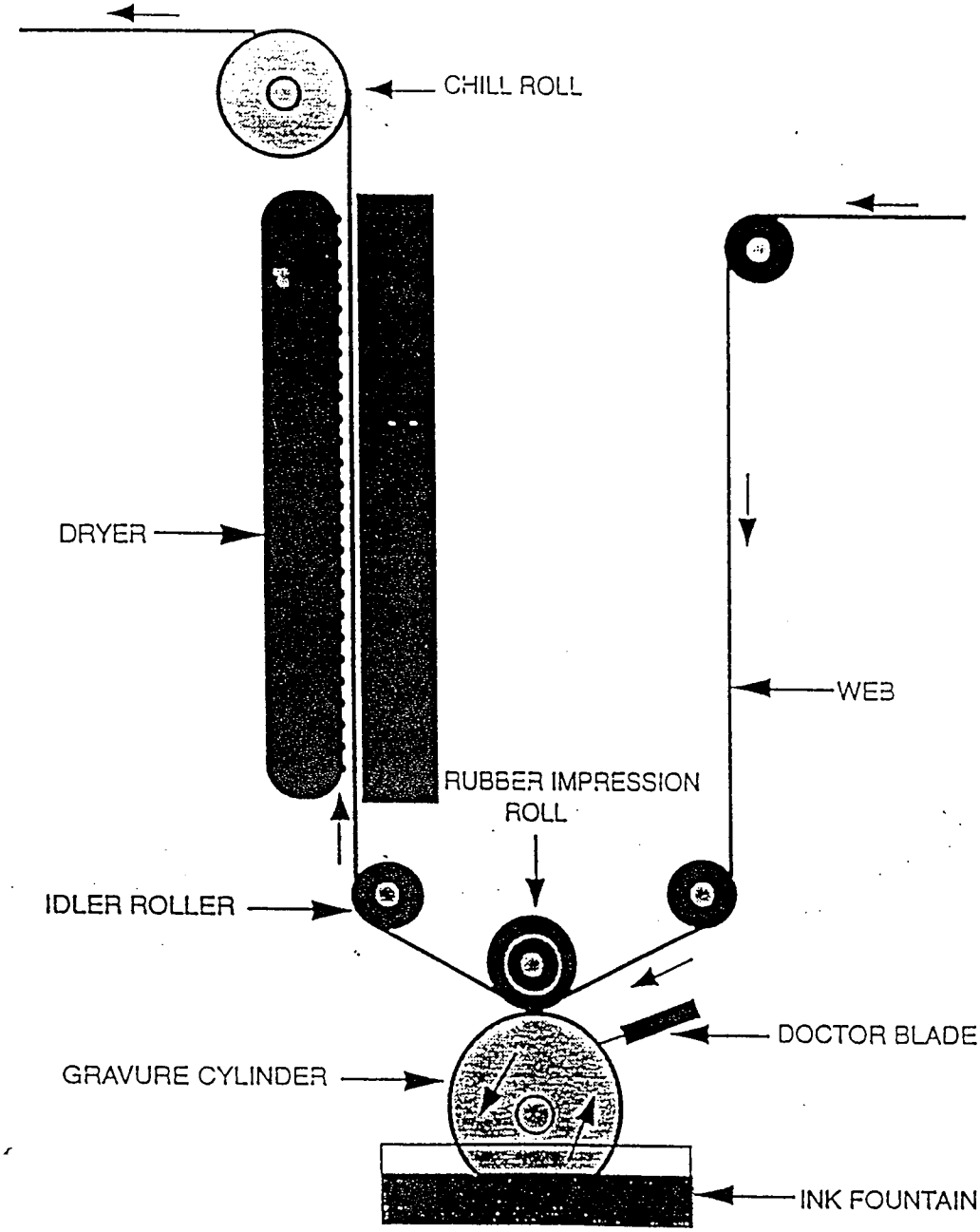


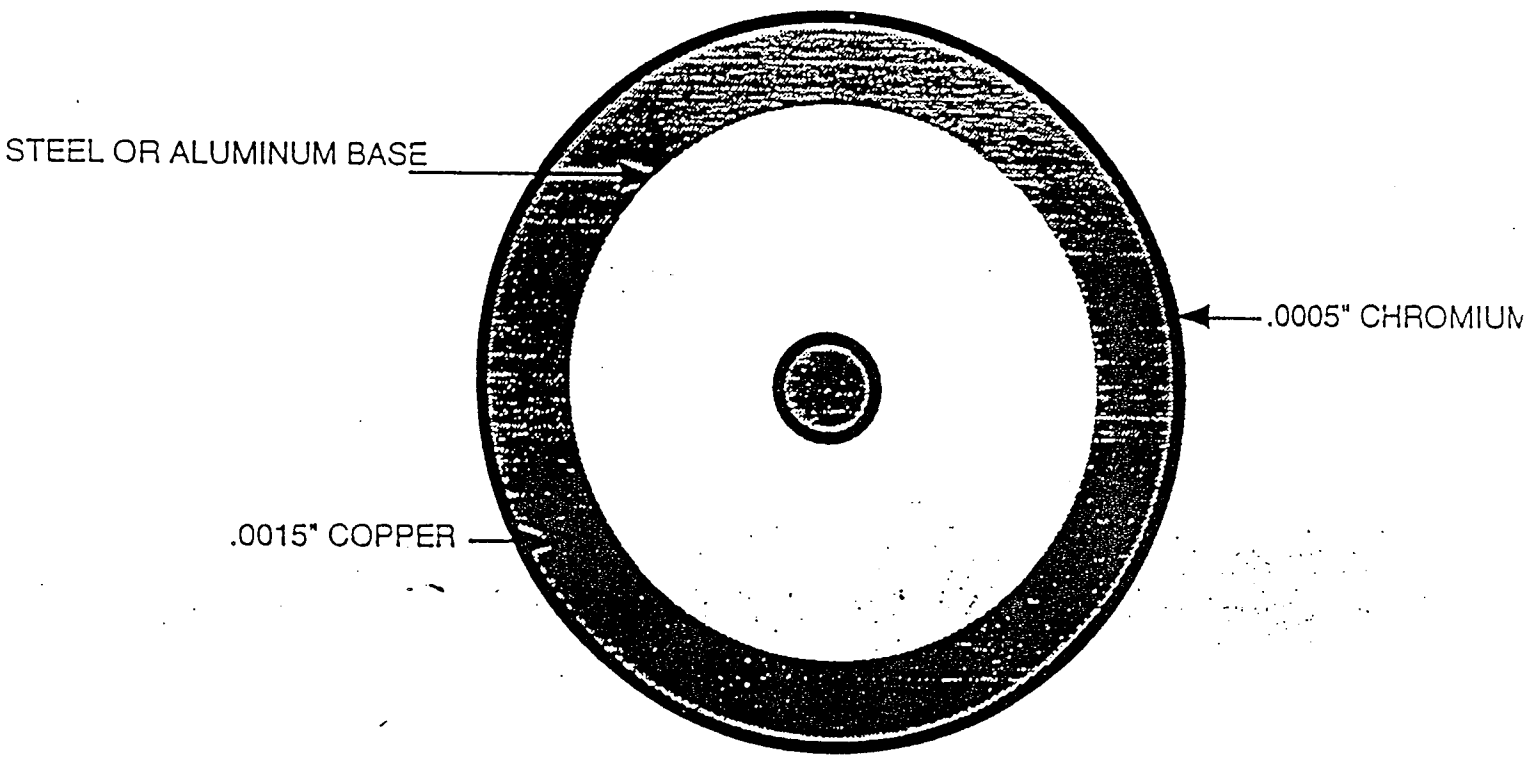
Figure 9. Principle of Flexography

BASIC GRAVURE PRINTING



Source: The Basics of Gravure Printing, GAA

THE GRAVURE CYLINDER



Source: The Basics of Gravure Printing, GAA

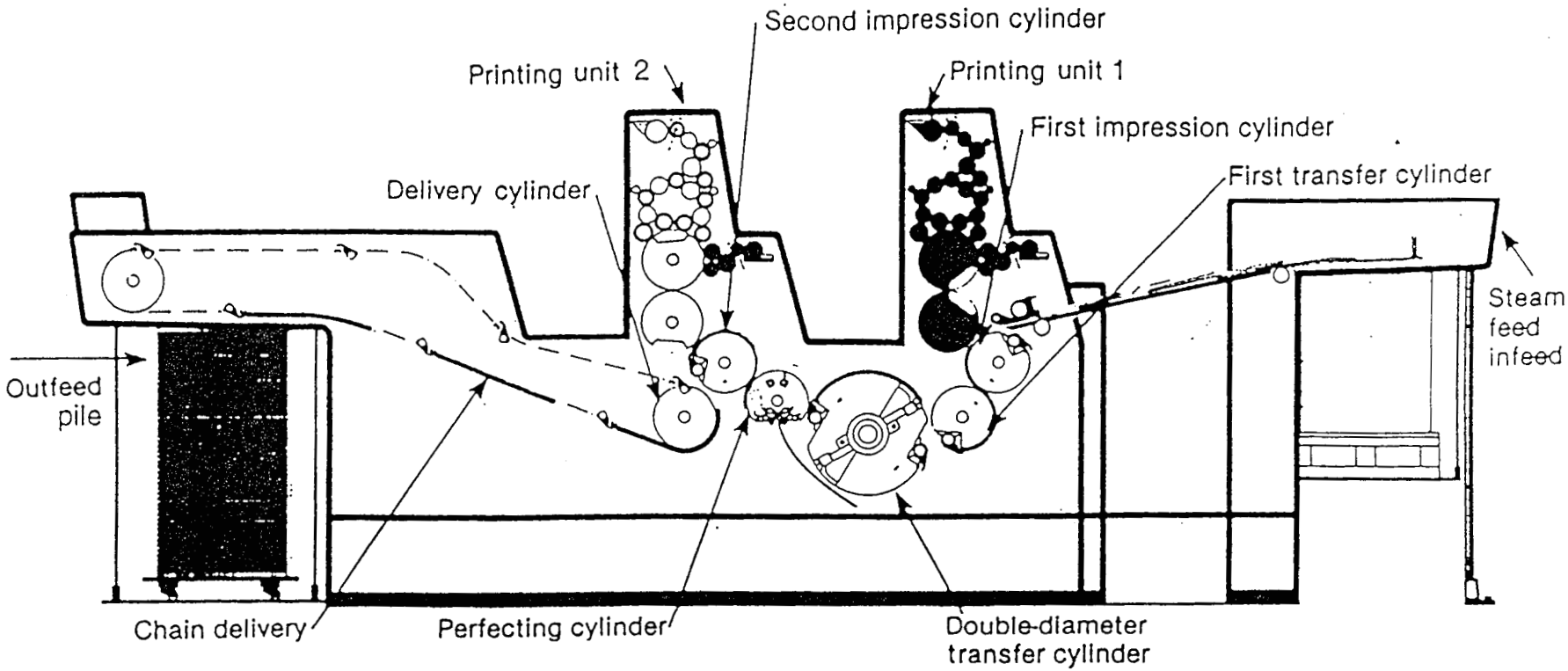


Figure 12.30. **A two-color, sheet-fed offset press equipped with a perfecting transfer system.** The two transfer cylinders and the perfecting cylinder in this press allow for printing one color on each side of the press sheet or two colors on one side of the press sheet.

Courtesy of Miller Printing Equipment Corp.

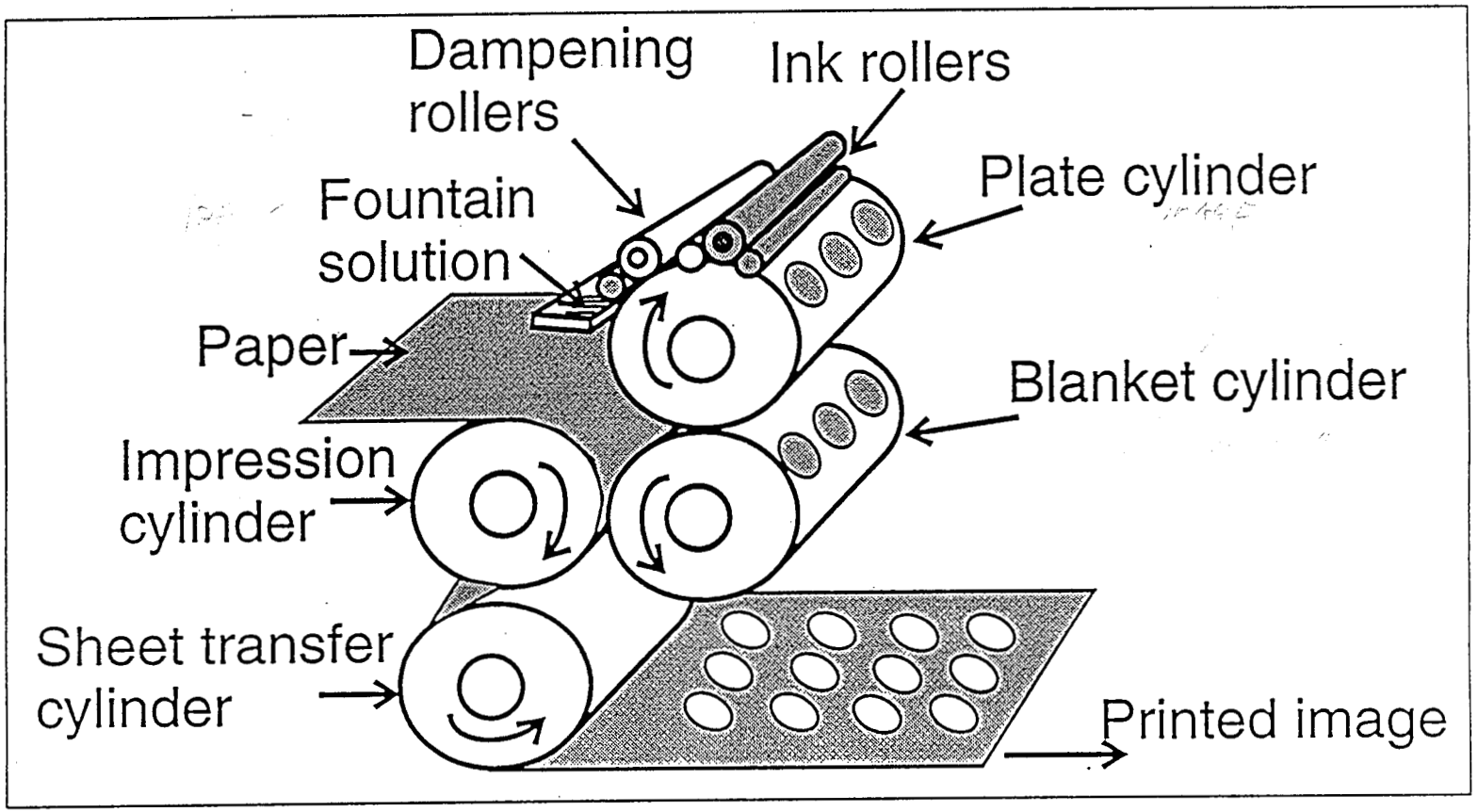


Figure 7. Principle of Offset Lithography

United States Environmental Protection Agency | Pollution Prevention and Toxics (7406) | EPA 744-F-95-006 February 1996

47510 a

EPA

Design for the Environment
Flexography Project

What Is Design for the Environment?

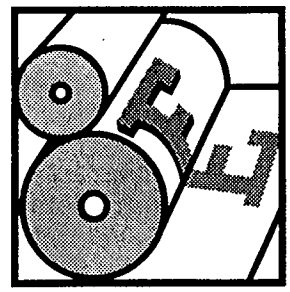
The Design for the Environment (DfE) Program harnesses EPA's expertise and leadership to facilitate information exchange and research on risk reduction and pollution prevention opportunities. DfE works with both large and small businesses on a voluntary basis, and its cooperative projects attempt to:

- Work with specific industries to evaluate the risks, performance, and costs of alternative chemicals, processes, and technologies.
- Change general business practices to incorporate environmental concerns.
- Help individual businesses undertake environmental design efforts through the application of specific tools and methods.

DfE partners include:

- Industry
- Professional Institutions
- Academia
- Environmental and Public Interest Groups
- Other Government Agencies

Focusing on Flexo Inks



More than 1,600 printers in the United States use flexographic presses. These presses can be found in facilities ranging from small (less than 10 employees) to large (200 to 300 employees). Flexography is primarily used for printing on consumer packages or labels made of paper, corrugated, and plastic films. In addition, some consumer and commercial products have parts that are produced on flexographic presses.

Flexography involves printing from a raised image on a printing plate made from either rubber or photopolymers with highly fluid, quick-drying inks. The ink is applied to the raised portion of the plate, and the image is transferred by the plate to a substrate (e.g., paper, film, or board). The inks used for flexography are liquid and contain solvents or water. Selection of inks is critical to meeting the quality and performance requirements for a wide variety of substrates with varying printing parameters.

The conventional inks used for flexography consist of solvents made of volatile organic compounds (VOCs), which can pose risks to human health and to the environment. For this reason, they are regulated as air pollutants and hazardous materials. The VOCs in conventional inks contribute to ozone pollution and can adversely affect air quality. These inks also can have potentially detrimental effects when disposed of improperly.

The flexography industry has been evaluating and adopting alternatives to the conventional ink formulations in an effort to find cleaner and safer materials for printing images. The industry's efforts in this area have included evaluating waterborne and UV-cured inks, as well as press modifications and add-on controls. Adopting these technologies can reduce the potential for pollution, eliminate or reduce air emissions, and prevent the generation of hazardous wastes and other discharges. There are technical and environmental advantages and disadvantages associated with each of these technologies, however. These advantages and disadvantages might affect product quality, production efficiency, and energy usage, or involve the transfer of pollution from one medium to another, transfer of waste streams, retraining facility personnel, and modification or replacement of existing equipment.

The Design for the Environment (DfE) Flexography Project is a unique voluntary effort between the flexographic printing industry and the U.S. Environmental Protection Agency (EPA) that seeks to provide information about the advantages and disadvantages associated with solvent, waterborne, and UV-cured flexographic ink technologies. The project will assess the performance, costs, environmental and human

health risks, and pollution prevention effects associated with these technologies. DfE's goal in working with flexographic printers is to help them make more informed choices now and in the future by easing the search for and evaluation of cleaner processes, products, and technologies.

How Did the DfE Printing Project Get Started?

DfE began working with the printing industry in 1992, when the Printing Industries of America (PIA) requested EPA's assistance in evaluating environmental claims for products. This effort ultimately grew into projects aimed at preventing pollution in three sectors of the industry: lithography, screen printing, and flexography. Each project addresses a different area of concern within the printing industry. For lithography the focus is on blanket washes; for screen printing the focus is on screen reclamation; and for flexography the project partners chose to look at the types of inks used. DfE flexography partners include the California Film Extruders and Converters Association (CFECA), the Flexible Packaging Association (FPA), the Flexographic Technical Association (FTA), the Industrial Technology Institute (ITI), the National Association of Printing Ink Manufacturers (NAPIM), the Plastic Bag Association (PBA), RadTech International, N.A., the National Institute of Standards and Technology (NIST), the Tag and Label Manufacturers Institute, Inc. (TLMI), the University of Tennessee, Western Michigan University, and individual printers and suppliers.

What Is the DfE Flexography Project?

The DfE flexography project has three key activity areas: technical studies, implementation tools, and outreach activities.

Technical Studies

The DfE Flexography Project is focusing its efforts on developing specific risk, performance, cost, pollution prevention, and process requirement information on conventional and alternative ink technologies in order to help flexographic printers make more informed decisions about the ink technologies that they use in their facilities.

The project is examining the environmental and human health risks of solvent-based, waterborne, and UV-curable ink technologies. The project is collecting information on hazards and environmental releases (i.e., releases to air, water, or land), energy consumption, and solid and hazardous wastes associated with the use of each technology. With this information, the project will assess the risks to human health and the environment posed by each of these flexographic ink technologies.

The performance of each ink technology will be evaluated in two ways: 1) by a laboratory under controlled conditions; and 2) by printers under real-world conditions of production. The information collected in the performance demonstration will be used to develop cost data for each ink technology. In addition, the DfE Flexography Project will identify workplace practice changes, pollution prevention options, and other steps that printers can implement to better utilize each ink technology.

Information on the comparative risk, performance, cost, and pollution prevention opportunities associated with these ink technologies will be included in the DfE Flexography Project's full technical report, the *Flexographic Inks Cleaner Technologies Substitutes Assessment* (CTSA). The draft CTSA is scheduled to be released for comment in 1996.

Implementation Tools

In an effort to encourage pollution prevention in the flexography sector of the printing industry, the DfE Flexography Project will create a variety of technical assistance tools for flexographic printers. For example, plans are in place to develop computer software that can help flexographic printers assess the profitability of pollution prevention investments using total cost assessment techniques. DfE is also planning to conduct pilot workshops for flexographic printers on how to use the software.

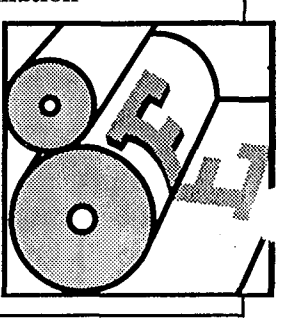
Outreach Activities

The project will create different informational materials based on the CTSA. The project partners will produce a simple, concise brochure to explain to printers the results of the technical work. A series of case studies also will be developed to help flexographic printers sort through some of the different factors that can make one ink technology a more attractive option than another. These and other products will be available on the Internet, making the information developed by the DfE Flexography Project easily accessible to printers and the general public.

How Can I Get More Information?

To learn more about the Flexography Project or EPA's Design for the Environment Program, contact:

EPA's Pollution Prevention Information Clearinghouse (PPIC)
U.S. Environmental Protection Agency
401 M Street, S.W. (3404)
Washington, DC 20460
Tel: 202 260-1023
Fax: 202 260-0178



A Cooperative Project between the U.S. Environmental Protection Agency and the Printing Trade Associations Nationwide

October 1996

EPA 744-F-96-014

design FOR THE ENVIRONMENT

LITHOGRAPHY PROJECT BULLETIN 3

BULLETIN HIGHLIGHTS

- How well do they perform?
- How much do they cost?
- What are the reduced health, fire, and environmental risks?

ALSO IN THIS BULLETIN

- Tips to get started in finding the best substitute blanket wash for you
- Questions to ask your blanket wash supplier
- How to recognize vegetable ester washes by their common names on MSDS forms

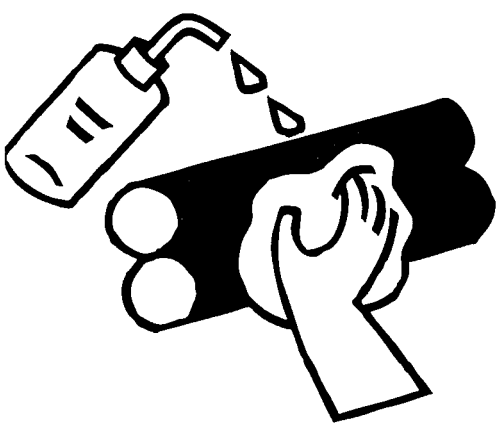
Vegetable Ester Blanket Washes

Through a series of product trials, EPA's Design for the Environment (DfE) Lithography Project evaluated 22 different commercially available blanket washes. All of the washes were scrutinized for their performance, cost, and environmental and health characteristics. Then each wash was categorized based on its chemical make-up. This bulletin highlights one category of these blanket washes: vegetable esters. Vegetable esters are fatty acid derivatives produced from agricultural sources, mainly soybean oil.

Use this bulletin to compare the performance, cost, and health and environmental benefits of vegetable ester blanket washes with your current wash. This information can help you get started in finding the best substitute blanket wash for you.

Lower VOCs: An Important Benefit

One of the biggest advantages of vegetable ester blanket washes is that they are lower in volatile organic compounds (VOCs) than many standard blanket washes. VOCs are chemicals that evaporate very quickly. The faster a chemical evaporates, the faster it will get into the air during use. While standard, solvent-based washes can contain up to 100% VOCs, the VOC content of the vegetable ester washes typically ranges from 12 to 30%. This range drops to 2% or less for vegetable ester and water mixtures.



Worker health concerns

The higher the VOC content of a product, the greater the chances that your workers are inhaling harmful chemicals. Vegetable ester washes, with their low VOC content, evaporate more slowly. Worker exposure is less, so potential health risks are decreased.

What are my options for a substitute blanket wash?

A substitute blanket wash can be classified by its primary chemical component. The Design for the Environment Lithography Project product trials evaluated 22 substitute blanket washes that were classified into four different categories of chemicals. These washes were tested and compared to a baseline wash by printers in their print shops. Some of the characteristics of the four categories and the baseline are listed below:

THE BASELINE

VM&P Naphtha:

- \+ quick-drying
- \- 100% volatile organic compounds (VOCs)
- \- health and environmental concerns

THE SUBSTITUTES

Petroleum-based:

- \+ quick-drying
- \- greater than 60% VOCs
- \- health and environmental concerns

Vegetable ester:

- \+ VOC content as low as 5%
- \+ unprocessed towels may be treated as non-hazardous waste
- \+ lack of odor

Petroleum/vegetable ester mixtures:

- +/- VOC content less than most petroleum-based washes, but not all are less than 30% VOC
- +/- Depending on proportion of petroleum, may have health and environmental concerns

Terpene:

- \+ low VOC, derived from wood and citrus products
- \+ does not deplete ozone
- \- odor can be irritating to press operators

Environmental Benefits

The quick evaporation of VOCs can also harm the environment. VOCs are a major contributor to smog, and are among the most persistent emissions problems in the printing industry. High-VOC washes will increase your shop's contribution to environmental problems.

Just as they can improve worker safety, low-VOC vegetable esters can reduce the environmental impact of your shop on your community.

A Less Flammable Substitute

Compared to most of the other blanket washes, vegetable esters are much less flammable. This is because they have a much higher flash point (the temperature at which the wash can be ignited). A less flammable blanket wash means a safer work environment.

Performance

During the product trials, overall press operator opinion of the performance of vegetable ester washes varied but was generally favorable. The printers found that the vegetable ester blanket washes handled quite differently from their traditional wash. Press operators discovered that a little extra effort was required, but with changes in the way the wash was used, the substitute performed as well as the standard wash. Some problems associated with using vegetable ester washes, and their solutions, include:

There is an oily film left on the blanket	⇒ **Use a wipe firmly wrung in water instead of a dry wipe to remove the oily film from the blanket surface**
It takes longer to dry	⇒ **Dry the blanket with a clean dry wipe**
The wash is thicker	⇒ **Give the wash enough time to soak into the wipe by keeping a supply of wipes and wash together in a covered container. When ready to use the wash-soaked wipe, squeeze or wring the excess wash back into the container.**

How to Identify A Vegetable Ester

These are some names for vegetable esters that you might find on an MSDS or product label:

- Fatty acid methyl esters
- Diethanolamine tallate
- Sorbitan compounds
- Soybean oils
- Tall oils
- Methyl stearates
- Methyl oleate
- Crillet 4

Ask your supplier if you have questions.

Cost

In general, vegetable ester washes cost more per gallon than many of the other blanket washes tested. However, it is important to remember that purchase price alone may not be the best indicator of the true overall cost of using a blanket wash. Take into account the following factors which may affect the actual cost of a blanket wash:

Compliance costs. Washes high in VOC content may yield waste—excess wash or used wipes—that has to be handled as regulated hazardous waste. Low-VOC washes such as vegetable esters may eliminate this potentially costly handling procedure. Also, with lower VOCs, a facility's air emissions may drop to levels below the threshold amounts that require costly permitting and reporting.

Quantity of blanket wash needed. Some printers found that once experienced in using a vegetable ester wash, they often needed much less wash for a given job. This can mean cost savings.

Insurance costs. Switching to a low-flammability vegetable ester wash may reduce your insurance costs. Check with your underwriter to see if such benefits apply to your facility.

EXHIBIT 6. Chemicals Used in the P nting Industry That are Listed as Hazardous Air Pollutants in the Clean Air Act Amendments

HAZARDOUS AIR POLLUTANT	
Benzene	Lead compounds
Cadium compounds	Methanol
Carbon tetrachloride	Methyl ethyl ketone
Chromium compounds	Methyl isobutyl ketone
Cobalt compounds	Methylene chloride
Cumene	Perchloroethylene
Dibutylphthalate	Polycyclic organic matter
Diethanolamine	Propylene oxide
Ethyl benzene	Toluene
Ethylene glycol	2,4-Toluene diisocyanate
Formaldehyde	1,1,2-Trichloroethane
Glycol ethers	Trichloroethylene
Hexane	Vinyl chloride
Hydrochloric acid	Xylenes
Isophorone	

EXHIBIT 11. EPA Toxic Characteristic Contaminants That May be Found in Printing Industry Waste

Waste Code	Contaminant
D005	Barium
D007	Chromium
D019	Carbon tetrachloride
D035	Methyl ethyl ketone
D011	Silver
D040	Trichloroethylene
D043	Vinyl chloride

[16]A solid waste is considered reactive if it exhibits any of the following properties: (1) is normally unstable and readily undergoes violent change without detonating; (2) reacts violently or forms potentially explosive mixtures with water; (3) when mixed with water, generates toxic gases, vapors or fumes in a quantity that can present a danger to human health or the environment (for a cyanide or sulfide bearing waste, this includes when exposed to pH between 2 and 12.5); (4) is capable of detonation or explosive reaction if subjected to a strong initiated source or if heated under confinement; or (5) is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure.

[17]For example, solvent-based inks such as packaging rotogravure or flexographic inks have flash points which are below 141°F. These inks would be hazardous wastes due to ignitability.

Table 11. Estimated Domestic Consumption of Raw Materials for Printing Inks, 1991

Raw Material	Millions of Pounds	Percent of Total
Hydrocarbon and Oxygenated Solvents	660[1]	35
Resins		
Rosin Esters & Adducts	132	7
Metallized Rosin	106	6
Hydrocarbon Resins	99	5
Alkyds	33	2
Acrylics	55	3
Nitrocellulose	2	0.1
Polyamides	15	1
Miscellaneous[2]	44	2
Resin Subtotal	486	26*
Oils	363	19
Pigments	330	17
Additives	66	3
Total	1,905	100

* Subtotal does not add due to rounding

[1] Printers use an additional 495 to 660 million pounds of solvents at press side to dilute inks supplied by the manufacturer in concentrated form.

[2] Includes polyurethanes, cyclized rubber, shellac, casein, melamines, and others

Source: SRI 1993.

Ink - Hazardous Ingredients and Substitutes

CAS Number	Description	Alt Description	Metal	Substitute Pigment	Comments
147148	Pigment Blue 15	Cu Phthalocyanine	Cu	Blue 16	Will be noticeably off shade
84583777	Pigment Blue 62	Victoria Blue CFA	Cu	Blue 1	
1328536	Pigment Green 7	Phthalo Green	Cu	Green 2 or Green 1	Poor strength, loss of other properties too.
14302137	Pigment Green 36	Phthalo Green	Cu	Green 2 or Green 1	Poor strength, loss of other properties too.
67801018	Pigment Orange 46	Ba Ethyl RLC	Ba	Orange 16+Red 22	Other oranges are available but significantly higher costs
7585413	Pigment Red 48:1	Ba Permanent Red 2B	Ba	Red 22	
5280660	Pigment Red 48:4	Mn Permanent Red 2B	Mn	Red 48:2	
1103384	Pigment Red 49:1	Ba Lithol	Ba	Red 2	
5160021	Pigment Red 53:1	Ba Red Lake C	Ba	Red 22	
68929135	Pigment Red 66	Anthosine Red 3B	Ba	Not Available	Discontinued routine use in the industry
12237637	Pigment Red 169	Rhodamine 6G CFA	Cu	Red 81:1	
12237626	Pigment Violet 27	Crystal Violet	Cu	Not Available	Discontinued production in the United States
1344372	Pigment Yellow 34	Cr and Pb	Cr	Yellow 14 or Yellow 12	Does not have strong opacity of Yellow 34
8007189	Pigment Yellow 53	Sb and Ni	Ni	Yellow 14 or Yellow 12	Does not have strong opacity of Yellow 34
68511626	Pigment Yellow 150		Ni	Yellow 14 or Yellow 12	Does not have strong opacity of Yellow 34

SHEETFED OFFSET (cont'd)
MAJOR CHEMICALS USED

Operation/Process	Major Chemicals Used (Volumes of Individual Chemical Used Vary Greatly)
Prepress	
Film/glass cleaner	Acetone, hexane, 1,1,1-trichloroethane, ethanol, n-propanol, perchloroethylene, 2-butoxy ethanol, isopropanol
Equipment cleaner	Isopropanol, hexane, acetone
Film developer	Sodium sulfite, sulfosalicyclic acid, hydroquinone, potassium sulfite, potassium hydroxide, butyl-diethanolamine
Film fixer	Ammonium thiosulfate, sodium acetate, acetic acid, aluminum sulfate
Plate developer	Benzyl alcohol, diethanolamine, polyvinyl alcohol, ethylene glycol, acetic acid
Plate finisher/ replenisher	Dextrin, mineral spirit, sodium hydroxide, N-methylpyrrolidone, sodium sulfite, potassium hydroxide
Image preserver	Stoddard solvent, phosphoric acid
Color proofing	n-Propanol
Press	
Ink, varnish	Petroleum distillates, vegetable oil, resin, rosin, dryers, pigments containing barium and copper
Coating	Polydimethyl siloxane
UV-ink	Acrylates, pentaerythritol tritetracrylates
Fountain solution	Isopropanol, 2-butoxy ethanol and other glycol ethers, gum arabic, ethylene glycol, phosphoric acid

Figure 13. Sheetfed Offset (continued).

SHEETFED OFFSET (cont'd)
MAJOR CHEMICALS USED (cont'd)

Operation/Process	Major Chemicals Used (Volumes of Individual Chemical Used Vary Greatly)
Press (cont'd)	
Wash solvent/plate cleaner	Aliphatic and aromatic hydrocarbons, mineral spirits, acetone, methylene chloride, xylene, toluene, glycol ethers, vegetable oils, fatty acids, surfactants
Copperizing solution	Ethylene glycol, isopropanol, methylene chloride
Glaze remover	Toluene, methanol, acetone
Postpress	
Glue	Paraffin wax
Bronzing powder	Copper, zinc, aluminum, stearic acid

Figure 13. Sheetfed Offset (continued).

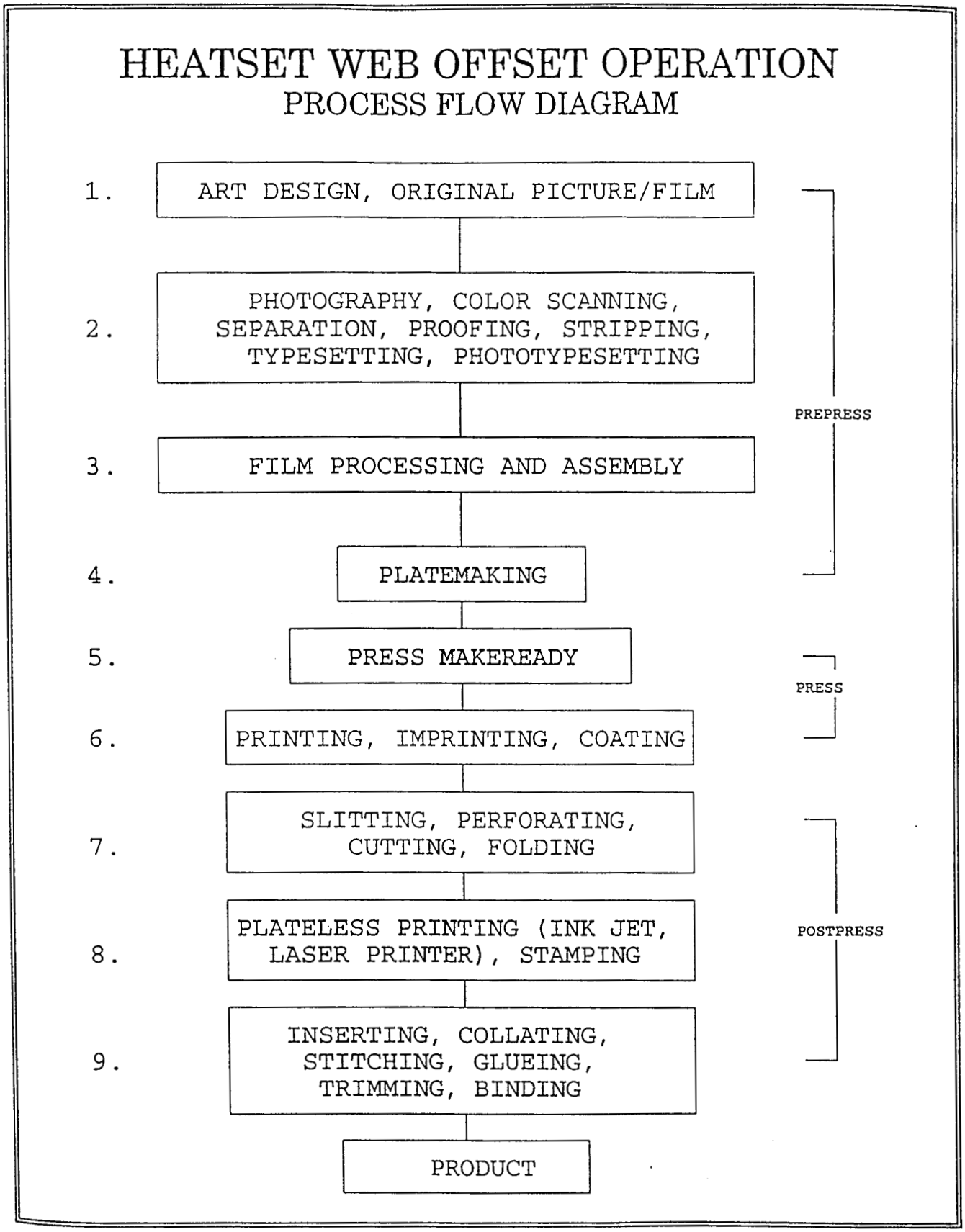


Figure 14. Heatset Web Offset (Source: GATF 1992b).

HEATSET WEB OFFSET (cont'd)
CHEMICAL/CHEMICAL COMPOUND USAGE

In reference to each step in the process flow diagram:

1. Adhesive, cleaning solvent

2. Color scanner cleaner, deletion fluid

3. Film developer and fixer, film cleaner, film system cleaner, image cleaner/preserver, antistatic spray, adhesive

4. Plate developer and finisher, plate toner, plate system cleaner

5/6. Fountain solution concentrate, fountain solution defoamer, fountain solution additive, isopropyl alcohol, isopropyl alcohol substitute, gum arabic, phosphoric acid

Heatset web offset ink, ink preserver, tack reducer, UV-ink

Blanket wash, roller wash, glaze remover, ink remover, plate preserver, roller lubricator, copperizing solution, rubber rejuvenator, blanket hardener, image remover, metering roller cleaning solvent

Varnish, silicone coating

7. None

8. Adhesive, ink, metal foil

9. Adhesive

- Specialty operations:

  Stamping (metal foil)
  Laminating (varnish)
  Numbering (ink)

Figure 14. Heatset Web Offset (continued).

HEATSET WEB OFFSET OPERATION (cont'd)
MAJOR CHEMICALS USED

Operation/Process	Major Chemicals Used (Volumes of Individual Chemicals Used Vary Greatly)
Prepress	
Film/glass cleaner	Acetone, hexane, 1,1,1 trichloroethane, ethanol, n-propanol, perchloroethylene, 2-butoxy ethanol, isopropanol
Equipment cleaner	Isopropanol, hexane, acetone
Film developer	Sodium sulfite, sulfosalicyclic acid, hydroquinone, potassium sulfite, potassium hydroxide, butyl-diethanolamine
Film fixer	Ammonium thiosulfate, sodium acetate, acetic acid, aluminum sulfate
Plate developer	Benzyl alcohol, diethanolamine, polyvinyl alcohol, ethylene glycol, acetic acid
Plate finisher/ replenisher	Dextrin, mineral spirit, sodium hydroxide, N-methylpyrrolidone, sodium sulfite
Image preserver	Stoddard solvent, phosphoric acid
Color proofing	n-Propanol
Press	
Ink, varnish	Petroleum distillates, vegetable oils, resin, rosin, dryer, pigments containing barium and copper
Fountain solution	Isopropanol, 2-butoxy ethanol and other glycol ethers, gum arabic, phosphoric acid, ethylene glycol
Wash solvent/plate cleaner	Aliphatic and aromatic hydrocarbons, mineral spirits, acetone, methylene chloride, xylene, toluene, isopropanol, glycol ethers, vegetable oils, fatty acids, surfactants
Glaze remover	Toluene, methanol, acetone
Postpress	
Glue	Paraffin wax, isopropanol, trichloroethylene, toluene, ammonia, amines

Figure 14. Heatset Web Offset (continued).

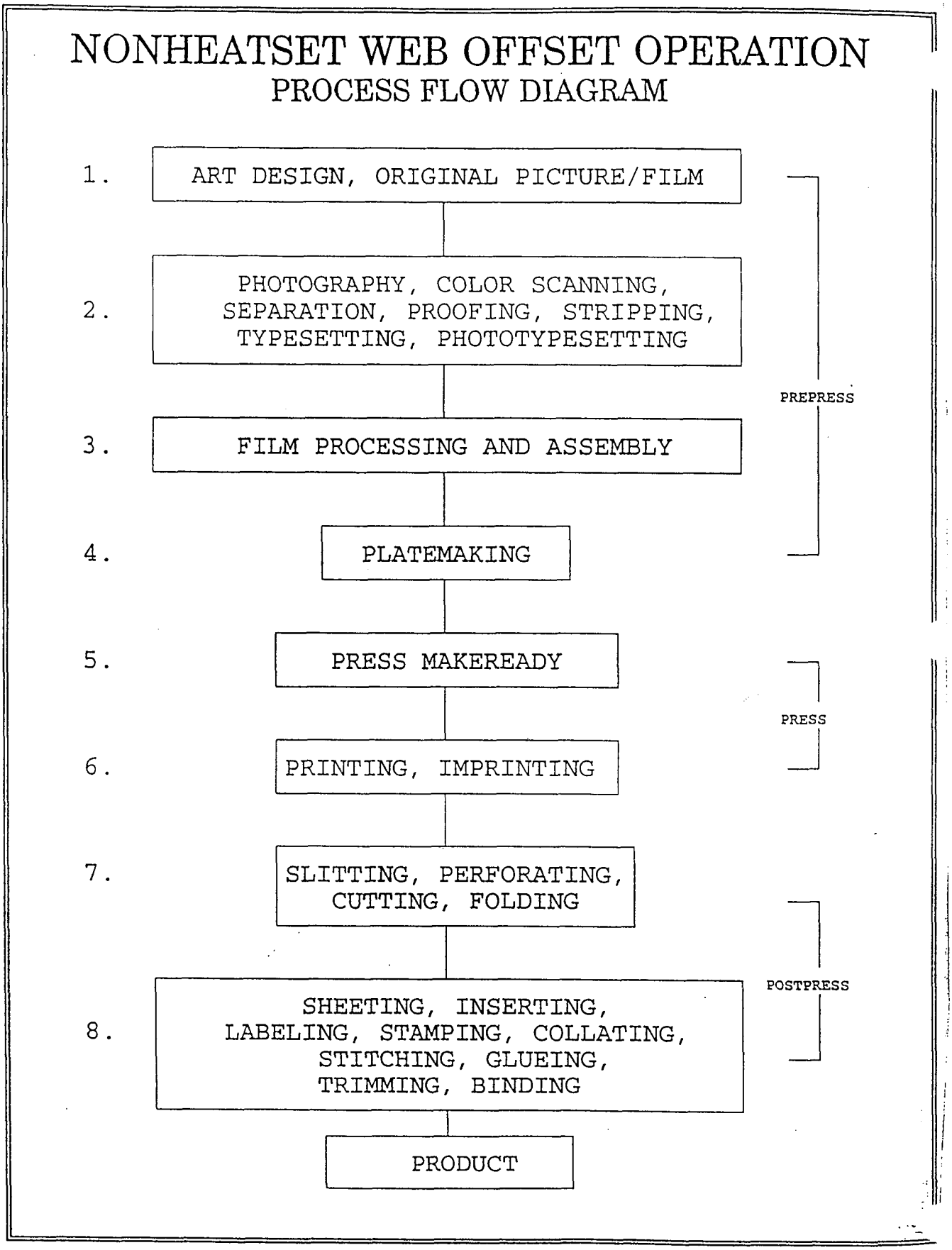


Figure 15. Non-heatset Web Offset (Source: GATF 1992b).

NONHEATSET WEB OFFSET (cont'd)
CHEMICAL/CHEMICAL COMPOUND USAGE

In reference to each step in the process flow diagram:

1. Adhesive, cleaning solvent, glass cleaner
2. Color scanner cleaner, deletion fluid
3. Film developer and fixer, film cleaner, film system cleaner, image cleaner/preserver, antistatic spray, adhesive
4. Plate developer and finisher, plate toner, plate system cleaner

5\6. Fountain solution concentrate, fountain solution defoamer, fountain solution additive, isopropyl alcohol, isopropyl alcohol substitute, gum arabic

Nonheatset web offset ink, ink preserver, tack reducer, UV-ink

Blanket wash, roller wash, glaze remover, UV-ink cleaner, sheetfed ink remover, plate preserver, roller lubricator, copperizing solution, rubber rejuvenator, blanket hardener, image remover

7. None
8. Adhesive, ink, metal foil

- Specialty operations:

  Stamping (metal foil)
  Thermography (polyamide resin)
  Numbering (ink)

Figure 15. Non-heatset Web Offset (continued).

NONHEATSET WEB OFFSET (cont'd)
MAJOR CHEMICALS USED

Operation/Process	Major Chemicals Used (Volumes of Individual Chemicals Used Vary Greatly)
Prepress	
Film/glass cleaner	Acetone, hexane, 1,1,1-trichloroethane, ethanol, n-propanol, perchloroethylene, 2-butoxy ethanol, isopropanol
Equipment cleaner	Isopropanol alcohol, hexane, acetone
Film developer	Sodium sulfite, sulfosalicyclic acid, hydroquinone, potassium sulfite, potassium hydroxide, butyl-diethanolamine
Film fixer	Ammonium thiosulfate, sodium acetate, acetic acid, aluminum sulfate
Plate developer	Benzyl alcohol, diethanolamine, polyvinyl alcohol, ethylene glycol, acetic acid
Plate finisher/ replenisher	Dextrin, mineral spirit, sodium hydroxide, N-methylpyrrolidone, sodium sulfite
Image preserver	Stoddard solvent, phosphoric acid
Press	
Ink	Soybean oil and other vegetable oils, hydrotreated & solvent extracted naphthenic distillates and paraffin oils, alkyds and other resins, rosin, dryers, clays, carbon black, pigments containing barium and copper
Fountain solution	Isopropanol, 2-butoxy ethanol, gum arabic, dextrin, phosphate salts, silicates, surfactants, polyols, ethylene glycol, dipropylene glycol, synthetic cellulose, isopropanol
Wash solvent/plate cleaner	Aliphatic and aromatic hydrocarbons, ethanol, mineral spirits, acetone, glycol ethers, vegetable oils, fatty acids
Glaze remover	Toluene, methanol, acetone
Postpress	
Glue	Paraffin wax, isopropanol, trichloroethylene, toluene

Figure 15. Non-heatset Web Offset (continued).

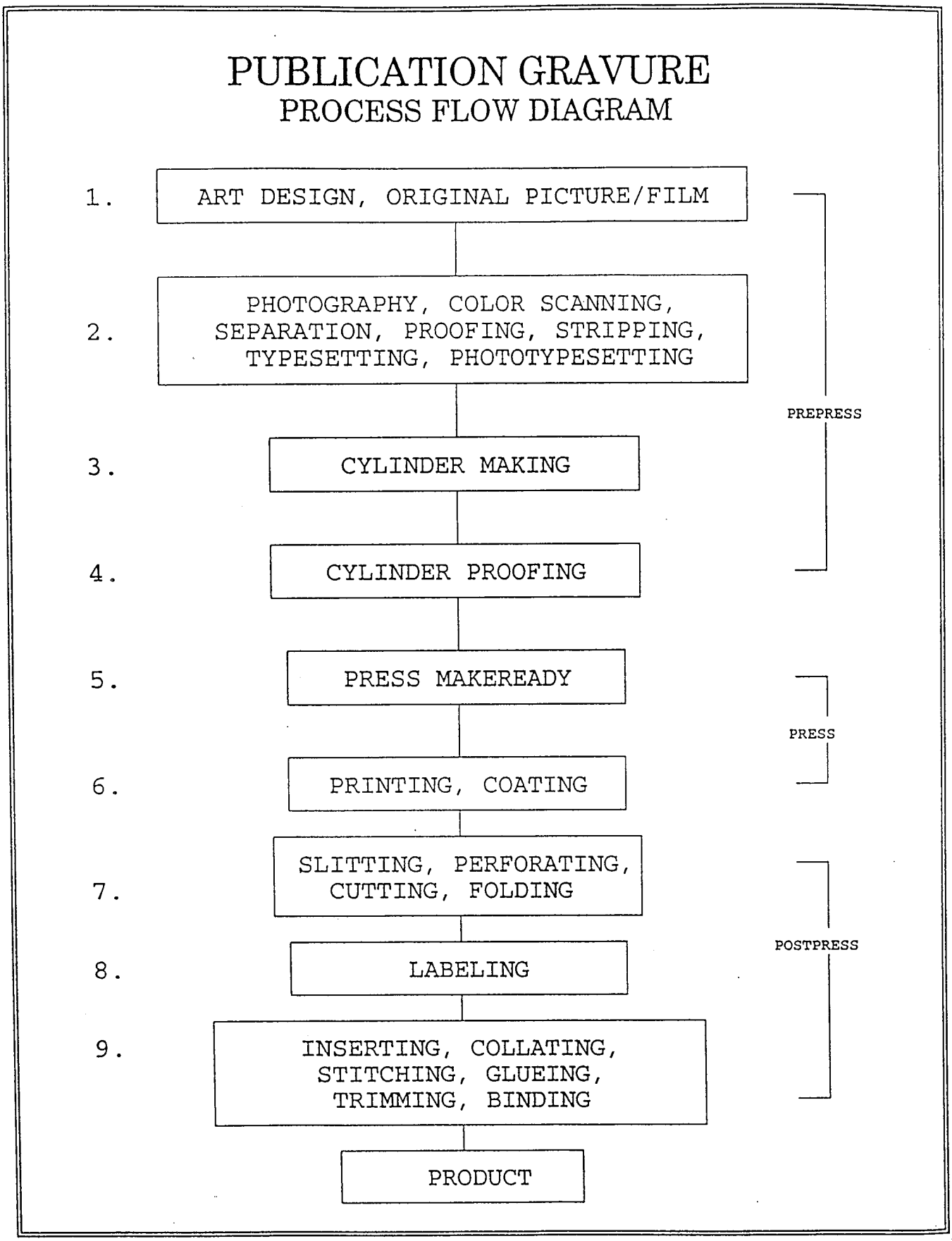


Figure 17. Publication Gravure (Source: GATF 1992b).

PUBLICATION GRAVURE (cont'd)
CHEMICAL/CHEMICAL COMPOUND USAGE

In reference to each step in the process flow diagram:

1. Adhesive, glass cleaner

2. Photographic processing solution, cleaning solvent

3. Chromium plating solution, polishing compound, etching solution, copper plating solution, nickel plating solution, sulfuric acid solution, degreasing salt, dechroming solution

4. Cylinder cleaner, gravure ink, cylinder cleaning solvent, roller cleaner, toluene, alkane hydrocarbons

5/6. Gravure ink, imprinting inks, ink remover, splicing cement, ink jet inks

7. None

8. Adhesive, cleaning solvent, adhesive remover

9. Adhesive, adhesive remover

Figure 17. Publication Gravure (continued) (Source: GATF 1992b).

PUBLICATION GRAVURE (cont'd)
MAJOR CHEMICALS USED

Operation/Process	Major Chemicals Used (Volumes of Individual Chemicals Used Vary Greatly)
Prepress	
Film/glass cleaner	Acetone, hexane, 1,1,1-trichloroethane, ethanol, n-propanol, perchloroethylene, 2-butoxy ethanol, isopropanol
Equipment cleaner	Isopropanol, hexane, acetone
Film developer	Sodium sulfite, sulfosalicyclic acid, hydroquinone, potassium sulfite, potassium hydroxide, butyl-diethanolamine
Film fixer	Ammonium thiosulfate, sodium acetate, acetic acid, aluminum sulfate
Cylinder making	Barium chloride, 1,1,1-trichloroethane, aliphatic petroleum distillates, ammonium oxalate, ammonium molybdate, barium formate, calcium benzoate, chromic acid, citric acid, copper sulfate, dicarboxylic acid, cupric tetrafluoborate, ethyl acetate, ethylenediamine, formaldehyde, copper, hydrogen peroxide, hydrochloric acid, muriatic acid, isopropanol, phosphoric acid, sodium hydroxide, sulfuric acid, zinc chloride
Press	
Ink, varnish	Hexane, mineral spirits, heptane, lactol spirits, petroleum naphtha, VM&P naphtha, toluene, xylene, alcohols
Wash solvent	Toluene, aliphatic and other aromatic hydrocarbons, ethanol, mineral spirits, acetone, isopropanol
Postpress	
Glue, adhesive	Paraffin wax, toluene, 1,1,1-trichloroethane, isopropanol

Figure 17. Publication Gravure (continued) (Source: Mathtech).

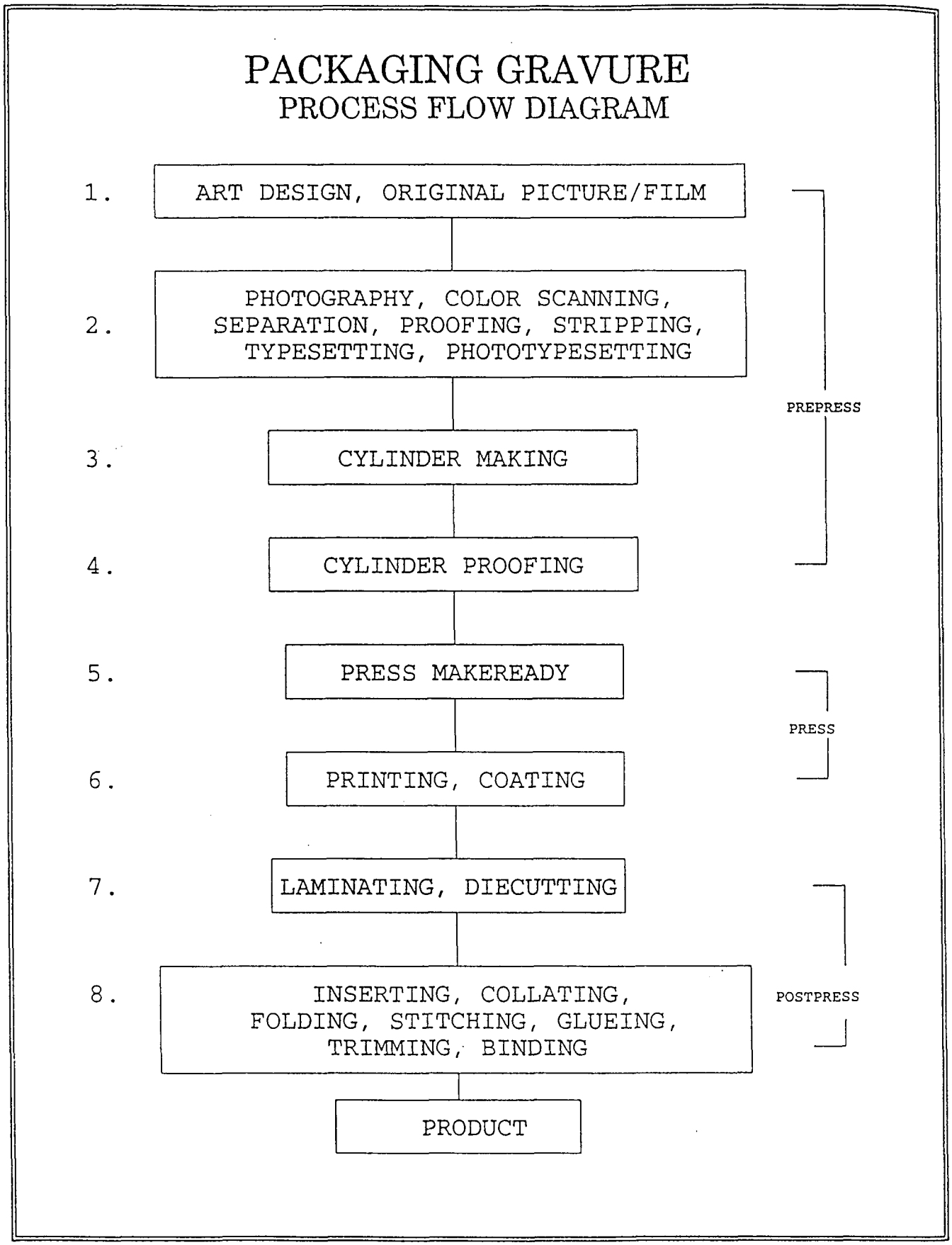


Figure 18. Packaging Gravure (Source: GATF 1992b).

PACKAGING GRAVURE (cont'd)
CHEMICAL/CHEMICAL COMPOUND USAGE

In reference to each step in the process flow diagram:

1. Adhesive, glass cleaner

2. Photographic processing solution, cleaning solvent

3. Chromium plating solution, polishing compound, etching solution, copper plating solution, nickel plating solution, sulfuric acid solution, degreasing salt, dechroming solution

4. Cylinder cleaner, gravure ink, cylinder cleaning solvent, roller cleaner

5/6. Gravure ink, imprinting inks, ink remover, splicing cement, isopropyl alcohol, ink jet inks

7. Adhesive, cleaning solvent, adhesive remover

8. Adhesive, adhesive remover

Figure 18. Packaging Gravure (continued) (Source: GATF 1992b).

PACKAGING GRAVURE (cont'd)
MAJOR CHEMICALS USED

Operation/Process	Major Chemicals Used (Volumes of Individual Chemicals Used Vary Greatly)
Prepress	
Film/glass cleaner	Acetone, hexane, 1,1,1-trichloroethane, ethanol, n-propanol, perchloroethylene, 2-butoxy ethanol, isopropanol
Equipment cleaner	Isopropanol, hexane, acetone
Film developer	Sodium sulfite, sulfosalicyclic acid, hydroquinone, potassium sulfite, potassium hydroxide, butyl-diethanolamine
Film fixer	Ammonium thiosulfate, sodium acetate, acetic acid, aluminum sulfate
Cylinder making	Barium chloride, 1,1,1-trichloroethane, aliphatic petroleum distillates, ammonium oxalate, ammonium molybdate, barium formate, calcium benzoate, chromic acid, citric acid, copper sulfate, dicarboxylic acid, cupric tetrafluoborate, ethyl acetate, ethylenediamine, formaldehyde, copper, hydrogen peroxide, hydrochloric acid, muriatic acid, isopropanol, phosphoric acid, sodium hydroxide, sulfuric acid, zinc chloride
Press	
Ink, varnish	Toluene, xylene, mineral spirits, acetone, methyl ethyl ketone, methyl isobutyl ketone, ethyl acetate, isopropyl acetate, n-propyl acetate, butyl acetate, n-butyl acetate, ethylene glycol monoethyl ether, methanol, ethanol, isopropanol, tri-decanol
Wash solvent	Aliphatic and aromatic hydrocarbons, ethanol, mineral spirits, acetone, toluene, isopropanol
Postpress	
Glue, adhesive	Paraffin wax, toluene, 1,1,1-trichloroethane, isopropanol

Figure 18. Packaging Gravure (continued) (Source: Mathtech).

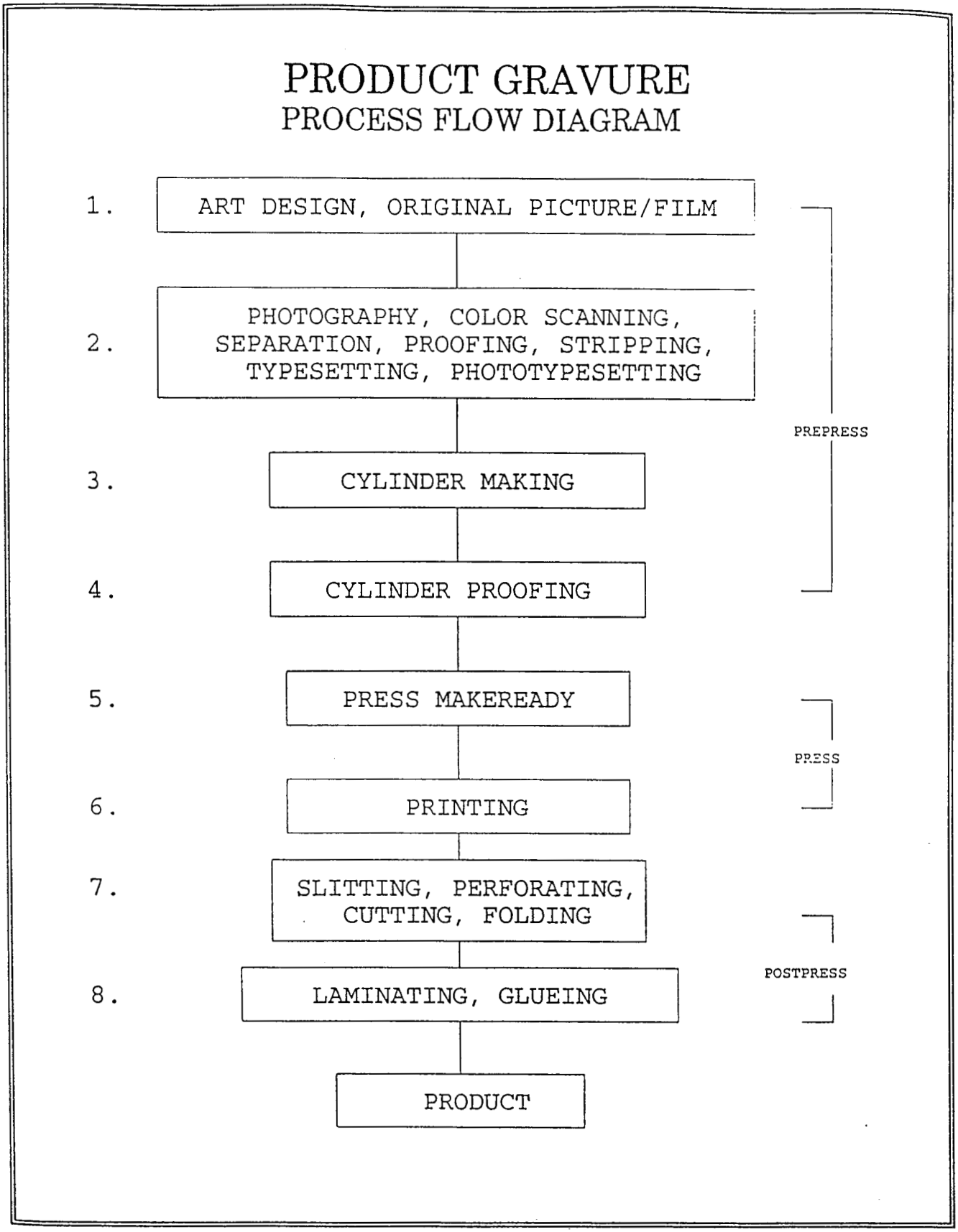


Figure 19. Product Gravure (Source: GATF 1992b).

PRODUCT GRAVURE (cont'd)
CHEMICAL/CHEMICAL COMPOUND USAGE

In reference to each step in the process flow diagram:

1. Adhesive, glass cleaner

2. Photographic processing solution, cleaning solvent

3. Chromium plating solution, polishing compound, etching solution, copper plating solution, nickel plating solution, sulfuric acid solution, degreasing salt, dechroming solution

4. Plate cleaner, gravure ink, cylinder cleaning solvent, roller cleaner

5/6. Gravure ink, imprinting inks, ink remover, splicing cement, isopropyl alcohol, ink jet inks

7. None

8. Adhesive, cleaning solvent, adhesive remover

Figure 19. Product Gravure (continued) (Source: GATF 1992b).

PRODUCT GRAVURE (cont'd)
MAJOR CHEMICALS USED

Operation/Process	Major Chemicals Used (Volumes of Individual Chemicals Used Vary Greatly)
Prepress	
Film/glass cleaner	Acetone, hexane, 1,1,1-trichloroethane, ethanol, n-propanol, perchloroethylene, 2-butoxy ethanol, isopropanol
Equipment cleaner	Isopropanol, hexane, acetone
Film developer	Sodium sulfite, sulfosalicyclic acid, hydroquinone, potassium sulfite, potassium hydroxide, butyl-diethanolamine
Film fixer	Ammonium thiosulfate, sodium acetate, acetic acid, aluminum sulfate
Cylinder making	Barium chloride, 1,1,1-trichloroethane, aliphatic petroleum distillates, ammonium oxalate, ammonium molybdate, barium formate, calcium benzoate, chromic acid, citric acid, copper sulfate, dicarboxylic acid, cupric tetrafluoborate, ethyl acetate, ethylenediamine, formaldehyde, copper, hydrogen peroxide, hydrochloric acid, muriatic acid, isopropanol, phosphoric acid, sodium hydroxide, sulfuric acid, zinc chloride
Press	
Ink, varnish	Toluene, xylene, mineral spirits, acetone, methyl ethyl ketone, methyl isobutyl ketone, ethyl acetate, isopropyl acetate, n-butyl acetate, ethylene glycol monoethyl ether, methanol, ethanol, isopropanol, tri-decanol
Wash solvent	Aliphatic and aromatic hydrocarbons, ethanol,mineral spirits, acetone, toluene, isopropanol
Postpress	
Glue, adhesive	Paraffin wax, toluene, 1,1,1-trichloroethane, isopropanol

Figure 19. Product Gravure (continued) (Source: Mathtech)

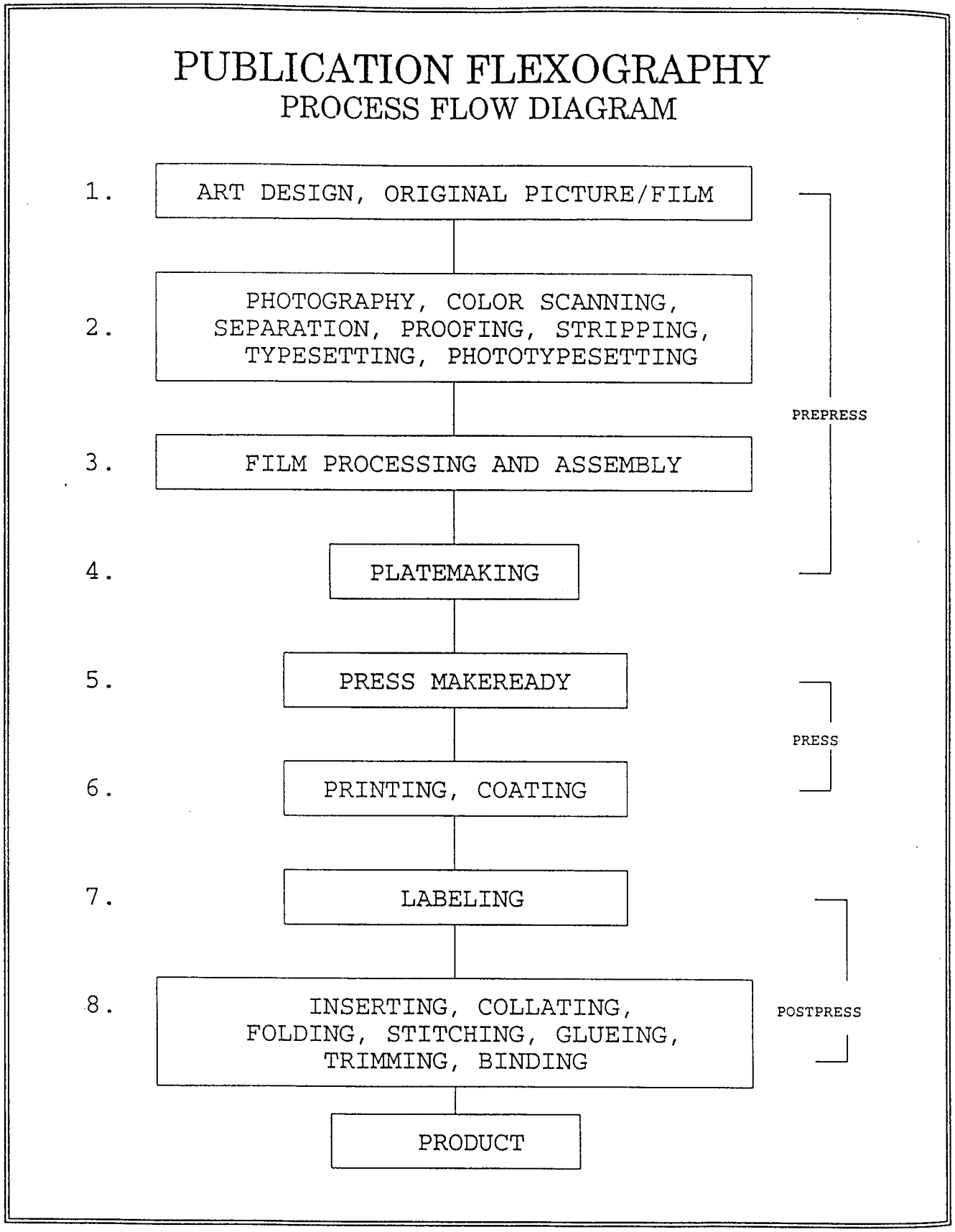


Figure 21. Publication Flexography (Source: GATF 1992b).

PUBLICATION FLEXOGRAPHY (cont'd)
CHEMICAL/CHEMICAL COMPOUND USAGE

In reference to each step in the process flow diagram:

1. Glue, cleaning solvent, class cleaner
2. Glue
3. Film fixer, film developer, film cleaner, antistatic spray
4. Platemaking photopolymer, plate washing, defoamer, plate etching compound, plate cleaning liquid, isopropyl alcohol
5. Microbial agent
6. Flexo ink (solvent- or water-based), varnish blanket and roller wash, ink cleaner/remover, plate preserver
7. Adhesive
8. Adhesive

Figure 21. Publication Flexography (continued).

PUBLICATION FLEXOGRAPHY (cont'd)
MAJOR CHEMICALS USED

Operation/Process	Major Chemicals Used (Volumes of Individual Chemicals Used Vary Greatly)
Prepress	
Film/glass cleaner	Acetone, hexane, 1,1,1-trichloroethane, ethanol, n-propanol, perchloroethylene, 2-butoxy ethanol, isopropanol
Equipment cleaner	Isopropanol, hexane, acetone
Film developer	Sodium sulfite, sulfosalicyclic acid, hydroquinone, potassium sulfite, potassium hydroxide, butyl-diethanolamine
Film fixer	Ammonium thiosulfate, sodium acetate, acetic acid, aluminum sulfate
Flexoplatemaking solution	Methacrylate monomer, organic phosphorous compounds, petroleum distillates, anionic surfactants, potassium hydroxide
Press	
Ink	Benzisothiazolinon, ethylenediamine, ammonium hydroxide, antimicrobial agents, isopropanol, toluene
Wash solvent/plate cleaner	Aliphatic and aromatic hydrocarbons, ethanol, mineral spirits, acetone, toluene
Wash solution	Ethylene glycol monoethyl ether, amines, ammonia
Postpress	
Glue, adhesive	Paraffin wax

Figure 21. Publication Flexography (continued).

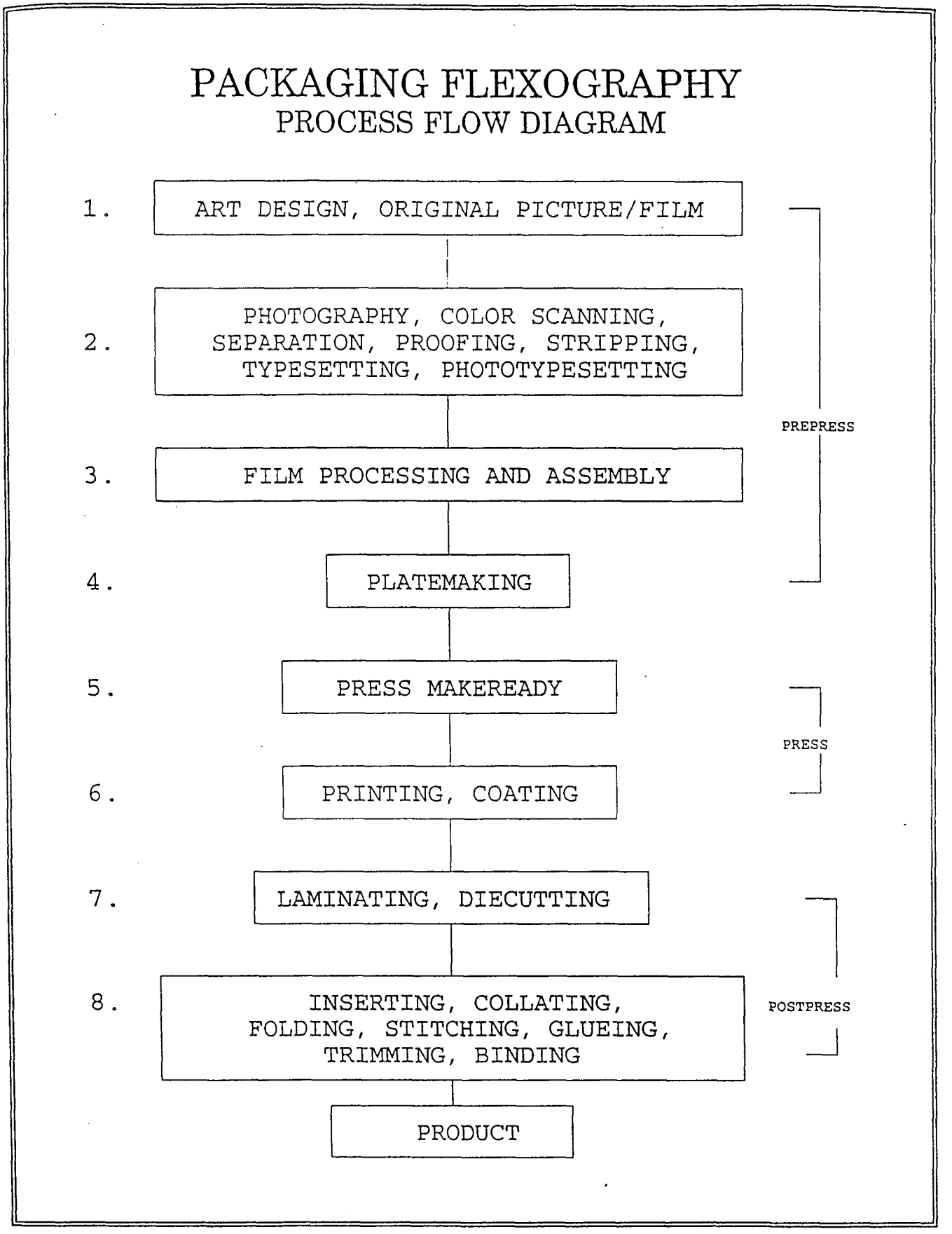


Figure 22. Packaging Flexography (Source: GATF 1992b).

PACKAGING FLEXOGRAPHY (cont'd)
CHEMICAL/CHEMICAL COMPOUND USAGE

In reference to each step in the process flow diagram:

1. Adhesive

2. Cleaning solvent, adhesive

3. Film fixer, film developer, film cleaning solvent

4. Platemaking fluid, spent platemaking fluid neutralization compound, muriatic acid

5. Plate cleaning solvent, ink, plating cleaning solution

6. Plate cleaner, plate preserver, flexo ink, varnish, roller cleaning solvent

7. Adhesive, adhesive remover

8. Adhesive, adhesive remover

- Specialty operations:

  Lamination (glue)

Figure 22. Packaging Flexography (continued).

PACKAGING FLEXOGRAPHY (cont'd)
MAJOR CHEMICALS USED

Operation/Process	Major Chemicals Used (Volumes of Individual Chemicals Used Vary Greatly)
Prepress	
Film/glass cleaner	Acetone, hexane, 1,1,1-trichloroethane, ethanol, n-propanol, perchloroethylene, 2-butoxy ethanol, isopropanol
Equipment cleaner	Isopropanol, hexane, acetone
Film developer	Sodium sulfite, sulfosalicyclic acid, hydroquinone, potassium sulfite, potassium hydroxide, butyl-diethanolamine
Film fixer	Ammonium thiosulfate, sodium acetate, acetic acid, aluminum sulfate
Flexoplatemaking solution	Methacrylate monomer, organic phosphorous compounds, petroleum distillates, anionic surfactants, glycol ethers, sodium hydroxide
Press	
Ink	Benzisothiazolinon, ethylenediamine, ammonium hydroxide, antimicrobial agents, isopropanol, toluene, n-propanol, n-propyl acetate, ethyl alcohol, n-heptane
Wash solvent/plate cleaner	Aliphatic and aromatic hydrocarbons, ethanol, mineral spirits, acetone, toluene, isopropanol, methyl isobutyl ketone, diethylene glycol ether, methyl ethyl ketone
Wash solution	Ethylene glycol monoethyl ether, amines, ammonia
Postpress	
Glue, adhesive	Paraffin wax, toluene, 1,1,1-trichloroethane, isopropanol

Figure 22. Packaging Flexography (continued).

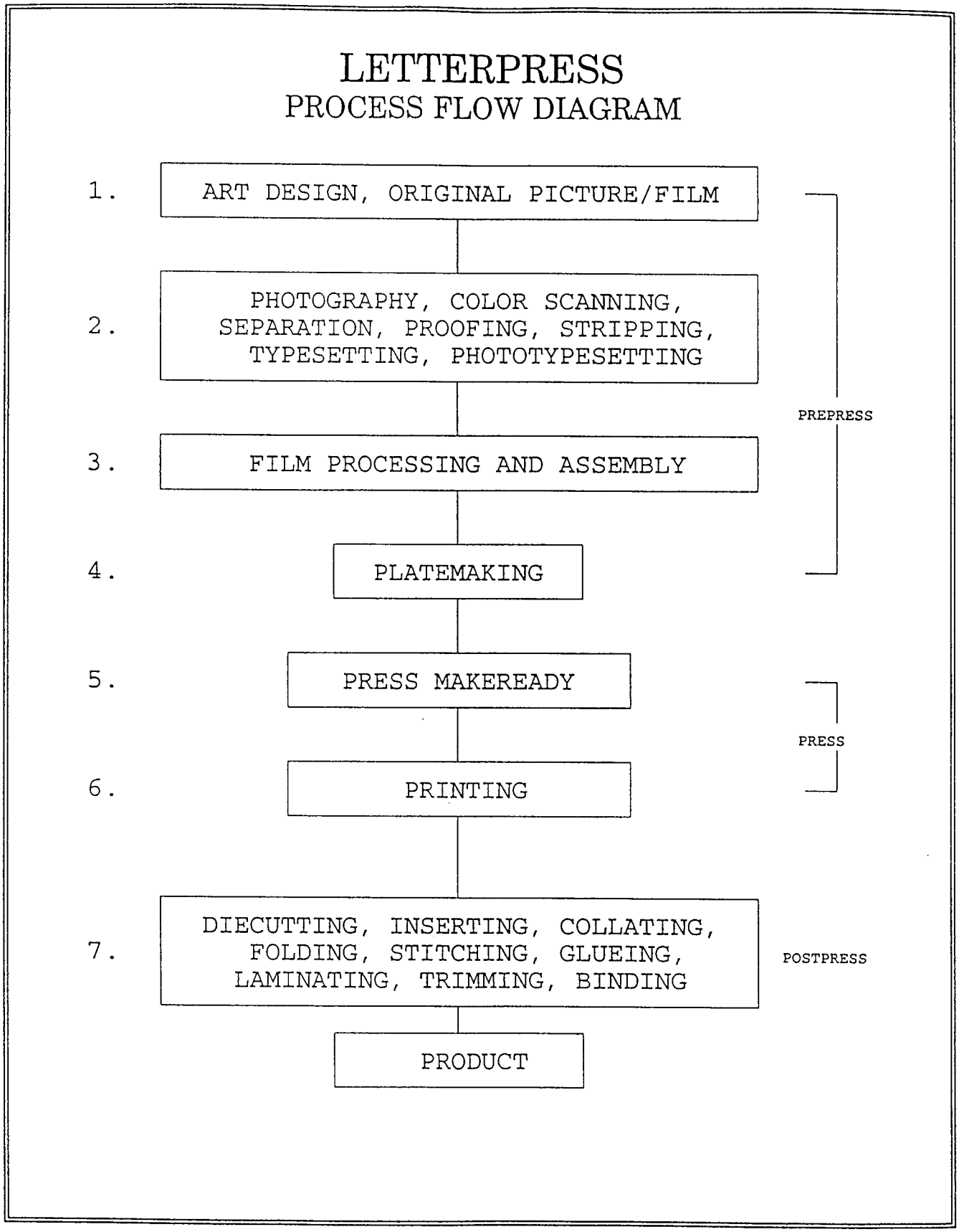


Figure 24. Letterpress (Source: GATF 1992b).

LETTERPRESS (cont'd)
CHEMICAL/CHEMICAL COMPOUND USAGE

In reference to each step in the process flow diagram:

1. Adhesive, cleaning solvent

2. Color scanner cleaner, deletion fluid

3. Film developer and fixer, film cleaner, film system cleaner, image cleaner/preserver, antistatic spray, adhesive

4. Plate developer and finisher, plate toner, plate system cleaner

5. Letterpress ink, blanket wash, roller wash, copperizing solution, anti-setoff powder

6. Adhesive, ink

7. Adhesive

- Specialty operations:

  Lamination (glue, varnish, plastics)
  Cellophane window (glue)

Figure 24. Letterpress (continued).

LETTERPRESS OPERATION (cont'd)
MAJOR CHEMICALS USED

Operation/Process	Major Chemicals Used (Volumes of Individual Chemicals Used Vary Greatly)
Prepress	
Film/glass cleaner	Acetone, hexane, 1,1,1-trichloroethane, ethanol, n-propanol, perchloroethylene, 2-butoxy ethanol, isopropanol
Equipment cleaner	Isopropanol, hexane, acetone
Film developer	Sodium sulfite, sulfosalicyclic acid, hydroquinone, potassium sulfite, potassium hydroxide, butyl-diethanolamine
Film fixer	Ammonium thiosulfate, sodium acetate, acetic acid, aluminum sulfate
Plate developer	Surfactant, Benzyl alcohol, diethanolamine, polyvinyl alcohol, ethylene glycol, thiol compounds, acetic acid
Plate	Photosensitive polymers
Press	
Ink, varnish	Petroleum distillates, vegetable oil, resin, rosin, toluene, isopropanol, xylene, pigments containing barium and copper
Ink thinner	Hydrotreated or solvent extracted naphthenic distillates
Wash solvent	Aliphatic and aromatic hydrocarbons, ethanol, turpentine, acetone
Linotype	Lead, zinc, tin
Postpress	
Glue	Paraffin wax, methanol, hexane, acetone, ethylene dichloride, methyl ethyl ketone, polyglycol dimethacrylates, methyl cyanoacrylates, toluene

Figure 24. Letterpress (continued).

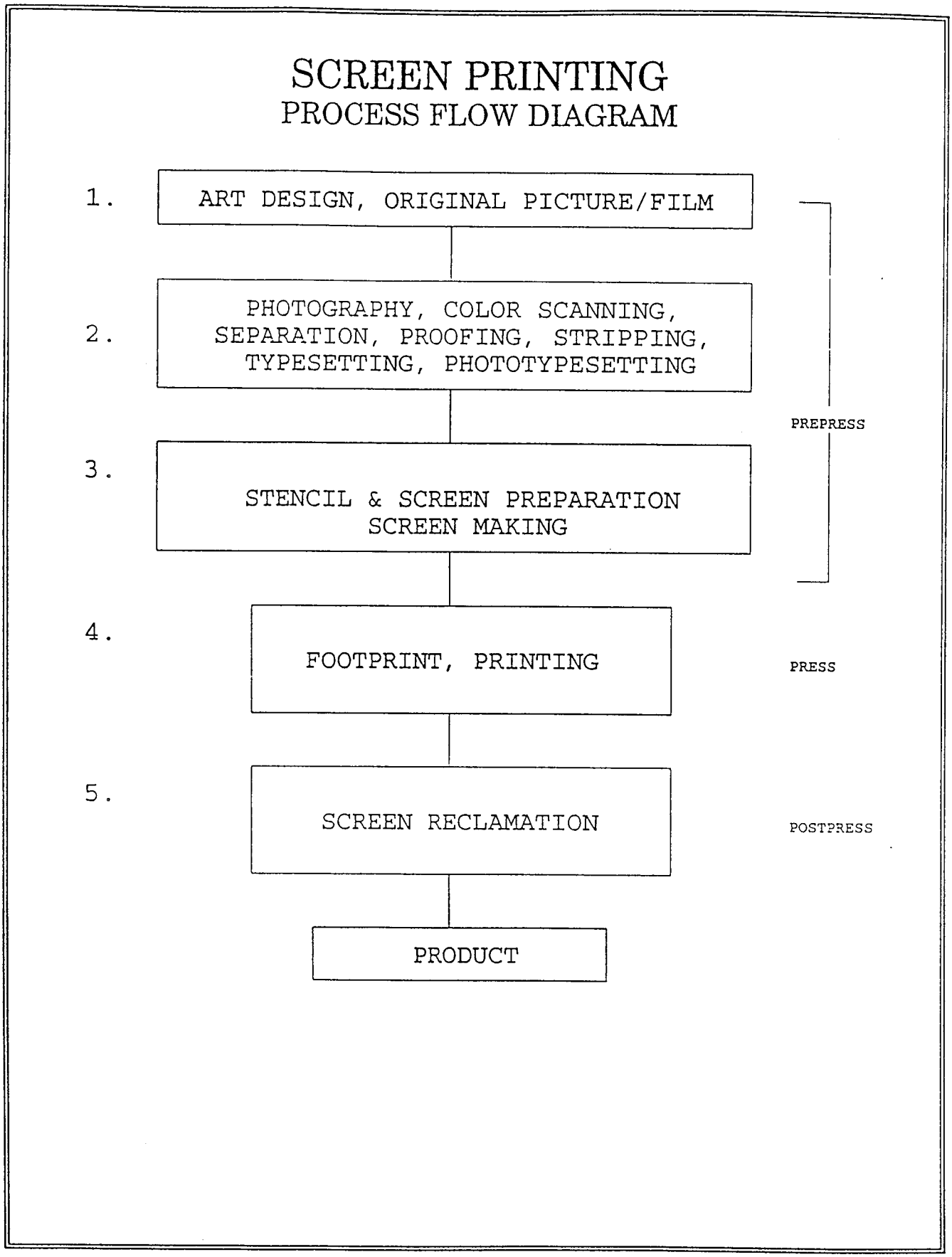


Figure 26. Screen Printing (Source: GATF 1992b).

SCREEN PRINTING (cont'd)
CHEMICAL/CHEMICAL COMPOUND USAGE

In reference to each step in the process flow diagram:

1. Adhesive, cleaning solvent

2. Cleaning solvent, film fixer and developer

3. Mesh preparation compounds, abrading compounds, degreasers, adhesives, stencil/emulsion systems, blockout solution

4. Screen printing ink, haze remover

5. Ink remover, stencil remover

Figure 26. Screen Printing (continued).

SCREEN PRINTING OPERATION (cont'd)
MAJOR CHEMICALS USED

Operation/Process	Major Chemicals Used (Volumes of Individual Chemicals Used Vary Greatly)
Prepress	
Film developer	Sodium sulfite, sulfosalicyclic acid, potassium hydroxide, potassium sulfite, hydroquinone, butyl-diethanolamine
Film fixer	Ammonium thiosulfate, sodium acetate, acetic acid, aluminum sulfate
Stencil emulsion	Polyvinyl alcohol, polyvinyl acetate, benzoate esters, citrate esters, trihexyl ester acetate, trimethylolpropane triacrylate, pentaerythritol tetracrylate, sodium citrate, phthalocyanine pigments, diazonium salts
Press	
Ink	Glycol ethers, aromatic and aliphatic petroleum distillates, ketones, esters, mono- and multifunctional acrylate monomers, acrylate oligomers, isocyanates, acrylic, vinyl, urethane, styrene, cellulosic, polyamide, epoxy, polyester and melamine resins, silicones, amines, pigments containing lead, chromium, and cadmium
Postpress	
Screen reclamation solvents	Mineral spirits, toluene, xylenes, limonenes, terpenes, acetone, methyl ethyl ketone, cyclohexanone, butyrolactone, ethyl acetate, butyl acetate, ethylene glycol mono butyl ether acetate, propylene glycol mono methyl ether acetate, propylene glycol mono ethyl ether acetate, diethylene glycol mono butyl ether acetate, dipropylene glycol mono methyl ether acetate, isopropanol, diacetone alcohol, benzyl alcohol, terpineol, ethylene glycol mono methyl ether, ethylene glycol mono ethyl ether

Figure 26. Screen Printing (continued).

SCREEN PRINTING OPERATION (cont'd)
MAJOR CHEMICALS USED

Operation/Process	Major Chemicals Used (Volumes of Individual Chemicals Used Vary Greatly)
Postpress (cont.)	
Screen reclamation solvents (cont.)	Ethylene glycol mono butyl ether, propylene glycol mono methyl ether, propylene glycol mono ethyl ether, propylene glycol mono butyl ether, diethylene glycol mono ethyl ether, diethylene glycol mono butyl ether, dipropylene glycol mono methyl ether, dipropylene glycol mono ethyl ether, dipropylene glycol mono butyl ether, N-methylpyrrolidone,
Screen reclamation surfactants	Alkybenzene sulphonates, alkyl sulphates, alkyl ether sulphates, aliphatic phosphate esters, alkyl sulphosuccinates, alkyl phenol ethoxylates, ethoxylated fatty alcohols, EO-PO block copolymers, tetra alkylammonium halides/phosphates, betaines, alkylimidazoline carboxy acids
Screen reclamation caustics	Sodium hydroxide, potassium hydroxide, sodium carbonate, trisodium phosphate
Screen reclamation oxidizers	Sodium metaperiodate, sodium hypochlorite, periodic acid, enzymes

Figure 26. Screen Printing (continued).

Figure 2-1: Where Are You on the Spectrum?

(identify where you fit on this listing of environmental and waste reduction activities)

Process Equipment or Operation	Where Are you on the Spectrum? Environmentally Sound Operation ⟺ Wasted Money and Resources		
Film Processing Fixer	Closed-loop recycling of fixer, with silver recovery	Silver recovery without recycling of fixer solution	Discharge fixer solution to *POTW*, septic tank. May exceed hazardous waste limits
Developer	Aware of hydroquinone in developer, unused developer may be hazardous waste		Discharge unused (old) developer to *POTW*, or septic tank. May exceed hazardous waste limits
Rinse Water	Counter current rinsing, variable flow rate for rinse		Continuous flow of rinse water
Film	Recycling scrap film and recovered silver; Direct plate technology		Throw away scrap or old films
Plate Processing	Recycling aluminum plates; Reuse of plates (back side)	Recycling aluminum plates	Throw used plates in dumpster
	Digital printing systems		
	Closed loop recycling, with off-site metal reclamation, for metal etching solutions		Discharge metal etching solutions directly to sewer
Fountain Solution	Low or Zero-VOC fountain solutions	Replace isopropyl alcohol (IPA) with alcohol substitutes	Non-refrigerated fountain solution with IPA
	Waterless printing		
Blanket and Roller Wash (Cleanup Solvent)	Low vapor pressure (<10 mm Hg @ 20°C) materials (slow to evaporate) or water miscible solvents	Low vapor pressure materials for blanket washes. Higher vapor pressure (faster to evaporate) materials to hard clean roller (spot cleaning)	Use of only higher vapor pressure materials
	No hazardous air pollutants (e.g.,toluene, MEK, trichloroethane)		"Type" Wash; Use of acetone, MEK, toluene
	Automatic blanket washers		
	On-site reclamation of solvent	Off-site solvent reclamation	Off-site disposal of waste solvent
Parts Washers	Non-hazardous waste solvent (flash point >140°F)	Kerosene or mineral spirits	Soak in type wash or other flammable solvents
Shop Towels (Cleanup Rags)	Centrifuge (or other equipment or methods) to remove excess solvent before laundering	Managed laundry service to clean towels	Disposal of used shop towels
Ink	Blending and reuse of inks		Off-site disposal of waste ink
Paper	Recycle waste paper and office paper		Dispose of waste office paper
Housekeeping	Facility is clean, neat and well lighted		Aisles crowded and unkept; Messy floors
Chemical Management	System to track current chemical inventory (chemical inventory)		No tracking of historical chemical usage
	Emphasis on spill prevention		Sloppy handling

Printers' National Environmental Assistance Center

888/USPNEAC (888/877-6322 http://www.pneac.org

Printer Fact Sheet

PRINTING INDUSTRY MANUALS ON COMPLIANCE, P2 & PROCESSES

Revised October 10, 1997

State/Province	Printing Type & Name of Manual	Completed or Updated	Contact	Address	Phone	Notes
Alabama						
Alaska	General Printing Alaska Health Project: Waste Reduction Tips for Print Shops	1987	Scott Lytle	Alaska Dept of Environmental Conservation Compliance Assistance Office 555 Cordova Street Anchorage, AK 99501		1st copy free.
	General Printing Waste Reduction Guidebook for the Printing Industry w/ a Summary of AK Hazardous Waste Regulations	1980's	Scott Lytle	Alaska Dept of Environmental Conservation Compliance Assistance Office 555 Cordova Street Anchorage, AK 99501		1st copy free.
	Litho, Screen, Platemaking, Typesetting, Forms AK Health Project:Waste ReductionAssistance Program On-Site Consultation Audit Report: Printing Co.	March 17, 1987	Scott Lytle	Alaska Dept of Environmental Conservation Compliance Assistance Office 555 Cordova Street Anchorage, AK 99501		1st copy free.
	Publishing AK Health Project:Waste Reduction Assitance Program On-Site Consulation Audit Report: Publishing House	December 12, 1988	Scott Lytle	Alaska Dept of Environmental Conservation Compliance Assistance Office 555 Cordova Street Anchorage, AK 99501		1st copy free.
Arizona						
Arkansas						

California	Lithographic CA Printers Environmental Handbook	1995	Ken Suzu'	Printing Industry of California P.O. Box 91-1151 Los Angeles, CA 90091-1151	213/728-9500 FAX: 213/724-2327	
	Lithographic P2 Assessment of the Office of State Printing	October 1991	CA EPA	CA EPA Dept of Toxic Substance Control 400 P Street, 4th Floor PO Box 806 Sacramento, CA 95812-0806	916/322-3670	
	General Printing Haz Waste Minimization Checklist & Assessment Manual for the Printing Industry	August 1994	CA EPA	CA EPA Dept of Toxic Substnce Control 400 P Street, 4th Floor PO Box 806 Sacramento, CA 95812-0806	916/322-3670	
	General Printing Compliance Assist Program-Graphic Arts Printing Ops Tech Manual	June 1992	CA EPA	CA EPA Air Resources Board Compliance Division PO Box 2815 Sacramento, CA 95812		
	General Printing Waste Minimization for the Commercial Printing Industry	May 1992	CA EPA	CA EPA Dept of Toxic Substnce Control 400 P Street, 4th Floor PO Box 806 Sacramento, CA 95812-0806	916/322-3670	
	General Printing Waste Audit Study-Commercial Printing Industry	Updated 1989	CA EPA	CA EPA Dept of Toxic Substnce Control 400 P Street, 4th Floor PO Box 806 Sacramento, CA 95812-0806	916/322-3670	
CA South Coast Air Quality Mgt. Dist.						
Colorado	General Printing P2 in Printing		Parry Burnap	CO Dept of Public Health & Environment 4300 Cherry Creek Drive, South Denver, CO 80222-1530	303/692-3009	
Connecticut	Lithographic State & Fed Regulations and Best Mgt Practices	December 1996	David Wescott	Dept. of Environmental Protection Office of P2 79 Elm Street, 4th Floor Hartford, CT 06106-5127	860/424-3297	

	See EPA Region 1 Lithographic compliance & p2 guide - Fit to Print	May 1997	Anne Leibv Sally Mai	U.S. Environmental Protection Agency	800/906-3328 FAX 617/565-4939	
Delaware						
Dist of Columbia						
Florida	Lithographic					
Georgia	General Printing	In Progress	Jancie Hatcher	GA Pollution Prevention Asst. Div. 7 Martin Luther King, Jr Drive Suite 450 Atlanta, GA 30334	404/651-5120	
Hawaii						
Idaho						
Illinois	Lithographic Compliance Plus Guide	January 1997	Eva Aloia	Printing Industry of IL & IN 70 East Lake Street Chicago, IL 60601	312/704-5000 FAX: 312-704-5025	Outside IL - $35 (to cover costs only)
			Deb Kramer	Waste Management & Research Center IL DNR (PNEAC) 3333 W. Arthington Chicago, IL 60624	773/265-2036 FAX: 773/265-8336	
	Lithographic Gravure Flexographic Screen	January 1997	Laurie Case	Waste Management & Research Center IL DNR One E. Hazelwood Drive Champaign, IL 61820	217/333-8948	U.S. EPA Region V distribution only $30/copy
Indiana	Lithographic	IN PROGRESS	Mark Stoddard	Dept of Environmental Mgt Office of P2 and Tech Assist Ista Building 150 W. Market Street, Suite 703 PO Box 6015 Indianapolis, IN 46206-6015	317/233-1039 FAX: 317/233-5627	
	General Printing P2 In Printing Operations	June 1994	Environmental Mgt Institute	Environmental Management Institute 5610 Crawfordsville Road, Suite 15 Indianapolis, IN 45224	800/488-8842	

	General Printing Pollution Prevention for Printing	December 1993	Paula Sm[illegible]	IN Department of Environmental Mgt ISTA Building 150 W. Market Street, Suite 703 PO Box 6015 Indianapolis, IN 46206-6015	800/451-6027	
Iowa	Lithographic Pollution Prevention Manual for Litho Printers	1995	Catherine Zeman	Iowa Waste Reduction Center University of Northern Iowa 75 Biology Research Complex Cedar Falls, IA 50614-0185	319/273-2079	
Kansas						
Kentucky						
Louisiana						
Maine	See EPA Region 1 Lithographic compliance & p2 guide - Fit to Print	May 1997	Anne Leiby Sally Mansur	U.S. Environmental Protection Agency	800/906-3328 FAX 617/565-4939	
Maryland						
Massachusetts	Lithographic, Screen, Flexographic Mass Printers Partnership Manual	March 1996	Nancy Wren	MA DEP 1Winter St. Boston, MA 02108	617/292-5587 FAX: 617/292-5778	
			George Frantz	MA Office of Tech Assistance 100 Cambridge St. Suite 2109 Boston, MA 02202	617/727-3260 FAX: 617/727-3827	
	See EPA Region 1 Lithographic compliance & p2 guide - Fit to Print	May 1997	Anne Leiby Sally Mansur	U.S. Environmental Protection Agency	800/906-3328 FAX 617/565-4939	
Michigan	Lithographic	In Progress	Lisa Harrington Anita Singh	MI Dept of Natural Resources 530 W. Allegan Lansing, MI 48933	517/335-4729 FAX: 517/335-4053	OSHA & Environmental Regs
Minnesota						
Mississippi						
Missouri						

Montana	Lithographic & Commercial Printing	June 1996	Todd Mc[illegible]den	MT State Univ Extension Svc MT P2 Program Bozeman, MT 59717	406/994-3451 FAX: 406/994-5417	
Nebraska						
Nevada	Lithographic P2 Risk Management & Regulatory Compliance for Lithographic Printers		Kevin Dick	University of Nevada-Reno Nevada Small Business Development Center/032 Reno, NV 89557-0100	702/784-1717 FAX: 702/784-1395	
New Hampshire	AIRGUIDE!	Feb 1996		New Hampshire Dept of Environmental Services Air Resources Division 64 North Main Street Concord, NY	603/271-1379	
	See EPA Region 1 Lithographic compliance & p2 guide - Fit to Print	May 1997	Anne Leiby Sally Mansur	U.S. Environmental Protection Agency	800/906-3328 FAX 617/565-4939	
New Jersey	General Printing Printing	1989 or 1990		NJDEP, Division of Hazardous Waste Management Hazardous Waste Minimization Program, 401 E. State Street, CN 028, Trenton, NJ 08625	Phone #: 609-292-8341	
New Mexico	Lithographic	In Progress	Fabian Masias	NM Environmental Department PO Box 26110 Santa Fe, NM 87502	505/827-1079 FAX: 505/827-0045	
New York	Lithographic New York State Printers Manual	Feb, 1993	Tim Freeman	Printing Industry of NY 455 Commerce Drive Amherst, NY 14228	716/691-3211	
	Litho, Flexo, Gravure, Letterpress P2 for Printers	July 1995	County of Erie	County of Erie Dept of Environment & Planning Office of Pollution Prevention 95 Franklin Street Room 1077 Buffalo, NY 14202	716/858-6370	
North Carolina						
North Dakota						
Ohio	Lithographic Enviroprint	1995*		Printing Industries of Ohio	614/794-2300	* Revision In Progress

	Lithographic Improve Efficiency & Reduce Waste Through Process Control in the Litho Printing Industry	May 15, 1997	Larry Kramer	Inst of Advanced Manuf. Sciences, Inc (IAMS) 1111 Edison Drive Cincinnatti, OH 45216-2265	513/948-2085 FAX 513/948-2007	
Oklahoma						
Oregon	General Printing Waste Reduction Guidebook for the Printing Industry	~1990	Terry Obteshka(??)	OR DEQ 811 SW 6th Avenue Portland, OR 97204	503/229-6147 503/229-5675 FAX 800/452-4011	Contains summary of OR Haz Waste Regs
Pennsylvania	Lithographic	In Progress	Cecily Beall 215/656-8709	PA SBAP Bureau of Air Quality Control Dept of Environmental Resources PO Box 8468 Harrisburg, PA 17105	717/787-1663 800/722-4743 FAX: 717/772-2303	
Puerto Rico						
Rhode Island	See EPA Region 1 Lithographic compliance & p2 guide - Fit to Print	May 1997	Anne Leiby Sally Mansur	U.S. Environmental Protection Agency	800/906-3328 FAX 617/565-4939	
South Carolina						
South Dakota						
Tennessee	Lithographic, Screen Waste Reduction Manual for Lithographic and Screen Printers	August 1994		Printing Industry Assoc of the South 305 Plus Park Boulevard Nashville, TN 37217	615/366-1094	
Texas	All Printing in TX	In Progress	Frank Salat	TNRCC - SMALL BUSINESS ASSISTANCE PROGRAM MC106 P.O. BOX 13087 AUSTIN, TX 78711-3087	512-239-1860 FAX 512-239-1065	Free of Charge
	General Printing-Litho Graphic Arts Guide to Environmental Health & Safety Regulations	Revised Spring 1997	Matt Kaarlella	Printing Industry of America - Texas 910 W. Mockingbird Lane Suite 200 Dallas, TX 75247-5174	214/630-8871 FAX 214/688-1767	

	General Printing Industry Specific Compliance Agreement with OSHA	In Progress	Matt Kaarlella	Printing Industry of America - Texas 910 W. Mockingbird Lane Suite 200 Dallas, TX 75247-5174	214/630-8871 FAX 214/688-1767	
	Lithographic Non-Heatset Offset Printing Operations		Matt Kaarlella	Printing Industry of America - Texas 910 W. Mockingbird Lane Suite 200 Dallas, TX 75247-5174	214/630-8871 FAX 214/688-1767	
Utah						
Vermont	See EPA Region 1 Lithographic compliance & p2 guide - Fit to Print	May 1997	Anne Leiby Sally Mansur	U.S. Environmental Protection Agency	800/906-3328 FAX 617/565-4939	
Virginia	General Printing Opportunities to Reduce Waste Generation: Printing Industry	March 1991	VA Waste Minimization Program	VA Waste Minimization Program 11th Floor, Monroe Building 101 North 14th Street Richmond, VA 23219	804/371-8716	
Virgin Islands						
Washington	Screenprinting	1994	Debra Liceaga	Local Hazardous Waste Mgt Program King County, WA	206/689-3050	
	Screenprinting Environmental Management and P2: A Guide for Screen Printers	Update May 1996	Jean Witt	WA Dept of Ecology PO Box 47600 Olympia, WA 98504-7600	360/407-7472 FAX 360/407-6989	Pub. #: 94-139R
	Lithographic Environmental Management and P2: A Guide for Lithographic Printers	Updated May 1996	Jean Witt	WA Dept of Ecology PO Box 47600 Olympia, WA 98504-7600	360/407-7472 FAX 360/407-6989	Pub. #: 94-139R
West Virginia						
Wisconsin	General Printing Waste Reduction Guidebook for the Printing Industry (with a summary of the Oregon Hazardous Waste Regulations)	1989 or 1990		Wisconsin's Hazardous Waste Minimization Technical Assistance Program, WI DNR, Box 7921 (SW/3), Madison, WI 53707	608/267-3763	

	Lithographic Green & Profitable Videoconference & course notebook (1 hour WI spceific)	May, 1996	Wayne P[illegible]ehirt or Tom Blewett	Univ of WI 610 Langdon Street Room 529 Madison, WI 53703	608/265-2361 FAX: 608/262-6250	
	Lithographic Environmental Regulatory Guide for Small-Medium Lithographic Printers in WI	Updated May 1997	Wayne Pferdehirt or Tom Blewett	Univ of WI 610 Langdon Street Room 529 Madison, WI 53703	FAX: 608/262-6250	14 pp. Summary
			PNEAC Web Site	http://www.hazard.uiuc.edu/pneac/pneac.html		
	Lithographic Compliance & P2 Name T.B.A	In Progress	Niall Power	Printing Industry of Wisconsin PO Box 128 Elm Grove, WI 53122	414/785-9090 FAX: 414/785-7043	
			Tom Blewett or Wayne Pferdehirt	Solid & Haz Waste Education Ctr Univ of WI 610 Langdon Street Room 529 Madison, WI 53703	608/265-2361 FAX: 608/262-6250	
Wyoming						

Country or Regional Group	Printing Type	Completed / Updated	Contact	Address	Phone/Fax	Notes
North East Waste Management Officials Association (NEWMOA)	Lithographic Gravure Flexographic Screen		Lisa Regenstein	NEWMOA 129 Portland Street Suite 502 Boston, MA 02114-2014	617/367-8558	$30
EPA Region 1 Connecticut, Maine, Massachusettes, New Hampshire, Rhode Island, Vermont	Lithographic Fit to Print: An Environmental Compliance & P2 Manual for New England Lithographers	May 1997	Anne Leiby Sally Mansur	U.S. Environmental Protection Agency Region I (Mail Code SPN) JFK Federal Building Boston, MA 02203	800/906-3328 FAX 617/565-4939	Free of charge
EPA Region X Alaska, Idaho, Oregon and Washington	Lithographic & Screen Commercial Printing Industry Compliance & Pollution Prevention Workbook	In Progress	Terry Obteshka terry.obteshka@state.or.us	Small Business Assistance Program Air Quality Division 811 SW Sixth Ave Portland, Oregon 97294-1390	503-229-6147 FAX: 503- 229 5675	free to small business assistance providers

Ontario, Canad	General Management Guide to a Safe Environment	March 1995		Ontario Printing & Imaging Association 6420 Kesterel Rd Mississauga, Ontario L5T 1Z7	905/564-9411 905/564-9413	
U.S. EPA	General Printing Profile of the Printing Industry	September 1995	Ginger Gotliffe	U.S. EPA Office of Compliance 401 M Street, SW (MC 2221-A) Washington, DC 20460	202/564-7072	EPA 310-R-95-014
U.S. EPA	General Printing: Federal Environmental Regulations Potentially Affecting the Commercial Printing Industry	March 1994	Ginger Gotliffe	U.S. EPA Office of Compliance 401 M Street, SW (MC 2221-A) Washington, DC 20460	202/564-7072	EPA 744-R-94-005
U.S. EPA	General Printing: Printing Industry & Use Cluster Profile	June 1994	Ginger Gotliffe	U.S. EPA Office of Compliance 401 M Street, SW (MC 2221-A) Washington, DC 20460	202/564-7072	EPA 744-B-94-003
U.S. EPA Office of Enforcement & Compliance Assurance	General Printing Guides to P2, The Commercial Printing Industry	August 1995	Doug Jamieson	U.S. EPA/OECA 1200 Pennsylvania Ave, NW Washington, DC 20044		RZ3-SAI-R11012-WA-00393
U.S. EPA	Screen Printing Draft Cleaner Technologies Substitutes Assessment: Screen Reclamation	September 1994	P2 Information Clearinghouse U.S. EPA	P2 Information Clearinghouse U.S. EPA 401 M Street, SW (7409) Washington, DC 20460	202/260-1023 FAX: 202/260-4659 ppic@epamail.epa.gov	EPA 744-R-94-005
U.S. EPA	Screen Printing Designing Solutions for Screen Printers: An Evaluation of Screen Reclamation Systems	September 1996	P2 Information Clearinghouse U.S. EPA	P2 Information Clearinghouse U.S. EPA 401 M Street, SW (7409) Washington, DC 20460	202/260-1023 FAX: 202/260-4659 ppic@epamail.epa.gov	EPA 744-F-96-010
U.S. EPA	Lithographic: Draft Cleaner Technologies Substitutes Assessment: Lithographic Blanket Wash	July 1996 Final 6/97	P2 Information Clearinghouse U.S. EPA	P2 Information Clearinghouse U.S. EPA 401 M Street, SW (7409) Washington, DC 20460	202/260-1023 FAX: 202/260-4659 ppic@epamail.epa.gov	EPA 744-R-95-008

U.S. EPA	Flexographic: P2 Experiences in Three Flexographic Printing Facilities	September 1996	P2 Infor[illegible]on Clearing[illegible]se U.S. EPA	P2 Information Clearinghouse U.S. EPA 401 M Street, SW (7409) Washington, DC 20460	202/260-1023 FAX: 202/260-4659 ppic@epamail.epa.gov	[illegible]A 744-R-96-001
U.S. EPA		August 1990	U.S. EPA	P2 Information Clearinghouse U.S. EPA 401 M Street, SW (7409) Washington, DC 20460	202/260-1023 FAX: 202/260-4659 ppic@epamail.epa.gov	Doc. #625/7-90/008
ORGANIZATIONS	**Printing Type & Manual Name**	**Completed/ Updated**	**Contact**	**Address**	**Phone/Fax**	**Notes**
Newspaper Association of America (NAA)	Printing Safety Hearing Conservation at Your Newspaper		Kelley Clark clark@naa.org	Newspaper Association of America 1921 Gallows Road Suite 600 Arlington, VA 22182-3900	703/902-1833 FAX 703/620-4557	
NAA	Printing Safety Forklift Safety for Newspapers: An Operator Training Program		Kelley Clark clark@naa.org	Newspaper Association of America 1921 Gallows Road Suite 600 Arlington, VA 22182-3900	703/902-1833 FAX 703/620-4557	
NAA	Printing Safety Ergonomics & the Newspaper Industry	June 1997 (production areas)	Kelley Clark clark@naa.org	Newspaper Association of America 1921 Gallows Road Suite 600 Arlington, VA 22182-3900	703/902-1833 FAX 703/620-4557	$100 member $200 non
NAA	Printing Safety Hazpak		Kelley Clark clark@naa.org	Newspaper Association of America 1921 Gallows Road Suite 600 Arlington, VA 22182-3900	703/902-1833 FAX 703/620-4557	Price to be determined
NAA	Printing Hazardous Waste Mgt/P2 Guide	RFP due 7/1/97	Allen Cooley coola@naa.org	Newspaper Association of America 1921 Gallows Road Suite 600 Arlington, VA 22182-3900	703/902-1834 FAX 703/902-1857	Guide & Training Video
NAA	Printing Guide for Waste Management	1991 (revision 4/98)	Kelley Clark clark@naa.org	Newspaper Association of America 1921 Gallows Road Suite 600 Arlington, VA 22182-3900	703/902-1833 FAX 703/620-4557	Price to be determined

Printing Industries of America (PIA)	Lithographic PIA Environmental Compliance Screening Guide	Revised August 1991	PIA	Printing Industry of America 100 Daingerfield Road Alexandria, VA 22314	703/519-8100 FAX 703/548-3227	
PIA	Lithographic PIA Environmental Management Self-Study Manual		PIA	Printing Industry of America 100 Daingerfield Road Alexandria, VA 22314	703/519-8100 FAX 703/548-3227	PIA/3M
PIA	Printing The PIA Safety Manual: A Management Guide to Safety in the Printing Plant	Revised May 1995	PIA	Printing Industry of America 100 Daingerfield Road Alexandria, VA 22314	703/519-8100 FAX 703/548-3227	
PIA	Printing PIA Hazard Communication Manual: A Model Program for Printing Plants	1985 (Revision Planned)	PIA	Printing Industry of America 100 Daingerfield Road Alexandria, VA 22314	703/519-8100 FAX 703/548-3227	
PIA	Printing The PIA Community Right to Know Manual	Revised May 1990	PIA	Printing Industry of America 100 Daingerfield Road Alexandria, VA 22314	703/519-8100 FAX 703/548-3227	
Printing Industries of New England (PINE)	Sheet-Fed Offset Lithographic	August 1991		Printing Industry of New England 10 Tech Circle P.O. Box 2009 Natic, MA 01760-0015	508/655-8700	
Graphic Arts Technical Foundation (GATF)	Lithographic Regulatory Concerns for the Printer: A Checklist	1992	Gary Jones Rick Hartwig	Graphic Arts Technical Foundation 4615 Forbes Ave Pittsburgh, PA 15213-3796	412/621-6902 FAX: 412/621-3049	$
GATF	Lithographic Controlling Waste in Web Offset Printing (video)		Gary Jones Rick Hartwig	Graphic Arts Technical Foundation 4615 Forbes Ave Pittsburgh, PA 15213-3796	412/621-6902 FAX: 412/621-3049	$39
GATF	Lithographic The Lithographers Manual		Gary Jones Rick Hartwig	Graphic Arts Technical Foundation 4615 Forbes Ave Pittsburgh, PA 15213-3796	412/621-6902 FAX: 412/621-3049	$60
Design for the Environment/Screenprinting & Graphic Imaging Association of America (DfE / SGIA)	Screenprinting Screen Printing P2	April, 1995	Marcia Kinter	Screenprinting & Graphic Imaging Association 10015 Main Street Fairfax, VA 22031-3489		

Printers Natior Environmental . .istance Center (PEAC) & SHWEC/Univ of WI	Lithographic Green & Profitable Training Series	May, 1996	Wayne Pf . 'shirt	Solid & Haz Waste Education Ctr Univ of WI 610 Langdon Street Room 529 Madison, wI 53703	608/265-2361 FAX: 608/262-6250	~~5
National Association of Printing Ink Manufacturers (NAPIM)	Printing Ink Handbook		George Fuchs	777 Terrace Ave Hasbrouck Heights, NJ 07604	201/288-9454 FAX 201/288-9453	Ink making & Printing
Gravure Association of America (GAA)	Gravure The Basics of Gravure Printing	1995	Gregg Tyszka	Gravure Association of America 1200-A Scottsville Road Rochester, NY 14624	716-436-2150 FAX 716-436-7689	
GAA	Gravure Gravure Process & Technology	1991	Gregg Tyszka	Gravure Association of America 1200-A Scottsville Road Rochester, NY 14624	716-436-2150 FAX 716-436-7689	
Safetyline	General Printing Safetyline: Health & Safety Program for Printers			Safety Line 124 Washington Ave Suite B2 Point Richmond, CA 94801	510-236-1900	$129. $99 to NAPL, PIA, NAQP & IAPHC members

PRINTING INDUSTRY TRADE ASSOCIATIONS

1/30/96 DFK

FIRST NAME	LAST NAME	COMPANY/AGENCY	TELEPHONE	FAX	E-MAIL ADDRESS
MICHAEL	O'NEAL	#1 NETWORK P.O. Box 1627 Effingham, IL 62401	217/536-5737	217/536-5141	
MARTY	COOLER, PRES (M&M BINDERY)	AMERICAN FOREST & PAPER ASSOCIATION 1111 19TH ST., N.W. Suite 800 Washington, DC 20036	202/463-2700	202/463-2785	
GORDON	HUGHES	AMERICAN BUSINESS PRESS 675 Third Avenue Suite 415 New York, NY 10017-5704	212/6616360	212/370-0736	
VICKI	KEENAN	ASSOCIATION of the GRAPHIC ARTS (AGA) 330 Seventh Ave. Ninth Floor New York, NY 10001	212/279-2100	212/279-5381	X
MARTY	COOLER	BINDING INDUSTRIES OF AMERICA Printing Industries of America 70 East Lake Street Chicago, IL 60601	312/372-7606	312/704-5025	
PAUL	TELLIS	BUSINESS FORMS MANAGEMENT ASSOCIATION 319 SW Washington Suite 7110 Portland, OR 97204-2579	503/227-3393	503/274-7667	X

DOUG	McCALLUM	CANADIAN PRINTING INDUSTRIES ASSOCIATION 75 Albert Street Fuller Building. Suite 906 Ottawa, Ontario K1P 5E7 CANADA	613/236-7208		
MAUREEN	CHRISTENSEN	CROSFIELD USERS GROUP PO Box 531 Marlton, NJ 08053-0531	609/985-6452	609/9850105	
JOHN A.	TRIESTE	DIGITAL GRAPHICS ASSOCIATION 408 Eighth Avenue Suite 10-A New York, NY 10001-1816	212/629-3232	212/465-2012	
JONAH	GITLITZ	DIRECT MARKETING ASSOCIATION 1120 Avenue of the Americas New York, NY 10036-6700	212/768-7277	212/768-4546	
RANDOLPH	CAMP	EDUCATION COUNCIL OF THE GRAPHIC ARTS INDUSTRY 1899 Preston White Drive Reston, VA 22091-4367	703648-1768		
		ENGRAVED STATIONERY MANUFACTURERS ASSOCIATION 305 Plus Park Blvd Nashville, TN 37217	615/366-1798		
MARK Sarah	WYGONIC Rice, MGR Technology &Reg	FLEXIBLE PACKAGING ASSOCIATION 1090 Vermont Avenue Suite 500 Washington, DC 20005	202/842-3880	202/842-3841	X

BILL	DOWDELL	FLEXOGRAPHIC TECHNICAL ASSOCIATION 900 Marconi Avenue Ronkonkoma, NY 11779	516/737-6020	516/737-6813	X
MARY	FULLER	FOIL STAMPING & EMBOSSING ASSOCIATION PO Box 56652 Washington, DC 20040	202/882-7949	202/882-7969	
WILLIAM	SOLOMON	GRAPHC ARTS EMPLOYERS OF AMERICA Printing Industries of America 100 Daingerfield Road Alexandria, VA 22314-2888	703/519-8150		
RICHARD	GORELICK	GRAPHIC ARTS SALES FOUNDATION 113 E. Evans Street West Chester, PA 19380	610/431-9780		
NORMAN	SCHARPF	GRAPHIC COMMUNICATIONS ASSOCIATION Printing Industries of America 100 Daingerfield Road Alexandria, VA 22314-2888	703/519-8160	703/548-2867	
SAM	LIPPMAN	GRAPHIC ARTS SHOW COMPANY 1899 Preston White Drive Reston, VA 22091	703/264-7200		
SHARON	ELSWICK	GRAPHIC COMMUNICATIONS INDUSTRIES ASSOCIATION PO Box 69107 Tulsa, OK 74169-1407	918/355-3232		PIA Affiliate
WALTER	ZERWECK	GRAPHIC ARTS ASSOCIATION of PA 1900 Cherry Street Philadelphia, PA 19103	215/299-3300		PIA Affiliate X

JACKIE	BLAND	GRAPHIC ARTS MARKETING INFORMATION SERVICE/PIA 100 Daingerfield Road Alexandria, VA 22314	705/519-8179		X
GARY RICK	JONES HARTWIG	GRAPHIC ARTS TECHNICAL FOUNDATION (GATF) 200 Deer Run Road Sewickley, PA 15143-2600	412/741-6860	412/741-2311	X
CHERYL	KASUNICH	GRAVURE ASSOCIATION OF AMERICA 1200-A Scottsville Road Rochester, NY 14624	716/436-2150	716/436-7689	X
MARTIN	OLSEN	HOT STAMPING ASSOCIATION c/o Kensol-Olsenmark 40 Melville Park Road Melville, NY 11747	516/694-7773		
LARRY	AARON	IN-PLANT MANAGEMENT ASSOCIATION 1205 W College Ave Liberty, MO 64068	816/781-1111		X
DAVID	FORT	INTERNATIONAL DIGITAL IMAGING ASSOCIATION (IDIA) Flemington, NJ	908/782-4635		
KEVIN	KEENE	INTERNATIONAL ASSOCIATION OF PRINTING HOUSE CRAFTSMEN 7042 Brooklyn Blvd. Minneapolis, MN 55429-1370	612/560-1620 800/466-4274	612/560-1350	X

Henry Kim	Hatch Fpgartu	INTERNATIONAL PREPRESS ASSOCIATION 7200 France Avenue S. Suite 327 Edina, MN 55435	612/896-1908	612/896-0181	
HERB Ronald S.	WELSH (Atlas Die) Ballard	INTERNATIONAL ASSOCIATION OF DIECUTTING AND DIEMAKING 9 South Wesley Avenue PO Box 2 Mount Morris, IL 61054	815/734-4178 800/828-4233	815/734-6076	
LOIS	ECK - DRELL	INTERNATIONAL THERMOGRAPHERS ASSOCIATION Printing Industries of America 100 Daingerfield Road Alexandria, VA 22314	703/519-8122		
HANK JEANNIE	BERGAIN IGLASIUS	INTERNATIONAL BUSINESS FORMS INDUSTRIES 2111 Wilson Blvd Suite 350 Arlington, VA 22201	703/841-9191	703/522-5750	X
KIM HENRY	FOGARTY HATCH	INTERNATIONAL PREPRESS ASSOCIATION (IPA) 7200 France Avenue, S Suite 327 Edina, MN 55435	612/896-1908	612/896-0181	X
VAN	TANNER	INTERNATIONAL DIGITAL IMAGING ASSOCIATION 5601 Roanne Way Suite 608 Greensboro, NC 27409	910/854-5697	910-632-0200	X

LOIS	ECK DRELL	LABEL PRINTING INDUSTRIES OF AMERICA Printing Industries of America 100 Daingerfield Road Alexandria, VA 22314	703/519-8122	703/548-3227	
DONALD	KUMMERFELD	MAGAZINE PUBLISHERS OF AMERICA 919 Third Avenue New York, NY 10022	212/872-3700		
THOMAS JOHN	BASORE JAYMONT	MAGAZINE PRINTERS SECTION Printing Industries of America 100 Daingerfield Road Alexandria, VA 22314	703/519-8141		
BRIAN THOMAS	GILL REEVES	MASTER PRINTERS OF AMERICA Printing Industries of America 100 Daingerfield Road Alexandria, VA 22314	703/519-8130		
DON	DUNHAM	NATIONAL ASSOCIATION OF QUICK PRINTERS 401 North Michigan Avenue Chicago, IL 60611	312/644-6610	312/321-6869	X
		NATIONAL ASSOCIATION OF MANUFACTURERS Washington, DC	202/637-3000	202/637-3182	X
GRACE	MASELLI	NATIONAL ASSOCIATION OF PRINTERS and LITHOGRAPHERS (NAPL) 780 Palisade Avenue Teaneck, NJ 07666	201/342-0700	201/692-0286	X

LEWIS LEWIS	KOPECKEY WORTHINGTON	NATIONAL ASSOCIATION OF LITHO CLUBS 6550 Donjoy Drive Cincinnati, OH 45242	800/869-8600 L.W. 513/793-2532	714/372-4371 510/638-5285	X
JAMES	SUTPHIN	NATIONAL ASSOCIATION OF PRINTING INK MANUFACTURERS Heights Plaza 777 Terrace Avenue Hasbrouck Heights, NJ 07604	201/288-9454	201/288-9453	
PETER	COLAIANNI	NATIONAL BUSINESS FORMS ASSOCIATION 433 E. Monroe Avenue Alexandria, VA 22301	703/836-6225		
TONDA	RUSH	NATIONAL NEWSPAPER ASSOCIATION 1525 Wilson Boulevard Suite 550 Arlington, VA 22209	703/907-7900		
JOHN	BUCKLEY	NATIONAL PAPER TRADE ASSOCIATION 111 Great Neck Road Great Neck, NJ 11021	516/829-3070		
DON	HENSEL	NEWSPAPER ASSOCIATION OF AMERICA (NAA) The Newspaper Center 11600 Sunrise Valley Drive Reston, VA 22091	703/648-1007 703/648-1215	703/620-4557	X
THOMAS BARBARA	BASORE BARBOUR	NON-HEATSET WEB SECTION Printing Industries of America 100 Daingerfield Road Alexandria, VA 22314	703/519-8156		

DAVID	STEINHARDT	NORTH AMERICAN GRAPHIC ARTS SUPPLIERS (NAGASA) 1720 Florida Avenue, NW Washington, DC 20009-2660	202/328-8441	202/328-8513	X
KIM	PRATT	NPES The Association for Suppliers of Printing and Publishing Technologies 1899 Preston White Drive Reston, VA 22091	703/264-7200	703/648-3219	X Kpratt@npes.org
JIM	OLSON	PACIFIC PRINTING IMAGING ASSOCIATION (PIA) 5319 S.W. Westgate Dr. Suite 117 Portland, OR 97221	206/285-8361		X
SCOTT	BAUMRUCK	PAPER INDUSTRY MANAGEMENT ASSOCIATION 1699 Wall Street Suite 212 Mt. Prospect, IL 60056-6213	847/956-0250	847/956-0520	
JAMES	TEPPER	PRINTING INDUSTRIES OF NEW ENGLAND (INCLUDES ME, MA, NH, RI, VT) 10 Tech Circle PO Box 2009 Natick, MA 01760-0015	508/655-8700		
PATRICIA	HANLEY	PRINT NEW JERSEY 75 Kearny Avenue PO Box 6 Kearny, NJ 07032	201/99-PRINT		

EVA	ALOIA	PRINTING INDUSTRIES OF IL & IN (Pii) 70 East Lake Street Chicago, IL 60601	312/704-5000	312/704-5025	piinet@aol.com
VINCENT	MALLARDL	PRINTING BROKERAGE/BUYERS ASSOCIATION 277 Royal Poinciana Way Suite 204 Palm Beach, FL 33480	407/844-9834	407/845-7130	
HARRY	WULFF	PRINTING INDUSTRY ASSOCIATION OF WESTERN PA 212 Ninth Street Suite 500 Pittsburgh, PA 15222	412/281-0400	412/281-0470	
JERRY	BENETTO	PRINTING INDUSTRIES OF SOUTHERN CALIFORNIA PO Box 91-1161 Los Angeles, CA 90091-1151	213/728-9500		X
JIM	SPRAUSS	PRINTING INDUSTRY ASSOCIATION OF GEORGIA (PIA) 5020 Highlands Parkway Smyrna, GA 30082	770/433-3050		X
NIALL	POWER	PRINTING INDUSTRIES OF WISCONSIN (PIW) PO Box 128 Elm Grove, WI 53122	414/785-9090	414/785-7043	X
BEN	COOPER	PRINTING INDUSTRIES OF AMERICA (PIA) (Headquarters) 100 Daingerfield Road Alexandria, VA 22314	703/519-8115	703/548-3227	X bcooper@printing.org

BILL NICK	BAIRD WAGONER	PRINTING INDUSTRIES OF MICHIGAN (PIM) 23815 Northwestern Highway 2700 Southfield, MI 480075-7713	810/354-9200	810/354-1711	X
SCOTT	SCHULER	PRINTING INDUSTRIES OF MINNESOTA (PIM) 750 University Park Plaza 2829 University Avenue, SE Minneapolis, MN 55414-3222	612/646-1257	612/646-8673	X scottray@aol.com
W. ROBINSON	WORTH	PRINTING INDUSTRIES OF VIRGINIA 1108 East Main Street Suite 300 Richmond, VA 23219	704/643-1800		
DAVID	BACON	PRINTING INDUSTRY ASSOCIATION OF THE SOUTH 305 Plus Park Blvd Nashville, TN 37217	615/366-1094		Includes AL, AR, KY, LA, MS, WV
MIRIUM	THOMPSON	PRINTING INDUSTRIES ASSOCIATION OF SAN DIEGO 3914 Murphy Canyon Road Suite A-107 San Diego, CA 92123	619/571-6555	619/571-7935	
DAN	NELSON	PRINTING INDUSTRIES OF NORTHERN CALIFORNIA 665 Third Street Suite 500 San Francisco, CA 94107-1990	415/495-8242		Includes Parts of NV

JAMES	FREY	PRINTING & IMAGING ASSOCIATION - MOUNTAIN STATES (PIA) 5031 S Ulster Street Suite 350 Denver, CO 80237	303/771-1578		Includes NM & part of WY frey@recycle.com
C. MITCHELL	SORENSEN	PRINTING INDUSTRY ASSOCIATION OF CONNECTICUT & W MASS One Regency Drive PO Box 30 Bloomfield, CT 06002	203/242-8991		
KENNETH	MILLER	PRINTING INDUSTRY OF CONNECTICUT PO Box 144 Milford, CT 06460	203/874-6793	203/874-0291	
JOHN	HARKINS	PRINTING & GRPAHIC COMMUNICATIONS ASSOCIATION 1333 H Street, NW Seven West Tower Washington, DC 2005	202/682-3001		
MICHAEL	STREIBIG	PRINTING ASSOCIATION OF FLORIDA (FL Headquarters) 6250 Hazeltine National Drive Suite 114 Orlando, FL 32822	407/240-6009	407/240-8333	
ROSS	FLEETWOOD	PRINTING ASSOCIATION OF FLORIDA (Northern Region Office) 215 S. Monroe Street Suie 350 Tallahassee, FL 32301	904/681-9237	904681-9631	

FRED	ROGERS	RESEARCH AND ENGINEERING COUNCIL OF THE GRAPHIC ARTS INDUSTRY PO Box 639 Chadds Ford, PA 19317	610/388-7394	610/388-2708	
MARCI	KINTER	SCREENPRINTING & GRAPHIC IMAGING ASSOCIATION INTL. (SGIA) 10015 Main Street Fairfax, VA 22031	703/385-1335	703/273-0456	X
LARRY	FLEISCHMAN	SUBURBAN NEWSPAPERS OF AMERICA 401 North Michigan Avenue Chicago, IL 60611	312/644-6610		
JILL	COVINGTON	TAG & LABEL MANUFACTURERS INSTITUTE (TLMI) 1700 First Avenue, S Iowa City, IA 52240	319/337-8247	319/337-8271	
KAREN	LAWRENCE	TECHNICAL ASSOCIATION OF THE GRAPHIC ARTS (TAGA) 68 Lomb Memorial Drive Rochester, NY 14623	716/475-7470	716/475-2250	
ARTHUR	LeFEBVRE	WATERLESS PRINTING ASSOCIATION PO Box 59800 Chicago, IL 60645	800/850-0660	312/743-5756	
THOMAS	BASORE	WEB OFFSET ASSOCIATION Printing Industries of America 100 Daingerfield Road Alexandria, VA 22314	703/519-8156		