ATTACHMENT 1

HIERARCHICAL PROCESS MAPS AND THE RESOURCE ACCOUNTING SHEETS

We did not have any process depictions for sheet-fed lithography readily available so we selected a flow chart provided by our trade association, the Printing Industries of New England.

![Flow Diagram of Lithographic Printing Process](image)

We decided that the perspective of the process is that of the image. It starts when the customer brings us the images for their printing job. The image is transferred to a plate in
the pre-press operation. Next, the image is transferred to the paper in the press operations. Finally the images are bound in the final product in the post press operations.

Top Level (Least Detailed) Process Map – Main Process

We felt that the press operations would create the most interest with our stakeholders. Here is a brief description of what happens in the press operation:

Once the plates are prepared, the actual printing can begin. Sheet-fed presses can print up to 3 impressions per second. Preparation for printing begins by attaching the plate to the plate cylinder of the press (make ready supporting process). Since litho plates are typically made of thin flat aluminum sheets, they can be wrapped around and attached to the plate cylinder. Virtually all presses print from a plate cylinder, as opposed to a flat plate. Each unit of a printing press prints a single color. To print a full color illustration, four separate units are typically required, one unit each for magenta, cyan, yellow, and black (See Figure 5). We will assume a black and white run is being made (i.e., a single unit as shown).

As the plate rotates on the cylinder, water-based mixtures, referred to as fountain solution, are applied to the plate to enhance the non-image area’s ability to repel inks. Fountain solutions may contain 5 to 10% isopropyl alcohol or they may contain alcohol substitutes that meet the same needs but with a lower VOC content.

Through the use of inking rollers, ink is applied to the plate, adhering only to the image area. To accelerate drying and control ink flow characteristics, lithographic inks contain solvents.

As the cylinder continues to rotate, the inked image is transferred or “offset” from the plate to a rubber roller called the blanket.

The blanket transfers the image to the substrate (e.g., paper). With non-heat-set lithography, the ink normally dries by absorption.

The paper is then removed from the press.
Here is a figure of what is happening in the press that illustrates what is described above.

Here is the hierarchical process map for the press operation.

**Second Level Process Map – Conduct Press Operations**

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| APPLY DAMPENING SOLUTION TO IMAGE 2.1 | APPLY INK TO THE IMAGE 2.2 | TRANSFER IMAGE TO THE BLANKET 2.3 |

| TRANSFER IMAGE TO THE PAPER 2.4 |
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The **make-ready process** is a supporting process of the press operation. Here is a description of the make-ready process:

Make-ready is the supporting process in which all the adjustments are made on the press, including proper registration and ink density, to achieve a reproduction equivalent to or comparable to the proof or acceptable to the pressman or customer's representative. The plate is applied to the plate cylinder in the make-ready process. All the fountains are filled making the press ready to operate. This supporting process may be the major source of waste from the printer’s point of view. Make-ready times can last from a few minutes to many hours. Make-ready can be conducted at low speeds or at press production speeds. The printer's objective is to minimize both the time involved in make-ready and the number of waste sheets or signatures coming off the press. The major wastes associated with make-ready are paper and air emissions.

Paper represents the largest supply item that a printer buys and is probably the most expensive component of this work. The printed paper produced in make ready is frequently the largest waste a printer generates and is non-hazardous. Paper waste from this supporting process is determined by the efficiency of the quality control press adjustments needed to achieve the desired pant quality, specifically through proper ink density and accurate registration. Both in make-ready and printing operations, printers need to know how much waste paper is generated relative to the quantity of acceptable pieces. One method that can be used by sheet-fed offset printers is to weigh discarded paper and discarded product signatures and express the weight of waste as a percent of total paper used. Press counters are available, but under some circumstances, such as when a jam occurs on the press and the counter is not turned off, the count may be inaccurate. A number of specific devices have been developed to automate press adjustments. With proper use, most of these are promoted by manufacturers as speeding up the make ready step and thus saving paper and ink. However, their direct benefit is to increase quality control.

The resources used and lost from the make-ready process can be assigned to the press operation in the resource accounting sheets.

The other key supporting process for the press operation is **the press cleaning operation**. A description of this process is provided below:

A press in good repair is essential to meeting eco-efficiency goals. In addition to preventative maintenance, regular cleaning is also necessary to keep the many moving parts operating. While it is easy to collect and recycle the used press oil for re-refining or energy recovery, minimizing solvents from press cleaning presents more of a challenge.
The Role and Composition of Press Cleaners

Cleaning solutions are predominantly petroleum based, are often mixed with detergents and water, contain up to 100 percent VOCs and can be used as a multipurpose press-wash or for cleaning just one part. One general cleaner is not always effective for cleaning rollers, blankets and the outside of the press.

Blanket cleaning consumes approximately two-thirds of cleaners used on a press and is performed once or twice a shift, between jobs and as needed to improve print quality. These cleaners must remove excess ink and dry quickly without leaving any oil residue. Remaining cleaner is used for cleaning press rollers.

Cleaners used on chain and ink rollers should be less volatile so solvent moves over all rollers before evaporating. For metal press parts, slower working solvents are as effective as a general press wash. Stronger solvents are needed for intermittent cleaning of hardened ink, or for specific purposes such as etching the chrome roller.

Cleaning Wastes and Alternatives

Cleaning the press generates several wastes:

* Waste cleaner with residual ink
* Waste ink from the ink fountain
* Rags containing cleaner and ink
* VOC emissions from cleaners

Charles River Printing must manage petroleum-based solvents and inks as hazardous waste. Some inks may not be hazardous when discarded but are unacceptable for landfill disposal because they are viscous. Most states require that a waste be tested to verify that it is non-hazardous and also solid for landfill acceptance.

Disposable rags may be landfilled if laboratory testing demonstrates that they are non-hazardous. Launderable rags are not typically subject to hazardous and solid waste regulations because they are reused after cleaning.

Press cleaning releases VOCS. Intentionally evaporating used solvent is illegal disposal of a hazardous waste and subject to penalty. Additionally, it exposes employees to hazardous working conditions.

Chemical manufacturers are developing low VOC cleaners. Just as there are many different presses, there are many different cleaners. Most low VOC cleaners still contain naphtha and average 3.5 pounds per gallon of VOCs and have a flashpoint greater than 200 degrees F. "Quick drying" cleaners may have slightly higher VOC content and usually have a flashpoint below 140 deg F, making them hazardous waste. Some substitutes present a two step approach, using a cleaning solution with a higher VOC content as step one to be immediately rinsed with a low VOC cleaner as a second step.
Consult proposed and enacted regulations regarding low VOC cleaners to ensure compliance.

Low VOC products continue to clean more effectively, but because the first cleaners performed poorly, the industry has not readily accepted them. EPA research has demonstrated successful substitution of low VOC cleaners using an integrated approach. Cleaning equipment, targeted product substitution and changing operator practices can reduce VOC from cleaning.

**On-Site Cleaner Recycling**

Charles River Printing uses a solvent sink to wash ink trays. These sinks circulate a solvent (generally naphtha-based) for quick, complete removal of residual ink. These sinks are usually serviced by a hazardous waste management company that replaces the used solvent with new solvent according to a set time schedule. The hazardous waste management company may recycle the solvent through distillation, reclaiming the purified solvent and disposing of the hazardous still bottoms.

The resources used and lost in press cleaning will be assigned to the press operations in proportion to how each step demands the resources.

The resource accounting sheets for the press operation are provided on the next few pages.
With the plate in place and the press operation calibrated using the make-ready supporting process, the dampening solution (fountain solution) is applied to the image as the plate is rotated on the plate cylinder to a point under the dampening solution fountain.

**Supporting Processes**
- Make-Ready
- Transport Fountain Solution
- Launder Rags
- Press Cleaning
- Dilute Fountain Solutions
- Container Disposal
- Maintain Press
- Store Fountain Solutions
- Fume Collection

**Other Information**
Description of the Work Step

The plate is rotated to a position below the ink fountain where ink is discharged and rolled on the lithographic plate.

Supporting Processes

<table>
<thead>
<tr>
<th>Make-Ready</th>
<th>Press Cleaning</th>
<th>Maintain Cleaning Sinks</th>
<th>Cleaning Solution Disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport Ink</td>
<td>Store Ink</td>
<td>Container Disposal</td>
<td></td>
</tr>
<tr>
<td>Launder Rags</td>
<td>Maintain Press</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Other Information
Description of the Work Step

The image is transferred from the plate to the blanket in the printing press.

<table>
<thead>
<tr>
<th>Supporting Processes</th>
<th>Make-Ready</th>
<th>Press Cleaning</th>
<th>Maintain Press</th>
<th>Blanket Storage and Transport</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blanket Disposal</td>
<td>Press Cleaning</td>
<td>Maintain Cleaning Sinks</td>
<td>Blanket Storage and Transport</td>
<td></td>
</tr>
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<td>Launder Rags</td>
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<td></td>
<td></td>
<td>Cleaning Solution Disposal</td>
</tr>
</tbody>
</table>

Other Information
**Description of the Work Step**

The image is transferred from the blanket to the paper.

**Supporting Processes**

- Make-Ready
- Press Cleaning
- Paper Storage and Transport
- Paper Recycling
- Maintain Conveyor
- Air Compressor
- Launder Rags

**Other Information**