

APPENDIX E

BACKGROUND AND METHODOLOGY FOR PERFORMANCE DEMONSTRATION: LITHOGRAPHY CTSA

E-1 BACKGROUND AND OVERVIEW OF METHODOLOGY

This section of the lithography CTSA summarizes performance information collected during laboratory and production run performance demonstrations with substitute blanket washes carried out between November 1994 and January 1995. Performance data collected included information such as quantity of wash used, time spent to wash the blanket, ink coverage, and the effectiveness of the wash. Data from the performance demonstrations, in conjunction with risk, cost and other information presented in other sections of the CTSA, provides a more complete assessment of substitute blanket washes than has otherwise been available from one source.

In a joint and collaborative effort, EPA worked with the Printing Industries of America (PIA), the Graphic Arts Technical Foundation (GATF), and other industry representatives to organize and conduct the performance evaluations of 36 substitute blanket washes and the baseline. The demonstration methodology was developed by consensus and was designed to allow the evaluation of the maximum number of blanket washes given the resources available to the project. Performance data were collected for each product in two distinct phases: (1) a laboratory test of the chemical and physical properties and the efficacy of the substitute products, and (2) evaluations conducted in a production setting at volunteer printing facilities. The intent of the laboratory evaluations was to independently measure some of the properties of the washes, such as volatile organic compound (VOC) content, and to assure that the blanket washes sent to volunteer printers would provide an acceptable level of performance. Facility demonstrations were undertaken at the request of printers participating in the DfE project so that blanket washes could be evaluated under the more variable conditions of production runs at printing facilities. It should be noted that the performance demonstrations are not rigorous scientific investigations. Instead, much of this chapter documents the printers' experiences with and opinions of these products as they were used in production at their facilities.

Participation in the demonstration project was open to all blanket wash manufacturers. Prior to the start of the demonstrations, the DfE project staff contacted nearly 100 blanket wash manufacturers to explain the project goals and request their submission of a product. All those who responded and submitted blanket washes were included in the first phase of the demonstrations.

Methodology

The performance evaluation methodology developed by the workgroup is described below and covers both the laboratory testing protocol and the on-site demonstrations methodology. In developing the methodology, the workgroup agreed that product names would be masked. Neither the volunteer printers nor the DfE observers knew the manufacturer of the products being evaluated. Trade names are not listed in this report, instead the blanket washes are referenced by a numerical code and a genericized chemical formulation. This agreement to mask product names was made for several reasons:

- The chemical formulations of commercial products containing distinct chemicals are frequently considered proprietary. Manufacturers of these products typically prefer not to reveal their chemical formulations because a competitor can potentially use the disclosed

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formulation to sell the product, often at a lower price, since the competitor did not have to invest in research and development.

- The performance of products may vary depending on use and shop conditions, and suppliers were concerned about the characterization of the performance of their products.
- The EPA was concerned about appearing to endorse brand name products that fared well in the CTSA evaluation.

In the initial stages of the Lithography Project the Project partners chose VM&P Naphtha as the baseline against which to compare the 36 substitute blanket washes. VM&P Naphtha, composed of 100 percent solvent naphtha, light aliphatic and referred to as formulation 28 in certain sections of the text, was chosen primarily because it is well known among lithographers as an effective blanket wash. Many lithographers have used VM&P in their shops and know how it works in their applications and what it costs. VM&P is known to be highly effective at very low cost, however, because of its high VOC content (100 percent) printers are searching for formulations to replace it.

As the Performance Demonstration was being conducted, some suppliers who had submitted blanket washes chose to withdraw. Their reasons included not wishing to reveal to EPA their complete formulations or concern over the potential results of the performance tests. The formulations that were withdrawn after work had already begun were numbers 2, 13, and 15. For this reason, those numbers are missing from all the tables in the CTSA.

Laboratory Evaluations

Laboratory testing was carried out by GATF in Pittsburgh, Pennsylvania. A total of 36 products were submitted plus the baseline. For each wash, the flash point, VOC content, and pH were tested. The vapor pressure of the product was not tested, but was submitted by the supplier. Two additional tests, a blanket swell test and a wipability test, were conducted to determine the efficacy of each wash prior to sending it out for field demonstrations. Only products that passed this functional demonstration stage were used in the field demonstration portion of the project. For both of these tests, GATF followed the manufacturer's instructions for diluting or mixing the product.

The blanket swelling potential of each product was tested to determine the effect of the wash on the blankets. The procedure used (detailed in Section E-3) involved measuring the thickness of the blanket test square (2 x 2 inches), maintaining contact between the test square and the wash for one hour, and taking another thickness measurement to calculate the percent swell. Another measurement is taken after 5 hours. Any wash where the blanket swell exceeded 3 percent after 5 hours indicated that the wash may dimensionally distort the blanket and was eliminated from field demonstrations.

Washability of each blanket wash was evaluated using both a wet and a dry ink film (detailed in Section E-4). To measure the washability, a standard volume of ink was evenly

applied to a section of a new, clean test blanket. A measured volume of the wash was applied to a cleaning pad. The pad was attached to a mechanized scrubber and the number of strokes required to remove the wet ink were recorded. The procedure was repeated for a dry ink film where the ink was dried with a blow dryer for 20 minutes prior to the cleaning. The dry ink and wet ink tests were repeated for each alternative blanket wash submitted. Any wash where more than 100 strokes were required to clean the blanket (with cleanliness determined by using a reflective densitometer) was eliminated from the field demonstrations.

Based on the results of the blanket swell and the washability tests, 22 of the original 36 products submitted (plus the baseline) qualified for further evaluation through field demonstrations. Prior to shipping substitute blanket washes to printers for these on-site evaluations, each wash was repackaged into a generic container so that those printers demonstrating the products did not know the manufacturer or product name. Masked Material Safety Data Sheets (MSDSs) were also developed and shipped along with the substitute blanket washes to be evaluated.

Printing Facility Demonstrations

PIA affiliates recruited printers located in the Boston, Baltimore, and Washington, D.C. areas, who volunteered their facilities and their time to conduct the field demonstrations of the substitute products. A total of 17 facilities participated. Each substitute product was demonstrated at two facilities and each facility demonstrated a minimum of two and up to five different blanket washes. The product brand name was replaced with a blanket wash number so that the demonstration facilities did not know what product they were using. In addition, the facility names have been replaced with a facility number. A list of participating facilities appears at the front of this document.

To start the on-site demonstration, an "observer" from the DfE project visited each of the volunteer facilities. DfE observers were not EPA employees, but were drawn from staff of the contractor, Abt Associates, Inc. The observers called each facility to review the details of their operation, discuss the goals of the project, and to schedule a site visit. The substitute products, a baseline product, MSDSs, application instructions, and a measuring device were shipped to each facility prior to the DfE observer's arrival.

During each one-day site visit, the observer collected information on the background of the facility, as well as data specific to blanket wash performance. Background data included information on the size of the presses, the number of employees, and current blanket washing practices. After collecting the initial background data, the observers documented information on three types of blanket washes: the blanket wash currently used at the facility, a baseline blanket wash, and the substitute wash. All information was recorded on an Observer's Evaluation Sheet (see Sections E-7 and E-8). Starting with their standard wash, the press operator cleaned the blanket while the observer recorded the quantity of wash used, the time required to clean the blanket, the length of the run, the type and color of the ink on the blanket, and the number of wipes used. After restarting the press, the press operator was asked to comment on the effectiveness of the blanket wash and to determine if there were any changes in subsequent print

quality that could be attributed to the blanket wash. This procedure was then repeated using Blanket Wash 28, VM&P Naphtha, the selected baseline. Naphtha was used at all participating facilities. By comparing the differences in the performance of the baseline at the two different facilities, any significant effects of facility-specific operating conditions (e.g., the type of ink, size of blanket, and operator's effort) on the performance of the substitute wash were more apparent. After cleaning the blanket with the baseline wash, the press operator then used the substitute wash provided. The observer recorded the same type of information as was recorded for both the current wash and the baseline wash. The total number of washes required varied from one facility to the next, since the observer was on-site for one day and recorded information on as many washes as were required during production that day.

After the observer's visit, the facility continued to use the substitute wash for one week. During the week, the printer at each volunteer print shop was asked to record information on product performance. The data recorded were similar to that collected by the on-site observer. However, the Printer's Evaluation Sheets (Section E-9) were simplified in an effort to minimize volunteer printers' burden and production disruptions. Facility background information such as the press size and type of shop towel used were recorded by the observer only. At the end of the week, the observer interviewed the press operator to obtain an overall opinion of the product. The exit interview information was recorded on another standardized form (Section E-10).

Data Collection, Summary, and Analysis

The information summarized in the following section comes from five sources.

- *Laboratory results:* the chemical characteristics and the results of the blanket swell and washability tests were reported for each wash.
- *Facility background information:* the observer collected information on operating conditions while on-site at each volunteer print shop.
- *Observer's data:* DfE observers recorded information on the performance of the facility's current blanket wash, a baseline wash, and the substitute blanket wash.
- *Printer's data:* press operators recorded performance data for each blanket wash completed during the week-long demonstration of the substitute blanket wash.
- *Follow-up interviews:* observers interviewed the press operators at the end of the week-long demonstration on their overall opinion of the substitute blanket wash.

For each of the 22 substitute blanket washes in the field demonstrations, data from the sources mentioned above were analyzed and are summarized in this section. The experiences of the two facilities who demonstrated each product are presented individually. As part of the analysis, a number of correlations were attempted for each facility but the results were typically not statistically significant due to small sample size. These analyses were run to determine if variations in the printer's opinion of the effectiveness of the blanket depended on any other variables such as ink coverage, effort and time spent on blanket washing, or run length. Where appropriate, these results were included within the text summaries of each substitute blanket wash. Additionally, some summary statistics, such as average amount of product used, were presented in accompanying tables.

Limitations

The widely variable conditions between and within printing facilities, the limited number of facilities, and the short duration of the performance demonstrations do not allow the results to be interpreted as definitive performance testing of the blanket washes. In addition, some facilities did not provide the full complement of evaluation forms because they found the performance of the substitute wash to be unacceptable and they discontinued use before the end of the week.

As mentioned previously, the performance demonstrations are not scientifically rigorous but are subjective assessments which reflect the conditions and experience of two individual print shops. There are a number of reasons why the results of performance demonstrations for any given blanket wash may differ from one facility to another. Among these reasons are:

- *Variability in operating conditions.* Because performance demonstrations were carried out during production runs, many factors which affect the performance of the blanket washes were not controlled during the evaluations including: ink type, ink coverage, condition of the blanket, the length of the run prior to blanket cleaning, and the ambient conditions such as temperature, humidity, and ventilation.
- *Variability of print jobs.* Different types of jobs had different requirements for blanket cleanliness. Observers noticed that what one facility considers to be a clean blanket another facility may find unacceptable.
- *Variability of staff involved in performance demonstrations.* Press operators' attitudes towards alternative blanket washes differ from one operator to the next and can affect their perception of performance. As previously mentioned, some of the information recorded was subjective and varied depending on a variety of factors including the attitude, perception, and previous experiences of the operator. For example, many of the substitute products were low in VOC content and did not evaporate as quickly as some of the more traditional blanket washes. Often, an extra step was needed to wipe the blanket with a dry rag to remove a residue left by some of the substitute washes. While extra cleaning steps can be time consuming and lead to increased production costs, even a minimal extra effort was regarded as an unacceptable burden by some operators. Other operators understood that some changes in their procedures and even some extra effort may be needed in order to effectively clean the blanket with an alternative product.
- *Variability in application method.* Press operators' overall opinion of the blanket wash could have been affected by their current application method. For example, operators who are accustomed to using high solvent blanket washes where little effort is required may differ in their opinion of "moderate effort" from operators who are currently using an alternative where some extra effort is already required. All manufacturers were asked to supply application procedures for their product. When instructions were supplied, the observer reviewed the procedures with the press operators, verified the correct procedure was used when the observer was on-site, and asked in the interview at the end of the week if the application procedures had been modified in any way. If any changes were made, the type of change and the reason for the change were described in the performance summary.

- *Short term nature of the demonstrations.* Printers used the substitute blanket washes in their facilities for one week. Any long term effects such as premature blanket wear or corrosion would not have been apparent.

Blanket Wash Summaries

A summary of the performance of each of the 22 substitute blanket washes is presented in Chapter 4 of the lithography CTSA. Since the trade names of the substitute blanket washes are not given in the lithography CTSA, each blanket wash is identified by a numerical code and a generic chemical formulation. The specific types of chemicals that make up each of the generic formulations are explained in greater detail in Chapter 2 of that document. In addition, the facility names have been replaced with a facility number.

Performance of each product is presented separately for the two facilities, and includes a description of the facility's current blanket wash, their past experience in testing alternative blanket washes, their overall opinion of the substitute wash performance, and, if applicable, a summary of the factors that may have influenced performance. A table is also included for each blanket wash which presents the results of the laboratory test of both the substitute blanket wash and the baseline wash. Averages of the volume of wash used, time required, and effort required, as recorded by the printers during field demonstrations are also included in each product performance table.

E-2 METHODOLOGY DETAILS

This section presents information on the methods that were used to gather the performance demonstration data at the print shops and in the laboratory, as presented in Chapters 4 and 7 of the Lithography CTSA. Specifically, this section includes:

- Characteristics to be Reported Out of the Performance Demonstration.
- Demonstration Methodology.
- Blanket Swell Test (laboratory test).
- Washability/wipe Test (laboratory test).

CHARACTERISTICS TO BE REPORTED OUT OF THE PERFORMANCE DEMONSTRATION

Cost of Each Product as Utilized

Product Cost

Interested product suppliers should include the manufacturer's suggested retail price (to the end user) of their products (\$ per 5 gallon drum) upon submission of samples for

demonstration so that the cost per volume used in a cleaning cycle can be determined and reported.

Disposal/Spoilage Costs

Suppliers should provide specific recommendations for the disposal or treatment of wastes associated with using their products. Based upon these recommendations and the wastes determined in the field tests, disposal or treatment costs will be estimated.

Labor/Down-time Costs

This information will be based on the time required to wash a standard 19" x 26" blanket (based on two measures: button-push to completion of wash excluding time for other activities, such as refilling paper; and, after washing, zero the counter and count the number of sheets to get back to salable printing), a standard press operator wage, and standard press time costs. The costs of time and paper losses while returning to salable printing following the wash should be included here as well as any costs that may be associated with changes in or destruction of the blanket or other printing system components. The standard press operator wage information will be obtained from the wage and hourly survey developed by the National Association of Printers and Lithographers.

Storage Costs

These costs will include any special storage required due to hazardous components present in the blanket wash materials.

Product Constraints

The blanket wash supplier should provide information about product compatibility with specific inks (e.g. petroleum or vegetable oil based, UV water based), if known. If the supplier does not provide information regarding product incompatibilities, it will be assumed that there are none.

Special Safety Storage Requirements

Suppliers should provide information about the flammability (as measured by flash point) of the product. This will be confirmed by the laboratory test in the pre-screening procedure.

Ease of Use

The physical effort required to effectively clean the blanket using the test product will be evaluated and reported. This is a subjective judgement based on the experience of the press operator.

Duration of the Cleaning Cycle

The measured time will be the entire cleaning cycle from press shut down to completion of the cleaning process (this excludes any activity unrelated to blanket cleaning). This information when correlated with labor and press-time costs will attempt to measure the total costs associated with the use of the product.

Effectiveness of the Blanket Wash Solution

This will be the subjective judgement of the press operator. The basic criteria will be whether the blanket is sufficiently clean to resume printing based on the judgement of the operator. VM&P Naphtha will be used as the baseline blanket wash to measure a test solution's efficacy, and the operator should also compare against what is normally used on the press.

Printing Equipment and Ink

Information will include the manufacturer, type and age of the press, the blanket and the ink, and the length of press run prior to blanket wash. This is basically descriptive information that may assist in discovering and reporting incompatibilities between the blanket washes and equipment or inks. Additionally, the type of printing job, type of fountain solution, paper size relative to press size, paper type, brief description of blanket condition (Note: the blanket used should be runnable with no smashes or repairs) along with a general description (light, medium, and heavy) of ink coverage will also be reported.

DEMONSTRATION METHODOLOGY**Product Pre-Screening and Masking**

The project will demonstrate alternative blanket washes. Products, product information and MSDSs will be submitted by suppliers in properly labeled generic commercial containers to an independent laboratory (e.g., GATF or university). The independent laboratory will test the flash point and VOC content of the alternative blanket washes. The vapor pressure of the product will be submitted by the supplier (the supplier will note whether the vapor pressure is based on a calculation or test data.) The pH of the product will be provided by the supplier and will be verified by the laboratory. Suppliers wishing to participate in the performance demonstration will have to make direct arrangements with the independent laboratory.

The laboratory will mask all products by removing the trade names and manufacturer from the containers and assign each sample a random ID number. Suppliers will provide a masked MSDS in addition to the standard MSDS sent for shipping. They will also give directions for use of the product without any identifying names, labels or characteristics.

The laboratory will perform a standard test for blanket swelling potential of each product. They will also perform a washability/wipe test for cleaning effectiveness on all of the products

submitted. The blanket swell test and the washability/wipe test proposed methodologies are described in Sections E-3 and E-4. The directions for each specific product will be used as much as possible, including the manufacturer's directions for dilution or mixing. Any deviation from the manufacturers directions will be noted along with the reasons for the deviation. Only products that pass this functional demonstration stage will be used in the field demonstration portion of the project.

Based on the results of the product pre-screening, products will be grouped into categories based on their formulation and/or chemical parameters. These categories should be consistent with the categories used in the EPA risk assessment. One or more products successfully completing the screening will be chosen to "represent" each of the categories; these representatives (one or two per category) will be from the average of the class. The selection of masked products will be sent to volunteer printers for field demonstration. The selection of printers will take into account the type of inks being used as well as the sizes and types of blankets. The variety of inks and blankets used for the demonstration will depend on the number of demonstration sites. Each printer will test a limited number of products. This number will be determined when the number of volunteer printers is established. Although contingent upon the number of categories, the number of volunteer printers, and available resources, each representative blanket wash will be field demonstrated by at least two.

Documentation of Existing Conditions at Volunteer Facility

Once the products have been shipped to the volunteer printing facilities, an observer¹ will record the type, color, and manufacturer of the ink currently being used on the press. The observer will also document the type, model, and condition of the press and blanket being used for the demonstration and the type of paper being run on the press. The observer will also briefly describe the experience of the press operators participating in the test and will document any past experiences that the printer has had with the demonstration of blanket washes; the observer will note any potential biases. The current waste and wipe disposal practices and costs will be documented by the observer. **NOTE:** Presence of observer should be cleared with insurance carrier if necessary, and the purpose of the observer should be carefully explained to the personnel in the pressroom.

The observer will record the product name and cleaning procedure for the blanket wash currently used by the company. The observer will record the cost of the current blanket wash solution. The observer will also record how the product is being stored (in bulk and at the press) and disposed of as waste.

¹ A contract is currently being prepared by EPA to staff this function. This observer will not provide technical assistance to the printers. The observer will serve to document the demonstration and record the operators observations. The observer will ensure the operator performs the demonstration according to the final approved methodology. The observer will additionally serve as the press operators conduit to the technical assistance personnel. This conduit is necessary so as to clearly document the direction given and the actions taken.

The observer will document the current practices by observing the clean up of a blanket, utilizing the company's current product. This will include any pre-application dilution of the product. The observer will measure the quantity used for the cleaning with the company's current blanket wash solution and record the time required for the cleanup. The pressman will use a clean rag to clean the blanket, and the observer will record the size and weight of the rags used for cleaning before and after the cleaning. This will provide an estimate of the retention factor of the product.

The observer will describe the density of the image currently being printed and will record information on the relative frequency of blanket cleaning. The observer will document the number of images required to obtain an acceptable print.

Establishing Evaluation Baseline at Volunteer Facility

The blanket will be cleaned by the press operator using the baseline solution (VM&P Naphtha). This initial cleaning will serve to familiarize the press operator with the baseline product performance. The printer will compare the baseline solution with the blanket wash that is typically used. It has been suggested that this initial cleaning should not be used for comparative purposes, but the information noted in each of the sections below should be noted for reference in any case.

Demonstration

The press will then be restarted for printing and then stopped for cleaning according to the company's standard procedures. The observer will measure the time of cleaning from button push to completion of wash excluding time for other activities, such as refilling paper, and will ask the press operator to zero the counter in order to count the number of sheets to get back to salable printing. The observer will document the volume of baseline solution used and describe the procedure used to ensure the directions were adhered to by the operator. This procedure will be followed for three complete cleaning cycles.

Press Operator Evaluation

At the completion of these cycles the press operator will subjectively evaluate the condition of the blanket, i.e., scaling, picking, etc. Additionally, the operator will evaluate the ease of use and performance of the baseline solution. The observer will describe the density of the image currently being printed. The observer will document the number of images required to obtain an acceptable print image for each of the cleaning cycles.

Resetting the Blanket

The blanket will be cleaned by the press operator using the test blanket wash solution. This initial cleaning will serve to familiarize the press operator with the product and to avoid complications with the previously used solutions. The press operator should measure the volume

after each cleaning (the volume used in the initial cleaning may not be used for comparative purposes).

Demonstration

The press will be restarted for normal operation and then be stopped for cleaning according to the company's standard practice. The observer will measure the time of cleaning from button push to completion of wash excluding time for other activities, such as refilling paper, and will ask the press operator to zero the counter in order to count the number of sheets to get back to salable printing. The observer will document the volume of solution used and describe the procedure used to ensure the directions were adhered to by the operator. This procedure will be followed for five complete cleaning cycles.

Press Operator Evaluation

At the completion of these cycles the press operator will subjectively evaluate the condition of the blanket, i.e., scaling, picking etc. Additionally, the press operator will document the density of the last printed image. The press operator will document the number of images required to obtain an acceptable print image for each of the cleaning cycles. The press operator will compare the relative performance of the test solution as compared to the baseline solution.

Long Term Test

After completion of the above demonstration, a longer term test will be performed by the printer. This test will consist of continued use of the supplied product for a period of one week. The blanket will not be cleaned with any other solutions until the observer returns. The press operator will record the total number of copies printed, the number and relative frequency of blanket washes performed, the volume of product used for each blanket wash, the total amount of product used, and the number of images required to obtain an acceptable print quality for each cleaning cycle.

At the completion of this phase, the observer will return to the shop and will record the press operator's data. The observer will then document the procedures used in a final cleaning of the blanket by the press operator. This will indicate whether there has been any deviation from the initial cleaning procedure by the press operator. If there has been a deviation the observer shall record the reasons for the deviation.

The press operator will then evaluate the condition of the blanket and describe the density of the product currently being printed.

If at any time during this phase of the demonstration there is problem with the solution or the press, the press operator or company point of contact will document the problem as

specifically as possible and call the technical assistance provider² for guidance. Any corrective action will be documented by both the technical assistance provider and the press operator. The observer will record the actions documented by the press operator.

Trouble Shooting

If problems arise during the field demonstration of the blanket solutions, the following procedures will be followed. If the observer is present, the problem will be documented and the observer will call the technical assistance provider for guidance. If the observer is not present the press operator will document the problem and contact the technical assistance provider.

The technical assistance provider will first review the procedures used by the press operator to ensure they are in compliance with the instructions provided with the product. If the procedures are correct then the technical assistance provider will contact one of the printers currently using a product in that category for assistance. Names of these support printers will be provided by the suppliers of the products. The technical assistance provider will relay and filter the recommendation of the support printer to the press operator. The technical assistance provider will ensure the confidentiality of the products is maintained during this period. The identity of the product in the field will remain masked, and the identity of the specific product being used by the support printer providing guidance will not be asked or provided by the printer.

The observer and/or the technical assistance provider will document all actions recommended and taken.

If the recommendations provided by the technical assistance provider are unsuccessful, the press operator will then attempt to solve the problem. The observer and/or the technical assistance provider will document the actions taken by the press operator and the success or failure of the actions.

The above procedures will be repeated for each product tested at the printer test site.

Results and Final Report

Final results will be assembled from the test sites and provided to a contractor to develop into a final report. The report will be developed so that the blanket wash products submitted for testing are grouped according to their formulations/chemical parameters (e.g., VOC content, vapor pressure). The results from similar products in a grouping will be reported in ranges so that the scope of performance from each group can be reported in the information provided to printers. The parameters delineating the grouping will be clearly defined so that both printer and supplier can determine the grouping for any particular blanket wash of interest. Special attention will be paid to the report-out of information on water-miscible products so that printers realize

² A contract will be prepared by EPA to staff this function. The technical assistance provider (i.e., GATF, university, etc.) will be available to trouble-shoot during the field demonstration portion of the project.

that the category characteristics are based on the use of proper amounts of water. (Note: No results will be provided for individual/named products, but blanket washes participating in the study will be listed in the report, along with their grouping.) Results from the field demonstration will be evaluated and assembled so that for any particular group the "average" experience with the products in the group is presented, along with the extreme reactions.

The report will thus have two parts. One part that presents the independent laboratory's screening and other information founded in essentially concrete or quantitative data and a second part that gives experiential anecdotes derived from the subjective evaluations of the demonstration site personnel. Both types of information can be used to develop a second type of information product: case studies of individual demonstration locations that discuss specific actions, changes in techniques, attitude adjustments or other factors that could be significant to a printer that is contemplating product substitution. The products would continue to be masked in the case study. It may be possible to combine several sites with similar experiences into a single report focussing on a single group of products.

E-3 BLANKET SWELL TEST

The purpose of this test is to determine the effect of blanket washes on lithographic blankets by measuring any change in thickness by the use of a micrometer.

Equipment:

- Crystallization Dish
- Cady Gauge (gauge +/- 0.0005 inch)
- Swell Test Clamp
- 2 x 2 inch squares compressible blankets
- VM&P Naphtha, Varnish Makers' and Painters' Naphtha; petroleum fractions meeting ASTM specifications. (Distillation range, at 760mm Hg 5 percent at 130 °C; greater than 90 percent at 145 °C)
- Various Blanket Washes

Experimental Procedure:

This procedure involves measuring and adding 10 ml of the blanket wash to a crystallization dish using a graduated cylinder. An initial caliper measurement is taken of the 2 x 2 inch blanket sample and then it is placed over the mouth of the dish. The dish and blanket are placed into the swell clamp where the blanket is tightened down onto the mouth of the dish until a leak proof seal is formed. The various washes are kept in contact with the blanket for one hour. Caliper readings are taken and the percent swell is calculated. The blanket is re-tightened, exposed for an additional five hours, and the caliper is measured again. This same procedure will be repeated for each blanket wash. The VM&P Naphtha will be used as a control.

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$$\text{Percent Swell} = \frac{\text{Final Caliper} - \text{Initial Caliper}}{\text{Initial Caliper}} \times 100$$

<u>Sample</u>	<u>% Caliper Change After 1 Hour</u>	<u>% Caliper Change After 6 Hours</u>
1. Control (VM&P Naphtha)		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		

Temperature _____

Relative Humidity _____

Blanket Type _____

E-4 WASHABILITY/WIPE TEST

Equipment:

Ink - Sheetfed Process Black
Blanket - Compressible Blanket Cut Into Squares
Quickpeek Brayer Apparatus
Gardner Scrubber Apparatus
Graduated Cylinder
Control Blanket Wash - VM&P Naphtha
Playtex® Panty Shield
Status T Reflective Densitometer
Standard 1200-1500 Watt Blow Dryer
Various Candidate Blanket Washes

Experimental Procedure:

The procedure involves an initial evaluation by using both a dry and wet ink film drawn down on separate pieces of blanket using a quickpeek brayer apparatus. The ink stripes will measure 2 inches wide and 5 inches in length. The amount of ink applied will be determined by using one small or large hole on the Quickpeek apparatus. The blanket will be new and cleaned with the standard prior to applying the ink films. One of the ink films will be dried with a standard blow dryer.

The piece of blanket will then be placed into the holder of the Gardener Scrubber Apparatus. A measured volume of standard and candidate washes will be evaluated. The number of strokes necessary to clean the blanket with the standard will be determined. Once the area has been cleaned with the standard, the densitometer will be used to evaluate the cleanliness of the blanket. Each candidate wash will be placed onto a clean Playtex® Panty Shield and the cleanliness of the blanket will be measured after the same number of strokes found necessary by the standard. If the blanket is not clean, the number of strokes necessary to clean the blanket will be noted. Any residue or other unusual conditions will be indicated.

One of the wet ink films will be dried for 20 minutes with the blow dryer. The same volume of standard and blanket wash as used for the wet ink will be use. The above procedure will be repeated.

The following represents a more detailed review of the step-by step procedure for the Gardner Scrubber Apparatus:

1. A piece of blanket is cut to fit into the holder of the Gardener Scrubber apparatus and the section to be scrubbed is drawn on the blanket. A measured quantity of ink is spread evenly onto the surface of the blanket, ensuring that the thickness of the ink is uniform in the area to be scrubbed. Inking should be done on a counter or other level surface - inking in the holder will result in an uneven surface.

2. The wooden block is used to hold the sample collector, in this case a Playtex[®] Panty Shield. A new, dry shield should be weighed, without the coated paper that protects the adhesive. Solvent will be placed on the shield, not on the inked surface. The initial weight of the shield should be noted and the shield placed on the wooden block. Affix the shield on the side of the block not marked "top" block using the shield's adhesive, and place the block in its holder. Make sure the shield ends are inside the metal holder. They can be forced in by hand or held with thumbtacks. Use the side screw to ensure the block is held securely.
3. Prepare a pipet with 0.4 mL of standard solvent. Ensure that the Scrubber counter is reset and that the holder is in a position where it can be stopped after the test. The far right hand side of the tray is suggested.
4. Place the inked blanket into the tray. Hold the wooden block with the panty shield up and away from the inked surface so that no ink gets on the panty shield. Pipet the wash onto the pad using a swirling motion to evenly distribute the solvent over the surface.
5. Turn the pad over and start the scrubber. It should be allowed to go back and forth 20 times. At the completion of the last cycle, lift the pad off the blanket surface.
6. Lift the tray and blanket out of the apparatus.
7. Remove the block holder and remove the panty shield. Place in a 110 °C forced draft oven for 2 hours to drive off the solvent. Weigh the dried panty shield and note the weight.
8. Clean the piece of blanket and re-ink to perform more tests.
9. Complete the tests for the blanket wash materials being tested with 2 replications each. Repeat the test using the standard solvent upon completion of the test series.

Note: A modified method may need to be developed for aqueous cleaners.

E-5 CATEGORIZATION FOR LITHOGRAPHIC BLANKET WASHES

Table E-1 presents the following categories and classification of formulations that were developed by the DfE Lithography Project Core Group and reviewed by the blanket wash suppliers. The categorization was developed to assist with the development of the Performance Demonstrations.

BACKGROUND AND METHODOLOGY FOR PERFORMANCE DEMONSTRATION

TABLE E-1: CATEGORIES AND CLASSIFICATIONS OF FORMULATIONS			
Category	Mix	Washes	
		All	Pass^a to Demo
1.	Vegetable fatty ester	1 26 29	1 26 29
1a.	Vegetable fatty ester (+glycol)	14 19	14 19
2.	Ester/Petroleum	3 21 36 38	21 36 38
2a.	Ester/Petroleum (+surfactant)	6 11 18 40	6 11 40
3.	Ester/Water	9 10	9 10
4.	Petroleum	31 32 35	31 32
5.	Petroleum/Terpene	13 15	13
6.	Petroleum/Water	5 8 20 37 39	20 37 39
6a.	Petroleum/Water (diluted for use)	12 30 33	30 12
7.	Water/Petroleum/Ester	22 34	22 34
8.	Terpene	16 24 27	24
8a.	Terpene (+ additives)	4 7 23 25	
9.	Detergent	17	

a) 1 indicates formulations passed blanket swell test ($\leq 3.0\%$) and basic washability.

E-6 PERFORMANCE DEMONSTRATION FORMS

The following four forms (shown on the following pages) were used by the observers and printers to record information for the performance demonstrations:

- Observer's Evaluation Sheet
- Observer's Performance Evaluation Sheet
- Printer's Evaluation Sheet
- End-of-Week Follow-up Questionnaire

E-7 OBSERVERS EVALUATION SHEET

FACILITY NAME: _____ **DATE:** _____

Ask each participating printer in the substitute blanket wash performance demonstrations to answer these questions when you call to schedule your visit to their facility. Once on-site, verify the answers.

1. Printing Process

Approximately what percentage of your business (based on annual sales) is in the following segments? Please check all boxes that apply.

	<50%	50 - 95%	95 - 100%
Lithography/Offset	☐	☐	☐
Gravure	☐	☐	☐
Flexography	☐	☐	☐
Screen printing	☐	☐	☐
Letterpress	☐	☐	☐
Other (specify)	☐	☐	☐

2. Products

What percentage of your *lithography* business (based on annual sales) is in the following products? Please check all boxes that apply.

	<50%	50 - 95%	95 - 100%
Commercial Printing	☐	☐	☐
Direct-mail Products	☐	☐	☐
Business Forms	☐	☐	☐
Publications (other than news)	☐	☐	☐
Packaging	☐	☐	☐
News	☐	☐	☐
Other (specify)	☐	☐	☐

3. General Facility Information

How many employees are at this location? _____

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How many employees work in the press room? _____

How many shifts does your facility run per day? _____

4. Press Type(s)

Describe the press(es) that will be used for the performance demonstrations. The required press size is in the 19" x 26" class.

1. **Press size:** _____ (in. x in.) **# of print units:** _____ **Print speed:** _____ (# impressions/hour)

2. **Press size:** _____ (in. x in.) **# of print units:** _____ **Print speed:** _____ (#
impressions/hour)

5. Blanket information

On the press(es) that will be used for the demonstration, what is the average number of times a blanket is washed per shift? _____

What type of blanket do you use on the press(es) that will be used for the demo:

- Manufacturer: _____

- Type (e.g., 3-ply compressible, etc.) _____

- Number of impressions on this blanket prior to the demonstrations:

1 week or less...☐ 1 week to 3 months...☐ 3 months or more...☐

- Do you have any automatic blanket washers in your facility? _____

6. Blanket Washes

Press Used in Demo.	Trade Name of Blanket Wash/Manufacturer	Cost (\$/gallon)	Dilution Ratio (wash:water)	Ink Type(s)
				conventional ☐ vegetable oil-based ☐ UV ☐ waterless ☐ other _____ ☐
				conventional ☐ vegetable oil-based ☐ UV ☐ waterless ☐ other _____ ☐

BACKGROUND AND METHODOLOGY FOR PERFORMANCE DEMONSTRATION

7. Experience with Substitute Blanket Washes

a. Have you tried any substitute blanket washes for environmental or worker health and safety reasons?

- Did the substitute wash work better, the same, or worse than your old wash? Why?

b. Besides substitute washes, have you changed any equipment, procedures or work practices that reduced your use of blanket wash solution or reduced the time required to wash the blanket? Yes.....☐ No.....☐ - If yes, please describe:

8a. Cleaning Procedure - CURRENT PRODUCT

Record blanket cleaning procedure using the chart below and the space at the bottom of the page for additional comments. In each column, check all that apply.

Method for Applying Blanket Wash	Type of Wipe Used to Clean the Blanket	Avg. No. of Wipes Used/Cleaning (cleaning+excess)	Method for Removing Excess Wash from Blanket	Wipes Management
Use squirt bottle to spray directly on blanket ☐	Disposable ☐ Size: _____	1-2 ☐	Clean dry rag ☐	Send off-site for laundering ☐
Use squirt bottle to spray on wipe and apply wipe to blanket ☐	Wet ☐ Dry ☐	2-4 ☐	Clean wet rag ☐	Launder on-site ☐
Dip wipe in blanket wash and apply to blanket ☐	Reusable ☐ Size: _____	4-6 ☐	Allow to evaporate ☐	Dispose of as hazardous waste
Use safety plunger can ☐	Wet ☐ Dry ☐	6-8 ☐	No excess ☐	Dispose of as non-hazardous waste ☐
None Used ☐		8-10 ☐	Other (specify) ☐	
Other (specify) ☐	Other (specify) ☐	Other (specify) ☐		Other (specify) ☐

■ Was the rotation of the blanket during washing (*circle one*): **manual** or **automatic**?

■ Note any other steps taken in washing the blanket:

- For the current blanket wash product, ask the press operator if there are ever any variations in the cleaning procedure, and if so, under what circumstances?

8b. Cleaning Procedure - BASELINE PRODUCT

Clean the blanket using the baseline product, VM&P Naphtha, recording the required information on the observer's evaluation sheet for each cleaning.

- Note the condition of the blanket **before** cleaning:
- Weigh the Naphtha container before use. Record weight: _____
- Pour Naphtha onto a clean, dry wipe.
- Weigh the Naphtha container again. Record weight: _____
- Record the difference in weight on the evaluation sheet.
- Clean the blanket.
- Was the rotation of the blanket during washing (*circle one*): **manual** or **automatic**?
- Note any other steps taken in washing the blanket:

8c. Cleaning Procedure - SUBSTITUTE PRODUCT # _____

Clean the blanket using the substitute blanket wash. Follow the manufacturers instructions and record the required information on the observer's evaluation sheet for each cleaning.

- Note the condition of the blanket **before** cleaning:
- Describe the cleaning procedure:
- Was the rotation of the blanket during washing (*circle one*): **manual** or **automatic**?

E-8 OBSERVER'S PERFORMANCE EVALUATION SHEET

Facility Name _____ Date _____

Demo Type: *(Check one and enter wash #)*

Current Wash _____ **Baseline Wash** _____ **Substitute Wash** _____
 (enter code # _____)
 Wash # _____ (1 - 3) Wash # _____ (1 - 5)

Ink used before wash-up	Specify ink color, type, and manufacturer: conventional ☐ vegetable oil-based.... ☐ other (specify) _____
Run length	Record length of run (# impressions) _____
Ink coverage <i>(obtain a sample sheet for each level of coverage)</i>	<i>(check one):</i> Heavy_____ Medium_____ Light_____
Substrate	<i>Record substrate printed:</i>
Drying time	Time from end of press run to start of blanket wash: _____ minutes
Dilution	_____ <i>(enter wash:water ratio or "none" if used at full strength)</i>
Quantity of wash used	_____ ounces <i>(pour wash on wipe; record volume of wash poured)</i>
Cleaning time	_____ minutes <i>(time for blanket cleaning only)</i> _____ rotations <i>(corresponding number of blanket rotations)</i>
Ease of cleaning	<i>(check one for each question):</i> • Compared to your standard wash, was the effort needed: Lower_____ Same_____ Higher_____ • Compared to the baseline wash, was the effort needed: Lower_____ Same_____ Higher_____ • Did the wash cut the ink: Well_____ Satisfactorily_____ Unsatisfactorily_____
Excess wash	Did you have to remove excess wash? <i>(check one)</i> Yes _____ No _____ If "Yes", how was it removed? <i>(check all that apply):</i> Wet wipe_____ Dry wipe_____ Allow to evaporate_____
Wipes used	Enter the total number of fresh wipes used for blanket washing <i>(includes both wipes used for washing and for removing excess wash) :</i> _____

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Odor	<i>(check one):</i> Odor not noticed_____ Odor detected_____ Strong odor_____
Printer's opinion of the wash performance?	The wash performance was <i>(check one)</i> : Good_____ Fair_____ Poor_____
Examine the blanket	Evaluate the blanket appearance after the wash:
Printing after the wash	Specify the ink color and type used after the wash: How many impressions were run to get back to acceptable quality? _____ Does the printer think the wash caused problems with the print quality? Yes <i>or</i> No If yes, explain:

E-9 PRINTER'S EVALUATION SHEET

Facility name: _____ Date: _____

Press Operator's Initials: _____

Answer these questions for the <i>BLANKET WASH ONLY</i> (do not include the roller cleaning)	
Ink used before wash-up	Specify ink color: _____ Specify ink type: _____ conventional..... ☐ other _____ vegetable oil-based... ☐
Run length	Record length of run: # impressions = _____
Ink coverage	circle one: Estimate the image coverage: Heavy Medium Light
Quantity of wash used for this cleaning	_____ # of ounces from Portion Aid dispenser provided
Cleaning rotations	_____ rotations (record the number of blanket rotations completed during the blanket cleaning)
Ease of cleaning	circle one: The effort needed to clean the blanket was: Low Medium High
Wipes used	Number of fresh wipes used for blanket washing: _____
What is your opinion of this blanket wash?	circle one: The wash performance was: Good Fair Poor
Examine the blanket condition after the wash	Is there any residue, debris, etc. on the blanket? Yes..... ☐ No..... ☐ If yes, please explain:
Printing after the wash	How many impressions were run to get back to acceptable print quality? Did the blanket wash cause problems with the print quality? Yes... ☐ No... ☐ If yes, please explain:
Comments or suggestions - Use the back of this sheet or the space below for any comments:	

E-10 END-OF-WEEK FOLLOW-UP QUESTIONNAIRE**End of Week Follow-Up to Lithographers**

At the end of the week-long demonstration, contact the press operator who used the blanket wash either in-person or by phone. Interview the operator to determine if there were any problems, changes, or concerns since your visit. If you are contacting them by phone, remind them to send in the completed forms immediately.

Facility Name _____ **Substitute Wash #** _____

1. In your opinion, was the performance of the substitute wash better, worse, or about the same as your standard wash? Why?
2. Did you find any conditions where the wash did not work? (e.g., a certain ink type, ink color, or especially heavy coverage). If so, describe the condition(s).
3. Have you changed the ampliation procedure in any way?
 - Do you use more wash?
 - Have you changed the dilution?
 - Have you changed the method for removing excess wash?
4. Do you think the number of impressions required to get back to acceptable print quality is greater, the same, or less than were required using your standard blanket wash? Why?
5. Did you use any other blanket washes during the week on this blanket? Why?
6. Note the condition of the blanket
7. Do you have any other comments, concerns or problems regarding the substitute blanket

