# Offset Blankets, Print Quality, and Sheet Movement

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Abstract

There were three objectives of this study. We wanted to compare the printability of different blankets with all other conditions equal. For a constant paper and press, we wanted to look for differences in interstation press movement of marks that could be attributed to blanket properties. Finally, this was an opportunity to compare process variability due to blankets and contrast this variability with a parallel project dealing with printing plates.

The first and last objectives were achieved while the second objective dealing with movement is more complicated. The movement question created more questions than answers, but it can be assumed that the sheet or blanket movement aspect presents the greatest opportunity to learn more about blanket and press dynamics.

Seven companies agreed to participate, as long as the results were coded. Some blanket companies provided two blankets, and the total is 12 blankets.

Before printing, the blankets were carefully measured for smoothness, caliper, and high magnification digital photographs were collected of the surface.

The blanket suppliers were polled as to what tension to torque and what blanket to plate squeeze to use. The various answers will be shared as well as the final settings chosen for the study. All blankets received identical treatment. Printing may have been on a different day, but the press, paper, ink, fountain chemistry, speed, plate, and temperature were identical. Random samples were pulled for print attribute measurement,

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and 30 consecutive sheets were measured with the Mitsubishi Digital Register Analysis System.

All the blankets were printed to the same approximate solid ink densities. The resulting tone value increases (dot gains) were remarkably close, exhibiting a range of perhaps 5% over all 12 blankets. The movement measurements showed much equivalence between all the blankets, for units 1-2 and 2-3. On the transfer between units 3-4, there were some differences between the 12 blankets. Some of the blankets showed twice the movement as others, but only on the one cylinder couple. This phenomenon will be the subject of further study and discussion with the press manufacturer. The printed samples were examined in the solids for ink lay and in the quarter tones for dot structure. It was clear from photomicrographs that some blankets, under these conditions, print better solids while others print sharper dots.

## Introduction

In this paper, we will start with a literature review of blanket studies, with a short history of blanket testing at GATF. There will be a short discussion of what is meant by performance relative to this paper. The section on materials and methods will carefully describe the printing conditions under which performance was measured. The fact that the participating blanket suppliers preferred to be represented by a letter code suggests that this is a very competitive market. Since the suppliers agreed to participate also shows that they are willing to learn more about the needs of the printer. The discussions of the findings will elaborate upon the effect of tension, movement, and print attributes. Finally, what all this means to a printer, supplier, or press manufacturer will be suggested. Future additional studies that are anticipated will close the paper.

## Blanket Performance, Past, Present, and in the Future

It is instructive to go back in time to show the value of record keeping and also to show how some studies must be done periodically to assess the advance of technology. The fancy word for this today is "benchmarking."

The earliest study that could be found in GATF/LTF records was a "SHOP MANUAL #6" published in 1945 (Anonymous, LTF,1945). This convenient reference book was to "refresh the memory of the craftsman." The blanket was the heart of the offset process, capable of the finest halftone dot, with low pressure and "fine grain plates." Even 400 lpi screens were considered possible because of the blanket. The problems discussed sound familiar today. Back then, the blanket was still made of natural rubber. Offset printing was just starting to displace letterpress.

Rubber deteriorated, and was attacked by driers in the ink and linseed oil in the vehicles. Over the course of a run, the blanket would become embossed by absorption of the oil. The solution was to "rest" the blanket, which meant let it set for a while in the dark. The colored warp threads on the back were there because the press operators had to cut the blankets square by hand. As for plate to blanket squeeze, 0.004 inches was recommended. This was before compressible blankets. As for tightening the blanket, the recommendation in the manual was "only the pressure of one man's hands, do not stand on the wrench."

In 1948, there was a Lithographic Technical Foundation (LTF) Blanket Survey Committee (Anonymous, LTF, 1948). The names of the companies that were on the committee would not be recognized today. The resulting Research Progress Report graded 19 different blankets according to a "use requirement test." The tests included stretch, firmness, oil absorption, resilience, and "serviceability." Like this present study, the names of the participants were coded.

Another step toward standardization was made by the LTF in 1951 with a study about dead weight micrometers for measurement of blanket caliper (Anonymous, LTF, 1951). "High quality printing demands standardization- the elimination or control of the variables in the process." This study was expanded in 1959 with a new packing gauge designed to give the same pressure for every reading (Anonymous, LTF, 1959).

MacPhee and Lind (MacPhee, 1990) addressed the blanket's effect on tone value increase for a compressible versus a conventional blanket, but there was no documentation of packing or torque for the blankets. Since this was a Heidelberg GTO 14 by 20-inch press, it can be assumed that it was to the manufacturer's recommendations, but as will be shown in a subsequent section, which manufacturer? Was it the press or the blanket recommendation?

A recent, very thorough study by Blom, Andrew, and Stroble (Blom, 2001) addressed blanket properties and print quality. This work emphasized runnability more than printability and gave no information about plate to blanket packing or blanket tensioning. Despite these omissions, this was truly the most complete blanket study to date. One particular finding of the Blom, Andrews, and Stroble study was that a blanket with a higher R(a) roughness resulted in greater tone value increase and lower print contrast. This is at odds with the results of this paper.

The student of TAGA proceedings will discover another twenty references to blanket research, going back to the beginning, but the studies will all be found to be related to runnability, cleaning devices, piling, and blanket release. These aspects of blanket performance are important, but are not dealt with in the present paper.

Blanket Performance, in the Present Tense

During the course of the present study, the opportunity presented itself to discuss the following blanket issues: packing latitude, blanket life, printer expectations, torque and packing frequency among printers, effect of blanket washing on blanket life, and the future of blankets. The comments will be streamed together but will not seem too disconnected to the reader.

Packing latitude is less of an issue today than in the past because most blankets in use are compressible, but correct packing provides greater smash resistance. The modern blanket fabric is calendered and pre-stretched. When a blanket is over-torqued, the compressible layers are converted into a conventional blanket, reducing smash resistance.

The life of a blanket drew a large amount of discussion. Embossing, which is the result of piling, ruins a blanket. More frequent washing will result in less waste and longer blanket life. The blanket must be durable and not be susceptible to edge cuts by the paper. The best printing blankets have the shortest life on press, which brings one back to the familiar compromise of lithography. All blankets start out printing well, but they sink and fall off at different rates. Low quality blankets continue to change throughout their life, and never stabilize. A blanket never really dies of natural causes; it is usually murdered.

An important point to any student of lithography is "what do the printer's expect?" The blanket can't be too stiff, since a stiff blanket might take more than one person to mount the blanket on the press. The color of the blanket is very important. A black blanket is less likely to be accepted by a press operator than a light colored surface. The touch and feel of the surface, related to the grinding or buffing process is important, like the surface of a new roller. The serious printer will look at tone value increase (dot gain), the even printing of screens, how easy it cleans, and durability.

The suppliers were asked whether their customers were as attentive to torque and packing as the GATF was for this study. One supplier claimed that half of the printers do this. Another said 40% of their customers use torque wrenches and another 20% use packing gauges. The last response from a supplier claimed that only one in ten printers ask about torque and packing of a blanket.

The final question to the suppliers was about the effect of automatic blanket washers on blanket life. Spray cleaners have no contact, and therefore, no effect. Cloth blanket cleaners can reduce blanket life if the setting is too tight. If the setting is correct, the blanket life can be extended. Brush blanket cleaners are usually set too tight and actually abrade the blanket surface.

The future of blankets will be discussed later under future work.

Materials and Printing Conditions

Blankets were supplied upon request from seven blanket suppliers. Some suppliers submitted more than one set of blankets, leading to 12 different sets of blankets. By agreement with the suppliers, the various blankets are referred to by an alphabetical code from A to L. Table 1 summarizes such properties as smoothness, caliper, and ply information for each blanket.

Table 1. Blanket properties, before and after printing.

| | **Before Printing** | | **After Printing** | |
|---|---|---|---|---|
| **Blanket** | **Caliper, inches** | **Smoothness, R(a)** | **Caliper, inches** | **Smoothness, R(a)** |
| A | 0.076 | 0.77 | 0.075 | 0.87 |
| B | 0.077 | 1.32 | 0.075 | 1.5 |
| C | 0.076 | 0.39 | 0.075 | 0.45 |
| D | 0.076 | 0.69 | 0.074 | 0.62 |
| E | 0.077 | 1.34 | 0.075 | 1.57 |
| F | 0.075 | 0.56 | 0.073 | 0.65 |
| G | 0.077 | 0.77 | 0.075 | 1.02 |
| H | 0.078 | 0.51 | 0.077 | 0.55 |
| I | 0.077 | 0.68 | 0.076 | 1 |
| J | 0.076 | 0.91 | 0.075 | 1.05 |
| K | 0.077 | 0.72 | 0.076 | 1.1 |
| L | 0.076 | 1.09 | 0.076 | 1.37 |

Smoothness as measured with a Rank Precision Surtronic profilometer with a ruby stylus. This is a relative smoothness measurement of average roughness in microns. Each value in the table is the average of at least 25 measurements. In the column referred to as after printing, the measurements were made in areas where ink was transferred more than a thousand times during the print run. Caliper measurements were also the average of at least 25 measurements with a dead weight micrometer. Digital photographs of each blanket surface, at 200x, are shown in appendix 3.

The following printing conditions were the same, to the best of our ability, for all of the blankets. Printing was done on a 2000 Heidelberg SM102 40 inch press equipped with a Technotrans temperature control system for inkers and fountain chemistry. Ink system temperature was maintained at 73.5 Fahrenheit (22 Celsius) while the dampening system was set at 50° Fahrenheit (10° Celsius). The 12 sets of blankets took several days to print and evaluate. At the beginning of each day, the form roller stripes were printed and adjusted if necessary. The press was operated at 10,000 iph for sample collection. The inks used for this experiment were INX OSF Vision series, with properties listed in Table 2. Fountain chemistry was Prisco 3451U at 2 ounces per gallon and Prisco Alkaless 3000 alcohol substitute at 3 ounces per gallon. If the pH drifted more than 0.5 units or the conductivity drifted more than 500 micromhos, the fountain chemistry was replaced. The paper was a #2 100 pound sheet from Roosevelt Paper Company. A hundred pound sheet is preferred for digital register analysis to minimize movement that could be attributed to the paper.

Table 2. Ink physical properties used in the blanket testing, INX OSF Vision ink.

| | **Viscosity Poise** | **Yield dynes/cm** | **Water Pick up** | **pH drift** | **conductivity drift micromhos** |
|---|---|---|---|---|---|
| **Black** | 476 | 1954 | 48 | 0.7 | 860 |
| **Cyan** | 608 | 2164 | 46 | 0.7 | 540 |
| **Magenta** | 489 | 3402 | 44 | 0.7 | 500 |
| **Yellow** | 372 | 3672 | 52 | 0.6 | 500 |

| | **Tack 1 minute** | **Color Strength versus SWOP** |
|---|---|---|
| **Black** | 17.3 | 9% weak |
| **Cyan** | 18.1 | 17% weak |
| **Magenta** | 16.5 | equal |
| **Yellow** | 15.9 | 9% weak |

Viscosity was measured according to ASTM Method D 4040-81. Emulsification, or Water Pick Up was performed according to ASTM Method D 4942-89. Tack was measured according to ASTM Method D 4361-89. Tinctorial color strength was measured with the National Printing Ink Research Institute (NPIRI) bleaching method. For the record, the use of these particular inks for this study is not an endorsement by the Graphic Arts Technical Foundation. The inks were used because of a series of studies that have been performed with the inks, and a comfort zone of knowing what to expect. Any ink company could provide a product with similar performance if a printer communicated such a request.

Each supplier was asked for a torque and plate-to-blanket squeeze recommendation. The results of this "survey" are shown in Table 3.

Table 3. Suggested plate to blanket packing and torque, according to the manufacturers.

| Blanket | Plate to Blanket Interference, inches | Torque, foot pounds |
|---|---|---|
| A | 0.004 | 47 |
| B | 0.004 | 47 |
| C | 0.004 | 40-45 |
| D | 0.004 | 40-45 |
| E | 0.004 | low as possible |
| F | 0.004 | low as possible |
| G | 0.004 | 38 |
| H | 0.004 | 38 |
| I | 0.004-0.006 | 40-45 |
| J | 0.0045 | 45 |
| K | . 0.0045 | 45 |
| L | | 40-45 |
| Heidelberg | 0.006 | 47-55 |

There must be reasons for the variety of settings shown in Table 3, but the individual approach was abandoned for the sake of benchmarking and expediency. First of all, each supplier was polled and asked whether they would accept a constant torque of 38 foot pounds. This was a very middle ground, and they were just glad that someone was going to torque the blankets all the same. Therefore, all the blankets were tensioned to 38 foot pounds.

The amount of plate-to-blanket squeeze that was recommended was the next issue. For the most part, these were all the same, except for blanket "I." The first blanket was mounted, tensioned, rolled up, and the solids were found to be weak. The back cylinder pressures were moved up with no improvement. Dry solids were printed to test the evenness of the packing. Break away solids were printed to show that the cylinders were parallel. The operator consulted the manual of the press to learn that for the SM102, the blanket should be mounted flush with the bearers. Since the plate is always 0.006 inches over bearer, the resultant recommended squeeze by Heidelberg is 0.006 inches. Subsequent conversations with the various suppliers revealed that all Speedmasters in the field are running at +0.006 inch squeeze (interference.) It was curious that every blanket supplier recommended nearly half that amount, or "as much as is needed to get good transfer." Therefore, all 12 sets of blankets were printed at 0.006 inch squeeze between the plate and the blanket.

An additional adjustment was the back cylinder pressure. The press manufacturer recommends a squeeze equivalent to the caliper of the paper. For most of the blankets, this was adequate, but if necessary, another 0.001 inch was added to achieve a better solid. This was left up to the discretion of the press operator.

For all the data shown in this paper, the mounting and tensioning procedure was the same, except for one case that will be explained further. When the blankets were first mounted, they were tightened and torqued at the tail to 38 foot pounds. The cylinder was rolled for five revolutions under impression, and the tail of the blanket was torqued again. This was repeated after ten more revolutions under impression. After 10 more revolutions under impression, the tail of the blanket was torqued a final time. The cylinder was taken off impression and the lead edge of the blanket was torqued to 38 foot pounds.

In one instance, two sets of blankets were given to a different press crew. They were not allowed to use a packing gauge or a torque wrench. These are trials C-2 and K-2. When the blankets were inspected for tension the next day, it was determined that the packing was still correct at 0.006 inch squeeze, but the tension or torque was approximately 25 foot pounds instead of 38 foot pounds.

When all the packing and tensioning was correct, the press was run to GRACoL #1 coated aimpoints for solid density (reference.) The density targets, wet, with allowance for dryback, were black 1.80, cyan 1.45, magenta 1.50, and yellow 1.05, all status T response.

The plates were Kodak Polychrome Graphics Electra thermal CTP plates with a positive 5% applied to the curve in the mid-tones. The screen ruling was 175 lpi.

Just before the final run, at the end of makeready, the blanket torques were checked one more time. If all was in order, a short run was made at 10,000 iph. The next day, 30 consecutive sheets were pulled for register analysis. From the same run, 20 random sheets were collected for print attribute measurement. Print attributes were measured on an X-Rite ATS scanning spectrodensitometer and also with a Tobias S-xy-40 scanning densitometer. The ATS was used to generate density, tone value increase, trapping, and print contrast data. The Tobias was used to read a 15 point tone scale in the middle of the sheet.

Digital register analysis employs a machine vision system to carefully measure relative position of triads of dots over 30 consecutive press sheets. Sheet movement is displayed in units of microns of standard deviation over the 30 sheet sample. There is a movement index for each unit to unit transfer. In this study, the movement was measured at 9 positions on each sheet. For the sake of simplicity and discussion, the three measurements at the tail of the sheet are averaged, as well as those of the lead edge of the sheet. For the reader's reference, standard deviations of 3 to 5 microns are insignificant. Movement of 8 to 10 microns standard deviation can result in micro-doubling in the quarter tones.

An Olympus microscope and digital camera were used to image each blanket surface at 200 times magnification. The digital photos were converted to gray scale images in PhotoShop to preserve the anonymity of the various blanket suppliers. Solids and quarter tones were imaged at 100 times magnification to show evenness of ink lay in solids and dot structure.

## Results and Discussion

In Table 1, it should be pointed out that despite these relatively short runs, nearly every blanket lost some gauge after printing, and the surface became more rough after printing. This is despite the fact that immediately at the end of the runs, the blankets were measured on press and showed no gauge loss. After resting for a week or two, gauge loss was observed. One would think that after printing, debris would have accumulated in the blanket pores causing roughness to decrease. On the other hand, a micro-embossing mechanism would swell the blanket material increasing the roughness. This could be traced over a longer time period by measuring the R(a) on a blanket on the press over a few hundred thousand clicks on the totalizer.

## Print Attributes for the First Print Runs

In the first print runs, all blankets were printed at the same conditions of tension and packing. The results of the 20 random X-Rite ATS scans are presented in Table 4. These numbers show a relatively small difference in printability between all of these blankets. Blankets G and H show a slightly greater tone value increase than the rest of the population. Overall, there is a small amount of print variability associated with the blanket, for all other conditions being equal. The run length was short, and it may by misleading to assume that this lack of blanket difference would persist over time. At the end of each run, the blanket tension and packing was inspected and it was found to be unchanged for all of the blankets in the study.

Table 4. Print attributes of status T density and tone value increase for the first print run of all blankets. TVI50 refers to the tone value increase at 50%, for a 175 lpi screen.

| Blanket | K-den | K-TVI50 | C-den | C-TVI50 | M-den | M-TVI50 | Y-den | Y-TVI50 |
|---|---|---|---|---|---|---|---|---|
| A | 1.63 | 22.9 | 1.48 | 19.6 | 1.51 | 21.3 | 1.01 | 19.0 |
| B | 1.63 | 21.4 | 1.46 | 18.1 | 1.49 | 19.8 | 1.00 | 18.0 |
| C | 1.71 | 24.5 | 1.56 | 21.8 | 1.53 | 22.6 | 1.02 | 20.5 |
| D | 1.62 | 22.6 | 1.46 | 20.6 | 1.50 | 22.7 | 1.00 | 20.8 |
| E | 1.66 | 21.8 | 1.50 | 19.2 | 1.49 | 20.1 | 1.01 | 18.8 |
| F | 1.69 | 21.5 | 1.46 | 18.9 | 1.54 | 19.4 | 1.01 | 18.6 |
| G | 1.68 | 25.6 | 1.51 | 20.6 | 1.58 | 26.2 | 1.04 | 21.6 |
| H | 1.62 | 25.2 | 1.46 | 22.0 | 1.50 | 23.8 | 1.00 | 22.6 |
| I | 1.68 | 21.8 | 1.54 | 19.5 | 1.57 | 20.6 | 1.06 | 19.0 |
| J | 1.70 | 22.5 | 1.52 | 17.9 | 1.51 | 19.9 | 1.06 | 18.7 |
| K | 1.65 | 20.0 | 1.48 | 18.1 | 1.57 | 20.4 | 1.01 | 17.3 |
| L | 1.62 | 21.2 | 1.51 | 18.5 | 1.51 | 20.9 | 1.01 | 17.4 |
| GRACoL1 | 1.70 | 22.0 | 1.40 | 20.0 | 1.50 | 20.0 | 1.05 | 18.0 |

Trapping and print contrast are shown in Table 5. Recall that blanket H had a little more tone value increase, but this resulted in a slightly greater trapping number. There really isn't a significant difference between these 12 blankets.

Table 5. Trapping (Preucil formula), and print contrast for all 12 blankets for print run one.

| | Trapping | | | Print Contrast | | | |
|---|---|---|---|---|---|---|---|
| Blanket | Red | Green | Blue | K-PC | C-PC | M-PC | Y-PC |
| A | 70.4 | 83.7 | 66.2 | 41 | 38.9 | 40.5 | 28.8 |
| B | 69.4 | 83.4 | 66.8 | 42.9 | 40.2 | 41.8 | 29.1 |
| C | 68.5 | 80.9 | 60.9 | 40.5 | 38.5 | 38.5 | 26.8 |
| D | 66.5 | 83 | 64.7 | 38.8 | 38.1 | 37.7 | 27.7 |
| E | 70.9 | 85.3 | 67.4 | 42.4 | 40.1 | 40.9 | 28.4 |
| F | 64 | 78.1 | 61.5 | 44 | 41 | 43.7 | 29.2 |
| G | 67.9 | 82.5 | 65.8 | 39.3 | 38.4 | 38.1 | 26.3 |
| H | 74.2 | 85.8 | 68.5 | 38.7 | 36.1 | 38.1 | 24.9 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I | 67.9 | 82.6 | 63.7 | 43.1 | 40.7 | 42.3 | 29.2 |
| J | 67.3 | 82 | 63.6 | 42.4 | 40.6 | 41.9 | 28.3 |
| K | 67.5 | 82 | 64.7 | 43.2 | 39.8 | 41.7 | 29.8 |
| L | 69.5 | 82.3 | 64.9 | 42.1 | 40.2 | 40.8 | 29.7 |
| Average | 68.7 | 82.6 | 64.9 | 41.5 | 39.4 | 40.5 | 28.2 |

The yellow print contrast is less than GRACoL in all cases. This can be explained by the fact that the Harlequin RIP on the CREO Trendsetter images the yellow plate at a higher screen ruling than the other three plates. The reason for this is two fold; to minimize moire, and to get around some patent issues. Since the screen ruling is greater, the print contrast values are lower than the film based target values of GRACoL.

Sheet Movement for the First Runs

The reader is referred to the Appendix for this Table. One of the hypotheses of this study was that blankets would show different amounts of movement from unit to unit on the press. The movement could be the result of pull away of the sheet from the blanket, movement due to the press, movement due to blanket construction, or movement due to the tension or plate-to-blanket squeeze used in this study.

The measurements show that, again, there is very little difference between the blanket for units 1 and 2 and units 2 and 3. When it comes to the transfer from unit 3 to unit 4, some blankets show greater movement than others, and to an appreciable extent. As expected, there is usually more movement at the tail than at the lead edge of the blanket. The differences in movement at one unit but not the other two units suggests that something was going on with the press. But why did some blankets show the movement but not the rest? For example, why did blankets G, K, and L show the movement in unit 3 to 4 transfer, but not blankets B, C, and D? An answer is not available at the writing of this paper. It may be related to the fact that all the blankets were packed to the same plate to blanket interference. The blankets that showed the most movement on this transfer may have shown less movement if packed to less interference. Likewise, the blankets that masked the movement in the press may have greater compressibility and smash resistance. Another way to state this is that, while up to now, all the blankets have printed nearly equivalent, there are some blankets that are more forgiving than others, with greater packing latitude.

Print Attributes and Movement, Run 2

The second run was made to show the necessity of the packing gauge, torque wrench, and dead weight micrometer for printing without movement. The second shift operators were given all the same materials and run parameters, but not a torque wrench or packing gauge. They were asked to repeat the print trials for blankets C and K (shown in the tables as C-2 and K-2). These blankets were chosen because they represented a range of movement on unit 3 and 4. The press operators were good sports, and they were challenged to print just as well as the first shift, but with fewer tools. At the beginning of the next shift, the packing and the torque were measured. The packing was the same as the previous runs, even with the bearer, and +0.006 inch plate to blanket. Torque measurements showed that instead of 38 foot pounds, the tension was 24 foot pounds. Print attributes and movement are shown in Tables 5 and 6, comparing the results to the first run.

Table 5. Print attributes of two blankets at different blanket tensions (torque).

| Blanket | K density | K TV 50% | C density | C TV 50% | M density | M TV 50% | Y density | Y TV 50% |
|---|---|---|---|---|---|---|---|---|
| C-1 | 1.71 | 24.5 | 1.56 | 21.8 | 1.53 | 22.6 | 1.02 | 20.5 |
| C-2 | 1.59 | 26.2 | 1.37 | 21.7 | 1.49 | 24.8 | 0.92 | 20.9 |
| K-1 | 1.65 | 20 | 1.48 | 18.1 | 1.57 | 20.4 | 1.01 | 17.3 |
| K-2 | 1.65 | 24.3 | 1.43 | 20.1 | 1.53 | 22.6 | 0.95 | 19.9 |

Table 6. Sheet movement of two blankets where the only change was blanket torque. Run 1 was 38 ft. pounds while Run 2 was 24 ft. pounds.

| Blanket | Position | units 1/2 | units 2/3 | units 3/4 |
|---|---|---|---|---|
| C-1 | tail | 3.78 | 4.42 | 5.89 |
| | lead edge | 3.84 | 4.33 | 5.28 |
| C-2 | tail | 3.96 | 4.11 | 3.68 |
| | lead edge | 3.92 | 4.1 | 4.57 |
| K-1 | tail | 6.45 | 3.7 | 11.33 |
| | lead edge | 2.8 | 4.48 | 9.79 |
| K-2 | tail | 4.78 | 3.95 | 6.89 |
| | lead edge | 3.07 | 3.98 | 5.95 |

Assuming all things equal except tension, a lower torque setting resulted in greater tone value increase of 2 to 4%, as much as the entire variability between all the blankets when they were all tensioned at 38 foot pounds. The effect on the quarter tones is even greater, as shown in Table 9. Less torque appears to translate into almost 10% more tone value in the quarter tones for magenta. Less tension results in less movement of the blanket K in the unit 3 to 4 transfer. This has been observed before in the field by those experienced with digital register analysis (personal communication.) The trade off is the greater tone value increase of the quarter tones.

It was pointed out that the unit 3 to 4 transfer seemed to give the most movement with some of the blankets, K included. Running with less tension showed less movement on the unit 3 to 4 transfer. For units 1-2 and 2-3, where the movement was insignificant, the movement was about the same at both torque settings. The tone value increase was 4-5% more for each color at the lower torque, from quarter tones through midtones.

Print Attributes and Movement, Run 3

The final run was made with blanket K, following press adjustments by the manufacturer. As far as we can tell, there was some slight adjustment of the thrust bearings in the unit 3-4 transfer. For the last condition, the torque setting was returned to 38 foot pounds. This was the third time that this set of blankets was mounted and tensioned on the press. The results are shown in Table 7 and Table 8.

Table 7. Print attributes of blanket K after press mechanical adjustment (K-3)

| Blanket | K density | K TV 50% | C density | C TV 50% | M density | M TV 50% | Y density | Y TV 50% |
|---|---|---|---|---|---|---|---|---|
| K-1 | 1.65 | 20 | 1.48 | 18.1 | 1.57 | 20.4 | 1.01 | 17.3 |
| K-3 | 1.63 | 21.5 | 1.4 | 17.3 | 1.52 | 20.4 | 0.96 | 18.2 |

Table 8. Sheet movement of blanket K after press mechanical adjustment (K-3).

| Blanket | Position | units 1/2 | units 2/3 | units 3/4 |
|---|---|---|---|---|
| K-1 | tail | 6.45 | 3.7 | 11.33 |
| | lead edge | 2.8 | 4.48 | 9.79 |
| K-3 | tail | 3.07 | 3.71 | 9.49 |
| | lead edge | 3.2 | 3.28 | 4.28 |

The tone value increase at the midtone has returned to the same value as the first run. The movement was less on the unit 3-4 transfer with a slight improvement on the unit 1-2 transfer at the tail of the sheet. Whether the movement of unit 3-4 can be improved upon remains to be discussed with the press manufacturer.

The Impact of Sheet Movement

During the course of this study, there were frequent discussions with the developers of the digital register analysis system about the meaning of our findings. For example, how can the blankets appear so similar in movement on two transfers but so different on the unit 3-4 transfer. A favorite discussion was about how much movement will translate into a visible printing difference, and where would the movement manifest itself first? The upper movement extreme is when a test image like the ladder targets show excessive movement. At this point, the register targets are too doubled or slurred to perform the analysis. What will be the result of movement of 10 micron standard deviation versus 4 or 5 micron standard deviation of movement? The movement is said to appear in the low quarter tones first. This is explored in more detail in Table 9. The magenta data is featured, since it is always related to the unit 3-4 transfer. The unit 2-3 movement is shown for comparison.

Table 9. Quarter tone value increase for magenta, and sheet movement

| Blanket | M TV 5% | M TV 10% | M TV 20% | M TV 25% | unit 2/3 lead edge | unit 2/3 tail | unit 3/4 lead edge | unit 3/4 tail |
|---|---|---|---|---|---|---|---|---|
| A | 14.3 | 21.5 | 35.5 | 41.5 | 3.52 | 3.39 | 6.08 | 6.39 |
| B | 14 | 21 | 34.7 | 40.6 | 4.83 | 4.21 | 4.21 | 4.89 |
| C-1 | 15.6 | 23.2 | 37 | 43.4 | 4.33 | 4.42 | 5.28 | 5.89 |
| C-2 | 28.9 | 36.2 | 49.1 | 55.1 | 4.1 | 4.11 | 4.57 | 3.68 |
| D | 12.5 | 20.3 | 35 | 41.3 | 5.02 | 3.52 | 5.87 | 5.67 |
| E | 14.3 | 21.5 | 35.5 | 41.5 | 3.51 | 4.28 | 4.29 | 6.05 |
| F | 14.3 | 21.5 | 35.5 | 41.5 | 4.2 | 3.35 | 3.95 | 5.93 |
| G | 16.4 | 24.2 | 38.1 | 44.1 | 3.91 | 4.1 | 7.63 | 9.61 |
| H | 16 | 24 | 38.1 | 44.3 | 3.52 | 3.61 | 4.3 | 6.14 |
| I | 16 | 23.2 | 36.7 | 42.4 | 3.82 | 3.33 | 7.62 | 5.89 |
| J | 14.3 | 21.5 | 35.5 | 41.5 | 4.37 | 3.7 | 6.76 | 7.93 |
| K-1 | 14.7 | 21.8 | 35.3 | 41.3 | 4.48 | 3.7 | 9.79 | 11.33 |
| K-2 | 17 | 25 | 39 | 46 | 3.98 | 3.95 | 5.95 | 6.89 |
| L | 13 | 20 | 33.4 | 39.8 | 3.57 | 3.68 | 6.5 | 9.63 |

For all 12 blankets, the average range of tone value in the quarter tones is 3 to 4.5%. Closer examination shows that blankets G, H, and C, for example, always have the highest tone value in the quarter tones, but the movement standard deviations are low. Blanket L has the lowest tone value increase in the quarter tones, but one of the greatest amount of movement in the unit 3-4 transfer. Greater movement did not predict greater tone value increase in the quarter tones for this series of test.

The quarter tones did respond to blanket tension, showing large changes in tone value increase at 24 foot pounds as opposed to 38 foot pounds for blanket C and K.

Solids and Tones

So far, the results have communicated to the supplier and the printer that for these printing conditions, all else being equal, there was a range of tone value increase of about 4% for all the blankets. The color of the blankets have been carefully concealed. A printer would want to know next just how the various blankets printed solids and halftones. This is revealed in a series of photomicrographs shown in Appendix 2. Once again, these are all for the magenta solid and 25% screen. The blanket surface is shown as well, to subjectively correlate surface structure and finish with solid and tones. The reader should keep in mind that these photographs are at a high magnification. As part of the makeready, the press operator visually determined that the solid was acceptable. These are all degrees of acceptable.

All of the blanket surface structures look similar, except for blankets F, H, and L. Blankets G, H, and K seem to have the smoothest solids. Blankets G and H had the greatest midtone tone value increase while blanket K had the most movement in unit 3-4 transfer. Blanket G and J actually show some slight doubling at these printing conditions. Blanket A-F, I, K, and L have the best dot structure, again, for these printing conditions.

Conclusions and Future Studies

When packed and torqued to the same settings, the resulting print attributes for the twelve blankets in the study were very similar, and all were close to GRACoL #1 coated for this ink and paper combination.

The manufacturers varied considerably in their recommended settings. Some of this is covered by the caveat where the printer is advised to adjust until good quality is apparent. It is possible that the settings used in this study were not optimum for all the blankets.

Digital register analysis revealed issues more likely related to the press than to the blanket. It was discovered that some blankets masked movement in the press better than others at these settings. This should be referenced back to the previous statement. With more time and paper, the blankets that gave the greatest movement on a particular press unit may have performed better if packed at a lower plate to blanket interference.

One way to decrease movement was to decrease the torque on the blanket, but this was at the cost of tone value increase. With a good torque wrench, a printer could use blanket tension as another tool to control and adjust the process.

By documenting all the settings, ink, paper, temperature, etc, it was possible to return to previous benchmark settings nearly a month later. This is further evidence of the value of process control to the printer.

Photomicrographs show that, at these settings, some blankets print better solids than dots.

Even after these generally short runs, the blankets generally lost gauge and became more rough in the image area. This will be explored in future work. Additional future work will be the same benchmarking experiment on a 38 inch web heatset offset press. This Rotoman press will be running by July of 2002.

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Appendices

Appendix 1. Sheet Movement

TechAlert Blanket Study, Sheet Movement

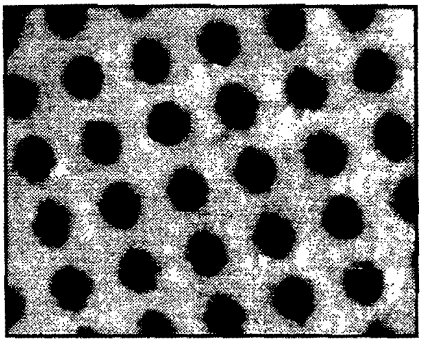
Manufacturers are coded, INX Vision Ink, Roosevelt #2 coated paper, Prisco 3451U fountian soluton. Press speed 10,000iph. Values for thirty consecutive sheets. Tail is average of 3 positions, or 90 measurements, same for lead edge. Values are standard deviation of movement in microns over the 30 sheet sample.

| blanket | | units 1/2 | units 2/3 | units 3/4 |
|---|---|---|---|---|
| A | tail | 4.20 | 3.39 | 6.39 |
| | lead edge | 3.59 | 3.52 | 6.08 |
| B | tail | 4.44 | 4.21 | 4.89 |
| | lead edge | 4.57 | 4.83 | 4.21 |
| C | tail | 3.78 | 4.42 | 5.89 |
| | lead edge | 3.84 | 4.33 | 5.28 |
| C-2 | tail | 3.96 | 4.11 | 3.68 |
| | lead edge | 3.92 | 4.10 | 4.57 |
| D | tail | 3.85 | 3.52 | 5.67 |
| | lead edge | 3.30 | 5.02 | 5.87 |
| E | tail | 3.65 | 4.28 | 6.05 |
| | lead edge | 3.46 | 3.51 | 4.29 |

| | | | | |
|---|---|---|---|---|
| F | tail | 3.56 | 3.35 | 5.93 |
| | lead edge | 3.80 | 4.20 | 3.95 |
| G | tail | 3.84 | 4.10 | 9.61 |
| | lead edge | 2.57 | 3.91 | 7.63 |
| H | tail | 4.10 | 3.61 | 6.14 |
| | lead edge | 4.04 | 3.52 | 4.30 |
| I | tail | 3.89 | 3.33 | 5.89 |
| | lead edge | 3.37 | 3.82 | 7.62 |
| J | tail | 3.89 | 3.70 | 7.93 |
| | lead edge | 4.67 | 4.37 | 6.76 |
| K | tail | 6.45 | 3.70 | 11.33 |
| | lead edge | 2.80 | 4.48 | 9.79 |
| K2 | tail | 4.78 | 3.95 | 6.89 |
| | lead edge | 3.07 | 3.98 | 5.95 |
| L | tail | 3.40 | 3.68 | 9.63 |
| | lead edge | 3.63 | 3.57 | 6.50 |
| average | tail | 4.09 | 3.77 | 7.11 |
| | lead edge | 3.64 | 4.09 | 6.02 |

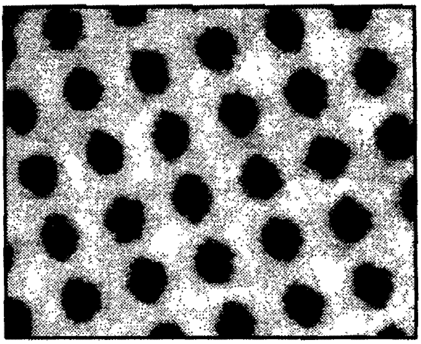
Appendix 2. Solid magenta and 25% magenta at 200x

Sample "A" Magenta Solid



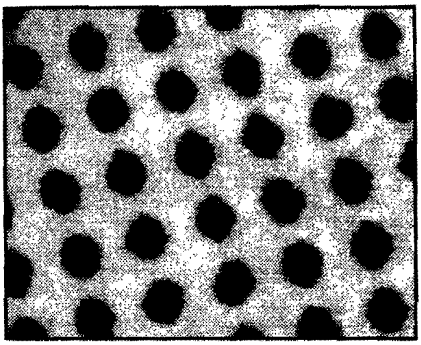
Sample "A" Magenta 25%

Sample "B" Magenta Solid



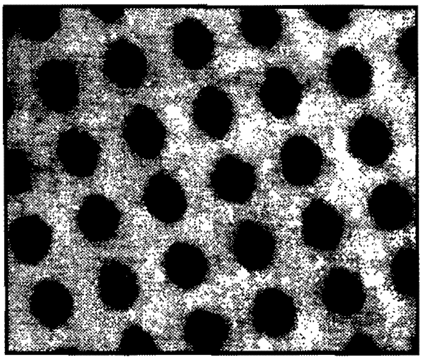
Sample "B" Magenta 25%

Sample "C" Magenta Solid

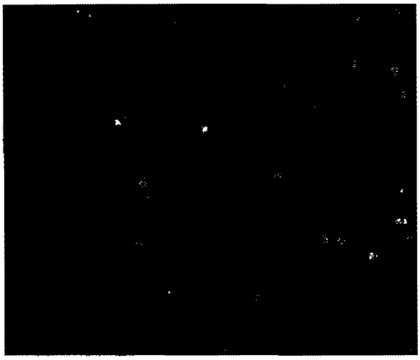


Sample "C" Magenta 25%

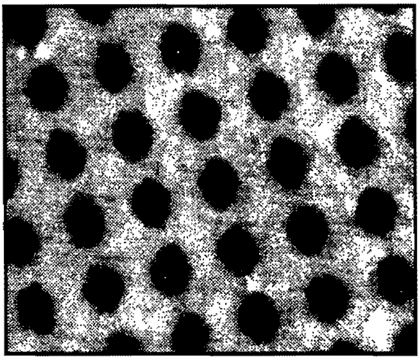
Sample "D" Magenta Solid



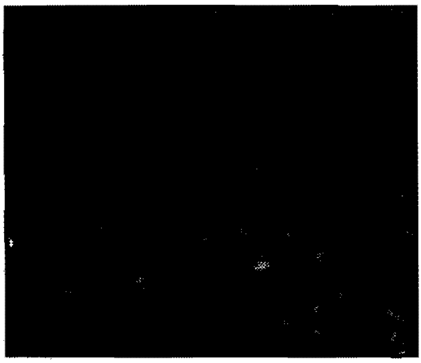
Sample "D" Magenta 25%



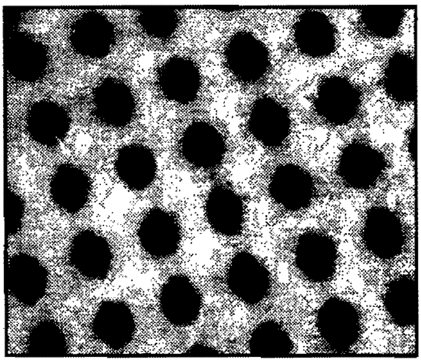
Sample "E" Magenta Solid



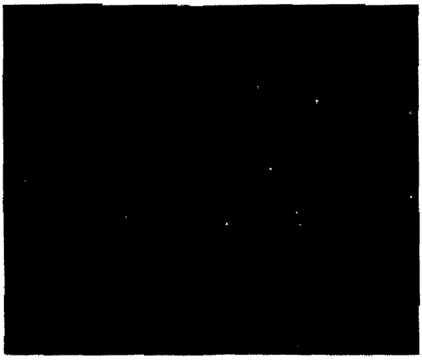
Sample "E" Magenta 25%

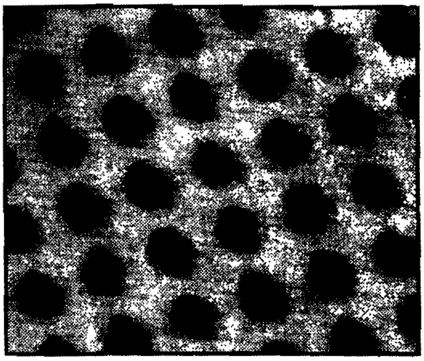


Sample "F" Magenta Solid

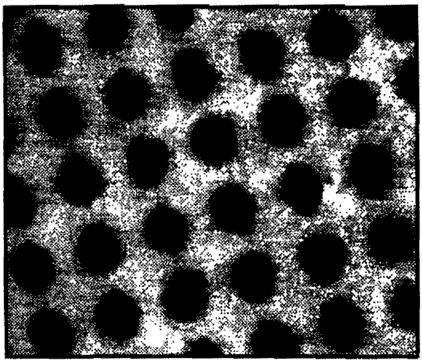


Sample "F" Magenta 25%

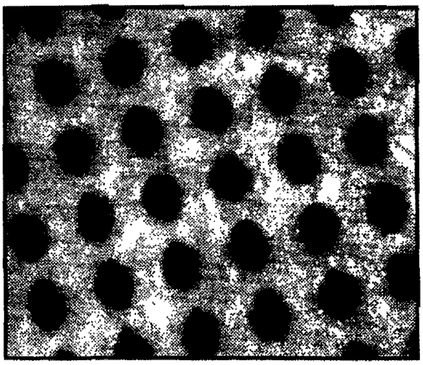

Sample "G" Magenta Solid


Sample "G" Magenta 25%

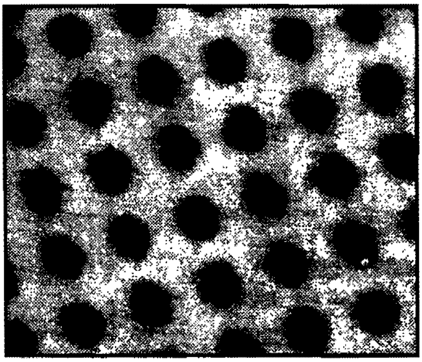

Sample "H" Magenta Solid


Sample "H" Magenta 25%


Sample "I" Magenta Solid

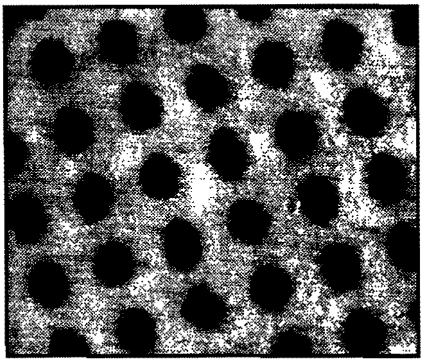

Sample "I" Magenta 25%

Sample "J" Magenta Solid



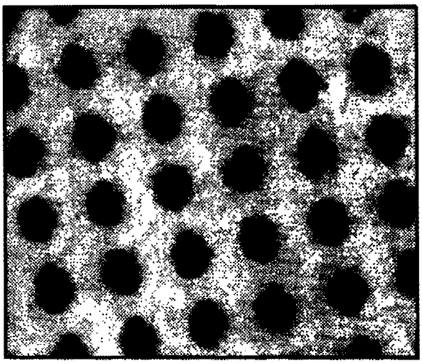
Sample "J" Magenta 25%

Sample "K" Magenta Solid



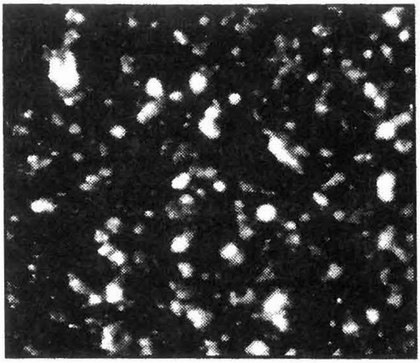
Sample "K" Magenta 25%

Sample "L" Magenta Solid

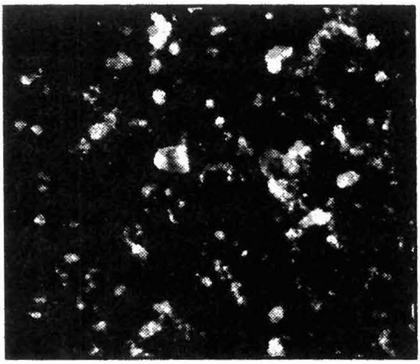


Sample "L" Magenta 25%

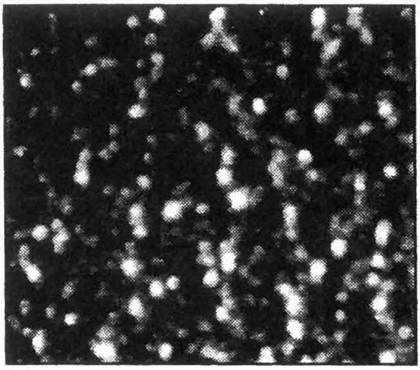
Appendix 3. Photomicrographs of blanket surfaces at 200x



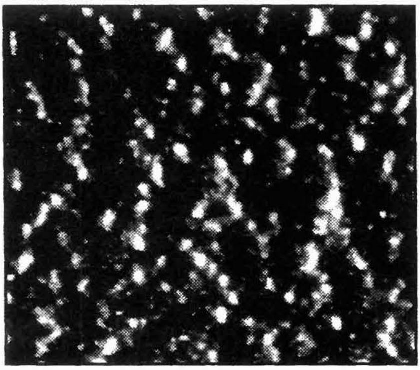
Blanket "A" 200x



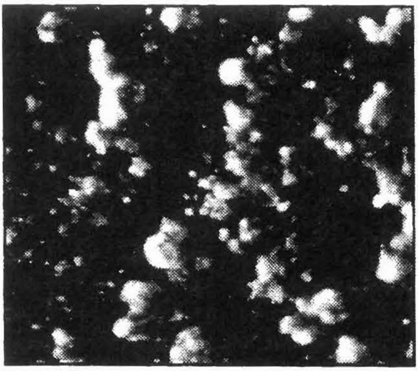
Blanket "B" 200x



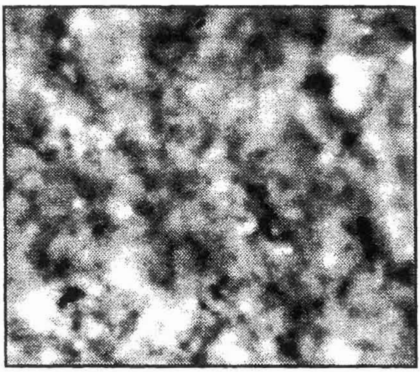
Blanket "C" 200x



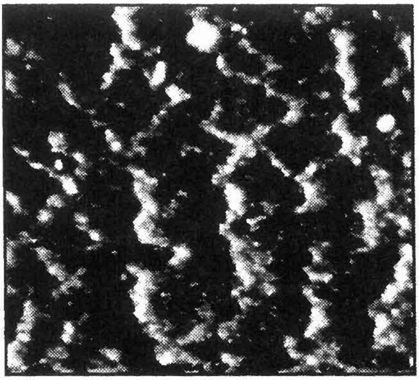
Blanket "D" 200x



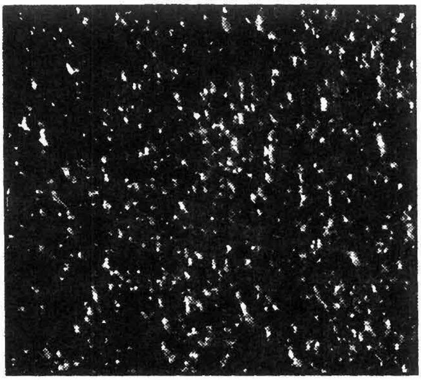
Blanket "E" 200x



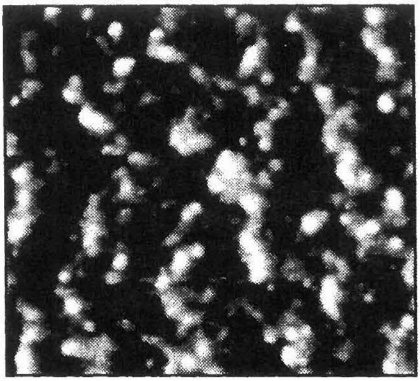
Blanket "F" 200x



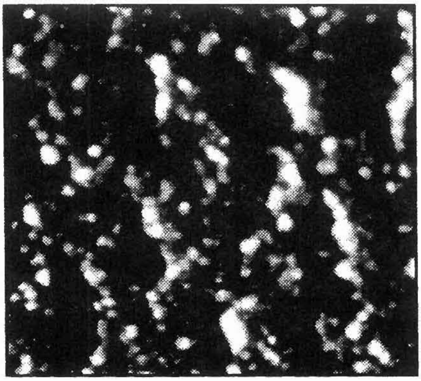
Blanket “G” 200x



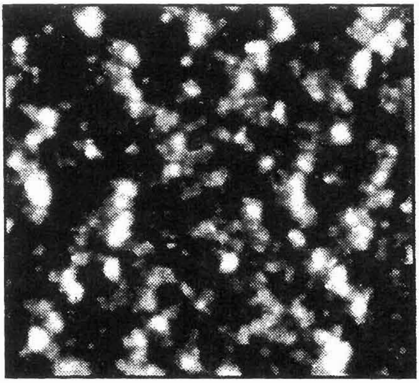
Blanket “H” 200x



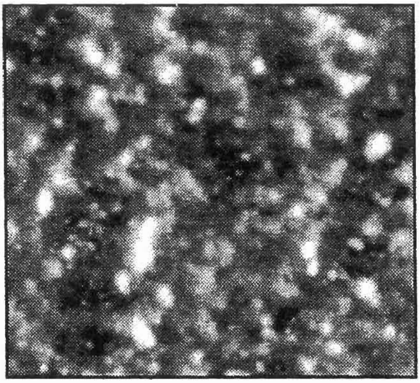
Blanket “I” 200x



Blanket “J” 200x



Blanket “K” 200x



Blanket “L” 200x