THE PLS PLATE SCANNER FOR THE BAKER PERKINS PRESS

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Abstract: The Tobias PLS plate scanner was incorporated into the Baker Perkins web press Instascan system. The approach emphasized the overall system concept requiring the close cooperation of the engineers involved with the plate scanner, the press and the printing operation. The plate scanner reads the image coverage of the plate corresponding to each key zone. It corrects for the effect of roller oscillation, and produces key setting values as the result of a non-linear function. This result is printed out on a 2000 char/sec printer and is also sent to a magnetic card encoder. For each plate, a magnetic card is read at the press console, resulting in automatic adjustment of the keys on the appropriate fountain. The makeready waste and time were reduced to the approximate requirement for reaching the running ink/water balance and proper register.

Introduction

Until recently, press ink fountain design had not changed for several decades. There had been various versions of thumb screw designs warping a moderately resilient blade against a fountain roller. The variable gap meters the ink volume fed into the roller system. Recently, there have been a number of presses that have centralized the

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key control through motorized remote control. The effective use of this control required that a numerical reading be obtained to indicate the size of the gap. The key interaction of the solid blade was eliminated via various configurations of segmented fountain blades.

The convenience and relative precision of the central console ink controls were manifest in reduction of makeready time and helped speed up operator corrective reaction for variations developed during the run.

One could now believe with moderate assurance, that the operator could "measure" out the amount of ink fed by each key of the press and if "one could measure one could control". It appears that this was part of a solution looking for a problem.

A common method of makeready currently consists of looking at the coverage of the plate by eye, setting the fountain keys as a best guess and then making corrections by observing the printed sheet. All this is done, generally, at low or makeready speeds.

Unfortunately as the press comes up to proper running speed the settings are upset to a degree by the dynamics of the press, water, ink and transfer conditions. The overall result is the painful cost of waste and expended time.

If the information for ink coverage were established by the image on the plate, why not use the plate as a quantitative source of such information? One could preset the ink fountain keys to the values obtained from the experience-determined relationship of the image area in each key zone on the plate, and the setting needed.

The Tobias PLS Plate Scanner

It was first decided that a plate should be scanned by viewing each key zone with a linear responding sensor. Each such sensor was positioned to view the reflectance of the plate with a maximum likely sampling error of 2 percent. Internal baffles were used to isolate each key zone from its neighbors.

Only modest requirements were made on the plate intended for use with the scanner system:

1. The image and background reflectivity should be uniform over the entire plate. Gum or image lacquer streaks should be reduced to a minimum. Uniformity to within plus or minus .02 density units would be ideal.

2. A small reference patch, 1/2 inch by 4 inches, was to be printed on the front or back clamp edge of the plate.

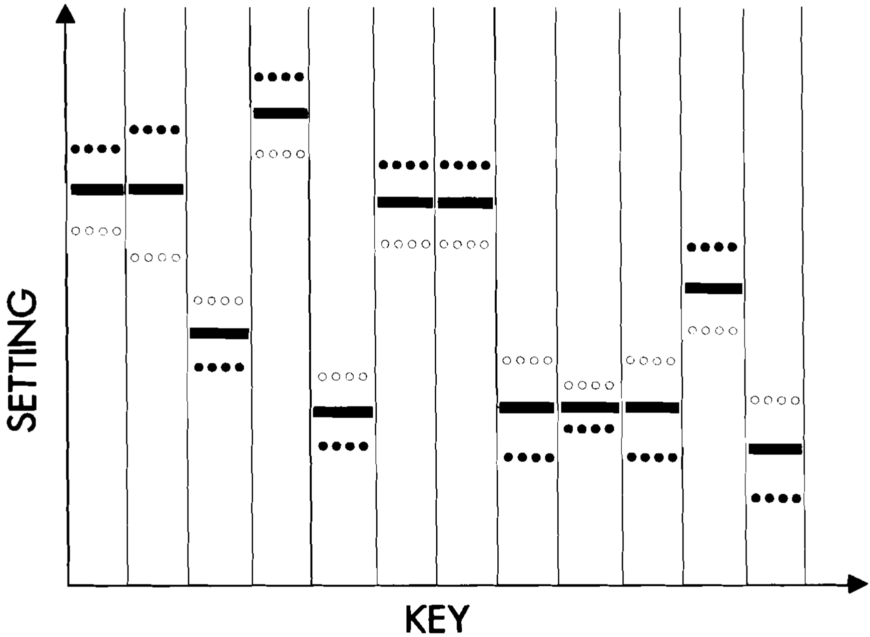
3. A density difference between the image and background should be greater than about 0.50. However, smaller differences than this have given acceptable scans.

The bridge containing the component sensors and light source is moved across the plate in the same direction as the rollers on press. This scan is completed in about 10 seconds. The data for presetting is then printed out in about 2 seconds followed by the encoding of a magnetic striped card similar to the common credit card. This card, which can be reencoded many times, is used at the press to set the fountain for the cylinder on which the plate is mounted.

The output of the internal computer in the PLS plate scanner consists of a number of sets of measured and derived data:

COVERAGE: The coverage corresponding to each individual key zone is obtained as raw data. From these the total coverage for the entire plate is printed out as useful information. The coverage in each key zone may vary from 0 to 100 percent (full coverage).

A series of test plates were made using approximately 9 different types of plates from several manufacturers. The test consisted of solid bars varying in coverage from 10 to 100 percent. Reproducibility and accuracy of the readings of coverage by the PLS were better than plus or minus 1 percent.



•••• Corrected values at fountain to produce
▬ Ink required at plate.
oooo Results at plate if no compensation at fountain.

Figure 1. Effect of Oscillation

A number of tints were also printed on these plates. The nominal values of these tints were only approximately correct. The negative dot area readings made with the Tobias PCT were compared with the plate dot area read with a reflection densitometer, as well as measured with a microscope. In general there was a deviation of about 3 percent between the negative values and the plate image. The PLS gave coverages to within 2 percent of the values obtained statically.

OSC. The oscillation of the vibrator drums smears the ink film between neighboring key zones. For this discussion assume a required ink feed at the plate as shown by the idealized solid line in figure 1. If one were to have this profile produced at the ink fountain, the effect of vibration would be similar to the effect of the erosion on a real landscape; the mountains would erode to a lower elevation and the valleys would fill in as indicated by the oooo line. It is then desirable that for the plate to receive the required amount of ink feed in each zone, the mountains have to be higher and the valleys lower at the fountain, as indicated by the ●●●● line. Unfortunately, if, on a plate coverage profile, a mountain is very high and a neighboring valley is close to zero, the ink feed theoretically required in the valley may be negative -- as yet an impossibility. This condition sometimes occurs when, for example, a postage stamp sized image is positioned next to a large solid area. Under these conditions, one must compromise...

With a 26 key press, the oscillation computation requires the solution of 26 simultaneous equations with 26 unknowns. Fortunately the microprocessor can do this in less than one second.

There appears to be a fallacy that some other approaches to plate scanning have incurred. In the scan, it is assumed that by having the adjacent key zones partially "seen" by the key sensor concerned, the effect of oscillation is approximated. Actually this results in readings that are more like the oooo lines rather than the ●●●● lines of figure 1. Thus the "correction" appears to be in the wrong direction as compared to the ink requirements at the plate, and if these values are used at the fountain the final ink film thickness at the plate would suffer further "erosion" effects from the oooo lines.

SETTING: This is the value of the key settings based upon the "OSC" figures previously discussed. There is a non-linear experience determined relationship between the corrected coverage values and the key setting needed. An empirically determined parameter or scale factor reflects the effect of paper absorption, ink strength, ink key scale and effective sweep. Introduced into this computation is "zero offset". The physical aspect of this factor is that in a given key zone, if the coverage were to diminish and approach zero, the ink key setting would not approach zero but would correspond to some minimum ink film. This would be the thickness on the form rollers required to obtain the proper density on even a miniscule sized image. Not for the same reason, the pressman generally will leave a film of ink to act as a lubricant even for no-feed requirement. Both the zero offset and scale factor are experience-determined figures, which give the best fit of the predicted settings to those actually run.

Unfortunately, most web layouts can not spare the room for a color bar and the method of determining acceptability is dependent upon the somewhat spongy values needed to produce an acceptably appearing result. If it were possible, the optimum parameters of scale factor and zero offset would best be obtained by first adjusting the inking to give standard values of densities in a color bar.

As is seen in figure 2, a series of values at the end of the printout gives useful information. The number of scans represents the number of 1/8 inch slices the working area of the plate was divided into during the scan. It is an indication of the proper operation of the scanner.

Figures are given for a) the amount of oscillation that had been input by the operator, b) the scale factor, c) the total percentage coverage, and d) the zero offset. The job number, color, and plate position are printed out, and are also encoded into the magnetic card.

JOB 7684 5319 K1 BOT

KEY	%COV	OSC	SET	KEY
1	6	6	9	1
2	4	3	8	2
3	7	7	10	3
4	8	8	10	4
5	9	9	11	5
6	11	12	11	6
7	8	6	9	7
8	14	15	12	8
9	16	17	13	9
10	14	14	12	10
11	11	11	11	11
12	10	10	11	12
13	11	12	11	13
14	9	8	10	14
15	10	11	11	15
16	7	6	9	16
17	9	9	11	17
18	9	10	11	18
19	6	5	9	19
20	7	6	9	20
21	13	15	12	21
22	8	8	10	22
23	5	4	8	23
24	6	6	9	24
25	6	7	10	25
26	0	0	4	26

364	SCANS
32	mm OSC
100	SCALE
9	% TOTAL COV
4	ZERO OFFSET

Figure 2. PLS Printout

In the initial stages of implementing this system, two types of test plates are useful. One is a simple plate carrying a 4 inch solid band across the full web. Under running conditions, the keys are adjusted to obtain a uniform standard density for the ink used. Ideally, if all zeroes are set properly, all keys should have the same value. Backlash and reproducibility can be evaluated as well as equivalency, by changing and resetting the keys judiciously. Effects of closing down blocks of end keys can also be determined. The sweep can be adjusted so that scale factors are equal for each color.

The second test plate is a "staircase" of solid area coverage, where 4 keys have a solid bar corresponding in distance around the cylinder to 10 percent of the printing length, another 4 keys, 30 percent, then 50 and finally 70 percent. This is not a tone value but a solid bar. Again under running conditions the keys are adjusted to give uniform standard densities across the web. The key settings are then used to obtain scale and zero offset values.

The quantitative effectiveness of any presetter can not be determined accurately by a single case. The economics of presetting a press, minimizing waste and makeready time, required that because of the variety of conditions that dictate the suitability of the results, the presetting be evaluated statistically for a substantial sampling of jobs. Yet in the process of optimizing a system it is essential that the results for each job be studied and design or operational moves be made to correct the correctable.

Listed here are ten factors which can affect the integrity of a presetting procedure:

1. Incorrect sets of separations or plate values necessitating compromise "color correcting" on press.

2. Position problems resulting from large printing areas adjacent to small, either across or around the cylinder.

3. Inherent errors of scanning the plate, caused by non-ideal image and background uniformity.

4. The error with which the ink feed from fountain and its transfer to the roller train can be controlled.

5. End keys have unique problems caused by emulsification and the dynamics of transfer with oscillation at the ends of the rollers in the train.

6. Changes in the characteristics of the ink and paper.

7. The relative sensitivity of some color

combinations to small changes in ink film thickness.

8. Uncontrolled water emulsification.

9. Press speed effect upon the ink feed profile and overall transfer.

10. The increase in relative error in both scanning and setting as coverage areas approach zero.

Like peeling layers off an onion, as one understands and controls the various variables in the presetting system, less obvious factors become more apparent. The segmenting of the fountain blades in the Baker Perkins press went though several stages of development in order to improve the reproducibility of the settings. Any of the earlier fountain designs would probably have been acceptable in the absence of the requirement of presettability. Relative adjustments in the key setting, using the conventional "eyeball" techniques, make little demand on the precision of an inker. To require that a key be set to a specific value to produce a given thickness of ink film is another matter entirely.

A zero or no ink feed setting must be synchronized with the zero display on the CRT.

The change in each key gap must be the same for a given change in key setting on all keys. The gap between key and fountain roller should vary linearly with the setting value.

The backlash of each key must be reduced or controlled by the direction of the setting move.

The effect of hydrodynamic ink pressure on the gap at the fountain roller must be reduced or at least compensated for, so that press speed changes have minimum effect on the profile of ink feed across the press or the overall feed per impression.

Baker Perkins in developing the Instascan system made substantial changes in the fountain hardware as well as in the console software. These changes addressed the factors just mentioned, as well as many others needed to implement a magnetically encoded card control for the ink key setting system.

The magnetic card system replaced the tape recorder formerly used to record the key settings for all fountains in order to rerun a job. Thus a card may be used as produced by the plate scanner to preset a single fountain. On the other hand, the card may also be used to remember the settings of all the fountains on the press. The time required for writing to or reading from the card is but a few seconds.

A tape cassette can store a large amount of data, generally more than is needed for press applications. The dust in a press room can be a problem if it infiltrates into the cassette. Rewinding and search procedures are needed with a cassette. A card is easily kept clean and can be read in a few seconds.

As many as 544 bytes of information can be stored on this card. Beside the operational convenience of using the card, there is the additional advantages of low cost and the convenience that the card can readily accompany the plate in its travels from platemaking to the pressroom.

The primary thrust for the proper use of the system requires emphasis on the need for proper zeroing of each of the keys. The key must just touch the roller to obtain a complete wipe off of the roller. Excessive pressure to insure a very clean wipe can cause serious error in the blade position reading being sent to the console; in addition it can bow the roller and the blade mount to cause a substantial discrepancy in the desired settings. Not only should the ink keys be properly calibrated to zero, but proper monitoring and maintenance of these settings are essential.

Two segmented blade approaches were implemented during the development of the system. Side by side comparisons of the two systems definitely pointed out the superiority of one system over the other. The relative advantages were readily seen by determining the accuracy of the presetting system. Without this presetting system, it would have been difficult to set up a criterion for judging comparative performance.

Further development of fountain ink controls at Baker Perkins will benefit from having the presetting system as a means for evaluating relative stability, precision and the degree of insensitivity to misuse.

Is there then a demonstrable advantage to presetting? There is little doubt in anyone's mind, connected with this program, that the advantages are substantial. The run data over several months use indicates that makeready to point of having saleable sheets is generally less than 1000 impressions as compared to between 5,000 and 15,000 impressions prior to the use of the system.

Using 50 pounds basis weight at $35 per hundred weight, each 1000 impressions is equivalent to $30, or about $300 average saving per makeready. This computation does not include ink, labor or overhead. Probably, the total advantage would be several times this figure.

Thus, as a result of this program, one can see a substantial reduction in waste, an increase of press capacity and a step further on the road to useful controls on the printing press.