A LOOK AT COLOR LOOK UP TABLES

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Abstract: Good color reproduction is what all printers try to achieve. To do this, they also must be able to get consistent color reproductions. This project attempts to determine whether consistent color can be output regardless of which format or computer application one is using. Four common page layout applications: PageMaker, Quark XPress, Freehand, and Illustrator; and two different file formats: EPS, and TIFF were used in determining this. Result and conclusions were discussed.

Introduction

Since the advent of electronic prepress, printers have been trying to find a universal color management system (CMS) that will allow them to reproduce colors as close to the originals as possible. One of the problems encountered is the variances in the look up tables (LUTs) in the different computer applications. When an original image is scanned in through Photoshop, it is possible to place it in a variety of applications from QuarkXPress, to PageMaker, Illustrator, and Freehand. Early observation has shown that color information for an image may not be identical if placed in these different applications. In addition, different file formats might store and recall color information differently. This may also effect the appearance of the final image. The experiment sought to examine the repeatability of a variety of specifications needed for a color original to be reproduced. This included things such as two and three color overlays, tone scales, gray balance targets, resolution targets, and others. Due to the large expanse of research required, the study was narrowed to study neutrals to determine if they are consistent across applications and file formats (only TIFF and EPS will be used) using a gray balance chart as the test target. To determine differences, separation films will be output from each of the applications and proofed for comparison purposes. Quantitative densitometric evaluations will be performed.

Materials and Equipment

Photoshop 3.0
Illustrator 5.5
Freehand 4.0
PageMaker 5.0
QuarkXPress 3.2.1
A capstand imagesetter
Transmission/reflection densitometer
Postscript level 1 RIP
Mac Calibrator 3.5

Hypothesis

Null Hypothesis:

H_{0-1} There will be no significant differences in the images when placed in different applications.

H_{0-2} There will be no significant differences in the images saved as different file formats.

Research Hypothesis:

H_{t-1} There will be significant differences in the images when placed in different applications.

H_{t-2} There will be significant differences in the images when saved as different file formats.

Statement of the Problem

Does the color information, with regard to neutrals, stay the same regardless of which application it is subsequently placed in?

Method of Study

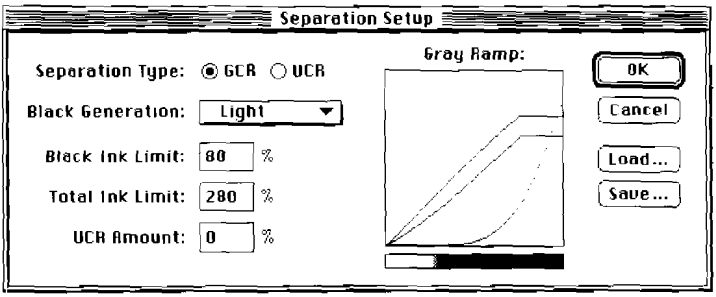
Stated Tolerances:

- All measurements were taken using an X–Rite 309 transmission densitometer.
- Recorded measurements are an average of three readings.
- Output from the different applications were imaged within the same hour on the same day.
- The imagesetter was calibrated and confirmed each day prior to sending any film.
- The dot percentages are considered accurate if they are plus or minus 3% of assigned dot percentages.
- The films *were not* sent from the same computer since the different applications are not all on one computer.

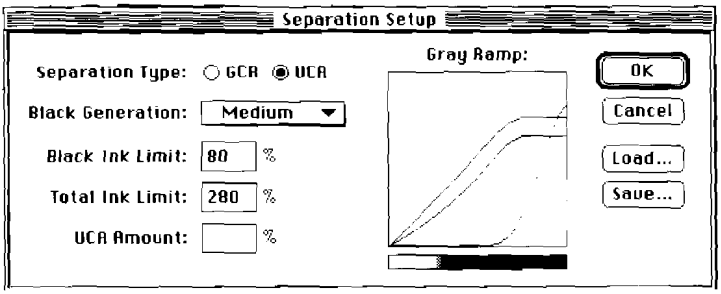
Procedures:

1. A 50% gray balance target was created in Photoshop under the following specifications.

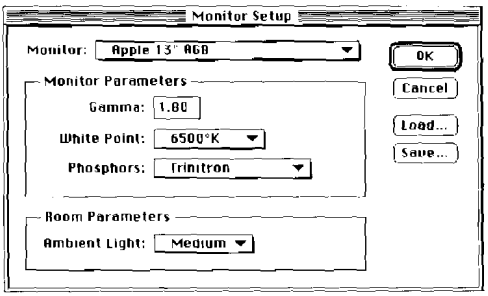
Preferences–Separation Setup–GCR



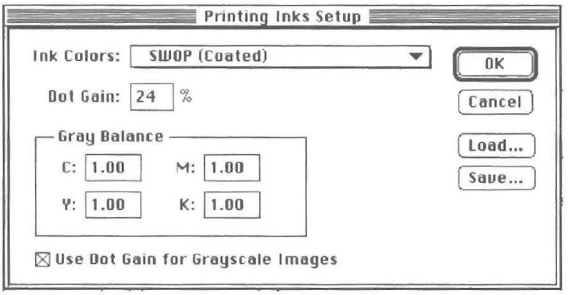
Preferences–Separation Setup–UCR



Preferences–Monitor Setup



Preferences–Printing Inks Setup



Preferences–Separation Tables

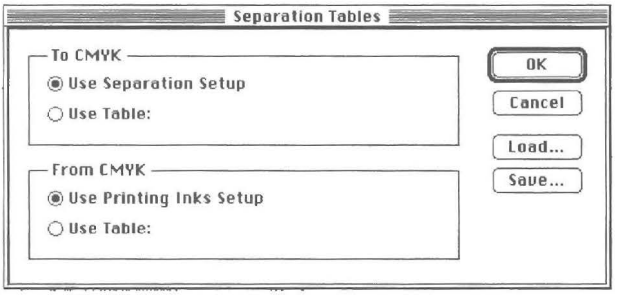
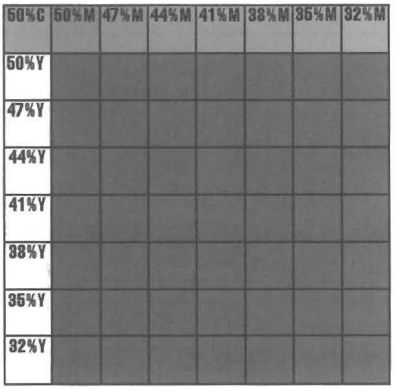
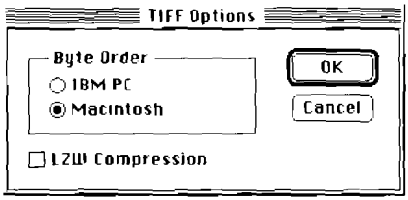


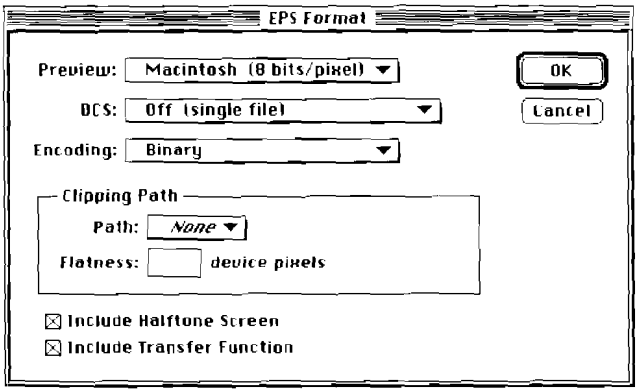
image size: 2" x 2"
resolution/line screen: 266/133
dot shape: elliptical
mode: CMYK



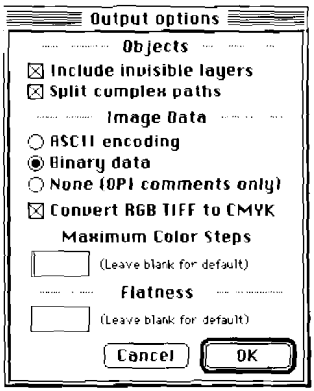
2. The file was saved three times.
   a. As a Photoshop 3.0 file.
   b. A second copy was saved as a TIFF file format using the following specifications.



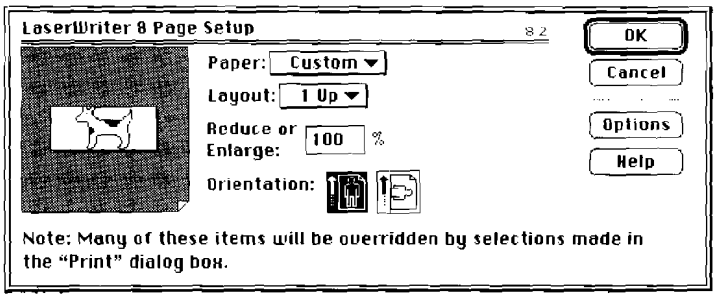
c. A third copy of the file was saved as an EPS file format using the following specifications.



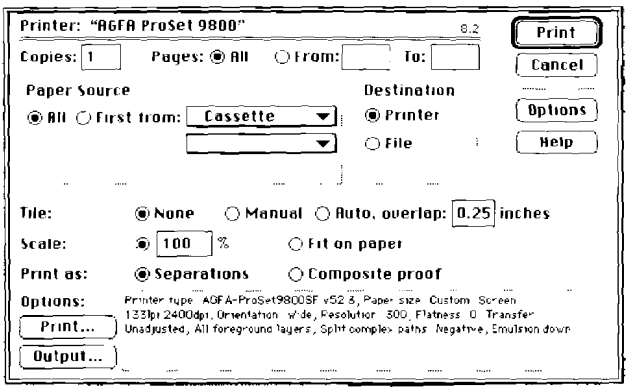
3. The TIFF and EPS file formats were then placed in PageMaker 5.0, QuarkXPress 3.2.1, and Freehand 4.0. Only the EPS file format was placed in Illustrator; it does not accept TIFF file formats.
4. The files were then output from the respective applications.
   a. From Freehand 4.0
      File–Output options



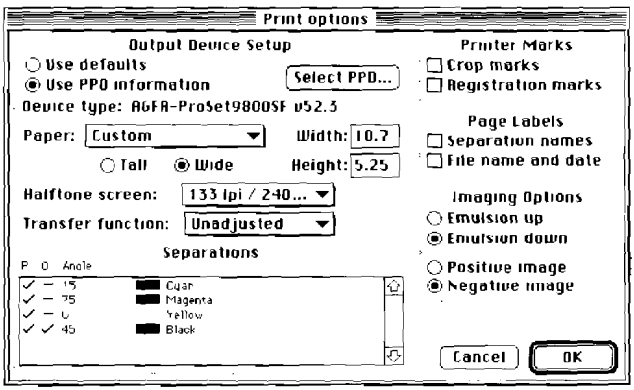
File–Page Setup



File–Print

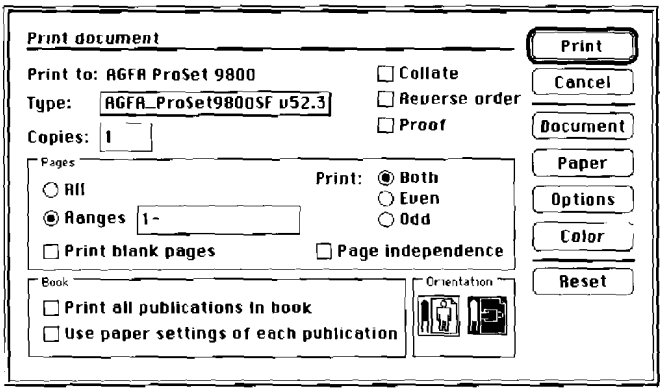


File–Print–Options

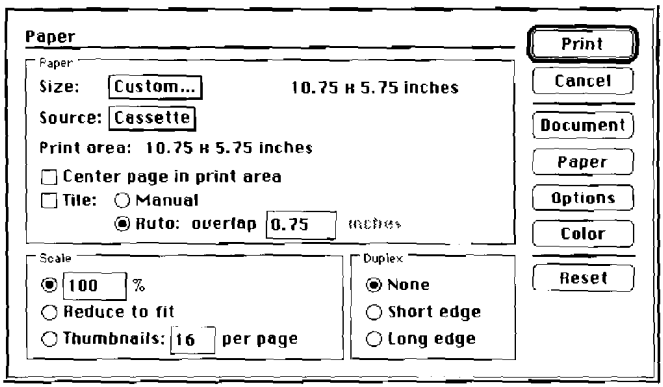


b. From PageMaker 5.0

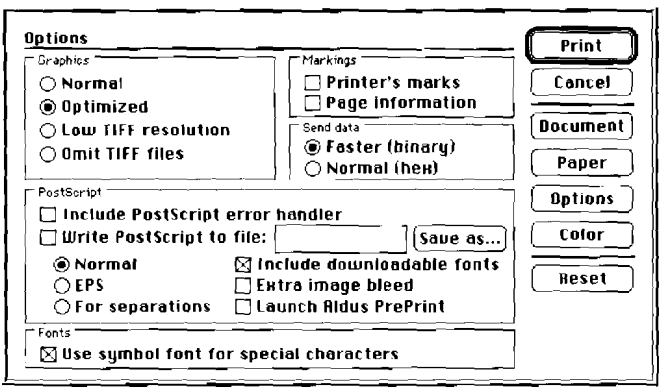
File–Print–Document



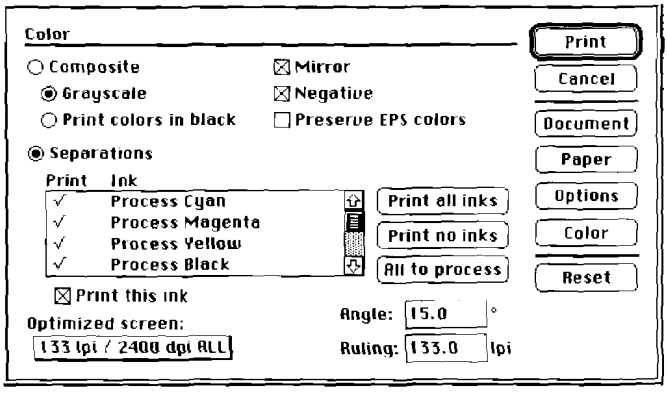
File–Print–Paper



File–Print–Options

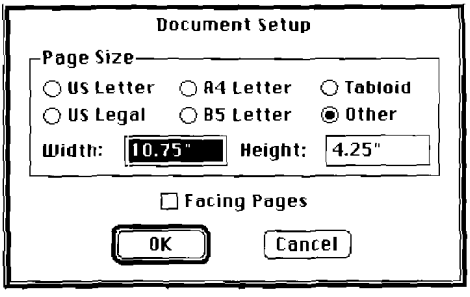


File–Print–Color

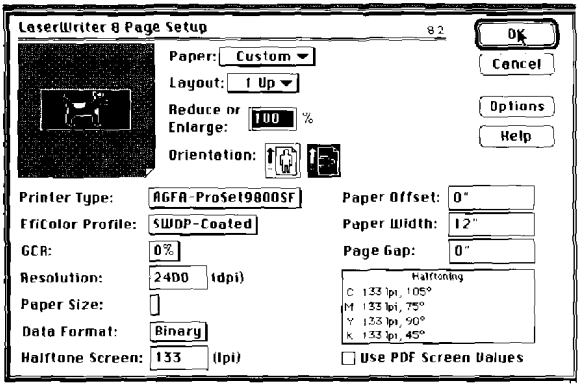


c. From QuarkXPress 3.2.1

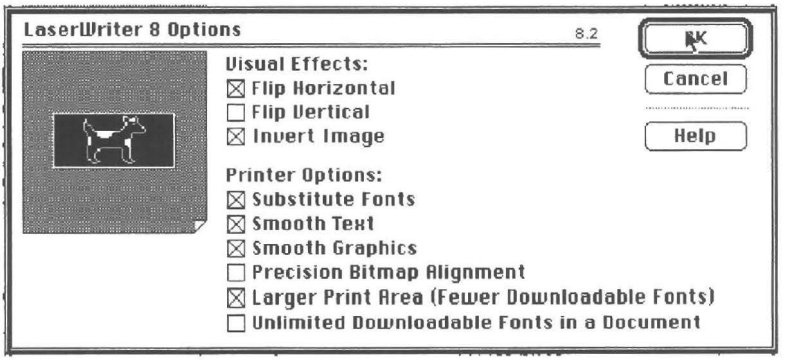
File–Document Setup



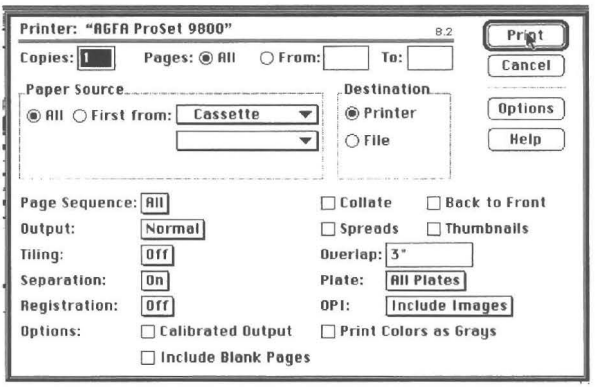
File–Page Setup



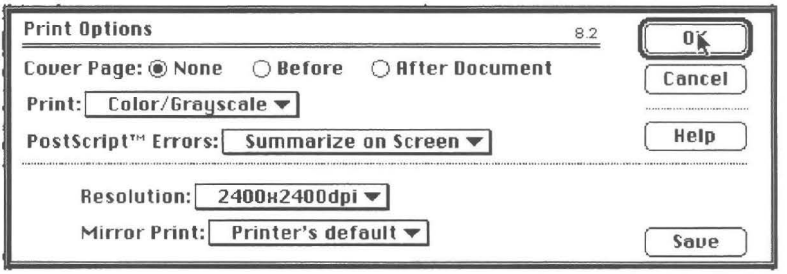
File–Page setup–Options



File–Print

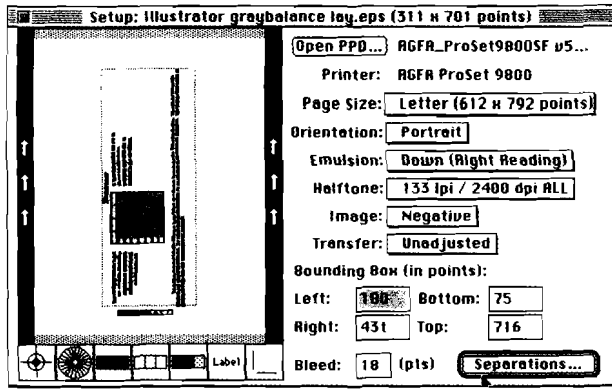


File–Print–Options

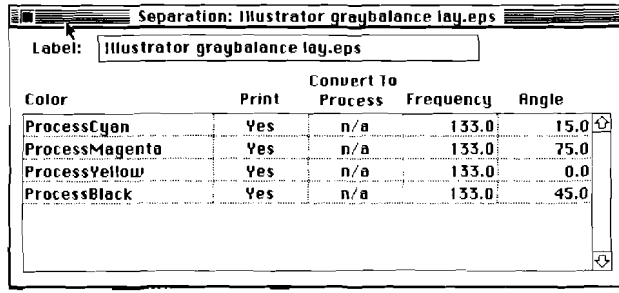


d. From Illustrator
Illustrator cannot output straight to an imagesetter; it needs to be pulled into Adobe Separator. To do this, the entire Illustrator file was saved as an EPS file, opened up in Adobe Separator and parameters were set as needed.

In Adobe Separator:

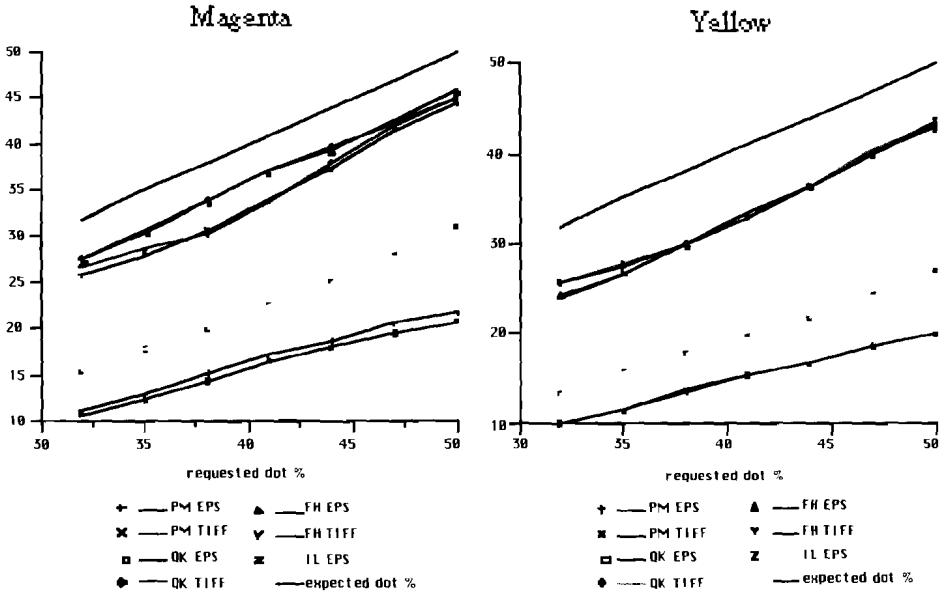


Separations



5. Analysis of Data.
   a. First attempt:
   Films were output from all four applications. On the average, dot percentages differed from the expected dot percentages as follows: (See APPENDIX A for actual data.)

From PageMaker:	30% below requested percentages
From QuarkXPress:	5% below requested percentages
From Freehand:	5% below requested percentages
From Illustrator:	20% below requested percentages



b. Second attempt:
The *Printing Inks Setup* preferences file in Photoshop was changed to 0% dot gain (versus the 24% dot gain during the first output). The EPS file format was resaved, again including the transfer function. The gray balance targets in the respective applications were not replaced, but they were relinked. The films were sent again using the same output procedure as before. On the average, the dot percentages differed from the expected dot percentages as follows: (See APPENDIX B for actual data.)

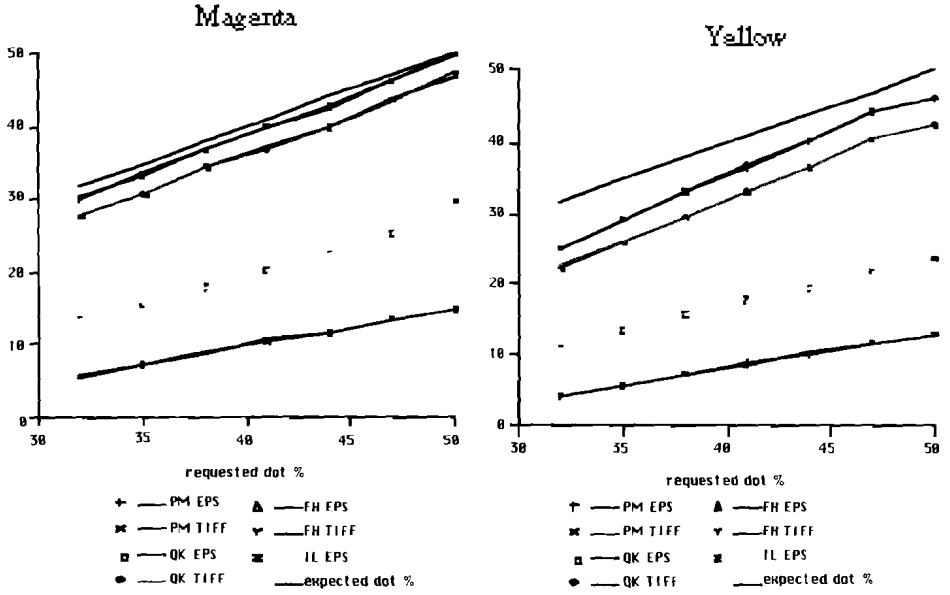
From PageMaker:	28% below requested percentages
From QuarkXPress:	25% below requested percentages
From Freehand:	1–2% below requested percentages
From Illustrator:	25% below requested percentages

c. Third attempt:
When the files were opened up in Photoshop again, the *Printing Inks Setup* was not at 0%. This preference does not save with files. Photoshop was opened at the computer they were being output from, the *Printing Inks Setup* was changed to zero, and the file was output from that computer. Only the PageMaker file was sent to reduce film use. The actual dot percentages were below the expected dot percentages by 34%. (See APPENDIX C for the actual data.)

d. Fourth attempt:
The *Printing Inks Setup* in Photoshop was set to 0%; both the TIFF and EPS file were saved again. The old gray balance targets in each application were replaced with these. Photoshop was opened at the computer the file were being sent and the *Printing Inks Setup* was set to 0%. The files were output. The actual dot percentages varied from the expected dot percentages as follows (See Appendix D for actual data):

From PageMaker:	35% below requested percentages
From QuarkXPress:	4% below requested percentages
From Freehand:	1–2% below requested percentages
From Illustrator:	23% below requested percentages

Comparison of Requested Dot Percentages to Actual Dot Percentages



e. Fifth attempt:
QuarkXPress and Illustrator were the farthest from the expected dot percentages; further research was concentrated on the Illustrator file. The imagesetter calibration films obtained from the imagesetter that morning were measured using an X-Rite 309 transmission densitometer. The densities were used to create a custom transfer curve in Adobe Separator. The transfer curve was applied and films were output. The actual dot percentages varied from the expected dot percentages by an average of 20% below.

See APPENDIX E for imagesetter film densities and measured dot percentages from Illustrator.)

f. Sixth attempt:
On the recommendation of Adobe, the files were sent directly from Photoshop. Within the plus or minus 3% due to imagesetter calibration variation, the cyan and magenta output correctly and the yellow was below tolerance at 6% below the expected dot percentages. (See APPENDIX F for actual data.)

g. Further attempts:
   1. A 50% box was created in Illustrator and output along with the gray balance target in Illustrator. This was to determine whether the problem stemmed from Photoshop (where the gray balance target was created) or from Illustrator. The tint patch measured 31% using an X–Rite 309 transmission densitometer.
   2. The dots were examined closely to confirm that they were 133 elliptical, as expected, versus other dot line rulings and sizes.
   3. A block was created in Illustrator consisting of 50% magenta, 50% yellow, and 50% cyan overlaying; it was then output from Illustrator. The expected 50% dot percentages came out as follows, as measured by an X–Rite 309 transmission densitometer:

      Cyan 30%
      Magenta 31%
      Yellow 28%

   4. It was confirmed that the Postscript Level 1 RIP is compatible with Illustrator 5.5 by the imagesetter manufacturer.

Summary

Basically, expected dot percentages could only be obtained from QuarkXPress and Freehand. It appeared that some default in Illustrator and PageMaker was overriding the Postscript information in these two latter programs.

The experiment provided insight into concerns encountered when moving a file through numerous applications. Even if the settings are not changed, one should be aware of where they are at the beginning to assure repeatability. In addition, other things to consider are the version of the software, the Postscript level of the RIP and the compatibility of the two.

The concern which has arisen as a result of the data involved Open Prepress Interface. This involves saving both a high resolution and low resolution file of the original scan. While operators work on the high

resolution file on higher end systems, the low resolution file is used for placement and sent to the customer for color approvals. Concern should arise when images travel through many different applications, compressions, or transforms. These images may not stay the same, or maintain the color information as expected or as the low resolution file.

Further Research

Further exploration into the reason why the dot percentages are not imaging as expected could be completed using an actual image, tone scales, and large test targets. At the time of submission of this study, both the manufacturer of the software and the imagesetter were informed of the problem and are running internal tests attempting to achieve better results.

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Appendices

APPENDIX A

First attempt at film output, measured with a transmission densitometer.

	PageMaker		QuarkXPress		Freehand		Illustrator
	EPS	TIFF	EPS	TIFF	EPS	TIFF	EPS
Cyan (50%)	21.0	21.1	45.0	45.0	45.0	45.0	29.0
Magenta (50%)	21.9	20.8	46.0	45.2	45.3	44.5	31.2
Magenta (47%)	20.6	19.6	42.5	42.0	42.3	41.5	28.3
Magenta (44%)	18.7	18.0	39.4	38.0	39.7	37.4	25.0
Magenta (41%)	17.1	16.4	37.0	33.7	37.0	33.8	22.5
Magenta (38%)	15.3	14.4	33.9	30.5	34.0	30.7	20.0
Magenta (35%)	12.9	12.3	30.7	28.7	30.6	28.1	17.8
Magenta (32%)	11.1	10.8	27.5	26.9	27.6	25.8	15.5
Yellow (50%)	20.0	20.0	43.0	43.4	43.8	43.8	27.0
Yellow (47%)	18.8	18.5	40.1	40.4	40.0	40.0	24.7
Yellow (44%)	16.9	16.9	36.4	36.5	36.5	36.5	21.8
Yellow (41%)	15.4	15.4	33.2	33.3	33.3	33.0	20.0
Yellow (38%)	13.6	13.8	30.1	30.3	30.0	30.0	17.8
Yellow (35%)	11.5	11.5	26.8	27.8	26.8	27.5	15.7
Yellow (32%)	10.0	10.0	24.0	25.7	24.2	25.8	13.4

APPENDIX B

Second attempt at output, measured with a transmission densitometer.

	PageMaker		QuarkXPress		Freehand		Illustrator
	EPS	TIFF	EPS	TIFF	EPS	TIFF	EPS
Cyan (50%)	23.4	23.7	25.2	24.9	50.3	50.1	25.0

Magenta (50%)	20.7	20.5	28.2	28.0	51.5	51.4	21.7
Magenta (47%)	18.7	18.6	24.8	24.9	48.7	48.5	19.9
Magenta (44%)	16.4	16.2	21.6	21.5	46.4	46.2	17.5
Magenta (41%)	14.5	14.2	19.1	19.0	44.2	44.0	15.6
Magenta (38%)	12.5	12.4	16.8	16.7	41.0	41.3	13.6
Magenta (35%)	10.6	10.4	14.3	14.2	37.7	37.5	11.6
Magenta (32%)	8.5	9.1	12.4	12.2	34.5	34.2	9.6
Yellow (50%)	25.0	24.5	21.2	21.0	48.5	48.6	27.5
Yellow (47%)	22.7	22.5	19.8	19.4	46.5	46.2	24.1
Yellow (44%)	19.6	19.7	17.6	17.2	43.5	43.1	20.0
Yellow (41%)	17.3	17.3	16.0	15.8	40.5	40.2	18.5
Yellow (38%)	15.4	15.6	14.0	14.3	37.1	37.3	16.3
Yellow (35%)	12.8	12.7	12.1	11.9	33.0	33.2	13.9
Yellow (32%)	11.0	11.1	10.1	10.0	29.1	29.4	12.2

APPENDIX C

Third attempt at output, measured with a transmission densitometer.
(PageMaker file only)

	PageMaker	
	EPS	TIFF
Cyan (50%)	16.9	17.1
Magenta (50%)	17.6	17.5
Magenta (47%)	16.0	16.2
Magenta (44%)	14.3	14.4
Magenta (41%)	13.0	12.8
Magenta (38%)	11.2	11.1
Magenta (35%)	9.2	9.3
Magenta (32%)	7.5	7.6
Yellow (50%)	15.2	15.2
Yellow (47%)	14.0	13.9
Yellow (44%)	12.3	12.3
Yellow (41%)	11.0	10.7
Yellow (38%)	9.2	9.1
Yellow (35%)	7.3	7.3
Yellow (32%)	5.6	5.6

APPENDIX D

Fourth attempt at output, measured with a transmission densitometer.

	PageMaker		QuarkXPress		Freehand		Illustrator
	EPS	TIFF	EPS	TIFF	EPS	TIFF	EPS
Cyan (50%)	14.2	14.1	46.7	46.8	49.8	49.7	26.5
Magenta (50%)	14.8	14.7	46.9	47.3	49.6	49.7	30.0
Magenta (47%)	13.5	13.4	43.9	43.6	46.3	46.2	25.5
Magenta (44%)	11.6	11.6	40.0	40.0	42.6	42.8	22.8
Magenta (41%)	10.6	10.4	37.3	37.0	40.0	40.0	20.4
Magenta (38%)	8.8	8.9	34.5	34.6	37.0	37.0	17.9
Magenta (35%)	7.2	7.2	31.0	31.0	33.4	33.7	15.4
Magenta (32%)	5.8	5.6	28.0	28.0	30.4	30.0	13.5
Yellow (50%)	12.8	12.7	42.4	42.6	46.3	46.2	24.0
Yellow (47%)	11.6	11.7	40.5	40.7	44.4	44.4	22.1
Yellow (44%)	10.1	10.2	36.6	36.6	40.4	40.2	19.6
Yellow (41%)	8.9	8.6	33.3	33.3	37.1	36.6	17.8
Yellow (38%)	7.3	7.2	29.7	29.7	33.4	33.4	15.5
Yellow (35%)	5.6	5.6	26.2	26.2	29.3	29.3	13.3
Yellow (32%)	4.2	4.3	22.4	22.8	25.3	25.3	11.4

APPENDIX E

Fifth attempt, measured with a transmission densitometer. Measured densities from imagesetter films and used those to create a custom transfer curve in Adobe Separator.

10%	.09
20%	.14
30%	.19
40%	.25
50%	.34
60%	.46
70%	.59
80%	.74
90%	1.04
100%	3.72

Output films:

Illustrator	EPS
Cyan (50%)	30.0
Magenta (50%)	32.0
Magenta (47%)	29.0
Magenta (44%)	25.6
Magenta (41%)	22.6
Magenta (38%)	20.3
Magenta (35%)	17.8
Magenta (32%)	15.7
Yellow (50%)	27.1
Yellow (47%)	25.3
Yellow (44%)	22.4
Yellow (41%)	20.2
Yellow (38%)	17.9
Yellow (35%)	15.7
Yellow (32%)	13.2

APPENDIX F

Photoshop files, measured with a transmission densitometer.

Photoshop Files	TIFF	EPS
Cyan (50%)	47.5	47.3
Magenta (50%)	48.2	48.2
Magenta (47%)	44.7	44.8
Magenta (44%)	41.9	41.7
Magenta (41%)	39.1	38.8
Magenta (38%)	36.3	35.9
Magenta (35%)	33.0	32.7
Magenta (32%)	30.0	29.6
Yellow (50%)	44.6	44.8
Yellow (47%)	42.4	42.1
Yellow (44%)	38.9	38.8
Yellow (41%)	35.6	35.5
Yellow (38%)	32.8	32.5
Yellow (35%)	29.3	29.0
Yellow (32%)	25.6	25.5