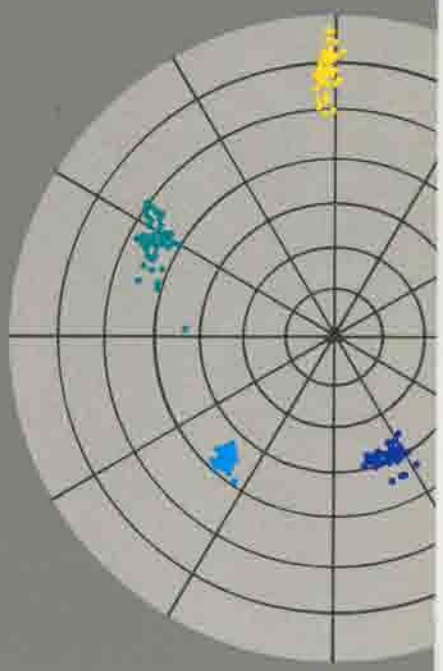
North American Commercial Print Survey



DUPONT

As part of its long-standing commitment to the printing industry, the Du Pont Company continuously monitors new trends and advancements in commercial and publication printing. The past two decades have seen major changes in the industry, including widespread introduction of electronic prepress operations, standardization of publication printing, and significant new techniques for press analysis and control.

Designed to examine the commercial printing segment, the North American Commercial Print Survey identified and analyzed the printing characteristics of a large sampling of printers and trade shops. This analysis provided a basis for determining what average, if any, was used to measure the performance of commercial offset printing. Restated, our goal was to discover what characterized good quality color printing and what results are representative of commercial work.

Du Pont's previously published (1983) North American Print Survey, helped support the development and introduction of SWOP standards for publication printing. The goal of this current study was to determine existing commercial printing characteristics and provide the basis for directing Du Pont's Proofing Product offering to satisfy the commercial printing market. This report, therefore, concentrates on three areas: solid ink density, dot gain and ink color properties.

We would like to acknowledge the cooperation of the many printers and trade shops across North America who volunteered to participate in this survey. Their names are listed at the end of this booklet.

Measurement Techniques

All participants were provided with separation films of the "Commercial Printing Calibration Target," shown in Figure 1, from which they produced press sheets. The form contained a pictorial reference as well as elements used for mechanical color measurements. For additional information, a System Brunner Control Bar was included on each press sheet. All halftone measurements were based on a screen ruling of 150 lines per inch. At the conclusion of the test run, press sheets were returned to Du Pont for analysis.

A spectrophotometer was used to obtain the actual color value of the various printing inks. The data are based on the CIE L*a*b* color measurement formulas.

Density and dot gain were measured on the Du Pont Print Manager using a narrow band densitometer, while hue error and trapping were measured with a wide band densitometer.

Table 1
PARTICIPANT COMPOSITE BUSINESS

BUSINESS	PERCENTAGE
Commercial Printer	80
Commercial Trade Shop	20

Figure 1
COMMERCIAL PRINTING CALIBRATION TARGET

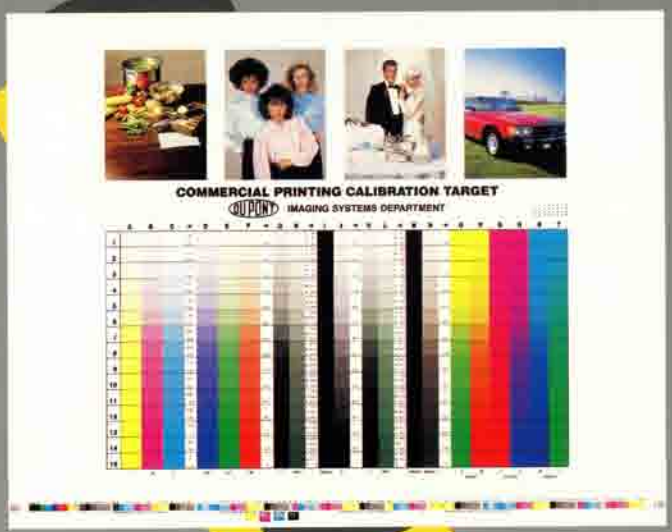


Table 3

PARTICIPANT COMPOSITE PRINTING STOCK

PRINTING STOCK	PERCENTAGE
80# Gloss, Coated	67
100# Gloss, Coated	13
70# Gloss, Coated	9
60# Gloss, Coated	4
A/O	7

Table 2

PARTICIPANT COMPOSITE PRESS TYPE

PRESS TYPE	PERCENTAGE
Sheet fed — 4 unit	45
Sheet fed — 6 unit	36
Sheet fed — 5 unit	13
Web	5

Table 4

PARTICIPANT COMPOSITE COLOR ROTATION

COLOR ROTATION	PERCENTAGE
K C M Y	84
C M Y K	7
Y C M K	4
A/O	5

All participants supplied technical information on their press condition during the press run. These conditions were not dictated by Du Pont because the intent of the survey was to determine how printers operated in normal practice. Tables 1 through 4 provide a participant composite.

Solid Ink Density

Figure 2 shows the total density range, and average, for each printing color. Figures 3 through 6 indicate the distribution of densities for each color and the frequency of occurrence in the sampling.

Conclusion: This wide density range indicates that no single density would meet the requirements of the commercial printing segment.

Figure 2
DENSITY RANGES AND AVERAGES

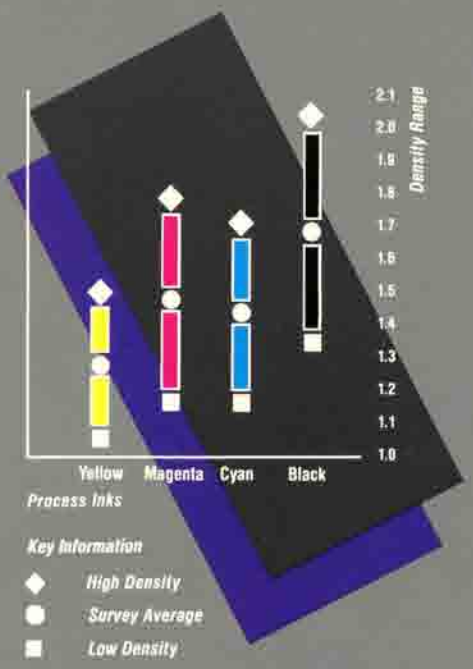


Figure 3
SOLID INK DENSITY YELLOW

Figure 4
SOLID INK
NSITY MAGENTA

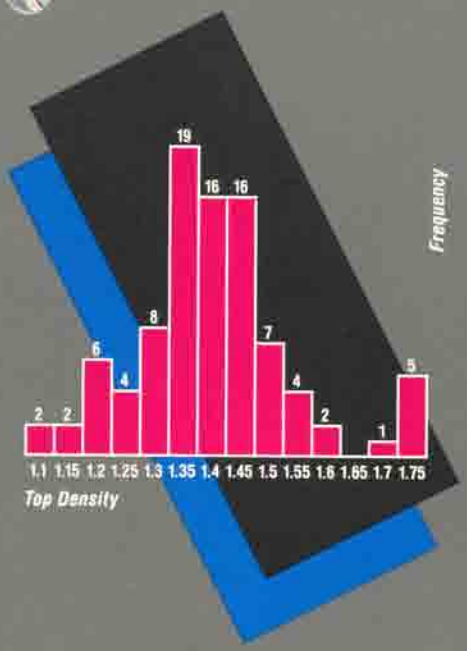


Figure 6
SOLID INK
DENSITY BLACK

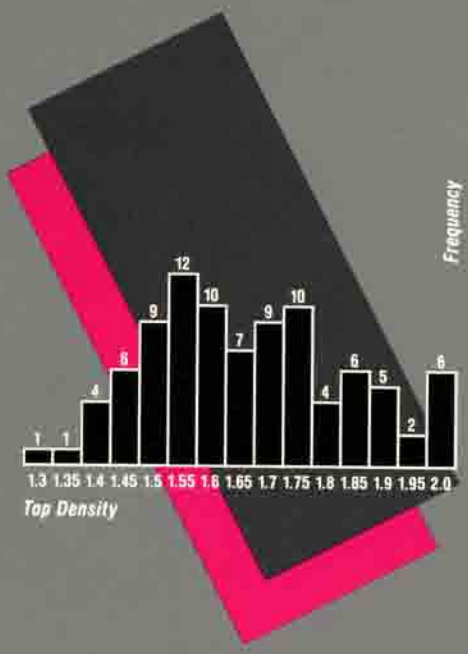
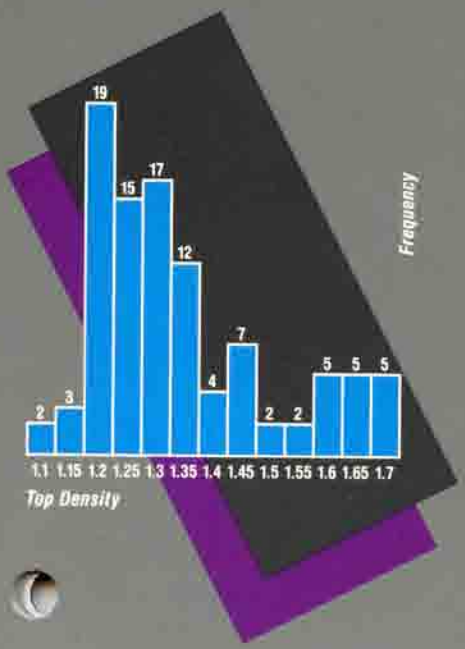


Figure 5
SOLID INK DENSITY CYAN



Dot Gain

The 25%, 50% and 75% halftone dot gain averages are shown in Figure 7. The average mid tone (50%) dot gains are:

Yellow—18%

Magenta—20%

Cyan—20%

Black—23%

The dot gain ranges and averages for yellow, magenta, cyan and black are shown in Figures 8 through 11 respectively.

Conclusion: These averages represent a definite downward trend from that of five years ago, but not as low as generally suggested.

Figure 8
DOT GAIN RANGE AND AVERAGE YELLOW

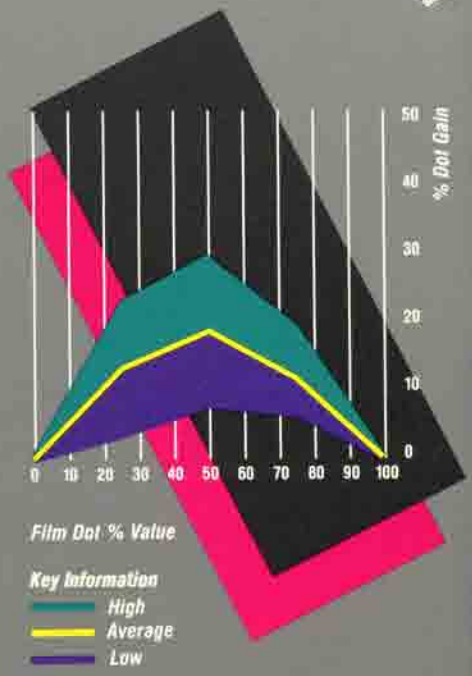


Figure 7
DOT GAIN AVERAGES

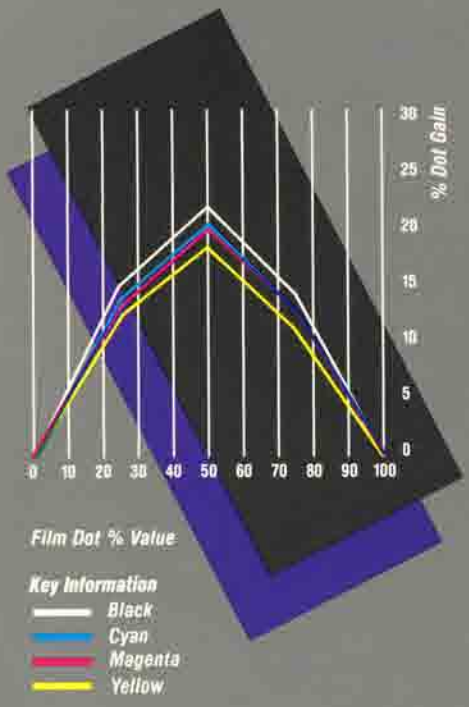


Figure 9
DOT GAIN RANGE AND AVERAGE MAGENTA

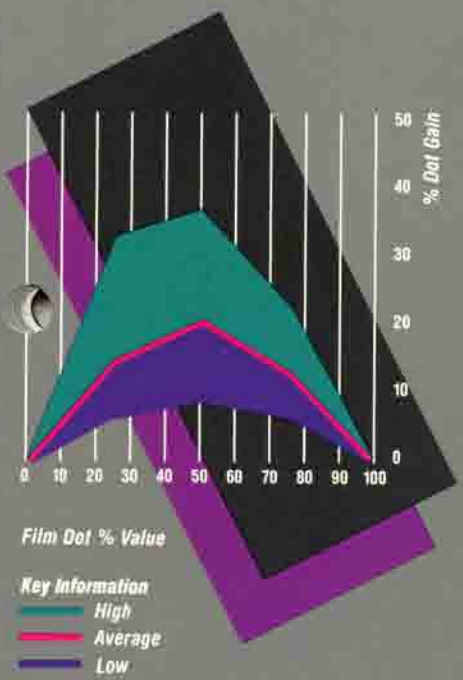


Figure 10
DOT GAIN RANGE AND AVERAGE CYAN

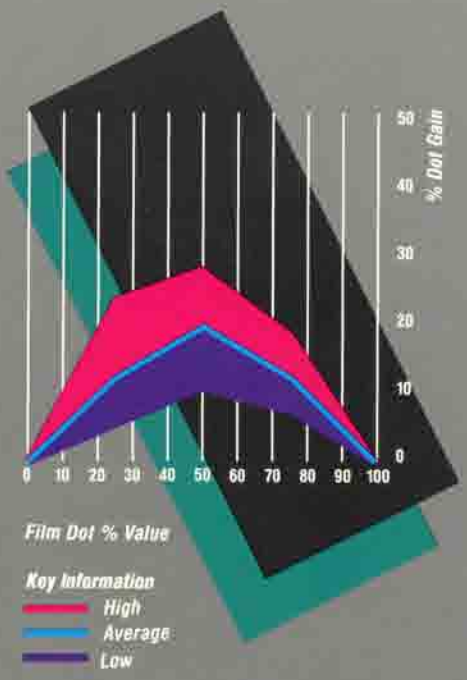


Figure 11
DOT GAIN RANGE AND AVERAGE BLACK

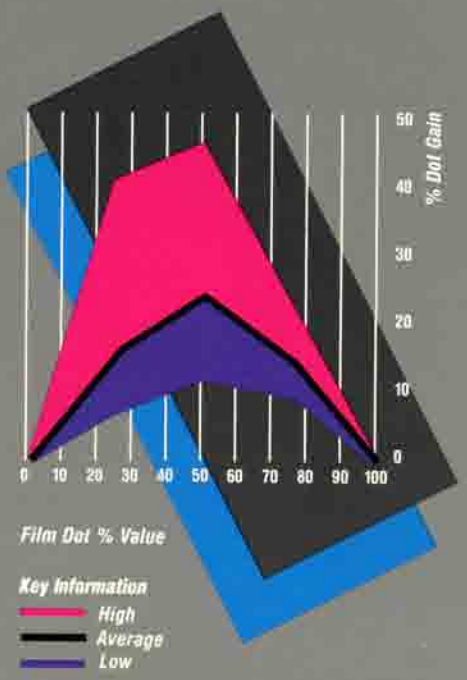


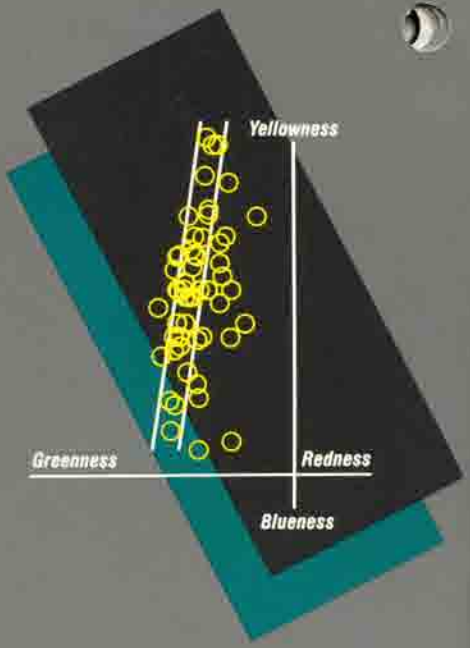
Figure 12 is a "Color Plot" of the relative position of each participant's ink colors, determined by the hue and strength measurement of each sample. Figures 13 through 15 are enlargements, by color, of the data depicted in Figure 12.

For comparison purposes, the hue line boundaries for SWOP inks are also depicted for each color. These hue lines indicate the limits in color space satisfied by a given hue. Any points outside that space would be visually different to the human eye, and represent a different hue of ink. Therefore, any two plotted points further apart than the distance identified by the hue lines would be a distinctly different color.

Conclusion: While there are evident groupings of data points in each color sampled, there remains a perceptible diversity among the respondents regarding "desired color" choices. The data show that participants produce a broad range of overprints.

Figure 12
COLOR CIRCLE SUMMARY

Figure 13
"A "B COLOR PLOTTING YELLOW



It is further evident from the data that SWOP colors are not sufficient to satisfy the color needs of the commercial printing segment. The trend depicted in the survey for each color vs. SWOP shows essentially a chromer yellow, a bluer magenta and a redder cyan, as well as higher strengths overall.

Figure 15
*A *B COLOR PLOTTING CYAN

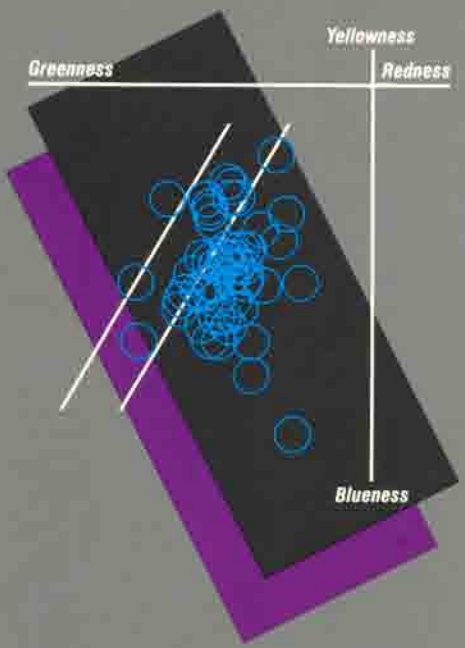
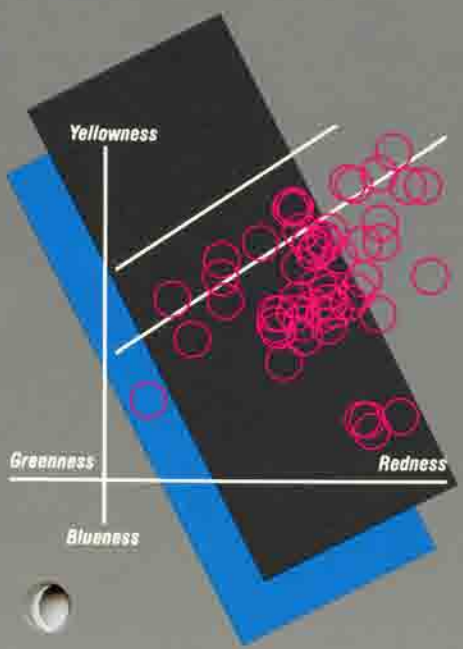


Figure 14
*A *B COLOR PLOTTING MAGENTA



Trapping

The trapping calculation is a percentage measurement of how well a wet ink has transferred to a previously printed ink, and is rotation sensitive. For the majority of participants (91%) the cyan-magenta-yellow color rotation was constant, and the following guidelines would apply when reviewing the data in Table 5.

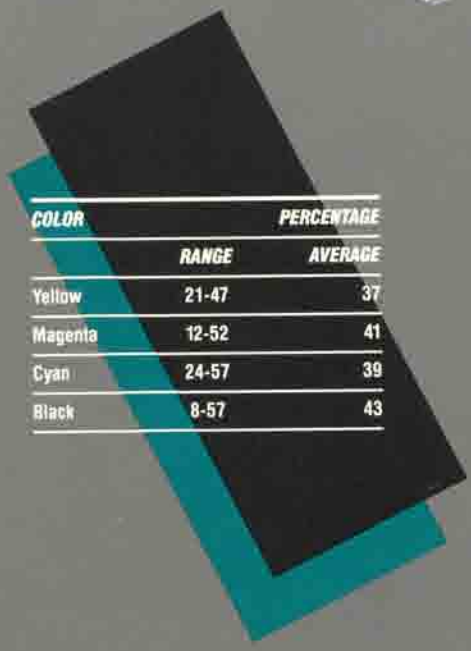
If the trapping percentage in red is lower than the average it would appear as a somewhat "colder" (– yellow) red, and if higher as "warmer" (+ yellow). For green a lower number indicates a bluer green (– yellow), and a higher number a yellower green. And, for blue a lower number indicates a "violet" blue (– magenta), and a higher number indicates "purple" blue (+ magenta).

This trapping summary is not a classification of "good vs. bad" trap. It is merely indicative of the range in overprint colors being utilized by the commercial segment to satisfy very unique printing requirements.

Print Contrast

Print contrast is a comparison measurement between the 75% halftone density and its respective solid. In general, lower contrast numbers mean less separation between the ¾ tone and solid values. Conversely, higher numbers mean a greater separation between these two values.

Table 6
PRINT CONTRAST SUMMARY



COLOR	PERCENTAGE	
	RANGE	AVERAGE
Yellow	21-47	37
Magenta	12-52	41
Cyan	24-57	39
Black	8-57	43

Table 5
TRAPPING SUMMARY

COLOR	PERCENTAGE	
	RANGE	AVERAGE
Red	52.8-79.3	70.5
Green	70.6-100.0	87.3
Blue	46.3-94.6	72.3

Table 8
INK GRAYNESS SUMMARY

COLOR	PERCENTAGE	
	RANGE	AVERAGE
Yellow	.8-3.5	1.98
Magenta	9.6-14.8	11.5
Cyan	7.6-14.7	9.4

Table 7
HUE ERROR SUMMARY

COLOR	PERCENTAGE	
	RANGE	AVERAGE
Yellow	2.5-8.2	4.9
Magenta	35-48	42.7
Cyan	18-23	20.1

In reviewing the data in Table 6, good print contrast results should fall generally within the 40%-50% value. While the contrast ranges in the survey are considerable, the average for the commercial segment agrees with the recommended range.

Hue Error

The measurement of ink hue error is designed to determine the amount of unwanted color being reflected by a particular ink, and is calculated by the following formula:

$$H/E = \frac{M-L}{H-L}$$

Because many in the industry have, over the years, attempted to also use hue error as a means of defining and controlling color, those reference figures have been provided in Table 7.

In reviewing these figures it should be pointed out that the higher the hue error number the greater the amount of unwanted color being reflected. In the case of yellow, the higher the number the greater the amount of blue being reflected; for magenta, the greater the amount of green; and for cyan, the greater the amount of red.

Summary

The results of this survey demonstrate a great deal of diversity in the way commercial printers meet their customers' needs.

Solid ink densities, as shown by the data, vary by as much as 50% from one printer to another. This diversity of density greatly influences the print contrast and color saturation of the final printed sheet.

Dot gain averages for each color range from 18-25% within the survey. These averages are not as low as generally suggested but show a definite downward trend.

Ink color properties data show several distinct hue lines within each process color gamut. No single set of process hues, therefore, would satisfy the commercial segment's ink color requirements.

Given the diversity found in the survey for top density, dot gain and ink color, it seems fair to infer that print buyers are asking for individualized treatment of their color printing, and that printers are providing this diversity to differentiate themselves in the marketplace.

The commercial printing segment is clearly made up of individuals who prize their identity, and use special treatments to distinguish their work from that of competitors. Special hues, characteristic reds, yellows and greens, saturated colors, sharpness of images, are all factors that help customers to select one printer over another. Yet these variations do not reflect differences in the quality of printing from one plant to another, but simply the means that printers use to satisfy the needs of their print buying customers.