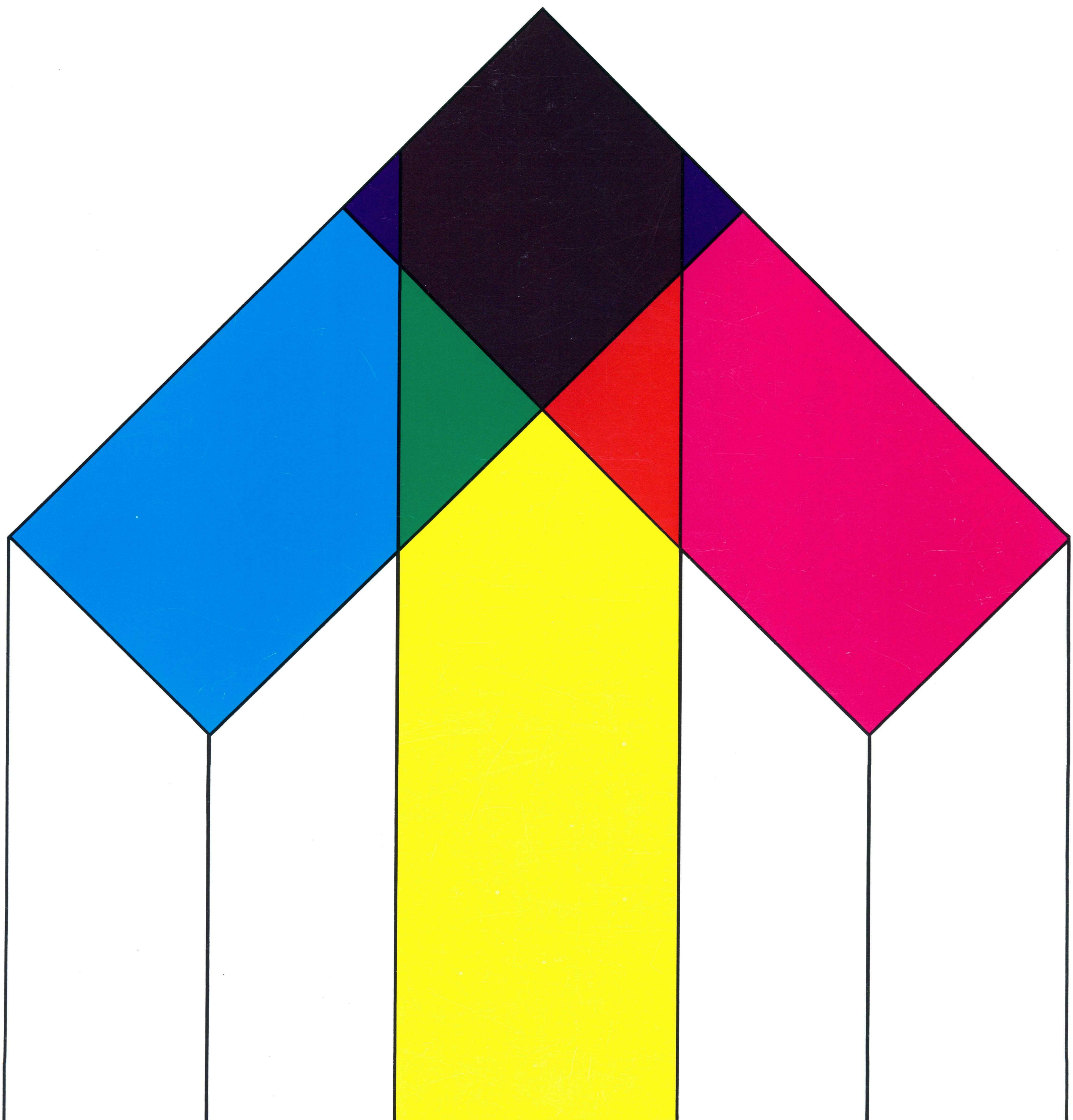
BULLETIN NO. 4

Wet Ink Trapping



WARREN

How will it print?

This bulletin is issued by S.D. Warren Company to aid the graphic arts community in dealing with the complexities of the printing process. Information contained herein combines the findings of scientists and the observations of experienced craftspeople.
No scientist will claim that existing knowledge is complete, and no sincere craftsperson will pose as a final authority. The text of this bulletin, therefore, represents merely the considered opinions of experienced and thoughtful analysts.

Wet Ink Trapping

You've adjusted ink for the third time and still haven't gotten your flesh tones. Not only are they too pink, they're uneven, mottled, and splotchy, which seems impossible when the color proof looked so good.

The same inks are being run on the same paper. And with your last try, you even increased the amount of ink. Water balance is O.K., as are cylinder pressure and register.

So what's wrong? Are you going to have to make new plates?

Perhaps not. Your problem may have nothing to do with plates or with any of the other conditions that you've checked and corrected for. It may simply be ***inadequate wet ink trap.***

Most problems with wet ink trapping were solved when we learned that inks must be laid down in proper tack sequence if they are to ***trap***, that is, to adhere to one another and produce the colors we want. The ink with the highest tack goes down first. The others are printed in descending tack order. The rule was obvious and easy to follow.

But processes and materials change, and today we've adopted some that simplify certain phases of our work yet complicate others. High speed presses and uniform tack inks are two such innovations. By increasing our productivity, they have reintroduced a problem—inadequate wet trap—that hasn't bothered us for years.

In this booklet, we'll cover the principles of wet ink trapping. Special emphasis will be placed on the relationships among tack, absorption, and speed; which concern ink, paper, and press respectively. You'll discover how trap is measured, what precautions to take in using various kinds of ink, why paper shouldn't be relied upon to do the whole job of trapping, and when press speed is a factor to consider in planning a job.

Then by following a few simple rules to keep systems in balance, you can again file wet ink trapping with problems safe to forget!

BULLETIN NO. 4
Wet Ink Trapping
Lusterkote Cover
Warren
ALKACID TEST RIBBON
FISHER SCIENTIFIC COMPANY
GATF COLOR TEST STRIP
BLACK

/E and
axony Embossed
warren
COSAR 61
SMART DENSITOMETER
MAN
AUTO
ID
TRAP
V
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Y
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0
OPERATE SIDE
Other Side For
Number Entry

A close look at wet trap

WHAT IS TRAPPING?

Trapping is the ability of a wet ink film to grasp and hold a second film that is printed over it. It's like putting the second coat of paint on a wall. If it doesn't stick, the results will be disappointing.

Ideally, you can trap one ink with another as efficiently as you can trap that ink with paper. Good multicolor printing depends on it. For unless inks overprint properly and combine their films in just the right proportions, your colors will be off.

We evaluate or measure trap in terms of percentage. A high percentage is "good" because it gives the desired color (Figure 1A). A low percentage, which gives uneven or off color, is "poor" (Figure 1B).

Figure 1A

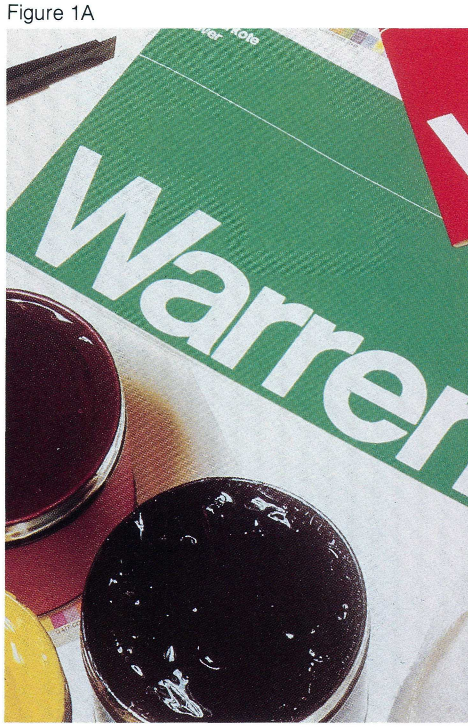


Figure 1B

SOME SAMPLES

Here's what different percentages of trap look like. Both samples were printed with the same colors of ink.

First you see 100% trap (Figure 2). Its color is true and even. The photomicrographic inset shows "good" magenta over yellow trap.

The second sample, illustrating 30% trap, is mottled and muddy (Figure 3). And in the inset, you see dots that are broken and uneven; "poor" magenta over yellow trap.

Pressmen are increasingly faced with such discrepancies. They receive a beautiful color proof, but their own production sheet, made from identical inks and paper, doesn't match it. Is the problem wet trap?

Figure 2

Figure 3

Measuring trap

WHAT YOU'LL NEED

How do you determine if it *is* poor trap that is causing your problem? The answer is to run a set of color bars, like the GATF Color Reproduction Guide, then take densitometer readings, and apply a simple formula.

What this procedure actually yields is a comparison, by percentage, of 1) the density of an ink film when it is printed over and trapped by another film, and 2) the density of that top film printed directly on paper.

How well is the ink trapping? Is it trapping as well as paper (100%)? Almost as well (88%)? Or isn't it holding on to much of the second color at all (30%)?

Figure 4

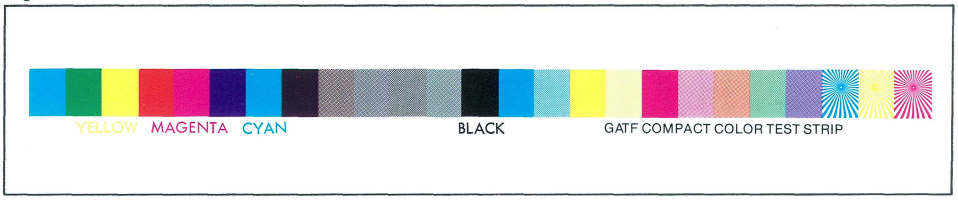
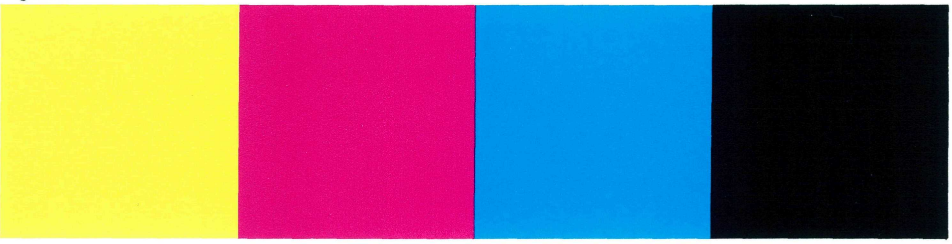


Figure 5



HOW TO PROCEED

Here is an example of what a ***complete*** set of color bars looks like (Figure 4). It shows the overprinting of all combinations of colors. ***Basic*** bars simply show ink density; they aren't designed to measure percent of trap (Figure 5). A complete set, therefore, should be run with every multicolor job.

Let's now assume that you're concerned with the trapping of ***magenta*** on ***cyan.*** You would take three readings with a densitometer through the appropriate filter for the color on top. (In this case the green filter for magenta.) (Figure 6): the solid cyan (Figure 7), the solid magenta (Figure 8), and the overlap of the two (Figure 9).

The percentage of trap is then found by applying this formula (Figures 10, 11, 12):

$$\frac{\text{Density of overlap (Magenta + Cyan)} - \text{Density of bottom color (Cyan)}}{\text{Density of top color (Magenta)}} \times 100 = \%\ \text{Trap}$$

(Figures 10, 11, 12)

Figure 6

Figure 7

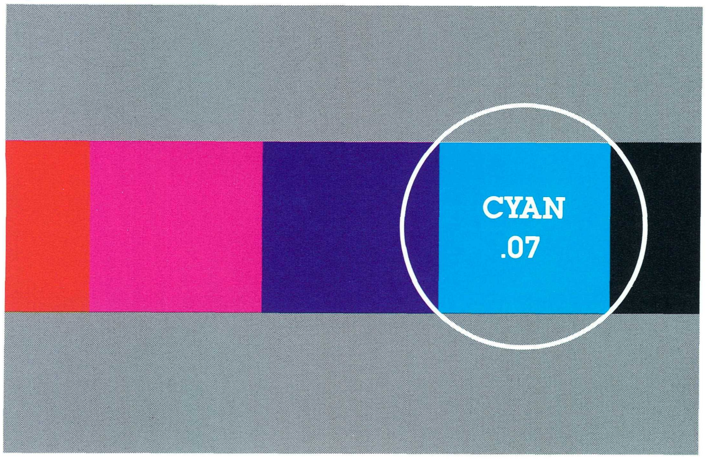


Figure 8

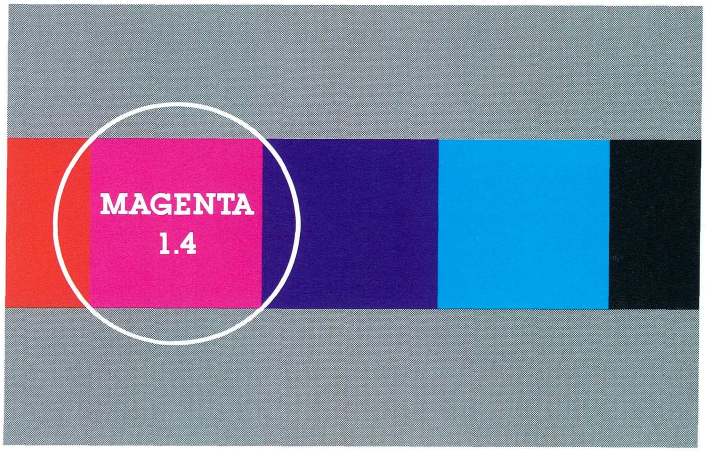


Figure 9

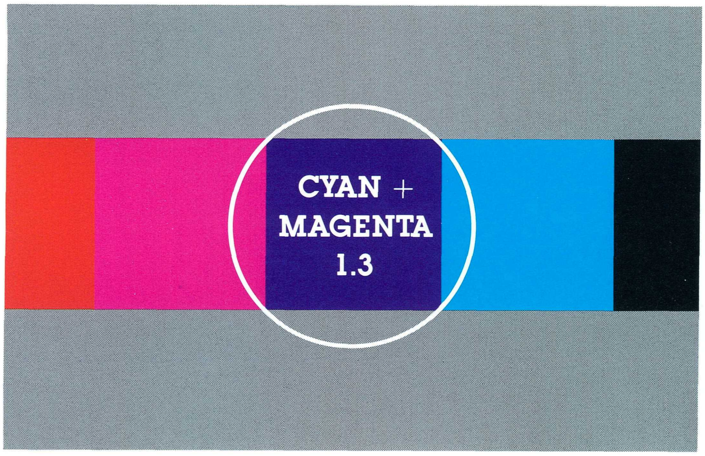


Figure 10

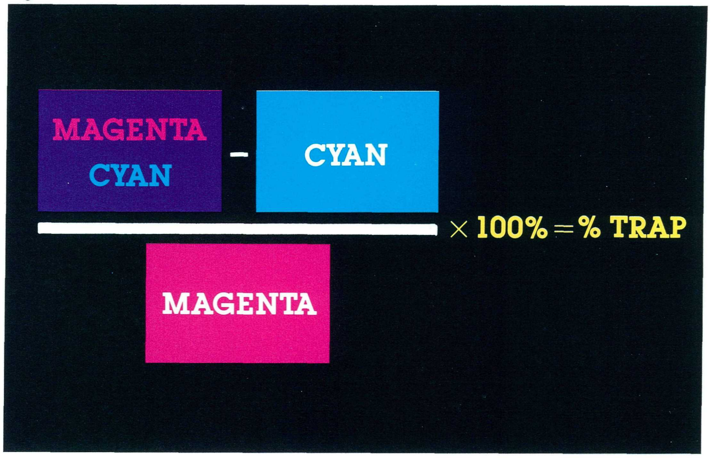


Figure 11

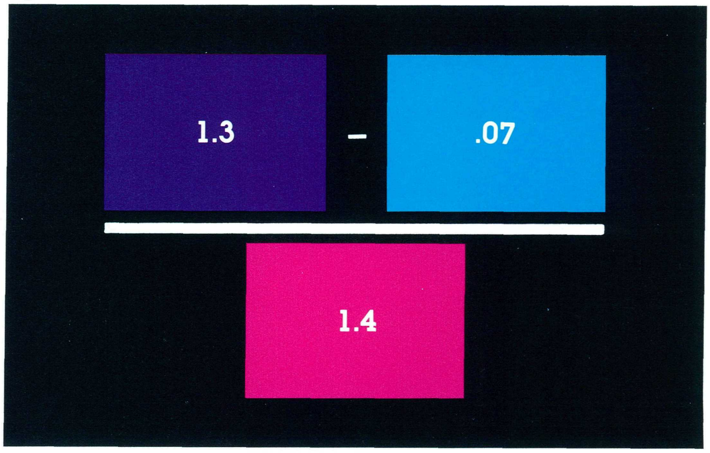
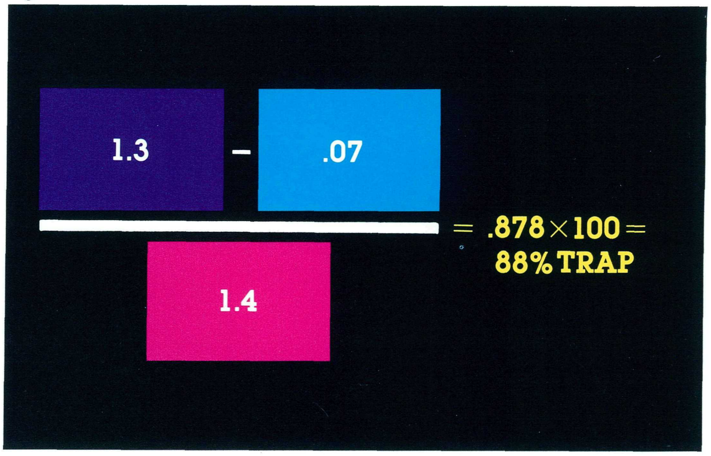


Figure 12

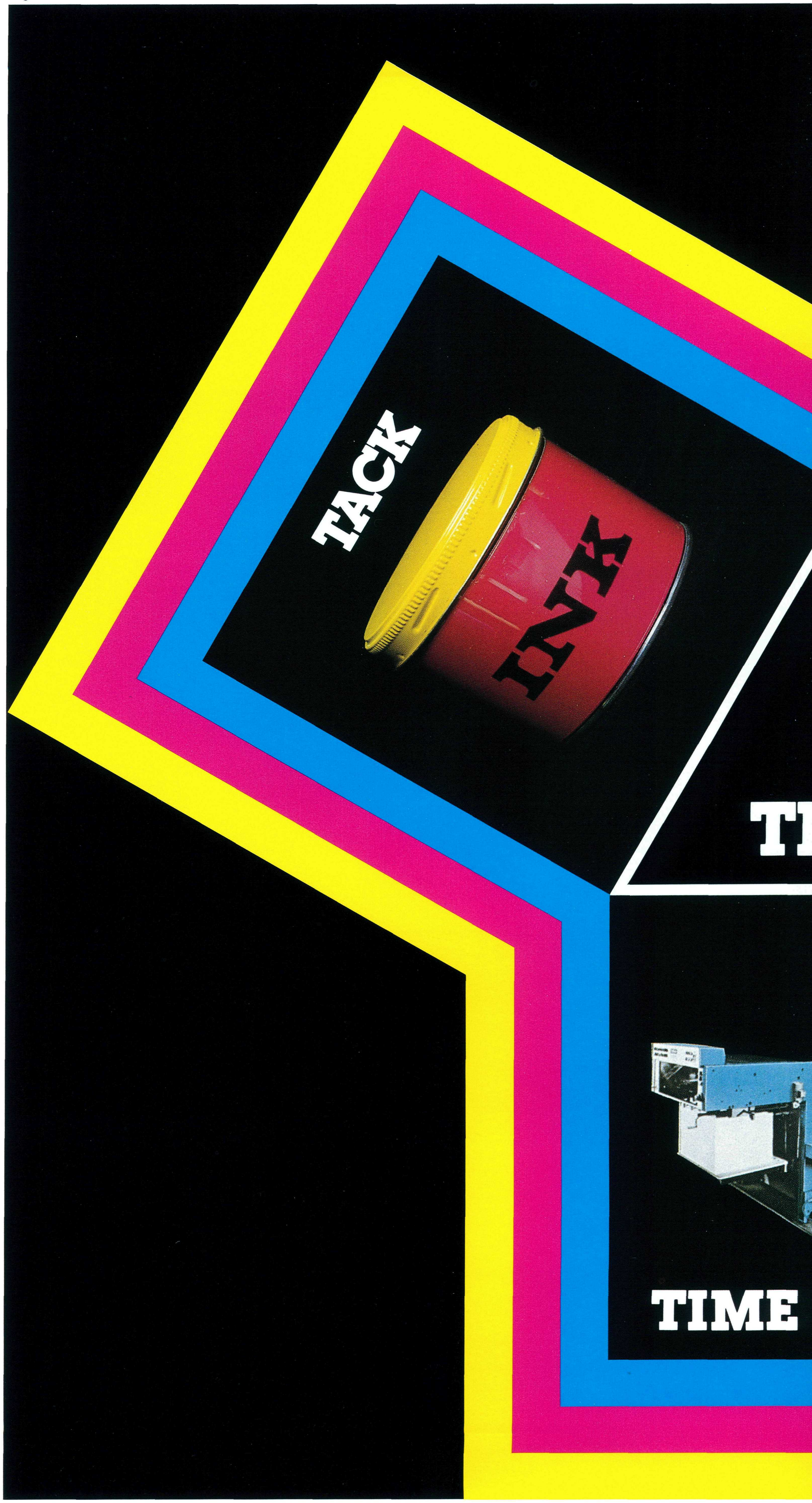


The three keys to trapping

A high percentage of trap requires the right balance of three factors: ***Tack, Absorption,*** and ***Time.*** Tack, as you'll see, is primarily a matter of ink. Absorption depends on paper. Time is press related (Figure 13).

It is important to keep these factors in mind, for when a trapping problem occurs, it can usually be traced to one or more of them. In the following pages, we'll look at trapping from these three points of view. By understanding the effects of each, you will be able to make decisions that can help assure more satisfactory printing results.

Figure 13




ABSORPTION

Tack / Ink

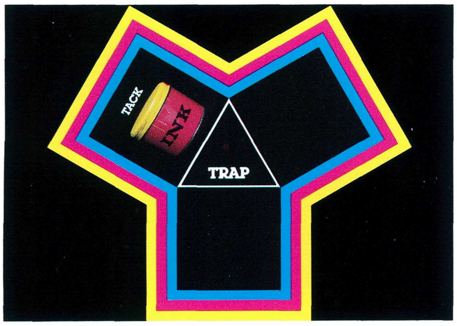
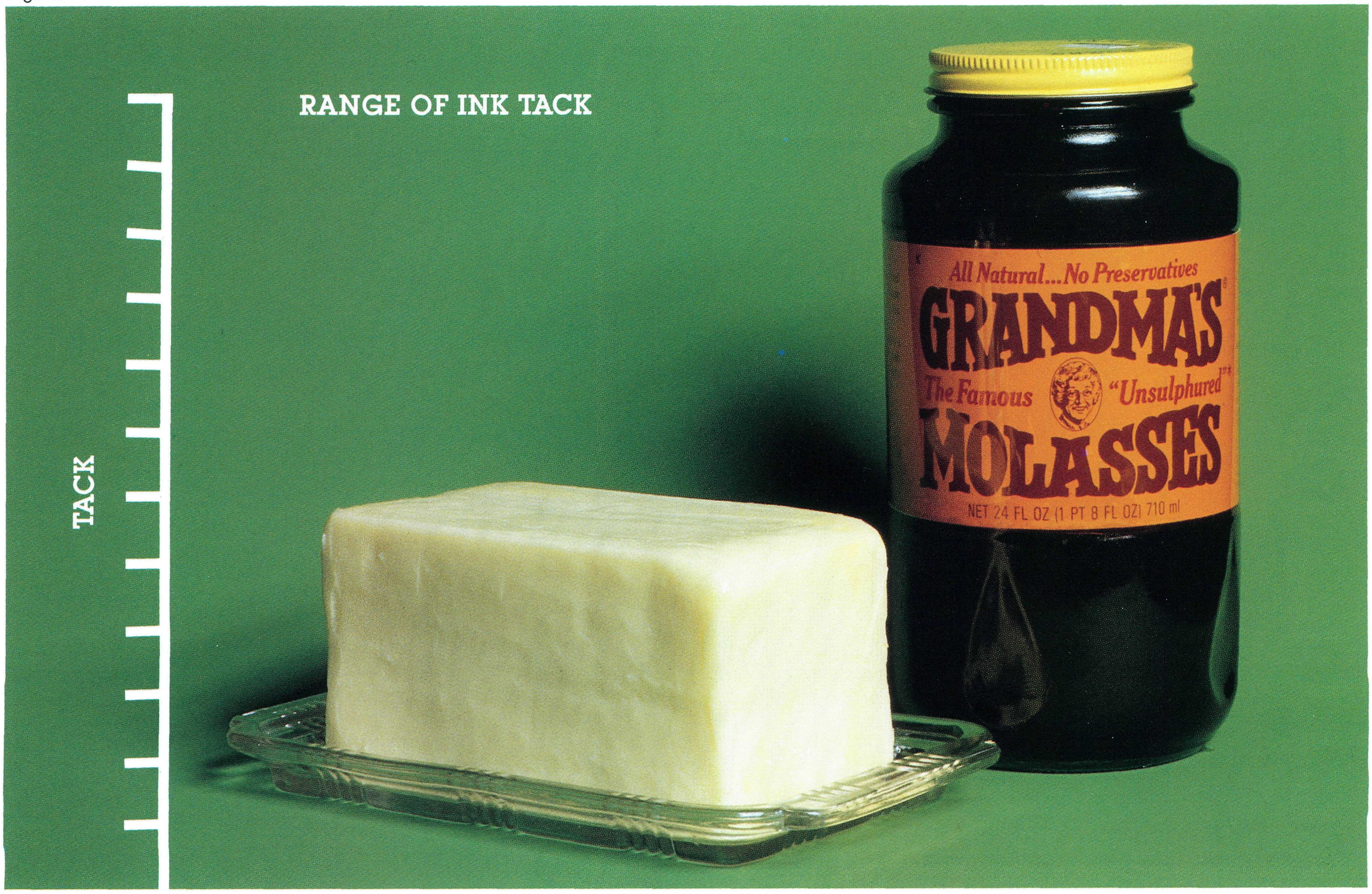


Figure 14



TACK—WHAT IS IT?

Tack is the "stickiness" of ink, which can range in consistency from molasses to soft butter (Figure 14). Tack is a measure of the force needed to split an ink film between two rotating rollers at a predetermined speed and temperature. You could determine the tack of honey, for example, by measuring the force needed to pull apart the two pieces of bread in a honey sandwich.

When you buy ink, it is tack rated. That is, all inks are formulated to specific tack levels, which are indicated on their cans and referred to as "can tack." But when you remove ink from the can and begin to work it, tack changes. It may increase 2 or 3 points by the time it runs through the press and is applied to paper. The new tack level, at the moment of impression, is an ink's "effective tack", and it is this, not "can tack," that you're really concerned with in trapping.

Figure 15

INK MAKE-UP

Why the tack gain? Generally speaking, inks are composed of pigments that provide color, solvents (vehicle) that promote setting, and resins that hold pigments on the paper's surface and give ink its particular degree of gloss (Figure 15).

When the ink comes in contact first with the blanket and then with the paper, solvents drain out of it and resins begin to solidify, making the ink tackier.

TACK SEQUENCE

Tack is a major factor that enables inks to adhere to, or trap, one another; it is tack sequence that enables us to control and achieve quality trapping. In the proper sequence, your first color down must have the highest tack. Subsequent colors have lower effective tacks, with a descending 2-to 4-point spread between them. Every ink film, therefore, will trap the one that follows.

SOME EXAMPLES

Let's simulate some more printing and see how this works in practice. To keep it simple, we'll use just two colors. In the first example, Cyan (with an effective tack of 14) was printed first. Then came Magenta (with an effective tack of 11). The sequence was correct and the trap is 100% (Figure 16).

In the second example, the order was changed. It was decided to run Cyan last. But then the tack sequence is wrong and the trap is only 40% (Figure 17). If you still want your Cyan last, you must either run a tackier Magenta or a less tacky Cyan. In example three, you see the latter and it works! (Figure 18)

It's essential to remember that when you alter your normal color sequence to meet special printing objectives, you must still maintain proper tack sequence.

Figure 16

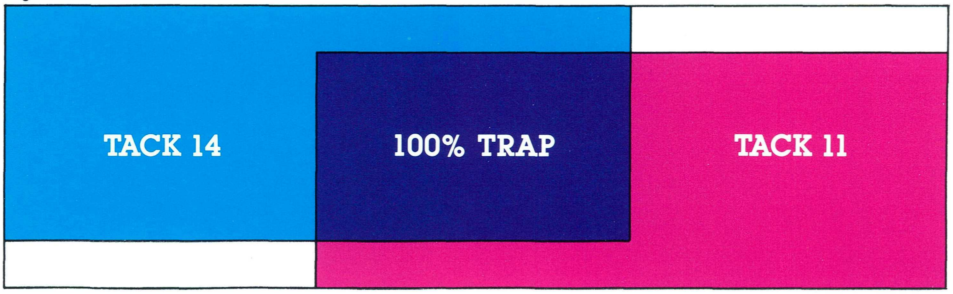


Figure 17

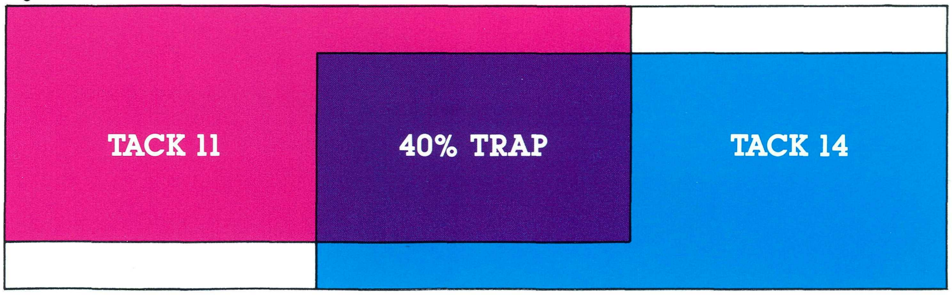


Figure 18

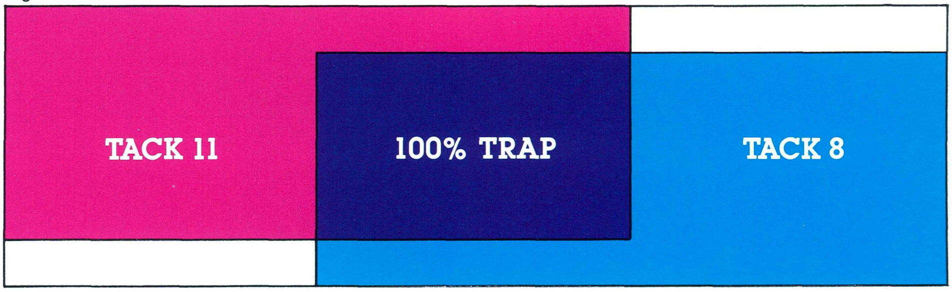


Figure 19

Figure 20

Figure 21

INK TYPES

Inks are available today in great variety. There are conventional inks, which are relatively slow setting. These were once the standard of the printing industry because of their simplicity and the consistency of the results they produced. In recent years, faster setting inks—quick setting, super setting, and acrylics—have come into widespread use (Figure 19). They are designed to take advantage of the production capabilities of our new high speed presses and quick back-up.

These different types of ink come in two forms: graded and uniform.

GRADED TACK INKS

The examples you saw on page 12 were printed with graded tack inks.

As you saw in Figure 18, it is sometimes necessary to have an inventory of certain inks with more than one tack value.

For example:
In Figure 16, when cyan was printed first, a tack of 14 was required. When magenta was printed first, however, the tack requirement for the cyan was 9.

UNIFORM TACK INKS

Uniform tack inks are formulated in sets with a single can tack. Your Magenta, Cyan, Yellow, and Black might all have a tack of 12. This benefits the printer by reducing inventory (no longer must you stock each color in a variety of tacks) and adding flexibility (since such inks may be run in whatever sequence you desire) (Figure 21).

But if good trapping depends on proper tack sequence, how can you trap with inks that all have the same tack. Two of the factors which allow uniform tack inks to work are the absorptivity of the paper and the press which gives adequate time for the tack to build.

EXAMPLES

Here's what happens. Your first ink down might have a tack of 12 (Figure 22), but by the time it reaches the second printing unit, its tack has increased to 14 (Figure 23).

This has occurred because the ink releases some of its solvents into the paper, and the time between impressions allows the ink to gain in tack. Now it can easily trap the second ink, whose tack is still only 12. In like manner the second ink will trap the third and the third traps the fourth.

It's important to remember, however, that the process only works with a paper and press combination allowing sufficient time for solvents to drain and tack to build between printing units. When this fails, the inks will not trap properly, as you see in the third example (Figure 24).

Figure 22

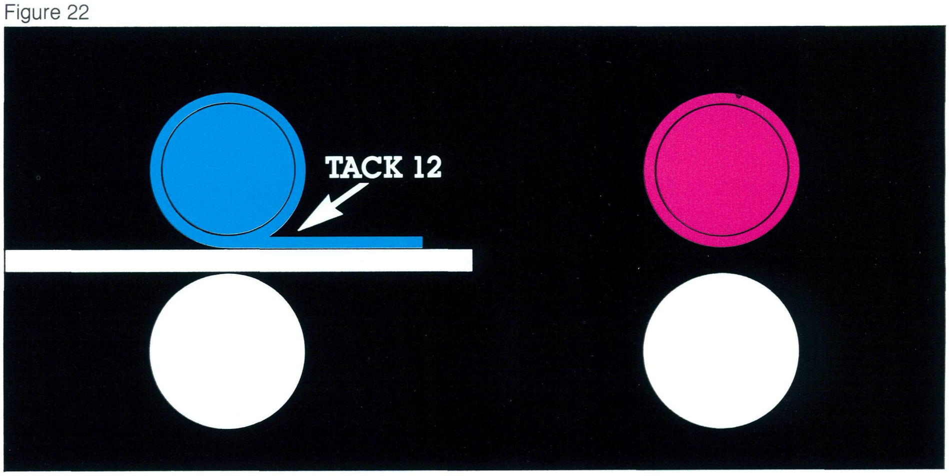


Figure 23

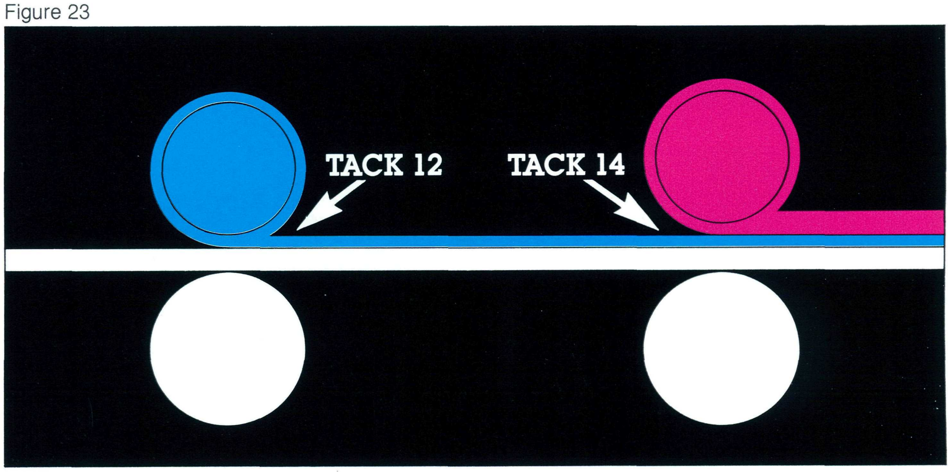
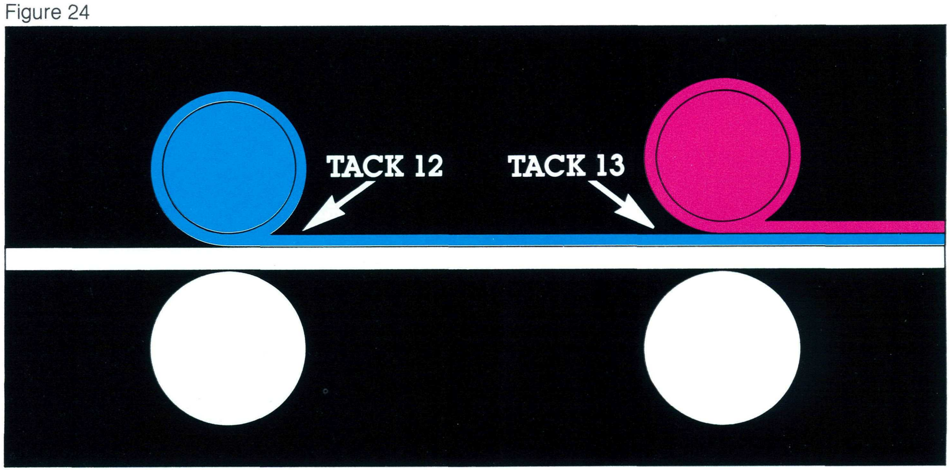


Figure 24



INK STABILITY

Ink tack stability is the rate at which tack increases with time and is one factor which determines "EFFECTIVE" Tack.

An inkometer is used to express tack stability of inks in terms of tack increase per minute.

EXAMPLES

The first graph (Figure 25) represents a set of four inks that have been run 10 minutes on the inkometer. These four inks began with can tacks of 18, 16, 14, and 12. The rate of tack build for all 4 inks is uniform.

The second graph (Figure 26) represents a set of inks that includes a black ink that has a faster rate of tack build.

Within five minutes this black ink has increased 10 tack units while the other three have gained only 2 tack units.

On press this gain raises the tack of this last-down black ink above that of the inks before it and results in inadaquate trapping.

Figure 25

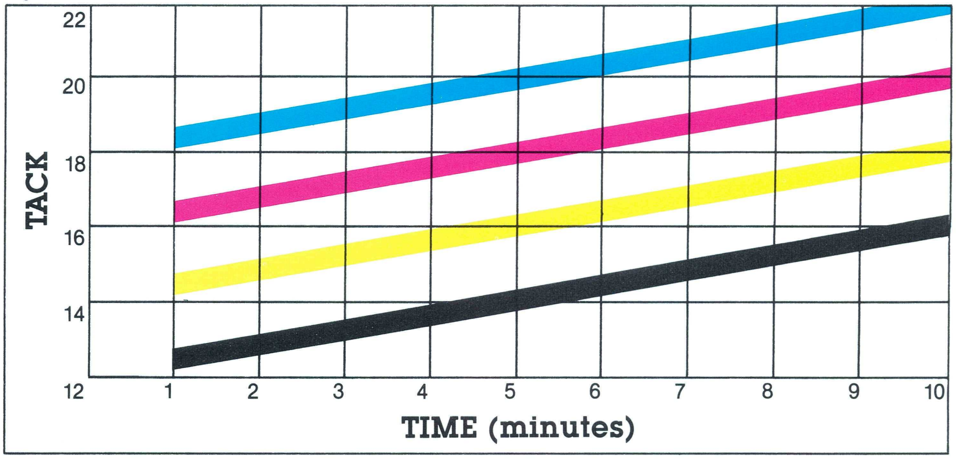
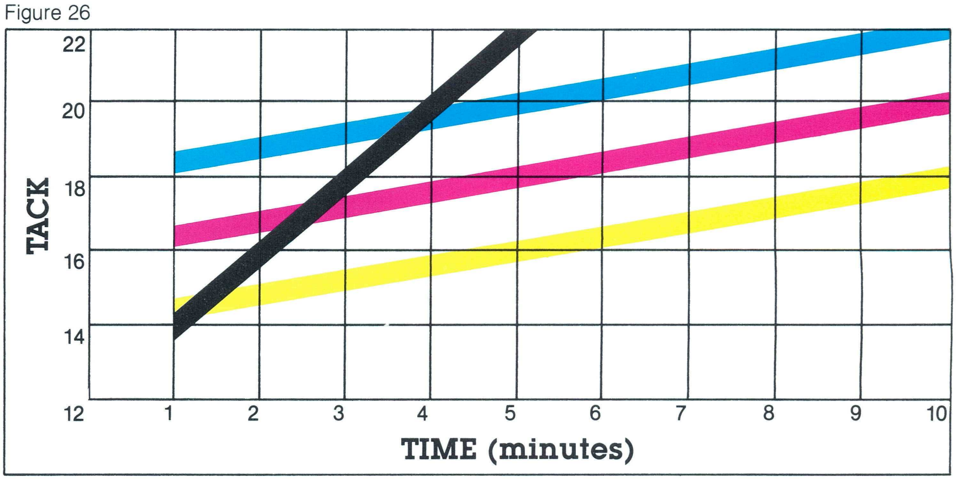


Figure 26



Absorption / Paper

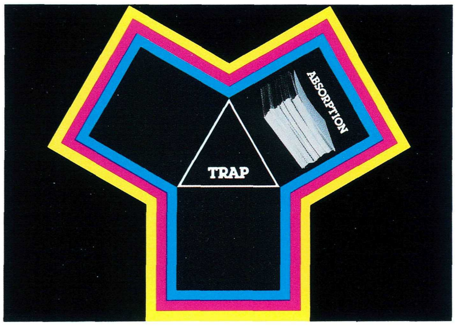


Figure 27A

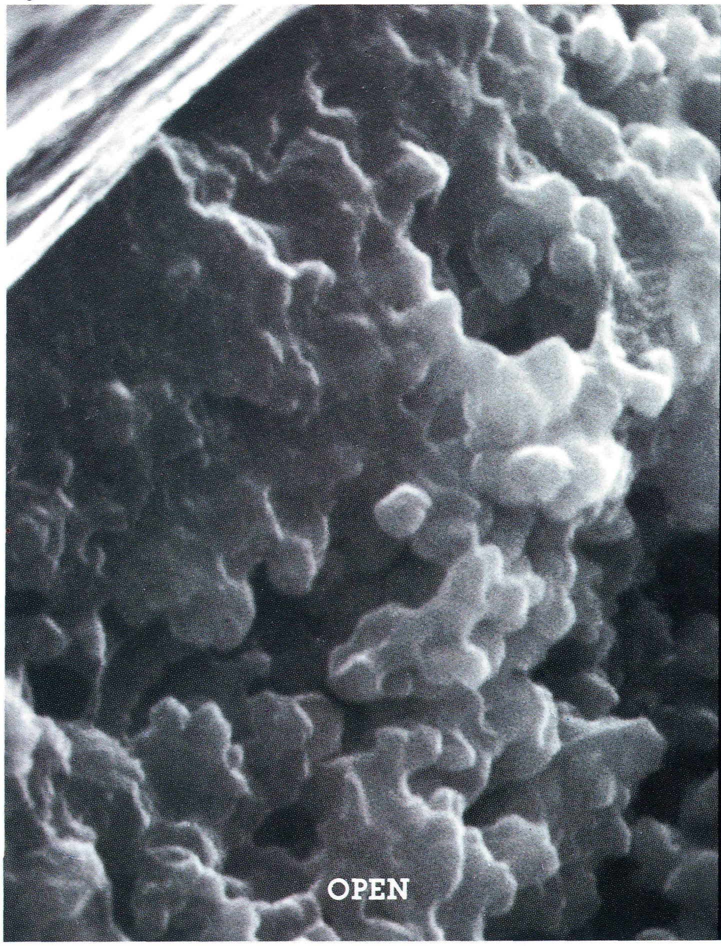
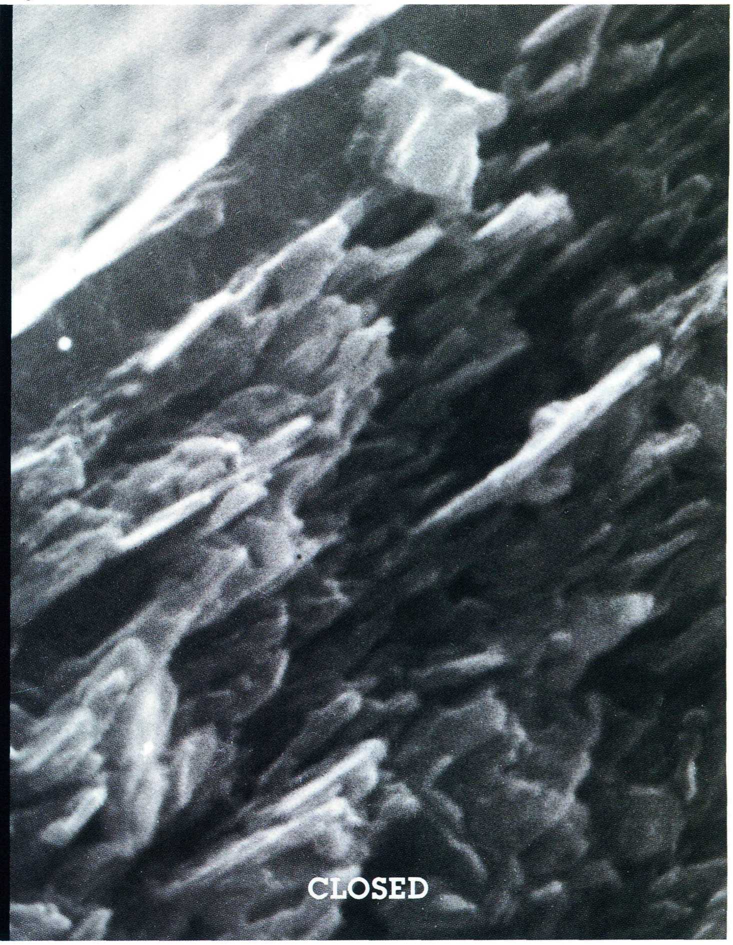


Figure 27B



PAPER STRUCTURE?

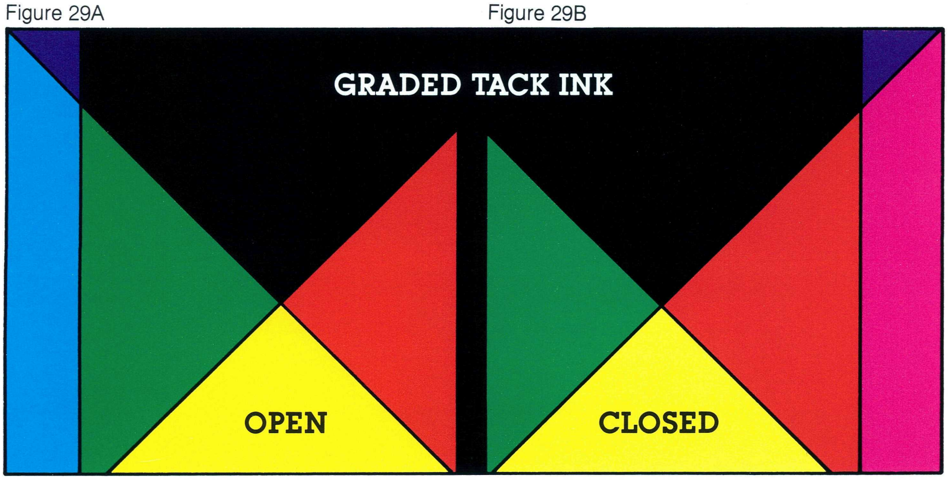
We've seen that trapping often requires solvents to be absorbed from the ink so that it can build tack. Absorption is primarily the task of paper. How quickly it performs this task, or its degree of absorption, is a function of its surface and structure.

You see here photomicrographs of the coating structure of two different papers. (These cross-sections are shown at a 45° angle, necessitated by equipment used to take photomicrographs. All that is visible is coating structure. No cellulose fiber appears.) The first, which is more open, has a higher degree of absorption because solvents can easily drain through its pores (Figure 27A). The second, with a closed structure, will provide better ink hold-out but also slower tack build, for solvents must flow around its flat, closely packed platelets (Figure 27B). The balance between hold-out and absorption is difficult to achieve, which is why papers differ considerably in their make-up.

The more absorbent the paper the greater the increase in tack. Recognition of this interaction enables the printer to make proper ink adjustments.

Figure 28A Figure 28B

Figure 29A Figure 29B



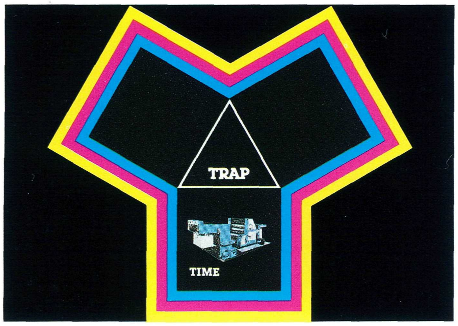
EXAMPLES

You see here two prints that demonstrate how trap is affected by different combinations of inks and papers. First, uniform tack inks are run on the two papers, one open and one closed.

With the open sheet, uniform tack inks trap satisfactorily (Figure 28A). But on the closed sheet, which does not permit rapid drainage of solvents, the percentage of trap is low and you get an off-color, mottled print (Figure 28B).

Consistently good results on any paper are easier to achieve with graded inks. As you see here (Figures 29A & B), trap is equally good on both the open and closed papers. Maintain proper tack sequence, use inks with good stability, and success is practically assured.

Time/Press



PRESS TYPES

Time is a function of press speed, which has increased steadily over the years so that today some sheet-fed presses can run at an average of 10,000 impressions per hour. While this yields tremendous production, it can also cause trouble, particularly with trapping. For now there is less dwell time (time between printing units) for tack to build.

These are the two most common configurations of modern multi-color presses (Figures 30 & 31). The first is an in-line or unitized press. The second, a common impression cylinder press. On a unitized press, paper travels from unit to unit where each color is applied. Although the interval between units is very short, it does provide adequate dwell time for most inks and papers to build tack for trapping. The common impression cylinder press, with two printing units working off one impression cylinder, provides less dwell time. It is estimated to be 1/8 of a second as opposed to 1 second on a unitized press. (These calculations are based on a press speed of 7,600 iph.)

Figure 30

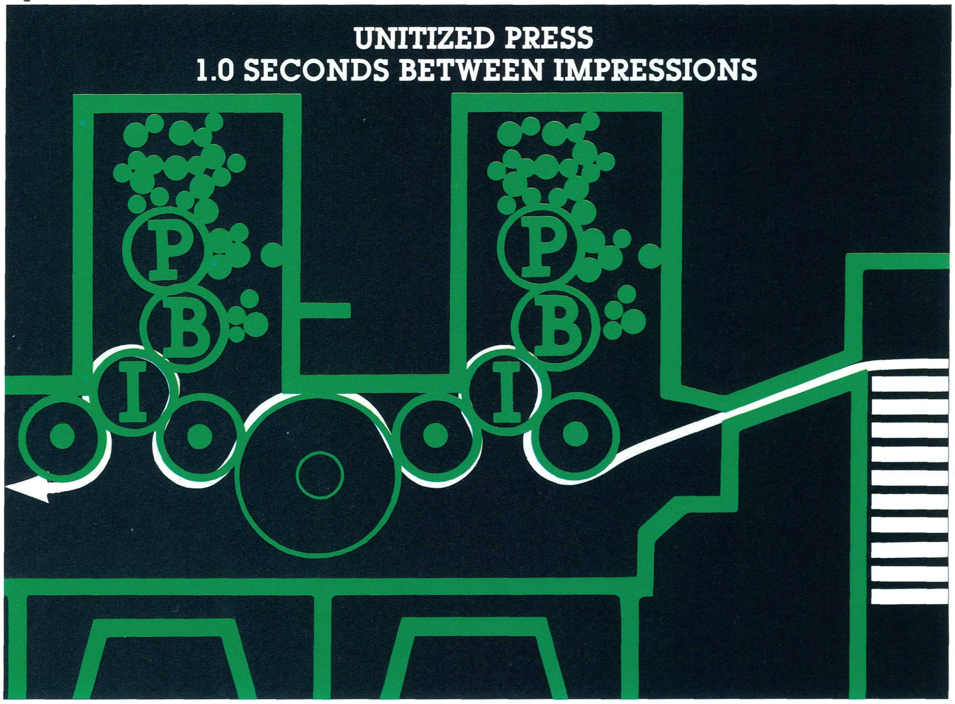


Figure 31

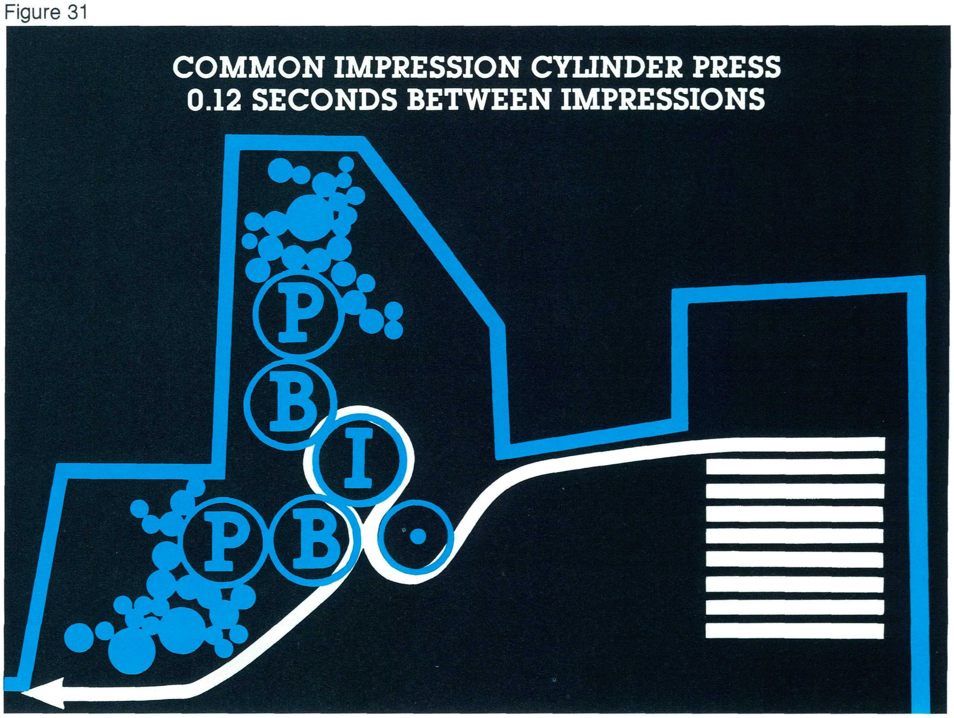


Figure 32A Figure 32B

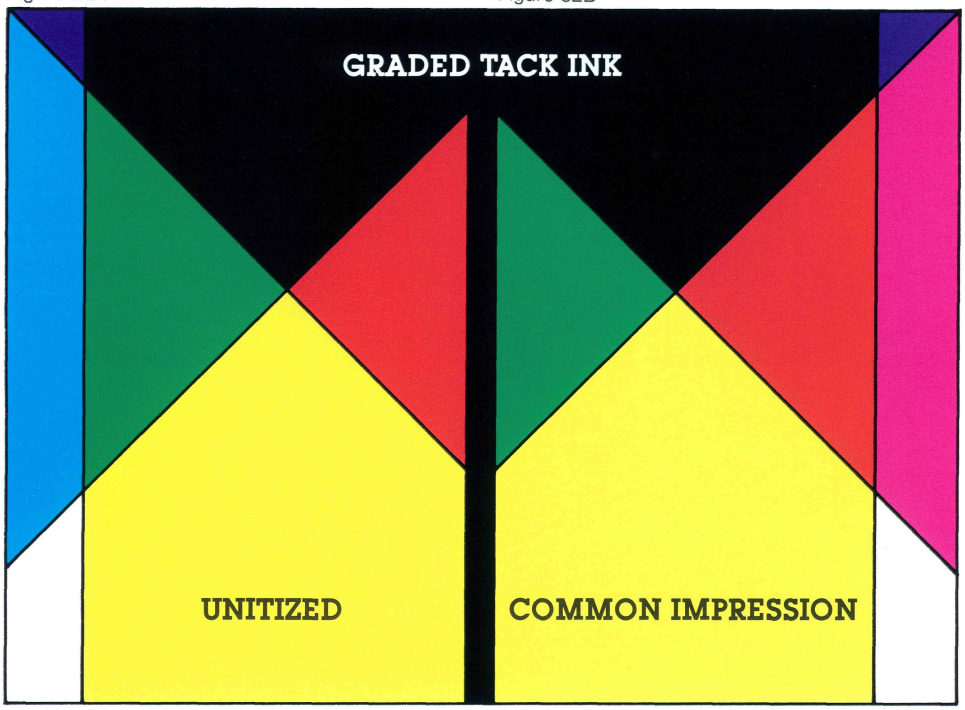
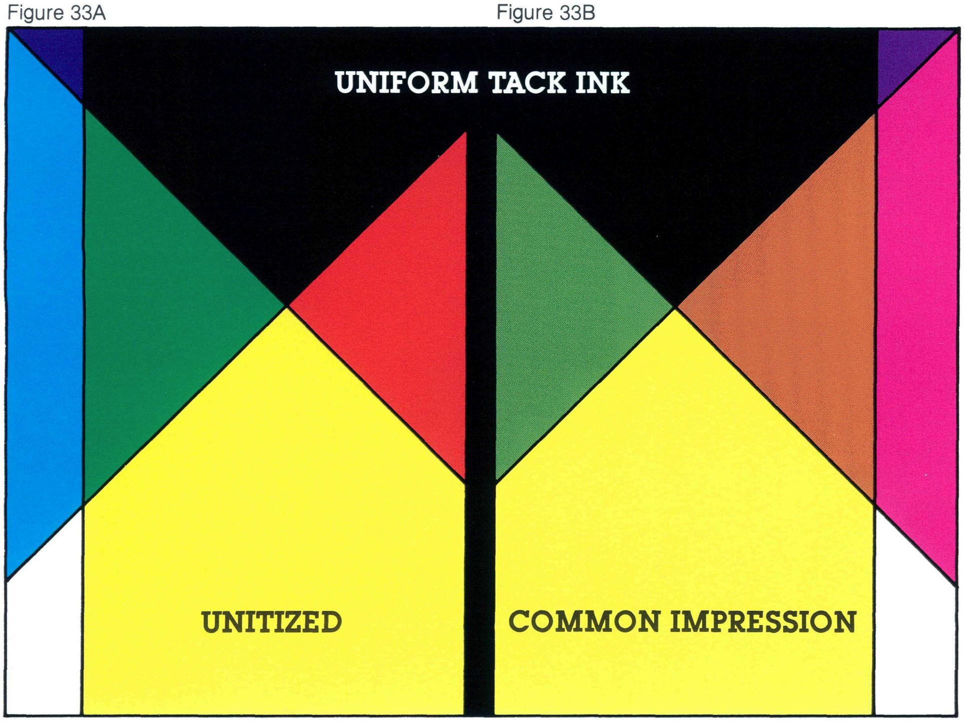


Figure 33A Figure 33B



EXAMPLES

Observe how quality of trap is affected by the dwell time that these two presses provide—first using graded inks, which are in proper tack sequence; and second using uniform tack inks, which must have time to release solvents before gaining the tack needed to trap. The same paper is used for all prints.

With graded inks, both prints are satisfactory—on the unitized press ***and*** the common impression cylinder press (Figure 32A & B).

But with uniform tack inks, in this case, you would get an acceptable print only on the unitized press. On the common impression cylinder press, there simply wasn't sufficient time for the tack to build (Figure 33A & B).

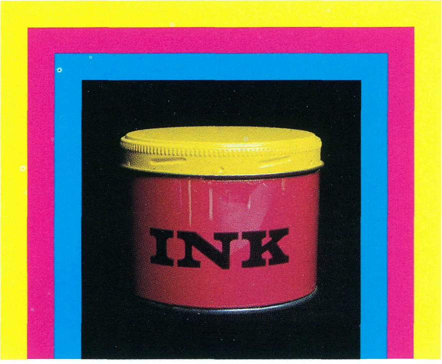
If we had used a different paper, the results might have been different. For on an open sheet, uniform tack inks could have trapped even with the short dwell time afforded by the common impression press. The paper would have absorbed the inks' solvents rapidly enough for tack to build. Matching paper with uniform inks can be difficult and limiting.

Summary

Satisfactory wet ink trap isn't difficult to achieve if you simply run your inks in the proper tack sequence. Start with the ink that has the highest tack and keep a 3- to 5-point spread between colors.

And remember that it's the ***effective tack*** of an ink film that counts, for tack in the can just isn't the same as tack at the time of impression.

Achieving this proper ***effective tack sequence*** involves three factors: Tack, Absorption, and Time.



TACK

The main determinant of tack is ink. With graded tack inks, tack value is ***built in***. But with uniform tack inks, it must be ***built up*** and, consequently, is as much a function of paper absorption and press time as it is of the ink itself. Trapping problems often occur when it is assumed that uniform tack inks will trap "automatically" and the paper and press influences are ignored.

It's well to remember also that tack can be affected by temperature, fountain solution, and ink film thickness.

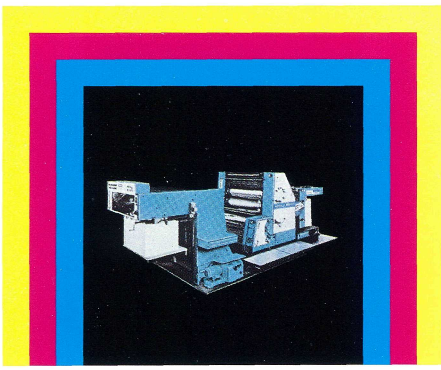
ABSORPTION

Absorption is mainly a function of paper. Its surface and overall structure permit the solvents to drain from an ink, allowing the tack building process to begin.

But paper has additional jobs to do, such as providing a smooth, tight surface for high ink hold-out. Graded tack inks trap well on a wide range of papers with varied absorption characteristics. Uniform tack inks, however, which depend on rapid drainage in order to develop tack, usually require a paper with a surface that is more open.

Note that blankets play a role here, too; and as they vary in the rate at which they absorb solvents during a run, each will affect the trapping process differently.

Conclusion



TIME

Time is a press factor. With increasing speeds, particularly on common impression cylinder presses, there is often inadequate time for uniform tack inks to build sufficient tack for good trapping. These inks are run more successfully on a unitized press, which provide a full second or more of dwell time in contrast with the 1/8th second provided by the common impression cylinder press.

The time factor can explain why the production run often fails to match the quality of proof sheets, even when run with the same inks on the same paper. If the type of press or the speed at which it is run varies, so might your results.

When your colors are off, mottled, or splotchy, you may be looking at a problem caused by poor wet trap. How can you know for sure? ***Always run a complete set of color bars on your press sheet.*** Then, by following the procedures outlined in this booklet, you can even determine percent of trap.

To help insure against poor wet trap, ***use graded tack inks.*** Because they provide proper tack sequence for a high percent of trap, they minimize the influence of all the other factors we've discussed, such as variation in paper and presses.

You've seen that absorption qualities vary from paper to paper (and from manufacturer to manufacturer). And that dwell time varies with the type of press you have and the speed at which it's run. But with stable graded tack inks and a clear understanding of the principles of wet ink trapping, every printer can produce job after job that is a source of pride to himself and to his customers.

Warren Paper Merchants

ALABAMA		
Birmingham	Dillard Paper Co.	
	Sloan Paper Co.	
Huntsville	Sloan Paper Co.	
Madison	Athens Paper	
Mobile	Strickland Paper Co.	
	Unijax, Inc.	
ALASKA		
Anchorage	Zellerbach Paper Co.	
ARIZONA		
Phoenix	Zellerbach Paper Co.	
Tucson	Zellerbach Paper Co.	
ARKANSAS		
Little Rock	Western Paper Co.	
CALIFORNIA		
Fresno	Zellerbach Paper Co.	
Los Angeles	LaSalle Paper Co.	
	Zellerbach Paper Co.	
Sacramento	Zellerbach Paper Co.	
San Diego	Zellerbach Paper Co.	
San Francisco	Zellerbach Paper Co.	
COLORADO		
Colorado Springs	Dixon Paper Co.	
Denver	Carpenter Paper Co.	
	Dixon Paper Co.	
	Zellerbach Paper Co.	
Grand Junction	Dixon Paper Co.	
CONNECTICUT		
South Windsor	Carter Rice	
	Lindenmeyr—Munroe	
West Haven	Carter Rice	
FLORIDA		
Jacksonville	Palmer Paper Co.	
	Zellerbach Paper Co.	
Miami	Palmer Paper Co.	
	Zellerbach Paper Co.	
Orlando	Palmer Paper Co.	
	Zellerbach Paper Co.	
Tampa	Palmer Paper Co.	
	Zellerbach Paper Co.	
GEORGIA		
Atlanta	Dillard Paper Co.	
	Sloan Paper Co.	
Augusta	Dillard Paper Co.	
Columbus	Sloan Paper Co.	
Macon	Dillard Paper Co.	
Rome	Dillard Paper Co.	
HAWAII		
Honolulu	HOPACO	
	Zellerbach Paper Co.	
IDAHO		
Boise	Dixon Paper Co.	
	Zellerbach Paper Co.	
ILLINOIS		
Champaign	Crescent Paper Co.	
Chicago	Bradner Smith & Co.	
	Leslie/Chicago Paper Div.	
	Hobart/ McIntosh Paper Co.	
	LaSalle Messinger Paper Co.	
	Midland Paper Co.	
Peoria	Tobey Peoria Paper Co.	
Rock Island	Leslie Paper	
INDIANA		
Fort Wayne	Taylor Martin Papers	
Indianapolis	Crescent Paper Co.	
	RIS Paper Co., Inc.	
South Bend	RIS Paper Co., Inc.	
IOWA		
Cedar Rapids	Midwestern Paper Co.	
Des Moines	Leslie Paper	
	Midwestern Paper Co.	
Sioux City	Midwestern Paper Co.	
KANSAS		
Topeka	Midwestern Paper Co.	
Wichita	Western Paper Co.	
KENTUCKY		
Lexington	Athens Paper	
Louisville	Athens Paper	
	Louisville/Southeastern Paper Co.	
LOUISIANA		
Baton Rouge	Butler Paper	
Lafayette	Butler Paper	
New Orleans	Palmer Paper Co.	
	Unijax, Inc.	
Shreveport	Butler Paper	
	Western Paper Co.	
MAINE		
Portland	C.H. Robinson Co.	
	Carter Rice	
MARYLAND		
Baltimore	Baltimore-Warner Paper Co.	
	Butler Paper	
Landover	Stanford Paper Co.	
	Zellerbach Paper Co.	
Savage	Wilcox Walter Furlong Paper Co.	
MASSACHUSETTS		
Boston	Carter Rice	
	The Century Paper Co., Inc.	
	Lindenmeyr—Monroe	
Woburn	C.H. Robinson Co.	
Worcester	Carter Rice	
MICHIGAN		
Detroit	Chope-Union Paper Co.	
	Seaman-Patrick Paper Co.	
Grand Rapids	Carpenter Paper Co.	
	Quimby-Walstrom Paper Co.	
Lansing	Copco Papers/Dudley Division	
Saginaw	Copco Papers/Dudley Division	
MINNESOTA		
Minneapolis	Leslie Paper	
	Inter-City Paper Co.	
MISSISSIPPI		
Jackson	Sloan Paper Co.	
MISSOURI		
Kansas City	Midwestern Paper Co.	
	Tobey Fine Papers	
St. Louis	Shaughnessy-Kniep-Hawe Paper Co.	
	Tobey Fine Papers	
Springfield	Midwestern Paper Co.	
MONTANA		
Billings	Dixon Paper Co.	
Great Falls	Zellerbach Paper Co.	
NEBRASKA		
Lincoln	Carpenter Paper Co.	
	Western Paper Co.	
Omaha	Carpenter Paper Co.	
	Western Paper Co.	
NEVADA		
Las Vegas	LaSalle Paper Co.	
	Zellerbach Paper Co.	
Reno	Zellerbach Paper Co.	
NEW HAMPSHIRE		
Concord	Carter Rice	

NEW JERSEY

Lyndhurst	Bulkley Dunton
Newark	Central Paper Co.
Rutherford	Lindenmeyr Paper Corp.
Trenton	Central Paper Co.

NEW MEXICO

Albuquerque	Dixon Paper Co.

NEW YORK

Albany	Hudson Valley Paper Co.
Binghamton	Hudson Valley Paper Co.
	Seneca Paper Co.
Buffalo	Alling and Cory
	Seneca Paper Co.
New York City	Alling and Cory
	Baldwin Paper Co.
	Bulkley Dunton
	Lindenmeyr Paper Corp.
	Marquardt & Co., Inc.
Rochester	Alling and Cory
	Seneca Paper Co.
Syracuse	Alling and Cory
	Seneca Paper Co.
Utica	Alling and Cory

NORTH CAROLINA

Charlotte	Caskie Paper Co., Inc.
	Dillard Paper Co.
	Zellerbach Paper Co.
Fayetteville	Caskie Paper Co., Inc.
Greensboro	Dillard Paper Co.
	Zellerbach Paper Co.
Raleigh	Dillard Paper Co.
	Zellerbach Paper Co.
Wilmington	Dillard Paper Co.
Winston-Salem	Dillard Paper Co.

OHIO

Cincinnati	Cordage Papers/Cincinnati Division
	RIS Paper Co., Inc.
Cleveland	Alling and Cory
	Millcraft Paper Co.
Columbus	Cordage Papers/Columbus Division
Cuyahoga Falls	Millcraft Paper Co.
Dayton	Cordage Papers/Dayton Division
	RIS Paper Co., Inc.
Toledo	Commerce Paper Co.

OKLAHOMA

Oklahoma City	Western Paper Co.
Tulsa	Zellerbach Paper Co.
	Western Paper Co.

OREGON

Portland	Zellerbach Paper Co.

PENNSYLVANIA

Allentown	Alling and Cory
Erie	Alling and Cory
Harrisburg	Alling and Cory
Lancaster	Lindenmeyr Paper Corp.
Philadelphia	Alling and Cory
	Lindenmeyr Paper Corp.
Pittsburgh	Alling and Cory
	Cordage Papers/Pittsburgh Division
Scranton	Alling and Cory

RHODE ISLAND

Pawtucket	Carter Rice
Rumford	The Rourke-Eno Paper Co., Inc.

SOUTH CAROLINA

Charleston	Dillard Paper Co.
Columbia	Dillard Paper Co.
Greenville	Caskie Paper Co., Inc.
	Dillard Paper Co.

TENNESSEE

Chattanooga	Athens Paper Co.
	Sloan Paper Co.
Knoxville	Dillard Paper Co.
Memphis	Western Paper Co.
Nashville	Athens Paper
	Cordage Papers/Nashville Division
	Sloan Paper Co.

TEXAS

Amarillo	Dixon Paper Co.
Austin	Monarch Paper Co.
	Olmsted-Kirk Paper Co.
Dallas	Monarch Paper Co.
	Olmsted-Kirk Paper Co.
El Paso	Dixon Paper Co.
Fort Worth	Monarch Paper Co.
	Olmsted-Kirk Paper Co.
Houston	Monarch Paper Co.
	Olmsted-Kirk Paper Co.
Lubbock	Dixon Paper Co.
San Antonio	Monarch Paper Co.
Waco	Olmsted-Kirk Paper Co.

UTAH

Salt Lake City	Dixon Paper Co.
	Zellerbach Paper Co.

VERMONT

Burlington	Hudson Valley Paper Co.

VIRGINIA

Bristol	Dillard Paper Co.
Lynchburg	Caskie Paper Co., Inc.
	Dillard Paper Co.
Norfolk	Dillard Paper Co.
Richmond	Dillard Paper Co.
	Virginia Paper Co.
Roanoke	Dillard Paper Co.

WASHINGTON

Seattle	Zellerbach Paper Co.
Spokane	Zellerbach Paper Co.

WEST VIRGINIA

Huntington	Cordage Papers/Huntington Division

WISCONSIN

Appleton	Universal Paper Corp.
Madison	Universal Paper Corp.
Milwaukee	H.M. Bouer Paper Co.
	Reliable Paper Co.
New Berlin	Universal Paper Corp.

EXPORT AND FOREIGN

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Canada	
Calgary	Barber-Ellis
Edmonton	Barber-Ellis
Montreal	Les papiers graphiques
Ottawa	Buntin Reid Paper
Regina	Barber-Ellis
Saskatoon	Barber-Ellis
Toronto	Buntin Reid Paper
	Graphic Papers
Vancouver	Barber-Ellis
Winnipeg	Barber-Ellis
Australia	Edwards Dunlop and B.J. Ball
New Zealand	B.J. Ball (N.Z.) Ltd.

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