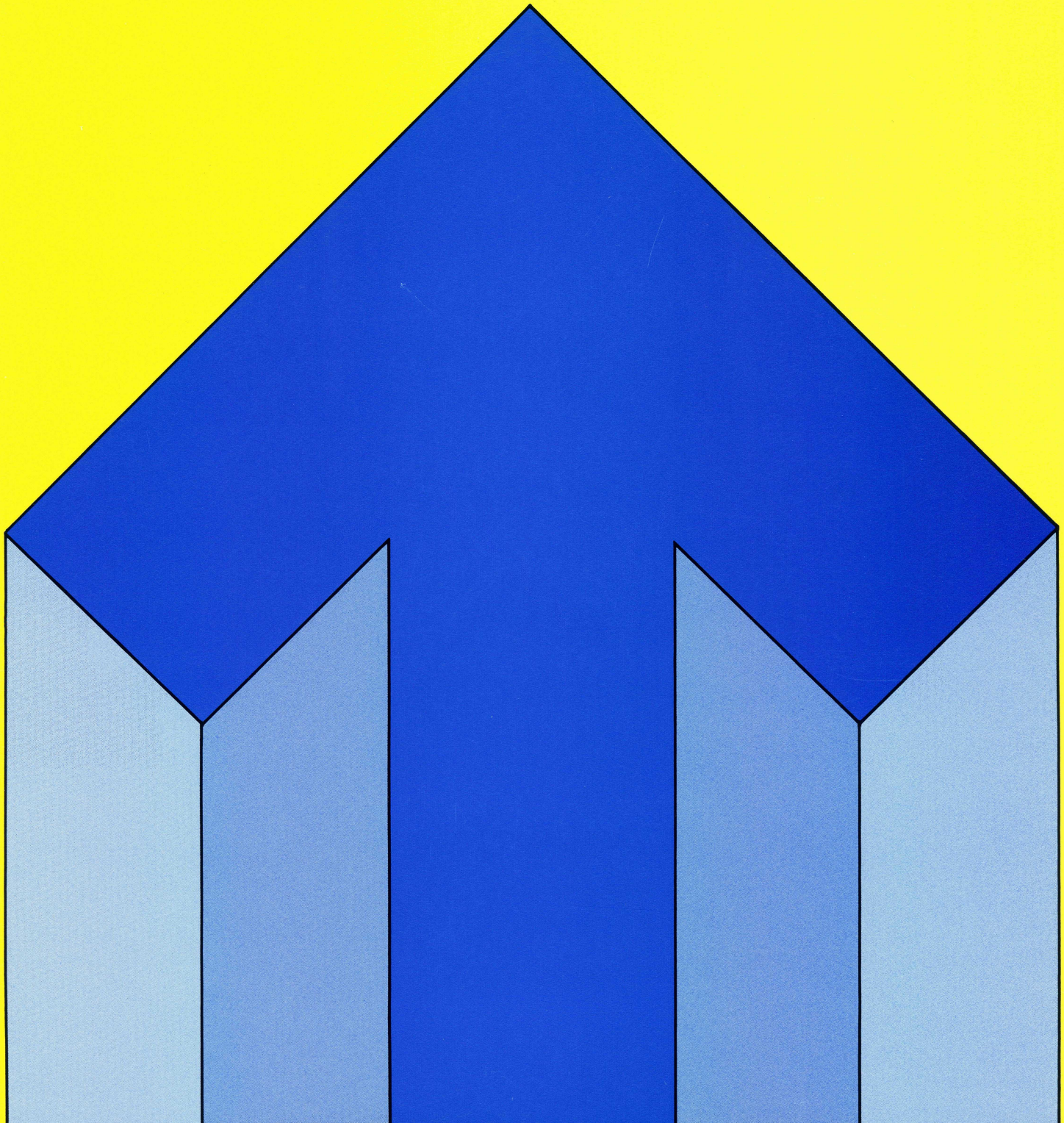
Bulletin No. 1

Ghosting



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.

Ghosting

Ghosting remains a problem throughout the printing industry. Ghosts having a mechanical origin – related to form layout, press capacities, plate or blanket difficulties – can usually be identified accurately and quickly and corrected by common sense remedies.

However, ghosts of a chemical origin – caused by interruptions and variations in ink drying cycles – are more troublesome. This is because their occurrence is erratic, making them hard both to prevent and to correct.

The exhibits and theories presented in this booklet that refer to chemical ghosting comprise the most workable and reliable information that we have been able to garner through research and practical experience. Although there may be varying opinions about the precise nature of why certain ghosts occur, these analyses and recommended remedies are based on practical experience and on deliberate efforts to create ghosts.

The accompanying printed demonstrations are not actual ghosts. In order to maintain uniformity, these prints were contrived to show the many different forms in which ghosts appear.

CONTENTS

This book is organized into three sections:

Section 1 provides background on press operations and ink chemistry that will be helpful in gaining a better understanding of what ghosts are and what causes them.

Section 2 illustrates a wide variety of ghosts, gives additional information on their causes, and suggests measures that have proved successful in correcting them.

Section 3 is a convenient, quick reference table that summarizes what is generally known about ghost types, causes, and correctives.

Ghosting

Section 1
Background

What Is a Ghost?

A ghost is an image – unplanned and unwanted – that is a result of the printing system itself. A ghost should not be confused with set-off or show-through.

The evolution of printing technology has increased the opportunities for ghosts to occur. Today's greater service demands, the "work-and-turn" format, and the development of quickset inks have all contributed to the problem.

Kinds of Ghosts

Basically there are two different kinds of ghosts. The first might be classified as a *mechanical ghost* and the second as a *chemical ghost.*

Mechanical Ghosts

These ghosts are usually discernible in a printed sheet as it falls into the delivery. They may be subdivided by cause.

Starvation Ghost

This ghost appears in large solids or dense halftones either as a light or a dark print of another part of the form. If part of the form contains block letters or other solids of a size to strip sufficient ink from the form rollers, and if this part is next to the solid and on the gripper side of it, the letters appear as a light-print ghost in the solid or halftones.

If, on the other hand, the block letters are reverses near the gripper edge of a large solid, they will print as dark ghosts in the solid because the reverse leaves excess ink on the form rollers. Thus, these ghosts repeat in the same inking channel, gradually fading out toward the tails of the form.

The basic cause of this ghost is the layout of the form combined with the overtaxing of the press's inking capability.

Blanket Ghost

This occurs in offset only and is the result of a previously used blanket having a swollen or a depressed image area caused by use on another job. If either of these areas falls within the halftone, screened tint, or solid parts of the form being printed, they will cause printing to appear different from the surrounding area – darker if the blanket is swollen and lighter if the blanket is depressed. Excessive impression causes the darker print and too little impression causes the lighter.

Plate Ghosts

There are two varieties of plate ghosts, both found in offset lithography. The first kind has nearly disappeared from the scene because it is caused by poor regraining of a previously used plate. The old image is not completely removed and begins to make an appearance on the new job, conflicting with the new form.

The second type of plate ghost occurs on multicolor presses where the form on one of the color units sensitizes the plate of the following color unit. Proper desensitizing of the affected plate and ink adjustments correct this situation.

Chemical Ghosts

These ghosts are related to the chemical activity of inks as they go through their normal drying phases. The appearance of chemical ghosts is normally unpredictable and more sporadic than that of mechanical ghosts, becoming evident only after printed sheets have been in the delivery pile for a period of time.

Chemical ghosts may appear as sharp or fuzzy reproductions of one side of a form, or one part of a form, in the solid area of another part. They may appear erratically – showing up in one printed area of a sheet but not in a similar or duplicate part.

They are usually in evidence as a dull ghost on a relatively glossy background or a glossy ghost on a somewhat duller background.

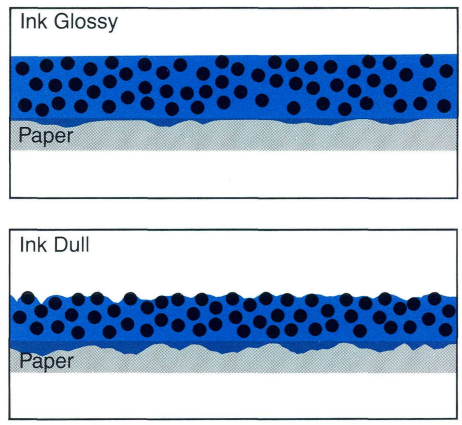
Causes of Gloss and Dullness

When an ink appears glossy, sufficient ink vehicle has filmed on the surface of the paper to provide a covering layer for pigment particles in the ink. When an ink appears dull, sufficient vehicle has been drained from the surface so that the irregularities of the individual pigment particles and paper surface are not covered with a vehicle film thick enough to create gloss. (Figure A)

If the intention is to provide a glossy result, then the ink vehicle must "level" sufficiently to overcome the irregularities of the paper's surface. On the other hand, to obtain a dull finish the ink vehicle must "set" at a rate that permits the dulling pigment to reach the film's surface.

Ghosts appear because of differentials in ink-drying times. These differentials cause ink films to level to various degrees of gloss. The different drying times are caused by localized influences within a delivery pile (from the printed sheet above) at critical stages in the drying cycle of the ink. The result is a ghost.

A: What Makes an Ink Glossy or Dull



Ink Drying Cycle

From the moment of impression, offset and letterpress inks go through two phases:

1. *Setting* – drainage and leveling of vehicle into the coating or fiber
2. *Oxidation* – polymerization of the vehicle into a solid mass

Older "conventional" ink vehicles were composed of resins with large reactive molecules dissolved in oils capable of oxidizing to hard films that adhere to the paper surface. These oils also have large, bulky molecules that, at best, drained slowly into the paper's coating. Because of slow drainage, an ink film could be subject to a number of adverse effects. Among them are:

1. *Offsetting* when a wet ink film transfers to the surface of the sheet next to it.
2. *Dull ink surfaces* from prolonged drainage.
3. *Slow drying* resulting in extended rehandling times.

To overcome the drawbacks of conventional vehicles, *quickset* vehicles came into the marketplace.

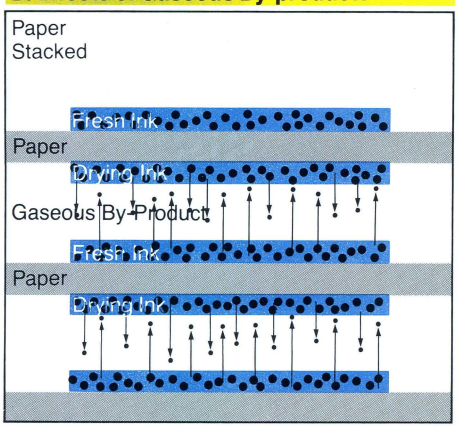
Quickset ink vehicles have evolved into solutions of two or more resins with relatively compact molecular dimensions and varying but limited solubility in petroleum-based oils. These oils have molecules much smaller than those of the drying oils used in conventional inks and are not chemically reactive.

The mechanism by which quickset vehicle inks set and dry involves two distinct phases. First, the petroleum oil drains rapidly into the paper coating, causing the ink to "gel" and become immobilized. Second, the resin proceeds to oxidize to a hard film, with these advantages:

1. Little to no surface tackiness which reduces the amount of set-off.
2. Enough vehicle surrounding the pigment particles to protect them from rubbing or offset in the pile.
3. More rapid rehandling without danger of marring the print.

Complete drying, however, still depends on oxidation and polymerization, which may require twenty-four to forty-eight hours for the ink to become smudge proof or abrasion resistant.

B: Effects of Gaseous By-products



The quickset ink films printed on the second side of a sheet can be exposed to the gaseous by-products from the oxidation of the first side if printed at a critical point in the first side inks' drying cycle. These gases affect the drying rate of the second side ink selectively (Figure B).

The result is a film which has been immobilized at two very different rates, and so has areas of high or low gloss, which reflect the image on the other side.

There is also the possibility that reaction by-products can either speed oxygen gathering or delay it to cause either glossy or dull ghosts.

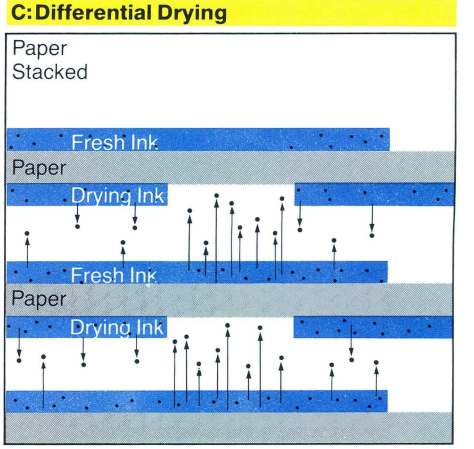
Variations

Varnish ghosts occur where ink coverage is very heavy or solid. They can be milky white and, unlike other chemical ghosts, become visible only after sheets have been overprinted with an off-line varnish.

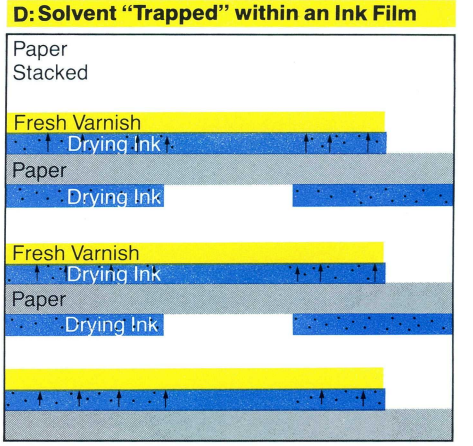
Such ghosts are characterized by countless "pinholes" in the varnish film, which individually are so small that they are visible only under extremely high magnification. The presence of pinholes suggests that these ghosts are caused by vapors from the overprinted ink film escaping through the immobilized, nearly dry varnish.

A possible source of these vapors is the solvent that drains from the ink into the paper coating. Solvent vapors can be sealed in by rapid setting of the ink's surface. But when an application of overprint varnish opens the seal (by rewetting the ink surface), these vapors are released. And as they break through the varnish film, they form the pinholes that give varnish ghosts their parcular appearance. (Figures C, D, E)

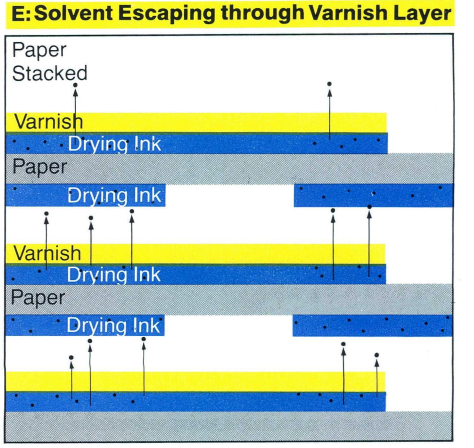
C: Differential Drying



D: Solvent "Trapped" within an Ink Film



E: Solvent Escaping through Varnish Layer



Crystallization ghosts (technically called Varnish Reticulation) result from a condition in which ink or varnish fails to "wet" a paper's surface. An analogy might be to rain not wetting the surface of a freshly waxed automobile.

The result is that a job has less gloss *after* varnishing than before. There are even times when gloss varnishes produce dull varnish effects.

Crystallization has two possible causes. The first is excess anti-offset spray, which makes an overprint varnish "crawl away" from the spray particles.

The second is ink formulated with a low-melt wax that was accidentally melted during the ink's manufacture. Instead of dispersing evenly as a particle throughout the ink, the melted wax forms small plate-like particles in the ink. These float to the printed ink film's surface and seal it. When the ink film then dries, the wax film at the surface is impervious to wetting by an overprint varnish.

In both of the above cases, varnish forms beads (like the rain drops mentioned). These beads scatter light to produce a dull rather than a gloss effect.

Discoloration ghosts. Some ghosts appear as yellowish stains on the unprinted reverse side of a sheet. Not always evident on a freshly printed job, they will often deepen in color over time. When such a ghost is difficult to see, its presence can be enhanced by viewing under ultraviolet light.

The effect of ink drying gases on UV brightness is not understood but has been observed. Often that effect occurs and can be observed with UV light yet there is no negative effect on any ink films which are subsequently printed.

Gold ink ghosts occur with inks containing bronze pigment and are caused by differential drying rates in a specific area. These ghosts appear when some parts of the film dry more slowly than others, allowing more of the bronze pigment to "leaf" or lie flat in those areas. Well leafed gold looks metallic and bright. When not well leafed, it looks tarnished.

Paper Effects on Ghosting?

Paper is not a causative factor in ghosting even though both mechanical ghosts and chemical ghosts appear more distinct on smooth-coated papers than on uncoated or fancy finish papers.

Just as a smooth-coated paper shows the detail of a print more sharply, it shows a ghost more clearly and reflects more distinctly the variations in gloss and dull areas of an ink film.

Uncoated papers do not show ghosting patterns so distinctly. Nevertheless, ghosting patterns – that are distinct enough to be objectionable – do appear on uncoated papers.

We have discounted the idea that chemical ghosts are caused by ink vehicles penetrating a sheet. Logically speaking, it would be impossible for ink to pass through a fibrous body like paper and reappear in a distinct halftone dot pattern on the reverse side. We have also seen, by splitting various papers and examining them under fluorescent light, that ink vehicles do not penetrate even to the center of a sheet of normal thickness and weight and, consequently, would not pass all the way through it.

The solution to ghosting relies not on paper selection, therefore. In the case of mechanical ghosting, it depends on form layout and press inking capacity; in the case of chemical ghosting, on timing or sequencing when running paper through a press. In other words, problems with ghosting can be significantly reduced by following what are generally agreed to be good pressroom practices, including winding, storage conditions, and size of lifts.

Ghosting

Section 2
Demonstrations

Simulated Diagrams

The accompanying demonstrations have been simulated to give the appearance of the many kinds of ghosts that are encountered in printing. Simulations rather than actual ghosts have been used because of the difficulty – particularly with chemical ghosts – of maintaining uniformity within a single publication.

Mechanical Ghosts

Figure One

This is a **light print ghost** – often called a **starvation ghost** – caused by the arrangement of the printing form and the limitations of inking on press. The small solids are just ahead of the large solid area on the form – that is, toward the gripper – and contact the form rollers on the press just prior to the heavy solid. They have removed more ink from the roller than the press can make up before these rollers come in contact with the solid. The solid, therefore, receives less ink in those areas and the small solids appear as a light print. Remedies for this difficulty lie in one or more of the following moves: turning the form to get these particular elements of the form out of the same inking channels; redesigning the form to eliminate the problem; putting the job on a larger press with more inking capacity; adding special rollers to the distributing system to better increase the press's ink capacity; in offset lithography, checking carefully to make sure that maximum ink strength and a minimum amount of water are being run to give the ink all the color strength it can provide.

Figure One

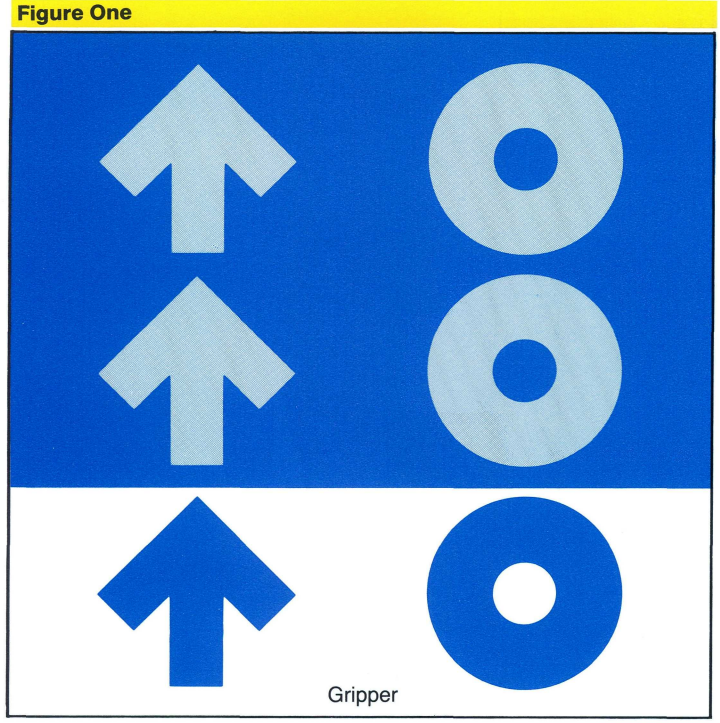


Figure Two

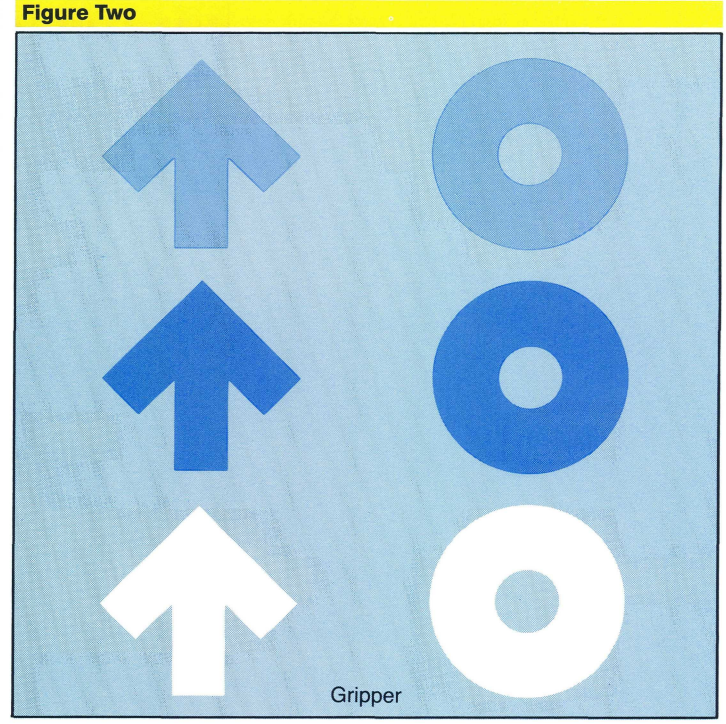


Figure Two

Here is a **dark print ghost** where reverse elements in the form immediately precede an area of heavy coverage – just the opposite result from that in Figure 1. Excess ink remains on the rollers in the reverses causing a dark print in the solid. Same remedy steps apply as in Figure 1.

Figure Three

This type of appearance – the block letters intruding into the printing as latent images – may be due to either a **plate ghost** or a **blanket ghost** and the cause can be readily detected by inspecting both the plate and blanket. The remedy is to make a new plate, or – in the case of the blanket – replace it.

Chemical Ghosts

Figure Four

This is the typical **unsharp dull ghost**. Note that the pattern of dullness radiates into the glossy circle from the back-up image, the arrow. The explanation for dullness – as compared to the surrounding ink film – is that the ink vehicle in the dull areas continued to penetrate the sheet. A possible reason the vehicle continued to penetrate is twofold: the gloss ink of the first side image demanded a large quantity of oxygen to dry hard or the rapid rate of oxidation of the gloss ink created heat while sheets were in close contact in the pile. As a result, the ink on the second side was robbed of some of the oxygen it required to dry hard, and the heat further softened the vehicle of the second-side ink so that it could flow more easily into the sheet.

Figure Five

A sharp, dull ghost. While the terminology sounds contradictory, it means a non-glossy ghost with a distinct outline. Heat generated in the pile by oxidation may cause softening and continued vehicle drainage in an ink film which is directly affected by the heat. The heat of oxidation is created by a drying ink film. If this reaction is occurring near the bottom of a skid of printed paper, the

Figure Three

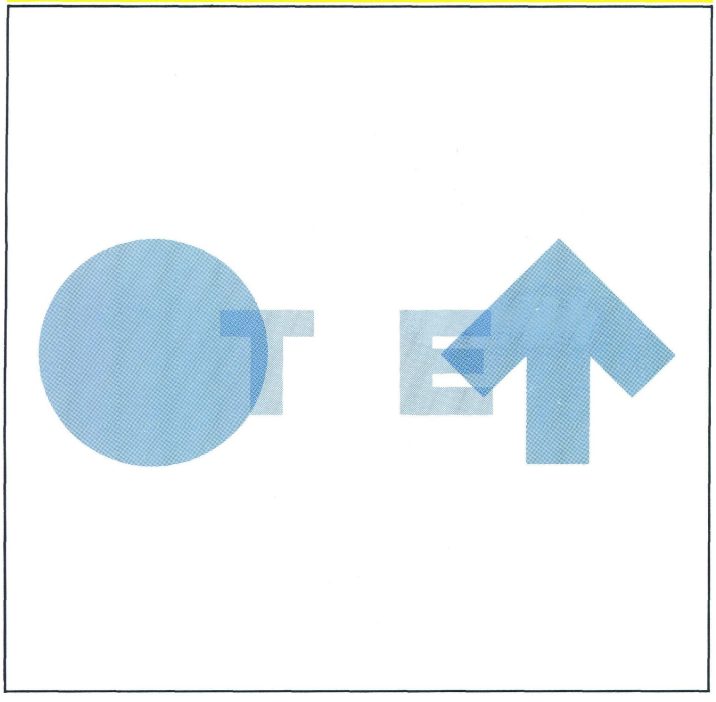
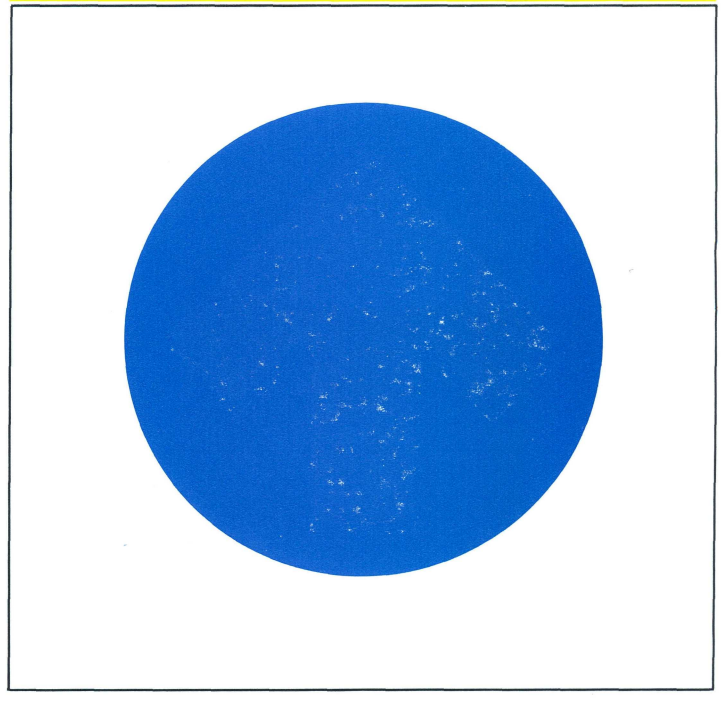


Figure Four



pressure of paper above will keep individual sheets in close contact. The result is that heat generated by the ink of areas as small as halftone dots or individual type characters – the arrow in our demonstration – cannot readily be diffused and may be directly absorbed by a facing ink film – usually the most recently printed side of the job. In this instance the circle is backing up the arrow.

Figure Six-A

Here is an instance the reverse of Figure 5. The ghost is sharp and glossy – sharp enough to show dot for dot and character for character with the backup form. Again the solid circle is backing up the arrow. This sort of ghost has prompted theorizing that the ink vehicle of the image has penetrated the paper. Both splitting the paper and examining with ultraviolet light and common sense rule out this possibility. No liquid could find its way through the coating materials of the paper surface, the fibers of the body stock and the coating materials of the other surface and reassemble itself with such precision.

The influence must occur directly on the surface of the paper; and the influence which causes the glossy, sharp ghost is probably a quickened drying of the second down ink. The quickened drying is caused by increased available oxygen in the form of oxidation products like peroxide or some similar gas. The peroxide or similar compound is given off by the first side at one particular stage in drying.

The second side must be at a critical stage of drying – while sufficient vehicle remains on the surface to cause gloss – for the peroxide to exert any influence; therefore, timing between the two inks is critical and occurrence of the ghosting will be spotty and of short duration.

Figure Six-B

Sometimes no ghost appears in a printed area until that area is overprinted with a solid. It then becomes apparent that the underlying ink has dried differentially because the overprinted solid dries showing an image.

As an example, a solid is printed on a cover (demonstration Figure 6b).

Figure Five

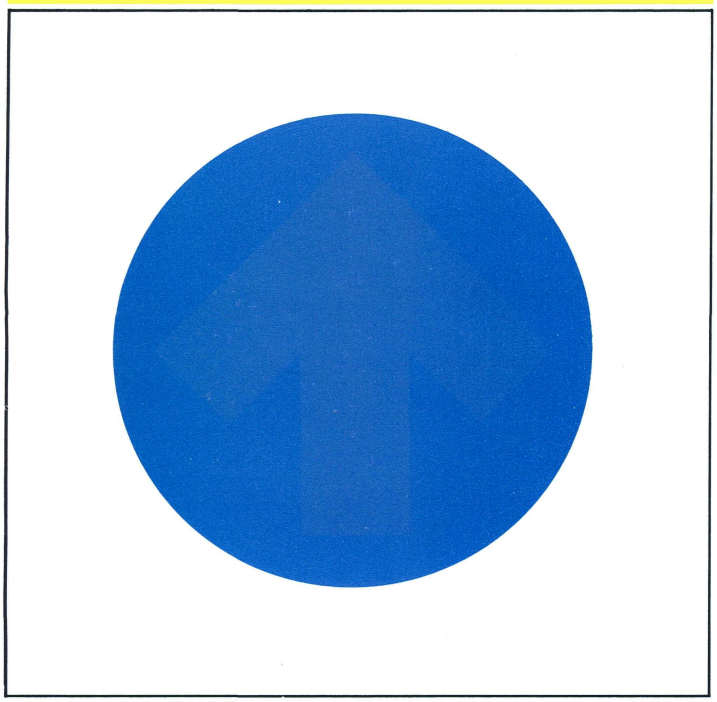
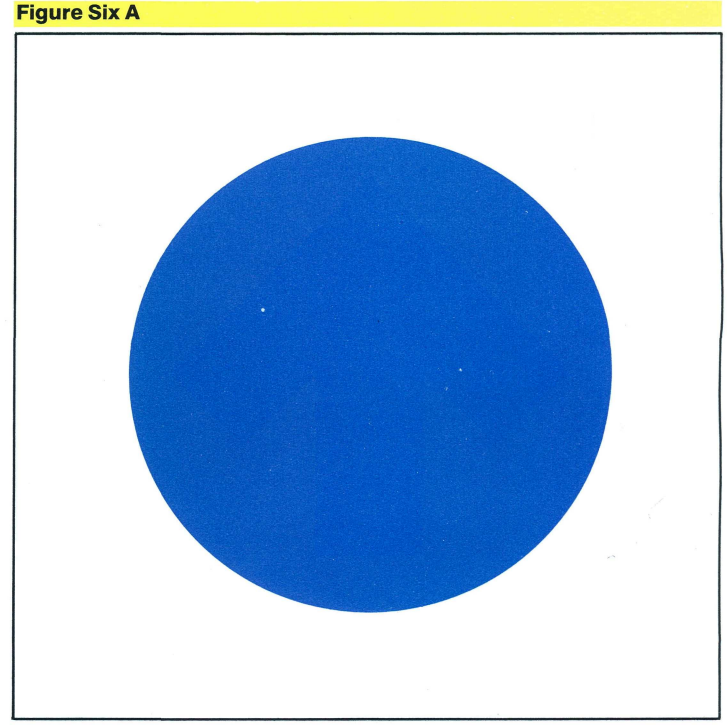


Figure Six A



Then the cover is backed up with another color printed as an arrow. Finally, the solid is overprinted with a second solid backup color – the circle. The overprinting solid dries showing a glossy ghost – arrow – of the back up or inside of the cover. When the first solid is rubbed before overprinting, most of the ink will rub away except for areas which duplicate the image on the backup side. Otherwise, when left undisturbed, it shows no ghosting.

The apparent explanation lies in the drying rate of the first ink being influenced by the image of the second down ink used for the back up. The influence was to speed the drying of the first down in the areas facing the backup image. The ghost was actually built into the first solid, but it did not show until it appeared in the overprinting solid.

To run through quickly again, Figure 6b illustrates the situation. The solid was printed first. The arrow was printed on the backup. The arrow caused speeded drying of the solid. When the circle solid was printed over the first solid, the drying differential in the first solid became noticeable as a differential drainage rate of the vehicle in the overprinting circle.

Figure Seven

Unsharp, glossy ghost. A glossy ghost can be created in an ink film by an increase in available oxygen. The ink film must be at the precise point in the drying cycle where increased oxidation would greatly speed the drying process. The shape of the ghost would be determined by the first down form – the arrow – coming in contact with the backup form. The balance of the second side form would have normal ink drainage to produce a duller effect.

An unsharp, glossy ghost, rather than a sharp one, Fig. 5, will tend to appear where contact between printed sheets is not close enough to prevent a slight diffusion of the gaseous compounds. Normally, then, this would occur in small lifts or near the top of a pile of printed paper. There would also be more opportunity for diffusion and, therefore, an unsharp ghost when using embossed, dull coated or uncoated papers. Such surfaces provide less overall contact between sheets.

Figure Six B

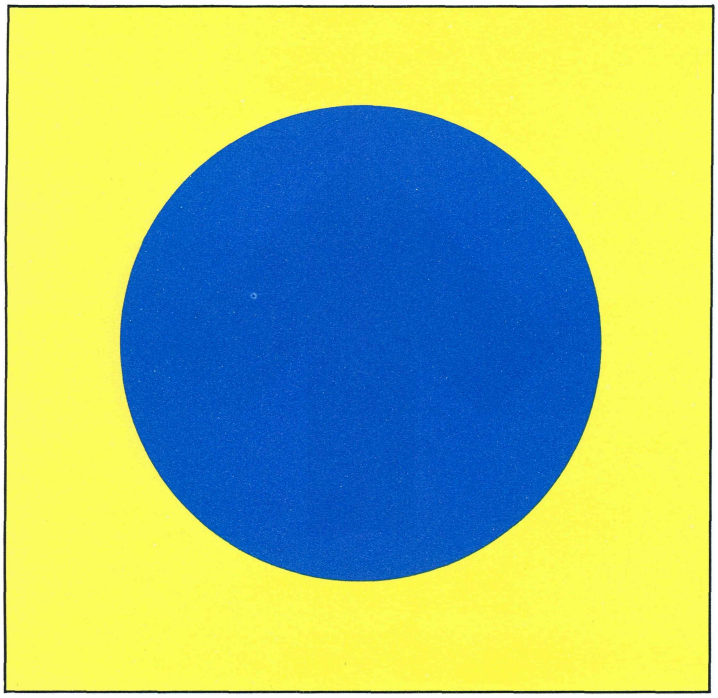


Figure Seven

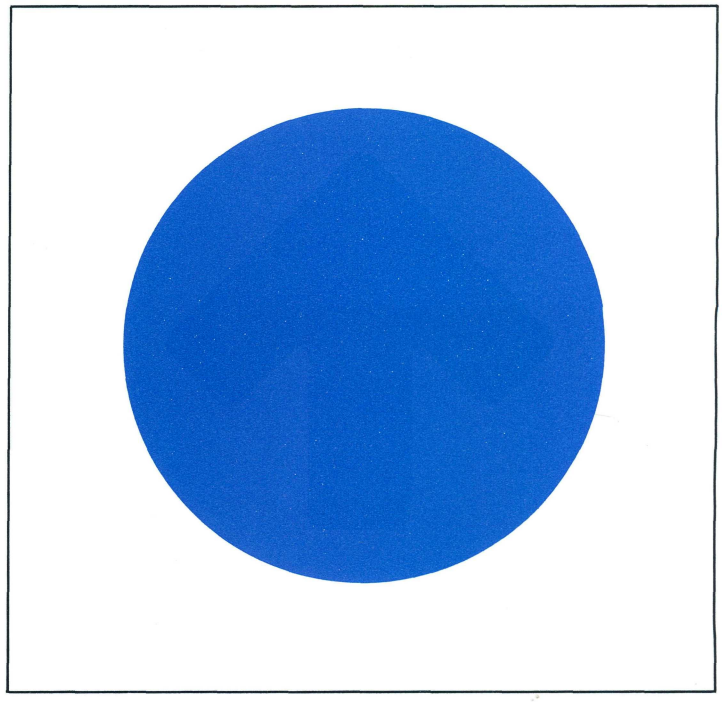


Figure Eight

Lateral glossy ghost. Here the drying of an ink film is affected in localized areas by a following color. Note that the arrow – the second color – is surrounded by a glossy outline of the first color. This is *not* a case of the second color overlapping a reverse in the first. In this instance, the arrow is keyed into a solid.

The glossy rim is caused by gases or oxidation products given off as the second ink dries. These gases hasten the drying cycle of the first ink wherever the two inks lie side by side. As a result, the glossy rim appears in the first color because of the speeded drying. The balance of the first color continues to drain into the paper at a normal rate to produce a relatively dull appearance.

Figure Nine

Streaky ghost. This kind of ghost occurs where drying conditions within the pile are not uniform. Heavy concentrations of spray may separate sheets in certain areas, trapping more air in the pile in those areas and thus permitting more rapid and thorough drying in those particular spots. The ghosts would be unsharp and glossy.

A skid may be standing with one edge next to a radiator or other source of heat, and the ink films subject to the heat may remain soft and continue to drain, whereas ink in the balance of the pile dries normally. A general, large, diffuse area of dullness would result.

A pile of press sheets standing next to a cold wall might evidence a reverse pattern, which would appear the same to casual observation – that is, large areas on the end or side of the paper that were duller than other areas. In this instance, however, the cold wall absorbed, from those parts of the pile next to it, much of the heat generated in oxidation so that the ink film set up faster and harder and showed glossier than the balance of the printed area. Consequently, the duller image appears in those areas not affected by the cold wall – the glossier appears in the cooled areas.

Paper that is baggy or loose in areas near the top of a delivery pile could conceivably entrap air that would hasten ink drying. The important point

Figure Eight

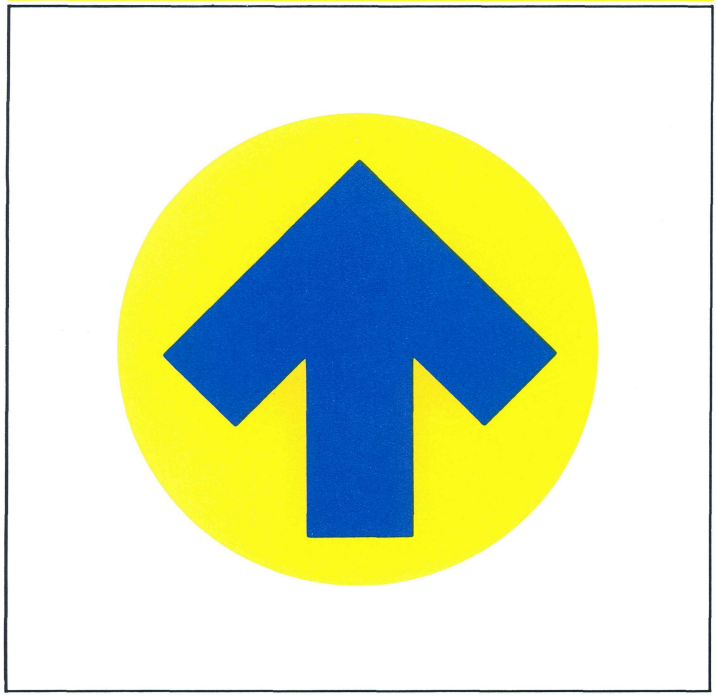
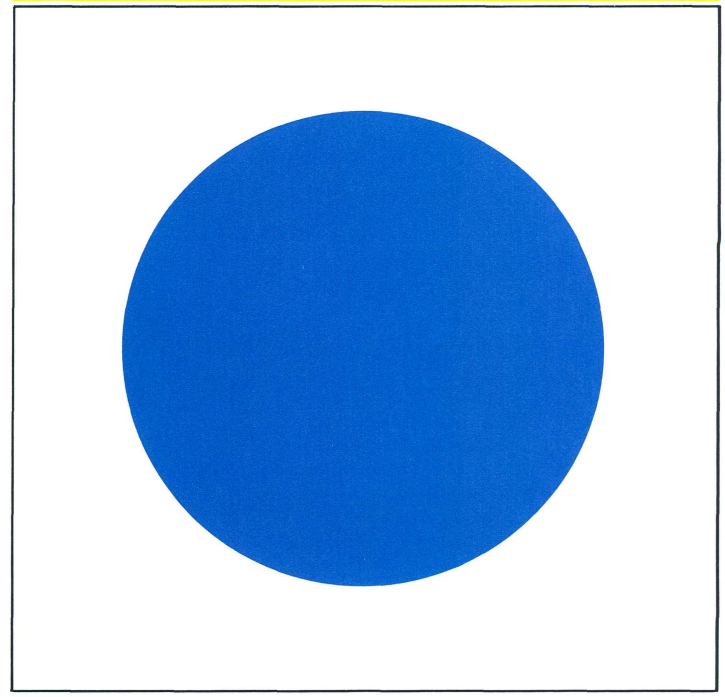


Figure Nine



is that these streaky ghosts will not occur consistently. The influences which contribute to this kind of ghosting can only create a ghost at critical times in the ink-drying cycle. All the factors have to coincide. That is why most ghosting patterns of a chemical or ink-drying cause are so erratic – they are caused by coincidences. They are not uniform in the pile.

Precautions can be taken so that the coincidences are minimized. Removing just one of the factors – using a minimum of spray so there is less build up, storing freshly printed paper away from outside walls and heat inlets – also removes the possibility of coincidence.

Figure Ten

Colony drying or "smallpox." The spotty appearance of drying in this manner is interesting because the patterns on the same sheets will change. There may appear tiny little pinpoints of ink that dry harder than the surrounding area. These can be discovered by rubbing the ink film, and they might show up when overprinted.

Hours or even days later, in some instances, the spots will have enlarged greatly to form hard-dry areas which eventually make contact with each other. Obviously this type of drying is noticed only with slow-drying ink films.

The cause of colony drying has not been determined. One tentative theory points to undispersed concentrations of drier in the ink, but this is theory only and points to no positive pressroom remedies.

Figure Eleven

Gold ink tarnish. A prime offender in tarnishing gold is sulfur in any reactive form. This particular form of ghosting on facing pages is covered earlier in the book.

Acid fountain solutions used in offset can cause overall tarnishing. Also streaky tarnishing may be caused by unbalanced distribution of fountain solution.

Figure Ten

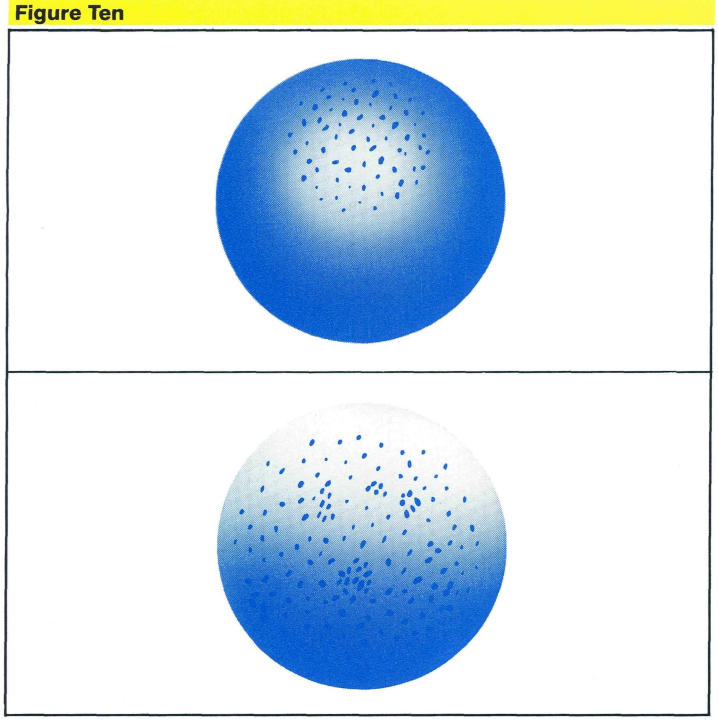


Figure Eleven

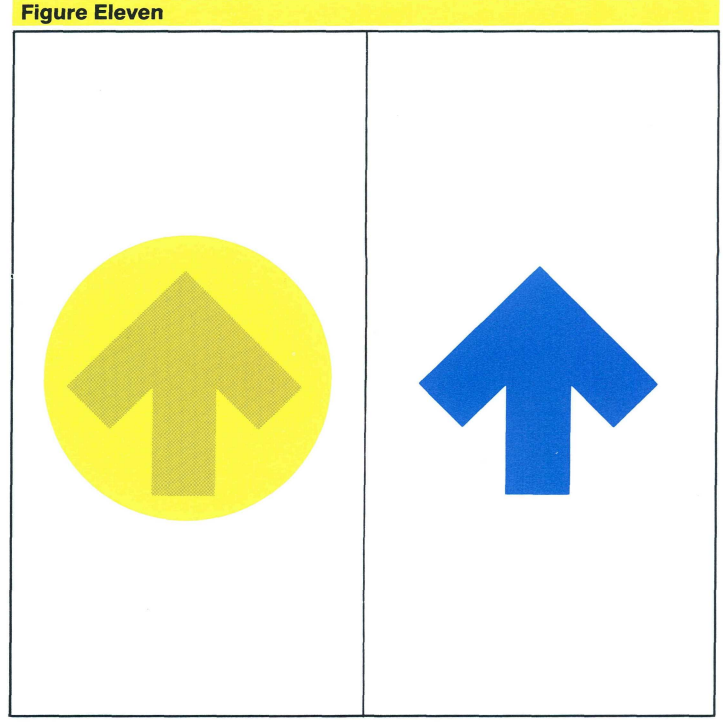


Figure Twelve

Reverse side stain. The cause of staining is associated with volatile oils given off in the ink-drying cycle as sheets dry in a pile. The volume of ink is an important factor. Dull inks and gold inks have been bad offenders for the reason that light or thin vehicle is needed for rapid penetration into paper, yet a relatively large volume of vehicle is required to carry the heavy coarse pigments involved in these two kinds of ink.

Reverse-side stains are present in almost all printed jobs, but they are not pronounced enough to show. They are easily detected with ultraviolet light. During work on this project no evidence has been found that these stains interfere with overprinting inks.

Figure Thirteen

Sublimation and bleed ghosts. These are rare phenomena. Occasionally heat or moisture conditions will be such that certain ink colors will bleed from a printed film to the facing paper or printing image. Sublimation is a turning from solid to gaseous state without going through a liquid phase. An every day example is dry ice which does not melt but evaporates.

The fumes of an ink pigment that sublimes can carry the color to a facing paper or print. However, the instances are extremely rare. Pigments that will sublime are few and rarely used in inks. Some pigments that may bleed when affected by moisture are occasionally used in printing, but are—needless to say—not found in inks for offset lithography.

Figure Fourteen

Varnish ghosts. These milky white varnish ghosts occur on jobs that are varnished off-line, with images occurring on both sides of the sheet. Inks overprinted with varnish retain more of their solvents in areas which (in the pile) face the ink films on the opposite side of the sheet. After varnish has been applied and before it has hardened, the ink solvent vapors escape through it, leaving behind vent holes which the immobilized varnish is unable to fill.

The best preventative measure against varnish ghosts is in-line varnishing. The most successful corrective is to apply an additional

Figure Twelve

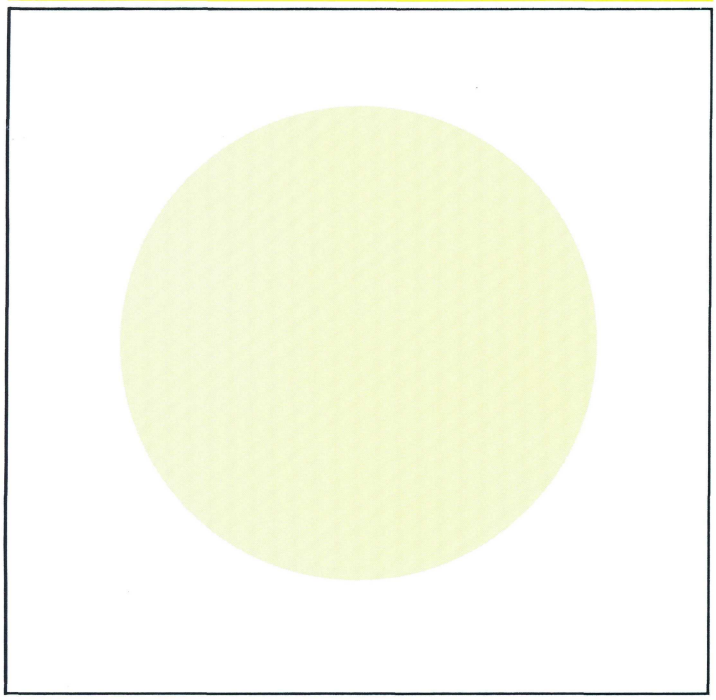
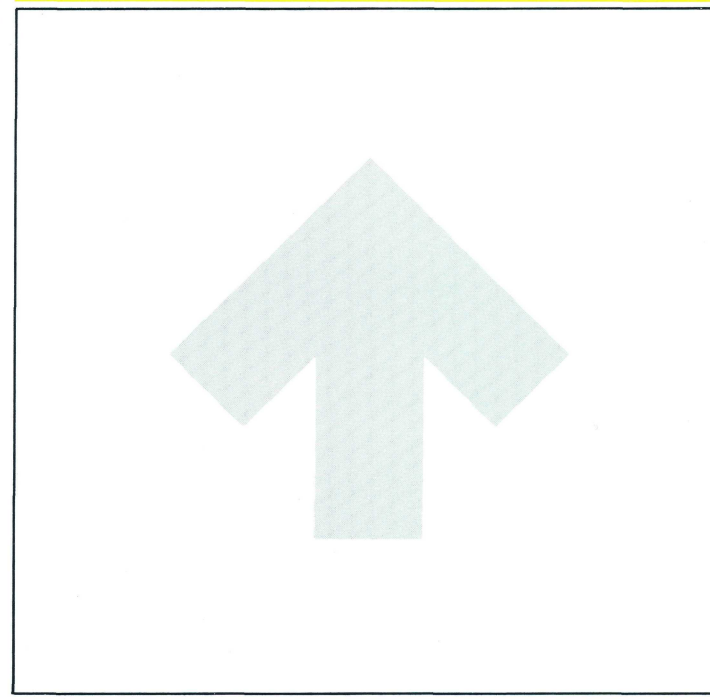


Figure Thirteen



layer of varnish, which gives a uniform gloss (or dull) level. Also if a ghost is discovered before the entire job is run, the remaining sheets can be blanked through a press equipped with an infrared heater. This will accelerate the oxidation rate, releasing the trapped gases.

Figure Fifteen

Crystallization. When a print has less gloss after varnishing than before, or when a gloss varnish produces dull varnish effects, the problem is crystallization.

In a crystallized state, varnish beads up and scatters light instead of reflecting it. Examined under magnification, crystallized varnish appears to be "crawling" on the ink surface.

There are two causes for this condition: excess anti-offset spray and ink that has accidentally been overheated during manufacture. In the first case, the spray repels varnish; in the second, the wax seals the ink surface, making it impervious to wetting by the varnish.

The best prevention for crystallization is to avoid excess anti-offset spray. When overheated wax is the suspected cause of the problem, a printer should immediately contact the ink supplier. The two most frequently used correctives are heat (to break up the wax plates) or a solution of beeswax dissolved in Butyl Carbitol Acetate (BCA) added to the varnish. When mixed with varnish, the beeswax/BCA will soften the wax platelets, allowing the beeswax to penetrate the dry ink film and form a bond.

Figure Fourteen

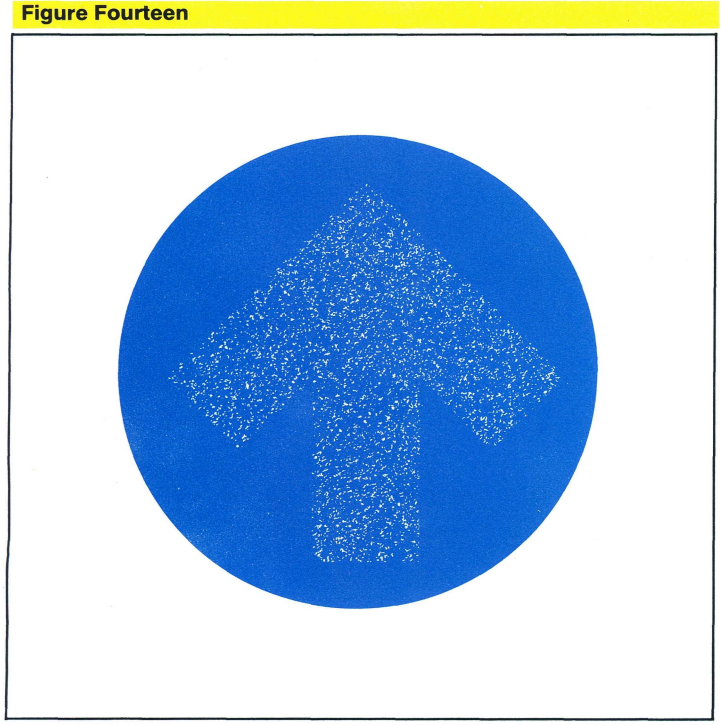
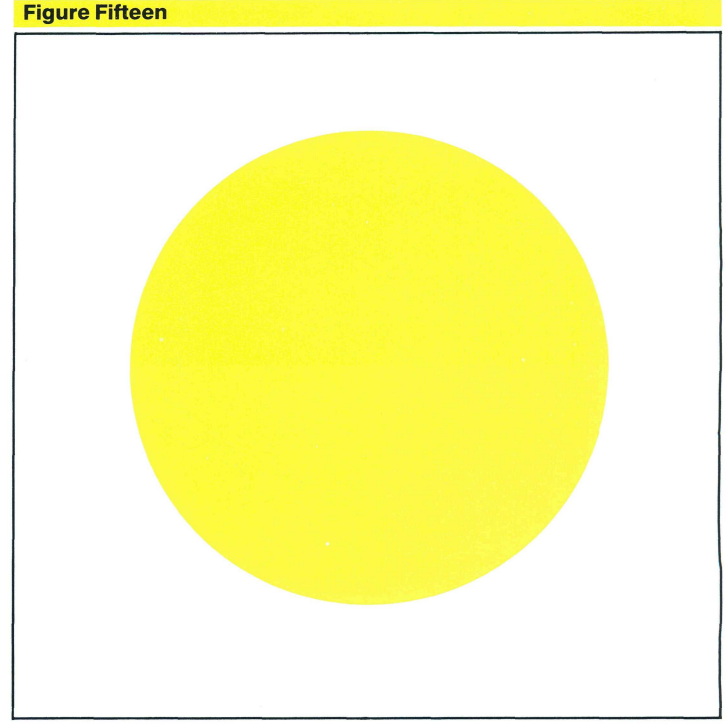


Figure Fifteen



Ghosting

Section 3
Quick Reference Table

Eliminating dull or glossy ghosts can often be accomplished by running another impression of ink or press varnish after the offending areas have dried. Two or more impressions may even be required.

Identity	Cause	Correction
starvation or light print ghost, dark print ghost	selective starving or flooding of form due to inadequate ink distribution or badly laid out form	If inking capacity can be increased, more demanding forms may be used. If not, form layout should be changed so that one part will not rob another in the same inking channels.
blanket ghost	high and low spots in blanket from previous forms	Change blanket. Proper conditioning and rest may correct offending blanket.
plate ghost	a. improperly removed image from old plate	a. Remove plate. Have regrained.
	b. improper desensitizing	b. Remove plate—or properly desensitize offender. Found on multicolor presses only.
chemical or ink-drying ghosts	interaction between drying ink films	Keep loads in proper sequence for backup and printing for successive colors. Maintain well-aired lifts in delivery. Keep loads away from uneven conditions of heat and cold (radiators, hot air outlets, walls, etc.). If ghosting occurs, overprint with varnish or appropriate color of ink after inks are thoroughly dry.
sublimation or bleeding ghosts	combination of heat or moisture and critical materials	Nothing can be done to salvage results that are objectionable. Change inks to different pigment base before re-running.
varnish ghosts	trapped gases breaking through varnish film	Run additional impression of varnish Apply varnish in-line whenever possible Blank the sheets through a press equipped with infrared heater Wind sheets
crystallization	excess anti-offset powder or ink with melted wax	Reduce amount of powder used Change ink for rerun Use heat or beeswax dissolved in BCA

Summary

Chemical or ink-drying ghosts can be analyzed on the basis of two principles:

1. Ink can be softened by heat at critical points in its drying, and the softening can be sufficient so that more vehicle flows down into the paper.
2. Gaseous oxidation products given off in the ink-drying cycle of one ink may act as a catalyst in the drying cycle of another causing a speed-up of oxidation into an immobile film.

The increased frequency of chemical or ink-drying ghosts is associated with the newer quick-set inks designed to produce quick drying and good gloss. The volatile components of the carrier vehicles trigger a relatively sudden state of "handling-dry" ink setting. The older linseed oil inks drained slowly and gradually without the "critical area" time in their drying cycle that the quick-sets and gloss inks tend to create.

Although heavy coverage forms and the amount of color work done by offset lithography today may create the impression that most chemical ghosting is found in that process, letterpress inks of this variety can cause it also. In fact, the heavier ink films used in letterpress tend to create more extreme examples of ghosting.

In reaching for high-gloss results by either process, it is well to remember that heat will be generated in the oxidation cycle – a burning flame is an example of rapid oxidation – and this heat can be defeating in two directions:

1. It can cause ghosting if other inks are at a critical point in their drying.
2. It can work against attaining gloss because the heat build-up affects the film of ink that is the cause of it – as well as other inks already printed.

The precautions which are helpful are:

1. Run small lifts.
2. Keep them well aired through winding.
3. Keep them in strict sequence for backup.
4. Keep them away from sources of heat or cold.

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	Zellerbach

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Columbus	Sloan Paper Co.
Macon	Dillard Paper Co.
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Saginaw	Copco Papers/Dudley Division

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Reno	Zellerbach

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Trenton	Central Paper Co.

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Printed in U.S.A. on
LUSTRO GLOSS COVER 100 lb.
and LUSTRO GLOSS 80 lb.

S.D. Warren Company,
A Subsidiary of Scott Paper Company
Boston, Massachusetts 02110