A WORKING GUIDE FOR SCREEN PRINTING GRAPHIC CONTROL PROCESSES

A Thesis
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Master of Arts Degree

Appalachian State University
Boone, North Carolina

by

John R. Craft, Jr.

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Approved by

Chairman of the Thesis Committee

Professor of Industrial Education and Technology

Professor of Industrial Education and Technology

Chairman of the Industrial Education and Technology Department

Dean of the Graduate School

ABSTRACT

CRAFT, JOHN RUFUS. A Working Guide For Screen Printing Graphic Control Processes. (Under the direction of Dr. Carl Moeller and Dr. Robert A Banzhaf).

This working guide is a technical manual explaining the facility, equipment, materials, and procedures needed to screen print the graphic control processes. Through this process, black and white photographs may be converted into non-silver color reproductions. To determine if there is a need for curriculum for the graphic control processes, a survey was sent to Graphic Arts Instructors throughout North Carolina. Graphs were used to illustrate the findings of the survey. It was through the use of the survey that support was given to this study.

The graphic control processes reviewed in this study are the continuous tone effect (enlarged grain, step approach process, texture screen, controlled reticulation, and halftone process), posterization, solarization (Sabattier Effect), bas-relief, and tone-line reproduction. Examples of the graphic control processes included in this study are results of experimentation with photographic screen printing using equipment commonly found in the graphic arts laboratory. Equipment such as a process camera, darkroom enlarger, and platemaker may be used to create the various effects of the graphic control processes from a black and white photograph.

It is through working with the graphic control processes that students may achieve an understanding of photographic screen printing.

Therefore, this guide is intended for use by Industrial Education Instructors teaching Graphic Arts. This guide may prove useful to commercial design students seeking to expand their creative capabilities as well as for graphic arts students seeking to expand their skills of photographic screen printing.

ACKNOWLEDGEMENTS

I would like to express my sincere appreciation to those who made contributions to this thesis. For his guidance, I am indebted to Dr. Carl Moeller, who helped edit and organize this thesis. I am especially indebted to Dr. Robert A. Banzhaf for allowing me to use the graphic arts laboratory facility at Appalachian State University. Dr. Banzhaf provided counsel and support during my experiments with screen printing the graphic control process. I am deeply grateful to Mr. Dan Yount for sharing his time and providing me with additional guidance. I am also grateful to Mr. Frank Steckel and Dr. William Graham for their patience and understanding.

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SCREEN PRINTING GRAPHIC CONTROL PROCESSES

Introduction

This study has evolved from an apparent need for in-depth understanding of screen printed photographic control processes within courses included in industrial education programs. The popularity of screen printing and photography among students today appears to stem from current developments in the technology of photographic screen printed processes, materials, and equipment. Some recent developments are: improved photo stencils, printing inks, photographic film, screen printing fabrics, processing equipment, and chemicals. These developments indicate the need for a study in the use of these materials and processes for photographic screen printing in the classroom. It is expected that the results of a study on the usability of these processes in the classroom can be translated into educational experiences for students who want to be current with graphic arts technology. The objective of this study is the development of a guide for the presentation of screen printing graphic control processes for classroom instruction. The effectiveness of this proposed guide depends upon the development of descriptive procedures coupled with practical examples. This "working guide" should acquaint instructors and students alike with terminology and skills that should encourage and stimulate students seeking to try these advanced techniques.

Statement of the Problem

It has not been possible to find or discover any "working guide," with information about photographic screen printing graphic control processes, which can easily be utilized by graphic instructors. In this thesis, the author will present such a "working guide" to aid instructors seeking to expand the options for student skill development in the area of photographic screen printing.

Justification of the Study

Course content should be periodically evaluated in order to revise subject matter, because the course content must be "relevant to the needs and objectives of the students within their own culture."[1] It must also be compatible with the needs of the instructors, as well as those of the student.

Screen printing produces a practical form of duplication. This type of printing saves time and energy in preparing hand drawn art work necessary to meet deadlines in the printing industry. This study about graphic control processes describes usability of an alternative design potential for graphics students seeking to create art work photomechanically from the combination of two distinct mediums: photography and screen printing. Photographic control processes such as posterization, tone-line reproduction, bas-relief, and other effects (mentioned throughout this experimental research) should generate appeal for the student's acquisition and mastery of the photographic screen printing skills.

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[1]Robert A. Banzhaf, "Technology of Graphics Arts," (unpublished Doctoral dissertation, North Carolina State University, 1972), p. 1.

Increased motivation from students should result in a desire to explore and experiment with each of these photographic control processes.

Objectives of Study

The major objective of this study is the development of an educational program that provides for the acquisition, establishment, revision, and expansion of an existing curriculum.[2] This thesis contains information to support a proposed program of instruction in graphic control processes. To be consistent with the current developments in photography and screen printing curricula, objectives should include:

1. The development of instructional techniques for screen printing and its derived photographic effects;

2. The provision for a resource guide that will enable instructors of photography and screen printing to better meet the needs of students at all levels;

3. The emphasis on practice, as well as theory, so that learning is based on actual experience;

4. The encouragement of the exploration of various photographic processes for use in screen printing;

5. The development of the skills of students involved with graphic arts so that they will more readily perceive the practical application of photographic screen printing;

6. The correlation of the graphic arts curriculum with both photographic and screen printing processes so it may be used by educators instructing graphics.

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[2]Robert A. Banzhaf, p. 1.

Limitations of the Study

Since photography and screen printing are vast areas of graphic communications, the following limitations define the study.

1. Belk Library resources, Appalachian State University.

2. Reference books from "Signs of the Times," of Cincinnati, Ohio. (See bibliography.)

3. Survey of instructors from North Carolina schools and colleges whose names are obtained from Printing Industries of the Carolinas (PICA).

4. Experiments with graphic control processes for screen printing: bas-relief, posterizations, continuous tone and halftone reproductions, reticulation, textured screens, solarization, Sabattier effect, tone-line reproduction, along with other processes defined in this study.

Definition of Terms

The following terms are important to this study.

Industrial Education. A generic term used in referring to industrial training, vocational-industrial education, industrial arts, technical education, apprenticeship, and the offerings of private trade schools. It is concerned with all education which has been adapted to meet the needs of industrial technology, and to interpret industry.[3]

Graphic Arts. A discipline within industrial education in which the study of processes relating to the printing industry are explored through practical experience. Areas in instruction in the Graphic Arts program

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[3] George Harold Silvius, Estell Curry, Managing Activities in Industrial Education, 2nd ed., (Bloomington, Illinois: McKnight and McKnight, 1971), p. 592.

include photography, graphic design, screen printing, relief printing, gravure printing, offset lithography, and bindery operations.

Screen Printing. A major printing process in which cloth fabric is stretched over a frame. A stencil is either cut by hand, or produced photographically and attached to the cloth fabric. Ink is placed inside the frame, and then forced through the open areas of the stencil by pressure from a squeegee to create an image on a printing substrate (paper, wood, metal, glass, plastic).

Graphic Control Processes. The graphic control processes such as posterization, solarization (and Sabattier effect), bas-relief, tone-line reproduction, continuous tone effect (reticualtion, halftones, textured screens, and other images created photomechanically for visual effect).[4]

Posterization. A line conversion process applied toward dividing the smooth continuous tone photographic image into two or more distinct patterns (or shades) of solid tone. The shades of solid tone can be easily screen printed, giving the appearance of a design that has a layered or poster-like quality.

Bas-Relief. An image that is bold and three-dimensional in appearance when produced photomechanically, giving the illusion of an image with a sculptured or wood-cut effect.

Sabattier Effect. The re-exposure of film during the development process.

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[4] Andreas Feininger, The Complete Photographer, (London: Prentice-Hall International, Inc., 1965), p. 320.

The final result appears as a compromise between a positive and a negative that is separated by thin white lines, known as Mackie lines.

Solarization. Similar in appearance to Sabattier Effect, except the effect is created with a camera. The film in the camera is subjected to an exposure 1000 times more than normal, thus solarizing the image.

Continuous Tone. A photographic image with a range of tones from light to dark displaying no visible boundaries.

Tone-Line Reproduction. The result of an image having the appearance of a pen and ink drawing, originating from a continuous tone photograph.

Halftone. The conversion of continuous tone copy into a series of dots creating the illusion of continuous tone which is necessary when printing reproductions of photographs and art work for publication.

Textured Screen. A commercially or handmade screen used like a halftone screen. It is made by converting the image into a series of artificial textures with the aid of a commerically made screen, or one manufactured by the processor. The screen effects include mezzotints, concentric circles, steeletched engraving, and any that may be created on clear mylar.

Reticulation. Crinkling and cracking of the film's emulsion caused by extreme temperature changes during the wash stage of the developing process. The effect when used for controlled purposes resembles the mezzotint image.

Chapter II

STUDY DESIGN

This paper began with research and development in the production of photographic screen prints of graphic control processes. The foundation of this endeavor was to generate skill improvement in the handling of materials and equipment as well as the understanding of the processes. After establishing results from experiments with the graphic control processes, the next step was to propose and seek approval for a study of the processes to be used as a supplement to the fundamental programs in screen printing and photography. Additional support was obtained by use of a survey. Questions used in the survey attempted to identify the need for such a guide to photographic screen printing of graphic control processes. Since the research and experiments were conducted at Appalachian State University, solicitation for input into the survey was based on the availability and location of graphic arts instructors. The instructors chosen to participate were those who are professional educators in the field of graphics who teach in North Carolina. The range of respondants represented levels of education from junior high school through university, their names having been obtained from a roster of members of the Printing Industries of the Carolinas (PICA). PICA is a graphic arts organization composed of members in education and industry. Activities of this organization include seminars for updating graphic arts educators on current trends in the printing industries development of a self study program on graphic arts, and other functions too numerous to mention.

The survey was mailed to the graphic arts instructors listed on the roster provided by PICA. A cover letter that accompanied the survey explained the purpose: to determine if a need existed for a study of screen printing graphic control processes for students seeking advanced instruction. A copy of the cover letter is included in appendix A.

The Survey

The questions presented in the survey were developed by the author of this paper during the beginning of this study. Some of the questions were designed to identify the types of courses currently offered and to determine the need for an additional instructional program in photographic screen printing. The other questions in the survey were used to determine whether or not the graphic control processes could be taught to students in order to satisfy requirements for the instruction of photographic screen printing. A copy of the questionnaire is included in appendix B.

The closed form type of questionnaire was used for this survey since the responses were short and restricted.[5] The first survey sent to graphic instructors in May, 1976, was replicated in November, 1980, in order to obtain more accurate and up-to-date data. The second survey was designed as a short item questionnaire and was useful in determining a need for a curriculum guide for the graphic control processes. The

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[5]John W. Best, Research in Education, (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1970), p. 163.

questionnaire generally attempted to identify the respondant's course offerings and whether or not they were interested in the proposed curriculum guide. It was not the intent of these questions to reveal weak areas in the program surveyed, but to provide and familiarize the author with information concerning the course offerings at other institutions in North Carolina. An interpretation of the answers could be used to support this thesis.

Results of the Survey

The survey played an important part in gathering information appropriate for the approval and support of this study. The questionnaire was designed to be as short as possible in order to permit ease in interpreting the results. Graphs illustrating the tabulated results are included in Figures 1, 2, 3, 4, 5, and 6. A majority of instructors polled indicated the need for a curriculum guide for photographic screen printing.

Space was permitted in the survey for instructors to comment on the proposed course of study. One instructor suggested the possibilities of an in-service program for demonstrating the graphic control processes.[6] Another instructor expressed an interest in teaching the photographic screen printing of graphic control processes as an expansion of design capabilities.[7] The last comment supported the belief of the author that the use of graphic control processes would provide strong motivational factors and encourage creativity in design.

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[6]John Johnson, Survey Respondant (first survey), Wilkes Vocational Center, Wilkesboro, North Carolina.

[7]Henry Harsch, Survey Respondant (second survey), Randolph Technical Institute, Asheboro, North Carolina.

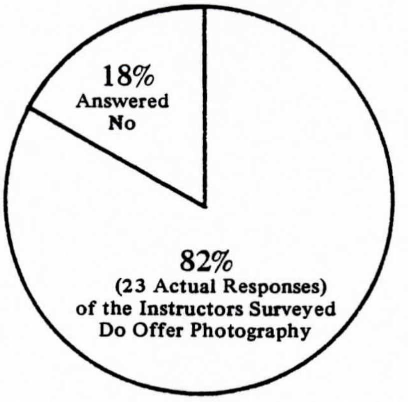

Figure 1. Circle Graph of Survey Question One Indicating the Percentage of Instructors Offering Photography as Part of Their Graphics Arts Curriculum.

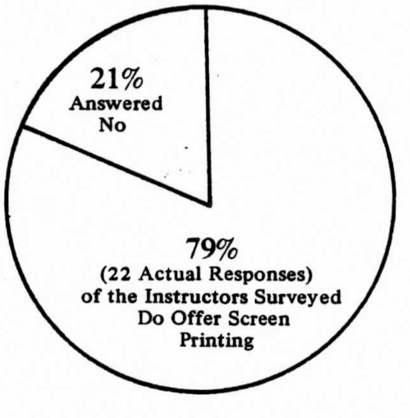

Figure 2. Results of Survey Question Two Indicating the Percentage of Instructors Offering Screen Printing as Part of Their Curriculum.

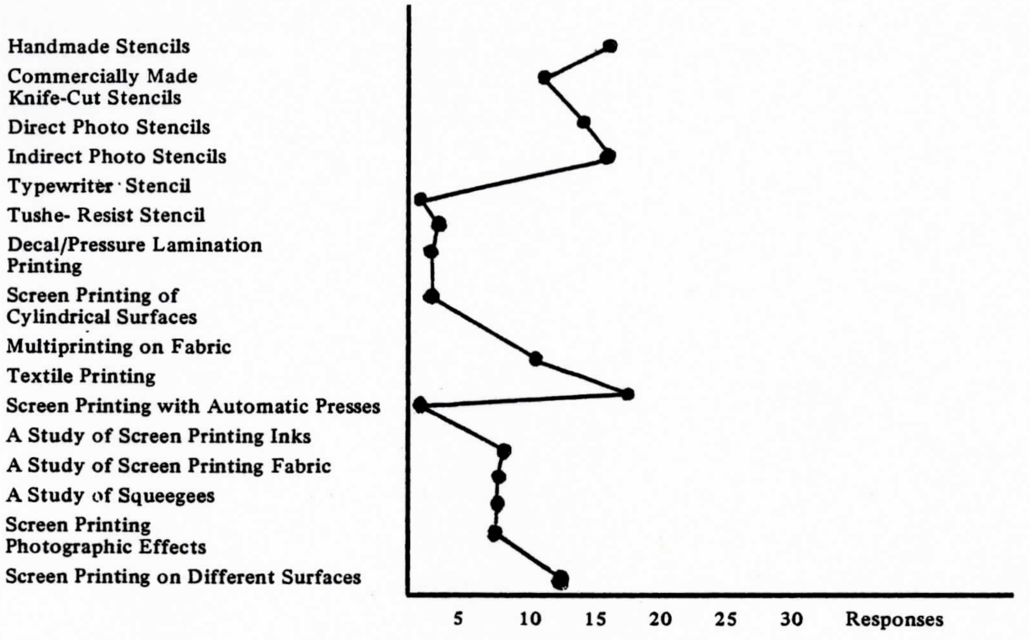

Figure 3. Line Graph of Survey Question Three: Types of Screen Printing Processes Studies Among Students of the Instructors Surveyed.

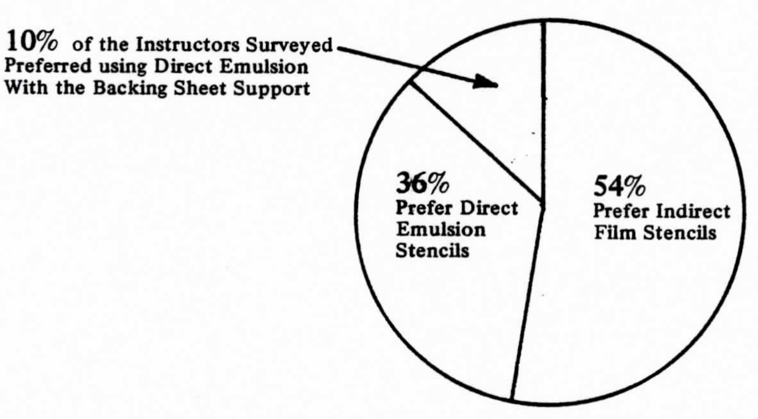

Figure 4. Circle Graph of Survey Question Four: Types of Photo Stencils Preferred by Instructors Answering Survey.

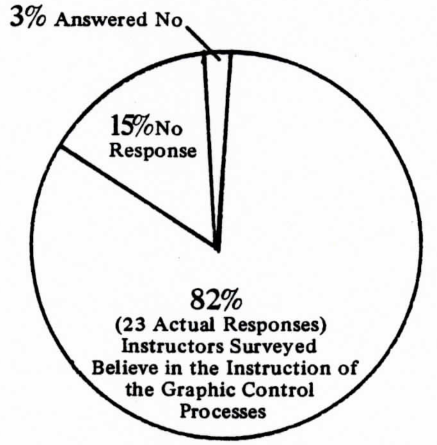

Figure 5. Results of Survey Question Five Indicating the Possibility of the Graphic Control Processes as Source for Meeting Course Objectives for the Instruction of Photographic Screen Printing.

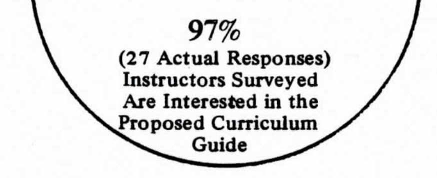

Figure 6. Results of Survey Question Six Indicating the Percentage of Instructors Interested in a Curriculum Guide on Graphic Control Processes.

Chapter III

FACILITY, EQUIPMENT, AND MATERIALS REQUIRED

This chapter will establish practical guidelines for developing a facility for screen printing graphic control processes. These guidelines are not to be interpreted as standards, but as aids to ensure successful planning of a proposed curriculum for instructors seeking to expand their programs. The proposed programs of screen printing graphic control processes can be applied to most graphic arts laboratories equipped with a darkroom. Graphic arts laboratories without darkrooms can be accommodated or modified with slight changes that would not affect the current laboratory facility.

Equipment and materials needed for production of graphic control processes may be found in most graphic arts laboratories. The handling and procedures for using the varieties of graphics materials and equipment available on the current market may deviate slightly from one product to another. One example would be that the different manufacturers of process cameras — such as Kenro, Robertson, and NuArc — are among the few who produce process cameras with the same basic parts. The basic parts of a process camera include a lens, bellows, copyboard, exposure lights, and timer. Their difference may be in product design, light source, and camera size, as well as other capabilities.

Planning Facilities

Proper planning to adapt a present facility so that the graphic control processes can be done effectively by students will depend on what is needed to produce the photographic screen printed images. According to Schmitt and Taylor, the darkroom is a leading requirement when setting up a modern graphic arts laboratory.[8] An area of the graphic arts laboratory should be set aside for the darkroom. The possibility of converting auxiliary or storage space into a usable darkroom may be considered so that photography could be used in the graphic arts program.

The following suggestions should help the instructor desiring to plan a darkroom, or it may serve as a checklist for those instructors whose facilities include darkrooms that may be used for producing the graphic control processes.

1. Location of the darkroom should be near the printing area, with a maze-like entrance or other light trap entrance and exit. The door should be designed for emergency exits. If a revolving door is installed, there is no need for a warning system. Entry and exit with this type of door will not allow light to ruin the light sensitive materials.

2. Needed space should be determined by estimating the number of students permitted to occupy the darkroom. Consideration for use of space should include the process camera, developing sink, an enlarger, working counters, film dryers (roll and sheet film), contact printer, film washer, print dryer (for resin-coated or uncoated fiber-based photography papers), storage cabinets and shelves for keeping chemicals, films, and accessories. A small refrigerator for keeping film fresh would be in the darkroom.

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[8] Marshall L. Schmitt and James L. Taylor, Planning and Designing Functional Facilities for Industrial Arts Education, (Washington, D. C.: U. S. Government Printing Office, 1968), p. 32.

3. Film or paper safes are needed in the darkroom for care and storage of film or photographic paper. A device with a sliding cover or a specially designed drawer with a light-tight cover and a master lock may be used. There are several varieties of paper and film safes manufactured as box-like units that may be positioned near the process camera or enlarger for easy reach. Some paper safes are designed with compartments for storing various sized films or papers. These compartments are protected with a cover which will roll open when film or paper is needed for use.

4. Sinks must be made of acid-resistant materials such as marble, ceramic, fiberglass, or stainless steel.

5. Temperature control for chemical solutions must be followed as per manufacturers' instructions. Hot and cold running water is useful in this regard.

6. Proper room ventilation is essential and should be included in the planning of the darkroom.

7. Safelights, normal room lighting, and additional lighting positioned for convenient examination of developed negatives and positives should be included.

8. Accessory equipment should include roll film developing tank with reels, changing bags, thermometer, amber bottles for keeping chemicals, tongs, adjustable and fixed easels, a vacuum easel, and products especially made for cleaning films and lenses, e.g., Edwal antistat film cleaner.

The printing facility should provide: designated work areas for planning, design, and composition; work surfaces to support screen printing equipment; exposure and washout area for the production of photostencils; cleanup area for reclaiming screens; drying area for printed projects; and storage area for equipment and supplies.

An excellent choice of safelights for the darkroom would include the Thomas Sodium Vapor Safelight.[9] This type of safelight puts out

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[9] Dennis Curtin and Joe DeMaio, The Darkroom Handbook, (New York: Curtin and London, Inc., Van Nostrand Reinhold Limited, 1979), p.97.

light from a narrow part of the spectrum. It has the least effect on photographic papers, but to the human eye, the darkroom appears bright with an abundant amount of visability. Another set of red number one A safelights should be included in the darkroom for use with the orthochromatic films.

Roll films requiring absolute darkness may be handled in changing bags. Changing bags are specially made for placing or loading film into the developing tanks without the use of a totally dark room. A zippered bag opening permits film, reel, tank, and scissors to be placed inside the bag. Scissors with blunt ends should be used because sharp points may rip the changing bag. Opposite the bag's zippered opening are two sleeve-like openings with an elastic band at each end of the sleeves. The hands should be inserted in both sleeve-like openings, with the elastic positioned firmly around the arms. When used correctly, there should not be any light leaks to cause unwanted additional exposure that may produce fogged film. If the person using the changing bag practices loading the film onto the reel and tank, adjusting to the limited space inside the bag poses no problem. This would aid the student in developing a skill for loading roll films onto reels and tanks in absolute darkness.

For the college student, emphasis on skill development should be augmented by experience with the photographic screen processes. Of course, development of skills should not stop at the university level. Rather, instruction at any level should provide a catalyst for a meaningful learning experience. The graphic arts laboratory should establish a relationship between industry and the classroom experiences.

The establishing of a facility for screen printing graphic control processes should blend into the existing facility. The equipment should be similar to that used in an industrial situation.

Equipment Required

Specific instructions for using any of the described equipment should be left up to the manufacturers of the equipment and the instructor of the program. Reprinting instructional procedures or the mention of name brand products in this paper would prove fruitless since there is a wide variety of manufacturers of photographic products. The manufacturers of photographic products have taken the initiative in explaining their products. For the purpose of this paper, only reference to products and equipment necessary for the production of screen printed graphic control processes will be give. A generic description of procedures for handling necessary equipment will be included with the described graphic control processes with specific suggestions for the operation of certain equipment requiring further explanation. The following is a suggested list of equipment that should be featured in the graphic arts facility in order to produce screen printed graphic control processes.

Enlargers. Many enlargers are available today, each differing in function, format size, quality, and price. Criteria for selection should include the format size of the negative to be used. The recommended format size is 35mm. The flexibility and economy of this film format would easily make it adaptable for instructional purposes. Other formats up to 4 x 5 film size may be considered. However, the quality of 35mm film, cameras, and other accessories is adequate for producing images needed for the graphic control processes.

Rigid construction is an important consideration in the selection of an enlarger. Enlargers which have plastic parts should be avoided unless the plastic is unaffected by high temperatures. The heat produced from the lamp could damage the lamp housing or condensers. If the lamphouse is made of plastic, certainly the proper lamp or bulb should be used as recommended by the manufacturer.

Parallel alignment between negative and easel is necessary in order to produce a sharp projected image on the paper. The base of the enlarger must be wide enough to support the easel evenly. A sturdy support for the enlarger is required so that the enlarger does not vibrate and cause blurred images. Counter tops that are in fixed positions are ideal for holding enlargers. Common features found in most enlargers include: lamphouse, base, column, lens, bellows, negative carrier, condenser, fine focus knob, and the elevation handle for raising the lamphouse assembly.

An enlarger is practical for producing direct positives on lith films from negatives (projection printing) as well as producing photographic prints for use in making other graphic control processes. The enlarger may be positioned to produce images that may extend, in size, beyond the dimensions of the printing base. A C-clamp may be used to hold the base to the counter or bench top. This allows the lamphouse to be positioned so that it may project the negative on the floor or the wall. A weight on the base of the enlarger may be used instead of C-clamps. A mirror mounted forty-five (45) degrees in front of the lens will also permit projection of the negative onto a wall. The mirror attachment may be purchased with the enlarger and usually fits beneath the lens onto a filter holder.

Easels. The purpose of the easel is to hold the film or paper flat on the plane of focus. It is positioned at the base of the enlarger when in use. There are two types available: fixed and adjustable. Fixed easels are inexpensive, with standard size masks ranging from 2½" x 3" to 8" x 10". The adjustable easel is variable in a range of sizes. Both types of easels provide a border around the image produced from the projection of transparent positives or negatives.

Another type of easel is the vacuum easel. This produces an image without a border and also makes it possible to project a positive or negative transparency on the wall where the easel may be mounted. Directions for making a vacuum easel may be found in Peterson's Photo Equipment You Can Make.[10]

Contact Printer. The contact printer may be a piece of ¼" plate glass, 11" x 14", placed on a sheet of soft foam rubber. The foam provides support in holding the negative and unexposed light sensitive material in contact with the glass resting on top as weight. This setup may be used with a 25 watt light source positioned three feet above the glass and foam rubber contact printer. Another convenient light source is the enlarger. A strip of masking tape on the outside edges of the

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[10] Parry C. Yob, et. al., Photo Equipment You Can Make, (Los Angeles: Peterson's Photographic Publishing Company, 1973), p.54.

glass prevents cuts that may occur when handling the glass.

There are commercially made contact printing units that include vacuum pressure. This becomes practical for highly detailed reproduction since the pressure of the vacuum lightly presses the film image in contact with the unexposed light sensitive material. The unexposed photosensitive materials may be photo-stencils, film, or paper. Also, a vacuum frame prevents Newton's rings (formations of circles that appear on the film when the film is in partial contact with the glass).

Cameras. All cameras, from subminiatures used by hobbyists to the process cameras used in industry, share certain basic characteristics. These characteristics common to all cameras include the lens, aperature, shutter mechanism, light tight chamber, and filmback. Some cameras may also include the focus, meter, timer, and automatic film advance. Line or process cameras also feature a control panel for exposure switch, timer, vacuum filmback, and focusing control for copyboard and lens. Other features may be included, such as internal light source for flashing halftones, adjustable vacuum pressure for different sizes of film, and other modifications that extend the capabilities of the process camers.

Whether the camera is used inside or outside the darkroom, the principles of photography still apply: the camera is a device used to create the formation of an image on photosensitive film or paper, and the formation of the image on film is produced by the action of light.[11]

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[11] Leslie Stroebel and Hollis Todd, Dictionary of Contemporary Photography, (Dobbs Ferry, New York: Morgan and Morgan, Inc., 1974), p. 143.

The only differing factor among cameras is the ability each has for producing quality images on film. Quality can be achieved by a good grade lens and proper development of film, as well as the camera operator's ability to handle the camera equipment properly. If the budget for funding camera equipment for instructional use is limited to the point that the purchase of a process camera is not possible, the purchase of a camera adequate for providing negatives that may be used with the enlarger might be considered as an alternative when selecting equipment. Alternatives such as a press or view camera could provide a means of producing negatives in the place of a process camera. Good quality negatives can be produced with this type of camera at low cost, while also taking less space than a process camera. A halftone may be produced with the press camera by using a film called autoscreen, which is available from most graphic arts suppliers. This particular type of film is prescreened, allowing halftones to be made from cameras unequipped with a vacuum back. The press or view camera is available in formats ranging from 2¼" x 3¼" to a film size of 8" x 10". In a sense, the view or press camera could be considered a miniature version of the process camera, sans vacuum back, electrical control panel, and illuminated copyboard. When compared in price with the process camera, the press or view camera would be economical for school systems; i.e., most view cameras range in price from \$200 to \$1000, whereas a standard process camera may range from \$1200 to \$5000. A copy stand with lamps can serve the same purpose as the illuminated copyboard for the process camera. The stand for holding the view camera could be purchased or made from wood or metal scraps. (Detailed instructions for making a copy stand may be found in Peterson's Photo Equipment You Can Make, by Parry C. Yob.) If the instructor elects to build the copy stand, it should include a compressible surface (positioned on the base of the copyboard) with grid markings to be used as guides for centering copy. Also included should be an adjustable track with a universal thread for mounting the camera. Lamps should be positioned on both sides of the copyboard at forty-five (45) degree angles. A cable release should be attached to the shutter mechanism so that the shutter may be tripped without causing movement of the camera. The camera should be tarnished or flat black, to prevent reflection off the copy or glass. There should be a locking screw to keep the camera in position when inserting the film into the chamber of the camera. The camera should be mounted in the vertical position, allowing the copy to lie flat.

The use of the process camera would aid the student in understanding a relationship of the transition from classroom to industry, since the process camera is used in industry. The use of a view camera will suffice since most of its functions are similar to the process camera, thus providing the principles of photography that students may apply toward skill development.

As mentioned earlier, the 35mm film format is by far the most economical format when compared to other size cameras. Film for 35mm cameras may be purchased in bulk and dispensed in reusable cassettes. This cuts the expense to less that half the cost of individually packaged film. This format would be ideal for producing negatives for the graphic control processes at a low cost affordable to just about any educational system. Of the two main types of 35mm cameras available (single lens reflex and rangefinder) the single lens reflex is recommended. The SLR offers many advantages such as interchangeable lenses, through the lens focusing and metering, along with other features provided by the manufacturers. The rangefinder camera has problems that cause it to be at a disadvantage when compared to the SLR. The most significant problem is that of parallax, caused by the viewfinder and lens being positioned apart on the camera. When the camera is moved closer to the subject, shifting of the image will occur, causing the image recorded by the lens to be in a different position from that which was viewed through the viewfinder. This type camera would prove impractical for copy work unless it had a parallax corrected viewfinder.

With the development of fine grain developers, fine grain films, and good quality optics, the 35mm camera is capable of producing satisfying results for students getting a start in photography. This size format camera would be recommended since it is adaptable to most photographic situations inside and outside the classroom.

Timers. Timers used with enlargers should feature not only a plug for the enlarger, but for the safelight as well. This would permit the safelight to automatically shut off when the lamphouse of the enlarger is on. The exposure of the negative onto the photosensitive material (paper or film) would then be possible without added interference from the safelight. Even though the light is safe for handling photosensitive materials, a slight fog may occur on the film or paper if the safelight and enlarger are on simultaneously. The safelight near the enlarger should be positioned no closer than four feet from where the photosensitive materials are handled.

Most process cameras feature a built-in timer on the control panel. The timer on the control panel is set according to the proper time it takes to expose film. This is determined by the type of light source and if it is being reduced, enlarged, or just copied from its original size.

Trays. Trays for holding chemical solutions for processing of film and paper are available in many sizes and made from various materials. Size of trays for classroom use could vary from 4" x 5" up to 20" x 24" depending on need. The best trays are made of high-impact plastic or stainless steel. Even though the stainless steel trays are more expensive, they have an indefinite life as well as good heat conductivity. If the sink is large enough to hold all the trays and chemicals required, a tempering bath could be used to regulate the temperature of the chemicals in the trays.

To keep the trays from being stained by developers, it is suggested that the tray containing the developer be alternated with the tray that is used for fixing (hypo) whenever possible, preferably each time the trays are being prepared for use. The stopbath and fixer (hypo) include quantities of acetic acid. The acetic acid serves as a cleanser and effectively keeps the trays from being stained by the developer. (This is possible if an alternating sequence is performed whenever using the trays.) When starting, the trays should be rinsed thoroughly with hot water before pouring the chemicals in the trays. This prevents contamination of the fresh chemicals. The trays should not be scrubbed with abrasives, steel pads, or anything that will cause scratches, since the smoothness of the trays' surfaces will have an effect on the quality of the work.

Bottles for Chemical Storage. The bottles should be amber or some other dark color that will not allow actinic light to affect the chemicals. Discarded glass bottles used by pharmacists may usually be obtained for free. The chemicals kept in the glass usually last longer than those stored in plastic bottles. Plastic bottles retain residue from old chemicals and require more effort to clean. Even though plastic bottles will not break from handling or accidental falls, the glass bottles obtained from drug stores are durable and can withstand a considerable amount of handling. The writer of this paper has had six, one-gallon amber glass bottles for nearly seven years, and has shared them for two years with ten to fifteen year old students without experiencing any breakage of bottles. The bottles to be used for storing solutions should be properly labeled for quick identification. This can be done by using felt-tipped markers and gum tape or pressure adhesive tape. Along with identifying the chemicals, other data should include date solutions were mixed and the ratio to be used. The solutions should be made safe from contact with air by securing the storage bottles with a proper stopper or cap. Otherwise, the chemical solutions will weaken.

Exposure Units for Producing Photo Stencils. A strong light source is an important factor for proper exposure of photo stencils. A requirement for exposing photo stencils is that the light source contain all the blue and ultraviolet end of the visual spectrum. Carbon arc lamps, photo floods, tungsten lamps, flourescent, and halogen lights provide the needed intensity to expose photo stencils. The exposed stencil is affected by the action of the actinic light. The actinic light causes the sensitized stencil to react when exposed for a certain length of time.[12] The distance of the light source to the stencil will also have an effect on exposure.[13] The reaction caused by the actinic light hardens areas of the sensitized stencil when the stencil is exposed to light.

Critera for selecting the light source should include cost, effectiveness, and capabilities for safe use by students. One source which meets these specifications is sunlight. This source of light lends itself to long exposures for producing a stencil from a positive with simple and non-critical detail. Using sunlight would be an ideal introduction to the use of an actinic light source for exposing photo stencils. Students could be given projects to experiment with this technique.

There are, of course exposure units which are elaborate in design and cost. For use at an elementary level of instruction, units containing a flexible vacuum back for use with indirect and direct

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[12] Albert Kosloff, Photographic Screen Process Printing, 2nd ed., (Ohio: Cincinnati, Signs of Our Times Publishing Company, 1962), p. 40.

[13] Ibid.

stencils are desirable. The light source is a combination of quartz lamp and ultraviolet fluorescent tubes. This particular combination of exposure lights would prove practical for use in classrooms, since the light source is clean, low cost, and safe for students to use. The prices of these self-contained units vary from $850 to $1000, depending on the features and accessories. In comparison, some units can be made for as low as five to twenty dollars, depending on materials used. The materials for such a low cost exposure unit would be a number one photo flood lamp, cord, plug switch, and fixtures. The photo flood light bulbs are readily available at most photo supply stores. A considerable amount of heat is generated from photo floods, requiring the light to be positioned no closer than three feet from the stencil. For small copy no larger than 11" x 14", the photo flood lamp will suffice for producing stencils within those limits.

The number two reflector floods are recommended for use, because they waste less light.[14] Since there is quite a large amount of heat emitted from the photoflood bulb, the bulb should be placed in a ceramic light fixture. On the average, the photoflood lasts for about eight hours. After that, the exposure should be increased by fifty percent each hour of use to compensate for the loss of intensity. Since the element is more sensitive than most tungsten lights, it will break when hot, subjected to sudden vibration, or from frequently turning the on/off light switch.

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[14] Andrew Garner, The Artist Silkscreen Manual, (New York: New York, Grosset and Dunlop, 1976), p. 86.

Fluorescent lights offer many advantages, especially the ultra violet fluorescent tubes, as well as ordinary cool white tubes available in various exposure units. An outstanding advantage is the ability of fluorescent lights to operate at a cool temperature, thus allowing the light source to be placed as close as four inches from the stencil during exposure. This allows the use of less space in a vacuum frame than needed for other light sources. The tubes are readily available and require less current to operate than other exposure lamps. Fluorescent lamps have a longer life expectancy than other light sources such as arc lamps, photo floods, and halogen lamps are ideal for exposing positives with great detail in order to create a photostencil. Unfortunately, the carbon arc exposure units have some disadvantages for educational use that outweigh its advantages as compared to other light sources. The carbon arc exposure units are expensive, become dirty, dangerous, and, at times, difficult for younger students to operate. Carbon arc lamps depend on electric current jumping between two carbon rods, producing a bright spark. Thus, quite a bit of heat is emitted from the exposure unit. This heat may prove damaging to the photo positives, stencils, and the rubber backing on a vacuum frame.

During and after the exposure, ashes fall around the equipment, and sometimes get in the air. Also, there is a high risk of damage to the retina of the eye. Another danger is the high temperature which may cause burns to the user who tries to change or adjust the carbon rods. This is especially true if the user is a younger student. The carbon arc exposure unit is recommended for advanced instruction and industrial use, where exposure units of this sort are required. There are carbon arc exposure units made for offset platemaking which may be used for producing indirect stencils. These exposure units are equipped with the light source enclosed within the cabinet with the vacuum back attached as either a light top or fliptop back. A screen coated with liquid emulsion could not be used, since the vacuum back cannot stretch to the shape of the screen printing frame. (Usage of the units with transfer of indirect stencils produce adequate results.) The cost of these units, depending on the size and the manufacturer, may range from the hundreds to the thousands of dollars. In most graphic arts laboratories where offset printing is part of the course offerings, the laboratory is equipped with such platemaking exposure units. Some of the platemakers may use pulsed xenon instead of carbon arc. This type of light source is much more intense than that of carbon arc and allows for a clean and safe operation. For direct stencils, xenon, mercury vapor, and quartz iodine lamps are useable but less desirable. Exposure time for this type may take up to nine minutes.

Some contact exposure units work with a portable light source that may be rolled into position in front of the contact exposure frame. One such unit that uses the portable light source is the polycop vacuum frame. The polycop vacuum frame may be used to hold either indirect film or screen coated frames with direct emulsion. The polycop vacuum units provide excellent contact between stencil and positive so that fine detail may be assured. For stencil areas larger than 11" x 14", the polycop is recommended. The polycop vacuum frame is designed so that the heavy frame with the flexible non-glare rubber blanket rests in contact with the bottom frame. The bottom frame holds the plate glass. The unit is kept together with hinges and locks which are used to open and hold the frame assembly together. A vacuum pump and gauge are used to create the firm contact necessary for making a sharp image from the positive onto the stencil.

Auxiliary Equipment. The following is a list of equipment, with brief descriptions, that would aid in the production of screen printing graphic control processes.

1. Daylight Roll Film Developing Tank: These are available for various film sizes (from pocket 110 to 120 roll) and are manufactured from materials such as stainless steel or plastic, and designed so that the lid of the tank has a trap light for liquid chemicals to enter. Reels which come with the tanks are either adjustable with a ratchet type loading system or fixed in one specific size. The fixed reel is usually made of stainless steel and operated by applying slight pressure to the edge of the roll film so that the film loads onto the space between the spiral wire.

2. Changing bag: The changing bag is used to load film into daylight tanks, thus eliminating the use of a darkroom. The bags are made of cloth with a zippered opening on one end and, at the opposite ends, two elastic sleeve openings for slipping one's arms into.

3. Tongs: Bamboo tongs with rubber tips are recommended for keeping hands from getting wet while processing film or paper in trays. The use of tongs would improve on the quality of work and prevent contamination of photographic chemicals during tray processing.

4. Funnel: The funnel is used for pouring chemicals back into storage bottles. Funnels are made of either plastic or stainless steel. Some are manufactured with a filter for keeping dust and scrap film from entering the storage bottles.

5. Stirring Rods: Made of either plastic or glass, the stirring rod is used for mixing and dissolving chemicals.

6. Hole Punch: These are used for notching negatives as a file system or for use in setting up for pin registration.

7. Static Brush: The static brush or a camel hair brush is used for eliminating dust from the negatives.

8. Thermometer: Since time and temperature are important factors in photographic processing, a thermometer is essential in establishing control for the developing processes of film. A dial thermometer is recommended since it is accurate and easier to read than most thermometers for determining the proper time needed for the film to stay in the chemical solutions.

9. Grain Magnifier or Focuser: The grain magnifier or focuser is an optional peice of equipment which is used on the base of the enlarger or placed on the easel. The negative is then projected onto the easel. The grain magnifier at this point is used to check the focus of the negative according to the grain structure of the negative. This is an aid for sharply focusing negatives when using the enlarger.

10. Paper Safe: This is necessary for the protection of paper or film. The paper safe allows for convenient handling of film or paper, cutting down on the risk of exposing paper accidentally.

11. Tray Siphon: If expense is limited when setting up a darkroom, the tray siphon is recommended for washing prints or films. The siphon hose is attached to the faucet and the siphon clipped to the tray. The siphon is then activated by the action of the water. The result is a spraying of a jet of water coming out of the siphon, causing water to circulate around the film or prints. An overflow allows for the siphon to drain so that continuous washing occurs for the film or paper. Continuous washing is an important stage of film developing so that unused chemicals may be removed from the film or paper. The price range of a tray siphon runs from about eighteen to twenty-five dollars, in comparison to a stainless steel drum valued at approximately one hundred twenty-five dollars.

12. Contrast Filters: The contrast filters are used with variable contrast papers so that compensation for contrast may be achieved with weak or thin negatives, eliminating the need to stock different grades of contrast papers.

13. Dodging and Burning Tools: Areas of the negative

may be lightened or darkened with the aid of a dodging or burning tool. Dodging and burning tools can be made from scrapboard. To make a dodging tool, cut a piece of cardboard to the desired size. Next, attach the cardboard to coathanger wire (7" to 10" long in size). The wire is used as a handle to control the action of the dodging. It must be kept in constant motion or the result will look obvious, rather than smooth. The dodger is used so that during the enlarging process, light may be held back on areas of the print that may otherwise appear dark. The burning tool is the opposite. It is used to add light to the print. This would eliminate the "washed out" areas of the print. These devices may also be purchased from a photographic supply store in kits. The handmade burning and dodging tools are just as effective as the ones purchased from a photographic supplier. Detailed illustrated instructions for using the dodging and burning tools may be obtained from Kodak's audio-visual library in Rochester, New York. The 35 mm slide presentation is entitled "Advanced Black and White Photography," and may be borrowed at the cost of postage and handling.

14. Bench Shears: (Paper Cutter) This is necessary for the trimming and cutting of film and paper to the desired size.

15. Negative Cleaning and Spotting Materials: These items add to the quality of the finished product. The Materials should consist of chamois cloth and liquid film cleaner (carbon tetrachloride may be used and is easily obtained from a chemistry laboratory, but caution must be taken in handling the liquid). There are also commercially made film cleaners such as Edwal or Kodak film cleaners that may be purchased from a photographic supplier. Also, materials such as scratch filler, opaquing fluid (pens and pencils), and anti-static brushes can be used in the photographic darkroom to add to the quality of the photographic image.

Materials Required

The materials mentioned in this paper are consumable items that are to be used during the processing of the graphic control processes. Materials such as screen printing fabrics, inks, solvents, paper, chemicals, and photographic films will be described for their use in creating graphic control processes. Materials may be acquired from photographic and screen printing suppliers.

Fabrics. The fabric best suited for reproducing the fine detail of the graphic control processes should be made of synthetic fibers. Synthetic woven fabrics, such as multifilament dacron and monofilament nylon fabrics, offer many advantages over silk, metal, and other fabric materials. These advantages include low cost, ease in preparation, handling, stability in fiber construction, resistance to any solvent, and excellence for use with photographic stencils.

Since nylon is a monofilament, problems may arise when trying to use indirect stencils. The fabric may need special screen preps, bonding solutions, and degreasers such as trisodium phosphate to insure good adhesion of indirect photostencils. Unlike the holding capabilities multifilament fabrics have for (transfer) indirect stencils, the nylon monofilament fabric requires this extra treatment, since the threads are too smooth, making it difficult for (transfer) indirect films to adhere. Ink passage is ideal with the nylon monofilament, thus allowing for fine detail such as that found in the graphic control processes.

The combination of nylon fabric with the direct emulsion liquid stencil provides excellent results, since the emulsion is applied directly to the screen. This is due to the nylon fibers having a make-up of single stranded fibers woven closely together in a range from 16 to 465 threads to the lineal inch. Depending on the detail of the image that is to be screen printed, nylon fabric with a mesh count of 12XX (120 threads per lineal inch) is recommended for printing graphic control processes such as posterization. Screen printing of 65 to 85 line halftones would require fabric with a mesh count ranging from 12XX to 16XX. One way to be sure of the 3:1 ratio for comparison between fabric and halftone is to use a screen mesh and halftone determiner. The screenmesh and halftone determiner may be purchased from a screen printing supply company at prices ranging from seventy-five cents to twenty-five dollars, depending on the materials it is made of. The inexpensive screen and halftone determiner, sufficient for classroom use, is made from .007 acetate film base. The determiner is placed in contact with the surface of the fabric or halftone so that the star pattern will appear and then point to one of the numerical gradations on the determiner. This will indicate the count for the fabric threads or halftone dots.

Nylon fabrics impregnated with yellow dye allow for antihalation protection during exposure of fabrics coated with liquid emulsions. This keeps the light source confined directly to the image during exposure of the stencil, and also protects the light from spreading, resulting in a stencil with sharp and accurate detail. The dyed yellow fabric (also available in red and orange) eliminates the bounce of light rays, called halation, that occurs during exposures of stencils coated on white screen fabric. This dyed fabric is mostly manufactured in Switzerland and is distributed in the United States through suppliers such as Advance Screen Printing Supply of Chicago.

Multifilament fibers are made up of very fine threads twisted together. Silk and polyester fabrics are examples of fabrics produced with a multifilament weave. When compared to the monofilament woven fabric, multifilament fabrics are coarser, having a better grip for adhesion of transfer films. When printing photographic detail with multifilament fibers, the addition of extender base to the ink minimizes clogged screens. In general, the nylon fabric is recommended over any of the multifilament fabrics for use in screen printing the graphic control processes.

Screen Printing Inks. Since evaporation poster inks are widely used, this section will deal with the evaporation poster inks used for classroom instruction of the graphic control processes.[15]

There are a large variety of inks available for screen printing. Some inks are manufactured for specific purposes, whereas, other inks may be applied toward other uses. Different uses for inks with capabilities of being printed on different substrates — such as textile, glass, plastic, metal, wood or paper — are formulated by the ink manufacturers. The inks are categorized by their drying characteristics. Categories include: evaporation inks (ethyl cellulose, nitro cellulose, acrylic and other types of plastic base inks); oxidation inks (enamels and synthetic enamels); thermosetting inks (plastisol and hot inks); and catalic inks (epoxy and certain polymer inks).[16]

The largest known group of inks that dry by solvent evaporation are mostly known as poster inks. The characteristic of this group of inks include hardening with age and undergoing chemical change while

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[15] Ibid., p. 26.

[16] Ibid., pp. 26-27.

drying. Ideal for classroom use, the evaporation inks may be redissolved with the original solvent. Younger students may easily learn the basic concepts of screen printing by the use of evaporative inks that are water soluble. Since most water soluble inks are nontoxic and require water as a cleansing agent, the use of this ink would allow students to understand and experience screen printing in just about any facility equipped with a sink and running water. When compared to other screen printing inks, water soluble inks would not necessitate the need for storage and handling of volatile solutions, special reclaiming troughs, or room ventilation. Furthermore, water base inks are available in brilliant colors for printing on textile and paper materials. Acrylic water soluble inks are manufactured for permanent applications on substrates such as masonite, paper, cloth, and wood. Permanence in this type of ink is achieved when the ink dries. When the acrylic ink is still wet, it is easily removed with water. Acrylic inks dry with a flat finish. If a glossy finish is desired, a coat of clear varnish may be screened or sprayed onto the surface of the printed image. This also may serve as a protective sealer, since the printed image will smudge when handled with moist hands.

Most photographic direct emulsion stencils are compatible with water soluble inks, and may be used for some of the simplified versions of the graphic control processes. Since the viscosity of water soluble inks are thick, printing or pulling the squeegee with the image of the stencil too close to the edge of the printing frame will cause a heavy and uneven deposit of ink. The same thing will happen when using a paper mask too close to the stencil. A water resistant blockout, such as lacquer base blockout, is recommended for use with water soluble inks. Also, by keeping the image portion of the stencil at least two to three inches from the edge of the frame, uneven deposits of ink can be avoided. This area around the image or stencil is known as the optimum printing area. Flooding the screen area with ink to prevent screen clog and printing by the "off contact" method (see glossary) are solutions to eliminating problems that usually occur when using thick inks.

Another type of evaporative ink commonly used for screen printing is oil based ink. It is considered the work horse of the screen printing industry.[17] The oil base inks may be formulated to dry by oxidation. Drying by oxidation is a slow process, since the ink is changing from a liquid to a solid state. When this change occurs, the ink from the image printed onto the surface is insoluble when dried. The oil based evaporative inks may be redissolved with the proper solvent.

Oil base inks can be used with any stencil and blockout. When printed on paper, it will not cause the paper to curl as will water soluble inks. These inks are available in many varieties of colors which dry in a flat, gloss, semi-gloss, opaque, transparent or luminescent finish. Depending on the humidity and coverage, oil base inks usually dry in about twelve to thirty minutes. A laboratory or work area facilitated with proper equipment and materials for handling oil

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[17] R. A. Banzhaf, p. 14.

based inks is necessary. Provisions for ventilation, storage of inks, solvents, and oily rags would require such a laboratory if oil based inks are to be used for the instruction of screen printing. There are guidelines for safety in the handling of volatile solutions that may be obtained from an OSHA (Occupational Health and Safety) representative or the Industrial Extension Service, located on the campus of North Carolina State University, Raleigh, North Carolina.

Oil base inks may be applied to all of the graphic control processes since the inks' mixture is capable of being adjusted for printing of fine details. Modifiers may be added to the ink, resulting in a consistency that is free flowing and capable of producing sharp detail. Modifiers such as transparent base, extender base, reducers, toners, and solvents are key ingredients used for stepping up the performance of ink. Transparent base adds body to the ink, permitting the ink to flow freely while acting as a lubricant. Also, transparent base is used as a filler for spreading the pigment and reducing opacity, when the need for printing process color work arises. The extender base is used to increase the volume of ink, allowing the ink to last longer without affecting its chromatic intensity. A ratio of one part extender base added to three parts ink is recommended when using extender base. Reducer is used to slow up drying, so that screen clog will not occur during a printing run. The use of toners, when added to the base of the ink mixture, will reduce different shades or tints of colors, thus increasing the variety of color values. Solvents reduce the viscosity of ink when used as a thinning agent. Solvents may also be used as cleansing agents for the removal of ink from the screens and squeegees, or whenever there is a need to break down soluble ink residue. The modifiers mentioned may be purchased from screen printing suppliers.

Inks and modifiers should be kept in sealable metal cans, which will protect the solutions from evaporation. When not in use, the ink cans should be stored in metal cabinets. Provisions should also be made for storage of inks that have already been mixed. Glass jars should be avoided because they are breakable. Polyvinyl and polystyrene containers should not be used for storage of inks with bases other than water, since this material will dissolve.

Solvents, Screen Preps, and Screen Cleaners. It is necessary to keep solvents, screen cleaners, and preps on hand when printing. Certain stencils fabrics, and inks require the use of these chemical solvents to aid in the preparation and cleaning of screens for printing. The type of solvent will vary according to the various materials such as fabrics, stencils, and inks. Chemical solvents such as lacquer thinner, acetone, ethylene dichloride, toluol, and methyl chloride require adequate room ventilation, protective clothing, and approved safety containers.[18] There is no set time for safe exposure to chemical solvents. It is dependent on individual tolerance, density of persons in the work area, and adequacy or inadequacy of ventilation of the work area. For example, an individual working alone would have less chance of over-

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[18] Edward A. Campbell, Ph.D., Safety Manual for the Graphic Arts Industry, (Pittsburgh, Pennsylvania: Education Council of the Graphic Arts Industry, Inc., 1972), pp. 91 - 92.

exposure to fumes than a group of students in a class would. Chance of overexposure to fumes of chemical solvents is increased when used in high density situations such as a large group working in a room with little or no ventilation. Well ventilated areas should be used to allow the damaging fumes to escape. Avoiding the use of more than one chemical solvent at any one time would cut down on unnecessary and harmful fumes. Other severe problems may occur if chemical solvents come in contact with the skin. Problems such as chapping of the skin, rashes, and a burning sensation are possible. To avoid contact with solvents, the use of polyethylene gloves is recommended for protection of sensitive skin.

The following chemical solvents or solutions will be needed to prepare and clean screens for printing the graphic control processes.

1. Acetic Acid. This chemical is used as a cleaner for fabric. It neutralizes the enzyme cleaners that are used for removing the gelatin-emulsion of the photostencils. It is also used to prepare nylon fabric for ease in adhering photostencils. Acetic acid at 5% is readily available as household vinegar, and requires no special preparation.

2. Acetone. Acetone may be found at most hardwares and drugstores. It is commonly used as a nail polish remover, but the highly flammable chemical may be used as a cleaner to remove stubborn spots of direct emulsion from the screen fabric.

3. Chlorine Bleach. Household chlorine bleach is used to remove direct emulsion for synthetic screen fabrics. The bleach should be mixed with water at a ratio of 1:10 (one part of bleach to ten parts water), so the fabric will not deteriorate.

4. Enzyme Cleaners. Screen printing suppliers have their own enzyme cleaners that are used to remove the gelatin photostencils (indirect or direct) from the screen. Liquid laundry detergents with trisodium phosphate can be used to remove old traces of ink residue and prepare screens for good adhesion of indirect photostencils. This solution would be considered a screen prep, degreaser, and enzyme

cleaner. Storage of this solution poses no problem, since it is non-flammable.

5. Ethylene Dichloride. When combined with methyl alcohol, ethylene dichloride will remove certain water soluble and lacquer base blockouts from the screen. However, it is highly flammable and should be kept in small quantities, and used as a last resort.

6. Mineral Spirits. Oleum, varnolene, pakosal, and odorless paint thinner are some of the names of chemical solutions used for mineral spirits. Mineral spirits are available in differing flash points. Flash point refers to temperature of ignition of the mineral spirit. The lower the flash point, the faster the chemical dissolves when mixed with ink. Mineral spirits with a lower flash point are very volatile and will quickly evaporate. Proper safety equipment such as metal plunger cans should be used to store the volatile solution. Mineral spirits may be purchased as paint thinners or paint brush cleaners from hardware stores.

7. Turpentine. Turpentine may be used to clean screens free of ethyl cellulose or enamel inks. This solvent has a high flash point, allowing it to break down paint or ink particles. Turpentine does not evaporate as quickly as mineral spirits or napha. Because of this, it can be used as an excellent and rapid cleaning agent.

There are three types of turpentines available at hardware stores: wood sulfite, steam-distilled, and gum turpentine. The types of turpentine that should be avoided are the thick and expensive types such as the lowgrade subturps and rectified turps that will tend to leave a sticky residue on the screen. When using turpentine to clean screens, the operator should wipe the screen dry so there is no buildup of turpentine residue on the fabric. Tri-sodium phosphate may be used as a treatment for removing turpentine residue from the fabric.

Recommended Paper for Screen Printing the Graphic Control Processes

Almost any substrate such as paper, glass, wood, metal, or cloth may be screen printed. But for the purpose of screen printing the graphic control process, ninety pound cover stock is recommended. The paper selected for screen printing should be of a quality that will not warp when printed on. Papers should be matched with the inks manufactured specifically for paper; otherwise, problems like ink blotting or ink cracking off the paper might occur when the ink dries.

Recommended Photosensitive Films and Papers

Panchromatic Films. Black and white continuous tone films (panchromatic roll or sheet film) with high speed ratings (ASA 400 or more), provide positives with the excellent detail needed in screen printing the graphic control processes. Films with a rating of 400 or more create tone and texture from the grain of the film. This is effective in retaining detail of tone when preparing the positive transparency. Kodak's Tri-X pan and Illford's HP5 were the films most often used by the author. Both films have a base ASA of 400, but may be pushed to higher speeds, such as 2400.

High speed films may be developed in high speed developers for shorter lengths of time. An example of one such combination of film and developer would be to use Kodak's Tri-X films with Acufine Developer. The Tri-X film, with a base rating of 400 ASA, may be advanced to a rating of 1200 ASA, when using recommended developing times supplied by Acufine. With the developer (Acufine) at 68 degrees, Tri-X that has been exposed at an E. I. (exposure index) of 1000 is left in the developer for five minutes and twenty five seconds.

The information concerning time and temperature for developing black and white films is furnished by the manufacturer of the film or developer. Data guide books may be purchased at photo supply stores.

The data guide books contain detailed information about film and the proper developing times: data guide books such as those published by Kodak also provide information on the different kinds of photographic papers and types of chemicals. Information on mixing chemicals and storage life of chemicals is also found in these data guide books.

Variable Contrast Photographic Paper. One type of black and white photographic paper to use for immediate results is variable contrast photographic paper with resin coating. The resin coating on the photographic paper requires shorter exposure, developing, washing, and drying times (since the paper absorbs very little water), when compared to the non-coated, fiber-based papers. The resin coated papers, after the wash stage, can be air dried without using heat or forced air. The prints will air dry to a high gloss or a semi-matte finish without any special treatment to the paper. Ferrotype or force drying should be avoided with RC (resin coated) papers, since the emulsion coating will melt at temperatures above 88 degrees C (190 degrees F).

Kodak Polycontrast and Illford Multigrade papers (available with resin coating or uncoated fiber base) are variable contrast papers commonly found at photographic suppliers. Variable contrast papers are coated with a mixture of several emulsions that will respond to filters. The filters are used to control the contrast of the print depending on the density of the negative. If the density of the negative is thin and produces a low contrast, flat looking image, the magenta filter with the highest number (3 - 4) is used to add contrast to the print. If the negative is dense, the yellow filters with the low numbers (0 - 2) are used to reduce the contrast of the print. The contrast filters are available in sets, with different shades of yellow and magenta filters assigned numbers to correspond with graded photographic papers. These are usually purchased from photographic supply stores. The filters are not sold together with the variable contrast paper, the variable contrast paper should have the same contrast value as a number two graded paper (normal contrast). The illustration (Figure 7) shows the relationship of the graded papers compared to Kodak's Polycontrast and Illford's Multigrade papers.

(P - refers to Polycontrast filters)

							Graded Photo Paper Contrast Values
0	1	2	3	4	5	6	
			P	P	P	P	
			3	$3\frac{1}{2}$	4	$3\frac{1}{2}$+4	

										Illford Paper
1+2	1	2	3	NF	4	5	6	7	6+7	

Figure 7. Comparison of Contrast Values Between Graded Papers and Variable Contrast Filters.

<u>Graded Photographic Paper</u>. Graded photographic paper (non-resin coated, also referred to as fiber based paper) with a contrast grade of "ultra hard" or a numerical rating of 4, 5, or 6, should be kept in the darkroom. The high contrast graded photo paper will produce excellent solarization with better clarity than resin coated variable contrast paper. Blotter paper, ferrotype plates, or some other effective method of drying will be necessary to keep the non-coated photographic paper flat.

Orthochromatic or Line Film. Orthochromatic or line film is used to make the positive transparencies that are placed in contact with the photographic stencil. The use of line film will produce an image from continuous tone or line copy that has a rich level of opaqueness needed to produce sharp detail for screen printing. Orthochromatic film is insensitive to red light and may be developed using two types of developers. (Kodak's Dektol developer mixed at a ratio of 2:1 is used to produce limited continuous-tone detail from an average continuous-tone photograph. Kodak's Kodalith A & B developer is used for producing line detail from continuous-tone or line copy.) "Ortho" film is available in sheet film sizes ranging from 4" X 5" to 20" X 24". Transparent positives may be made from this film either by direct contact printing from a line negative or projection printing from a negative placed in an enlarger.

The process camera will be needed to produce a line negative. The line negative (made from ortho film) is used to generate the positive. After the ortho film is exposed (exposure to ortho film depends on the amount and intensity of light), it is ready for the developing process. The developing process is also to be done under safelight conditions. The exposed ortho film is placed in a developer, stopbath, fixer, and wash. For a continuous-tone effect, Dektol developer mixed at a ratio of one part chemical to two parts water may be used. For regular line detail, equal amounts of lith developers, Parts A & B, are mixed to make a working solution. To insure sharp detail and quality images, fresh stock developers will be required and an adequate place for continuous washing will be necessary. Washing the film would eliminate stains from fixer caused by the soluble salts of the chemicals. The left-over salts could hinder the detail of the image, causing a disruption of the image's clarity. Corrections can be easily made on line film. Opaquing pens or fluids may be applied to the line film to remove unwanted pinholes, dust, or scratches.

Chemicals for Producing Graphic Control Processes

The types of chemicals needed for producing graphic control processes are chemicals recommended by the films' manufacturers. This information is provided in the form of data sheets supplied with films or photosensitive papers. Each data sheet will have a chart with the recommended processing steps.

Developers. For the purpose of classroom instruction, black and white film should be used for the graphic control processes. Black and white films (pan or ortho) require a developer, stopbath, fix, and wash. A universal developer would simplify processing and cut down confusion when stocking chemicals. A universal developer such as Kodak's Dektol (generally used for photographic paper developing) may be used with pan films for the production of continuous-tone negatives. The developer (Dektol) should be mixed at a ratio of 2:1 for use with Kodak's Tri-X (400 ASA pushed to 1000 ASA) developed for two minutes at sixty-eight degrees. The grain detail will provide excellent results for screen printing. When finer detail is desired, a fine grain developer such as Kodak's D-76 or Microdol-X may be used. Dektol (a paper developer) may be used with ortho film for producing a transparent positive with continuous-tone detail.

When line negatives or positives are needed, the lithographic ortho film should be used with its respective developers. Developers for ortho or lith films should be kept separate, in the two parts labeled A or B. Equal parts of A and B are combined to create a working solution. At a temperature of sixty-eight degrees, lithographic films should be developed in the lithographic developer for two minutes and forty-five seconds.

Stopbath. The second chemical is stopbath. Indicator stopbath may be used for films and papers. When exhausted, indicator stopbath will change in color, from a yellowish-orange to a lavender color. This chemical is important since it will permit the fixer to last longer.

Fix (hypo). For resin coated papers, a non-hardening hypo or fixer is recommended. Hardening fix may be used with pan films or ortho films, to speed up the fixing process.

The usual time for a rapid fix (with hardener) for photographic paper and films is two to five minutes at sixty-eight degrees. Fixers without hardeners usually take eight to ten minutes.

Hypo clearing agents or hypo eliminators remove the leftover fix and save water by permitting the film or paper to be washed for a short time. It is not necessary to treat resin coated papers in this solution, since the resin coated papers absorb little water.

Water. The final step in the developing process is water. Water is used to wash the developed paper or film. Running water must be used, and the temperature of this water must be consistent with the temperature of the chemicals used in previous developing processes. The washing time will vary according to the kind of paper or film being used. For example, pan roll film requires continuous washing for twenty minutes. Orthochromatic films require a ten minute wash. Film treated in hypo clearing agent for two minutes requires only a five minute wash. Wash time for photographic papers will vary according to the kind of paper being used. For example, resin coated papers require only four to five minutes washing time in running water, whereas fiber based papers require washing times up to ninety minutes.

As explained earlier in the section on photographic paper, the drying process will differ according to the type of paper used. Care in drying films or photographic paper should be taken to prevent damage to the clarity of the developed image. A designated area for drying films and papers should be established in the darkroom to permit efficiency in maintaining quality of the entire developing process.

Drying equipment can be made from used lockers for hanging roll film, or such equipment (ranging in price from \$150 to \$1500) may be purchased from photographic suppliers. It will be necessary to have a definite system of drying and storing films and photographic papers. This provision will provide protection from scratches, dust, smudges, and fingerprints. Once the film is dry, the production of the stencil may begin.

Chapter IV

PREPARING POSITIVE TRANSPARENCIES

This chapter will serve as a "working guide" for preparing positive transparencies to be used for making the photo stencils for screen printing graphic control processes. It includes a description of the process, materials, equipment, and procedures useful to produce the graphic control processes on film.

Examples of the graphic control processes (provided in the Appendix Section) should enable the student to visually identify characteristics of the processes. The student should be aware of these identifiable characteristics despite variations of subject matter, different colors in paper and ink, or any other way the effect may be modified. The examples should be studied for ideas and used as a guide for aiding students and instructors.

If the graphic control process is not planned correctly, the finished prints may be unsatisfactory. Emphasis on the selection of the subject matter should be stressed by the instructor. A display could be set up to show examples of the graphic control processes used to illustrate designs for magazines, books, advertising, movie or television titling and as a source for frameable prints. The instructor should explain to the student how the graphic control processes allow the artist, darkroom technician, or printer the option of creating and improving the appearance of the design. The use of graphic control processes should improve student's abilities in acquiring skill and expertise in the areas of photography and screen printing. It is through the graphic control processes that black and white photographs can easily be converted into color, creating more visual impact and appeal for the photographic image.

THE POSTERIZATION PROCESS

Posterization is a good starting point for students attempting to screen print a photographic process, due to the simplicity of its detail and the short time it takes to produce screen printed images from this process. This should be accomplished by selecting a single subject that is easily recognizable. Some examples are: people, animals, trees, or buildings with limited detail. Students should experiment with different types of subject matter to determine what appeals to personal taste.

The first step in screen printing a posterization is to make a series of high contrast positive transparancies, which are used to produce photo stencils. This is accomplished by making density separations from a continuous tone (black and white or color) photograph. These density separations are prepared by reducing or separating the continuous tone photograph into several distinct shades of tone using orthochromatic film. This line conversion of the continuous tone image may be printed in various colors or may be printed in a monochromatic color scheme, displaying flat and blocklike gradations of single color.

Students beginning the photographic screen process should start with a two-tone posterization. (Refer to Appendix) The two-tone posterization is a straight line conversion of the continuous tone photo in which a separation for the mid-tones is made. This process would give the student experience with the use of line (orthochromatic) film and photographic stencils. Almost any of the photographic stencils may be used with the posterized positives.

A three-toned posterization requires two density separations. (See Appendix). A four-tone posterization requires three density separations. (See Appendix). The more separations produced, the more the posterization effect appears to look like the original continuous tone copy from which the density separations were made. The posterization becomes visually effective by limiting the number of separated tones to no more than five.

Using the Enlarger for Posterization

The use of the enlarger for making the positives by projection printing will eliminate extra steps in making a negative and contact printing, when compared to the process camera. Time and materials can be saved.

The darkroom enlarger is used to prepare the density separations directly on film from a continuous tone negative. The size of the negative must be matched with the correct format size of the enlarger. A negative that will not fit in the enlarger should be contact printed and re-photographed with a (process) camera.

One advantage of using the enlarger to produce separations is that during the exposure process, certain areas of the negative may be controlled to add emphasis to the subject matter. Negatives with unbalanced densities may be burned or dodged during exposure to improve the image. This method of control by burning or dodging is know as selective exposure control and may be used with any of the other graphic control processes.

Another way of controlling densities of positives is to use reducers or intensifiers. These chemicals may be used after the density separations have been developed and washed. The reducer is used as a chemical treatment to reduce the density of the (overdeveloped or over-exposed) negative or positive. The intensifier is used to increase the density of the negative or positive. Reducers and intensifiers may be purchased through photographic suppliers. Detailed instructions for using the chemical treatments and safety in handling them are supplied by the manufacturer. Care in handling should be exercised since the chemicals are hazardous (instructions should be carefully read and followed).

Another way of correcting the density separations is the use of opaquing fluid. The fluid may be painted over the pinholes, scratches, and fingerprints as an aid for quality control over the film.

<u>Equipment</u>. Equipment needed to produce density separations directly are: an enlarger with timer; easel (adjustable, fixed or vacuum); developing trays; film dryer (optional); tongs; thermometer; a clock with second and minute hand sweep to monitor the developing time; No. 1A red safelights; and tray siphon (or some way of washing film continuously).

<u>Materials</u>. Materials needed to produce density separations directly are: orthochromatic film; chemicals to develop orthochromatic film (A and B developer, stopbath, fixer). To chemically control the density of the film, reducer or intensifier could be used.

Procedures. To achieve a set of posterized transparancies, the procedures are as follows:

1. Prepare and pour the chemicals into the trays placed in the sink. Trays should be arranged with developer in the first tray, stop-bath in the second, and fixer in the third tray. The chemicals should be within a 65 - 75 degree temperature range. Recommended time as determined by the temperature of the developer is furnished by the manufacturer of the chemical. (For instance, if A and B Kodalith developer is used with a temperature reading of 68 degrees, developing time for the ortho film is two minutes and forty-five seconds).

2. Inspect the enlarger and condenser lens for dust; otherwise, white spots or pinholes will show up on the positives. Clean the glass of the lens with a proper liquid cleaner and cloth. Then dust the lens with a soft brush or a can of compressed air.

3. Remove the negative from the storage envelope and place emulsion side down in the negative carrier. At this point the negative should also be free of dust and fingerprints. If it requires cleaning, a liquid film cleaner by Edwal or Kodak may be used to remove the fingerprints. Use a soft cloth and wipe with a circular motion to prevent streaking or scratching the surface of the film. Avoid using paper to clean film since this will leave a collection of lint. A static brush may be used to knock loose dust off the negative. Guidelines from the manufacturer should be followed in handling this brush since it contains polonium a radioactive substance.

4. Place the negative carrier between the condenser and main lens. The lens should be set at its largest opening by adjusting the aperture ring.

5. Room lights should be turned off.

6. Turn on No. 1A Red Safelights. These should be positioned no closer than three feet from where the film will be handled.

7. Turn on the enlarger light.

8. Position the lamphouse so that the image is arranged to the desired size.

9. With the lens setting wide open, focus the projected image on the easel until it is sharp and clear.

10. Stop down lens opening by setting the aperture ring until fine detail begins to fade.

11. Turn off the enlarger and set timer. The timer may be set at a time to make test exposures. An initial setting is four seconds. Place a sheet of unexposed ortho film in the easel and cover it with cardboard. The cardboard is removed to uncover a strip at a fraction of the area of the film being exposed. For instance, if an 8" x 10" sheet of film is used, the cardboard should be moved to expose one-fourth that area. The film when developed, should look similar to a gray scale. Reading the scale will help determine the proper exposure time. An example of a test exposure scale is included in the Appendix D of this paper.

12. Set the timer by selecting one of the strips according to the desired density indicated by the test exposure scale. The exposure time may be determined for a positive transparancy with a middle-tone density by using the scale as a exposure guide.

13. Place a full size sheet of ortho film on the easel.

14. Press the exposure switch on the timer to expose the film.

15. Remove the exposed film from the easel and place it in the developer. Rock the tray gently by hand to agitate the film during the time it is in the developer.

16. Remove the film from the developer with tongs once the film has developed (follow the time suggested by the manufacturer of the film). If Kodak's Kodalith is used and processed in A and B Kodalith developer at a temperature of 68 degrees, it requires a developing time of two and three quarter minutes. Tongs should be used for handling the film during processing to insure quality and to avoid streaks caused by the film processor's fingers. Allow about ten seconds for excess developer to drain off the film before transferring it to the next tray to cut down on chemical contamination.

17. Place the developed film in stopbath for about thirty seconds with added agitation during this process.

18. Remove the film from the stopbath and place it in the third tray containing fixer. Allow the film to remain in the fix for about two minutes before turning on the room lights (or until the film completely clears). The film should remain in the fixer up to four minutes or twice the time it takes the cloudy-like appearance of the film to clear.

19. Remove the film from the stopbath and place it in the film washer. A tray siphon may be hooked up to the tap and connected to a tray. The tray rests within the sink, allowing for the siphon to fill the tray, circulate water, and drain. This allows the film to become throughly washed and removes traces of spent chemical that would otherwise cause stains on the film. The tray siphon may be purchased from

photographic supplier. Some graphic arts sinks are specially designed with a section of the sink to be used for washing the film. These types of sinks are adequate for washing line film if a tray siphon is not available. The film should wash in continuous water for about ten minutes.

20. Once the film is placed somewhere safe to dry, such as a film dryer or cabinet for protection against dust and scratches, it will be ready for use in making the photostencil. At this stage, a middle-tone transparent film positive is made; when dry, it should be stored in an envelope until the rest of the separations are made or the photostencil is ready to expose.

21. Refer back to the test exposure scale and select a tone with a darker density. Set the timer for a longer exposure time as indicated on the test exposure scale. Process the film in the same manner as the middle-tone transparent positive was made. When dry, carefully store the film positive with the previously made positive until needed for use in making the stencil.

22. To make a positive with less density, set the timer for a shorter exposure time. Place a sheet of ortho film on the easel and expose by turning on the timer switch. Process in the same manner as the other positives.

23. The film positives are assembled and placed together for comparison. Inspect the film for pinholes and uneven densities. If the temperature of the chemicals is kept about the same, and the film is properly agitated, quality separations should result. The separations may need opaquing to eliminate some minor scratches or pinholes. The

film positives may also need treatment in reducers or intensifiers to modify the density of the film.

At this point, three film positives are ready for use in making photostencils to print a four-tone posterization. If additional density separations are needed, other tone separations may be produced logically by adjusting the exposure time for each of the extra separations. The film positive with the darkest density should be used to make the first stencil that will print the highlight or lightest color (such as yellows or tints from other colors). The middle-tone positive should be printed after the first printing run and the ink has had time to set up. The best color for middle-tone color should be brilliant reds, blues, greens or browns. The middle-tone color may be tinted or shaded slightly, according to the taste of the printer. The final color for shadow detail should be made from the positive with the least density. Darker to the darkest shades of color should be used for printing the shadow detail of the image. Experimentation with transparent base added to the ink may be tried to create a variety of color.

Using the Process Camera to Produce a Posterization

To prepare a set of positives using the process camera, a continuous tone print is re-photographed with the process camera to produce the line negative. A negative is made for every density separation that is needed to produce the posterized effect. Each of the negatives are contact printed to produce the positive transparancies that will later be used for making the photostencils. When compared with the enlarger, the process camera requires an intermediate step before the positive transparancy can be made. This indirect method of making the positive transparancy takes up additional time and materials since the negative would have to be contact printed onto another sheet of film. A fast method that might be used for making positive transparancies with the process camera is the diffusion-transfer process. The negative paper (such as Kodak's PMT negative paper) exposed in the process camera is placed together with the transparent film into a motor-driven processor which contains a single chemical called activator. When the sandwiched film comes out of the processor, the two sheets are pealed apart after waiting twenty-five seconds. The results are quick and inexpensive, and allow for a simplified presentation of how density separations may be achieved from continuous toned prints. One of the disadvantages of using the diffusion-transfer process is that the density of the image is not quite opaque enough to reliably duplicate an accurate range of separations. However, the results obtained are adequate for middle-tone density separations. Experimentation is recommended to determine the limitations of this process.

Equipment. To make density separations (posterization) by the diffusion-transfer process, the following equipment is needed: process camera, No. 1A red safelights, diffusion-transfer processor, and film washer.

Materials. To make density separations (posterization by the diffusion-transfer process, the following materials are needed: continuous tone print, diffusion-transfer (or photomechanical transfer) negative paper, transparent receiver film, and activator developer.

Procedures. The following are step-by-step procedures to be used as guidelines for preparing posterized positive transparancies by the diffusion-transfer process.

1. Prepare the diffusion processor by checking the chemical level. To do this, the cover must be removed so that the chemical trough may be examined. If the chemical is a deep yellow or brown color, it should be discarded. Activator developer is poured into the trough and brought to the proper level as indicated in the processor. The cover is replaced and the power switch to the processor is turned on. The rollers in the processor should be cleaned; if the rollers start moving with a buildup of dried chemical, problems of grit and stains may affect the quality of the work.

2. Prepare the copy camera by removing the lens cap and adjusting the lights, F-Stops, and timer controls.

3. Place the continuous tone photograph on the center of the copyboard of the process camera.

4. Set the timer for the time recommended by the film manufacturer. (If Kodak PMT film is used, the recommended exposure time for copy shot at 100% is 20 seconds at f/11-16. This exposure time would be adequate for middle-tone density. Also, the room temperature and age of the chemical may affect the processing of PMT film. A longer exposure time may be needed to compensate for the changes.)

5. Turn on the safe lights and turn off room lights.

6. Open the camera back. Position the PMT negative paper on the platen and turn on the vacuum switch.

7. Close the camera back and turn on the exposure switch.

8. The timer switch should turn off the exposure lights. When the exposure lights go out, open the camera back and remove the negative paper.

9. The exposed PMT negative paper is placed in contact with the clear PMT transparent receiver film. The transparent receiver film should be facing the negative paper with the emulsion side (emulsion to emulsion) in contact. The emulsion of the transparent receiver can be found by locating the notched corner of the film.

10. The PMT negative paper is positioned over the emulsion side of the transparent receiver. The negative paper and transparent receiver film are positioned in the opening of the processor and fed through the processor at the same time. A plastic strip in the processor should keep the negative paper and transparent receiver separate until the rollers bring the film in contact. The film will pass through the processor in a matter of seconds. The film will come out of the rear of the processor, sandwiched together. After about 20 - 30 seconds, the paper negative and transparency are peeled apart. The transparency is washed in running water and allowed to dry. When dried, the transparency is ready for use in making the photo stencil.

Without removing the photograph from the copyboard, other density separations may be made on PMT film. The timer should be set for a longer exposure time to produce a positive with thin detail for printing the shadow area of the posterized image. Setting the timer for a shorter exposure time would create a positive with dense detail for printing the highlight areas. A Stouffer Step Scale may prove useful when using PMT film. The Stouffer Step Scale is placed along side the photographic print on the copyboard. A reading of step four or five on the scale indicates proper exposure for the middle-tone positive.

Using the Process Camera for Making Negative Density Separations

The procedures for making negative density separations are similar to the ones used for making a positive transparency using the process camera. The difference lies in the type developer and film. The process also requires the positive to be produced indirectly, by first making the negatives and then placing them in contact (emulsion to emulsion) with a sheet of orthochromatic film. A contact printer or a larger sheet of glass is placed over the negative and film. A lamp with a 15 watt light source is used to expose the film.

Equipment. The following is a list of equipment needed for making posterized positive transparancies indirectly: process camera, sink series number 1A safelight, developing trays, film washer (or tray siphon), film dryer (optional), contact printer (or large sheet of glass, with a lamp set up for point source exposure), tongs, thermometer, a clock with a second and minute hand sweep.

Materials. The following materials are needed for making posterized positive transparancies indirectly: orthochromatic film, chemicals for processing orthochromatic film (A and B lith developer, stopbath, and fixer), reducer or intensifier, Photo-Flo, opaque, film cleaner, continuous tone photographic print, and a cameraman's 12 step sensitivity guide.

Procedures. The following procedures are to be used as guidelines for making posterized positive transparancies.

1. Prepare the chemical baths.

2. Remove lens cap, and position the continuous tone photographic print on the copyboard of the camera. Place a 12-step sensitivity guide next to the continuous tone print.

3. Make the necessary adjustments on the camera (timer, size, f-stops, and position the lights.

4. Open the back of the camera and place the ortho film on the platen.

5. Turn the vacuum switch on (some cameras are equipped with a pressure back, pressing the film across a sheet of glass instead of holding the film using vacuum pressure).

6. Close the back of the camera and expose the film for the mid-tone density.

7. After the exposure light goes off, remove the film from the platen.

8. The film is placed in the chemical baths (developer, stop-bath, fixer, and water) for processing. Treat negative in Photo-Flo, to eliminate water spots.

9. To make the next separation with a denser negative, the camera is set for a longer exposure (when developed, a 100% solid density at step nine should appear on the sensitivity guide.)

10. After exposing and developing the film in the same manner as the first negative, the camera is reset at a shorter exposure time to produce a negative of a thin density (when developed, a 100% solid

density at step one should appear on the sensitivity guide.)

11. After the three line negatives are completely dry, contact print the negatives to produce the positives.

12. The contact printing frame is prepared for making the positives. The glass should be cleaned with the proper cleaner to remove dust or spots.

13. Position the light source at least three feet above the contact printing frame.

14. Set up the chemicals for process photography. If the chemicals that were used to process the line negatives are not exhausted, it may be used to process the positives.

15. Turn on the safelights.

16. Open the contact frame and raise the glass top.

17. Place a sheet of ortho film, the size of the line negative, emulsion side up on the bed of the contact frame.

18. Place the line negative in direct contact emulsion side down over the unexposed ortho film.

19. Close the glass top and turn on the vacuum. If the contact printer is not equipped with a vacuum, the weight of the glass may provide enough pressure to hold the film flat. Improper contact will cause Newton's rings to appear on the image of the film.

20. Set the timer to the recommended time (as determined by making test exposures on film or according to the manufacturer of the films instructions). The same exposure time should be used for each negative (regardless of density) to maintain the detail from negative to positive.

21. Expose the film.

22. After exposure of the film is complete, open the contact frame and remove the film for processing.

23. The film is processed in the chemicals in the same manner the negatives were processed.

24. The steps are repeated for each of the separated negatives. Developing and agitation of the film should be carefully watched to keep the detail of the line negative from being lost during processing.

25. The three density separated positives are ready for use in making the photo stencils to screen print a four-tone posterization. Other separations may be made by changing exposure times to create more tones.

CONTINUOUS TONE REPRODUCTION

To screen print an image with continuous and unbroken tones may seem impossible since this type of printing is known as a reproduction of a flat color process. However, it may be done by preparing positive transparancies using the following processes: the step approach, enlarged grain structure; reticulation; halftone and texture screens.

The Step Approach

The step approach process has to do with the screen printing of subtile graduations of continuous tone. Hans-Peter Hass of Stutgart, Germany, developed the system of "stufendruck" (step printing) in the early part of the 1960s. Hass uses a single continuous tone transparancy to produce a series of direct emulsion screens. Each of the coated screens is given progressively longer exposures that will cause a stippled gradation of tones during the washout of the stencil. The principle is similar to the density separations made on film to produce the posterization process.[19]

Equipment. To produce a single-tone positive transparancy for the step approach method, the following equipment is needed: enlarger; number 1A red safelights; developing sink; trays; ten screen printing frames; and exposure unit for direct emulsion coated screens, plus an exposure source bright enough to expose the coated screen.

Materials. To produce the continuous tone positive transparancy and stencil for printing, the following materials are needed: a continuous tone negative, orthochromatic film, a universal developer (such as Dektol developer mixed at one part developer to two parts water), stop-bath, fixer, and direct emulsion photo stencil.

Procedures. The following guidelines are to be used for screen printing a continuous tone image:

1. Prepare the chemicals.
2. Place the continuous tone negative in the enlarger.
3. Turn on safelights and turn off roomlights.
4. Enlarge the image to the desired size and focus.

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[19] E. J. Kyle, "Continuous Tone Screen Printing: Part Two," Screen Printing, (January 1975), p. 56.

5. Project image onto a sheet of orthochromatic film.

6. Process the orthochromatic film in universal developer according to information provided by the manufacturer of the chemical. (If Dektol is used, develop for one minute at 68 degrees.)

7. Complete the chemical processing in stopbath and fixer.

8. The film should then be thoroughly washed.

9. After washing, the film should be placed somewhere safe to dry.

10. Examine the film over a light table and check for any unevenness in densities in the continuous tone image.

11. The continuous tone transparancy is placed emulsion side down in the exposure unit (facing the glass.)

12. The coated screen is placed in contact with the continuous tone positive.

13. The vacuum pressure is turned on.

14. Turn on the exposure light and expose the first screen for a short exposure time such as 30 seconds.

15. After exposure, carefully open the exposure unit and remove the screen.

16. Place the screen in the sink to begin the wash-out procedure.

17. Carefully spray the screen with warm water. Attention should be given to the image during the wash-out to make sure a stippled grain appears. Since this stencil is to be used as a first step printer, there should be large open areas in the stencil after

the image has been developed. On the screen frame, label it as the first step.

18. Using the same continuous tone transparency, repeat this process by increasing the exposure time at twenty second increments. The printer may make from five to twelve different screens from the same continuous tone transparency. Each screen should be labeled by step number for identification. Step one should be printed on the darkest color. Unlike the posterization, the continuous tone stencils are printed in opposite order with the least amount of detail printed in the darkest color. Transparent base should be added to the dark color ink so that the image, when printed, will appear as the highlight area. Additional shades of tone are created with the printing of each screen, producing the shadow detail.

Enlarged Grain Structure

Screen printing a continuous tone image involves reproducing as many tones as possible to create a printed image with smooth and unbroken tones. The process should start with a camera, high speed film, and a suitable subject. Small format cameras such as 35mm or small would be adequate for this process. The film should be rated at a higher film speed. An exposure index (E.I.)[20] of 1000 would rpoduce satisfying results. The grainier the film, the better the amount of tone distribution for the positive transparency.

Equipment. To prepare a continuous tone positive transparency with enlarged grain, the following equipment is needed: 35mm (or smaller)

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[20] For further explanation of E. I., see Chapter 3, p. 41.

camera, film developing tank, thermometer, timer, enlarger, trays, and tongs. (This is the same type of equipment used to produce the Step Approach process.)

Materials. The following materials are needed for making an enlarged grain continuous tone positive transparency: high speed 35mm black and white film (or film matched with format of camera), and chemicals to process roll film (developer, stopbath and fixer). Also the materials used to prepare direct image screens for the Step Approach process will be needed: a screen fabric stretched on a frame coated with a liquid direct emulsion, orthochromatic film and chemicals (Dektol developer, stopbath, and fixer) to produce the continuous tone positive transparency.

Procedures. The following procedures are guidelines for making continuous tone positive transparancy with enlarged grain:

1. Using a camera and selected subject, expose the film for a proper amount of time as determined from an exposure meter, or data guide sheet. The subject matter should have recognizable features that includes texture (brick walls, wood, etc.).

2. In the darkroom, remove the exposed film from the camera. This procedure should be done in complete darkness.

3. Using a bottle opener, open the film cartridge and remove the film wrapped around the spool. If the film is wrapped with a paper backing, it should be carefully separated from the backing.

4. The film is carefully loaded onto a reel. This procedure requires practice and familiarization with the reel before loading film.

It is recommended that the student practice under the supervision of the instructor. Practice should be done using dead film. A detailed description of how film is loaded on reels may be found on pages 90-91 of Photography, by Phil Davis.[21]

5. The reel is placed in the tank. The lid is placed securely on the tank. The room lights may be turned on for the remaining processes.

6. The cap is opened to allow the developer to pass through the light trap opening. The time the film remains in the developer is determined by a data guide sheet supplied with the film. For a more comprehensive source of information, Kodak's Dataguide for Black and White Processing[22] or the Photographic Lab[23] may be used. (Dektol, a Kodak paper developer, when used at a ratio of one part developer to two parts water would intensify the grain of the film. Kodak Tri-X Pan film, which has a normal E.I. of 400, may be pushed processed for two and one half minutes to have an E.I. of 1200.

7. The cap to the light trap opening is removed and the developer is poured back into its bottle.

8. A mild stopbath solution (acetic acid) is poured through the light trap opening of the tank. After about 30 seconds to a minute, the stopbath is drained.

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[21]Phil Davis, Photography, Second Edition, (Dubuque, Iowa: Wm. C. Brown Company, 1975).

[22]Kodak's Dataguide for Black and White Film Processing, (Rochester, New York: Eastman Kodak Company, 1978), p. 6.

[23]John S. Carroll, Photographic Lab Handbook, fifth edition, (Garden City, NY: American Photographic Book Publishing Company), 1979, p. 55.

9. Fixer is poured into the light trap opening of the tank. Refer to the film manufacturer's data sheet for information on types of fixers. As a rule of thumb, leave the film in the fixer twice as long as it takes the film to clear.

10. Hypo clearing agent is recommended for use in saving water. The film should be placed in hypo clear for two minutes.

11. If the film has been treated in hypo clearing agent, the film is placed in running water for five minutes. If the film has not been treated in hypo clear, then a wash time of twenty to thirty minutes will be required.

12. To break up the surface tension of the water on the film, the film should be treated in a solution of Photo-Flo. This will make the water wetter, minimizing water spots on film.

13. The film should be carefully removed from the reel and placed in a dust free cabinet to dry. If force drying the film with heat, extra care should be taken to keep the film from being damaged by heat from the dryer.

14. After the film has dried, it is ready for enlargement. The film may then be placed in the enlarger and projected onto a sheet of orthochromatic film.

15. After the positive transparency is made, it is then used for producing the photo stencil. The procedures for the Step Approach process are used to prepare the direct emulsion stencils from the continuous tone positive transparency.

Controlled Reticulation Process

Reticulation is produced by subjecting the emulsion layer of the film to extreme temperature change during the developing process. The resulting formation of wrinkled and cracked silver grains create unified patterns of tone similar to those produced by a texture screen. (The texture screen is used to superimpose an artificial design onto the photographic image.)

Many years ago, the reticulated effect was considered undesirable since it would occur accidentally as a result of carelessness. This happened when the film was subjected to a shift in temperature from treatment in cold stopbath or cold water rinse (lower than 50 degrees Fahrenheit) and then placed in warm fixer. Today, modern films have an improved imulsion that resists reticulation. It takes a considerable amount of effort and skill to produce the effect. A knowledge of how the film reacts to certain conditions would make it possible to achieve successful results with this process. Thinner emulsion film, such as 35mm, softens easier than the larger format roll or sheet film. The 35mm film format is recommended for use since the heavy sheet films are not affected by extreme changes in temperature during the developing process.

As a graphic control process, the reticulation effect may be created deliberately to produce a positive transparancy with intricate details. Since the process is unpredictable, records of the experimentation with the process using different types of films and temperatures should be kept to insure getting the desired results each time the process is tried.

A duplicate negative should be made of the image since this process has a permanent effect on the film and may result in the loss of the image. A 35 mm camera mounted on a copystand can be used to make duplicate negatives from the photographic print. A bulk loader for 35mm film may be used to provide ten or more frames to a roll of film, which is enough to copy several photographic prints.

Photographs having images with simple and uncomplicated detail are effective for this process. The textures created with this process add to the detail of the screen printed image, giving the illusion of tone. (See Appendix D, p. 119.)

Equipment. The following equipment is recommended for use in making a controlled reticulated image for screen printing: an electric burner or hotplate, three stainless steel tanks, one stainless steel reel, a thermometer (that reads past 180 degrees Fahrenheit), pot holders (to handle the hot stainless steel reels), and a stiff wire for transferring a reel from one tank to another.

Materials. The materials needed to produce a reticulated image are a roll of properly exposed black and white film, chemicals for processing black and white roll film (Kodak's D-76 or other developer suitable for roll film processing, stopbath, fixer, and a hypo or fixer eliminator).

Procedures. The following is a summary of procedures for producing a reticulated negative:

1. Choose subject matter or make a copy negative by exposing the roll film in a camera.

2. Develop the film according to the instructions provided by

the manufacturer. If Kodak's Tri-X 35mm roll film is used, the film may be processed in Kodak D-76 developer for moderately fine grain. Kodak recommends developing Tri-X film in D-76 developer for eight minutes if the temperature of the developer is 68 degrees.

3. Place a stainless steel tank partially filled with acetic acid on a burner. When the temperature of the stopbath reaches 140 degrees, it will be ready for use in the reticulation process. After the film has been developed, the developer is poured back into the storage bottle.

4. Using pot holders to remove the heated stopbath from the burner, place it on a trivet or surface that will not be harmed from the heated tank.

5. Turn the lights off and remove the lid from the developing tank and transfer the reel to the tank containing the heated stopbath.

6. Cover the tank with the proper lid and turn on the lights. The reel and film should remain in the heated stopbath for about one minute.

7. Drain the stopbath through the light trap opening of the tank.

8. Cold water (below 50 degrees Fahrenheit) is poured into the light trap opening of the film developing tank and allowed to remain for a period of one minute.

9. The cold water is drained, and hot water (180-190 degrees Fahrenheit) is poured into the tank for one minute.

10. The hot water is drained and another cold water bath is poured into the tank for one minute.

11. Drain the cold water and pour the chemical fixer into the film tank.

12. Fix the film according to the manufacturer's instructions. If Kodak's rapid fix is used, fix the film from two to four minutes.

13. Pour the fixer back into the proper storage bottle when fixation period is over.

14. Treat the reticulated film in hypo eliminator. Kodak requires two minutes treatment in Hypo Clearing Agent followed by a five minute wash. If the chemical is not available, the film will have to be washed for a longer period of time (i.e. as much as 30 minutes).

15. After the film is processed and completely dried, it is ready for enlargement. The negative is placed in the enlarger to produce the positive transparancy. Orthochromatic film should be used for making the positive transparancy from the reticulated negative. Once the positive transparancy has been made, it is ready for use in making the photo stencil for screen printing.

Halftone Process

There are several ways halftones may be reproduced by the screen printing process. The simplest way is to recopy (copy-dotting) an illustration that has been pre-screened. The process of "copy-dotting" requires care in exposing and processing the negative. The halftone illustration is copied using a (process) camera with an exposure setting for line copy. The exposed film is processed in a tray using the still developing technique to bring out the fine detail of the dots. This is done by placing the exposed film in the tray and rapidly rocking the tray for about the first twenty seconds of the developing time. The film is then allowed to remain still for about one or two minutes. Rapid agitation is followed until the image reaches uniform density during the developing time. After the film has been treated in the other chemical baths (stopbath and fixer), it should be rinsed and then examined with a linen tester. The shadow area of the negative should be represented with tiny black pinpoint dots; the midtone area should have a checkerboard pattern, and highlight area should appear as a black area white pinpoint dots. The dots in the negative should be the same size as the dots in the original illustration. Test exposures may be necessary to determine the aperture of greatest resolving power (the ability of the lens or film emulsion to record fine detail). The dots should appear identical in size to the halftone illustration upon examination. Loss of detail may be caused by overexposure or overdevelopment. The "copy-dot" process is limited to images that have the halftone pattern. For the purpose of practice and experimentation with screen printing the halftone image, this process could be used to copy halftone illustrations from magazines, newspapers, or any image that has a halftone dot structure. There are times when a screen printer receives an order to duplicate a halftoned image that is included as part of the camera ready paste-up. Knowledge of special processing techniques such as the still development technique, would enable the screen printer to make a reproduction of prescreen halftones with a minimal loss of detail.

The purpose of the halftone screen is to convert all of the grays in the continuous tone image into a series of dots. An illusion of smooth gradations of tone is created when viewing the halftoned image at ten or more inches. There are several ways of producing the halftone image for screen printing. Methods of producing a screened halftone include: the use of two sheet glass screens, single sheet glass screens, contact screens, and specially manufactured film (Kodak's Autoscreen film) that has a halftone dot pattern as part of the emulsion. For best results, the contact screen should be used. This is due to the preciseness of the dot structure provided with most contact screens.

The best way of producing a halftone positive is to make a copy negative on very fine grain film (such as Kodak's Panatomic X, ASA 32). A 35mm camera could be used to produce the copy negative. The negative (after completion of the chemical processing) is then printed onto a sheet of orthochromatic film. This is done by placing the negative in an enlarger. The contact screen is placed firmly over the unexposed orthochromatic film. The exposure is made and the film is processed in the proper chemicals to produce the screened halftone positive transparancy. To determine the proper mesh count and size of the halftone dots, a mesh determiner could be purchased from a screen printing supplier. The mesh determiner is placed in contact with the screen fabric. The mesh determiner is turned until a moiré star appears. The star pattern will point to a calibrated scale of numbers which indicate the size of the fabric's mesh openings. The same procedure is used to determine the dot size of the halftone positive transparancy. The dot size of the halftone positive transparancy should be large enough to cover the fibers of the screen fabric at a ratio of one halftone dot to four strands of fiber. (See Appendix D, p. 120.)

To produce a duotone, a normal halftone and unflashed halftone is each made from a negative in the enlarger. The halftone transparancies are made using orthochromatic film. A protractor is used to determine the screen angle of the halftone screen. The contact screen should be placed at a 30 degree angle when making the positive transparancy for the unflashed halftone. A stencil is made of each of the transparancies for screen printing the duotone effect.

Color separations may be made by placing a color photographic print on a copstand. A series of negatives are made by recopying the color photograph using a 35mm camera loaded with fine grain film such as Kodak's Panatomic X. Filters are placed in front of the lens of the camera. A blue (Kodak Wratten number 47B) filter is used to produce the negative for the yellow printer. A green (Kodak Wratten number 58) filter is used to produce the negative for the magenta printer. A red (Kodak Wratten number 25) filter is used to produce the negative for the cyan printer. Combining all three filters or using a neutral density filter produces the negative for the black printer. A record should be kept listing the order of exposures. The camera should be mounted in a fixed position when recopying the color photograph. This should assure accurate register of the separations. Once the negative separations have been developed and dried, the enlargement procedures may begin. This is done by placing the strip of negative separations in the enlarger. The negative for the yellow printer is positioned in the negative carrier. The carrier is placed in the enlarger. The enlarger switch is turned on so that the image of the negative printer is positioned and focused on the easel. The enlarger switch is turned off. An unexposed sheet of orthochromatic film is placed in the easel, emulsion side up. A vacuum easel may be used to insure firm contact between screen and film. A halftone screen is placed over the unexposed film at a precise angle of 90 degrees. Exposure is made and the film is processed in chemicals recommended by the manufacturer. Without changing the position of the enlarger lamphouse and easel, move the negative for the magenta printer into position. The focus, position, exposure time, and developing time should remain the same. The halftone screen should be at a 75 degree angle for the magenta printer. After processing the positive transparancy for the magenta printer, the negative for the cyan printer should be positioned in the enlarger. The screen angle for the cyan printer should be 105 degrees. The final separation is positioned in the enlarger after the cyan printer transparancy has been processed. The screen angle for the black printer should be at 45 degrees. To screen print a reproduction of the color photograph, a photostencil is made from each of the halftone separations.

<u>Equipment</u>. The following is a list of equipment needed for making a halftoned positive transparancy directly on film. Copystand, camera, film developing tank, enlarger, number 1A red safelight, developing sink, thermometer, trays, and tongs.

<u>Materials</u>. The following is a list of materials needed for making a halftoned positive transparancy: fine grain roll film such as Kodak's Panatomic X, chemicals for processing the film (developer, stopbath, and fixer), orthochromatic film, chemicals for processing orthochromatic film (A and B lith developers, stopbath, and fixer), and a halftone

screen (65, 85, or 100 line).

Procedures. The following is a summary of steps to be used in processing a halftoned positive transparancy:

1. The camera should be loaded with a fine grain film.

2. Mount the camera on the copystand.

3. Place the photograph on the copystand.

4. Position lamps on the copystand at a 45 degree angle so that the light is evenly distributed across the print.

5. After the necessary exposures are made, remove the film from the camera.

6. The film is then loaded in the developing tank. This process must be done in absolute darkness.

7. The film should be processed in chemicals recommended by the manufacturer. If Kodak's Panatomic X is used, it may be developed for five and three-forths minutes in developer D-76 at 68 degrees.

8. The film is developed in the remaining chemicals (stopbath, fixer, and hypo eliminator). After the film is processed and completely dried, it is ready for enlargement.

9. The negative is placed in the enlarger.

10. The safelight should be turned on.

11. The image from the negative is positioned and focused to the desired size on the easel.

12. Orthochromatic film is placed in the easel, emulsion side up.

13. The halftone screen is placed in firm contact over the film.

14. The enlarger timer switch is pushed to make the first exposure. To determine the main and flash exposure times, test strips should be made.

15. The negative carrier is removed from the lamphouse.

16. The timer switch is pushed to make the flash exposure as indicated from the test strip.

17. The exposed film is processed in lith developer such as Kodalith part A and B.

18. After developing, the film is placed in the stopbath and then in fixer.

19. The film is washed and dried. After the halftoned film positive transparancy is completely dry, it is ready for use in making the photostencil.

Texture Screens

Texture screens are used to form a structured pattern to the photographic image. Materials for preparing "home-made" textured screens may be made from cloth, wire, glass, hosery, or plastic. Commercially made screens manufactured with varied textures and line effects include: mezzotint (simulated grain pattern); concentric circle (sometimes referred to as a bulls-eye screen); and straight or wavy line screens. The screens are available from manufacturers like Caprock Developments, Inc. (475 Speedwell Avenue, Morris Plains, New Jersey, 07950); and Spiratone, Inc. (135-06 Northern Boulevard, Flushing New York, 11354). These companies will provide brochures which show examples of the various textures and line effects available.

The textured screens are referred to as special effect screens since they bring about interesting and eye-catching results. The effects from these screens add emphasis to the image. The disadvantage of using the commercially prepared textured screens is the expense. "Home-made" screens produce satisfying results and may be used if the commercially made screens are unaffordable. The best texture screen to use for screen printing is the mezzotint. This type of screen does not subject the image to undesirable moire patterns.

Texture screens are used in the same manner as halftone screens (i.e. the screen is placed over the film before the exposure is made). A slight loss of contrast may result in the image from using the texture screen. Test exposures on scrap film should be made to determine the exposure time for the desired contrast.

Other textural effects may be obtained by recording images from a television screen or an office machine (Xerox) copier. Using a 35mm camera loaded with pan film (such as Kodak's Tri-X film) the image from the television screen can be photographed. A slow shutter speed must be used (i.e. 1/30 of a second or below) to record the image that is formed on the television thirty times a second. Part of the television image does not appear if a faster shutter speed is used. The exposed film is processed in chemicals recommended by the manufacturer of the film. The negative is placed in the enlarger and projected onto a sheet of orthochromatic film. When developed, the lines formed on the image of the positive transparancy should appear similar to those created by a straight line contact screen. (See Appendix D, p. 122.) Using the office copier to generate copies from a continuous tone photo produces a grainy texture on the image that may be re-copied on orthochromatic film to produce a positive transparancy. The photographic print is placed on the glass platen facing the lens of the copier. The start switch is pushed to make a copy of the photograph. One of the most widely used non-silver halide copying processes is the electrostatic process. The copiers such as Xerox may be found in most school offices and libraries.

Equipment. The following equipment is needed to produce a positive transparancy using a texture screen: process camera, contact printer, trays, tongs, darkroom sink, and red (series 1A) safelight.

Materials. The following materials are needed to produce a positive transparancy using a texture screen: continuous tone print, texture screen, orthochromatic film, and chemicals to develop orthochromatic film.

Procedures. The following is a summary of steps for using the texture screen for making positive transparancies:

1. Prepare the trays and chemicals for processing orthochromatic film.

2. Place the continuous tone photographic print on the copyboard of the process camera.

3. Set timer for the basic exposure time for line negatives. If copy is being photographed with no reduction at 100 percent, the timer may be set at twenty seconds with the aperture set at f/16.

4. Turn on the safelight.

5. Place a sheet of orthochromatic film on the film back of the camera.

6. Use basic exposure time of twenty seconds.

7. Place the texture screen over the film after the first exposure is made.

8. Place the film back of the camera in position for the second

exposure.

9. Reset the timer to three times the basic exposure time. If a twenty second exposure time was used, a sixty second exposure time should be used.

10. After the second exposure is made, remove the film from the camera and process it in the proper chemicals. When the film positive is completely dry, it may be used to make the stencil for screen printing.

Solarization and Sabattier Effect

The solarization process is caused by extreme overexposure of the film when taking pictures with a camera. Years ago, this effect would occur during the night while making long exposures on film. The lights in the scene would overexpose the film, causing the image to appear almost as a positive on the negative. The same thing happens when shooting into direct sunlight or anything equally as bright. Today, this effect is difficult to produce because of improved films manufactured to prevent reversal during a long exposure.

The Sabattier effect is the process of reexposing photographic film or paper after two-thirds of the developing time. The Sabattier effect is referred to incorrectly as a solarization process, because of the similarities of the resulting image. The effect is named after a French photographer, Armand Sabattier, who is credited for the discovery of the process in 1862. The Sabattier effect is unpredictable unless a standard procedure is followed. A record of main exposure and flash times should be kept for controlled results. The results of this process may look similar to the outlined detail created by the tone-line and bas-relief processes. Just about any recognizable subject may be used for the Sabattier effect. Subject matter such as portraits of people or studies of buildings with textures and line detail solarize better than subject matter that is plain and open in detail. (See Appendix D, p. 123.)

Equipment. The following equipment is needed to produce the Sabattier effect for screen printing: an enlarger, a lamp for flashing the image with a 15 watt bulb, trays, thermometer, graduate cylinder, and a red number one safelight.

Materials. The materials needed to do the Sabattier effect are a contrasty negative with a recognizable subject, orthochromatic film and an extra tray filled with water.

Procedures. The following is a summary of steps for using the Sabattier effect to make positive transparencies.

1. Prepare a tray with (Kodalith) A & B lith film developer. To maintain contrast, Solarol may be used to add to the surrealistic effect created from this process. Most developers produce a muddy effect, caused by streaks on the image being solarized. Solarol may be obtained from photographic suppliers or directly from the manufacturer at the Solarol Company, Inc., P. O. Box 1048, El Cerrito, California, 94530. Either developer may be used for successful results.

2. The other trays should be positioned and prepared with the proper chemicals needed for the process. A second tray should be filled with stopbath and a third with fixer. After the film has been processed, it should be washed in running water.

3. The red number one safelight should be turned on and the room lights turned off.

4. Place the contrasty negative in the enlarger and expose it onto a sheet of orthochromatic film.

5. The exposed film is placed in the developer for one minute and fifty seconds, or two-thirds the normal developing time. (Solarol only requires a developing time of thirty-five seconds at seventy degrees Fahrenheit, diluted 1:1.)

6. Place the partially developed film in a tray of water. Above the tray of water should be a lamp with a fifteen watt light bulb. The lamp should be turned on cautiously with dry hands to avoid electrical shock.

7. Flash or re-expose the partially developed film for less than a second.

8. Return the film to the developer and complete the developing time.

9. Remove the film from the developer and continue the processing sequence in stopbath, fixer, and wash.

10. After the film has dried, it should be contact printed with another sheet of orthochromatic film. The formation of lines created from this should emphasize the detail of the image. Alexander Mackie first described the outline or halo-like effect around the image and called them Mackie lines. The lines produced on film by this effect may be used for preparing a photo stencil for screen printing.

THE BAS-RELIEF PROCESS

The bas-relief process is used to give the photographic image the appearance of a three-dimensional wood-cut or sculpture on paper.

Even though the resulting image is flat, the optical illusion of dimension is created by the exaggeration of shadow lines formed on the image. This is done by "sandwiching" a continuous tone negative and a continuous tone positive transparancy. The sandwich is placed in a contact printing frame over a sheet of unexposed film. Light is projected through the sandwich onto the unexposed film. The exposed film is developed to reveal an outlined image with emphasis in the shadow area. Variations of this process may be tried by experimenting until a desired effect is obtained (see Appendix D, p. 124).

Equipment. The following equipment is needed to make a bas-relief positive transparancy: enlarger; contact printer (or plate glass); timer; trays; hole punch; register pins; and thermometer.

Materials. The following materials are needed to make a bas-relief positive transparancy: a contrasty continuous tone negative; orthochromatic film; paper developer (such as Kodak's Dektol paper developer); stopbath; fixer; and transparent tape.

Procedures. The following is a summary of steps for producing a bas-relief positive transparancy:

1. Prepare the trays with the developer (Dektol mixed at a ratio of 1:2); stopbath; and fixer.

2. Turn on (red number 1A) safelights and turn off roomlights.

3. Place the negative in the enlarger and make a positive transparancy.

4. The negative is projected onto a sheet of orthochromatic film.

5. The exposed orthochromatic film is processed in the developer. The image, when processed, should appear as a transparent continuous tone positive.

6. After the film has dried, a contact print is made on another sheet of orthochromatic film to produce the continuous tone negative. The continuous tone negative should match the positive in size and density.

7. The continuous tone negative and positive are placed in contact together (emulsion to emulsion) to form a "sandwich."

8. Tape the negative and the positive together slightly out of register. If possible, this should be done over a light table.

9. Once the negative and positive have been taped to the desired position, punch holes (at least two) on the outside edge of the film.

10. Remove the tape and attach register pins to punched holes.

11. Position the film "sandwich" over a sheet of orthochromatic film.

12. Place the "sandwich" and orthochromatic film in a contact printer. If a contact printer is not available, position the lamphouse of the enlarger so that the lamp may be used as an exposure source. Place the "sandwich" and film on the base of the enlarger. A sheet of plate glass is placed over the "sandwich" and film for added pressure.

13. Turn on the enlarger lamp and expose the film through the "sandwiched" film negative and positive.

14. Develop the film (using Dektol developer mixed at one part developer and three parts water). Examine the film after processing. Results may not be satisfying at first. Several test exposures should be made to produce the desired effect. The resulting image should have

rich and bold shadow lines suitable for screen printing (refer to Appendix).

TONE-LINE PROCESS

Screen printing the tone-line process produces an image that appears similar to a pen and ink drawing (see Appendix D, p. 125). The effect is used for purposes of technical illustration to create firm lines that simulate a pictoral assembly drawing. The outlined image formed by this effect is created photographically and may be rendered with additional artwork using basic layout tools, such as T-squares, triangles, dividers, technical pens, and French curves. With these tools, extra line detail may be added to the tone-line image, giving it the appearance of a drawing prepared by a draftsman. A continuous tone photographic print is needed to begin the tone-line process. The print is converted (using orthochromatic film) into a line negative and positive of matching densities. The line negative and positive are taped together in tight register to make a film sandwich. The film sandwich is used to produce the tone-line effect.

Equipment. The following equipment is needed to produce a tone-line transparancy: a contact printing frame mounted to the turntable of a record player; a 75 watt enlarger bulb, cord, and socket mounted on a tripod; and trays to process the film.

Materials. The following materials are needed to produce a tone-line transparancy: a line negative and line positive (transparancy) from the same image matched in density and size; orthochromatic film; and chemicals for processing orthochromatic film.

Procedures. The following is a summary of procedures for producing a tone-line transparancy:

1. Prepare the chemicals for processing orthochromatic film.

2. Mount a contact frame to a record player turntable.

3. Mount the light source (75 watt bulb) on a tripod.

4. Position the light source so that the bulb is facing the contact printer at a 45 degree angle. The bulb should not be closer than three feet.

5. Tape the line negative and positive in close register. The sandwiched film may be punched with holes on the excess margin of the film and held together with register pins.

6. Turn on the safelights and turn off the room lights.

7. Place a sheet of unexposed orthochromatic film (emulsion side up) on the base of the contact printer.

8. Place the "sandwiched" line negative and positive over the unexposed film.

9. Lower the glass of the contact frame over the film.

10. Turn the power switch on to the record player. The speed of the turntable should be set at 78 r.p.m.

11. Turn on the light source. The amount of time is determined by making test exposures.

12. Remove the film from the contact printer after the exposure has been made.

13. The film is then processed in developer (such as Kodalith A and B), stopbath, and fixer. Once the film has been washed and completely dried, it is ready for use in making the photo stencil for screen printing.

Chapter V

PHOTOGRAPHIC STENCILS

The technology for today's photographic stencil can be credited to William H. Fox Talbot. Around 1852, Talbot started using potassium bichromate as a sensitized solution for making his colloid negatives. He discovered that when one added potassium bichromate (a photosensitive salt) to a gelatinous emulsion, exposure to light caused this mixture to harden and become insoluble in water.[24]

The gelatin emulsion Talbot used might have been made from a substance such as glue, albumen (egg white), or animal hides. Animal hides were usually prepared by being soaked in lime, delimed in acid, washed, and then cooked. The crude gelatin was filtered until it set up as a jelly; then it may have been cut and dried into slices for application as a film emulsion. Talbot concluded that light energy has an actinic effect on a sensitized colloid, changing it from a soluble state to an insoluble state. Colloid, a gelatinous substance, is derived from the Greek word "Kolla," meaning glue.[25]

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[24] J. I. Biegeleissen, Screen Printing, (New York: Watson-Guptill Publications, 1971), p.65.

[25] C. E. Kenneth Mees (D. Sc., F.R.S.), From Dry Plates to Ektachrome Film, (Rochester, New York: Ziff Davis Publishing Company, Eastman Kodak, 1961), p.3.

The Direct Emulsion

Today's modern photostencil can be described as a synthetic colloid. That is, the screen may be coated with a liquid emulsion made of either Poly vinyl-alcohol (PVA) or a mixture of Polyvinyl-alcohol-acetate (PVA/PVAC).[26] These solutions may be purchased unsensitized from a screen printing supplier. The choice of diazo or dichromate sensitizers may also be purchased separate from the base emulsion coating, or it may be purchased ready for use with a sensitizer premixed.

The dichromate sensitizers (ammonium or potassium dichromate) take several hours to set up when mixed with the base emulsion. If possible, the mixture should be allowed to set up overnight. After letting the mixture set a few hours (or when the coating has dried on the screen), the dichromate sensitized emulsion should be exposed and developed as soon as possible (usually within a period of twenty-four hours after dichromate has been mixed with the emulsion base). This is necessary since dichromate-sensitized emulsions will harden without the action of light.[27]

The diazo sensitized emulsion may be used immediately after it is coated and dried onto the screen. The diazo coated screen may also be stored up to three months at room temperature (six when refrigerated), allowing many screens to be coated at one time and stored for later use.

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[26]E. J. Kyle, "Modern Photo Stencils," Part 6, Screen Printing Magazine, (Cincinnati, Ohio: Signs of the Times Publishing Company, September 1974), p. 26.

[27]Ibid, p. 27.

Ratios for adding sensitizers to emulsions will vary depending on the manufacturer of the product. Some manufacturers prefer that their emulsions be mixed at a ratio of one part dichromate sensitizer to four parts emulsion (Hunt Speedball Direct Emulsion), whereas some recommend using a ratio of one part sensitizer to seven parts emulsion (Advance Direct Emulsion). Whatever product is used, the manufacturer's instructions for preparing the emulsion should be followed. Basically, the sensitized direct emulsion solution is coated onto the screen mesh, allowed to dry, and then placed in contact with a positive transparency. Next, the stencil is exposed to an actinic light source.[28] During exposure, areas of the transparency exposed to light will harden. After exposure, the screen is developed by spraying both sides of the screen with warm water (temperature of the water as specified by the manufacturer of the emulsion). Areas of the screen not exposed to light will wash away, creating a stencil on the fabric.

The stencil may be reclaimed from the screen by using a household bleach mixed at a ratio of one part bleach to ten parts water. Special reclaimers may be purchased from screen printing suppliers for removal of direct emulsion stencils. Before reclaiming, the ink should be completely removed from the screen. Doing this would allow the stencil to break down during the reclaiming operation without interference from the ink.

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[28]The polycop contact exposure unit is recommended for use with frames coated with direct emulsion. For detailed instructions using the polycop, refer to Appendix E.

Transfer or Indirect Stencils

A controlled coating of synthetic colloid is applied onto a backing sheet, creating a transfer or indirect stencil. When the indirect stencil is exposed, developed (some do not require special chemical developers), and washed out, the stencil reacts like the direct emulsion. Exposure to an actinic light source causes the exposed areas of the indirect emulsion to harden and non-exposed areas of the stencil to wash away.

The screen should be prepared by degreasing the fabric with a detergent or scrubbing the fabric with a powdered cleanser. This will allow the emulsion to transfer from the backing sheet and adhere with ease to the printing fabric.

The transfer film or indirect stencil is placed in contact with the positive in an exposure unit. (The exposure unit necessary for this type of stencil is one that will provide an intense actinic light source). Offset plate exposure units may be used for exposing the indirect film. Indirect stencil film (which lies flat in the exposure unit) has an advantage over direct emulsions. Screens coated with direct emulsions require a flexible vacuum back that will stretch to the form of the frame. Most graphic arts laboratories are outfitted with plate makers, which make the use of photo stencils accessible to the graphics program.

When exposed, the indirect film is placed in a developer or directly washed out. This depends on the manufacturer of the stencil film, since they have their own specifications for processing indirect stencil film. A developer such as a commercially prepared chemical solution of hydrogen peroxide may be used. (Most of the Ulano type Blue Poly 2 films require the Ulano High-Fi developer. The Autotype Company produces an indirect stencil that just requires a washout for developing the stencil image.)

During the washout stage, the film is sprayed with warm water until the image appears. When the washout is complete (from visual inspection) the film should be given a spray of cold water to chill the emulsion. This will fix the image on the stencil, since the stencil is very soft from the warm water.

The stencil is then ready to be adhered to the screen. This is done by blotting the stencil with unprinted newsprint paper. The stencil film is immediately placed on a pad of paper for support after the washout. The stencil should lie as flat as possible to prevent air bubbles from keeping the stencil from adhering evenly. The screen is placed over the wet stencil. The blotting procedure is repeated until no moisture remains on the newsprint. Printed newsprint should not be used, since the ink on the newsprint repels moisture from the stencil film, causing it to adhere unevenly. When the stencil has completely dried (when attached to the fabric), the backing sheet is removed and the screen is ready for printing preparation (blockout, applying tape to the frame, etc.).

This type of stencil is excellent for use in the classroom since water is required for cleaning the stencil off the fabric. The unexposed stencil should be handled carefully by keeping it away from bright lights and by storing it in a light tight container. Denting the indirect stencil film should be avoided since that may affect the adhering process.

(Transfer) Indirect-Direct Photographic Film

The indirect-direct photographic film stencil has a resistance to most solvents with the exception of household bleach. Household bleach may be used to remove this stencil when reclaiming the screen. This stencil is ideal for industrial use, because it is able to withstand long production runs. Also, the small "jagged saw-tooth" edges on the stencils' image is minimized, since there is less shrinkage when the stencil is drying on the screen mesh openings.

The chemical makeup and application to the screen fabric of the indirect-direct stencil is very similar in handling to the direct couted screens. The indirect (transfer)-direct stencil is prepared by coating the screen with a substance similar to glue. A polyvinyl backing, with the emulsion side up, is attached to the bottom side of the freshly coated screen. The screen is allowed to dry. When dried, the screen is then sensitized by painting on ammonium bichromate with a smooth haired brush. This procedure should be performed in subdued lighting, so as to prevent the stencil from prematurely hardening. When dried, the polyvinyl backing is removed, and the screen is ready for exposure and washout.

Chapter VI

SCREEN PRINTING THE GRAPHIC CONTROL PROCESSES

Preparatory Steps

The printing process begins once the stencil has been made from any of the graphic control positive transparancies. Preparation for printing should begin by gathering the necessary materials and equipment for screen printing. The screen fabric should be cleaned with an enzyme cleanser and then degreased before adhering the stencil. A screen with a transfer stencil should be wiped with turpentine to remove the adhesive residue left from the backing sheet. This is done to the underside of the screen. A well sharpened squeegee blade with appropriate length and hardness is needed to force the ink through the openings of the stencil. The tip of the squeegee blade should be free of dried ink residue, replaced if warped, or sharpened if needed. The correct type of ink should be chosen for the substrate to be printed. Modifiers such as reducers and transparent base may be added to the ink to aid in the printing of fine detail. Registration tabs or guides should be prepared from thin strips of cardboard. Benzene cans or plunger containers should be filled with proper solvents for cleaning and thinning inks. the printing area should be set up and arranged with the following equipment and materials: the screen printing unit (frame and printing base with a hinging system to hold frame); ink knife for scooping and mixing ink; gummed tape for masking inside and outside the screen frame; a rack or system for drying the screened prints; transparent (Scotch) tape for emergency blockout repairs; five mil acetate sheet (size larger than image to be printed); paper cut to size; rags for cleanup; and separate waste receptacles for rags and paper.

Prepare the stencil and adhere it to the stretched fabric on the frame according to manufacturer's instructions. Areas around the image not to be printed should be closed with proper blockout. Water soluble blockouts should not be used with water soluble stencils; otherwise, the stencil will disolve. Lacquer base or similar blockout solutions specially prepared for water soluble stencils should be used. Gummed tape may also be used for blocking out around the stencil if there is a reasonable amount of space from the image. (Optimum printing space requires two inches from the image to the edge of the frame.) The frame should be attached to a rigid printing base. Hinge clamps mounted on the printing baseboard may be effectively used for holding the frame in place.

Screen Printing Procedures

The following guidelines list basic procedures that may be used for screen printing any of the graphic control processes.

1. Prepare and arrange screen printing equipment.

2. Select the type of photostencil. (e.g. If Ulano Blue Poly 2 is used, mix and combine Hi-Fi Developer A and B as part of the preparatory stage of the process. The selection of this type stencil should be based on the detail and number of copies that are to be printed. A

chart recommending the type of stencil, fabric, ink, and substrate for screen printing the graphic control processes is included in Appendix F of this thesis.

3. Place the sensitized photo stencil in contact with the selected graphic control process transparancy in the exposure unit.

4. Expose the stencil.

5. Remove the stencil from the exposure unit.

6. Develop the stencil if required.

7. Wash out stencil.

8. Adhere stencil screen (unless it is a direct emulsion screen.)

9. Use blockout filler around the stencil. Mask the inside and outside of the screen frame with gummed tape to keep ink from seeping into the wood where the screen is attached. This allows easier cleaning of the fabric and screen frame.

10. Attach screen frame to the screen printing baseboard by inserting hinge pins or placing the frame in hinge clamps.

11. Tape thick (1/8" to 1/4") strips of cardboard to the outside corners opposite the hinged side of the frame. These should be attached to the underside of the screen for off-contact printing. Hinge clamps mounted on the printing baseboard are appropriate for use with the off-contact printing method. The rear side of the printing frame attached to the clamps is elevated about one eighth of an inch from the baseboard. The cardboard should be added to the other side of the printing frame opposite the clamped side to keep the frame level. The pressure from pulling the squeegee causes the print to separate from the underside of the screen due to the elevation of the frame. This method of printing

is recommended for screen printing images with extremely fine detail.

12. Tape a sheet of five mil acetate to the side of the baseboard. The sheet of acetate should be positioned directly underneath the image of the stencil. The acetate should be slightly larger than the size of the paper to be printed.

13. A small amount of ink is added to an area above the image inside the screen frame.

14. The squeegee is placed inside the frame so that the blade is evenly touching the ink. The squeegee is pulled (using both hands) at an approximate angle of 60 degrees. Enough pressure should be used in one pass of the squeegee to force the ink through the stencil openings.

15. The frame is then raised, allowing the kick stand to support the frame. The squeegee is used to flood the image area of the stencil with ink. This keeps the stencil from becoming clogged with ink.

16. The image printed on the plastic acetate is examined and then corrected for any pinholes caused by the stencil. If the damage to the stencil is extensive for a simple repair using tape, then the stencil should be remade.

17. When corrections have been made, the size paper to be printed is placed underneath the printed plastic.

18. The paper is positioned until the desired margins have been found. A line gauge may be used to aid in establishing the margins.

19. Using a pencil, lines are drawn on the outer edge of the corner of the paper. (as part of preparing the screen printing unit,

the baseboard should be covered with kraft paper so that lines may be easily drawn on a clean surface that is protected from ink spills.)

20. After the margins have been established, three register guides are positioned on the marked lines. Two register guides should be positioned near the front of the screen printing unit and the third one should be positioned on the same side as the kickstand (see Figure 8).

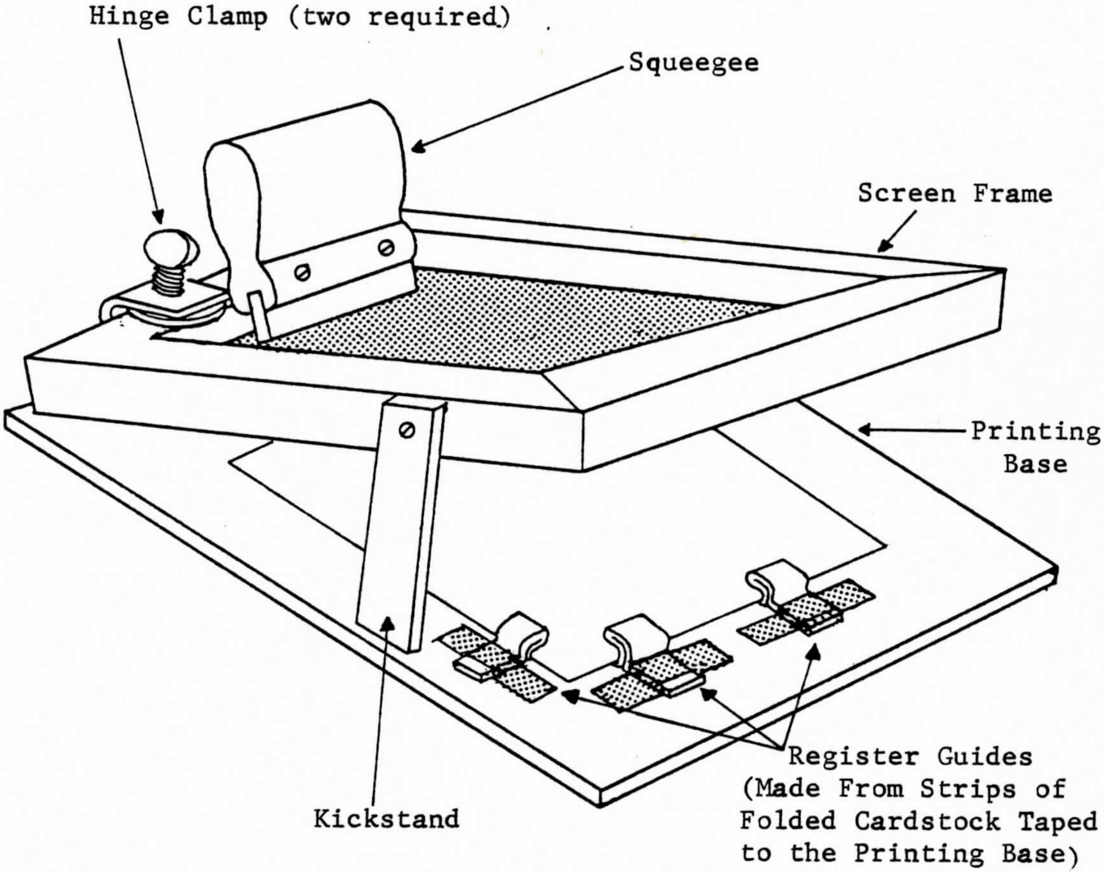

Figure 8. Screen Printing Unit

21. The plastic acetate is removed, and the screen is lowered to produce the prints. (A waterless hand cleaner and some rags should be kept near the printing unit to keep hands clean.) A screen will be needed for each color to be printed. The frame should be checked during

the printing run to make sure that it is not loose at the hinge. The fabric should also be checked to make sure that it is tight. Loose frame and fabric cause register problems.

22. After printing the first color, surplus ink is removed from the screen and returned to the ink container.

23. The screen is disengaged from the hinges and placed over several layers of newspapers.

24. The proper cleaning solvent for the type of ink used is poured onto the screen.

25. Rags are used to remove the ink from the screen. The solvent should loosen the ink so that it can be wiped off with rags.

26. The screen should then be held in a vertical position and scrubbed from both sides. The fabric may be placed in a reclaiming trough to soak. This should remove the stencil and ink. After the screen has been completely reclaimed, it is ready for the next stencil.

Chapter VII

CONCLUSION

The use of graphic control processes such as bas-relief, Sabattier effect, solarization, reticulation, posterization, tone-line reproduction, halftone, and textured screen effects expand the scope of the existing screen printing program. This program enrichment should provide more options for the independent study curriculums or large group instruction for students desiring to increase their technical knowledge and competencies of the photographic screen printed processes. Further study of the graphic control processes may be field tested among schools equipped with a graphic arts laboratory to determine the effectiveness of this "working guide." This, in the opinion of the author, is in agreement with the philosophy of Albert Kosloff, who said "Photography has revolutionized and contributed to the growth of screen printing as it has contributed to other phases of printing." The use of screen printing photographic imagery produces "a method of printing that is limitless," as it encourages the use of one's perceptive and creative abilities. In the industrial education curriculum, the development of such abilities is increasingly challenging with changes and advancement of technology.

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APPENDICIES

Appendix A

November 18, 1980

Mr. Micheal Gene Davis
Graphics Arts Department
Asheville High School
Asheville, North Carolina

Dear Mr. Davis,

I am compiling a survey among graphic arts educators in North Carolina to determine the need for a curriculum guide for the instruction of photographic screen printing. A series of experiments on screen printing selected graphic control processes have been made during the last two years. A guide has been developed explaining the procedures of screen printing the graphic control processes. Two copies of the completed study will be available through the Belk Library at Appalachian State University after the present study is completed.

Your help in filling out this survey will be greatly appreciated, and will be of great value in determining the need for a guide to photographic screen processes. Please answer the enclosed survey and return it to me by December 10, 1980. A prepaid envelope has been enclosed.

Thankyou for your help,

John R. Craft

Appendix B

QUESTIONNAIRE

1. Does your graphic arts curriculum include the instruction of photography?
   - ☐ yes
   - ☐ no

2. Does your graphic arts curriculum include the instruction of screen printing?
   - ☐ yes
   - ☐ no

IF ANSWER IS NO TO EITHER OR BOTH QUESTIONS ONE AND TWO, PLEASE CONTINUE ON TO QUESTIONS FIVE AND SIX.

3. What is included in your screen printing program? (Check as many as apply.)
   - ☐ Handmade stencils
   - ☐ Water soluble commercially prepared stencils
   - ☐ Direct photo stencil preparation
   - ☐ Indirect (transfer) photo stencil preparation
   - ☐ Typewritten stencil
   - ☐ Tushe-resist stencil
   - ☐ Decalcomania or pressure lamination printing
   - ☐ Screen printing of cylindrical surfaces
   - ☐ Multiprinting on fabric
   - ☐ Multicolor reproduction techniques
   - ☐ Textile printing
   - ☐ Screen printing with the use of automatic or semi-automatic presses
   - ☐ A study of screen printing inks
   - ☐ A study of screen printing fabric
   - ☐ A study of squeegees
   - ☐ A study of screen printing photographic effects such as posterizations and tone-line reproductions
   - ☐ A study of printing on different surfaces; such as wood, metal, plastic, leather, paper, and glass

4. If your program includes the instruction of photo stencils, which process is stressed?
   - ☐ Direct emulsion
   - ☐ Direct emulsion with backing sheet support (direct-indirect)
   - ☐ Indirect (transfer) stencil

5. Do you feel graphic control processes (posterization, solarization/Sabattier effect, tone-line reproduction, bas-relief, halftone,and texture screens) could prove useful as a source for meeting your course objectives for the instruction of photographic screen printing?
   - ☐ yes
   - ☐ no

6. If such a curriculum guide were available that would provide the graphic control processes and procedures for the teaching of photographic screen printing, would you be interested?
   - ☐ yes
   - ☐ no

PLEASE FEEL FREE TO MAKE ANY COMMENTS IN THE SPACE PROVIDED

____

____

____

Appendix C

RESULTS OF SURVEY

I. **Number of Graphic Arts Instructors surveyed:** 30

II. **Number of surveys returned:** 28

III. **The schools participating in the survey:**
Appalachian State University, Asheville High School, Central Piedmont Community College, Chapel Hill Senior High School, Chowan College, Cummings Senior High School, Davie High School, Drexel High School, Drexel High School, East Carolina University, East Mecklinburg High School, E. E. Smith Senior High School, Havelock High School, Jacksonville Senior Highschool, Lexington Senior High School, McDowell Technical College, North Carolina State University, North Iredell High School, Pisgah Senior High School, Roanoke Rapid High School, Southwestern Technical Institute, West Stanly High School, and Wilkes Vocational Center

IV. **Findings:**

1. Does your graphic arts curriculum include the instruction of photography?

   23 yes

   5 no

2. Does your graphic arts curriculum include the instruction of screen printing?

   22 yes

   6 no

3. What is included in your screen printing program?

   17 Handmade stencils

   12 Water soluble commercially prepared stencils

   15 Direct photo stencil preparation

   17 Indirect (transfer) photo stencil preparation

   1 Typewritten stencil

   4 Tushe-resist stencil

   3 Decalcomania or pressure lamination printing

   3 Screen printing of cylindrical surfaces

   11 Multiprinting on fabric

   18 Textile printing

   1 Screen printing with use of automatic or semi-automatic presses

   9 A study of screen printing inks

   8 A study of screen printing fabric

   8 A study of squeegees

   8 A study of screen printing photographic effects such as posterizations and tone-line reproductions

   13 A study of printing on different surfaces; such as wood, metal, plastic, leather, paper, and glass

4. If your program includes the instruction of photo stencils, which process is stressed?

   10 Direct emulsion

   3 Direct emulsion with backing sheet support (direct-indirect)

   16 Indirect (transfer) stencil

5. Do you feel graphic control processes (posterization, solarization/Sabattier effect, tone-line reproduction, bas-relief, halftone, and texture screens) could prove useful as a source for meeting your course objectives for the instruction of photographic screen printing?

   23 yes

   1 no

6. If such a curriculum guide were available that would provide the graphic control processes and procedures for the teaching of photographic screen printing, would you be interested?

   27 yes

   0 no

Appendix D

EXAMPLES OF GRAPHIC CONTROL PROCESSES

POSTERIZATION
First Color Progressive Proof

Appendix D (continued)

POSTERIZATION
Second Color Progressive Proof

Appendix D (continued)

POSTERIZATION

Second Color Printed Over First Color: 3-Tone Posterization

Appendix D (continued)

POSTERIZATION
Third Color Progressive Proof

Appendix D (continued)

POSTERIZATION

Third Color Printed Over First And Second Color: 4-Tone Posterization

Appendix D (continued)

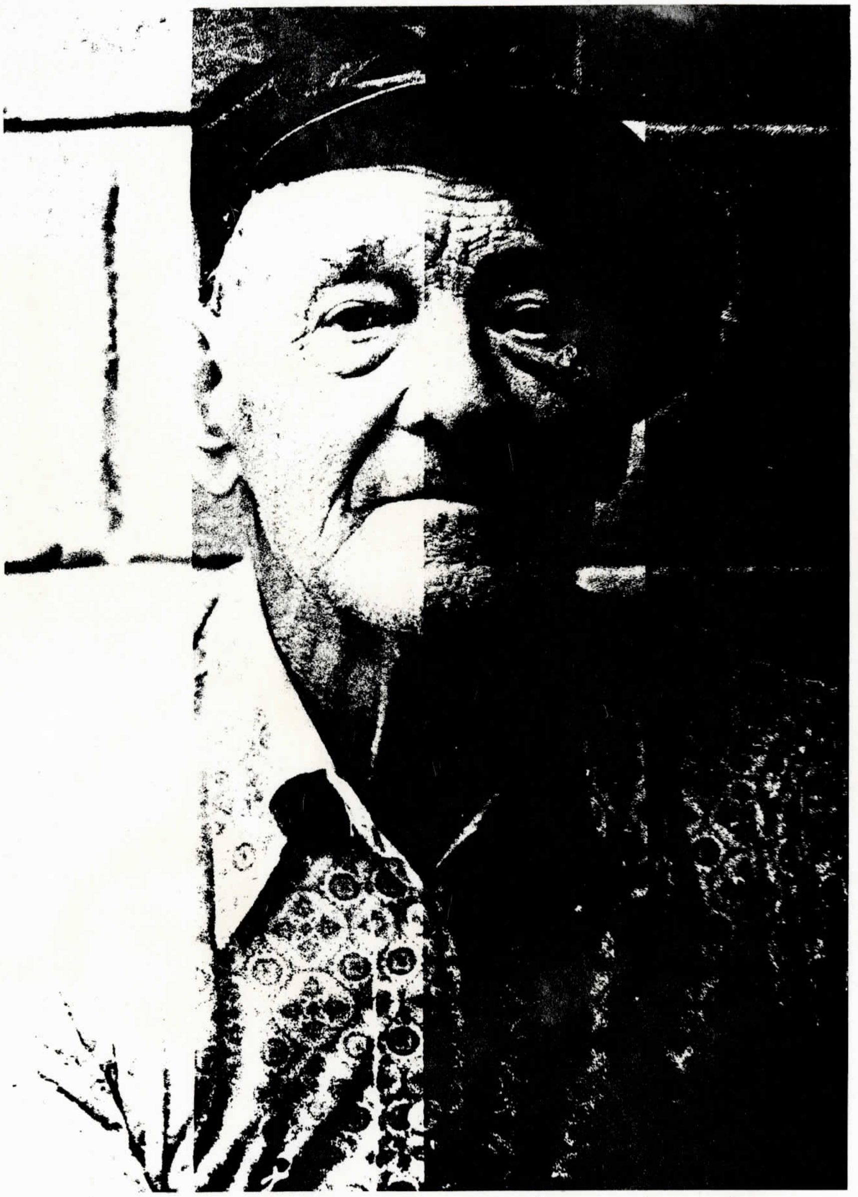
POSTERIZATION
Fourth Color Progressive Proof

Appendix D (continued)

POSTERIZATION

Fourth Color Printed Over First, Second, And Third Color: 5-Tone Posterization

Appendix D (continued)



EXPOSURE				
1st	4	4	4	4
2nd		4	4	4
3rd			4	4
4th				4
Total Seconds	4	8	12	16

TEST STRIP

The test strip is used to determine the exposure times for making density separated positive transparancies for posterizations from orthochromatic film.

Appendix D (continued)

CONTINUOUS TONE REPRODUCTION:
Enlarged Grain Structure

Appendix D (continued)

CONTROLLED RETICULATION

Appendix D (continued)

HALFTONE

Appendix D (continued)

TEXTURE SCREEN: Mezzotint

Appendix D (continued)

TEXTURE SCREEN: Television Screen

Appendix D (continued)

SOLARIZATION

Appendix D (continued)

BAS-RELIEF

Appendix D (continued)

TONE-LINE PROCESS

Appendix E

PROCEDURES FOR USING THE POLYCOP

1. Position the contact frame in the horizontal position.

2. Unlock the frame so that the frame with the rubber back is raised in the upright position.

3. Position the image (positive) on the glass so that it appears right reading.

4. Place the coated screen frame or transfer film in contact with the image (positive).

5. Place the cord along the glass from the vacuum opening to the inside of the screen printing frame. The type of cord for use with the polycop can be clothesline cord or the same that is used for stretching screen printing fabric on the frame. The use of the cord would allow for better vacuum pressure.

6. Place foam rubber along the corners of the screen printing frame. This is necessary for the protection of the rubber blanket from rips or punctures caused by sharp corners of the screen printing frame. The rubber blanket may be repaired with materials similar to a simple automobile patching kit.

7. Secure the latch after lowering the framed rubber blanket over the coated screen printing frame, positive, and glass.

8. Turn the vacuum switch on. The pressure gauge should read from 20 to 25 lbs. psi.

9. Swing the frame into the vertical position once the correct pressure is reached. So that this can be done, a release latch is pulled, allowing the vacuum frame to be guided into position.

10. Move the light source into position in front of the polycop vacuum frame. Depending on the source of light and the distance to the polycop, the exposure time can be determined by the step wedge test. The step wedge test may be used for establishing exposure factors for various stencils. Information on making a step wedge test is included in most instructions for the stencils supplied by the manufacturer. The test involves removing strips of thick cardboard tape to the outer glass facing the light source. Each strip of cardboard is removed at different stages of time when the stencil is being exposed. For example, the strips of cardboard are taped to the glass covering the stencil. For every ten seconds that pass when the exposure light is turned on, a

strip could be removed. The result would be a series of densities on the stencil allowing the processor to select the best time needed for exposing stencil with the exposure unit available.

11. Turn off the light source and shut off the vacuum after exposure of stencil is completed. After that, the frame latch or locks may be opened so that the washout procedures for developing the image be started.

Appendix F

MATERIAL APPLICATIONS CHART
FOR SCREEN PRINTING GRAPHIC CONTROL PROCESSES

GRAPHIC CONTROL PROCESSES

Tone-Line	Bas-Relief	Solarization/Sabattier Effect	Textured Screen	Halftone	Reticulation	Continuous Tone (Step Approach)	Posterization		
✓	✓	✓	✓	✓	✓	✓	✓	Monofilament	FABRICS
	✓						✓	Multifilament	
✓	✓	✓	✓	✓	✓	✓	✓	Direct Emulsion	PHOTO STENCILS
✓	✓	✓	✓	✓	✓		✓	Indirect Film	
							✓	Direct/Indirect	
✓	✓	✓	✓	✓	✓	✓	✓	Poster	INKS
	✓		✓				✓	Lacquers	
	✓		✓				✓	Acrylic — Water Soluble	
	✓		✓				✓	Enamel	
✓	✓	✓	✓	✓	✓	✓	✓	Paper (Sub 90)	SUBSTRATES
✓	✓	✓	✓	✓	✓	✓	✓	Card Stock (over Sub 110)	
							✓	Masonite	
			✓				✓	Metal	
	✓		✓				✓	Glass	
	✓						✓	Wood	
✓	✓		✓	✓			✓	Textiles	
	✓		✓				✓	Plastics	

VITA

John Rufus Craft, Jr. was born in Fort Jackson, South Carolina on February 21, 1951. He attended elementary schools in Fayetteville, North Carolina and was graduated from Seventy-First High School in June 1969. On September 1970, he entered Sandhills Community College in Southern Pines, North Carolina and after two years, received an Associate in Arts Degree. In the fall of 1972, he entered Appalachian State University and after three years received the Bachelor of Science Degree with a major in Industrial Education. In the fall of 1975, he accepted a teaching assistantship at Appalachian State University and began study toward a Master's Degree.

In the fall of 1976, Mr. Craft began employment for the Lexington County Schools in South Carolina. In the summer of 1978, he became the Graphic Communications Instructor at Mitchell Community College in Statesville, North Carolina.

The author is a member of the Graphic Arts Technical Foundation, Printing Industries of the Carolinas, The Charlotte Club of Printing House Craftsmen, and the Inplant Printing Managers Association.

Mr. Craft resides at 437 Walnut Street, Statesville, North Carolina.

His mother is Mrs. Mary Ornes Craft of Melbourne, Florida. His father, Mr. John Rufus Craft, Sr., is deceased. Mr. Craft, Sr., had served in the United States Army for thirty-three years.