Commercial Screen Printing

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Introduction

The silk screen printing process is a stencil method of printing in which the ink, in the form of a semi-fluid paint-like substance, is forced through a mesh on to whatever surface is to be printed.

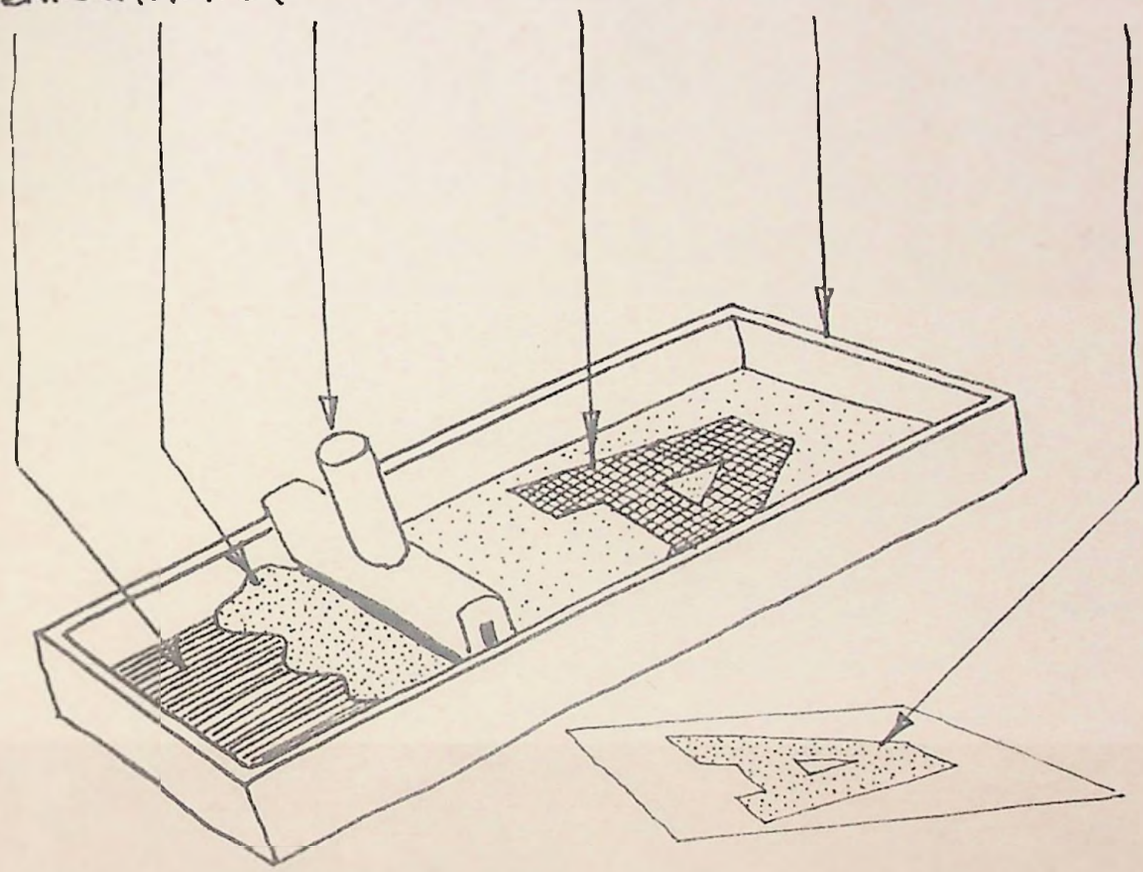
The fundamental requirements for screen printing are a fine mesh, stretched and mounted on a frame; a stencil is then adhered to the screen in which the non printing areas are protected by the stencil. The printing is achieved on a simple press by feeding paper or whatever material is to be printed under the screen. One then applies the ink to the screen, spreading and forcing it through the fine mesh openings in the stencil with a rubber squeegee.

Versatility is the principle advantage of screen printing Any surface can be printed – wood, glass, metal, fabric, plastic etc. in any shape or design, any thickness or size. In advertising, screen printing is used for posters, banners, decals (transfers) showcards, displays, novelty items etc. Heavy boards can be printed direct eliminating costly mounting. Wallpapers, draperies and textiles can be printed by the screen process method. There are also many new applications for screen printing such as the printing of electronic circuits, the screening of adhesives and numerous other non-graphic applications.

For the multiple reproduction of designs or images in any number of colours or printing compounds on to the widest possible range of materials, it is the least expensive and most versatile method yet evolved.

PRINCIPLE OF SCREEN PRINTING

* FABRIC * INK * SQUEEGEE * STENCIL * FRAME * PRINTED IMAGE *



Section 1.

History.

History

Commercial screen printing as we know it today, had its beginings in the early 1900s, but the basic principle of reproducing by means of a stencil have been known for centuries. Archaeologists believe that the Egyptians used stencils to ornament buildings and their contents. The stencil method of decoration later influenced design applications by the Romans, Normans, Greeks and Gauls. At the same time China was entering into European trade markets with items with finely detailed decoration which was achieved with stencils made from tiny pieces of rice paper held together with strands of human hair. Beyond these brief historical accounts there is very little reference to further developments or use of the stencil printing process.

In 1907 a patent relating to silk screen printing was granted to Samuel Simon of Manchester, England. The Simon patent covered the use of the screen as a carrier for the stencil, but it did not include a squeegee. Simon used a bristle brush instead of a squeegee to force the paint through the silk.

Although the process had its uncertain beginings in China, Japan and Europe it was in America that it was first developed and exploited as a commercial craft. In 1914 a multicolour screen process was perfected by a commercial artist named John Pilsworth of San Francisco. He was later granted a patent for screening several colours from a single screen, this was known and commercialized as the Selectasine method. At about the same time, Louis D'Autremont in Dayton Ohio, advanced a multi-layered knife cut stencil film. These early developments

emerged basically at the demands of an industry that was begining to show definite signs of growth. By 1915 the screen printing of automobile spare tyre covers was a boom trend in the industry and it keyed several operations into large volume business. This era 1910 to 1919 is considered as the fathering of commercial screen printing. The escalating demand for identical outdoor signs produced in quantity, the sudden demand for highway markers, instore signs and general point of sale displays were ideal markets for this new facet of printing.
One of the most significant developments in the industry came in the 1930s when Joe Ulano, a foreman in a New York screen shop developed a film which he patented as Nufilm. This was to be the forerunner of photographic stencil making and the elimination of a number of problems associated with solvent resistance and stencil adhesion to screens.

The industry recieved a major educational boost in 1942 and the years following when the U.S. armed services made extensive use of screenprinting. The process was used in producing markings, training aids and displays as well as electronic circuits. The indepth training provided at military bases throughout the country was undoubtably the biggest educational lift the industry had experienced at any time in its previous history. For many it provided career orientation as the nation returned to peace in 1945, and did much to expand the industry base. for the years ahead.

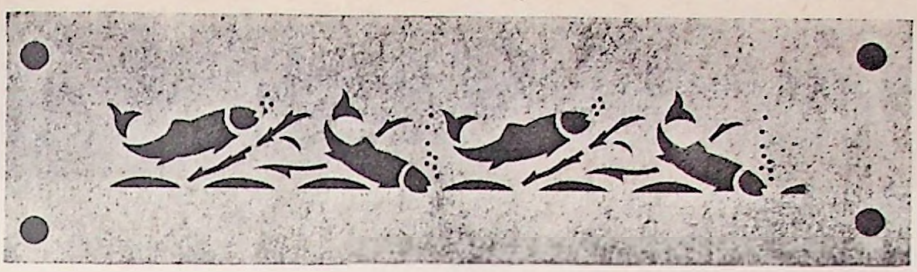
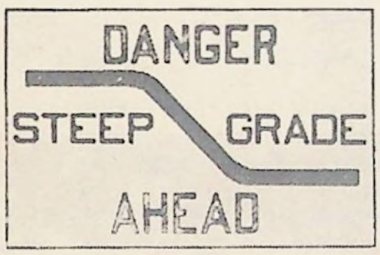
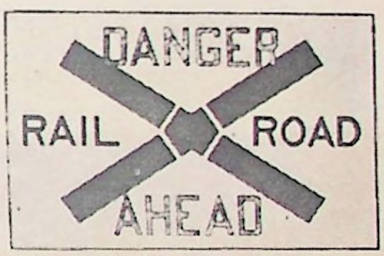


FIG. *a.—Decorator's paper stencil.* Showing ties or bridges worked into the design to keep the integral parts of the stencil together.

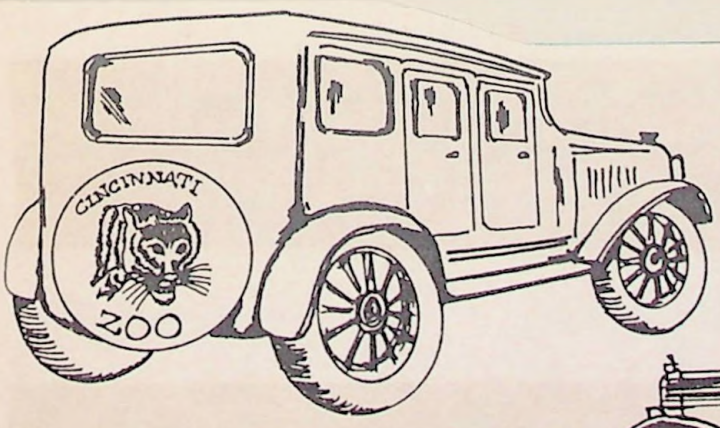
FIG. *b.—Japanese stencil.* Tieless Japanese stencil showing the intricate handcut design held together by fine strands of hair.

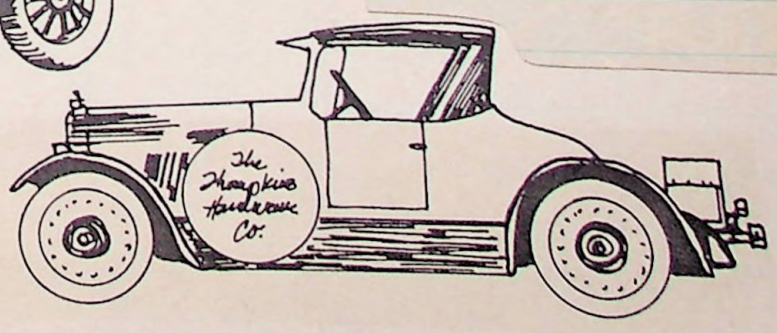




Some early examples of Commercial Screen Printing.

The display card above, screen printed for Montgomery Ward's about 60 years ago, is an early example of the use of screen printing to produce quantity signs for the retail market.





The screen printing of spare auto tire covers was such a hot commercial venture in 1915, that it sparked the growth of many large screen operations and led to the belief among many in the industry that this period marked the beginning of commercial screen printing.

Section 2.

Basic Equipment and Tools.

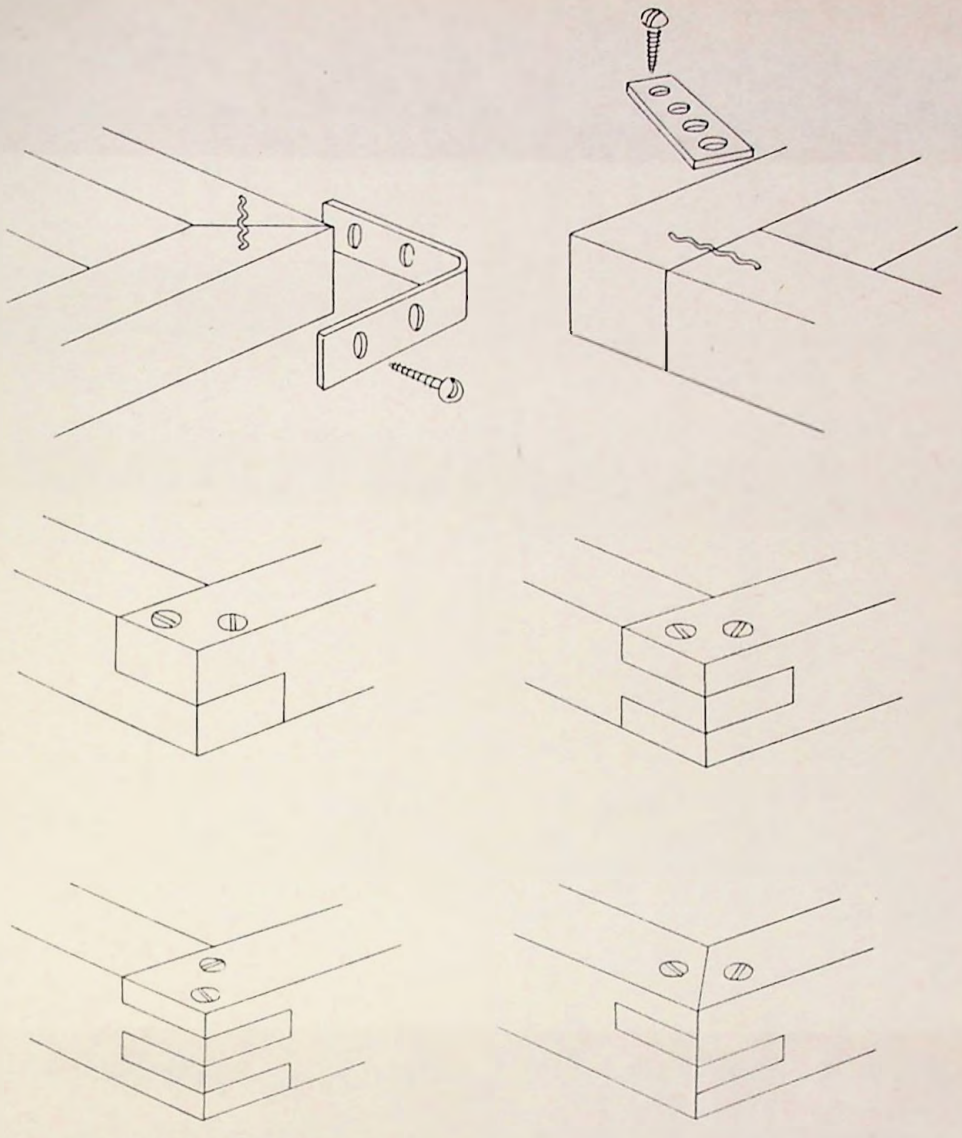
Basic Equiptment and Tools

The Frame

The function of the frame is to act as a supporting stretcher for the silk or screen fabric. Frames are usually rectangular in shape, and generally constructed in timber. For some specialised applications metal frames are used.

Timber frames should be assembled from strong knotfree wood which should be free from warpage. Kiln dried pine or cedar is most suitable. The dimensions of the frames sides are not standardized but for screens less than eighteen inches square the minimum size of timber used should be two inches by one inch. For screens up to four foot square timber measuring three inches by two inches should be used. Screens larger than four foot square are normally constructed in or supported by metal.
There are numerous ways in which to join the frame components together. The simplest types of joints are the butt and mitre type, however neither of these are rigid or secure without additional support such as corner braces or corrugated fastners. The best and most commonly used joints are the lap joint and the tongue and groove joint.

However the frame is constructed it is critical that it should be rigid, square, and absolutely flat, all factors which are vital in ensuring a close tolerence of register, essential for quality printing.



1.2 Various joints used for screen frames. From top left: miter, butt, lap, simple tongue-and-groove, double tongue-and-groove, miter tongue-and-groove.

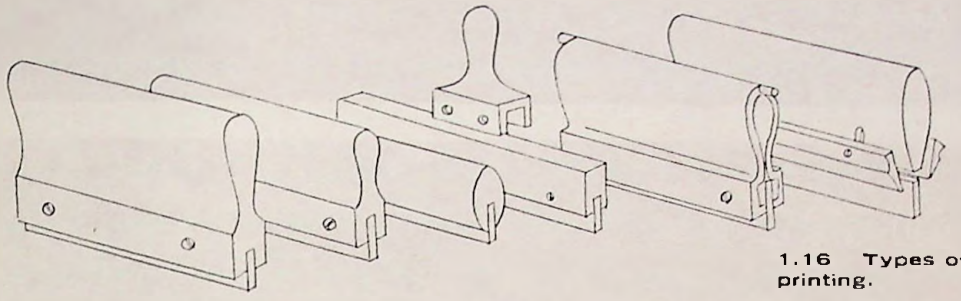
The Squeegee

The squeegee is the tool employed to force the ink through the screen on to the surface to be printed.

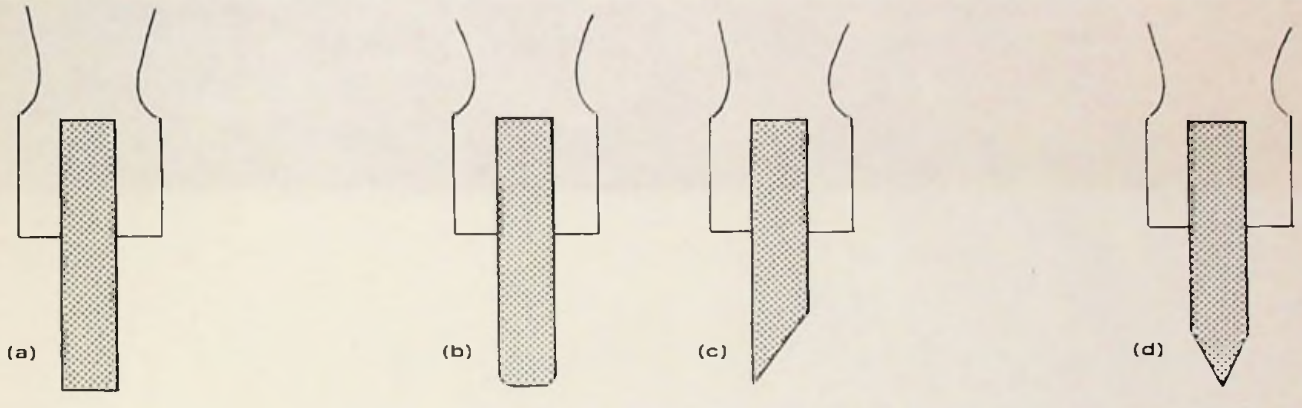
The basic type of traditional squeegee used in screen printing consists of a heavy strip of rubber fixed between two pieces of wood with the rubber projecting about an inch and a quarter at one end of the holder.
The rubber insert which is known as the blade is produced in a variety of thicknesses and is available in a number of compositions of both natural and syntethic rubber. The flexibility of rubber is measured in terms of durometers. A sixty durometer rubber blade is best suited to general purpose screen printing. A softer rubber (thirty or forty durometers) is used on soft or highly textured surfaces such as cloth which requires a heavier deposit of ink. A very hard rubber (seventy or eighty durometers) will produce a thinner film of ink, resulting in a sharper print such as is required in very fine half tone printing. The latter is used extensively in automated printing operations.

The traditional rubber blade is fast being replaced by more recently developed syntethic materials, which have very distinct advantages in that they are almost completely resistant to all solvents. These new materials can be used with almost any type of printing compound without any detrimental chemical effect. Available under the general heading of plastic blades, they do not lose their sharp edge and consequently will not streak prints or harden with age.

For convenience in operating a squeegee can be fitted with a simple brush-handle type device. On more elaborate automated printing presses, the squeegee is incorporated into a unit which basically consists of a heavy squeegee arm which rides along a rail. A counterbalancing device provides stable pressure during the operating of the squeegee.

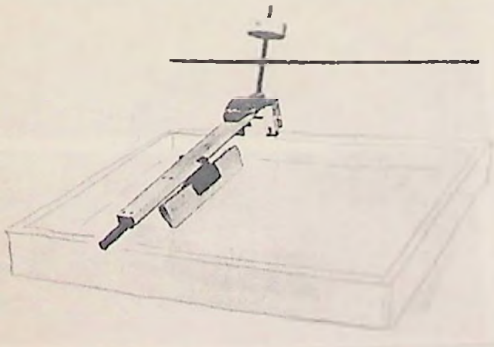


1.16 Types of squeegee handles for hand printing.



1.17 Types of squeegee blades. From top left: (a) Square—for printing on flat surfaces. (b) Square with rounded corners—for printing heavier deposits on flat surfaces (textiles). (c) Single-sided bevel—for printing on glass. (d) Double-sided bevel—for direct printing on uneven surfaces or fine detail on textiles. (e) Rounded edge—for textile printing with very heavy ink deposits. (f) Double-sided bevel with flat point—for ceramic printing.

EASY SQUEEGEE ATTACHMENT



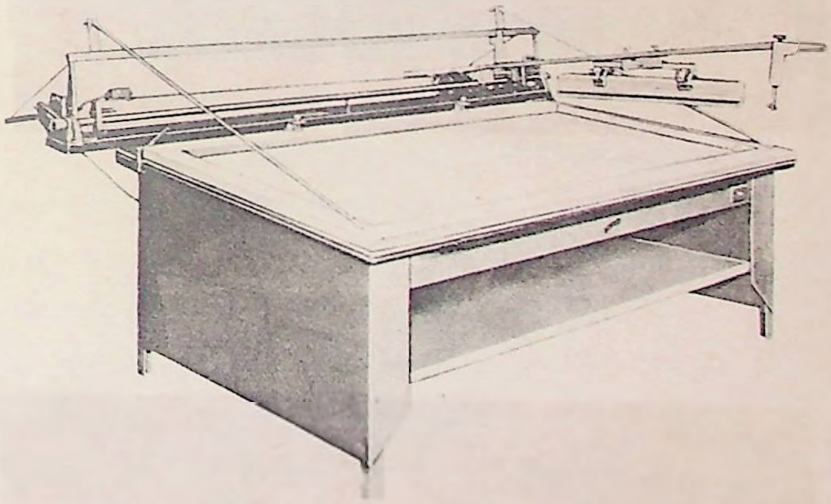


FIG. 95. The "One-man squeegee," an efficient manual printing unit with a patented counterbalanced squeegee device. (*Courtesy Cincinnati Screen Process Supplies, Inc.*)

Screen Fabric

The traditional fabric associated with the screen printing process is silk. With the rapid growth of commercial screen printing requiring increasingly varied applications of specialized techniques, has come the development of a number of alternative screen fabrics. These new fabrics have properties which often superior to silk in various ways. Nylon, dacron, polyester, stainless steel and phospher bronze are all fabrics in common use in the screen printing industry today.

Silk fabric is made up of a fine thread, composed of many twisted fibres. It is available in three grades of weight and a wide variety of meshes. The mesh count is identified by number and the weight by the symbol "x". The range of meshes available is graded from number six to number twentyfive ie. the lower numbers indicating coarse mesh and the highest being the finest mesh. One "x" indicates single weight, "xx" double weight and "xxx" triple weight. The "x" weight symbol refers to the thickness of thread used in spinning.
The most common weight in use is double weight and the most versatile mesh is number twelve (12xx) which is medium fine and is suitable for general all round work. For really fine work such as half tone reproduction a finer mesh such as sixteen "xx" will give best results. Silks strength, durability and resistance to a wide range of solvents and inks make it a popular choice as a screen fabric. As the silk threads are made up of many twisted fibres it means that the material is extremely

absorbent thus making stencil adhesion excellent in every respect for all kinds of stencil processes. Silk can however cause bluring of printed edges and a build up of ink in the screen. Another disadvantage with silk is that its dimensional stability is poor, it tends to slacken under prolonged tension and can be adversly affected by changes in temperature and humidity.
Although silk is resistant to a wide range of solvents and cleaners it is not however resistant to the straight chlorine bleach that is necessary for the removal of stencils of the direct photographic emulsion type. Any strong bleach will cause silk to decompose.
Advances particularly in the area of photo stencil techniques are rapidly making silk an obsolete screen fabric at least in the commercial printing industry.
In commercial screen printing the need is for screen fabrics that can be used primarily with photographic stencils.

Nylon has for many years been a popular alternative to silk.
Nylon is stable and resistant to all solvents, it is the fabric generally used with photo stencils. Since it is made up of a monofilament thread it is in most cases unsuitable for use with solvent-adhering stencils (hand cut and transfer photo stencils) as it does not offer the natural anchorage that silk possesses.

Dacron is the most popular screen fabric in use today. It has a multifilament thread and is resistant to all solvents. Dacron is also extremely stable, a factor which is vital when close registration is required.

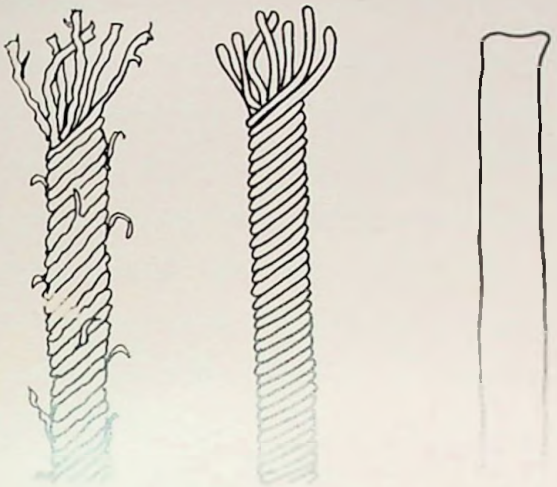
Polyester fabrics are best suited for very precise and finely detailed industrial work such as printed electrical circuits. Polyester is superior to silk, nylon and dacron in dimensional stability. Because it has excelent durability it is most suitable for use in very long printing runs or when abreaisive materials are used in printing.

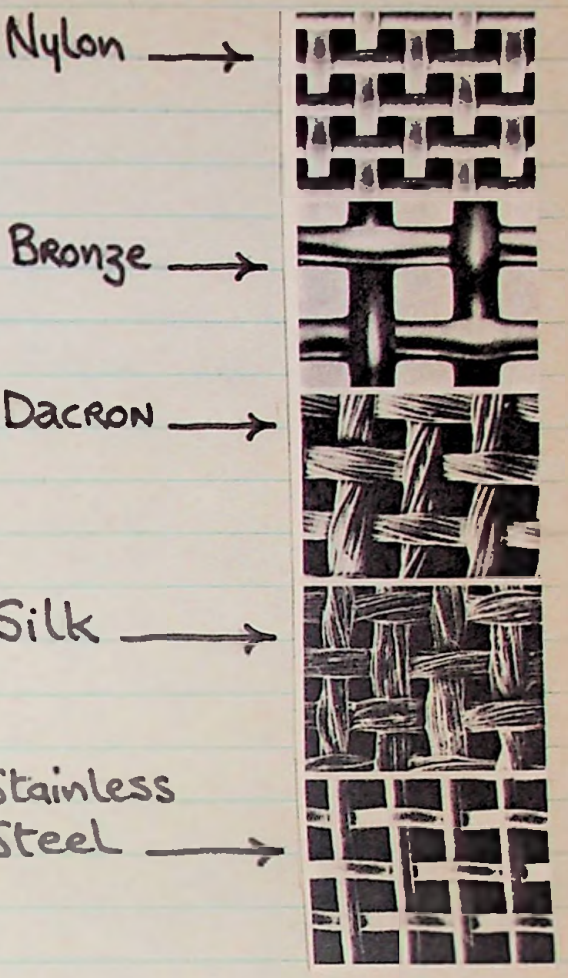
Stainless steel and phospher bronze screen fabrics provide the ultimate in durability and dimensional stability. Their high cost however somewhat limits their popularity for general purpose printing.

The codes that are used to identifie silk meshes are also used to desceibe weight, mesh count etc., of other screen fabrics.

The determining factors to be taken into account when deciding which type of screen fabric should be used depend on a number of varying considerations. The type of stencil, the type of ink, the degree of registration required, the length of run and also the application of the finished product.
Many commercial printing plants tend to specialise ie. industrial printing or high quality reproduction, thereby confining themselves to specific basic materials and proceedures.

SCREEN FABRIC THREADS





Highly magnified view of screen fabrics.

MESH EQUIVALENCY CHART

SILK		DACRON		NYLON	POLYESTER
6xx	70-75	6xx	74-76	70-83	86
8xx	86	8xx	86	83-95	86-110
10xx	105-109	10xx	109-110	103-114	110-125
12xx	124-125	12xx	124-125	120-160	125-160
14xx	138-139	14xx	135-140	160-200	160-200
16xx	152-157	16xx	157	220-245	200-245
18xx	160-166	18xx	166	260-306	262-305
20xx	173-176	20xx	175	305-335	305-330
25xx	193-200	25xx	197	340-380	350-390

Inks And Other Printing Compounds

There are many different inks, paints, lacquers and printing compounds that can be used in the screen process printing method.
In most cases the choice of ink or printing compound is directly related to the specific function required and to the surface to be printed. The choice of ink or compound will influence or determine the type of screen fabric and stencil to be used.

Inks

Basically the types of inks available for screen printing can be placed into four categories, evaporation inks, oxidation inks, thermosetting inks and catalytic inks.

Evaporation Inks.

The largest group of inks, evaporation inks, dry by solvent evaporation, hardening with age and undergoing no chemical change while drying. They can be redissolved with their original solvent. Ethyl cellulose inks are the most common general purpose inks in use. They are suitable for printing on paper, card, wood etc. and are generally referred to as "poster" inks. These inks can be thinned with mineral spirits. No special drying equipment or conditions are necessary and they can be used with any fabric, mesh or stencil.

Nitrocellulose inks, generally referred to as "lacquers" need to be thinned with lacquer thinner solvents. They do not require special drying conditions but tend to dry at a slower rate than ethyl cellulose inks. These inks are most often used for printing decals, they can

also be printed on metal, foil and some plastics. Any screen fabric can be used but a fine mesh in silk or dacron is recommended. Monofilament fabric can be used but a mesh finer than 16XX should be used.
Any stencils used must be lacquerproof, such as water soluble or photographic type stencils.

Plastic inks should generally be used only with the particular plastic recommended by the individual ink manufacturer. Practically all plastic inks dry by solvent evaporation. All require specific solvents and thinners as recommended by the ink manufacturer. Any screen fabric can be used with plastic inks but monofilaments are generally preferred because they allow easier ink passage and less ink build-up in the screen. Lacquerproof stencils must be used.

In general with plastic inks one should refer to the manufacturers product information leaflets for specific details of each individual products chemical properties.

Oxidation Inks

Oxidation inks primarily include the enamel and synthetic enamel range of inks. These inks undergo a chemical change during drying that renders them insoluble to their original solvent or thinner. They offer a higher gloss finish and greater durability than evaporation inks and are suitable for printing on a wide range of materials including metals, foils, glass, certain plastics, wood, card and paper. They dry more slowly than evaporation inks, requiring from two to eight hours to air dry. In commercial operations, hot air drying is

usually employed. Any type of screen fabric can be used but monofilaments are most suitable. Any type of stencil can be used with these inks. They are commonly thinned with mineral spirits or similarly compatible solvents.

Thermosetting Inks

All thermosetting inks require heat in order to set or dry completely. They are generally used when great durability is required. They are used when a superior type bond is needed such as when printing on metal, glass and certain plastics.
Thermosetting inks are used to print synthetic fabrics as the heat treatment fuses the ink with the fibres, rendering it washable etc.
Certain oxidation and catalytic inks come under the above heading where there is a need for heat drying.

Catalytic Inks

Most catalytic inks are of the epoxy type that require the addition of a catalyst just prior to printing. These inks do not dry, but cure (polymerize) as a result of the catalytic action. Heat is not generally required but is sometimes employed to speed up the final hardening and to reduce the tackiness of the surface. In certain brands in which the catalyist is premixed with the ink, heat curing is necessary to activate the catalyist.
Catalytic inks are used when maximum durability, adhesion and resistance to chemicals are required.

Other Printable Materials and Compounds

Ceramic Printing Vehicles (medium)

Ceramic vehicles are not inks in the conventional sence. They are not pigmented inks but vehicles carrying a glaze. After the vehicle is printed it burns out cleanly leaving only the fired glaze. Suppliers do not generally supply prepared glaze inks, only the necessary ingredients to make up the required working solution.

Varnishes

There is a wide variety of varnishes (clear coatings etc.) available for specific applications. Overprint varnishes are used as a protective coating over other printed inks. Binding varnishes are used to achieve adhesion between two incompatible materials. Different types of varnish are selected for their compatability with the inks previously used and the end product application.

Etching and Plating Resists

Silk screen printing plays a major part in the manufacture of electronic printed circuits. Etching, plating and solder resists are designed to print easily and accurately, to clean up easily and yet be unaffected by the solutions and chemicals that they will later come into contact with. Plating resists are used when circuits are electroplated onto a nonconductive substance. Etching resists are used in the etching of printed electronic circuits. Solder resists are used when molten solder will flow over a substrate to produce a circuit.

Metalic Inks

Metalic inks use finely powdered metal in place of a pigment. They do not achieve the high polished finish of metal but tend to have a dull burnished effect similar to metalic paints. Metal inks used in the printing of electronic circuits contain a conductive silver powder.

Glass Etching Ink

There are two ways in which the screen process may be used to produce an etched or frosted design on glassware.
One involves the use of asphaltum which is screened onto the glass. Following the drying of the asphaltum the glass is immersed in an acid bath which effects only those areas not protected by the asphaltum resulting in a facsimile etched pattern of the stencil.
A second method involves the use of a prepared screen compound suitable for producing an etching effect on glass. This product does not produce the deep coarse etch associated with acid etching but creates a pronounced frosting of the glass in the pattern of the stencil.

INK APPLICATIONS CHART

		PRINTING INK													
		Acid Resist	Polyethylene	Fluorescent	General Plastic	Acetate	Acrylic	Mylar	Vinyl Gloss	Vinyl Flat	Thermoset	Epoxy	Enamels	Lacquers	Poster Process
TYPE	Evaporation	X	X	X	X	X	X	X	X	X				X	X
	Oxidation		X										X		
	Catalytic											X			
	Heat										X				
FINISH	Gloss		X		X	X	X	X	X		X	X	X	X	X
	Flat			X		X		X		X	X	X	X	X	X
FABRIC	Silk	X	X	X	X	X	X		X	X			X	X	X
	Nylon	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Dacron	X	X	X	X	X	X		X	X			X	X	X
	Polyester	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Stainless	X	X	X	X	X	X	X	X	X			X	X	X
STENCIL	Lacquer			X									X		X
	Indirect Photo	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Direct Photo	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Water-Soluble	X	X	X	X	X	X	X	X	X	X	X	X	X	X
MATERIAL	Paper			X									X	X	X
	Cardboard			X									X	X	X
	Masonite												X		X
	Metal	X									X	X	X	X	
	Glass										X	X	X	X	
	Foil							X			X		X	X	
	Leather													X	
	Ceramics											X			
	Wood												X	X	
	Cellulose Acetates				X	X	X		X				X	X	
	Polystyrene				X		X					some plastics			
	Acrylics				X		X								
	Rigid Vinyl				X		X	X	X						
	Flexible Vinyl						X	X	X	X					
	Polyethylene		X										X		
	Polyester							X							
	Textiles														
SCREEN MESH		12xx-20xx	230-45	8xx-14xx	12xx-16xx, 200-30	230-405	12xx-14xx	230-65	12xx, 230	10xx-14xx, 230	8xx-16xx	12xx-16xx	10xx-16xx, 200-305	12xx-16xx, 230	12xx-16xx, 160-230

SOLVENT AND CHEMICAL USE CHART

	Acetone	Isopropyl Alcohol	Methyl Alcohol	Ethyl Alcohol	Ethylene Dichloride	Methyl Chloride	Mineral Spirits	Turpentine	Kerosene	Xylol	Butyl Cellosolve	White Vinegar	Water	Lacquer Thinner	Trisodium Phosphate	Hydrogen Peroxide	Enzyme	Naphtha	Benzene	Potassium Bichromate	Ammonium Bichromate	Chlorine Bleach
Process Ink Thinner							X		X	X												
Process Ink Clean-up							X	X		X								X	X			
Lacquer Ink Thinner														X								
Lacquer Ink Clean-up														X								
Enamel Thinner							X				X											
Enamel Clean-up							X	X		X												
Hide Glue Solvent													X									
Water-Soluble Block-out Remover			X	X	X	X							X									
Water-Soluble Block-out Thinner			X	X	X	X																
Lacquer Stencil Adherer	X													X								
Lacquer Stencil Remover	X		X											X								
Water-Soluble Stencil Adherer		X										X	X									
Water-Soluble Stencil Remover												X	X									
Indirect Photo Stencil Developer																X						
Indirect Photo Stencil Wash-out													X									
Indirect Photo Stencil Remover													X				X					
Direct Photo Stencil Wash-out													X									
Direct Photo Stencil Remover	X																					X
Nylon Screen Prep												X										
Enzyme Neutralizer												X										
Fabric Degreaser												X			X							
Shellac Solvent			X	X																		
Screen Spot Remover	X				X																	
Photo Screen Sensitizer																				X	X	

PRODUCT INFORMATION

MATT VINYL
Screen Inks

PROPERTIES

Matt Vinyl Screen Inks have been formulated for easy printing on rigid and flexible PVC, PVC copolymers, vinyl coated paper, CAB ("Cabulite"), top coated polyester sheets and most grades of Polystyrene Acrylics and Polycarbonates.

Matt Vinyl has these outstanding advantages:-

* Excellent printing qualities with self solvent properties.
* Mild odour with fast drying.
* Sharp definition suitable for halftone work.
* Intense pigmentation yielding high opacity and exceptional coverage.
* Non arcing pigments for high frequency welding.
* Suitable for jet or natural air drying.
* Wide range of intermixable, bleed and light stable colours as listed overleaf.

THINNING

Limp PVC :	thin	10-15% with Vinyl Thinner & Cleaner
Rigid PVC :	thin up to	10% with Rigid Vinyl Thinner

Vinyl Retarder is available for use under hot conditions but is not normally necessary. Wash up with Vinyl Thinner & Cleaner.

PRINTING

Matt Vinyl inks are self solvent on the screen and there is no limitation on the type of screen fabrics that can be used. All stencil materials are suitable except those attacked by lacquer type solvents - e.g. Stenplex Amber and solvent adhering films. A coverage of about 15-20,000 sq. in./lb. (21-29 sq. metres/kilo) can be expected with a 160NN (European reference 62T) Nylon. Some plastics are prone to static troubles and these may often be cured by wiping the surface with a rag soaked in white spirit or isopropanol.

DRYING

Limp PVC : air drying time is usually 5-20 minutes
Rigid PVC : air drying time for first colour is 20-50 minutes, for overprints 10-20 minutes

Matt Vinyl inks dry exceptionally well through Jet Air Dryers at low temperatures. When air drying, free air circulation is desirable. The use of fans or a Rack Dryer is recommended particularly in confined spaces.

FLUORESCENT VINYL INKS

These have the exceptional brilliance and almost the same lightfastness of the well known Flare range and should be reduced with Rigid Vinyl Thinner. The above remarks concerning the printing of PVC hold good, but in addition the rules governing the use of fluorescent colours apply. Thus to improve light resistance, heavy deposits or even overvarnishing

APPLICATIONS:

All PVC Products
ABS and CAB

Most grades of:

Acrylics
Polystyrene
Polycarbonate
Pressure Sensitive PVC and
Top Coated Polyester Films

Window Stickers
Self Adhesive Labels
Inflatable Toys
High Frequency Welding
3 & 4 Colour Printing

Sample, Product Information leaflet.

The Stencil

In commercial screen printing today there is really only one major method employed in producing stencils and that is the photographic method.

The Photo Stencil

The basic principle of the photo stencil is that it is made up of materials that have been chemically treated so that they are sensitive to light (in particular ultraviolet light). When exposed to ultra violet light they undergo a chemical change and can then be further processed (developed) to bring about the final required condition necessary to make a stencil.
The design or image to be printed is achieved in a photo stencil with the aid of a transparent positive.
A positive consists of a transparent sheet of film which contains a black or opaque shape of the design or image to be printed.
The positive is placed between the light source and the stencil material. The black / opaque areas of the positive effectively cut off the light to the areas of stencil film it covers.
The other unprotected areas undergo a chemical change which hardens when developed, the protected areas ie. the design area dissolves leaving an open area in the stencil conforming to the image to be printed.

There are two basic methods used in the application of the photo stencil technique in screen printing. One is called the "direct" method, the other the "transfer" method.

The Direct Method.

In the direct method the screen fabric is coated with a light sensitive gelatine emulsion which forms the structure of the stencil.
When the complete screen with positive in position is exposed to the ultraviolet light, the emulsion will undergo the previously mentioned chemical changes resulting in the formation of a stencil. This type of stencil will in effect be formed into the screen fabric making it considerably more durable than "stuck on" type stencils.

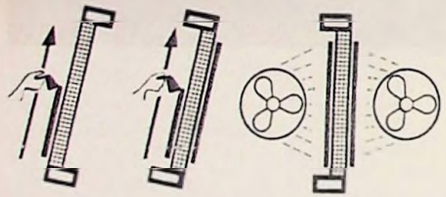
The Transfer Method.

With the transfer method the photographic principle is the same as the direct method. The main difference between the two being that in the transfer method, a sensitized stencil film — not the screen itself — is exposed beneath the positive. Following development the stencil film is then adhered to the screen fabric. Transfer photo stencil film consists of a laminated sheet made up of two components. The top material is a sensitized gelatine emulsion underneath which is a transparent backing sheet which acts as a support for the emulsion until the stencil has adhered to the screen. On drying the backing sheet can be easily removed leaving the open areas of the stencil ready for printing

In commercial screen printing the photo stencil is used extensively because of its versatility, efficiency and the high degree of detail obtainable for use in colour seperation, half tone work etc.

Water resistant direct coating screen emulsion with diazo sensitizer for producing screen process photostencils. Ecologically sound. Simple to use. Removable. - For long runs only, the stencil must be treated with the ULANO hardener.

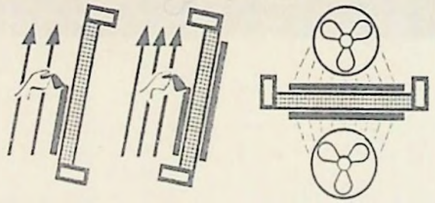
SCREEN EMULSION



The simple method

COATING

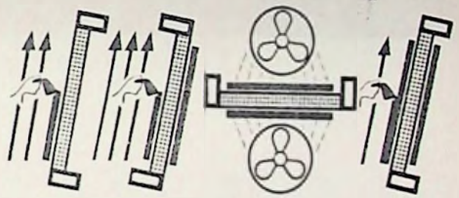
a) 1x printing side
b) 1x squeegee side
c) Dry in horizontal or vertical position.
d) Continue as shown under picture 4.



An improved method

COATING

a) 2x printing side
b) 2-5x squeegee side) wet in wet
c) Dry in horizontal position, printing side downwards. Or with circulating air at 30 - 40°C vertically.
d) Continue as shown under picture 4.

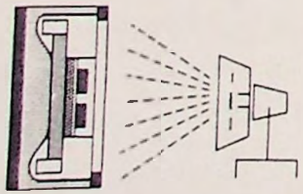


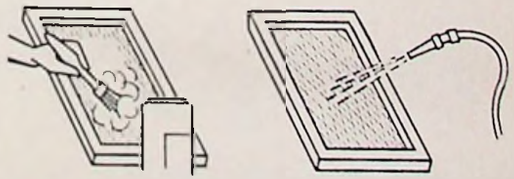
The best method for high quality

COATING

a) 2x printing side
b) 2-5x squeegee side
c) Intermediate drying, printing side downwards.
d) 1x printing side
e) Dry horizontally. Or at 30 - 40°C vertically.
f) Continue as shown under picture 4 or:
g) Repeat d) and e) until desired stencil thickness is achieved. Then expose.

The Direct Stencil Method





EXPOSURE

- Exposure times, distances, light sources: see reverse side.
- A step-wedge is recommended to find out the proper exposure time.
- Under-exposure causes bad adhesion, unsharp edges, unsufficient ink, suitability and tacky stencils.
- Over-exposure is less dangerous, but reduces the resolution.
- According to the coating technique, viscosity, number and colour of mesh, the exposure time has to be adjusted.

WASH-OUT

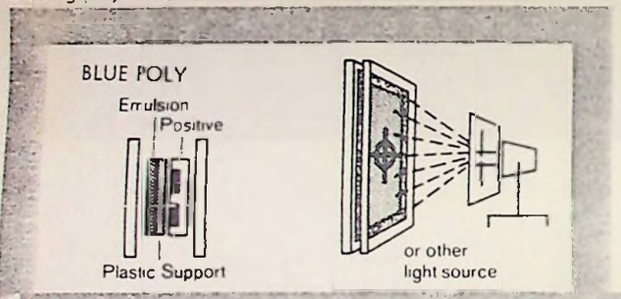
a) Wet both sides of screen with water 15 - 40°C.
b) Wash with soft spray quickly from the squeegee side until the image opens up.
c) Use intensive spray from printing side to wash-out.
d) Rinse the whole stencil from squeegee side with soft spray.
e) Take off excess water from printing side with unprinted newspaper.
f) Then dry and touch-up.
g) For long runs treat dry stencil with the ULANO hardener. Instructions on reverse side.

REMOVAL

a) Take out ink residues.
b) Degrease (ULANO degreaser No. 3).
c) Rinse with hard water spray (ev. high pressure device).
d) Apply remover (ULANO No. 4 liquid or No. 5 paste) and let stand the necessary time.
e) Then spray out with high pressure unit, if hardened or not hardened.
f) Remove ink and haze residues with ULANO haze remover where necessary.

High resolution, flexible stencil sheet on clear polyester .002" (5/100 mm) with non-sticky coating, for all types of fabrics including polyester.

ULANO AG. 8700 KÜSNACHT-ZÜRICH SWITZERLAND

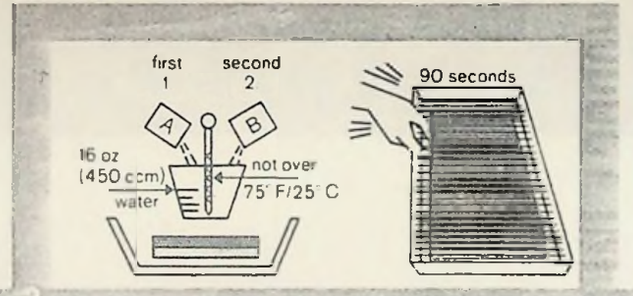


1

1. EXPOSURE

40 Amp., mono 30"/ 75 cm 160 secs. carbon arc
50 Amp., mono 39"/100 cm 240 secs. carbon arc
60 Amp., tri 48"/120 cm 155 secs. carbon arc
1 HPR/MBU 125 watt 12"/30 cm 170 secs.
2 HPR/MBU 125 watt 18"/45 cm 240 secs.
4 HPR/MBU 125 watt 24"/60 cm 500 secs.

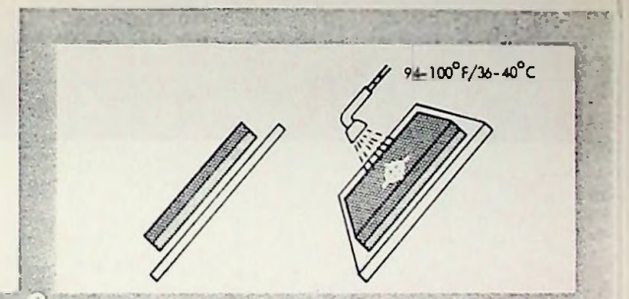
Lamp:	
Distance lamp - film:	inches
Exposure:	seconds



2

2 DEVELOPING

Use ULANO A+B powders as per instructions on each set of packets. 1 set makes 16 ounces (450 ccm) of developer. Dissolve both powders completely. Develop at least 90 seconds in subdued light wetting the film surface quickly and uniformly. Cover after each use. Discard developer every day. - Wrinkling of the film emulsion during wash-out indicates spoiled developer. "Waving" or uneven film thickness is due to irregular developing. - You can also use a 2% hydrogen peroxide solution for 2 minutes at your own risk.

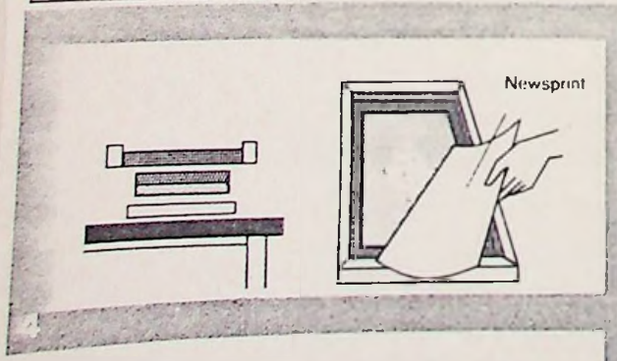


3

3. WASH-OUT

Position film on a piece of glass and wash the emulsion under a mild spray (illustration). Continue to wash until draining from the image is clear. Chill thoroughly with cold water. - You can also wash-out in a tray by rocking it continously and finishing washing under a cold spray. - Scum is caused by unsufficient wash-out. Water temperature over 100° F makes a thinner film.

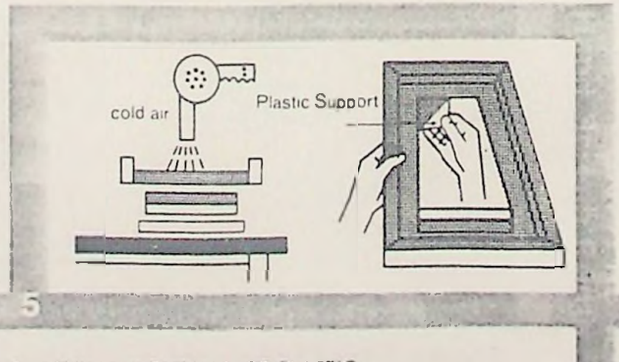
The Transfer Stencil Method.



4

4. ADHERING

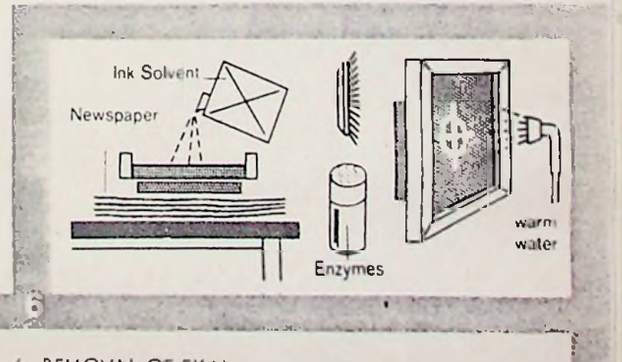
Provide the usual contact by positioning the emulsion upwards on a piece of glass smaller than the inside measurements of the frame. Make sure the gauze is cleaned properly. Place the wet screen (silk, nylon, metal or polyester) over the film emulsion in position and press lightly. Take newsprint to remove excess moisture from the film (illustration). Change newsprint until it remains dry.



5

5. DRYING + PEELING OF PLASTIC

Take off frame with stencil from the piece of glass. Dry gauze and plastic with cold air. While the plastic sheet is still on, apply "ULANO Screen Filler 60" to block-out the open area. - Use a fan to hasten drying, cold air is preferable. Blow from the squeegee side. After the film is dry, the plastic sheet can be peeled with little resistance (illustration). Wash off the adhesive residues from the film side with Toluol, Xylol or Benzine.



6

6. REMOVAL OF FILM

Remove inks from screen with solvent and dry. Wet stencil from both sides with hot water and let stand for a few minutes. Use brush and hot water to clean gauze completely (illustration). - To take out any haze and for fast action cleaning use a small amount of "ULANO ENZYMES" by following our instructions. Be sure to wash afterwards with vinegar to kill action of Enzymes. - On synthetic fabrics clorox or a 4% sodium hypochlorite solution can be used followed by neutralizing with vinegar and a wash with water.

The Positive

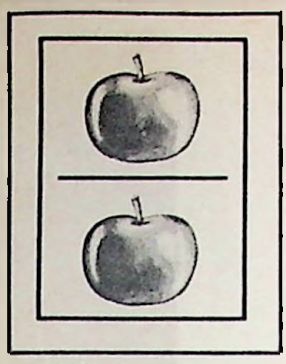
The quality of the photo stencil is related directly to the quality of the positive. There are two basic ways to create positives for use in making photo stencils.

(1) Photographically - by means of camera produced film positives.

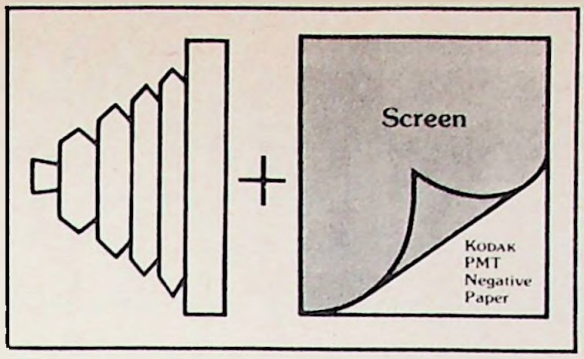
(2) Mechanically - by masking by hand with opaque inks, or with hand cut masking film specially produced for this purpose.

Commercially virtually all positives are made photographically. The original artwork or copy is prepared in black and white and photographed onto sheet film thus creating the positive. This method allows enlargement or reduction, duplication etc. In the case of positives required to reproduce half tone photographs, a contact screen is placed between the positive film and the projected image of the photograph. Conventional methods used to achieve colour seperation for four colour trichromatic work by other printing processes are suitable for producing similar positives for screen printing stencils.

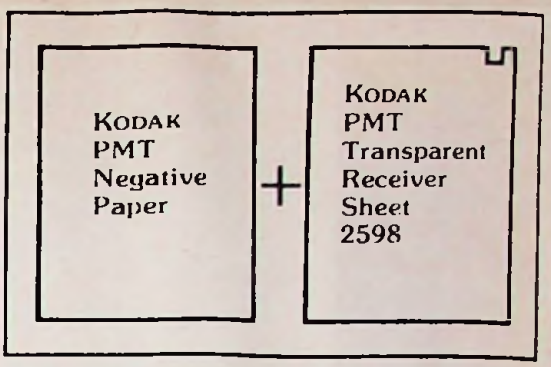
In general, finished artwork, copy etc., for use in producing positives for stencils, is prepared in the same manner as all other artwork used to produce by photomechanical means, blocks, plates etc., for conventional printing processes.



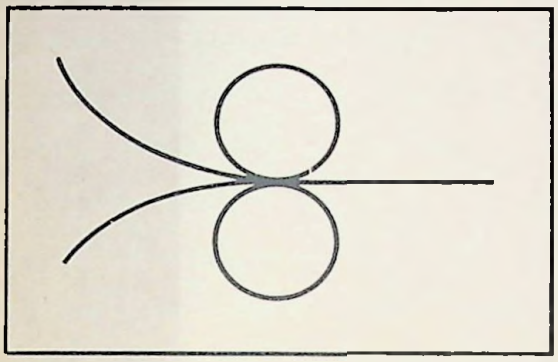
original copy.



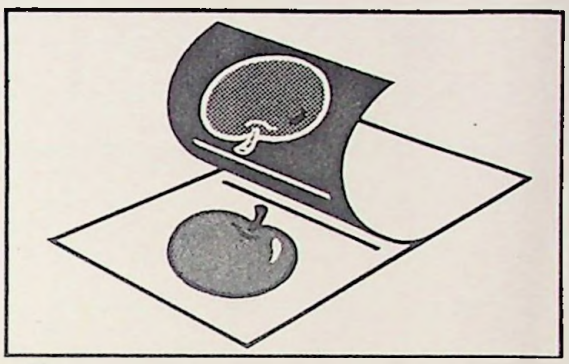
1. Load camera under 1A safelight with KODAK PMT Negative Paper. Expose and flash through PMT Gray Contact Screen (65, 85, 100, or 133 line).



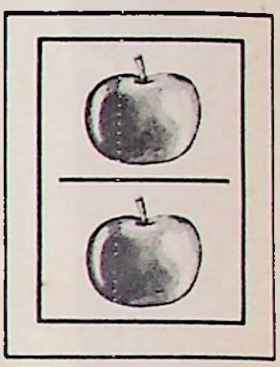
2. Place exposed side of negative paper in contact with coated side of PMT Transparent Receiver Sheet 2598.



3. Feed both into diffusion transfer processor with PMT Activator.



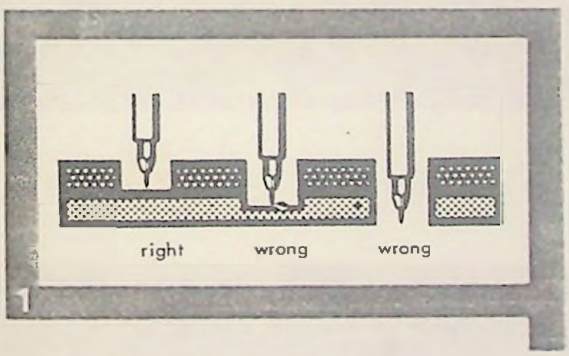
4. After about 6 seconds in processor, film and paper emerge. Wait 30 seconds in safelight, and peel apart.



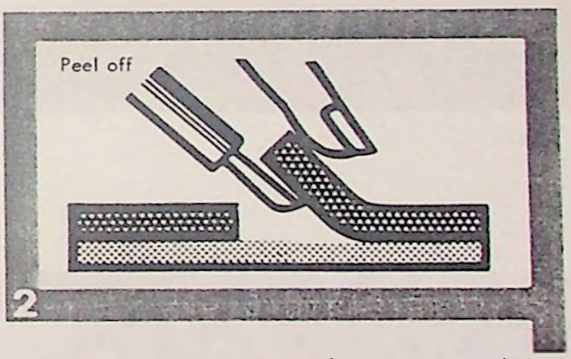
5. Discard negative paper. Finished film positive is done.

Camera Produced Positive

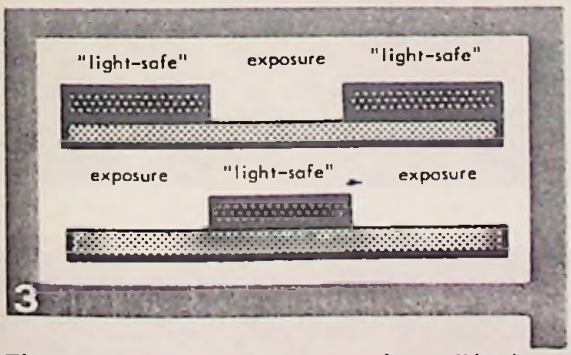
Knife-cut masking films are now used every day for masking open windows, outlinings, drop-outs, masks, camera-ready copy, color overlays etc. by lithographers, engravers, screen printers, artists, photographers, designers, lay-out men, engineers of the electronic industries etc.



Cut through the red coat of this piece of film, following the outline.



Afterwards peel off those parts from the polyester base where the light should pass.



The remaining red parts make a "light-safe" mask, a positive or a negative.

Hand-cut Positive.

Section 3.

Automation.

Automation

Some examples of semi and fully automatic screening units.

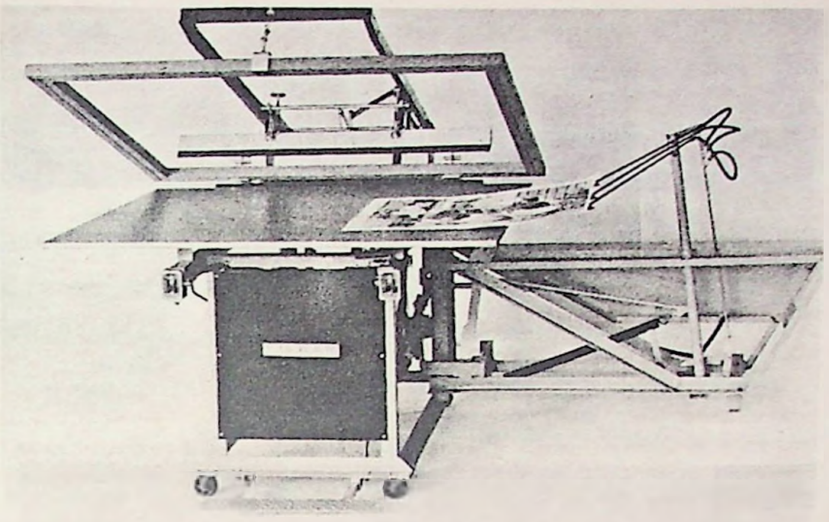


FIG. 93. The Filbar Press, with automatic take-off device. Its versatility permits it to print on both rigid and flexible material at speeds adjusted to the nature of the material. It is comparatively inexpensive but sturdy in construction. (*Courtesy Graphic Equipment of Boston, Inc.*)

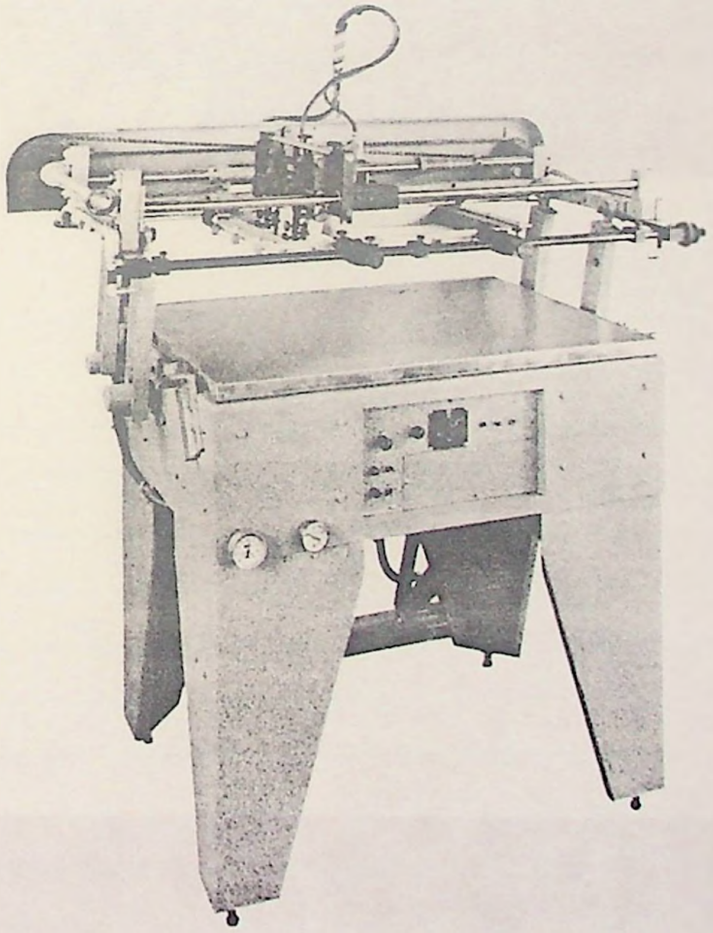
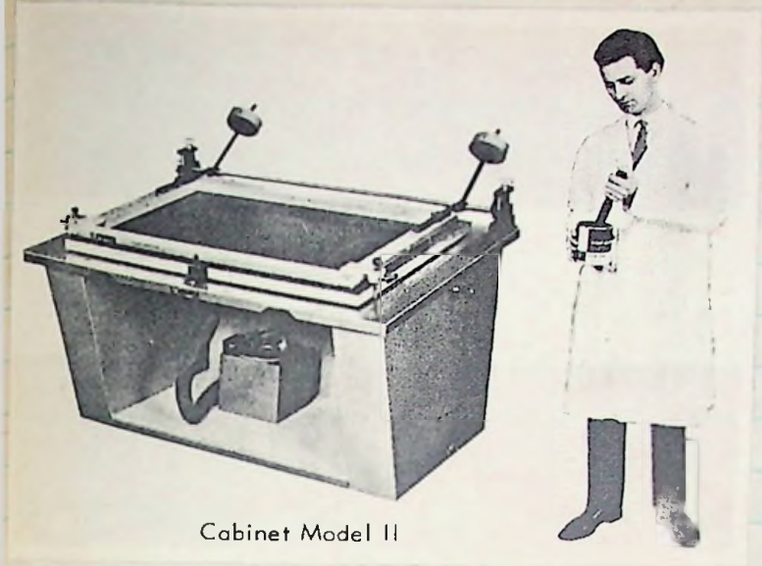
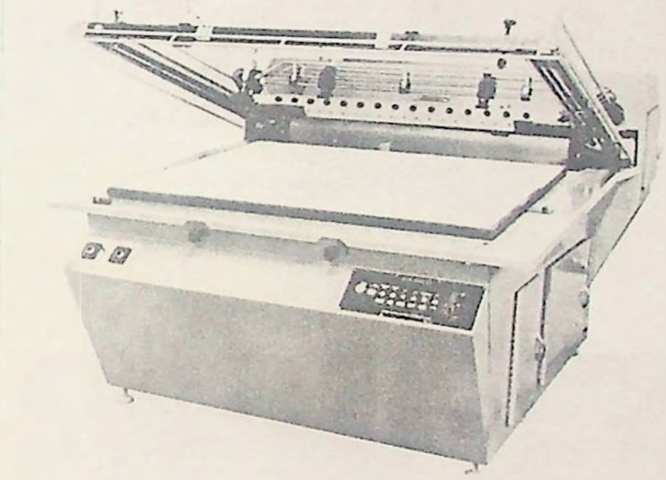


FIG. 94. The Precision Industrial Screen Printer, versatile but especially well suited for screening printed circuits and other industrial fabrications. (*Courtesy Precision Screen Machines Co.*)



Cabinet Model II



Aeropress Model III

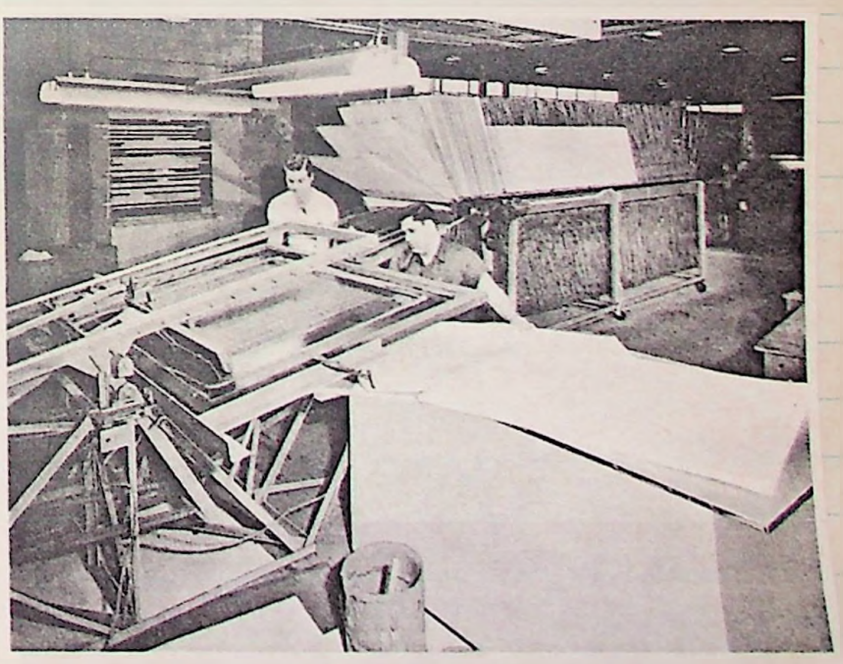


FIG. 119. View of printing department, showing automatic printing and drying equipment in use.

Section 4.

Applications.

Applications

Printing on Unusual Surfaces

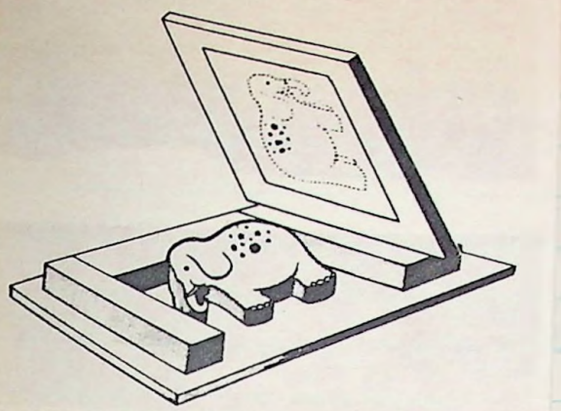
Cylindrical Surfaces

Most screen printing on round surfaces is accomplished with a flat frame and stencil.

In its most simplified form the stencil rests directly on the curvature or crest of the cylindrical surface to be screened. The item to be screened rotates on a set of rolling-pin type supports. As the screen is moved sideways, it turns the item with it, producing the printed image on the surface as they make contact. A wide variety of highly sofisticated automatic units have been developed to screen print onto cylindrical surfaces. Multicolour registration can be achieved on finely engineered equiptment which rotates the item to be printed in synch-ronization with the frame movement.

Electronic Circuits

This technique was originated and developed by the United States Government during the second world war.
Following the war when this technology was released to commercial interests it was apapted and converted for use in the manufacture of car radios. Electronic manufacturers also further researched and developed circuit printing for use in the production of hearing aids, television sets, telephones etc. plus a wide variety of electronic consumer goods.
In the main, screen printing of printed circuits involves printing with metallic inks which have the property of conducting an electric charge. They eliminate the need for individual wiring.



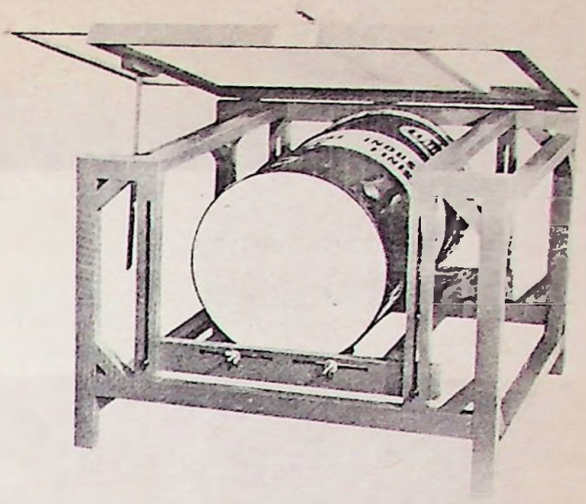


FIG. 81. The "Sparky" jig, a simple device for screening on round objects.

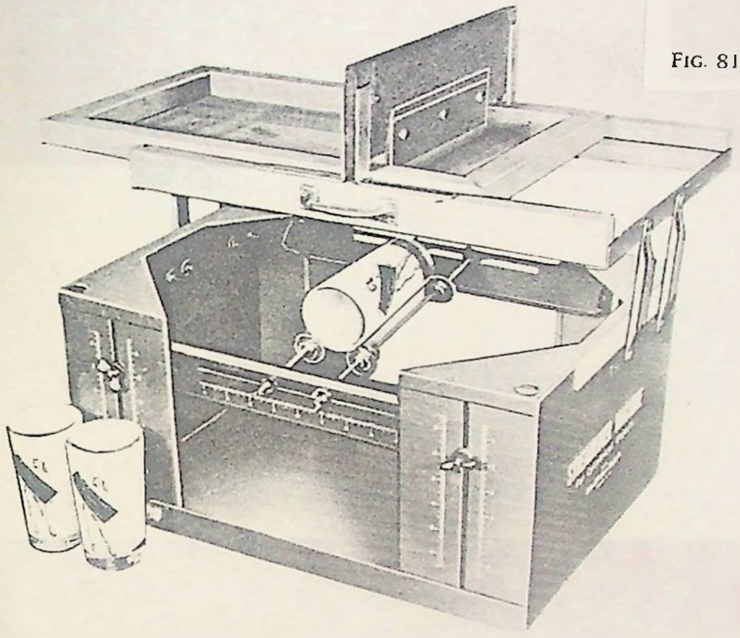


FIG. 82. The "Streamliner," a screening set-up for printing on large cylindrical objects. (*Courtesy Atlas Silk Screen Supply Co.*)

Some examples of units used to print on unusual surfaces.

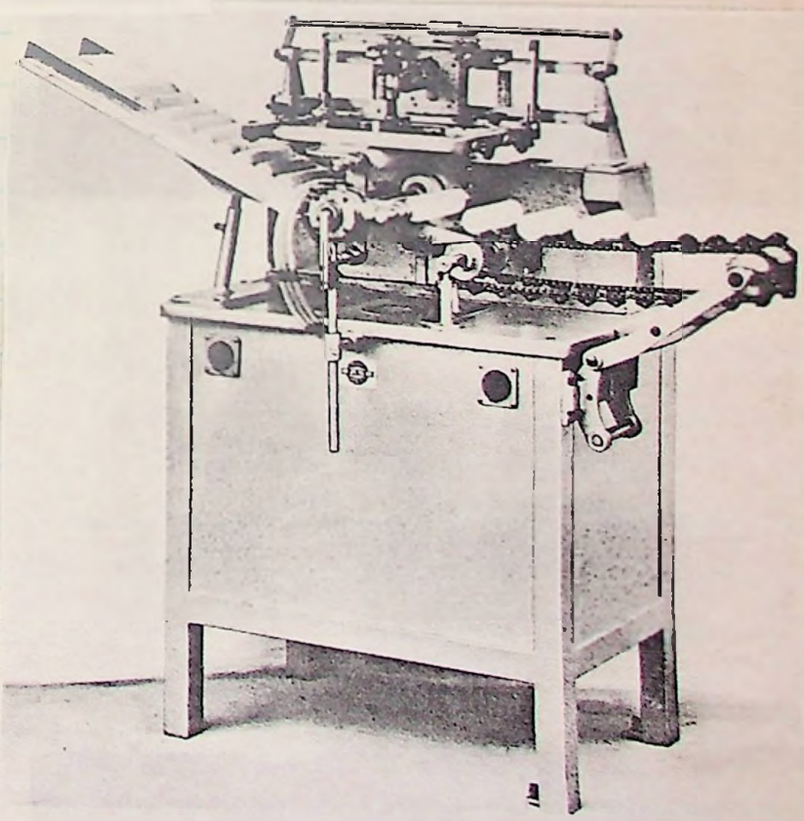


FIG. 83. Fully automatic turret printer designed for high-speed screening on cylinders. It features a multicolor registration device and an automatic inflating device for soft wall plastic containers. (*Courtesy American Screen Process Equipment Co.*)

Some everyday samples of screenprinted items of unusual shapes and surfaces.

Screenprinting electronic circuits.

Textile and Wallpaper Printing

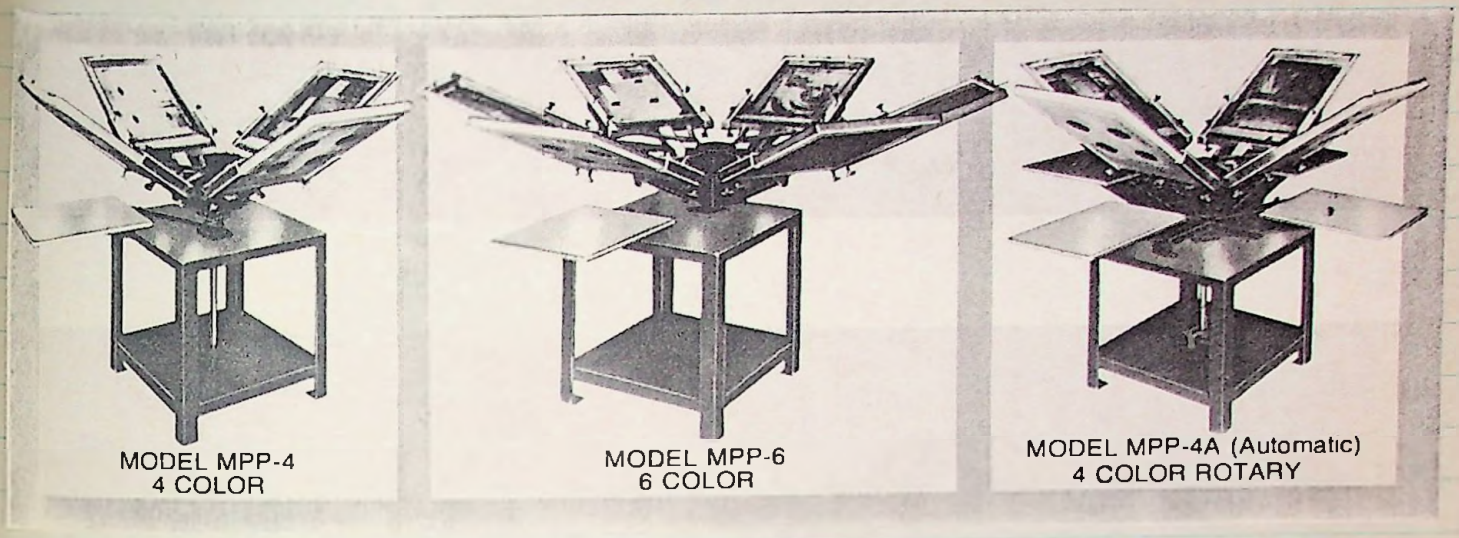
In large scale commercial textile or wallpaper printing - two distinct industries in themselves, the continuous bolt or roll method is used.
Both these industries are so highly specialized in techniques and procedures that it would not be correct to group them under the general heading of commercial screen printing. The basic principle however of ink being forced through a stencil supported by a mesh is the common factor.
When the printing is done direct from rolls, the method of printing is one which employs a rotary type machine for continuous roll printing.

Textile Printing (piece goods)

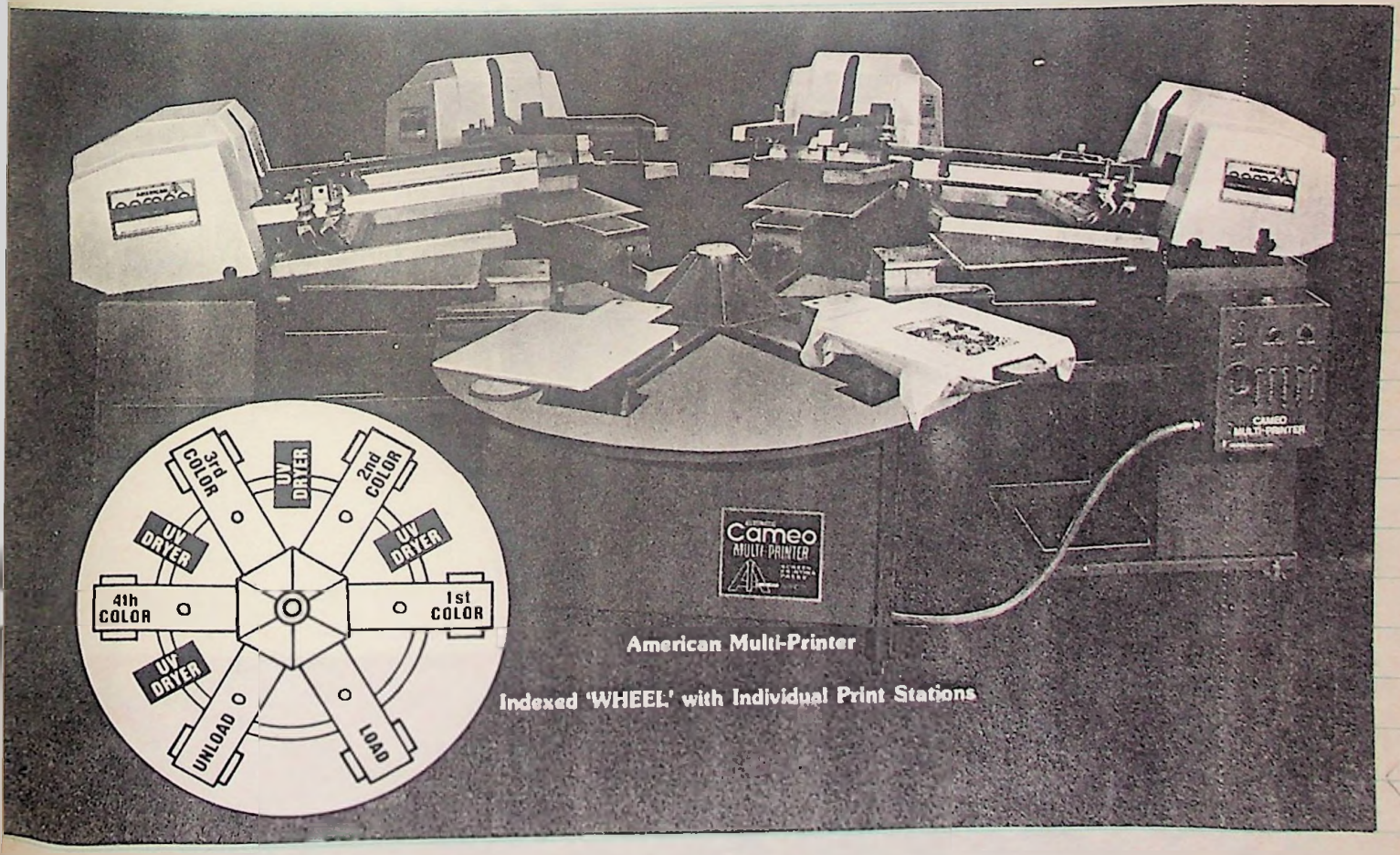
Screen printing on piece goods in most cases can be accomplished with basic flat printing equipment altered or adapted using custom built jigs to suit the size or format etc. of the finished product.
Among the extensive list of items in this category are "T Shirts", pennants, banners, tablecloths, draperies etc.

Miscellaneous Surfaces and Shapes

In addition to cylindrical, spherical, convex and concave surfaces, screen printing is used for printing on a wide variety of fabricated objects and materials. The basic screen printing principle remains the same but the make-ready, inks, and special machinery are adjusted to suit the individual requirements for the specific job in hand. Generally where screening is geared to mass production, entire factories are blueprinted to screen a particular product.



Units used to print on textile piece goods (T shirts etc.)



Highly sophisticated fully automatic unit for screenprinting on piece goods

Section 5.

The Future of Screen Printing.

The Future of Screen Printing_

The Future of Screen Printing

The growth potential of the screen printing industry has allways relied on the continuing development of presses, dryers and stencil systems.
Presses and dryers are related, in the sense that faster presses depend on speedier drying systems.
Stencil systems apart from improvements in processing techniques are related to printed image quality. Stencils are however also related to screen fabrics in matters related to adhesion, wear etc.
The screen fabric manufacturers development has its own equally important role to play in the general development pattern

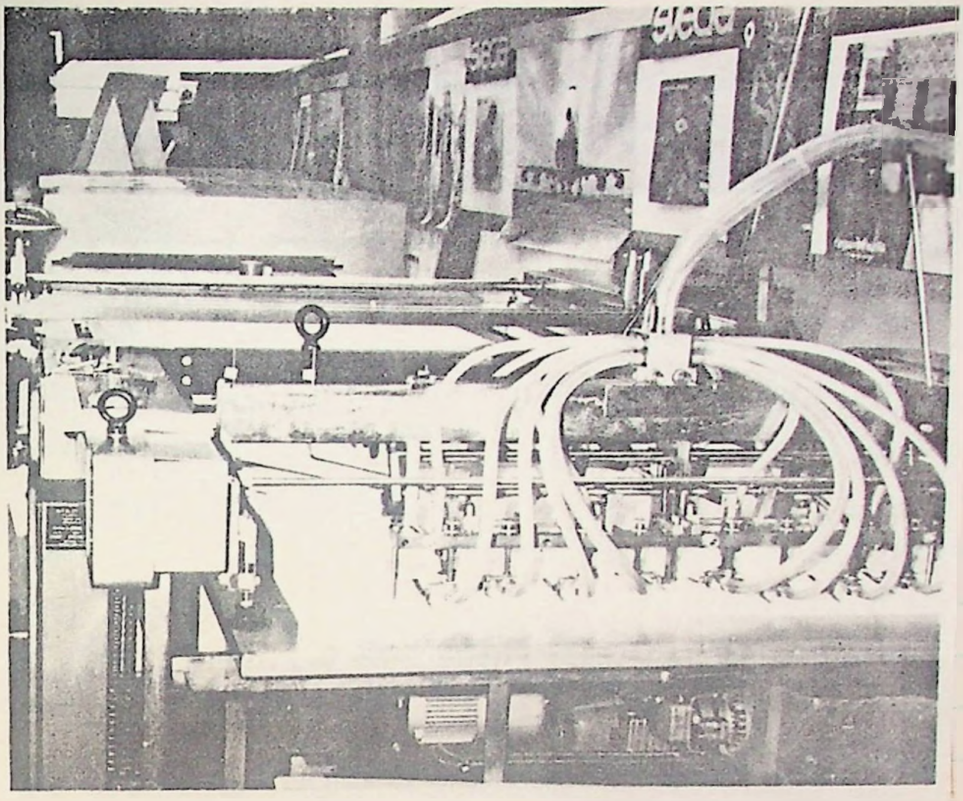
Most screen printers recognize flat-bed and cylinder presses as the two main types of machinery in use in the industry today. At the 1977 DRUPA exhibition in Dusseldorf there were several exhibitors demonstrating web-fed or reel to reel systems, in some cases using rotary screens printing on a continuous web movement. (web = a roll of paper used in web or rotary printing) Also at the same exhibition there were examples where makers of conventional printing presses such as letterpress, were offering their machines with built in screen heads, for in line combination printing with mixed systems. This extremely interesting development signifies that the major printing processes are recognizing the potentials of screen printing in this manner. These presses with drying systems capable of matching their output invite the screen printer to compete in the offset-litho market.
The screen printing industry is on the verge of entering a state of turmoil with the realisation that what has always been regarded as a highly specialised process could find

itself competing successfully in a market sector formally controled by other systems.
Some screen printers are of the opinion that screen printing has its real strength in applications for which its distinctive character and advantages are best suited. Other screen printers however feel that high speed screen presses are a logical and healthy development in a growing industry.
High speed screen presses will continue to be developed with the increasing use of sophisticated electronic register and ink feed devices.
Drying however is a much more speculative area, it has always been the major bottleneck in screen printing operations. At present the industry is using in the main solvent-based inks and evaporation drying systems. Now there is an increasing interest in ultraviolet drying systems and there are a number of UV dryers already on the market. Ultravidet drying systems are non-polluting as the liquid contents of the ink are polymerized almost instantly without giving off any vapours. Ultraviolet drying units are much smaller than the conventional evaporation dryers. At the DRUPA exhibition there were speculative reports about a new drying technology, not named that might be introduced even before UV drying could be fully developed.
The major part of the stencil system is its development and processing procedure and in this area there are now available fully automatic processers. Automatic stencil processing and other forms of programmed control of operations that used to call for skilled manipulation and judgment will play a major part in the future of screen printing.
Improved screen fabrics at present on the market include metallized mesh and polyester fabrics with

chemically modified surfaces, designed to give better performance and to overcome the adhesion problems associated with indirect stencils.

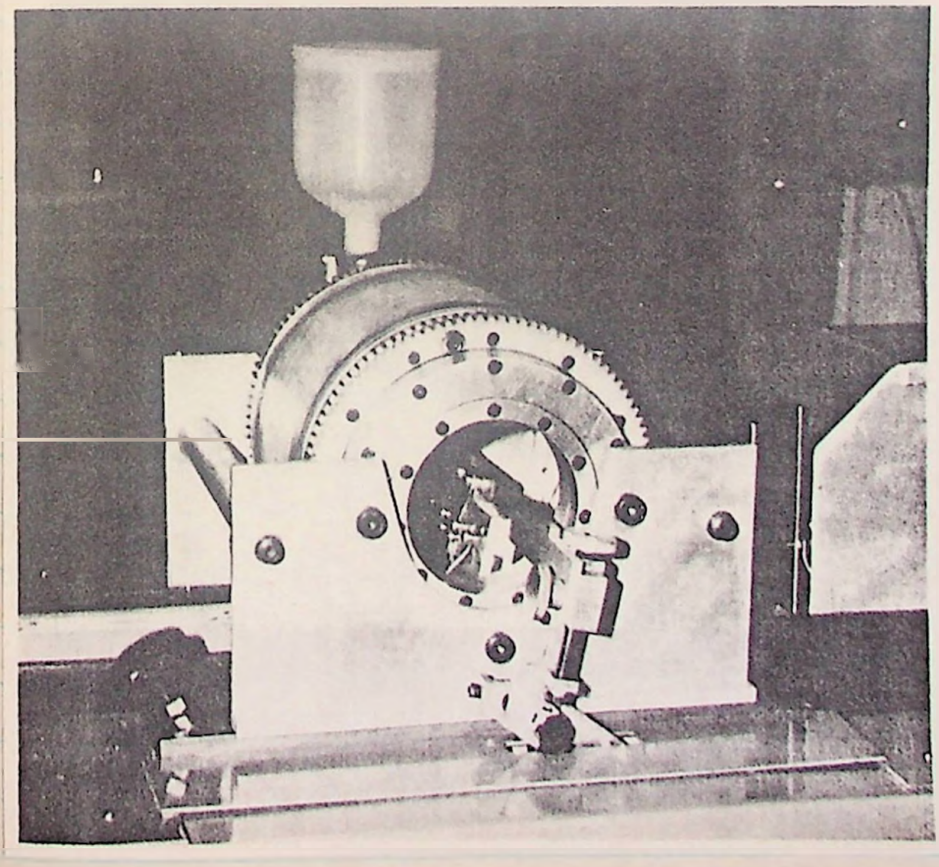
Whatever developments may come in the future the screen, the stencil, and the squeegee will still be essentially at the heart of the commercial screen printing system.

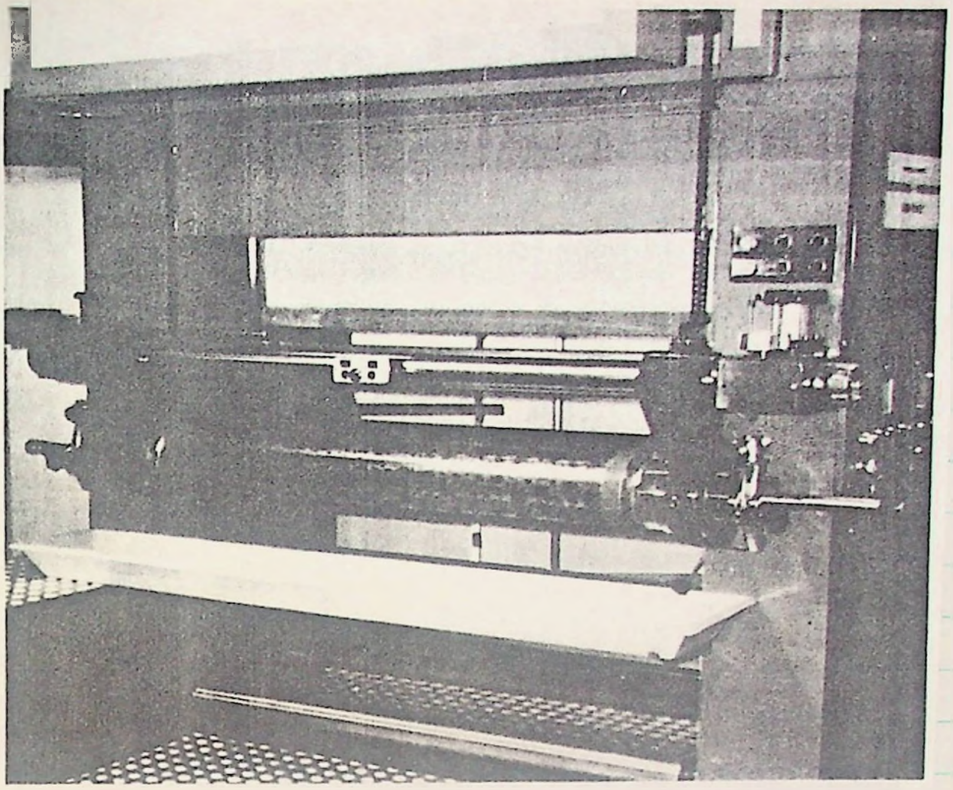
Equipment of the future for screenprinting.



Although conventional printing and drying techniques are likely to be in use for years to come, equipment continues to advance along sophisticated lines. Above is a modern high speed press line with feeder and evaporation dryer.

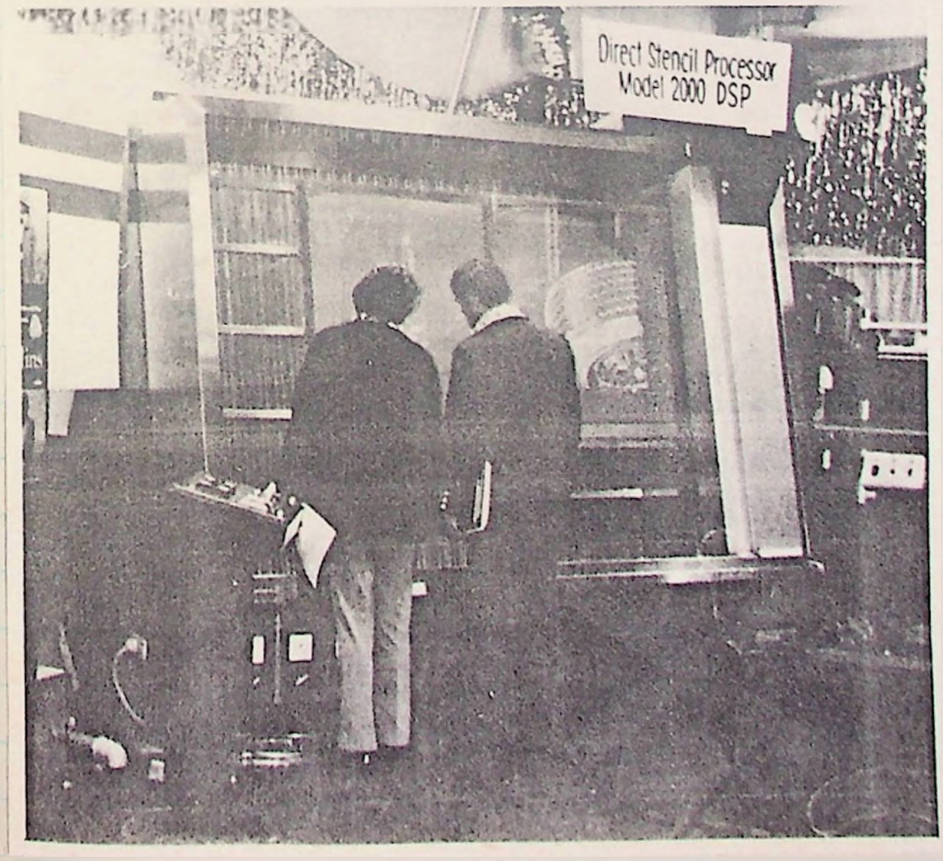
Below is a small rotary screen unit designed for continuous high speed printing by means of a web-fed system. Note the squeegee assembly inside the drum-like rotary screen head.





Presses such as this one , with an industrial rotary screen printing head, can be combined in a series for multi color, web-fed printing, thus breaking into the short-run end of the offset-litho market, an area some screeners says the industry shouldn't try to compete in.

Presses, of course, aren't the only area in which equipment advancements are being made. Automatic stencil processing, for example, is taking over the conventional hand spray and sink. Below is such an automatic device for processing direct emulsion screens.



Section 6.

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In compiling the information required to produce this thesis, reference has been made to the following sources.

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