The Sten-Screen: Making and Using a Low-Cost Printing Process

by Ian McLaren

Published by:

Intermediate Technology Development Group (ITDG)

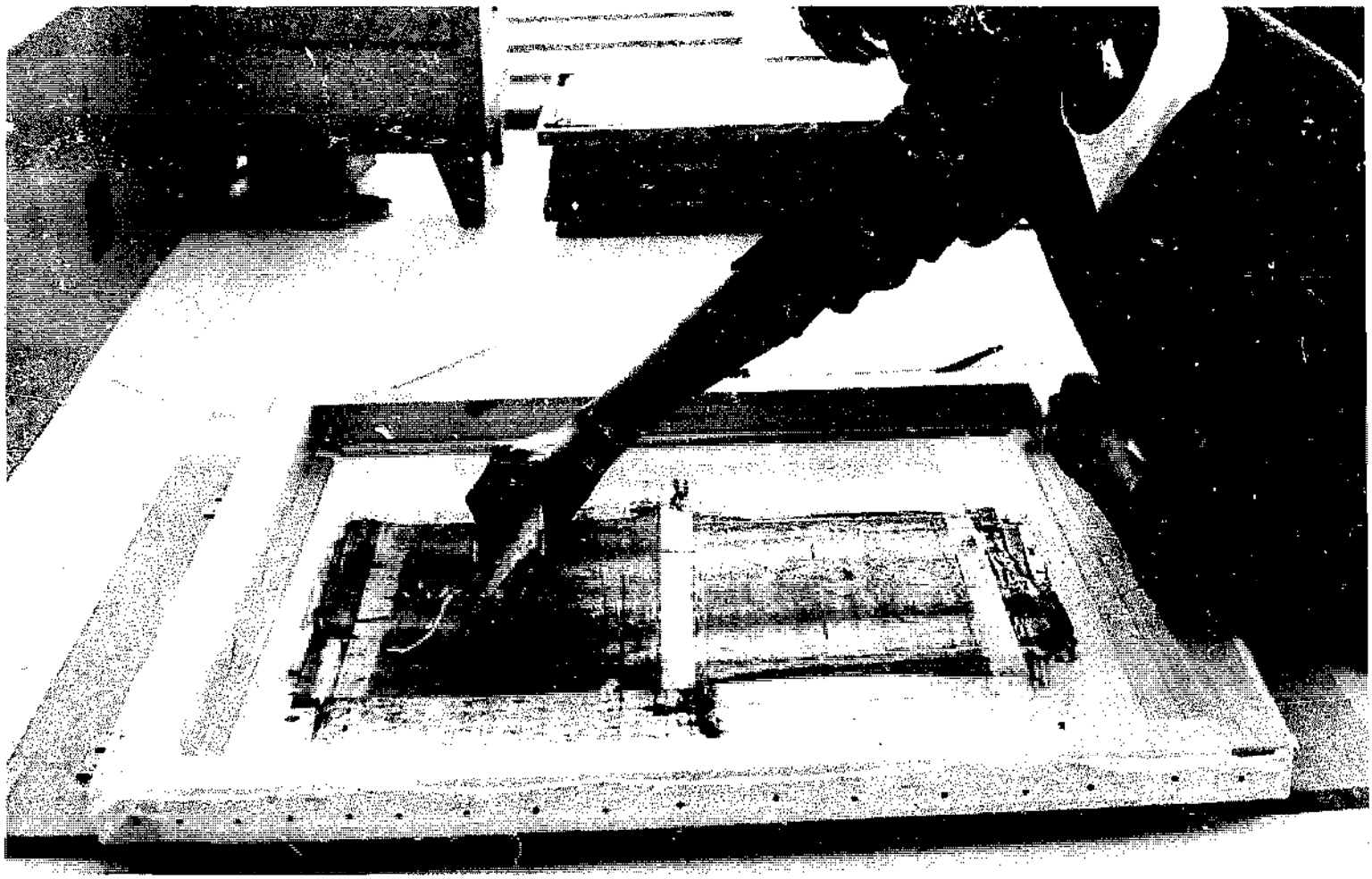
Available from:

Intermediate Technology Publications
9 King Street
London WC2E 8HN
ENGLAND

The Sten-screen

Making and using a low-cost printing process

Ian McLaren



THE STEN-SCREEN PRINTER

A manual on how to produce and use
a low cost printing device

Ian McLaren

ILLUSTRATION 1

Printing with the Sten-Screen process at the Co-operative College Moshi. Notice that the work is conducted in the open air, without the need for electricity.

1- General description

The Sten-Screen Process is a hybrid duplicating and printing technique. Basically it combines stencil duplicator stencils with the screen process. This enables one to create legible and compact printed matter, using equipment which one can make oneself out of readily available items. The process does not require electricity.

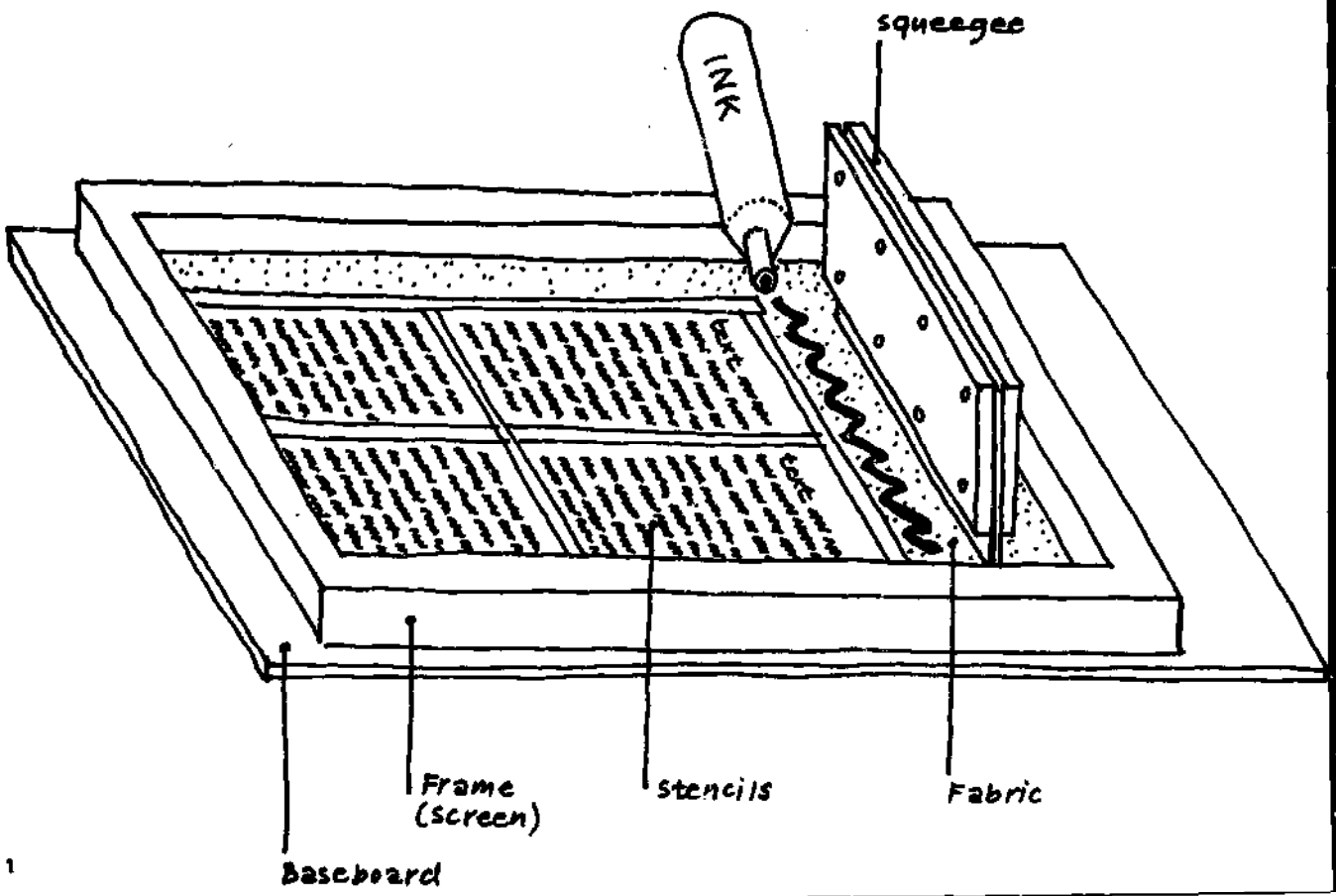
These instructions give guidance on how to build and use the equipment. The screen uses a simple rectangular frame with textile stretched across it. This is used as a support for stencil duplicator stencils. The text and images which are required to be reproduced may be either typed, handwritten or drawn upon these.(One may also reproduce photographs, details are given in Section 4.7)

If one wishes to print two or more pages simultaneously one simply fixes the corresponding number of stencils to the underside of the screen.

Because it is a form of screen process printing one may print onto a large sheet. If the intention is to produce posters the sheet will be left unfolded. Alternatively one may fold the sheet to produce newspaper or booklet formats.

The process may also be developed to print onto materials other than paper; eg cloth, plastics, etc.

Our drawing shows the basic elements of the process.



PREFACE

The Sten-Screen printing process was developed to produce a simple low cost printing technique which fulfills the following criteria:

- it can produce legible and compact text
- it does not require electricity to run
- it can be made from locally available materials
- it can print on a variety of materials apart from paper
- it can be easily operated without the aid of sophisticated equipment

Essentially, the Sten-screen process is a combination of a screen process 'press' with stencil duplicating stencils for the production of the original text and imagery.

Following a UNESCO funded study on low cost printing techniques in which the Sten-screen was first mentioned, Intermediate Technology Industrial Services provided funding for the development and field testing of the process. The field testing was conducted in three African countries, Kenya, Tanzania and Zimbabwe, during the summer of 1982. Kenya and Tanzania made their own equipment from the original draft of this manual, and a ready made up unit was sent to Zimbabwe for demonstration at the Rural Technology Development Fair. Inevitably, there were variations in the results of the device from the various locations, but the reactions in all cases were very positive and encouraging. As a result, it was decided to publish this modified version of the original manual.

The screen should be built from seasoned timber, preferably hardwood (1). A smooth baseboard is essential; this is best made from blockboard, marine ply, or hardwood.

The equipment can be used to print either a single page individually by using a single stencil:or if a large number of copies are required, one can reduce the labour of printing by making duplicate stencils. If one does this one can print two or more copies simultaneously by mounting the duplicate stencils onto the screen. The process is probably best suited to this type of work.

Alternatively one may print a document with a number of pages using a single pass of the press by mounting the appropriate number of stencils onto the screen. Sections 3.3 and 4.4 give further guidance on this.

1) Hardwood is recommended because one uses liquid generously when washing the equipment after use. This may cause softwood to warp; which will make it difficult to print effectively. If you have only softwood available and wish to prolong the life of the screen then it might be worthwhile giving it either a protective coating of sealer, or impregnating the timber. However, we do not know whether there is likely to be any reaction between the protective medium and whatever ink you may use.

In industrial applications the screen is made from rectangular section stainless steel tube. An A1 sized screen of this type costs £23 in the UK, plus fabric. If you can get something suitable made up bear in mind that you will require a sophisticated method of fixing the fabric to the screen if the correct tension is to be maintained. We can provide details of this.

To make the press you will require

Screen

To print an A2 sheet (594 : 420mm, 33 1/3 : 23 3/8").

- Timber

  approximately 45 : 45mm ex 2 : 2")
  two lengths, each of approximately 2m (6' 7") and 1.4m (4' 9").

- Dowel (and glue) or screws to join the timber

- Fabric
  (organdie, rayon, nylon or silk) to act as a support for the stencil

- Hinges
  to join the screen to the baseboard.
  75mm (3"), rising butts are best for this purpose, see section 2.4

- Battens
  for extra tightening of the screen (see Section 2.3) and for spacing apart the screen and baseboard (see Section 2.4). You will need a total of 6 pieces, all approximately 5mm (3/16") thick.
  4 lengths approximately 850mm (2' 9 1/2")
  2 lengths approximately 600mm (1' 11 1/2")

Baseboard

To act as a smooth surface on which to print.

- Plywood or blockboard
  1 : 0.8m (3' 4" : 2' 8")

Squeegee

To press the ink through the stencil

- Offcuts of timber, an old ruler, or some other similar smooth straight material.

Tools

You will also require the following

- Carpenters saw
- Wood drill, to suit the dowels
- 4 carpentry C clamps

- Scissors
- Hammer and 12mm (/2") tacks, or staple gun
- Screwdriver
- Bradawl

To prepare the stencil
you will require:

- Something with which to create the master on the stencil.
  A typewriter for lengthy text, and/or a pointed tool such as a dried-up biro (or needle), if you wish to write by hand or make drawings. (Section 3.1)

- Water
  to help stretch the stencils smoothly onto the screen: (Section 3.2) and also to clean up with after-wards. (Section 4)

- A clothes line and clothes pegs (or string and paperclips) to hang the printed copies upon when drying. Alternatively you can use a drying rack, if you can get hold of one. (Section 3.3)

- Rags, and maybe a sponge. (Sections 3.2 and 4.7)

- Gumstrip
  (paper tape with a water soluble adhesive on one side - the wider the tape the better for some uses) for fixing the stencil (s) to the screen. (Section 3.2)

When printing you will require:

- Something to print upon of the appropriate size. If you use paper, the more absorbent it is the better. A glazed surface is likely to take longer to dry and this can be troublesome if you have a lot of wet copies flapping around. If you wish to make more robust copies you may also print by Sten-screen onto cloth, plastic and other materials.

- An overrall or working clothes

- A minimum space of 2.4 : 1.2m (8 : 4')

- A work surface the size of a standard door

- Ink
  stencil duplicator ink is adequate

- As little wind as possible!

- You will also need a calm methodical working atmosphere. It will probably be helpful to have someone to assist you; children seem to enjoy taking part in this activity.

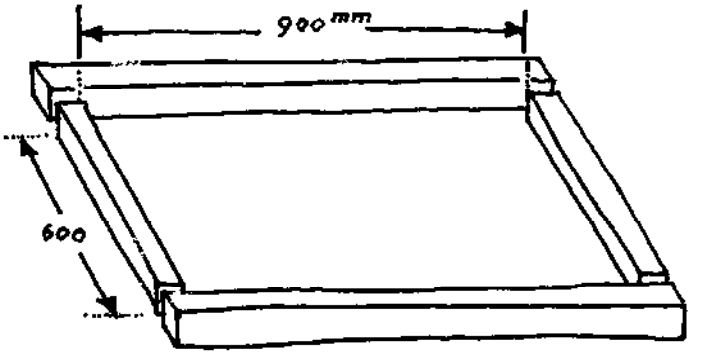
After printing you will require

- Plenty of rags

- Water
  It is important to clean the screen thoroughly as soon as you finish printing. (Section 4.7)
  If you have a short length of hose available (say 2m - 6') which you can fix to a tap, this will make cleaning much quicker and more effective.

2 - Making the screen

You may decide to use a professional carpenter, or someone with better wood working skills than you have yourself. The jointing method suggested here is suitable for someone with only modest carpentry ability. A professional carpenter may prefer to use something more elegant. The precise way in which one makes the frame is not significant: but it is <u>important</u> that the screen is flat, ie that it does not 'rock' when in contact with the baseboard.



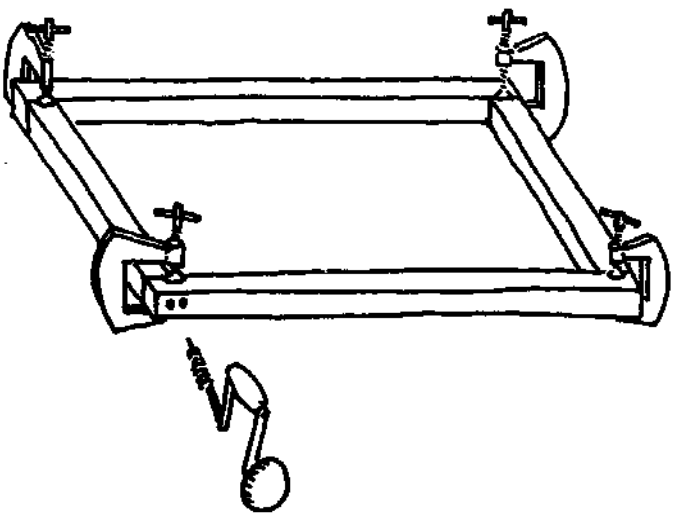
NB This drawing specifies <u>internal</u> dimensions in millimetres.

2.1 <u>Cut the timber to size</u>

These instructions enable one to build a screen which will print an A2 sheet (594 : 420mm, 23 3/8 : 16 1/2"). The screen is larger than the printed sheet to give one extra room when printing. The amount of this extra space is a matter of personal preference, you may after trying these suggestions decide that you need to allow a little more.

Assuming you accept the dimensions we suggest here (and use 45 : 45mm / ex 2 : 2" wood) you will require four lengths of timber, two each of approximately 2m and 1.2m (6'7" and 3'11"). Ideally the timber should be cedar or rahmin, seasoned softwood is OK but bear in mind our comments in Section 1.

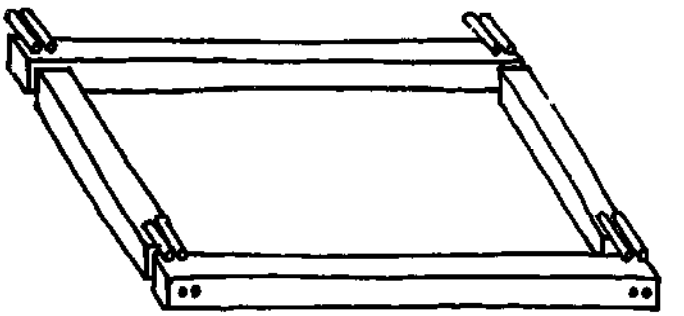
Our drawing shows the required <u>internal</u> dimensions; depending upon the size of timber you use this will affect the overall external dimensions.



2.2 <u>Joining the Timber</u>

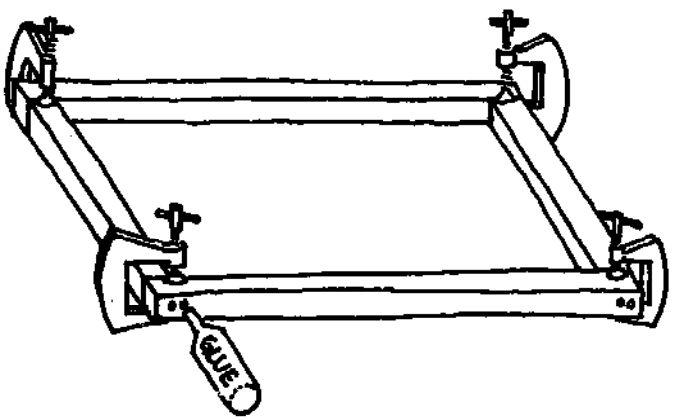
<u>Drill the joints</u>

Clamp the timber in place and drill (preferable two) holes per joint. One may use either screws or dowels as fixings. If you choose to employ screws proceed to Section 2.3 - but bear in mind that it is best to use countersunk screws. <u>Cut the dowels</u> to the right length.



<u>Glue the Joints</u>

Insert the dowels; and when the glue has dried, smooth off any surplus dowel or hardened glue (this may snag the material which you will be using for the screen).



It is important that the timber is smooth where it will come in contact with the fabric; otherwise the fabric may tear as it is stretched tight. Use a flat file or sandpaper to smooth all of the undersides and round off all edges and corners.

2.3 Stretching the Fabric

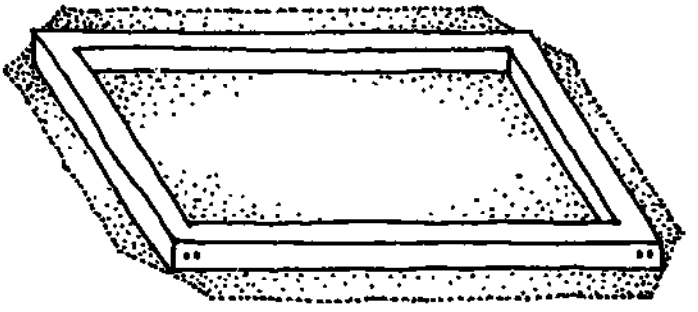
This is probably the most difficult part of the business of making the screen. It can probably only be done by an adult. You need strong fingers if working on your own - or one person to pull the fabric and a second to secure it.

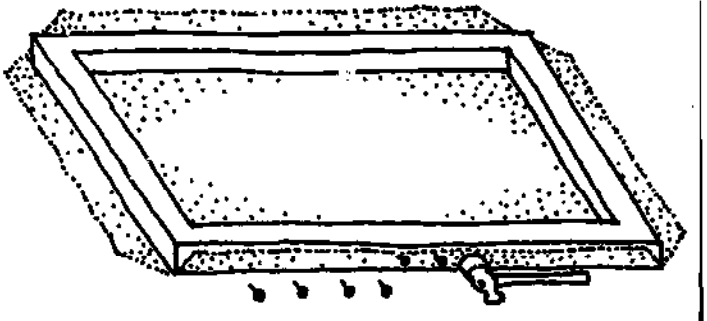
Lay the fabric out and place the screen on top of it. Cut out of the fabric to allow extra so that you will be able to wrap the fabric over the frame.

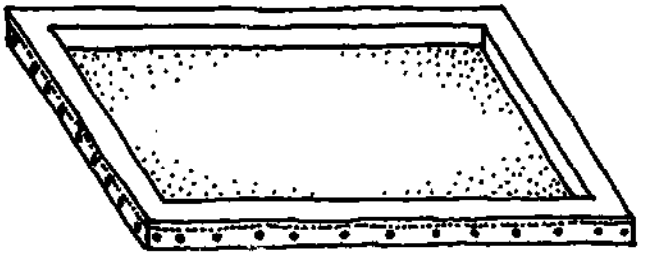
Fix the fabric to the frame with either staples or tacks.

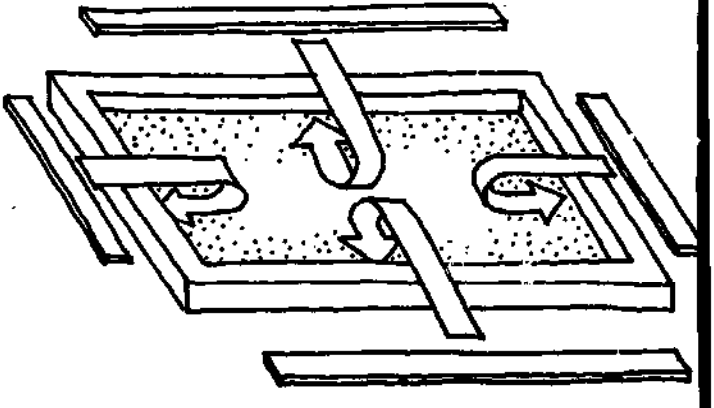
It is important that the fabric is nice and taut. (As a guide, it should be sufficiently taut that a small light object such as a coin will bounce if dropped onto it from approximately 300mm (12").

The best way to obtain the correct degree of tension is to start along one of the long sides. Spread the fabric evenly along the sides of the frame and tack it at approximately 70mm (23/4") intervals. It is a good idea at this stage not to drive the tacks home fully, as you may wish to remove them as the fabric becomes tighter. Once you have done this repeat the process on the opposite (long) side. Having made a preliminary fixing in this way, pull the fabric as tight as you can over the edge of the frame and double the number of tacks (or staples). You may find that as the fabric tightens you will need to change the position of the first row of tacks. If you find that the fabric is insufficiently taut after fixing, you can increase the tension by pushing thin bits of cardboard or wooden battens approximately 5mm (3/16"), between the frame and the fabric. Similarly, if you use a natural fabric for the screen, and this tends to "give" with use; you can use this technique to increase the tension.









You are likely to find that after using the screen several times it becomes torn or clogs in places with dried ink or other wastes. When this happens you will have to take off the fabric and stretch new material onto the frame.

2.4 Hingeing the Screen and Baseboard

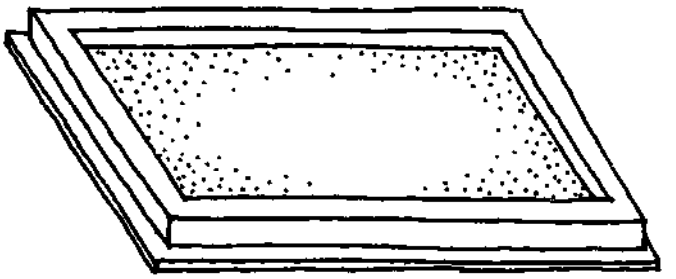
We mentioned in Section 1 that you need to print onto a smooth flat surface if you are to obtain legible results. Also, when printing you will need to position the screen accurately onto the paper.

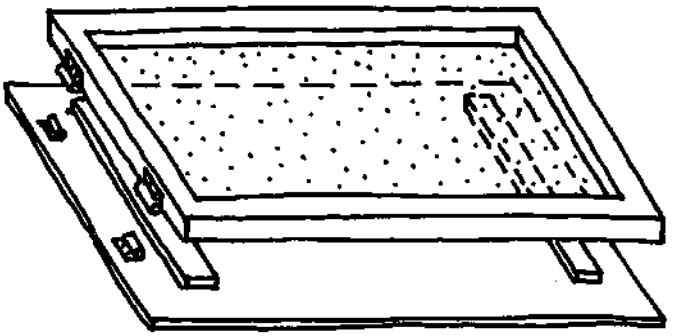
To do this you need a baseboard cut from a sheet of smooth flat wood (such as chipboard or plywood). This should be a little larger than the screen, which should be joined to the baseboard with a pair of hinges. It is best to use rising butt hinges, so that you can remove the screen easily from the baseboard when you have finished printing. If you have nothing to hand, a hinge can be improvised by simply nailing a bit of textile or leather to both the screen and baseboard. Before you fix the hinges see Section 4.1.

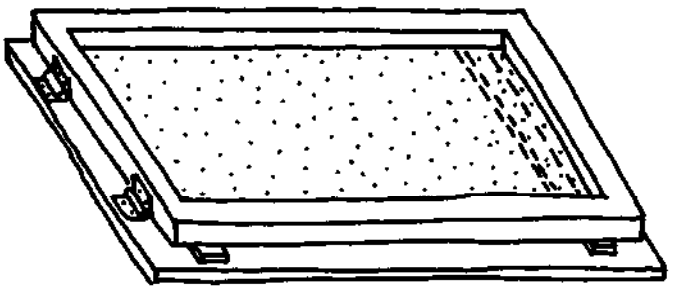
2.5 Supporting the Screen

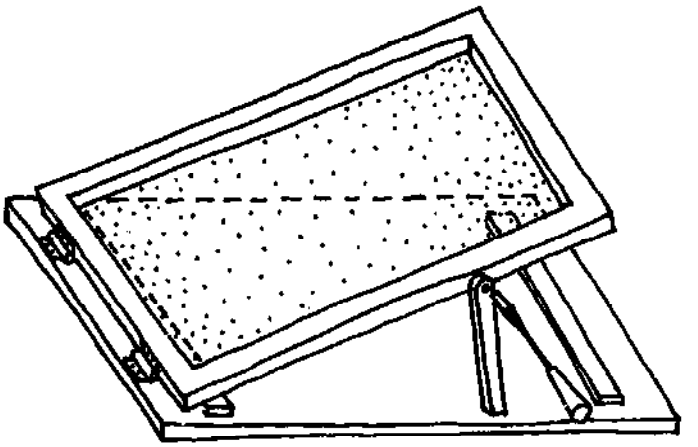
While printing you will be continuously loading and unloading sheets of paper between the screen and baseboard. It is useful (though not essential) to be able to prop the screen up temporarily for this purpose. A simple light piece of wood is sufficient to act as a prop and screen. (An added 'touch' - to prevent the prop getting in the way when printing one can fit a hook and eye to keep things tidy).

Industrial screen printing tables use a counterbalance so that the screen rises automatically after each impression. Equipment of this type costs £1,450 in the UK for an A1 sized sheet. You may be able to improvise a counterbalance.





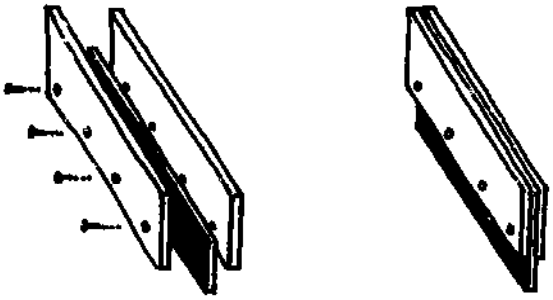




2.6 Making the "Squeegee"

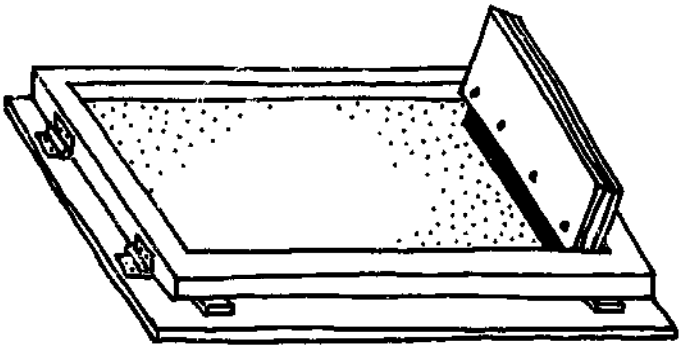
In Section 1 we mentioned that the ink is forced through the stencil by passing a film of ink across the screen (once the stencil has been fixed to it).

To obtain a consistent and manageable film of ink one requires a smooth straight blade of some sort. Conventional screen processs printers use a rubber blade approximately 7mm (1/4") thick mounted in a wooden handle. This tool has the wonderful name "squeegee". We find that one does not require a professional squeegee to obtain adequate results; and have improvised one by sandwiching an old plastic ruler or piece of perspex between two bits of wood. This suggests that any smooth straight edge which has a little "give" in it will probably be OK.



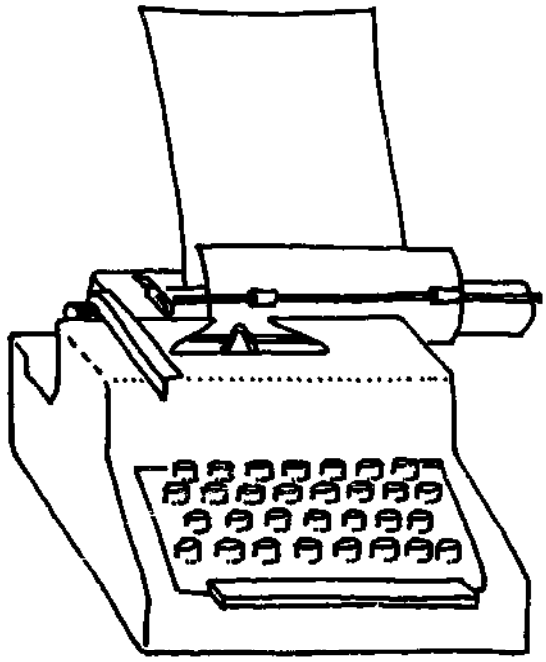
Once you have your;
- screen
- baseboard and
- squeegee

you have a "printing press"!



3 - Using the screen

3.1 Prepare the Stencil(s)

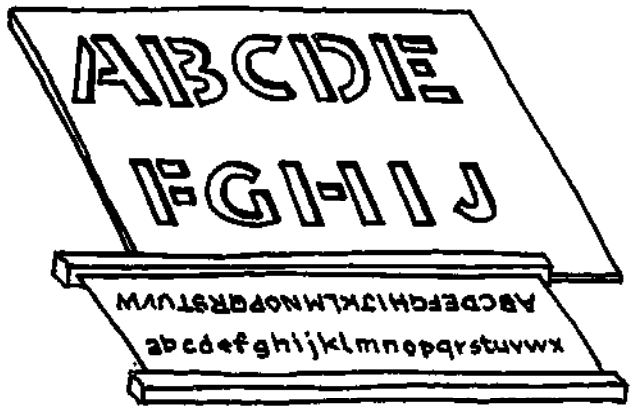


Once you have a screen and the other ancillaries you are in a position to start print production.

Assuming you have a clear idea of what you wish to print; for example to whom your message is addressed; the form it should take (the written style, mix of words and illustrations, etc); the number of copies required; and have the necessary supplies of paper and ink - then you are in a position to start preparing the stencil(s).

Although one can draw and write onto the stencils (using a dried out biro or similar tool) the best way to compress text so that it is compact but still legible, is to use a typewriter. If you have a choice of sizes of alphabet, until you have some experience of the Sten-screen Process it is probably best to use a typewriter with a larger size. Ten characters to the inch (often known as "pica") is preferable. Bear in mind that the ink is likely to spread when printed, so if you have a choice of style of alphabet it is best to choose one where the shapes are "open". By this we mean a design where the interior forms of the letters (such as o,e,a,m, etc.) are as large as possible.

Prepare the stencils in the same way as you would if you were using a stencil duplicator. You will find supplementary advice in Section 4 on how to combine individual stencils so that you may make full use of the potential of the Sten-screen Process to minimise the labour of printing.



If you require text which is larger than a typewriter can produce you can either handwrite this, or if one is available, use a (drawing) stencil. These are used for a variety of different purposes including: technical drawing, agriculture (forestry); and despatch (where they are used for labelling packing cases); as well as signwriting.

3.2 Stretch the Prepared Stencil onto the Screen

Once you have prepared the necessary stencils, these have to be mounted onto the screen. It is important that they are bonded evenly, without any wrinkles in the image making area. (If not, the final copies will duplicate faithfully these irregularities). The best way to ensure an even contact between the stencil and the screen is to wet the screen fairly generously; and to spread the stencil onto the screen with a damp cloth or sponge. It is particularly important to do this in hot climates, otherwise you may find that the glue will dr before a good bond is obtained.

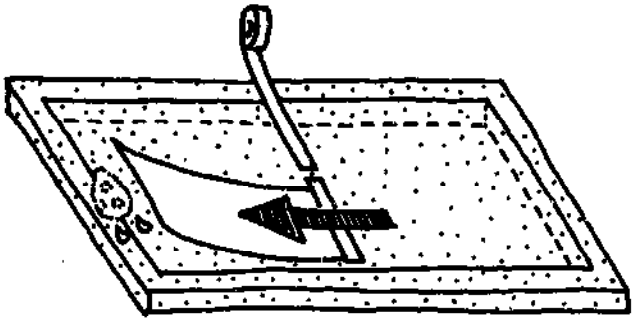
Note: It is essential that you mount the stencil on the underside of the screen. The easiest way to do this is to simply turn the screen upside down and fix one of the short sides of the stencil to the screen with dampened gumstrip. (1) The stencils should be mounted facedown.

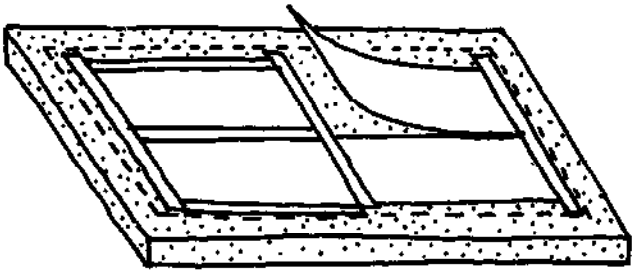
It is helpful to draw guidelines on the screen for mounting the stencils. You can do this simply by drawing onto the fabric with a 'soft' pencil (2B). If you first draw guidelines onto the baseboard you can trace these through by laying the screen on the baseboard. Incidentally the guidlines on the baseboard will be useful later when printing (for positioning the paper). It is also a good idea to number each page in the position required, on both the baseboard and the screen. Then, when you turn the screen over to mount the stencils you will have a useful guide for the correct location (and orientation) of each stencil.

Once you have one side taped into position, and have smooothed the stencil down evenly, it is a simple matter to stick the other sides down using more gumstrip.

Having fixed the first stencil, follow the same procedure for the rest of them.

When all of the stencils are in position it is necessary to mask off the rest of the screen completely, to prevent surplus ink from making everything messy. Masking is easily done



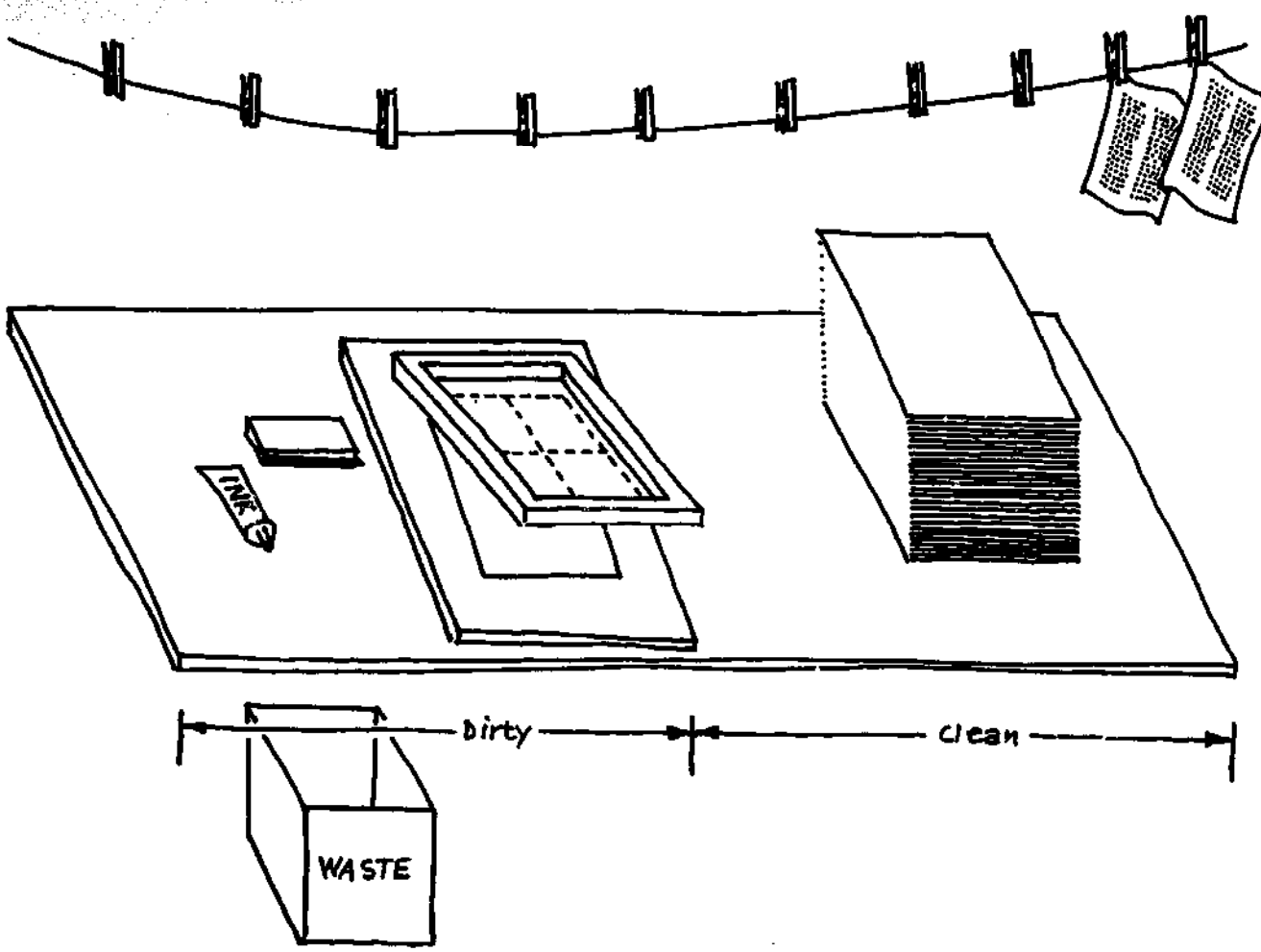


using either lots of gumstrip; or if you have a large area to cover, pieces of unused stencil stuck down with gumstrip. When you have completely masked the screen check that there are no holes where the ink can sneak through, by holding the screen up to the light. Cover any remaining holes with patches of gumstrip.

When the screen is neatly protected stand it up to dry in a warm, well ventilated location (best out of strong sunlight).

Once it is dry you are ready to print!

1) If gumstrip is not available you can use strips of practically any strong non-absorbent paper and glue these with a water soluble glue. Use water soluble glue, otherwise you will have difficulty cleaning the screen after use. As we mentioned in Section 1, once the screen becomes permanently blocked you will have to restretch it. You will find further advice in Section 4.7.



3.3 Printing

Before you start printing it is well worthwhile sorting out the workspace into "clean" and "dirty" areas. You will probably find that no matter how carefully you work, you will tend to get ink onto your fingers. Once this happens it is easy for the printed matter to become messy - as well as everything else you touch!

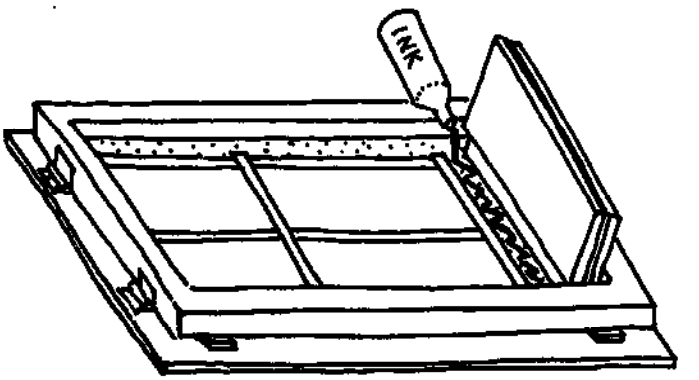
It is helpful to have a second person to assist you, if only to hang the printed sheet up to dry. We find that children from twelve years old are capable of assisting, and even seem to enjoy the business of printing itself. The act of taking an impression does not require great strength or skill; older children are in our experience capable of this.

Once you have prepared your workspace; and instilled in your assistant(s) the need for a calm and methodical working atmosphere; stand the squeegee against the inside of the screen.

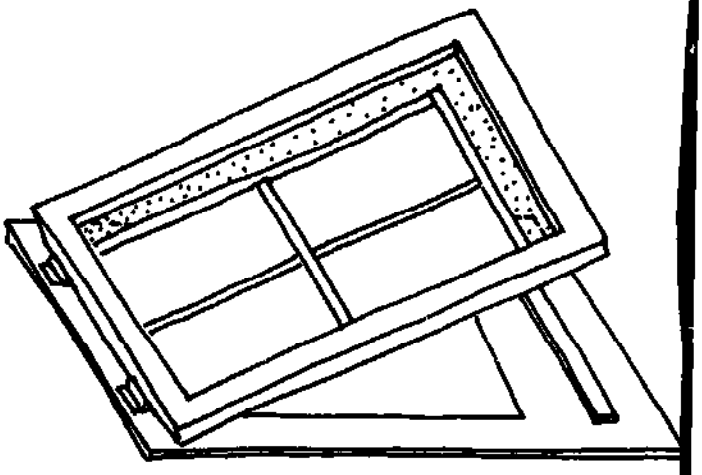
Place paper under the screen and position it, as described in Section 3.4. Squeeze a ribbon of ink onto the screen, between the squeegee and the stencil image.

Scrape the ink across the stencil wherever an image is required. Try to keep the film of ink even. You will probably use more ink than you require. Trial and error will demonstrate that you in fact require surprisingly little ink for it to penetrate the fabric. Having made the impression, collect the ink together with the squeegee before you lift the screen - try to keep the stencil free of ink when lifting the screen.

Having lifted the screen, remove the printed copy; hang it up to dry; and load another sheet of paper.



3.4 Positioning the Paper



If you have drawn the guidelines onto the baseboard as suggested in Section 3.2 you can avoid fiddling around each time you make a copy lining up the paper with the stencil. If you want an additional aid for positioning the paper then you can use four (or more) "lay marks" made by simply sticking short lengths of gumstrip onto the baseboard. These are usually sufficient to prevent the paper from moving as you close the screen.

We mentioned in Section 1 that this Sten Screen Process is also capable of printing onto fabric and other materials such as plastic, glass, etcetera. If you intend to try this you will probably have to use different inks; and in the case of fabric may have to bake or steam the printed cloth to prevent the design from fading when washed. It is hoped that these techniques will be a subject for further development work; in which case we would expect to publish an additional publication describing suitable inks, printing and fixing techniques.

4 - Maintenance, Enhancements, Tips

4.1 Fixing the Hinges

The quality of the printed result is usually better if the fabric 'jumps' away from the paper as the squeegee passes. This is known as the 'snap distance'. It is easy to achieve this if the screen is kept about 5mm (3/16") above the paper. If you put something of this depth under the screen when fixing the hinges this will automatically give you the snap distance for one side of the screen. Once the hinges are fixed in position place another spacer at the opposite end of the screen and you will have an even snap distance over the full length of the screen.

4.2 Alternative Sized Screens

These instructions are for the production of a screen suitable to print an A2 sized sheet of paper. You can of course make the screen to suit any size of paper. We assume that you will probably also require ultimately other sized screens to suite A1 and A3 production.

4.3 Formats obtainable from an A2 Sheet

We have mentioned that you can print items with a large format, such as posters or wallcharts, by mounting several stencils onto the screen. By doing this you can obtain a printed image over the entire sheet. When you do this you must bear in mind that the stencils are fixed to the screen with gumstrip - which will not allow the ink to penetrate. If your design requires stencils to be joined you will have to take account of this. (That is, you will have narrow bands in the image which will not be capable of printing). You can often camouflage this by adopting a "modular" design, such as this publication. Also, where you have large text running over two stencils, you can usually arrange for the gumstrip to be stuck in the space between the words.

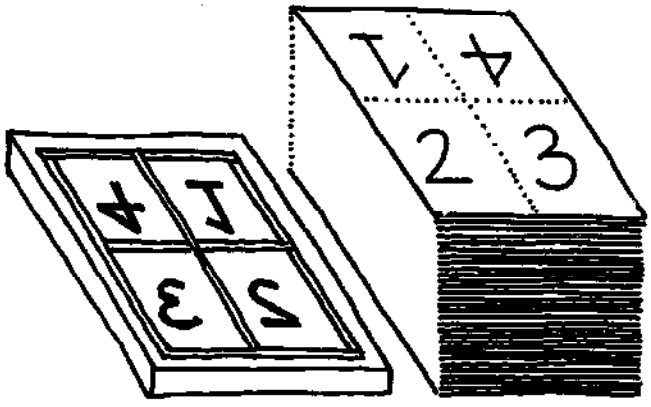
4.4 Printing Pages Simultaneously

You may find that the principal advantage of the Sten-screen Process is that you can print two or more pages simultaneously. For example with an A2 screen you can print 4 pages of A4 with a single pass of the press. With this sized equipment you can print numerous different types of publication. You have the choice for example of printing any of the following:

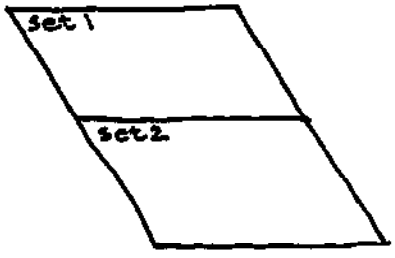
- an 8 page booklet
By printing 4 pages on each side of the sheet.

- two copies of a 4 page booklet
By printing all of the pages simultaneously. Then once you have printed all the sheets on one side, turn the entire supply over, rotate it through 360° and continue printing on the reverse of the sheet.

To do this you will have to mount the stencils on the screen in the order which is shown in the drawing.

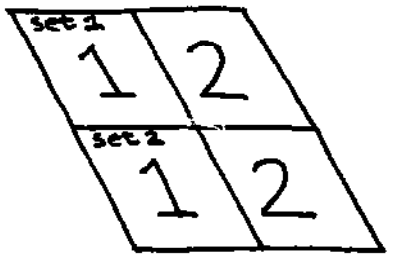


- two copies of A3 size
printed one side
By making duplicate stencils and mounting both sets onto the same screen.



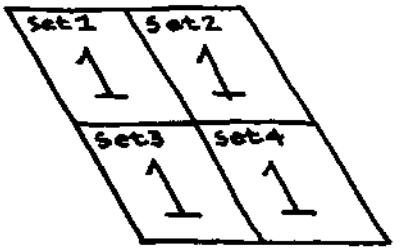
- two copies of an A4 size,
printed both sides
By making duplicate stencils again, and printing both sets simultaneously. In this case you should mount the

stencils as indicated in the drawing. Having printed all the sheet simply turn them over and print on the back - on this occasion you do not need to rotate the pile.



- four copies of an A4 size, printed on one side only.

By making four duplicate sets of stencils and printing in the same way as the previous example.



4.5 Amounts of Ink

When spreading the ink over the screen for the first time you will require much more ink that you will subsequently. Once you have a good film of ink over the area you require, then only very little is needed to print. For example a single ribbon of ink from the tube will usually be sufficient for 4 or 5 copies. When printing it is best of pull the ink towards you; and to maintain a firm and even pressure. When printing the squeegee should be held at approximately 45°.

4.6 Photographs

Preliminary trials suggest that if an electronic stencil cutter is available this can be used to produce stencils in the conventional way, but to print them by Sten-screen. If you decide to experiment with this you must ensure that when the stencil has been cut that the perforations are sufficiently 'open' for the ink to pass through with ease. To test the stencil simply hold it up to the light. If light shows through clearly, then you should have no difficulty printing with them. If the image is not clear enough, then remake the stencil with a more contrasty setting on the machine.

Once you have an adequate stencil then mount it in exactly the same way as described in Section 3.2.

4.7 Cleaning the Screen

We said in Section 1 that the process depends upon the ink passing through the fabric of the screen. It is obvious therefore that if you wish to re-use the screen you should keep it as clean as possible. This is not difficult if you clean up as you finish printing. Stencil duplicator inks are soluble with white spirit, you do not require specialist cleaning fluids.

Start the cleaning by wiping up most of the surplus ink onto scrap paper. When most of the ink is off, you can wash off the stencil and gumstrip with water. Use a hose for this, because if the supply is sufficient you can squirt a high pressure jet at the fabric without damaging it; and this is a good way of clearing waste matter from the fabric. Use the turps to dissolve any patches of ink which remain, and for cleaning the screen fabric generally.

Cleaning up is a messy business - you will need plenty of rags, a large waste bin, and a generous supply of water.

If you are scrupulous in the way in which you clean up, it is possible to lift off the stencil - and if it is clean enough, you may be able to store it and use it for a second edition at some future time. You can also leave the stencils on the screen and print further copies later, so long as you mop up most of the ink with paper.

No matter how clean you keep the screen, nor how careful you are with it, ultimately it will need replacing. When this time comes follow the procedures outlined in Section 2.3