Commonwealth Secretariat

Equipping Small-Scale Printing Units

Commonwealth Education Handbooks

Equipping Small-Scale Printing Units

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FOREWORD

Ministers of Education at the Eighth Commonwealth Education Conference recommended that the Commonwealth Secretariat should organise some of its meetings of experts in such a way as to enable them to prepare handbooks, training manuals and other educational publications as a contribution to various forms of national development.

This handbook is one of a series arising from those recommendations. It began as a working paper prepared by Mr C. S. Morris of the Department of Typography and Graphic Communication at Reading University for a regional meeting of experts on teacher support services. The meeting, which took place at the Auckland Secondary Teachers College in 1982, was held under the auspices of the Commonwealth Secretariat and with the support of the New Zealand Department of Education. The group which revised the working paper in the light of their experience and of the conditions in their countries comprised: Mr T. W. George (The Gambia), Mr Tsang Kwok-keung (Hong Kong), Mr Norman Nathan (a CFTC expert working in Mauritius), Mr Sefalu Ioane (the Director of the Pacific Islanders Educational Resource Centre in Auckland), Mr Colin Smith (New Zealand), and Mr Colin Roberts (Vanuatu).

They were assisted in their task by written comments on the working paper submitted by Fiji, Papua New Guinea, the Intermediate Technology Development Group (Britain), and the British Council. Subsequently, the draft prepared in Auckland was further revised by Mr Morris and now appears as the present handbook. In addition, an account of the origin and development of the Book Production and Material Resources Unit of The Gambia Ministry of Education has been included as an appendix which it is hoped will be a source of encouragement to small states with limited resources.

We offer the present handbook in the hope that it will prove useful to all those departments of government, non-government

organisations and private businesses that are seeking to add a publishing and printing capability to their existing office facilities. It is particularly our hope that it will assist departments and organisations throughout the Commonwealth which, despite limited resources, are determined to make at least a modest beginning in this important field.

We wish to record our appreciation of the efforts of all those who have contributed to the preparation of this handbook.

Rex E. O. Akpofure
Director, Eduation Programme
Human Resource Development Group

INTRODUCTION

This handbook is intended for people in management and administrative positions who do not themselves possess a knowledge of printing techniques but whose organisations need to have anything from a few dozen copies to one or two thousand copies of inexpensive printed materials to support their work.

In the formal education sector such people may be lecturers and teachers wishing to prepare learning materials for their students, or they may be curriculum developers, schools broadcasters or distance educators. In non-formal education they may be engaged in literacy training, agricultural extension, health and nutrition education, sanitation projects, village co-operatives or a variety of other community development projects. Outside of education they may belong to non-governmental or commercial organisations, or to businesses wishing to bring the services they offer to the attention of the general public. They may require leaflets, newsletters, pamphlets or booklets. They may have access to an electrical power supply, or they may not.

Though the range of such people is wide, and their needs diverse, they are likely to have the following things in common:

A limited capital budget with which to purchase equipment.

A clear idea of immediate needs, an expectation of growth, but no certainty of the pace and direction of that growth.

One or more typewriters, and one or more secretaries with typing and other office skills.

Printing requirements which fluctuate to an extent that specialist printing staff cannot be fully (and therefore economically) employed, and a staff structure which does not easily assimilate the employment of printers at salary levels comparable to those they can obtain in commerce.

No skilled staff to operate sophisticated printing machinery or to maintain and repair it.

A need to be able to exercise close supervision of every operation from the time that printed materials are first conceived up to the time they are distributed.

What this handbook sets out to do is to help management staff to make informed decisions on the purchase and utilisation of small-scale printing equipment which suits their needs and takes into account the budgetary and personnel constraints within which most organisations are compelled to operate. It recognises the problems - both mechanical and economic - that confront anyone given the responsibility of starting up a printing unit.

Its sequence follows as closely as possible the stages that have to be undertaken in preparing and producing printed materials. It begins with methods of setting the text, including typewriter setting, word processing, photocomposition and headlining, and continues with graphics, layout, and the other processes involved in preparing camera-ready copy. Then come three sections dealing with the various ways of producing multiple copies of printed materials - by mimeographing, silk screening and offset printing. There is also a section on the process camera and darkroom for units requiring relatively large quantities of high quality work. Various ways of collating, folding, binding and trimming are then described, and the main part of the handbook concludes with procedures and practices required in managing a small printing unit. Wherever possible the relative advantages and disadvantages of the different processes and machines are compared as an aid in assessing which of them are best suited to units of different sizes.

Inevitably, a book of this size cannot hope to cover every eventuality, and questions are sure to arise which it does not answer. In these circumstances, the best thing to do is to seek advice from a printing unit similar in size to yours, or consult someone with expertise in the subject provided that the person is impartial and not personally engaged in selling printing equipment.

SECTION ONE

COMPOSITION SYSTEMS

TYPEWRITER COMPOSITION

Anyone who has visited a newspaper office, a Government Printer or the like, will have seen large and costly machines being used to set type. Some use molten metal to form the characters and words (hot metal setting); some use photographic methods (photocomposition). All are very expensive and employ skilled operators who need special training. These machines therefore lie outside the scope of this handbook.

Small type-composition units are recommended to use an office typewriter rather than any of the specialist machines for setting text. One reason is that a typewriter can be operated by anyone with ordinary secretarial skills. Another is that it can be used for ordinary letters, invoices, and a host of office jobs, so the machine need never be left wastefully idle. The results are satisfactory for a wide range of publications. Many organisations, including the Commonwealth Secretariat, make frequent use of typewriter setting. This book is no exception: it was set on an IBM Selectric II typewriter using Orator, Diplomat and Courier golfballs.

Manual Typewriters

Manual typewriters will have to be used where: (a) there is no power supply or where the supply is subject to frequent interruption; and (b) there are severe financial limitations.

If a manual typewriter is used it must be kept in the best possible condition. The typist needs to operate the machine

This is an example of typing done on a 12-pitch manual typewriter. 12-pitch means that there are 12 letters to the inch. The ribbon has been used more than once. The lines are one space apart.

This is an example of 10-pitch typing on a golfball machine. There are 10 letters to the inch. The lines are 1½ spaces apart.

Here are some examples of golfball typing

ORATOR - A 10-PITCH GOLFBALL FOR HEADINGS

Bookface - a 10-pitch ball for clear text

Diplomat - a 12-pitch golfball, good for subheads

Prestige Elite - the standard 12-pitch golfball

Courier - used for typing this handbook

Courier Italic - for emphasising certain words

This is an example of a passage printed by a word processor. It stores the words set by the operator and prints them whenever they are required according to the instructions it is given.

One of the things a word processor can do is to space the words in such a way that each line is exactly the same length. In the first paragraph it was instructed to print lines four inches long; in this paragraph 3½ inches long.

Diagram 1

more slowly than usual. One reason for this is to maintain an evenness of strike not always possible when a manual machine is being used at speed. Another is to keep errors to a minimum. Messy typing will show up badly in the finished copy.

Manual typewriters are adequate for simple printing operations such as stencilling. They are seldom satisfactory for scanning (see page 37) or for producing offset masters. (See pages 41-43) If they have to be used for these purposes it is best to use "once only" ribbons to produce good results.

Electric Typewriters

One of the advantages of an electric machine is that it controls the impact. Even the full stop strikes with just the right amount of force to mark the surface of the paper and not drive right through. Another advantage is that the operator can reach higher speeds with less fatigue. Each key needs only a touch on it to make the electrical connection whereas the manual typewriter needs a physical effort to make the character strike the paper. As with manual typewriters, "once only" ribbons are the best to use.

Both manual and electric typewriters can have either 10-pitch or 12-pitch characters. The 10-pitch machine has 10 characters to the inch: the 12-pitch machine has 12 characters to the inch (see diagram 1). Obviously the 12-pitch machine is more economical in its use of space.

It is worth trying out various makes of typewriter before you buy. Specimen pages typed on different machines will help you to choose the model best suited to the needs of the unit.

Golfball Typewriters

The golfball typewriter is an electrically operated machine with the big advantage of having interchangeable type-heads. For a small outlay, a variety of typefaces can be selected, and bold and italic versions of them can also be obtained to help to emphasise headings, book titles, quotations, etc.

The typefaces used for any publication should be chosen with care. Where they are randomly mixed, the pages look ugly.

Golfballs not only come with different typefaces, they also come in different sizes. The two commonest are 10-pitch and 12-pitch. 10-pitch is usually best for cutting stencils as the characters come out looking clearer than they do from a smaller typeface.

It should be noted that some machines which look alike take differently designed golfballs. This means that great care must be taken when ordering additional or replacement golfballs.

Some golfballs are designed with floating accents (i.e. without characters beneath or above them). They can be used to put the appropriate accent above (or below) any character with careful use of the backspace. It is also possible to obtain golfballs designed for languages other than English and for typing mathematical symbols.

For a little more money it is possible to buy golfball typewriters with a correcting facility which enables the operator to rectify errors with ease, provided they are noticed before the page has been removed from the carriage.

Golfball Composition Typewriters

The next step up the ladder is the golfball composition typewriter. This produces a wider variety of size of print. With this machine the traditional kind of justified print can be produced, that is the right-hand ends of the lines are not left ragged as they are in this handbook. Two examples of justified print (produced by a word processor) are shown in diagram 1.

It must be emphasised that a golfball composition typewriter is extremely delicate and needs: (a) trained operators; (b) readily available technicians; and (c) high capital outlay.

Word processing and phototypesetting are possible alternatives to golfball composition typewriters.

Daisywheel Typewriters

As the name suggests, the type element of these machines looks something like a flower with the characters at the ends of spokes resembling petals which radiate from the centre of the element. It is claimed that faster typing speeds can be reached with this type of machine.

They are recent developments and clients are advised to seek out and compare the capabilities of daisywheel and golfball models before deciding which to buy. They are roughly the same price. The availability of replacement parts and of reliable servicing may be important factors in determining which kind of machine, and which model, to buy.

WORD PROCESSING

This is also called "information processing", "text processing" and "copy processing". The term "word processing" was used as long ago as 1960 when IBM defined it as "the sum of activities involved in composing, dictating, recording, transcribing, and typing words in a modern office" - the ultimate in office printing.

The important word here is "recording". The early machines punched a paper tape for this purpose; machines today use magnetic cards or discs which store the typewritten word. When fitted into the word processor, they will automatically retype any material stored on them, in full or in part and in a variety of layouts.

The things to look for when considering purchase are:

The Keyboard

This consists of a standard typewriter layout of modern electronic design. In addition to the normal alphabet, numeral and symbol keys, a number of command or instruction keys are provided.

The Visual Display Unit (VDU)

The material keyed by the typist is displayed on the VDU. This looks very much like a television screen, and what

is displayed on it should bear a fairly realistic resemblance to what appears on the printed-out copy. At the very least the tabular matter should be aligned on the screen, and indented material should appear indented. Whether or not it is possible to display justified text, the line-endings should be the same on screen as on the print-out.

Storage

This is usually on floppy discs or diskettes with a capacity of 250,000 to 300,000 characters. Some word processors use paper or magnetic tape. Material stored on a disc can be merged with other information from another disc. This gives the facility for preparing documents from standard paragraphs or for compiling standard letters and merging them with existing address lists. Variable information can be prepared in advance and inserted automatically into a recorded document.

Print-out

Most word processors print from a daisy-wheel head at a speed of 45 to 50 characters per second. The print-out unit can be on-line to the keyboard, or can stand separately and service the product from more than one keyboard. A bold face is sometimes produced by the characters being printed twice, the second time a minute fraction of an inch to the side of the first set. Extra copies can be produced as often as necessary from information keyed in.

Operating a Word Processor

All material keyboarded is displayed on the screen as it is keyed. The number of characters displayed at any one time varies from system to system; the average is between 1500 and 2000.

Format details giving the document name, line length, line spacing, margins and tabs are displayed at the top of the screen and can be changed at any time, for example to extend or shorten line length, alter line spacing, etc.

Corrections can be made at any time. Typing errors can be corrected by substituting characters. Words or paragraphs can be deleted or inserted as necessary. A cursor can be

moved independently by the operator to the position where corrections are to be made.

The VDU can also be used to display material that has been stored on disc. This can be updated or corrected and put back on the disc ready to be printed out.

Training

To get the best from the machine, a competent office typist should be selected for training. One or two weeks' instruction will be necessary depending on the complexity of the word processor. This training will teach the typist all the programming necessary to operate the machine. Training is normally provided at the offices of the suppliers of the machine and is usually without charge. Any additional costs (i.e. travel, subsistence or accommodation) will have to be paid for by the purchaser.

Factors in Making a Choice

There is an extremely wide choice of word processors on the market. Prices vary with complexity: the more the word processor can do, the more it will cost.

Very few machines are compatible with one another - probably only those produced by the same manufacturer. The incompatibility arises from the number and function of the instruction keys. To make keyboards compatible, an interface must be used. This is an electronic unit (black box) programmed to change the instructions on one disc to instructions that can be read by the other keyboard or print-out unit.

Before a word processor can be interfaced to a phototypesetter, not only must a black box be made to produce compatible discs, but extra instructions must be programmed into the keyboard. Phototypesetters have different typefaces, styles and sizes available at the touch of a key. The word processing print-out unit has not. Consequently, almost no word processors are being used as input for phototypesetting systems.

Because of the amount of research being carried out on word

processors, models may become obsolete almost as soon as they are sold. Anyone thinking of making use of one should therefore consider hireage as an alternative to purchase. Most suppliers operate a rental system which will enable you to update the equipment without incurring large capital costs.

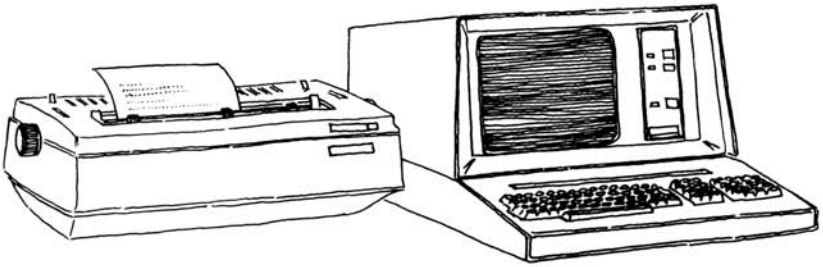


Diagram 2: A Word Processor. The keyboard and VDU are on the right and the printer on the left.

PHOTOTYPESETTING

Phototypesetting is also known as photocomposition. It is a fast and flexible method of setting type by photographic means. Its crispness of image and the fit of character to character gives a quality equal to that of hot metal setting and much better than any typewriter.

Phototypesetting equipment is expensive. The cheapest machines cost at least twelve times as much as a golfball typewriter; expensive ones over 150 times as much. All modern machines make use of computer memories and work with discs or with paper or magnetic tape. It is the complexity of the computer in the phototypesetter that controls the price. Cheap phototypesetters have very limited computer facilities.

The most important advantage that phototypesetters have over other systems is speed: many thousands of characters per hour can be exposed by the machine onto photographic paper or film.

Various typefaces and sizes can be used at a command from the keyboard. Most phototypesetters manufactured today have visual display units which look like those on word processors and fulfil the same sort of functions. The VDU enables the operator to adjust spacing and correct errors before the material is actually exposed onto the paper or film.

A disc or tape similar to those used in word processors will act as long-term storage for a job after it has been processed. If the job is needed again at a later date, with alterations, the disc or tape can be fed into the VDU which will then display the job on the screen. The operator can then modify the material and pass it back to be recorded on the disc or tape for immediate output and/or storage.

The machines are made up in two modules: (a) a keyboarding unit which consists of the keyboard with the instruction keys and VDU; and (b) the exposure unit, which will hold the photographic material, the light source, lenses and the character matrix. These modules are common to all machines. They can be combined in one case or can be separate. While one job is being keyboarded, a different text can be exposed onto the photographic material.

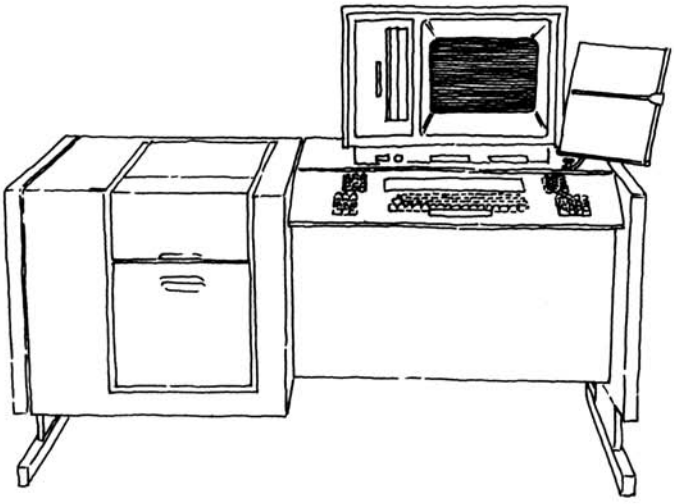


Diagram 3: A Phototypesetter

The range of typefaces available at any particular time will depend on the model of machine. Most typefaces are adapted from typestyles of hot metal typefaces. Others have been designed specifically for photocomposition. The operator can expect to have at least two typefaces in two or four styles available on the machine at any one time. With the system of lenses in the expensive unit, he will have type sizes from 5 point to 36 point available in those typestyles.

The typefaces are in negative form either on a disc matrix or on a strip matrix, and can be changed very quickly and easily. The more expensive machines can have a number of disc matrices which are selected by command. This gives the operator an even wider choice of typeface.

Prices vary: the cheapest strip matrices will cost about twice the price of a golfball typewriter head; the average price for disc matrices is about 12 times that of a golfball head.

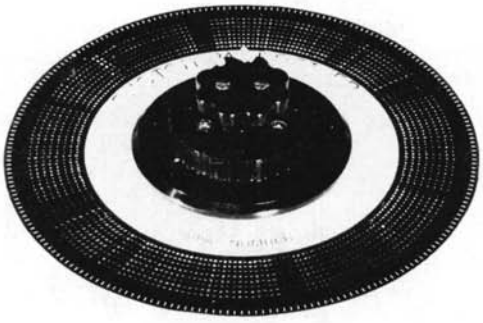


Diagram 4: Disc matrix

Phototypesetters are programmed to carry out many tasks when the appropriate key is pressed: line right, centre, line left, justify to full measure, tabulate, hyphenate, etc. Machines are now available which check spelling. So far very few small printing units are using phototypesetting. However, some people believe that before many years have passed phototypesetting will be as commonplace in the small printing unit as golfball typesetting is today.

As with word processing, phototypesetting is a technique that is changing from day to day and machines quickly become obsolete. If print managers wish to keep in touch with all the advances in this area, they can do so through such trade journals as *The British Printer, Printing World,* and *The Lithoprinter.*

A NOTE ON COPYRIGHT

If an individual or an organisation wants to copy or print a prose passage, or a poem, or a picture, or anything else originally produced by another person, every care must be taken to ensure that that person's copyright is not infringed. In every country there is a law to protect the works of authors, translators, photographers, illustrators, musicians and other creative artists, not only during their lifetime but for years after their death. Breaking the copyright law may be serious, and may incur legal penalties, so permission should be sought from the copyright owner of any material you wish to use before you send it to be printed. In most cases, the best person to contact is the publisher of the book, magazine, newspaper or other work in which the material appears.

Further information on these matters is given in *The Copyright System: Practice and Problems in Developing Countries,* published by the Commonwealth Secretariat.

SECTION TWO

PREPARATION OF CAMERA-READY COPY

This consists of bringing together all the various pieces of the job that is to be printed and pasting them together in their correct order and position. It is generally known as paste-up or make-up.

All printing units that use offset litho will need some basic items of equipment for the make-up of paper (e.g. from typewriter setting) and film material (e.g. from phototype-setting).

All make-up operations should be carried out in consultation with (a) whoever makes the plates, (b) the pressman, (c) the binder. Make sure to choose the equipment that best meets your needs, in particular the volume of your work.

ILLUSTRATIONS

Choosing and preparing illustrations for reproduction must be done with great care. There are two styles of illustration: line and tone. Tone illustrations are usually photographs; line images are usually prepared by hand with pen and ink.

Whichever style is used, the procedure for producing illustrations is the same. Illustrations being prepared for a printing process must be drawn on good quality white paper with a smooth surface capable of taking pen and ink work without fluffing or spreading. The ink must be a good dense black to give the greatest contrast. Technical pens (see diagram 7) with changeable nibs are necessary for this work, and a good set of drawing instruments is a great asset.

The other form of illustration is the tonal image. This can be a photograph or a pen and ink drawing with a brush wash or a black and white painting.

Low-quality illustrations can be made by using a 35 mm camera. Medium-quality illustrations can be achieved with a plate-maker. But for high-quality half-tone illustrations a process camera is needed. (See Section 3)

Half-tone illustrations, produced with a process camera, demand the use of a 'screen'. This is a piece of film on which a number of parallel lines have been drawn with identical lines crossing them at right angles. The screen breaks up the photographic image into dots graduated in size according to the tone of the image. Screens are available in the following grades: 65 lines to the inch; 85 lines to the inch; 120 lines to the inch; and 133 lines to the inch. The higher the number of lines, the higher the quality of the printing paper that has to be used.

If you look through a magnifying glass at a photographic illustration in a book, magazine or newspaper, you will be able to see the dots created by the screen. Magnified even further they look like Diagram 5.

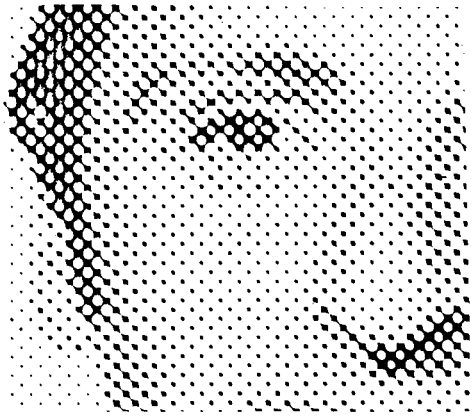


Diagram 5: Enlargement of part of a halftone

The best-quality results can only be achieved by using half-tone screens with a process camera. They are expensive to buy, delicate to handle, and difficult to use correctly. It

would take at least a week, possibly longer, to train an already proficient camera-operator in their use.

It may be possible to have the half-tone illustrations put on film by an outside concern. If such illustrations are seldom required, this would be the best and cheapest solution.

If no process camera is available, a cheaper but lower quality method is to make a (same size) screened bromide. This is done by taking the negative of the work to be printed and placing a half-tone screen (usually made of transparent plastic) above it and exposing it onto bromide paper. The result is a photograph with the half-tone screen on it. This can be done if ordinary photographic facilities are available in the printing unit. The photograph can then be treated as a line image and pasted up with the text in the normal way.

If half-tone illustrations are to be photographed in the unit and 'stripped' (this is the term used for cutting and joining film) into film later, it is as well to prepare for this at the artwork stage. This is carried out as follows:

1. The text is pasted onto the backing sheet in its correct position, leaving space where the half-tone illustration will appear.

2. Rectangles of black paper are cut to the size of the half-tone illustrations.

3. The black rectangles are pasted onto the artwork in the correct position. This will appear as a clear window in the negative film, behind which the half-tone negative can be glued.

If the illustrations are to be transferred to plates via a process camera and film, they can be drawn larger than the finished print. Artists often find this helpful for their work. But it is essential that the illustrations are drawn to scale. This means two things. First, if a drawing is being prepared at twice the required size, any line used in that drawing must be twice as long ***and also twice as thick*** as that wanted in the finished print. If you see a thin, spidery illustration in a publication, you can be reasonably sure that this requirement has been overlooked. Second, it

means that all illustrations in one publication should be drawn to the same scale. Unless this is done, the process camera has to be adjusted for each individual illustration, which raises operating costs. Of course, if the illustrations are to be used with the text matter, and the artist has no objection, it is sensible to draw them to the correct size and paste them down at the artwork stage.

Line illustrations need not be original: they can also be obtained from other sources such as books, magazines, advertisements, etc, though the laws of copyright must be observed. Illustrations must be chosen with great care and the same consideration given to them as to original work (i.e., they must be of high contrast and cleanly printed). Any faults in the image will be exaggerated by the various photographic processes.

EQUIPMENT AND SUPPLIES FOR COPY PREPARATION

The Lightbox

A useful piece of equipment is the lightbox. It is possible to work with a home-made device consisting of a wooden box with a cold lightsource beneath a piece of frosted glass. Frosted glass is better than ordinary plain glass as it diffuses the light from below, spreading it evenly over the whole area of the glass. It can be a model designed to stand on a table and thus be reasonably portable, or it can have built-in legs to make it free-standing. It will make the operator's work easier if the box can be angled in some way, preferably so that it can be adjusted to suit the needs of the individual operator. At least one edge must be straight enough to enable a T-square to be used. This is the minimum requirement of a lightbox.

A very useful addition is parallel motion - that is cross and traverse beams which enable the equipment to be used for ruling grids (for use later as a base sheet for paste-up), or checking the work for squareness. Any work which is pasted up out of square (something which can easily happen if a grid is not used) will be embarrassingly obvious on the printed page.

If the lightbox being used does not have parallel motion and a vertical rule, then a T-square and set-square will be necessary for the operator to draw right-angles, etc. It is more difficult than it seems at first to use a T-square and set-square successfully on a lightbox. Formal training is not necessary but the operator will need some practice before attempting a job for printing.

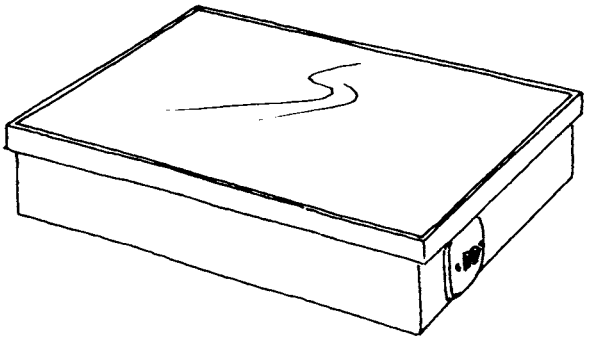


Diagram 6: A Lightbox

Adhesives

To augment the lightbox and assist in the assembly of artwork, other items of equipment are necessary. Whatever the nature of the work, rubber cement, a wax coater, or self-adhesive tape and sheets will be needed. It is best if all three are available.

Rubber Cement

This is the cheapest material for sticking down artwork. Its big advantage is that it does not dry immediately, so work can be easily removed and repositioned. It can be purchased one tin (or tube) at a time. All that is needed for its application is a spreader, usually made of non-rigid plastic. Also useful is a supply of waste paper on which to lay the paper being pasted up during application of the cement. If corrections have to be made to artwork after a period of time, it is possible to loosen the rubber cement by the careful application of cigarette-lighter fluid. The fluid must

be induced to run between the artwork and the backing sheet and the artwork pulled gently away as the rubber cement dissolves.

If applied too generously, rubber cement will squeeze out round the edges of the pasted-up pieces and pick up dust and dirt. Time will be lost in either cleaning the artwork before negative-making or in "spotting out" the finished negatives (that is, covering with opaque liquid all the small holes in the emulsion caused by black marks on the artwork).

Wax Coating

This is probably the best form of adhesive. It is certainly the cleanest, and allows removal and repositioning at almost any time. The wax coating can be applied by a hand-held machine (a waxer) which spreads a layer of wax 40 - 50 mm (1½ - 2 inches) wide on the artwork. This is sufficient for handling all the work of a small printing unit. For the larger printing unit machines capable of applying wax to paper of up to 500 mm (20 inches) in width are available. These machines are semi-automatic with electrically-driven rollers to pass the paper over the wax. All models of waxer need an electrical supply. Electricity is necessary in the hand-held model to melt the wax, and in the automatic machine to melt the wax and drive the rollers. Little skill is needed to use these machines, but the paper must be fed into them correctly and the wax kept up to the right level.

Self-adhesive

Some material, such as that produced by headliners, comes with self-adhesive backing. It is difficult to position this with total accuracy and once in place it is impossible to remove without damaging the backing sheet. Experienced operators are therefore needed.

Headlines

Where typewriter setting is used the range of type sizes is limited and headlines are difficult to distinguish from the main body of the text. Other methods of producing headlines are therefore necessary.

Lettering Guides

Lettering guides have certain advantages for a limited class of work. A lettering guide consists of a plastic strip with the various characters cut through. Any character can be traced onto a piece of paper by pushing a technical pen (see diagram 7) through the appropriate hole. The guides are reasonably cheap and can be used by almost anyone with a little practice. The drawback is the limitation of type-styles, sizes and line thicknesses.

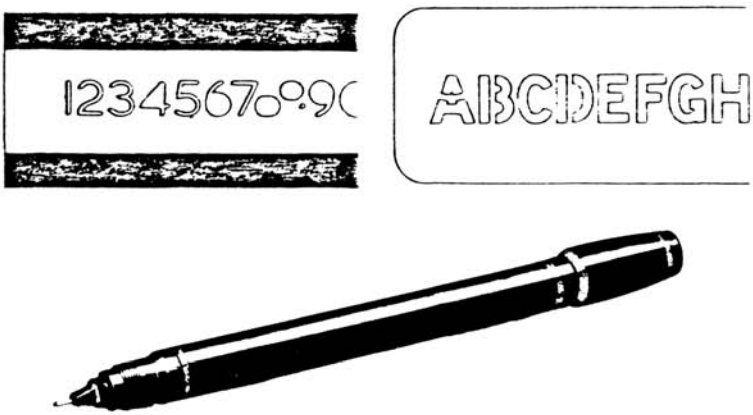


Diagram 7: Lettering guides and a technical pen

Rub-down Letters

A simple method of producing larger type sizes is with rub-down lettering. It comes in sheets of alphabets and figures of varying typefaces and sizes printed on a clear, thin plastic sheet with a self-adhesive back. When a sheet is placed on paper and pressure is applied to one of the characters, the character is transferred from its backing sheet to the paper. The easiest way to apply pressure is with the point of a soft pencil or crayon pressing down on the outline of the letter. The sizes of the letters are, like the golfball composition typewriter faces, based on the printer's point system. Probably the most useful sizes are 18, 24 and 36 point.

The small sizes are quite easy to press down, and guides are supplied on the sheet to enable the characters to be placed in straight lines. Difficulties arise when supplies are stored for long periods. Hairline cracks often appear on large typefaces, and these will be visible on the finished print unless filled in with black ink using a pen or a brush.

The sheets, which are quite expensive, tend to be wasteful because some characters are never used and others never seem to be available in sufficient quantity. Wastage can be reduced to some extent by purchasing as few different typefaces and sizes as possible.

The range of faces and sizes available is very wide and caters for exotic alphabets in addition to the more traditional designs. The sheets are produced with black or white characters and, in a few cases, in colour. As well as alphabets, an increasing number of sheets is being produced which enable the operator to lay down tints of various gradations, or which have mathematical, architectural or surveying signs. Diagram 8 shows some examples.

Diagram 8: Examples of rub-down lettering

Letterpress 'repro'

Another way of obtaining display work is to purchase the word or words needed from an outside source. This could be a letterpress printer who would set the desired text in type and print it on any good quality white paper to give the best possible impression, a method known as "repro" (short for reproduction). This is as costly as obtaining the same material from a printer or typesetter who has a headlining machine, but the letterpress printer will be able to supply as many as half a dozen prints of the repro for the same cost, whereas there is only one print available from the headliner source.

Headliners

If large quantities of headlines are foreseen, a photoheadliner is the answer. The characters are on film sandwiched between two pieces of clear plastic.

Headliners come in two forms. These are:

(a) the strip headliner, and

(b) the circular headliner

The strip headliner is the most popular style of headliner in the printing industry. It operates from an image carrier that has the characters arranged in one or two rows along a strip of plastic. This image carrier is known as a strip negative. It contains the capital letters, small letters, figures and punctuation of one typeface in one size only. To be able to set a range of sizes, more strip negatives have to be purchased.

The popularity of this machine is due to its simplicity of operation and the fact that it can sometimes be used without a darkroom. The product is always a single line of typesetting that has to be pasted onto the work that is being prepared, either as camera copy or for platemaking. On some machines the exposure times are either calculated and set manually; on others the machine will calculate and set them automatically.

The circular headliner is a machine into which one of a range of discs can be fitted. Each disc has a particular typeface set around the edge. When a disc is fitted into the machine it can be rotated so that any of the characters can be aligned with a slot for printing.

Inside the machine is a paper strip made in two layers, the upper layer being a thin transparent film and the lower layer being the paper. Just below the strip is a carbon ribbon. When the required character on the disc is aligned with the slot in the machine, a button is depressed. This forces the character against the paper and the paper against the carbon. The result is an image of the character on the paper.

The strip of headline letters which comes out of the machine can be cut off by depressing a second button. The letters themselves can then be peeled off from the transparent film and pasted in position on the artwork.

The printing process is slow because only one character at a time can be printed. Changing of character size or type design needs the corresponding change of the disc. It is advisable to stock at least three different sizes of type, eg 18, 24 and 30 point.

The products of these machines are intended to be used as display lines for text matter that has been set by some other method. It is impossible to set justified lines of text with these machines. If justified display is needed, this must be done at the paste-up stage with each word being cut out and pasted down separately.

Other Equipment for Copy Preparation

Cutting tools

Sharp cutting tools are necessary for cutting and trimming paper and film. Razor blades will do, but a scalpel (of the kind surgeons use) with replaceable blades is safer.

Cutting surface

It is inadvisable to cut material on the lightbox as most glass will get scratched. An old metal offset litho plate,

gives a good clean edge to the cut though it tends to blunt the blade quite quickly. Alternatively an old piece of cardboard may be used. This tends to leave a "burr" (a slight roughening) on the cut edge but is much kinder to the scalpel blade. For a relatively small sum a cutting mat can be purchased which will enable the operator to get a clean edge to the work and will not blunt the blade so quickly. Cutting mats are made of plastic with a "self-healing" surface which lasts a long time. They come in a variety of sizes. For cutting complicated shapes, swivel knives are available but these really need to be used with one of the more expensive and sophisticated lightboxes.

Technical pens

These consist of a barrel, plus a number of hollow nibs of different sizes for drawing different widths of lines. (See diagram 7). Unscrewing one nib from the barrel and putting another in its place can be done quickly and easily. Because the nibs are delicate they should be handled carefully. Only the recommended ink should be used. An ink solvent is available to clean the fine ink channels in the nib should they become clogged with dried ink.

Opaquing liquid and red masking tape

These are needed for sticking negatives together and for "spotting out" unwanted dots. During the exposure of artwork to film in the process camera (see Section 3), any dust in the air interrupts the light and produces small, clear dots on the processed film. If left, these dots are transferred to the litho plate and eventually appear on the finished print. To get rid of them the film must be placed on the lightbox and all unwanted dots and other marks (for example paste-up marks) eliminated with either opaquing liquid or red masking tape. Where negatives have to be joined together, red masking tape is used (red being as impervious to light as black in this context) to prevent the light from penetrating the joins in the negatives.

Additional items

The operator will gradually build up a set of other items to meet his needs. It will probably include a T-square,

triangles, french curves, protractor, compass, dividers, bow instruments, a range of soft to hard pencils, erasers, scissors, steel rules, a hand guillotine or card cutter, masking or drafting tape, and cleaning tissues.

SECTION THREE

CAMERA AND DARKROOM

PROCESS CAMERA

Process cameras are expensive pieces of equipment and will be needed only by units using printing machines larger than A3. They are used to prepare negative and positive film needed for the processing of pre-sensitized metal litho plates (Section 5). Most small printing units can operate very successfully without one. Nor is one necessary immediately a unit buys a larger printing machine: the negatives can be made by any other printing unit that operates a process camera.

There are four essential parts to any process camera: the copyboard, lighting, lens, and film holder. Any extras or refinements after this are governed by the needs of the printer and the funds available. It is not possible to operate with only those four elements, but it is essential that they are borne in mind when deciding which camera to buy.

Vertical and Horizontal Cameras

There are two basic types of process camera: vertical and horizontal. Most small printing units use vertical cameras. Their great virtues are compactness and economy of floor space. The operator can perform most of the working functions standing on one spot. They must be operated in a darkroom, but as a darkroom is necessary for processing the film, this is no drawback.

Horizontal cameras have very little to offer a small printing unit; and the following account therefore concentrates on vertical cameras.

Main Features of a Vertical Camera

The Copyboard

This must be capable of accommodating the largest size of artwork the unit expects to use. The method of holding the copy firm is important. Most of the cheaper cameras have a sheet of glass which is clamped over the artwork to hold it against the copyboard. For this method of fixing it is essential that the artwork is of the same thickness all over. Some cameras have vacuum beds which hold the copy firm, but this is a refinement that most small printing units can manage without.

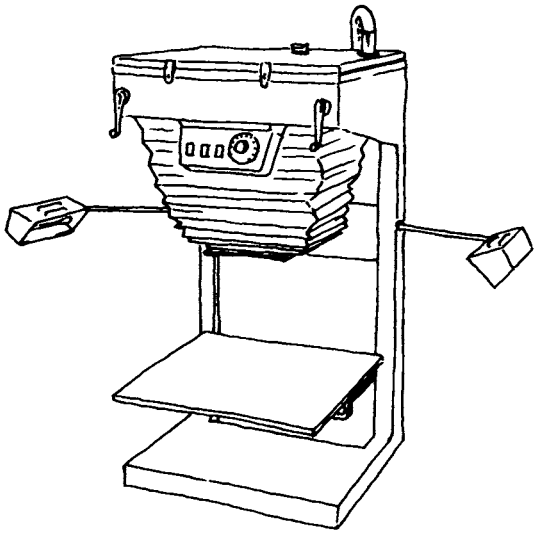


Diagram 9: Vertical process camera

The lens

The camera lens must be capable of projecting an image over the maximum film area, and must offer the required degree of

enlargement or reduction. Some cameras have a series of lenses that have to be changed manually, in which case ease of access is important. Where funds are available, the movement of the lens turret and the copyboard can be controlled by motorized aids, and the camera will have an automatic shutter. In cheaper cameras, the film is exposed either by taking off the lens cap for the required time or by switching the lights on and off. Both methods are a little rough and ready.

The required enlargement or reduction is obtained by focusing the lens. This is done by turning handwheels manually or by pressing a button. The first method is slow and depends on the skill of the operator. The second is fast and depends on the accuracy of the machine, but costs more.

The film

The film-holder must be large enough to accommodate the biggest piece of film that will be exposed. If the camera is to be used only for line work, then a film-holder with a spring clamp should suffice. Ideally however, the film-holder should have a vacuum back, and the better ones have a back to which the vacuum can be applied zonally according to the size of the film.

Choosing the Camera

Basically, the choice is between a simple, inexpensive camera, and a sophisticated, expensive one. In the first case the operator must be skilled in making the necessary mathematical calculations to get a properly-focused, clear negative with the correct contrast between the light and dark areas. In the second the operator must be skilled in setting the various built-in electronic and automatic devices.

The film produced by the camera can be developed by hand in the three-bath system, or, if a processor has been purchased for the headlining machine, the film from the camera can also be processed in it.

Hints and Tips for the Process Camera

1. Do not contemplate the use of a process camera unless a proper darkroom can be established. Cameras are available which do not require a darkroom (daylight cameras) but these should be thoroughly investigated prior to the large capital outlay involved.

2. In the three-bath photography a certain amount of silver deposits are contained in the liquid chemicals. By use of a simple electrical device this silver can be recovered and sold rather than wasted.

3. Proper storage facilities must be assured for the expensive materials involved in the process.

4. Air conditioning in tropical climates is required, and refrigerated storage for film should be provided.

5. Films are available as negatives and positives. The positives are more expensive. When choosing films for use in the camera, ensure that they are the right size for the camera and the right size to fit the job on the copy board.

6. When purchasing films, ensure that they have not been kept in storage for a long period.

7. Films are available from many different suppliers. Each make of film needs to be processed by its own specified chemicals. If chemicals are obtained either ready-mixed or in powder form, they must be mixed according to the supplier's instructions.

8. To avoid pollution, arrangements for the drainage of highly toxic waste chemicals from the darkroom should be made at the planning stage when designing the darkroom. Arrangements for ventilation and fume extraction should be made at the same time. It may be advisable to seek expert advice on these matters.

9. Colour work is done with different film, and the darkroom operation is in complete darkness. Line and halftone work can operate with a red light.

Supplies for the Darkroom

1. Thick dark cloth materials for use as curtains in a dark room.

2. Red and green safe lights outside the room.

3. Red and green safe lights inside the room.

4. Amber light inside the room.

5. In the event of not using a built-up sink with three compartments, three plastic trays will suffice.

6. Tongs with rubber grippers for handling films and to squeeze off excess solutions and waste.

7. Timer clock for controlling the developing process.

8. If a drying oven is not used, a simple hair-dryer will be sufficient to dry the film.

9. Cupboards for storing new films (which must not be fogged before use) and for processed films.

SECTION FOUR

DUPLICATORS AND PLAIN PAPER COPIERS

DUPLICATORS

The term "duplicator" covers a wide range of machines, from the jelly in a tray of the hectograph to small offset duplicators.

Hectograph duplicating

This is the simplest method of duplicating. The capital outlay for a complete kit is about the same as for a golfball typing head. The equipment consists of a light plastic tray containing a special jelly, carbon papers, special pens and pencils in four colours, and a sponge.

Master copies can be made by writing or drawing with pens or pencils or by typing on one of the carbons which transfers the image to a sheet of paper below. Any illustrations required can be added to the master with the hectograph pens and pencils.

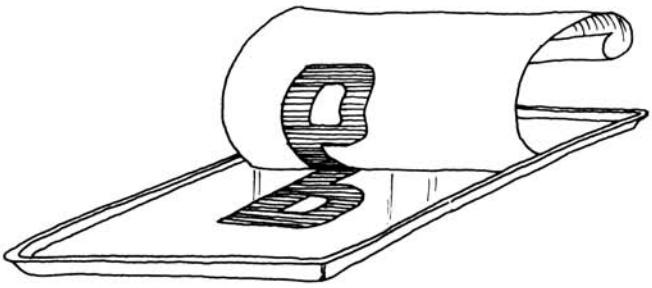


Diagram 10: A hectograph duplicator

When the master is complete, it is laid face down on the jelly compound, smoothed down and left for 30 - 40 seconds. This allows the image to be transferred from the master to the jelly. Duplicating paper is then laid on the jelly, pressed against it with a roller, left for about a second and peeled off. All the colours are printed in this one operation.

A carbon image on the jelly will last for a maximum of 100 copies. It gets gradually paler as the run continues, and finally disappears altogether. Pen and pencil images fade more quickly

The operation is manual and, apart from a light application of water to freshen the jelly compound, no liquids are needed. It will print on most surfaces, even material, but will give the best results and the longest runs on smooth, non-absorbent papers.

Spirit duplicators

These will reproduce typing, handwriting or drawing in up to seven colours: purple, blue, black, red, green, yellow and brown. A master copy is needed before printing can begin. Purple is usually used for typing, being the colour which lasts longest and produces the clearest image.

The master copy is prepared on a sheet of art paper (i.e. paper with a very shiny and smooth surface). A special carbon paper is placed in contact with the art paper. This can now be typed or drawn on (or both) with the art paper uppermost. A ballpoint pen or a pencil is all that is necessary for drawing. The pressure of the typing or drawing will transfer some of the coating from the carbon paper to the back of the art paper. This image when looked at will be in reverse - a mirror image of the words and illustrations on the other side of the art paper. This mirror image is the master.

If different colours are needed, it is quite simple to change the carbon paper. As some colours work better than others, some experience is needed before good results are

obtained every time. This is the only office-type duplicator that will reproduce more than one colour in one run through the machine.

The master copy is fixed around the cylinder of the machine, with the mirror image outwards. Paper is fed into the duplicator and passes under a pad which dampens it with spirit (methyl alcohol). The paper then passes between an impression cylinder and the master copy. The spirit in the paper dissolves a small proportion of the carbon image on the master copy. This is transferred to the paper by the pressure of the impression cylinder. As printing continues, the image is gradually dissolved away. Shiny art paper produces the maximum number of copies; duplicating paper absorbs very much more of the image each time and consequently the image dissolves more quickly, giving a short run.

The spirit dries almost immediately and there is little chance of the copies smudging as they leave the machine. Minor alterations can be made to the master copy during the run. A master can also be stored for future use if the image is not too exhausted.

The most popular and therefore the cheapest machines are A4 in size. Their cost is a little more than half that of an electric golfball typewriter. Other sizes are available but they are disproportionately expensive. The machines can be manually or power operated. It is seldom worth while to have a power-driven machine when the maximum number of copies from one master is only 250.

Advantages of Spirit Duplicating

1. The machine is robust.

2. Operating costs are lower than for most other methods.

3. Masters are simple to produce. They can be made on any shiny-surfaced paper, e.g. art paper.

4. Pure methylated spirit can be used. It is usually more easily available and much cheaper than the trade fluid.

5. Carbons can sometimes be re-used.

Disadvantages of Spirit Duplicating

1. Colour will fade badly in strong light.

2. Only short runs are possible.

3. Damaged felts cause poor reproduction; spare felts must always be readily available. (A worn felt can be reconditioned by running an A4 sheet of fine sandpaper through the machine several times.)

4. The clarity of the print can be good but it is not to be compared with stencil duplicating or offset printing.

Stencil Duplicating

Stencil duplicators will reproduce typewriting, handwriting or drawing. They work on the principle of ink being pushed through a stencil onto absorbent paper.

All stencil duplicators must have a good-quality stencil to produce a good-quality print. The best stencils are cut on electric typewriters rather than manual ones.

Preparation of masters

Special stencils must be used. The complete stencil consists of three layers: a top sheet, a carbon and a backing sheet. The top sheet has a wax coating to prevent ink from penetrating. This coating must be cut through in the areas which have to print. This can be done with a typewriter with the ribbon out of action (machines have a special adjustment for this); it can also be done by writing or drawing with a ball-point pen or a special instrument called a stylus.

To get a good result a hard surface, e.g. glass, plastic, formica, must be used when drawing or writing.

Electronic Stencils

These are different from ordinary duplicating stencils.

They are always black. The stencils are cut by a machine called a scanner which uses a photo-electric cell requiring a reliable electricity supply.

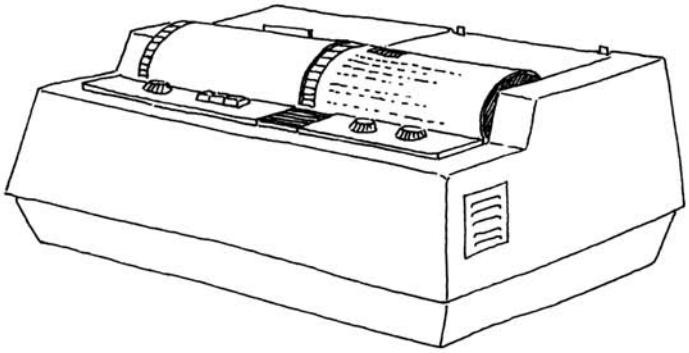


Diagram 11: An electronic scanner

The scanner can copy any black and white line images - newspaper headlines, rub-down letters, drawings, typing. Photographs are less successful and some scanners will not copy them properly at all.

A page of the material to be scanned and one of the electronic stencils are clipped side by side on a revolving drum. When the power is switched on, the drum spins rapidly and the image is gradually transferred to the stencil. Ordinary correcting fluid can be used to obliterate any pinholes or similar errors in the stencil before it is rolled, but if anything has to be altered a new stencil must be scanned. It can be sent from a central production agency (e.g. a Ministry of Education) to any place (e.g. a school) where copies can be rolled on an electrical or hand-operated duplicating machine. An electronic stencil should produce at least 1,000 copies.

A big advantage of a scanner is that it can be kept with a duplicating machine in an office, thus enabling illustrated leaflets and booklets to be produced on the spot. A machine capable of scanning an A4 sheet will cost about twice the price of a golfball typewriter. Any of the office staff will be able to operate it after five or ten minutes' instruction.

Duplicating Machines

Most machines are of the rotary type. The stencil is fitted around a drum containing the ink. As the drum revolves, the paper is fed into the machine and ink is forced through the stencil onto the paper.

These machines can be operated manually or by power. The manual model will cost about the same as the spirit duplicator, and the electric model about half as much again.

Because the ink is slow-drying it is best to use an absorbent paper. This will avoid smudging. Up to 4,000 copies can be obtained and, when necessary, stencils can be stored and re-used. If they are to give good results at the second printing, they must be handled carefully and protected during storage.

Only one colour can be printed at a time, but this does not prevent other colours from being used. The drum-type duplicator is best for multi-colour duplicating. Changing colours on tube-feed type machines is messy and complicated. For every different colour a new stencil must be cut. Each copy must pass through the machine for each different colour.

COPIERS

The extent to which a printing unit should be involved with plain paper copiers will entirely depend on individual circumstances. The range of equipment available enables many options in terms of size, speed and simplicity to be considered.

There are two main types of copier: chemical transfer and electrostatic.

Chemical Transfer System

This requires two special papers, their chemistry being closely allied to conventional photography. Negative paper is placed in contact with the original and subjected

to light. It is then contacted with a positive paper and fed through a bath of chemicals. When the papers are pulled apart the image has been transferred to the positive paper. Its quality is sufficiently good to be suitable for art work.

The system can also produce paper or foil litho plates. It is slower than electrostatic copying and depends to some degree on the skill of the operator.

A machine capable of producing A4 sheets will cost about the same as a basic golfball typewriter.

Electrostatic Copier

Electrostatic copying is fast and simple and this explains its rise to become the most widely used method. Techniques of the various copiers differ slightly but are basically similar. An electrostatic image of the original is created. This attracts molecules of carbon compound, which are fused to create a permanent copy.

Considerations

Copiers must be chosen to suit the needs of the unit. Certain factors must be taken into consideration:

Speed

This must be looked at in two ways: (a) the speed with which the first copy is taken from the machine; (b) the speed with which subsequent copies are produced. If the demand for copies is low then the first factor is important. If the machine is to be used as a duplicator producing multiple copies, then the second factor is most important.

Capacity

This is the ability of the copier to handle more than flat, flexible sheets. Some copiers have a roller carrier method which would prevent the user from taking copies from pages of books.

Accessibility

Is the copier to be available to all staff, or is it to be operated as a service by the printing unit? If it is available to all, time will be saved but the machine will be open to excessive use and abuse. Control by printing staff is recommended for an expensive machine.

Additional refinements

These will depend on the user's needs. They include the ability to reduce the size of the image by a pre-determined amount, normally by 30% or 50%. This enables economies in paper to be made whether the copier is used as a production machine or as a plate-maker. The basic models cost about the same as a golfball typewriter but become more expensive as their complexity increases.

SECTION FIVE

PLATES AND PLATEMAKING

LITHO PLATES

Offset litho plates must meet certain essential qualities. They must have a durable base. They must also have a surface that is water-receptive but will also accept and keep a substance that is grease-receptive.

For the small printing unit, only four kinds of plates need consideration: direct image, chemical transfer, electrostatic and pre-sensitized metal.

The Direct Image Plate

This is a plate on which the image is applied directly by typewriter, pen or pencil. The base is either paper or plastic treated with a water-retentive substance. The typewriter ribbon, or pen or pencil, produces an image with soft, greasy characteristics. This is held on the surface of the plate and destroys the water-retentive properties in those areas.

This plate can reproduce only same-size work as it is the master as well as the printing surface. It can only be used for short runs. After about 100 prints the image starts to deteriorate.

Chemical Transfer Plate

This kind of plate has a direct link with early photocopying techniques. The master is put in direct contact with paper negative material and placed in a lightbox and exposed. The

exposed negative is then fed through a chemical processor where it is brought into contact with the printing plate made of paper, plastic or foil. Paper plates can be used only for short runs. Plastic plates will easily last for 500 copies and foil ones for 2,500.

The main limitation is that of being able to reproduce only same-size images.

Electrostatic Plate

To produce this kind of plate, the master is exposed to a lightsource which reflects the image onto a special plate where it creates an electrostatic charge. Oppositely-charged particles of a grease-receptive substance are then attracted to those areas of the plate where the image has created the charge. The plate is then passed through a heating machine which fuses the greasy image permanently onto the plate. These plates will last for about 2,000 copies, but can only reproduce same-size images.

Comparing the First Three Methods

These are the three simplest methods of platemaking. Depending on the size of the printing unit, any of them could be used. The direct image plate is the cheapest, but quality is poor and the length of run limited. It is not to be recommended as the main method but it could be used in conjunction with one of the others.

There is little to choose between the other two methods. The chemical transfer uses two wet chemicals. These, together with the negative sheets and the plates, are the only recurrent costs. With the electrostatic method, the recurrent costs are the plates and the etch solution (or powder) used to form the image.

Both systems can produce paper, plastic or foil plates, and both need electricity. Little skill is required, and a few minutes' tuition should be sufficient for the average technician. With both methods, plates can be made in five minutes and stored ready for use, but they must be kept in dry conditions to avoid deterioration. They can also be stored after use if a re-run is likely.

Pre-Sensitized Metal Plate

The fourth type of plate available to the small unit is the pre-sensitized metal plate. It consists of a thin sheet of aluminium, one side of which has a fine grain imparted to it in manufacture. To this is added a light-sensitive, grease-receptive coating. Before the plate can be used, a film negative or positive is required. To obtain this either a process camera is needed, or access to a printing unit in the area that can provide film for you. When the plate is brought in contact with film in the platemaker and exposed to ultraviolet light, the coating on the exposed areas is hardened. The remainder, which is the non-printing area, stays soft and is washed away with chemicals.

Many kinds of pre-sensitized plates are manufactured. They differ in that some use a single chemical, some use water with chemical additives, and some use water only. All of these plates are good for long-run work and can be produced quite quickly once the film is to hand. Exposure times vary from three to five minutes. The development time is about the same depending on the type of plate being used and the style of image that is required.

A certain amount of skill is necessary for making pre-sensitized plates. The length of exposure times needed for different images has to be judged. Although the manufacturers give guidelines for the various exposure times, it is only with experience that the operator will be able to get a perfect plate every time.

Platemaking Units

Pre-sensitized plates need special equipment to expose the film to the plate. These are called platemaking units. Many types are available. All have two things in common: a lightsource, and a vacuum bed to hold the plate and film in close contact. Some have a vacuum bed that swings over to present the plate and film to a lightsource contained below in the body of the unit. In others the lightsource is above the vacuum bed, and these can be used as tabletop units. The lightsources are controlled in different ways: in some units the light is always on and the exposure is governed by the bed flipping over when the necessary time has elapsed.

This is commonly called a 'flip-top' platemaker. Other models have a timeswitch built into the lighting system and the lights switch on and off to give the correct exposure. A darkroom is not necessary, but plates should be handled in subdued light to prevent daylight from fogging the plate during the time spent positioning the film on it.

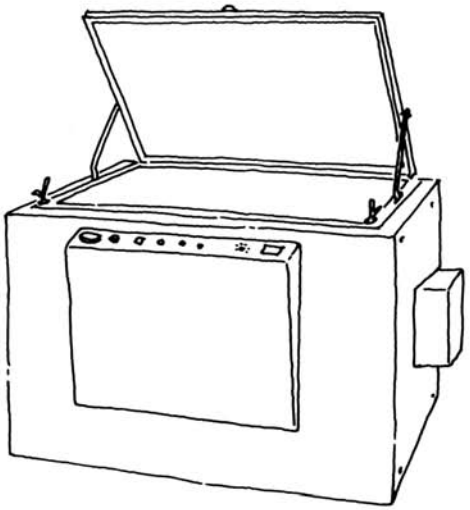


Diagram 12: A flip-top platemaker

Electricity and running water are necessary for platemaking and the unit should, if possible, be housed in a room that is comparatively dust free. The only other running cost involved in platemaking is for the replacement of the lamps in the lightsource. The cost of these varies considerably. Some of the chemicals used in the plate-development, although not harmful, are extremely strong-smelling, and an extractor fan or other ventilation would make the working environment much more pleasant.

Plate Processing

There are plate-processors on the market which differ very little from film processors. They are used for developing the plate after it has been exposed in the platemaking unit.

The plate is fed into the processor after exposure and the chemicals develop the plate as it is fed through the machine. They are very expensive and can be justified only if over 100 plates are needed each day.

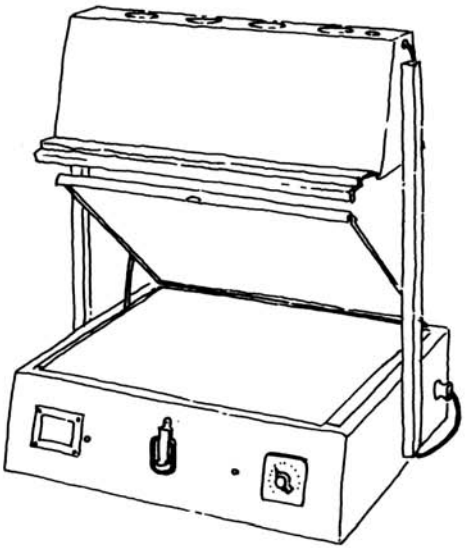


Diagram 13: Platemaker with overhead light source (bench model)

The running costs for the processing side of platemaking are taken up almost entirely with the purchase of chemicals, and this is not a small item. With hand processing, unless great care is taken, more chemicals are used than are necessary. This problem is difficult to rectify as it is part of the operator's skill to judge just how much chemical to pour onto the plate. With a processing machine the problem is different: if the throughput is in keeping with the maker's recommendations, there will be no waste. However, if the chemicals are left in the processor with very little work passing through, they will deteriorate quickly. In most processors the chemicals have to be changed at least once a week.

SECTION SIX

OFFSET PRESSES

TABLE-TOP OFFSET LITHO MACHINE

The cheapest machine is the A4 table-top press. It is not much different from a duplicator to look at. It is capable of producing reasonable-quality work from paper plates of

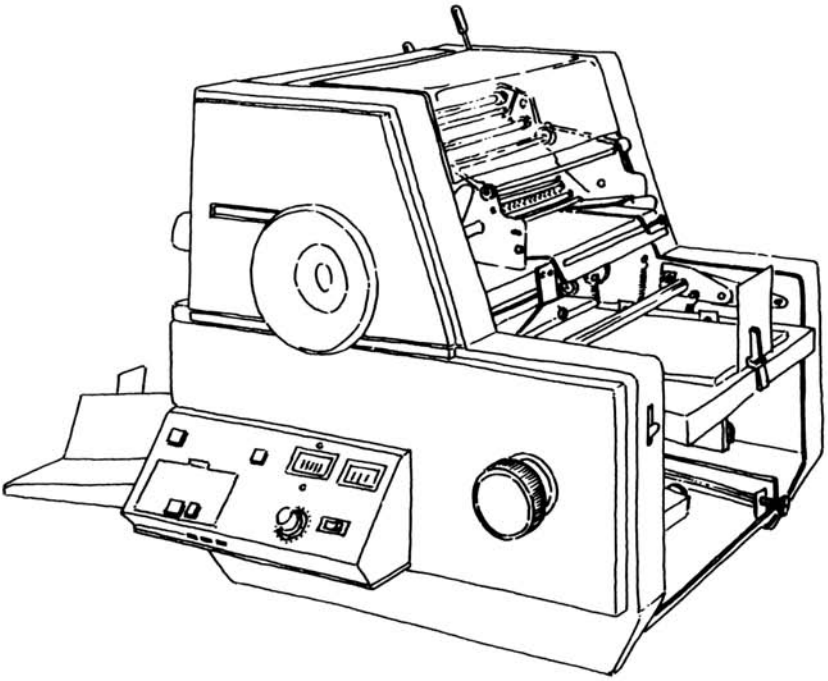


Diagram 14: An A4 table-top machine (A. B. Dick)

any of the following kinds: direct image, chemical, or electrostatic. The quality and length of run will depend on the type of plate that is used.

The term 'A4' applies to the largest size of paper that the machine can handle (i.e. about twice the size of one page of this book). These machines are incapable of handling very

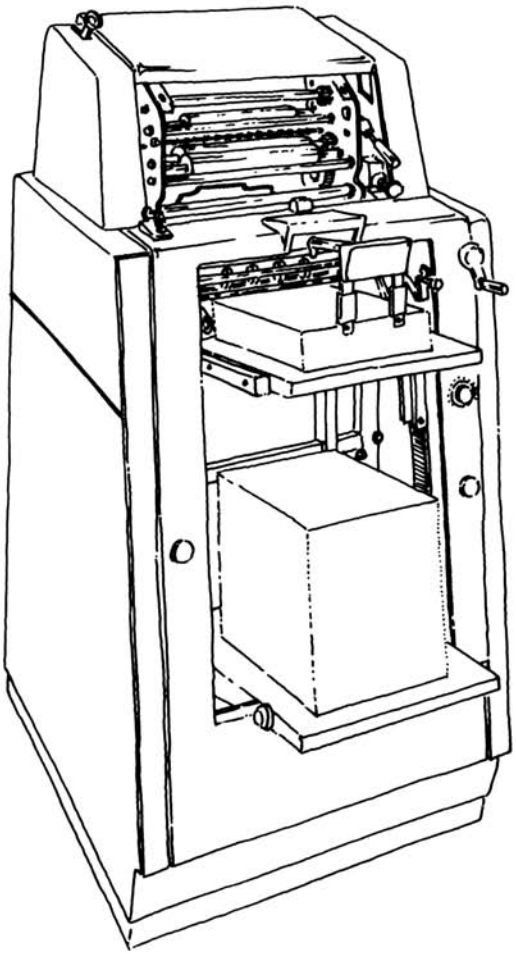


Diagram 15: An A4 freestanding offset litho machine

small sheets of paper because of the difficulty of feeding them into the gripping rollers. With very few exceptions, table-top machines are friction fed: that is to say the paper is pushed into the printing cylinders by means of a rubber roller or similar mechanism. This control is adequate for most of the tasks that small printing units usually do, but it is not suitable for printing two or more colours close to each other. It also has problems with some kinds of paper.

FREESTANDING A4 OFFSET LITHO MACHINE

A4 presses are also made as free-standing models. They are built a little more robustly than table-top models but the same advantages and limitations apply. Most of these machines are simple to handle, having only one control. This is moved through various positions so that the printing process is carried out in the correct sequence (i.e. water applied to the plate before ink). The machines undertake each successive function (damping, inking, printing, and, in some cases, cleaning) with as little operator involvement as possible.

There are two basic types of A4 freestanding machines: one with suction feed, the other with friction feed. They are capable of producing 3,500 to 6,000 sheets per hour depending on the operator's skill and the size of the machine. They are capable of relatively fine registration and colour work.

A3 OFFSET LITHO MACHINE

A3 machines are more complex than the smaller A4 models. Their controls are not so simple, and an operator will need a course lasting for two to three weeks to become efficient in operating and servicing the machine. An even longer period will be needed after the initial training before the operator is able to master all the printing problems that may arise. Breakdowns will require the attention of a specialist 'offset' technician.

A3 machines are capable of feeding not only a larger sheet, but also a far wider range of papers than A4 models. They

are more economical than A4 machines for long runs. Pre-sensitized metal plates are needed for quality work. Paper plates can be used for short runs, but they tend to stretch over long runs and the quality of the print suffers.

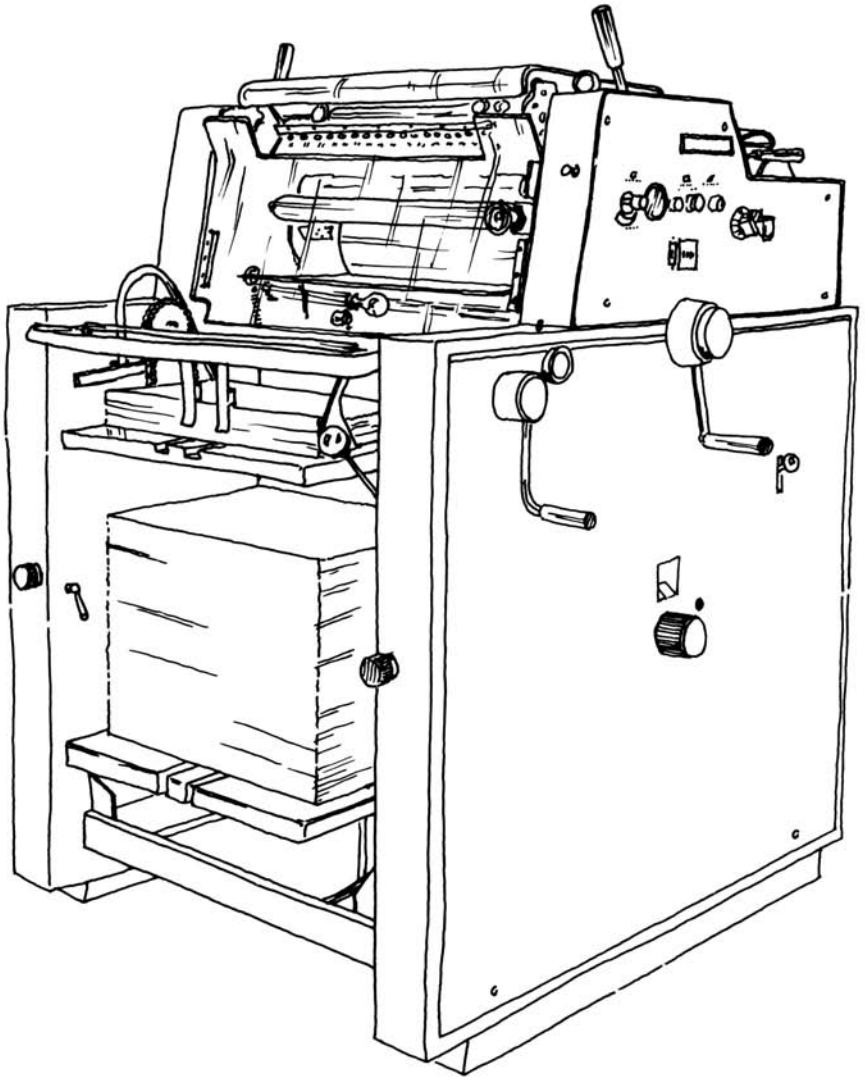


Diagram 16: An A3 machine (Rotaprint 30/90)

Some Refinements on Offset Litho Machines

Many of the large presses also have refinements not always found on smaller models:

1. Suction feed. The paper is picked up along its length by a number of rubber suckers and is moved directly into the grippers on the impression cylinder. (A4 machines generally have a friction feed in which the paper is pushed into the grippers and sometimes goes crooked.)

2. Micrometer side lays. Once the side lay has been positioned roughly, the micrometer adjustment allows the operator to do the finer movement without loosening the main setting screw.

3. Stroker side lays. This mechanism gently strokes each sheet of paper into the side lay and prevents it springing back. This is normally an extra on A3 machines and is not available for A4 models. It is only worth considering if complex colour work is to be printed.

4. Double sheet and missed sheet detector. This will either stop the machine when two sheets are fed at the same time, or lift the impression when the feeding mechanism fails to pick up a sheet.

5. Single-sheet feed control. This enables the operator to feed single sheets for proofing, without activating the main feed mechanism which will feed continuously until stopped.

6. Anti-setoff spray. This sprays a fine powder onto each printed sheet to prevent the next down from being marked. Very few A3 machines have this as a standard fitment. It can be fitted to all machines at extra cost. When large areas of ink are printed, it is essential. Not worth thinking about for an A4 machine.

Some of these refinements are standard and are included in the advertised price of the machine. Others are additions which can be left until more money is available. It is as well when purchasing a machine to judge it according to the number of extras that might have to be paid for later.

HINTS ON THE USE OF OFFSET LITHO MACHINES

Machine speeds depend in part on the type and weight of paper being used. Thin papers and thick cards give the best results if fed through the machine at speeds slower than for middle-weight cartridges in the weight range between 80 grams per square metre and 135 grams per square metre. Speeds also depend on the kind of image being printed. The easiest images to print are those plates that contain only text. With the right paper and the best image, speeds in excess of 4,000 impressions per hour (iph) can be reached. Bank papers, under the same conditions, will probably run best at 1,000 iph and cards at 5,000 iph. If the image is composed of large solid areas that demand a lot of ink, the machine speed will have to be reduced accordingly. If the machine runs too fast it becomes difficult for the paper to separate from the offset cylinder; if art paper is used in these circumstances it becomes almost impossible to print at any speed. A good rule of thumb for the amount of solid that can be printed successfully is 50% of the paper area, wherever possible avoiding a solid band on the leading edge.

Whenever difficulty is experienced in the feeding or delivery of any paper, the first remedy to try is a slower running-speed. Problems on the printed page can often be carried out by the operator by varying the amounts of water and ink. The ability to control these problems quickly will come only with experience. Most machines develop individual characteristics of performance which a competent operator will soon discern.

With an A3 machine, two pages of A4 or four pages of A5 can be printed from one plate. If use is made of double-sided plates, the plate costs per page are not much higher than those for the smaller A4 machines.

MAKING THE CHOICE

Until a few years ago most small printing units would have considered buying only an A4 offset press. Now, however, many have a press capable of printing A3. The A4 machine is still the real workhorse, with the A3 for special work or

for very long runs. With these two sizes of machine, a small unit would be very well equipped. Although financial constraints are likely to prevent the purchase of the two machines at the same time, the qualities of the larger press should be borne in mind for future expansion.

SECTION SEVEN

SILKSCREEN PRINTING

INTRODUCTION

The simplest way of describing silkscreening is to compare it with stencilling. Both processes consist of ink penetrating "holes" in a screen onto sheets of paper beneath.

Silkscreening is used mainly for making posters. It can also be used for printing book covers. It is cheap and has the big advantage of using opaque inks - thus allowing the silk-screen printer to apply light-coloured ink to very dark paper or card. Its main disadvantage is its slowness.

Silkscreening is a widely practised community craft in many countries. If you want to see it in action, it should not be difficult to find someone who makes a living from it. It is most likely that he will be printing signs and designs on-to plastics, wood, metal, ceramics or glass. None of these materials presents problems for silkscreen printers.

The equipment does not have to be large or expensive. In fact most items can be made by hand. No matter what the cost of the equipment, it must have three basic elements - the silkscreen frame, the baseboard, and the squeegee with which the ink is pushed through the screen.

THE FRAME

This consists of four lengths of wood securely fastened together to make a rigid rectangle. It should stand about 3 inches high. Its function is to act as a support for the

silk and it must also be strong enough to allow the silk to be stretched over it without distortion. It can be made in any woodwork shop by a carpentry technician.

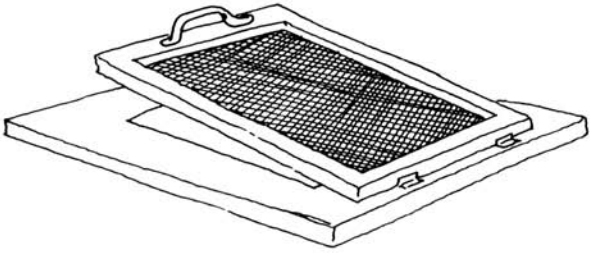


Diagram 17: Screen printing frame

Various sizes of frame are a good investment: the largest should be big enough to allow for printing over the whole area of the largest sheet of paper or card you envisage using; the smallest should be about a quarter of the size of the largest.

THE SCREEN FABRIC

Any porous fabric can be used for the screen itself. The coarser the weave, the more ink will pass through. If the mesh is too coarse it will use too much ink. If it is too fine it becomes difficult to force the ink through. The three main fabrics in use for making screens are silk, organdy and man-made fibres such as nylon and terylene.

Silk is the best fabric to use. It is the most expensive but will last longer than either organdy or man-made fibres. If the screen fabric is cleaned thoroughly after each printing, it should be possible to use it time and time again. Organdy quickly becomes floppy and once this happens it must be replaced. Man-made fibres come between these two extremes in both performance and cost. They will last almost as long as silk and are slightly cheaper to replace.

Stretching the fabric on the frame

The frame should be placed on a strong, flat bench or table to allow the fabric to be correctly stretched. Ordinary carpet tacks can be used to fasten the fabric to the frame. The four corners should be tacked temporarily to hold the fabric in place. One side at a time should be stretched, beginning with a long side. The tacks must be driven in at 2-inch intervals. When this side is completed, the frame can be turned round and the opposite side done in the same way. After this, the two short sides can be stretched and fastened. When using tacks to fasten the fabric, make sure they are hammered well in so that the heads sink in level with the wood. Another method is to staple the fabric to the frame with a staple gun. It is just as efficient and much quicker. It is always easier if two people work together to stretch the fabric, one stretching it over the frame, the other doing the fastening. To assist in obtaining tension on the fabric, it is best to dampen it before stretching.

There are various tools that can be bought to help in getting tension on the fabric, the simplest of which is a specially adapted pair of pliers.

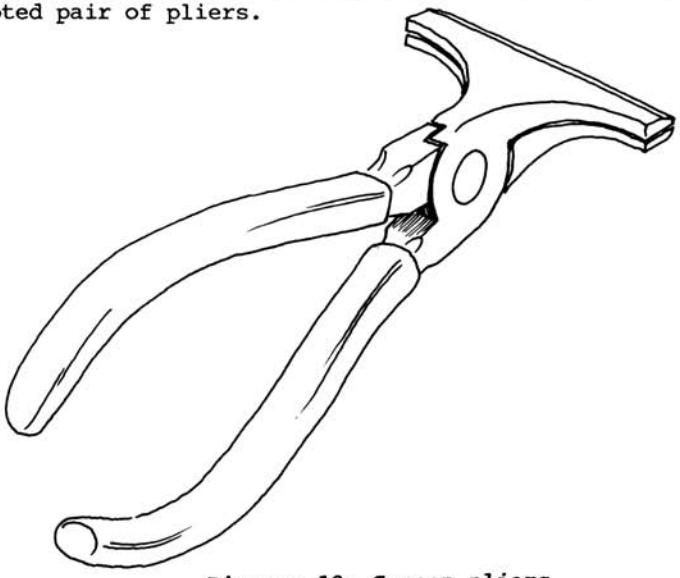


Diagram 18: Screen pliers

The next stage is to seal the edges to prevent ink from seeping between frame and fabric. Gummed brown paper about 2 inches wide is stuck to the frame and the fabric to cover the tacks or staples. Another strip is gummed on the inside of the frame, half of it on the wood and the other half on the fabric. A further strip is now stuck on the fabric slightly overlapping the previous piece.

THE BASE

This must be flat, very smooth and solid enough to stand varying amounts of pressure, yet still remain rigid. An ideal surface is a laminate such as formica mounted on thick plywood or blockboard. It is easy to keep clean, does not warp and is very smooth. Thick plywood or blockboard alone could be made usable with two or three coatings of shellac to seal the surface and give a finish that is easy to clean.

The base can be portable or be fixed to a table top depending on the amount of use to which it will be put. It should be larger than the largest frame if possible.

Attaching the frame to the baseboard

The frame must be fastened to the baseboard in such a way that it will move up and down and always fall back into exactly the same position on the baseboard. In addition it must be easy to detach from the baseboard for cleaning the screen.

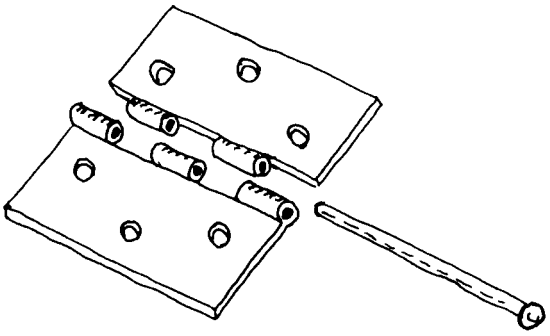


Diagram 19: Hinge and pin assembly

The simplest method is to screw two half hinges onto one side of the baseboard. The other halves of the hinges are secured to one side of the frame so that the hinge pins can be slipped in and out. This method has the advantage of allowing different frames to be put into use very quickly.

THE SQUEEGEE

This piece of equipment is used to force the ink through one screen onto the paper below. It consists of a straight-edged flexible blade, usually made of rubber or some form of plastic. It should be firm but pliable. The stiffer it is, the more force is needed to push the ink through the screen.

The material for the blade can be purchased from a dealer in silkscreen supplies, or improvised by someone with experience. It must be sandwiched between two pieces of wood or metal. If possible it should be made in such a way that both sides of the blade can be used.

The length of the squeegee depends on the width of the frame. For each width of frame a corresponding squeegee will be needed.

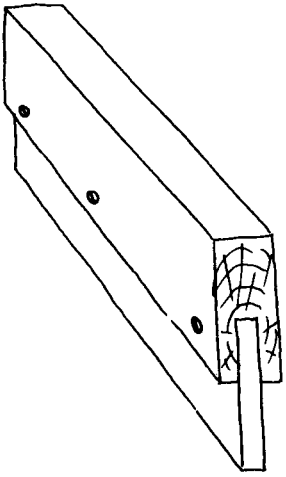


Diagram 20: Squeegee

The blade must always be kept perfectly straight and level. Any distortion will fail to give sufficient pressure to force the ink through the screen and will leave blank areas on the print.

Maintenance of the squeegee is most important. Care should be taken to keep the blade sharp and not allow it to become rounded. There are gadgets on the market to assist the printer in this, but a cheap and quite efficient method is to glue a strip of coarse sandpaper to a flat board and clamp it to a bench. As the edges of the squeegee begin to round off, stroke the blade firmly and evenly along the sandpaper for its whole length. By having this type of block available, the blades can be sharpened after each printing if necessary.

STENCILS

The stencil is the essence of the silkscreen process. Its purpose is to cover part of the screen and so prevent ink from getting through. For example, if you want to print a letter A, you must find a way of preventing the ink from penetrating the mesh of the whole screen except for the letter A itself.

Different kinds of stencil material can be used, each having a distinct use and giving a distinctive result.

Paper Stencil

Paper makes the simplest stencil. Always at hand and easiest to use, it has quite a wide range of possibilities. The paper should be thin enough to be cut with scissors or a scalpel. Very fine work is not possible, but large letters suitable for a poster can be cut with a scalpel.

The paper stencil is fastened to the screen by the first inking sweep of the squeegee. The cut paper is placed on the baseboard, the screen lowered onto it and the ink squeegeed over the screen: this will result in the ink sticking the paper to the screen. The main drawback of this type of

stencil is that it has only a short life - seldom more than 20 or 30 prints. In addition, it is not possible to clean a screen with a paper stencil and run a different colour.

Liquid Stencil

Liquid exists which can be painted or sprayed onto the screen. Wherever it is applied, it fills up the mesh. On drying it prevents ink from being squeegeed through.

It is essential to use a liquid stencil that will not be soluble in the inks that are used. Thus, if a water-based ink is to be used for the printing run, then a spirit-based filler must form the stencil.

The silkscreen printing of posters and book covers is always done with a spirit-based ink. It is therefore necessary to use a water-based liquid to block out the mesh. The best is manufactured under the name "blue filler".

Application can be by various methods: the liquid can be sprayed on (aerosol cans are sold containing the filler), dabbed on with a sponge or painted on with a brush. Only by experiment will the various effects by seen, and only experience will tell when they should be used.

Hand-Cut Stencil Film

Many designs are unsuitable for paper or liquid stencils. They may be too complicated, or require long runs or changes of colour. In such cases special films are available. They last longer and can be cut with accuracy into complex shapes.

Each sheet of film is made up of two layers of material held together with a temporary glue. One of the layers is a transparent backing sheet, often of plastic. The other is a thin stencil material, usually coloured and almost transparent.

To use the film, lay the design to be cut on a hard surface, then fix the stencil film securely on top with the part of the film that has to be cut uppermost. The design will be

visible through the film. Using a sharp scalpel, trace the design carefully so that only the top layer of the film, and not the backing sheet, is cut away. The underneath layer is there as a backing sheet to hold all the parts of the design together. The pieces of the stencil material that are not needed can then be peeled off and thrown away. These are the parts of the design that will print. Left on the backing sheet are the parts of the design that will not print.

Place the stencil on a flat surface with the stencil layer uppermost. The screen is placed on top and a wet sponge applied, working over the whole area. The water will loosen an adhesive in the film. Any excess water left must be removed. A good way to do this is to lay sheets of old newspapers on it and, using a handroller, gently press over the area of the screen until all the water is soaked up. Alternatively you can use an electric iron. Lay a sheet of paper on the backing sheet and iron over it. Later you can peel off the backing sheet.

The screen must now be dried, either in the sun, by a radiator, or possibly with the help of an ordinary hand-held hair-dryer. After about 20 minutes, it should be possible to remove the backing sheet from the stencil and, after covering the edges of the screen, start printing.

DRYING RACK

If only a small number of sheets is to be printed, it is possible to lay them out on benches or to hang them on lines to dry. But when the length of run increases, this method is not quite so feasible and a drying rack may be needed.

This consists of a number of wire shelves, usually 50, hinged to a frame and fastened one above the other with about one inch of space between. It will give drying room for possibly as many as 100 posters.

ADDITIONAL POINTS

A silkscreen workshop should have a plentiful supply of water. Most of the stencils are soluble in water, so water

is necessary for cleaning the screen when printing has finished.

The skill required is in proportion to the type of stencil being used. Experience in handling the equipment, especially the squeegee, is the most important need for the operator.

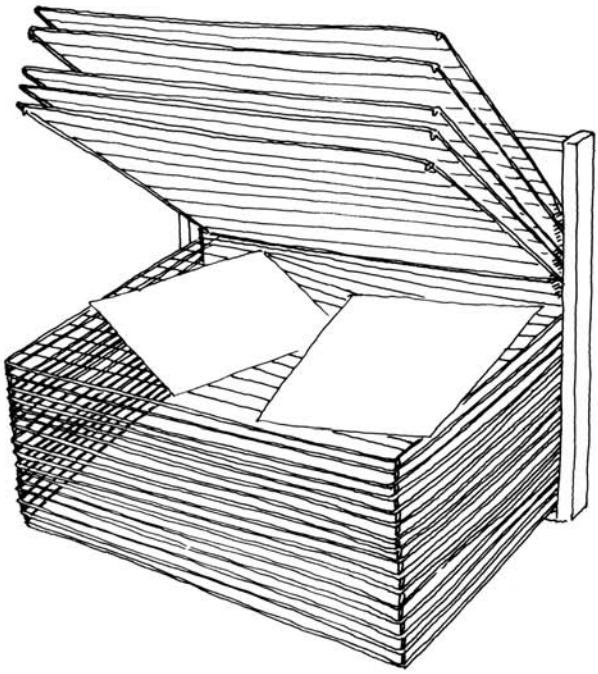


Diagram 21: Drying rack

The number of copies that can be produced will vary according to the type of stencil being used. For short runs, paper stencils will be adequate if fine line work is not needed. Longer runs will be accomplished better with handcut or photostencils. Photostencils are extremely sensitive to light and can only be made in a darkroom. If a darkroom is not available it may be possible to have the photostencil made by an outside agency.

The output of the operator will be determined by the size of the poster or other object being produced, the amount of ink that has to be pushed through the screen, and the drying facilities. An experienced operator can produce about 100 copies an hour. This number can be increased if two technicians work together: one to lay paper on the bed and print, the other to take the finished print and lay it out to dry. The number of copies printed, however, will not necessarily be doubled.

SECTION EIGHT

FINISHING

COLLATING AND GATHERING

Hand Collating

Collating can be carried out by unskilled staff with little or no training and in many cases without equipment. A benchtop is all that is needed. It should be long enough to allow the sheets or sections to be laid out in order. These are then gathered one by one to make up the finished job. If the worktop is wide enough, the sheets can be laid out in two rows, head to head. The person or persons collating then walk round the bench picking up the sheets and stacking the sets at the end of each circuit. If only a few sections are being collated, it may be possible to stack two identical sets of sections head to head and stack the sets at the end of each half circuit. It is best to experiment with different techniques to see which suits staff, space and worktop best.

The time taken to collate any particular job by hand will depend on the number of workers gathering the sheets. It will be found that some workers are fast and some slow. It is important when using a number of staff for collating to choose a team in which everyone works at about the same pace.

Though hand collating is a primitive system, it lends itself not only to the gathering of single sheets but also to folded sections before they are either side-stitched or perfect bound into books. In addition it is easy for the workers to see and remove any spoiled or blank sheets. It can provide work for unskilled staff.

Collating Machines

Where a large volume of collating is undertaken, semi-automatic and automatic collators are available. They speed up the process, cut out fatigue in the workers, and reduce the number of personnel involved in hand collating.

Revolving circular table models save both floor space and legwork. The revolving table has containers to hold the sheets to be collated, and the operator can sit in one place and gather sheets as the table revolves. The machine is controlled by a pedal which not only starts and stops it but also adjusts the speed to suit the operator.

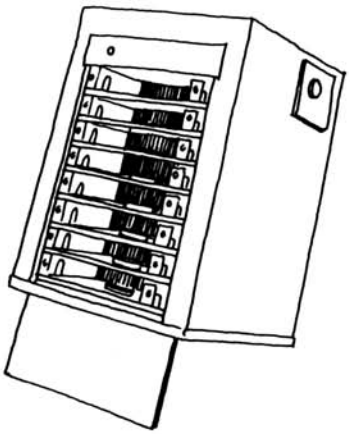


Diagram 22: Bench top collator

Benchtop models contain six or eight trays of varying capacity ranged one above the other. The action is semi-automatic. When a foot control is pressed, the top sheet in each tray is thrust forward by friction feed rollers. The whole set can then be gathered between thumb and fingers and withdrawn for stacking. This system can be doubled by placing two such collators side by side. It will still need only one operator, who will use both hands at the same time.

Horizontal models have 12 bins for the sheets, inclined at an angle of about 60°. They can be freestanding or benchtop. Each bin has a maximum capacity of 300 sheets, varying with the thickness of the printed paper. By depressing a lever the top sheet of each bin is raised, and the complete set can be gathered with one sweep of the hand.

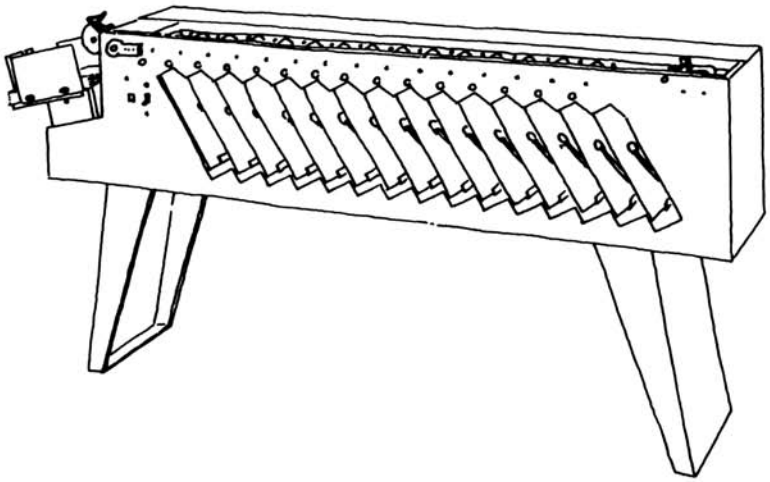


Diagram 23: Floor standing horizontal collator

The electric models automatically present the sheets at a regular rate which can be pre-set. The sheets are gathered by passing a rubber-faced pad over them. It is possible to gather over 1000 sheets an hour with this type of collator. These models can only handle successfully the middle range of paper thickness. Very thin papers will need specially-designed collators that have sheet separation mechanisms and suction feed systems.

The important thing in choosing a collating machine is to ensure that it is not too small to handle the output of the printing machines. This is one part of a printshop where bottlenecks can easily occur.

Jogging Machine

After collating, the sheets need to be carefully aligned at the top (head) and at the back. This can be done manually by banging them lightly on the bench with both hands or by using a jogging machine.

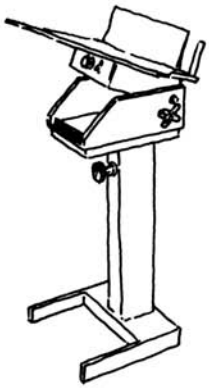


Diagram 24: Jogger

Conclusion

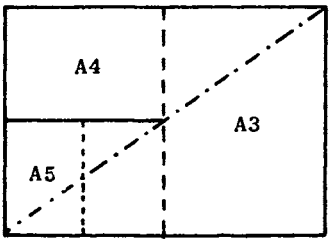
The simplest collators are quite easy to operate. The number of sets gathered from these models is dependent solely on the dexterity of the operator.

For really high-volume collating, there are fully-automatic machines capable of gathering sets of up to 22 sheets at speeds in excess of 2000 sets an hour. This is more than a small printing unit will need. Some of these collators can be put in line with folders and staplers.

FOLDING

Folding can be done with or without machines. If it is only occasionally necessary to fold printed sheets, it is best to fold them by hand rather than buy a machine that will frequently stand idle.

To fold sheets by hand, only one simple tool is needed: a 'bone', so called because it is made from a rounded and polished section of animal bone. Four-page and eight-page sections can be folded quite easily and speedily by hand. An A3 sheet is probably the largest paper size a unit would use. When an A3 sheet is folded as Diagram 24 shows, it gives two A4 size sheets; and when an A4 sheet is folded again, it gives an A5 size. To produce an accurate fold each sheet must be folded separately.



A3 *297 x 420 mm*
A4 *210 x 297 mm*
A5 *148 x 210 mm*

Diagram 25: Folding A3 paper to give A4 and A5

Folding machine

As an increasing number of books are being produced in A4 format, the single fold of an A3 sheet to A4 will be used quite often. Most of the work of the folding machine will be to fold an A4 sheet to form an A5 section, or to fold an A4 sheet into three to make a leaflet or brochure.

Folding machines will fold only one sheet of paper at a time. Small ones of the sort shown in diagram 26 are able to take a sheet up to A4 in size and make either one fold on two parallel folds in it. They cannot make right-angle folds.

There are two kinds of folding machine: buckle or plate models, and knife and buckle models. Each kind has its advantages and disadvantages.

Buckle folder

The buckle folder is certainly the most versatile for producing a number of folds at high speed and it is this

principle that is employed on most present-day machines. They are made in a variety of models to accommodate different paper sizes. The smallest models take an A4 sheet and make one or two parallel folds. These are benchtop models and are intended for the busy office rather than the small printer.

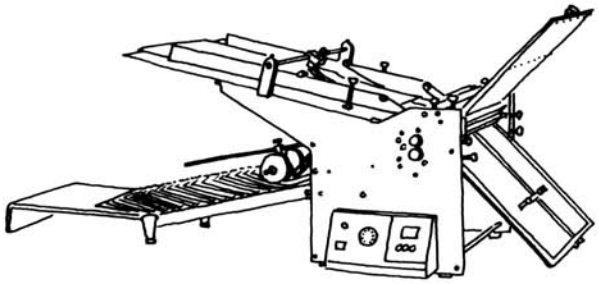


Diagram 26: Bench top folder (parallel folds only)

The next size up is capable of feeding an A3 sheet and is probably the best folder for the small printing unit to purchase at the outset. It can make a variety of folds, but only in parallel. If the work of a small unit sometimes requires a crossfold, the second fold can be done by hand. A crossfold extension to the machine can be added when the volume of work justifies the expense.

It is difficult to give machine speeds for folding as much depends on the type of fold and the weight of paper. It should be possible to set the machine up (that is to do the adjustments necessary to produce an accurately folded sheet) and fold about 1500 sheets an hour. A certain amount of skill is required to make the correct adjustments, but the skills could be acquired in a day at most. The majority of problems arising will become less troublesome as the operator's experience with the machine increases. The only running cost for a folding machine is electricity.

Buckle and knife folder

Its main advantage is that it can make a parallel fold and a right-angle fold at the same time with great accuracy. Its chief disadvantage is its cost, which is at least twice as much as for the buckle folder. It is used mainly for folding 16-page or 32-page book or magazine sections.

Hints and tips

1. Although buckle folders are very versatile in the number of folds they can make, they have limitations in the kind of stock they can handle. Card thicker than 200 gsm and paper thinner than approximately 60 gsm in weight cannot be accurately folded with any certainty.

2. Art or coated papers also cause problems. The surface tends to crack along the fold and give an unsightly appearance to the sheet. This can be overcome only by passing sheets through a creasing mechanism first. Although it means the sheets going through the folder twice, the result is worth while.

3. Care must be taken to feed the printed sheets correctly into the folding machine. Page numbers must be checked to give the correct sequence of pages after the final fold. It will be advisable to perform a sample fold before running off the printed sheets.

BINDING AND TRIMMING

Binding

The output of a small printing unit consists most commonly of single sheets which must be collated and fastened together. It is possible to do this with a single staple in the top left-hand corner, but this can hardly be dignified with the name of "binding". Any small printing unit will need to possess equipment capable of something more ambitious.

There are two binding methods: hand binding, and mechanical binding.

Hand binding

This very simple form of binding has been in use for many years for binding pads or writing blocks. The binding is done by using adhesive. It is a simple method and can be done by hand. The sheets are held in a press, the spine is coated with glue (adhesive) and a muslin strengthening strip

is added. Today not only pads but books of almost any thickness can be bound in this way. However it is not suitable for books that have to be used often: the glue will crack and allow pages to fall out.

To improve the appearance and to give extra strength, it is usual to apply a self-adhesive tape of linen or plastic along the spine and fold it over the front and back covers. This self-adhesive tape will also improve the appearance of side-stitched books.

There are various makes of machine available to do this job. The commonest type contains clamping bars to hold the sheets while they are being glued, and an infra-red heating element to speed up the drying of the adhesive. The linen tape for the spine is then added. Only one book at a time can be finished in these machines.

Adhesive binding

Machines exist which clamp, bind and tape the backs in one operation. The tape has a heat-softened adhesive which allows the machine to glue it to the spine. If the spine is to be titled, this must be done before the back is glued on. It is not possible to print the title by offset: some other method must be used. Such a machine would cost a little less than an electric golfball typewriter.

Plastic slide binding

This is the simplest method of fastening loose sheets together. It makes use of a plastic slide which clips over the spines of all the sheets including the cover. This method is cheap and very useful if material has to be up-dated, as any sheet can be easily replaced at any time.

The slide binders vary in width up to an inch, according to the thickness of the work to be bound, and come in pre-determined lengths and in different colours. No special equipment or skill is required. A little extra space must be left on the inside margins to allow for space taken up by the plastic slide. Those setting the text should be instructed

to leave the extra space on the right-hand side of left-hand (even-numbered) pages, and on the left-hand side of right-hand (odd-numbered) pages. Printers should be warned to make allowance for the extra spine margin and not print the text centrally on the page.

Stapling

Material can be stapled in two ways. The first, known as 'side stitching' consists of stapling single sheets of paper down one side. The sheets are collated with their covers, carefully aligned, and two or more staples driven through the long edge. Any stapler can be used for side stitching up to about 10 sheets of paper of average thickness. For more than that number, a heavy duty stapler or bench stapler may be needed which can take staples of varying lengths.

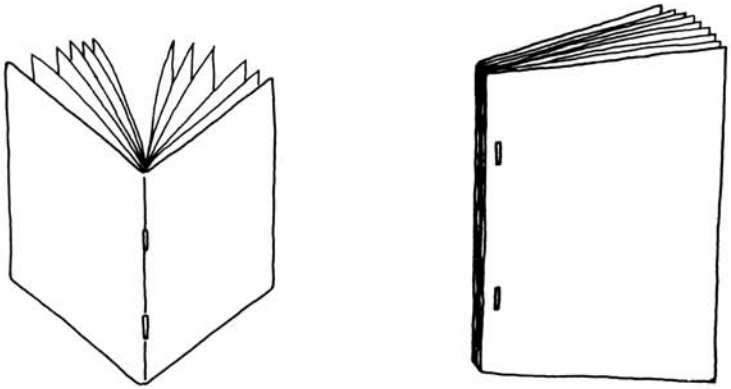


Diagram 27: Saddle stitch (left) and side stitch

For the second method, known as "saddle stitching" the sheets to be bound are folded in half and gathered into sets. Each set is then opened up again and two staples are inserted along the line of fold. In order to reach as far as the fold a "long-arm" stapler is needed with an arm 8 or 10 inches in length. Inexpensive ones are made which can punch through about 10 or 12 sheets of paper. As there are four pages on every folded sheet, this stapler should be able to staple a 40-page book.

Bench stapler

This is the best machine for a small printing unit to start with as it is capable of stapling much thicker pads and books than the long-arm stapler. It usually has an adjustable plate so that saddle-stitching and side-stitching can both be accommodated with very little trouble. The kind with a foot control is faster tc operate as it leaves both hands free to manoeuvre the material to be stapled. There is also a freestanding machine operated by a foot control. It is more expensive than the bench model but has the advantage of being easily portable.

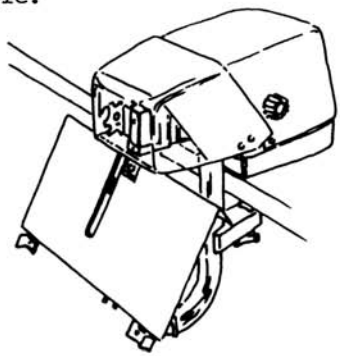


Diagram 28: Electric bench stapler

Wire Stitchers

Where thicker books are to be stitched, or a higher level of production is needed, a power-driven wire stitcher is essential. Although freestanding, this machine is heavy and needs to be connected to a power supply so it cannot be moved about. It is not difficult to operate but skill is needed to adjust the machine before work can start.

The staples are formed by the machine from a long length of wire. To overcome the problem of the staples buckling when being forced through very thick books, different thicknesses of wire can be used. With the correct adjustment, books an inch thick can be stapled. Stainless steel wire is recommended so that the staples do not rust. Over long runs the wastage of staples will be considerably less than the other types of stapling machines.

Plastic comb binding

This process makes use of two machines. The first punches a row of holes in the collated sheets including the cover and the backing sheet. Preformed plastic combs are put into the second machine, which opens them up to allow the punched sheets to be slipped over the teeth of the combs. The combs are made from plastic and the teeth are quite springy. Once released they curl back again to hold the sheets together. They come in a variety of sizes. The operation can be done either manually or electrically.

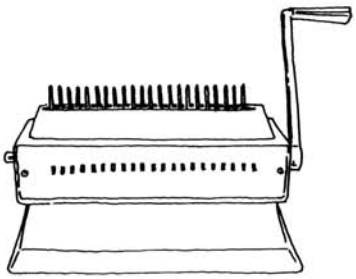


Diagram 29: Comb binder

Spiral wire binding

This process is very similar to the plastic comb binding. Two manually-operated machines are usually needed. One machine punches a row of holes along the side of the collated sheets including the cover and backing sheet. The second machine feeds a preformed wire spiral through the punched holes and clamps the ends. The size of the wire spiral will depend on the number of pages to be bound. The preformed wire spirals can be obtained in various lengths and diameters.

There is a single, but more expensive, machine which does the job more quickly. It punches the holes and feeds the wire through them from a spool. The spiral formed by the machine must be adjusted to the thickness of the book being bound. The machine is electrically powered and the operator needs a little more training than for the manually-operated machine.

Perfect binding

Perfect binding is expensive and complicated, and a small printing unit would need a large turnover of books to justify the purchase of one of these machines. If perfect binding is required and the equipment is not available, then the printed sheets can be sent out to a printer.

The sheets to be bound are fed by hand into clamps on the machine. The machine then does the complete binding operation, leaving only the trimming of three edges to be carried out at the end.

Case binding

When a hard cover is put on a book, it is called "case binding". It is a highly-skilled craft needing some expensive equipment. This is a method of binding that a small unit should not contemplate. If this type of binding is needed, it would be best to find an outside binder to do the work for you.

TRIMMING

Cardcutters

It will always be useful to have a cardcutter in the unit. It need not be large but should be capable of cutting as many as 32 sheets of paper, depending on the thickness, at one time, accurately. It can be quite simple, with a baseboard with a leading edge set at rightangles to the blade and raised to give a stop against which the paper can be placed. At the edge of the baseboard where the blade comes down there should be a hand-operated clamp to hold the sheets firm during the cutting operation.

Many print-room operators refer to the simplest forms of papercutter as "guillotines". This is incorrect. These simple types consisting of a baseboard and hinged blade are not guillotines but papercutters or cardcutters.

It is possible to buy cardcutters with the leading edge marked in inches and/or millimetres. Some will also have a device beyond the blade to give the measure of the piece of paper being cut off. However, these are only refinements to the basic machine. What a good cardcutter must have is a strong clamp and the leading edge on the base at exactly 90° to the blade.

Cardcutters are made in a range of sizes to suit different paper sizes and need very little skill to operate.

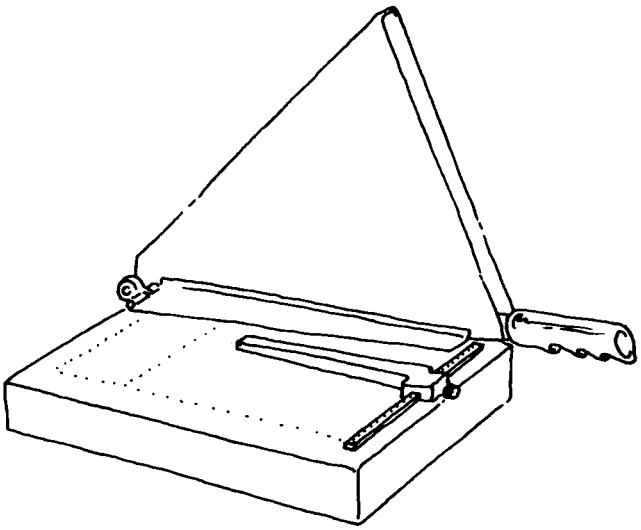


Diagram 30: Card cutter

Guillotine

The true guillotine of the printing trade is a machine capable of cutting through as many as 500 sheets of paper. The most popular models are driven by an electric motor and do not need the physical strength that is demanded by a manual machine. The choice is a matter of economics. A manual model with a cutting blade of 18 inches will cost about three-quarters the price of a golfball typewriter; an 18-inch power driven guillotine will cost about twice as much.

Some guillotines are large, sophisticated, and expensive. They are intended for big printing firms, not small units.

All models are fitted with a safety device. One such device ensures that the operator must simultaneously press two buttons positioned on opposite sides of the machine. If either hand is lifted for any reason, the blade stops immediately. Another consists of a number of moving bars which, if touched, automatically halt the machine. A third uses "magic eyes". A number of beams of light are displayed across the face of the machine and, if they are impeded at any time, the machine stops immediately.

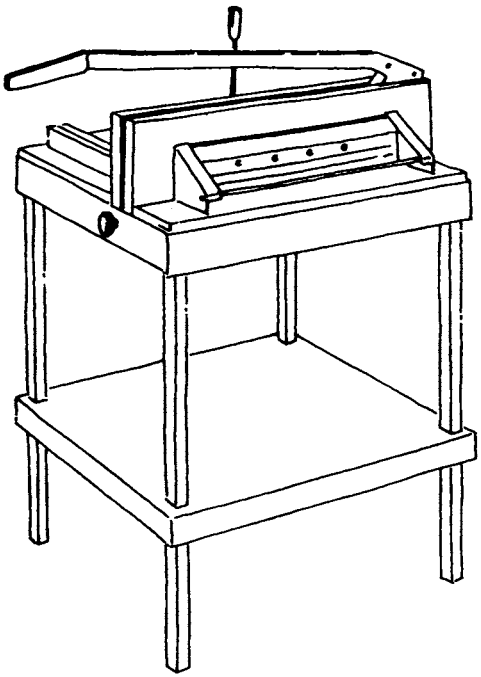


Diagram 31: Hand guillotine

For the small printing unit, the best machine to purchase will be semi-automatic, that is a model where back-plate and clamp are operated by control wheels at the front of the machine, and a blade that is motor driven and has one of the built-in safety devices mentioned above.

When choosing a guillotine, make sure it is wide enough to take the largest sheets of paper used in the print room. The length of the diagonal of the sheet can be used as a guide. This enables the paper to be turned in the guillotine without having to be brought out.

Operating speeds with a manual guillotine depend on the skill and temperament of the operator. For electrically-driven models most manufacturers give machine speeds at so many cuts per minute. This is somewhat misleading as they are only pointing out how many times the blade will go up and down, without taking into account changing the position of the back plate, turning the paper, and clamping.

The siting of the guillotine is important. It is the machine that is used at the beginning of the operation to cut paper for the printing machines, and at the end to trim the finished work. It is unsound economically to have more than one guillotine. Because a guillotine is not easy to move, its location must be as permanent as possible. A quiet section away from the flow of personnel would benefit the operator.

SECTION NINE

MANAGEMENT

In a printing unit the manager is responsible for the smooth running of all the production departments, the day-to-day liaison with customers, the cost of work, and the ordering of supplies and materials. The extent of management required will depend on the size of the unit. Very small printing units do not need a full-time manager. If a part-time manager is employed, he should be involved daily with office work and production.

A printing unit within an institution must record all the printing jobs carried on for each department. Each job should be given a number. This should be entered in a log book which also records details of material and time expended.

ESTIMATING

An estimate of cost and delivery date can be given accurately only if all the facts are known (see check list opposite). Some of the things to consider are:

Has the copy already been set? If not, how many words are to be set and by what method? (e.g. typewriter, word processor)

Are any headlines needed? If so, by what method?

Are there any line or tone illustrations?

Are the sheets to be printed on both sides?

How many pages will be required and what size is wanted?

Checklist of things to be considered when giving an estimate

Title of job and description	It helps if each job has a title that is agreed by customer and printer. A brief description is also useful.
Quantities	
Number of pages and format	Leaflets and books are usually printed in sections of 4, 8 or 16 pages. Format is page size when trimmed.
Binding	There are numerous ways of binding. The best for a particular job must be chosen.
Colours	If possible an accurate description of the ink: maker's name and number.
Paper substance	Can be from stock or may have to be specially ordered.
Cover substance	Can be from stock or may have to be specially ordered.
Type face	Size and face for text and headings
Description of illustrations	Line or halftone; approximate number of either or both
Schedule	Either a specific completion date or dates by which the different operations must be completed.
Any other information	
Name and address of client	

Diagram 32: Checklist

If there are to be more than four pages, what type of binding will be used?

How many copies are wanted?

What paper, what ink, and how many colours?

Is the proposed delivery date one that can be kept?

Once the answers have been obtained to all these questions, estimates should be possible.

A PROGRESS SYSTEM

A checking system must be devised which will allow the manager to follow the progress of jobs through the unit. The details of each job as it reaches the manager must be entered in a book. The date the work is received should be shown, and a job number should be allocated.

The Job Sheet

A printed job sheet (see page 83) should be filled in giving all the production details. This will be fastened to the copy and stay with the job as it proceeds stage by stage to completion.

The nature of the job sheet will depend on the printing facilities. Things to take into account when preparing one are the job number, estimated completion date, number of copies wanted, number of pages. This could be followed by instructions to the typist giving size and style of type and maximum line length. Paper details could come next, and then instructions to the printer will give ink colour and any special binding requirements.

STOCK CONTROL

In a sophisticated and highly productive unit, a method of stock control is essential if supplies are to be ordered at

the right time. Stock sheets should be kept, giving up-to-date totals of all materials being used.

Ordering itself is a simple matter. How much to order and when to order is more difficult. Some supplies may be

JOB NO. **CLIENT**
Delivery date
Description
Quantity
Typesetting completed
Proof passed
Platemaking completed
Printing completed
Finishing completed
Job despatched

Diagram 33: Example of progress card

obtainable the same day, others may take weeks or months. This time-lag between ordering goods and receiving them will be found out only by experience. The manager should make a note of this time-lag on his first order; then by keeping a strict stock control an estimate can be made for ordering further supplies. It may be possible to make an annual order to suppliers with specific instructions for goods to be supplied at regular intervals during the year.

Ordering too much of some supplies is as bad as ordering too little. Offset plates will deteriorate if stored for too long. This results in wastage and in machines standing idle until more plates are available. Rub-down letters and some chemicals and papers also suffer in the same way. Printing inks are reasonably immune to deterioration and will stay usable for long periods. Most types of paper will, if stored properly, remain stable for some time.

SCHEDULING

In graphics and typesetting, schedules should be planned so as to ensure a steady flow of work. Thus, jobs that call for many hours of typing and only short runs should be stretched over a number of days to allow other small printing jobs to be fitted in and keep the printers as well as the typists busy. Similarly, short run, single-sheet jobs should be interspaced with work that gives the binders something to do. Equally important, a very long run on the printing press should not be allowed to lead to a pile-up of jobs waiting to be printed.

STAFF TRAINING

Every small printing unit in a developing country needs to have an organised training programme for all its personnel. The organisation of on-the-job training is the manager's responsibility. He should ensure that technical staff receive instruction from those skilled in the operation of the various machines. Where a unit cannot undertake its own training, assistance should be sought from outside instructors. Time should be set aside for this on a regular basis. Formalised full-time training should also be envisaged, perhaps at a technical college.

JOB

JOB No.

This sheet must accompany the job through each process (copy and proofs to be attached) and returned to the office immediately the order has been delivered.

Date order received _____

Customer _____

Quantity _____

Description _____

Remarks _____

Proof wanted _____

Proof sent _____ Returned _____

Order wanted _____ Delivered _____

Delivery to _____

Typesetting completed _____ Printing completed _____

Binding completed _____

MATERIALS

Paper _____

Card _____

Negatives _____

Plates _____

Inks _____

Binding _____

Extras _____

Diagram 34: Example of a job sheet

If everyone in a small printing unit is trained in more than one of the production processes, a steady flow of work can usually be maintained. Machine breakdowns are more difficult to overcome. One possibility is to ask another printer to help you out - a favour you may well be asked to return.

WORKSHOP PLANNING

An elaborate or specialised building is not needed to house a small printing unit: a room the size of a small classroom should be adequate. Nor is it possible to draw up a standard floor plan for all small printing units. What is important is to locate the machines and supplies in a way that allows for the work to flow from origination through platemaking and printing to finishing. Most rooms are not built in a way that makes it possible to do this in a straight line. In such cases, the work-flow must be bent round in the form of a U to enable the work to start and finish at adjacent points.

If possible, the management area should be separate from but accessible to the workshop. The remainder of the unit can be housed in one large room or a series of smaller rooms.

Paper Storage

Paper storage should either be a small room with shelving, or a corner of the workshop partitioned off and provided with shelves. The lowest shelves should be wide enough to take the largest depth of paper or card that is used.

Platemakers

Platemakers can be located within the workshop. If the supplies are stored in cupboards underneath, the operator will be able to work with maximum efficiency. If a large platemaker is used, a sink unit with running water should be located nearby.

Darkroom

This will be necessary when a process camera is purchased. If a small room is not available, a part of the main workshop will have to be partitioned off. It must be made completely lightproof, with an entrance that will enable the operator to enter without light penetrating inside (see section 3).

The area must be large enough to hold the film-processing equipment as well as the camera. A sink unit with running water and large enough to hold two trays the size of the largest film will be needed for hand processing; or where a processor is used, a smaller sink unit will be needed with a bench for the processor.

Cupboards and shelves must be built-in to give storage for the film, material and the chemicals. Every effort should be made to prevent dust entering the darkroom.

It would be an advantage if the darkroom were made large enough to contain the large platemaker, then the same sink can be used for processing and platemaking.

Printing Section

Clean bench space is needed to store paper for jobs in progress and jobs waiting to be printed. Moveable trays under the benches will assist in moving the piles of paper round the unit.

The workshop will need a place where inks can be stored; gums, chemicals, oil, cleaning materials and tools can also be kept there.

Finishing Section

This department will take up more of the workshop area than all the other departments put together. Most of it will be bench space. All jobs moving through the printing unit will be stored here while awaiting finishing or despatch. A

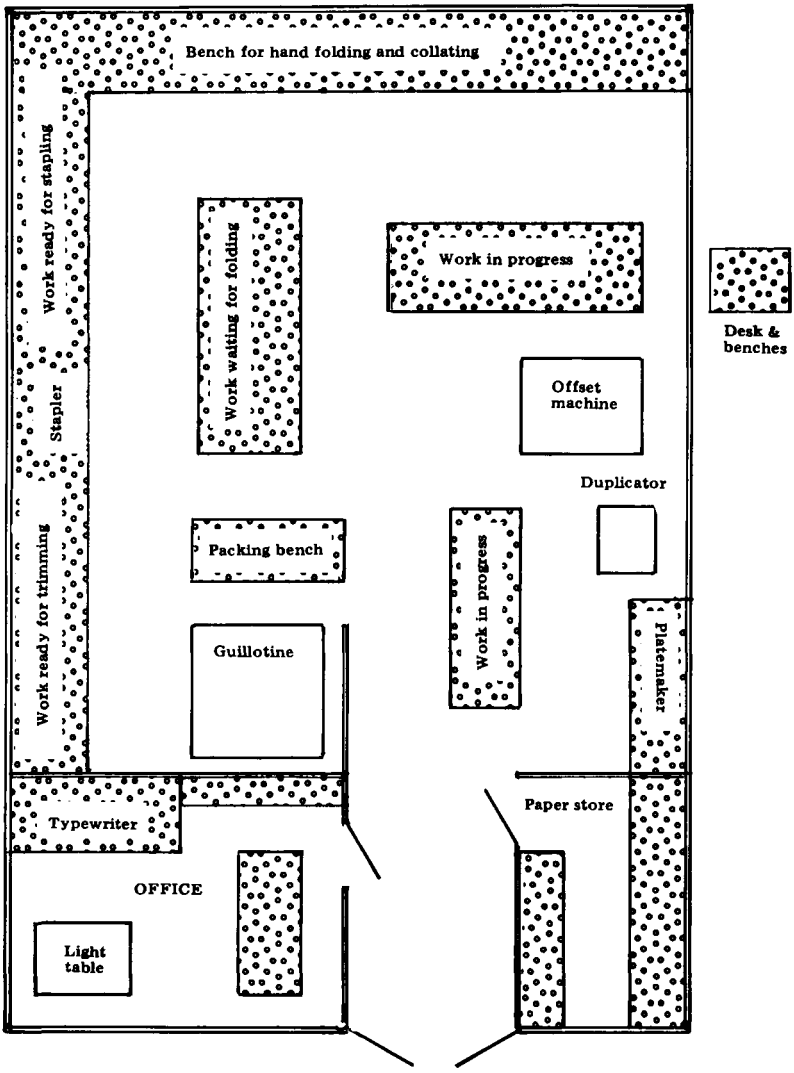


Diagram 35: A workshop layout for simple equipment (Benches would have built-in storage space beneath)

large bench for hand folding and collating is essential; and whatever type of binding system is used, space will be needed for the machine, and bench-space on either side of it for the work in progress.

Trimming of finished printing will also require bench-space for books before and after the operation.

The material will have to be finally packaged on a strong bench or table and will need some system of storage while it awaits collection.

Hygiene

Hand-washing and toilet facilities for the staff should be as close as possible to the work area. The provision of an area for the preparation of food and drink should also be considered.

A first-aid box should be available and displayed in a prominent place.

The Building

Doors should be wide enough to allow for the easy movement of machinery and materials. One exterior door should be a double door. Extractor fans will be necessary in areas where strong-smelling or toxic chemicals are in use.

SAFETY MEASURES

Safety measures need to be observed in each section of a printing unit.

Composing and Graphic Section

When not in use, pens and inks should be kept away from artwork, and lids fastened securely on tins of adhesive. Accidents can easily happen and the artwork can be ruined.

Golfball and daisywheel typeheads should on no account be allowed to drop on the floor. The metal of a golfball is very thin and can easily buckle. Daisywheels are made of plastic and the finger-like projections can break easily if they are not handled carefully.

Because the electronic mechanisms of the typewriters are delicate, no food, drink or smoking should be allowed in their vicinity.

Printing Section

Printing and duplicating machines tend to be noisy and if possible should be operated in a closed room.

Machines should be placed at least three feet apart so as to allow ample room for the operators to move around during the working operation. Safety devices should not be tampered with.

All tools and accessories should be stored in proper tool boxes. These can either be placed under the machines or mounted on the wall with a safe lock.

Because of the extensive use of paper and chemicals in offset printing, no smoking should be allowed in the print room and a NO SMOKING sign should be displayed.

If kerosene is used for cleaning purposes, it must be stored in a safe place. Cleaning rags impregnated with kerosene should be thrown in tins with lids so that there is no possibility of their catching fire.

Stencils after use have ink all over them. If they are to be retained, the backing sheets should be replaced and they should be put away in cupboards.

Finishing Section

The safety of the operator is most important when working on guillotines. All models have built-in safety devices which must not be tampered with to increase operating speeds.

INKS

The inks used for writing (in the case of calligraphy), for duplicating, for offset printing, and for silkscreen printing, are all different. Printing ink is more akin to paint than to writing inks. It consists of a finely-ground pigment which imparts the colour, and a liquid medium for conveying the pigment to the print surface. Ink pigments are fairly standard, but the liquid medium varies according to the printing process. For example, some processes require a tacky ink in which linseed oil or varnish is a constituent; some need thin ink; some need a quick-drying ink. Consult your supplier to make sure that the type of ink you buy is the one best suited to your purposes.

PAPER

Paper is made from cellulose fibres which can be found in all plant material. Printing papers use two main sources: softwood trees and esparto grass. They are used both individually and as a mixture. The cheapest papers are made from wood-pulp only, and the best papers are made from esparto. An essential ingredient of paper, called "size" helps to hold the fibres together and makes the paper resistant to the penetration of ink and water.

Some papers have filling agents added: the most common is china clay. It improves the opacity and gives an extremely smooth surface for printing.

Printing Papers

Newsprint, one of the lowest grades, is made from wood-pulp. It is used when permanence is not important; it tends to discolour.

Bond is a strong, opaque paper used mainly for stationery printing. It is made from esparto and is available in colours that are reasonably permanent.

Uncoated is the most basic and least sophisticated type of paper. It is made from a mixture of woodpulp and esparto. Its surface varies according to the treatment it receives during making.

Coated papers have china clay as an ingredient. Usually they have a high gloss finish and are ideal for printing half-tone illustrations.

Cast coated has a very high gloss and is expensive. It is used mainly for book jackets, and, in card weight, for glossy covers for paperback books.

Choice of Paper

Paper for offset printing must be properly "sized" (see above) so as to resist the moisture content of the process. Because offset inks are more tacky than others, the paper should have a good surface strength to prevent it being removed during printing (picking).

Uncoated papers tend to absorb ink: this causes the image to spread. Half-tone illustrations on these papers tend to become less sharp than on other papers.

Coated papers, having a smoother surface and less absorbency, give a sharper image.

If the surface is smooth, the ink transfer will be more uniform than on rougher papers. This will give a sharper, cleaner impression.

When choosing papers, the type of job (whether text, line illustration or half-tone), and the permanence of the work must be taken into account.

APPENDIX A : THE BOOK PRODUCTION AND MATERIAL RESOURCES UNIT IN THE GAMBIA

ORIGINS AND DEVELOPMENT: 1973 TO 1978

The present Book Production and Material Resources Unit of the Ministry of Education began with a different title, in a different place and with a much narrower objective.

In late 1973, the material available to back up the course of training for primary teachers conducted in Yundum College (now Gambia College) left a great deal to be desired. Textbooks were scarce and most of those that were available were not really suitable. Certain pieces of audio, visual and audio-visual equipment were available, but rarely, if ever, used. There were no slide sets, no OVH transparencies, only a very few (rather battered) picture sets for wall display, and certainly no gramophone records or cassette tapes.

It was against this background of need that we decided to set up a College Resources Centre. Several problems had to be overcome. First we had to find a place in which to set up the centre. As only one small room was available we had little choice. Second, no suitable furniture was available. The answer was found in a number of sturdy packing cases in the College store, together with one or two sheets of hardboard in more or less good condition.

We were now ready to move the equipment into its new home. This did not take long as all we had was one old and battered rotary ink duplicator, a manual typewriter of similar age and condition, a slide-type rotary trimmer, a desk-type hand stapling machine, a pencil sharpener, a small paper punch, a tool for inserting eyelets (not in great demand!), an assortment of blackboard instruments, and a small stock

of paper and duplicating ink. As for the staff, it consisted of only three people: the manager who served also as reprographic technician, the Principal's secretary as compositor, with the Principal himself providing graphic art work and photography. All three combined for the finishing stage of collating, stapling and trimming. It was not possible to provide any full-time staff as the three persons involved had their normal duties to perform. This meant that the bulk of resources work had to be done after working hours.

By mid-1975, the Yundum College Resources Centre was functioning well and had a modest list of publications to its credit; all short runs of around 50 to 100 copies of small booklets and sets of single sheet illustrations. The belief that the need was there had been vindicated and demand was growing.

There was clear indication that the closer a finished piece of work approximated to a commercial standard, the more value and confidence both lecturers and students placed in it. An imaginative and appropriate cover design on coloured card, a balanced, professional looking layout of headings and text, justified type and clear uniformly inked printed copy all helped to promote the belief that the home-grown product really could offer a viable alternative to the commercial equivalent.

The time had arrived to do something about the equipment. Four new items were procured: a new and somewhat more versatile rotary ink duplicator which would use coloured inks without our having to clean the rollers each time; an electronic stencil cutter (or scanner) to meet the growing demand for single sheet illustrations and work-cards; a golfball typewriter; and a small electric stapling machine. The improvement was immediately apparent. But when the scanner was put to use we found we needed one other piece of equipment. This was a light box, needed for spotting out pinholes in scanned stencils before they were run on the duplicator. As no funds were available we took a piece of glass out of an old window frame and made the box to hold it in the College woodwork shop, using various remnants. An old lamp-holder (bayonet fitting) was installed, a sheet of tracing paper acted as a diffuser, and we had a light box

made entirely from scrap material (except for the lamp). It is still in use in the present Book Production and Material Resources Unit.

Throughout 1977, consolidation and a steady improvement in technique was the major theme. We had come a long way since the first ideas of 1973. The centre now handled all procurement for the academic side of the College. The stock of raw material (paper, card, etc.), although not lavish, was adequate, and the number of non-book resource items had increased. There was an excellent requisitioning, issuing and retrieval system. The quality of production had reached a high level, demonstrating what could be achieved with scanning and duplicating equipment. Our success was due not only to good typesetting and good printing, it was also dependent on the infant graphics section. The introduction of "rub-on" lettering gave an added dimension to headings and cover layout, while the facility of the electric typewriter to change type faces was a further refinement. Our cover designs, layout, diagrams, illustrations and so on, impressed everyone.

THE PERIOD OF EXPANSION: 1978 TO 1982

In 1978, the decision was taken to move the unit from the College to its own premises in Banjul and set it up as a separate entity called the Book Production and Material Resources Unit (BPMRU). At first there was no formal staff establishment in the Government Estimates; in effect the Unit did not exist! All staff (there were four) were seconded on a full-time basis. This situation was both a hindrance and a help. A hindrance, because if we did not exist with an official staff there could be no official vote for funding the Unit. A help, because we were not forced to accept unsuitable people in order to fill officially-established posts that could not be left vacant for long. However, as we had to build a staff, a useful expedient was found whereby we could select the people we wanted and have the means to employ them. They were employed as temporary unqualified teachers and seconded to the Unit.

For the sort of work we had to undertake no pool of trained personnel was available. In order to continue the idea of full commitment and hard work established in the former College Resources Centre, we knew we would have to select our staff with the utmost care and then mould them into a committed team. We decided not to take people who had already been in employment where they might have picked up bad work habits. Instead we looked towards those who had recently left secondary school or were about to do so. In this way we also satisfied another of our requirements, which was a minimum of four GCE O-level passes including certain specific subjects.

So a search of the Secondary High Schools began. We were looking for recruits who had attained our minimum educational requirement, who showed an interest in the sort of work we were offering, and who had the potential to absorb further training.

We needed people for training as graphic artists, as editors, and as compositors. From the schools' art departments came our future graphic section personnel; from the commercial classes we selected the best typists we could find; while from the ranks of those who had achieved high-level passes in English and other languages we drew our embryo editors.

For certain senior posts we looked to the teaching profession. The Chief Editor's post, for example, required a mature person with a good academic background, a teaching qualification and wide teaching experience. In the equipment maintenance area we sought two teachers from the secondary technical schools; one with a background of electronics, the other trained in the basics of mechanical engineering. Those to be trained as offset press operators and for finishing and binding work we selected from secondary technical school leavers.

These people were not all recruited at the same time. The process took over two years; but by 1981 it was more or less complete. All the recruits had to serve a probationary year in order to give them time to be sure that they really wanted to do the type of work in which they were involved. It also enabled us to evaluate their suitability. Once they had reached a sufficiently high standard on the in-

house, on-the-job training programmes, efforts would be made to secure funding to send them for formal training abroad so that they could obtain recognised qualifications in their special field of work.

By the end of 1979 it became clear that if our trainees were to reach the high standard envisaged, we would need some outside expertise for some aspects of our in-house training programme. As our funding was (and is) limited, we approached various agencies responsible for voluntary service overseas. One of them generously provided people trained and experienced in graphic arts, printing and finishing. We also managed to squeeze enough out of our own funds to employ on a part-time basis an excellent local typing instructor who put our trainee compositors through the advanced stage of the examination of an international typing institution. More recently, in the same way, we have employed on local terms an expert in typography and composition who we hope will turn our advanced typists into typographers capable of producing copy of a high standard.

So that our personnel can work full-time on the production schedule, we set aside Saturday mornings for the formal in-house training programme.

The decision to remove the Unit from the College and set it up as a separate entity resulted in more rapid growth than would otherwise have been the case. This meant that we had to think again about the choice of equipment. To rely entirely on the sort we already possessed would mean limiting our work to a fairly narrow field. On the other hand, to invest in equipment beyond our in-house training capacity and maintenance ability would be to invite problems. We decided to set up a set of guidelines against which we could measure our requirements. Our list eventually came to something like this:

Will the equipment have the capacity to handle the projected production level for (say) the next five years?

Is the operating skill required simple and easy to teach to totally unskilled personnel?

Is the equipment sturdy enough to stand up to the handling

of trainees while at the same time functioning as a piece of full-time production equipment?

Can we do most of the maintenance likely to be required?

Are spares readily available and reasonably priced?

Two other points were also considered. First, so that we could purchase all machine supplies in the cheapest possible market, we avoided any equipment for which supplies (e.g. inks, fountain solution, etch, plates, etc.) could be purchased only from the manufacturer of the machine. This gave us the opportunity to shop around for quality goods. Second, we thought it would be best to deal with as few manufacturers as possible, provided they could supply what we wanted at the right price. By standardising ouf equipment in this way we could save on administrative costs and - even more importantly - on the range of spare parts we would have to keep in stock.

If standardisation of equipment is necessary, so is compatibility between the function of one machine and another. For instance, it is necessary to choose a platemaker that can be used with any of the formats that the printing presses can handle. The same principle applies to collating equipment. If much of the production is to be centre-fold A5 books (i.e. folded A4), it is best to obtain collate/stitch/fold equipment where all the operations are carried out by one machine. To collate on one machine (or by hand) and then fold on another and stitch on a third can be very inefficient when producing long print runs of (say) 10,000 copies or more. Another example concerns lamination. The laminator must be able to handle all the formats that you are likely to use. Yet another is the photographic equipment. If you are going to use hard-dot or half-tone screens it is important that they are within the range of the plate material and the platemaker to handle successfully.

By proceeding in this manner, the Unit slowly acquired a sound basic range of equipment. We made mistakes of course, but fortunately none that could be considered as expensive disasters! Naturally, we have not got all the equipment

we would like, but at the moment we have enough for our needs and are adding to our range as the opportunity arises.

Although the organisation and management of the present Unit is more complex than that of the old Yundum College Resources Centre, the groundwork done at that time has proved capable of smooth expansion. Today the Unit is organised into seven sections - editing, composing, graphics, printing, procurement, finishing and maintenance. Each section has a senior person or supervisor responsible to the Director for its efficiency and smooth running. The personnel within each section must not only be proficient in the work involved, they must also have at least a working knowledge of the processes found in the other sections. Thus the staff in the graphics section are able to type, so if the absence of one of the compositors threatens to slow down an important job a person from graphics can fill the gap. Similarly, if the finishing section is under pressure during an exceptionally long print run or a rush job, personnel from other sections can lend a hand. Other advantages of this multi-functioning are that staff numbers - and therefore wage bills - are kept to a minimum; there is less crowding in our very small premises; and there are very few (if any) staff sitting around with "nothing to do".

The heads of the sections hold regular meetings to discuss production matters, future developments, etc. Full staff meetings are also held to give staff at all levels a chance to voice ideas, register complaints, and generally participate in the running of the Unit.

Overall management is in the hands of the Director. Any person in this position must have at least a working knowledge of all the production tasks, although obviously he can hardly be an expert in each one. It is also his task to use whatever funds he has in the best possible way and to ensure that the procurement of supplies goes smoothly and that the various sections always have the things required to carry out their work. It is also his concern that staff morale remains high and that quality of production is maintained at the highest possible level.

WHAT LESSONS HAVE WE LEARNED?

Among the most important is that in a developing country with very limited amounts of hard currency, a moderate, step-by-step approach pays off. Though outside aid is sure to be necessary, a great deal can be done with existing resources if one is not over-ambitious. Outside aid in terms of capital expenditure on such items as buildings and equipment is not so very difficult to obtain, especially if an obviously successful local effort has been made. It is in the area of recurrent expenditure that difficulties arise and for this reason whatever is established must not be beyond the capability of the country to maintain.

In a developing country there are good reasons why certain operations should be labour intensive. But this is not the case with a publication unit. If educational and training materials are to be produced as a viable alternative to the commercial equivalent, a small, highly trained and efficient staff pays better dividends in the long term than a few skilled supervisors directing a large unskilled or semi-skilled work-force.

Staff must be selected very carefully. It is sometimes assumed that anyone can be trained to do a first-rate job. It is our experience that this is not the case. The people appointed must show interest and some aptitude. This is why it is best to appoint on a trial basis only. If in a year of in-house training they demonstrate the necessary attributes, then higher level, formalised training can be arranged. Staff-building may take time, but it is time well spent.

Books do not write themselves, and without authors even the most skilful production team cannot be effective. Skilled writers must therefore be identified. We have been fortunate so far, but are always conscious of the need to encourage local writers.

The purchase of equipment needs careful thought. It is necessary to assess the needs of the market and to estimate

likely growth and possible future diversification. On this basis a phased programme for procuring equipment and training personnel to operate and maintain it can be drawn up. Maintenance is particularly important. Most of the machines likely to be installed are fairly easy to operate. But this simplicity has often been achieved by using complex technology in its manufacture. Unless it is carefully maintained, it will break down. A well trained, competent technician is therefore one of the most essential persons on the staff. To support him in his job, technical manuals, a good set of tools, and an adequate supply of spares must be available.

When considering the procurement of paper and similar items, it is best to deal either with manufacturers directly or with firms linked with manufacturers and who supply the commercial printing sector. By ordering reasonably large quantities (e.g. around ten metric tonnes) a considerable reduction in price can be obtained. It is also better to order the larger sizes of paper and cut them as required. A quantity of ten metric tonnes may sound a lot (it is about a year's supply for BPMRU), but it is useful to build up a good stock at times when funds are available so that in leaner years there is something in reserve.

Sensitised material such as photographic paper, offset paper plates and similar items, deteriorate more rapidly in a tropical climate than in a temperate one. Unless a permanently air conditioned store is available, it is best to arrange for several deliveries a year. The use of paper plates for the offset printing process is another money-saving approach. They are much cheaper than metal plates and for print runs of up to about 20,000 copies are quite satisfactory. Metal plates are not really necessary unless production is needed in very much larger quantities.

APPENDIX B: CATEGORIES OF PRINTING UNITS

Five categories of small-scale printing units can be identified. In increasing order of complexity they are:

A. Those without electricity, e.g. some schools, agricultural and rural extension offices, and small rural teachers' centres.

B. Those with office skills only, e.g. offices, schools, small teachers' centres, departments in colleges.

C. Those with office and graphic skills, e.g. curriculum development units, teachers' resources centres, large government departments, libraries, tertiary institutions.

D. Those with office, graphic, and printing skills, e.g. small book production units, fully established small printers.

E. Those with office, graphic, printing, accounting and commercial skills, e.g. fully developed offset printing units.

Equipment suitable for each of these categories is listed in the following table.

	A	B	C	D	E
Manual typewriter	*	*	*	*	
Electric Typewriter		*	*	*	*
Rub-down letters			*	*	*
Headliners				*	*
Phototypesetter					*
Wordprocessor					*

	A	B	C	D	E
Lettering guides	*	*	*	*	
Scanner			*	*	
Paper plate				*	*
Darkroom					*
Process camera					*
Metal plate maker					*
Hectograph	*	*			
Spirit duplicator	*	*	*		
Ink duplicator		*	*	*	*
Photocopier			*	*	*
A4 offset				*	*
A3 offset					*
Collator			*	*	*
Long-arm stapler	*	*			
Bench stapler		*	*	*	
Wire stitcher					*
Binder					*
Cardcutter	*	*	*	*	*
Guillotine				*	*

GLOSSARY

Adhesive binding Where single sheets are held together in book form by glue applied to the spine.

Anti-set off spray A device for depositing microscopic grains of powder on each printed sheet as it reaches the delivery pile.

Art work Copy assembled and ready for photographing by a process camera.

Card cutter Small hand-operated cutting machine for cutting small amounts of paper.

Collate To arrange sheets or sections in proper sequence so the pages will be in the correct order for sewing and binding.

Continuous tone Illustrations that are tonal (e.g. photographs).

Cutting mat A specially formulated plastic sheet on which copy can be cut by scalpel. The cut in the mat closes up and the edge of the scalpel lasts longer.

Daisy wheel A typing head for use on electric typewriters and word processors, shaped like a flower head, the letters held on arms like petals.

Dark room A room completely blacked out for the processing of photographic material.

Display type Type used to attract attention, usually 18 point or larger.

Drying rack A rack of shelves on which wet prints can be placed for drying. Usually associated with screen printing.

Film stripping The process of joining different pieces of photographic film together.

Floppy disc A disc that is used on word processors and photosetters to store information before outputting.

Foil blocking Using a metallic foil to stamp designs or lettering on to the cover of a folder or book. The foil is transferred by heat.

Golf ball A replaceable typing head for electric typewriters.

Guillotine A machine for cutting large amounts of paper.

Headliner In photosetting, a trade name for a machine that produces display sizes of type.

Hectograph A very cheap duplicator. It comprises a tray of jelly and various coloured pencils. Will produce a limited number of prints in colour.

Illustration General term for any form of drawing, diagram, halftone, or colour image that serves to enhance a printed work.

Imposition In printing, the arrangement of pages in a form so that they will appear in the correct order when the printed sheet is folded and trimmed. Also the plan for such an arrangement.

Impression cylinder Cylinder in a printing machine that presses the paper against the printing surface so that contact is made and an impression is produced.

Interface An electronic device to enable floppy discs from word processors to be made compatible with photosetters.

Justification Setting lines of type flush left and right by placing more or less space between words.

Light box A glass topped box which contains a light source. Used in the production of artwork or for the stripping and spotting of negatives.

Mechanical tints Pre-printed tints that can be laid down on to artwork.

Negative A reverse photographic image on paper or film. White becomes black and black becomes white.

Opaquing liquid Used for eliminating any portion of a film negative by painting over the unwanted areas.

Paste-up Assembly of all type and design elements on art-board in exact position and containing instructions either in the margin or on an overlay.

Photocomposition The preparation of manuscript for printing by the projection of images of type characters onto photosensitive film or paper.

Platemaker A machine used for the production of litho-graphic printing plates.

Point system Printers measuring system a point is 0.01383 inch. Although developed for hot metal type faces, it is still used on most photosetters.

Process camera A camera specially designed for producing both line and half-tone film for printing.

Processor A machine for developing film or plates for off-set litho. Can consist of two or three tanks containing chemicals through which the material to be developed is passed.

Perfect binding A method of binding in which pages are held together and fixed to the cover by means of a flex-ible adhesive. Widely used for paperbacks.

Red masking tape A self adhesive plastic tape used for joining negatives. The red colour prevents light pen-etrating during exposure.

Repro Also called reproduction proof. Printed on specially coated paper and used in paste-up.

Scanner Photoelectric equipment for scanning copy usually to prepare stencils for mimeographing.

Screen In printing, the finely cross-ruled glass plate placed before the lens of the camera (or a contact screen placed in contact with the film) to break up continuous tone copy into dots for reproduction as half-tone. Screens are designated by the number of ruled lines to the inch, the greater the number of lines, the finer the dot.

Screen fabric Material used to cover the frame for silk-screen printing.

Scumming A defect in offset printing caused by the unwanted sensitizing of a non-image area of the litho plate so that it accepts ink and prints.

Side-lay A device on a printing press that ensures that one side of a sheet of paper is in the correct position before it is fed through the printing cylinders.

Silkscreen printing A printing method in which the image is transferred to the surface to be printed by means of ink squeezed through a fabric or metal screen stretched over a frame. Also called screen process printing.

Spotting out The elimination of white dots on a negative by painting over them.

Squeegee A device used for squeezing ink through the screen in silkscreen printing.

Suction feed A method of feeding single sheets of paper into an automatic printing press.

Type face The letters of the alphabet and all other characters used singly or collectively, to create words etc.

Visual display unit (VDU) A cathode ray tube which gives a visual display of photosetter or computer output.

Wax coater A device for depositing a thin film of wax on the back of work that is to be pasted up.

Wire stitching The inserting of wire staples through the spine or side of a book or pamphlet to bind the pages together.

Word processor A machine that has a typewriter keyboard, a VDU and some means of storage that will enable the typed matter to be retrieved, corrected or changed and then re-outputted.

Many organisations in the developing world would like to produce inexpensive printed materials to support their work but do not know how best to begin. They are looking for answers to the following questions:

What are the most suitable machines to meet our needs?

How much do they cost?

What skills are needed to operate them?

How can we make the most effective use of the equipment and personnel we already have?

This guide will help management staff to answer such questions and make informed decisions on the purchase and utilisation of small-scale printing equipment.

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