

PROGRESS IN LASERGRAVURE

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Abstract: The technical status of a method for producing gravure cylinders by Laser engraving methods is presented. The form of the Lasergravure cylinder is described, together with details of the various process steps between the raw base cylinder and press ready engraved cylinder. Finally a short status report is provided on the first installation of a Lasergravure equipment at Sun Printers Limited., in Watford, England.

Whenever one starts to put together a status report on the process of producing a gravure cylinder using Laser engraving techniques, it becomes quickly obvious that one is talking about a number of processes which are combined to produce the end result of a gravure cylinder, which will provide long print runs on a high speed press and produce good quality printed results. These processes include the conversion of the original text and graphic material into digitised data, its assembly into page form and the subsequent assembly or imposition of those pages to their proper positions on the cylinder. It also includes the chemical pre and post engraving treatments of the cylinder, the application and treatment of the engravable material and the means of rendering the engravable surface dimensionally accurate and non-printing. Last but not least, there is the engraving process itself, with the accurate control of a machine bed and high power carbon dioxide laser.

I would like to start at the heart of the system, and explain just what a laser engraved cylinder looks like.

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At first glance, a plated laser engraved cylinder, looks very much like a normal chrome plated gravure cylinder - but there the similarity stops. Figure 1 shows how the cylinder is built up, using a standard gravure cylinder base, which has been coated with a layer of a specially formulated epoxy resin in the region of 0.008 - 0.007 inches thick. After engraving, the epoxy surface is electrolessly plated building up 0.00025 inches of hard nickel.

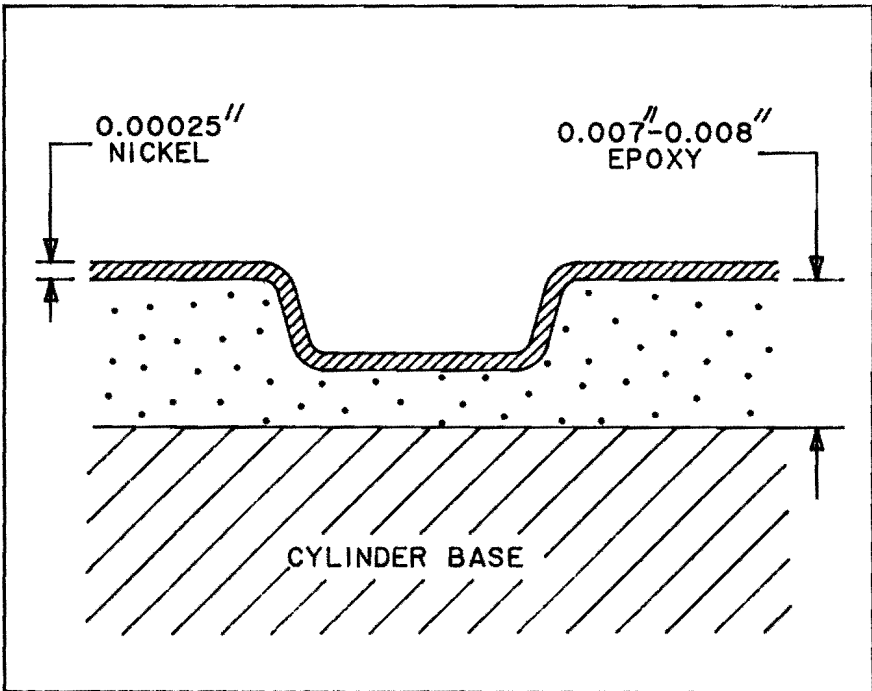


Figure 1. Section through Lasergravure Cylinder.

During the engraving process, a helix of grooves are cut into the surface of the epoxy by the laser. The grooves are spaced at 0.0033 inches apart, centre to centre. The width and depth of the grooves are varied according to the print density required at that point, by varying the laser power in accordance with the image data. Figure 2 shows diagrammatically the groove formation with depth

variations for highlight, mid-tone and shadow tones. The deepest shadows are typically 0.001 inches deep, and the highlight tones 0.00006 inches deep. The ratio of groove to groove wall width varies from 1 : 1 for highlight areas to 6 : 1 for shadows.

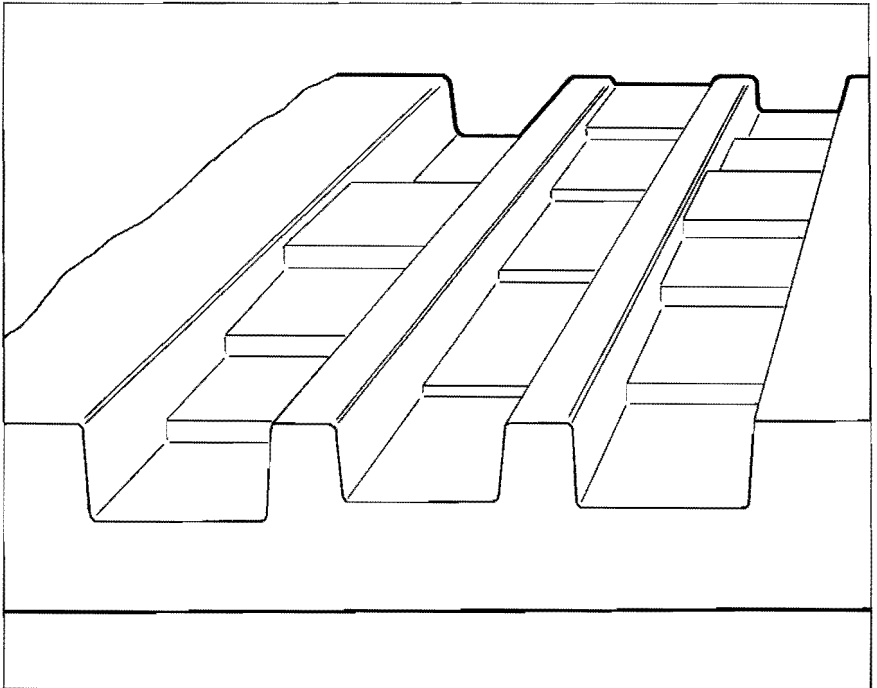


Figure 2. Groove Depth Variation.

After engraving is complete, the cylinder is plated and proofed, before being taken to the production press. At this stage, any necessary correction can be applied. Correction follows the traditional lines of plating copper into the grooves, in order to achieve negative correction and conventional rolling up to protect groove walls and etching the nickel away to provide positive correction.

The final gravure cylinder produced in this way gives outstandingly high quality results both in tonal range and

smoothness. The effective resolution of the system of 300 lines per inch along the face of the cylinder, and 300 picture elements per inch in the circumferential direction provides exceptional detail rendering.

Figure 3 shows diagrammatically the complete process flow and I would like now to take each block in turn, and give some details as to the process at each stage.

1. Turned Copper Base.

All gravure printers have a very large investment in cylinder bases. It was therefore determined at the beginning of the Lasergravure project, that the process would use conventional cylinder bases. A conventional cylinder base is therefore copper plated and turned, so that its diameter is approximately 0.014 inches smaller than the desired printing diameter; thus allowing the application of approximately 0.007 inches of epoxy coating.

2. Copper Pre-treatment.

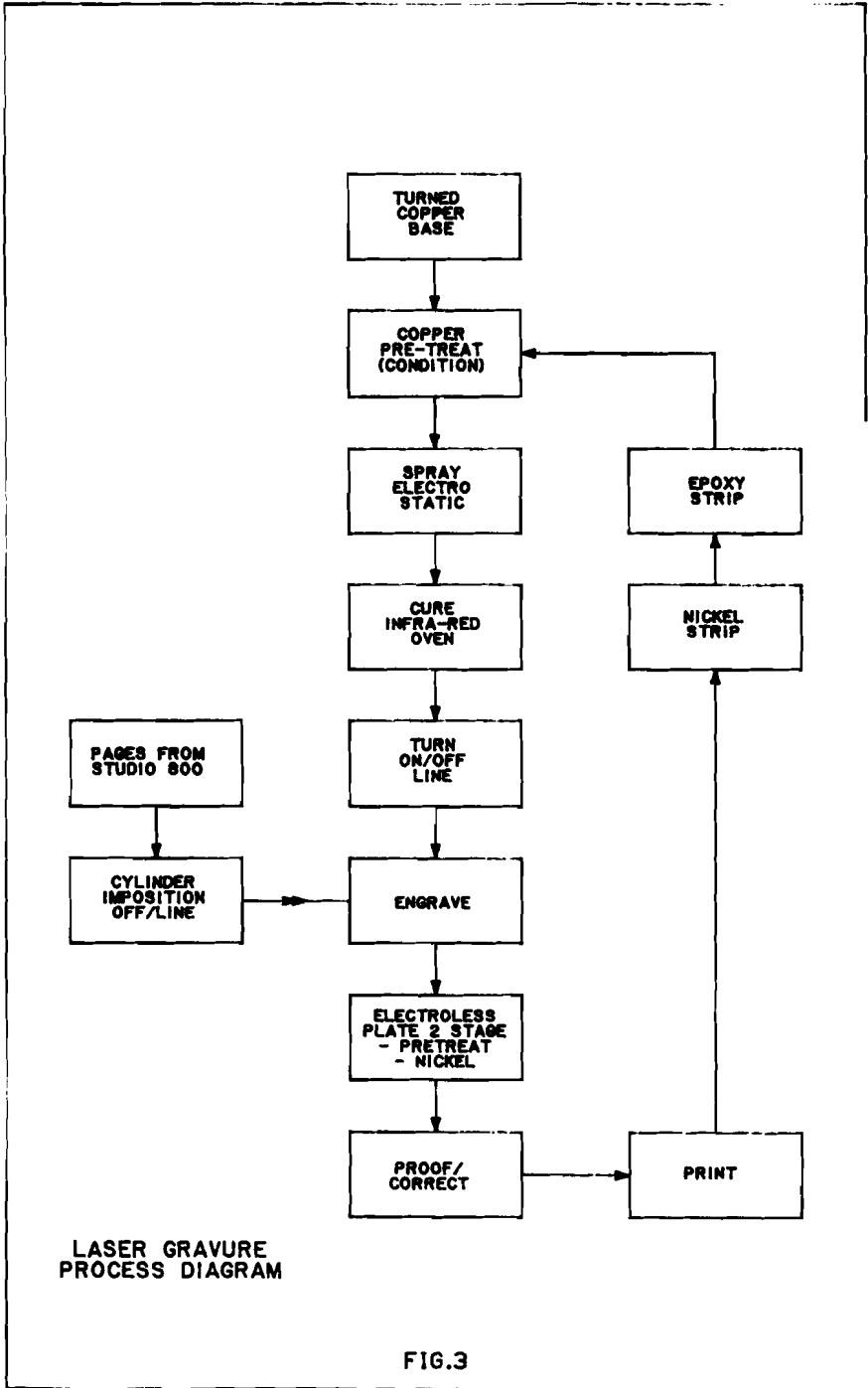
The turned copper base is next transferred to a Pre-treatment Station where it receives a single bath, degrease, de-oxidise and a light surface etch followed by a rinse with de-ionised water and a nitrogen drying cycle. The control of the bath, rinsing and drying cycles, together with the actual movement of the cylinder, in and out of the Bath Station, is fully automated under microprocessor control. This stage provides a completely uncontaminated surface, which will ensure perfect adhesion between the base and the subsequent epoxy coating.

3. Electrostatic Power Application.

The epoxy resin is applied to the cylinder in powder form, by means of electrostatic spraying techniques similar to those developed for paint application. The spray system has however had to be substantially modified to provide coatings which are much thicker than those generally applied in the painting process, and to ensure even and pin hole free coatings. Again as will apply to all stages of the process, the movement of the cylinder and the control of the spray rate and spray traverse rate is made by software.

4. Curing.

The next step is to flow and cure the resin to a hard and durable surface. An Infra-red oven is used for this purpose with a maximum heat output of up to 70 kilowatts. The cylinder is rotated in front of the elements and its surface temperature measured and controlled. The surface



temperature is first taken to around 130 degrees centigrade, at which temperature the curing process is slow, but the epoxy powder is rapidly converted to liquid form and flows evenly over the surface. There is a short dwell period at this temperature, to allow uniform flow and the elimination of any possible air inclusions. The temperature is then raised to 220 degrees centigrade at the surface, at which temperature full cross-linking occurs rapidly and the curing process is completed.

5. Turning.

The coated cylinder is now diamond turned to give a pattern free non-printing surface with a surface finish of 0.1 microns centre line average. The turning can be accomplished on the laser engraving machine itself, using the tool posts provided along side the engraving head, and with this approach, it is theoretically possible to turn and engrave in a single pass of the machine head. It is however more practical to turn the cylinders on an independent diamond turning or polishing machine, so that the cylinders can be checked for dimensional accuracy and surface finish prior to the engraving stage.

It should be noted that up to this stage, all the processes so far described, can be carried out off-line from the main engraving and plating cycle: such that a stock of cylinders can be built up in advance of engraving which are fully prepared and ready to be mounted in the engraving machine.

6. Data Preparation.

I should now like to digress for a moment and talk briefly about the preparation of the text and graphic data, which will be engraved on the cylinder. The scanning, page assembly and imposition of graphic material is a subject which could fill many TAGA Papers in its own right, and I will therefore contain my remarks in this Paper to a very brief overview of the system used by Crosfield. The video data which is used to control the laser power and hence the track, width and depth is read on-line from a 300 megabyte disc pack which is connected to the engraving machine controller. Therefore, all data to be engraved must be pre-digitised, page made up and properly positioned. The main digitising unit is the Crosfield Magnascan 640 1 scanner, which can scan, digitise and store on disc, original colour transparencies or reflection copy, continuous tone originals or page made up separations and text and line art. The scanning resolution for all types

of material is 300 x 300 elements/inch.

If the material which is scanned is already in the form of page made up separations or mono images, then disc packs containing this data can be transferred directly to the imposition stage. Alternatively, scanned originals can be made up into pages electronically, using the full range of the facilities provided by the Crosfield Studio 800 series of electronic page make and retouching systems. These systems provide full facilities for cropping, sizing, rotating, adding borders, tint blocks, generating drop-out marks and carrying out a wide range of both local and global electronic retouching. Pages prepared electronically in this way, are in the same digital format as any pages which were originally scanned as fully page made up material, and again, pass onto the imposition system.

The imposition system consists of two stages. In the first stage the Operator enters into the system all of the data required to define a particular job, for example, cylinder diameters, numbers of ribbons, numbers of montages, the lay of the page, position of register marks, tone wedges etc., etc.,. This data is stored on floppy disc and may be re-used or modified slightly for similar jobs. Individual digitised pages from the Studio 800 or direct from the scanner are introduced into the system and an output disc is recorded with all the pages for a particular colour imposed into their correct positions ready for engraving. Register marks, tone wedges etc., are generated electronically. The disc pack prepared in this way is then transported to the engraving machine and engraving can commence.

Text may be introduced into the system by scanning the film or R.C. paper output from a typesetter. However, Crosfield have recently announced a co-operation with Information International Incorporated which will allow text to be keyed directly into the system through a TECS 3300 system from lll and using the Studio 800 system, page composed and output to disc, ready for imposition, directly from stored digital fonts with no intermediate film required.

7. Engraving.

The engraving machine consists of a precision machine bed hydro-static bearings in the head and tail stock and means of rotating the gravure cylinder at 1000 revolutions per minute. At one end of the machine is mounted a high power carbon dioxide laser, whose power output can be continuously modulated between 0 and 140 watts. The laser is stationary

and its beam is projected along the bed of the machine to a travelling saddle where it is focussed down onto the surface of the material. The carriage travel is accurately controlled by a precision servo and lead screw mechanism, and its traverse rate is such that, 300 grooves per inch are cut into the surface. This means that a 100 inch face length cylinder will be fully engraved in 33 minutes; again the whole engraving process is under computer control.

8. Electroless Nickel Plating.

In order to provide a durable surface for long run printing, it is necessary to apply 0.00025 inch thick layer of hard nickel plate. Obviously, standard electro plating techniques cannot be used to plate down to a plastic surface, and therefore, an electroless method is used. This is a two bath process with the cylinder being transferred automatically between the baths. The first bath is a pre-treatment stage, in which the cylinder is subjected sequentially to solutions which prepare the surface to receive the electroless nickel. These solutions consist of an etch, neutralise, pre-activator, activator and accelerator stages with intermediate rinses. Although this may sound a complex operation, I must stress again, that the equipment is fully automated so that as far as the Operator is concerned, the cylinder is merely brought to the Plating Station and the automatic systems then take over and control the application of the various solutions; the immersion times and temperatures and the automatic transfer of the cylinder to the final nickel plating bath.

The nickel plating is a single solution treatment. The thickness of plating deposited being dependent upon the time of immersion and the temperature of the bath. Once nickel plating is complete, the cylinder is ready for proofing.

9. Proofing.

The cylinder may be proofed by any of the conventional proofing methods. During the research phase of the project Crosfield has used a single revolution Timmins Proofpress and a Palatia sheet fed gravure press in order to assess printing quality.

10. Printing.

The cylinders may be printed on any standard gravure press, and no modifications are required to the press or doctoring system; again in order to assess printing quality and run length during the research phase, Crosfield purchased a single unit Halley Press and have carried out wear trials with paper and ink running up to 1,000,000 impressions.

11. Nickel and Epoxy Stripping.

After the print run, the nickel and epoxy coating may be stripped off, using the same conditioning plant that was used to pre-condition the copper before spraying using two different solutions; one to remove the nickel and another to subsequently remove the epoxy. At this stage the cylinder is back to copper base, ready for re-cycling through the system.

PROGRESS OF THE FIRST INSTALLATION OF
LASERGRAVURE AT SUN PRINTERS LTD.,
WATFORD, ENGLAND.

Around the middle of 1981, Crosfield Electronics Limited concluded the first order for a Lasergravure system to be installed at a production site. The order was placed by Sun Printers Limited, a Member of the British Printing Corporation Group, and who print many high circulation magazines and supplements in the United Kingdom, such as T.V. Times, Sunday Times colour supplement, Weekend and Woman's Own.

Following the order, there was a detailed site planning stage, and work started on an impressive facility to house the new system in October of 1981. This work completed, Crosfield Electronics started delivering equipment; starting the installation on the Sun site, at the end of February, 1982 and at the time of writing, the following pieces of equipment have been delivered and commissioned.

Pre-conditioning Plant
Spray Booth
Infra-red Oven
Engraving Machine
A Magnascan 550 based Scanning Station
Imposition System.

Major portions of the Plating Plant, the last remaining major item, have been delivered and installation is well underway.

During the run-up stage, pages are being provided in the form of montaged continuous tone separations with additional drop-out mask and text films, and these are scanned to disc using a Magnascan 550, and then imposed to the final cylinder format using the production planning and cylinder imposition system.

One week before the TAGA Annual Technical Conference, we were able to engrave the first cylinder on the engraving machine installed at Sun Printers, and proofs of this cylinder will be shown to TAGA Members at the Annual Technical Conference.

Over the next few weeks, the installation and commissioning of all the equipment will be completed which will enable thorough evaluation of the performance of cylinders produced by the Lasergravure process on the high speed (40,000 revolutions per hour) presses, which are being operated at Sun.