HALFTONE GRAVURE UPDATE

Wilfred B. Marsh*

Abstract: The rapidity of the switch to halftone input by American gravure printers is unprecedented in the annals of that industry. One of the advantages of the new system is that it allows close correlation between pre-press proof and press sheet, so corrections can be made before engraving the cylinders. A method of calibrating gravure cylinder engraving machines to provide these advantages is included in this paper, as well as a short update on the state of halftone gravure.

Throughout the history of gravure printing, experimenters pursued the possibility of using halftone, instead of continuous tone, films for making gravure cylinders. These early pioneers of halftone gravure saw the advantage of using the same kind of screened images for all printing processes, but their task was a difficult one. The critical nature of the materials and processes used for etching cylinders, and the problem of eliminating moire patterns when rescreening the original halftones were only two of the obstacles they had to overcome. The first of these methods to achieve some measure of commercial as well as technical success was Frank Sportelli's CONVERLOG® system which was used for advertising pages in gravure printed magazines in the early 1950s. But for the most part, the gravure printing process traditionally required continuous tone or special lateral dot positives for etching images on cylinders, and more recently, continuous tone films for electronic engraving. In the past two to three years this requirement has changed, and a majority of North American magazine, catalog, and supplement printers have converted to halftone images as input for their cylinder making operation. This changeover was made possible by the widespread use of electronic cylinder engraving machines, and by the advances in the optics and electronics in these machines which made halftone input practical. It was spurred on by the promise of several possible advantages over continuous tone input, which did in fact materialize. Keep in mind that with electronic engraving, the cell configuration on the cylinder is the same whether halftone or continuous tone input is used. This is not true of etched cylinders, where the need for rescreening the original halftone films produces unique cell shapes in some areas of the printing cylinder. Some of the advantages realized by the switch to halftone input for electronic engraving include relatively easier preparatory operations when compared with continuous tone, the possibility of making accurate and predictable pre-press proofs from original halftone films (pre-press proofs from continuous tone positives required that intermediate screen positives be made), and an unexpected bonus has been the

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* E. I. Du Pont de Nemours & Co., Inc., Retired

impression of increased sharpness on the printed page. Also, in many cases it is possible to use generic or universal halftone color separations (made to offset specifications, but used in gravure) but there are still some limitations to this approach.

Halftone gravure got its start in Europe but printers in the United States started testing the new method shortly after it's introduction in Germany, and made quick progress. Most American magazine and catalog printers have been using halftone input for over a year, and the Sunday supplement printers switched over as a group in February of this year. Some packaging and specialty gravure printers with electronic engraving machines have already made the switch, and others are following closely in their wake.

In order to expedite the use of universal films, in mid 1985 the Gravure Technical Association approved a new set of publication inks, designated Group VI, with hues close to SWOP colors, which makes the color correction built into offset separations more accurate for gravure. Separations made for printing with GTA Group I and in many cases Group V inks require different color correction. One of the last hurdles to be surmounted is highlight dot size. With some subject matter, a very light sky defining the edge of a picture for instance, the small two and three percent dots on offset separation films may not print in gravure. For this reason, GTA specifications define a three percent dot as being fade off, with a five percent dot needed for the first squared off printing tone.

CALIBRATING CYLINDER ENGRAVING MACHINES FOR HALFTONE GRAVURE

The latest digitally controlled cylinder engraving machines are very sophisticated devices. It is possible to adjust the reproduction curve of these machines for the paper, inks, and press being used. They provide one more controllable step, between the final set of films and the printing surface, that does not exist in offset printing. In offset, the image on the printing plate is, to a large measure, controlled by the films that are used to make them. Engraving machines are capable of making drastic changes in the way the films reproduce on the printed sheet. Certainly, flexibility like this must not be misused, but in a controlled situation it offers several advantages.

When American printers started testing halftone gravure, it wasn't long before it become apparent that the engraving gradations used with continuous tone input were not entirely satisfactory for halftone. There are also other factors involved, Alfredo Fiorelli (TAGA Proceedings, 1985) reports that 'offset preproofing systems are more than adequate for gravure application', but points out that in order to get close similarity between pre-press proof and printed result 'The engraving gradation curve on Helioklischograf has been modified taking into account parameters derived from previous printed results.' With this in mind it is sensible, even if several different engraving gradient curves may provide adequate printed results (especially when the color separations are produced to accomodate the curve being used), that an operating curve be selected that provides a close similarity between the pre-press proof and press result. It is possible to adjust the system so that good printed results are achieved from films that do not make good pre-press proofs, but by correlating the two together,and achieving close similarity, the gravure industry has a new and useful tool that had not been possible before, because most pre-press proofing methods are halftone systems and until now, gravure has been continuous tone.

There are several ways to analyse press results and change the engraving gradient curve, either to correlate to an pre-press proof, or for some other reason. The empirical approach is always popular, and it works, but at times it can be slow because it is not always possible to find the required densities in all of the colors on the press job being analyzed, so an accumulation of data over a period of time is required. Also, when making the corrections, a certain amount of judgement and intuition are needed. Another popular approach is the four quadrant graph, or Jones curve. With the proper target it also works well, but has the disadvantage of being complicated, and in some cases, uses information that is not pertinent to the problem at hand. Du Pont Printing Systems has developed a method for calibrating electronic cylinder engraving machines that has some advantages over the methods mentioned above, and it is described below.

DU PONT HALFTONE GRAVURE CALIBRATION SYSTEM

In the Du Pont Halftone Gravure Calibration System, a set of four special target films is used. The films contain screened step wedges for each of the individual colors, and several two and three color overprints (Fig. 1). The single color wedges are used for the engraving machine calibration. A negative or positive print is made from each of these films on a high contrast print film which has a white, opaque, size-holding, base, like Du Pont CDH-7 or CNH-7. It is best that these 'bromides' be made in the same conditions that subsequent 'live' work will be produced, so that any anomalies will be factored out in the calibration.

The screened 'bromides' are mounted on the scanning drum of the cylinder engraving machine, and the input value for each of the steps of the individual color step wedges is noted. For increased accuracy it is best that each step be read several times, and that an averaged value be used. Because these input values are critical, it may also be necessary to use curve smoothing techniques later in the calibration. The input values required are identified as DIGITAL INPUT NUMBERS on the Helio Klischograph, and as INPUT VOLTAGE on the Ohio Electronic Engraver. The targets are then engraved under standard conditions, and the engraving gradient curves recorded. The gradient curves are resident in the engraving machine and can be in the form of a graph, or sets of corresponding INPUT VOLTAGE-OUTPUT VOLTAGE or DIGITAL INPUT-DIGITAL OUTPUT NUMBERS which define the curves. In the latter case, it is not necessary that the input values be those produced by the various steps of the calibration target, but they can be if convenient.

The cylinders should now be printed, also under standard conditions. It goes without saying that standardizing all steps of the process is very important, so that any subtle changes recommended by this calibration are not lost in system variability.

At this point a Cromalin® pre-press proof is made, matching the highlight and shadow densities on the Cromalin® proof to the press sheet. The middle tones are not important now, it is the purpose of this calibration to bring them into line. There is another factor that must be taken into consideration here. When using a reflection densitometer to read the shadow densities of the press sheets and Cromalin® proofs, the readings can be affected by the surface gloss of the sample. With many of the smoother surfaced papers (and other substrates) used in gravure printing, this influence may be safely ignored, because Cromalin® has a glossy surface. But with rougher newsprint type papers, a slightly different procedure is used. The press sheet on newsprint paper is placed on a piece of Kromekote® stock, laminated with a layer of Cromalin® film and hardened by exposure to ultra-violet energy. The glossy surface on both samples now makes the solid density readings more compatible. It must be emphasized that the lamination of the press sheet is for the purpose of this calibration only, and is not to be included in standard pre-proofing procedure.

ENGRAVING CURVE ANALYSIS

The next step is to read and record the densities of each step of the yellow, magenta, cyan, and black single color wedges on both the press sheet and Cromalin® proof. Zero the densitometer on the unprinted paper or proofstock backgrounds before taking these readings. This is all the information that is needed to perform the operations described below.

The engraving gradient analysis can be performed in two ways. A computer program can be used to perform the mathematical transformations involved and to present the data and results in organized fashion, or a graphical method of solution can be used. I will describe the graphical method below because it illustrates the principles clearly.

Two separate graphs are required for each ink color. In the first, densities of the press sheet and Cromalin® proof, on the 'y' axis, are plotted against engraving machine input values, on the 'x' axis, resulting in two separate curves on the same graph (Fig. 2). The second graph is the gradient curve used when the test cylinders were engraved. In this one, the output values, on the 'y' axis, are plotted against the input values, on the 'x' axis (Fig. 3). The input value scale on both graphs must be the same. These graphs are now used to derive the engraving curve needed to get close similarity between pre-press proof and printed result.

One typical way of doing this is as follows. On a drawing board, place the Press Sheet-Cromalin® Proof Graph above the Engraving Curve so that the edges line up and all lines are parallel. Tape them into this position. A series of rectangles will be drawn that results in a set of data points defining the new engraving curve. On the top graph, draw a horizontal line (somewhere in the middle of the curves) between the 'Press Sheet' and the 'Cromalin® Proof' curves. Now draw a vertical line from the intersection of the horizontal line with the 'Press Sheet' curve on the top graph, down into the lower graph. Draw another vertical line down from the intersection of the horizontal line and the 'Cromalin® Proof' curve. On the bottom graph draw a horizontal line from the point where the 'Press Sheet' vertical line meets the engraving curve, over to the 'Cromalin®' vertical line. Where these lines cross we have one data point for the new engraving curve. This procedure should be repeated at least nine more times, evenly spaced across the 'x' axis to derive the new curve. This wordy but simple procedure is illustrated in Fig. 4. Output values can be picked off the new engraving curve to match any input values required to reprogram the engraving machine for the new reproduction curve (Fig. 5).

Now the target bromides should be engraved again, using the new engraving curves, to confirm results (Fig. 6). This confirming test can be used for fine tuning the curves if necessary. This method has been used successfully for calibrating several gravure cylinder engraving machines.

Literature Cited:
Fiorelli, Alfredo
1985 "Validity and Limits of Color Preproofing In Conversion Gravure" 1985 TAGA Proceedings

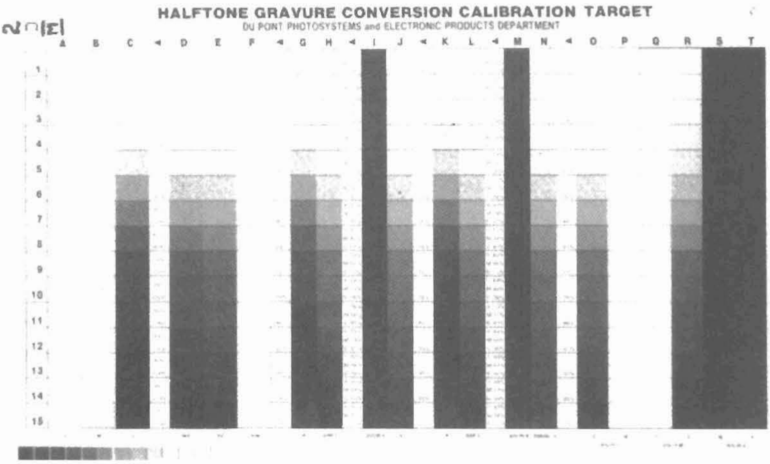


Figure 1 DU PONT HALFTONE GRAVURE CALIBRATION TARGET

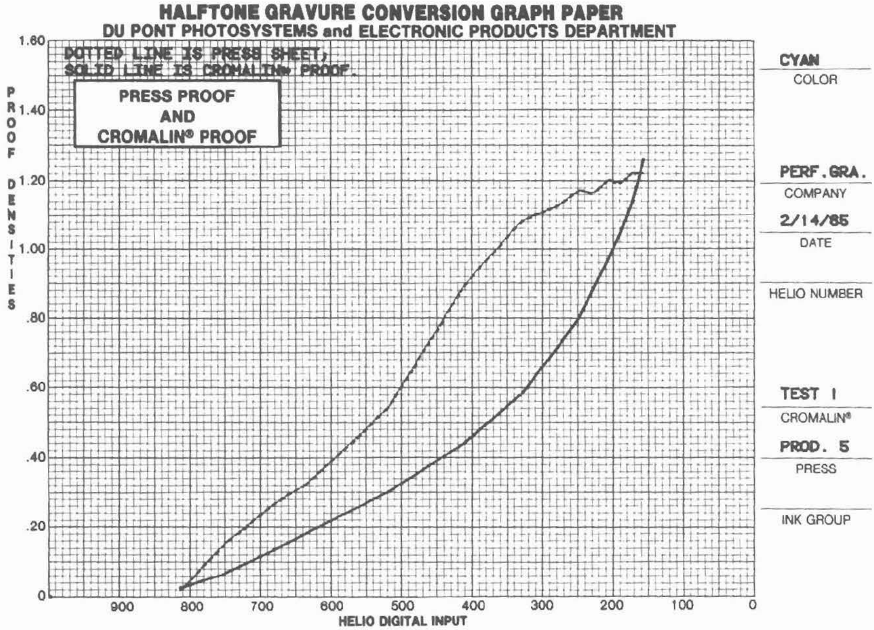
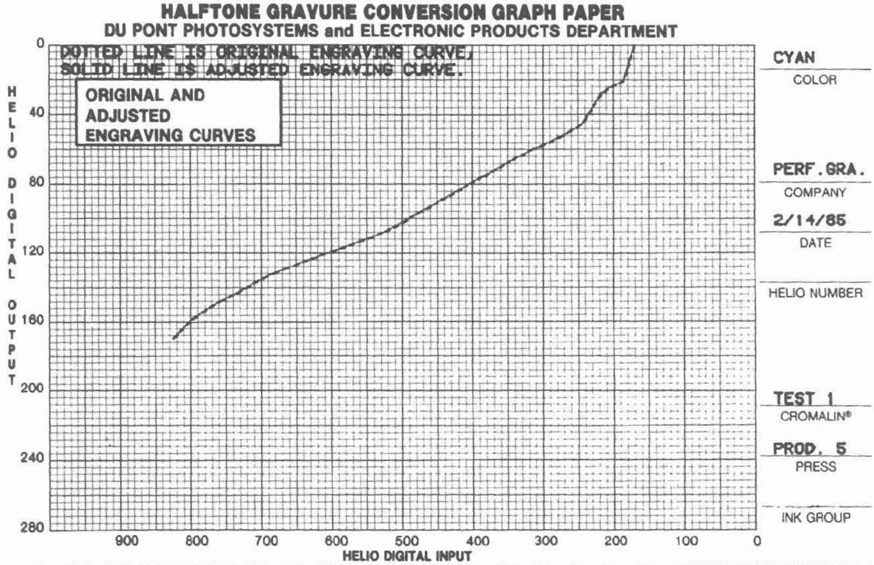
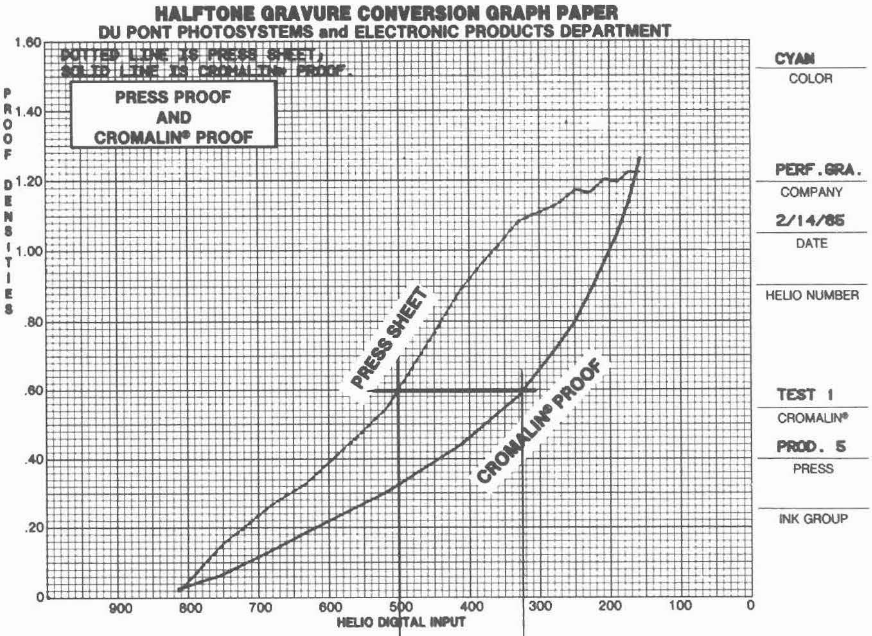


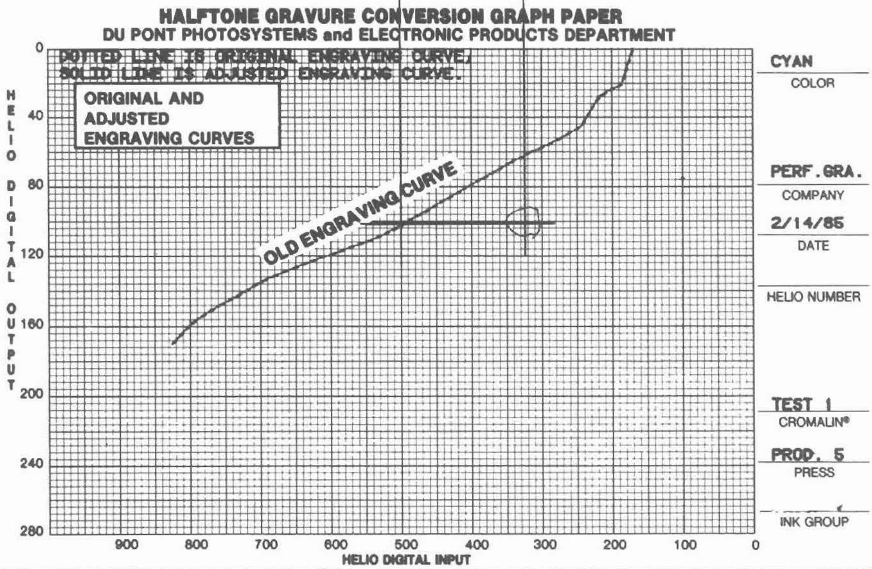
Figure 2 PRESS PROOF & CROMALIN® PROOF CURVES



DIGITAL INPUT		820	792	760	668	640	524	416	336	280	256	236	212	196	180	164
ADJUSTED OUTPUT																
ORIGINAL OUTPUT		170	158	150	134	126	109	84	68	55	50	45	28	24	21	0

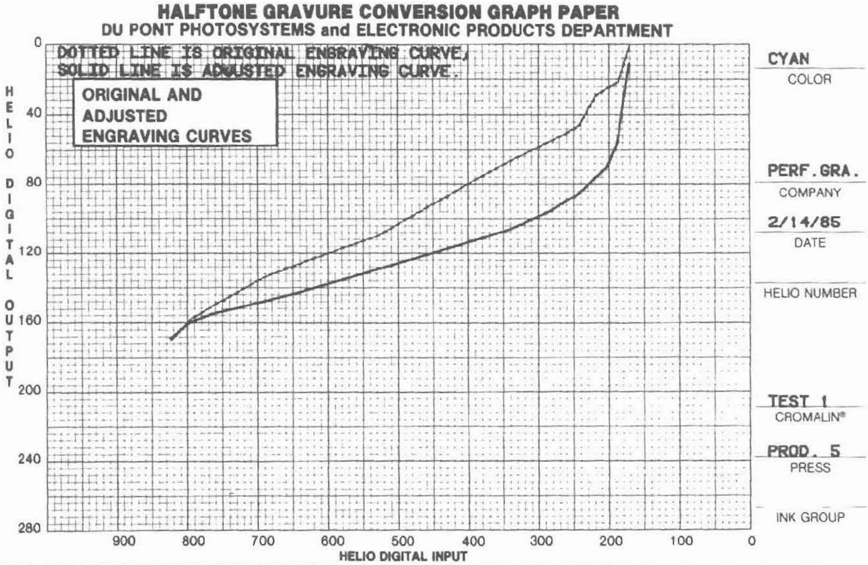
Figure 3 ORIGINAL ENGRAVING CURVE





DIGITAL INPUT		820	792	760	688	640	524	416	336	280	256	236	212	196	180	164
ADJUSTED OUTPUT																
ORIGINAL OUTPUT		170	158	150	134	126	109	84	68	55	50	45	28	24	21	0

Figure 4 METHOD OF DERIVING NEW ENGRAVING CURVES



DIGITAL INPUT	820	792	760	688	640	524	416	336	280	256	236	212	196	180	164
ADJUSTED OUTPUT	168	159	154	147	142	128	115	105	95	89	84	75	69	54	10
ORIGINAL OUTPUT	170	158	150	134	126	109	84	66	55	50	45	28	24	21	0

Figure 5 ORIGINAL AND ADJUSTED ENGRAVING CURVES

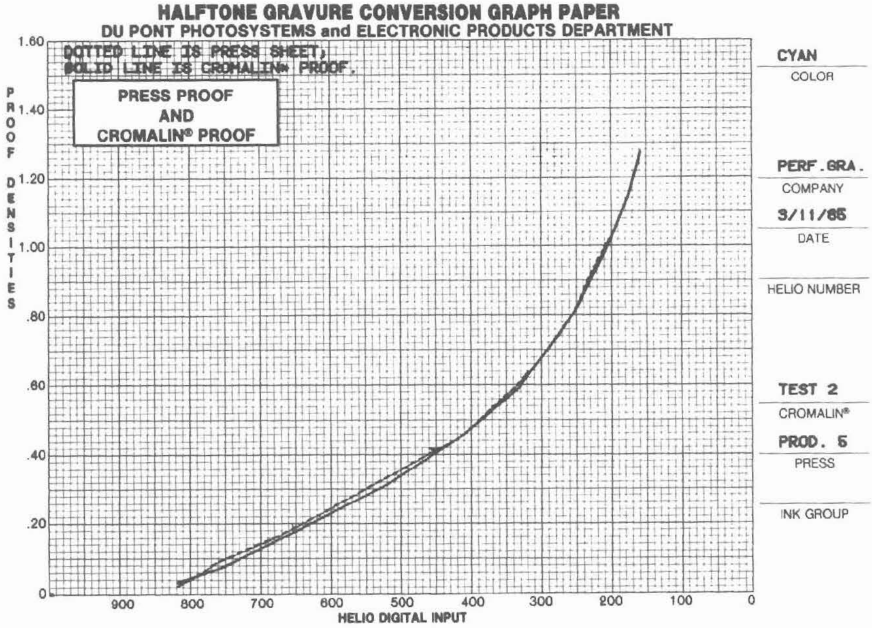


Figure 6 RESULTS WITH NEW ENGRAVING CURVE