The Precision Imaging of Offset Plates.

L.E.Lawson, Howson-Algraphy.

Precision halftoning - some new thoughts.

Most of you know that various European trade associations are currently running projects concerned with the standardisation of printed colour reproduction. Parts of the following provided the basis of my recent appreciation of positive platemaking to the appropriate PIRA body.

Since the demise of deep-etch, presensitised surface platemaking has appeared so simple and idiot proof, that nearly everyone believes that nothing can go wrong. Unfortunately, due to the persistent drift towards precision and standardisation as well as finer screens this is not true - especially with today's labour force. Field experience suggests that some re-thinking is required.

To proceed to one of the main aspects of this report, there is the obvious and vital matter of plate exposure. The time honoured continuous tone guide has been augmented in Europe, by fine line plate control scales - often known as micro-line scales. They come in various forms; they are all similar and one pays one's money and takes one's choice. The important point is that they need to be understood and used objectively - as will be seen.

Micro-line scales are proving to be particularly relevant in respect of all types of positive working plates, and the trend towards their adoption with negative working plates is also imminent. Incidentally, in keeping with European practice when producing high quality process colour - I have assumed that positive working surface plates are the order of the day.

Early work showed that to obtain precise and meaningful results, over the whole of the surface of a large plate, necessitates all the process variables of the platemaking operation being accurately controlled.(More accurately than often occurs). As well as confirming that extraneous actinic room illumination (i.e. fog light) can influence the accuracy of halftone imaging, the work showed that the choice and condition of the plate developer is important.

In keeping with the comments by UGRA(the Swiss research people) to the effect that when positive plates are used image loss/sharpening must occur, there are currently at least two different schools of thought as to the criteria employed when micro-line control scales are used. These are attributed to Felix Brunner, the German FOGRA Research Association, and also to UGRA.

The Brunner school is particularly precise and it is suitably press (press room) orientated. It specifies a 2 micron image latitude. Saying that lines 8 micron wide should not be reproduced on the metal and that lines 9, 10, and 11 micron wide can be imaged on the metal, whilst lines of 11 micron width and above must be rendered. This is the same as saying that the geometric image tolerance should be $\pm$ 1 micron, and that the aim point for the plate operator is the imaging of 10 micron width lines. Halftone plate imaging is apparently a significantly higher precision business than some of us have been aware of.

FOGRA are less specific and less press orientated. They indicate that a 4 micron geometric tolerance (over and above their concept of the prevailing fine line plate 'resolution') is adequate. Given that the Fogra plate 'resolution' varies from one brand of plate to another this recommendation looks (when viewed from the graphic reproduction standpoint) to be insufficiently specific or precise. Although, given that the basic fine line 'resolution' is usually the ability to image 6 micron width lines the recommendation means that lines that are up to 10 microns wide can be reproduced. This equates with geometric image tolerance of $\pm$ 2 microns and an aim point of 8 micron lines.

The differences between the two concepts appear to have arisen because they have different main objectives in mind; that of Brunner being controlled dot sharpening to counteract press gain alias dot gain or dot growth, and that of FOGRA being the minimisation of film edge and dust spot reproduction when working from positives.

Our work has shown that the specification of a plate 'resolution' of 6 micron width lines can be readily met by a large proportion of plates on the market, and it follows from the users standpoint that the micro-line criteria permitted by both parties are not difficult to achieve. During the work it became obvious that unduly narrow plate specifications are best avoided - due to the inherent variables in the platemaking operations. For those who may not be aware of these platemaking variables they include:

(1) the normal batch variations in photo characteristics of the plate.
(2) the typical variations in intensity of useful frame illumination
    (a) over the area of large plates and
    (b) from plate to plate
(3) the inevitable variations caused by human and equipment discrepencies when choosing the duration of exposure.
(4) the variations due to local minute to minute and hour to hour differences in plate processing.

It is widely appreciated that a batch variation in unused photo sensitive plates of up to '1 step' when assessed with the customary (0.15 density increment) continuous tone scale is normal and that this is equivalent to saying that a plate's exposure requirements are likely to vary by approximately $\pm$ 15%. Thus with a lamp controller set to give a constant (nominally correct) exposure equivalent to a duration of say 60 seconds, any given plate of any particular brand is very likely to be mis-exposed from from the outset by the equivalent of 9 or 10 seconds. Moreover, additional errors will be introduced by the inevitable uneven illumination over the frame particularly when exposing large flats, montages or formes, as well as due to the variations in plate processing as well as exposure.

The discrepencies due to plate processing often pass unnoticed and their magnitudes are difficult to assess,but they exist. The discrepencies in exposure due to inadequately uniform illumination by the exposing equipment which are likely to cause as great as a 2 to 1 ratio in actinic intensity, have been estimated by our Service department as occurring in approximately one third or more of plate imaging installations; and additional exposure discrepencies due to deficiencies in the repeatability of the electrical control (of the order of 10%)are known to be a characteristic of many modern (integrated) installations.

Tests in a typical metal halide exposing installation have shown that for the micro-line imaging of a typical positive plate (Spartan) to comply with the Brunner requirement, the exposure needs to be kept within 25 to 40 seconds. It follows that faulty exposing equipment (e.g. many flip top frames) would automatically yield a wider exposure spread than this - equivalent from 22-1/2 to approximately 45 seconds. Thus with such equipment the chosen/given exposure would have to be exactly correct. There would be no room at all to accommodate the slightest batch variation in the plate, whilst the repeatability of the exposing system and of the plate processing would have to be unrealistically perfect. With a realistic total of discrepencies the dubious exposing equipment would inevitably cause the tight European specification to be exceeded somewhere over the surface of a large plate.

Other tests with the same brand of plate in the same modern installation have shown that to comply with the FOGRA criteria, the exposure would need to be kept within 20 to 50 seconds. This wider range would obviously be nearly encompassed by the exposure characteristics of the typical inadequate equipment and little scope would remain to accommodate the equivalent of only a few seconds total variation in exposure, due to the other variable discrepencies.

Neither of the recommendations can be said to be 'practical' in what might be described as somewhat earthy workshops especially if the specifications are to be satisfied over the whole area of large formats and plates.

Before agreeing or adopting a plate imaging specification it is relevant to note that achieving the middle of the Brunner recommendation can be expected to result in a 50 percent ideal '150 screened' dot tone being geometrically imaged at 43 percent. This and the following companion figures were obtained by employing the 'edge zone / dot diameter' theory referred to by J.A.S. Viggiano of RIT last year, there being adequate published evidence that this theory is suitable for control and comparative purposes. Achieving the middle of the FOGRA suggestion can be expected to create a corresponding dot image with a different area of 44.5 percent. When suitably tabulated and rounded, this and companion comparative data are as shown in Table 1.

Percent dot area of positive	Imaged to 10um target ± 1um tolerance on plate	Imaged to 8um target ± 2um tolerance on plate
3%	1.5% ± 0.1%	2% ± 0.2%
5%	3% ± 0.2%	3.5% ± 0.4%
10%	7% ± 0.3%	7.5% ± 0.6%
20%	16% ± 0.5%	17% ± 1.0%
50%	43% ± 1.0%	44.5% ± 2.0%

Table 1. Dot areas of plate image.

Complying with the 8 micron target obviously achieves the more accurate of the two reproductions of the positive, even though these differences are difficult to measure (with reliability).

It follows that for low 'press gain' situations, e.g. plates on well set single unit presses or 'last units' of multi-colour presses when satisfactorily handling good inks on smooth stocks, the 8 micron target criteria must be preferable to the 10 micron specification. It also follows that for high 'press gain' situations (e.g. 4 colour wet-on-wet halftone printing) that the 10 micron aim point is the best of the two.

More dot sharpening - as achieved by just imaging the 12 micron wide positive lines (as sometimes requested by customers) would inevitably result in undue loss of highlight dots (we all know that dots less than 2 percent are notoriously difficult to hold).

Less dot sharpening - as achieved by retaining the 6 micron wide lines, would result in what some would regard as unnecessary retention of film edges and dust spots. Although this would without doubt produce the most accurate reproduction of the positive. Compare Table 2 with Table 1.

Percentage dot area of positive	Imaged to 6um target ± 1um tolerance on plate
3%	2% ± 0.1%
5%	4% ± 0.2%
10%	8.5% ± 0.3%
20%	18% ± 0.5%
50%	46% ± 1.0%

Table 2. Dot areas of plate image.

Attaining the 6 micron target and the narrow degree of image tolerance requires precision platemaking, especially if this level of quality is required to occur over the whole area of large formats or plates.

The use of micro-line control scales and the plate imaging specification can therefore, either be general or precise to allow plate imaging to conform to one or more of the foregoing possibilities. If people prefer (say) the FOGRA concept 8 ± 2 micron (and make their positives accordingly) who is to say they are wrong? Almost any standard is better than no standard at all, provided the permitted image tolerance is acceptable and attainable over the whole of the work area of the job.

Processing

At the onset I referred to the process variables that influence plate image quality and accuracy.

For numerous years H-A have arranged their auto-processors to keep the temperature of the developing bath within plus and minus 2 degrees centigrade and in 1980 we reported to TAGA that the 'strength' or chemical activity of the developer also needs to be controlled within close limits if reliable and consistent precise imaging of halftones and microlines is to be obtained. The problem was - how best to do this? - particularly when the matter of replenishment or regeneration or topping up of the developing bath was necessary. As we all know no two image areas of various component colours and job configurations are the same area-wise, and most platemakers appreciate that the extent of replenishment depends on the precise area of exposed positive coating developed away from each of the preceeding plates.

We found that one answer is to ensure that the activity of the developing bath (in relation to fully exposed plates) is always the same and to that end we have come up with our Posidev Monitor.

The Posidev Monitor is an inexpensive meter which indicates the 'strength' of the developing bath, via a purpose designed and automatic temperature compensating circuit - on an easily readable and easily understood dial. It enables the operator to check and adjust the strength of the developing bath, before committing the plate.

The device is not a pH meter - for several reasons. One being that although the pH of positive plate developer is virtually 12, being highly caustic, it does not change sufficiently during use and pH is not the only factor that controls the degree of development. Another reason for not employing the pH parameter is that it is difficult for non laboratory trained staff to measure pH sufficiently precicisely in practical platemaking circumstances.

Although the device is a specially compensated and ruggedised conductivity meter, arranged to suitably respond and to record full strength positive (alkaline) plate developer at 100 percent activity, the use of electrical terminology is unnecessary.

When a bath or tank of positive plate developer is insufficiently replenished, the Posidev Monitor shows this by reading low - say 90 percent or even 80 percent. When a bath is over replenished for example by haphazard 'topping up' - the meter reads high e.g. 105 percent.Over active developer always results in loss of press performance as well as in undue dot sharpening and tone loss - making nonsense of the carefully determined colour correcting procedures, scanner settings, plate exposures. Insufficiently active developer does the converse - unless adequately compensated - giving faulty reproduction of the original and of the control scales, as well as erratic and spasmodic imaging of film edges and spots due to dust or dirt.

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Footnote. The 1980 contribution referred to 'macroline scales' - since then by common usage they have become known as micro-lines.

ABSTRACT

The European trend towards standardisation of colour printing accompanied by increased precision in the repro, platemaking and press rooms, as well as Howson-Algraphy's research and field experience, have prompted the following.

After pointing out the prevalence of unsuitably illuminated plate departments the matters of precision plate exposure scales and precision plate exposures are dealt with. Particular attention is given to these items in relation to positive working (surface) plates.

The second part is concerned with a new and novel means of monitoring and controlling the chemical activity of the plate developers. It introduces a Posidev Monitor, which avoids wastage of plates and chemicals whilst maximising the precision with which high quality halftone positives can be consistently imaged on metal.