Contrast

The dot gain measuring value is one of the most important variables for quality control and standardization in printing. Printing without dot gain is not possible, both for technical reasons and due to the effect of light entrapment (optical gain).

N.B.! The dot gain Z (%) measuring value indicates the difference between the halftone value on film F_F and the halftone value in print F_D.
It is not a percentage of the film value.

Example: $F_F = 40\%$
$F_D = 55\%$

$Z\ (\%) = 15\%$

The dot gain is of varying extent in the different halftone value ranges. For this reason, figures on dot gain should also include the halftone value in the film where the measurement was made.

Example: 15% dot gain ($F_F = 40\%$).

Print characteristic

The dot gain as a deviation of the halftone value in print F_D as against the halftone value in film F_F can be clearly represented for direct use in repro work in the form of what is called a print characteristic (Fig. 20).

To calculate the print characteristic, one must print screen step scales with a minimum of three, better five or more steps and a solid field. Then use a densitometer to measure the ink densities in the solid and in the screen steps, and calculate the halftone values. When the figures thus obtained are entered in a diagram above the corresponding film values, we obtain the transfer characteristic, which for standardized plate making represents a print characteristic. It is valid only for the particular combination of ink, paper, printing pressure, blanket and plate for which it was calculated. If the same job is printed on another press, with different ink or on different paper, then a different print characteristic will be obtained each time.

Characteristic 1 runs below 45°, and represents the ideal curve which in normal conditions is unattainable. Print and film in such a case would be identical.

Characteristic 2 reproduces the halftone values actually measured in the print. The marked area between the two curves represents the dot gain. Example: with a halftone value in film of 40%, characteristic 2 shows a halftone value in print of 55%. This gives a dot gain figure of 15% ($F_F = 40\%$).

For determining the dot gain in print, the middle-tone range is the most significant. The print characteristic shows that here the halftone value deviations are at their maximum.

Standardization in printing

One of the objectives of standardization is to lay down standard values for dot gain in all presses, subdivided into paper groups, and to take this standard dot gain into consideration when producing the film. The task of the pressman here is to monitor the halftone value and to maintain it inside the standard range.

Contrast K (%)

The relative print contrast K (%) serves for checking the screen in the three-quarter tone.

The relative print contrast is also calculated from the measured values of the solid ink density DV and the screen ink density DR. The DR value here is measured in the three-quarter tone.

$$K\ (\%) = \frac{DV - DR}{DV} \times 100$$

The figure thus obtained expresses how large the contrast between solid and screen is.

A print should have as high a contrast as possible, i.e. the solids should have a high ink density, but the screen should still print open (optimum halftone value difference). The printed dots form a contrast to the solid. When the inking is increased, with an accompanying rise in the ink density of the individual dots, the contrast is increased. The increase in ink feed, however, is desirable only up to a certain limit. If the ink film thickness is increased still further the dots tend to exhibit gain, and thus, especially in three-quarter tone, tend to fill in. This reduces the proportion of paper white, and the contrast decreases (Fig. 21).

If there is no densitometer available with a direct contrast display feature, the relative print contrast can be determined using the formula calculation.

Contrast K (%)

	DV	DR	K (%)
Unprinted paper shows no contrast.	0.00	0.00	0 %
With rising ink density the contrast value also rises.	1.00	0.65	35 %
With "standard ink density" the highest contrast is achieved.	1.50	0.85	43 %
With over-inking, the dots tend to gain – the contrast decreases again.	2.00	1.25	38 %
In extreme cases the screen fills in completely – the contrast value is then 0.	3.00	3.00	0 %

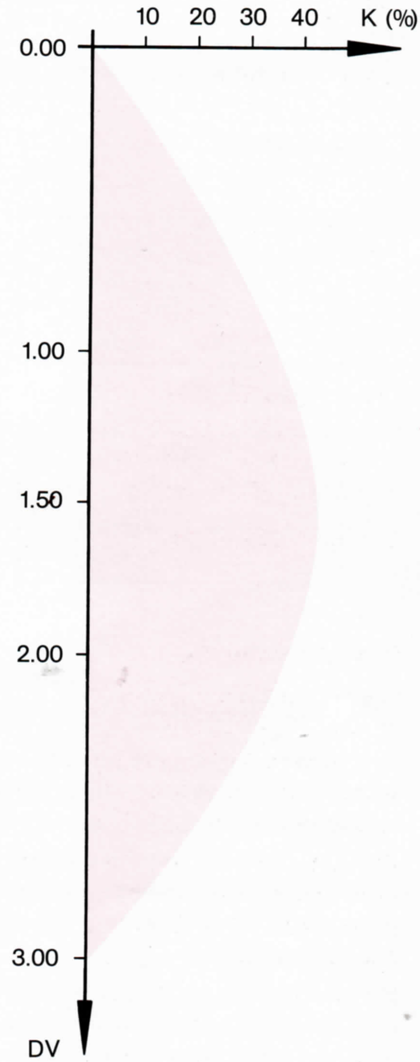


Fig. 21

Screen control

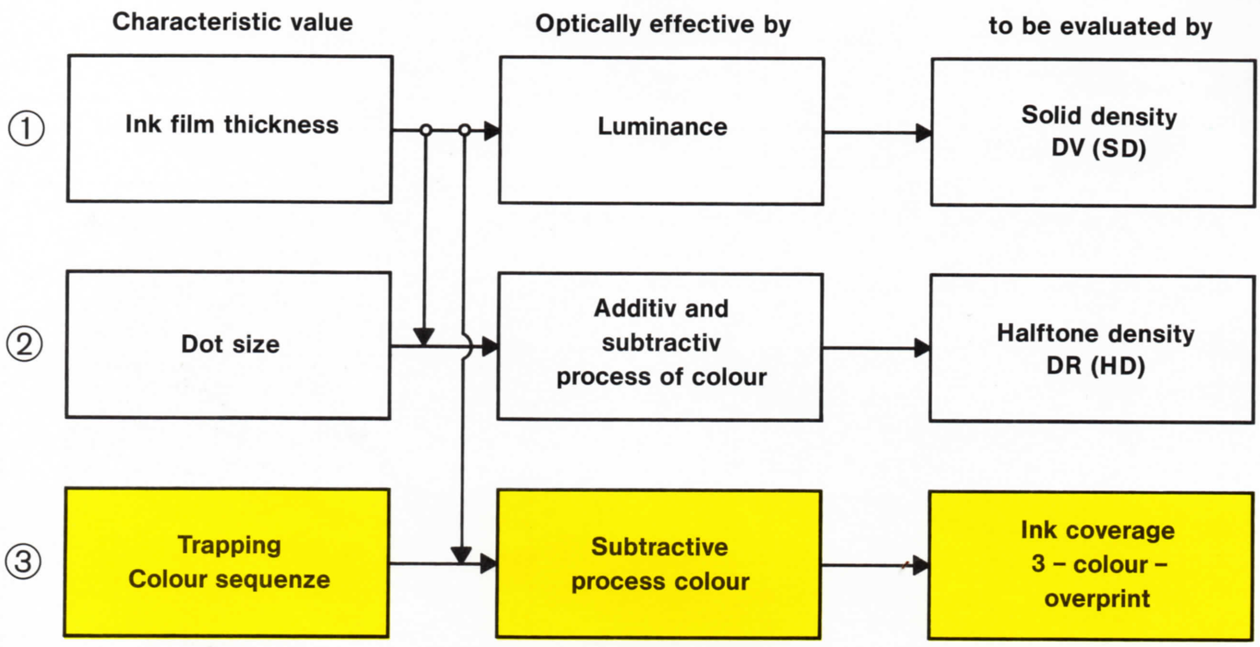
The relative print contrast is used for checking the dot quality in three-quarter tone.

For example, if the contrast value deteriorates during a production run in spite of constant DV ink density, this may be a sign that the blankets need washing.

In addition, the contrast value can be used to assess – given an identical ink density DV – various factors which influence the print result, e.g.:

- rolling/packing and printing pressure
- blankets and underlays
- dampening
- printing inks and additives.

The main criteria for print control



Ink trapping and colour sequence

The third main variable influencing the print result, the ink trapping characteristic, is closely linked to the colour sequence. There is a difference whether a colour is printed onto white paper, or superimposed on an already printed and dried colour, or whether 2 or 4 colours are superimposed wet-on-wet.

If a second colour is applied to an already printed one, e.g. magenta onto cyan, and the coverage is uniform, and if the hue is located at the correct coordinates, then we speak of good ink trapping. If the ink trapping is faulty, then the desired hue will not be achieved. This, of course, also applies to the other mixed colours. The consequence: the colour range is reduced, certain colour shadings can no longer be reproduced.

Fig. 23 shows the effect of differing colour sequences on the print result in practice. Although the printing blocks are equally inked in all cases, and the ink film thicknesses on the paper are also the same when only one colour is printed, when these colours are superimposed the second one printed will not be accepted completely. Consequently, the violet hue designed to be achieved by superimposing magenta and cyan will turn out redder if the colour sequence is magenta/cyan, and bluer if the colour sequence is cyan/magenta. The appearance of the colour printed last is also less smooth.

Visual assessment of ink trapping

The quality of the ink trapping can be checked and assessed visually, by examining the consistency of the coverage with two- and three-colour superimposition in large-solid image areas and also in the superimposition fields of the print control strip. If the three superimposed chromatic colours produce a passably neutral black or gray, then a good ink trapping result can be assumed.

Measuring assessment of ink trapping

Objective measuring assessment of ink trapping is only possible with colourimetry, an option which for a normal print shop is prohibitively expensive.

However, a densitometer enables a relative value for ink trapping FA (%) to be measured and calculated with comparative ease. The procedure is as follows: the solid densities DV are measured for every individual colour in the solid fields, for all two-colour superimpositions, and for the three-colour superimposition in the solid superimposition fields of the print control strip. Special "rules" apply here for selecting the filters.