

## Tech Tip #112 - *Distortion Correction Factors for Proper Negative Preparation*

Print images elongate when flexographic printing plates are mounted around cylinders. This image elongation can be corrected by uniformly shrinking the artwork (original or negative) a predetermined amount in the press direction. The ratio of a properly distorted image to the desired image is known as the distortion correction factor (DCF).

### DCF CALCULATION

Image elongation is affected by cylinder repeat length (CRL), cylinder undercut (UC), underpacking thickness (UT), and photopolymer printing plate substrate thickness (ST). The distortion correction factor (DCF) can be determined by the following formula:

$$DCF = \frac{CRL - 2\pi(UC - UT - ST)}{CRL} \quad \text{Equation 1}$$

**Note:** CRL, UC, UT, and ST all must be in the same units of measure.

This formula also assumes the following relationship is true:

$$UC \leq UT + PT \text{ (Plate Thickness)} \quad \text{Equation 2}$$

This means that the plate package (plate and underpacking) must ensure that the plate surface is at or above the pitch line of the press.

For example:

Plate thickness = 107 mils (0.107 inches)

Stickyback = 20 mils (0.020 inches)

Substrate thickness = 4 mils (0.004 inches)

Undercut = 125 mils (0.125 inches)

Repeat length = 20 inches

$\pi = 3.1415$

Then from Equation 1, the distortion correction factor is:

$$DCF = \frac{20 - 2\pi(0.125 - 0.020 - 0.004)}{20} = 0.9683$$

Thus the negative must be distorted so that its press direction dimensions are 96.83% of the desired printed dimension.

**Note:** Plate thickness was not used in this calculation because Equation 2 held true (undercut = 125 mils  $\leq$  107 + 20 = 127 mils).

## SIMPLIFIED CALCULATION

The following table displays simplified formulas for calculating the DCF for typical press configurations. For example, if we assume the same press conditions of the foregoing example, Equation 1 reduces to the equation shown in row 7 of the table below, i.e.:

$$\begin{aligned} \text{DCF} &= (\text{CRL} - 0.6346)/\text{CRL} \\ &= (20 - 0.6346)/20 \\ &= 0.9683 \end{aligned}$$

**Note:** The cylinder repeat length had to be in inches or an incorrect distortion factor would have resulted.

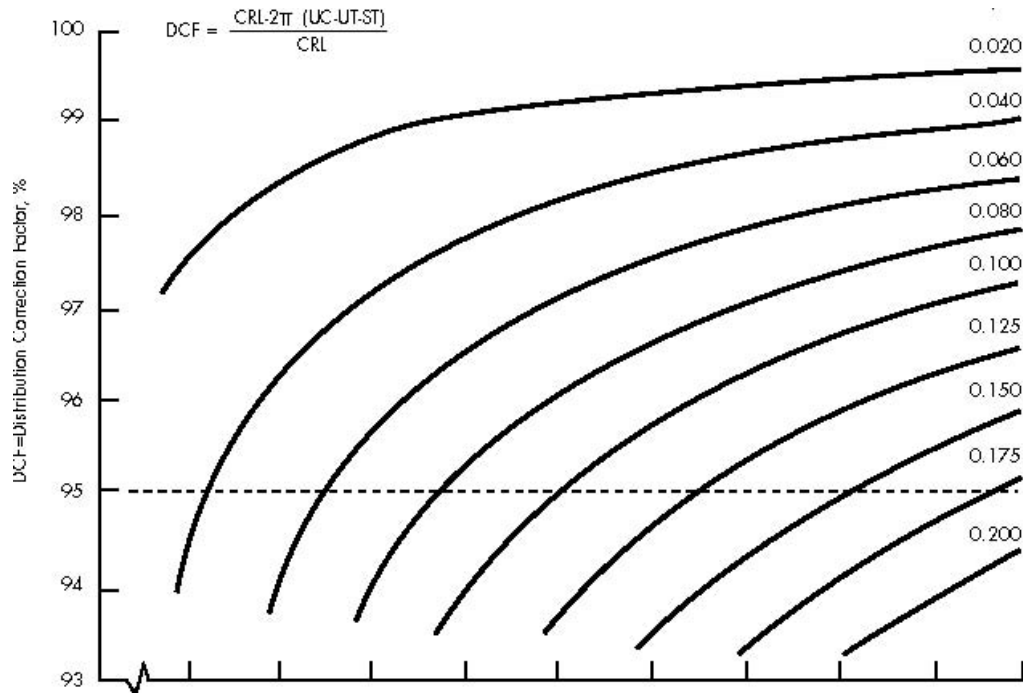
A "caution line" is shown in Figures 1 and 2 at DCF = 95%. Any combination of plate thickness and cylinder size resulting in DCF values below the line (94%, 93%, etc.) may result in unacceptably high stress at the print surface of the plates. This stress could increase plate splitting, chipping, edge lifting, and other failures of the printing plate.

**Distortion Correction Factor  
(Simplified Formulas)**

Plate Cylinder Under cut, Inches	Underpacking Thickness, mils	Photopolymer Printing Plate Substrate Thickness, mils	Distortion Correction Factor
0.085	15	4	(CRL-0.4147)/CRL
0.085	15	7	(CRL-0.3958)/CRL
0.085	20	4	(CRL-0.3833)/CRL
0.085	20	7	(CRL-0.3644)/CRL
0.125	15	4	(CRL-0.6660)/CRL
0.125	15	7	(CRL-0.6471)/CRL
0.125	20	4	(CRL-0.6346)/CRL
0.125	20	7	(CRL-0.6157)/CRL

**Note:** CRL must be in units of inches

**Figure 1:**  
*Distortion Correction Factor – MacDermid Liquid Photopolymer Plates*



**Figure 2:**  
*Distortion Correction Factor – MacDermid Liquid Photopolymer Plates*

