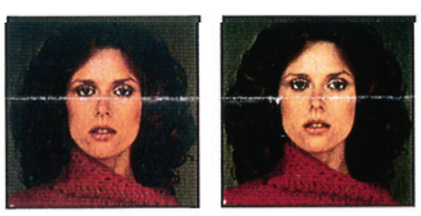
The Role of Color Balance

The answer to this question rests largely with the way the ink flow is regulated in 4-color printing. The standard method for controlling color on press is to measure a given level of solid ink density. (Color bars with solid density patches are typically placed at the lead or trailing edge of the press form, and are read by the press operator using a densitometer.) However, past research has shown that improper or out-of-balance midtone dot gain is the primary reason for color variation on press, rather than ink density.

The pictures below demonstrate this. As the magenta ink film thickness increases; i.e., ink density increases by 20 points, there is only moderate color change occurring in the face and sweater. As magenta dot gain is increased while magenta ink density is held the same, color variation in the face shifts significantly.

Ink density change; no dot gain change.



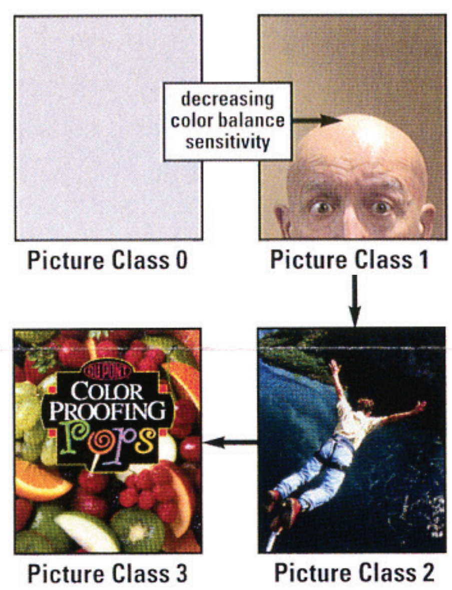
Dot gain change; no ink density change.

Examples by System Brunner.

Studies involving press operations have shown that the most significant color balance shifts occur when the dot gain is out of balance or diverges between colors during the run. Ideally, dot gain should be the same for all colors. The importance of balanced dot gain is confirmed by looking at printed jobs in which dot gain in all three colors varies from the norm—but by the same amount, and in the same direction. In this case, what is seen is merely a change in overall gradation (lightness or darkness), which most viewers consistently find less objectionable than a color shift. When dot gain is well controlled, density shifts of as much as .20 and .30 have surprisingly little effect on many pictorials, as illustrated. This suggests that it might be useful to change to a measurement and control system which places greater emphasis on dot gain than on solid density.

Experienced print producers intuitively know that some pictures are a great deal more sensitive to color fluctuation than others. Often, we hear that flesh and wood tones are especially difficult to control. But what do such so-called difficult subjects have in common? In the 1980s, Felix Brunner of System Brunner, Switzerland, did extensive practical testing to determine the reasons for these differences. He concluded that the human eye's ability to perceive shifts in color balance is strongly influenced by the amount of color contrast present in the image.

To gain a better handle on how these differences impact printing quality, Brunner proposed classifying images according to four "contrast classes," or picture classes.* The images below may be representative of these picture classes stated on a numerical basis.



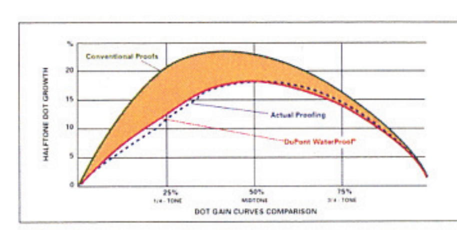
Class 1 pictures contain little or no color contrast, which increases their sensitivity to shifts in color balance. Class 3 pictures have high contrast and show the least sensitivity to color balance variation during printing. The dot gain tolerance range for Class 3 pictures can be as high as plus or minus 6%, meaning about a 6% shift in the midtone in either direction is needed to register an obvious color change. The typical tolerance range for Class 1 pictures is only plus or minus 2%, which for these sensitive pictures would be enough to create detectable color variation.

The validity of allowing a wider tolerance for higher-contrast images has been confirmed many times, and viewers consistently report seeing greater color variation in flatter, low-contrast pictures. This also leads to the conclusion that high-contrast pictures will print well with less attention than low-contrast images. These sensitivity differences apply to the separation process as well as printing. In-line problems on press can be more apparent when matching low-contrast pictures. Finally, low-contrast images within cross-overs always add to project difficulty.

Role of the Analog and Digital Proof

As stated, more noticeable color variation is largely tied to dot gain imbalances with lower-contrast images. These dot gain imbalances often are the result of using proofs that do not properly emulate the dot gain profile of normal printing.

Inaccurate proofs oftentimes force the press operator to adjust inking levels higher (and to inappropriate levels) to try and match unrealistic quartertone levels. These higher levels can cause color compromises—typically, color balance shifts and loss of shadow detail—and create color instability during the production run. Lower-contrast Class 0 and 1 images that are in line with critical color match quartertone images are poorly served when matching to inaccurate proofs.



DuPont WaterProof® is an accurate proof because it closely emulates the press dot gain curve of production presses. Matching on press to analog WaterProof® helps establish uniform and stable inking levels, and allows for optimal quartertone matching with fewer compromises elsewhere in the reproduction curve.

As to digital proofing, formulating the proper calibration aimpoint of the digital proofing device is fundamental to optimal print prediction. High-end digital proofs output to match WaterProof® is a great approach to accurate print prediction—either in a partial or total digital workflow.

* Brunner also gives seminars to teach this theory, and has software for pressroom color control.