INCREASING PROFITABILITY IN PRODUCTION

Tim Quinn describes how to decrease make-ready time and increase run-time in order to achieve neutral colour faster and maintain predictable colour control

THE IMPORTANCE OF GREY balance and proportionality is nothing new, but prioritising press adjustments based on this concept is. As a consultant who installs high-end colour management workflows and delivers colour management training, and as a G7 expert who implements shop-wide G7 qualifications for all print processes, I am amazed that some industry experts are still in doubt about 'grey balanced printing'.

I work with companies that print screen, offset, web, flexo and large format digital, often all within one plant and often using all of their print processes to meet the needs of only one graphics kit – or they use different presses to attempt to match one part to another. This is a reasonable expectation of a workflow when many types of equipment and workflows have been invested in. The key to making all of these processes appear similar and to a contracted industry standard proof, is neutrality through the entire grey scale.

When highlight neutrals transition into shadow neutrals, equal neutrality occurs. When images print correctly in some areas and incorrectly in others, there is an imbalance within the grey scale. It doesn't matter if red apples or green grass are being printed, there is a component of grey and if it is out of balance, everything else is too. In other words if a print has a colour casted grey scale, you are not printing accurately to the file.

GREY BALANCE

A friend once told me: "I cannot visually guarantee you are compliant to ISO, or any other print standard, when you are grey balanced, but I can guarantee you are not compliant without grey balance." Grey balance is the foundation of colour – every process colour image has an inherent blended amount of grey – indeed, every process colour has a blended amount of grey, and every ink colour has some component of other colours.

The grey component begins within each individual colour and accumulatively builds to grey as non-proportional ratios to one another. Understanding this ratio is critical to attaining quick make-ready and maintaining accurate neutrality. Grey balance press control can be elusive and frustrating for press operators if not adjusted for in the correct sequence. For example, if printing to grey balance and a press adjustment is made in the wrong sequence, valuable press time is wasted because more colours will be inadvertently adjusted than was intended, and more than once.

This article aims to increase profitability in production by describing how to decrease make-ready time and increase run-time through prioritised MCY press adjustments in order to achieve neutral colour faster and maintain predictable colour control. Prioritising to MCY press adjustments is a new concept and a continuation of my research on predictable single colour progressive build to grey.

AN ANALOGY

Grey balanced press control is like chess: prioritising which process colour to adjust first is what I refer to as 'the King, Queen, Pawn rule of printing'. In chess, mobility of the piece equates to rank and power and like chess, inks have a rank. Grey balance is definitely the king, magenta is the queen because it has the most mobility, and cyan is similar to a rook or bishop. (Cyan has a slight amount of yellow with a little more magenta component ratio – not as neutral a mobile effect as magenta, but definitely more than yellow.) Yellow is the pawn as it has a perceived lack of power.

A press adjustment made to yellow only, has no effect on the neutral component ratio so if you need yellow and add it, you only get yellow. This is because the grey component of yellow is the lowest of the CMY combination. Cyan and magenta grey component ratios disturb the neutral balance with every move. Yellow is the easiest neutral ratio concept to understand because it has a minimal amount of magenta or cyan component, and as yellow has the smallest amount of component ratio it would quickly turn green, red or orange.

The misconception here is that yellow is simply weak. It has been said that you cannot see a 5-10% yellow dot by itself, however it is the lack of yellow that can cast a print to the bluish side, sending press operators on a quest to fix blue. In this case, more yellow would neutralise the image and realign the chroma; hue changes colour, chroma just makes a colour more saturated.

With a pre-2007 industry standard density of 1.4, magenta contains a component ratio of about half yellow and about one-third cyan. Magenta has the largest components of all three colours – Figure 1 shows these component relationships.

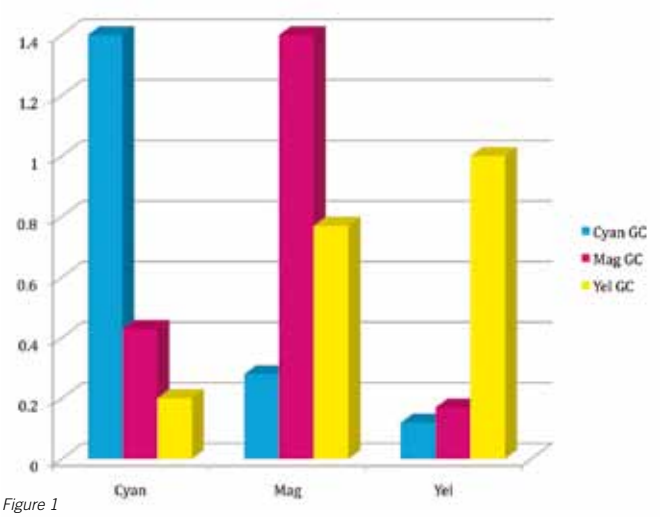

Figure 1

THE ARGUMENT

Some people have the misconception that grey balance only controls neutral density, not colour reproduction. This is wrong – all colours have a component ratio amount of grey, which is sometimes referred to as contamination. This portion of colour, at the point to which they have equal amounts, is the transition of the spectral response. An isolated colour to one particular tonal range, the 50% for instance, will cause a ripple effect that sends a wave of distorted colour out into chroma. This distortion does not stop until it reaches the edge of gamut, which is the primary CMY colours, combined overprints or secondary RGBs, the substrate and the black point. (An imbalance in saturated hues, such as apples, is not as easily discernible in areas lacking chroma, such as pavement, or achromatic areas.)

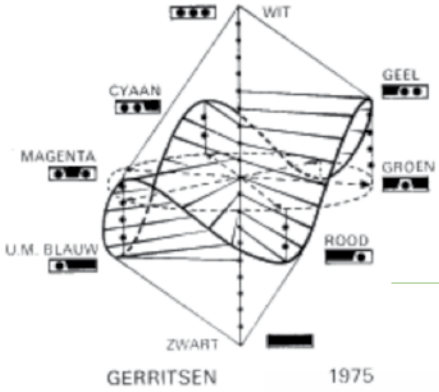

Figure 2: gamut edge of sample

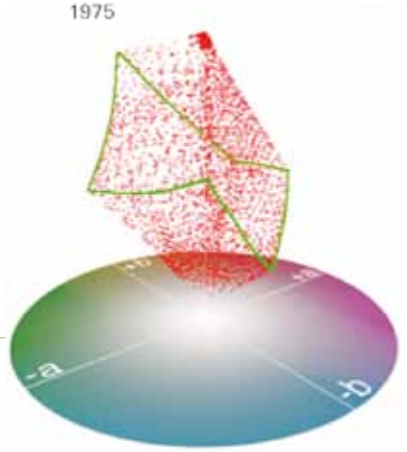

Figure 3

THE HISTORY OF GREY

In 1967, before dot gain and density became a popular means of press control, JAC Yule wrote: "In photomechanical reproduction, [ ] neutral reproduction of neutral greys is required." However the industry in general, and colleges as well, used solid ink density and dot gain alone as the primary means of print quality control for at least two decades.

Finally, ISO supplied 12647-2 to the industry which defines grey balance as "neutral". I am not aware of anyone who has ever written about or used the component ratio as a means of prioritised press control. This is not to say a press can be adjusted to neutral without first having been set to a known condition through plates, screens or transforms – this has to be done meticulously for the overall process to work. If the press has been calibrated to meet a qualification, prioritised adjustments can then be used to get back to that condition, or at least to neutralise the mid-point.

The grey ramp cannot always be linearised through press adjustments alone; adjustments can be made to attain balance at various aim points. For example, if printing flesh tones and having to choose, the 50% mid-tone would be the best control point. If the press has been calibrated, press-compensated or profiled using colour transforms to linearise the grey ramp, adjustments can be made to the mid-point 50% grey which realign the grey scale to a repeatable calibrated condition.

PROCESS PARTICIPATION

As a manufacturing process, printing must have the most variables to control because it has the most variables that can be out of control. Unlike other manufacturing processes, printing has had many process improvement advances such as 'prioritised press control' that are not categorised as 'lean'. For example, a 2009 survey conducted by RSM McGladery showed that all manufacturing processes, except printing, increased participation 'going lean' from 2008 to 2009. Printing & Publishing reported a decline from 55% in 2008 to 51%, and a recent USA Today advertisement boasted that ink was "the most expensive liquid on the planet".

Printing is an expensive process that will need future efficiency improvements that far outweigh the benefits of lean. G7, if implemented only in a simplified realistic version, is a process improvement that can help significantly.

Continued over

Figure 4

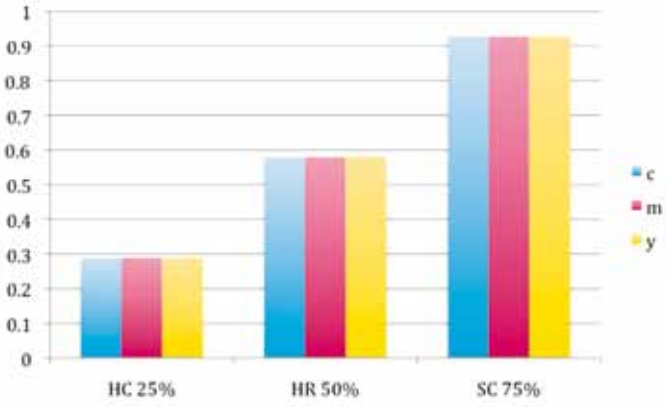

Figure 5: the ideal 'neutral' aim

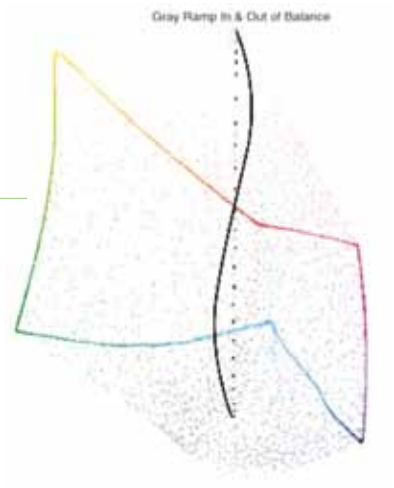

Figure 6

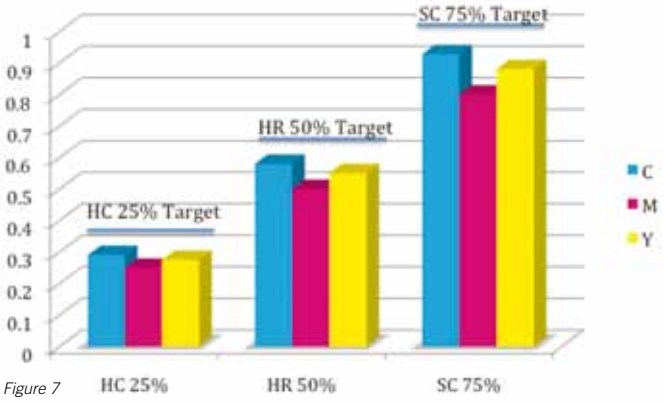

Figure 7

EXAMPLE 1

The G7 HR 50% grey patch is built into the file with a 50% cyan, 40% magenta and 40% yellow build. If aiming for a density weight value of .59 in the HR, which ideally would be .59c, .59m and .59y with a high / low and spread tolerance between each colour of no more than .04 in the HR, all that is needed is a densitometer for a control device.

Tolerances are not currently defined in density, by any standard, but testing by Nazdar Consulting has shown .03, .04 and .05 respectively to be reasonable spread tolerances from highlight to shadow. On press it uses three grey patches to monitor the grey scale: these are the HC, HR & SC, 25%, 50% and 75% builds of grey. Figure 4 shows no spread between CM or Y and is within +or- .04 of the target .58. This would pass for G7 compliance.

It should be remembered that neutrality imbalance is usually a ramp from the shadow end to the shoulder or an 'S' shape, not a tilted 'straight line' axis as in most illustrations. The reason for this is that the paper is fixed and the black point doesn't change much, so if you are within tolerance in the HR, as shown in Figure 5, you may still be failing in the highlight and or shadow.

In Figure 6 the HR crosses through the grey ramp at the 50% and

Figure 8

fails in the 25% and 75%, and in opposite directions. This example would produce a green highlight, grey mid-tone and red casted shadow. When all three aim points are out of tolerance and there is no alternative but to pick one, pick the 50% HR. The HR is the mid-point for the press operator; if it is correctly balanced and the HC and / or SC are out, you only need corrected compensation curves or new transforms.

Some printing processes and presses have more latitude to move this spread. For example, if you really push the press, can you move the magenta spread 10 points? If so, then you can pull the press 10 points when needed. Knowing this beforehand is critical, and documenting the effects of each variable is just as important. Assuming you can pull your press 10 points, you have the following spread in grey balance in the 50% HR (and see figure 7):

	HR		HR		HR
C	.57	M	.50	Y	.55

This would not pass: the grey balance is ramped out of balance to the green side, or lacks magenta. The density spread between CMY is .07 and the density weight value is too low. This can be fixed with one move: when the magenta unit, not ink, is adjusted, everything else is fine.

Because the cyan component is one-third cyan and half yellow, the grey component fixes itself. If all three units were adjusted at the same time because they all appeared to be low, you would over-shoot the target. Adjusting the magenta, aware of its inherent cyan yellow components, pulls the grey balance to neutral based on the component ratios of the inks.

EXAMPLE 2

Not every situation is this easy. For example, if we were aiming for a weight value of .6 and the component was:

	HR		HR		HR
C	.57	M	.50	Y	.60

Figure 9

This would require two press moves (see figures 7 and 8). The magenta has to come up, which will bring up the grey component for cyan and yellow. In this case magenta will fix the cyan and both will equal .6. As the yellow, however, is half the magenta component, it will be too high and climb to .65, requiring an additional move of reducing yellow.

EXAMPLE 3

In another example, if the cyan and magenta densities are .59 and the yellow spread is .10 points low, you will have a blue cast. Incorrect press adjustments are often made for this due to a visual assessment seeing blue. When correcting the imbalance, yellow has minimal components of cyan and yellow so when the yellow is adjusted up to .6, CM will move no more than .01 and stay within tolerance.

If you see a casted greyscale, it is either:

- Red cast = too much magenta and yellow or lack of cyan

Continued over

Figure 10

Figure 11

- Green cast = too much cyan and yellow or lack of magenta
- Blue cast = too much cyan and magenta or lack of yellow.

There are several ways to qualify grey balance: you can measure L*c*h*, L*a*b* or density 'All'. Most pressrooms have densitometers that measure density only and not L*c*h or L*a*b. Figures 10, 11 and 12 show what grey balance looks like from the same sample, moving the display from one measurement space to another.

L*c*h* is the easiest to understand – the closer it is to 0 c* or no chroma, the more neutral it is. L*c*h* is derived from L*a*b* but is displayed as a single number derived from two co-ordinates. L*a*b* can be more confusing because 0 a* and 0 b* are the Cartesian co-ordinate for neutral. Knowing which colour resides in which quadrant will give you a cast, but not necessarily indicate what to do on press. Density 'All' shows a spread of .02 when the chroma is less than 1; this is the easiest and quickest way to attain neutral grey with equipment you may already have.

CONCLUSION

After reading this article, I hope you are remembering whether you have ever made changes to a single colour based on knowing its collateral effect on grey balance. If you have ever moved one colour more than once and then began doubting grey balance, this article should help explain why. I believe this is worthwhile information for the advance of printing as a manufacturing process. ■

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The author would like to thank George Pavolack, Mike Edwards, Jason Childress and Miller Zell for their help with this article.

Figure 12

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