CMYK colours defined as K-only

Printing K-only data with black toner only

This white paper describes K-only or 'plain' black data. It provides some historical and technical information to understand the meaning of this data. It also gives users of the Océ CPS800/CPS900 Platinum some practical help both in dealing with this data and in achieving the desired output quality.

This white paper is part of a set of white papers to explain the Océ technologies and applications. See also the white papers 'Selection of colour mixing schemes', 'RGB, CMYK and Spot' and 'Rich Black and Direct Imaging'.

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1 Meaning of K-only data

In traditional full-colour offset printing, device CMYK data is used most of the time. These CMYK values directly represent the proportions of inks (cyan, magenta, yellow and black) used on top of each other in the print engine. This CMYK data is therefore directly related to the device-dependent inks used. For example to get reddish colours, magenta and yellow ink layers are used on top of each other. If a little cyan or black is added, the colour becomes darker.
A neutral colour can be achieved by mixing cyan, magenta and yellow ink layers. An alternative neutral colour can be achieved by using a single layer of black ink only. This means there are two traditional ways of generating a neutral colour. One of these is by using 'CMYK' data, meaning cyan, magenta, yellow and black inks, and the other is by using 'K-only' data, defined only by black ink with no cyan, magenta and yellow inks.

2 Advantages of K-only data

If CMYK data is used, the definition of the inks needs to be known and the correct inks must also be used. Neutral colours can be achieved by a mixture of cyan, magenta and yellow. Neutral colours are sensitive to the exact ratio of cyan, magenta and yellow inks and the colour definitions of these inks. In practice, the correct definitions or inks are not always used, and therefore the desired neutrality is not achieved.

If K-only data is used, there is no colour cast at all because only black toner is used. The neutrality is therefore created in a reliable way. Using K-only also offers other advantages, such as:

- Less toner is used because there is only a single layer of ink instead of three layers
- Cost accounting is as a black & white page, which is often lower
- Drying time is reduced, for example with inkjet printing
- Text legibility is higher when using black toner only, because of unavoidable misalignment effects when three colours are used
- The colour uniformity of a large area printed only with black toner is higher than when three colours are used, due to superposition of the non-uniformities of the separate colours

Graphic designers therefore often define neutral colours as K-only to achieve these advantages.

3 Printing in the dynamic colour-mixing scheme

In the CPS800/900, the output data of the EFI controller is transferred to the engine and converted to seven toner colours. If the dynamic colour-mixing scheme is used, neutral colours

are made with red, cyan and green toners, combined with paper white or black toner.
In the dynamic colour-mixing scheme, neutral tones are printed with coloured toners. For example grey text, defined as C=M=Y=50%, is printed with the coloured toners red, green, cyan and some black.
However, neutral tones defined as C=M=Y=0% and a K value are printed with black toner only. For example grey text, defined as 50%K only (and C=M=Y=0%), is printed with black toner only even when the dynamic colour-mixing scheme is selected.

Note that:

- The K-only data is printed with the classic screen (fine)
- Some additional settings are needed in the CMYK workflow. These settings are described in the following sections
- If neutral tones are defined as 'grey scale' only, black toner is used as well. The EFI Fiery controller deals with this type of 'grey' definition

The Full Source GCR is required to ensure that K-only input data is printed with black toner only.

4 Using the GCR setting to ensure printing K-only data with black toner

The Full Source GCR setting is needed to preserve the K-only behaviour. This setting is present in the CMYK workflow, as shown in Figure 1.

Figure 1: Full Source GCR and Full Output GCR settings.

This means that K-only data in the input file is respected in the output values to the engine. The Full Source GCR setting is necessary for both the dynamic and the classic colour-mixing schemes. The K-only data is forced to the classic black screen for both the dynamic and the classic colour-mixing schemes.

If Full Output GCR is used, the K-only behaviour will be lost due to general colour management transformations. The input CMYK in a document (four-dimensional) is converted first to a Lab value, which is a three-dimensional value. So at this stage the K-only information is lost.

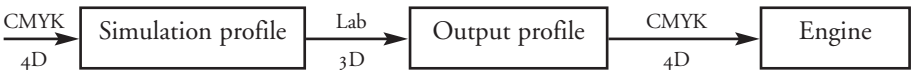

Figure 2: Full Output GCR workflow.

The transformation is also influenced by the simulation profile used. If a Euroscale simulation is used, a CMYKin value is converted to a different Lab colour value than for example with a

SWOP simulation. In general, K-only data is converted to a Lab value with non-zero a or b co-ordinates. The output to the engine (CMYKout) is in general no longer K-only, but is defined by the output profile. In brief, the Full Output GCR path does not preserve K-only information from input to output.

Note that when printing K-only data without colour management, only black toner will be used in the print. The drawback of this option is that the accuracy of other colours is not defined, because the definition of the CMYK input colours is not taken into account.

5 Artefacts in some cases

In general, complete objects are defined as black-only data and printed with the classic screening, despite the dynamic setting for all other data.

In some cases, some local artefacts may occur and these are described below.

5.1 CMYK blend

This example describes an almost neutral blend in CMYK from grey to white. The blend is defined by CMYK values, where the CMY values vary around zero.

Figure 3: CMYK blend from an almost neutral CMYK colour to white.

Two screening methods are applied in this type of blend: classic screening for the K-only area where cyan, magenta and yellow are exactly 0%, and dynamic screening in other areas. The result is that in an area where classic screening is applied, only black toner is used. However, in the other areas where dynamic screening is performed, a combination of red, cyan and green toners is used. The switching between screening methods may result in visible local artefacts. The solution for problems of this type is to use the classic colour-mixing scheme, so there is no spatial change in the screening method.

5.2 CMYK images

In full-colour CMYK images, a lot of colour CMYK combinations occur and almost all of them have a non-zero colour component. For specific pixels in an image, the cyan, magenta and yellow components may incidentally be zero. This leads to a local change to the classic screening. In practice, this artefact is hardly visible on the print and is not a real problem.