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Rendering Intents

The following instructions will help you understand the concept of rendering intents as used when converting files from one color space to another in an ICC workflow.

General Philosophy & Overview

We are often asked here at DTG, “which rendering intent should I use”? Like most questions, our initial response is, “well, that depends...”.

When working with digital images, conversions take place from one color space to another almost constantly. Obviously when we convert from RGB to CMYK, or when we print an image, a conversion of the data has to take place. But even while we are simply viewing an image on our monitor a conversion is taking place (from the working space of the file to the monitor space). This is possible because of ICC profiles (descriptions of how devices “capture”, display, and print color) and color management engines (the software/math behind the scenes that does the conversion).

Working spaces, devices, and printers (and media) all have different color gamuts (ranges of color capability), So when we convert from one color space to another color space some of the colors are in gamut and some are out of gamut relative to each other. When converting images from one color space to another, the out of gamut colors need to be “re-mapped” to in gamut colors of the destination space. This is handled by the color managment engine and in specific, the rendering intent.

There are four possible rendering intents to choose from in most software applications: Perceptual, Relative Colorimetric, Absolute Colorimetric, and Saturation. Let’s discuss these....

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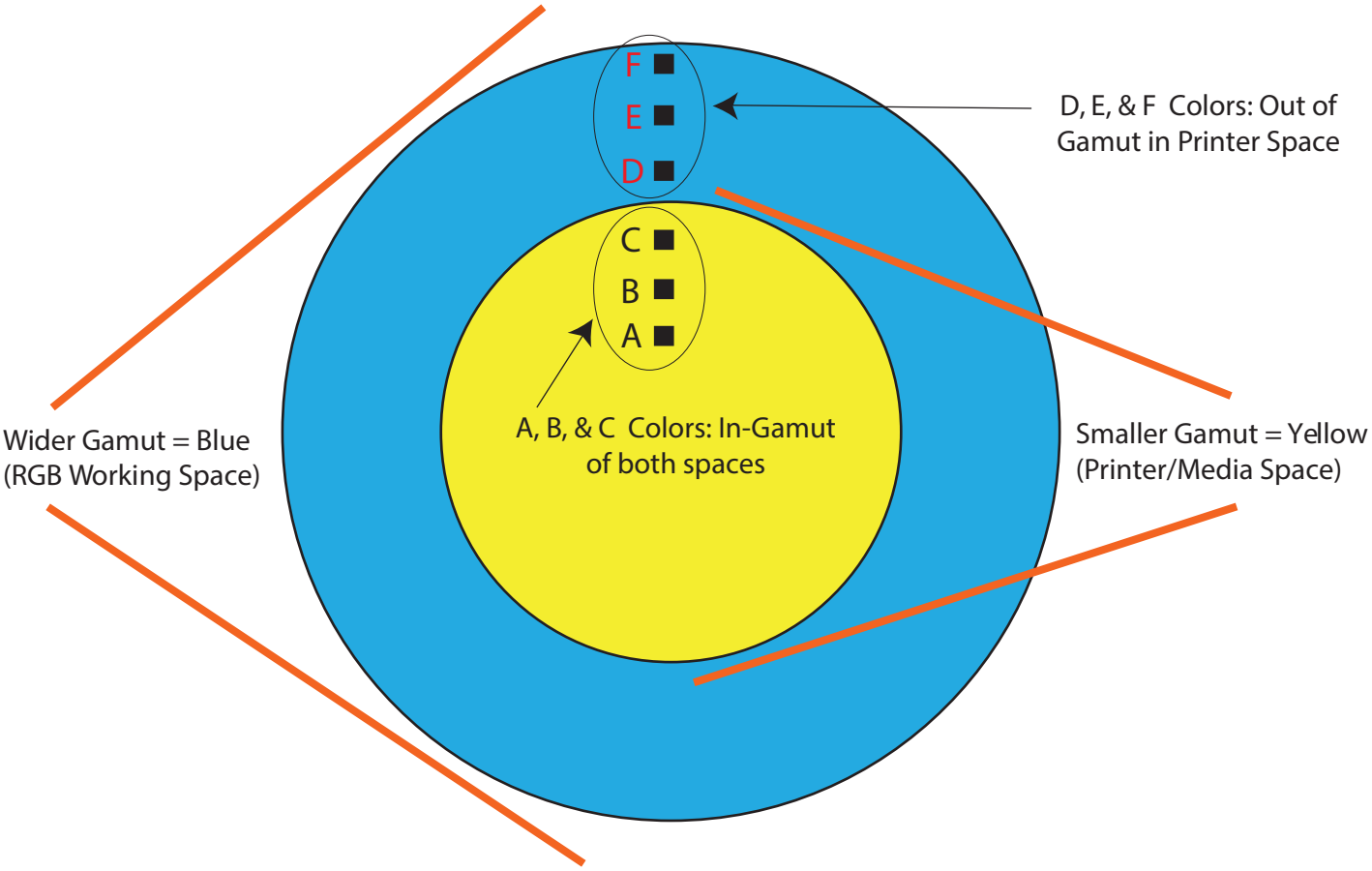
Overview of Larger & Smaller Color Space

In a typical conversion, you may be converting from your file's working color space like AdobeRGB to a printer's color space - say on fine art paper. The gamut volume in the working space is much larger than the fine art paper's. However, there also might be colors in the paper's space that are also outside of the working space (not shown in the below illustration for simplicity).

The below illustration is a very simple representation of a larger gamut vs, a smaller gamut. Color spaces are not spherical but are oblong in shape. We also show in gamut and out of gamut colors in the same axis (which they rarely are). But to more easily illustrate and demonstrate gamuts and rendering intents we are going to continue using the simple illustration below.



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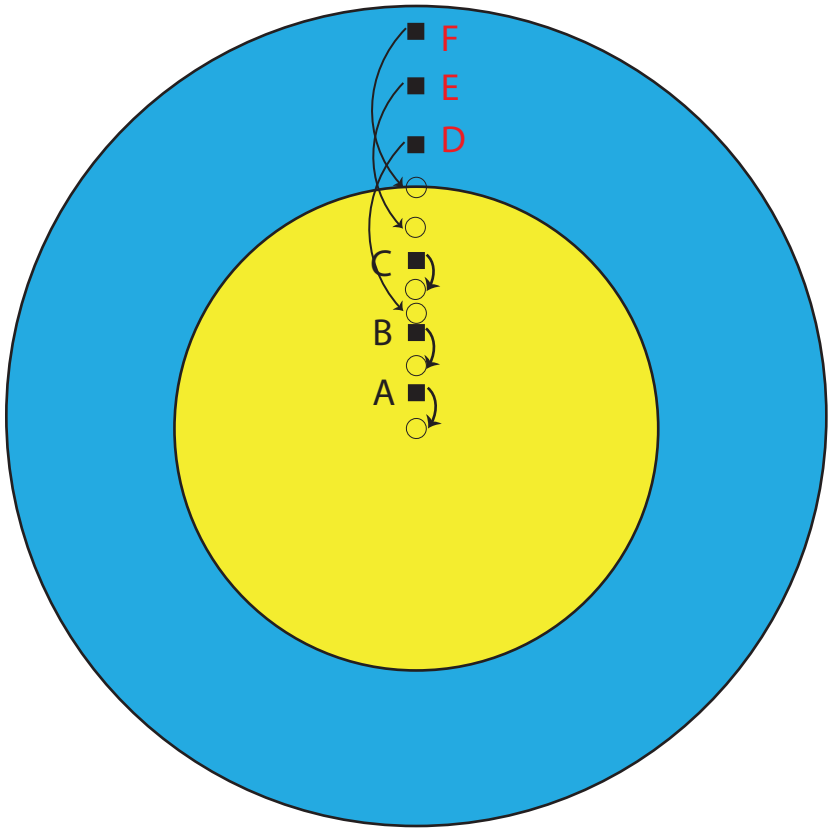
Perceptual:

With the perceptual intent, the entire gamut of the original file is compressed in order to fit inside the gamut of the destination space. This means that all colors outside the gamut are shifted to inside the gamut AND all colors INSIDE the gamut are shifted as well. Looking at the illustration below, you can see that every single pixel is being moved. You would think that all out of gamut pixels (D, E, F) would be positioned to the outer most edge of the gamut for the best gamut possible. You would also think that in-gamut colors (A,B,C) would be left alone since they are in-gamut and would better match the original. But that's not perceptual's goal. Perceptual is as it sounds -- it preserves the "even" distribution of tones proportionally to each other so that the viewer's perception of the final image is pleasing and "natural".

Perceptual General Uses:
Large RGB to small CMYK conversions. Everyday photographic images in order to give natural tonality to people and objects. Very detailed images with a wide variety of colors and tones.

Perceptual Intent



■ = Original Colors
○ = Destination of Colors after Conversion

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Colorimetric (Relative & Absolute):

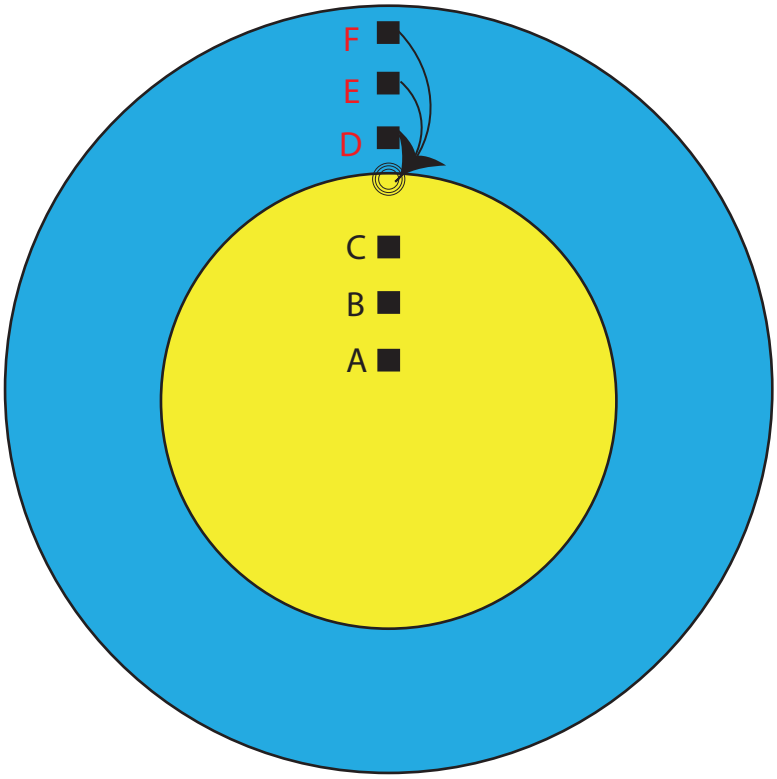
With the colorimetric intents, out of gamut colors are all compressed and mapped to the closest possible in gamut color while in gamut colors are left completely alone, with no compression. The colorimetric intent does not pay attention to the relationship of neighboring pixels. In our basic illustration below since the colors are in the same line, colors D,E,&F are all mapped to the same color so that it can achieve the most saturated color for each out of gamut color. This dispraportionate behavior can create problems like banding, especially in images/files with gradients because multiple, different shades within the gradient could get mapped to the same color. However, one of the advantages of the colorimetric intent is that all in gamut colors retain their place and there is no shift of those colors - achieving a closer match.

Both relative and absolute behave the same in terms of their gamut mapping accept for how the white point is managed. With relative, the white point of the input color space is remapped to the white of the destination profile so that the white in the image remains white in the conversion. With absolute, the white in the destination profile becomes the white in the source profile.

General Uses:

Relative Colorimetric Uses: CMYK to CMYK conversion, files with lots of solid colors, logos, narrow gamut RGB images. Absolute Colrimetric Uses: Proofing, need to simulate white point of printing stock.

Colorimetric Intent



■= Original Colors

◯= Destination of Colors after Conversion

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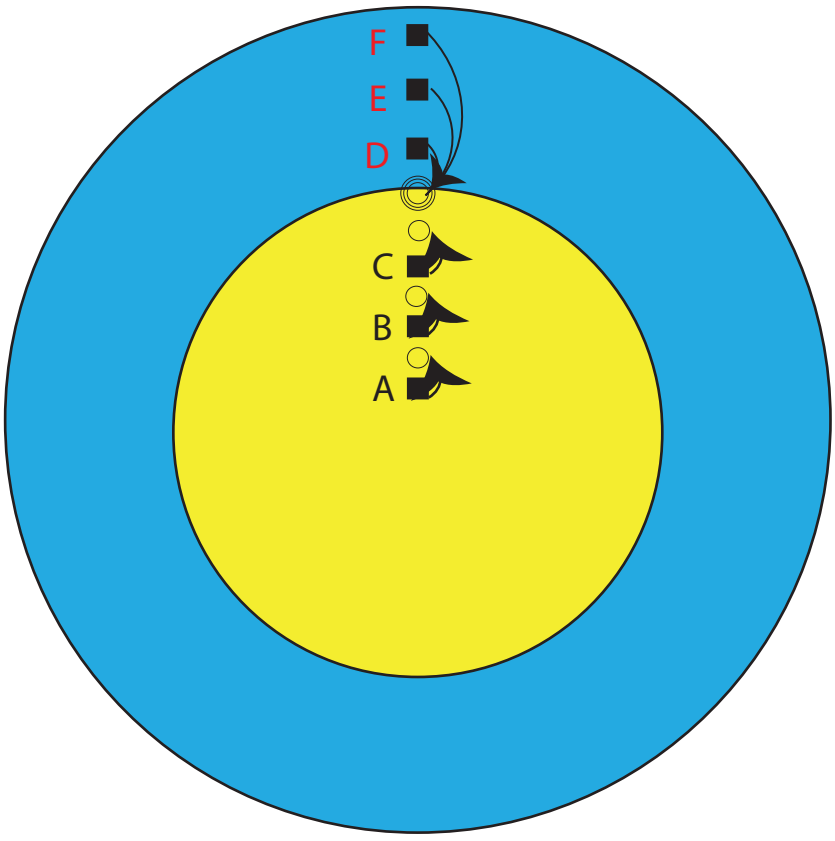
Saturation:

The saturation intent is all about...saturation. As with the colorimetric intent out of gamut colors are moved to the most saturated corresponding in gamut color. As you see in the graphic below pixels D,E, & F go to the same in exact color at the edge of the smaller gamut. Not only that, in gamut pixels A, B, & C also move... outward, to more saturated colors which increases the overall saturation of all in gamut pixels.

Saturation General Uses:
This is the least used intent as it is generally used for business graphics, electronic presentations and occasionally in the print industry for cartoon or comic book applications.

Saturation Intent



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Conclusion

As you can see, rendering intents are an important part of the color management process. Choosing the “correct” one while printing can impact the overall quality and accuracy of the final output. This all depends on the original image/file and also the printer/media combination.

One of the nice features of many Adobe applications is that you can “soft proof” the rendering intent, previewing on your screen how each intent will affect the final output. Please refer to our guide on soft proofing for more information.

While this documents makes general recommendations on the uses and applications of each rendering intent, there are no hard or universal rules. We encourage you to experiment by soft proofing rendering intents or printing with different rendering intents.

DTG has been providing color management solutions and support since 1998. At DTG you can purchase digital imaging equipment, supplies, and software as well as contact us for pre-sales consultation on all of your digital color and printing needs. If you have any questions at all please don’t hesitate to contact DTG at 800.681.0024.