CMYK is a limited color space

**Image created in rgb**
Imagine you have created this image on your computer in rgb color space.


In this document the image is converted to cmyk, to be printed in offset – or on your inkjet or laser printer.

See the difference between the screen view in rgb and the cmyk print on paper.

When you compare the cmyk to the rgb you clearly see that the cmyk color space is very limited.

There is no power in the cmyk colors, when you see both samples at the same time.
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Two worlds
Comparing the additive and the subtractive systems is perhaps not fair. It is two different worlds. For example, cyan and magenta do not have the same nuance in RGB and CMYK – they are brighter and more pure in RGB. More power.

The additive system
The RGB (additive) system is light only, directly from the screen to your eyes. The RGB additive color space is very large, and almost all colors can be created here.

The subtractive system
The CMYK (subtractive) system is pigments printed on paper to be reflected and filtered by light. The CMYK subtractive color space is limited and many colors cannot be created in this color space.

The pigments and the reflections are partly why the CMYK color space is smaller than the RGB color space.

The original image "21. Sample in rgb.tif" is created in Adobe Photoshop using the working space Adobe RGB (1998). The RGB file is converted to CMYK using the ISO Coated v2 (ECI) and the rendering intent is set up to perceptual.

Rgb is the additive color system creating colors by light.

Cmyk is the subtractive color system creating colors by pigments.
CMYK is a limited color space

The CMYK gamut
When you create a RGB color outside the CMYK color space and convert the color to be printed in CMYK, the color is to be contracted to the CMYK gamut.

It means that your software have to contract some colors to a color space where the colors do not exist!

The bright green sample in RGB 0-255-0 is contracted to CMYK 81-1-89-0.

This is how it works and if it is not satisfactory, you have to print the green color as a fifth special color.

Still, you have a problem when the image is to be printed in a magazine printed only in CMYK!

It is a great limitation and you cannot do anything about it.

Color codes

<table>
<thead>
<tr>
<th></th>
<th>RGB</th>
<th></th>
<th>LAB</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>255 0 0</td>
<td></td>
<td>63 90 78</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green</td>
<td>0 255 0</td>
<td></td>
<td>83 -128 87</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blue</td>
<td>0 0 255</td>
<td></td>
<td>30 69 -114</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyan</td>
<td>0 255 255</td>
<td></td>
<td>86 -83 -22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magenta</td>
<td>255 0 255</td>
<td></td>
<td>68 101 -51</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow</td>
<td>255 255 0</td>
<td></td>
<td>98 -16 104</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

When you create the RGB color code 0-255-0 in Adobe Photoshop you at the same time get the values of CMYK, LAB, HSB and HEX. Note the Lab value in the a-axis is -128.
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Color settings – rendering intent
On this page the green rgb color is contracted to the cmyk color space using four different rendering intents.

Above here you have the four different separations in cmyk.

Perceptual
In general the perceptual rendering intent is the most used when rgb images are to be separated to cmyk.
In the Adobe Photoshop Lab color space the values in the a and b axes are from -128 to 127.

Adobe Photoshop Lab color space
The six rgb colors from the front page image are here placed in the Adobe Photoshop Lab color space.

The circular area is the general CIE Lab diagram from -100 to 100 in the a and b axes.

Read about the CIE Lab color space in "1. CMYK GUIDE – CIE Lab color space.pdf" on www.cmykguide.com under downloads.

The rgb colors are to be contracted to the cmyk color space to be printed in cmyk.

This shows how small the cmyk color space is, when you compare to the CIE Lab color space. This also shows why you cannot get all colors printed in cmyk!

On the following pages the rgb colors are converted to cmyk, using different rendering intents.
1. Perceptual.
2. Saturation.
3. Relative colorimetric.
4. Absolute colorimetric.
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1. Perceptual
2. Saturation
3. Relative colorimetric
4. Absolute colorimetric
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**Your choice**
When you create colors to be printed in cmyk, you should not choose colors from a screen view in a color space outside the cmyk gamut.

Instead, choose colors from the natural environment of cmyk: printed colors on paper.

In the Triangle Colorscale® CMYK GUIDE you have a very realistic reference of what actually can be printed on paper in cmyk.

**CMYK XTRA**
In the Triangle Colorscale® CMYK XTRA you have a great tool expanding the cmyk color space.
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CMYK XTRA – the easy way to HIFI colors
The Triangle Colorscale®
CMYK XTRA Highline matte is the easy way to begin printing HIFI colors.

To expand the cmyk color space you simply print the dominating basic color twice. This expands the color space significantly.

Perhaps you have printed a deep-red car in cmyk only to see how the colors died.

Double magenta brings back life to your car.

Read about CMYK XTRA in “11. CMYK XTRA – The easy way to HIFI colors.pdf”.

Try it yourself by printing the “12. CMYK XTRA – Test form A4 ink jet or laser print.pdf”.

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