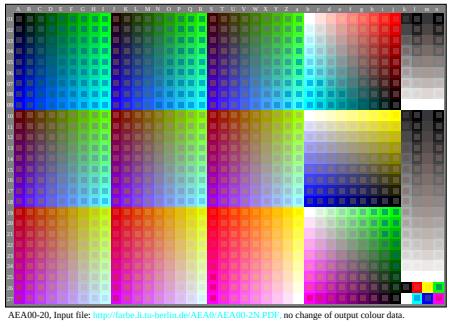
PostScript-Colour Parameters and 1-Minus-Relation (1MR) of *rgb* and *cmyk*

```
01  Colour parameters setgray, setrgbcolor, and setcmykcolor in PostScript.
02
03  k setgray with 0 <= k <= 1 defines colours in the space DeviceGray.
04  For k=0 the colour is black, for k=1 the colour is white.
05  For 0 <= k <= 1 a grey colour is defined between black and white.
06
07  r g b setrgbcolor with 0<= r,g,b <=1 defines colors in the space DeviceRGB.
08  For r=g=b=0 the colour is black, for r=g=b=1 the colour is white.
09  For 0 <= r,g,b <= 1 many colours including greys are defined.
10
11  c m y k setcmykcolor mit 0<= cmyk <=1 defines colours in the space DeviceCMYK.
12  If k=0 and c=m=y=1 the colour is black, for c=m=y=0 the colour is white.
13  If c=m=y=0 and k=1 the colour is black, for k=0 the colour is white.
14  For 0<=c,m,y<=1 and k=0 many colours including greys are defined.
15
16  For 0<=c,m,y<=1 and k=0 the minimum of {c, m, y} can be changeds by k.
17  In this case the new parameters of setcmykcolor are {c-k, m-k, y-k, k}.
18  Lines 16 and 17 define the 1-Minus-Relation for the cmyk values.
19  The 1-Minus-Relation for values of rgb and cmy0 is r=1-c, g=1-m, b=1-y.

Lines 03 to 14: parameters of setgray, setrgbcolor, and setcmykcolor.
Lines 16 to 19: 1-Minus-Relation between {c,m,y,0}, {c,m,y,k}, and {r,g,b}.
```

AEA00−1N



AEA00-20, Input file: http://farbe.li.tu-berlin.de/AEA0/AEA00-2N.PDF, no change of output colour data.

CIELAB measurement of output colours on an LCD display

At work places the ambient room light produces reflections on any display.
Figure AEA01-3N shows 2,5% reflection compared to White W (100%).
Figure AEA01-4N shows 20% reflection compared to White W (100%).

Result
The scaling of the grey scale remains not approximately equally spaced.
In Figure AEA01-4N may dark grey steps can not be distinguished.

Requirement
Apply display-output linearization to get the output equally spaced.

Scientific result
In many cases a reduction of the display *gamma* helps.

Test and application
ISO 9241-306:2018 defines 15 steps of *gamma* g_a.
In may cases an ISO file shows solutions of the problem, see
http://standards.iso.org/iso/9241/306/ed-2/AE49/AE49F0P0.PDF
http://standards.iso.org/iso/9241/306/ed-2/AE49/AE49F0N0.PDF
See many other files with output questions in englisch, french, and german
http://standards.iso.org/iso/9241/306/ed-2/index.html

AEA01−1N

CIELAB measurement of output colours in offset print

The output colours depend of the colour separation method.
Figure AEA01-5N applies the separation method of Figure AEA00-5N.

Result
Many dark and chromatic steps are missing in the print.

Scientific result
Figure AEA01-7N shows the continuous overprint of Rd and Cd with black.
Pure black is not possible because the presence of Rd or Cd produces a chromatic tint.

Solution
Increase the overprint of black from 0 to 100%,
and reduce appropriate Rd or Cd from 100% to 0%.

Application result
Figure AEA01-6N shows the continuous overprint of Rd and Cd with black,
and at the same time an appropriate reduction of Rd and Cd.

Output-linearization based on the above application result
Figure AEA01-8N shows the intended equally spaced grey and chromatic steps.

Figure AEA01-8N produces **100% Under Colour Removal (UCR),**
the grey series is **only** printed by the black colorant.

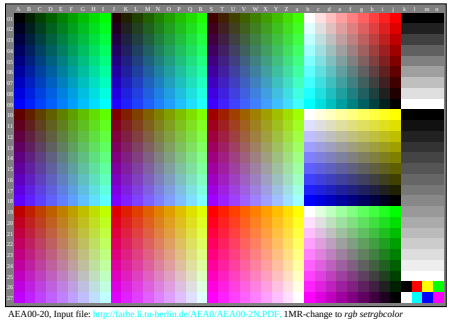
AEA01−2N

Frame File PostScript Code for 1-Minus-Relation (1MR) to *setrgbcolor*

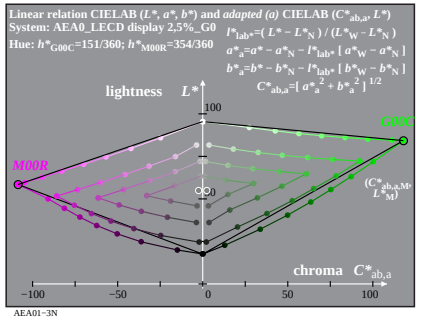
```
01 %!PS-Adobe-3.0 EPSF-3.0, 1MR for change to setrgbcolor
02 /FFM_setrgbcolor {setrgbcolor} bind def
03 /1MR-0000 {%BEG procedure 1MR-0000
04 %%1MR-Transform of setgray and setcmykcolor to FFM_setrgbcolor
05
06 /setgray {%BEG procedure setgray to setrgbcolor
07          dup dup FFM_setrgbcolor
08        } def %END procedure setgray to setrgbcolor
09
10 /setcmykcolor {%BEG procedure setcmykcolor to setrgbcolor
11 /FFM_k exch def /FFM_y exch def /FFM_m exch def /FFM_c exch def
12 FFM_k 0 eq {1 FFM_c sub 1 FFM_m sub 1 FFM_y sub FFM_setrgbcolor}
13            {1 FFM_k sub dup dup FFM_setrgbcolor} ifelse
14          } def %END procedure setcmykcolor to setrgbcolor
15
16 } def %END procedure 1MR-0000
17 %%Trailer %END 1-Minus-Relation (1MR) to setrgbcolor

Remarks:
line 02: necessary for the revised definition of rgb setrgbcolor.
         The FF_PS file shall include line 02 before the use of 1MR-0000.
line 06 to 08: change of w setgray to rgb setrgbcolor.
line 10 to 14: change of cmyk setcmykcolor to rgb setrgbcolor.
```

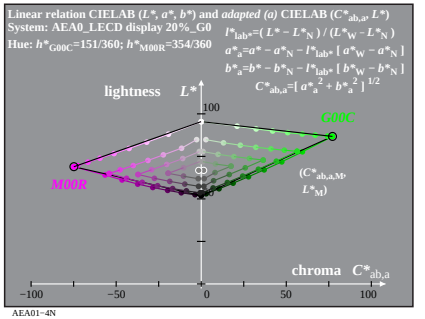
AEA00−3N



AEA00-20, Input file: http://farbe.li.tu-berlin.de/AEA0/AEA00-2N.PDF, 1MR-change to *rgb setrgbcolor*



AEA01−3N



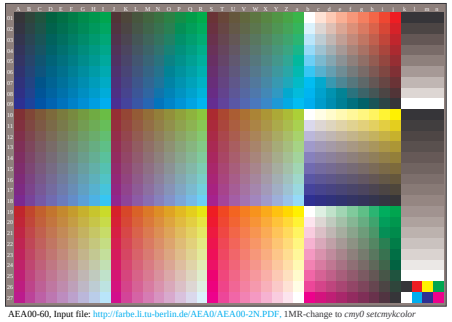
AEA01−4N

Frame File PostScript-code for 1-Minus-Relation (1MR) to *cmy0 setcmykcolor*

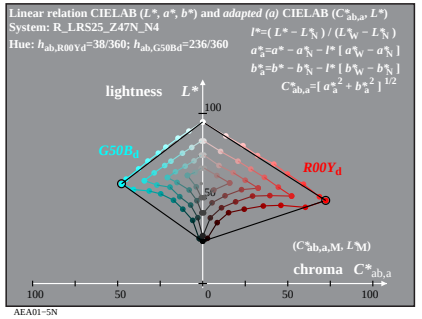
```
01 %!PS-Adobe-3.0 EPSF-3.0, 1MR-0002 for change to cmy0 setcmykcolor
02 /FFM_setcmykcolor {setcmykcolor} bind def
03 /1MR-0002 {%BEG procedure 1MR-0002 to cmy0 setcmykcolor
04 %BEG setgray, setrgbcolor, cmyk setcmykcolor to cmy0 setcymkcolor
05 /setgray {%BEG procedure setgray to cmy0 setcmykcolor
06           /Mw exch def 1 Mw sub dup dup 0 FFM_setcmykcolor
07         } def %END procedure setgray to cmy0 setcmykcolor
08 /setrgbcolor {%BEG procedure setrgbcolor to cmy0 setcmykcolor
09              /Mb exch def /Mg exch def /Mr exch def
10              1 Mr sub 1 Mg sub 1 Mb sub 0 FFM_setcmykcolor
11            } def %END procedure setrgbcolor to cmy0 setcmykcolor
12 /setcmykcolor {%BEG procedure cmyk to cmy0 setcmykcolor
13               /Mk exch def /My exch def /Mm exch def /Mc exch def
14               Mk 0 ne {Mc Mk add Mm Mk add My Mk add 0}
15                       {Mc Mm My 0} ifelse FFM_setcmykcolor
16             } def %END %END procedure cmyk to cmy0 setcmykcolor
17 %%Trailer %END procedure (1MR-0002) to cmy0 setcmykcolor

Remarks:
line 02: necessary for the revised definition of cmy0 setcmykcolor.
         The FF_PS file shall include line 02 before the use of 1MR-0002.
line 05 to 07: change of setgray to cmy0 setcmykcolor.
line 08 to 16: change of setrgbcolor & setcmykcolor to cmy0 setcmykcolor.
```

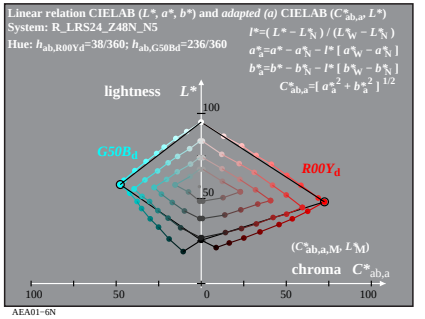
AEA00−5N



AEA00-60, Input file: http://farbe.li.tu-berlin.de/AEA0/AEA00-2N.PDF, 1MR-change to *cmy0 setcmykcolor*



AEA01−5N

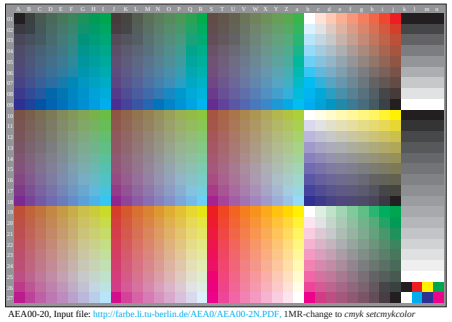


AEA01−6N

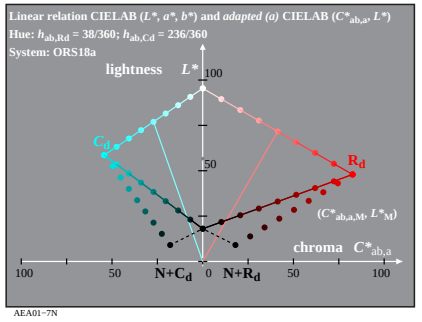
Frame File PostScript-code for 1-Minus-Relation (1MR) to *cmyk setcmykcolor*

```
01 %!PS-Adobe-3.0 EPSF-3.0, 1MR-0003 for change to cmyk setcmykcolor
02 /FFM_setcmykcolor {setcmykcolor} bind def
03 /1MR-0003 {%BEG procedure 1MR-0003 to cmyk setcmykcolor
04 /Mind {/Min Mc def %procedure to define Minimum of Mc, Mm, My
05    Mc Mm le Mc My le and {/Min Mc def} if
06    Mm My le Mm Mc le and {/Min Mm def} if
07    My Mc le My Mm le and {/Min My def} if} bind def
08 /setgray {%BEG procedure setgray to 000k setcmykcolor
09           /Mk exch def 0 0 0 1 Mk sub FFM_setcmykcolor
10         } def %END procedure setgray to 000k setcmykcolor
11 /setrgbcolor {%BEG procedure setrgbcolor to cmyk setcmykcolor
12          /Mb exch def /Mg exch def /Mr exch def
13          Mc Min sub  Mm Min sub  My Min sub  Min FFM_setcmykcolor
14        } def %END procedure setrgbcolor to cmyk setcmykcolor
15 /setcmykcolor {%BEG procedure cmy0 to cmyk setcmykcolor
16           /Mk exch def /My exch def /Mm exch def /Mc exch def Mind
17           Mk 0 eq {Mc Min sub  Mm Min sub  My Min sub  Min}
18                   {Mc  Mm  My  Mk} ifelse FFM_setcmykcolor
19         } def %END %END procedure cmy0 to cmyk setcmykcolor
20 21 %%Trailer %END procedure (1MR-0003) to cmyk setcmykcolor
Remarks:
line 02: necessary for the revised definition of cmyk setcmykcolor.
         The FF_PS file shall include line 02 before the use of 1MR-0003.
line 08 to 20: change of setgray, setrgbcolor, setcmykcolor to cmy0 setcmykcolor.
```

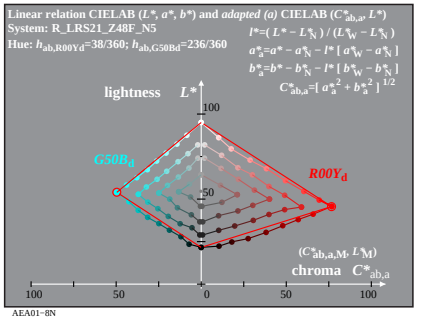
AEA00−7N



AEA00-20, Input file: http://farbe.li.tu-berlin.de/AEA0/AEA00-2N.PDF, 1MR-change to *cmyk setcmykcolor*



AEA01−7N



AEA01−8N

TUB-test chart AEA0; Application of 1-Minus-Relation
Output and steering of test chart AE49 of ISO 9241-306

input: *w/rgb/cmyk −> w/rgb/cmyk−*
output: *all[2],rgb[4],cmy0[6,8],cmyk[10]*