

Standard and Wide Gamut colour code (SGcode and WGcode) compatible with CIELAB, ISO/IEC 15775 and DIS ISO/IEC 19839-1 to 4 for colorimetric colour management and communication

Klaus RICHTER, Prof. Dr.
Federal Institute of Materials Research and Testing (BAM)
Head of Project Group: Visual Methods and Image Reproduction for NDT
Unter den Eichen 87
D-12200 Berlin, Germany
email: klaus.richter@bam.de
internet: <http://www.ps.bam.de> or <http://o2.ps.bam.de>

ABSTRACT

*For colorimetric colour management and communication 8bit colour codes in perceptible space (*colour space) are described. Two Standard Gamut Colour codes for Printing (PR) and Television (TV) and one universal Wide Gamut Colour code (WGcode) which includes all real colours of both PR and TV. There are reverse transformations between the two different SGcodes of PR and TV, the universal WGcode and the CIELAB colour coordinates. The SGcodes and the WGcode are compatible with CIELAB, ISO/IEC 15775 [1] and DIS ISO/IEC 19839-1 to 4 which specify image reproduction properties of colour copiers, printers, scanners and monitors. These standards correspond to DIN 33866-1 to 5 [3].*

The SGcodes and the WGcode can be calculated for all colours of the four ISO/IEC-test charts which are all defined in CIELAB coordinates. Main colour series are equally spaced in CIELAB colour space both in lightness L^ and chroma C^* . Up to now there are productions of DIN (German Standard Institute) and JBMA (Japan Business Machine Makers Association) according to ISO/IEC 15775 which can be used for all applications.*

The 8bit SGcode of television is similar compared to the nonlinear 8bit code of the sRGB colour space defined in IEC 61966-2-1:1999-10 [4] which is incompatible to CIELAB and ISO/IEC 15775

Keywords: Image reproduction, ISO/IEC-test charts, colour code, colour space, colour management, colour communication, standard gamut, wide gamut.

History of ISO/IEC Standards

The International Standard ISO/IEC 15775: Information technology † Office machines † Machines for colour image reproduction - *Method of*

specifying image reproduction of colour copying machines by analog test charts † Realisation and application was developed by the committee ISO/IEC JTC1/SC28 Information technology, Office equipment. The new Draft International Standards DIS ISO/IEC 19839-1 to 4 [2] and the International Standard ISO/IEC 15775 are based on equivalent colour series and test charts.

All standards use the same colour series both in **digital** and **analog** test charts and the same layout. The application of the new drafts [2] is under test within DIN-NI-28 and ISO/IEC JTC1/SC28 since about two years.

Wide Gamut code (WGcode) for Colour Management

A universal wide gamut 8bit colour code (WGcode) is developed for colour management and colour communication. This code serves for the needs of users which like to have a colorimetric reproduction. The colorimetric reproduction reproduces the CIELAB data of the original colours by the output device, e. g. by a printer or a monitor. The standard original colours are the 6 chromatic colours CMYOLV of printing (PR) or television (TV) including White W and Black N defined in ISO/IEC 15775 for CIE illuminant D65, the CIE 2 degree observer and the CIE 45/0 measurement geometry.

The intended accuracy for the office environment is 3 CIELAB units. The universal standard WGcode is an 8bit code and includes a 6bit code (64 steps) for the 16-step gray and colour series used in the ISO/IEC-test charts. The accuracy of this WGcode is 1.2 CIELAB units. The number 1.2 (=77/64) is given by the achromatic standard gray scale with the CIE lightness range 77 (from $L^*=18$ to $L^*=95$) and the 64 steps (6bit). This is much less compared to the intended 3 CIELAB units.

Input	Output	Input and output media and applications			Standard
		Input media	Output media	Application	
–	–	–	–	Basis	ISO/IEC 19839–1
analog	analog	ISO/IEC-test chart (hardcopy)	Hardcopy	Copier	ISO/IEC 15775
analog	digital	ISO/IEC-test chart (hardcopy)	File	Scanner	ISO/IEC 19839–3
digital	analog	ISO/IEC-test chart (file)	{ Hardcopy Softcopy	Printer Monitor	ISO/IEC 19839–2 ISO/IEC 19839–4

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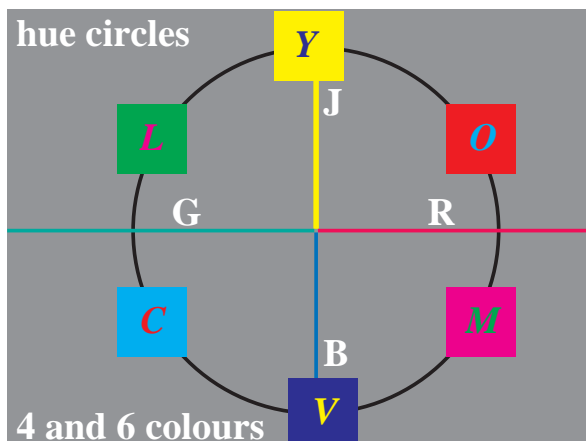
Table 1: Realisation and application of ISO/IEC-test charts for specifying image reproduction
ISO/IEC-test charts

Table 1 describes the application and realisation of ISO/IEC-test charts and the methods for the specification of reproduction properties of colour image devices **analog - analog** (copiers), **analog - digital** (scanners, Photo-CD-systems) and **digital - analog** (printers, monitors) and may therefore be used as a basis for the comparison and the choice of such devices.

The produced **analog** ISO/IEC-test charts are compared visually with the **analog** original. One must reproduce the **analog** ISO/IEC-test charts on copiers or the **digital** ISO/IEC-test charts on printers and monitors. There is also an ISO/IEC colorimetric method for comparison (Examples, see Annex G of ISO/IEC 15775)

For scanners one must use the **analog** ISO/IEC-test charts for input.

Figure 1: Hue circles with four unitary and six reproduction colours



ISO/IEC Color Space *CMYOLVNW**

The colour space *CMYOLVNW** is based on colours defined in the International Standard for offset printing using CIE illuminant D65, the CIE 2 degree observer and the CIE 45/0 measurement geometry. ISO/IEC 15775 use the following colour terms shown in Fig. 1. The four colours *RGBJ* are used for the unitary hues and the six colours *CMYOLV* are used for the reproduction colours. The terms for White and Black are *W* and *N* (french = Noir). The unitary hue yellow is called *J* (french = Jaune).

The relative coordinates *nru** (Blackness *n**, Radial Chroma *c** and Unique Hue *u**) are based on the unitary hues of *Miescher* (see [5] and Fig. 1). This system is called Natural Offset Reflective System (ORS) and is very user friendly.

Basis for Colour Management

The colour space *CMYOLVNW** is designed for **colour management** and mainly for **colours in reflective mode**. Especially for the **colorimetric colour reproduction of our natural environment** the colours of the offset printing process are the only standard reflective colours we can use. The full theory for colour management, see [6], cannot be discussed here. Fig. 2 to 9 show the colours used in chromaticity diagrams. Fig. 10 to 16 visualize the colours including the different calculated codes.

The CIELAB colour space is recommended by the CIE and used since many years for colour measurement. The only output of many colour measurement devices are the *LAB** color data of the CIELAB color space. The basic color measurement space is CIELAB but most of the graphic software can not use the coordinates of this space up to now. Together with the transformations based on Fig. 2 to 9 there are different possibilities to work with the CIELAB color space on all devices with normal graphic software, e.g. using *cmv** or *olv** data.

color space CIELAB 1976, color values, -attributes, -chromaticities ($a\hat{a}$, $b\hat{a}$)

tristimulus values $X, Y, Z \rightarrow$ color attributes L^*, a^*, b^*

lightness $L^* = 116 (Y/Y_n)^{1/3} - 16$
 RG-chromaticness $a^* = 500 [(X/X_n)^{1/3} - (Y/Y_n)^{1/3}] = 500 [a\hat{a} - a\hat{a}_n] Y^{1/3}$
 JB-chromaticness $b^* = 200 [(Y/Y_n)^{1/3} - (Z/Z_n)^{1/3}] = 500 [b\hat{a} - b\hat{a}_n] Y^{1/3}$

color attributes $L^*, a^*, b^* \rightarrow$ tristimulus values X, Y, Z

tristimulus values $X = X_n [(L^* + 16) / 116 + a^*/500]^3$
 $Y = Y_n [(L^* + 16) / 116]^3$
 $Z = Z_n [(L^* + 16) / 116 - b^*/200]^3$

chromaticity for CIELAB 1976, LABHNU 1977, LABHNUx 1979

CIELAB 1976, 2°	$a\hat{a} = 0,2191 (x/y)^{1/3}$	$b\hat{a} = -0,08376 (z/y)^{1/3}$
LABHNU 1977	$a\hat{a} = (x/y + 1/6)^{1/3} / 4$	$b\hat{a} = -(z/y + 1/6)^{1/3} / 12$
LABHNU1 1979	$a\hat{a} = (x/y + 1) / 15$ linear!	$b\hat{a} = -(z/y + 1/6)^{1/3} / 12$
LABHNU2 1979	$a\hat{a} = (x/y + 1/6)^{2/3} / 15$	$b\hat{a} = -(z/y + 1/6)^{1/3} / 12$
CIELAB 1976, 10°	$a\hat{a} = 0,2193 (x_{10}/y_{10})^{1/3}$	$b\hat{a} = -0,08417 (z_{10}/y_{10})^{1/3}$
chromaticity constants	$a_2 = 500 (1/X_n)^{1/3} = 0,2191$	$b_2 = -200 (1/Z_n)^{1/3} = -0,08376$
CIELAB, 2°, 10°	$a_{10} = 500 (1/X_{n10})^{1/3} = 0,2193$	$b_{10} = -200 (1/Z_{n10})^{1/3} = -0,08417$

Table 2: Definition of CIELAB coordinates and different chromaticity coordinates including the nonlinear $a\hat{a}$, $b\hat{a}$ chromaticity coordinates for D65.

CIELAB and chromaticity diagrams

In 1976 the CIE has defined a chromaticity diagram for the CIELUV colour space but not for the CIELAB colour space. In Table 2 there is a definition of a nonlinear ($a\hat{a}$, $b\hat{a}$) chromaticity diagram. The two CIELAB chroma coordinates a^* and b^* can be computed by the chromaticity difference, e. g. $a\hat{a} - a\hat{a}_n$ of a sample and the D65 surround multiplied by the cube root of the luminance factor. This ($a\hat{a}$, $b\hat{a}$) chromaticity diagram is very useful for the following discussion.

The standard printing colours can be mixed with the offset colour black N (overprint of N). Then the chromaticity remains approximately constant over a wide range. For the standard television colours the chromaticity remains constant if the luminance of one phosphor, e. g. red, green or blue or a fixed mixture, is reduced from one to zero.

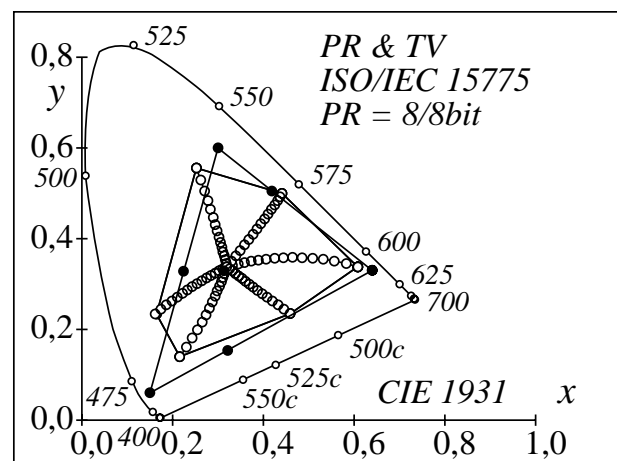


Figure 2: Standard printing and television colours in the CIE (x,y) chromaticity diagram.

The 16-step colour series produced in offset printing within the analog ISO/IEC-test charts are defined in CIELAB colour space in Table 1 and Annex H in the International Standard ISO/IEC 15775. The six

chromatic standard colours of both printing (open balls) and television (black balls) are shown in the CIE (x,y) chromaticity diagram. Additionally the 16-step colour series between White W (chromaticity D65) and the six chromatic colours $CMYOLV$ are shown.

The analog DIN-test charts produced by DIN for DIN 33866-1 to 5 and the analog ISO/IEC-test charts produced by JBMA for ISO/IEC 15775 include all the 16-step colour series as real samples.

The accuracy of production is within the intended 3 CIELAB units. There are colour series changing only in c^* (Cyanblue) between 0, 0.063, 0.133, etc., 0.933 1.000 (0/15, 1/15, etc., 15/15 corresponding to the 16 steps) for constant $m^*=0$ and $y^*=0$ and similar for the series m^* , y^* , o^* , l^* , v^* , and n^* .

The task to calculate the olv^* and cmv^* from LAB^* coordinates has been solved by a *PostScript* (PS) and *Portable Document* (PDF) computer program.

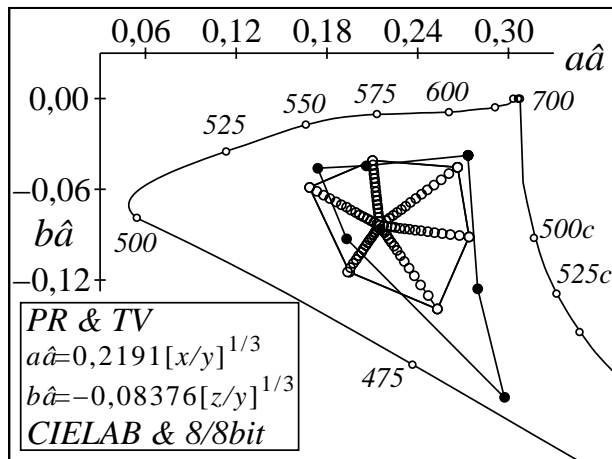


Figure 3: Standard printing and television colours in the $(a\hat{O}, b\hat{O})$ chromaticity diagram for CIELAB and illuminant D65.

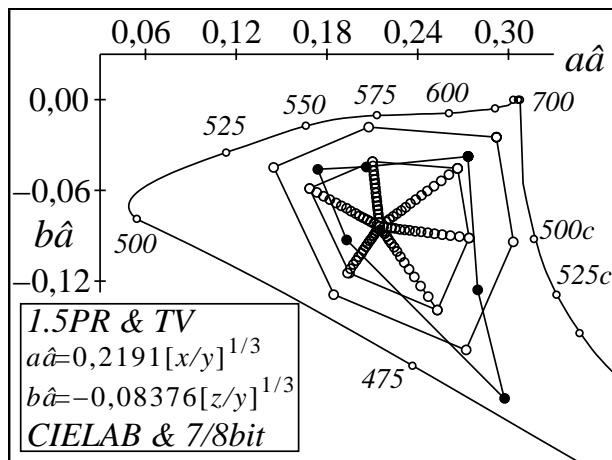


Figure 4: Standard printing and television colours and 1.5 times more chromatic printing colours in the $(a\hat{O}, b\hat{O})$ chromaticity diagram.

Figure 3 shows the sample of Fig. 2 now in the $(a\hat{O}, b\hat{O})$ chromaticity diagram defined for the CIELAB colour space for illuminant D65.

Figure 4 shows again the samples of Fig. 3 in the CIE $(a\hat{O}, b\hat{O})$ chromaticity diagram. The chromaticities of the larger PR-hexagon are calculated from the chromaticities of the standard PR-hexagon multiplied by a factor 1.5.

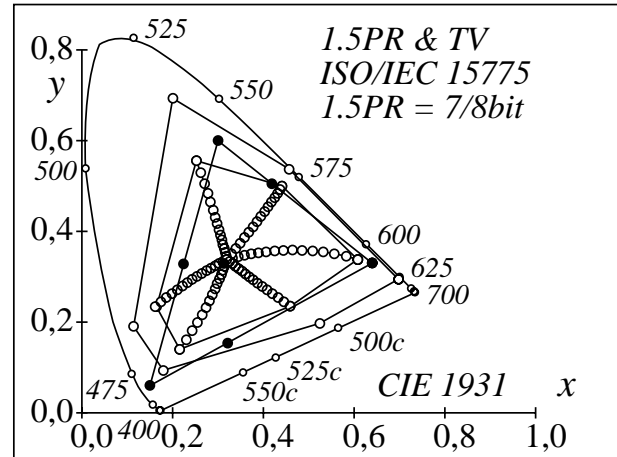


Figure 5: Standard printing and television colours and 1.5 times more chromatic printing colours in the CIE (x,y) chromaticity diagram.

Figure 5 shows the samples of Fig. 4 in the CIE (x,y) chromaticity diagram. The chromaticities (x,y) are calculated from the $(a\hat{O}, b\hat{O})$ chromaticities of Fig. 4.

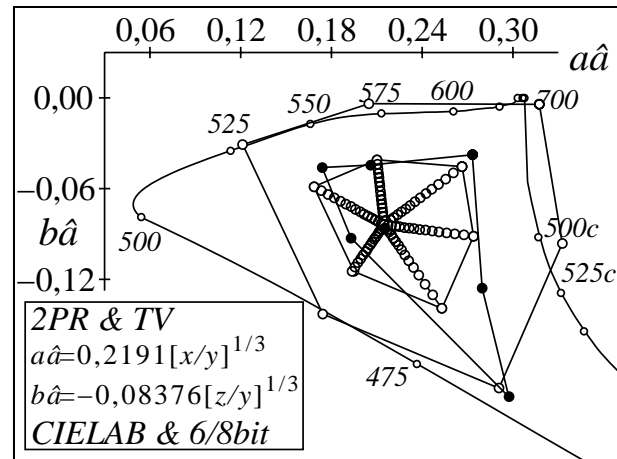


Figure 6: Standard printing and television colours and the 2 times more chromatic printing colours in the $(a\hat{O}, b\hat{O})$ chromaticity diagram.

Figure 6 shows again the samples of Fig. 3 in the CIE $(a\hat{O}, b\hat{O})$ chromaticity diagram. The chromaticities of the larger PR-hexagon are calculated from the chromaticities of the standard PR-hexagon multiplied by a factor 2.

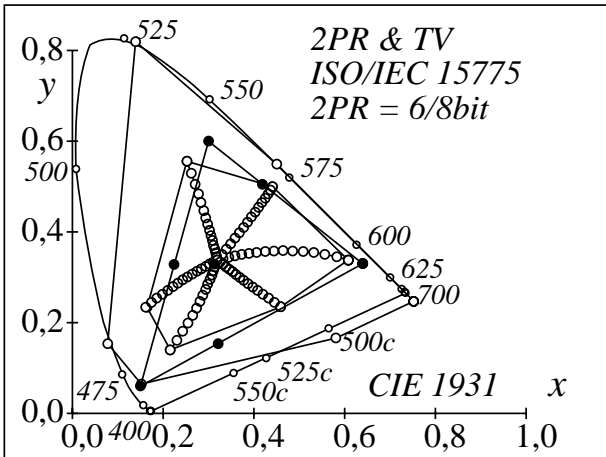


Figure 7: Standard printing and television colours and the 2 times more chromatic printing colours in the CIE (x,y) chromaticity diagram.
 Figure 7 shows the samples of Fig. 6 in the CIE (x,y) chromaticity diagram. The chromaticities (x,y) are calculated from the $(a\hat{O}, b\hat{O})$ chromaticities of Fig. 6.

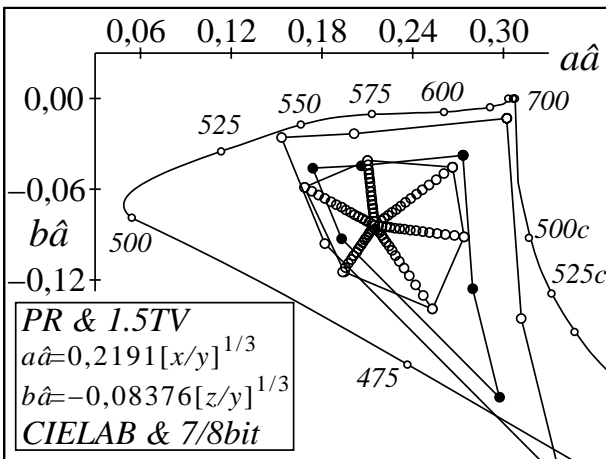


Figure 8: Standard printing and television colours and the 1.5 times more chromatic television colours in the $(a\hat{O}, b\hat{O})$ chromaticity diagram.

Figure 8 shows again the samples of Fig. 3 in the CIE $(a\hat{O}, b\hat{O})$ chromaticity diagram. The chromaticities of the larger TV-hexagon are calculated from the chromaticities of the standard TV-hexagon multiplied by a factor 1.5. Some colours of the series White < Cyanblue are still outside the extended TV-hexagon.

Figure 9 shows the samples of Fig. 6 in the CIE (x,y) chromaticity diagram. The chromaticities (x,y) are calculated from the $(a\hat{O}, b\hat{O})$ chromaticities of Fig. 8.

Therefore only the extended PR-diagrams of Fig. 6 and 7 are useful for the definition of a universal Wide Gamut code (WGcode) which is defined and calculated in Fig. 10 to 16.

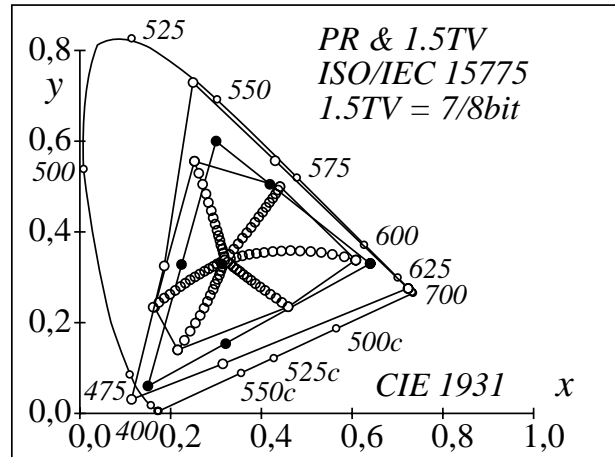


Figure 9: Standard printing and television colours and the 1.5 times more chromatic television colours in the CIE (x,y) chromaticity diagram.

CIELAB and SGcode and WGcode

Fig. 10 to 16 show the standard PR and standard TV colours in both the PR and TV colour system. Therefore the mixed situations are included.

The CIELAB coordinates of the 8 standard colours of printing (PR) and television (TV) are given in Table 1 of ISO/IEC 15775:1999-12. For black and white of both printing and television the lightness range $L^*=18$ to $L^*=95$ of standard printing is used. The choice of this range is no limitation of the WGcode which includes CIELAB colours with $L^*=0$ and $L^*=100$ and the extended chromaticity range of Fig. 6 and 7.

The standard (*absolute LAB**) CIELAB coordinates in Fig. 10 to 16 are transformed to *relative lab** CIELAB coordinates and device adapted (da) CIELAB coordinates for illuminant D65. The olv^* and cmv^* colour data (the star indicate the perceptible colour space) are calculated.

The numerical value of the olv^* or cmv^* data is either 0 or 1 and the SGcode is either 0 or 255 for all standard PR18 colours in the PR18 system (Fig. 10) and for all standard TV18 colours in the TV18 system (Fig. 12).

sRGB and RTU* coordinates

The numerical data of the tristimulus values R_sRGB , G_sRGB , B_sRGB and the nonlinear coordinates $R\hat{O}_sRGB$, $G\hat{O}_sRGB$, $B\hat{O}_sRGB$ in the sRGB colour space according to IEC 61966-2-1:1999-10 are also either 0 or 1 but only for the TV18 colours (Fig. 11, 12, 14, 15). The CIE tristimulus values XYZ are calculated using the luminance factor $Y=88.6$. The white offset reference paper has the luminance factor $Y=88.6$ which corresponds to the lightness $L^*=95$.

Input: Abs. LAB*, rel. lab* *color data L*CIE: 58.62 0.52 A*CIE: -32.62 -0.32 B*CIE: -42.74 -0.42 C*CIE: 53.78 H*CIE: 232.65 L*CIEda: 58.62 0.52 A*CIEda: -32.34 -0.31 B*CIEda: -45.01 -0.44 C*CIEda: 55.44 H*CIEda: 234.3 olv*, olv*0, olv*95 *color data (8bit): o*nPR18: 0.0 0 95 l*nPR18: 1.0 255 158 v*nPR18: 1.0 255 158 cmy*, cmy*0, cmy*95 *color data (8bit): c*wPR18: 1.0 255 158 m*wPR18: 0.0 0 95 y*wPR18: 0.0 0 95 ORS *color data (Offset Reflective Syst.) XCIE1: 20.77 RsRGB: -0.18 YCIE1: 30.04 GsRGB: 0.39 ZCIE1: 80.49 BsRGB: 0.8 R*ORS: -2.45 R*ORS: 100 GsRGB: 0.66 T*ORS: 50 BsRGB: 0.9 U*ORS: G53B	Input: Abs. LAB*, rel. lab* *color data L*CIE: 48.13 0.39 A*CIE: 75.2 0.75 B*CIE: -6.79 -0.06 C*CIE: 75.51 H*CIE: 354.83 L*CIEda: 48.13 0.39 A*CIEda: 75.28 0.75 B*CIEda: -8.36 -0.07 C*CIEda: 75.74 H*CIEda: 353.66 olv*, olv*0, olv*95 *color data (8bit): o*nPR18: 1.0 255 158 l*nPR18: 0.0 0 95 v*nPR18: 1.0 255 158 cmy*, cmy*0, cmy*95 *color data (8bit): c*wPR18: 0.0 0 95 m*wPR18: 1.0 255 158 y*wPR18: 0.0 0 95 ORS *color data (Offset Reflective Syst.) XCIE1: 37.33 RsRGB: 0.78 YCIE1: 19.07 GsRGB: 0.0 ZCIE1: 25.84 BsRGB: 0.25 R*ORS: 0.9 R*ORS: 100 GsRGB: 0.07 T*ORS: 50 BsRGB: 0.54 U*ORS: B63R	Input: Abs. LAB*, rel. lab* *color data L*CIE: 90.37 0.93 A*CIE: -11.15 -0.1 B*CIE: 96.17 0.96 C*CIE: 96.82 H*CIE: 96.62 L*CIEda: 90.37 0.93 A*CIEda: -10.26 -0.09 B*CIEda: 91.75 0.92 C*CIEda: 92.32 H*CIEda: 96.38 olv*, olv*0, olv*95 *color data (8bit): o*nPR18: 1.0 255 158 l*nPR18: 1.0 255 158 v*nPR18: 0.0 0 95 cmy*, cmy*0, cmy*95 *color data (8bit): c*wPR18: 0.0 0 95 m*wPR18: 0.0 0 95 y*wPR18: 1.0 255 158 ORS *color data (Offset Reflective Syst.) XCIE1: 77.28 RsRGB: 1.1 YCIE1: 87.02 GsRGB: 0.88 ZCIE1: 11.82 BsRGB: 0.0 R*ORS: 1.04 R*ORS: 100 GsRGB: 0.94 T*ORS: 50 BsRGB: -0.12 U*ORS: J2G	Input: Abs. LAB*, rel. lab* *color data L*CIE: 47.94 0.39 A*CIE: 65.31 0.65 B*CIE: 52.07 0.52 C*CIE: 83.53 H*CIE: 38.56 L*CIEda: 47.94 0.39 A*CIEda: 65.39 0.65 B*CIEda: 50.52 0.51 C*CIEda: 82.63 H*CIEda: 37.69 olv*, olv*0, olv*95 *color data (8bit): o*nPR18: 1.0 255 158 l*nPR18: 0.0 0 95 v*nPR18: 0.0 0 95 cmy*, cmy*0, cmy*95 *color data (8bit): c*wPR18: 0.0 0 95 m*wPR18: 1.0 255 158 y*wPR18: 1.0 255 158 ORS *color data (Offset Reflective Syst.) XCIE1: 34.02 RsRGB: 0.79 YCIE1: 18.9 GsRGB: 0.02 ZCIE1: 3.27 BsRGB: 0.01 R*ORS: 0.9 R*ORS: 100 GsRGB: 0.17 T*ORS: 50 BsRGB: 0.12 U*ORS: R10J
Input: Abs. LAB*, rel. lab* *color data L*CIE: 50.9 0.42 A*CIE: -62.96 -0.62 B*CIE: 36.71 0.37 C*CIE: 72.89 H*CIE: 149.76 L*CIEda: 50.9 0.42 A*CIEda: -62.83 -0.62 B*CIEda: 34.96 0.35 C*CIEda: 71.91 H*CIEda: 150.91 olv*, olv*0, olv*95 *color data (8bit): o*nPR18: 0.0 0 95 l*nPR18: 1.0 255 158 v*nPR18: 0.0 0 95 cmy*, cmy*0, cmy*95 *color data (8bit): c*wPR18: 1.0 255 158 m*wPR18: 0.0 0 95 y*wPR18: 1.0 255 158 ORS *color data (Offset Reflective Syst.) XCIE1: 9.84 RsRGB: -0.05 YCIE1: 21.65 GsRGB: 0.31 ZCIE1: 7.98 BsRGB: 0.04 R*ORS: -0.69 R*ORS: 100 GsRGB: 0.59 T*ORS: 50 BsRGB: 0.23 U*ORS: J73G	Input: Abs. LAB*, rel. lab* *color data L*CIE: 25.72 0.1 A*CIE: 31.45 0.31 B*CIE: -44.35 -0.43 C*CIE: 54.38 H*CIE: 305.34 L*CIEda: 25.72 0.1 A*CIEda: 31.1 0.31 B*CIEda: -44.4 -0.43 C*CIEda: 54.22 H*CIEda: 305.0 olv*, olv*0, olv*95 *color data (8bit): o*nPR18: 0.0 0 95 l*nPR18: 0.0 0 95 v*nPR18: 1.0 255 158 cmy*, cmy*0, cmy*95 *color data (8bit): c*wPR18: 1.0 255 158 m*wPR18: 1.0 255 158 y*wPR18: 0.0 0 95 ORS *color data (Offset Reflective Syst.) XCIE1: 8.05 RsRGB: 0.05 YCIE1: 5.25 GsRGB: 0.03 ZCIE1: 24.19 BsRGB: 0.24 R*ORS: 0.27 R*ORS: 100 GsRGB: 0.19 T*ORS: 50 BsRGB: 0.53 U*ORS: B15R	Input: Abs. LAB*, rel. lab* *color data L*CIE: 18.01 0.0 A*CIE: 0.5 0.01 B*CIE: -0.46 0.0 C*CIE: 0.69 H*CIE: 316.77 L*CIEda: 18.01 0.0 A*CIEda: 0.0 0.0 B*CIEda: 0.0 0.0 C*CIEda: 0.0 H*CIEda: 45.0 olv*, olv*0, olv*95 *color data (8bit): o*nPR18: 0.0 0 95 l*nPR18: 0.0 0 95 v*nPR18: 0.0 0 95 cmy*, cmy*0, cmy*95 *color data (8bit): c*wPR18: 1.0 255 158 m*wPR18: 1.0 255 158 y*wPR18: 1.0 255 158 ORS *color data (Offset Reflective Syst.) XCIE1: 2.7 RsRGB: 0.02 YCIE1: 2.84 GsRGB: 0.02 ZCIE1: 3.09 BsRGB: 0.02 R*ORS: 0.18 R*ORS: 100 GsRGB: 0.18 T*ORS: 0 BsRGB: 0.18 U*ORS: R22J	Input: Abs. LAB*, rel. lab* *color data L*CIE: 18.01 0.0 A*CIE: -0.98 0.0 B*CIE: 4.76 0.05 C*CIE: 4.86 H*CIE: 101.75 L*CIEda: 95.41 1.0 A*CIEda: 0.0 0.0 B*CIEda: 0.0 0.0 C*CIEda: 0.0 H*CIEda: 45.0 olv*, olv*0, olv*95 *color data (8bit): o*nPR18: 1.0 255 158 l*nPR18: 1.0 255 158 v*nPR18: 1.0 255 158 cmy*, cmy*0, cmy*95 *color data (8bit): c*wPR18: 0.0 0 95 m*wPR18: 0.0 0 95 y*wPR18: 0.0 0 95 ORS *color data (Offset Reflective Syst.) XCIE1: 95.04 RsRGB: 0.99 YCIE1: 99.99 GsRGB: 1.0 ZCIE1: 108.89 BsRGB: 0.99 R*ORS: 0.99 R*ORS: 0 GsRGB: 1.0 T*ORS: 100 BsRGB: 0.99 U*ORS: R22J

Fig. 10: PR18 standard colors in PR18sa system with L*=18–95 (WGcode=95–158=N–W)

Input: Abs. LAB*, rel. lab* *color data L*CIE: 86.88 0.89 A*CIE: -46.17 -0.45 B*CIE: -13.56 -0.13 C*CIE: 48.13 H*CIE: 196.38 L*CIEda: 86.88 0.89 A*CIEda: -46.18 -0.45 B*CIEda: -13.57 -0.13 C*CIEda: 48.14 H*CIEda: 196.38 olv*, olv*0, olv*95 *color data (8bit): o*nPR18: 0.39 99 119 l*nPR18: 1.42 362 184 v*nPR18: 1.01 257 158 cmy*, cmy*0, cmy*95 *color data (8bit): c*wPR18: 0.61 155 133 m*wPR18: -0.41 -104 70 y*wPR18: 0.0 0 95 ORS *color data (Offset Reflective Syst.) XCIE1: 53.8 RsRGB: 0.0 YCIE1: 78.73 GsRGB: 1.0 ZCIE1: 106.98 BsRGB: 1.0 R*ORS: 0.0 R*ORS: 104 GsRGB: 1.0 T*ORS: 91 BsRGB: 1.0 U*ORS: G21B	Input: Abs. LAB*, rel. lab* *color data L*CIE: 57.5 0.51 A*CIE: 94.35 0.94 B*CIE: -58.41 -0.57 C*CIE: 110.97 H*CIE: 328.23 L*CIEda: 57.5 0.51 A*CIEda: 94.34 0.94 B*CIEda: -58.42 -0.57 C*CIEda: 110.97 H*CIEda: 328.23 olv*, olv*0, olv*95 *color data (8bit): o*nPR18: 0.86 219 149 l*nPR18: 0.09 22 100 v*nPR18: 2.03 517 222 cmy*, cmy*0, cmy*95 *color data (8bit): c*wPR18: 0.14 35 103 m*wPR18: 0.91 232 152 y*wPR18: -1.02 -260 31 ORS *color data (Offset Reflective Syst.) XCIE1: 59.65 RsRGB: 1.0 YCIE1: 28.71 GsRGB: 0.0 ZCIE1: 97.52 BsRGB: 1.0 R*ORS: 1.0 R*ORS: 194 GsRGB: 0.01 T*ORS: 105 BsRGB: 1.0 U*ORS: B38R	Input: Abs. LAB*, rel. lab* *color data L*CIE: 92.66 0.96 A*CIE: -20.7 -0.2 B*CIE: 90.75 0.91 C*CIE: 93.08 H*CIE: 102.86 L*CIEda: 92.66 0.96 A*CIEda: -20.71 -0.2 B*CIEda: 90.74 0.91 C*CIEda: 93.08 H*CIEda: 102.86 olv*, olv*0, olv*95 *color data (8bit): o*nPR18: 0.95 242 154 l*nPR18: 1.13 288 166 v*nPR18: 0.03 7 96 cmy*, cmy*0, cmy*95 *color data (8bit): c*wPR18: 0.05 12 98 m*wPR18: -0.12 -30 88 y*wPR18: 0.97 247 156 ORS *color data (Offset Reflective Syst.) XCIE1: 76.98 RsRGB: 0.99 YCIE1: 92.76 GsRGB: 1.0 ZCIE1: 13.85 BsRGB: 0.0 R*ORS: 0.99 R*ORS: 110 GsRGB: 1.0 T*ORS: 58 BsRGB: 0.0 U*ORS: J11G	Input: Abs. LAB*, rel. lab* *color data L*CIE: 50.5 0.42 A*CIE: 76.92 0.77 B*CIE: 64.55 0.65 C*CIE: 100.42 H*CIE: 40.0 L*CIEda: 50.5 0.42 A*CIEda: 76.91 0.77 B*CIEda: 64.54 0.65 C*CIEda: 100.4 H*CIEda: 40.0 olv*, olv*0, olv*95 *color data (8bit): o*nPR18: 1.15 293 167 l*nPR18: -0.02 -5 94 v*nPR18: -0.08 -20 90 cmy*, cmy*0, cmy*95 *color data (8bit): c*wPR18: -0.14 -35 87 m*wPR18: 1.03 262 159 y*wPR18: 1.09 277 163 ORS *color data (Offset Reflective Syst.) XCIE1: 41.23 RsRGB: 0.99 YCIE1: 21.26 GsRGB: 0.0 ZCIE1: 1.93 BsRGB: 0.0 R*ORS: 0.99 R*ORS: 124 GsRGB: 0.0 T*ORS: 52 BsRGB: 0.0 U*ORS: R14J
Input: Abs. LAB*, rel. lab* *color data L*CIE: 83.63 0.85 A*CIE: -82.76 -0.82 B*CIE: 79.9 0.8 C*CIE: 115.04 H*CIE: 136.01 L*CIEda: 83.63 0.85 A*CIEda: -82.77 -0.82 B*CIEda: 79.89 0.8 C*CIEda: 115.04 H*CIEda: 136.02 olv*, olv*0, olv*95 *color data (8bit): o*nPR18: 0.34 86 116 l*nPR18: 1.59 405 195 v*nPR18: -0.04 -10 93 cmy*, cmy*0, cmy*95 *color data (8bit): c*wPR18: 0.66 168 136 m*wPR18: -0.58 -147 59 y*wPR18: 1.05 267 161 ORS *color data (Offset Reflective Syst.) XCIE1: 35.75 RsRGB: 0.0 YCIE1: 71.5 GsRGB: 1.0 ZCIE1: 11.91 BsRGB: 0.0 R*ORS: 0.0 R*ORS: 165 GsRGB: 1.0 T*ORS: 77 BsRGB: 0.0 U*ORS: J54G	Input: Abs. LAB*, rel. lab* *color data L*CIE: 30.39 0.16 A*CIE: 76.06 0.76 B*CIE: -103.59 -1.03 C*CIE: 128.52 H*CIE: 306.29 L*CIEda: 30.39 0.16 A*CIEda: 76.05 0.76 B*CIEda: -103.6 -1.03 C*CIEda: 128.52 H*CIEda: 306.28 olv*, olv*0, olv*95 *color data (8bit): o*nPR18: -0.03 -7 94 l*nPR18: -0.08 -20 90 v*nPR18: 2.28 581 238 cmy*, cmy*0, cmy*95 *color data (8bit): c*wPR18: 1.04 265 160 m*wPR18: 1.09 277 163 y*wPR18: -1.27 -323 15 ORS *color data (Offset Reflective Syst.) XCIE1: 18.04 RsRGB: 0.0 YCIE1: 7.21 GsRGB: 0.0 ZCIE1: 95.07 BsRGB: 1.0 R*ORS: 0.0 R*ORS: 236 GsRGB: 0.0 T*ORS: 110 BsRGB: 1.0 U*ORS: B16R	Input: Abs. LAB*, rel. lab* *color data L*CIE: 18.01 0.0 A*CIE: 0.01 0.0 B*CIE: 0.01 0.0 C*CIE: 0.01 H*CIE: 45.0 L*CIEda: 18.01 0.0 A*CIEda: 0.0 0.0 B*CIEda: 0.0 0.0 C*CIEda: 0.0 H*CIEda: 45.0 olv*, olv*0, olv*95 *color data (8bit): o*nPR18: 0.0 0 95 l*nPR18: 0.0 0 95 v*nPR18: 0.0 0 95 cmy*, cmy*0, cmy*95 *color data (8bit): c*wPR18: 1.0 255 158 m*wPR18: 1.0 255 158 y*wPR18: 1.0 255 158 ORS *color data (Offset Reflective Syst.) XCIE1: 2.7 RsRGB: 0.02 YCIE1: 2.84 GsRGB: 0.02 ZCIE1: 3.09 BsRGB: 0.02 R*ORS: 0.18 R*ORS: 0 GsRGB: 0.18 T*ORS: 0 BsRGB: 0.18 U*ORS: R22J	Input: Abs. LAB*, rel. lab* *color data L*CIE: 95.41 1.0 A*CIE: 0.01 0.0 B*CIE: 0.01 0.0 C*CIE: 0.01 H*CIE: 45.0 L*CIEda: 95.41 1.0 A*CIEda: 0.0 0.0 B*CIEda: 0.0 0.0 C*CIEda: 0.0 H*CIEda: 45.0 olv*, olv*0, olv*95 *color data (8bit): o*nPR18: 1.0 255 158 l*nPR18: 1.0 255 158 v*nPR18: 1.0 255 158 cmy*, cmy*0, cmy*95 *color data (8bit): c*wPR18: 0.0 0 95 m*wPR18: 0.0 0 95 y*wPR18: 0.0 0 95 ORS *color data (Offset Reflective Syst.) XCIE1: 95.04 RsRGB: 0.99 YCIE1: 99.99 GsRGB: 1.0 ZCIE1: 108.89 BsRGB: 0.99 R*ORS: 0.99 R*ORS: 0 GsRGB: 1.0 T*ORS: 100 BsRGB: 0.99 U*ORS: R22J

Fig. 11: TV18 standard colors in PR18sa system with L*=18–95 (WGcode=95–158=N–W)

Input: Abs. LAB*, rel. lab* *color data L*CIE: 86.88 0.89 A*CIE: -46.17 -0.45 B*CIE: -13.56 -0.13 C*CIE: 48.13 H*CIE: 196.38 L*CIEda: 86.88 0.89 A*CIEda: -46.18 -0.45 B*CIEda: -13.57 -0.13 C*CIEda: 48.14 H*CIEda: 196.38 olv*, olv*0, olv*95 *color data (8bit): o*nTV18: 0.0 0 95 l*nTV18: 1.0 255 158 v*nTV18: 1.0 255 158 cmy*, cmy*0, cmy*95 *color data (8bit): c*wTV18: 1.0 255 158 m*wTV18: 0.0 0 95 y*wTV18: 0.0 0 95 TLS *color data (Telev. Luminous Syst.): XCIEI: 53.8 RsRGB: 0.0 YCIEI: 78.73 GsRGB: 1.0 ZCIEI: 106.98 BsRGB: 1.0 R*RGB: 0.0 R*TLS: 100 G*RGB: 1.0 T*TLS: 50 B*RGB: 1.0 U*TLS: G21B	Input: Abs. LAB*, rel. lab* *color data L*CIE: 57.5 0.51 A*CIE: 94.35 0.94 B*CIE: -58.41 -0.57 C*CIE: 110.97 H*CIE: 328.23 L*CIEda: 57.5 0.51 A*CIEda: 94.34 0.94 B*CIEda: -58.42 -0.57 C*CIEda: 110.97 H*CIEda: 328.23 olv*, olv*0, olv*95 *color data (8bit): o*nTV18: 1.0 255 158 l*nTV18: 0.0 0 95 v*nTV18: 1.0 255 158 cmy*, cmy*0, cmy*95 *color data (8bit): c*wTV18: 0.0 0 95 m*wTV18: 1.0 255 158 y*wTV18: 0.0 0 95 TLS *color data (Telev. Luminous Syst.): XCIEI: 59.65 RsRGB: 1.0 YCIEI: 28.71 GsRGB: 0.0 ZCIEI: 97.52 BsRGB: 1.0 R*RGB: 1.0 R*TLS: 100 G*RGB: 0.01 T*TLS: 50 B*RGB: 1.0 U*TLS: B38R	Input: Abs. LAB*, rel. lab* *color data L*CIE: 92.66 0.96 A*CIE: -20.7 -0.2 B*CIE: 90.75 0.91 C*CIE: 93.08 H*CIE: 102.86 L*CIEda: 92.66 0.96 A*CIEda: -20.71 -0.2 B*CIEda: 90.74 0.91 C*CIEda: 93.08 H*CIEda: 102.86 olv*, olv*0, olv*95 *color data (8bit): o*nTV18: 1.0 255 158 l*nTV18: 1.0 255 158 v*nTV18: 0.0 0 95 cmy*, cmy*0, cmy*95 *color data (8bit): c*wTV18: 0.0 0 95 m*wTV18: 0.0 0 95 y*wTV18: 1.0 255 158 TLS *color data (Telev. Luminous Syst.): XCIEI: 76.98 RsRGB: 0.99 YCIEI: 92.76 GsRGB: 1.0 ZCIEI: 13.85 BsRGB: 0.0 R*RGB: 0.99 R*TLS: 100 G*RGB: 1.0 T*TLS: 50 B*RGB: 0.0 U*TLS: J11G	Input: Abs. LAB*, rel. lab* *color data L*CIE: 50.5 0.42 A*CIE: 76.92 0.77 B*CIE: 64.55 0.65 C*CIE: 100.42 H*CIE: 40.0 L*CIEda: 50.5 0.42 A*CIEda: 76.91 0.77 B*CIEda: 64.54 0.65 C*CIEda: 100.4 H*CIEda: 40.0 olv*, olv*0, olv*95 *color data (8bit): o*nTV18: 1.0 255 158 l*nTV18: 0.0 0 95 v*nTV18: 0.0 0 95 cmy*, cmy*0, cmy*95 *color data (8bit): c*wTV18: 0.0 0 95 m*wTV18: 1.0 255 158 y*wTV18: 1.0 255 158 TLS *color data (Telev. Luminous Syst.): XCIEI: 41.23 RsRGB: 0.99 YCIEI: 21.26 GsRGB: 0.0 ZCIEI: 1.93 BsRGB: 0.0 R*RGB: 0.99 R*TLS: 100 G*RGB: 0.0 T*TLS: 50 B*RGB: 0.0 U*TLS: R14J
Input: Abs. LAB*, rel. lab* *color data L*CIE: 83.63 0.85 A*CIE: -82.76 -0.82 B*CIE: 79.9 0.8 C*CIE: 115.04 H*CIE: 136.01 L*CIEda: 83.63 0.85 A*CIEda: -82.77 -0.82 B*CIEda: 79.89 0.8 C*CIEda: 115.04 H*CIEda: 136.02 olv*, olv*0, olv*95 *color data (8bit): o*nTV18: 0.0 0 95 l*nTV18: 1.0 255 158 v*nTV18: 0.0 0 95 cmy*, cmy*0, cmy*95 *color data (8bit): c*wTV18: 1.0 255 158 m*wTV18: 0.0 0 95 y*wTV18: 1.0 255 158 TLS *color data (Telev. Luminous Syst.): XCIEI: 35.75 RsRGB: 0.0 YCIEI: 71.5 GsRGB: 1.0 ZCIEI: 11.91 BsRGB: 0.0 R*RGB: 0.0 R*TLS: 100 G*RGB: 1.0 T*TLS: 50 B*RGB: 0.0 U*TLS: J54G	Input: Abs. LAB*, rel. lab* *color data L*CIE: 30.39 0.16 A*CIE: 76.06 0.76 B*CIE: -103.59 -1.03 C*CIE: 128.52 H*CIE: 306.29 L*CIEda: 30.39 0.16 A*CIEda: 76.05 0.76 B*CIEda: -103.6 -1.03 C*CIEda: 128.52 H*CIEda: 306.28 olv*, olv*0, olv*95 *color data (8bit): o*nTV18: 0.0 0 95 l*nTV18: 0.0 0 95 v*nTV18: 1.0 255 158 cmy*, cmy*0, cmy*95 *color data (8bit): c*wTV18: 1.0 255 158 m*wTV18: 1.0 255 158 y*wTV18: 0.0 0 95 TLS *color data (Telev. Luminous Syst.): XCIEI: 18.04 RsRGB: 0.0 YCIEI: 7.21 GsRGB: 0.0 ZCIEI: 95.07 BsRGB: 1.0 R*RGB: 0.0 R*TLS: 100 G*RGB: 0.0 T*TLS: 50 B*RGB: 1.0 U*TLS: B16R	Input: Abs. LAB*, rel. lab* *color data L*CIE: 18.01 0.0 A*CIE: 0.01 0.0 B*CIE: 0.01 0.0 C*CIE: 0.01 H*CIE: 45.0 L*CIEda: 18.01 0.0 A*CIEda: 0.0 0.0 B*CIEda: 0.0 0.0 C*CIEda: 0.0 H*CIEda: 45.0 olv*, olv*0, olv*95 *color data (8bit): o*nTV18: 0.0 0 95 l*nTV18: 0.0 0 95 v*nTV18: 0.0 0 95 cmy*, cmy*0, cmy*95 *color data (8bit): c*wTV18: 1.0 255 158 m*wTV18: 1.0 255 158 y*wTV18: 1.0 255 158 TLS *color data (Telev. Luminous Syst.): XCIEI: 2.7 RsRGB: 0.02 YCIEI: 2.84 GsRGB: 0.02 ZCIEI: 3.09 BsRGB: 0.02 R*RGB: 0.18 R*TLS: 0 G*RGB: 0.18 T*TLS: 0 B*RGB: 0.18 U*TLS: R22J	Input: Abs. LAB*, rel. lab* *color data L*CIE: 95.41 1.0 A*CIE: 0.01 0.0 B*CIE: 0.01 0.0 C*CIE: 0.01 H*CIE: 45.0 L*CIEda: 95.41 1.0 A*CIEda: 0.0 0.0 B*CIEda: 0.0 0.0 C*CIEda: 0.0 H*CIEda: 45.0 olv*, olv*0, olv*95 *color data (8bit): o*nTV18: 1.0 255 158 l*nTV18: 1.0 255 158 v*nTV18: 1.0 255 158 cmy*, cmy*0, cmy*95 *color data (8bit): c*wTV18: 0.0 0 95 m*wTV18: 0.0 0 95 y*wTV18: 0.0 0 95 TLS *color data (Telev. Luminous Syst.): XCIEI: 95.04 RsRGB: 0.99 YCIEI: 99.99 GsRGB: 1.0 ZCIEI: 108.89 BsRGB: 0.99 R*RGB: 0.99 R*TLS: 0 G*RGB: 1.0 T*TLS: 100 B*RGB: 0.99 U*TLS: R22J

Fig. 12: TV18 standard colors in TV18sa system with L*=18-95 (WGcode=95-158=N-W)

Input: Abs. LAB*, rel. lab* *color data L*CIE: 58.62 0.52 A*CIE: -32.62 -0.32 B*CIE: -42.74 -0.42 C*CIE: 53.78 H*CIE: 232.65 L*CIEda: 58.62 0.52 A*CIEda: -32.34 -0.31 B*CIEda: -45.01 -0.44 C*CIEda: 55.44 H*CIEda: 234.3 olv*, olv*0, olv*95 *color data (8bit): o*nTV18: 0.65 -140 61 l*nTV18: 0.01 155 133 v*nTV18: 0.89 226 151 cmy*, cmy*0, cmy*95 *color data (8bit): c*wTV18: 1.56 397 193 m*wTV18: 0.39 99 119 y*wTV18: 0.11 28 101 TLS *color data (Telev. Luminous Syst.): XCIEI: 20.77 RsRGB: -0.18 YCIEI: 30.04 GsRGB: 0.39 ZCIEI: 80.49 BsRGB: 0.8 R*RGB: -2.45 R*TLS: 145 G*RGB: 0.66 T*TLS: 17 B*RGB: 0.9 U*TLS: G53B	Input: Abs. LAB*, rel. lab* *color data L*CIE: 48.13 0.39 A*CIE: 75.2 0.75 B*CIE: -6.79 -0.06 C*CIE: 75.51 H*CIE: 354.83 L*CIEda: 48.13 0.39 A*CIEda: 75.28 0.75 B*CIEda: -8.36 -0.07 C*CIEda: 75.74 H*CIEda: 353.66 olv*, olv*0, olv*95 *color data (8bit): o*nTV18: 0.84 214 147 l*nTV18: -0.01 -2 95 v*nTV18: 0.5 127 126 cmy*, cmy*0, cmy*95 *color data (8bit): c*wTV18: 0.16 40 105 m*wTV18: 1.02 260 159 y*wTV18: 0.5 127 126 TLS *color data (Telev. Luminous Syst.): XCIEI: 37.33 RsRGB: 0.78 YCIEI: 19.07 GsRGB: 0.0 ZCIEI: 25.84 BsRGB: 0.25 R*RGB: 0.9 R*TLS: 86 G*RGB: 0.07 T*TLS: 41 B*RGB: 0.54 U*TLS: B63R	Input: Abs. LAB*, rel. lab* *color data L*CIE: 90.37 0.93 A*CIE: -11.15 -0.1 B*CIE: 96.17 0.96 C*CIE: 96.82 H*CIE: 96.62 L*CIEda: 90.37 0.93 A*CIEda: -10.26 -0.09 B*CIEda: 91.75 0.92 C*CIEda: 92.32 H*CIEda: 96.38 olv*, olv*0, olv*95 *color data (8bit): o*nTV18: 1.04 265 160 l*nTV18: 0.92 234 152 v*nTV18: 0.0 0 95 cmy*, cmy*0, cmy*95 *color data (8bit): c*wTV18: -0.03 -7 94 m*wTV18: 0.08 20 100 y*wTV18: 1.01 257 158 TLS *color data (Telev. Luminous Syst.): XCIEI: 77.28 RsRGB: 1.1 YCIEI: 87.02 GsRGB: 0.88 ZCIEI: 11.82 BsRGB: 0.0 R*RGB: 1.04 R*TLS: 104 G*RGB: 0.94 T*TLS: 51 B*RGB: -0.12 U*TLS: J2G	Input: Abs. LAB*, rel. lab* *color data L*CIE: 47.94 0.39 A*CIE: 65.31 0.65 B*CIE: 52.07 0.52 C*CIE: 83.53 H*CIE: 38.56 L*CIEda: 47.94 0.39 A*CIEda: 65.39 0.65 B*CIEda: 50.52 0.51 C*CIEda: 82.63 H*CIEda: 37.69 olv*, olv*0, olv*95 *color data (8bit): o*nTV18: 0.87 221 149 l*nTV18: 0.03 7 96 v*nTV18: 0.06 15 98 cmy*, cmy*0, cmy*95 *color data (8bit): c*wTV18: 0.13 33 103 m*wTV18: 0.97 247 156 y*wTV18: 0.94 239 154 TLS *color data (Telev. Luminous Syst.): XCIEI: 34.02 RsRGB: 0.79 YCIEI: 18.9 GsRGB: 0.02 ZCIEI: 3.27 BsRGB: 0.01 R*RGB: 0.9 R*TLS: 84 G*RGB: 0.17 T*TLS: 45 B*RGB: 0.12 U*TLS: R10J
Input: Abs. LAB*, rel. lab* *color data L*CIE: 50.9 0.42 A*CIE: -62.96 -0.62 B*CIE: 36.71 0.37 C*CIE: 72.89 H*CIE: 149.76 L*CIEda: 50.9 0.42 A*CIEda: -62.83 -0.62 B*CIEda: 34.96 0.35 C*CIEda: 71.91 H*CIEda: 150.91 olv*, olv*0, olv*95 *color data (8bit): o*nTV18: -0.39 -99 71 l*nTV18: 0.55 140 129 v*nTV18: 0.04 10 97 cmy*, cmy*0, cmy*95 *color data (8bit): c*wTV18: 1.4 357 183 m*wTV18: 0.45 114 123 y*wTV18: 0.96 244 155 TLS *color data (Telev. Luminous Syst.): XCIEI: 9.84 RsRGB: -0.05 YCIEI: 21.65 GsRGB: 0.31 ZCIEI: 7.98 BsRGB: 0.04 R*RGB: -0.69 R*TLS: 95 G*RGB: 0.59 T*TLS: 7 B*RGB: 0.23 U*TLS: J73G	Input: Abs. LAB*, rel. lab* *color data L*CIE: 25.72 0.1 A*CIE: 31.45 0.31 B*CIE: -44.35 -0.43 C*CIE: 54.38 H*CIE: 305.34 L*CIEda: 25.72 0.1 A*CIEda: 31.1 0.31 B*CIEda: -44.4 -0.43 C*CIEda: 54.22 H*CIEda: 305.0 olv*, olv*0, olv*95 *color data (8bit): o*nTV18: 0.01 2 95 l*nTV18: 0.03 7 96 v*nTV18: 0.46 117 123 cmy*, cmy*0, cmy*95 *color data (8bit): c*wTV18: 0.99 252 157 m*wTV18: 0.97 247 156 y*wTV18: 0.54 137 129 TLS *color data (Telev. Luminous Syst.): XCIEI: 8.05 RsRGB: 0.05 YCIEI: 5.25 GsRGB: 0.03 ZCIEI: 24.19 BsRGB: 0.24 R*RGB: 0.27 R*TLS: 45 G*RGB: 0.19 T*TLS: 23 B*RGB: 0.53 U*TLS: B15R	Input: Abs. LAB*, rel. lab* *color data L*CIE: 18.01 0.0 A*CIE: 0.5 0.01 B*CIE: -0.46 0.0 C*CIE: 0.69 H*CIE: 316.77 L*CIEda: 18.01 0.0 A*CIEda: 0.0 0.0 B*CIEda: 0.0 0.0 C*CIEda: 0.0 H*CIEda: 45.0 olv*, olv*0, olv*95 *color data (8bit): o*nTV18: 0.0 0 95 l*nTV18: 0.0 0 95 v*nTV18: 0.0 0 95 cmy*, cmy*0, cmy*95 *color data (8bit): c*wTV18: 1.0 255 158 m*wTV18: 1.0 255 158 y*wTV18: 1.0 255 158 TLS *color data (Telev. Luminous Syst.): XCIEI: 2.7 RsRGB: 0.02 YCIEI: 2.84 GsRGB: 0.02 ZCIEI: 3.09 BsRGB: 0.02 R*RGB: 0.18 R*TLS: 0 G*RGB: 0.18 T*TLS: 0 B*RGB: 0.18 U*TLS: R22J	Input: Abs. LAB*, rel. lab* *color data L*CIE: 95.41 1.0 A*CIE: -0.98 0.0 B*CIE: 4.76 0.05 C*CIE: 4.86 H*CIE: 101.75 L*CIEda: 95.41 1.0 A*CIEda: 0.0 0.0 B*CIEda: 0.0 0.0 C*CIEda: 0.0 H*CIEda: 45.0 olv*, olv*0, olv*95 *color data (8bit): o*nTV18: 1.0 255 158 l*nTV18: 1.0 255 158 v*nTV18: 1.0 255 158 cmy*, cmy*0, cmy*95 *color data (8bit): c*wTV18: 0.0 0 95 m*wTV18: 0.0 0 95 y*wTV18: 0.0 0 95 TLS *color data (Telev. Luminous Syst.): XCIEI: 95.04 RsRGB: 0.99 YCIEI: 99.99 GsRGB: 1.0 ZCIEI: 108.89 BsRGB: 0.99 R*RGB: 0.99 R*TLS: 0 G*RGB: 1.0 T*TLS: 100 B*RGB: 0.99 U*TLS: R22J

Fig. 13: PR18 standard colors in TV18sa system with L*=18-95 (WGcode=95-158=N-W)

Input: Abs. LAB*, rel. lab* *color data L*CIE: 86.88 0.89 A*CIE: -46.17 -0.45 B*CIE: -13.56 -0.13 C*CIE: 48.13 H*CIE: 196.38 L*CIEda: 86.88 0.89 A*CIEda: -46.18 -0.45 B*CIEda: -13.57 -0.13 C*CIEda: 48.14 H*CIEda: 196.38 olv*, olv*0, olv*91 *color data (8bit): o*nPR18: 0.39 99 119 l*nPR18: 1.42 362 193 v*nPR18: 1.01 257 163 cmy*, cmy*0, cmy*91 *color data (8bit): c*wPR18: 0.61 155 134 m*wPR18: -0.41 -104 62 y*wPR18: 0.0 0 91 ORS *color data (Offset Reflective Syst.) XCIEI: 53.8 RsRGB: 0.0 YCIEI: 78.73 GsRGB: 1.0 ZCIEI: 106.98 BsRGB: 1.0 R*ORS: 104 T*ORS: 91 U*ORS: G21B GsRGB: 1.0 BsRGB: 1.0	Input: Abs. LAB*, rel. lab* *color data L*CIE: 57.5 0.51 A*CIE: 94.35 0.94 B*CIE: -58.41 -0.57 C*CIE: 110.97 H*CIE: 328.23 L*CIEda: 57.5 0.51 A*CIEda: 94.34 0.94 B*CIEda: -58.42 -0.57 C*CIEda: 110.97 H*CIEda: 328.23 olv*, olv*0, olv*91 *color data (8bit): o*nPR18: 0.86 219 152 l*nPR18: 0.09 22 97 v*nPR18: 2.03 517 237 cmy*, cmy*0, cmy*91 *color data (8bit): c*wPR18: 0.14 35 101 m*wPR18: 0.91 232 156 y*wPR18: -1.02 -260 18 ORS *color data (Offset Reflective Syst.) XCIEI: 59.65 RsRGB: 1.0 YCIEI: 28.71 GsRGB: 0.0 ZCIEI: 97.52 BsRGB: 1.0 R*ORS: 194 T*ORS: 105 U*ORS: B38R GsRGB: 1.0 BsRGB: 1.0	Input: Abs. LAB*, rel. lab* *color data L*CIE: 92.66 0.96 A*CIE: -20.7 -0.2 B*CIE: 90.75 0.91 C*CIE: 93.08 H*CIE: 102.86 L*CIEda: 92.66 0.96 A*CIEda: -20.71 -0.2 B*CIEda: 90.74 0.91 C*CIEda: 93.08 H*CIEda: 102.86 olv*, olv*0, olv*91 *color data (8bit): o*nPR18: 0.95 242 159 l*nPR18: 1.13 288 172 v*nPR18: 0.03 7 93 cmy*, cmy*0, cmy*91 *color data (8bit): c*wPR18: 0.05 12 94 m*wPR18: -0.12 -30 83 y*wPR18: 0.97 247 160 ORS *color data (Offset Reflective Syst.) XCIEI: 76.98 RsRGB: 0.99 YCIEI: 92.76 GsRGB: 1.0 ZCIEI: 13.85 BsRGB: 0.0 R*ORS: 110 T*ORS: 58 U*ORS: J11G GsRGB: 1.0 BsRGB: 0.0	Input: Abs. LAB*, rel. lab* *color data L*CIE: 50.5 0.42 A*CIE: 76.92 0.77 B*CIE: 64.55 0.65 C*CIE: 100.42 H*CIE: 40.0 L*CIEda: 50.5 0.42 A*CIEda: 76.91 0.77 B*CIEda: 64.54 0.65 C*CIEda: 100.4 H*CIEda: 40.0 olv*, olv*0, olv*91 *color data (8bit): o*nPR18: 1.15 293 173 l*nPR18: -0.02 -5 90 v*nPR18: -0.08 -20 86 cmy*, cmy*0, cmy*91 *color data (8bit): c*wPR18: -0.14 -35 81 m*wPR18: 1.03 262 165 y*wPR18: 1.09 277 169 ORS *color data (Offset Reflective Syst.) XCIEI: 41.23 RsRGB: 0.99 YCIEI: 21.26 GsRGB: 0.0 ZCIEI: 1.93 BsRGB: 0.0 R*ORS: 124 T*ORS: 52 U*ORS: R14J GsRGB: 0.0 BsRGB: 0.0
Input: Abs. LAB*, rel. lab* *color data L*CIE: 83.63 0.85 A*CIE: -82.76 -0.82 B*CIE: 79.9 0.8 C*CIE: 115.04 H*CIE: 136.01 L*CIEda: 83.63 0.85 A*CIEda: -82.77 -0.82 B*CIEda: 79.89 0.8 C*CIEda: 115.04 H*CIEda: 136.02 olv*, olv*0, olv*91 *color data (8bit): o*nPR18: 0.34 86 115 l*nPR18: 1.59 405 205 v*nPR18: -0.04 -10 89 cmy*, cmy*0, cmy*91 *color data (8bit): c*wPR18: 0.66 168 138 m*wPR18: -0.58 -147 50 y*wPR18: 1.05 267 166 ORS *color data (Offset Reflective Syst.) XCIEI: 35.75 RsRGB: 0.0 YCIEI: 71.5 GsRGB: 1.0 ZCIEI: 11.91 BsRGB: 0.0 R*ORS: 165 T*ORS: 77 U*ORS: J54G GsRGB: 1.0 BsRGB: 0.0	Input: Abs. LAB*, rel. lab* *color data L*CIE: 30.39 0.16 A*CIE: 76.06 0.76 B*CIE: -103.59 -1.03 C*CIE: 128.52 H*CIE: 306.29 L*CIEda: 30.39 0.16 A*CIEda: 76.05 0.76 B*CIEda: -103.6 -1.03 C*CIEda: 128.52 H*CIEda: 306.28 olv*, olv*0, olv*91 *color data (8bit): o*nPR18: -0.03 -7 89 l*nPR18: -0.08 -20 86 v*nPR18: 2.28 581 255 cmy*, cmy*0, cmy*91 *color data (8bit): c*wPR18: 1.04 265 165 m*wPR18: 1.09 277 169 y*wPR18: -1.27 -323 0 ORS *color data (Offset Reflective Syst.) XCIEI: 18.04 RsRGB: 0.0 YCIEI: 7.21 GsRGB: 0.0 ZCIEI: 95.07 BsRGB: 1.0 R*ORS: 236 T*ORS: 110 U*ORS: B16R GsRGB: 0.0 BsRGB: 1.0	Input: Abs. LAB*, rel. lab* *color data L*CIE: 18.01 0.0 A*CIE: 0.01 0.0 B*CIE: 0.01 0.0 C*CIE: 0.01 H*CIE: 45.0 L*CIEda: 18.01 0.0 A*CIEda: 0.0 0.0 B*CIEda: 0.0 0.0 C*CIEda: 0.0 H*CIEda: 45.0 olv*, olv*0, olv*91 *color data (8bit): o*nPR18: 0.0 0 91 l*nPR18: 0.0 0 91 v*nPR18: 0.0 0 91 cmy*, cmy*0, cmy*91 *color data (8bit): c*wPR18: 1.0 255 163 m*wPR18: 1.0 255 163 y*wPR18: 1.0 255 163 ORS *color data (Offset Reflective Syst.) XCIEI: 2.7 RsRGB: 0.02 YCIEI: 2.84 GsRGB: 0.02 ZCIEI: 3.09 BsRGB: 0.02 R*ORS: 0 T*ORS: 0 U*ORS: R22J GsRGB: 0.18 BsRGB: 0.18	Input: Abs. LAB*, rel. lab* *color data L*CIE: 95.41 1.0 A*CIE: 0.01 0.0 B*CIE: 0.01 0.0 C*CIE: 0.01 H*CIE: 45.0 L*CIEda: 95.41 1.0 A*CIEda: 0.0 0.0 B*CIEda: 0.0 0.0 C*CIEda: 0.0 H*CIEda: 45.0 olv*, olv*0, olv*91 *color data (8bit): o*nPR18: 1.0 255 163 l*nPR18: 1.0 255 163 v*nPR18: 1.0 255 163 cmy*, cmy*0, cmy*91 *color data (8bit): c*wPR18: 0.0 0 91 m*wPR18: 0.0 0 91 y*wPR18: 0.0 0 91 ORS *color data (Offset Reflective Syst.) XCIEI: 95.04 RsRGB: 0.99 YCIEI: 99.99 GsRGB: 1.0 ZCIEI: 108.89 BsRGB: 0.99 R*ORS: 0 T*ORS: 100 U*ORS: R22J GsRGB: 0.99 BsRGB: 0.99

Fig. 14: TV18 standard colors in PR18sa system with L*=18-95 (WGcode=91-162=N-W)

Input: Abs. LAB*, rel. lab* *color data L*CIE: 86.88 0.89 A*CIE: -46.17 -0.45 B*CIE: -13.56 -0.13 C*CIE: 48.13 H*CIE: 196.38 L*CIEda: 86.88 0.89 A*CIEda: -46.18 -0.45 B*CIEda: -13.57 -0.13 C*CIEda: 48.14 H*CIEda: 196.38 olv*, olv*0, olv*63 *color data (8bit): o*nPR18: 0.39 99 112 l*nPR18: 1.42 362 243 v*nPR18: 1.01 257 191 cmy*, cmy*0, cmy*63 *color data (8bit): c*wPR18: 0.61 155 140 m*wPR18: -0.41 -104 11 y*wPR18: 0.0 0 63 ORS *color data (Offset Reflective Syst.) XCIEI: 53.8 RsRGB: 0.0 YCIEI: 78.73 GsRGB: 1.0 ZCIEI: 106.98 BsRGB: 1.0 R*ORS: 104 T*ORS: 91 U*ORS: G21B GsRGB: 1.0 BsRGB: 1.0	Input: Abs. LAB*, rel. lab* *color data L*CIE: 57.5 0.51 A*CIE: 94.35 0.94 B*CIE: -58.41 -0.57 C*CIE: 110.97 H*CIE: 328.23 L*CIEda: 57.5 0.51 A*CIEda: 94.34 0.94 B*CIEda: -58.42 -0.57 C*CIEda: 110.97 H*CIEda: 328.23 olv*, olv*0, olv*63 *color data (8bit): o*nPR18: 0.86 219 172 l*nPR18: 0.09 22 74 v*nPR18: 2.03 517 320 cmy*, cmy*0, cmy*63 *color data (8bit): c*wPR18: 0.14 35 80 m*wPR18: 0.91 232 178 y*wPR18: -1.02 -260 -66 ORS *color data (Offset Reflective Syst.) XCIEI: 59.65 RsRGB: 1.0 YCIEI: 28.71 GsRGB: 0.0 ZCIEI: 97.52 BsRGB: 1.0 R*ORS: 194 T*ORS: 105 U*ORS: B38R GsRGB: 1.0 BsRGB: 1.0	Input: Abs. LAB*, rel. lab* *color data L*CIE: 92.66 0.96 A*CIE: -20.7 -0.2 B*CIE: 90.75 0.91 C*CIE: 93.08 H*CIE: 102.86 L*CIEda: 92.66 0.96 A*CIEda: -20.71 -0.2 B*CIEda: 90.74 0.91 C*CIEda: 93.08 H*CIEda: 102.86 olv*, olv*0, olv*63 *color data (8bit): o*nPR18: 0.95 242 183 l*nPR18: 1.13 288 206 v*nPR18: 0.03 7 66 cmy*, cmy*0, cmy*63 *color data (8bit): c*wPR18: 0.05 12 69 m*wPR18: -0.12 -30 48 y*wPR18: 0.97 247 186 ORS *color data (Offset Reflective Syst.) XCIEI: 76.98 RsRGB: 0.99 YCIEI: 92.76 GsRGB: 1.0 ZCIEI: 13.85 BsRGB: 0.0 R*ORS: 110 T*ORS: 58 U*ORS: J11G GsRGB: 1.0 BsRGB: 0.0	Input: Abs. LAB*, rel. lab* *color data L*CIE: 50.5 0.42 A*CIE: 76.92 0.77 B*CIE: 64.55 0.65 C*CIE: 100.42 H*CIE: 40.0 L*CIEda: 50.5 0.42 A*CIEda: 76.91 0.77 B*CIEda: 64.54 0.65 C*CIEda: 100.4 H*CIEda: 40.0 olv*, olv*0, olv*63 *color data (8bit): o*nPR18: 1.15 293 209 l*nPR18: -0.02 -5 61 v*nPR18: -0.08 -20 53 cmy*, cmy*0, cmy*63 *color data (8bit): c*wPR18: -0.14 -35 46 m*wPR18: 1.03 262 193 y*wPR18: 1.09 277 201 ORS *color data (Offset Reflective Syst.) XCIEI: 41.23 RsRGB: 0.99 YCIEI: 21.26 GsRGB: 0.0 ZCIEI: 1.93 BsRGB: 0.0 R*ORS: 124 T*ORS: 52 U*ORS: R14J GsRGB: 0.0 BsRGB: 0.0
Input: Abs. LAB*, rel. lab* *color data L*CIE: 83.63 0.85 A*CIE: -82.76 -0.82 B*CIE: 79.9 0.8 C*CIE: 115.04 H*CIE: 136.01 L*CIEda: 83.63 0.85 A*CIEda: -82.77 -0.82 B*CIEda: 79.89 0.8 C*CIEda: 115.04 H*CIEda: 136.02 olv*, olv*0, olv*63 *color data (8bit): o*nPR18: 0.34 86 106 l*nPR18: 1.59 405 264 v*nPR18: -0.04 -10 58 cmy*, cmy*0, cmy*63 *color data (8bit): c*wPR18: 0.66 168 146 m*wPR18: -0.58 -147 -10 y*wPR18: 1.05 267 196 ORS *color data (Offset Reflective Syst.) XCIEI: 35.75 RsRGB: 0.0 YCIEI: 71.5 GsRGB: 1.0 ZCIEI: 11.91 BsRGB: 0.0 R*ORS: 165 T*ORS: 77 U*ORS: J54G GsRGB: 1.0 BsRGB: 0.0	Input: Abs. LAB*, rel. lab* *color data L*CIE: 30.39 0.16 A*CIE: 76.06 0.76 B*CIE: -103.59 -1.03 C*CIE: 128.52 H*CIE: 306.29 L*CIEda: 30.39 0.16 A*CIEda: 76.05 0.76 B*CIEda: -103.6 -1.03 C*CIEda: 128.52 H*CIEda: 306.28 olv*, olv*0, olv*63 *color data (8bit): o*nPR18: -0.03 -7 60 l*nPR18: -0.08 -20 53 v*nPR18: 2.28 581 352 cmy*, cmy*0, cmy*63 *color data (8bit): c*wPR18: 1.04 265 195 m*wPR18: 1.09 277 201 y*wPR18: -1.27 -323 -98 ORS *color data (Offset Reflective Syst.) XCIEI: 18.04 RsRGB: 0.0 YCIEI: 7.21 GsRGB: 0.0 ZCIEI: 95.07 BsRGB: 1.0 R*ORS: 236 T*ORS: 110 U*ORS: B16R GsRGB: 0.0 BsRGB: 1.0	Input: Abs. LAB*, rel. lab* *color data L*CIE: 18.01 0.0 A*CIE: 0.01 0.0 B*CIE: 0.01 0.0 C*CIE: 0.01 H*CIE: 45.0 L*CIEda: 18.01 0.0 A*CIEda: 0.0 0.0 B*CIEda: 0.0 0.0 C*CIEda: 0.0 H*CIEda: 45.0 olv*, olv*0, olv*63 *color data (8bit): o*nPR18: 0.0 0 63 l*nPR18: 0.0 0 63 v*nPR18: 0.0 0 63 cmy*, cmy*0, cmy*63 *color data (8bit): c*wPR18: 1.0 255 190 m*wPR18: 1.0 255 190 y*wPR18: 1.0 255 190 ORS *color data (Offset Reflective Syst.) XCIEI: 2.7 RsRGB: 0.02 YCIEI: 2.84 GsRGB: 0.02 ZCIEI: 3.09 BsRGB: 0.02 R*ORS: 0 T*ORS: 0 U*ORS: R22J GsRGB: 0.18 BsRGB: 0.18	Input: Abs. LAB*, rel. lab* *color data L*CIE: 95.41 1.0 A*CIE: 0.01 0.0 B*CIE: 0.01 0.0 C*CIE: 0.01 H*CIE: 45.0 L*CIEda: 95.41 1.0 A*CIEda: 0.0 0.0 B*CIEda: 0.0 0.0 C*CIEda: 0.0 H*CIEda: 45.0 olv*, olv*0, olv*63 *color data (8bit): o*nPR18: 1.0 255 190 l*nPR18: 1.0 255 190 v*nPR18: 1.0 255 190 cmy*, cmy*0, cmy*63 *color data (8bit): c*wPR18: 0.0 0 63 m*wPR18: 0.0 0 63 y*wPR18: 0.0 0 63 ORS *color data (Offset Reflective Syst.) XCIEI: 95.04 RsRGB: 0.99 YCIEI: 99.99 GsRGB: 1.0 ZCIEI: 108.89 BsRGB: 0.99 R*ORS: 0 T*ORS: 100 U*ORS: R22J GsRGB: 0.99 BsRGB: 0.99

TV18 standard colors in PR18sa system with L*=18-95 (WGcode=63-190=N-W)

Input: Abs. LAB*, rel. lab* *color data L*CIE: 90.0 0.93 A*CIE: -10.0 -0.09 B*CIE: 0.01 0.0 C*CIE: 10.01 H*CIE: 179.94 L*CIEda: 90.0 1.0 A*CIEda: -10.0 -0.09 B*CIEda: 0.01 0.0 C*CIEda: 10.01 H*CIEda: 179.94 olv*, olv*0, olv*63 *color data (8bit): o* _n PR18: 0.84 214 169 l* _n PR18: 1.04 265 195 v* _n PR18: 0.92 234 179 cmy*, cmy*0, cmy*63 *color data (8bit): c* _w PR18: 0.16 40 83 m* _w PR18: -0.03 -7 60 y* _w PR18: 0.08 20 73 ORS *color data (Offset Reflective Syst.) XCIE1: 76.59 RsRGB: 0.69 YCIE1: 86.12 GsRGB: 0.91 ZCIE1: 93.77 BsRGB: 0.85 R̄sRGB: 0.84 R*ORS: 20 ḠsRGB: 0.96 T*ORS: 94 B̄sRGB: 0.93 U*ORS: G7B	Input: Abs. LAB*, rel. lab* *color data L*CIE: 80.0 0.8 A*CIE: -30.0 -0.29 B*CIE: 0.01 0.0 C*CIE: 30.01 H*CIE: 179.98 L*CIEda: 80.0 0.87 A*CIEda: -30.0 -0.29 B*CIEda: 0.01 0.0 C*CIEda: 30.01 H*CIEda: 179.98 olv*, olv*0, olv*63 *color data (8bit): o* _n PR18: 0.52 132 129 l* _n PR18: 1.12 285 205 v* _n PR18: 0.78 198 162 cmy*, cmy*0, cmy*63 *color data (8bit): c* _w PR18: 0.48 122 123 m* _w PR18: -0.11 -28 50 y* _w PR18: 0.22 56 90 ORS *color data (Offset Reflective Syst.) XCIE1: 48.51 RsRGB: 0.24 YCIE1: 63.97 GsRGB: 0.75 ZCIE1: 69.65 BsRGB: 0.63 R̄sRGB: 0.52 R*ORS: 61 ḠsRGB: 0.88 T*ORS: 82 B̄sRGB: 0.81 U*ORS: G7B	Input: Abs. LAB*, rel. lab* *color data L*CIE: 70.0 0.67 A*CIE: -40.0 -0.39 B*CIE: 0.01 0.0 C*CIE: 40.01 H*CIE: 179.99 L*CIEda: 70.0 0.73 A*CIEda: -40.0 -0.39 B*CIEda: 0.01 0.0 C*CIEda: 40.01 H*CIEda: 179.99 olv*, olv*0, olv*63 *color data (8bit): o* _n PR18: 0.29 73 99 l* _n PR18: 1.1 280 202 v* _n PR18: 0.65 165 145 cmy*, cmy*0, cmy*63 *color data (8bit): c* _w PR18: 0.71 181 153 m* _w PR18: -0.09 -22 52 y* _w PR18: 0.35 89 107 ORS *color data (Offset Reflective Syst.) XCIE1: 31.03 RsRGB: 0.04 YCIE1: 45.99 GsRGB: 0.58 ZCIE1: 50.07 BsRGB: 0.45 R̄sRGB: 0.24 R*ORS: 81 ḠsRGB: 0.78 T*ORS: 70 B̄sRGB: 0.7 U*ORS: G7B	Input: Abs. LAB*, rel. lab* *color data L*CIE: 60.0 0.54 A*CIE: -50.0 -0.49 B*CIE: 0.01 0.0 C*CIE: 50.01 H*CIE: 179.99 L*CIEda: 60.0 0.6 A*CIEda: -50.0 -0.49 B*CIEda: 0.01 0.0 C*CIEda: 50.01 H*CIEda: 179.99 olv*, olv*0, olv*63 *color data (8bit): o* _n PR18: 0.07 17 71 l* _n PR18: 1.08 275 200 v* _n PR18: 0.51 130 127 cmy*, cmy*0, cmy*63 *color data (8bit): c* _w PR18: 0.93 237 181 m* _w PR18: -0.07 -17 55 y* _w PR18: 0.49 124 125 ORS *color data (Offset Reflective Syst.) XCIE1: 18.35 RsRGB: -0.06 YCIE1: 31.74 GsRGB: 0.43 ZCIE1: 34.55 BsRGB: 0.31 R̄sRGB: -0.84 R*ORS: 101 ḠsRGB: 0.68 T*ORS: 57 B̄sRGB: 0.59 U*ORS: G7B
Input: Abs. LAB*, rel. lab* *color data L*CIE: 50.0 0.41 A*CIE: -50.0 -0.49 B*CIE: 0.01 0.0 C*CIE: 50.01 H*CIE: 179.99 L*CIEda: 50.0 0.47 A*CIEda: -50.0 -0.49 B*CIEda: 0.01 0.0 C*CIEda: 50.01 H*CIEda: 179.99 olv*, olv*0, olv*63 *color data (8bit): o* _n PR18: -0.05 -12 57 l* _n PR18: 0.95 242 183 v* _n PR18: 0.38 96 111 cmy*, cmy*0, cmy*63 *color data (8bit): c* _w PR18: 1.06 270 197 m* _w PR18: 0.05 12 69 y* _w PR18: 0.62 158 141 ORS *color data (Offset Reflective Syst.) XCIE1: 11.06 RsRGB: -0.07 YCIE1: 20.78 GsRGB: 0.29 ZCIE1: 22.63 BsRGB: 0.2 R̄sRGB: -0.95 R*ORS: 101 ḠsRGB: 0.57 T*ORS: 45 B̄sRGB: 0.48 U*ORS: G7B	Input: Abs. LAB*, rel. lab* *color data L*CIE: 40.0 0.28 A*CIE: -45.0 -0.44 B*CIE: 0.01 0.0 C*CIE: 45.01 H*CIE: 179.99 L*CIEda: 40.0 0.33 A*CIEda: -45.0 -0.44 B*CIEda: 0.01 0.0 C*CIEda: 45.01 H*CIEda: 179.99 olv*, olv*0, olv*63 *color data (8bit): o* _n PR18: -0.13 -33 47 l* _n PR18: 0.77 196 160 v* _n PR18: 0.26 66 96 cmy*, cmy*0, cmy*63 *color data (8bit): c* _w PR18: 1.14 290 207 m* _w PR18: 0.23 58 92 y* _w PR18: 0.74 188 156 ORS *color data (Offset Reflective Syst.) XCIE1: 6.49 RsRGB: -0.05 YCIE1: 12.69 GsRGB: 0.18 ZCIE1: 13.82 BsRGB: 0.12 R̄sRGB: -0.69 R*ORS: 91 ḠsRGB: 0.46 T*ORS: 31 B̄sRGB: 0.38 U*ORS: G7B	Input: Abs. LAB*, rel. lab* *color data L*CIE: 30.0 0.15 A*CIE: -36.0 -0.35 B*CIE: 0.01 0.0 C*CIE: 36.01 H*CIE: 179.98 L*CIEda: 30.0 0.2 A*CIEda: -36.0 -0.35 B*CIEda: 0.01 0.0 C*CIEda: 36.01 H*CIEda: 179.98 olv*, olv*0, olv*63 *color data (8bit): o* _n PR18: -0.18 -45 41 l* _n PR18: 0.54 137 131 v* _n PR18: 0.13 33 79 cmy*, cmy*0, cmy*63 *color data (8bit): c* _w PR18: 1.19 303 214 m* _w PR18: 0.46 117 121 y* _w PR18: 0.87 221 173 ORS *color data (Offset Reflective Syst.) XCIE1: 3.66 RsRGB: -0.02 YCIE1: 7.03 GsRGB: 0.09 ZCIE1: 7.66 BsRGB: 0.06 R̄sRGB: -0.35 R*ORS: 73 ḠsRGB: 0.34 T*ORS: 18 B̄sRGB: 0.29 U*ORS: G7B	Input: Abs. LAB*, rel. lab* *color data L*CIE: 20.0 0.07 A*CIE: -20.0 -0.19 B*CIE: 0.01 0.0 C*CIE: 20.01 H*CIE: 179.97 L*CIEda: 20.0 0.07 A*CIEda: -20.0 -0.19 B*CIEda: 0.01 0.0 C*CIEda: 20.01 H*CIEda: 179.97 olv*, olv*0, olv*63 *color data (8bit): o* _n PR18: -0.15 -38 44 l* _n PR18: 0.24 61 93 v* _n PR18: 0.01 2 64 cmy*, cmy*0, cmy*63 *color data (8bit): c* _w PR18: 1.16 295 210 m* _w PR18: 0.76 193 159 y* _w PR18: 0.99 252 188 ORS *color data (Offset Reflective Syst.) XCIE1: 2.11 RsRGB: 0.0 YCIE1: 3.37 GsRGB: 0.04 ZCIE1: 3.67 BsRGB: 0.03 R̄sRGB: -0.01 R*ORS: 40 ḠsRGB: 0.23 T*ORS: 4 B̄sRGB: 0.2 U*ORS: G7B

Fig. 16: RAL colors C*max, H*=180, PR18sa system L*=18–95 (WGcode=63–190=N–W)

The radial chromaticness R^* , the triangle lightness T^* , and the unique hue U^* are given. For the six standard chromatic colours of PR and TV the radial chromaticness R^* is 100 and the triangle lightness T^* is 50 in the corresponding systems PR and TV.

One may study as example the TV-colours in PR-system in Fig. 11. For the violet-blue TV-colour in the PR system the radial chromaticness $R^*=236$ indicates that this colour is 2.36 times more chromatic (in relative CIELAB units) compared to the standard PR-colour. The triangle lightness $T^*=110$ indicates a factor 2.2 ($=110/50$) times lighter compared to $T^*=50$ of the standard PR-colour.

The visualization with rectangles is based on the PostScript colour spaces CIELAB, CMY, and RGB using the PostScript parameters *setcolor*, *setcmykcolor* and *setrgbcolor*. On most devices (printers and monitors) the colours with corresponding LAB*, olv* and cmy* coordinates look very different. There are new possibilities with the equations of this paper to make them equal.

The calculations in Fig. 10 to 16 are based on the standard offset printing colours and the standard television colours (see ISO/IEC 15775 for definition). There are large differences, e. g. 75 CIELAB units for the two violet-blue colours in printing and television, which is equal to the CIELAB difference of black N and white W .

CIELAB RAL color System

The RAL color system includes about 1500 glossy samples for the CIE illuminant D65, the CIE 10 degree observer and the CIE 45/0 measurement geometry.

The samples are produced according to the CIELAB colour system. The RAL colour order system is similar compared to the Munsell colour order system. In one hue plane the samples vary in chroma C^* and lightness L^* in steps of 5 or 10 CIELAB units depending on the hue angle.

The hue angle varies between 10 and 360 degrees in steps of 10 degrees.

In the green region (hue angle $H^*=180$) there are very chromatic real samples on the RAL colour order surface. In Fig. 16 the CIELAB data of this RAL colours are used as input, e. g. $L^*=60$, $a^*=-50$ and $b^*=0$. According to Fig. 16 all RAL colours are outside the gamut of the standard printing gamut. For the light green colours there are values larger 1.0 for the green l^* coordinate and for the darker colours there are negative values of the red o^* coordinate in Fig. 16. This indicates the out of standard gamut position for all colours in Fig. 16.

It is clear that all the RAL colours can be coded within the WGcode. This WGcode contains 6bit (64 steps) for the range between Black N and White W .

Fig. 16 shows that the **Mean Gamut code (MGcode)** which contains 7bit (128 steps) for the range between Black N and White W is **sufficient to code all highly chromatic greens** and the other highly chromatic colours of the RAL colour order system. For a higher bit precision it may be useful in many cases to use the MGcode.

Useful applications are photographic and ink jet printers which produce highly chromatic colours.

It is easy to transform from the cmy^* or olv^* values to the standard, mean or wide gamut code (SGcode, MGcode or WGcode).

For the achromatic colours between Black and White (N/W) the standard code range is between 0 and 255. This range is reduced between 63 (=127-64) and 190 (=127+63) for the MGcode and between 95 (=127-32) and 158 (127+31) for the WGcode.

Digital ISO/IEC-test charts

One can find the **digital** ISO/IEC-test charts by using the following URLs (click to go!):

www.ps.bam.de

www.ps.bam.de/INFIE13/INFIE13.HTM

One can find the **digital** DIN-test charts by using the following URL:

www.ps.bam.de/INFDE13/INFDE13.HTM

One can use the digital files according to ISO/IEC 15775 or DIN 33866 to produce an **analog** output on monitors and printers.

Technical reports about image technology and much more examples one can find by the URLs:

www.ps.bam.de/INFXY90.HTM

One can start at the page

www.ps.bam.de/INFVM03/7410/A4Q7410E.PDF

and navigate from page to page or from figure to figure if starting with the URL:

www.ps.bam.de/INFVM03/7410/E7410-3N.PDF

Some more information about ISO/IEC JTC1/SC28 is on the home page and drafts of ISO/IEC standards are under the following URLs (click to go!):

www.actech.com.br/sc28

www.actech.com.br/sc28/15775.html

Future Developments

There are digital files by the URL:

www.ps.bam.de/INFVM03/8910/A4Q8910E.PDF

which allow to optimize the output on any device by colour measurement or visual comparison with the analog ISO/IEC-test charts. It is intended to get a linear relationship between the CIELAB input coordinates (input may be corresponding cmy^* data) and the CIELAB output coordinates (measured by an instrument). Fig. B4 and D4 within the ISO/IEC-test

charts are examples of this linear relationship.

For printers the mean CIELAB differences often can be reduced by a factor 3, e.g. from 12 to 4 CIELAB units. The printer and scanner manufacturers have started to optimize their devices according to ISO/IEC-test charts. Then a user often needs no additional software, e. g. *ICC*-profiles within his software.

If a user is still not satisfied by the device output then he can use his own optimizing method for his application. If a user already works with *ICC*-profiles and is still not satisfied, then again he can use his own optimizing method for his application. In that case this is a kind of update of the *ICC*-method.

References

[1] ISO/IEC 15775: 1999-12, Information technology < Office machines < Machines for colour image reproduction - *Method of specifying image reproduction of colour copying machines by analog test charts < Realisation and application*

[2] ISO/IEC DIS 19839-1 to 4: 2000-04, Information technology < Office machines < Machines for colour image reproduction:

Part 1: *Method of specifying image reproduction by **digital** and **analog** DIN-test charts < Classification and principles*

Part 2: *Method of specifying image reproduction with **digital** input and **analog** output as **hardcopy** of colour image devices: **digital** < **analog** (printers) < Realisation and application*

Part 3: *Method of specifying image reproduction with **analog** input and **digital** output of colour image devices: **analog** < **digital** (scanners) < Realisation and application*

Part 4: *Method of specifying image reproduction with **digital** input and **analog** output as **softcopy** of colour image devices: **digital** < **analog** (monitors) < Realisation and application*

[3] DIN 33866-1 to 5: 2000-07 Information technology < Office machines < Machines for colour image reproduction < Part 2 corresponds to ISO/IEC 15775; Part 1, 3, 4 and 5 corresponds to ISO/IEC DIS 19839-1 to 4.

[4] IEC 61966-2-1: 1999-10, Multimedia systems and equipment < Colour measurement and management - *Part 2-1: Colour management - Default RGB colour space - sRGB*

[5] Klaus Richter, Computergrafik und Farbmetrik, VDE-Verlag, Berlin, 1996, with 500 colour figures in PS and PDF on CD-ROM, ISBN 3-8007-1775-1

[6] Klaus Richter, Automatic colour management for variable processes between original and reproduction using 16 colours of ISO/IEC 15775, CIS2000, Uni Derby, England, p. 197-204, 321-328