see similar files: http://farbe.li.tu-berlin.de/
technical information: http://farbe.li.tu-berlin.de/
http://farbe.li.tu-berlin.de/DE16/DE16L0N1.TXT /.PS
N: no 3D-linearization (OL) in file (F) or PS-startup (S), page 1/1
TUB register: 20180701-DE16L0N1.TXT /.PS
application for movement of offset print output
TUB material: code=fha4a
TUB-text DE16; JUDD observer, colorimetric clculations of chromatic values
Data see K. Richter, PhD thesis, University of Basel (Switzerland), 1969

Transformation between the *Judd* tristimulus and opponent values
Data see *K. Richter*, PhD thesis, University of Basel (Switzerland), 1969, page 81.
For the antagonistic spectral elementary colours
λ_R= 475 nm, λ_G= 502 nm, λ_Y= 574 nm, λ_B= 494e nm
the coordinates $\bar{i}, \bar{d}, \bar{n}$ are used instead of modern coordinates $\bar{l}, \bar{a}, \bar{b}$.
Linear model equations between spectral colour values in both directions:

$$\begin{pmatrix}\bar{x}(\lambda)\\ \bar{y}(\lambda)\\ \bar{z}(\lambda)\end{pmatrix} = \begin{pmatrix} b_{11} & b_{12} & b_{13}\\ b_{21} & b_{22} & b_{23}\\ b_{31} & b_{32} & b_{33}\end{pmatrix} \cdot \begin{pmatrix}\bar{i}(\lambda)\\ \bar{d}(\lambda)\\ \bar{n}(\lambda)\end{pmatrix} \quad \begin{matrix} 0,0000 & 1,0000 & 0,0000\\ 2,9797 & -2,6862 & 0,0980\\ 0,4139 & 1,4571 & -2,4046\end{matrix} \quad \begin{pmatrix}\bar{i}(\lambda)\\ \bar{d}(\lambda)\\ \bar{n}(\lambda)\end{pmatrix} = \begin{pmatrix} a_{11} & a_{12} & a_{13}\\ a_{21} & a_{22} & a_{23}\\ a_{31} & a_{32} & a_{33}\end{pmatrix} \cdot \begin{pmatrix}\bar{x}(\lambda)\\ \bar{y}(\lambda)\\ \bar{z}(\lambda)\end{pmatrix} \quad \begin{matrix} 0,9093 & 0,3338 & -0,0133\\ 1,0000 & 0,0000 & 0,0000\\ 0,4494 & -0,0574 & -0,4136\end{matrix} \quad \begin{pmatrix}\bar{x}(\lambda)\\ \bar{y}(\lambda)\\ \bar{z}(\lambda)\end{pmatrix} \quad (2)$$

The tristimulus values $\bar{x}, \bar{y}, \bar{z}$ and $\bar{i}, \bar{d}, \bar{n}$ are linear transformations.
The unnormalized purity data q_i and h_i are defined in LaMultin 1969 as follows:
$q_i = \bar{i}/(\bar{i}+\bar{d}+\bar{n})$ (3) $h_i = \bar{d}/(\bar{i}+\bar{d}+\bar{n})$ $\quad i=r\,|\,y\,|\,g\,|\,b$
The purity data q_i and h_i are defined in LaMultin 1969 as follows:
$q_r = (0{,}6\bar{i} - 0{,}2\bar{d} - 0{,}1\bar{n}) / (\bar{i}+\bar{d}+\bar{n})$
$= (0{,}6\cdot 0{,}3577 - 0{,}2\cdot 0{,}5702 - 0{,}1\cdot 0{,}0960) / (\bar{i}+\bar{d}+\bar{n})$
$= (0{,}2577) / (\bar{i}+\bar{d}+\bar{n})$ (6)
$h_r = (0{,}6\bar{i}_{Or} - 0{,}2\bar{d}_{Or} - 0{,}1\bar{n}_{Or}) / (\bar{i}+\bar{d}+\bar{n})$
$= (1{,}2986 - 1{,}2861 - 2{,}4046) / (\bar{i}+\bar{d}+\bar{n})$ (7)

DE16|0–7N

Transformation between the *Judd* tristimulus and opponent values
Data see *K. Richter*, PhD thesis, University of Basel (Switzerland), 1969, page 81.
For the antagonistic spectral elementary colours
λ_R= 475 nm, λ_G= 502 nm, λ_Y= 574 nm, λ_B= 494e nm
modern coordinates $\bar{l}, \bar{a}, \bar{b}$ are used instead of $\bar{i}, \bar{d}, \bar{n}$ (= 0 to 3).
Linear model equations between spectral colour values in both directions:

$$\begin{pmatrix}\bar{x}(\lambda)\\ \bar{y}(\lambda)\\ \bar{z}(\lambda)\end{pmatrix} = \begin{pmatrix} b_{11} & b_{12} & b_{13}\\ b_{21} & b_{22} & b_{23}\\ b_{31} & b_{32} & b_{33}\end{pmatrix} \cdot \begin{pmatrix}\bar{l}(\lambda)\\ \bar{a}(\lambda)\\ \bar{b}(\lambda)\end{pmatrix} \quad \begin{matrix} 0,0000 & 1,0000 & 0,0000\\ 2,9797 & -2,6862 & 0,0980\\ 0,4139 & 1,4571 & -2,4046\end{matrix} \quad \begin{pmatrix}\bar{l}(\lambda)\\ \bar{a}(\lambda)\\ \bar{b}(\lambda)\end{pmatrix} = \begin{pmatrix} a_{11} & a_{12} & a_{13}\\ a_{21} & a_{22} & a_{23}\\ a_{31} & a_{32} & a_{33}\end{pmatrix} \cdot \begin{pmatrix}\bar{x}(\lambda)\\ \bar{y}(\lambda)\\ \bar{z}(\lambda)\end{pmatrix} \quad \begin{matrix} 0,9093 & 0,3338 & -0,0133\\ 1,0000 & 0,0000 & 0,0000\\ 0,4494 & -0,0574 & -0,4136\end{matrix} \quad \begin{pmatrix}\bar{x}(\lambda)\\ \bar{y}(\lambda)\\ \bar{z}(\lambda)\end{pmatrix} \quad (2)$$

The tristimulus values $\bar{x}, \bar{y}, \bar{z}$ and $\bar{l}, \bar{a}, \bar{b}$ are linear transformations.
The unnormalized purity data q_i and h_i are defined in LaMultin 1969 as follows:
$q_i = \bar{l}/(\bar{l}+\bar{a}+\bar{b})$ (3) $h_i = \bar{a}/(\bar{l}+\bar{a}+\bar{b})$ $\quad i=r\,|\,y\,|\,g\,|\,b$
The purity data q_i and h_i are defined in LaMultin 1969 as follows:
$q_r = (0{,}6\bar{l} - 0{,}2\bar{a} - 0{,}1\bar{b}) / (\bar{l}+\bar{a}+\bar{b})$
$= (0{,}6\cdot 0{,}3577 - 0{,}2\cdot 0{,}5702 - 0{,}1\cdot 0{,}0960) / (\bar{l}+\bar{a}+\bar{b})$
$= (0{,}1996) / (\bar{l}+\bar{a}+\bar{b})$ (6)
$h_r = (0{,}6\bar{l}_{Or} - 0{,}2\bar{a}_{Or} - 0{,}1\bar{b}_{Or}) / (\bar{l}+\bar{a}+\bar{b})$
$= (1{,}2986 - 1{,}2861 - 2{,}4046) / (\bar{l}+\bar{a}+\bar{b})$ (7)

DE16|0–7N

Transformation between the *Judd* tristimulus and opponent values
Data see *K. Richter*, PhD thesis, University of Basel (Switzerland), 1969, page 81.
For the antagonistic spectral elementary colours
λ_R= 475 nm, λ_G= 502 nm, λ_Y= 574 nm, λ_B= 494e nm
modern coordinates $\bar{l}, \bar{a}, \bar{b}$ are used instead of $\bar{i}, \bar{d}, \bar{n}$ (= 0 to 3).
Linear model equations between spectral colour values in both directions:

$$\begin{pmatrix}\bar{x}(\lambda)\\ \bar{y}(\lambda)\\ \bar{z}(\lambda)\end{pmatrix} = \begin{pmatrix} b_{11} & b_{12} & b_{13}\\ b_{21} & b_{22} & b_{23}\\ b_{31} & b_{32} & b_{33}\end{pmatrix} \cdot \begin{pmatrix}\bar{l}(\lambda)\\ \bar{a}(\lambda)\\ \bar{b}(\lambda)\end{pmatrix} \quad \begin{matrix} 0,0000 & 1,0000 & 0,0000\\ 2,9797 & -2,6862 & 0,0980\\ 0,4139 & 1,4571 & -2,4046\end{matrix} \quad \begin{pmatrix}\bar{l}(\lambda)\\ \bar{a}(\lambda)\\ \bar{b}(\lambda)\end{pmatrix} = \begin{pmatrix} a_{11} & a_{12} & a_{13}\\ a_{21} & a_{22} & a_{23}\\ a_{31} & a_{32} & a_{33}\end{pmatrix} \cdot \begin{pmatrix}\bar{x}(\lambda)\\ \bar{y}(\lambda)\\ \bar{z}(\lambda)\end{pmatrix} \quad \begin{matrix} 0,9093 & 0,3338 & -0,0133\\ 1,0000 & 0,0000 & 0,0000\\ 0,4494 & -0,0574 & -0,4136\end{matrix} \quad \begin{pmatrix}\bar{x}(\lambda)\\ \bar{y}(\lambda)\\ \bar{z}(\lambda)\end{pmatrix} \quad (2)$$

The tristimulus values $\bar{x}, \bar{y}, \bar{z}$ and $\bar{l}, \bar{a}, \bar{b}$ are linear transformations.
The unnormalized purity data q_i and h_i are defined in LaMultin 1969 as follows:
$q_i = \bar{l}/(\bar{l}+\bar{a}+\bar{b})$ (3) $h_i = \bar{a}/(\bar{l}+\bar{a}+\bar{b})$ $\quad i=r\,|\,y\,|\,g\,|\,b$
The purity data q_i and h_i are defined in LaMultin 1969 as follows:
$q_r = (0{,}6\bar{l} - 0{,}2\bar{a} - 0{,}1\bar{b}) / (\bar{l}+\bar{a}+\bar{b})$
$= (0{,}6\cdot 0{,}3577 - 0{,}2\cdot 0{,}5702 - 0{,}1\cdot 0{,}0960) / (\bar{l}+\bar{a}+\bar{b})$
$= (0{,}1996) / (\bar{l}+\bar{a}+\bar{b})$ (6)
$h_r = (0{,}6\bar{l}_{Or} - 0{,}2\bar{a}_{Or} - 0{,}1\bar{b}_{Or}) / (\bar{l}+\bar{a}+\bar{b})$
$= (1{,}2986 - 1{,}2861 - 2{,}4046) / (\bar{l}+\bar{a}+\bar{b})$ (7)

DE16|0–7N

Transformation between the *Judd* purity and chromatic values
Data see *K. Richter*, PhD thesis, University of Basel (Switzerland), 1969, page 83.
For the antagonistic spectral elementary colours
λ_R= 475 nm, λ_G= 502 nm, λ_Y= 574 nm, λ_B= 494e nm
modern coordinates $\bar{l}, \bar{a}, \bar{b}$ are used instead of $\bar{i}, \bar{d}, \bar{n}$ (= 0 to 3).
Relation between opponent and spectral colour values:

$$\begin{pmatrix}\bar{x}(\lambda)\\ \bar{y}(\lambda)\\ \bar{z}(\lambda)\end{pmatrix} = \begin{pmatrix} a_{11} & a_{12} & a_{13}\\ a_{21} & a_{22} & a_{23}\\ a_{31} & a_{32} & a_{33}\end{pmatrix} \cdot \begin{pmatrix}\bar{l}(\lambda)\\ \bar{a}(\lambda)\\ \bar{b}(\lambda)\end{pmatrix} \quad \begin{matrix} 0,9093 & 0,3338 & -0,0133\\ 1,0000 & 0,0000 & 0,0000\\ 0,4494 & -0,0574 & -0,4136\end{matrix} \quad \begin{pmatrix}\bar{l}(\lambda)\\ \bar{a}(\lambda)\\ \bar{b}(\lambda)\end{pmatrix} \quad (2)$$

The tristimulus values $\bar{x}, \bar{y}, \bar{z}$ and $\bar{l}, \bar{a}, \bar{b}$ are linear transformations.
The normalized purity data q_i and h_i are defined in LaMultin 1969 as follows:
$u_i = u_{Ni} = x_i/(x_i+y_i+z_i)$ $\quad v_i = v_{Ni} = y_i/(x_i+y_i+z_i)$ $\quad i=r\,|\,y\,|\,g\,|\,b$ (4)
$x_i = x_{Ni} = u_i/(u_i+v_i+w_i)$ $\quad y_i = y_{Ni} = v_i/(u_i+v_i+w_i)$ $\quad z_i = 1-x_i-y_i$ (5)
Use of equations (2) to (5) leads to:

$$\begin{pmatrix}\bar{x}\\ \bar{y}\\ \bar{z}\end{pmatrix} = \begin{pmatrix} a_{11} & a_{12} & a_{13}\\ a_{21} & a_{22} & a_{23}\\ a_{31} & a_{32} & a_{33}\end{pmatrix} \cdot \begin{pmatrix}\bar{l}\\ \bar{a}\\ \bar{b}\end{pmatrix} \quad (6) \quad \text{and with } s=\bar{X}/(\bar{X}+\bar{Y}+\bar{Z}) \text{ and } t=\bar{Y}/(\bar{X}+\bar{Y}+\bar{Z}) \quad (7)$$

$$\bar{x} = (a_{11}\cdot\bar{a}_r + a_{12}\cdot\bar{b}_r)\cdot\bar{l}_r / (a_{21}\cdot\bar{a}_r + a_{22}\cdot\bar{b}_r)\cdot\bar{l}_r + (a_{13}\cdot\bar{a}_r + a_{23}\cdot\bar{b}_r)\cdot\bar{l}_r + (a_{11}\cdot\bar{a}_y + a_{12}\cdot\bar{b}_y)\cdot\bar{l}_y + (a_{13}\cdot\bar{a}_y + a_{23}\cdot\bar{b}_y)\cdot\bar{l}_y + (a_{11}\cdot\bar{a}_g + a_{12}\cdot\bar{b}_g)\cdot\bar{l}_g + (a_{13}\cdot\bar{a}_g + a_{23}\cdot\bar{b}_g)\cdot\bar{l}_g + (a_{11}\cdot\bar{a}_b + a_{12}\cdot\bar{b}_b)\cdot\bar{l}_b + (a_{13}\cdot\bar{a}_b + a_{23}\cdot\bar{b}_b)\cdot\bar{l}_b$$
$$= (0{,}9093\cdot 0{,}1102_{Or} - 0{,}0133\cdot 0{,}2127_{Or})\cdot 0{,}0987_{Or} + (0{,}9093\cdot 0{,}1102_{Or} - 0{,}0133\cdot 0{,}2127_{Or})\cdot 0{,}2764_{Or} - 0{,}4205\bar{b}_r) \quad (8)$$

$$\bar{y} = (a_{21}\cdot\bar{a}_r + a_{22}\cdot\bar{b}_r)\cdot\bar{l}_r + (a_{23}\cdot\bar{a}_r + a_{23}\cdot\bar{b}_r)\cdot\bar{l}_r + (a_{21}\cdot\bar{a}_y + a_{22}\cdot\bar{b}_y)\cdot\bar{l}_y + (a_{23}\cdot\bar{a}_y + a_{23}\cdot\bar{b}_y)\cdot\bar{l}_y + (a_{21}\cdot\bar{a}_g + a_{22}\cdot\bar{b}_g)\cdot\bar{l}_g + (a_{23}\cdot\bar{a}_g + a_{23}\cdot\bar{b}_g)\cdot\bar{l}_g + (a_{21}\cdot\bar{a}_b + a_{22}\cdot\bar{b}_b)\cdot\bar{l}_b + (a_{23}\cdot\bar{a}_b + a_{23}\cdot\bar{b}_b)\cdot\bar{l}_b$$
$$= (1{,}0000\cdot 0{,}1102_{Or} - 0{,}0133\cdot 0{,}2127_{Or})\cdot 0{,}0987_{Or} + (0{,}9093\cdot 0{,}1102_{Or} - 0{,}0133\cdot 0{,}2127_{Or})\cdot 0{,}2764_{Or} - 0{,}4205\bar{b}_r) \quad (9)$$

$$\bar{z} = (a_{31}\cdot\bar{a}_r + a_{32}\cdot\bar{b}_r)\cdot\bar{l}_r + (a_{33}\cdot\bar{a}_r + a_{33}\cdot\bar{b}_r)\cdot\bar{l}_r + (a_{31}\cdot\bar{a}_y + a_{32}\cdot\bar{b}_y)\cdot\bar{l}_y + (a_{33}\cdot\bar{a}_y + a_{33}\cdot\bar{b}_y)\cdot\bar{l}_y + (a_{31}\cdot\bar{a}_g + a_{32}\cdot\bar{b}_g)\cdot\bar{l}_g + (a_{33}\cdot\bar{a}_g + a_{33}\cdot\bar{b}_g)\cdot\bar{l}_g + (a_{31}\cdot\bar{a}_b + a_{32}\cdot\bar{b}_b)\cdot\bar{l}_b + (a_{33}\cdot\bar{a}_b + a_{33}\cdot\bar{b}_b)\cdot\bar{l}_b$$
$$= (0{,}4494\cdot 0{,}1102_{Or} - 0{,}4136\cdot 0{,}2127_{Or})\cdot 0{,}0987_{Or} + (0{,}4494\cdot 0{,}1102_{Or} - 0{,}4136\cdot 0{,}2127_{Or})\cdot 0{,}2764_{Or} - 0{,}4205\bar{b}_r) \quad (10)$$

DE16|0–7N

Transformation between the *Judd* purity and chromatic values
Data see *K. Richter*, PhD thesis, University of Basel (Switzerland), 1969, page 83.
For the antagonistic spectral elementary colours
λ_R= 475 nm, λ_G= 502 nm, λ_Y= 574 nm, λ_B= 494e nm
modern coordinates $\bar{l}, \bar{a}, \bar{b}$ are used instead of $\bar{i}, \bar{d}, \bar{n}$ (= 0 to 3).
Relation between opponent and spectral colour values:

$$\begin{pmatrix}\bar{x}(\lambda)\\ \bar{y}(\lambda)\\ \bar{z}(\lambda)\end{pmatrix} = \begin{pmatrix} a_{11} & a_{12} & a_{13}\\ a_{21} & a_{22} & a_{23}\\ a_{31} & a_{32} & a_{33}\end{pmatrix} \cdot \begin{pmatrix}\bar{l}(\lambda)\\ \bar{a}(\lambda)\\ \bar{b}(\lambda)\end{pmatrix} \quad \begin{matrix} 0,9093 & 0,3338 & -0,0133\\ 1,0000 & 0,0000 & 0,0000\\ 0,4494 & -0,0574 & -0,4136\end{matrix} \quad \begin{pmatrix}\bar{l}(\lambda)\\ \bar{a}(\lambda)\\ \bar{b}(\lambda)\end{pmatrix} \quad (2)$$

The tristimulus values $\bar{x}, \bar{y}, \bar{z}$ and $\bar{l}, \bar{a}, \bar{b}$ are linear transformations.
The normalized purity data u_i and v_i are defined in LaMultin 1969 as follows:
$u_i = u_{Ni} = x_i/(x_i+y_i+z_i)$ $\quad v_i = v_{Ni} = y_i/(x_i+y_i+z_i)$ $\quad i=r\,|\,y\,|\,g\,|\,b$ (4)
$x_i = x_{Ni} = u_i/(u_i+v_i+w_i)$ $\quad y_i = y_{Ni} = v_i/(u_i+v_i+w_i)$ $\quad z_i = 1-x_i-y_i$ (5)
Use of equations (2) to (5) leads to:

$$\begin{pmatrix}\bar{x}\\ \bar{y}\\ \bar{z}\end{pmatrix} = \begin{pmatrix} a_{11} & a_{12} & a_{13}\\ a_{21} & a_{22} & a_{23}\\ a_{31} & a_{32} & a_{33}\end{pmatrix} \cdot \begin{pmatrix}\bar{l}\\ \bar{a}\\ \bar{b}\end{pmatrix} \quad (6) \quad \text{and with } s=\bar{X}/(\bar{X}+\bar{Y}+\bar{Z}) \text{ and } t=\bar{Y}/(\bar{X}+\bar{Y}+\bar{Z}) \quad (7)$$

$$\bar{x} = (a_{11}\cdot\bar{a}_r + a_{12}\cdot\bar{b}_r)\cdot\bar{l}_r / (a_{21}\cdot\bar{a}_r + a_{22}\cdot\bar{b}_r)\cdot\bar{l}_r + (a_{13}\cdot\bar{a}_r + a_{23}\cdot\bar{b}_r)\cdot\bar{l}_r + (a_{11}\cdot\bar{a}_y + a_{12}\cdot\bar{b}_y)\cdot\bar{l}_y + (a_{13}\cdot\bar{a}_y + a_{23}\cdot\bar{b}_y)\cdot\bar{l}_y + (a_{11}\cdot\bar{a}_g + a_{12}\cdot\bar{b}_g)\cdot\bar{l}_g + (a_{13}\cdot\bar{a}_g + a_{23}\cdot\bar{b}_g)\cdot\bar{l}_g + (a_{11}\cdot\bar{a}_b + a_{12}\cdot\bar{b}_b)\cdot\bar{l}_b + (a_{13}\cdot\bar{a}_b + a_{23}\cdot\bar{b}_b)\cdot\bar{l}_b$$
$$= (0{,}9093\cdot 0{,}1102_{Or} - 0{,}0133\cdot 0{,}2127_{Or})\cdot 0{,}0987_{Or} + (0{,}9093\cdot 0{,}1102_{Or} - 0{,}0133\cdot 0{,}2127_{Or})\cdot 0{,}2764_{Or} - 0{,}4205\bar{b}_r) \quad (8)$$

$$\bar{y} = (a_{21}\cdot\bar{a}_r + a_{22}\cdot\bar{b}_r)\cdot\bar{l}_r + (a_{23}\cdot\bar{a}_r + a_{23}\cdot\bar{b}_r)\cdot\bar{l}_r + (a_{21}\cdot\bar{a}_y + a_{22}\cdot\bar{b}_y)\cdot\bar{l}_y + (a_{23}\cdot\bar{a}_y + a_{23}\cdot\bar{b}_y)\cdot\bar{l}_y + (a_{21}\cdot\bar{a}_g + a_{22}\cdot\bar{b}_g)\cdot\bar{l}_g + (a_{23}\cdot\bar{a}_g + a_{23}\cdot\bar{b}_g)\cdot\bar{l}_g + (a_{21}\cdot\bar{a}_b + a_{22}\cdot\bar{b}_b)\cdot\bar{l}_b + (a_{23}\cdot\bar{a}_b + a_{23}\cdot\bar{b}_b)\cdot\bar{l}_b$$
$$= (1{,}0000\cdot 0{,}1102_{Or} - 0{,}0133\cdot 0{,}2127_{Or})\cdot 0{,}0987_{Or} + (0{,}9093\cdot 0{,}1102_{Or} - 0{,}0133\cdot 0{,}2127_{Or})\cdot 0{,}2764_{Or} - 0{,}4205\bar{b}_r) \quad (9)$$

$$\bar{z} = (a_{31}\cdot\bar{a}_r + a_{32}\cdot\bar{b}_r)\cdot\bar{l}_r + (a_{33}\cdot\bar{a}_r + a_{33}\cdot\bar{b}_r)\cdot\bar{l}_r + (a_{31}\cdot\bar{a}_y + a_{32}\cdot\bar{b}_y)\cdot\bar{l}_y + (a_{33}\cdot\bar{a}_y + a_{33}\cdot\bar{b}_y)\cdot\bar{l}_y + (a_{31}\cdot\bar{a}_g + a_{32}\cdot\bar{b}_g)\cdot\bar{l}_g + (a_{33}\cdot\bar{a}_g + a_{33}\cdot\bar{b}_g)\cdot\bar{l}_g + (a_{31}\cdot\bar{a}_b + a_{32}\cdot\bar{b}_b)\cdot\bar{l}_b + (a_{33}\cdot\bar{a}_b + a_{33}\cdot\bar{b}_b)\cdot\bar{l}_b$$
$$= (0{,}4494\cdot 0{,}1102_{Or} - 0{,}4136\cdot 0{,}2127_{Or})\cdot 0{,}0987_{Or} + (0{,}4494\cdot 0{,}1102_{Or} - 0{,}4136\cdot 0{,}2127_{Or})\cdot 0{,}2764_{Or} - 0{,}4205\bar{b}_r) \quad (10)$$

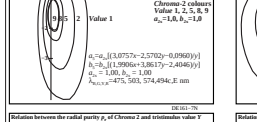
DE16|0–7N

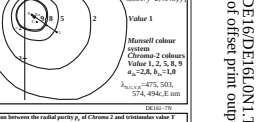
Transformation between the *Judd* tristimulus and opponent values
Data see *K. Richter*, PhD thesis, University of Basel (Switzerland), 1969, page 81.
For the antagonistic spectral elementary colours
λ_R= 475 nm, λ_G= 502 nm, λ_Y= 574 nm, λ_B= 494e nm
modern coordinates $\bar{l}, \bar{a}, \bar{b}$ are used instead of $\bar{i}, \bar{d}, \bar{n}$.
Linear model equations between spectral colour values in both directions:

$$\begin{pmatrix}\bar{x}(\lambda)\\ \bar{y}(\lambda)\\ \bar{z}(\lambda)\end{pmatrix} = \begin{pmatrix} b_{11} & b_{12} & b_{13}\\ b_{21} & b_{22} & b_{23}\\ b_{31} & b_{32} & b_{33}\end{pmatrix} \cdot \begin{pmatrix}\bar{l}(\lambda)\\ \bar{a}(\lambda)\\ \bar{b}(\lambda)\end{pmatrix} \quad \begin{matrix} 0,0000 & 1,0000 & 0,0000\\ 2,9797 & -2,6862 & 0,0980\\ 0,4139 & 1,4571 & -2,4046\end{matrix} \quad \begin{pmatrix}\bar{l}(\lambda)\\ \bar{a}(\lambda)\\ \bar{b}(\lambda)\end{pmatrix} = \begin{pmatrix} a_{11} & a_{12} & a_{13}\\ a_{21} & a_{22} & a_{23}\\ a_{31} & a_{32} & a_{33}\end{pmatrix} \cdot \begin{pmatrix}\bar{x}(\lambda)\\ \bar{y}(\lambda)\\ \bar{z}(\lambda)\end{pmatrix} \quad \begin{matrix} 0,9093 & 0,3338 & -0,0133\\ 1,0000 & 0,0000 & 0,0000\\ 0,4494 & -0,0574 & -0,4136\end{matrix} \quad \begin{pmatrix}\bar{x}(\lambda)\\ \bar{y}(\lambda)\\ \bar{z}(\lambda)\end{pmatrix} \quad (2)$$

The tristimulus values $\bar{x}, \bar{y}, \bar{z}$ and $\bar{l}, \bar{a}, \bar{b}$ are linear transformations.
The normalized purity data q_i and h_i are defined in LaMultin 1969 as follows:
$q_i = \bar{l}/(\bar{l}+\bar{a}+\bar{b})$ (3) $h_i = \bar{a}/(\bar{l}+\bar{a}+\bar{b})$ $\quad i=r\,|\,y\,|\,g\,|\,b$
The purity data q_i and h_i are defined in LaMultin 1969 as follows:
$q_r = (0{,}6\bar{l} - 0{,}2\bar{a} - 0{,}1\bar{b}) / (\bar{l}+\bar{a}+\bar{b})$
$= (0{,}6\cdot 0{,}3577 - 0{,}2\cdot 0{,}5702 - 0{,}1\cdot 0{,}0960) / (\bar{l}+\bar{a}+\bar{b})$
$= (0{,}1996) / (\bar{l}+\bar{a}+\bar{b})$ (6)
$h_r = (0{,}6\bar{l}_{Or} - 0{,}2\bar{a}_{Or} - 0{,}1\bar{b}_{Or}) / (\bar{l}+\bar{a}+\bar{b})$
$= (1{,}2986 - 1{,}2861 - 2{,}4046) / (\bar{l}+\bar{a}+\bar{b})$ (7)

DE16|0–7N



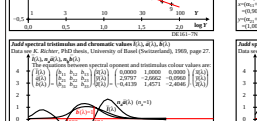


DE16|0–7N

Relation between the radial purity p_i of *Chroma* 2 and tristimulus value Y
Data see *K. Richter*, Phil Diss, University of Basel (Switzerland), 1969, page 103

Value	Sample data									
Y	x_R	x_G	x_Y	x_{cal}	b_{cal}	x_B	y_R	y_G	y_Y	p_{cal}
1,000	1,210	0,315	0,296	1,060	−2,130	0,314	0,324	0,330	−1,623	2,290
0,800	77,770	0,314	0,323	0,340	−1,640	0,314	0,324	0,330	−1,623	0,760
0,600	78,660	0,314	0,326	0,250	−1,590	0,314	0,324	0,330	−1,623	0,560

$\log p_i$ $\quad p_i$ radial purity of *Chroma* 2 hue circles.
$y = (0{,}0000\cdot\ln(1{,}1532_{Or} - 0{,}0133_{Or})\cdot 0{,}2587 - 0{,}0987_{Or} - 0{,}4205\bar{b}_r)$
$y = (1{,}0000 - 0{,}0000_{Or} + 0{,}0000_{Or})\cdot 1{,}2587 - 0{,}0987_{Or} - 0{,}4205\bar{b}_r)$



DE16|0–7N

Relation between the radial purity p_i of *Chroma* 2 and tristimulus value Y
Data see *K. Richter*, Phil Diss, University of Basel (Switzerland), 1969, page 103

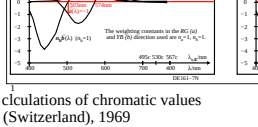
Value	Sample data									
Y	x_R	x_G	x_Y	x_{cal}	b_{cal}	x_B	y_R	y_G	y_Y	p_{cal}
1,000	1,210	0,315	0,296	1,060	−2,130	0,314	0,324	0,330	−1,623	2,290
0,800	77,770	0,314	0,323	0,340	−1,640	0,314	0,324	0,330	−1,623	0,760
0,600	78,660	0,314	0,326	0,250	−1,590	0,314	0,324	0,330	−1,623	0,560

For experimental (Ex) surrounded (bold data), overwhelmed, JOSA 30 (1940) p. 622.
$y = (0{,}0000\cdot\ln(1{,}1532_{Or} - 0{,}0133_{Or})\cdot 0{,}2587 - 0{,}0987_{Or} - 0{,}4205\bar{b}_r)$
$y = (1{,}0000 - 0{,}0000_{Or} + 0{,}0000_{Or})\cdot 1{,}2587 - 0{,}0987_{Or} - 0{,}4205\bar{b}_r)$ (10)

DE16|0–7N

Judd spectral tristimulus and chromatic values $\bar{i}(\lambda)$, $\bar{a}(\lambda)$, $\bar{b}(\lambda)$
Data see *K. Richter*, PhD thesis, University of Basel (Switzerland), 1969, page 27:
For the antagonistic spectral elementary colours
λ_R= 475 nm, λ_G= 502 nm, λ_Y= 574 nm, λ_B= 494e nm
modern coordinates $\bar{l}, \bar{a}, \bar{b}$ are used instead of $\bar{i}, \bar{d}, \bar{n}$ (= 0 to 3).
Linear model equations between spectral colour values in both directions:

$$\begin{pmatrix}\bar{x}(\lambda)\\ \bar{y}(\lambda)\\ \bar{z}(\lambda)\end{pmatrix} = \begin{pmatrix} b_{11} & b_{12} & b_{13}\\ b_{21} & b_{22} & b_{23}\\ b_{31} & b_{32} & b_{33}\end{pmatrix} \cdot \begin{pmatrix}\bar{i}(\lambda)\\ \bar{d}(\lambda)\\ \bar{n}(\lambda)\end{pmatrix} \quad \begin{matrix} 0,0000 & 1,0000 & 0,0000\\ 2,9797 & -2,6862 & 0,0980\\ 0,4139 & 1,4571 & -2,4046\end{matrix} \quad \begin{pmatrix}\bar{i}(\lambda)\\ \bar{d}(\lambda)\\ \bar{n}(\lambda)\end{pmatrix} = \begin{pmatrix} a_{11} & a_{12} & a_{13}\\ a_{21} & a_{22} & a_{23}\\ a_{31} & a_{32} & a_{33}\end{pmatrix} \cdot \begin{pmatrix}\bar{x}(\lambda)\\ \bar{y}(\lambda)\\ \bar{z}(\lambda)\end{pmatrix} \quad \begin{matrix} 0,9093 & 0,3338 & -0,0133\\ 1,0000 & 0,0000 & 0,0000\\ 0,4494 & -0,0574 & -0,4136\end{matrix} \quad \begin{pmatrix}\bar{x}(\lambda)\\ \bar{y}(\lambda)\\ \bar{z}(\lambda)\end{pmatrix} \quad (2)$$



DE16|0–7N

Judd spectral tristimulus and chromatic values $\bar{l}(\lambda)$, $\bar{a}(\lambda)$, $\bar{b}(\lambda)$
Data see *K. Richter*, PhD thesis, University of Basel (Switzerland), 1969, page 27:
For the antagonistic spectral elementary colours
λ_R= 475 nm, λ_G= 502 nm, λ_Y= 574 nm, λ_B= 494e nm
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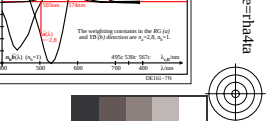
Linear model equations between spectral colour values in both directions:

$$\begin{pmatrix}\bar{x}(\lambda)\\ \bar{y}(\lambda)\\ \bar{z}(\lambda)\end{pmatrix} = \begin{pmatrix} b_{11} & b_{12} & b_{13}\\ b_{21} & b_{22} & b_{23}\\ b_{31} & b_{32} & b_{33}\end{pmatrix} \cdot \begin{pmatrix}\bar{l}(\lambda)\\ \bar{a}(\lambda)\\ \bar{b}(\lambda)\end{pmatrix} \quad \begin{matrix} 0,0000 & 1,0000 & 0,0000\\ 2,9797 & -2,6862 & 0,0980\\ 0,4139 & 1,4571 & -2,4046\end{matrix} \quad \begin{pmatrix}\bar{l}(\lambda)\\ \bar{a}(\lambda)\\ \bar{b}(\lambda)\end{pmatrix} = \begin{pmatrix} a_{11} & a_{12} & a_{13}\\ a_{21} & a_{22} & a_{23}\\ a_{31} & a_{32} & a_{33}\end{pmatrix} \cdot \begin{pmatrix}\bar{x}(\lambda)\\ \bar{y}(\lambda)\\ \bar{z}(\lambda)\end{pmatrix} \quad \begin{matrix} 0,9093 & 0,3338 & -0,0133\\ 1,0000 & 0,0000 & 0,0000\\ 0,4494 & -0,0574 & -0,4136\end{matrix} \quad \begin{pmatrix}\bar{x}(\lambda)\\ \bar{y}(\lambda)\\ \bar{z}(\lambda)\end{pmatrix} \quad (2)$$



DE16|0–7N