Transformation between the *Judd* tristimulus and opponent values

Data see *K. Richter*, PhD thesis, University of Basel (Switzerland), 1969, page 58.

elementary colour	dominant wavelength	*Judd* spectral tristimulus values $\bar{x}(\lambda)$	$\bar{y}(\lambda)$	$\bar{z}(\lambda)$	chromatic values *RG* $\bar{x}_2(\lambda)$	*YB* $\bar{x}_3(\lambda)$
blue	λ_B=475 nm	0,8267	0,9339	0,0017	0,0000	–
green	λ_G=502 nm	0,0107	0,0038	0,0005	−1,0000	0,0000
yellow	λ_Y=574 nm	0,1304	0,1124	0,9281	0,0000	1,0000
red	λ_R=494c,E nm	0,0028	0,3701	0,2238	–	0,0000

There are six equations to calculate the six constants: b_{21} to b_{33}

$\bar{x}_2(\lambda_B)=b_{21}\bar{x}(\lambda_B)+b_{22}\bar{y}(\lambda_B)+b_{23}\bar{z}(\lambda_B)=0$ $\quad\bar{x}_3(\lambda_G)=b_{31}\bar{x}(\lambda_G)+b_{32}\bar{y}(\lambda_G)+b_{33}\bar{z}(\lambda_G)=0$

$\bar{x}_2(\lambda_G)=b_{21}\bar{x}(\lambda_G)+b_{22}\bar{y}(\lambda_G)+b_{23}\bar{z}(\lambda_G)=-1$ $\quad\bar{x}_3(\lambda_Y)=b_{31}\bar{x}(\lambda_Y)+b_{32}\bar{y}(\lambda_Y)+b_{33}\bar{z}(\lambda_Y)=1$

$\bar{x}_2(\lambda_Y)=b_{21}\bar{x}(\lambda_Y)+b_{22}\bar{y}(\lambda_Y)+b_{23}\bar{z}(\lambda_Y)=0$ $\quad\bar{x}_3(\lambda_R)=b_{31}\bar{x}(\lambda_R)+b_{32}\bar{y}(\lambda_R)+b_{33}\bar{z}(\lambda_R)=0$

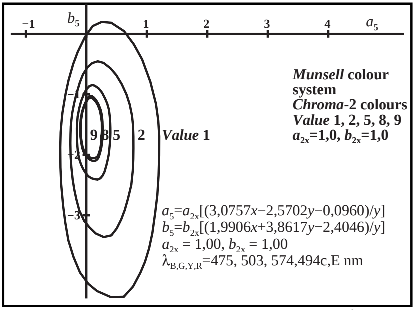
Together with the use of the standard equation: $\bar{x}_1(\lambda)=\bar{y}(\lambda)$ (1)

the equations between spectral opponent and tristimulus colour values are:

$$\begin{pmatrix}\bar{x}_1(\lambda)\\ \bar{x}_2(\lambda)\\ \bar{x}_3(\lambda)\end{pmatrix}=\begin{pmatrix}b_{11}&b_{12}&b_{13}\\ b_{21}&b_{22}&b_{23}\\ b_{31}&b_{32}&b_{33}\end{pmatrix}\cdot\begin{pmatrix}\bar{x}(\lambda)\\ \bar{y}(\lambda)\\ \bar{z}(\lambda)\end{pmatrix}=\begin{pmatrix}0{,}0000&1{,}0000&0{,}0000\\ 2{,}9797&-2{,}6662&-0{,}0960\\ -0{,}4139&1{,}4571&-2{,}4046\end{pmatrix}\cdot\begin{pmatrix}\bar{x}(\lambda)\\ \bar{y}(\lambda)\\ \bar{z}(\lambda)\end{pmatrix} \quad (2)$$

Remark: The weighting ratio in the *RG* and *YB* direction is 2,8:1 or 1:0,3571.

DE161−7R

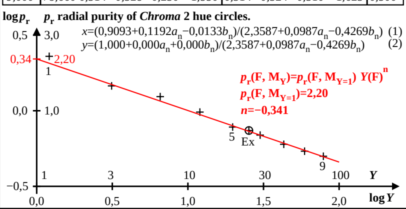


DE161−7R

Relation between the radial purity p_r of *Chroma* 2 and tristimulus value *Y*

Data see *K. Richter*, PhD thesis, University of Basel (Switzerland), 1969, page 101.

V	Y	x_M	y_M	$a_{n,M}$	$b_{n,M}$	x_U	y_U	$a_{n,U}$	$b_{n,U}$	$p_{r,MU}$
1,000	1,210	0,315	0,296	1,060	−2,130	0,314	0,324	0,310	−1,623	2,290
5,000	19,770	0,314	0,323	0,340	−1,640	0,314	0,324	0,310	−1,623	0,780
9,000	78,660	0,314	0,328	0,230	−1,550	0,314	0,324	0,310	−1,623	0,500



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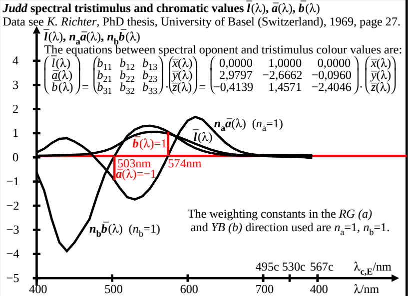
***Judd* spectral tristimulus and chromatic values $\bar{l}(\lambda)$, $\bar{a}(\lambda)$, $\bar{b}(\lambda)$**

Data see *K. Richter*, PhD thesis, University of Basel (Switzerland), 1969, page 27.



DE161−7R

Transformation between the *Judd* tristimulus and opponent values

Data see *K. Richter*, PhD thesis, University of Basel (Switzerland), 1969, page 58.

elementary colour	dominant wavelength	*Judd* spectral tristimulus values $\bar{x}(\lambda)$	$\bar{y}(\lambda)$	$\bar{z}(\lambda)$	chromatic values *RG* $\bar{a}(\lambda)$	*YB* $\bar{b}(\lambda)$
blue	λ_B=475 nm	0,8267	0,9339	0,0017	0,0000	–
green	λ_G=502 nm	0,0107	0,0038	0,0005	−1,0000	0,0000
yellow	λ_Y=574 nm	0,1304	0,1124	0,9281	0,0000	1,0000
red	λ_R=494c,E nm	0,0028	0,3701	0,2238	–	0,0000

There are six equations to calculate the six constants: b_{21} to b_{33}

$\bar{a}(\lambda_B)=b_{21}\bar{x}(\lambda_B)+b_{22}\bar{y}(\lambda_B)+b_{23}\bar{z}(\lambda_B)=0$ $\quad\bar{b}(\lambda_G)=b_{31}\bar{x}(\lambda_G)+b_{32}\bar{y}(\lambda_G)+b_{33}\bar{z}(\lambda_G)=0$

$\bar{a}(\lambda_G)=b_{21}\bar{x}(\lambda_G)+b_{22}\bar{y}(\lambda_G)+b_{23}\bar{z}(\lambda_G)=-1$ $\quad\bar{b}(\lambda_Y)=b_{31}\bar{x}(\lambda_Y)+b_{32}\bar{y}(\lambda_Y)+b_{33}\bar{z}(\lambda_Y)=1$

$\bar{a}(\lambda_Y)=b_{21}\bar{x}(\lambda_Y)+b_{22}\bar{y}(\lambda_Y)+b_{23}\bar{z}(\lambda_Y)=0$ $\quad\bar{b}(\lambda_R)=b_{31}\bar{x}(\lambda_R)+b_{32}\bar{y}(\lambda_R)+b_{33}\bar{z}(\lambda_R)=0$

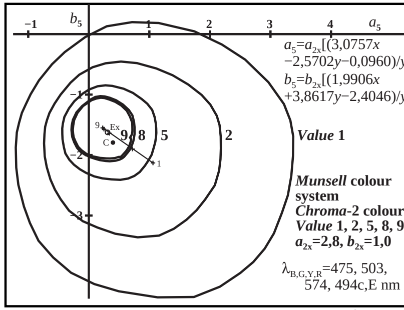
Together with the use of the standard equation: $\bar{l}(\lambda)=\bar{y}(\lambda)$ (1)

the equations between spectral opponent and tristimulus colour values are:

$$\begin{pmatrix}\bar{l}(\lambda)\\ \bar{a}(\lambda)\\ \bar{b}(\lambda)\end{pmatrix}=\begin{pmatrix}b_{11}&b_{12}&b_{13}\\ b_{21}&b_{22}&b_{23}\\ b_{31}&b_{32}&b_{33}\end{pmatrix}\cdot\begin{pmatrix}\bar{x}(\lambda)\\ \bar{y}(\lambda)\\ \bar{z}(\lambda)\end{pmatrix}=\begin{pmatrix}0{,}0000&1{,}0000&0{,}0000\\ 2{,}9797&-2{,}6662&-0{,}0960\\ -0{,}4139&1{,}4571&-2{,}4046\end{pmatrix}\cdot\begin{pmatrix}\bar{x}(\lambda)\\ \bar{y}(\lambda)\\ \bar{z}(\lambda)\end{pmatrix} \quad (2)$$

Remark: The weighting ratio in the *RG* and *YB* direction is 2,8:1 or 1:0,3571.

DE161−7R



DE161−7R

Relation between the radial purity p_r of *Chroma* 2 and tristimulus value *Y*

Data see *K. Richter*, PhD thesis, University of Basel (Switzerland), 1969, page 101.

Value *V*	sample data *Y*	x_M	y_M	$a_{n,M}$	$b_{n,M}$	surround data x_U	y_U	$a_{n,U}$	$b_{n,U}$	purity $p_{r,MU}$
1,000	1,210	0,315	0,296	1,060	−2,130	0,314	0,324	0,310	−1,623	2,290
2,000	3,130	0,314	0,308	0,720	−1,900	0,314	0,324	0,310	−1,623	1,460
3,000	6,560	0,314	0,315	0,560	−1,780	0,314	0,324	0,310	−1,623	1,240
4,000	12,000	0,314	0,320	0,430	−1,690	0,314	0,324	0,310	−1,623	0,980
5,000	19,770	0,314	0,323	0,340	−1,640	0,314	0,324	0,310	−1,623	0,780
5,570	**25,300**	**0,314**	**0,324**	**0,310**	**−1,623**	**0,314**	**0,324**	**0,310**	**−1,623**	**0,740**
6,000	30,050	0,314	0,325	0,300	−1,610	0,314	0,324	0,310	−1,623	0,690
7,000	43,060	0,314	0,326	0,270	−1,590	0,314	0,324	0,310	−1,623	0,600
8,000	59,100	0,314	0,327	0,250	−1,570	0,314	0,324	0,310	−1,623	0,540
9,000	78,660	0,314	0,328	0,230	−1,550	0,314	0,324	0,310	−1,623	0,500

For experimental (Ex) surround (bold data), see*Newhall*, JOSA 30 (1940) p. 622

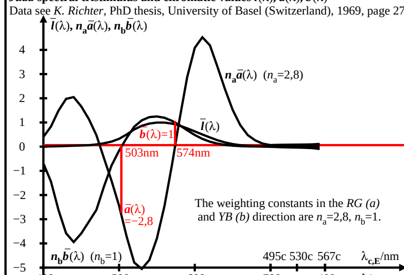
$x=(\alpha_{11}+\alpha_{12}a_n+\alpha_{13}b_n)/(\alpha_{31}+\alpha_{32}a_n+\alpha_{33}b_n)$
$=(0{,}9093+0{,}1192a_n-0{,}0133b_n)/(2{,}3587+0{,}0987a_n-0{,}4269b_n)$ (9)

$y=(\alpha_{21}+\alpha_{22}a_n+\alpha_{23}b_n)/(\alpha_{31}+\alpha_{32}a_n+\alpha_{33}b_n)$
$=(1{,}000+0{,}000a_n+0{,}000b_n)/(2{,}3587+0{,}0987a_n-0{,}4269b_n)$ (10)

DE161−7R

***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.



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