## Equations: colorimetric data transfer from *LCH*a* (CIELAB) to *nce** and *olv*3*

**Given: CIELAB data of any colour *L**, *C*ab,a*, *hab,a* = *LCH*a* = *LAB*LCH*a* or *L**, *a*a*, *b*a***
**CIELAB data *L**, *C*ab,a*, *hab,a*, *a*a*, *b*a* of eigth basic colours *X* = *OYLCVMNW***
**Aim: *nce** and *rgb* device data *olv*3* of the given colour** (in example *M* located between *O* and *Y)*

| | | | |
|---|---|---|---|
| CIELAB Hue angle of colour and maximum colour *M* | $h_{ab,a} = h_{ab,a,M}$ | ( 0 <= $h_{ab,a}$ <= 360 ) | (1) |
| Relative device hue angle ratio of *M* | $\alpha_{a,M} = [h_{ab,a,M} - h_{ab,a,O}] / [h_{ab,a,Y} - h_{ab,a,O}]$ | | (2) |
| CIELAB lightness of *M* | $L^*_M = \alpha_{a,M}\, L^*_{a,Y} + (1 - \alpha_{a,M})\, L^*_{a,O}$ | | (3) |
| CIELAB red-green chroma of *M* | $a^*_{a,M} = \alpha_{a,M}\, a^*_{a,Y} + (1 - \alpha_{a,M})\, a^*_{a,O}$ | | (4) |
| CIELAB yellow-blue chroma of *M* | $b^*_{a,M} = \alpha_{a,M}\, b^*_{a,Y} + (1 - \alpha_{a,M})\, b^*_{a,O}$ | | (5) |
| radial CIELAB chroma of *M* | $C^*_{ab,a,M} = [\, a^{*2}_{a,M} + b^{*2}_{a,M} \,]^{1/2}$ | | (6) |
| relative lightness of the given colour | $l^* = [\, L^* - L^*_N \,] / [\, L^*_W - L^*_N \,]$ | | (7) |
| relative chroma of the given colour | $c^* = C^*_{ab,a} / C^*_{ab,a,M}$ | | (8) |
| relative triangle lightness of the given colour | $t^* = l^* - [\, L^*_M - L^*_N \,] / [\, L^*_W - L^*_N \,]\, c^* + 0{,}5\, c^*$ | | (9) |
| relative blackness of the given colour | $n^* = 1 - t^* - 0{,}5\, c^*$ | | (10) |
| relative whiteness of the given colour | $w^* = 1 - n^* - c^*$ | | (11) |
| elementary hue angle of the given colour | $e^* =$ function [ $h_{ab,a}$ ] | (with table/equation) | (12) |
| relative *olv*3,M* data of *M* | $o^*_{3,M} = \alpha_{a,M}\, o^*_{3,Y} + (1 - \alpha_{a,M})\, o^*_{3,O}$ | | (13) |
| | $l^*_{3,M} = \alpha_{a,M}\, l^*_{3,Y} + (1 - \alpha_{a,M})\, l^*_{3,O}$ | | (14) |
| | $v^*_{3,M} = \alpha_{a,M}\, v^*_{3,Y} + (1 - \alpha_{a,M})\, v^*_{3,O}$ | | (15) |
| relative *olv*3* data of the given colour | $o^*_3 = w^* + c^*\, o^*_{3,M}$ | | (16) |
| | $l^*_3 = w^* + c^*\, l^*_{3,M}$ | | (17) |
| | $v^*_3 = w^* + c^*\, v^*_{3,M}$ | | (18) |

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## Equations: colorimetric data transfer from *nce** to *olv*3* (*rgb* data) and *LCH*a*

**Given: *nce** data (similar NCS) of any colour *nce** = *lab*nce**** ( 0 <= *n**, *c**, *e** <= 1 )
**adapted CIELAB data *L**, *C*ab,a*, *hab,a*, *a*a*, *b*a* of eigth basic colours *X* = *OYLCVMNW***
**Aim: *rgb* device data *olv*3* and *LCH*a* of the given colour**

| | | | |
|---|---|---|---|
| elementary hue number of a colour | $e^*$ | ( 0 <= $e^*$ <= 1 ) | (1) |
| CIELAB hue angle of colour and maximum colour *M* | $h_{ab,a} =$ function [ $e^*$ ] | (with table/equation) | (2) |
| relative whiteness of the given colour | $w^* = 1 - n^* - c^*$ | | (3) |
| relative triangle lightness of the given colour | $t^* = = 1 - n^* - 0{,}5\, c^*$ | | (4) |
| *olv*3,M* data of maximum colour *M* | $o^*_{3,M} =$ function [ $h_{ab,a}$ ] | (with table/equation) | (5) |
| | $l^*_{3,M} =$ function [ $h_{ab,a}$ ] | (with table/equation) | (6) |
| | $v^*_{3,M} =$ function [ $h_{ab,a}$ ] | (with table/equation) | (7) |
| relative *olv*3* data of the given colour | $o^*_3 = w^* + c^*\, o^*_{3,M}$ | | (8) |
| | $l^*_3 = w^* + c^*\, l^*_{3,M}$ | | (9) |
| | $v^*_3 = w^* + c^*\, v^*_{3,M}$ | | (10) |
| adapted CIELAB *LCH*a,M* data of maximum colour *M* | $L^*_M =$ function [ $h_{ab,a}$ ] | (with table/equation) | (11) |
| | $C^*_{ab,a,M} =$ function [ $h_{ab,a}$ ] | (with table/equation) | (12) |
| | $h_{ab,a,M} = h_{ab,a}$ | | (13) |
| relative lightness of maximum colour M | $l^*_M = [\, L^*_M - L^*_N \,] / [\, L^*_W - L^*_N \,]$ | | (14) |
| relative lightness of the given colour | $l^* = t^* + l^*_M\, c^* + 0{,}5\, c^*$ | | (15) |
| adapted CIELAB *LCH*a* data of the given colour | $L^* = l^* [\, L^*_W - L^*_N \,] + L^*_N$ | | (16) |
| | $C^*_{ab,a} = c^*\, C^*_{ab,a,M}$ | | (17) |
| | $h_{ab,a} = h_{ab,a,M}$ | | (18) |

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## Equations: colorimetric data transfer from *LCH*a* (CIELAB) to *nce** and *olv*3*

**Given: adapted CIELAB data of any colour *L**, *C*ab,a*, *hab,a* = *LCH*a* = *LAB*LCH*a***
**adapted CIELAB data *L**, *C*ab,a*, *hab,a*, *a*a*, *b*a* of eigth basic colours *X* = *OYLCVMNW***
**Aim: *nce** and *rgb* device data *olv*3* of the given colour**

| | | | |
|---|---|---|---|
| hue angle of of the given colour and of *M* | $h_{ab,a} = H^*_a$ | | (1) |
| CIELAB *LCH*a,M* data of maximum colour *M* | $L^*_M =$ function [ $h_{ab,a}$ ] | (with table/equation) | (2) |
| | $C^*_{ab,a,M} =$ function [ $h_{ab,a}$ ] | (with table/equation) | (3) |
| | $h_{ab,a,M} = h_{ab,a}$ | | (4) |
| relative lightness of the given colour | $l^* = [\, L^* - L^*_N \,] / [\, L^*_W - L^*_N \,]$ | | (5) |
| relative chroma of the given colour | $c^* = C^*_{ab,a} / C^*_{ab,a,M}$ | | (6) |
| relative triangle lightness of the given colour | $t^* = l^* - [\, L^*_M - L^*_N \,] / [\, L^*_W - L^*_N \,]\, c^* + 0{,}5\, c^*$ | | (7) |
| relative blackness of the given colour | $n^* = 1 - t^* - 0{,}5\, c^*$ | | (8) |
| relative whiteness of the given colour | $w^* = 1 - n^* - c^*$ | | (9) |
| elementary hue angle of the given colour | $e^* =$ function [ $h_{ab,a}$ ] | (with table or equation) | (10) |
| relative *olv*3,M* data of maximum colour *M* | $o^*_{3,M} =$ function [ $h_{ab,a}$ ] | (with table/equation) | (11) |
| | $l^*_{3,M} =$ function [ $h_{ab,a}$ ] | (with table/equation) | (12) |
| | $v^*_{3,M} =$ function [ $h_{ab,a}$ ] | (with table/equation) | (13) |
| relative *olv*3* data of the given colour | $o^*_3 = w^* + c^*\, o^*_{3,M}$ | | (14) |
| | $l^*_3 = w^* + c^*\, l^*_{3,M}$ | | (15) |
| | $v^*_3 = w^* + c^*\, v^*_{3,M}$ | | (16) |

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## Equations: colorimetric data transfer from *olv*3* to *nce** data and *LCH*a* data

**Given: *rgb* device data of any colour *olv*3* = *lab*olv*3***
**adapted CIELAB data *L**, *C*ab,a*, *hab,a*, *a*a*, *b*a* of eigth basic colours *X* = *OYLCVMNW***
**Aim: *nce** = *lab*nce** (similar to NCS data) and *LCH*a* data of the given colour** ( 0 <= $e^*$ <= 1 )

| | | | |
|---|---|---|---|
| relative chroma of the given colour | $c^* = max$ [ *olv*3* ] − *min* [ *olv*3* ] | | (1) |
| relative blackness of the given colour | $n^* = 1 - max$ [ *olv*3* ] | | (2) |
| relative triangle lightness of the given colour | $t^* = 1 - n^* - 0{,}5\, c^*$ | | (3) |
| relative red-green chroma in 60 degree system s | $a^*_{rs} = o^*_3\, cos(30) + l^*_3\, cos(150)$ | | (4) |
| relative yellow-blue chroma in 60 degree system s | $b^*_{rs} = o^*_3\, sin(30) + l^*_3\, sin(150) + v^*_3\, sin(270)$ | | (5) |
| hue angle in 60 degree system s | $h_{ab,s} = arctan\, [\, b^*_{rs} / a^*_{rs} \,]$ | ( 0 <= $h_{ab,s}$ <= 360 ) | (6) |
| CIELAB hue angle in device system | $h_{ab,a} =$ function [ $h_{ab,s}$ ] | (with table/equation) | (7) |
| elementary hue number of the given colour | $e^* =$ function [ $h_{ab,a}$ ] | (with table/equation) | (8) |
| adapted CIELAB *LCH*a* data of maximum colour *M* | $L^*_M =$ function [ $h_{ab,a}$ ] | (with table/equation) | (9) |
| | $C^*_{ab,a,M} =$ function [ $h_{ab,a}$ ] | (with table/equation) | (10) |
| | $h_{ab,a,M} = h_{ab,a}$ | | (11) |
| relative lightness of maximum colour *M* | $l^*_M = [\, L^*_M - L^*_N \,] / [\, L^*_W - L^*_N \,]$ | | (12) |
| relative lightness of the given colour | $l^* = t^* + l^*_M\, c^* + 0{,}5\, c^*$ | | (13) |
| adapted CIELAB *LCH*a* data of the given colour | $L^* = l^* [\, L^*_W - L^*_N \,] + L^*_N$ | | (14) |
| | $C^*_{ab,a} = c^*\, C^*_{ab,a,M}$ | | (15) |
| | $h_{ab,a} = h_{ab,a,M}$ | | (16) |

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BAM-test chart ZE12; colorimetric coordinate transfer
Equations for the transfer between *olv*3*, *LCH*a* and *nce**

input: *rgb (->olv*3) setrgbcolor*
output: no change compared to input