

**Rozvoj lidských zdrojů TUL pro zvyšování relevance,
kvality a přístupu ke vzdělání v podmínkách Průmyslu 4.0**

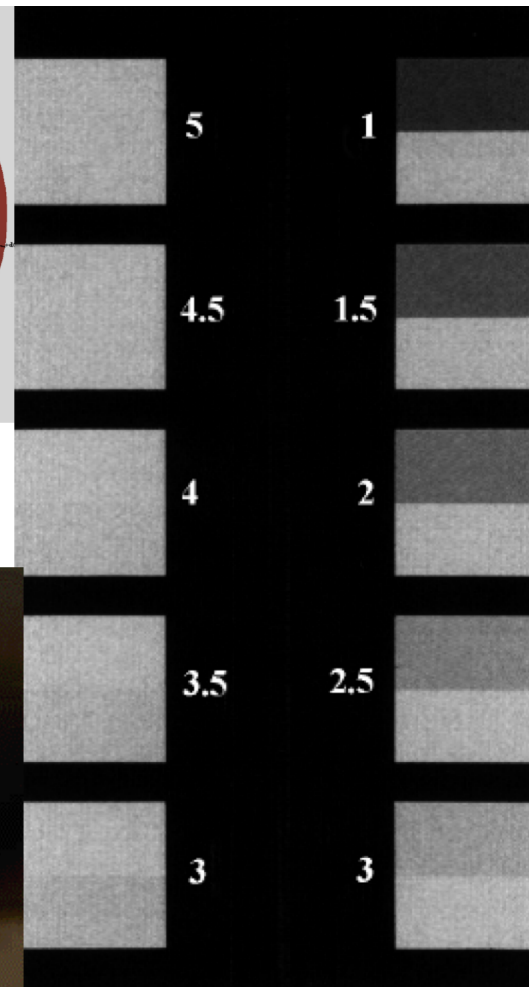
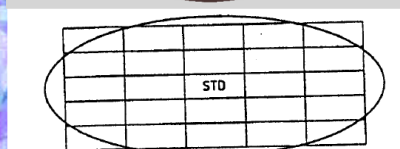
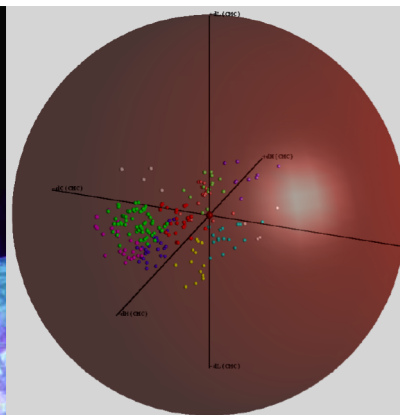
Základy KOLORISTIKY

Lektor: doc. Ing. Michal Vik, Ph.D.
doc. Ing. Martina Viková, Ph.D.



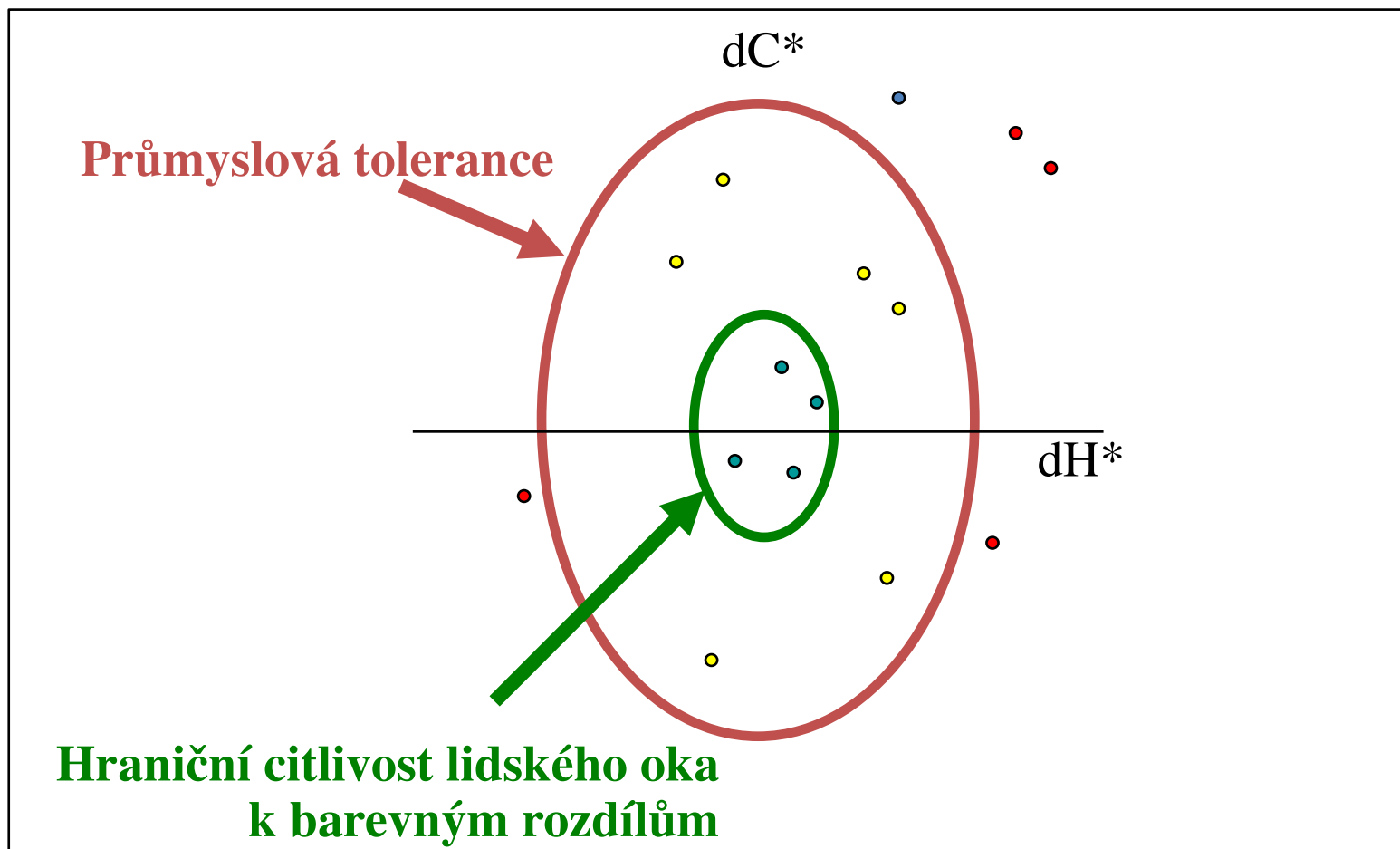
EVROPSKÁ UNIE
Evropské strukturální a investiční fondy
Operační program Výzkum, vývoj a vzdělávání

Indexy a odstínové třídění

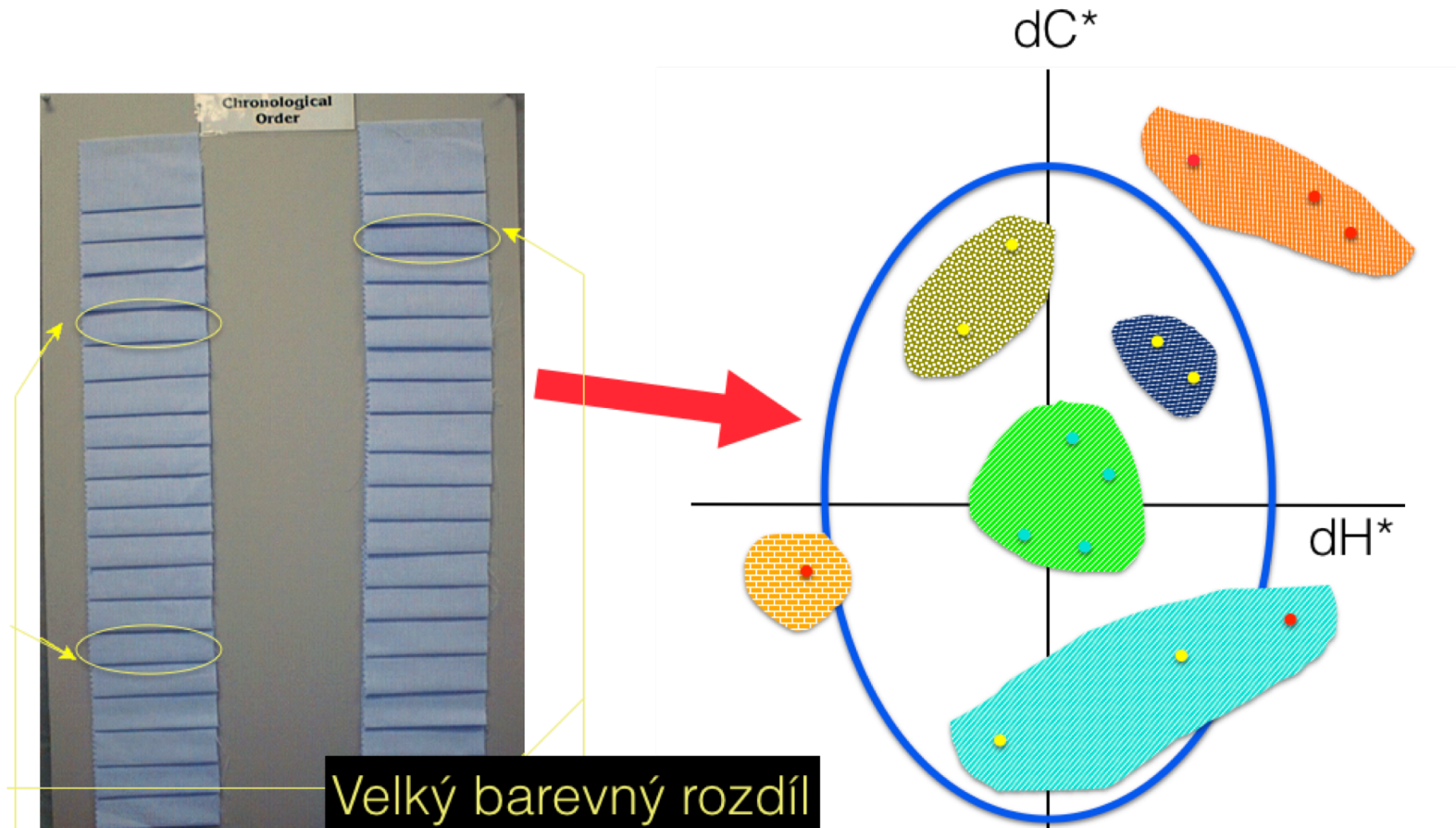


Rozdíl mezi průmyslovou tolerancí a hraniční citlivostí

- řešení je pomocí odstínového třídění

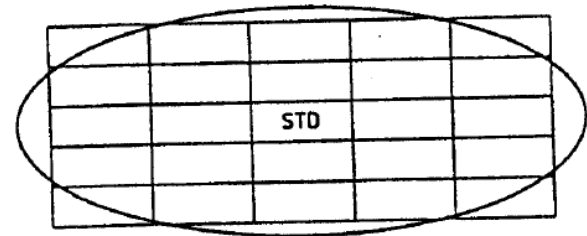
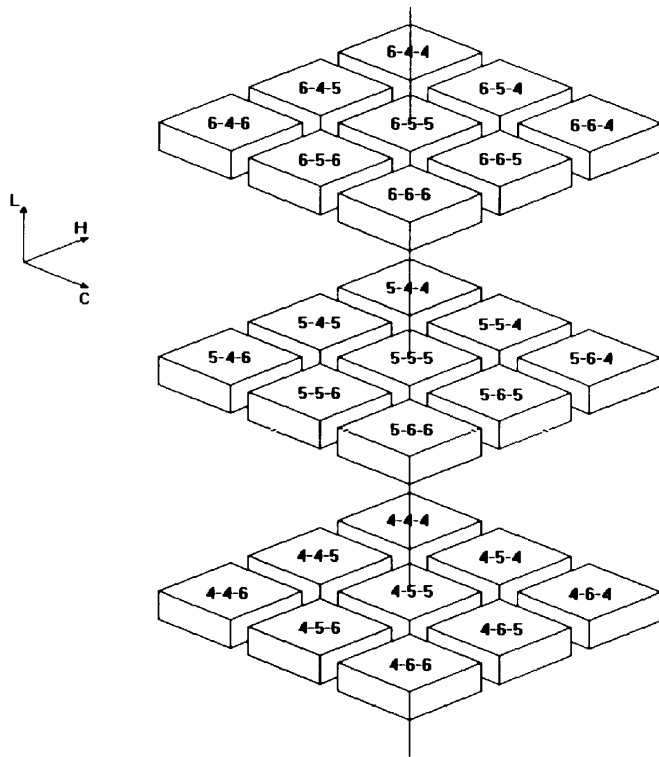


Vizuální třídění



Vizuální třídění je velmi náročné a provádí se na prohlížecích stolech nebo v koloristických skříních.

System 555 (1961 – Prof. Simon) I



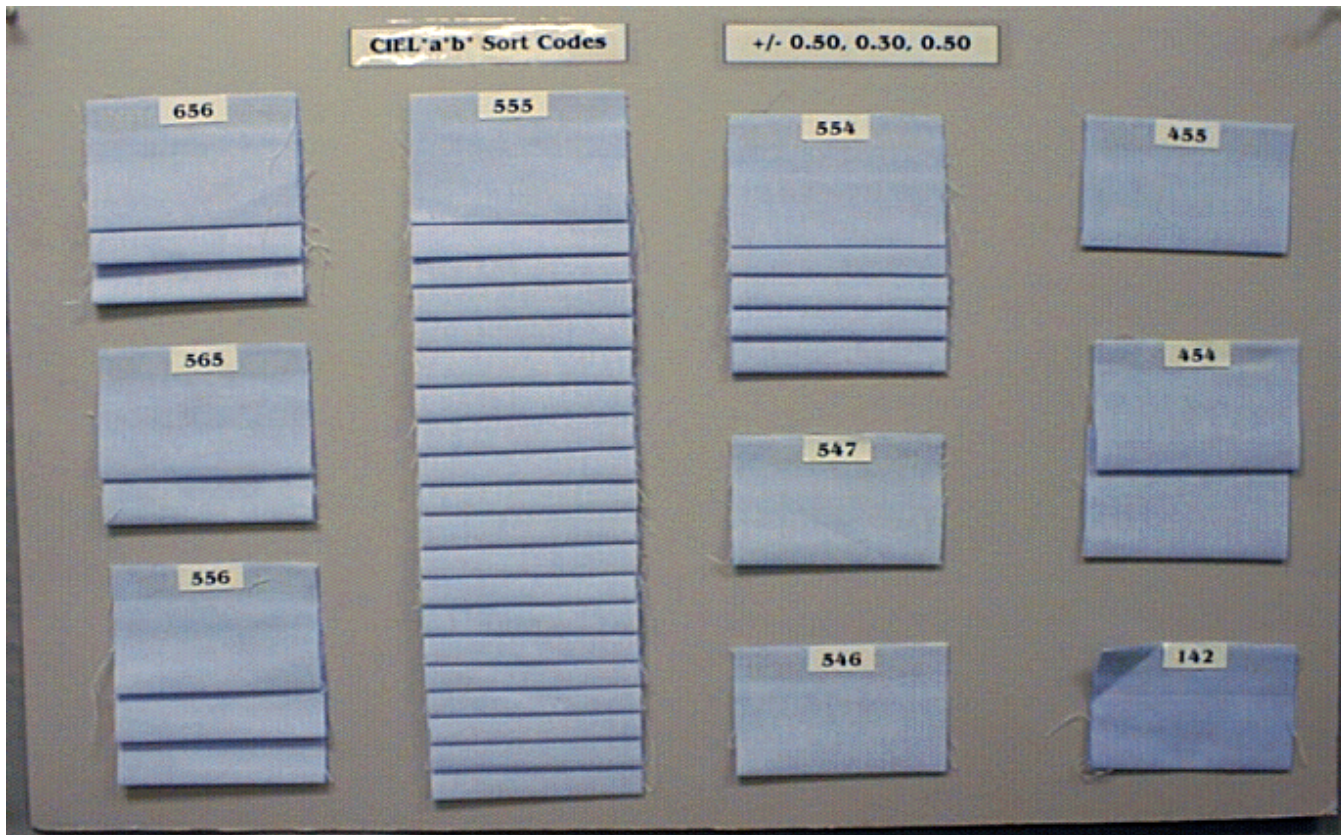
$$S = 100.N_L + 10.N_C + N_H,$$

$$N_L = \text{Integer} \left[\frac{\Delta L^*}{T_L} + 5,5 \right],$$

$$N_C = \text{Integer} \left[\frac{\Delta C^*}{T_C} + 5,5 \right],$$

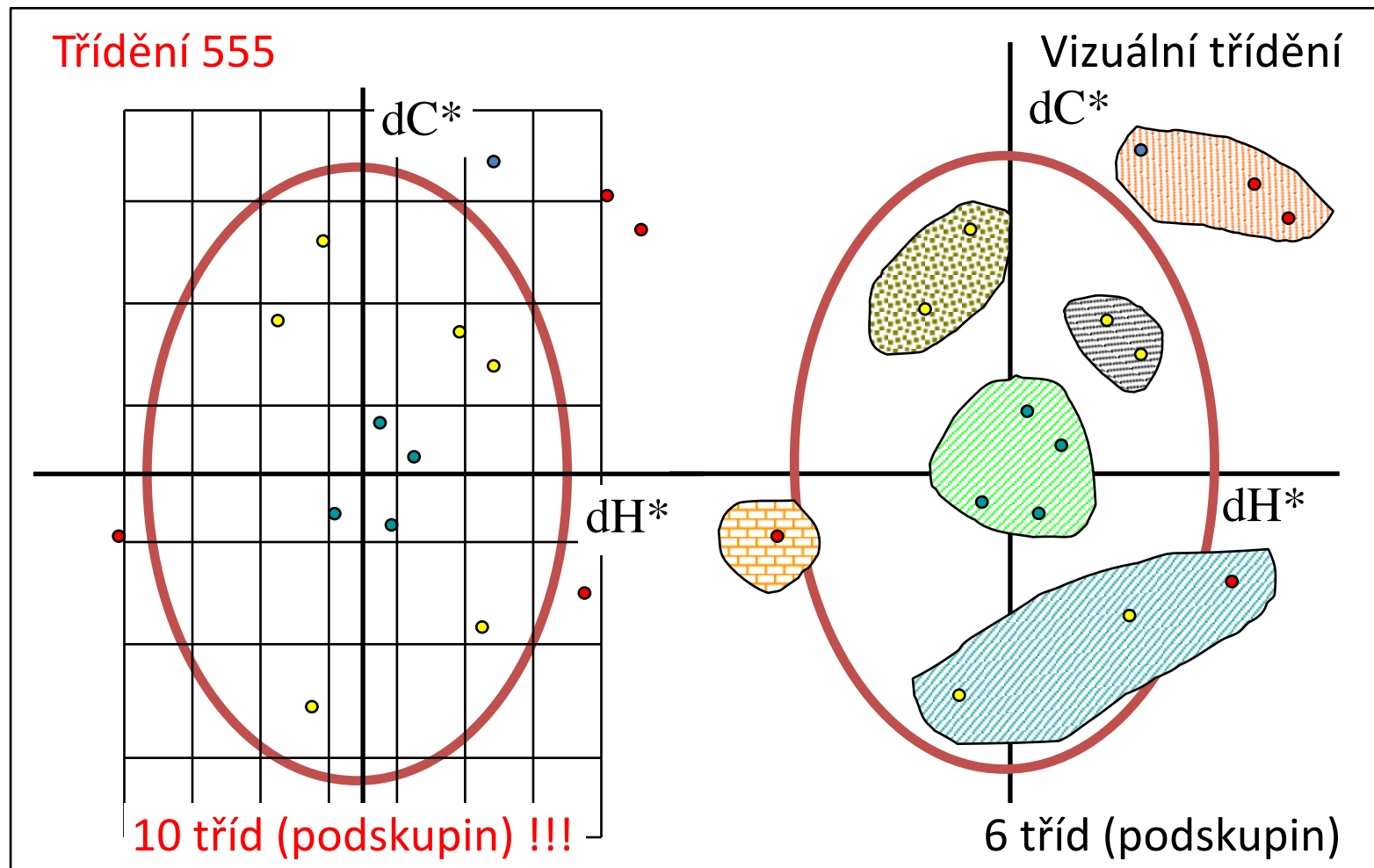
$$N_H = \text{Integer} \left[\frac{\Delta H^*}{T_H} + 5,5 \right],$$

System 555 (1961 – Prof. Simon) II

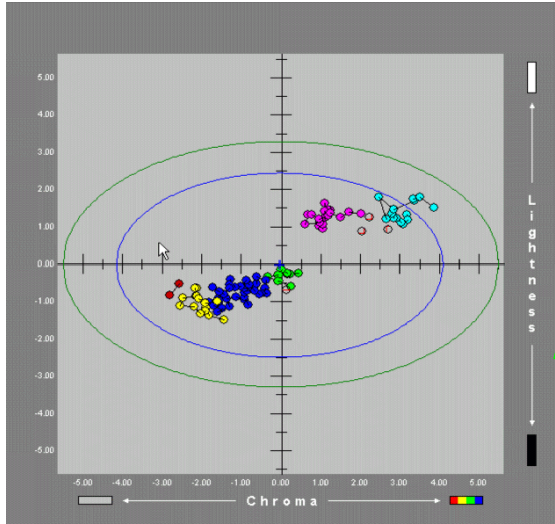


Nevýhoda: vzniklo 10 ! skupin

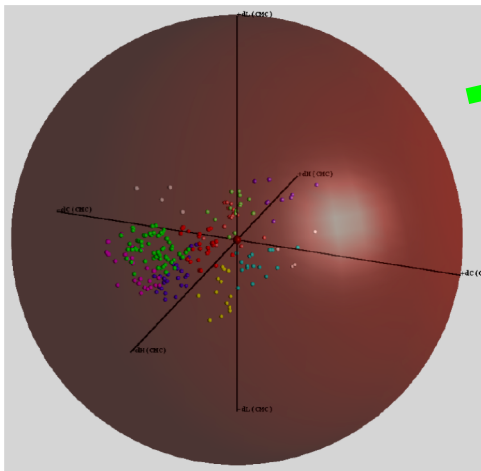
555 vs. vizuální třídění



Klástrové třídění

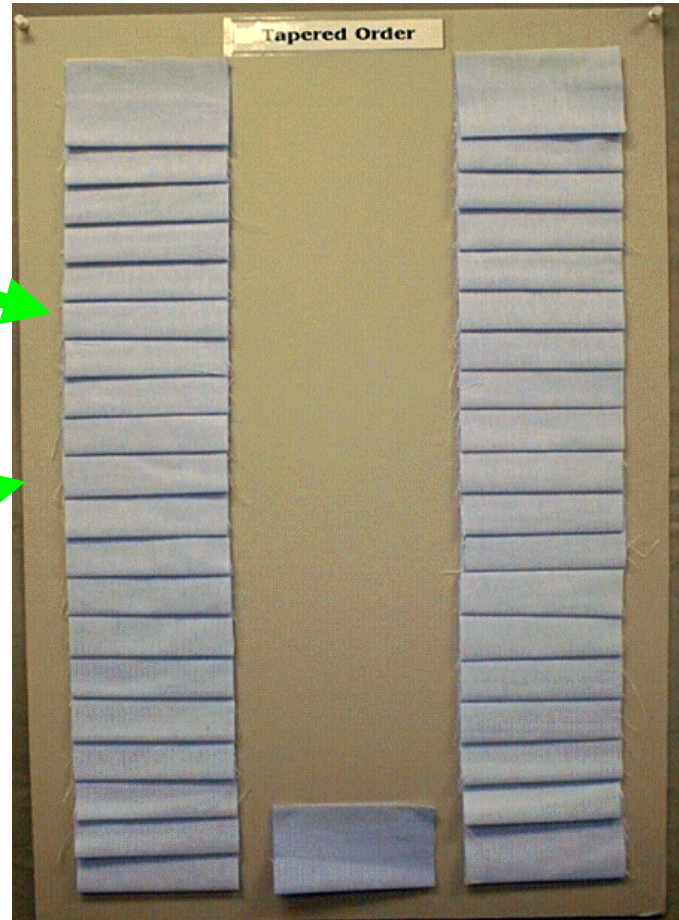


SheLyn, Incorporated

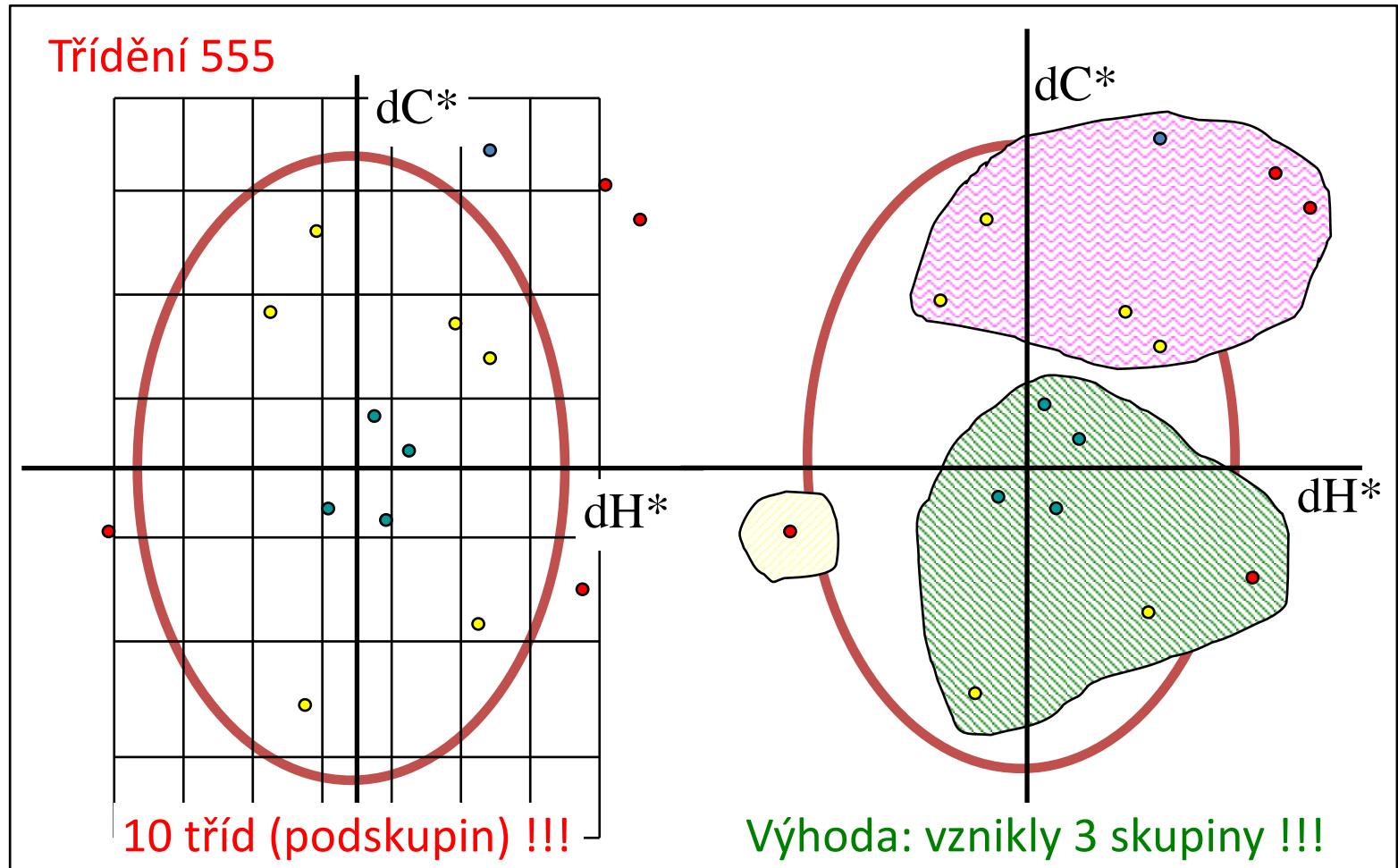


Datacolor International

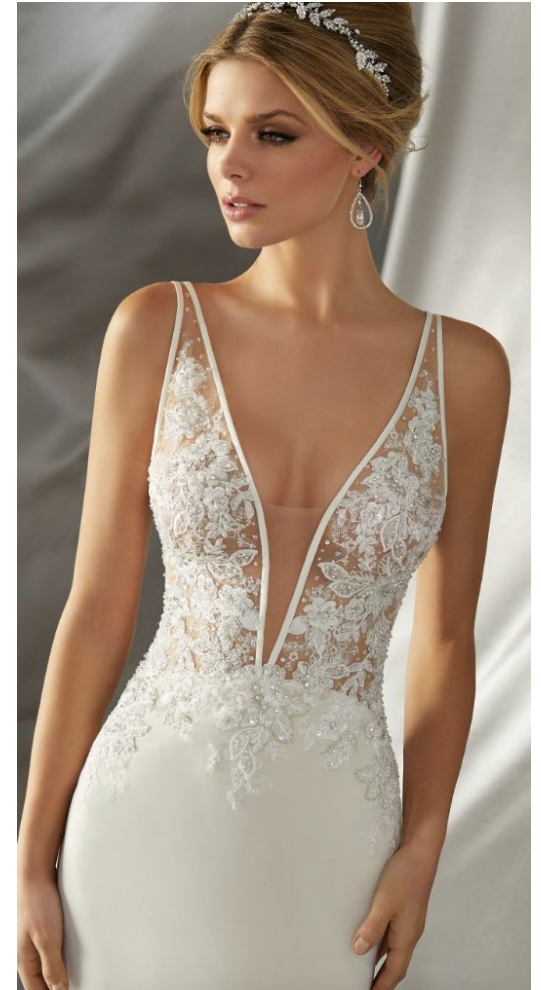
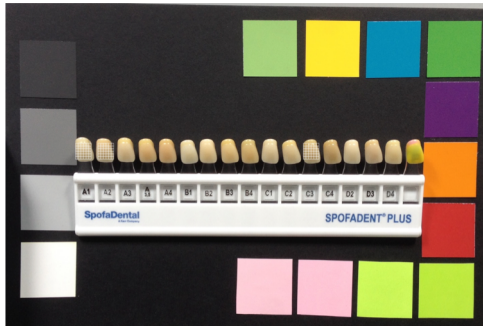
Výhoda: vznikly 3 skupiny !!!



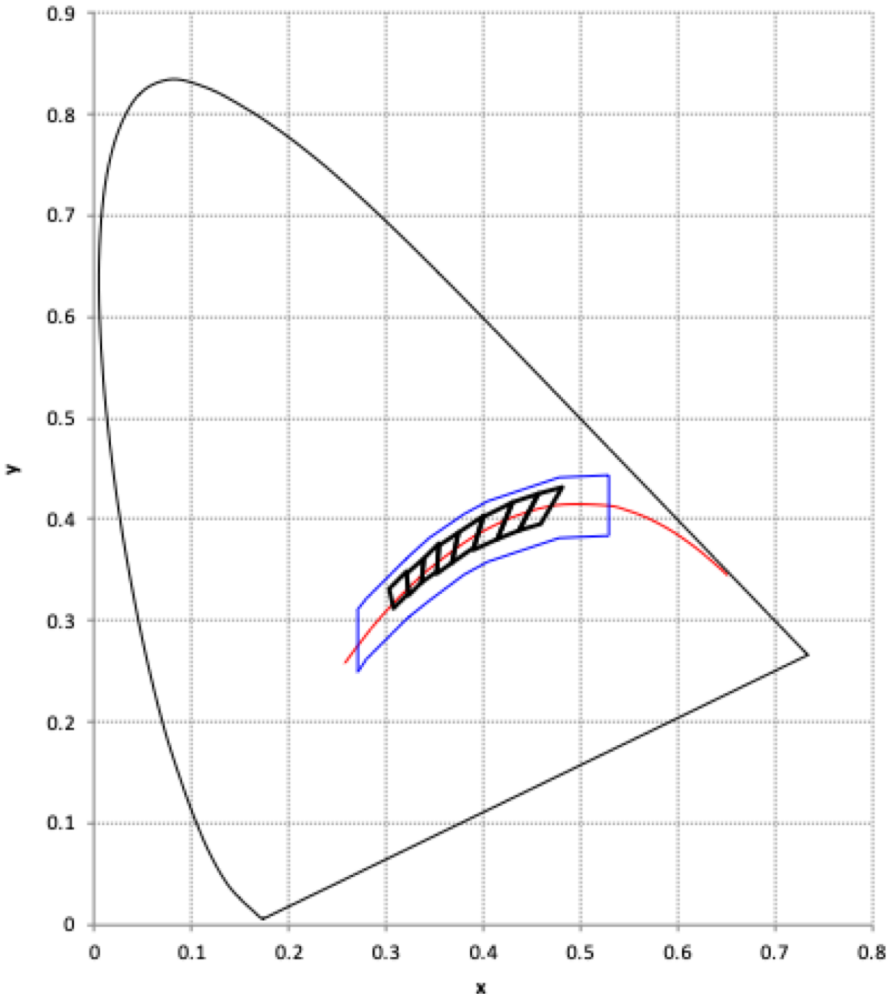
555 vs. Klástrové třídění



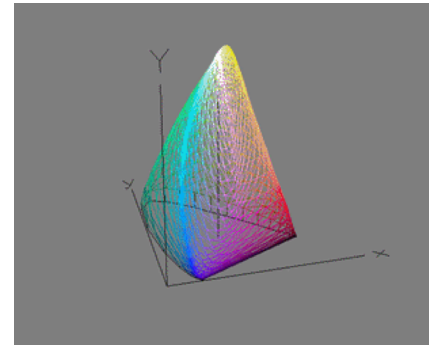
BÍLÁ NA RŮZNÝCH MATERIÁLECH



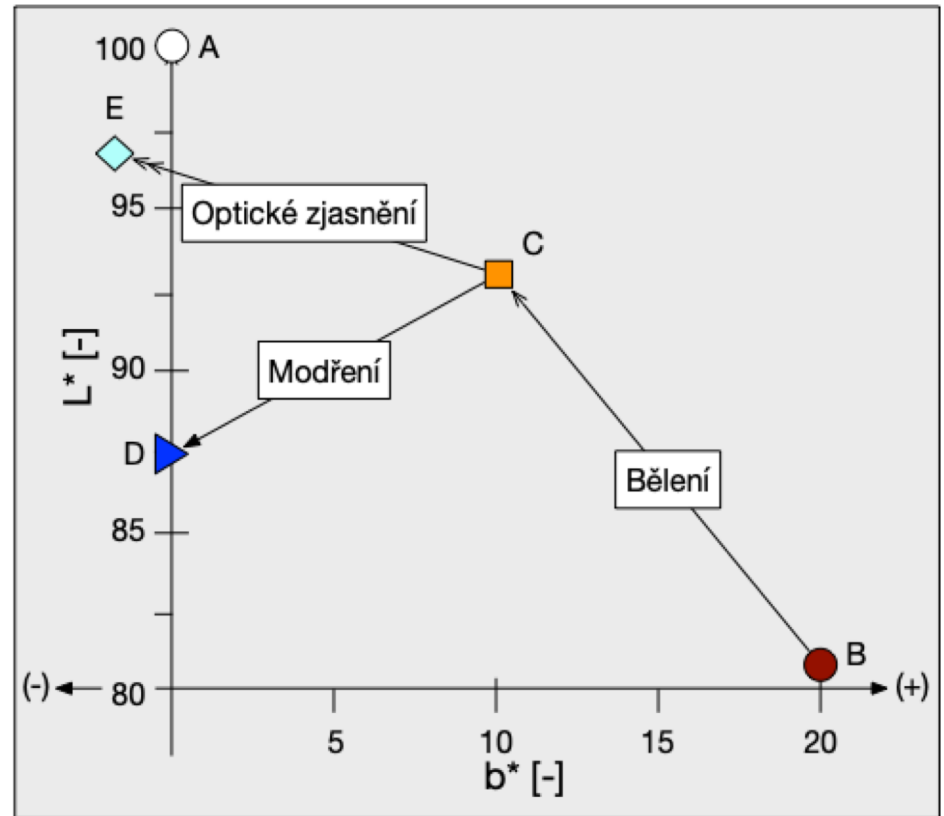
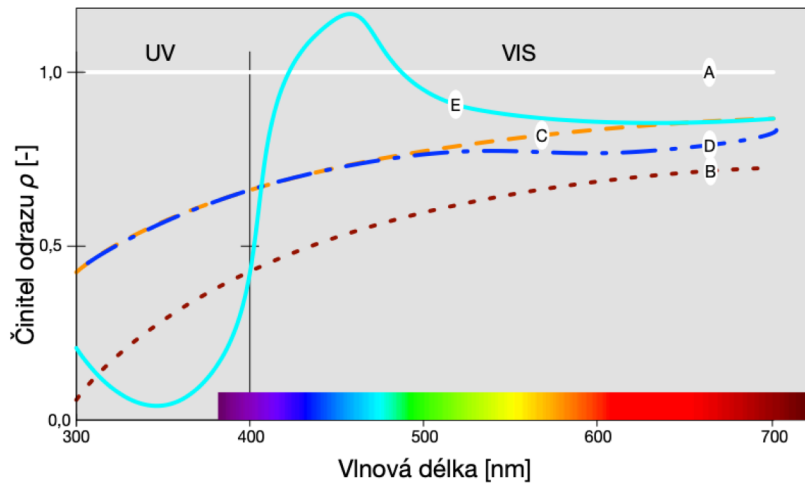
CO JE TO BÍLÁ?



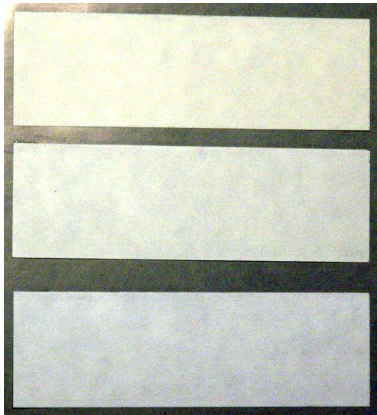
- ❖ přibližně 3% z celkového objemu dosažitelných barev u druhotných zářičů
- ❖ cca 20 ze 100 rozlišitelných rozdílů ve světlosti
- ❖ cca 2500 rozlišitelných rozdílů v



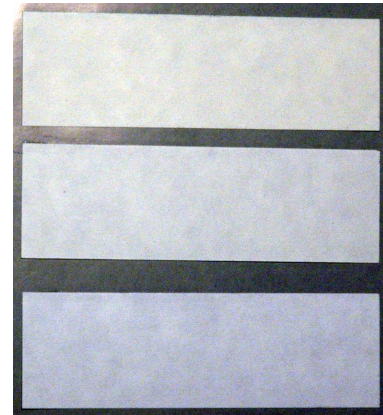
BĚLEJŠÍ NEŽ BÍLÁ?



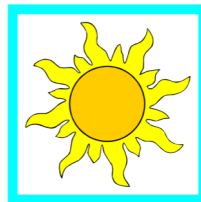
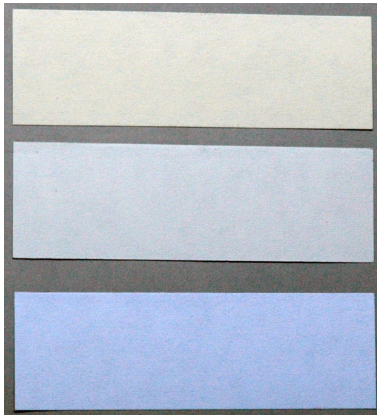
Bělost



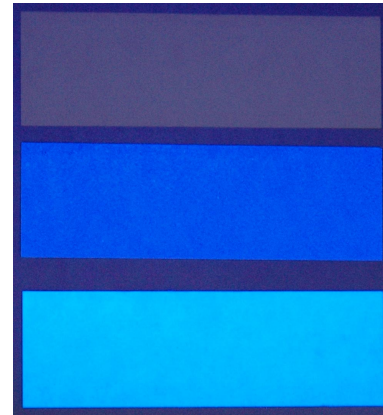
A



F11

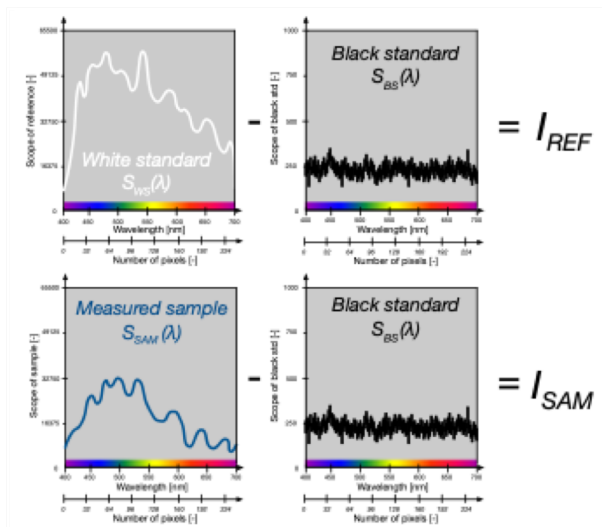
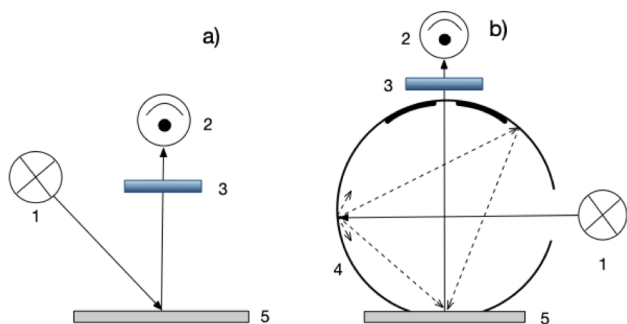


D65

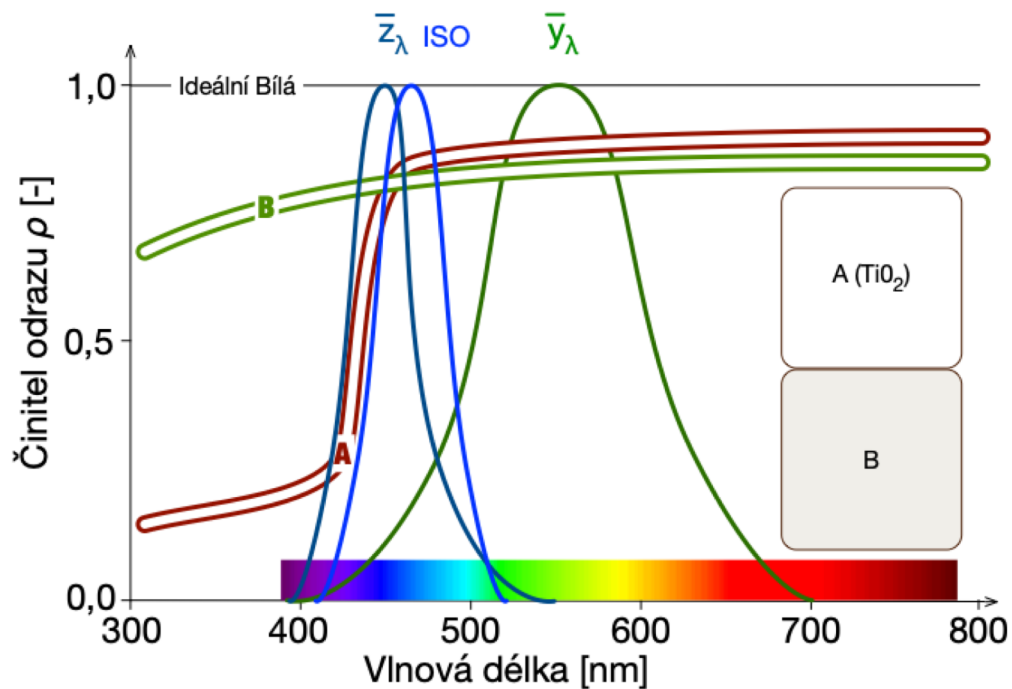


UV

R457 I (TAPPI 525, ISO 2470)

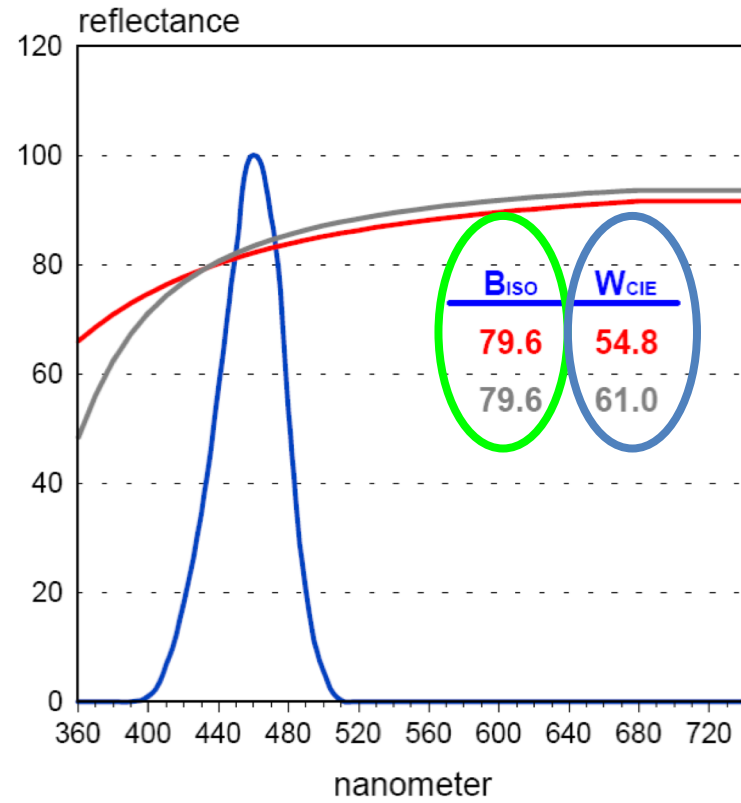
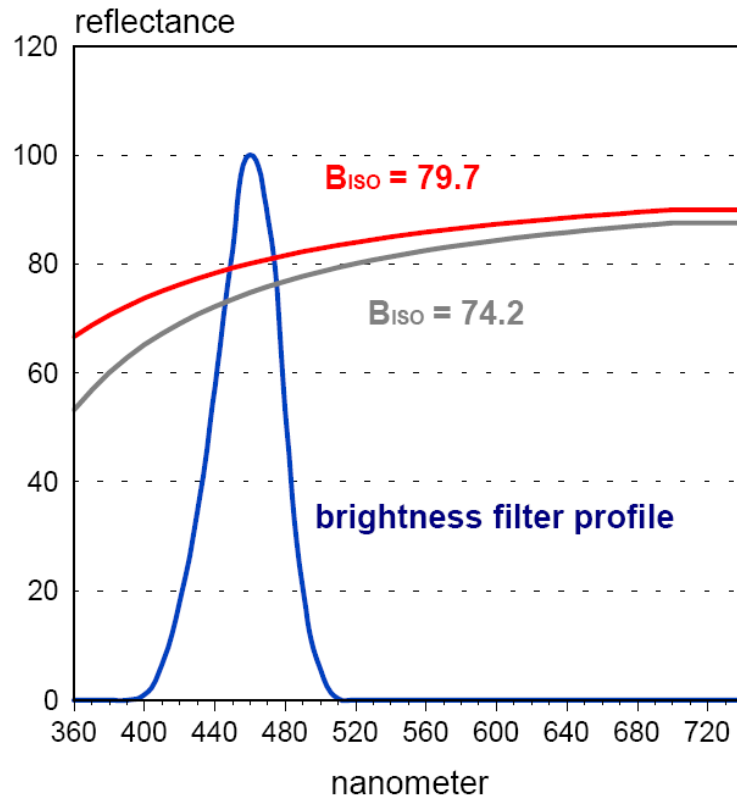


$$\rho_{\lambda} = R_{\lambda} = \frac{I_{\lambda}}{I_{0\lambda}} = \frac{I_{SAM}(\lambda)}{I_{REF}(\lambda)} = \frac{S_{SAM}(\lambda) - S_{BS}(\lambda)}{S_{WS}(\lambda) - S_{BS}(\lambda)}$$

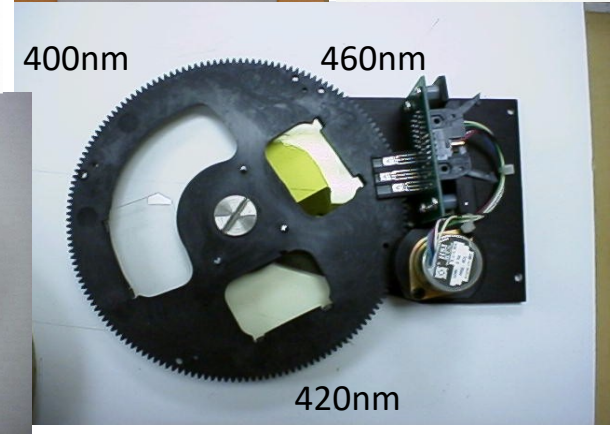
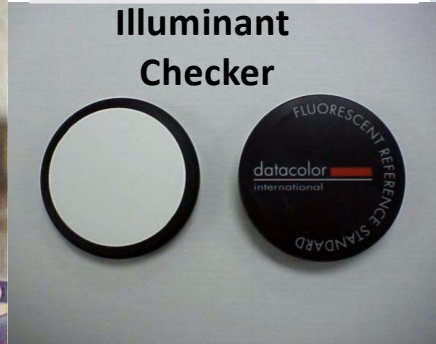
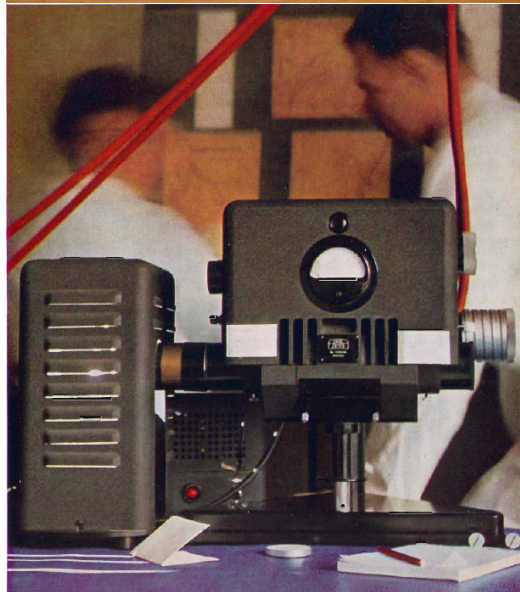


Y vs. %Z vs. ISO Bělost

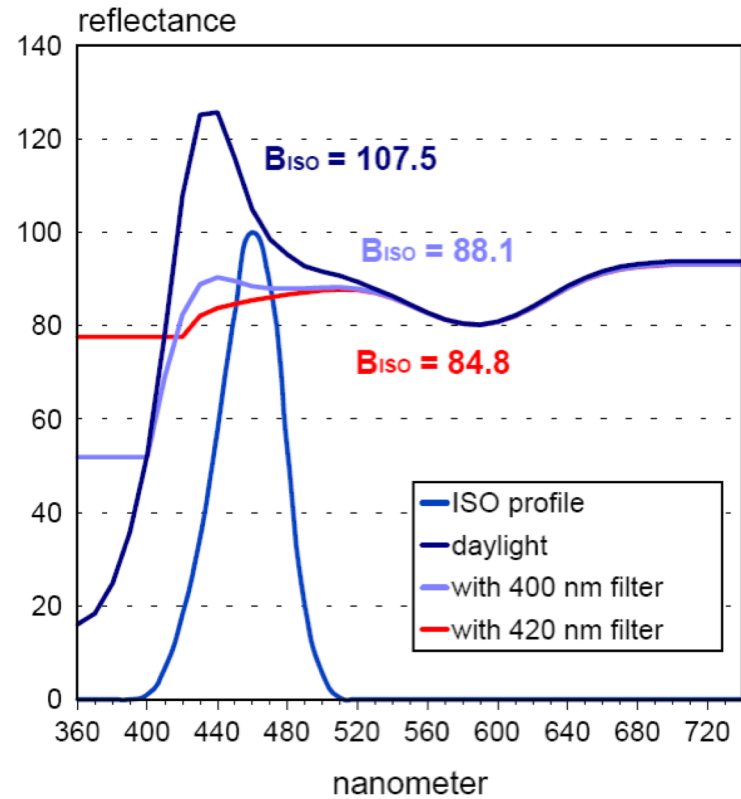
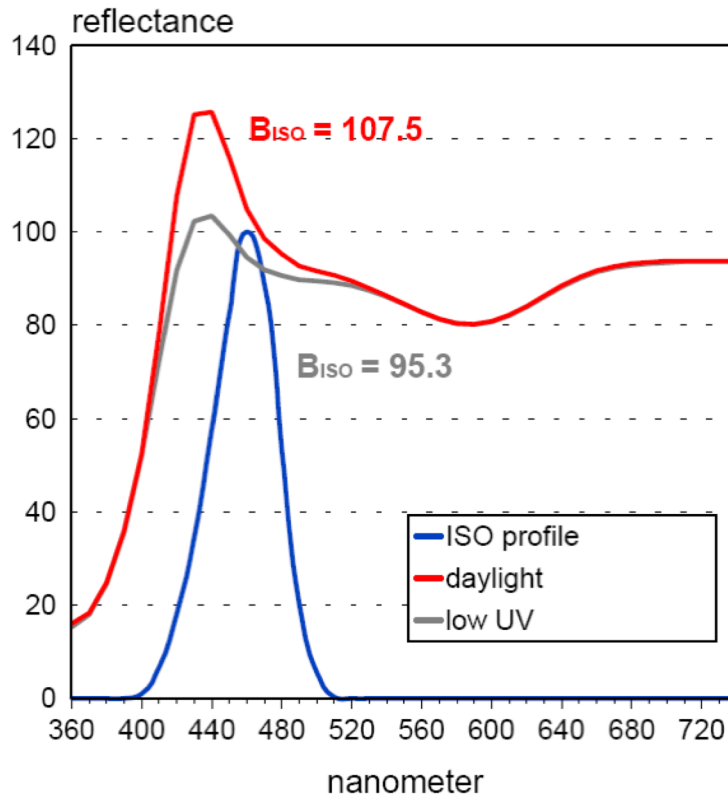
R457 II



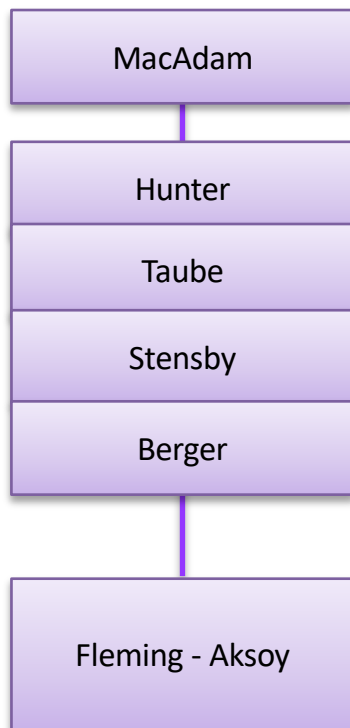
ELREPHO



Brightness (R457) vs. různý podíl UV záření



Stupně běli založené na trichromatických složkách



$$W = f(X, Y, Z)$$

$$W_{Berger}(C/2) = Y + 3.452.Z - 3.908.X$$

$$W_{Taube}(C/2) = 3.727.Z - 3.Y$$

$$W_{Stensby}(C/2) = \frac{19.297.Z - 11.X}{\sqrt{Y}}$$

$$W_{Stensby}(C/2) = \frac{19.297.Z + 55.251.X - 63.5.Y}{\sqrt{Y}}$$

$$W_{FA} = Y(1/2) \frac{[x^2 + 2xy + y^2] / c_2^2}{\sqrt{Y}}$$

Ganz-Griesserova kalibrace I



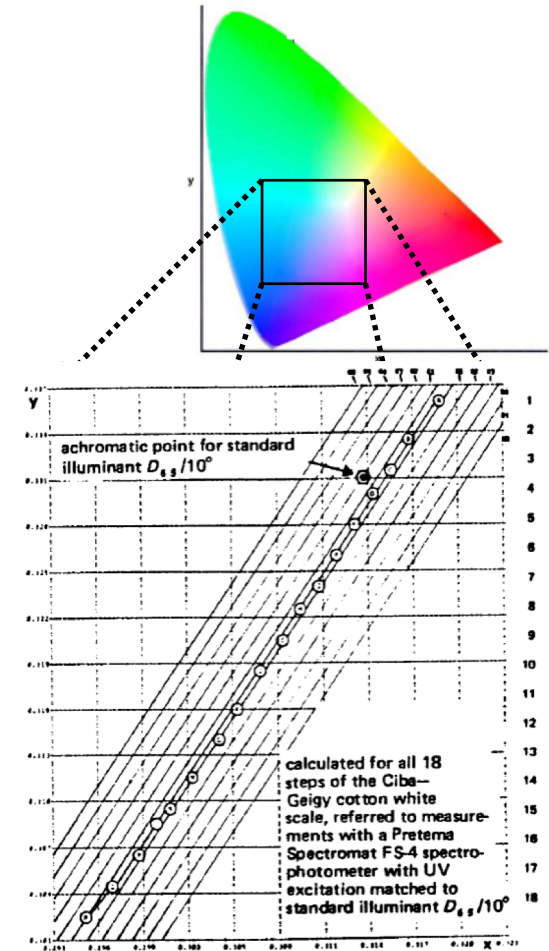
D65



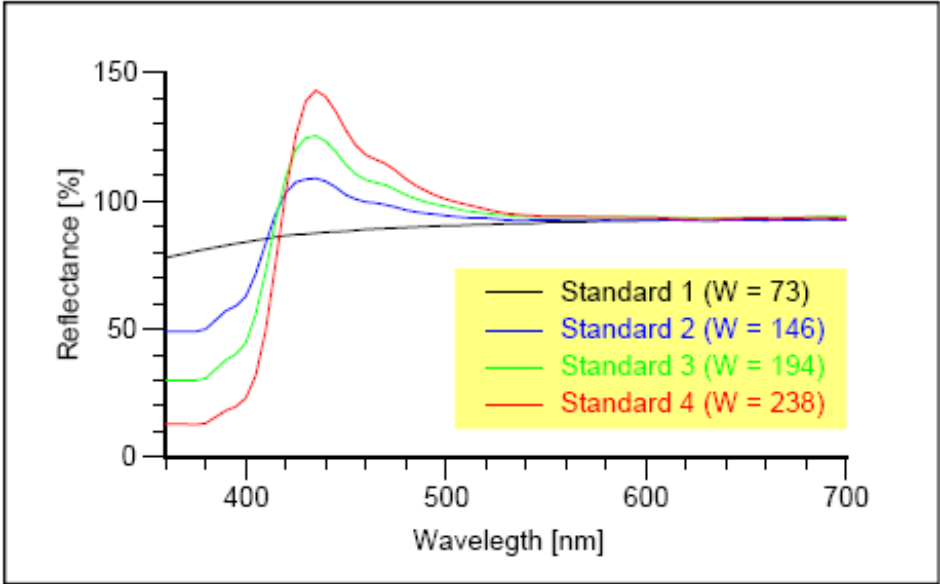
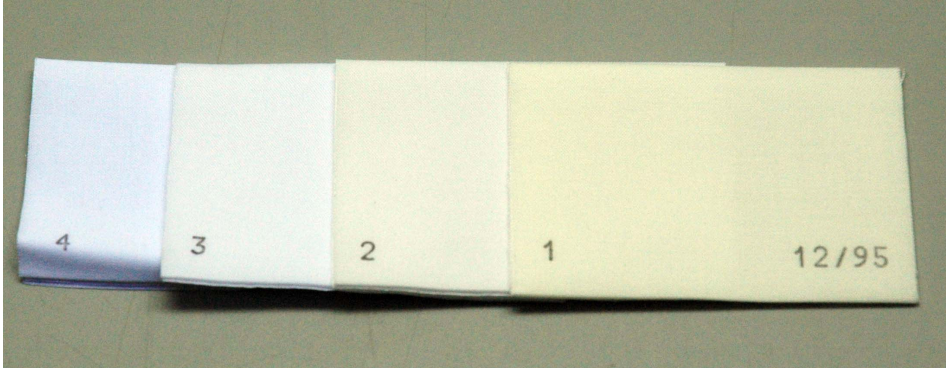
A



UV



Ganz-Griesser kalibrace II



TEXTILFORSCHUNGS
INSTITUT
THÜRINGEN -
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Stupeň běli Ganz-Griesser

$$WI\ GANZ = DY + Px + Qy + C\ \text{for}\ D65/10^\circ$$

$$D = \frac{\delta W}{\delta Y} = 1$$

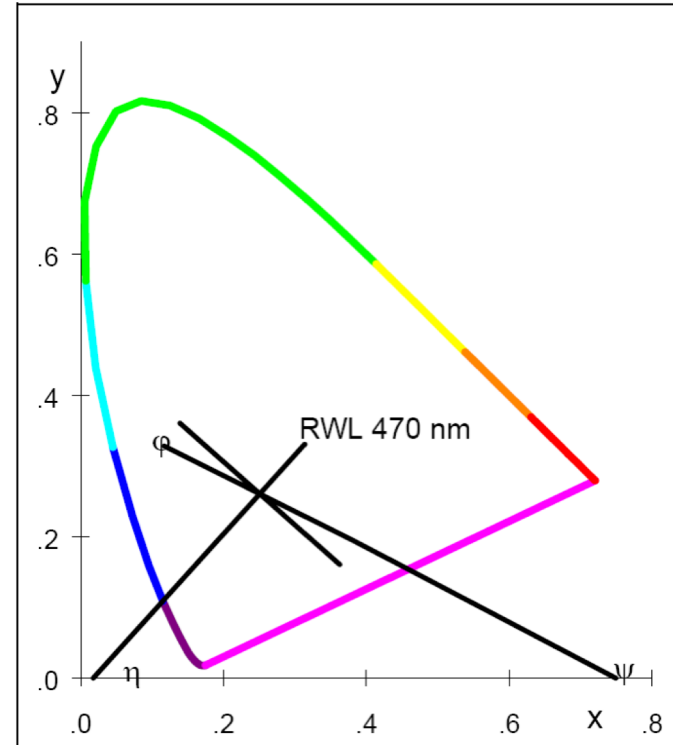
$$P = \left(\frac{-\delta W}{\delta S} \right) * \left(\frac{\cos(\varphi + \eta)}{\cos(\varphi)} \right) = -1868.322$$

$$Q = \left(\frac{\delta W}{\delta S} \right) * \left(\frac{\sin(\varphi + \pi)}{\cos(\varphi)} \right) = -3695.690$$

$$C = \left[W_0 * \left(1 - \frac{\delta W}{\delta Y} \right) \right] - (P_{x_n}) - (Q_{y_n}) = 1809.441.$$

$$\frac{\delta W}{\delta Y} = 1 \quad W_0 = 100 \quad \leftarrow \text{Ideal white}$$

$$\frac{\delta W}{\delta S} = 4000 \quad \leftarrow 4000 \pm 50$$



Stupeň běli CIE

$$W = Y + 800 (x_n - x) + 1700 (y_n - y)$$

Odstínový nádech CIE

$$T = T_x (x_n - x) - 650 (y_n - y)$$

Value	C/2°	D50/2°	D65/2°	C/10°	D50/10°	D65/10°
T_x	1000	1000	1000	900	900	900
x_n	0.3101	0.3457	0.3127	0.3104	0.3477	0.3138
y_n	0.3161	0.3585	0.3290	0.3191	0.3595	0.3310

Odstínový nádech Ganz-Griesser

$$\text{Tint GANZ} = mx + ny + k$$

$$m = \frac{-\cos(\alpha)}{BW} = -937.588$$

$$n = \frac{\sin(\alpha)}{BW} = 826.697$$

$$k = -m\bar{x} - n\bar{y} = 21.352$$

Žlutost



$$YI = 100(C_X X - C_Z Z) / Y$$

ASTM E313-05



TABLE 1 Coefficients of the Equations for Yellowness Index

Quantity	CIE Standard Illuminant and Standard Observer			
	C, 1931	D ₆₅ , 1931	C, 1964	D ₆₅ , 1964
X _n	98.074	95.047	97.285	94.811
Y _n	100.000	100.000	100.000	100.000
Z _n	118.232	108.883	116.145	107.304
F _A	0.7987	0.8105	0.7987	0.8103
F _B	0.2013	0.1895	0.2013	0.1897
C _X	1.2769	1.2985	1.2871	1.3013
C _Z	1.0592	1.1335	1.0781	1.1498
Residual error	-0.0006	-0.0004	-0.0004	-0.0006

Old methods are defined for C/2

Yellowness after BASF:

$$G_B = \frac{X}{0.7831} + 0.833 \cdot Z$$

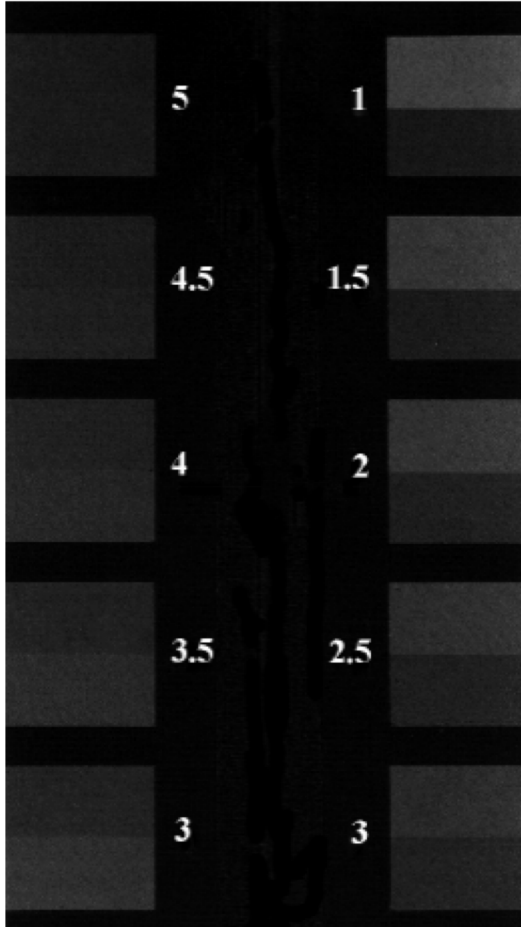
Yellowness TM-1925 and DIN 6167:

$$YI = \frac{1.2750 \cdot X - 1.0584 \cdot Z}{Y}$$

Yellowness ASTM-E 313-73:

$$YI = 100 \cdot \left(1 - 0.847 \cdot \frac{Z}{Y} \right)$$

Šedé stupnice



Pro hodnocení změny odstínu
ČSN EN ISO 105-A02 (GSR)

$$\Delta E_{F(\text{SEK})} = \sqrt{(\Delta L^*)^2 + (\Delta C_F)^2 + (\Delta H_F)^2},$$

ΔE_F	GSR
0 - 0,40	5
0,41 - 1,25	4 - 5
1,26 - 2,10	4
2,11 - 2,95	3 - 4
2,96 - 4,10	3
4,11 - 5,80	2 - 3
5,81 - 8,20	2
8,21 - 11,60	1 - 2
>11,61	1

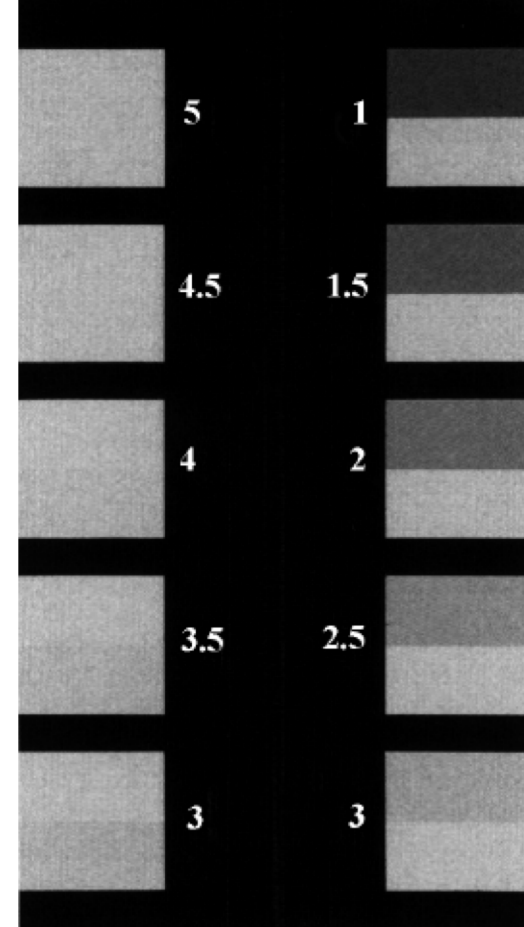
Pro hodnocení stupně zapouštění
ČSN EN ISO 105-A04 (SSR)

$$\text{SSR} = 6,1 - 1,45 \ln (\Delta E_{\text{GS}})$$

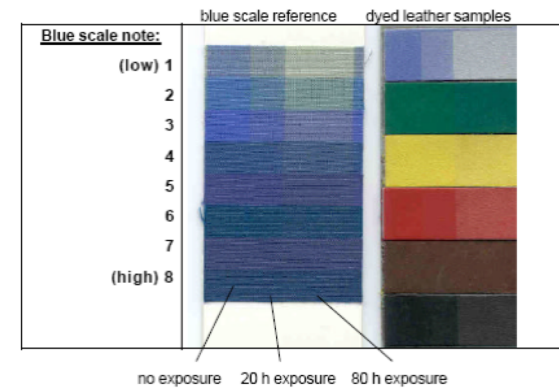
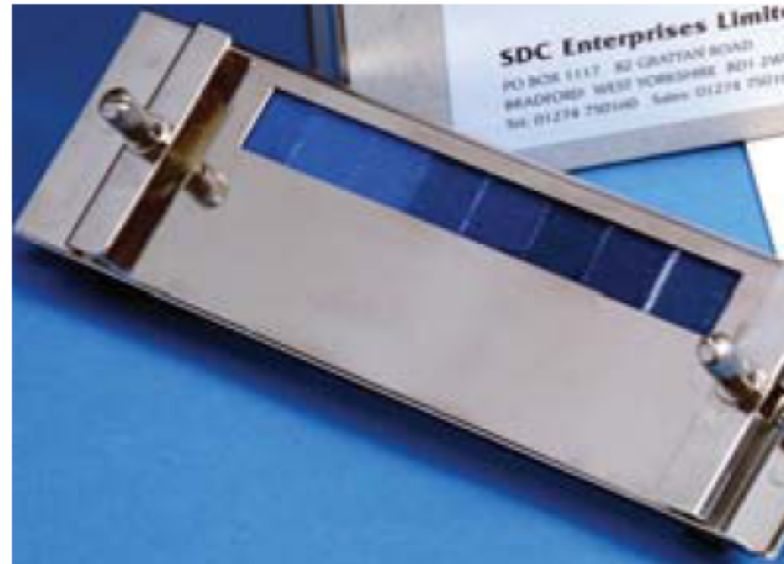
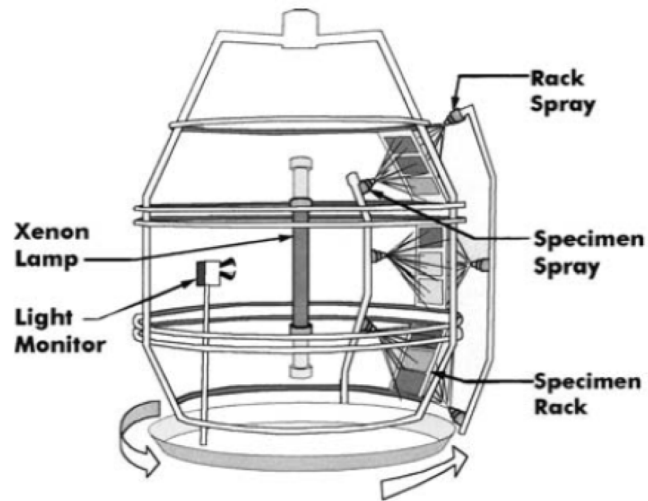
pro $\text{SSR} < 4$ a pro $\text{SSR} > 4$:

$$\text{SSR} = 5 - 0,23 (\Delta E_{\text{GS}}), \text{ kde}$$

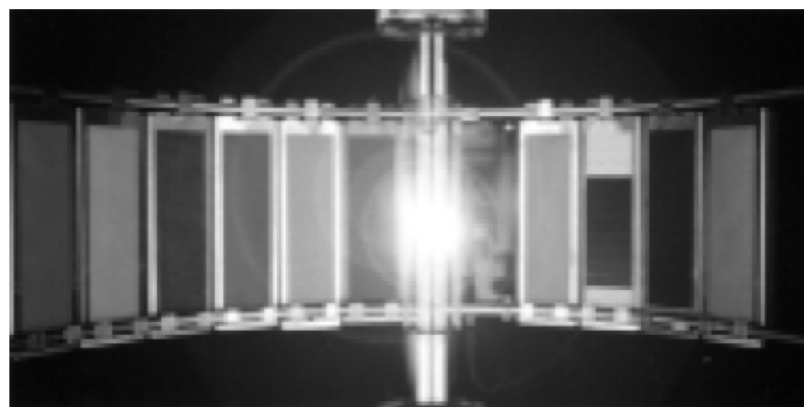
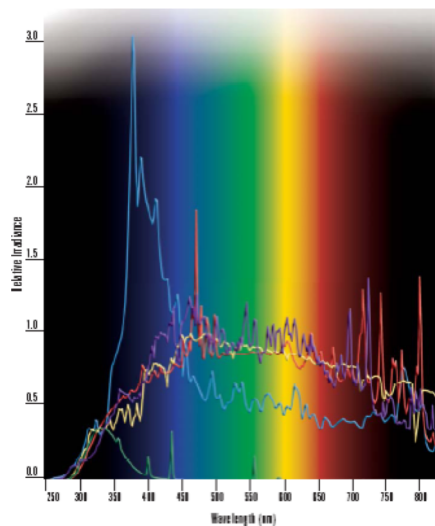
$$\Delta E_{\text{GS}} = \Delta E_{\text{CIELAB}} - 0,4 \sqrt{(\Delta E_{\text{CIELAB}}^2 - \Delta L_{\text{CIELAB}}^2)}$$



Hodnocení světlostálosti I



Hodnocení světlostalostí II



Tomato scores

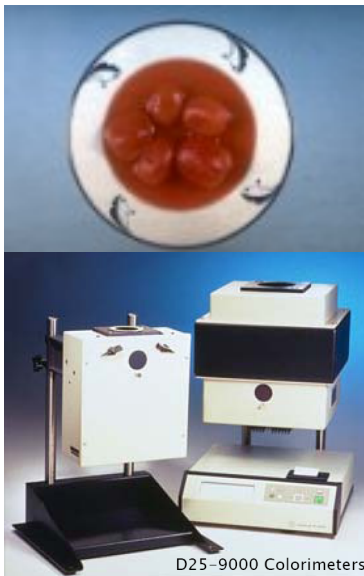
$$\text{Tomato Juice} = \text{TJS} = 29.6000 + 0.88354a - 1.8553b$$

$$\text{Tomato Paste and Puree} = \text{TPS} = -46.383 + 1.0211a + 10.607b - 0.42198(b)^2$$

$$\text{Tomato Sauce} = \text{TSS} = -154.39 + 1.1142a + 22.596b - 0.86736(b)^2$$

$$\text{Tomato Catsup} = \text{TCS} = -74.937 + 7.5172a - 0.1278(a)^2 - 0.8051b$$

a, b jsou souřadnice kolorimetrické soustavy HunterLab



HunterLab

