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## **Calibration Report**

**Radiance Factors at 0°:45° Geometry for Reflectance Standards: B2 Red, B6 Mid-Grey, B8 Black, B9 Yellow, B14 Deep-Blue, B13 Cyan, S13 Mid-Green, P15 Grey 50%, Ceram-White and CM-A103 White**

*For*

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## Identification

Ten reflectance standards, identified as B2 Red, B6 Mid-Grey, B8 Black, B9 Yellow, B14 Deep-Blue, B13 Cyan, S13 Mid-Green, P15 Grey 50%, Ceram-White and CM-A103 White, were received from Mt. Baker Research L.L.C. The standards were to be calibrated for their 0°:45° radiance factors over the wavelength range 250 nm to 850 nm at 5 nm intervals.

## Calibration of Spectral 0°:45° Radiance Factors

The spectral 0°:45° radiance factors,  $\beta(\lambda)$ , were measured on a Perkin-Elmer Lambda-19 UV/VIS/NIR spectrophotometer equipped with a Labsphere 0°:45° bidirectional reflectance accessory Model RSA-PE-19. The data were recorded at ambient temperature ( $23 \pm 1$ )°C and a relative humidity of ( $17 \pm 5$ ) %. The standards were measured from 250 nm to 850 nm with a fixed spectral bandwidth of 5 nm. The irradiated area of the standard was approximately 4 mm x 8 mm. The test standards were measured over the period of February 19 to February 22, 2008.

## Traceability

The reference standard was pressed polytetrafluoroethylene (PTFE) powder ( $1.0 \pm 0.1$ ) gm/cm<sup>3</sup>. The NRC absolute 0°:45° radiance factor scale from 380 nm to 850 nm at 5 nm intervals is traceable to a master pressed PTFE radiance factor standard (NRC Reference: HA45NISTD) calibrated in the 0°:45° geometry by the US National Institute of Standards and Technology (NIST). The NIST reported expanded uncertainties ( $k=2$ ; 95% confidence levels) for the calibration of this NRC master PTFE standard is  $\pm 0.004$  radiance units.

The validation of the NRC absolute 0°:45° radiance factor calibration results is based on the following NRC reflectance standards: NRC Spectralon SRS-99-020-RECL-51-A (ref: REN19894), and SRS-99-020-RECL-51-B (ref: REN19895)

## Results

Three independent measurements were performed on each test reflectance standard and averaged. The results of the data averaging are reported in both graphical form (Figures 1, 2, 3 and 4) and tabular form (Tables 1, 2, 3 and 4) at a 5 nm measurement interval. The results from 250 nm to 375 nm are uncertified. The scale is from zero to unity (unity corresponds to 100% 0°:45° radiance factor with respect to the perfect reflecting diffuser identically irradiated and viewed).

## Uncertainties of Spectral 0°:45° Radiance Factors

The reported uncertainties were calculated according to the methods described in the “ISO Guide to the Expression of Uncertainty in Measurement, ISBN 92-67-10188-9, (1995)”.

The Type B standard uncertainty,  $u_B(\beta)$ , of the NRC 0°:45° radiance factor scale is estimated to be better than 0.25% of the radiance factor value for the spectral range 380 nm to 850 nm. The standard uncertainty of the wavelength scale,  $u(\lambda)$ , is 0.1 nm for spectral range 380 nm to 850 nm. The combined standard uncertainty  $u_C(\beta)$  is based on the combination in quadrature of the standard uncertainty in the radiance factor scale,  $u_B(\beta)$ , the standard uncertainty,  $u_S(\beta)$ , given by the independent sample measurements assuming a rectangular distribution, and the additional term,  $u_\lambda(\beta) = (\partial\beta / \partial\lambda) u(\lambda)$ , due to the uncertainty in the wavelength scale:

$$U(\beta) = 2u_C(\beta) = k[u_B^2(\beta) + u_S^2(\beta) + u_\lambda^2(\beta)]^{1/2}$$

The expanded uncertainties,  $U(\beta)$ , reported in parentheses as the corresponding last digits of the quoted numerical value, represent a confidence level of approximately 95%. They were obtained by assuming a normal distribution and by multiplying the combined standard uncertainties by a coverage factor  $k=2$ .

**Table 1. Spectral 0°:45° Radiance Factors, and Associated Expanded Uncertainty ( $k=2$ ) with a Confidence Level of 95% for Samples B2 Red, B6 Mid-Grey, B8 Black.**

$\lambda$ (nm)	PCX8300 B2 Red	PCX8301 B6 Mid-Grey	PCX8302 B8 Black	$\lambda$ (nm)	PCX8300 B2 Red	PCX8301 B6 Mid-Grey	PCX8302 B8 Black
250	0.0053	0.0292	0.0021	485	0.0231 (1)	0.2449 (15)	0.0033 (1)
255	0.0050	0.0306	0.0020	490	0.0233 (1)	0.2447 (14)	0.0033 (1)
260	0.0048	0.0328	0.0021	495	0.0234 (2)	0.2443 (13)	0.0033 (1)
265	0.0048	0.0356	0.0020	500	0.0236 (1)	0.2441 (14)	0.0033 (1)
270	0.0048	0.0392	0.0022	505	0.0239 (1)	0.2432 (13)	0.0033 (1)
275	0.0050	0.0438	0.0023	510	0.0241 (2)	0.2422 (14)	0.0033 (1)
280	0.0052	0.0493	0.0023	515	0.0245 (1)	0.2412 (14)	0.0033 (1)
285	0.0056	0.0557	0.0024	520	0.0250 (1)	0.2403 (13)	0.0033 (1)
290	0.0061	0.0631	0.0026	525	0.0259 (1)	0.2396 (13)	0.0033 (1)
295	0.0066	0.0721	0.0027	530	0.0269 (1)	0.2394 (14)	0.0035 (1)
300	0.0074	0.0818	0.0029	535	0.0280 (2)	0.2394 (13)	0.0035 (1)
305	0.0082	0.0932	0.0030	540	0.0289 (1)	0.2396 (12)	0.0035 (1)
310	0.0093	0.1054	0.0032	545	0.0297 (2)	0.2402 (14)	0.0036 (1)
315	0.0104	0.1185	0.0033	550	0.0303 (2)	0.2407 (14)	0.0036 (1)
320	0.0115	0.1325	0.0033	555	0.0310 (2)	0.2407 (13)	0.0037 (1)
325	0.0128	0.1466	0.0023	560	0.0315 (2)	0.2407 (12)	0.0036 (1)
330	0.0141	0.1602	0.0035	565	0.0322 (2)	0.2401 (12)	0.0037 (1)
335	0.0152	0.1732	0.0036	570	0.0331 (2)	0.2394 (14)	0.0036 (1)
340	0.0164	0.1860	0.0037	575	0.0346 (2)	0.2384 (13)	0.0036 (1)
345	0.0174	0.1969	0.0036	580	0.0384 (3)	0.2374 (13)	0.0036 (1)
350	0.0182	0.2073	0.0035	585	0.0467 (5)	0.2367 (13)	0.0036 (1)
355	0.0189	0.2158	0.0035	590	0.0646 (11)	0.2366 (12)	0.0036 (1)
360	0.0195	0.2235	0.0035	595	0.1003 (21)	0.2367 (13)	0.0037 (1)
365	0.0199	0.2293	0.0035	600	0.1667 (37)	0.2368 (13)	0.0037 (1)
370	0.0202	0.2339	0.0035	605	0.2743 (53)	0.2368 (13)	0.0038 (1)
375	0.0204	0.2376	0.0035	610	0.4059 (59)	0.2369 (13)	0.0039 (1)
380	0.0208 (1)	0.2396 (14)	0.0035 (1)	615	0.5254 (51)	0.2368 (13)	0.0039 (1)
385	0.0208 (1)	0.2403 (13)	0.0034 (1)	620	0.6090 (43)	0.2363 (12)	0.0040 (1)
390	0.0210 (2)	0.2415 (13)	0.0035 (1)	625	0.6630 (38)	0.2359 (12)	0.0040 (1)
395	0.0211 (2)	0.2409 (14)	0.0035 (1)	630	0.6961 (37)	0.2354 (12)	0.0040 (1)
400	0.0212 (1)	0.2410 (13)	0.0035 (1)	635	0.7181 (37)	0.2353 (13)	0.0042 (1)
405	0.0214 (1)	0.2399 (14)	0.0034 (1)	640	0.7323 (38)	0.2349 (12)	0.0043 (1)
410	0.0214 (1)	0.2386 (14)	0.0034 (1)	645	0.7430 (38)	0.2349 (13)	0.0043 (1)
415	0.0216 (2)	0.2384 (14)	0.0034 (1)	650	0.7516 (38)	0.2352 (14)	0.0044 (1)
420	0.0217 (1)	0.2376 (13)	0.0034 (1)	655	0.7583 (40)	0.2363 (13)	0.0045 (1)
425	0.0218 (1)	0.2370 (14)	0.0034 (1)	660	0.7635 (40)	0.2372 (13)	0.0046 (1)
430	0.0218 (1)	0.2369 (14)	0.0034 (1)	665	0.7684 (39)	0.2391 (13)	0.0046 (1)
435	0.0219 (1)	0.2372 (13)	0.0034 (1)	670	0.7725 (39)	0.2414 (14)	0.0048 (1)
440	0.0221 (1)	0.2375 (14)	0.0035 (1)	675	0.7758 (41)	0.2444 (13)	0.0049 (1)
445	0.0222 (2)	0.2380 (13)	0.0034 (1)	680	0.7794 (39)	0.2478 (13)	0.0051 (1)
450	0.0222 (2)	0.2393 (14)	0.0034 (1)	685	0.7825 (41)	0.2517 (14)	0.0054 (1)
455	0.0223 (1)	0.2402 (14)	0.0035 (1)	690	0.7852 (40)	0.2563 (14)	0.0057 (1)
460	0.0225 (1)	0.2414 (14)	0.0034 (1)	695	0.7879 (40)	0.2605 (14)	0.0060 (1)
465	0.0225 (1)	0.2426 (13)	0.0034 (1)	700	0.7905 (43)	0.2649 (14)	0.0064 (1)
470	0.0228 (1)	0.2433 (13)	0.0034 (1)	705	0.7942 (42)	0.2696 (15)	0.0068 (1)
475	0.0229 (1)	0.2441 (15)	0.0034 (1)	710	0.7978 (43)	0.2740 (15)	0.0074 (1)
480	0.0230 (1)	0.2447 (14)	0.0033 (1)	715	0.7994 (40)	0.2782 (15)	0.0079 (1)

**Table 1. Spectral 0°:45° Radiance Factors, and Associated Expanded Uncertainty ( $k=2$ ) with a Confidence Level of 95% for Samples B2 Red, B6 Mid-Grey, B8 Black (Continued).**

$\lambda$ (nm)	PCX8300 B2 Red	PCX8301 B6 Mid-Grey	PCX8302 B8 Black
720	0.8014 (40)	0.2822 (15)	0.0087 (1)
725	0.8032 (42)	0.2864 (16)	0.0094 (1)
730	0.8045 (40)	0.2915 (15)	0.0102 (1)
735	0.8043 (41)	0.2954 (16)	0.0110 (1)
740	0.8031 (46)	0.2996 (17)	0.0118 (1)
745	0.8044 (41)	0.3036 (15)	0.0128 (1)
750	0.8037 (41)	0.3069 (17)	0.0137 (1)
755	0.8044 (42)	0.3110 (18)	0.0147 (1)
760	0.8045 (44)	0.3142 (17)	0.0155 (1)
765	0.8036 (44)	0.3175 (23)	0.0166 (1)
770	0.8022 (42)	0.3203 (19)	0.0174 (2)
775	0.8028 (42)	0.3232 (18)	0.0188 (1)
780	0.8047 (43)	0.3263 (17)	0.0199 (2)
785	0.8039 (41)	0.3285 (18)	0.0213 (2)
790	0.8024 (45)	0.3316 (17)	0.0227 (2)
795	0.8015 (43)	0.3342 (18)	0.0240 (2)
800	0.8013 (40)	0.3376 (19)	0.0258 (2)
805	0.8007 (42)	0.3407 (19)	0.0272 (2)
810	0.8008 (44)	0.3443 (20)	0.0290 (2)
815	0.8005 (41)	0.3476 (18)	0.0308 (2)
820	0.7997 (42)	0.3534 (21)	0.0325 (3)
825	0.7983 (40)	0.3567 (19)	0.0345 (3)
830	0.7995 (43)	0.3608 (19)	0.0369 (4)
835	0.7964 (42)	0.3674 (19)	0.0389 (3)
840	0.7977 (44)	0.3719 (22)	0.0414 (5)
845	0.7975 (54)	0.3770 (23)	0.0433 (9)
850	0.7947 (63)	0.3831 (28)	0.0457 (8)

**Table 2. Spectral 0°:45° Radiance Factors, and Associated Expanded Uncertainty ( $k=2$ ) with a Confidence Level of 95% for Samples B9 Yellow, B14 Deep-Blue, B13 Cyan.**

$\lambda$ (nm)	PCX8303 B9 Yellow	PCX8304 B14 Deep-Blue	PCX8305 B13 Cyan	$\lambda$ (nm)	PCX8303 B9 Yellow	PCX8304 B14 Deep-Blue	PCX8305 B13 Cyan
250	0.0070	0.0035	0.0053	485	0.1715 (16)	0.0287 (2)	0.4585 (24)
255	0.0069	0.0035	0.0049	490	0.2066 (19)	0.0256 (2)	0.4517 (23)
260	0.0067	0.0035	0.0045	495	0.2480 (22)	0.0232 (2)	0.4425 (23)
265	0.0064	0.0036	0.0044	500	0.2937 (25)	0.0213 (1)	0.4303 (23)
270	0.0063	0.0038	0.0045	505	0.3408 (27)	0.0197 (1)	0.4154 (22)
275	0.0061	0.0040	0.0047	510	0.3883 (29)	0.0182 (2)	0.3985 (21)
280	0.0059	0.0044	0.0050	515	0.4351 (31)	0.0171 (1)	0.3789 (21)
285	0.0060	0.0049	0.0055	520	0.4780 (31)	0.0164 (1)	0.3581 (20)
290	0.0062	0.0054	0.0062	525	0.5155 (32)	0.0160 (1)	0.3360 (19)
295	0.0066	0.0063	0.0070	530	0.5460 (31)	0.0160 (1)	0.3141 (18)
300	0.0070	0.0072	0.0082	535	0.5705 (35)	0.0162 (1)	0.2923 (17)
305	0.0076	0.0085	0.0098	540	0.5901 (35)	0.0167 (1)	0.2713 (16)
310	0.0083	0.0102	0.0116	545	0.6064 (33)	0.0172 (1)	0.2510 (15)
315	0.0089	0.0125	0.0140	550	0.6207 (35)	0.0174 (1)	0.2317 (14)
320	0.0094	0.0160	0.0170	555	0.6336 (40)	0.0170 (1)	0.2136 (13)
325	0.0100	0.0203	0.0207	560	0.6468 (36)	0.0158 (1)	0.1967 (13)
330	0.0108	0.0267	0.0257	565	0.6596 (40)	0.0144 (1)	0.1812 (11)
335	0.0114	0.0348	0.0320	570	0.6713 (38)	0.0130 (1)	0.1675 (10)
340	0.0124	0.0451	0.0405	575	0.6810 (41)	0.0118 (1)	0.1552 (9)
345	0.0133	0.0576	0.0514	580	0.6896 (39)	0.0109 (1)	0.1443 (9)
350	0.0143	0.0722	0.0649	585	0.6952 (38)	0.0104 (1)	0.1351 (8)
355	0.0156	0.0874	0.0821	590	0.7026 (39)	0.0103 (1)	0.1270 (7)
360	0.0171	0.1025	0.1027	595	0.7082 (41)	0.0104 (1)	0.1204 (7)
365	0.0184	0.1175	0.1266	600	0.7218 (39)	0.0108 (1)	0.1148 (6)
370	0.0197	0.1316	0.1522	605	0.7324 (40)	0.0112 (1)	0.1100 (6)
375	0.0207	0.1432	0.1795	610	0.7391 (40)	0.0117 (1)	0.1061 (6)
380	0.0219 (3)	0.1532 (10)	0.2085 (16)	615	0.7441 (39)	0.0120 (1)	0.1026 (6)
385	0.0226 (2)	0.1617 (9)	0.2350 (17)	620	0.7465 (42)	0.0122 (1)	0.0998 (5)
390	0.0235 (2)	0.1684 (11)	0.2611 (17)	625	0.7507 (41)	0.0124 (1)	0.0980 (5)
395	0.0242 (2)	0.1730 (10)	0.2862 (17)	630	0.7533 (42)	0.0124 (1)	0.0965 (5)
400	0.0250 (1)	0.1746 (10)	0.3087 (18)	635	0.7566 (39)	0.0125 (1)	0.0957 (6)
405	0.0257 (1)	0.1732 (11)	0.3288 (19)	640	0.7585 (42)	0.0126 (1)	0.0955 (6)
410	0.0268 (2)	0.1685 (10)	0.3453 (21)	645	0.7608 (41)	0.0129 (1)	0.0958 (5)
415	0.0281 (2)	0.1624 (11)	0.3616 (19)	650	0.7626 (41)	0.0134 (1)	0.0967 (6)
420	0.0298 (3)	0.1535 (12)	0.3752 (20)	655	0.7648 (41)	0.0141 (1)	0.0984 (5)
425	0.0319 (2)	0.1427 (10)	0.3880 (21)	660	0.7665 (41)	0.0153 (1)	0.1008 (6)
430	0.0347 (3)	0.1311 (10)	0.4001 (21)	665	0.7689 (40)	0.0171 (1)	0.1039 (6)
435	0.0380 (3)	0.1190 (12)	0.4109 (22)	670	0.7717 (41)	0.0198 (2)	0.1078 (6)
440	0.0421 (3)	0.1067 (8)	0.4205 (22)	675	0.7738 (42)	0.0236 (3)	0.1125 (7)
445	0.0473 (4)	0.0944 (8)	0.4298 (23)	680	0.7755 (40)	0.0297 (4)	0.1184 (7)
450	0.0538 (4)	0.0828 (7)	0.4387 (22)	685	0.7784 (43)	0.0391 (5)	0.1251 (7)
455	0.0621 (5)	0.0716 (6)	0.4476 (24)	690	0.7805 (40)	0.0532 (8)	0.1328 (8)
460	0.0723 (6)	0.0617 (6)	0.4548 (23)	695	0.7820 (45)	0.0738 (11)	0.1418 (9)
465	0.0849 (7)	0.0524 (5)	0.4601 (23)	700	0.7839 (41)	0.1018 (15)	0.1515 (10)
470	0.0999 (9)	0.0444 (5)	0.4629 (23)	705	0.7858 (42)	0.1378 (19)	0.1620 (9)
475	0.1187 (10)	0.0379 (3)	0.4637 (24)	710	0.7886 (43)	0.1805 (22)	0.1722 (10)
480	0.1421 (13)	0.0327 (3)	0.4626 (24)	715	0.7899 (42)	0.2283 (27)	0.1820 (10)

**Table 2. Spectral 0°:45° Radiance Factors, and Associated Expanded Uncertainty ( $k=2$ ) with a Confidence Level of 95% for Samples B9 Yellow, B14 Deep-Blue, B13 Cyan (Continued).**

$\lambda$ (nm)	PCX8303 B9 Yellow	PCX8304 B14 Deep-Blue	PCX8305 B13 Cyan
720	0.7913 (41)	0.2787 (28)	0.1907 (10)
725	0.7931 (44)	0.3297 (29)	0.1971 (12)
730	0.7942 (41)	0.3779 (30)	0.2020 (13)
735	0.7953 (43)	0.4211 (31)	0.2055 (10)
740	0.7959 (43)	0.4588 (30)	0.2077 (12)
745	0.7975 (43)	0.4890 (30)	0.2080 (10)
750	0.7959 (40)	0.5143 (35)	0.2078 (11)
755	0.7989 (42)	0.5324 (30)	0.2067 (13)
760	0.7992 (40)	0.5459 (30)	0.2056 (11)
765	0.8007 (40)	0.5554 (30)	0.2040 (11)
770	0.8011 (48)	0.5631 (29)	0.2016 (11)
775	0.8026 (41)	0.5661 (31)	0.1991 (10)
780	0.8030 (42)	0.5690 (29)	0.1983 (11)
785	0.8031 (41)	0.5693 (31)	0.1969 (10)
790	0.8044 (45)	0.5690 (31)	0.1958 (10)
795	0.8052 (41)	0.5677 (35)	0.1959 (10)
800	0.8033 (40)	0.5652 (38)	0.1974 (10)
805	0.8037 (42)	0.5616 (31)	0.2003 (12)
810	0.8006 (44)	0.5588 (29)	0.2047 (11)
815	0.8077 (53)	0.5560 (31)	0.2106 (13)
820	0.8065 (40)	0.5515 (32)	0.2177 (13)
825	0.8099 (42)	0.5481 (35)	0.2262 (13)
830	0.8092 (41)	0.5419 (29)	0.2359 (16)
835	0.8099 (44)	0.5366 (40)	0.2472 (18)
840	0.8100 (50)	0.5301 (31)	0.2592 (26)
845	0.8114 (44)	0.5283 (32)	0.2731 (19)
850	0.8149 (54)	0.5215 (30)	0.2896 (34)

**Table 3. Spectral 0°:45° Radiance Factors, and Associated Expanded Uncertainty ( $k=2$ ) with a Confidence Level of 95% for Samples S13 Mid-Green, P15 Grey 50% and Ceram-White.**

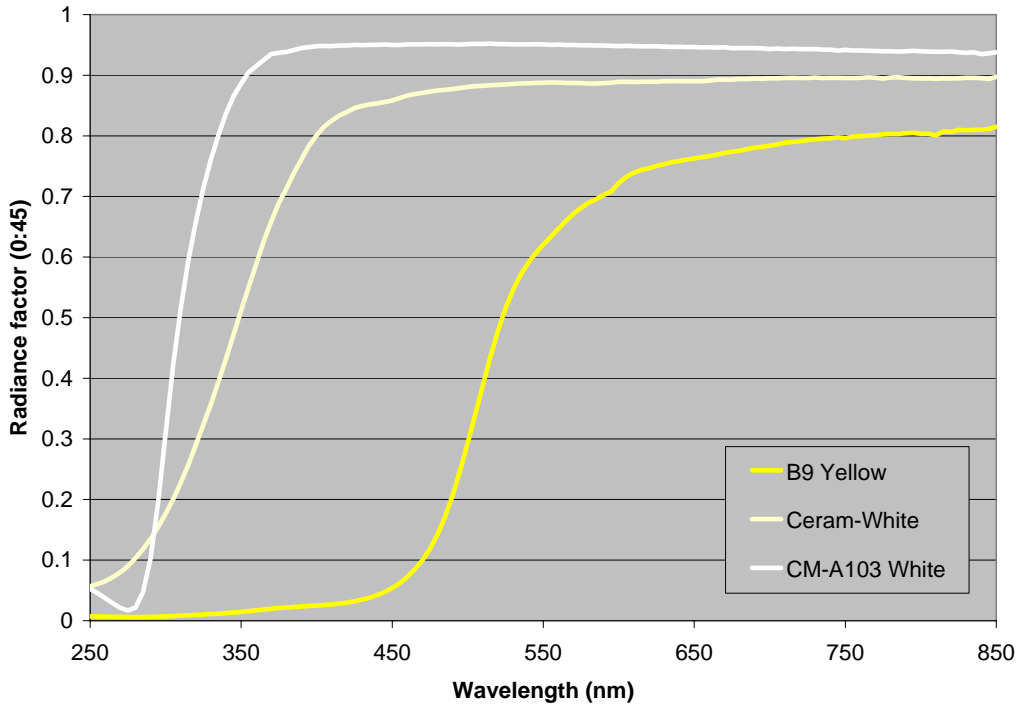
$\lambda$ (nm)	PCX8306 S13 Mid-Green	PCX8307 P15 Grey 50%	PCX8308 Ceram-White	$\lambda$ (nm)	PCX8306 S13 Mid-Green	PCX8307 P15 Grey 50%	PCX8308 Ceram-White
250	0.0173	0.0354	0.0567	485	0.3729 (23)	0.4658 (24)	0.8760 (44)
255	0.0176	0.0369	0.0606	490	0.4015 (24)	0.4642 (24)	0.8773 (44)
260	0.0182	0.0393	0.0651	495	0.4282 (24)	0.4623 (25)	0.8789 (44)
265	0.0192	0.0421	0.0716	500	0.4491 (25)	0.4608 (23)	0.8807 (44)
270	0.0208	0.0458	0.0796	505	0.4628 (24)	0.4583 (24)	0.8820 (44)
275	0.0227	0.0508	0.0902	510	0.4688 (25)	0.4554 (23)	0.8827 (44)
280	0.0251	0.0565	0.1031	515	0.4679 (24)	0.4532 (23)	0.8836 (45)
285	0.0281	0.0643	0.1179	520	0.4608 (25)	0.4523 (23)	0.8842 (44)
290	0.0314	0.0731	0.1349	525	0.4483 (24)	0.4518 (23)	0.8846 (45)
295	0.0353	0.0840	0.1544	530	0.4325 (24)	0.4526 (23)	0.8857 (45)
300	0.0396	0.0968	0.1764	535	0.4152 (23)	0.4553 (23)	0.8865 (45)
305	0.0446	0.1118	0.2009	540	0.3971 (22)	0.4580 (23)	0.8868 (45)
310	0.0493	0.1296	0.2276	545	0.3790 (21)	0.4617 (23)	0.8874 (45)
315	0.0546	0.1497	0.2570	550	0.3618 (20)	0.4637 (23)	0.8875 (45)
320	0.0601	0.1731	0.2899	555	0.3449 (19)	0.4648 (23)	0.8882 (44)
325	0.0652	0.1976	0.3232	560	0.3292 (19)	0.4630 (23)	0.8878 (45)
330	0.0711	0.2237	0.3575	565	0.3146 (17)	0.4598 (23)	0.8873 (45)
335	0.0770	0.2512	0.3949	570	0.3013 (16)	0.4561 (23)	0.8875 (44)
340	0.0842	0.2785	0.4325	575	0.2890 (15)	0.4520 (23)	0.8870 (45)
345	0.0917	0.3066	0.4723	580	0.2776 (15)	0.4484 (23)	0.8863 (44)
350	0.0990	0.3326	0.5116	585	0.2672 (14)	0.4465 (23)	0.8863 (45)
355	0.1073	0.3577	0.5510	590	0.2581 (14)	0.4471 (25)	0.8871 (46)
360	0.1156	0.3803	0.5885	595	0.2494 (13)	0.4497 (23)	0.8876 (45)
365	0.1231	0.4001	0.6265	600	0.2424 (13)	0.4534 (23)	0.8892 (45)
370	0.1304	0.4167	0.6591	605	0.2357 (12)	0.4566 (23)	0.8891 (45)
375	0.1363	0.4300	0.6894	610	0.2300 (12)	0.4594 (23)	0.8889 (45)
380	0.1413 (8)	0.4396 (23)	0.7135 (43)	615	0.2254 (12)	0.4613 (23)	0.8892 (45)
385	0.1456 (8)	0.4473 (23)	0.7393 (42)	620	0.2213 (12)	0.4625 (24)	0.8893 (45)
390	0.1490 (9)	0.4529 (23)	0.7618 (40)	625	0.2180 (11)	0.4629 (24)	0.8892 (45)
395	0.1519 (9)	0.4564 (24)	0.7841 (43)	630	0.2156 (12)	0.4636 (24)	0.8901 (45)
400	0.1546 (9)	0.4582 (24)	0.8014 (43)	635	0.2142 (12)	0.4645 (24)	0.8901 (45)
405	0.1571 (9)	0.4583 (24)	0.8154 (41)	640	0.2130 (11)	0.4649 (24)	0.8907 (45)
410	0.1600 (10)	0.4573 (23)	0.8254 (42)	645	0.2128 (11)	0.4663 (24)	0.8903 (45)
415	0.1637 (9)	0.4566 (23)	0.8335 (42)	650	0.2129 (12)	0.4698 (24)	0.8902 (46)
420	0.1679 (9)	0.4555 (24)	0.8394 (43)	655	0.2141 (11)	0.4747 (24)	0.8903 (45)
425	0.1735 (9)	0.4553 (23)	0.8457 (42)	660	0.2162 (12)	0.4823 (25)	0.8914 (45)
430	0.1798 (9)	0.4553 (23)	0.8493 (43)	665	0.2188 (12)	0.4925 (25)	0.8927 (45)
435	0.1875 (10)	0.4560 (23)	0.8519 (43)	670	0.2219 (12)	0.5053 (26)	0.8928 (45)
440	0.1963 (12)	0.4571 (24)	0.8535 (43)	675	0.2261 (12)	0.5209 (27)	0.8926 (47)
445	0.2072 (11)	0.4593 (23)	0.8558 (43)	680	0.2313 (12)	0.5403 (32)	0.8940 (47)
450	0.2193 (13)	0.4609 (23)	0.8583 (43)	685	0.2373 (13)	0.5627 (30)	0.8937 (45)
455	0.2346 (14)	0.4636 (23)	0.8625 (43)	690	0.2445 (13)	0.5857 (34)	0.8946 (46)
460	0.2517 (15)	0.4661 (23)	0.8664 (43)	695	0.2524 (14)	0.6104 (33)	0.8943 (45)
465	0.2710 (16)	0.4671 (24)	0.8691 (44)	700	0.2611 (15)	0.6327 (33)	0.8951 (48)
470	0.2927 (18)	0.4676 (24)	0.8709 (44)	705	0.2702 (16)	0.6524 (35)	0.8949 (45)
475	0.3173 (19)	0.4678 (24)	0.8730 (44)	710	0.2788 (15)	0.6694 (35)	0.8954 (46)
480	0.3440 (21)	0.4671 (24)	0.8748 (44)	715	0.2874 (15)	0.6839 (35)	0.8956 (45)

**Table 3. Spectral 0°:45° Radiance Factors, and Associated Expanded Uncertainty ( $k=2$ ) with a Confidence Level of 95% for Samples S13 Mid-Green, P15 Grey 50%, Ceram-White (Continued).**

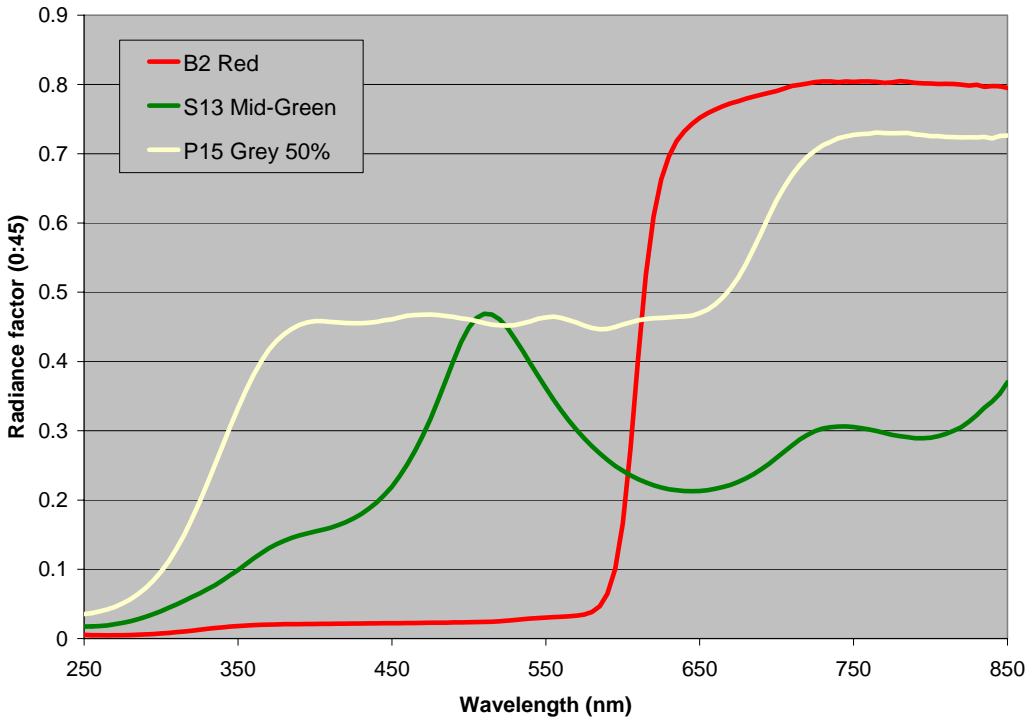
$\lambda$ (nm)	PCX8306 S13 Mid-Green	PCX8307 P15 Grey 50%	PCX8308 Ceram-White
720	0.2941 (15)	0.6957 (35)	0.8956 (46)
725	0.2996 (15)	0.7046 (36)	0.8956 (45)
730	0.3033 (16)	0.7120 (37)	0.8961 (45)
735	0.3052 (15)	0.7171 (39)	0.8955 (47)
740	0.3062 (15)	0.7222 (43)	0.8957 (45)
745	0.3063 (16)	0.7249 (38)	0.8959 (48)
750	0.3056 (17)	0.7271 (39)	0.8954 (45)
755	0.3038 (16)	0.7283 (41)	0.8955 (45)
760	0.3019 (15)	0.7289 (37)	0.8956 (45)
765	0.2997 (18)	0.7306 (38)	0.8967 (45)
770	0.2969 (17)	0.7298 (38)	0.8960 (46)
775	0.2942 (17)	0.7294 (38)	0.8945 (47)
780	0.2923 (15)	0.7296 (37)	0.8962 (47)
785	0.2909 (15)	0.7300 (37)	0.8968 (47)
790	0.2892 (16)	0.7278 (37)	0.8955 (46)
795	0.2891 (15)	0.7270 (42)	0.8951 (46)
800	0.2900 (15)	0.7253 (41)	0.8948 (47)
805	0.2922 (17)	0.7253 (42)	0.8946 (48)
810	0.2955 (16)	0.7242 (39)	0.8941 (45)
815	0.3001 (20)	0.7239 (40)	0.8946 (51)
820	0.3053 (17)	0.7233 (40)	0.8948 (48)
825	0.3133 (19)	0.7236 (36)	0.8951 (46)
830	0.3225 (18)	0.7235 (37)	0.8957 (52)
835	0.3333 (19)	0.7240 (44)	0.8959 (57)
840	0.3421 (29)	0.7221 (43)	0.8953 (48)
845	0.3534 (27)	0.7255 (40)	0.8937 (54)
850	0.3702 (27)	0.7262 (47)	0.8974 (79)

**Table 4. Spectral 0°:45° Radiance Factors, and Associated Expanded Uncertainty ( $k=2$ ) with a Confidence Level of 95% for Sample CM-A103 White.**

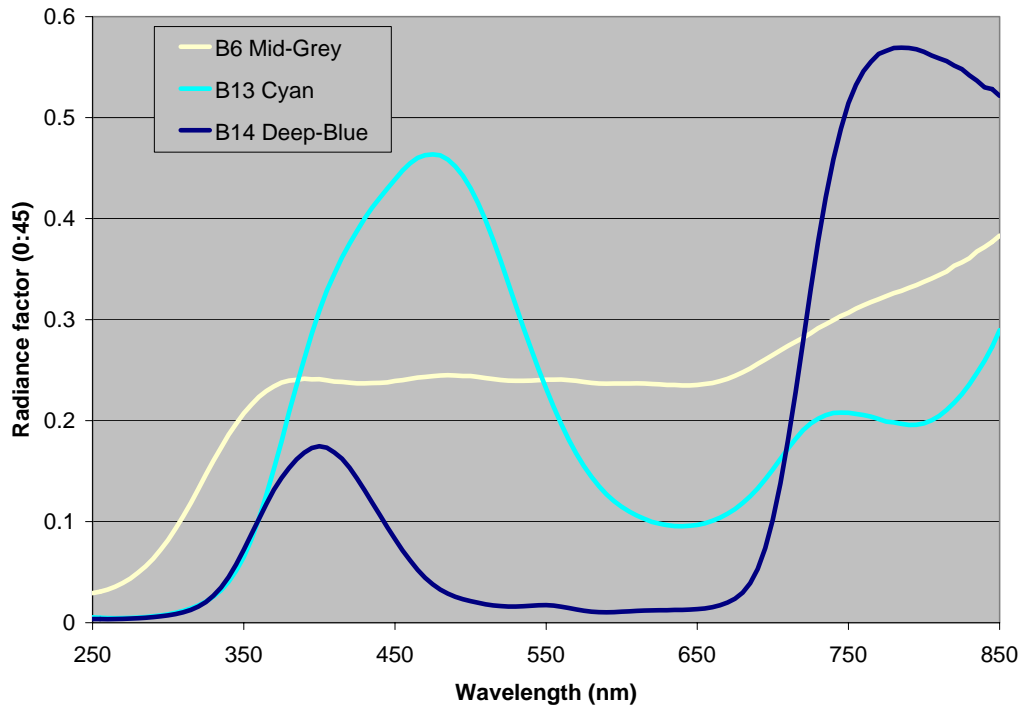
$\lambda$ (nm)	PCX8309 CM-A103 White	$\lambda$ (nm)	PCX8309 CM-A103 White	$\lambda$ (nm)	PCX8309 CM-A103 White
250	0.0524	485	0.9512 (48)	720	0.9434 (51)
255	0.0453	490	0.9511 (48)	725	0.9431 (48)
260	0.0372	495	0.9506 (48)	730	0.9433 (48)
265	0.0285	500	0.9515 (48)	735	0.9421 (47)
270	0.0211	505	0.9516 (48)	740	0.9423 (49)
275	0.0167	510	0.9518 (48)	745	0.9407 (47)
280	0.0213	515	0.9521 (48)	750	0.9420 (47)
285	0.0470	520	0.9515 (48)	755	0.9410 (48)
290	0.1022	525	0.9514 (48)	760	0.9411 (50)
295	0.1938	530	0.9510 (48)	765	0.9405 (50)
300	0.3081	535	0.9508 (48)	770	0.9400 (48)
305	0.4226	540	0.9510 (48)	775	0.9397 (48)
310	0.5160	545	0.9511 (48)	780	0.9397 (47)
315	0.5937	550	0.9510 (48)	785	0.9390 (48)
320	0.6578	555	0.9502 (48)	790	0.9397 (49)
325	0.7135	560	0.9505 (48)	795	0.9404 (47)
330	0.7618	565	0.9499 (48)	800	0.9397 (48)
335	0.8018	570	0.9499 (48)	805	0.9391 (47)
340	0.8371	575	0.9494 (48)	810	0.9388 (50)
345	0.8653	580	0.9494 (48)	815	0.9390 (55)
350	0.8861	585	0.9490 (48)	820	0.9394 (52)
355	0.9049	590	0.9490 (48)	825	0.9379 (47)
360	0.9153	595	0.9485 (48)	830	0.9369 (57)
365	0.9253	600	0.9481 (48)	835	0.9381 (67)
370	0.9352	605	0.9484 (48)	840	0.9348 (51)
375	0.9369	610	0.9480 (48)	845	0.9361 (65)
380	0.9385 (49)	615	0.9479 (47)	850	0.9380 (68)
385	0.9418 (48)	620	0.9477 (50)		
390	0.9448 (48)	625	0.9478 (49)		
395	0.9466 (49)	630	0.9474 (48)		
400	0.9481 (49)	635	0.9468 (47)		
405	0.9484 (49)	640	0.9470 (48)		
410	0.9481 (49)	645	0.9465 (48)		
415	0.9491 (49)	650	0.9468 (49)		
420	0.9491 (48)	655	0.9459 (47)		
425	0.9500 (48)	660	0.9460 (48)		
430	0.9496 (48)	665	0.9457 (49)		
435	0.9502 (48)	670	0.9461 (48)		
440	0.9503 (48)	675	0.9447 (48)		
445	0.9505 (48)	680	0.9450 (47)		
450	0.9498 (48)	685	0.9449 (49)		
455	0.9499 (48)	690	0.9448 (48)		
460	0.9509 (48)	695	0.9443 (48)		
465	0.9511 (48)	700	0.9434 (47)		
470	0.9511 (48)	705	0.9443 (47)		
475	0.9512 (48)	710	0.9431 (47)		
480	0.9509 (48)	715	0.9436 (47)		



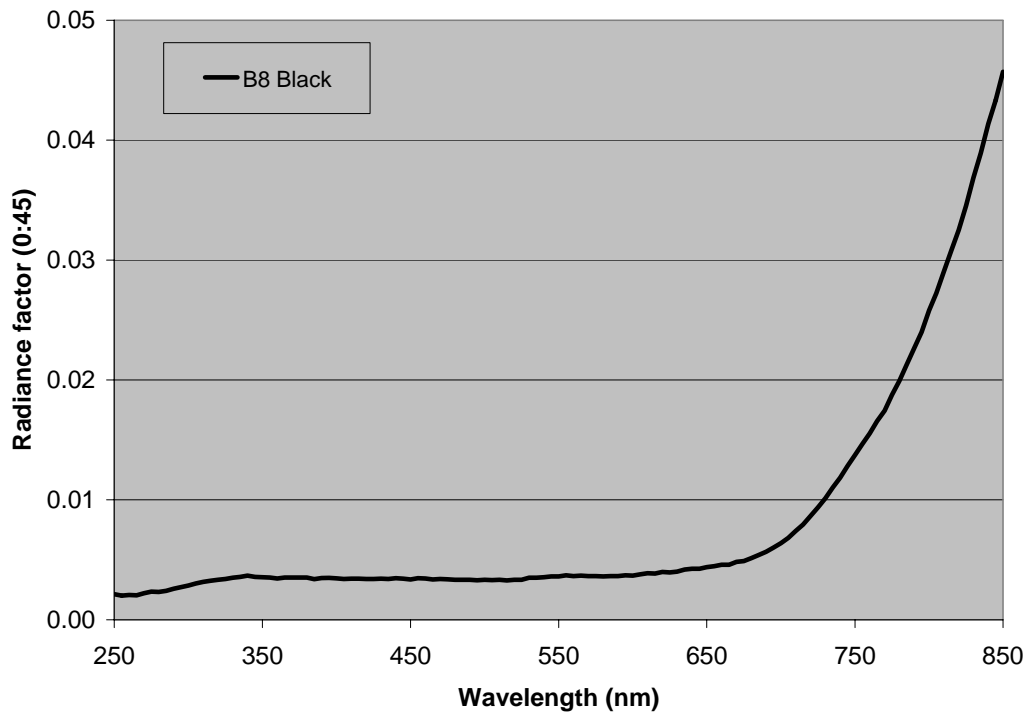
**Figure 1.** Spectral 0:45 Radiance Factors for Test Standards B9 Yellow, Ceram-White and CM-A103 White.



**Figure 2.** Spectral 0:45 Radiance Factors for Test Standards B2 Red, S13 Mid-Green and P15 Grey 50%.



**Figure 3.** Spectral 0:45 Radiance Factors for Test Standards B6 Mid-Grey, B13 Cyan and B14 Deep-Blue.



**Figure 4.** Spectral 0:45 Radiance Factors for Test Standard B8 Black.