

Report – Luminous & Spectral Reflectance Measurements



27JAN2015

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The total Luminous Reflectance for the 10° Observer under Illuminant D-65 is equal to:

$$\text{CIE } Y_{D65-10^\circ} = 57.46$$

Measurement Modality

The measurement of reflectance was made on a hemispherical / D8° geometry modality. This is in accordance with ASTM E 1477-98a(2013) *Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by use of Integrating Sphere Reflectometers*.

Certification

Color Science Consultancy certifies that the data are accurate and a true representation of the material. Further, Color Science Consultancy certifies that all the statements in this report are true and accurate to the best of my knowledge and belief.

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Location

Reflectance test - the sample was measured at Hemmendinger Color Laboratory located in Tatamy, PA.

Equipment Used

The reflectance measurements were made on a Datacolor Spectraflash 100 spectrometer, serial number 1809. The calibration, data reduction and validation of the measurements with this instrument are based on the transmittance and reflectance standards from NIST, Gaithersburg, M.D. and the NPL, Teddington, UK.

Equipment Condition

The Datacolor Spectroflash 100 spectrometer, serial number 1809, use to make these measurements is in good working order. This was attested to by measuring standard reference materials BCRA set CCS-1, and comparing results to internationally accepted values.

Environment

The average temperature at the time of measurement was 24.8°C.

Interferences

There was no change in the standard laboratory conditions, which would affect the test results or have a negative influence on precision.

Deviations from Normal Procedure

There were no deviations from normal laboratory procedures or the applicable ASTM specifications that occurred during the measurement sequence.

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Tristimulus Weighting Factors

The tristimulus weighting factors used to prepare the tristimulus data in this report are based on ASTM D 308, *Standard practice for computing the colors of objects by using the CIE system*. The tables and provide bandpass compensation in the calculation were selected.

Sampling

A single specimen was measured in multiple locations to ensure a statistically rigorous value.

Conditioning

The specimen was allowed ample time to stabilize to the measurement environment.

Precision

The instrumental uncertainty (repeatability) is less than 0.01 CIE Y, standard deviation unit under illuminant D-65 for the 1964 standard 10° observer. This is in accordance with the practice describing E 1345-98 (2014), *Standard practice for reducing the effect of variability of color measurement by the use of multiple measurements*.

The specimen was measured four times with replacement to achieve a measurement variation of less than 0.03 CIE Y standard deviation unit under illuminant D-65 for the 1964 10° observer. This is in accordance with the practice described in E 1345-98 (2014), *Standard practice for reducing the effect of variability of color measurement by the use of multiple measurements*.

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Data Report

Copper	Read 1	Read 2	Read 3	Read 4	Mean	Std Dev
400	42.62	42.76	42.16	42.19	42.43	0.30
410	41.40	41.76	41.33	41.23	41.43	0.23
420	40.83	41.08	40.92	40.72	40.89	0.15
430	40.27	40.53	40.07	40.07	40.24	0.22
440	39.93	40.24	39.44	39.67	39.82	0.34
450	39.95	40.22	39.51	39.66	39.84	0.31
460	39.98	40.31	39.90	39.81	40.00	0.22
470	40.22	40.49	40.37	40.13	40.30	0.16
480	40.58	40.88	40.61	40.51	40.65	0.16
490	41.55	41.87	41.23	41.38	41.51	0.28
500	43.29	43.55	42.67	43.02	43.13	0.38
510	45.61	45.83	44.94	45.18	45.39	0.40
520	48.04	48.13	47.75	47.80	47.93	0.18
530	49.98	50.11	50.11	49.91	50.03	0.10
540	51.49	51.76	51.86	51.65	51.69	0.16
550	54.03	54.29	54.31	54.14	54.19	0.13
560	57.51	57.77	57.53	57.58	57.60	0.12
570	61.63	61.80	61.25	61.43	61.53	0.24
580	65.85	65.99	65.34	65.70	65.72	0.28
590	70.56	70.56	70.06	70.38	70.39	0.24
600	75.00	74.85	74.76	74.81	74.86	0.10
610	77.97	77.74	77.98	77.98	77.92	0.12
620	79.55	79.34	79.76	79.55	79.55	0.17
630	79.93	79.80	80.32	80.09	80.04	0.22
640	79.68	79.64	80.02	79.85	79.80	0.17
650	79.44	79.36	79.72	79.55	79.52	0.16
660	79.07	79.24	79.19	79.22	79.18	0.08
670	79.23	79.20	79.06	79.22	79.17	0.08
680	79.45	79.40	79.09	79.38	79.33	0.16
690	79.70	79.74	79.29	79.66	79.60	0.21
700	80.41	80.29	80.01	80.23	80.24	0.17

CIE X **60.00**
CIE Y **57.46**
CIE Z **43.11**

CIE L* **80.44**
CIE a* **13.59**
CIE b* **18.69**