

Photochromic Lens Transmittance Report

This measurement report refers to the evaluation of a photochromic lens sample in accordance with ISO 8980-3:2013 for uncut finished spectacle lenses and ISO 12312-1:2013 for sunglasses for general use. All quantities reported below are defined in these documents.

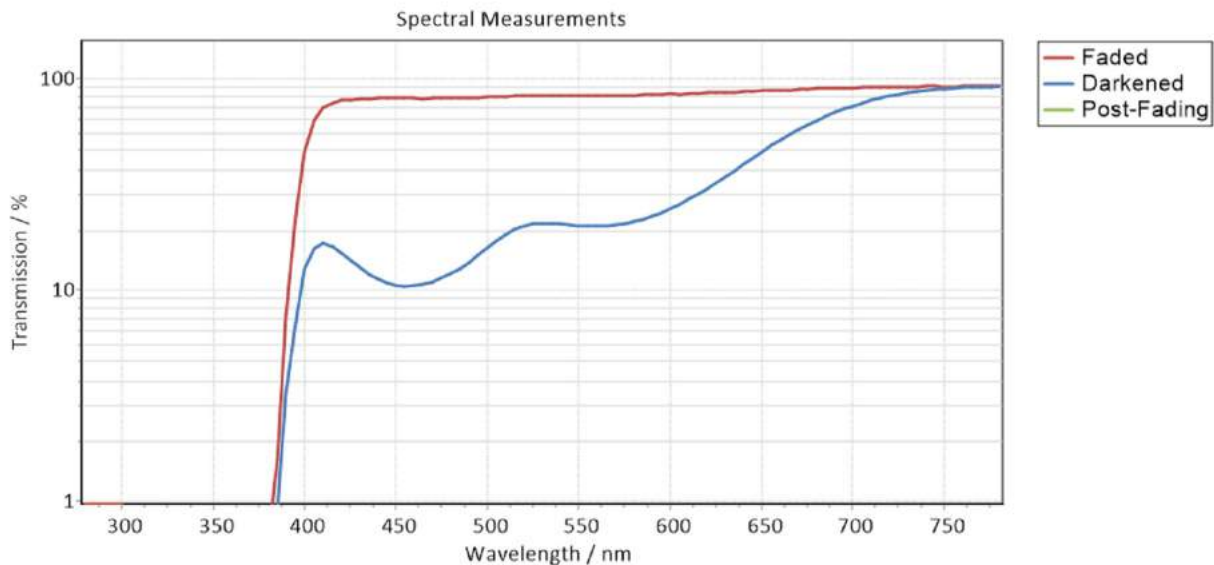
These tests consist of the measurement of the spectral transmittance of the sample over the spectral range 280-780nm both after prior conditioning (faded state) and after exposure to an AM2 solar simulator for a period of fifteen minutes (darkened state).

An additional measurement, not required by the standard, may be included to evaluate the fading back dynamics and lens transmission at a given period after extinguishing the AM2 solar simulator.

Sample Information

Sample Reference	Photochromic Sample		
Measurement Profile	ISO 8980-3:2013 Standard		
Date/Time	13/11/2014 14:32	Irradiation Source	50 klx
Water Bath Temperature	23.0 °C	Darkening Process Time	15.0 min
Refractive Index Correction	1.50	Fading Process Time	N/A
Hardware	Bentham BPC300		

Spectral Measurements



Photochromic Results

Photochromic Response

Ratio	3.86
Classification	PASS

Photochromic Category

Faded Category	Category 0
Darkened Category	Category 2

Transmittance Properties

Colourimetric Parameters: CIE 1931

	τ_V	x	y
Faded	82.74	0.3388	0.3373
Darkened	21.45	0.4172	0.3773
Post-Fading			

Colourimetric Parameters: CIE Lab

	CIE 2° Observer			CIE 10° Observer		
	L*	a*	b*	L*	a*	b*
Faded	92.90	0.60	2.30	92.83	0.65	2.30
Darkened	53.44	8.78	21.56	52.80	9.36	20.43
Post-Fading						

Visual Attenuation Coefficient: Incandescent Traffic Signals

	Q_{red}		Q_{yellow}		Q_{green}		Q_{blue}	
Faded	1.028	PASS	1.009	PASS	0.995	PASS	0.982	PASS
Darkened	1.485	PASS	1.112	PASS	0.925	PASS	0.751	PASS
Post-Fading								

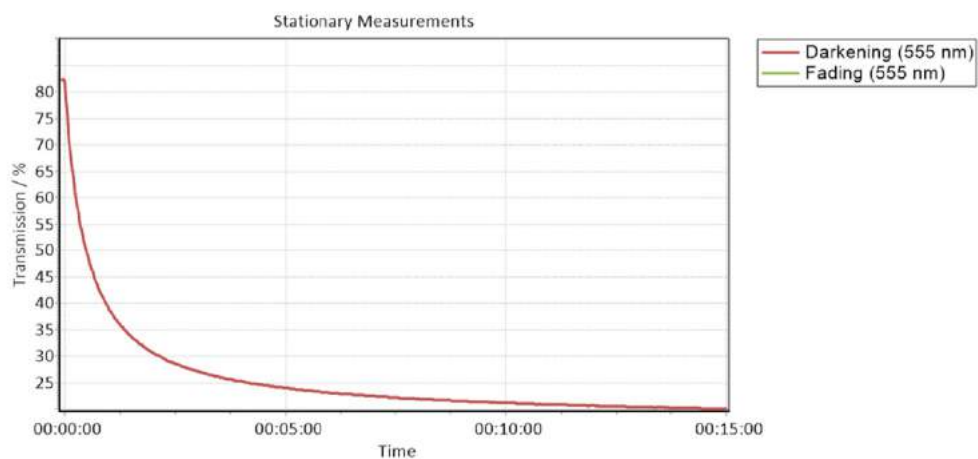
Visual Attenuation Coefficient: LED Traffic Signals

	Q_{red}		Q_{yellow}		Q_{green}		Q_{blue}	
Faded	1.034	PASS	1.006	PASS	0.985	PASS	0.972	PASS
Darkened	1.618	PASS	1.022	PASS	0.808	PASS	0.550	PASS
Post-Fading								

UV Transmittance

	τ_{SB} (%)	τ_{SUVA} (%)	τ_{SUVB} (%)
Faded	79.1	2.42E-01	1.87E-03
Darkened	12.0	1.42E-01	7.11E-03
Post-Fading			

Stationary Measurements



Spectral Data

Wavelength / nm	Transmission / %	
	Faded	Darkened
280	0.000	0.029
285	0.000	0.013
290	0.000	0.010
295	0.000	0.003
300	0.000	0.007
305	0.001	0.008
310	0.002	0.007
315	0.005	0.006
320	0.012	0.014
325	0.024	0.029
330	0.052	0.036
335	0.154	0.085
340	0.422	0.215
345	0.528	0.270
350	0.490	0.262
355	0.376	0.233
360	0.235	0.162
365	0.215	0.158
370	0.318	0.176
375	0.443	0.277
380	0.636	0.428
385	1.569	0.908
390	7.571	3.263
395	22.330	6.986
400	44.940	12.476
405	62.791	15.666
410	72.184	16.535
415	76.233	16.030
420	78.218	14.827
425	78.951	13.744
430	79.515	12.728
435	79.802	11.754
440	80.207	11.244
445	80.079	10.662
450	80.313	10.482
455	80.373	10.369
460	80.364	10.409
465	79.910	10.566
470	80.319	10.861
475	80.274	11.305

Spectral Data

Wavelength / nm	Transmission / %	
	Faded	Darkened
480	80.262	11.850
485	80.272	12.504
490	80.585	13.449
495	80.793	14.532
500	81.137	15.731
505	81.260	17.005
510	81.575	18.185
515	81.967	19.160
520	82.078	19.881
525	82.368	20.304
530	82.000	20.373
535	82.378	20.444
540	82.514	20.317
545	82.407	20.186
550	82.687	20.038
555	82.268	19.928
560	82.612	19.919
565	82.600	19.971
570	82.707	20.095
575	82.818	20.385
580	82.866	20.807
585	83.270	21.399
590	83.264	22.043
595	83.504	22.918
600	83.918	24.013
605	83.841	25.101
610	84.257	26.571
615	84.582	28.142
620	84.910	29.870
625	85.051	31.841
630	85.528	34.058
635	85.816	36.429
640	86.329	39.200
645	86.521	41.939
650	86.931	44.902
655	87.323	47.915
660	87.866	51.161
665	87.799	54.020
670	88.448	57.257
675	88.705	60.178

Spectral Data

Wavelength / nm	Transmission / %	
	Faded	Darkened
680	89.131	63.161
685	89.326	66.139
690	89.473	68.770
695	89.669	71.341
700	89.748	73.733
705	90.165	76.207
710	90.173	78.245
715	90.406	80.252
720	90.588	82.139
725	90.819	83.856
730	90.888	85.232
735	90.976	86.401
740	91.167	87.582
745	91.136	88.352
750	90.801	88.563
755	91.031	89.418
760	91.315	90.131
765	91.511	90.454
770	91.495	90.772
775	91.500	91.013
780	91.643	91.177

Stationary Data

Stationary Data	
Darkening Time /s	Darkening /%
-4.23	82.152
-3.71	82.343
-1.98	82.252
0.00	81.767
2.00	77.385
4.03	73.682
6.01	70.440
8.00	67.553
10.00	65.048
12.00	62.729
14.01	60.638
16.02	58.708
18.00	57.094
20.00	55.522
22.01	54.119
24.01	52.750
26.01	51.434
28.00	50.288
30.00	49.193
32.00	48.208
34.01	47.251
36.00	46.402
38.00	45.547
40.00	44.808
42.00	44.004
44.01	43.317
46.00	42.676
48.02	42.035
50.00	41.415
52.00	40.805
54.01	40.320
56.00	39.806
58.00	39.233
60.00	38.815
61.99	38.417
64.01	37.945
66.00	37.563
68.02	37.115
70.00	36.813
71.99	36.391

Stationary Data

Stationary Data	
Darkening Time /s	Darkening /%
74.01	36.043
76.02	35.681
78.00	35.420
80.00	35.063
81.99	34.761
84.01	34.481
86.00	34.214
88.02	33.968
90.00	33.667
92.01	33.440
94.02	33.103
96.00	32.938
98.00	32.702
100.00	32.516
102.02	32.255
104.01	32.103
106.00	31.892
108.00	31.651
110.01	31.444
112.01	31.301
114.01	31.086
116.00	30.945
118.00	30.763
120.00	30.587
122.01	30.369
124.02	30.262
126.00	30.146
128.00	29.989
130.00	29.835
132.01	29.681
134.01	29.529
136.00	29.367
138.00	29.276
140.00	29.113
142.02	28.983
144.01	28.887
146.00	28.815
148.01	28.665
150.00	28.560
152.01	28.452

Stationary Data

Stationary Data	
Darkening Time /s	Darkening /%
154.00	28.363
156.02	28.233
158.00	28.154
160.00	28.010
162.01	27.970
164.02	27.792
166.00	27.763
168.00	27.602
170.00	27.582
172.01	27.469
174.00	27.392
176.00	27.308
178.00	27.189
179.99	27.093
182.02	27.056
184.00	26.951
186.00	26.883
188.01	26.801
190.01	26.712
192.01	26.666
194.00	26.607
196.00	26.528
198.00	26.415
200.01	26.383
202.01	26.325
204.00	26.187
206.00	26.209
208.00	26.125
210.02	26.017
212.01	25.965
214.02	25.923
216.00	25.857
218.00	25.843
220.01	25.683
222.01	25.677
224.00	25.628
226.00	25.565
228.00	25.540
230.01	25.446
232.01	25.384

Stationary Data

Stationary Data	
Darkening Time /s	Darkening /%
234.00	25.357
236.00	25.272
238.01	25.234
240.01	25.238
242.02	25.122
244.00	25.060
246.00	25.037
248.00	24.977
250.01	24.921
252.02	24.863
254.00	24.879
256.00	24.821
258.00	24.798
260.02	24.745
262.00	24.730
264.00	24.632
266.00	24.628
267.99	24.575
270.01	24.527
272.00	24.478
274.00	24.460
276.01	24.448
278.01	24.379
280.01	24.341
282.00	24.278
284.02	24.267
286.00	24.213
288.01	24.181
290.01	24.114
292.00	24.099
294.00	24.083
296.00	24.023
298.03	24.009
300.01	23.992
302.00	23.914
304.00	23.938
306.00	23.875
308.01	23.828
310.01	23.807
312.00	23.776

Stationary Data

Stationary Data	
Darkening Time /s	Darkening /%
314.02	23.720
316.00	23.711
318.01	23.662
320.02	23.633
322.00	23.626
323.98	23.560
326.01	23.571
328.01	23.547
330.01	23.469
331.99	23.479
334.00	23.460
336.00	23.436
338.01	23.419
340.02	23.363
342.00	23.351
344.00	23.328
346.00	23.282
348.01	23.251
350.00	23.216
352.00	23.213
354.00	23.177
356.00	23.166
358.02	23.137
360.02	23.088
362.00	23.033
364.00	23.045
366.01	23.055
368.01	23.029
370.00	22.964
372.00	22.960
374.00	22.929
376.01	22.916
378.02	22.889
380.00	22.852
382.02	22.839
384.00	22.850
386.01	22.826
388.01	22.788
390.00	22.767
392.02	22.711

Stationary Data

Stationary Data	
Darkening Time /s	Darkening /%
394.00	22.732
396.01	22.660
398.01	22.681
400.00	22.667
402.00	22.636
404.00	22.613
406.01	22.616
408.01	22.598
410.02	22.548
412.00	22.533
414.00	22.539
416.01	22.478
418.02	22.489
420.00	22.455
422.00	22.450
424.00	22.426
426.02	22.415
428.01	22.394
430.00	22.333
432.00	22.345
434.00	22.300
436.01	22.293
438.00	22.311
440.00	22.273
442.00	22.220
444.00	22.256
446.01	22.235
448.00	22.203
450.00	22.168
452.00	22.191
453.99	22.150
456.01	22.091
458.00	22.085
460.00	22.106
462.01	22.070
464.01	22.076
466.01	22.064
468.02	22.050
470.00	22.056
472.00	22.011

Stationary Data

Stationary Data	
Darkening Time /s	Darkening /%
474.01	21.989
476.01	21.953
478.00	21.946
480.00	21.958
482.00	21.929
484.01	21.930
486.01	21.901
488.00	21.902
490.02	21.862
492.00	21.858
494.01	21.832
496.02	21.833
498.00	21.793
500.00	21.815
502.01	21.766
504.02	21.781
505.99	21.769
508.02	21.741
510.00	21.721
512.01	21.709
514.01	21.724
516.01	21.679
518.00	21.650
520.00	21.665
522.00	21.655
524.02	21.639
526.00	21.607
528.00	21.600
530.00	21.606
532.00	21.591
534.01	21.599
536.00	21.549
538.00	21.543
540.00	21.518
542.01	21.513
544.01	21.514
546.00	21.487
548.00	21.463
550.00	21.454
552.01	21.428

Stationary Data

Stationary Data	
Darkening Time /s	Darkening /%
554.01	21.444
556.00	21.436
558.00	21.404
560.01	21.416
562.01	21.386
564.01	21.377
566.02	21.370
568.00	21.350
570.00	21.334
572.03	21.333
574.01	21.340
576.00	21.322
578.00	21.283
580.01	21.314
582.01	21.271
584.01	21.295
586.02	21.243
588.00	21.268
590.00	21.211
592.01	21.228
594.01	21.237
596.00	21.187
598.00	21.200
600.00	21.169
602.02	21.187
604.01	21.172
606.00	21.162
608.00	21.165
610.00	21.139
612.02	21.133
614.01	21.118
616.00	21.089
618.00	21.114
620.01	21.052
622.01	21.064
624.00	21.065
626.00	21.064
628.00	21.056
630.00	21.039
632.01	21.042

Stationary Data

Stationary Data	
Darkening Time /s	Darkening /%
634.02	20.991
636.00	21.020
638.00	21.017
640.01	20.911
642.01	20.956
644.00	20.963
646.00	20.989
648.00	20.954
650.03	20.960
652.01	20.922
654.00	20.914
656.00	20.900
658.00	20.895
660.03	20.892
662.01	20.887
664.00	20.881
666.00	20.842
668.00	20.853
670.03	20.831
672.01	20.834
674.00	20.840
676.00	20.821
678.01	20.809
680.01	20.807
682.02	20.822
684.00	20.769
686.00	20.799
688.00	20.772
690.01	20.761
692.01	20.767
694.00	20.768
696.01	20.739
698.00	20.697
700.01	20.760
702.01	20.719
704.00	20.680
706.00	20.693
708.01	20.674
710.01	20.690
712.02	20.628

Stationary Data

Stationary Data	
Darkening Time /s	Darkening /%
714.00	20.690
716.00	20.650
718.00	20.649
720.01	20.643
722.02	20.633
724.00	20.647
726.00	20.611
728.00	20.622
730.01	20.589
732.02	20.588
734.00	20.565
736.00	20.562
737.99	20.577
740.02	20.571
742.02	20.571
744.00	20.533
746.01	20.523
748.01	20.522
750.01	20.528
752.00	20.508
754.00	20.488
756.01	20.497
758.01	20.512
760.01	20.487
762.00	20.481
764.00	20.470
766.00	20.440
768.01	20.464
770.01	20.435
772.00	20.434
774.00	20.426
776.00	20.442
778.01	20.429
780.01	20.401
782.02	20.407
784.00	20.401
786.00	20.423
788.01	20.405
790.07	20.365
792.55	20.399

Stationary Data

Stationary Data	
Darkening Time /s	Darkening /%
794.00	20.379
796.00	20.390
798.01	20.371
800.01	20.345
802.00	20.307
804.00	20.316
806.00	20.310
808.02	20.333
810.00	20.371
812.00	20.360
814.00	20.333
816.01	20.304
818.01	20.330
820.00	20.370
822.00	20.298
824.01	20.260
825.99	20.285
828.01	20.199
830.00	20.276
832.00	20.227
834.00	20.226
836.03	20.225
838.01	20.227
840.02	20.247
842.00	20.195
844.00	20.208
846.03	20.172
848.01	20.166
850.00	20.214
852.00	20.216
854.00	20.156
856.01	20.180
858.01	20.175
860.00	20.154
862.02	20.150
864.00	20.149
866.01	20.116
868.01	20.113
870.00	20.093
872.00	20.112

Stationary Data

Stationary Data	
Darkening Time /s	Darkening /%
874.00	20.100
876.01	20.063
878.02	20.108
880.00	20.080
882.00	20.052
884.00	20.069
886.01	20.078
888.02	20.049
890.00	20.079
892.00	20.081
894.00	20.058
896.01	20.034
898.00	20.040
900.00	20.032

Measurement System Overview



Bentham BPC300 Photochromic Spectrometer

The Bentham BPC300 is a turn-key solution for the quick and accurate characterisation of photochromic lenses in accordance with ISO 8980-3: 2013 and ISO 12312-1:2013 (test methods applicable to ISO 12312-1:2013).

A monochromatic probe, 280-780nm, is generated from a deuterium and a quartz halogen source by a Bentham TMc300 single monochromator. This probe is made to be incident on the sample under test in the determination of spectral transmittance whilst to activate the photochromic, the sample is irradiated by an AM2 solar simulator.

Of the light incident on the system detector station- transmitted by the sample from both sources- only that from the monochromatic source is sought. Discrimination of the two components is achieved by modulating the optical probe on a known carrier wave using an optical chopper, recovering the signal with a fully automated DSP lock-in amplifier and employing spatial filtering to reduce the amount of transmitted light from the solar simulator.

The sample is mounted in a temperature controlled water bath for the purposes of maintaining sample temperature during solar simulator irradiation and to permit evaluating the photochromic response at different temperatures.

The BPC300 system is fully automated by the Benwin+ proprietary Windows application in which measurement profiles may be defined, the procedure culminating in the production of a measurement report which includes the evaluation of all parameters required by these standards.

