The NMF box and the round robin test of the SURFACE project

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Introduction and conclusions

As a part of the SURFACE project, seven artificial samples – simulating road surfaces – have been manufactured for use in a round robin test of measuring equipment.

The NMF box (normally called "Lådan") took part in this test. As a preparation for the test, Mikael Lindgren, RISE had calibrated the standard used for the NMF box. However, the value was so close to the previous value that it was decided not to change the calibration level.

The NMF box is described in a report "A box for the measurement of road surface reflection properties" version 21 February 2018 (can be downloaded from nmfv.dk). The actual measured values are two values of a reduced luminance coefficient, r_1 and r_2. Values of the average luminance Q0 and the alternative coefficient in diffuse illumination Qd are derived by correlations. The specularity is measured by the specular factor S1, which is the ratio r_2/r_1.

The measurements were carried out on 24 January 2020. Mikael Lindgren arrived in Lyngby with the samples and assisted Dennis Corell; DTU Fotonik and Kai Sørensen with the measurements. He then left, bringing the samples back to RISE.

The measurements were done three times for each of the samples with observation angles α of 1,00° and 2,29°. The observation angle of 1,00° is conventional for road surfaces while the observation angle of 2,29° represents the 30 m geometry of EN 1436:2018 "*Road marking materials - Road marking performance for road users and test methods*".

A measurement report was sent to Valerie Muzet early March 2020.

The only results available from the test are found in a presentation by Paola Iacomussi.

These results are all for an observation angle α of 1,00°, even if participants were encouraged to supply results for other values of the observation angle.

This is a pity, because numerous measurements with the NMF box demonstrate that measured values do not depend much on the observation angle. This applies also for the samples used for the test.

Additionally, the results include only Q0 and not the alternative Qd value, which is also a pity.

Two of the samples are omitted in the presentation. These are GK000 and GK210, which are both characterized as "glossy black" and has very low Q0 values. This leaves the results for five samples only.

The samples on the average are quite specular – none of them fits into classes R1 or R2, while only one or two fit into class R3; else class R4. The same would be the case if the N classes were used instead of the R classes. Refer to CIE 144:2001 "*Road surface and road marking reflection characteristics*".

It is stated in the presentation that eight instruments took part in the test, of which four are laboratory goniometers and four are portable devices. However, there are results from nine instruments each represented by a label. The ninth instrument is labelled “ref” and is probably a “reference” instrument.

In this note, the results of one of the instruments are disregarded, because the values are obviously much too low. The other eight instruments are evaluated by means of their deviations from the common averages. This is done for both Q0 and S1.

It is shown that the results for the NMF box are quite central with deviations from the average of only -0,003 for Q0 and 0,038 for S1. Only two other instruments show equally low deviations (H425 and REF), while the remaining five instruments show much higher deviations.

It is concluded that the NMF box is a sound and reliable instrument that can match even laboratory goniometers. It does measure only two values, but these are the most characteristic values in road surface reflection, and they are measured correctly.

This puts the following statement to shame:

> “*For another device, Q0 is estimated by a linear combination of two r-values, r(0, 0) and r(0, 2), which are the ones used for the specular factor. The coefficients of the linear combination are found by applying a linear regression on a database of r-tables measured with a laboratory instrument. However, due to the small number of measurement points, this method gives results that have a high standard deviation*”.

The statement is copied from a paper: “Review of road surface photometry methods and devices – Proposal for new measurement geometries” by V. Muzet , J. Bernasconi , P. Iacomussi , S. Liandrat, F. Greffier , P. Blattner, J. Reber and M. Lindgren and published in Lighting Res. Technol. 2020; 0: 1–17.

Report

The results in the presentation by Paola Iacomussi are shown by means of diagrams as illustrated in figure 1.

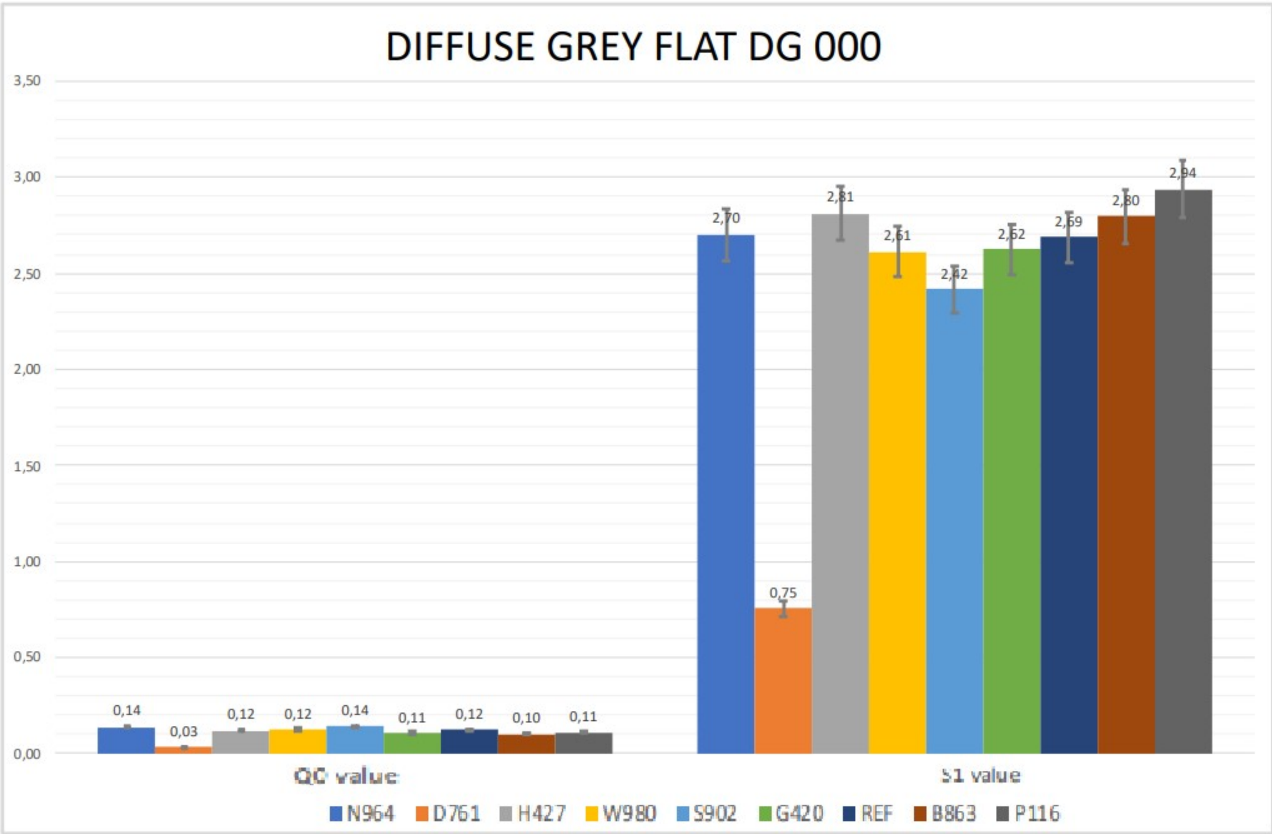


Figure 1: Example of diagrams with results.

The results have been read off the diagrams and entered into tables 1 and 2 for respectively Q0 and S1 values.

The Q0 values are provided in the diagrams with only two decimals, which is a pity. However, the values for the NMF box are taken from the measurement report and has three decimals. The S1 values are also provided with two decimals, which is sufficient for S1 values.

It is instrument D761 that has much too low values for both Q0 and S1. Its values are shown with strike through in both tables.

The NMF box has the label G420 and its results are shown by a fat type in the tables.

It is assumed that the average values for the remaining eight instruments (excluding the values for the instrument D7671) represent the “true” values. If so, each of the instruments can be assigned deviations from the average values.

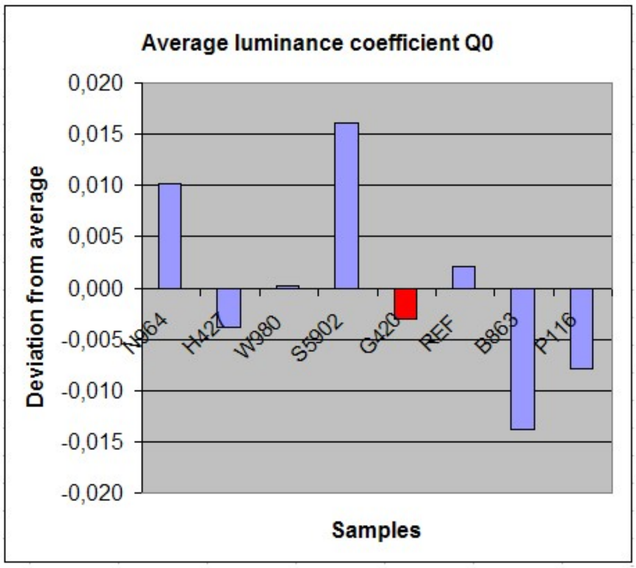
These are shown in figure 2, where the deviations for the NMF box are shown in red instead of blue. The figure shows that the results for the NMF box are quite central with deviations from the average of only -0,003 for Qd and 0,038 for S1. Only two other instruments show equally low deviations (H425 and REF), while the remaining five instruments show much higher deviations.

Table 1: Q0 values

Q0	DK000	DG000	DK210	DG210	DG110
N964	0,100	0,140	0,030	0,040	0,040
D761	~~0,020~~	~~0,030~~	~~0,010~~	~~0,020~~	~~0,010~~
H427	0,080	0,120	0,020	0,030	0,030
W980	0,090	0,120	0,020	0,040	0,030
S5902	0,110	0,140	0,040	0,050	0,040
G420	**0,076**	**0,107**	**0,032**	**0,038**	**0,031**
REF	0,090	0,120	0,030	0,040	0,030
B863	0,050	0,100	0,020	0,030	0,030
P116	0,060	0,110	0,030	0,030	0,030

Table 2: S1 values.

S1	DK000	DG000	DK210	DG210	DG110
N964	2,350	2,700	1,350	1,230	1,060
D761	~~0,770~~	~~0,750~~	~~0,950~~	~~0,560~~	~~0,550~~
H427	2,590	2,810	1,570	1,130	0,860
W980	2,320	2,610	1,370	0,940	0,980
S5902	2,510	2,420	1,800	1,010	0,990
G420	**2,630**	**2,620**	**1,620**	**1,170**	**1,210**
REF	2,470	2,690	1,480	1,120	1,030
B863	2,500	2,800	2,030	1,380	1,200
P116	2,570	2,940	1,890	1,380	1,170
Classes	R4	R4	R4	R3/R4	R3



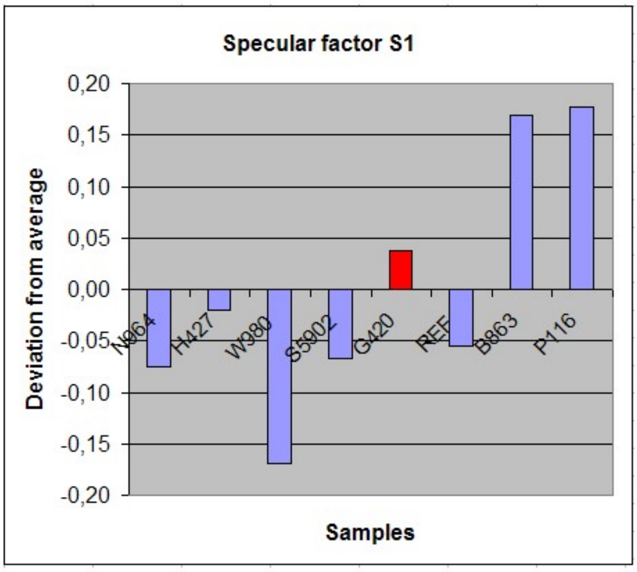


Figure 2: Deviations from common averages.