Nordic certification of road marking materials

Results of initial performance measurements at the Danish test site 2019

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Preface

A Nordic certification system for road marking materials, that applies to the countries of Denmark, Iceland (from 2019), Norway and Sweden, was introduced in 2015. In these countries, a documented product approval is required in order to use a road marking material on roads managed by the national road authorities. Product approval is based on monitored and documented performance measurements of material samples applied on test fields on public roads.

Test fields have been established in Denmark and in Norway/Sweden. The Danish test field, currently located on road 22 close to Gørlev, is the basis for approval of road marking products in Denmark. In 2019, 18 materials were applied at the Danish test site. The present report documents the results of the initial measurements taken shortly after application. The results show whether the materials qualify for continued participation in the road trials.

Certification of road marking materials are based on performance measurements carried out one and two years after application. Results from these measurements are published in the VTI report series annually.

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Abstract

Nordic certification of road marking materials – Results of initial performance measurements at the Danish test site 2019

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This report documents the results of the initial performance measurements at the Danish test site in 2019. In total, 18 materials were applied, all as *certification materials*, which means that all materials participated in the test with the purpose of being certified for use on roads managed by the Danish Road Directorate.

Performance measurements of coefficient of retroreflected luminance R_L under dry and wet conditions, luminance coefficient under diffuse illumination *Qd*, chromaticity in daylight, and friction were carried out approximately two weeks after application. The aim of these initial measurements was to determine whether the materials qualify for continued participation in the road trials.

All 18 certification materials were approved for continued participation.

1. Introduction

A Nordic certification system for road marking materials, that applies to the countries of Denmark, Iceland (from 2019), Norway and Sweden, was introduced in 2015. In these countries, a documented product approval is required in order to use a road marking material on roads managed by the national road authorities. Product approval is based on monitored and documented performance measurements of material samples applied on test fields on public roads. The certification system includes two test sites: one in Denmark (for product approval in Denmark) and one in Norway or Sweden (for product approval in Iceland, Norway and Sweden). At present, the Danish test site is located on road 22 close to Gørlev.

A fifth round of tests in Denmark started in August 2019 with initial performance measurements two weeks later. In total, 18 materials were applied, all as *certification materials*[1], i.e. they participated with the purpose of being certified for use on roads managed by the Danish Road Directorate. The present report documents the results of the application and of the initial performance measurements.

The aim of the initial examination and measurements was to determine whether the materials qualify for continued participation in the road trials. Follow-up measurements will be carried out and reported on materials that are approved at the initial measurements.

No material certification will be given based on the initial measurements (i.e. the results presented in this report). Certification will be given based on the results at the follow-up measurements in 2020 and 2021.

The certification system is further described in the document *Nordic certification system for road marking materials – Version 6:2019* (Fors and Johansen, 2019) which is freely available at www.vti.se/en/publications and at www.nordiccert.com.

[1] There is a possibility to participate in the road trials without the purpose of being certified. Such materials participate as *test materials*, see also *Nordic certification system for road marking materials – Version 6:2019* (Fors and Johansen, 2019).

2. Measurements

2.1. General

The performance measurements of coefficient of retroreflected luminance R_L under dry and wet conditions, luminance coefficient under diffuse illumination *Qd*, chromaticity in daylight, and friction were carried out approximately two weeks after application.

All measurements were carried out by operators from Ramböll, supervised by an observer from VTI.

All measurement equipment was calibrated according to procedures recommended by the respective manufacturer.

2.2. Methods and measuring instruments

2.2.1. Thickness measurements

The thickness of the material was measured immediately after application. When applying the lines, material was also applied on steel plates that were placed in the end of two of the nine lines. One of the plates was applied with drop on material, and the other without any drop on. The plates were weighed before and after application. The thickness was measured from the plate without drop on, and also controlled by the weight of the material on the plate.

2.2.2. Retroreflection R_L and luminance coefficient *Qd*

The coefficient of retroreflected luminance, R_L, under dry conditions, and the luminance coefficient under diffuse illumination, *Qd*, were measured using an *LTL-XL* (Delta, Denmark). Measurements were taken at three points in a row within the measurement area defined by EN 1824, Figure 1. The result of an individual line was calculated as the average of the three measurements.

The coefficient of retroreflected luminance, R_L, under wet conditions was measured on type II markings, with the same instrument and measurement points as described above. Approximately 3 litres of clean water was poured over the measurement area, and measurements were carried out 60 s afterwards.

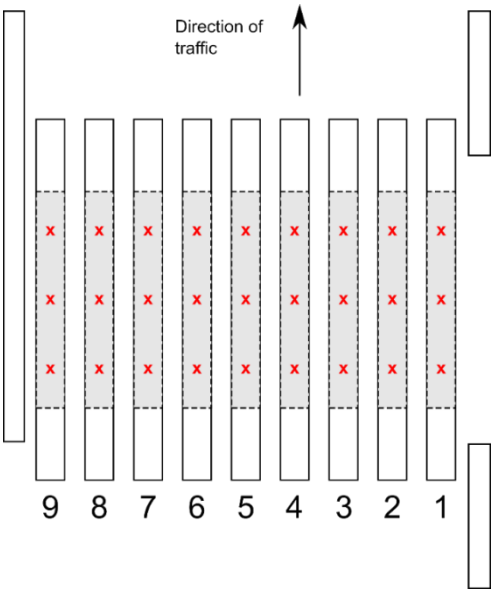

Figure 1. The measurement points (red crosses) for R_L and Qd were placed in a row within the measurement area (grey) defined by EN 1824.

The markings were not cleaned before the measurements, but in case a substantial part of the measurement area was abnormally dirty (e.g. oil stain or blackening from tyres), the instrument was moved in the longitudinal direction to the closest area not affected by abnormal dirt.

2.2.3. Chromaticity coordinates

Chromaticity coordinates were measured in one point on each line, located at the centre of the line, see Figure 2, using a *Konica Minolta Spectrophotometer CM-25cG*.

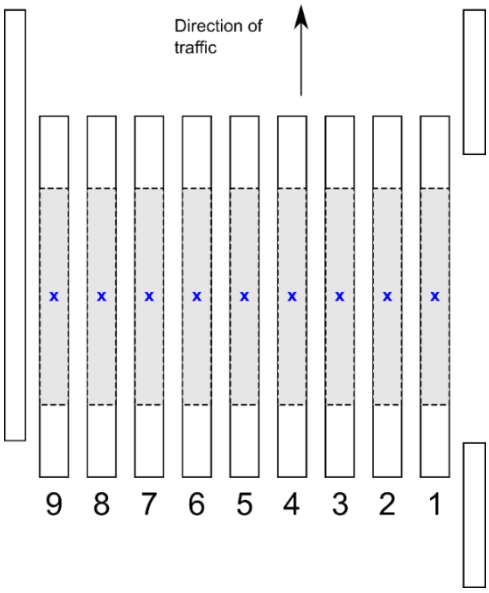

Figure 2. The measurement points (blue crosses) for chromaticity coordinates were placed in the centre of the lines.

For materials that had a very non-homogenous surface (due to unevenly distributed drop-on), an area that appeared to represent the average surface of the material was selected as a measurement point. This point had to be located within the grey area in Figure 2.

The markings were not cleaned before the measurements, but in case a substantial part of the measurement area was abnormally dirty (e.g. oil stain or blackening from tyres), the instrument was moved to the closest area not affected by abnormal dirt.

2.2.4. Friction

Friction measurements were carried out using a *Portable Friction Tester version 4* (PFT), along the centre of each line, Figure 3. The PFT takes a sample approximately every 1.9 cm and thus, about 70 samples are taken on each line. The result of an individual line is calculated as the average of all samples from that line.

In case there were any notches, joints or other abnormalities on the marking surface, the measurement area/line was either reduced or moved somewhat, so that no samples were taken from the abnormality.

Friction was measured on wetted markings. The friction measurements were always carried out after the measurements of the coefficient of retroreflected luminance, R_L, the luminance coefficient under diffuse illumination, *Qd*, and chromaticity coordinates.

The PFT instrument is further described in (Wälivaara 2007).

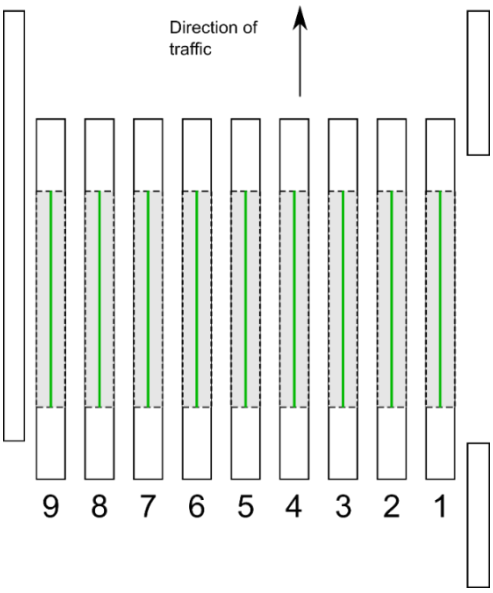

Figure 3. The measurement areas (green lines) for friction.

2.2.5. Measurement values that do not fulfil the performance requirements

In case a measured value was just below the performance requirement (see Chapter 3), extra measurements were taken to assure a correct result. If the new measurement values fulfilled the requirements, this was regarded as the final result and the material was thus approved with respect to that parameter. If the new measurements did not fulfil the requirements, the original measurement was regarded as the final result, i.e. the material was not approved.

2.3. Weather conditions

During the measurements, it was cloudy and the air temperature was approximately 14˚ C (morning) – 17˚ C (day). The temperature of the road surface and the road markings were 14–20˚ C. All performance measurements of $R_{L,dry}$, *Qd* and chromaticity coordinates were carried out on absolutely dry markings.

3. Performance requirements

The performance requirements include four parameters for type I markings, five parameters for type II markings and three parameters for antiskid materials, which are given in Table 1.

Table 1. Performance requirements for type I and type II markings and antiskid materials.

Performance parameter	White markings	Applies to marking type	Antiskid materials
Coefficient of retroreflected luminance, R_L dry [mcd/m^2/lx]	≥ 150	I, II	-
Coefficient of retroreflected luminance, R_L wet [mcd/m^2/lx]	≥ 35	II	-
Luminance coefficient under diffuse illumination, *Qd* [mcd/m^2/lx]	≥ 130	I, II	≥ 130
Friction, [PFT units]	≥ 0.52	I, II	≥ 0.71
Chromaticity coordinates, x, y	*	I, II	*

*) According to EN 1436

Regarding friction, a PFT value of 0.52 corresponds to an SRT value of 50 (class S2 in EN 1436), whereas a PFT value of 0.71 corresponds to an SRT value of 65 (S5). See also Section **Fel! Hittar inte referenskälla.**.

The measurement results from the nine lines were averaged and compared to the performance requirements in Table 1. In order for a material to be approved for continued participation, all relevant performance parameters must fulfil the requirements.

Materials can be applied in five thicknesses. Maximum allowed thicknesses at application are given in Table 2.

Table 2. Maximum allowed thicknesses at application.

Thickness (and type of material)	Maximum thickness at application [mm]
0.4 mm wet (paint)	0.45 mm wet
0.6 mm wet (paint)	0.65 mm wet
1.5 mm (example: spray plastic)	2.0 mm
3.0 mm (example: extruded thermoplastic)	3.5 mm
5.0 mm (structured/profiled type II markings and friction materials with a very coarse surface, example: thermoplastic and cold plastic)	5.5 mm

Regarding the requirements on thickness and geometry, individual lines were disqualified if they didn't fulfil the requirements.

The reason for evaluating R_L, *Qd*, friction and chromaticity coordinates based on the average of the nine lines but evaluating thickness and geometry for individual lines is that the four former represent the properties of the material and the most representative data on these properties is the average of all measurements taken. But for thickness and geometry, all individual lines must fulfil the requirement, since at the follow-up measurement the performance is evaluated for different P classes, where one

line represent a certain P class. The performance of a single line will then have a large impact on the result, and in case it was too thick at application, this will give unfair results. This however implies that, for materials where one or more lines were disqualified because they didn't fulfil the requirements on thickness and geometry, there is a risk that these materials cannot be evaluated and certified for certain P-classes.

3.1. Special considerations regarding friction

The translation from PFT units into SRT units and vice versa results in an uncertainty of approximately 10% (Wälivaara, 2007). Consequently, there is a risk that a reading of a value just below 0.52 PFT units, in fact has 50 SRT units and therefore should fulfill the requirement.

In order to minimize the risk that materials are rejected because of the uncertainty when translating PFT units into SRT units, the required limit for approval was lowered by approximately 10% or 0.05 PFT units, from 0.52 to 0.47 for type I and type II markings, and from 0.71 to 0.66 for antiskid materials.

4. Results

Table 3–Table 4 show the results of the initial measurements of coefficient of retroreflected luminance R_L under dry and wet conditions, luminance coefficient under diffuse illumination *Qd*, friction, chromaticity coordinates, and thickness for all 18 materials registered and applied as *certification materials* at the Danish test site in Gørlev 2019.

Explanation of the denotations in the result tables	
$R_{L,dry}$	Mean value of the coefficient of retroreflected luminance for dry road marking, $R_{L,dry}$ [mcd/m^2/lx]
$R_{L,wet}$	Mean value of the coefficient of retroreflected luminance for wet road marking, $R_{L,wet}$ [mcd/m^2/lx]
Qd	Mean value of luminance coefficient under diffuse illumination, *Qd* [mcd/m^2/lx]
Frict.	Mean value of friction [PFT units]
Colour	"OK", when colour coordinates are inside the colour box (daylight colour)
Thick.	Material thickness [mm]
Appr.	Approved (**A**) or Not Approved (**NA**) for continued participation. **A*** = one or more lines are disqualified.

Values that do not fulfil the performance requirements are indicated in orange.

Note: the performance requirement on friction was lowered from 0.52 to 0.47 PFT units for type I and type II markings and from 0.71 to 0.66 PFT units for antiskid materials in order to minimize the risk that materials are rejected because of an uncertainty in the translation from PFT units into SRT units.

4.1. White road markings

4.1.1. Type I

4.1.1.1. Material thickness 3 mm

Table 3. Results of the initial measurements at the test field in Denmark 2019. White type I markings, 3 mm. Alphabetical order by manufacturer.

Manufacturer *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Thick.*	*Appr.*
Ennis Flint Lifeline D2019.1	275	-	197	0.62	OK	3.5	**A**
Ennis Flint Lifeline D2019.2	256	-	208	0.62	OK	3.3	**A**
Ennis Flint Lifeline D2019.3	295	-	186	0.62	OK	3.3	**A**
Geveko Markings ViaTherm DK3-65E	224	-	215	0.53	OK	3.5	**A**
Geveko Markings ViaTherm DK4 AW	158	-	189	0.71	OK	3.4	**A**
Promax DK19WI	214	-	194	0.55	OK	1.3	**A**

4.1.2. Type II

4.1.2.1. Material thickness 5 mm

Table 4. Results of the initial measurements at the test field in Denmark 2019. White type II markings, 5 mm. Alphabetical order by manufacturer.

Manufacturer *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Thick.*	*Appr.*
Ennis Flint D2019.4 *Profile/pattern:* Longdot	200	79	159	0.66	OK	5.2	**A**
Ennis Flint D2019.5 *Profile/pattern:* Longdot	341	132	153	0.65	OK	5.0	**A**
Ennis Flint Longflex D2019.6 *Profile/pattern:* Longflex	247	77	162	0.64	OK	3.8	**A**
Ennis Flint Longflex D2019.7 *Profile/pattern:* Longflex	273	76	173	0.62	OK	3.5	**A**
Ennis Flint Multidot D2019.8 *Profile/pattern:* Dots	237	97	189	0.68	OK	5.0	**A**
Ennis Flint Multidot D2019.9 *Profile/pattern:* Dots	253	105	186	0.73	OK	5.0	**A**
Geveko Markings ViaTherm DK1 LongDot *Profile/pattern:* LongDot	284	118	172	0.63	OK	4.8	**A**
Geveko Markings ViaTherm DK1 LongFlex *Profile/pattern:* LongFlex	249	119	149	0.64	OK	4.4	**A**
Geveko Markings ViaTherm DK2 LongDot *Profile/pattern:* LongDot	318	113	199	0.58	OK	4.7	**A**
Geveko Markings ViaTherm DK2 LongFlex *Profile/pattern:* LongFlex	306	115	171	0.55	OK	4.8	**A**
Geveko Markings ViaTherm DK2 ViziSpot *Profile/pattern:* ViziSpot	227	100	206	0.58	OK	5.4	**A**
Promax DK19WII *Profile/pattern:* Rullad	253	165	170	0.69	OK	4.4	**A**

4.2. Summary of the results

In total, 18 materials, participated as *certification materials*. All 18 materials were approved for continued participation. The number of approved and not approved materials per material category is shown in Table 5.

Table 5. Summary of the results of the initial measurements for white materials applied at the Danish test site in 2019. Number of approved and not approved materials per material category.

	White		
	Type I	Type II	
Result	3 mm	5 mm	*Total*
Approved	6	12	*18*
Not approved	-	-	-
Total	*6*	*12*	*18*

References

Fors, C. and Johansen, T.C. (2019). *Nordic certification system for road marking materials – Version 6:2019.* VTI notat 10A-2019. Swedish National Road and Transport Research Institute, Linköping, Sweden.

Wälivaara, B. (2007). *Validering av VTI-PFT version 4. Mätningar på plana och profilerade vägmarkeringar* [Validation of VTI-PFT version 4. Measurements on flat and profiled road markings]. VTI notat 16-2007. Swedish National Road and Transport Research Institute, Linköping, Sweden.