Nordic certification system for road marking materials

Results of performance measurements in 2022

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VTI PM 2022:14A
Published 2022
vti.se/publications

VTI PM 2022:14A

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Översatt titel: Nordiskt certifieringssystem för vägmarkeringsmaterial. Resultat för uppföljande funktionsmätningar 2022.
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Reg. No., VTI: 2021/0228-8.4
Publication: VTI PM 2022:14A
Published by VTI 2022

Kort sammanfattning

En nordisk certifiering av vägmarkeringsmaterial, benämnd *NordicCert*, introducerades 2015 och omfattar för närvarande Danmark, Island, Norge och Sverige. I dessa länder krävs ett dokumenterat godkännande av vägmarkeringsmaterial som används på vägar som administreras av den statliga väghållaren. Detta godkännande baseras på funktionsmätningar på materialprover som har applicerats på provfält på allmän väg. Materialen godkänns (certifieras) i relation till antalet hjulpassager de klarar med bibehållen funktion.

Certifieringssystemet omfattar vägmarkeringsmaterial för längsgående och tvärgående vägmarkeringar i olika kategorier med avseende på färg (vit eller gul), typ (typ I, typ II, nedfräst typ II, friktion, handläggning, slitstarka icke-reflekterande samt temporära) och tjocklek (0,4; 0,6; 1,5; 3 och 5 mm).

Föreliggande rapport dokumenterar resultaten från de uppföljande funktionsmätningar som gjordes på NordicCerts provfält 2022, det vill säga ettårsuppföljning av material som lades ut 2021 och tvåårs-uppföljning av material som lades ut 2020. Funktionsmätningarna omfattar retroreflexion (R_L) i torrt och vått tillstånd, luminanskoefficient (*Qd*), friktion, färg i dagsljus och färg i fordonsbelysning (för gula material).

Av de 34 material som lades ut på det isländsk-norsk-svenska provfältet 2021 var det 28 som klarade funktionskraven i minst en av hjulpassageklasserna P0–P4 efter ett år. Av de 44 material som lades ut 2020 var det 2 som klarade funktionskraven i hjulpassageklass P5 efter två år.

Av de 8 material som lades ut på det danska provfältet 2021 var det 5 som klarade funktionskraven i minst en av hjulpassageklasserna P0–P5 efter ett år. 2020 skedde ingen utläggning av material i Danmark.

Nyckelord

Vägmarkeringsmaterial, certifiering.

Abstract

A certification system for road marking materials, *NordicCert*, applies to Denmark, Iceland, Norway and Sweden. In these countries, a documented product approval is required 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 materials are approved (certified) in relation to the number of wheel passages they will stand, with preserved performance.

The certification system includes road marking materials for longitudinal and transverse road markings in categories with respect to colour (white or yellow), type (type I, type II, type II inlaid, antiskid, hand application, non-reflective with enhanced durability, and temporary) and thickness (0.4, 0.6, 1.5, 3 and 5 mm).

The present report documents the follow-up performance measurements that were carried out at the test fields in 2022, i.e., one-year follow-up measurements for materials applied in 2021 and two-years follow-up measurements for materials applied in 2020. The performance parameters include the coefficient of retroreflected luminance (R_L) under dry and wet conditions, the luminance coefficient under diffuse illumination (*Qd*), the friction, the chromaticity in daylight, and the chromaticity of retroreflected light (yellow materials, only).

Out of the 34 materials applied at the Icelandic-Norwegian-Swedish test site in 2021, 28 fulfilled the performance requirements in at least one roll-over class P0–P4 after one year. Out of the 44 materials applied in 2020, 2 fulfilled the performance requirements in roll-over class P5 after two years.

Out of the 8 materials applied at the Danish test site in 2021, 5 fulfilled the performance requirements in at least one roll-over class P0–P5 after one year. No material application was carried out in Denmark in 2020.

Keywords

Road marking material, certification

Preface

A Nordic certification system for road marking materials was introduced in 2015. The certification of products is based on documented performance measurements of material samples applied on test fields on public roads. This report compiles and presents the results of the performance measurements carried out in 2022 on road marking materials applied for certification at the Danish and at the Icelandic-Norwegian-Swedish test site in 2020–2021.

Performance measurements of the coefficient of retroreflected luminance, the luminance coefficient under diffuse illumination, friction and chromaticity coordinates were carried out by operators from Ramboll, supervised by staff from VTI.

The road trials are administered as a joint project between Ramboll and the Swedish National Road and Transport Research Institute (VTI). Trond Cato Johansen at Ramboll is the project manager and Carina Fors is the project leader at VTI. Michael Ruben Anker Larsen, the Danish Road Directorate, Ásbjörn Ólafsson, the Icelandic Road and Coastal Administration, Bjørn Skaar, the Norwegian Public Roads Administration and Ulf Söderberg, the Swedish Transport Administration constitute a steering committee for the Nordic certification system.

Drammen, November 2022

Trond Cato Johansen
Project manager

Granskare/Examiner

Hanna Fager, VTI.

De slutsatser och rekommendationer som uttrycks är författarens/författarnas egna och speglar inte nödvändigtvis myndigheten VTI:s uppfattning./The conclusions and recommendations in the report are those of the author(s) and do not necessarily reflect the views of VTI as a government agency.

Contents

1. Introduction

A Nordic certification system for road marking materials, *NordicCert*, that applies to the countries of Denmark, Iceland, Norway, and Sweden, was introduced in 2015. In these countries, a documented product approval is required 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. Certification in Iceland, Norway and Sweden is based on the results from a test site in Norway or in Sweden and certification in Denmark is based on the results from a test site in Denmark.

A new round of material tests is initiated at the test fields yearly. In short, samples of materials that are to be tested for certification are applied in nine longitudinal lines across the lane, Figure 1. Follow-up measurements of the performance parameters coefficient of retroreflected luminance R_L under dry and wet conditions, luminance coefficient under diffuse illumination *Qd*, chromaticity in daylight, chromaticity of retroreflected light (yellow materials only) and friction are carried out one, two and optionally three years after application.

Materials are certified in relation to the number of wheel passages they will stand. Measurements of the transversal distribution of wheel passages are carried out yearly at the test sites, and roll-over classes (P-classes, defined by EN 1824) are determined for each of the nine lines of road marking materials that were applied in the lane.

The certification procedure includes an identification analysis that verifies the manufacturer's declaration of constituents of the material. From 2020 onwards, the identification analysis is carried out only on materials that fulfil the performance requirements in one or more P-classes.

The certification system is further described in the document *Nordic certification system for road marking materials – Version 9:2022* (Fors and Johansen, 2022) which is a public report available at www.vti.se/en/publications and at www.nordiccert.com.

Lists of certified materials from 2015 onwards are available at www.nordiccert.com.

Figure 1. Materials applied at the Icelandic-Norwegian-Swedish test site. (Photo: Trond Cato Johansen, Ramboll).

1.1. Aim

The aim of this report is to compile and present the results of the follow-up performance measurements carried out in 2022 on the materials applied at the Danish and at Icelandic-Norwegian-Swedish test sites in 2020 (two-years follow-up) and 2021 (one-year follow-up).

Note: The results presented in this report do not show which materials have received certification. To receive certification, an identification analysis of the material must be carried out, which is done upon request by the manufacturer after the results of the performance measurements have been published.

The report includes results of materials registered as *certification materials*. Results of materials registered as *test materials* will be available only to the specific manufacturer. Result reports for 2016–2021 are available at www.nordiccert.com.

2. The certification procedure

The certification procedure consists of several steps and requirements, which are explained in Figure 2

. In year 0, the manufacturer registers the material for the certification procedure and applies the material at the test site. Provided that requirements 1–5 are fulfilled, initial performance measurements are carried out. If the material fulfils the performance requirements, it qualifies for follow-up measurements in year 1.

If the material fulfils the performance requirements in one or more P-classes (see Section 5.2) in year 1, the manufacturer may request an identification analysis of the material. If the result of the analysis agrees with the manufacturer's declaration of constituents, a certificate is issued.

If the manufacturer has registered the material for 2- or 3-years follow-up, additional performance measurements are carried out in year 2 and 3, provided that the material fulfilled the performance requirements in the highest P-class in the year before. If the material fulfils the requirements in a higher P-class, the certificate is updated.

From year 3 onwards, the validity of the certificate is maintained provided that annual audits of the manufacturing process and the factory production control are carried out and approved.

Activities that require actions from the manufacturer are:

- Registration of the material, including paying registration fee and submitting necessary product documents
- Application of the material at the test site
- Requesting identification analysis of the materials the manufacturer wants to certify. To avoid unnecessary administration and costs, the manufacturer is advised to request analysis only of products that have fulfilled the requirements in P-classes that are of relevance for contracts in Denmark, Iceland, Norway, and Sweden.
- Ensuring that annual audits of the manufacturing process and the factory production control are carried out, and to submit a verification of the audit to the administration of NordicCert (requirement from 2022 onwards).

The audits shall be executed by an accredited laboratory, experienced and specialized in the analyses of road marking products and surveillance of the relevant production process.

Details about the activities and requirements shown in Figure 2 can be found in Fors and Johansen (2022).

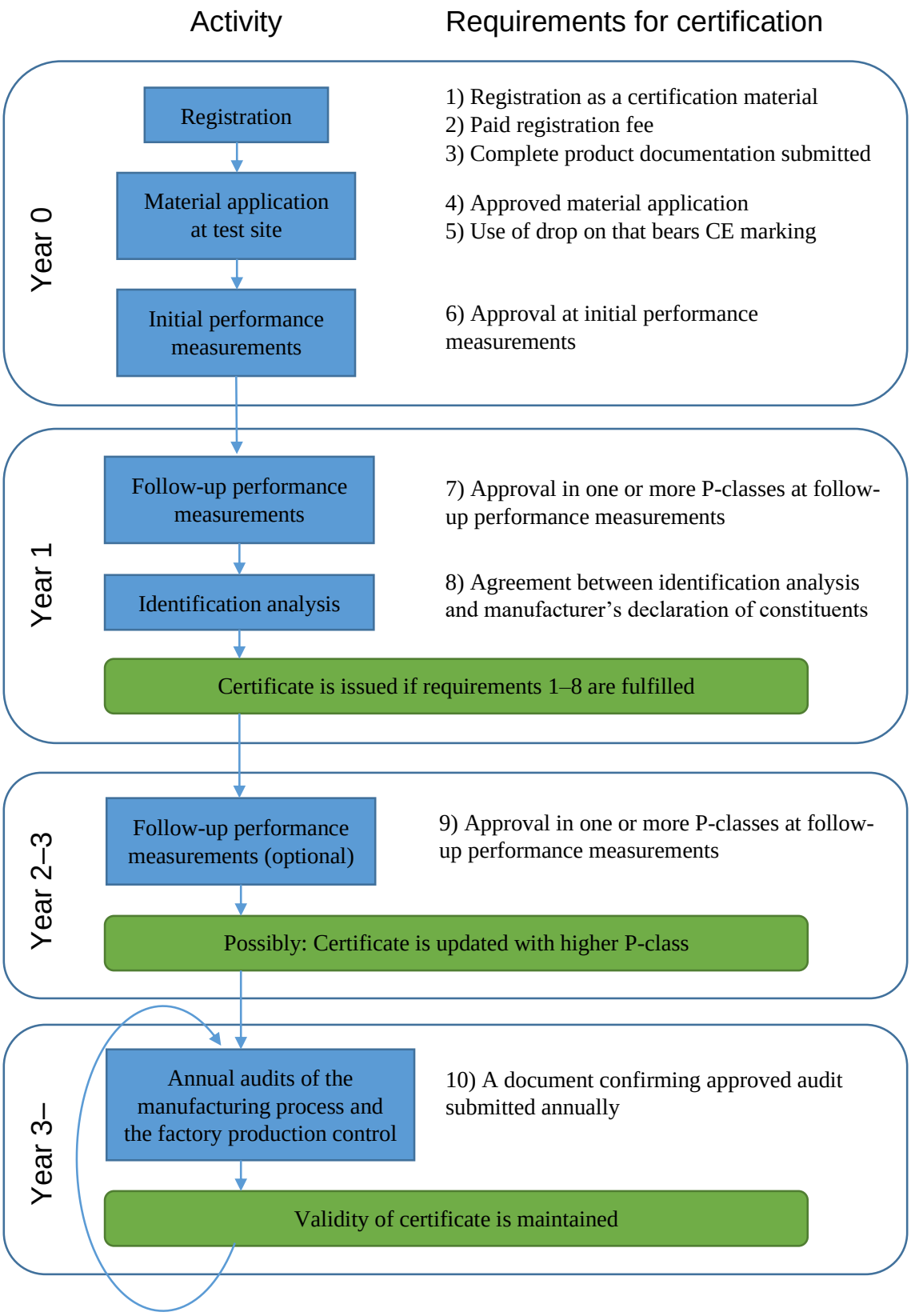

Figure 2. The certification procedure.

3. Test sites

3.1. The Danish test site

The Danish test site that was used in 2016–2021[1] (including follow-up measurements in 2022 and 2023) is located close to Gørlev, Denmark.

3.1.1. General

The road used for the test site is a two-lane rural road surrounded by an open landscape, Figure 3. The road is relatively straight and flat and without any major junctions. It has an annual average daily traffic (AADT) of around 8 100 vehicles/day and the posted speed limit is 80 km/h. The width of the road is 7.1 m and each lane is 3.30 m wide. The road surface consists of a stone matrix asphalt of type SMA8 that was applied in 2015. The averaged mean texture depth (MTD) is approximately 0.67 mm, i.e., the roughness class is RG2.

Figure 3. The road used for the Danish test site in Gørlev. (Photo: Trond Cato Johansen, Ramboll).

The Köppen (climatic) classification of the test site is Cfb, based on data for the period 1951–2000 (Kottek, Grieser, Beck, Rudolf and Rubel, 2006). The climatic class of the Danish test site according to the European Standard EN 1824 is C3, i.e. Cfb with winter maintenance. The extent of winter maintenance may vary a lot between years.

Studded tyres are permitted in Denmark from 1 November to 15 April. However, the percentage of cars with studded tyres is low (estimation: about 5 %).

Further details can be found in Fors and Johansen (2021).

3.1.2. Material application

Each marking material is applied as a row of nine longitudinal lines in the direction of the traffic (nine lines in the lane, no line on the shoulder). The length of the lines is 2.5 m and the width is 0.15 m. The

[1] A new Danish test site was established in 2022 close to Herning, Jutland.

distance between two adjacent rows of lines was at least 2 m. The lines are numbered from right to left in the driving direction, i.e., line 1 is the one next to the edge line and line 9 is the one next to the centre line.

3.1.3. Traffic volume and wheel passages

Measurements of wheel passages are carried out yearly, in order to determine roll-over classes (P-classes) for the lines, see also Section 5.2. The number and type of vehicles and their lateral position are registered by a portable traffic analyser based on coaxial cable technique, developed at VTI. Measurements are carried out at one or more empty positions on the test fields (i.e., where no material is applied). Wheel passages are registered for one week on each measurement occasion. In addition, official annual average daily traffic (AADT) data is obtained from the Danish Road Directorate.

Table 1 shows the official AADT and the distribution of passenger cars, heavy vehicles and other vehicles (two-wheelers, working vehicles) obtained from the wheel passage measurements, for 2020–2021.

Table 1. AADT (both lanes) and distribution of passenger cars, heavy vehicles and other vehicles for 2020–2021, at the Danish test site in Gørlev.

Year	AADT	Passenger cars (%)	Heavy vehicles (%)	Other vehicles (%)
2020	7 761	-	-	-
2021	8 209	90.4	9.3	0.3

No materials were applied at the Danish test site in 2020 and thus no wheel passage measurements were carried out that year. The P-classes for the test field established in 2021 are based on wheel passage measurements carried out in September 2021, which are presented below.

Figure 5 shows the distribution of wheel passages for the average week at the test field established in 2021. The curves are adjusted so that the number of vehicles corresponds to the official AADT, to have results that are representative for the average traffic flow for the entire year.

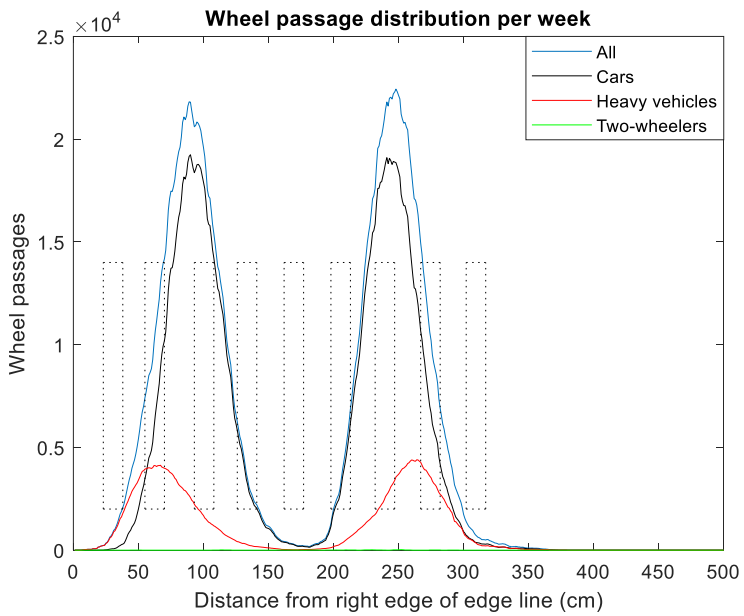

Figure 4. Wheel passages per week at the test field established at the Danish test site in 2021 (measurement in 2021). The dashed areas correspond to the ten lines (line 1 to the left, line 9 to the right). Please note that the shoulder is to the left in the figure. The number of two-wheelers is too few to be visible in the figure.

Table 2 shows the number of wheel passages per line and week for the test field of 2021, as averages for the 15 cm wide lines (corresponding to the measurement area, see Figure 7–Figure 9).

Table 2. Number of wheel passages per line and week, at the test field established at the Danish test site in 2021. Line 1 is the one next to the edge line, see also Figure 7.

Line	Line 1	Line 2	Line 3	Line 4	Line 5	Line 6	Line 7	Line 8	Line 9
Number of wheel passages per week	825	10 004	19 521	3 799	290	3 136	20 981	10 674	777

3.1.4. Weather conditions

The weather conditions from September 2021 to August 2022 are shown in Table 3.

Table 3. Weather conditions at the Danish test site in Gørlev, from September 2021 to August 2022.

Weather parameter	**Value**
Annual average temperature	9.7 °C
Average summer temperature (Apr-Sep)	14.2 °C
Average winter temperature (Oct-Mar)	5.3 °C
Highest temperature	33.9 °C
Lowest temperature	-8.9 °C
Annual precipitation	530 mm
Number of sun hours per month	160 h
Number of weeks with snow or frost	8
Number of times the snow plough has operated	10
Number of times the road has been salted	67

Weather data was retrieved from *the Danish Meteorological Institute* (DMI), at the following places: Flakkebjerg approximately 28 km south of the test site (temperature, sun hours, snow/frost) and Rye close to the test site (precipitation). Information about snow plough operations and salting was obtained from *the Danish Road Directorate*.

3.2. The Icelandic-Norwegian-Swedish test site

The present Icelandic-Norwegian-Swedish test site was established in Haslemoen, Norway in 2017. Materials have been applied yearly at this test site in 2017–2022.

3.2.1. General

The road used for the test site is a two-lane rural road located in Hedmark, close to Haslemoen in eastern Norway, approximately 180 km northeast of Oslo, Figure 5. The road is straight and relatively flat and without any major junctions. The annual average daily traffic (AADT) is around 3 200 vehicles/day (measured in 2021, retrieved from Trafikkdata[2]) and the posted speed limit is 90 km/h. The width of the road is 9 m and each lane is 3.15 m from the edge of milling track in the middle to the edge of milling at the edge line.

[2] http://www.trafikkdata.no

Figure 5. The road used for the Icelandic-Norwegian-Swedish test site. (Photo: Trond Cato Johansen, Ramboll).

For materials applied 2020 onwards (southbound direction), the road surface consists of a stone matrix asphalt (SMA) of type SKA 11 that was installed in 2019. The roughness class is RG2 i.e., the averaged mean texture depth (MTD) is 0.60–0.90 mm.

The Köppen classification of the test site is Dfc, close to the boundary of the Dfb climate zone, based on data for the period 1951–2000 (Kottek, Grieser, Beck, Rudolf and Rubel, 2006). The climatic class according to EN 1824 is C3.

Studded tyres are permitted in Norway from 1 November to the first Sunday after Easter. The estimated percentage of cars with studded tyres is 50–55%.

Further details can be found in Fors and Johansen (2022).

3.2.2. Material application

Each marking material is applied as a row of ten longitudinal lines in the direction of the traffic (nine lines in the lane, one line on the shoulder). The length of the lines is 2.5 m and the width is 0.15 m. The distance between two adjacent rows of lines is 2 m. The lines are numbered from right to left in the driving direction, i.e., line 1 is the one on the shoulder and line 10 is the one next to the centre line.

Regarding inlaid materials, line 2, 3, 9 and 10 are inlaid. Lines 4–8 are applied as non-inlaid lines and they are not included in the evaluation of the material.

3.2.3. Traffic volume and wheel passages

Measurements of wheel passages are carried out yearly, in order to determine roll-over classes (P-classes) for the lines, see also Section 5.2. The number and type of vehicles and their lateral position are registered by a portable traffic analyser based on coaxial cable technique, developed at VTI. Measurements are carried out at one or more empty positions on the test fields (i.e. where no material is applied). Wheel passages are registered for one week on each measurement occasion. In addition,

official annual average daily traffic (AADT) data is obtained from the website Trafikkdata[3], provided by the Norwegian Public Roads Administration.

Table 4 shows the official AADT and the distribution of passenger cars, heavy vehicles, and other vehicles (two-wheelers, working vehicles) obtained from the wheel passage measurements, for 2020–2021.

Table 4. AADT (both lanes) and distribution of passenger cars, heavy vehicles, and other vehicles for 2020–2021, at the Icelandic-Norwegian-Swedish test site.

Year	AADT	Passenger cars (%)	Heavy vehicles (%)	Other vehicles (%)
2020	3 082	85.4	14.3	0.3
2021	3 199	85.5	13.8	0.7

The P-classes for the test field established in 2021 are based on wheel passage measurements carried out in September 2021 and in September 2022, which are presented below. The results of the wheel passage measurements carried out on the test field established in 2020 can be found in in Johansen and Fors (2021).

Figure 6 shows the distribution of wheel passages for the average week at the test field established in 2021. The curves are adjusted so that the number of vehicles corresponds to the official AADT, to have results that are representative for the average traffic flow for the entire year.

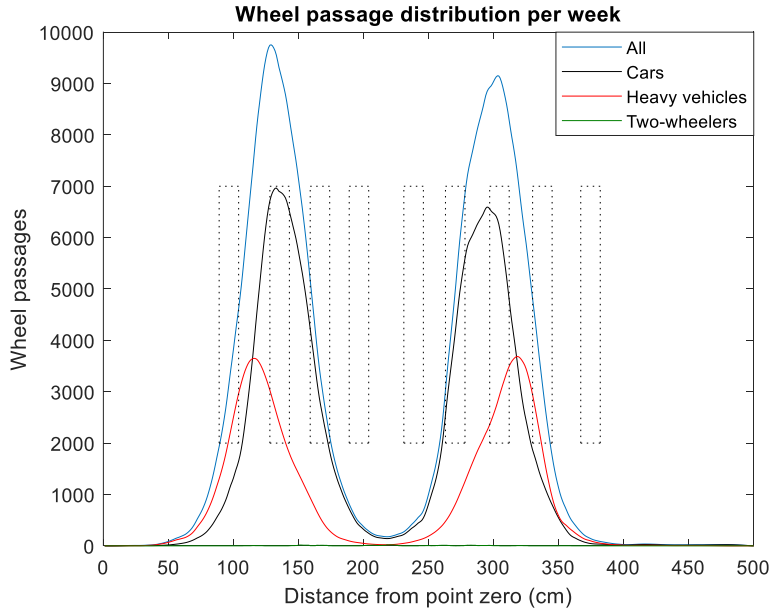

Figure 6. Wheel passages per week at the test field established at the Icelandic-Norwegian-Swedish test site in 2021 (measurement in 2021). The dashed areas correspond to the ten lines (line 1 to the left, line 10 to the right). Please note that the shoulder is to the left in the figure. The number of two-wheelers is too few to be visible in the figure.

Table 5 shows the number of wheel passages per line and week for the test field of 2021, as averages for the 15 cm wide lines (corresponding to the measurement area, see Figure 7–Figure 9) and of the two measurement occasions.

[3] http://www.trafikkdata.no, measurement point Haslemosletta, Rv 2, Hp 11, 4175

Table 5. Number of wheel passages per line and week, at the test field established at the Icelandic-Norwegian-Swedish test site in 2021. Line 2 is the one next to the edge line, see also Figure 7.

Line	Line 2	Line 3	Line 4	Line 5	Line 6	Line 7	Line 8	Line 9	Line 10
Number of wheel passages per week	2 770	9 649	3 179	404	389	5 055	8 852	2 828	111

3.2.4. Weather conditions

The weather conditions from September 2021 to August 2022 are shown in Table 6.

Table 6. Weather conditions at the Icelandic-Norwegian-Swedish test site in Haslemoen, from September 2021 to August 2022.

Weather parameter	Value
Annual average temperature	6.0 °C
Average summer temperature (Apr-Sep)	12.5 °C
Average winter temperature (Oct-Mar)	-0.4 °C
Highest temperature	29.5 °C
Lowest temperature	-20.2 °C
Annual precipitation	543 mm
Number of sun hours per month	n/a
Number of weeks with snow	16
Number of times the snow plough has operated	130
Number of times the road has been salted	105

Weather data was retrieved from Yr[4], which is a joint weather service from *the Norwegian Meteorological Institute* and *the Norwegian Broadcasting Corporation.* Data on temperature, precipitation and snow are from a weather station located approximately 10 km from the test site.

Information about winter snow plough operations and salting was obtained from the contractor for winter maintenance.

[4] https://www.yr.no/

4. Performance measurements

4.1. General

Performance measurements were carried out according to EN 1824 and EN 1436.

Measurements of all performance parameters were carried out by operators from Ramboll, supervised by an observer from VTI. All measurement equipment was calibrated according to procedures recommended by the respective manufacturer.

Performance measurements were carried out in September 2022.

4.2. Methods and measuring instruments

4.2.1. Coefficient of retroreflected luminance R_L and luminance coefficient under diffuse illumination *Qd*

The coefficient of retroreflected luminance, R_L, and the luminance coefficient under diffuse illumination, *Qd*, were measured using an *LTL3500* (Delta, Denmark). Measurements were taken at three points along the centre line, Figure 7. 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 (i.e., road markings with special properties intended to enhance the retroreflection in wet or rainy conditions), with the same instrument and measurement points as described above. Approximately 3 litres of clean water were poured over the measurement area, and measurements were carried out 60 seconds afterwards.

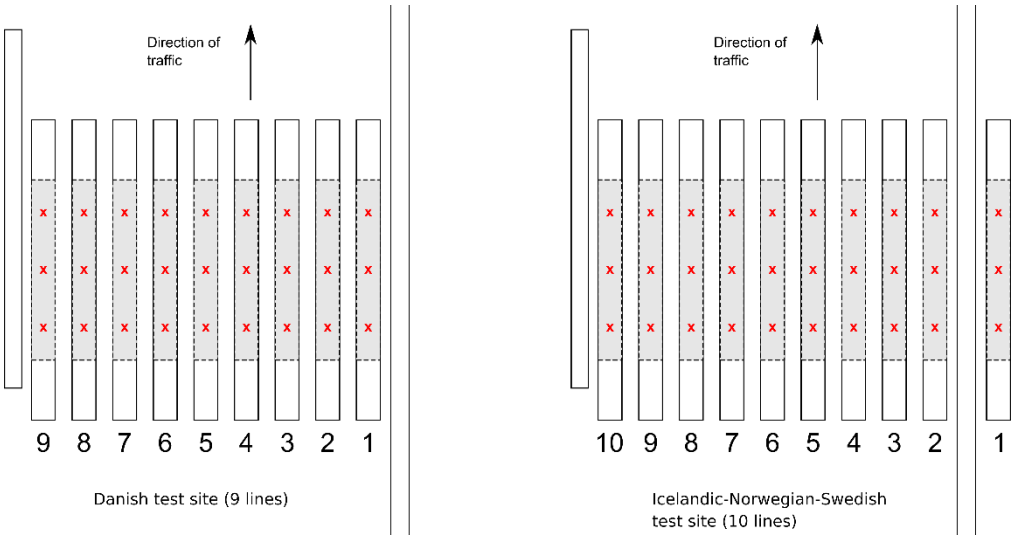

Figure 7. The measurement points (red crosses) for R_L and Qd were placed along the centre line within the measurement area (grey) defined by EN 1824. Left: the Danish test site with nine lines. Right: the Icelandic-Norwegian-Swedish test site with ten lines.

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), the instrument was moved in the longitudinal direction to the closest area not affected by abnormal dirt.

Some marking lines were too worn to be measured. If the measurement area of the marking lines were worn in a way that made representative measurements impossible, these single lines were not measured. However, other marking lines of the same product, that were not equally worn, were measured.

4.2.2. Chromaticity coordinates

Chromaticity (colour) coordinates were measured in one point on each line, located at the centre of the line, Figure 8. A *Spectrophotometer CM-25cG* (Konica Minolta, Japan) was used to measure the colour coordinates. The chromaticity coordinates of yellow materials in retroreflected light (night-time colour) were measured by an *LTL3500* (Delta, Denmark).

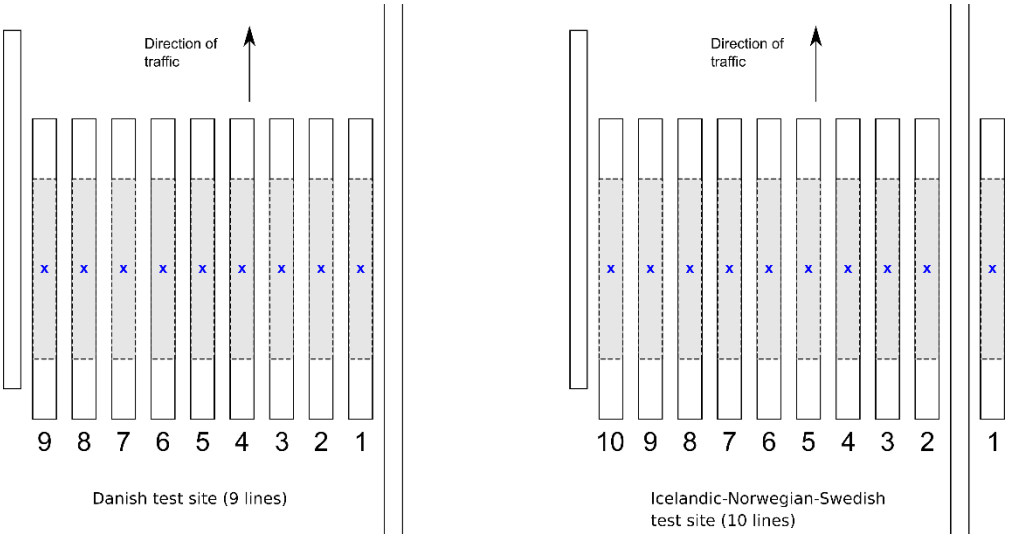

Figure 8. The measurement points (blue crosses) for chromaticity coordinates were placed in the centre of the lines. Left: the Danish test site with nine lines. Right: the Icelandic-Norwegian-Swedish test site with ten lines.

For materials with a high degree of wear, the measurement was taken at an area where the material was intact, if possible. 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 measurement point. In some cases, several measurement points were selected, to ensure correct chromaticity coordinates. These points had to be located within the grey area in Figure 4.

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), the instrument was moved to the closest area not affected by abnormal dirt.

4.2.3. Friction

Friction measurements were carried out using a *Portable Friction Tester version 4,* PFT (Coralba, Sweden), along the centre of each line, Figure 9. 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 wet 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).

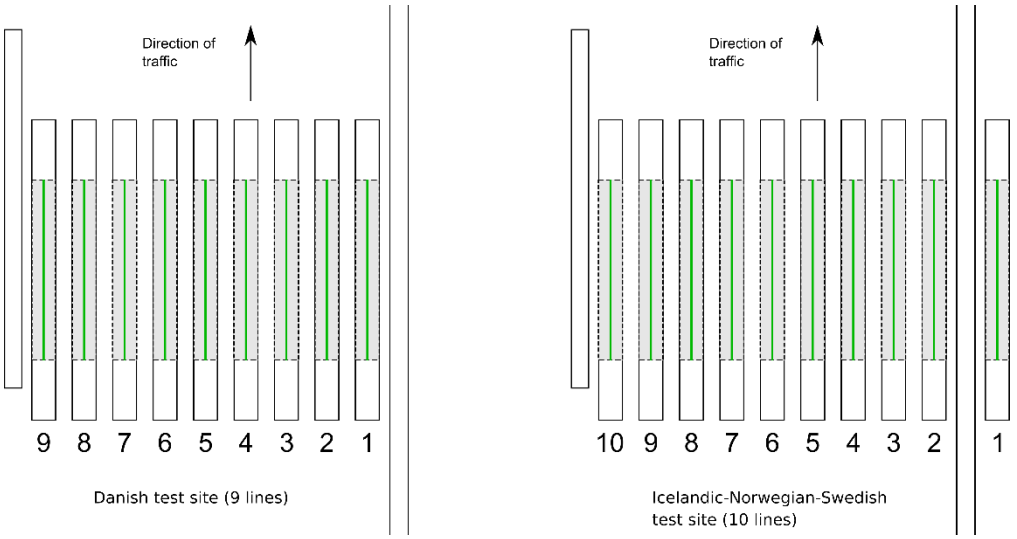

Figure 9. The measurement areas (green lines) for friction. Left: the Danish test site with nine lines. Right: the Icelandic-Norwegian-Swedish test site with ten lines.

4.2.4. Measurement values that do not fulfil the performance requirements

In case a measured value was just below the performance requirement (see Section 5.1), 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.

4.3. Weather conditions at the time of measurements

During the measurements in Norway in week 37, it was mostly cloudy. The air temperature was approximately 10–12˚ C (day/evening). The road surface temperature was approximately 12–15˚ C. The measurements in Denmark in week 38 had sunny conditions, with air temperatures at 17–22˚ C. The road surface temperature was approximately 22–25˚ C. All performance measurements of $R_{L,dry}$, *Qd* and chromaticity coordinates were carried out on absolutely dry markings.

5. Performance requirements

5.1. Performance parameters

The performance requirements include four parameters for type I markings[5] and five parameters for type II markings[6] which are given in Table 7. These requirements apply also to inlaid markings. Table 8 shows the requirements for materials for hand applications and Table 9 shows the performance requirements for materials with enhanced durability and for temporary markings. Table 10 shows the performance requirements for antiskid materials.

Table 7. Performance requirements for type 1 and type II markings, including inlaid markings.

Performance parameter	**Type I, white**	**Type I, yellow**	**Type II, white**	**Type II, yellow**
Coefficient of retroreflected luminance, R_L dry [mcd/m^2/lx]	≥ 150	≥ 100	≥ 150	≥ 100
Coefficient of retroreflected luminance, R_L wet [mcd/m^2/lx]	-	-	≥ 35	≥ 35
Luminance coefficient under diffuse illumination, *Qd* [mcd/m^2/lx]	≥ 130	≥ 100	≥ 130	≥ 100
Friction, [PFT units]	≥ 0.52	≥ 0.52	≥ 0.52	≥ 0.52
Chromaticity coordinates, x, y	*	**	*	**

*) Type I and II white – Chromaticity coordinates, x, y – According to EN 1436.
**) Type I and II yellow – Chromaticity coordinates, x, y – Includes both daytime (class Y1) and night-time colour (class RC1), according to EN 1436:2018.

Table 8. Performance requirements for materials for hand application.

Performance parameter	**Materials for hand application, retroreflective, white**	**Materials for hand application, retroreflective, yellow**	**Materials for hand application, non-retroreflective, white**	**Materials for hand application, non-retroreflective, yellow**
Coefficient of retroreflected luminance, R_L dry [mcd/m^2/lx]	≥100	≥ 100	-	-
Coefficient of retroreflected luminance, R_L wet [mcd/m^2/lx]	-	-	-	-
Luminance coefficient under diffuse illumination, *Qd* [mcd/m^2/lx]	≥ 130	≥ 100	≥ 130	≥ 100
Friction, [PFT units]	≥ 0.65	≥ 0.65	≥ 0.71	≥ 0.71
Chromaticity coordinates, x, y	*	**	*	**

*) Materials for hand application, retroreflective and non-retroreflective, white – Chromaticity coordinates, x, y – According to EN 1436.
**) Materials for hand application, retroreflective and non-retroreflective, yellow – Chromaticity coordinates, x, y – Includes both daytime (class Y1) and night-time colour (class RC1), according to EN 1436:2018.

[5] Type I refers to flat markings.

[6] Type II refers to markings with special properties intended to enhance the retroreflection in wet or rainy conditions.

Table 9. Performance requirements for materials with enhanced durability and for temporary markings.

Performance parameter	**Materials with enhanced durability, white**	**Materials with enhanced durability, yellow**	**Temporary markings, white**	**Temporary markings, yellow**
Coefficient of retroreflected luminance, R_L dry [mcd/m^2/lx]	-	-	≥ 150	≥ 200
Coefficient of retroreflected luminance, R_L wet [mcd/m^2/lx]	-	-	-	-
Luminance coefficient under diffuse illumination, *Qd* [mcd/m^2/lx]	≥ 130	≥ 100	≥ 130	≥ 130
Friction, [PFT units]	≥ 0.52	≥ 0.52	≥ 0.52	≥ 0.52
Chromaticity coordinates, x, y	*	**	*	***

*) Materials with enhanced durability and temporary markings, white – Chromaticity coordinates, x, y – According to EN 1436.
**) Material with enhanced durability, yellow – Chromaticity coordinates, x, y – Includes both daytime (class Y1) and night-time colour (class RC1), according to EN 1436:2018.
***) Temporary markings, yellow – Chromaticity coordinates, x, y – Includes both daytime (class Y2) and night-time colour (class RC1), according to EN 1436:2018.

Table 10. Performance requirements for antiskid materials.

Performance parameter	**Antiskid materials, white**
Coefficient of retroreflected luminance, R_L dry [mcd/m^2/lx]	-
Coefficient of retroreflected luminance, R_L wet [mcd/m^2/lx]	-
Luminance coefficient under diffuse illumination, *Qd* [mcd/m^2/lx]	≥ 130
Friction, [PFT units]	≥ 0.71
Chromaticity coordinates, x, y	*

*) Antiskid materials, white – Chromaticity coordinates, x, y – 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 0.65 corresponds to an SRT value of 60 (S4). A PFT value of 0.71 corresponds to an SRT value of 65 (S5). See also Section 5.1.1.

5.1.1. Special considerations regarding friction

A PFT value of 0.52 corresponds to a *Skid Resistance Tester* (SRT) value of 50. 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 fulfil 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, from 0.65 to 0.60 for retroreflective

materials for hand application, and from 0.71 to 0.66 for antiskid materials and for non-retroreflective materials for hand application.

5.2. Certification in relation to P-classes

Materials are certified in relation to the number of wheel passages they will stand. The nine lines within the driving lane are exposed to different numbers of wheel passages, which means that different roll-over classes are reached on different lines at different times.

Roll-over classes according to EN 1824 are determined from the measurements of wheel passages for each line in the lane, Table 11. Materials are thus certified for a certain roll-over class (P-class). To get approval in a certain P-class (see also requirements 7 and 9 in Figure 2), all relevant performance requirements (see Section 5.1) must be fulfilled for that particular class.

Certification is given based on the follow-up measurements one and two (and optional three) years after application. No certification is given based on the initial measurements that are carried out a few weeks after application (the initial measurements must however be approved for the material to qualify for follow-up measurements).

Based on the wheel passage measurements, the lines that are the most representative of the respective P-classes are selected for the follow-up measurements (see Section 5.2.1). One line is selected for each P-class and the results of the performance measurements on that line constitute the result for that material and P-class. All roll-over classes in Table 11 might not be available at the test sites.

The materials must fulfil the performance requirements for all classes lower than that it is to be certified for, provided that the lower classes exist on the test field. Example: For a material to be certified in roll-over class P3, the performance requirements must be fulfilled also for classes P0, P1 and P2.

If a material has been certified for a certain P-class after one year (i.e., based on the one-year follow-up measurement), this certification is valid irrespective of the results of the measurements after two years. The two-year follow-up measurements are merely used to evaluate whether the material fulfils the requirement for a higher P-class than what it is already certified for.

Table 11. Roll-over classes, EN 1824.

Roll-over class	**Number of wheel passages**
P0	≤ 50 000
P1	Between 50 000 and 60 000
P2	100 000 ± 20 000
P3	200 000 ± 40 000
P4	500 000 ± 100 000
P5	1 000 000 ± 200 000
P5.5	1 500 000 ± 150 000
P6	2 000 000 ± 200 000
P7	4 000 000 ± 400 000

5.2.1. P-classes at the Danish test site in 2022

For materials applied in 2021, P-classes P0, P3, P4 and P5 were reached in 2022. All P-classes were represented by one line, Table 12.

Table 12. P-classes at the Danish test site, materials applied in 2021.

Roll-over class	Lines	Measured
P0	Line 5	September 2022
P1	-	-
P2	-	-
P3	Line 6	September 2022
P4	Line 8	September 2022
P5	Line 3	September 2022
P5.5	-	Summer 2023 (expected)
P6	-	Summer 2023 (expected)

No materials were applied at the Danish test site in 2020.

5.2.2. P-classes at the Icelandic-Norwegian-Swedish test site in 2022

For materials applied in 2020, P-classes P0, P2, P3 and P4 (inlaid markings: P0, P3 and P4) were reached in 2021 and P-class P5 was reached in 2022. For materials applied in 2021, P-classes P0, P2, P3 and P4 were reached in 2022 (inlaid markings: P0, P2, P4). All P-classes were represented by one line, Table 13–Table 14.

Table 13. P-classes at the Icelandic-Norwegian-Swedish test site, materials applied in 2020.

Roll-over class	Lines, not inlaid	Lines, inlaid	Measured
P0	Line 6	Line 10	August 2021
P1	-	-	-
P2	Line 7	-	August 2021
P3	Line 4	Line 2	August 2021
P4	Line 3	Line 3	August 2021
P5	Line 3	Line 3	September 2022

Table 14. P-classes at the Icelandic-Norwegian-Swedish test site, materials applied in 2021.

Roll-over class	**Lines, not inlaid**	**Lines, inlaid**	**Measured**
P0	Line 6	Line 10	September 2022
P1	-	-	-
P2	Line 9	Line 9	September 2022
P3	Line 7	-	September 2022
P4	Line 3	Line 3	September 2022
P5	-	-	Summer 2023 (expected)

6. Results

This section contains an overview of the results of the performance measurements carried out in 2022 on materials applied at the test sites in 2020 and 2021 (the results tables for materials applied in 2020 also include the results from the performance measurements in 2021, see Section 5.2). **A** means that the material fulfils the requirement on all relevant performance parameters, in that P-class (Approved). **NA** means that the material did not fulfil one or more of the performance requirements (Not approved). Empty cells imply that the material was not approved in a lower P-class.

Only materials that were approved at the initial measurements and that participate as *certification materials* are included in the tables below (see also Chapter 2). Results are presented for the time period the material was registered for, i.e., one- or two-years follow-up.

No manufacturer has requested three-years follow-up measurements of materials applied in 2019.

Note that the results do *not* show which materials have received certification. To receive certification, also certification requirement 8 must be fulfilled, and to maintain the validity of a certificate the certification requirement 10 must be fulfilled annually (from 2023), see Chapter 2.

Detailed measurement results can be found in Appendix 1.

6.1. Materials applied at the Danish test site in 2020

No materials were applied in Denmark in 2020.

6.2. Materials applied at the Danish test site in 2021

6.2.1. White road markings

Type I

Material thickness 3 mm

Table 15. Results of the performance measurements of materials applied at the Danish test site in 2021. Roll-over classes P0, P2, P3 and P4. White type I materials, 3 mm.

Manufacturer *Material*	**P0**	**P3**	**P4**	**P5**
Geveko Markings TP21-DK4	**A**	**A**	**A**	**A**
Geveko Markings TP21-DK6	**A**	**A**	**NA**	
Saferoad Grawil DKTI21-01	**NA**			

Type II

Material thickness 5 mm

Table 16. Results of the performance measurements of materials applied at the Danish test site in 2021. Roll-over classes P0, P2, P3 and P4. White type II materials, 5 mm.

Manufacturer *Material*	**P0**	**P3**	**P4**	**P5**
Geveko Markings TP21-DK1 *Profile/pattern:* LongDot	**A**	**A**	**A**	**A**
Geveko Markings TP21-DK2 *Profile/pattern:* ViziSpot	**A**	**A**	**A**	**A**
Geveko Markings TP21-DK3 *Profile/pattern:* LongFlex	**NA**			
Saferoad Grawil DKTII21-01 *Profile/pattern:* Longdot	**NA**			

Antiskid materials

Material thickness 3 mm

Table 17. Results of the performance measurements of materials applied at the Danish test site in 2021. Roll-over classes P0, P2, P3 and P4. White antiskid materials, 3 mm.

Manufacturer *Material*	**P0**	**P3**	**P4**	**P5**
Geveko Markings TP21-DK5	**A**	**A**	**A**	**NA**

6.3. Materials applied at the Icelandic-Norwegian-Swedish test site in 2020

6.3.1. White road markings

Type I

Material thickness 1.5 mm

Table 18. Results of the performance measurements of materials applied at the Icelandic-Norwegian-Swedish test site in 2020. Roll-over classes P0, P2, P3, P4 and P5. White type I materials, 1.5 mm.

Manufacturer *Material*	**P0**	**P2**	**P3**	**P4**	**P5**
Svevia X 2050	**A**	**NA**			
Svevia X 2051	**A**	**NA**			

Material thickness 3 mm

Table 19. Results of the performance measurements of materials applied at the Icelandic-Norwegian-Swedish test site in 2020. Roll-over classes P0, P2, P3, P4 and P5. White type I materials, 3 mm.

Manufacturer *Material*	**P0**	**P2**	**P3**	**P4**	**P5**
Kestrel Thermoplastics Eurolux SC White 0029	**A**	**A**	**A**	**A**	**A**
Kestrel Thermoplastics Eurolux SC White 0030	**A**	**A**	**A**	**A**	**A**
Kestrel Thermoplastics Eurolux SC White 0031 (Type I)	**A**	**A**	**A**	**NA**	
Promax ESNI20WI	**A**	**A**	**A**	**NA***	
Promax SNI20WI1	**A**	**A**	**A**	**NA**	
Promax SNI20WI2	**A**	**A**	**A**	**NA**	
Svevia X 2010	**A**	**NA**			
Svevia X 2020	**A**	**NA**			
Svevia X 2030	**A**	**A**	**A**	**NA**	

*) P4 – Promax ESNI20WI – Line 3 was disqualified at application (too thick).

Type II

Material thickness 5 mm

Table 20. Results of the performance measurements of materials applied at the Icelandic-Norwegian-Swedish test site in 2020. Roll-over classes P0, P2, P3, P4 and P5. White type II materials, 5 mm.

Manufacturer *Material*	**P0**	**P2**	**P3**	**P4**	**P5**
Geveko Markings ViaTherm® EXP 18 71EP [rilled] *Profile/pattern:* Rilled	**A**	**NA**			
Geveko Markings ViaTherm® EXP 18 71EP [stairs] *Profile/pattern:* Stairs	**NA**				
Geveko Markings ViaTherm® EXP 20 35E [rilled] *Profile/pattern:* Rilled	**A**	**NA**			
Geveko Markings ViaTherm® EXP 20 35E [stairs] *Profile/pattern:* Stairs	**A**	**NA**			
Promax SNI20WII1 *Profile/pattern:* Rullad	**A**	**NA**			
Promax SNI20WII2 *Profile/pattern:* Rullad	**NA***				
Svevia X 2011 *Profile/pattern:* Rolled	**NA**				
Svevia X 2021 *Profile/pattern:* Rolled	**NA**				
Svevia X 2031 *Profile/pattern:* Rolled	**A**	**A**	**A**	**NA**	

*) P0 – Promax SNI20WII2 – No result due to missing documentation.

Inlaid type II

Material thickness 5 mm

Table 21. Results of the performance measurements of materials applied at the Icelandic-Norwegian-Swedish test site in 2020. Roll-over classes P0, P3, P4 and P5. White inlaid type II materials, 5 mm.

Manufacturer *Material*	**P0**	**P3**	**P4**	**P5**
Geveko Markings ViaTherm® EXP 20 35E [inl., drops] *Profile/pattern:* Drops	**A**	**NA**		
Kestrel Thermoplastics Eurolux SC White 0031 (Type II) *Profile/pattern:* Dots	**A**	**NA**		
Promax SNI20WII3 *Profile/pattern:* Rullad	**NA***			

*) P0 – Promax SNI20WII3 – No result due to missing documentation.

Materials for hand application, retroreflective

Material thickness 3 mm

Table 22. Results of the performance measurements of materials applied at the Icelandic-Norwegian-Swedish test site in 2020. Roll-over classes P0, P2, P3, P4 and P5. White materials for hand application, retroreflective, 3 mm.

Manufacturer *Material*	**P0**	**P2**	**P3**	**P4**	**P5**
Geveko Markings ViaTherm® EXP 20 71HF [r]	**A**	**A**	**A**	**A**	**NA**

Materials for hand application, non-retroreflective

Material thickness 3 mm

Table 23. Results of the performance measurements of materials applied at the Icelandic-Norwegian-Swedish test site in 2020. Roll-over classes P0, P2, P3, P4 and P5. White materials for hand application, non-retroreflective, 3 mm.

Manufacturer *Material*	**P0**	**P2**	**P3**	**P4**	**P5**
Geveko Markings ViaTherm® EXP 20 71HF [non-r]	**A**	**A**	**A**	**A**	**NA**

Materials with enhanced durability

Material thickness 3 mm

Table 24. Results of the performance measurements of materials applied at the Icelandic-Norwegian-Swedish test site in 2020. Roll-over classes P0, P2, P3, P4 and P5. White materials with enhanced durability, 3 mm.

Manufacturer *Material*	**P0**	**P2**	**P3**	**P4**	**P5**
Geveko Markings ViaTherm® EXP 20 57E	**A**	**A**	**A**	**A**	**NA**

6.3.2. Yellow Road Markings

Type I

Material thickness 1.5 mm

Table 25. Results of the performance measurements of materials applied at the Icelandic-Norwegian-Swedish test site in 2020. Roll-over classes P0, P2, P3, P4 and P5. Yellow type I materials, 1.5 mm.

Manufacturer *Material*	**P0**	**P2**	**P3**	**P4**	**P5**
Geveko Markings ViaTherm® EXP 20 NTY 71S	**A**	**A**	**A**	**A**	**NA**

Material thickness 3 mm

Table 26. Results of the performance measurements of materials applied at the Icelandic-Norwegian-Swedish test site in 2020. Roll-over classes P0, P2, P3, P4 and P5. Yellow type I materials, 3 mm.

Manufacturer *Material*	**P0**	**P2**	**P3**	**P4**	**P5**
Geveko Markings ViaTherm® EXP 20 NTY 71E	**A**	**A**	**A**	**NA**	
Kestrel Thermoplastics Eurolux SC Yellow 0027	**A**	**NA**			
Kestrel Thermoplastics Eurolux SC Yellow 0028	**A**	**A**	**A**	**NA**	
Promax SNI20YI1	**A**	**A**	**A**	**A**	**NA**

6.4. Materials applied at the Icelandic-Norwegian-Swedish test site in 2021

6.4.1. White road markings

Type I

Material thickness 0.4 mm

Table 27. Results of the performance measurements of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over classes P0, P2, P3 and P4. White type I markings, 0.4 mm.

Manufacturer *Material*	**P0**	**P2**	**P3**	**P4**
Geveko Markings EXP 21 AQ 1	**NA**			
Geveko Markings EXP 21 AQ 2	**NA**			

Material thickness 1.5 mm

Table 28. Results of the performance measurements of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over classes P0, P2, P3 and P4. White type I markings, 1.5 mm.

Manufacturer *Material*	**P0**	**P2**	**P3**	**P4**
Hot Mix Hotmix EE10-921W [spray]	**A**	**A**	**A**	**NA**
Hot Mix Hotmix EE921W [spray]	**A**	**A**	**A**	**NA**
Hot Mix Hotmix POE1021W [spray 1]	**A**	**A**	**A**	**NA**
Hot Mix Hotmix POE1021W [spray 2]	**A**	**A**	**A**	**NA**
Hot Mix Hotmix POE1721W [spray 1]	**A**	**A**	**NA**	
Promax SSNI21WI1	**NA**			
Svevia X 2120	**A**	**NA**		

Material thickness 3 mm

Table 29. Results of the performance measurements of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over classes P0, P2, P3 and P4. White type I markings, 3 mm.

Manufacturer *Material*	**P0**	**P2**	**P3**	**P4**
Hot Mix Hotmix EE10-921W [type I]	**A**	**A**	**A**	**A**
Hot Mix Hotmix EE921W [type I]	**A**	**A**	**A**	**NA**
Hot Mix Hotmix POE1021W [type I-1]	**A**	**A**	**A**	**A**
Hot Mix Hotmix POE1021W [type I-2]	**A**	**A**	**A**	**A**
Hot Mix Hotmix POE1721W [type I-1]	**A**	**A**	**A**	**NA**
Hot Mix Hotmix POE1721W [type I-2]	**A**	**A**	**A**	**NA**
Promax SNI21WI1	**NA**			
Svevia X 2110	**A**	**A**	**A**	**A**

Type II

Material thickness 3 mm

Table 30. Results of the performance measurements of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over classes P0, P2, P3 and P4. White type II markings, 3 mm.

Manufacturer *Material*	**P0**	**P2**	**P3**	**P4**
3M Stamark A380ESD	**A**	**NA**		

Material thickness 5 mm

Table 31. Results of the performance measurements of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over classes P0, P2, P3 and P4. White type II markings, 5 mm.

Manufacturer *Material*	**P0**	**P2**	**P3**	**P4**
Geveko Markings EXP 21 TP - 4	**A**	**A**	**A**	**NA**
Hot Mix Hotmix EE10-921W [type II]	**A**	**NA**		
Hot Mix Hotmix EE921W [type II]	**A**	**NA**		

Inlaid type II

Material thickness 5 mm

Table 32. Results of the performance measurements of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over classes P0, P2, P3 and P4. White inlaid type II markings, 5 mm.

Manufacturer *Material*	**P0**	**P2**	**P4**
Geveko Markings EXP 21 TP - 6	**A**	**A**	**NA**

Materials for hand application, retroreflective

Material thickness 3 mm

Table 33. Results of the performance measurements of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over classes P0, P2, P3 and P4. White materials for hand application, retroreflective, 3 mm.

Manufacturer *Material*	**P0**	**P2**	**P3**	**P4**
Geveko Markings EXP 21 TP – 1	**A**	**A**	**A**	**A**
Svevia X 2130	**A**	**A**	**A**	**A**

Materials for hand application, non-retroreflective

Material thickness 3 mm

Table 34. Results of the performance measurements of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over classes P0, P2, P3 and P4. White materials for hand application, non-retroreflective, 3 mm.

Manufacturer *Material*	**P0**	**P2**	**P3**	**P4**
Geveko Markings EXP 21 TP - 2	**A**	**A**	**A**	**A**

*) No requirement

6.4.2. Yellow Road Markings

Type I

Material thickness 1.5 mm

Table 35. Results of the performance measurements of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over classes P0, P2, P3 and P4. Yellow type I markings, 1.5 mm.

Manufacturer *Material*	**P0**	**P2**	**P3**	**P4**
Hot Mix Hotmix EE921Y [spray]	**A**	**A**	**NA**	
Hot Mix Hotmix POE1721Y [spray]	**A**	**NA**		
Promax SSNI21YI1	**A**	**A**	**A**	**A**
Svevia Y 2120	**A**	**A**	**NA**	

Material thickness 3 mm

Table 36. Results of the performance measurements of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over classes P0, P2, P3 and P4. Yellow type I markings, 3 mm.

Manufacturer *Material*	**P0**	**P2**	**P3**	**P4**
Hot Mix Hotmix EE921Y [type I]	**A**	**A**	**NA**	
Hot Mix Hotmix POE1721Y [extr]	**A**	**NA**		
Svevia Y 2110	**A**	**A**	**A**	**NA**

7. Overview of performance measurement results in 2015–2022

This chapter presents an overview of the results of the follow-up performance measurements of materials applied at the test sites since the establishment of NordicCert in 2015. Only materials registered as *certification materials* are included.

Note that the overview does *not* present the number of certified materials. To receive certification, also certification requirement 8 (see Figure 2) must be fulfilled, and to maintain the validity of a certificate the certification requirement 10 must be fulfilled annually (from 2023).

Lists of products with valid certificates are available at www.nordiccert.com.

7.1. Denmark

7.1.1. White road markings

Table 37 shows the number of materials that have fulfilled the performance requirements in respective P-class since 2015, per material category.

Table 37. The total number of materials that have fulfilled the performance requirements at the Danish test site since 2015, per category and P-class. White materials.

Material category	No P-class	P0	P1	P2	P3	P4	P5	P5.5	P6
Type I, 0.4 mm	2	-	-	-	-	-	-	-	-
Type I, 1.5 mm	-	3	3	3	1	1	-	-	-
Type I, 3 mm	16	50	48	44	37	27	11	5	4
Type II, 0.4 mm	-	1	-	-	-	-	-	-	-
Type II, 3 mm	1	-	-	-	-	-	-	-	-
Type II, 4–5 mm*	7	20	13	13	13	12	7	1	-
Antiskid materials, 3 mm	-	3	3	3	3	3	2	2	2
Antiskid materials, 4 mm	-	1	1	1	1	1	1	1	1
Total	*26*	*78*	*68*	*64*	*55*	*44*	*21*	*9*	*7*

*) Type II, 4–5 mm – 4 mm in 2016–2017, 5 mm from 2018 onwards.

7.2. Iceland, Norway and Sweden

7.2.1. White road markings

Table 38 shows the number of materials that have fulfilled the performance requirements in respective P-class since 2015, per material category.

Table 38. The total number of materials that have fulfilled the performance requirements at the Icelandic-Norwegian-Swedish test site since 2015, per category and P-class. White materials.

Material category	No P-class	P0	P1	P2	P3	P4	P5
Type I, 0.4 mm	39	2	-	-	-	-	-
Type I, 0.6 mm	9	2	-	-	-	-	-
Type I, 1.5 mm	11	31	25	23	13	5	1
Type I, 3 mm	37	77	74	68	49	32	13
Type II, 0.6 mm	3	-	-	-	-	-	-
Type II, 3 mm	7	1	-	-	-	-	-
Type II, 4–5 mm*	13	27	15	15	2	-	-
Inlaid type II, 0.6 mm	2	-	-	-	-	-	-
Inlaid type II, 5 mm	2	10	6	5	1	1	-
Materials for hand application, retroreflective, 3 mm	3	5	5	5	5	5	1
Materials for hand application, non-retroreflective, 3 mm	-	3	3	3	3	3	1
Materials with enhanced durability, 3 mm	-	2	2	2	1	1	-
Antiskid materials, 4 mm	-	2	2	2	2	2	2
Total	*126*	*162*	*132*	*123*	*76*	*49*	*18*

*) Type II, 4–5 mm – 4 mm in 2016–2017, 5 mm from 2018 onwards.

7.2.2. Yellow road markings

Table 39 shows the number of materials that have fulfilled the performance requirements in respective P-class since 2015, per material category.

Table 39. The total number of materials that have fulfilled the performance requirements at the Icelandic-Norwegian-Swedish test site since 2015, per category and P-class. Yellow materials.

Material category	**No P-class**	**P0**	**P1**	**P2**	**P3**	**P4**	**P5**
Type I, 0.4 mm	3	-	-	-	-	-	-
Type I, 0.6 mm	1	-	-	-	-	-	-
Type I, 1.5 mm	16	10	7	7	4	2	-
Type I, 3 mm	39	24	21	17	8	3	-
Type II, 3 mm	2	-	-	-	-	-	-
Type II, 4–5 mm*	2	1	-	-	-	-	-
Materials for hand application, retroreflective, 3 mm	1	-	-	-	-	-	-
Total	*64*	*35*	*28*	*24*	*12*	*5*	-

*) Type II, 4–5 mm – 4 mm in 2016–2017, 5 mm from 2018 onwards.

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Appendix 1 – Results of the performance measurements

Table 41–Table 52 show the results for roll-over classes P0, P3, P4 and P5 for materials applied at the Danish test site in 2021. Table 53–Table 61 show the results for roll-over class P5 for materials applied at the Icelandic-Norwegian-Swedish test site in 2020. Table 62–Table 100 show the results for roll-over classes P0, P2, P3 and P4 for materials applied at the Icelandic-Norwegian-Swedish test site in 2021.

Two-years follow-up measurements were carried out only on materials that fulfilled the requirements for the highest roll-over class in year one. Three-years follow-up measurements were carried out only upon request by the manufacturer (no such request was made in 2022).

Table 40 explains the denotations in the result tables.

Table 40. 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)
NTY	“OK”, when colour coordinates are inside the colour box (night-time colour)
Appr.	Approved (**A**) or Not Approved (**NA**) in the P-class referred to
worn	No measurements could be carried out, because the material was too worn.
n.m.	Not measured (if there was a high degree of wear and the material did not fulfil the requirements for one or more of the other parameters or, for two-years follow-up measurements, the material did not fulfil the requirements for the highest roll-over in the one-year follow-up measurement).
d	Disqualified (e.g. due to missing documentation or because the line was too thick).
-	The parameter does not apply to the material.

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

Rows marked in grey indicate that the material has not fulfilled the requirements in a lower P-class. It can thus not be approved in the present P-class.

Materials applied at the Danish test site in 2021

Roll-over class P0

Table 41. Results of the performance measurements in 2022 of materials applied at the Danish test site in 2021. Roll-over class P0. White materials, type I, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Geveko Markings TP21-DK4	257	-	163	0.54	OK	**A**
Geveko Markings TP21-DK6	288	-	160	0.58	OK	**A**
Saferoad Grawil DKTI21-01	275	-	146	0.44	OK	**NA**

Table 42. Results of the performance measurements in 2022 of materials applied at the Danish test site in 2021. Roll-over class P0. White materials, type II, 5 mm. Alphabetical order by manufacturer.

Type II, 5 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Geveko Markings TP21-DK1 *Profile/pattern:* LongDot	252	56	145	0.60	OK	**A**
Geveko Markings TP21-DK2 *Profile/pattern:* ViziSpot	258	62	147	0.56	OK	**A**
Geveko Markings TP21-DK3 *Profile/pattern:* LongFlex	289	31	147	0.53	OK	**NA**
Saferoad Grawil DKTII21-01 *Profile/pattern:* Longdot	187	47	117	0.60	OK	**NA**

Table 43. Results of the performance measurements in 2022 of materials applied at the Danish test site in 2021. Roll-over class P0. White antiskid materials, 3 mm. Alphabetical order by manufacturer.

Antiskid, 3 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Geveko Markings TP21-DK5	(47)*	-	146	0.94	OK	**A**

*) No requirement

Roll-over class P3

Table 44. Results of the performance measurements in 2022 of materials applied at the Danish test site in 2021. Roll-over class P3. White materials, type I, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Geveko Markings TP21-DK4	232	-	149	0.54	OK	**A**
Geveko Markings TP21-DK6	214	-	150	0.60	OK	**A**
Saferoad Grawil DKTI21-01	259	-	143	0.44	OK	**NA**

Table 45. Results of the performance measurements in 2022 of materials applied at the Danish test site in 2021. Roll-over class P3. White materials, type II, 5 mm. Alphabetical order by manufacturer.

Type II, 5 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Geveko Markings TP21-DK1 *Profile/pattern:* LongDot	201	44	145	0.64	OK	**A**
Geveko Markings TP21-DK2 *Profile/pattern:* ViziSpot	201	53	141	0.62	OK	**A**
Geveko Markings TP21-DK3 *Profile/pattern:* LongFlex	201	19	141	0.58	OK	**NA**
Saferoad Grawil DKTII21-01 *Profile/pattern:* Longdot	173	41	120	0.65	OK	**NA**

Table 46. Results of the performance measurements in 2022 of materials applied at the Danish test site in 2021. Roll-over class P3. White antiskid materials, 3 mm. Alphabetical order by manufacturer.

Antiskid, 3 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Geveko Markings TP21-DK5	(45)*	-	133	0.91	OK	**A**

*) No requirement

Roll-over class P4

Table 47. Results of the performance measurements in 2022 of materials applied at the Danish test site in 2021. Roll-over class P4. White materials, type I, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm ***Manufacturer*** *Material*	***$R_{L,dry}$***	***$R_{L,wet}$***	***Qd***	***Frict.***	***Colour***	***Appr.***
Geveko Markings TP21-DK4	171	-	154	0.59	OK	**A**
Geveko Markings TP21-DK6	133	-	154	0.65	OK	**NA**
Saferoad Grawil DKTI21-01	120	-	158	0.65	OK	**NA**

Table 48. Results of the performance measurements in 2022 of materials applied at the Danish test site in 2021. Roll-over class P4. White materials, type II, 5 mm. Alphabetical order by manufacturer.

Type II, 5 mm ***Manufacturer*** *Material*	***$R_{L,dry}$***	***$R_{L,wet}$***	***Qd***	***Frict.***	***Colour***	***Appr.***
Geveko Markings TP21-DK1 *Profile/pattern:* LongDot	162	37	139	0.65	OK	**A**
Geveko Markings TP21-DK2 *Profile/pattern:* ViziSpot	162	50	138	0.64	OK	**A**
Geveko Markings TP21-DK3 *Profile/pattern:* LongFlex	154	25	144	0.64	OK	**NA**
Saferoad Grawil DKTII21-01 *Profile/pattern:* Longdot	114	40	126	0.71	OK	**NA**

Table 49. Results of the performance measurements in 2022 of materials applied at the Danish test site in 2021. Roll-over class P4. White antiskid materials, 3 mm. Alphabetical order by manufacturer.

Antiskid, 3 mm ***Manufacturer*** *Material*	***$R_{L,dry}$***	***$R_{L,wet}$***	***Qd***	***Frict.***	***Colour***	***Appr.***
Geveko Markings TP21-DK5	(40)*	-	137	0.86	OK	**A**

*) No requirement

Roll-over class P5

Table 50. Results of the performance measurements in 2022 of materials applied at the Danish test site in 2021. Roll-over class P5. White materials, type I, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Geveko Markings TP21-DK4	150	-	140	0.58	OK	**A**
Geveko Markings TP21-DK6	115	-	144	0.64	OK	**NA**
Saferoad Grawil DKTI21-01	123	-	150	0.63	OK	**NA**

Table 51. Results of the performance measurements in 2022 of materials applied at the Danish test site in 2021. Roll-over class P5. White materials, type II, 5 mm. Alphabetical order by manufacturer.

Type II, 5 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Geveko Markings TP21-DK1 *Profile/pattern:* LongDot	150	49	138	0.63	OK	**A**
Geveko Markings TP21-DK2 *Profile/pattern:* ViziSpot	151	45	135	0.62	OK	**A**
Geveko Markings TP21-DK3 *Profile/pattern:* LongFlex	128	35	137	0.63	OK	**NA**
Saferoad Grawil DKTII21-01 *Profile/pattern:* Longdot	94	23	116	0.81	OK	**NA**

Table 52. Results of the performance measurements in 2022 of materials applied at the Danish test site in 2021. Roll-over class P5. White antiskid materials, 3 mm. Alphabetical order by manufacturer.

Antiskid, 3 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Geveko Markings TP21-DK5	(34)*	-	126	0.85	OK	**NA**

*) No requirement

Materials applied at the Icelandic-Norwegian-Swedish test site in 2020

Roll-over class P5

Table 53. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2020. Roll-over class P5. White materials, type I, 1.5 mm. Alphabetical order by manufacturer.

Type I, 1.5 mm ***Manufacturer*** *Material*	***$R_{L,dry}$***	***$R_{L,wet}$***	***Qd***	***Frict.***	***Colour***	***Appr.***
Svevia X 2050	n.m.	-	n.m.	n.m.	n.m.	**NA**
Svevia X 2051	n.m.	-	n.m.	n.m.	n.m.	**NA**

Table 54. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2020. Roll-over class P5. White materials, type I, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm ***Manufacturer*** *Material*	***$R_{L,dry}$***	***$R_{L,wet}$***	***Qd***	***Frict.***	***Colour***	***Appr.***
Kestrel Thermoplastics Eurolux SC White 0029	165	-	185	0.75	OK	**A**
Kestrel Thermoplastics Eurolux SC White 0030	175	-	185	0.71	OK	**A**
Kestrel Thermoplastics Eurolux SC White 0031 (Type I)	n.m.	-	n.m.	n.m.	n.m.	**NA**
Promax ESNI20WI	n.m.	-	n.m.	n.m.	n.m.	**NA**
Promax SNI20WI1	n.m.	-	n.m.	n.m.	n.m.	**NA**
Promax SNI20WI2	n.m.	-	n.m.	n.m.	n.m.	**NA**
Svevia X 2010	n.m.	-	n.m.	n.m.	n.m.	**NA**
Svevia X 2020	n.m.	-	n.m.	n.m.	n.m.	**NA**
Svevia X 2030	n.m.	-	n.m.	n.m.	n.m.	**NA**

Table 55. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2020. Roll-over class P5. White materials, type II, 5 mm. Alphabetical order by manufacturer.

Type II, 5 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Geveko Markings ViaTherm® EXP 18 71EP [rilled] *Profile/pattern:* Rilled	n.m.	n.m.	n.m.	n.m.	n.m.	**NA**
Geveko Markings ViaTherm® EXP 18 71EP [stairs] *Profile/pattern:* Stairs	n.m.	n.m.	n.m.	n.m.	n.m.	**NA**
Geveko Markings ViaTherm® EXP 20 35E [rilled] *Profile/pattern:* Rilled	n.m.	n.m.	n.m.	n.m.	n.m.	**NA**
Geveko Markings ViaTherm® EXP 20 35E [stairs] *Profile/pattern:* Stairs	n.m.	n.m.	n.m.	n.m.	n.m.	**NA**
Promax SNI20WII1 *Profile/pattern:* Rullad	n.m.	n.m.	n.m.	n.m.	n.m.	**NA**
Promax SNI20WII2 *Profile/pattern:* Rullad	d	d	d	d	d	**NA**
Svevia X 2011 *Profile/pattern:* Rolled	n.m.	n.m.	n.m.	n.m.	n.m.	**NA**
Svevia X 2021 *Profile/pattern:* Rolled	n.m.	n.m.	n.m.	n.m.	n.m.	**NA**
Svevia X 2031 *Profile/pattern:* Rolled	n.m.	n.m.	n.m.	n.m.	n.m.	**NA**

Table 56. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2020. Roll-over class P5. White inlaid materials, type II, 5 mm. Alphabetical order by manufacturer.

Inlaid type II, 5 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Geveko Markings ViaTherm® EXP 20 35E [inl., drops] *Profile/pattern:* Drops	n.m.	n.m.	n.m.	n.m.	n.m.	**NA**
Kestrel Thermoplastics Eurolux SC White 0031 (Type II) *Profile/pattern:* Dots	n.m.	n.m.	n.m.	n.m.	n.m.	**NA**
Promax SNI20WII3 *Profile/pattern:* Rullad	d	d	d	d	d	**NA**

Table 57. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2020. Roll-over class P5. White materials for hand application, retroreflective, 3 mm. Alphabetical order by manufacturer.

Materials for hand application, retroreflective, 3 mm ***Manufacturer*** *Material*	***$R_{L,dry}$***	***$R_{L,wet}$***	***Qd***	***Frict.***	***Colour***	***Appr.***
Geveko Markings ViaTherm® EXP 20 71HF [r]	91	-	151	0.86	OK	**NA**

Table 58. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2020. Roll-over class P5. White materials for hand application, non-retroreflective, 3 mm. Alphabetical order by manufacturer.

Materials for hand application, non-retroreflective, 3 mm ***Manufacturer*** *Material*	***$R_{L,dry}$***	***$R_{L,wet}$***	***Qd***	***Frict.***	***Colour***	***Appr.***
Geveko Markings ViaTherm® EXP 20 71HF [non-r]	(32)*	-	95	0.88	OK	**NA**

*) $R_{L,dry}$ – No requirement

Table 59. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2020. Roll-over class P5. White materials with enhanced durability, 3 mm. Alphabetical order by manufacturer.

Materials with enhanced durability, 3 mm ***Manufacturer*** *Material*	***$R_{L,dry}$***	***$R_{L,wet}$***	***Qd***	***Frict.***	***Colour***	***Appr.***
Geveko Markings ViaTherm® EXP 20 57E	(worn)*	-	worn	worn	worn	**NA**

*) $R_{L,dry}$ – No requirement

Table 60. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2020. Roll-over class P5. Yellow materials, type I, 1.5 mm. Alphabetical order by manufacturer.

Type I, 1.5 mm ***Manufacturer*** *Material*	***$R_{L,dry}$***	***$R_{L,wet}$***	***Qd***	***Frict.***	***Colour***	***NTY***	***Appr.***
Geveko Markings ViaTherm® EXP 20 NTY 71S	27	-	92	0.87	OK	n.m.	**NA**

Table 61. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2020. Roll-over class P5. Yellow materials, type I, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm ***Manufacturer*** *Material*	***$R_{L,dry}$***	***$R_{L,wet}$***	***Qd***	***Frict.***	***Colour***	***NTY***	***Appr.***
Geveko Markings ViaTherm® EXP 20 NTY 71E	n.m.	-	n.m.	n.m.	n.m.	n.m.	**NA**
Kestrel Thermoplastics Eurolux SC Yellow 0027	n.m.	-	n.m.	n.m.	n.m.	n.m.	**NA**
Kestrel Thermoplastics Eurolux SC Yellow 0028	n.m.	-	n.m.	n.m.	n.m.	n.m.	**NA**
Promax SNI20YI1	worn	-	worn	worn	worn	worn	**NA**

Materials applied at the Icelandic-Norwegian-Swedish test site in 2021

Roll-over class P0

Table 62. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P0. White materials, type I, 0.4 mm. Alphabetical order by manufacturer.

Type I, 0.4 mm ***Manufacturer*** *Material*	***$R_{L,dry}$***	***$R_{L,wet}$***	***Qd***	***Frict.***	***Colour***	***Appr.***
Geveko Markings EXP 21 AQ 1	43	-	80	0.89	OK	**NA**
Geveko Markings EXP 21 AQ 2	59	-	113	0.84	OK	**NA**

Table 63. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P0. White materials, type I, 1.5 mm. Alphabetical order by manufacturer.

Type I, 1.5 mm ***Manufacturer*** *Material*	***$R_{L,dry}$***	***$R_{L,wet}$***	***Qd***	***Frict.***	***Colour***	***Appr.***
Hot Mix Hotmix EE10-921W [spray]	172	-	154	0.65	OK	**A**
Hot Mix Hotmix EE921W [spray]	194	-	167	0.56	OK	**A**
Hot Mix Hotmix POE1021W [spray 1]	207	-	151	0.57	OK	**A**
Hot Mix Hotmix POE1021W [spray 2]	224	-	157	0.56	OK	**A**
Hot Mix Hotmix POE1721W [spray 1]	261	-	175	0.59	OK	**A**
Promax SSNI21WI1	203	-	174	0.56	outside	**NA**
Svevia X 2120	190	-	179	0.72	OK	**A**

Table 64. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P0. White materials, type I, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Hot Mix Hotmix EE10-921W [type I]	158	-	165	0.63	OK	**A**
Hot Mix Hotmix EE921W [type I]	158	-	166	0.55	OK	**A**
Hot Mix Hotmix POE1021W [type I-1]	236	-	169	0.57	OK	**A**
Hot Mix Hotmix POE1021W [type I-2]	241	-	165	0.55	OK	**A**
Hot Mix Hotmix POE1721W [type I-1]	256	-	181	0.59	OK	**A**
Hot Mix Hotmix POE1721W [type I-2]	240	-	173	0.56	OK	**A**
Promax SNI21WI1	223	-	168	0.60	outside	**NA**
Svevia X 2110	244	-	192	0.67	OK	**A**

Table 65. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P0. White materials, type II, 3 mm. Alphabetical order by manufacturer.

Type II, 3 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
3M Stamark A380ESD	238	35	181	0.79	OK	**A**

Table 66. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P0. White materials, type II, 5 mm. Alphabetical order by manufacturer.

Type II, 5 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Geveko Markings EXP 21 TP - 4	211	84	189	0.77	OK	**A**
Hot Mix Hotmix EE10-921W [type II]	166	52	181	0.72	OK	**A**
Hot Mix Hotmix EE921W [type II]	214	60	178	0.70	OK	**A**

Table 67. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P0. White inlaid materials, type II, 5 mm. Alphabetical order by manufacturer.

Inlaid type II, 5 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Geveko Markings EXP 21 TP - 6	285	75	175	0.69	OK	**A**

Table 68. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P0. White materials for hand application, retroreflective, 3 mm. Alphabetical order by manufacturer.

Materials for hand application, retroreflective, 3 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Geveko Markings EXP 21 TP – 1	196	-	175	0.69	OK	**A**
Svevia X 2130	208	-	187	0.72	OK	**A**

Table 69. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P0. White materials for hand application, non-retroreflective, 3 mm. Alphabetical order by manufacturer.

Materials for hand application, non-retroreflective, 3 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Geveko Markings EXP 21 TP - 2	(196)*	-	179	0.78	OK	**A**

*) No requirement

Table 70. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P0. Yellow materials, type I, 1.5 mm. Alphabetical order by manufacturer.

Type I, 1.5 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*NTY*	*Appr.*
Hot Mix Hotmix EE921Y [spray]	146	-	128	0.63	OK	OK	**A**
Hot Mix Hotmix POE1721Y [spray]	132	-	114	0.58	OK	OK	**A**
Promax SSNI21YI1	128	-	134	0.60	OK	OK	**A**
Svevia Y 2120	190	-	126	0.67	OK	OK	**A**

Table 71. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P0. Yellow materials, type I, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*NTY*	*Appr.*
Hot Mix Hotmix EE921Y [type I]	141	-	127	0.59	OK	OK	**A**
Hot Mix Hotmix POE1721Y [extr]	131	-	131	0.58	OK	OK	**A**
Svevia Y 2110	184	-	143	0.66	OK	OK	**A**

Roll-over class P2

Table 72. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P2. White materials, type I, 0.4 mm. Alphabetical order by manufacturer.

Type I, 0.4 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Geveko Markings EXP 21 AQ 1	worn	-	worn	worn	worn	**NA**
Geveko Markings EXP 21 AQ 2	worn	-	worn	worn	worn	**NA**

Table 73. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P2. White materials, type I, 1.5 mm. Alphabetical order by manufacturer.

Type I, 1.5 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Hot Mix Hotmix EE10-921W [spray]	180	-	170	0.70	OK	**A**
Hot Mix Hotmix EE921W [spray]	230	-	164	0.60	OK	**A**
Hot Mix Hotmix POE1021W [spray 1]	215	-	165	0.60	OK	**A**
Hot Mix Hotmix POE1021W [spray 2]	220	-	152	0.63	OK	**A**
Hot Mix Hotmix POE1721W [spray 1]	238	-	160	0.64	OK	**A**
Promax SSNI21WI1	186	-	170	0.64	OK	**NA**
Svevia X 2120	78	-	128	0.87	OK	**NA**

Table 74. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P2. White materials, type I, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Hot Mix Hotmix EE10-921W [type I]	171	-	167	0.69	OK	**A**
Hot Mix Hotmix EE921W [type I]	237	-	169	0.58	OK	**A**
Hot Mix Hotmix POE1021W [type I-1]	200	-	162	0.60	OK	**A**
Hot Mix Hotmix POE1021W [type I-2]	210	-	168	0.63	OK	**A**
Hot Mix Hotmix POE1721W [type I-1]	195	-	169	0.64	OK	**A**
Hot Mix Hotmix POE1721W [type I-2]	202	-	167	0.64	OK	**A**
Promax SNI21WI1	212	-	167	0.61	outside	**NA**
Svevia X 2110	194	-	173	0.71	OK	**A**

Table 75. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P2. White materials, type II, 3 mm. Alphabetical order by manufacturer.

Type II, 3 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
3M Stamark A380ESD	worn	worn	worn	worn	worn	**NA**

Table 76. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P2. White materials, type II, 5 mm. Alphabetical order by manufacturer.

Type II, 5 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Geveko Markings EXP 21 TP - 4	175	41	183	0.77	OK	**A**
Hot Mix Hotmix EE10-921W [type II]	174	29	176	0.78	OK	**NA**
Hot Mix Hotmix EE921W [type II]	208	25	187	0.66	OK	**NA**

Table 77. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P2. White inlaid materials, type II, 5 mm. Alphabetical order by manufacturer.

Inlaid type II, 5 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Geveko Markings EXP 21 TP - 6	153	35	132	0.81	OK	**A**

Table 78. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P2. White materials for hand application, retroreflective, 3 mm. Alphabetical order by manufacturer.

Materials for hand application, retroreflective, 3 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Geveko Markings EXP 21 TP – 1	150	-	175	0.80	OK	**A**
Svevia X 2130	167	-	171	0.75	OK	**A**

Table 79. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P2. White materials for hand application, non-retroreflective, 3 mm. Alphabetical order by manufacturer.

Materials for hand application, non-retroreflective, 3 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Geveko Markings EXP 21 TP - 2	(163)*	-	178	0.79	OK	**A**

*) No requirement

Table 80. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P2. Yellow materials, type I, 1.5 mm. Alphabetical order by manufacturer.

Type I, 1.5 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*NTY*	*Appr.*
Hot Mix Hotmix EE921Y [spray]	110	-	124	0.72	OK	OK	**A**
Hot Mix Hotmix POE1721Y [spray]	86	-	118	0.76	OK	OK	**NA**
Promax SSNI21YI1	115	-	130	0.65	OK	OK	**A**
Svevia Y 2120	130	-	124	0.76	OK	OK	**A**

Table 81. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P2. Yellow materials, type I, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*NTY*	*Appr.*
Hot Mix Hotmix EE921Y [type I]	111	-	137	0.66	OK	OK	**A**
Hot Mix Hotmix POE1721Y [extr]	96	-	128	0.68	OK	OK	**NA**
Svevia Y 2110	138	-	134	0.71	OK	OK	**A**

Roll-over class P3

Table 82. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P3. White materials, type I, 0.4 mm. Alphabetical order by manufacturer.

Type I, 0.4 mm ***Manufacturer*** *Material*	***$R_{L,dry}$***	***$R_{L,wet}$***	***Qd***	***Frict.***	***Colour***	***Appr.***
Geveko Markings EXP 21 AQ 1	worn	-	worn	worn	worn	**NA**
Geveko Markings EXP 21 AQ 2	worn	-	worn	worn	worn	**NA**

Table 83. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P3. White materials, type I, 1.5 mm. Alphabetical order by manufacturer.

Type I, 1.5 mm ***Manufacturer*** *Material*	***$R_{L,dry}$***	***$R_{L,wet}$***	***Qd***	***Frict.***	***Colour***	***Appr.***
Hot Mix Hotmix EE10-921W [spray]	192	-	185	0.69	OK	**A**
Hot Mix Hotmix EE921W [spray]	160	-	145	0.70	OK	**A**
Hot Mix Hotmix POE1021W [spray 1]	201	-	168	0.65	OK	**A**
Hot Mix Hotmix POE1021W [spray 2]	199	-	157	0.64	OK	**A**
Hot Mix Hotmix POE1721W [spray 1]	48	-	101	0.84	OK	**NA**
Promax SSNI21WI1	166	-	172	0.66	OK	**NA**
Svevia X 2120	worn	-	worn	worn	worn	**NA**

Table 84. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P3. White materials, type I, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Hot Mix Hotmix EE10-921W [type I]	183	-	185	0.65	OK	**A**
Hot Mix Hotmix EE921W [type I]	229	-	166	0.56	OK	**A**
Hot Mix Hotmix POE1021W [type I-1]	191	-	173	0.62	OK	**A**
Hot Mix Hotmix POE1021W [type I-2]	206	-	182	0.61	OK	**A**
Hot Mix Hotmix POE1721W [type I-1]	194	-	167	0.62	OK	**A**
Hot Mix Hotmix POE1721W [type I-2]	199	-	177	0.61	OK	**A**
Promax SNI21WI1	181	-	170	0.63	OK	**NA**
Svevia X 2110	176	-	189	0.71	OK	**A**

Table 85. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P3. White materials, type II, 3 mm. Alphabetical order by manufacturer.

Type II, 3 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
3M Stamark A380ESD	worn	worn	worn	worn	worn	**NA**

Table 86. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P3. White materials, type II, 5 mm. Alphabetical order by manufacturer.

Type II, 5 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Geveko Markings EXP 21 TP - 4	170	60	195	0.77	OK	**A**
Hot Mix Hotmix EE10-921W [type II]	178	29	179	0.72	OK	**NA**
Hot Mix Hotmix EE921W [type II]	209	27	173	0.65	OK	**NA**

Table 87. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P3. White materials for hand application, retroreflective, 3 mm. Alphabetical order by manufacturer.

Materials for hand application, retroreflective, 3 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Geveko Markings EXP 21 TP – 1	141	-	175	0.79	OK	**A**
Svevia X 2130	154	-	194	0.75	OK	**A**

Table 88. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P3. White materials for hand application, non-retroreflective, 3 mm. Alphabetical order by manufacturer.

Materials for hand application, non-retroreflective, 3 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Geveko Markings EXP 21 TP - 2	(150)*	-	181	0.78	OK	**A**

*) No requirement

Table 89. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P3. Yellow materials, type I, 1.5 mm. Alphabetical order by manufacturer.

Type I, 1.5 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*NTY*	*Appr.*
Hot Mix Hotmix EE921Y [spray]	27	-	85	0.86	OK	outside	**NA**
Hot Mix Hotmix POE1721Y [spray]	56	-	103	0.89	OK	OK	**NA**
Promax SSNI21YI1	100	-	138	0.67	OK	OK	**A**
Svevia Y 2120	worn	-	worn	worn	worn	worn	**NA**

Table 90. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P3. Yellow materials, type I, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm ***Manufacturer*** *Material*	***$R_{L,dry}$***	***$R_{L,wet}$***	***Qd***	***Frict.***	***Colour***	***NTY***	***Appr.***
Hot Mix Hotmix EE921Y [type I]	97	-	129	0.68	OK	OK	**NA**
Hot Mix Hotmix POE1721Y [extr]	77	-	117	0.70	OK	OK	**NA**
Svevia Y 2110	129	-	156	0.70	OK	OK	**A**

Roll-over class P4

Table 91. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P4. White materials, type I, 0.4 mm. Alphabetical order by manufacturer.

Type I, 0.4 mm ***Manufacturer*** *Material*	***$R_{L,dry}$***	***$R_{L,wet}$***	***Qd***	***Frict.***	***Colour***	***Appr.***
Geveko Markings EXP 21 AQ 1	worn	-	worn	worn	worn	**NA**
Geveko Markings EXP 21 AQ 2	worn	-	worn	worn	worn	**NA**

Table 92. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P4. White materials, type I, 1.5 mm. Alphabetical order by manufacturer.

Type I, 1.5 mm ***Manufacturer*** *Material*	***$R_{L,dry}$***	***$R_{L,wet}$***	***Qd***	***Frict.***	***Colour***	***Appr.***
Hot Mix Hotmix EE10-921W [spray]	worn	-	worn	worn	worn	**NA**
Hot Mix Hotmix EE921W [spray]	worn	-	worn	worn	worn	**NA**
Hot Mix Hotmix POE1021W [spray 1]	worn	-	worn	worn	worn	**NA**
Hot Mix Hotmix POE1021W [spray 2]	55	-	106	0.79	OK	**NA**
Hot Mix Hotmix POE1721W [spray 1]	worn	-	worn	worn	worn	**NA**
Promax SSNI21WI1	168	-	180	0.69	OK	**NA**
Svevia X 2120	worn	-	worn	worn	worn	**NA**

Table 93. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P4. White materials, type I, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Hot Mix Hotmix EE10-921W [type I]	153	-	164	0.71	OK	**A**
Hot Mix Hotmix EE921W [type I]	worn	-	worn	worn	worn	**NA**
Hot Mix Hotmix POE1021W [type I-1]	204	-	175	0.65	OK	**A**
Hot Mix Hotmix POE1021W [type I-2]	199	-	170	0.64	OK	**A**
Hot Mix Hotmix POE1721W [type I-1]	46	-	106	0.84	OK	**NA**
Hot Mix Hotmix POE1721W [type I-2]	127	-	140	0.75	OK	**NA**
Promax SNI21WI1	165	-	170	0.68	OK	**NA**
Svevia X 2110	164	-	186	0.74	OK	**A**

Table 94. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P4. White materials, type II, 3 mm. Alphabetical order by manufacturer.

Type II, 3 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
3M Stamark A380ESD	worn	worn	worn	worn	worn	**NA**

Table 95. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P4. White materials, type II, 5 mm. Alphabetical order by manufacturer.

Type II, 5 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Geveko Markings EXP 21 TP - 4	166	31	194	0.78	OK	**NA**
Hot Mix Hotmix EE10-921W [type II]	185	20	185	0.74	OK	**NA**
Hot Mix Hotmix EE921W [type II]	199	11	177	0.66	OK	**NA**

Table 96. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P4. White inlaid materials, type II, 5 mm. Alphabetical order by manufacturer.

Inlaid type II, 5 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Geveko Markings EXP 21 TP - 6	98	16	115	0.84	OK	**NA**

Table 97. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P4. White materials for hand application, retroreflective, 3 mm. Alphabetical order by manufacturer.

Materials for hand application, retroreflective, 3 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Geveko Markings EXP 21 TP – 1	133	-	174	0.80	OK	**A**
Svevia X 2130	140	-	188	0.77	OK	**A**

Table 98. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P4. White materials for hand application, non-retroreflective, 3 mm. Alphabetical order by manufacturer.

Materials for hand application, non-retroreflective, 3 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Geveko Markings EXP 21 TP - 2	(136)*	-	184	0.82	OK	**A**

*) No requirement

Table 99. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P4. Yellow materials, type I, 1.5 mm. Alphabetical order by manufacturer.

Type I, 1.5 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*NTY*	*Appr.*
Hot Mix Hotmix EE921Y [spray]	worn	-	worn	worn	worn	worn	**NA**
Hot Mix Hotmix POE1721Y [spray]	worn	-	worn	worn	worn	worn	**NA**
Promax SSNI21YI1	109	-	138	0.71	OK	OK	**A**
Svevia Y 2120	worn	-	worn	worn	worn	worn	**NA**

Table 100. Results of the performance measurements in 2022 of materials applied at the Icelandic-Norwegian-Swedish test site in 2021. Roll-over class P4. Yellow materials, type I, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm ***Manufacturer*** *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*NTY*	*Appr.*
Hot Mix Hotmix EE921Y [type I]	worn	-	worn	worn	worn	worn	**NA**
Hot Mix Hotmix POE1721Y [extr]	worn	-	worn	worn	worn	worn	**NA**
Svevia Y 2110	24	-	94	0.87	OK	outside	**NA**

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