

Nordic certification system for road marking materials

Results of performance
measurements in 2024

Trond Cato Johansen
Carina Fors

The logo for VTI (Vägar och Trafikinformationsverket) consists of the lowercase letters 'vti' in a bold, sans-serif font. A vertical red line is positioned to the left of the logo.

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Kort sammanfattning

Det nordiska certifieringssystemet *NordicCert* syftar till att testa och certifiera vägmarkeringsmaterial med avseende på hållbarhet (livslängd). Produktcertifieringen baseras på funktionsmätningar på materialprover som har applicerats på provfält på allmän väg. Materialen 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 kulör (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 2024, det vill säga ettårsuppföljning av material som lades ut 2023 och tvåårsuppföljning av material som lades ut 2022. Rapporten redovisar även resultat för funktionsmätningar utförda på material avsedda för temporär vägmarkering som lades ut 2024. Funktionsmätningarna omfattar retroreflexion (R_L) i torrt och vått tillstånd, luminanskoefficient (Q_d), friktion, kulör i dagsljus och kulör i fordonsbelysning (för gula material).

Av de 36 material som lades ut på det finsk-isländsk-norsk-svenska provfältet 2023 var det 24 som klarade funktionskraven i minst en av hjulpassageklasserna P0–P4 efter ett år. Av de 42 material som lades ut 2022 var det 3 som klarade funktionskraven i hjulpassageklass P5 efter två år. Ett material avsett för temporär vägmarkering lades ut 2024 och klarade funktionskraven i minst en av hjulpassageklasserna T0–T2.

Av de 23 material som lades ut på det danska provfältet 2023 var det 16 som klarade funktionskraven i minst en av hjulpassageklasserna P0–P5 efter ett år. Av de 10 material som lades ut 2022 var det inget som klarade funktionskraven i hjulpassageklasserna P5.5–P6 efter två år.

Nyckelord

Vägmarkeringsmaterial, certifiering.

Abstract

The Nordic certification system *NordicCert* aims at testing and certifying road marking materials with respect to the durability of the products. Product certification is based on monitored and documented performance measurements of material samples applied on test fields on public roads. The materials are certified in relation to the number of wheel passages they will stand, with maintained 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 2024, i.e., one-year follow-up measurements for materials applied in 2023 and two-years follow-up measurements for materials applied in 2022. The report also includes results of the performance measurement of materials intended for temporary road markings that were applied in 2024. The performance parameters include the coefficient of retroreflected luminance (R_L) under dry and wet conditions, the luminance coefficient under diffuse illumination (Qd), the skid resistance, the chromaticity in daylight, and the chromaticity of retroreflected light (yellow materials, only).

Out of the 36 materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023, 24 fulfilled the performance requirements in at least one roll-over class P0–P4 after one year. Out of the 42 materials applied in 2022, 3 fulfilled the performance requirements in roll-over class P5 after two years. One material intended for temporary road markings was applied in 2024 and fulfilled the performance requirements in at least one roll-over class T0–T2.

Out of the 23 materials applied at the Danish test site in 2023, 16 fulfilled the performance requirements in at least one roll-over class P0–P5 after one year. Out of the 10 materials applied in 2022, none fulfilled the performance requirements in roll-over classes P5.5–P6 after two years.

Keywords

Road marking material, certification.

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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 2024 on road marking materials applied for certification at the Danish and at the Finnish-Icelandic-Norwegian-Swedish test site in 2022–2023.

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

The road trials are administered as a joint project – *NordicCert* – between Ramboll and the Swedish National Road and Transport Research Institute (VTI).

Oslo, November 2024

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Project manager



Granskare/Examiner

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Publikationen godkänd för publicering

Anna Anund, VTI

1. Introduction

A Nordic certification system for road marking materials, *NordicCert*, was established in 2015. The certification system aims at testing and certifying road marking materials with respect to the durability of the products, which allows for public purchasers of road marking materials to set requirements on product quality in their procurements and contracts. Product certification 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 with different characteristics with respect to climate and winter maintenance: one in Norway, representative of the conditions in Finland, Iceland, Norway and Sweden, and one in Denmark, representative of the conditions 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 Q_d , chromaticity in daylight, chromaticity of retroreflected light (yellow materials only) and skid resistance 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- or T-classes, defined by EN 1824 (Swedish Standards Institute [SIS], 2018)) 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 10:2024* (Fors, Johansen and Fager, 2024) which is a public report available at www.vti.se/en/publications and at www.nordiccert.com.

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



*Figure 1. Materials applied at the Finnish-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 2024 on the materials applied at the Danish and at Finnish-Icelandic-Norwegian-Swedish test sites in 2022 (two-years follow-up) and 2023 (one-year follow-up). The report also includes results of follow-up performance measurements of materials intended for temporary markings applied in 2024.

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 2016–2023 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 1–4, stated in Figure 2, 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, provided that full product documentation has been submitted.

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 can be updated.

From year 3 onwards, the validity of the certificate is maintained provided that audits of the manufacturing process and the factory production control (see Section 6.3) are carried out and approved, every two years.

Activities that require actions from the manufacturer are:

- Registration of the material, including paying registration fee.
- Application of the material at the test site.
- Requesting identification analysis of the materials the manufacturer wants to have certified, including submission of full product documentation.
- Ensuring that 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 every two years.

Note: the revised requirement regarding the periodicity of the audits and certificate renewal (from one to two years) applies from 2025 onwards, i.e., certificates issued and valid in 2024 are valid for one year and must thus be renewed in 2025.

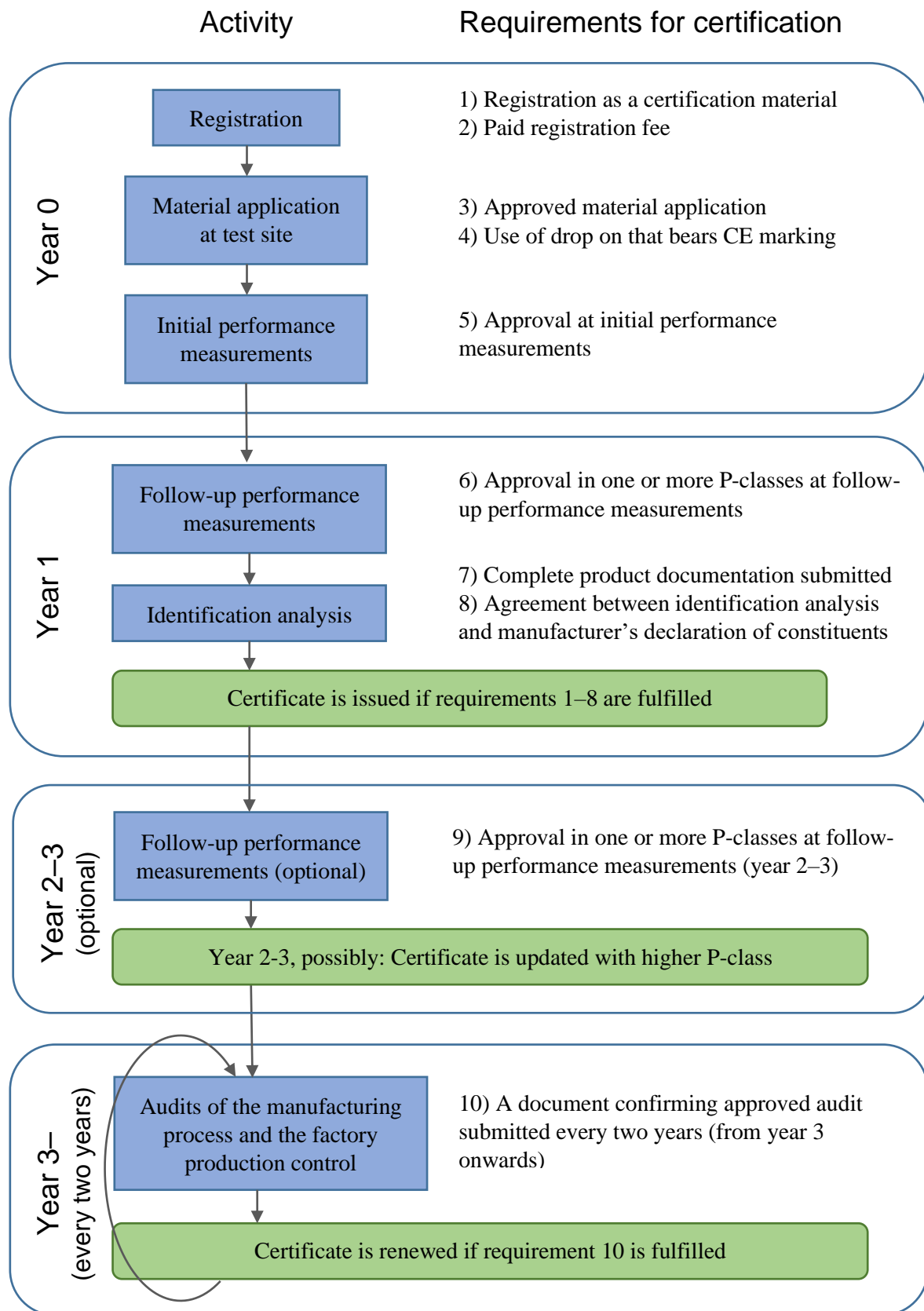


Figure 2. The certification procedure.

3. Test sites

3.1. The Danish test site

3.1.1. General

The Danish test site that has been used since 2022 is located close to the village of Havnstrup, approximately 100 km west of Aarhus, Jutland. A description can be found in Fors, Johansen and Fager (2024).

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 distance between two adjacent rows of lines is 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, see also Figure 5.

3.1.3. Traffic volume and wheel passages

Measurements of wheel passages are carried out yearly, in order to determine roll-over classes (P- or T-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 2–7 days 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 2023–2024.

Table 1. AADT (both lanes) and distribution of passenger cars, heavy vehicles and other vehicles in 2023–2024, at the Danish test site in Havnstrup.

Year	AADT	Passenger cars (%)	Heavy vehicles (%)	Other vehicles (%)
2023–2024	8 645	92.4	7.5	0.1

No roll-over classes for materials applied at the test field in Havnstrup in 2022 were determined, as there are no performance results to present from that test field (see also Chapter 5.2.1). The P-classes for materials applied at the test field in Havnstrup in 2023 are based on wheel passage measurements carried out in September 2024, which are presented below.

Figure 3 shows the distribution of wheel passages for the average week for materials applied at the original¹ test field in Havnstrup in 2023. 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.

¹ All profiled type II road markings applied in Havnstrup in 2023 were moved from the original test field to another location of because of noise issues. Thus, there are two separate test fields for materials applied in 2023. Wheel passage measurements were carried out at both locations.

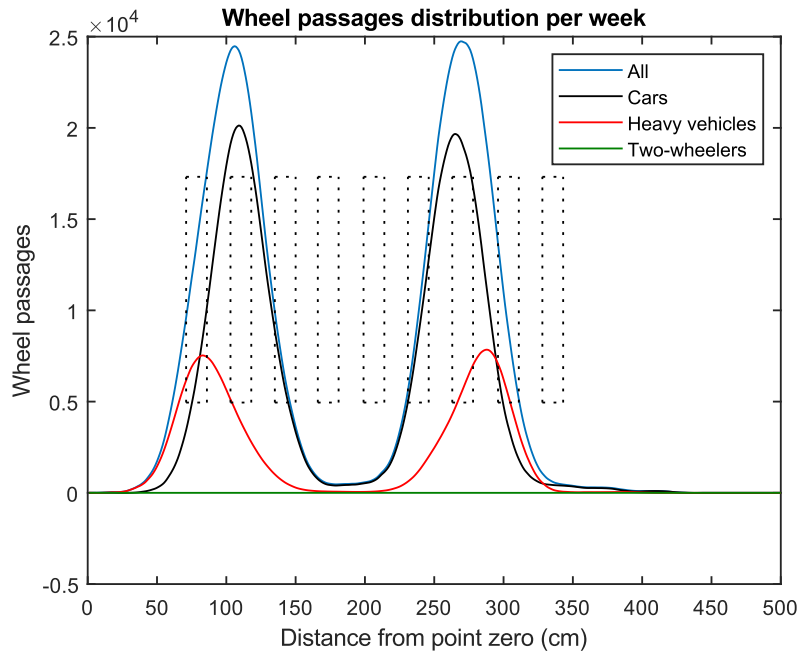


Figure 3. Wheel passages per week for materials applied at the original Danish test site in Havnstrup in 2023 (measurement in 2024). The dashed areas correspond to the nine lines (line 1 to the left, line 9 to the right). Please note that the shoulder is to the left in the figure. The number of two-wheelers 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 2023, as averages of the measurements at the two locations, i.e., at the original test field with type I markings and at the new test field with type II markings.

Table 2. Number of wheel passages per line and week, for materials applied at the Danish test site in Havnstrup in 2023. Line 1 is the one next to the edge line, see also Figure 5.

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	12 644	25 019	5 133	375	880	13 736	23 721	7 486	493

3.1.4. Weather conditions

The weather conditions from September 2023 to August 2024 for the test site in Havnstrup are shown in Table 3.

Table 3. Weather conditions at the Danish test site in Havnstrup, from September 2023 to August 2024.

Weather parameter	Value
Annual average temperature	9.0 °C
Average summer temperature (Apr-Sep)	13.8 °C
Average winter temperature (Oct-Mar)	4.2 °C
Highest temperature	27.6 °C
Lowest temperature	-16.5 °C
Annual precipitation	1317 mm
Number of sun hours per month	130 h
Number of weeks with snow or frost	8
Number of times the snow plough has operated	76
Number of times the road has been salted	131

Weather data was retrieved from *the Danish Meteorological Institute* (DMI), at the following places for Gørlev: Flakkebjerg approximately 28 km south of the test site (temperature, sun hours, snow/frost) and Rye close to the test site (precipitation), and at the following places for Havnstrup: Isenvad approximately 23 km east of the test site (temperature, sun hours, snow/frost) and Herning Centralrenseanlæg approximately 7 km east of the test site (precipitation), (DMI, 2024). Information about snow plough operations and salting was obtained from *the Danish Road Directorate*.

3.2. The Finnish-Icelandic-Norwegian-Swedish test site

3.2.1. General

The present Finnish-Icelandic-Norwegian-Swedish test site was established in Haslemoen, Norway in 2017. Materials have been applied yearly at this test site in 2017–2024. Further details can be found in Fors, Johansen and Fager (2024).

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 at least 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, see also Figure 5. The line on the shoulder has no wheel passages and is not included in the certification.

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-and T-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 2–7 days on each measurement occasion. In addition, official annual average daily traffic (AADT) data is obtained from the website Trafikkdata, provided by the Norwegian Public Roads Administration (Trafikkdata, 2024).

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 2021–2023.

Table 4. AADT (both lanes) and distribution of passenger cars, heavy vehicles, and other vehicles for 2021–2023, at the Finnish-Icelandic-Norwegian-Swedish test site.

Year	AADT	Passenger cars (%)	Heavy vehicles (%)	Other vehicles (%)
2021	3 199	85.5	13.8	0.7
2022	3 223	85.9	13.4	0.7
2023	3 220	86.1	13.7	0.2

The results of the wheel passage measurements carried out for materials applied in 2022 can be found in in Johansen and Fors (2023). The roll-over for materials applied in 2023 are based on wheel passage measurements carried out in September 2023 and in September 2024, which are presented below.

Figure 4 shows the distribution of wheel passages for the average week for materials applied in 2023. 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.

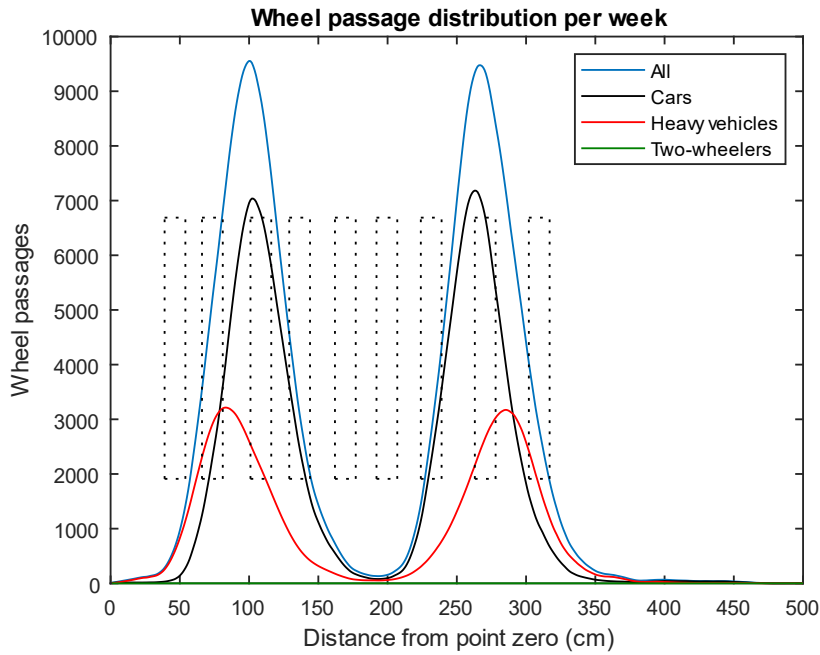


Figure 4. Wheel passages per week for materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023 (measurement in 2024). The dashed areas correspond to the nine lines in the lane (line 2 to the left, line 10 to the right). Please note that the shoulder is to the left in the figure. 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 2023, as averages of the two measurement occasions.

Table 5. Number of wheel passages per line and week, for materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023 Line 2 is the one next to the edge line, see also Figure 5.

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	657	4 836	9 423	2 869	344	130	2 633	9 615	2 561

3.2.4. Weather conditions

The weather conditions from September 2023 to August 2024 are shown in Table 6.

Table 6. Weather conditions at the Finnish-Icelandic-Norwegian-Swedish test site in Haslemoen, from September 2023 to August 2024.

Weather parameter	Value
Annual average temperature	5.0 °C
Average summer temperature (Apr-Sep)	13.2 °C
Average winter temperature (Oct-Mar)	-3.2 °C
Highest temperature	28.3 °C
Lowest temperature	-30.3 °C
Annual precipitation	576 mm
Number of sun hours per month	n/a
Number of weeks with snow	16
Number of times the snow plough has operated	161
Number of times the road has been salted	147

Weather data was retrieved from Yr, which is a joint weather service from *the Norwegian Meteorological Institute* and *the Norwegian Broadcasting Corporation* (Yr, 2024). 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. Performance measurements

4.1. General

Performance measurements were carried out according to EN 1824 (SIS, 2020) and EN 1436 (Swedish Standards Institute [SIS], 2018).

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 2024.

4.2. Methods and measuring instruments

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

The coefficient of retroreflected luminance, R_L , and the luminance coefficient under diffuse illumination, Q_d , were measured using an *LTL3500* (Delta, Denmark). Measurements were taken at three points along the centre of each line, Figure 5. 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.

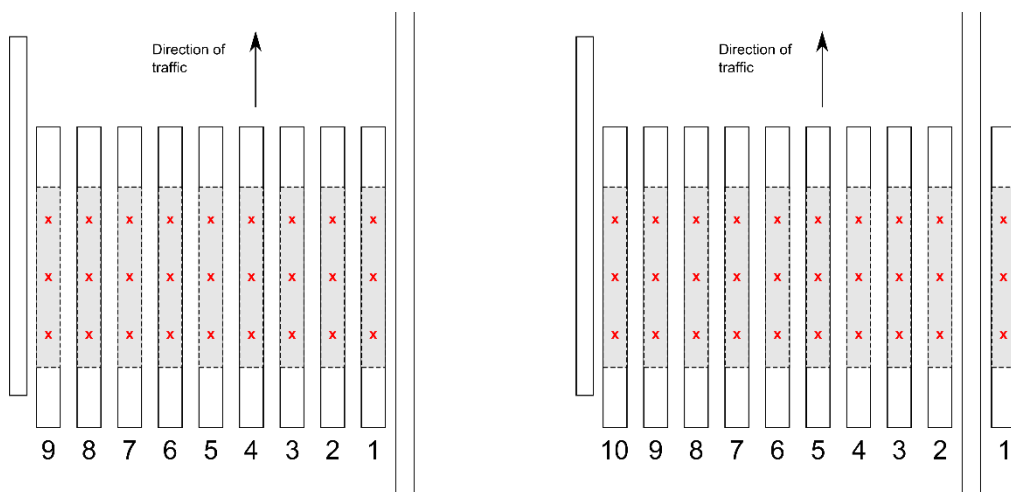


Figure 5. The measurement points (red crosses) for R_L and Q_d were placed along the centre of each line within the measurement area (grey) defined by EN 1824 (SIS, 2020). Left: the Danish test site with nine lines. Right: the Finnish-Icelandic-Norwegian-Swedish test site with ten lines.

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 6. 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).

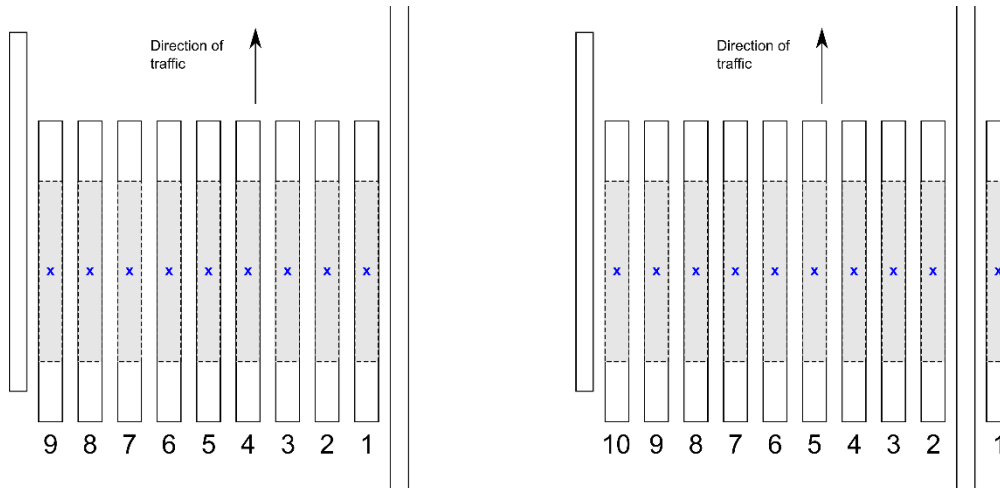


Figure 6. The measurement points (blue crosses) for chromaticity coordinates were placed in the centre of the lines. Left: the Danish test site with nine lines. Right: the Finnish-Icelandic-Norwegian-Swedish test site with ten lines.

For materials with a high degree of wear, the measurement was taken at an area where the material was intact, if possible. 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 6.

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. Skid resistance

Skid resistance measurements were carried out using a *Portable Friction Tester version 4*, PFT (Coralba, Sweden), along the centre of each line, Figure 7. 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.

Skid resistance was measured on wet markings. The skid resistance measurements were always carried out after the measurements of the coefficient of retroreflected luminance, R_L , the luminance coefficient under diffuse illumination, Q_d , and chromaticity coordinates.

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

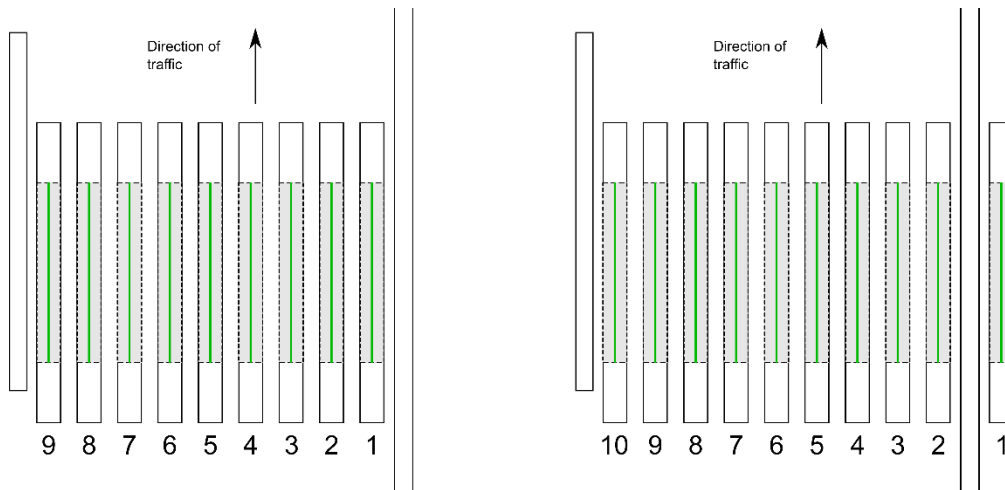


Figure 7. The measurement areas (green lines) for skid resistance. Left: the Danish test site with nine lines. Right: the Finnish-Icelandic-Norwegian-Swedish test site with ten lines.

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 39, it was mostly cloudy. The air temperature was approximately 15–17° C (day/evening). The road surface temperature was approximately 16–18° C. The measurements in Denmark in week 38 had sunny conditions, with air temperatures at 22–26° C. The road surface temperature was approximately 24–26° 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 markings² and five parameters for type II markings³ 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 I 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, Q_d [mcd/m ² /lx]	≥ 130	≥ 100	≥ 130	≥ 100
Skid resistance, [PFT units]	≥ 0.52	≥ 0.52	≥ 0.52	≥ 0.52
Chromaticity coordinates, x, y	4	5	4	5

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, Q_d [mcd/m ² /lx]	≥ 130	≥ 100	≥ 130	≥ 100
Skid resistance, [PFT units]	≥ 0.65	≥ 0.65	≥ 0.71	≥ 0.71
Chromaticity coordinates, x, y	6	7	6	7

² Type I refers to flat markings.

³ Type II refers to markings with special properties intended to enhance the retroreflection in wet or rainy conditions.

⁴ Type I and II white – Chromaticity coordinates, x, y – According to EN 1436:2018 (SIS, 2018).

⁵ 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 (SIS, 2018).

⁶ Materials for hand application, retroreflective and non-retroreflective, white – Chromaticity coordinates, x, y – According to EN 1436:2018 (SIS, 2018).

⁷ 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 (SIS, 2018).

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, Q_d [mcd/m ² /lx]	≥ 130	≥ 100	≥ 130	≥ 100
Skid resistance, [PFT units]	≥ 0.52	≥ 0.52	≥ 0.52	≥ 0.52
Chromaticity coordinates, x, y	8	9	8	10

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, Q_d [mcd/m ² /lx]	≥ 130
Skid resistance, [PFT units]	≥ 0.71
Chromaticity coordinates, x, y	11

Regarding skid resistance, a PFT value of 0.52 corresponds to an SRT value of 50 (class S2 in EN 1436 (SIS, 2018)), 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 skid resistance

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.

⁸ Materials with enhanced durability and temporary markings, white – Chromaticity coordinates, x, y – According to EN 1436:2018 (SIS, 2018).

⁹ 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 (SIS, 2018).

¹⁰ Temporary markings, yellow – Chromaticity coordinates, x, y – Includes both daytime (class Y2) and night-time colour (class RC1), according to EN 1436:2018 (SIS, 2018).

¹¹ Antiskid materials, white – Chromaticity coordinates, x, y – According to EN 1436:2018 (SIS, 2018).

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 roll-over classes

Materials are certified in relation to the number of wheel passages they will withstand. 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 (SIS, 2020). Separate classes are defined for permanent (P) and temporary (T) road markings, Table 11–Table 12. Materials are thus certified for a certain roll-over class, i.e., a P-class or a T-class. To get approval in a certain roll-over 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 of materials intended for permanent road markings is given based on the follow-up measurements one and two (and optional three) years after application, while certification of materials intended for temporary road markings is given based on follow-up measurements approximately three months 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 roll-over classes are selected for the follow-up measurements. One line is selected for each roll-over class and the results of the performance measurements on that line constitute the result for that material and roll-over class. All roll-over classes in Table 11–Table 12 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 for materials intended for permanent road markings, EN 1824 (SIS, 2020).

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

Table 12. Roll-over classes for materials intended for temporary road markings, EN 1824 (SIS, 2020).

Roll-over class	Number of wheel passages
T0	≤ 50 000
T1	Between 50 000 and 60 000
T2	100 000 ± 20 000

5.2.1. P-classes at the Danish test sites in 2024

For materials applied in 2022, P-classes P0, P2, P4 and P5 were reached in 2023. As no material fulfilled the requirements for P-class P5 in 2023, there are no results to present in 2024. For materials applied in 2023, P-classes P0, P3, P4 and P5 were reached in 2024. All P-classes were represented by one line, Table 13–Table 16.

Table 13. P-classes at the Danish test site, materials applied in 2022.

Roll-over class	Lines	Measured
P0	Line 4	September 2023
P1	-	-
P2	Line 5	September 2023
P3	-	-
P4	Line 1	September 2023
P5	Line 6	September 2023
P5.5	n/a	-
P6	n/a	-

Table 14. P-classes at the Danish test site, materials applied in 2023.

Roll-over class	Lines	Measured
P0	Line 4	September 2024
P1	-	-
P2	-	-
P3	Line 3	September 2024
P4	Line 8	September 2024
P5	Line 7	September 2024
P5.5	-	Summer 2025 (expected)
P6	-	Summer 2025 (expected)

5.2.2. P-classes at the Finnish-Icelandic-Norwegian-Swedish test site in 2024

For materials applied in 2022, P-classes P0, P2, P3 and P4 (inlaid markings: P0, P2, P3, P4) were reached in 2023 and P-class P5 was reached in 2024. For materials applied in 2023, P-classes P0, P2, P3 and P4 were reached in 2024. For materials intended for temporary road markings applied in 2024, T-classes T0, T1 and T2 were reached in 2024. All P-classes were represented by one line, Table 15–Table 17.

Table 15. P-classes at the Finnish-Icelandic-Norwegian-Swedish test site, materials applied in 2022.

Roll-over class	Lines, not inlaid	Lines, inlaid	Measured
P0	Line 5	Line 10	August 2023
P1	-	-	-
P2	Line 2	Line 2	August 2023
P3	Line 9	Line 9	August 2023
P4	Line 3	Line 3	August 2023
P5	Line 3	Line 3	September 2024

Table 16. P-classes at the Finnish-Icelandic-Norwegian-Swedish test site, materials applied in 2023.

Roll-over class	Lines	Measured
P0	Line 6	September 2024
P1	-	-
P2	Line 10	September 2024
P3	Line 5	September 2024
P4	Line 9	September 2024
P5	-	Summer 2025 (expected)

Table 17. T-classes at the Finnish-Icelandic-Norwegian-Swedish test site, materials applied in 2024.

Roll-over class	Lines	Measured
T0	Line 2	September 2024
T1	Line 5	September 2024
T2	Line 3	September 2024

6. Results

This section contains an overview of the results of the performance measurements carried out in 2024 on materials intended for permanent road markings applied at the test sites in 2022 and 2023 (the results tables for materials applied in 2022 also include the results from the performance measurements in 2023, see Section 5.2) and on materials intended for temporary road markings applied in 2024. **A** means that the material fulfils the requirement on all relevant performance parameters, in that roll-over 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 roll-over 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 2021.

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, see Chapter 2.

Detailed measurement results can be found in Appendix 1.

6.1. Materials applied at the Danish test site in 2022

6.1.1. White road markings

Type I

Material thickness 3 mm

Table 18. Results of the performance measurements of materials applied at the Danish test site in 2022. Roll-over classes P0, P2, P4, P5, P5.5, P6. White type I materials, 3 mm.

Manufacturer Material	P0	P2	P4	P5	P5.5	P6
Geveko Markings TP22-DK3	A	A	A	NA		
Geveko Markings TP22-DK4	A	A	NA			

Type II

Material thickness 5 mm

Table 19. Results of the performance measurements of materials applied at the Danish test site in 2022. Roll-over classes P0, P2, P4, P5, P5.5, P6. White type II materials, 5 mm.

Manufacturer Material	P0	P2	P4	P5	P5.5	P6
Geveko Markings TP22-DK1 <i>Profile/pattern: ViziSpot</i>	A	A	NA			
Geveko Markings TP22-DK2 <i>Profile/pattern: ViziSpot</i>	A	A	A	NA		
Promax DK22EWII <i>Profile/pattern: Dots</i>	NA					
Promax DK22EWIIR <i>Profile/pattern: Rilled</i>	NA					

6.2. Materials applied at the Danish test site in 2023

6.2.1. White road markings

Type I

Material thickness 0.4 mm

Table 20. Results of the performance measurements of materials applied at the Danish test site in 2023. Roll-over classes P0, P3, P4, P5. White type I materials, 0.4 mm.

Manufacturer Material	P0	P3	P4	P5
Geveko Markings EXP 2023 AQ1	NA			
Geveko Markings EXP 2023 AQ4	NA			

Material thickness 0.6 mm

Table 21. Results of the performance measurements of materials applied at the Danish test site in 2023. Roll-over classes P0, P3, P4, P5. White type I materials, 0.6 mm.

Manufacturer Material	P0	P3	P4	P5
Team Segnal PETRAFAST 3K SP	NA			

Material thickness 3 mm

Table 22. Results of the performance measurements of materials applied at the Danish test site in 2023. Roll-over classes P0, P3, P4, P5. White type I materials, 3 mm.

Manufacturer Material	P0	P3	P4	P5
Geveko Markings TP23-DK2	A	NA		
Geveko Markings TP23-DK4	A	NA		
Kelly Bros KB White Extrusion/Screed H	A	A	NA	
Saferoad Grawil White TYPE I 2023	A	A	NA	
Svevia E23150 T1	A	A	NA	
Swarco Vestglas SWARCOTHERM ECO HP160	A	A	A	NA

Type II

Material thickness 5 mm

Table 23. Results of the performance measurements of materials applied at the Danish test site in 2023. Roll-over classes P0, P3, P4, P5. White type II materials, 5 mm.

Manufacturer Material	P0	P3	P4	P5
Geveko Markings TP23-DK1 Profile/pattern: Agglo	A	A	NA	
Geveko Markings TP23-DK3 Profile/pattern: Agglo	A	A	NA	
Kelly Bros KB White Drop-on-Dot F Profile/pattern: Drop-on-Dots	A	NA		
Kelly Bros KB White Drop-on-Dot G Profile/pattern: Drop-on-Dots	NA			
Promax EDK23WII1 Profile/pattern: Drops - systematic	A	A	NA	
Promax EDK23WII2 Profile/pattern: Drops - systematic	A	NA		
Promax EDK23WII3 Profile/pattern: Drops - systematic	A	NA		
Saferoad Grawil White TYPE II 2023 Profile/pattern: Dot	A	A	NA	
Svevia E23150 T2 Profile/pattern: Multi dot 65 % cov.	A	A	NA	
Swarco Vestglas SWARCOTHERM ECO HP 165 Profile/pattern: Agglomerates	A	A	NA	

Antiskid materials

Material thickness 5 mm

Table 24. Results of the performance measurements of materials applied at the Danish test site in 2023. Roll-over classes P0, P3, P4, P5. White antiskid materials, 5 mm.

Manufacturer Material	P0	P3	P4	P5
Svevia HAS2365	A	NA		

6.3. Materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2022

6.3.1. White road markings

Type I

Material thickness 1.5 mm

Table 25. Results of the performance measurements of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2022. Roll-over classes P0, P2, P3, P4, P5. White type I materials, 1.5 mm.

Manufacturer Material	P0	P2	P3	P4	P5
Geveko Markings EXP 2022 TP11	A	A	A	A	NA
Geveko Markings EXP 2022 TP12	A	A	A	A	NA
Kelly Bros White Spray G	A	NA			
Svevia S22150	A	A	NA		

Material thickness 3 mm

Table 26. Results of the performance measurements of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2022. Roll-over classes P0, P2, P3, P4, P5. White type I materials, 3 mm.

Manufacturer Material	P0	P2	P3	P4	P5
Geveko Markings EXP 2022 TP4	A	A	A	A	A
Geveko Markings EXP 2022 TP5	A	A	A	NA	
Kelly Bros White Ext/Scd A	A	A	A	NA	
Kelly Bros White Ext/Scd B	A	A	A	NA	
Kelly Bros White Ext/Scd C	A	NA			
Kelly Bros White Ext/Scd D	A	NA			
Kelly Bros White Ext/Scd H	NA				
Svevia X22150	A	A	A	A	NA

Type II

Material thickness 5 mm

Table 27. Results of the performance measurements of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2022. Roll-over classes P0, P2, P3, P4, P5. White type II materials, 5 mm.

Manufacturer Material	P0	P2	P3	P4	P5
Geveko Markings EXP 2022 TP6 Profile/pattern: Rilled	A	NA			
Geveko Markings EXP 2022 TP7 Profile/pattern: Rilled	A	NA			
Geveko Markings EXP 2022 TP8 Profile/pattern: Stairs	A	NA			
Svevia E22150 Profile/pattern: Rolled	A	A	A	NA	

Inlaid type II

Material thickness 3 mm

Table 28. Results of the performance measurements of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2022. Roll-over classes P0, P2, P3, P4, P5. White inlaid type II materials, 3 mm.

Manufacturer Material	P0	P2	P3	P4	P5
3M Stamark A380ESDc Profile/pattern: Diamond shape	A	NA			

Material thickness 5 mm

Table 29. Results of the performance measurements of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2022. Roll-over classes P0, P2, P3, P4, P5. White inlaid type II materials, 5 mm.

Manufacturer Material	P0	P2	P3	P4	P5
Geveko Markings EXP 2022 TP9 Profile/pattern: Drops	A	NA			

Materials for hand application, retroreflective

Material thickness 3 mm

Table 30. Results of the performance measurements of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2022. Roll-over classes P0, P2, P3, P4, P5. White materials for hand application, retroreflective, 3 mm.

Manufacturer Material	P0	P2	P3	P4	P5
Svevia H2250	A	A	A	NA	

Materials for hand application, non-retroreflective

Material thickness 3 mm

Table 31. Results of the performance measurements of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2022. Roll-over classes P0, P2, P3, P4, P5. White materials for hand application, non-retroreflective, 3 mm.

Manufacturer Material	P0	P2	P3	P4	P5
Geveko Markings EXP 2022 TP2	A	A	A	A	A

6.3.2. Yellow road markings

Type I

Material thickness 1.5 mm

Table 32. Results of the performance measurements of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2022. Roll-over classes P0, P2, P3, P4, P5. Yellow type I materials, 1.5 mm.

Manufacturer Material	P0	P2	P3	P4	P5
Svevia S22100-Y	A	A	NA		

Material thickness 3 mm

Table 33. Results of the performance measurements of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2022. Roll-over classes P0, P2, P3, P4, P5. Yellow type I materials, 3 mm.

Manufacturer <i>Material</i>	P0	P2	P3	P4	P5
Geveko Markings EXP 2022 TP10	A	A	A	A	A
Kelly Bros Yellow Ext/Scd E	A	NA			
Kelly Bros Yellow Ext/Scd F	A	NA			
Svevia E22100-Y	A	A	A	NA	

6.4. Materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023

6.4.1. White road markings

Type I

Material thickness 0.4 mm

Table 34. Results of the performance measurements of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023. Roll-over classes P0, P2, P3, P4. White type I materials, 0.4 mm.

Manufacturer Material	P0	P2	P3	P4
Geveko Markings EXP 2023 AQ1	NA			
Geveko Markings EXP 2023 AQ2	NA			
Geveko Markings EXP 2023 AQ3	NA			
Geveko Markings EXP 2023 AQ5	NA			
Geveko Markings EXP 2023 AQ6	NA			

Material thickness 1.5 mm

Table 35. Results of the performance measurements of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023. Roll-over classes P0, P2, P3, P4. White type I materials, 1.5 mm.

Manufacturer Material	P0	P2	P3	P4
Cleanosol Hotmark Spray 1	A	NA		
Geveko Markings EXP 2023 TP2	A	NA		
Hot Mix HOTWHITE JH2301KHEH [spr]	A	A	NA	
Hot Mix HOTWHITE JH2303KHEH [spr]	A	A	NA	
Promax ESSNI23WI1	A	A	A	NA
Promax SSNI23WI1	A	NA		
Svevia S23150-1	A	A	A	NA
Svevia S23150-2	A	A	A	NA

Material thickness 3 mm

Table 36. Results of the performance measurements of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023. Roll-over classes P0, P2, P3, P4. White type I materials, 3 mm.

Manufacturer Material	P0	P2	P3	P4
Hot Mix HOTWHITE JH2301KHEH [extr]	A	A	A	NA
Hot Mix HOTWHITE JH2303KHEH [extr]	A	A	A	NA
Kelly Bros KB White Extrusion/Screed B	A	A	A	A
Promax ESNI23W11	A	A	A	A
Saferoad Grawil White20231	A	NA		
Saferoad Grawil White20232	A	A	A	NA
Svevia E23150	A	A	A	NA
Svevia X23150	A	A	A	NA

6.4.2. Yellow Road Markings

Type I

Material thickness 1.5 mm

Table 37. Results of the performance measurements of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023. Roll-over classes P0, P2, P3, P4. Yellow type I materials, 1.5 mm.

Manufacturer Material	P0	P2	P3	P4
Hot Mix HOTYELLOW JH2301EHKH	A	A	NA	
Svevia S23100-Y1	A	A	NA	
Svevia S23100-Y2	A	A	A	NA

Material thickness 3 mm

Table 38. Results of the performance measurements of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023. Roll-over classes P0, P2, P3, P4. Yellow type I materials, 3 mm.

Manufacturer Material	P0	P2	P3	P4
Hot Mix HOTYELLOW JH2303EHKH	A	A	NA	
Kelly Bros KB Yellow Extrusion/Screed C	NA			
Saferoad Grawil Yellow20231	A	NA		
Saferoad Grawil Yellow20232	A	A	NA	
Svevia E23100-Y1	A	NA		
Svevia E23100-Y2	A	A	A	NA

6.5. Materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2024

Note: the results of follow-up performance measurements of materials intended for permanent road markings applied on the test field in 2024 will be published in next year's result report.

6.5.1. Yellow road markings

Temporary markings

Material thickness 3 mm

Table 39. Results of the performance measurements of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2024. Roll-over classes T0, T1, T2. Yellow materials intended for temporary markings, 3 mm.

Manufacturer <i>Material</i>	T0	T1	T2
3M 3M Stamark A711IR	A	NA	

7. Overview of performance measurement results in 2015–2024

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.

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

7.1. Denmark

7.1.1. White road markings

Materials intended for permanent road markings

Table 40 shows the number of materials that have fulfilled the performance requirements in respective P-class since 2015, per material category.

Table 40. 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	4	-	-	-	-	-	-	-	-
Type I, 0.6 mm	2	-	-	-	-	-	-	-	-
Type I, 1.5 mm	-	3	3	3	1	1	-	-	-
Type I, 3 mm	22	58	54	50	42	29	11	5	4
Type II, 0.4 mm	-	1	-	-	-	-	-	-	-
Type II, 3 mm	1	-	-	-	-	-	-	-	-
Type II, 4–5 mm ¹²	10	31	21	21	20	13	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
Antiskid materials, 5 mm	-	1	-	-	-	-	-	-	-
<i>Total</i>	39	98	82	78	67	47	21	9	7

¹² Type II, 4–5 mm – 4 mm in 2016–2017, 5 mm from 2018 onwards.

7.2. Finland, Iceland, Norway and Sweden

7.2.1. White road markings

Materials intended for permanent road markings

Table 41 shows the number of materials that have fulfilled the performance requirements in respective P-class since 2015, per material category.

Table 41. The total number of materials that have fulfilled the performance requirements at the Finnish-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	50	3	-	-	-	-	-
Type I, 0.6 mm	13	3	-	-	-	-	-
Type I, 1.5 mm	11	43	33	31	18	7	1
Type I, 3 mm	43	92	86	80	61	36	14
Type II, 0.6 mm	4	-	-	-	-	-	-
Type II, 3 mm	7	1	-	-	-	-	-
Type II, 4–5 mm ¹³	13	31	16	16	3	-	-
Inlaid type II, 0.6 mm	2	-	-	-	-	-	-
Inlaid type II, 3 mm	-	1	-	-	-	-	-
Inlaid type II, 5 mm	2	11	6	5	1	1	-
Materials for hand application, retroreflective, 3 mm	6	6	6	6	6	5	2
Materials for hand application, non-retroreflective, 3 mm	-	4	4	4	4	4	2
Materials with enhanced durability, 3 mm	-	2	2	2	1	1	-
Antiskid materials, 4 mm	-	2	2	2	2	2	2
<i>Total</i>	<i>151</i>	<i>199</i>	<i>155</i>	<i>146</i>	<i>96</i>	<i>56</i>	<i>21</i>

¹³ Type II, 4–5 mm – 4 mm in 2016–2017, 5 mm from 2018 onwards.

Materials intended for temporary road markings

Table 42 shows the number of materials that have fulfilled the performance requirements in respective T-class since 2015, per material category.

Table 42. The total number of materials that have fulfilled the performance requirements at the Finnish-Icelandic-Norwegian-Swedish test site since 2015, per category and T-class. White materials.

Material category	No T-class	T0	T1	T2
Temporary markings, 3 mm	-	1	1	1
<i>Total</i>	-	1	1	1

7.2.2. Yellow road markings

Materials intended for permanent road markings

Table 43 shows the number of materials that have fulfilled the performance requirements in respective P-class since 2015, per material category.

Table 43. The total number of materials that have fulfilled the performance requirements at the Finnish-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	14	11	11	5	2	-
Type I, 3 mm	40	33	26	22	11	4	1
Type II, 3 mm	2	-	-	-	-	-	-
Type II, 4–5 mm ¹⁴	2	1	-	-	-	-	-
Materials for hand application, retroreflective, 3 mm	3	-	-	-	-	-	-
<i>Total</i>	67	48	37	33	16	6	1

¹⁴ Type II, 4–5 mm – 4 mm in 2016–2017, 5 mm from 2018 onwards.

Materials intended for temporary road markings

Table 44 shows the number of materials that have fulfilled the performance requirements in respective T-class since 2015, per material category.

Table 44. The total number of materials that have fulfilled the performance requirements at the Finnish-Icelandic-Norwegian-Swedish test site since 2015, per category and T-class. Yellow materials.

Material category	No T-class	T0	T1	T2
Temporary markings, 3 mm	3	1	-	-
<i>Total</i>	3	1	-	-

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Appendix 1 – Results of the performance measurements

Table 46–Table 47 show the results for roll-over class P5.5 and P6 for materials applied at the Danish test site in 2022. Table 48–Table 67 show the results for roll-over classes P0, P3, P4 and P5 for materials applied at the Danish test site in 2023. Table 68–Table 76 show the results for roll-over class P5 for materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2022. Table 77–Table 96 show the results for roll-over classes P0, P2, P3 and P4 for materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023. Table 97–Table 99 show the results for roll-over classes T0, T1 and T2 for materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2024.

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 2024).

Table 45 explains the denotations in the result tables.

Table 45. 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]
Q_d	Mean value of luminance coefficient under diffuse illumination, Q_d [mcd/m ² /lx]
μ_{PFT}	Mean value of skid resistance [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 2022

Roll-over classes P5.5 and P6

No materials fulfilled the requirements for class P5 in 2023. Therefore, no performance measurements were carried out in 2024.

Table 46. Results of the performance measurements in 2024 of materials applied at the Danish test site in 2022. Roll-over class P5.5 and P6. White type I materials, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm						
Manufacturer	$R_{L,dry}$	$R_{L,wet}$	Qd	μ_{PFT}	Colour	Appr.
<i>Material</i>						
Geveko Markings TP22-DK3	n.m.	-	n.m.	n.m.	n.m.	NA
Geveko Markings TP22-DK4	n.m.	-	n.m.	n.m.	n.m.	NA

Table 47. Results of the performance measurements in 2024 of materials applied at the Danish test site in 2022. Roll-over class P5.5 and P6. White type II materials, 5 mm. Alphabetical order by manufacturer.

Type II, 5 mm						
Manufacturer	$R_{L,dry}$	$R_{L,wet}$	Qd	μ_{PFT}	Colour	Appr.
<i>Material</i>						
Geveko Markings TP22-DK1 <i>Profile/pattern: ViziSpot</i>	n.m.	n.m.	n.m.	n.m.	n.m.	NA
Geveko Markings TP22-DK2 <i>Profile/pattern: ViziSpot</i>	n.m.	n.m.	n.m.	n.m.	n.m.	NA
Promax DK22EWII <i>Profile/pattern: Dots</i>	n.m.	n.m.	n.m.	n.m.	n.m.	NA
Promax DK22EWIIR <i>Profile/pattern: Rilled</i>	n.m.	n.m.	n.m.	n.m.	n.m.	NA

Materials applied at the Danish test site in 2023

Roll-over class P0

Table 48. Results of the performance measurements in 2024 of materials applied at the Danish test site in 2023. Roll-over class P0. White type I materials, 0.4 mm. Alphabetical order by manufacturer.

Type I, 0.4 mm						
Manufacturer	$R_{L,dry}$	$R_{L,wet}$	Q_d	μ_{PFT}	Colour	Appr.
<i>Material</i>						
Geveko Markings EXP 2023 AQ1	126	-	122	0.66	OK	NA
Geveko Markings EXP 2023 AQ4	141	-	124	0.62	OK	NA

Table 49. Results of the performance measurements in 2024 of materials applied at the Danish test site in 2023. Roll-over class P0. White type I materials, 0.6 mm. Alphabetical order by manufacturer.

Type I, 0.6 mm						
Manufacturer	$R_{L,dry}$	$R_{L,wet}$	Q_d	μ_{PFT}	Colour	Appr.
<i>Material</i>						
Team Segnal PETRAFAST 3K SP	196	-	115	0.48	OK	NA

Table 50. Results of the performance measurements in 2024 of materials applied at the Danish test site in 2023. Roll-over class P0. White type I materials, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm						
Manufacturer	$R_{L,dry}$	$R_{L,wet}$	Q_d	μ_{PFT}	Colour	Appr.
<i>Material</i>						
Geveko Markings TP23-DK2	200	-	130	0.63	OK	A
Geveko Markings TP23-DK4	270	-	133	0.54	OK	A
Kelly Bros KB White Extrusion/Screed H	209	-	135	0.52	OK	A
Saferoad Grawil White TYPE I 2023	210	-	160	0.54	OK	A
Svevia E23150 T1	174	-	133	0.62	OK	A
Swarco Vestglas SWARCOTHERM ECO HP160	264	-	140	0.70	OK	A

Table 51. Results of the performance measurements in 2024 of materials applied at the Danish test site in 2023. Roll-over class P0. White type II materials, 5 mm. Alphabetical order by manufacturer.

Type II, 5 mm						
Manufacturer	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Qd</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>Appr.</i>
<i>Material</i>						
Geveko Markings TP23-DK1 <i>Profile/pattern: Agglo</i>	208	76	140	0.67	OK	A
Geveko Markings TP23-DK3 <i>Profile/pattern: Agglo</i>	242	74	143	0.59	OK	A
Kelly Bros KB White Drop-on-Dot F <i>Profile/pattern: Drop-on-Dots</i>	231	94	130	0.66	OK	A
Kelly Bros KB White Drop-on-Dot G <i>Profile/pattern: Drop-on-Dots</i>	206	83	117	0.67	OK	NA
Promax EDK23WII1 <i>Profile/pattern: Drops - systematic</i>	190	68	130	0.66	OK	A
Promax EDK23WII2 <i>Profile/pattern: Drops - systematic</i>	210	48	141	0.60	OK	A
Promax EDK23WII3 <i>Profile/pattern: Drops - systematic</i>	200	68	131	0.57	OK	A
Saferoad Grawil White TYPE II 2023 <i>Profile/pattern: Dot</i>	203	69	139	0.63	OK	A
Svevia E23150 T2 <i>Profile/pattern: Multi dot 65 % cov</i>	187	74	140	0.63	OK	A
Swarco Vestglas SWARCOTHERM ECO HP 165 <i>Profile/pattern: Agglomerates</i>	282	90	137	0.56	OK	A

Table 52. Results of the performance measurements in 2024 of materials applied at the Danish test site in 2023. Roll-over class P0. White antiskid materials, 5 mm. Alphabetical order by manufacturer.

Antiskid, 5 mm						
Manufacturer	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Qd</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>Appr.</i>
<i>Material</i>						
Svevia HAS2365	(31) ¹⁵	-	132	0.80	OK	A

¹⁵ No requirement

Roll-over class P3

Table 53. Results of the performance measurements in 2024 of materials applied at the Danish test site in 2023. Roll-over class P3. White type I materials, 0.4 mm. Alphabetical order by manufacturer.

Type I, 0.4 mm Manufacturer <i>Material</i>	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Qd</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>Appr.</i>
Geveko Markings EXP 2023 AQ1	86	-	104	0.65	OK	NA
Geveko Markings EXP 2023 AQ4	112	-	113	0.61	OK	NA

Table 54. Results of the performance measurements in 2024 of materials applied at the Danish test site in 2023. Roll-over class P3. White type I materials, 0.6 mm. Alphabetical order by manufacturer.

Type I, 0.6 mm Manufacturer <i>Material</i>	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Qd</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>Appr.</i>
Team Segnal PETRAFAST 3K SP	147	-	106	0.55	OK	NA

Table 55. Results of the performance measurements in 2024 of materials applied at the Danish test site in 2023. Roll-over class P3. White type I materials, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm Manufacturer <i>Material</i>	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Qd</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>Appr.</i>
Geveko Markings TP23-DK2	119	-	126	0.69	OK	NA
Geveko Markings TP23-DK4	175	-	120	0.60	OK	NA
Kelly Bros KB White Extrusion/Screed H	189	-	143	0.59	OK	A
Saferoad Grawil White TYPE I 2023	157	-	165	0.57	OK	A
Svevia E23150 T1	155	-	130	0.62	OK	A
Swarco Vestglas SWARCOTHERM ECO HP160	195	-	137	0.68	OK	A

Table 56. Results of the performance measurements in 2024 of materials applied at the Danish test site in 2023. Roll-over class P3. White type II materials, 5 mm. Alphabetical order by manufacturer.

Type II, 5 mm						
Manufacturer Material	$R_{L,dry}$	$R_{L,wet}$	Qd	μ_{PFT}	Colour	Appr.
Geveko Markings TP23-DK1 Profile/pattern: Agglo	153	58	133	0.68	OK	A
Geveko Markings TP23-DK3 Profile/pattern: Agglo	174	59	142	0.64	OK	A
Kelly Bros KB White Drop-on-Dot F Profile/pattern: Drop-on-Dots	205	90	121	0.65	OK	NA
Kelly Bros KB White Drop-on-Dot G Profile/pattern: Drop-on-Dots	156	70	118	0.68	OK	NA
Promax EDK23WII1 Profile/pattern: Drops - systematic	153	68	137	0.64	OK	A
Promax EDK23WII2 Profile/pattern: Drops - systematic	140	45	138	0.62	OK	NA
Promax EDK23WII3 Profile/pattern: Drops - systematic	139	55	107	0.62	OK	NA
Saferoad Grawil White TYPE II 2023 Profile/pattern: Dot	154	49	135	0.64	OK	A
Svevia E23150 T2 Profile/pattern: Multi dot 65% cov	153	64	131	0.67	OK	A
Swarco Vestglas SWARCOTHERM ECO HP 165 Profile/pattern: Agglomerates	175	70	133	0.65	OK	A

Table 57. Results of the performance measurements in 2024 of materials applied at the Danish test site in 2023. Roll-over class P3. White antiskid materials, 5 mm. Alphabetical order by manufacturer.

Antiskid, 5 mm						
Manufacturer Material	$R_{L,dry}$	$R_{L,wet}$	Qd	μ_{PFT}	Colour	Appr.
Svevia HAS2365	(27) ¹⁶	-	125	0.74	OK	NA

¹⁶ No requirement

Roll-over class P4

Table 58. Results of the performance measurements in 2024 of materials applied at the Danish test site in 2023. Roll-over class P4. White type I materials, 0.4 mm. Alphabetical order by manufacturer.

Type I, 0.4 mm Manufacturer <i>Material</i>	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Q_d</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>Appr.</i>
Geveko Markings EXP 2023 AQ1	78	-	106	0.68	OK	NA
Geveko Markings EXP 2023 AQ4	115	-	118	0.64	OK	NA

Table 59. Results of the performance measurements in 2024 of materials applied at the Danish test site in 2023. Roll-over class P4. White type I materials, 0.6 mm. Alphabetical order by manufacturer.

Type I, 0.6 mm Manufacturer <i>Material</i>	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Q_d</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>Appr.</i>
Team Signal PETRAFAST 3K SP	41	-	154	0.68	OK	NA

Table 60. Results of the performance measurements in 2024 of materials applied at the Danish test site in 2023. Roll-over class P4. White type I materials, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm Manufacturer <i>Material</i>	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Q_d</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>Appr.</i>
Geveko Markings TP23-DK2	132	-	139	0.68	OK	NA
Geveko Markings TP23-DK4	178	-	127	0.61	OK	NA
Kelly Bros KB White Extrusion/Screed H	202	-	118	0.62	OK	NA
Saferoad Grawil White TYPE I 2023	119	-	148	0.62	OK	NA
Svevia E23150 T1	136	-	131	0.65	OK	NA
Swarco Vestglas SWARCOTHERM ECO HP160	181	-	145	0.74	OK	A

Table 61. Results of the performance measurements in 2024 of materials applied at the Danish test site in 2023. Roll-over class P4. White type II materials, 5 mm. Alphabetical order by manufacturer.

Type II, 5 mm						
Manufacturer	$R_{L,dry}$	$R_{L,wet}$	Q_d	μ_{PFT}	Colour	Appr.
<i>Material</i>						
Geveko Markings TP23-DK1 <i>Profile/pattern: Agglo</i>	137	47	132	0.70	OK	NA
Geveko Markings TP23-DK3 <i>Profile/pattern: Agglo</i>	168	46	122	0.65	OK	NA
Kelly Bros KB White Drop-on-Dot F <i>Profile/pattern: Drop-on-Dots</i>	158	55	119	0.68	OK	NA
Kelly Bros KB White Drop-on-Dot G <i>Profile/pattern: Drop-on-Dots</i>	150	53	109	0.70	OK	NA
Promax EDK23WII1 <i>Profile/pattern: Drops - systematic</i>	112	49	118	0.70	OK	NA
Promax EDK23WII2 <i>Profile/pattern: Drops - systematic</i>	126	45	119	0.69	OK	NA
Promax EDK23WII3 <i>Profile/pattern: Drops - systematic</i>	119	48	109	0.68	OK	NA
Saferoad Grawil White TYPE II 2023 <i>Profile/pattern: Dot</i>	134	44	117	0.66	OK	NA
Svevia E23150 T2 <i>Profile/pattern: Multi dot 65% cov</i>	133	50	126	0.69	OK	NA
Swarco Vestglas SWARCOTHERM ECO HP 165 <i>Profile/pattern: Agglomerates</i>	131	57	128	0.71	OK	NA

Table 62. Results of the performance measurements in 2024 of materials applied at the Danish test site in 2023. Roll-over class P4. White antiskid materials, 5 mm. Alphabetical order by manufacturer.

Antiskid, 5 mm						
Manufacturer	$R_{L,dry}$	$R_{L,wet}$	Q_d	μ_{PFT}	Colour	Appr.
<i>Material</i>						
Svevia HAS2365	(27) ¹⁷	-	116	0.81	OK	NA

¹⁷ No requirement

Roll-over class P5

Table 63. Results of the performance measurements in 2024 of materials applied at the Danish test site in 2023. Roll-over class P5. White type I materials, 0.4 mm. Alphabetical order by manufacturer.

Type I, 0.4 mm <i>Manufacturer Material</i>	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Qd</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>Appr.</i>
Geveko Markings EXP 2023 AQ1	25	-	91	0.65	OK	NA
Geveko Markings EXP 2023 AQ4	23	-	85	0.64	OK	NA

Table 64. Results of the performance measurements in 2024 of materials applied at the Danish test site in 2023. Roll-over class P5. White type I materials, 0.6 mm. Alphabetical order by manufacturer.

Type I, 0.6 mm <i>Manufacturer Material</i>	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Qd</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>Appr.</i>
Team Segnal PETRAFAST 3K SP	25	-	163	0.67	OK	NA

Table 65. Results of the performance measurements in 2024 of materials applied at the Danish test site in 2023. Roll-over class P5. White type I materials, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm <i>Manufacturer Material</i>	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Qd</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>Appr.</i>
Geveko Markings TP23-DK2	112	-	138	0.67	OK	NA
Geveko Markings TP23-DK4	115	-	101	0.59	OK	NA
Kelly Bros KB White Extrusion/Screed H	99	-	133	0.66	OK	NA
Saferoad Grawil White TYPE I 2023	80	-	149	0.65	OK	NA
Svevia E23150 T1	112	-	144	0.65	OK	NA
Swarco Vestglas SWARCOTHERM ECO HP160	137	-	156	0.74	OK	NA

Table 66. Results of the performance measurements in 2024 of materials applied at the Danish test site in 2023. Roll-over class P5. White type II materials, 5 mm. Alphabetical order by manufacturer.

Type II, 5 mm						
Manufacturer	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Qd</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>Appr.</i>
<i>Material</i>						
Geveko Markings TP23-DK1 <i>Profile/pattern: Agglo</i>	92	28	116	0.71	OK	NA
Geveko Markings TP23-DK3 <i>Profile/pattern: Agglo</i>	106	20	115	0.65	OK	NA
Kelly Bros KB White Drop-on-Dot F <i>Profile/pattern: Drop-on-Dots</i>	worn	worn	worn	worn	worn	NA
Kelly Bros KB White Drop-on-Dot G <i>Profile/pattern: Drop-on-Dots</i>	59	17	94	0.67	OK	NA
Promax EDK23WII1 <i>Profile/pattern: Drops - systematic</i>	67	14	103	0.66	OK	NA
Promax EDK23WII2 <i>Profile/pattern: Drops - systematic</i>	104	28	121	0.68	OK	NA
Promax EDK23WII3 <i>Profile/pattern: Drops - systematic</i>	85	25	112	0.67	OK	NA
Saferoad Grawil White TYPE II 2023 <i>Profile/pattern: Dot</i>	100	23	124	0.67	OK	NA
Svevia E23150 T2 <i>Profile/pattern: Multi dot 65 % cov</i>	69	12	105	0.68	OK	NA
Swarco Vestglas SWARCOTHERM ECO HP 165 <i>Profile/pattern: Agglomerates</i>	74	27	125	0.72	OK	NA

Table 67. Results of the performance measurements in 2024 of materials applied at the Danish test site in 2023. Roll-over class P5. White antiskid materials, 5 mm. Alphabetical order by manufacturer.

Antiskid, 5 mm						
Manufacturer	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Qd</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>Appr.</i>
<i>Material</i>						
Svevia HAS2365	(26) ¹⁸	-	139	0.81	OK	NA

¹⁸ No requirement

Materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2022

Roll-over class P5

Table 68. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2022. Roll-over class P5. White type I materials, 1.5 mm. Alphabetical order by manufacturer.

Type I, 1.5 mm Manufacturer <i>Material</i>	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Qd</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>Appr.</i>
Geveko Markings EXP 2022 TP11	worn	-	worn	worn	worn	NA
Geveko Markings EXP 2022 TP12	worn	-	worn	worn	worn	NA
Kelly Bros White Spray G	n.m.	-	n.m.	n.m.	n.m.	NA
Svevia S22150	n.m.	-	n.m.	n.m.	n.m.	NA

Table 69. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2022. Roll-over class P5. White type I materials, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm Manufacturer <i>Material</i>	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Qd</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>Appr.</i>
Geveko Markings EXP 2022 TP4	192	-	189	0.65	OK	A
Geveko Markings EXP 2022 TP5	n.m.	-	n.m.	n.m.	n.m.	NA
Kelly Bros White Ext/Scd A	n.m.	-	n.m.	n.m.	n.m.	NA
Kelly Bros White Ext/Scd B	n.m.	-	n.m.	n.m.	n.m.	NA
Kelly Bros White Ext/Scd C	n.m.	-	n.m.	n.m.	n.m.	NA
Kelly Bros White Ext/Scd D	n.m.	-	n.m.	n.m.	n.m.	NA
Kelly Bros White Ext/Scd H	n.m.	-	n.m.	n.m.	n.m.	NA
Svevia X22150	worn	-	worn	worn	worn	NA

Table 70. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2022. Roll-over class P5. White type II materials, 5 mm. Alphabetical order by manufacturer.

Type II, 5 mm						
Manufacturer Material	$R_{L,dry}$	$R_{L,wet}$	Qd	μ_{PFT}	Colour	Appr.
Geveko Markings EXP 2022 TP6 Profile/pattern: Rilled	n.m.	n.m.	n.m.	n.m.	n.m.	NA
Geveko Markings EXP 2022 TP7 Profile/pattern: Rilled	n.m.	n.m.	n.m.	n.m.	n.m.	NA
Geveko Markings EXP 2022 TP8 Profile/pattern: Stairs	n.m.	n.m.	n.m.	n.m.	n.m.	NA
Svevia E22150 Profile/pattern: Rolled	n.m.	n.m.	n.m.	n.m.	n.m.	NA

Table 71. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2022. Roll-over class P5. White inlaid type II materials, 3 mm. Alphabetical order by manufacturer.

Inlaid type II, 3 mm						
Manufacturer Material	$R_{L,dry}$	$R_{L,wet}$	Qd	μ_{PFT}	Colour	Appr.
3M Stamark A380ESDc Profile/pattern: Diamond shape	n.m.	n.m.	n.m.	n.m.	n.m.	NA

Table 72. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2022. Roll-over class P5. White inlaid type II materials, 5 mm. Alphabetical order by manufacturer.

Inlaid type II, 5 mm						
Manufacturer Material	$R_{L,dry}$	$R_{L,wet}$	Qd	μ_{PFT}	Colour	Appr.
Geveko Markings EXP 2022 TP9 Profile/pattern: Drops	n.m.	n.m.	n.m.	n.m.	n.m.	NA

Table 73. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2022. Roll-over class P5. White materials for hand application, retroreflective, 3 mm. Alphabetical order by manufacturer.

Hand application, retroreflective, 3 mm						
Manufacturer Material	$R_{L,dry}$	$R_{L,wet}$	Qd	μ_{PFT}	Colour	Appr.
Svevia H2250	n.m.	-	n.m.	n.m.	n.m.	NA

Table 74. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2022. Roll-over class P5. White materials for hand application, non-retroreflective, 3 mm. Alphabetical order by manufacturer.

Hand application, non-retroreflective, 3 mm Manufacturer <i>Material</i>	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Qd</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>Appr.</i>
Geveko Markings EXP 2022 TP2	(132) ¹⁹	-	176	0.72	OK	A

Table 75. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2022. Roll-over class P5. Yellow type I materials, 1.5 mm. Alphabetical order by manufacturer.

Type I, 1.5 mm Manufacturer <i>Material</i>	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Qd</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>NTY</i>	<i>Appr.</i>
Svevia S22100-Y	n.m.	-	n.m.	n.m.	n.m.	n.m.	NA

Table 76. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2022. Roll-over class P5. Yellow type I materials, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm Manufacturer <i>Material</i>	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Qd</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>NTY</i>	<i>Appr.</i>
Geveko Markings EXP 2022 TP10	110	-	132	0.71	OK	OK	A
Kelly Bros Yellow Ext/Scd E	n.m.	-	n.m.	n.m.	n.m.	n.m.	NA
Kelly Bros Yellow Ext/Scd F	n.m.	-	n.m.	n.m.	n.m.	n.m.	NA
Svevia E22100-Y	n.m.	-	n.m.	n.m.	n.m.	n.m.	NA

¹⁹ No requirement

Materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023

Roll-over class P0

Table 77. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023. Roll-over class P0. White type I materials, 0.4 mm. Alphabetical order by manufacturer.

Type I, 0.4 mm <i>Manufacturer</i> <i>Material</i>	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Qd</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>Appr.</i>
Geveko Markings EXP 2023 AQ1	69	-	114	0.85	OK	NA
Geveko Markings EXP 2023 AQ2	63	-	110	0.88	OK	NA
Geveko Markings EXP 2023 AQ3	77	-	120	0.84	OK	NA
Geveko Markings EXP 2023 AQ5	68	-	115	0.85	OK	NA
Geveko Markings EXP 2023 AQ6	70	-	113	0.84	OK	NA

Table 78. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023. Roll-over class P0. White type I materials, 1.5 mm. Alphabetical order by manufacturer.

Type I, 1.5 mm <i>Manufacturer</i> <i>Material</i>	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Qd</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>Appr.</i>
Cleanosol Hotmark Spray 1	169	-	166	0.70	OK	A
Geveko Markings EXP 2023 TP2	182	-	197	0.72	OK	A
Hot Mix HOTWHITE JH2301KHEH [spr]	274	-	156	0.52	OK	A
Hot Mix HOTWHITE JH2303KHEH [spr]	199	-	172	0.68	OK	A
Promax ESSNI23WI1	208	-	162	0.59	OK	A
Promax SSNI23WI1	164	-	167	0.63	OK	A
Svevia S23150-1	191	-	157	0.60	OK	A
Svevia S23150-2	203	-	157	0.58	OK	A

Table 79. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023. Roll-over class P0. White type I materials, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm						
Manufacturer <i>Material</i>	$R_{L,dry}$	$R_{L,wet}$	Q_d	μ_{PFT}	Colour	Appr.
Hot Mix HOTWHITE JH2301KHEH [extr]	283	-	162	0.52	OK	A
Hot Mix HOTWHITE JH2303KHEH [extr]	188	-	180	0.66	OK	A
Kelly Bros KB White Extrusion/Screed B	222	-	141	0.62	OK	A
Promax ESNI23W11	224	-	162	0.59	OK	A
Saferoad Grawil White20231	171	-	163	0.60	OK	A
Saferoad Grawil White20232	190	-	146	0.59	OK	A
Svevia E23150	194	-	156	0.60	OK	A
Svevia X23150	182	-	163	0.64	OK	A

Table 80. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023. Roll-over class P0. Yellow type I materials, 1.5 mm. Alphabetical order by manufacturer.

Type I, 1.5 mm							
Manufacturer <i>Material</i>	$R_{L,dry}$	$R_{L,wet}$	Q_d	μ_{PFT}	Colour	NTY	Appr.
Hot Mix HOTYELLOW JH2301EHKH	122	-	117	0.56	OK	OK	A
Svevia S23100-Y1	105	-	119	0.61	OK	OK	A
Svevia S23100-Y2	123	-	115	0.57	OK	OK	A

Table 81. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023. Roll-over class P0. Yellow type I materials, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm Manufacturer Material	$R_{L,dry}$	$R_{L,wet}$	Qd	μ_{PFT}	Colour	NTY	Appr.
Hot Mix HOTYELLOW JH2303EHKH	126	-	119	0.56	OK	OK	A
Kelly Bros KB Yellow Extrusion/Screed C	146	-	107	0.67	OK	outside	NA
Saferoad Grawil Yellow20231	106	-	129	0.66	OK	OK	A
Saferoad Grawil Yellow20232	124	-	122	0.57	OK	OK	A
Svevia E23100-Y1	107	-	124	0.63	OK	OK	A
Svevia E23100-Y2	126	-	117	0.56	OK	OK	A

Roll-over class P2

Table 82. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023. Roll-over class P2. White type I materials, 0.4 mm. Alphabetical order by manufacturer.

Type I, 0.4 mm Manufacturer <i>Material</i>	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Qd</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>Appr.</i>
Geveko Markings EXP 2023 AQ1	worn	-	worn	worn	worn	NA
Geveko Markings EXP 2023 AQ2	worn	-	worn	worn	worn	NA
Geveko Markings EXP 2023 AQ3	worn	-	worn	worn	worn	NA
Geveko Markings EXP 2023 AQ5	worn	-	worn	worn	worn	NA
Geveko Markings EXP 2023 AQ6	worn	-	worn	worn	worn	NA

Table 83. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023. Roll-over class P2. White type I materials, 1.5 mm. Alphabetical order by manufacturer.

Type I, 1.5 mm Manufacturer <i>Material</i>	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Qd</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>Appr.</i>
Cleanosol Hotmark Spray 1	119	-	165	0.74	OK	NA
Geveko Markings EXP 2023 TP2	137	-	186	0.73	OK	NA
Hot Mix HOTWHITE JH2301KHEH [spr]	248	-	155	0.62	OK	A
Hot Mix HOTWHITE JH2303KHEH [spr]	171	-	172	0.70	OK	A
Promax ESSNI23WI1	165	-	144	0.54	OK	A
Promax SSNI23WI1	115	-	164	0.69	OK	NA
Svevia S23150-1	192	-	164	0.61	OK	A
Svevia S23150-2	200	-	167	0.62	OK	A

Table 84. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023. Roll-over class P2. White type I materials, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm						
Manufacturer <i>Material</i>	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Qd</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>Appr.</i>
Hot Mix HOTWHITE JH2301KHEH [extr]	268	-	157	0.55	OK	A
Hot Mix HOTWHITE JH2303KHEH [extr]	167	-	176	0.69	OK	A
Kelly Bros KB White Extrusion/Screed B	211	-	148	0.63	OK	A
Promax ESNI23W11	191	-	150	0.52	OK	A
Saferoad Grawil White20231	139	-	166	0.66	OK	NA
Saferoad Grawil White20232	187	-	151	0.53	OK	A
Svevia E23150	186	-	162	0.60	OK	A
Svevia X23150	160	-	154	0.65	OK	A

Table 85. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023. Roll-over class P2. Yellow type I materials, 1.5 mm. Alphabetical order by manufacturer.

Type I, 1.5 mm							
Manufacturer <i>Material</i>	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Qd</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>NTY</i>	<i>Appr.</i>
Hot Mix HOTYELLOW JH2301EHKH	106	-	114	0.66	OK	OK	A
Svevia S23100-Y1	100	-	119	0.63	OK	OK	A
Svevia S23100-Y2	111	-	122	0.60	OK	OK	A

Table 86. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023. Roll-over class P2. Yellow type I materials, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm							
Manufacturer <i>Material</i>	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Qd</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>NTY</i>	<i>Appr.</i>
Hot Mix HOTYELLOW JH2303EHKH	104	-	122	0.66	OK	OK	A
Kelly Bros KB Yellow Extrusion/Screed C	111	-	109	0.67	outside	outside	NA
Saferoad Grawil Yellow20231	76	-	133	0.66	OK	OK	NA
Saferoad Grawil Yellow20232	101	-	125	0.58	OK	OK	A
Svevia E23100-Y1	83	-	127	0.67	OK	OK	NA
Svevia E23100-Y2	111	-	117	0.60	OK	OK	A

Roll-over class P3

Table 87. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023. Roll-over class P3. White type I materials, 0.4 mm. Alphabetical order by manufacturer.

Type I, 0.4 mm <i>Manufacturer</i> <i>Material</i>	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Qd</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>Appr.</i>
Geveko Markings EXP 2023 AQ1	worn	-	worn	worn	worn	NA
Geveko Markings EXP 2023 AQ2	worn	-	worn	worn	worn	NA
Geveko Markings EXP 2023 AQ3	worn	-	worn	worn	worn	NA
Geveko Markings EXP 2023 AQ5	worn	-	worn	worn	worn	NA
Geveko Markings EXP 2023 AQ6	worn	-	worn	worn	worn	NA

Table 88. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023. Roll-over class P3. White type I materials, 1.5 mm. Alphabetical order by manufacturer.

Type I, 1.5 mm <i>Manufacturer</i> <i>Material</i>	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Qd</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>Appr.</i>
Cleanosol Hotmark Spray 1	118	-	185	0.76	OK	NA
Geveko Markings EXP 2023 TP2	140	-	187	0.73	OK	NA
Hot Mix HOTWHITE JH2301KHEH [spr]	54	-	102	0.88	OK	NA
Hot Mix HOTWHITE JH2303KHEH [spr]	146	-	177	0.74	OK	NA
Promax ESSNI23WI1	151	-	154	0.59	OK	A
Promax SSNI23WI1	114	-	164	0.73	OK	NA
Svevia S23150-1	179	-	166	0.65	OK	A
Svevia S23150-2	194	-	168	0.61	OK	A

Table 89. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023. Roll-over class P3. White type I materials, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm						
Manufacturer	$R_{L,dry}$	$R_{L,wet}$	Q_d	μ_{PFT}	Colour	Appr.
Material						
Hot Mix HOTWHITE JH2301KHEH [extr]	245	-	173	0.56	OK	A
Hot Mix HOTWHITE JH2303KHEH [extr]	152	-	183	0.73	OK	A
Kelly Bros KB White Extrusion/Screed B	166	-	150	0.69	OK	A
Promax ESNI23W11	168	-	163	0.56	OK	A
Saferoad Grawil White20231	126	-	167	0.67	OK	NA
Saferoad Grawil White20232	160	-	150	0.58	OK	A
Svevia E23150	176	-	171	0.62	OK	A
Svevia X23150	170	-	158	0.64	OK	A

Table 90. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023. Roll-over class P3. Yellow type I materials, 1.5 mm. Alphabetical order by manufacturer.

Type I, 1.5 mm							
Manufacturer	$R_{L,dry}$	$R_{L,wet}$	Q_d	μ_{PFT}	Colour	NTY	Appr.
Material							
Hot Mix HOTYELLOW JH2301EHKH	52	-	105	0.79	OK	outside	NA
Svevia S23100-Y1	87	-	135	0.67	OK	OK	NA
Svevia S23100-Y2	101	-	128	0.63	OK	OK	A

Table 91. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023. Roll-over class P3. Yellow type I materials, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm Manufacturer Material	$R_{L,dry}$	$R_{L,wet}$	Qd	μ_{PFT}	Colour	NTY	Appr.
Hot Mix HOTYELLOW JH2303EHKH	88	-	119	0.70	OK	OK	NA
Kelly Bros KB Yellow Extrusion/Screed C	89	-	111	0.74	OK	outside	NA
Saferoad Grawil Yellow20231	66	-	123	0.70	OK	OK	NA
Saferoad Grawil Yellow20232	87	-	118	0.64	OK	OK	NA
Svevia E23100-Y1	91	-	128	0.66	OK	OK	NA
Svevia E23100-Y2	110	-	116	0.62	OK	OK	A

Roll-over class P4

Table 92. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023. Roll-over class P4. White type I materials, 0.4 mm. Alphabetical order by manufacturer.

Type I, 0.4 mm						
Manufacturer	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Qd</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>Appr.</i>
<i>Material</i>						
Geveko Markings EXP 2023 AQ1	worn	-	worn	worn	worn	NA
Geveko Markings EXP 2023 AQ2	worn	-	worn	worn	worn	NA
Geveko Markings EXP 2023 AQ3	worn	-	worn	worn	worn	NA
Geveko Markings EXP 2023 AQ5	worn	-	worn	worn	worn	NA
Geveko Markings EXP 2023 AQ6	worn	-	worn	worn	worn	NA

Table 93. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023. Roll-over class P4. White type I materials, 1.5 mm. Alphabetical order by manufacturer.

Type I, 1.5 mm						
Manufacturer	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	<i>Qd</i>	<i>μ_{PFT}</i>	<i>Colour</i>	<i>Appr.</i>
<i>Material</i>						
Cleanosol Hotmark Spray 1	36	-	120	0.83	OK	NA
Geveko Markings EXP 2023 TP2	119	-	175	0.71	OK	NA
Hot Mix HOTWHITE JH2301KHEH [spr]	worn	-	worn	worn	worn	NA
Hot Mix HOTWHITE JH2303KHEH [spr]	99	-	147	0.77	OK	NA
Promax ESSNI23WI1	131	-	156	0.59	OK	NA
Promax SSNI23WI1	95	-	166	0.72	OK	NA
Svevia S23150-1	113	-	149	0.72	OK	NA
Svevia S23150-2	110	-	147	0.75	OK	NA

Table 94. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023. Roll-over class P4. White type I materials, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm							
Manufacturer	$R_{L,dry}$	$R_{L,wet}$	Q_d	μ_{PFT}	Colour		Appr.
Material							
Hot Mix HOTWHITE JH2301KHEH [extr]	worn	-	worn	worn	worn		NA
Hot Mix HOTWHITE JH2303KHEH [extr]	120	-	160	0.73	OK		NA
Kelly Bros KB White Extrusion/Screed B	188	-	141	0.63	OK		A
Promax ESNI23W11	150	-	153	0.59	OK		A
Saferoad Grawil White20231	105	-	168	0.67	OK		NA
Saferoad Grawil White20232	147	-	145	0.59	OK		NA
Svevia E23150	128	-	158	0.66	OK		NA
Svevia X23150	130	-	159	0.69	OK		NA

Table 95. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023. Roll-over class P4. Yellow type I materials, 1.5 mm. Alphabetical order by manufacturer.

Type I, 1.5 mm							
Manufacturer	$R_{L,dry}$	$R_{L,wet}$	Q_d	μ_{PFT}	Colour	NTY	Appr.
Material							
Hot Mix HOTYELLOW JH2301EHKH	worn	-	worn	worn	worn	worn	NA
Svevia S23100-Y1	77	-	125	0.70	OK	OK	NA
Svevia S23100-Y2	75	-	113	0.69	OK	OK	NA

Table 96. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2023. Roll-over class P4. Yellow type I materials, 3 mm. Alphabetical order by manufacturer.

Type I, 3 mm Manufacturer Material	<i>R_{L,dry}</i>	<i>R_{L,wet}</i>	Qd	<i>μ_{PFT}</i>	Colour	NTY	Appr.
Hot Mix HOTYELLOW JH2303EHKH	worn	-	worn	worn	worn	worn	NA
Kelly Bros KB Yellow Extrusion/Screed C	worn	-	worn	worn	worn	worn	NA
Saferoad Grawil Yellow20231	63	-	126	0.68	OK	OK	NA
Saferoad Grawil Yellow20232	89	-	121	0.59	OK	OK	NA
Svevia E23100-Y1	80	-	127	0.70	OK	OK	NA
Svevia E23100-Y2	92	-	131	0.66	OK	OK	NA

Materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2024

Roll-over class T0

Table 97. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2024. Roll-over class T0. Yellow materials intended for temporary markings, 3 mm. Alphabetical order by manufacturer.

Temporary, 3 mm Manufacturer <i>Material</i>	$R_{L,dry}$	$R_{L,wet}$	Q_d	μ_{PFT}	Colour	NTY	Appr.
3M 3M Stamark A711IR	426	(217) ²⁰	116	0.66	OK	OK	A

Roll-over class T1

Table 98. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2024. Roll-over class T1. Yellow materials intended for temporary markings, 3 mm. Alphabetical order by manufacturer.

Temporary, 3 mm Manufacturer <i>Material</i>	$R_{L,dry}$	$R_{L,wet}$	Q_d	μ_{PFT}	Colour	NTY	Appr.
3M 3M Stamark A711IR	392	(173) ²⁰	113	0.68	outside	OK	NA

Roll-over class T2

Table 99. Results of the performance measurements in 2024 of materials applied at the Finnish-Icelandic-Norwegian-Swedish test site in 2024. Roll-over class T2. Yellow materials intended for temporary markings, 3 mm. Alphabetical order by manufacturer.

Temporary, 3 mm Manufacturer <i>Material</i>	$R_{L,dry}$	$R_{L,wet}$	Q_d	μ_{PFT}	Colour	NTY	Appr.
3M 3M Stamark A711IR	317	(92) ²⁰	110	0.69	OK	OK	NA

²⁰ No requirement

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