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Nordic certification of road marking materials in Iceland, Norway and Sweden 2017–2019

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Abstract

A Nordic certification system for road marking materials, that applies to the countries of Denmark, Iceland, Norway and Sweden, was introduced in 2015. In these countries, a documented product approval is required in order to use a road marking material on roads managed by the national road authorities (Iceland from 2020). 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 function.

The certification system includes road marking materials for longitudinal and transverse road markings in categories with respect to colour (white, 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 Norwegian-Swedish test site in 2019, i.e. one-year follow-up measurements for materials applied in 2018 and two-years follow-up measurements for materials applied in 2017. 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).

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Referat

En nordisk certifiering av vägmarkeringsmaterial 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 (Island från och med 2020). 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, 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 det norsk-svensk provfältet 2019, det vill säga ettårsuppföljning av material som lades ut 2018 och tvåårsuppföljning av material som lades ut 2017. Funktionsmätningarna omfattar retroreflexion (R_L) i torrt och vått tillstånd, luminanskoefficient (Qd), friktion, färg i dagsljus och färg i fordonsbelysning (för gula material).

Titel:	Nordisk certifiering av vägmarkeringsmaterial i Island, Norge och Sverige 2017–2019
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Preface

A Nordic certification system for road marking materials was introduced in 2015. 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 2019 on road marking materials applied for certification at the Norwegian-Swedish test site in 2017–2018.

Performance measurements of retroreflection, luminance coefficient, 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 AB 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, October 2019

Trond Cato Johansen
Project Manager

Quality review

Internal peer review was performed 3 November 2019 by Anna Anund. Carina Fors has made alterations to the final manuscript of the report. Anna Anund examined and approved the report for publication on 4 November 2019. The conclusions and recommendations expressed are the authors' and do not necessarily reflect VTI's opinion as an authority.

Kvalitetsgranskning

Intern peer review har genomförts 3 november 2019 av Anna Anund. Carina Fors har genomfört justeringar av slutligt rapportmanus. Anna Anund har därefter granskat och godkänt publikationen för publicering 4 november 2019. De slutsatser och rekommendationer som uttrycks är författarnas egna och speglar inte nödvändigtvis myndigheten VTI:s uppfattning.

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Summary

Nordic certification of road marking materials in Iceland, Norway and Sweden 2017–2019

by Trond Cato Johansen (Ramboll) and Carina Fors (VTI)

A Nordic certification system for road marking materials, that applies to the countries of Denmark, Iceland, Norway and Sweden, was introduced in 2015. In these countries, a documented product approval is required in order to use a road marking material on roads managed by the national road authorities (Iceland from 2020). 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. The certification system includes road marking materials for longitudinal and transverse road markings in categories with respect to colour (white, 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).

A Norwegian-Swedish test site was established in 2015, where 43 to 81 materials have been applied yearly. Approximately two weeks after application, the initial performance of 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) are determined.

Follow-up measurements of the performance parameters mentioned above are carried out one and two years after application. The present report documents the follow-up measurements that were carried out in 2019, i.e. one-year follow-up measurements for materials applied in 2018 and two years follow-up measurements for materials applied in 2017.

Materials are certified in relation to the number of wheel passages they will stand, with preserved functionality. Depending on the traffic flow, the position in the lane and the exposure time, different roll-over classes (P0–P6, corresponding to ≤50 000–2 000 000 wheel passages, defined by EN 1824) will be reached. For materials applied in 2018, roll-over classes P0, P1, P2 and P4 were reached in 2019 and for materials applied in 2017, roll-over class P5 was reached in 2019.

Out of the 42 materials applied in 2018, 32 (31 white, 1 yellow) were approved at the initial measurements and did thus qualify for follow-up measurements. Out of the 31 white materials, 6 fulfilled the requirement for roll-over class P4, 7 fulfilled the requirement for roll-over class P2, 9 fulfilled the requirement for roll-over class P1 and 16 fulfilled the requirement for roll-over class P0. 15 white materials did not fulfil the requirement for any roll-over class. The yellow material fulfilled the requirements for roll-over classes P0–P4.

Nine materials applied in 2017 fulfilled the requirement for class P4 in 2018. The follow-up measurements carried out in 2019 showed that six of these materials fulfilled the requirement for class P5. Thus, the final result for the 66 materials applied in 2017 is as follows:

- No P-class: 24 white, 12 yellow
- P0: 24 white, 6 yellow
- P2: 20 white, 3 yellow
- P3: 10 white, 1 yellow
- P4: 9 white, 0 yellow
- P5: 6 white, 0 yellow.

Sammanfattning

Nordisk certifiering av vägmarkeringsmaterial i Island, Norge och Sverige 2017–2019

av Trond Cato Johansen (Ramboll) och Carina Fors (VTI)

En nordisk certifiering av vägmarkeringsmaterial introducerades 2015 och avser 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 (Island fr o m 2020). Detta godkännande baseras på funktionsmätningar på vägmarkeringar som har applicerats på provfält på allmän väg. Certifiering i Island, Norge och Sverige baseras på resultat från provfält i Norge eller i Sverige, medan certifiering i Danmark baseras på resultat från provfält i Danmark. Certifieringssystemet omfattar vägmarkeringsmaterial för längsgående och tvärgående vägmarkeringar i olika kategorier med avseende på färg (vit, 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).

Ett svensk-norskt provfält etablerades 2015, där mellan 43 och 81 material har lagts ut för provning varje år. Cirka två veckor efter utläggningen görs initiala mätningar av vägmarkeringarnas retroreflexion, R_L i torrt och vått tillstånd, luminanskoefficient, *Qd*, friktion, färg i dagsljus och färg i fordonsbelysning (för gula material).

Uppföljande mätningar av ovan nämnda funktionsparametrar görs ett respektive två år efter utläggning. Föreliggande rapport dokumenterar resultaten från de uppföljande mätningar som gjordes 2019, det vill säga ettårsuppföljning av material som lades ut 2018 och tvåårsuppföljning av material som lades ut 2017.

Materialen certifieras i relation till antalet hjulpassager de tål, med bibehållen funktion. Beroende på trafikflöde, position i körfältet och exponeringstid, uppnås olika hjulpassageklasser (P0–P6, motsvarande ≤50 000–2 000 000 hjulpassager) som definieras av europastandarden EN 1824. På provfältet som lades ut 2018 uppnåddes klasserna P0, P1, P2 och P4 under 2019 och på provfältet som lades ut 2017 uppnåddes klassen P5 under 2019.

Av de 42 material som lades ut för certifiering 2018 godkändes 32 (31 vita, 1 gult) vid de initiala mätningarna och de kvalificerade sig därmed för uppföljande mätningar. Av de 31 vita materialen uppfyllde 6 kraven för hjulpassageklass P4, 7 för klass P2, 9 för klass P1 och 16 för klass P0. 15 vita material uppfyllde inte kraven i någon hjulpassageklass. Det gula materialet uppfyllde kraven i klasserna P0–P4.

Nio material som lades ut 2017 uppfyllde kraven för klass P4 under 2018. De uppföljande mätningarna som gjordes 2019 visade att sex av dessa material uppfyllde kraven för klass P5. De slutgiltiga resultaten för de 66 material som lades ut 2017 är således:

- Ingen P-klass: 24 vita, 12 gula
- P0: 24 vita, 6 gula
- P2: 20 vita, 3 gula
- P3: 10 vita, 1 gula
- P4: 9 vita, 0 gula
- P5: 6 vita, 0 gula.

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 in order to use a road marking material on roads managed by the national road authorities (Iceland from 2020). 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. The results from the Danish test site are presented in a separate report (Johansen and Fors, 2019).

The first round of material tests started in May 2015, when 81 materials were applied at the Norwegian-Swedish test site, which at that time was located to Sunne, Sweden. In 2016, another 72 materials were applied for certification at the test site in Sunne – 48 white and 24 yellow. In 2017, a new test site for certification in Norway and Sweden was established in Haslemoen in Norway, where 69 materials were applied. 66 materials – 48 white and 18 yellow – were applied for certification and 3 for manufacturer's internal test. In 2018 and 2019, another 43 and 52 materials respectively, were applied at the test site in Haslemoen.

Since Iceland joined NordicCert in 2019, the Norwegian-Swedish test site is from now on denoted the *Icelandic-Norwegian-Swedish test site*.

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 year and two years after application. Thus, in 2019, two-years follow-up measurements for materials applied in 2017 and one-year follow-up measurements for materials applied in 2018 were carried out.

Materials are certified in relation to the number of wheel passages they will stand. Measurements of the transversal distribution of wheel passages have been carried out at the test sites, and roll-over classes (P-classes, defined by EN 1824) have been determined for each of the nine lines of road marking materials that were applied in the lane (see also Sections 2.2). For materials applied at the Icelandic-Norwegian-Swedish test site in 2017, the P-classes P0, P2, P3 and P4 were reached in 2018 and P-class P5 was reached in 2019. For materials applied at the Norwegian-Swedish test site in 2018, the P-classes P0, P1, P2 and P4 (inlaid: P0, P1 and P4) were reached in 2019.

The certification system is further described in the document *Nordic certification system for road marking materials – Version 6:2019* (Fors and Johansen, 2019) which is a public report available at www.vti.se/en/publications and at www.nordiccert.com. The document (and its previous versions) is referred to as *NCSRM-X:201x* in the present report.

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

1.1. Aim

The aim of this report is to compile and present the results of the follow-up performance measurements carried out in 2019 on the materials applied at the Icelandic-Norwegian-Swedish test sites in 2017 and in 2018, i.e. the report presents which materials have been certified for use in Iceland, Norway and Sweden, for the P-classes mentioned above. Results for higher P-classes for materials applied in 2018 will be published after the two-years follow-up measurements in 2020.

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.

2. Test site

The present Icelandic-Norwegian-Swedish test site was established in Haslemoen, Norway in 2017. Materials have been applied in 2017, 2018 and 2019.

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 1. The road is straight and relatively flat and without any major junctions. The annual average daily traffic (AADT) is 3 300 vehicles/day (measured in 2018, retrieved from Trafikkdata[1]) 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.

Figure 1. The road used for the Icelandic-Norwegian-Swedish test site. (Photo: Trond Cato Johansen, Ramböll).

The road surface consists of a stone matrix asphalt (SKA) that was installed in 2016. The roughness class is RG2 i.e. the averaged measured texture depth is in the range of 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 *NCSRM-6:2019.*

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

2.2. Material application

Each marking material was applied as a row of ten longitudinal lines in the direction of the traffic. The length of the lines was 2.5 m and the width was 0.15 m. The distance between two adjacent rows of lines was 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. Line 4–8 are applied as non-inlaid lines and they are not included in the evaluation of the material.

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 4.2. The P-classes for 2019 are based on wheel passage measurements carried out in September 2018 and in August-September 2019. The number and type of vehicles and their lateral position were registered by a portable traffic analyser based on coaxial cable technique, developed at VTI. The measurement equipment was placed in empty positions (i.e. were no material was applied), both at the test field of 2017 and the test field of 2018. As the latter is divided into two sections – one with non-inlaid materials and one with inlaid materials – which are separated by approximately 300 m, measurements of wheel passages where carried out at both sections. Wheel passages were registered for one week.

On average, 84.5% of the registered vehicles were passenger cars, 15.0% were heavy vehicles, and 0.5% were other vehicles (two wheelers, working vehicles). The registered number of vehicles was adjusted so that it corresponded to the annual average daily traffic (AADT) of 1644 vehicles per lane, by using information from Trafikkdata[2].

As the lines are positioned somewhat different at the three sections of the test field (2017, 2018 non-inlaid and 2018 inlaid), three different wheel passage distributions were calculated. Figure 2 shows the distribution of wheel passages for the average week for the test field of 2018, non-inlaid materials.

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

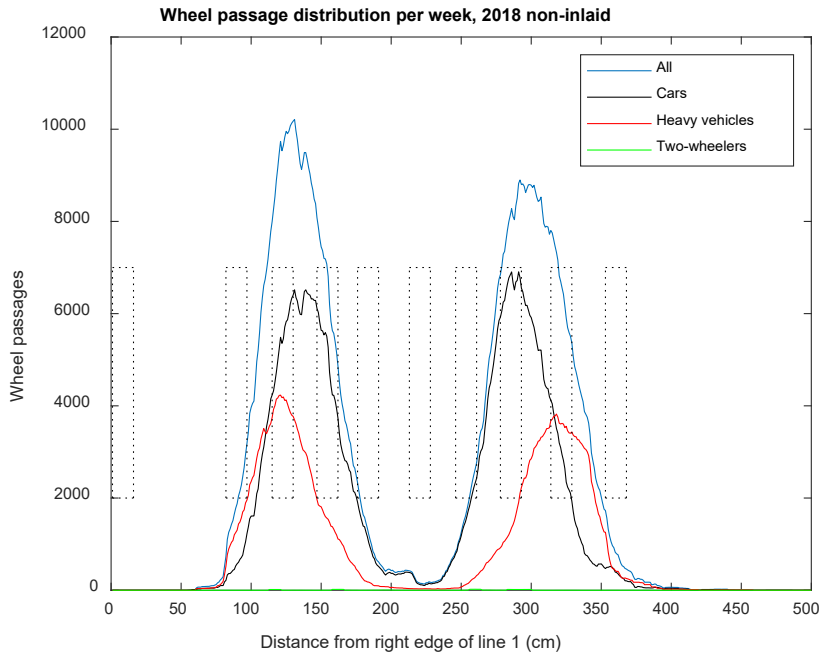

Figure 2. Wheel passages per week at the test field established in Haslemoen in 2018, non-inlaid materials. The dashed areas correspond to the ten lines (line 1 to the left, line 10 to the right). Please note that the shoulder is to the left in the figure. The number of two-wheelers is too few to be visible in the figure.

Table 1 shows the number of wheel passages per line and week for the test field of 2018, for non-inlaid and for inlaid materials, respectively, as averages for the 15 cm wide lines (corresponding to the measurement area, see Figure 3–Figure 5.

Table 1. Number of wheel passages per line and week, at the test field established in Haslemoen in 2018. Line 2 is the one next to the edge line, see also Figure 3.

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, not inlaid	1775	9641	6894	1336	166	1621	8063	6734	854
Number of wheel passages per week, inlaid	673	7732	-	-	-	-	-	7081	894

On the test field of 2017, line 4 was selected for P-class P5 and it had 7379 wheel passages per week (see also Section 4.2.1).

2.4. Weather conditions 2018–2019

The weather conditions from August 2018 to August 2019 are shown in Table 2.

Table 2. Weather conditions at the Icelandic-Norwegian-Swedish test site in Haslemoen, from August 2018 to August 2019.

Weather parameter	**Value**
Annual average temperature	5.6 °C
Average summer temperature (Apr-Sep)	12.4 °C
Average winter temperature (Oct-Mar)	-1.3 °C
Highest temperature	32.0 °C
Lowest temperature	-24.3 °C
Annual precipitation	673 mm
Number of sun hours per month	*
Number of weeks with snow	19
Number of times the snow plough has operated	205
Number of times the road has been salted	117

*) No information available

Weather data was retrieved from Yr[3], which is a joint weather service from *the Norwegian Meteorological Institute* and *the Norwegian Broadcasting Corporation*, and from eKlima[4], which is a weather and climate database provided by *the Norwegian Meteorological Institute.* Data on temperature, precipitation and snow are from a weather station located approximately 10 km from the test site.

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

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

[4] http://eklima.met.no/

3. Performance measurements

3.1. General

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

Performance measurements were carried out in August-September 2019.

3.2. Methods and measuring instruments

3.2.1. 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 *LTL-XL* (Delta, Denmark). Measurements were taken at three points along the centre line, Figure 3. 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.

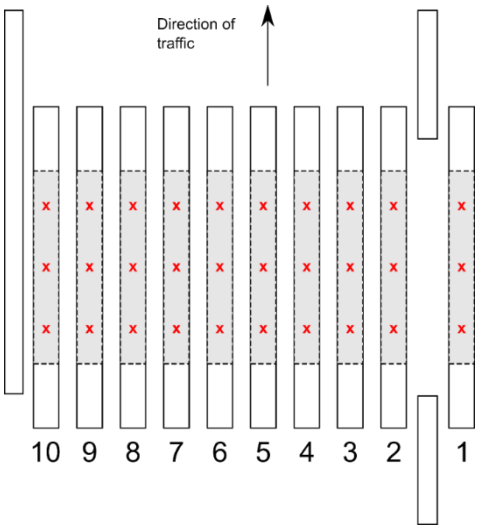

Figure 3. The measurement points (red crosses) for R_L and Qd were placed along the centre line within the measurement area (grey) defined by EN 1824.

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.

3.2.2. Chromaticity coordinates

Chromaticity (colour) coordinates were measured in one point on each line, located at the centre of the line, Figure 4. A *Spectrophotometer CM-2500c* and a *Spectrophotometer CM-25cG* (Konica Minolta, Japan) were used to measure the colour coordinates. The chromaticity coordinates of yellow materials in retroreflected light (night-time colour) were measured by an *LTL 2000Y* (Delta, Denmark).

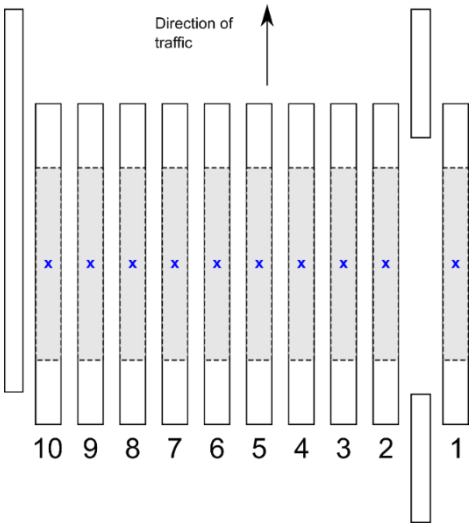

Figure 4. The measurement points (blue crosses) for chromaticity coordinates were placed in the centre of the lines.

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.

3.2.3. Friction

Friction measurements were carried out using a *Portable Friction Tester version 4,* PFT (Coralba, Sweden), along the centre of each line, Figure 5. The PFT takes a sample approximately every 1.9 cm and thus, about 70 samples are taken on each line. The result of an individual line is calculated as the average of all samples from that line.

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

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

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

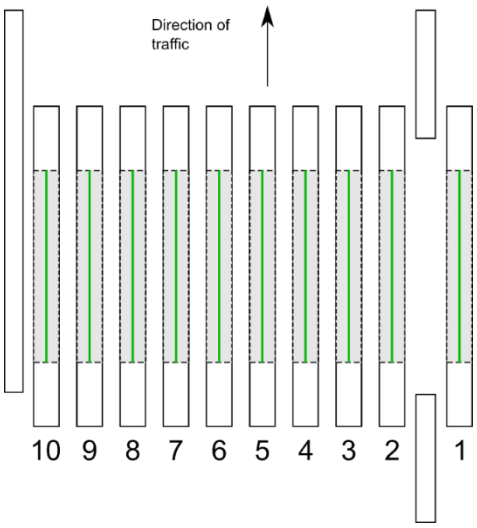

Figure 5. The measurement areas (green lines) for friction.

3.2.4. Measurement values that do not fulfil the performance requirements

In case a measured value was just below the performance requirement (see Section 4.1), 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.

3.3. Weather conditions

During the measurements in August, it was cloudy and the air temperature was approximately 16–20˚ C. During the measurements in September, it was cloudy or partly cloudy. The air temperature was approximately 12˚ C (morning) – 18˚ C (day/evening), and the road surface temperature was approximately 12–19 ˚ C. All performance measurements of $R_{L,dry}$, Qd and chromaticity coordinates were carried out on absolutely dry markings.

4. Performance requirements

4.1. Performance parameters

The performance requirements include four parameters for type I markings[5] and five parameters for type II markings[6] and three parameters for antiskid materials, which are given in Table 3. The requirements for type I and type II markings apply also to inlaid markings.

Table 3. Performance requirements.

Performance parameter	White markings	Yellow markings	Applies to marking type	Antiskid materials
Coefficient of retroreflected luminance, R_L dry [mcd/m^2/lx]	≥ 150	≥ 100	I, II	-
Coefficient of retroreflected luminance, R_L wet [mcd/m^2/lx]	≥ 35	≥ 35	II	-
Luminance coefficient under diffuse illumination, *Qd* [mcd/m^2/lx]	≥ 130	≥ 100	I, II	≥ 130
Friction, [PFT units]	≥ 0.52	≥ 0.52	I, II	≥ 0.71
Chromaticity coordinates, x, y	*	**	I, II	*

*) According to EN 1436:2018

**) Includes both daytime (class Y1) and night-time colour (class RC1), according to EN 1436:2018

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 4.1.1.

4.1.1. 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, and from 0.71 to 0.66 for antiskid materials.

4.2. 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 4.

[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.

Materials are thus certified for a certain roll-over class (P-class). In order to be certified, all four (type I markings), five (type II markings) or three (antiskid materials) performance requirements must be fulfilled for that particular class.

Certification is given based on the follow-up measurements one and two years after application. No certification is given based on the initial measurements that are carried out a few weeks after application.

At the follow-up measurements, the performance parameters are defined as the registered value of the line which is the most representative of a certain P-class (see Section 4.2.1).

The materials have to fulfil the requirements for all classes lower than that it is certified for, provided that the lower classes exist on the test field. Example: In order for a material to be certified as a P3 material, the performance requirements have to 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. at 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 4. 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%
P3	200 000 ± 20%
P4	500 000 ± 20%
P5	1 000 000 ± 20%
P5.5	1 500 000 ± 20%
P6	2 000 000 ± 20%

4.2.1. P-classes at the Icelandic-Norwegian-Swedish test site 2019

For materials applied at the test site in Haslemoen in 2017, P-classes P0, P2, P3 and P4 were reached in 2018, and P-class P5 was reached in 2019. For materials applied in 2018, P-classes P0, P1, P2 and P4 (inlaid markings: P0, P1 and P4) were reached in 2019 and P5 is expected to be reached in 2020. All P-classes were represented by one line, Table 5–Table 6.

Table 5. P-classes at the test site in Haslemoen, materials applied in 2017.

Roll-over class	**Lines**	**Measured**
P0	Line 6	August 2018
P1	-	-
P2	Line 10	August 2018
P3	Line 8	August 2018
P4	Line 4	August 2018
P5	Line 4	September 2019

Table 6. P-classes at the test site in Haslemoen, materials applied in 2018.

Roll-over class	**Lines, not inlaid**	**Lines, inlaid**	**Measured**
P0	Line 6	Line 2	August-September 2019
P1	Line 10	Line 10	August-September 2019
P2	Line 7	-	August-September 2019
P3	-	-	-
P4	Line 3	Line 3	August-September 2019
P5	-	-	Summer 2020 (expected)

5. Certification of materials applied in 2017

Table 7–Table 15 show the certification of road marking materials in P-classes P0, P2, P3, P4 and P5 for materials applied at the test site in Haslemoen 2017. **A** means approved and **NA** not approved material. 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* with two years follow-up are included in the tables below.

Measurement data per material and P-class can be found in Appendix 1.

5.1. White road markings

5.1.1. Type I

5.1.1.1. Material thickness 0.4 mm

Table 7. Certification of road marking materials for use on Icelandic, Norwegian and Swedish roads, roll-over classes P0–P5. White type I materials, 0.4 mm, applied in 2017.

Manufacturer *Material*	**P0**	**P2**	**P3**	**P4**	**P5**
Kelly Bros White Waterborne Paint	**NA**				

5.1.1.2. Material thickness 1.5 mm

Table 8. Certification of road marking materials for use on Icelandic, Norwegian and Swedish roads, roll-over classes P0–P5. White type I materials, 1.5 mm, applied in 2017.

Manufacturer *Material*	**P0**	**P2**	**P3**	**P4**	**P5**
Ennis Flint Spray W2017.7	**A**	**NA**			
Geveko Markings ViaTherm EXP1771S W	**A**	**A**	**A**	**A**	**A**
Svevia X1732	**A**	**A**	**NA**		

5.1.1.3. Material thickness 3 mm

Table 9. Certification of road marking materials for use on Icelandic, Norwegian and Swedish roads, roll-over classes P0–P5. White type I materials, 3 mm, applied in 2017.

Manufacturer *Material*	**P0**	**P2**	**P3**	**P4**	**P5**
Ennis Flint Screed/extr. W2017.1	NA				
Ennis Flint Screed/extr. W2017.2	NA				
Ennis Flint Screed/extr. W2017.3	NA				
Geveko Markings ViaTherm EXP1771EP W	A	A	A	A	A
Kelly Bros Cold White MMA	A	NA			
Kelly Bros White Extr./Scr. Briteline Plus	A	A	A	A	NA
Kestrel Thermoplastics Eurolux SC White 0010	A	A	A	A	A
Kestrel Thermoplastics Eurolux SC White 0011	A	A	A	A	NA
Promax Promax prime white 2017 TYP II	A	A	A	A	A
SAR TH 603	A	A	NA		
SAR TH 613	A	A	NA		
Stroypolimer LLC Markaplast T1W11b	NA				
Svevia X1710	A	A	A	A	NA
Swarco Vestglas Swarcotherm ERP 17	A	A	NA		
Veluvine Thermolit Funen 17	A	A	NA		
Veluvine Thermolit Lolland 17	A	A	NA		

5.1.2. Type II

5.1.2.1. Material thickness 3 mm

Table 10. Certification of road marking materials for use on Icelandic, Norwegian and Swedish roads, roll-over classes P0–P5. White type II materials, 3 mm, applied in 2017.

Manufacturer *Material*	**P0**	**P2**	**P3**	**P4**	**P5**
Promax Promax prime white 2017 TYP I *Profile/pattern:* Flat	NA				

5.1.2.2. Material thickness 4 mm

Table 11. Certification of road marking materials for use on Icelandic, Norwegian and Swedish roads, roll-over classes P0–P5. White type II materials, 4 mm, applied in 2017.

Manufacturer *Material*	**P0**	**P2**	**P3**	**P4**	**P5**
Geveko Markings ViaTherm EXP1750EP W *Profile/pattern:* Chess/stairs	NA				
Geveko Markings ViaTherm EXP1771EP W *Profile/pattern:* Chess/stairs	A	NA			
Geveko Markings ViaTherm EXP1771EP W *Profile/pattern:* Drops	A	A	NA		
Kelly Bros Cold White MMA Agglomerate *Profile/pattern:* Structure stochastic	NA				
Kestrel Thermoplastics Eurodot SC White 0016 *Profile/pattern:* Borum DotnLine	NA				
Svevia X1711 *Profile/pattern:* Rullad trappflex	A	A	NA		
Svevia X1721 *Profile/pattern:* Rullad trappflex	A	A	NA		
Swarco Limburger Lackf. Limboplast D480 *Profile/pattern:* Structure stochastic	A	NA			
Swarco Limburger Lackf. Limboplast D492 *Profile/pattern:* Structure stochastic	A	A	NA		

5.1.3. Antiskid

5.1.3.1. Material thickness 4 mm

Table 12. Certification of road marking materials for use on Icelandic, Norwegian and Swedish roads, roll-over classes P0–P5. White antiskid materials, 4 mm, applied in 2017.

Manufacturer *Material*	**P0**	**P2**	**P3**	**P4**	**P5**
Geveko Markings ViaTherm EXP1731HF W	**A**	**A**	**A**	**A**	**A**
Svevia X1743	**A**	**A**	**A**	**A**	**A**

5.2. Yellow road markings

5.2.1. Type I

5.2.1.1. Material thickness 1.5 mm

Table 13. Certification of road marking materials for use on Icelandic, Norwegian and Swedish roads, roll-over classes P0–P5. Yellow type I materials, 1.5 mm, applied in 2017.

Manufacturer *Material*	**P0**	**P2**	**P3**	**P4**	**P5**
Ennis Flint Spray Y2017.8	**A**	**NA**			

5.2.1.2. Material thickness 3 mm

Table 14. Certification of road marking materials for use on Icelandic, Norwegian and Swedish roads, roll-over classes P0–P5. Yellow type I materials, 3 mm, applied in 2017.

Manufacturer *Material*	**P0**	**P2**	**P3**	**P4**	**P5**
Ennis Flint Screed/extr. Y2017.4	NA				
Ennis Flint Screed/extr. Y2017.5	NA				
Ennis Flint Screed/extr. Y2017.6	NA				
Geveko Markings ViaTherm EXP1773EP Y	A	NA			
Hot Mix Hotmix 3000 kombi Yellow A	A	A	NA		
Kestrel Thermoplastics Eurolux SC YELLOW 0013	A	A	A	NA	
Svevia Y 1750	A	A	NA		
Swarco Vestglas Swarcotherm ERP 17 Yellow	NA				

5.2.2. Type II

5.2.2.1. Material thickness 4 mm

Table 15. Certification of road marking materials for use on Icelandic, Norwegian and Swedish roads, roll-over classes P0–P5. Yellow type II materials, 4 mm, applied in 2017.

Manufacturer *Material*	**P0**	**P2**	**P3**	**P4**	**P5**
Geveko Markings ViaTherm EXP1773EP Y *Profile/pattern:* Drops	A	NA			
Kestrel Thermoplastics Eurodot SC YELLOW 0015 *Profile/pattern:* Borum DotnLine	NA				

5.3. Summary of the results

Out of the 66 materials applied for certification at the Icelandic-Norwegian-Swedish test site in Haslemoen 2017, 30 have received certification in one or more P-classes. The final results, including materials with one and two years follow-up, per material category and P-class are shown in Table 16–Table 17.

Detailed results for P-classes P0–P4 can be found in the report *Nordic certification of road marking materials in Norway and Sweden 2016–2018* (Johansen and Fors, 2018).

Table 16. Summary of the final results for materials applied at the Icelandic-Norwegian-Swedish test site in 2017. Number of certified white materials per material category and P-class.

	White							
	Type I				Type II		Antiskid	
P-class	**0.4 mm**	**0.6 mm**	**1.5 mm**	**3 mm**	**3 mm**	**4 mm**	**3 mm**	***Total***
No P-class	9	3	-	7	1	4	-	*24*
P0	-	-	4	12	-	6	2	*24*
P2	-	-	3	11	-	4	2	*20*
P3	-	-	2	6	-	-	2	*10*
P4	-	-	1	6	-	-	2	*9*
P5	-	-	1	3	-	-	2	*6*

Table 17. Summary of the final results for materials applied at the Icelandic-Norwegian-Swedish test site in 2017. Number of certified yellow materials per material category and P-class.

	Yellow						
	Type I				Type II		
P-class	**0.4 mm**	**0.6 mm**	**1.5 mm**	**3 mm**	**3 mm**	**4 mm**	***Total***
No P-class	1	1	-	8	1	1	*12*
P0	-	-	1	4	-	1	*6*
P2	-	-	-	3	-	-	*3*
P3	-	-	-	1	-	-	*1*
P4	-	-	-	-	-	-	-
P5	-	-	-	-	-	-	-

6. Certification of materials applied in 2018

Table 18–Table 25 show the certification of road marking materials in P-classes P0, P1, P2 and P4 for materials applied at the test site in Haslemoen in 2018. **A** means approved and **NA** not approved material. 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* with one or two years follow-up are included in the tables below.

Measurement data per material and P-class can be found in Appendix 1.

6.1. White road markings

6.1.1. Type I

6.1.1.1. Material thickness 0.4 mm

Table 18. Certification of road marking materials for use on Icelandic, Norwegian and Swedish roads, roll-over classes P0–P4. White type I materials, 0.4 mm, applied in 2018.

Manufacturer *Material*	**P0**	**P1**	**P2**	**P4**
Visafo VIT VISA 31 [0.4 mm]	**A**	**NA**		
Visafo VIT VISA 33 [0.4 mm]	**NA**			
Visafo VIT VISA 34	**A**	**NA**		
Visafo VIT VISA 35	**NA**			

6.1.1.2. Material thickness 0.6 mm

Table 19. Certification of road marking materials for use on Icelandic, Norwegian and Swedish roads, roll-over classes P0–P4. White type I materials, 0.6 mm, applied in 2018.

Manufacturer *Material*	**P0**	**P1**	**P2**	**P4**
Geveko Markings EXP18 N01	**NA**			

6.1.1.3. Material thickness 3 mm

Table 20. Certification of road marking materials for use on Icelandic, Norwegian and Swedish roads, roll-over classes P0–P4. White type I materials, 3 mm, applied in 2018.

Manufacturer *Material*	**P0**	**P1**	**P2**	**P4**
Ennis Flint Screed Extrusion W2018.1	NA			
Ennis Flint Screed Extrusion W2018.2	NA			
Ennis Flint Screed Extrusion W2018.3	A	A	A	A
Ennis Flint Screed Extrusion W2018.4	A	A	A	A
Hot Mix Hotmix 3000 kombi B	A	A	A	A
Promax Promax prime white typ I 2018	A	A	A	A
Svevia X 1810	A	A	A	A
Swarco Vestglas Swarcotherm ERP 18	NA			
Swarco Vestglas Swarcotherm ERP 19	A	A	NA	
Veluvine Thermolit Funen 2018 A	NA			
Veluvine Thermolit Funen 2018 B	NA			

6.1.2. Type II

6.1.2.1. Material thickness 3 mm

Table 21. Certification of road marking materials for use on Icelandic, Norwegian and Swedish roads, roll-over classes P0–P4. White type II materials, 3 mm, applied in 2018.

Manufacturer *Material*	**P0**	**P1**	**P2**	**P4**
Swarco Limburger Lackf. Limboplast D492 *Profile/pattern:* Flat	NA			
Swarco Limburger Lackf. Limboplast Reibeplastik Struktur *Profile/pattern:* Flat	NA			
Swarco Limburger Lackf. Limbopl. Reibeplastik Struktur D492 *Profile/pattern:* Flat	NA			

6.1.2.2. Material thickness 5 mm

Table 22. Certification of road marking materials for use on Icelandic, Norwegian and Swedish roads, roll-over classes P0–P4. White type II materials, 5 mm, applied in 2018.

Manufacturer *Material*	**P0**	**P1**	**P2**	**P4**
Geveko Markings ViaTherm EXP1850EP W *Profile/pattern:* Chess/Stairs	NA			
Geveko Markings ViaTherm EXP1850EP W *Profile/pattern:* Drops	A	NA		
Geveko Markings ViaTherm EXP1871EP W *Profile/pattern:* Chess/Stairs	NA			
Geveko Markings ViaTherm EXP1871EP W *Profile/pattern:* Drops	A	NA		
Svevia X 1811 *Profile/pattern:* Rolled	A	A	A	NA
Svevia X 1821 *Profile/pattern:* Rolled	A	NA		

6.1.3. Inlaid type II

6.1.3.1. Material thickness 0.6 mm

Table 23. Certification of road marking materials for use on Icelandic, Norwegian and Swedish roads, roll-over classes P0–P4. White inlaid type II materials, 0.6 mm, applied in 2018.

Manufacturer *Material*	**P0**	**P1**	**P4**
Visafo VIT VISA 31 [0.6 mm] *Profile/pattern:* Drop on large beads	NA		

6.1.3.2. Material thickness 5 mm

Table 24. Certification of road marking materials for use on Icelandic, Norwegian and Swedish roads, roll-over classes P0–P4. White inlaid type II materials, 5 mm, applied in 2018.

Manufacturer *Material*	**P0**	**P1**	**P4**
Geveko Markings ViaTherm EXP1850EP W *Profile/pattern:* Drops w. bottom line	A	NA	
Geveko Markings ViaTherm EXP1850EP W *Profile/pattern:* Drops	A	A	NA
Geveko Markings ViaTherm EXP1871EP W *Profile/pattern:* Drops	A	A	A
Kestrel Thermoplastics Eurodot Plus SC White 0018 *Profile/pattern:* Dot'n'line	A	NA	
Kestrel Thermoplastics Eurodot SC White 0019 *Profile/pattern:* Dots	NA		

6.2. Yellow road markings

6.2.1. Type I

6.2.1.1. Material thickness 3 mm

Table 25. Certification of road marking materials for use on Icelandic, Norwegian and Swedish roads, roll-over classes P0–P4. Yellow type I materials, 3 mm, applied in 2018.

Manufacturer *Material*	**P0**	**P1**	**P2**	**P4**
Promax Promax prime yellow typ I 2018	A	A	A	A

6.3. Summary of the results

Out of the 42 materials – 38 white and 4 yellow – applied for certification at the Icelandic-Norwegian-Swedish test site in Haslemoen 2018, 17 have received certification in one or more P-classes after one year. Out of the 38 white materials, 6 fulfilled the requirement for roll-over class P4, 7 fulfilled the requirement for roll-over class P2, 9 fulfilled the requirement for roll-over class P1 and 16 fulfilled the requirement for roll-over class P0. 22 white materials did not fulfil the requirement for any roll-over class (7 did not fulfil the requirement at the initial measurements and 15 did not fulfil the requirement for class P0). Out of the 4 yellow materials, 1 fulfilled the requirements for roll-over classes P0–P4. 3 yellow materials did not fulfil the requirement for any roll-over class (none of them fulfilled the requirement at the initial measurement). The result per material category and P-class is shown in Table 26–Table 27.

The 7 materials that have fulfilled the requirement for roll-over class P4 have the opportunity to receive certification in roll-over class P5, which is expected to be reached in 2020.

Table 26. Summary of the results after one year for materials applied at the Icelandic-Norwegian-Swedish test site in 2018. Number of certified white materials per material category and P-class.

	White							
	Type I			Type II		Inlaid type II		
P-class	**0.4 mm**	**0.6 mm**	**3 mm**	**3 mm**	**5 mm**	**0.6 mm**	**5 mm**	***Total***
No P-class	2	1	10	4	2	2	1	*22*
P0	2	-	6	-	4	-	4	*16*
P1	-	-	6	-	1	-	2	*9*
P2	-	-	5	-	1	-	1	*7*
P4	-	-	5	-	-	-	1	*6*
P5	-	-	*	-	-	-	*	*

*) Result will be published in 2020.

Table 27. Summary of the results after one year for materials applied at the Icelandic-Norwegian-Swedish test site in 2018. Number of certified yellow materials per material category and P-class.

	Yellow	
	Type I	
P-class	**3 mm**	***Total***
No P-class	3	*3*
P0	1	*1*
P1	1	*1*
P2	1	*1*
P4	1	*1*
P5	*	*

*) Result will be published in 2020.

7. Summary of materials certified for use in Iceland, Norway and Sweden

Table 28–Table 32 shows the total number of certified materials per category and P-class. Included in the table are results from the one- and two-years follow-up measurements of materials applied in 2015–2017, and the results from the one-year follow-up measurement of materials applied in 2018.

Table 28. The total number of certified materials for use in Iceland, Norway and Sweden, per category and P-class. White type I materials.

	White				
	Type I				
P-class	**0.4 mm**	**0.6 mm**	**1.5 mm**	**3 mm**	***Total***
No P-class	26	4	8	33	*71*
P0	2	-	16	52	*70*
P1	-	-	15	51	*66*
P2	-	-	13	45	*58*
P3	-	-	7	27	*34*
P4	-	-	3	18	*21*
P5	-	-	1	6	*7*

Table 29. The total number of certified materials for use in Iceland, Norway and Sweden, per category and P-class. White type II materials.

	White					
	Type II			Type II inlaid		
P-class	**0.6 mm**	**3 mm**	**4–5 mm***	**0.6 mm**	**5 mm**	***Total***
No P-class	3	7	9	2	1	*22*
P0	-	-	14	-	4	*18*
P1	-	-	9	-	2	*11*
P2	-	-	9	-	1	*10*
P3	-	-	-	-	1	*1*
P4	-	-	-	-	1	*1*
P5	-	-	-	-	-	-

*) 2016–2017: 4 mm. 2018–: 5 mm.

Table 30. The total number of certified materials for use in Iceland, Norway and Sweden, per category and P-class. White antiskid materials.

	White	
	Antiskid	
P-class	4 mm	*Total*
No P-class	-	-
P0	2	*2*
P1	2	*2*
P2	2	*2*
P3	2	*2*
P4	2	*2*
P5	2	*2*

Table 31. The total number of certified materials for use in Iceland, Norway and Sweden, per category and P-class. Yellow type I materials.

	Yellow				
	Type I				
P-class	0.4 mm	0.6 mm	1.5 mm	3 mm	*Total*
No P-class	3	1	14	33	*51*
P0	-	-	4	15	*19*
P1	-	-	3	14	*17*
P2	-	-	3	10	*13*
P3	-	-	2	3	*5*
P4	-	-	-	1	*1*
P5	-	-	-	-	-

Table 32. The total number of certified materials for use in Iceland, Norway and Sweden, per category and P-class. Yellow type II materials.

	Yellow		
	Type II		
P-class	**3 mm**	**4–5 mm***	***Total***
No P-class	2	2	*4*
P0	-	1	*1*
P1	-	-	-
P2	-	-	-
P3	-	-	-
P4	-	-	-
P5	-	-	-

*) 2016–2017: 4 mm. 2018–: 5 mm.

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

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Appendix 1 – Results of the performance measurements

Table 33–Table 34 show the results for roll-over class P5 for materials applied in 2017. Table 35–Table 42 show the results for roll-over classes P0, P1, P2 and P4 for materials applied in 2018.

For materials applied in 2017 that did not fulfil the requirements for P-class P4 in 2018, only the coefficient of retroreflected luminance, R_L, and the luminance coefficient under diffuse illumination, *Qd*, were measured in 2019 (P-class P5).

Explanation of the denotations in the result tables	
Parameters	
$R_{L,dry}$	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
Comments and annotations	
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).
d	Disqualified due to missing documentation.
-	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 in 2017

Roll-over class P5

Table 33. The performance of materials applied at the Icelandic-Norwegian-Swedish test site in 2017 after two years. Roll-over class P5. White materials, per type and thickness. Alphabetical order by manufacturer.

Manufacturer *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Type I, 0.4 mm						
Kelly Bros White Waterborne Paint	worn	-	worn	worn	worn	NA
Type I, 1.5 mm						
Ennis Flint Spray W2017.7	59	-	255	n.m.	n.m.	NA
Geveko Markings ViaTherm EXP1771S W	240	-	148	0.70	OK	A
Svevia X1732	worn	-	worn	worn	worn	NA
Type I, 3 mm						
Ennis Flint Screed/extr. W2017.1	48	-	217	n.m.	n.m.	NA
Ennis Flint Screed/extr. W2017.2	96	-	199	n.m.	n.m.	NA
Ennis Flint Screed/extr. W2017.3	99	-	228	n.m.	n.m.	NA
Geveko Markings ViaTherm EXP1771EP W	428	-	182	0.56	OK	A
Kelly Bros Cold White MMA	21	-	193	n.m.	n.m.	NA
Kelly Bros White Extr./Scr. Briteline Plus	worn	-	worn	worn	worn	NA
Kestrel Thermoplastics Eurolux SC White 0010	266	-	186	0.69	OK	A
Kestrel Thermoplastics Eurolux SC White 0011	worn	-	worn	worn	worn	NA
Promax Promax prime white 2017 TYP II	214	-	188	0.70	OK	A
SAR TH 603	worn	-	worn	worn	worn	NA
SAR TH 613	worn	-	worn	worn	worn	NA
Stroypolimer LLC Markaplast T1W11b	worn	-	worn	worn	worn	NA
Svevia X1710	worn	-	worn	worn	worn	NA
Swarco Vestglas Swarcotherm ERP 17	worn	-	worn	worn	worn	NA

Veluvine Thermolit Funen 17	worn	-	worn	worn	worn	NA
Veluvine Thermolit Lolland 17	worn	-	worn	worn	worn	NA
Type II, 3 mm						
Promax Promax prime white 2017 TYP I	155	n.m.	271	n.m.	n.m.	NA
Type II, 4 mm						
Geveko Markings ViaTherm EXP1750EP W [Ch./st.]	worn	worn	worn	worn	worn	NA
Geveko Markings ViaTherm EXP1771EP W [Ch./st.]	worn	worn	worn	worn	worn	NA
Geveko Markings ViaTherm EXP1771EP W [Drops]	worn	worn	worn	worn	worn	NA
Kelly Bros Cold White MMA Agglomerate	worn	worn	worn	worn	worn	NA
Kestrel Thermoplastics Eurodot SC White 0016	worn	worn	worn	worn	worn	NA
Svevia X1711	worn	worn	worn	worn	worn	NA
Svevia X1721	worn	worn	worn	worn	worn	NA
Swarco Limburger Lackf. Limboplast D480	worn	worn	worn	worn	worn	NA
Swarco Limburger Lackf. Limboplast D492	worn	worn	worn	worn	worn	NA
Antiskid, 4 mm						
Geveko Markings ViaTherm EXP1731HF W	(76)*	-	186	0.89	OK	A
Svevia X1743	(82)*	-	191	0.86	OK	A

*) No requirement

Table 34. The performance of materials applied at the Icelandic-Norwegian-Swedish test site in 2017 after two years. Roll-over class P5. Yellow materials, per type and thickness. Alphabetical order by manufacturer.

Manufacturer *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*NTY*	*Appr.*
Type I, 1.5 mm							
Ennis Flint Spray Y2017.8	28	-	166	n.m.	n.m.	n.m.	NA

Type I, 3 mm							
Ennis Flint Screed/extr. Y2017.4	29	-	148	n.m.	n.m.	n.m.	**NA**
Ennis Flint Screed/extr. Y2017.5	43	-	140	n.m.	n.m.	n.m.	**NA**
Ennis Flint Screed/extr. Y2017.6	52	-	171	n.m.	n.m.	n.m.	**NA**
Geveko Markings ViaTherm EXP1773EP Y	103	-	134	n.m.	n.m.	n.m.	**NA**
Hot Mix Hotmix 3000 kombi Yellow A	91	-	168	n.m.	n.m.	n.m.	**NA**
Kestrel Thermoplastics Eurolux SC YELLOW 0013	worn	-	worn	worn	worn	worn	**NA**
Svevia Y 1750	87	-	120	n.m.	n.m.	n.m.	**NA**
Swarco Vestglas Swarcotherm ERP 17 Yellow	worn	-	worn	worn	worn	worn	**NA**
Type II, 4 mm							
Geveko Markings ViaTherm EXP1773EP Y	worn	worn	worn	worn	worn	worn	**NA**
Kestrel Thermoplastics Eurodot SC YELLOW 0015	worn	worn	worn	worn	worn	worn	**NA**

Materials applied in 2018

Roll-over class P0

Table 35. The performance of materials applied at the Icelandic-Norwegian-Swedish test site in 2018 after one year. Roll-over class P0. White materials, per type and thickness. Alphabetical order by manufacturer.

Manufacturer *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Type I, 0.4 mm						
Visafo VIT VISA 31 [0.4 mm]	152	-	133	0.80	OK	A
Visafo VIT VISA 33 [0.4 mm]	94	-	124	0.90	OK	NA
Visafo VIT VISA 34	201	-	131	0.80	OK	A
Visafo VIT VISA 35	120	-	119	0.79	OK	NA
Type I, 0.6 mm						
Geveko Markings EXP18 N01	90	-	135	0.78	OK	NA
Type I, 3 mm						
Ennis Flint Screed Extrusion W2018.1	135	-	198	0.78	OK	NA
Ennis Flint Screed Extrusion W2018.2	128	-	205	0.80	OK	NA
Ennis Flint Screed Extrusion W2018.3	206	-	203	0.77	OK	A
Ennis Flint Screed Extrusion W2018.4	259	-	203	0.72	OK	A
Hot Mix Hotmix 3000 kombi B	202	-	206	0.71	OK	A
Promax Promax prime white typ I 2018	286	-	220	0.64	OK	A
Svevia X 1810	205	-	213	0.73	OK	A
Swarco Vestglas Swarcotherm ERP 18	121	-	159	0.78	OK	NA
Swarco Vestglas Swarcotherm ERP 19	155	-	161	0.78	OK	A
Veluvine Thermolit Funen 2018 A	143	-	188	0.85	OK	NA
Veluvine Thermolit Funen 2018 B	131	-	184	0.84	OK	NA

Type II, 3 mm						
Swarco Limburger Lackf. Limboplast D492	199	19	178	0.76	OK	NA
Swarco Limburger Lackf. Limboplast Reibeplastik Struktur	122	24	154	0.87	OK	NA
Swarco Limburger Lackf. Limbopl. Reibeplastik Struktur D492	166	19	152	0.81	OK	NA
Type II, 5 mm						
Geveko Markings ViaTherm EXP1850EP W [Ch./st.]	250	31	170	0.74	OK	NA
Geveko Markings ViaTherm EXP1850EP W [Drops]	226	40	170	0.75	OK	A
Geveko Markings ViaTherm EXP1871EP W [Ch./st.]	352	31	200	0.70	OK	NA
Geveko Markings ViaTherm EXP1871EP W [Drops]	328	39	171	0.65	OK	A
Svevia X 1811	198	50	215	0.80	OK	A
Svevia X 1821	221	35	223	0.78	OK	A
Inlaid type II, 0.6 mm						
Visafo VIT VISA 31 [0.6 mm]	104	2	116	0.84	OK	NA
Inlaid type II, 5 mm						
Geveko Markings ViaTherm EXP1850EP W [Drops b. l.]	236	40	162	0.72	OK	A
Geveko Markings ViaTherm EXP1850EP W [Drops]	220	58	149	0.76	OK	A
Geveko Markings ViaTherm EXP1871EP W	315	51	177	0.69	OK	A
Kestrel Thermoplastics Eurodot Plus SC White 0018	222	42	155	0.74	OK	A
Kestrel Thermoplastics Eurodot SC White 0019	153	20	118	0.77	OK	NA

Table 36. The performance of materials applied at the Icelandic-Norwegian-Swedish test site in 2018 after one year. Roll-over class P0. Yellow materials, per type and thickness. Alphabetical order by manufacturer.

Manufacturer *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*NTY*	*Appr.*
Type I, 3 mm							
Promax Promax prime yellow typ I 2018	159	-	145	0.66	OK	OK	A

Roll-over class P1

Table 37. The performance of materials applied at the Icelandic-Norwegian-Swedish test site in 2018 after one year. Roll-over class P1. White materials, per type and thickness. Alphabetical order by manufacturer.

Manufacturer *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Type I, 0.4 mm						
Visafo VIT VISA 31 [0.4 mm]	38	-	115	0.88	OK	NA
Visafo VIT VISA 33 [0.4 mm]	25	-	102	0.86	OK	NA
Visafo VIT VISA 34	63	-	111	0.87	OK	NA
Visafo VIT VISA 35	44	-	104	0.88	OK	NA
Type I, 0.6 mm						
Geveko Markings EXP18 N01	35	-	125	0.85	OK	NA
Type I, 3 mm						
Ennis Flint Screed Extrusion W2018.1	162	-	224	0.85	OK	NA
Ennis Flint Screed Extrusion W2018.2	133	-	221	0.81	OK	NA
Ennis Flint Screed Extrusion W2018.3	164	-	216	0.81	OK	A
Ennis Flint Screed Extrusion W2018.4	183	-	210	0.77	OK	A
Hot Mix Hotmix 3000 kombi B	215	-	215	0.71	OK	A
Promax Promax prime white typ I 2018	288	-	229	0.61	OK	A
Svevia X 1810	209	-	219	0.70	OK	A
Swarco Vestglas Swarcotherm ERP 18	168	-	176	0.78	OK	NA
Swarco Vestglas Swarcotherm ERP 19	170	-	177	0.81	OK	A
Veluvine Thermolit Funen 2018 A	125	-	198	0.89	OK	NA
Veluvine Thermolit Funen 2018 B	126	-	203	0.89	OK	NA

Type II, 3 mm						
Swarco Limburger Lackf. Limboplast D492	39	1	206	0.97	OK	NA
Swarco Limburger Lackf. Limboplast Reibeplastik Struktur	95	14	162	0.93	OK	NA
Swarco Limburger Lackf. Limbopl. Reibeplastik Struktur D492	102	8	159	0.88	OK	NA
Type II, 5 mm						
Geveko Markings ViaTherm EXP1850EP W [Ch./st.]	213	27	145	0.78	OK	NA
Geveko Markings ViaTherm EXP1850EP W [Drops]	188	29	152	0.81	OK	NA
Geveko Markings ViaTherm EXP1871EP W [Ch./st.]	404	41	194	0.69	OK	NA
Geveko Markings ViaTherm EXP1871EP W [Drops]	worn	worn	worn	worn	worn	NA
Svevia X 1811	196	42	209	0.76	OK	A
Svevia X 1821	227	11	231	0.73	OK	NA
Inlaid type II, 0.6 mm						
Visafo VIT VISA 31 [0.6 mm]	97	13	118	0.88	OK	NA
Inlaid type II, 5 mm						
Geveko Markings ViaTherm EXP1850EP W [Drops b. l.]	273	24	170	0.74	OK	NA
Geveko Markings ViaTherm EXP1850EP W [Drops]	234	42	159	0.72	OK	A
Geveko Markings ViaTherm EXP1871EP W	395	67	182	0.62	OK	A
Kestrel Thermoplastics Eurodot Plus SC White 0018	270	23	174	0.74	OK	NA
Kestrel Thermoplastics Eurodot SC White 0019	208	48	140	0.74	OK	NA

Table 38. The performance of materials applied at the Icelandic-Norwegian-Swedish test site in 2018 after one year. Roll-over class P1. Yellow materials, per type and thickness. Alphabetical order by manufacturer.

Manufacturer *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*NTY*	*Appr.*
Type I, 3 mm							
Promax Promax prime yellow typ I 2018	142	-	151	0.68	OK	OK	A

Roll-over class P2

Table 39. The performance of materials applied at the Icelandic-Norwegian-Swedish test site in 2018 after one year. Roll-over class P2. White materials, per type and thickness. Alphabetical order by manufacturer.

Manufacturer *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Type I, 0.4 mm						
Visafo VIT VISA 31 [0.4 mm]	49	-	111	0.87	OK	NA
Visafo VIT VISA 33 [0.4 mm]	27	-	92	0.88	OK	NA
Visafo VIT VISA 34	115	-	110	0.86	OK	NA
Visafo VIT VISA 35	55	-	105	0.85	OK	NA
Type I, 0.6 mm						
Geveko Markings EXP18 N01	29	-	121	0.86	OK	NA
Type I, 3 mm						
Ennis Flint Screed Extrusion W2018.1	150	-	215	0.82	OK	NA
Ennis Flint Screed Extrusion W2018.2	120	-	213	0.80	OK	NA
Ennis Flint Screed Extrusion W2018.3	167	-	213	0.83	OK	A
Ennis Flint Screed Extrusion W2018.4	237	-	203	0.75	OK	A
Hot Mix Hotmix 3000 kombi B	247	-	219	0.68	OK	A
Promax Promax prime white typ I 2018	292	-	229	0.61	OK	A
Svevia X 1810	201	-	216	0.71	OK	A
Swarco Vestglas Swarcotherm ERP 18	130	-	176	0.80	OK	NA
Swarco Vestglas Swarcotherm ERP 19	120	-	174	0.81	OK	NA
Veluvine Thermolit Funen 2018 A	127	-	204	0.87	OK	NA
Veluvine Thermolit Funen 2018 B	126	-	197	0.87	OK	NA

Type II, 3 mm						
Swarco Limburger Lackf. Limboplast D492	31	0	206	1.01	OK	NA
Swarco Limburger Lackf. Limboplast Reibeplastik Struktur	29	2	165	1.02	OK	NA
Swarco Limburger Lackf. Limbopl. Reibeplastik Struktur D492	32	0	161	1.01	OK	NA
Type II, 5 mm						
Geveko Markings ViaTherm EXP1850EP W [Ch./st.]	256	15	170	0.73	OK	NA
Geveko Markings ViaTherm EXP1850EP W [Drops]	203	26	158	0.76	OK	NA
Geveko Markings ViaTherm EXP1871EP W [Ch./st.]	361	28	191	0.68	OK	NA
Geveko Markings ViaTherm EXP1871EP W [Drops]	288	36	168	0.68	OK	NA
Svevia X 1811	188	46	214	0.79	OK	A
Svevia X 1821	208	32	225	0.77	OK	NA

Table 40. The performance of materials applied at the Icelandic-Norwegian-Swedish test site in 2018 after one year. Roll-over class P2. Yellow materials, per type and thickness. Alphabetical order by manufacturer.

Manufacturer *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*NTY*	*Appr.*
Type I, 3 mm							
Promax Promax prime yellow typ I 2018	138	-	148	0.70	OK	OK	A

Roll-over class P4

Table 41. The performance of materials applied at the Icelandic-Norwegian-Swedish test site in 2018 after one year. Roll-over class P4. White materials, per type and thickness. Alphabetical order by manufacturer.

Manufacturer *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*Appr.*
Type I, 0.4 mm						
Visafo VIT VISA 31 [0.4 mm]	worn	-	worn	worn	worn	NA
Visafo VIT VISA 33 [0.4 mm]	worn	-	worn	worn	worn	NA
Visafo VIT VISA 34	worn	-	worn	worn	worn	NA
Visafo VIT VISA 35	worn	-	worn	worn	worn	NA
Type I, 0.6 mm						
Geveko Markings EXP18 N01	worn	-	worn	worn	worn	NA
Type I, 3 mm						
Ennis Flint Screed Extrusion W2018.1	145	-	221	0.80	OK	NA
Ennis Flint Screed Extrusion W2018.2	107	-	220	0.77	OK	NA
Ennis Flint Screed Extrusion W2018.3	153	-	218	0.80	OK	A
Ennis Flint Screed Extrusion W2018.4	158	-	210	0.73	OK	A
Hot Mix Hotmix 3000 kombi B	196	-	228	0.75	OK	A
Promax Promax prime white typ I 2018	257	-	231	0.64	OK	A
Svevia X 1810	168	-	218	0.70	OK	A
Swarco Vestglas Swarcotherm ERP 18	113	-	171	0.73	OK	NA
Swarco Vestglas Swarcotherm ERP 19	122	-	171	0.73	OK	NA
Veluvine Thermolit Funen 2018 A	100	-	199	0.86	OK	NA
Veluvine Thermolit Funen 2018 B	105	-	192	0.88	OK	NA

Type II, 3 mm						
Swarco Limburger Lackf. Limboplast D492	26	0	191	1.01	OK	NA
Swarco Limburger Lackf. Limboplast Reibeplastik Struktur	21	1	165	0.96	OK	NA
Swarco Limburger Lackf. Limbopl. Reibeplastik Struktur D492	20	3	170	0.96	OK	NA
Type II, 5 mm						
Geveko Markings ViaTherm EXP1850EP W [Ch./st.]	139	2	153	0.80	OK	NA
Geveko Markings ViaTherm EXP1850EP W [Drops]	191	8	171	0.80	OK	NA
Geveko Markings ViaTherm EXP1871EP W [Ch./st.]	246	4	169	0.73	OK	NA
Geveko Markings ViaTherm EXP1871EP W [Drops]	278	16	176	0.74	OK	NA
Svevia X 1811	177	31	210	0.75	OK	NA
Svevia X 1821	205	28	223	0.76	OK	NA
Inlaid type II, 0.6 mm						
Visafo VIT VISA 31 [0.6 mm]	worn	worn	worn	worn	worn	NA
Inlaid type II, 5 mm						
Geveko Markings ViaTherm EXP1850EP W [Drops b. l.]	216	12	165	0.75	OK	NA
Geveko Markings ViaTherm EXP1850EP W [Drops]	115	10	118	0.82	OK	NA
Geveko Markings ViaTherm EXP1871EP W	266	37	152	0.66	OK	A
Kestrel Thermoplastics Eurodot Plus SC White 0018	202	3	148	0.68	OK	NA
Kestrel Thermoplastics Eurodot SC White 0019	worn	worn	worn	worn	worn	NA

Table 42. The performance of materials applied at the Icelandic-Norwegian-Swedish test site in 2018 after one year. Roll-over class P4. Yellow materials, per type and thickness. Alphabetical order by manufacturer.

Manufacturer *Material*	$R_{L,dry}$	$R_{L,wet}$	*Qd*	*Frict.*	*Colour*	*NTY*	*Appr.*
Type I, 3 mm							
Promax Promax prime yellow typ I 2018	124	-	151	0.67	OK	OK	A

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