



Nordic certification system for road marking materials

Version 5:2018

Carina Fors
Trond Cato Johansen
Sven-Olof Lundkvist
Sara Nygårdhs

Nordic certification system for road marking materials

Version 5:2018

Carina Fors

Trond Cato Johansen

Sven-Olof Lundkvist

Sara Nygårdhs

Author': Carina Fors, VTI, <https://orcid.org/0000-0002-2061-5817>
Trond Cato Johansen, Ramböll
Sven-Olof Lundkvist, VTI
Sara Nygårdhs, VTI
Reg. No., VTI: 2017/0377-8.4
Publication No.: VTI notat 12A-2018
Cover pictures: Carina Fors and Trond Cato Johansen
Published by VTI, 2018

Preface

A Nordic certification system for road marking materials was introduced in 2015. This implies that a documented product approval will be required in order to use the road marking material on roads managed by national road authorities, in countries that apply the certification system.

A product approval is based on monitored and documented performance measurements of material samples applied on test fields on public roads. The present report describes the certification system and the road trials.

In the first stage, the certification system applies for Norway, Denmark and Sweden. Finland will not apply the certification system in this first stage but may join later.

The guidelines and procedures related to the certification system have been developed by a working group consisting of Kenneth Kjemtrup, Danish Road Directorate, Tuomas Österman, Finnish Transport Agency, Björn Skaar, Norwegian Public Roads Administration, Ulf Söderberg, Swedish Transport Administration, Kai Sörensen, Johnsen Consult, Trond Cato Johansen, Ramböll, Carina Fors, Sara Nygårdhs and Sven-Olof Lundkvist, Swedish National Road and Transport Research Institute (VTI).

Drøbak, April 2018

Trond Cato Johansson
Project leader

Quality review

Internal peer review was performed on 19 May 2018 by Anna Anund. Carina Fors has made alterations to the final manuscript of the report. Research director Anna Anund examined and approved the report for publication on 21 May 2018. 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 19 maj 2018 av Anna Anund. Carina Fors har genomfört justeringar av slutligt rapportmanus. Forskningschef Anna Anund har därefter granskat och godkänt publikationen för publicering 21 maj 2018. De slutsatser och rekommendationer som uttrycks är författarnas egna och speglar inte nödvändigtvis myndigheten VTI:s uppfattning.

Content

Summary	7
Sammanfattning	9
1. Introduction	11
1.1. Application of the certification system in the Nordic countries.....	11
1.1.1. Norway.....	11
1.1.2. Sweden.....	11
1.1.3. Denmark.....	12
1.1.4. Finland	12
1.2. Roles and responsibilities.....	12
2. Road marking materials	13
2.1.1. Colour	13
2.1.2. Type I and type II.....	13
2.1.3. Inlaid markings	13
2.1.4. Antiskid material.....	13
2.1.5. Temporary markings.....	14
2.1.6. Content of material	14
2.1.7. Requirements regarding health, environment and safety	14
3. Test sites	15
3.1. The Norwegian-Swedish test site.....	15
3.1.1. Location	15
3.1.2. Road characteristics	15
3.1.3. Traffic volume	17
3.1.4. Climatic conditions	17
3.1.5. Studded tyres.....	18
3.2. The Danish test site	18
3.2.1. Location	18
3.2.2. Road characteristics	18
3.2.3. Traffic volume	19
3.2.4. Climatic conditions	20
3.2.5. Studded tyres.....	20
3.3. Measurements of wheel passages.....	20
3.4. Measurements of weather conditions.....	20
4. Application of road marking materials	22
4.1. Application pattern.....	22
4.2. Application method.....	22
4.3. Material thickness	22
4.4. Determination of the rate of application of drop on components.....	23
4.5. Weather conditions at application.....	23
4.6. Practical information about the application of materials	23
4.7. Practical information about customs bill of entry to Norway	23
4.8. Suppliers' responsibilities	24
5. Performance measurements	25
5.1. Periodicity of measurements	25
5.2. Performance parameters.....	25

5.3. Measurement details	25
6. Samples for identification.....	27
7. Certification.....	28
7.1. General.....	28
7.1.1. Norway and Sweden	28
7.1.2. Denmark.....	28
7.1.3. Finland	28
7.2. Certification materials and test materials	28
7.3. Performance requirements	29
7.4. Certification in relation to roll-over classes	30
7.5. Validity of certification	31
7.6. Documentation	31
7.7. Certificates	31
7.8. Complaints	32
7.9. Registration	32
7.10. Participant fee and other costs.....	33
References	35
Appendix 1. Terms and definitions.....	37
Appendix 2. Report form for registration of materials.....	39
Appendix 3. Report form for application of materials.....	41
Appendix 4. Report form for performance measurements	43
Appendix 5. Product sheet requirements	45
Appendix 6. Contact information	47

Summary

Nordic certification system for road marking materials – Version 5:2018

by Carina Fors (VTI), Trond Cato Johansen (Ramböll), Sven-Olof Lundkvist (VTI) and Sara Nygårdhs (VTI)

A Nordic certification system for road marking materials was introduced in 2015. The system is based on documented performance measurements of material samples applied on test fields on public roads. From 2016, the certification system includes both flat (type I) and structured/profiled (type II) markings. Since 2017 the certification system also includes antiskid materials (a material with enhanced friction). From 2018 the certification system will also include temporary markings (Denmark only), and inlaid markings (Norway only).

Material tests are carried out at two test sites: one in Norway and one in Denmark. The test fields are situated on public roads and the tested materials are thus exposed to real traffic conditions and to weather conditions representative for the Nordic countries. The materials are followed up by performance measurements during one or two years. The certification includes requirements on coefficient of retroreflected luminance R_L under dry and wet conditions, luminance coefficient under diffuse illumination Q_d , friction and colour coordinates. The number of wheel passages is measured at the test sites annually. The certification system includes material identification, which allows for future material sampling and analysis.

The certification system is based on the European standards *EN 1824 Road marking materials – Road trials*, *EN 1436 Road marking materials – Road marking performance for road users*, and *EN 12802 Road marking materials – Laboratory methods for identification*.

The report describes the certification system and how it is applied in the Nordic countries. Procedures and methods that are used for application of materials and performance measurements are specified.

Sammanfattning

Nordiskt certifieringssystem för vägmarkeringsmaterial – Version 5:2018

av Carina Fors (VTI), Trond Cato Johansen (Ramböll), Sven-Olof Lundkvist (VTI) och Sara Nygårdhs (VTI)

Ett nordiskt certifieringssystem för vägmarkeringsmaterial introducerades under 2015. Systemet baseras på dokumenterade materialtester på provfält, där materialen certifieras utifrån hur många hjulpassager de klarar. Från och med 2016 omfattar certifieringssystemet både plana (typ I) och profilerade/våtsynbara (typ II) markeringar. År 2017 utökades certifieringssystem ytterligare till att även inkludera friktionsmaterial (material med förbättrad friktion). Från 2018 kommer certifieringssystemet även att inkludera temporära markeringar (endast Danmark), och nedfrästa markeringar (endast Norge).

Materialtester görs på två provfält: ett i Norge och ett i Danmark. Provfälten är placerade på allmän väg och materialen som testas är således exponerade för reell trafik samt för väderförhållanden representativa för de nordiska länderna. Materialen följs upp med funktionsmätningar under ett eller två år. Certifieringen omfattar krav på retroreflexion R_L , luminanskoefficient Q_d , friktion och färgkoordinater. Antalet hjulpassager materialen utsätts för mäts årligen. Certifieringssystemet inkluderar även materialidentifiering, vilket möjliggör senare stickprovskontroller vid entreprenader.

Certifieringssystemet baseras på europastandarderna *EN 1824 Road marking materials – Road trials*, *EN 1436 Road marking materials – Road marking performance for road users*, samt *EN 12802 Road marking materials – Laboratory methods for identification*.

Rapporten beskriver hur certifieringssystemet fungerar och hur det tillämpas i de nordiska länderna. Vidare beskrivs de procedurer och metoder som används vid utläggning av material, samt vid mätning av materialens funktionsparametrar.

1. Introduction

A Nordic certification system for road marking materials was introduced in 2015. The requirements for the use of certified materials will be implemented in national regulations gradually. Denmark implemented requirements for certified materials in 2017, and Norway in 2018. Sweden is expected to implement the requirements with the tenders for the 2019 season. When the system comes into force, a documented product approval will be required in order to use the road marking material on roads managed by the national road authorities, in countries where the certification system applies.

There are several reasons for introducing a certification system:

- to promote fair competition
- to promote the development of new and better materials
- to obtain better documentation of the use of public funds
- to guarantee that the road authorities get the material paid for
- to improve the quality of the road markings from the road user perspective
- to increase the knowledge about road marking materials.

For type I (flat) markings, the certification comprises the road marking material, in the applied thickness and with the specified drop on material. For type II (road markings with special properties intended to enhance the retroreflection in wet or rainy conditions) markings, the certification comprises the *assembly*, i.e. the material itself, including the drop on material, in the applied design put out on the trials. Product approval is based on monitored and documented performance measurements of material samples applied on test fields on public roads. The certification system includes all types of white and yellow longitudinal markings, as well as antiskid markings for transversal and longitudinal use. From 2018 the certification system will also include yellow temporary markings, as used at roadworks (Denmark only), and inlaid markings (Norwegian test site only).

The certification system is anchored in national guidelines and regulations. Performance requirements include coefficient of retroreflected luminance R_L under dry and wet conditions, luminance coefficient under diffuse illumination Q_d , friction and colour coordinates. Approval is given in relation to the number of wheel passages the material will withstand.

The procedures for application and measurements are based on the standards *EN 1824 Road marking materials – Road trials* and *EN 1436 Road marking materials – Road marking performance for road users*.

The certification system may be modified and/or extended later on.

Some terms and definitions are given in Appendix 1.

1.1. Application of the certification system in the Nordic countries

1.1.1. Norway

The certification system applies to roads managed by *the Norwegian Public Roads Administration*.

1.1.2. Sweden

The certification system will apply (from 2019) to roads managed by *the Swedish Transport Administration*.

1.1.3. Denmark

The certification system applies to roads managed by *the Danish Road Directorate*.

1.1.4. Finland

At present, the certification system will not apply to Finland. The Finnish road authorities will decide later when and in which types of contracts a material certification is required. There is also a possibility that Finnish municipalities may apply the certification system later.

The Finnish Transport Agency has no plans for any certification system of its own. When product approval requirements will be introduced in Finland, the Nordic certification system will be followed.

1.2. Roles and responsibilities

The Nordic road authorities constitute the controlling authority of the certification system:

- Norwegian Public Roads Administration, Norway
- Swedish Transport Administration, Sweden
- Danish Road Directorate, Denmark.

The Swedish National Road and Transport Research Institute (VTI) and Ramböll together have the formal responsibility of the road trials and the material approval. VTI supervises the measurements, analyses data and is the economic administrator of the road trials. Ramböll carries out measurements and is responsible for administration and contact with participants as well as data handling. Ramböll also provides the project leader of the certification system. The project leader is responsible for contacts with the road authorities.

The procedures and the guidelines for the road trials and for the certification system have been compiled by a working group with representatives from the road authorities in Norway, Sweden, Denmark and Finland, and from VTI, Ramböll and Johnsen Consult.

The administration of the road trials refers to Ramböll and VTI.

Contact information can be found in Appendix 6.

2. Road marking materials

The certification system mainly includes materials for longitudinal markings. Any material intended for longitudinal marking can be used, including preformed road markings, provided that the materials comply with current legislation. The certification system can also include materials for transversal markings, and markings with enhanced antiskid properties.

From 2018, materials for temporary markings (Denmark), and inlaid markings (Norway) will be included in the certification system.

The road marking materials are tested as applied assemblies, with drop on materials as recommended by the manufacturer.

2.1.1. Colour

The certification system includes white and yellow materials.

Other colours may be applied as *Test materials* (see definitions in Section 7.2).

2.1.2. Type I and type II

From 2016, the certification system includes both type I and type II markings. For type II materials, certification is given for the combination of material and pattern/design that was applied on the test field. The design/pattern will be documented by a photo.

Any type of pattern or design is allowed for type II markings.

Note: Type II markings may give rise to unwanted noise. For the present, there are no requirements or guidelines regarding noise levels from road markings in the Nordic countries. Nor are there any standardized methods¹ for measurements of such noise. The certification system will thus not include any performance requirements related to noise for the moment, but it should be noted that road authorities may want to include restrictions regarding noise in tendering procedures later on.

2.1.3. Inlaid markings

Inlaid markings are markings that will be installed in a milled track. The bottom of the milled track will be flat, and the width will be 30–35 cm. The depth of the track will be about 7 mm, so that the surface of the marking will stay below the surface of the pavement. This kind of markings are in regular use in Scandinavia, and several public tenders will specify such markings. The purpose of inlaid markings is to extend the functional lifetime of the markings, as snowploughs will not affect markings that are placed below the surface of the pavement.

Inlaid markings can be applied in white or yellow colour, as type I or type II, on the Norwegian trial site.

2.1.4. Antiskid material

From 2017, the certification system includes white road marking assemblies intended to provide enhanced antiskid properties². Such road markings are sometimes used in urban areas with street lighting, for instance for pedestrian crossings. For antiskid materials there will be no requirement for

¹ The European Committee for standardization (CEN) is currently working with methods and requirements in the working group “*Test methods and requirements for (positive and negative) noise produced by structured road markings*” (CEN/TC226/WG2/EP5).

² In the previous version of this document (version 4:2017) materials with enhanced antiskid properties were called “friction materials”.

coefficient of retroreflected luminance, R_L . However, the requirement for friction will be increased (see section 7.3).

2.1.5. Temporary markings

Temporary yellow markings are typically in use when traffic must be redirected due to roadworks. At the road trials, the temporary markings will be followed up during maximum 6 months after application. Winter conditions will not be included in the follow up period. Materials will be certified according to the achieved T-class. Temporary markings will be applied on the Danish test site only.

2.1.6. Content of material

All ingredients/components of the material, including drop on aggregates and binder, are parts of the material. This means that the certification is valid only for the specific mixture (type of binder, amount of glass beads etc.) applied on the test field. The only exception from this rule is the drop on glass bead/aggregate: the certification permits the use of another drop on glass bead/aggregate than those that was used on the road trials, provided that the technical specifications of the products are identical. The alternative drop on system must have the same type of coatings, refractive index, granulometry and antiskid aggregate. The type – and relative amount of antiskid aggregates in the drop on system must be same as certified on the trials.

Product data sheets and safety data sheets for the road marking material and for the drop on materials must be handed in together with the registration form. Registered materials must not be applied on the test field unless the documentation is complete. Suppliers will not be asked to provide the administration of the road trials with recipes of their materials. For further information, see Appendix 5.

Drop on materials (glass beads and antiskid aggregates) must bear CE marking and shall be in accordance with EN1423, and their properties shall be documented according to the specifications and classes given in the named standard.

2.1.7. Requirements regarding health, environment and safety

Materials applied on the test field must comply with current chemicals-, health, safety-, and environment legislation and practice in the Nordic countries. Materials must not contain any heavy metals or other materials that are in violation of legislation. Volatile organic compounds (VOCs) shall not exceed 2% by weight of any materials.

The use of yellow lead chromate pigments is not allowed in the Nordic countries.

Solvent based paint is prohibited in the Nordic countries and is thus not allowed on the test field.

Cold plastic materials are allowed on the road trials, but they are currently not used in the Nordic countries.

3. Test sites

The road trials of the certification system are in 2018 carried out in Norway and Denmark. The locations of the test sites are shown in Figure 1.

The reason for having two test sites is the differences between Norway and Sweden (and Finland) on one hand, and Denmark on the other hand, with respect to climate and the use of studded tyres. See also Section 7.1.



Figure 1. Locations of the test sites. (Image: Modified from www.purposegames.com).

3.1. The Norwegian-Swedish test site

The present Norwegian-Swedish test site was established in 2017.

3.1.1. Location

The Norwegian-Swedish test site is currently located in Hedmark, close to Haslemoen in eastern Norway, approximately 180 km northeast of Oslo, Norway. The location is intended to represent the average climate conditions in Norway and Sweden (and Finland).

The road used for the test site is road Rv2, from Haslemoen and southeast approximately 5 km. The GPS coordinates for the test site in WGS84 DDM are:

- N 60° 38.665
- E 11° 52.755

Signs with the text *prøvefelt vegoppmerking* (English: *Test field, road markings*) inform drivers about the test site.

3.1.2. Road characteristics

The road used for the test site is a two-lane rural road located in an open landscape, Figure 2. The road is straight and relatively flat and without any major junctions. The posted speed limit is 90 km/h.

Only one of the lanes is used as test field.



Figure 2. The road used for the Norwegian test site. (Photo: Trond Cato Johansen, Ramböll).

The width of the road is 9 m. Each lane is 3.15 m from the edge of milling track in the middle to the edge of milling at the edge line. The shoulders are 1.00 m, 0.65 m outside the milling track.

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 roughness classification is based on the annual road surface assessments, which provides information on *Mean Profile Depth* (MPD). From this data, the averaged *Measured Texture Depth* (MTD) has been estimated (Freitas et al, 2008).

A picture of the road surface is shown in Figure 3.



Figure 3. The road surface on the Norwegian test site. (Photo: Trond Cato Johansen, Ramböll).

3.1.3. Traffic volume

The annual average daily traffic (AADT) is 3 200 vehicles per day (measured in 2016). The amount of heavy vehicles is 15% of the total number of vehicles.

Measurements of the traffic volume and the transversal distribution of wheel passages are carried out at the test site annually, see Section 3.3.

3.1.4. Climatic conditions

The average temperature during the last year (April 2017–March 2018) was 4.2°C. The highest and lowest temperatures registered were 27.9°C and -22.6°C, respectively. The total precipitation during the last year was 691 mm. The largest snow depth was 60 cm. (*Weather data: www.yr.no*)

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 et al. 2006). The large areas in the inlands in the north of Finland, Norway and Sweden belong to climate zone Dfc, while the most densely populated areas in the south of Finland and Sweden and along the south and west coasts of Norway belong to climate zones Dfb and Cfb. The climatic class according to EN 1824 is C3.

During winter time, the road is salted and cleared from snow by a snowplough (steel blade). The road entrepreneur will be asked to be careful when clearing the road at the test site, however no guarantee can be given that damages from the winter maintenance will be totally avoided.

The weather conditions at the test site will be registered continuously during the road trials, see Section 3.4.

3.1.5. Studded tyres

Studded tyres are permitted in Norway from 1 November to the first Sunday after Easter. (In the northern areas of Nordland, Troms and Finnmark, it is permitted to begin using studded tyres from 15 October.) There is no data available regarding the amount of vehicles with studded tyres on the test site road, but in Hamar, which is located around 60 km northwest of the test site, the amount of cars with studded tyres is 45% and it can be estimated that the amount of cars with studded tyres is 50–55%, according to Jon Haglund at the Norwegian Public Roads Administration. Heavy vehicles may use studded tyres, but can also have non-studded winter tyres.

3.2. The Danish test site

The present Danish test site was established in 2016.

3.2.1. Location

The Danish test site is located on Zealand, approximately 100 km west of Copenhagen, Denmark. The road used is road 22, close to the village Gørlev. The GPS coordinates in WGS84 DDM for the test site are:

- N 55° 33.013
- E 11° 12.318

Warning signs with subpanels inform drivers about the test site, Figure 4.



Figure 4. Warning sign. (Photo: Kai Sørensen).

3.2.2. Road characteristics

The road used for the test site is a two-lane rural road surrounded by an open landscape, Figure 5. The road is relatively straight and flat and without any major junctions. The posted speed limit is 80 km/h. The northbound lane is used for the test field.

The width of the road is 7.1 m. Each lane is 3.30 m wide.

The road surface consists of asphalt of type SMA8 that was placed in 2015. The averaged measured texture depth (MTD) is approximately 0.67 mm, i.e. the roughness class is RG2. A picture of the road surface is shown in Figure 6.



Figure 5. The road used for the Danish test site. (Photo: Trond Cato Johansen, Ramböll).



Figure 6. The road surface on the Danish test site. (Photo: Trond Cato Johansen, Ramböll).

3.2.3. Traffic volume

The annual average daily traffic (AADT) is approximately 8 100 vehicles per day. The amount of heavy vehicles is >10% of the total number of vehicles.

Measurements of the traffic volume and the transversal distribution of wheel passages are carried out at the test site annually, see Section 3.3.

3.2.4. Climatic conditions

The annual average temperature during the years 2013–2017 was 9°C. The highest and lowest temperatures registered were 30°C and -15°C, respectively. On average, the temperature was below 0°C 57 days per year. The annual average precipitation was 621 mm and the average number of sun hours was 1 682. (*Weather data: www.dmi.dk*)

The Köppen classification of the test site is Cfb, based on data for the period 1951–2000 (Kottek et al. 2006). The climate zone Cfb covers the whole of Denmark, the southern parts of Sweden and the south and west coasts of Norway. The climatic class of the Danish test site according to EN 1824 is C3, i.e. Cfb with winter maintenance. The extent of winter maintenance may vary a lot between years.

During winter time, the road is salted and cleared from snow by a snowplough (rubber blade or steel blade).

The weather conditions at the test site will be registered continuously during the road trials, see Section 3.4.

3.2.5. Studded tyres

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

3.3. Measurements of wheel passages

The number of wheel passages and the transversal distribution of wheel passages is measured annually at the test sites. The assessment of wheel passages is conducted after the markings have been applied, in order to account for any influence on vehicles' lateral position from the markings.

The measurement equipment that is used is based on coaxial cable technique, which provides data with high accuracy. Data is collected during approximately one week in the autumn or in the spring (i.e. studded tyres are not used when data is collected). The measurements of wheel passages are carried out by VTI.

From the collected data, the distribution of wheel passages is calculated according to the procedures described in Annex B in EN 1824. Roll-over classes will then be determined from the calculated distributions, see Section 7.4.

3.4. Measurements of weather conditions

The following data is registered at the test sites each year:

- annual average temperature
- average summer temperature
- average winter temperature
- annual precipitation
- number of sun hours
- number of weeks with snow (in Denmark: snow or frost)
- number of times the snow plough has operated
- number of times the road has been salted.

Meteorological data is retrieved from *Yr* (which is a joint service by *the Norwegian Meteorological Institute* and *the Norwegian Broadcasting Corporation*) and *the Danish Meteorological Institute* (DMI), respectively. Information about winter maintenance is obtained from the road entrepreneurs.

4. Application of road marking materials

The application of road marking materials is based on EN 1824. Details are given below.

4.1. Application pattern

The application pattern is based on the longitudinal pattern described in Section 5.2.3 in EN 1824.

Each marking material is applied as a row of longitudinal lines in the direction of the traffic.

Specifications:

- nine longitudinal lines in a row in the lane and, at the Norwegian test site, a tenth line on the shoulder
- length of the lines: 2.5 m
- width of the lines: 0.15 m
- distance between two adjacent lines: 0.15 m
- distance between two adjacent rows of lines: depends on the number of materials/rows, but at least 1 m.

The position of the lines will be pre-marked. The administration of the road trials is responsible for the application of pre-markings. The position of the lines will also be measured after application.

The tenth line on the shoulder serves as a reference without any wheel passages.

For inlaid markings, there will be a milled flat track over two sections in line positions 2, 3, 9 and 10 (the lines are numbered from right to left, i.e. line 1 is the line on the shoulder and line 10 is the one next to the centre line). Inlaid markings will be applied in those milled tracks. The other line positions will be filled with the same type of markings, but will not be inlaid. The administration of the road trials is responsible for the milling of tracks.

A dummy material not included in the actual tests can be applied on the first row, since there is a possibility that the wear will be higher on that row.

4.2. Application method

Preferably, materials shall be applied using self-propelled road marking equipment of maximum 3 500 kg. Application by hand is permitted, e.g. in case the supplier does not have a self-propelled machine. Due to practical reasons of precision and not having newly applied markings run over, heavy truck mounted equipment is to be avoided³. The application method will be documented in the certification report.

4.3. Material thickness

Materials can be applied in five thicknesses:

- 0.4 mm wet (example: paint). Maximum thickness allowed at application: 0.45 mm wet
- 0.6 mm wet (example: paint). Maximum thickness allowed at application: 0.65 mm wet
- 1.5 mm (example: spray plastic). Maximum thickness allowed at application: 2.0 mm

³ If there is no other possibility for application, a special approval for using heavy truck mounted equipment has to be given beforehand by the administration of the road trials. The manufacturer then has to apply for the approval by making contact with the project leader (see Appendix 6) at the last day for registering materials, at the latest.

- 3.0 mm (example: extruded thermoplastic). Maximum thickness allowed at application: 3.5 mm
- 5.0 mm (Structured/profiled type II markings and antiskid materials only. Example: thermoplastic and cold plastic). Maximum thickness allowed at application: 5.5 mm.

Prefab and tape shall be applied in commercially available thicknesses.

The thickness is measured when the material is applied. For each row of lines, a steel plate is placed in the end of two of the lines that are expected to reach the highest number of wheel passages. One plate is to be applied with drop on material, and the other is to be applied without any drop on. When material is applied on those lines, the length of the lines should be lengthened so that material is applied also on the steel plates. The thickness of the material is then measured on the steel plate. In addition, the thicknesses of a random sample of lines (other than those with the highest P class) will be measured by a portable measurement tool.

The thickness of the material is measured on the sample plate without any drop-on glass beads or aggregates.

The steel plates are weighed before and after application, so that the volume applied can be controlled, and the mean thickness be calculated.

If the thickness of any of the lines is greater than the maximum thickness allowed, these lines are disqualified and excluded from the road trial. Lines that fulfil the requirements on thickness will be approved for continued participation, but this however implies that there is a risk that the material cannot be certified for certain P-classes.

4.4. Determination of the rate of application of drop on components

The rate of application of drop on components will be determined according EN 1824. The amount of drop on materials, as registered and recorded during application at the road trials, will be issued in the eventual certificate of the road marking material.

4.5. Weather conditions at application

The supplier is to verify that the weather conditions during application of his materials are within acceptable limits. Meteorological data at application will be registered.

4.6. Practical information about the application of materials

The test sites will be open for application of materials for approximately one or two weeks. Suppliers will get instructions on when and where to apply their materials. The application will be organized so that the risk of materials being spoiled by weather, traffic or other suppliers' equipment or presence is minimized.

The lane where the markings will be applied will be closed during application and for a few hours after application. The administration of the road trials will be responsible for the closing of the road.

The supplier is responsible for masking the road surface during application of his materials, to avoid spill and damage of other materials. Roofing felt or tar paper is suitable for this purpose, but also other types of masking materials can be acceptable. The supplier himself is responsible for the masking and availability of masking materials.

4.7. Practical information about customs bill of entry to Norway

As Norway is not a member of the European Union, a registration of machinery and equipment, when entering the country, is necessary. This is an easy and inexpensive procedure. Your Chamber of

Commerce will issue an ATA carnet for this purpose. The documents are to be presented to the customs office at the border upon entering the country. The ATA carnet is also to be presented to the customs office when leaving Norway.

4.8. Suppliers' responsibilities

The supplier, or his representative, is responsible for his participating products during installation on the test field, and he has to verify a correct application of his materials. A protocol for each material applied on the test field is to be signed by the participant and the administration of the road trials, see Appendix 3.

Suppliers are obliged to:

- Apply their own materials on the test field(s) at their own cost.
- Follow the instructions given by the administration of the road trials on-site.
- Provide the administration of the road trials with a sample of each material (see Chapter 6).
- Mask the road surface during application of his materials, to avoid spill and damage of other materials. Roofing felt or tar paper is suitable for this purpose, but also other types of masking materials can be acceptable. The supplier himself is responsible for the masking and availability of masking materials.
- Make sure that all personnel working on the road at the Norwegian test site have a minimum level of road safety training.
- Make sure that all personnel working on the road at the Swedish test site have carried out and passed an online test on road work basic skills⁴, before going to the test site. This applies to all personnel that will be at the test site either during the application or later.

After the road trials have been closed for application, the participant, or his representative, is not allowed to enter the trials site to do their own measurements without a permission granted by the actual road administration in charge. For all kind of activities on the road trials, it is necessary to have an approved traffic safety plan. This plan will also describe the necessary level of warning systems and safety barriers. The participant will have to cover all costs for such a plan and all necessary safety equipment. Please contact the administration of the road trials for contact details of the respective road administrations and of suppliers of safety barriers.

The administration of the road trials will arrange an “open day” at the test sites in May each year, when participants can visit the test site and assess the condition of their materials. More information about the open days will be sent out by email.

⁴ <https://www.trafikverket.se/en/startpage/suppliers/Work-on-the-road-basic-skills/>

5. Performance measurements

Performance measurements are based on EN 1824 and EN 1436.

5.1. Periodicity of measurements

Initial measurements of all materials are carried out approximately two weeks after application. Follow-up measurements are carried out after approximately one year and, if the supplier wishes, after two years. After two years, higher P-classes will have been reached, which implies that the material may be certified for a higher P-class. Follow-up measurements for temporary markings are carried out after approximately 1–3 months.

Dates for the follow-up measurements are decided after the annual measurements of wheel passages (see also Sections 3.3 and 7.4).

In case a material does not fulfil the requirements stated in Chapter 7 at the initial measurements, the material will be excluded from the certification program. If the participator wishes, the excluded materials can have a continued follow-up as a *Test material* (see Section 7.2).

5.2. Performance parameters

The following parameters are included in the certification system:

- coefficient of retroreflected luminance, R_L dry
- coefficient of retroreflected luminance, R_L wet (type II markings only)
- luminance coefficient under diffuse illumination, Qd
- friction
- chromaticity coordinates, x , y .

Performance requirements are given in Chapter 7.

5.3. Measurement details

The coefficient of retroreflected luminance, R_L , and the luminance coefficient under diffuse illumination, Qd , are measured in three points on each line, within the measurement area defined by figure 2 in EN 1824 (a 0.15 x 1.5 m large area centred on the line). The parameter values are calculated as the average of the three measurements. Measurements of R_L and Qd , are done using an *LTL-XL* (Delta, Denmark).

For measurements of the coefficient of retroreflected luminance R_L on wet markings, water is poured on the measurement area 60 s before the measurement is carried out.

Friction is measured along the centre of each line (one measurement per line), on wetted markings. Measurements are carried out using a *Portable Friction Tester version 4* (PFT), which has a proven correlation with the *Skid Resistance Tester* (SRT), see (Wälivaara 2007).

Chromaticity coordinates are measured in one point on each line. A *Konica Minolta Spectrophotometer CM-2500c* or *CM-25cG* is used to measure the chromaticity coordinates. The chromaticity coordinates of yellow materials in retroreflected light are measured by an *LTL 2000Y* (Delta, Denmark). If necessary, more than one measurement point is selected.

All measurements are carried out in the direction of the traffic. Measurements are done on dry markings in dry weather. The markings are not cleaned before carrying out the measurements, but polluted measurement points will be avoided.

Measurements that involve wetting of the markings, i.e. coefficient of retroreflected luminance R_L on wet markings and friction, are carried out after the measurements of the coefficient of retroreflected luminance R_L on dry markings, luminance coefficient under diffuse illumination Qd and chromaticity coordinates.

All measurement equipment will be calibrated.

6. Samples for identification

Samples of the base material and of the drop on material are taken from all products that are applied on the test fields for certification purposes. Samples are taken directly from the application machine during installation at the test field. The sampling is done by the administration of the road trials. An identification analysis is executed shortly after sampling, by an accredited testing laboratory, according to EN 12802:2001.

The purpose of the identification analysis is to make it possible for purchasers of road marking materials to check whether a purchased material corresponds to the material tested and certified at the test field.

The Norwegian Public Roads Administration, the Swedish Transport Administration, and the Danish Road Directorate will implement and apply an assessment system for materials used in contracts. Material analyses will be carried out both randomly and in case the road authority has reason to believe that the purchased material does not correspond to the product specification.

The assessment system is further described in the report *Method description – assessment of road marking materials used in contracts* (Johansen and Fors, 2018).

7. Certification

7.1. General

The certification system applies to Denmark, Norway and Sweden.

7.1.1. Norway and Sweden

In Norway and Sweden, material certification based on the results from the Norwegian-Swedish test site will be required in order to use the road marking material on roads managed by the national road authorities.

7.1.2. Denmark

In Denmark, the material certification will be based on the results from the supplementary test site in Denmark, and the documentation will be required in order to use the road marking material on roads managed by the national road authority.

7.1.3. Finland

At present the certification system does not apply to Finland. If Finland decides to join the certification system later, material certifications received from the Norwegian-Swedish road trials will be valid in Finland.

7.2. Certification materials and test materials

Suppliers will have to register their material(s) either as a *certification material*, or as a *test material*, before the material is applied on the test field.

- **Certification material:** The material is applied on the test field for certification purposes, which implies that it will receive certification for use in Norway and Sweden, or Denmark, provided that it fulfils the performance requirements. Application and performance measurements will be done in accordance with the procedures described in this report. The results of the materials registered as certification materials will be published in a public report, see Section 7.6. The administration of the road trials may use de-identified data for research purposes.
- **Test material:** The material is applied on the test field for test purposes only. The application and the performance measurement will be done in the same way as for certification materials. The results of the performance measurements will be available to the administration of the road trials, to the supplier of the material as well as to the steering group. The results will be confidential to other suppliers. The administration of the road trials may however use de-identified data for research purposes. Materials registered as test materials **cannot** receive certification. Test materials may be applied on the Norwegian-Swedish as well as on the Danish test site.

From 2016, the certification system includes both type I and type II markings. Materials that are applied as type I markings are certified (provided that they fulfil the performance requirements) for use as type I markings. Materials that are applied as type II markings are certified for use as type II markings only, and as assemblies, i.e. the combination of the material and the design/pattern applied on the test field. Materials that are certified as temporary markings, are certified for temporary use only.

7.3. Performance requirements

The performance requirements include four parameters for type I markings and five parameters for type II markings which are given in Table 1. These requirements apply also to inlaid markings. Table 2 shows the performance requirements for temporary markings and antiskid materials.

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

Performance parameter	White markings	Yellow markings	Applies to marking type
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, Q_d [mcd/m ² /lx]	130	100	I, II
Friction, [PFT units]	0.52	0.52	I, II
Chromaticity coordinates, x, y	*	**	I, II

*) According to EN 1436

**) Includes both daytime and night-time colour, according to EN 1436:2018.

Table 2. Performance requirements for temporary markings and antiskid materials.

Performance parameter	Temporary markings	Antiskid materials
Coefficient of retroreflected luminance, R_L dry [mcd/m ² /lx]	200	-
Coefficient of retroreflected luminance, R_L wet [mcd/m ² /lx]	-	-
Luminance coefficient under diffuse illumination, Q_d [mcd/m ² /lx]	130	130
Friction, [PFT units]	0.52	0.71
Chromaticity coordinates, x, y	**	*

*) According to EN 1436

**) Includes both daytime and night-time colour, according to EN 1436:2018.

Friction will be measured by a PFT (see also Section 5.3). A PFT value of 0.52 corresponds to an SRT value of 50 (S2), whereas a PFT value of 0.71 corresponds to an SRT value of 65 (S5).

At the initial measurements, the performance parameters are calculated as averages of the nine lines in the lane. At the follow-up measurements, the performance parameters are calculated as averages of the measurement points of one of the lines that belong to a certain P-class, see also Section 7.4.

As the average is the most representative value of the performance of the material, the performance of individual lines will not be evaluated at the initial measurement. This implies that there might be individual lines that do not fulfil the requirements, but as long as the average does, the material will be approved. This also implies that if the average is below any of the values in Table 1, all lines will be disqualified, regardless of whether individual lines fulfil the requirements.

Materials that do not fulfil the performance requirements at the initial measurement will be excluded from the certification program.

7.4. Certification in relation to roll-over classes

Materials will be certified in relation to the number of wheel passages it will stand. The nine lines on the test field will be exposed to different numbers of wheel passages, which means that different roll-over classes will be reached on different lines.

Roll-over classes according to EN 1824 will be determined from the measurements of wheel passages (see Section 3.3), for each of the nine lines (see Section 4.1), Table 3–Table 4. The tenth line on the shoulder at the Norwegian-Swedish test site will have no wheel passages and will thus not be included in the calculation of the performance parameters for certification purposes.

Materials will thus be certified for a certain roll-over class (P-class for permanent road markings or T-class for temporary road markings). In order to be certified, all relevant performance requirements (see Section 7.3) must be fulfilled for that particular class.

In case two or more of the nine lines represent the same roll-over class, the line most representative for the class will be chosen for analysis and the performance parameters of this line will be used as the result for that class. The same line will be used for all materials.

The materials have to fulfil the requirements for all classes lower than 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 1-year follow-up measurement), this certification is valid irrespective of the results of the measurements after two years. The 2-year follow-up measurements will merely be used to evaluate whether the material fulfils the requirement for a higher P-class than what it already is certified for.

The expected roll-over classes for permanent road markings range from approximately P0 to P3 or P4 after one year and P4 or P5 after two years at the Norwegian-Swedish test site. At the Danish test site, roll-over classes P0–P5 are expected after one year and P5.5–P6 after two years. The time needed to reach the different P-classes will be derived from the measurements of wheel passages, and possibly the points in time for the performance measurements will be adjusted in order to obtain data representing all (possible) P-classes.

Table 3. Roll-over classes for permanent road markings, EN 1824.

Roll-over class	Number of wheel passages
P0	$\leq 50\,000$
P1	Between 50 000 and 60 000
P2	$100\,000 \pm 20\%$
P3	$200\,000 \pm 20\%$
P4	$500\,000 \pm 20\%$
P5	$1\,000\,000 \pm 20\%$
P5.5	$1\,500\,000 \pm 20\%$
P6	$2\,000\,000 \pm 20\%$

Table 4. Roll-over classes for temporary road markings, EN 1824.

Roll-over class	Number of wheel passages
T0	$\leq 50\,000$
T1	Between 50 000 and 60 000
T2	$100\,000 \pm 20\%$

7.5. Validity of certification

Materials that have received certification from the Norwegian-Swedish test site are approved for use in Norway and Sweden. Materials that have received certification from the Danish test site are approved for use in Denmark.

A certification is valid until the material is changed or until the requirements are changed.

Certifications from other European countries are not valid in Norway, Sweden and Denmark due to climatic conditions and/or the use of studded tyres.

7.6. Documentation

The results of the one year and two years follow-up performance measurements of all materials registered as certification materials are published in a public report. Results are published regardless of whether the material fulfils the requirements or not. The names of the supplier and of the material are published along with the results.

The report includes a list of certified materials, and the roll-over classes the materials are certified for. Data from the performance measurements, i.e. the measured (averaged) values of each performance parameter for each P class and for each material, are presented as well.

The reports are freely available from www.vti.se.

The results of the initial measurements are compiled in reports which are distributed to the participants. Materials that are not approved at the initial measurements will not be included in the result reports of the follow-up measurements.

Report forms for registration, application and performance measurements can be found in Appendix 2–4.

7.7. Certificates

Certificates for materials that have fulfilled the requirements in one or more P-classes are issued in digital form (pdf files) after the result reports have been published. From 2018, certificates will be issued after the one-year follow-up performance measurements, regardless of whether the material is registered for one or two years follow-up. After the two years follow-up measurements, new certificates will be issued for materials that fulfils the requirements in higher P-classes. An example of the certificate is shown in Figure 7.

The product name on the certificate will be identical to that in the registration form. If the manufacturer wishes, there is a possibility to request new certificates with commercial product names. To request a new certificate, the following is required:

- Verification from an accredited laboratory that the product content is identical to the product that was applied on the test field.

- A signed declaration from the participant by person with a legally binding signature, verifying that the materials are identical.

Figure 7. An example of the certificate.

7.8. Complaints

Complaints related to measurement results and certification must be sent to the administration of the road trials within two weeks after the result report has been distributed to the participants, preferably by email. The administration of the road trials will handle the complaint and make a decision.

A copy of the decision will be sent to the road authority representatives (see Appendix 6).

7.9. Registration

The registration form for participation in the road trials can be found in Appendix 2. To be accepted for participation, the registration form must be completely filled out and all required documents must be enclosed.

The material that is applied on the test field must be identical to that specified in the registration form. It is not possible to make any changes when the material is applied on the test field. Any changes must be declared in written form, by sending a new registration form and/or new product documentation to the administration of the road trials at least one week before application on the test field.

An invitation to participate in the road trials, including the registration form and deadline for registration is sent out during the spring by the administration of the road trials.

7.10. Participant fee and other costs

A fee is charged for each material applied on the test fields. For type I, type II and antiskid materials, there are two options:

- 1-year follow-up: Includes administration, performance measurements after two weeks (initial) and after one year (follow-up), and documentation of the results.
Participant fee: SEK 35 000.
- 2-years follow-up: Includes administration, performance measurements after two weeks (initial) after one year and after two years (follow-up), and documentation of the results.
Participant fee: SEK 50 000.

For temporary markings and inlaid markings, the following fees apply:

- Temporary markings: 1-3 months follow-up measurements, and documentation of the results.
Participant fee: SEK 35 000.
- Inlaid markings: Includes administration, milling of the tracks, performance measurements after two weeks (initial) after one year and after two years (follow-up), and documentation of the results.
Participant fee: SEK 55 000.

The same participant fees apply to certification materials and test materials.

The participant fee will be charged before the application of materials. If payment has not been received, materials must not be applied on the test field.

Costs for application of materials (cost of labour, material, equipment) are paid by the supplier.

The administration of the road trials will bear the costs for closing of the road, pre-marking, plates for thickness measurements and containers for material samples.

References

Freitas, E. F., Pereira, P. A. A., Antunes, M. L. and Domingos, P. (2008). *Analysis of test methods for texture depth evaluation applied in Portugal*. C-TAC - Comunicações a Conferências Nacionais, Portugal.

Kottek, M., Grieser, J., Beck, C., Rudolf, B. and Rubel, F. (2006). *World Map of Köppen-Geiger Climate Classification updated*. Meteorol. Z. **15**(3):259–263. Web:
<http://koeppen-geiger.vu-wien.ac.at/present.htm>

Trafikverket (2014). *Undersökning av däcktyp i Sverige – vintern 2014 (januari-mars)*. Trafikverket publikation 2014:100. Web:
http://www.dackinfo.se/wp-content/uploads/2012/04/Dackundersokning_PV_vinter_2014.pdf

Wälivaara, B. (2007). *Validering av VTI-PFT version 4. Mätningar på plana och profilerade vägmarkeringar*. VTI notat 16-2007. Statens väg- och transportforskningsinstitut, Linköping.

Appendix 1. Terms and definitions

<i>AADT</i>	<i>Annual average daily traffic</i> , a measure of traffic flow.
Antiskid material	A material with enhanced antiskid (friction) properties.
Certification material	A material that is applied on the test field for certification purposes, see also Section 7.2.
Chromaticity coordinates, x, y	Describes the colour of the material.
Coefficient of retroreflected luminance, R_L	Retroreflection under vehicle headlamp illumination.
Luminance coefficient under diffuse illumination, Q_d	Reflection in daylight.
P-class	The P-class (synonym: roll-over class) describes the number of wheels passing over a point of a road surface within a specified period of time, for permanent road markings.
<i>PFT</i>	<i>Portable Friction Tester</i> , an instrument for measurement of friction.
Roughness class	Describes the roughness of a road surface.
<i>SDS</i>	<i>Safety Data Sheet</i> , a documentation of the properties and safe use of chemicals.
<i>SRT</i>	<i>Skid Resistance Tester</i> , an instrument for measurement of skid resistance (friction).
T-class	The T-class (synonym: roll-over class) describes the number of wheels passing over a point of a road surface within a specified period of time, for temporary road markings.
Test material	A material that is applied on the test field for test purposes, see also Section 7.2. Test materials cannot receive certification.
Type I marking	A flat marking.
Type II marking	A marking with enhanced wet night visibility.

Appendix 2. Report form for registration of materials

Registration of material

Company			
Manufacturer:			
Address:			
Contact person:			
Phone:			
E-mail:			
Invoicing information			
Invoicing address: <i>(street address, postal code, city, country OR email address)</i>		Reference: (optional)	
		VAT number:	
Material			
Name of material:			
Country of origin:			
Material type:	<input type="checkbox"/> Thermoplastic extrusion/screed <input type="checkbox"/> Cold plastic <input type="checkbox"/> Thermoplastic spray <input type="checkbox"/> Paint <input type="checkbox"/> Thermoplastic preformed <input type="checkbox"/> Other:		
Density of material: <i>(When applied)</i>			
Name of drop on: <i>(Full product name, including producer, size distribution, percentage of antiskid material etc)</i>			
Rate of application of drop on components:			
Test site:	<input type="checkbox"/> Danish test site <input type="checkbox"/> Norwegian-Swedish test site		
Certification or test:	<input type="checkbox"/> Certification material <input type="checkbox"/> Test material		
Marking type:	<input type="checkbox"/> Type I marking <input type="checkbox"/> Type II marking <input type="checkbox"/> Antiskid material <input type="checkbox"/> Inlaid marking <i>(Norway only)</i> <input type="checkbox"/> Temporary marking <i>(Denmark only)</i> For type II markings, type of profile/pattern:		
Colour:	<input type="checkbox"/> White <input type="checkbox"/> Yellow <input type="checkbox"/> Other: _____ <i>("Other" is only allowed for test materials)</i>		

Intended thickness at application:	<input type="checkbox"/> 0.4 mm <input type="checkbox"/> 0.6 mm <input type="checkbox"/> 1.5 mm <input type="checkbox"/> 3.0 mm <input type="checkbox"/> 5.0 mm <i>(type II and antiskid materials only)</i>	
Application method at test field:	<input type="checkbox"/> Self-propelled machine <input type="checkbox"/> By hand	
Application method at normal use:	<input type="checkbox"/> Extrusion/screed <input type="checkbox"/> Spray <input type="checkbox"/> Manually w/heater	
Follow-up:	<input type="checkbox"/> 1 year (SEK 35 000) <input type="checkbox"/> 2 years (SEK 50 000) <input type="checkbox"/> 2 years, inlaid markings (SEK 55 000) <input type="checkbox"/> Temporary markings (SEK 35 000)	
Signature		
<p>To be accepted for participation, the registration form must be completely filled out and all required documents must be enclosed. The participant fee must be paid before application on the test field. The material that is applied on the test field must be identical to that specified in the registration form. See also Section 7.9 in the instruction.</p>		
I hereby certify that the material complies with current chemicals legislation and practice in the Nordic countries:		<input type="checkbox"/> Yes
The following documentation is enclosed with the registration form (mandatory):		
Document:	Filename:	
<input type="checkbox"/> Product sheet, road marking material		
<input type="checkbox"/> Product sheet, drop on materials		
<input type="checkbox"/> Safety Data Sheet (SDS), road marking material		
<input type="checkbox"/> Safety Data Sheet (SDS), drop on materials		
Place and date:		
Signature:		
Clarification of signature:		

To be filled in by the administration of the road trials

Date	
Material ID	

Appendix 3. Report form for application of materials

Application of material

Product data	
Manufacturer:	
Name of material:	
Name of drop on:	
Material ID:	
Type:	<input type="checkbox"/> Certification material <input type="checkbox"/> Test material
Pattern of application:	<input type="checkbox"/> Type I <input type="checkbox"/> Type II. Type of profile: _____ <input type="checkbox"/> Antiskid material <input type="checkbox"/> Inlaid marking <input type="checkbox"/> Temporary marking
	Type II: the type of profile has been documented by a photo: <input type="checkbox"/> Yes
Colour:	<input type="checkbox"/> White <input type="checkbox"/> Yellow <input type="checkbox"/> Other: _____
Thickness:	<input type="checkbox"/> 0.4 mm <input type="checkbox"/> 0.6 mm <input type="checkbox"/> 1.5 mm <input type="checkbox"/> 3.0 mm <input type="checkbox"/> 5.0 mm
Test site	
Test site:	<input type="checkbox"/> Danish test site <input type="checkbox"/> Norwegian-Swedish test site
Position on test site:	
Application	
Date of application:	
Installed by (contractor):	
Application method:	<input type="checkbox"/> Self-propelled machine <input type="checkbox"/> By hand
Application device:	
Thickness at application:	_____ mm <input type="checkbox"/> Approved <input type="checkbox"/> Not approved (<i>measured using a steel plate</i>)
Thickness samples:	Number: _____ <input type="checkbox"/> Approved <input type="checkbox"/> Not approved
Meteorological data	
Road surface temperature (°C):	
Ambient temperature (°C):	
Wind speed (m/s):	
Humidity (%):	
Comments	

Supplier's signature	
I hereby approve the application of the material and its participation in the road trials:	<input type="checkbox"/> Yes <input type="checkbox"/> No
Date:	
Place:	
Signature:	
Clarification of signature:	
Administrator's signature	
The material fulfils the requirements for participation in the road trial:	<input type="checkbox"/> Yes <input type="checkbox"/> No
Date:	
Place:	
Signature:	
Clarification of signature:	

Appendix 4. Report form for performance measurements

Performance measurements (preliminary version)

Material and test site										
Material ID:										
Test site:	<input type="checkbox"/> Danish test site <input type="checkbox"/> Norwegian test site									
Position on test site:										
Meteorological data:										
Road marking temperature (°C):										
Ambient temperature (°C):										
Relative humidity (%):										
Measurements										
Date of measurements:										
Type:	<input type="checkbox"/> Initial <input type="checkbox"/> 1 year <input type="checkbox"/> 2 years									
Line (1 is the rightmost in the direction of the lane)	1	2	3	4	5	6	7	8	9	10
R_L (mcd/m ² /lx), point 1										
R_L (mcd/m ² /lx), point 2										
R_L (mcd/m ² /lx), point 3										
Qd , (mcd/m ² /lx), point 1										
Qd , (mcd/m ² /lx), point 2										
Qd , (mcd/m ² /lx), point 3										
PFT										
Colour, x, white										
Colour, y, white										
Colour, x, yellow Y1										
Colour, y, yellow Y1										
Colour, x, yellow NTY										
Colour, y, yellow NTY										
Comments:										

Administrator's signature	
The performance measurements have been done in accordance with prescribed procedures:	<input type="checkbox"/> Yes
Date:	
Place:	
Signature:	
Clarification of signature:	

Appendix 5. Product sheet requirements

Road marking materials

As a minimum, the product sheet of the road marking material should include the following information:

- Name of material
- Manufacturer and contact information
- Country of origin
- Field(s) of application
- Technical data (if relevant): colour, density, thinner, content (%) of components (eg. binder, solvent, glass beads)
- Application instructions (if relevant):
 - Preparation of material
 - Preparation of road surface
 - Weather restrictions
 - Recommendations on layer thickness
 - Recommendations on drop-on material
 - Recommendations on application technique
- Packaging information
- Storage information

Drop-on materials

As a minimum, the product sheet of the drop-on material should include the following information:

- Name of material
- Manufacturer and contact information
- Country of origin
- Technical specification (if relevant): size distribution, coating, refractive index, perfect/defective beads (%), hazardous substances
- Application instructions (if relevant)
- Affirmation that the product is in accordance with EN1423
- Packaging information
- Storage information

Safety data sheets (SDS)

Safety data sheets (SDS) for road marking materials and for drop-on materials must be compiled according to the REACH regulations.

For further information, see:

<http://echa.europa.eu/regulations/reach>

Guidelines for compilation of safety data sheets:
http://echa.europa.eu/documents/10162/13643/sds_en.pdf

Appendix 6. Contact information

Name	Organisation	E-mail	Phone
Road authority representatives			
Kenneth Kjemtrup	The Danish Road Directorate, Denmark	kk@vd.dk	+45 724 437 18
Björn Skaar	The Norwegian Public Roads Administration, Norway	bjorn.skaar@vegvesen.no	+47 915 02 030
Ulf Söderberg	The Swedish Transport Administration, Sweden	ulf.a.soderberg@trafikverket.se	+46-771 921 921
Administration of the road trials			
Trond Cato Johansen (Project leader)	Ramböll, Norway	Trond-Cato.Johansen@ramboll.se	+47 905 365 05
Carina Fors	The Swedish National Road and Transport Research Institute (VTI), Sweden	carina.fors@vti.se	+46 709 430 436

For questions about the road trials and the certification system, please contact Trond Cato Johansen.

For questions related to national guidelines, tendering, and contracts, please contact the respective road authority representative.

VTI, Statens väg- och transportforskningsinstitut, är ett oberoende och internationellt framstående forskningsinstitut inom transportsektorn. Huvuduppgiften är att bedriva forskning och utveckling kring infrastruktur, trafik och transporter. Kvalitetssystemet och miljöledningssystemet är ISO-certifierat enligt ISO 9001 respektive 14001. Vissa provningsmetoder är dessutom ackrediterade av Swedac. VTI har omkring 200 medarbetare och finns i Linköping (huvudkontor), Stockholm, Göteborg, Borlänge och Lund.

The Swedish National Road and Transport Research Institute (VTI), is an independent and internationally prominent research institute in the transport sector. Its principal task is to conduct research and development related to infrastructure, traffic and transport. The institute holds the quality management systems certificate ISO 9001 and the environmental management systems certificate ISO 14001. Some of its test methods are also certified by Swedac. VTI has about 200 employees and is located in Linköping (head office), Stockholm, Gothenburg, Borlänge and Lund.

HEAD OFFICE
LINKÖPING
SE-581 95 LINKÖPING
PHONE +46 (0)13-20 40 00

STOCKHOLM
Box 55685
SE-102 15 STOCKHOLM
PHONE +46 (0)8-555 770 20

GOTHENBURG
Box 8072
SE-402 78 GOTHENBURG
PHONE +46 (0)31-750 26 00

BORLÄNGE
Box 920
SE-781 29 BORLÄNGE
PHONE +46 (0)243-44 68 60

LUND
Medicon Village AB
SE-223 81 LUND
PHONE +46 (0)46-540 75 00

