



# Nordic certification system for road marking materials

Version 3:2016

Carina Fors  
Trond Cato Johansen  
Sven-Olof Lundkvist



VTI notat 17A-2016

# **Nordic certification system for road marking materials**

**Version 3:2016**

Carina Fors

Trond Cato Johansen

Sven-Olof Lundkvist

Diarienummer: 2015/0161-8.2

Omslagsbilder: Mohammad-Reza Yahya/VTI och Trond Cato Johansen/Ramböll

Tryck: LiU-Tryck, Linköping 2016

---

## 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.

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 the countries of 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, The Danish Road Directorate, Tuomas Österman, Finnish Transport Agency, Bjørn Skaar, The Norwegian Public Roads Administration, Lars Petersson, The Swedish Transport Administration, Kai Sørensen, Johnsen Consult, Trond Cato Johansen, Ramböll, and Carina Fors and Sven-Olof Lundkvist, The Swedish National Road and Transport Research Institute (VTI).

Linköping, May 2016

*Carina Fors*

---

## Quality review

---

Internal peer review was performed on 6 June 2016 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 7 June 2016. 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 6 Juni 2016 av Anna Anund. Carina Fors har genomfört justeringar av slutligt rapportmanus. Forskningschef Anna Anund har därefter granskat och godkänt publikationen för publicering 7 juni 2016. De slutsatser och rekommendationer som uttrycks är författarnas egna och speglar inte nödvändigtvis myndigheten VTI:s uppfattning.

---

# Content

---

<b>Summary .....</b>	<b>7</b>
<b>Sammanfattning .....</b>	<b>9</b>
<b>1. Introduction .....</b>	<b>11</b>
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.....	11
1.1.4. Finland .....	12
1.2. Roles and responsibilities.....	12
<b>2. Road marking materials .....</b>	<b>13</b>
2.1.1. Colour .....	13
2.1.2. Type I and type II.....	13
2.1.3. Content of material .....	13
2.1.4. Requirements regarding health, environment and safety .....	13
<b>3. Test sites .....</b>	<b>15</b>
3.1. The Swedish test site.....	15
3.1.1. Location .....	15
3.1.2. Road characteristics .....	15
3.1.3. Traffic volume .....	16
3.1.4. Climatic conditions .....	16
3.1.5. Studded tyres.....	17
3.2. The Danish test site.....	17
3.2.1. Location .....	17
3.2.2. Road characteristics .....	17
3.2.3. Traffic volume .....	18
3.2.4. Climatic conditions .....	19
3.2.5. Studded tyres.....	19
3.3. Measurements of wheel passages.....	19
3.4. Measurements of weather conditions.....	19
<b>4. Application of road marking materials .....</b>	<b>21</b>
4.1. Application pattern.....	21
4.2. Application method.....	21
4.3. Material thickness .....	21
4.4. Weather conditions at application.....	22
4.5. Practical information about the application of materials .....	22
4.6. Suppliers' responsibilities .....	22
<b>5. Performance measurements .....</b>	<b>24</b>
5.1. Periodicity of measurements .....	24
5.2. Performance parameters.....	24
5.3. Measurement details .....	24
<b>6. Samples for identification .....</b>	<b>26</b>
<b>7. Certification .....</b>	<b>27</b>
7.1. General.....	27

7.1.1. Norway and Sweden .....	27
7.1.2. Denmark.....	27
7.1.3. Finland .....	27
7.2. Certification materials and test materials.....	27
7.3. Performance requirements .....	28
7.4. Certification in relation to P-classes .....	28
7.5. Validity of certification.....	29
7.6. Documentation.....	29
7.7. Complaints .....	30
7.8. Participant fee and other costs.....	30
<b>References .....</b>	<b>31</b>
<b>Appendix 1 – Terms and definitions.....</b>	<b>33</b>
<b>Appendix 2 – Report form for registration of materials.....</b>	<b>35</b>
<b>Appendix 3 – Report form for application of materials.....</b>	<b>37</b>
<b>Appendix 4 – Report form for performance measurements .....</b>	<b>39</b>
<b>Appendix 5 – Product sheet requirements .....</b>	<b>41</b>
Road marking materials .....	41
Drop-on materials .....	41
Safety data sheets (SDS).....	42
<b>Appendix 6 – Contact information .....</b>	<b>43</b>



---

## Summary

---

### **Nordic certification system for road marking materials – Version 3:2016**

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

Material tests are carried out at two test sites: one in Sweden 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 RL under dry and wet conditions, luminance coefficient under diffuse illumination Qd, friction and colour coordinates. The number of wheel passages are 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 3:2106**

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

Materialtester görs på två provfält: ett i Sverige 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 RL, luminanskoefficient Qd, 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. 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 road marking *materials* only. For type II (structured/profiled) markings, the certification comprises the *assembly*, i.e. the material itself 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.

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 will apply to roads managed by *The Norwegian Public Roads Administration*.

#### 1.1.2. Sweden

The certification system will apply to roads managed by *The Swedish National Transport Administration*.

#### 1.1.3. Denmark

The certification system will apply 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:

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

The Swedish National Road and Transport Research Institute (VTI) has the formal responsibility of the road trials and the material approval. VTI supervises the measurements and analyses data. Ramböll carries out measurements and is responsible for administration and contact with participants.

The procedures and the guidelines for the road trials and for the certification system has 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 includes materials for longitudinal markings only. Any material intended for longitudinal marking can be used, including preformed road markings, provided that the materials comply with current legislation.

Materials for temporary markings and inlaid markings are not yet 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 methods<sup>1</sup> 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. Content of material

All ingredients/components of the material, including glass beads 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 beads: the certification permits the use of another drop on glass beads than those that was used on the road trials, provided that the technical specifications of the products are identical.

Product data sheets for the road marking material and for the drop on glass beads must be handed in together with the registration form. Suppliers will not be asked to provide the administration of the road trials with recipes of their materials, however, national agencies may require a certain specification to check whether the materials fulfil their national environmental requirements. For further information, see Appendix 5.

Drop on glass beads shall be in accordance with EN1423, and their properties shall be documented according to the specifications and classes given in the named standard.

### 2.1.4. 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

---

<sup>1</sup> 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).

metals or other materials that are in violation of legislation. Volatile organic compounds (VOCs) shall not exceed 2% by weight of any materials.

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 carried out in Sweden and Denmark. The locations of the test sites are shown in Figure 1.

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



Figure 1. Locations of the test sites.  
(Image: modified from NuclearVacuum/CC-BY-SA-3.0)

#### 3.1. The Swedish test site

##### 3.1.1. Location

The Swedish test site is located close to the village Sunne in western Sweden, approximately 130 km east of Oslo, Norway. The location is intended to represent the average climate conditions in Finland, Norway and Sweden.

The road used for the test site is road E45, from 3 km north of Sunne to approximately 8 km north of Sunne. The GPS coordinates in WGS84 DDM are:

- Start: N 59° 51.945, E 13° 07.988
- End: N 59° 54.398, E 13° 08.060

Signs with the text *Provält vägmarkering* (English: *Test field, road markings*) will 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 a fairly 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 the northbound lane is used as test field. This minimizes the risk of poor visual conditions due to sun glare for drivers passing the test site.

There are some minor intersections along the road. Road marking materials are not applied in the intersections.



Figure 2. The road used for the Swedish test site. Photo: Mohammad-Reza Yahya, VTI.

The width of the road is 9 m. Each lane is 3.75 m and the shoulders are 0.75 m.

The road surface consists of a thin asphalt overlay that was placed in 2012. The roughness class is RG3 i.e. the averaged measured texture depth is in the range of 0.90–1.20 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.

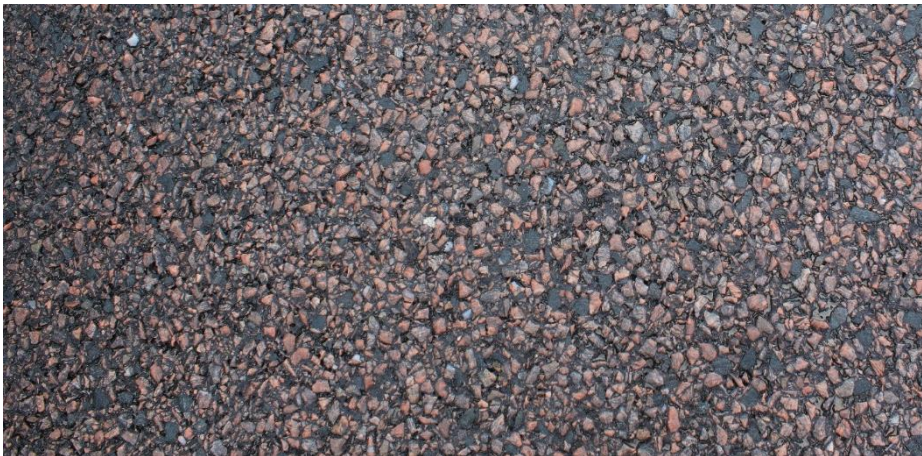


Figure 3. The road surface on the Swedish test site. Photo: Mohammad-Reza Yahya, VTI.

### 3.1.3. Traffic volume

The annual average daily traffic (AADT) is 3910 vehicles per day (estimated in 2014). The amount of heavy vehicles is 11 % 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 annual average temperature during the years 2009–2013 was 5 °C. The average temperature during summer was 15 °C and during winter -6 °C. The highest and lowest temperatures registered

were 31 °C and -28 °C, respectively. The annual average precipitation was 743 mm. On average, there was snow approximately 4 months per year. (*Weather data: www.smhi.se*)

The Köppen classification of the test site is Dfb, close to the boundary of the Dfc 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 Sweden from 1 October to 15 April. There is no data available regarding the amount of vehicles with studded tyres on the test site road, but in Karlstad, which is located 70 km south of the test site, the amount of cars with studded tyres was 80 % in 2014 (Trafikverket, 2014). Heavy vehicles may use studded tyres, but usually they have studless winter tyres.

## 3.2. The Danish test site

### 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:

- Start: N 55° 32.895, E 11° 12.446
- End: N 55° 33.169, E 11° 12.158

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

Please note that the test site described above, which will be used from 2016, is not the same as the test site used in 2015.



*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.

Details about the road surface (type, age, roughness class) was not available at the time of printing, but will be sent out to participants as soon as possible. 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 7400 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 2011–2015 was 9 °C. The highest and lowest temperatures registered were 30 °C and -15 °C, respectively. On average, the temperature was below 0 °C 56 days per year. The annual average precipitation was 620 mm and the average number of sun hours was 1760. (*Weather data: [www.dmi.dk](http://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 amount 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
- Number of times the snow plough has operated

Meteorological data is retrieved from *the Swedish Meteorological and Hydrological Institute* (SMHI) and *the Danish Meteorological Institute* (DMI), respectively. Information about snow plough operations is obtained from the road entrepreneurs.

---

## 4. Application of road marking materials

---

The application of road marking materials are 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:

- Six longitudinal lines in a row in the lane and, at the Swedish test site, a seventh line on the shoulder
- Length of the lines: 2,5 m
- Width of the lines: 0.3 m
- Distance between two adjacent lines: 0.2–0.3 m (depends on the width of the lane)
- Distance between two adjacent rows of lines: Depends on the number of materials/rows, but at least 2 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 seventh line on the shoulder serves as a reference without any wheel passages.

A dummy material not included in the actual tests will 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. Application by hand is permitted, e.g. in case the supplier does not have a self-propelled machine. The application method will be documented in the certification report.

### 4.3. Material thickness

Materials can be applied in three thicknesses:

- 0.4 mm wet (paint). Maximum thickness allowed at application: 0,45mm wet.
- 1.5 mm (example: spray plastic). Maximum thickness allowed at application: 2.0 mm.
- 3.0 mm (example: extruded thermoplastic). Maximum thickness allowed at application: 3.5 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 also 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. 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.

#### 4.5. Practical information about the application of materials

The test sites will be open for application of materials for approximately one week. 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.

#### 4.6. 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 and every material applied on the test field is to be signed by the participant and the administration, 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)
- 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 skills (see link below), before the application occasion. This applies to all personnel that will be at the test site during the application.

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. For personnel working on the road, doing measurements etc. at the Swedish test site, a minimum level of road work safety training is required, see web link below.



Web link to the Swedish Transport Administration online “Road work - basic” course and test:  
<http://www.trafikverket.se/en/startpage/suppliers/Work-on-the-road-basic-skills/>

Please contact the administration of the road trials for contact details of the respective road administrations and of suppliers of safety barriers.

---

## 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.

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* 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.

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 are taken from all materials 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 procedures for material analysis that will be applied in future contracts and purchases. Material analyses will be carried out both randomly and in case the road authority has reason to believe that the purchased material do not correspond to the product specification.

---

## 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 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 road trial 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 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.
- **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 and to the supplier of the material. The results will be confidential to other suppliers. The results will not be published anywhere, not even in a de-identified form. Materials registered as test materials **cannot** receive certification. Test materials may be applied on the 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 and, until further notice<sup>2</sup>, also for use as type II 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.

---

<sup>2</sup> This might be changed when there are certified type II materials available.

### 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.

Table 1. Performance requirements.

Performance parameter	White markings	Yellow markings	Applies to marking type
Coefficient of retroreflected luminance, $R_L$ dry [ $\text{mcd}/\text{m}^2/\text{lx}$ ]	150	100	I, II
Coefficient of retroreflected luminance, $R_L$ wet [ $\text{mcd}/\text{m}^2/\text{lx}$ ]	35	35	II
Luminance coefficient under diffuse illumination, $Q_d$ [ $\text{mcd}/\text{m}^2/\text{lx}$ ]	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. Daytime colour: according to class Y1 in EN 1436. Night-time colour: according to ASTM D6628.

Friction will be measured by a PFT (see also section 5.3). A PFT value of 0.52 corresponds to a SRT value of 50.

At the initial measurements, the performance parameters are calculated as averages of the six lines in the lane. At the follow-up measurements, the performance parameters are calculated as averages 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 (or, at the follow-up measurements, the lines belonging to the same P-class) will be approved. This also implies that if the average is below any of the values in Table 1, all lines (at the follow-up measurements: all lines belonging to the same P-class) 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 P-classes

Materials will be certified in relation to the number of wheel passages it will stand. The six 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 six lines (see Section 4.1), Table 2. The seventh line on the shoulder at the Swedish test site will have no wheel passages and will thus not be included in the calculation of the performance parameters for certification purposes.

The expected roll-over classes range from approximately P0 to P3 or P4 after one year and P4 or P5 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 of time for the performance measurements will be adjusted in order to obtain data representing all (possible) P-classes.

Materials will thus be certified for a certain roll-over class (P-class). In order to be certified, all four performance requirements must be fulfilled for that particular class.

In case two or more of the six lines represent the same P-class, the average of the performance parameters of these lines will be used as the result for that P-class.

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.

Table 2. Roll-over classes, 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	$2\ 000\ 000 \pm 20\ \%$

## 7.5. Validity of certification

Materials that have received certification from the 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 forever 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 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](http://www.vti.se).

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

## 7.7. 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).

## 7.8. Participant fee and other costs

A fee is charged for each material applied on the test fields. 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.**

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](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.
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.
<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).
Test material	A material that is applied on the test field for test purposes, see also section 7.2. Test materials <b>cannot</b> receive certification.
Type I marking	A flat marking.
Type II marking	A structured or profiled marking, with enhanced wet night visibility.



## Appendix 2 – Report form for registration of materials

### Registration of material

<b>Company</b>			
Manufacturer:			
Contact person:			
Phone:			
E-mail:			
<b>Invoicing information</b>			
Invoicing address: (street address, postal code, city, country)	Reference: (optional)		
	VAT number:		
<b>Material</b>			
Name of material:			
Country of origin:			
Material type:			
Type: <i>Select either Certification material or Test material (see section 7.2 in the instruction)</i>	<input type="checkbox"/> Certification material	<input type="checkbox"/> Swedish test site	<input type="checkbox"/> Type I
	<i>Select test site and material type →</i>	<input type="checkbox"/> Danish test site	<input type="checkbox"/> Type II
	<input type="checkbox"/> Test material	<input type="checkbox"/> Swedish test site	<input type="checkbox"/> Type I
	<i>Select test site and material type →</i>	<input type="checkbox"/> Danish test site	<input type="checkbox"/> Type II
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"/> 1.5 mm <input type="checkbox"/> 3.0 mm		
Follow-up:	<input type="checkbox"/> 1 year (SEK 35 000) <input type="checkbox"/> 2 years (SEK 50 000)		
Application method:	<input type="checkbox"/> Self-propelled machine <input type="checkbox"/> By hand		
<b>Signature</b>			
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):		<input type="checkbox"/> Product sheet, road marking material <input type="checkbox"/> Product sheet, drop on glass beads <input type="checkbox"/> Safety Data Sheet (SDS)*, road marking material <input type="checkbox"/> Safety Data Sheet (SDS)*, drop on glass beads	
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:		
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: _____	
	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"/> 1.5 mm <input type="checkbox"/> 3.0 mm	
Test site		
Test site:	<input type="checkbox"/> Danish test site <input type="checkbox"/> 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:	Recommended by manufacturer	As applied on the test site
Road surface temperature (°C):		
Ambient temperature (°C):		
Wind speed (m/s):		
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:	
<b>Administrator's signature</b>	
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"/> Swedish 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 <i>(1 is the rightmost in the direction of the lane)</i>	1	2	3	4	5	6	7
$R_L$ (mcd/m <sup>2</sup> /lx), point 1							
$R_L$ (mcd/m <sup>2</sup> /lx), point 2							
$R_L$ (mcd/m <sup>2</sup> /lx), point 3							
$Q_d$ , (mcd/m <sup>2</sup> /lx), point 1							
$Q_d$ , (mcd/m <sup>2</sup> /lx), point 2							
$Q_d$ , (mcd/m <sup>2</sup> /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
- 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
- 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](http://echa.europa.eu/documents/10162/13643/sds_en.pdf)

## Appendix 6 – Contact information

### Working group

Name	Organisation	E-mail	Phone
<b>Road authority representatives</b>			
Kenneth Kjemtrup	The Danish Road Directorate, Denmark	kk@vd.dk	+45 724 437 18
Tuomas Österman	Finnish Transport Agency, Finland	Tuomas.Osterman@fta.fi	+358 295 34 3000
Bjørn Skaar	The Norwegian Public Roads Administration, Norway	bjorn.skaar@vegvesen.no	+47 915 02 030
Lars Petersson	The Swedish Transport Administration, Sweden	lars.petersson@trafikverket.se	+46-771 921 921
<b>Administration of the road trials</b>			
Trond Cato Johansen	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
Sven-Olof Lundkvist	The Swedish National Road and Transport Research Institute (VTI), Sweden	sven-olof.lundkvist@vti.se	+46 709 103 250
<b>Consult</b>			
Kai Sørensen	Johnsen Consult, Denmark	kai.sorensen@newmail.dk	-

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

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

