BS EN 1824:2011

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Road marking materials — Road trials

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National foreword

This British Standard is the UK implementation of EN 1824:2011. It supersedes BS EN 1824:1998 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/509/2, Horizontal road markings and road studs.

A list of organizations represented on this committee can be obtained on request to its secretary.

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ISBN 978 0 580 72621 7

ICS 93.080.20

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 June 2011.

Amendments issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 1824

June 2011

ICS 93.080.20

Supersedes EN 1824:1998

English Version

Road marking materials - Road trials

Produits de marquage routier - Essais routiers

Straßenmarkierungsmaterialien - Feldprüfungen

This European Standard was approved by CEN on 22 April 2011.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. EN 1824:2011: E

Contents

Foreword

This document (EN 1824:2011) has been prepared by Technical Committee CEN/TC 226 “Road equipment”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2011, and conflicting national standards shall be withdrawn at the latest by December 2011.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 1824:1998.

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The Annexes A to G of this European Standard are normative and Annex H is informative.

This European Standard is one of a package of inter-related European Standards with a common date of withdrawal (dow) fixed on December 2011 *(including the request of an extension for the co-existence period)*:

— EN 1790, *Road marking materials — Preformed road markings*,

— EN 1824, *Road marking materials — Road trials*,

— EN 1871, *Road marking materials — Paint, thermoplastic and cold plastic materials — Specifications,*

— EN 12802, *Road marking materials — Laboratory methods for identification*,

— EN 13197, *Road marking materials — Wear simulator Turntable*,

— EN 13212, *Road marking materials — Requirements for factory production control*,

— EN 13459, *Road marking materials — Sampling and testing*.

1 Scope

This document specifies the requirements for conducting road trials for road marking materials intended for use in both permanent and temporary road marking. Details are given for test sites, for the application of road marking materials on the test sites, for the parameters to be measured and the frequency of the measurements and for the presentation of the results in the form of a test report.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1436, *Road marking materials — Road marking performance for road users*

EN 13036-1, *Road and airfield surface characteristics — Test methods — Part 1: Measurement of pavement surface macrotexture depth using a volumetric patch technique*

3 Terms and definitions

For the purpose of this document, the following terms and definitions apply.

3.1
roll-over
number of wheels passing over a point of a road surface within a specified period of time

3.2
useful rate of application
quantity, expressed in $g \times m^{-2}$, of drop-on and/or non-drop materials which have adhered to the road marking substrate, when lines are done

3.3
rate of consumption during application
quantity, expressed in $g \times m^{-2}$, of drop-on or injection materials at the exit of the guns of the application equipment

3.4
percentage of heavy vehicles
ratio between the number of heavy vehicles and the number of all vehicles circulating on the test site

4 Test sites and conditions

4.1 General

Test sites shall be arranged at suitable locations in accordance with 4.2 to 4.5. The test results may depend on test field location, climate, road surface and traffic which shall be described according to 4.2 to 4.6.

4.2 Test sites characteristics and location

The test site shall be located in an area which belongs to one of the climatic classes defined in 4.3.

The test site shall consist of a field, where the road marking materials are to be applied, with extra space at both ends. The roads used for test sites should be straight and flat and without junctions, substantial obstacles to daylight, sources of frequent dirt (quarries, field exits, etc.) or tracked vehicles.

NOTE It is desirable to have additional areas at the roadsides in order to allow safe working conditions and convenient operation of application with road marking equipment.

The percentage of heavy vehicles on the test site shall be 10 % to 25 % of all vehicles.

The location of the test site shall be indicated in the test report.

4.3 Climatic conditions and classes

Climatic classes (see Table 1) are defined according to the Köppen classification and the use of winter maintenance.

Köppen classification shall be determined according to Annex A.

Winter maintenance is defined by the number of times that snowplough have operated on the test field during the road trials. Winter maintenance is applicable if this number is equal to or greater than 20 and shall be considered only for the Köppen zone Cfb.

Table 1 – Test Field climatic classes

Climatic Class	Climatic zone according to Köppen
C1	Dfc E
C2	Cfb without Winter maintenance
C3	Cfb with Winter maintenance Dfb Dsb
C4	Csa Bsh Cfa Csb

4.4 Road surface conditions and classes

Road trials shall be carried out on asphaltic road surfaces of an age of 1 year or more, which are in good condition and not in need of repair for the duration of the road trials and are not damaged by the presence of wheel tracks, fissures, cracks or similar. Highly porous surfaces shall be avoided.

NOTE 1 Road trials on cement concrete surfaces do not give repeatable results because of on-going chemical reactions.

NOTE 2 Road trials on highly porous surfaces do not give comparable results due to the draining properties.

At the commencement of a road trial, a road surface report of the road trial shall be available. The test surface report shall include a general description of the road surface and an account of the texture depth (MTD: mean texture depth), determined in accordance with EN 13036-1.

The MTD shall be measured at several locations on the test field. The number of measurements depends on the test field length. Measurements shall be carried out, at least, at three transversal locations and repeated every 30 m on the test field. The transversal measurements locations are in the centre of the carriageway, near the right and left edge line.

The averaged mean texture depth is derived from these measurements. The standard deviation shall be less than 0,15 mm.

NOTE 3 The averaged texture depth may also be directly determined in accordance with EN ISO 13473-1. Depending to the averaged measured texture depth, the test field roughness is described in term of roughness class according to Table 2.

Table 2 – Test field roughness classes

Roughness class	Averaged measured texture depth
RG1	≤ 0,60 mm
RG2	> 0,60 mm and ≤ 0,90 mm
RG3	> 0,90 mm and ≤ 1,20 mm
RG4	> 1,20 mm

NOTE 4 The texture depth has an influence on the result of road trials, at least for materials applied in thin layers.

4.5 Roll-over classes

The volume of traffic shall be such as to ensure that one or more measurement areas with the desired roll-over class can be selected (see 7.2).

At the termination of a road trial, a traffic report for the duration of the road trial should be made available. The traffic report shall include the roll-over classes according to Table 3, determined on the measurement area(s) in accordance with Annex B.

Table 3 – Roll-over classes

Roll-over class	Number of wheel passages
T0	≤ 50 000
T1	Between 50 000 and 60 000
T2	100 000 ± 20 %
P0	≤ 50 000
P1	Between 50 000 and 60 000
P2	100 000 ± 20 %
P3	200 000 ± 20 %
P4	500 000 ± 20 %
P5	1 000 000 ± 20 %
P5.5	1 500 000 ± 10 %
P6	2 000 000 ± 10 %
NOTE The roll-over classes T0, T1 and T2 are for materials intended for temporary road markings, while the roll-over classes P0 to P6 are for materials intended for permanent road markings.	

The traffic report should further include the percentage of heavy vehicles together with an indication of the counting method used.

A vehicle is considered a heavy vehicle if its maximum gross mass is above 7500 kg.

4.6 Studded tyres classes

For road trial sites where studded tyres are used to a significant degree, this shall be indicated on the test report.

NOTE From general experience, such traffic conditions can be relevant to the erosion of road markings.

5 Organization of road trials

5.1 Duration

A road trial shall include at least one full climatic cycle of one year for materials intended for permanent road marking and up to 6 months for materials intended for temporary road marking.

In some cases, test markings may fall below the performance requirements of the road authority. In these cases, it may be necessary for the markings to be removed.

5.2 Transverse and longitudinal application patterns

5.2.1 General

Road marking materials shall be applied in patterns of lines either transverse or longitudinal to the road.

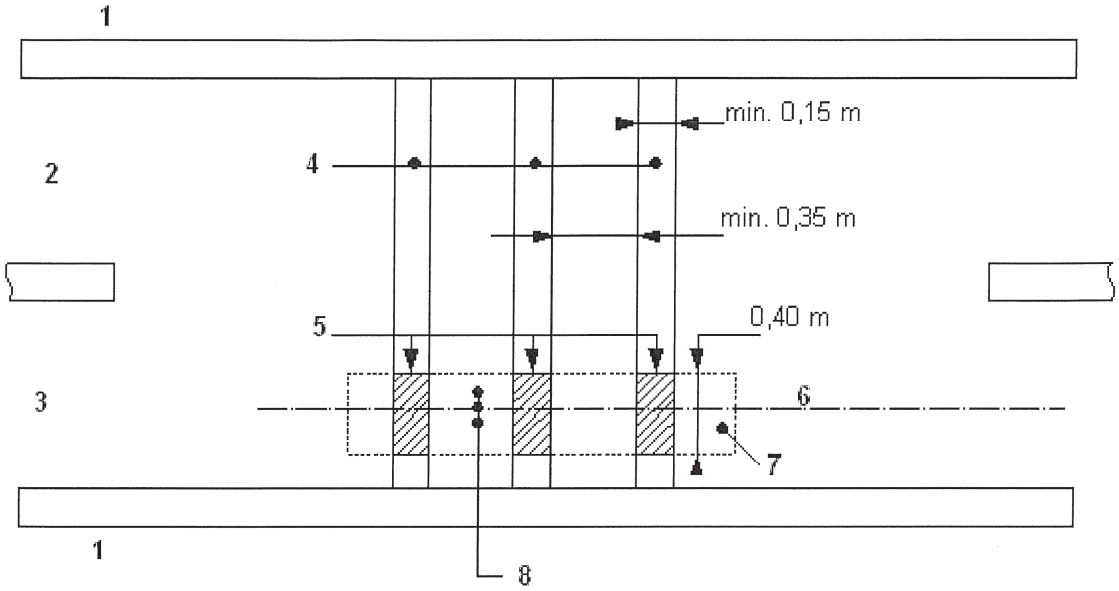
When a long (more than 40 cm) measurement area is necessary, the transverse pattern cannot be used.

When both the transverse and longitudinal patterns are used on the same test site, they shall be used on separate parts of that test site.

5.2.2 Transverse pattern

At least three lines shall be applied for each road marking material. The distance between two adjacent lines should be at least 0,35 m and the width at least 0,15 m as shown in Figure 1. The application could be done across one or two lanes.

NOTE Lines of the same material need not be adjacent.



Key

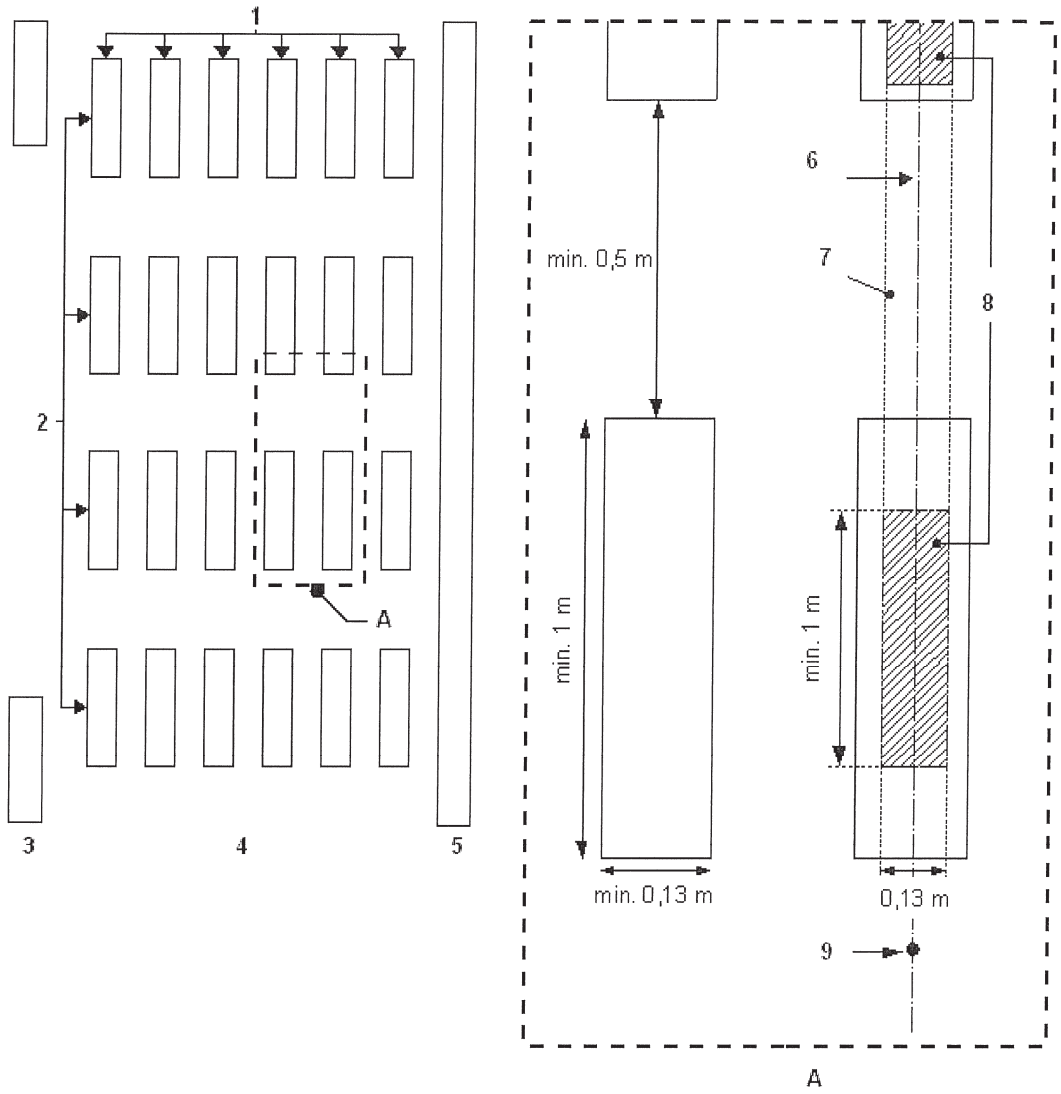
1 edge line
2 Lane 2
3 Lane 1
4 road marking material in test
5 measurement areas
6 axis of measurement column
7 measurement column
8 measurement points for determination of the number of wheel passages

Figure 1 – Example of a transverse pattern showing a measurement column

5.2.3 Longitudinal pattern

Lines are applied in transverse rows and longitudinal columns. For each of the road marking materials there shall be one line in each column containing measurement areas (see 7.2.2.3).

The lines should be at least 0,13 m wide and at least 1 m long as shown in Figure 2. Unmarked space between the lines is a minimum of 0,5 m in the longitudinal direction.



Key

1 6 columns
2 4 rows
3 centre line
4 Lane 1
5 edge line
6 axis of measurement column
7 Measurement column
8 Measurement areas
9 Measurement point for the determination of the number of wheel passages

Figure 2 – Example of a longitudinal pattern showing a measurement column

6 Application of road marking materials

6.1 General

In case of longitudinal pattern, the application shall be done in the direction of the traffic.

NOTE The test results depend on various factors related to the application of the road marking materials, i.e. application method, quantities applied, weather conditions, etc.

6.2 Periods for application

Road marking materials shall be applied when the weather conditions are as defined in 6.3.

NOTE The participating parties can agree to include one or more periods for application. One period can, for instance, be for materials intended for use as temporary road markings and another for materials intended for use as permanent road markings. There are practical advantages to having the period(s) as short as possible.

For temporary road marking materials, the application period shall be such that the required number of wheel passages is obtained, and the subsequent measurements carried out, prior to or after winter conditions.

6.3 Conditions suitable for application

Conditions shall be deemed suitable when:

a) the road surface appears to be dry and dew is not being formed;

b) the road surface temperature is within limits agreed upon by the participating parties;

c) the wind speed is less than the maximum agreed upon by the participating parties.

Special road marking materials can be applied in other weather conditions, which shall be noted in the individual test report (see Clause 8).

EXAMPLE The road surface temperature is at least 3 °C above the dew point of the air, the road surface temperature is between 10 °C and 50 °C and the maximum wind speed is less than 10 $m \times s^{-1}$.

6.4 Technical specification for application

Prior to the commencement of the road trials, the applicant shall submit to the test authority the application instructions of the road marking material.

NOTE 1 The application instructions will include preparation methods (such as how to melt a thermoplastic material), what type of application to use (e.g. extrusion of a thermoplastic material), any particular road marking equipment required, the pattern of application (e.g. plain or a certain type of structure), the rate(s) of application (in grams per square metre), what drop-on materials to add, their rate(s) of application and the method to use.

Whenever possible the road marking material shall be applied using self-propelled road marking equipment, and drop-on materials shall be applied mechanically.

NOTE 2 Most materials, except preformed materials, can be applied using self-propelled road marking equipment; this ensures better repeatability of the application.

NOTE 3 The road marking equipment used can either be those put to general commercial use or special road marking equipment. The road marking equipment can be operated by the usual crews or by staff at the test site.

If the test authority and the applicant agree to test road marking equipment prior to the application of a road marking material, the rate of application of marking materials and of drop-on materials shall be adjusted and the rate of application applied verified in accordance with Annex C. A road marking equipment shall be

rejected if any of three rates of application applied in three successive test runs deviates more than 20 % from the average rate of application.

6.5 Sampling and measurements

6.5.1 Sampling

When samples are required for identification or other purposes, each road marking material, all the components of a multiple component material, and drop-on materials shall be taken into account.

NOTE 1 For certification purposes, sampling will be done by test laboratory.

NOTE 2 For materials used in more than one application, it is not necessary to sample every application.

NOTE 3 The participating parties can agree to include further specifications for sampling, such as quantities to sample.

NOTE 4 If diluents are allowed and used for the application, the rate of dilution will be verified sampling materials both from the original container and from the tank.

6.5.2 Measurement of drying time and weather conditions

When required by the participating parties, the drying time shall be measured for paints and cold plastics.

The drying time shall be determined in accordance with Annex D for every line that contains a measurement area (see 7.3) for further measurements.

The drying time shall be reported together with an account of the weather conditions, including the ambient temperature, the road surface temperature, the relative air humidity and the wind speed as measured during application in accordance with Annex E.

6.5.3 Determination of the useful rate(s) of application and the rate(s) of consumption during application

During the application of a road marking material, the useful rates of application of the material and of any drop-on or non drop-on material shall be determined in accordance with Annex C. When the rate(s) of consumption of material(s) during application are also required, they should be also determined in accordance with Annex C.

NOTE The participating parties can agree to include a criterion for the acceptability of the application of a road marking material. For example, the application is rejected if any of the rates of application from the different lines deviates more than 10 % from the average rate of application, or if the average rate of application deviates more than, for example, 15 % from the rate of application given in the specification for the material.

7 Measurements related to performance

7.1 General

Test lines shall only be washed when it is necessary to do so and by agreements between the participating parties. Washing shall be with a soft brush using clear water. The performance shall be then determined once the product is dry. When test lines have been washed, it shall be indicated on the test report.

7.2 Parameters

The following parameters are relevant to this document:

a) coefficient of retroreflected luminance, R_L dry;

b) coefficient of retroreflected luminance, R_L wet;

c) coefficient of retroreflected luminance, R_L during rain;

d) luminance coefficient in diffuse illumination, *Qd*;

e) colour: luminance factor, β, and x,y chromaticity co-ordinates;

f) skid resistance, SRT value;

g) removability (only for removable temporary materials); may be measured if required for informative purpose only;

h) wear index may be measured if required for informative purpose only.

The parameters a) to f) are defined in EN 1436 and shall be measured in accordance with that standard.

If required, removability shall be measured in accordance with Annex F.

If required, wear index shall be measured in accordance with Annex G.

NOTE 1 For road surfaces with texture depth greater than 1,5 mm, the determination of wear index is irrelevant.

NOTE 2 The participating parties can agree which parameters to measure on the basis of the intended use of the road marking materials.

7.3 Measurement areas

7.3.1 Roll-over classes

One or more measurement areas shall be defined in terms of roll-over in accordance with Table 3 taking into account the periodicity of measurements (see 7.6).

7.3.2 Position

7.3.2.1 Roll-over

The roll-overs shall be determined in accordance with Annex B.

7.3.2.2 Transverse pattern

When introducing a measurement area, wide column along the road shall be selected (see Figure 1) so that points within the column are expected to have as close to the desired number of wheel passages as possible. The width of the column shall be at least 0,15 m and not exceed 0,4 m.

The measurement area shall consist of at least two lines of the same road marking material.

7.3.2.3 Longitudinal pattern

When introducing a measurement area, a 0,15 m wide column along the road shall be selected (see Figure 2) so that points within the column lie within longitudinal lines and have as close to the desired number of wheel passages as possible.

The measurement area shall consist of at least 1 m of one line of one road marking material (see Figure 2).

7.4 Direction of measurements

For transverse pattern, measurements shall be carried out in the direction of the application excepted SRT which shall be determined in the direction of the traffic.

For longitudinal pattern, measurements shall be carried out in the direction of the application.

7.5 Number of measurements in the measurement area

One measurement shall be conducted for each of a number of measurement points evenly distributed across the measurement area. The result shall be expressed as the average value for the different measurement points.

In the transverse pattern, a measurement area consists of at least two parts. The measuring points shall be divided equally between each part.

For colour, β, R_L (dry, wet, during rain), skid resistance and Qd measurement shall be carried out according to EN 1436. For R_L (dry, wet or/and during rain) and Qd use a number of measuring locations to provide a total minimum measured surface area of 400 cm². For colour and luminance factor, use a number of measuring locations to provide a total minimum measured surface area of 25 cm².

For skid resistance at least two points shall be selected.

For removability it shall be tested for two of the lines on the transverse pattern, and for the first half of a line in the longitudinal pattern in accordance with Annex F.

7.6 Periodicity of measurements

The parameters shall be measured as shown in Table 4 (marked '+').

Table 4 – Periodicity of measurements

Parameter	**Initial measurements** After application, measurements shall be taken after a minimum of 3 days after exposure to traffic an before a maximum of 14 days (permanent and temporary)	**Retained measurements** Before 6 months[c] (temporary only)	**Retained measurements** After one or more full climatic cycle[d] (permanent only)
R_L (in dry, wet and under rain condition when relevant)	+	+	+
Q_d	+	+	+
Colour	+	+	+
SRT	+	+	+
Removability		+	
NOTE Other measuring periods can be used in field trials with special purposes.			

[a] On one measurement area only, preferably the one with most traffic.

[b] This limit can be extended to 30 days after application in case of justified problem like major meteorological perturbations.

[c] On measurement areas with roll-overs T0, T1 and T2 in accordance with Clause 7.

[d] On measurement areas with roll-overs P0, P1, P2, P3 P4, P5, P5.5 and P6 in accordance with Clause 7. A full climatic cycle is always 12 months.

8 Individual test report for road marking material

The individual test report for a road marking material shall at least include:

- product name and similar general information;
- intended use of the material;
- technical data for application and removability including technical specifications for materials, road marking equipment used, drying time and rates of application (see Clause 6);
- results of measurement (see Clause 7);
- summary of climatic, traffic and road surface conditions for the test site and its location according to Clause 4;
- % of heavy vehicle (informative).

NOTE 1 It may be appropriate to attach to the individual test report, the general report for the test site (see Clause 4).

NOTE 2 A model of an individual test report is given in Annex H.

Annex A
(normative)

Köppen classification

A.1 Generalities

The aim of this annex is to determine in which climatic area belongs a test field using the Köppen classification system.

The Köppen Climate Classification System is the most widely used for classifying the world's climates. It defines six major climate types based on annual and monthly averages of temperature and precipitation. Each type is designated by a capital letter (A, B, C, D, E and H).

Further sub-types, designated by a second lower case letter (f, m, s or w), were established to distinguish specific seasonal characteristics of temperature and precipitation.

To further denote variations in climate a third lower letter (a, b, c, d, h or k) was added.

A.2 to A.5 present the different steps that shall be used to determine the Köppen climate type from meteorological data measured closed to the test field. Temperature and rainfall parameters have to be derived from the last 30 years.

A.2 Step 1: Determine whether a climate is arid/semiarid (climate B)

A.2.1 Determine the annual rainfall r (in mm) and the annual average temperature t (in °C).

A.2.2 If r > 20 x (t+14) it is not a climate B. Go to A.3.

A.2.3 Determine the rainfall distribution. Then determine Bs, Bw or neither according to the criteria given in Table A.1 below.

Table A.1

Rainfall Distribution	Not a **B** climate Go to A.3	**Bs** (Semi-arid)	**Bw** (Arid)
70% of rainfall in warmest 6 months	**r** > 20 x (**t**+14)	10 x (**t**+14) < **r** < 20 x (**t**+14)	**r** < 10 x (**t**+14)
70% of rainfall in coldest 6 months	**r** > 20 x t	10 x **t** < **r** < 20 x t	**r** <10 x **t**
Even rainfall distribution (neither of above)	**r** > 20 x (**t**+7)	10 x (**t**+7) < **r** < 20 x (**t**+7)	**r** <10 x (**t**+7)

A.3 Step 2: If not a B Climate, identify the climate as A, C, D or E according to temperature data

The climate is determined according to temperature of coldest (t_{min}) and/or warmest month (t_{max}).

A.3.1 if t_{min}> 18°C, it is an A climate;

A.3.2 if - 3° ≤ t_{min} ≤ 18°C and t_{max} > 10°C, it is a C climate;

A.3.3 if t_{min} < - 3°C and t_{max} > 10°C, it is a D climate;

A.3.4 if t_{max} < 10°C, it is a E climate.

A.4 Step 3: After identifying A, Bs, Bw, C, D or E, determine the climate subcategories

A.4.1 A climates

Consider the average rainfall of the driest month $\mathbf{r_{min}}$ (in mm):

— if $r_{min} \geq 60$ m, it is a f subcategory;

— if r_{min} < 60 mm and r_{min} > 100 – (r/25), it is an m subcategory;

— if it is not a f or m subcategory, it is a w subcategory.

A.4.2 B climates

Consider the average annual temperature **t**:

— if t ≥ 18°C m, it is a h subcategory;

— if t < 18°C, it is a k subcategory.

A.4.3 C or D climates

Consider the highest and lowest average rainfall for summer months r_{max}(summer), r_{min}(summer), and the highest and lowest average rainfall for winter months r_{max}(winter), r_{min}(winter).

— if r_{max}(summer) ≥ 10 x r_{min}(winter), it is a w subcategory;

— if r_{max}(winter) ≥ 3 x r_{min}(summer), it is a s subcategory;

— if it is not a w or s subcategory, it is a f subcategory. Go to A.5 for the third letter.

A.4.4 E climates

Consider the average temperature of the warmest month t_{max}.

— if $t_{max} \geq 0°$, it is a t subcategory;

— if t_{max} <0°, it is a f subcategory.

A.5 Step 4: For C and D climates, determine a third letter

Consider the average temperature of the warmest month t_{max} and the coldest month t_{min}.

— if $t_{max} \geq 22°C$, it is an a subcategory;

— if t_{max} < 22°C and at least 4 months with an average temperature > 10°, it is an b subcategory;

— if t_{max} < 22°C and 1 to 3 months with an average temperature > 10°, it is an c subcategory;

— if t_{min} < 38°C, it is an d subcategory.

Annex B
(normative)

Measurement of the number of wheel passages and the percentage of heavy vehicles

B.1 Generalities

This annex aims at defining the methods that could be used to determine the number of wheel passage and percentage of heavy vehicle. As different counting systems could be used, the annex gives general information regarding methodology to get these values.

As the length of the whole test field can be quite long, it is generally not possible to determine the number of wheel passages at every longitudinal location of the whole site. Usually, the measurement is made at one single section of the test field. Therefore, test field must be designed or selected in such way that vehicles circulate on it without too much lateral displacement.

On test field, the transversal distribution of the number of wheel passages depends on many parameters (width of lane, visual environment,…). Therefore, the distribution measured on one test field cannot be used on another test field. Moreover, the distribution should be determined again when important modification of the environment occurs.

This annex applies for transversal and longitudinal pattern.

In case of transverse pattern, the method allows to define the location on the road surface where the characteristics of road markings have to be measured, taking into account the periodicity of measurement for a certain roll-over class.

In case of longitudinal pattern, the method allows to define the location on the road surface where the lines should be applied to get the wanted roll-over class, taking into account the periodicity of measurement.

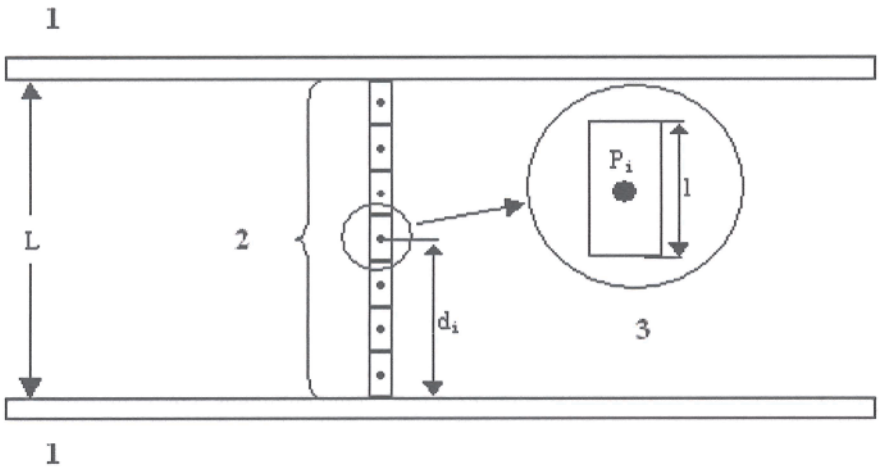
The methodology described in the present annex applies for single carriageway test field. In case of dual or more carriageways, the method shall be applied at each traffic lane.

B.2 Definitions

Number of wheel passages:
The number of wheel passages must be understood as the number of wheels rolling over a segment of length l centred on point P_i at a transversal road section (half carriageway) during a period of time ΔT.

Measurement segment S_i:
It corresponds to the spatial resolution of the counting measurement system. The transversal road section of length L can be generally divided into N segments S_i of equivalent length l (spatial resolution of the measurement system).

Measurement points P_i :
The measurements points P_i correspond to the centre of the segments S_i. In general, these points are located by distance d_i, measured from a reference point on the transversal road section (as edge line for example).



Key
1 edge line
2 N segments S_i
3 segment S_i

Figure B.1 – Illustration of definitions

B.3 Principles

The principle of the method is based on the counting of wheels rolling over segments S_i on one traffic lane of the test field. For this purpose, the test field should be equipped with a suitable measurement system able to count the wheel passages during a period of time Δt_i.

The counting during the period(s) Δt_i is then used to derive the number of wheel passages for a larger period of time ΔT.

When the recording period Δt_i is equal to the whole periodicity of measurement ΔT, the counting measured on each segments S_i provides directly the number of wheel passages.

When the recording period Δt_i is shorter than the whole periodicity of measurement ΔT, the determination may require to couple the roll-over counting system with another system which is able to count the average daily traffic on the test field.

B.4 Wheel counting measurement system

The measurements shall be carried out using any suitable counting system such as video recording or detector (pneumatic tubes, piezzo electric sensors…).

The system should be able to count the number of wheel passages rolling over one of several segments of a transversal road section of the test field.

The length of the segments should be in adequacy with the measurement areas dimensions of the equipments used for the road marking performances measurement. A maximum length l of 17 cm shall be used.

The system should allow recording the number of wheel passages $n_L(\Delta t_i, S_j)$ and $n_H(\Delta t_i, S_j)$ corresponding respectively to light and heavy vehicles rolling on each segment S_i.

It should also be able recording the number of light vehicles $N_L(\Delta t_i)$ and heavy vehicles $N_L(\Delta t_i)$, belonging to each of these categories, which have rolled over the system during Δt_i.

NOTE The transversal distribution of wheel passages depends on the driver's behaviour. According to this consideration, several precautions should be taken to ensure that the distribution determined at one location of the test field is representative of the distribution on the whole test field. Therefore the system must be as unobtrusive as possible (from the point of view of the driver) in order to avoid modifying its behaviour and trajectory of its vehicle.

B.5 Determination of the number of wheel passages

B.5.1 General

Usually, the number of wheel passages has to be determined for a long period of time ΔT (6 months or 12 months) which could be much more larger than the recording period of the counting system Δt_i.

It involves that the number of wheel passages needs to be estimated on the basis on measurements recorded during Δt_i. In this case, the measurements need to be coupled with average daily traffic data (ADT): N_{ADT}

B.5.2 Determination of the transversal relative wheel passages distribution for one day

It is based on roll-overs counting with a suitable system as defined in A.3. The counting periods Δt_i should be spread out during the chosen measuring day between 00:00 and 24:00. The measuring day should be chosen to avoid exceptional traffic conditions.

It is strongly recommended to consider measurement period(s) including day and night conditions when counting system is able to cope with both situations.

— Record the number of vehicles $N_L(\Delta t_i)$ and $N_H(\Delta t_i)$ which have rolled over the system during one or several period of time Δt_i.

— Record the number of wheel passages $n_L(\Delta t_i, S_j)$ and $n_H(\Delta t_i, S_j)$ for one or several period of time Δt_i for each measurement segments S_j.

— Calculate the averaged number of wheels passages per vehicle on each segment S_j for light and heavy vehicles

$$n_L(S_j) = \frac{\sum_{i=1}^{i=n} n_L(\Delta t_i, S_j)}{\sum_{i=1}^{i=n} N_L(\Delta t_i)} \text{ and } n_H(S_j) = \frac{\sum_{i=1}^{i=n} n_H(\Delta t_i, S_j)}{\sum_{i=1}^{i=n} N_H(\Delta t_i)}$$

B.5.3 Determination of the number of wheel passages during ΔT

As the traffic differs a lot between working days and weekends, $n_L(S_j)$ and $n_H(S_j)$ should be determined at least for one day of the week, Sunday and Saturday according to B.5.2. The corresponding values are called $n_L(day, S_j)$, $n_H(day, S_j)$ respectively for light and heavy vehicles with day Є {working day, Saturday, Sunday}

These data should be coupled with:

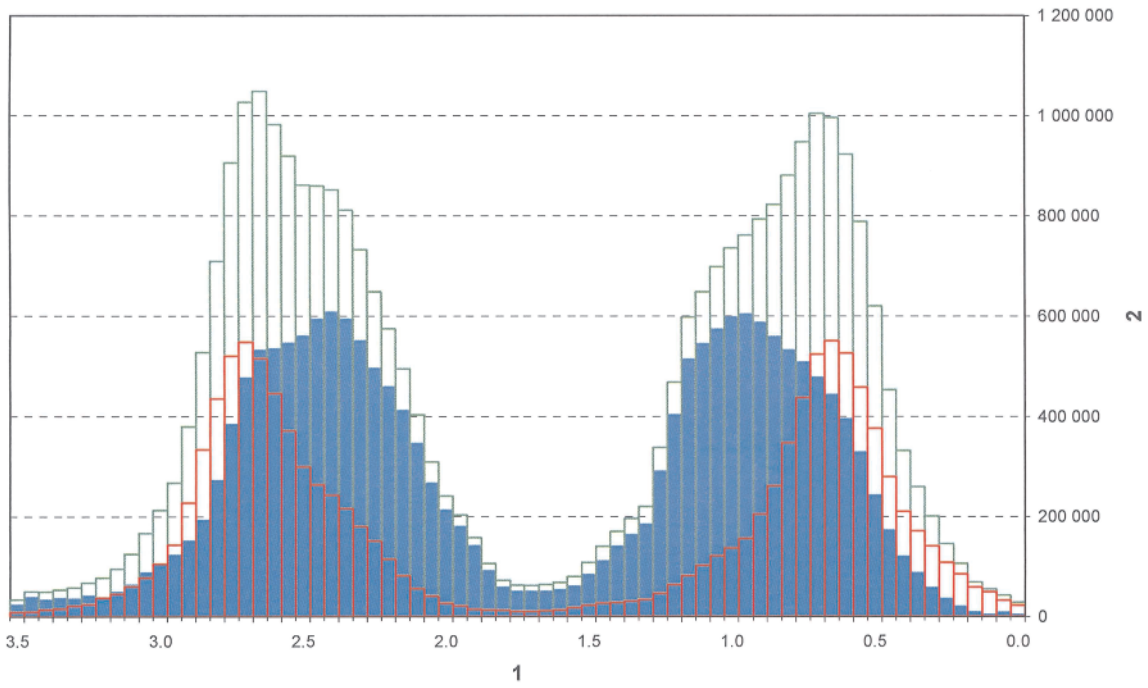
— The average daily traffic data $ADT_L(day)$ and ADT_H (day) corresponding to these 3 days, given respectively for light and heavy vehicle categories,

— The number of working days $N_{day}(day)$, included in the ΔT period of time while the test field was circulated with day Є {working day, Saturday, Sunday}.

The number of wheel passages is then determined as follows :

$$n(\Delta T, S_j) = \sum_{day} n_L(S_j, day) \times ADT_L(day) \times N_{day}(day) + n_H(S_j, day) \times ADT_H(day) \times N_{day}(day),$$

with day Є {working day, Saturday, Sunday}



Key

1 distance from edge line (m)

2 number of wheel passages

n(Heavy vehicles)

n(Light vehicles)

n(All vehicles)

Figure B.2 – Example of number of wheel passages derived during ΔT for light, heavy and all vehicles

NOTE 1 To achieve better accuracy, roll-over counting should be carried out as many times as possible. In particular when test field is used for the first time, the counting measurements should be repeated for several measuring day spread over different periods of the year.

NOTE 2 According to national regulations, traffic of heavy vehicles might be restricted during public days. Therefore, when public days correspond to days of the week it is recommended to use the relative transversal wheel passages distribution determined for Saturday or Sunday.

B.5.4 Determination of the percentage of heavy vehicles

The percentage of heavy vehicle can usually be obtained from systems used for the determination of the average daily traffic. These systems are often able to provide the proportion between each type of vehicles for every day.

Nevertheless, when an average daily traffic counting system provides only the number of vehicle without distinction between light and heavy vehicles, the percentage of heavy vehicle can be determined using a roll-over counting system able to distinguish roll-over between the two categories of vehicle.

The percentage should then be calculated taking into account the whole days included in the period of time ΔT and the existing differences between working and weekend days.

Annex C
(normative)

Determination of the rate of application and the rate of consumption of material during application

C.1 General

The method described in this annex is appropriate for determining the useful rate of application (normative) and the rate of consumption (informative) during application of road marking product and component that are used to produce the marking. It is also applicable to adhesives, primers, etc. used during the application of some road markings.

This method can be used:

a) to determine for road marking equipment the repeatability of the rates of application;

b) to identify adjustment to the road marking equipment necessary to achieve the specified rates of application.

C.2 Apparatus

C.2.1 Analytical balance accurate to 0,1 g.

C.2.2 Smooth, rigid substrates of predetermined mass, that are heat resistant and of dimensions providing a minimum marked area of 0,1 m^2.

C.2.3 Flexible substrates of predetermined mass and of dimensions providing a minimum marked area of 0,1 m^2.

C.2.4 Adhesive paper.

C.2.5 Watertight container of predetermined mass.

C.3 Determination of the rate of consumption during application (informative)

The method described below should be used for any materials that are added during the application of the road marking product (i.e. drop on glass beads, injected glass beads, aggregates…).

C.3.1 During the application determine the average speed s (in $m^x s^{-1}$) at which the lines have been applied.

C.3.2 Then in static mode, collect separately every component at the exit(s) of the road marking equipments in container(s) during a period of time t (in s) (t should be at least 10s) using the same settings of the machine.

C.3.3 Weight the content of each containers m (in g).

C.3.4 Knowing the width of the applied line w (in m), the rate of consumption during application is calculated according the following formula:

$$\frac{m}{t \times w \times s}$$

NOTE For preformed road markings, the cans containing the primer or adhesive components shall be weighted prior and after application. The weighting difference allow determining the rate of consumption during application.

C.4 Determination of the useful rate of application (normative)

The method used for the determination of the rate of application depends on the number of components and how they are applied on the road marking product.

C.4.1 Drop-on or non drop-on materials

When only one component is used (drop-on or non drop-on materials), use the procedure described in C.4.3.

C.4.2 Drop-on and non drop-on materials

This clause applies when components are applied with different techniques.

C.4.2.1 Apply the procedure described in C.4.3 which will provide an intermediate result about the whole amount of components that have been applied.

C.4.2.2 Determine the rate of consumption during application of each component according to C.3.

C.4.2.3 Calculate the ratio of the rate of consumption during application between the different components and apply this to the result given in C.4.2.1 to determine the useful rate of application of each component.

C.4.3 Determination of the rate of application of the road marking material and its components

C.4.3.1 Before the application lay and fixed two flexible substrates of identical dimensions to the lines that will be applied. The first substrate should be placed at the beginning of the lines and the second near the end.

First substrate will be used to determine the amount of product with all components when the second one will give the amount of road marking alone.

NOTE When the application devices are in contact with the road surfaces, it is recommended to use the substrates defined in C.2.3. In other cases, substrates defined in C.2.2 and C.2.3 can be indifferently used.

C.4.3.2 Apply the line of road marking product with drop-on materials just before the second substrate is reached. When the second substrate is reached stop the spread of any component. The same surface of product **S** should be applied on the two substrates.

C.4.3.3 Let dry the content applied on the substrates.

C.4.3.4 Determine the weight **m** of the substrate with road marking product and components and the weight **m'** of the substrate with only road marking product subtracting the predetermined mass of the substrate.

C.4.3.5 The rate of application of the road marking product is: $\frac{m'}{S}$.

C.4.3.6 The useful rate of application of components by line is calculated according to the following formula: $\frac{m - m'}{S}$.

C.4.3.7 Average the values obtained for each line, to obtain the useful rate of application of components for the road marking product.

C.5 Expression of results

Express the results of each determination in grams per square metre.

Annex D
(normative)

Drying time determination

D.1 The purpose of this test is to determine the drying time, i.e. the period of time after which it is possible for a road marking to be subjected to traffic. The drying time is defined as the time elapsed between the moment of application of the road marking and when a wheel passing over the marking no longer drags along any road marking materials.

The drying time depends, among other things, on the prevailing weather conditions and on the rate of application of the materials and should not be stated without this information.

D.2 The apparatus used consists of a wheelbarrow loaded to a total mass of 200 kg $\pm$ 10 kg and fitted with a 135 $\times$ 13 passenger car tyre with tread pattern inflated to a pressure of 0,14 MPa $\pm$ 0,01 MPa.

D.3 Record t_1, the time of application.

D.4 Record t_2, the time at which the wheelbarrow pushed by hand at a constant speed of about 5 km/h longitudinally over the stripe, does not drag along any trace of the road marking material on its tyre.

NOTE There can be tyre prints in the marking.

D.5 Calculate the drying time, in minutes, as the mean value of t_2 - t_1 for the various stripes.

Annex E
(normative)

Meteorological determinations during application

E.1 General

Meteorological parameters are determined, in accordance with E.2 to E.5, at appropriate intervals during the application of road marking materials.

E.2 Road surface temperature

Using a thermometer able to measure a minimum surface of 5 mm^2 make one measurement of the road surface temperature at the centre of the relevant test lane.

E.3 Temperature and relative humidity of the air

Place the probes in a meteorological shelter designed in accordance with international recommendations to ensure ventilation and to protect the probes from direct, reflected or diffused radiation (sides with double jalousies, base consisting of blades forming baffles, double roof, all painted white).

Ensure that the measurement points are located at a height of between 1,5 m and 2 m, with the meteorological shelter centred on the application area.

E.4 Dew point

Take the dew point from Table E.1.

EXAMPLE For an air temperature of 20 °C and a relative humidity of 60 %, the dew point is 12 °C.

Table E.1 – Determination of the dew point

Air temperature °C	Relative humidity of the air %								
	50 %	55 %	60 %	65 %	70 %	75 %	80 %	85 %	90 %
5	-4,1	-2,9	-1,8	-0,9	0,0	0,9	1,8	2,7	3,6
6	-3,2	-2,1	-1,0	-0,1	0,9	1,8	2,8	3,7	4,5
7	-2,4	-1,3	-0,2	0,8	1,8	2,8	3,7	4,6	5,5
8	-1,6	-0,4	0,8	1,8	2,8	3,8	4,7	5,6	6,5
9	-0,8	0,4	1,7	2,7	3,8	4,7	5,7	6,6	7,5
10	0,1	1,3	2,6	3,7	4,7	5,7	6,7	7,6	8,4
11	1,0	2,3	3,5	4,6	5,6	6,7	7,6	8,6	9,4
12	1,9	3,2	4,5	5,6	6,6	7,7	8,6	9,6	10,4
13	2,8	4,2	5,4	6,6	7,6	8,6	9,6	10,6	11,4
14	3,7	5,1	6,4	7,5	8,6	9,6	10,6	11,5	12,4
15	4,7	6,1	7,3	8,5	9,5	10,6	11,5	12,5	13,4
16	5,6	7,0	8,3	9,5	10,5	11,6	12,5	13,5	14,4
17	6,5	7,9	9,2	10,4	11,5	12,5	13,5	14,5	15,3
18	7,4	8,8	10,2	11,4	12,4	13,5	14,5	15,4	16,3
19	8,3	9,7	11,1	12,3	13,4	14,5	15,5	16,4	17,3
20	9,3	10,7	12,0	13,3	14,4	15,4	16,4	17,4	18,3
21	10,2	11,6	12,9	14,2	15,3	16,4	17,4	18,4	19,3
22	11,1	12,5	13,8	15,2	16,3	17,4	18,4	19,4	20,3
23	12,0	13,5	14,8	16,1	17,2	18,4	19,4	20,3	21,3
24	12,9	14,4	15,7	17,0	18,2	19,3	20,3	21,3	22,3
25	13,8	15,3	16,7	17,9	19,1	20,3	21,3	22,3	23,2
26	14,8	16,2	17,6	18,8	20,1	21,2	22,3	23,3	24,2
27	15,7	17,2	18,6	19,8	21,1	22,2	23,2	24,3	25,2
28	16,6	18,1	19,5	20,8	22,0	23,2	24,2	25,2	26,2
29	17,5	19,1	20,5	21,7	22,9	24,1	25,2	26,2	27,2
30	18,4	20,0	21,4	22,7	23,9	25,1	26,2	27,2	28,2

E.5 Wind speed

Measure the wind speed using an anemometer with three hemispherical cups. Ensure that the measurement point is at a height of between 1,5 m and 2,0 m, centred on the application.

Monitor the wind speed for 1 min and note the maximum wind speed during that time.

Annex F
(normative)

Removability

F.1 General

This annex applies only to removable temporary materials that are capable of being removed entirely without damage to the road surface and without leaving evident residual traces.

F.2 Assessment of removability

Assess the degree of removability of the material by checking that no coloured traces remain, traces of transparent binder or adhesive are acceptable.

In the individual test report (see Clause 8), indicate whether the material has passed the removability test by marking ‘Y’ or ‘N’.

Annex G
(normative)

Determination of wear index

G.1 General

The wear index is determined using a rating system based on a photograph of the measurement area of the road marking on which a grid frame is superimposed.

The method described hereafter may be adapted using image processing techniques.

G.2 Apparatus

G.2.1 A good quality camera equipped to provide a photograph such that the measurement area of the road marking occupies 2/3 of the photographic area.

G.2.2 Colour film with good definition or digital camera with 3 millions pixels minimum.

G.2.3 A grid frame equal to the size of the measurement area with frames that subdivide the area into a minimum of 12 equal squares of dimensions as shown in Figure G.1.

Dimensions in millimetres

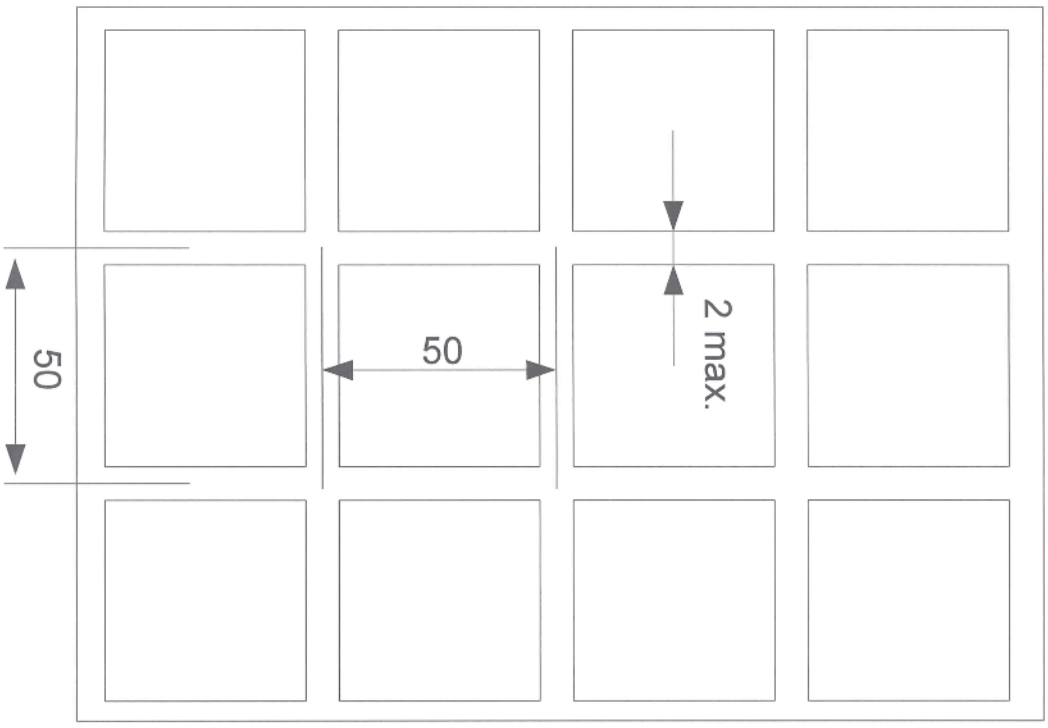


Figure G.1 – Example of a reference grid frame consisting of 12 squares

G.3 Procedure

Place a coded reference next to the measurement area on which the grid frame is superimposed. Hold the camera at a suitable distance above the measurement area so as to include the measurement area and the coded reference, and take one or more photographs.

NOTE If the road marking is dirty it should be cleaned to avoid misinterpretation of the photographs.

G.4 Evaluation

Prepare a photograph of the measurement area as a paper copy or as a projection slide.

Assess the degree of wear of each of the grid squares in terms of the ratings defined in Table G.1 and record the number of squares in each grade.

Using the tabular form shown in Figure G.2, calculate the wear index by multiplying the number of squares in each grade by the relevant weighting factor. Add the four subtotals for both sets to obtain T_1 and T_2. Calculate the wear index as T_2/T_1.

Table G.1 – Assessment of rating of grid squares

Grade	Area of road marking remaining	Weighting factor
a	Greater than or equal to 75 %	1
b	Greater than or equal to 50 % and less than 75 %	2
c	Greater than or equal to 25 % and less than 50 %	3
d	Less than 25 %	4

Grade	Number of squares	Weighting factor	
a		1	
b		2	
c		3	
d		4	
	T1 :		T2 :

Figure G.2 – Specimen wear index

The wear index is evaluated independently by three assessors. Should any of the indices differ by more than 0,6 from the other two, indices have to be re-evaluated.

Express the result as the average of the three independently assessed wear indexes, in the range 1 to 4, rounded to the first decimal place.

Annex H
(informative)

Model of test report

This Annex provides a model for an individual test report for permanent road marking material. It is recommended that the participating parties define the content of the individual test report for each test site taking into account the purpose of the tests.

Table H.1 – Model of an individual test report

<table>
<tr><td colspan="4">PRODUCT DESCRIPTION</td></tr>
<tr><td colspan="4">Road marking or road marking assembly as defined in EN 1871 or EN 1790 as relevant.</td></tr>
<tr><td colspan="4">LABORATORY IN CHARGE OF TESTS</td></tr>
<tr><td colspan="4">Name and address</td></tr>
<tr><td colspan="2">TECHNICAL SPECIFICATIONS FOR APPLICATION</td><td>Recommended by manufacturer</td><td>As applied on the test site</td></tr>
<tr><td rowspan="5">Meteorological data</td><td>Road surface temperature (in °C)</td><td></td><td></td></tr>
<tr><td>Limit temperatures for materials (in °C)</td><td></td><td></td></tr>
<tr><td>Limiting relative humidity for materials (in %)</td><td></td><td></td></tr>
<tr><td>Ambient temperature (in °C)</td><td></td><td></td></tr>
<tr><td>Wind speed (in $m.s^{-1}$)</td><td></td><td></td></tr>
<tr><td rowspan="2">Useful
Rate of application ($g \cdot m^{-2}$)</td><td>Non-drop-on materials
Ref :</td><td></td><td></td></tr>
<tr><td>Drop-on materials
Ref :</td><td></td><td></td></tr>
<tr><td rowspan="2">Rate of consumption during application ($g \cdot m^{-2}$) (informative)</td><td>Non-drop-on materials
Ref :</td><td></td><td></td></tr>
<tr><td>Drop-on materials
Ref :</td><td></td><td></td></tr>
<tr><td colspan="4">Description of the application device required:</td></tr>
<tr><td colspan="4">Month and year of application: Drying time (in min):</td></tr>
<tr><td colspan="4">Test fields characteristics and performance results are given on the next page</td></tr>
</table>

TEST FIELD CHARACTERISTICS					
Climatic Class		**Roughness Class**		**Studded tyres (Y/N)**	
TEST FIELD LOCATION					
For informative purpose : % of Heavy vehicle (between 10% and 25%)					

PERFORMANCE RESULTS											
Duration of the test (in month)		R_L (mcd.m^{-2}.lx^{-1})			Qd (mcd.m^{-2}.lx^{-1})	β	Color		SRT	Wear index (informative)
		dry	wet	rain			x	y		
Initial Measurements										
Retained Measurements	P0									
	P1									
	P2									
	P3									
	P4									
	P5									
	P5.5									
	P6									

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[2] EN ISO 13473-1, *Characterization of pavement texture by use of surface profiles — Part 1: Determination of Mean Profile Depth (ISO 13473-1:1997)*

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