Road marking materials — Paint, thermoplastic and cold plastic materials — Physical properties

Straßenmarkierungsmaterialien — Markierungsfarben, Kaltplastikmassen und Heißplastikmassen — Physikalische Eigenschaften

Produits de marquage routier — Peintures, enduits à froid et à chaud — Propriétés physiques

ICS:

Descriptors:
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</tbody>
</table>
Foreword

This document (FprEN 1871: 2017) has been prepared by Technical Committee CEN/TC 226 “Road equipment”, the secretariat of which is held by AFNOR.

This document will supersede EN 1871:2000.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).
1 Scope

This standard covers testing of physical properties of road marking materials by laboratory methods.

The products covered and specified by this European Standard are white and yellow paint, thermoplastic and cold plastic materials, with or without premix glass beads, to be used for permanent and/or temporary road markings on highways and other areas used by vehicular traffic. Other products and colours intended for road markings are not covered in this European Standard.

2 Normative references

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


EN 12802-1:2001, Road marking materials — Laboratory methods and identification

EN 13459, Road marking materials — Sampling from storage and testing


EN ISO 1514, Paints and varnishes — Standard panels for testing (ISO 1514)


EN ISO 4892-3, Plastics — Methods of exposure to laboratory light sources — Part 3: Fluorescent UV lamps (ISO 4892-3)

ISO 16474 PAINT TESTING

3 Terms and definitions

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

3.1 paint: liquid product which contains binders, pigments, fillers, solvents and additives, which can be supplied in single or multi-component systems and which, when applied, produces a cohesive film by the process of solvent/water evaporation and/or a chemical reaction and/or coalescence process (in the case of water base product).

3.2 thermoplastic: solvent-free marking product which is supplied in block, granular or powder forms, which is heated to a molten state prior to application to road surfaces, and which forms a cohesive film by cooling

3.3 cold plastic: viscous products supplied in multi-component forms (at least one main component and a hardener system), the cohesive film being formed after mixing of all components only by a chemical reaction following which the cold plastic becomes a solid
4 Requirements

4.1 General

This clause gives three separate lists of requirements for the product groups: *Paints, thermoplastics and cold plastics*

4.2 Paint

4.2.1 Chromaticity co-ordinates and luminance factor: the colour shall be defined by \((x, y)\) chromaticity co-ordinates and luminance factor \(\beta\) of the CIE standard system.

When measured according to 5.2.1, the results of the test for the luminance factor shall comply with Table 1a).

<table>
<thead>
<tr>
<th>Colour</th>
<th>Class</th>
<th>Luminance factor (\beta)</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>LF5</td>
<td>(\geq 0,75)</td>
</tr>
<tr>
<td></td>
<td>LF6</td>
<td>(\geq 0,80)</td>
</tr>
<tr>
<td></td>
<td>LF7</td>
<td>(\geq 0,85)</td>
</tr>
<tr>
<td>Yellow</td>
<td>LF1</td>
<td>(\geq 0,40)</td>
</tr>
<tr>
<td></td>
<td>LF2</td>
<td>(\geq 0,50)</td>
</tr>
</tbody>
</table>

When measured according to 5.2.1, the chromaticity co-ordinates shall lie within the regions defined by the corner points given in Table 1b).

<table>
<thead>
<tr>
<th>Chromaticity co-ordinates</th>
<th>Corner point N°</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>White x</td>
<td>0,355</td>
</tr>
<tr>
<td></td>
<td>y</td>
</tr>
<tr>
<td>Yellow x</td>
<td>0,494</td>
</tr>
<tr>
<td></td>
<td>y</td>
</tr>
</tbody>
</table>

4.2.2 Hiding power: The capacity of the paint to reduce the contrast between a black surface and a white surface over which the paint has been applied and dried.

When measured according to 5.2.2, the result, expressed as the contrast ratio, shall comply with Table 2.
Table 2 — Classes of hiding power

<table>
<thead>
<tr>
<th>Colour</th>
<th>Class</th>
<th>Hiding Power (contrast ratio)</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>HP0</td>
<td>No value requested</td>
</tr>
<tr>
<td></td>
<td>HP2</td>
<td>≥ 90%</td>
</tr>
<tr>
<td></td>
<td>HP3</td>
<td>≥ 92%</td>
</tr>
<tr>
<td></td>
<td>HP4</td>
<td>≥ 95%</td>
</tr>
<tr>
<td>Yellow</td>
<td>HP0</td>
<td>No value requested</td>
</tr>
<tr>
<td></td>
<td>HP1</td>
<td>≥ 88%</td>
</tr>
<tr>
<td></td>
<td>HP2</td>
<td>≥ 90%</td>
</tr>
</tbody>
</table>

4.2.3 Storage stability: the paint shall be free from skin and settlement that cannot be re-incorporated by stirring. When tested in accordance with 5.2.3, the paint shall have a rating equal to or above 4.

4.2.4 UV ageing: a film of paint is submitted to cycles of UV radiation and condensation and examined for discolouration.

When tested in accordance with 5.2.4, the difference in luminance factor $\Delta\beta$ shall be as in Table 3 (where: $\Delta\beta = \text{original luminance factor} - \text{luminance factor after test}$).

Table 3 — Classes of difference in luminance factor after UV ageing

<table>
<thead>
<tr>
<th>Colour</th>
<th>Class</th>
<th>$\Delta\beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>White and Yellow</td>
<td>UV0</td>
<td>No value requested</td>
</tr>
<tr>
<td></td>
<td>UV1</td>
<td>≤ 0,05</td>
</tr>
<tr>
<td></td>
<td>UV2</td>
<td>≤ 0,10</td>
</tr>
</tbody>
</table>

The chromaticity co-ordinates shall lie within the regions defined by the corner points given in Table 1b).

4.2.5 Bleed resistance: this test is only applicable for paint which is intended to be applied directly to asphaltic surfaces. The film of paint applied to a bituminous surface is examined for discolouration.

When tested in accordance with 5.2.5, the difference in luminance factor $\Delta\beta$ shall be as in Table 4 (where: $\Delta\beta = \text{original luminance factor} - \text{luminance factor after test}$).

Table 4 — Classes of difference in luminance factor after bleed resistance test

<table>
<thead>
<tr>
<th>Colour</th>
<th>Class</th>
<th>$\Delta\beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>White and Yellow</td>
<td>BR0</td>
<td>No value requested</td>
</tr>
<tr>
<td></td>
<td>BR1</td>
<td>≤ 0,03</td>
</tr>
<tr>
<td></td>
<td>BR2</td>
<td>≤ 0,05</td>
</tr>
</tbody>
</table>

The chromaticity co-ordinates shall lie within the regions defined by the corner points given in Table 1b).
4.2.6 Alkali resistance: this test is only applicable for paint which is intended to be applied directly to hydraulic concrete surfaces. The film of paint is submitted to the effect of a solution of sodium hydroxide and examined for surface deterioration.

When tested in accordance with 5.2.6, the paint film shall show no signs of partial or complete film destruction, surface roughening or discolouration.

4.3 Thermoplastics

4.3.1 General

Thermoplastic materials need to be melted before application so that their characteristics should remain stable after supporting a period of heating. This is the reason why the standard includes requirements before and after a heating cycle.

4.3.2 Tests before heat stability

4.3.2.1 Chromaticity co-ordinates and luminance factor: the colour shall be defined by \((x,y)\) chromaticity co-ordinates and luminance factor \(\beta\) of the CIE standard system.

When measured according to 5.3.2.1, the results of the test for the luminance factor shall comply with Table 5.

<table>
<thead>
<tr>
<th>Colour</th>
<th>Class</th>
<th>Luminance factor (\beta)</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>LF3</td>
<td>(\geq 0.65)</td>
</tr>
<tr>
<td></td>
<td>LF4</td>
<td>(\geq 0.70)</td>
</tr>
<tr>
<td></td>
<td>LF5</td>
<td>(\geq 0.75)</td>
</tr>
<tr>
<td></td>
<td>LF6</td>
<td>(\geq 0.80)</td>
</tr>
<tr>
<td>Yellow</td>
<td>LF1</td>
<td>(\geq 0.40)</td>
</tr>
<tr>
<td></td>
<td>LF2</td>
<td>(\geq 0.50)</td>
</tr>
</tbody>
</table>

The chromaticity co-ordinates shall lie within the regions defined by the corner points given in Table 1b).

4.3.2.2 Softening point: it is the temperature at which a given layer of thermoplastic material experiences a given deformation under the action of a steel ball.

When measured in accordance with 5.3.2.2, the softening point of the thermoplastic material shall comply with Table 6.

<table>
<thead>
<tr>
<th>Class</th>
<th>Softening point in °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP0</td>
<td>No value requested</td>
</tr>
<tr>
<td>SP1</td>
<td>(\geq 65)</td>
</tr>
<tr>
<td>SP2</td>
<td>(\geq 80)</td>
</tr>
<tr>
<td>SP3</td>
<td>(\geq 95)</td>
</tr>
<tr>
<td>SP4</td>
<td>(\geq 110)</td>
</tr>
</tbody>
</table>
4.3.2.3 **Alkali resistance:** this test is only applicable for thermoplastic which is intended to be applied directly to hydraulic concrete surfaces. The thermoplastic is submitted to the effect of a solution of sodium hydroxide and examined for surface deterioration.

When tested in accordance with 5.3.2.3, the thermoplastic film shall show no signs of partial or complete film destruction, surface roughening or discolouration.

4.3.2.4 **Cold impact resistance:** this test measures the resistance of thermoplastic material, at cold temperature, to the impact of a falling steel ball.

When tested in accordance with 5.3.2.4 the number of specimens passing the test shall comply with Table 7.

**Table 7 — Classes for cold impact resistance**

<table>
<thead>
<tr>
<th>Class</th>
<th>Temperature of test in °C</th>
<th>Ball</th>
<th>Number of specimens passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>CI 0</td>
<td>No requirement</td>
<td>-</td>
<td>No value requested</td>
</tr>
<tr>
<td>CI 1</td>
<td>0</td>
<td>a</td>
<td>6</td>
</tr>
<tr>
<td>CI 2</td>
<td>-10 ± 3</td>
<td>a</td>
<td>6</td>
</tr>
<tr>
<td>CI 3</td>
<td>-10 ± 3</td>
<td>b</td>
<td>6</td>
</tr>
</tbody>
</table>

4.3.2.5 **UV ageing:** a film of thermoplastic is submitted to cycles of UV radiation and condensation and examined for discolouration.

When tested in accordance with 5.3.2.5, the difference in luminance factor $\Delta \beta$ shall be as in Table 3 (where: $\Delta \beta =$ original luminance factor – luminance factor after test).

The chromaticity co-ordinates shall lie within the regions defined by the corner points given in Table 1b).

4.3.3 **Tests after heat stability**

4.3.3.1 **Chromaticity co-ordinates and luminance factor:** when tested in accordance with 5.3.3.1, the difference in luminance factor $\Delta \beta$ shall be no more than 0,10 for both white and yellow. The chromaticity co-ordinates shall be as given in Table 1b.

4.3.3.2 **Softening point:** when tested in accordance with 5.3.3.2, the difference in softening point $\Delta SP$ (where: $\Delta SP =$ original softening point – softening point after heating) shall not be more than ± 10 °C.

4.3.3.3 **Indentation:** it is the time required for a standardised cylinder to sink 10 mm into the thermoplastic at a given temperature.

When tested in accordance with 5.3.3.3, the mean value for the indentation time shall comply with Table 8a.

**Table 8a — Classes for indentation**

<table>
<thead>
<tr>
<th>Class</th>
<th>Indentation time</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN0</td>
<td>No value requested</td>
</tr>
<tr>
<td>IN1</td>
<td>5 s to 45 s</td>
</tr>
<tr>
<td>IN2</td>
<td>46 s to 2 min</td>
</tr>
<tr>
<td>IN3</td>
<td>2 min 1 s to 5 min</td>
</tr>
</tbody>
</table>
Table 9b — Standardised temperature for test

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
</tr>
<tr>
<td>30</td>
</tr>
<tr>
<td>40</td>
</tr>
</tbody>
</table>

4.3.4 Cold plastics

4.3.4.1 Chromaticity co-ordinates and luminance factor: the colour shall be defined by \((x,y)\) chromaticity co-ordinates and luminance factor \(\beta\) of the CIE standard system.

When tested in accordance with 5.3.4.1, for the luminance factor, the results of the test shall comply with Table 5.

The chromaticity co-ordinates shall lie within the regions defined by the corner points given in Table 1b).

4.3.4.2 Storage stability: the products shall be free from skin and settlement that cannot be re-incorporated by stirring.

When tested in accordance with 5.3.4.2, the product shall have a rating equal to or above 3.

NOTE See C.3.2 for components containing peroxides.

4.3.4.3 UV ageing: a film of cold plastic is submitted to cycles of UV radiation and condensation and examined for discolouration.

When tested in accordance with 5.3.4.3, the difference in luminance factor \(\Delta\beta\) shall be as in Table 3 (where \(\Delta\beta\) = original luminance factor – luminance factor after test).

The chromaticity co-ordinates shall lie within the regions defined by the corner points given in Table 1b).

4.3.4.4 Alkali resistance: this test is only applicable for cold plastic which is intended to be applied directly to hydraulic concrete surfaces. A film of cold plastic is submitted to the effect of a solution of sodium hydroxide and examined for surface deterioration.

When tested in accordance with 5.3.4.4, the cold plastic film shall show no signs of partial or complete film destruction, surface roughening or discolouration.
5 Test methods

5.1 General

This clause gives three separate lists of test methods. Paints, thermoplastics and cold plastics

If not specified in the relevant test method sampling shall be made according to EN 13459.

5.2 Paint

5.2.1 **Chromaticity co-ordinates and luminance factor**: The x,y chromaticity co-ordinates and luminance factor $\beta$ shall be measured as specified in Annex A.

5.2.2 **Hiding power**: it shall be tested in accordance with Annex B applying the paint at a rate of 400 microns +/- 40 micron. (wet film).

5.2.3 **Storage stability**: each of the components of paint shall be tested separately in different containers. It shall be tested in accordance with Annex C.

5.2.4 **UV ageing**: the paint shall be applied as in A.3 to panels as described in A.2. The specimens shall be tested in accordance with EN ISO 4892-3 for 168 h under lamp type II (UVB - 313) in cycles of 8 h of radiation at 60 °C ± 2 °C and 4 h of condensation at 50 °C ± 2 °C.

5.2.5 **Bleed resistance**: it shall be tested in accordance with Annex D.

5.2.6 **Alkali resistance**: it shall be tested in accordance with Annex E.

5.3 Thermoplastics

5.3.1 **General**: the thermoplastics shall be melted according to the manufacturers recommendations. If nothing is stated, follow Annex H.

5.3.2 **Tests before heat stability test**.

5.3.2.1 **Chromaticity co-ordinates and luminance factor**: the x,y chromaticity co-ordinates and luminance factor $\beta$ shall be measured as specified in Annex F.

5.3.2.2 **Softening point**: it shall be tested in accordance with Annex G.

5.3.2.3 **Alkali resistance**: it shall be tested in accordance with Annex E.

5.3.2.4 **Cold impact resistance**: it shall be tested in accordance with Annex I.

5.3.2.5 **UV ageing**: the thermoplastic shall be applied at the manufacturer's stated thickness to panels as described in A.2 and tested in accordance with EN ISO 4892-3 for 168 h under lamp type II (UVB - 313) in cycles of 8 h of radiation at 60 °C ± 2 °C and 4 h of condensation at 50 °C ± 2 °C.

5.3.3 **Tests after heat stability**

It shall be carried out after submitting the thermoplastic to heat stability according to Annex H.
5.3.3.1 **Chromaticity co-ordinates and luminance factor:** the x,y chromaticity co-ordinates and luminance factor $\beta$ shall be measured as specified in Annex F.

5.3.3.2 **Softening point:** it shall be tested in accordance with Annex G.

5.3.3.3 **Indentation:** it shall be tested in accordance with Annex J.

5.3.4 **Cold plastics**

5.3.4.1 **Chromaticity co-ordinates and luminance factor:** the x,y chromaticity co-ordinates and luminance factor $\beta$ shall be measured as specified in Annex A.

5.3.4.2 **Storage stability:** the components of cold plastics shall each be tested separately in different containers. They shall be tested in accordance with Annex C.

5.3.4.3 **UV ageing:** the cold plastic shall be applied at the manufacturer’s stated thickness to test panels as described in A.2 and tested in accordance with EN ISO 4892-3 for 168 h under lamp type II (UVB - 313) in cycles of 8 h of radiation at 60 °C ± 2 °C and 4 h of condensation at 50 °C ± 2 °C.

5.3.4.4 **Alkali resistance:** it shall be tested in accordance with Annex E.
Annex A
(normative)

Paint and cold plastics – Test method for determining the chromaticity co-
ordinates and luminance factor

A.1 Principle and apparatus

The principle of measurement and the choice of apparatus are given in EN 1436,: Annex C.

The equipment shall be set up with observer angle 2°, Illuminant D65

A.2 Materials

Test panels shall be made of aluminium, of minimum size 150 mm × 75 mm × 0,60 mm, prepared for test by solvent cleaning.

A.3 Procedure

A.3.1 Paint

Prepare the aluminium panel and apply the paint to the panel to give a wet film thickness of 400 µm ± 40 µm using shims and a doctor blade. In the case of paint containing premix glass beads a coating equivalent to 1 000 g/m² may be applied. Allow the panel to dry for a minimum of 24 h in a horizontal position at (23 ± 5) °C and 75 % relative humidity (max), out of sunlight and with protection from dust. Measure in accordance with EN 1436.

A.3.2 Cold plastic

For each of the test, at least 500 g of cold plastic shall be prepared in the specific manner.

Prepare the aluminium panel and apply the cold plastic to the panel to give a wet film in accordance with the tolerance, instructions and method described in technical sheet of the producer. Allow the panel to dry for a minimum of 24 h in a horizontal position at (23 ±5) °C and (75 % relative humidity (max), out of sunlight and with protection from dust. Measure in accordance with EN 1436.
Annex B
(normative)

Paint – Test method for determining the hiding power

B.1 Definitions and background

Opacity is a material property that impedes the light transmission. In the specific case of paint dry films, the opacity or hiding power can be understood as the capacity of the paint to reduce the contrast between a black surface and a white surface over which the paint has been applied and dried.

The test method is based in determining the contrast ratio when the paints are applied at a fixed dosage.

B.2 Apparatus

a) A film applicator type Doctor Blade or similar.

b) A device provided with an engine, a driving system and a suction plate to move the Doctor Blade at a constant speed on a flat surface.

c) A reflectometer or colorimeter in accordance with the specifications given in EN 1436.

d) Cards impervious to paint solvents, flat surface and enough surface to allow good adherence to the suction plate. One card side shall be marked with black and white alternative squares or stripes of at least 40 mm size. The luminance factor, measured as described in EN 1436, shall be 0,02 as maximum for the black surface and 0,80 as minimum for the white surface.

e) Precision balance with a minimum resolution of 0,001 g.

f) Measuring instrument able to evaluate 0,5 mm.

B.3 Procedure

B.3.1 Sampling

Representative sample of the paint shall be taken as specified in EN 13459.

B.3.2 Preparation of test films

Weight the card on the precision balance and place it over the suction plate taken care that it is completely adhered to the surface. Immediately before the application mix the paint thoroughly by vigorous stirring taking care not to incorporate air bubbles. The paint is then applied across the card at an intended dosage of (400 μm ± 40 μm) driving the applicator “Doctor Blade” at a constant speed by means of the automatic device. The applied paint width shall be higher than the relevant width of the white and black parts of the card.

The procedure shall be repeated to obtain six paint film cards for testing. The films shall be within the tolerance of

400 μm ± 40 μm

In order to assess that the resulting test film is inside the intended interval and just after the application, the applied thickness may be measured. Appropriate instruments for measuring thickness may be used for this purpose.

Keep the test films to dry in horizontal position at (23 ±5)°C and (75% max of relative humidity for at least 24 h and not more than 48 h, taken care that they are well protected from direct radiation and dust.
B.3.3 Determination of the applied weight

Take a new card with a weight not differing more than ± 0.3% with regard to the other cards used for preparing the test films and cut pieces of black and white surfaces with a minimum width of 40 mm to be used as weight zero (\( z \)).

Once the test films have dried and before manipulating them, measurements of reflectance shall be taken in accordance with the indications given in B.3.4. To be validated afterwards, they shall be taken at the same positions on which the weight of applied paint is to be determined.

From each of the six cards with the test films dried in accordance with the specifications given in B.3.2, cut carefully identical pieces of black and white substrates with the same dimensions as for the new one abovementioned. The surface (\( A \)) shall be computed from the measured dimensions and expressed in cm\(^2\). The weight of dry paint actually applied (WA) on the test films shall be determined by difference between the weight of these pieces and the relevant weight zero and expressed in mg. The dosage of dry paint per surface unit (DS) shall be expressed in g/m\(^2\) from the formula:

$$ DS = \frac{10 \cdot \text{WA}}{A} $$

To transform the dosage of dry paint (DS) into dosage of liquid paint (DL) it is necessary to determine de non-volatile content (S) shall be determined in accordance with the test method specified in EN 12802. The final result, i.e. the dosage of the liquid paint actually applied, shall be expressed in g/m\(^2\) from the formula:

$$ DL = \frac{100 \cdot DS}{S} $$

DS and DL are expressed in g/m\(^2\) and S in %.

B.3.4 Measurement of the luminance factor

Measurements of luminance factor shall be carried out on coated cards over the surfaces of each of the weighted pieces of black and white substrates in accordance with the specifications given in EN 1436.

B.4 Expression of results

The hiding power of a dry film of paint, for a fixed dosage, shall be expressed by means of the contrast ratio (\( r_c \)) defined as a percentage for each coated card or film from the average luminance factor over the black substrates (\( \beta_B \)) and over the white substrates (\( \beta_W \)) from the formula:

$$ r_c = \frac{\beta_1}{\beta_2} \times 100 $$

where

- \( r_c \) is the contrast ratio of the dry film of paint;
- \( \beta_1 \) is the average value of the luminance factor of the dry film of paint applied over the weighted black substrates of each coated card;
- \( \beta_2 \) is the average value of the luminance factor of the dry film of paint applied over the weighted white substrates of each coated card.

It is assumed that for the narrow interval of 400 μm ± 40 μm\(^2\) of liquid paint, the contrast ratio is a linear function of the dosage of liquid paint. Consequently, the value of the contrast ratio for the exact dosage of 400 μm ± 40 μm shall be obtained by graphical interpolation in the resulting diagram representing the contrast ratios versus the determined liquid dosages for each of the six tested cards.
Annex C
(normative)

Paint and cold plastics – Test method for determining the storage stability

C.1 Principle

The test method covers the determination of the degree of pigment suspension and ease of remixing a shelf-aged sample of paint to a homogeneous condition suitable for immediate use.

C.2 Apparatus

a) Three 250 ml wide-neck bottles (test vessels) of clear glass, 55 mm in diameter, 110 mm in height, with an opening 45 mm in diameter with an ISO thread and a screw-type plastic (PE) inset top;

b) Steel spatula weighing 45 g ± 1 g, square, 123 mm ± 1 mm in length and with a blade 20,5 mm ± 0,5 mm in width: the spatula shall be made by cutting the top from an ordinary 127 mm flexible steel laboratory spatula to obtain the specified length;

c) Warming cabinet, with forced ventilation capable of reaching a temperature of either 45°C ± 3 °C or 60°C ± 3 °C;

d) Tamping apparatus in accordance with EN ISO 787-11:1995 (see Figure C.1);

e) Holder for the test vessel (see Figure C.1).
Dimensions in millimetres

Key

1 rubber sleeve 1 mm
2 holder for vessel
3 shaft
4 sleeve
5 anvil
6 cam
7 tamping apparatus in accordance with EN ISO 787-11:1995

Figure C.1 — Tamping volumeter
C.3 Procedure

C.3.1 Paint

Place a sample of the paint in each of the three 250 ml wide-neck bottles, taking care to ensure that the level of
paint in each test vessel is identical and reaches the lower edge of the thread (approximately 20 mm below the
screw top but to a maximum of 80 % of the volume).

The edges and thread of the test vessels shall be thoroughly cleaned using cellulose and solvent. The test vessels
are then hermetically closed and labelled 1 to 3. The samples shall be then weighed to the nearest 0,1 g and
stored in the warming cabinet and subjected to 4 cycles of storing and tamping for a total of 28 days at (45 ± 3)°C
or if the boiling point allows for 88 h at (60 ± 3)°C. After each seven day period, or after each 22-hour period if
applicable, the samples shall be subjected to 25 000 strokes of the automatic tamping equipment. By observing the
samples through the glass it can be seen whether the phases separate.

After each series of 25 000 strokes the samples shall be returned into the warming cabinet. All three samples shall
be reweighed immediately after storage under accelerated conditions (action of heat and tamping) in order to
determine any loss of mass. Loss of weight shall not exceed 2 %. Any samples with a loss of mass exceeding 2 %
are deemed to have failed the test.

C.3.2 Cold plastics

Cold plastics shall be tested in the same way as paints but using only the cycle of 28 days at 45 °C (for safety
reasons). The components of cold plastic shall be tested for the presence of peroxides prior to testing.

The components containing peroxides shall not be stored in the warming cabinet but at room temperature and shall
not be subjected to the tamping test.

C.4 Determination of the degree of suspension and ease of remixing

After weighing, open the three test vessels carefully without shaking or agitation and examine the samples. Do not
remove any surface layer that may have formed on the samples (skin formation). Use a spatula to examine the
extent to which portions of the paint have separated to form a layer at the bottom of the test vessel during storage
and tamping. Hold one end of the spatula so that it is perpendicular to the central area of the paint and its bottom
edge is level with the top of the test vessel. Drop the spatula from this height, then move the spatula manually over
the bottom of the test vessel in a lateral direction. Assess the resistance of the cake of settled pigment to this
movement and the ease of remixing for all three samples in accordance with C.5, after which determine and record
the average rating for the three samples.

C.5 Rating

Rate the sample for degree of settling on a scale of 10 to 0 in accordance with Table C.1. Give intermediate
conditions the appropriate odd number.
Table C.1 —Rating scale for storage stability

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description of product condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Perfect suspension. No change from the original condition of the product.</td>
</tr>
<tr>
<td>8</td>
<td>Settling has definitely taken place. A slight deposit is raised when the spatula is dropped into the product. No significant resistance to sideways movement of the spatula.</td>
</tr>
<tr>
<td>6</td>
<td>Definite cake of settled pigment. Spatula drops through cake under its own weight. Definite resistance to sideways motion of the spatula. Coherent portions of cake may be removed on spatula. Product can be remixed readily to a homogeneous state.</td>
</tr>
<tr>
<td>4</td>
<td>Spatula does not fall through cake to bottom of test vessel under its own weight. Difficult to move spatula through cake sideways and slight edgewise resistance. Product can be remixed readily to a homogeneous state.</td>
</tr>
<tr>
<td>3</td>
<td>Definite resistance to edgewise movement of the spatula after it has been pushed through the settled layer by exerting slight pressure on it. Product can be remixed to a homogeneous state by stirring manually with a small amount of effort.</td>
</tr>
<tr>
<td>2</td>
<td>When spatula has been forced through the settled layer it is very difficult to move spatula sideways. Definite edgewise resistance to movement of spatula. Paint can be remixed to a homogeneous state.</td>
</tr>
<tr>
<td>0</td>
<td>Very firm cake that cannot be incorporated with the liquid to form a smooth homogeneous product by stirring manually.</td>
</tr>
</tbody>
</table>

A non-accelerated test may be carried out in the following manner. Place a sample of paint or cold plastic to within 10 mm of the top of a 1 litre friction top paint tin (86.0 mm ± 1.6 mm diameter and 96.4 mm ± 1.6 mm in height) and close tightly. Store undisturbed for shelf ageing at between 18 °C and 23 °C for 6 months or said period as agreed between the purchaser and the vendor. Test for settlement in accordance with C.4 and record the result in accordance with C.5.
Annex D
(normative)

Paint – Test method for determining the bleed resistance

D.1 Principle

The paint is applied to a bitumen surface and the film is examined for discolouration after conditioning for 72 h.

D.2 Apparatus and materials

a) Light source and colorimeter as described in EN 1436;
b) warming cabinet with forced ventilation capable of reaching a temperature of 70 °C ± 3°C;
c) hardboard carrier panels in accordance with EN ISO 1514, and at least 100 mm x 200 mm x 3 mm minimum in size with density 0.75g/cm³;
d) doctor blade with which to apply the paint, with a ratio of (300 ± 30) µm of wet paint and at least 60 mm wide;
e) type B 70/100 pen bitumen or similar: the quantity should be sufficient to coat the required number of carrier panels;
f) toluene (solvent).

D.3 Preparation of bitumen coated carrier panel

Several coats of a 50 % bitumen solution in toluene shall be applied with a brush to the smooth face of the carrier panel in an efficient fume cupboard such that 50 g/m² of bitumen shall remain on the plate after drying. The carrier panel is first stored in a warming cabinet for 72 h at 70 ± 3 °C, then for 24 h at room temperature in order to age the bitumen remaining on the carrier panel. Check temperature and time.

D.4 Procedure

Place a strip of transparent tape of width not less than 50 mm on the bitumen surface, approximately 75 mm from the edge of the panel and parallel to the shortest length side (see Figure D.1).

Thoroughly stir the paint under test and apply the paint by means of a doctor blade of a ratio of (300 ± 30) µm of wet film, along the length of the carrier panel, in an approximate interval of 4 s, so that approximately the half of the applied surface meets on the zone transparent tape.

For multicomponent paint, mix according to the manufacturer’s instructions. Ensure that the components are mixed thoroughly.

As the test panel (consisting of the carrier panel plus road marking paint) is ready, then allow drying for 72 h. at 23 °C ± 3 °C, followed by 24 h. at 45 °C ± 3 °C.

After then, the luminance factor of the paint both on the coated test surface to which adhesive tape is applied (β) and on the test surface coated with bitumen (β') is determined photometrically in accordance with Annex C of EN 1436:.

Record both values. Calculate the difference between the luminance factor of the paint on the transparent tape (β) and that of the paint on the bitumen coating (β'). The result of the test is: (Δβ = β - β').
Chromaticity co-ordinates of the paint on the surface covered with bitumen shall be determined, in accordance with EN 1436:

Key
1 applied paint
2 strip of transparent tape*
3 face of hardboard
* note re suitable type of tape to be used

Figure D.1 — Example of Procedure
Annex E
(normative)

Paint, cold plastics and thermoplastics – Test method for determining the alkali resistance of the materials

E.1 General

The purpose of this test method is to aid the selection of a road marking material which is suitable for direct application onto alkaline reactive substrates (hydraulic concrete pavements).

E.2 Principle

A specimen fraction of paint or cold plastics shall be applied to three carrier panels using a doctor blade. A specimen fraction of a thermoplastic material shall be heated to a mouldable state, pressed into a sheet and then applied to three carrier panels. The test panels shall be conditioned and subjected to the action of a 10 % solution of sodium hydroxide for a period of 48 h. After watering and brushing, the surface characteristics of the test zones shall be assessed conforming to E.7.

E.3 Apparatus and reagents

E.3.1 General

a) Panels, three panels 100 mm x 200 mm x 10 mm of acrylic glass, transparent, roughened, graining of 150 flint coated paper;
b) spatula;
c) nail brush;
d) oven, capable of forced circulation to a temperature of (45 ± 3)ºC, aeration;
e) solution of 10 % sodium hydroxide, in water.

E.3.2 Paint and cold plastics

a) Doctor blade or screed box with adjustable slit with which to apply the paint or cold plastics, at their appropriate range;
b) beaker, 1 000 ml capacity.

E.3.3 Thermoplastics

a) Vessel with lid;
b) paint scraper;
c) pen knife;
d) roll mill, with two rolls (each at least 300 mm long);
e) heat resistant plastic foil, 300 mm wide, heat resistant to 200 ºC;
f) heating cabinet, capable of being set to any temperature up to 200 ºC.
E.4 Number of tests

A specimen fraction of each material shall be applied to three carrier panels. Two of these panels are subjected to the sodium hydroxide solution and subsequently tested. The third one serves as a reference.

E.5 Preparation of test panels

E.5.1 Paint

Apply a wet film of (400 ± 40) µm using a doctor blade over three roughened, cleaned and without fat, acrylic glass carrier panels, 100 mm x 200 mm x 10 mm. After 24 h of drying at (23 ± 5) °C and (75% max of relative humidity and 150 h at (45 ± 3) °C with forced circulation. At the end of this period cool to room temperature and it is okay to be tested.

Mix the components of multicomponent paints (at the mixing ratio prescribed by the manufacturer) directly before application. Ensure that the components are mixed thoroughly.

If the manufacturer prescribes that the paint be applied in several layers, select the slit width of the doctor blade, which corresponds to the largest of the wet film thickness stated.

NOTE The phenomena related to the bond between two paint layers are not covered by this test.

Screen a paint containing oversize before application. Take care to use a screen with an opening slit as close as possible to the wet film thickness to be applied.

Condition the test panels (carrier panels with paint) by storing for 24 h at room temperature and then in an oven, in a horizontal position, for 150 h at a temperature of (45 ± 3) °C. Cool the test panels to room temperature.

E.5.2 Thermoplastics

Store a specimen fraction of thermoplastics of approximately 1 kg, placed in a vessel covered with a lid, in an oven to be heated to a mouldable state. Specific temperatures cannot be stated since the application temperatures for thermoplastics are usually in the range 160 °C to 200 °C. In general, the application temperature stated by the manufacturer should be adequate. If a manufacturer gives a range of temperatures, the heating cabinet shall be adjusted to the average value of the temperatures stated.

Having reached the mouldable state, stir the heated specimen fraction with a paint scraper for homogenisation.

Adjust the gap between the two rolls of the mill so that a sample of the layer thickness prescribed by the manufacturer can be produced by pressing between two sheets of heat resistant plastic foil.

A strip of heat resistant plastic foil of length of approximately 3 m is folded in half. The fold is inserted between the two rolls, wrapping the two ends of the folded strip around them.

After homogenisation, and while the sample is still in a mouldable state, gradually place it between the two strips of heat resistant plastic foil while a second operator slowly and uniformly operating the crank handle of the roll mill. The rotative motion of the rolls pulls the two halves of the foil strip between the rolls pressing them together and at the same time producing a sheet sample of defined thickness. After cooling to room temperature, cut panels from the sheet using a pen knife and one of the carrier panels as a template. Using the carrier panels, prepare three test panels. Condition the three test panels (carrier panels with thermoplastics) by storing, in a horizontal position, in an oven for 14 days at a temperature of 45 °C ± 3 °C, then cool the test panels to room temperature.

E.5.3 Cold plastics

Safety glasses should be worn when handling peroxides.

Mix cold plastics components immediately before application. Using the mixing ratio prescribed by the manufacturer, weigh a total of 250 g of mixed product prepared from all components to an accuracy of 1 % into a beaker. Weigh the basic material first, followed by the other components. Stir the components intensively using a
spatula for 1 min, or according to the manufacturer’s instructions. Apply the cold plastics to be tested to three roughened carrier panels using a doctor blade or a screed box. The slit size, in this case, shall be the equivalent of the wet film thickness of the material prescribed by the manufacturer of the cold plastics (at least 400 \( \mu \text{m} \)).

Condition the test panels (carrier panels with cold plastics) by storing for 24 h to 48 h at room temperature.

### E.6 Testing

Use one of the panels as a reference. Place the two remaining panels, with the material face up, and test it according to EN ISO 2812-1: method 1, procedure A. After then sink it in site a sodium hydroxide solution of 10 % concentration per weight during 48 h at (23 ± 3) °C.

Then remove the test panels and place them under running water and brush with a hard nail brush until all loose particles are removed from the test zone (till the rising water is clear).

Condition the test panels by storing in a horizontal position for 24 h-48 h at (23 ± 3) °C and (50 ± 10) % of humidity.

### E.7 Evaluation of the surface conditions

The surface of the coloured films in the zones subjected to the test solution shall be described with respect to the following signs of partial or complete film destruction, surface roughening or discolouration.

### E.8 Precision and repetition

The two panels shall give the same result otherwise the test shall be repeated.
Annex F
(normative)

Thermoplastics – Test method for determining the chromaticity co-ordinates and luminance factor

F.1 Principle

The principle of measurement is given in EN 1436. A solid block of thermoplastic material is measured. This test method specifies a test specimen of appropriate dimension and thickness to give a smooth surface and maximum reflection. Other specimens can be used if it is verified that they have the same specific properties.

F.2 Apparatus

a) Light source and measuring device as in EN 1436. The equipment settings shall be 2° standard colorimetry observer, Illuminant D65.

b) Silicone rubber mould consisting of a flat sheet of silicone rubber, approximately 10 mm thick, to be used as a base plate and a top sheet of similar size and thickness with a 100 mm circle cut in it.

F.3 Procedure

F.3.1 Melt sufficient material to fill a prepared rubber mould and cast a slab of approximately 100 mm in diameter and 10 mm thick.

Materials should not be heated above the manufacturer’s stated safe heating temperature.

For routine purposes specimens may be cast on a smooth metal sheet coated with permanent release coating of PTFE (polytetrafluoroethylene).

Ensure the surfaces to be used for casting the sample are smooth and free from imperfections (e.g. scratches, pits and air voids)

If, after having been tested, the specimen is to be kept for further measurements, it should be returned to its mould and kept at a low temperature, preferably in a refrigerator, in order to avoid distortion.

Provided the cast face (under surface) of the specimen is used for the measurement, the presence of solid glass beads in the material is unlikely to affect its luminance. If necessary, in order to obtain a smooth under surface, the top of the mould may be loaded with a mass of 5 kg whilst the specimen is warm.

F.3.2 Allow the specimen to cool to room temperature, remove it from the mould and immediately measure the chromaticity co-ordinates x and y on three different areas of the upper surface of the specimen.
Annex G
(normative)

Thermoplastics – Test method for determining the softening point

G.1 Principle

The principle of this method is to determine the softening point of thermoplastic road materials in accordance with Wilhelmi.

The softening point is the temperature, under the testing conditions of this method, at which a given layer of thermoplastic material experiences a given deformation under the action of a steel ball of 13,9 g mass.

G.2 Apparatus

a) Ring, in accordance with Wilhelmi (see Figure G.1), consisting of a bottom ring half and a top ring half with bayonet catch, retaining rod and prominently protruding nipples;

b) beaker, appropriate form for the equipment;

c) steel ball of mass 13,9 g ± 0,1 g (approximate diameter 15 mm);

d) thermometer + 30 °C to + 200 °C graduated in 0,5 °C divisions;

e) base plate of metal or glass;

f) mould parting agent, e.g. mixture of glycerine and dextrine in 1:1 ratio;

g) knife;

h) tongs or tweezers, for holding the ball;

i) test liquids, freshly boiled distilled water, glycerine;

j) device for heating the beaker, enabling the temperature of the test liquid to be raised uniformly from 5 °C to 180 °C at a rate of 5 °C per 60 s ± 5 s and with stirring if necessary to maintain a constant heating rate.

G.3 Samples

The sample mass shall amount to approximately 50 g. Two test specimens shall be tested.

G.4 Preparation of the ring

Heat the bottom half of the ring and base plate, thinly coated with the mould parting agent, together with the sample, to the manufacturer's suggested softening point + 70 °C.

Fill the bottom half of the ring with the hot material. Place the top half of the ring onto the bottom half so that the superfluous portion of the material is pressed out of the whole of the top half and leave standing for 30 min at room temperature (18 °C to 28 °C). The salient portion of the test specimen is trimmed off with the warmed knife so that the surface of the test specimen is smooth and flat.

Insert the bottom half of the ring into the top half and fasten with the bayonet catch. The test specimen is now firmly clamped between the two halves of the ring, and is not capable of becoming deformed at the edges.
Suspend the ring, after preparation as in G.4, in the beaker in such a way that its bottom face is situated 50 mm above the bottom of the beaker. Pour the test liquid into the beaker up to a height of 50 mm above the top face of the ring.
the ring at a temperature of approximately 5 °C or 30 °C respectively according to the test liquid used (see Table G.1). Place the ball in the test liquid but not on the test specimen. Suspend the thermometer in the beaker in such a way that its bottom end lies flush with the bottom face of the ring, but does not touch either the ring or the beaker.

The type of test liquid and the initial temperature will depend on the softening point of the sample and are listed in Table G.1.

<table>
<thead>
<tr>
<th>Softening point in accordance with Wilhelmi</th>
<th>Test liquid</th>
<th>Initial temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 80 °C</td>
<td>Freshly boiled distilled water</td>
<td>5 °C</td>
</tr>
<tr>
<td>Over 80 °C</td>
<td>Glycerine</td>
<td>30 °C</td>
</tr>
</tbody>
</table>

Freshly boiled distilled water should be used as otherwise the test results may be affected by air bubbles. The glycerine is still so viscous at temperatures below 50 °C that streaks are formed during the heating process. However, the prescribed uniform temperature rise ensures that no difficulties will occur at a temperature above 60 °C.

After immersion of the ball leave the beaker standing for 10 min at room temperature (18 °C to 28 °C) on the beaker heating device, which has not yet been switched on. After these 10 min place the ball on the test specimen in the middle of the ring, with the aid of the tongs or tweezers.

Heat the beaker in such a way that the temperature of the test liquid increases uniformly at a rate of 5 °C/min, with non-turbulent stirring. Use the first few minutes to adjust the rate of temperature rise. At a temperature which is at least 15 °C below the softening point of the sample, adjust the rate of the temperature rise with sufficient accuracy to ensure that the further rate of temperature rise from this point onwards takes place at a rate of 5 °C per 60 s ± 5 s. Deviations shall only occur within the range of these ± 5 s and shall even then not be compensated for during the progress of the test.

As the temperature increases, the test specimen becomes more cambered in a downward direction under the weight of the ball. At the instant when either the test specimen or the ball comes into contact with the bottom of the beaker read off the temperature to the nearest 0,5 °C.

Test the second specimen in a second heating process.

If the temperatures measured on the two test specimens differ from one another by more than the permissible 2 °C then repeat the test on two new test specimens.

Carry out the test procedure within 48 h of test specimen preparation.

G.6 Expression of the result

With reference to this test method, report the mean value of the two measurements, rounded to the nearest 1 °C. This represents the softening point in accordance with Wilhelmi.
Annex H
(normative)

Thermoplastics – Test method for determining the heat stability

H.1 Principle

The method is intended for the determination of the heat stability of a thermoplastic road marking material under prescribed conditions. The test is designed to simulate the heating conditions which occur during normal application operations.

H.2 Summary

The thermoplastic material is melted and then heated for 6 h at application temperature. Determinations, such as chromaticity co-ordinates $x,y$ and luminance factor, softening point, indentation value, and UV ageing are then performed as required.

H.3 Apparatus

a) Heating equipment, suitable for heating the sample up to a temperature of about 220 °C and maintaining this temperature ± 2 °C;

b) Paddle stirrer, electrically driven and controlled to rotate at 100 r/min ± 10 r/min. The shaft of the stirrer is an approximately 10 mm diameter rod of suitable length fitted with a "double blade" paddle of 50 mm to 55 mm length, and approximately 20 mm depth and 1 mm thickness. See Figures H.1, H.2 and H.3 for examples of the equipment;

c) Thermometer, measuring range up to 250 °C with 1 °C divisions and an accuracy of ± 1 °C;

d) One litre paint containers with rim, made of tin, aluminium, glass or stainless steel, inner diameter approximately 100 mm and height of approximately 130 mm. Use glass for products containing hard coarse aggregate. Aluminium foil to cover the container during heating;

e) Spatula, or other suitable tool for stirring the marking material;

f) Dividing tool (if required), e.g. hammer or sledge-hammer.

H.4 Preparation of sample

H.4.1 Division of sample

Divide the thermoplastic material where necessary using a hammer or sledge-hammer. To facilitate this process, the sample may be frozen in a freezing cabinet for at least a couple of hours (or overnight) to obtain a more brittle consistency before being divided into smaller pieces with a hammer.

During this operation protective eyewear is recommended. The sample may be covered with a cloth to prevent danger from flying fragments.

After division, remove pieces, with a total mass of approximately 1,7 kg, at random from various parts of the interior of the sample.

H.4.2 Heating

Place the sample in the paint containers for heating. Place the container with the sample in a thermostatically regulated heating equipment for heating to the application temperature. Place the stirrer in the centre of the
container, 15 mm above the bottom of the container. Place the thermometer in the sample, just between stirrer and
container wall, 50 mm to 60 mm above the bottom of the container. This can normally be done when the test
sample has reached a temperature of approximately 150 °C. Whilst being brought up to temperature stir the
sample continuously. Cover the container with the sample with foil during this heating period. A suitable stirring
speed is 100 r/min. Heating from 150 °C to the test temperature (200 °C ± 2 °C or ± 2 °C of the maximum specified
application temperature) should not take more than approximately 1.5 h.

When the sample has reached the required temperature and is fully homogenised, maintain test conditions for 6 h.
Switch off the heating equipment and leave the container and sample to cool to room temperature in the
equipment.

A temperature above the required test temperature can be accepted for short periods of time but these shall not
total more than 20 min over the test period. The temperature shall never exceed the maximum temperature given
by the manufacturer.

Figure H.1 —Equipment for heating the thermoplastic road marking material
Approximate dimensions in millimetres

Figure H.2 — Stirrer shaft
Figure H.3 — Stirrer paddle
Thermoplastics – Test method for determining the cold impact resistance

I.1 Principle

The principle is to measure the resistance of thermoplastic materials, which have been stored at cold temperatures, to the impact of a falling steel ball.

I.2 Apparatus and reagents

a) Hobart mixer model N 50 (electric paddle stirrer), or similar equipment, having a mixing container, capacity 5 l, which can be heated during mixing and which is capable of preventing overheating. Single bladed paddle;

b) thermometer, measuring range 0 °C to 250 °C with an accuracy of ±1 °C;

c) cylindrical spring moulds:
   1) internal diameter: 50 mm ± 0,5 mm;
   2) depth: 25 mm ± 0,3 mm;

d) glass or metal plate;

e) metal tray containing a cylindrical recess in the base with a diameter of 52 mm and a depth of 2 mm;

f) base plate with centering device;

g) steel balls, either:
   1) mass 66,8 g ± 0,2 g (approximate diameter 25,4 mm); or
   2) mass 110 g ± 0,3 g (approximate diameter 30,0 mm);

h) electromagnet;

i) silicon paper strips, length 155 mm, width 25 mm;

j) release oil;

k) brine solution, a solution of 130 g sodium chloride (NaCl) in 1 l of water (for storing specimens at -10 °C);

l) freezer cabinet, capable of reaching -10 °C ± 3 °C;

m) ice and water mixture.

I.3 Procedure

I.3.1 Specimen preparation

Heat the material in the mixing container (in the case of block form material break into pieces no larger than 100 g). Stir constantly and measure the temperature. Continue heating until the material has good flowability.

Do not heat above the supplier's advised maximum safe heating temperature.
Place the silicon paper strips round the inside of the moulds and place the moulds on the metal or glass plate which has been previously treated with release oil.

Fill the moulds with the molten material so that it is slightly above the top level of the moulds. Allow the specimens to cool and then level off the top surface of the moulds using a heated knife. Remove the specimens from the moulds and immerse them for 3 h in a suitable container filled with a mixture of ice and water at 0 °C or in a freezing cabinet at -10 °C ± 3 °C.

I.3.2 Test at 0 °C

Remove a specimen from the container and place it, with the levelled face downwards, into the recess of the metal tray. Fill the tray with ice and water at 0 °C to the level of the upper surface of the specimen.

With the aid of the electromagnet allow the steel ball of 66.8 g to fall onto the centre of the specimen from a height of 2.00 m (measured from the top surface of the specimen to the underside of the ball). Examine the specimen to see if it has broken or shows evidence of cracking. Test for the presence of hidden cracks by trying to break the specimen by hand. Repeat the procedure until 10 specimens, prepared from the same material, have been tested. Record the number of specimens which have not broken or cracked.

I.3.3 Test at -10 °C

Remove a specimen from the freezing cabinet and place it, with the levelled face downwards, into the recess of the metal tray. Fill the tray with brine solution at -10 °C to the level of the specimen. Test as in I.3.2 but using the steel ball of either 66.8 g or 110.0 g.
Annex J
(normative)

Thermoplastics – Test method for determining the indentation value

J.1 Principle

The principle is the determination of the indentation value of a thermoplastic road marking material. The indentation value is the time in seconds required for a cylinder with a base area of 100 mm² and a force of 525 N to sink 10 mm into the road marking material at a given temperature.

J.2 Summary

A sample of the thermoplastic road marking material shall be cast in moulds to produce 70 mm test cubes. The test cubes shall be conditioned in the mould in a water bath.

A cylindrical stamp with a cross-section of 100 mm² shall be applied perpendicular to the sample surface and loaded with a force of 525 N. The indentation depth of the test stamp varies with time and shall be recorded.

The time taken to reach 10 mm indentation shall be recorded. Normally, determinations are carried out on two samples.

J.3 Apparatus

a) Indentation load equipment, with test stamp, dial gauge calibrated in 0,1 mm divisions and water bath with a capacity of 7,5 l (see Figure J.1).

The apparatus is designed so that the sample can be subjected by the stamp to a total load of (525 ± 1) N applied perpendicular to the test surface. The loading shaft itself contributes a force of 25 N and the mass acting on the sample surface a further (500 ± 0,9) N; the total mass acting on the sample is (53,5 ± 0,1) kg.

b) Test stamp, consisting of a steel cylinder with a flat bottom having an area of 100 mm² (corresponding to a diameter of 11,3 mm ± 0,1 mm). The mantle and bottom surface of the stamp are ground to a high finish.

c) Dial gauge, with graduations of 0,1 °C and an accuracy of ± 0,1°C.

d) Water bath, capable of controlling the temperature at the required test temperature ± 0,5 °C.

The entire apparatus shall be placed on a flat surface.

e) Square steel mould, inner size 70 mm ± 1 mm, with base plate and fixing device (see Figure J.2).

f) Apparatus for heating the sample (see Figure H.1).

g) One litre paint container (see H.3).

h) Stopwatch, with graduations of 0,1 s and with an accuracy of ± 0,1 s.

i) Glycerine for lubricating the mould and baseplate.

j) Dividing tool (see H.3).

k) Spatula or other suitable tool for stirring the sample.

l) Oven, capable of being controlled at any temperature up to 200 °C.
Figure J.1 — Indentation load apparatus

Key
1 weights
2 raising and lowering mechanism
3 dial gauge
4 fine adjustment
5 test stamp
6 water bath

Figure J.2 — Steel mould with fixing device

Key
1 mould
2 fixing device
3 steel plate
36

J.4 Preparation of the sample

J.4.1 Division of sample

Divide the thermoplastic road marking material as described in H.4.1.

J.4.2 Heating and casting of test cubes

Carry out the heating as described in H.4.2. When the sample has reached the required temperature and finally homogenised with a spatula, cast it in the test cubes.

Pour the heating sample evenly, with a small excess, into the mould which has been previously lubricated with glycerine. After the test cube has cooled somewhat, use a tool, such as a spatula, to produce a small elevation in the centre of the top surface. The elevation shall be sufficiently big so that a flat surface is formed when the test cube has cooled completely.

When the test cube has reached room temperature remove it from the mould, turn so that one side is at the bottom and remount in this way in the mould. It is important that the test cube rests completely on the base plate.

J.4.3 Conditioning

After being turned in the mould and firmly re-fixed, place the test cube in the water bath and condition at 20 °C ± 0.5 °C for at least 1 h. Other standard test temperatures may be specified, refer to Table 8 for alternative testing temperatures. Prepare two cubes and carry out the test on both cubes.

J.5 Testing

Place the test cube under the test stamp, with the total load moved upwards with the aid of the raising and lowering device. Apply the loading shaft alone (force 25 N) to the surface of the test cube at a distance of approximately 20 mm from the edge of the cube. When this load is stabilised set the dial gauge to zero with the fine adjustment. Apply the total load (525 N) to the shaft by slowly turning the raising and lowering device and turning the arm 2 to 3 times so that the load is completely free, and start the stopwatch. Record the time for 10 mm indentation.

Carry out the testing procedure within 48 h of test cube preparation.

NOTE: Tests shall be applied to even and well formed surfaces. Avoid testing top surface as this may have irregularities.

J.6 Calculation

The time taken for 10 mm indentation shall be specified in seconds for each test cube. The arithmetic mean shall be calculated.

J.7 Interpretation of the results

If the deviation between individual values and the mean does not exceed 5 s for means less than 50 s, or 10 % for means greater than 50 s, then the values shall be approved.

If the deviation is greater, test two further cubes and calculate the arithmetic mean of all the values. If the deviation between this mean and any individual value is greater than 5 s or 10 % respectively, reject the value and repeat the test again.
Bibliography


