BS EN 15836-1:2010

BSI Standards Publication

Plastics — Plasticized poly(vinyl chloride) (PVC-P) membranes for inground swimming pools

Part 1: Homogenous membranes of nominal thickness equal to or greater than 0,75 mm

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National foreword

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

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Plastics - Plasticized poly(vinyl chloride) (PVC-P) membranes for inground swimming pools - Part 1: Homogenous membranes of nominal thickness equal to or greater than 0,75 mm

Plastiques - Membranes en poly(chlorure de vinyle) plastifié (PVC-P) pour piscines enterrées - Partie 1: Membranes homogènes d'épaisseur nominale supérieure ou égale à 0,75 mm

Kunststoffe - Kunststoffbahnen aus weichmacherhaltigem Polyvinylchlorid (PVC-P) für erdverlegte Schwimmbäder - Teil 1: Homogene Bahnen mit einer Nenndicke von mindestens 0,75 mm

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Contents

Page

Foreword

This document (EN 15836-1:2010) has been prepared by Technical Committee CEN/TC 249 “Plastics”, the secretariat of which is held by NBN.

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of an identical text or by endorsement, at the latest by December 2010, and conflicting national standards shall be withdrawn at the latest by December 2010.

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.

EN 15836, *Plastics — Plasticized poly(vinyl chloride) (PVC-P) membranes for inground swimming pools*, consists of the following parts:

— *Part 1: Homogenous membranes of nominal thickness equal to or greater than 0,75 mm* [this standard]

— *Part 2: Reinforced membranes of nominal thickness equal to or greater than 1,5 mm*

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies the visual, dimensional, mechanical and durability characteristics of plasticized poly(vinyl chloride) (PVC-P) homogenous membranes of nominal thickness greater than or equal to 0,75 mm for use as liners for inground swimming pools. It also specifies the characteristics of the composition of the PVC-P used to produce the membranes.

It applies specifically to homogenous membranes intended for use in swimming pools where the water temperature is less than or equal to 28 °C. If the membrane manufacturer permits a temperature of water continuously maintained above 28 °C, this document also applies.

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 438-2:2005, *High-pressure decorative laminates (HPL) — Sheets based on thermosetting resins (usually called Laminates) — Part 2: Determination of properties*

EN 495-5, *Flexible sheets for waterproofing — Determination of foldability at low temperature — Part 5: Plastic and rubber sheets for roof waterproofing*

EN 1107-2, *Flexible sheets for waterproofing — Determination of dimensional stability — Part 2: Plastic and rubber sheets for roof waterproofing*

EN 1848-2, *Flexible sheets for waterproofing — Determination of length, width, straightness and flatness — Part 2: Plastic and rubber sheets for roof waterproofing*

EN 1849-2, *Flexible sheets for waterproofing — Determination of thickness and mass per unit area — Part 2: Plastic and rubber sheets*

EN 1850-2, *Flexible sheets for waterproofing — Determination of visible defects — Part 2: Plastic and rubber sheets for roof waterproofing*

EN 12310-2, *Flexible sheets for waterproofing — Determination of resistance to tearing — Part 2: Plastic and rubber sheets for roof waterproofing*

EN 12316-2, *Flexible sheets for waterproofing — Determination of peel resistance of joints — Part 2: Plastic and rubber sheets for roof waterproofing*

EN 12317-2, *Flexible sheets for waterproofing — Determination of shear resistance of joints — Part 2: Plastic and rubber sheets for roof waterproofing*

EN 20105-A02, *Textiles — Tests for colour fastness — Part A02: Grey scale for assessing change in colour (ISO 105-A02:1993)*

EN ISO 62:2008, *Plastics — Determination of water absorption (ISO 62:2008)*

EN ISO 175:2000, *Plastics — Methods of test for the determination of the effects of immersion in liquid chemicals (ISO 175:1999)*

EN ISO 291, *Plastics — Standard atmospheres for conditioning and testing (ISO 291:2008)*

EN ISO 527-1, *Plastics — Determination of tensile properties — Part 1: General principles (ISO 527-1:1993 including Corr 1:1994)*

EN ISO 527-3, *Plastics — Determination of tensile properties — Part 3: Test conditions for films and sheets (ISO 527-3:1995)*

EN ISO 846:1997, *Plastics — Evaluation of the action of microorganisms (ISO 846:1997)*

EN ISO 1183-1, *Plastics — Methods for determining the density of non-cellular plastics — Part 1: Immersion method, liquid pyknometer method and titration method (ISO 1183-1:2004)*

EN ISO 4892-2:2006, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps (ISO 4892-2:2006)*

EN ISO 5470-1:1999, *Rubber- or plastics-coated fabrics — Determination of abrasion resistance — Part 1: Taber abrader (ISO 5470-1:1999)*

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

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

3.1.1
homogenous membrane
sheet made of calendered or extruded, waterproof and gas-pervious, plasticized poly(vinyl chloride) (PVC-P), packaged in rolls, for use in the manufacture of swimming pool liners

3.1.2
liner
removable independent pocket, factory-made from waterproof, flexible, expandable, plasticized poly(vinyl chloride) (PVC-P) membranes

NOTE The liner contributes to the leaktightness of a swimming pool in the same way as the parts to be sealed and the pipework.

3.1.3
inground swimming pool
permanent installation containing treated water for water activities totally or partially realized under the ground level with a water depth ≥ 0,85 m or a water volume ≥ 8 m^3

3.2 Symbols

E_n thickness of the membrane declared by the manufacturer, in millimetres

l_n width declared by the manufacturer, in metres or millimetres

L_n length of the roll declared by the manufacturer, in metres

ρ_n mass density declared by the manufacturer, in grams per cubic centimetre

3.3 Abbreviations

$CaCO_3$ calcium carbonate

PVC-P plasticized poly(vinyl chloride)

4 Sampling and conditioning

4.1 Sampling

The test pieces shall be taken only from rolls of unused membranes.

4.2 Conditioning of test pieces

Unless otherwise specified by the applicable test method, the test pieces used for the determination of the characteristics shall be conditioned before testing for at least 4 h in standard atmosphere 23/50 [(23 ± 2) °C, (50 ± 10) % HR] according to EN ISO 291:2008.

5 PVC-P compound

5.1 Characteristics of the compound

When tested in accordance with the test methods as specified in Table 1 using the parameters indicated, the PVC-P compound shall have characteristics conforming to the requirements given in Table 1.

Table 1 — Characteristics of the compound

Characteristic	Requirement	Test parameters		Test method
Density	(ρ_n ± 0,02) g/cm^3 ρ_n: density as declared by the manufacturer	Test temperature	23 °C	EN ISO 1183-1
Water absorption	≤ 1 % mass	Duration of immersion Test temperature	168 h (23 ± 2) °C	EN ISO 62:2008, Method 1
$CaCO_3$ content	≤ 3 % mass			Annex A

5.2 Heavy metals and other dangerous substances

The PVC-P membranes should conform to all national and international regulations in force.

The PVC-P membranes shall consist of materials that are not substances classified as carcinogen category 1 or carcinogen category 2, mutagen category 1 or mutagen category 2, toxic to reproduction category 1 or toxic to reproduction category 2 (see Directive 76/769/EEC [1]).

The total concentration of lead (Pb), cadmium (Cd), mercury (Hg), hexavalent chromium [Cr(VI)] and arsenic (As) shall not exceed 100 mg/kg.

NOTE This requirement is based on the concentration levels of heavy metals present in packaging as defined in Directive 94/62/EC, Article 11 [2].

For the determination of the total concentration of Pb, Cd, Hg, Cr(VI) and As, the method given in Annex A shall be used.

5.3 Environmental aspects

The PVC-P compounds are recyclable materials that can be treated in a material recovery process intended to save resources while minimising harmful emissions into air, water and soil as well as their impacts on human health.

NOTE A scheme for the characterisation of plastics waste is given in EN 15347 [3] and data for the characterisation of PVC recyclates are given in EN 15346 [4].

6 Visual characteristics

6.1 Appearance

Visible defects in the membrane shall be determined using the method specified in EN 1850-2.

A visual inspection shall be made on a minimum area of the PVC-P membrane that is 2 m long and as wide as the membrane itself. The inspection shall be performed on samples of both sides of the membrane taken at random from a roll laid down, without tension, on a flat, opaque surface.

The membrane shall have no defects visible to the naked eye, such as bubbles, blisters, coloured streaks, pinholes, mottles, folds or ripples. However air inclusion and mottles cannot be completely avoided in PVC-P sheet.

The appearance shall be uniform, as even as that of the reference test piece, irrespective of the area examined. The surface condition (smooth or embossed) and the colour reflection shall be in conformance with those of the reference test piece.

Non-printed membranes shall have an even surface finish.

In the case of a printed membrane, the imprint shall be even with no smudging. No ink shall be transferred to the non-printed side.

An embossed membrane shall have a regular appearance with an even pattern.

The pigments shall be homogeneously and evenly distributed throughout the material. Slight differences in colour, related to composition and manufacture shall generally be permissible.

The rolls of membranes shall be suitably and sufficiently tight.

The result of the visual examination shall be expressed as "appearance conform" or "appearance non-conform". In the latter case, the defects noted shall be listed.

6.2 Colour (plain coloured membranes)

The colour of the unused (new) membrane, as delivered, shall be the same as that of the reference sample as agreed between the supplier and the customer.

The contrast or visual differences between the unused membrane and the reference sample shall be assessed in accordance with EN 20105-A02.

NOTE The trichromatic coordinates L^*, a^* and b^* determined according to ISO 7724-1 [5], ISO 7724-2 [6] and ISO 7724-3 [7] can be used to assess the colour of the membrane, as well as any differences in colour between the membrane and the reference sample. However, permissible limits cannot be defined in this document.

6.3 Abrasion resistance (printed and/or coated membranes)

6.3.1 Test method

In the case of printed and/or coated PVC-P membranes, the abrasion resistance on the pattern shall be assessed by means of the method specified in EN ISO 5470-1, with the following test conditions:

— set of abrasive wheels (in accordance with Table 1 of EN ISO 5470-1:1999): CS 17 for severe abrasive action;

— load applied to each wheel during the test: 5 N;

— number of abrasion cycles applied: 100 cycles;

— rotational speed of the test specimen holder: 60 r/min.

6.3.2 Requirement

When the printed and/or coated membrane is tested in accordance with 6.3.1, no signs of abrasion attack on the pattern shall be visible to the naked eye after 100 cycles.

7 Physico-chemical characteristic

PVC-P membranes are materials that are permeable to water vapour.

The manufacturer may declare the water vapour resistance factor, μ, measured over an unused membrane in accordance with EN ISO 12572.

8 Dimensional characteristics

When tested in accordance with the test methods as specified in Table 2 using the parameters indicated, the PVC-P membrane shall have dimensional characteristics conforming to the requirements given in Table 2.

Table 2 — Dimensional characteristics

Characteristic	Requirement	Test parameters		Test method
Width l	l_n ± 5 mm l_n: width as declared by the manufacturer			EN 1848-2
Roll length L	$L \geq L_n$ L_n: roll length as declared by the manufacturer			EN 1848-2
Flatness p	$p \leq 10$ mm	Test width	Width of the membrane [a]	EN 1848-2
Straightness g	$g \leq 50$ mm	Test width	Width of the membrane [a]	EN 1848-2
Mean thickness (Transverse direction) [b]	E_n ± 3 % E_n: thickness as declared by the manufacturer			EN 1849-2 [c]
Single point thickness	E_n ± 5 %			EN 1849-2 [c]

[a] In the event of agreement between the supplier and the customer, an additional test can be performed over a half-width of the membrane to determine its flatness and straightness. The flatness and straightness measured over the half-width of the membrane shall conform to the requirements defined by this agreement.

[b] Arithmetic mean of the thicknesses measured along the same transverse line of the membrane.

[c] Take five measurements twice over the width of the membrane at 3 m intervals or at the beginning and the end of the roll.

9 Mechanical characteristics

When tested in accordance with the test methods as specified in Table 3 using the parameters indicated, the PVC-P membrane shall have mechanical characteristics conforming to the requirements given in Table 3.

Table 3 — Mechanical characteristics

Characteristic	Requirement	Test parameters		Test method
Tensile strength Strain (elongation) at tensile failure	≥ 17 N/mm² ≥ 300 %	Type of test specimen Width of test specimen Length of test specimen Gauge length Initial distance between grips Test speed Test directions	Type 2 15 mm 170 mm (100 ± 1) mm (120 ± 5) mm 200 mm/min longitudinal and transverse	EN ISO 527-1 EN ISO 527-3
Tensile modulus (between 1 % and 2 % elongation) E_S	5 MPa ≤ E_S ≤ 15 MPa	Type of test specimen Width of test specimen Length of test specimen Gauges length Initial distance between grips Test speed Test directions	Type 2 15 mm 170 mm (50 ± 0,5) mm (120 ± 5) mm 5 mm/min longitudinal and transverse	EN ISO 527-1 EN ISO 527-3
Tear resistance	≥ 70 N/mm	Test directions	Longitudinal and transverse	EN 12310-2
Dimensional stability	≤ 2 %	Test directions	Longitudinal and transverse	EN 1107-2
Resistance to foldability at low temperature	no crack or fracture above - 25 °C	Test directions	Longitudinal and transverse	EN 495-5
Peel resistance of joints	≥ 1,6 N/mm of the joint width	Test directions	Longitudinal and transverse	EN 12316-2
Shear resistance of joints [a]	60 % of the tensile strength of the membrane. Rupture out from the joint	Test directions	Longitudinal and transverse	EN 12317-2

10 Characteristics for durability

When tested in accordance with the test methods as specified in Table 4 using the parameters indicated, the PVC-P membrane shall have characteristics for durability conforming to the requirements given in Table 4.

Two classes of durability are defined in Table 4: the standard class and the higher class of durability. To be declared as belonging to one or other of these classes, the membrane shall meet all the requirements of that class.

Table 4 — Characteristics for durability

Characteristic	Requirement		Test parameters		Test method
	Standard class	Higher class	Standard class	Higher class	
Resistance to artificial ageing	Assessment by colour change according to the grey scale after exposure				EN 20105-A02
Plain coloured membranes	Level of contrast ≥ degree 3 for a UV radiant exposure (300 nm to 400 nm) of 648 MJ/m^2	Level of contrast ≥ degree 3 for a UV radiant exposure (300 nm to 400 nm) of 1 296 MJ/m^2	Duration of exposure: 3 000 h	Duration of exposure: 6 000 h	EN ISO 4892-2:2006 Method A - Cycle no. 1
Printed membranes	Level of contrast ≥ degree 3 for a UV radiant exposure (300 nm to 400 nm) of 648 MJ/m^2	Level of contrast ≥ degree 3 for a UV radiant exposure (300 nm to 400 nm) of 648 MJ/m^2	Duration of exposure: 3 000 h	Duration of exposure: 3 000 h	
Resistance to action of microorganisms	Mass loss $\Delta m/m \leq 5$ %	Mass loss $\Delta m/m \leq 1$ %			EN ISO 846:1997 Method D
Resistance to streptoverticilium reticulum bacteria	No stains	No stains			EN ISO 846:1997 Method C Strain: ATCC 25607
Chlorine resistance	Grey scale colour change ≥ degree 3	Grey scale colour change ≥ degree 3			Annex B
Resistance to staining agents	Rating ≥ 2	Rating ≥ 4			Annex C
Resistance to staining agents after abrasion [a]	Rating ≥ 2	Rating ≥ 4			6.3.1 Annex C

[a] Only applicable to coated PVC-P membranes.

NOTE Resistance to isocyanuric acid has not been included in this document to characterise the durability of PVC-P membranes because, according to current knowledge, isocyanuric acid alone has no harmful effect on the PVC-P membranes, although it does have a blocking effect on the action of chlorine.

11 Storage conditions

The rolls of membranes shall be stored horizontally in their original packaging in a dry room at a moderate ambient temperature. Additional recommendations may be provided by the membrane manufacturer.

12 Installation, refurbishment, exploitation and maintenance

The installation, refurbishment, exploitation and maintenance of PVC-P homogenous membranes for inground swimming pools shall be performed according to the manufacturer's recommendation and national standard/ regulation, if any.

13 Designation and marking

13.1 Designation

The membrane designation shall include the following information:

a) identification of the type of membrane;

b) manufacturer's name and/or trade mark;

c) number of this document: EN 15836-1;

d) identification of the material: PVC-P;

e) durability class: standard or higher;

f) nominal thickness of the membrane, expressed in millimetres;

g) nominal width of the membrane, expressed in millimetres or metres;

h) nominal length of the roll, expressed in metres;

i) net mass of the roll, not including the mandrel, expressed in kilograms;

j) nominal density of the PVC-P compound, expressed in grams per cubic centimetre.

13.2 Marking

Membrane marking is optional. It can include the following information:

a) manufacturer's identification;

b) identification of the type of membrane;

c) identification of the material: PVC-P;

d) manufacturing batch number for traceability purpose.

Annex A
(normative)

Determination of the contents of $CaCO_3$, heavy metals and other elements

A sample taken from a PVC-P membrane is taken into solution by closed vessel microwave digestion using nitric acid and hydrogen peroxide. Then, the resultant solution is analyzed either by a graphic furnace atomic absorption spectrometry, GFAAS, or by an inductively coupled plasma - mass spectrometry, ICP-MS.

The content in $CaCO_3$ is expressed from the content in Ca.

NOTE Information on laboratory apparatus, reagents necessary for testing, the microwave digestion system and the analytical technique is given in EN 14902:2005 [8] (see Clauses 6, 7 and 9).

Annex B
(normative)

Assessment of chlorine resistance

B.1 Principle

Test specimens cut from an unused membrane are completely immersed in an aqueous solution of dichloroisocyanuric acid or sodium hypochlorite, for 28 days at 28 °C, in accordance with the procedure specified in EN ISO 175.

The change in colour of the test specimens is assessed after the test liquid has been removed, in accordance with the grey scale and in conformance with the method indicated in EN 20105-A02. It is used to assess resistance to chlorine.

B.2 Test liquid

B.2.1 Aqueous solution including a content of available chlorine, measured by a colorimetric method with DPD reagents (diethyl-p-phenylenediamine) of free chlorine approximately 20 ppm, prepared from (40 ± 1) g/m³ of dichloroisocyanuric acid, of pH (7,0 ± 0,1).

B.2.2 Aqueous solution including a content of available chlorine, measured by a colorimetric method with DPD reagents (diethyl-p-phenylenediamine) of free chlorine approximately 20 ppm, prepared from (400 ± 10) g/m³ of sodium hypochlorite solution (active chlorine: 12 % to 15 %), of pH (7,0 ± 0,1).

B.3 Apparatus

B.3.1 Enclosure, thermostatically maintained at the test temperature.

B.3.2 Three beakers.

B.3.3 Thermometer.

NOTE See 5.2 of EN ISO 175:2000 for further information about the apparatus.

B.4 Test pieces

Four 40 mm × 80 mm test specimens shall be taken from an unused membrane sample and conditioned at (28 ± 2) °C for 3 h.

Keep a separate test specimen to be used as a reference specimen to assess the results.

B.5 Procedure

Put a test specimen for each beaker placed under the laboratory fume hood, the temperature of which is maintained at (28 ± 2) °C, and immerse it completely in at least 8 ml of test liquid B.2.1 or B.2.2 per square centimetre of test specimen area.

Store the beakers in the dark, e.g. in a closed chamber.

Stir the liquid in each beaker at least once a day.

Replace the liquid with an equal quantity of the original liquid, every seven days.

After the test specimens have been immersed for 28 days, remove them, rinse them with distilled water and wipe them with filter paper.

Immediately after wiping, measure the change in colour on each immersed test specimen by comparing it with a reference specimen removed from the same membrane sample, using the method based on the grey scale given in EN 20105-A02.

No result shall be less than the value specified in Table 4.

B.6 Test report

The test report shall include the following information:

a) reference to this annex of EN 15836-1:2010;

b) identification of the membrane, including manufacturer, type of material and production date;

c) test temperature;

d) test liquid: B.2.1 or B.2.2;

e) assessment of the chlorine resistance, expressed according to the grey scale given in EN 20105-A02;

f) any deviation from the specified test method;

g) date of test.

Annex C
(normative)

Assessment of the resistance to staining agents

C.1 Principle

Test specimens are cut from either an unused membrane or an unused membrane after the abrasion test according to 6.3.1 (only for coated membrane) and are left in contact with a series of staining agents. The time and conditions of contact are specified for each staining agent. At the end of the prescribed contact period, the test specimens are washed and examined for residual surface marks.

C.2 Staining agents

Prepare the staining agents, as listed in Table C.1.

Table C.1 — Staining agents and test conditions

Description	Test conditions	Contact time
Mixture of sunflower oil and 10 % (by mass) of carbon black paste	Apply staining agent at (23 ± 2) °C	24 h
Mixture of distilled water and 2 % (by mass) iodine		10 min
Marker blue		10 min
Yellow mustard		16 h
Mixture of sunflower oil and 1 % (by mass) of eosin Y CAS N° 17372-87-1.		10 min
Mixture of distilled water and 0,1 % methylene blue		16 h
Mixture of sunflower oil and 1 % (by mass) of solvent red 27 C.I. 26125		10 min

C.3 Apparatus

See 26.4 of EN 438-2:2005.

C.4 Test specimens

23 test specimens (40 mm × 20 mm) shall be cut from the unused membrane under test and then conditioned at (23 ± 2) °C for 3 h.

Keep two separate test specimens to be used as reference specimens to assess the results.

For each of the staining agents, three test specimens shall be used.

C.5 Procedure

For each staining agent, apply two drops of the staining agent to each of three freshly wiped test specimens; lay the test specimens flat in a clean, dry place, sheltered from air, at (23 ± 2) °C.

After the contact time specified in Table C.1, avoiding all contact and contamination, remove the staining agent with an absorbent paper and clean each test specimen by brushing it lightly with a brush soaked in a solution of ethanol with a volume fraction of 95 %.

One hour after cleaning, assess the effect on the surface of the test specimens by comparing them with the two reference specimens, observing the test specimens in daylight, perpendicularly and tangentially.

C.6 Expression of results

The effect on the surface of the specimen shall be expressed in accordance with the following rating scale for each of the staining agents:

— Rating 5: No visible change;

— Rating 4: Slight change of gloss and/or colour, only visible at certain viewing angles;

— Rating 3: Moderate change of gloss and/or colour;

— Rating 2: Marked change of gloss and/or colour;

— Rating 1: Surface distortion and/or blistering.

For each of the staining agents, none of the three results shall be less than the value specified in Table 4.

In case of doubt about the test results for one of the staining agents, repeat the test with three new test specimens, and take only the more unfavourable series of assessments as your result.

C.7 Test report

The test report shall include the following information:

a) reference to this annex of EN 15836-1:2010;

b) identification of the membrane, including the manufacturer, type of material and production date;

c) assessment of stain resistance for each staining agent applied, expressed in accordance with the rating scale;

d) any deviation from the specified test method;

e) date of the test.

Bibliography

[1] Council Directive 76/769/EEC on the approximation of the laws, regulations and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations, as regards substances classified as carcinogens, mutagens or substances toxic to reproduction

[2] European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste

[3] EN 15347, *Plastics — Recycled Plastics — Characterisation of plastics wastes*

[4] EN 15346, *Plastics — Recycled plastics — Characterisation of poly(vinyl chloride) (PVC) recyclates*

[5] ISO 7724-1, *Paints and varnishes — Colorimetry — Part 1: Principles*

[6] ISO 7724-2, *Paints and varnishes — Colorimetry — Part 2: Colour measurement*

[7] ISO 7724-3, *Paints and varnishes — Colorimetry — Part 3: Calculation of colour differences*

[8] EN 14902:2005, *Ambient air quality — Standard method for the measurement of Pb, Cd, As and Ni in the PM10 fraction of suspended particulate matter*

[9] EN ISO 12572, *Hygrothermal performance of building materials and products — Determination of water vapour transmission properties (ISO 12572:2001)*

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