BS EN 15346:2014

BSI Standards Publication

Plastics — Recycled plastics — Characterization of poly(vinyl chloride) (PVC) recyclates

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National foreword

This British Standard is the UK implementation of EN 15346:2014. It supersedes BS EN 15346:2007 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PRI/89, Plastics recycling.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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

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Plastics - Recycled plastics - Characterization of poly(vinyl chloride) (PVC) recyclates

Plastiques - Plastiques recyclés - Caractérisation des recyclats de poly(chlorure de vinyle) (PVC)

Kunststoffe - Kunststoff-Rezyklate - Charakterisierung von Polyvinylchlorid (PVC)-Rezyklaten

This European Standard was approved by CEN on 20 September 2014.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (EN 15346:2014) 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of an identical text or by endorsement, at the latest by May 2015 and conflicting national standards shall be withdrawn at the latest by May 2015.

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 15346:2007.

EN 15346:2014 includes the following significant technical change with respect to EN 15346:2007: revision of Annex C.

This European Standard is one part of series of CEN publications on Plastics Recycling which is structured as follows:

— EN 15342, *Plastics — Recycled Plastics — Characterization of polystyrene (PS) recyclates*

— EN 15343, *Plastics — Recycled Plastics — Plastics recycling traceability and assessment of conformity and recycled content*

— EN 15344, *Plastics — Recycled Plastics — Characterization of Polyethylene (PE) recyclates*

— EN 15345, *Plastics — Recycled Plastics — Characterization of Polypropylene (PP) recyclates*

— EN 15346, *Plastics — Recycled plastics — Characterization of poly(vinyl chloride) (PVC) recyclates*

— EN 15347, *Plastics — Recycled Plastics — Characterization of plastics wastes*

— EN 15348, *Plastics — Recycled plastics — Characterization of poly(ethylene terephthalate) (PET) recyclates*

— CEN/TR 15353, *Plastics — Recycled plastics — Guidelines for the development of standards for recycled plastics*

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, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

Recycling of plastics waste is one type of material recovery process intended to save resources (virgin raw materials, water, and energy), while minimizing harmful emissions into air, water and soil as well as any impacts on human health. The environmental impact of recycling has to be assessed over the whole life cycle of the recycling system (from the waste generation point to the disposal of final residues). To ensure that recycling constitutes the best environmental option for treating the available waste, some prerequisites should preferably be met:

— recycling scheme being contemplated should generate lower environmental impacts than alternative recovery options;

— existing or potential market outlets should be identified that will secure a sustainable industrial recycling operation;

— collection and sorting schemes should be properly designed to deliver recyclable plastics waste fractions fitting reasonably well with the available recycling technologies and with the (changing) needs of the identified market outlets, preferably at minimum costs to society.

This European Standard has been produced in accordance with the guidance produced by CEN on Environmental Aspects and in accordance with CEN/TR 15353.

NOTE CEN/TR 15353 considers the general environmental aspects which are specific to the recycling process.

It is often impossible to trace back each individual product at the end user stage and to check whether the product has been used correctly through its life. Consequently products are out of industrial control for a period of time. It is possible that during this period contamination with other materials might occur that could affect the product's suitability for recycling into the intended application.

1 Scope

This European Standard defines a method of specifying delivery conditions for poly(vinyl chloride) (PVC) recyclates.

It gives the most important characteristics and associated test methods for assessing of PVC recyclates intended for use in the production of semi-finished/finished products.

It is intended to support parties involved in the use of recycled PVC to agree on specifications for specific and generic applications.

This European Standard does not cover the characterization of plastics wastes. See EN 15347.

This European Standard is applicable without prejudice to any existing legislation.

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 12099, *Plastics piping systems — Polyethylene piping materials and components — Determination of volatile content*

CEN/TR 15353, *Plastics — Recycled plastics — Guidelines for the development of standards for recycled plastics*

EN ISO 182-2, *Plastics — Determination of the tendency of compounds and products based on vinyl chloride homopolymers and copolymers to evolve hydrogen chloride and any other acidic products at elevated temperatures — Part 2: pH method (ISO 182-2)*

EN ISO 182-3, *Plastics — Determination of the tendency of compounds and products based on vinyl chloride homopolymers and copolymers to evolve hydrogen chloride and any other acidic products at elevated temperatures — Part 3: Conductometric method (ISO 182-3)*

EN ISO 182-4, *Plastics — Determination of the tendency of compounds and products based on vinyl chloride homopolymers and copolymers to evolve hydrogen chloride and any other acidic products at elevated temperatures — Part 4: Potentiometric method (ISO 182-4)*

EN ISO 306, *Plastics — Thermoplastic materials — Determination of Vicat softening temperature (VST) (ISO 306)*

EN ISO 472, *Plastics — Vocabulary (ISO 472)*

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

EN ISO 527-2, *Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics (ISO 527-2)*

EN ISO 868, *Plastics and ebonite — Determination of indentation hardness by means of a durometer (Shore hardness) (ISO 868)*

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)*

EN ISO 1269, *Plastics — Homopolymer and copolymer resins of vinyl chloride — Determination of volatile matter (including water) (ISO 1269)*

EN ISO 3451-5, *Plastics — Determination of ash — Part 5: Poly(vinyl chloride) (ISO 3451-5)*

EN ISO 6186, *Plastics — Determination of pourability (ISO 6186)*

ISO 182-1, *Plastics — Determination of the tendency of compounds and products based on vinyl chloride homopolymers and copolymers to evolve hydrogen chloride and any other acidic products at elevated temperatures — Part 1: Congo red method*

ISO 565, *Test sieves — Metal wire cloth, perforated metal plate and electroformed sheet — Nominal sizes of openings*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 472 and CEN/TR 15353 and the following apply.

3.1
sieve retention
percentage of the recycled test sample retained on a sieve at the end of the test

Note 1 to entry: The sieve retention is expressed in per cent (mass fraction).

3.2
container retention
percentage of recycled material retained in the container at the bottom of a stack of sieves, or under a single sieve, at the end of the test compared to the mass of the sample tested

3.3
average particulate dimension
single value of size, expressed to the nearest 0,001 mm, representing the dominant particle size for the whole test sample

4 Characterization of PVC recyclates

A single batch is the quantity of recyclate that has homogeneous characteristics within the specified tolerances.

The characteristics of PVC recyclates, given in Table 1, are divided into two types:

— required characteristics needed to characterize PVC recyclates in general, and required for all recyclates;

— optional characteristics needed to characterize PVC recyclates according to customer specifications and applications.

These characteristics shall be assessed by using the test methods given in Table 1.

A certificate of analysis giving the test results for each batch of recyclates shall be provided by the supplier to the purchaser upon request.

NOTE Typical compositions of PVC compounds are given in Annex A.

The supplier shall provide the necessary information about the material composition of the recyclates, as specified by the purchaser or required by the applicable regulations.

Table 1 — Characterization of PVC recyclates

Characteristic	Units	Test method	PVC-U	PVC-P	Comments
Required					
Bulk density	kg/m^3	Annex B	X	X	
Ash content	%	EN ISO 3451-5 Method A	X	X	Linked with filler and mineral content
Colour		Visual Inspection	X	X	e.g. natural colour, single, mixed
Hardness		EN ISO 868		X	For calendering stiffness may be evaluated instead of hardness. See Annex F.
Impurities	%	Annex C	X	X	An alternative method agreed by both parties may also be used.
Particle size and distribution	g, %	Annex D [a] Annex E [b]	X	X	Size distribution is needed for materials with a low particle size.
Shape		Visual	X	X	e.g. micronized material, pellets, particles
Optional					
Dry flow rate	s	EN ISO 6186	O	O	Recommended for micronized materials or small particle size recyclates
Density	kg/m^3	EN ISO 1183-1 Method A	O	O	
Fitness of processing of PVC recyclates — by calendering — by extrusion		Annex F Annex G	O O	O O	
Residual humidity	%	EN 12099 [c]	O	O	Weight loss, 105 °C
Tensile stress at yield	MPa	EN ISO 527-1 EN ISO 527-2	O	O	
Tensile strain at break	%	EN ISO 527-1 EN ISO 527-2	O	O	Elongation
Thermal stability	min	ISO 182-1 EN ISO 182-2 EN ISO 182-3 EN ISO 182-4	O	O	Linked to stabilizer content Specify which is used.
Vicat softening temperature	°C	EN ISO 306 Method B50	O		

Volatile content	%	EN ISO 1269	O	O	Linked to moisture content
Key X required characteristics to be quantified O optional characteristics to be quantified					
Other tests may be carried out by an agreement between the purchaser and the supplier. The test results should be reported.					
a Only applicable for micronized recycled PVC compounds. b Only applicable for recycled PVC crushes. c Although the scope of EN 12099 is limited, it is considered relevant.					

5 Quality assurance

In order that the purchaser of the recyclate can have confidence in the quality of the product, the supplier shall maintain records of the quality control carried out, including incoming materials, processes and finished products.

NOTE A quality management system certified to EN ISO 9001 may be a suitable guarantee of consistent recyclate quality but not the recycled content.

The specification and the standard deviation or range of values within and between batches of material shall be agreed between the supplier and the purchaser.

Where a statement of recycled content, or the previous history of the material, is requested, documentary evidence shall be provided. These records should be available to the purchaser on request.

Where a recyclate has been produced via a melt process, the supplier may choose to state the level of filtration applied during that process. This will determine the maximum size of any non-melting contaminants present in the recyclate. The statement of filtration level shall include details of the filter. Recyclates which have not passed through a melt process cannot be quantified in the same way, and the supplier may state this.

Annex A
(informative)

Typical compositions of PVC compounds

Resins of vinyl chloride are always converted as compounds that composition depends upon the application. Typical compositions of compounds are given in Table A.1.

PVC recyclates are made from these compounds.

Table A.1 — Typical compositions of PVC compounds

Dimensions in phr (parts per hundred parts of resin)

Application	PVC resin	Plasticizer	Filler range	Other additives [a]
Rigid packaging	100	0	0	5 to 20
Flexible packaging	100	20 to 40	0	1 to 20
Plastic piping components for pressure applications	100	0	2 to 5	4
Plastic piping components for non-pressure applications	100	0	0 to 20	3 to 5
Windows and doors	100	0	5 to 10	7 to 16
Other profiles	100	0	0 to 40	5 to 15
Cables	100	30 to 60	0 to 50 [b]	3 to 10
Flooring	100	25 to 50	0 to 300	2 to 5
Sheets	100	40 to 70	0 to 30	2 to 10
Coated fabrics	100	40 to 90	0 to 30	7 to 20 [c]

[a] Such as stabilizers, impact modifiers, lubricants, etc.

[b] Bedding up to about 250 phr.

[c] Synthetic textile fibres included.

Annex B
(normative)

Determination of bulk density

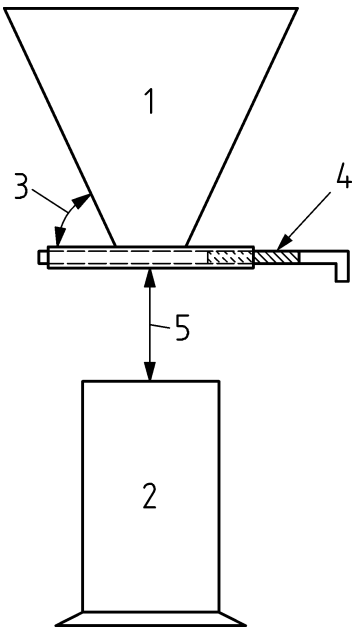
B.1 General

This test method specifies a method of determining the bulk density, i.e. the mass per unit of volume, of loose material (powder or granular material) that can be poured from a funnel of specific design.

When the method is applied to relatively coarse materials, rather variable results might be obtained, owing to the error introduced when a straightedge blade is drawn across the top of the cylinder.

A knowledge of bulk density is of limited value in estimating the relative fluffiness or bulk of moulding materials, unless their densities in the moulded condition are approximately the same.

It therefore gives a fairly good idea of stability of mixing, presence of humidity and stability between batches (consistency).



Key

1 volume of approximately 2 500 ml, diameter of hole at base 55 mm ± 0,25 mm

2 inner height: 200 mm ± 0,2 mm, Inner diameter: 113 mm ± 0,2mm, Volume: 2 000 ml

3 angle approximately 65°

4 diameter of hole approximately 60 mm

5 distance of 100 mm ± 0,5 mm

Figure B.1 — Typical apparatus for determining bulk density

B.2 Material

Powder or granular material.

B.3 Apparatus

B.3.1 **Balance**, accurate to 0,1 g.

B.3.2 **Measuring cylinder**, smoothly finished inside, which shall be constructed of metal, of a capacity of 2 000 ml (Inner height 200 mm and inner diameter 113 mm).

B.3.3 **Conical funnel**, of the form and dimensions shown in Figure B.1, of a capacity of 2 500 ml, internal diameter at base 55 mm, equipped with a metal trap plate for the lower orifice. Diameter of the orifice in trap plate 60 mm.

B.4 Preparation of test sample

Mix the sample well before the test.

B.5 Procedure

B.5.1 Support the funnel (B.3.3) vertically with its lower orifice 100 mm above the measuring cylinder (B.3.2) and coaxial with it. Mix the sample of the powder or granular material well before testing. With the lower orifice of the funnel closed by means of the trap, place a quantity of 2 200 ml to 2 400 ml of the sample material in the funnel.

B.5.2 Open the trap quickly and allow the sample to flow into the measuring cylinder.

When the measuring cylinder is full, draw a straightedge blade across the top of the measuring cylinder to remove any excess of the sample. Weigh the contents of the measuring cylinder to the nearest 0,1 g, using the balance (B.3.1).

B.5.3 Repeat procedure B.5.1 and B.5.2 to complete at least two determinations of the sample under test.

B.6 Expression of results

The bulk density of the material under test is given, in grams per millilitre, by Formula (B.1):

$$\frac{m}{V} \qquad \text{(B.1)}$$

where

m is the mass, in grams, of the contents of the measuring cylinder;

V is the volume, in millilitre, of the measuring cylinder.

Take as the result the arithmetic mean of the results of the determinations obtained by following the procedure B.5.

B.7 Test report

The test report shall include the following information:

a) reference to this European Standard (EN 15346:2014);

b) all details necessary for complete identification of the material tested;

c) individual results determined following the procedure B.5 and the arithmetic mean of the results;

d) details of any deviation from the test method, as well as any incident which might have influenced the results;

e) date of the test.

Annex C
(normative)

Determination of tetrahydrofuran insoluble impurities

C.1 General

The determination of the amount of impurities in recycled PVC compounds, which are insoluble in tetrahydrofuran (THF).

C.2 Apparatus

C.2.1 Weighing scales with a precision of ± 0,01 g.

C.2.2 Magnetic stirrer with an adjustable speed of 0 rpm to 1 200 rpm.

C.2.3 Triangular magnetic stirring bar.

C.2.4 Fume cupboard.

C.2.5 Beaker.

C.2.6 Conical Erlenmeyer flask with stopper and a venting tube.

C.2.7 Woven polyamide filter with mesh of 125 microns.

C.2.8 Pair of gloves.

C.2.9 Safety glasses.

C.2.10 Conical grid metal support for the filter.

C.2.11 Rinsing pipette.

C.2.12 Microscope.

C.3 Reagent

Tetrahydrofuran (THF), solvent.

WARNING — It is most important for safety reasons that personal protective clothing is used when applying solvents to the test specimen. The use of solvents in regard to application of this European Standard might be further controlled under National and/or regional legislation. In particular, the used THF has to be collected, stored and sent to solvent recovery.

C.4 Procedure

C.4.1 Take a test specimen of (50 ± 0,1) g of the recycled PVC sample to be tested with a 6 mm maximum size from the sorting of sifted or crushed PVC. Record the actual mass of the test specimen, M_S.

C.4.2 Put on gloves and safety glasses.

All operations shall be carried out in the fume cupboard.

C.4.3 Prepare an Erlenmeyer flask with 800 ml of THF, put in it the triangular magnet and start the stirrer, adjusted to a speed of 500 rpm for 3 h and maintained at (23 ± 2) °C.

C.4.4 Pour the test specimen gradually into the Erlenmeyer flask in order to avoid clumping.

C.4.5 Put the stopper in place with a tube to vent the THF vapours from the flask.

C.4.6 Weigh the polyamide filter with a mesh of 125 microns (M_F).

C.4.7 When the dissolution of the PVC is complete, filter the solution through the polyamide filter of 125 microns fitted on a conical metal grid support at the top of a container (receptacle).

C.4.8 Rinse the Erlenmeyer flask and the stirrer over the filter.

C.4.9 Rinse the insoluble material recovered in the filter.

C.4.10 Dry the filter with the insoluble material naturally by keeping it in the ventilated fume cupboard for 12 h.

C.4.11 After 12 h, weigh the filter with the insoluble material (M_T).

C.5 Expression of results

The mass of the insoluble material, M_I, is given by the difference between M_F and M_T expressed in grams to the nearest 0,1 g.

Calculate the percentage of insoluble material from Formula (C.1):

$$(M_T - M_F) / M_S \times 100 \quad \text{(C.1)}$$

The insoluble material can be analysed by means of a microscope, comparing it with a sample of reference impurities.

C.6 Test report

The test report shall include the following information:

a) reference to this test method, i.e. EN 15346:2014, Annex C;

b) all details necessary for complete identification of the batch of the recycled PVC compound;

c) the actual mass of the test specimen, M_S, the initial mass of the filter, M_F, the mass of the filter with the insoluble material, M_T, and the mass of the insoluble material, M_I (g);

d) the percentage of insoluble material;

e) type of insoluble impurities and foreign matter, if required;

f) date of the test.

Annex D
(normative)

Size and distribution of particles contained in micronized recycled PVC compounds by sieving

D.1 General

This determination of the dimensional distribution (size) of the particles of micronized recycled PVC compound is based on the measurement of the quantities retained in a range of sieves having meshes of various sizes.

A portion of the recycled PVC compound is filtered through a single sieve, or stack of sieves of various mesh opening sizes, helped by mechanical vibrations. When several sieves are selected to form a stack, the sieves are assembled in ascending order of the mesh opening sizes so that the largest mesh opening is at the top.

The results are expressed in terms of quantity retained on the various sieves or as the mean particulate dimension for the whole sample tested (that which has the greatest frequency).

This test method is not recommended to be used with sieves having sizes of mesh openings lower than 0,125 mm.

D.2 Reagents

Aluminium oxide powder or **equivalent**, antistatic agent.

D.3 Apparatus

D.3.1 **Balance** accurate to ± 0,1 g, the range and the size sufficiently adapted to the individual sieves and to retained recycled matter in these sieves.

D.3.2 **Sieves** with a nominal diameter of 200 mm according to ISO 565, supplemented by a lid and by a receiver container. The following mesh opening sizes are used in this test method: 0,250 mm, 0,500 mm, 0,850 mm and 1,000 mm.

D.3.3 **Mechanical sieve shaker** comprising a complete mechanical device with an automatic time switch, capable to subject the sieve or the stack of sieves to a uniform vertical movement which is achieved by a “hammer” or “vibrator” (dry blows) at the end of each sequence, and with a rate of tapping adjustable to (150 ± 15) blows / min.

D.3.4 **Soft bristle brush.**

D.3.5 **Vacuum cleaner**, suitable and electrically reliable for the use with very fine powders.

D.4 Procedure

D.4.1 Ensure that the sieve or the sieves, as applicable, the lid and the container are free from particles of recycled matter by cleaning with a vacuum cleaner and by the use of soft bristle brushes releasing all the stubborn remainders.

D.4.2 Examine the sieve or the sieves, as applicable, for the damage to the mesh or any deformation of the matrix of the meshes. Replace all defective meshes.

D.4.3 Weigh the sieve or each individual sieve, as applicable, to the nearest 0,1 g.

D.4.4 Weigh the container to the nearest 0,1 g.

D.4.5 Assemble the sieve or the sieves, as applicable, and the container, one on top of the other. By assembling a stack of sieves, ensure that they are gathered in the ascending order of the mesh opening sizes so that the largest opening is at the top.

NOTE By using a stack of sieves to determine average particulate dimension (see D.6.3), it is necessary to choose a selection of the mesh opening sizes such as the retained combined matter in the higher sieves and the container are less than 4,0 % of the test sample. As many necessary sieves will be used by having an evaluated distribution of the mesh opening sizes. A possible combination of the sieves is given in D.4.2.

D.4.6 Take a specimen of (50 ± 0,1) g of recycled PVC sample to be tested and add the anti-static agent. When aluminium oxide is used as an anti-static agent, add a quantity of aluminium oxide between 0,2 g and 0,3 g .

D.4.7 Mix the specimen and the anti-static agent with a spatula and transfer the mixture to the uncovered sieve, by avoiding overflow and a cloud of dust. Use the brush to carry out the transfer, if necessary.

D.4.8 Cover the sieve or the stack of sieves, as applicable, by the lid and secure them in the mechanical device vibrator for sieving.

D.4.9 Set the timer of the vibration device to 6 min to nearest minute and switch on the power.

D.4.10 After the period of shaking, carefully separate the sieve or the sieves, as applicable, starting at the top, and weigh each sieve and the container with their contents.

D.5 Number of determinations

Make two determinations for each recycled test sample.

D.6 Determination and expression of the results

D.6.1 The object is to calculate of the average mass in grams of recycled material maintained in a sieve of a given mesh opening and also the average of retentions in the container. For each mesh opening of the sieves or the container, calculate the average mass of maintained recycled material for the two determinations as follows:

$$(m_1 - m_2) = m_3 \text{ and } (m_4 - m_5) = m_6 \quad \text{(D.1)}$$

$$(m_3 + m_6) / 2 = m_r \quad \text{(D.2)}$$

where

m_1 and m_4 are the respective masses of the sieves, for a given mesh opening or the container, with their contents of retained recycled matter, for the first and second determinations;

m_2 and m_5 are the respective masses of the sieves, for a given mesh opening or the container for the first and second determinations;

m_3 and m_6 are the respective masses, of retained recycled matter on the sieves, for a given mesh opening, or the container, for the first and second determinations;

m_r is the average recycled mass retained on the sieve, for a given size of opening, or the container.

NOTE If the value of m_r exceeds 20 g, for any particular mesh opening of sieve, the mesh will be considered "without visibility" and the process repeated with recycled test samples of less than 50 g in mass.

D.6.2 Calculation of the percentage of the test sample maintained on a sieve, with a given mesh opening, or in the container.

$$R = m_r \times 100 / m_s \quad \text{(D.3)}$$

where

R is % of recycled matter maintained on a sieve, with a given mesh opening, or in the container;

m_s is the average mass in grams of the two test samples taken. Unless a test sample smaller than indicated was used (see the Note in D.6.1), the value of the m_s in Formula (D.3) may be taken as 50,2 g.

Thus percent (%) of retained recycled material, can be re-expressed as

$$R = m_r \times 100 / 50{,}2 \quad \text{(D.4)}$$

D.6.3 Calculation of average particulate dimension.

Calculate % of the retained test samples, R, for each mesh opening and the container according to Formula (D.4). The cumulative total for these values for the stack of sieves, as well as the container, shall be more than 99 % if it is not the case, the testing method should be repeated.

D.7 Test report

The test report shall include the following information:

a) reference to this test method, i.e. EN 15346:2014, Annex D;

b) all details necessary for complete identification of the batch of the recycled PVC compound;

c) average mass in grams of the specimen used for the test;

d) anti-static agent used;

e) values expressed as a weight and a percentage of the test sample retained on the sieves of various opening mesh sizes or average particulate dimension for recycled PVC compound;

f) date of the test.

Annex E
(normative)

Size and distribution of recycled PVC crushes by sieving

E.1 General

This procedure specifies a method for the determination of the dimensional distribution (size) of recycled PVC crushes by measuring the quantities retained in a range of sieves having meshes of various sizes.

The results can be expressed in terms of quantity retained on the various sieves or as the mean particulate dimension for the whole sample tested (that which has the greatest frequency).

A determined sample is filtered through a single sieve, or stack of sieves of various mesh opening sizes, helped by mechanical or manual vibrations. When several sieves are selected to form a stack, the sieves are assembled in ascending order of the mesh opening sizes so that the largest mesh opening is at the top.

E.2 Apparatus

E.2.1 **Weighing scales** with a precision of ± 0,1 g.

E.2.2 **Sieves** with a nominal diameter of 200 mm, in accordance with ISO 565 supplemented by a lid and by a receiver container. Sieves are made of ring wire.

The sieves used have the following square mesh opening sizes of: 1 mm, 2 mm, 3,15 mm, 4 mm, 6,30 mm, 8 mm and 12,5 mm are used.

E.2.3 **Mechanical sieve shaker.**

E.3 Procedure

E.3.1 Examine the sieve, or the sieves, for the damage to the mesh or any deformation of the matrix of the meshes. Replace all defective meshes.

E.3.2 Weigh the sieve, or each individual sieve, with a margin of 0,1 g.

E.3.3 Weigh the container to the nearest 0,1 g.

E.3.4 Assemble the sieve, or the sieves, and the container, one on top of the other. By assembling a stack of sieves, you ensure that they are gathered in the ascending order of the mesh opening sizes so that the largest opening is at the top.

E.3.5 Weigh (150 ± 0,1) g of crushes sample to be tested.

E.3.6 Transfer the sample to the uncovered sieve, by avoiding overflow.

E.3.7 Cover the sieve, or the stack of sieves by the lid and secure them in the mechanical device vibrator for sieving.

E.3.8 Set the timer of the vibration device to 25 min.

E.3.9 After the period of shaking, carefully separate the sieve, or the sieves, starting at the top, and weigh each sieve and the container with their contents.

E.4 Number of determinations

Make two determinations for each test sample.

E.5 Determination and expression of the results

E.5.1 The target is to calculate the average mass in grams of crushes maintained in a sieve of a given mesh opening and also the average of retentions in the container. For each sieve and the container, calculate the average mass of maintained crushes for the two determinations as follows:

$$(m_1 - m_2) = m_3 \text{ and } (m_4 - m_5) = m_6 \quad \text{(E.1)}$$

$$(m_3 + m_6) / 2 = m_r \quad \text{(E.2)}$$

where

m_1 and m_4 are the respective masses of each sieve, or the container, with their contents of retained crushes, for the first and second determinations;

m_2 and m_5 are the respective masses of each sieve, or the container empty;

m_3 and m_6 are the respective masses, of retained crushes on each sieve, or the container, for the first and second determinations;

m_r is the average crushes mass retained on each sieve, or the container.

E.5.2 Calculation of the percentage of the test sample maintained on each sieve or in the container.

$$R = m_r \times 100 / m_s \quad \text{(E.3)}$$

where

R is the % of crushes maintained on sieve or in the container;

m_s is the average mass in grams of the two test samples taken;

m_r is the average crushes mass retained on each sieve, or the container.

E.5.3 Calculation of average particulate dimension.

Calculate the % of the retained test samples, R, for each mesh opening and the container according to Formula (E.3). The cumulative total for these values for the stack of sieves, as well as the container, shall be more than 99 %. If it is not the case, the testing method should be repeated.

E.6 Test report

The test report shall include the following information:

a) reference to this test method, i.e. EN 15346:2014;

b) all details necessary for complete identification of the batch of the recycled PVC crushes;

c) average mass in grams of the specimen used for the test;

d) values expressed as a weight and a percentage of the test sample retained for each sieve and the container;

e) date of the test.

Annex F
(normative)

Fitness for processing of PVC recyclates by calendering

F.1 General

The fitness for processing of PVC recyclates is determined by preparing a sheet made of PVC recyclates by means of a two roll mill followed by checking its visual aspect. The conditions shall be chosen to be representative as possible of the industrial processing conditions.

F.2 Apparatus

Two roll mill with heated cylinders.

F.3 Procedure

F.3.1 Introduce the PVC recyclate sample between the heated cylinders of the two roll mill with the following parameters:

a) Cylinders' temperature: between 140 °C and 190 °C depending on the PVC compound formulation. Cylinder temperatures for different formulations are given in Table F.1;

Table F.1 — Cylinder temperatures according the compound formulation

PVC compound	Cylinder temperatures °C
Very plasticized PVC recyclate (PVC-P)	150
Plasticized PVC recyclate (PVC-P)	160
Lightly plasticized PVC recyclate (PVC-P)	170
Unplasticized PVC recyclate (PVC-U)	180

b) linear speed:

1) Cylinder 1: 10 m/min;

2) Cylinder 2: 10 m/min to 15 m/min;

3) Friction ratio: 1,0 to 1,5;

c) gap between the two cylinders: between 0,2 mm and 1,5 mm.

After each passing through the cylinders, recover the recyclates and carry out the same operation until the melting of the material is completed.

F.3.2 Homogenize the melted material by cutting out bands of the sheet in contact with the fastest cylinder and by reintroducing them between the two cylinders to obtain a regular pad. If it is impossible to homogenize the material, record it.

F.3.3 Prepare a 0,5 mm to 2 mm thickness calendared sheet after a defined time between 5 min and 20 min. Evaluate how easy it is to remove the sheet from the cylinder and record the result and check the surface of the cylinders and record the result.

F.3.4 Cool the sheet before checking its surface appearance by a visual inspection. Record the surface aspect (smooth, rough), the presence of non-molten grains, holes, fibres, etc.

F.3.5 For PVC-P, evaluate the stiffness of the sheet manually and compare it to that of a reference sheet. In case of problems encountered during steps F.3.2, F.3.3, F.3.4 and F.3.5, test another sample of PVC recyclates.

Annex G
(normative)

Fitness for processing of PVC recyclates by extrusion

G.1 General

Annex G specifies a test method to evaluate the ability to use PVC recyclates for the manufacturing of products by preparing an extruded strip from the recyclate followed by checking its visual aspects and density.

It is recommended to record the processing parameters (backpressure, torque) to evaluate the long-term behaviour.

G.2 Apparatus

G.2.1 Extruder.

G.2.2 Balance, accurate to ± 0,1 g.

G.2.3 Extrusion die with a rectangular opening of approximately 10 mm to 20 mm in width and 1 mm to 4 mm in thickness.

When determining the size of the sample strip and the related extrusion die, it is recommended to take into account these sizes for further mechanical testing.

G.3 Procedure

Inspection of the extrusion process should be carried out at regular time periods, according to quality assurance international standards and with suitable virgin material.

G.3.1 Introduce the PVC-U recyclate sample in the extruder with the following conditions:

— at a constant extruder temperature near the processing temperature of the final product;

— at a constant extruder speed depending on the type of extruder and screws.

G.3.2 Follow-up the extrusion and record the changes of the backpressure and/or the torque. When the backpressure and/or the torque is (are) constant, start sampling. To be sure of the process stability as these parameters should not change during the sampling duration.

G.3.3 Extrude a strip of a specified length, preferably between 0,5 m and 1,5 m. Evaluate the ease of processing and record the result.

G.3.4 Cool the strip in air before checking its surface appearance by a visual inspection. Record the surface aspect (smooth, rough), the presence of non-melted particles, holes, etc.

In case of problems encountered during steps G.3.2, G.3.3 and G.3.4, test a new sample of the recyclate.

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