

Plastics — Recycled Plastics — Characterization of Polypropylene (PP) recyclates

ICS 13.030.50; 83.080.20

National foreword

This British Standard is the UK implementation of EN 15345:2007.

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.

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

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 29 February 2008

© BSI 2008

ISBN 978 0 580 53966 4

Amendments/corrigenda issued since publication

Date	Comments

EUROPEAN STANDARD

EN 15345

NORME EUROPÉENNE

EUROPÄISCHE NORM

December 2007

ICS 13.030.50; 83.080.20

English Version

Plastics - Recycled Plastics - Characterisation of Polypropylene (PP) recyclates

Plastiques - Plastiques recyclés - Caractérisation des
recyclats de polypropylène (PP)

Kunststoffe - Kunststoff-Rezyklate - Charakterisierung von
Polypropylen (PP)-Rezyklaten

This European Standard was approved by CEN on 25 October 2007.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, 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 United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

Contents

Page

Foreword.....	3
Introduction	4
1 Scope	5
2 Normative references	5
3 Terms, definitions and abbreviated terms	6
4 Characteristics of PP recyclates	6
5 Quality Assurance	7
Annex A	9
Bibliography	12

Foreword

This document (EN 15345:2007) has been prepared by Technical Committee CEN/TC 249 "Plastics recycle characterisation of PP", 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 June 2008, and conflicting national standards shall be withdrawn at the latest by June 2008.

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 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—Characterisation of Polyethylene (PE) recyclates
- EN 15345 Plastics—Recycled Plastics—Characterisation of Polypropylene (PP) recyclates
- EN 15346 Plastics—Recycled plastics—Characterisation of poly(vinyl chloride) (PVC) recyclates
- EN 15347 Plastics — Recycled Plastics — Characterisation 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, 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.

Introduction

Recycling of plastics waste is one type of material recovery process intended to save resources (virgin raw materials, water, and energy), while minimising 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 standard has been produced in accordance with the guidance produced by CEN on Environmental Aspects and in accordance with CEN/TR 15353, Plastics — Recycled plastics — Guidelines for the development of standards for recycled plastics.

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 may 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 Polypropylene (PP) recyclates.

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

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

This standard does not cover the characterisation of plastics wastes. See EN 15347.

This standard is applicable without prejudice to any existing legislation.

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

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

EN ISO 1133, *Plastics — Determination of the melt mass-flow rate (MFR) and the melt volume-flow rate (MVR) of thermoplastics (ISO 1133:2005)*

EN ISO 178, *Plastics — Determination of flexural properties (ISO 178:2001)*

EN ISO 179-1, *Plastics — Determination of Charpy impact properties — Part 1: Non-instrumented impact test (ISO 179-1:2000)*

EN ISO 179-2, *Plastics — Determination of Charpy impact properties — Part 2: Instrumented impact test (ISO 179-2:1997)*

EN ISO 180, *Plastics — Determination of Izod impact strength (ISO 180:2000)*

EN ISO 472:2001, *Plastics — Vocabulary (ISO 472:1999)*

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

EN ISO 527-2, *Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics (ISO 527-2:1993 including Corr 1:1994)*

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

EN ISO 3451-1, *Plastics — Determination of ash — Part 1: General methods (ISO 3451-1:1997)*

CEN/TR 15353:2007 *Plastics — Recycled Plastics — Guidelines for the development of standards relating to recycled plastics*

3 Terms, definitions and abbreviated terms

For the purposes of this European Standard, the terms and definitions given in EN ISO 472:2001 and CEN/TR 15353:2007 apply.

4 Characteristics of PP recyclates

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

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

- Required characteristics needed to characterize PP recyclates in general and required for specified recyclates.
- Optional characteristics needed to characterize PP recyclates according to customer specifications and applications.

NOTE Polypropylene, or polypropylene-containing plastics wastes may contain a variety of propylene polymers such as homo- and co-polymers, isotactic, syndiotactic and atactic, and be with or without fillers, fire retardants etc. The performance of recyclates derived from such wastes will depend on the relative proportions of these components. In order to be described as recycled polypropylene, the recyclate must contain polypropylene as the most important polymeric component.

These characteristics shall be assessed by using the test methods given in Table 1. Where possible, the supplier should provide information on the original application of the material.

A Certificate of Analysis, providing the test results for each batch of recyclate shall be provided by the supplier to the purchaser on request.

To secure the legal use of the recyclate, the supplier shall provide the necessary information about the material composition of the recyclates, as specified by the purchaser.

Table 1 – Characterisation of PP recyclates

Characteristic	Unit	Test Method	Comment
Required			
Colour		Visual inspection	
Density	Kg/m ³	EN ISO 1183-1 Method A	
Impact Strength	KJ/m ²	EN ISO 179-1, EN ISO 179-2 or EN ISO 180	
Melt Flow Rate	g/10min	EN ISO 1133 Condition M	
Shape		Visual inspection ^a	
Optional			
Ash Content	%	EN ISO 3451-1	
Bulk Density	Kg/m ³	See Annex A	
Extraneous Polymers	%	Thermal/Infra-red Analyses	
Flexural Properties	MPa	EN ISO 178	
Filtration Level		Mesh Size	Provide information on mesh size.
Recycled Content	%	EN 15343	
Tensile stress at yield	MPa	EN ISO 527-1 EN ISO 527-2	
Tensile strain at break	%	EN ISO 527-1 EN ISO 527-2	
Volatile Content	%	EN 12099 ^b or other	
^a For example, ground, micronised, pellets, flakes. ^b Although the scope of EN 12099 is limited, it is considered relevant. Other tests may be carried out by agreement between the purchaser and the supplier and the results reported.			

5 Quality Assurance

In order that the purchaser of the recyclate may 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. A quality management system certified to EN ISO 9001 may be a suitable guarantee of consistent recyclate quality.

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, where there is no analytical method available to supply such information. These records should be available to the purchaser on request.

EN 15345:2007 (E)

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.

NOTE EN 15343 describes a qualified recycling process and gives details of traceability and the assessment of recycled content.

Annex A

(Normative)

Test Method for the determination of bulk density

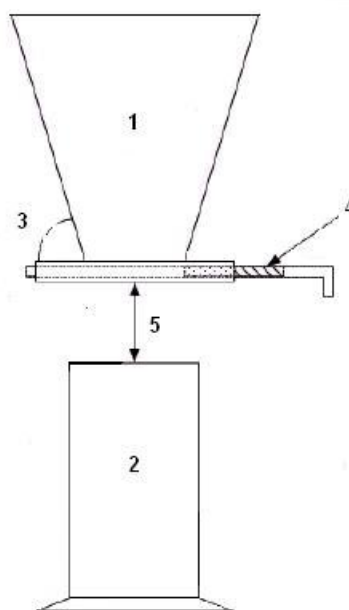
A.1 Scope

This test method specifies a method for 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 may 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 \pm 0,25 mm
- 2 Inner height: 200 mm \pm 0,2mm, Inner diameter: 113 mm \pm 0,2mm, Volume: 2 000 ml
- 3 Angle approximately 65 °
- 4 Diameter of hole approximately 60 mm
- 5 Distance of 100 mm \pm 0,5 mm

Figure A.1 — Typical apparatus

A.2 Material

Powder or granular material.

A.3 Apparatus

A.3.1 Balance, accurate to 0,1 g.

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

A.3.3 Conical funnel, of the form and dimensions shown in Figure A1, 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 orifice in trap plate 60 mm.

A.4 Preparation of test sample

Mix the sample before testing.

A.5 Procedure

A.5.1 Support the funnel (A.3.3) vertically with its lower orifice 100 mm above the measuring cylinder (A.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 2 200 ml to 2 400 ml of the powder or granular material in the funnel.

A.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 (A.3.1).

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

A.6 Expression of results

The bulk density of the material under test is given, in grams per millilitre, by the formula:

$$\frac{m}{V} \tag{A.1}$$

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 A.5.

A.7 Test report

The test report shall include the following information:

a) reference to this European Standard (EN 15345:2007);

- b) all details necessary for complete identification of the material tested;
- c) individual results determined following the procedure A.5 and the arithmetic mean of the results;
- d) details of any deviation from the test method, as well as any incident which may have influenced the results;
- e) date of the test.

Bibliography

- [1] EN ISO 1873-1, Polypropylene (PP) moulding and extrusion materials - Part 1: Designation system and basis for specifications (ISO 1873-1:1995)
- [2] UNI 10667-3, Recycled plastic materials - Polypropylene from industrial residue and/or from post consumer materials to be used for general purposes - Requirements and test methods
- [3] UNI 10853-2, Recycled plastic materials from recovery of durable goods to end of life - Polypropylene - Requirements and test methods
- [4] EN ISO 1043-2, Plastics - Symbols and abbreviated terms - Part 2: Fillers and reinforcing materials (ISO 1043-2:2000)
- [5] EN-ISO 1043-3, Plastics - Symbols and abbreviated terms - Part 3: Plasticizers (ISO 1043-3:1996)
- [6] EN ISO 1043-4, Plastics - Symbols and abbreviated terms - Part 4: Flame retardants (ISO 1043-4:1998)
- [7] EN ISO 11469, Plastics - Generic identification and marking of plastics products (ISO 11469:2000)
- [8] ASTM D 5577, Standard Guide for Techniques to Separate and Identify Contaminants in Recycled Plastics
- [9] ASTM D 6288, Standard Practice for Separation and Washing of Recycled Plastics Prior to Testing
- [10] EN ISO 9001, Quality management systems — Requirements (ISO 9001:2000)

BSI — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover.
Tel: +44 (0)20 8996 9000. Fax: +44 (0)20 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: +44 (0)20 8996 9001.
Fax: +44 (0)20 8996 7001. Email: orders@bsi-global.com. Standards are also available from the BSI website at <http://www.bsi-global.com>.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre.
Tel: +44 (0)20 8996 7111. Fax: +44 (0)20 8996 7048. Email: info@bsi-global.com.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration.
Tel: +44 (0)20 8996 7002. Fax: +44 (0)20 8996 7001.
Email: membership@bsi-global.com.

Information regarding online access to British Standards via British Standards Online can be found at <http://www.bsi-global.com/bsonline>.

Further information about BSI is available on the BSI website at <http://www.bsi-global.com>.

Copyright

Copyright subsists in all BSI publications. BSI also holds the copyright, in the UK, of the publications of the international standardization bodies. Except as permitted under the Copyright, Designs and Patents Act 1988 no extract may be reproduced, stored in a retrieval system or transmitted in any form or by any means – electronic, photocopying, recording or otherwise – without prior written permission from BSI.

This does not preclude the free use, in the course of implementing the standard, of necessary details such as symbols, and size, type or grade designations. If these details are to be used for any other purpose than implementation then the prior written permission of BSI must be obtained.

Details and advice can be obtained from the Copyright & Licensing Manager.
Tel: +44 (0)20 8996 7070. Fax: +44 (0)20 8996 7553.
Email: copyright@bsi-global.com.