SLOVENSKI STANDARD
kSIST-TS FprCEN/TS 18396:2026

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Embalaža - Načrtovanje za recikliranje plastične embalaže - Postopek za ocenjevanje zmožnosti recikliranja fleksibilne embalaže iz biorazgradljive plastike

Packaging - Design for recycling for plastic packaging products - Recyclability evaluation process for flexible packaging made of biodegradable plastics

Verpackung - Recyclinggerechte Gestaltung von Kunststoffverpackungen - Verfahren zur Bewertung der Recyclingfähigkeit von flexiblen Verpackungen aus biologisch abbaubaren Kunststoffen

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Packaging - Design for recycling for plastic packaging products - Recyclability evaluation process for flexible packaging made of biodegradable plastics

Verpackung - Recyclingorientierte Gestaltung von Kunststoffverpackungsprodukten - Verfahren zur Bewertung der Recyclingfähigkeit von flexiblen Verpackungen aus biologisch abbaubaren Kunststoffen

This draft Technical Specification is submitted to CEN members for Vote. It has been drawn up by the Technical Committee CEN/TC 261.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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European foreword

This document (FprCEN/TS 18396:2026) has been prepared by Technical Committee CEN/TC 261 “Packaging”, the secretariat of which is held by AFNOR.

This document is currently submitted to the Vote on TS.

Introduction

Biodegradable plastics are polymeric materials able to be broken down by biological processes under aerobic conditions to carbon dioxide, water and mineral salts of any other elements present (mineralization) and new biomass.

Biodegradability is an intrinsic property that is determined by the fundamental chemical composition and structure of a material. Chemical bonds of biodegradable polymers are recognized by naturally occurring enzymes and the biodegradability of polymeric materials is determined by the chemical structure responsible for functional group stability, reactivity, hydrophilicity, and swelling behaviour.

The rate and extent of biodegradation depend on the polymer's chemical composition, crystallinity, molecular weight, and environmental parameters such as temperature, moisture, pH, and microbial community composition.

Recycling is generally defined by the Waste Framework Directive (2008/98/EC) as any recovery operation where waste materials are reprocessed into products, materials, or substances for original or other purposes. It includes organic material reprocessing, but excludes energy recovery and conversion into fuels or materials for backfilling.

On the other hand, according to the Regulation (EU) 2025/40[1], known as the Packaging and Packaging Waste Regulation ("PPWR"), material recycling refers specifically to the reprocessing of waste into materials or substances, excluding biological treatment, organic material reprocessing, energy recovery, and conversion into fuels or backfilling materials.

Following the PPWR most packaging placed on the market, including packaging made of biodegradable plastic polymers and other biodegradable materials, shall be recyclable i.e. it is designed for material recycling, and when it becomes waste, it can be collected separately and sorted into specific waste streams without affecting the recyclability of other waste streams and recycled at scale. However, certain compostable packaging is exempt from meeting material recycling requirements due to a derogation (in line with Article 9.1 and 9.2 of the PPWR).

On this basis, different types of packaging made from biodegradable plastics can be created that need to be managed appropriately.

— The first type comprises packaging made from biodegradable plastics that falls within packaging applications that are required by European or national laws to be compatible with the standard for composting in industrially controlled conditions in bio-waste treatment facilities. This packaging is marked with labels as compostable and enter the biodegradable waste stream (known as bio-waste). It is not recycled as material but converted into compost or similar substances. Compostable packaging generally needs to fulfil a number of requirements, including being made from biodegradable materials and containing undesirable substances at levels below certain predetermined thresholds. It also may not negatively impact the final compost end product. The characteristics of compostable packaging are defined by a relevant European standard (EN 13432).

— The second type also comprises packaging made from biodegradable plastics that however would need to be recovered by material recycling because the derogation is only applied to some territories. There is growing interest in certain packaging formats that can be recycled in both the bio-waste stream and the material recycling stream, depending on local regulations and infrastructure.

— The third type concerns packaging made from biodegradable plastics that is not intended to be recovered by organic recycling, either due to the decision of the person placing it on the market or current regulations. In this case, the use of biodegradable plastic is not motivated by its biodegradability, but by other factors. The fact that it is biodegradable is incidental; this

[1] Regulation (EU) 2025/40 of the European Parliament and of the Council of 19 December 2024 on packaging and packaging waste (commonly known as the "PPWR")

characteristic is neither communicated nor used for recovery purposes. It is important to note that this is already the case with other biodegradable packaging materials, such paper-based packaging, which, despite being predominantly made of a biodegradable material (i.e. cellulose), are generally recovered by material recycling and not labelled as compostable. In this case, the packaging needs to be designed to enable material recycling, but it is not required to show biodegradability according to the criteria defined in the relevant European standard for compostable packaging.

This document addresses the second and/or the third types of packaging.

Biodegradable polymers such as polylactic acid (PLA), aliphatic-aromatic copolyesters, and polyhydroxyalkanoates (PHA), can be used to produce plastic packaging that can be recycled similarly to PET. However, the adoption of packaging made of biodegradable plastics is currently limited compared to widely used plastics like PE, PP, PET and separate sorting and recycling systems still need to be built up at scale. Therefore, this document is based on experiences from other plastics and from ongoing European projects aimed at scaling up sorting and recycling procedures.

The objective of this document is to facilitate consistent design for recycling criteria for packaging made from biodegradable plastics, ensuring that when sorting and recycling infrastructure mature, these specifications can be smoothly incorporated into the broader standard framework. **This document provides guidance based on current technological capabilities and does not represent state-of-the-art collection, sorting and recycling as defined in EN 18120.** As technical developments progress and further consensus is achieved the content of this document may be subject to modification, review and revision.

This document intends to follow the philosophy of EN 18120 consisting of 15 parts. Given the early market implementation in Europe of packaging made from biodegradable plastics and the low volumes of such packaging currently in the waste streams, existing material recycling technologies for packaging waste made from biodegradable plastics (with levels of maturity varying depending on the polymer type) do not currently fit into the “state-of-the-art” definition as set in EN 18120. Therefore, these TS are proposed outside the scope of EN 18120 at this stage, while maintaining its philosophy and structure as closely as possible. EN 18120 aims via series of guidelines and protocols to establish consistency and improvement for the Design for recycling for household, industrial, and commercial plastic packaging products.

Design for recycling guidelines are a common way of describing compatibility with plastic packaging collection, sorting and recycling into recycled plastic. They provide guidance on the level compatibility, defined as:

— Green: Packaging constituents with full compatibility with collection, sorting and recycling;

— Yellow: Packaging constituents with limited compatibility with collection, sorting and recycling;

— Red: Packaging constituents which are not compatible with collection, sorting and recycling.

Recyclability guidelines will require regular review and improvement to reflect innovations in design, collection, sorting and recycling.

The Design for Recycling Guidelines provided cover all steps from design for recycling, packaging waste collection, sorting, recycling into recycled plastic and to use in a new application. Compliance with the design guidelines does not guarantee that the recycled plastic quality will be fit for purpose for a specific targeted end application or compliant with applicable regulations.

Packaging recyclability is the combination of design for recycling, proven collection, sorting, and recycling.

1 Scope

This document defines requirements for the evaluation process for the part of the flexible packaging unit which comprises the main body and the integrated components and is predominantly made of biodegradable plastics and for separate components predominantly made of biodegradable plastics with respect to compatibility of the design with the collection, sorting, and recycling processes.

2 Normative references

The following documents are referred to in the text in such a way their content constitutes requirements 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 ISO 527-1, *Plastics — Determination of tensile properties — Part 1: General principles (ISO 527-1:2019)*

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

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

EN ISO 527-4, *Plastics — Determination of tensile properties — Part 4: Test conditions for isotropic and orthotropic fibre-reinforced plastic composites (ISO 527-4)*

EN ISO 527-5, *Plastics — Determination of tensile properties — Part 5: Test conditions for unidirectional fibre-reinforced plastic composites (ISO 527-5)*

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

EN ISO 1133-1, *Plastics — Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics — Part 1: Standard method (ISO 1133-1)*

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)*

EN ISO 6383-2, *Plastics — Film and sheeting — Determination of tear resistance — Part 2: Elmendorf method (ISO 6383-2)*

EN ISO 11357-1, *Plastics — Differential scanning calorimetry (DSC) — Part 1: General principles (ISO 11357-1)*

EN ISO 11357-3, *Plastics — Differential scanning calorimetry (DSC) — Part 3: Determination of temperature and enthalpy of melting and crystallization (ISO 11357-3)*

EN ISO 15512, *Plastics — Determination of water content (ISO 15512)*

EN ISO 18314-1, *Analytical colorimetry — Part 1: Practical colour measurement (ISO 18314-1)*

ISO 4593, *Plastics — Film and sheeting — Determination of thickness by mechanical scanning*

ISO 14782, *Plastics — Determination of haze for transparent materials*

ASTM E1164, *Standard Practice for Obtaining Spectrometric Data for Object-Color Evaluation*

ASTM D882, *Standard Test Method for Tensile Properties of Thin Plastic Sheeting*

ASTM D7191-18, *Standard Test Method for Determination of Moisture in Plastics by Relative Humidity Sensor*

ASTM D5748, *Standard Test Method for Protrusion Puncture Resistance of Stretch Wrap Film*

EN 14477:2004, *Packaging — Flexible packaging material — Determination of puncture resistance — Test methods*

ASTM D1003-21, *Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics*

ASTM F88/F88M-21, *Standard Test Method for Seal Strength of Flexible Barrier Materials*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply. For all other terms and definitions that are not defined below, please refer to the definitions in the EN 18120-1.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp/

— IEC Electropedia: available at https://www.electropedia.org/

3.1
aliphatic-aromatic copolyester
thermoplastic copolyester made by the polycondensation of an aliphatic diol with aliphatic and aromatic diacids

3.2
biodegradable plastic

plastic capable of undergoing biological decomposition, such that it ultimately decomposes into carbon dioxide (CO_2), biomass and water, and meets the inherent biodegradability requirements of the relevant composting standards

Note 1 to entry: Biodegradable plastic in the context of this document is characterized only by its inherent biodegradability as per EN 13432 (and not by other requirements of EN 13432).

3.3
depolymerisation
reversion of a polymer to its monomer(s) or to a polymer of lower relative molecular mass

3.4
green category
category for identifying components or constituents of a plastic packaging that is in the scope of the design for recycling guidelines of a given packaging type and are recognised as compatible with collection, sorting and recycling processes or are demonstrated as suitable for recycling through technical evaluation and can fully meet the quality requirements of secondary raw material in the recycling process

3.5
oxo(bio)degradable additive, oxo(bio)degradation additive
additive which, through oxidation, lead to the fragmentation of the plastic material into micro-fragments or to chemical decomposition

Note 1 to entry: Definition is based on definition EN 18120-1:2026, 3.92.

Note 2 to entry: Oxo(bio)degradable additive and oxo(bio)degradation additive are used synonymously.

3.6
polybutylene adipate terephthalate
PBAT
thermoplastic copolyester made by the polycondensation of 1,4 butandiol with terephthalic acid and adipic acid

3.7
polybutylene succinate
PBS
thermoplastic polyester made by the polycondensation of succinic acid and 1,4-butanediol

3.8
polycaprolactone
PCL
thermoplastic polyester made by the ring-opening polymerization of ε-caprolactone

3.9
polyethylene glycol
PEG
thermoplastic polyether made by polymerization of ethylene glycol

3.10
polyethylene wax
low-molecular-weight synthetic polymer of ethylene, characterized by wax-like properties such as low viscosity, hardness, and high melt point

3.11
polyhydroxyalkanoate
PHA
thermoplastic polyester, predominantly consisting of 3-hydroxybutyrate and/or 4-hydroxybutyrate (e.g., PHB, PHBV, PHBH, P3,4HB)

3.12
polylactic acid
PLA
thermoplastic polyester made by the polymerisation of lactic acid or lactide

3.13
polytetramethylene glycol
PTMG
synthetic resin made by the polymerization of tetramethylene glycol

3.14
red category
category for identifying components or constituents of a plastic packaging that is in the scope of the design for recycling guidelines of a given packaging type and generally leads to rejection of the packaging item in sorting or recycling processes or are generally recognized as detrimental (disrupting) for recycling or are demonstrated as disrupting for recycling through technical evaluation or are demonstrated as unacceptably downgrading the yield or the quality of plastic secondary raw materials

3.15
yellow category
category for identifying components or constituents of a plastic packaging that is in the scope of the design for recycling guidelines of a given packaging type and are recognized as acceptable with limited compatibility with collection, sorting and recycling processes, or are demonstrated as having limited compatibility through technical evaluation or will not meet all the quality requirements for secondary raw material in the recycling process

4 Recyclability evaluation process

4.1 Principle

This document provides a method of evaluating the technical recyclability of a sample consisting of flexible packaging made of biodegradable plastics. The results characterize both the processability of the sample as well as the quality of the recycled plastic.

This document does not describe sorting steps that occur at material recovery facilities or plastics recovery facilities. For the evaluation of such sorting operations, see EN 18120-3.

Depending on the choice of the sample, the protocol can either provide a technical recyclability determination for a full packaging design, or it can be employed to selectively study the impact of individual constituents or integrated components of flexible plastic packaging made of biodegradable plastics on technical recyclability. The latter approach may be employed to generate data for the updating of design for recycling guidelines.

The protocol follows the steps (unit operations) that occur in a recycling process for flexible packaging made of biodegradable plastics and seeks to simulate each operation on a laboratory scale. If one or more unit operations are tested leveraging a pilot line or an industrial line, this is also permitted as long as the operation tested is representative.

The final test report shall include all relevant information as described in the corresponding sections of this document.

4.2 Applicable unit operations for packaging type

For flexible packaging made of biodegradable plastics, such as household predominant flexible packaging, industrial and commercial [flexible] packaging, the following unit operations are applicable and are shown in Table 1 for PLA, Table 2 for PHA and Table 3 for aliphatic aromatic copolyesters. In all tables, Step 0 describes material selection, Steps 1 to 2 describe the plastic recycling process itself whereas step 3 represents the conversion to the articles.

Evaluation of the technical recyclability of a sample consisting of flexible packaging made of biodegradable plastics should simulate commercially operating recycling processes at lab scale, based on benchmarks, considering the following steps:

— evaluation of existing recycling infrastructure and processes;

— pre-treatment;

— extrusion: pellet production and evaluation;

— conversion: various conversion methods as described for each predominant polymer;

— quality and performance evaluation.

The goal of the evaluation process is to identify all foreseeable critical points and establish a testing strategy that either confirms or excludes a negative impact for each critical point considered.

Annex E provides an overview of the dilution and naming of samples.

Table 1 — List of unit operations in mechanical recycling of PLA predominant flexible packaging

Step #	Unit operation	Description of the test procedure
0	Control material selection	Before any testing, control material to compare the evaluated packaging shall be selected. A minimum of 15 kg of the test packaging and 25 kg of control material shall be tested. See Annex D for Virgin and Control Materials.
1 Pre-treatment: pieces preparation – this step simulates the preparation of PLA pieces		
1.1	Cutting	PLA based flexible packaging is cut into pieces.
1.2	Washing	The pieces are washed to remove product residue and optionally components such as labels.
1.3	Drying	The pieces are dried to reduce their moisture to less than 0,5 % by mass.
2 Treatment: Pellets preparation – this step simulates the production of PLA pellets		
2.1	Pieces blend preparation	The pieces of tested samples are mixed with control samples with different shares.
2.2	Pellet production	The dried pieces are extruded into pellets. A temperature range of the control material as specified in its technical datasheet supplied by the supplier of the control resin should be used to prevent polymer degradation.
3 Conversion: This step simulates the conversion of the above pellets into articles		
3.1	Pellet blend preparation	The recycled pellets are blended with other pellets, typically including virgin grades of the same polymer.
3.2	Cast film extrusion	PLA pellet blends are converted into products by cast film extrusion.

NOTE The technical recyclability of PLA based on other processes such as chemical recycling (monomer recovery) cannot be derived from the protocol described in this document. Future versions of this document can include evaluation processes for these recycling technologies.

The detailed recyclability evaluation protocol for PLA predominant flexible packaging, including test procedures, pellet characterization, conversion steps, and reporting requirements, is specified in Annex A (normative).