



BSI Standards Publication

**Plastics — Agricultural plastic products —
Installation, use, removal, sorting,
collection, preparation for recycling and
design for recycling guidelines**

National foreword

This British Standard is the UK implementation of EN 18109:2025.

The UK participation in its preparation was entrusted to Technical Committee PRI/300.

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

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

© The British Standards Institution 2025
Published by BSI Standards Limited 2025

ISBN 978 0 539 31509 7

ICS 13.030.50; 65.040.30; 65.060.01; 83.080.01; 83.140.10

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 31 August 2025.

Amendments/corrigenda issued since publication

Date	Text affected
------	---------------

English Version

Plastics - Agricultural plastic products - Installation, use,
removal, sorting, collection, preparation for recycling and
design for recycling guidelines

Plastiques - Produits pour l'agriculture en matières
plastiques - Installation, utilisation, dépose, tri, collecte,
préparation au recyclage et lignes directrices pour la
conception en vue du recyclage

Kunststoffe - Landwirtschaftliche
Kunststofferzeugnisse - Installation, Verwendung,
Abbau, Sortierung, Sammlung, Aufbereitung für das
Recycling und Richtlinien für recyclinggerechte
Gestaltung

This European Standard was approved by CEN on 16 June 2025.

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-CENELEC 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-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of 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, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and United Kingdom.



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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Contents

Page

European foreword	5
Introduction	6
1 Scope.....	7
2 Normative references.....	8
3 Terms, definitions and abbreviated terms.....	9
3.1 Terms and definitions	9
3.2 Abbreviated terms.....	12
4 Plastic products for agriculture: design for recycling, manufacture, use, removal, collection and preparation for recycling.....	12
4.1 Main characteristics of plastic products for agricultural and horticultural use.....	12
4.2 Consideration of the different impacts of design, manufacture, use and collection on the end-of-life recovery of plastics for agricultural and horticultural use	14
4.2.1 General.....	14
4.2.2 The cost of reprocessing used products	14
4.2.3 Retaining the value of the product after use.....	14
4.2.4 Impact of soilage and preparation of used agricultural plastics	15
4.3 Extended producer responsibility and the role of the user	17
4.3.1 General.....	17
4.3.2 Integrated management of agricultural plastics	17
4.3.3 Social and Environmental Responsibility	17
4.3.4 Energy efficiency	17
4.3.5 Mitigation of environmental impact.....	18
4.3.6 Improvement of working conditions.....	18
4.4 The integrated management methodology for plastics for agricultural and horticultural use	18
4.4.1 General.....	18
4.4.2 Anticipating the end of life of products during their implementation.....	19
4.4.3 General instructions for storage before use, installation, use and removal	19
4.4.4 General instructions for storage before and during use and for disposal	20
4.4.5 Collection and packaging of used agricultural plastics for reprocessing.....	20
4.4.6 Characterization of used agricultural plastics	21
4.4.7 Characterization of recyclates from agricultural plastics.....	21
4.5 Criteria for eco-design (including design for recycling).....	22
4.5.1 General.....	22
4.5.2 Impact of design on the product lifecycle	22
4.5.3 Composition and recyclability	22
4.5.4 Thickness	22
4.5.5 Integration of recycled plastics	22
5 Films and tubes.....	23
5.1 Film preparation and storage.....	23
5.1.1 General.....	23
5.1.2 Film reception.....	23
5.1.3 Storage before use	23
5.1.4 Instructions for installation and use	23
5.1.5 Film preparation for collection and recovery	23

5.2	Covering films	24
5.2.1	Greenhouse cover films.....	24
5.2.2	Small tunnel cover films.....	31
5.2.3	Films for covering livestock and storage buildings	33
5.3	Silage films and tubes for horizontal silos.....	33
5.3.1	Use.....	33
5.3.2	Installation instructions and anticipation of end of life	33
5.3.3	Conditions of use and maintenance	35
5.3.4	Durability of silage film	35
5.4	Stretch film for bale wrapping.....	35
5.4.1	Use.....	35
5.4.2	Installation instructions and anticipation of end of life	35
5.4.3	Use, maintenance and instructions for storage of wrapped bales.....	36
5.4.4	Durability of silage wrapping film.....	37
5.4.5	Specific removal instructions for opening and preparation of wrapped bales	37
5.5	Mulch films and solarisation films	37
5.5.1	Use.....	37
5.5.2	Installation instructions, conditions of use and anticipation of end of life	38
5.5.3	Specific removal instructions.....	38
5.6	Fumigation films	39
5.6.1	Use.....	39
5.6.2	Installation instructions, conditions of use and anticipation of end of life	39
5.6.3	Specific removal instructions.....	39
6	Twines and nets	40
6.1	Horticultural twines and accessories.....	40
6.1.1	General	40
6.1.2	Trellising twine	40
6.1.3	Twines for crops tutoring.....	40
6.1.4	Accessories for horticultural twines	41
6.2	Baler twine for seasonal crops	41
6.2.1	Use and implementation	41
6.2.2	Specific removal instructions.....	41
6.3	Protective nets.....	42
6.3.1	General	42
6.3.2	Anti-hail and rain nets	42
6.3.3	Shading nets.....	43
6.3.4	Insect proof nets	43
6.3.5	Harvesting nets.....	44
6.3.6	Windbreaks nets.....	44
6.4	Design for recycling of twines and nets.....	45
6.5	Baling nets for catling	47
6.5.1	Use.....	47
6.5.2	Implementation and anticipation of the end of life	47
6.5.3	Maintenance during the period of use	47
6.5.4	Specific removal instructions.....	47
7	Fabrics and nonwovens.....	47
7.1	Characterization of fabrics and nonwovens	47
7.2	Receipt and storage of fabrics and nonwovens	47
7.3	Canvas.....	48
7.3.1	General	48
7.3.2	Hydroponic cultivation canvas	48
7.3.3	Protective covers	48

7.4	Nonwoven veils.....	49
7.4.1	General.....	49
7.4.2	Nonwoven frost protection and insect-proof veils	49
7.4.3	Nonwoven protective veils for agricultural goods stored temporary at the field.....	50
8	Pipes, fittings and accessories, rigid ducts for irrigation	50
8.1	General.....	50
8.2	Characterization of driplines, pipes and ducts	51
8.2.1	General.....	51
8.2.2	Characteristics of products delivered to the farmer.....	51
8.2.3	Industry standard formats of products delivered to the farmer.....	52
8.2.4	Checking procedures for new products.....	54
8.2.5	Labelling of irrigation pipes.....	55
8.2.6	Storage and handling of used irrigation pipes and ducts.....	55
8.3	Thin wall driplines (TWD) or “Tapes”	55
8.3.1	Use	55
8.3.2	Implementation and anticipation of the end of life.....	55
8.3.3	Maintenance during the period of use	55
8.3.4	Specific removal instructions.....	56
8.4	Heavy wall driplines (HWD: semi-rigid irrigation pipes)	56
8.4.1	Use	56
8.4.2	Implementation and anticipation of the end of life.....	56
8.4.3	Maintenance during the period of use	57
8.4.4	Specific removal instructions.....	57
8.5	Irrigation ducts.....	57
8.5.1	Use	57
8.5.2	Implementation and anticipation of the end of life.....	57
8.5.3	Maintenance during the period of use	57
8.5.4	Specific removal instructions.....	58
8.6	Irrigation fittings and accessories (connectors, valves, filters, etc.).....	58
8.6.1	General.....	58
8.6.2	Use	58
8.6.3	Implementation and anticipation of the end of life.....	58
8.6.4	Maintenance during the period of use	58
8.6.5	Specific removal and storage instructions	58
8.7	Rain guns.....	58
8.7.1	General.....	58
8.7.2	Use	59
8.7.3	Implementation and anticipation of the end of life.....	59
8.7.4	Maintenance during the period of use	59
8.7.5	Specific removal and collection instructions.....	59
Annex A (informative)	Classification of used agricultural plastic films in France	60
Annex B (informative)	Example of methods for the establishment of a dedicated collection scheme	61
Annex C (informative)	Measurement of soilage rate in agricultural plastics	66
Bibliography		67

European foreword

This document (EN 18109:2025) has been prepared by Technical Committee CEN/TC 249 “Plastics”, the secretariat of which is held by SIS.

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 February 2026, and conflicting national standards shall be withdrawn at the latest by February 2026.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a standardization request addressed to CEN by the European Commission. The Standing Committee of the EFTA States subsequently approves these requests for its Member States.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations 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, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

Introduction

In recent years, the use of plastic products in agriculture has become a subject of concern due to its impact on the environment. To address this issue, there is a growing need for a European standard that sets guidelines in agricultural practices.

The European standardization for agricultural products aims to promote sustainable practices, reduce plastic waste, and protect the environment. It emphasizes the importance of reducing plastic waste, improving recycling and reuse methods. Also, it takes into account the entire life cycle of plastic products, from production to end of use, and encourages the adoption of practices that contribute to a circular economy, primarily recycling.

One of the key aspects is to encourage farmers and producers to opt for the implementation of collection and recycling systems specifically designed for agricultural plastic waste.

The European standardization emphasizes the importance of proper waste management and disposal. It encourages the establishment of collection points and recycling facilities for agricultural plastic waste, ensuring that it is processed and recycled in an environmentally responsible manner. Additionally, it promotes awareness and education among farmers and producers regarding the proper handling and disposal of plastic products.

Furthermore, the European standardization encourages research and innovation in the field of sustainable materials. It calls for the development of new technologies and materials that are recyclable, reusable. This includes exploring options such as bio-based materials made from renewable resources or utilizing natural materials that have minimal impact on the environment.

By implementing these guidelines, farmers and producers will contribute to a more sustainable agricultural industry that balances the need for plastic products with the preservation of our natural resources.

1 Scope

This document specifies the integrated management of agricultural plastic products with agronomic performance.

This document gives guidance and requirements for their installation, use, removal, sorting, collection and preparation for recycling as well as general guidelines for design for recycling.

NOTE 1 EN 13206:2025, EN 13207:2025, EN 13655:2025, EN 14932:2025 and EN 17098-1:2025 include a specific clause dedicated to design for recycling.

NOTE 2 Design for recycling for products not covered by a standard is detailed in this document.

This document first aims professional users and can be used also for domestic purposes.

This document is applicable to:

- covering films that comply with EN 13206:2025 or with specifications laid out by the film manufacturer/supplier, used for covering greenhouses, small tunnels or livestock buildings, as well as to direct crop covers used for semi-forcing plants and seed;
- silage films for horizontal silos that comply with EN 13207:2025 or with specifications laid out by the film manufacturer/supplier;
- sheaths for horizontal silos (forage crop and grain storage) that comply with EN 13207:2025 or with specifications laid out by the sheath manufacturer/supplier;
- stretch films for wrapping bales that comply with EN 14932:2025 or with specifications laid out by the film manufacturer/supplier;
- thermoplastic mulching films that comply with EN 13655:2025 or with specifications laid out by the film manufacturer/supplier;
- barrier films for agricultural and horticultural soil disinfection by fumigation that comply with EN 17098-1:2025;
- nets and twines for catling and horticulture that comply with the specifications laid out by EN ISO 4167 or by the manufacturer/supplier;
- flexible ducts, semi-rigid and rigid pipes and fittings for irrigation that comply with ISO 8779, EN ISO 9261, ISO 13460-1, ISO 16438, EN 14267, EN 12324-2, EN 13635, EN 13997, EN 17176-2:2019+A1:2022 or with specifications laid out by the manufacturer/supplier;
- fabrics and non-woven nets and sheets for catling and horticulture that comply with ISO 9073 series or with specifications laid out by the manufacturer/supplier.

This document does not cover construction, packaging and food-contact products.

NOTE 3 For products non-suitable for recycling in the context of this document, specific procedures apply.

2 Normative references

The following documents are referred to in the text in such a way that some or all of 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 10244-2, *Steel wire and wire products — Non-ferrous metallic coatings on steel wire — Part 2: Zinc or zinc alloy coatings*

EN 12324-2, *Irrigation techniques — Reel machine systems — Part 2: Specifications of polyethylene tubes for reel machines*

EN 13031-1, *Greenhouses — Design and construction — Part 1: Commercial production greenhouses*

EN 13206, *Plastics — Thermoplastic covering films for use in agriculture and horticulture*

EN 13207, *Plastics — Thermoplastic silage films and tubes for use in agriculture*

EN 13635, *Irrigation techniques — Localised irrigation systems — Terminology and data to be supplied by the manufacturer*

EN 13655, *Plastics — Thermoplastic mulch films recoverable after use, for use in agriculture and horticulture*

EN 13997, *Irrigation techniques — Connection and control accessories for use in irrigation systems — Technical characteristics and testing*

EN 14267, *Irrigation techniques — Irrigation hydrants*

EN 14932, *Plastics — Thermoplastic stretch films for wrapping silage bales*

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 — Characterisation of Polypropylene (PP) recyclates*

EN 15347-1, *Plastics — Sorted plastics wastes — Part 1: General characterization*

EN 15347-2, *Plastics — Sorted plastics wastes — Part 2: Quality grades of sorted Polyethylene (PE) wastes and specific test methods*

EN 15347-3, *Plastics — Sorted plastics wastes — Part 3: Quality grades of sorted Polypropylene (PP) wastes and specific test methods*

EN 17098-1, *Plastics — Barrier films for agricultural and horticultural soil disinfection by fumigation — Part 1: Specifications for barrier films*

EN 17176-2:2019+A1:2022, *Plastics piping systems for water supply and for buried and above ground drainage, sewerage and irrigation under pressure — Oriented unplasticized poly(vinyl chloride) (PVC-O) — Part 2: Pipes*

EN 17615, *Plastics — Environmental Aspects — Vocabulary*

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

EN ISO 9261, *Agricultural irrigation equipment — Emitters and emitting pipe — Specification and test methods (ISO 9261)*

ISO 8779, *Plastics piping systems — Polyethylene (PE) pipes for irrigation — Specifications*

ISO 9092, *Nonwovens — Vocabulary*

ISO 13460-1, *Agricultural irrigation equipment — Plastics saddles — Part 1: Polyethylene pressure pipes*

ISO 15270,¹ *Plastics — Guidelines for the recovery and recycling of plastics waste*

ISO 16348, *Metallic and other inorganic coatings — Definitions and conventions concerning appearance*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 472, EN 17615, ISO 9092 and the following apply.

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

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1.1

conventional expected lifetime

expected lifetime defined by agreement between the manufacturer/supplier and the customer or, by default, the minimum use duration that the product needs to satisfy

Note 1 to entry: It is expressed in years, months or seasons.

EXAMPLE Products include e.g. film, sheath, net, twine, canvas, nonwoven, pipe, etc.

3.1.2

actual useful lifetime

time interval defined as starting on the fitting date, or installation date, of a product until its removal or early failure

Note 1 to entry: It is expressed in months or seasons for greenhouse covering films.

EXAMPLE Products include e.g. film, sheath, net, twine, canvas, nonwoven, pipe, etc.

3.1.3

use ratio

ratio of the *actual useful lifetime* (3.1.2) of a product to its *conventional expected lifetime* (3.1.1)

Note 1 to entry: It is expressed as a percentage, %.

EXAMPLE Products include e.g. film, sheath, net, twine, canvas, nonwoven, pipe, etc.

¹ Under revision as a multi-part standard.

3.1.4

remaining use potential

difference between the *conventional expected lifetime* (3.1.1) of a product and its *actual useful lifetime* (3.1.2), determined over the lifespan of the product

Note 1 to entry: It is expressed in months or seasons for greenhouse covering films.

EXAMPLE Products include e.g. film, sheath, net, twine, canvas, nonwoven, pipe, etc.

3.1.5

soilage

S

natural foreign material found in a used product as mineral, water and organic material

Note 1 to entry: It is expressed as a percentage, %.

3.1.6

soilage rate

SR

proportion of foreign material found in a used product calculated relatively to the mass of used product

Note 1 to entry: The formula can be found in 4.2.4.1.

Note 2 to entry: Soilage rate and soilage coefficient can be transposed one into another, using the related mathematical formulae in 4.2.4.1.

3.1.7

dry soilage rate

proportion of foreign material found in a used product calculated relatively to the mass of used product, excluding water content

Note 1 to entry: The formula can be found in 4.2.4.1.

3.1.8

soilage coefficient

SC

proportion of foreign material found in a used product calculated relatively to the original product mass, obtained by a transposition formula from the *soilage rate* (3.1.6)

Note 1 to entry: The formula can be found in 4.2.4.1.

3.1.9

reprocessor

natural or legal person applying a physical treatment to a collected used plastic modifying its shape or physical properties

EXAMPLE Grinding, shredding-washing, etc.

3.1.10

recycler

natural or legal person applying a physical treatment to a collected used plastic that transform it in a new raw material directly usable in a production process

3.1.11**collection operator**

natural or legal person ensuring by himself or via a contractor the systematic collection of used plastic

3.1.12**recyclability**

ability of a product, including the related accessories, to be sorted and recycled in practice and at scale in the current recycling technology and infrastructure, and deliver recyclates of suitable quality to be integrated into new products, respecting product standards and regulations in force

Note 1 to entry: The adjective of “recyclability” is “recyclable”.

[SOURCE: M/584 COMMISSION IMPLEMENTING DECISION of 1.8.2022 on a standardisation request to the European Committee for Standardisation and the European Committee for Electrotechnical Standardisation as regards plastics recycling and recycled plastics - modified]

3.1.13**design for recycling****DFR**

design of product, including the related accessories, in order to ensure its *recyclability* (3.1.12) under the current practices of removal, sorting, collection and recycling systems

Note 1 to entry: The purpose with the design for recycling criteria is to be able to use the recyclates back in the same product, independent of producer of material.

3.1.14**recycling of plastics**

process of recovering plastics waste into products, materials or substances to be used again but excluding energy recovery and materials intended to be used as fuels

Note 1 to entry: Recycling can be mechanical, chemical, physical or organic.

Note 2 to entry: Recycling is also defined in Directive 2008/98/EC, Article 3 (15a).

[SOURCE: EN 17615:2022, 3.211]

3.1.15**mechanical recycling**

processing of plastic waste into secondary raw materials or products without significantly changing the chemical structure of the material

Note 1 to entry: Plastics secondary raw material is a synonym of recyclate.

[SOURCE: EN ISO 472:2013, 2.1697, modified — Note 1 to entry changed; “plastics waste” changed to read “plastic waste”.]

3.1.16**chemical recycling**

conversion of polymers into chemical substances by changing the chemical structure of plastic waste through processes such as cracking, pyrolysis, gasification or depolymerization excluding energy recovery and the production of materials that are to be used as fuels or for backfilling operations

Note 1 to entry: “Feedstock recycling” is widely used as a synonym for “chemical recycling”.

[SOURCE: EN 17615:2022, 3.53]

3.1.17

post-consumer plastics

plastics, generated by the end-users of products, that has fulfilled its intended purpose and can no longer be used for its intended purpose (including plastics returned from within the distribution chain)

Note 1 to entry: The term “post-use” is sometimes used synonymously.

Note 2 to entry: Often abbreviated as PCR.

3.1.18

pre-consumer plastics

plastics diverted from the waste stream during a manufacturing process

Note 1 to entry: Excluded is reutilization of plastics such as rework, regrind or scrap generated in a process and capable of being reclaimed within the same process that generated it.

3.1.19

national collection scheme

NCS

voluntary or mandatory national collection system of defined plastic fractions used in agriculture or horticulture applications

3.2 Abbreviated terms

For the purposes of this document, abbreviated terms related to recyclates given in EN ISO 1043-1 and the following apply.

DFR	Design for recycling
EOR	End of row
EPR	Extended Producer Responsibility
HWD	Heavy wall driplines
NAP	New agricultural product
NCS	National collection scheme
OTR	Over the row
PAR	Photosynthetically active radiation
PCR	Post-consumer recyclates
PRO	Producer Responsibility Organization
RUP	Remaining use potential
TWD	Thin wall driplines
UAP	Used agricultural product

4 Plastic products for agriculture: design for recycling, manufacture, use, removal, collection and preparation for recycling

4.1 Main characteristics of plastic products for agricultural and horticultural use

Plastics products used for agricultural or horticultural purpose take advantage of their various agronomic performances obtained by the material properties (light, air, heat, moisture control, etc.).

They are usually made mono-polymeric resins with organic and/or mineral additives, with a thickness in accordance with the intended condition of use in open air.

Products shall be used according to specifications to ensure full recyclability (as over-used products might not be suitable for recycling of plastics).

These characteristics make them usually especially suitable for mechanical recycling whenever the soilage and moisture content after use and sun exposure during use do not hinder excessively the polymer quality. In a similar way, chemical contamination should be minimized (as it will be released in a later phase, during collection, cleaning, extrusion or the useful lifetime in new products).

Thermoplastic products are recyclable materials that can be re-processed in a material recovery process intended to save resources while minimizing harmful emissions into the air, water and soil, as well as their impacts on human health. As a consequence:

- all products shall be sorted after use and collected for recycling of plastics;
- all products shall contribute for the financing of their end-of-life management;
- all products shall have a designation: the purpose of designation is to provide the product relevant information for the intended use on the sales and logistics documents. When post-consumer plastics is integrated, the designation shall include the minimum content of recycled post-consumer plastics (percentage of total mass);
- all products shall have a marking on the packaging or label: when post-consumer plastics is integrated, the marking on the packaging or label shall include the minimum content of recycled post-consumer plastics (percentage of total mass);
- products not complying with DFR requirements described in this document shall be submitted to a separate handling. In the above mentioned cases, product manufacturers shall provide a certificate from an official certification body certified by Producer Responsibility Organization (PRO) proving their compliance with the DFR requirements of this document. This compliance can be shown by the mention “(DFR compliant)” along with the product’s marking;
- used products not complying with the technical minimum requirements of the collection operators are considered to be not recyclable and shall be collected separately.

NOTE Content of recycled pre-consumer plastics can also be declared separately.

The following standards shall be followed:

- EN 15347-1, EN 15347-2 and EN 15347-3 provide a framework for characterizing plastic waste.
- EN 15343 provides the procedures necessary for ensuring the traceability of recycled plastics.
- EN 15344 provides data for characterizing polyethylene recyclates.
- EN 15345 provides data for characterizing polypropylene recyclates.
- ISO 15270² provides guidelines for terminology and material recovery, in particular through mechanical recycling.

² Under revision as a multi-part standard.

4.2 Consideration of the different impacts of design, manufacture, use and collection on the end-of-life recovery of plastics for agricultural and horticultural use

4.2.1 General

The purpose of this subclause is to simplify as much as possible the reverse logistics and cleaning operations and to preserve the mechanical properties of the collected plastics.

4.2.2 The cost of reprocessing used products

4.2.2.1 General

The reprocessing of used products is split into three main steps:

- a) product cleaning, separation and conditioning by the farmer;
- b) product collection, sorting and grouping for massification by the collection operator;
- c) recycling of plastics itself with grinding, washing and extrusion by the reprocessor.

NOTE An excessive expense in one of those steps can easily make the reprocessing unable to self-sustain through the value of regenerated material.

4.2.2.2 The impact of design and manufacture

Products design and manufacturing process have an impact on reverse logistics, cleaning and reprocessing when avoiding or adding future costs, depending on the case. Sources of such costs can be complexity in the removal of the products, lowering the quality of polymeric chains, mixing of polymers, trapping of soilage or moisture, chemicals capture or inclusion of a substance acting as reprocessing disruptor, among others.

Designers that want to prevent excessive reprocessing cost shall anticipate the impact of their proposals on the above-mentioned factors or any other capable to complicate the end-of-life management.

Manufacturing has a similar impact and, with in addition consequences on the effective quality of the delivered product, depending on the conduction of the production process.

4.2.2.3 The impact of use, removal and collection

The use phase of a product has an impact on the mechanical properties and soilage of the product, depending on the conditions of use (sun or heat exposure, presence of mud, mechanical fatigue, etc.).

Removal operations contribute to lower or increase the soilage content, depending on their organization (weather conditions, shaking and sweeping before folding, water presence, prevention of contamination by foreign objects or material, storage practices, etc.). The removal shall not harm the product, tearing shall be minimized as much as possible.

Collection contributes to lower or increase the soilage content and to preserve the value of plastics, depending on their organization (weather conditions, time between removal and collection grouping per homogenous batches, storage practices, prevention of foreign objects, etc.).

4.2.3 Retaining the value of the product after use

4.2.3.1 General

The value of a used plastic is connected to its ability to be reused as feedstock after reprocessing. Feedstock quality is evaluated:

- according to the physical and mechanical properties of the intended product (colour, strength, dart resistance, elongation, light and heat filtration, etc.);
- according to its processability in the intended manufacturing process (blow annular or cast extrusion, knitting or felting, perforation, folding or coiling conditioning, etc.).

4.2.3.2 The impact of design and manufacture

Design and manufacturing have an impact on the potential condition of the product after use (polymer and additive quality, mixing of polymers tendency to soiling, etc.).

This impact can be improved by an appropriate marking of the product (for example by indication of thickness and durability) and training of users.

4.2.3.3 The impact of use, removal and collection

The impact of use, removal and collection is mainly on the quality of the plastic, meaning its physical and mechanical properties. As a general principle, the use, removal and collection of agricultural plastic products should aim to preserve their value by:

- limiting its soilage by dirt and organic material, to lower the need for cleaning, avoiding an additional loss of mechanical properties;
- preventing their contamination by adsorbed material that will be released in later phases;
- conserving as much as possible its mechanical properties, preventing exposure to moisture, direct sunlight, excessive heat, rough terrains and stones.

Collection can provoke the mixing of products coming from different sources, made with different polymers. It creates heterogeneity in batches while recycling (coincidence of different polymer grades, and sometimes even grades such as PE-LLD, PE-LD, PE-HD, sometimes in the original product itself).

4.2.4 Impact of soilage and preparation of used agricultural plastics

4.2.4.1 General

Soilage is the main limiting factor of plastics reprocessing as it can create several causes of mechanical degradation of the recycling equipment:

- early deterioration of equipment (abrasion of the whole recycling chain by silica);
- early deterioration of tools (more frequent sharpening of grinder knives or overloading of filters during extrusion);
- increased water consumption for the washing phase;
- overproduction of outgoing sludge.

Soilage can produce lower quality of recyclates due to the presence of impurities.

Soilage is calculated counting all material different from the plastic, humidity excluded.

In addition, soilage has a huge impact on reprocessing efficiency, increasing water consumption for the washing step and energy consumption.

The soilage rate is calculated counting all material different from the plastic, water included, using Formula (1). The dry soilage rate is calculated using Formula (2), the soilage coefficient is calculated using Formula (3) and the dry soilage coefficient is calculated using Formula (4):

$$\text{Soilage rate} = \frac{W_{UAP} - W_{NAP}}{W_{UAP}} \quad (1)$$

$$\text{Dry soilage rate} = \frac{W_{DUAP} - W_{NAP}}{W_{DUAP}} \quad (2)$$

$$\text{Soilage coefficient} = \frac{W_{UAP}}{W_{NAP}} \quad (3)$$

$$\text{Dry soilage coefficient} = \frac{W_{DUAP}}{W_{NAP}} \quad (4)$$

where

W_{UAP} is the weight of used agricultural product, in kilograms;

W_{DUAP} is the weight of dry used agricultural product, in kilograms;

W_{NAP} is the weight of new agricultural product, in kilograms;

NOTE 1 The dry weight at the first border crossing can be considered equal to the one of the last loading point.

NOTE 2 The local authority can fix a limit value for soilage rate.

NOTE 3 Outside storage and atmospheric conditions can affect measurement of soilage rate; for example wind and rain conditions.

Practically the soilage coefficient is obtained using a relation to soilage rate (see Annex C).

A sampling method from A.D.I.VALOR [1], with accuracy margins, is described in the reference [2] of the Bibliography.

4.2.4.2 Impact of design and manufacture

Design and manufacture have an impact on the product likelihood to attract and retain soilage.

4.2.4.3 The impact of use, removal and collection

The use phase is the main source of soilage that varies according to the type of installation (grounding in the soil, exposure to stain, etc.) and operations (sticking of vegetable remains, type of irrigation, etc.).

For products expose at length to dust, a regular cleaning helps to prevent inclusion of particle in the plastic (greenhouse, silage and building coverage films, etc.).

Removal of products after use is the second source of soilage, especially when dirt and organic material accumulated during the use phase. A minimal cleaning is necessary to prevent this materials form degrading the plastic quality by inclusion or adsorption effects. In addition, they add a significant weight to the original product increasing the logistics and reprocessing costs, in direct proportion of the soilage rate.

Collection operations are the third source of soilage, especially related to the organization of grouping centres when existing, the picking of used products and the storage practices before reprocessing.

4.3 Extended producer responsibility and the role of the user

4.3.1 General

Technical constraints linked to the reprocessing of plastics for agriculture, especially the need to massify volumes, make individual management of those products once used difficult, to the exception of the clean ones.

In this context, to help users to fulfil their legal responsibility, collection schemes have been created, by law or on the initiative of professionals, applying the principles of the extended producer responsibility (EPR): cost internalization, nationwide coverage of all marketed products, dedicated operator, continuous improvement, with a shared governance between all economic actors (converters, distributors and users).

With a collection scheme for used agricultural plastics, users can focus on the preparation of their used plastics products for reprocessing. This preparation is the first step of the reprocessing chain, as is determine the maximal achievable quality of reprocessed material.

4.3.2 Integrated management of agricultural plastics

Each step of the plastic value chain having an impact on the next one, reprocessing of agricultural plastics depends on the previous links of the value chain: design, manufacture, distribution, use, removal, and collection.

The scheme requires an integrated management in which each link of the value chain considers the steps to come in its decision-making process. It requires a proper formation for professionals on the following:

- design for recycling (DFR), including recyclates incorporation;
- use, removal and preparation best practice;
- characterization of used plastics.

4.3.3 Social and Environmental Responsibility

Users, marketers and manufacturers are responsible of the effect of the products they are using and selling.

This responsibility requires appropriate waste management systems to collect products after use in order to minimize the consequences on human health and the environment (releases from open burning, spillage of plastics, storage in field, leakage to the environment, etc.).

Therefore, considering the extreme difficulty to organize individual management of used agricultural plastics, converters shall provide their professional customers with an appropriate end-of-life management, tools, methods, training or services, whenever possible in collaboration with the distributors, especially final retailers.

4.3.4 Energy efficiency

Agricultural plastics also contribute to improve the energy efficiency of food production by allowing savings in fuel consumption and fertilizer or other chemicals use.

The energy efficiency of agricultural plastics shall be taken in account when selecting a product or designing a protected crop installation.

4.3.5 Mitigation of environmental impact

Agricultural plastics contribute to mitigate the environmental impact of food production through a better efficiency of water, fertilizers, protection products and energy, allowing a lower consumption of inputs.

Mitigation of such impact can be improved taking advantage of the barrier effect of plastics, especially in protected crops or air-tight storage, where it allows bugs-free environment, avoiding the need for pesticides.

In absence of a proper end-of-life management, environmental impact of agricultural plastics can be important, especially when left in the soil or the riverbeds. Therefore, a convenient end-of-life management shall be part of the professional use of any kind of agricultural plastics that require to provide professional users with appropriate solutions, either, directly by the product manufacturer or by the mean of a collective collection system. Collective or individual collection systems can be mandated by the applicable local legislation.

4.3.6 Improvement of working conditions

Agricultural plastics contribute to improve working conditions, especially the efficiency of labour force allowing elimination of many operations.

Working conditions shall be considered during the design phase, especially to avoid any painful maintenance operations and focussing on easing the installation and removal operations, such as easy unfolding and refolding of silage sheets and greenhouse films or anti-stain greenhouse films.

NOTE 1 Such improvement can be achieved in collaboration with agricultural machinists, developing for example bale openers, mulch and drip irrigation cleaning-rolling machines, protective nets rolling machines, etc.

NOTE 2 Such improvement of working conditions is easier to achieve when they are integrated in the scopes of research and development programs ahead.

NOTE 3 Film thickness is a key factor in the contamination rate, the thinner the film (e.g. less than 25 µm) the more contaminated, difficult and expensive it will be to remove, recover and recycle.

4.4 The integrated management methodology for plastics for agricultural and horticultural use

4.4.1 General

Agricultural plastics integrated management consist in the anticipation of all lifecycle steps, with their influential factors, mainly soilage and mechanical properties. Each actor of the lifecycle shall take in account his own step and the following ones, considering that each link of the value chain affects the following ones.

An essential step in the process is the design for recycling (DFR) which determines the recyclability of the product, its easiness in use and removal and its mechanical properties after a use cycle in standard conditions.

Production phase is the second most critical as it determines the effective realization of design specifications.

Use and removal phases comes after, as they determine the effective collection and recyclability of the product.

Collection, sorting and recycling phase determine the final destination of the product and the quality of recyclates effectively retrieved from its reprocessing.

The end-of-life management of agricultural plastics is one of the key elements of its integrated management. Considering the limited volumes of agricultural plastics and their dissemination on large

territories their recycling requires a massification of used product and therefore specific collection systems, operating at national level.

Considering the impact of use and removal phase on the effective recyclability of used agricultural plastic it is recommended to associate all economic actors to the design and management of collection schemes, according to their own place in the value chain.

Specific collection systems for agricultural plastics can be organized according to the following methods:

- Individual service by the product manufacturer: it happens when a manufacturer or importer solve or covers the collection costs of its own products, once used, for all its final professional customers.
- Voluntary collective initiative: it happens when actors of the economic value chain of agricultural plastics create and finance a dedicated body to cover the collection costs of members' products, once used. Members can be manufacturers and importers, distributors, final professional users or a combination of it.
- Legally required service: it happens when the applicable local legislation specifies the conditions in which used agricultural plastics are collected and the way the cost is covered.

4.4.2 Anticipating the end of life of products during their implementation

Agricultural plastics implementation needs to consider the specific way they will be collected after use, according to minimal technical recommendations of collection operators. The implementation technic shall ensure the possibility to follow these minimal technical recommendations.

4.4.3 General instructions for storage before use, installation, use and removal

All new products shall be stored before use in proper conditions, avoiding direct sun exposure and temperature source and rain before use and accordingly to product standards referred in the scope of this document, taking into account the manufacturer's storage requirements.

NOTE For PE films, humidity can make film layers stick together.

Installation shall be done whenever possible in dry conditions, with limited wind speed. In case of wind, unrolling and installation shall be done facing it. Proper tension shall be applied to obtain a smooth unrolling and prevent wind entrapment. Anchoring shall be provided when requested by the product notice from the manufacturer or distributor. The main available technics are the grounding edges in the soil (greenhouse, mulch, small tunnel, etc.) the product ballasting (silage) and the use of tensioning devices (clips on tubes, clip-on profiles or elastic bands).

Unusual meteorological conditions can affect warranties on the product. For films, specific values are given in Clause 5.

Removal shall include a preliminary cleaning of earth, organic material and debris that can be done with mechanical removal when applicable. Removal shall be done whenever possible in dry conditions, with limited wind speed. In case of wind, rolling shall be done in the wind direction.

Mechanical removal shall apply proper tensioning to the product to prevent material tearing that would lead to plastic spillage in the field.

Only agricultural plastics complying with the minimum technical requirements issued by the local collection operator can be recycled. Non-complying products are collected for specific treatment that may result in additional fees.

If additional removal instructions are given by local collection operator, they shall be followed.