Paper and Board – Recyclability Laboratory Test Method – Part III: Recycling mill with specialised process (UBC)

Harmonised European laboratory test method to generate parameters enabling the assessment of the recyclability of paper and board products in recycling mills with specialised process (UBC)

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1. INTRODUCTION

With its very high recycling rates, the paper and paper board value chain is an example of the circular economy in action. In addition, technical innovation is creating new products from paper and board and other cellulose fibre-based materials that are increasingly replacing traditional packaging materials. These new materials sometimes need different and more sophisticated or specialised recycling process.

To maintain and further increase the sustainability and circularity of the paper and board value chain and to help EU Member States and other European countries meet high recycling targets,[1] it is important to ensure that paper- and board-based materials and other cellulose fibre-based products are duly (re)processed in a recycling mill 'with specialised process'.

The paper manufacturing and converting industry has issued joint guidance on paper-based packaging recyclability[2] at national and European levels. To confirm recyclability, it is also necessary to define harmonised test methods for a recycling mill 'with specialised process' as a basis for assessing the general recyclability of these materials and products.

This method mimics the most common stages of the industrial processes to measure the main recyclability parameters for paper and board-based materials and other cellulose fibre-based products, based on current knowledge and technology. This makes it possible to:

- Supplement the evaluation of recyclability required by EN 13430 with regard to paper and board-based materials and other cellulose fibre-based products that are sent for recycling in the paper industry.
- Guide eco-design, in terms of recyclability, of paper and board-based materials and other cellulose fibre-based products currently in use, as well as new materials under development and additives used in the converting phase that can affect the recyclability of the final product.
- Support declarations related to the recyclability of materials or products based on grading systems developed by third-party organisations.

This document describes the procedures for the Recyclability Laboratory Test Method – Part III: Recycling mill with specialised process (used beverage cartons, UBC) published by 4evergreen in 2025. These recycling mills typically (re)process used beverage cartons (paper grade group 5.03.00 of the EN 643). They are characterised by the same material composition, both for the paper and non-paper components.

The method as described in this guide includes references to the Paper and Board – Recyclability Laboratory Test Method – Part I: Recycling mill with conventional process, Version 3.

2. SCOPE

This document describes a method for determining, at a laboratory scale, the key parameters for evaluating the recyclability in a recycling mill 'with specialised process'. Given the complexity and variety of specialised process setups, this method was initially developed for evaluating UBCs. The specialised recycling process required for handling fibre-based composite packaging (FBCP) will be addressed in later versions.

[1] E.g. directives 2018/851/EU, 2018/852/EU set high recycling targets for municipal waste and paper-based packaging (85% by 2025, 90% by 2030).
[2] 4evergreen: Circularity by Design Guidelines for Fibre-based Packaging, Version 3, October 2024.

3. REFERENCES

This document incorporates, by way of dated or undated references, provisions from other publications. These references are cited at the appropriate places in the text and the publications are listed below. For dated references, changes to any of these publications apply to this document only when incorporated by amendment or revision. For undated references, the latest version or edition of the referenced publication (including amendments) applies.

Recyclability Laboratory Test Method – Part I
Paper and Board – Recyclability Laboratory Test Method – Part I: Recycling mill with conventional process, Version 3

EN 643
Paper and board – European list of standard grades of paper and board for recycling

EN 13430
Packaging – Requirements for packaging recoverable by material recycling

ISO 536
Paper and board – Determination of grammage

ISO 638-1
Paper, board, pulps and cellulosic nanomaterials – Determination of dry matter content by oven-drying method – Part 1: Materials in solid form

ISO 1762
Paper, board, pulps and cellulose nanomaterials – Determination of residue (ash content) on ignition at 525°C

ISO 4119
Pulps – Determination of stock concentration

ISO 5269-2
Pulps – Preparation of laboratory sheets for physical testing – Part 2: Rapid-Köthen method

TAPPI ANSI T275
Screening of pulp (Somerville-type equipment)

ISO 1924-2
Paper and board – Determination of tensile properties – Part 2: Constant rate of elongation method (20mm/min)

ISO 15360-2
Recycled pulps – Estimation of Stickies and Plastics – Part 2: Image analysis method

ISO 187
Paper, board and pulps – Standard atmosphere for conditioning and testing and procedure for monitoring the atmosphere and conditioning of samples

4. TERMS AND DEFINITIONS

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

4.1 Paper

Range of materials in the form of a coherent sheet or web, made by deposition of pulp from a fluid suspension onto a suitable forming device, with or without the addition of other substances.

Note 1: Papers may be coated, impregnated or otherwise converted, during or after their manufacture, without necessarily losing their identity as paper. In conventional papermaking processes, the fluid medium is water; new developments, however, include the use of air and or fluids other than water.
Note 2: The primary distinction between paper and board is normally based upon thickness or grammage, though in some instances the distinction will be based on the characteristics and/or end-use.
Note 3: Sheets or laps of pulp as commonly understood for papermaking or dissolving purposes are excluded.
Note 4: Pulp fibres are generally of vegetable origin, typically cellulose. For special grades, other origins are possible.

4.2 Board

Generic term applied to certain types of paper frequently characterised by their relatively high rigidity in comparison to paper.

Note: The primary distinction between paper and board is normally based upon thickness or grammage, though in some instances the distinction will be based on the characteristics and/or end-use.

4.3 Fibre-based product

Finished objects (such as packaging, printed materials, articles for domestic use, etc.) comprised of over 50% (in weight) of paper and board.

4.4 Paper and board for recycling

Natural fibre-based paper and board suitable for recycling and consisting of:

> paper and board in any shape;
> products made predominately from paper and board, which may include other constituents that cannot be removed by dry sorting, such as coatings, laminates, spiral bindings, etc.

4.5 Recyclability

Recyclability of paper-based packaging is the individual suitability of a paper-based package for its factual reprocessing in the post-use phase into new products and board. Factual reprocessing means that collection, sorting (if relevant), and at scale recycling takes place. Recyclability criteria of materials are described in ISO 14021 (guidelines for self-declared environmental claims).

4.6 Stock concentration

Ratio of the oven-dry organic and inorganic mass of material that can be filtered from a stock sample to the mass of the unfiltered sample.

4.7 Manual separation

Easy removal of non-paper constituents from a paper or board surface by hand (i.e. without using any tools).

Note: Easy removal is considered fulfilled if the paper and board products contain instructions and/or devices on how to separate the non-paper constituents.

4.8 Screenable non-paper constituents

Any non-paper material which is an intended part of paper, board, or products which cannot be removed by manual separation and which can be retrieved on a screening plate after pulping.

Note: The fibre-free coarse reject determined by using the Paper and Board – Recyclability Laboratory Test Method – Part I: Recycling mill with conventional process is considered as the screenable non-paper constituents.

4.9 PolyAl

PolyAl (sometimes referred to as PE-AL or ALPE) is the residual material after the paper (re)pulping process in a recycling mill 'with specialised process' (UBC). This material contains a mixture of the plastics and aluminium used as functional barrier materials, lamination, caps and closures in the beverage cartons. Typical UBC mills have a dedicated next step to recycle this by-product. Therefore, this material can be added to the total

packaging score and is considered an integral part of this test method.

4.10 Recycling mill with specialised process

A recycling mill with specialised process treats a mix of special grades (group 5 of EN 643) but also compatible grades from other groups (1 to 4 of EN 643). Each mill determines the optimal mix and adds one or more pieces of dedicated equipment, such as a horizontal high consistency drum pulper, a separate batch pulper with longer pulping time, deinking, fine cleaners, hot dispersion, or special process- and waste-water systems. These mills can treat fibre-based packaging that has been coated with non-water-soluble products such as wax, plastic film or other layers like aluminium, polyester or polyethylene entering the recycling process in homogeneous lots. In order to optimise the recycling process, fibre-based composite packaging, which cannot be handled in a conventional process, should be delivered to a mill with specialised process in EN 643 identified flows. The result of the specialised recycling process, as well as the conventional one, is a very high-quality fibrous material suspended in water ready for papermaking.

4.11 Repulpable sample parts

Any fibre-based material that is an intended part of paper, board or fibre-based products that can be included in the recycled fibre yield after the pulping process in a recycling mill.

5. PRINCIPLE

This method enables the analysis of the following parameters:

- Coarse rejects
- Coarse reject quality
- Fine rejects
- Sheet adhesion
- Visual impurities
- Ash content
- Tensile index
- Dissolved and colloidal substances (optional)
- Macrostickies analysis (optional)
- Disintegration curve (k-factor) (optional)

In addition, the parameter (theoretical) 'recyclable rejects' is not determined during the methodology applied by this guide, but can be calculated if the necessary information is provided in the datasheet.

The polyAl recycling can be considered in this methodology if the polyAl composition is proven (via datasheet or laboratory tests) to be fully or conditionally compliant with 4evergreen design-for-recycling guidelines.

The method comprises the following steps:

- Disintegration
- Coarse screening for the determination of the 5 mm hole residue (coarse reject)
- Reject characterisation for the determination of the coarse reject quality levels
- Determination of the ash content using the 'accept' of the coarse screening (filter cake)
- Sheet-formation using the accept of the coarse screening for sheet adhesion test and visual impurities test
- Determination of the stock concentration after the coarse screening
- Fine-screening for the determination of the 150 µm slot residue (fine reject)
- Sheet-formation using the accept of the fine-screening for sheet adhesion test and visual impurities test
- Extra sheet-formation using the accept of the fine-screening for the determination of the tensile index

Optional:

- Filtrate analysis for the determination of the evaporation residue (ER)
- Macrostickies analysis
- Further disintegration times for the disintegration curve approach

A flowchart showing the steps of the method is shown in the Part III annexes.

6. EQUIPMENT AND MATERIALS

This chapter presents a list of all equipment and materials needed to run the described recyclability test.

6.1 Equipment

1. Analytical balance with accuracy of ± 0.01 g
2. Barrels for collecting the accept from coarse and fine-screening
3. Beakers
4. Büchner funnel (diameter 125 mm) equipped with suction flask and water jet pump
5. Ceramics cups
6. Couching roller for the sheet formation
7. Cutting mat for photo documentation
8. Drying oven (temperatures (105 ± 2)°C and (130 ± 2)°C)
9. Metal plates (pressure 1.18 kPa or 3.7 kg, 20 cm diameter) for the sheet adhesion test
10. Muffle furnace according to ISO 1762
11. Rapid-Köthen sheet former compliant with ISO 5269-2 (if another sheet-former is used, it has to be proved that this makes no difference to the method)
12. Standard disintegrator compliant with ISO 5263-1
13. Slotted plate (slot size 150 µm) for fine screening in Somerville-fractionator
14. Somerville-fractionator according to TAPPI/ANSI T275
15. Stopwatch/Timer Somerville-fractionator
16. Tensile testing device according ISO 1924-2
17. Thermometer
18. Desiccator
19. Vacuum filtration unit with 39 mm bottom inner diameter of the funnel
20. Büchner funnel (diameter 150 mm) (optional)
21. Cuvette rack for the COD determination (optional)
22. Glass bottle to store the filtrate (optional)
23. Image analysis system comprising (optional): Scanner (e.g. EPSON V-750 PRO) with minimal optical resolution of 2000 dpi
24. Software for analysing area and size distribution of adhesive particles (macrostickies), complaint with ISO 15360-2 (optional)
25. LED light panel for the photo documentation (optional)
26. Metal plates (pressure 0.95 kPa or 6 kg, 28 cm diameter) for the macrostickies analysis (optional)
27. Refrigerator to store the filtrate (optional)

6.2 Materials

1. Carrier board and cover sheets
2. Filter paper grade 388 diameter 125 mm (basis weight 84 g/m², filtration speed 10 s/10 ml, deposition range 12-15 µm)
3. Aluminium trays for the determination of the evaporation residue (optional)
4. Black water-based ink, e.g. Pelikan No. 4001 (optional)
5. Corundum powder (optional)
6. Deionised water (optional)
7. Filter paper grade 388 diameter 150 mm (basis weight 84 g/m², filtration speed 10 s/10 ml, deposition range 12-15 µm (optional)
8. Filter paper grade 1289 diameter 240 mm (basis weight 84 g/m², filtration speed 20 s/10 ml, deposition range 8-12 µm)
9. Silicon paper (60 g/m²) compliant with ISO 15 360 for the macrostickies determination (optional)

7. PREPARATION OF SAMPLES

The quantity of tested material or product must be sufficient to carry out all the measurements indicated by the method. An indicative quantity is 250 g air-dry weight. Perform a double determination of the dry matter content of the product or material in compliance with ISO 638-1.

If the material or product contains water strength agents (WSA) and has been produced less than 30 days before the test, it has to be stored for the remaining time needed to reach 30 days from the date of production. Alternatively, it can be artificially aged at (60 ± 1)°C for 72 hours. The accelerated ageing is needed to mimic the natural ageing of the material between production and recycling where, for example, a post-curing of wet strength agents may still happen. For materials and products without WSA, make sure the sample is at least 15 days old from the date of production, therefore no ageing is necessary.

Weigh one aliquot of air-dried material or product, corresponding approximately to (50 ± 1) g dry weight. If the product or material weighs more than 50 g, it is necessary to ensure that the test sample contains the same proportion of elements different from the base product or material (e.g. labels, seals, hotmelt application, metallisation, ink application, etc.). Any relevant information allowing a correct and proportional sampling must be present in the technical datasheet provided with the sample. The technical datasheet must contain the minimum information indicated in Chapter 9.

Cut the sample into pieces of 3 cm x 3 cm with a tolerance of 0.5 cm in each direction. Easily removable non-paper components posing a potential risk for the standard disintegrator can be removed during cutting.

This means that their weight should not be included in the 50 g oven-dried material for disintegration. Instead, they should be weighed separately to enable the calculation of the reject share relative to the total sample weight.

All sample quantities indicated hereinafter refer to the calculated ‘dry weight’ (i.e. matter dried in an oven at (105 ± 2)° C. For more information on the sample preparation, check the “detailed work description for sample preparation” in the Part III annexes.

8. PROCEDURE

8.1 Disintegration

This step should be carried out as described in Paper and Board – Recyclability Laboratory Test Method – Part I: Recycling mill with conventional process, Version 3.

Disintegrate (50 ± 1) g of the oven-dried sample using a disintegrator compliant with ISO 5263-1, diluting it with tap water at (40 ± 1)° C and a mildly alkaline pH (7-8). The total volume of sample and water must be approximately 2000 g, so that a stock concentration of 2.5 % is achieved. Ensure that there is no pre-wetting or soaking of the sample. The disintegration time is 10 minutes. (30,000 revolutions).

Further disintegration times are not yet included in Version 1 of the evaluation protocol, and should be considered as supplementary information only. For more detailed information about the disintegration, check the detailed work description in the Part III annexes.

8.2 Filtrate analysis (optional)

This step is optional in the Part III method and, if carried out, it should be done as described in Paper and Board – Recyclability Laboratory Test Method – Part I: Recycling mill with conventional process, Version 3.

Perform the filtration of the total stock immediately after the disintegration. Homogenise the total stock and pour a known amount of it (approximately 100 g) over a filter paper (diameter 150 mm) using the Büchner funnel (if possible, without wetting the filter paper previously). Return the filter cake to the total stock and use the filtrate to rinse the suction flask and then discard it.

Filter more 200 g of total stock, retrieve the filtrate from the suction flask and filter it again using the same paper filter. Return the filter cake to the total stock and save the filtrate at room temperature for the further procedures.

For more detailed information about the filtration, including photographs and instructions on how to produce a uniform filter cake, check the detailed work description in the Part III annexes.

8.2.1 Evaporation residue (optional)

After the filtration proceed to the determination of the evaporation residue. Pour a known amount (e.g. 70 g or a quantity that fits) of filtrate on a previously weighed aluminium tray and dry it in the oven at (105 ± 2) °C until reaching a constant mass in compliance with ISO 638-1. Repeat the procedure to have a double determination of the evaporation residue.
If necessary, store the remaining filtrate in the refrigerator at 4 °C for further analyses.
Determine the evaporation residue of the tap water used in the disintegration to be deducted from the evaporation residue of the filtrate.

The evaporation residue (ER) in (mg residue / g packaging) is calculated as follows:

$$ER\ filtrate\ (g\ residue/g\ filtrate) = \frac{m3\ (g) - m1(g)}{m2\ (g)}$$

$$ER\ sample\ (g\ residue/g\ filtrate) = ER\ filtrate\ (g/g) - ER\ tap\ water\ (g/g)$$

$$ER\ packaging\ (mg/g) = ER\ sample\ (g/g) * 1000\ (mg/g) * c\ (\ )$$

m1 = mass of the empty aluminium tray
m2 = mass of the filtrate that was taken in
m3 = mass of tray after drying
c = stock concentration after disintegration, expressed in decimals

8.3 Coarse screening for the determination of coarse rejects

This step should be carried out as described in Paper and Board – Recyclability Laboratory Test Method – Part I: Recycling mill with conventional process, Version 3.

This section entails the determination of the coarse reject from the total stock according to the TAPPI/ANSI T 275.

Proceed with the coarse screening using the Somerville-fractionator equipped with a perforated plate containing holes with 5 mm of diameter and set with a water flow of (8.6 ± 0.2) l/min. The required characteristics of the referred plate are set out in the annex documents.

Wait until the screening plate is covered by approximately 2.5 cm of water to pour in the total stock (including the filter cake mentioned in the filtrate analysis). Perform the coarse screening for 5 minutes, counting from the time when the sample starts to flow over the weir.

Collect the accept of the coarse screening in a specific container to be used for the subsequent procedures: determination of the ash content, stock concentration, sheet formation, fine-screening and macrostickies analysis (optional).

On completion of the test, proceed with the reject characterisation described below.

After the reject characterisation is completed, transfer any residue on the plate to a specific container and wash the plate with a sufficient amount of water to ensure it is completely clean, making sure that any fragments trapped in the body of the Somerville-fractionator and in the holes of the screening plate are also recovered and added to the reject.

Filter the reject over a paper filter (125 mm in diameter) previously calibrated in the oven at (105 ± 2) °C using a Büchner funnel. If the reject does not fit on the 125 mm filter paper, place it in a previously calibrated aluminium tray or a larger (240 mm) filter paper using the Rapid-Köthen sheet-former. Next step is to dry the reject in the oven at (105 ± 2) °C until reaching a constant mass according to ISO 638.

Calculate the dry weight of the coarse reject, net of the weight of the paper filter, and express the result as a percentage with respect to the dry weight of the starting sample. The results can be rounded to the first decimal place. Report any dry-removed components as part of the coarse reject.

For more details, including photo documentation of the coarse reject, check the detailed work description in the Part III annexes.

8.4 Reject characterisation (RC)

This section describes the procedure for the reject characterisation, which should be carried out after the coarse- and fine-screening steps are complete, i.e. while the rejects are still laying on the screening plates.

If there is no reject material on the screening plate(s), tick the box 'reject absent' and the characterisation process is concluded. If reject material can be observed on the plate, check to which category it belongs (cellulose fibres and flakes, polymer barrier coating, adhesives, metallised film, metal and aluminium, mixed and others). Then, if applicable, also check the degree of disintegration of cellulose fibres and flakes (not disintegrated and partly disintegrated material) and the degree of fragmentation of non-cellulose-based rejects (unfragmented, partly fragmented, and completely fragmented). Tick the boxes in the decision tree according to what can be observed. Further observations can be noted in the 'additional comments' section.

Photograph the residues with special attention on the different 'reject categories' observed, especially the coarse reject characteristics needed to assess its quality levels, notably:

Level 1: Loose fibres and flakes easy to wash away; encapsulated fibres in sealed seams are allowed.
Level 2: Single fibre layers and flakes attached to polymers (such as barrier coatings, metal films, and others).
Level 3: Sample material only partly disintegrated; significant amount of fibres and flakes still attached to polymers (such as barrier coatings, metal films, and others).
Level 4: Sample material not disintegrated.

Observations: The category mix should only be selected if there are fibres and/or flakes combined with polymer barriers, metallised films, metal/aluminium, and/or others. The field significant (S) refers to the reject amount and it is optional, but important to assess the coarse reject quality levels.

For visual examples of the reject characterisation and coarse reject quality levels check the Part III annexes.

8.5 Determination of the stock concentration after the coarse screening

This step should be carried out as described in Paper and Board – Recyclability Laboratory Test Method – Part I: Recycling mill with conventional process, Version 3.
This section entails the determination of the stock concentration according to ISO 4119 (stock concentration between 0.05 % and 0.3 %).

Homogenise the accepted fraction of the coarse screening and transfer a known amount of it (approximately 1000 ml) to the tared beaker.

Filter 1000 ml of the accept over the 125-150 mm diameter filter paper previously calibrated in the oven at (105 ± 2) °C using the Büchner funnel. Place the filter paper between two cover sheets and dry each side of it in the sheet former for 7 minutes at (93 ± 4) °C. Let the filter paper cool down in the desiccator before weighing it. Determine the dry mass of the filter cake as follows:

$$c\,(\%) = \frac{m_{3\,(g)} - m_{2\,(g)}}{m_{1\,(g)}}\, x\ 100$$

m_1 = mass of sample input
m_2 = mass of filter paper without sample
m_3 = mass of filter paper with sample after drying

The stock concentration calculated above is used for the further test steps (determination of ash content and fine-screening). However, after the test method is completed, check if the stock concentration was correct by drying the filter paper used for it in the oven at (105 ± 2) °C overnight and checking the dry mass content again. If the stock

concentration has changed after the second drying, the input for the fine-screening should be corrected in the laboratory report template (excel file).

8.6 Determination of the ash content

Drain 3.5 g oven-dried accept from the coarse screening (AC accept) on a pre-weighted filter (240 mm, used for the macrostickies analysis) using the Rapid-Köthen sheet former for the ash content (ASH) determination. Perform a double determination by repeating the process. Fold the filter papers and dry them in the oven at 105 °C overnight. Use the filter papers and filter cakes to determine the ash content at 525 °C, according to ISO 1762 in [%]

If there is available data for ash content and the tensile index obtained after 20 minutes of disintegration, this can be used in the evaluation protocol. There is no need to repeat the tests after the 10-minute disintegration step.

8.7 Sheet formation with the accept from coarse screening

This step should be carried out as described in Paper and Board – Recyclability Laboratory Test Method – Part I: Recycling mill with conventional process, Version 3.

After homogenising the accepted fraction, take a sufficient amount of pulp to form two lab sheets with (60 ± 2) g/m², corresponding to approximately 1.8 g in dry weight for each sheet. If the target weight of (60 ± 2) g/m² is not reached, adjust the amount of pulp required for sheet formation.

For performing the sheet adhesion test, place the lab sheet between a carrier board (bottom side) and a cover sheet (top side) and pre-dry them in the dryer of the sheet former for 7 minutes at (93 ± 4) °C. Keeping the carrier board and cover sheet in place, the next step is to dry them in the oven at (130 ± 2) °C between two preheated brass plates (pressure of 1.18 kPa or 3.7 kg) for 2 minutes. Lastly, cool them in the desiccator for approximately 10 minutes.

Perform the sheet adhesion test immediately after taking the handsheets out of the desiccator separating the carrier board first and then the cover sheet with a fluent motion from lab sheet itself. The separation of the carrier board and cover sheet should not take longer than 1-3 seconds each.

8.8 Assessment of sheet adhesion and visual impurities

This step should be carried out as described in Paper and Board –Recyclability Laboratory Test Method – Part I: Recycling mill with conventional process, Version 3.

To assess the sheet adhesion test, check for any damage or breakages in the sheets using a bright oblique light, according to the following levels:

Level 1: Tackiness absent – The lab sheet can be separated completely from the carrier board and cover sheet without any damage or breakings. A few single fibre pickups can be present on the carrier board and cover sheet. Visible damage to the lab sheets and fragments of paper on the carrier board and cover sheet are not permitted.

Level 2: Tackiness partly present – The lab sheet can be separated completely from the carrier board and cover sheet. Fibre tears and particles occur on the carrier board, the cover sheet and the lab sheet itself.

Level 3: Tackiness present – The lab sheet cannot be separated from its carrier board and the cover sheet without visible damage to the lab sheet itself; breaks or holes of > 1mm (in two dimensions) occur.

Ensure that the rating is an average of all sheet adhesion tests carried out. The rating should comply with the overall impression of the sheet adhesion test. In case of a single hole, e.g. despite the absence of fibre tears. A single occurrence of a defect can be neglected.

Pictures of the sheet adhesion levels, as well as a video showing the performance of the sheet adhesion test can be consulted in the Part III annexes.

Assess the visual impurities by inspecting the lab sheets for the presence of impurities. This inspection should be conducted visually with and without a source of transmitted light. Based on the observations, assign the appropriate rating given by the visual impurities decision tree.
The visual impurities decision tree can be consulted in the Part III annexes

8.9 Fine-screening for the determination of fine rejects

This step should be carried out as described in Paper and Board – Recyclability Laboratory Test Method – Part I: Recycling mill with Conventional process, Version 3.

This section entails the determination of the fine reject present in the accept after the coarse screening.

Proceed with the fine-screening using the Somerville-fractionator equipped with a plate containing 0.15 mm width slots and set to a water flow of (8.6 ± 0.2) l/min.

Homogenise the accept from the coarse screening and take an aliquot of 20 g oven-dry for the fine-screening. Wait until the screening plate is covered by approximately

2.5 cm of water before pouring in the 20 g oven-dried accept. The pouring time should not be longer than 4 minutes. Perform the fine-screening for 20 minutes, starting the stopwatch only after the sample begins to flow over the weir. During the screening, collect at least the first 50 l of the sorted material to be used for assessing the second adhesive test and any subsequent visual impurities.

On completion of the test, proceed with the reject characterisation described above. After the reject characterisation is completed, transfer all the reject remaining on the plate to a specific container and wash the plate with a sufficient amount of water to ensure it is completely clean, making sure that any fragments trapped in the slots are also recovered and added to the reject.

Filter the reject over a 125-150 mm filter paper previously calibrated in the oven at (105 ± 2) °C using a Büchner funnel, and then place the paper between two cover sheets and dry it in the oven at (105 ± 2) °C, until reaching a constant mass according to ISO 638.

Calculate the dry weight of the fine reject minus the paper filter, and express the result as a percentage with respect to the dry weight of the accepted pulp aliquot used for the test. The results can be rounded to the first decimal place.

The use of a thickener is not acceptable in the current version of this method because its influence on the tensile index still needs to be investigated.

For more details, including instructions on how to photograph the fine reject, check the detailed work description in the Part III annexes.

8.10 Sheet formation with the accept from fine screening

After homogenising the accepted fraction, take a sufficient amount of pulp to form two (60 ± 2) g/m² lab sheets corresponding to approximately 1.8 g dry weight for each sheet. If the target weight (60 ± 2) g/m² is not reached, adjust the amount of pulp required for sheet formation. These sheets will be used for the sheet adhesion test.

To perform the sheet adhesion test, place the lab sheet between a carrier board (bottom side) and a cover sheet (top side) and pre-dry it in the sheet former for 7 minutes (93 ± 4) °C. Put the sample, including top and bottom layers, between two preheated brass plates (pressure of 1.18 kPa or 3.7 kg) and place in the oven for 2 minutes at (130 ± 2) °C. Finally, cool them in the desiccator for approximately 10 minutes.

Perform the sheet adhesion test immediately after taking the handsheets out of the desiccator by separating the carrier board first and then the cover sheet with a fluent motion from lab sheet itself. The separation of the carrier board and cover sheet should not take longer than 1-3 sec each.

The assessment of sheet adhesion and visual impurities should be carried as described in section 8.8 of this document.

Four additional (80 ± 2) g/m² lab sheets – corresponding to around 2.5 g in dry weight for each sheet – are needed to determine the tensile index (see 8.11). These sheets must be formed climate conditioned according to ISO 187 and must not be touched with bare hands. If the accept material is not sufficient for producing all extra sheets, another disintegration step is needed. If needed, this second disintegration step can be done within 20 minutes.

More information on further disintegration times can be found in the detailed work description in the Part III annexes.

8.11 Determination of the tensile index

The lab sheets must be conditioned according to ISO 187. Determine the grammage – (80 ± 2) g/m² according to ISO 536 – to be able to calculate the tensile index [Nm/g], which is obtained by dividing the mean tensile strength [N/m] by the grammage [g/m²]. Next, determine the tensile strength according to EN ISO 1924-2, by cutting at least 10 representative test pieces from the lab sheets to the correct dimensions.

8.12 Calculation of (theoretical) recyclable rejects

The theoretical recyclable rejects (RR) are calculated based on polyAl composition given in the Part III datasheet:

$$RR = 100\% - share\ of\ all\ repulpable\ sample\ parts^{*}$$

**(related to the total sample unit weight)*

This calculation is only possible if the detailed composition of the sample material is provided in the datasheet.

An example calculation of the RR is given in the laboratory report template for the method Part III.

8.13 Macrostickies analysis (optional)

This step is optional in the Part III methodology, but if carried out it should be done as described in Paper and Board – Recyclability Laboratory Test Method – Part I: Recycling mill with conventional process, Version 3.

8.14 Further disintegration times (optional)

The 10-minute disintegration time is the only validated

(scored) in Version 1 of the Recyclability Evaluation Protocol published by 4evergreen in January 2025. However, it is expected that the disintegration behaviour curve approach (k-factor) will be implemented in future releases, which means that further disintegration times can be integrated into the protocols. For more details on how to perform the test with further disintegration times, check the detailed work description in the Part III annexes.

8.15 Overview of parameters

Parameter	Pulp	Specimen	Method
Coarse rejects	--	Reject of coarse-screening	Paper and Board – Recyclability Laboratory Test Method – Part I: Recycling mill with conventional process
Fine rejects	--	Reject of fine-screening	
Total screening reject	--	Reject of coarse- and fine screening (correction factor α applied on fine reject)	
Total screening yield		100 % minus total screening reject	
Sheet adhesion	Accept of coarse- and fine- screening	RK sheet 60 g/m²	
Visual impurities	Accept of coarse- and fine- screening	RK sheet 60 g/m²	
Coarse reject quality	--	Reject of coarse screening	Paper and Board – Recyclability Laboratory Test Method – Part III: Recycling mill with specialised process
Ash content	Accept of coarse screening	Filter cake	
Tensile index	Accept of fine-screening	RK sheet 80 g/m²	
(Theoretical) recyclable rejects	--	--	

Table 1: Measured parameters

9. TEST REPORT

The test report must include at least the following information:

1) Reference to this test method
2) Date and place of the test
3) Any photographic documentation of the material or product
4) Reference of the tested sample (product name or number), reference to the technical datasheet, production date of sample
5) A summary of the main information included on the sample datasheet (grammage, materials and shares for multilayer materials, adhesives, sealing, printing, metallisation, accessory components or other specific features useful to identify the sample)
6) Specific sample preparation, if any (e.g. emptying, removal of manually separable accessories intended to be removed before disposal)
7) Share and type of non-paper constituents (screenable or not)
8) Number and type of adhesive applications
9) Finished product or intermediate (component/ constituent)
   - > Semi-finished: Sheets of packaging material/ substrate (paper, cardboard, solid board, corrugated board)
   - > Semi-finished: Sheets of packaging material/ substrate with 'upgrading' (polymer/metal coating, print, varnish)
   - > Finished product: Intermediate, not yet ready to be used
   - > Finished product: Ready to be used
   - > Finished product: Used
10) The results of the test expressed in compliance with the established criteria:
    - > Coarse-screening reject, expressed as a percentage
    - > Coarse-screening reject characterisation
    - > Coarse reject quality levels, expressed as levels
    - > Assessment of the sheet adhesion and visual impurities of the coarse-screening accept, expressed as levels
    - > Fine-screening reject expressed as a percentage
    - > Fine-screening reject characterisation
    - > Ash content of the coarse-screening accept according to ISO 1762
    - > Tensile index of the fine-screening accept according to ISO 1924-2
11) Remark in case the ash content and/or the tensile index were determined after 20 minutes of disintegration time
12) Theoretical recyclable rejects, if applicable
13) Compliance of polyAl (fully or conditionally) with 4evegreen design for recycling guidelines, if applicable
14) The exact designation of the laboratory testing equipment used
15) Any specific comments, such as specific observations, e.g. changes in stock concentration after pulping, long drainage time during sheet formation, foam formation
16) Further photographic documentation regarding the results

In the event that it is not possible to perform all steps of the test method in accordance with this standard or it is not possible to determine one or more measurement parameters due to the nature and/or characteristics of the sample material or product, the circumstances must be reported by the laboratory in the test report.

Examples:

Pulping resistance prevents the pulper from working or there is a risk of damage to the equipment.
The presence of dense flakes or foams prevents the transfer of the accept to the next stage.

ABOUT 4EVERGREEN

4evergreen is a cross-industry alliance perfecting the circularity of fibre-based packaging to contribute to a climate-neutral and sustainable society. Our goal is to raise the overall recycling rate of fibre-based packaging to 90% by 2030. We bring a particular focus on packaging with a lower circularity performance today, namely the types used for household, out-of-home and on-the-go consumption.

The alliance brings together industry representatives from across the fibre-based packaging value-chain, from pulp, paper and board manufacturers and recyclers to packaging producers and converters, including brand owners, retailers and waste management companies. It also comprises non-fibre material suppliers (e.g., adhesives, inks, coatings), technology providers (e.g., machinery, collection, and recycling solutions), and leading research institutes.

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For general enquiries please contact 4evergreen@cepi.org