

ANNEX DOCUMENTS PART II – PAPER MILL WITH FLOTATION- DEINKING RECYCLING PROCESS

APRIL 2025 - UPDATED EDITION (JUNE 2026)
TO ALIGN TERMINOLOGY WITH PPWR



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1. ANNEX PART II METHOD FLOWCHART

VERSION 1, JANUARY 2025 - UPDATED EDITION (JUNE 2026)



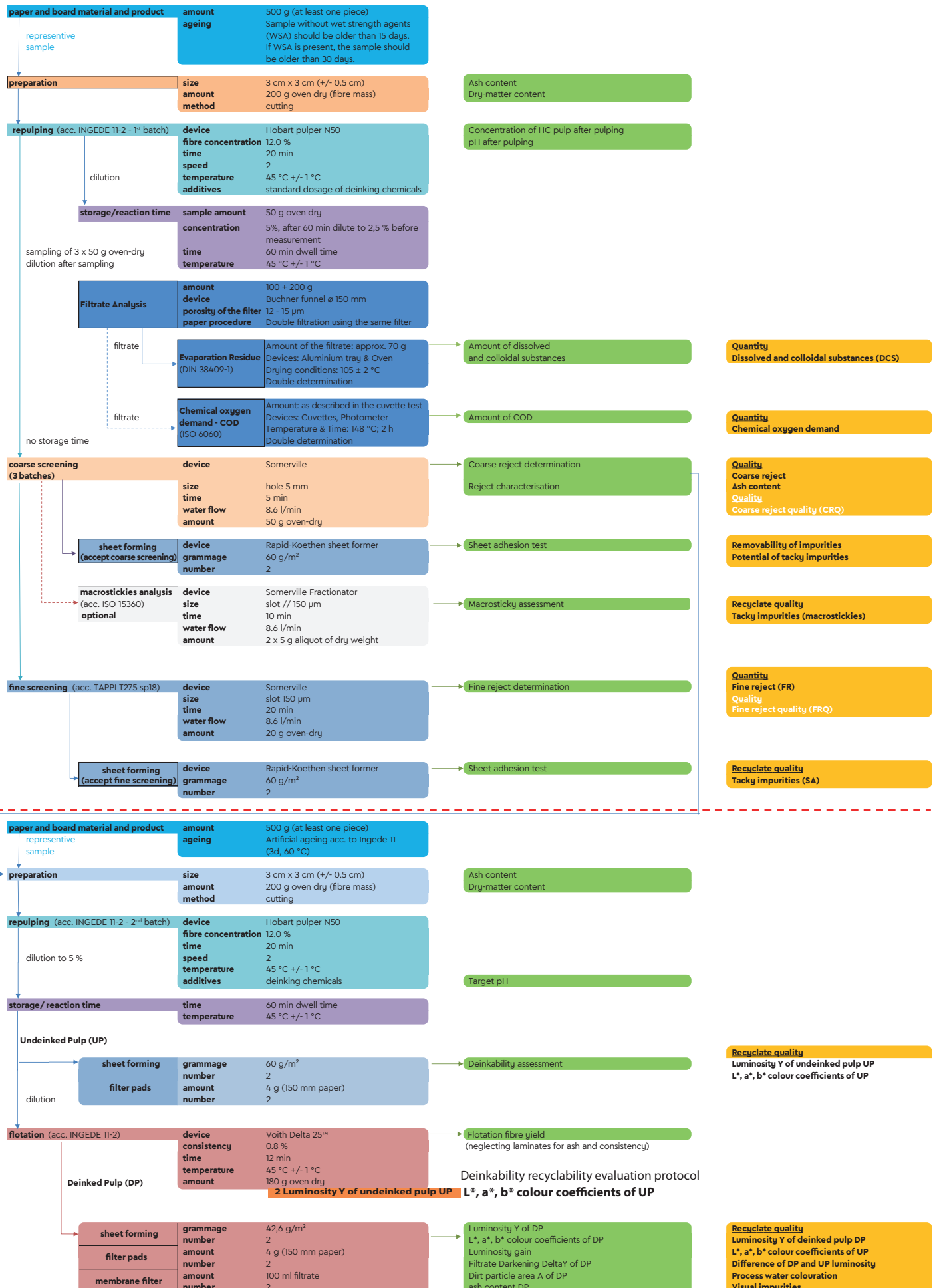
Recyclability laboratory test method – Part II

Paper mill with flotation-deinking recycling process

Version 1 (Jan 2025) - updated edition (June 2026)

Measurement

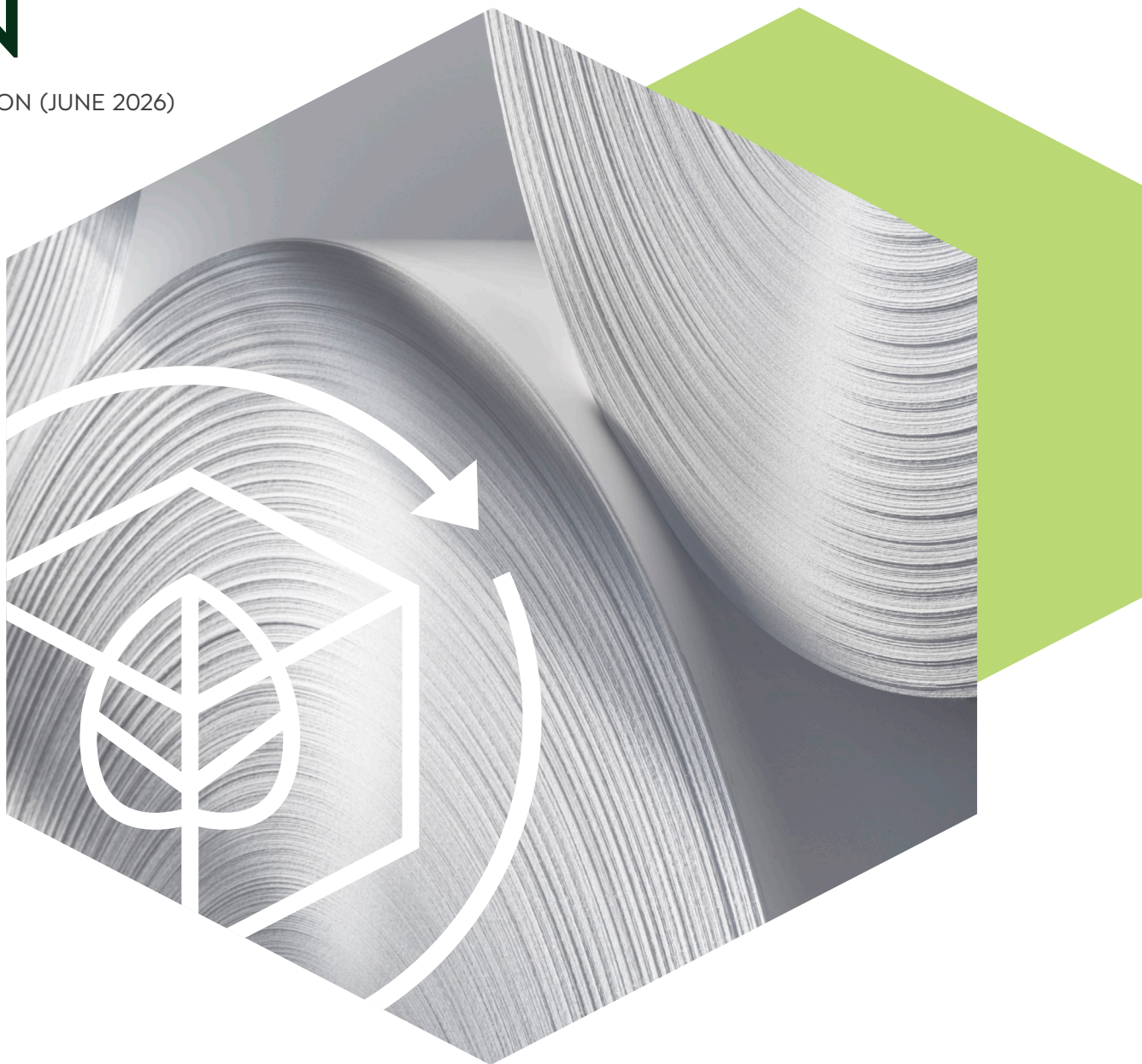
Parameter for recyclability evaluation protocol



2. ANNEX SHEET ADHESION

VERSION JANUARY 2025 - UPDATED EDITION (JUNE 2026)

This Annex is relevant for Part I,
Part II and Part III



Annex sheet adhesion

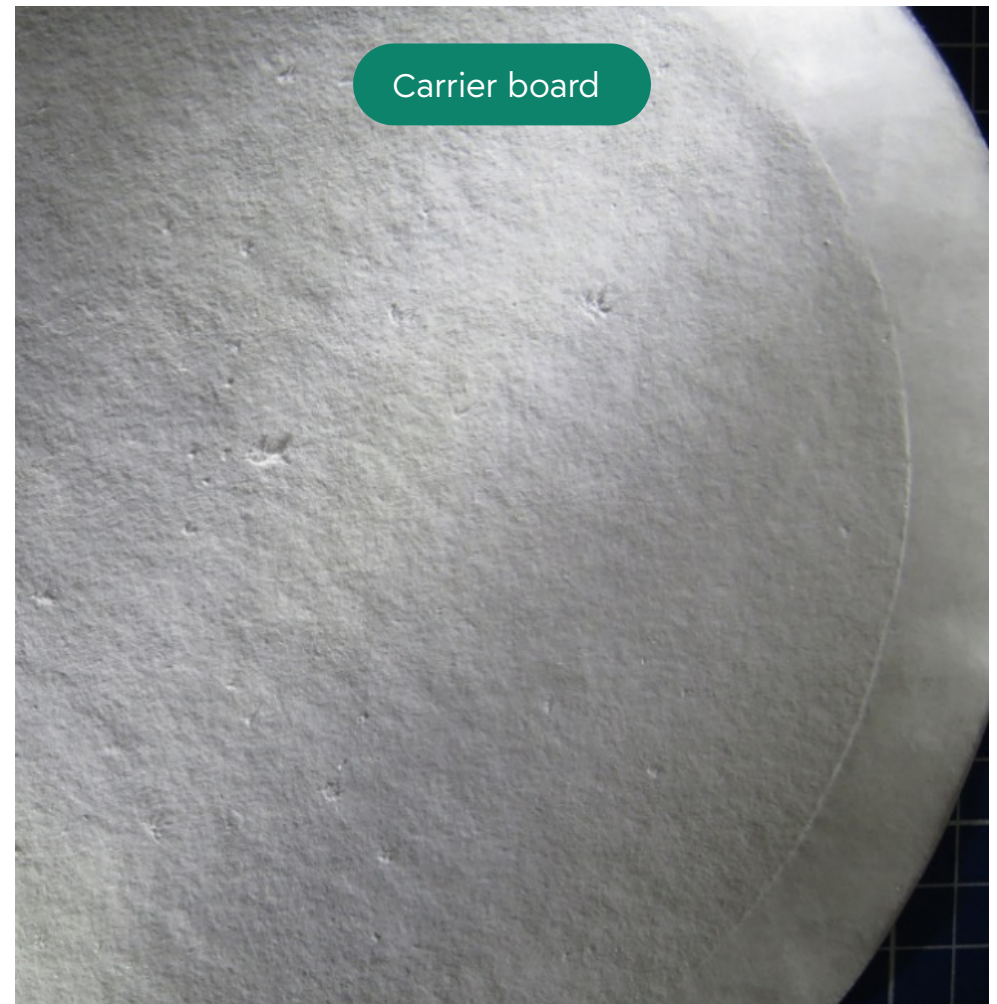
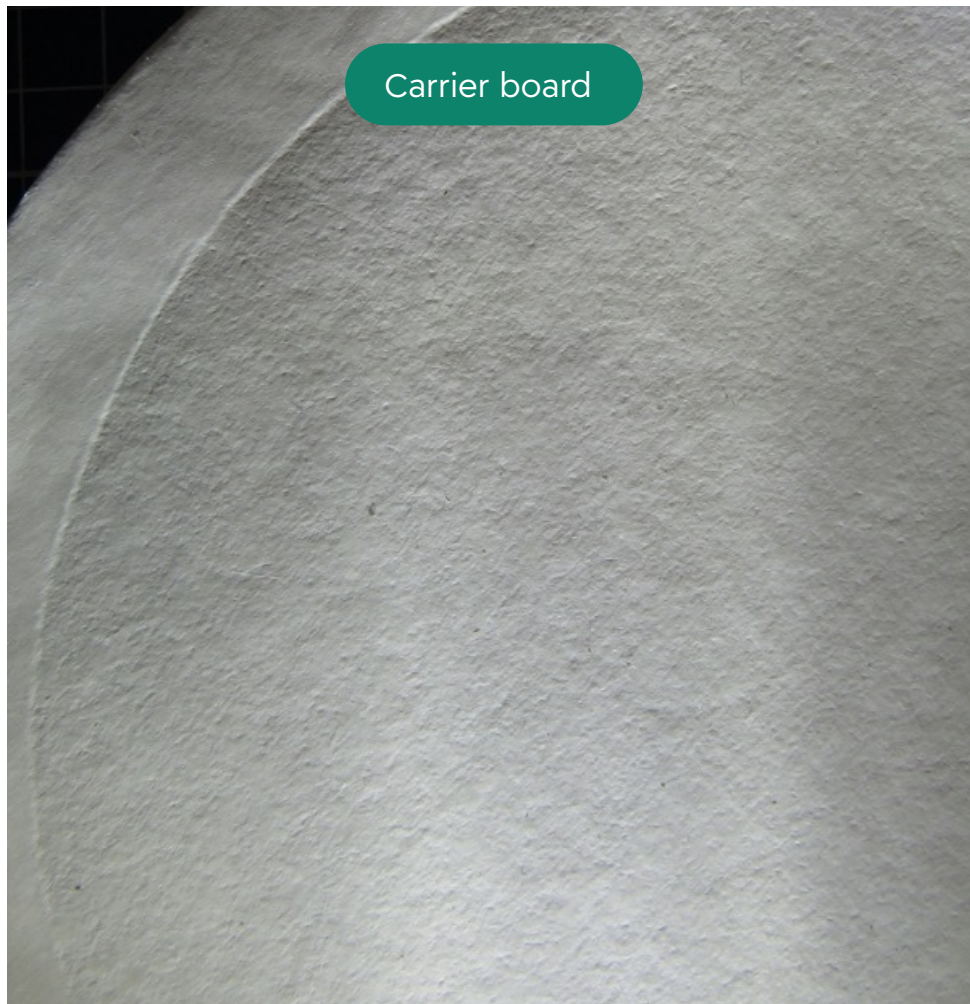
1 Performance video of the sheet adhesion test



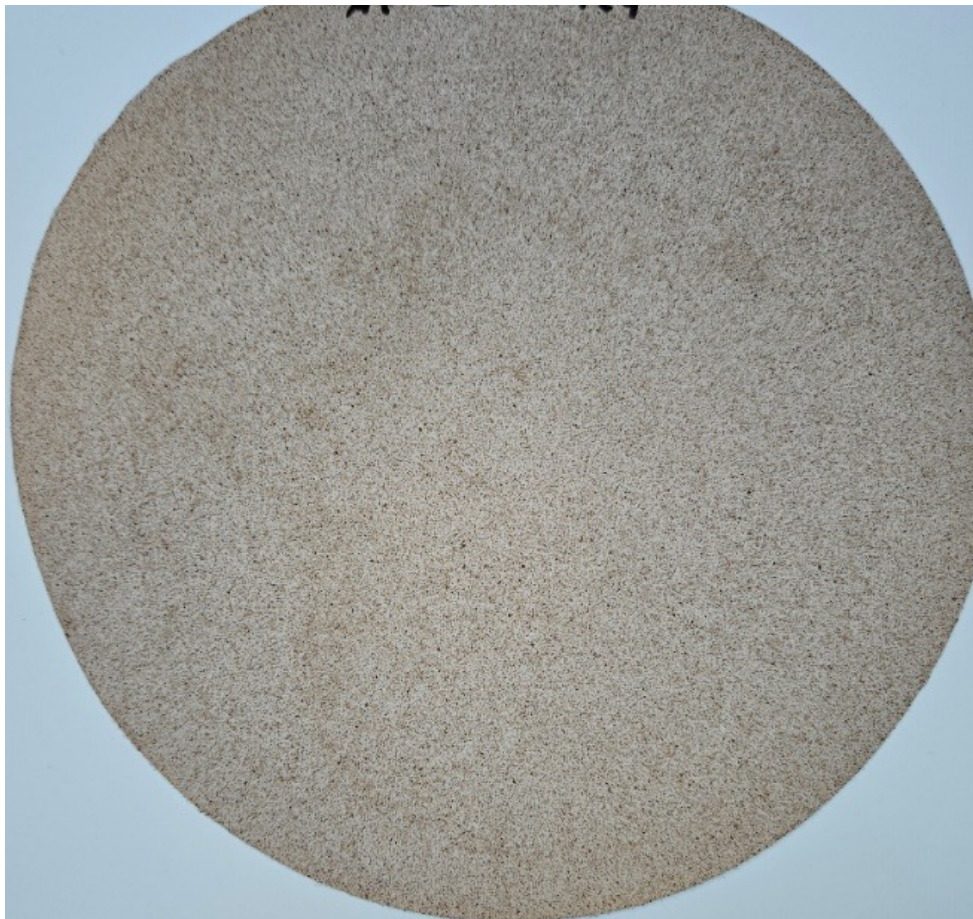
<https://youtu.be/c3n76YMfnkU>

2 Reference pictures for the sheet adhesion levels

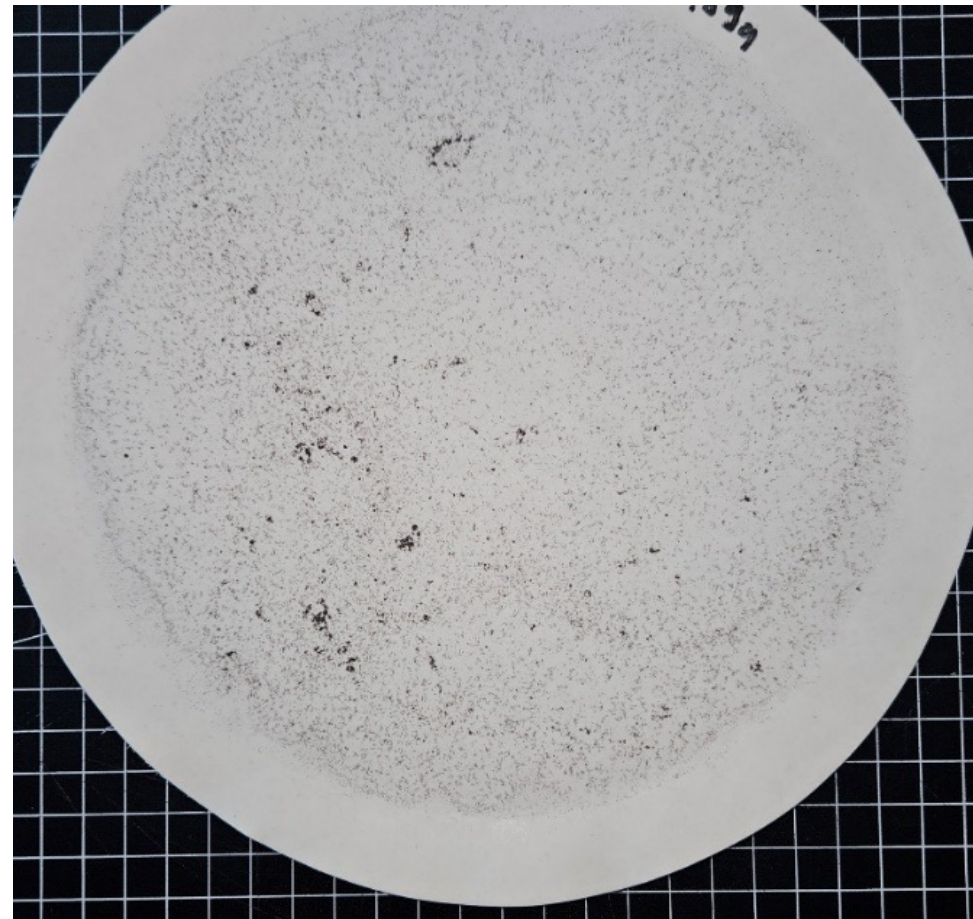
Level 1 Tackiness absent: the handsheet can be separated completely from the carrier board and cover sheet without any damage or breakages. A few single fibre pickups can be present on the carrier board and cover sheet. Visible damage to the handsheets and fragments of paper on the carrier board and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



Examples of attached particles, such as ink or varnish, not leading to tackiness and therefore not affecting the sheet adhesion test

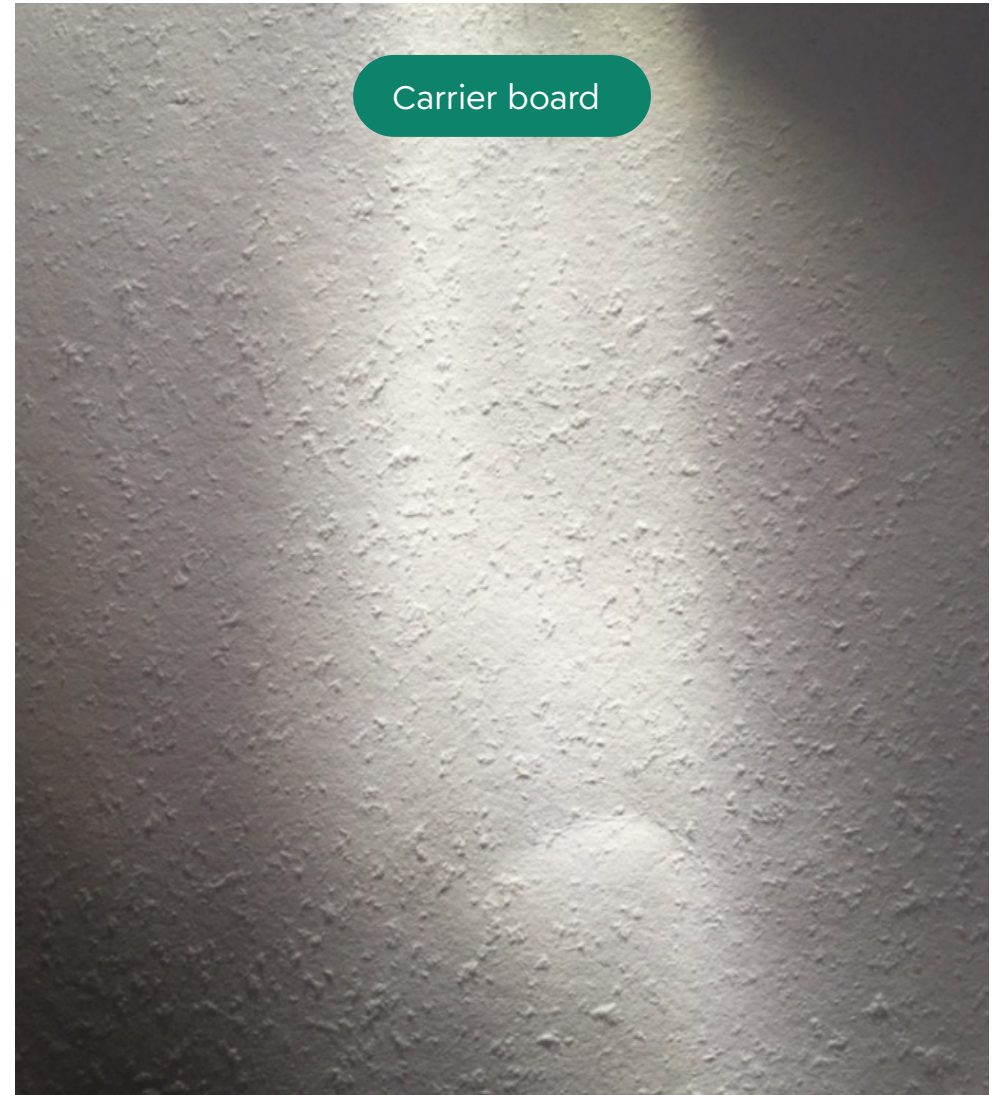
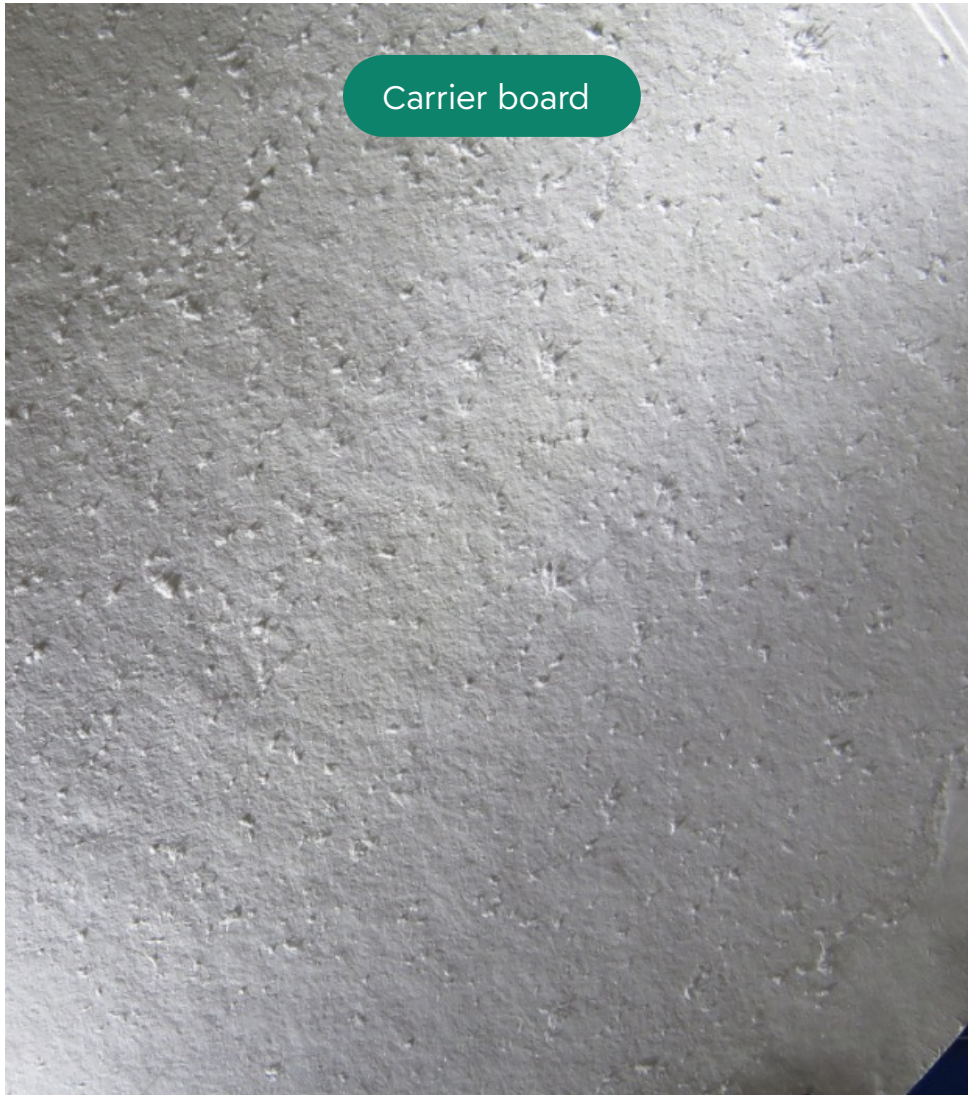


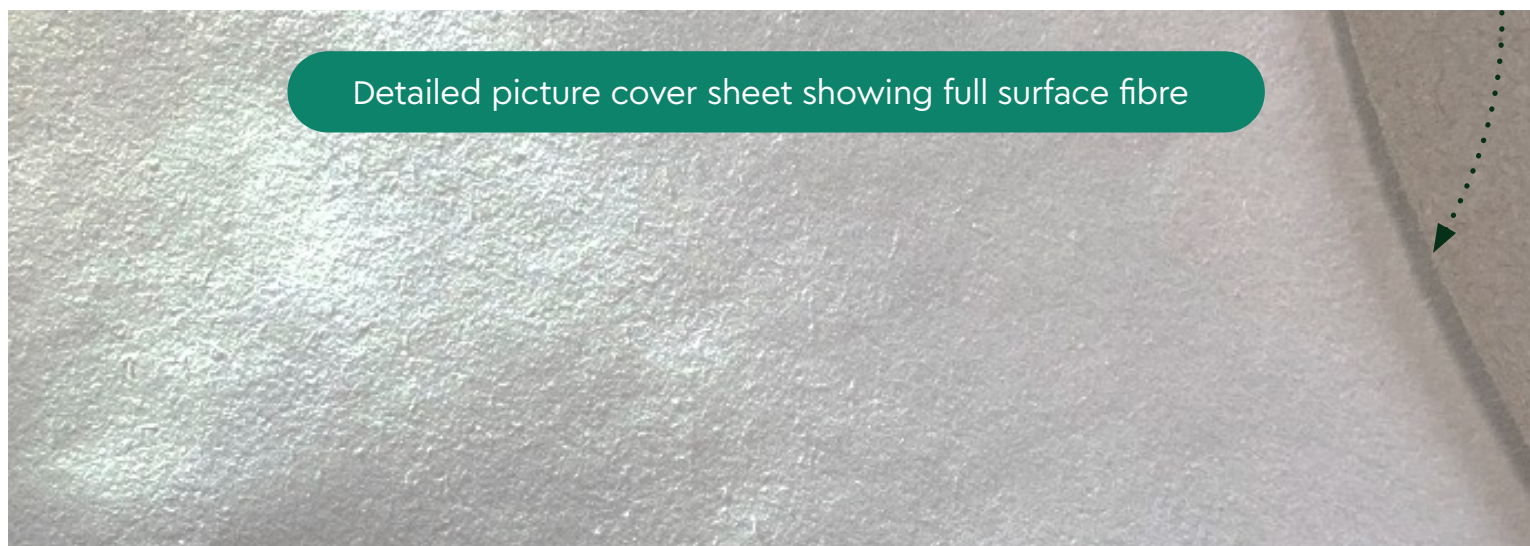
Handsheet on transmitted light with ink and varnish particles.



Carrier board from sheet adhesion test without tear-outs. Ink and varnish particles are attached to the carrier board but don't affect the sheet adhesion test rating.

Level 2 Tackiness partly present: the handsheet 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 handsheet itself.

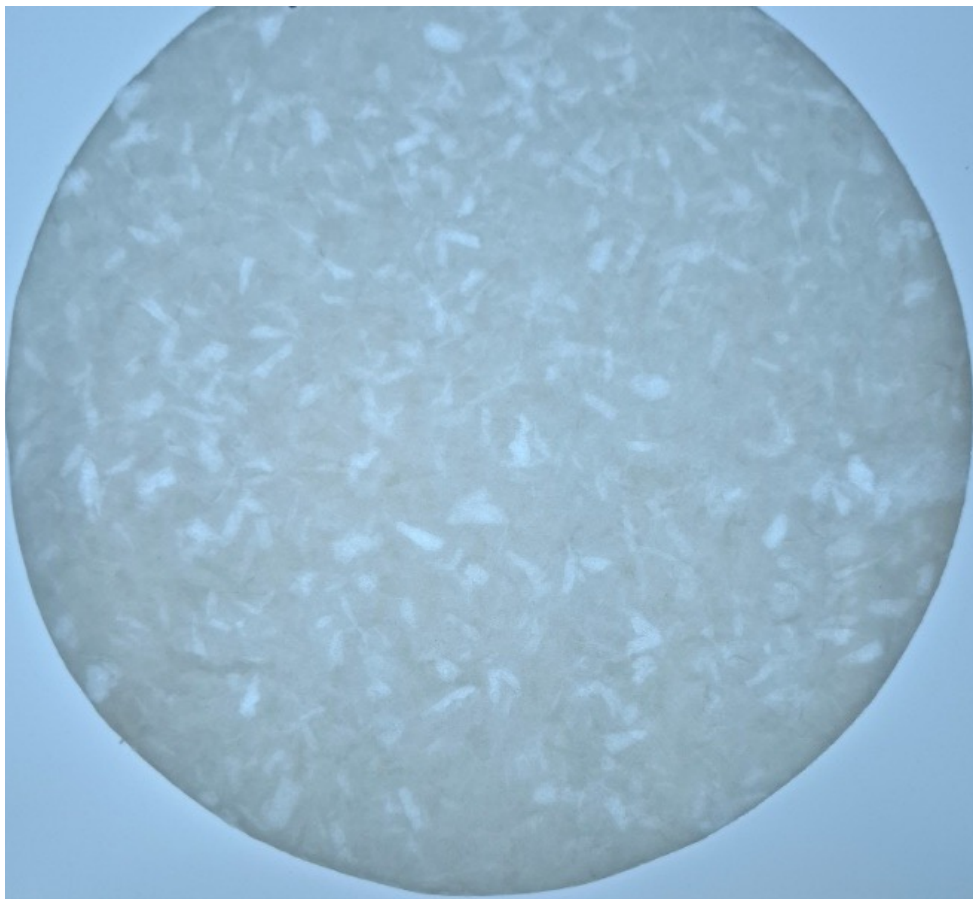




Further examples of carrier boards with Level 2



Further examples of carrier boards with Level 2



Handsheet on transmitted light.



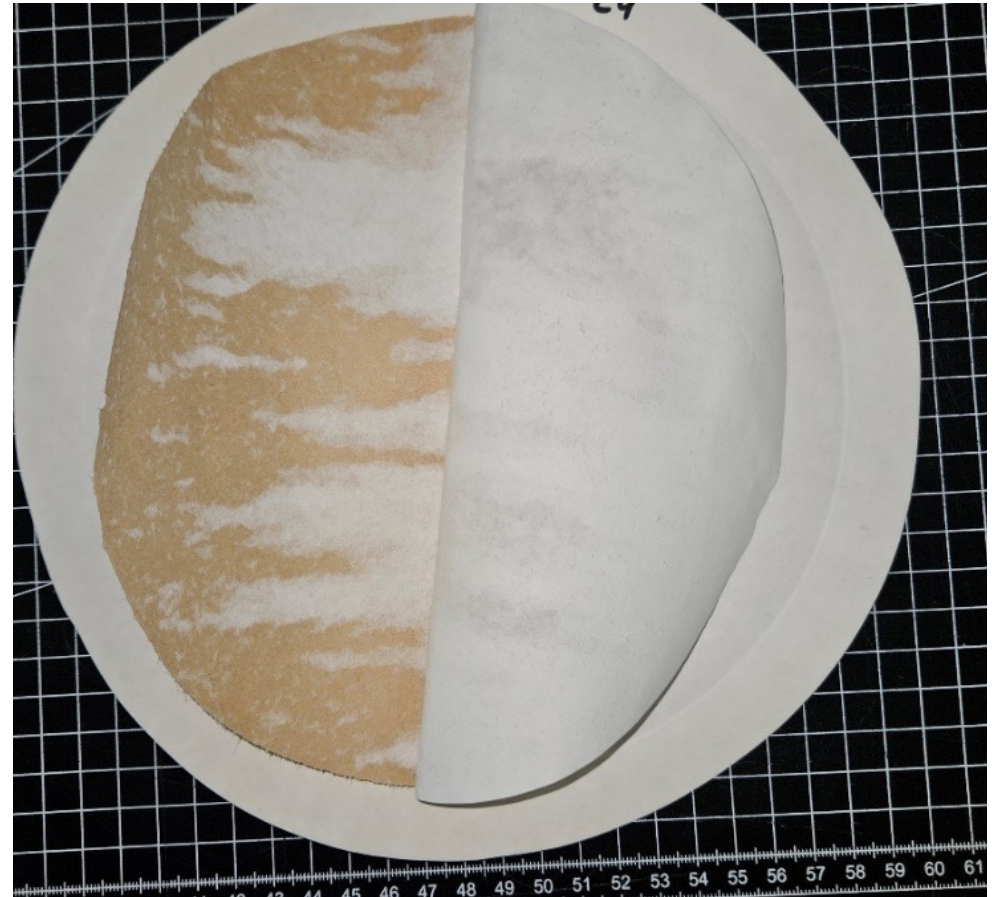
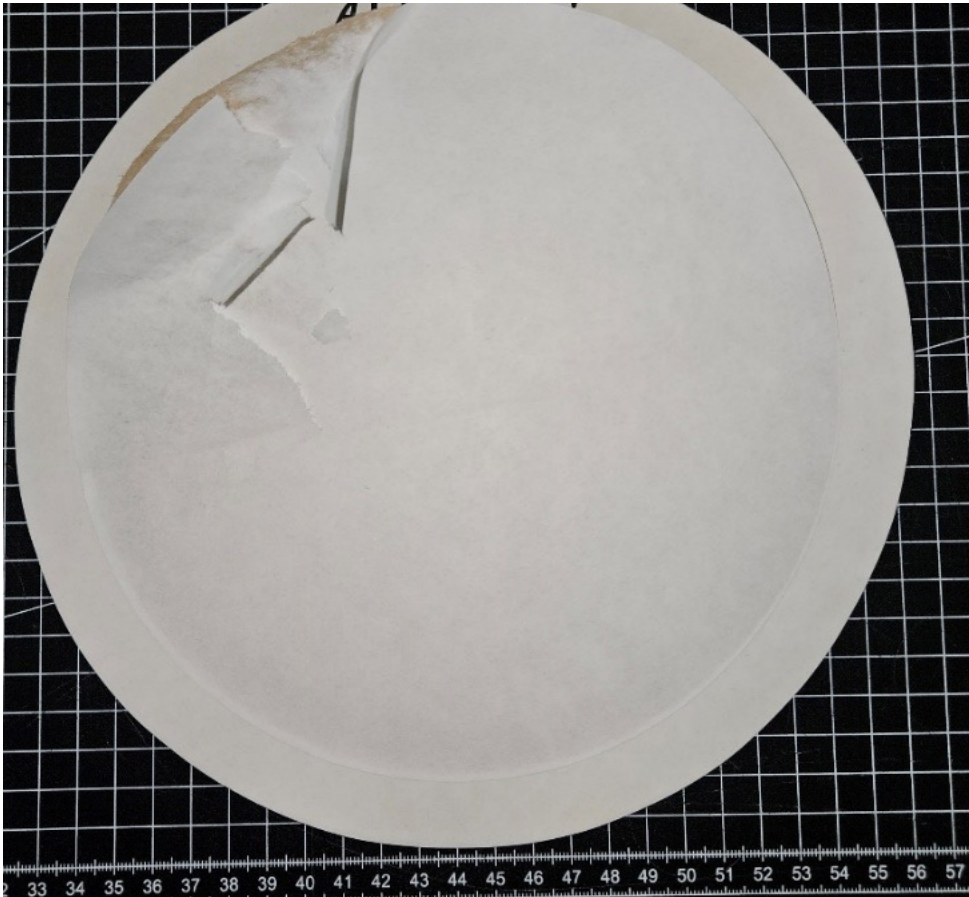
Carrier board from sheet adhesion test with tear-outs over a large area (where polymer particles in the handsheet are observed). Still no breaking of the handsheet is observed.

Level 3 Tackiness present: the handsheet cannot be separated from its carrier board and the cover sheet without visible damage to the handsheet itself. A breaking of the handsheet or holes ($> 1\text{mm}$ [in two dimensions]) occur.



The rating must reflect all sheet adhesion tests conducted, and provide an accurate representation of overall performance. A single occurrence of a defect may be disregarded if it is limited to an isolated hole and does not exhibit any fibre tears.

Further examples of sheet adhesion Level 3

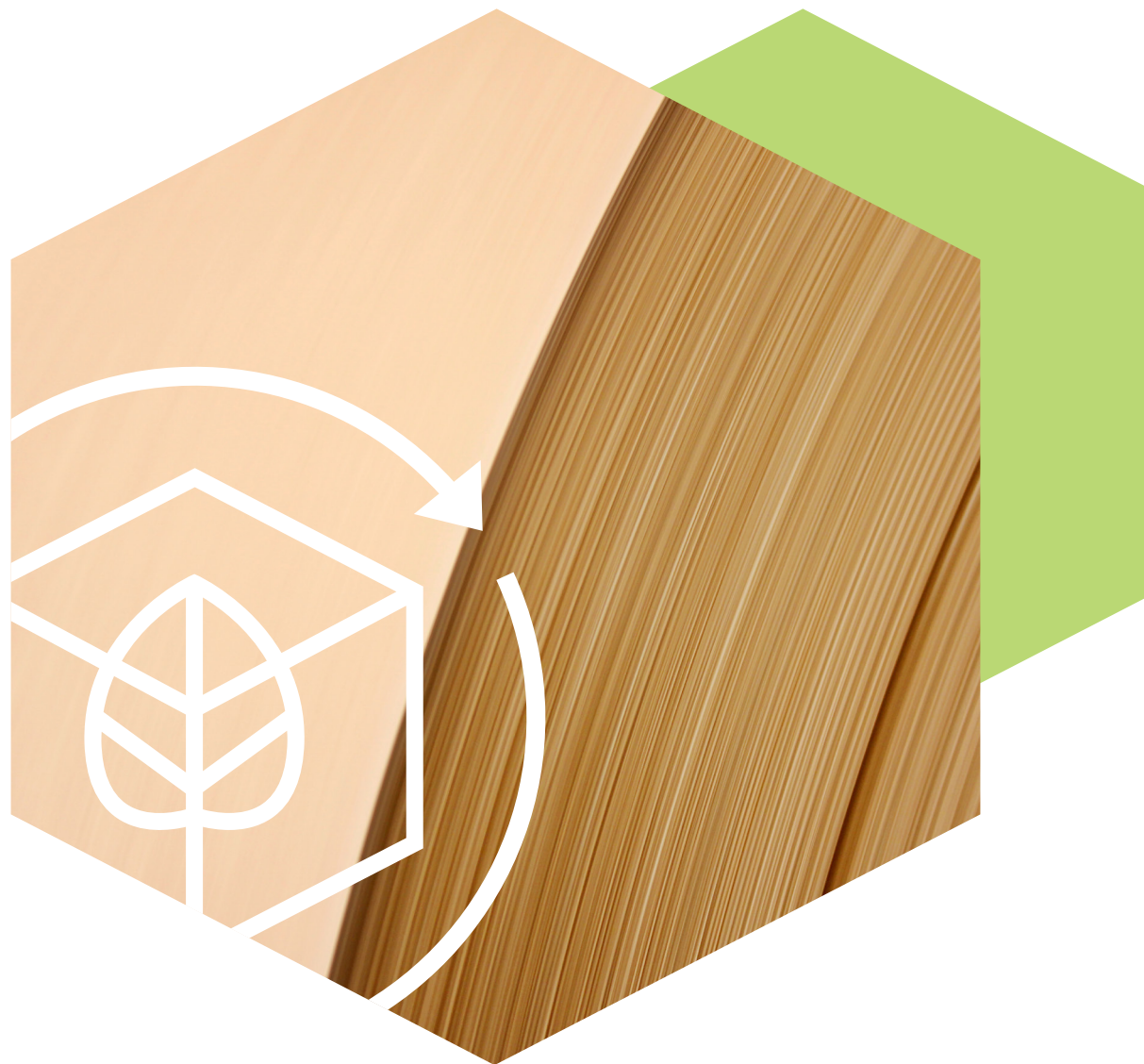


The rating must reflect all sheet adhesion tests conducted, and provide an accurate representation of overall performance. A single occurrence of a defect may be disregarded if it is limited to an isolated hole and does not exhibit any fibre tears.

3. ANNEX REJECT CHARACTERISATION

VERSION JUNE 2026

This Annex is relevant for Part I,
Part II and Part III



Reject characterisation

User guide and purpose

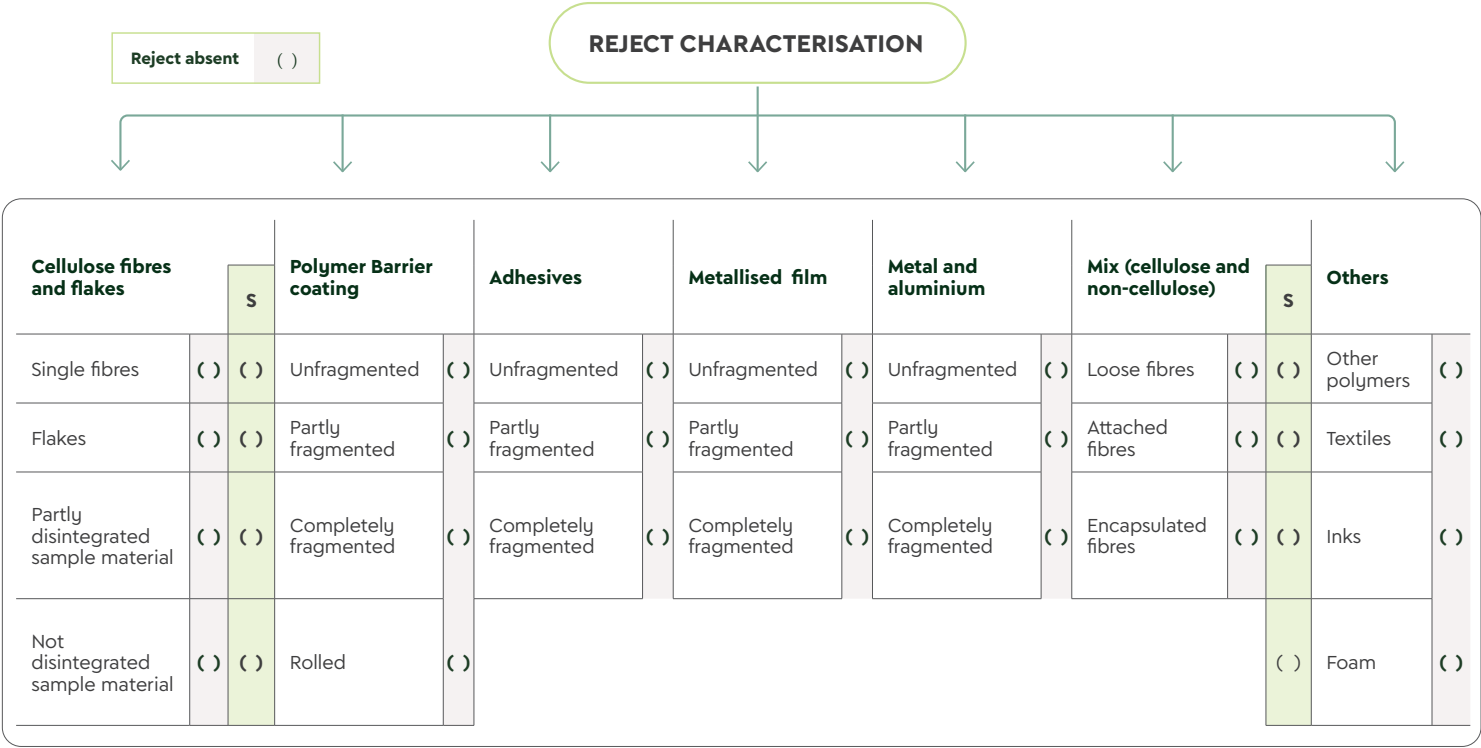
- > The Reject characterisation tree must be filled for the coarse and fine rejects (separately) in Part I, II and III. This should be done while the rejects are still on the screening plates, before drying, so that the different reject components can be better visualised.
- > The reject characterisation supports decisions on:
 - Part I: Characterisation of coarse and fine reject is needed for assessing “significant amount of fibres” (20 min disintegration option)
 - Part III: Characterisation of the coarse reject is needed for assessing the coarse reject quality CRQ levels.
- > The reject characterisation does not directly impact the calculation of score points in the recyclability evaluation protocol.



Remark: It is planned to incorporate more example pictures in the future versions of this annex.

Reject characterisation tree - Version June 2026

Disintegration	Not disintegrated material Fibrous based pieces with original cut size and /or encapsulated fibres	Partly disintegrated material Fibrous based pieces with sharp edges, smaller than original cut size, not broken down into flakes	
Fragmentation	Unfragmented Original cut size pieces	Partly fragmented Medium pieces (size > 1 cm in one dimension), sharp edges	Completely fragmented Granular pieces (size ≤ 1 cm in one dimension), no sharp edges.
Amount (optional)	Significant (S) Extensive quantity, relevant in Part I and III	Field S is optional, but crucial for decisions on 20 min disintegration (Part I) and coarse reject quality levels (Part III)	



Additional comments:

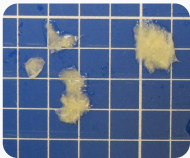
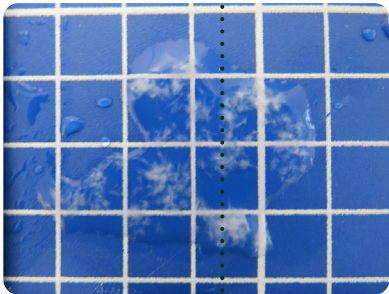
Reject characterisation examples

Disintegration	Partly disintegrated material Fibrous based pieces with sharp edges, smaller than original cut size, not broken down into flakes	Not disintegrated material Fibrous based pieces with original cut size and /or encapsulated fibres
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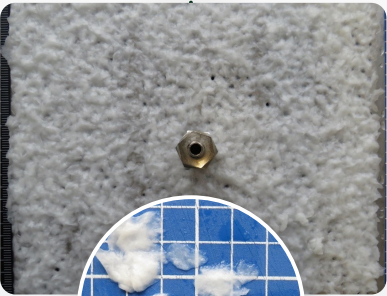
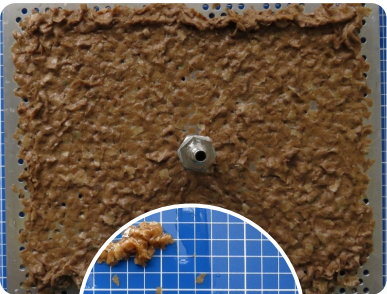
Cellulose fibres and flakes		S
Single fibres	()	()
Flakes	()	()
Partly disintegrated sample material	()	()
Not disintegrated sample material	()	()

Amount (optional)	Significant (S)
	Extensive quantity, relevant in Part I and III
Field S is optional, but crucial for decisions on 20 min disintegration (Part I) and coarse reject quality levels (Part III)	

Single fibres



Flakes



Partly disintegrated



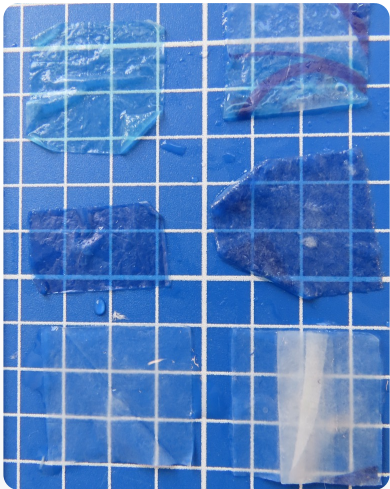
Not disintegrated/ original size



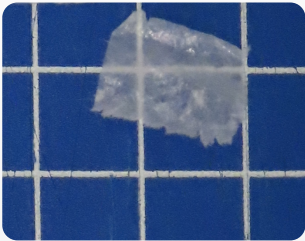
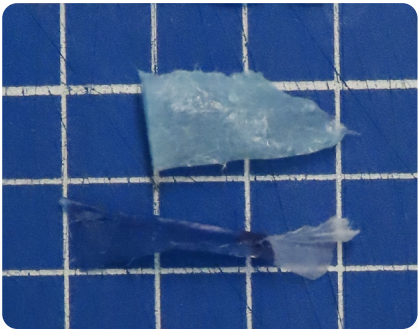
Reject characterisation examples

Fragmentation	Unfragmented Original cut size pieces	Partly fragmented Medium pieces (size > 1 cm in one dimension), sharp edges	Completely fragmented Granular pieces (size ≤ 1 cm in one dimension), no sharp edges
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Unfragmented



Partly fragmented



Completely fragmented

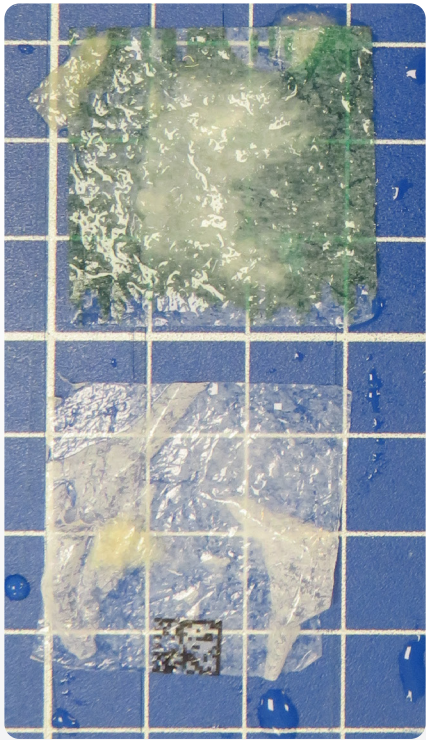


Polymer Barrier coating	
Unfragmented	()
Partly fragmented	()
Completely fragmented	()
Rolled	()

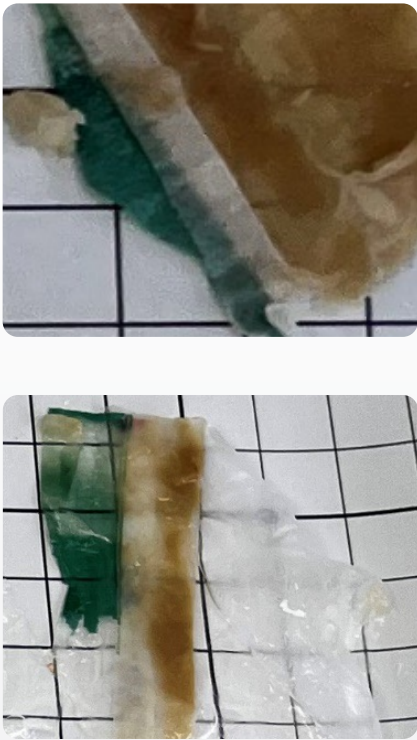
Reject characterisation examples

Mix (cellulose and non-cellulose)		S
Loose fibres	()	()
Attached fibres	()	()
Encapsulated fibres	()	()

Loose fibres



Attached fibres



Encapsulated fibres

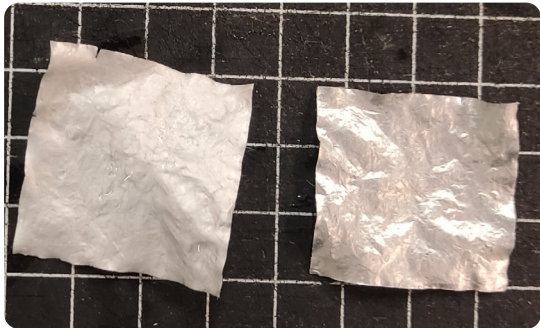


Amount (optional)	Significant (S) Extensive quantity, relevant in Part I and III
Field S is optional, but crucial for decisions on 20 min disintegration (Part I) and coarse reject quality levels (Part III)	

Reject characterisation examples

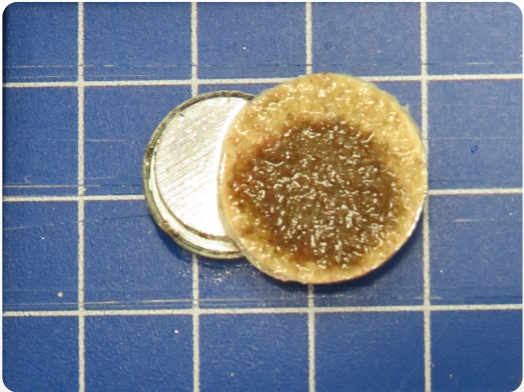
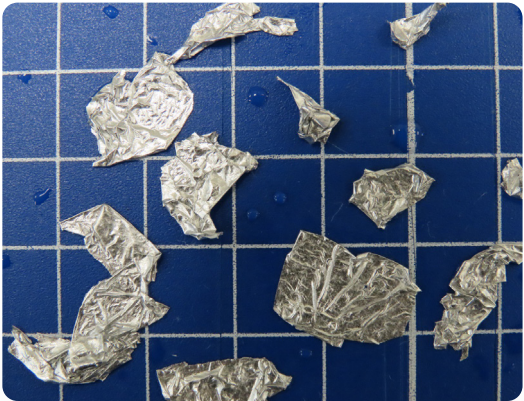
Metallised film

Unfragmented	()
Partly fragmented	()
Completely fragmented	()



Metal and aluminium

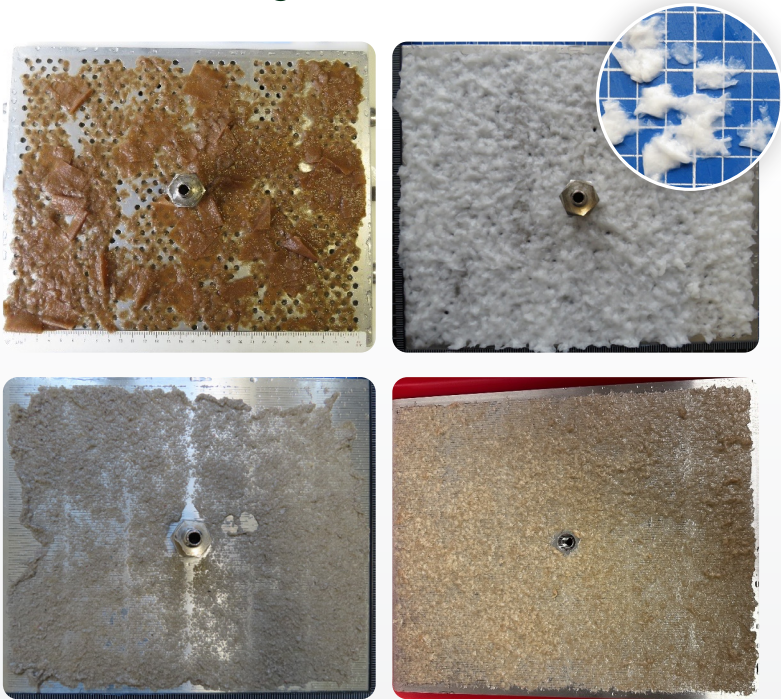
Unfragmented	()
Partly fragmented	()
Completely fragmented	()



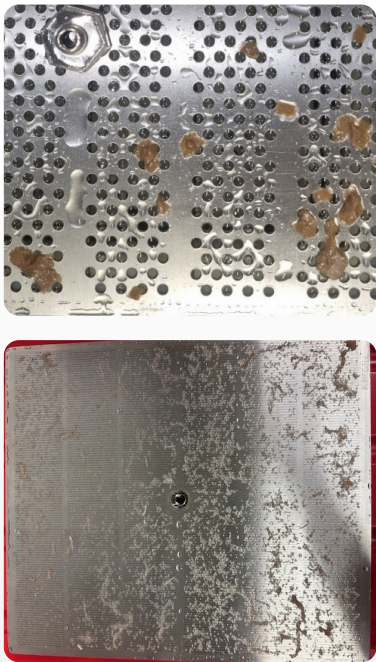
Reject characterisation examples

Cellulose fibres and flakes		S
Single fibres	() ()	
Flakes	() ()	
Partly disintegrated sample material	() ()	
Not disintegrated sample material	() ()	

Significant amount



Not significant amount



Amount (optional)	Significant (S) Extensive quantity, relevant in Part I and III
Field S is optional, but crucial for decisions on 20 min disintegration (Part I) and coarse reject quality levels (Part III)	

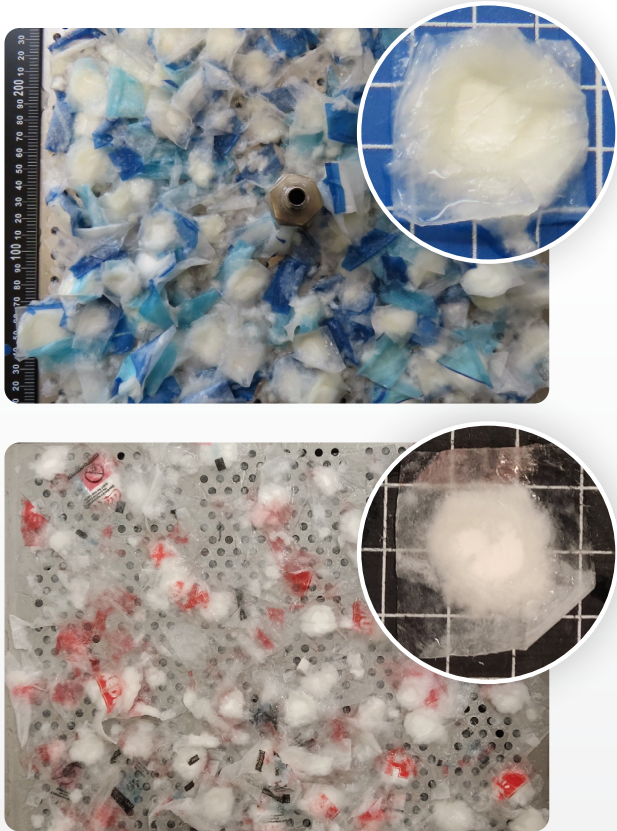


Remark: The 20 min disintegration option in Part I method requires a total screening reject of at least 15% and a significant amount of fibres in the coarse and/or fine reject.

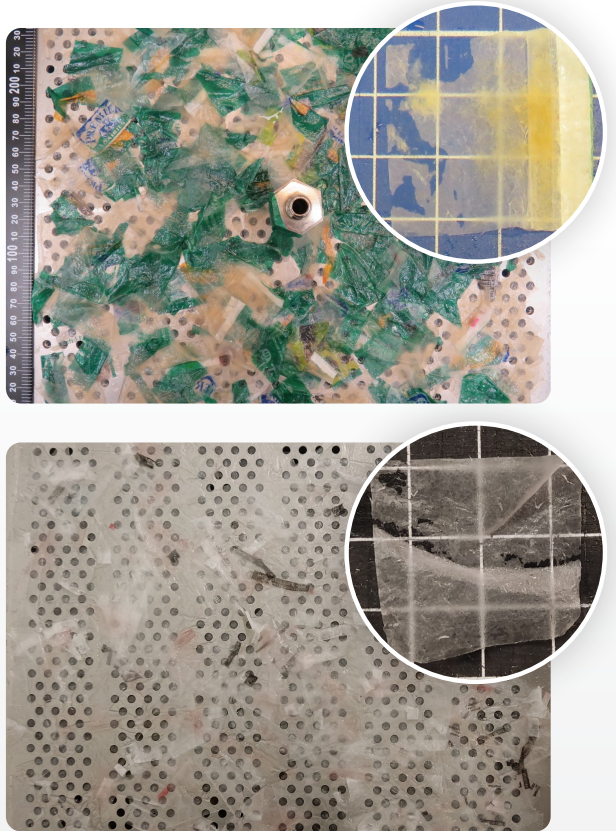
Reject characterisation examples

Mix (cellulose and non-cellulose)		S
Loose fibres	()	()
Attached fibres	()	()
Encapsulated fibres	()	()

Significant amount



Not significant amount



Amount (optional)	Significant (S)
Extensive quantity, relevant in Part I and III	
Field S is optional, but crucial for decisions on 20 min disintegration (Part I) and coarse reject quality levels (Part III)	

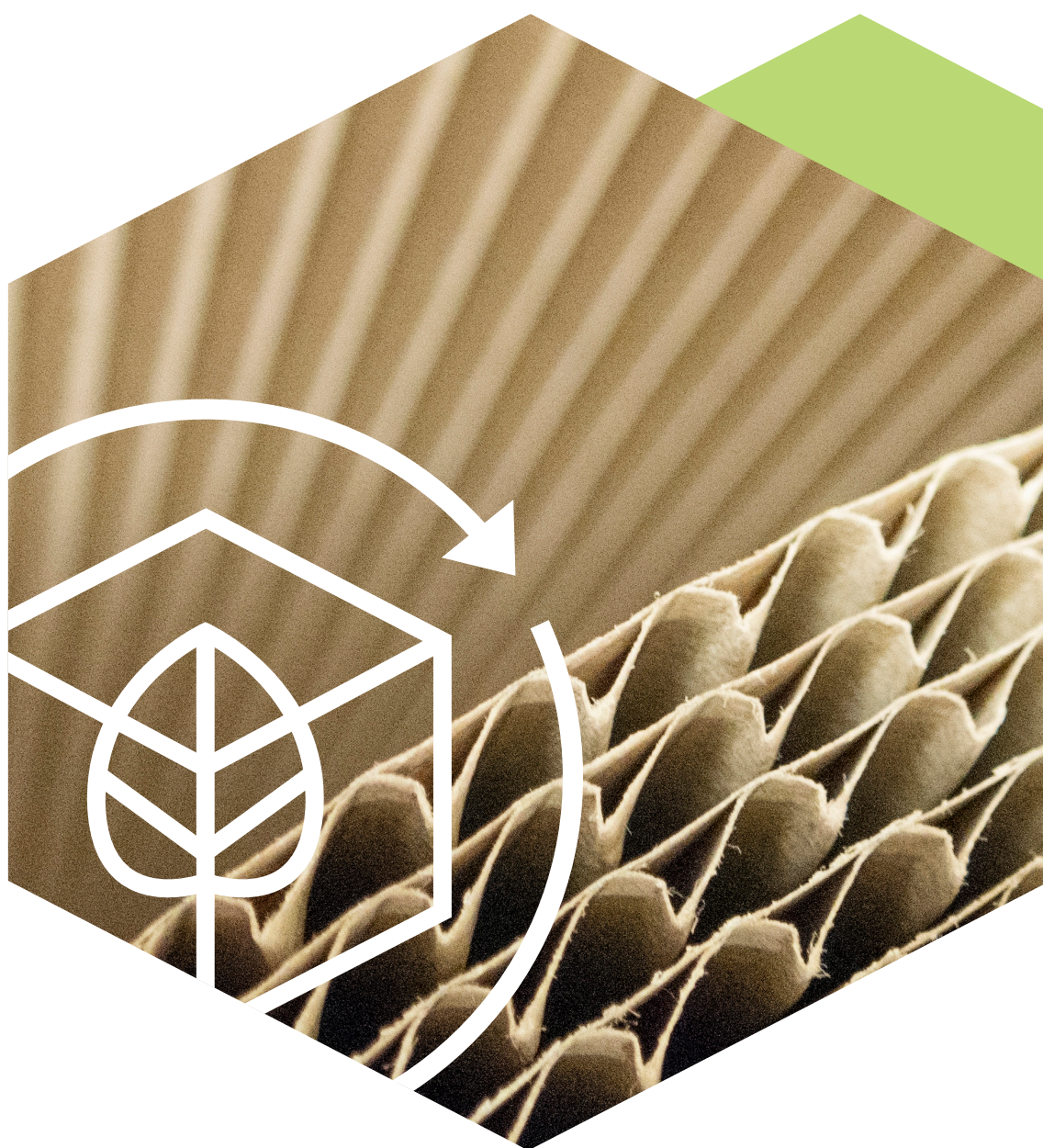


Remark: The assessment of significant amount of fibres and flakes in the category mix will be further developed in the future versions of this annex.

4. ANNEX DETAILED WORK DESCRIPTION FOR SAMPLE PREPARATION

VERSION 1, JANUARY 2025 - UPDATED EDITION (JUNE 2026)

This Annex is relevant for Part I,
Part II and Part III



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List of abbreviations and symbols

OD	Oven Dry
PPWR	Packaging and Package Waste Regulation
WSA	Wet Strength Agents

1 Purpose and scope

This document describes the necessary laboratory procedures for the preparation of sample material to be analysed according to the following recyclability methods:

- > Paper and Board – Recyclability
Laboratory Test Method – Part I: Paper mill with conventional recycling process, Version 3
- > Paper and Board – Recyclability
Laboratory Test Method – Part II: Paper mill with flotation-deinking recycling process, Version 1

- > Paper and Board – Recyclability
Laboratory Test Method – Part III: Paper mill with specialised recycling process (LPC), Version 1

Please note that certain details and differences must be considered depending on the method applied, such as the amount of sample material needed for disintegration. Also note, that this is a living document, where further work will be implemented in the future, such as more or detailed requirements coming from the EU Packaging and Packaging Waste Regulation (PPWR).

2 Sample preparation

2.1 Simple sample preparation for Part I and Part III methods

This topic provides a detailed procedure for preparing simple sample materials, meaning semi-finished products that are flat and do not have different components.

Step Nr.	Notes	Description
1	Material amount	> A minimum amount of 250 g air-dried material is needed to carry out all following measurements.
2	Dry content determination	> Place the sample in the oven at (105 ± 2) °C until it reaches a constant mass to determine the moisture content according to ISO 638-1. The sample must be cooled for around 30 min. in a desiccator before every weighing. > If the packaging sample is too large to fit in the oven, cut it beforehand placing it in the oven and then in the vacuum desiccator. > If the sample contains dry-removed parts (e.g. metal clips), do not count their weight within the 50 g oven dry (OD) material for disintegration. Instead, include it in the reject amount calculation.
3	Cutting the specimen	> If the specimen has the form of a roll, cut it to A4 size. > Put the A4 format sample into a cutting machine or punch and cut/punch it to $(3 \times 3 \pm 0.5)$ cm. > If cutting the sample in $(3 \times 3 \pm 0.5)$ cm pieces is not possible because parts of the sample are already smaller than that (e.g.: the edges of a cup), perform it as close as possible to specification (with as little deviation as possible), and note it accordingly in the spreadsheet. > At least 65 g air dry sample has to be cut / punched.
4	Ageing	> If the sample contains wet strength agents (WSA) and was produced less than 30 days ago, store it for the time needed to complete this ageing and then proceed with the test. > Another option is to perform accelerated ageing by placing the sample in the oven at (60 ± 1) °C for 72 hours. > In case of samples without WSA, make sure the sample is at least 15 days old from the date of production, and therefore no ageing is necessary.
5	Documentation in Excel	> Enter the dry content of the sample in the Excel spreadsheet. > Calculate the sample weight equivalent to 50 g OD. > Enter the experiment date and processor abbreviation in the Excel spreadsheet.

2.2 Complex sample preparation for Part I and Part III methods

2.2.1 Example 1: paper cup

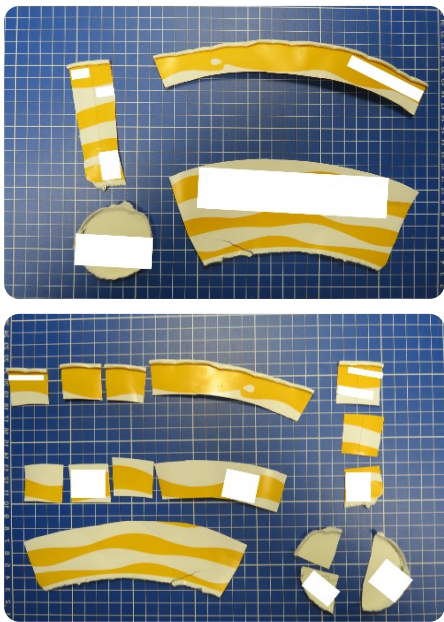
Step Nr.	Notes/Pictures	Description
1	Dry content determination	> Place the sample, or at least each different part of the sample (sealing, gluing, paper, etc.) in the oven at $(105 \pm 2)^{\circ}\text{C}$ to determine the moisture content according to ISO 638-1. > If the packaging sample is too large to fit in the oven, cut it beforehand placing it in the oven and then in the vacuum desiccator. > If the sample contains dry-removed parts (e.g. metal clips or rigid plastic) that can harm the disintegrator, it is allowed to separate them before the disintegration step (dry removal). For that, do not count their weight within the 50 g OD material for disintegration, but instead, include them in the coarse reject calculation. > The use of electronic equipment instead of the oven method mentioned in the standard needs to be reported. Some rejects can behave differently when electronic devices are used in the dry content determination.
2	Cutting the specimen  © 2024 PTS	> Cut the cup along the side gluing all the way to the bottom. > Remove the bottom section by hand. > Cut off the side gluing seam. > Cut off the rolled edge. > Weigh all parts individually and enter their weights in the Excel spreadsheet. > Weigh out sample portions corresponding to 50 g OD and cut it to $(3 \times 3 \pm 0.5)$ cm pieces. > If there is a sample where this is not possible because pieces are smaller than $(3 \times 3 \pm 0.5)$, perform the sample preparation with as little deviation as possible, and note it accordingly in the spreadsheet.
3	Documentation in Excel	> Enter the dry content in Excel spreadsheet. > Enter the weight of each sample components in Excel spreadsheet. > Enter the date and abbreviation of the processor in the Excel spreadsheet.

Figure 1. Example of cutting preparation for cup sample

2.2.2 Example 2: Shopping bag

Step Nr.	Notes/Pictures	Description
1	Dry content determination	> Perform it as in topic 2.1.
2	Cutting the specimen  Figure 2. Example of cutting preparation for shopping bag sample	> Cut the bag along the side gluing all the way to the bottom. > Cut off the bottom. > Cut off the side gluing seam. > Cut off the handle including adhesives. > Metal parts that are not shredded are marked as dry removed. > Weigh all parts individually and enter their weights in the Excel spreadsheet. > Weigh out sample portions corresponding to 50 g OD and cut it into $(3 \times 3 \pm 0.5)$ cm pieces. > If this preparation is not possible because the sample pieces are smaller than $(3 \times 3 \pm 0.5)$ cm, perform it as close as possible to specification (with as little deviation as possible), and note it accordingly in the spreadsheet.
3	Documentation in Excel	> Perform it as in topic 2.2.1.

2.2.3 Example 3: Multicomponent packaging

Step Nr.	Notes/Pictures	Description
	If a sample contains several different components, such as polymer and metal components or a user instruction booklet, special care is needed for the sample preparation and testing.	
1	Dry content determination	> Perform it as in topic 2.1.
2	Cutting the specimen  © 2023 CTP	> Cut the folding box along the side gluing all the way to the bottom. > Cut off the bottom. > Cut off the side gluing seam. > Cut off the plastic hanger and mark as dry removed. > Cut off the metal part and mark as dry removed. > Cut off the polymer window including adhesives. > Weigh out the user instructions booklet and establish whether it will be included in the test or not. This should be discussed with the customer beforehand. > Weigh all parts individually and enter their weights in the Excel spreadsheet. > Weigh out sample portions corresponding to 50 g OD and cut into $(3 \times 3 \pm 0.5)$ cm pieces. > If this preparation is not possible because the sample pieces are smaller than $(3 \times 3 \pm 0.5)$ cm, do it as close as possible to specification (with as little deviation as possible), and note it accordingly in the spreadsheet. > The dry removed non-paper components will normally be added to the coarse reject. Only components significantly smaller than 5 mm will be added to the fine reject. > Ensure that the right calculations are used for the total reject with dry-removed components factored in. > Integrated components should only be dry removed when they could cause harm to the disintegration device or heavily influence its behaviour (e.g. big ridged plastic parts or metal). > When the sample is then tested, observe whether the different components plausibly appear during testing.

Figure 3. Example of cutting preparation for multicomponent sample

Overview of the components

Component	Procedure	Explanation
Bottom gluing	> Determine mass share and dry matter content > Include in the disintegration	> Paper part of the sample which can be disintegrated
Side gluing	> Determine mass share and dry matter content > Include in the disintegration	> Paper part of the sample which can be disintegrated
Remaining folding box	> Determine mass share and dry matter content > Include in the disintegration	> Paper part of the sample which can be disintegrated
Plastic hanger (two green pieces)	> Determine mass share and the size of the component > Include in the disintegration	> Non-paper component of the sample, which can be included into the disintegration as there is no harm expected for the disintegration device
Second plastic part	> Determine mass share and the size of the component > If the component is significant smaller than 5 mm it will be added to the coarse reject	> Dry-removed non-paper component of the sample with no adhesive application
Metal closure	> Determine mass share and the size of the component > If the component is significant smaller than 5 mm it will be added to the coarse reject	> Dry-removed non-paper component of the sample with no adhesive application
Polymer window with adhesive application	> Determine mass share of the component	> Non-paper component of the sample with adhesive application has to be included in the disintegration > The possible tacky influence of the adhesive application needs to be observed
User instruction	> Determine mass share of the component > Discuss with the customer the purpose of testing and explain different disposal options for graphic components	> As this is a separatable component, the recommendation is to not include it in the disintegration, because it would be disposed with graphic products

3	Documentation in Excel	> Perform it as in topic 2.2.1.
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2.2.4 Example 4: Beverage cartons (Focus of the Part III method)

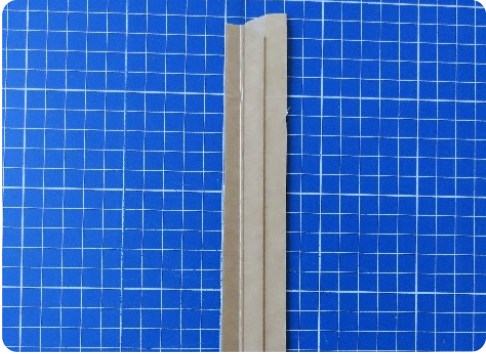
Step Nr.	Notes/Pictures	Description
1	Dry content determination	> Perform it as in topic 2.1.
2	Cutting the specimen Sealed or glued pieces 	> Be careful with the cutting size of the sealed or glued pieces of the packaging sample. The two parts tend to separate during the disintegration, and when they are smaller than (3 x 3 cm ± 0.5) cm, they might give a false impression of fragmentation in the reject characterisation. Smaller parts can also go through the screening steps. Hence, the whole glue seam component should be ideally cut in a way that the single parts measure at least 2.5 x 2.5 cm. If this is not possible, keep in mind that smaller pieces might appear in the results. During sample preparation, do not detach glued pieces that would not otherwise be detached by the consumer (e.g. the lateral glue in the picture).
3	Documentation in Excel	> Perform it as in topic 2.2.1.
4	Plastic closures	> If plastic closures can damage the disintegrator, they can be dry removed from the sample before the disintegration, but in this case their weight should be added to the coarse reject. > Sample parts removed before the disintegration should be documented with photos in the test report. Disclaimer: Further deviations and examples on how to handle different components are planned. For example, the handling of the glue used in attached closures.
5	Straws and plastic wrappings 	> Sample components that are usually not separated by the end-consumer before disposal, such as a wrapped paper straw from a portion pack, should be tested together. > Use the PPWR as a guide for taking decisions in this regard. > The customer can also be consulted on this matter.

Figure 5. Wrapped straw attached to portion pack

Step Nr.	Notes/Pictures	Description
6	Photo documentation	> Take photographs of how the beverage carton sample was cut using a sense of scale like a cutting mat. If possible, place the cut pieces in a way that gives an impression of how the total beverage carton looked before cutting. Also take pictures of parts that were for some reason not included in the test (e.g. narrow edges). This gives important insights for the reject characterisation (pieces with round or pointy corners, different dimensions, etc.).

7

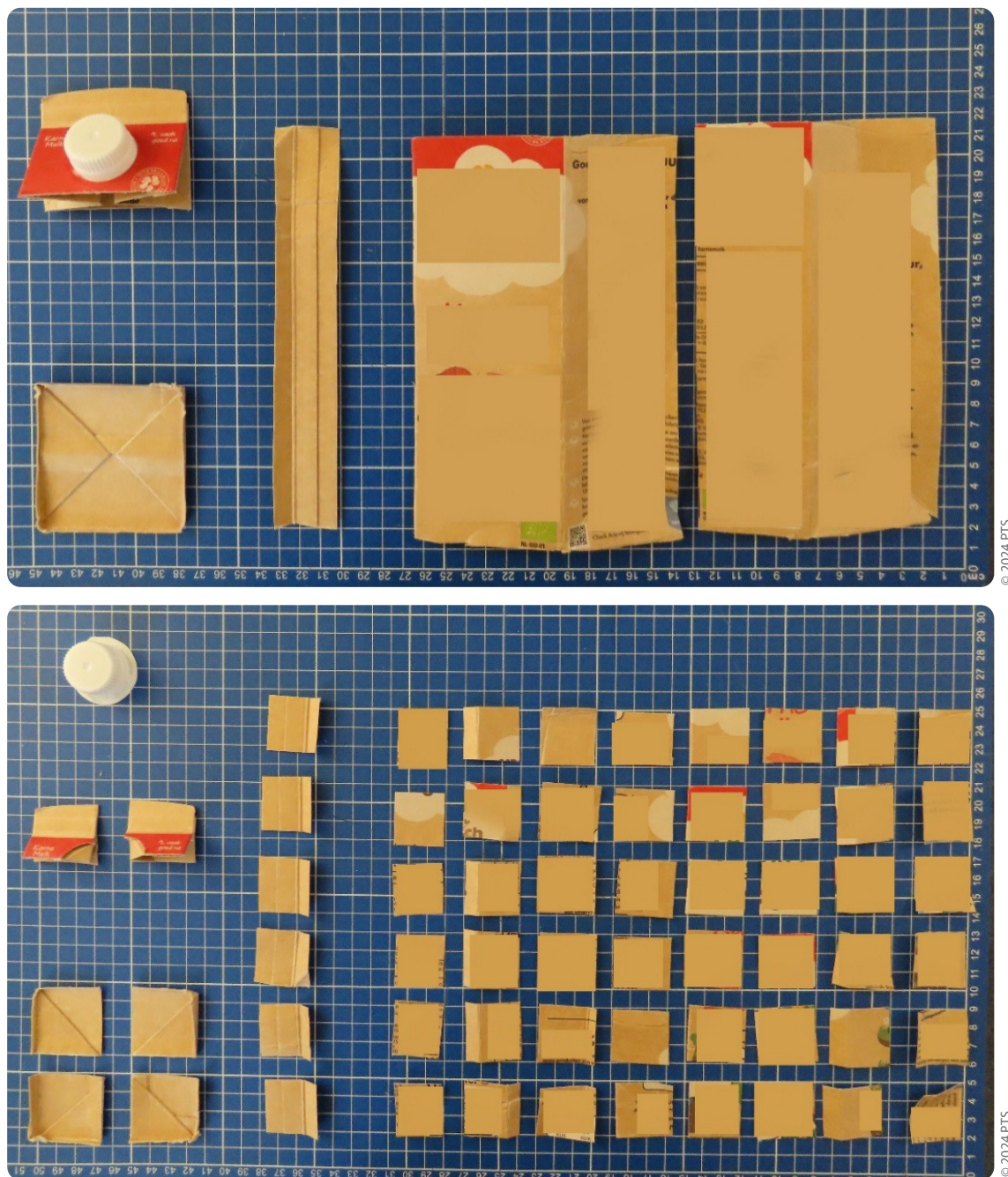
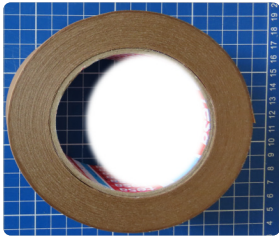
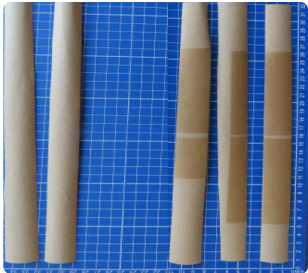
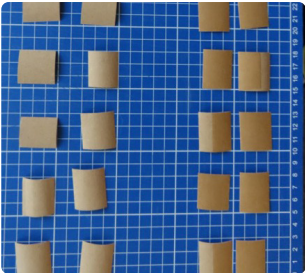


Figure 6. Preparation of beverage carton sample with sealed closure, closures not included in the disintegration step

2.2.5 Packaging aid sample preparation

Step Nr.	Notes/Pictures	Description
1	General information	> The following packaging aid products should be analysed: - Paper-based adhesive tape - Labels - RFID-tags - Others Disclaimer: More examples and pictures will be added in a later version of these guidelines. > They are typically used for the following applications: - E-commerce shipping - Closing of a folding box - Security label - Others Disclaimer: In a later version more application examples could be collected. > The typical base material for packaging aid products are: - Testliner for corrugated board - Pigment coated or non-pigment coated carton board - Paper for flexible packaging - Others > Volume or mass of packaging aid products should be established from the 'typical mass share' identified from collected market data. > It is suggested to have a mass ratio of 5% packaging aid to 95% base substrate.
2	Preparation steps	> Apply adhesive tape or other packaging aid on the selected base material (defined mass share) with constant pressure/compacting, e.g. using a final roll or couching roll. > With regards to the age and the dry matter content of the individual components, weigh out sample portions corresponding to 50 g OD and cut it into $(3 \times 3 \pm 0.5)$ cm pieces. > If this preparation is not possible because the sample or components of the sample are than $(3 \times 3 \pm 0.5)$ cm, do it as close as possible to specification (with as little deviation as possible), and note it accordingly in the spreadsheet.

Step Nr.	Notes/Pictures	Description
3	1. Initial sample Adhesive tape  2. Adhesive tape applied to test liner with defined mass share    3. Sample material cut into 3 x 3 cm   © 2024 PTS	
4	Documentation in Excel	> Perform it as in topic 2.2.1.

3 Sample preparation for Part II method

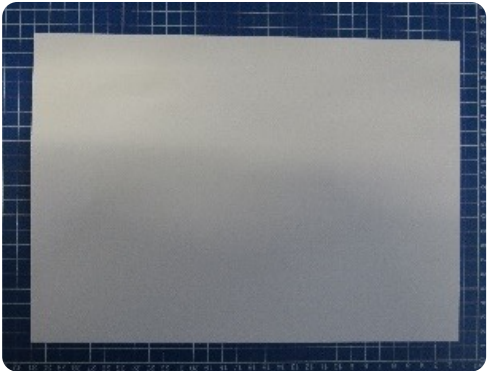
3.1 Sample preparation and dilution water and chemical preparation

This topic describes the necessary procedures for the Part II sample preparation. In the event of a complex sample, please see chapter 2.2. for the appropriate preparation and adjust the procedure to the specific needs of Part II, as described below.

Step Nr.	Notes	Description
1	Required sample amount	> For the disintegration of Batch 1 and 2, around 1500 g in total of the sample material is needed. - For Batch 1, the amount of chemicals needed depends on the ash and the dry matter content of the sample material. The amount of chemicals corresponds to the sample needed, calculated in the Laboratory Excel Spreadsheet. - The amount of chemicals needed for Batch 2, depends on the pH value obtained in Batch 1.
2	Ageing	> The sample material needed for Batch 1 is not subject to accelerated ageing. But if the sample contains WSA and was produced less than 30 days prior to testing, store it for the time needed to complete the ageing process before proceeding with the test. For samples without WSA, make sure the material is at least 15 days' old from the date of production, and therefore no ageing is necessary. > For Batch 2, place the samples in a drying oven for accelerated ageing at $(60 \pm 3) ^\circ\text{C}$ for 72 h. Individual stacks should not contain more than 100 g per A4 equivalent.
3	Determination of dry matter content	> Place a representative amount of the sample in the oven at $(105 \pm 2) ^\circ\text{C}$ until it reaches a constant mass value to determine the moisture content according to ISO 638-2. The sample must be cooled for around 10 min. in a desiccator before weighing. > If the sample is too large to fit in the oven, cut it before placing in the oven and then to the vacuum desiccator. > If the sample contains dry-removable parts (e.g. metal clips), do not count their weight within the required sample amount for disintegration. Instead, include it in the reject amount calculation.
4	Determination of ash content	> Muffle furnace according to ISO 1762.

Step Nr.	Notes	Description								
5	Cutting the specimen	> Cut the samples into pieces of about (3 x 3 ± 0.5) cm. > If there is a sample where this is not possible, then perform the preparation with as little deviation as possible, and note it accordingly in the spreadsheet. > At least 600 g air dry sample has to be cut/punched.								
6	Documentation in Excel	> Enter the dry content of the sample in the Excel spreadsheet. > After adding the dry matter and ash content of the sample to the Excel Lab Result sheet, the sample weight equivalent to 200 g oven-dry fibres is calculated automatically. > Enter the experiment date and processor abbreviation in the Excel spreadsheet.								
7	Preparation of dilution water	> During the laboratory process only use deionised water adjusted to a calcium hardness of 3.21 mmol/l, equivalent to 128 mg Ca²⁺/l. > To obtain the requested water hardness, add 472 mg/l calcium chloride dihydrate (CaCl₂ · 2 H₂O) to deionised water. This is equivalent to 128 mg Ca²⁺/l. > The dilution water should be stored in a temperature-controlled water bath to maintain a constant temperature (45 ± 2) °C > It is also possible to heat part of the dilution water to a considerably higher temperature by means of a water heater, and successively adding cold dilution water until the desired temperature has been reached.								
8	Preparation of chemicals	> It is advisable to prepare the chemicals by mass as volume is affected by temperature. The standard deinking recipe is as follows:<table><tr><td>Sodium hydroxide</td><td>0.6% (100%)</td></tr><tr><td>Sodium silicate</td><td>1.8% (1,3–1,4 g/cm³)</td></tr><tr><td>Hydrogen peroxide</td><td>0.7% (related to a H₂O₂ concentration of 100%)</td></tr><tr><td>Oleic acid</td><td>0.8% (extra pure)</td></tr></table> > Prepare a total amount of 2000 g of deinking solution which will be sufficient for several tests. > Dissolve 6 g of sodium hydroxide in approximately 600 g of deionised water, heat slowly to approximately 60 °C, and proceed by adding 8 g of oleic acid. > Mix until the solution is clear, then add 18 g of sodium silicate, and fill up with deionised water to 2000 g. > The formation of soap reduces the alkalinity (0.114 % sodium hydroxide is needed to neutralise the oleic acid. > In addition, prepare 100 g of hydrogen peroxide solution for each test, using deionised cold water. > The required amount of deinking solution and of hydrogen peroxide is dependent on the sample amount used for pulping and shall be calculated individually. > Do not use a deinking solution which is older than one week.	Sodium hydroxide	0.6% (100%)	Sodium silicate	1.8% (1,3–1,4 g/cm ³)	Hydrogen peroxide	0.7% (related to a H ₂ O ₂ concentration of 100%)	Oleic acid	0.8% (extra pure)
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Hydrogen peroxide	0.7% (related to a H ₂ O ₂ concentration of 100%)									
Oleic acid	0.8% (extra pure)									

4 Photo documentation

Step Nr.	Notes	Description
1	 Figure 8. Paper sample positioned on the cutting mat, with detailed cutting map lines	> Photograph the front and back side, and all individual parts/ components of the specimen on the cutting mat (if available) so that the scale of the mat can be seen. > If possible, place the specimen so that it lies against a mat line. Additionally a ruler can be placed near to the sample. > The photo should be made as straight as possible (use the cutting mat or ruler as an aid). > Photographs of specific sample portions are recommended for complex specimens.

5 Further documentation

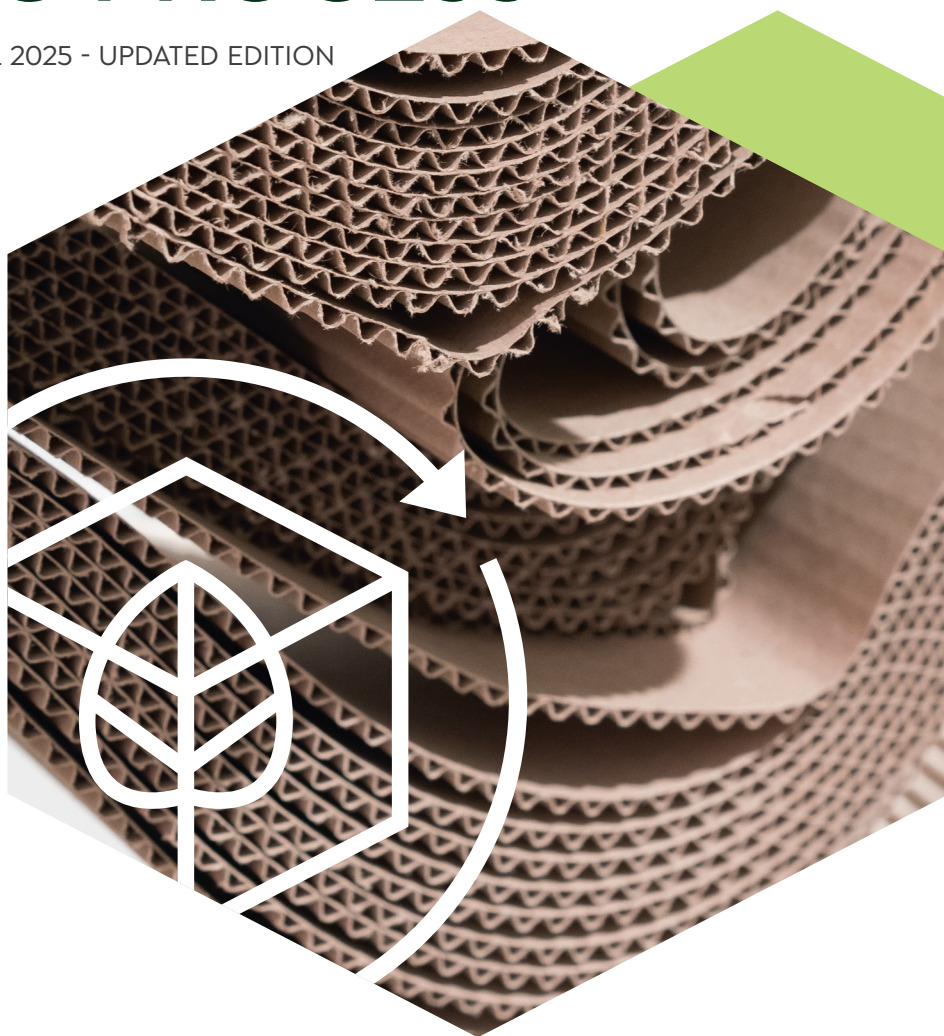
Please use corresponding laboratory report template for further documentation.

List of changes

Rev.	Valid from	Author	Change(s)
01/2023-03-27	March 2023	Marie Geißler	First version of the detailed work description
01/2023-09-18	September 2023	Marie Geißler	Adding multicomponent sample
01/2024-10-30	October 2024	Vanessa Wortmann	Preparation of beverage carton samples added
01/2025-01-01	January 2025	Marie Geißler	Adding Part II needs into document, restructuring of the document

5. ANNEX DETAILED WORK DESCRIPTION FOR THE PAPER AND BOARD – RECYCLABILITY LABORATORY TEST METHOD – PART II: PAPER MILL WITH FLOTATION-DEINKING RECYCLING PROCESS

VERSION 9.1 APRIL 2025 - UPDATED EDITION
JUNE 2026



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List of abbreviations and symbols

AC	Accept from coarse screening
AF	Accept from fine screening
COD	Chemical oxygen demand
OD	Oven dry
ER	Evaporation residue
RK	Rapid Köthen
UP	Undeinked pulp
DP	Deinked pulp
WSA	Wet strength agents

1 Purpose and scope

This work instruction specifies the procedure for the **determination of the technical recyclability of paper and board according to ‘Paper and Board – Recyclability Laboratory Test Method – Part II: Paper mill with flotation-deinking recycling process’**. The test procedure described is split into two batches.

This document aims to address difficulties and/or issues with clarity in the method implementation.

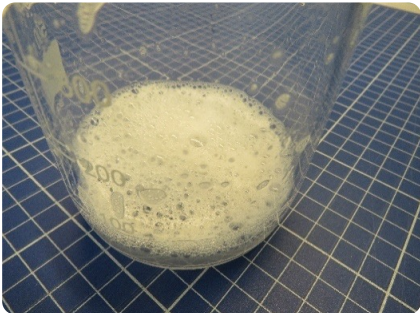
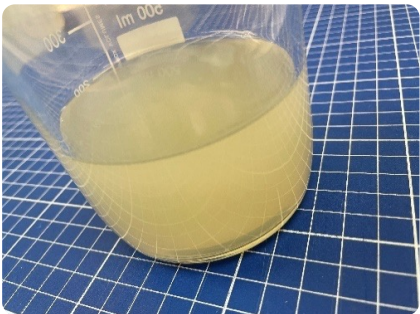
2 Sample preparation for Batch 1 (repulpability) and Batch 2 (flotation-deinking)

The sample preparation should be carried out according to the current version of the Detailed Work Description for the sample preparation.

3 Repulping Batch 1

Step Nr.	Notes/Pictures	Description
1		> Note the real sample amount you have weighed in. Considering that you have 3 x 3 cm pieces, you may have to use a little less or a little more than the required sample amount (but be aware that adding a whole piece might result in more than the desired amount).
2	Repulping	> The total mass is 1667 g including the sample material itself, the chemicals as well as the water. For samples with screenable non-paper constituents the total mass is also including the amount of the non-paper constituents (g). > Proceed using the calculated amount of chemicals, considering the ash content of the sample. > Preheat the pulper with hot water to a temperature of $(45 \pm 2)^{\circ} \text{C}$ and discard the water after the pulper reached the requested temperature. > If the required volume of the stock solution is too high for the required fibre concentration, modify the amount of water added during the preparation of the deinking solution, to achieve the required fibre concentration. > Add the prescribed sample mass to the Hobart pulper (200 g oven-dried fibres). Add the calculated amount of dilution water to the calculated amount of deinking solution. Place this deinking liquor into the pulper and run it for a few seconds at low speed. Then stop the pulper and brush down any paper scraps from the sidewall if present. > After the first stop, add the required amount of peroxide solution diluted to 100 g with deionised water. > Immediately after, repulp the stock for a total time of 20 min at approximately 45°C, using rotor speed 2. Repeat the stopping and brushing as often as necessary until the walls of the vessel remain free of adhered sample pieces. Stop the watch/timer as long as you stop the pulping. > After the repulping, measure the pH value (take a small amount of the pulp and press it out manually to obtain some filtrate on which the pH is measured). Both the fibres and the filtrate are transferred back into the Hobart pulper.
3	Splitting the disintegrated sample into four parts	> Dilute the overall amount of pulp to a consistency of 5%, using prepared dilution water. Then split the pulp up into four individual samples: - One sample of approximately 50 g oven-dry pulp (calculated amount using INGEDE Method 11-2 formula 9) is taken directly after dilution and splitting and is stored in a water bath as described in INGEDE Method 11-2 (chapter 7.4.4 – ‘Storage’) for 60 min. at 45°C in water bath - After the storing time, the pulp is diluted to 2.5% concentration (using 1000 mL prepared dilution water) and used for the filtrate analysis as described in chapter 5. - The other three samples of approximately 50 g oven-dry pulp each (calculated amount using the formula 9 according to INGEDE Method 11-2) are taken directly after disintegration to be used for coarse- and fine-screening without further storing time, as described in chapter 6.2 of this document.

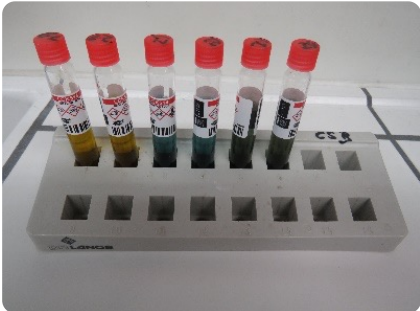
4 Filtrate analysis Batch 1

Step Nr.	Notes/Pictures	Description
1	Sampling	> After the storage time the pulp is diluted to 2.5 % concentration (using 1000 mL prepared dilution water) and can now be used immediately for the filtration.
2	Filtration (ISO 4119)  © 2024 PTS Figure 1. Büchner funnel set for the pulp filtration  © 2024 PTS Figure 2. Filtrate presenting foam  © 2024 PTS Figure 3. Filtrate presenting colouration	> Use the suction flask and the Büchner funnel exclusively for water analysis tests. > Wash the suction flask with deionized water and let it dry upside down as well as possible, before using it. > Place a filter (grade 388) paper (150 mm) onto the Büchner funnel (150 mm). > Attach the vacuum hose and turn the vacuum pump on. > Filter 100 g of the total stock through the Büchner funnel, without moisturising the filter paper. To prevent the sample from reaching the flask without passing through the filter, first pour a few drops of the sample to firmly set the filter on the funnel and then proceed with the rest. > Use the filtrate to rinse the suction flask and return it to the total stock in the beaker. > Separate the filter cake from the filter paper and return it to the total stock in the beaker. > Place another filter paper (150 mm) onto the Büchner funnel (150 mm). > Filter another 200 g of the total stock via a Büchner funnel as described above. > Retrieve the filtrate from the suction flask and filter it via the Büchner funnel again using the same paper filter. > Pour filtrate into a clean glass bottle or beaker glass and label it. > Photograph the filtrate, especially if it presents some colouration. > Proceed immediately the determination of the evaporation residue and COD. > After use, wash the funnel and the flask with deionised water.

4.1 Evaporation residue

Step Nr.	Notes/Pictures	Description
1	Evaporation residue  © 2022 PTS Figure 4. Evaporation residue (white stain) left on the aluminium tray	> Pour a known amount (approximately 70 g) of filtrate on a previously weighed aluminium tray. > Note down the mass of the empty aluminium tray 'm1' and the mass of the filtrate that was taken in 'm2' (approximately 70 g). > Repeat the procedure to have a double determination of the evaporation residue. > Place the tray with the filtrate in the drying oven at (105 ± 2)° C to remove the solvent. > Determine the residue in line with DIN 38409-1. > When there is visibly no more water in the tray, take it out of the oven for the first time. > In order to control the residue mass, cool the tray in the desiccator for approximately 10 min. before weighing it. > Repeat the process until the residue reaches a constant mass value, and note it down. > Enter the values in the Excel spreadsheet.
2	Calculation	> The evaporation residue (ER) of the sample is calculated as follows: $ER \text{ filtrate } (g \text{ residue} / g \text{ filtrate}) = \frac{m_3 - m_1}{m_2}$ m₁ = mass of the empty aluminium tray m₂ = mass of the filtrate that was taken in m₃ = mass of tray after drying including the evaporation residue The evaporation residue can be calculated in relation to the used stock suspension. The evaporation residue percentage is calculated as follows: $\frac{ER \text{ sample } (\frac{g}{g})}{Packaging \text{ mass } (\frac{g}{L})} \times 1000 (\frac{g}{L}) \times 100\% = ER \text{ sample } (\%)$ The results must be given with one decimal place.

4.2 Chemical oxygen demand (COD)

Step Nr.	Notes/Pictures	Description
1	Cuvette test  © 2022 PTS Figure 5. Cuvette used in the COD measurement	> Conduct the COD determination preferentially directly after the filtration of the total stock. > In exceptional cases, when direct measurement is not possible, store the filtrate in a glass bottle in the refrigerator at approximately 4° C for upmost 24 hours. > Record in the Excel spreadsheet if the filtrate was stored in the refrigerator and the duration of it. > Select the COD cuvette with the expected measuring range for the tests according to ISO 15705:2022. > Perform a double determination (two cuvettes). > Write the sample number on the cuvette lid (the barcode must remain legible and the glass must be clean for measurement). > Invert the cuvette to homogenise the solution. > Shake the glass bottle containing the filtrate. > Depending on the cuvette test range, a different volume of the filtrate is required (for details, see the instructions on the packaging). > Add the filtrate to the cuvette carefully (run along the edge). > Close the cuvette securely. > If the cuvette solution immediately presents a green coloration as in Figure 5, discard the sample and either use a higher measuring range or dilute the filtrate with deionised water. > Invert the cuvette containing the preparation.
2	Boiling  © 2022 PTS Figure 6. Cuvette in the heating block  © 2022 PTS Figure 7. Cuvette cooling on the cuvette rack	> Place the cuvettes in the heating block. > Set the heating block to work for 2 h and at 148° C. > Remove the hot cuvette from the heating block. > Carefully invert the cuvette. > Cool the cuvette to room temperature on the cuvette rack.

Step Nr.	Notes/Pictures	Description
3	Photometry measurement  Figure 8. Cuvette on the photometer	> Start the photometer. > Do not to stir up sediment in the cuvette. > The outside of the cuvette must be clean (wipe it clean if necessary). > Place the cuvette in the photometer and perform the measurement (absorbance at 600 nm). > Enter the results in the Excel spreadsheet. > Repeat the same procedure using the deinking solution instead of filtrate.
4	Calculation	> The COD value must be calculated in relation to the used stock suspension. As approximately 50 g of sample were disintegrated in 2 L of water, the packaging mass is 25 g/L. Thus, the COD is calculated as follows: $COD \left(\frac{g O_2}{kg Packaging} \right) = \frac{COD \left(\frac{mg O_2}{L} \right)}{Packaging mass \left(\frac{g}{L} \right)}$ The results must be given with two decimal places.

5 Screening Batch 1

5.1 Reject characterisation

Step Nr. Notes/Pictures

Description

This chapter explains how the reject characterisation should be performed after the coarse- and fine-screening steps, according to the reject characterisation tree. The screening steps are described next.

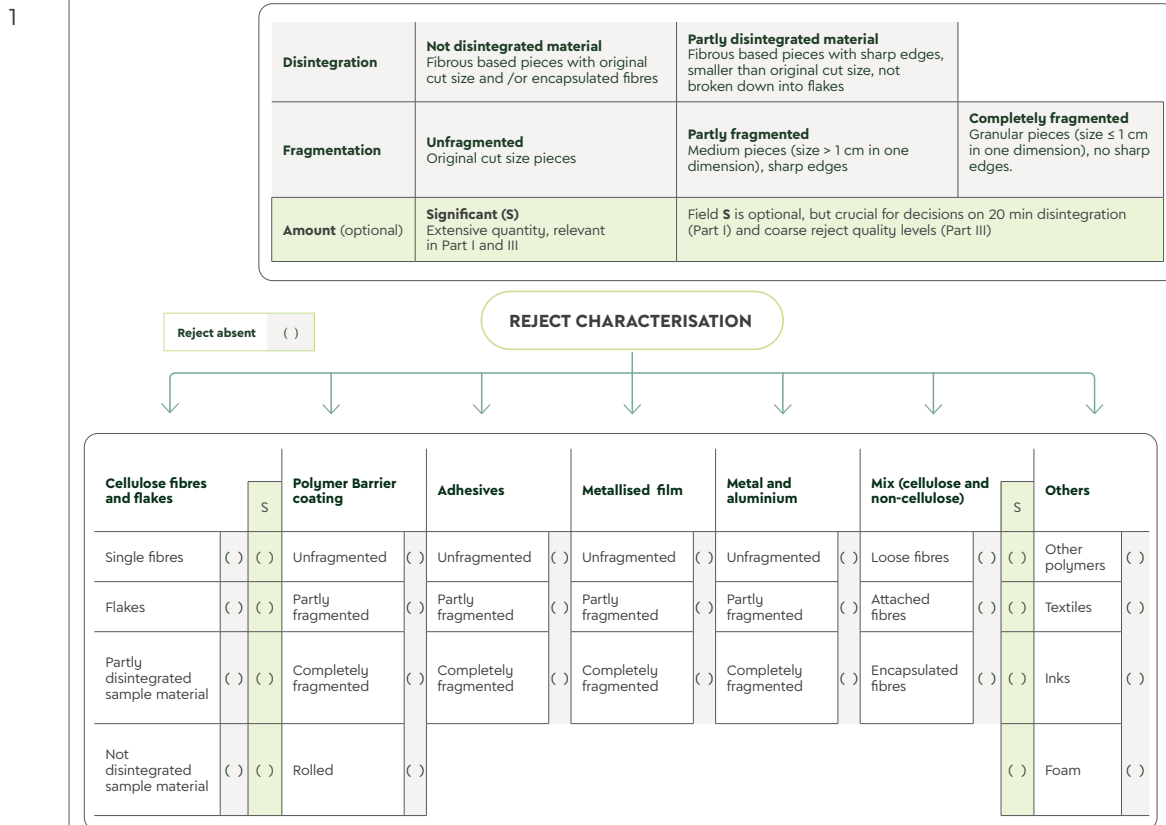


Figure 9. Reject characterisation tree Version 2025

2 Instructions to fill the reject characterisation tree

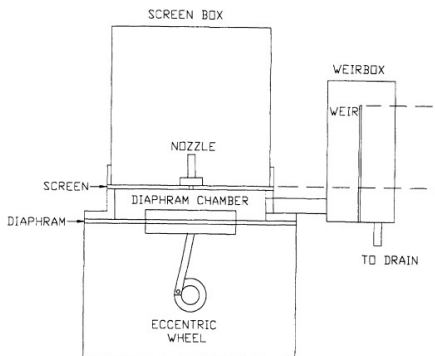
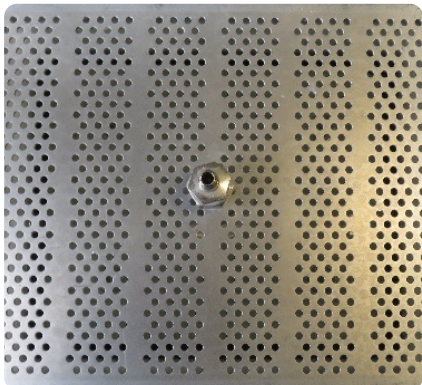


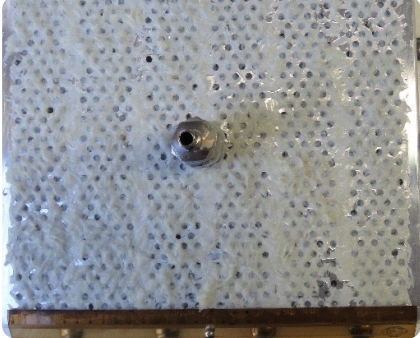
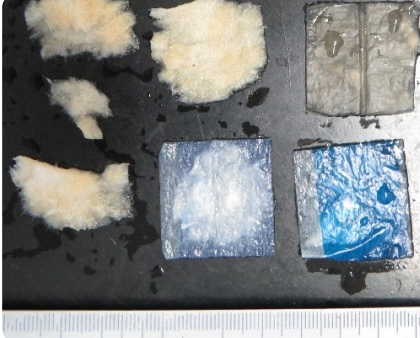
Figure 10. Coarse (above) and fine (below) rejects on the screening plates

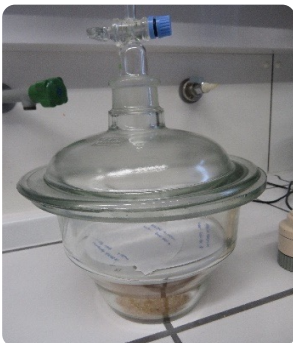
- > The reject characterisation should be carried out after coarse and fine reject screening. Please do it while the rejects are still on the screening plate, so the different reject components can be better visualised.
- > Fill the reject characterisation tree for the coarse and fine reject separately. There is space for that in the Excel spreadsheet
- > Check the definitions concerning the degree of disintegration (partly, not disintegrated) and the degree of fragmentation (completely, partly, unfragmented) on the top right of the tree. If not clear, check the example pictures in the Annex Reject Characterisation.
- > If there is no reject left on the plate, tick the box 'reject absent'.
- > If there are rejects left on the plate, check to which category they belong and the degree of fragmentation or disintegration (if cellulose fibres and flakes). Tick the orange boxes accordingly to what you have observed. You can tick as many boxes as you need.
- > The category mix (cellulose and non-cellulose) should only be selected if there are fibres and/or flakes combined with polymer barrier, metallised films, metal/aluminium, and/or others. Example pictures of can be found in the Annex Reject Characterisation.

Step Nr.	Notes/Pictures	Description
2	Intructions to fill the reject characterisation tree  Figure 11. Washing step	> To differentiate loose and attached fibres and flakes, insert one or two reject pieces into a beaker with tap water. Then, manually stir the reject pieces in the water to release as much entangled fibres and flakes as possible. Do not physically delaminate structures or rub the reject pieces. Check if the reject pieces still contain fibre and flakes attached to them, or if they were washed out. > If a large amount of fibres and flakes were washed out in the washing step, try to recover them using a pre-weighted filter paper and include their weight in the reject determination. > Exclusively for categories: 'cellulose fibres and flakes' and 'mix', there is an extra optional ticking column in grey for significant amounts of fibres and flakes. This option 'significant' means that there are so many fibres and flakes that you can no longer count them. > The overall impression of the test should be considered. For example, if there is only one single polymer piece with a significant amount of fibres attached to it, the 'S' field should not be selected, because it does not represent the overall impression of the test. > If you have additional information about the reject characterisation that was not covered by the tree (e.g. a type of reject that is not available in the tree) write it down in the 'additional comments'.

5.2 Determination of the 5 mm coarse reject

Step Nr.	Notes/Pictures	Description
1	Somerville check	> Check the Somerville regularly to ensure the following conditions: - The space below the screening plates should be clean, some adhesives and fibres can be stuck on it and be carried over to the next sample. - The plates should be clean, especially the fine-screening plate, where fibres tend to become attached. - The spray nozzle should follow the TAPPI T 275 sp-12 specifications. - The slots of the fine-screening plate cannot be obstructed by the structure of the screen box. - The water flow should be 8.6 l/min. It might be affected by the type of screening plate used.
2	Sampling	> Take one of the pulp parts of 50 g oven-dry pulp each (note down which amount is used) from the split pulp to be used for coarse and further fine screening without further storing time. > The coarse screening is done three times in a row from all three left/residual pulp parts.
3	Sampling Procedure  Figure 12. Sketch of the Somerville set up (TAPPI, 2018)  Figure 13. Perforated plate (5 mm hole) UNI 11743  Figure 14. Coarse screening in the Somerville fractionator	> Place the 5 mm perforated plate into the Somerville fractionator. > Attach the instrument screen box tightly. > Attach the instrument hose onto the plate nozzle. > Place the glass protection cover over the screen box. > Ensure that the weir is positioned in the bottom of the weir box. > Start the water flow (8.6 l/min) and pour the total amount of the sample onto the screening plate, when it is covered with approximately 2.5 cm of water. > When the sample starts to overflow through the weir, start the screening time using a timer. > During the screening process, the sorted suspension (AC) is collected in a barrel. > After 5 min., turn off the motor and the water supply. > Pull the weir out the weir box, so the water can be drained. > Open the unit when the water has completely drained off. > Carefully open the screening box. > Transfer the fibres stuck on the screening box of the Somerville into the barrel, where the 'accept' of at least two coarse-screening steps is collected. > 3 x 50 g are screened but from two runs only the accept is collected because this is sufficient for the subsequent procedure. > Please pay attention to the cleanliness of the Somerville after use. Examine for possible deposits in the body of the device and to avoid clogging in the sorting plates. > Particles and deposits stacked in the bottom of the Somerville after screening should be transferred in the corresponding 'accept'.

Step Nr.	Notes/Pictures	Description
3	 Figure 15. Coarse reject after the water draining	
4	Photo documentation  Figure 16. Coarse reject after the coarse screening  Figure 17. Detailed picture of reject components	> Photograph the residue on the perforated plate using a ruler to show the scale, as in Figure 16. > Photograph the perforated plate again, zooming in on the reject. > If applicable, separate the different components in the coarse reject and photograph them on a dark background using something to give a sense of scale (Figure 17). > Stretch the reject components to show their size clearly in the picture. This is important to evaluate the reject fragmentation. > If applicable, show in the picture fibres attached to non-paper components.

Step Nr.	Notes/Pictures	Description
5	Measurement of the coarse reject  Figure 18. Büchner funnel used for the residue filtration  Figure 19. Filter papers cooling in desiccator  Figure 20. Coarse reject dried in the aluminium tray	> Carefully transfer the residue to a vessel using a dough scraper or squeeze bottle. Be sure that all fragments trapped on the plate are also recovered. > Place a weighed filter paper (125 mm grade 388, basis weight 84 g/m², filtration rate 10 s/10ml, filtration range 12-15 µm) on the Büchner funnel and pour the residue over it. > If the reject does not fit on the filter paper (125 mm), place it in a previously calibrated aluminium tray. > Place the filter paper between two cover sheets, and optionally pre-dry it in the dryer of the sheet former for 7 min. (93 ± 4)° C. > Place the filter paper or the aluminium tray in the oven at 105° C, until the mass becomes constant. > Allow the filter paper to cool in the desiccator. > Weigh the paper filter on the analytical balance. > If the reject amount is too high to fit in the filter paper (Figure 20), place it in a weighed aluminium tray and dry it directly in the oven (105°C) until reaching a constant mass. > Transfer the results to the Excel spread-sheet, and calculate the coarse reject (dry-weight) in respect to the starting sample. > Round the coarse reject to the first decimal place.

5.3 Determination of the consistency after the coarse screening

Step Nr.	Notes/Pictures	Description
1	Determination of the consistency	> The determination of the stock concentration is carried out according to ISO 4119 as follows (stock concentration between 0.03% and 0.1%): > For the homogenisation, if possible use a barrel stirrer. If homogenised manually, for example, use a 3 l beaker to mix the entire quantity inside the barrel. > Homogenise the screened stock collected from at least two coarse-screening steps in a barrel. > Tare the sampling vessel on the analytical balance. > Transfer approximately 1000 ml suspension into the tared vessel. > Weigh the mass of the sample taken ('m1'). > Place a filter paper (weighed in topic 3.4 'm2') on the Büchner funnel (diameter 125 mm) and moisten it with water using a spray bottle. > Make sure that all pores in the Büchner funnel are covered by the filter paper. > Apply negative pressure by means of a vacuum pump. > Place the sample over the paper filter into the Büchner funnel. > Rinse the sample vessel with water and pour the liquid into the funnel to not lose any sample residue. > Wait until the filter cake has formed completely and there is no longer a water column on it. > Remove the filter paper containing the pulp cake from the funnel. > Return any material remaining on the funnel wand to the paper filter. > Place the filter paper between two cover sheets and optionally pre-dry it in the dryer of the former sheet for 7 min. (93 ± 4)° C. > Place the filter paper in the oven at (105 ± 2)° C, until the mass becomes constant . > Transfer the filter paper to a desiccator to cool it down. > Determine the dry mass of the filter cake on the analytical balance and document it as 'm3'.
2	Calculation of the concentration	$c (\%) = \frac{m_3 (g) - m_2 (g)}{m_1 (g)} \times 100 \%$ m1 = mass of sample before drying m2 = mass of filter paper without sample m3 = mass of sample with filter paper after drying The results must be given with two decimal places.
3	Ash content of the coarse reject	> Determine the ash content of a representative sample of the coarse reject according to ISO 1762, which is needed for the second batch of pulping as described in chapter 7.

5.4 Sheet formation and sheet adhesion test after coarse screening

Step Nr.	Notes/Pictures	Description
1	Sheet formation (AC)  Figure 21. Sheet former and the couch roller	> Homogenise the total amount of the sample carefully before sampling. > Take approximately 2000 g of pulp from the barrel, in which the 'accept' material was collected during the screening. > Form a lab sheet in the Rapid-Köthen sheet former, according to the ISO 5269-2 > The target weight is $(60 \pm 2) \text{ g/m}^2$ or approximately $1.8 \text{ g} \pm 0.06 \text{ g}$ if it is not reached, and adjust the amount of pulp required for sheet formation. > Form two Rapid-Köthen handsheets following ISO 5269-2, and dry the handsheets according to step 3.
2	Photo documentation  Figure 22. Lab sheet AC1	> Photograph each lab sheet as in Figure 22.
3	Sheet adhesion test  Figure 23. Drying oven used for the sheet adhesion test  Figure 24. Lab sheet with carrier board and cover sheet placed between brass plates into the oven	> The handsheets from step 1 are used to perform the sheet adhesion test. > Place the filter paper between two cover sheets and dry it in the dryer of the sheet former for 7 min. at $(93 \pm 4)^\circ \text{C}$. > Turn around the filter paper and dry it again in the dryer of the sheet former for 7 min. at $(93 \pm 4)^\circ \text{C}$. > Place the lab sheet with carrier board and cover sheet flat between two preheated brass plates (pressure of 1.18 kPa or 3.7 kg) into the drying oven and dry it at $(130 \pm 2)^\circ \text{C}$ for 2 min. > Place the lab sheet with carrier board and cover sheet in the desiccator for 10 min. to cool down (use a timer or stopwatch). > After taking it out of the desiccator, perform both sheet adhesion tests immediately by separating the carrier board and the cover sheet from the lab sheet. Please note which of the cover sheet or carrier board was removed first. > Weigh the lab sheet on the analytical balance. > Record the observations of the sheet adhesion test and any other noteworthy observations in the laboratory Excel spreadsheet. > Observe the fibre tearing in oblique light.

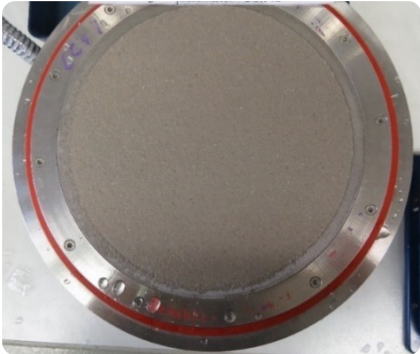
Step Nr.	Notes/Pictures	Description
4	Labelling	> Label all sheets with the sample code and the abbreviation SA for sheet adhesion. > Label the cover sheet and the carrier board in the same way as the lab sheets. > Regarding the carrier board, the side that was in touch with the lab sheet must be labelled. > Regarding the cover sheet, the side that was not in touch with the lab sheet must be labelled.
6	Photo documentation Figure 25. Hand sheets analysed in the sheet adhesion test (AC1, AC2) with incident light Figure 26. Lab sheets (AC1, AC2) on the LED panel with transmitted light	> Photograph the sheets on the cutting map, using the auxiliary lines to align the photo. > Place the carrier board at the right-hand side and at the lowest line. > Place the lab sheet in the middle and two lines above the carrier board. > Place the cover sheet on the left-hand side and one line above the carrier board. > Photograph the lab sheets on the LED panel, showing the measurement scale.

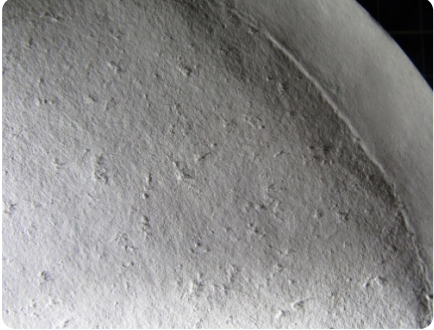
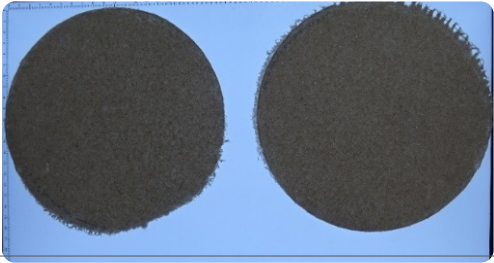
5.5 Determination of the 150 µm slot fine reject

Step Nr.	Notes/Pictures	Description
Somerville fractionator according to TAPPI T275 sp18		
1	Sampling	> Homogenise all of the sample material. If possible use a barrel stirrer. If homogenised manually, for example use a 3l beaker to mix the entire quantity inside the barrel. Take 20 g OD from the AC barrel for the fine screening.
2	Screening procedure  Figure 27. Slotted plate (150 µm slots)  Figure 28. Fine screening in the Somerville fractionator  Figure 29. Fine reject after water draining	> Place the 150 µm slotted plate into the Somerville fractionator . > Set the Somerville as described in chapter 6.1. > Start the water flow (8.6 l/min) and wait until the screening plate is covered with 2.5 cm of water. > Start pouring the sample material on the plate. > When the overflow through the weir starts, start the 20 min. screening time using a stopwatch. > The pouring time should be as short as possible and not be longer than 5 min. > Record the time needed to pour the sample. > A thickener should be used to collect all the accept material (AF) in a barrel and to reduce the water volume. If no thickener is available collect the first 50 l of the AF. > Note in the protocol if a thickener was used or not. > After 20 min. turn off the motor and then the water supply. > Pull the weir out of the weir box, so the water can be drained. > Open the unit when the water has completely drained off. > Carefully open the screening box and perform the photo documentation. > Transfer the fibres stuck on the screening box of the Somerville into the barrel, where the sorted material is collected. > Particles and deposits remaining in the bottom of the Somerville after screening should be transferred to the corresponding accept.

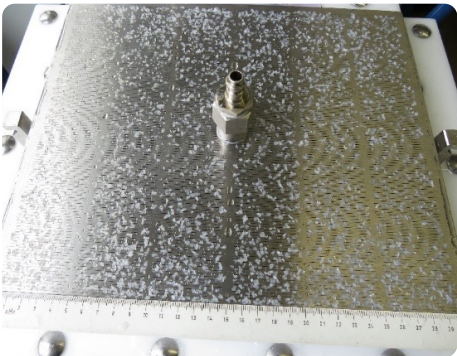
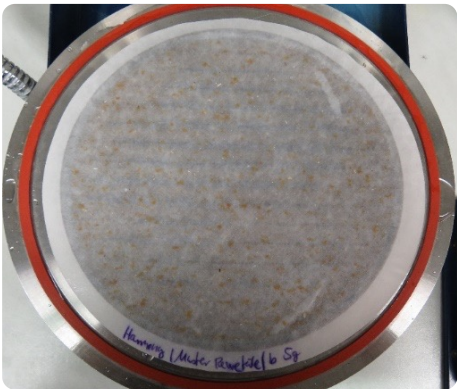
Step Nr.	Notes/Pictures	Description
3	Photo documentation  Figure 30. Fine reject on the 150 µm plate  Figure 31. Fine reject in detail	> Photograph the fine-screening residue on the slotted plate using a ruler as a scale (Figure 30). > Take a detailed picture of the residues, as in Figure 31, if necessary.
4	Measurement of fine reject	> Handle the determination of the fine screen rejects according to the coarse-screen reject determination in step 5 of chapter 6.1.

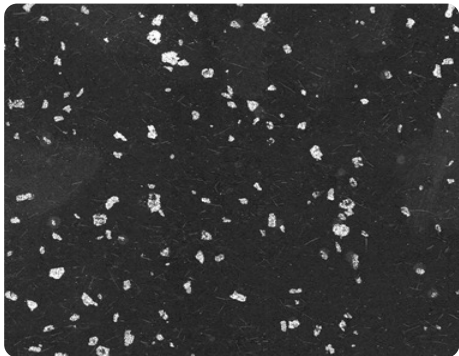
5.6 Sheet formation after sheet adhesion after fine screening

Step Nr.	Notes/Pictures	Description
1	Sheet formation	> Perform the sheet formation according to chapter 6.3, step 1.
2	Photo documentation 	> Photograph each lab sheet as in Figure 32.
3	Sheet adhesion test	> Perform the sheet adhesion test according to chapter 6.3, step 3.

Step Nr.	Notes/Pictures	Description
4	Labelling	> Perform the labelling according to chapter 6.3, step 4.
5	Photo documentation  Figure 33. Handsheets analysed in the sheet adhesion test (AF1, AF2) with incident light   Figure 34. Individual pictures of the cover sheet, lab sheet and carrier board with incident light.  Figure 35. Lab sheets (AF1, AF2) on the LED panel with transmitted light	> Photograph the sheets on the cutting map, using the auxiliary lines to align the photo according to chapter 6.3. > Photograph each sheet individually with an oblique light. > Photograph the lab sheets on the LED panel, showing the measurement scale.

5.7 Macrostickies determination (optional)

Step Nr.	Notes/Pictures	Description
Somerville fractionator according to ISO 15360-2		
1	Sampling	> Homogenise the 'accept' from the coarse screening carefully before sampling. > Take 10 g OD from the AC barrel for determining the macrostickies. > Perform at least a double determination.
2	Macrostickies screening	> Place the 150 µm slotted plate into the Somerville fractionator. > Set the Somerville as described in topic 6.4. > When the overflow through the weir starts, commence the 10 min. screening time using a stopwatch. > Turn off the motor and the water supply after the screening time. > Open the unit carefully when the water has completely drained off.
3	Photo documentation  Figure 36. Macrostickies screening reject on the 150 µm plate	> Photograph the residue on the slotted plate using a sense of scale. > Take a detailed picture if necessary.
4	Aspiration of the reject  Figure 37. Aspirated reject on the filter paper	> Carefully transfer the residue into a beaker using a dough scraper or squeeze bottle. > Label the filter sheet (grade 1289 diameter 240 mm) using a pencil. Write down the sample name, the oven-dry quantity and the slot width. > Place the labelled filter sheet on Rapid-Köthen sheet former, moisten it with a squeeze bottle, smooth it by hand, and close the sheet former. > Aspirate the water from the reject in the Rapid Köthen sheet former. > Start the sheet former on the manual mode. > Fill it with water to approximately 2 l. > Add the sample and bubble it for approximately 8 s. > Switch to aspiration when the water has completely passed through the sieve and aspirate it dry for approximately 10-15 s, or until there is no more water in the column. > Rinse off adhered particles in the sheet former column using a squeeze bottle. > If the stickies quantity on the filter paper is too high (they overlap each other), they should be divided onto several filter papers. > A reduction of screening amount or an extension of screening time is not foreseen. > When putting macro stickies on several filter papers, divide the residue into two or more equal parts on two or more filters.

Step Nr.	Notes/Pictures	Description
5	Specimen preparation	> Carefully remove the filter from the sheet former, place it with the underside on a carrier board and cover it with silicon paper (siliconised side in contact with the stickies). > Dry it in the dryer of the sheet former for 10 min. $(93 \pm 4)^{\circ} \text{C}$. > Pour the black ink (e.g. Pelikan No. 4001) onto a plate. > Dip the filter sheet completely into the ink. The entire filter surface must be covered in ink. > Place the filter sheet over a piece of kitchen paper to absorb the ink excess. > Place the dyed filter sheet with the underside on one carrier board and cover it with silicon paper. > Dry the sample in the dryer of the sheet former for 10 min. $(93 \pm 4)^{\circ} \text{C}$. > Pulverise the sticky side of the filter sheet with a large quantity corundum powder evenly. > Place the filter sheet with the underside on one used carrier board and cover it with a second one. > Dry the sample between two preheated metal plates (6 kg, 28 cm diameter) for 10 min. in a drying oven at $(105 \pm 2)^{\circ} \text{C}$. Store the metal brass plates permanently in the oven at $(105 \pm 2)^{\circ} \text{C}$. > Remove the excess corundum powder using a brush.
6	Visual inspection 	> Visually check the filter sheets to avoid the stickies overlapping. > Remove any hydrophobic contamination (e.g. plastic pieces) by hand or using tweezers or colour them black using a permanent marker. > The surface of filter sheets should not contain bends or waves.
7	Distribution of stickies in several filter papers	> In case the stickies are overlapping on the filter paper, they should be distributed across many filter papers.
8	Analysis using image analysis system, e.g. PTS-DOMAS Multispec (see separate description)	

6 Disintegration Batch 2

6.1 Repulping

Process no.	Remarks	Description
1	Sample amount	> Repulping of Batch 2 for the flotation is done according to INGEDE Method 11-2 with the adjusted dosage chemical and taking the amount of non-paper constituents (percentage of coarse reject and ash content) into account.
2	Chemical dosing	> Temper the stock solution to $(45 \pm 2) ^\circ\text{C}$. > The amount of chemicals needed for Batch 2 depends on the pH value obtained in Batch 1 and can be found in the auto-matic calculation carried out by the Excel spreadsheet. > The amount of stock solution is extrapolated proportionally and the amount of dilution water is reduced according to the equation below. > Prepare 100 g of peroxide solution.
3	Dilution water	> The amount of dilution water is calculated using the following equation: $m_{dw} = 1667 \text{ g} - 100 \text{ g} - m_{St} - m_{ps,ad}$ m_{dw} = mass of dilution water in g $m_{ps,ad}$ = mass of air-dried printed sample in g m_{St} = mass of stock solution 1667 g = total mass of material in the Hobart pulper 100 g = mass of hydrogen peroxide solution > The sample amount required for disintegration in Hobart is automatically calculated in the Excel spreadsheet.
4	Preparation Hobart	> Preheat the Hobart pulper to the $(45 \pm 2) ^\circ\text{C}$ for disintegration (temperature setting on the side of the device).
5	Repulping	> Put the sample quantity (see Laboratory spreadsheet) into the Hobart pulper. > Add the calculated amount m_{dw} of dilution water, heated to the required temperature, to the calculated amount m_{ds} of deinking solution. Add this deinking liquor to the vessel and run the pulper for a few seconds at low speed. > Then stop the pulper and brush down any paper scraps from the sidewall if present. > After the first stop, add the required amount of peroxide solution diluted to 100 g with deionised water. > Immediately after, repulp the stock for a total time of 20 min at approximately 45°C, using rotor speed 2. Repeat the stop-ping and brushing as often as necessary until the walls of the vessel remain free of adhered sample pieces. Stop the watch/timer as long as you stop the pulping. > Fibre consistency of approximately 12% is desired, depending on the amount of non-paper constituents, and as determined in the coarse screening step of Batch 1. > Important! Cover the vessel with the lid while pulping to avoid splashing and solution loss.
6	Measure pH	> Measure the pH value in the fibre suspension in the Hobart immediately after disintegration. > Therefore, take a small amount of the pulp and press it out manually to obtain some filtrate on which the pH is measured. Both the fibres and the filtrate are transferred back into the Hobart pulper. > The pH must be 9.5 ± 0.5 (note: if the pH value is outside this range, the test must be repeated with an adjusted stock solution). > The pH value needs to be noted down.

6.1.1 Storage and dilution of the pulped sample

Process no.	Remarks	Description
1	Storage	> Pour the pulped sample completely into a 5-10 l barrel (tare it on the scale beforehand). > Rinse the Hobart with dilution water ($^{\circ}\text{dH} = 18$) and fill up to 5 % consistency with dilution water. > Store at $(45 \pm 2)^{\circ}\text{C}$ for 60 min. > pH value measure before and after storage in the fibre suspension, document the pH value in the Excel spreadsheet. > After storage, 1 x 400 g sample (UP) is taken after thorough mixing.
2	Dilution for flotation	> Dilute 3.6 l from the remaining pulp sample with dilution water to a total of 18 l.

6.1.2 Flotation

Process no.	Remarks	Description
1	Preparation	> Preheat the flotation cell with lukewarm water to approximately $(45 \pm 2)^{\circ}\text{C}$. > Drain the water. > Place a large weighed barrel to collect the reject overflow. > Place a large barrel to collect the accept from the outlet tap. > Insert the sample into the flotation cell. > Fill it with dilution water at approximately $(45 \pm 2)^{\circ}\text{C}$ up to 22.5 l. > Measure the pH value (note: the pH value after dilution must be ≥ 7.5, otherwise the test must be discarded and repeated with a higher dosage of NaOH). > Put on the foam scraper.
2	Flotation	> Turn on the rotor. > Set air supply scale 9-10 (7 l/min). > When opening the air supply start the stopwatch. > Float for 12 min. > Rinse off deposits on the edge and foam scraper with the spray bottle during flotation. > Increase the water level in the flotation tank with approximately $(45 \pm 2)^{\circ}\text{C}$ dilution water to keep the overflow constant. > Collect the flotation foam in a barrel.
3	Drain	> Drain the accept completely into a barrel. > Fill the flotation cell completely with water for cleaning.
4	Reject	> Weigh the reject in the barrel and document it in the Excel spreadsheet, making sure to include the foam that is attached to the flotation cell or overflow from the foam barrel. > Perform a double determination of the consistency filtering approximately 200 g of flotate.

6.1.3 Specimen preparation for analysis

Process no.	Remarks	Description																				
1	Sample preparation	> Filter sheets and laboratory sheets must be prepared from the following samples: - UP: 4 x filter pads (2 of them left with filter paper for residue on ignition) - DP: 4 x filter pads (2 of which are left with filter paper for residue on ignition) + 2 x laboratory handsheet s + 2 x membrane filters - Float: 2 x filter pads																				
2	Photo documentation	> All filter sheets, laboratory sheets and the membrane filters must be documented in pictures to be used in the test report of each sample.																				
3	UP	2 x filter pads are made according to INGEDE Method 1. > Transfer 400 g sample into a barrel. > Fill it up to 2 L (= 20 g OD). > Use the filter paper type Munktell type 1289. > Perform 2 x consistency measurements, these filters will also be used for determining the ash content (including filter paper). > Also produce 2 filter pads according to INGEDE Method 1 for optical properties). > 2 x optical properties: 4 g OD (adjust this amount depending on the sample consistency) drain it over a 150 mm filter sheet. > Important! After the filtration, carefully peel off the filter sheet from the sample. > The labelling is done on the side in which the filter sheet was in contact with. > If the Büchner funnel is a different size, the sample volume must be adjusted according to the table below. > Dry the filter paper in the dryer of the sheet former between two clean cover sheets 2 x 10 min. and optical properties 1 x 10 min. <table><tr><th>Diameter max Büchner funnel in mm</th><th>Diameter filter paper (Munktell 1289) in mm</th><th>Oven dry material in g</th><th>Sample volume at 0.4% consistency in ml</th></tr><tr><td>120</td><td>110</td><td>2,15</td><td>538</td></tr><tr><td>135</td><td>125</td><td>2,75</td><td>688</td></tr><tr><td>160</td><td>150</td><td>4,00</td><td>1000</td></tr><tr><td>195</td><td>185</td><td>6,10</td><td>1525</td></tr></table>	Diameter max Büchner funnel in mm	Diameter filter paper (Munktell 1289) in mm	Oven dry material in g	Sample volume at 0.4% consistency in ml	120	110	2,15	538	135	125	2,75	688	160	150	4,00	1000	195	185	6,10	1525
Diameter max Büchner funnel in mm	Diameter filter paper (Munktell 1289) in mm	Oven dry material in g	Sample volume at 0.4% consistency in ml																			
120	110	2,15	538																			
135	125	2,75	688																			
160	150	4,00	1000																			
195	185	6,10	1525																			

Process no.	Remarks	Description
4	DP	2 x filter pads, 2 x membrane filters and 2 x laboratory sheets are made according to INGEDE Method 1. <u>2 x filter pads:</u> > Determine the consistency from the barrel. > Use the filter paper type Munktell 1289. > Prepare 2 filter pads according to INGEDE Method 1 (2 x optical properties), save the filtrate. - 4 g dry sample, depending on the consistency of the stock, dewater it using a 150 mm filter sheet. > Important! Use the suction flask and the Büchner funnel exclusively for water analysis tests. > Important! After filtration, carefully peel off the filter sheet from the sample. > Dry in the dryer of the sheet former between two cover sheets for 10 min. > If the Büchner funnel is a different size, the sample volume must be adjusted according to the table as it was done for the UP. <u>2 x membrane filter:</u> > For the optical properties (according to INGEDE Method 1), pour the two filtrates of the filter papers produced together and homogenise them. > Dewater 2 x 100 mL of the filtrate by means of vacuum filtration using a membrane filter each. > If fibre content is found on the membrane filter, it means that fibres have passed through the filter during the production of the filter pads. In this case, remanufacture the filter pads and membrane filter. > The filtrate of the membrane filter must be predominantly col-ourless and clear. If this is not the case, proceed as follows: - Repeat filtration with a new sample (100 mL) - Add a flocculant prior to filtration - Add a saturated aluminium sulphate solution before membrane filtration to a pH of 6.0 ± 0.5 - In parallel, a reference membrane filter with 100 mL of dilution water and the corresponding amount of flocculant must be prepared - If used, note in the test report the type and amount of flocculant used <u>2 Laboratory handsheets</u> > 1.35 g OD sample is taken from the distributor. > The sheet former is operated in fresh water mode. > Each handsheet is removed from the screen and placed on a carrier board, covered with a cover sheet and dried for 7 min. in the drier of the sheet former. > The grammage should be (42.6 ± 1.6) g/m² or must have weight of (1.35 ± 0.05) g OD. > If the basis weight is not reached, the amount of suspension must be adjusted accordingly > Perform at least two handsheets. > Make sure to label each handsheet.
5	Special cases	> In case of the presence of any screenable non-paper constituents observed in the first handsheet, screen 20 g of the deinked pulp (150 µm slot width, 20 min.) according to fine-screening step of Paper and Board – Recyclability Laboratory Test Method – Part II: Paper mill with flotation-deinking recycling process. > Collect the ‘accept’ of this screening step (this may be thick-ened according to Paper and Board – Recyclability Laboratory Test Method – Part II: Paper mill with flotation-deinking recycling process) and form the laboratory handsheets using this pulp, as described above.

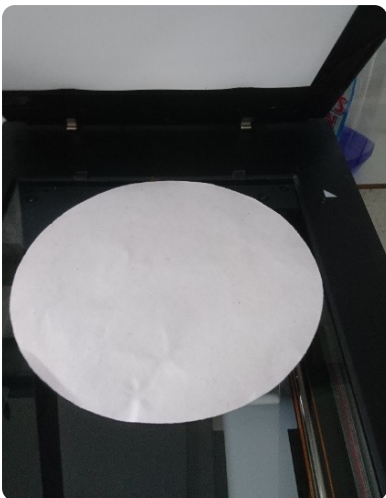
6.2 Analyses

Process no.	Remarks	Description
1	Ash content	> The determination of the ash content according to ISO 1762 is carried out for the following samples: – UP: 2 x filter from consistency measurement – DP: 2 x filter from consistency measurement
2	Optical properties	> The optical properties are carried out on the following samples according to INGEDE Method 2: – UP: 2 x filter pads – DP: 2 x filter pads, 2 membrane pads
3	Dirt specks	> The dirt specks are measured using a visual analysis software e.g. PTS DOMAS-Multispec (description under section 6.4) > To measure the dirt specks, use the two DP laboratory handsheet and measure the front and back sides of them.

6.3 Calculation of flotation yield

Process no.	Remarks	Description
1	Overall yield	> The total yield is calculated using the following formula: $Yield = \frac{(c_{UP} * m_{UP}) - (c_{Flotate} * m_{Flotate})}{(c_{UP} * m_{UP})} * 100 \%$ Yield = total yield c_{UP} = concentration of undeinked pulp in % m_{UP} = mass of undeinked pulp in kg $c_{Flotate}$ = concentration of flotate in % $m_{Flotate}$ = mass of flotate in kg
2	Fibre yield	> The fibre yield is calculated using the following formula: $fibre\ Yield = Yield * \frac{100\% - c_{asc,DP}}{100\% - c_{asc,UP}}$ $c_{ash, DP}$ = residue on ignition 525 °C of deinked pulp in % $c_{ash, UP}$ = residue on ignition 525 °C of the undeinked pulp in %

6.4 Measurement dirt specks

Process no.	Remarks	Description
1	Insert sample  Figure 39. Positioning of laboratory handsheet	> At first, perform a blank scan for the scanner position. > Place the sample (RK sheet with a diameter of 200 mm), positioning it at the top edge and at the right edge with respect to the scanner glass plate. > Place the stack of white sheets on the sample. > Close the scanner and start the measurement according to the procedures needed for the chosen scanner and in accordance to the INGEDE Method 2.
	 Figure 40. Cover of the handsheet	
2	Note	> If the dirt speck measurement is disturbed, due to the presence of metal particles or other disturbing particles, measure the sheet anyway and look in the assessment scheme for further calculations and handling.

7 Evaluation

Step Nr.	Notes/Pictures	Description
1	The evaluation scheme for this method is published separately.	

8 Documentation

Please use Part II laboratory report template for further documentation.

List of changes

Rev.	Valid from	Author	Change(s)
Rev. 01/2021-09-01	May 2022	Marie Geißler	First version of the detailed description Part II
Rev. 01/2021-09-01	June 2022	Marie Geißler	Adding the Screening step of the deinked Pulp, if any non-paper constituents occur in the first handsheet for the dirt specks measurement
Rev. 01/2021-09-01	August 2022	Marie Geißler	Adding Comments from Christian Trieb and already changing acc. to the comments
Rev. 01/2021-09-01	September 2022	Marie Geißler	Adding Comments from CTP and already changing acc. to the comments, Adding the process scheme
Rev. 01/2021-09-01	September 2022	Marie Geißler	Adding Comments from CTP and Propakma and already changing acc. to the comments, Adding the process scheme
Rev. 01/2021-09-01	October 2022	Marie Geißler	Finalizing the description acc. to last Comments from Propakma
Rev. 01/2021-09-01	November 2022	Marie Geißler	Finalizing of the Group Expert Group Decisions on last open Comments
Rev. 01/2021-09-01	January 2023	Marie Geißler	Finalizing of Propakmas last open Comments
Rev. 01/2021-09-01	March 2023	Marie Geißler/ Christian Trieb	Finalizing of last Comments and Document
Rev. 11/20230516	May 2023	Peter Hengesbach	Editorial changes, accepting all changes done before, Version for WS consultation
Rev. 12/2024-10-31	Oct 2024	Christian Trieb	Editorial changes

ABOUT 4EVERGREEN

[4evergreen](#) is a cross-industry alliance perfecting the circularity of paper-based packaging to contribute to a climate-neutral and sustainable society. Our goal is to raise the overall recycling rate of paper-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 paper-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.



For general enquiries please contact 4evergreen@cepi.org