RecyClass

SORTING EVALUATION PROTOCOL

FOR PLASTIC PACKAGING

STANDARD TESTING PRACTICE

VERSION 2.0

UPDATED ON JANUARY 2024

RecyClass

CONTENT

GLOSSARY

PET	Polyethylene Terephthalate
PE	Polyethylene
LDPE	Low Density Polyethylene
HDPE	High Density Polyethylene
PP	Polypropylene
PS	Polystyrene
NIR	Near-Infrared

DISCLAIMER

RecyClass is an initiative working on enhancing and evaluating the recyclability of plastic packaging through a technical perspective. The Sorting Protocol and the Recyclability Evaluation Protocols promote recyclability by encouraging industry to test new plastic technologies, materials or products before market launch and giving advice and recommendations to the companies.

The Protocols are available to download on the Plastics Recyclers Europe and RecyClass websites. Companies providing plastic packaging concepts are encouraged to use them to self-assess the impact of their solutions on recyclability and highlight potential issues. **However, compliance with a RecyClass Protocol is not a replacement for an official assessment and may not be used as a marketing tool.**

All tests must follow the Protocols recommended by the RecyClass Technical Committees and/or the Certification Bodies recognized by RecyClass and must be conducted by an independent laboratory or facility recognized by RecyClass which has no legal affiliation to the applicant.

More information is reported in the RecyClass Internal Procedures available on the *RecyClass website.*

RecyClass

1. INTRODUCTION AND PURPOSE OF THE PROTOCOL

The "Sorting Evaluation Protocol" referred to in this document as "The Protocol" describes the methodology that may be followed by the Applicant at pilot or industrial scale to determine the sorting behaviour and the recycling stream of the tested packaging.

The Protocol evaluates the sorting behaviour of plastic packaging considering the following waste streams:

- PE flexibles,
- PP flexibles,
- Mixed plastics flexibles,
- PET bottles, (transparent clear/light blue vs transparent colored)
- PET trays (transparent clear)
- PP rigids,
- HDPE rigids,
- PS rigids,
- Mixed plastics rigids.

The Protocol also considers the design issues that can misdirect the plastic packaging to the streams of ferrous metals, non-ferrous metals, drinking carboard, or residues.

This document provides guidance on the testing methodology that shall be followed, including benchmark recommendations to guide the interpretation of the results.

2. SCOPE OF THE PROTOCOL

The scope of the Protocol covers any plastic packaging mainly made of PE, PP, PET or PS. Prior to initiating the evaluation, the Applicant is invited to review the RecyClass Design for Recycling Guidelines[1], Online Tool[2] and Recyclability Methodology[3] in order to verify that the packaging design will not mislead the sorting results.

This protocol covers consumer plastic packaging formats, including but not limited to:

1. Flexible films
2. Pouches
3. Bags
4. Bottles
5. Containers
6. Tubes
7. Pots
8. Cups
9. Trays
10. Foam and expanded foam packaging

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1 Design for Recycling Guidelines available here

[2] RecyClass Online Tool available here

[3] Recyclability Methodology of RecyClass available here

The Protocol provides guidance on the sorting parameters to apply to determine the recycling stream of the plastic packaging. Packaging containing predominantly different material than plastic or made of different plastic polymers than the ones listed above shall not refer to this Protocol and shall be separately considered to assess their sorting behaviour.

3. DISCLAIMER

The Protocol is created to represent as accurately as possible how the current European sorting facilities work at an industrial scale. The RecyClass Technical Committees reserve the right for further testing if necessary and the RecyClass Sorting Task Force may update the Protocol following new sorting practices.

State of the art European sorting facilities are operating with the following steps:

- Sieve drum,
- Wind sifter,
- Magnet,
- Eddy current,
- Ballistic separation
- NIR detections and RGB camera

Consequently, any other sorting innovation (tracers, digital marks, AI) is not considered in the Protocol and will not be considered until widely used at commercial scale.

4. TESTING METHODOLOGY

This methodology aims to reproduce the setting of state-of-the-art European sorting facilities by following the same steps and by applying similar parameters. The methodology described below shall be followed precisely and any modifications or problems must be noted during the testing phase.

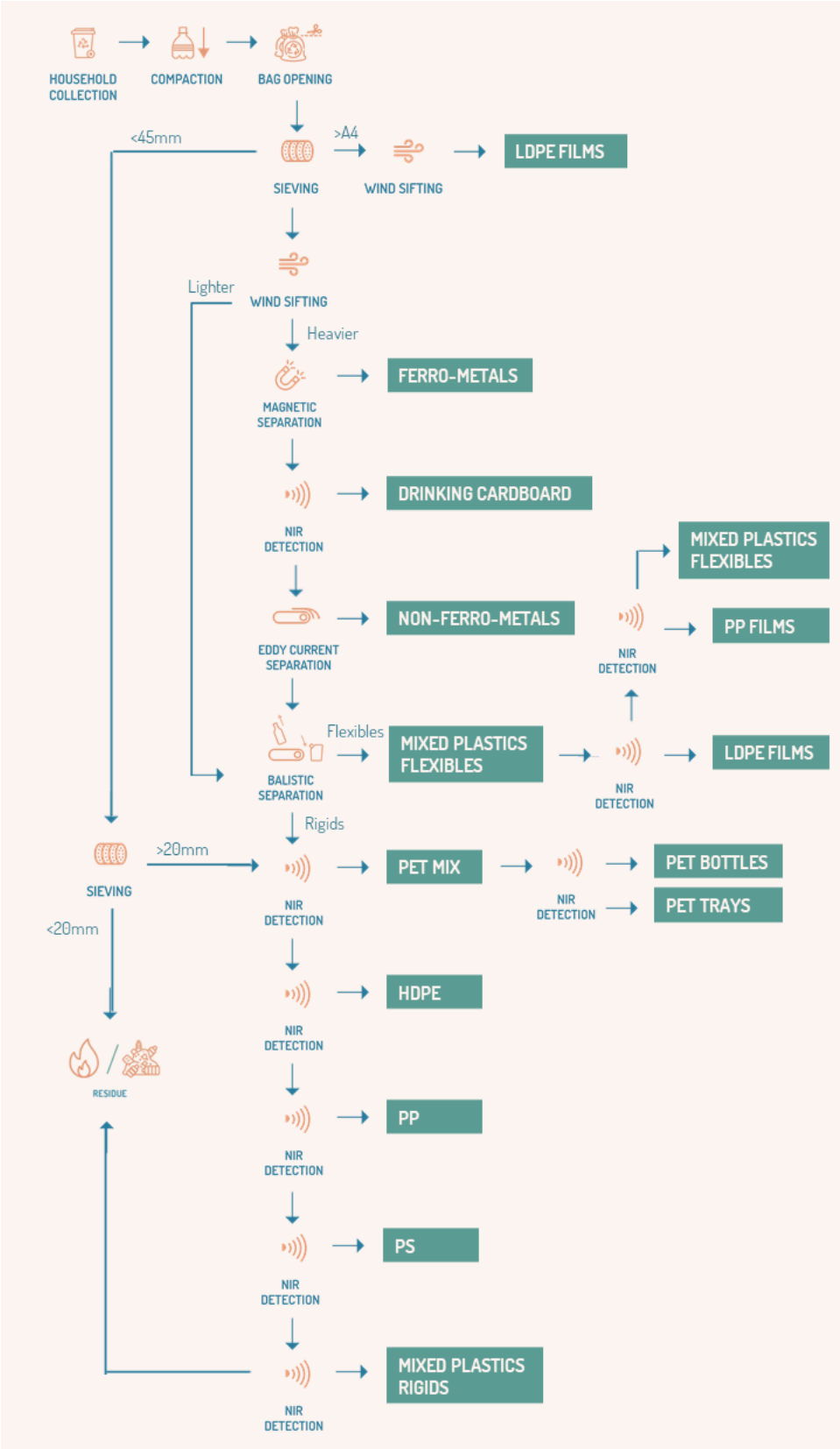
Line settings

The settings of the line for the trials must be representative of a European MRF (Materials Recovery Facility) sorting line. Any deviation from standard setting will have to be reported in the results.

A Sorting Evaluation Report compiling all the results obtained shall be prepared by the testing facility to record the results. Any remarks observed during the testing must be noted in this Report.

See below in Figure 1 a diagram where the flow of the methodology is described.

Figure 1: Methodology Diagram



4.1 SAMPLE SELECTION

For the purpose of the tests, the Applicant should provide at minimum the quantities of samples described in Table 1.

Table 1. Number of samples for testing.

Type of packaging	Volume or dimension	Minimum Samples required
Rigid plastic bottles/containers/tubes	≥ 0,45 litre	50
Rigid plastic bottles/containers/tubes	< 0,45 litre	100
Rigid plastic tubes or trays	At least one side ≥ 10 cm	50
Rigid plastic tubes or trays	Sides < 10 cm	100
Foam or expanded foam packaging	≥ 5 cm; <50 cm	50
Flexible plastic packaging (films/pouches/bags)	At least one side ≥ 10 cm	50
Flexible plastic packaging (films/pouches/bags)	Sides < 10 cm	100

More packaging could be requested by the RecyClass recognized testing facilities, if necessary. It is worth to point out that the packaging to be tested is not limited to one component but to the packaging as a whole. Therefore, the packaging must be submitted to the sorting centre as placed on the market with labels, adhesives, closure system, liners, seals, valves, and any other components.

4.2 SAMPLE PREPARATION PROCEDURE

Household packaging waste enters the sorting process crushed and folded due to transportation and logistics. To get a representative situation, the protocol must simulate the compression and the friction of the process as typically caused by truck compression and transfer. Typical compression rate applied by truck during waste collection is 20% of the waste volume collected.

It is noteworthy that consumer behaviour is not considered in the Protocol since it differs widely and is not representative of the way the packaging is disposed of and collected. Indeed, the same packaging can be discarded by consumer as it is or flattened, emptied and cleaned or containing partial residues, depending on consumer behaviour, and/or based on brand or local authorities' recommendations.

- **All packaging must be provided by the Applicant with the closures on.**
- **It is mandatory to provide packaging filled in with product in case the Easy-to-Empty[4] or Easy-to-Access index is higher than 5 %.**
- **In case of semifinished packaging (RecyClass 'Letter of Compatibility'), it is not mandatory to provide packaging filled with product.**

[4] RecyClass Methodology

4.2.1 GENERAL SAMPLE PREPARATION

The following steps should be considered by the RecyClass recognized facilities to prepare the samples for testing.

Procedure:

1. In case a certification body highlights issues with product residues (i.e., Easy to Empty index higher than 5 because of the packaging design or the product viscosity), the testing facility must require the Applicant to provide filled samples (exception for semi-finished packaging, i.e. RecyClass Letter of Compatibility) It is noteworthy that product residues can have an impact on the packaging sorting behaviour.
2. In case filled packaging is supplied, the packaging is emptied by the testing facilities following the RecyClass methodology and tested with the product residue. If not, step 2 can be skipped.
3. Packaging is crushed by applying pressure to simulate truck compression. In case of flexibles packaging, crumbling the packaging manually is enough.
   Compression must be applied by using a compression machine. Pressure applied should be recorded in the report. Compression rate applied should target be 1/5 at least.
   3.1 Introduce packaging with product residues (in case the EtE index is higher than 5%) in the compression machine (semifinished packaging are exempted in this case).
   3.2 Ensure that the compression machine is fully filled with other packaging materials.
   3.2 Compress the packaging to reduce the volume to 1/5.
   3.3 Open the press and mix the material; compress with the same settings three times without interruptions.
   3.3 Separate interlocked packaging
   3.4 Record the pressure applied during the compression.

   Pictures before and after compression must be provided with the Report.

Sample identification:

The recognized facility must report information about the packaging in the following table:

Table 2. Report of the packaging conditions during the preparation procedures.

#	Number/Value	Note	Picture
Packaging used			
EtE index (only in case of finished packaging)			
Packaging compressed			
Packaging not or partially compressed			
Packaging with all components still on after compression			
Packaging without component 1 (specify components 1[5])			
Packaging without component 2 (specify component 2)			

In case of packaging with partial removal of one component (e.g. partial removal of the sleeve, of the lid, of elements from the closures, etc.) figures and pictures must be provided.

[5] *Packaging component could be cap, closure system, label, sleeve, any other attachment.*

4.2.2 INNOVATIVE PACKAGING PROVIDED WITH CELLULOSE-BASED COMPONENTS

In case of plastic packaging provided with unglued cellulose-based decorations, to simulate in a close way realistic condition in terms of collection and transportation:

1. Store the emptied and crushed packaging in a collection bin.
2. After 7 days, mix the packaging and crush it once again.

Seven days is a typical period between the collection and the sorting for plastic packaging. During the 7 days fibres can absorb moisture and assume different behaviour. The Protocols aims to determine the impact of such technologies on plastic packaging sorting.

Sample identification:

Pictures before collection and after collection, after contamination, after 1st and 2nd compression steps must be provided with the report.

4.3 CHECK DIMENSIONS

After the compression and friction simulation, spread out crumbled packaging (and/or separated components) on a surface:

- ✓ Is any of the 3 dimensions (width/height/depth) of the packaging or component(s) small enough to be rejected by the sieve drum (check 1: <30 mm, check 2: <50 mm)?
- ✓ Is the packaging larger than 30 cm?

If either of the above questions is answered with 'Yes', a **Sieve Drum** Test should be performed.

In all other cases it is assumed that the packaging will not face issues at the sieve drum and can continue onto the next sorting step.

4.3.1 SIEVE DRUM TEST

The Sieve Drum Test aims to eliminate small items that will fall through the holes of the sieve.

Procedure:

- Feed samples* to the conveyor belt with other packaging waste. This should be the belt which is feeding the Sieve Drum.
  *(*Depending on the number of samples provided, use 20 from 100 or 10 from 50 samples)*
- Count the number of samples passing on to the next sorting step.
- Add more samples when the outcome is ambiguous.
- At least two people are required for this test (one feeding the process, one analysing the output.

Results of the Sieve drum test:

- ✓ Materials being discarded as too small, will end-up in the **RESIDUE fraction**.
- ✓ Materials being discarded as too large, will continue to the step "**The Wind Sifter**".
- ✓ Materials in between will also continue to the step "**The Wind Sifter**".

4.4 THE WIND SIFTER

The Wind Sifter creates an upward facing airflow over the conveyor belt. This airflow sucks up the light-weight-materials and separates them from heavier material. The over-sized materials (which passed the sieve drum) will move to the dedicated Wind Sifter.

Procedure for over-sized materials (which passed the sieve drum):

- Feed samples* to the conveyor belt at the end of the Sieving Drum and prior to the dedicated Wind Sifter. Add the samples on the line whilst other packaging waste is on there as well.
  *(*Depending on the number of samples provided, use 20 from 100 or 10 from 50 samples)*
- Observe and count the number of samples being sucked up by the Wind Sifter.
- Add more samples when the outcome is ambiguous.

Results of the Wind Sifter:

- ✓ Materials being sucked up by the Wind Sifter, will end-up in the **MIXED FILM fraction**.
- ✓ Materials not being sucked up by the Wind Sifter, will end-up in the **RESIDUE fraction**.

Procedure for other materials (which fell through the holes in the sieve drum):

- Determine the appropriate Wind Sifter (depending on size < or > 24 cm).
- Feed samples* to the conveyor belt after the wholes of the Sieving Drum and prior to the dedicated Wind Sifter. Add the samples to the line whilst other packaging waste is on there as well.
  *(*Depending on the number of samples provided, use 20 from 100 or 10 from 50 samples)*
- Observe and count the number of samples being sucked up by the Wind Sifter.
- Add more samples when the outcome is ambiguous.

Results of the Wind Sifter:

- ✓ Materials > 24cm being sucked up by the Wind Sifter, will end-up in the **MIXED FILM fraction**.
- ✓ Materials < 24cm being sucked up by the Wind Sifter, will continue to the step "**The Ballistic Separation**".
- ✓ Materials over and under 24cm not being sucked up by the Wind Sifter, will continue to the step "**The Magnet**".

4.5 THE MAGNET

Materials falling through the holes in the Sieve Drum and not being separated by the Wind Sifter, go to the next step: the magnet. Based on the description in the required input data and sense-observation, the presence of ferrous-metals in the packaging is checked:

1. If metals are found and it's uncertain if they are ferrous or non-ferrous, a quick test on the packaging is done with a small hand-magnet.
2. If no ferrous-metals have been reported or found with the magnet, the packaging will continue to the step "**NIR-Beverage Carton**".
3. Packaging containing ferrous metals are run through the following procedure.

Procedure:

- Feed samples* to the conveyor belt with other packaging waste. This should be the belt which is running towards the over-belt-magnet.
  *(*Depending on the number of samples provided, use 20 from 100 or 10 from 50 samples)*
- Count the number of samples passing on to the next sorting step (or, depending on the local situation, count the number of samples being sorted in the Ferro-metals).
- Add more samples when the outcome is ambiguous.
- At least two people are required for this test (one feeding the process, one analysing the output).

Results of the Magnet:

- ✓ Materials sorted by the magnet, will end-up in the **FERROUS-METAL fraction**.
- ✓ Materials not sorted by the magnet, will continue to the step "**NIR-Beverage cartons**".

4.6 NIR-BEVERAGE CARTON

Materials that pass the magnet, continue to the next sorting step: the NIR for beverage cartons. Based on the description in the required input data and sense-observation, the presence of cardboard in the packaging is checked:

1. If no cardboard has been reported or found in the packaging, the packaging will continue to the step "**Eddy Current**".
2. Packaging containing cardboard are run through the following procedure.

Procedure:

- Feed samples* to the conveyor belt with other packaging waste. This should be the belt which is running towards the NIR for Beverage cartons.
  *(*Depending on the number of samples provided, use 50 from 100 samples)*
- Count the number of samples passing on to the next sorting step (or, depending on the local situation, count the number of samples being sorted in the Beverage cartons fraction).
- Add more samples when the outcome is ambiguous.
- At least two people are required for this test (one feeding the process, one analysing the output).

NIR program:

The NIR program used for the test must be the one referenced in the site accreditation. The program used should be reported in the results.

Results of the NIR-Beverage carton:

- ✓ Indicate settings used with reference to the sorting program.
- ✓ Materials sorted by the NIR for Beverage cartons, will end-up in the **BEVERAGE CARTON fraction**.
- ✓ Materials not sorted by the NIR for Beverage carton, will continue to the step "**Eddy Current"**.

4.7 EDDY CURRENT

Materials that are not sorted by the NIR for Beverage cartons, continue to the next sorting step: the Eddy Current. The goal of this step is to separate the packaging (components) made from (or containing) non-ferrous metals. Based on the description in the required input data and sense-observation, the presence of non-ferrous metals in the packaging is checked:

1. If no non-ferrous metals have been reported or visually identified, the packaging will continue to the step "**Ballistic Separation**".
2. Packaging containing or expected to contain non-ferrous metals are run through the following procedure.

Procedure:

- Feed samples* to the conveyor belt with other packaging waste. This should be the belt which is running towards the Eddy Current. Make sure the materials are placed on the belt prior to the point at which they receive the electrostatic charge.
  *(*Depending on the number of samples provided, use 20 from 100 or 10 from 50 samples)*
- Count the number of samples passing on to the next sorting step (or, depending on the local situation, count the number of samples being sorted in the non-ferrous metals).
- Add more samples when the outcome is ambiguous.
- At least two people are required for this test (one feeding the process, one analysing the output).

Results of the Eddy Current:

- ✓ Materials sorted by the Eddy Current, will end-up in the **NON-FERROUS METAL fraction**.

✓ Materials not sorted by the Eddy Current, will continue to the step "**Ballistic Separation**".

4.8 BALLISTIC SEPARATION

The Ballistic Separation aims to distinguish rigid (or 3D) packaging from flexible (or 2D) packaging. The materials passing step 6 will move into this process-step.

Procedure:

- Feed samples* to the ballistic separator. Add the samples whilst other packaging waste is on there as well.
  *(*Depending on the number of samples provided, use 20 from 100 or 10 from 50 samples)*
- Count the number of samples moving up and moving down.
- Add more samples when the outcome is ambiguous.

Results of the Ballistic Separation:

✓ Materials moved up, will end-up in the **MIXED PLASTIC FLEXIBLES fraction**.
✓ Materials moved down, will continue to the step "**Static Test**".

4.9 STATIC TEST

Prior to running through the individual NIR-polymer-sorters, a static test with the material is performed.

Procedure:

- Use an empty NIR sorter and put a couple of samples on the non-rolling-conveyor-belt.
- Check at the screen which type of polymer the packaging is identified by the NIR.
- Check different angles and different shaped (crushed) samples.
- Check if the identification also activates the air-nozzles.
- If the static test clearly identifies one type of polymer, continue to that specific sorting test: PET, PE, PP, PS, and mixed plastics.

4.10 NIR

The NIR programs used for the test must be the ones referenced in the site accreditation. The programs used will be reported in the results. The site ensures that the program used is representative of European MRFs standard settings.

4.10.1 NIR PET

Materials that pass the static test continue to the next sorting step: the NIR for PET. Based on the description in the required input data and sense-observation, the presence of PET in the packaging is checked:

1. If no PET has been reported or found in this packaging, the packaging will continue to the step "**NIR PE**".
2. Packaging containing PET are run through the following procedure.

Procedure:

- Check the program used is compliant with the accreditation requirements.
- Feed samples* to the conveyor belt with other packaging waste. This should be the belt which is running towards the NIR for PET.
  *(*Depending on the number of samples provided, use 50 from 100 samples)*

- Count the number of samples passing on to the next sorting step (or, depending on the local situation, count the number of samples being sorted in the PET).
- Add more samples when the outcome is ambiguous.
- At least two people are required for this test (one feeding the process, one analysing the output).

Results of the NIR PET:

- ✓ Indicate settings used with reference to the sorting program. Any deviation from the reference program should be reported.
- ✓ Materials sorted by the NIR PET, will (depending on country and sorting facility) either end-up in the general **PET fraction** or pass on to the step "**PET-bottles or PET-trays**" for additional sorting in PET-trays and PET-bottles.
- ✓ Materials not sorted by the NIR PET, will continue to the step "**NIR PE**".

4.10.2 NIR PET-BOTTLES OR PET-TRAYS

Materials that were sorted as PET continue to the next sorting step: the separation of bottles from trays. The packaging is run through the following procedure.

Procedure:

- Check the program used is compliant with the accreditation requirements.
- Feed samples* to the conveyor belt with other packaging waste This should be the belt which is running towards the NIR for PET-bottle/tray separation.
  *(*Depending on the number of samples provided, use 50 from 100 samples)*
- Count the number of samples being sorted as PET-bottle (or, depending on the local situation, count the number of samples being sorted in the PET-trays).
- Add more samples when the outcome is ambiguous.
- At least two people are required for this test (one feeding the process, one analysing the output).

Results of the NIR PET-Bottles or PET-Trays:

- ✓ Indicate settings used with reference to the sorting program. Any deviation from the reference program should be reported.
- ✓ Materials sorted by the NIR PET-Bottles, will end-up in the **PET-BOTTLES fraction**.
- ✓ Materials sorted by the NIR PET-Trays, will end-up in the **PET-TRAYS fraction**.

4.10.3 NIR PE

Materials that pass the NIR PET step continue to the next sorting step: the NIR for PE. Based on the description in the required input data and sense-observation, the presence of PE in the packaging is checked:

1. If no PE has been reported or found in this packaging, the packaging will continue to the step "**NIR PP**".
2. Packaging containing PE are run through the following procedure.

Procedure:

- Check the program used is compliant with the accreditation requirements.
- Feed samples* to the conveyor belt with other packaging waste. This should be the belt which is running towards the NIR for PE.
  *(*Depending on the number of samples provided, use 50 from 100 samples)*
- Count the number of samples passing on to the next sorting step (or, depending on the local situation, count the number of samples being sorted in the PE).
- Add more samples when the outcome is ambiguous.
- At least two people are required for this test (one feeding the process, one analysing the output).

Results of the NIR PE:

- ✓ Indicate settings used with reference to the sorting program. Any deviation from the reference program should be reported.
- ✓ Materials sorted by the NIR PE, will end-up in the **PE fraction**.
- ✓ Materials not sorted by the NIR PE, will continue to the step "**NIR PP**".

4.10.4 NIR PP

Materials that pass the NIR PE step continue to the next sorting step: the NIR for PP. Based on the description in the required input data and sense-observation, the presence of PP in the packaging is checked:

1. If no PP has been reported or found in this packaging, the packaging will continue to the step "**NIR PS**".
2. Packaging containing PP are run through the following procedure.

Procedure:

- Check the program used is compliant with the accreditation requirements.
- Feed samples* to the conveyor belt with other packaging waste. This should be the belt which is running towards the NIR for PP.
  *(*Depending on the number of samples provided, use 50 from 100 samples)*
- Count the number of samples passing on to the next sorting step (or, depending on the local situation, count the number of samples being sorted in the PP).
- Add more samples when the outcome is ambiguous.
- At least two people are required for this test (one feeding the process, one analysing the output).

Results of the NIR PP:

- ✓ Indicate settings used with reference to the sorting program. Any deviation from the reference program should be reported.
- ✓ Materials sorted by the NIR PP, will end-up in the **PP fraction**.
- ✓ Materials not sorted by the NIR PP, will continue to the step "**NIR PS**".

4.10.5 NIR PS

Materials that pass the NIR PP step continue to the next sorting step: the NIR for PS. Based on the description in the required input data and sense-observation, the presence of PS in the packaging is checked:

1. If no PS has been reported or found in this packaging, the packaging will continue to the step "**NIR Mixed Plastics**".
2. Packaging containing PS are run through the following procedure.

Procedure:

- Check the program used is compliant with the accreditation requirements.
- Feed samples* to the conveyor belt with other packaging waste. This should be the belt which is running towards the NIR for PS.
  *(*Depending on the number of samples provided, use 50 from 100 samples)*
- Count the number of samples passing on to the next sorting step (or, depending on the local situation, count the number of samples being sorted in the PS).
- Add more samples when the outcome is ambiguous.
- At least two people are required for this test (one feeding the process, one analysing the output).

Results of the NIR PS:

- ✓ Indicate settings used with reference to the sorting program. Any deviation from the reference program should be reported.
- ✓ Materials sorted by the NIR PS, will end-up in the **PS fraction**.
- ✓ Materials not sorted by the NIR PS, will continue to the step "**NIR Mixed Plastics**".

4.10.6 NIR MIXED PLASTICS

Materials that pass the NIR PS step continue to the next sorting step: the NIR for Mixed Plastics Rigids. Based on the description in the required input data and sense-observation, the presence of recognisable polymers in the packaging is checked. The packaging is run through the following procedure.

Procedure:

- Check the program used is compliant with the accreditation requirements.
- Feed samples* to the conveyor belt with other packaging waste. This should be the belt which is running towards the NIR for Mixed Plastics Rigids.
  *(*Depending on the number of samples provided, use 50 from 100 samples)*
- Count the number of samples passing on to the next sorting step (or, depending on the local situation, count the number of samples being sorted in the Mixed Plastics Rigids).
- Add more samples when the outcome is ambiguous.
- At least two people are required for this test (one feeding the process, one analysing the output).

Results of the NIR Mixed Plastics:

- ✓ Indicate settings used with reference to the sorting program. Any deviation from the reference program should be reported.
- ✓ Materials sorted by the NIR Mixed Plastics, will end-up in the **MIXED PLASTICS RIGIDS fraction**.
- ✓ Materials not sorted by the NIR Mixed Plastics, will end-up in the **RESIDUE**.

4.11 MANUAL QUALITY INSPECTION

During the manual inspection, the quality is being improved by removing unwanted material from the different automatically sorted material fractions.

Based on the product residue in the packaging (for instance silicone) or specifications of unwanted materials, manual removal of certain packaging is standard practise.

Procedure:

- Compare the product with quality inspection guidelines.
- Align the score of the automatic sorting tests with its manual correction.

4.12 REPORT CONTENT

The report should contain the following information:

- Reference to the Sorting Protocol.
- Description of the sorting facility: equipment and settings applied.
- A full and complete identification of the material tested with photographs.
- Description of the samples during each step.
- The photographs are welcome whenever useful for documenting specific situations.

- Details of any deviation from the test method, as well as any incident which may have influenced the results.
- Results & Discussion
- Conclusions, percentage of each fraction and recommendations (if any)
- Test figures. Use the tables below as reference.

Table 2: Size sorting tests

Packaging reference	Packaging photo	Samples tested	>5cm Correctly sorted	<5cm Additional sieve	<5 and >2cm Re-enter process	<2cm Residue / Fines

Table 3: Dynamic tests

Packaging reference	Packaging photo	Samples tested	Wind Sifter (LDPE films)	Ferro-metals	Drinking Cardboard	Non-Ferro-metals

Packaging reference	Packaging photo	Samples tested	Ballistic separation		Flexible MPO		
			Flexibles	Rigids	PE flexibles	PP flexibles	Mixed plastic flexibles

Packaging reference	Packaging photo	Samples tested	PET		PE rigids	PP rigids	PS rigids	Mixed plastic rigids
			PET-Bottles	PET-Trays				

4.13 RESULTS INTERPRETATION

To guide the auditor in the results interpretation, the sorting centre should apply the following rules:

- in case the packaging ends in the mix rigid or mix flexible streams, the test is failed. The packaging is considered disqualified for recyclability.

- in case the packaging ends in a polymer stream:
  a) the test is failed, and the packaging is disqualified for recyclability in case the resin used for the packaging body and the stream do not correspond;
  b) the test is passed in case more than 50% of the packaging ends in the stream corresponding to the resin used for the packaging body; in this case the following rules are applied by the auditor:

- ✓ **sorting efficiency higher than 80% and the rest not sorted (residues) or sorted in the mixed streams**: the packaging is fully sortable and no penalties are applied; if more than 10% is sorted in another stream 1 class penalty is applied.
- ✓ **sorting efficiency lower than 80% but higher than 70%, with the rest not sorted (residues) or sorted in the mixed streams**: the packaging is sortable with minor inefficiency and 1 class penalty is applied; if more than 10% is sorted in another streams 2 class penalties are applied.
- ✓ **sorting efficiency lower than 70% (but higher than 50%) with the rest not sorted (residues) or sorted in the mixed streams**: the packaging is sortable but with low efficiency and 2 class penalties are applied.
- ✓ **sorting efficiency lower than 70% (but higher than 50%) with more than 10% contaminating another polymer stream**: the test is passed and 3 class penalties are applied.
- ✓ **sorting efficiency lower than 70% (but higher than 50%) with more than 20% contaminating another polymer stream**: the test is failed and the packaging is disqualified for recyclability.

Results will be summarized in one table, following the template below:

Pack. Descrip.	RecyClass grade	Compaction	Sieving	Wind sifting	Behaviour conveyor	Ballistic separation	Eddy current & non-ferrous	NIR	Final stream

The colour of the bow depends on the results of the test (red = fail; orange = some issues; green = passed).

In any case the sorting efficiency is lower than 50% the tests are failed, and the packaging is disqualified for recyclability.

The below table summarize the test results and should guide the applicant and the auditor in the interpretation of the results.

Table 4: Sorting efficiency results

Sorting efficiency	Contamination in another mono-stream	Test Results	Penalties (classes)	Penalties (rate)
≥ 80%	≤ 10%	Passed	-	-
≥ 80%	> 10%	Passed	-1	-10%
70-80%	≤ 10%	Passed	-1	-10%
70-80%	> 10%	Passed	-2	-30%
50-70%	≤ 10%	Passed	-2	-30%
50-70%	> 10%	Passed	-3	-50%
50-70%	> 20%	Failed	Disqualified	Disqualified

<50%	n.a.	Failed	Disqualified	Disqualified

4.14 OPTICAL SORTING

Mandatory for PET bottles and trays. Test procedures are under development.

ANNEX I

It is essential for certain types of packaging to be tested according to the RecyClass Sorting Protocol, as their design can affect either partially or fully the packaging sortability, leading to the losses of materials.

The packaging designed with the following characteristics[6] must be tested in order to determine the sensor-based sorting efficiency:

- Large labels (covering > 50% of the surface) made from a different polymer
- Full body sleeves
- Perforated full body sleeves
- Multi-layer structures (excluding PE/PP EVOH)
- Metallisation (excluding on the inside/in the middle layer)
- Non NIR detectable colours on the packaging (i.e., when dark colours used for internal layers)
- Different types of plastic used on the top and bottom side of the packaging, as presented on the belt
- Different types of plastic (rigids and flexibles) used in the packaging
- Ferrous magnetic components
- Non-ferrous magnetic components
- Round shape, very rigid and hard to compact
- Foam and expanded foam packaging

[6] For detailed information, refer to RecyClass Recyclability Methodology where mandatory sorting test designs are listed. Design features reported as low/non compatible with recycling should not be tested for sorting because the recyclability of the packaging will remain low in any case.

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ANNEX II

For each packaging design reported in Annex I, there are minimum requirements for sorting test to fulfil.[7]

Packaging design	Minimum requirements
Different types of plastic (rigids and flexibles) used in the packaging	full protocol
Ferrous magnetic components	full protocol
Non-ferrous magnetic components	full protocol
Round shape, very rigid and hard to compact	full protocol
Foam or expanded foam packaging	full protocol
Two of three dimensions lower than 40 mm	full protocol
Large labels (covering > 50% of the surface) made from a different polymer	dynamic NIR tests, full NIR battery
Full body sleeves	dynamic NIR tests, full NIR battery
Perforated full body sleeves	dynamic NIR tests, full NIR battery
Multi-layer structures (excluding PE/PP EVOH)	dynamic NIR tests, full NIR battery
Metallisation (excluding on the inside/in the middle layer)	dynamic NIR tests, full NIR battery
Non NIR detectable colours on the packaging (i.e., when dark colours used for internal layers)	dynamic NIR tests, full NIR battery
Different types of plastic used on the top and bottom side of the packaging, as presented on the belt	dynamic NIR tests, full NIR battery

[7] *Sample preparation procedures remain valid for all packaging, including compression.*

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DOCUMENT VERSION HISTORY

VERSION	PUBLICATION DATE	REVISION NOTES
1.0	September 2021	Sorting Evaluation Protocol for Plastic Packaging release
2.0	January 2024	Modification of the compaction procedures Modification sample preparation procedures Addition of Annex II

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