

The RecyClass PET Technical Committee (TC) investigated the influence of the PET bottle colour shade on their sorting behaviour. This campaign was coordinated with the support of Returpack and Infinitum, respectively the Swedish and Norwegian Deposit Return Systems (DRSs). Besides, ALPLA, Polyrecycling, and Freudenberg Group supported with the delivery of samples directly picked from their PET recycling lines. After 6 months of investigation, the RecyClass PET Technical Committee successfully reached consensus on the initial set of recommendations for designing PET bottles according to their color shade, aiming to facilitate proper sorting.

Two main objectives were targeted with this test campaign:

- 1) Define a range of Lab* colour coordinates for PET bottles to be correctly sorted in the transparent clear, light blue or coloured streams.
- 2) Add data to the work started by Infinitum and Returpack to drive harmonisation in Europe for existing and future DRSs.

In this test campaign, 28 different PET bottles were analysed using a Konica Minolta CM-5 at Norner. Among the 28 samples tested, 18 bottles collected at PET recyclers plants were analysed, each of them corresponding to a different Stock Keeping Unit (SKU). In addition to this, 10 of these SKUs were collected at retailers' level, to compare the colour characteristics of the PET bottle after production and at reception in the PET recycling plant. From the 18 bottles collected by recyclers, 4 were picked in the clear transparent stream, 9 in the light blue transparent stream and 5 in the coloured transparent stream (see Annex I). All samples were collected within a general collection system in Austria, Italy, Poland or Switzerland. Samples were then analysed in Norner according to the method presented in Annex II.

Regarding the results, as expected, the bottles with the darkest shades of blue showed a* and b* parameters values up to -14 and -21 respectively, while all the clear transparent PET bottles had values between -1 and 0 for a* and -2 and 2 for b* (see Annex III). One of the main observations was the confirmation that clear and light blue bottles collected as product or as waste exhibited similar results when analysed after cleaning, meaning that measurements could be done at the producer or recycler level. Only few dark blue bottles showed more extreme a* and b* values when collected in the waste

stream, with a ΔE^1 value between 4 and 6. Besides, it was confirmed that the thickness of the PET bottle is not playing an important role in the colour sorting. Most of the dark blue PET bottles were about 150 μm thick, while clear transparent bottles showed thickness between 160 and 300 μm , thus proving that thicker bottles were not considered as more coloured. Regarding the L^* parameter, clear transparent bottles were reported with values above 93, while light blue bottles obtained results between 90 and 95, and dark blue bottles below 91. Therefore, a trend could easily be observed, with a decrease of L^* value with darker shade of PET bottles. Note that current recommendations by Returpack and Infinitem for the colour of PET bottles matched well RecyClass results, in particular when looking to the Lab^* values for clear transparent PET bottles.

While this test campaign is only showing a very small amount of data compared to the number of PET bottles present on the market, the RecyClass PET TC considered that these results are representative of the market, and are confirming previous findings and data collected from Returpack and Infinitem. It is important to keep in mind that while RecyClass collaborated with DRSs on this test campaign, analysed samples were coming from general collection. Based on this, the RecyClass PET TC decided to endorse Infinitem definitions for clear transparent and light blue transparent PET bottles, as the range of colour for the light blue fraction was broader compared to Returpack definition. Therefore, the following recommendations should be followed:

Table 1. Lab^* parameters for clear transparent and light blue transparent PET bottles (July 2024).

Lab* parameters	Clear transparent stream		Light blue transparent stream	
	<i>Min</i>	<i>Max</i>	<i>Min</i>	<i>Max</i>
L*	93	-	89	-
a*	- 0.7	2.0	- 4.0	2.0
b*	- 2.0	2.0	- 3.0	2.0

The RecyClass PET Technical Committee would also like to clarify that these colour definitions for the PET streams are developed in the context where DRS are observing a decrease in the quality of their streams, due to an increase of the yellowing and amount of particles in PET bottles. This leads to less bottles available for the clear transparent stream and an increase of coloured bottles, which can be

¹ $\Delta E = \sqrt{((a^*1 - a^*0)^2 + (b^*1 - b^*0)^2 + (L^*1 - L^*0)^2)}$

detrimental for the circularity of PET bottles. The RecyClass PET TC will therefore continue to investigate the origin of the yellowing and particles present in the rPET.

The RecyClass PET TC also highlights that the current recommendations on colour are not here to restrain the use of recycled content in PET bottles. These recommendations are mainly used to understand which Design for Recycling Guidelines apply depending on the colour of the PET bottle. No penalty can be applied during a recyclability certification based on the colour definitions here reported.

Revision – March 2026

In 2025, RecyClass PET TC decided to conduct additional tests with tailormade coloured PET bottles covering a range of blue and green tints with an a^* and b^* ranges of $[-21.5 ; 0.4]$ and $[-16.9 ; 2.6]$ respectively (see Annex IV). These bottles were tested in 5 different locations (Tomra, Site Zero, CROK, Retourpack, CSI) to define the main colour stream they would be sorted in, either clear, light blue, blue, green or other colours. While some of the bottles were sorted similarly no matter the test location, several examples could be defined as borderline cases between light blue and blue streams. These critical bottles with borderline a^* and b^* values were produced in a second version targeting an L^* value between 85 and 90 to represent a more realistic range of brightness. These results led to a new definition of the light blue and dark blue bottles depending on their Lab* settings. Therefore, the RecyClass PET TC defines now the clear and light blue PET bottles within the following Lab* values:

Table 2. Lab* parameters for clear transparent and light blue transparent PET bottles (March 2026).

Lab* parameters	Clear transparent stream		Light blue transparent stream	
	Min	Max	Min	Max
L^*	93	-	89	-
a^*	- 0.7	2.0	- 3.0	2.0
b^*	- 2.0	2.0	- 4.0	2.0

With the release of a colour sorting module for PET bottles within the RecyClass Sorting Evaluation Protocol, a range of bottle coloration was defined as “to be tested” in order to generate additional data, without penalising the level of compatibility of the PET bottle, for now. PET bottles with Lab* values within the following range must be tested to evaluate their colour sorting:

- $L^* < 89$;
- $-6 < a^* < -2$ or $1 < a^* < 3$;
- $-6 < b^* < -3$ or $1 < b^* < 3$.

About RecyClass

RecyClass is a non-profit, cross-industry initiative advancing recyclability, bringing transparency to the origin of plastic waste and establishing a harmonized approach toward recycled plastic calculation & traceability in Europe. RecyClass develops Recyclability Evaluation Protocols and scientific testing methods for innovative plastic packaging materials which serve as the base for the Design for Recycling Guidelines and the RecyClass Online Tool. RecyClass established Recyclability Certifications for plastic packaging, Recycling Process Certification and Recycled Plastics Traceability Certification for plastic products.

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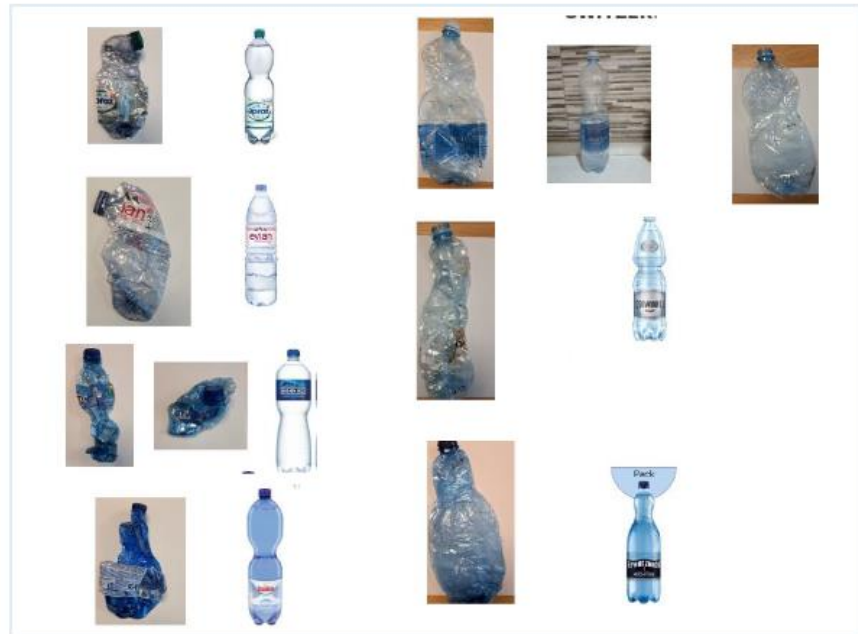
Contact : Jean-Emile.Potaufoux@plasticsrecyclers.eu, www.recyclclass.eu

Annex I

Transparent Clear



Transparent Light blue fraction



Transparent Blue fraction

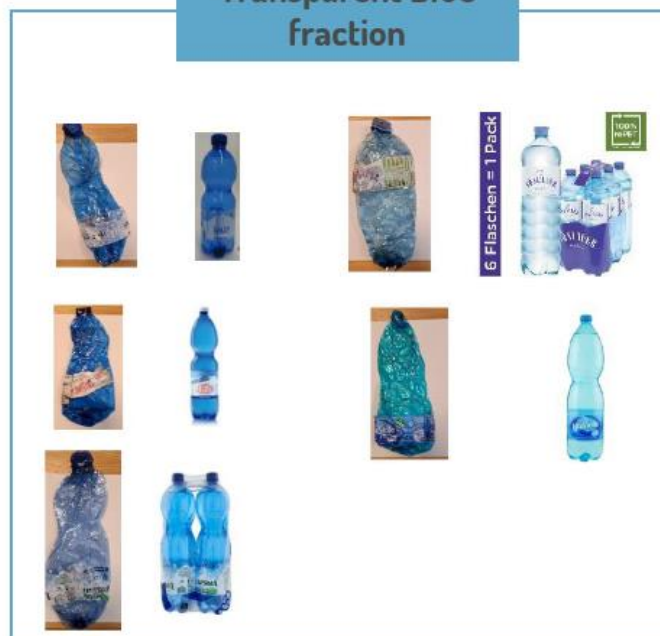


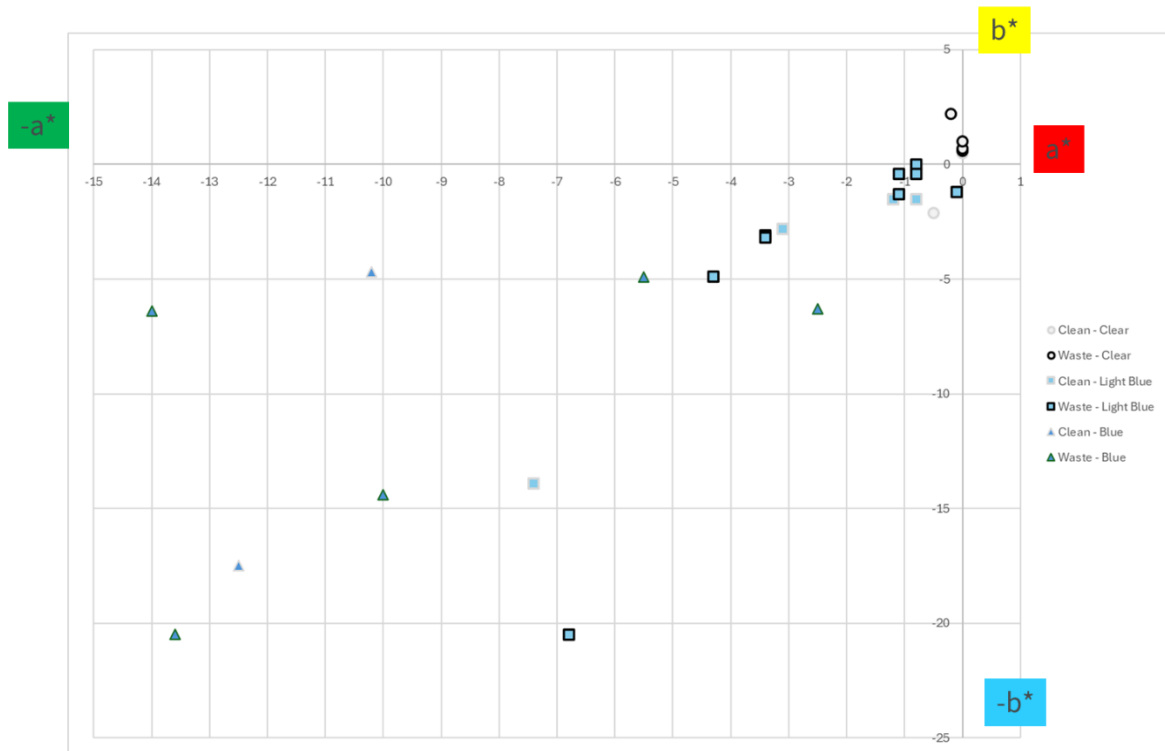
Figure 1: PET bottles tested for the test campaign

Annex II

Instructions:

1. Cut out a piece of the bottle from the middle section approx. 5 x 5 cm. Choose a place on the bottle without decor and as flat as possible. If needed, clean off any remaining residues from beverage or adhesive. For samples coming from the waste stream, wash them with mild solvent (water, acetone) to remove dust or product residues.
2. Measure the wall thickness of the piece
3. Clamp the sample in the transmission holder so it covers the ball opening, with the bend against the opening
4. Measure the L^* , a^* , b^* values using a Konica Minolta CM-5, with the following settings: D65 light, 10° , transmittance mode $di:0^\circ$ (SCI)

Annex III



Annex IV

Colour			Results					
L*	a*	b*	Tomra	Site Zero	CROK	Returpack	CSI (Pellenc)	CSI (Tomra)
96.8	0.4	-0.1	Clear	Clear / Light blue	Clear	Clear / Light blue	Clear	Clear
95.9	0.4	0.9	Clear	Clear / Light blue	Clear	Clear / Light blue	Clear	Clear
95.7	0.12	-1.24	Clear	Clear / Light blue	Blue	Clear / Light blue	Clear / Light blue	Light blue
95.4	-2.9	0	Green	Other Colors	Green	Coloured	Green	Green
94.8	-1.9	-2	Light blue	Clear / Light blue	Blue (weak transparent)	Clear / Light blue	Light blue	Blue/ Light blue
95	-0.4	-3.4	Blue	Clear / Light blue	Blue	Clear / Light blue	Light blue	Light blue
96	0.2	2.6	Other colours	Other Colors / Clear / Light blue	Clear	Clear / Light blue	Clear	Clear / Coloured
94	-0.5	-3.9	Blue	Clear / Light blue	Blue	Clear / Light blue	Light blue	Light blue
94.1	-5.3	-0.9	Green	Other Colors	Green / Turquoise	Coloured	Green	Coloured
93.7	-4.8	-3.5	Unknown	Clear / Light blue	Blue	Clear / Light blue	Coloured	Coloured
84.5	-10.9	-16.9	Blue	Other Colors	Blue	Coloured	Blue	Blue
93.7	-2.7	-4.4	Light blue	Clear / Light blue	Blue	Coloured	Light blue	Blue
89.9	-21.53	-4.65	Green	Other Colors	Turquoise	Coloured	Green	Coloured