



Quick Test for Color PET-S-03

APR recognizes that packaging innovation drives the growth of bottles available for recycling and growth of supply of bottles is essential to the well being of the plastic bottle recycling industry. APR also recognizes that some innovations may create bottles that present technical challenges for recycling.

This document is a preliminary screening procedure to help innovators determine potential difficulties in additive mixtures being considered for inclusion in PET bottles. In particular, additives that screen ultraviolet light and scavenge small molecules and provide functional changes to PET should be considered for the Quick Test. Experience has shown some additive mixtures can impart significant levels of color in otherwise clear PET.

The intent of this Quick Test is to meld successful results here with expectation of successful testing by APR's Critical Guidance Document. **The Quick Test does not replace the more thorough Critical Guidance testing**, but should be considered a preliminary screening for color effects. The Quick Test applies only to uncolored resin.

This document lists testing at 0% and 100% recommended additive mixture inclusion. Additional testing at 25%, 50%, and 75% can increase learning, but are not included.

The 0% testing is baseline or control testing.

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**Champions for Change
PET Quick Test for Color**

The intent is to compare color and haze for PET samples with and without additive mixtures after two meltings of the resin and mixtures.

Test Samples are defined as follows:

Samples are made by grinding preforms. Ground preforms are referred to here as flakes.

Sample A: Control flakes made from preforms molded from virgin PET Control Resins listed below. Note need to select proper Control Resin in note 2. below.

Sample B: Additive test flakes made by one of the following scenarios:

1. Additive mixture added to PET Control Resin used for Sample A to make preforms. Be sure additive is included at maximum recommended concentration. Flakes made from preforms. OR
2. Additive mixture incorporated into commercial PET at point of PET manufacture. Preforms made. Flakes made from preforms. Select a Control Resin of similar IV to make Sample A.

Control Resins

<i>Low IV, Water Bottle</i>	<i>CSD and Non-Water Bottle</i>
Auriga Polyclear Splash 3301	Auriga Polyclear Refresh 1101
M&G Cleartuf Turbo II	M&G Cleartuf MAX
DAK Laser+W L44A	DAK (Wellman) HP 806

Procedure

1. Test plaques are to be made of polymer, with or without additive, which will have been made of flakes from ground preforms. The test plaques will be a second melt history.
2. Prepare/obtain preforms of test and control material.
 - Sample B – Preforms including additive mixture
 - a. If the additive mixture to be investigated is in the form of powder, liquid, or concentrate, prepare blends with a control resin pellets at the recommended additive concentration, dry materials, and mold preforms. This is sample B. Or
 - b. If the additive has already been added and a preform made, call this sample B. Or
 - c. If the additive has been included into a resin that contains functional additives, such as ultraviolet inhibitors/screens, dry resin and mold preforms. This is sample B.
 - i. Dry with desiccated air at 320 F +/- 20F (160C +/- 12C) for 4 to 6 hours to achieve water levels in dried pellets of below 50 ppm before injection molding.



Sample A – Preforms made of the Control Resin used to make Sample B or one of similar IV for Sample B as a commercial resin composition. This is Sample A.

3. Separately, grind Samples A and B.
4. Separately dry ground samples A and B, and mold into 3 mm plaques with sufficient mold cooling to avoid any crystalline haze. The samples are now Sample A1 and Sample B1
5. Measure color and haze by transmission. Record results.

Color Measurement

- a. Calibrate spectrophotometer to the manufacturer’s recommendations.
- b. Measurements should be made with Hunter Miniscan XE or equivalent in transmission. The reported number should be the average of at least five color measurements of CIELAB on at least five plaques.

L* Test

Property	Test Method	Critical Value
L*	CIELAB 3 mm plaque, test in <u>transmission</u> , <u>absolute</u>	For <u>clear</u> PET, L* greater than 82 for Samples A1 and B1.

b* Test

Property	Test Method	Critical Value
b*, test Sample B1	CIELAB 3 mm plaque, test in <u>transmission</u> , <u>absolute</u> . ASTM D 1003-B	Δb^* for Sample B1 b* minus Sample A1 b* should be less than 3.0.
NOTE: TESTING IS ON 100% RECOMMENDED CONCENTRATION OF ADDITIVE, NOT 50% LEVEL IN THE APR CRITICAL GUIDANCE DOCUMENT AND COLOR GUIDANCE IS IN RELATIVE UNITS. THESE GUIDANCE ARE CONSISTENT WITH THE APR CRITICAL GUIDANCE.		

Haze Test

Property	Test Method	Critical Value
% Haze	3 mm thick sample, test in transmission, measured at 550 nm, ASTM D 1003-B	For Samples A1 and B1 haze less than 9.5% should not be a problem. Haze between 9.5% and 14% needs study and haze over 14% is likely noticeable



APPENDIX A

APR recognizes that the most desirable results would include the Sample A and Sample B using the same resin and that resin being a named Control Resin. It is more important that the comparison of Sample A and Sample B be made to examine the effect of the additive mixture and not differences in base resins.

- Preferred: Use a named Control Resin for Sample A and for the base resin in Sample B. The Control Resin should be appropriate for the intended application.
- Acceptable: Use the same resin, not a Control Resin, for Sample A and for the base resin in Sample B. The resin selected should be appropriate for the intended application.
- Least Desirable: The use of different PET resins for Sample A and for Sample B

APPENDIX B

This Quick Test is intended as a screening test. As such, it is the intent that testing costs be reduced so more testing be done. To that end, it is acceptable to make Samples as follows:

Sample A: Intermediate control pellets can be made by extruding and pelletizing the selected base resin. See Appendix A for selection of base resin.

Sample B: Intermediate additive test pellets made by one of the following scenarios:

1. Additive mixture added to PET Control Resin used for Sample A to make pellets. Be sure additive is included at maximum recommended concentration. Extruded material repelletized. OR
2. Additive mixture incorporated into the same commercial PET used for Sample A with the combined additive and PET melted and pelletized.

Procedure

1. Test plaques are to be made of polymer, with or without additive, which will have been made melted and pelletized to create a first melt history. The test plaques will be a second melt history.
2. Prepare melt-mixed pellets of test (Sample B) and control (Sample A) material.
Sample B – Pellets including additive mixture
 - a. If the additive mixture to be investigated is in the form of powder, liquid, or concentrate, prepare blends with a base resin pellets at the recommended additive concentration, dry materials, and melt mix and pelletize. This is sample B. Or



- b. If the additive has already been added and a preform made, call this sample B once ground. Or
- c. If the additive has been included into a resin that contains functional additives, such as ultraviolet inhibitors/screens, dry resin and melt mix and pelletize. This is sample B.
 - i. Dry with desiccated air at 320 F +/- 20F (160C +/- 12C) for 4 to 6 hours to achieve water levels in dried pellets of below 50 ppm before injection molding.

Sample A – Pellets made by repelletizing a Control Resin used to make Sample B or repelletizing the non-Control Resin used for Sample B. This is Sample A.

- 3. Separately dry samples A and B pellets, and mold into 3 mm plaques with sufficient mold cooling to avoid any crystalline haze. The samples are now Sample A1 and Sample B1
- 4. Measure color and haze by transmission. Record results.