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# Standard Practice for Separation and Identification of Poly(Vinyl Chloride) (PVC) Contamination in Poly(Ethylene Terephthalate) (PET) Flake[1]

This standard is issued under the fixed designation D5991; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

## 1. Scope*

1.1 This practice covers four procedures for separation and qualitative identification of poly(vinyl chloride) (PVC) contamination in poly(ethylene terephthalate) (PET) flakes.

NOTE 1—Although not presented as a quantitative method, procedures presented in this practice may be used to provide quantitative results at the discretion of the user. The user assumes the responsibility to verify the reproducibility of quantitative results. Data from an independent source suggest a PVC detection level of 200 ppm (w/w) based on an original sample weight of 454 g.

1.2 *Procedure A* is based on different fluorescence of PVC and PET when these polymers are exposed to ultraviolet (UV) light.

1.3 *Procedure B* is an oven test based upon the charring of PVC when it is heated in air at 235°C.

1.4 *Procedures C and D* are dye tests based on differential staining of PVC and PET.

NOTE 2—Other polymers (for example, PETG) also absorb the stain or brightener. Such interferences will result in false positive identification of PVC as the contaminant.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* For specific hazards see Section 8.

NOTE 3—There is no known ISO equivalent to this standard.

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

2.1 *ASTM Standards:*[2]

D883 Terminology Relating to Plastics

D1600 Terminology for Abbreviated Terms Relating to Plastics

## 3. Terminology

3.1 *Definitions*—For definitions of terms that appear in this specification relating to plastics, refer to Terminology D883. For abbreviations that appear in the specification, refer to Terminology D1600.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *light material, n*—paper, polymers such as polyethylene and polypropylene, and other materials with densities less than 1.00 g/cm$^3$.

## 4. Summary of Practice

4.1 For the Beilstein Test, chlorine-containing materials heated in a flame in contact with a copper wire produce a characteristic green flame.

4.2 With Procedure A, a known amount of PET flakes is exposed to ultraviolet radiation. PET normally fluoresces with a blue or violet color. Flakes fluorescing with different colors are removed, weighed, and identified as PVC if they burn with a bright green flame when heated on a copper wire.

4.3 With Procedure B, PET flakes are heated in an oven maintained at 235 ± 5°C. After a minimum of 45 min, the flakes are visually examined with removal and subsequent weighing of black, charred pieces. Pieces are confirmed as PVC using the same flame test mentioned in 4.1.

4.4 With Procedure C, PET flakes are soaked in a blue acetone dye solution that preferentially stains any PVC flakes. These flakes are visually identified and subsequently removed, and weighed. The identification of PVC flakes is confirmed with the flame test.

[1] This practice is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.95 on Recycled Plastics.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

***A Summary of Changes section appears at the end of this standard**

4.5 With Procedure D, PET flakes are heated with an aqueous solution containing an optical brightener that also preferentially stains the PVC flakes. The flakes are sorted under UV light in a dark room with removal and subsequent weighing of any blue fluorescing PVC flakes.

## 5. Significance and Use

5.1 Presence of even low concentrations of PVC in recycled PET flakes results in equipment corrosion problems during processing. The PVC contamination level shall dictate the market for use of the recycled polymer in secondary products. Procedures presented in this practice are used to identify the PVC contamination in recycled PET flakes.

NOTE 4—These procedures may also be used to estimate the concentration of PVC contamination.

## 6. Apparatus

6.1 *Procedure A:*

6.1.1 *Bright Aluminum Tray,* shallow depth (0.75 cm).

6.1.2 *Light Fixture,* equipped with GE F40/BLB, or equivalent, black light bulbs.

6.1.3 *Ultraviolet Shield Glasses.*

6.1.4 *Tweezers.*

6.2 *Procedure B:*

6.2.1 *Circulating or Forced-Air Oven,* equipped with a temperature readout device for the range of 230 to 240°C.

6.2.2 *Baking Trays,* 14 by 20 by 3 cm.

6.2.3 *Tweezers.*

6.2.4 *Thermally Insulated Gloves,* or equivalent.

6.3 *Procedure C:*

6.3.1 *Measuring Cup,* 1.5 L.

6.3.2 *Plastic Stretch or Cling Wrap.*

6.3.3 *Paper Towels,* newspaper, or equivalent.

6.3.4 *Tweezers.*

6.4 *Procedure D:*

6.4.1 *Measuring Cup,* 1.5 L.

6.4.2 *Tweezers.*

6.4.3 *Hot Plate,* or equivalent heating device.

6.4.4 *Light Fixture,* equipped with GE F40/BLB, or equivalent, black light bulbs.

6.4.5 *Ultraviolet Shield Glasses.*

## 7. Materials

7.1 *Detergent.*

7.2 *Rit Tint and Dye* (Navy Blue #30), or equivalent, required for Procedure C.

7.3 *Rit Brightener and Whitener,* or equivalent, required for Procedure D.

## 8. Hazards

8.1 The ultraviolet light used in Procedures A and D is harmful to exposed skin and unprotected eyes, so a UV filtering face shield or UV absorbing glasses shall be worn when performing this test. Exposed hands and arms shall be covered with gloves and long sleeves.

8.2 Hot trays and flake samples shall be handled with thermally insulated gloves to avoid burns while placing trays containing samples into or removing them from the oven (Procedure B).

8.3 Acetone used to prepare the dye solution for Procedure C is flammable. Use this reagent only in a well ventilated area free of open flames or spark sources.

## 9. Procedure

9.1 *Flame Test to Verify PVC Identification (Beilstein Test):*

9.1.1 Heat a copper wire in a propane torch flame until it is very hot.

9.1.2 Touch the hot wire to a suspected PVC flake to melt a small amount of the flake on to the wire.

9.1.3 Reheat the wire tip in the flame. If the tested flake is PVC, a bright green flame will be visible as the wire heats and the plastic burns. Absence of a green flame indicates that the test flake is not PVC.

9.1.4 The flame test can give false positive PVC results if there is another halogenated material present in the PET. Brominated or chlorinated flame retardants or any additive with a halogen will give a positive color change with the flame test as indicated.

NOTE 5—CPVC, PVDC, brominated polystyrene, etc. are examples of materials that will give a false positive.

9.2 *Procedure A:*

9.2.1 Weigh 454 ± 10 g of clean, dry PET flake sample and transfer the sample into a shallow aluminum tray.

9.2.2 Place the tray under the UV light in a dark environment.

9.2.3 Using tweezers, sort through the flakes in the tray and remove all particles that do not exhibit the standard PET blue or violet-blue color. Set the isolated flakes aside in a separate tray for subsequent weighing or testing in accordance with 9.1.

NOTE 6—Finding uniquely colored flakes under UV light should not be interpreted as fact that these particles are PVC. PVC can exhibit many colors (yellow/green, bright blue, dark violet, light orange) under UV light, and because of the blue colors exhibited by some PVC material, these flakes may not be discernible from PET flakes under UV light.

NOTE 7—Clear PET fluoresces strongly emitting a blue to violet-blue color. Other PET products, however, have been observed to fluoresce with pale blue or clear, dark purple, or turquoise colors. Green PET used for soft drink containers normally fluoresces from a bright to a dull green under UV light and amber PET flakes appear black under UV light.

NOTE 8—Paper, labels, and assorted pigmented plastics may also exhibit a spectrum of fluorescent colors or these materials may appear very dark under UV light.

9.3 *Procedure B:*

9.3.1 Weigh 454 ± 10 g of clean, dry PET flake sample and transfer the sample into a baking tray.

9.3.2 Adjust and equilibrate the oven temperature to 235 ± 5°C.

9.3.3 Quickly place the tray containing the flake into the heated oven.

9.3.4 After a minimum of 45 min, remove the hot tray from the oven and place it on a suitable surface to cool to room temperature.

NOTE 9—If heating times are short, any PVC may not char completely and the discoloration may stop at a yellow-orange state that is typical of