



Standard Test Method for Determination of Xylene Solubles in Propylene Plastics¹

This standard is issued under the fixed designation D 5492; 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 test method is to be used for determining the 25°C xylene-soluble fraction of polypropylene homopolymers and copolymers.

1.2 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

NOTE 1—This test method is technically equivalent to **ISO 16152**.

2. Referenced Documents

2.1 ASTM Standards:²

D 883 Terminology Relating to Plastics

D 1600 Terminology for Abbreviated Terms Relating to Plastics

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

2.2 ISO Standard:

ISO 16152 Plastics—Determination of Xylene Solubles of Polypropylene³

3. Terminology

3.1 Definitions:

3.1.1 For definitions of plastic terms see Terminology **D 883** and for abbreviations see Terminology **D 1600**.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *soluble-fraction (S_S)*—the percentage of the polymer mass that does not precipitate out when the polymer solution is cooled from reflux temperature to $+25 \pm 0.5^\circ\text{C}$ and held at that temperature for a specified period of time.

4. Summary of Test Method

4.1 A weighed amount of sample is dissolved in xylene under reflux conditions. The solution is cooled under controlled conditions and maintained at a $+25^\circ\text{C}$ equilibrium temperature so that the crystallization of the insoluble fraction takes place. When the solution is cooled the insoluble portion precipitates and is isolated by filtration. The ortho-xylene is evaporated from the filtrate, leaving the soluble fraction in the residue. The percentage of this fraction in the plastic is determined gravimetrically.

5. Significance and Use

5.1 The results of this test provide a relative measure of the total soluble fraction of polypropylene homopolymers and copolymers. The soluble fraction can be approximately correlated to the amorphous fraction in the polypropylene. Xylene is widely used for determining the soluble fraction in polypropylene. Xylene is more specific to the atactic fraction than other solvents. The concentration of a soluble fraction obtained with a specific solvent has been found to relate closely to the performance characteristics of a product in certain applications, for example film and fiber. Data obtained by one solvent and at one precipitation time cannot be compared with data obtained by another solvent or precipitation time, respectively.

6. Interferences

6.1 Materials with solubilities similar to the soluble fraction, such as additives, may interfere with the measurement of solubles. When present in concentrations that are judged to impart a significant error to the soluble-fraction data, the level of interference must be determined and corrections made.

6.2 Small-particle fillers and pigments that may pass through the filter and insoluble gels present in the polymer may cause errors in the measurement.

¹ This test method is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.15 on Thermoplastic Materials.

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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.

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

6.3 The polymer flakes and spheres must be dried before testing to eliminate moisture that can influence the initial weight of sample added to the flask.

7. Apparatus

7.1 *Reflux-Condenser Apparatus*, 400 mm, with 24/40 glass joint.

7.2 *Flat-Bottom Boiling Flask*, with one or two necks, 400 mL with 24/40 joint, Erlenmeyer flask, or cylindrical bottle.

7.3 *Insulation Disk*, made of fiberglass or rock wool.

7.4 *Electromagnetic Stirrer Unit*, with temperature-controlled heating plate, thermostatted oil bath, or heater block capable of maintaining 145 to 150°C.

7.5 *Stirring Bar*.

7.6 *Pipet*, Class A, 200 mL or equivalent.

7.7 *Pipet*, Class A, 100 mL or equivalent.

7.8 *Glass-Stoppered Volumetric Flask*, 250 mL.

7.9 *Thermostatically Controlled Water Bath*, at $+25 \pm 0.5^\circ\text{C}$.

7.10 *Electromagnetic Stirrers*.

7.11 *Filter Paper*, fluted, Whatman No. 4, No. 541,⁴ or equivalent, at least 125 mm in diameter.

7.12 *Funnel*, 60°, or equivalent, at least 125 mm in diameter.

7.13 *Heated Vacuum Oven*.

7.14 *Aluminum Pans*, 300-mL capacity, with smooth sides or other suitable container of similar design.

7.15 *Temperature-Controlled Heating Plate*.

7.16 *Analytical Balance*, with minimum weighing sensitivity to 0.0001 g (a sensitivity of 0.00001 g is preferred).

7.17 *Desiccator*, containing appropriate desiccant.

7.18 *Timer*, preferably with an alarm, in minutes.

7.19 *Oven*, conventional forced air or gravity.

8. Reagents

8.1 *Reagent-Grade Ortho-Xylene (o-Xylene)*—Assay gas chromatography (GC) = 98 % min; less than 2 % ethylbenzene as established by GC; evaporation residue at 140°C less than 0.002 g/100 mL; boiling point 144°C.

8.2 *Reagent-Grade Para-Xylene (p-Xylene)*—Assay gas chromatography (GC) = 98 % min; less than 2 % ethylbenzene as established by GC, evaporation residue at 140°C less than 0.002 g/100 mL; boiling point 138°C.

NOTE 2—Mixed xylene may be used within a laboratory if the ratio of para-xylene to ortho-xylene remains constant from lot to lot and the level of ethylbenzene is less than 2 %.

NOTE 3—Grade ortho-xylene shall be used as the reference solvent whenever there is a dispute between laboratories on test results, unless the laboratories agree otherwise.

9. Procedure

9.1 Preparation of the Xylene:

9.1.1 Stabilization of the xylene is not required. When testing non-stabilized polypropylene powders or spheres, antioxidants may be added to prevent degradation. This addition is optional if previous testing shows there is no significant change in xylene soluble level.

NOTE 4—Butylated hydroxyl toluene (BHT), 4,4 thiobis (6-tert-butyl-m-cresol), and tetrakis (3,5-di-tert-butyl-4-hydroxy-hydrocinnamate) methane at an approximate concentration of 0.02 g/L of xylene have been found to be effective stabilizers. Agitate with a magnetic stirring bar and heat for a minimum of one hour at 80°C to 90°C to ensure the thorough mixing of the antioxidants and the xylene. This is a suitable heating temperature for BHT, which is highly volatile.

9.1.2 Degas the xylene. Using nitrogen gas, purge the xylene for a minimum of 1 h every 24 h.

9.2 *Determine the Level of Contamination in the Xylene (Solvent Blank)*:

9.2.1 The purpose of the solvent blank is to determine whether the xylene to be used contains significant amounts of evaporation residue or foreign components. A solvent-blank test for residue should be run on every new lot of xylene. Test and average the solvent-blank results, for three aliquots per bottle or lot of xylene. Each aliquot shall be 200 mL.

NOTE 5—If the xylene is an extrapure grade (minimum 99.5 %) and is used immediately after being opened, the determination of the blank may be eliminated. If not used immediately (within three days) a solvent blank must be run. It is recommended that xylene be purchased in glass or glass-lined containers and of a size such that the xylene will be used within three days, once opened. Containers of larger size may be used if the xylene is used up within a short period of time. The purpose of the short time period is to ensure purity and minimize moisture pickup and other contaminants.

9.2.2 Pipet 200 mL of unstabilized or stabilized xylene into a clean empty flask.

9.2.3 Place a 125-mm diameter or larger No. 4 filter paper or equivalent in a 125-mm diameter of larger funnel in a funnel rack over a 250-mL glass-stoppered flask.

9.2.4 For each sample blank, pour the contents from the flask into a funnel and allow the filtrate to drip into a second flask. Continue the filtration until all the filtrate has been collected.

9.2.5 Dry the aluminum pans (or other suitable container) for 30 min in an oven at 200°C. Cool the pans in a desiccator until ready to use. For each sample weigh a clean, dry pan on the analytical balance to the nearest 0.0001 g.

9.2.6 With a Class A pipet, pipet a 100-mL aliquot of the filtered xylene into the weighed pan.

9.2.7 Place the pan on a temperature-controlled heating plate maintained at 145 to 150°C. Allow the aliquot to obtain a rolling boil to prevent splashing. Blanket the pan with a slow stream of nitrogen. Continue heating the pan until the residue in the dish is almost dry.

9.2.8 Place the pan into a vacuum oven at $100 \pm 10^\circ\text{C}$ at a pressure less than 13.3 kPa for a known suitable time where constant weight is observed.

9.2.9 Cool the pan to room temperature in a desiccator for a minimum of 15 minutes and weigh the pan to the nearest 0.0001 g. Calculate the average blank-residual mass of the three determinations.

9.3 *Determine the Percent Soluble Fraction in the Polymer:*

⁴ The sole sources of supply (EU/U.S.) of the apparatus known to the committee at this time are Whatman Int'l. Ltd., Maidstone, England or from Fisher Scientific, 711 Forbes Ave., Pittsburgh, PA 15219. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,¹ which you may attend.